UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

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In the matter of: *
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FORUM: EMERGING FLIGHT DATA *
AND LOCATOR TECHNOLOGY *
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NTSB Board Room and Conference Center
429 L'Enfant Plaza SW
Washington, D.C. 20024

Tuesday,
October 7, 2014

The above-entitled matter came on for hearing, pursuant to Notice, at 8:00 a.m.

BEFORE: THE NATIONAL TRANSPORTATION SAFETY BOARD

APPEARANCES:

CHRISTOPHER A. HART, Acting Chairman
JOSEPH M. KOLLY, Ph.D., Office of Research and Engineering
JOHN DELISI, Office of Aviation Safety

NTSB Technical Panel

SARAH McCOMB, Office of Research and Engineering
JAMES R. CASH, Office of Research and Engineering
THOMAS R. JACKY, Office of Aviation Safety
ERIN GORMLEY, Office of Research and Engineering
CHRISTOPHER BABCOCK, Office of Research and Engineering

Panel 1: Regulatory Overview

MARGARET GILLIGAN, Federal Aviation Administration (FAA)
THOMAS MICKLER, European Aviation Safety Agency (EASA)
MARCUS COSTA, International Civil Aviation Organization (ICAO)

Panel 2: Airframe, On-Board System, and Service Provider Viewpoint

PASCAL ANDREI, Ph.D., Airbus
MARK SMITH, Boeing Commercial Airplane Company
CHRIS BENICH, Honeywell
STEVE KONG, Inmarsat

Panel 3: Technology Solutions

PHILIPPE PLANTIN de HUGUES, Ph.D., Bureau d'Enquetes et d'Analyses (BEA)
RIC SASSE, Naval Sea Systems Command
THOMAS SCHMUTZ, L3 Communications Corporation
BLAKE VAN DEN HEUVEL, DRS Technologies Canada Ltd.
RICHARD HAYDEN, FLYHT Aerospace Solutions Ltd.

Panel 4: Future Path

CAPT. CHARLES HOGEMAN, Airline Pilots Association (ALPA)
DENNIS ZVACEK, American Airlines
TIMOTHY SHAVER, FAA

I N D E X

I N D E X (Cont.)

I N D E X (Cont.)

P R O C E E D I N G S

(8:31 a.m.)

ACTING CHAIRMAN HART: I would like to call this forum to order. Good morning. Welcome to the Board Room of the National Transportation Safety Board and to this forum on Emerging Flight Data and Locator Technology. My thanks to all the panelists who will provide their perspectives and expertise.

I am Christopher Hart, and it is my privilege to serve as Acting Chairman of the NTSB. Today I will be joined on the dais by Dr. Joseph Kolly, Director of our Office of Research and Engineering, and Mr. John Delisi, Director of our Office of Aviation Safety.

The NTSB depends on flight data recorders and cockpit voice recorders to help determine the causes of accidents and incidents in aviation. Because of their value in investigations, rapid location and recovery of these recorders and access to the vital information they contain are among our highest priorities. Flight data recorders were first created specifically to capture information after a crash and were designed to survive the catastrophic conditions that a crash can entail. Their introduction has been a boon to aviation safety.

In many cases, recorders are the most significant source of useful information about an accident, and in some cases they are the only source. As accident investigations exposed additional data needs, and as the technology to meet these needs became more integral to aircraft, flight data recorders evolved. Now, recorders capture many more parameters. Flight data are accessible in ways other than storage on mandatory flight recorders and are increasingly being used by operators and manufacturers, as well as by accident investigators, for prevention and not just for investigation.

Time and again, recorders have ensured the survival of accident data under the harshest of circumstances. Time and again they have yielded useful data despite the traumatic forces of accident sequences, and despite subsequent immersion in water or being engulfed in fire. The required underwater locator beacons designed to guide searchers to submerged recorders are evolving as well.

The data that recorders preserve have shed light on accident circumstances helping to guide safety improvements. Through these improvements, they have undoubtedly saved many lives, perhaps yours and perhaps mine. The data yielded by traditional recorders have been the signposts along the path of our decades long aviation safety journey. They have guided us to our present era of unprecedented aviation safety. But at the same time, progress has surged forward elsewhere in aviation.

Increased engine and system reliability allow today's aircraft to fly farther from a suitable landing point than ever before. Satellite tracking makes it possible to monitor aircraft even in the most remote parts of the globe. These advances have changed the way we fly. We routinely fly over the poles to get to a destination more efficiently. Our flights span wide ocean expanses instead of hugging the coastlines. When an accident does happen, it may be in one of these remote locations. It takes longer to respond and it's more difficult to get the appropriate resources to the search area.

The NTSB called this forum today to reexamine traditional requirements in light of today's and tomorrow's realities. One such reality has become glaringly apparent. At present, for the data to be recovered the recorders must be recovered. This means that searchers must locate the aircraft wreckage and retrieve the recorders. In recent years, there have been a few exhaustive, expensive, and well-publicized searches for missing aircraft and their recorders.

Such events have raised serious concerns with the NTSB and in other safety organizations here and abroad. These concerns are far from academic. Without the data, the lessons from the accident may forever remain unknown because the circumstances of the accident may remain forever unknown. We have all seen the human face of such uncertainty, the uniquely agonizing human toll for those whose loved ones were aboard such flights. To those have endured such uncertainty, we offer our deepest sympathy.

It is our hope that the work we do here today can help to prevent such uncertainty, while providing investigators the data that they need. The wider effect of such tragic events is the loss of confidence that they engender among the flying public. In our age of seemingly unlimited information, we can sit at our computers and call up aerial or street level views of our homes. Our cars know precisely where they are on a GPS grid. There are apps for our smartphones that can show us where our friends and family members are.

Against this backdrop of ubiquitous information flow, when a flight cannot be located, an incredulous public asks, how can they possibly lose an entire airplane? But the application of new technology in aviation is itself a complex and consequential process. Introducing new technology on an aircraft that carries 300 people, or into a navigation system that has to track thousands of aircraft, requires forethought and caution.

The costs, downtime, maintenance, and training have to be accounted for in the aviation industry. Regulators must harmonize their efforts across the global aviation sphere. Above all, it is of paramount importance to avoid unintended consequences that may compromise safety. A quick fix based on a hasty conclusion could result in lesser safety benefits. And worse, such a quick fix could introduce hazards of its own.

In recent years, significant advances have been made that can aid in the location of aircraft wreckage and help collect, transfer, and distribute recorded data. These innovations can be packaged and integrated in many ways. But to have confidence in the benefits of any products or technologies, we need to fully understand how they work, what they offer, how the users feel, and how current standards and regulations will impact their implementation.

Throughout this forum we will discuss the more efficient recovery of flight data. We will examine ways to more quickly locate and retrieve traditional recorders. We will explore recorders that deploy from the aircraft. We will learn about means of transmitting data wirelessly in the case of an abnormal event. Some of these technologies are already being used by commercial or military operators. They make life easier. Operators can know whether their flight is on time, proactively detect problems, and have a replacement part waiting when an airplane arrives.

But to broadly implement such solutions, we have to ask the right questions. How does each of these technologies work? How might they be configured to work together and to work with existing systems in aviation? What are the regulatory implications of implementing these technologies? Who owns the data? What are its proper uses? And what privacy issues arise?

We will hear from aircraft manufacturers, manufacturers of avionic systems, manufacturers offering new means of data retrieval, regulators, operators, and pilots. We welcome all of their points of view because like an individual airplane, aviation itself is a complex system.

The many solutions that we have been working toward must be successfully integrated into this complex system for the parts to work together as a whole. To do less would be to jeopardize the progress we have made on the aviation safety journey arrived at through decades of industry-wide collaboration, regulatory guidance, and painstaking investigative work. There is a future in which we know the fate of every accident flight. Today, we hope to take one more step toward that future.

Now I will turn to Dr. Joseph Kolly who, along with his staff and staff from the Office of Aviation Safety, has done an outstanding job in organizing this form.

Dr. Kolly.

DR. KOLLY: Thank you, Acting Chairman Hart.

Today's forum has been designed to get at the heart of several questions relevant to more efficient, timely, and certain recovery of flight data. Each panel will open with presentations by the panelists. The presentations will be followed by a round of questions from the Technical Panel, then questions from the dais. We have selected topics and panelists to address the range of issues concerning emerging flight data and locator technology.

We recognize that all stakeholders may not be represented in person at this forum. Organizations and individuals who wish to submit written comments for inclusion in the forum's archived materials may do so until October 21st. Submissions should be directly addressed to one or more of the forum topic areas, and should be submitted electronically as an attached document to recorderforum@ntsb.gov.

At the conclusion of each panel there will be a break, in addition to our midday lunch break.

Our first panel will be on Regulatory Overview. This session will review the organizational framework and structure of the U.S. and international regulatory and standards bodies. The processes involved in developing and implementing recommendations, regulations, standards, and practices will be reviewed. Panelists will discuss current rules, upcoming changes, and ongoing activities in the areas of flight recorders and aircraft position reporting. The first panel will be followed by a morning break.

Our second panel will be on Airframe, On-Board System, and Service Provider Viewpoint. We will hear panelists' perspectives on technology solutions to provide for a more timely location and recovery of flight data following an accident. We will then break for lunch after our second panel.

When we reconvene after lunch, the third panel will be on Technology Solutions. Panelists will discuss specific technical solutions to allow for more efficient recovery of flight data. They will explore the technical details of wreckage location, recorder recovery, and an overview of three specific recorder technologies. The third panel will be followed by our afternoon break.

After the break, we will return to our fourth and final panel, the Future Path. This panel will address some of the obstacles that need to be overcome to implement new and emerging technology that would allow for a more timely and efficient recovery of flight data. Discussions will include difficulties in technical certification, and management and labor perspectives on data use, storage, and protection.

I'll now turn to Erin Gormley, an aerospace engineer in the Office of Research and Engineering, who is serving as the Forum Manager. Erin will provide some important auditorium safety information, attend to some housekeeping, and then introduce our first panel.

Ms. Gormley.

MS. GORMLEY: Thank you, Dr. Kolly.

For safety purposes, please note the nearest emergency exit. You can use the rear doors that you came through to enter the conference center. There is also a set of emergency doors on either side of the stage up front.

We will keep to the posted schedule, so the agenda you picked up on your way in can be your guide. It is also listed on the website. Because we have a full agenda, we appreciate your cooperation in helping keep us on schedule and ask that panelists respect the time limits. Discussion should keep focused on the subject at hand rather than slip into topics covered by other panels.

As Dr. Kolly mentioned, after the second panel we will encourage you to get lunch. There are a variety of places to dine upstairs in L'Enfant Plaza. Take the escalator, and there will be some restaurant choices. For more options, continue to walk past these restaurants, the post office, some shops, and you'll find a food court.

If you've not already done so, please silence your electronic devices at this time.

Later this week, presentations provided by our speakers will be available on our website. Also, a video archive of the webcast will be available next week and be accessed through the web page, the same page where you may view the live webcast.

Before we begin I would like to introduce our Technical Panel. From my left to right are: Ms. Sarah McComb, Chief, Vehicle Recorder Division, Office of Research and Engineering; Mr. James Cash, Chief Technical Advisor, Office of Research and Engineering; Mr. Tom Jacky, Aerospace Engineer, Office of Aviation Safety; myself, Erin Gormley, Aerospace Engineer, Office of Research and Engineering; and Mr. Chris Babcock, Aerospace Engineer, Office of Research and Engineering.

Mr. Sean Payne seated behind us is a Mechanical Engineer with the Office of Research and Engineering, and he will be operating the audiovisual equipment this morning.

We are now ready to hear from our first panel of the day, Regulatory Overview. For our presenters, please push the button the microphone. A green light indicates the microphone is on. Bring the microphone close to speak, and when you are done speaking please use the button to turn it back off again.

Our first panel will discuss the organizational framework and structure of the U.S. and international regulatory and standards bodies. Our panelists are: Margaret Gilligan, Associate Administrator for Aviation Safety, Federal Aviation Administration, or FAA; Thomas Mickler, European Aviation Safety Agency representative, or EASA; and Marcus Costa, Chief, Accident Investigation Section, International Civil Aviation Organization, or ICAO.

Ms. Gilligan.

MS. GILLIGAN: Thank you, Ms. Gormley. And I want to thank the Chairman and the Board for calling this forum together to shed some light on this very important issue.

But we also want to underscore that what we are doing is building on the tremendous safety record that we already enjoy in aviation. We got to this safety record by constantly looking for ways to advance the science and technology of flight.

The technology that brings us here today, flight data collection, actually was spawned by a series of accidents that began back in the '40s, more than 75 years ago. And since that time we've made huge strides thanks in large part to the number of recommendations we've received from the NTSB that constantly pushed both FAA and the industry to continue to work to improve on what we recorded and how we protected it.

But as you move forward today, I ask that you keep in mind that this is just one of many safety issues that we in the industry are facing, and that we must always look for the right balance of where and how we invest our safety dollars.

I've been asked to talk about the rulemaking processes and challenges. So the first question is, why do we do rulemaking? We use rulemaking to set the safety standards that every person and every product that's introduced into the aviation system will be required to meet. We get input into the rulemaking process from many sources. The U.S. Congress has oftentimes directed us to consider certain topics for rulemaking. As I've mentioned, many of the recommendations that we receive from the National Transportation Safety Board also recommend that we enhance our safety standards.

Because this is a constantly evolving industry, we're always looking at new technologies and new business models to make sure that our safety standards are keeping up and assuring the appropriate level of safety as those changes are introduced. Internal to the FAA, we produce many safety analyses that also give us a basis for changing our standards. And as the Chairman mentioned, we work very hard to harmonize our safety standards with our partners around the world so that we can assure a consistent of set of safety or standard of safety for all who travel by air.

The process that we go through is intended to be a very deliberative process. It is governed by the Administrative

Procedure Act, which sets out the requirements that all government agencies must meet as they set standards. So this is not unique to aviation safety.

The process requires that the Agency first consider what it is we want to propose, and we look not just at the safety impacts, but at the operational or efficiency impacts. We want to consider improvements for the environment for this industry, and we must consider the economics.

Once we make our proposal, the statute requires that there be a comment period that allows all interested parties to comment on what we have proposed because it would not be appropriate for the federal government to impose requirements on a citizen, whether an individual or a corporation, without allowing some input and insights from those who will be affected.

After the comment period, we must consider those comments and issue our final determination. And in that final determination we must address those comments that we've accepted, where we've made changes, and those comments that we have not accepted and why those have not influenced the outcome.

That, as I said, is a process that is intended to be deliberative. So, let's look now at how that process has affected recorder history.

As you see on this timeline, we have made tremendous strides in what is recorded and how well it is protected. Starting back in the 1950s, we had very rudimentary requirements based on what it was technology permitted. Over the years, we've been able to constantly improve both what is recorded, how it's recorded, how it's protected, and how much information can be stored.

All of these improvements have resulted in the outstanding safety analyses that the NTSB has been able to provide after accidents, which has resulted in improvements to overall aviation safety, resulting in the reduction in accidents that we've seen over the last 20 years. Let me highlight some significant changes that have been made since the mid-1990s.

The revision that we issued in 1997 was perhaps the most fundamental revision up to that time. And again, much of it was driven by what the technology permitted. We were able to substantially increase the number of parameters that were recorded on flight data recorders, thus improving the amount of analysis that could be done after the accident occurred. That rule was responsive was three very significant NTSB recommendations.

Once that rule had been in place for a while, in 2003, we determined that there were some improvements and corrections that needed to be made. And so, we made some adjustments to make the requirement more effective and to also allow for some leeway as to what older aircraft had to be able to record, so as to accommodate those aircraft.

2008 was the second most significant revision. And again, it was very much driven by what technology could permit.

As you see, we increased the recording duration, we increased the parameters, we required physical separation. Probably most importantly, we increased the reliability of the power supply, which assured that the systems collected the most data for the longest period of time. This addressed five significant NTSB recommendations. We had a sort of partner rule with that at the same time that made some particular revisions for particular aircraft types of types of operations, which covered two of the NTSB recommendations.

And then, in 2010, we made the last most recent change, which prohibited filtering of data, which was something that we learned from an accident investigation and was, again, in response to three NTSB recommendations.

Now, just to be clear, I need to make the point that while we have addressed many of the NTSB recommendations, we have not satisfied all of the NTSB recommendations on flight data recorders. There have been over 50 flight data recorder recommendations. In some cases, we did not move as quickly as the Board would have liked. And so, although we actually met the intent of the recommendation, the Board found it unacceptable because it had taken us too long a period of time.

There are several recommendations where although we met the intent of the recommendation, we did not include all of the operating environments that the Board would have recommended. And so, that was found not to be completely satisfactory. And we have not required video imaging recording, as the Board has recommended on several occasions.

As we look at how the FAA requirements link to the international requirements, we see that FAA's requirements are very consistent with what ICAO has set as standards. In fact, in many cases the FAA, working with EASA and its predecessor JAA, drove the requirements that were set for the international standards. So we are fully harmonized with our partners in EASA, and we are consistent with the ICAO standards.

There is a new ICAO standard that will come into effect in January 2016. We have not yet determined whether and how we will meet that requirement. And if we do not have the requirement in place by that date, we will file a difference.

There are some differences in the applicability in the way we define which operators have to meet certain standards and how ICAO defines them. We set our requirements based on aircraft seating, engines, and the type of operation, whereas ICAO standards are based on aircraft weight and engines. But with that slight exception, we are fully harmonized.

I think as important as what we have required by standard is what it is we've enabled that have allowed for improved safety. And as the Chairman referred to, there are a number of technologies available now which help support collection of data. And we have -- and you'll hear much more detail about this in later presentations, but FAA has put out either technical standard orders or other kinds of approvals to allow for various kinds of additional ways of collecting data that are voluntarily adopted by many operators.

And finally, we think that the most important use of data is not ideally after the accident, but more ideally before any accident occurs. And as the Chairman is well aware, we have with our industry quite a bit of work underway to voluntarily collect information, to analyze that in advance of any kind of catastrophic failure, and identify safety enhancements.

These programs, which are partnerships between government and industry, have been very successful in reducing the accident rate or contributing to the reduction of the accident rate over the last 20 years. And we see a tremendous benefit in enhancing and increasing the amount of voluntary information that can be collected so that we can better anticipate and address safety risk before we are faced with a catastrophic failure.

So, again, I want to congratulate the Board for calling this forum, and we look forward to what all of us can learn both about specific technologies as well as the processes for taking advantage of those as you complete the forum today. Thank you.

MS. GORMLEY: Thank you, Ms. Gilligan.

Our next speaker for this panel will be Thomas Mickler of EASA. Mr. Mickler.

MR. MICKLER: Thank you, Mr. Chairman, for inviting EASA onto this panel. It is an honor for me, and a pleasure to be here.

Oh, I need the clicker. Thank you very much.

Before I provide you with a general overview on rulemaking activities in Europe, I will briefly illustrate who is playing what role in the European legislative process.

The EU Parliament and Council of Ministers adopted a co-decision process, the highest ranking regulations. Those regulations define the scope of powers transferred from member states to the community, and specify general regulatory objectives and form of essential requirements. EASA's basic regulation is a typical example of such high-level legislation.

All provisions are directly applicable and binding in all 28 EU member states. The Commission is empowered to adopt more specific rules to implement the essential requirements, simply called the implementing rules. Implementing rules under the basic regulation are normally adopted through a process called comitology. Member states are represented in their respective committees, where they deliberate and vote on a legislative proposal by the Commission. Commission implementing rules are also directly binding on member states and are therefore considered hard law.

The Agency, EASA, is considered the EU expert body for aviation safety and assists the Commission in all its legislative activities related to aviation safety. EASA does not have powers to adopt binding legislation in its own right, but it develops and publishes what is called soft law, namely, certification specifications, acceptable means of compliance, and guidance material. But it also has an important role to play in its capacity as the Commission's expert body for aviation safety, as it develops on behalf of the Commission draft proposals for essential requirements or implementing rules, the so-called opinions, which form the basis for Commission's regulatory proposals.

This map is to give you an idea on the geographical reach of EU legislation today. The basic relation and its implementing rules are, as I've said, directly applicable and binding in the 28 EU member states. There are a number of states that have committed themselves through bilateral or multilateral agreements to implement European regulations into their national law. Other states regularly transpose EU legislation into their national law. The total number of European states where European aviation safety regulations are either directly applicable or rendered applicable through an act of national legislation is 46. All those states have subjected themselves through working arrangements to EASA's standardization process.

Today's requirements for flight data recorder, cockpit voice recorder, data link recording, and ELTs are contained in EU-OPS, another European regulation aside from the basic regulation, and JAR-OPS 3 for helicopters, which has been developed under the JAR system and nationally implemented.

However, in a few days the 2-year opt out period for the implementation of the new European OPS requirements ends, namely, on the 27th October 2014. That means as of this month, the paragraphs listed here on this slide are binding in all 28 EU member states and 4 EFTA states, and will be rendered applicable in the other states I mentioned at their own pace.

Overall, those standards are aligned with ICAO Annex 6 provisions, although ICAO's November 2013 amendments to Annex 6 are not yet fully reflected. The implementing rules are complemented by acceptable means of compliance, guidance material, ETSOs and EASA's certification specifications for aeroplanes and helicopters, which refer to internationally recognized industry standards, such as EUROCAE doc ED-112 and ED-62A, to mention only a few.

So what comes next? In December 2013, EASA published a Notice of Proposed Amendment, NPA 2013-26, to amend requirements for flight recorders and underwater locating devices. The proposal reflects ICAO's latest Annex 6 changes, but it also suggests, for example, to extend significantly the duration of CVR recording capabilities for aircraft with more than 27 tons maximum certificated takeoff mass, for which the certificate of airworthiness is first issued on or after 1st January 2020. The 20 hours you see here on this slide I understand are currently again under discussion. It is possible that this will be raised to 25 hours.

As part of the NPA process, a regulatory assessment was performed and stakeholders were duly consulted. As a result of this process, EASA issued its opinion in May 2014. It forms now the basis for the Commission's regulatory proposal to the EASA committee.

After MH370 disappeared without traces, the Commission and EASA have been looking also into possibilities to encourage the implementation of aircraft tracking, and are working on draft performance-based requirements to become part of this regulatory package. For the general public in Europe, it is incomprehensible that a commercial airliner can simply disappear, and expectations are high to address identified weaknesses in the system swiftly. The time schedule proposed by the Commission is therefore very ambitious.

The 8th March 2015 marks the first commemoration of MH370. By then, the Commission would like to have a full package of regulatory amendments on the table, including for flight tracking. In order the achieve that, the draft regulation would need to be finalized towards the end of this year, taking into account discussions with member states in the next coming days and any developments at ICAO level, and possibly to vote on it at the EASA committee's meeting end of January.

Of course, Europe is interested in globally agreed solutions and committed to keep its regulations aligned with the work performed at international level. The draft regulatory proposal may therefore still need to be adjusted throughout the process as the picture matures. The ICAO high-level safety conference in February will be a good opportunity to agree on viable solutions and a common way forward. In an ideal scenario, if proposals mature by January 2015, and member states vote positively, the Commission could adopt and publish the full package in May 2015.

This concludes my presentation, Mr. Chairman. And I would also like to thank you for organizing this panel at this very appropriate point in time. Thank you very much.

MS. GORMLEY: Thank you, Mr. Mickler.

Our next speaker for this panel will be Marcus Costa of ICAO.

Mr. Costa.

MR. COSTA: Thank you, Ms. Gormley, and good morning everyone.

Twenty-four hours a day, 365 days of the year, an aircraft takes off or lands every few seconds somewhere on the face of this planet. Every one of these flights is handled in the same uniform manner whether by air traffic control, airport authorities, or pilots at the control of the aircraft. Behind the scenes are millions of employees involved in manufacturing, maintenance, and monitoring of the products and services required in the never-ending cycle of flights.

Modern aviation is one of the most complex systems of interaction between human beings and machines ever created. This clockwork precision in procedures and systems is made possible by the existence of universally accepted standards known as Standards and Recommended Practices, or SARPs, as we refer to. SARPs cover all technical and operational aspects of international civil aviation such as personal licensing, operation of aircraft, aerodromes, air traffic services, accident investigations, and the environment.

My goal today here is to walk you through the procedure of developing a standard or a recommended practice to be universally accepted. The origin of the proposal, as you can see in the slide here, may come from contracting states, from the Assembly, from the Council of ICAO, from the Secretariat of ICAO, from the Air Navigation Commission -- that's what ANC stands for -- from meetings, from panels, from committees, and so on. And this would be a proposal for action for ICAO.

And, of course, the Air Navigation Commission is our technical body, so any SARPs -- for technical SARPs, proposals are analyzed first by the Air Navigation Commission. And depending on the nature of the proposal, the Commission may assign its review to a specialized working group that we call sometimes Air Navigation Commission panels, sometimes Air Navigation study groups, divisional type meetings, and so on.

And then it goes to what we call a preliminary review by the Commission. It's a very structured process that is in place in ICAO to develop a standard or a recommended practice. And this is an important thing to call your attention to. After the preliminary review, all contracting states and international organizations are consulted on the preliminary proposal.

After this consultation, which usually is given to states, 3 months -- let me go back here. It comes back to the Secretariat. We do the analysis of all the replies, we reproduce the replies in full for the Commission to see, and it goes back to the Commission for the final review. And this is usually roughly 6, 8 months after the preliminary review.

And this is pretty much my last slide, actually. I have two others to use, if you want. This is going to be available, I believe, for all of you.

So after the final review of the Commission -- and, of course, the proposal may be rejected, depending on the replies by states and the international organizations, or it may be amended. So experience has shown that the original proposal is never the same one at the final stage. You may have a change in the applicability date, in the weight of the aircraft involved, and so on. So it goes to the Council adoption here, and then we have the Green Addition, which is a preliminary amendment to the Annex.

And even after the adoption by the Council, states still may disapprove this. The policy prescribes that states are allowed 3 months after the Green Addition to indicate disapproval of adopted amendments to SARPs. We never had such case because of course when it gets to the Council level a consultation phase has been processed. States have sent their replies, their positions, international organizations; the Air Navigation Commission has done its final review, so when it comes to the level of Council adoption it's a pretty mature proposal. But states still have the flexibility or the option to reject after the Green Addition. They have 3 months. If the majority of states reject, then the proposal would be killed of course.

Provided that the majority of states have not registered disapproval, then the amendment becomes effective, usually in July. Council adopts in February/March, 4 months later the amendment becomes effective, and then it enters into force. And then in November of the same year, the amendment becomes applicable. It's a jargon, ICAO jargon, but that's the difference between effective date and applicability date. By the applicability date the states would need to have implemented the proposal.

And I don't expect you to read this, but this is the previous slide only with all the timeframes here, if you want to take a look at it later. And, of course, this is the whole cycle I was intending to show you in the beginning, but I didn't mean to scare you. And this is what is the work that is presently being done in ICAO regarding recovery of flight data recorder and locator transmitter, and so on.

FLIRECP, it stands for Flight Recorder Panel. That's the active work of the panel. The panel met last week in Montreal, and the proposals will be taken to the Air Navigation Commission for preliminary review next year, if I'm not mistaken. I have the chair of the panel here. He can help me later. So, we are working on proposals for accident site location, automatic deployable flight recorders, working on RPAS, guidance for maintenance flight recorders, and so on.

And the last one here talks about airborne image recorders. And this one is pending, waiting for the results of the work to further protect safety information. This work is presently being done, and proposals for airborne image recorders will follow after we finish the work on further protection of safety information.

That's pretty much what I had to say. And thank you very much, Mr. Chairman, for the opportunity to come here. It's as great pleasure, and I want to congratulate you for the initiative. Thank you.

MS. GORMLEY: Thank you, Mr. Costa.

This concludes the presentations for this panel. We are now ready for questions from our Technical Panel. I'll turn things over to Mr. Cash, the Technical Panel lead for this topic.

MR. CASH: Good morning. I would like to thank my panelists for taking time out of their busy schedule to participate here today.

My first question is to Ms. Gilligan. In your presentation, you briefly described the FAA's rulemaking process. Can you discuss what rules are currently in the pipeline and how long that pipeline is, and what the priorities are, and if any of them are recorder or aircraft locator technology improvements?

MS. GILLIGAN: Yes, sir. We have over 50 identified rulemakings on our agenda right now. Several of them were directed by congressional action. Some of those are at the notice stage, some of them are moving to the final rules stage. But those are among our highest priorities because, of course, the congressional direction suggests that that's the appropriate public policy. In addition, we have some safety rules both for operations as well as for aircraft certification design standards, which are on that list as well.

Currently, I don't recall -- I don't believe we have any particular project related to flight data recorders or to technology for recording data because, again, we have quite a heavy agenda directed from some other external sources. But based on whatever we learn today, and, of course, we're following the ICAO and IATA work quite closely to see what, if any, recommendations from that group as well. And we'll look to see whether and how we might fit some additional priorities, if we need to.

MR. CASH: Thank you. Again, back to you, Ms. Gilligan. The Safety Board has some recommendations to the FAA, and we recently received feedback from you saying that you guys really liked the idea, you endorsed it, support it, but the concept was turned down because it would not pass a cost/benefit analysis.

We realize that flight data recorders are a unique case and, as such, are difficult to associate a tangible benefit versus the cost to industry. Can you explain the cost/benefit analysis process, maybe discuss ways around this seemingly formidable obstacle?

MS. GILLIGAN: Yes. The Executive Order does require that agencies look at the costs that might be imposed as a result of a new standard and that we be able to justify that that cost is appropriate, given whatever the benefits may be.

Because of the high number of priorities that we already have on our rulemaking agenda, we are looking closely at those rules which may be more difficult to build that cost justification and we are holding those in abeyance while we complete the projects that we already have in the pipeline, which we believe, having done some preliminary analysis, we believe that we can demonstrate that the cost of the proposals that we have pending will, in fact, justify -- be justified by the benefits to the public.

It is a necessary step in all the analysis, and it can be quite a challenge, especially because aviation is so safe. It is because of the hard work of the Board and so many in the industry, and we have very few accidents at this point. And so, it does sometimes make it more difficult for us to perform that analysis. But we continue to look at whether and how we can anticipate what the benefits might be.

We are looking at ways that we can take credit for benefits from predicting or avoiding potential risks. All of those are new ways that we're trying to look at our rulemaking to be able to enhance our standards and meet the expectations for the analysis.

MR. CASH: Just as a follow-on, does the mandates from Congress negate the cost/benefit analysis, or is it still required?

MS. GILLIGAN: The process requires that the cost/benefit analysis be performed because it is important that we be informed by just what will these new standards cost. But when it is congressionally directed, we do have the added benefit that the public policy determination that Congress has indicated argues in favor of it being cost-justified.

MR. CASH: Okay. Mr. Mickler, does EASA have a similar process that they go through?

MR. MICKLER: Thank you. EASA also performs a cost/benefit analysis, actually a somewhat wider analysis. We call it a regulatory impact assessment. The economical aspects are only one aspect we are looking at. We also are looking at safety aspects. We are looking at social aspects. In total, there are a number of six dimensions we are looking at.

And for the regulatory amendment proposal that I presented, which is based on -- which is the Opinion 1/2014, such a regulatory impact assessment has been performed and came to a positive conclusion. For the tracking part, no such regulatory impact assessment has been performed to date. Thank you.

MR. CASH: And Mr. Costa, does ICAO also review cost versus benefit?

MR. COSTA: In ICAO, the most important thing is the impact assessment that we -- and, of course, it involves costs to the states and the industry, and this is not very easy to get. Very recently, we had implemented an impact assessment, and I think the Flight Recorder Panel just made one -- made some, because we need an impact assessment for every proposal, and this is to assess the costs that would be incurred in the states. That's not easy. Sometimes we have found that the information might be confidential, depending on who is providing the information.

So we haven't been successful in assessing the costs, but we have the mandate to assess them. It hasn't been easy at all, but we would like to know what would be the cost of every proposal. Of course, the benefit is safety at large. But retrofitting is something that is very well analyzed, if it's necessary to have a retrofitting in a proposal.

Usually the proposal is forward looking. The proposals that are being discussed right now, most of them are for new types certificate. But, again -- and this would be a message to the industry if we could make available the costs when -- and this is discussed in the panel and we have the industry representative on the panel, but it's not always easy to find out the costs. But we do want to know them.

MR. CASH: And I'm sure member states in their letters back give you plenty of feedback as far as the cost is concerned. Do you have to resolve all those?

MR. COSTA: All the replies from states, they are reproduced in full in the proposal. We do not edit them. We just -- well, sometimes if "may" comes with double Y, we can cut out one because it's a typo, but the -- all the replies are fully assessed. We may or may not agree with the reply. We don't have to agree, but we have to justify why we disagree. And then we take it to the Commission who has the final word before going to the Council.

And again, costs -- in the investigation, at least on the investigation side, we haven't received precise costs from states for our proposals. They are usually for new types, as I said, and states when they disapprove proposals in the investigation field, it is usually due to their national legislation. And, of course, we understand this. But sometimes the proposal goes forward because in this case it perhaps would be advisable for the state to reconsider the legislation and amend it, if it is for the benefit of safety.

MR. CASH: Okay. Thank you.

Ms. Gilligan, we're hearing from industry that any flight data and locator rule would be a performance-based rule. Could you please explain what a performance-based rule is and why would it be preferred in this instance?

MS. GILLIGAN: Yes, sir. In most cases now, we are looking at trying to describe what is the safety risk that needs to be addressed, and how might technology perform in order to address that risk, rather than to require by regulation a particular technology. What we've learned over the years -- and I think the slide that I showed on recorders shows it -- technology does nothing but improve over time.

And we actually have some regulations where we named a particular technology, because at the time none of us really thought that there could be anything better than what we had already designed at that point, and then we find a few years later we must go in and change the rule. And that requires a notice and comment, a full analysis, all of the process that I talked about.

So what we're looking to do in all of our rulemaking is to describe what it is that the aircraft needs to do or the operator needs to do or the pilot needs to do, and allow for the industry to determine how they will demonstrate that they meet those standards. They still have to demonstrate compliance to the standard; we need to find that they've demonstrated that compliance. But by demonstrating it against a performance standard, it allows for much more flexibility, much more innovation, and it allows our regulations to extend longer without our having to go in and make changes.

MR. CASH: Doesn't that complicate the certification process?

MS. GILLIGAN: No, actually. I think because we understand what the performance is that needs to be demonstrated, we've seen that our industry is really quite competent at being able to demonstrate that they meet those standards. A number of our design standards are performance-based standards already, so we have good experience both within the regulating community as well as on the industry side to demonstrate compliance with performance standards. And as I said, it allows then for a lot of innovation, and it allows for -- as a regulator, for us to allow the rule to grow with whatever new technologies may be able to demonstrate compliance.

MR. CASH: Mr. Mickler, does EASA have the same kind of philosophy?

MR. MICKLER: Yes, sir. I have not much to add to what Ms. Gilligan said except that we are exactly on the same page. We made the same experiences, and the new regulations the Commission at EASA are discussing with regard to aircraft tracking will be performance-based regulations. They allow for the necessary flexibility and leeway for the industry to come up with good solutions, and they also allow, without necessary regulatory changes, to follow the technological evolution. So we think it's the better way of regulating. Thank you.

MR. CASH: And my next question, Mr. Mickler, would EASA be opposed to a phased-in-rule approach for a location solution? And what I mean by that, can EASA create a rule that would initially apply only to aircraft that currently have the necessary hardware, and then sometime in the future put the -- you know, the rule would cover more aircraft sometime in the future?

MR. MICKLER: I have to admit that I haven't fully grasped your question.

MR. CASH: It basically is a phased-in rule where, say, on locator technology the aircraft that may be equipped right now would be -- it would be applicable to those, and then at some time in the future the rule would extend to other airplanes.

MR. MICKLER: Well, the future rules will be more and more performance-based. As far as the locator rules are concerned, we do have certain minimum criteria as to what we expect the locator, the devices are supposed to fulfill. It is, of course, appreciated if certain technology is -- or that is already available is implemented by industry even though it is not necessarily required by the regulations.

And in future regulatory impact assessments, the equipage of the fleet is certainly a factor that needs to be considered to what extent it would satisfy the regulatory objective. I hope that I roughly addressed your question.

MR. CASH: Thank you.

Ms. Gilligan, could the FAA deal with a phased-in rule?

MS. GILLIGAN: Well, Mr. Cash, we always look at -- especially for technology, we always look at three segments. One is what to require for new type designs that may come in the future, and that is to set a new standard then for design for all new type certifications. We look at whether the technology can be -- or how it can be cut into current production, and what the obstacles or challenges may be to that. And we look at whether or not the existing fleet can be retrofitted and sometimes, as you suggested, or categories within that retrofit of some aircraft that can accommodate a retrofit more easily than others.

So we have many rules that have all three of those requirements; we have some rules that are only for new type design; we have some that are cut into production but don't have a retrofit. In terms of within the retrofit category, I can't think of one offhand where we've described the requirement differently based on either the age or capability of the aircraft, although we do at times have rules that apply to aircraft type-certificated after a certain date or produced after a certain date.

So we certainly look at all those options as we look to how can we balance what the challenges will be and what the safety benefits will be.

MR. CASH: In a phased-in approach, it would actually almost drill down to the individual aircraft, you know, this airplane is equipped, this one would not be, in the same fleet.

Could the FAA deal with that or is that just too much overhead?

MS. GILLIGAN: We haven't taken that approach to date, although I suppose we could look at it. One of the issues, or one of the constructs, concepts that we want to address is the appropriate level of safety for the operation within the system. And so, we have tended to look at it in those categories that I described, whether it can be applied to brand new design, whether it can be applied to those aircraft that are still under construction, and whether or not it can also be retrofitted in the fleet, to assure ourselves that we've got an appropriate level of safety throughout the system.

MR. CASH: Thank you.

Mr. Costa, if airlines are basically going to be charged with receiving tracking data, they're going to be the keepers of the data, what process could be implemented with member states to ensure the timely transfer of this data to the accident investigation community in the event of a lost airplane?

MR. COSTA: As you should be aware, there is a task force working on aircraft tracking right now, and the work is still going on; it's very preliminary and I don't have any final positions yet. But I can tell you that the results will be represented to the -- will be presented to the ICAO Council in the next few weeks, so I don't have any information as of now.

MR. CASH: Mr. Mickler, do you have any idea on how we could get the data from the individual airlines, if there is an accident?

MR. MICKLER: First and foremost, the airlines need to have the data. If they don't have the data, we can't get the data. And this is what the regulatory proposals in Europe are directed at, to make sure that in the future we receive the data. Once we have the data, the next question is how do we share the data? We in EASA think it is very, very important to share the data so that experts around the world can sit together and deliberate how we can improve aviation safety.

And we know that there are certain obstacles and hurdles. Data protection is a big issue, particularly when it comes to the long-term objective or possibility of data streaming, but it is worth looking into it. And I'm sure solutions will be found for the benefit of safety.

MR. CASH: Thank you.

Ms. Gilligan, do you have any thoughts on that subject?

MS. GILLIGAN: Yes, I think as Mr. Costa indicated, that the work being done both at ICAO and through the IATA task force is looking not just at what technologies might be available, but what are the roles and responsibilities of all of the players, whether the operator, the regulatory organization, the accident investigation organization, and ICAO itself. So I do think we will address all of those requirements as part of whatever the recommendations are that follow that work.

You raise a good point, but it is a matter that we've been able to address up to this point quite effectively. And I'm sure we'll find equally effective ways to make sure that the data is properly shared, properly protected, and that it can be used, as Mr. Mickler suggests, by the experts who need it to really understand what has occurred, and more importantly, how can we prevent it in the future.

MR. CASH: Thank you.

I believe Ms. McComb has some questions.

MS. McCOMB: Thank you, Mr. Cash.

This essentially can be addressed by each of our panelists. Given the regulatory challenges that exist in implementing new technologies, would you please discuss the range of options each of your organizations have to encourage industry to adopt new recommended practices without regulations?

MS. GILLIGAN: If I may begin. Certainly all of the U.S. operators look very closely at ICAO's recommended practices, in addition to the actual standards, to see if there are ways that they can improve their own safety performance. We've already seen that there are a number of non-required technologies that many operators are already implementing, and I know you'll hear quite a bit about that in your later panels. Some of them are adopted because they not only provide safety data, but they also provide data that can be used to assure the operator they're operating their aircraft in the most effective, efficient way.

So certainly technologies that can help the operator understand how their aircraft are operating and whether or not there are safety objectives that are not being met, are ways to encourage the operators to take on those technologies, whether they're required or not.

MR. MICKLER: EASA has a number of initiatives to foster and encourage the industry to discuss safety data and to find appropriate solutions that would enhance aviation safety. We have the instruments of publications, technical publications, safety information bulletins, and we have various fora. We have the forum that is called European Strategic Safety Initiative, ESSI, which rests on three pillars: one is ECAST for commercial air transport, one is EHEST for helicopters, and one is EGAST for the general aviation.

And these fora are fora with industry, with the various stakeholders, where safety initiatives are typically being discussed. And they help to encourage the industry to move into a certain direction, and we at EASA, we assist them on this way as good as we can. It is a collective exercise, and I understand and hear -- I admire the FAA. They have set up a system, which is actually far more advanced from what we have. Today in Europe with the InfoShare, I had the pleasure to attend the InfoShare meeting and their other fora as well, so I think these are the fora through we reach consensus with the industry to collectively improve aviation safety.

MR. COSTA: Yes, as I mentioned previously, everything that is done in ICAO is heavily discussed and coordinated. And we usually refer to the four C's of aviation. That's very ICAO-ese and I apologize for that. But we usually say that a good SARP requires cooperation, consensus, compliance, and commitment. So cooperation in the sense that you -- in the formulation of SARPs. So all the panels and the study groups and divisional meetings, those are all composed by states and international organizations.

So, Erin, for instance, if she allows me to say, is a member of the Flight Recorder Panel of ICAO. Jim Cash was our chair of the Flight Recorder Panel some years ago. Two on the table. So it's everything that is done is discussed among states, among international organizations, and the Air Navigation Commission is also composed by states. And, of course, the Council is also composed by states. So everybody that works in ICAO, except from the Secretariat -- the Secretariat comes from states, but they do not represent states, so we are not even allowed to have our flag on our desks because we serve the world, as you know.

But the ANC, the Air Navigation Commission, the Council, the study groups, the panels, they are all composed by you, by states and by international organizations. So, when a SARP gets out of the oven to be implemented, they are very, very mature. So I think the implementation of what is developed in ICAO, when it gets to the stage of the implementation that we call applicability date, it's a very mature process.

And the whole package from the very beginning, from the very beginning of the concept, it's an average of 5 years to get there. So I don't see any big challenge in implementing what gets approve in ICAO because of this.

MS. McCOMB: Thank you.

I have one additional question for Ms. Gilligan. You mentioned earlier about how our regulations here in the United States may essentially at some point -- I believe it's in 2016 -- have some differences between what ICAO recommends.

Can you talk a little bit further about what challenges are posed when the activities going on at the ICAO/IATA level, when there are changes in EASA, how -- if other countries start implementing significantly different recorder or technologies through their regulations, how any differences would be handled with the United States?

MS. GILLIGAN: Yes. If we are not in compliance with an ICAO standard at the time of applicability, ICAO has a process for states to notify that they have a difference from that standard. And if that's necessary, we will file that difference. What we do then is continue to evaluate whether and how we can implement the standard, or how close we might get to the standard. But again, it has to go through the rulemaking process. And right now, as I said, we have a list of 50 rulemakings underway already. And so, it is a matter of when and if we can fit that new project into our agenda.

So, we're always balancing those kinds of considerations: Are there higher safety issues, higher safety risks that need to be addressed first? And we think right now we have our higher priority rulemaking projects underway, and we'll continue to evaluate the ICAO standard and put that in place when we have the ability to add that to our rulemaking process.

MS. McCOMB: Thank you.

I believe Ms. Gormley has a question.

MS. GORMLEY: Mr. Costa, my recollection is after Air France 447 that there was a process by which a letter was sent to states encouraging adoption of 90-day ULBs, for instance. I understand the complexity of the process in terms of the general SARPs, and the 5-year process.

Can you explain that letter to the states? Is that a different process? Is that a quicker way or a less formal way to encourage adoption?

MR. COSTA: The adoption actually of the 90-day battery life, right, you're talking about, there is a provision in place -- I cannot recollect right now; Philippe may help me here with the dates -- but it was agreed that before the applicability date of that provision that ICAO would encourage the states to implement them as soon as possible. It was a unique case. We knew that the battery was available, but in the applicability date of the provision that exists took into account the life of existing batteries. So by the time they would need to be changed, and then they would put a 90-day battery. And there was also the understanding that the 30-day battery would be discontinued. In other words, you had some existing ones on the shelves, but they would not be manufactured anymore.

So, yeah, it was a unique situation in which ICAO encouraged the states to implement a provision that was not applicable yet, for the benefit of safety.

MS. McCOMB: Thank you.

MR. CASH: Acting Chairman Hart, that completes the Technical Panel questions for this panel.

ACTING CHAIRMAN HART: Thank you, Mr. Cash, and thanks again to all of our panelists.

We will now hear questions from the dais. Mr. Delisi?

MR. DELISI: Thank you.

And thank you to the panel for discussing the harmonization of international standards. I think that's so critical to accident investigation. Years ago we used to use the term domestic accident or international accident, but these days every aviation accident is an international event. The Board in the last few months has completed investigations of accidents involving a Korean carrier who was operating a U.S. airplane, and a U.S. operator that was operating a European-built aircraft. So the harmonization is so critical.

Recovering data is certainly a key to a successful investigation, but sometimes recovering the wreckage is also vitally important. And one area in which the regulations are not fully harmonized is the carriage of ELTs aboard commercial aircraft. And, Ms. Gilligan, I wonder if you can talk through what the FAA philosophy on ELTs is?

MS. GILLIGAN: Yes, sir. As it applies to commercial operations, it has been the FAA's position that those operations are in constant contact with air traffic control. And so, there was -- we did not see a need for having that additional technology, although, as you know, many of the aircraft do carry ELTs and other kinds of alerting systems. But because of the constant and regular contact with air traffic control, it has been our position that we will know where the aircraft are based on that technology.

DR. MURPHY: Great.

Mr. Mickler, in Europe, would an ELT be required to be carried aboard a commercial airliner?

MR. MICKLER: Well, certainly, yes, ELTs are required. We unfortunately also observe that existing ELTs when they are really needed don't show the performance that we would expect. We have done an analysis, and the percentage of malfunctioning ELTs is rather high. It's I think -- I don't want to quote the wrong number, but I recollect something in the order of 50% where the antennas have come off or where eventually the ELT was useless.

The Cospas-Sarsat system remains as a whole still the most effective global system for emergency location. I think there's only a weakness in the devices of the ELTs, and these weaknesses are currently being addressed. There's a EUROCAE Working Group 98 that is precisely addressing these issues. And this group also looks into the possibility for ELTs to be activated when an emergency situation is already discovered rather than after the fact when the accident has occurred.

Apart from the aspects that you mentioned, a functioning ELT is extremely important also to rescue potential survivors. We had accidents in the past where people had drowned because the rescue teams could not access the accident site quickly enough.

Thank you.

MR. DELISI: Sure, and -- thank you. And just to be clear, an ELT is not a device that's designed to help locate an aircraft underwater. Correct?

One other area, we are starting to see the voluntary equipage of aircraft with video recorders. The Board next month will be considering the report of an accident involving an Airbus helicopter that was equipped with an Appareo video recorder that provided crucial information to the completion of that investigation.

Mr. Costa, I was going to ask you, you mentioned that the flight recorder working group at some point in the future is going to be considering some video imaging standards. I wonder if you might be able to elaborate on what might be on their plate.

MR. COSTA: Yes. Actually the panel has already deliberated on the proposal for airborne image recorders. Annex 13 on paragraph 512, today we have -- we address airborne image recorders. However, the Air Navigation Commission of ICAO, when this proposal was presented I believe 2 years ago, maybe 3, was of the view that we would need to strengthen the protection of such recorders, that the protection that we have in 512 today that is subject to what we call the balancing test by the judicial authorities, it was the view of the Commission that that protection is not sufficient.

So for this reason, ICAO established the Safety Information Protection Task Force that worked for over 2 years. And at the end of the work of the task force, in general, this year, the provisions addressing specifically the protection of airborne image recorders, the task force was of the view that another group would need to further review those proposals. And this is the group of experts on protection of accident and incident records that is currently working. And this work is going to be finalized in this coming November and this will clear the way for the Flight Recorder Panel to proceed with the proposal.

MR. DELISI: Very good. Thank you.

ACTING CHAIRMAN HART: Thank you, Mr. Delisi.

Mr. Kolly, do you have any questions?

DR. KOLLY: Yes, I have one.

Again, I'd just like to follow up on the issue of voluntary encouragement and measures to get safety changes accomplished. And, Ms. Gilligan, you had described very eloquently the process in which rulemaking is done, and also referred to some of your efforts in improving safety through voluntary measures.

Can you tell me when that approach, the voluntary approach is preferable? You know, specifically, for instance, there is an image recorder recommendation out there, and you've kind of taken that towards the voluntary implementation route. Can you tell me when that's preferable from the FAA's perspective and how that process and decision is arrived at?

MS. GILLIGAN: Sure, Dr. Kolly, I'd be glad to. Let me talk on the video imaging first of all. We in the FAA have shared the same concerns that you just heard Mr. Costa describe for ICAO. We believe that the protection of video data is even more difficult than the protection of some of the other data that we currently already collect for accident investigation, and that we need to be assured that there are strong protections for that kind of information in place as we look to whether or not to mandate that.

Generally, we look for voluntary compliance as a primary way of going forward. It's faster. If we can -- working with the industry, if we see data that suggests there is a safety risk of a certain type and that certain mitigations will reduce that risk, it's very difficult for safety professionals to walk away from that. And so, what we are learning in our Commercial Aviation Safety Team, for example, is that when we come together as a community and we look at the data to see where we have risk in the system, we find ways to mitigate that, and we all go back and do what we need to do to make sure that we are reducing that level of risk. So we think that that's always a preferable way.

If after the fact, we need to raise our standards to be consistent with what we voluntarily implemented, it sometimes makes the rulemaking easier as well because we can demonstrate that the community is already implementing some of those changes. So that's our preferred way of going forward.

In these areas of data collection, we're seeing that when the data system not only enhances safety but also provides the operator some information that they can use to operate their aircraft more efficiently and effectively, that that's the kind of technology that they can more easily voluntarily put in place because they get regular daily value from it just by operating the aircraft and learning more about whether and how they're operating it. And then they have the data for the time when they have the anomaly or, God forbid, they actually have a catastrophic failure. We can all benefit from that data as well.

So the more useful the data is to the operator, the more likely that they'll voluntarily implement that data collection source.

DR. KOLLY: And being voluntary, does the FAA take actions to follow up on the effectiveness of that particular approach?

MS. GILLIGAN: Again, through the Commercial Aviation Safety Team we are looking at metrics that evaluate whether in fact we've all implemented what we had committed to implement, and then whether or not it's actually being effective. And we can do that because much of the data that the operators collect through their flight operations quality assurance programs and their voluntary employee reporting programs. So we do have metrics now for some of the safety risks that we've undertaken.

So, for example, we set about reducing the number of unstable approaches. We now have data that lets us evaluate whether or not the number of unstable approaches is coming down. We are seeing good results as a result of that, but we'll continue to monitor it. And if we see an increase at either a particular location or whatever it might be, we'll look to see have we implemented what we said? And if not, let's fix that. And if we did implement it and we're not being effective, what more can we do to address that safety risk?

ACTING CHAIRMAN HART: Thank you, Dr. Kolly.

Just one question for Ms. Gilligan. You mentioned the Commercial Aviation Safety Team. Are they doing anything about recorders and locators, or are they focused primarily on how to prevent the crash in the first place?

MS. GILLIGAN: Mr. Chairman, we are, as you well know, very much focused on trying to understand those hazards that are still in the system that haven't manifested themselves and trying to address those. So, no, we have not taken on any work related to locator or flight data recording for the purposes of accident investigation. Of course, we'll watch closely what comes out of ICAO and IATA, and if there is a role for the Commercial Aviation Safety Team, we'll certainly look at whether and how we might fill that.

ACTING CHAIRMAN HART: Okay. Thank you. And I just asked the question because it has proven how voluntary implementation can be so effective in some many ways. So thank you for that.

Thank you once again to all of our panelists for your great presentations and to start the discussion this morning. You've laid an excellent foundation for our understanding of this issue from a regulatory and standards perspective. So we appreciate that to inform the rest of the day.

After the break, we'll hear from our second panel, which will address the airframe, on-board system, and service provider viewpoint.

We stand adjourned until 10:15.

(Off the record at 9:55 a.m.)

(On the record at 10:18 a.m.)

ACTING CHAIRMAN HART: Welcome back. We're now ready to hear from our second panel, which will address the airframe, on-board system, and service provider viewpoint. I'll turn things over once again to Erin Gormley.

Ms. Gormley.

MS. GORMLEY: Thank you, Acting Chairman Hart.

As a reminder for our panelists, please push the button on the microphone to activate and bring it close to you while speaking. Push the button again to turn it off when you are completed.

Our next panel is designed to provide us with perspectives on technology solutions that would allow for a more efficient recovery of flight data. Our panelists are Andrei Pascal [sic], Product Security Officer and Executive Expert from Airbus Group; and Mark Smith, Senior Accident Investigator and Associate Technical Fellow from Boeing Commercial Airplane Company, who will discuss current and future commercial aircraft; Chris Benich, Vice President, Aerospace Regulatory Affairs from Honeywell, who will present an avionics provider point of view; and Steve Kong, Business and Development Manager from Inmarsat, who will present a satellite provider point of view.

Dr. Andrei.

DR. ANDREI: So, thank you, Ms. Gormley.

Just waiting for my slides. Here we are.

So, this first slide, this first chart is aiming at giving you an outlook of the Airbus record in flight recorder recoveries. It was a question that has been asked to us recently.

The most important message on this slide is to show that all wreckages and recorders have been retrieved quite immediately after an accident of an Airbus aircraft, except in three of them. And more especially when we are talking about overseas accidents, that took more than a couple of days, and one of them a few years. As you know it was the Air France 447, unfortunately.

The second message of this chart is that all recorders have been retrieved in good shape, and have been able to be decoded, except in four of them: two in bad shape, but decoded at the end, and two of them never decoded at all. And despite that, however, these are good statistics because we consider that the statistics are very good.

Airbus has been very much engaged in and committed in all international initiatives like ICAO, IATA, BEA, and the others. And we have been very proactive externally, but also internally because inside Airbus we have led and have personally coordinated a lot of internal projects to improve the safety of our aircraft, and more especially the search and rescue, the aircraft tracking, the wreckage and flight data recovery in order to explain and to avoid a new accident.

On this page, you can see the status of our current situation regarding the aircraft tracking and localization. One important message is that most of our fleet, of our aircraft, are equipped today to send data to the ground. Those aircraft that I'm talking are long-range aircraft, 85% of our fleet; A380, 100%

of the fleet; and A350, 100% of the fleet, are equipped with FANS-A equipment. And they allow airlines to communicate to the ground either on the AOC system. The AOC is the data share between the aircraft and the flight operations from the airline or to the ATC.

Regarding the ATC, we have the ADS-B, of course, and the ADS-C. All our aircraft are -- equipped with that. The ADS-B is based on the broadcasting of the data, but it's -- the only issue is that it's only over a continent, it's continental only. And the ADS-C is broadcast worldwide, but -- so it's not broadcast worldwide, but it depends with the contact with the ground segment. So, we -- the ADS-B in the future, as soon as we will have a worldwide satellite constellation, to have full coverage of the Earth.

The second message on this slide -- and probably we'll talk about that later on, but we have worked very much on the flight envelope of an aircraft, and we are able now to trigger some data on it by understanding and broadcasting of the data of an aircraft of alerts in case of loss of control on the aircraft. And a very important message on that regarding the ADS-B is that the ADS-B will be compliant with SESAR and NextGen in the future. So it's something also which has a waiting of our decision.

The first page made a focus on the four solutions that Airbus is supporting today. So, as you have seen on the previous slide, the tracking alerts, it's something which is easily feasible because all our aircraft are equipped today. It's a useful solution for retrofit and also forward fit for sure.

The localization, location and retrieval of the data, we have decided to support and to make feasibility studies in the past years of the deployable recorder. And Airbus today has taken the decision to provide in the future on some aircraft -- and you will see on the next slide the combined recorders on board the aircraft, one being deployable with an ELT integrated and floatability capability.

To locate the wreckage, we will implement the additional underwater locator beacon, the additional ULB, the low frequency one attached to the airframe. And this answers to the EASA NPA that was released the end of last year and probably hold force in 2019.

The recorder localization, of course, because once we have found the haystack with thanks to this 8.8 low frequency ULB, we need to find the needle in the haystack, so we will extend the battery life of our attached ULBs on the recorders. It also answers to an EASA NPA. And the solution has been very much worked out with our suppliers, so we are ready to implement.

On the last slide you have the outlook of the potential solutions that we would like to implement on our programs. I'm not saying that this is fixed, but at least we have made all feasibility studies on all the different solutions. The permanent aircraft tracking and early warning will be proposed for all

Airbus aircraft in forward-fit and retrofit, and of course, forward-fit remains part of the airlines.

Something which is important there is to say that for an airlines that would like to implement such a solution, it's just a software modification. And when you want to trigger the broadcasting of data from the aircraft to the ground, it's just a software modification. No need to change any equipment.

The double recorder, combined recorders, one being deployable, will be done on the forward-fit of the A350 and the A380. It will be useful for us to ensure the localization of the accident and to retrieve the flight data at the early stage before retrieving the fixed recorder. The additional ULB attached to the airframe is currently under definition for all aircraft, including the single-aisle, single-aisle meaning A320, A319, A318, and A321 that operated over water.

So this is the most important point to say that as soon as we are traveling, we are having flights over oceans, we are -- it's important to ensure that we have such a capability. And the 90 days that will be attached to the fixed recorders is also proposed in retrofit and forward-fit on all aircraft to localize the wreckage and to localize the recorder.

Just in conclusion, I have to say that Airbus has been, is, and will be always compliant with regulations. That's why we have made all of those changes during the last years. It was important to us to be ready, and to be ready to face future regulations. And we rely very much on this framework regarding what I heard from the first panel just before us; it's important to have a framework from the regulations.

Thank you, Mr. Chairman.

MS. GORMLEY: Thank you, Dr. Andrei.

Our next presenter is Mark Smith of Boeing Commercial Airplane Company.

Mr. Smith.

MR. SMITH: Good morning. I've been asked to discuss Boeing's viewpoint on technologies to help improve our ability to locate downed airplanes. In this respect, Boeing was a participant in the BEA working groups after Air France 447 that examined these technologies.

So in the slide I'm showing now, I'm listing some of the technical solutions, a list of options that will allow us to improve our ability to locate the impact point on land or on water. In an underwater accident knowing the exact impact point with higher accuracy would allow us a more effective search and rescue effort, and then would follow with a minimized underwater search area.

The second bullet shows options that would improve our ability to locate recorders that are already underwater. Due to time limitations, I will only be discussing the items shown in yellow text. These lists show that there are more than one way to solve this problem. Be aware that each of these options also has drawbacks that we have to be aware of when introducing them into the commercial fleet.

So that we can be data driven, I'd like to review some statistics. This is a bit of an eye chart. I apologize, but this is a list of all underwater accidents worldwide since 1980. This list was originally put together by the BEA working group after Air France 447, and it includes transport category airplanes from all manufacturers, not just Boeing.

The columns on the chart, in addition to the accident date, the type of airplane and location of the accident, the last three columns show depth of the wreckage, how many days it took to locate the wreckage on the seafloor, and then how many days it took to recover the recorders. This list is sorted by the last column, how many days it took to recover the recorders.

This shows that recorders were recovered in less than 30 days in 21 of the 31 accidents; 4 of these accidents took more than 30 days to recover; and 3 took more than 1 year to recover. If you look at averages with this whole list, in the last 34 years, since 1980, there were a total of 31 underwater accidents listed in the 34 years. This results in an industry average of one underwater accident per year. It also shows that once every 10 years it takes longer than 1 year to recover the recorders. This is the issue we are addressing today, the ones that take a long time to recover.

Looking at the data in a slightly different way, this chart shows how many accidents occurred worldwide on land, and how many in water for the last 6 years, 2008 through 2013. Along the first line there, on average, there are 15 accidents on land as compared to 1 per year underwater. And those are averages, once again. Our current-day recorder systems are doing an excellent job of helping us understand all of these accidents. Boeing believes we can leverage equipment already on board the airplane to help improve the underwater location ability and collect the reorders.

The statistics in the lower right corner show how many airplanes were flying worldwide in 2013, where we had the 13 on land accidents and we had none underwater. With over 22,000 airplanes flying worldwide, there were over 25 million flights in 2013. This results in an average of 69,000 flights per day. The reason I highlight these numbers is any change that we introduce to the fleet introduces the potential of unintended consequences on those 69,000 every day flights that did not have a problem. And some of these might be in years where we've had no underwater accidents, as with 2012 and '13.

Moving on to some of the work that Boeing has done on improving locating recorders underwater. Boeing has already taken steps to improve our ability to locate an impact location. Reports transmitted via the ACARS system have been significant in understanding accidents prior to recovery of recorders. Boeing has leveraged this by adding lat/long information to some of the message headers, and by implementing an emergency position report when an exceedance occurs. These are learnings that came out of the Air France 447 work with the BEA.

This triggered transmission via ACARS increases the frequency of position reports once an exceedance is detected, and these reports include lat/long, altitude, speed, heading, and so forth, to help better pinpoint the water entry point of an accident. Using the ACARS systems over oceans where we're using satellite connections, one of the drawbacks of this might be that the data might not be able to sent off the airplane all the way through impact due to connectivity issues with the satellites.

These changes I've discussed, lat/long in some message headers and the emergency position reports are already flying on some of our newer Boeing models.

I was also asked to speak about our history with deployable recorders. We have no commercial applications of deployables; however, we have installed deployables on some of our military variants for certain customers, as requested by the customer. The first picture there is the P-8, a maritime patrol aircraft, which is a variant of the 737. One customer of eight of those airplanes requested deployable recorders, and we have installed them. Right below that is the E4B Airborne Command Post, which is a variant of the 747, with deployable recorders.

Our history with this is limited in service, but during development with these two applications we experienced inadvertent deployment, deployment failures, and inadvertent ELT activations. In one case, a deployable was released over a downtown area. These were events that happened in development. We believe we have them corrected, but it highlights some of the issues that can occur with deployables. I do not have in-service results yet on how successful these are in an in-service situation.

On the F-18 fighter on the right side, since 2004 there have been 24 accidents where a recorder was deployed. Eighteen of those were recovered, resulting in a 75% recovery rate. So, I'm bringing these points up to highlight some of the potential unintended consequences that can occur. Unintended deployments from a commercial airplane would not be acceptable and would be a risk that we have to manage. Additionally, even with a deployable installed, it does not guarantee recovery of the data at 100% assurance.

I see I'm out of time, so I'm going to skip to my last slide here. In summary, Boeing, is already delivering airplanes with capabilities that will help locate a downed airplane, including the emergency position report, lat/long in some ACARS message headers. Next year, Boeing will be introducing the new 90-day pingers attached to the recorders. We also are participating in industry activities on full-time flight tracking and triggered ELT concept, which I have not discussed here.

I would like to reiterate that each option here, as well as benefits, has drawbacks, and that there is no one perfect solution. We need to be aware of introducing unintended consequences to the large commercial fleet that's flying.

Lastly, industry and Boeing prefers performance-based requirements rather than prescribed technological solutions. This allows for different technologies to be used to meet a requirement as technology changes and advances.

That concludes my presentation. Thank you for allowing us to contribute to the discussion.

MS. GORMLEY: Thank you, Mr. Smith.

Now that we have two manufacturer views of current and future commercial aircraft, we turn to Chris Benich of Honeywell for an avionics provider perspective.

Mr. Benich.

MR. BENICH: Thank you. And good morning, and thanks very much for the opportunity for us to present our views on this important topic.

Honeywell has been providing, developing, maintaining, supporting recorder systems for well over 50 years. We provide recorders for air transport airline, regional airline, business aviation, helicopters, so a whole variety of fleets. And for the most part, as you've heard -- actually I won't go into the statistics as my colleagues have, but the performance has been quite good. When data recorders are recovered, the data recovery is excellent. The information is available the vast majority of the time.

That said, it's not 100%. We're always looking to try to make the system better, to make the system work more consistently. A couple of those areas that we're working on right now -- again, you've heard of some of this already, but the 90-day duration of the ULD is in work. Our recorders as of 2015 will include this feature.

In addition, this notion of having an additional device, an additional locator device with a lower frequency to extend the range is an important addition to ensure finding the location of the aircraft as well as the recorders, again, addressing a problem that we've seen primarily in very deep water and places where you've got terrain or other things under the surface that can impact the ability of the existing pingers.

A third area that we're not actively working on but certainly understand the need, is the voice recording and extending the duration of the recording to cover the entire flight. So when we have operations of aircraft at 14, 15 hours, extending that capability makes a lot of sense and certainly with the solid-state recorders that we're providing today is not a huge technical challenge.

So a couple thoughts on a couple of these ideas that certainly we'll hear more about over the course of the day. Deployable recorders, we aren't doing any active work in this area. We don't view this as being really technically, you know, very super challenging. It's doable, and it's certainly been deployed on military aircraft. At the same time, there are a number of challenges, risks associated with it.

Certainly, adding the complexity to the airplane, where we currently install recorders deep into the frame of the airplane, is an engineering challenge; maintenance for the airlines and the operators of the aircraft, the risks associated with those maintainers, those people working around the airplane; and then the uncertainty associated whether it works as intended. So that's certainly not going to be 100% type of a device as well.

And at the end of the day we hear a lot about the cost and the time associated with retrieving the recorders today. And I think as a reminder, and certainly you guys know this better than us, but at the end of the day the overall aircraft wreckage is of importance and value, and the cost of going to get that is the same cost that's associated with going to get the recorders. And so, at the end of the day, getting the recorders is going to be part of the deal.

So, in streaming data, another one that technically is very doable, we have a great connectivity on the airplanes today. That connectivity doesn't come for free. We have to consider the value of streaming this data. And as we've already heard, the certainty of that data due to unusual attitudes and other things that can happen, especially during the time of an accident, is also not 100%. So we would view this as absolutely something to consider. How we use it, we view this as really being an augmentation to the current system, something we can do to improve the availability of the data, but not necessarily at the end of the day replacing the need for recorders on airplanes.

So what we're really trying to do is to ensure that we're addressing the problems that we're seeing, and some of those enhancements are along those lines. And one of the key ones that I think we're experiencing today and that we're very aware of is the importance of locating the wreckage and locating the aircraft. And the sooner and the more accurate that you know that, the better chance you have of recovering the airplane as well as the recorders.

So with that in mind, I'm thinking about a few solutions that already exist, keeping track of the airplane, ACARS, we've heard some about that already. The vast majority of the fleet, if not the entire fleet, operating in the oceanic environment are currently equipped with ACARS systems. Honeywell provides the communication management units or kind of the router, if you will, on these airplanes.

Those systems are configurable by the airlines. The airlines have the option, and always have, to manage those reports, set them up any way they want. They're set up on the ground in advance of the flight. They can happen automatically. They can transmit any kind of data they want at any frequency, and it can also be triggered by certain events, failures of systems on the airplane, et cetera.

The down side to that is that they are connected to the cockpit. So even though some of these systems, the reports can happen automatically, there is also an interface in the cockpit to turn any of that off, disable any of those reports, pull circuit breakers, et cetera.

An extension of ACARS is Automatic Dependent Surveillance-Contract, so the FANS, air traffic control like addition to the ACARS system. This is also configured from the cockpit. This requires a log-on by the pilot to the system. The big difference here is that the air traffic control environment controls the amount of communication as well as the frequency.

A couple other systems I'd just thought I'd mention that can be used in the tracking of the airplane and the flights, this new Aspire 200, which is a SwiftBroadband Inmarsat system, provided mainly as a back of the bus cabin communication system often or primarily on business jets. The unique part of the system though that is valuable is that when it is turned on -- and it can be completely in the background, powered up with the aircraft system -- it's automatically communicating with the Inmarsat network and providing regular updates, latitude and longitude, you know, not just an hourly handshake, but in fact a very short-term handshake with the system.

And the other system I was going to mention is the Sky Connect, and that's something that is an Iridium-based tracking system. We provide these primarily on helicopter fleets, although we have certified it and it is in use in some individual air transport type aircraft. It is also back of the airplane, independent from the cockpit, powered on with the aircraft, and it's in constant communication with the network. These transmissions are going back to the operator and are being used mainly just for fleet tracking, but could also be used across operations globally, if needed.

So, in summary, the recorders, they work well. We're continuing to improve their performance based on gaps we find in the system. We're really looking at trying to locate the airplane. I think that's the key challenge that we have in front of us. There's a lot of systems out there today to provide that capability. It's not adding a lot of cost to the airplane, but we also can harden those systems, if needed, to improve the continuity of that function.

So, thanks very much for the opportunity to talk here today, and I look forward to taking any questions.

MS. GORMLEY: Thank you, Mr. Benich.

Our final presenter in this panel will be Steve Kong of Inmarsat for a satellite provider perspective.

Mr. Kong.

MR. KONG: Good morning, and thank you to the NTSB for the opportunity to present.

I'd like to go through and take a step back a bit. We're obviously really enamored on flight tracking, and I believe that that's going to be solved pretty well. I'd like to talk about the instance where we are waiting for any information due to recovery of the flight data recorder or, you know, sometimes we won't ever recover a flight data recorder.

I use the analogy of the smartphones. Our smartphones can tell us exactly where we are at any time and place of the day, but what's more important, if we're trying to locate a loved one because they're missing, we'd like to know the sequence of events that led up to the disappearance of that loved one: what text messages they sent, what Facebook things they liked, what they purchased, everything else. Those are very crucial important information leading up to the event of locating someone. And so, that's the analogy there.

And we've got technologies coming online that I'd like to tell you about that is happening in the aviation sector too. But also, while we're looking at recommendations for technologies, and performance-based requirements, let's not pass up any ideas that -- or solutions that are hiding in plain sight. So the aviation sector has got a bunch of programs that are putting technology on board that can help solve some of these situations, and use them more effectively.

So here's a picture of Inmarsat's ADS-C tracking. This is one week's worth -- actually last week's -- of all inbound and outbound flights into and out of the U.S. We have the information, we do store that information, and it's readily accessible in case of an accident or emergency. In the last few high profile accidents, we made that information available where possible. In the latest tragedy, we only had the satellite look angle to provide. We did not have the ADS-C. But this is a solution that all long-haul aircraft almost have.

If it's not ADS-C, then it is ACARS waypoint position reporting, as my fellow colleagues have presented. But in the performance requirements basis, we should just say the performance requirement is that aircraft must send lat/long by an approved ICAO method: ADS-C, ADS-B, FMC WPR, et cetera.

Number two. So should those systems become inoperable for whatever reason or another, don't forget that aircraft are putting on SatCom equipment for business reasons, for operational reasons, and passenger WiFi. Here is an example of one of our latest technologies, where we are actually sending not only lat/long, but also heading, speed, and altitude. That is very similar to ADS-B intent, but -- not quite, but this is a test flight, actually a revenue flight that we did from Miami to New York. It sent lat/long, heading, speed, and altitude by non-ICAO approved. Just in case the systems become inoperative, we have a second layer of tracking that comes along with it.

Now, important to note, almost every single airliner has a passenger WiFi system either installed or will be installed within the next 5 years. So that is a big technological step, just like the smartphone revolution is that all passenger airlines are probably going to have a WiFi system on board. Now, in that case the passenger, if there is an accident and something happens and it disappears, we will know what the passenger is doing on board that aircraft more than what we will know what the cockpit is doing. So it is very important that we use the technology that we have on board and glean the information out while we are trying to locate the data recorders, locate where it is, et cetera.

So we have approved ICAO tracking means: ADS-B, ADS-C, FMC Waypoint Position Reporting. We have backup -- maybe non-approved, but these are performance requirements -- we have backup handshakes. You obviously know Inmarsat's famous seven arcs handshake. We've now improved that, and we're going to incorporate into our newer systems lat/long, speed, and altitude, and heading. And so all these other enhancements should be part of the solution that we address.

Real time data, we all think that real-time data is impossibly expensive to do, but Inmarsat is committed to working with the industry to make it affordable. It's not that we want to send everything. We want to send what you need and only when you need it. So we've made the 15-minute lat/long ADS-C for free now, so that's one part of the way we're making things affordable. But there's a solution that already exists via the ACMS system, Aircraft Condition Monitoring System. That is the bowels of the aircraft. That is where the 1's and 0's happen.

It is all stored within the aircraft, and it is a matter of gleaning that stuff out. It is connected to the ACARS system. And within the ACARS system it's connected to the SatCom system. You can get any -- the capabilities differ upon aircraft model, but we should think about what we should send, whether it's pitch, roll, yaw, those rates, angle of attack, pitot study, cabin pressurization/depressurization.

With the last few high profile accidents we knew very little. On Air France we knew something. And even in that unusual attitude, airplane stalling, airplane overspeed, whatever, the SatCom still remained connected.

So before an emergency event happens, it is imperative that during the time that we try to locate the recorder, if we can, it's very important that we stream something off, because in the future, in the next 5 years when we -- when and if we have another accident, we'll end up saying, well, what did the passenger do? Because passenger WiFi is going to be pervasive, we should in the cockpit keep up with that pervasiveness, and that knowledge of what happened in the cockpit as well. Whether it's voice recording, whether it's video recording, whatever, we can all talk about what we want to do.

So let's focus on some of that stuff as well, and not just tracking and locating because sooner or later the technology is going to, as we say, outpace our requirements. So don't wait. A lot of requirements take decades to implement. We've got the technology on board. Some of these solutions that I've presented here require no wiring changes. The business case is folded into passenger connectivity or other operational requirements. So it's just how can we better use and smartly use the situations and the technologies that we have here today. Thank you.

MS. GORMLEY: Thank you, Mr. Kong.

This concludes the presentations for this panel. We are now ready for questions from our Technical Panel. I'll turn things over to Mr. Jacky the Technical Panel lead for this topic.

MR. JACKY: Thank you, Ms. Gormley.

Before I get started, I want to thank each of the panelists for your presentations. Appreciate the information and as well as the hard work that goes into making these presentations.

First of all, what I intend to do is to ask each one of the panelists some individual questions and then hopefully at the end have enough time to follow up with some questions for each or for all of the panel.

To begin with, Dr. Andrei, in your presentation, and on page 5 -- if we could pull that up, please? This is the chart that you showed that showed the potential short and medium term solutions for the Airbus programs.

While he's pulling it up, the question I have for you is -- this is a good overview -- could you provide a thumbnail or some further information as far as the timeline for implementing these solutions and where Airbus is at as far as the status of these solutions, please?

DR. ANDREI: Okay, of course, sir. In fact, so I'm going to go through each of them. On the first one, the aircraft tracking is ready now. The only drawbacks we have on that, and that's why it's something which is still under investigation, first of all, is it relies very much on the airlines, on the wish of the airlines to transmit the data from the aircraft to the ground.

The second one is technical limitations. We need to send data to the ground through communication means, Inmarsat Iridium, so from the SatCom more especially. But we, in some cases or some aircraft attitude, we may lose the line of sight with the satellite and we have to ensure that we can transmit in any cases the data we want to have, and more especially, the tracking.

Another one, which is when you have a full engine flameout, or when you have big damage on the aircraft with no more engines, then you have lack of energy, you rely on the electrical supply energy. And the SatCom, which is a high consumer of electricity is not supplied in such cases. So that means that when you need to trigger the data, you cannot rely anymore on such equipment. But for this first part, we are ready. Technically speaking, it's feasible very quickly.

For the combined recorders, we have made a lot of studies regarding inadvertent deployment, speeds of deployments.

We've been working with suppliers, DRS, which is in this room, also Airbus Defense and Space are also providing deployable recorders. And we can say today that we are quite confident in the future of this addition. I don't have any roadmap to give you, but at least we have found the localization of the aircraft to integrate such a deployable recorder. We've been working with suppliers of recorders to integrate the full architecture, and this is something which would come very soon after some more studies and assessments.

The low frequency ULB is ready, quite ready. We have defined RFPs with our suppliers. So this is something which is on the way. The localization also on the aircraft has been assessed, and on the forward-fit, which is something that we already do by our own, and of course we will support any kind of requirements from operators to install the search ULB on retrofit. And on the 90 days battery extension life of the ULB, this is the same thing, as we are ready. The technology exists since years. It was just a matter of regulation. So we are ready to follow up.

MR. JACKY: Thank you.

There was discussion earlier, and in the international community as well, with regard to the concept of triggered flight data recorder information, or even the continual transmission of flight data recorder from the airplane back down to the ground.

Has Airbus done any studies in this realm? And, if so, could you describe them please?

DR. ANDREI: Yeah, of course. In fact, we don't believe, as it has been said just earlier that we needed to send, to broadcast the full content of the black boxes. According to the aircraft governances, we have to use a -- or event-driven broadcast of information. It can be on failure mode. You know, that we have an earth monitoring system on board our new generation of aircraft, so we can rely on this system in service today to trigger on a failure event some data.

And also, we can -- we have made some studies with Airbus flight test department to be able to detect loss of control, an aircraft in a loss of control situation. And then, when we achieve such a -- when we reach such a situation, we can trigger a couple of data from the aircraft to the ground, of course. So this is a more event-driven broadcasting of data.

We can also support airlines to trigger -- to change this equipment, as I said, just with a software-based modification to trigger the periodicity of the data sent to the ground. For instance, as it has been said by Inmarsat, if we send periodically a set of parameters every 10 minutes, if you have it moving away from a scheduled waypoint, we can send every minute the same set of parameters details to the ground that make an alert to the ground saying that the aircraft is moving away from the scheduled path.

MR. JACKY: Thank you.

If I could direct you to page 3, of your presentation please? And in the Chairman's opening statement there was a discussion about uses, or the concept of use of flight data in ways other than the storage on flight data recorders. In the industry there's discussion of that, or uses of that in terms of airplane health monitoring by use of ACARS or other systems.

I believe that the slide here, page 3, hints towards that. Could you give an overview of Airbus's use of these concepts? How the data is recorded, how you used it, and how you work with operators with this data?

DR. ANDREI: Okay. This relies very much on the agreement and the contract we have with the airlines. So today our new generations of aircraft, like the A380 and the A350, are able to make -- and then some long range, are able to make maintenance monitoring on board during the flight and to send regularly a report to the ground,

We have Netac, which is a service inside Airbus. We are able today to monitor such a system on board the aircraft, and to ask the aircraft to send more data, if necessary, to the ground. This is something which is done only with some airlines, according to the contract we have with them. And we can use, of course, such a system to trigger some information on an aircraft when we have suspicious events on board an aircraft today.

MR. JACKY: And as a follow-up, in your experience, is the data, after an event or an accident, is that data provided to accident investigators or agencies or is that done by the operators?

DR. ANDREI: I don't know. To be honest with you, I don't know.

MR. JACKY: Okay. Thank you very much.

DR. ANDREI: You're welcome.

MR. JACKY: Turning to Mr. Smith and Boeing, actually the same question with regard to aircraft health monitoring and the ACARS system, or using the ACARS system. Could you provide a thumbnail from the Boeing perspective please?

MR. SMITH: On how we use airplane health monitoring?

MR. JACKY: Correct.

MR. SMITH: So the airplane health monitoring and the ACARS system are set up to -- they're operational requirements for the operators. It transmits various types of messages when the airplane is lifted off, when it's landed, when it's reached a certain waypoint. It can report if failure has occurred on board and there's associated maintenance with it. This allows the operator to prepare parts and mechanics at the destination to get the airplane repaired quickly and get it back into service. So it's put there for operational reasons. And each operator sets this up and tailors it to their own needs, if you will.

That system, even though it's on board for operational reasons, has been of great benefit in several of our investigations, as we've talked about here. The data is typically owned by the operator. Sometimes Boeing has access to it, sometimes not. It depends on the arrangement with the operator. And in an accident investigation, if we don't have access to it, we would go to the operator through the investigation agency to obtain it. Does that answer the question there?

MR. JACKY: Yes. Thank you very much.

If I can refer to your presentation, please? And I'm going to start with page number 5, or slide number 5, "Enhancements to Reports with ACARS," please.

And I want to touch base on the bullet number 3 there, which discussed the Emergency Position Report when exceedances occurred. And I was hoping you might provide us a little bit more information regarding that, specifically with regard to whether Boeing and/or an operator that may have it on their models, has there been any sort of in-service experience with that?

MR. SMITH: So I asked that question before I left, and I have not -- I don't have an answer to it. I don't know the answer to that. What I can tell you is it is -- let me give you the 787 as an example. It's basic on that airplane. It's set up with some default values that were chosen by Boeing, and, you know, there's a list of maybe a dozen trigger exceedance parameters.

The exceedance points are chosen by Boeing, and what this report will do is once an exceedance is detected it will start increasing -- it will increase the position reports to once every 10 seconds, once every 20 seconds. That is all completely configurable by the operator. They can turn it off, they can set the exceedance values to a place that they choose, and so forth. So it's not necessarily going to be constant around the fleet because it's operator dependent. And I do not have the service history on that right now.

MR. JACKY: And as a follow-up to that, I guess if you don't know the service history, then the methodology for sharing that information with accident investigators?

MR. SMITH: Well, so, with the 787 in particular, there's a centralized facility at Boeing where all messages come through on that airplane. It's a different arrangement than our previous models. I think I could get it for the 787 and report it. But the data -- let's say we are having nuisance trips of that. Obviously, a 787 has not gone down, so we don't have an accident to chase the data for. But if there are some nuisance trips of this exceedance report, I think I could get the data.

But technically, the operator would own that and I would have to get their permission to share it with you, but it would be that sort of a path that would take place. It's available. I've just got to work through the process.

MR. JACKY: And then, finally, with regard to the system, would that system be retrofittable to already manufactured airplanes?

MR. SMITH: Well, the function gets put in when there's a software part number role to a function. So, yes, it would be possible to do that, I believe, but it would probably be a software role that isn't necessarily mandated and some operators might not accept it. It also depends on -- some of the older airplanes, if some of the parameters are available on the data bus to do the function, and so forth. So there's quite a different range of airplane configurations out there that makes it difficult to answer that question.

MR. JACKY: Thank you.

On the next slide, which is the Boeing deployable recorder history, a question for you regarding that. You mentioned in the presentation that deployable recorders on future new models of airplanes needs study. And actually, that may be a reference to the next slide, which you very quickly went over, or skipped over.

MR. SMITH: Yes.

MR. JACKY: From your organization and in the experience that you've had with deployable recorders on military and other applications, what elements of those deployable recorders do you believe or Boeing believes needs -- or concerns for future study?

MR. SMITH: I guess in two areas. Let's start first with the deployment mechanism. Deployables have been a great success, I understand from my colleagues on the military side, from the F-18 experience. It's given them data that they didn't have before. The F-18 triggers deployment on ejection seat trigger, and there's one other that I can't remember right now.

But a commercial airplane doesn't have the ejection seat option. So we would have to look at other ways to trigger it, as with a G-switch or a frangible switch.

And let me give you an example of a G-switch. The G-switch is what we use on the ELTs that were discussed earlier. We do not have a good service history of those switches activating in an accident. So the trigger mechanism on a commercial airplane would be a lot different than it is on the fighter, for instance. That's one item.

The second item I would have to go to is the inadvertent deployment point. If we could go back to slide 4, please? That's 3. One more, 4. Right. Nope, the other way. Right there. Thank you.

This is one reason I brought up this slide. The fleet hours in the bottom, if we take the fleet hours, 54 -- I'll round it to 55 million flight hours. In an active system like this where we have to make the system do something, nuisance deployments would be an issue. A good nuisance deployment rate number for our experience in service is 10^{-6}, which is 1 per million, or 10^{-7}, which is 1 per 10 million.

10^{-7} is a difficult number to achieve with an active system because of parts failures; you have to build redundancy in and so forth. If we take the 55 million flight hours at a 10^{-7} nuisance rate, that would give us five or six deployments per year around the world, if all 22,000 of those airplanes were equipped with them. So that's the sort of unintended consequences that we want to caution here. I'm not saying deployables are a bad idea. It's there's a balance of benefit and consequences here that we have to keep in mind.

MR. JACKY: Thank you very much.

I'm just looking down here at your next slide, or slide 7, and I notice that or I remember that you did quickly go over that. Are there any other points that you want to make regarding that slide?

MR. SMITH: Yes, and let me run through this real quick. So, the first two items I did discuss in detail: the lat/long in some messages and the emergency report on some of our newer models are already flying and in future models, obviously, very feasible.

The full-time position tracking and triggered ELT concepts are being actively studied by industry. We are a member of those industry groups in supporting those, so we will follow the recommendations that come out of that.

Fulltime transmission of FDR data we are not currently pursuing. And when I -- that particular concept is full-time offload of the full FDR parameter set, which is quite a number of parameters and high sample rate data trying to replace the recorder. We are not looking at that because we don't currently think it's feasible or the infrastructure supports it. It doesn't mean it won't be in the future.

Deployable recorders we're aware of. We think they need study, and we're monitoring, and we'll see where the requirements come out of these various panels.

On the underwater localization, on the bottom, the 90-day pingers are -- we're ready to implement those, as the gentleman from Honeywell said. We're waiting for the TSO standard to be approved by the FAA on those pingers, and as soon as it is, we will start delivering those some time next year into our fleet. And then, those will be retrofit by attrition into the existing fleet. That is a significant improvement across the fleet, in my opinion.

The third pinger, the new third pinger, the low frequency pinger, we are not currently pursuing. We're waiting for the other items to settle out here, if you will. If we are successful in impact localization to a very small number like the 6 nautical miles, we don't believe the third pinger is a necessary piece of equipment to have on the airplane. But that all comes out when you marry together all of the options here.

MR. JACKY: And just to follow up, when you talk about the other technologies, you're meaning the ones at the top, lat/long in messages and Emergency Position Report? Is that the type of technologies that you refer to that would make the third pinger not necessary?

MR. SMITH: Yes, in general. And let me fill in a little bit of that. So the emergency report -- actually, both of those. In understanding what happened in the Air France 447 accident, as the airplane descended it stayed fairly with wings level and it maintained its connectivity with the satellite, and many of the messages that were put off the airplane occurred fairly close to the impact point. Those messages at the time didn't have any position information in them. Our emergency report would have triggered in that case, as well as some of those messages may have had the lat/long in them to help localize that wreckage. So this all came out of the learnings from Air France 447.

MR. JACKY: Thank you very much.

Now, turning to Honeywell and Mr. Benich, and if we could pull up his presentation please? And I'm going to start with the last slide, number 9.

In the summary you mentioned, the third bullet there, narrowing the search zone is the key challenge. Could you provide an overview or describe how existing Honeywell products or enhancements to those products could assist accident investigators narrow that search zone?

MR. BENICH: Sure. Well, the simple answer is just knowing where the airplane was when it went down. And so, the solutions we have are really the ones that I referred to earlier. ACARS is the most available system today, and ACARS can be configured in, as I indicated, a lot of different ways and sending information at many different intervals. And, you know, so the -- really deciding on what is that right interval, what is the right amount of data, clearly the latitude and longitude are key. And then, there's other factors that -- other pieces of information that you could include. And that really is what leads you to zeroing in on the location and developing a search zone out of that So ACARS is one, you know, Sky Connect, the new SatCom system -- I mean, there's a number of other systems at work, but I only referenced ACARS as being the one that's most widely available today.

MR. JACKY: Thank you.

And regarding -- if we go up a couple slides to slide number 7, with regard to the Aspire system, could you provide maybe an overview or the information that is provided and that could be provided beyond just aircraft position from using that system?

MR. BENICH: Well, the data that is provided -- actually, I suspect Mr. Kong can address it even more clearly, but it's a feature of the SwiftBroadband. So our Aspire 200 is one radio essentially that connects to the SwiftBroadband system. But the aircraft state data is the type of information that is included in the handshake. Exactly the set of data that's available, I don't -- I can certainly get back to you on that to be complete. But the latitude, longitude, altitude, air speed is kind of the heading, kind of the basic information.

MR. JACKY: Mr. Kong, anything to add to that while he mentioned you?

MR. KONG: No, it -- don't worry, I used to work for their competitor, so -- and I used to work for Boeing for 10 years as well, so I kind of know the ins and outs of everything.

But that graphic in the bottom right-hand corner, the SwiftBroadband system is a 3G mobile phone system in the sky. Each of those footprints, the three of them -- we actually have four of them now. There are 200 spot-beam cellphone tower beams per one of those global footprints. And our satellites require lat/long every -- at a minimum every 2 minutes to hand you off seamlessly between each of the spot beams. So it's an intrinsic lat/long already, so anyone that installs this system has inherent flight tracking, so to speak, but obviously not in the ICAO formatted standard.

MR. JACKY: Thank you.

And just to follow up on that, Mr. Benich, if you mentioned I missed it, the type of applications or the airframes that these systems are being applied to or used on?

MR. BENICH: Yeah, primarily today -- in fact, I think I would say exclusively today they're on business aircraft, business jets, global operators, although it's available for airline aircraft as well. It really is an augmentation to a cabin communication system or cabin IFE kind of a system.

MR. JACKY: Thank you.

And then, I'm going to move ahead to slide number 8 with regard to the Sky Connect system. And you mentioned that this system does have a history now, and if you could provide any sort of real world experience with use of the data from this system to locate a helicopter or an aircraft that might have gone into the water or that was lost?

MR. BENICH: I'm not familiar with any accidents where the Sky Connect was involved on the aircraft and provided data, which I guess I would say is a good thing for our customers. It's really on the airplane, and the reason our customers have it is to track their fleets, and to -- you know, on a continuous basis without intervention from the cockpit, that, you know, when the airplane is moving they're getting data. And so, the experience has been quite good. Again, often used on helicopter fleets, offshore oil platforms, they -- you know, they're just keeping an eye on where everything is.

MR. JACKY: And I'll ask you the same as a follow-up. The information or the tracking data, that is going to the operator and not to Honeywell?

MR. BENICH: Well, it passes through Honeywell, so Honeywell has a data center or service center, and so the messages are addressed out of the Iridium system to the Honeywell data center. We unpack the data. There's a -- I think it's a phone number identification that is in the file, and that directs it to the customer. So we're really just the post office, sort of, and then ultimately the information is delivered to the customer and it's their data.

MR. JACKY: Thank you.

And finally, to Mr. Kong, with regard to your presentation, there's a lot of information that you're talking about that could be recorded or that is being sent back through your system. I was wondering if you could talk about -- or at least as an overview -- the concept of privacy of the data, sharing of the data, and how would that data -- how is what data shared with accident investigators and other government agencies?

MR. KONG: In reverse order, shared with accident investigations, obviously upon accidents?

MR. JACKY: Yes, please.

MR. KONG: We immediately shared Air France. We shared it the BEA immediately. MH370, we shared it with the U.K. Accident Investigation Bureau as well as the Malaysia government DCA. So, no restrictions there obviously, due process, due causes of any requirements or warrants or subpoenas, great, all that stuff. We don't have too much transparency on the content of the data, apart from the lat/longs and the heading and air speed that we store in our own servers. But obviously, we will make that available upon request or demand on due process.

All of our information is encrypted by the 3G protocols, so it's secure. We obviously have and run security assessment tests on our network regularly. So pretty standard security requirements.

MR. JACKY: Thank you.

And if we can pull up your presentation as well, and I'm going to first refer to panel -- or slide number 4. It was your Solution #2, the enhanced handshakes. I just wanted a clarification on that.

You mentioned changes or retrofit, and I believe you were referring to the satellite system with regard to this, or would it be retrofit on an airplane software or hardware level? Could you elaborate on that please?

MR. KONG: So, going forward on all new systems, such as the Aspire system, we're going to include these enhanced parameters. For instance, on MH370 we could only tell the satellite look angle and Doppler shift, for instance. On these new systems we will have, very similar to ADS-B intent, items that's standard and that's configurable down to the seconds, if need be. But obviously, too much data is too much data. So we want to know what the balance is on the enhanced handshakes.

MR. JACKY: And I guess it's an obvious question, but you will have the capability to record all this information? It sounds like a lot of information coming in. You have enough servers to --

MR. KONG: Yes, sir. It's all recorded, especially this stuff.

MR. JACKY: Okay. And I guess that -- to the next slide, number 3, with regard to the real-time data options, the same question. You'll be able to handle that amount of data that would be coming in from all these different airplanes?

MR. KONG: So what we need to do is look at which technology -- the current technology that's deployed on tens of thousands of aircraft are like a 2G text and voice service. And so, that 2G text and voice service can only handle small packets of ACARS messages. We handle quite a few, in the order of millions of ACARS messages every year. And so via the streaming of -- ACARS is ironically very efficient because each packet is only 220 characters. And so you can't stack it with, you know, headers and et cetera, like e-mail does.

So, it's inherently efficient. And if you send the right ACARS amount, even on existing 2G systems, which is deployed on over 10,000 aircraft a day, it can handle quite substantial amounts of information. So we look to industry experts here, Airbus, Boeing, yourselves, to figure out on the over 10,000 aircraft a day what live data that you need, and only send what you need; don't send everything. I heard that we -- you know, we're not looking into sending the entire contents of the flight data recorder. That's not what our purpose is.

Our purpose is to send what you need. Because in the time that it takes to locate a recorder, and in some cases we can't locate it at all, extreme anxiety happens, and the answer that we don't know isn't acceptable. So let's stream something, don't stream everything, and on our 3G systems, which is the Aspire systems, it can handle basically what a 3G smartphone can handle. But obviously, we don't want to send too much and get datarhea, for instance. But we want to send enough to help us in investigating an accident until we retrieve the flight data recorders.

MR. JACKY: Thank you very much.

Now I have a question for the four of you, so I would just suggest that maybe you go right down the line as far as answering it.

In the first panel today there was talk of performance-based requirements. And turning to you as the manufacturers of these equipments, could you provide an overview of what additional policies, procedures, or performance requirements do you believe are necessary for your organization to implement or equip airplanes with these new technologies that you discussed today?

MR. SMITH: Okay, I'll start. Let me give an example. I'll give you two examples. If we take the ELT as an example, the regulations -- the recommendations from ICAO and the regulations from EASA say thou shalt put an ELT on the airplane. That is a prescriptive requirement saying put this piece of equipment on. A performance-based requirement would be, be able to locate the airplane within a certain number of miles. Instead of how to do it, say here is what we want done. So that's an example of a prescriptive requirement versus a performance-based requirement.

In this case here, coming out of the Air France 447 --

the BEA working group after 447 that led into ICAO changes, the current requirement being looked at for locating impact is being able to locate an impact site within 6 nautical miles. That is a performance-based requirement. It does not say do it with deployable recorders or do it with a satellite laser beam, or whatever the technology might be.

We prefer the performance-based requirement rather than the prescriptive way to do it because that allows various options to be looked at, traded, and it allows the options to change as the technology allows change.

DR. ANDREI: I have to agree a little bit of what Mark has just said, but as soon as we are talking about prescriptive or performance, we have also to -- I have many things in mind. The first thing is, for us it's important to have the framework for the vehicle certification because this is key. We have to understand, and our chief engineers they have to understand how to certify our aircraft.

Another point, which has been highlighted by Mark, regarding the ELT, of course, the ELT is not so much efficient today. And we have ELT are triggered in less than 28% of the aircraft crashes today, so which is quite useless if you take the ELT as it is and we wait for the pre-activated ELT in the future. And this leads me to explain, if you remember my slides with all the scenarios and all the technical solutions, we don't push for all of them. It's a combination of most of them.

In fact, if you have an aircraft equipped with a deployable recorder, which is efficient -- we hope so, and I wish that it will be efficient -- plus a pre-activated ELT which is working, you don't need the low frequency ULB. So, in fact, you have to think about the combination of different solutions regarding the performance versus prescriptions.

MR. BENICH: So, a couple thoughts, performance-based requirements, in general we support them and have over time. Peggy Gilligan talked this morning about that, and we've been supportive of her organization in trying to shift in that direction. But we need to keep in mind also that it doesn't work for everything. And often when you're dealing with other systems that are part of the solution, like the satellite constellations or -- you know, that you can't just say, well, just do it any old way you want. You have to acknowledge what's out there and what's available.

And also, while it might be easier for us to understand as manufacturers, it adds complexity for our customers, the airlines in particular, to understand what they actually need to meet a requirement. And I just throw out ADS-B, Automatic Dependent Surveillance Broadcast, as an example, performance-based requirement in part, but the data link, 1090 MHz, is not a performance-based. Everybody has to have that transmission so that they can interoperate. So that's not performance-based. It's very prescriptive on the technology.

The performance-based part comes into the accuracy and integrity of the position, which is set at a level and not saying what you need. But now we're finding and our airline customers are finding, well, what exactly does that mean? You can use GPS? GPS WAAS is okay. GPS with SA-aware receivers may or may not be okay. What about the constellation? How many satellites on any given day? A lot of questions, where -- again, it provides flexibility, but also creates a lot of uncertainty for the operators.

So I would say the same thing would be true for tracking. If we say you can -- you just need to be able to track the airplane, you know, within 5 minutes, there's a lot of ways you can do that -- we talked about a number of them today -- but at what level of certainty? Is it truly global or is it -- you know, the Polar Regions, are they included? At what level of integrity? A lot of questions that show up and, therefore, make defining what exactly that requirement is a little bit more challenging.

MR. KONG: I think they've said it all in terms of tracking, so just as a reminder, you know, please consider some performance requirements on knowledge of what happened before the event of your accident.

MR. JACKY: Mr. Babcock has a couple of questions.

MR. BABCOCK: Thank you.

Just a couple questions, one a clarification, Mr. Smith. You mentioned in your discussion about deployables a recovery rate of 75%. Can you clarify, is that 75% of devices recovered or 75% of devices where data was recovered, or what are measuring there?

MR. SMITH: Standby. So it basically is the end-to-end product of the recorder coming off, recovering it, and getting data off of it. So recorder data not recovered includes recorder recovered but data not readable, recorder did not survive, recorder did not -- was not located, recorder location beacon was not detected and therefore was not located.

I have limited information here. The gentleman from DRS on your next panel has a lot of information on that, but it's the whole end-to-end process.

MR. BABCOCK: Okay. Thank you.

And one question for Mr. Kong. Your presentation mentioned, I guess it was two or three, what might be hypothetical performance-based requirements. But what I didn't see there is what happens when that data is transmitted off the aircraft? You've been open about providing investigators information that Inmarsat does have recorded, but is that a responsibility that you would envision being the responsibility of the satellite provider or would that be the end user?

MR. KONG: So the content of the information is ultimately -- the operator is responsible for divulging that information.

MR. BABCOCK: Okay. Thank you.

MR. JACKY: Acting Chairman Hart, this completes the Technical Panel questions for this panel.

ACTING CHAIRMAN HART: Thank you, Mr. Jacky. And thanks again to all of our panelists.

Now we'll take questions from the dais. Mr. Delisi.

MR. DELISI: Thank you.

Mr. Smith, I've heard this urban legend that if a 787 in flight had some sort of maintenance issue, that Boeing engineers and executives would real time be getting notes on their iPhone about the status of that airplane. Can you talk about that?

MR. SMITH: That is not legend. That's correct. The 787 was developed with fleet monitoring in mind. At Boeing at its center up in Everett there's a whole control room. It looks like a NASA launch room. It's quite impressive. It monitors all 87s around the world real time. And so, basically, though, the information coming off of those airplanes is through this same ACARS type of system that we've been discussing. And it's the on-condition reports, or the position reports, or so forth, that come into that central location and then are distributed.

That system will send e-mails to our fleet managers' BlackBerrys and so forth so we can monitor real-time issues that are going on.

MR. DELISI: Interesting. Thanks.

And, Mr. Kong, you talked about passenger WiFi. And as accident investigators we need to sometimes be very efficient and creative in tapping into all sources of data to try to understand what might have happened on an accident flight. Can you tell me a little bit more about how data from passenger WiFi might be a tool?

MR. KONG: Okay. And just to finish up on your last question, various models of Boeing -- and I used to work at Boeing for 10 years as an avionics engineer. So we used to glean data off on -- you know, we did manual reports from the ground. So if we got a fault report over air, we could actually ping the aircraft for more information. So that technology exists on 67s, 57s, and 37s as well. It's not just on the 87. The 87 is just way more fancy and glamorous, but it does exist on other aircraft. And I'm sure Airbus aircraft have that functionality as well.

On passenger WiFi, as you know, every ISP, whether it's your home broadband provider, if subpoenaed or whatever, they can look up all your website addresses, everything that you've done, every message that you've sent that. They can do that. Now, we are technically not a service provider. We are a satellite provider. We have service providers that sit in front of us and handle that with the airlines.

So when the passenger WiFi systems are pervasive -- in the U.S. almost all aircraft on almost all flights have passenger WiFi surfing, if there were an incident, again, a 9/11 happened or something like that, passengers could Tweet it or whatever, or could -- they could hold up a camera and secretly record it, for instance. So those are some of the things that are out-of-the-box solutions that just happen to be there because the technology is there. And I think my concern is, it'll be operating in the cabin, but we won't have that technology in the cockpit, which is -- which would be my biggest concern.

MR. DELISI: Great. Thank you.

ACTING CHAIRMAN HART: Thank you, Mr. Delisi.

Dr. Kolly.

DR. KOLLY: Yes. Mr. Benich, your last slide, the summary slide, actually the last bullet of the last slide refers to the potential to improve tamper resistance. I wonder if you could explain to me a little bit more specifically -- I'm not sure I heard a lot about that in your presentation. You know, what does that essentially apply to, and what means are you looking into?

MR. BENICH: Sure. Well, so it implies or it's -- you know, that humans on an airplane, if they're knowledgeable enough about the way the system works, can disable functions, whether they're crewmembers or not crewmembers. And so today most of these functions, like ACARS in particular, are designed with the human interface in mind, you know, that the way the system works intentionally the crew should be able to go in and configure or reconfigure, turn on turn off. And certainly then we have circuit breakers involved in the system because sometimes there are problems, and that's why circuit breakers are there to cut electrical power in the case of a malfunction of a unit or some other issue on the airplane. That's the way it was designed.

Whether it's the crewmember or some other rogue individual on the airplane taking control, if they're aware of how the system works, then they can go in and disable things because -- taking advantage of the design, we can -- the tamper proof is to then bury certain subfunctions so that they can't be disabled in certain instances, remove it out of -- as I was describing on some of these other systems like Sky Connect, literally taking it out of the cockpit. And, yeah, there's a circuit breaker, but it's back in a electronics cabinet somewhere and not immediately accessible. As soon as you bring power onto the airplane, the system is running.

So, we can design it with that in mind. That was not the intent when these systems were designed. We can go back and rethink it and say, well, how do we secure that function better on the airplane so that any individual who has bad intentions cannot disable the function.

DR. KOLLY: This question is for you again, Mr. Benich, but also perhaps Mr. Kong. It has to do with the Aspire Inmarsat SwiftBroadband System.

In your slide, you say that the system may also be used for data or voice application. I'd like to know a little more about that, and do you have any customers using it for, say, voice application?

MR. BENICH: Sure. It's a SatCom radio that operates in the back of the cabin, so it's used for cabin communications, Inmarsat streaming information. Just like any SatCom device on an airplane, it can be used for voice, it can be used for data, you can send video. It has a bandwidth of I think roughly 200 or 400 kilobytes per second, so it can stream reasonable amounts of data. And that is the purpose. But again the purpose -- the reason a customer will put it on an airplane is to support the passenger operations cabin in the sky or office in the sky kinds of things in the cabin of the airplane.

DR. KOLLY: So that's not to be confused with any type of cockpit voice recorder application?

MR. BENICH: That's correct. It's not the intent of -- that's not why it's installed in the airplane today. It's not wired into the cockpit at all.

DR. KOLLY: That's all the questions I have.

ACTING CHAIRMAN HART: Okay. Thank you, Dr. Kolly.

I think we have a couple minutes left, if the Technical Panel has any further questions? Okay. Thank you.

Thanks again to our panelists for excellent presentations and excellent discussions. It's been very helpful. You've helped us understand many of the technologies that must interact as a system as recorder and locator technologies continue to advance, so we appreciate that.

After lunch, we will hear from our third panel, which will address technology solutions. So, you heard Ms. Gormley describe the lunch options, and you can ask her again if you want more detail when we go to lunch. But what we're going to do now is take a break and resume at 1:15. Thank you.

(Whereupon, at 11:43 a.m., a lunch recess was taken.)

A F T E R N O O N   S E S S I O N

(1:15 p.m.)

ACTING CHAIRMAN HART: We're now back in session.

Good afternoon and welcome back. We're now ready to hear from our third panel of the day, which will move the discussion to technology solutions. I'll turn things over once again to Erin Gormley.

Ms. Gormley.

MS. GORMLEY: Thank you, Acting Chairman Hart.

For those of you joining us after lunch, for safety purposes please note the nearest emergency exit. You can use the rear doors that you came through to enter the conference center. There is also a set of emergency doors on either side of the stage up front. Please silence all electronic devices at this time.

As a reminder for our panelists, please push the button on the microphone to activate, and bring it close to you when speaking. When done, turn off the microphone by again depressing the button.

Our next panel will provide an overview of technology solutions to allow for a more efficient recovery of data. Our panelists are Philippe Plantin de Hugues, Advisor on International Affairs, and Senior Safety Investigator from France's Bureau d'Enquêtes et d'Analyses, or BEA; Ric Sasse, Program Manager of Deep Ocean Search and Recovery, from Naval Sea Systems Command; Thomas Schmutz, Vice President of Engineering, from L3

Communications; Blake van den Heuvel, Director, Air Programs, from DRS Technologies Canada Ltd; and Richard Hayden, Director, FLYHT Aerospace Solutions Ltd.

Our first panelist will be Dr. Philippe Plantin de Hugues of the BEA, who will give us an overview of some working group activities.

Dr. Plantin de Hugues.

DR. PLANTIN de HUGUES: Thank you.

So I'm going to present the work of two international working groups: the Flight Data Recovery, and the Trigger Transmission of Flight Data working group.

So 3 months after the accident of A447, because it was not possible anymore to hear the pingers on the site, we decided to create an international working group to evaluate the new technology that will help in the future to secure the flight data and to facilitate the localization of on-board recorders.

We tried, in fact, to have a complete overview with existing solution that was at the time available or be available in the future in the field of flight data transmission, new flight recorder technology, wreckage localization technology. And we did perform this work by analyzing the technical feasibility, as well as the cost of the various solutions. So we did perform a cost/benefit analysis of the potential solutions.

So this group was composed of about 100 members for the flight data recovery. We had almost 150 members for the Trigger

Transmission of Flight Data working group. So we had two meetings for each of the working groups, and almost 60 participants from attending the meetings. We had, I will say, everybody on board: people from manufacturers, airline associations, service providers, civil aviation authorities, investigation authorities. So everybody was concerned by the accident of A447 definitely.

So when we were performing the solution evaluation, we didn't want to focus on only one event that was A447, so we did perform an analysis of all events over water, including A447. So among the 52 events over water, accidents over water since '69, 38 happened between 1996 and 2014. And from these 38 events, accident on the water, 8 recorders were not found.

So the evaluation of the various solutions were based on the technical feasibility, maturity in equipment, the cost, and, in fact, we were using at the time costs provided by FAA. So, before starting to work, we went to see the FAA requesting costs to say, when is it green, yellow, or red. And we developed some mathematical scoring to be able to -- for each of the solutions to give the best scoring or the best rate.

And then, the benefit part of the cost/benefit analysis was the applicability to the past event. So each of the solutions were considered obviously as a potential improvement for all the accidents we had on the list. And I have definitely continued to update this list up to now, so it is why you have 38 events within the last 18 years.

So the conclusion of the first flight data recovery was on the short-term basis that we should extend the duration of the ULB attached to the recorder from 30 days to 90 days because the technology was there. So 90-days beacon were available on the market, but nobody was installing them. Then, on the short term, it was again the installation of a low frequency beacon at 8.8 kHz. So there is standards that have been published on the ICAO Annex 6 in 2012, mandating for the 1st January 2018 all aircraft to be equipped with 90-day beacon and for long-range aircraft to be equipped with a low frequency beacon.

Then, on the middle basis it was regular transmission of basic aircraft parameters, and the trigger transmission was found as a good potential solution. It is why we created the second working group. And then, on the long-term basis the recommendation based on the work of this working group was regarding the installation of an ED-112 -- so this is specification from EUROCAE -- for deployable recorders. And last week I chaired the flight recorder panel, and we proposed amendments to the Annex 6.

Then, the second working group was Trigger Transmission Flight Data working group. So the concept is on the primary purpose to define the position of impact. So as soon as an emergency situation is detected, so sufficient information will be sent to the ground to have a position of the impact, so accident site, and if it is feasible to send additional parameters, if it does not compromise the first objective.

Just an information, in 2010 we went to see a manufacturer, and in real time there was an aircraft flying. He was just pushing a button on his computer, and all the data from the FDR were downloaded on the computer. So it was already feasible in 2010.

So the trigger transmission objectives, so just make sure that the triggering criteria we are going to develop are able to detect any emergency situation, so ideally 100%. And just to be sure it was part of the cost/benefit analysis, that on the regular basis, on normal flight, there will be no false positive that may have a cost for the airline.

And so we tried also to define the connection and transmission time to see if it is compatible with the emergency situation. And it does -- I will say the satellite antenna allows a continuous transmission, or regular transmission, even if the aircraft is going on, I will say, unusual attitudes.

So to accomplish this work, we created a database of 68 events, real events, so data coming from various accident investigation authorities around the world. And we were using, I will say, calculation with the connectivity with satellite to be able to assess and to provide some results to substantiate the recommendation. And we did perform this work with Inmarsat and Iridium constellation.

So the trigger transmission conclusion were that robust emergency detection criteria are achievable. There were three sets of criteria that were developed. It was almost 100% detection of the 68 accidents on the database, so it is technically feasible to reduce the search area by trigger transmission, new generation of ELT triggered in flight, or increasing the frequency of the position report. And it led to the conclusion that if we have a performance-based solution, it shall be within 6 nautical miles, and this 6 nautical mile radius performance-based solution was detailed on the report.

So the joint EUROCAE Working Group 98/RTCA 229 is currently developing some specifications for the second generation of ELT, so the one that will be in particular triggered in flight, so specification for the triggering criteria as well. And last week the ICAO Flight Recorder Panel proposed amendments to the Annex 6 regarding distress system on board and trigger transmission.

So the reports from both working groups are available on the website and I'm inviting you to download them. You will have all the rationale explaining frequency and regular transmission and 6 nautical mile objectives. Thank you.

MS. GORMLEY: Thank you, Dr. Plantin de Hugues.

Our next presenter is Ric Sasse of the Naval Sea Systems Command, who will speak on recorder recovery.

Mr. Sasse.

MR. SASSE: Thank you.

My hope this afternoon is to provide a perspective on the current state of the art in pinger location as it is now, briefly describe how we arrived here, and provide some possible insights for going forward.

ACTING CHAIRMAN HART: Mr. Sasse, could you pull the microphone a little closer please?

MR. SASSE: Yes.

ACTING CHAIRMAN HART: Thank you.

MR. SASSE: To provide a little background, SUPSALV provides a broad spectrum of underwater focused technical expertise for the U.S. Navy. Within the area of salvage, we maintain a deep ocean search and recovery capability down to a depth of 20,000 feet. This is the program that maintains our current underwater pinger location capability.

The evolution of the towed pinger locator system spans approximately 30 years. During this time, four distinct generations of technology have been developed. The first generation was essentially a passive hydrophone at the end of a very long cable. This is a simple design that has proven very effective over the years. Since then there have been several attempts to incorporate new technologies, specifically in Generations 2 and 3, and some of these new enhanced technologies include multiple directional hydrophones, increased digital signal processing, and refinements to the towbody shape.

With all these refinements what we've found through operational testing is that the first generation simpler system proved most effective. Then we developed a Generation 4, incorporating lessons learned from the Air France Flight 447 search, and this is a return to the simpler Gen 1 with some digital enhancements to help the operator in detecting the pinger.

The current TPL-25 is the latest design. It uses a commercial off-the-shelf towbody. It has a 1 atmosphere 6,000 meter rated housing bolted to the underside. It incorporates a single omnidirectional hydrophone with a minimum detection range of 1 nautical mile. And under certain environmental conditions that detection range can be upwards of 2 nautical miles. There are some digital telemetry that is encoded on top of the raw acoustic signal. The system can run on basically any two-conductor cable. And that signal is sent topside where the operator can hear the acoustic signal.

From a methodology standpoint, the towed pinger locator is towed in a defined search grid. When the operator first detects and hears the signal, we plot a detection point on the NAV computer. We then monitor the peak signal strength, and then we keep listening to the pinger and find the last point of detection. After this, we run reciprocal lines and then perpendicular lines to further triangulate and localize the source of the pinger sound. What you can see on the screen here is the spectrum analyzer, which provides a visual indication of what the operator is actually hearing. And you can see both peak frequency and the beat rate of the pinger there.

One of the things we have learned as we've gone through this development process is that in our experience simpler has proven more effective and more reliable for operationally deployable systems. We've gone down both routes of adding complexity and simplicity, and simplicity has proven most effective. We have been advising other people. Some people are going down the more complex route, but again, our experience suggests that simple is better.

Another emerging technology for locating pingers is the use of untethered autonomous vehicles instead of going with towed systems. This brings certain challenges with it, but there's a possibility that this could be an enhancement going forward.

And finally, the one thing that I would suggest as we look at new technologies is that we take a holistic view of what it takes to operationally deploy and locate a pinger. There's many things that logistically come into effect: having to transport on short notice around the world, deploy on ships with opportunities in any environment. So looking at it from a holistic standpoint, I think will actually be the right course of action instead of just the latest technology.

If anyone is looking for further information on SUPSALV, or our TPL systems, it can be found on the web at www.supsalv.org. Thank you.

MS. GORMLEY: Thank you, Mr. Sasse.

Our next presenter is Thomas Schmutz from L3 Communications who will speak on traditional flight recorders.

Mr. Schmutz?

MR. SCHMUTZ: Well, thank you for having me today. L3 is an aerospace and defense contractor, and we supply communication and electronic systems. Within our company we make commercial and military aviation products, including integrated avionics, flight data displays, emergency power supplies, support services. But specific to today, we make data acquisition and connectivity and storage solutions, which include cockpit voice recorders, flight data recorders, and Iridium SatCom systems.

So there's been a lot of discussion recently over the augmenting of crash-protected flight recorders on aircraft. As mentioned earlier, crash recorders are directly responsible for significant improvements in aircraft safety over our history within aviation. And certainly, the new capabilities are intended to augment recorders on board. And these include items such as triggered real-time monitoring of recorded data, and also tracking techniques to better understand aircraft location. So I'm going to discuss both of these capabilities towards the end of the presentation.

L3 makes a large number of flight recorders and cockpit voice recorders, and there's a lot of different aircraft requirements, and therefore, we make a lot of different recorders to satisfy those requirements.

For the flight data recorder equipment, or the FDRs, the governing Minimum Operating Performance Standard, or MOPS, is ED-112A. It was published in September of 2013. It's been reissued about four times over the last 23 years, so about every 7 years it gets refreshed.

From a rules standpoint, the current Technical Standard Order is TSO-124c. It's been effective since December of 2013. And there's a corresponding European TSO, which currently 124b is in effect and we expect 124c, which mirrors the TSO, to be issued soon. The cockpit flight recorder equipment is also governed by ED-112A. The TSO that governs cockpit voice recorders is 123c, and there's also a corresponding European TSO for that TSO as well.

So, when ED-112A was reissued in September of 2013 there were some changes that were included. This included details that were added based on the Air France 447 catastrophe, as well as other incidents that had occurred. There was changes made to the deployable recorder section and also changes made to the cockpit voice recorder section. Specifically for the cockpit voice recorder, for the classes of recorders, there was a 10, 15, and 25-hour class added to the 2-hour class of cockpit voice recorders.

For the flight data recorder, additional parameters were added to ED-112A, as well as increased sampling rates on some FDR parameters. There's also a requirement to add a data frame layout information file, or what's called a FRED file, to the recorder. And that's to assist investigators to decode the data if the recorder's found.

So from a real-time monitoring standpoint, the key points that we would like to discuss are standardization, privacy, security, and reliability. From a standardization standpoint, it's clear to us that the recorder MOPS has been successful in harmonizing worldwide standards for recording. So we think this has been a real success story. We think that harmonization should continue. And for real-time monitoring, standardization may mean that we consider using all means of aircraft communication; we use the recorder to trigger the data transmission since the recorder has the data.

From a privacy standpoint there's sticky points. Currently, cockpit voice recorders cannot be downloaded when they're on aircraft. Ownership of flight data and audio varies according to the country and the installation. And so these are going to be important parts of any discussion about real-time monitoring.

And on reliability, because the flight recorder will be augmented potentially with this real-time monitoring capability in the future, which may be triggered, then it may be that high reliability could impede the acceptance due to cost. So there may be a tradeoff made that extremely high reliability is not required, and that may ease the acceptance of triggered real-time monitoring.

This was touched on earlier. In terms of goals for real- time monitoring, the flight data recorder has always been only considered part of an overall investigation. Investigators review all of the available data, including the data on the recorder before the event. And when recorders are found in an accident, as much of the wreckage is still recovered and pieced together and evaluated, and forms an important part of the evaluation. So we don't believe that real-time monitoring will change this at all.

So some realistic goals might be for real-time monitoring to help find the aircraft, to alert authorities of a problem and try to prevent the mishap, if possible. And then, the last event would be to have a dataset, if the recorder can't be found or if it's damaged or it can't be located for some period of time.

Just so that we're clear on the types of rates that we're talking about in real-time monitoring, for a flight data recorder the typical rate is about 12 kilobytes per second, and the image size is about 138 megabytes. And for the cockpit voice recorder with the three pilot channels and the one cockpit area microphone channel, the total raw data rate is about 640 kilobytes per second. All of these figures are presented without any compression.

So in addition to real-time monitoring, L3 is also promoting the idea of an L3 tracker, which would be a near real-time tracking of flight position. So the idea would be to add a Iridium short burst data modem and a GPS to a flight data recorder. And there's several reasons why we think that this should be considered and may be a good idea.

The flight data recorder is wired and positioned in the aircraft such that it's difficult to disable during flight, so it's difficult to turn off. It's completely independent of any other aircraft system, so a system such as this could be implemented and would be independent of any other systems. It could be done in such a way that it had absolutely no impact to current aircraft wiring, and the same system could be used for both forward-fit and retrofit.

So two concepts are shown here: one universal concept on the left, which fits between the FDR and the rack, and one on the right, which would be a custom unit that would a part of the flight recorder.

So how it would potentially work would be that the tracker would periodically send either periodic or triggered location, GPS location data, over our Iridium short burst data channel. Alternatively, it could be requested from the ground. The Iridium system could channel that through a gateway to a ground server and ultimately to an operations center. This would work for both location data and it could also work for triggered flight data, if there was an incident that caused that trigger to occur.

That's the result of my presentation. Thank you very much.

MS. GORMLEY: Thank you, Mr. Schmutz.

Our next presenter is Blake van den Heuvel of DRS, who will speak on deployable recorders.

Mr. van den Heuvel.

MR. van den HEUVEL: Thank you Chairman Hart, all members of the NTSB, Forum Chair Manager Erin Gormley, Panelists for allowing me to participate in this important meeting.

DRS has been a manufacturer of deployable emergency locator beacons and deployable black boxes for 40 years, over 40 years. During that time, we've fitted some 50 different aircraft platforms with multiple fleets flying in 50 countries, both fixed and rotary wing.

Some of the world's most recent accident examples, such as Adam Air, which took 7 months to recover the black boxes; Air France, which took 2 years; Yemenia 626, which not only took 2 months to find the black boxes, but also resulted in loss of life, loss of survivors; and, of course, the disappearance of Malaysia Air 370, all are examples of situations that deployable flight recorders were designed to address.

Today, aviation exports experts, including aircraft OEMs, accident investigators, and national regulators are evaluating the use of deployable recorder technology as one of the recorders for installation in a dual-combined recording system. This is to alleviate the challenges of overwater and remote location in crash circumstances.

ADFRs, or deployable black boxes, are designed to survive a crash differently than a fixed black box system, akin to using in your car seatbelts along with an airbag, two complementary technologies. They separate from the aircraft upon crash impact or at the point of a midair breakup, and are designed to avoid the crash impact zone. And finally, over water they can float indefinitely.

The fundamental element to help locate the downed aircraft recorder is the fact that these systems alert to the global COSPAS-SARSAT search and rescue system. The deployable black box through its ELT will transmit the aircraft tail number, the country of origin, the location of the aircraft at separation, and also the location of that deployable black box as it floats on water. This is invaluable for ETOPS, polar route, and free flight events.

There are no perpetual service fees related with this technology. COSPAS-SARSAT global infrastructure is a free-of-charge service to all users. And finally, the ADFR preserves the integrity of the investigative process and public trust by keeping tangible secure data in the hands of national investigative authorities.

So what is a deployable black box? Essentially, it's a fixed black box, but it floats. Everything is in one container, and rather than having an underwater locator pinger, it has an emergency locator transmitter. Since 1998, the aviation safety community has worked under the leadership of EUROCAE to agree the minimum operational performance specs. And as Tom point out before, he went through all the details of ED-112A, so I won't do that. The benefit of this approach though is we do have harmonization between EASA and FAA, which is very, very important.

The DRS, deployable recorder experience includes approximately 4,000 systems installed worldwide, over 60 million combined flight hours. And some important sort of safety factors is since that time, keeping track, we have 100% safe separation, which is an important factor for OEMs. And equally important for air transport and helicopter installations, we have 100% data recovery rate. So, pointed out earlier, on F-18 supersonic fast jets that are quite old in vintage, there have been some failures. But in air transport and in helicopter operations, a stellar success rate.

How do they work? Sensors detect positive deformation of the aircraft structure or in-flight breakup. In rare events without aircraft deformation, a pressure switch would activate deployment in water. The unit releases from the aircraft, the ELT is activated at exactly the same time, and aerodynamic forces push the beacon away from the aircraft. The deployable will land either on water or on land. It doesn't matter where. In water obviously it floats.

The ELT transmits its signal to SAR authorities, and that triggers an alert for mission control and rescue control center organizations. The deployable also has a homing signal, 121.5, and that is what is used by rescue crews to get that final 2 or 3 kilometers to the accident site. SAR personnel will work to recover survivors, secure the wreckage, and finally, they'll pick up the deployable recorder and bring it back for accident analysis.

Value to air transportation. And I apologize. I'll summarize. There's a lot of data on this slide. Deployable reorders help ensure that accident investigators get all of the data all of the time regardless of event scenario. Deployable recorders are also importantly designed to provide immediate location of a downed aircraft and survivors. Deployable reorders are highly complementary to a fixed recorder in a dual-combined installation. Using both types of reorders maximizes the potential for full recovery of flight data.

For national safety boards, this means that it maintains control of the data, as they do today. Deployables are a tangible block box that will be controlled by the investigative team in charge. They eliminate concerns about manipulation of information and security breaches by third parties, and they ensure security of data and integrity of the investigative process, paramount to maintaining public trust, and finally, to mitigate issues caused by civil liberties and privacy concerns by pilots and crew.

This concludes my formal presentation today. In closing, I would like to thank the NTSB for the opportunity to share our experience with deployable recorders with you today, and I look forward to answering your questions.

MS. GORMLEY: Thank you, Mr. van den Heuvel.

Our final presenter for this panel will be Richard Hayden of FLYHT, who will discuss streaming flight data.

Mr. Hayden?

MR. HAYDEN: Thank you.

Thank you to NTSB, and all parties concerned, for the opportunity to participate. I feel a little bit like Ms. Gormley gave me the ice bucket challenge to try to sell this story in 8 minutes or less, but we'll give it a go.

I'm going to address the subject on the agenda called wireless data transmission. The context is in air to ground, as opposed to wireless gate link, which is another connotation. Although all of our customers voluntarily have chosen AFIRS to enhance their operational control and save money on operations, it has an inherent mode of operation that provides triggered position and data in real time, which is our focus today. So keep that in mind, but the main context today is triggered data transmission.

These accidents have raised the questions we're trying to answer: Where is the aircraft and what happened? Maybe more optimistically, or more generically, we perhaps have the technology to prevent the crash rather than record it, in some instances. Both these questions can be answered today with the same technology, which is available and in services.

AFIRS was purpose built with an operations focus. It's not an in-flight entertainment system. It's particularly built to support flight operations. It has global coverage. Those are our origins in northern Canada, and our first customers indeed were flying into the Arctic, and that's where the demand for the system came from. We specialize in remote areas. The system is certified by multiple national authorities, and it's not a development item. It is mature and in service with 40 customers on 6 continents.

The solution consists of two components. The AFIRS is the on-board system that takes advantage of installed equipment and data sources. It is effectively a passive bus monitor, which records, analyzes, stores, and then selectively transmits data according to embedded rules in the box. UpTime is a web-based server, which is secure. It receives data from AFIRS, stores it, processes it, and delivers it to designated sources, recipients over the Internet securely.

This is pretty basic. A box goes on the aircraft. It does support voice data and text, two ways. It connects to the FDR and other data sources, as I mentioned. When it has a message to send, and data, it does so by its embedded Iridium modem. And the information and data are delivered to users by predefined protocols. And by the way, for those who worried about BlackBerrys this morning, we don't discriminate. We can also get the messages on iPhones as well.

You might call this in the context of this morning's discussions sort of a rough outline of a performance requirement. This is based on our experience since Air France 447, where we got actively involved in this. First, incident alerting is a key component. Again, we're focused on opportunities to prevent the crash rather than just record it. However, in the event that an aircraft is going down, the sooner the alert comes, the sooner the response can come.

Precise position tracking, basically the aircraft and the system have embedded GPS so that the tracking can be done in high rate, as short as 5 seconds, so you can figure out what the lateral -- how far an airplane can go in 5 seconds, depending on its orientation. The rate of the position tracking can actually be escalated by the person in control of the system, which would be the dispatcher or the AOC. And then, when we get to the point where we have a bona fide emergency, selected aircraft data, up to and including all of the FDR data, can be fed directly to AOC subject matter experts and third parties.

I'd like to ask our driver to bring up a quick video. This is very quick. It's to give you an idea of how the system works. This is showing an operation by our first operator who's doing a dedicated -- do I have to start that? Okay.

This is what a dispatcher would see. This is First Air based in Canada. They operate in the north. So the dispatcher has a view of all of his aircraft in a high-level status report. The aircraft self-report their position and their status as they go. And then, if we have an emergency, the dispatcher receives a message, something he hopefully can't ignore, and the system automatically starts reporting, in their case in 20 second resolution, and it starts downloading data immediately to the designated sources.

And what comes down is the FDR file in real time, as well as other information that AFIRS has. Now, if we're trying to respond to a situation actively, only NTSB and BEA could actually tell what that data means, so we translate that into useful engineering context. This is one of several tools.

On the left you see the engine data, four parameters selected by the subject matter expert, that are streaming in real time as the aircraft is maneuvering. On the right you see what the pilots would see, the instruments. So this data is driving these displays, and if people are involved in a three-party conversation with the crew, this is a way in which this data can facilitate a possible resolution of the problem.

Also, as I mentioned, the position tracking is in real time. This aircraft has been put into streaming mode for a demonstration, and as you can see, the position accuracy is whatever GPS is as a function of the ground speed.

Can we close that out, please? Thank you.

So some of the lessons learned. We've been doing this for over 10 years with customers, slowly ramping up, and we've had to build a second generation box to take advantage of some of the lessons learned. And then, we were active in the development of triggered streaming post Air France 447.

First, as has been mentioned earlier today, we never want all the data all the time, as has been suggested by some in the press. Secondly, the routine operations data can support operations. And finally, exception-based reporting, flight manual exceedances that drive maintenance or high-speed position data, as we've seen here. Importantly, the infrastructure is available today to support this. Basically, I have the Internet, SatCom, and GPS. There is no additional infrastructure required to support this system.

Safety and security. The system is basically independent of the flight crew in every respect. There are no discretionary standby modes, no interrupts, no breakers that the crew can access. It operates off a battery. It's a very low power system. So in the event of a loss of aircraft power, AFIRS, since it has its own GPS, would continue broadcast the GPS position, and any backlogged data, and it also would support Iridium cockpit voice simultaneously. The transport layer is encrypted, and the data only goes to pre-designated recipients over secure Internet connections.

I won't go through this chart, but I was asked to talk about implementation requirements and timelines. The bottom line here is basically this system could be deployed today. The CONOPS, concept of operation, there's a baseline, as I mentioned, with our launch user, which is evolving, but this can evolve with participation of all parties over time.

So, in summary, AFIRS provides on a regular operational basis for people of continuous situational awareness of operational control. More importantly, it pays for itself. It creates operational and monetary benefits on a daily basis, reducing operating costs, improving dispatch availability, and avoiding unscheduled maintenance. And finally, when emergencies or needs occur, it can provide automatic alerting, high-resolution tracking, and flight data in real time.

Thank you very much for the opportunity.

MS. GORMLEY: Thank you, Mr. Hayden.

This concludes the presentations for this panel. We are now ready for questions from our Technical Panel, and I will act as the Technical Panel lead for this topic.

I appreciate all the panelists taking the time to join us here today and share their expertise. I know everybody is busy, so we appreciate you coming along here today.

Dr. Plantin de Hugues, you talked about the Flight Data Recovery working group and all the different entities that were involved in coming up with those recommendations. One of the things you mentioned was the acceptable position for wreckage localization within 6 nautical miles. Could you go into a little bit of detail about how that value was determined of 6 nautical miles?

DR. PLANTIN de HUGUES: Yes. Can you maybe go to my presentation? I have two extra slides that may explain, in fact, the rationale for that. We'll go very quickly just to the last slide.

So on the triggered transmission of flight data working group, so we did perform some calculation of the connectivity and the position of the 68 events we had on the database, and the connectivity with the Inmarsat constellation. So we have made a calculation of accidents, so the 68 accidents over the complete globe almost 600 points. And what we did is we tried to determine the -- I would say the position between the last possible reported position and the ground.

So, it means that the connectivity, you have the satellite and then your aircraft as an event, so 68 events, and we tried to see if it was possible to transmit sufficient information to the ground. And what you can see on the chart is that you have on the X-axis is the distance, on the Y-axis is the percentage of aircraft events from the database, and you can see that with, in fact, there's a slope, at 6 nautical miles we have almost all the aircraft -- all the events from the database at the maximum value.

It was not possible to have the last 15% because there was no coverage with the Inmarsat constellation over the globe. So for the accidents -- or I would say over the pole. So for the accident over the pole, it was not possible to determine the position of impact. So it was a rationale for the 6 nautical miles, and in addition to that is what could be the frequency of transmission to achieve the 6 nautical miles?

On this chart what you have is on the X-axis you have the positioning of report, so 1 minute, 2 minute, and so on. On the Y-axis you have the number of aircraft events from our database. And then, with the color, the value 6 nautical mile objective or 4 nautical mile objective, and so on. And here you have a direct link between frequency of reporting position every 1 minute, and if you are transmitting every minute, or at least every minute, you will have 95% of your aircraft from our database within the 6 nautical miles.

MS. GORMLEY: Thank you very much.

Mr. Sasse, you described the current methods available in locating and retrieving traditional flight recorders underwater. This morning we heard about the near-term measures or the measures that are to be implemented of 90-day beacons and 8.8 ULD low frequency devices, as well as the 6 nautical miles that Philippe was talking about in terms of wreckage localization.

How do these measures assist in underwater location and retrieval of recorders going forward?

MR. SASSE: The first challenge really is to know where to start to search. So, any technological changes that help identify where the search is to start, and can limit the maximum extent of the search box are very valuable. Our TPL currently can listen to frequencies as low as 3 kHz. So, being able to detect and localize a 8.8 kHz pinger is completely possible at this time, and that lower frequency should give a longer detection range. With the increased battery life, that also increases the window of operation to search for a pinger. So both of those developments would increase your chances of success.

MS. GORMLEY: Thank you.

Mr. Schmutz, you described the MOPS, the Minimum Operating Performance Standards, and the periodic improvement process through the EUROCAE and ED-112 that has occurred historically for flight recorders.

As a manufacturer, do you think that this method of developing and augmenting the standards is an adequate way as we go forward with this technology to make sure we keep up with changes and the needs of recorders?

MR. SCHMUTZ: Yes, I do. It's been effective in creating the right kinds of discourse within the industry between the investigators, between the manufacturers, between the OEMs. The working groups that typically update the EUROCAE documents I think do so in a way that is pragmatic and brings a great deal of value to the industry. And I think that the changes that are being wrought through that document -- I think I showed about every 7 years it was being updated. I think that frequency, while it may seem low to some outside of the industry, within the industry it's a reasonable pace. New things are learned, they're incorporated into the technology, they're incorporated into aircraft, and ultimately we continue to build upon the success that we had. So, yes, I agree with continuing to harmonize through standards such as ED-112A.

MS. GORMLEY: Great. Thank you.

Mr. van den Heuvel, we heard earlier about some of the cases of inadvertent deployment or unintended consequences, and you mentioned that in different aircraft that the historical capabilities of that has been different.

Can you elaborate a little bit on some of the history of that? And if it would affect the aircraft flying capability in any way, should something like that occur?

MR. van den HEUVEL: Sure, I'd like to do that. I mentioned earlier we've been on more than 50 different platforms. The vast majority of those are transport and helicopter. Two or three, four, have been on fast jets. Through the ED-112 process that Tom spoke to, over a period since 1998, there's a tremendous amount of work that has gone into what are the acceptable requirements for a deployable recorder, to make sure that when you do have a crash that they're going to activate properly and in routine maintenance or routine operation that they don't deploy in an uncommanded fashion.

So we have made sure, as an example, that a deployable recorder is not allowed to have a manual deploy button. Now, until recently that was a fundamental requirement. You had to have that, and that was really a retrograde move when it was introduced in 1997 because finger trouble begets unintended deployments.

The other things that we looked at were absolutely you cannot have a single access G-switch or a single G-switch because we've learned from ELT technologies that G-switches don't work very well. So we've removed that from the systems, and you have to have positive deformation of the aircraft structure. That's what you need in order to reliably make sure the system works properly.

So it's actually lessons learned from F-18 experience where we implemented a -- you know, we didn't, the OEM implemented a single access G-switch, a complete pyrotechnic from stem to tail release mechanism, and, you know, no water activation, for example, that has caused some failures.

On the flip side, the other things that we talked about are the actual uncommanded deployments. And working under subgroup lead by Airbus, we did make changes this past couple of years to ED-112A to mandate a 1 x 10^{-7} safety factor. So, it's incumbent between the system supplier and the OEM integrator to substantiate that as part of the certification of the system.

And when you can achieve -- and we are with our systems today, we are achieving that number. When you get to that level, you are now sort of the equivalent of having maybe a wheel fall off an airplane or a maintenance access panel fall off an airplane. And as Mark Smith pointed out earlier today, I mean, it is hard to achieve, but it is showing the level of robustness and reliability that are built into the systems.

MS. GORMLEY: Great. Thank you.

Mr. Hayden, depending on the circumstances of an accident, an aircraft may undergo unusual attitudes or abnormal flight profiles.

How would the AFIRS system operate under these conditions? Would there be a loss of signal that would prevent transfer of data or that would require a startup time to begin transferring again?

MR. HAYDEN: Great question. Could I have he clicker, please? Could I bring up my presentation again?

This issue was raised when we got engaged after Air France 447 in the SESAR working groups and BEA triggered transmission working groups. I think the question was motivated by experience with SatCom, where in turbulence and other maneuvers, SatCom connectivity has been lost. So, we didn't have a good answer to it, to be honest, so we challenged one of our customers to work with us, and this is what we did.

The mission of the day was to fly a flight while the AFIRS system was in full streaming mode and break the connection with Iridium. Frankly, the pilots loved that challenge. That's a lot more interesting than a regular boring flight. So this is what they flew, and the data was -- that's the position report, so it was obviously very high frequency position reporting. And this is a sample of the data that resulted from it. This is a typical tool that is used in flight data monitoring.

And you'll see that -- you can see, this will on the website -- that basically the aircraft went through excursions of up to I think 23 or 24 degrees pitch up, then over 80 degrees roll with snap rolls back and forth, and the data never stopped flowing. So that's one test. It's encouraging and I believe that there's some inherent attributes of Iridium that make Iridium less susceptible to disconnect than geostationary satellites.

MS. GORMLEY: Great. Thank you.

Dr. Plantin de Hugues, in your PowerPoint presentation you mentioned a distress system that would assist with localizing data based on triggered criteria. Can you tell us a little bit about that effort, the history, and how it's going to proceed forward?

DR. PLANTIN de HUGUES: Yes. So, in fact, there is a different part. First of all, the ICAO created an ad hoc working group, so it was in May 2014. So, I'm part of this ad hoc working group and this group is looking for middle-term and long-term solutions to be able to find an aircraft. And CONOPS, which was called at the beginning, and the report was developed and completed just a few days ago, will provide recommendations for the various ICAO panels to provide a proposed amendment for the Annex 6 and the other Annex of the ICAO.

Then, in fact, we are doing and using as a basis the work of the Triggered Transmission of Flight Data working group. We used the work and the fact that, I will say, the triggering criteria are robust enough to provide sufficient information for the aircraft to trigger and to send data to the ground. We decided to -- we proposed, in fact, some, I will say, working paper to propose amendments to the Annex 6 dealing with, I will say, transmission of flight data when a distress situation is detected.

So it is part of the global pictures, and this is one of the stunts that are used to make sure that the various annexes in the future will be robust enough to find an aircraft. In addition to that, the EUROCAE working group and air-to-sea working group are working jointly to make sure that the specifications are well defined and are robust enough to complement the work of the ICAO.

MS. GORMLEY: Great. Thank you.

Mr. Sasse, aside from the current methods available, which you covered in underwater retrieval, what emerging technologies, methods, or analysis, do you see coming forward and even looking farther into the future that would help with a less timely and less costly search process?

MR. SASSE: The biggest thing that would aid in the actual search is the accuracy of the initial starting point with the search. When it comes to performing the underwater search itself, some of the AUV technologies, the untethered autonomous technologies, may give the ability for multiple of these search assets to be deployed from a single vessel, so you could cover more area per vessel deployed, which could give you a force multiplier.

But I think really the biggest thing is narrowing your starting point and the total extent of your search box is really where the most value is. Once you've done that, the technology's there to actually search that box.

MS. GORMLEY: And as a follow-up to that, how does the delay in that initial search affect the outcome?

MR. SASSE: With a finite pinger battery time period. The more time you can spend on site actually performing the search, the greater your chances of success are. So any delay in making decisions in mobilization, directly impact the amount of search area covered. So it's important to actually have that initial starting point and make a decision to mobilize quickly.

MS. GORMLEY: Great. Thank you.

Mr. Schmutz, flight recorders have had a long history of successful data retrieval. Based on your experience as a manufacturer in assisting all the accident investigative authorities in various scenarios, do you believe that the current survivability requirements of recorders are adequate and that the way that, again, it's been reevaluated on a periodic basis is meeting the needs of the community?

MR. SCHMUTZ: Yes, I do. Unfortunately, we do see accidents with our equipment installed. We are successful in recovering the data currently with the survivability standards that we've designed into our equipment and that meet the requirements in the MOPS ED-112, ED-112A. There are instances where the accidents cause scenarios that exceed the survivability requirements. In cases like those, we're happy that our equipment performs over and above the requirements. In some instances, we have to get creative.

This is in a very few instances we've had to recover dye and things like that to recover that last amount of data. That's typically found in incidents that have a great deal of fire that burn really, really hot for a really long time. But generally, we feel like there's a good balance right now inside of ED-112A that call out survivability. The survivability part of the MOPS has been stable now for quite a while. I think that's a tribute to it being probably on target.

MS. GORMLEY: Great. Thank you.

Mr. van den Heuvel, you mentioned that there were over 4,000 systems that have been delivered. And you mentioned a little bit about the type of aircraft.

If you can speak to it, can you describe what the operator's decision-making process was in putting those units on board in terms -- was it because they were doing more overwater remote operations or the type of operations, just to get a little bit of history of the people who have put those on there?

MR. van den HEUVEL: Okay. I think historically the technology was designed in Canada for the vast northern expanse, and we saw people using deployable ELTs in remote areas. As we moved into the '60s and '70s, we saw militaries gravitate to the technology in which they were flying many of the missions over water. And then, finally in the '80s, I would say the helicopter market started to pick up where the technology for a deployable ELT became mandated in North Sea oil operations.

So, I think in -- you know, as it evolved, it has been to not really to find the flight recorder, and not even to find an airplane. It was to have passengers survive, to find survivors within the golden hour. So it has always been high-risk flight operations over water and in remote locations. And I think that's where the decision making came from to move in that.

Now, as we're looking forward where the costs of this technology -- when you take it out of the military and you put it into the commercial realm, the costs are coming down drastically, and now there's the opportunity for commercial operators to get those same features. If you looked at the search aircraft involved in MH370, you saw P-3s from Canada -- from Australia and Japan, you saw Sea King Seahawks, you saw a Japan P-8I flying. All of those search and rescue aircraft had deployable flight recorders on them.

MS. GORMLEY: Mr. Hayden, when talking about streaming flight data the issue often seems to arise about limited bandwidth. Can you explain exactly what this means and if this is a limitation that might prevent transmission of data as a viable option?

MR. HAYDEN: Yes. I'll try to do that without getting irritated at the -- what we've been hearing in the media.

I think the notion of bandwidth limitations arose from an incorrect understanding of what we're talking about by streaming data. I think people thought of it the same way they stream movies onto their computers and handheld devices. The data that is required to -- as you know, looking at accidents, to determine what happened to an airplane is nowhere near as extensive as what people are watching on movies.

In fact, the challenge we took on after Air France 447 was to see if we could stream -- how much flight data recorder we could stream from using Iridium, which has a small bandwidth per channel; however, it has many, many, many channels. So first thing, we do extensive data compression on board, and then Iridium has a short burst data mode that's extremely efficient.

So, to make a long story short, using an Airbus aircraft operated by one of our customers, we first discovered that we could actually stream all 260 parameters, give or take a few, I don't remember the exact number -- that that particular flight data recorder was capable of, including GPS position, at the rate that they were being recorded on the flight data recorder, which ranges from a quarter second to, you know, many seconds, but roughly once per second for each of the data points.

So, you know, as they say in math, QED. And our colleagues in the industry graciously gave us some guidance saying that was pretty good, but in fact we don't actually need that much; we don't need all those parameters to do what we need to do. So we've worked with Iridium. There's literally no -- you could have every aircraft in the sky reporting at the same time and Iridium can support that.

On the other hand is the Internet, and I don't think we need to dwell on how much data the Internet can handle. The aircraft data is a drop in the bucket compared to what's moving around on the Internet. Does that answer your question?

MS. GORMLEY: Great. Thank you.

This next question I guess would be applicable to the three manufacturers, and it's a little bit of a two-part question. But the first would be, we heard about longer durations CVRs that are coming on board, as well as data link requirements, and FDRs. Do you anticipate being able to accommodate those with the recorder design, particularly L3 and DRS, as the mandatory requirements?

And the second part would be, in general terms, either that or for the upcoming is what are the costs of these systems?

In terms of L3, you mentioned putting that tracking capability on there. With DRS, with outfitting that, whether it's to a forward-fit or even a retrofit capability, and then putting the system on board for streaming flight data. Can you speak to the ability to comply with requirements that are coming down the pipe as well as some of the costs associated with it?

MR. SCHMUTZ: Sure. On the first point, we can comply with the 25-hour CVR requirement today from a forward-fit perspective. We have products in our portfolio that will satisfy that requirement.

And the second point, which was with regards to the tracker, we're excited about that technology. Again, I showed two different instances of it. One instance might be a universal tracker that would fit inside an ARINC style tray, and that could be retrofittable to any existing ARINC style deployment, whether it's an L3 deployment or other, of an FDR. So that type of equipment we think could be sold, you know, at price points equal to or around the same as that of the FDR. For a tracker technology that was embedded inside of the flight data recorder, it could be deployed at a much lower cost.

The first is very strong in its ability to be retrofittable across the entire fleet, all aircraft at this time, and a more custom arrangement might be more suitable for a forward-fit. So that just gives you an idea some of the strength of that idea.

MR. van den HEUVEL: With regard to the 25-hours or 20 hours of CVR, we do not see any technical challenges there. If you asked that question a couple years ago, we would say that the -- actually the low temperature, the 10-hour low temperature fire test is, in fact, more difficult than the high temperature fire test because of the duration. So we have to watch what's available in terms of memory. And, you know, that could be the only thing that I could caution at this point, but I don't see a problem.

With respect to costs, I can talk to that as well. One of the points that has come out of the EUROCAE working group efforts and the proposals that are in front of the industry, that if you're going to fit a deployable recorder on your aircraft, it has a built in ELT; therefore, that particular aircraft won't be required to carry a fixed automatically activated ELT because the one in the deployable would meet that requirement.

So, what we're -- in terms of becoming cost neutral for an airline implementing dual-combined recorders, is that the deployable then has to come in at a price, which is the equivalent of a fixed recorder in its installation and a fixed ELT in its installation. And to that end, ICAO has done of a lot of study work there, and I think people are happy that the cost of deployable recorder technology has in fact come down to where it is cost neutral. Now, that's on forward-fit.

I want to make it clear that I don't think there are any proposals anywhere that are considering putting deployable recorder technology as retrofit or back-fit. That being said, over half of our installations are in fact retrofit, so there's a lot of experience by aircraft completion houses and OEMs with respect to retrofit. And it's likely that, you know, retrofit, including the added cost and the added certification cost, when it's amortized over a number of aircraft would likely add about, I don't know, 10- to 15-, maybe $20,000, if it was a retrofit. But we know that's really not the plan going forward.

MR. HAYDEN: The AFIRS system is delivered as a completely integrated service, so it's just like buying a cellphone for the first time. They have one-time costs for the hardware, and that includes a warranty for as long as the service contract is enforced.

I won't beat around the bush. Our costs are -- typically for the aircraft kit is in the neighborhood of under $50,000. It depends on circumstances: the aircraft type and the specific arrangement. There's roughly 200 hours to install in a retrofit mode. Almost all the installations are done during a sea check cycle, which usually involves 5- or 6,000 man hours of labor. So the airplane is taken apart and -- so, if done during a sea check, it's a bit less. So the actual outlay is, you know, typically probably under $70,000 to get going.

The service fees are dependent on a menu of services. Some people operating Cessnas, doing work in Africa, only use voice and tracking because that's about all the data they have on the aircraft. And then we have carriers and business jet operators using everything we have. So the service fees are a few dollars an hour. Probably the highest service fee is, you know, in the neighborhood of $10 a flight hour. You put that in context of an hourly operating cost of aircraft, it's between say 3,000 and $30,000 per flight hour. That's the appropriate context.

Now, as I said in my introduction, the system is not sold -- it's not mandated. It's optional equipment, and it's basically selected because it provides benefits. So in every case the purchasing decision by the customer is made on the basis of hard cost-benefits. And the core of these cost-benefits typically would be reducing data errors, reducing manpower for people handling data, accuracy, timeliness of event reporting, and flight manual deviations that require inspections or maintenance, thereby saving some dispatch delays.

And a big one, of course, is fuel savings. We monitor the way the aircraft is handled against SOPs approved by each airline, usually following the IATA guidelines. And those typically translate into at least a 2% savings on the fuel budget, which pays for the capability almost instantaneously these days.

Those are all retrofit statements. We have two OEMs installing this system on the line, and frankly, I don't know how much the end customer pays for them. I know how much they pay for the system going in. So that's our story.

MS. GORMLEY: Great. Thank you.

I think some of my colleagues -- Ms. McComb.

MS. McCOMB: Thank you. I have a few follow-up questions for Dr. Plantin de Hugues.

You had mentioned the joint EUROCAE/RTCA working group activities. Would you please go into a few more details regarding what the working group is doing for reliability of ELTs?

DR. PLANTIN de HUGUES: Okay. So, in fact, there will be a new constellation provided by COSPAS-SARSAT, the MEOSAR constellation. This is mainly payloads dedicated to COSPAS-SARSAT that will be on the Glonass, Galileo, and GPS constellations. And taking advantage of this new constellation, there was a need to improve the -- I will say to create a second generation of ELTs, first of all, because it's no longer necessary to wait for 50 seconds before to trigger an ELT, so now it can be done in flight.

So with the second generation of ELT and the new constellation, as soon as an emergency detection -- there will be an emergency detected onboard, the ELT will be able to transmit the signal to the satellite, and then to transmit to the ground. So the working group is, first of all, dealing with this second generation of ELT, so there will be a MOPS. So it is a specification for a single entity like the ELT. And in addition to that, there will be a MASPS, which is specification for a system that will be dedicated to the specification for the triggering criteria.

So each triggering criteria is, for example, as soon as your aircraft is banking like that, from some value you will have to start transmitting. Or if your pitch is too high, you will have to transmit. So this document will detail as a performance-based all the specification for this kind of triggering criteria. And then, at the end because you will have a new MASPS, so specification for the system, and a new MOPS for the new second generation of ELT, you should improve the, I will say, robustness of the system and be able to provide a position of impact within 6 nautical miles, at least.

MS. McCOMB: Thank you. Can you talk a little bit about what the timeline is for completing the work?

DR. PLANTIN de HUGUES: It is planned to have at least the MOPS and the MASPS published by end of 2016. Because, in fact, the flight recorder panel proposed amendments to the Annex 6, and this Annex 6 will published end of 2016. I would like, in fact, to have the MASPS to be published before end of 2015 so it will be easier for the Annex 6 to reference the MASPS to make sure that we have a performance-based solution that will be not only for ELTs, but any solution that could be triggered by any means, so that could be triggered by this specification. So it is why we would like to have this MASPS published before the end of 2015.

MS. McCOMB: Thank you.

I also have a follow-up question for Mr. Schmutz. You had discussed the L3 tracker system, which sounds very interesting. How far along in the process are you in implementing either of the possible solutions?

MR. SCHMUTZ: So your question is regarding the tracker? I didn't quite hear you.

MS. McCOMB: Yes.

MR. SCHMUTZ: So we currently supply Iridium-based systems in the industry. We don't supply a system that we've identified here. We are going through an evaluation of that equipment in the market for feasibility. We think it's a good idea. We'd like to understand whether or not if we build it, if it will be profitable and what kind of uptake it would take. So right now we are gathering data.

MS. McCOMB: And in terms of another question, have any of your customers expressed interest in such a system?

MR. SCHMUTZ: There has been discussions. There hasn't been -- again, it's not a requirement, it's not a mandate, so -- you know, one of our purposes is to discuss it in forums like this to try to see if we can elevate the discussion and see if we can derive mandates for things like this.

MS. McCOMB: Thank you. That concludes my questions.

MS. GORMLEY: Mr. Babcock.

MR. BABCOCK: One follow-up question for Mr. Sasse. With the advent of the 8.8 kHz beacon -- you answered half my question about using the same equipment to search for both beacons. But with the advent of the lower frequency beacon, does that change the search techniques that you use to search for one or both of the pingers that may be together or separated in a wreckage field?

MR. SASSE: Essentially, the techniques, the technologies, and the systems would all be the same. Currently, we would only be able to search for one or the other frequency at one time. Partly because of the filters and the spread of the differences in the frequencies, it would be very difficult to try and triangulate and localize both frequencies simultaneously with the same sensor. But there would be no difficulty in switching from a triangulation of a lower frequency, and having to make the determination to switch to the higher frequency. They just can't be done simultaneously.

MR. BABCOCK: Thank you.

MS. GORMLEY: Just to follow up, in terms of -- we heard the regulators this morning, ICAO, EASA and FAA, talk about some of the processes that have to happen in voluntary versus regulatory.

In terms of the technologies, in terms of wreckage location and the technologies going forward of new and innovative, do you think that there's anything else that the community or that the regulators can be doing, working groups, that would help facilitate and embrace the operators to take some of these on board, or do you feel that it's going at a speed that it needs to go, based on customer driven? It's for anyone.

MR. HAYDEN: Well, I've never hesitated to put my foot in my mouth in public, so I'll comment on that. I think from a -- I think the pace is maddeningly slow, frankly. In some cases that's justified, but in this case I think that what the technology demonstrated -- and essentially, you heard the alignment of OEMs and others with the concept of triggered position data transmission. I don't think the time frame is fast enough.

DR. PLANTIN de HUGUES: So I think what is very important is to have harmonization. And as I mentioned before, what is very important is that when there is a new regulation like the Annex 6, it is referenced to standards, to documents like EUROCAE ED-112A, or the future standards for the new second generation of ELT like ED-62B or DO-204B. So it is very important to have a broad view to make sure that all these working group is working simultaneously to make sure that at some point everybody will be ready to make sure that each regulation, ICAO or EASA or everyone has all the needs, all the documents ready for the regulation.

Definitely, we will work with EASA and ICAO to make sure that the proper documents have been forwarded to the ANC for the modification of Annex 6 will be consistent with the proposal of the opinion by EASA and the European Commission. So harmonization is very important definitely.

MS. GORMLEY: Acting Chairman Hart, this completes the

Technical Panel questions for Panel 3.

ACTING CHAIRMAN HART: Thank you, Ms. Gormley. And thanks again to all of our panelists for excellent presentations. We will now take questions from the dais.

Mr. Delisi.

MR. DELISI: Thank you.

Dr. Plantin de Hugues, I'm interested in knowing a little bit more about the ACARS data that was initially collected in Air France 447. Certainly in the early days of the investigation that's all you had to go on. What were you able to garner from that level of information?

DR. PLANTIN de HUGUES: So the first fact was that because there was 25 messages sent in a very limited time, so we were able to say that between the last position that was reported by the ACARS system every 10 minutes, so between the last reported position and the last ACARS messages there was 5 minutes of flight. So we assumed at this time that the maximum distance that had been covered by the aircraft was 14 nautical miles. So this is why we came to this area when we were looking for the position.

MR. DELISI: Good. Thank you. I was more interested in your ability to solve the accident, to determine a cause. Were you able to begin to paint a picture of what might have been happening in the cockpit based solely on the ACARS data that you had at first?

DR. PLANTIN de HUGUES: We have been working for 2 years, I will say, on the ACARS messages. We had a lot of hypotheses, and then, I will say, when we recovered both flight recorders, we were able to perform the complete analysis. But it was impossible only with 25 ACARS messages to have, I will say, a complete picture and to have only one hypothesis.

MR. DELISI: Gotcha. So the full complete picture only was developed when you recovered the recorders and had hundreds and hundreds of parameters available?

DR. PLANTIN de HUGUES: Yes, because we had the complementing data from FDR and CVR, both of them.

MR. DELISI: Mr. Sasse, I wanted to talk to you about the underwater locator beacons. They're obviously required on aircraft flying all around the world. The towed pinger locator capability that you described, is that something that's unique to SUPSALV?

MR. SASSE: The technology isn't unique, but I believe SUPSALV is the only one that actually has a fieldable system that can deploy on a moment's notice anywhere on the globe.

MR. DELISI: So, should a commercial airliner go down anywhere in the world, folks are going to reach out to you to deploy that listening technology?

MR. SASSE: Yes. And we've been involved in most aviation accidents in one form or another.

MR. DELISI: And how does a deployment like that work? Do you put that on a ship and set sail, or do you deploy it and look for a host ship close by?

MR. SASSE: The logistics, first, we normally have to fly it into theater. Most of the time these things are not in the U.S. waters, so we have to fly it to theater. And in the process of flying it there, we're looking for a vessel of opportunity. And there's a whole logistics of how to get it from point A to point B, mobilize it on the vessel, and then transmit -- or transport to site. And that whole process can take up to 7 days, depending on where you are. So there's a lengthy process in getting all that mobilized.

MR. DELISI: Great. Thank you.

ACTING CHAIRMAN HART: Thank you, Mr. Delisi.

Dr. Kolly.

DR. KOLLY: Yes, I have a few questions. Maybe we could pick up with Mr. Sasse with regarding the underwater recovery and location.

Can you describe some of the technical difficulties that arise that make the recovery of a recorder -- specifically, what I'm concerned about is things like, do you run into issues with false signals or signal quality or specific environmental conditions and that sort of thing?

MR. SASSE: One of the things we do is we make sure we tow the fish deep down towards the sea bottom, so we get it away from thermoclines and surface noise and other things like that. But it is possible for the pinger to be buried either in sediment or within the wreckage itself, which could shield the signal and make it harder to detect. Also, if you have severe bottom terrain, that could cause some echoes and also some areas where the signal doesn't propagate as well.

So the environmental factors do have an effect, but even with those parameters, normally we can detect a pinger within 1 nautical mile. If the other conditions and factors are well, we could probably hear it up to 2 nautical miles.

DR. KOLLY: Are there any particular improvements that you would like to see that could make your recovery more successful or easier?

MR. SASSE: As mentioned earlier, battery life increases the window of opportunity to do the search. Lower frequency pingers have the ability to create a longer detection range, which could increase the amount of search area coverage in any one period of time. And also, any of the other technologies that have been mentioned here, which would help localize the starting point for the search, would have pay dividends.

DR. KOLLY: I know all of us have seen your efforts and applaud them. There's certainly a certain amount of risk, safety risk to the recovery effort, and it's obvious that there's an enormous amount of cost associated with that as well.

Have you ever been involved in providing any type of an analysis of that for regulators or any type of official when they're calculating their cost/benefit analysis of what -- just what you bring to the table and how much that costs and what risks are involved?

MR. SASSE: When performing a search for a civilian airline, we're normally working hand-in-hand with NTSB, or in the case of Air France, with the BEA and other aviation agencies. So we do work hand-in-hand with their investigators, and so there is good dialogue on site about what is involved because they're normally there with us at the time helping to direct and lead the effort.

DR. KOLLY: I'd like to address a few questions now to Mr. van den Heuvel. The deployment of these -- or the operation of the deployable recorders, I'd like to talk about the safety of that deployment.

I've heard about issues of unintended deployments being risky to both aircraft and personnel. Can you describe if those risks are real, and also what your company has done to address them?

MR. van den HEUVEL: Okay. I can talk to that. I think first of all, if I talk about in operation, there is a perception that these things fly off the aircraft at altitude and are going to hit a person or a cow -- I've heard a cow. And I think it's important to know that the design, if you don't use the old style G-switches and you're operating solely on deformation of aircraft structure, then -- and as pointed out by the NTSB over the years, you want to the recorder to ride out as much of the accident as it can. You want the last few seconds, so -- and, in fact, we don't deploy until aircraft deformation.

So in 99% of our events there are on the ground or on water. And in the very, very rare occasion in a midair breakup it can happen at altitude, but at that point there's a lot of other things going on too, so we wouldn't be the only thing falling from altitude.

The topic that was addressed I think about maintenance is that if you go back to the early '70s, there was technology by manufacturers that used explosive bolts to eject, to physically eject a deployable from an aircraft. And if that happened in a hangar, there would be the possibility to cause harm to a maintenance personnel. Today, those systems have been outlawed, and certainly in a system like ours, it's just a small spring. If one of these released because somebody tripped something in the system, you'd actually have to run up and grab it. You'd want to go and catch it rather than get away from it because it might fall on the floor. So it's quite, quite the contrary.

The other thing that I believe is happening in talking with some of the OEMs that are considering this technology for civilian aviation, is there is a consideration -- nobody's made a decision yet, but a consideration to have a disable feature when on the ground, certain conditions on the ground. So in that event, you know, it would be impossible for the system to try and trigger.

Now, I think we have to look at that carefully because 30% of our accidents that have involved deployable recorders are takeoff and landing. So it's quite possible that you would have wheels, weight on wheels, so that wouldn't necessarily be a good parameter to use. But there are times and are conditions when it might be appropriate to lock the unit out.

DR. KOLLY: I have a question. Again, this morning I was asking about -- the FAA about voluntary implementation, and I'm thinking of ways to get safety improvements that may not take the normal regulatory route.

Are any of the manufacturers that are here today, are they aware of any particular incentives, say, from insurance companies or from their buyers that would tend to defray some of these costs associated with these technologies?

MR. HAYDEN: As I mentioned in earlier remarks, we're not selling a system that's waiting for an accident to happen so the return on investment of AFIRS has to stand on its own from the outset. We're evolving the emergency mode into something that can provide further benefit. The benefits that are easiest to quantify are easiest to measure because they're not controversial are basically fuel savings.

And we actually have been approached by a major aviation insurance company to become educated because they are contemplating a significant insurance premium reduction for people that equip their airlines and other operators that equip their aircraft, either of which would pay for the system in a heartbeat. So I won't reiterate all the other components of the benefits that are evaluated before people decide to go forward with this, but -- they're on the record -- but the instance potential is there.

In a former life when I was working on helicopter HUMS, I was involved in a situation where Lloyd's granted our commercial European helicopter operator an 8% premium reduction on the basis that they were going to be safer as a result of having the information from a system like that. So it seems that the same thought process has found its way into the fixed-wing world.

DR. KOLLY: Anyone else?

MR. SCHMUTZ: I don't have any information from the insurance industry, but there are certain platforms that are less safe to fly than others based on records, and it seems as though the air framers for those systems are more interested in buying non-required equipment to gather data and to understand -- to identify the reasons behind less-than-stellar safety records, and to try to identify if it's equipment problem, if it's operator problem, or a combination of both.

ACTING CHAIRMAN HART: Thank you, Dr. Kolly.

I'm going to ask a very high-level question, and it's based largely on my lack of knowledge of this arena. And this is fascinating to learn so much about this in such a short period of time.

But the high-level question is, is it in the foreseeable future that we will not be looking for the box because we're going to get uplink-downlink and we're going to have everything we need without ever having to find the box? So I'm going to ask first Mr. Hayden and then Mr. van den Heuvel for your disparate viewpoints on that question, and then anybody else who would like chime in.

So the question is, is it within the foreseeable future that we will not be looking for the boxes anymore because we'll have everything we need already uplink-downlink?

MR. van den HEUVEL: Well, thank you, Chairman Hart for putting me on the spot, and I appreciate that. I'm not sure a technology solution provider is necessarily best-equipped to answer that question. I can only tell you that I've been involved in EUROCAE working groups, IATA working groups, ICAO working groups since -- I think I started doing this in about 1995. And the only constant I would say that I've heard throughout those 2 decades is that there's an absolute need for a tangible black box.

I can't say that I've heard accident investigators talking about getting data from a cloud and feeling that that's going to be secure and reliable and tamper proof. And then, from the Airline Pilots Association, who as we know, they can be very vocal in these groups, they talk about privacy of data and civil liberties, et cetera.

So while I'm not the right person to have the definitive perspective on this, I think there's a significant impetus, a will inside the accident investigation community for, in fact, a tangible black box and I think to have that for a long time into the future.

MR. HAYDEN: Thank you for the question. It's a good one. And I think to sort of not answer it in a way, I think what we can expect is -- and really can do today is get the important data off the aircraft reliably even as it's going down. Now, clearly, there's some additional testing and certification of transmission when the aircraft's in an abnormal attitude and so forth.

But I think that it's safe to say that we've demonstrated that you can have an end-to-end solution that operates in near real time to get most of the data. Now, as I said earlier, we don't bring all the data necessarily. It's really a pre-defined set of data, which could be up to and including most of the data in the flight data recorder.

I do think that the -- there's no question, systems fail, and there are several potential points of failure for a specific incident in data transmission. So I think that in the near -- I don't know what near means, but in the near future I don't foresee replacing a hard recording medium with SatCom only. But I think part of my -- I want to maybe explain my perhaps terse comment before about the pace.

Part of our source of frustration is we are focused more on using the technology to intervene, to help people intervene, and reduce the probability of a crash than recovering the results. And we know from examples, that we've helped avoid some serious incidents. And the way we do this is that all parties, all subject matter experts receive the same data at the same time. So the collaboration includes the flight crew, the operator, and the OEM, who are all looking at the same data. So we expand the number of subject matter experts that are involved in a real-time situation, accordingly.

So, my hope is that the technology can be accelerated -- the use of the technology can be accelerated to avoid some incidents that are avoidable if intervention occurs in real time.

ACTING CHAIRMAN HART: Okay. Thank you very much. I appreciate that. Anybody else with any -- would like to opine on that question?

DR. PLANTIN de HUGUES: Yes. In fact -- thank you for the question. In 2009, when we started the Flight Data Recovery working group, it was one of the solutions we envisaged. So it was a transmission of the complete set of FDR data to the ground. So it was not at that time not appropriate because, in fact, if all aircraft are doing the same on the same time, you can saturate the satellite. So you can tell me that it can be solved, but in 10 years maybe we don't want to transmit 100 parameters, but 1,000 parameters. In such a case, if all aircraft are doing the same, we'll still be able to saturate the satellite.

So we did consider this solution. We found that it was not a good one, but if we have any solution that will help us to localize a wreckage as soon as possible, and we have extra data, it will be preferable definitely. But as an investigator, I would like to have our recorders.

ACTING CHAIRMAN HART: Thank you very much. Anyone else would like to speak to that?

Okay. Tech Panel, do you have -- we have a couple minutes. Any more questions from the Tech Panel? Okay.

Well, thank you again to all of our panelists for great presentations and discussion. That's been fascinating. And thank you, Erin, for doing double duty by being the Technical Panel lead in addition to running the whole joint.

You have given all of us some glimpses of some interesting technology, and we appreciate that. We're going to go on break until 3:15, and return for the final panel of the day. Do I have that correct?

MS. GORMLEY: 3:25.

ACTING CHAIRMAN HART: 3:25. Okay. I'm sorry. On break until 3:25, and then return for the final panel of the day, which is the future path. Thank you very much.

(Off the record at 3:05 p.m.)

(On the record at 3:25 p.m.)

ACTING CHAIRMAN HART: Welcome back. We're now ready to hear from our fourth and final panel, which will address the future path. I will turn things over once again to Erin Gormley.

Ms. Gormley?

MS. GORMLEY: Thank you, Acting Chairman Hart.

As a reminder for this panel, please push the button on the microphone. A green light will indicate the microphone is on. When speaking, bring the microphone close to you, and push the button to turn the microphone off.

In our first three panels, we have discussed the present regulatory landscape, a variety of stakeholder viewpoints, and some proposed technology solutions, yielding the context for our fourth and final panel, The Future Path. This panel will discuss the issues that need to be resolved in order to move forward.

Our panelists are Capt. Charles Hogeman, Aviation Safety Chair of the Airline Pilots Association, or ALPA; Dennis Zvacek, Senior Manager, Avionics Engineering, with American Airlines; and Tim Shaver, Manager of the Avionics Maintenance Branch of the Federal Aviation Administration.

The first panelist will be Charles Hogeman, who will discuss use and protection of flight data from the pilot perspective.

Captain Hogeman.

CAPT. HOGEMAN: Thank you, Ms. Gormley.

I appreciate the opportunity to speak before the NTSB on this very, very important subject. And we've heard a lot of good information. My remarks are going to be markedly different in that I'd like to talk more philosophically about the use of data and the data that is derived from flight recorders.

But before I do, I'm obligated by law to tell you who ALPA is. We have 51,000 professional airline pilots and 31 pilot groups at airlines in the U.S. and Canada. We do have a record of over 80 years of safety advocacy, and we are the largest nongovernmental safety organization in the world. We have 400 pilot representatives in various disciplines working purely on safety issues, and we're assisted by 23 full-time professional staff.

So as we move into data recording considerations, safety data must be used only for that purpose. And I'm reminded, dare I say, over 35 years ago when I started flying, one of the oral questions on the airplane I was checking out in is, what is the flight data recorder required to capture? And the answer was SHAVE, which is speed, heading, altitude, vertical velocity, and elapsed time. And certainly, flight data recorders, and the use of cockpit voice recorders, has emerged over many years to the point to where if you ask that question today what is the flight data recorder required to capture, the answer is a bunch.

We have evolved over time, moving from accident investigation to the use of information and data. Much of what you heard this morning is impressive on what we can capture. And I go back to Acting Chairman Hart's comments this morning opening up this forum in that there is a lot of information that we're able to capture, but I think that we have to move forward. And the Acting Chairman made the point, we have to move forward in not a knee-jerk fashion, but we have to be measured and objective.

You know, after hearing all of the impressive presentations prior to our panel, you know, I'm thinking that technology is not really the -- is the less challenging part. But we must not underestimate the need to engage all stakeholders, both domestically and internationally, on the use and protection of safety data.

While the use of recorders is essential to accident investigation, getting more data also presents some challenges for us. You know, one way to think about this is that the safety case should scale what we record, how long we record it, and how long it is saved. Protection of data is not just a technical issue, but rather it is one that has to be worked on by all facets in the industry, certainly the regulators, accident boards, and all that. Safety data has proven to be of value. It is a tremendously valuable resource and we have to protect it.

You know, with all the information that is now available, certainly in a commercials standpoint, we are able -- just the general public is able to derive information from flight track data almost anywhere in the world. We know how fast the aircraft's moving, whether it's climbing, whether it's descending, what its ground speed is. And the fear that I have is that inappropriate use of that kind of information is actually going to challenge the integrity of an accident investigation, should we find ourselves doing that. We don't want to use information from all these data sources that are going to hurt the sanctity of an official investigation.

And I think technology needs to also address the security of data. And the data that we collect does get old, it gets stale, and we ask ourselves how long do we keep it? Almost all stale data, or data taken out of context, is almost worse than no data.

We heard a lot this morning about on-board technology, and I would ask that we need to maximize the use of our existing technology on locating the aircraft. A lot of work and a lot of discussion this morning about streamed data. And I'm sure there will be some questions later on as, you know, the benefits of streaming data. But I would argue that as we talk about technology solutions such as streaming, we don't want to lose track of analysis of data and I think that is just as important.

There are technological, regulatory, and political challenges to streaming. And let's face it, you know, whether we get our data streamed or whether we get it taken off a flight recorder itself, it doesn't necessarily guarantee we won't prevent bad things from happening. But as a safety industry, I think we need to be looking forward and looking at using technology also for analysis of data.

So as we look head, you know, I think you heard -- I think the Acting Chairman mentioned it this morning, I heard the

FAA and EASA say it -- what is it that we really need? What do we build, how do we build it, and how do we use it? And, of course, inherent into that discussion is what is the cost? And what do we need -- you know, what is the risk benefit of some of the technologies that we are looking at? You know, I think we need to work together on protecting data and the information that we get, and look beyond the accident investigation piece of it.

So, just in closing, I think the NTSB can lead the partnership to change the paradigm to collect, safeguard, and analyze data before accidents occur. And I think that'll occur in the legislative arena, in the regulatory arena, and certainly as SMS and other programs like that come online within the airlines, affect cultural change. And with that, I look forward to your questions. Thank you.

MS. GORMLEY: Thank you, Captain Hogeman.

Our next presenter is Dennis Zvacek of American Airlines, who will discuss issues regarding technology implementation, data ownership, storage, and security from the airline operator perspective.

Mr. Zvacek.

MR. ZVACEK: Thank you very much, and good afternoon. I appreciate the opportunity to be here today.

I'd like to offer just a few basic comments, if I could. I was very happy, as the day has progressed, to see that many of the comments that we had prepared paralleled the discussions that went on during the day. There are some common threads throughout the day that are common to our objectives as well.

As an airline, or the aircraft operator, we're very close to the people that we're all trying to keep safe. And a little bit of framework around our position in this situation, when a question like this comes up, typically, a little bit of review, we, as an operator, participate in the definition of the operational requirements. We work together with everyone in the room to help develop the solutions. We often lead in the implementation of the solution, especially when it's a retrofit installation of a system or a function in our aircraft. And then, our passengers realize the benefit when the solution works.

We've seen today, and it's certainly true, that data that is tracked by today's flight recorder systems is very robust and provides good information when used to support the difficult safety investigations that come before us. We've come a long way since that original five-parameter oral recorder, but it wasn't always easy to get here today. The number of parameters and the data that we have available is accepted and commonplace now, but it came over the years with some difficult modifications and some programs that provided some deadlines and some obstacles for the airlines in a few cases.

Having this much data available now in some ways creates some challenges. We've discussed the perception of how much data we move around and where we might store that data. The question of ownership of the data and where it is stored and how it is moved to a place and position when it's needed is still something that needs a little bit of work.

Now, the technology that is in use today, and coming in our new airplanes, can support even better data availability and tracking than we typically utilize, and certainly, much more than we imagined when the last round of rulemaking was accomplished, as was mentioned earlier today. And the flight following system that's in the United States results in very tight aircraft tracking. We actually have very rapid reaction to any aircraft that has lost communication or is off its intended track.

So if we take the technology and the system that we have in the U.S., with the planned introduction of satellite-based surveillance technology, and integration through future aerospace programs throughout the world, this will give us the opportunity to expand the type of flight following and aircraft tracking that we have here in the U.S. It's likely that we just need to tie a few of our existing systems and functions together and we'll be able to meet the needs of the future. We recognize the IATA level forums and other industry activity that's underway to lay out these guidelines.

An example of taking some of that data and utilizing it in a little different way, as was mentioned earlier as well, flight operations quality assurance programs, and recently, maintenance operations quality programs that are developing. We have flight recorder, and in some cases quick access recorder data, available in our airplanes. And it was reserved, it was held for investigative situations. Now we're taking that data and using it in proactive fashions to help identify ways that we can operate the aircraft more efficiently or, hopefully, more safely.

But overall, we think it's important that our response in this situation addresses the need. Rushing to a new or a separate technology to solve a problem, perhaps a single event, that's not really been understood by a thorough safety investigation might utilize our resources, our limited resources in a way that's not to our best advantage.

I was actually encouraged by the discussions that opened up very early today to talk about the cost/benefit analysis of the situation. It's sometimes a real difficult topic to bring up in this discussion, but it's a real obstacle, a real item that we have to deal with in the operator's world.

We're interested in a solution that can be applied to all of our aircraft in the same or in a very similar method, and certainly one that can be applied internationally. You know, interoperability of our aircraft, most -- many of our aircraft operate in various regions in the world, and interoperability is a very important factor.

An efficient design or efficient solution for this challenge is one that will allow a simple implementation utilizing the capable equipment that we have in place today. That design, through its simplicity, will also allow us to have timely access to the data if we need it in the future.

So, in summary, we acknowledge the capability of the equipment that we have today, we want to make sure that we understand the need, maybe circle back one more time and make sure that we understand the need that we're addressing here, and we look forward to enhancing our aircraft and our systems to meet the needs that we've identified. Thank you very much.

MS. GORMLEY: Thank you, Mr. Zvacek.

Our final panelist will be Tim Shaver of the FAA, who will discuss technical certification of new technology.

Mr. Shaver.

MR. SHAVER: Hi, and good afternoon.

So the role of the FAA is to establish the regulations, policy, and guidance for both the certification and continued airworthiness of flight data and location type systems and technologies.

So, as you all know, the flight recorder systems were originally mandated to provide data for both accident and incident investigation. But that has grown over the years to include systems that have been developed to support a proactive review of data, so things like FOQA, flight data monitoring, aircraft condition monitoring systems, engine monitoring systems. All of those systems have evolved from the basic concept of collecting data, and we've found some very proactive uses for those.

So the mandatory flight recorders used on airplanes today, of course, the digital flight data recorder, we've mandated up to 91 parameters based on many criteria -- aircraft manufacture dates. But there are thousands of other parameters that non-required that are also being recorded in flight data recorders today. We see data rates up to eight-plus samples per second mandated -- some of those are even higher in other systems -- and we've mandated that there's 25 hours of data minimum that is in crash-protected memory.

And along the same lines, with cockpit voice recorders, the crash-protected 2-hour solid-state memory, we have four channels of audio, and it also includes data link.

So some of the other technologies we see -- this is a little different type of mandate. The underwater locator beacons, for example, are required. So, instead of rulemaking, we actually revised the Technical Standard Order to delete the old one. We rescinded the authorization to produce those, and are now producing a 90-day battery. So that goes in effect in 2015, so through attrition, those older type locator beacons or devices will be replaced.

We also have developed the TSO for the low frequency airframe ULD. That TSO will allow manufacturers today to have an FAA-approved production and design of those type of components.

So there are other non-required types of recorder technologies that are being certified and developed. Some of those things like deployable recorders, we worked for years to update our TSOs and worked with EUROCAE and industry to develop the minimum performance standards for those. We've issued TSOs for those and will voluntarily support the evaluation and installation of any of those systems, as it comes along, anybody that wants to install them.

Image recorders have come a long way. In 2005, we did a proof of concept study that the NTSB participated in. We've since developed TSOs and we've worked on other systems where image recorders are actually being used to capture required information for the flight recorder requirement. So we're trying to push that as a non-invasive, lower cost method of collecting mandatory parameters. And, hopefully, we'll see other benefits with that.

So, in summary, enhancing data recorder and location technology is something that we promote. We're working with the international community to develop the performance-based approach. We strongly believe in the performance-based approach for the purpose of locating aircraft wreckage.

And we're also working with the industry to try to minimize the certification burden for systems, and in my case, recorders and location systems, by trying to approach it in a risk-based decision-making process so the level of certitude would also be matched with the level of risk; right sizing the certification requirements, not over burdening the installation of these systems with certification requirements so we minimize those; and developing standard policy and guidance that will promote these system installations. Thank you.

MS. GORMLEY: Thank you, Mr. Shaver.

This concludes the presentations for this panel. We are now ready for questions from our Technical Panel. I will turn things over to Mr. Babcock, the Technical Panel lead for this topic.

Mr. Babcock.

MR. BABCOCK: Thank you. And thank you to our panelists for those informative presentations, and for being here today for this discussion.

I'm going to start with Mr. Shaver, if you don't mind. We heard a lot of talk about some performance-based rulemaking and performance-based approaches this morning. Could you remind everybody what we're talking about when you mention performance-based rulemaking?

MR. SHAVER: Yeah, and a good example you've heard bantered about quite a bit today would be like a 6 nautical mile -- the ability to locate an accident within 6 nautical miles. That's a performance-based requirement. There could be many systems that actually meet that requirement. So when we talk about performance-based approach, that's what we try to capture.

MR. BABCOCK: Having a performance-based approach opens up the playing field, I guess, for applicants to have novel solutions to problems. Does that increase the burden on the FAA to have more robust technical analysis to make sure that while you're meeting the intent of the performance-based rule, you're not -- you're meeting it in a robust way and without unduly impacting other systems?

MR. SHAVER: I don't see a significant impact where -- we do that type of analysis regularly in our certification and operational approach. For example, the use of image recording to capture discretes, you know, that's a novel approach that we have taken. Where traditionally we could look at the flight data recorder output -- if we would have the performance-based -- that same type of analysis, you could make sure that you could capture that within the same rate and accuracy using a completely different system. So, we've done it in the past. I don't think it's a significant burden.

MR. BABCOCK: Thank you.

Mr. Zvacek, you mentioned your flight following process in the U.S., and you're working on increasing that capability to work on a more global basis. Do you have a timeline for that type of implementation, and can you describe the technology that you're using to put that into effect?

MR. ZVACEK: I don't think I have a direct timeline available. Probably the primary candidate for the technology in that area, our ADS-B work, our ADS-B preparation work is underway now. And there is some strong discussion -- it's actually more than that -- some work to put ADS-B transponders and equipment on satellite constellations that are coming in the near future. That is one example of a system that will provide the tracking similar to what we will have over the United States and other areas, other landmass areas in the world in the oceanic areas. That's probably the primary example that's coming in the future.

The ADS-C and general FANS position reporting, satellite communication supported surveillance is an example of some of that early technology that's in place now.

MR. BABCOCK: The data that you're seeing today, whether it be ACARS messages, position reporting domestically, how is that data being stored by American currently?

MR. ZVACEK: The data is stored, for lack of a better term, departmentally. We have certain regulatory requirements for handling of our flight recorder data to ensure its accuracy and functional reliability. That data is handled by the engineering or maintenance groups within the airline. The flight operations quality assurance data is utilized -- is sent and utilized by a department of -- or group of analysts that utilize that data in the flight department.

Typically today, the data is more departmentalized than we hope to have it in the future. A general repository with the expanded availability and perhaps security that will be expected in the future is a future requirement.

MR. BABCOCK: Thank you. And if there is in some point in the future new rulemaking that's requiring position reporting or better location of aircraft, what fleet segment should those possible rules be targeted to? I know you mentioned you want a single solution to apply to all aircraft in your fleet. Does that mean everything from an MD-88 type aircraft to a triple 7?

MR. ZVACEK: I think that's a good question, because we talked earlier today about ELTs, and ELTs over the domestic U.S. As I mentioned, we really should tailor the response to meet the need. And a lot of what we've been talking about are being able to find aircraft or track aircraft when they're in the remote areas of the globe, whether it's over water, or a polar operation, or even some -- there are some large landmasses as well that are considered somewhat remote.

So, implementation, although we'd like a common solution to meet the need, whether it's a transmission solution or access or availability of recorders, it shouldn't necessarily be applied to every airplane. It should be addressed to the need in that region of the world.

MR. BABCOCK: Thank you.

Captain Hogeman, we've heard a lot of discussion throughout the day today about various technologies, some of them currently being implemented, some of them in the near or midterm future. Given that these technologies are in existence or near existence, what is the best way to address some of those concerns that the pilots have possibly that a operations supervisor or a maintenance supervisor can have streaming flight data sent to his phone on a near real-time basis?

CAPT. HOGEMAN: Well, I mean, that's a very good -- that's a good question, and that is an area of concern for us. You know, I think that what needs to run parallel to the advancing technologies that we see is continued discussion on governance on how we're going to manage data and who gets the data. You know, as we heard this morning, we have -- the voluntary safety initiatives that the FAA pointed out, a lot of that is built on confidence. And confidence, you know, of certainly the pilots that are flying the airplanes, and that the data that their airplanes are reporting is protected.

And I just think there needs to be a continuing dialogue on how we protect that information from being used. You know, part of our concern is with all the technology, data is starting -- you could see where data would actually pile up. And, you know, we ought to be looking beyond that to how that data is translated into actionable information so that we can eventually hopefully achieve some wisdom.

And so, I think there needs to a continuing discussion on, number one, what's the data being used for? Is it truly being used for safety purposes? And, you know, what happens when it comes in front door and where does it go and who has it?

MR. BABCOCK: I don't mean this to be a loaded question, but do you feel right now that that dialogue is currently taking place?

CAPT. HOGEMAN: Yeah, you know, I think there are examples where it's been very positive. Certainly from my membership's standpoint, I think we've seen some very, very positive things through the Commercial Air Safety Team that you heard about this morning. Information sharing -- and, you know, it's information sharing and not just data sharing. It's information sharing that I think is the key point.

And, you know, there are opportunities. There are some -- certainly opportunities here in the U.S. from a voluntary standpoint where I think it's been successful, and I think it continues to be successful. But it's fragile, and misuse of data for commercial purposes, for competitive purposes, or disciplinary purposes can be damaging. And I think we all have to work together to protect that.

MR. BABCOCK: Thank you.

And then, this question I guess is for Captain Hogeman and for Mr. Zvacek. The data that we talk about when we're talking about traditional FOQA-type programs can come from usually an FDR or a QAR system. Does data reported from an aircraft, whether that be enhanced ACARS or ADS-B or any other type of data from some of these technologies that we heard about earlier, should that be part of a traditional FOQA program or stand separate from that?

CAPT. HOGEMAN: Well, I think it can, and I believe it should. But as we just mentioned, the data needs to be handled properly. Your question earlier, how do we handle the flight recorder data? We've developed fairly strict guidelines, and I discussed earlier the focused departments for the separate types of data or the different situations that we utilize data, that's developed to in some ways limit the access or limit the handling of the data so we maintain that trust. And it is that, a level of trust within the company, within the different individuals in the company, and the departments in the company.

So the data that we're talking about transmitting over ACARS, or perhaps ADS-B data, is very similar or the same to the data that's available through the recorder systems, so it seems to fit well.

MR. ZVACEK: Yeah, you know, as we move into NextGen technologies and we look at the prominence of ACARS and data link data, I think that's as fair area to examine in collecting that. But I think you have to look at it for the full regime of flight. And it's very easy to take ACARS messaging and data out of context unless you have the benefit of seeing it from start to finish.

MR. BABCOCK: Thank you.

My next question is for Mr. Shaver. You mentioned a couple different avenues based on required equipment or optional equipment. Can you talk about the level of FAA review? For example, if an operator is trying to put a non-required piece or equipment versus a piece of equipment that's intended to meet a rule of the FAA?

MR. SHAVER: Yeah, there's several systems that provide safety enhancements that are not required. So, the level of review can be, I guess, delegated more to the manufacturer, and based on the risk too. So the system that comes to mind immediately is like AOA systems on private aircraft now.

You know, we have had a big push in development for a safety-enhancing piece of equipment, and lowered the level of certitude based on the risk that it's going to have. So for other systems we're looking at right now for flight data monitoring installations, we're just getting ready to do a test in the tech center in Atlantic City for those type of systems. So our goal there is to hopefully provide an Advisory Circular that will help define the type of equipment that needs to be installed, where it needs to installed, and how that can be used. And then, back it off to the minimum level of certification where maybe an inspector can review the data and then actually do the approval.

On the flip side of that, when it's a required piece of equipment, there is certification that has to happen at the product level and at the component level, and various other regulatory steps that it needs to go through. So it can be quite a significant difference when we can minimize the amount of certification that is required for installation of those systems.

MR. BABCOCK: Thank you.

I'm going to turn it over to Ms. Gormley. She has a couple questions.

MS. GORMLEY: Captain Hogeman, you mentioned in your presentation about stale data and that sometimes using the wealth of information could compromise the sanctity of an investigation.

Coming from an investigator standpoint, you know, having more data usually is better. Even if it doesn't help, it doesn't usually harm. So I'm interested if you could expand on that statement.

CAPT. HOGEMAN: Yeah, my remarks were pointed to the wealth of information that's not only available to us in the safety world, and certainly to the NTSB or other investigative agencies, but the wealth of information that is available to the media and the general public.

And, you know, literally it's possible to pull up flight track data from a commercial provider, and to the untrained eye make some very, very astounding conclusions that can put pressure on the investigation board to have to respond to or react to that, when that information formally was provided through a thorough investigation, a sound investigation process, and that information was disclosed after it was properly vetted.

And my concern is with the information and data explosion that we see through the advancements in technology, we don't want to lose track that the investigation boards have the role and the responsibility. And, yes, it is important for the investigation board to have as much data as they want.

MS. GORMLEY: So I think that goes back to the second part of your statement in terms of what's more important is the analysis of the data versus just the data itself?

CAPT. HOGEMAN: Absolutely. And, you know, we've listened to some very, very impressive presentations here. But where I think it would be very interesting to move from this point forward is what's the technology of parsing data, of cataloguing data? And what is that -- how we can use technology to improve the information, the lessons learned, from certainly an investigation and the data we receive?

Like I said, we have a lot of data coming in the front door, but what are we doing with it after it comes in the front door?

MS. GORMLEY: And going forward on that theme of lessons learned, Mr. Zvacek, you talked about the need to assess the information for having to need it, et cetera. But I assume with all the data that's out there that the operator will find a use for the data in terms of efficiency or maintenance. So there are programs such as gatelink or ACARS where you will explore those technologies of gathering the data, protecting it, having internal controls.

Is there information sharing and lessons learned among the operators to discuss the best way to do that, so as to not reinvent the wheel in terms -- we are going to assess it, but we have to go forward in terms of coming up with some of those standards?

MR. ZVACEK: I think we have the beginnings of that. At American Airlines we're very close to introducing the 787 aircraft. The 787 is a generational step in the amount of data that's available coming from an aircraft. We've had to do quite a bit of work with our IT folks to prepare our ground systems to handle that data, and utilize it properly and move it to the departments that can use it.

This is also driving a pretty big culture change within our company. Our maintenance department are folks -- most of the folks there are a little more used to turning wrenches and going out and moving parts on airplanes. The availability of all this data -- we learned some from earlier types of aircraft, and as was mentioned earlier, health monitoring systems and data that's available. But with the aircraft, the next generation of aircraft that are coming, both the 787 and the A350, we're going to have a lot more data to utilize. And we're going to have to parse it properly into plain English information that we can use, and then store it and secure it properly.

And the industry activity that I've seen in that area -- AEEC is doing a little bit of work on -- well, they've done a fair amount of work on the security of data, and they're doing some work on handling the logs that come out, the event logs that come out of the airplanes. And so, I think we're seeing the beginnings of some work between the airlines, but there's more to do.

MR. BABCOCK: Ms. McComb, I believe, has a couple questions.

MS. McCOMB: This question is for Captain Hogeman. In terms of ALPA's perspective on implementing new technology, are there any particular concerns when you look at this potential implementation of all these new technologies, looking at domestic fleets versus international fleets?

CAPT. HOGEMAN: No, I think our approach towards, you know, domestic or international with a priority -- you know, I think our concerns are about the protection, and getting the data that really speaks to safety and identifying what it is, number one, we don't have right now; what do we need and what could we get? And, you know, defining the problem and then trying to identify solutions.

And, you know, it's been said here earlier today -- I mean, you know, technology, if we're not careful, is moving so far ahead that we have the technology looking for a -- you know, looking for a problem to solve. And I think, you know, at times I think we need to sit down through industry venues and identify just what is it that we need, what is missing, and moving on that. And looking at a variety of possible solutions, rather than be beholden to necessarily one type of technology.

MS. McCOMB: And just a little bit of a follow-up, we've often heard that -- from the pilot community's perspective, concerns about protection, particularly in international arenas.

Can you go a little bit -- can you talk a little bit about ALPA's perspective in terms of data protection or information protection as it relates to some of the technologies that we've heard about today?

CAPT. HOGEMAN: Well, you know, the more you collect the more the -- the more data that you collect or are able to collect, the more the risk that the data won't be used, unless you've identified specifically what you need that data for. And, you know, the flavor internationally certainly would probably vary from country to country. But, you know, again, it is defining what it is that we don't have, and then, you know, discussing what kind of technological solutions there are to solve that.

MS. McCOMB: Thank you.

MR. BABCOCK: Mr. Cash.

MR. CASH: Mr. Shaver, I hope you can answer this. With the new air traffic systems that are coming on board, NextGen basically, and ADS-B and C, how -- is that getting us a long way towards what we want as far as, you know, oceanic tracking? And can you speak to that at all?

MR. SHAVER: As for oceanic tracking, unfortunately --

MR. CASH: Well, or remote area tracking and wreckage location?

MR. SHAVER: The coverage of ADS-B right now is fairly limited because it's based on ground station implementation. However, as mentioned --

MR. CASH: But that's changing, though?

MR. SHAVER: Yeah, however, they are looking at other systems that could, you know, provide satellite-based collection of that, and Canada has gone a long way into that. So I think eventually ADS-B could be used for that and would help a lot in that venue, but right now it's fairly limited into those areas where we have the ground stations.

MR. CASH: But the plan is to go towards, you know, long-range tracking and air traffic control system, right?

MR. SHAVER: For ADS-B, as far as I know it's -- the implementation is more to ground-based control. That's the sites right now in the U.S., so --

MR. CASH: And the other question is, Mr. Zvacek, in your remarks I heard you say that you thought that a single solution for an entire airline would be preferable? Is that really what you meant to say, or do you really want narrow bodies and wide bodies having the same equipage and --

MR. ZVACEK: No, it's not exactly the same. I was hoping for one technology instead of a type of equipment that we would use in one type of aircraft and a different -- a whole other technology that we would use in a different area. I'd hoped to stay within the same family of technology, and then we can scale that to the need and the type of aircraft then, based again on the operation -- the mission of the aircraft and the region of the world.

So, it was meant more that -- the aircraft wouldn't be exactly the same, although that would be nice. But typically when you compromise that way, you get a system that doesn't fit exactly anywhere. So it was more aimed at I'd like to stay with a technology and scale that, as needed.

MR. CASH: Okay. Thank you.

MR. BABCOCK: Acting Chairman Hart that concludes the questions from the Technical Panel.

ACTING CHAIRMAN HART: Thank you, Mr. Babcock. And thank you to all of our panelists for very informative presentations and answers to our questions. I appreciate that. And I'll take questions from the dais.

Mr. Delisi.

MR. DELISI: Thank you.

Captain Hogeman, there are very high levels of protection in place for the data collected in an accident investigation from the flight data recorder and, in particular, from the cockpit voice recorder. But there's one source of data that we don't have yet, which is video in the cockpit.

What's ALPA's position on the installation of video recorders?

CAPT. HOGEMAN: John, I'm glad you asked that question. You know, as we move forward and looking for what's missing, you know, we're not -- I'm not convinced, and ALPA's not convinced that video imaging is necessarily going to give you that increase of information. There's stuff that you won't see from video that you will see from a cockpit voice recorder and a flight data recorder. And, quite honestly, again, we come back to the security of that and the protections.

And so, ALPA at this point is, you know, is opposed to video at this point until we can be assured that there's going to be the appropriate level of security, and that there is, you know, reason, there is absolutely irrefutable reason that that will improve an investigation.

MR. DELISI: Thanks.

Mr. Zvacek, I just want to be sure I have the mental image correct now about how data is delivered to American Airlines. If there were to be an accident, we're very familiar with going to the accident site, pulling the flight data recorder, reading it out in our lab. If an airplane was involved in an accident, but still landed and taxied to the gate, on American Airlines' fleet now, is that flight operational data automatically transmitted off the airplane?

MR. ZVACEK: We do have some types of aircraft that have quick access recorders that utilize a cellular form of data transmission, and it is an automatic transmission of that data. So, that would -- depending on the situation that could continue in that automatic nature. The quick access recorder data is very similar, in some cases the same data, or partially the same set of parameters that is recorded as flight recorder data.

MR. DELISI: It certainly is fascinating how even when we have a flight data recorder there are occasions where the quick access recorder data provides a slightly different sample or a few different parameters or samples taken at a slightly different time, and sometimes it really does help and supplement that. But it now seems like that data -- in the past, we could control that by going to an accident scene or getting to an accident airplane and only under certain circumstances advancing the investigation by collecting that data. But now it seems like that data, that flight operational data may have already left the airplane without any human intervention.

MR. ZVACEK: Technically, it is possible. Now, that data within our company is still in a controlled environment. So it's not something that would be widely available within the company or -- excuse me -- yeah, within the company or outside the company, certainly.

MR. DELISI: Good. Thank you.

Final question, Mr. Shaver, you talked about the FAA developing TSOs, Technical Standard Orders. And I was wondering a little bit about that process. Is it really that the FAA sits down and thinks about what the requirements for a new piece of equipment ought to be, or is it more that the industry gets together and decides what's possible and the FAA memorializes that with a technical standard?

MR. SHAVER: Yeah, I guess it's better described as the latter. It typically is an industry organization that would get together and develop the technical standards, the minimum operational performance standards of the system, and then they would produce -- right now, we usually use EASA, RCTA, or EUROCAE as one of those bodies. And then, we would use that as the basis for the Technical Standard Order, with some other requirements.

MR. DELISI: Very good. Thank you.

ACTING CHAIRMAN HART: Thank you, Mr. Delisi.

Dr. Kolly.

DR. KOLLY: Thank you.

Sean, could you pull up the last slide of Mr. Shaver's presentation please?

Mr. Shaver, a question on your summary slide. The last bullet is very interesting to me. I'm not sure I understood from your presentation -- I'm not sure I got a full picture of what you meant by minimizing the certification burden for recorders and locating systems, and then with these particular aspects. Could you maybe just kind of walk through that again?

MR. SHAVER: Sure. And I guess it comes back down to the certification, as we've talked about earlier, for required and non-required systems.

So when a system is typically installed, there is a level of burden to ensure that that system performs its intended function, especially for required equipment. When we have non-required safety enhancing equipment, there can be some, I guess, lessening of that burden by the manufacturer of that equipment making a statement or a determination that the system meets the requirements. There's not a level of FAA involvement.

So for certain systems on certain airplanes, we may be able to take it that we've established the necessary technical requirements, and then let the manufacturer determine that they've met those requirements. And then, also that gets to the point of when it's actually being installed on the airplane.

When it's non-required equipment, the aircraft installation -- actually, we look at things to make sure basically it's not a danger to the airplane: so it's not going to catch fire, it's secured, it provides the, you know, the necessary electrical protections, that kind of requirements. And those are basic known requirements that are easy to, you know, evaluate and certify.

So when you have -- like a traditional flight recorder system today takes a higher level of certitude that you have to go in and validate that all of those parameters are correctly -- you know, the system's going to operate -- especially for the crashworthiness aspects of a traditional recorder. If we could lessen those and have the manufacturer make a statement of finding that they've met those, and we see a -- what is it, TSO-199, it's a lesser, you know, degree of crash protection required.

But those, in essence, reduce the cost of the certification, which hopefully will help incentivized its use across a broader range of operators. Does that help answer your question at all?

DR. KOLLY: Yes, it does. Thank you.

ACTING CHAIRMAN HART: Thank you, Dr. Kolly.

Does the Tech Panel have any further questions?

MS. GORMLEY: I just have one question.

Mr. Shaver, you just mentioned about when you're looking at certification particularly of non-mandatory equipment that you make sure that there's no danger in terms of fire or unintended consequences. I think we'd all agree from what we've heard today, and in general, that there's an explosive growth of technology and different novel, innovative concepts.

How does the FAA ensure that they have an appropriate level of expertise, I guess you would say, or how do they get spooled up on some of this technology and ensure -- or do they have enough resources to deal with all this, you know, various technology that's coming in to be evaluated? Or is that something where there's going to be a delay in terms of evaluating that?

MR. SHAVER: I guess it depends on if it's new technology, brand new technology, of course, there's a higher level of review and coming up to speed. But if it's repurposing existing technology, if we're just doing a software change to an ACARS system to where it would allow that to be triggered and transmit information -- you know, so it just depends on the level of newness of the technology.

So part of the right sizing risk too is to look at those things and try to determine what areas the FAA needs to be involved in and what areas we need to review. And then, put the burden back onto -- you know, certification and insurance, back onto the installer and the system manufacturer. So those things that are lower risk, we can depend on them to step up, and then only review the higher risk items.

MS. GORMLEY: Thank you. That's all.

ACTING CHAIRMAN HART: Thank you. That brings us to the end of a fascinating and informative day, and I appreciate all the work that everybody's put into that.

For starters, I'd like to thank Dr. Kolly and Mr. Delisi for joining me here on the dais for our presentation. I would like to certainly thank Erin Gormley and her team for setting up such a great program and for making it run smoothly and productively. And then, last but not least, of course I want to thank all of our panelists who took time out of their busy day to come and help us address a pressing issue that worldwide we're going to have to address.

Manufacturers of airframe, avionics, and new technologies, as well as representatives from operator and pilot groups have brought their perspectives and enriched our knowledge of these emerging technologies. Representatives from the FAA and the European Aviation Safety Agency, as well as from ICAO, have aired some the challenges of finding the right balance in making these changes.

It's been an illuminating day, especially from a systems perspective. Some of the technologies we examined today build on existing avionics in civil aviation and others are on completely new platforms. Regardless of the platform, industry and regulators must work collaboratively to enable solutions that provide more efficient data recovery without compromising safety. That takes thoughtful and thorough consideration. Today's presentations also shed light on some of the complexities that are introduced by these technologies that are not immediately obvious, sometimes even to the experts.

As we know from investigations, accidents result from a series of failures. In bringing together perspectives from throughout aviation and aviation safety it's been our goal to broadly address some of the many interactions that are necessary to modify a highly successful commercial aviation system. The introduction of new technologies must not introduce new and unintended consequences.

More efficient recovery of data will mean quickly identifying that an event has taken place, determining the location of the accident and retrieving the data to help determine the sequence of events that led to the accident. In our age of nonstop data, it's easy to envision a future where we maximize use of all available assets, but it is not a simple process to get there.

More than 75 years ago, on July 2nd, 1927, a twin engine

Lockheed Electra was due to land at Howland Island in the Pacific. The pilot was in communication with the Coast Guard Cutter *Itasca* via radio, but according to the *Itasca*'s crew the pilot apparently could not hear their replies. At 8:43 that morning the pilot, of course that's Amelia Earhart, sent her final transmission. The captain of the *Itasca* commenced the first of many searches, but as is so well known that airplane has never been found.

This summer Amelia Rose Earhart symbolically completed her namesake's journey around the world. Along the way ordinary citizens like you and me could track the progress of her flight online real time.

While there are many challenges and complexities to broadly implementing technologies such as those discussed today, lost aircraft, and with them lost data, properly belong in the last century. In this century, the continuation of the safety journey will depend on a great deal of hard work by those we heard from today and many others to ensure more effective data retrieval. We hope that the information we heard today will help the aviation community achieve that very important goal.

Thank you, and we stand adjourned.

(Whereupon, at 4:22 p.m., the forum in the above-entitled matter was adjourned.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF: FORUM: EMERGING FLIGHT FLIGHT DATA AND LOCATOR TECHNOLOGY

PLACE: Washington, D.C.

DATE: October 7, 2014

was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording accomplished at the hearing.

Timothy Atkinson
Official Reporter

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

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In the matter of: *
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FORUM: EMERGING FLIGHT DATA *
AND LOCATOR TECHNOLOGY *
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NTSB Board Room and Conference Center
429 L'Enfant Plaza SW
Washington, D.C. 20024

Tuesday,
October 7, 2014

The above-entitled matter came on for hearing, pursuant to Notice, at 8:00 a.m.

BEFORE: THE NATIONAL TRANSPORTATION SAFETY BOARD

APPEARANCES:

CHRISTOPHER A. HART, Acting Chairman
JOSEPH M. KOLLY, Ph.D., Office of Research and Engineering
JOHN DELISI, Office of Aviation Safety

NTSB Technical Panel

SARAH McCOMB, Office of Research and Engineering
JAMES R. CASH, Office of Research and Engineering
THOMAS R. JACKY, Office of Aviation Safety
ERIN GORMLEY, Office of Research and Engineering
CHRISTOPHER BABCOCK, Office of Research and Engineering

Panel 1: Regulatory Overview

MARGARET GILLIGAN, Federal Aviation Administration (FAA)
THOMAS MICKLER, European Aviation Safety Agency (EASA)
MARCUS COSTA, International Civil Aviation Organization (ICAO)

Panel 2: Airframe, On-Board System, and Service Provider Viewpoint

PASCAL ANDREI, Ph.D., Airbus
MARK SMITH, Boeing Commercial Airplane Company
CHRIS BENICH, Honeywell
STEVE KONG, Inmarsat

Panel 3: Technology Solutions

PHILIPPE PLANTIN de HUGUES, Ph.D., Bureau d'Enquetes et d'Analyses (BEA)
RIC SASSE, Naval Sea Systems Command
THOMAS SCHMUTZ, L3 Communications Corporation
BLAKE VAN DEN HEUVEL, DRS Technologies Canada Ltd.
RICHARD HAYDEN, FLYHT Aerospace Solutions Ltd.

Panel 4: Future Path

CAPT. CHARLES HOGEMAN, Airline Pilots Association (ALPA)
DENNIS ZVACEK, American Airlines
TIMOTHY SHAVER, FAA

I N D E X

I N D E X (Cont.)

I N D E X (Cont.)

P R O C E E D I N G S

(8:31 a.m.)

ACTING CHAIRMAN HART: I would like to call this forum to order. Good morning. Welcome to the Board Room of the National Transportation Safety Board and to this forum on Emerging Flight Data and Locator Technology. My thanks to all the panelists who will provide their perspectives and expertise.

I am Christopher Hart, and it is my privilege to serve as Acting Chairman of the NTSB. Today I will be joined on the dais by Dr. Joseph Kolly, Director of our Office of Research and Engineering, and Mr. John Delisi, Director of our Office of Aviation Safety.

The NTSB depends on flight data recorders and cockpit voice recorders to help determine the causes of accidents and incidents in aviation. Because of their value in investigations, rapid location and recovery of these recorders and access to the vital information they contain are among our highest priorities. Flight data recorders were first created specifically to capture information after a crash and were designed to survive the catastrophic conditions that a crash can entail. Their introduction has been a boon to aviation safety.

In many cases, recorders are the most significant source of useful information about an accident, and in some cases they are the only source. As accident investigations exposed additional data needs, and as the technology to meet these needs became more integral to aircraft, flight data recorders evolved. Now, recorders capture many more parameters. Flight data are accessible in ways other than storage on mandatory flight recorders and are increasingly being used by operators and manufacturers, as well as by accident investigators, for prevention and not just for investigation.

Time and again, recorders have ensured the survival of accident data under the harshest of circumstances. Time and again they have yielded useful data despite the traumatic forces of accident sequences, and despite subsequent immersion in water or being engulfed in fire. The required underwater locator beacons designed to guide searchers to submerged recorders are evolving as well.

The data that recorders preserve have shed light on accident circumstances helping to guide safety improvements. Through these improvements, they have undoubtedly saved many lives, perhaps yours and perhaps mine. The data yielded by traditional recorders have been the signposts along the path of our decades long aviation safety journey. They have guided us to our present era of unprecedented aviation safety. But at the same time, progress has surged forward elsewhere in aviation.

Increased engine and system reliability allow today's aircraft to fly farther from a suitable landing point than ever before. Satellite tracking makes it possible to monitor aircraft even in the most remote parts of the globe. These advances have changed the way we fly. We routinely fly over the poles to get to a destination more efficiently. Our flights span wide ocean expanses instead of hugging the coastlines. When an accident does happen, it may be in one of these remote locations. It takes longer to respond and it's more difficult to get the appropriate resources to the search area.

The NTSB called this forum today to reexamine traditional requirements in light of today's and tomorrow's realities. One such reality has become glaringly apparent. At present, for the data to be recovered the recorders must be recovered. This means that searchers must locate the aircraft wreckage and retrieve the recorders. In recent years, there have been a few exhaustive, expensive, and well-publicized searches for missing aircraft and their recorders.

Such events have raised serious concerns with the NTSB and in other safety organizations here and abroad. These concerns are far from academic. Without the data, the lessons from the accident may forever remain unknown because the circumstances of the accident may remain forever unknown. We have all seen the human face of such uncertainty, the uniquely agonizing human toll for those whose loved ones were aboard such flights. To those have endured such uncertainty, we offer our deepest sympathy.

It is our hope that the work we do here today can help to prevent such uncertainty, while providing investigators the data that they need. The wider effect of such tragic events is the loss of confidence that they engender among the flying public. In our age of seemingly unlimited information, we can sit at our computers and call up aerial or street level views of our homes. Our cars know precisely where they are on a GPS grid. There are apps for our smartphones that can show us where our friends and family members are.

Against this backdrop of ubiquitous information flow, when a flight cannot be located, an incredulous public asks, how can they possibly lose an entire airplane? But the application of new technology in aviation is itself a complex and consequential process. Introducing new technology on an aircraft that carries 300 people, or into a navigation system that has to track thousands of aircraft, requires forethought and caution.

The costs, downtime, maintenance, and training have to be accounted for in the aviation industry. Regulators must harmonize their efforts across the global aviation sphere. Above all, it is of paramount importance to avoid unintended consequences that may compromise safety. A quick fix based on a hasty conclusion could result in lesser safety benefits. And worse, such a quick fix could introduce hazards of its own.

In recent years, significant advances have been made that can aid in the location of aircraft wreckage and help collect, transfer, and distribute recorded data. These innovations can be packaged and integrated in many ways. But to have confidence in the benefits of any products or technologies, we need to fully understand how they work, what they offer, how the users feel, and how current standards and regulations will impact their implementation.

Throughout this forum we will discuss the more efficient recovery of flight data. We will examine ways to more quickly locate and retrieve traditional recorders. We will explore recorders that deploy from the aircraft. We will learn about means of transmitting data wirelessly in the case of an abnormal event. Some of these technologies are already being used by commercial or military operators. They make life easier. Operators can know whether their flight is on time, proactively detect problems, and have a replacement part waiting when an airplane arrives.

But to broadly implement such solutions, we have to ask the right questions. How does each of these technologies work? How might they be configured to work together and to work with existing systems in aviation? What are the regulatory implications of implementing these technologies? Who owns the data? What are its proper uses? And what privacy issues arise?

We will hear from aircraft manufacturers, manufacturers of avionic systems, manufacturers offering new means of data retrieval, regulators, operators, and pilots. We welcome all of their points of view because like an individual airplane, aviation itself is a complex system.

The many solutions that we have been working toward must be successfully integrated into this complex system for the parts to work together as a whole. To do less would be to jeopardize the progress we have made on the aviation safety journey arrived at through decades of industry-wide collaboration, regulatory guidance, and painstaking investigative work. There is a future in which we know the fate of every accident flight. Today, we hope to take one more step toward that future.

Now I will turn to Dr. Joseph Kolly who, along with his staff and staff from the Office of Aviation Safety, has done an outstanding job in organizing this form.

Dr. Kolly.

DR. KOLLY: Thank you, Acting Chairman Hart.

Today's forum has been designed to get at the heart of several questions relevant to more efficient, timely, and certain recovery of flight data. Each panel will open with presentations by the panelists. The presentations will be followed by a round of questions from the Technical Panel, then questions from the dais. We have selected topics and panelists to address the range of issues concerning emerging flight data and locator technology.

We recognize that all stakeholders may not be represented in person at this forum. Organizations and individuals who wish to submit written comments for inclusion in the forum's archived materials may do so until October 21st. Submissions should be directly addressed to one or more of the forum topic areas, and should be submitted electronically as an attached document to recorderforum@ntsb.gov.

At the conclusion of each panel there will be a break, in addition to our midday lunch break.

Our first panel will be on Regulatory Overview. This session will review the organizational framework and structure of the U.S. and international regulatory and standards bodies. The processes involved in developing and implementing recommendations, regulations, standards, and practices will be reviewed. Panelists will discuss current rules, upcoming changes, and ongoing activities in the areas of flight recorders and aircraft position reporting. The first panel will be followed by a morning break.

Our second panel will be on Airframe, On-Board System, and Service Provider Viewpoint. We will hear panelists' perspectives on technology solutions to provide for a more timely location and recovery of flight data following an accident. We will then break for lunch after our second panel.

When we reconvene after lunch, the third panel will be on Technology Solutions. Panelists will discuss specific technical solutions to allow for more efficient recovery of flight data. They will explore the technical details of wreckage location, recorder recovery, and an overview of three specific recorder technologies. The third panel will be followed by our afternoon break.

After the break, we will return to our fourth and final panel, the Future Path. This panel will address some of the obstacles that need to be overcome to implement new and emerging technology that would allow for a more timely and efficient recovery of flight data. Discussions will include difficulties in technical certification, and management and labor perspectives on data use, storage, and protection.

I'll now turn to Erin Gormley, an aerospace engineer in the Office of Research and Engineering, who is serving as the Forum Manager. Erin will provide some important auditorium safety information, attend to some housekeeping, and then introduce our first panel.

Ms. Gormley.

MS. GORMLEY: Thank you, Dr. Kolly.

For safety purposes, please note the nearest emergency exit. You can use the rear doors that you came through to enter the conference center. There is also a set of emergency doors on either side of the stage up front.

We will keep to the posted schedule, so the agenda you picked up on your way in can be your guide. It is also listed on the website. Because we have a full agenda, we appreciate your cooperation in helping keep us on schedule and ask that panelists respect the time limits. Discussion should keep focused on the subject at hand rather than slip into topics covered by other panels.

As Dr. Kolly mentioned, after the second panel we will encourage you to get lunch. There are a variety of places to dine upstairs in L'Enfant Plaza. Take the escalator, and there will be some restaurant choices. For more options, continue to walk past these restaurants, the post office, some shops, and you'll find a food court.

If you've not already done so, please silence your electronic devices at this time.

Later this week, presentations provided by our speakers will be available on our website. Also, a video archive of the webcast will be available next week and be accessed through the web page, the same page where you may view the live webcast.

Before we begin I would like to introduce our Technical Panel. From my left to right are: Ms. Sarah McComb, Chief, Vehicle Recorder Division, Office of Research and Engineering; Mr. James Cash, Chief Technical Advisor, Office of Research and Engineering; Mr. Tom Jacky, Aerospace Engineer, Office of Aviation Safety; myself, Erin Gormley, Aerospace Engineer, Office of Research and Engineering; and Mr. Chris Babcock, Aerospace Engineer, Office of Research and Engineering.

Mr. Sean Payne seated behind us is a Mechanical Engineer with the Office of Research and Engineering, and he will be operating the audiovisual equipment this morning.

We are now ready to hear from our first panel of the day, Regulatory Overview. For our presenters, please push the button the microphone. A green light indicates the microphone is on. Bring the microphone close to speak, and when you are done speaking please use the button to turn it back off again.

Our first panel will discuss the organizational framework and structure of the U.S. and international regulatory and standards bodies. Our panelists are: Margaret Gilligan, Associate Administrator for Aviation Safety, Federal Aviation Administration, or FAA; Thomas Mickler, European Aviation Safety Agency representative, or EASA; and Marcus Costa, Chief, Accident Investigation Section, International Civil Aviation Organization, or ICAO.

Ms. Gilligan.

MS. GILLIGAN: Thank you, Ms. Gormley. And I want to thank the Chairman and the Board for calling this forum together to shed some light on this very important issue.

But we also want to underscore that what we are doing is building on the tremendous safety record that we already enjoy in aviation. We got to this safety record by constantly looking for ways to advance the science and technology of flight.

The technology that brings us here today, flight data collection, actually was spawned by a series of accidents that began back in the '40s, more than 75 years ago. And since that time we've made huge strides thanks in large part to the number of recommendations we've received from the NTSB that constantly pushed both FAA and the industry to continue to work to improve on what we recorded and how we protected it.

But as you move forward today, I ask that you keep in mind that this is just one of many safety issues that we in the industry are facing, and that we must always look for the right balance of where and how we invest our safety dollars.

I've been asked to talk about the rulemaking processes and challenges. So the first question is, why do we do rulemaking? We use rulemaking to set the safety standards that every person and every product that's introduced into the aviation system will be required to meet. We get input into the rulemaking process from many sources. The U.S. Congress has oftentimes directed us to consider certain topics for rulemaking. As I've mentioned, many of the recommendations that we receive from the National Transportation Safety Board also recommend that we enhance our safety standards.

Because this is a constantly evolving industry, we're always looking at new technologies and new business models to make sure that our safety standards are keeping up and assuring the appropriate level of safety as those changes are introduced. Internal to the FAA, we produce many safety analyses that also give us a basis for changing our standards. And as the Chairman mentioned, we work very hard to harmonize our safety standards with our partners around the world so that we can assure a consistent of set of safety or standard of safety for all who travel by air.

The process that we go through is intended to be a very deliberative process. It is governed by the Administrative

Procedure Act, which sets out the requirements that all government agencies must meet as they set standards. So this is not unique to aviation safety.

The process requires that the Agency first consider what it is we want to propose, and we look not just at the safety impacts, but at the operational or efficiency impacts. We want to consider improvements for the environment for this industry, and we must consider the economics.

Once we make our proposal, the statute requires that there be a comment period that allows all interested parties to comment on what we have proposed because it would not be appropriate for the federal government to impose requirements on a citizen, whether an individual or a corporation, without allowing some input and insights from those who will be affected.

After the comment period, we must consider those comments and issue our final determination. And in that final determination we must address those comments that we've accepted, where we've made changes, and those comments that we have not accepted and why those have not influenced the outcome.

That, as I said, is a process that is intended to be deliberative. So, let's look now at how that process has affected recorder history.

As you see on this timeline, we have made tremendous strides in what is recorded and how well it is protected. Starting back in the 1950s, we had very rudimentary requirements based on what it was technology permitted. Over the years, we've been able to constantly improve both what is recorded, how it's recorded, how it's protected, and how much information can be stored.

All of these improvements have resulted in the outstanding safety analyses that the NTSB has been able to provide after accidents, which has resulted in improvements to overall aviation safety, resulting in the reduction in accidents that we've seen over the last 20 years. Let me highlight some significant changes that have been made since the mid-1990s.

The revision that we issued in 1997 was perhaps the most fundamental revision up to that time. And again, much of it was driven by what the technology permitted. We were able to substantially increase the number of parameters that were recorded on flight data recorders, thus improving the amount of analysis that could be done after the accident occurred. That rule was responsive was three very significant NTSB recommendations.

Once that rule had been in place for a while, in 2003, we determined that there were some improvements and corrections that needed to be made. And so, we made some adjustments to make the requirement more effective and to also allow for some leeway as to what older aircraft had to be able to record, so as to accommodate those aircraft.

2008 was the second most significant revision. And again, it was very much driven by what technology could permit.

As you see, we increased the recording duration, we increased the parameters, we required physical separation. Probably most importantly, we increased the reliability of the power supply, which assured that the systems collected the most data for the longest period of time. This addressed five significant NTSB recommendations. We had a sort of partner rule with that at the same time that made some particular revisions for particular aircraft types of types of operations, which covered two of the NTSB recommendations.

And then, in 2010, we made the last most recent change, which prohibited filtering of data, which was something that we learned from an accident investigation and was, again, in response to three NTSB recommendations.

Now, just to be clear, I need to make the point that while we have addressed many of the NTSB recommendations, we have not satisfied all of the NTSB recommendations on flight data recorders. There have been over 50 flight data recorder recommendations. In some cases, we did not move as quickly as the Board would have liked. And so, although we actually met the intent of the recommendation, the Board found it unacceptable because it had taken us too long a period of time.

There are several recommendations where although we met the intent of the recommendation, we did not include all of the operating environments that the Board would have recommended. And so, that was found not to be completely satisfactory. And we have not required video imaging recording, as the Board has recommended on several occasions.

As we look at how the FAA requirements link to the international requirements, we see that FAA's requirements are very consistent with what ICAO has set as standards. In fact, in many cases the FAA, working with EASA and its predecessor JAA, drove the requirements that were set for the international standards. So we are fully harmonized with our partners in EASA, and we are consistent with the ICAO standards.

There is a new ICAO standard that will come into effect in January 2016. We have not yet determined whether and how we will meet that requirement. And if we do not have the requirement in place by that date, we will file a difference.

There are some differences in the applicability in the way we define which operators have to meet certain standards and how ICAO defines them. We set our requirements based on aircraft seating, engines, and the type of operation, whereas ICAO standards are based on aircraft weight and engines. But with that slight exception, we are fully harmonized.

I think as important as what we have required by standard is what it is we've enabled that have allowed for improved safety. And as the Chairman referred to, there are a number of technologies available now which help support collection of data. And we have -- and you'll hear much more detail about this in later presentations, but FAA has put out either technical standard orders or other kinds of approvals to allow for various kinds of additional ways of collecting data that are voluntarily adopted by many operators.

And finally, we think that the most important use of data is not ideally after the accident, but more ideally before any accident occurs. And as the Chairman is well aware, we have with our industry quite a bit of work underway to voluntarily collect information, to analyze that in advance of any kind of catastrophic failure, and identify safety enhancements.

These programs, which are partnerships between government and industry, have been very successful in reducing the accident rate or contributing to the reduction of the accident rate over the last 20 years. And we see a tremendous benefit in enhancing and increasing the amount of voluntary information that can be collected so that we can better anticipate and address safety risk before we are faced with a catastrophic failure.

So, again, I want to congratulate the Board for calling this forum, and we look forward to what all of us can learn both about specific technologies as well as the processes for taking advantage of those as you complete the forum today. Thank you.

MS. GORMLEY: Thank you, Ms. Gilligan.

Our next speaker for this panel will be Thomas Mickler of EASA. Mr. Mickler.

MR. MICKLER: Thank you, Mr. Chairman, for inviting EASA onto this panel. It is an honor for me, and a pleasure to be here.

Oh, I need the clicker. Thank you very much.

Before I provide you with a general overview on rulemaking activities in Europe, I will briefly illustrate who is playing what role in the European legislative process.

The EU Parliament and Council of Ministers adopted a co-decision process, the highest ranking regulations. Those regulations define the scope of powers transferred from member states to the community, and specify general regulatory objectives and form of essential requirements. EASA's basic regulation is a typical example of such high-level legislation.

All provisions are directly applicable and binding in all 28 EU member states. The Commission is empowered to adopt more specific rules to implement the essential requirements, simply called the implementing rules. Implementing rules under the basic regulation are normally adopted through a process called comitology. Member states are represented in their respective committees, where they deliberate and vote on a legislative proposal by the Commission. Commission implementing rules are also directly binding on member states and are therefore considered hard law.

The Agency, EASA, is considered the EU expert body for aviation safety and assists the Commission in all its legislative activities related to aviation safety. EASA does not have powers to adopt binding legislation in its own right, but it develops and publishes what is called soft law, namely, certification specifications, acceptable means of compliance, and guidance material. But it also has an important role to play in its capacity as the Commission's expert body for aviation safety, as it develops on behalf of the Commission draft proposals for essential requirements or implementing rules, the so-called opinions, which form the basis for Commission's regulatory proposals.

This map is to give you an idea on the geographical reach of EU legislation today. The basic relation and its implementing rules are, as I've said, directly applicable and binding in the 28 EU member states. There are a number of states that have committed themselves through bilateral or multilateral agreements to implement European regulations into their national law. Other states regularly transpose EU legislation into their national law. The total number of European states where European aviation safety regulations are either directly applicable or rendered applicable through an act of national legislation is 46. All those states have subjected themselves through working arrangements to EASA's standardization process.

Today's requirements for flight data recorder, cockpit voice recorder, data link recording, and ELTs are contained in EU-OPS, another European regulation aside from the basic regulation, and JAR-OPS 3 for helicopters, which has been developed under the JAR system and nationally implemented.

However, in a few days the 2-year opt out period for the implementation of the new European OPS requirements ends, namely, on the 27th October 2014. That means as of this month, the paragraphs listed here on this slide are binding in all 28 EU member states and 4 EFTA states, and will be rendered applicable in the other states I mentioned at their own pace.

Overall, those standards are aligned with ICAO Annex 6 provisions, although ICAO's November 2013 amendments to Annex 6 are not yet fully reflected. The implementing rules are complemented by acceptable means of compliance, guidance material, ETSOs and EASA's certification specifications for aeroplanes and helicopters, which refer to internationally recognized industry standards, such as EUROCAE doc ED-112 and ED-62A, to mention only a few.

So what comes next? In December 2013, EASA published a Notice of Proposed Amendment, NPA 2013-26, to amend requirements for flight recorders and underwater locating devices. The proposal reflects ICAO's latest Annex 6 changes, but it also suggests, for example, to extend significantly the duration of CVR recording capabilities for aircraft with more than 27 tons maximum certificated takeoff mass, for which the certificate of airworthiness is first issued on or after 1st January 2020. The 20 hours you see here on this slide I understand are currently again under discussion. It is possible that this will be raised to 25 hours.

As part of the NPA process, a regulatory assessment was performed and stakeholders were duly consulted. As a result of this process, EASA issued its opinion in May 2014. It forms now the basis for the Commission's regulatory proposal to the EASA committee.

After MH370 disappeared without traces, the Commission and EASA have been looking also into possibilities to encourage the implementation of aircraft tracking, and are working on draft performance-based requirements to become part of this regulatory package. For the general public in Europe, it is incomprehensible that a commercial airliner can simply disappear, and expectations are high to address identified weaknesses in the system swiftly. The time schedule proposed by the Commission is therefore very ambitious.

The 8th March 2015 marks the first commemoration of MH370. By then, the Commission would like to have a full package of regulatory amendments on the table, including for flight tracking. In order the achieve that, the draft regulation would need to be finalized towards the end of this year, taking into account discussions with member states in the next coming days and any developments at ICAO level, and possibly to vote on it at the EASA committee's meeting end of January.

Of course, Europe is interested in globally agreed solutions and committed to keep its regulations aligned with the work performed at international level. The draft regulatory proposal may therefore still need to be adjusted throughout the process as the picture matures. The ICAO high-level safety conference in February will be a good opportunity to agree on viable solutions and a common way forward. In an ideal scenario, if proposals mature by January 2015, and member states vote positively, the Commission could adopt and publish the full package in May 2015.

This concludes my presentation, Mr. Chairman. And I would also like to thank you for organizing this panel at this very appropriate point in time. Thank you very much.

MS. GORMLEY: Thank you, Mr. Mickler.

Our next speaker for this panel will be Marcus Costa of ICAO.

Mr. Costa.

MR. COSTA: Thank you, Ms. Gormley, and good morning everyone.

Twenty-four hours a day, 365 days of the year, an aircraft takes off or lands every few seconds somewhere on the face of this planet. Every one of these flights is handled in the same uniform manner whether by air traffic control, airport authorities, or pilots at the control of the aircraft. Behind the scenes are millions of employees involved in manufacturing, maintenance, and monitoring of the products and services required in the never-ending cycle of flights.

Modern aviation is one of the most complex systems of interaction between human beings and machines ever created. This clockwork precision in procedures and systems is made possible by the existence of universally accepted standards known as Standards and Recommended Practices, or SARPs, as we refer to. SARPs cover all technical and operational aspects of international civil aviation such as personal licensing, operation of aircraft, aerodromes, air traffic services, accident investigations, and the environment.

My goal today here is to walk you through the procedure of developing a standard or a recommended practice to be universally accepted. The origin of the proposal, as you can see in the slide here, may come from contracting states, from the Assembly, from the Council of ICAO, from the Secretariat of ICAO, from the Air Navigation Commission -- that's what ANC stands for -- from meetings, from panels, from committees, and so on. And this would be a proposal for action for ICAO.

And, of course, the Air Navigation Commission is our technical body, so any SARPs -- for technical SARPs, proposals are analyzed first by the Air Navigation Commission. And depending on the nature of the proposal, the Commission may assign its review to a specialized working group that we call sometimes Air Navigation Commission panels, sometimes Air Navigation study groups, divisional type meetings, and so on.

And then it goes to what we call a preliminary review by the Commission. It's a very structured process that is in place in ICAO to develop a standard or a recommended practice. And this is an important thing to call your attention to. After the preliminary review, all contracting states and international organizations are consulted on the preliminary proposal.

After this consultation, which usually is given to states, 3 months -- let me go back here. It comes back to the Secretariat. We do the analysis of all the replies, we reproduce the replies in full for the Commission to see, and it goes back to the Commission for the final review. And this is usually roughly 6, 8 months after the preliminary review.

And this is pretty much my last slide, actually. I have two others to use, if you want. This is going to be available, I believe, for all of you.

So after the final review of the Commission -- and, of course, the proposal may be rejected, depending on the replies by states and the international organizations, or it may be amended. So experience has shown that the original proposal is never the same one at the final stage. You may have a change in the applicability date, in the weight of the aircraft involved, and so on. So it goes to the Council adoption here, and then we have the Green Addition, which is a preliminary amendment to the Annex.

And even after the adoption by the Council, states still may disapprove this. The policy prescribes that states are allowed 3 months after the Green Addition to indicate disapproval of adopted amendments to SARPs. We never had such case because of course when it gets to the Council level a consultation phase has been processed. States have sent their replies, their positions, international organizations; the Air Navigation Commission has done its final review, so when it comes to the level of Council adoption it's a pretty mature proposal. But states still have the flexibility or the option to reject after the Green Addition. They have 3 months. If the majority of states reject, then the proposal would be killed of course.

Provided that the majority of states have not registered disapproval, then the amendment becomes effective, usually in July. Council adopts in February/March, 4 months later the amendment becomes effective, and then it enters into force. And then in November of the same year, the amendment becomes applicable. It's a jargon, ICAO jargon, but that's the difference between effective date and applicability date. By the applicability date the states would need to have implemented the proposal.

And I don't expect you to read this, but this is the previous slide only with all the timeframes here, if you want to take a look at it later. And, of course, this is the whole cycle I was intending to show you in the beginning, but I didn't mean to scare you. And this is what is the work that is presently being done in ICAO regarding recovery of flight data recorder and locator transmitter, and so on.

FLIRECP, it stands for Flight Recorder Panel. That's the active work of the panel. The panel met last week in Montreal, and the proposals will be taken to the Air Navigation Commission for preliminary review next year, if I'm not mistaken. I have the chair of the panel here. He can help me later. So, we are working on proposals for accident site location, automatic deployable flight recorders, working on RPAS, guidance for maintenance flight recorders, and so on.

And the last one here talks about airborne image recorders. And this one is pending, waiting for the results of the work to further protect safety information. This work is presently being done, and proposals for airborne image recorders will follow after we finish the work on further protection of safety information.

That's pretty much what I had to say. And thank you very much, Mr. Chairman, for the opportunity to come here. It's as great pleasure, and I want to congratulate you for the initiative. Thank you.

MS. GORMLEY: Thank you, Mr. Costa.

This concludes the presentations for this panel. We are now ready for questions from our Technical Panel. I'll turn things over to Mr. Cash, the Technical Panel lead for this topic.

MR. CASH: Good morning. I would like to thank my panelists for taking time out of their busy schedule to participate here today.

My first question is to Ms. Gilligan. In your presentation, you briefly described the FAA's rulemaking process. Can you discuss what rules are currently in the pipeline and how long that pipeline is, and what the priorities are, and if any of them are recorder or aircraft locator technology improvements?

MS. GILLIGAN: Yes, sir. We have over 50 identified rulemakings on our agenda right now. Several of them were directed by congressional action. Some of those are at the notice stage, some of them are moving to the final rules stage. But those are among our highest priorities because, of course, the congressional direction suggests that that's the appropriate public policy. In addition, we have some safety rules both for operations as well as for aircraft certification design standards, which are on that list as well.

Currently, I don't recall -- I don't believe we have any particular project related to flight data recorders or to technology for recording data because, again, we have quite a heavy agenda directed from some other external sources. But based on whatever we learn today, and, of course, we're following the ICAO and IATA work quite closely to see what, if any, recommendations from that group as well. And we'll look to see whether and how we might fit some additional priorities, if we need to.

MR. CASH: Thank you. Again, back to you, Ms. Gilligan. The Safety Board has some recommendations to the FAA, and we recently received feedback from you saying that you guys really liked the idea, you endorsed it, support it, but the concept was turned down because it would not pass a cost/benefit analysis.

We realize that flight data recorders are a unique case and, as such, are difficult to associate a tangible benefit versus the cost to industry. Can you explain the cost/benefit analysis process, maybe discuss ways around this seemingly formidable obstacle?

MS. GILLIGAN: Yes. The Executive Order does require that agencies look at the costs that might be imposed as a result of a new standard and that we be able to justify that that cost is appropriate, given whatever the benefits may be.

Because of the high number of priorities that we already have on our rulemaking agenda, we are looking closely at those rules which may be more difficult to build that cost justification and we are holding those in abeyance while we complete the projects that we already have in the pipeline, which we believe, having done some preliminary analysis, we believe that we can demonstrate that the cost of the proposals that we have pending will, in fact, justify -- be justified by the benefits to the public.

It is a necessary step in all the analysis, and it can be quite a challenge, especially because aviation is so safe. It is because of the hard work of the Board and so many in the industry, and we have very few accidents at this point. And so, it does sometimes make it more difficult for us to perform that analysis. But we continue to look at whether and how we can anticipate what the benefits might be.

We are looking at ways that we can take credit for benefits from predicting or avoiding potential risks. All of those are new ways that we're trying to look at our rulemaking to be able to enhance our standards and meet the expectations for the analysis.

MR. CASH: Just as a follow-on, does the mandates from Congress negate the cost/benefit analysis, or is it still required?

MS. GILLIGAN: The process requires that the cost/benefit analysis be performed because it is important that we be informed by just what will these new standards cost. But when it is congressionally directed, we do have the added benefit that the public policy determination that Congress has indicated argues in favor of it being cost-justified.

MR. CASH: Okay. Mr. Mickler, does EASA have a similar process that they go through?

MR. MICKLER: Thank you. EASA also performs a cost/benefit analysis, actually a somewhat wider analysis. We call it a regulatory impact assessment. The economical aspects are only one aspect we are looking at. We also are looking at safety aspects. We are looking at social aspects. In total, there are a number of six dimensions we are looking at.

And for the regulatory amendment proposal that I presented, which is based on -- which is the Opinion 1/2014, such a regulatory impact assessment has been performed and came to a positive conclusion. For the tracking part, no such regulatory impact assessment has been performed to date. Thank you.

MR. CASH: And Mr. Costa, does ICAO also review cost versus benefit?

MR. COSTA: In ICAO, the most important thing is the impact assessment that we -- and, of course, it involves costs to the states and the industry, and this is not very easy to get. Very recently, we had implemented an impact assessment, and I think the Flight Recorder Panel just made one -- made some, because we need an impact assessment for every proposal, and this is to assess the costs that would be incurred in the states. That's not easy. Sometimes we have found that the information might be confidential, depending on who is providing the information.

So we haven't been successful in assessing the costs, but we have the mandate to assess them. It hasn't been easy at all, but we would like to know what would be the cost of every proposal. Of course, the benefit is safety at large. But retrofitting is something that is very well analyzed, if it's necessary to have a retrofitting in a proposal.

Usually the proposal is forward looking. The proposals that are being discussed right now, most of them are for new types certificate. But, again -- and this would be a message to the industry if we could make available the costs when -- and this is discussed in the panel and we have the industry representative on the panel, but it's not always easy to find out the costs. But we do want to know them.

MR. CASH: And I'm sure member states in their letters back give you plenty of feedback as far as the cost is concerned. Do you have to resolve all those?

MR. COSTA: All the replies from states, they are reproduced in full in the proposal. We do not edit them. We just -- well, sometimes if "may" comes with double Y, we can cut out one because it's a typo, but the -- all the replies are fully assessed. We may or may not agree with the reply. We don't have to agree, but we have to justify why we disagree. And then we take it to the Commission who has the final word before going to the Council.

And again, costs -- in the investigation, at least on the investigation side, we haven't received precise costs from states for our proposals. They are usually for new types, as I said, and states when they disapprove proposals in the investigation field, it is usually due to their national legislation. And, of course, we understand this. But sometimes the proposal goes forward because in this case it perhaps would be advisable for the state to reconsider the legislation and amend it, if it is for the benefit of safety.

MR. CASH: Okay. Thank you.

Ms. Gilligan, we're hearing from industry that any flight data and locator rule would be a performance-based rule. Could you please explain what a performance-based rule is and why would it be preferred in this instance?

MS. GILLIGAN: Yes, sir. In most cases now, we are looking at trying to describe what is the safety risk that needs to be addressed, and how might technology perform in order to address that risk, rather than to require by regulation a particular technology. What we've learned over the years -- and I think the slide that I showed on recorders shows it -- technology does nothing but improve over time.

And we actually have some regulations where we named a particular technology, because at the time none of us really thought that there could be anything better than what we had already designed at that point, and then we find a few years later we must go in and change the rule. And that requires a notice and comment, a full analysis, all of the process that I talked about.

So what we're looking to do in all of our rulemaking is to describe what it is that the aircraft needs to do or the operator needs to do or the pilot needs to do, and allow for the industry to determine how they will demonstrate that they meet those standards. They still have to demonstrate compliance to the standard; we need to find that they've demonstrated that compliance. But by demonstrating it against a performance standard, it allows for much more flexibility, much more innovation, and it allows our regulations to extend longer without our having to go in and make changes.

MR. CASH: Doesn't that complicate the certification process?

MS. GILLIGAN: No, actually. I think because we understand what the performance is that needs to be demonstrated, we've seen that our industry is really quite competent at being able to demonstrate that they meet those standards. A number of our design standards are performance-based standards already, so we have good experience both within the regulating community as well as on the industry side to demonstrate compliance with performance standards. And as I said, it allows then for a lot of innovation, and it allows for -- as a regulator, for us to allow the rule to grow with whatever new technologies may be able to demonstrate compliance.

MR. CASH: Mr. Mickler, does EASA have the same kind of philosophy?

MR. MICKLER: Yes, sir. I have not much to add to what Ms. Gilligan said except that we are exactly on the same page. We made the same experiences, and the new regulations the Commission at EASA are discussing with regard to aircraft tracking will be performance-based regulations. They allow for the necessary flexibility and leeway for the industry to come up with good solutions, and they also allow, without necessary regulatory changes, to follow the technological evolution. So we think it's the better way of regulating. Thank you.

MR. CASH: And my next question, Mr. Mickler, would EASA be opposed to a phased-in-rule approach for a location solution? And what I mean by that, can EASA create a rule that would initially apply only to aircraft that currently have the necessary hardware, and then sometime in the future put the -- you know, the rule would cover more aircraft sometime in the future?

MR. MICKLER: I have to admit that I haven't fully grasped your question.

MR. CASH: It basically is a phased-in rule where, say, on locator technology the aircraft that may be equipped right now would be -- it would be applicable to those, and then at some time in the future the rule would extend to other airplanes.

MR. MICKLER: Well, the future rules will be more and more performance-based. As far as the locator rules are concerned, we do have certain minimum criteria as to what we expect the locator, the devices are supposed to fulfill. It is, of course, appreciated if certain technology is -- or that is already available is implemented by industry even though it is not necessarily required by the regulations.

And in future regulatory impact assessments, the equipage of the fleet is certainly a factor that needs to be considered to what extent it would satisfy the regulatory objective. I hope that I roughly addressed your question.

MR. CASH: Thank you.

Ms. Gilligan, could the FAA deal with a phased-in rule?

MS. GILLIGAN: Well, Mr. Cash, we always look at -- especially for technology, we always look at three segments. One is what to require for new type designs that may come in the future, and that is to set a new standard then for design for all new type certifications. We look at whether the technology can be -- or how it can be cut into current production, and what the obstacles or challenges may be to that. And we look at whether or not the existing fleet can be retrofitted and sometimes, as you suggested, or categories within that retrofit of some aircraft that can accommodate a retrofit more easily than others.

So we have many rules that have all three of those requirements; we have some rules that are only for new type design; we have some that are cut into production but don't have a retrofit. In terms of within the retrofit category, I can't think of one offhand where we've described the requirement differently based on either the age or capability of the aircraft, although we do at times have rules that apply to aircraft type-certificated after a certain date or produced after a certain date.

So we certainly look at all those options as we look to how can we balance what the challenges will be and what the safety benefits will be.

MR. CASH: In a phased-in approach, it would actually almost drill down to the individual aircraft, you know, this airplane is equipped, this one would not be, in the same fleet.

Could the FAA deal with that or is that just too much overhead?

MS. GILLIGAN: We haven't taken that approach to date, although I suppose we could look at it. One of the issues, or one of the constructs, concepts that we want to address is the appropriate level of safety for the operation within the system. And so, we have tended to look at it in those categories that I described, whether it can be applied to brand new design, whether it can be applied to those aircraft that are still under construction, and whether or not it can also be retrofitted in the fleet, to assure ourselves that we've got an appropriate level of safety throughout the system.

MR. CASH: Thank you.

Mr. Costa, if airlines are basically going to be charged with receiving tracking data, they're going to be the keepers of the data, what process could be implemented with member states to ensure the timely transfer of this data to the accident investigation community in the event of a lost airplane?

MR. COSTA: As you should be aware, there is a task force working on aircraft tracking right now, and the work is still going on; it's very preliminary and I don't have any final positions yet. But I can tell you that the results will be represented to the -- will be presented to the ICAO Council in the next few weeks, so I don't have any information as of now.

MR. CASH: Mr. Mickler, do you have any idea on how we could get the data from the individual airlines, if there is an accident?

MR. MICKLER: First and foremost, the airlines need to have the data. If they don't have the data, we can't get the data. And this is what the regulatory proposals in Europe are directed at, to make sure that in the future we receive the data. Once we have the data, the next question is how do we share the data? We in EASA think it is very, very important to share the data so that experts around the world can sit together and deliberate how we can improve aviation safety.

And we know that there are certain obstacles and hurdles. Data protection is a big issue, particularly when it comes to the long-term objective or possibility of data streaming, but it is worth looking into it. And I'm sure solutions will be found for the benefit of safety.

MR. CASH: Thank you.

Ms. Gilligan, do you have any thoughts on that subject?

MS. GILLIGAN: Yes, I think as Mr. Costa indicated, that the work being done both at ICAO and through the IATA task force is looking not just at what technologies might be available, but what are the roles and responsibilities of all of the players, whether the operator, the regulatory organization, the accident investigation organization, and ICAO itself. So I do think we will address all of those requirements as part of whatever the recommendations are that follow that work.

You raise a good point, but it is a matter that we've been able to address up to this point quite effectively. And I'm sure we'll find equally effective ways to make sure that the data is properly shared, properly protected, and that it can be used, as Mr. Mickler suggests, by the experts who need it to really understand what has occurred, and more importantly, how can we prevent it in the future.

MR. CASH: Thank you.

I believe Ms. McComb has some questions.

MS. McCOMB: Thank you, Mr. Cash.

This essentially can be addressed by each of our panelists. Given the regulatory challenges that exist in implementing new technologies, would you please discuss the range of options each of your organizations have to encourage industry to adopt new recommended practices without regulations?

MS. GILLIGAN: If I may begin. Certainly all of the U.S. operators look very closely at ICAO's recommended practices, in addition to the actual standards, to see if there are ways that they can improve their own safety performance. We've already seen that there are a number of non-required technologies that many operators are already implementing, and I know you'll hear quite a bit about that in your later panels. Some of them are adopted because they not only provide safety data, but they also provide data that can be used to assure the operator they're operating their aircraft in the most effective, efficient way.

So certainly technologies that can help the operator understand how their aircraft are operating and whether or not there are safety objectives that are not being met, are ways to encourage the operators to take on those technologies, whether they're required or not.

MR. MICKLER: EASA has a number of initiatives to foster and encourage the industry to discuss safety data and to find appropriate solutions that would enhance aviation safety. We have the instruments of publications, technical publications, safety information bulletins, and we have various fora. We have the forum that is called European Strategic Safety Initiative, ESSI, which rests on three pillars: one is ECAST for commercial air transport, one is EHEST for helicopters, and one is EGAST for the general aviation.

And these fora are fora with industry, with the various stakeholders, where safety initiatives are typically being discussed. And they help to encourage the industry to move into a certain direction, and we at EASA, we assist them on this way as good as we can. It is a collective exercise, and I understand and hear -- I admire the FAA. They have set up a system, which is actually far more advanced from what we have. Today in Europe with the InfoShare, I had the pleasure to attend the InfoShare meeting and their other fora as well, so I think these are the fora through we reach consensus with the industry to collectively improve aviation safety.

MR. COSTA: Yes, as I mentioned previously, everything that is done in ICAO is heavily discussed and coordinated. And we usually refer to the four C's of aviation. That's very ICAO-ese and I apologize for that. But we usually say that a good SARP requires cooperation, consensus, compliance, and commitment. So cooperation in the sense that you -- in the formulation of SARPs. So all the panels and the study groups and divisional meetings, those are all composed by states and international organizations.

So, Erin, for instance, if she allows me to say, is a member of the Flight Recorder Panel of ICAO. Jim Cash was our chair of the Flight Recorder Panel some years ago. Two on the table. So it's everything that is done is discussed among states, among international organizations, and the Air Navigation Commission is also composed by states. And, of course, the Council is also composed by states. So everybody that works in ICAO, except from the Secretariat -- the Secretariat comes from states, but they do not represent states, so we are not even allowed to have our flag on our desks because we serve the world, as you know.

But the ANC, the Air Navigation Commission, the Council, the study groups, the panels, they are all composed by you, by states and by international organizations. So, when a SARP gets out of the oven to be implemented, they are very, very mature. So I think the implementation of what is developed in ICAO, when it gets to the stage of the implementation that we call applicability date, it's a very mature process.

And the whole package from the very beginning, from the very beginning of the concept, it's an average of 5 years to get there. So I don't see any big challenge in implementing what gets approve in ICAO because of this.

MS. McCOMB: Thank you.

I have one additional question for Ms. Gilligan. You mentioned earlier about how our regulations here in the United States may essentially at some point -- I believe it's in 2016 -- have some differences between what ICAO recommends.

Can you talk a little bit further about what challenges are posed when the activities going on at the ICAO/IATA level, when there are changes in EASA, how -- if other countries start implementing significantly different recorder or technologies through their regulations, how any differences would be handled with the United States?

MS. GILLIGAN: Yes. If we are not in compliance with an ICAO standard at the time of applicability, ICAO has a process for states to notify that they have a difference from that standard. And if that's necessary, we will file that difference. What we do then is continue to evaluate whether and how we can implement the standard, or how close we might get to the standard. But again, it has to go through the rulemaking process. And right now, as I said, we have a list of 50 rulemakings underway already. And so, it is a matter of when and if we can fit that new project into our agenda.

So, we're always balancing those kinds of considerations: Are there higher safety issues, higher safety risks that need to be addressed first? And we think right now we have our higher priority rulemaking projects underway, and we'll continue to evaluate the ICAO standard and put that in place when we have the ability to add that to our rulemaking process.

MS. McCOMB: Thank you.

I believe Ms. Gormley has a question.

MS. GORMLEY: Mr. Costa, my recollection is after Air France 447 that there was a process by which a letter was sent to states encouraging adoption of 90-day ULBs, for instance. I understand the complexity of the process in terms of the general SARPs, and the 5-year process.

Can you explain that letter to the states? Is that a different process? Is that a quicker way or a less formal way to encourage adoption?

MR. COSTA: The adoption actually of the 90-day battery life, right, you're talking about, there is a provision in place -- I cannot recollect right now; Philippe may help me here with the dates -- but it was agreed that before the applicability date of that provision that ICAO would encourage the states to implement them as soon as possible. It was a unique case. We knew that the battery was available, but in the applicability date of the provision that exists took into account the life of existing batteries. So by the time they would need to be changed, and then they would put a 90-day battery. And there was also the understanding that the 30-day battery would be discontinued. In other words, you had some existing ones on the shelves, but they would not be manufactured anymore.

So, yeah, it was a unique situation in which ICAO encouraged the states to implement a provision that was not applicable yet, for the benefit of safety.

MS. McCOMB: Thank you.

MR. CASH: Acting Chairman Hart, that completes the Technical Panel questions for this panel.

ACTING CHAIRMAN HART: Thank you, Mr. Cash, and thanks again to all of our panelists.

We will now hear questions from the dais. Mr. Delisi?

MR. DELISI: Thank you.

And thank you to the panel for discussing the harmonization of international standards. I think that's so critical to accident investigation. Years ago we used to use the term domestic accident or international accident, but these days every aviation accident is an international event. The Board in the last few months has completed investigations of accidents involving a Korean carrier who was operating a U.S. airplane, and a U.S. operator that was operating a European-built aircraft. So the harmonization is so critical.

Recovering data is certainly a key to a successful investigation, but sometimes recovering the wreckage is also vitally important. And one area in which the regulations are not fully harmonized is the carriage of ELTs aboard commercial aircraft. And, Ms. Gilligan, I wonder if you can talk through what the FAA philosophy on ELTs is?

MS. GILLIGAN: Yes, sir. As it applies to commercial operations, it has been the FAA's position that those operations are in constant contact with air traffic control. And so, there was -- we did not see a need for having that additional technology, although, as you know, many of the aircraft do carry ELTs and other kinds of alerting systems. But because of the constant and regular contact with air traffic control, it has been our position that we will know where the aircraft are based on that technology.

DR. MURPHY: Great.

Mr. Mickler, in Europe, would an ELT be required to be carried aboard a commercial airliner?

MR. MICKLER: Well, certainly, yes, ELTs are required. We unfortunately also observe that existing ELTs when they are really needed don't show the performance that we would expect. We have done an analysis, and the percentage of malfunctioning ELTs is rather high. It's I think -- I don't want to quote the wrong number, but I recollect something in the order of 50% where the antennas have come off or where eventually the ELT was useless.

The Cospas-Sarsat system remains as a whole still the most effective global system for emergency location. I think there's only a weakness in the devices of the ELTs, and these weaknesses are currently being addressed. There's a EUROCAE Working Group 98 that is precisely addressing these issues. And this group also looks into the possibility for ELTs to be activated when an emergency situation is already discovered rather than after the fact when the accident has occurred.

Apart from the aspects that you mentioned, a functioning ELT is extremely important also to rescue potential survivors. We had accidents in the past where people had drowned because the rescue teams could not access the accident site quickly enough.

Thank you.

MR. DELISI: Sure, and -- thank you. And just to be clear, an ELT is not a device that's designed to help locate an aircraft underwater. Correct?

One other area, we are starting to see the voluntary equipage of aircraft with video recorders. The Board next month will be considering the report of an accident involving an Airbus helicopter that was equipped with an Appareo video recorder that provided crucial information to the completion of that investigation.

Mr. Costa, I was going to ask you, you mentioned that the flight recorder working group at some point in the future is going to be considering some video imaging standards. I wonder if you might be able to elaborate on what might be on their plate.

MR. COSTA: Yes. Actually the panel has already deliberated on the proposal for airborne image recorders. Annex 13 on paragraph 512, today we have -- we address airborne image recorders. However, the Air Navigation Commission of ICAO, when this proposal was presented I believe 2 years ago, maybe 3, was of the view that we would need to strengthen the protection of such recorders, that the protection that we have in 512 today that is subject to what we call the balancing test by the judicial authorities, it was the view of the Commission that that protection is not sufficient.

So for this reason, ICAO established the Safety Information Protection Task Force that worked for over 2 years. And at the end of the work of the task force, in general, this year, the provisions addressing specifically the protection of airborne image recorders, the task force was of the view that another group would need to further review those proposals. And this is the group of experts on protection of accident and incident records that is currently working. And this work is going to be finalized in this coming November and this will clear the way for the Flight Recorder Panel to proceed with the proposal.

MR. DELISI: Very good. Thank you.

ACTING CHAIRMAN HART: Thank you, Mr. Delisi.

Mr. Kolly, do you have any questions?

DR. KOLLY: Yes, I have one.

Again, I'd just like to follow up on the issue of voluntary encouragement and measures to get safety changes accomplished. And, Ms. Gilligan, you had described very eloquently the process in which rulemaking is done, and also referred to some of your efforts in improving safety through voluntary measures.

Can you tell me when that approach, the voluntary approach is preferable? You know, specifically, for instance, there is an image recorder recommendation out there, and you've kind of taken that towards the voluntary implementation route. Can you tell me when that's preferable from the FAA's perspective and how that process and decision is arrived at?

MS. GILLIGAN: Sure, Dr. Kolly, I'd be glad to. Let me talk on the video imaging first of all. We in the FAA have shared the same concerns that you just heard Mr. Costa describe for ICAO. We believe that the protection of video data is even more difficult than the protection of some of the other data that we currently already collect for accident investigation, and that we need to be assured that there are strong protections for that kind of information in place as we look to whether or not to mandate that.

Generally, we look for voluntary compliance as a primary way of going forward. It's faster. If we can -- working with the industry, if we see data that suggests there is a safety risk of a certain type and that certain mitigations will reduce that risk, it's very difficult for safety professionals to walk away from that. And so, what we are learning in our Commercial Aviation Safety Team, for example, is that when we come together as a community and we look at the data to see where we have risk in the system, we find ways to mitigate that, and we all go back and do what we need to do to make sure that we are reducing that level of risk. So we think that that's always a preferable way.

If after the fact, we need to raise our standards to be consistent with what we voluntarily implemented, it sometimes makes the rulemaking easier as well because we can demonstrate that the community is already implementing some of those changes. So that's our preferred way of going forward.

In these areas of data collection, we're seeing that when the data system not only enhances safety but also provides the operator some information that they can use to operate their aircraft more efficiently and effectively, that that's the kind of technology that they can more easily voluntarily put in place because they get regular daily value from it just by operating the aircraft and learning more about whether and how they're operating it. And then they have the data for the time when they have the anomaly or, God forbid, they actually have a catastrophic failure. We can all benefit from that data as well.

So the more useful the data is to the operator, the more likely that they'll voluntarily implement that data collection source.

DR. KOLLY: And being voluntary, does the FAA take actions to follow up on the effectiveness of that particular approach?

MS. GILLIGAN: Again, through the Commercial Aviation Safety Team we are looking at metrics that evaluate whether in fact we've all implemented what we had committed to implement, and then whether or not it's actually being effective. And we can do that because much of the data that the operators collect through their flight operations quality assurance programs and their voluntary employee reporting programs. So we do have metrics now for some of the safety risks that we've undertaken.

So, for example, we set about reducing the number of unstable approaches. We now have data that lets us evaluate whether or not the number of unstable approaches is coming down. We are seeing good results as a result of that, but we'll continue to monitor it. And if we see an increase at either a particular location or whatever it might be, we'll look to see have we implemented what we said? And if not, let's fix that. And if we did implement it and we're not being effective, what more can we do to address that safety risk?

ACTING CHAIRMAN HART: Thank you, Dr. Kolly.

Just one question for Ms. Gilligan. You mentioned the Commercial Aviation Safety Team. Are they doing anything about recorders and locators, or are they focused primarily on how to prevent the crash in the first place?

MS. GILLIGAN: Mr. Chairman, we are, as you well know, very much focused on trying to understand those hazards that are still in the system that haven't manifested themselves and trying to address those. So, no, we have not taken on any work related to locator or flight data recording for the purposes of accident investigation. Of course, we'll watch closely what comes out of ICAO and IATA, and if there is a role for the Commercial Aviation Safety Team, we'll certainly look at whether and how we might fill that.

ACTING CHAIRMAN HART: Okay. Thank you. And I just asked the question because it has proven how voluntary implementation can be so effective in some many ways. So thank you for that.

Thank you once again to all of our panelists for your great presentations and to start the discussion this morning. You've laid an excellent foundation for our understanding of this issue from a regulatory and standards perspective. So we appreciate that to inform the rest of the day.

After the break, we'll hear from our second panel, which will address the airframe, on-board system, and service provider viewpoint.

We stand adjourned until 10:15.

(Off the record at 9:55 a.m.)

(On the record at 10:18 a.m.)

ACTING CHAIRMAN HART: Welcome back. We're now ready to hear from our second panel, which will address the airframe, on-board system, and service provider viewpoint. I'll turn things over once again to Erin Gormley.

Ms. Gormley.

MS. GORMLEY: Thank you, Acting Chairman Hart.

As a reminder for our panelists, please push the button on the microphone to activate and bring it close to you while speaking. Push the button again to turn it off when you are completed.

Our next panel is designed to provide us with perspectives on technology solutions that would allow for a more efficient recovery of flight data. Our panelists are Andrei Pascal [sic], Product Security Officer and Executive Expert from Airbus Group; and Mark Smith, Senior Accident Investigator and Associate Technical Fellow from Boeing Commercial Airplane Company, who will discuss current and future commercial aircraft; Chris Benich, Vice President, Aerospace Regulatory Affairs from Honeywell, who will present an avionics provider point of view; and Steve Kong, Business and Development Manager from Inmarsat, who will present a satellite provider point of view.

Dr. Andrei.

DR. ANDREI: So, thank you, Ms. Gormley.

Just waiting for my slides. Here we are.

So, this first slide, this first chart is aiming at giving you an outlook of the Airbus record in flight recorder recoveries. It was a question that has been asked to us recently.

The most important message on this slide is to show that all wreckages and recorders have been retrieved quite immediately after an accident of an Airbus aircraft, except in three of them. And more especially when we are talking about overseas accidents, that took more than a couple of days, and one of them a few years. As you know it was the Air France 447, unfortunately.

The second message of this chart is that all recorders have been retrieved in good shape, and have been able to be decoded, except in four of them: two in bad shape, but decoded at the end, and two of them never decoded at all. And despite that, however, these are good statistics because we consider that the statistics are very good.

Airbus has been very much engaged in and committed in all international initiatives like ICAO, IATA, BEA, and the others. And we have been very proactive externally, but also internally because inside Airbus we have led and have personally coordinated a lot of internal projects to improve the safety of our aircraft, and more especially the search and rescue, the aircraft tracking, the wreckage and flight data recovery in order to explain and to avoid a new accident.

On this page, you can see the status of our current situation regarding the aircraft tracking and localization. One important message is that most of our fleet, of our aircraft, are equipped today to send data to the ground. Those aircraft that I'm talking are long-range aircraft, 85% of our fleet; A380, 100%

of the fleet; and A350, 100% of the fleet, are equipped with FANS-A equipment. And they allow airlines to communicate to the ground either on the AOC system. The AOC is the data share between the aircraft and the flight operations from the airline or to the ATC.

Regarding the ATC, we have the ADS-B, of course, and the ADS-C. All our aircraft are -- equipped with that. The ADS-B is based on the broadcasting of the data, but it's -- the only issue is that it's only over a continent, it's continental only. And the ADS-C is broadcast worldwide, but -- so it's not broadcast worldwide, but it depends with the contact with the ground segment. So, we -- the ADS-B in the future, as soon as we will have a worldwide satellite constellation, to have full coverage of the Earth.

The second message on this slide -- and probably we'll talk about that later on, but we have worked very much on the flight envelope of an aircraft, and we are able now to trigger some data on it by understanding and broadcasting of the data of an aircraft of alerts in case of loss of control on the aircraft. And a very important message on that regarding the ADS-B is that the ADS-B will be compliant with SESAR and NextGen in the future. So it's something also which has a waiting of our decision.

The first page made a focus on the four solutions that Airbus is supporting today. So, as you have seen on the previous slide, the tracking alerts, it's something which is easily feasible because all our aircraft are equipped today. It's a useful solution for retrofit and also forward fit for sure.

The localization, location and retrieval of the data, we have decided to support and to make feasibility studies in the past years of the deployable recorder. And Airbus today has taken the decision to provide in the future on some aircraft -- and you will see on the next slide the combined recorders on board the aircraft, one being deployable with an ELT integrated and floatability capability.

To locate the wreckage, we will implement the additional underwater locator beacon, the additional ULB, the low frequency one attached to the airframe. And this answers to the EASA NPA that was released the end of last year and probably hold force in 2019.

The recorder localization, of course, because once we have found the haystack with thanks to this 8.8 low frequency ULB, we need to find the needle in the haystack, so we will extend the battery life of our attached ULBs on the recorders. It also answers to an EASA NPA. And the solution has been very much worked out with our suppliers, so we are ready to implement.

On the last slide you have the outlook of the potential solutions that we would like to implement on our programs. I'm not saying that this is fixed, but at least we have made all feasibility studies on all the different solutions. The permanent aircraft tracking and early warning will be proposed for all

Airbus aircraft in forward-fit and retrofit, and of course, forward-fit remains part of the airlines.

Something which is important there is to say that for an airlines that would like to implement such a solution, it's just a software modification. And when you want to trigger the broadcasting of data from the aircraft to the ground, it's just a software modification. No need to change any equipment.

The double recorder, combined recorders, one being deployable, will be done on the forward-fit of the A350 and the A380. It will be useful for us to ensure the localization of the accident and to retrieve the flight data at the early stage before retrieving the fixed recorder. The additional ULB attached to the airframe is currently under definition for all aircraft, including the single-aisle, single-aisle meaning A320, A319, A318, and A321 that operated over water.

So this is the most important point to say that as soon as we are traveling, we are having flights over oceans, we are -- it's important to ensure that we have such a capability. And the 90 days that will be attached to the fixed recorders is also proposed in retrofit and forward-fit on all aircraft to localize the wreckage and to localize the recorder.

Just in conclusion, I have to say that Airbus has been, is, and will be always compliant with regulations. That's why we have made all of those changes during the last years. It was important to us to be ready, and to be ready to face future regulations. And we rely very much on this framework regarding what I heard from the first panel just before us; it's important to have a framework from the regulations.

Thank you, Mr. Chairman.

MS. GORMLEY: Thank you, Dr. Andrei.

Our next presenter is Mark Smith of Boeing Commercial Airplane Company.

Mr. Smith.

MR. SMITH: Good morning. I've been asked to discuss Boeing's viewpoint on technologies to help improve our ability to locate downed airplanes. In this respect, Boeing was a participant in the BEA working groups after Air France 447 that examined these technologies.

So in the slide I'm showing now, I'm listing some of the technical solutions, a list of options that will allow us to improve our ability to locate the impact point on land or on water. In an underwater accident knowing the exact impact point with higher accuracy would allow us a more effective search and rescue effort, and then would follow with a minimized underwater search area.

The second bullet shows options that would improve our ability to locate recorders that are already underwater. Due to time limitations, I will only be discussing the items shown in yellow text. These lists show that there are more than one way to solve this problem. Be aware that each of these options also has drawbacks that we have to be aware of when introducing them into the commercial fleet.

So that we can be data driven, I'd like to review some statistics. This is a bit of an eye chart. I apologize, but this is a list of all underwater accidents worldwide since 1980. This list was originally put together by the BEA working group after Air France 447, and it includes transport category airplanes from all manufacturers, not just Boeing.

The columns on the chart, in addition to the accident date, the type of airplane and location of the accident, the last three columns show depth of the wreckage, how many days it took to locate the wreckage on the seafloor, and then how many days it took to recover the recorders. This list is sorted by the last column, how many days it took to recover the recorders.

This shows that recorders were recovered in less than 30 days in 21 of the 31 accidents; 4 of these accidents took more than 30 days to recover; and 3 took more than 1 year to recover. If you look at averages with this whole list, in the last 34 years, since 1980, there were a total of 31 underwater accidents listed in the 34 years. This results in an industry average of one underwater accident per year. It also shows that once every 10 years it takes longer than 1 year to recover the recorders. This is the issue we are addressing today, the ones that take a long time to recover.

Looking at the data in a slightly different way, this chart shows how many accidents occurred worldwide on land, and how many in water for the last 6 years, 2008 through 2013. Along the first line there, on average, there are 15 accidents on land as compared to 1 per year underwater. And those are averages, once again. Our current-day recorder systems are doing an excellent job of helping us understand all of these accidents. Boeing believes we can leverage equipment already on board the airplane to help improve the underwater location ability and collect the reorders.

The statistics in the lower right corner show how many airplanes were flying worldwide in 2013, where we had the 13 on land accidents and we had none underwater. With over 22,000 airplanes flying worldwide, there were over 25 million flights in 2013. This results in an average of 69,000 flights per day. The reason I highlight these numbers is any change that we introduce to the fleet introduces the potential of unintended consequences on those 69,000 every day flights that did not have a problem. And some of these might be in years where we've had no underwater accidents, as with 2012 and '13.

Moving on to some of the work that Boeing has done on improving locating recorders underwater. Boeing has already taken steps to improve our ability to locate an impact location. Reports transmitted via the ACARS system have been significant in understanding accidents prior to recovery of recorders. Boeing has leveraged this by adding lat/long information to some of the message headers, and by implementing an emergency position report when an exceedance occurs. These are learnings that came out of the Air France 447 work with the BEA.

This triggered transmission via ACARS increases the frequency of position reports once an exceedance is detected, and these reports include lat/long, altitude, speed, heading, and so forth, to help better pinpoint the water entry point of an accident. Using the ACARS systems over oceans where we're using satellite connections, one of the drawbacks of this might be that the data might not be able to sent off the airplane all the way through impact due to connectivity issues with the satellites.

These changes I've discussed, lat/long in some message headers and the emergency position reports are already flying on some of our newer Boeing models.

I was also asked to speak about our history with deployable recorders. We have no commercial applications of deployables; however, we have installed deployables on some of our military variants for certain customers, as requested by the customer. The first picture there is the P-8, a maritime patrol aircraft, which is a variant of the 737. One customer of eight of those airplanes requested deployable recorders, and we have installed them. Right below that is the E4B Airborne Command Post, which is a variant of the 747, with deployable recorders.

Our history with this is limited in service, but during development with these two applications we experienced inadvertent deployment, deployment failures, and inadvertent ELT activations. In one case, a deployable was released over a downtown area. These were events that happened in development. We believe we have them corrected, but it highlights some of the issues that can occur with deployables. I do not have in-service results yet on how successful these are in an in-service situation.

On the F-18 fighter on the right side, since 2004 there have been 24 accidents where a recorder was deployed. Eighteen of those were recovered, resulting in a 75% recovery rate. So, I'm bringing these points up to highlight some of the potential unintended consequences that can occur. Unintended deployments from a commercial airplane would not be acceptable and would be a risk that we have to manage. Additionally, even with a deployable installed, it does not guarantee recovery of the data at 100% assurance.

I see I'm out of time, so I'm going to skip to my last slide here. In summary, Boeing, is already delivering airplanes with capabilities that will help locate a downed airplane, including the emergency position report, lat/long in some ACARS message headers. Next year, Boeing will be introducing the new 90-day pingers attached to the recorders. We also are participating in industry activities on full-time flight tracking and triggered ELT concept, which I have not discussed here.

I would like to reiterate that each option here, as well as benefits, has drawbacks, and that there is no one perfect solution. We need to be aware of introducing unintended consequences to the large commercial fleet that's flying.

Lastly, industry and Boeing prefers performance-based requirements rather than prescribed technological solutions. This allows for different technologies to be used to meet a requirement as technology changes and advances.

That concludes my presentation. Thank you for allowing us to contribute to the discussion.

MS. GORMLEY: Thank you, Mr. Smith.

Now that we have two manufacturer views of current and future commercial aircraft, we turn to Chris Benich of Honeywell for an avionics provider perspective.

Mr. Benich.

MR. BENICH: Thank you. And good morning, and thanks very much for the opportunity for us to present our views on this important topic.

Honeywell has been providing, developing, maintaining, supporting recorder systems for well over 50 years. We provide recorders for air transport airline, regional airline, business aviation, helicopters, so a whole variety of fleets. And for the most part, as you've heard -- actually I won't go into the statistics as my colleagues have, but the performance has been quite good. When data recorders are recovered, the data recovery is excellent. The information is available the vast majority of the time.

That said, it's not 100%. We're always looking to try to make the system better, to make the system work more consistently. A couple of those areas that we're working on right now -- again, you've heard of some of this already, but the 90-day duration of the ULD is in work. Our recorders as of 2015 will include this feature.

In addition, this notion of having an additional device, an additional locator device with a lower frequency to extend the range is an important addition to ensure finding the location of the aircraft as well as the recorders, again, addressing a problem that we've seen primarily in very deep water and places where you've got terrain or other things under the surface that can impact the ability of the existing pingers.

A third area that we're not actively working on but certainly understand the need, is the voice recording and extending the duration of the recording to cover the entire flight. So when we have operations of aircraft at 14, 15 hours, extending that capability makes a lot of sense and certainly with the solid-state recorders that we're providing today is not a huge technical challenge.

So a couple thoughts on a couple of these ideas that certainly we'll hear more about over the course of the day. Deployable recorders, we aren't doing any active work in this area. We don't view this as being really technically, you know, very super challenging. It's doable, and it's certainly been deployed on military aircraft. At the same time, there are a number of challenges, risks associated with it.

Certainly, adding the complexity to the airplane, where we currently install recorders deep into the frame of the airplane, is an engineering challenge; maintenance for the airlines and the operators of the aircraft, the risks associated with those maintainers, those people working around the airplane; and then the uncertainty associated whether it works as intended. So that's certainly not going to be 100% type of a device as well.

And at the end of the day we hear a lot about the cost and the time associated with retrieving the recorders today. And I think as a reminder, and certainly you guys know this better than us, but at the end of the day the overall aircraft wreckage is of importance and value, and the cost of going to get that is the same cost that's associated with going to get the recorders. And so, at the end of the day, getting the recorders is going to be part of the deal.

So, in streaming data, another one that technically is very doable, we have a great connectivity on the airplanes today. That connectivity doesn't come for free. We have to consider the value of streaming this data. And as we've already heard, the certainty of that data due to unusual attitudes and other things that can happen, especially during the time of an accident, is also not 100%. So we would view this as absolutely something to consider. How we use it, we view this as really being an augmentation to the current system, something we can do to improve the availability of the data, but not necessarily at the end of the day replacing the need for recorders on airplanes.

So what we're really trying to do is to ensure that we're addressing the problems that we're seeing, and some of those enhancements are along those lines. And one of the key ones that I think we're experiencing today and that we're very aware of is the importance of locating the wreckage and locating the aircraft. And the sooner and the more accurate that you know that, the better chance you have of recovering the airplane as well as the recorders.

So with that in mind, I'm thinking about a few solutions that already exist, keeping track of the airplane, ACARS, we've heard some about that already. The vast majority of the fleet, if not the entire fleet, operating in the oceanic environment are currently equipped with ACARS systems. Honeywell provides the communication management units or kind of the router, if you will, on these airplanes.

Those systems are configurable by the airlines. The airlines have the option, and always have, to manage those reports, set them up any way they want. They're set up on the ground in advance of the flight. They can happen automatically. They can transmit any kind of data they want at any frequency, and it can also be triggered by certain events, failures of systems on the airplane, et cetera.

The down side to that is that they are connected to the cockpit. So even though some of these systems, the reports can happen automatically, there is also an interface in the cockpit to turn any of that off, disable any of those reports, pull circuit breakers, et cetera.

An extension of ACARS is Automatic Dependent Surveillance-Contract, so the FANS, air traffic control like addition to the ACARS system. This is also configured from the cockpit. This requires a log-on by the pilot to the system. The big difference here is that the air traffic control environment controls the amount of communication as well as the frequency.

A couple other systems I'd just thought I'd mention that can be used in the tracking of the airplane and the flights, this new Aspire 200, which is a SwiftBroadband Inmarsat system, provided mainly as a back of the bus cabin communication system often or primarily on business jets. The unique part of the system though that is valuable is that when it is turned on -- and it can be completely in the background, powered up with the aircraft system -- it's automatically communicating with the Inmarsat network and providing regular updates, latitude and longitude, you know, not just an hourly handshake, but in fact a very short-term handshake with the system.

And the other system I was going to mention is the Sky Connect, and that's something that is an Iridium-based tracking system. We provide these primarily on helicopter fleets, although we have certified it and it is in use in some individual air transport type aircraft. It is also back of the airplane, independent from the cockpit, powered on with the aircraft, and it's in constant communication with the network. These transmissions are going back to the operator and are being used mainly just for fleet tracking, but could also be used across operations globally, if needed.

So, in summary, the recorders, they work well. We're continuing to improve their performance based on gaps we find in the system. We're really looking at trying to locate the airplane. I think that's the key challenge that we have in front of us. There's a lot of systems out there today to provide that capability. It's not adding a lot of cost to the airplane, but we also can harden those systems, if needed, to improve the continuity of that function.

So, thanks very much for the opportunity to talk here today, and I look forward to taking any questions.

MS. GORMLEY: Thank you, Mr. Benich.

Our final presenter in this panel will be Steve Kong of Inmarsat for a satellite provider perspective.

Mr. Kong.

MR. KONG: Good morning, and thank you to the NTSB for the opportunity to present.

I'd like to go through and take a step back a bit. We're obviously really enamored on flight tracking, and I believe that that's going to be solved pretty well. I'd like to talk about the instance where we are waiting for any information due to recovery of the flight data recorder or, you know, sometimes we won't ever recover a flight data recorder.

I use the analogy of the smartphones. Our smartphones can tell us exactly where we are at any time and place of the day, but what's more important, if we're trying to locate a loved one because they're missing, we'd like to know the sequence of events that led up to the disappearance of that loved one: what text messages they sent, what Facebook things they liked, what they purchased, everything else. Those are very crucial important information leading up to the event of locating someone. And so, that's the analogy there.

And we've got technologies coming online that I'd like to tell you about that is happening in the aviation sector too. But also, while we're looking at recommendations for technologies, and performance-based requirements, let's not pass up any ideas that -- or solutions that are hiding in plain sight. So the aviation sector has got a bunch of programs that are putting technology on board that can help solve some of these situations, and use them more effectively.

So here's a picture of Inmarsat's ADS-C tracking. This is one week's worth -- actually last week's -- of all inbound and outbound flights into and out of the U.S. We have the information, we do store that information, and it's readily accessible in case of an accident or emergency. In the last few high profile accidents, we made that information available where possible. In the latest tragedy, we only had the satellite look angle to provide. We did not have the ADS-C. But this is a solution that all long-haul aircraft almost have.

If it's not ADS-C, then it is ACARS waypoint position reporting, as my fellow colleagues have presented. But in the performance requirements basis, we should just say the performance requirement is that aircraft must send lat/long by an approved ICAO method: ADS-C, ADS-B, FMC WPR, et cetera.

Number two. So should those systems become inoperable for whatever reason or another, don't forget that aircraft are putting on SatCom equipment for business reasons, for operational reasons, and passenger WiFi. Here is an example of one of our latest technologies, where we are actually sending not only lat/long, but also heading, speed, and altitude. That is very similar to ADS-B intent, but -- not quite, but this is a test flight, actually a revenue flight that we did from Miami to New York. It sent lat/long, heading, speed, and altitude by non-ICAO approved. Just in case the systems become inoperative, we have a second layer of tracking that comes along with it.

Now, important to note, almost every single airliner has a passenger WiFi system either installed or will be installed within the next 5 years. So that is a big technological step, just like the smartphone revolution is that all passenger airlines are probably going to have a WiFi system on board. Now, in that case the passenger, if there is an accident and something happens and it disappears, we will know what the passenger is doing on board that aircraft more than what we will know what the cockpit is doing. So it is very important that we use the technology that we have on board and glean the information out while we are trying to locate the data recorders, locate where it is, et cetera.

So we have approved ICAO tracking means: ADS-B, ADS-C, FMC Waypoint Position Reporting. We have backup -- maybe non-approved, but these are performance requirements -- we have backup handshakes. You obviously know Inmarsat's famous seven arcs handshake. We've now improved that, and we're going to incorporate into our newer systems lat/long, speed, and altitude, and heading. And so all these other enhancements should be part of the solution that we address.

Real time data, we all think that real-time data is impossibly expensive to do, but Inmarsat is committed to working with the industry to make it affordable. It's not that we want to send everything. We want to send what you need and only when you need it. So we've made the 15-minute lat/long ADS-C for free now, so that's one part of the way we're making things affordable. But there's a solution that already exists via the ACMS system, Aircraft Condition Monitoring System. That is the bowels of the aircraft. That is where the 1's and 0's happen.

It is all stored within the aircraft, and it is a matter of gleaning that stuff out. It is connected to the ACARS system. And within the ACARS system it's connected to the SatCom system. You can get any -- the capabilities differ upon aircraft model, but we should think about what we should send, whether it's pitch, roll, yaw, those rates, angle of attack, pitot study, cabin pressurization/depressurization.

With the last few high profile accidents we knew very little. On Air France we knew something. And even in that unusual attitude, airplane stalling, airplane overspeed, whatever, the SatCom still remained connected.

So before an emergency event happens, it is imperative that during the time that we try to locate the recorder, if we can, it's very important that we stream something off, because in the future, in the next 5 years when we -- when and if we have another accident, we'll end up saying, well, what did the passenger do? Because passenger WiFi is going to be pervasive, we should in the cockpit keep up with that pervasiveness, and that knowledge of what happened in the cockpit as well. Whether it's voice recording, whether it's video recording, whatever, we can all talk about what we want to do.

So let's focus on some of that stuff as well, and not just tracking and locating because sooner or later the technology is going to, as we say, outpace our requirements. So don't wait. A lot of requirements take decades to implement. We've got the technology on board. Some of these solutions that I've presented here require no wiring changes. The business case is folded into passenger connectivity or other operational requirements. So it's just how can we better use and smartly use the situations and the technologies that we have here today. Thank you.

MS. GORMLEY: Thank you, Mr. Kong.

This concludes the presentations for this panel. We are now ready for questions from our Technical Panel. I'll turn things over to Mr. Jacky the Technical Panel lead for this topic.

MR. JACKY: Thank you, Ms. Gormley.

Before I get started, I want to thank each of the panelists for your presentations. Appreciate the information and as well as the hard work that goes into making these presentations.

First of all, what I intend to do is to ask each one of the panelists some individual questions and then hopefully at the end have enough time to follow up with some questions for each or for all of the panel.

To begin with, Dr. Andrei, in your presentation, and on page 5 -- if we could pull that up, please? This is the chart that you showed that showed the potential short and medium term solutions for the Airbus programs.

While he's pulling it up, the question I have for you is -- this is a good overview -- could you provide a thumbnail or some further information as far as the timeline for implementing these solutions and where Airbus is at as far as the status of these solutions, please?

DR. ANDREI: Okay, of course, sir. In fact, so I'm going to go through each of them. On the first one, the aircraft tracking is ready now. The only drawbacks we have on that, and that's why it's something which is still under investigation, first of all, is it relies very much on the airlines, on the wish of the airlines to transmit the data from the aircraft to the ground.

The second one is technical limitations. We need to send data to the ground through communication means, Inmarsat Iridium, so from the SatCom more especially. But we, in some cases or some aircraft attitude, we may lose the line of sight with the satellite and we have to ensure that we can transmit in any cases the data we want to have, and more especially, the tracking.

Another one, which is when you have a full engine flameout, or when you have big damage on the aircraft with no more engines, then you have lack of energy, you rely on the electrical supply energy. And the SatCom, which is a high consumer of electricity is not supplied in such cases. So that means that when you need to trigger the data, you cannot rely anymore on such equipment. But for this first part, we are ready. Technically speaking, it's feasible very quickly.

For the combined recorders, we have made a lot of studies regarding inadvertent deployment, speeds of deployments.

We've been working with suppliers, DRS, which is in this room, also Airbus Defense and Space are also providing deployable recorders. And we can say today that we are quite confident in the future of this addition. I don't have any roadmap to give you, but at least we have found the localization of the aircraft to integrate such a deployable recorder. We've been working with suppliers of recorders to integrate the full architecture, and this is something which would come very soon after some more studies and assessments.

The low frequency ULB is ready, quite ready. We have defined RFPs with our suppliers. So this is something which is on the way. The localization also on the aircraft has been assessed, and on the forward-fit, which is something that we already do by our own, and of course we will support any kind of requirements from operators to install the search ULB on retrofit. And on the 90 days battery extension life of the ULB, this is the same thing, as we are ready. The technology exists since years. It was just a matter of regulation. So we are ready to follow up.

MR. JACKY: Thank you.

There was discussion earlier, and in the international community as well, with regard to the concept of triggered flight data recorder information, or even the continual transmission of flight data recorder from the airplane back down to the ground.

Has Airbus done any studies in this realm? And, if so, could you describe them please?

DR. ANDREI: Yeah, of course. In fact, we don't believe, as it has been said just earlier that we needed to send, to broadcast the full content of the black boxes. According to the aircraft governances, we have to use a -- or event-driven broadcast of information. It can be on failure mode. You know, that we have an earth monitoring system on board our new generation of aircraft, so we can rely on this system in service today to trigger on a failure event some data.

And also, we can -- we have made some studies with Airbus flight test department to be able to detect loss of control, an aircraft in a loss of control situation. And then, when we achieve such a -- when we reach such a situation, we can trigger a couple of data from the aircraft to the ground, of course. So this is a more event-driven broadcasting of data.

We can also support airlines to trigger -- to change this equipment, as I said, just with a software-based modification to trigger the periodicity of the data sent to the ground. For instance, as it has been said by Inmarsat, if we send periodically a set of parameters every 10 minutes, if you have it moving away from a scheduled waypoint, we can send every minute the same set of parameters details to the ground that make an alert to the ground saying that the aircraft is moving away from the scheduled path.

MR. JACKY: Thank you.

If I could direct you to page 3, of your presentation please? And in the Chairman's opening statement there was a discussion about uses, or the concept of use of flight data in ways other than the storage on flight data recorders. In the industry there's discussion of that, or uses of that in terms of airplane health monitoring by use of ACARS or other systems.

I believe that the slide here, page 3, hints towards that. Could you give an overview of Airbus's use of these concepts? How the data is recorded, how you used it, and how you work with operators with this data?

DR. ANDREI: Okay. This relies very much on the agreement and the contract we have with the airlines. So today our new generations of aircraft, like the A380 and the A350, are able to make -- and then some long range, are able to make maintenance monitoring on board during the flight and to send regularly a report to the ground,

We have Netac, which is a service inside Airbus. We are able today to monitor such a system on board the aircraft, and to ask the aircraft to send more data, if necessary, to the ground. This is something which is done only with some airlines, according to the contract we have with them. And we can use, of course, such a system to trigger some information on an aircraft when we have suspicious events on board an aircraft today.

MR. JACKY: And as a follow-up, in your experience, is the data, after an event or an accident, is that data provided to accident investigators or agencies or is that done by the operators?

DR. ANDREI: I don't know. To be honest with you, I don't know.

MR. JACKY: Okay. Thank you very much.

DR. ANDREI: You're welcome.

MR. JACKY: Turning to Mr. Smith and Boeing, actually the same question with regard to aircraft health monitoring and the ACARS system, or using the ACARS system. Could you provide a thumbnail from the Boeing perspective please?

MR. SMITH: On how we use airplane health monitoring?

MR. JACKY: Correct.

MR. SMITH: So the airplane health monitoring and the ACARS system are set up to -- they're operational requirements for the operators. It transmits various types of messages when the airplane is lifted off, when it's landed, when it's reached a certain waypoint. It can report if failure has occurred on board and there's associated maintenance with it. This allows the operator to prepare parts and mechanics at the destination to get the airplane repaired quickly and get it back into service. So it's put there for operational reasons. And each operator sets this up and tailors it to their own needs, if you will.

That system, even though it's on board for operational reasons, has been of great benefit in several of our investigations, as we've talked about here. The data is typically owned by the operator. Sometimes Boeing has access to it, sometimes not. It depends on the arrangement with the operator. And in an accident investigation, if we don't have access to it, we would go to the operator through the investigation agency to obtain it. Does that answer the question there?

MR. JACKY: Yes. Thank you very much.

If I can refer to your presentation, please? And I'm going to start with page number 5, or slide number 5, "Enhancements to Reports with ACARS," please.

And I want to touch base on the bullet number 3 there, which discussed the Emergency Position Report when exceedances occurred. And I was hoping you might provide us a little bit more information regarding that, specifically with regard to whether Boeing and/or an operator that may have it on their models, has there been any sort of in-service experience with that?

MR. SMITH: So I asked that question before I left, and I have not -- I don't have an answer to it. I don't know the answer to that. What I can tell you is it is -- let me give you the 787 as an example. It's basic on that airplane. It's set up with some default values that were chosen by Boeing, and, you know, there's a list of maybe a dozen trigger exceedance parameters.

The exceedance points are chosen by Boeing, and what this report will do is once an exceedance is detected it will start increasing -- it will increase the position reports to once every 10 seconds, once every 20 seconds. That is all completely configurable by the operator. They can turn it off, they can set the exceedance values to a place that they choose, and so forth. So it's not necessarily going to be constant around the fleet because it's operator dependent. And I do not have the service history on that right now.

MR. JACKY: And as a follow-up to that, I guess if you don't know the service history, then the methodology for sharing that information with accident investigators?

MR. SMITH: Well, so, with the 787 in particular, there's a centralized facility at Boeing where all messages come through on that airplane. It's a different arrangement than our previous models. I think I could get it for the 787 and report it. But the data -- let's say we are having nuisance trips of that. Obviously, a 787 has not gone down, so we don't have an accident to chase the data for. But if there are some nuisance trips of this exceedance report, I think I could get the data.

But technically, the operator would own that and I would have to get their permission to share it with you, but it would be that sort of a path that would take place. It's available. I've just got to work through the process.

MR. JACKY: And then, finally, with regard to the system, would that system be retrofittable to already manufactured airplanes?

MR. SMITH: Well, the function gets put in when there's a software part number role to a function. So, yes, it would be possible to do that, I believe, but it would probably be a software role that isn't necessarily mandated and some operators might not accept it. It also depends on -- some of the older airplanes, if some of the parameters are available on the data bus to do the function, and so forth. So there's quite a different range of airplane configurations out there that makes it difficult to answer that question.

MR. JACKY: Thank you.

On the next slide, which is the Boeing deployable recorder history, a question for you regarding that. You mentioned in the presentation that deployable recorders on future new models of airplanes needs study. And actually, that may be a reference to the next slide, which you very quickly went over, or skipped over.

MR. SMITH: Yes.

MR. JACKY: From your organization and in the experience that you've had with deployable recorders on military and other applications, what elements of those deployable recorders do you believe or Boeing believes needs -- or concerns for future study?

MR. SMITH: I guess in two areas. Let's start first with the deployment mechanism. Deployables have been a great success, I understand from my colleagues on the military side, from the F-18 experience. It's given them data that they didn't have before. The F-18 triggers deployment on ejection seat trigger, and there's one other that I can't remember right now.

But a commercial airplane doesn't have the ejection seat option. So we would have to look at other ways to trigger it, as with a G-switch or a frangible switch.

And let me give you an example of a G-switch. The G-switch is what we use on the ELTs that were discussed earlier. We do not have a good service history of those switches activating in an accident. So the trigger mechanism on a commercial airplane would be a lot different than it is on the fighter, for instance. That's one item.

The second item I would have to go to is the inadvertent deployment point. If we could go back to slide 4, please? That's 3. One more, 4. Right. Nope, the other way. Right there. Thank you.

This is one reason I brought up this slide. The fleet hours in the bottom, if we take the fleet hours, 54 -- I'll round it to 55 million flight hours. In an active system like this where we have to make the system do something, nuisance deployments would be an issue. A good nuisance deployment rate number for our experience in service is 10^{-6}, which is 1 per million, or 10^{-7}, which is 1 per 10 million.

10^{-7} is a difficult number to achieve with an active system because of parts failures; you have to build redundancy in and so forth. If we take the 55 million flight hours at a 10^{-7} nuisance rate, that would give us five or six deployments per year around the world, if all 22,000 of those airplanes were equipped with them. So that's the sort of unintended consequences that we want to caution here. I'm not saying deployables are a bad idea. It's there's a balance of benefit and consequences here that we have to keep in mind.

MR. JACKY: Thank you very much.

I'm just looking down here at your next slide, or slide 7, and I notice that or I remember that you did quickly go over that. Are there any other points that you want to make regarding that slide?

MR. SMITH: Yes, and let me run through this real quick. So, the first two items I did discuss in detail: the lat/long in some messages and the emergency report on some of our newer models are already flying and in future models, obviously, very feasible.

The full-time position tracking and triggered ELT concepts are being actively studied by industry. We are a member of those industry groups in supporting those, so we will follow the recommendations that come out of that.

Fulltime transmission of FDR data we are not currently pursuing. And when I -- that particular concept is full-time offload of the full FDR parameter set, which is quite a number of parameters and high sample rate data trying to replace the recorder. We are not looking at that because we don't currently think it's feasible or the infrastructure supports it. It doesn't mean it won't be in the future.

Deployable recorders we're aware of. We think they need study, and we're monitoring, and we'll see where the requirements come out of these various panels.

On the underwater localization, on the bottom, the 90-day pingers are -- we're ready to implement those, as the gentleman from Honeywell said. We're waiting for the TSO standard to be approved by the FAA on those pingers, and as soon as it is, we will start delivering those some time next year into our fleet. And then, those will be retrofit by attrition into the existing fleet. That is a significant improvement across the fleet, in my opinion.

The third pinger, the new third pinger, the low frequency pinger, we are not currently pursuing. We're waiting for the other items to settle out here, if you will. If we are successful in impact localization to a very small number like the 6 nautical miles, we don't believe the third pinger is a necessary piece of equipment to have on the airplane. But that all comes out when you marry together all of the options here.

MR. JACKY: And just to follow up, when you talk about the other technologies, you're meaning the ones at the top, lat/long in messages and Emergency Position Report? Is that the type of technologies that you refer to that would make the third pinger not necessary?

MR. SMITH: Yes, in general. And let me fill in a little bit of that. So the emergency report -- actually, both of those. In understanding what happened in the Air France 447 accident, as the airplane descended it stayed fairly with wings level and it maintained its connectivity with the satellite, and many of the messages that were put off the airplane occurred fairly close to the impact point. Those messages at the time didn't have any position information in them. Our emergency report would have triggered in that case, as well as some of those messages may have had the lat/long in them to help localize that wreckage. So this all came out of the learnings from Air France 447.

MR. JACKY: Thank you very much.

Now, turning to Honeywell and Mr. Benich, and if we could pull up his presentation please? And I'm going to start with the last slide, number 9.

In the summary you mentioned, the third bullet there, narrowing the search zone is the key challenge. Could you provide an overview or describe how existing Honeywell products or enhancements to those products could assist accident investigators narrow that search zone?

MR. BENICH: Sure. Well, the simple answer is just knowing where the airplane was when it went down. And so, the solutions we have are really the ones that I referred to earlier. ACARS is the most available system today, and ACARS can be configured in, as I indicated, a lot of different ways and sending information at many different intervals. And, you know, so the -- really deciding on what is that right interval, what is the right amount of data, clearly the latitude and longitude are key. And then, there's other factors that -- other pieces of information that you could include. And that really is what leads you to zeroing in on the location and developing a search zone out of that So ACARS is one, you know, Sky Connect, the new SatCom system -- I mean, there's a number of other systems at work, but I only referenced ACARS as being the one that's most widely available today.

MR. JACKY: Thank you.

And regarding -- if we go up a couple slides to slide number 7, with regard to the Aspire system, could you provide maybe an overview or the information that is provided and that could be provided beyond just aircraft position from using that system?

MR. BENICH: Well, the data that is provided -- actually, I suspect Mr. Kong can address it even more clearly, but it's a feature of the SwiftBroadband. So our Aspire 200 is one radio essentially that connects to the SwiftBroadband system. But the aircraft state data is the type of information that is included in the handshake. Exactly the set of data that's available, I don't -- I can certainly get back to you on that to be complete. But the latitude, longitude, altitude, air speed is kind of the heading, kind of the basic information.

MR. JACKY: Mr. Kong, anything to add to that while he mentioned you?

MR. KONG: No, it -- don't worry, I used to work for their competitor, so -- and I used to work for Boeing for 10 years as well, so I kind of know the ins and outs of everything.

But that graphic in the bottom right-hand corner, the SwiftBroadband system is a 3G mobile phone system in the sky. Each of those footprints, the three of them -- we actually have four of them now. There are 200 spot-beam cellphone tower beams per one of those global footprints. And our satellites require lat/long every -- at a minimum every 2 minutes to hand you off seamlessly between each of the spot beams. So it's an intrinsic lat/long already, so anyone that installs this system has inherent flight tracking, so to speak, but obviously not in the ICAO formatted standard.

MR. JACKY: Thank you.

And just to follow up on that, Mr. Benich, if you mentioned I missed it, the type of applications or the airframes that these systems are being applied to or used on?

MR. BENICH: Yeah, primarily today -- in fact, I think I would say exclusively today they're on business aircraft, business jets, global operators, although it's available for airline aircraft as well. It really is an augmentation to a cabin communication system or cabin IFE kind of a system.

MR. JACKY: Thank you.

And then, I'm going to move ahead to slide number 8 with regard to the Sky Connect system. And you mentioned that this system does have a history now, and if you could provide any sort of real world experience with use of the data from this system to locate a helicopter or an aircraft that might have gone into the water or that was lost?

MR. BENICH: I'm not familiar with any accidents where the Sky Connect was involved on the aircraft and provided data, which I guess I would say is a good thing for our customers. It's really on the airplane, and the reason our customers have it is to track their fleets, and to -- you know, on a continuous basis without intervention from the cockpit, that, you know, when the airplane is moving they're getting data. And so, the experience has been quite good. Again, often used on helicopter fleets, offshore oil platforms, they -- you know, they're just keeping an eye on where everything is.

MR. JACKY: And I'll ask you the same as a follow-up. The information or the tracking data, that is going to the operator and not to Honeywell?

MR. BENICH: Well, it passes through Honeywell, so Honeywell has a data center or service center, and so the messages are addressed out of the Iridium system to the Honeywell data center. We unpack the data. There's a -- I think it's a phone number identification that is in the file, and that directs it to the customer. So we're really just the post office, sort of, and then ultimately the information is delivered to the customer and it's their data.

MR. JACKY: Thank you.

And finally, to Mr. Kong, with regard to your presentation, there's a lot of information that you're talking about that could be recorded or that is being sent back through your system. I was wondering if you could talk about -- or at least as an overview -- the concept of privacy of the data, sharing of the data, and how would that data -- how is what data shared with accident investigators and other government agencies?

MR. KONG: In reverse order, shared with accident investigations, obviously upon accidents?

MR. JACKY: Yes, please.

MR. KONG: We immediately shared Air France. We shared it the BEA immediately. MH370, we shared it with the U.K. Accident Investigation Bureau as well as the Malaysia government DCA. So, no restrictions there obviously, due process, due causes of any requirements or warrants or subpoenas, great, all that stuff. We don't have too much transparency on the content of the data, apart from the lat/longs and the heading and air speed that we store in our own servers. But obviously, we will make that available upon request or demand on due process.

All of our information is encrypted by the 3G protocols, so it's secure. We obviously have and run security assessment tests on our network regularly. So pretty standard security requirements.

MR. JACKY: Thank you.

And if we can pull up your presentation as well, and I'm going to first refer to panel -- or slide number 4. It was your Solution #2, the enhanced handshakes. I just wanted a clarification on that.

You mentioned changes or retrofit, and I believe you were referring to the satellite system with regard to this, or would it be retrofit on an airplane software or hardware level? Could you elaborate on that please?

MR. KONG: So, going forward on all new systems, such as the Aspire system, we're going to include these enhanced parameters. For instance, on MH370 we could only tell the satellite look angle and Doppler shift, for instance. On these new systems we will have, very similar to ADS-B intent, items that's standard and that's configurable down to the seconds, if need be. But obviously, too much data is too much data. So we want to know what the balance is on the enhanced handshakes.

MR. JACKY: And I guess it's an obvious question, but you will have the capability to record all this information? It sounds like a lot of information coming in. You have enough servers to --

MR. KONG: Yes, sir. It's all recorded, especially this stuff.

MR. JACKY: Okay. And I guess that -- to the next slide, number 3, with regard to the real-time data options, the same question. You'll be able to handle that amount of data that would be coming in from all these different airplanes?

MR. KONG: So what we need to do is look at which technology -- the current technology that's deployed on tens of thousands of aircraft are like a 2G text and voice service. And so, that 2G text and voice service can only handle small packets of ACARS messages. We handle quite a few, in the order of millions of ACARS messages every year. And so via the streaming of -- ACARS is ironically very efficient because each packet is only 220 characters. And so you can't stack it with, you know, headers and et cetera, like e-mail does.

So, it's inherently efficient. And if you send the right ACARS amount, even on existing 2G systems, which is deployed on over 10,000 aircraft a day, it can handle quite substantial amounts of information. So we look to industry experts here, Airbus, Boeing, yourselves, to figure out on the over 10,000 aircraft a day what live data that you need, and only send what you need; don't send everything. I heard that we -- you know, we're not looking into sending the entire contents of the flight data recorder. That's not what our purpose is.

Our purpose is to send what you need. Because in the time that it takes to locate a recorder, and in some cases we can't locate it at all, extreme anxiety happens, and the answer that we don't know isn't acceptable. So let's stream something, don't stream everything, and on our 3G systems, which is the Aspire systems, it can handle basically what a 3G smartphone can handle. But obviously, we don't want to send too much and get datarhea, for instance. But we want to send enough to help us in investigating an accident until we retrieve the flight data recorders.

MR. JACKY: Thank you very much.

Now I have a question for the four of you, so I would just suggest that maybe you go right down the line as far as answering it.

In the first panel today there was talk of performance-based requirements. And turning to you as the manufacturers of these equipments, could you provide an overview of what additional policies, procedures, or performance requirements do you believe are necessary for your organization to implement or equip airplanes with these new technologies that you discussed today?

MR. SMITH: Okay, I'll start. Let me give an example. I'll give you two examples. If we take the ELT as an example, the regulations -- the recommendations from ICAO and the regulations from EASA say thou shalt put an ELT on the airplane. That is a prescriptive requirement saying put this piece of equipment on. A performance-based requirement would be, be able to locate the airplane within a certain number of miles. Instead of how to do it, say here is what we want done. So that's an example of a prescriptive requirement versus a performance-based requirement.

In this case here, coming out of the Air France 447 --

the BEA working group after 447 that led into ICAO changes, the current requirement being looked at for locating impact is being able to locate an impact site within 6 nautical miles. That is a performance-based requirement. It does not say do it with deployable recorders or do it with a satellite laser beam, or whatever the technology might be.

We prefer the performance-based requirement rather than the prescriptive way to do it because that allows various options to be looked at, traded, and it allows the options to change as the technology allows change.

DR. ANDREI: I have to agree a little bit of what Mark has just said, but as soon as we are talking about prescriptive or performance, we have also to -- I have many things in mind. The first thing is, for us it's important to have the framework for the vehicle certification because this is key. We have to understand, and our chief engineers they have to understand how to certify our aircraft.

Another point, which has been highlighted by Mark, regarding the ELT, of course, the ELT is not so much efficient today. And we have ELT are triggered in less than 28% of the aircraft crashes today, so which is quite useless if you take the ELT as it is and we wait for the pre-activated ELT in the future. And this leads me to explain, if you remember my slides with all the scenarios and all the technical solutions, we don't push for all of them. It's a combination of most of them.

In fact, if you have an aircraft equipped with a deployable recorder, which is efficient -- we hope so, and I wish that it will be efficient -- plus a pre-activated ELT which is working, you don't need the low frequency ULB. So, in fact, you have to think about the combination of different solutions regarding the performance versus prescriptions.

MR. BENICH: So, a couple thoughts, performance-based requirements, in general we support them and have over time. Peggy Gilligan talked this morning about that, and we've been supportive of her organization in trying to shift in that direction. But we need to keep in mind also that it doesn't work for everything. And often when you're dealing with other systems that are part of the solution, like the satellite constellations or -- you know, that you can't just say, well, just do it any old way you want. You have to acknowledge what's out there and what's available.

And also, while it might be easier for us to understand as manufacturers, it adds complexity for our customers, the airlines in particular, to understand what they actually need to meet a requirement. And I just throw out ADS-B, Automatic Dependent Surveillance Broadcast, as an example, performance-based requirement in part, but the data link, 1090 MHz, is not a performance-based. Everybody has to have that transmission so that they can interoperate. So that's not performance-based. It's very prescriptive on the technology.

The performance-based part comes into the accuracy and integrity of the position, which is set at a level and not saying what you need. But now we're finding and our airline customers are finding, well, what exactly does that mean? You can use GPS? GPS WAAS is okay. GPS with SA-aware receivers may or may not be okay. What about the constellation? How many satellites on any given day? A lot of questions, where -- again, it provides flexibility, but also creates a lot of uncertainty for the operators.

So I would say the same thing would be true for tracking. If we say you can -- you just need to be able to track the airplane, you know, within 5 minutes, there's a lot of ways you can do that -- we talked about a number of them today -- but at what level of certainty? Is it truly global or is it -- you know, the Polar Regions, are they included? At what level of integrity? A lot of questions that show up and, therefore, make defining what exactly that requirement is a little bit more challenging.

MR. KONG: I think they've said it all in terms of tracking, so just as a reminder, you know, please consider some performance requirements on knowledge of what happened before the event of your accident.

MR. JACKY: Mr. Babcock has a couple of questions.

MR. BABCOCK: Thank you.

Just a couple questions, one a clarification, Mr. Smith. You mentioned in your discussion about deployables a recovery rate of 75%. Can you clarify, is that 75% of devices recovered or 75% of devices where data was recovered, or what are measuring there?

MR. SMITH: Standby. So it basically is the end-to-end product of the recorder coming off, recovering it, and getting data off of it. So recorder data not recovered includes recorder recovered but data not readable, recorder did not survive, recorder did not -- was not located, recorder location beacon was not detected and therefore was not located.

I have limited information here. The gentleman from DRS on your next panel has a lot of information on that, but it's the whole end-to-end process.

MR. BABCOCK: Okay. Thank you.

And one question for Mr. Kong. Your presentation mentioned, I guess it was two or three, what might be hypothetical performance-based requirements. But what I didn't see there is what happens when that data is transmitted off the aircraft? You've been open about providing investigators information that Inmarsat does have recorded, but is that a responsibility that you would envision being the responsibility of the satellite provider or would that be the end user?

MR. KONG: So the content of the information is ultimately -- the operator is responsible for divulging that information.

MR. BABCOCK: Okay. Thank you.

MR. JACKY: Acting Chairman Hart, this completes the Technical Panel questions for this panel.

ACTING CHAIRMAN HART: Thank you, Mr. Jacky. And thanks again to all of our panelists.

Now we'll take questions from the dais. Mr. Delisi.

MR. DELISI: Thank you.

Mr. Smith, I've heard this urban legend that if a 787 in flight had some sort of maintenance issue, that Boeing engineers and executives would real time be getting notes on their iPhone about the status of that airplane. Can you talk about that?

MR. SMITH: That is not legend. That's correct. The 787 was developed with fleet monitoring in mind. At Boeing at its center up in Everett there's a whole control room. It looks like a NASA launch room. It's quite impressive. It monitors all 87s around the world real time. And so, basically, though, the information coming off of those airplanes is through this same ACARS type of system that we've been discussing. And it's the on-condition reports, or the position reports, or so forth, that come into that central location and then are distributed.

That system will send e-mails to our fleet managers' BlackBerrys and so forth so we can monitor real-time issues that are going on.

MR. DELISI: Interesting. Thanks.

And, Mr. Kong, you talked about passenger WiFi. And as accident investigators we need to sometimes be very efficient and creative in tapping into all sources of data to try to understand what might have happened on an accident flight. Can you tell me a little bit more about how data from passenger WiFi might be a tool?

MR. KONG: Okay. And just to finish up on your last question, various models of Boeing -- and I used to work at Boeing for 10 years as an avionics engineer. So we used to glean data off on -- you know, we did manual reports from the ground. So if we got a fault report over air, we could actually ping the aircraft for more information. So that technology exists on 67s, 57s, and 37s as well. It's not just on the 87. The 87 is just way more fancy and glamorous, but it does exist on other aircraft. And I'm sure Airbus aircraft have that functionality as well.

On passenger WiFi, as you know, every ISP, whether it's your home broadband provider, if subpoenaed or whatever, they can look up all your website addresses, everything that you've done, every message that you've sent that. They can do that. Now, we are technically not a service provider. We are a satellite provider. We have service providers that sit in front of us and handle that with the airlines.

So when the passenger WiFi systems are pervasive -- in the U.S. almost all aircraft on almost all flights have passenger WiFi surfing, if there were an incident, again, a 9/11 happened or something like that, passengers could Tweet it or whatever, or could -- they could hold up a camera and secretly record it, for instance. So those are some of the things that are out-of-the-box solutions that just happen to be there because the technology is there. And I think my concern is, it'll be operating in the cabin, but we won't have that technology in the cockpit, which is -- which would be my biggest concern.

MR. DELISI: Great. Thank you.

ACTING CHAIRMAN HART: Thank you, Mr. Delisi.

Dr. Kolly.

DR. KOLLY: Yes. Mr. Benich, your last slide, the summary slide, actually the last bullet of the last slide refers to the potential to improve tamper resistance. I wonder if you could explain to me a little bit more specifically -- I'm not sure I heard a lot about that in your presentation. You know, what does that essentially apply to, and what means are you looking into?

MR. BENICH: Sure. Well, so it implies or it's -- you know, that humans on an airplane, if they're knowledgeable enough about the way the system works, can disable functions, whether they're crewmembers or not crewmembers. And so today most of these functions, like ACARS in particular, are designed with the human interface in mind, you know, that the way the system works intentionally the crew should be able to go in and configure or reconfigure, turn on turn off. And certainly then we have circuit breakers involved in the system because sometimes there are problems, and that's why circuit breakers are there to cut electrical power in the case of a malfunction of a unit or some other issue on the airplane. That's the way it was designed.

Whether it's the crewmember or some other rogue individual on the airplane taking control, if they're aware of how the system works, then they can go in and disable things because -- taking advantage of the design, we can -- the tamper proof is to then bury certain subfunctions so that they can't be disabled in certain instances, remove it out of -- as I was describing on some of these other systems like Sky Connect, literally taking it out of the cockpit. And, yeah, there's a circuit breaker, but it's back in a electronics cabinet somewhere and not immediately accessible. As soon as you bring power onto the airplane, the system is running.

So, we can design it with that in mind. That was not the intent when these systems were designed. We can go back and rethink it and say, well, how do we secure that function better on the airplane so that any individual who has bad intentions cannot disable the function.

DR. KOLLY: This question is for you again, Mr. Benich, but also perhaps Mr. Kong. It has to do with the Aspire Inmarsat SwiftBroadband System.

In your slide, you say that the system may also be used for data or voice application. I'd like to know a little more about that, and do you have any customers using it for, say, voice application?

MR. BENICH: Sure. It's a SatCom radio that operates in the back of the cabin, so it's used for cabin communications, Inmarsat streaming information. Just like any SatCom device on an airplane, it can be used for voice, it can be used for data, you can send video. It has a bandwidth of I think roughly 200 or 400 kilobytes per second, so it can stream reasonable amounts of data. And that is the purpose. But again the purpose -- the reason a customer will put it on an airplane is to support the passenger operations cabin in the sky or office in the sky kinds of things in the cabin of the airplane.

DR. KOLLY: So that's not to be confused with any type of cockpit voice recorder application?

MR. BENICH: That's correct. It's not the intent of -- that's not why it's installed in the airplane today. It's not wired into the cockpit at all.

DR. KOLLY: That's all the questions I have.

ACTING CHAIRMAN HART: Okay. Thank you, Dr. Kolly.

I think we have a couple minutes left, if the Technical Panel has any further questions? Okay. Thank you.

Thanks again to our panelists for excellent presentations and excellent discussions. It's been very helpful. You've helped us understand many of the technologies that must interact as a system as recorder and locator technologies continue to advance, so we appreciate that.

After lunch, we will hear from our third panel, which will address technology solutions. So, you heard Ms. Gormley describe the lunch options, and you can ask her again if you want more detail when we go to lunch. But what we're going to do now is take a break and resume at 1:15. Thank you.

(Whereupon, at 11:43 a.m., a lunch recess was taken.)

A F T E R N O O N   S E S S I O N

(1:15 p.m.)

ACTING CHAIRMAN HART: We're now back in session.

Good afternoon and welcome back. We're now ready to hear from our third panel of the day, which will move the discussion to technology solutions. I'll turn things over once again to Erin Gormley.

Ms. Gormley.

MS. GORMLEY: Thank you, Acting Chairman Hart.

For those of you joining us after lunch, for safety purposes please note the nearest emergency exit. You can use the rear doors that you came through to enter the conference center. There is also a set of emergency doors on either side of the stage up front. Please silence all electronic devices at this time.

As a reminder for our panelists, please push the button on the microphone to activate, and bring it close to you when speaking. When done, turn off the microphone by again depressing the button.

Our next panel will provide an overview of technology solutions to allow for a more efficient recovery of data. Our panelists are Philippe Plantin de Hugues, Advisor on International Affairs, and Senior Safety Investigator from France's Bureau d'Enquêtes et d'Analyses, or BEA; Ric Sasse, Program Manager of Deep Ocean Search and Recovery, from Naval Sea Systems Command; Thomas Schmutz, Vice President of Engineering, from L3

Communications; Blake van den Heuvel, Director, Air Programs, from DRS Technologies Canada Ltd; and Richard Hayden, Director, FLYHT Aerospace Solutions Ltd.

Our first panelist will be Dr. Philippe Plantin de Hugues of the BEA, who will give us an overview of some working group activities.

Dr. Plantin de Hugues.

DR. PLANTIN de HUGUES: Thank you.

So I'm going to present the work of two international working groups: the Flight Data Recovery, and the Trigger Transmission of Flight Data working group.

So 3 months after the accident of A447, because it was not possible anymore to hear the pingers on the site, we decided to create an international working group to evaluate the new technology that will help in the future to secure the flight data and to facilitate the localization of on-board recorders.

We tried, in fact, to have a complete overview with existing solution that was at the time available or be available in the future in the field of flight data transmission, new flight recorder technology, wreckage localization technology. And we did perform this work by analyzing the technical feasibility, as well as the cost of the various solutions. So we did perform a cost/benefit analysis of the potential solutions.

So this group was composed of about 100 members for the flight data recovery. We had almost 150 members for the Trigger

Transmission of Flight Data working group. So we had two meetings for each of the working groups, and almost 60 participants from attending the meetings. We had, I will say, everybody on board: people from manufacturers, airline associations, service providers, civil aviation authorities, investigation authorities. So everybody was concerned by the accident of A447 definitely.

So when we were performing the solution evaluation, we didn't want to focus on only one event that was A447, so we did perform an analysis of all events over water, including A447. So among the 52 events over water, accidents over water since '69, 38 happened between 1996 and 2014. And from these 38 events, accident on the water, 8 recorders were not found.

So the evaluation of the various solutions were based on the technical feasibility, maturity in equipment, the cost, and, in fact, we were using at the time costs provided by FAA. So, before starting to work, we went to see the FAA requesting costs to say, when is it green, yellow, or red. And we developed some mathematical scoring to be able to -- for each of the solutions to give the best scoring or the best rate.

And then, the benefit part of the cost/benefit analysis was the applicability to the past event. So each of the solutions were considered obviously as a potential improvement for all the accidents we had on the list. And I have definitely continued to update this list up to now, so it is why you have 38 events within the last 18 years.

So the conclusion of the first flight data recovery was on the short-term basis that we should extend the duration of the ULB attached to the recorder from 30 days to 90 days because the technology was there. So 90-days beacon were available on the market, but nobody was installing them. Then, on the short term, it was again the installation of a low frequency beacon at 8.8 kHz. So there is standards that have been published on the ICAO Annex 6 in 2012, mandating for the 1st January 2018 all aircraft to be equipped with 90-day beacon and for long-range aircraft to be equipped with a low frequency beacon.

Then, on the middle basis it was regular transmission of basic aircraft parameters, and the trigger transmission was found as a good potential solution. It is why we created the second working group. And then, on the long-term basis the recommendation based on the work of this working group was regarding the installation of an ED-112 -- so this is specification from EUROCAE -- for deployable recorders. And last week I chaired the flight recorder panel, and we proposed amendments to the Annex 6.

Then, the second working group was Trigger Transmission Flight Data working group. So the concept is on the primary purpose to define the position of impact. So as soon as an emergency situation is detected, so sufficient information will be sent to the ground to have a position of the impact, so accident site, and if it is feasible to send additional parameters, if it does not compromise the first objective.

Just an information, in 2010 we went to see a manufacturer, and in real time there was an aircraft flying. He was just pushing a button on his computer, and all the data from the FDR were downloaded on the computer. So it was already feasible in 2010.

So the trigger transmission objectives, so just make sure that the triggering criteria we are going to develop are able to detect any emergency situation, so ideally 100%. And just to be sure it was part of the cost/benefit analysis, that on the regular basis, on normal flight, there will be no false positive that may have a cost for the airline.

And so we tried also to define the connection and transmission time to see if it is compatible with the emergency situation. And it does -- I will say the satellite antenna allows a continuous transmission, or regular transmission, even if the aircraft is going on, I will say, unusual attitudes.

So to accomplish this work, we created a database of 68 events, real events, so data coming from various accident investigation authorities around the world. And we were using, I will say, calculation with the connectivity with satellite to be able to assess and to provide some results to substantiate the recommendation. And we did perform this work with Inmarsat and Iridium constellation.

So the trigger transmission conclusion were that robust emergency detection criteria are achievable. There were three sets of criteria that were developed. It was almost 100% detection of the 68 accidents on the database, so it is technically feasible to reduce the search area by trigger transmission, new generation of ELT triggered in flight, or increasing the frequency of the position report. And it led to the conclusion that if we have a performance-based solution, it shall be within 6 nautical miles, and this 6 nautical mile radius performance-based solution was detailed on the report.

So the joint EUROCAE Working Group 98/RTCA 229 is currently developing some specifications for the second generation of ELT, so the one that will be in particular triggered in flight, so specification for the triggering criteria as well. And last week the ICAO Flight Recorder Panel proposed amendments to the Annex 6 regarding distress system on board and trigger transmission.

So the reports from both working groups are available on the website and I'm inviting you to download them. You will have all the rationale explaining frequency and regular transmission and 6 nautical mile objectives. Thank you.

MS. GORMLEY: Thank you, Dr. Plantin de Hugues.

Our next presenter is Ric Sasse of the Naval Sea Systems Command, who will speak on recorder recovery.

Mr. Sasse.

MR. SASSE: Thank you.

My hope this afternoon is to provide a perspective on the current state of the art in pinger location as it is now, briefly describe how we arrived here, and provide some possible insights for going forward.

ACTING CHAIRMAN HART: Mr. Sasse, could you pull the microphone a little closer please?

MR. SASSE: Yes.

ACTING CHAIRMAN HART: Thank you.

MR. SASSE: To provide a little background, SUPSALV provides a broad spectrum of underwater focused technical expertise for the U.S. Navy. Within the area of salvage, we maintain a deep ocean search and recovery capability down to a depth of 20,000 feet. This is the program that maintains our current underwater pinger location capability.

The evolution of the towed pinger locator system spans approximately 30 years. During this time, four distinct generations of technology have been developed. The first generation was essentially a passive hydrophone at the end of a very long cable. This is a simple design that has proven very effective over the years. Since then there have been several attempts to incorporate new technologies, specifically in Generations 2 and 3, and some of these new enhanced technologies include multiple directional hydrophones, increased digital signal processing, and refinements to the towbody shape.

With all these refinements what we've found through operational testing is that the first generation simpler system proved most effective. Then we developed a Generation 4, incorporating lessons learned from the Air France Flight 447 search, and this is a return to the simpler Gen 1 with some digital enhancements to help the operator in detecting the pinger.

The current TPL-25 is the latest design. It uses a commercial off-the-shelf towbody. It has a 1 atmosphere 6,000 meter rated housing bolted to the underside. It incorporates a single omnidirectional hydrophone with a minimum detection range of 1 nautical mile. And under certain environmental conditions that detection range can be upwards of 2 nautical miles. There are some digital telemetry that is encoded on top of the raw acoustic signal. The system can run on basically any two-conductor cable. And that signal is sent topside where the operator can hear the acoustic signal.

From a methodology standpoint, the towed pinger locator is towed in a defined search grid. When the operator first detects and hears the signal, we plot a detection point on the NAV computer. We then monitor the peak signal strength, and then we keep listening to the pinger and find the last point of detection. After this, we run reciprocal lines and then perpendicular lines to further triangulate and localize the source of the pinger sound. What you can see on the screen here is the spectrum analyzer, which provides a visual indication of what the operator is actually hearing. And you can see both peak frequency and the beat rate of the pinger there.

One of the things we have learned as we've gone through this development process is that in our experience simpler has proven more effective and more reliable for operationally deployable systems. We've gone down both routes of adding complexity and simplicity, and simplicity has proven most effective. We have been advising other people. Some people are going down the more complex route, but again, our experience suggests that simple is better.

Another emerging technology for locating pingers is the use of untethered autonomous vehicles instead of going with towed systems. This brings certain challenges with it, but there's a possibility that this could be an enhancement going forward.

And finally, the one thing that I would suggest as we look at new technologies is that we take a holistic view of what it takes to operationally deploy and locate a pinger. There's many things that logistically come into effect: having to transport on short notice around the world, deploy on ships with opportunities in any environment. So looking at it from a holistic standpoint, I think will actually be the right course of action instead of just the latest technology.

If anyone is looking for further information on SUPSALV, or our TPL systems, it can be found on the web at www.supsalv.org. Thank you.

MS. GORMLEY: Thank you, Mr. Sasse.

Our next presenter is Thomas Schmutz from L3 Communications who will speak on traditional flight recorders.

Mr. Schmutz?

MR. SCHMUTZ: Well, thank you for having me today. L3 is an aerospace and defense contractor, and we supply communication and electronic systems. Within our company we make commercial and military aviation products, including integrated avionics, flight data displays, emergency power supplies, support services. But specific to today, we make data acquisition and connectivity and storage solutions, which include cockpit voice recorders, flight data recorders, and Iridium SatCom systems.

So there's been a lot of discussion recently over the augmenting of crash-protected flight recorders on aircraft. As mentioned earlier, crash recorders are directly responsible for significant improvements in aircraft safety over our history within aviation. And certainly, the new capabilities are intended to augment recorders on board. And these include items such as triggered real-time monitoring of recorded data, and also tracking techniques to better understand aircraft location. So I'm going to discuss both of these capabilities towards the end of the presentation.

L3 makes a large number of flight recorders and cockpit voice recorders, and there's a lot of different aircraft requirements, and therefore, we make a lot of different recorders to satisfy those requirements.

For the flight data recorder equipment, or the FDRs, the governing Minimum Operating Performance Standard, or MOPS, is ED-112A. It was published in September of 2013. It's been reissued about four times over the last 23 years, so about every 7 years it gets refreshed.

From a rules standpoint, the current Technical Standard Order is TSO-124c. It's been effective since December of 2013. And there's a corresponding European TSO, which currently 124b is in effect and we expect 124c, which mirrors the TSO, to be issued soon. The cockpit flight recorder equipment is also governed by ED-112A. The TSO that governs cockpit voice recorders is 123c, and there's also a corresponding European TSO for that TSO as well.

So, when ED-112A was reissued in September of 2013 there were some changes that were included. This included details that were added based on the Air France 447 catastrophe, as well as other incidents that had occurred. There was changes made to the deployable recorder section and also changes made to the cockpit voice recorder section. Specifically for the cockpit voice recorder, for the classes of recorders, there was a 10, 15, and 25-hour class added to the 2-hour class of cockpit voice recorders.

For the flight data recorder, additional parameters were added to ED-112A, as well as increased sampling rates on some FDR parameters. There's also a requirement to add a data frame layout information file, or what's called a FRED file, to the recorder. And that's to assist investigators to decode the data if the recorder's found.

So from a real-time monitoring standpoint, the key points that we would like to discuss are standardization, privacy, security, and reliability. From a standardization standpoint, it's clear to us that the recorder MOPS has been successful in harmonizing worldwide standards for recording. So we think this has been a real success story. We think that harmonization should continue. And for real-time monitoring, standardization may mean that we consider using all means of aircraft communication; we use the recorder to trigger the data transmission since the recorder has the data.

From a privacy standpoint there's sticky points. Currently, cockpit voice recorders cannot be downloaded when they're on aircraft. Ownership of flight data and audio varies according to the country and the installation. And so these are going to be important parts of any discussion about real-time monitoring.

And on reliability, because the flight recorder will be augmented potentially with this real-time monitoring capability in the future, which may be triggered, then it may be that high reliability could impede the acceptance due to cost. So there may be a tradeoff made that extremely high reliability is not required, and that may ease the acceptance of triggered real-time monitoring.

This was touched on earlier. In terms of goals for real- time monitoring, the flight data recorder has always been only considered part of an overall investigation. Investigators review all of the available data, including the data on the recorder before the event. And when recorders are found in an accident, as much of the wreckage is still recovered and pieced together and evaluated, and forms an important part of the evaluation. So we don't believe that real-time monitoring will change this at all.

So some realistic goals might be for real-time monitoring to help find the aircraft, to alert authorities of a problem and try to prevent the mishap, if possible. And then, the last event would be to have a dataset, if the recorder can't be found or if it's damaged or it can't be located for some period of time.

Just so that we're clear on the types of rates that we're talking about in real-time monitoring, for a flight data recorder the typical rate is about 12 kilobytes per second, and the image size is about 138 megabytes. And for the cockpit voice recorder with the three pilot channels and the one cockpit area microphone channel, the total raw data rate is about 640 kilobytes per second. All of these figures are presented without any compression.

So in addition to real-time monitoring, L3 is also promoting the idea of an L3 tracker, which would be a near real-time tracking of flight position. So the idea would be to add a Iridium short burst data modem and a GPS to a flight data recorder. And there's several reasons why we think that this should be considered and may be a good idea.

The flight data recorder is wired and positioned in the aircraft such that it's difficult to disable during flight, so it's difficult to turn off. It's completely independent of any other aircraft system, so a system such as this could be implemented and would be independent of any other systems. It could be done in such a way that it had absolutely no impact to current aircraft wiring, and the same system could be used for both forward-fit and retrofit.

So two concepts are shown here: one universal concept on the left, which fits between the FDR and the rack, and one on the right, which would be a custom unit that would a part of the flight recorder.

So how it would potentially work would be that the tracker would periodically send either periodic or triggered location, GPS location data, over our Iridium short burst data channel. Alternatively, it could be requested from the ground. The Iridium system could channel that through a gateway to a ground server and ultimately to an operations center. This would work for both location data and it could also work for triggered flight data, if there was an incident that caused that trigger to occur.

That's the result of my presentation. Thank you very much.

MS. GORMLEY: Thank you, Mr. Schmutz.

Our next presenter is Blake van den Heuvel of DRS, who will speak on deployable recorders.

Mr. van den Heuvel.

MR. van den HEUVEL: Thank you Chairman Hart, all members of the NTSB, Forum Chair Manager Erin Gormley, Panelists for allowing me to participate in this important meeting.

DRS has been a manufacturer of deployable emergency locator beacons and deployable black boxes for 40 years, over 40 years. During that time, we've fitted some 50 different aircraft platforms with multiple fleets flying in 50 countries, both fixed and rotary wing.

Some of the world's most recent accident examples, such as Adam Air, which took 7 months to recover the black boxes; Air France, which took 2 years; Yemenia 626, which not only took 2 months to find the black boxes, but also resulted in loss of life, loss of survivors; and, of course, the disappearance of Malaysia Air 370, all are examples of situations that deployable flight recorders were designed to address.

Today, aviation exports experts, including aircraft OEMs, accident investigators, and national regulators are evaluating the use of deployable recorder technology as one of the recorders for installation in a dual-combined recording system. This is to alleviate the challenges of overwater and remote location in crash circumstances.

ADFRs, or deployable black boxes, are designed to survive a crash differently than a fixed black box system, akin to using in your car seatbelts along with an airbag, two complementary technologies. They separate from the aircraft upon crash impact or at the point of a midair breakup, and are designed to avoid the crash impact zone. And finally, over water they can float indefinitely.

The fundamental element to help locate the downed aircraft recorder is the fact that these systems alert to the global COSPAS-SARSAT search and rescue system. The deployable black box through its ELT will transmit the aircraft tail number, the country of origin, the location of the aircraft at separation, and also the location of that deployable black box as it floats on water. This is invaluable for ETOPS, polar route, and free flight events.

There are no perpetual service fees related with this technology. COSPAS-SARSAT global infrastructure is a free-of-charge service to all users. And finally, the ADFR preserves the integrity of the investigative process and public trust by keeping tangible secure data in the hands of national investigative authorities.

So what is a deployable black box? Essentially, it's a fixed black box, but it floats. Everything is in one container, and rather than having an underwater locator pinger, it has an emergency locator transmitter. Since 1998, the aviation safety community has worked under the leadership of EUROCAE to agree the minimum operational performance specs. And as Tom point out before, he went through all the details of ED-112A, so I won't do that. The benefit of this approach though is we do have harmonization between EASA and FAA, which is very, very important.

The DRS, deployable recorder experience includes approximately 4,000 systems installed worldwide, over 60 million combined flight hours. And some important sort of safety factors is since that time, keeping track, we have 100% safe separation, which is an important factor for OEMs. And equally important for air transport and helicopter installations, we have 100% data recovery rate. So, pointed out earlier, on F-18 supersonic fast jets that are quite old in vintage, there have been some failures. But in air transport and in helicopter operations, a stellar success rate.

How do they work? Sensors detect positive deformation of the aircraft structure or in-flight breakup. In rare events without aircraft deformation, a pressure switch would activate deployment in water. The unit releases from the aircraft, the ELT is activated at exactly the same time, and aerodynamic forces push the beacon away from the aircraft. The deployable will land either on water or on land. It doesn't matter where. In water obviously it floats.

The ELT transmits its signal to SAR authorities, and that triggers an alert for mission control and rescue control center organizations. The deployable also has a homing signal, 121.5, and that is what is used by rescue crews to get that final 2 or 3 kilometers to the accident site. SAR personnel will work to recover survivors, secure the wreckage, and finally, they'll pick up the deployable recorder and bring it back for accident analysis.

Value to air transportation. And I apologize. I'll summarize. There's a lot of data on this slide. Deployable reorders help ensure that accident investigators get all of the data all of the time regardless of event scenario. Deployable recorders are also importantly designed to provide immediate location of a downed aircraft and survivors. Deployable reorders are highly complementary to a fixed recorder in a dual-combined installation. Using both types of reorders maximizes the potential for full recovery of flight data.

For national safety boards, this means that it maintains control of the data, as they do today. Deployables are a tangible block box that will be controlled by the investigative team in charge. They eliminate concerns about manipulation of information and security breaches by third parties, and they ensure security of data and integrity of the investigative process, paramount to maintaining public trust, and finally, to mitigate issues caused by civil liberties and privacy concerns by pilots and crew.

This concludes my formal presentation today. In closing, I would like to thank the NTSB for the opportunity to share our experience with deployable recorders with you today, and I look forward to answering your questions.

MS. GORMLEY: Thank you, Mr. van den Heuvel.

Our final presenter for this panel will be Richard Hayden of FLYHT, who will discuss streaming flight data.

Mr. Hayden?

MR. HAYDEN: Thank you.

Thank you to NTSB, and all parties concerned, for the opportunity to participate. I feel a little bit like Ms. Gormley gave me the ice bucket challenge to try to sell this story in 8 minutes or less, but we'll give it a go.

I'm going to address the subject on the agenda called wireless data transmission. The context is in air to ground, as opposed to wireless gate link, which is another connotation. Although all of our customers voluntarily have chosen AFIRS to enhance their operational control and save money on operations, it has an inherent mode of operation that provides triggered position and data in real time, which is our focus today. So keep that in mind, but the main context today is triggered data transmission.

These accidents have raised the questions we're trying to answer: Where is the aircraft and what happened? Maybe more optimistically, or more generically, we perhaps have the technology to prevent the crash rather than record it, in some instances. Both these questions can be answered today with the same technology, which is available and in services.

AFIRS was purpose built with an operations focus. It's not an in-flight entertainment system. It's particularly built to support flight operations. It has global coverage. Those are our origins in northern Canada, and our first customers indeed were flying into the Arctic, and that's where the demand for the system came from. We specialize in remote areas. The system is certified by multiple national authorities, and it's not a development item. It is mature and in service with 40 customers on 6 continents.

The solution consists of two components. The AFIRS is the on-board system that takes advantage of installed equipment and data sources. It is effectively a passive bus monitor, which records, analyzes, stores, and then selectively transmits data according to embedded rules in the box. UpTime is a web-based server, which is secure. It receives data from AFIRS, stores it, processes it, and delivers it to designated sources, recipients over the Internet securely.

This is pretty basic. A box goes on the aircraft. It does support voice data and text, two ways. It connects to the FDR and other data sources, as I mentioned. When it has a message to send, and data, it does so by its embedded Iridium modem. And the information and data are delivered to users by predefined protocols. And by the way, for those who worried about BlackBerrys this morning, we don't discriminate. We can also get the messages on iPhones as well.

You might call this in the context of this morning's discussions sort of a rough outline of a performance requirement. This is based on our experience since Air France 447, where we got actively involved in this. First, incident alerting is a key component. Again, we're focused on opportunities to prevent the crash rather than just record it. However, in the event that an aircraft is going down, the sooner the alert comes, the sooner the response can come.

Precise position tracking, basically the aircraft and the system have embedded GPS so that the tracking can be done in high rate, as short as 5 seconds, so you can figure out what the lateral -- how far an airplane can go in 5 seconds, depending on its orientation. The rate of the position tracking can actually be escalated by the person in control of the system, which would be the dispatcher or the AOC. And then, when we get to the point where we have a bona fide emergency, selected aircraft data, up to and including all of the FDR data, can be fed directly to AOC subject matter experts and third parties.

I'd like to ask our driver to bring up a quick video. This is very quick. It's to give you an idea of how the system works. This is showing an operation by our first operator who's doing a dedicated -- do I have to start that? Okay.

This is what a dispatcher would see. This is First Air based in Canada. They operate in the north. So the dispatcher has a view of all of his aircraft in a high-level status report. The aircraft self-report their position and their status as they go. And then, if we have an emergency, the dispatcher receives a message, something he hopefully can't ignore, and the system automatically starts reporting, in their case in 20 second resolution, and it starts downloading data immediately to the designated sources.

And what comes down is the FDR file in real time, as well as other information that AFIRS has. Now, if we're trying to respond to a situation actively, only NTSB and BEA could actually tell what that data means, so we translate that into useful engineering context. This is one of several tools.

On the left you see the engine data, four parameters selected by the subject matter expert, that are streaming in real time as the aircraft is maneuvering. On the right you see what the pilots would see, the instruments. So this data is driving these displays, and if people are involved in a three-party conversation with the crew, this is a way in which this data can facilitate a possible resolution of the problem.

Also, as I mentioned, the position tracking is in real time. This aircraft has been put into streaming mode for a demonstration, and as you can see, the position accuracy is whatever GPS is as a function of the ground speed.

Can we close that out, please? Thank you.

So some of the lessons learned. We've been doing this for over 10 years with customers, slowly ramping up, and we've had to build a second generation box to take advantage of some of the lessons learned. And then, we were active in the development of triggered streaming post Air France 447.

First, as has been mentioned earlier today, we never want all the data all the time, as has been suggested by some in the press. Secondly, the routine operations data can support operations. And finally, exception-based reporting, flight manual exceedances that drive maintenance or high-speed position data, as we've seen here. Importantly, the infrastructure is available today to support this. Basically, I have the Internet, SatCom, and GPS. There is no additional infrastructure required to support this system.

Safety and security. The system is basically independent of the flight crew in every respect. There are no discretionary standby modes, no interrupts, no breakers that the crew can access. It operates off a battery. It's a very low power system. So in the event of a loss of aircraft power, AFIRS, since it has its own GPS, would continue broadcast the GPS position, and any backlogged data, and it also would support Iridium cockpit voice simultaneously. The transport layer is encrypted, and the data only goes to pre-designated recipients over secure Internet connections.

I won't go through this chart, but I was asked to talk about implementation requirements and timelines. The bottom line here is basically this system could be deployed today. The CONOPS, concept of operation, there's a baseline, as I mentioned, with our launch user, which is evolving, but this can evolve with participation of all parties over time.

So, in summary, AFIRS provides on a regular operational basis for people of continuous situational awareness of operational control. More importantly, it pays for itself. It creates operational and monetary benefits on a daily basis, reducing operating costs, improving dispatch availability, and avoiding unscheduled maintenance. And finally, when emergencies or needs occur, it can provide automatic alerting, high-resolution tracking, and flight data in real time.

Thank you very much for the opportunity.

MS. GORMLEY: Thank you, Mr. Hayden.

This concludes the presentations for this panel. We are now ready for questions from our Technical Panel, and I will act as the Technical Panel lead for this topic.

I appreciate all the panelists taking the time to join us here today and share their expertise. I know everybody is busy, so we appreciate you coming along here today.

Dr. Plantin de Hugues, you talked about the Flight Data Recovery working group and all the different entities that were involved in coming up with those recommendations. One of the things you mentioned was the acceptable position for wreckage localization within 6 nautical miles. Could you go into a little bit of detail about how that value was determined of 6 nautical miles?

DR. PLANTIN de HUGUES: Yes. Can you maybe go to my presentation? I have two extra slides that may explain, in fact, the rationale for that. We'll go very quickly just to the last slide.

So on the triggered transmission of flight data working group, so we did perform some calculation of the connectivity and the position of the 68 events we had on the database, and the connectivity with the Inmarsat constellation. So we have made a calculation of accidents, so the 68 accidents over the complete globe almost 600 points. And what we did is we tried to determine the -- I would say the position between the last possible reported position and the ground.

So, it means that the connectivity, you have the satellite and then your aircraft as an event, so 68 events, and we tried to see if it was possible to transmit sufficient information to the ground. And what you can see on the chart is that you have on the X-axis is the distance, on the Y-axis is the percentage of aircraft events from the database, and you can see that with, in fact, there's a slope, at 6 nautical miles we have almost all the aircraft -- all the events from the database at the maximum value.

It was not possible to have the last 15% because there was no coverage with the Inmarsat constellation over the globe. So for the accidents -- or I would say over the pole. So for the accident over the pole, it was not possible to determine the position of impact. So it was a rationale for the 6 nautical miles, and in addition to that is what could be the frequency of transmission to achieve the 6 nautical miles?

On this chart what you have is on the X-axis you have the positioning of report, so 1 minute, 2 minute, and so on. On the Y-axis you have the number of aircraft events from our database. And then, with the color, the value 6 nautical mile objective or 4 nautical mile objective, and so on. And here you have a direct link between frequency of reporting position every 1 minute, and if you are transmitting every minute, or at least every minute, you will have 95% of your aircraft from our database within the 6 nautical miles.

MS. GORMLEY: Thank you very much.

Mr. Sasse, you described the current methods available in locating and retrieving traditional flight recorders underwater. This morning we heard about the near-term measures or the measures that are to be implemented of 90-day beacons and 8.8 ULD low frequency devices, as well as the 6 nautical miles that Philippe was talking about in terms of wreckage localization.

How do these measures assist in underwater location and retrieval of recorders going forward?

MR. SASSE: The first challenge really is to know where to start to search. So, any technological changes that help identify where the search is to start, and can limit the maximum extent of the search box are very valuable. Our TPL currently can listen to frequencies as low as 3 kHz. So, being able to detect and localize a 8.8 kHz pinger is completely possible at this time, and that lower frequency should give a longer detection range. With the increased battery life, that also increases the window of operation to search for a pinger. So both of those developments would increase your chances of success.

MS. GORMLEY: Thank you.

Mr. Schmutz, you described the MOPS, the Minimum Operating Performance Standards, and the periodic improvement process through the EUROCAE and ED-112 that has occurred historically for flight recorders.

As a manufacturer, do you think that this method of developing and augmenting the standards is an adequate way as we go forward with this technology to make sure we keep up with changes and the needs of recorders?

MR. SCHMUTZ: Yes, I do. It's been effective in creating the right kinds of discourse within the industry between the investigators, between the manufacturers, between the OEMs. The working groups that typically update the EUROCAE documents I think do so in a way that is pragmatic and brings a great deal of value to the industry. And I think that the changes that are being wrought through that document -- I think I showed about every 7 years it was being updated. I think that frequency, while it may seem low to some outside of the industry, within the industry it's a reasonable pace. New things are learned, they're incorporated into the technology, they're incorporated into aircraft, and ultimately we continue to build upon the success that we had. So, yes, I agree with continuing to harmonize through standards such as ED-112A.

MS. GORMLEY: Great. Thank you.

Mr. van den Heuvel, we heard earlier about some of the cases of inadvertent deployment or unintended consequences, and you mentioned that in different aircraft that the historical capabilities of that has been different.

Can you elaborate a little bit on some of the history of that? And if it would affect the aircraft flying capability in any way, should something like that occur?

MR. van den HEUVEL: Sure, I'd like to do that. I mentioned earlier we've been on more than 50 different platforms. The vast majority of those are transport and helicopter. Two or three, four, have been on fast jets. Through the ED-112 process that Tom spoke to, over a period since 1998, there's a tremendous amount of work that has gone into what are the acceptable requirements for a deployable recorder, to make sure that when you do have a crash that they're going to activate properly and in routine maintenance or routine operation that they don't deploy in an uncommanded fashion.

So we have made sure, as an example, that a deployable recorder is not allowed to have a manual deploy button. Now, until recently that was a fundamental requirement. You had to have that, and that was really a retrograde move when it was introduced in 1997 because finger trouble begets unintended deployments.

The other things that we looked at were absolutely you cannot have a single access G-switch or a single G-switch because we've learned from ELT technologies that G-switches don't work very well. So we've removed that from the systems, and you have to have positive deformation of the aircraft structure. That's what you need in order to reliably make sure the system works properly.

So it's actually lessons learned from F-18 experience where we implemented a -- you know, we didn't, the OEM implemented a single access G-switch, a complete pyrotechnic from stem to tail release mechanism, and, you know, no water activation, for example, that has caused some failures.

On the flip side, the other things that we talked about are the actual uncommanded deployments. And working under subgroup lead by Airbus, we did make changes this past couple of years to ED-112A to mandate a 1×10^{-7} safety factor. So, it's incumbent between the system supplier and the OEM integrator to substantiate that as part of the certification of the system.

And when you can achieve -- and we are with our systems today, we are achieving that number. When you get to that level, you are now sort of the equivalent of having maybe a wheel fall off an airplane or a maintenance access panel fall off an airplane. And as Mark Smith pointed out earlier today, I mean, it is hard to achieve, but it is showing the level of robustness and reliability that are built into the systems.

MS. GORMLEY: Great. Thank you.

Mr. Hayden, depending on the circumstances of an accident, an aircraft may undergo unusual attitudes or abnormal flight profiles.

How would the AFIRS system operate under these conditions? Would there be a loss of signal that would prevent transfer of data or that would require a startup time to begin transferring again?

MR. HAYDEN: Great question. Could I have he clicker, please? Could I bring up my presentation again?

This issue was raised when we got engaged after Air France 447 in the SESAR working groups and BEA triggered transmission working groups. I think the question was motivated by experience with SatCom, where in turbulence and other maneuvers, SatCom connectivity has been lost. So, we didn't have a good answer to it, to be honest, so we challenged one of our customers to work with us, and this is what we did.

The mission of the day was to fly a flight while the AFIRS system was in full streaming mode and break the connection with Iridium. Frankly, the pilots loved that challenge. That's a lot more interesting than a regular boring flight. So this is what they flew, and the data was -- that's the position report, so it was obviously very high frequency position reporting. And this is a sample of the data that resulted from it. This is a typical tool that is used in flight data monitoring.

And you'll see that -- you can see, this will on the website -- that basically the aircraft went through excursions of up to I think 23 or 24 degrees pitch up, then over 80 degrees roll with snap rolls back and forth, and the data never stopped flowing. So that's one test. It's encouraging and I believe that there's some inherent attributes of Iridium that make Iridium less susceptible to disconnect than geostationary satellites.

MS. GORMLEY: Great. Thank you.

Dr. Plantin de Hugues, in your PowerPoint presentation you mentioned a distress system that would assist with localizing data based on triggered criteria. Can you tell us a little bit about that effort, the history, and how it's going to proceed forward?

DR. PLANTIN de HUGUES: Yes. So, in fact, there is a different part. First of all, the ICAO created an ad hoc working group, so it was in May 2014. So, I'm part of this ad hoc working group and this group is looking for middle-term and long-term solutions to be able to find an aircraft. And CONOPS, which was called at the beginning, and the report was developed and completed just a few days ago, will provide recommendations for the various ICAO panels to provide a proposed amendment for the Annex 6 and the other Annex of the ICAO.

Then, in fact, we are doing and using as a basis the work of the Triggered Transmission of Flight Data working group. We used the work and the fact that, I will say, the triggering criteria are robust enough to provide sufficient information for the aircraft to trigger and to send data to the ground. We decided to -- we proposed, in fact, some, I will say, working paper to propose amendments to the Annex 6 dealing with, I will say, transmission of flight data when a distress situation is detected.

So it is part of the global pictures, and this is one of the stunts that are used to make sure that the various annexes in the future will be robust enough to find an aircraft. In addition to that, the EUROCAE working group and air-to-sea working group are working jointly to make sure that the specifications are well defined and are robust enough to complement the work of the ICAO.

MS. GORMLEY: Great. Thank you.

Mr. Sasse, aside from the current methods available, which you covered in underwater retrieval, what emerging technologies, methods, or analysis, do you see coming forward and even looking farther into the future that would help with a less timely and less costly search process?

MR. SASSE: The biggest thing that would aid in the actual search is the accuracy of the initial starting point with the search. When it comes to performing the underwater search itself, some of the AUV technologies, the untethered autonomous technologies, may give the ability for multiple of these search assets to be deployed from a single vessel, so you could cover more area per vessel deployed, which could give you a force multiplier.

But I think really the biggest thing is narrowing your starting point and the total extent of your search box is really where the most value is. Once you've done that, the technology's there to actually search that box.

MS. GORMLEY: And as a follow-up to that, how does the delay in that initial search affect the outcome?

MR. SASSE: With a finite pinger battery time period. The more time you can spend on site actually performing the search, the greater your chances of success are. So any delay in making decisions in mobilization, directly impact the amount of search area covered. So it's important to actually have that initial starting point and make a decision to mobilize quickly.

MS. GORMLEY: Great. Thank you.

Mr. Schmutz, flight recorders have had a long history of successful data retrieval. Based on your experience as a manufacturer in assisting all the accident investigative authorities in various scenarios, do you believe that the current survivability requirements of recorders are adequate and that the way that, again, it's been reevaluated on a periodic basis is meeting the needs of the community?

MR. SCHMUTZ: Yes, I do. Unfortunately, we do see accidents with our equipment installed. We are successful in recovering the data currently with the survivability standards that we've designed into our equipment and that meet the requirements in the MOPS ED-112, ED-112A. There are instances where the accidents cause scenarios that exceed the survivability requirements. In cases like those, we're happy that our equipment performs over and above the requirements. In some instances, we have to get creative.

This is in a very few instances we've had to recover dye and things like that to recover that last amount of data. That's typically found in incidents that have a great deal of fire that burn really, really hot for a really long time. But generally, we feel like there's a good balance right now inside of ED-112A that call out survivability. The survivability part of the MOPS has been stable now for quite a while. I think that's a tribute to it being probably on target.

MS. GORMLEY: Great. Thank you.

Mr. van den Heuvel, you mentioned that there were over 4,000 systems that have been delivered. And you mentioned a little bit about the type of aircraft.

If you can speak to it, can you describe what the operator's decision-making process was in putting those units on board in terms -- was it because they were doing more overwater remote operations or the type of operations, just to get a little bit of history of the people who have put those on there?

MR. van den HEUVEL: Okay. I think historically the technology was designed in Canada for the vast northern expanse, and we saw people using deployable ELTs in remote areas. As we moved into the '60s and '70s, we saw militaries gravitate to the technology in which they were flying many of the missions over water. And then, finally in the '80s, I would say the helicopter market started to pick up where the technology for a deployable ELT became mandated in North Sea oil operations.

So, I think in -- you know, as it evolved, it has been to not really to find the flight recorder, and not even to find an airplane. It was to have passengers survive, to find survivors within the golden hour. So it has always been high-risk flight operations over water and in remote locations. And I think that's where the decision making came from to move in that.

Now, as we're looking forward where the costs of this technology -- when you take it out of the military and you put it into the commercial realm, the costs are coming down drastically, and now there's the opportunity for commercial operators to get those same features. If you looked at the search aircraft involved in MH370, you saw P-3s from Canada -- from Australia and Japan, you saw Sea King Seahawks, you saw a Japan P-8I flying. All of those search and rescue aircraft had deployable flight recorders on them.

MS. GORMLEY: Mr. Hayden, when talking about streaming flight data the issue often seems to arise about limited bandwidth. Can you explain exactly what this means and if this is a limitation that might prevent transmission of data as a viable option?

MR. HAYDEN: Yes. I'll try to do that without getting irritated at the -- what we've been hearing in the media.

I think the notion of bandwidth limitations arose from an incorrect understanding of what we're talking about by streaming data. I think people thought of it the same way they stream movies onto their computers and handheld devices. The data that is required to -- as you know, looking at accidents, to determine what happened to an airplane is nowhere near as extensive as what people are watching on movies.

In fact, the challenge we took on after Air France 447 was to see if we could stream -- how much flight data recorder we could stream from using Iridium, which has a small bandwidth per channel; however, it has many, many, many channels. So first thing, we do extensive data compression on board, and then Iridium has a short burst data mode that's extremely efficient.

So, to make a long story short, using an Airbus aircraft operated by one of our customers, we first discovered that we could actually stream all 260 parameters, give or take a few, I don't remember the exact number -- that that particular flight data recorder was capable of, including GPS position, at the rate that they were being recorded on the flight data recorder, which ranges from a quarter second to, you know, many seconds, but roughly once per second for each of the data points.

So, you know, as they say in math, QED. And our colleagues in the industry graciously gave us some guidance saying that was pretty good, but in fact we don't actually need that much; we don't need all those parameters to do what we need to do. So we've worked with Iridium. There's literally no -- you could have every aircraft in the sky reporting at the same time and Iridium can support that.

On the other hand is the Internet, and I don't think we need to dwell on how much data the Internet can handle. The aircraft data is a drop in the bucket compared to what's moving around on the Internet. Does that answer your question?

MS. GORMLEY: Great. Thank you.

This next question I guess would be applicable to the three manufacturers, and it's a little bit of a two-part question. But the first would be, we heard about longer durations CVRs that are coming on board, as well as data link requirements, and FDRs. Do you anticipate being able to accommodate those with the recorder design, particularly L3 and DRS, as the mandatory requirements?

And the second part would be, in general terms, either that or for the upcoming is what are the costs of these systems?

In terms of L3, you mentioned putting that tracking capability on there. With DRS, with outfitting that, whether it's to a forward-fit or even a retrofit capability, and then putting the system on board for streaming flight data. Can you speak to the ability to comply with requirements that are coming down the pipe as well as some of the costs associated with it?

MR. SCHMUTZ: Sure. On the first point, we can comply with the 25-hour CVR requirement today from a forward-fit perspective. We have products in our portfolio that will satisfy that requirement.

And the second point, which was with regards to the tracker, we're excited about that technology. Again, I showed two different instances of it. One instance might be a universal tracker that would fit inside an ARINC style tray, and that could be retrofittable to any existing ARINC style deployment, whether it's an L3 deployment or other, of an FDR. So that type of equipment we think could be sold, you know, at price points equal to or around the same as that of the FDR. For a tracker technology that was embedded inside of the flight data recorder, it could be deployed at a much lower cost.

The first is very strong in its ability to be retrofittable across the entire fleet, all aircraft at this time, and a more custom arrangement might be more suitable for a forward-fit. So that just gives you an idea some of the strength of that idea.

MR. van den HEUVEL: With regard to the 25-hours or 20 hours of CVR, we do not see any technical challenges there. If you asked that question a couple years ago, we would say that the -- actually the low temperature, the 10-hour low temperature fire test is, in fact, more difficult than the high temperature fire test because of the duration. So we have to watch what's available in terms of memory. And, you know, that could be the only thing that I could caution at this point, but I don't see a problem.

With respect to costs, I can talk to that as well. One of the points that has come out of the EUROCAE working group efforts and the proposals that are in front of the industry, that if you're going to fit a deployable recorder on your aircraft, it has a built in ELT; therefore, that particular aircraft won't be required to carry a fixed automatically activated ELT because the one in the deployable would meet that requirement.

So, what we're -- in terms of becoming cost neutral for an airline implementing dual-combined recorders, is that the deployable then has to come in at a price, which is the equivalent of a fixed recorder in its installation and a fixed ELT in its installation. And to that end, ICAO has done of a lot of study work there, and I think people are happy that the cost of deployable recorder technology has in fact come down to where it is cost neutral. Now, that's on forward-fit.

I want to make it clear that I don't think there are any proposals anywhere that are considering putting deployable recorder technology as retrofit or back-fit. That being said, over half of our installations are in fact retrofit, so there's a lot of experience by aircraft completion houses and OEMs with respect to retrofit. And it's likely that, you know, retrofit, including the added cost and the added certification cost, when it's amortized over a number of aircraft would likely add about, I don't know, 10- to 15-, maybe $20,000, if it was a retrofit. But we know that's really not the plan going forward.

MR. HAYDEN: The AFIRS system is delivered as a completely integrated service, so it's just like buying a cellphone for the first time. They have one-time costs for the hardware, and that includes a warranty for as long as the service contract is enforced.

I won't beat around the bush. Our costs are -- typically for the aircraft kit is in the neighborhood of under $50,000. It depends on circumstances: the aircraft type and the specific arrangement. There's roughly 200 hours to install in a retrofit mode. Almost all the installations are done during a sea check cycle, which usually involves 5- or 6,000 man hours of labor. So the airplane is taken apart and -- so, if done during a sea check, it's a bit less. So the actual outlay is, you know, typically probably under $70,000 to get going.

The service fees are dependent on a menu of services. Some people operating Cessnas, doing work in Africa, only use voice and tracking because that's about all the data they have on the aircraft. And then we have carriers and business jet operators using everything we have. So the service fees are a few dollars an hour. Probably the highest service fee is, you know, in the neighborhood of $10 a flight hour. You put that in context of an hourly operating cost of aircraft, it's between say 3,000 and $30,000 per flight hour. That's the appropriate context.

Now, as I said in my introduction, the system is not sold -- it's not mandated. It's optional equipment, and it's basically selected because it provides benefits. So in every case the purchasing decision by the customer is made on the basis of hard cost-benefits. And the core of these cost-benefits typically would be reducing data errors, reducing manpower for people handling data, accuracy, timeliness of event reporting, and flight manual deviations that require inspections or maintenance, thereby saving some dispatch delays.

And a big one, of course, is fuel savings. We monitor the way the aircraft is handled against SOPs approved by each airline, usually following the IATA guidelines. And those typically translate into at least a 2% savings on the fuel budget, which pays for the capability almost instantaneously these days.

Those are all retrofit statements. We have two OEMs installing this system on the line, and frankly, I don't know how much the end customer pays for them. I know how much they pay for the system going in. So that's our story.

MS. GORMLEY: Great. Thank you.

I think some of my colleagues -- Ms. McComb.

MS. McCOMB: Thank you. I have a few follow-up questions for Dr. Plantin de Hugues.

You had mentioned the joint EUROCAE/RTCA working group activities. Would you please go into a few more details regarding what the working group is doing for reliability of ELTs?

DR. PLANTIN de HUGUES: Okay. So, in fact, there will be a new constellation provided by COSPAS-SARSAT, the MEOSAR constellation. This is mainly payloads dedicated to COSPAS-SARSAT that will be on the Glonass, Galileo, and GPS constellations. And taking advantage of this new constellation, there was a need to improve the -- I will say to create a second generation of ELTs, first of all, because it's no longer necessary to wait for 50 seconds before to trigger an ELT, so now it can be done in flight.

So with the second generation of ELT and the new constellation, as soon as an emergency detection -- there will be an emergency detected onboard, the ELT will be able to transmit the signal to the satellite, and then to transmit to the ground. So the working group is, first of all, dealing with this second generation of ELT, so there will be a MOPS. So it is a specification for a single entity like the ELT. And in addition to that, there will be a MASPS, which is specification for a system that will be dedicated to the specification for the triggering criteria.

So each triggering criteria is, for example, as soon as your aircraft is banking like that, from some value you will have to start transmitting. Or if your pitch is too high, you will have to transmit. So this document will detail as a performance-based all the specification for this kind of triggering criteria. And then, at the end because you will have a new MASPS, so specification for the system, and a new MOPS for the new second generation of ELT, you should improve the, I will say, robustness of the system and be able to provide a position of impact within 6 nautical miles, at least.

MS. McCOMB: Thank you. Can you talk a little bit about what the timeline is for completing the work?

DR. PLANTIN de HUGUES: It is planned to have at least the MOPS and the MASPS published by end of 2016. Because, in fact, the flight recorder panel proposed amendments to the Annex 6, and this Annex 6 will published end of 2016. I would like, in fact, to have the MASPS to be published before end of 2015 so it will be easier for the Annex 6 to reference the MASPS to make sure that we have a performance-based solution that will be not only for ELTs, but any solution that could be triggered by any means, so that could be triggered by this specification. So it is why we would like to have this MASPS published before the end of 2015.

MS. McCOMB: Thank you.

I also have a follow-up question for Mr. Schmutz. You had discussed the L3 tracker system, which sounds very interesting. How far along in the process are you in implementing either of the possible solutions?

MR. SCHMUTZ: So your question is regarding the tracker? I didn't quite hear you.

MS. McCOMB: Yes.

MR. SCHMUTZ: So we currently supply Iridium-based systems in the industry. We don't supply a system that we've identified here. We are going through an evaluation of that equipment in the market for feasibility. We think it's a good idea. We'd like to understand whether or not if we build it, if it will be profitable and what kind of uptake it would take. So right now we are gathering data.

MS. McCOMB: And in terms of another question, have any of your customers expressed interest in such a system?

MR. SCHMUTZ: There has been discussions. There hasn't been -- again, it's not a requirement, it's not a mandate, so -- you know, one of our purposes is to discuss it in forums like this to try to see if we can elevate the discussion and see if we can derive mandates for things like this.

MS. McCOMB: Thank you. That concludes my questions.

MS. GORMLEY: Mr. Babcock.

MR. BABCOCK: One follow-up question for Mr. Sasse. With the advent of the 8.8 kHz beacon -- you answered half my question about using the same equipment to search for both beacons. But with the advent of the lower frequency beacon, does that change the search techniques that you use to search for one or both of the pingers that may be together or separated in a wreckage field?

MR. SASSE: Essentially, the techniques, the technologies, and the systems would all be the same. Currently, we would only be able to search for one or the other frequency at one time. Partly because of the filters and the spread of the differences in the frequencies, it would be very difficult to try and triangulate and localize both frequencies simultaneously with the same sensor. But there would be no difficulty in switching from a triangulation of a lower frequency, and having to make the determination to switch to the higher frequency. They just can't be done simultaneously.

MR. BABCOCK: Thank you.

MS. GORMLEY: Just to follow up, in terms of -- we heard the regulators this morning, ICAO, EASA and FAA, talk about some of the processes that have to happen in voluntary versus regulatory.

In terms of the technologies, in terms of wreckage location and the technologies going forward of new and innovative, do you think that there's anything else that the community or that the regulators can be doing, working groups, that would help facilitate and embrace the operators to take some of these on board, or do you feel that it's going at a speed that it needs to go, based on customer driven? It's for anyone.

MR. HAYDEN: Well, I've never hesitated to put my foot in my mouth in public, so I'll comment on that. I think from a -- I think the pace is maddeningly slow, frankly. In some cases that's justified, but in this case I think that what the technology demonstrated -- and essentially, you heard the alignment of OEMs and others with the concept of triggered position data transmission. I don't think the time frame is fast enough.

DR. PLANTIN de HUGUES: So I think what is very important is to have harmonization. And as I mentioned before, what is very important is that when there is a new regulation like the Annex 6, it is referenced to standards, to documents like EUROCAE ED-112A, or the future standards for the new second generation of ELT like ED-62B or DO-204B. So it is very important to have a broad view to make sure that all these working group is working simultaneously to make sure that at some point everybody will be ready to make sure that each regulation, ICAO or EASA or everyone has all the needs, all the documents ready for the regulation.

Definitely, we will work with EASA and ICAO to make sure that the proper documents have been forwarded to the ANC for the modification of Annex 6 will be consistent with the proposal of the opinion by EASA and the European Commission. So harmonization is very important definitely.

MS. GORMLEY: Acting Chairman Hart, this completes the

Technical Panel questions for Panel 3.

ACTING CHAIRMAN HART: Thank you, Ms. Gormley. And thanks again to all of our panelists for excellent presentations. We will now take questions from the dais.

Mr. Delisi.

MR. DELISI: Thank you.

Dr. Plantin de Hugues, I'm interested in knowing a little bit more about the ACARS data that was initially collected in Air France 447. Certainly in the early days of the investigation that's all you had to go on. What were you able to garner from that level of information?

DR. PLANTIN de HUGUES: So the first fact was that because there was 25 messages sent in a very limited time, so we were able to say that between the last position that was reported by the ACARS system every 10 minutes, so between the last reported position and the last ACARS messages there was 5 minutes of flight. So we assumed at this time that the maximum distance that had been covered by the aircraft was 14 nautical miles. So this is why we came to this area when we were looking for the position.

MR. DELISI: Good. Thank you. I was more interested in your ability to solve the accident, to determine a cause. Were you able to begin to paint a picture of what might have been happening in the cockpit based solely on the ACARS data that you had at first?

DR. PLANTIN de HUGUES: We have been working for 2 years, I will say, on the ACARS messages. We had a lot of hypotheses, and then, I will say, when we recovered both flight recorders, we were able to perform the complete analysis. But it was impossible only with 25 ACARS messages to have, I will say, a complete picture and to have only one hypothesis.

MR. DELISI: Gotcha. So the full complete picture only was developed when you recovered the recorders and had hundreds and hundreds of parameters available?

DR. PLANTIN de HUGUES: Yes, because we had the complementing data from FDR and CVR, both of them.

MR. DELISI: Mr. Sasse, I wanted to talk to you about the underwater locator beacons. They're obviously required on aircraft flying all around the world. The towed pinger locator capability that you described, is that something that's unique to SUPSALV?

MR. SASSE: The technology isn't unique, but I believe SUPSALV is the only one that actually has a fieldable system that can deploy on a moment's notice anywhere on the globe.

MR. DELISI: So, should a commercial airliner go down anywhere in the world, folks are going to reach out to you to deploy that listening technology?

MR. SASSE: Yes. And we've been involved in most aviation accidents in one form or another.

MR. DELISI: And how does a deployment like that work? Do you put that on a ship and set sail, or do you deploy it and look for a host ship close by?

MR. SASSE: The logistics, first, we normally have to fly it into theater. Most of the time these things are not in the U.S. waters, so we have to fly it to theater. And in the process of flying it there, we're looking for a vessel of opportunity. And there's a whole logistics of how to get it from point A to point B, mobilize it on the vessel, and then transmit -- or transport to site. And that whole process can take up to 7 days, depending on where you are. So there's a lengthy process in getting all that mobilized.

MR. DELISI: Great. Thank you.

ACTING CHAIRMAN HART: Thank you, Mr. Delisi.

Dr. Kolly.

DR. KOLLY: Yes, I have a few questions. Maybe we could pick up with Mr. Sasse with regarding the underwater recovery and location.

Can you describe some of the technical difficulties that arise that make the recovery of a recorder -- specifically, what I'm concerned about is things like, do you run into issues with false signals or signal quality or specific environmental conditions and that sort of thing?

MR. SASSE: One of the things we do is we make sure we tow the fish deep down towards the sea bottom, so we get it away from thermoclines and surface noise and other things like that. But it is possible for the pinger to be buried either in sediment or within the wreckage itself, which could shield the signal and make it harder to detect. Also, if you have severe bottom terrain, that could cause some echoes and also some areas where the signal doesn't propagate as well.

So the environmental factors do have an effect, but even with those parameters, normally we can detect a pinger within 1 nautical mile. If the other conditions and factors are well, we could probably hear it up to 2 nautical miles.

DR. KOLLY: Are there any particular improvements that you would like to see that could make your recovery more successful or easier?

MR. SASSE: As mentioned earlier, battery life increases the window of opportunity to do the search. Lower frequency pingers have the ability to create a longer detection range, which could increase the amount of search area coverage in any one period of time. And also, any of the other technologies that have been mentioned here, which would help localize the starting point for the search, would have pay dividends.

DR. KOLLY: I know all of us have seen your efforts and applaud them. There's certainly a certain amount of risk, safety risk to the recovery effort, and it's obvious that there's an enormous amount of cost associated with that as well.

Have you ever been involved in providing any type of an analysis of that for regulators or any type of official when they're calculating their cost/benefit analysis of what -- just what you bring to the table and how much that costs and what risks are involved?

MR. SASSE: When performing a search for a civilian airline, we're normally working hand-in-hand with NTSB, or in the case of Air France, with the BEA and other aviation agencies. So we do work hand-in-hand with their investigators, and so there is good dialogue on site about what is involved because they're normally there with us at the time helping to direct and lead the effort.

DR. KOLLY: I'd like to address a few questions now to Mr. van den Heuvel. The deployment of these -- or the operation of the deployable recorders, I'd like to talk about the safety of that deployment.

I've heard about issues of unintended deployments being risky to both aircraft and personnel. Can you describe if those risks are real, and also what your company has done to address them?

MR. van den HEUVEL: Okay. I can talk to that. I think first of all, if I talk about in operation, there is a perception that these things fly off the aircraft at altitude and are going to hit a person or a cow -- I've heard a cow. And I think it's important to know that the design, if you don't use the old style G-switches and you're operating solely on deformation of aircraft structure, then -- and as pointed out by the NTSB over the years, you want to the recorder to ride out as much of the accident as it can. You want the last few seconds, so -- and, in fact, we don't deploy until aircraft deformation.

So in 99% of our events there are on the ground or on water. And in the very, very rare occasion in a midair breakup it can happen at altitude, but at that point there's a lot of other things going on too, so we wouldn't be the only thing falling from altitude.

The topic that was addressed I think about maintenance is that if you go back to the early '70s, there was technology by manufacturers that used explosive bolts to eject, to physically eject a deployable from an aircraft. And if that happened in a hangar, there would be the possibility to cause harm to a maintenance personnel. Today, those systems have been outlawed, and certainly in a system like ours, it's just a small spring. If one of these released because somebody tripped something in the system, you'd actually have to run up and grab it. You'd want to go and catch it rather than get away from it because it might fall on the floor. So it's quite, quite the contrary.

The other thing that I believe is happening in talking with some of the OEMs that are considering this technology for civilian aviation, is there is a consideration -- nobody's made a decision yet, but a consideration to have a disable feature when on the ground, certain conditions on the ground. So in that event, you know, it would be impossible for the system to try and trigger.

Now, I think we have to look at that carefully because 30% of our accidents that have involved deployable recorders are takeoff and landing. So it's quite possible that you would have wheels, weight on wheels, so that wouldn't necessarily be a good parameter to use. But there are times and are conditions when it might be appropriate to lock the unit out.

DR. KOLLY: I have a question. Again, this morning I was asking about -- the FAA about voluntary implementation, and I'm thinking of ways to get safety improvements that may not take the normal regulatory route.

Are any of the manufacturers that are here today, are they aware of any particular incentives, say, from insurance companies or from their buyers that would tend to defray some of these costs associated with these technologies?

MR. HAYDEN: As I mentioned in earlier remarks, we're not selling a system that's waiting for an accident to happen so the return on investment of AFIRS has to stand on its own from the outset. We're evolving the emergency mode into something that can provide further benefit. The benefits that are easiest to quantify are easiest to measure because they're not controversial are basically fuel savings.

And we actually have been approached by a major aviation insurance company to become educated because they are contemplating a significant insurance premium reduction for people that equip their airlines and other operators that equip their aircraft, either of which would pay for the system in a heartbeat. So I won't reiterate all the other components of the benefits that are evaluated before people decide to go forward with this, but -- they're on the record -- but the instance potential is there.

In a former life when I was working on helicopter HUMS, I was involved in a situation where Lloyd's granted our commercial European helicopter operator an 8% premium reduction on the basis that they were going to be safer as a result of having the information from a system like that. So it seems that the same thought process has found its way into the fixed-wing world.

DR. KOLLY: Anyone else?

MR. SCHMUTZ: I don't have any information from the insurance industry, but there are certain platforms that are less safe to fly than others based on records, and it seems as though the air framers for those systems are more interested in buying non-required equipment to gather data and to understand -- to identify the reasons behind less-than-stellar safety records, and to try to identify if it's equipment problem, if it's operator problem, or a combination of both.

ACTING CHAIRMAN HART: Thank you, Dr. Kolly.

I'm going to ask a very high-level question, and it's based largely on my lack of knowledge of this arena. And this is fascinating to learn so much about this in such a short period of time.

But the high-level question is, is it in the foreseeable future that we will not be looking for the box because we're going to get uplink-downlink and we're going to have everything we need without ever having to find the box? So I'm going to ask first Mr. Hayden and then Mr. van den Heuvel for your disparate viewpoints on that question, and then anybody else who would like chime in.

So the question is, is it within the foreseeable future that we will not be looking for the boxes anymore because we'll have everything we need already uplink-downlink?

MR. van den HEUVEL: Well, thank you, Chairman Hart for putting me on the spot, and I appreciate that. I'm not sure a technology solution provider is necessarily best-equipped to answer that question. I can only tell you that I've been involved in EUROCAE working groups, IATA working groups, ICAO working groups since -- I think I started doing this in about 1995. And the only constant I would say that I've heard throughout those 2 decades is that there's an absolute need for a tangible black box.

I can't say that I've heard accident investigators talking about getting data from a cloud and feeling that that's going to be secure and reliable and tamper proof. And then, from the Airline Pilots Association, who as we know, they can be very vocal in these groups, they talk about privacy of data and civil liberties, et cetera.

So while I'm not the right person to have the definitive perspective on this, I think there's a significant impetus, a will inside the accident investigation community for, in fact, a tangible black box and I think to have that for a long time into the future.

MR. HAYDEN: Thank you for the question. It's a good one. And I think to sort of not answer it in a way, I think what we can expect is -- and really can do today is get the important data off the aircraft reliably even as it's going down. Now, clearly, there's some additional testing and certification of transmission when the aircraft's in an abnormal attitude and so forth.

But I think that it's safe to say that we've demonstrated that you can have an end-to-end solution that operates in near real time to get most of the data. Now, as I said earlier, we don't bring all the data necessarily. It's really a pre-defined set of data, which could be up to and including most of the data in the flight data recorder.

I do think that the -- there's no question, systems fail, and there are several potential points of failure for a specific incident in data transmission. So I think that in the near -- I don't know what near means, but in the near future I don't foresee replacing a hard recording medium with SatCom only. But I think part of my -- I want to maybe explain my perhaps terse comment before about the pace.

Part of our source of frustration is we are focused more on using the technology to intervene, to help people intervene, and reduce the probability of a crash than recovering the results. And we know from examples, that we've helped avoid some serious incidents. And the way we do this is that all parties, all subject matter experts receive the same data at the same time. So the collaboration includes the flight crew, the operator, and the OEM, who are all looking at the same data. So we expand the number of subject matter experts that are involved in a real-time situation, accordingly.

So, my hope is that the technology can be accelerated -- the use of the technology can be accelerated to avoid some incidents that are avoidable if intervention occurs in real time.

ACTING CHAIRMAN HART: Okay. Thank you very much. I appreciate that. Anybody else with any -- would like to opine on that question?

DR. PLANTIN de HUGUES: Yes. In fact -- thank you for the question. In 2009, when we started the Flight Data Recovery working group, it was one of the solutions we envisaged. So it was a transmission of the complete set of FDR data to the ground. So it was not at that time not appropriate because, in fact, if all aircraft are doing the same on the same time, you can saturate the satellite. So you can tell me that it can be solved, but in 10 years maybe we don't want to transmit 100 parameters, but 1,000 parameters. In such a case, if all aircraft are doing the same, we'll still be able to saturate the satellite.

So we did consider this solution. We found that it was not a good one, but if we have any solution that will help us to localize a wreckage as soon as possible, and we have extra data, it will be preferable definitely. But as an investigator, I would like to have our recorders.

ACTING CHAIRMAN HART: Thank you very much. Anyone else would like to speak to that?

Okay. Tech Panel, do you have -- we have a couple minutes. Any more questions from the Tech Panel? Okay.

Well, thank you again to all of our panelists for great presentations and discussion. That's been fascinating. And thank you, Erin, for doing double duty by being the Technical Panel lead in addition to running the whole joint.

You have given all of us some glimpses of some interesting technology, and we appreciate that. We're going to go on break until 3:15, and return for the final panel of the day. Do I have that correct?

MS. GORMLEY: 3:25.

ACTING CHAIRMAN HART: 3:25. Okay. I'm sorry. On break until 3:25, and then return for the final panel of the day, which is the future path. Thank you very much.

(Off the record at 3:05 p.m.)

(On the record at 3:25 p.m.)

ACTING CHAIRMAN HART: Welcome back. We're now ready to hear from our fourth and final panel, which will address the future path. I will turn things over once again to Erin Gormley.

Ms. Gormley?

MS. GORMLEY: Thank you, Acting Chairman Hart.

As a reminder for this panel, please push the button on the microphone. A green light will indicate the microphone is on. When speaking, bring the microphone close to you, and push the button to turn the microphone off.

In our first three panels, we have discussed the present regulatory landscape, a variety of stakeholder viewpoints, and some proposed technology solutions, yielding the context for our fourth and final panel, The Future Path. This panel will discuss the issues that need to be resolved in order to move forward.

Our panelists are Capt. Charles Hogeman, Aviation Safety Chair of the Airline Pilots Association, or ALPA; Dennis Zvacek, Senior Manager, Avionics Engineering, with American Airlines; and Tim Shaver, Manager of the Avionics Maintenance Branch of the Federal Aviation Administration.

The first panelist will be Charles Hogeman, who will discuss use and protection of flight data from the pilot perspective.

Captain Hogeman.

CAPT. HOGEMAN: Thank you, Ms. Gormley.

I appreciate the opportunity to speak before the NTSB on this very, very important subject. And we've heard a lot of good information. My remarks are going to be markedly different in that I'd like to talk more philosophically about the use of data and the data that is derived from flight recorders.

But before I do, I'm obligated by law to tell you who ALPA is. We have 51,000 professional airline pilots and 31 pilot groups at airlines in the U.S. and Canada. We do have a record of over 80 years of safety advocacy, and we are the largest nongovernmental safety organization in the world. We have 400 pilot representatives in various disciplines working purely on safety issues, and we're assisted by 23 full-time professional staff.

So as we move into data recording considerations, safety data must be used only for that purpose. And I'm reminded, dare I say, over 35 years ago when I started flying, one of the oral questions on the airplane I was checking out in is, what is the flight data recorder required to capture? And the answer was SHAVE, which is speed, heading, altitude, vertical velocity, and elapsed time. And certainly, flight data recorders, and the use of cockpit voice recorders, has emerged over many years to the point to where if you ask that question today what is the flight data recorder required to capture, the answer is a bunch.

We have evolved over time, moving from accident investigation to the use of information and data. Much of what you heard this morning is impressive on what we can capture. And I go back to Acting Chairman Hart's comments this morning opening up this forum in that there is a lot of information that we're able to capture, but I think that we have to move forward. And the Acting Chairman made the point, we have to move forward in not a knee-jerk fashion, but we have to be measured and objective.

You know, after hearing all of the impressive presentations prior to our panel, you know, I'm thinking that technology is not really the -- is the less challenging part. But we must not underestimate the need to engage all stakeholders, both domestically and internationally, on the use and protection of safety data.

While the use of recorders is essential to accident investigation, getting more data also presents some challenges for us. You know, one way to think about this is that the safety case should scale what we record, how long we record it, and how long it is saved. Protection of data is not just a technical issue, but rather it is one that has to be worked on by all facets in the industry, certainly the regulators, accident boards, and all that. Safety data has proven to be of value. It is a tremendously valuable resource and we have to protect it.

You know, with all the information that is now available, certainly in a commercials standpoint, we are able -- just the general public is able to derive information from flight track data almost anywhere in the world. We know how fast the aircraft's moving, whether it's climbing, whether it's descending, what its ground speed is. And the fear that I have is that inappropriate use of that kind of information is actually going to challenge the integrity of an accident investigation, should we find ourselves doing that. We don't want to use information from all these data sources that are going to hurt the sanctity of an official investigation.

And I think technology needs to also address the security of data. And the data that we collect does get old, it gets stale, and we ask ourselves how long do we keep it? Almost all stale data, or data taken out of context, is almost worse than no data.

We heard a lot this morning about on-board technology, and I would ask that we need to maximize the use of our existing technology on locating the aircraft. A lot of work and a lot of discussion this morning about streamed data. And I'm sure there will be some questions later on as, you know, the benefits of streaming data. But I would argue that as we talk about technology solutions such as streaming, we don't want to lose track of analysis of data and I think that is just as important.

There are technological, regulatory, and political challenges to streaming. And let's face it, you know, whether we get our data streamed or whether we get it taken off a flight recorder itself, it doesn't necessarily guarantee we won't prevent bad things from happening. But as a safety industry, I think we need to be looking forward and looking at using technology also for analysis of data.

So as we look head, you know, I think you heard -- I think the Acting Chairman mentioned it this morning, I heard the

FAA and EASA say it -- what is it that we really need? What do we build, how do we build it, and how do we use it? And, of course, inherent into that discussion is what is the cost? And what do we need -- you know, what is the risk benefit of some of the technologies that we are looking at? You know, I think we need to work together on protecting data and the information that we get, and look beyond the accident investigation piece of it.

So, just in closing, I think the NTSB can lead the partnership to change the paradigm to collect, safeguard, and analyze data before accidents occur. And I think that'll occur in the legislative arena, in the regulatory arena, and certainly as SMS and other programs like that come online within the airlines, affect cultural change. And with that, I look forward to your questions. Thank you.

MS. GORMLEY: Thank you, Captain Hogeman.

Our next presenter is Dennis Zvacek of American Airlines, who will discuss issues regarding technology implementation, data ownership, storage, and security from the airline operator perspective.

Mr. Zvacek.

MR. ZVACEK: Thank you very much, and good afternoon. I appreciate the opportunity to be here today.

I'd like to offer just a few basic comments, if I could. I was very happy, as the day has progressed, to see that many of the comments that we had prepared paralleled the discussions that went on during the day. There are some common threads throughout the day that are common to our objectives as well.

As an airline, or the aircraft operator, we're very close to the people that we're all trying to keep safe. And a little bit of framework around our position in this situation, when a question like this comes up, typically, a little bit of review, we, as an operator, participate in the definition of the operational requirements. We work together with everyone in the room to help develop the solutions. We often lead in the implementation of the solution, especially when it's a retrofit installation of a system or a function in our aircraft. And then, our passengers realize the benefit when the solution works.

We've seen today, and it's certainly true, that data that is tracked by today's flight recorder systems is very robust and provides good information when used to support the difficult safety investigations that come before us. We've come a long way since that original five-parameter oral recorder, but it wasn't always easy to get here today. The number of parameters and the data that we have available is accepted and commonplace now, but it came over the years with some difficult modifications and some programs that provided some deadlines and some obstacles for the airlines in a few cases.

Having this much data available now in some ways creates some challenges. We've discussed the perception of how much data we move around and where we might store that data. The question of ownership of the data and where it is stored and how it is moved to a place and position when it's needed is still something that needs a little bit of work.

Now, the technology that is in use today, and coming in our new airplanes, can support even better data availability and tracking than we typically utilize, and certainly, much more than we imagined when the last round of rulemaking was accomplished, as was mentioned earlier today. And the flight following system that's in the United States results in very tight aircraft tracking. We actually have very rapid reaction to any aircraft that has lost communication or is off its intended track.

So if we take the technology and the system that we have in the U.S., with the planned introduction of satellite-based surveillance technology, and integration through future aerospace programs throughout the world, this will give us the opportunity to expand the type of flight following and aircraft tracking that we have here in the U.S. It's likely that we just need to tie a few of our existing systems and functions together and we'll be able to meet the needs of the future. We recognize the IATA level forums and other industry activity that's underway to lay out these guidelines.

An example of taking some of that data and utilizing it in a little different way, as was mentioned earlier as well, flight operations quality assurance programs, and recently, maintenance operations quality programs that are developing. We have flight recorder, and in some cases quick access recorder data, available in our airplanes. And it was reserved, it was held for investigative situations. Now we're taking that data and using it in proactive fashions to help identify ways that we can operate the aircraft more efficiently or, hopefully, more safely.

But overall, we think it's important that our response in this situation addresses the need. Rushing to a new or a separate technology to solve a problem, perhaps a single event, that's not really been understood by a thorough safety investigation might utilize our resources, our limited resources in a way that's not to our best advantage.

I was actually encouraged by the discussions that opened up very early today to talk about the cost/benefit analysis of the situation. It's sometimes a real difficult topic to bring up in this discussion, but it's a real obstacle, a real item that we have to deal with in the operator's world.

We're interested in a solution that can be applied to all of our aircraft in the same or in a very similar method, and certainly one that can be applied internationally. You know, interoperability of our aircraft, most -- many of our aircraft operate in various regions in the world, and interoperability is a very important factor.

An efficient design or efficient solution for this challenge is one that will allow a simple implementation utilizing the capable equipment that we have in place today. That design, through its simplicity, will also allow us to have timely access to the data if we need it in the future.

So, in summary, we acknowledge the capability of the equipment that we have today, we want to make sure that we understand the need, maybe circle back one more time and make sure that we understand the need that we're addressing here, and we look forward to enhancing our aircraft and our systems to meet the needs that we've identified. Thank you very much.

MS. GORMLEY: Thank you, Mr. Zvacek.

Our final panelist will be Tim Shaver of the FAA, who will discuss technical certification of new technology.

Mr. Shaver.

MR. SHAVER: Hi, and good afternoon.

So the role of the FAA is to establish the regulations, policy, and guidance for both the certification and continued airworthiness of flight data and location type systems and technologies.

So, as you all know, the flight recorder systems were originally mandated to provide data for both accident and incident investigation. But that has grown over the years to include systems that have been developed to support a proactive review of data, so things like FOQA, flight data monitoring, aircraft condition monitoring systems, engine monitoring systems. All of those systems have evolved from the basic concept of collecting data, and we've found some very proactive uses for those.

So the mandatory flight recorders used on airplanes today, of course, the digital flight data recorder, we've mandated up to 91 parameters based on many criteria -- aircraft manufacture dates. But there are thousands of other parameters that non-required that are also being recorded in flight data recorders today. We see data rates up to eight-plus samples per second mandated -- some of those are even higher in other systems -- and we've mandated that there's 25 hours of data minimum that is in crash-protected memory.

And along the same lines, with cockpit voice recorders, the crash-protected 2-hour solid-state memory, we have four channels of audio, and it also includes data link.

So some of the other technologies we see -- this is a little different type of mandate. The underwater locator beacons, for example, are required. So, instead of rulemaking, we actually revised the Technical Standard Order to delete the old one. We rescinded the authorization to produce those, and are now producing a 90-day battery. So that goes in effect in 2015, so through attrition, those older type locator beacons or devices will be replaced.

We also have developed the TSO for the low frequency airframe ULD. That TSO will allow manufacturers today to have an FAA-approved production and design of those type of components.

So there are other non-required types of recorder technologies that are being certified and developed. Some of those things like deployable recorders, we worked for years to update our TSOs and worked with EUROCAE and industry to develop the minimum performance standards for those. We've issued TSOs for those and will voluntarily support the evaluation and installation of any of those systems, as it comes along, anybody that wants to install them.

Image recorders have come a long way. In 2005, we did a proof of concept study that the NTSB participated in. We've since developed TSOs and we've worked on other systems where image recorders are actually being used to capture required information for the flight recorder requirement. So we're trying to push that as a non-invasive, lower cost method of collecting mandatory parameters. And, hopefully, we'll see other benefits with that.

So, in summary, enhancing data recorder and location technology is something that we promote. We're working with the international community to develop the performance-based approach. We strongly believe in the performance-based approach for the purpose of locating aircraft wreckage.

And we're also working with the industry to try to minimize the certification burden for systems, and in my case, recorders and location systems, by trying to approach it in a risk-based decision-making process so the level of certitude would also be matched with the level of risk; right sizing the certification requirements, not over burdening the installation of these systems with certification requirements so we minimize those; and developing standard policy and guidance that will promote these system installations. Thank you.

MS. GORMLEY: Thank you, Mr. Shaver.

This concludes the presentations for this panel. We are now ready for questions from our Technical Panel. I will turn things over to Mr. Babcock, the Technical Panel lead for this topic.

Mr. Babcock.

MR. BABCOCK: Thank you. And thank you to our panelists for those informative presentations, and for being here today for this discussion.

I'm going to start with Mr. Shaver, if you don't mind. We heard a lot of talk about some performance-based rulemaking and performance-based approaches this morning. Could you remind everybody what we're talking about when you mention performance-based rulemaking?

MR. SHAVER: Yeah, and a good example you've heard bantered about quite a bit today would be like a 6 nautical mile -- the ability to locate an accident within 6 nautical miles. That's a performance-based requirement. There could be many systems that actually meet that requirement. So when we talk about performance-based approach, that's what we try to capture.

MR. BABCOCK: Having a performance-based approach opens up the playing field, I guess, for applicants to have novel solutions to problems. Does that increase the burden on the FAA to have more robust technical analysis to make sure that while you're meeting the intent of the performance-based rule, you're not -- you're meeting it in a robust way and without unduly impacting other systems?

MR. SHAVER: I don't see a significant impact where -- we do that type of analysis regularly in our certification and operational approach. For example, the use of image recording to capture discretes, you know, that's a novel approach that we have taken. Where traditionally we could look at the flight data recorder output -- if we would have the performance-based -- that same type of analysis, you could make sure that you could capture that within the same rate and accuracy using a completely different system. So, we've done it in the past. I don't think it's a significant burden.

MR. BABCOCK: Thank you.

Mr. Zvacek, you mentioned your flight following process in the U.S., and you're working on increasing that capability to work on a more global basis. Do you have a timeline for that type of implementation, and can you describe the technology that you're using to put that into effect?

MR. ZVACEK: I don't think I have a direct timeline available. Probably the primary candidate for the technology in that area, our ADS-B work, our ADS-B preparation work is underway now. And there is some strong discussion -- it's actually more than that -- some work to put ADS-B transponders and equipment on satellite constellations that are coming in the near future. That is one example of a system that will provide the tracking similar to what we will have over the United States and other areas, other landmass areas in the world in the oceanic areas. That's probably the primary example that's coming in the future.

The ADS-C and general FANS position reporting, satellite communication supported surveillance is an example of some of that early technology that's in place now.

MR. BABCOCK: The data that you're seeing today, whether it be ACARS messages, position reporting domestically, how is that data being stored by American currently?

MR. ZVACEK: The data is stored, for lack of a better term, departmentally. We have certain regulatory requirements for handling of our flight recorder data to ensure its accuracy and functional reliability. That data is handled by the engineering or maintenance groups within the airline. The flight operations quality assurance data is utilized -- is sent and utilized by a department of -- or group of analysts that utilize that data in the flight department.

Typically today, the data is more departmentalized than we hope to have it in the future. A general repository with the expanded availability and perhaps security that will be expected in the future is a future requirement.

MR. BABCOCK: Thank you. And if there is in some point in the future new rulemaking that's requiring position reporting or better location of aircraft, what fleet segment should those possible rules be targeted to? I know you mentioned you want a single solution to apply to all aircraft in your fleet. Does that mean everything from an MD-88 type aircraft to a triple 7?

MR. ZVACEK: I think that's a good question, because we talked earlier today about ELTs, and ELTs over the domestic U.S. As I mentioned, we really should tailor the response to meet the need. And a lot of what we've been talking about are being able to find aircraft or track aircraft when they're in the remote areas of the globe, whether it's over water, or a polar operation, or even some -- there are some large landmasses as well that are considered somewhat remote.

So, implementation, although we'd like a common solution to meet the need, whether it's a transmission solution or access or availability of recorders, it shouldn't necessarily be applied to every airplane. It should be addressed to the need in that region of the world.

MR. BABCOCK: Thank you.

Captain Hogeman, we've heard a lot of discussion throughout the day today about various technologies, some of them currently being implemented, some of them in the near or midterm future. Given that these technologies are in existence or near existence, what is the best way to address some of those concerns that the pilots have possibly that a operations supervisor or a maintenance supervisor can have streaming flight data sent to his phone on a near real-time basis?

CAPT. HOGEMAN: Well, I mean, that's a very good -- that's a good question, and that is an area of concern for us. You know, I think that what needs to run parallel to the advancing technologies that we see is continued discussion on governance on how we're going to manage data and who gets the data. You know, as we heard this morning, we have -- the voluntary safety initiatives that the FAA pointed out, a lot of that is built on confidence. And confidence, you know, of certainly the pilots that are flying the airplanes, and that the data that their airplanes are reporting is protected.

And I just think there needs to be a continuing dialogue on how we protect that information from being used. You know, part of our concern is with all the technology, data is starting -- you could see where data would actually pile up. And, you know, we ought to be looking beyond that to how that data is translated into actionable information so that we can eventually hopefully achieve some wisdom.

And so, I think there needs to a continuing discussion on, number one, what's the data being used for? Is it truly being used for safety purposes? And, you know, what happens when it comes in front door and where does it go and who has it?

MR. BABCOCK: I don't mean this to be a loaded question, but do you feel right now that that dialogue is currently taking place?

CAPT. HOGEMAN: Yeah, you know, I think there are examples where it's been very positive. Certainly from my membership's standpoint, I think we've seen some very, very positive things through the Commercial Air Safety Team that you heard about this morning. Information sharing -- and, you know, it's information sharing and not just data sharing. It's information sharing that I think is the key point.

And, you know, there are opportunities. There are some -- certainly opportunities here in the U.S. from a voluntary standpoint where I think it's been successful, and I think it continues to be successful. But it's fragile, and misuse of data for commercial purposes, for competitive purposes, or disciplinary purposes can be damaging. And I think we all have to work together to protect that.

MR. BABCOCK: Thank you.

And then, this question I guess is for Captain Hogeman and for Mr. Zvacek. The data that we talk about when we're talking about traditional FOQA-type programs can come from usually an FDR or a QAR system. Does data reported from an aircraft, whether that be enhanced ACARS or ADS-B or any other type of data from some of these technologies that we heard about earlier, should that be part of a traditional FOQA program or stand separate from that?

CAPT. HOGEMAN: Well, I think it can, and I believe it should. But as we just mentioned, the data needs to be handled properly. Your question earlier, how do we handle the flight recorder data? We've developed fairly strict guidelines, and I discussed earlier the focused departments for the separate types of data or the different situations that we utilize data, that's developed to in some ways limit the access or limit the handling of the data so we maintain that trust. And it is that, a level of trust within the company, within the different individuals in the company, and the departments in the company.

So the data that we're talking about transmitting over ACARS, or perhaps ADS-B data, is very similar or the same to the data that's available through the recorder systems, so it seems to fit well.

MR. ZVACEK: Yeah, you know, as we move into NextGen technologies and we look at the prominence of ACARS and data link data, I think that's as fair area to examine in collecting that. But I think you have to look at it for the full regime of flight. And it's very easy to take ACARS messaging and data out of context unless you have the benefit of seeing it from start to finish.

MR. BABCOCK: Thank you.

My next question is for Mr. Shaver. You mentioned a couple different avenues based on required equipment or optional equipment. Can you talk about the level of FAA review? For example, if an operator is trying to put a non-required piece or equipment versus a piece of equipment that's intended to meet a rule of the FAA?

MR. SHAVER: Yeah, there's several systems that provide safety enhancements that are not required. So, the level of review can be, I guess, delegated more to the manufacturer, and based on the risk too. So the system that comes to mind immediately is like AOA systems on private aircraft now.

You know, we have had a big push in development for a safety-enhancing piece of equipment, and lowered the level of certitude based on the risk that it's going to have. So for other systems we're looking at right now for flight data monitoring installations, we're just getting ready to do a test in the tech center in Atlantic City for those type of systems. So our goal there is to hopefully provide an Advisory Circular that will help define the type of equipment that needs to be installed, where it needs to installed, and how that can be used. And then, back it off to the minimum level of certification where maybe an inspector can review the data and then actually do the approval.

On the flip side of that, when it's a required piece of equipment, there is certification that has to happen at the product level and at the component level, and various other regulatory steps that it needs to go through. So it can be quite a significant difference when we can minimize the amount of certification that is required for installation of those systems.

MR. BABCOCK: Thank you.

I'm going to turn it over to Ms. Gormley. She has a couple questions.

MS. GORMLEY: Captain Hogeman, you mentioned in your presentation about stale data and that sometimes using the wealth of information could compromise the sanctity of an investigation.

Coming from an investigator standpoint, you know, having more data usually is better. Even if it doesn't help, it doesn't usually harm. So I'm interested if you could expand on that statement.

CAPT. HOGEMAN: Yeah, my remarks were pointed to the wealth of information that's not only available to us in the safety world, and certainly to the NTSB or other investigative agencies, but the wealth of information that is available to the media and the general public.

And, you know, literally it's possible to pull up flight track data from a commercial provider, and to the untrained eye make some very, very astounding conclusions that can put pressure on the investigation board to have to respond to or react to that, when that information formally was provided through a thorough investigation, a sound investigation process, and that information was disclosed after it was properly vetted.

And my concern is with the information and data explosion that we see through the advancements in technology, we don't want to lose track that the investigation boards have the role and the responsibility. And, yes, it is important for the investigation board to have as much data as they want.

MS. GORMLEY: So I think that goes back to the second part of your statement in terms of what's more important is the analysis of the data versus just the data itself?

CAPT. HOGEMAN: Absolutely. And, you know, we've listened to some very, very impressive presentations here. But where I think it would be very interesting to move from this point forward is what's the technology of parsing data, of cataloguing data? And what is that -- how we can use technology to improve the information, the lessons learned, from certainly an investigation and the data we receive?

Like I said, we have a lot of data coming in the front door, but what are we doing with it after it comes in the front door?

MS. GORMLEY: And going forward on that theme of lessons learned, Mr. Zvacek, you talked about the need to assess the information for having to need it, et cetera. But I assume with all the data that's out there that the operator will find a use for the data in terms of efficiency or maintenance. So there are programs such as gatelink or ACARS where you will explore those technologies of gathering the data, protecting it, having internal controls.

Is there information sharing and lessons learned among the operators to discuss the best way to do that, so as to not reinvent the wheel in terms -- we are going to assess it, but we have to go forward in terms of coming up with some of those standards?

MR. ZVACEK: I think we have the beginnings of that. At American Airlines we're very close to introducing the 787 aircraft. The 787 is a generational step in the amount of data that's available coming from an aircraft. We've had to do quite a bit of work with our IT folks to prepare our ground systems to handle that data, and utilize it properly and move it to the departments that can use it.

This is also driving a pretty big culture change within our company. Our maintenance department are folks -- most of the folks there are a little more used to turning wrenches and going out and moving parts on airplanes. The availability of all this data -- we learned some from earlier types of aircraft, and as was mentioned earlier, health monitoring systems and data that's available. But with the aircraft, the next generation of aircraft that are coming, both the 787 and the A350, we're going to have a lot more data to utilize. And we're going to have to parse it properly into plain English information that we can use, and then store it and secure it properly.

And the industry activity that I've seen in that area -- AEEC is doing a little bit of work on -- well, they've done a fair amount of work on the security of data, and they're doing some work on handling the logs that come out, the event logs that come out of the airplanes. And so, I think we're seeing the beginnings of some work between the airlines, but there's more to do.

MR. BABCOCK: Ms. McComb, I believe, has a couple questions.

MS. McCOMB: This question is for Captain Hogeman. In terms of ALPA's perspective on implementing new technology, are there any particular concerns when you look at this potential implementation of all these new technologies, looking at domestic fleets versus international fleets?

CAPT. HOGEMAN: No, I think our approach towards, you know, domestic or international with a priority -- you know, I think our concerns are about the protection, and getting the data that really speaks to safety and identifying what it is, number one, we don't have right now; what do we need and what could we get? And, you know, defining the problem and then trying to identify solutions.

And, you know, it's been said here earlier today -- I mean, you know, technology, if we're not careful, is moving so far ahead that we have the technology looking for a -- you know, looking for a problem to solve. And I think, you know, at times I think we need to sit down through industry venues and identify just what is it that we need, what is missing, and moving on that. And looking at a variety of possible solutions, rather than be beholden to necessarily one type of technology.

MS. McCOMB: And just a little bit of a follow-up, we've often heard that -- from the pilot community's perspective, concerns about protection, particularly in international arenas.

Can you go a little bit -- can you talk a little bit about ALPA's perspective in terms of data protection or information protection as it relates to some of the technologies that we've heard about today?

CAPT. HOGEMAN: Well, you know, the more you collect the more the -- the more data that you collect or are able to collect, the more the risk that the data won't be used, unless you've identified specifically what you need that data for. And, you know, the flavor internationally certainly would probably vary from country to country. But, you know, again, it is defining what it is that we don't have, and then, you know, discussing what kind of technological solutions there are to solve that.

MS. McCOMB: Thank you.

MR. BABCOCK: Mr. Cash.

MR. CASH: Mr. Shaver, I hope you can answer this. With the new air traffic systems that are coming on board, NextGen basically, and ADS-B and C, how -- is that getting us a long way towards what we want as far as, you know, oceanic tracking? And can you speak to that at all?

MR. SHAVER: As for oceanic tracking, unfortunately --

MR. CASH: Well, or remote area tracking and wreckage location?

MR. SHAVER: The coverage of ADS-B right now is fairly limited because it's based on ground station implementation. However, as mentioned --

MR. CASH: But that's changing, though?

MR. SHAVER: Yeah, however, they are looking at other systems that could, you know, provide satellite-based collection of that, and Canada has gone a long way into that. So I think eventually ADS-B could be used for that and would help a lot in that venue, but right now it's fairly limited into those areas where we have the ground stations.

MR. CASH: But the plan is to go towards, you know, long-range tracking and air traffic control system, right?

MR. SHAVER: For ADS-B, as far as I know it's -- the implementation is more to ground-based control. That's the sites right now in the U.S., so --

MR. CASH: And the other question is, Mr. Zvacek, in your remarks I heard you say that you thought that a single solution for an entire airline would be preferable? Is that really what you meant to say, or do you really want narrow bodies and wide bodies having the same equipage and --

MR. ZVACEK: No, it's not exactly the same. I was hoping for one technology instead of a type of equipment that we would use in one type of aircraft and a different -- a whole other technology that we would use in a different area. I'd hoped to stay within the same family of technology, and then we can scale that to the need and the type of aircraft then, based again on the operation -- the mission of the aircraft and the region of the world.

So, it was meant more that -- the aircraft wouldn't be exactly the same, although that would be nice. But typically when you compromise that way, you get a system that doesn't fit exactly anywhere. So it was more aimed at I'd like to stay with a technology and scale that, as needed.

MR. CASH: Okay. Thank you.

MR. BABCOCK: Acting Chairman Hart that concludes the questions from the Technical Panel.

ACTING CHAIRMAN HART: Thank you, Mr. Babcock. And thank you to all of our panelists for very informative presentations and answers to our questions. I appreciate that. And I'll take questions from the dais.

Mr. Delisi.

MR. DELISI: Thank you.

Captain Hogeman, there are very high levels of protection in place for the data collected in an accident investigation from the flight data recorder and, in particular, from the cockpit voice recorder. But there's one source of data that we don't have yet, which is video in the cockpit.

What's ALPA's position on the installation of video recorders?

CAPT. HOGEMAN: John, I'm glad you asked that question. You know, as we move forward and looking for what's missing, you know, we're not -- I'm not convinced, and ALPA's not convinced that video imaging is necessarily going to give you that increase of information. There's stuff that you won't see from video that you will see from a cockpit voice recorder and a flight data recorder. And, quite honestly, again, we come back to the security of that and the protections.

And so, ALPA at this point is, you know, is opposed to video at this point until we can be assured that there's going to be the appropriate level of security, and that there is, you know, reason, there is absolutely irrefutable reason that that will improve an investigation.

MR. DELISI: Thanks.

Mr. Zvacek, I just want to be sure I have the mental image correct now about how data is delivered to American Airlines. If there were to be an accident, we're very familiar with going to the accident site, pulling the flight data recorder, reading it out in our lab. If an airplane was involved in an accident, but still landed and taxied to the gate, on American Airlines' fleet now, is that flight operational data automatically transmitted off the airplane?

MR. ZVACEK: We do have some types of aircraft that have quick access recorders that utilize a cellular form of data transmission, and it is an automatic transmission of that data. So, that would -- depending on the situation that could continue in that automatic nature. The quick access recorder data is very similar, in some cases the same data, or partially the same set of parameters that is recorded as flight recorder data.

MR. DELISI: It certainly is fascinating how even when we have a flight data recorder there are occasions where the quick access recorder data provides a slightly different sample or a few different parameters or samples taken at a slightly different time, and sometimes it really does help and supplement that. But it now seems like that data -- in the past, we could control that by going to an accident scene or getting to an accident airplane and only under certain circumstances advancing the investigation by collecting that data. But now it seems like that data, that flight operational data may have already left the airplane without any human intervention.

MR. ZVACEK: Technically, it is possible. Now, that data within our company is still in a controlled environment. So it's not something that would be widely available within the company or -- excuse me -- yeah, within the company or outside the company, certainly.

MR. DELISI: Good. Thank you.

Final question, Mr. Shaver, you talked about the FAA developing TSOs, Technical Standard Orders. And I was wondering a little bit about that process. Is it really that the FAA sits down and thinks about what the requirements for a new piece of equipment ought to be, or is it more that the industry gets together and decides what's possible and the FAA memorializes that with a technical standard?

MR. SHAVER: Yeah, I guess it's better described as the latter. It typically is an industry organization that would get together and develop the technical standards, the minimum operational performance standards of the system, and then they would produce -- right now, we usually use EASA, RCTA, or EUROCAE as one of those bodies. And then, we would use that as the basis for the Technical Standard Order, with some other requirements.

MR. DELISI: Very good. Thank you.

ACTING CHAIRMAN HART: Thank you, Mr. Delisi.

Dr. Kolly.

DR. KOLLY: Thank you.

Sean, could you pull up the last slide of Mr. Shaver's presentation please?

Mr. Shaver, a question on your summary slide. The last bullet is very interesting to me. I'm not sure I understood from your presentation -- I'm not sure I got a full picture of what you meant by minimizing the certification burden for recorders and locating systems, and then with these particular aspects. Could you maybe just kind of walk through that again?

MR. SHAVER: Sure. And I guess it comes back down to the certification, as we've talked about earlier, for required and non-required systems.

So when a system is typically installed, there is a level of burden to ensure that that system performs its intended function, especially for required equipment. When we have non-required safety enhancing equipment, there can be some, I guess, lessening of that burden by the manufacturer of that equipment making a statement or a determination that the system meets the requirements. There's not a level of FAA involvement.

So for certain systems on certain airplanes, we may be able to take it that we've established the necessary technical requirements, and then let the manufacturer determine that they've met those requirements. And then, also that gets to the point of when it's actually being installed on the airplane.

When it's non-required equipment, the aircraft installation -- actually, we look at things to make sure basically it's not a danger to the airplane: so it's not going to catch fire, it's secured, it provides the, you know, the necessary electrical protections, that kind of requirements. And those are basic known requirements that are easy to, you know, evaluate and certify.

So when you have -- like a traditional flight recorder system today takes a higher level of certitude that you have to go in and validate that all of those parameters are correctly -- you know, the system's going to operate -- especially for the crashworthiness aspects of a traditional recorder. If we could lessen those and have the manufacturer make a statement of finding that they've met those, and we see a -- what is it, TSO-199, it's a lesser, you know, degree of crash protection required.

But those, in essence, reduce the cost of the certification, which hopefully will help incentivized its use across a broader range of operators. Does that help answer your question at all?

DR. KOLLY: Yes, it does. Thank you.

ACTING CHAIRMAN HART: Thank you, Dr. Kolly.

Does the Tech Panel have any further questions?

MS. GORMLEY: I just have one question.

Mr. Shaver, you just mentioned about when you're looking at certification particularly of non-mandatory equipment that you make sure that there's no danger in terms of fire or unintended consequences. I think we'd all agree from what we've heard today, and in general, that there's an explosive growth of technology and different novel, innovative concepts.

How does the FAA ensure that they have an appropriate level of expertise, I guess you would say, or how do they get spooled up on some of this technology and ensure -- or do they have enough resources to deal with all this, you know, various technology that's coming in to be evaluated? Or is that something where there's going to be a delay in terms of evaluating that?

MR. SHAVER: I guess it depends on if it's new technology, brand new technology, of course, there's a higher level of review and coming up to speed. But if it's repurposing existing technology, if we're just doing a software change to an ACARS system to where it would allow that to be triggered and transmit information -- you know, so it just depends on the level of newness of the technology.

So part of the right sizing risk too is to look at those things and try to determine what areas the FAA needs to be involved in and what areas we need to review. And then, put the burden back onto -- you know, certification and insurance, back onto the installer and the system manufacturer. So those things that are lower risk, we can depend on them to step up, and then only review the higher risk items.

MS. GORMLEY: Thank you. That's all.

ACTING CHAIRMAN HART: Thank you. That brings us to the end of a fascinating and informative day, and I appreciate all the work that everybody's put into that.

For starters, I'd like to thank Dr. Kolly and Mr. Delisi for joining me here on the dais for our presentation. I would like to certainly thank Erin Gormley and her team for setting up such a great program and for making it run smoothly and productively. And then, last but not least, of course I want to thank all of our panelists who took time out of their busy day to come and help us address a pressing issue that worldwide we're going to have to address.

Manufacturers of airframe, avionics, and new technologies, as well as representatives from operator and pilot groups have brought their perspectives and enriched our knowledge of these emerging technologies. Representatives from the FAA and the European Aviation Safety Agency, as well as from ICAO, have aired some the challenges of finding the right balance in making these changes.

It's been an illuminating day, especially from a systems perspective. Some of the technologies we examined today build on existing avionics in civil aviation and others are on completely new platforms. Regardless of the platform, industry and regulators must work collaboratively to enable solutions that provide more efficient data recovery without compromising safety. That takes thoughtful and thorough consideration. Today's presentations also shed light on some of the complexities that are introduced by these technologies that are not immediately obvious, sometimes even to the experts.

As we know from investigations, accidents result from a series of failures. In bringing together perspectives from throughout aviation and aviation safety it's been our goal to broadly address some of the many interactions that are necessary to modify a highly successful commercial aviation system. The introduction of new technologies must not introduce new and unintended consequences.

More efficient recovery of data will mean quickly identifying that an event has taken place, determining the location of the accident and retrieving the data to help determine the sequence of events that led to the accident. In our age of nonstop data, it's easy to envision a future where we maximize use of all available assets, but it is not a simple process to get there.

More than 75 years ago, on July 2nd, 1927, a twin engine

Lockheed Electra was due to land at Howland Island in the Pacific. The pilot was in communication with the Coast Guard Cutter *Itasca* via radio, but according to the *Itasca*'s crew the pilot apparently could not hear their replies. At 8:43 that morning the pilot, of course that's Amelia Earhart, sent her final transmission. The captain of the *Itasca* commenced the first of many searches, but as is so well known that airplane has never been found.

This summer Amelia Rose Earhart symbolically completed her namesake's journey around the world. Along the way ordinary citizens like you and me could track the progress of her flight online real time.

While there are many challenges and complexities to broadly implementing technologies such as those discussed today, lost aircraft, and with them lost data, properly belong in the last century. In this century, the continuation of the safety journey will depend on a great deal of hard work by those we heard from today and many others to ensure more effective data retrieval. We hope that the information we heard today will help the aviation community achieve that very important goal.

Thank you, and we stand adjourned.

(Whereupon, at 4:22 p.m., the forum in the above-entitled matter was adjourned.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF: FORUM: EMERGING FLIGHT FLIGHT DATA AND LOCATOR TECHNOLOGY

PLACE: Washington, D.C.

DATE: October 7, 2014

was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording accomplished at the hearing.

Timothy Atkinson
Official Reporter