Ground Control Systems

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- Define what is a GCS
- Show the level of maturity of GCS's
- Where the industry currently is
- Where the industry development is going
- Levels of Autonomy – Stanag 4586

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Design Safety Considerations

- The Control Station is the UA "Cockpit" that can be on the Ground, in the Air, or on a Ship
  - Designed using established aircraft certification standards
  - Roll in the unique features of Unmanned Aircraft control
  - Provide common training for all systems and type certification for specific aircraft (ala Airbus)
  - It can be used as a basis for Flight Operations Quality Assurance (FOQA) for Unmanned Aircrafts

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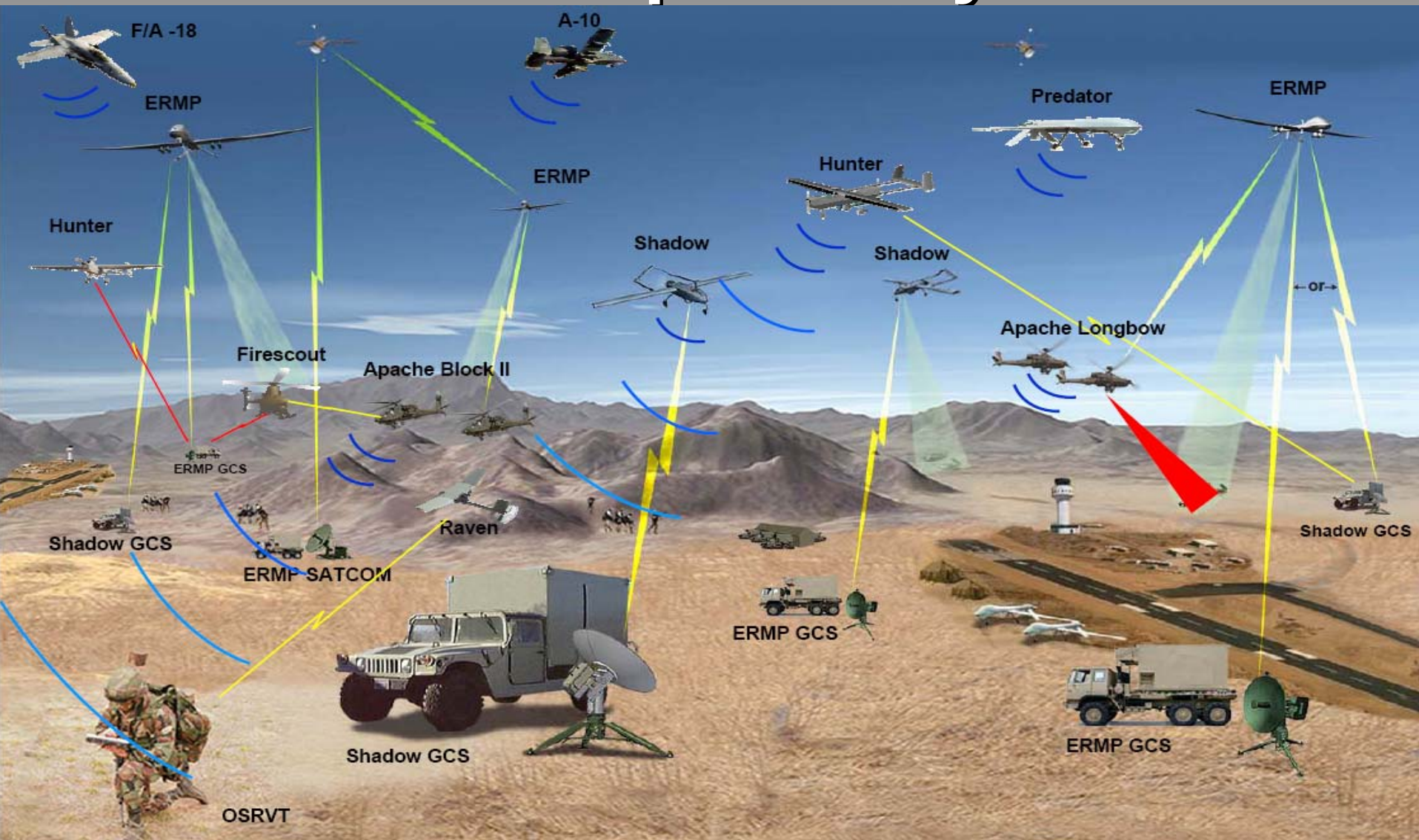
Interoperability



20 Years of Proud UAV History

1985-1986 — Pioneer

RQ-2A

- Dope & Fabric Wing
- Fiber Glass Fuselage
- 26 HP Engine
- "C" Band Data Link

GCS 2000

- Intell 8086 Processor
- Distributed Processing

1990 — Improved Pioneer

RQ-2B

- All Composite Airframe
- Alternate Band D/L
- Improved Avionics
- Waypoint NAV

Portable Mission Control Station

- Sun 3 Processor
- Color Graphics
- ADA Programming

1992-1994 — Shadow 600

- 12+ hr Endurance
- 52 HP Engine
- Multiple Payload

- 6+ hr Endurance
- Compact Avionics
- Short Field OPS
- TV/IR Payload

Mission Planning Control Station

- Sun 4 Processor
- Glass Cockpit
- Fly Any UAV

1995-1999

Shadow 400 TUAV

- Shipboard OPS
- 5-6 hrs. Endurance
- 38 HP Engine
- TUAV GCS
- AUTOLAND

Improved Pioneer

- Auto Recovery
- New Payload
- MIAG Electronics
- New Engine

Tactical Control Station (TCS)

- Software Interoperability
- Rapid Imaging Dissemination
- Scaleable Interaction

1999-2001

Shadow 200 RQ-7A

- 5+ hrs Endurance
- EO-IR Payload
- Launcher/Auto Landing
- C-130 Transportable

Shadow 200-T

- Parafoil Recovery
- Wide Skids
- Larger Fuselage
- Tractor Engine

TUAV GCS

- Mature Software
- Modular Design
- COTS-Based
- Open Architecture

2004-2005

Shadow 200 RQ-7B

- Improved Avionics
- Improved Wing shape
- Improved Endurance (6+ hrs)
- Improved EO/IR Payload
- Improved Target Accuracy
- TCDL"ready"

"One System" GCS

- Army Commonality
- Multiple AV's and Missions
- Increased Operational Capability

2006

Aerosonde Mk 4

- 30+ Hours Endurance
- TUAV Common datalinks
- Extensive payload selection
- Intel / Recce / support
- Science Support
- Autonomous Operations
- Over the horizon operations
- 2000 NM range
- (payload dependent)

"One System" Portable GCS

- DoD Commonality
- STANAG 4586
- Flexible transportation
- Minimal Maintenance

One System Ground Control System Generation 1

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Generation 1 Shelter

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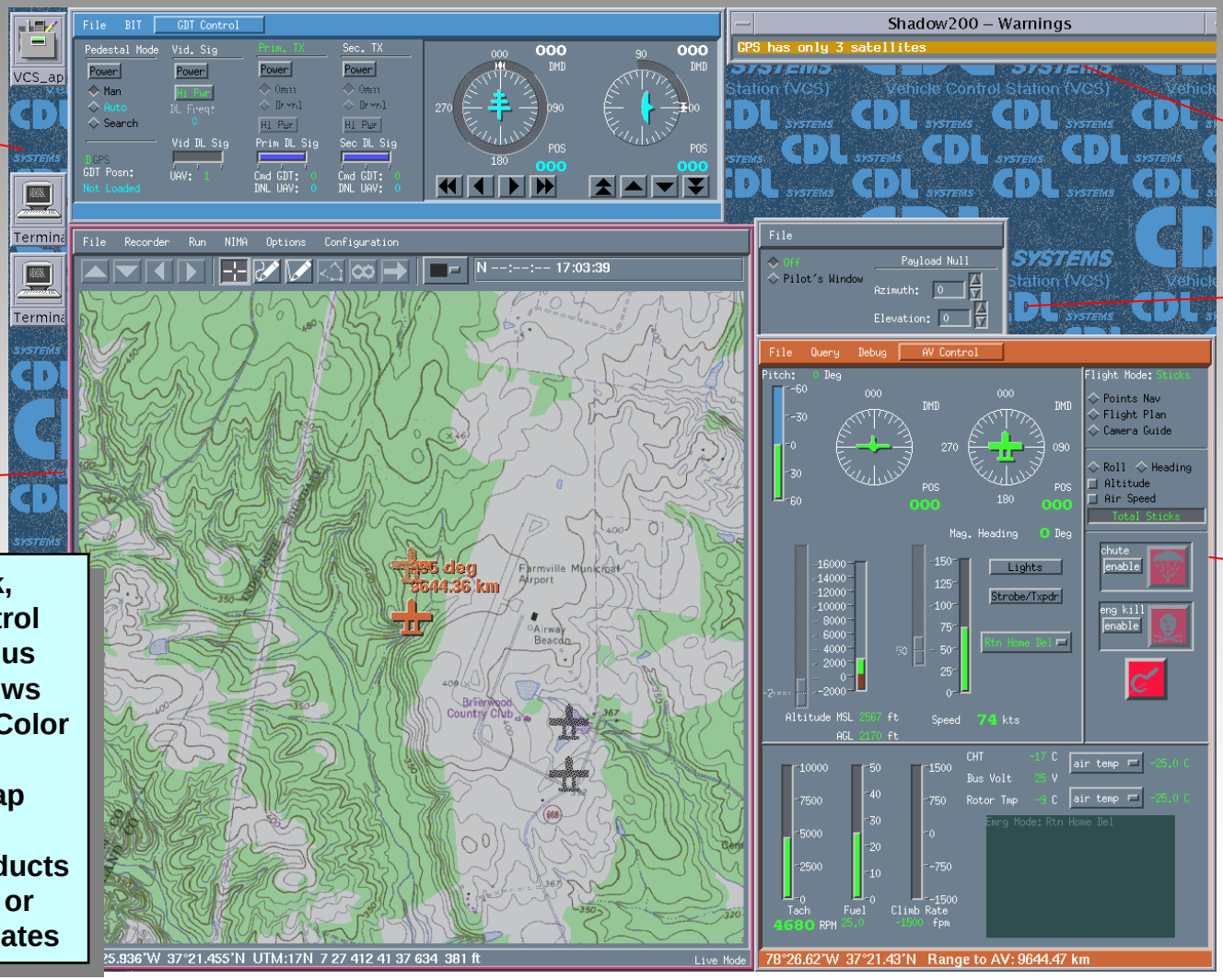
Interior View

Pilot Display



GDT Control Panel

Warning Panel

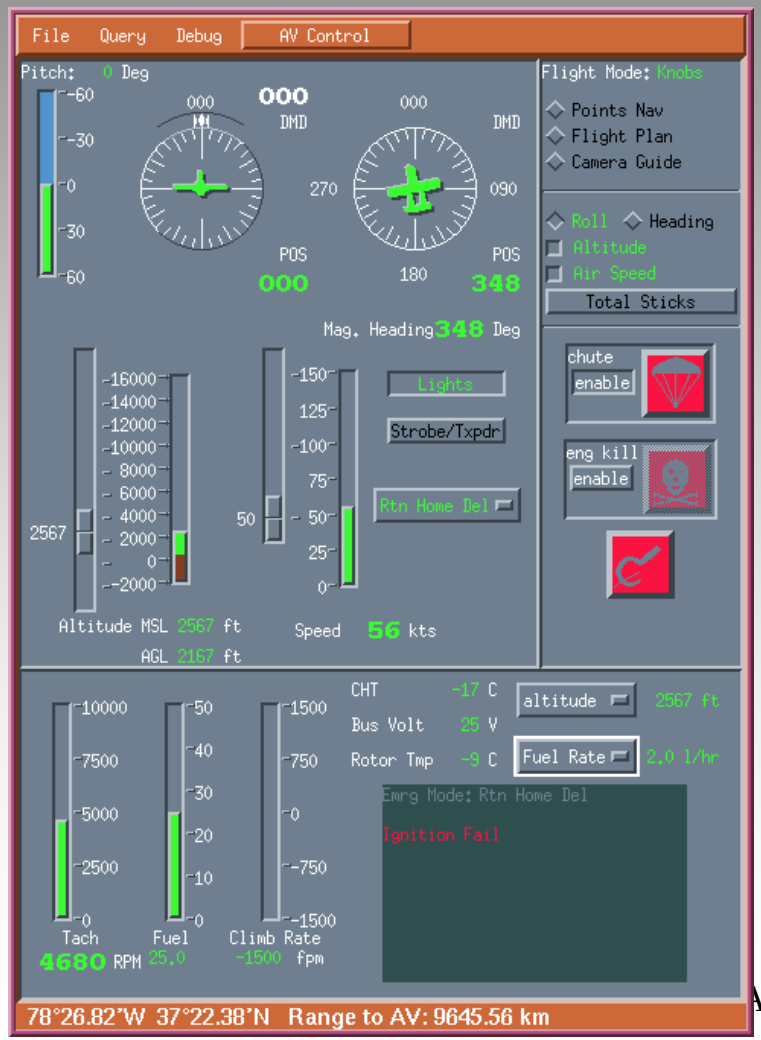
Payload Overlays (Pilots Window)

Main Window Map Display

AV Control Panel

- **Point and Click, Keyboard Control**
- **Pull Down Menus**
- **Multiple Windows**
- **Indicators are Color Coded**
- **Customized Map Display**
- **NIMA Map Products**
- **Lat/Long, UTM or MGRS Coordinates**

Mission Control Modes



- **Flight Plan**
  - **Preplan Mission**
- **Points Navigation**
  - **Point and Click on Map Manually Enter Coordinate**
- **Knobs (Manual Control)**
  - **Heading, Roll, Airspeed, and Altitude**
- **Auto Search Modes**

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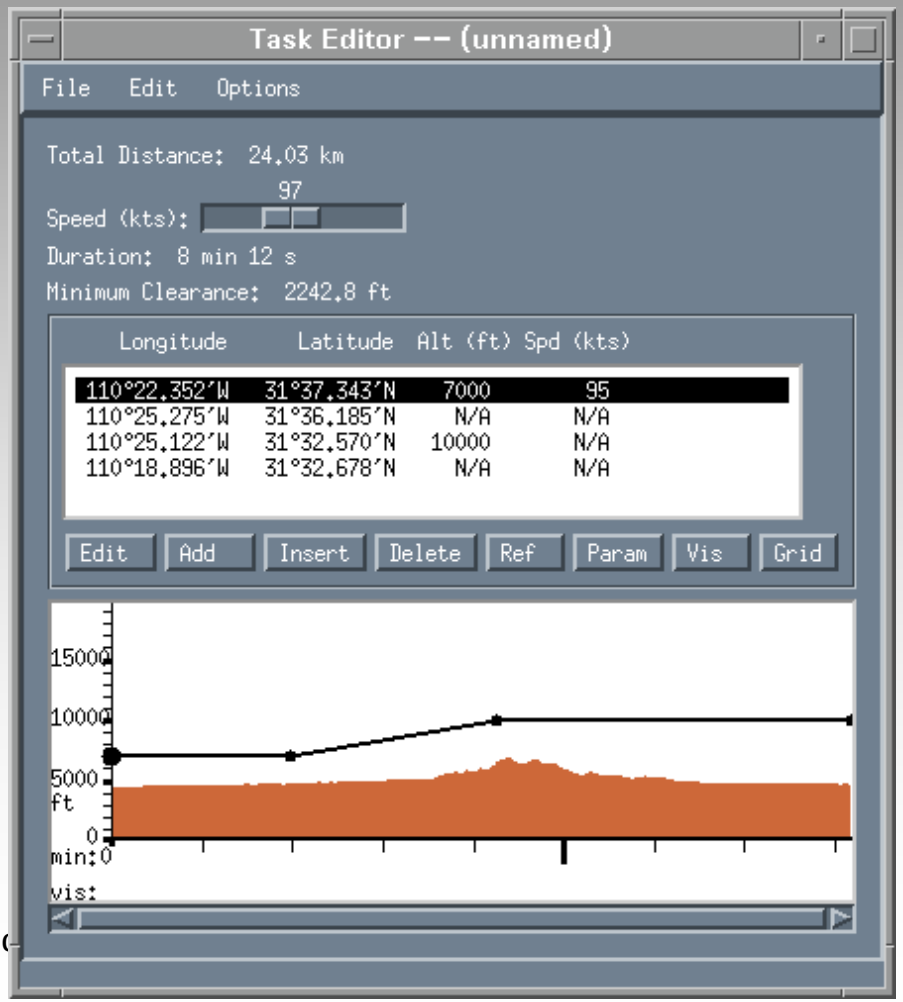
Mission Analysis

- **Distance - From the 1st waypoint to last waypoint**
- **Duration - From the 1st waypoint to last waypoint**
- **Minimum Clearance between the AV and Terrain**
- **Visibility between the GDT and AV**



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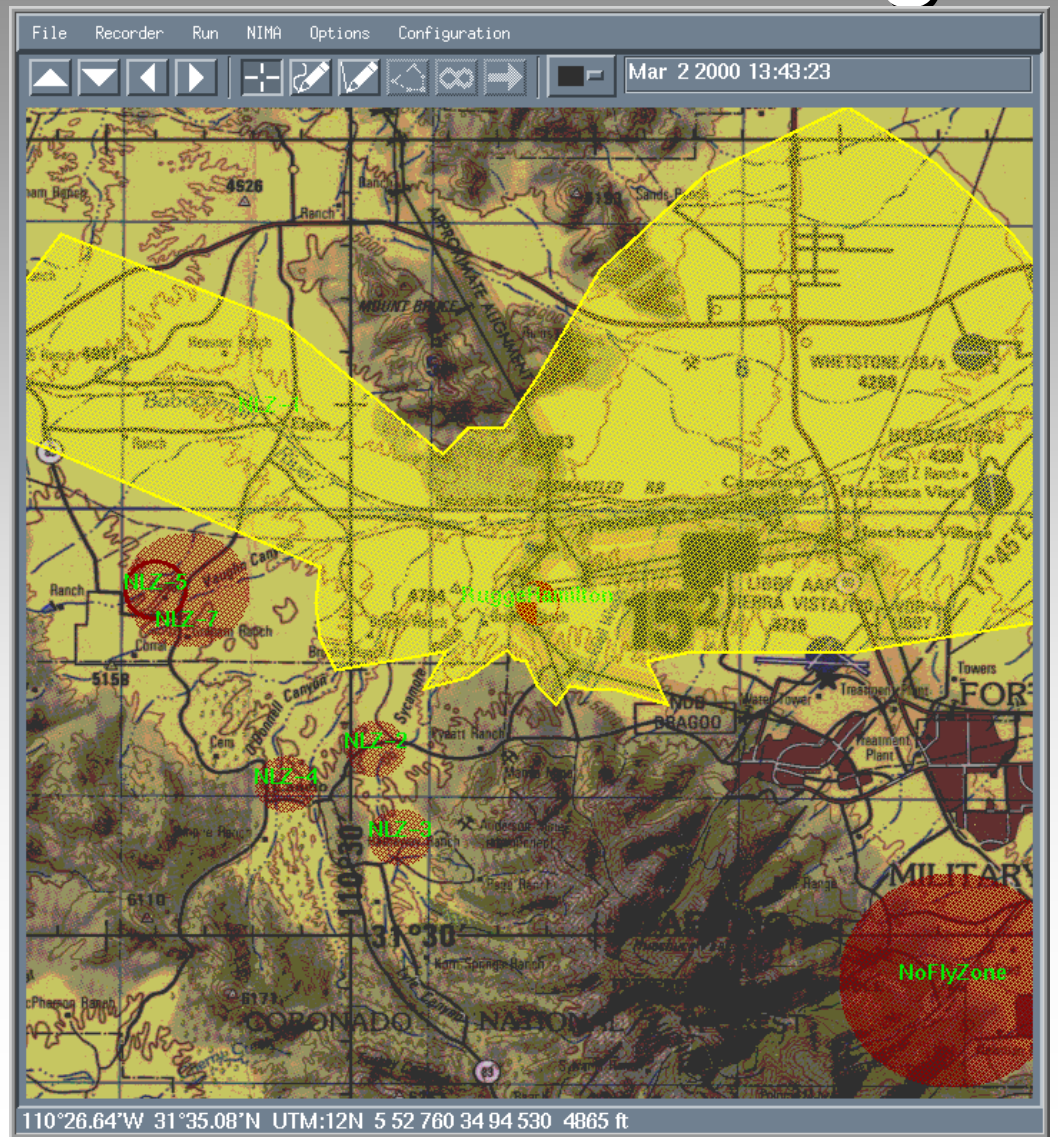
Datalink Coverage



One System Ground Control System Generation 2

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Generation 2 Shelter

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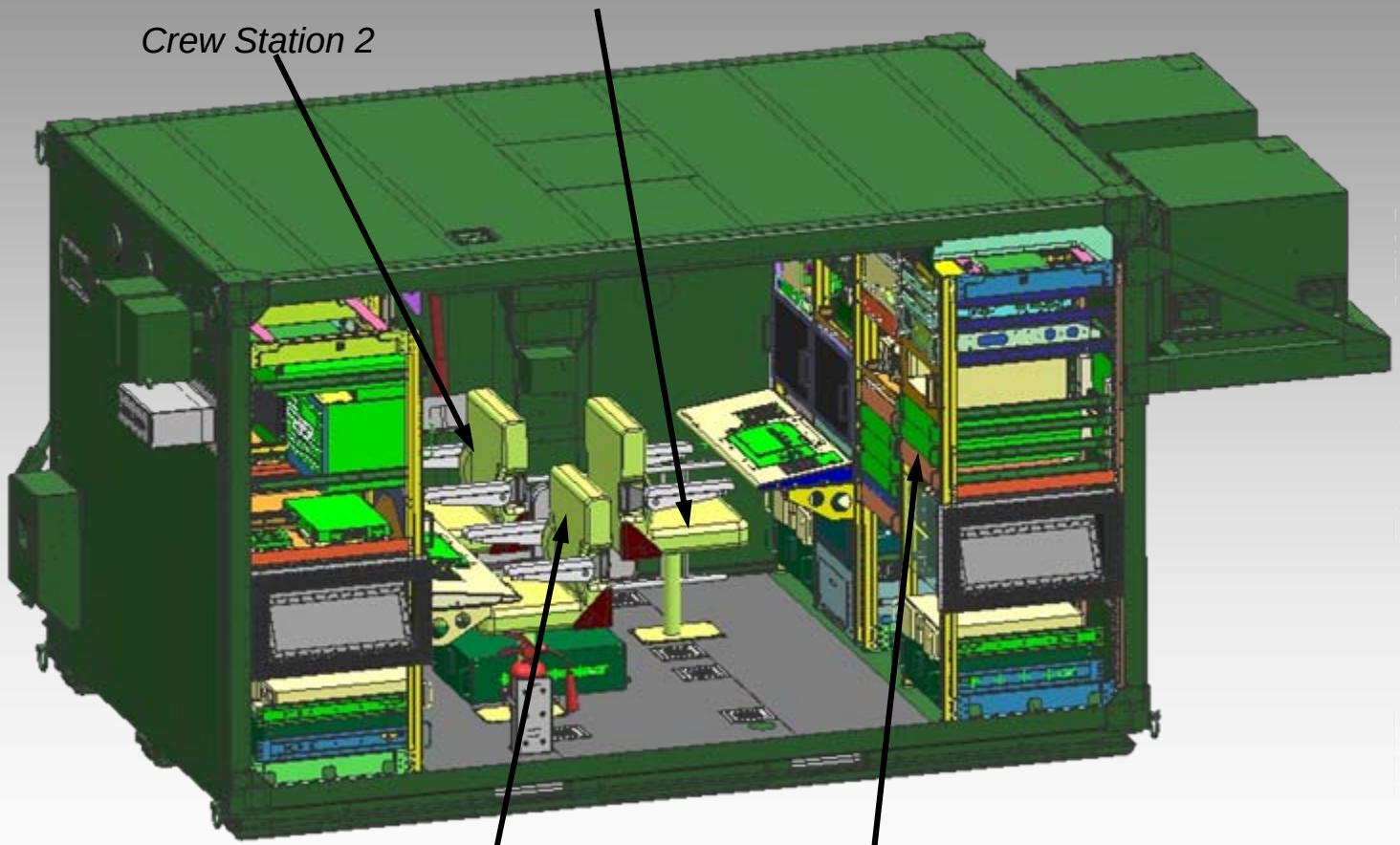
Interior View



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Pilot Display

Secondary Display

Primary Display

C4I, IMETS

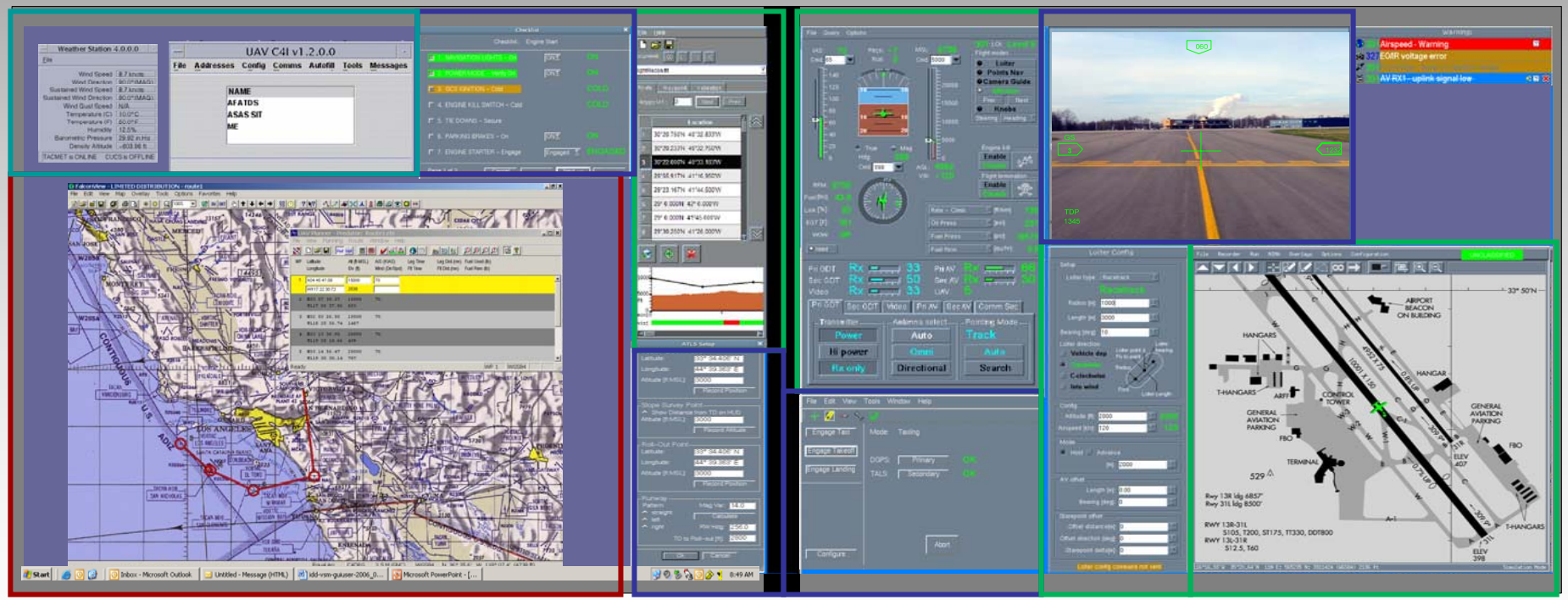
VSM Checklist

CUCS Mission Monitor

CUCS AV Panel

VSM HUD

WCA Panel



AMPS, CLAW

VSM Transient

VSM Main

CUCS Transient

CUCS Map

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One System Ground Control System Generation 3

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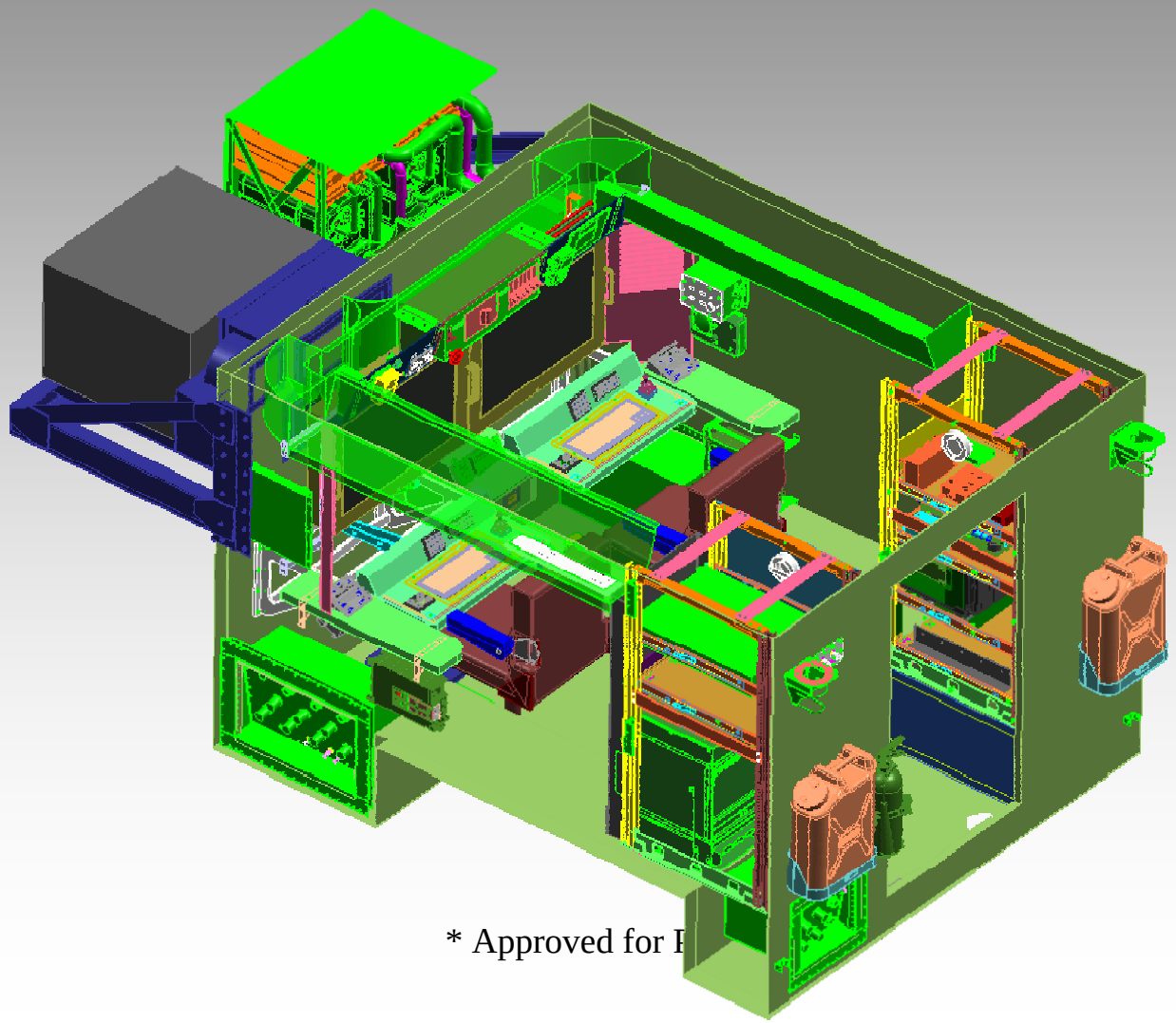
Interior View



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GCS Certification

- Requires both existing and new standards
- We need to certify subcomponents and then full Unmanned Aircraft System
  - Certified avionics are components of manned aircraft
- GCS architectures must support multiple aircraft with a common “look, feel, and certification”
  - STANAG 4586 is the first step
- Certification of Datalinks and Spectrum is top priority

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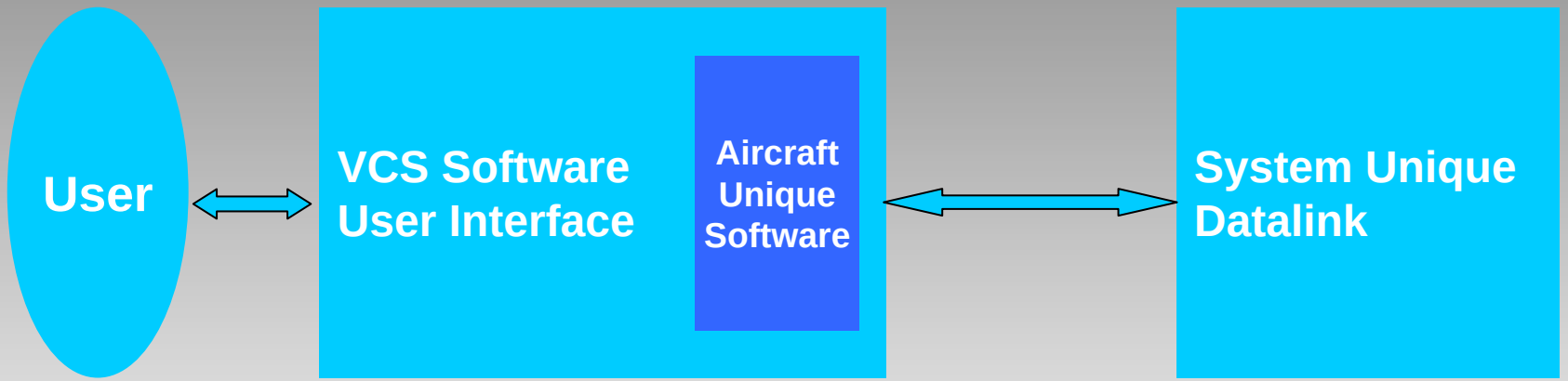
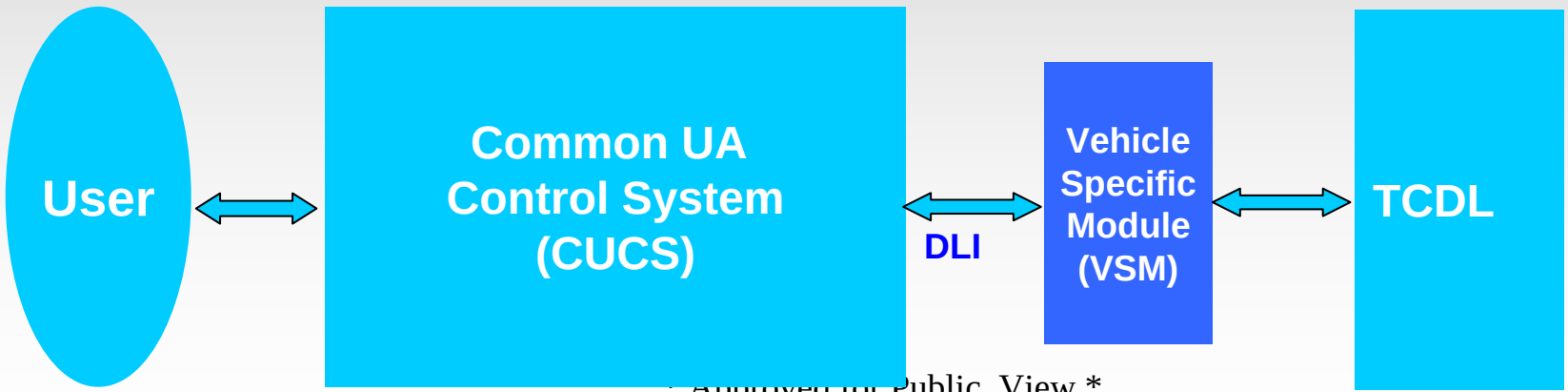
Transition to STANAG 4586

Previous Systems



STANAG 4586 System



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UAS Industry Needs Support from FAA/NTSB

- **The industry must mature/work well with manned aircraft in the NAS**
  - Safety requirements mandate similar (but not identical) certification standards
  - UAS need incremental access to the NAS (Crawl, Walk, Run)
- **Understand the differences between UAS and Manned Aircraft**
  - Unmanned aircraft have no souls on board
  - Cockpit is on the ground
    - Communication issues (Data Link, voice relay, etc)
    - “Sensing” remote environments (Detect, Sense, Avoid; Remote Operation)

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UAS Industry Needs Support from FAA/NTSB

- **Insuring public safety requires UAS industry to bring standards to maturity in a timely manner**
  - Industry and partners are making recommendations to certification agencies
  - Safe Test areas are badly needed
  - DARs, DERs, and FAA staff with UAS understanding
- **Crawl, Walk, and Run approach to enter the NAS is required**
  - Allow routine use of “proven” UAS in TFR situations, e.g. disaster support, border security
  - Create TSOs for UA subsystems so UAS certification time is shortened
    - GCS, Datalinks, Flight Control Systems, etc
  - Gov’t support for rapid development of UAS Detect, Sense, and Avoid (DSA) subsystems (as was done for TCAS) is badly needed
  - Move quicker to type certify UAS (e.g., RQ-1, RQ-7, etc)

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CELEBRATING

~~100,000~~ FLIGHT HOURS

~~145,000~~

300,000

…AND COUNTING