Lockheed Martin Positive Train Control

March 2, 2005

Brian Caine
Manager, Business Development
Lockheed Martin Corporation

LM Background Programs

Lockheed Martin - National Aero-

Responsible for the entire United States Air Traffic Control System

Lockheed Martin - ITS National Systems Architecture Program

Intelligent Transportation System program For USDOT

Lockheed Martin - High

Industry leader in high accuracy GPS applications

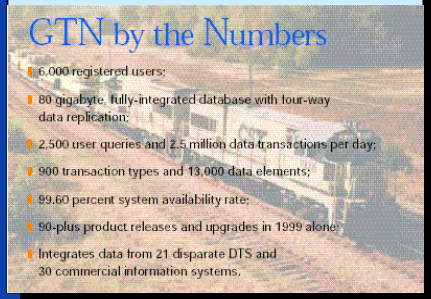
North American Joint Positive Train Control (NAJPTC)

Deployment of open standard control system

Lockheed Martin - Air Traffic Management Common ARTS

Shares responsibility with FAA for technical support of air traffic of the entire United States

Lockheed Martin - Global



Secure Internet Transportation Network with 2.5 million transactions per day

Lockheed Martin – Vessel

Applies most advanced technologies to surveillance and management of maritime traffic

PTC Office Server

- Key element of NAJPTC design—centralized network asset monitoring and control capability
- Works in conjunction with Railroad Dispatch system to monitor and control switch positions, signals, crossings and locomotives at high safety levels
- Hardware redundancy and high level of availability for mission-critical applications
- Application software ensures safety-critical network operations >150,000 lines of SW
- Scalable to handle multiple territory (Signaled, Dark) and train types (equipped & unequipped)
- Runs on COTS HW and HP- UNIX SW

Location Determination System

- Continuously provides train position in lieu of track circuits or transponders
  - Uses GPS and differential GPS
  - Uses gyro and accelerometers
  - Uses track database and navigation algorithms
  - Not dependent on any one input
  - Functional in case of longer GPS outages
- Performance Accuracy
  - Along track position accuracy < 10'
  - Velocity - able to detect at "0" speed
  - High dependability Track Discrimination
- Safety-critical, vital design
- Non-proprietary interface definitions

Sensor Interface

DGPS

Communications

80586 Processor

PC104 Circuit Card Assemblies

FRA Rule Compliance

LOCKHEED MARTIN

Product Safety Plan (PSP)

SSDD	Description of Product	Human Factors Analysis	ASCAP, O&SHA, LM HMI Studies
UPRR Rules, ASCAP Safety Case	Description of Railroad Operation	Training Requirements	O&SHA Training Plan Training Material
IDOT PTC CONOPS	Operational Concepts Documentation	Procedures for Installation & Operation	User Manuals
	Safety Requirements Document	Applicability Part 236 Subpart A to G Rules & Regulations	
SSDD, HDIP, IRS, HRS, SRS, IDD, SWDD, HDD	Product Architecture	Security Measures	
ACCESS Database	Hazard Log	Warnings & Warning Labels	User Manuals, O&SHA
ASCAP, MTTHE , FTA	Risk Assessment	Implementation Testing Procedures	Fault Injection Tests, Contractor Master Test Plan, Test Plans, Test Procedures
PHA, FFT, SSHA O&SHA, FTA, FHA	Hazard Mitigation Analysis	Post Implementation Test / Safety Records	Test Reports
Fault Injection Tests, FTA, FMEA	Description of Safety Assessment and Verif& Validation Processes	Safety Critical Assumptions	Safety Critical Guidelines
	Safety Assurance Concepts	Description of Predefined Changes	

LM Product/System Approach

- Non-proprietary system design -- lower costs, attract new suppliers, facilitate interoperability and provide greater control for railroads
- Support FRA Rule on Train Control -- provides beneficial engineering structure and process for PTC system developments
- Safety-critical, vital design at system and subsystem level
- Coordination of railroad Dispatch and vital PTC Office Server enables greater network-wide safety, visibility and control benefits
- Precise locomotive position determination independent of existing track infrastructure
- Designed to provide railroad benefits without having to equip entire locomotive fleet (Incremental Deployment)