



AS DIVERSE AS AVIATION ITSELF



Aviation Products



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ACSS • Aviation Recorders • Avionics Systems • Display Systems • Electronic System Services

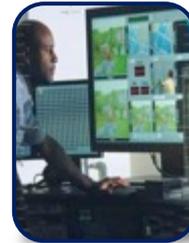


L-3 At A Glance

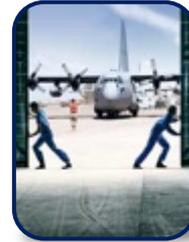
- Aerospace and Defense Contractor - 2013 Sales \$12.6B
 - Fortune 200 Company
 - 48,000 Employees
- Prime for ISR, Aircraft Modernization, Logistics, Enterprise IT
- Supplier of Communication and Electronic Systems
- Attributes:
 - Broad/Diverse Technologies, Customers
 - High Earnings-to-Cash Flow Conversion
 - Efficient Capital Structure
 - Investment Grade Credit



C³ISR



National Security Solutions



Platform & Logistics Solutions



Electronic Systems



Commercial Aviation

■ Integrated Avionics

- TCAS
- TAWS
- ADS-B
- Transponders
- Lightning Detection
- Weather Mapping
- Airborne Navigation
- Standby Systems
- Touch Screen Controllers

■ Flight Displays

- Displays & Processors
- 3D Moving Map & Synthetic Vision

■ Data Acquisition, Connectivity & Storage

- Flight Data & Cockpit Voice Recorders
- Iridium SATCOM

■ Emergency Power Supplies

■ Support Services

- Aftermarket; MRO & Logistics



Commercial and Military Aviation Solutions.



Augmenting Crash Protected Flight Recorders

- Crash recorders are directly responsible for significant improvements in aircraft safety
 - Recorders are specified by a Minimum Operation Performance Standard (MOPD) ED-112A
 - Periodic improvements to the MOPS have driven recorders to be more capable and reliable
 - Underwater locator beacons are an important component to the recorder solution
- New capabilities to augment on board recorders are being discussed
 - Triggered real time monitoring of recorded data
 - Tracking techniques to better understand aircraft location



FDR/CVR Types at L-3



FA5000 CVR/FDR
MADRAS



FA2100 FDR



SRVIVR® CVR/FDR



FA2500 CVR/FDR



FA2100 CVR/FDR



FA2300 MADRAS



Flight Data Recorder Equipment

- Governing Minimum Operation Performance Standard
 - Standard published by EUROCAE (www.eurocae.org)
 - ED-112A published September 2013
 - Supersedes:
 - ED-112 published March 2003
 - ED-55 published May 1990
 - Reissued 4 times over 23 years
- Technical Standard Order (E/TSO)
 - TSO-124c effective 12/19/2013 (ED-112A requirement)
 - TSO-124b applications no longer approved after June, 2015
 - Existing authorizations to TSO-124b will stand
 - ETSO-124b effective 12/21/10 (ED-112 requirement)
 - ETSO-124c issue is expected



Cockpit Voice Recorder Equipment

- Governing Minimum Operation Performance Standard
 - ED-112A published September 2013
 - Supersedes:
 - ED-112 published March 2003
 - ED-56A published December 1993
- Technical Standard Orders (E/TSO)
 - TSO-123c effective 12/19/2013 (ED-112A requirement)
 - TSO-123b applications no longer approved after June, 2015
 - Existing authorizations to TSO-123b will stand
 - ETSO-123b effective 12/21/10 (ED-112 requirement)
 - ETSO-123c issue is expected



Changes in ED-112A

- ED-112A added detail to the flight recorder standard specifically addressing recent aviation investigations including:
 - Air France 447 in Atlantic
 - British Airways 38 engine incident at Heathrow
- Deployable Recorder Changes
 - Requirement for deployable recorders to be fitted with a dual frequency 406/121.5 MHz radio transmitter for detection
- Cockpit Voice Recorder Changes
 - Implemented additional classes of CVR's with longer recording durations
 - Current standard class is 2 hours
 - Added 10, 15 and 25 hours classes



Changes in ED-112A: FDR

- Flight Data Recorder (FDR) additional parameters were added
 - Engine fuel metering valve position
 - Vertical speed
 - Flight director commands
 - Computed weight
 - Cabin pressure altitude
- Increased sampling rates on some existing FDR parameters
 - Control forces, Inputs and Surfaces
 - Attitude
 - Navigation data (lat and long)
 - Power level position
 - Accelerations
- FDR to also store the data frame layout information (FRED File) for investigators to decode the flight data.



Changes in ED-112A: ULB

- Underwater locator beacon (37.5 kHz ULB) controlled by TSO-C121a
 - TSO-C121b established 90 day versus 30 day beacon
 - TSO-C121b will revoke TSO-C121/C121a in March 2015
 - 90 day beacons will become standard by attrition
 - ICAO has published in Annex 6 that recorders shall have 90 day ULB's in January 2018
- ED-112A adds a shear test to the ULB retention mechanism so that the beacons won't become detached
 - The BEA (French Safety Board) provided a study where many water incidents had recorders with beacons detached.
- Transport aircraft operating over oceanic areas be fitted with the low frequency ULB by January 2019
 - 8.8kHz Low Frequency Beacon spawned from the AF447 Working Group
 - Described the Recorder ULB as a means to find a needle in the haystack
 - Described the Low Frequency Beacon as a means to find the haystack



Real Time Monitoring: Key Points

- Standardization
 - Recorder MOPS has been very successful in driving worldwide standards for Flight Recording
 - Real time monitoring requirements should continue to be harmonized through international committees and added to ED-112A
 - Consider using all available aircraft communication means and use the recorder to trigger the transmission
- Privacy
 - ED-112A: Cockpit Voice Recorders are not downloaded while on aircraft
 - Pin strapping prevent download while installed
 - Ownership of flight data and audio varies according to country and situation
 - Important part of any discussion on real time monitoring
- Security
 - Transport methods should be encrypted and secure
 - Storage concepts should protect and secure data according to data owners wishes
 - Storage persistence should be clearly identified
- Reliability
 - Extremely high reliability of data transfer may not be necessary; existing recorder provides backup
 - High reliability could impede acceptance due to costs



Goals for Real Time Monitoring

- Flight recorder data has always been considered only part of an overall investigation
- Investigators review all of the available data; information recorded prior to any “trigger” point may be important to the case and may not be transmitted due to warning time
- Even when flight recorders are found in an accident, as much of the wreckage as can be recovered is pieced together and evaluated
- Real Time monitoring will not change this fundamental approach
- Goals for Real Time Monitoring Could Be:
 1. Find the aircraft
 2. Alert authorities of a problem; try to prevent a mishap
 3. Have a data set to investigate if recorder cannot be found or is damaged



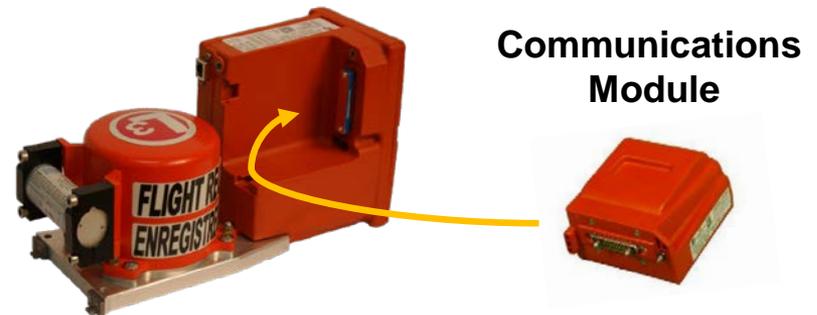
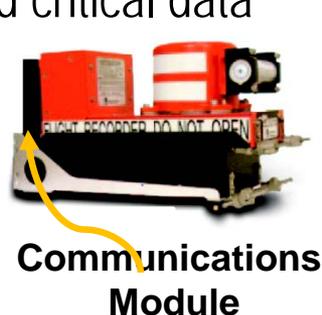
Data Rates For FDR/CVR Systems

- FDR typical parameters recorded from a 1024 word per second ARINC 717 interface. Words are 12 bits.
 - Typical Rate = 12,288 bits/Second
 - Duration = 25 hours
 - Image Size = 1,106 Gbit = 138.24 MByte
 - Compression possible
- CVR recorded from three pilot channels, one cockpit area microphone, one ARINC429 input
 - 3 Pilot Audio Channels sampled at 8 kHz
 - $3 \times 16 \text{ bits} \times 8 \text{ kHz} = 384 \text{ kbps}$
 - 1 Cockpit Area Microphone Channel sampled at 16 kHz
 - $1 \times 16 \text{ bits} \times 16 \text{ kHz} = 256 \text{ kbps}$
 - Total Raw Audio Channel Rate = 640 kbps
 - Good compression techniques are available to compress these raw data rates
 - CPDLC Messages are also required to be recorded on aircraft with Datalink installed
 - The message record rate is variable and small compared to audio rates



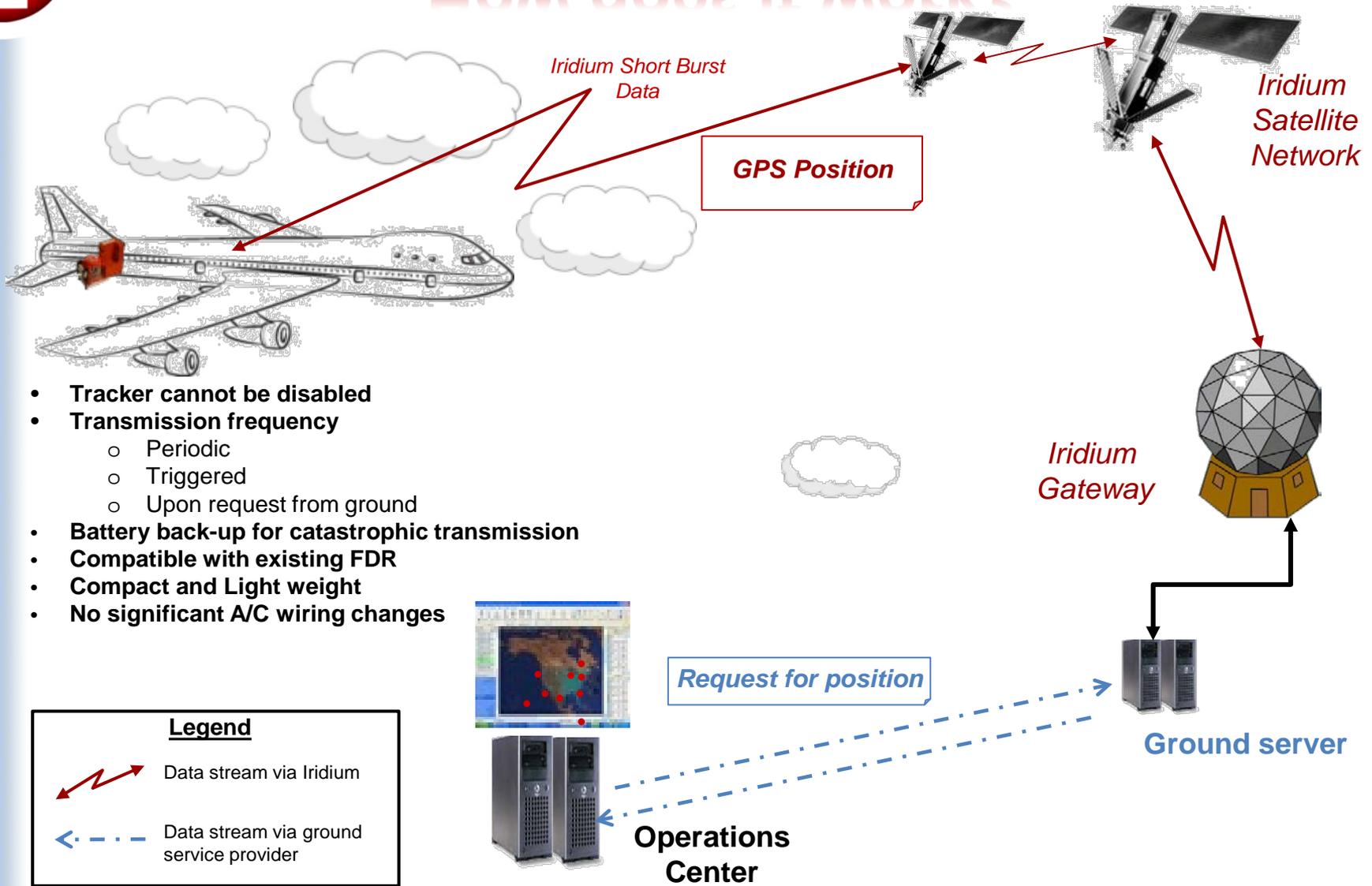
L-3 Tracker: Near-real time tracking of flight position and critical data

- Recent flight incidents underline the need to provide flight data and position in near real-time
- While position streaming equipment exists today (e.g. ADS-B, Iridium ADS-C), this equipment can be placed in stand-by or turned off while the aircraft is in flight
- The flight data recorder is, by rule, wired and positioned in the aircraft such that it cannot be easily disabled in flight
- By adding a short-burst Iridium modem to send data on a periodic, triggered or on demand basis, we can offer a near real-time solution for streaming flight position and critical data





How does it work?



- **Tracker cannot be disabled**
- **Transmission frequency**
 - Periodic
 - Triggered
 - Upon request from ground
- **Battery back-up for catastrophic transmission**
- **Compatible with existing FDR**
- **Compact and Light weight**
- **No significant A/C wiring changes**

Legend

↔ Data stream via Iridium

← - - - Data stream via ground service provider



End

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