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APIM- 17- 005 TIMELY RECOVERY OF FLIGHT DATA
Continuous and Triggered Data Transmission Initial Discussion

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Goal

- Provide references to applicable – mandates, regulations, ARINC standards
- Provide basic data flow – comparison of approaches, detailed streaming approach
- Options related to hosting platform – candidate architectures
- Preliminary data throughput analysis and parameters specification
- Questions to answer by APIM17-005 in near term

Regulatory References

ICAO documents

ICAO Annex 6, Circular 347	Aircraft tracking Implementation Guidelines
ICAO Annex 6, Part 1	Operation of Aircraft, Part I, International Commercial Air Transport – Aeroplanes
GADSS Concept of Operations	Global Aeronautical Distress and Safety System (GADSS) – Concept of Operations – Version 6
Doc 10054	Manual on Location of Aircraft in Distress and Flight Recorder Data Recovery

European Organization for Civil Aviation Equipment (EUROCAE) documents

EUROCAE MOPS-ED 112A	Minimum Operational Performance Specification For Crash Protected Airborne Recorder Systems
EUROCAE ED-237	Minimum Aviation System Performance Specification For Criteria To Detect In-Flight Aircraft Distress Events To Trigger Transmission Of Flight Information

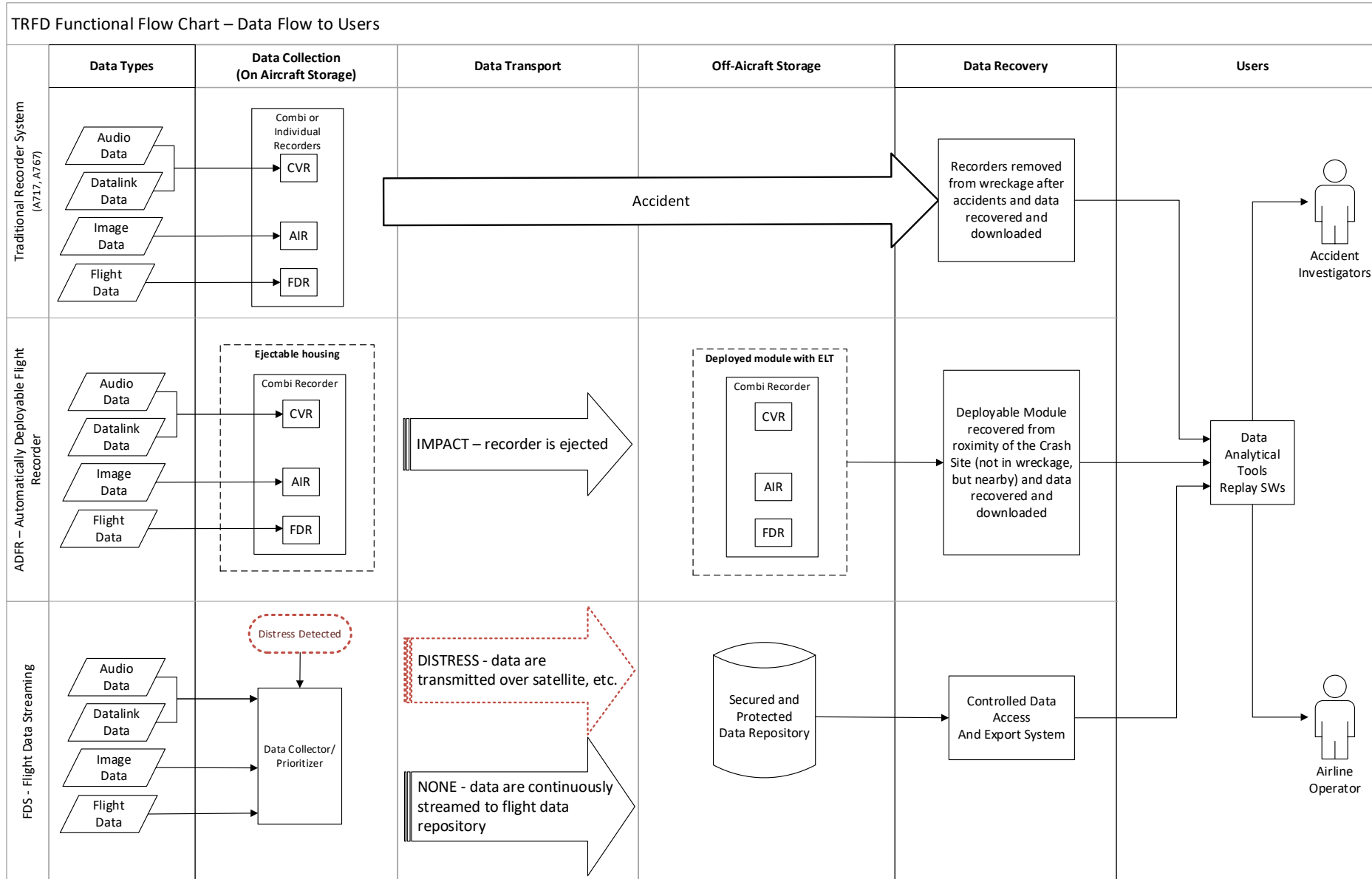
Applicable ARINC standards

- ARINC 573 Design guidance for the development and installation of an expandable Flight Data Acquisition and Recording System. The functions defined include flight data acquisition through suitable electrical interfaces, conversion of analog input signals into a standard serial data output and the capability for expansion to permit increased data handling capacity.
- ARINC 647-1 Design guidance for Flight Recorder Electronic Documentation (FRED), is an international standard defining the content and format of electronic files which document Flight Data Recording systems. The FRED specification is an expansion of the Flight Recorder Configuration Standard (FRCS) and is intended to provide guidelines for software systems designers and developers of ground support equipment for flight data recorders
- ARINC 657 This document defines the characteristics necessary to standardize the airborne recorder download file format in order to facilitate data import, transcription, and exchange. A standardized data format will reduce the variety of readout equipment required for airborne recorder data transcription This document defines the detailed architecture of the Recorder Standard Output(RSO) file.
- ARINC 664, Part 5 The purpose of ARINC Specification 664: Aircraft Data Network, Part 5 – Network Domain Characteristics and Interconnection, is to provide design and implementation guidelines for networks installed in aircraft. Such networks may be used to allow network devices to communicate among themselves and with networks outside of the aircraft.
- ARINC 717 Design guidance for a Digital Expandable Flight Data Acquisition and Recording System. It describes the equipment and installation standards necessary for satisfying the mandatory flight data recording requirements set by the FAA and other regulatory bodies
- ARINC 747 Design guidance for the development and installation of Flight Data Recorders (FDR) which may utilize solid state memory and which may employ some means of data compression. The document does not cover the overall flight recorder system requirements but does take into consideration currently defined systems
- ARINC 757 This document is intended to provide design guidance for the development and installation of a new generation of Cockpit Voice Recorders (CVRs) which may utilize solid state memory and employ analog to digital conversions and related voice encoding techniques.
- ARINC 767 Design guidance for the development and installation of an Enhanced Airborne Flight Recorder (EAFR). The EAFR standard addresses combinations of any or all of the following in a single Line Replaceable Unit (LRU), a Digital Flight Data Recorder (DFDR) function, a Cockpit Voice Recorder (CVR) function, a data link recording function, and an image recording function.

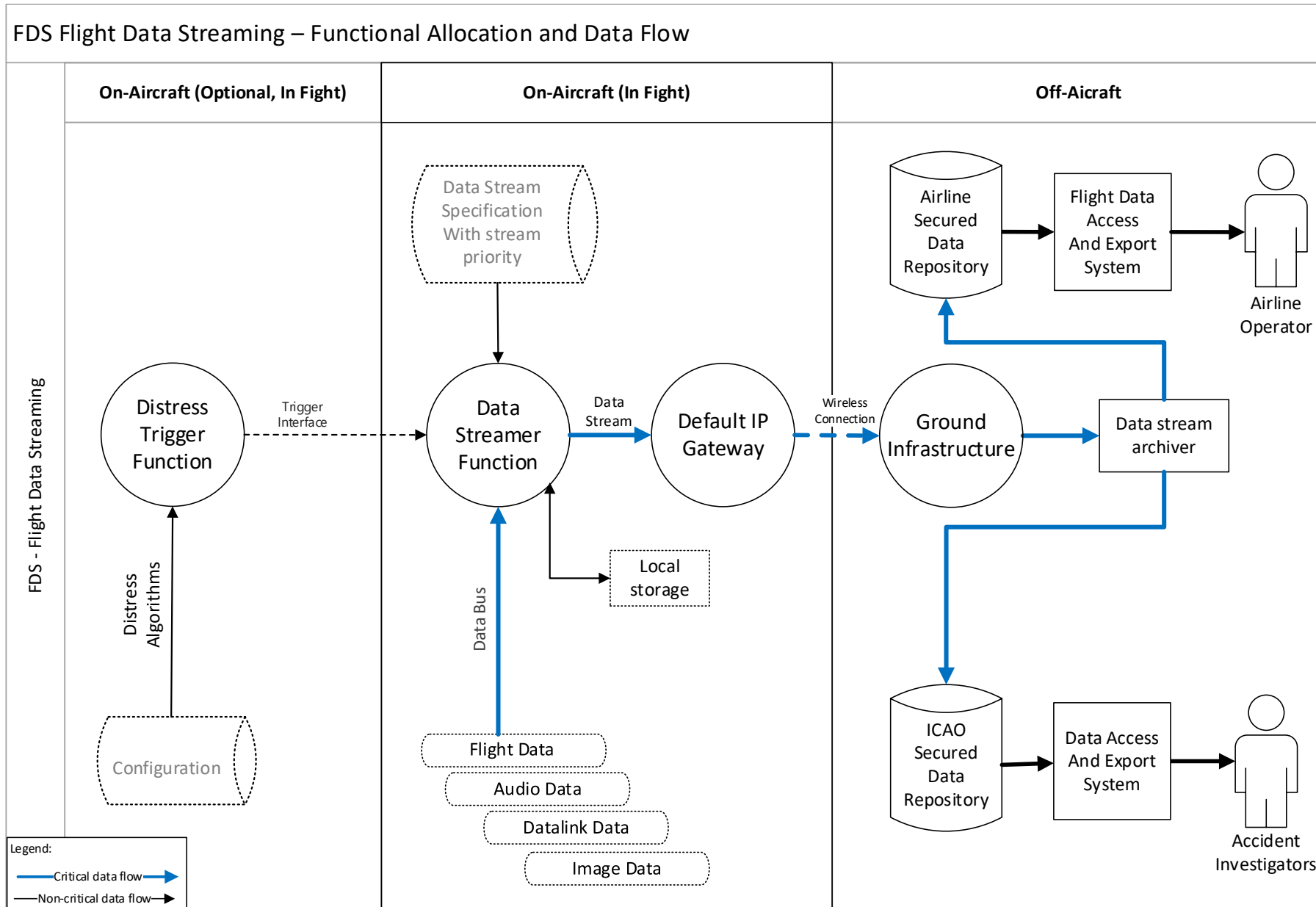
Other References

AC 20-141B Airworthiness and Operational Approval of Digital Flight Data Recorder Systems
AC 20-186 Airworthiness Operational Approval of Cockpit Voice Recorder Systems

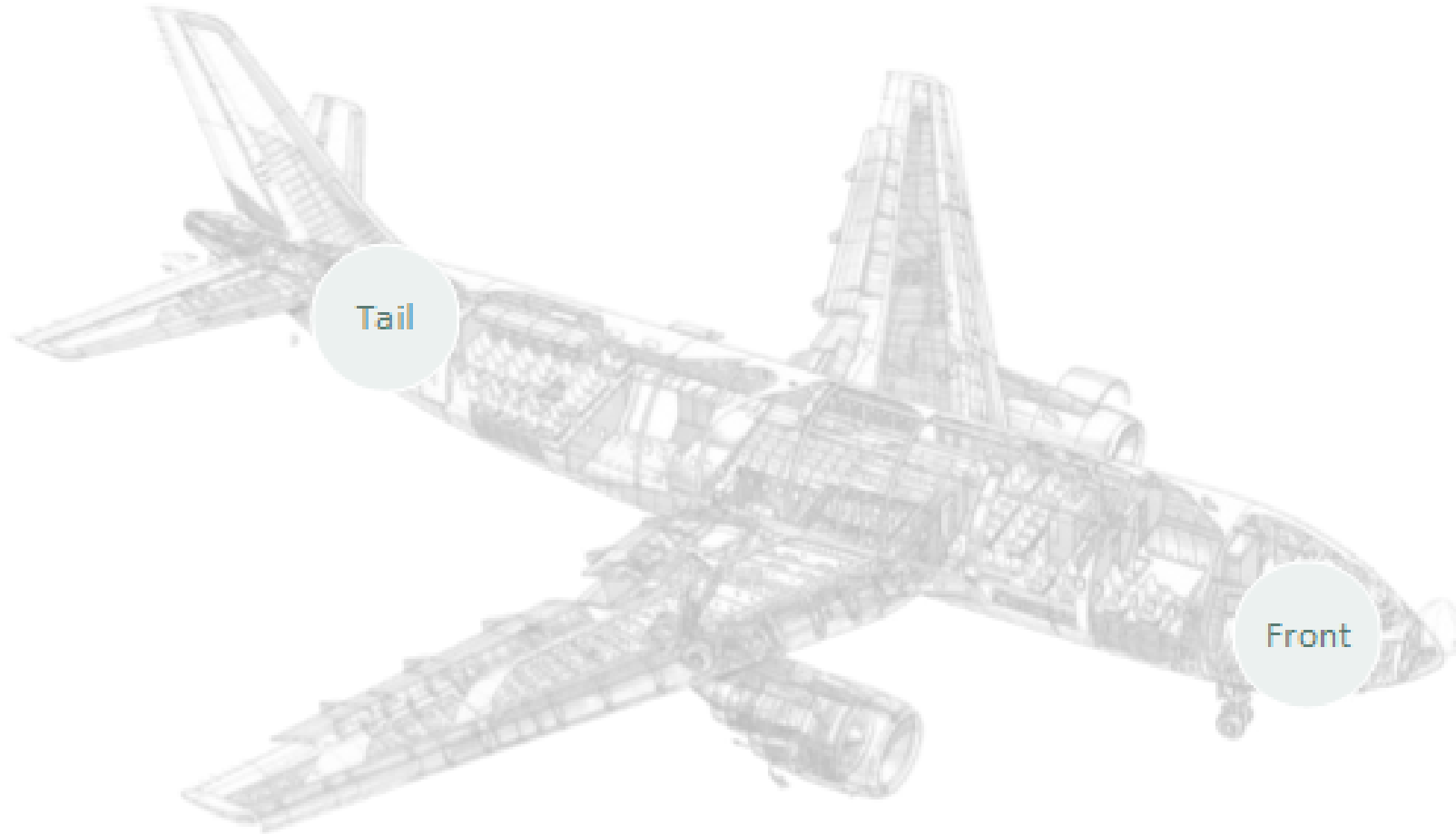
TRFD Functional Flow Overview



Distress and Continuous Data Transmission System Components

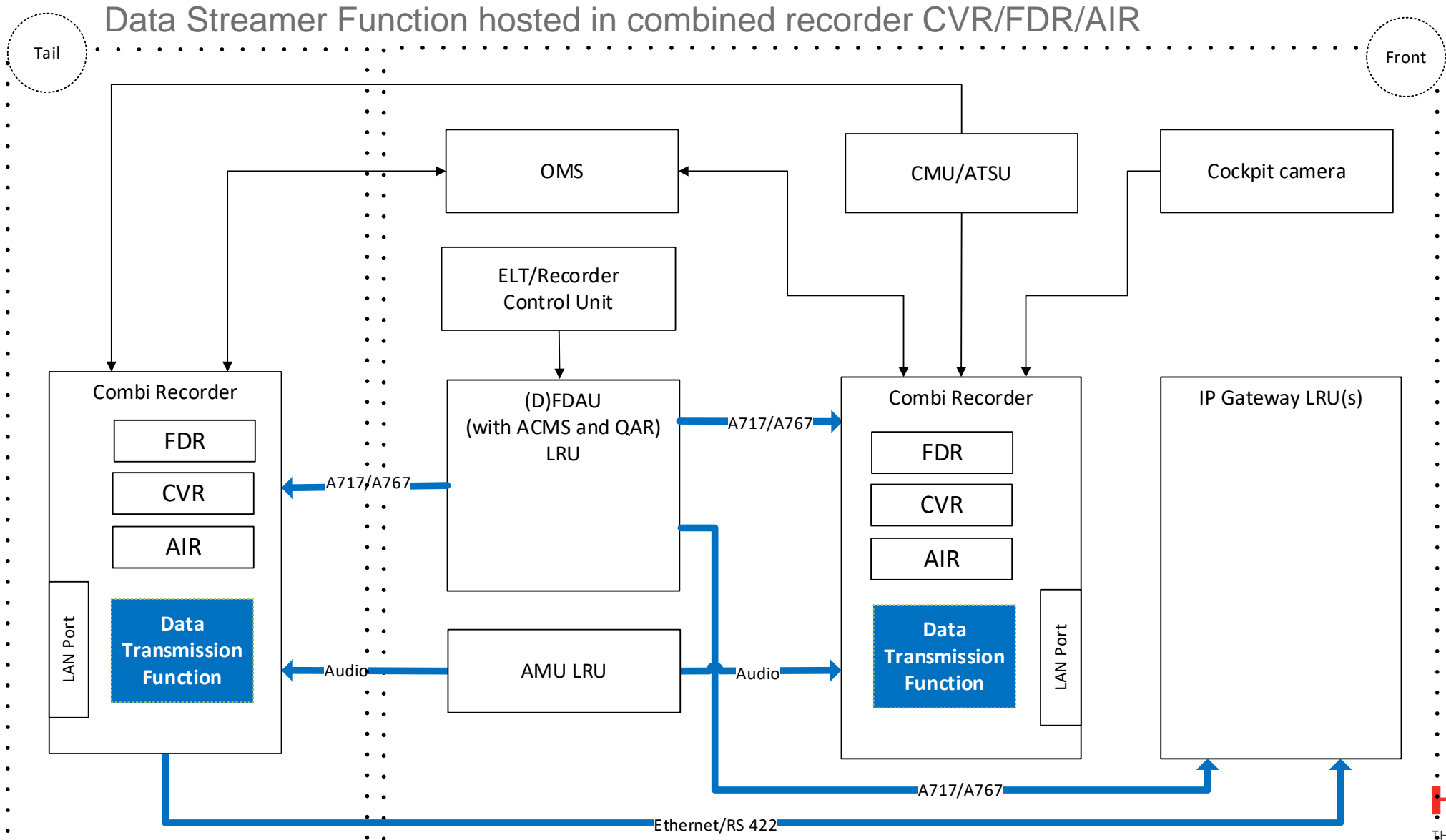


1 | Onboard units/systems - Future Deployment (2 combined recorders)

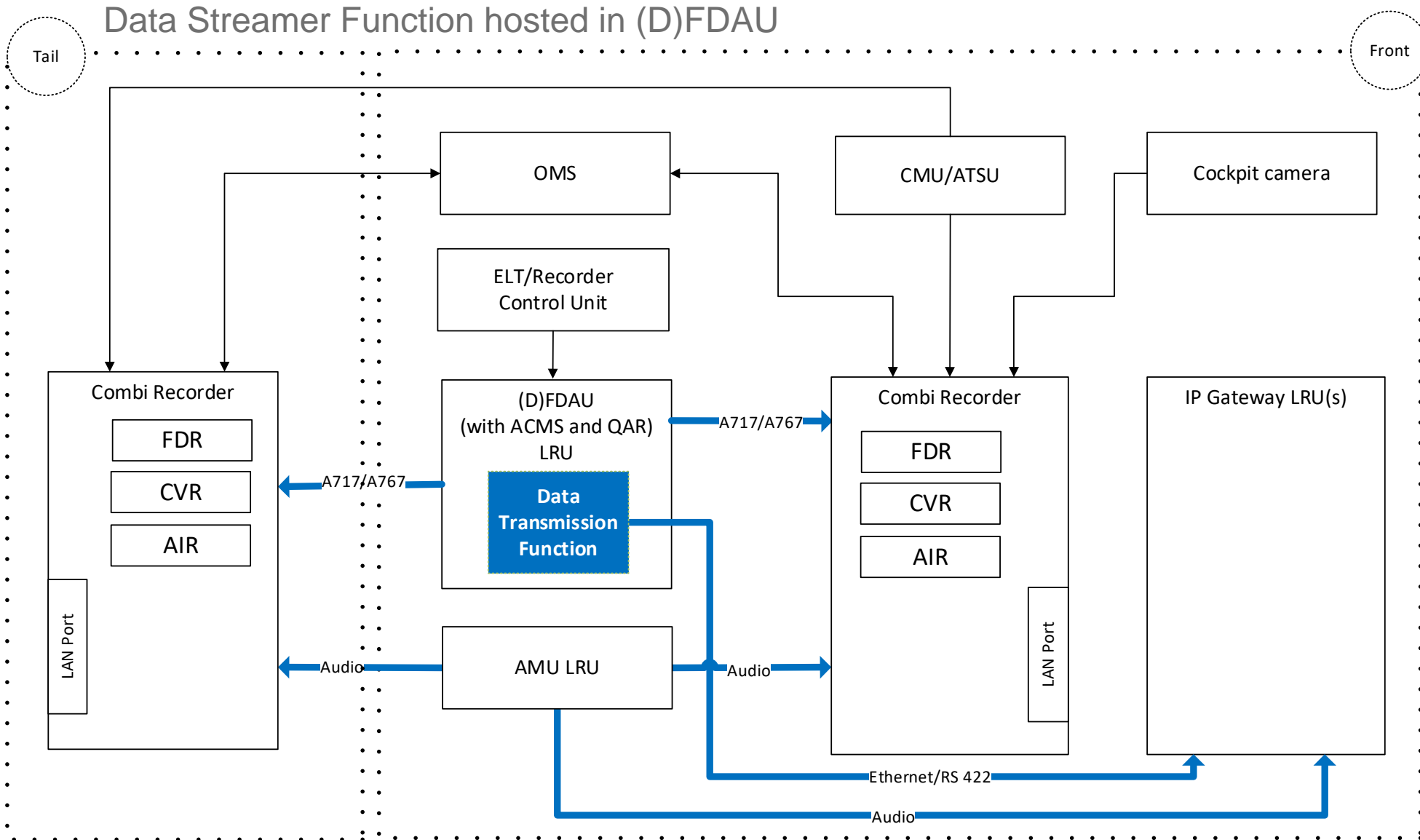


See EUROCAE, ED-112, TABLE 1-1.2: MATRIX OF RECOMMENDED COMBINATION OF FLIGHT RECORDERS

1 | Onboard units/systems - Candidate Architecture A

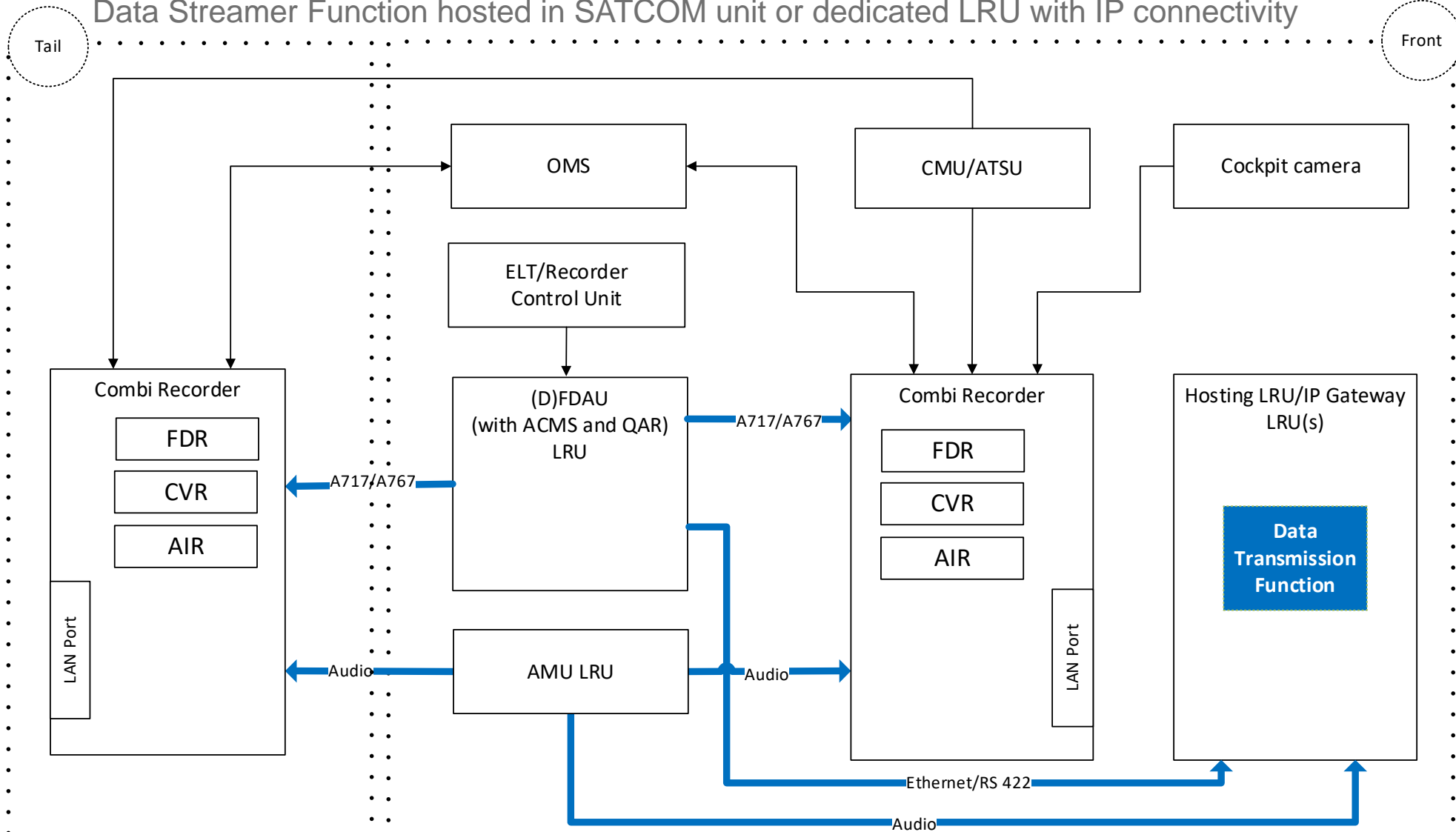


1 | Onboard units/systems - Candidate Architecture B



1 | Onboard units/systems - Candidate Architecture C

Data Streamer Function hosted in SATCOM unit or dedicated LRU with IP connectivity

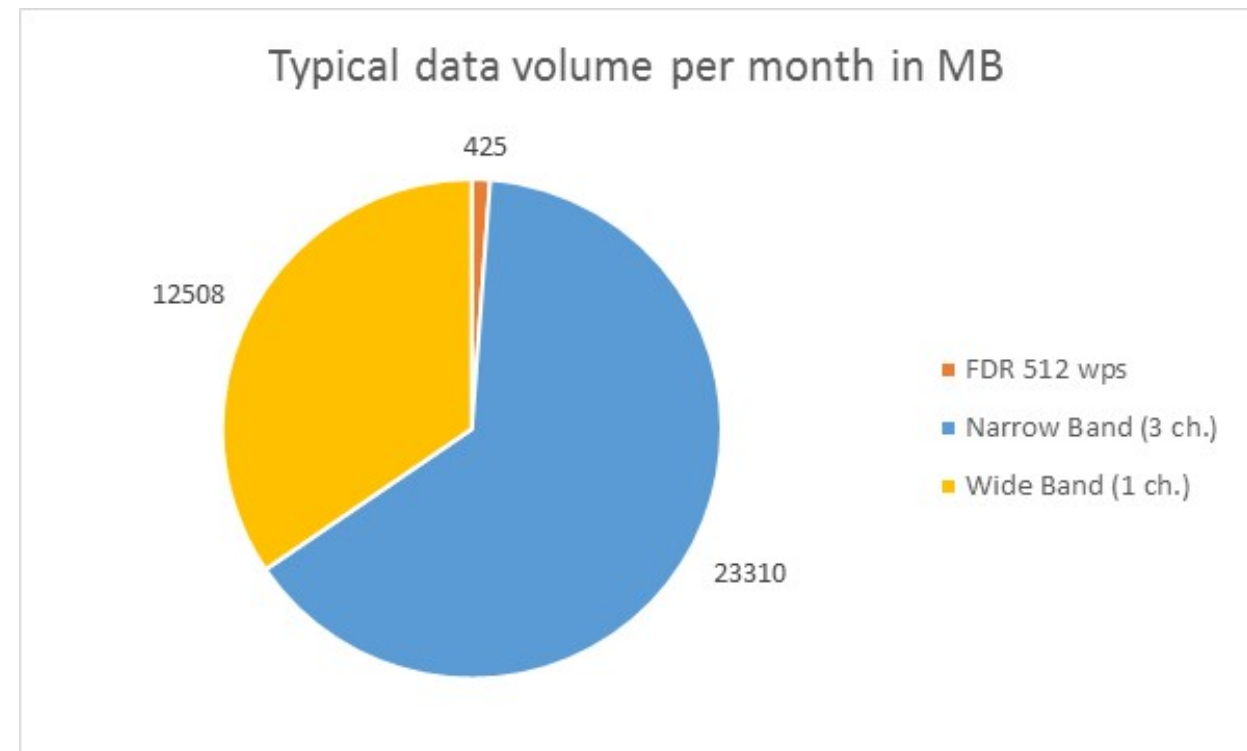
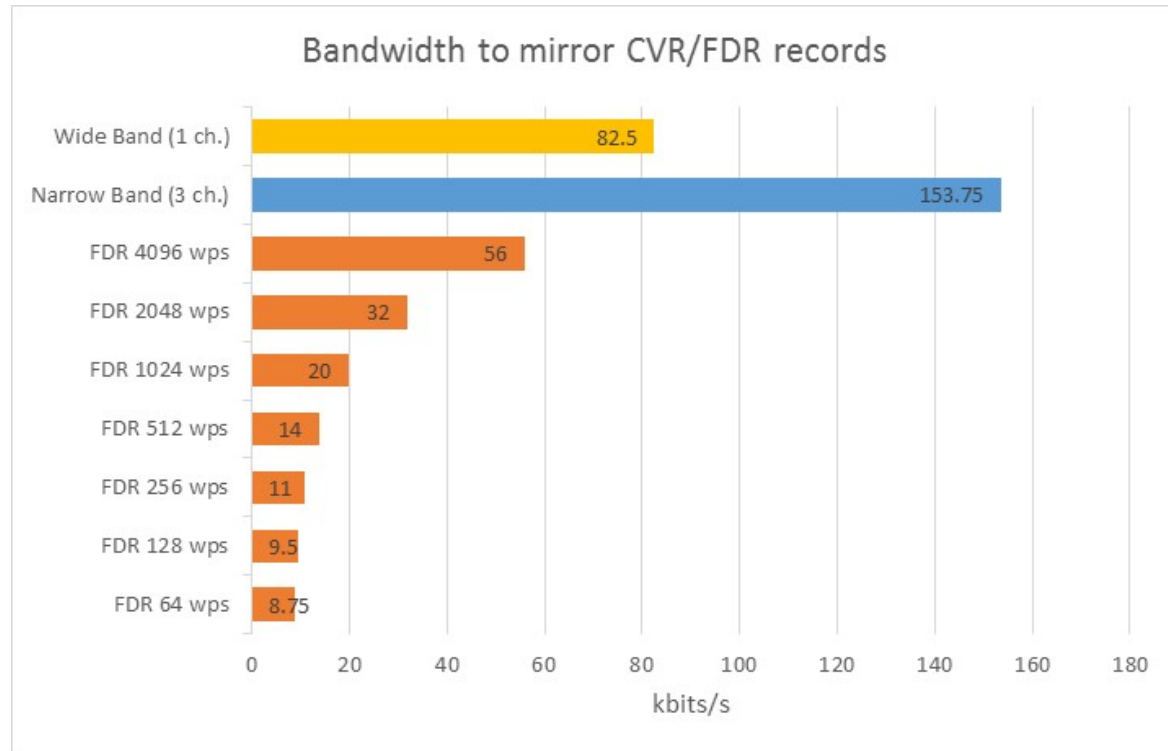


Data Sources – Mandatory Parameters and Specification

- ICAO *Table A8-1 Parameter Guidance for Crash Protected Flight Data Recorders of Annex 6 Part I Appendix 8*, defines set of parameters (total **78**) grouped based on data functional allocation:
 - Flight path and speed
 - Attitude
 - Engine power
 - Configuration
 - Operation
- FAA defines (total **91**) FAR mandatory parameters section 125.226
- EASA defines (total **82**) mandatory parameters (ED-112), *TABLE II-A.1: PARAMETERS TO BE RECORDED - AEROPLANES*
- ARINC 647-1 defines suggested parameters names, mnemonics and units

Note: Parameters are typically group of multiple different signals depending on source of data and configuration of DFDAU

Data Sources – Stream Throughput Analysis with transmission protocol overhead



FDR Only: < 14 kbits/s (512wps)

Total: < 250 kbits/s

Note 1: CVR Data calculation in kbps: Number of channels x Sample rate x Bits per sample (compressed) / Bits per kb + header size

Note 2: FDR Data calculation in kbps: Number of words x Word size in bits / Compression ratio / Bits per kb + special header size

Questions to answer in near term

- How EASA plans to define/specify TRFD and when?
- TRFD and ADT requirements overlap – how to handle it?
 - Connection to Distress Detection Function (ED-237)
- ARINC standard fidelity and scope of the work
- Do we plan to define specific bus type for connection between Data Streamer Functions and Satellite unit? RS422, Ethernet 100BASE-T, A429?
- Are we consider specific satellite band? L-Band, Ku Band, Ka Band, do we consider future LTE connectivity at higher altitude over ground?
- Connection over TCP/IP
 - Do we allow only Aircraft Control Domain (ACD) or any domain?
 - Do we plan to specific streaming protocol to mitigate cases of having proprietary protocol developed independently by manufactures
 - What kind of parameters will be critical with respect to QoS? - performance requirements
 - What are the security risks and how to differentiate data
- Stream priority – how and where it is configured?
- Critical parameters definition and how those are specified (A647-1)

How EASA plans to define/specify TRFD and when?

- Greg M. to address this

TRFD and ADT requirements overlap – how to handle it?

- Transmission of flight data could be used for tracking purposes and end of flight location
- ELT of ADFR could be used for ADT purposes and end of flight location
- There is a common interface for the GAT functions, those interfaces are defined by ADT documents, those will be referenced in TRFD requirements
- At minimum triggering for ADT and for triggered data transmission should be the same
- ADT could potentially provide pre-distress trigger in order to satisfy ICAO recommendation to begin a transmission before circumstances reach ED-237 level event?
- Need to check with ADT group whether we can incorporate pre-distress trigger in the A429 label 202

Q&A, Discussion

