Global Harmonization Through Collaboration

RTCA SC-206 Aeronautical Information and Meteorological Data Link Services

Presented By: *Allan Hart*

Date: *August 30, 2012*

EUROCONTROL

Federal Aviation Administration

AIR TRANSPORTATION INFORMATION EXCHANGE CONFERENCE - (FEATURING AIXM, WXXM AND FIXM)

August 28, 2012 - August 31, 2012
NOAA Auditorium and Science Center
Silver Spring, Maryland

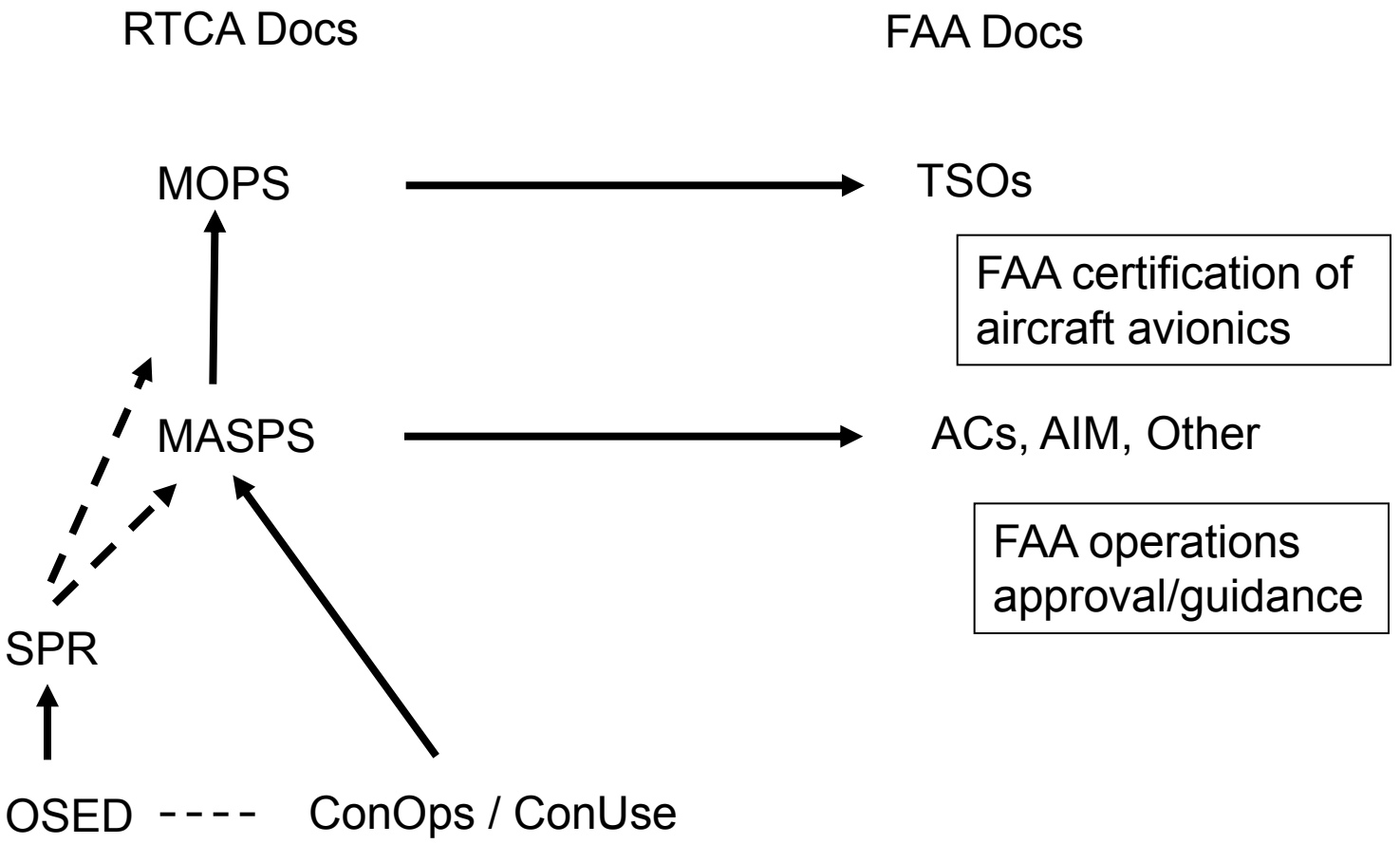
RTCA Special Committee 206

Air Transportation Information Exchange Conference - (featuring AIXM, WXXM and FIXM)

- Established Feb. 11, 2005 at the request of the FAA to address the future ATM concept of:
  - Establishing the aircraft as a primary participant in collaborative decision making (CDM).
  - Transitioning to a global Aeronautical Information Management (AIM) environment.
  - Using Broadcast, Demand, and Contract data link modes for accessing AIS/MET information.
  - Establishing the data link services as the normal (or primary) means for cockpit receipt & decisions using time-critical information
  - ***For the first two Terms of Reference (TOR) deliverables listed below, this SC worked in conjunction with EUROCAE WG-76***
- Leadership
  - Co-Chairs: Rocky Stone, United Airlines and Allan Hart, Honeywell
  - Designated Federal Official: Richard Heuwinkel, FAA - Weather Policy and Requirements
  - Secretary: Tom Evans, NASA
  - RTCA Program Director: Harold (Hal) Moses
- Sub-groups
  - #1 (Wake) Ed Johnson, NASA & Clark Lunsford, MITRE (Completed)
  - #2 (ConUse) Tim Rahmes, Boeing & Ernie Dash AvMet (submitted);
  - #3 (Architecture) Matt De Ris, North Star & Bill Carson, MITRE
  - #4 (DO-252) Tim Rahmes, Boeing & Tammy Farrar, FAA;
  - #5 (MOPS) Stephanie Smith, Garmin & ???; and
  - #6 (MASPS) TBD

Deliverable	Date	Status
Operational Service and Environment Description (OSED) for Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services	Dec 2007	Completed
Safety and Performance Requirements (SPR) for AIS and MET Data Link Services	Oct 2010	Completed
Wake Vortex, Air Traffic Management, and Weather Applications OSED	June 2012	Completed
Concept of Use of AIS and MET Data Link Services (supports MASPS)	June 2012	Submitted
AIS and MET Services Delivery Architecture Recommendations	December 2013	In works
Revise DO-252 to include performance standards for determining EDR and meteorological sensor reports and status	December 2013	Just starting
Minimum Operational Performance Standards (MOPS) for Flight Information Services – Broadcast (FIS-B) with Universal Access Transceiver (UAT)	March 2014	Just starting
Minimum Aviation System Performance Standards (MASPS) for AIS and MET Uplink Services	June 2014	Not started

RTCA Approach – FAA Use



RTCA DO-308 / EUROCAE ED-151

- Title: Operational Services and Environment Definition (OSED) for Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services

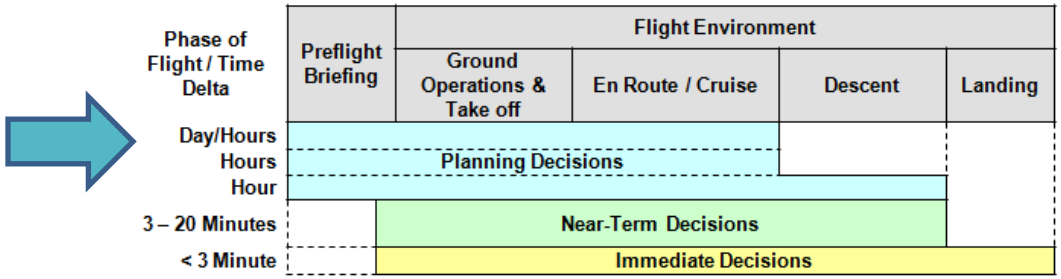
- Scope / Purpose / Objectives
  - Identify data link ***services*** that provide for:
    - Real-time distribution of aeronautical & meteorological information (AIS & MET) to the aircraft.
    - A foundation for the evolution that meets emerging operational needs of ATM.
    - Information for pilot decision support and CDM
    - Information for defining the Safety and Performance Requirements (SPR) and Interoperability documents.
  - Define data link services that are media independent

  - ***"The AIS intent is to augment and eventually replace the current AIRAC system based on the 28-day cycle".***

- Data Link Modes
  - Broadcast (1-way): Continuous, repeated transmission of AIS / MET information to all aircraft within communication range
  - Demand (2-way): A method for the aircraft to request and receive specific information
  - Contract (2-way): A method for the aircraft to request & receive specific information until the contract is terminated

- AIS Data Link Services
  - Aeronautical Update (D-AUS): provides permanent & temporary changes applicable to a flight, independent of the stored data
  - Baseline Synchronization (D-BSS): provides more frequent updates of the stored database than the current AIRAC 28-day update cycle.
    - There are 2 types of Baseline Sync (complete & update)

- MET Data Link Services
  - Decision Based Services
    - Planning (D-WPDS) : >20 minutes
    - Near-Term (D-WNDS): 3 – 20 minutes
    - Immediate (D-WIDS): < 3 minutes
  - Downlink & Crosslink Services



- Expected Benefits
  - Improved Safety, Capacity, Efficiency, Economic, & Environment

MET Examples

Candidate METLINK Product	MET Data Category	Pilot Decision Support			Refresh Rate (+)	Validity (hours)	Common Usage Category (#)			
		WPDS	WNDS	WIDS						
Aerodrome Information										
* METAR	P	X	X		24-48	0.5-1	A	B		D
* SPECI	P	X	X		24-48	0.5-1	A	B		D
* Local Special Report	P	X	X	X	24-48	0.5-1	A	B		D
* Local Routine Report	P	X	X	X	24-48	0.5-1	A	B		D
* Trend Forecast	P	X	X		24-48	0.5-1	A			D
* TAF	P	X			1-6	6-30	A	B		D
Aerodrome Forecast - Tabular form	P	X			1-6	24				
Local Area Forecast	T	X			1-4	6				
* Aerodrome Warning	T	X	X		0-12	12				
* Wind Shear Warning	T		X	X	24-48	0.5-1				
* Forecast for Take off	P	X			48	0.5	A	B		
* Actual QNH	P	X	X		24-48	0.5-1				

[*] indicates that this product is defined in ICAO Annex 3

Legend

MET Data Category

P	Point Data
T	Text Area
V	Vector Graphic
G	Gridded Data

Pilot Decision Support Product Classification

WPDS	Planning
WNDS	Near-Term
WIDS	Immediate

Common Usage Category (circa 2007/8)

A	Preflight planning
B	Displayed for crew and operators
C	Low level flight
D	In-flight

RTCA DO-324 / EUROCAE ED-175

- Title: Safety and Performance Requirements (SPR) for Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services

- Scope / Purpose
  - Defines & allocates a set of baseline minima for the operational, safety, & performance requirements for AIS/MET data link services
    - Provides requirements for the OSED data link services, except AIS Baseline Sync & Wx Downlink & Crosslink.
  - Provides a framework & methodology for assessing implementation of data link systems

- SPR Content
  - Description of the operational objectives for the AIS/MET data link services per the Air Traffic Services objectives (ICAO Annex 11)
  - Overview of the environment and identification of conditions related to the provision and use of the AIS/MET data link services
  - Defined for the AIS / MET data link services:
    - Common features: Modes & Operational Service Descriptions
    - Specific features: D-AUS, D-WPDS, D-WNPS, & D-WIDS
    - Services Operational Requirements & Recommendations: Common & Specific
    - Operational Safety Assessment (OSA) & Performance Assessment (OPA) results
  - Summaries of:
    - Operational, Safety and Performance Requirements
    - Approach used for the Operational Safety Assessment (OSA) and Operational Performance Assessment (OPA)
  - Detail AIS/MET Results
    - Operational Safety Assessment (OSA) for ED1
    - Operational Performance Assessment (OPA) for ED1

- Defines a notional architecture to support safety & performance analysis
  - Safety analysis scope considers only errors introduced by the data link system; thus out of scope are:
    - The AIS / MET data sources;
    - Any message format, content & security reqs; &
    - The aircraft side, crew interaction & systems.

SPR Sample Requirements

Air Transportation Information Exchange Conference - (featuring AIXM, WXXM and FIXM)

Service	Mode	Domain	TT_{ET}	TT_{95}	C_{RCP}	A_{RCP}	I_{RCP}
D-AUS	Broadcast	ENR	260 s	180 s	0.9999	0.999999	0.999999
		TMA	90 s	45 s	0.9999	0.999999	0.999999
		APT	120 s	60 s	0.9999	0.999999	0.999999
	Demand	ENR	260 s	180 s	0.999	0.99999	0.999999
		TMA	90 s	45 s	0.999	0.99999	0.999999
		APT	120 s	60 s	0.999	0.99999	0.999999
	Contract	ENR	260 s	180 s	0.9999	0.9999	0.999999
		TMA	90 s	45 s	0.999	0.9999	0.999999
		APT	120 s	60 s	0.9999	0.9999	0.999999
D-WPDS	Broadcast	ENR	260 s	180 s	0.999	0.999	0.999
		TMA	180 s	90 s	0.999	0.999	0.999
		APT	240 s	120 s	0.999	0.999	0.999
	Demand	ENR	440 s	210 s	0.999	0.999	0.999
		TMA	180 s	90 s	0.999	0.999	0.999
		APT	440 s	210 s	0.999	0.999	0.999
	Contract	ENR	260 s	180 s	0.999	0.999	0.999
		TMA	180 s	90 s	0.999	0.999	0.999
		APT	240 s	120 s	0.999	0.999	0.999
D-WNDS	Broadcast	ENR	210 s	105 s	0.9999	0.9999	0.999
		TMA	90 s	45 s	0.999	0.9999	0.999
		APT	120 s	60 s	0.9999	0.9999	0.999
	Demand	ENR	210 s	105 s			0.9999
		TMA	90 s	45 s			0.9999
		APT	120 s	60 s			0.9999
	Contract	ENR	210 s	105 s	0.9999	0.999	0.9999
		TMA	90 s	45 s	0.9999	0.999	0.9999
		APT	120 s	60 s	0.9999	0.999	0.9999
D-WIDS	Broadcast	ENR		30 s	0.99999	0.99999	0.99998
		TMA		10 s	0.99999	0.99999	0.99998
		APT		30 s	0.99999	0.99999	0.99998
	Demand						
	Contract	ENR		30 s	0.99999	0.99999	0.99998
		TMA		10 s	0.99999	0.99999	0.99998
		Surface		30 s	0.99999	0.99999	0.99998
		Departure Arrival		10 s			

- **TT_{ET} = Transaction Expiration Time**
  Maximum time for completion of a transaction
- **TT_{95} = 95% Transaction Time**
  Time that 95% of all transactions are completed
- **C_{RCP} = Continuity**
  The probability that the transaction will be completed before the transaction expiration time
- **A_{RCP} = Availability of Use**
  The probability that the communication system between parties is in service when needed (both aircraft & ground system services)
- **I_{RCP} = Integrity**
  The probability (reliability) the data link service provider can transmit information (% of transactions completed with undetected errors)

RCP = Required Communication Performance

RTCA DO-339

Air Transportation Information Exchange Conference - (featuring AIXM, WXXM and FIXM)

Title: Aircraft Derived Meteorological Data via Data Link for Wake Vortex, Air Traffic Management, and Weather Applications Operational Services and Environmental Definition (OSED)

- Scope / Purpose
  - Describes the information content necessary to support a broad range of applications without constraining the data elements or rates to stay within the limits of any specific link (takes a link agnostic approach).
  - Describes a number of wake turbulence, air traffic management, and meteorological applications that can benefit from the downlink and crosslink of these aircraft-derived data.
  - Describes the specific data to be transmitted, including:
    - Bit count and timing;
    - Acquisition of required data from standard data labels on standard aircraft data buses as well as provisions for participation by aircraft not equipped with data buses and/or flight management systems;
    - Constraints under which the proposed service must operate; and
    - An overview of potentially applicable performance standards, error handling, system safety, and system security.

- OSED Content
  - Expected Benefits & Anticipated Constraints
    - System Overview & Architecture
    - Data for wake turbulence, air traffic and weather applications
  - Service Level Description
    - Desired Atmospheric Characterization
    - Proposed Meteorological Data Reception Frequencies
    - Reserved Status Bits
    - Performance Standards and Error Handling
    - Security overview of the service level application
    - Proposed Data Transmission
    - Availability of data from current aircraft buses
    - Operational Assumptions and Recommendations
    - Safety overview for the service level application
    - Conceptual endpoint for service level application
  - Applications
    - Wake Turbulence
    - Air Traffic Management
    - Weather situational awareness & Meteorological

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DO-339 Data Transmissions Characterize the Atmosphere for Real-Time Applications

Data Element	Airport and Terminal Maneuvering Area	En Route
Atmospheric Data Elements Wind Speed Wind Direction Static Pressure Static Temperature Eddy Dissipation Rate Humidity/ Water Vapor	Every 50’ of altitude Every 1 NM in level flight	Every 500’ of altitude Every 5 NM in level flight
Hazardous Weather Data Elements Wind Shear Microburst Icing Peak Turbulence	On Condition	
Aircraft Surveillance Data Elements Position Altitude Track Heading Vertical Rate True Airspeed Mach Number	Transmitted at 1 Hz (rates suitable for use in real time decision support tools)	
Aircraft Data Elements Aircraft ID Aircraft Type Weight Wing Span Aircraft Configuration Wake Vortex Initial Circulation Strength	Transmitted in conjunction with atmospheric data elements	

Meteorological Parameters to be Transmitted Under the DO-339 Concept Include:

Data Field	# of bits	Range	LSB/Comments	Desired Reception Period (seconds)
Wind Speed	8	0..255 knots	1 knot	3
Wind Direction	9	0…359 degrees	1 degree See Note 1	3
Static Air Temperature	9	-128..127.5 degrees C	0.5 degrees C	10
Static Air Pressure	11	0..2047 hPa	1 hPa See Note 2	10
Average Turbulence Metric (EDR1/3)	8	0..1.27 in EDR1/3 units	0.005 in EDR1/3 units. See Note 8	10
Humidity/water vapor	7	0..100%	100/127 percent, See Note 5	20
Peak Turbulence Metric ($EDR^{1/3}$)	8	0..1.27 in $EDR^{1/3}$ units	0.005 in $EDR^{1/3}$ units. See Note 8	20 nominal 10 on triggering event
Icing Hazard Metric	2	00=none, 01=light 10=moderate, 11=severe	See note 7	20 nominal 10 on triggering event
Windsheer or Microburst Indication	2	00= none 01=winds hear 10=microburst		20 nominal 10 on triggering event
Volcanic Ash Hazard Metric	2	00=none, 01=light 10=moderate, 11=severe	See note 8	20 nominal 10 on triggering event

Notes:

(1) The time and location of each observation is included with the transmitted parameters

(2) Vertical Wind Speed is a desired parameter for some potential applications. However, aircraft-derived vertical winds are often “noisy” and require specialized filtering. This may diminish usability.

ConUse

Air Transportation Information Exchange Conference - (featuring AIXM, WXXM and FIXM)

Title: Concept of Use (ConUse) for Aeronautical Information Services (AIS) & Meteorological (MET) Data Link Services

- Scope / Purpose
  - Describes system concepts and user applications for using data link services for communicating Aeronautical (AIS) and meteorological (MET) information to and from aircraft.

- ConUse Content
  - Stakeholder Identification
  - Services Justification
  - Change Processes
    - Operations & Equipage
    - Cultural Changes Required
    - Other Considerations
  - Two Key Appendix
    - Appendix B: Use Case Descriptions

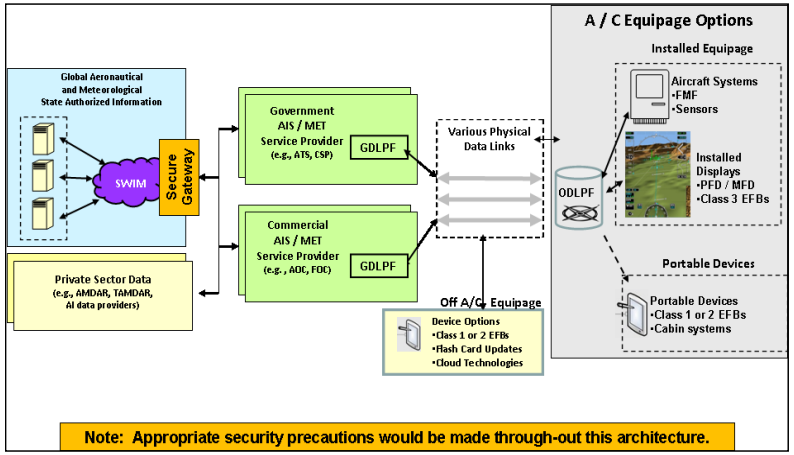
  Operational Needs & Proposed Services
  Operational Concept

  Standards & Policies Required
  Personnel Skill Changes Required

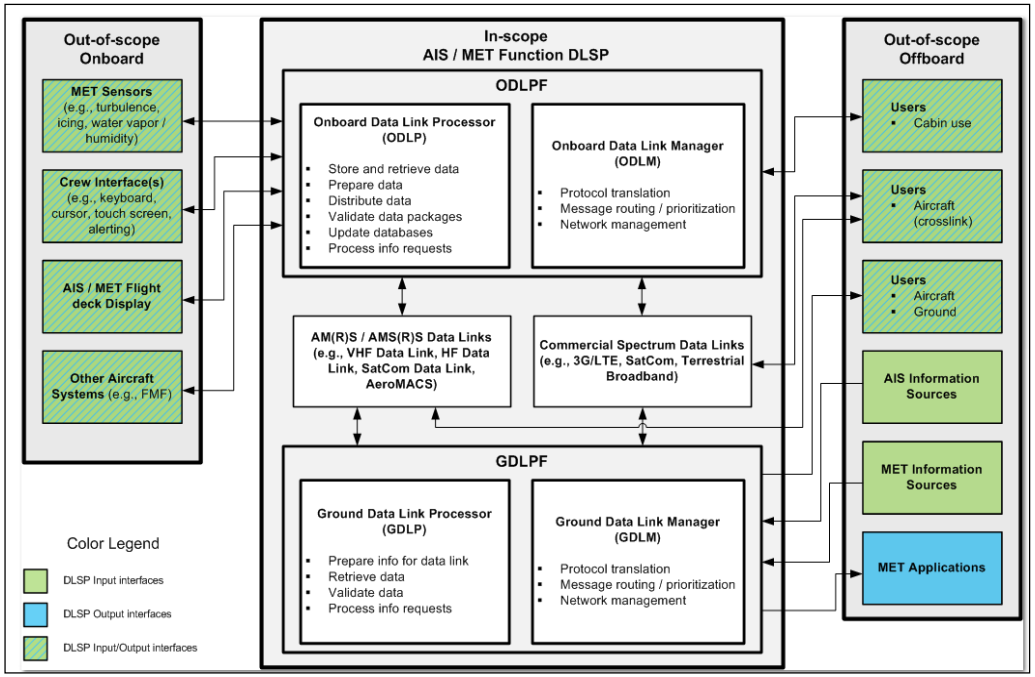
  Appendix C: AIS, MET, & ATM Tables

- Key Concept
  - Two categories of AIS & MET data link services are discussed:
    - Category 1: A compilation of systems used as the primary means for communicating AIS and MET information services to and from aircraft to meet aviation regulatory requirements.
      - ✓ Users may act on information delivered by Category 1 Services without any need for confirming its validity.
    - Category 2: A compilation of systems that can be useful for communications to and from aircraft on which to base operational decisions.
      - ✓ Should not be used as the only source of AIS and MET information meeting aviation regulatory requirements

ConUse Architecture



AIS and MET services physical architecture (notional)



AIS and MET services functional architecture

AIS, MET, & ATM Information Categories

Air Transportation Information Exchange Conference - (featuring AIXM, WXXM and FIXM)

Information Categories	Flight Scenario														Services				
	Situational Awareness							Hazard Avoidance			Diversion		Optimize Flight		MET			AIS	
	Pre Flt	Sfc Ops	Term Ops	En Route	OCN	Polar	RMT	Term Ops	En Route Route Dev	En Route Alt Chng	Destination	Emergency e.g., medical	Surface/ Terminal	En Route	WPDS	WNDS	WIDS	BSS	AUS
MET Examples																			
Airport/ Aerodrome Wx	X	X	X	X	X	X	X				X	X	X	X	X	X	X		
Hazardous Weather																			
Convective Activity	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Turbulence	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Icing/Freezing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Microburst	X	X	X					X			X	X	X			X	X		
Wind shear	X	X	X					X			X	X	X			X	X		
Wake Turbulence	X	X	X	X	X	X	X	X			X	X	X			X	X		
Volcanic Ash	X			X	X	X	X		X	X				X	X	X	X		
Winds/Temps																			
Flight Path	X			X	X	X	X		X	X				X	X	X			
Arrival/Departure	X	X	X								X	X	X		X	X			
BSS Examples																			
Aerodrome Map	X	X	X								X	X	X					X	
Aerodrome Info	X	X	X								X	X	X					X	
Airspace and Com	X	X	X	X	X	X	X				X	X	X	X				X	
Electronic Charts	X	X	X	X	X	X	X				X	X	X	X				X	
Geopolitical	X			X	X	X	X				X			X				X	
Magnetic Field/Flux																		X	
Navigation	X	X	X	X	X	X	X				X	X	X	X				X	
Obstacle	X	X	X	X	X	X	X				X	X	X	X				X	
Terrain	X	X	X	X	X	X	X				X	X	X	X				X	
Miscellaneous																		X	
AUS Examples																			
Aerodrome	X	X	X	X	X			X			X	X	X						X
Airspace	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X
Services	X	X	X	X	X	X	X	X	X		X	X	X	X					X
Points & NAVAIDs	X		X	X	X	X													X
Communications	X	X	X	X	X	X					X	X							X
Surveillance	X	X	X	X	X	X					X	X	X	X					X
Procedures	X	X						X			X	X		X					X
Routes	X			X	X	X	X		X	X	X	X	X	X					X
Obstacles	X	X	X	X	X	X		X			X	X	X						X
Miscellaneous																			X
Air Traffic Management Examples																			
Traffic Flow Info	X	X	X	X	X	X	X				X		X	X					X
ATC Procedures	X	X	X	X	X	X	X				X		X	X					X

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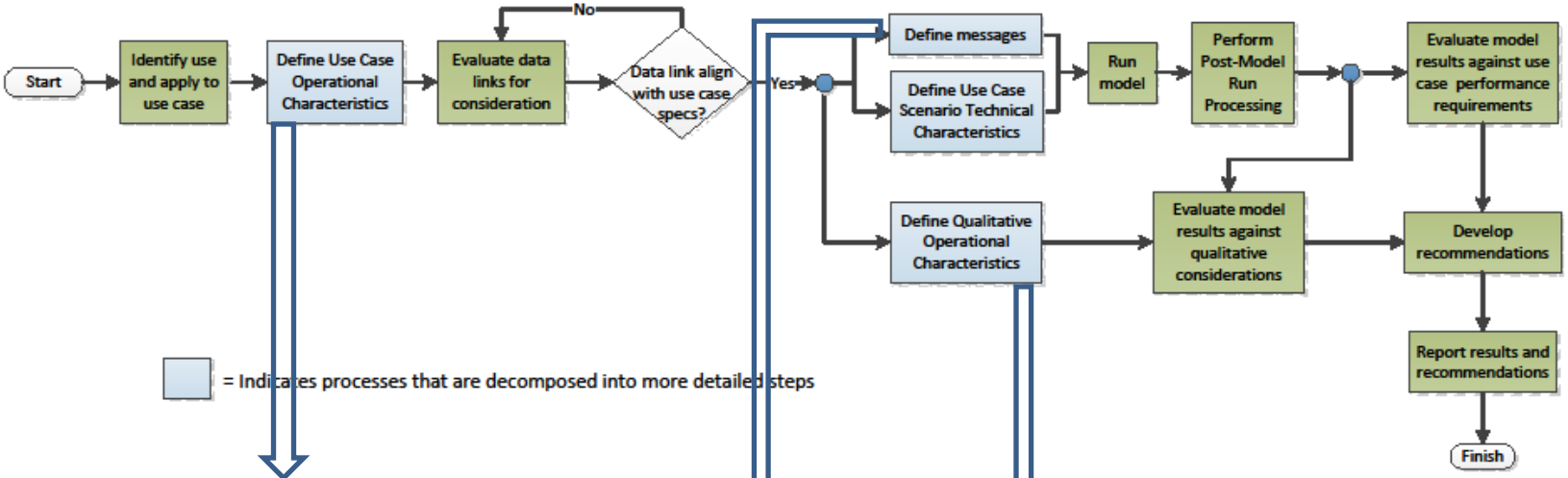
Services Delivery Architecture

1. Introduction
2. Data Link Concept
    1. Intended Use
    2. Concept Architecture
    3. Modes of Operation
    4. Services Under Consideration
3. Architecture
    1. Architecture Trade Studies
    2. Architecture Recommendations
4. Information Quality Assurance
    1. Current Info Quality Process
        a. AIS
        b. MET
    2. Info Quality Recommendations
5. Security
    1. Current Approach to Security
    2. Security Recommendations
6. Allocation of Use to Data Link
    1. Current Methods of Data Link Allocation
    2. Data Link Allocation Recommendations
        a. Purpose of Process
        b. DL Analysis Process
        c. Data Link Allocation Process
        d. Procedure Steps
            1) Identify Use and Apply to Use Case
            2) Define Use Case Operational Characteristic
            3) Evaluate DLs for Consideration
            4) Determine DLs that Align with Use Case
            5) Define Messages
            6) Define Use Case Tech Chars
            7) Data Link Models
            8) Define Qualitative Operational Characteristics
            9) Evaluate Model Results Against Use Case Performance Requirements and Qualitative Considerations
            10) Develop Recommendations
            11) Report Results and Recommendations
7. Use Case Process Analyses
    1. Wake/ATM/MET OSED
    2. ConUse for AIS/MET Data Link Services
    3. Other Use Cases
8. General DL Architecture Recommendations

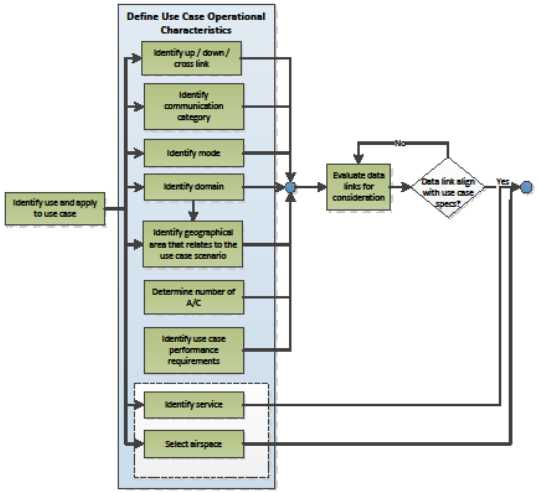
Appendix

A. Membership
B. Use Cases Applied to Analysis
C. Metrics Matrix
D. Use Case Results Template

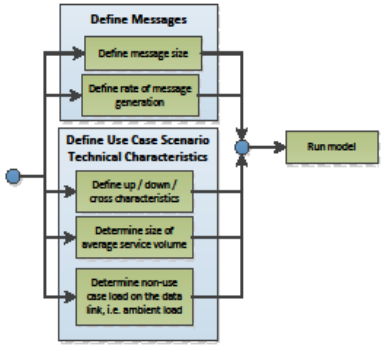
Analysis Process



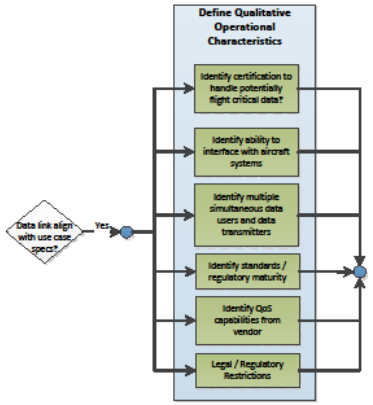
Decomposition - Define Use Case Operational Characteristics



Decomposition –
Define Messages
Define Use Case Scenario Technical Characteristics



Decomposition –
Define Qualitative Operational



Roadmap & Status

Deliverables	2012							2013												2014												2015		
	June ACY	July	Aug	Sept	Oct DC	Nov	Dec	Jan	Feb ATL or PHX	Mar	Apr	May Boulder	June	July	Aug	Sept KC or CHI	Oct	Nov	Dec DC	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
OSED (SG1)	PMC	Determine the work program for including the specific information that was taken out with respect to a follow on MASPS &/or MOPS for wake, ATM & MET apps.																																
ConUse (SG2)			PMC	Information used as a basis for the MASPS																																
Architecture (SG3)					(1)											Fapp		Fres		PMC															
DO-252A Update (SG4)																Fapp		Fres		PMC															
MOPS (FIS-B/UAT) (SG5)																		Fapp		Fres		PMC													
MASPS AIS/MET Uplink (SG6)																				Fapp		Fres		PMC											
	(1) Report to the PMC on the process for alternative suitability and a representation of the intended use of the services defined in the OSED (Wake, ATM, and MET)																																	
Faap = FRAC approval																																		
Fres = FRAC resolution																																		
Meeting months and location																																		

- SG-3 Architecture: # of sub-teams are working document, including SG-1
- SG-4 DO-252: Leadership setup, defining scope ***and membership***
- SG-5 MOPS for FIS-B w/UAT: Leadership setup, defining scope ***& membership***
- SG-6 MASPS AIS/MET Uplink: Pursuing leadership ***and membership***

Next Meeting

The next meeting will be held at the RTCA facilities:

- •1150 18th Street, NW, Suite 910 Washington, DC 20036
- •Monday October 22 through Friday October 26, 2012

Proposed Agenda

Monday: 9:00 AM Opening Plenary

- Chairmen's remarks, host's comments & attendees' introductions
- Review and approval of previous meeting minutes and this meeting's agenda
- Action item review
- Sub-groups status & plan
- Presentations (focus on industry coordination)

Monday Afternoon or Tuesday Morning (8:30 AM) through Thursday 5:00 PM

- Sub-Group meetings

Friday: 8:30 AM – 1:00 PM Closing Plenary

- SGs reports
- Presentations
- Industry Coordination
- Action item review
- Future meeting plans and dates
- Other business

Questions?

Air Transportation Information Exchange Conference - (featuring AIXM, WXXM and FIXM)

Contact Information

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