Future Connectivity for Aviation – FCAV

Webinar 2/2

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FCAV Team

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Agenda

I. Context
II. Task Force description
III. Connectivity landscape: a common vision
IV. Key takeaways
V. Transition roadmap

Terminology used to describe connectivity

Applications

- Baseline 1 = B1, current Controller Pilot Data Link Communications (CPDLC) in Europe
- FANS 1/A in the US, other domestic airspaces and for Oceanic
- B2
- Custom AOC/AIS and ARINC standardized AOC/AIS applications

Networks

- Aeronautical Telecommunication Network (ATN) OSI (Open Systems Interconnection)
- ATN IPS (Internet Protocol Suite) in the future
- Aircraft Communications Addressing and Reporting System (ACARS)
- Internet Protocol (IP)

Links

- VHF Data Link Mode 2 (VDL2)
- HF Data Link
- SATCOM (Classic, New SATCOM Performance Class B, commercial non-safety, etc.)

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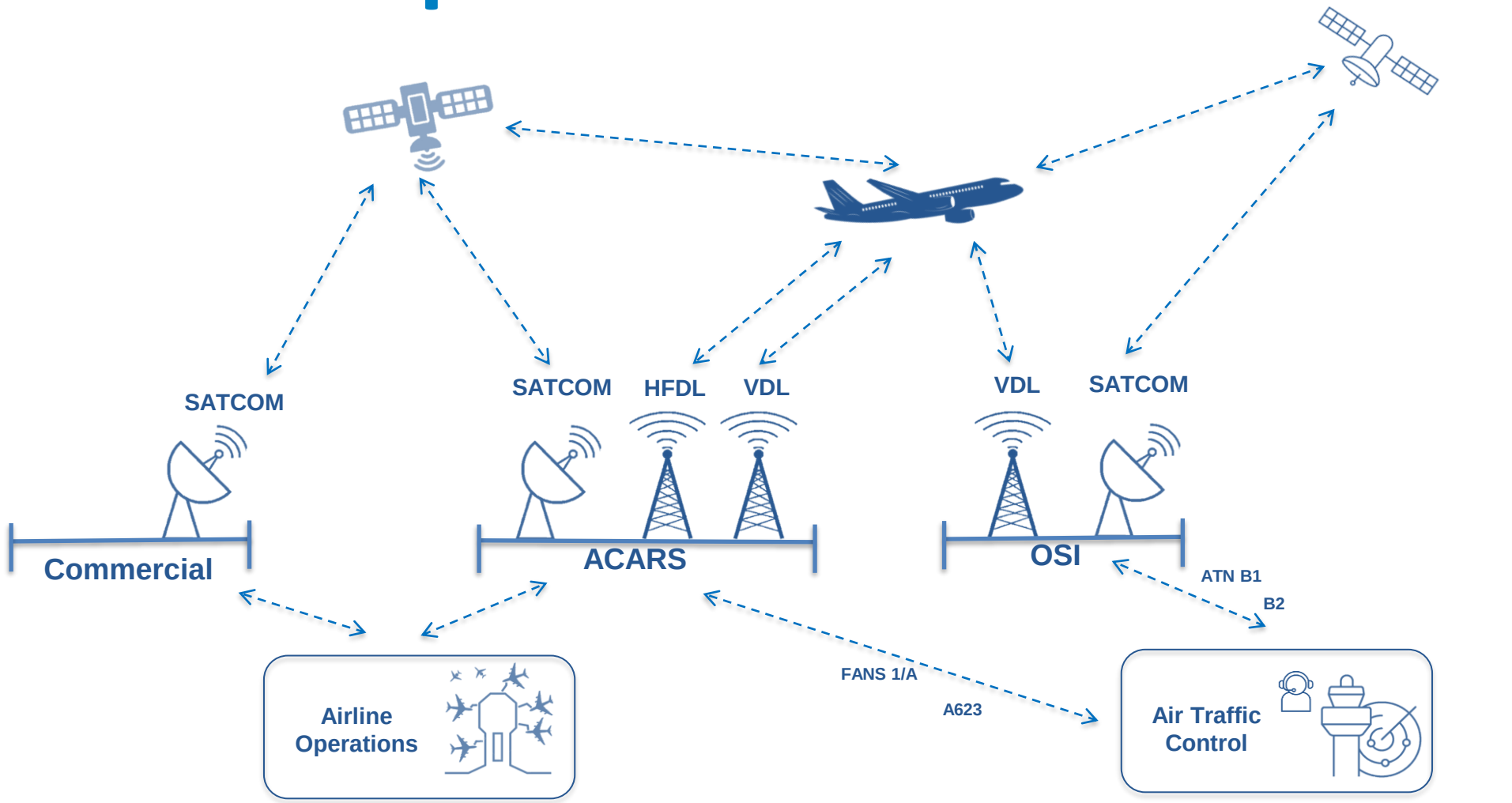
I. Context

Current landscape



CURRENT DATA LINK TECHNOLOGY

Current issues

General

- Current communications reaching their limits, both in terms of capacity & performance

ATM

- Maximum safety link capacity not sufficient
- Technologies are not fully interoperable

Airline operations

- Increasing operational reliance and increasing volume of communications for operators
- Mostly using same link as ATM

Expected evolutions

ATM

- More demanding future ATM concepts
- Increased data volume (EPP, B2)

Airline Operations

- More demanding enhanced airline operations concepts
- Increase of data volume
- Utilisation of aviation-protected spectrum could be optimised
- Increasing connectivity offer with non-safety (“public”) links

Autonomy

- Autonomy concepts need connectivity for Pilot assistance or C2 link

II. Task Force description

Scope

Type of communications

- ATM, operational, aeronautical information, and ‘command and control’
- Air/ground connectivity
- *Excluding passenger connectivity & RPAS payload connectivity*

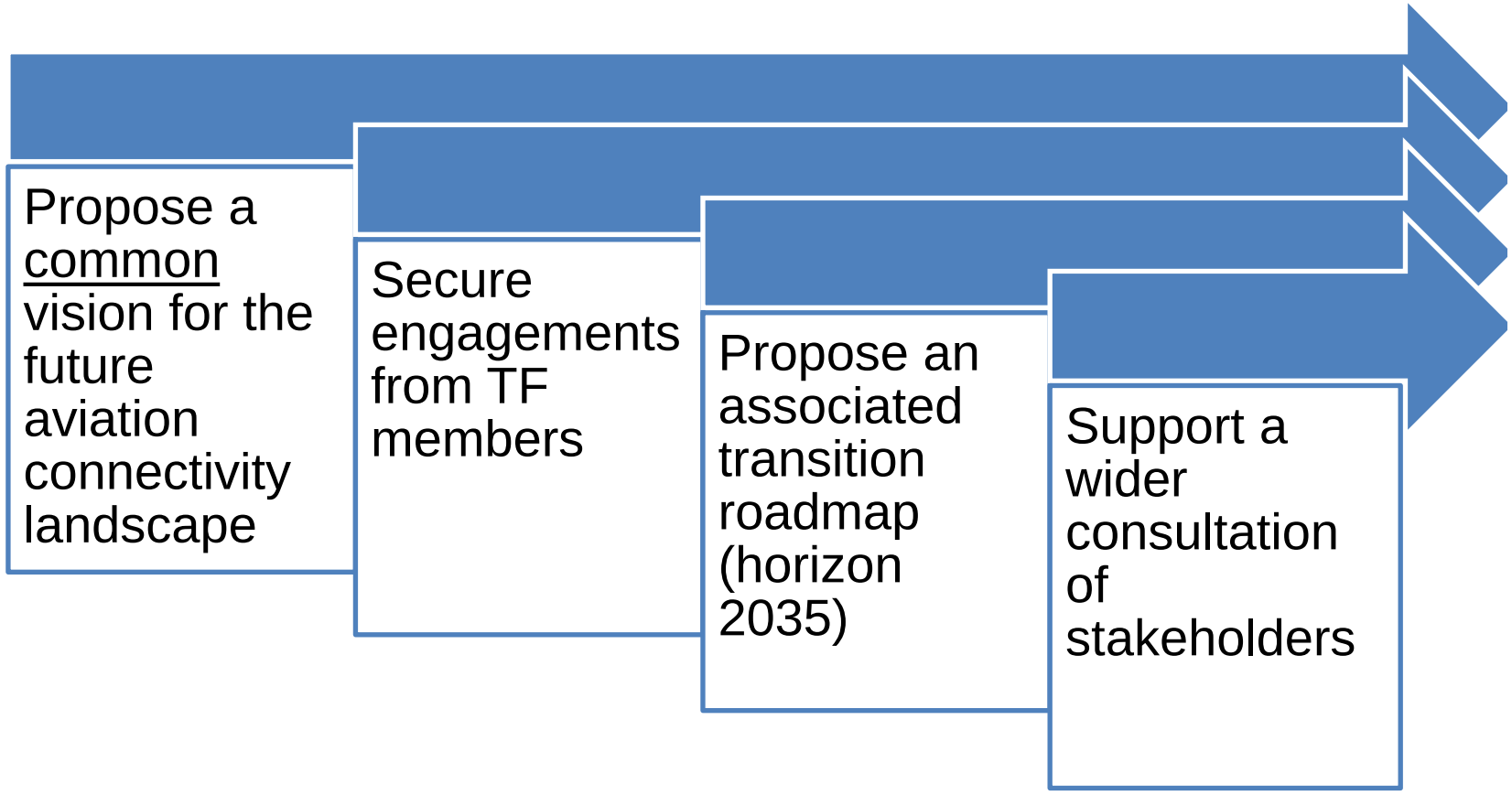
Geographical areas

- US domestic airspace
- EU domestic airspace
- Oceanic/continental remote airspace

Type of airborne vehicles

- Piloted large aircraft
- RPAS in IFR airspace + more autonomous large aircraft
- *Excluding smaller UAS operating at low level altitude or in U-space*

Objectives



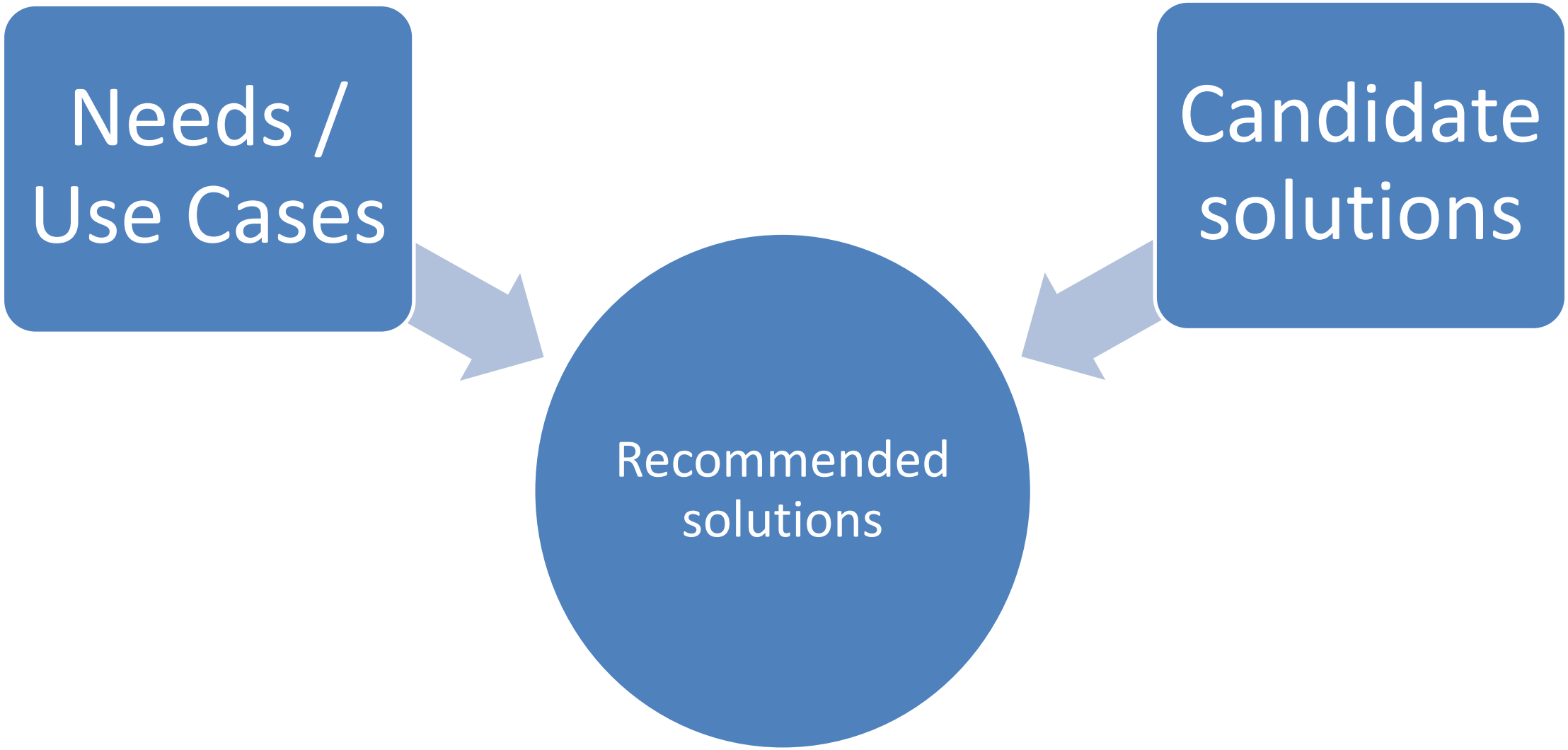
FUTURE CONNECTIVITY FOR AVIATION

EU/US task force

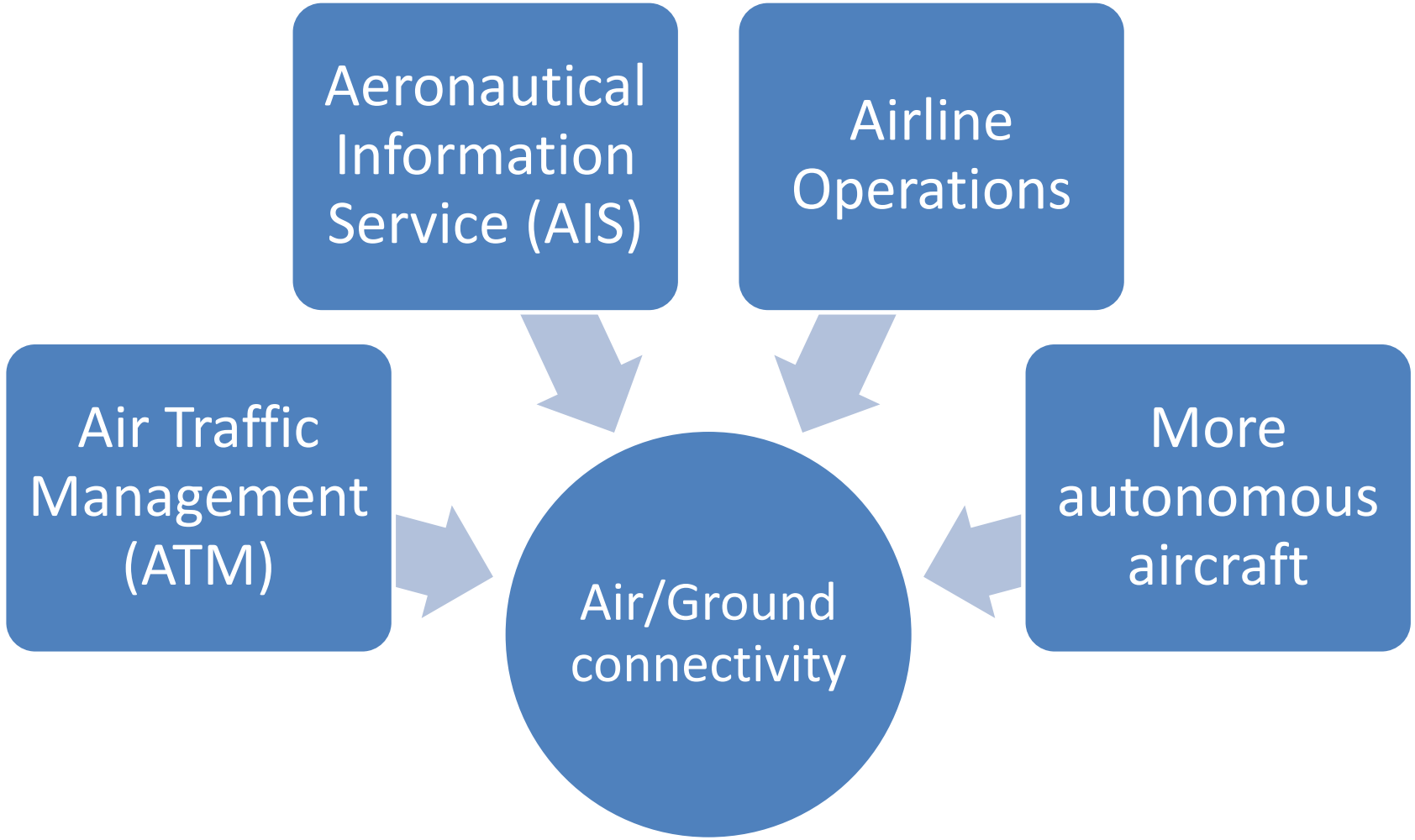
White Paper

Dated 09/11/2022, Issue 1

Methodology



Summary of Use Cases (UC)



III. Connectivity landscape: a common vision

Key objectives for the target connectivity landscape

1. Adequate Capacity, Performance, Safety and Security
2. “State of the art” and “future-proof” technologies
3. Economic efficiency, at the **global industry scale**
4. Efficient usage of the available aviation protected spectrum
5. **Global interoperability**, with a single aircraft avionics capability

Target connectivity solutions

For use cases subject to required demonstrated performance[1]

Preliminary

	Applications / Services	Network / Protocols	Links **Preferred** Option	Links Fallback Option
ATM	B2	IPS	VDL2 SATCOM Performance Class B Commercial links as complement (Hyperconnected ATM[2])	SATCOM Performance Class B+ LDACS
AIS urgent	Standard applications			
Autonomy (assistance)	Proprietary applications			
Autonomy (C2)			C-band (SATCOM and/or ground-based)	Commercial link (FSS)

[1] Solutions (applications) for which performance requirements are established and standardized.

[2] Use of non safety links to complement safety links with timely backup mechanism for required performance demonstration.

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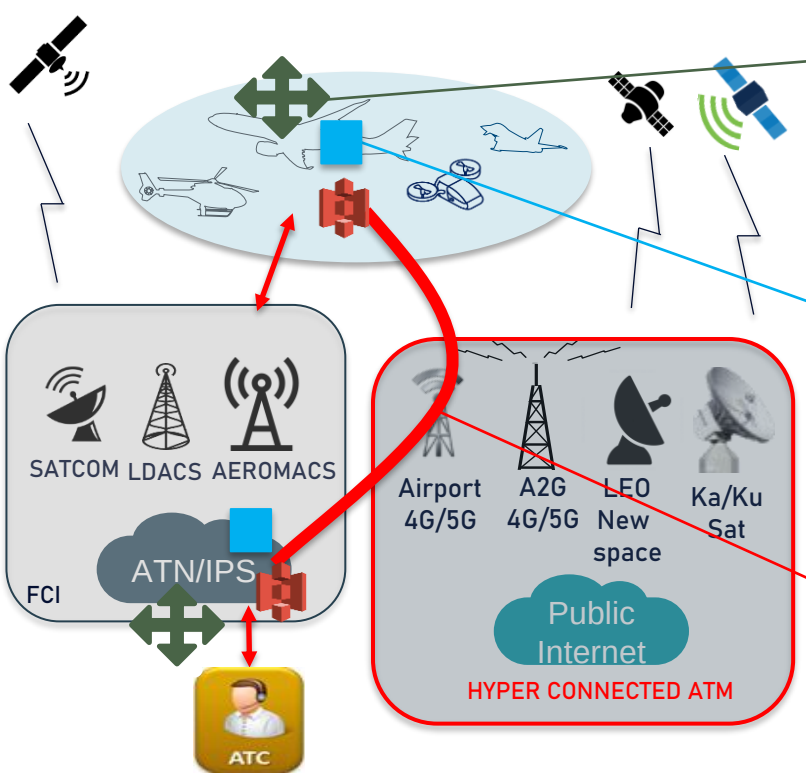
Target connectivity solutions

For use cases not subject to required demonstrated performance

	Applications / Services	Network / Protocols	Links **Preferred** Option	Links Fallback Option
ATFM negotiation	Standard / Custom applications	IP	Non-safety links	N/A
Airline Operations				
AIS not urgent				

Hyperconnected ATM overview



3 SAFETY & PERFORMANCE BASED MULTILINK with FALL BACK

2 ADEQUATE LINK STATUS AND PERFORMANCE MONITORING

1 APPROPRIATE SECURITY PROTECTIONS

IV. Key takeaways

Key takeaways

1. **No new terrestrial communication infrastructure** on protected spectrum necessary
2. Agreed **aircraft equipage goals (B2, IPS).** Ground required to **support different aircraft configurations** (OSI, IPS, ACARS), during transition phases
3. 'Hyperconnected' ATM technology = needs to be **further developed**
4. Communications not subject to RDP (a priori all AOC) → **offloaded from the** safety links when feasible
5. **Necessary regulatory clarity**: usage of protected spectrum
6. **C-Band solution to be further assessed and developed** to support C2 link for some autonomy applications

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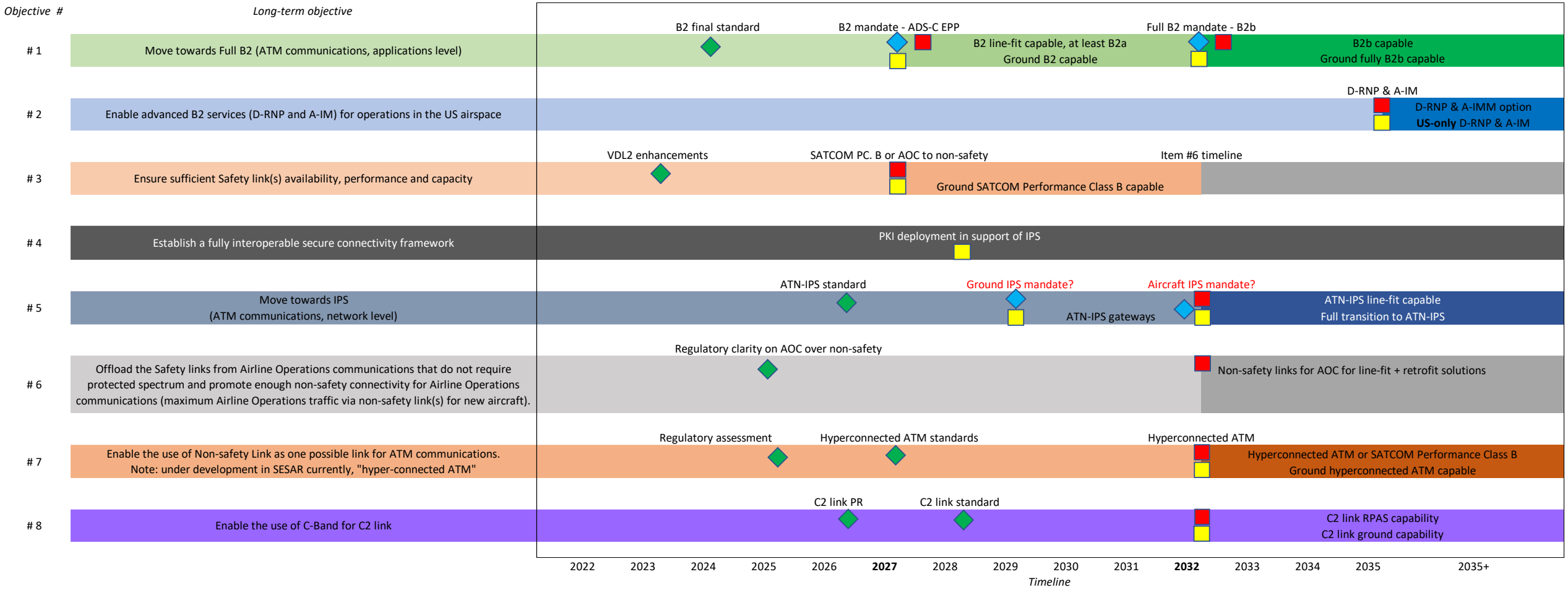
V. Transition roadmap


Objective #
Long-term objective
1
Move towards Full B2 (ATM communications, applications level)
B2 final standard
B2 mandate - ADS-C EPP
B2 line-fit capable, at least B2a
Ground B2 capable
Full B2 mandate - B2b
B2b capable
Ground fully B2b capable
2
Enable advanced B2 services (D-RNP and A-IM) for operations in the US airspace
D-RNP & A-IM
D-RNP & A-IMM option
US-only D-RNP & A-IM
3
Ensure sufficient Safety link(s) availability, performance and capacity
VDL2 enhancements
SATCOM PC. B or AOC to non-safety
Ground SATCOM Performance Class B capable
Item #6 timeline
4
Establish a fully interoperable secure connectivity framework
PKI deployment in support of IPS
5
Move towards IPS
(ATM communications, network level)
ATN-IPS standard
Ground IPS mandate?
ATN-IPS gateways
Aircraft IPS mandate?
ATN-IPS line-fit capable
Full transition to ATN-IPS
6
Offload the Safety links from Airline Operations communications that do not require protected spectrum and promote enough non-safety connectivity for Airline Operations communications (maximum Airline Operations traffic via non-safety link(s) for new aircraft).
Regulatory clarity on AOC over non-safety
Non-safety links for AOC for line-fit + retrofit solutions
7
Enable the use of Non-safety Link as one possible link for ATM communications.
Note: under development in SESAR currently, "hyper-connected ATM"
Regulatory assessment
Hyperconnected ATM standards
Hyperconnected ATM
Hyperconnected ATM or SATCOM Performance Class B
Ground hyperconnected ATM capable
8
Enable the use of C-Band for C2 link
C2 link PR
C2 link standard
C2 link RPAS capability
C2 link ground capability
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2035+
Timeline
Mandate
Standard or Rule update
Aircraft equipment upgrade
Ground equipment upgrade

Airframers

	2027	2032	2035
Application	All linefit **B2** (Europe)		**B2 advanced services for FAA** available linefit as an option
Network		All linefit **IPS**	
Link	If **B2**, linefit **VDL2** + ➢ **SATCOM Class B** AND/OR ➢ **Cabin SATCOM/A2G and AOC offload**	All linefit with ➢ **SATCOM Class B** AND/OR ➢ **Cabin SATCOM/A2G + Hyper Connected ATM and AOC offload**	

Operators

	2027	2032	2035
Application	➢ All line fit equipped with **B2** (EU Mandate) ➢ Voluntary retrofit to **full B2**		Voluntary retrofit to **B2 advanced services** for US.
Network		Voluntary retrofit of existing aircrafts for **ATN/IPS**	
Link	➢ Voluntary retrofit with **SATCOM class** B and ➢ Voluntary **move AOC traffic over non safety links** ➢ Prioritize use of SATCOM vs. VDL2 for ATM traffic	When equipping existing fleets with non-safety connectivity, **ensure hyper-connected ATM capability**	

Standardisation bodies and regulators

	2027	2032	2035
Application	➢ **Freeze B2 standard by 2023** ➢ Update definition of services that can or should use protected spectrum		FAA to develop and issue policy for tailored procedures for advanced B2 services
Network	➢ **Freeze ATN/IPS standard by 2023** ➢ Standardize ACARS over IP protocol and ensure compatibility with existing ACARS services	➢ **EU to develop the ATN/IPS mandate (TBC)** ➢ FAA to develop the IPS policy (including OSI compatibility)	
Link	➢ Finalize VDL2 improvements ➢ **Allow the use of non safety links for ATM** ➢ **Develop standards for Hyper connected ATM by 2027**		

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ANSPs

	2027	2032	2035
Application	EU ANSP **Ensure B2 ADS-C capability** and maintain B1 CPDLC compatibility US ANSP Ensure FANS 1/A backward compatibility for B2 aircraft	US & EU ANSP **Ensure Full B2 (CPDLC + ADS-C) capability**	US ANSP Ensure advanced B2 capability
Network		US & EU ANSP **Ensure support of ATN-IPS**	
Link	US & EU ANSP ➢ **Ensure transparent integration of Satcom class B in DL infrastructure** ➢ Deploy **VDL2 improvements**	EU & US ANSP **Ensure seamless and transparent integration of multiple datalinks, i.e. Hyper Connected ATM**	

Data Link SPs

	2027	2032	2035
Application			
Network		EU DSP ➢ Maintain compatibility with ATN-OSI ➢ Ensure compatibility with ATN-IPS US DSP Maintain compatibility with FANS/ACARS, ATN/IPS and ATN/OSI	
Link	➢ Deploy VDL2 improvements ➢ Ensure transparent integration of SATCOM class B in Data Link infrastructure	Ensure non-safety communication networks can be connected to the ANSPs and implement Hyperconnected ATM mechanisms	

Thank you for your attention!

Questions are welcome.