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05 March 2019

IPS DEPLOYMENT SCENARIOS

AEEC IPS Subcommittee – PP858

Honeywell
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Objectives

This presentation

- High-level, notional architecture diagrams for *potential* IPS deployment scenarios based on application-set + network combinations for both airborne and ground systems
 - Expands upon initial architecture options in Santi Ibarz' (Airtel) presentation on "Air Ground Considerations"
- Scenarios consider:
 - Multiple sub-options (for some scenarios)
 - Security and data compression
 - *Two key topics of discussions during AEEC IPS Meeting 07*
 - Potential deployment region(s) and notional deployment timing
 - Based on "EU-US Air/Ground Data Communications Strategy" roadmap, 7 Nov 2017

Next steps, through stakeholder discussions

- Identify/prioritize most likely deployment scenarios, and *if possible*, eliminate scenarios that are least likely based on some criteria (e.g., cost, timing, practicality, certification, etc.)
- Assess transition options and gateway placement for the most likely scenarios.

Version Changes

- 05 March 2019

- Compression

- Per AEEC NIS M08/M09 discussion to make compression part of the application rather than ATNPKT, which minimizes changes to Doc. 9896:
 - Remove ATNPKT compression from DS-01 thru DS-04
 - Change FANS compression option #2 from ATNPKT to FANS Adapter in DS-05 thru DS-08

- Airbus/Boeing Perspectives on IPS Deployment Scenarios

- Add summary matrix based on Airbus/Boeing presentations during M08/M09, and subsequent coordination discussions (new Slide 4)
- Annotate DS-03c, DS-03d, DS-04b, DS-05, and DS-08 as unlikely scenarios.

- Notional Timeframe

- Change DS-02, DS-04a from Later to Mid (per *Airbus Views on IPS Deployment V1*)
- Update Notional Timeframe Summary (Slide 26) to reflect changes

Potential IPS Deployment Scenarios

Deployment Scenario & Sub options		Airborne System Capability [5]		Ground System Capability		Description	Notes
		App Set	Network	App Set	Network		
DS-01	--	B1, B2	IPS	B1, B2	IPS	B1, B2: IPS aircraft to IPS ground	
DS-02	--	B1, B2	IPS	B1, B2	IPS + OSI	B1, B2: IPS aircraft to dual-stack ground	
DS-03	a-d	B1, B2	IPS	B1, B2	OSI	B1, B2: IPS aircraft to legacy OSI ground	
DS-04	a-b	B1, B2	OSI	B1, B2	IPS	B1, B2: OSI aircraft to IPS ground	1, 2
DS-05	--	FANS1/A	IPS	FANS1/A	IPS	FANS1/A: IPS aircraft to IPS ground	
DS-06	--	FANS1/A	IPS	FANS1/A	IPS + ACARS	FANS1/A: IPS aircraft to dual-stack ground	
DS-07	a-d	FANS1/A	IPS	FANS1/A	ACARS	FANS1/A: IPS aircraft to legacy ACARS ground	
DS-08		FANS1/A	ACARS	FANS1/A	IPS	FANS1/A: ACARS aircraft to IPS ground	3, 4

Notes:

1. An B1,B2/OSI airborne system communicating with a dual-stack B1,B2/IPS+OSI ground system is shown notionally on DS-02
2. An B1,B2/OSI airborne system communicating with a legacy B1,B2/OSI ground system is an existing deployment.
3. A FANS1/1A -ACARS airborne system communicating with a dual-stack FANS1/A-IPS+ACARS ground system is shown notionally on DS-06
4. A FANS1/A-ACARS airborne system communicating with a FANS1/A-ACARS ground system is an existing deployment.
5. Dual-stack aircraft is not shown explicitly, but is a combination of multiple deployment scenarios.

Summary of Airbus and Boeing Views on IPS Scenarios

AIRBUS				BOEING			
Scenario #	Timing	Region	Comments	Scenario #	Timing	Region	Comments
✓ DS-01	End-state	All		DS-01	End-state	All	
✓ DS-02	Mid-term	EU US	No plan to develop, but support technically. Potential to accommodate OSI aircraft in the US; TBC business case.	DS-02	Mid-term	EU	OSI-IPS transition. Potential to accommodate OSI aircraft in the US; TBC business case.
⚠ DS-03a	--	--	No E2E security; possible option if G-G security is adequate. Potential ANSP concern about responsibility delegation.	DS-03a	Mid-term	EU	OSI-IPS transition with GW security proxy (sDS).
⚠ DS-03b	--	--		DS-03b	Mid-term	EU	OSI-IPS transition with GW security proxy (sDS+DTLS).
✓ DS-03c	--	--	Requires security upgrade to existing OSI ES → TBC business case.	DS-03c	--	--	Requires security upgrade to existing OSI ES → TBC business case.
✓ DS-03d	--	--	Potential ANSP concern about responsibility delegation.	DS-03d	--	--	
✓ DS-04a	Mid-term	US	Potential to accommodate OSI aircraft in the US. No E2E security → becomes green with a "valid" security solution for the ground. Potential to accommodate OSI aircraft in the US; TBC business case.	DS-04a	Mid-term	EU	OSI-IPS transition. Combine with DS-03a/b → no security for OSI aircraft, GW security proxy for IPS aircraft. Potential to accommodate OSI aircraft in the US; TBC business case.
✓ DS-04b	--	--	Not considered; requires security upgrade to existing aircraft systems → no business case.	DS-04b	--	--	Not considered; requires security upgrade to existing aircraft systems → no business case.
✓ DS-05	--	--	FANS/IPS not considered; unlikely option.	DS-05	--	--	Unlikely option.
✓ DS-06	TBC	US	FANS/IPS not considered; preferred US option.	DS-06	TBC	US	ACARS-IPS transition; FAA dual-stack end system. Note: DS-07b/-07d are alternatives since no changes to existing ES
DS-07a	TBC	US	FANS/IPS not considered; TBC business case.	DS-07a	Initial	US	ACARS-IPS transition; GW security proxy (sDS).
DS-07b	TBC	US	FANS/IPS not considered; TBC business case.	DS-07b	Initial	US	ACARS-IPS transition; GW security proxy (sDS+DTLS)
DS-07c	TBC	US	FANS/IPS not considered; TBC business case.	DS-07c	Initial	US	ACARS-IPS transition; is no security acceptable (?).
DS-07d	TBC	US	FANS/IPS not considered; TBC business case.	DS-07d	Initial	US	ACARS-IPS transition; GW security proxy (DTLS).
✓ DS-08	--	--	FANS/IPS not considered; unlikely option. No impact on aircraft systems or air-ground interface.	DS-08	--	--	Unlikely option (similar to DS-05) No impact on aircraft systems or air-ground interface.

NOTE 1

NOTE 1

Note 1: Scenario sub-option is TBD based on results of security assessment and needs.

Deployment Scenario Diagram Notes

Applications

- FANS1/A = FANS1/A+ application set
 - AFN, CPDLC, ADS-C
- B1, B2 = B1, B2 application set
 - CM, CPDLC, ADS-C

Note: Although each individual scenario focuses on a specific application set, the application sets are not mutually exclusive, i.e., deployments may include both.

Communications

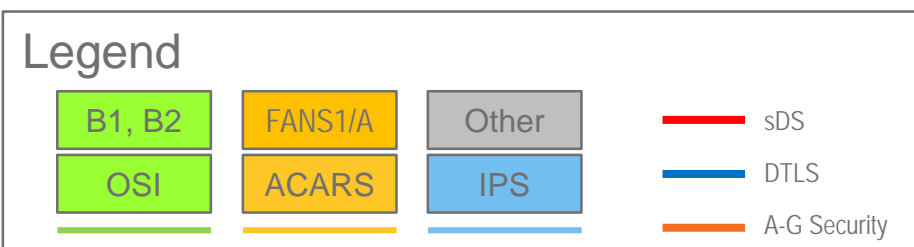
- Wires-and-clouds representation
- Does not illustrate sub-network detail (e.g., radios, ground stations, internal routing, etc.)
- Does not illustrate mobility

Airborne and Ground Systems

- High-level protocol stack representations
- Does not illustrate aircraft implementation detail (e.g., MCDU, FMC, CMF, VDR, on-aircraft networking etc.)
- Does not illustrate ground implementation detail (e.g., datalink front-end/back-end processors, flight data processor, user consoles/systems, intra-networking, etc.)

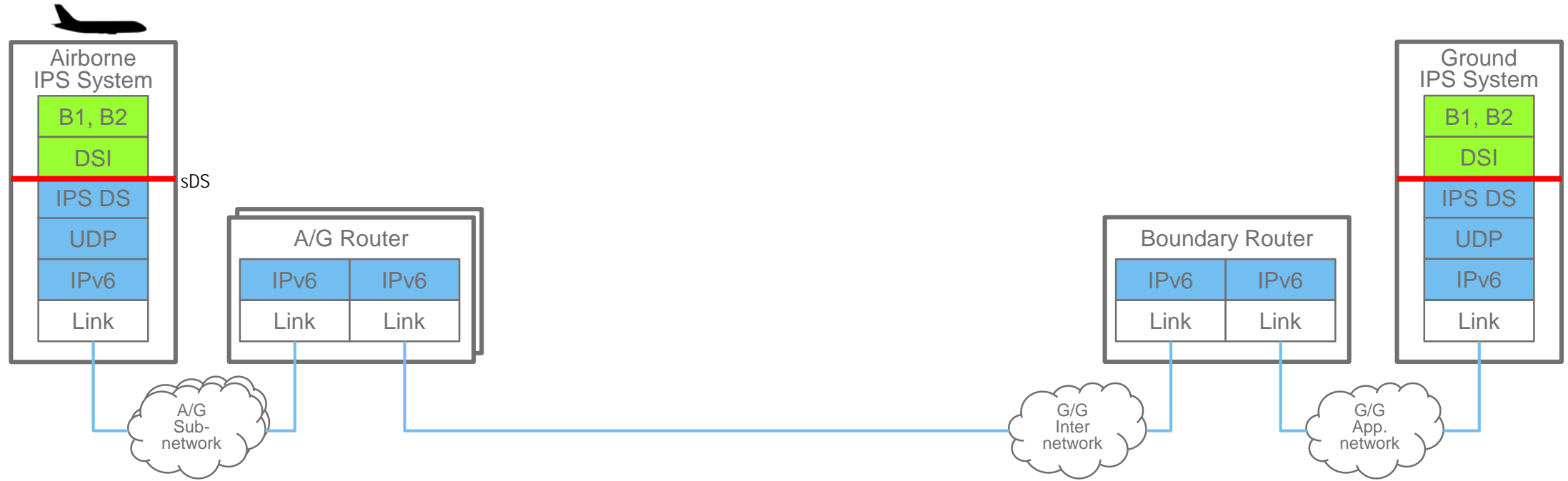
Security & Compression

- Considers air-ground and end-to-end security
 - Assumes Airborne IPS systems implement a VDLm2 security solution
- Does not illustrate ground-ground security
- Considers data compression only.
- Application layer data compression is not shown and is considered transparent to IPS (i.e., part of the user data payload)



DS-01 – B1,B2: IPS to IPS

Architecture



Security



Compression

(Optional)
A-G datalink



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

Later

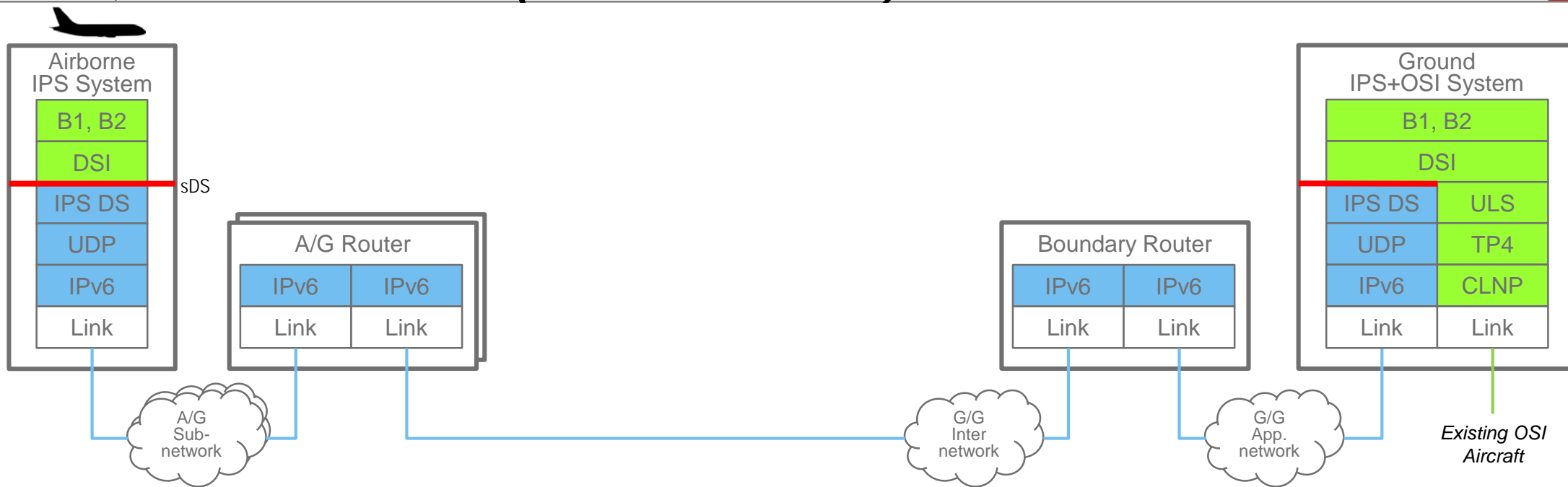
Transition

End State

DS-02 – B1,B2: IPS to IPS (dual-stack ES)

Scenario likely to be demonstrated as part of IRIS IOC/FOC Project (without sDS)

Architecture



Security



Compression

(Optional)
A-G datalink



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

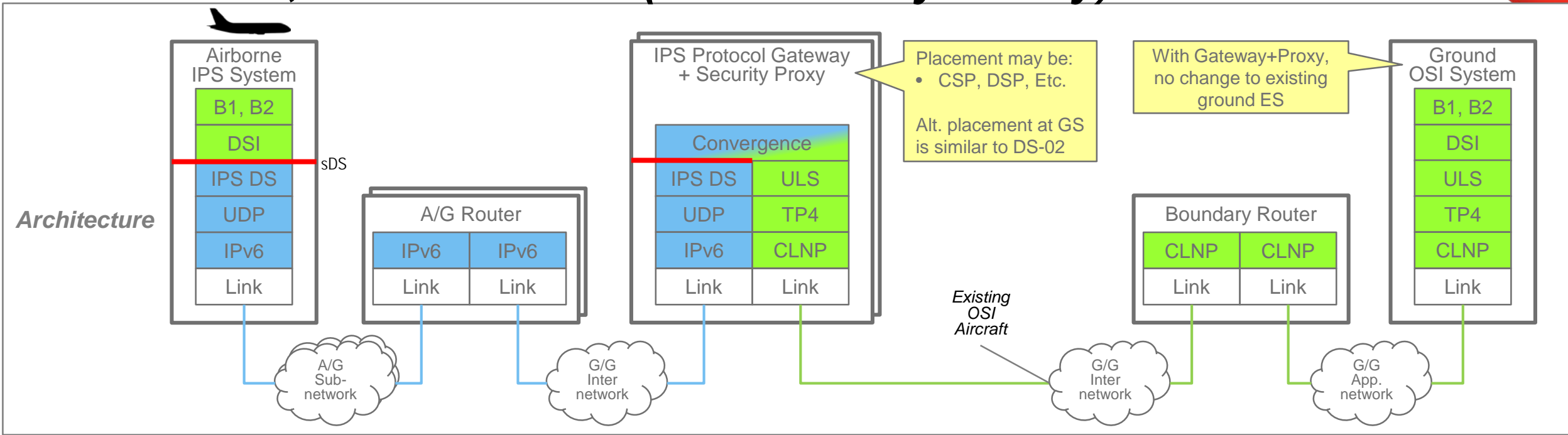
Later

Transition

End State

DS-03a – B1,B2: IPS to OSI (IPS Gateway+Proxy)

Scenario likely to be demonstrated as part of SESAR PJ14.2.4 (without security)



Security

Progress indicator: A red line with a gradient bar starting from the left and extending across the width of the section.

Compression

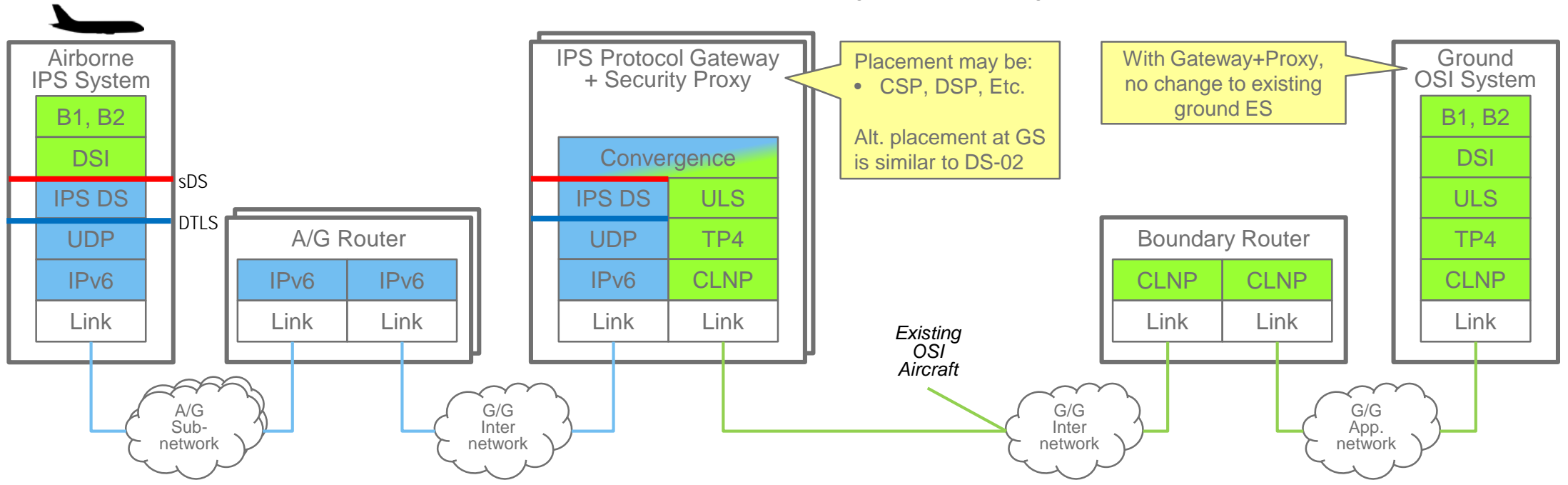
(Optional) A-G datalink

Progress indicator: A solid purple bar extending across the width of the section.

Potential Deployment Region (US, EU, Other) **Notional Timeframe** (Earlier, Mid, Later) (Transition, End State)

DS-03b – B1,B2: IPS to OSI (IPS Gateway+Proxy w/ DTLS)

Architecture



Security



Compression

(Optional)
A-G datalink



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

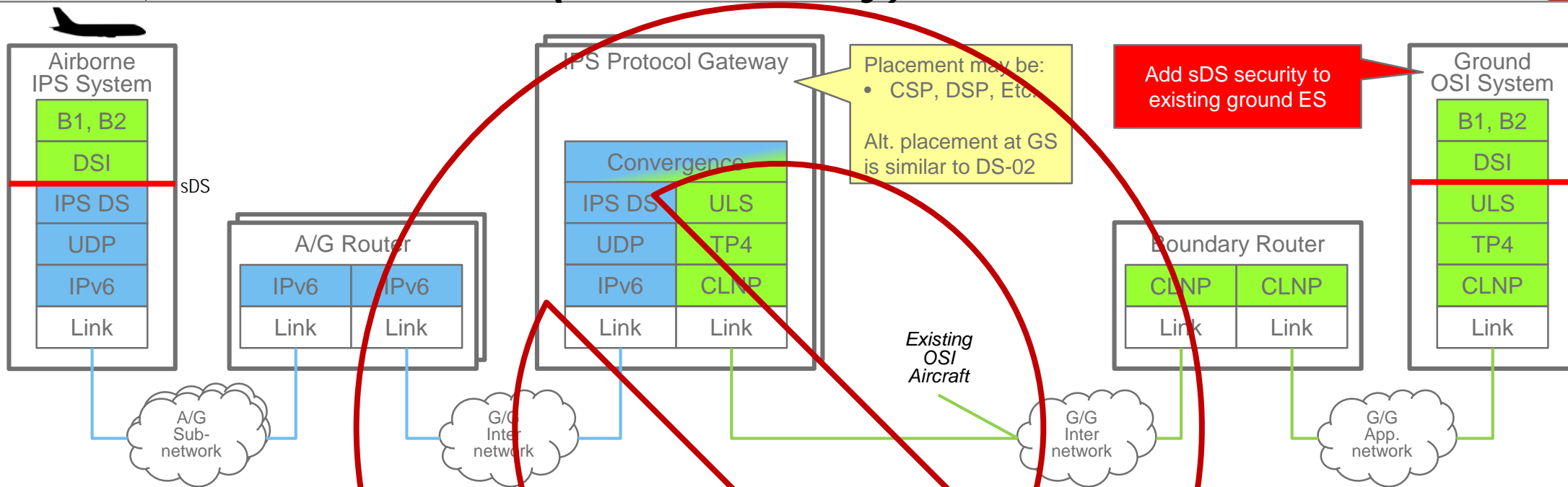
Later

Transition

End State

DS-03c – B1,B2: IPS to OSI (IPS Gateway)

Architecture



Security



Compression

(Optional)
A-G datalink



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

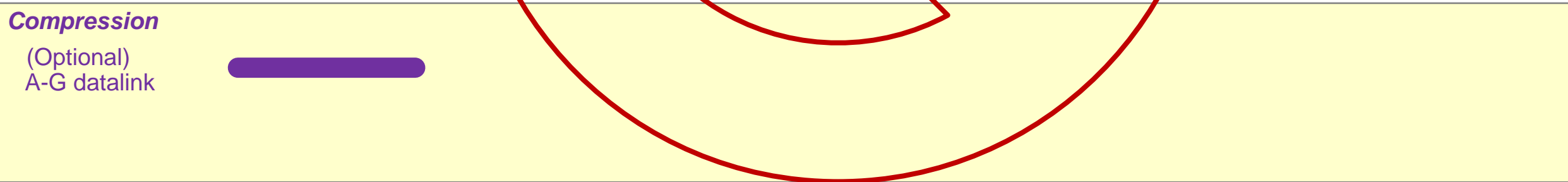
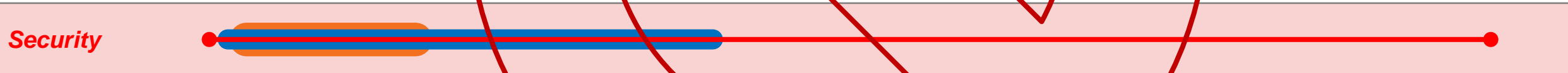
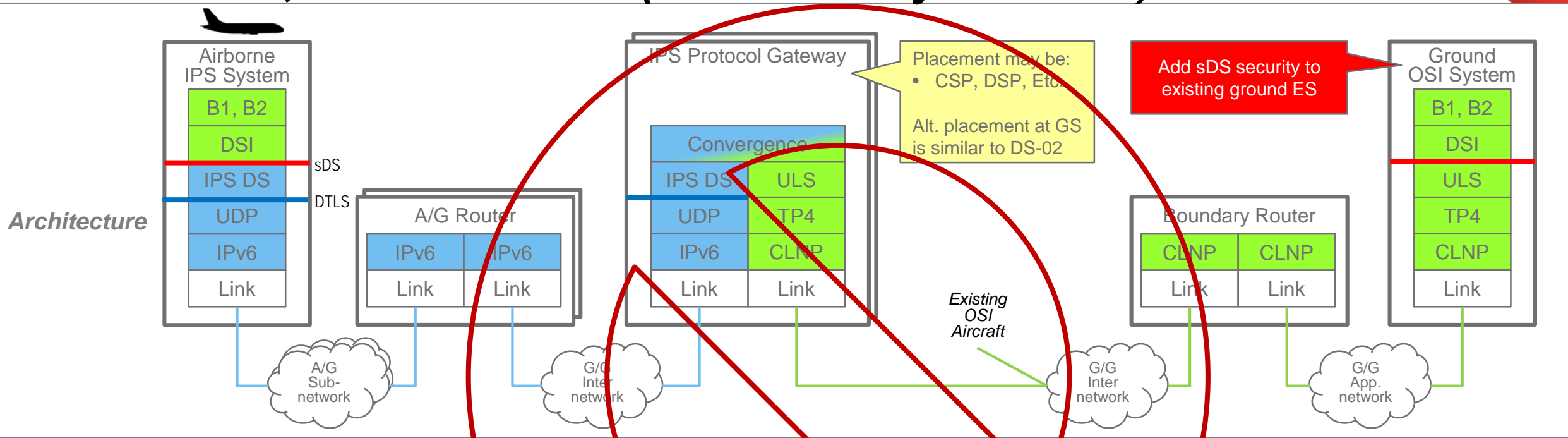
Mid

Later

Transition

End State

DS-03d – B1,B2: IPS to OSI (IPS Gateway w/ DTLS)



Potential Deployment Region US EU Other

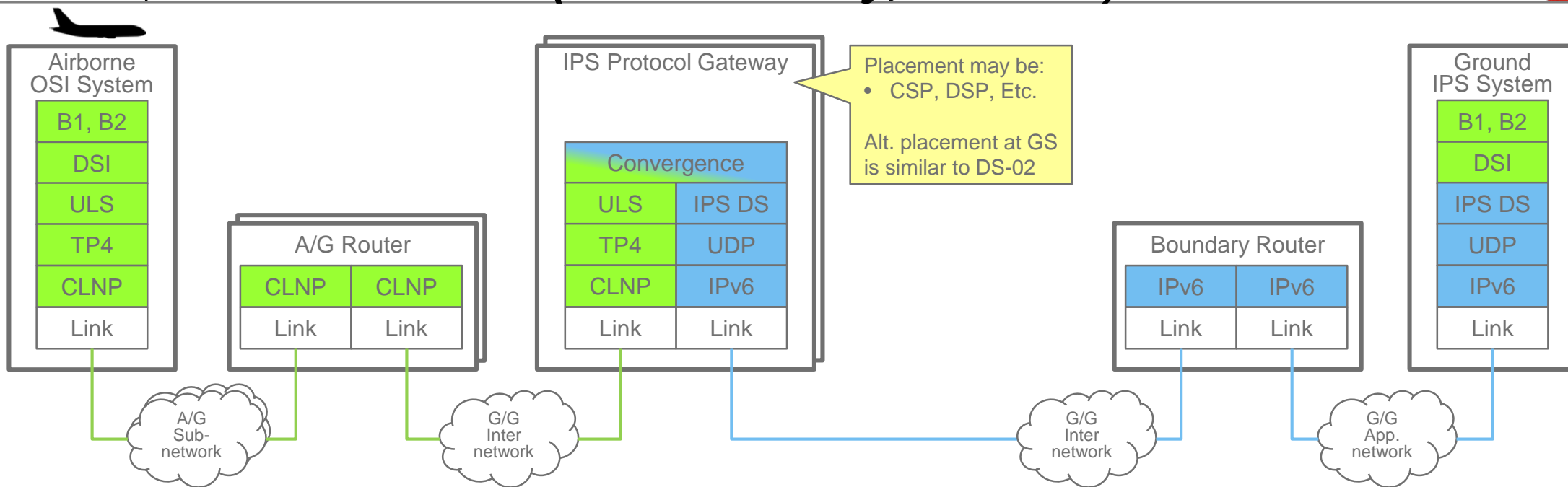
Notional Timeframe Earlier Mid Later

Transition End State

DS-04a – B1,B2: OSI to IPS (*IPS Gateway, no sDS*)

Impact on IPS Gateway, but not relevant to PP858 specification of Airborne IPS system.

Architecture



Security

SATCOM & AeroMACS
(not VDLm2)

Compression

(Optional)
A-G datalink

SATCOM & VDLm2

Potential Deployment Region

US?

EU?

Other

Notional Timeframe

Earlier

Mid

Later

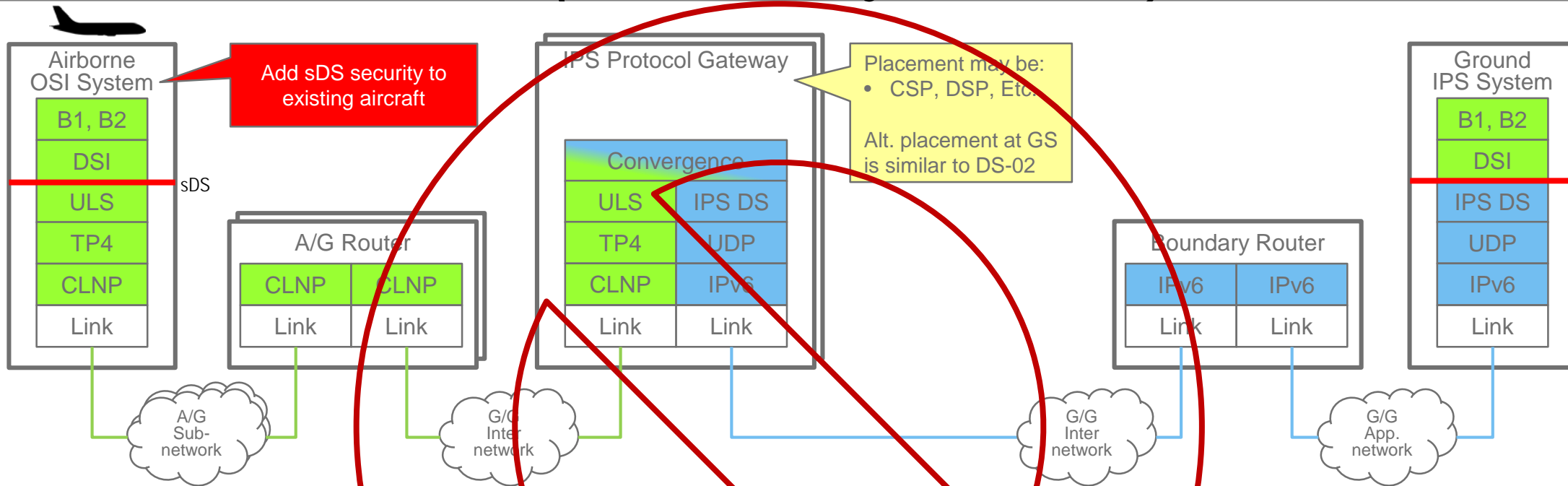
Transition

End State

DS-04b – B1,B2: OSI to IPS (*IPS Gateway, with sDS*)

Impact on IPS Gateway, but not relevant to PP858 specification of Airborne IPS system.

Architecture



Security

SATCOM & AeroMACS (not VDLm2)

Compression

(Optional) A-G datalink

SATCOM & VDLm2

Potential Deployment Region

US?

EU?

Other

Notional Timeframe

Earlier

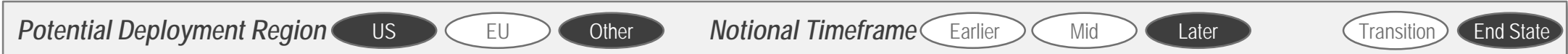
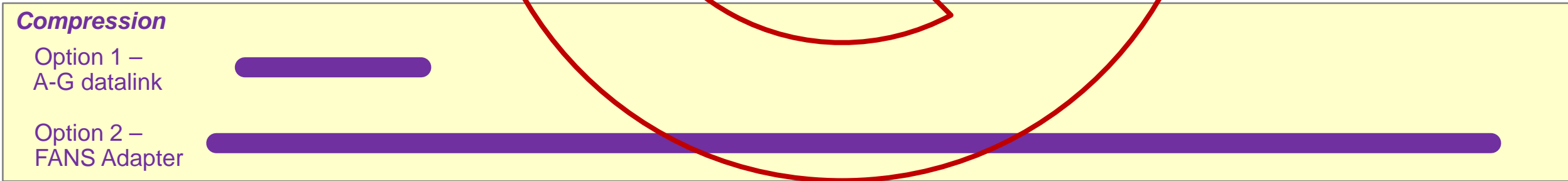
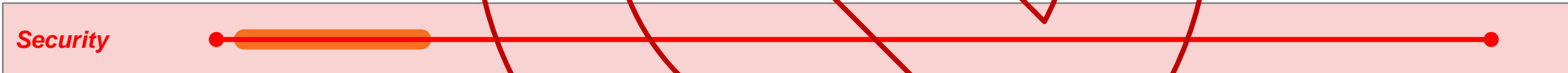
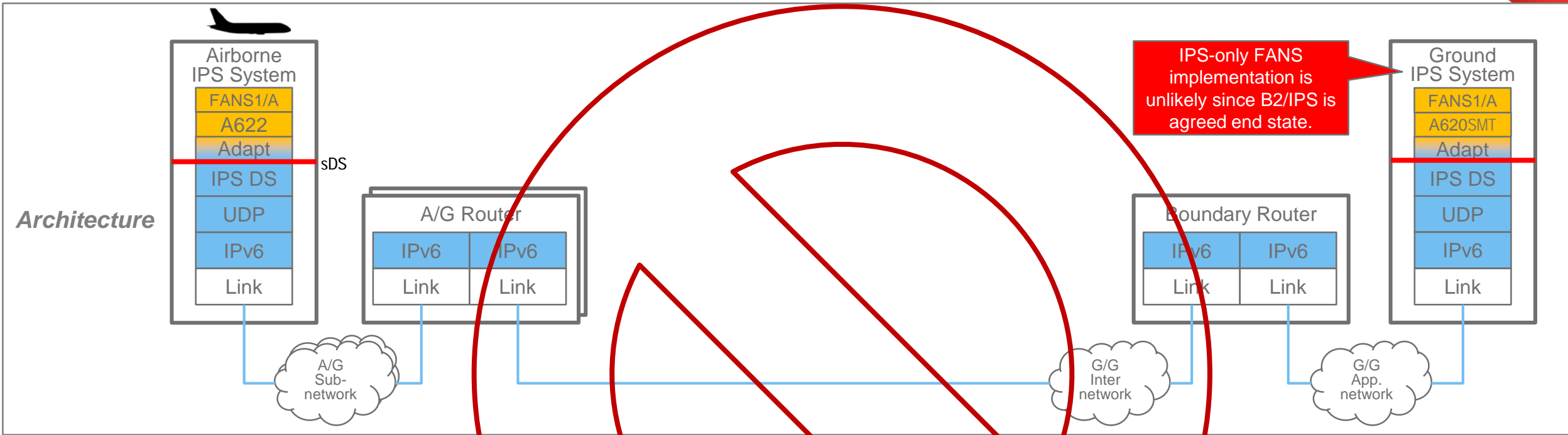
Mid

Later

Transition

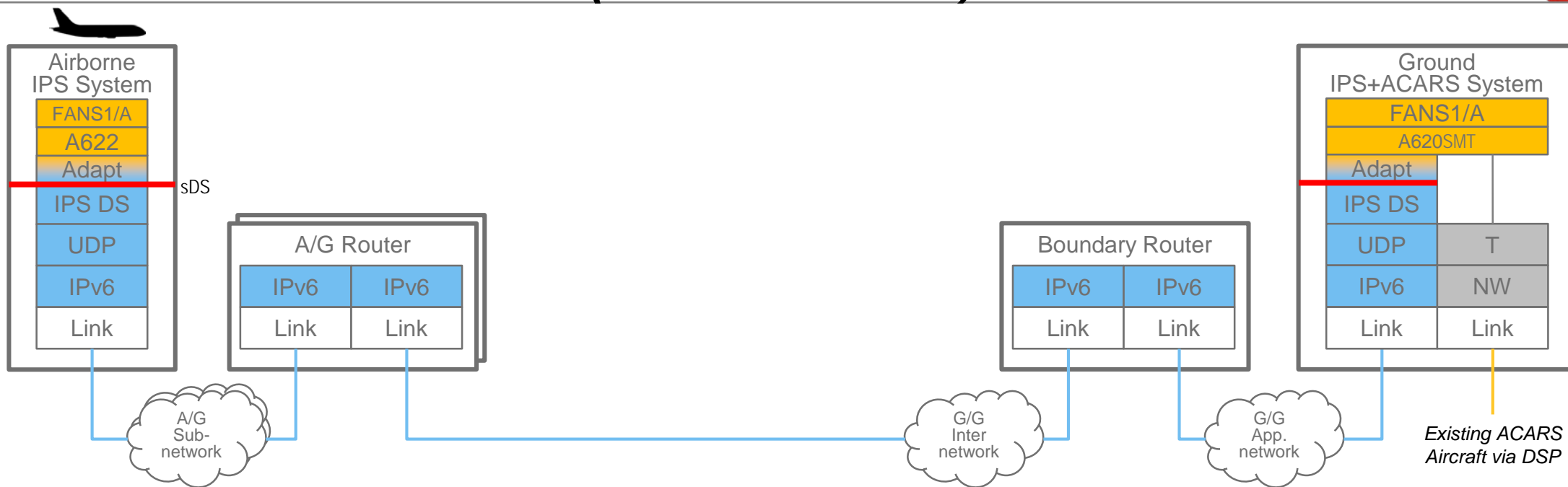
End State

DS-05 – FANS1/A: IPS to IPS



DS-06 – FANS1/A: IPS to IPS (dual-stack ES)

Architecture



Security

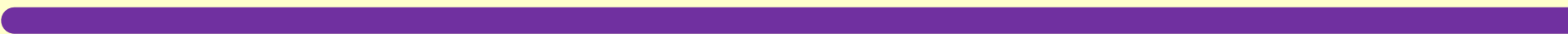


Compression

Option 1 – A-G datalink



Option 2 – FANS Adapter



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

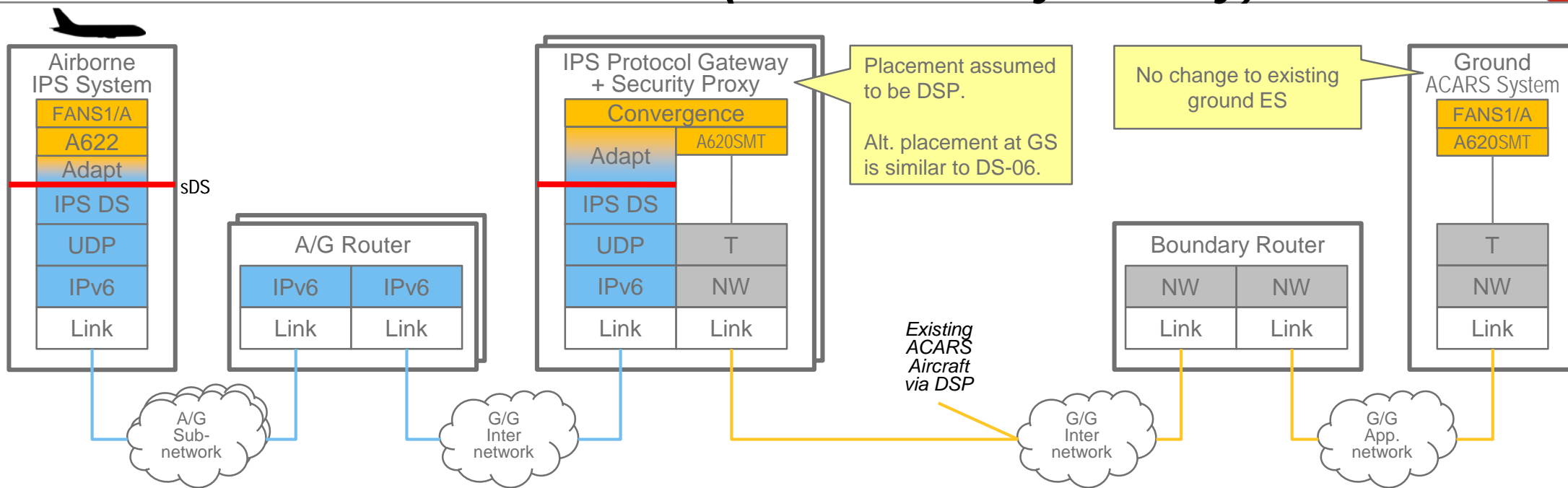
Later

Transition

End State

DS-07a – FANS1/A: IPS to ACARS (IPS Gateway+Proxy)

Architecture



Security



Compression

Option 1 – A-G datalink



Option 2 – FANS Adapter



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

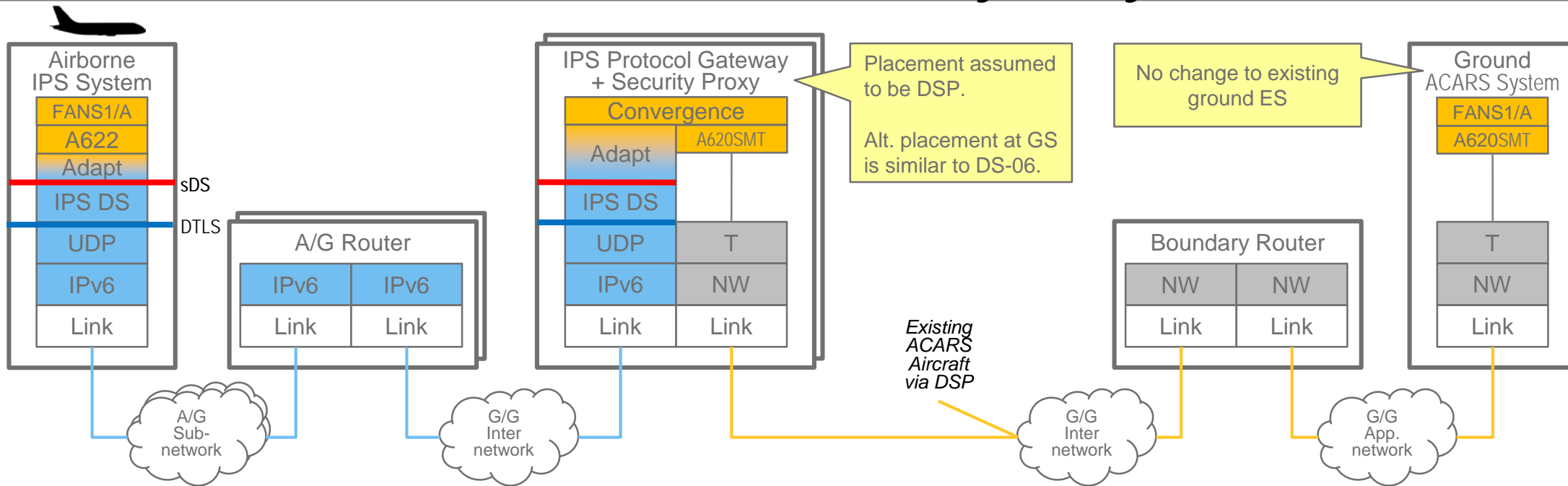
Later

Transition

End State

DS-07b – FANS1/A: IPS to ACARS (IPS Gateway+Proxy w/ DTLS)

Architecture



Security



Compression

Option 1 –
A-G datalink



Option 2 –
FANS Adapter



Potential Deployment Region

- US
- EU
- Other

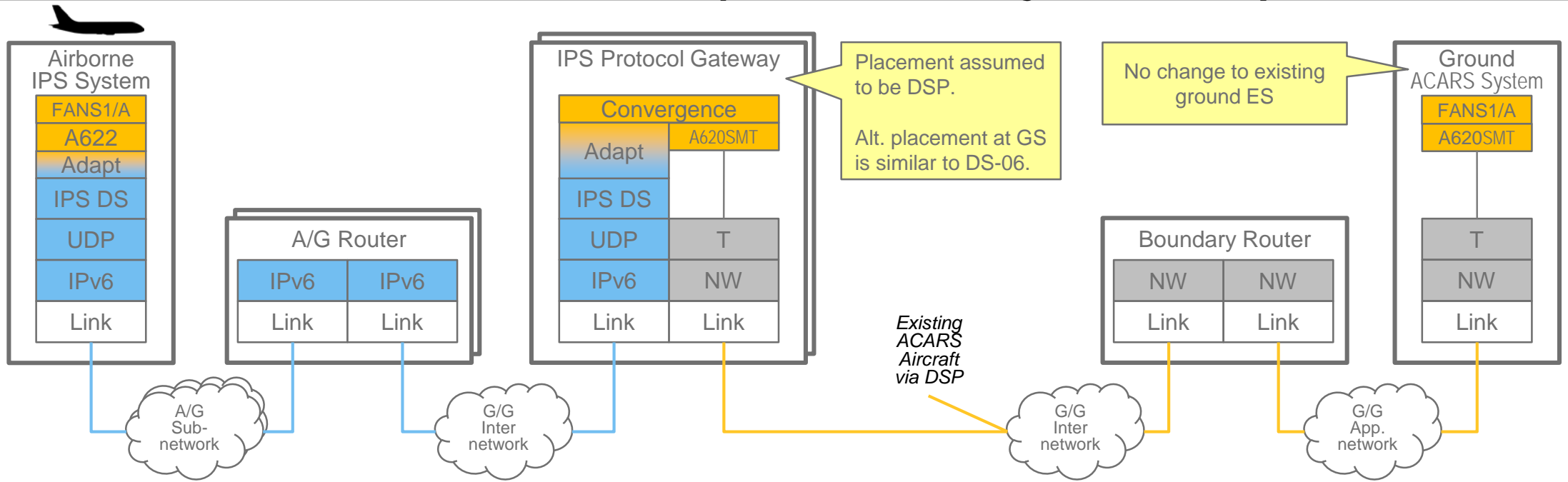
Notional Timeframe

- Earlier
- Mid
- Later

- Transition
- End State

DS-07c – FANS1/A: IPS to ACARS (IPS Gateway, no sDS)

Architecture



Security



Compression

Option 1 –
A-G datalink



Option 2 –
FANS Adapter



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

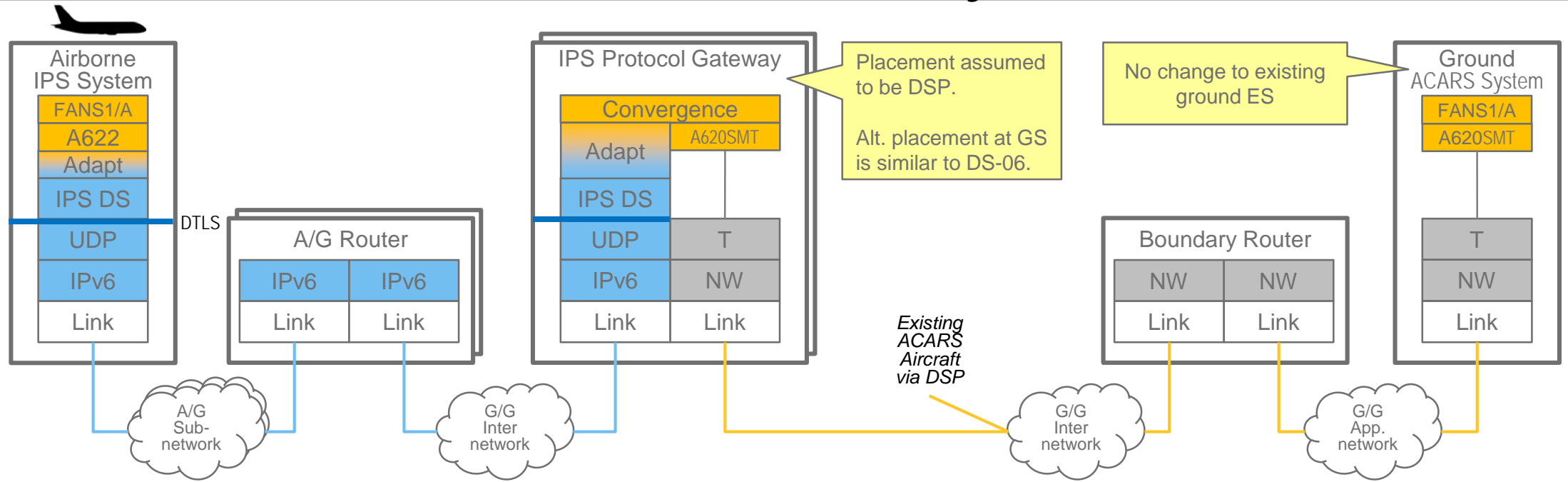
Later

Transition

End State

DS-07d – FANS1/A: IPS to ACARS (IPS Gateway, no sDS w/ DTLS)

Architecture



Security

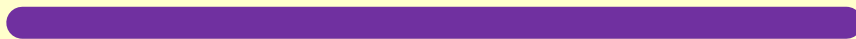


Compression

Option 1 – A-G datalink



Option 2 – FANS Adapter



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

Later

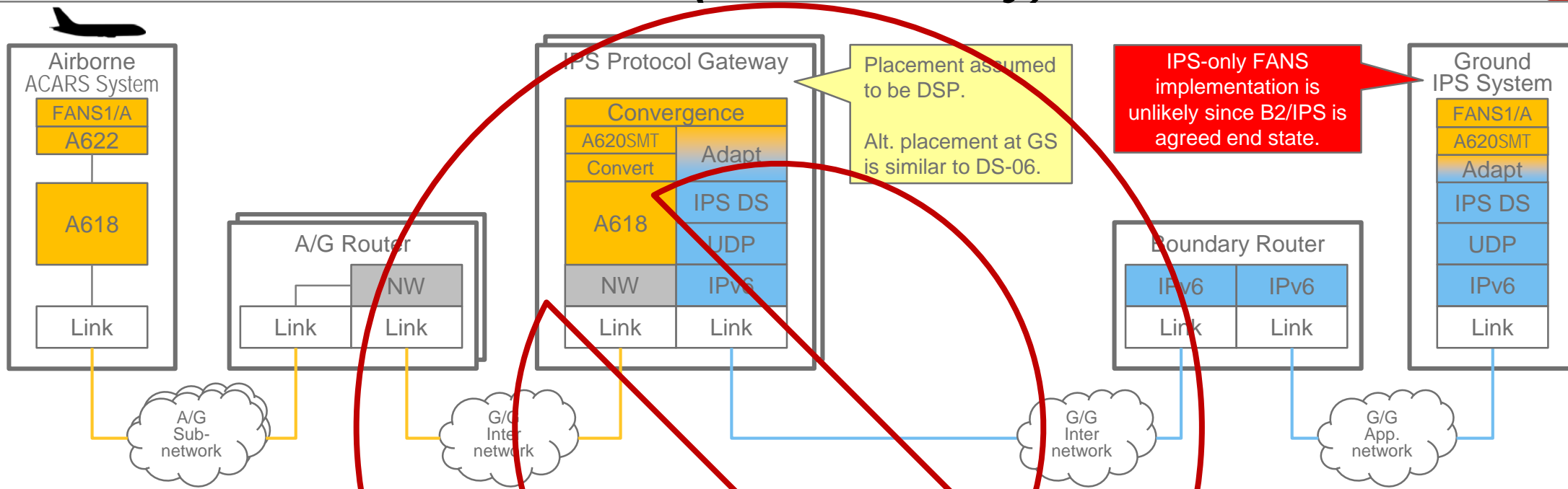
Transition

End State

DS-08 – FANS1/A: ACARS to IPS (IPS Gateway)

Impact on IPS Gateway, but not relevant to PP858 specification of Airborne IPS system.

Architecture



IPS-only FANS implementation is unlikely since B2/IPS is agreed end state.

Security

Compression

- Option 1 – A-G datalink
- Option 2 – FANS Adapter

Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

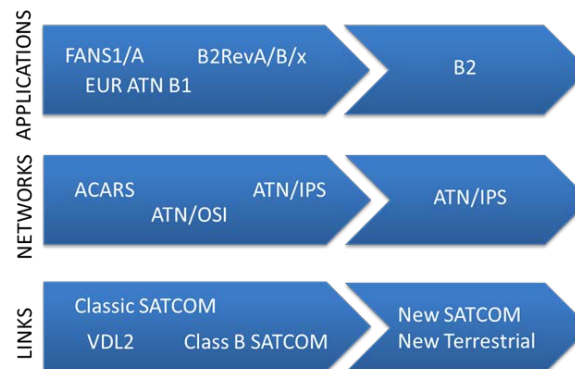
Mid

Later

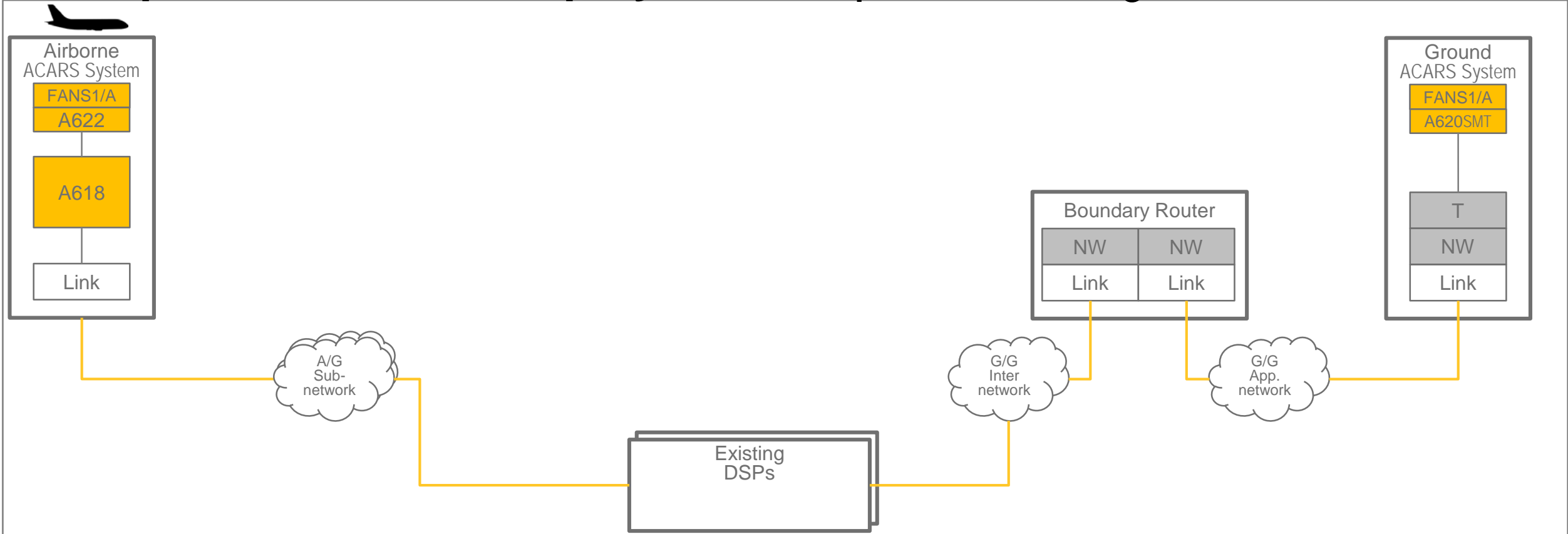
Transition

End State

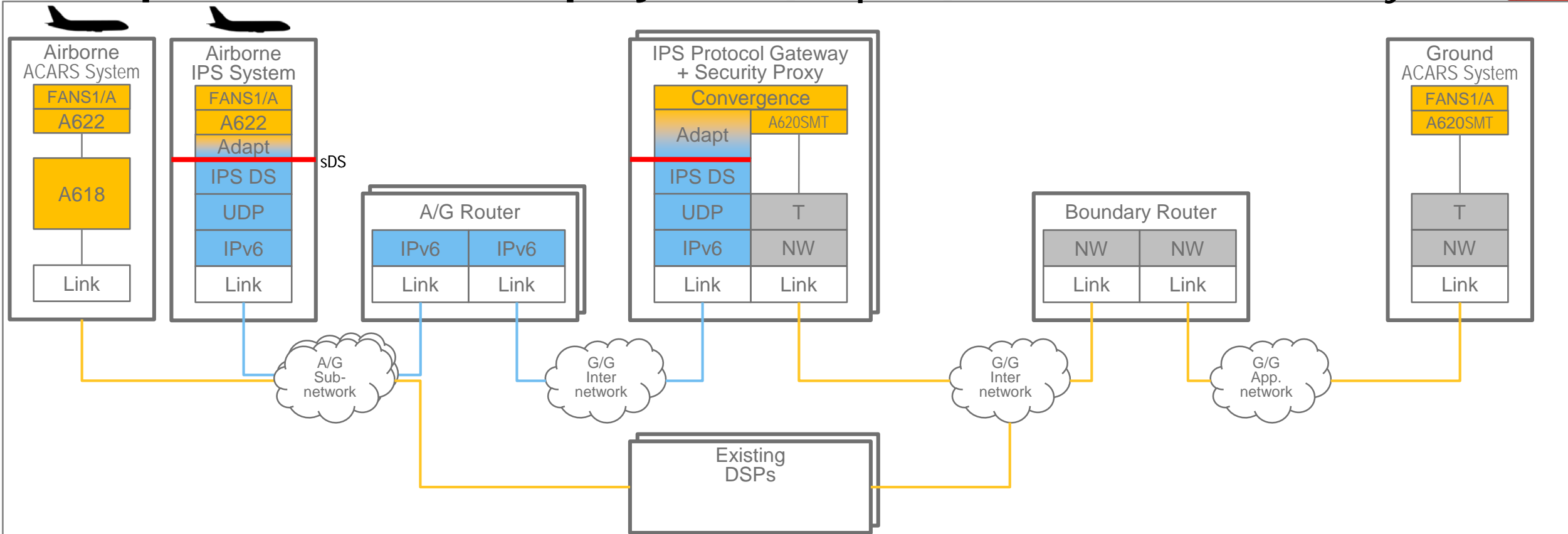
Notional Example: Phased IPS Deployment leading to the Target Harmonized DataComm Environment



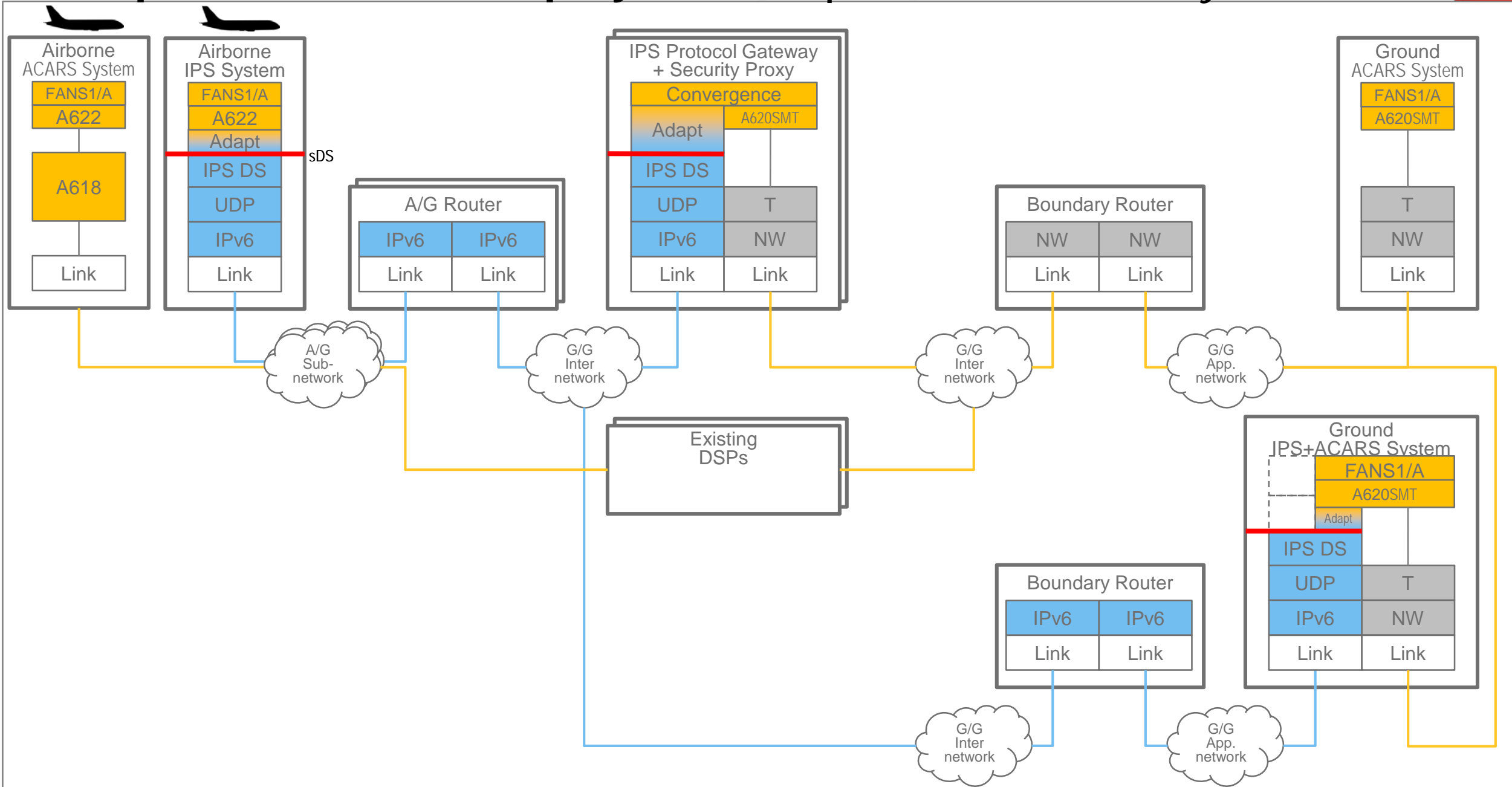
Example: Phased IPS Deployment [Step 1/4] – Existing



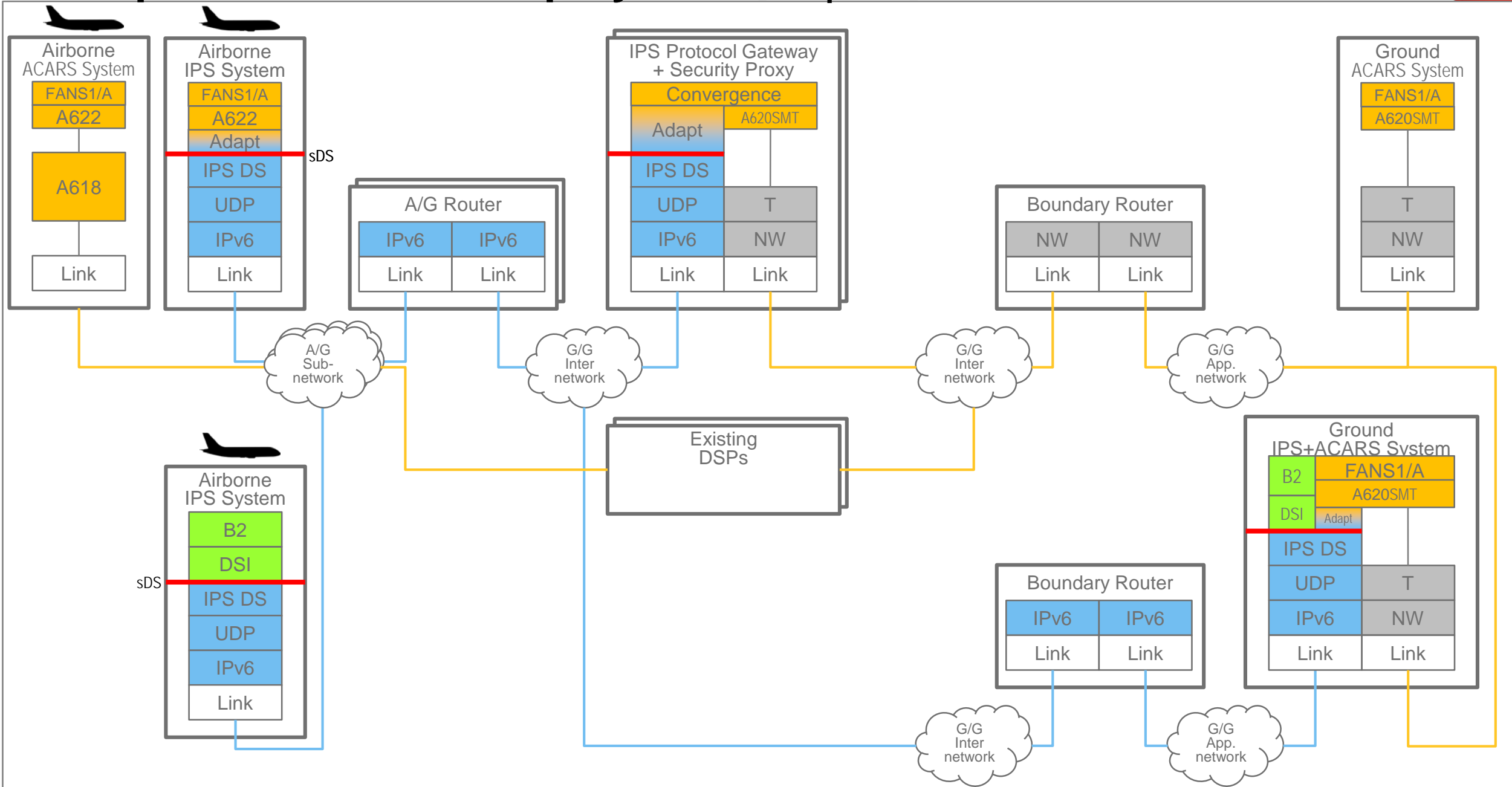
Example: Phased IPS Deployment [Step 2/4] – IPS Aircraft + Gateway



Example: Phased IPS Deployment [Step 3/4] – IPS Ground System



Example: Phased IPS Deployment [Step 4/4] – B2 Introduction



Notional Timeframe Summary

<p>B1,B2</p>	<p>DS-02 <i>(B1,B2: IPS w/ dual-stack ES)</i></p> <p>DS-03a,b <i>(B1,B2: IPS-OSI Gateway+Proxy)</i></p> <p>DS-03c,d <i>(B1,B2: IPS-OSI Gateway, E2E security)</i></p> <p>DS-04a <i>(B1,B2: OSI-IPS Gateway)</i></p>	<p>DS-01 <i>(B1,B2: IPS-IPS)</i></p> <p>DS-04b <i>(B1,B2: OSI-IPS Gateway)</i></p>
<p>FANS1/A</p> <p>DS-07a,b,c,d <i>(FANS1/A: IPS-ACARS Gateway)</i></p>	<p>DS-06 <i>(FANS1/A: IPS w/ dual-stack ES)</i></p>	<p>DS-05 <i>(FANS1/A: IPS-IPS)</i></p> <p>DS-08 <i>(FANS1/A: ACARS-IPS Gateway)</i></p>
<p>Earlier</p>	<p>Middle</p>	<p>Later</p>

YELLOW = Select scenarios considered in the next section

Discussion: RC-IMS Gateway ICD Overlay on Select Deployment Scenarios

M = Protocol Gateway Management Functionality

Notional Timeframe Summary

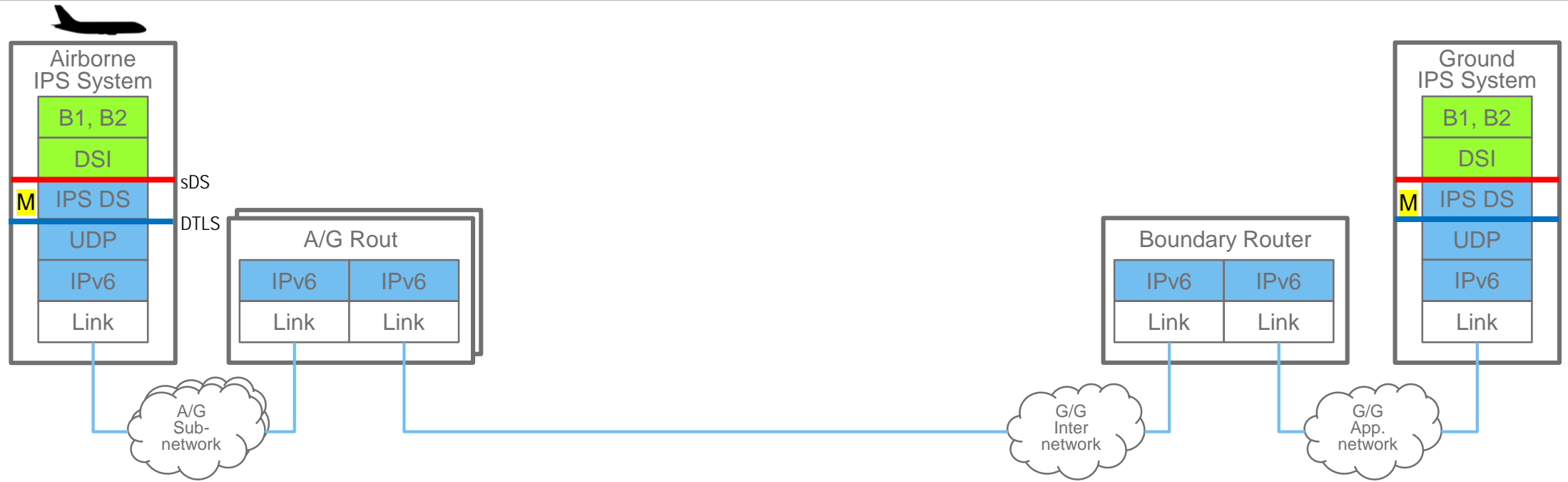
<p>B1,B2</p>	<p>DS-02 <i>(B1,B2: IPS w/ dual-stack ES)</i></p> <p>DS-03a,b <i>(B1,B2: IPS-OSI Gateway+Proxy)</i></p> <p>DS-03c,d <i>(B1,B2: IPS-OSI Gateway, E2E security)</i></p> <p>DS-04a <i>(B1,B2: OSI-IPS Gateway)</i></p>	<p>DS-01 <i>(B1,B2: IPS-IPS)</i></p> <p>DS-04b <i>(B1,B2: OSI-IPS Gateway)</i></p>
<p>FANS1/A</p>	<p>DS-06 <i>(FANS1/A: IPS w/ dual-stack ES)</i></p>	<p>DS-05 <i>(FANS1/A: IPS-IPS)</i></p> <p>DS-08 <i>(FANS1/A: ACARS-IPS Gateway)</i></p>
<p>Earlier</p>	<p>Middle</p>	<p>Later</p>

DS-07a,b,c,d
(FANS1/A: IPS-ACARS Gateway)

YELLOW = Select scenarios considered in the this section

DS-01(RC1) – B1,B2: IPS to IPS

Architecture



Security

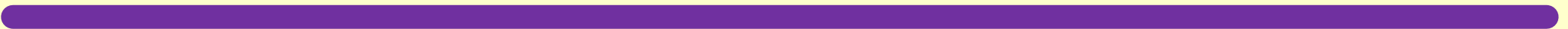


Compression

Option 1 –
A-G datalink



Option 2 –
ATNPKT



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

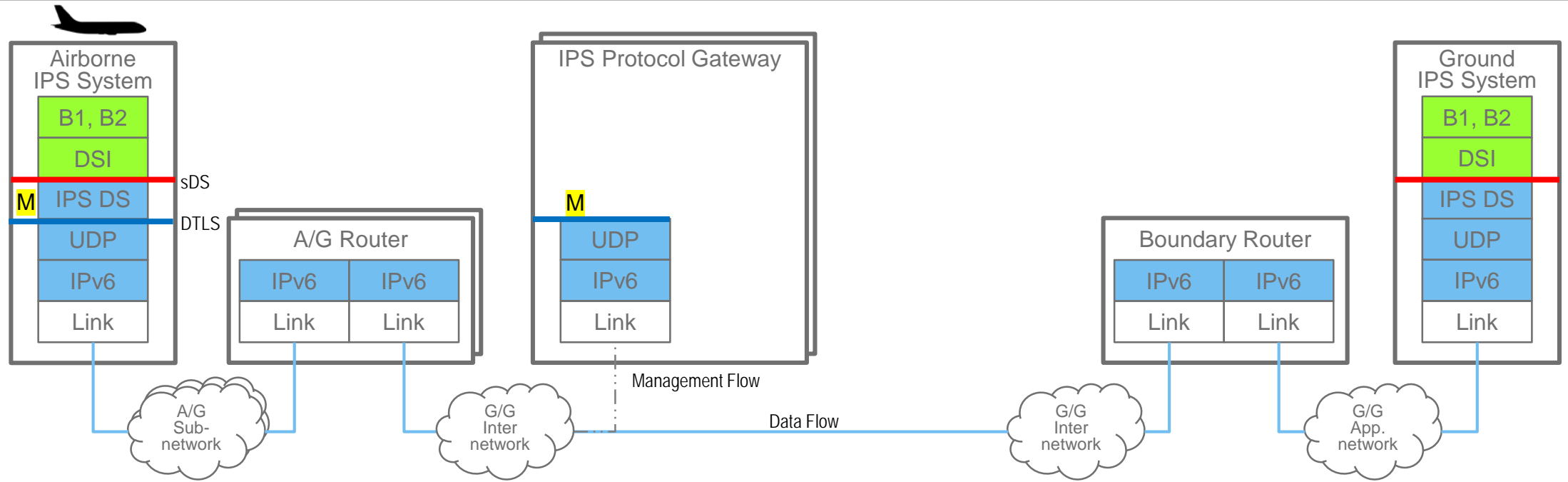
Later

Transition

End State

DS-01(RC2) – B1,B2: IPS to IPS

Architecture



Security

Compression

Option 1 – A-G datalink

Option 2 – ATNPKT

Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

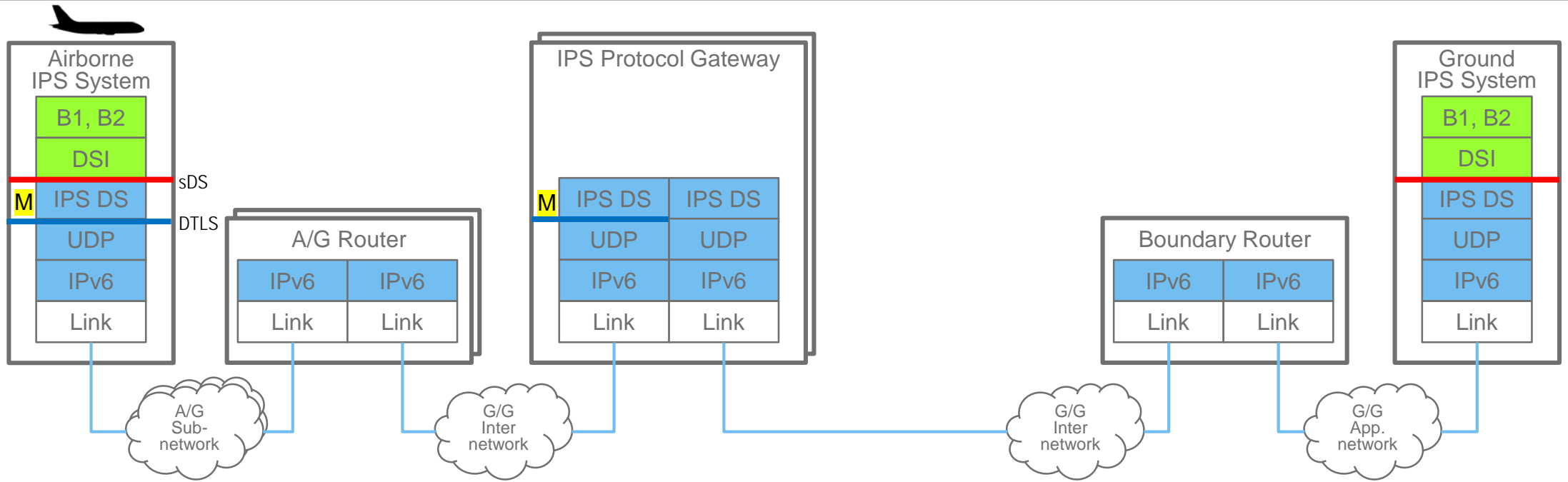
Later

Transition

End State

DS-01(RC3) – B1,B2: IPS to IPS

Architecture



Security

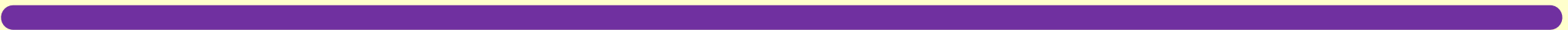


Compression

Option 1 –
A-G datalink



Option 2 –
ATNPKT



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

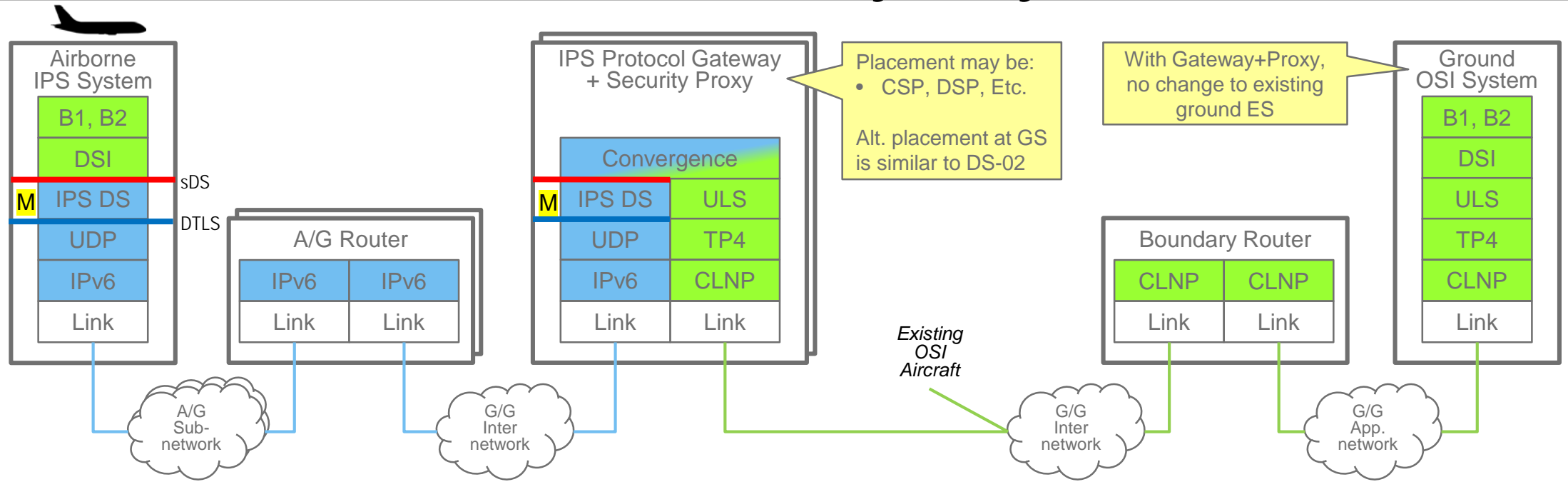
Later

Transition

End State

DS-03b^(RC) – B1,B2: IPS to OSI (IPS Gateway+Proxy w/ DTLS)

Architecture



Security

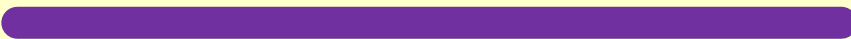


Compression

Option 1 – A-G datalink



Option 2 – ATNPKT



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

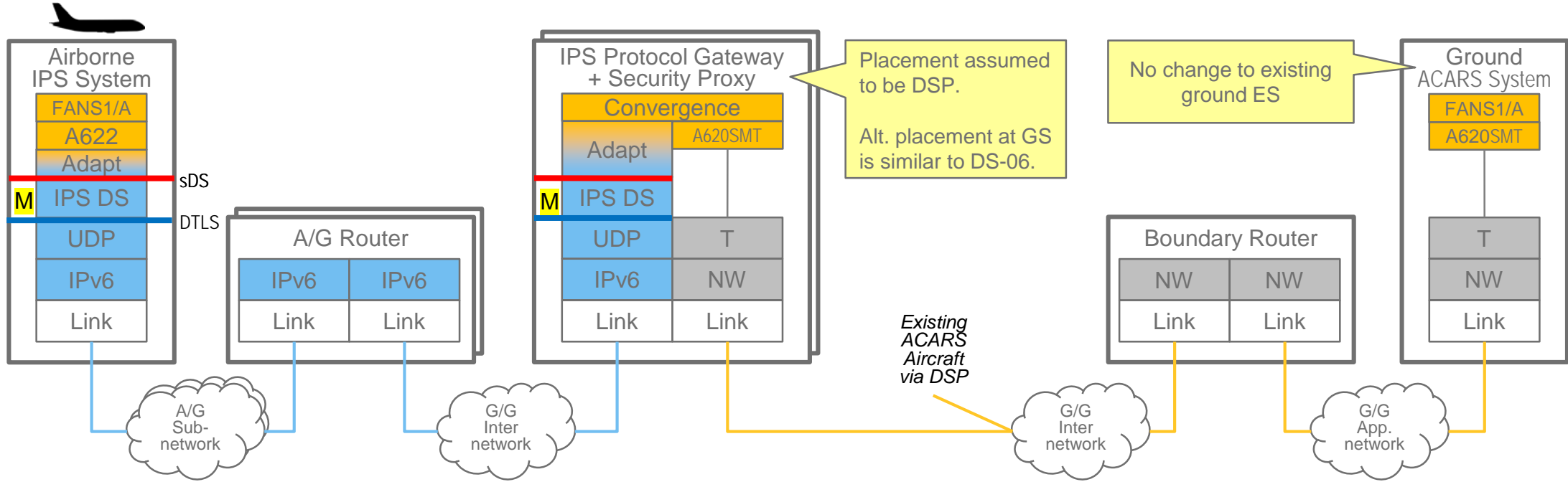
Later

Transition

End State

DS-07b^(RC) – FANS1/A: IPS to ACARS (IPS Gateway+Proxy w/ DTLS)

Architecture



Security

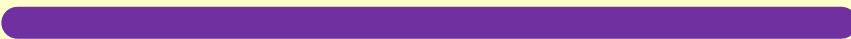


Compression

Option 1 – A-G datalink



Option 2 – ATNPKT



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

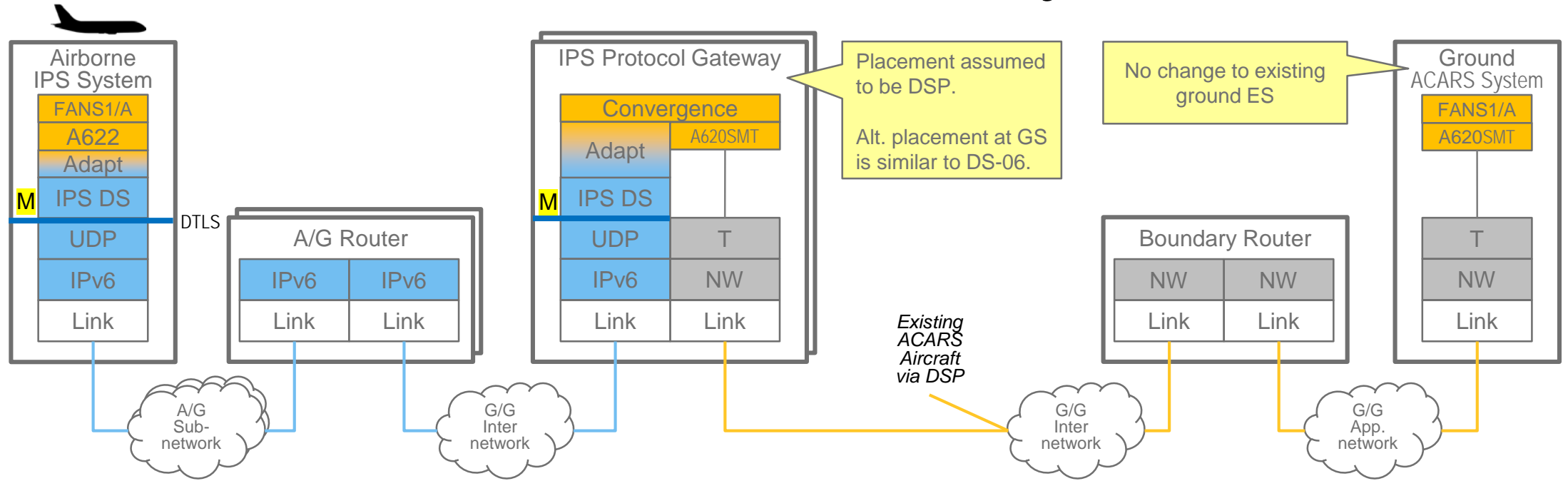
Later

Transition

End State

DS-07d^(RC) – FANS1/A: IPS to ACARS (IPS Gateway, no sDS w/ DTLs)

Architecture



Security

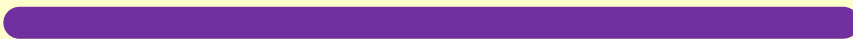


Compression

Option 1 – A-G datalink



Option 2 – ATNPKT



Potential Deployment Region

US

EU

Other

Notional Timeframe

Earlier

Mid

Later

Transition

End State