

GNSS Performance Monitoring System (GPMS)

GACA/ANS

GNSS Performance Monitoring System (GPMS)

- Comply with ICAO – Annex 10.
- Monitoring and Recording of GNSS Data.
- Wide Area RAIM Prediction .
- GNSS NOTAMs.

GNSS Performance Monitoring System (GPMS)

It is an ICAO requirement for:

- ATC shall be provided with operational status of radio navigation aids authorized to be used for civil aviation. This will include GNSS.
- State approving GNSS operations should ensure relevant GNSS data are recorded to be used in incident/accident investigation.
- State approving GNSS shall issue NOTAMs for changes on the operational status.

GNSS Performance Monitoring System (GPMS)

- GPMS continually monitors actual GNSS (GPS) satellites in view, determining real-time availability of GNSS (GPS) and alerts during periods of unavailability.
- GNSS (GPS) data recorded for playback and analysis.
- GPMS predicts GNSS (GPS) Receiver Autonomous Integrity Monitoring (RAIM) for FIR regions and airports.

KSA GPMS Architecture

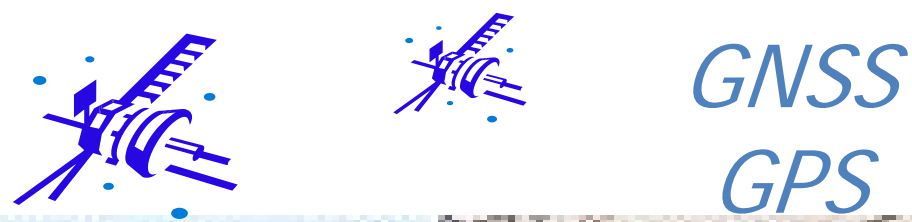
GPMS composed of:

- (5) Local Monitors (LM) subsystem.
- Performance Processing (PP) subsystem.
- (2) Performance Display (PD) subsystem.
- Data Link (DL) subsystem.

KSA GPMS Functional Description

- System to monitor GPS performance in real time
- Store data for historical assessment
- Built-in GPS RAIM prediction capability
- 5 LM sites deployment:
 - ✓ Receiver Sites: GPS receiver + Antenna at:
 - ✓ Jeddah, Riyadh, Dammam, Abha, Al Jouf
 - ✓ Central Database Server at Jeddah
 - ✓ Performance Display at:
 - ✓ Jeddah
 - ✓ Riyadh

KSA GPMS System Overview



System



Applications



LM: Local Monitor
PP : Performance Processing
PD: Performance Display

Architecture

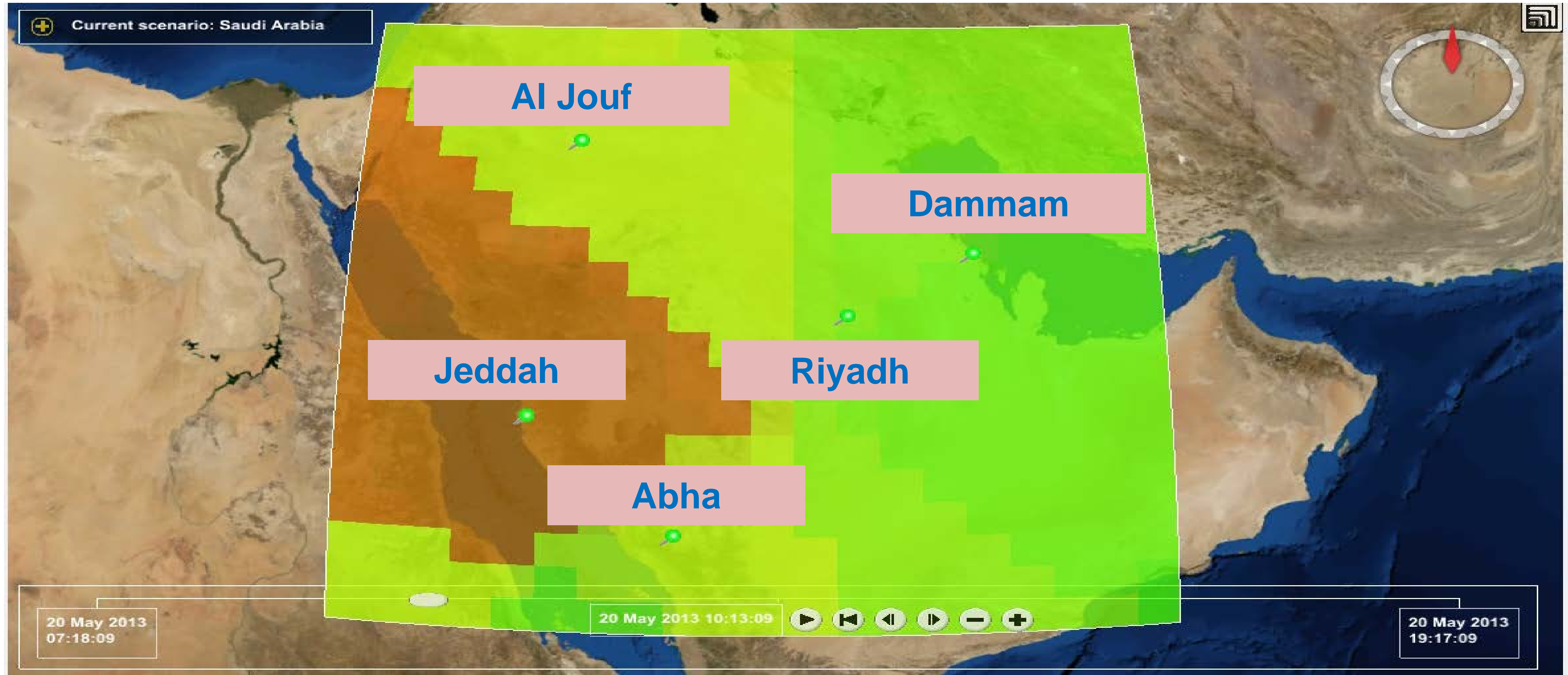
Local Area Monitor – (LAM)

- Live monitoring of receiver data
- Charts and tabular display
- Rule-based alerting (includes Jamming and ionospheric Interference)
- Historical data replay

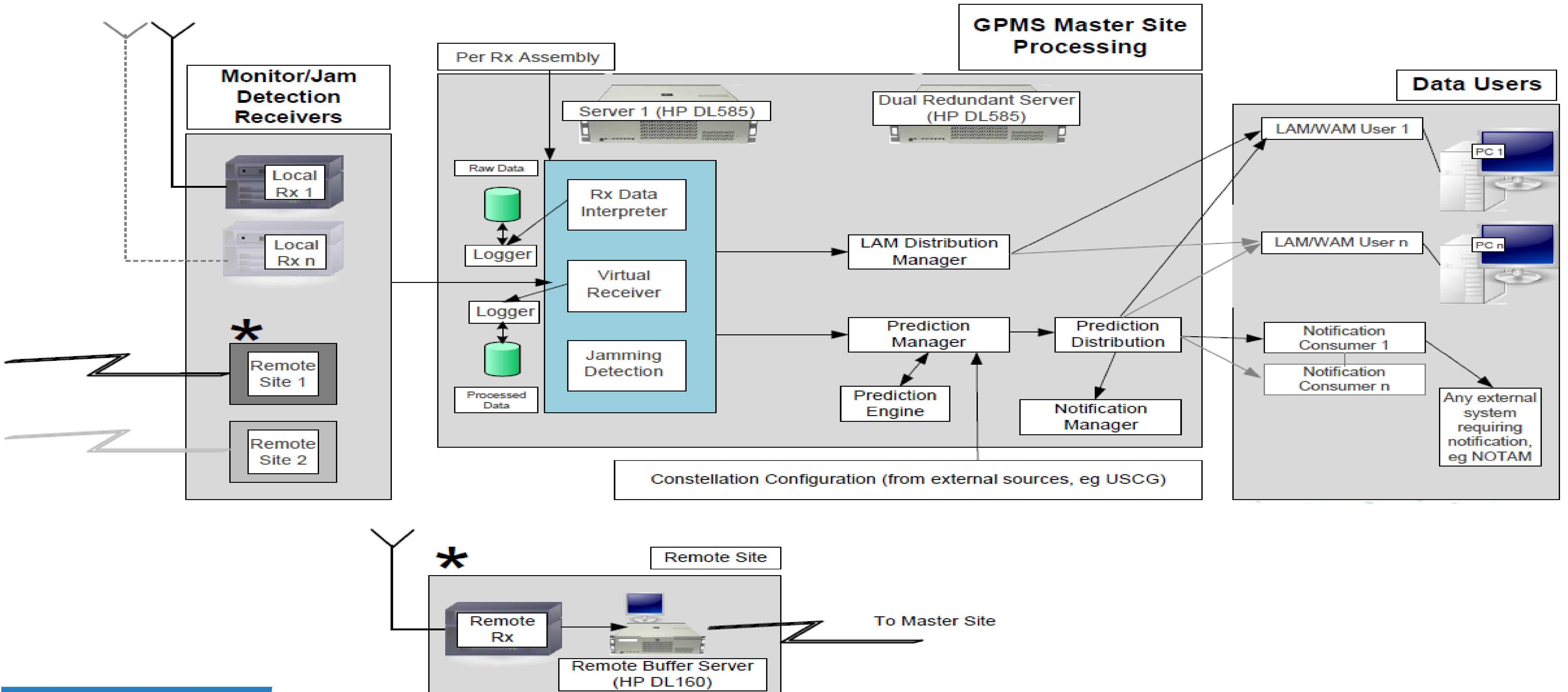
Wide Area Monitor – WAM

- WAM Performance Data Types:
 - ✓ RAIM prediction capability
 - ✓ Load prediction results
 - ✓ Map display
- Region predictions:
 - ✓ Time animation
 - ✓ Service assessment
- Point predictions:
 - ✓ Time series
 - ✓ Service availability reports

Saudi Arabia GPMS



Architecture



Architecture

Receiver Hardware

- NovAtel GPS Receiver ProPak-V3-RT2
- NovAtel Antenna GPS-702-GG



Architecture

Receiver Site Location

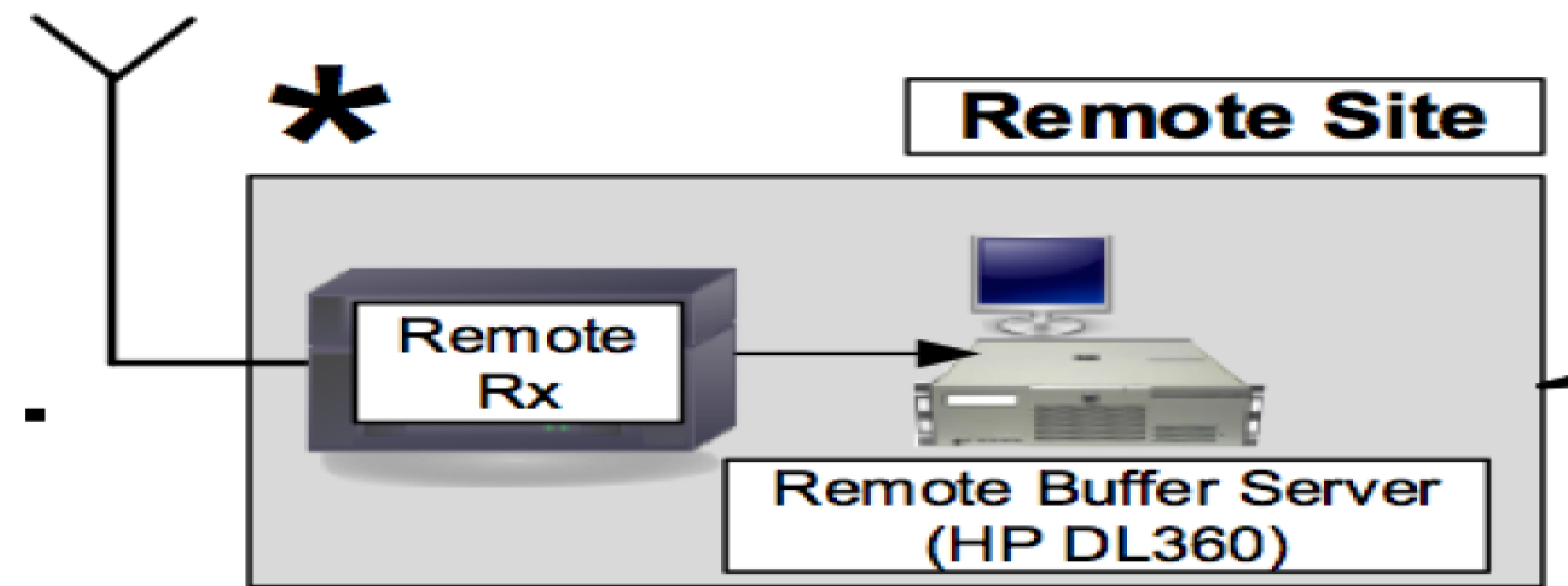


GPS Frequencies
L1 at 1575.42 MHz
L2 at 1227.60 MHz



Architecture

- 1x GPS Antenna
- 1x GPS Receiver
- 1x Server (HP Proliant DL 360 Gen8)



NOTAM Post Processing

GPMS has the ability to generate GPS NOTAMs based on outages predicted in a calculation scenario, usually airport 0.3 NM RNP approach (NPA) NOTAMs are generated for point predictions only and are automatically sent to the GACA AIS system

PBN Status in KSA

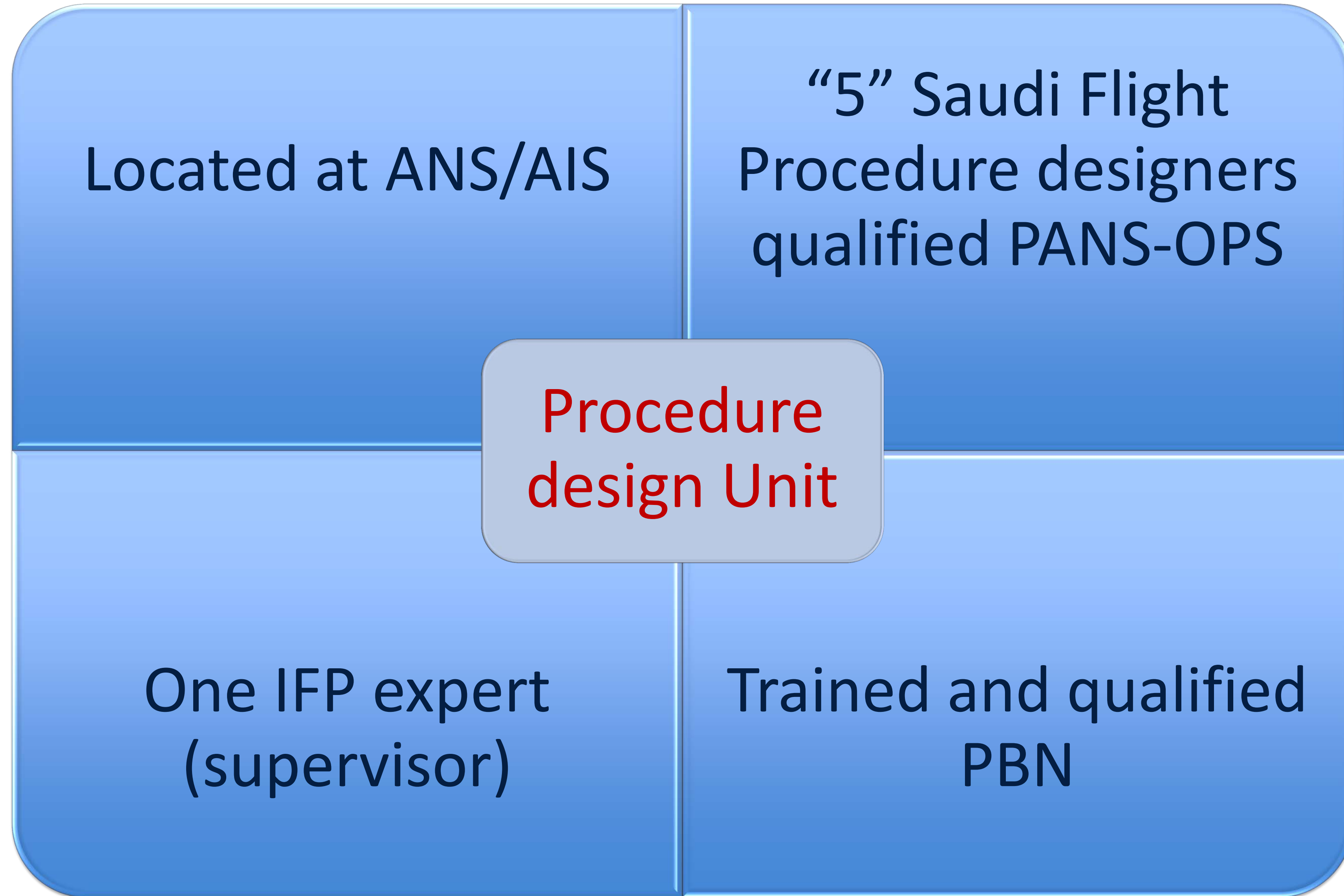
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Airports

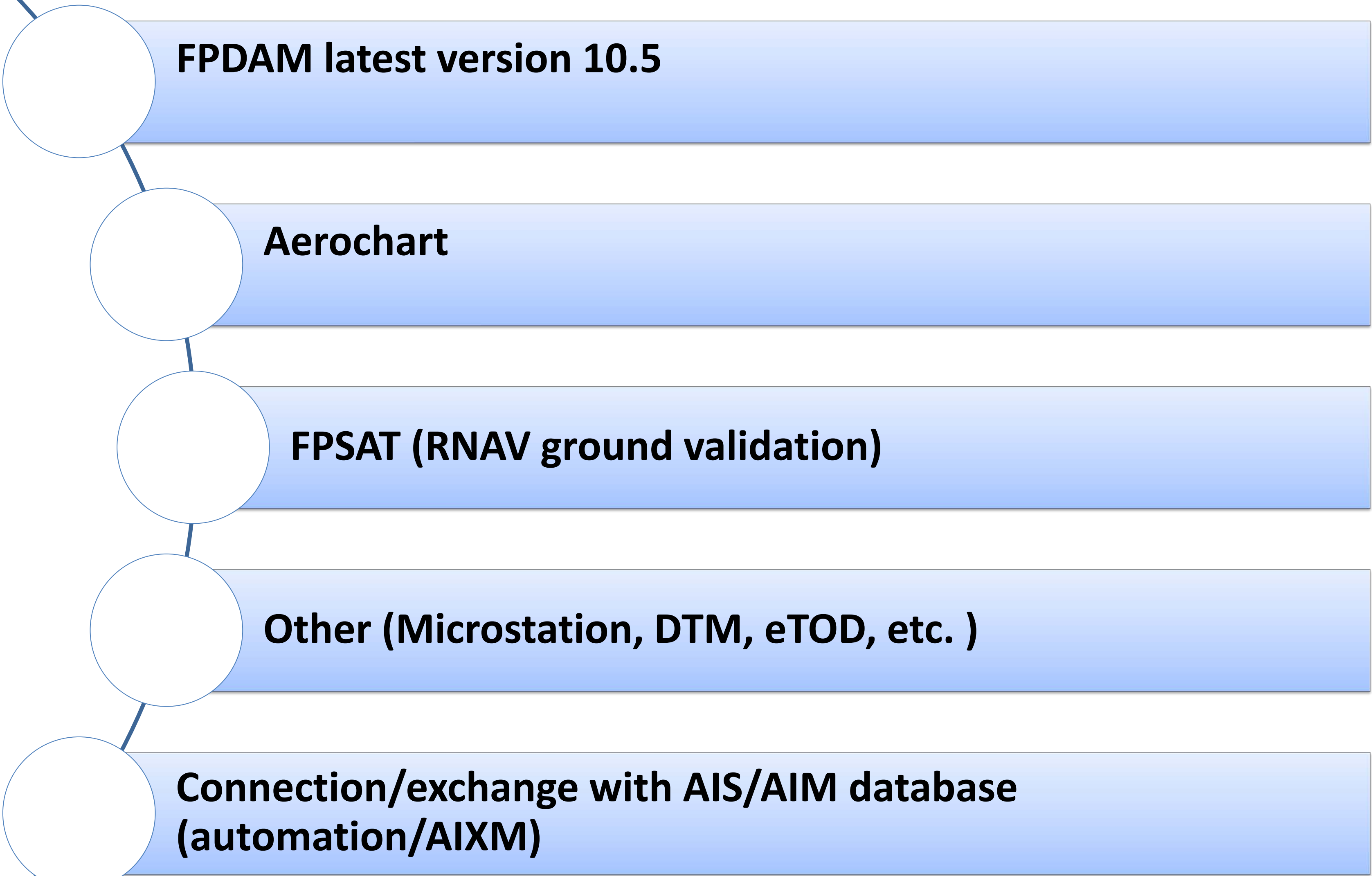
International airports	Regional airports	Domestic airports	Other Airports with IFP	Other Airports without IFP
4	8	15	12 airports	17
Riyadh	Abha	Al Ahsa	Dhahran	Abqaiq
Jeddah	Jazan	All Baha	King Saud	Harad
Dammam	Gassim	Al Jouf	Jubail	Jeddah King Faicel NB
Madinah	Hail	Arar	Khamis Mushait	Pump station 3
	Tabuk	Bisha	Ras Mishab	Pump station 6
	Taif	Al Dawadmi	Riyadh Airbase	Pump station 9
	Nejran	Guriat	Al kharj	Pump station 10
	Yenbo	Qaisumah	Batha	Ras tanura
		Rabigh	Shabitah	Ras tanajib
		Rafha	Thablotin	Ummlejj
		Sharura	Aradah	Al hawta
		Turaif	Om El Melh	IPSA 3
		Wadi Al Dawasir		Shaibah
		Wejh		Udhailah
		Alula		Khurais
				Thumamah
				Jubal (OEJL)
27 airports			12 airprorts	17 airports

Total 56 airports

Our experience



Software



Best practice



Current status

- RNAV 5 in all ATS Routes implemented
- TMA:
 - ✓ SID & STAR: RNAV 1 – Radar required
 - ✓ Approach: RNP APCH

Current status

International airports

International airports	PBN status
OEMA-PRINCE MOHAMMAD BIN ABDULAZIZ INTL-MADINAH	<ul style="list-style-type: none">- 4 RWY Ends- 2 RWY Ends ILS CAT II- 1 RWY END ILS CAT I- RNP APCH- LNAV- RNAV 1 SID- RNAV 1 STAR <p style="text-align: right;">} PUBLISHED 2014</p>

Current status

International airports

International airports	PBN status
OEJN-KING ABDULAZIZ INTL-JEDDAH	<ul style="list-style-type: none"> - 6 RWY Ends - 2 RWY Ends ILS CAT I - 2 RWY Ends ILS CAT II - 2 RWY ENDS ILS CAT III - RNP APCH - LNAV/VNAV - RNAV 1 SID - RNAV 1 STAR - CCO/CDO <div style="text-align: right; margin-top: 10px;"> <p>ON GOING TO BE PUBLISHED 23 JUNE 2016</p> </div>

Current status

International airports

International airports	PBN status
OERK-KING KHALED INTL-RIYADH	<ul style="list-style-type: none">- 4 RWY Ends- 4 RWY Ends ILS CAT I- RNP APCH- LNAV/VNAV- RNAV 1 SID- RNAV 1 STAR- CCO/CDO <p data-bbox="2425 1001 2925 1114">ON GOING TO BE PUBLISHED MID 2016</p>

Current status

International airports

International airports	PBN status
OEDF-KING FAHD INTL-DAMMAM	<ul style="list-style-type: none">- 4 RWY Ends- 4 RWY Ends ILS CAT II- RNP APCH- LNAV/VNAV- RNAV 1 SID- RNAV 1 STAR- CCO/CDO <p data-bbox="2425 1050 2915 1172">Planned end of 2016 (RFP)</p>

Current status

Airports	PBN status
<ul style="list-style-type: none">• Yenbo/Prince Abdulmohsin Bin Abdulaziz Airport• Hail Airport• Jubail airport	<ul style="list-style-type: none">- 4 RWY Ends- RNP APCH- LNAV <p data-bbox="2225 757 2335 930">}</p> <p data-bbox="2372 821 2925 930">UNDER PROCESS OF VALIDATION – MID 2016</p>

2016 -2018

Air Navigation Systems & Procedures Development Project

19 Airports	PBN status
<ul style="list-style-type: none">• Dammam / King Fahd International Airport• Hail Airport• Gassim / Prince Nayef bin Abdulaziz Airport• Al-Ahsa Airport• Abha Airport• Jazan/King Abdullah bin Abdulaziz Airport• Bisha Airport• Nejran Airport• Taif Airport• Al-Baha Airport• Tabuk Airport• Yenbo/Prince Abdulmohsin bin Abdulaziz Airport• Al-Jouf Airport• Wadi Al Dawasir Airport• Wejh Airport• Alula/Prince Abdulmajeed Bin Abdulaziz Airport• Guriat Airport• Al-Dawadmi/King Salman Bin Abdulaziz Airport• Arar Airport	<ul style="list-style-type: none">- 22 RWY Ends- Redesign from FAA-TERPS to ICAO PANS-OPS- RNP APCH- LNAV/VNAV- RNAV 1 SID- RNAV 1 STAR- CCO/CDO <p>TO BE PUBLISHED BETWEEN 2016 and 2018</p>

TMA_s PROCEDURES Implementation Status as of DEC 2016

Saudi Arabia

Int'l Aerodrome	RWY	Approach							SID		STAR		Provided PBN Plan Update date	Remarks
		precision		VOR or NDB	LNAV	LNAV/ VNAV	RNP AR	LPV	Conventional	RNAV	Conventional	RNAV		
		ILS	CAT											
OEDF	16L	ILS	II	VORDME	y	y			Y	y	y	y		
	16R	ILS	II	VORDME	y	y			Y	y	y	y		
	34L	ILS	II	VORDME	y	y			Y	y	y	y		
	34R	ILS	II	VORDME	y	y			Y	y	y	y		
OEJN	16L	ILS	I	---	Y	Y			Y	Y	Y	Y		
	16C	ILS	III	---	Y	Y			Y	Y	Y	Y		
	16R	ILS	II	VORDME	Y	Y			Y	Y	Y	Y		
	34L	ILS	II	VORDME	Y	Y			Y	Y	Y	Y		
	34C	ILS	III	VORDME	Y	Y			Y	Y	Y	Y		
	34R	ILS	I	---	Y	Y			Y	Y	Y	Y		
OEMA	17	ILS	II	VORDME	Y	Y			Y	Y	---	Y		
	18		--	VORDME	Y	Y			Y	Y	---	Y		
	35	ILS	II	VORDME	Y	Y			Y	Y	---	Y		
	36	ILS	I	VORDME	Y	Y			Y	Y	---	Y		
OERK	15L	ILS	I	VORDME	Y	Y			Y	Y	Y	Y		
	15R	ILS	I	VORDME	Y	Y			Y	Y	Y	Y		
	33L	ILS	I	VORDME	Y	Y			Y	Y	Y	Y		
	33R	ILS	I	VORDME	Y	Y			Y	Y	Y	Y		
TOTAL	18	17		15	18	18	0	0	18	14	14	18	y	
%		94		83	100	100	0	0	100	77	77	100		

MIDANPIRG/15

B0 – APTA: Optimization of Approach Procedures including vertical guidance Saudi Arabia

B0 – APTA: Optimization of Approach Procedures including vertical guidance			
Elements	Applicability	Targets	Status
States' PBN Implementation Plan	All	80 % by Dec. 2014 100% by Dec. 2015	Done
LNAV	All RWYs Ends at International Aerodromes	All runway ends at Int'l Aerodromes, either as the primary approach or as a back-up for precision approaches by Dec. 2016	<ul style="list-style-type: none"> • OEMA: 2014 • OEJN & OERK: MID 2016 • OEDF: END 2016
LNAV/VNAV	All RWYs ENDS at International Aerodromes	All runway ends at Int'l Aerodromes, either as the primary approach or as a backup for precision approaches by Dec. 2017	<ul style="list-style-type: none"> • OEMA: 2017 • OEJN & OERK: MID 2016 • OEDF: END 2016

MIDANPIRG/15

B0 – CDO: Improved Flexibility and Efficiency in Descent Profiles (CDO)

Saudi Arabia

B0 – CDO: Improved Flexibility and Efficiency in Descent Profiles (CDO)			
Elements	Applicability	Targets	Status
PBN STARS	In accordance with States' implementation Plans	100% by Dec. 2016 for the identified Aerodromes/TMAs 100% by Dec. 2018 for all the International Aerodromes/TMAs	<ul style="list-style-type: none">• OEMA: END 2018• OEJN & OERK: 2016• OEDF: END 2016
International aerodromes/TMAs with CDO	In accordance with States' implementation Plans	100% by Dec. 2018 for the identified Aerodromes/TMAs	

MIDANPIRG/15

B0 – CCO: Improved Flexibility and Efficiency Departure Profiles - Continuous Climb Operations (CCO)

Saudi Arabia

Elements	Applicability	Targets	Status
B0 – CCO: Improved Flexibility and Efficiency Departure Profiles - Continuous Climb Operations (CCO)			
PBN SIDs	in accordance with States' implementation Plans	100% by Dec. 2016 for the identified Aerodromes/TMAs 100% by Dec. 2018 for all the International Aerodromes/TMAs	<ul style="list-style-type: none">• OEMA: END 2018• OEJN & OERK: MID 2016• OEDF:END 2016
International aerodromes/TMAs with CCO	in accordance with States' implementation Plans	100% by Dec. 2018 for the identified Aerodromes/TMAs	



Challengers

- PBN IFP for all International, Domestic and Regional airports
- IFP Maintenance (Obstacles, data, regulations, etc..)
- eTOD area 2 and 3
- One integrated and complete system (IFP, AIM, eTOD)
- Restructure of KSA airspace and ATS routes (including civil/military coordination)
- New technology, GLS, SBAS, GBAS, etc.



Thank you