



Safety driven technical performance

Esther Delgado Pinedo, INDRA
edelgadop@indra.es



Performance Based CNS

Concept

Performance
Based
Concept

Technology agnostic

From system-based operations towards the delivery of CNS services.

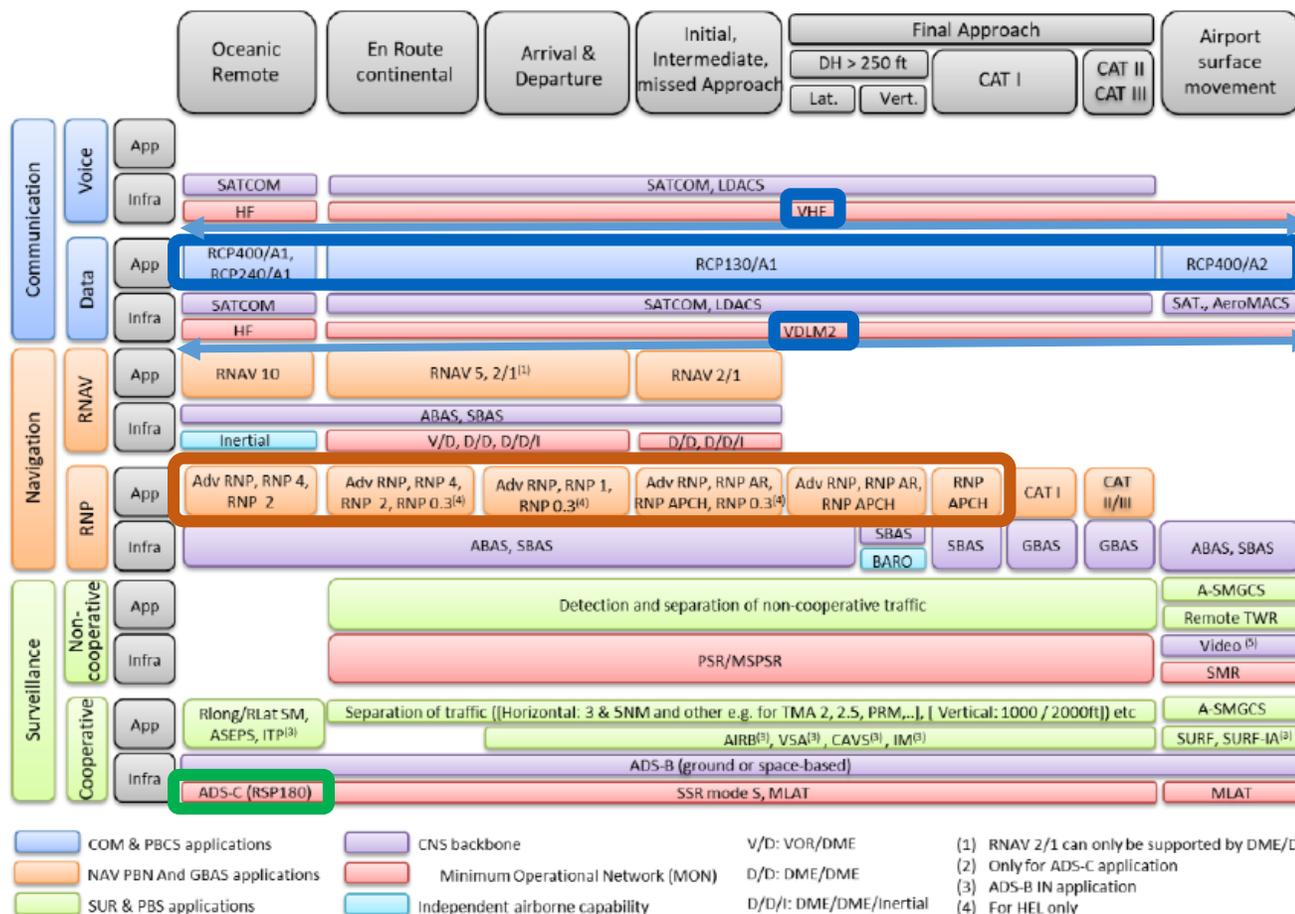
Shift from technology-based to performance-based CNS framework

Performance based standards: requirements focused on what needs to be achieved operationally

Aims at achieving Operational Objectives within an Airspace Concept: Safety, Capacity, Efficiency, Environment

Performance Based CNS

Framework



PBCS Manual Doc 9869

PBN Manual Doc 9613

PBCS Manual Doc 9869



ICAO Oceanic Performance-based separation

Lateral Separation Minimum (LatSM)		COM	NAV	SUR
	30NM	-	RNP4	-
50 NM	-	RNP4 or 10	-	-

Longitudinal Separation Minimum (LongSM)		COM	NAV	SUR
	10 Min	See Note 1	See Note 2	Procedural Position Report
	50 NM	Direct pilot-controller communications (DCPC: Voice or CPDLC)	RNP10	
	30 NM	CPDLC	RNP4	ADS-C
	50 NM	CPDLC	RNP4 or 10	ADS-C

Note1. Suitable to comply with the requirements for position reporting contained in 4.11 of Doc 4444.
Note2. Navigation aids permitting frequent determination of position and speed.

10 November 2016

Lateral Separation Minimum (LatSM)		COM	NAV	SUR		COM	NAV	SUR
	30NM	-	RNP4	-	-	23NM	RCP240	RNP4
50 NM	-	RNP4 or 10	-	-	50 NM	-	RNP4 or 10	-

Longitudinal Separation Minimum (LongSM)		COM	NAV	SUR		COM	NAV	SUR
	10 Min	See Note 1	See Note 2	Procedural Position Report	10 Min	See Note 1	See Note 2	Procedural Position Report
	50 NM	Direct pilot-controller communications (DCPC: Voice or CPDLC)	RNP10		50 NM	Direct pilot-controller communications (DCPC: Voice or CPDLC)	RNP10	
	30 NM	CPDLC	RNP4	ADS-C	5 Min	RCP240	RNP4	RSP180
	50 NM	CPDLC	RNP4 or 10	ADS-C	30 NM	RCP240	RNP4	RSP180
				50 NM	RCP240	RNP4 or 10	RSP180	

Note1. Suitable to comply with the requirements for position reporting contained in 4.11 of Doc 4444.
Note2. Navigation aids permitting frequent determination of position and speed.

Separation minimum applicable only to PBCS capable aircraft

Operational Need:

To increase *Capacity* over the oceanic areas.



PBCS framework for Oceanic areas
Separation minima reduction achieved

SALSA Project

Satellite-based ADS-B for lower separation minima application

Introduction of **LOWER SEPARATION MINIMA** on oceanic flight routes (NAT area), where traffic density is concentrated in peak periods.

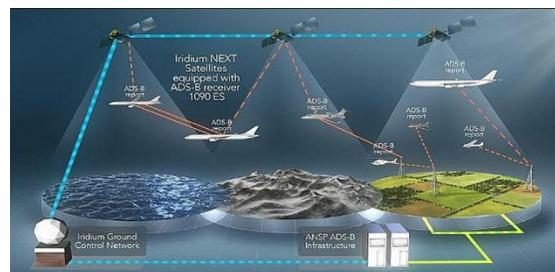
SALSA findings: Separation depends on:

- Precision of aircraft position report
- Latency of communications

Minima separation reduction to **15 to 18 NM** could be possible using **Satellite ADS-B + current SATCOM (RCP240)**.

Technical enabler:

AIREON
Space-Based
Satellite



Combining

Satellite ADS-B +

Satellite VHF voice

it is possible to provide a **Higher reduction** of the current separation minima in NRA , as well as to improve the **safety and efficiency** of the ATC operations.

Technical enabler:

New R&D solutions



Oceanic North Atlantic Tracks

Gander and Shanwick OCA

Current and Proposed Minimum Separation Standards for Oceanic Airspace

The International Civil Aviation Organization (ICAO) publishes minimum separation standards and related eligibility requirements for oceanic airspace. Air navigation service providers, such as the Federal Aviation Administration (FAA), may adopt these standards or apply standards that are more conservative (e.g., require greater distances between aircraft). Table 1 lists selected ICAO current and proposed minimum separation standards for oceanic airspace that rely on either Automatic Dependent Surveillance-Contract (ADS-C) or space-based Automatic Dependent Surveillance-Broadcast (ADS-B).

Table 2: Selected International Civil Aviation Organization (ICAO) Minimum Separation Standards for Oceanic Airspace^a

Separation standard	Aircraft requirements	Other requirements	Status
<i>Lateral distance</i>			
23 nautical miles (NM)	<ul style="list-style-type: none"> Required navigation performance^b of 2NM (RNP 2) or 4NM (RNP 4); Required communication performance^c of 240 seconds (RCP 240); Required surveillance performance^d of 180 seconds (RSP 180); Use Automatic Dependent Surveillance-Contract (ADS-C) to send reports when <ul style="list-style-type: none"> aircraft passes a waypoint, or aircraft deviates laterally from flight plan 	Tracks are parallel or non-intersecting	Published in 2016
19 NM	<ul style="list-style-type: none"> RNP 2 or 4; RCP 240; Use air traffic services (ATS) surveillance (Currently space-based Automatic Dependent Surveillance-Broadcast (ADS-B) is the only ATS surveillance technology available in oceanic airspace) 	Tracks are parallel, non-intersecting, or intersecting	Pending; approval expected in 2020
15 NM	<ul style="list-style-type: none"> RNP 2 or 4; RCP 240; Use ATS surveillance (Currently space-based ADS-B is the only ATS surveillance technology available in oceanic airspace) 	Tracks are parallel, non-intersecting, or intersecting and airspace meets other density or stringent deviation measures	Pending; approval expected in 2020

Separation depends on:

- Precision of aircraft position report
- Latency of communications

Separation standard	Aircraft requirements	Other requirements	Status
<i>Longitudinal distance</i>			
30 NM	<ul style="list-style-type: none"> RNP 2 or 4; RCP 240; RSP 180 Maximum ADS-C periodic reporting interval of 12 minutes 	Same track or crossing tracks provided the relative angle between tracks is less than 90 degrees	Published in 2002
20 NM	<ul style="list-style-type: none"> RNP 2 or 4; RCP 240; RSP 180; Maximum ADS-C periodic reporting interval of 3.2 minutes 	Same track or crossing tracks provided the relative angle between tracks is less than 90 degrees	Pending; approval expected in 2020
17 NM	<ul style="list-style-type: none"> RNP 2 or 4; RCP 240; Use ATS surveillance (Currently space-based ADS-B is the only ATS surveillance technology available in oceanic airspace) 	Same tracks or crossing tracks provided the relative angle between tracks is less than 90 degrees	Pending; approval expected in 2020
14 NM	<ul style="list-style-type: none"> RNP 2 or 4; RCP 240; Use ATS surveillance (Currently space-based ADS-B is the only ATS surveillance technology available in oceanic airspace) 	Relative angle between tracks is less than 45 degrees	Pending; approval expected in 2020

Source: GAO analysis of ICAO information. | GAO-19-532



Performance Based CNS

Implementing Performance-Based Approach

New operational need

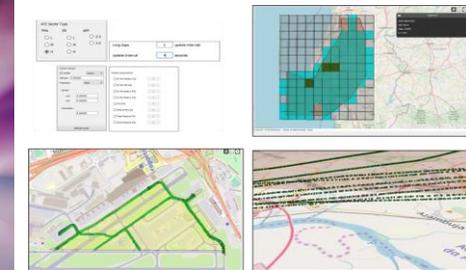
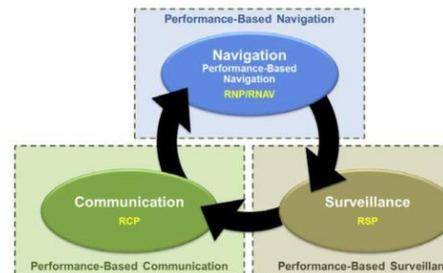
Convert operational need into a plan

Safety Risk Assessment

Performance Based Requirements

Implementation

Performance Monitoring



Implementing Performance-Based Approach

Performance Based Surveillance Example

CNS challenge

Minimum Radar Separation between aircraft (final approach) was 2.5 NM.
The **operational need was to accept aircraft as close as 2NM.**



Need to lower the update rate:
less chance that something unexpected happens between updates

Simulate the worse case scenarios for an airport's traffic mix using different update rate/surveillance error assumptions

Operational need met

2NM achievable:

- update rate is \leq XX seconds &
 - surveillance error \leq YY meters,
- In a **technology agnostic** manner (could be SSR, WAM or ADS-B)

Performance Based Requirements

Conclusions

Operational benefits



Safer Operations

Enabled by new RCP and RSP



Enable ANSPs and Operators to expand their business while **rationalizing terrestrial infrastructures**



Preferred Routes

to optimize:

- flight time
- fuel consumption and extra fuel



Redesigned organized track systems:

- more & shorter routes
- higher levels of QoS & punctuality



Reduce CO2 emissions