ICAO

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The Road to Integrated CNS

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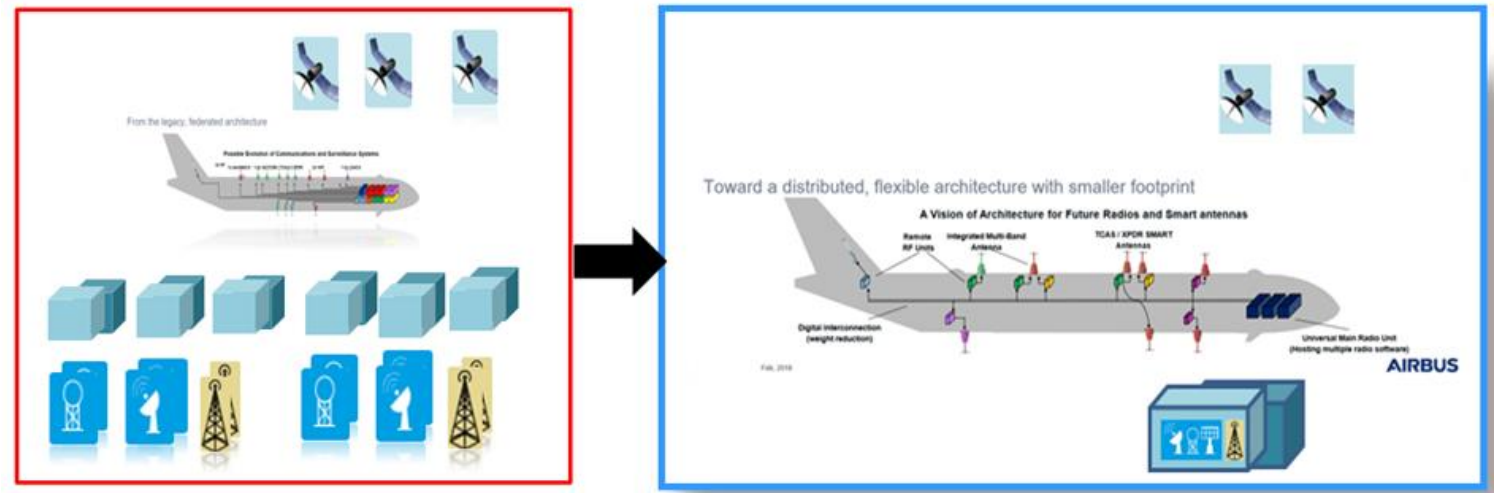
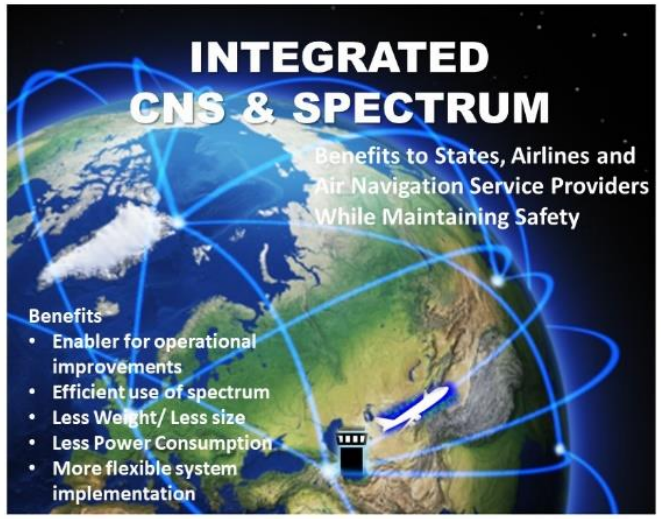
Introduction

- Pace of Innovation
  - CNS systems supporting safety of life functions need to meet stringent operational requirements
  - Current systems will not be able to accommodate the projected growth and the introduction of new airspace users (e.g. UAM and RPAS)
  - Aviation CNS infrastructure is being digitally transformed offering a unique opportunity to evolve CNS systems
- Avionics evolution
  - Toward a distributed, flexible architecture with smaller footprint



Benefits and opportunities

- An integrated approach for CNS systems, in a harmonized manner globally, could achieve:
  - Improved CNS capability
  - Spectrum Efficiency
  - Safety



- Additionally, an integrated approach for CNS systems would provide opportunities to tackle the following expectations:

Accommodation of New Entrants

- New entrants (RPAS, UAM, etc.) may have different CNS capabilities and requirements
- Applying existing aviation protocols to these users could constrain innovation
- 3-step transition
  - Near-term: operation in segregated airspace
  - Mid-term: better integration in the existing airspace structure
    - Requires technical, regulatory and operational changes
    - This will depend on the new entrant's performance and capabilities, and the required level of safety
  - Long-term: full integration in the airspace management system
    - Safety will be ensured through robust technical, regulatory and operational standards, rules and procedures
    - Focus on performance, capabilities and required level of safety instead of segregation by type of user

Reduction of the Impact on Environment

- Environmental protection and sustainability as one of ICAO's strategic objectives
- New integrated CNS functionalities can provide:
  - Further optimization of flight routes and automation
  - Reduced fuel consumption and noise levels

Growth in demand

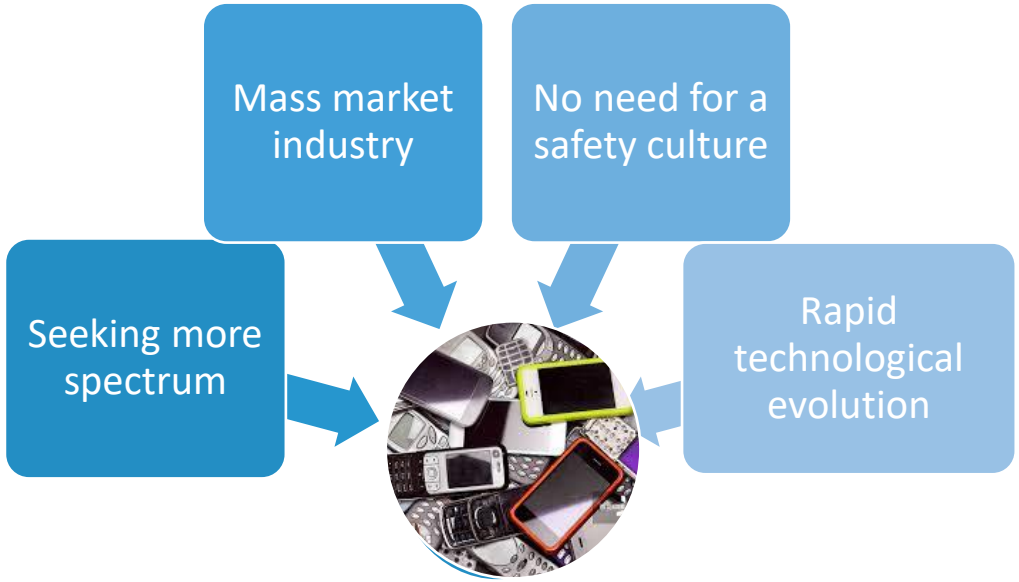
- Growth in existing traffic combined with the new entrants
- Need to maintain/improve required safety levels
- New CNS solutions needed to support:
  - Automation;
  - Trajectory coordination; and
  - Capacity Management.
- New technologies supporting better aircraft to aircraft co-ordination can reduce the reliance on air traffic management and allow reduced separation standards.

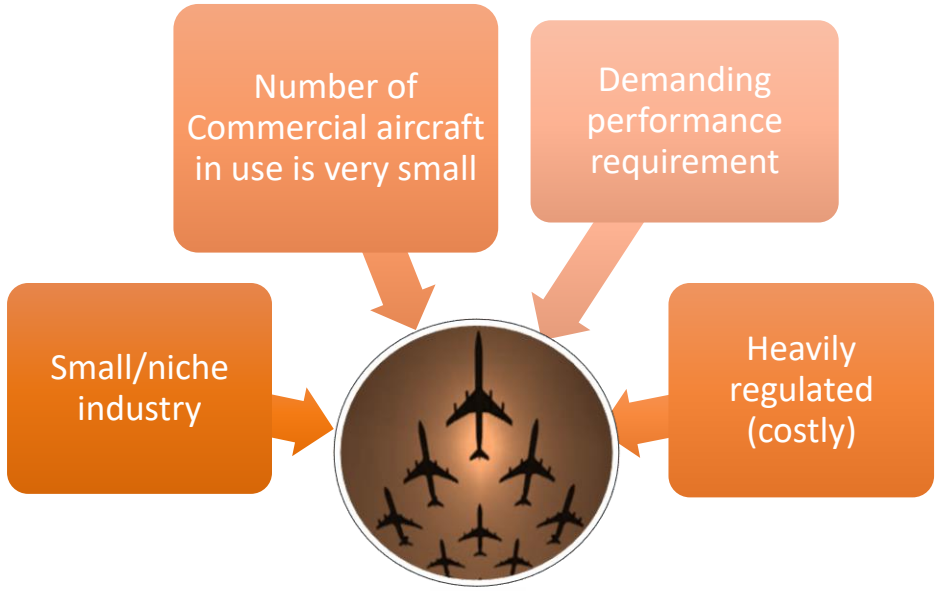
Challenges

- The evolution of the CNS systems will require aviation to face two main challenges:
  - Spectrum challenge
    - Limited spectrum resource
    - Increasing pressure from non-aviation users
  - Institutional challenge
    - Slow adoption of new technology across the globe
    - Regulatory framework needs to accommodate the accelerating pace of innovation

Spectrum challenge

Mass market Telecoms vs. Aviation





Revenue comparison for spectrum use:

- Cellular Phone Industry
  - ~5,000,000,000 users
  - Add $1.00 to the monthly bill of each user

  => Up by $5.000.000.000 a month

  (orders of magnitude more)

- Aviation Industry
  - 30.000 aircraft,
  - low bandwidth requirement

  $100 per day per aircraft * 30.000 aircraft

  => $90.000.000 in new monthly revenue to telecoms (orders of magnitude less)

Spectrum challenge

Pressure on Spectrum

- **Pressure on aviation is increasing due to:**
  - Expected growth and the flexibility with which airspace is used;
  - Expansion of operations int airspaces not traditionally used (e.g. below 1,000 ft including urban areas);
  - Growth in connectivity requirements on current platforms;
  - Growth in other industry sectors seeking to expand their capacity; and
  - Spectral efficiency of aviation technology lagging other industries.
- **Spectrum as a fundamental requirement in the development of future systems**
- **Transition strategy required to adjust the aviation spectrum allocations**

Modern CNS/ATM

The backbone of modern CNS/ATM

ICAO Standards and Recommended Practices:

- DSB-AM VHF voice communications – 1950
- Instrument Landing System (ILS) – 1950
- VHF Omnidirectional Range (VOR) – 1950
- UHF Distance Measuring Equipment (DME) – 1950+
- Non-Directional radio Beacon (NDB) – 1952
- Secondary Surveillance Radar (SSR) – 1958
- Single Sideband (SSB) HF voice communications – 1961
- Selective Calling System (SELCAL) – 1962

…

- Airborne Collision Avoidance System (ACAS or TCAS) – 1995
- Aeronautical Mobile Satellite Service (AMSRS) – 1995
- VHF Digital Link Mode 2 (VDL-2) – 2000
- Global Navigation Satellite System (GNSS) – 2001

…

Institutional Challenge

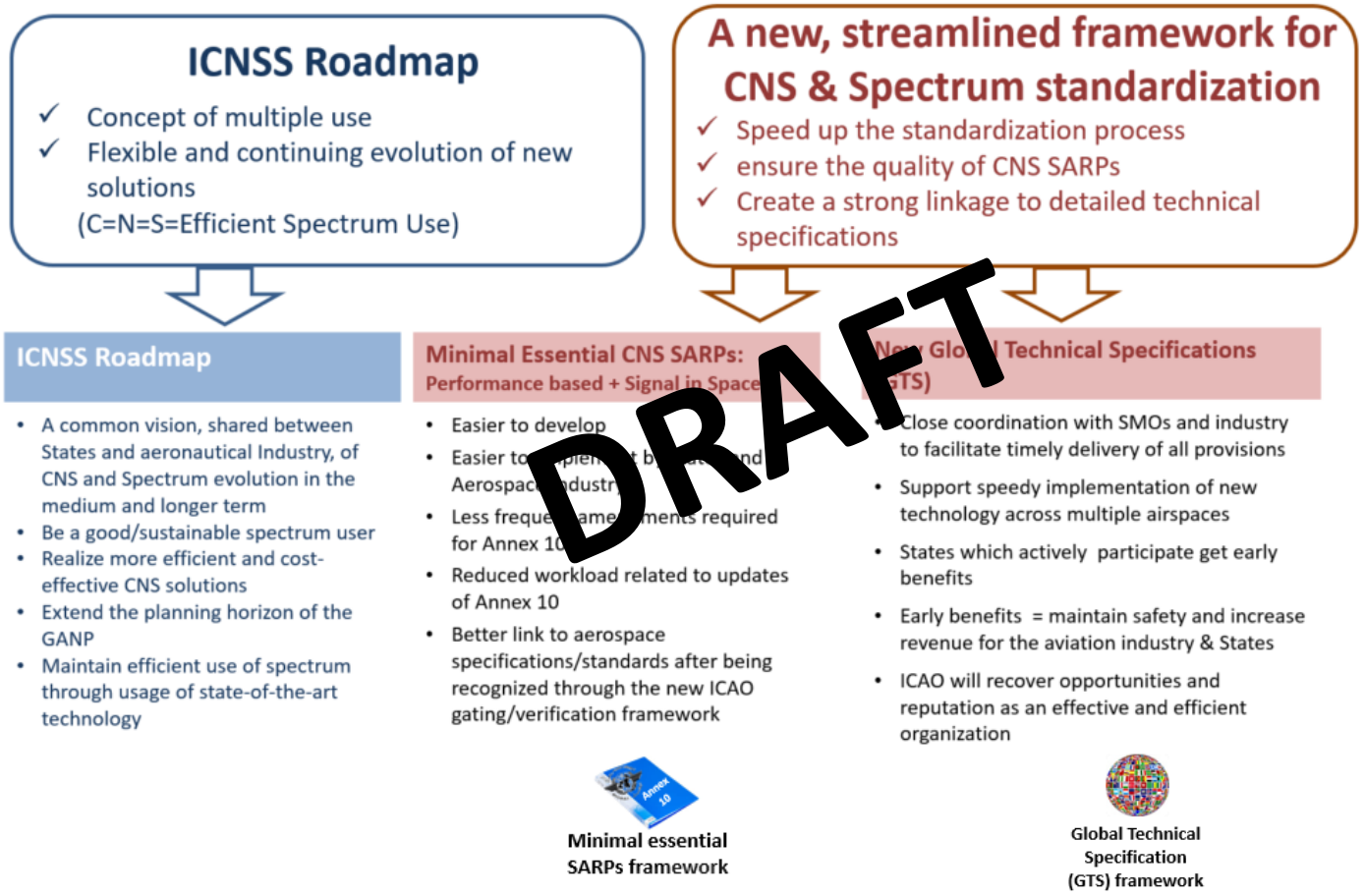
- **Slow adoption of new technologies.**
  - Long life cycle of aeronautical systems
  - Rigid regulatory framework
  - Lack of streamlined processes for safety certifications and operational approval
  - Diverse operational needs
  - Need for interoperability
  - Need of coordination across multiple stakeholders
  - Combined with the relatively small market, which means that the development process results in high unit costs and longer return on investment periods
- **Regulatory framework needs to accommodate the accelerating pace of innovation**
  - Regulatory framework needs to evolve, while ensuring that the level of integrity and reliability of aeronautical systems is maintained.

  - > Streamlined SARPs and global technical specification framework will ensure that systems providing CNS functionality continue to be sustainable within the quickly evolving environment.

The Road Ahead

➢**As a first step facing these challenges, ICAO established the ICNSS Task Force with two main objectives:**

- Develop roadmaps for CNS in the near, medium and long terms; and
- Develop a new, streamlined framework for CNS & Spectrum standardization.



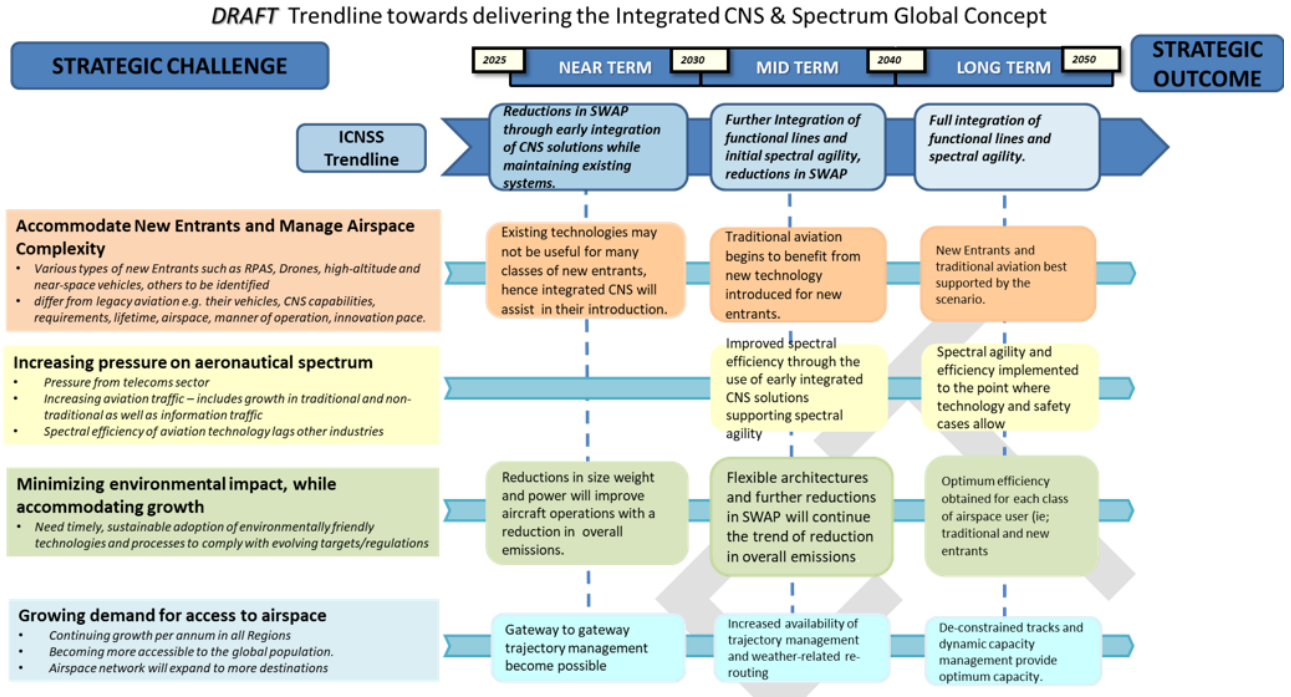
ICNSS Roadmap (1 of 3)

- Leverage recent state-of-the-art advances in CNS technologies
- Ensure aviation remains a responsible user of spectrum
- Focus on Safety, Security, Efficiency and Sustainability of global aviation
- Benefits of the Roadmap
  - Be a common vision, shared between States and aeronautical industry, of CNS and Spectrum evolution in the medium and long term;
  - Realize more efficient and cost-effective CNS solutions; and
  - Extend the planning horizon of the GANP.

ICNSS Roadmap (2 of 3)

High-Level Roadmaps and Detailed roadmaps:
- see https://www.icao.int/airnavigation/ICNSS_project

High-level roadmaps:	Status
1. Strategic Roadmap	✓
2. Trendline towards Spectral efficiency	✓
3. Trendline towards the Integrated CNS and Spectrum Global Concept	✓



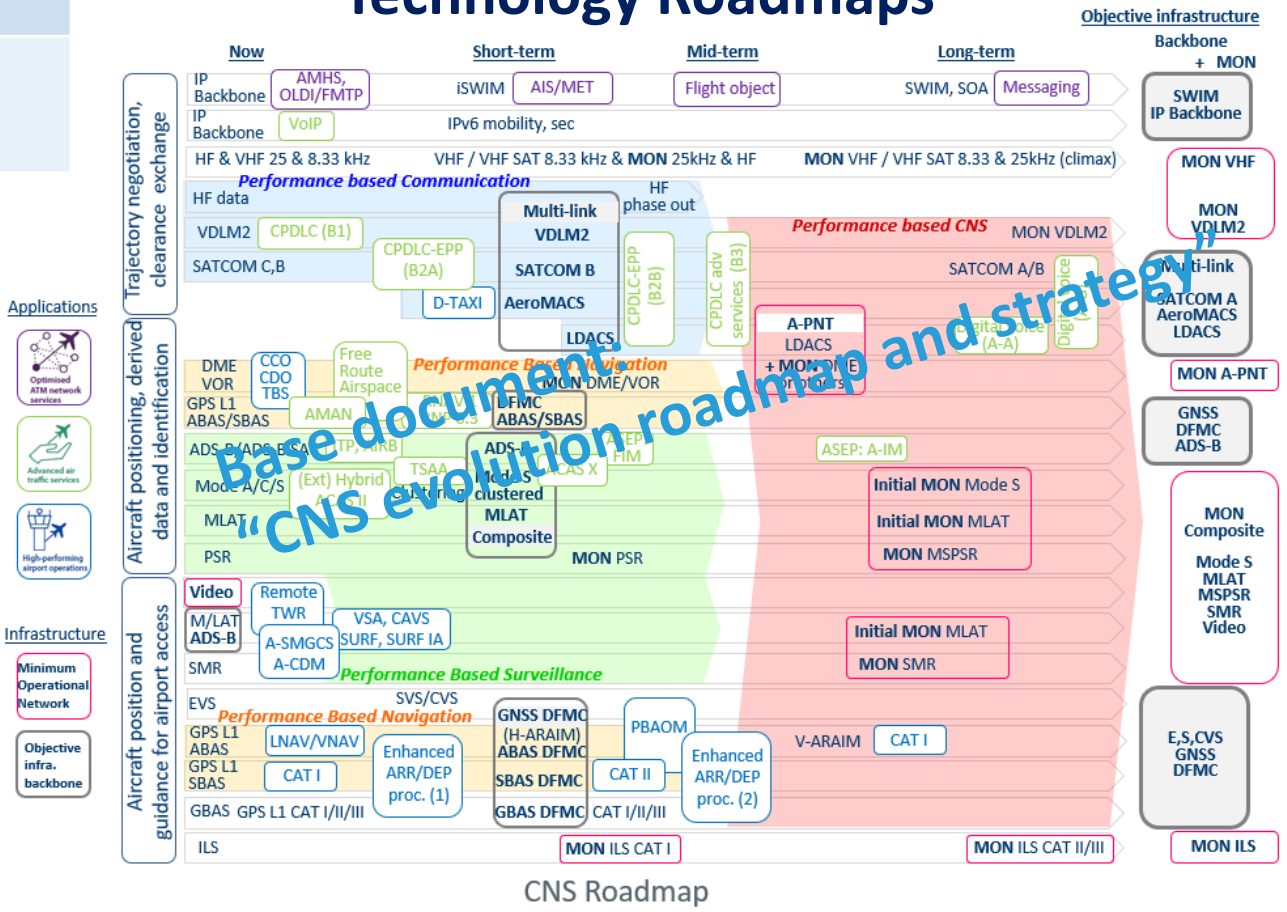
ICNSS Roadmap (3 of 3)

Detailed roadmaps:	Status
1. Detailed Conceptual Roadmaps	✓
2. Technology Roadmaps	Under development!

In cooperation with EUROCONTROL, the ICNSS TF has started working on "Technology Roadmaps"

Will indicate Information on moving toward
1) performance-based CNS and
2) integrated CNS technologies

Technology Roadmaps



CNS Roadmap

Source: SESAR/EUROCONTROL dated 2019

Streamlined Standardization Framework

- A new approach for the development of SARPs and Detailed Technical Specifications
- Leverage a more performance-based approach
- Ensure interoperability
- Expected Benefits include, but not limited to:
  - Less frequent amendments required for Annex 10;
  - Better link to aerospace specifications/standards outside ICAO;
  - Support speedy implementation of new technologies; and
  - Close coordination between SMO's to facilitate timely deliver of all provisions.

Minimal essential SARPs framework

Global Technical Specification (GTS) framework

Remaining Tasks

- Definition of minimum essential SARPs for CNS and supporting documents
- Develop amendment to Assembly Resolution, if required
- Coordination with internal and external bodies
- Development of Technology roadmap
- Gating function…

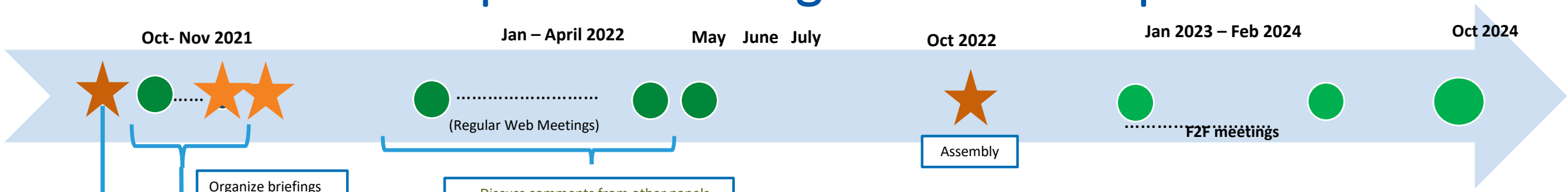
Remaining Tasks

On going work to define minimum essential SARPs for CNS

	A	B	C	D	E
1	**Potential documents where key system parameters could reside: (for discussion, decide what should be required and what should be desired). In general, high level functional performance-based metrics and parameters required to demonstrated interoperability with other CNS systems and radio regs are minimum essential SARPs. These are examples, not necessarily all required since systems vary in their required parameters.**	**Minimum Essential SARPs**	**Global Technical Specifications**	**Non-ICAO** (All of these could be in scope of the non-ICAO docs, but it's helpful to know what doesn't belong in ICAO.	**Notes**
2					
3	**System level Characteristics**				
4	High-level concept of operations	X			
5	Detailed system architectures		X	X	
6	Frequency Planning Criteria	X			Volume 5 with reference to handbook
7	Frequency Assignment Planning		X		Reference to handbook. These could be regional plans as well
8	System testing methods and procedures				
9					
10	**Transmitter Characteristics**				
11	Frequency range(s) of transmissions	X			More certain for globally harmonized equipment and frequency plans. Regional and National differences may exist subject to coordination on a regional basis. Annex 10 CNS volumes can also point to V5.
12	Signal Center Frequency	X			More certain for globally harmonized equipment and frequency plans. Regional and National differences may exist subject to coordination on a regional basis. Could point to v5, handbook, or regional plans.
13	Frequency stability	X			
14	Max power, range of power, and where that is referenced	X			An alternative could be a minimum signal in space the transmitting system must provide
15	Signal Modulation (e.g. QPSK, 8-PSK, 64-QAM, spread spectrum (code rate), etc.)				
16	Signal type (pulsed,CW, other)	X			
17	Signals-in-space characteristics	X			
18	Signal Data Rate (if applicable)	X	X		Related to the maximum duty cycle for SARPs to protect other systems, but finer details required for proper system function goes in GTS
19	Chirp Frequency (if applicable)	X			
20	Out of band roll-off of transmitted spectrum (at -3 dB, -20 dB, -40 dB, -60 dB points)	X			A transmitter spectrum mask figure is helpful
21	Maximum unwanted emissions in the spurious domain	X			
22	TX harmonic suppression or Tx harmonic power limit	X			
23	Tx intermodulation products suppression	X			
24	peak to average power ratio (PAPR)	X			

Schedule

- Global concept for the Integrated CNS & Spectrum



Finalize draft global concept for Integrated CNS and Spectrum **by end of Oct**

Organize briefings **for inter-panel coordination**

Ask all CNS panels and ASBU group to provide comments on Chap 1and Chap 2 draft Global Concept

Sec

Draft assembly WP

- Allocate tasks for briefing
- Dry run for the briefing

- Discuss comments from other panels
- Based on those comments, finalize Chap 1 and 2

- Finalize 3.1 of Chapter 3

- Need to develop an assembly WP to support agenda item T3: Aviation Safety and Air Navigation Standardization

Assembly WP

Deliver Draft Global Concept for Integrated CNS & Spectrum including

- **Introduction (Chapter 1)**
- **a CNSS Evolution Roadmap (Chapter 2),**
- **A brief explanation of a need of the Streamlined SARPS with better connection to technical specifications (Chapter 3)**

- Finalize the technology roadmaps

- Finalize the recommendation in Chapter 3

- Continue developing **draft** Chapter 4

- Develop amendment proposals to assembly resolutions if required

- Start coordinating with internal and external bodies

DRAFT

QUESTIONS?

Thank You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