



# Global Air Navigation System

## ~Interoperability and Harmonization ~

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Workshop on the development of  
National Performance Framework for  
Air Navigation Systems  
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# Presentation Outline

- **Vision and dream**
- **Interoperability, Harmonization and Seamlessness**
- **Why do we need harmonization**
- **Approach to Harmonization**
- **Global tasks for interoperability and Harmonization**
- **Examples of Harmonization**

# **ATM Community**

## **~Vision Statement~**

- **To foster the implementation of an interoperable global air traffic management system for all users during all phases of flight that:**
  - **meets agreed levels of safety**
  - **provides for optimum economic operations**
  - **is environmentally sustainable**
  - **meets national security requirements.**

# Dream

**A single set of avionics for seamlessness  
across States and regions**

# Reality

- **Systems are country specific**
- **Stand-alone (high diversity, different protocols)**
- **Lack similar functionalities**
- **No standard interfaces**
- **Thus resulting in**
  - **set of “island” solutions**
  - **incoherent ATC systems**

# **Interoperability, harmonization and seamlessness**

- **Interoperability: ability to transfer information or effect functionality across any discontinuity to enable operations**
  - **Achieved through common standards, designs and procedures**
- **Harmonization: Accord or agreement for a consistent and orderly implementation of systems/procedures**
  - **Achieved through common timing or appropriate tools**
- **Interoperability and harmonization results in seamlessness**
  - **Seamlessness is the property that allows transition across any discontinuity**

# Why do we need harmonization? ...

- **Air Navigation systems have**
  - **number of operational options**
    - **RNP, horizontal and vertical separation standards**
  - **number of technical options**
    - **data links, GNSS augmentation systems**
  - **number of organizational options**
    - **different service providers ( global, regional, subregional/multinational and national)**

# Why do we need harmonization?

- **Air Navigation systems have**
  - **different timings in implementation**
  - **different levels of implementation**
  - **different methods of financing and cost recovery**



# What to harmonize?

- **Between ground based air navigation systems and CNS/ATM systems**
  - **Operational procedures**
  - **Technical systems**
  - **Institutional format**
- **Amongst CNS/ATM systems**
  - **Operational procedures**
  - **Technical systems**
  - **Institutional format**

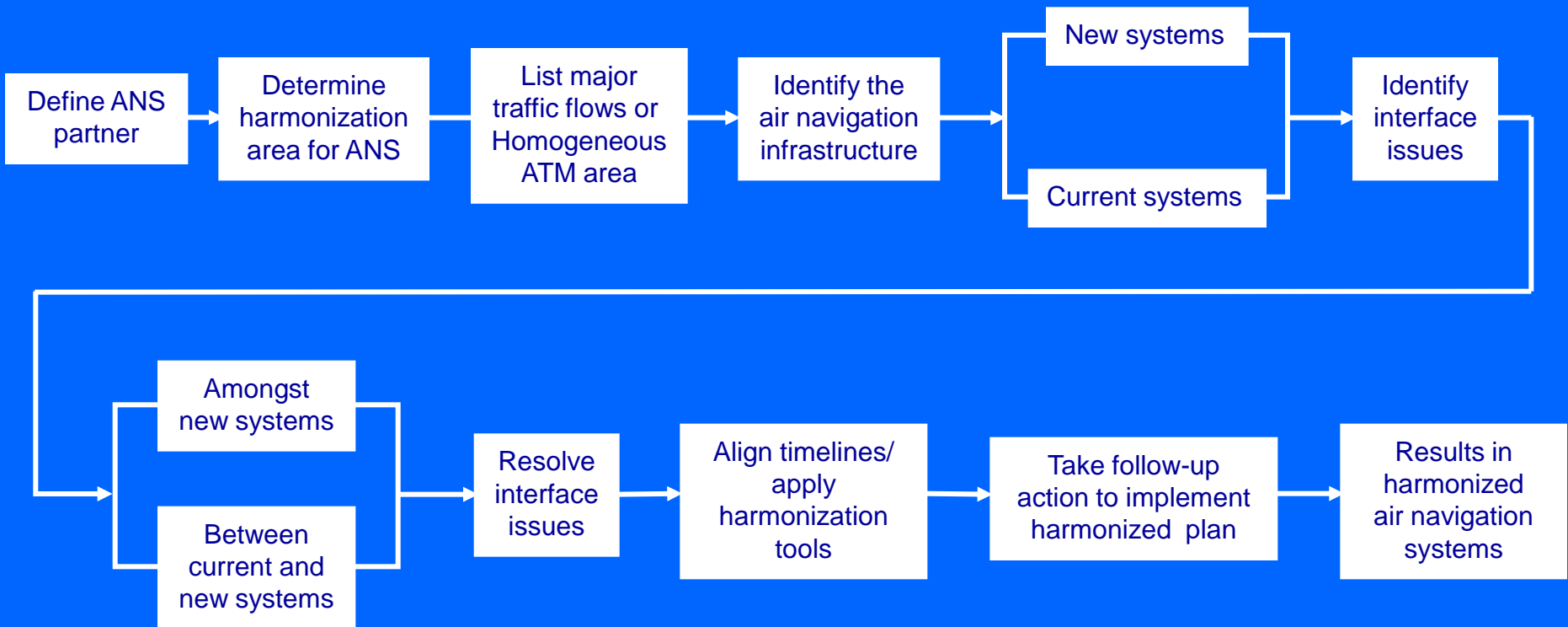
# Harmonization of air navigation systems

## Methods

- **Systems approach**
  - ATM
  - Communications
  - Navigation
  - Surveillance
  
- **Major traffic flow approach**
  - ATM objectives
  - ATM requirements for communications, navigation and surveillance

# Approach to harmonization of air navigation systems

## A framework



# Air navigation systems partners

- States
  - ANS service providers
- Subregional groups
- Regional groups
- Airspace users
- International Service providers
- Manufacturers



# Interface areas for air navigation systems

## ➤ Within the area

- State
- Subregion
- Region

## ➤ Across the area

- Inter-State
- Inter-subregion
- Inter-region



# **Homogeneous ATM areas and major traffic flows**

## **Homogeneous ATM area**

**An airspace with a common ATM interest based on similar characteristics of traffic density, complexity, air navigation infrastructure requirements or other specified considerations, wherein a common detailed plan fosters the implementation of interoperable CNS/ATM systems**

# Homogeneous ATM areas and major traffic flows

## Major traffic flows

***Major traffic flow:*** A concentration of significant volumes of air traffic on the same or proximate flight trajectories.

***Note:*** *Major traffic flows may cross several homogeneous ATM areas with different characteristics*

***Routing area:*** A defined area encompassing one or more major traffic flows

# Selecting homogeneous ATM areas and major traffic flows

- Identify major traffic flows
  - Within a State/Subregion/  
Region/interregional
- Identify homogeneous ATM area





# Air navigation systems infrastructure

## ➤ Present

- Take stock of the current inventory of technical systems and operational procedures

## ➤ New

- Take into account what is being planned in terms of technical systems and operational procedures



# Infrastructure – Current systems

- **Air traffic management**
  - **ATS Route structure**
  - **Separation standards**
  - **Airspace reservation**
  - **ATC procedures**
  - **Flow management**
  
- **Communications/navigation/surveillance**
  - **Data and voice communications**
  - **En-route, approach and landing aids**
  - **Primary and secondary radars**



# Infrastructure – New systems

Communication	Navigation	Surveillance	Air Traffic Management
<b>Data</b> <ul style="list-style-type: none"> <li>• VHF</li> <li>• HF</li> <li>• Mode S</li> <li>• Satellite</li> <li>• ATN</li> </ul> <b>Voice</b> <ul style="list-style-type: none"> <li>• VHF</li> <li>• Satellite</li> </ul>	<b>GNSS</b> <ul style="list-style-type: none"> <li>• GPS</li> <li>• GLONASS</li> <li>• GALILEO*</li> </ul> <b>Augmentation</b> <ul style="list-style-type: none"> <li>• ABAS</li> <li>• GBAS</li> <li>• SBAS</li> </ul>	<b>SSR</b> <ul style="list-style-type: none"> <li>• Modes A/C</li> <li>• Mode S</li> </ul> <b>ADS-C</b> <ul style="list-style-type: none"> <li>• VHF</li> <li>• HF</li> <li>• Satellite</li> </ul> <b>ADS-B</b>  <b>MULTLAT</b>	<b>ASM</b> <ul style="list-style-type: none"> <li>• Airspace organization ATS Route structure</li> <li>• Airspace management Flexible use of airspace</li> </ul> <b>ATS: Conflict management</b> <ul style="list-style-type: none"> <li>• Air Traffic Control</li> <li>• RASM and RVSM</li> <li>• Search and Rescue</li> <li>• Decision support systems</li> </ul> <b>ATFM</b> <ul style="list-style-type: none"> <li>• Demand and capacity balancing</li> <li>• Traffic synchronization</li> </ul>

*\*emerging systems*



# Interface issues

- **Between current air navigation systems and CNS/ATM systems**
  - **Operational procedures**
  - **Technical systems**
  - **Institutional format**
- **Amongst CNS/ATM systems**
  - **Operational procedures**
  - **Technical systems**
  - **Institutional format**



# **Interface issues – between current and new air navigation systems**

- **Operational procedures**
  - **Reserved and flexible use of airspace**
  - **Non RNP and RNP environment**
  - **Non RVSM and RVSM environment**
- **Technical systems**
  - **ACARS and VDL air/ground data communications**
  - **Analog and digital voice communications**
  - **Ground-based and satellite-based navigation aids**
  - **Different geodetic reference systems**
  - **Radar and ADS-C/ADS-B**



# Interface issues – amongst CNS/ATM systems

## Communications/Navigation/Surveillance

- **Different air/ground data links**  
(HFDDL, AMSS, SSR Mode S and VDL Modes 2, 3 & 4)
- **Different GNSS augmentation systems**  
(ABAS, SBAS and GBAS )
- **Different satellite constellations**  
(GPS, GLONASS and \*Galileo)
- **Different surveillance systems**  
(primary radars, secondary radars, ADS-C, ADS-B and MULTILAT)

\* Emerging systems

# **Interface issues – amongst CNS/ATM systems**

## **Air traffic management**

- **Operational procedures**
  - **Different RNP environments**
  - **Different Regional airspace safety performance monitoring structure**
  - **Different operational approvals for RNP**
  - **???**



# Resolution of interface issues

## Mechanism

LEVEL	MECHANISM
National	States
Subregional	Subregional Groups
Regional	Planning & Implementation Regional Groups
Interregional/ Global	Interregional interface meetings and ALLPIRG



# Application of interface tools

Between current and new air navigation systems

- **Align implementation timelines**
- **Apply harmonization tools**
  - **VHF data analog/digital: Message processor/dual stack**
  - **VHF voice analog/digital: Multi-mode radio**
  - **ILS/MLS/GNSS: Multi-mode receiver**
  - **PSR/SSR Mode S/ ADS-C and ADS-B: Integrated ATC work station**
  - **ATC procedures to respond to different requirements**

# Application of interface tools

## Amongst CNS/ATM systems

- **Align implementation timelines**
- **Apply harmonization tools**
  - **VHF data/AMSS/HF/SSR Mode S: ATN**
  - **GPS/GLONASS/\*GALILEO: integrated GNSS receiver**
  - **WAAS/EGNOS/MSAS/GAGAN: Interoperability SARPs**
  - **ABAS/SBAS/GBAS: integrated GNSS receiver**
  - **SSR Mode S/ ADS-A/ADS-B/MULTILAT: Integrated ATC work station**
  - **ATC Procedures to respond different requirements**

\* Emerging systems



# Follow-up tasks

- **Decide on the new timeframe as a consequence of aligning the implementation timelines**
- **Plan for implementing the appropriate harmonization tools**
- **Incorporate the relevant changes in the regional air navigation plan (ANP)**

# **Interoperability and Harmonization of air navigation systems**

## **Benefits**

- **Seamlessness**
- **Cost-effectiveness**
- **Easy migration path**
- **Enhanced safety**

**Resulting in an integrated  
global air traffic management system**

# Interoperability and Harmonization issues being addressed by ICAO ...

Issue	Current Status
Additional guidance material on the RNP operational approvals process for each RNP types is required	Guidance on the RNP 10/RNP 4 approval process has been provided. Development of guidance material for other RNP approval is in progress
Provisions and guidance material for annotation of RNP requirements on aeronautical charts	Development completed and released by ICAO as an amendment to chart manual

# **Interoperability and Harmonization issues being addressed by ICAO ...**

<b>Issue</b>	<b>Current Status</b>
<b>Combined GNSS receiver to integrate signals from different constellations</b>	<b>SARPs for combined GPS/GLONASS receiver have been developed; Issues associated with combined use of GPS and Galileo are under consideration by the NSP of ICAO</b>
<b>Harmonization of different satellite-based augmentation systems for GNSS (WAAS/EGNOS/MSAS/GAGAN)</b>	<b>SARPs for SBAS have been developed; SBAS interface issues are being addressed by NSP of ICAO and the Interoperability Working Group, which is comprised of SBAS service providers.</b>

# Interoperability and Harmonization issues being addressed by ICAO ...

Issue	Current Status
Development of an operational concept of air traffic management	The ATM operational concept as developed by ATMC Panel was approved by ICAO
Development of a uniform standard for use by States in certification of aircraft for RVSM operation	SASP of ICAO has developed a new chapter “Aircraft requirements and approvals”, and included in the Second edition of RVSM Manual ( Doc 9564)

# **Interoperability and Harmonization issues being addressed by ICAO ...**

<b>Issue</b>	<b>Current Status</b>
<b>ATS route planning and implementation between regions</b>	<b>Being addressed as part of the work programme of interregional coordination meetings by ICAO Regional offices and PIRGs</b>
<b>Harmonization of procedures for transition from RVSM levels to non-RVSM levels</b>	



# **Interoperability and Harmonization issues being addressed by ICAO ...**

<b>Issue</b>	<b>Current Status</b>
<b>Progressive implementation of ATN islands, domains and backbones and their interconnections</b>	<b>Guidance material has been developed; Being addressed by the interregional coordination meetings by ICAO Regional offices and PIRGs</b>
<b>Multi-mode receiver (MMR) for integrating ILS/MLS/GNSS</b>	<b>MMR specifications have been finalized; The equipage is presently under development by the Industry</b>

# **Interoperability and Harmonization issues being addressed by ICAO**

<b>Issue</b>	<b>Current Status</b>
<b>Availability of ANP/FASID documents of all the regions</b>	<b>Transition to eANP is under progress and to be completed by January 2013</b>
<b>Application of BORPC for all the regions</b>	<b>A common BORPC is now applicable to all regions. This is being revised and new BORPC will be released in June 2011.</b>

# **Examples of harmonization in implementation of air navigation systems**

## **Interregional approach**

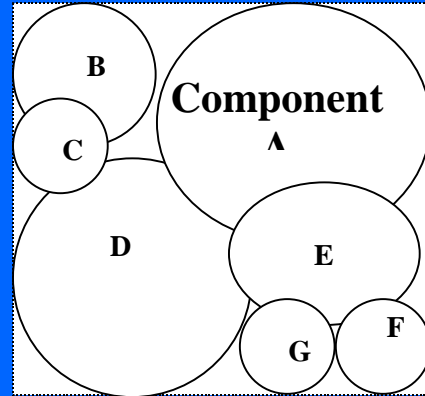
- **Revision of interregional ATS Trunk Route Structure covering Europe/ Middle East/Asia**
  - **Task was coordinated amongst three regions**
  - **Implemented**
- **Implementation of RVSM on interregional Major Traffic Flow from Asia to Europe through Middle East**
  - **Task was coordinated amongst three regions**
  - **Implemented**

# Examples of harmonization in implementation of air navigation systems

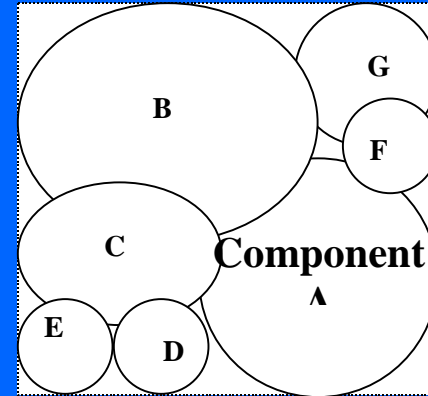
## Interregional approach

- **Implementation of RVSM on interregional Major Traffic Flow from South America to Europe through Africa**
  - Task was coordinated amongst three regions
  - Already implemented from 24 Jan 2002
  
- **Implementation of RVSM on interregional Major Traffic Flow from South America through Caribbean to North America**
  - Task is coordinated amongst three regions
  - Implemented on 20 Jan 2005

# Interregional harmonization

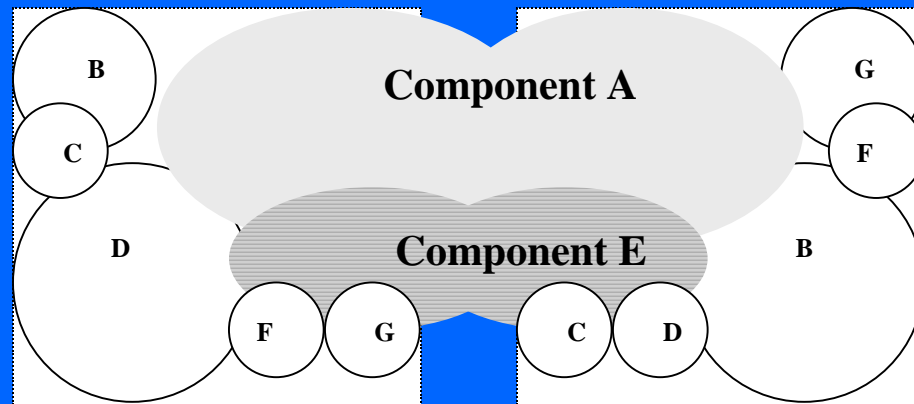


Region A



Region B

Initial Use of Components



Region A

Region B

Regional Harmonization

# **Examples of harmonization in implementation of air navigation systems**

## **Regional approach**

- **Implementation of RNP5/RNAV in Middle East region on selected routes**
  - **Task was coordinated amongst States of the Region**
  - **Already implemented**
  
- **Implementation of AMHS in Asia/Pacific Region**
  - **Task is being coordinated amongst States of the Region**
  - **Implementation is scheduled for 2011**

# **Examples of harmonization in implementation of air navigation systems**

## **Subregional approach**

- **Implementation of Ground - Ground communications network in SADC/ Central Caribbean subregion.**
  - **Task was coordinated amongst the States of subregion using subregional approach**
  - **Already implemented**
  
- **Implementation of RNP5/RNAV in ECAC area**
  - **Task was coordinated amongst the States of subregion using subregional approach**
  - **Already implemented**

# SUMMARY

- **Understood the concept of Interoperability, Harmonization and seamlessness**
- **Recognized the need for harmonization**
- **Discussed a framework for harmonization including tools**
- **Noted the work of ICAO in progress to enhance Interoperability and Harmonization**
- **Acknowledged the success stories of harmonization carried out by regions/subregional groups**



— END —