



SIP/2009-WP/7
Business case

Global ATM System

~Interoperability and Harmonization ~

H.V. SUDARSHAN, Technical Officer
International Civil Aviation Organization

**Workshop on the Development of Business Case
for the Implementation of CNS/ATM Systems
(Antigua, 25-29 May 2009)**

Presentation Outline

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

ICAO – Vision Statement for Global ATM system

- 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**

Why do we need harmonization? ...

- CNS/ATM 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?

- CNS/ATM systems have
 - different timings in implementation
 - different levels of implementation
 - different methods of financing and cost recovery

What to harmonize?

- **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

Harmonization of air navigation systems

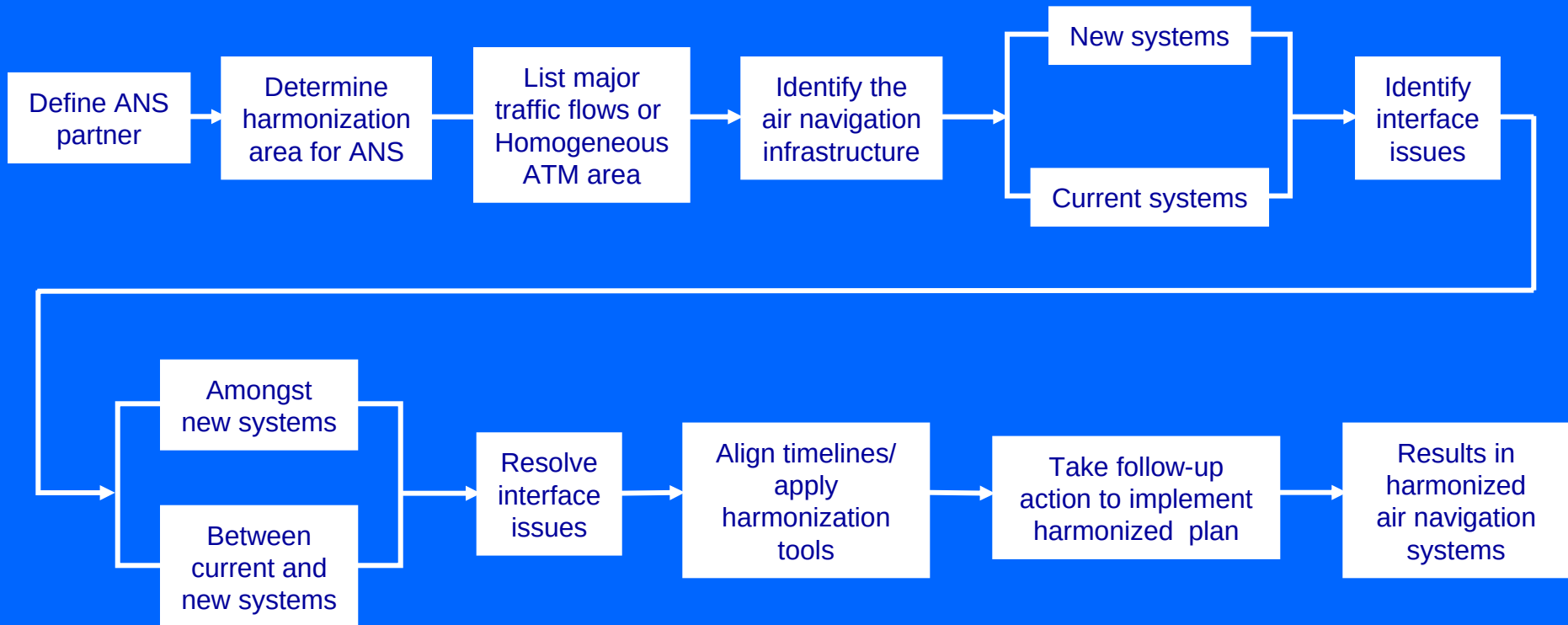
Methods

- **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
Data • VHF • HF • Mode S • Satellite • ATN Voice • VHF • Satellite • HF VOIP	GNSS • GPS • GLONASS • GALILEO* Augmentation • ABAS • GBAS • SBAS DME/DME	SSR • Modes A/C • Mode S ADS-C • VHF • HF • Satellite ADS-B MLAT	ASM • Airspace organization ATS Route structure • Airspace management Flexible use of airspace ATS: Conflict management • Air Traffic Control • RHSM and RVSM • Search and Rescue • Decision support systems ATFM • Demand and capacity balancing • Traffic synchronization

**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 Mode 2)
- **Different GNSS augmentation systems**
(SBAS and GBAS)
- **Different satellite constellations**
(GPS, GLONASS and *Galileo)
- **Different surveillance systems**
(primary radars, secondary radars, ADS-C and ADS-B)
 - » * 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
 - SBAS/GBAS: integrated GNSS receiver
 - SSR Mode S/ ADS-A/ADS-B: 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)
- Present the revised regional ANP to the respective PIRG meeting for its concurrence



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 ...

Issue	Current Status
Combined GNSS receiver to integrate signals from different constellations	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
Harmonization of different satellite-based augmentation systems for GNSS (WAAS/EGNOS/MSAS/GAGAN)	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.

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 an 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 ...

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

Interoperability and Harmonization issues being addressed by ICAO ...

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

Interoperability and Harmonization issues being addressed by ICAO

Issue	Current Status
Availability of ANP/FASID documents of all the regions	The documents already made available excepting for MID region which will be completed in late 2008.
Application of BORPC for all the regions	A common BORPC, which is now applicable to all regions, has been approved by ICAO in 2005

Examples of harmonization in implementation of air navigation systems

Interregional approach

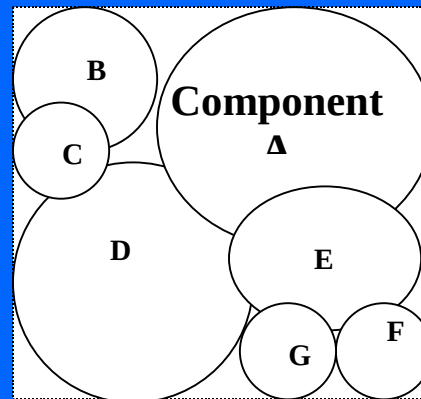
- **Revision of interregional ATS Trunk Route Structure covering Europe/ Middle East/Asia**
 - **Task is coordinated amongst three regions**
 - **Implemented on 28 Nov 2002**
- **Implementation of RVSM on interregional Major Traffic Flow from Asia to Europe through Middle East**
 - **Task is coordinated amongst three regions**
 - **Implemented on 27 Nov 2003**

Examples of harmonization in implementation of air navigation systems

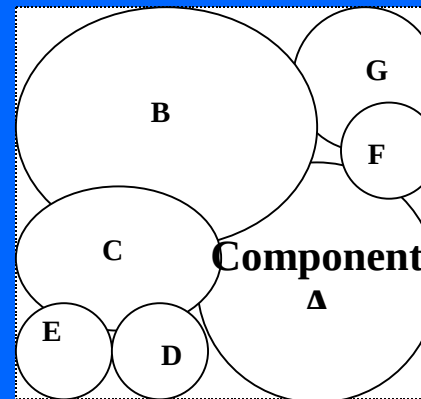
Interregional approach

- **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

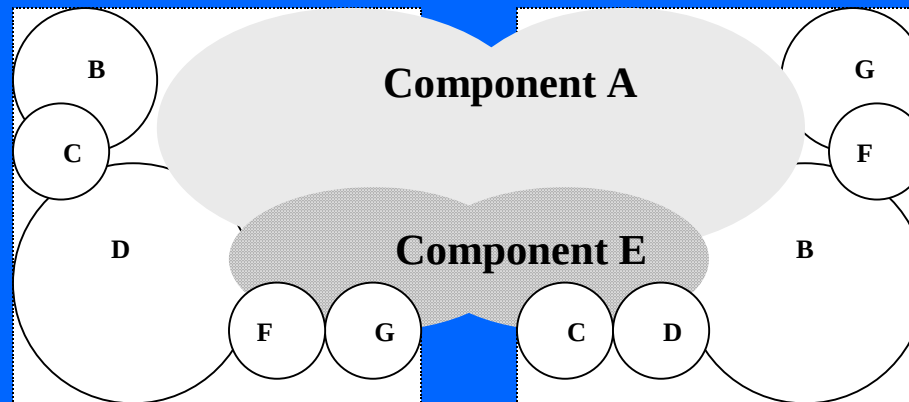


Region A



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 from 14 June 2001

- **Implementation of AMHS in Asia/Pacific Region**
 - Task is being coordinated amongst States of the Region
 - Implementation date to be aligned

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 in January 1998

SUMMARY

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

— END —