Global ATM System

~Interoperability and Harmonization ~

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International Civil Aviation Organization

Workshop on the Development of Business Case
for the Implementation of CNS/ATM Systems
(Antigua and Barbuda, 28 September – 2 October 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

1. Define ANS partner
2. Determine harmonization area for ANS
3. List major traffic flows or Homogeneous ATM area
4. Identify the air navigation infrastructure
5. Identify interface issues
   - Amongst new systems
   - Between current and new systems
6. Resolve interface issues
7. Align timelines/apply harmonization tools
8. Take follow-up action to implement harmonized plan
9. Results in harmonized air navigation systems
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

<table>
<thead>
<tr>
<th>Communication</th>
<th>Navigation</th>
<th>Surveillance</th>
<th>Air Traffic Management</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data</strong></td>
<td><strong>GNSS</strong></td>
<td><strong>SSR</strong></td>
<td><strong>ASM</strong></td>
</tr>
<tr>
<td>• VHF</td>
<td>• GPS</td>
<td>• Modes A/C</td>
<td>• Airspace organization</td>
</tr>
<tr>
<td>• HF</td>
<td>• GLONASS</td>
<td>• Mode S</td>
<td>• ATS Route structure</td>
</tr>
<tr>
<td>• Mode S</td>
<td>• GALILEO*</td>
<td></td>
<td>• Airspace management</td>
</tr>
<tr>
<td>• Satellite</td>
<td>Augmentation</td>
<td></td>
<td>• Flexible use of airspace</td>
</tr>
<tr>
<td>• ATN</td>
<td>DME/DME</td>
<td><strong>ADS-C</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Voice</strong></td>
<td><strong>ADS-C</strong></td>
<td><strong>ADS-B</strong></td>
<td><strong>ATS: Conflict management</strong></td>
</tr>
<tr>
<td>• VHF</td>
<td>• VHF</td>
<td><strong>MLAT</strong></td>
<td>• Air Traffic Control</td>
</tr>
<tr>
<td>• Satellite</td>
<td>• HF</td>
<td></td>
<td>• RHSM and RVSM</td>
</tr>
<tr>
<td>• HF VOIP</td>
<td>• Satellite</td>
<td></td>
<td>• Search and Rescue</td>
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<tr>
<td></td>
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<td></td>
<td>• Decision support systems</td>
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</tbody>
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*emerging systems

**ATFM**
- Demand and capacity balancing
- Traffic synchronization
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
  (HFDL, 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

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>MECHANISM</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>States</td>
</tr>
<tr>
<td>Subregional</td>
<td>Subregional Groups</td>
</tr>
<tr>
<td>Regional</td>
<td>Planning &amp; Implementation Regional Groups</td>
</tr>
<tr>
<td>Interregional/Global</td>
<td>Interregional interface meetings and ALLPIRG</td>
</tr>
</tbody>
</table>
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 workstation
  - 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 ...

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

**issues being addressed by ICAO ...**

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<tr>
<td>Combined GNSS receiver to integrate signals from different constellations</td>
<td>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</td>
</tr>
<tr>
<td>Harmonization of different satellite-based augmentation systems for GNSS (WAAS/EGNOS/MSAS/GAGAN)</td>
<td>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.</td>
</tr>
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**Interoperability and Harmonization issues being addressed by ICAO …**

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<tr>
<td>Development of an operational concept of air traffic management</td>
<td>The ATM operational concept as developed by ATMC Panel was approved by ICAO</td>
</tr>
</tbody>
</table>
| 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 …

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<td>ATS route planning and implementation between regions</td>
<td>Being addressed as part of the work programme of interregional coordination meetings by ICAO Regional offices and PIRGs</td>
</tr>
<tr>
<td>Harmonization of procedures for transition from RVSM levels to non-RVSM levels</td>
<td></td>
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**Interoperability and Harmonization issues being addressed by ICAO**

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

### Current Status

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

Initial Use of Components

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