Special Implementation Project

CNS/ATM Systems –
Interoperability and Harmonization

(Presented by H.V.SUDARSHAN)

Workshop on the development of business case for the implementation of CNS/ATM systems
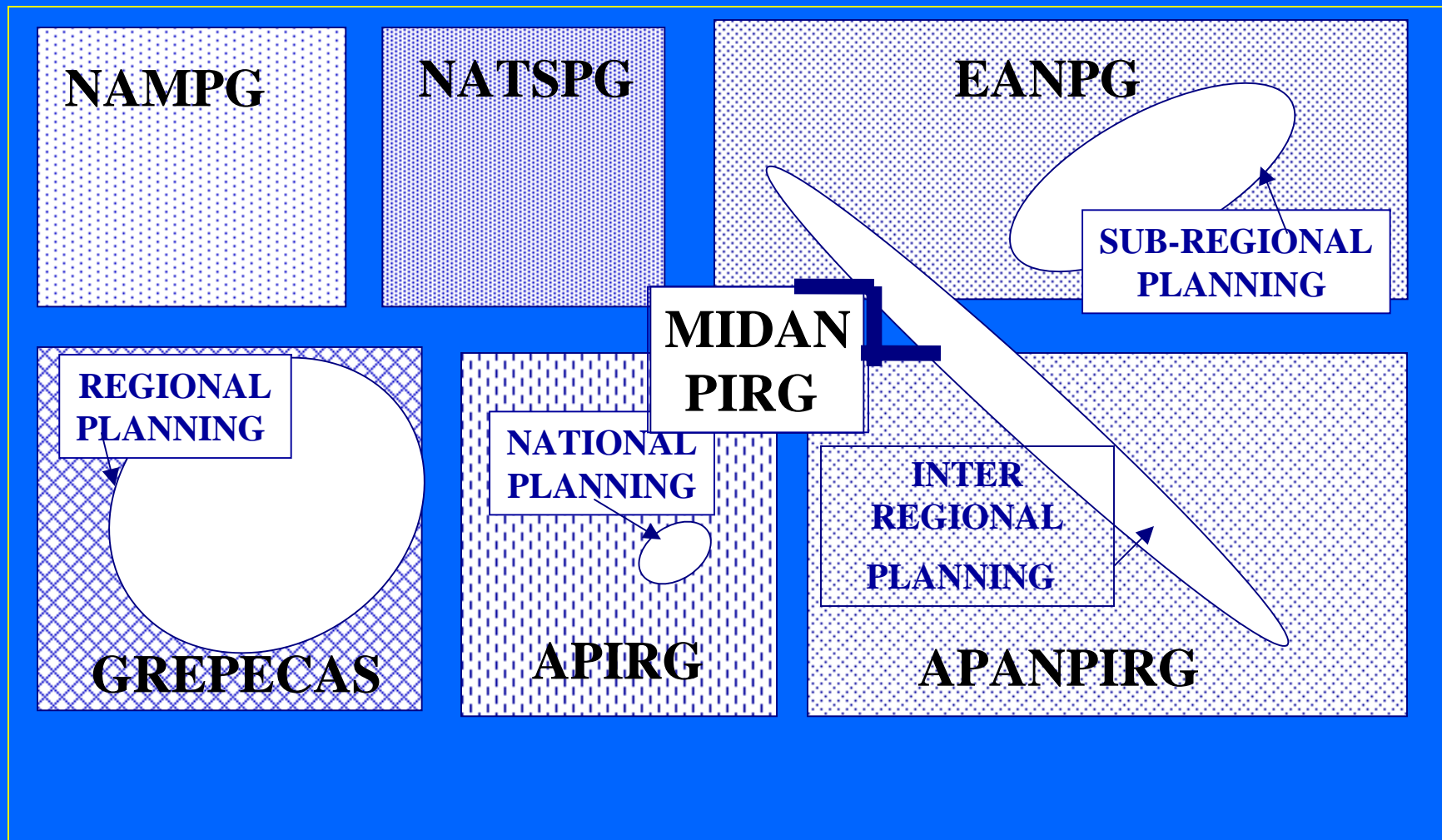**Cairo, 6–9 September 2004**

ICAO-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
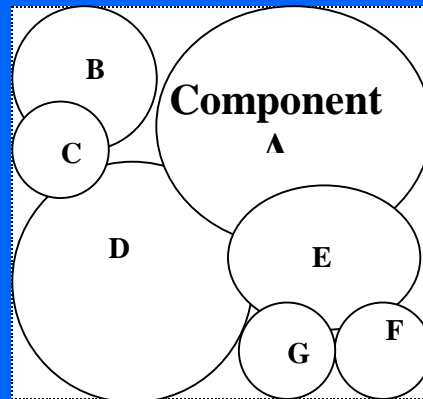- ✓ meets national security requirements.
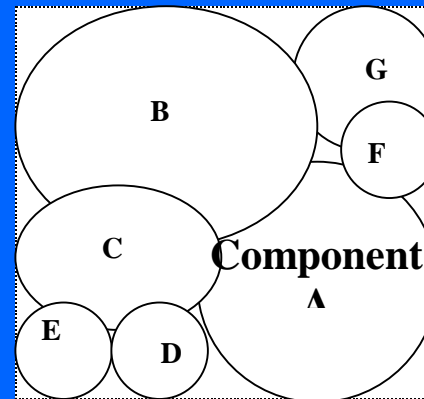
ICAO AIR NAVIGATION PLANNING PROCESS

NAMPG

NATSPG

EANPG

SUB-REGIONAL PLANNING

MIDAN PIRG

REGIONAL PLANNING

NATIONAL PLANNING

INTER REGIONAL PLANNING

GREPECAS

APIRG

APANPIRG

"Interface" issues

Regional Harmonization

Component A

B

C

D

E

F

G

Region A

G

B

F

C

Component A

E

D

Region B

Initial Use of Components

B

C

D

F

G

Component A

Component E

G

F

C

D

B
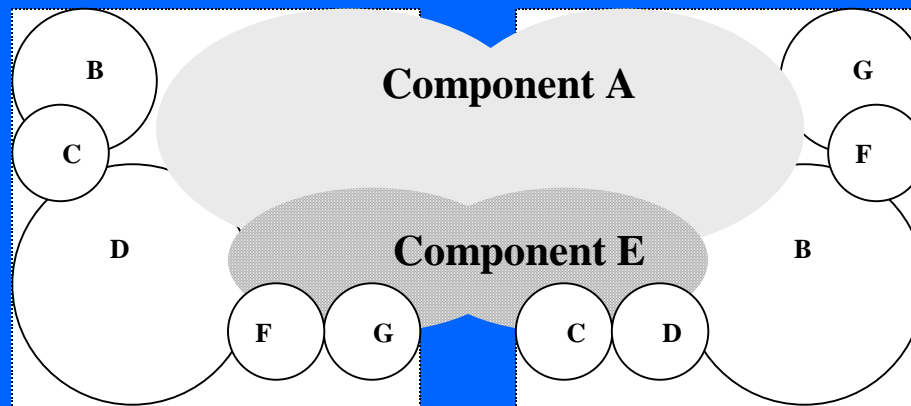
Region A

Region B

Regional   Harmonization

Why do we need Harmonization?…

- **Current Air Navigation systems**
  - ✓ **Country-specific**
  - ✓ **Stand-alone (high diversity, different protocols)**
  - ✓ **Lack similar functionalities**
  - ✓ **No standard interfaces**
- **Thus resulting in**
  - ✓ **Set of "island" solutions**
  - ✓ **Incoherent ATC systems**

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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)**

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Why do we need Harmonization?

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

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What is Harmonization?

- **What is harmonization as applied to CNS/ATM systems planning and implementation?**

    ✓ **Accord or agreement for a consistent, orderly implementation and the use of CNS/ATM systems through global interoperability thus resulting in an integrated, seamless Global ATM system**

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
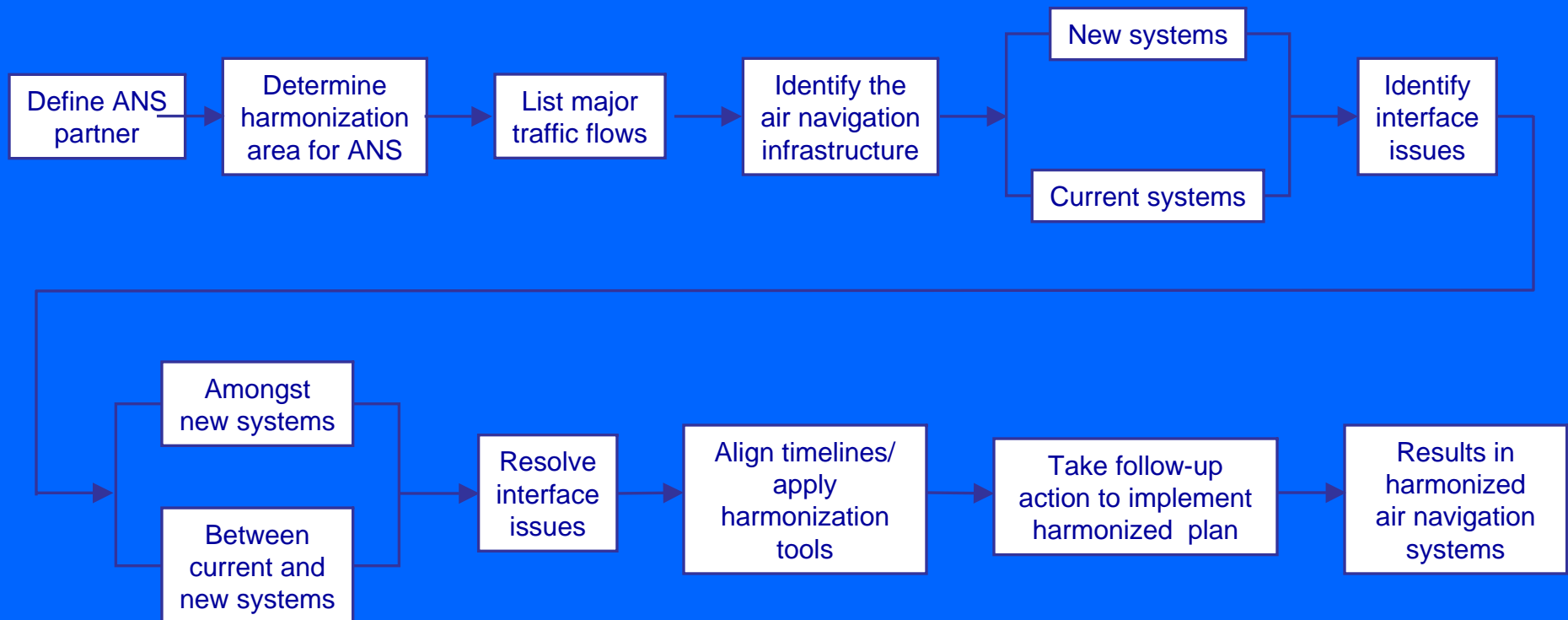# of Air Navigation Systems

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

```
Define ANS
partner
   │
   ▼
Determine
harmonization
area for ANS
   │
   ▼
List major
traffic flows
   │
   ▼
Identify the
air navigation
infrastructure
   │
   ▼
┌─ New systems ─┐
│               │
└─ Current systems ─┘
   │
   ▼
Identify
interface
issues
```

```
┌─ Amongst
│  new systems ─┐
│               │
└─ Between      ─┘
   current and
   new systems
   │
   ▼
Resolve
interface
issues
   │
   ▼
Align timelines/
apply
harmonization
tools
   │
   ▼
Take follow-up
action to implement
harmonized plan
   │
   ▼
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 the homogeneous ATM area under consideration such as**
    - ▪ **State**
    - ▪ **Subregion**
    - ▪ **Region**
  - ✓ **Across the homogeneous ATM area under consideration such as**
    - ▪ **Inter-State**
    - ▪ **Inter-subregion**
    - ▪ **Inter-region**

Air Navigation Systems Infrastructure

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

- ## Future
  - ✓ 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 – Future Systems

Communication	Navigation	Surveillance	Air Traffic Management
Data • VHF • HF • Mode S • Satellite • ATN Voice • VHF • Satellite	GNSS • GPS • GLONASS • *GALILEO Augmentation • ABAS • GBAS • SBAS • *GRAS	SSR • Modes A/C • Mode S ADS • VHF • HF • Satellite *ADS-B	ASM • ATS Route structure • RNP and RNAV • Airspace utilization ATS • ATC • RHSM and RVSM • Search and Rescue • Decision support systems ATFM • Planning • Coordination

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 Air Navigation Systems and CNS/ATM 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**

Interface Issues – amongst CNS/ATM Systems

Communications/Navigation/Surveillance

- **Different air/ground data links** (HFDL, AMSS, SSR Mode S and VDL Modes 2, 3 & 4)

- **Different GNSS augmentation systems** (SBAS, GBAS and *GRAS)

- **Different satellite constellations** (GPS, GLONASS and *Galileo)

- **Different surveillance systems** (primary radars, secondary radars , ADS-A 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 Air Navigation Systems and CNS/ATM 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: 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: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

Harmonization of Air Navigation Systems

Benefits

- Interoperability
- Standardization
- Seamlessness
- Cost-effectiveness
- Easy migration path
- Enhanced safety

Resulting in an integrated global air traffic management system

Interregional issues for Regional Harmonization being addressed

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 RNP 1 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**

Interregional issues for Regional Harmonization being addressed

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 GNSS Panel of ICAO**
Harmonization of different satellite-based augmentation systems for GNSS (WAAS/EGNOS/MSAS)	**SARPs for SBAS have been developed; SBAS interface issues are being addressed by GNSSP of ICAO and the Interoperability Working Group, which is comprised of SBAS service providers.**

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Issue	Current Status
Development of an operational concept of air traffic management	Draft 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)

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Interregional issues for Regional Harmonization being addressed

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	

Interregional issues for Regional Harmonization being addressed

Issue	Current Status
Progressive implementation of ATN islands, domains and backbones and their interconnections	**Guidance material has been developed;** **To be addressed in due course 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**

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Interregional issues for Regional Harmonization being addressed

Issue	Current Status
Availability of ANP/FASID documents of all the regions	**This is presently under finalization;** **The documents already made available excepting for MID and Asia/Pacific regions**
Application of BORPC for all the regions	**This is presently under consideration by the Commission and expected to be approved by January 2005**

Examples of Harmonization in implementation of Air navigation systems
Interregioanl approach

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

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Examples of Harmonization in implementation of Air navigation systems

Interregioanl 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
  - Implementation date aligned to 20 Jan 2005

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 coordinated amongst States of the region
    - Implementation date aligned to 2005

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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

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