International Forum for Aviation Research

Fumikazu Itoh
IFAR Chairman
Japan Aerospace Exploration Agency (JAXA)

30th Congress of the International Council of the Aeronautical Sciences
Daejeon, Korea
September 29th, 2016

IFAR | INTERNATIONAL FORUM FOR AVIATION RESEARCH

History & Objectives of IFAR

- Established in 2010
- 10 organizations (2010)
  → 26 members (2016)

- Objectives:

NETWORKING & INFORMATION EXCHANGE

TECHNICAL COOPERATION

EDUCATION OF NEXT GENERATION OF AERONAUTICAL RESEARCHERS

COMMUNICATION

IFAR Summit

2010 – Berlin (DLR)

2011 – Paris (ONERA)

2012 – Nagoya (JAXA)

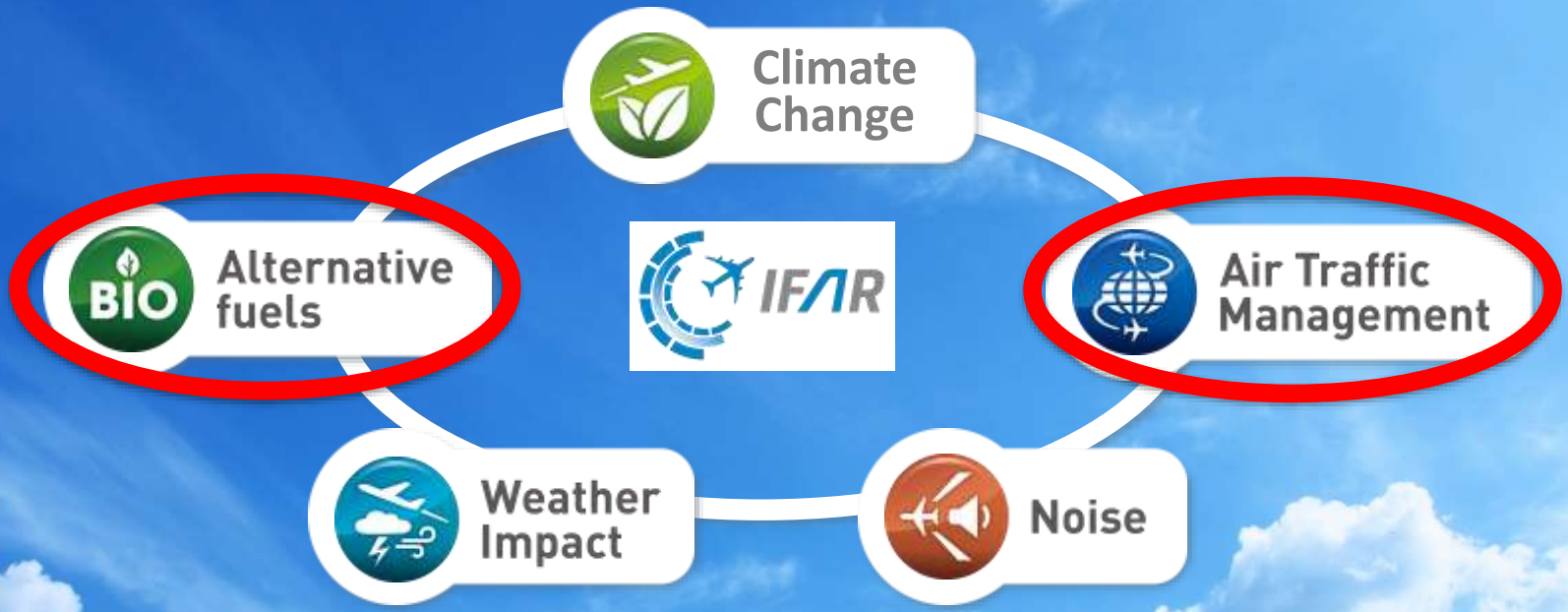
2013 – Moscow (TsAGI)

2014 – Zhuhai (CAE)

2015 – California (NASA)

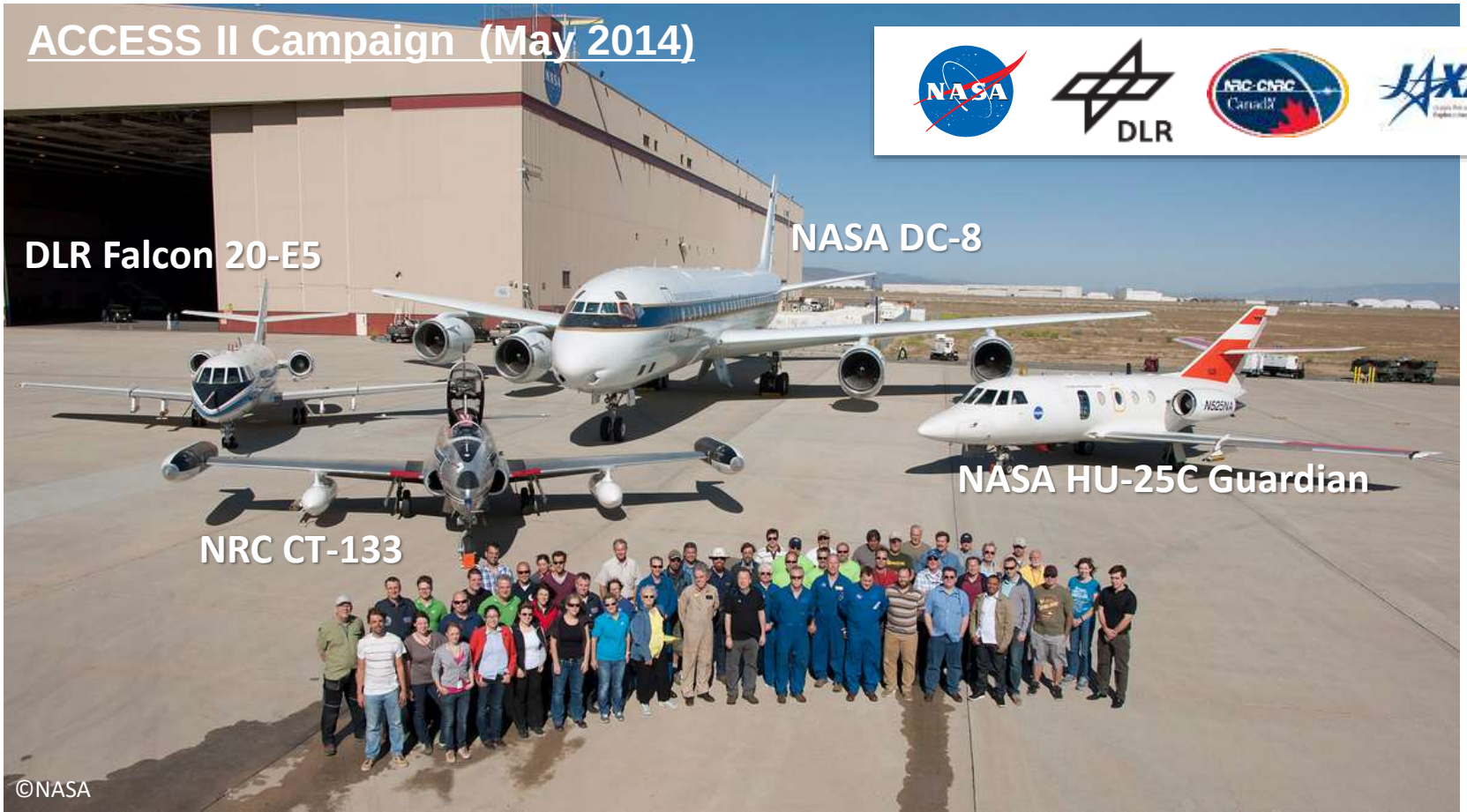
IFAR Technical Activities – 5 Focus Areas

Non-competitive aviation research & development related to global technical challenges



Alternative Aviation Fuels

- Alternative Fuel flight: NASA
- Exhaust gas composition: NASA, DLR
- Dynamics the DC-8 wake: NRC
- Analysis and ground test of HEFA fuel: JAXA



Global Growth in Aviation Shifting to Asia-Pacific Region

Global Air Passengers by Region (% of Total)

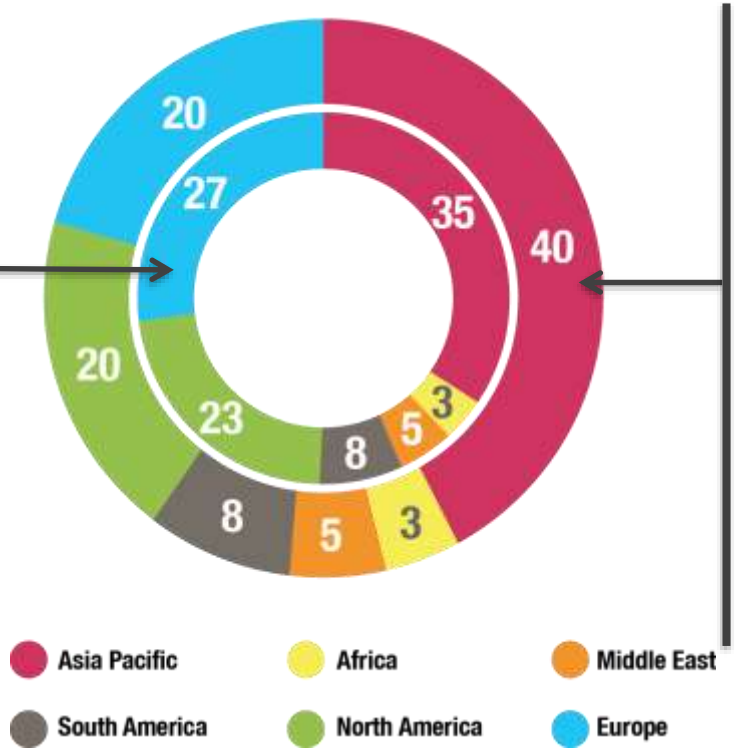
2014
Global Aviation Industry

3.3B Passenger Trips

North America and Europe combined is half of all Passenger Trips

58M Jobs

$2.4T GDP



2034
Global Aviation Industry, est.

7B Passenger Trips

Asia-Pacific Passenger Trips equal to North America and Europe combined

105M Jobs

$6T GDP

Sources: International Air Transport Association, Air Transport Action Group, Boeing

Over 36,000 New Aircraft required over the 20 year period → **Need for acceleration of ATM efficiency**

Air Traffic Management

Problems

- Delays result in excess fuel/noise/emission, and lost productivity
- Operational needs are only addressed at regional level
- ICAO Aviation System Block Upgrades (ASBU) 2 (2018) and 3 (2023) are not sufficiently defined
- Limited research collaboration


March 2016 – ATM Workshop @ NavCanada

Objective of IFAR ATM Working Group

- 12 member initiative on ATM Operations to inform ***ICAO "Aviation System Block Upgrades (ASBU)" 2 and 3***
- Capture global challenges and research capabilities
- Enable Collaboration

Air Traffic Management

"Globally Addressing Air Traffic Management Challenges"

1. Regional perspectives from:
    1. North America (*Dr. Jaiwon Shin*, NASA)
    2. Europe (*Mr. Michel Peters*, NLR)
    3. Asia (*Dr. Eung-Tai Kim*, KARI)
2. IFAR's ATM Working Group activities (Akbar Sultan, NASA)

Cooperation is an essential building block for our common aviation future

IFAR Chair
Fumikazu Itoh
JAXA, Japan

IFAR Vice-Chair
Michel Peters
NLR, Netherlands

IFAR Past Chair
Jaiwon Shin
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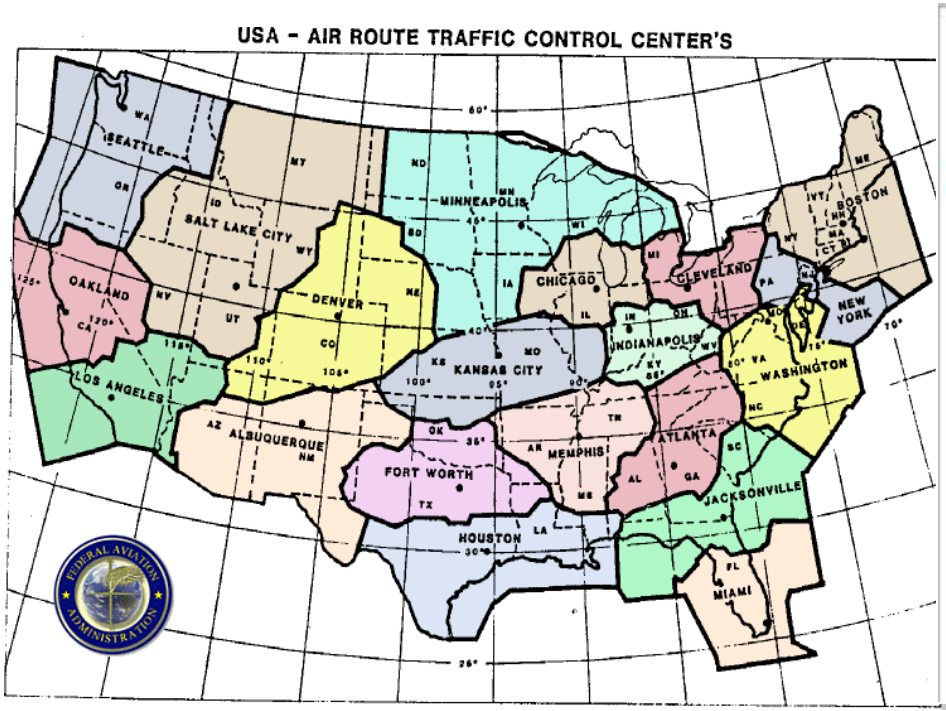
THANK YOU!

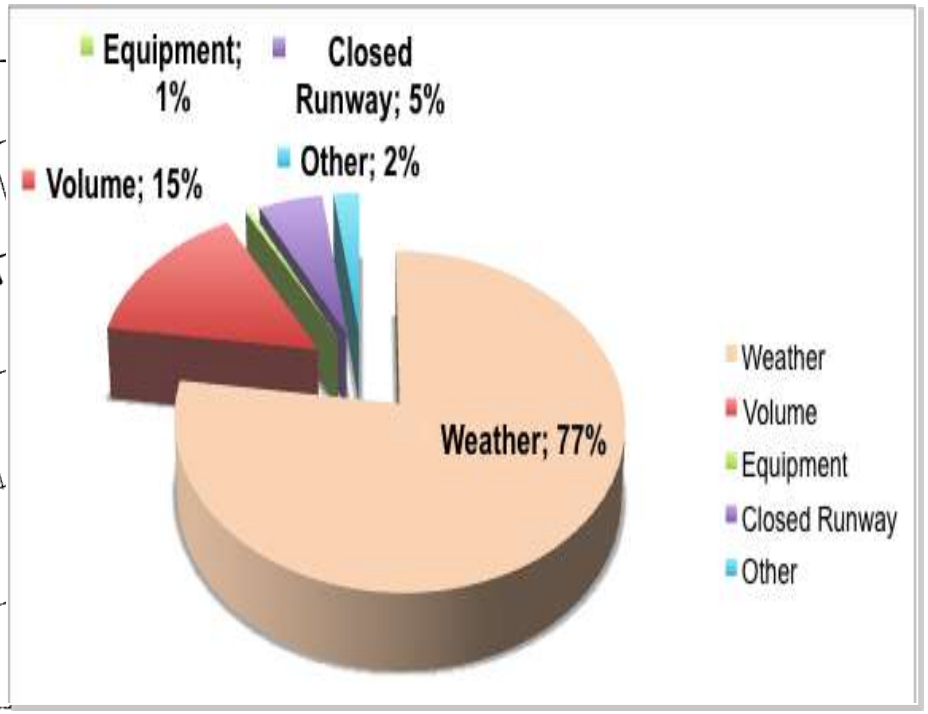
IFAR Air Transport Efficiency ATM Working Group

Regional Perspectives and impact of IFAR WG for Global Harmonization

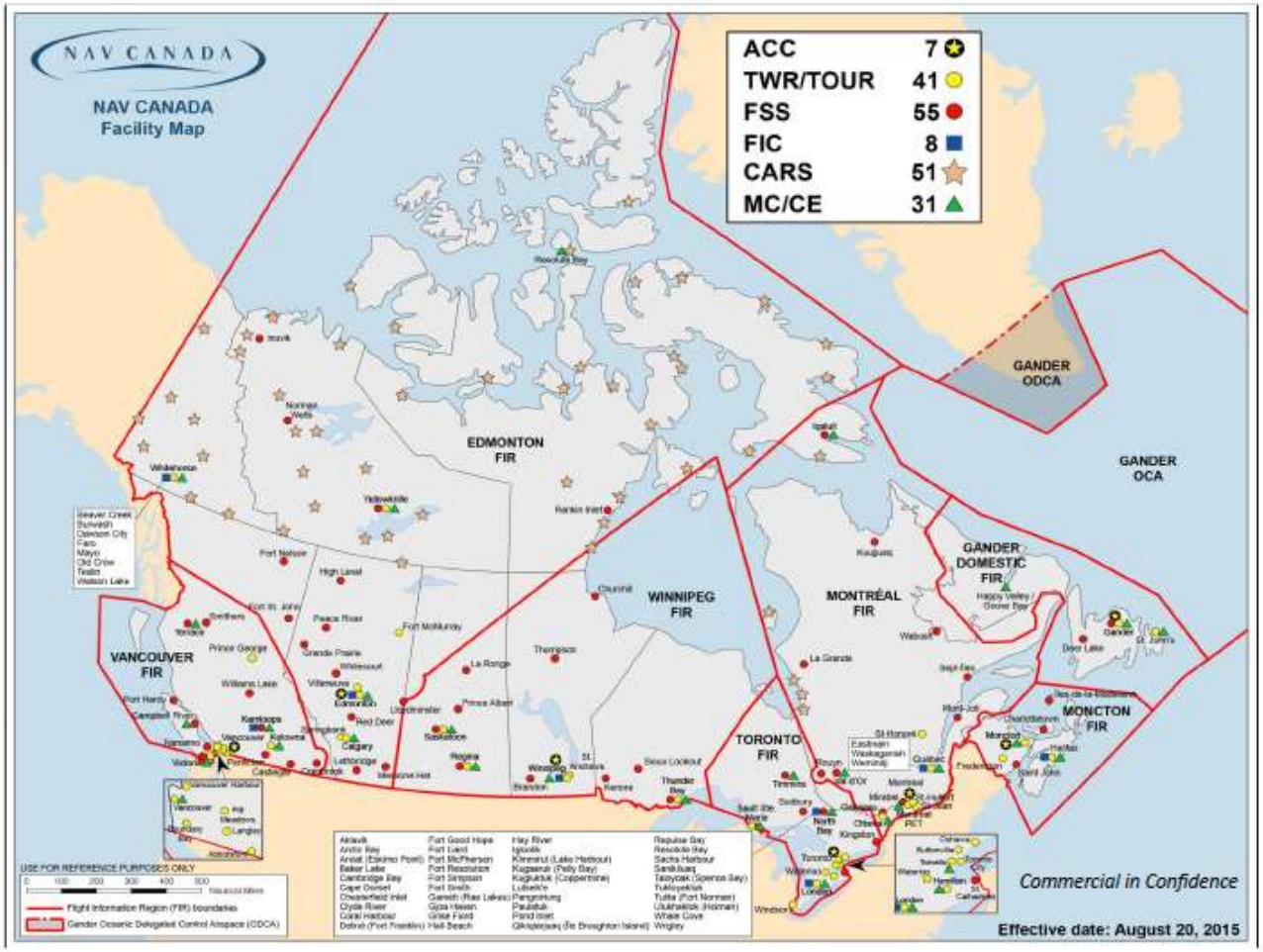
For the 7th IFAR Summit and ICAS
Daejeon, Korea

Operations: North and South America

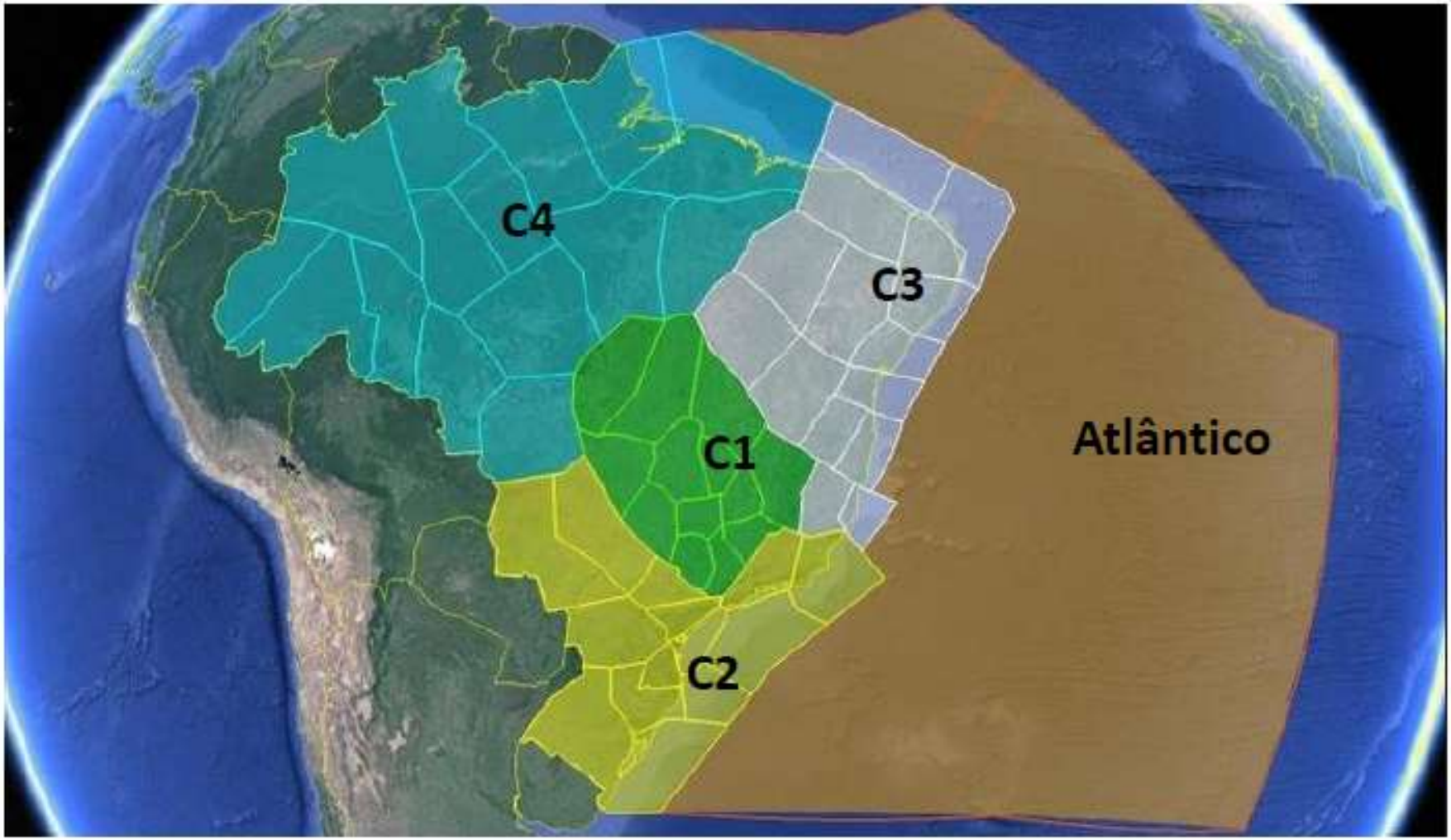




Operations: North and South America



Operations: North and South America



Transformation: North and South America

Figure 1: Overview of NAS Far-Term Concept of Operations

Transformation: North and South America

NAV CANADA

Corporate Objectives

Safety record: top decile globally

ANS customer service charges: bottom quartile, and decline over long term

Modern, cost-efficient technology: top quartile

Provide value to our customers: improving operational efficiency through technology and service

People: create a productive and fulfilling workplace

Environment: Contribute to reduced aviation footprint

Operational Challenges

Weather uncertainty

Human workload limits capacity, throughput, and precision delivery

Interactions: arrivals, departures and surface

Prediction uncertainty (trajectory, aircraft count, aircraft location)

Mixed equipage

Trade-off between environment and capacity/throughput

Key Focus Areas

Dynamic Airspace Configuration to best balance supply to demand

Proactive collaboration with carriers and airports to maximize predictability and efficiency

Arrivals: integrated scheduling, sequencing, merging & spacing

Integrated arrival/departure operations

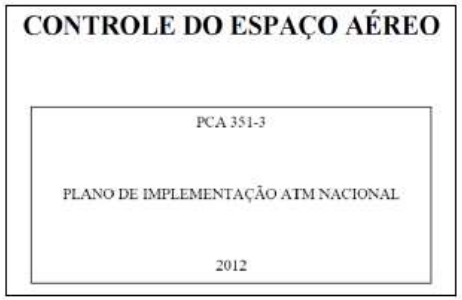
Surface operations optimization

Technology transition

Transformation: North and South America

ATM Implementation Plan

PCA 351-3 "National ATM Implementation Plan"
PROJECT SIRIUS



- Latest version: March 2012
- Oriented to new technologies integration, development of solutions and application of new procedures to improve the aerial navigation services in the airspace under Brazilian responsability
  - Rational use of the airspace
  - Improvement of the ATM efficiency
  - Reduction of emissions
  - Reduction of noise
  - Reduction of crew and controllers workload
  - Reduction of service costs
  - Improvement of the service quality

Research: North and South America

- NASA: in support of NextGen and beyond
  - Optimized pushback/taxi scheduling, and surface movement
  - Optimal Profile Descent and ADS-B enabled Terminal Spacing and Sequencing; Full Gate-to-gate TBO
  - Realtime Systemwide Safety Assurance
  - UAS Traffic Management

- NRC Canada and NavCanada
  - Working and traveling on aircraft
  - Enhanced Flight Deck Situational Awareness
  - Reduced Cabin & Flight Deck Energy Consumption
  - Crew Fatigue Monitoring and Mitigation
  - Prevent landing/takeoff runway excursions

- IAE, ICEA, and DECEA
  - Optimization of the FIR/UIR and ATS network ...*RNP4 in the Atlantic region and RNP2 in the continental region*
  - PBN Implementation on approach phases of flights; Remote ATS
  - Optimization of rotary wings special routes (Sao Paolo is one of the worlds busiest rotary wing air taxi hubs)
  - Integration of UAVs into non-segregated airspace

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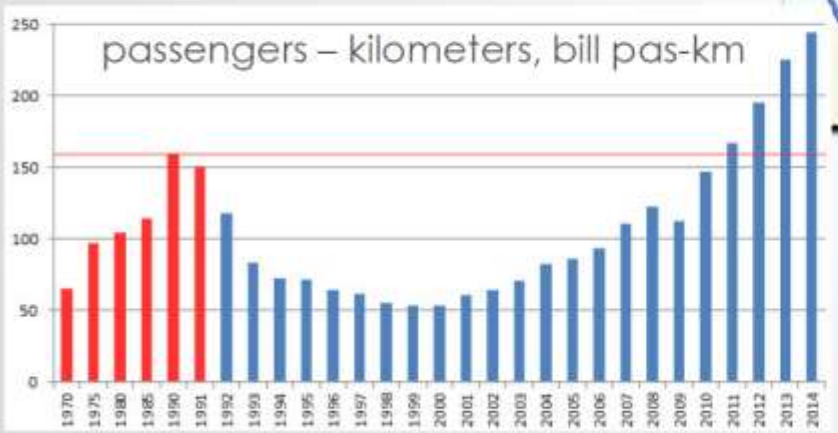
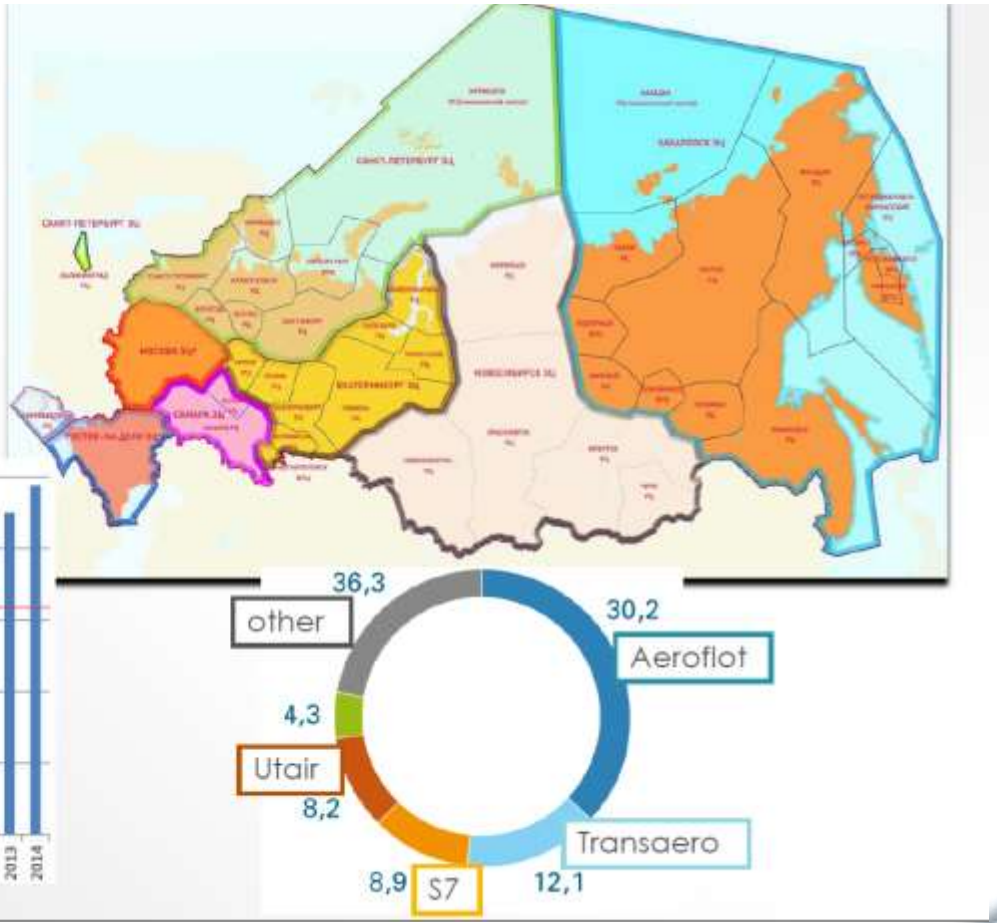
Operations: Europe

CAPACITY

Operations: Europe

- Area – $25 \cdot 10^6\ km^2$
- Length of airways is 678 507 km
- Number of airways is 869
- 7 large and 29 regional ATM centers





Transformation: Europe

SESAR's performance ambition

SECURITY
- Ensuring high levels of security

COST EFFICIENCY
- Up to **40%** reduction in air navigation services costs per flight

CAPACITY
- Up to **30%** reduction in departure delays
- Up to **10%** additional flights landing at congested airports
- A system capable of handling up to **100%** more traffic

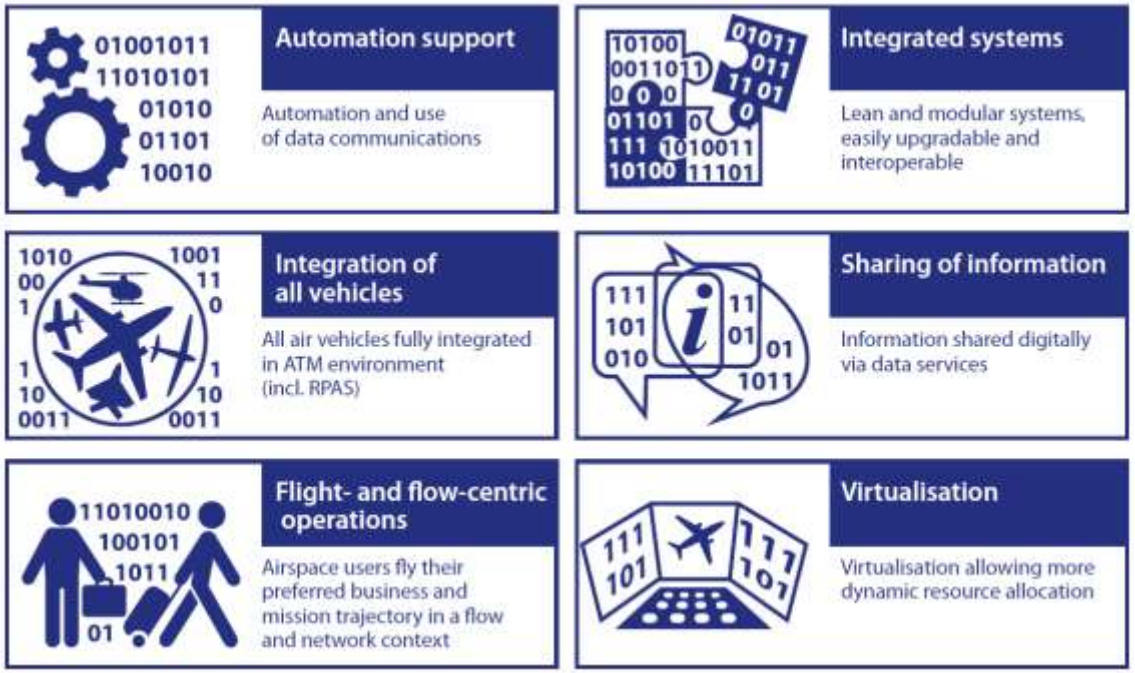
ENVIRONMENT
- Up to **10%** reduction in CO_2 emissions
- Positive impact on noise and air quality

SAFETY
- Improvement by up to a factor of **4**

OPERATIONAL EFFICIENCY
- Up to **6%** reduction in flight time
- Up to **10%** reduction in fuel burn

Transformation: Europe

What is needed to achieve this ambition

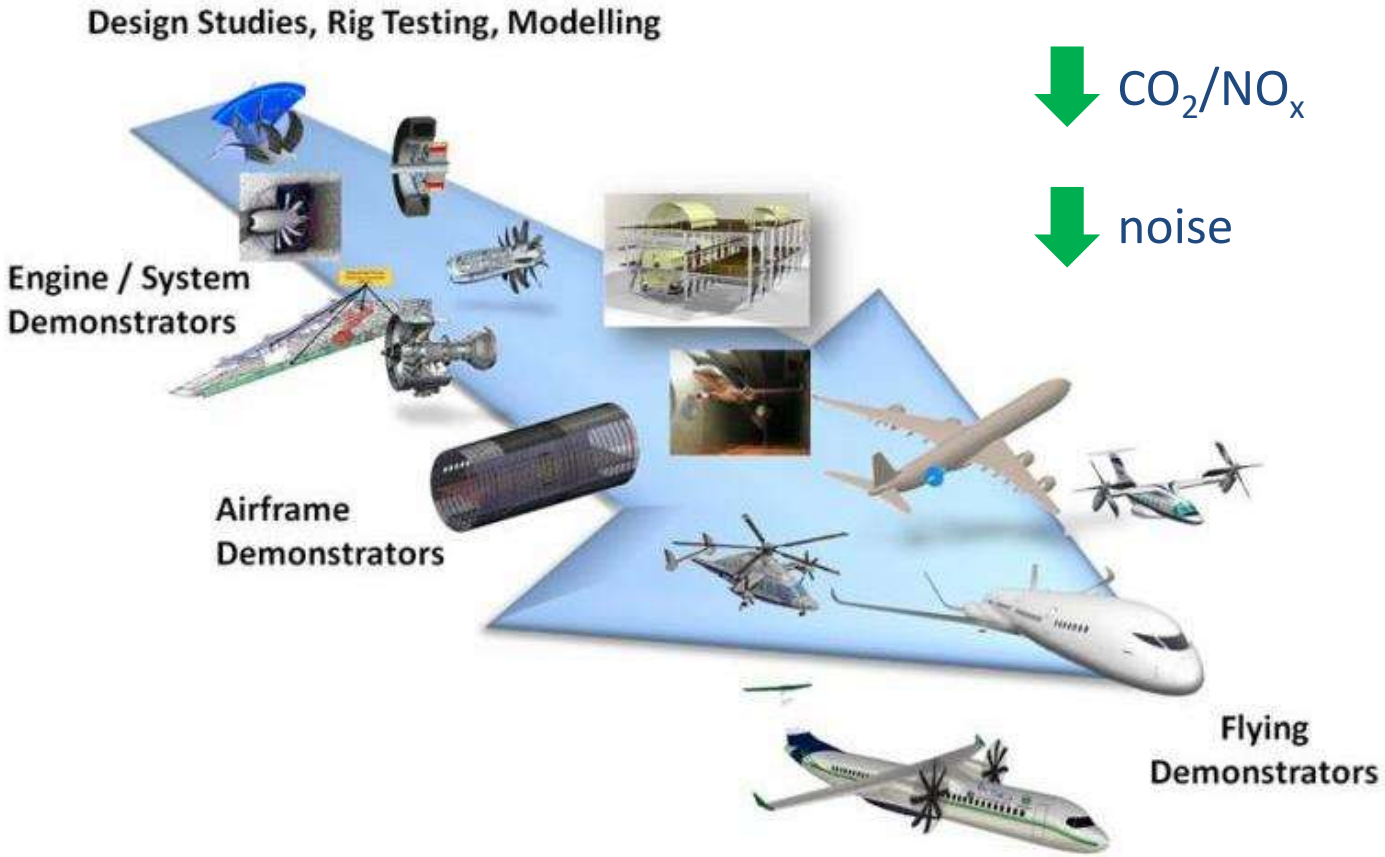


Four areas

Transformation: Europe

CleanSky

Developing new generations of greener aircraft



Research: Europe

- NLR:
  - Airport surface movement and conflict prediction/resolution
  - Improvement navigation in low visibility; Enhanced Visual Operations (synthetic vision)
  - RPAS surface operation integration
- Onera:
  - IESTA Environmental Modeling; 4D Trajectory Contract Management
  - Very Low Altitude UAS Traffic Management
- DLR:
  - Air Traffic Management and AMAN/DMAN/SMAN integration
  - Remotely Piloted Aircraft Systems; Airport and Ground Traffic Management
  - Validation Methodology
- TsAGI:
  - 4-D Trajectory Management; New instrumentation for air traffic controllers
  - Aircraft icing; Wake Vortex Safety
- CIRA:
  - Traffic Avoidance, Enhanced Collision Avoidance, Continuous Descent and Curved Approach
  - 4D Trajectory Management; Airborne Merging and Spacing
  - RPAS Integration

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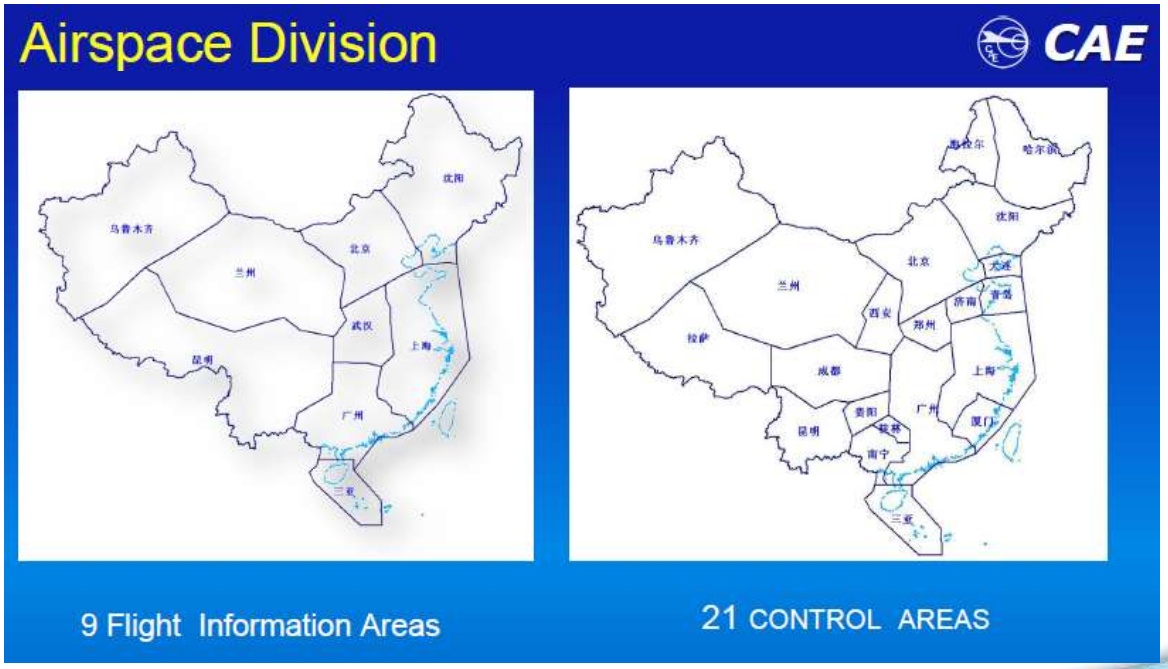
Operations: Asia

China

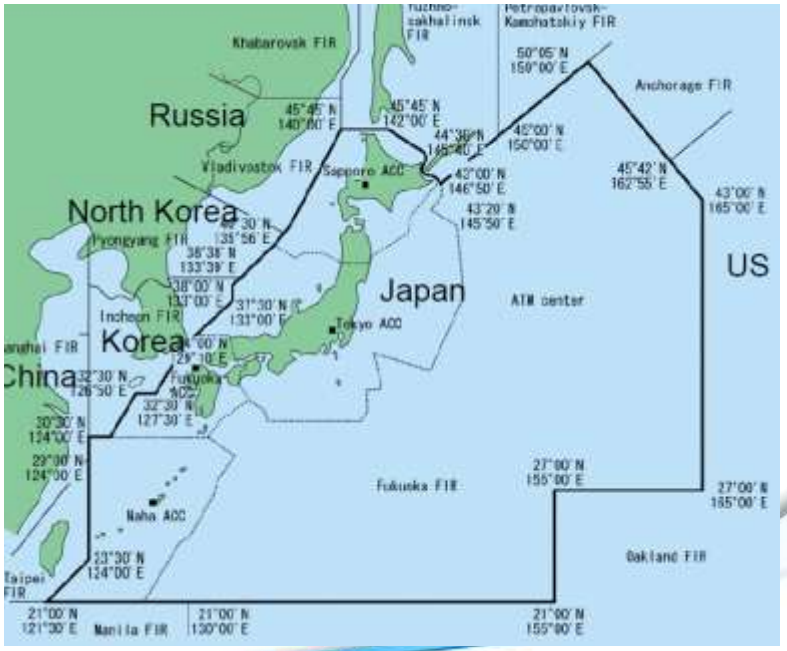
- **Exponential aviation demand growth**
- **Increasing number of overflights between rest of Asia Pacific and Europe going through exponential growth**



Operations: Asia

Japan

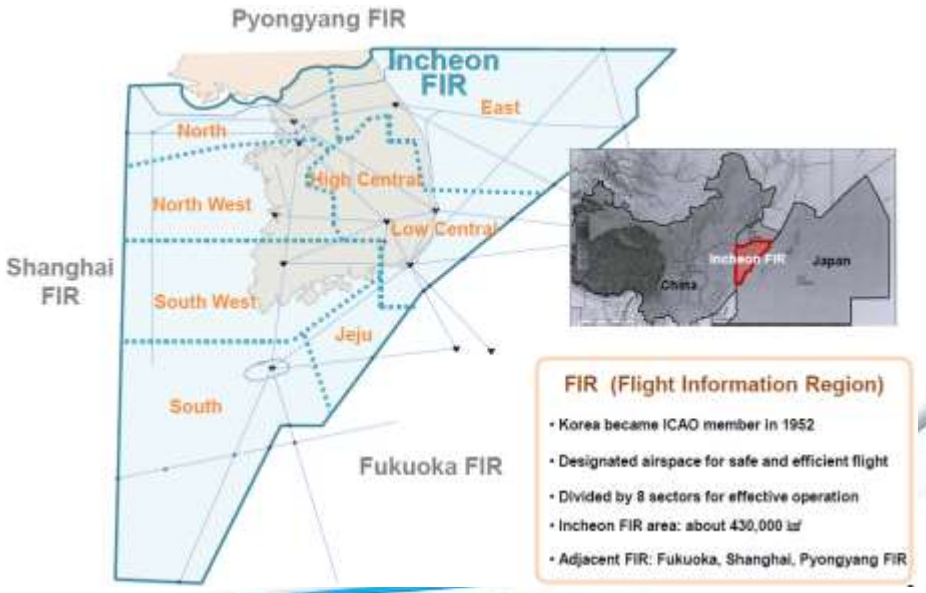
- Fukuoka FIR between US and Asia : flyover traffic about 15% of all air traffic
- International flights and over-flights increased
- The number of aircraft exceed air traffic control capacity around 2025
- Promotion of inbound tourism, and growth of Low Cost Carriers
- Short Domestic flights (< 2 hrs.)
- Efficiency of terminal operations



Operations: Asia

Korea

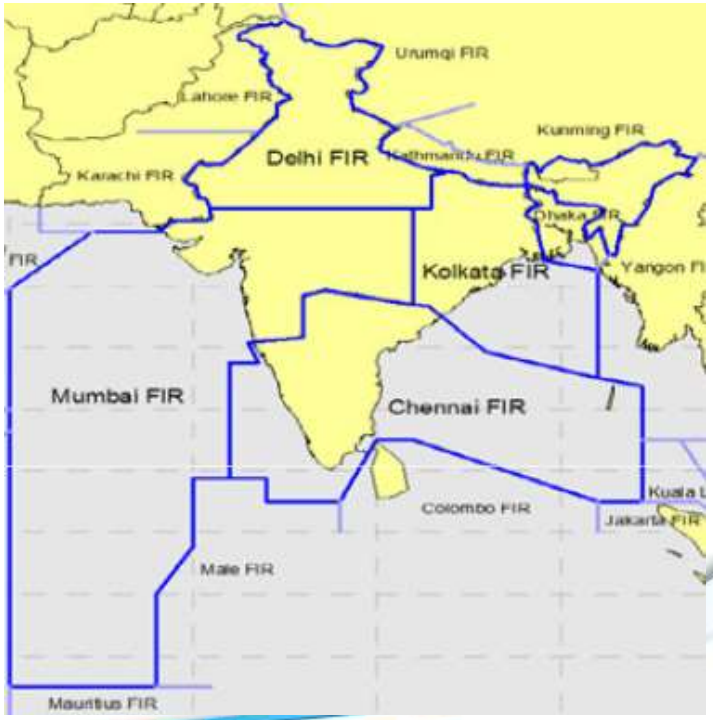
- Extremely limited airspace
- Two major airports close to each other
  - Short distance from Shanghai FIR Boundary with Incheon FIR
- Military and other restricted zones, in addition to the demilitarized zone and the capital area defense zone
- Very little airspace to maneuver for traffic and absorb delays
- High dependency on Japan and China's ATM systems
- Several air routes which are among the world's ten busiest air routes.



Operations: Asia

India

- Over 442 air access locations
- 80+ fully operational airports
- Evenly distributed across the country
- Some airport at higher elevations
- A few airports handle majority of the traffic
- Overflights for the Middle East to Asia, and Europe to Australia flight corridors
- 200,000 overflights with a mix of short and long routes (2014)

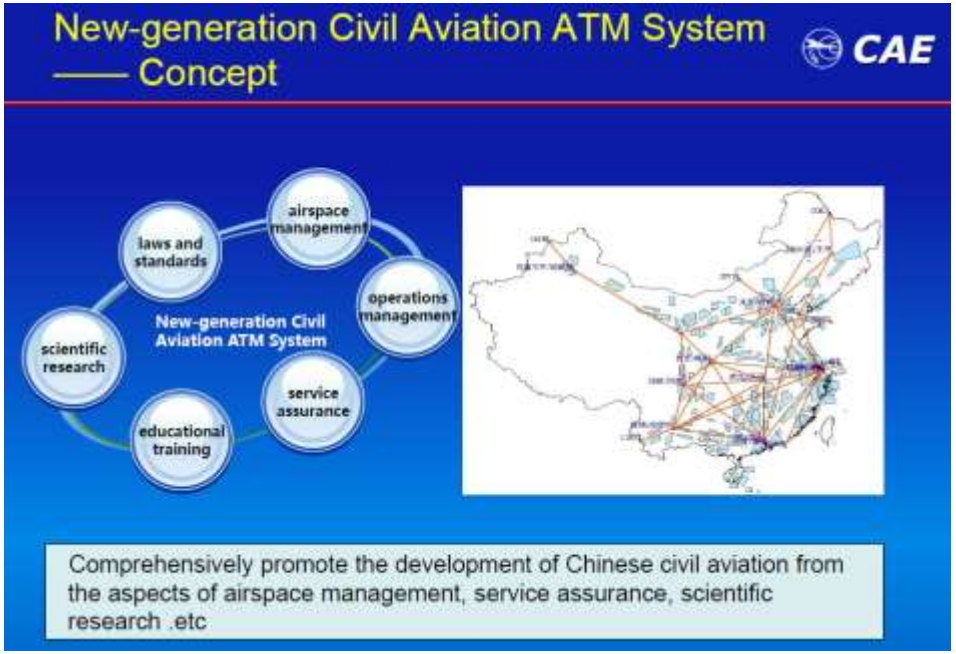


Transformation: Asia

China

- ATM System Construction
- Airspace management reform
- ATM support capability
- ATM operation security

- The Goal: Move from
  - ➢ Civil and military aviation respective operation to coordinated operation

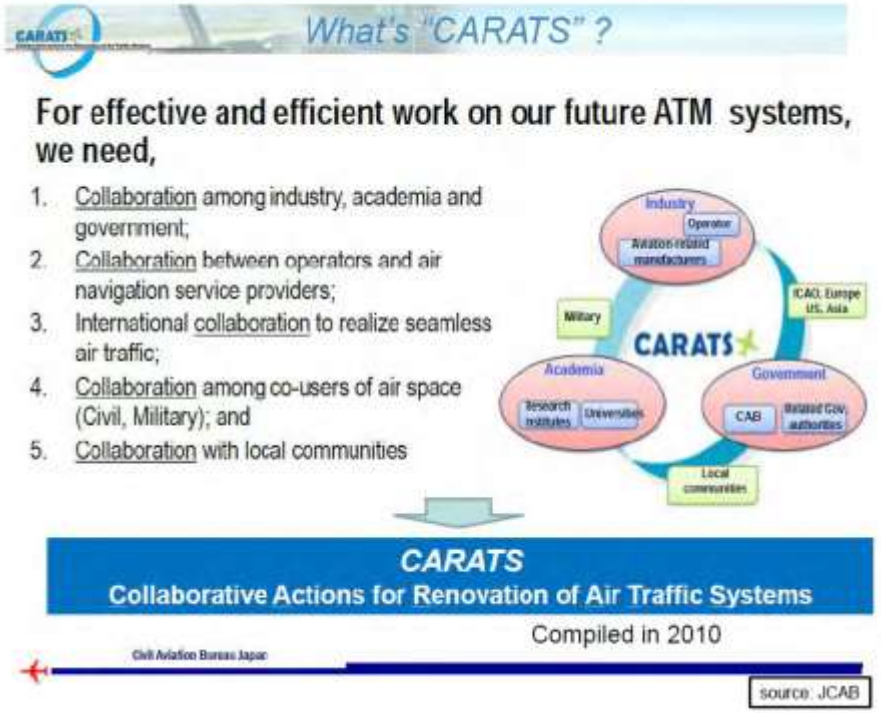


  - ➢ Extensive airspace management to intensive pattern
  - ➢ Large scale infrastructure construction to focus on efficiency

Transformation: Asia

Japan

- **CARATS 2025 target**
  - **Increase safety level 5 times**
  - **Reduce fuel consumption and CO2 emissions per flight by 10%**
  - **Double ATC capacity in congested airspace**
  - **Improve service level by 10%**



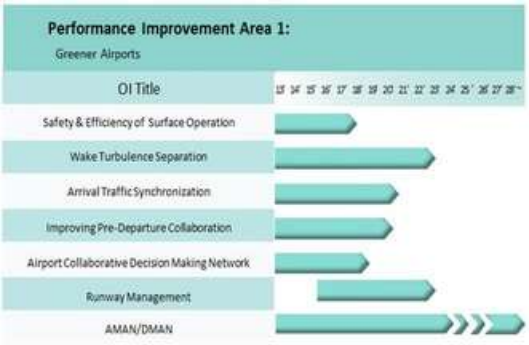
Transformation: Asia

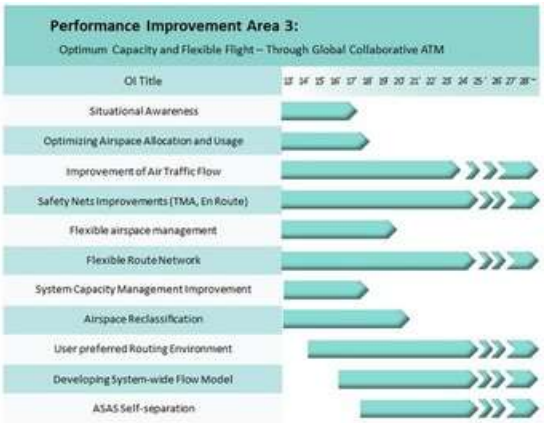
South Korea

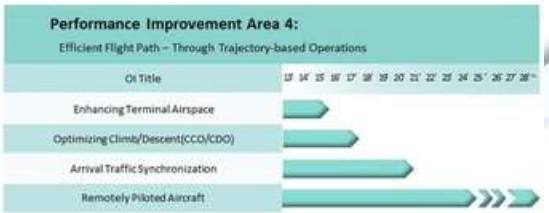
- Modernizing of air navigation system (CNS/ATM, aviation tech.)
- Future ATM plan (2011)
- Working group (Nov. 2011) as a group of researcher from academia and civil aviation organization ➔ draft NAREA

NARAE

National ATM Renovation & Enhancement Plan







Research: Asia

- CAE:
  - Communication
  - Performance based NAV (PBN)
  - Interval Management and Conflict Detection
- KARI:
  - Arrival and Departure Manager
  - UAS Integration into Controlled Airspace based on TBO concepts
  - ADS-B validation system
- JAXA:
  - Disaster-relief operations
  - Wake vortex and wind shear forecasting technology
  - Noise abatement operation technology
  - GPS/INS integrated navigation technology
- NAL:
  - Performance Based Navigation

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Global Need for Coordination and Collaboration

- Both differences and similarities in operational challenges
- Similar goals and objectives in transformation of the ATM system
- Research efforts have similarities & complementary in nature

- Complementary collaboration
- Global harmonization
- Impact and inform global mid and long term roadmaps (national efforts & ICAO)

IFAR Air Traffic Management Working Group Progress

- Captured the regional operational environments, challenges, and modernization efforts
- Captured national R&D efforts and capability
- Identified potential areas of collaboration between members
  - Some bilateral engagement already underway
- Begin engagement with the national ICAO ATM Requirements and Performance Panel (RPP) representatives
- Begin informing ICAO ASBUs with research results
- Form a Users Forum of regulators, ANSPs, airlines, airports, and industry
  - Share results
  - Gain subject matter input
  - Collaborative activities and joint deliverables

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International Council of the Aeronautical Sciences

INTERNATIONAL FORUM FOR AVIATION RESEARCH

ICAS-IFAR Award

- To honor an individual who has made a significant contribution to Aeronautical Science within his/her doctoral thesis (Ph.D. or equivalent)
- Eligibility:
  - Within 2 years of the date after the PhD was obtained
  - Under 40 years old at nomination date
- Selected by IFAR Evaluation Team & ICAS Honors & Awards Committee
- The 2016 Award Winner was selected out of 12 candidates nominated by IFAR members worldwide