The Long-Term Vision of Future Air Traffic Systems in Japan

CARATS
~shift to more intelligent air traffic systems~

The 2nd ENRI International Workshop on ATM/CNS

Akihabara, Tokyo, Japan
10 November, 2010

Contents

Theme topic for EIWACS 2010
FORSEE: FOR (e) Safety, Efficiency and Environment

1. What’s “CARATS”?  
2. Background  
3. Trend & Characteristics of air traffic in/around Japan  
4. Outline of “CARATS”  
5. Goals of “CARATS”  
6. Directions of ATM Renovations  
7. Work plan for 2010  
8. R&D aspect in CARATS
1. What’s “CARATS”? 

In order to effectively and efficiently work on future ATM systems, we need:

1. Collaboration among industry, academia and government;
2. Collaboration between operators and air navigation service providers;
3. International collaboration to realize seamless air traffic environment;
4. Collaboration among co-users of air space (civil, Self-Defense Force, US Force); and
5. Collaboration with local communities.

---

CARATS: Collaborative Actions for Renovation of Air Traffic Systems

Civil Aviation Bureau Japan

---

2. Background (1)

Social and Economic Challenges in Japan

- Decreasing population
- Declining birth rate
- Aging society
- Global warming issues
- Rapid growth of economy in Asia

A “Growth Strategy” needed to sustain Japan’s economy and enhance its international position

“Aviation” is one of essential foundations for social and economic development and upgrading of life standards

Improvement of aviation services level needed in both quality and quantity

For example, ATC capacity enlargement in congested air spaces and streamlining air traffic systems, while meeting users and social needs

Air Traffic Systems, through its renovation, will continue to be a cornerstone for future growth of Japan

Civil Aviation Bureau Japan
2. Background (2)

Constraints in present ATM systems

- Shortage of ATC capacity unable to meet high demand of air traffic
- Chronic delay of traffic due to the ATC overload
- Inefficient operation due to inflexible use of airspaces and routes
- Accidents/incidents attributable to human errors and HMI under the current systems

"Dynamic" and "Strategic" renovation of Air Traffic Systems

Global Trend in "Global ATM Concept" Crystallization

- ICAO: Adopted "Global ATM Operational Concept(Doc.9854)" targeting at 2025, has been promoting the Concept with its stress on global harmonization.
- US/EU: Completed an ATM master plan and are now in development phase
- Asia/Pacific: Some States maybe are studying its own master plan or having one, but neither the regional nor sub-regional programme does exist.

Intra-regional and inter-regional cooperation for realizing "Global ATM"

3. Trend/Characteristics of air traffic (1)

The number of flight, including overflight, is forecast to increase by 50% around 2027.

Average rate of increase in 2005-2017 (prediction)
- Fly over: +4.0%
- Int'l: +3.0%
- Domestic: +1.8%

For your reference:
- Over Flights: 2005: 598 (100), 2017: 1672 (302), 2027: 2709 (568)
- Domestic Flights: 2005: 822 (151), 2017: 716 (135), 2027: 600 (120)

Numbers in (): % ratio to 1990

*1: Prediction of demand is premised on the capacity limitation of metropolitan airports.
*2: The figures beyond 2022 is tentative prediction and will be re-forecast at the next reviewing process.
3. Trend/Characteristics of air traffic (2)

Looking at intra/inter regional traffic of Asia, · · ·

A steady increase of air traffic in the Asia/Pacific region, along with its robust economy. Still, further growth is expected.

- Within Europe: 319.34M (+2.3%)
  - Europe - Asia: 38.22M (+4.2%)
- Within Asia: 356.26M (+5.3%)
- Within North America: 279.15M (+2.7%)
- North America - Europe: 58.71M (+2.7%)
- North America - Asia: 19.18M (+3.0%)

Number of International and Domestic passengers within the region (2009, million)
Expectancy of International passengers within the region (from 2009 to 2013)
Number of International passengers between regions (2009)


3. Trend/Characteristics of air traffic (3)

Looking at a domestic air transport network, · · ·

Convergence of air traffic into the metropolitan area.

TOKYO [HANEDA] User 55,460,000 (66.1%)

Other airport

2009 Domestic passenger transportation (83,870,000)

Haneda-based domestic air transport network

TOKYO [HANEDA]
3. Trend/Characteristics of air traffic (4)

Looking at a traffic flux over metroplex, 

Congested flows of air traffic, radar-vectored through segmented and layered airspaces.

Traffic flow over Japan

Traffic flow over Japan

3. Trend/Characteristics of air traffic (5)

Looking up at the air corridor above us, 

A hike of over flight and cross-boundary traffic in Fukuoka FIR can aggravate efficiency, ATC capacity and regularity.

Note: The figures are daily average number of aircraft controlled by Fukuoka ATM Center in 2007.

Civil Aviation Bureau Japan
3. Trend/Characteristics of air traffic (6)

Looking at air navigation service clients, · · ·

- High expectation of “rapidness” in transportation
- High expectation in “regularity” of transportation

On-Time Arrival Rate

Serviceability of Flight

3. Trend/Characteristics of air traffic (7)

In a “jigsaw-puzzled air space”, to be improved, for example, are;
- Continuous RNAV routes across FIR boundaries
- Automated ATC transfer across FIR boundary
- Optimum altitude assignment across boundary

Looking at other aspects, · · ·

- Inefficient cross-boundary operation due to the ops/tech gaps

Restricted routes and procedures due to the tech/topographical constraints

Civil Aviation Bureau Japan
4. Outline of CARATS (1)

Features: What’s “CARATS” in short?

- A long-term vision, foreseeing at 2025 and beyond
- A product thru collaborative work among ATM stakeholders
- Aiming at performance-based ATM system with clear targets
- Encompassing wide actors and systems, including airborne
- Stepped approach based on roadmaps
- Performance review and goal achievement analysis

4. Outline of CARATS (2)

Structure: What does “CARATS” comprise?

7 Goals
1. Enhance safety
   5 times Safety
2. Increase ATC capacity
   Double Capacity
3. Improve user convenience
   +10% Service level
4. Improve operation efficiency
   -10% Fuel Consumption
5. Enhance ATM service efficiency
   +50% Productivity
6. Reduce environment effects
   -10% CO2 emission
7. Strengthen International Cooperation and Contribution

8 Direction of ATM Renovation
1. Trajectory-based Operation
2. Enhancing predictability
3. Performance-based Operation
5. Improving Situational Awareness
6. System automation and HMI
7. CDM on Information Sharing Platform
8. High Density Operation

Roadmap(*)

Short Term
- TBO at Decent phase
- RNP-AR
- Data Link
- Improved ATFM
- Airport surface ATM

Mid Term
- Precision Approach using SAT NAV
- SWIM
- Dynamic ASM incl. non-civil Airspace

Long Term
- ASAS
- Full 4D Trajectory

(*) Roadmaps are under consideration.
5. Goals of CARATS (1)

Enhanced Level of Safety (5 times safety)

While air traffic volume is forecast to increase by 1.5 times in 2025, the air traffic systems should reduce the number of aircraft accidents at least by half.

\[(1.5 \times 1.5) \times 2 = 4.5 \quad \text{Round-up} \quad 5.0\]

Numerical target

Descriptive goal

- “Safety” continues to be a major prerequisite in designing and establishing the future air traffic systems.
- Focus on the countermeasures against accidents attributable to human errors, meteorological factor, inadequacy of information sharing among stakeholders and lack of situational awareness.
- In terms of crisis management, security measures and contingency measures must be secured to provide continuous and stable AN services.
- For continuity of operation, the systems should be designed with high reliability and invulnerability against external factors.

6. Directions of ATM Renovation (1)

ATM renovation supported by CNS innovation to achieve “seven goals” by overcoming the existing constraints.

8-pillared renovation

1. Realization of trajectory-based operation (TBO)
2. Improving predictability in ATM
3. Promoting performance-based operation (PBO)
4. Development of satellite-based navigation during all flight phases
5. Adequate situational awareness in the air and on the ground
6. Maximum application of human and machine capability, on the platform of automated ATM systems
7. Information sharing and collaborative decision making (CDM on SWIM Platform)
8. Attainment of high-density operation in congested airspaces and at airports
With “TBO” as a core element, 8 lines of renovation will pave the way to ATM paradigm shift.

**Line 1. Trajectory-based Operations**

Benefits by TBO
- Optimized, user-preferred route setting
- Efficient operation both on board and on the ground
- Optimized use of the entire airspace by allowing for numerous factors
- Fuel-efficiency and less CO2 emission
- Integration of ground systems
- Less human intervention
- etc

Benefits by GNSS operation
- Provision of navigation service to cover the entire Fukuoka FIR
- Continuous Navigation service from departure to arrival using GNSS
- Higher precision and flexibility in design and use of airspaces, routes and procedures
- Less operational restriction resulting from ground obstacles
- Safety enhancement
- High fuel-efficiency and less CO2 emission
- Tool for noise abatement
- etc

**Line 4. Satellite-based Navigation**

Example: 4. Sat-Nav

**Line 2: Improving predictability**
- Maximum use of WXR forecast information
- Improvement of WXR forecast, using down-linked airborne data
- Provision of optimum 4DT, capitalized on high predictability

**Line 5: Enhancing situational awareness**
- Improvement of visibility for surface movement, esp. for blind areas
- Improvement of ground-air surveillance capability
- Improvement of air-air surveillance capability

**Line 4: SatNav in all flight phases**
- Provision of navigation service at lower altitude
- GNSS-based precision approach
- Flexible route setting to avoid the ground constraints

**Line 7: CDM and Information sharing**
- Adequate coordination among ATM stakeholders
- Timely accessibility to needed information
- Well-informed decision with more transparency

Example: Safety Enhancement (Goal 1) and relevant renovation
7. Work plan of 2010 (1)

So far, a vision on future ATM has been blueprinted. In FY2010, “CARATS Promotion Committee” will ...

- **Lay out a roadmap**, representing step-by-step implementation of the measures required to build the future air traffic systems.

- **Clarify the roles** of the industry, academy and government partners.

- **Study and set indices** for achievement analysis of numerical targets.

- **Consider a framework**, as necessary, to ensure the steady implementation of the mapped measures.

7. Work plan of 2010 (2)

To ensure our future system be interoperable with others, we will...

- **Continue to have dialogues** with overseas counterparts to secure harmonization.

- **Contribute to international standardization activities** under ICAO framework.

- **Work on “Seamless Sky” initiative with Asia/Pacific States**.

- **Assist States in need for smooth transition to future ATM systems**.
8. R&D aspect in CARATS (1)

R&D will also be undertaken in a phased approach with external factors taken into account.

**Vision** (Concept, Targets, Lines of renovation, etc)

**Roadmaps**

- Government Policies
- Aviation Policies/Directives
- Social / Economic trends
- Operational needs

• ICAO’s global ATM policy
• ATM modernization in other Regions/States
• Technology innovation
• Global issues affecting Aviation

Selection & focus-on

**Mainly CNS/ATM**
- R&D long-term vision incl. roadmap
- Five-year work program
- Annual work plan
- etc

**Mainly Aircraft Operation**
- “DREAMS” project
- Five-year work program
- Annual work plan
- etc

Technical solutions, validation, verification, evaluation, safety assessment etc

8. R&D aspect in CARATS (2)

Under CARATS vision, expectations to research institutes are:

- To conduct R & D, taking well into account operational needs and international trends.
- To analyze and evaluate brand-new tech and ATM ops in a timely manner, in cooperation with CAB, operators and others.
- To collaborate with academia and industries, leading to wider spectrum of ATM research and R&D calibre in Japan.

Effective and efficient role playing to be laid out over a long span.

<table>
<thead>
<tr>
<th></th>
<th>Planning</th>
<th>R &amp; D</th>
<th>Standardization</th>
<th>Development</th>
<th>Implementation</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSP</td>
<td>• Leading • Policy making</td>
<td>• Request • Support</td>
<td>• Leading • Legislation</td>
<td>• Regulation • Procedures • Manuals</td>
<td>• Implementation</td>
<td>• Operational evaluation</td>
</tr>
<tr>
<td>Research Institutes</td>
<td>• Proposal • Needs finding</td>
<td>• R &amp; D</td>
<td>• Participation</td>
<td>• Safety Assessment • Validation</td>
<td>• Support to implementation</td>
<td>• Support to evaluation</td>
</tr>
<tr>
<td>Operators</td>
<td>• Needs presentation</td>
<td>• Request • Support</td>
<td>• Participation</td>
<td>• Procedures • Manuals</td>
<td>• Equipage</td>
<td>• Operational evaluation</td>
</tr>
</tbody>
</table>

Note: The above table is an example only, does not constitutes CARATS vision. Involvement of academia and industries are subject to individual cases.
8. R&D aspect in CARATS (3)

R&D institutes are expected to play significant roles in forging a global ATM by:

- Involvement and contribution to int’l standards making.
- Cooperative work with R&D entities of other projects.
- Keeping abreast with the tech evolution and proactive involvement.

Global ATM based on Doc. 9854 (ICAO)

ANC Panels, Study Groups, Standards RTM

Harmony & Collaboration

APAC regional initiative

R&D organizations

NextGen (USA)

RTCA, R&D organizations

SEPAR (EU)

EUROCAE, R&D organizations

CARATS (Japan)

ANSPs, Government, Academia, Industries, Operators, etc

Enri

JAXA

The End

Thank you for your attention.
Merci pour votre attention.
Gracias por su atención.
清聴谢谢
청취 감사합니다
ご清聴、ありがとうございました。
For further information, please access to
http://www.mlit.go.jp/koku/koku_CARATS.html,
or contact JCAB. at
Call: +81-3-5253-8739
Email: nakada-t2g4@mlit.go.jp