CARATS
(Collaborative Actions for Renovation of Air Traffic Systems)
Background
International flight and flying-over are increased. Domestic flight is dependent on the case of GDP. Even if GDP is estimated low, the number of aircrafts will exceed the limit of air traffic control capacity around 2025. The demand may go up rather than this forecast by further promotion of inbound tourism and the growth of LCC.

* Basic case of GDP is set up based on the economic growth rate which is a target of the Japanese future strategy. (economic growth rate is set up to 1.7% from 2010 to 2017 and 2.0% from 2017 to 2032)
* In upper case, economic growth rate is set up 1% higher than basic case.
* In lower case, economic growth rate is set up 1% lower than basic case.
* The number of IFR flights is that to add military, non-scheduled and cargo flights to those above.
The number of flights increased 1.5 times in the past 15 years.
The number of staffs decreased slightly every year.

We have conducted air traffic services corresponding to the increase of air traffic demand by the enhancement of systems and the improvement of productivity.

*The staffs include air traffic controller, air traffic communication specialist, air navigation service engineer, aeronautical lighting and electricity specialist and aeronautical satellite operations specialist.*
CARATS Overview
Consideration of long-term vision

• 2009～2010 Development of long-term vision
  – Establishment of “Study group for Promoting Renovation of the Air Traffic System”
  – Development and promulgation of “Collaborative Actions for Renovation of Air Traffic Systems” (CARATS)

• 2010～2011 Development of roadmap for each measures
  – Establishment of “Committee for Promoting Renovation of the Air Traffic System”
  – Consideration of concrete measures and development of roadmap

• 2011～ Implementation of the measures
The committee manages whole CARATS activity.
Each concrete discussion of the measure is carried out in each WGs, ad-hoc and SG under the PBN WG.
All of these meetings are collaborative activity in which JCAB, research institute, manufacturer and airline have participated.
## Objectives of CARATS

**Objectives to be achieved by 2025**
(clarifying numerical targets)

<table>
<thead>
<tr>
<th>Objective</th>
<th>Numerical target</th>
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<tbody>
<tr>
<td>Enhancing safety</td>
<td>Increase safety level by 5 times</td>
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<tr>
<td>Responding to the increase in air traffic volume</td>
<td>Double the air traffic control capacity in congested airspace</td>
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<tr>
<td>Improving user conveniences</td>
<td>Improve services level (punctuality and reduction of flight time) by 10%</td>
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<tr>
<td>Improving operational efficiency</td>
<td>Reduce fuel consumption per flight by 10%</td>
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<tr>
<td>Improving productivity of air traffics services</td>
<td>Improve productivity of air traffic services by 50% or more</td>
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<tr>
<td>Responding to environmental issues</td>
<td>Reduce CO2 emissions per flight by 10%</td>
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<tr>
<td>Enhancing the international presence of Japan in the aviation field</td>
<td>(Qualitative objective)</td>
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<tr>
<td>Objective and Numerical target</td>
<td>Outline of indicator</td>
</tr>
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<td>--------------------------------</td>
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<tr>
<td>1 Enhancing safety</td>
<td>The number of aircraft accident and important incident resulting from ATC (the average number for the past five years)</td>
</tr>
<tr>
<td>(Increase safety level by 5 times)</td>
<td></td>
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<tr>
<td>2 Responding to the increase in air traffic volume</td>
<td>(Under consideration)</td>
</tr>
<tr>
<td>(Double the air traffic control capacity in congested airspace)</td>
<td></td>
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<tr>
<td>3 Improving user conveniences</td>
<td>Punctuality: The rate of the arrival delay flights exceeding 15 minutes</td>
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<tr>
<td>(Improve services level by 10%)</td>
<td>Actual operation rate: The flight cancellation rate by the influence of the weather (the average rate for the past three years)</td>
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<td>4 Improving operational efficiency</td>
<td>Rapidness: Flight time of Gate-to-Gate of main routes.</td>
</tr>
<tr>
<td>(Reduce fuel consumption per flight by 10%)</td>
<td>The amount of the fuel consumption per flight in main routes</td>
</tr>
<tr>
<td>5 Improving productivity of air traffics services</td>
<td>The flight plan operation number of each air traffic controller</td>
</tr>
<tr>
<td>(Improve productivity of air traffic services by 50% or more)</td>
<td>The flight plan operation number to the maintenance expense (the average number for the past three years)</td>
</tr>
<tr>
<td>6 Responding to environmental issues</td>
<td>The amount of the CO2 emissions per flight in main routes</td>
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<tr>
<td>(Reduce CO2 emissions per flight by 10%)</td>
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</table>
4. Realizing Satellite-based Navigation for All Flight Phases

Aircraft can determine position and time accurately in all FIR of Japan by Satellite-based navigation.

1. Realizing Trajectory-based Operation (TBO)

Fly regularly on a pre-coordinated trajectory from departure to arrival.

Accurate time-based management.

2. Improving Predictability

The calculation of air traffic control capacity, estimation of traffic flow, improving of predictability of meteorological phenomena.

3. Promoting Performance-based Operation (PBO)

Cooperation between ground and air, information sharing.

Integrated ATC processing system.

5. Enhancing Situational Awareness on the Ground and in the Air

8. Realizing High-density Operation in Congested Airports and Airspace

6. Making Maximum Use of the Capability of Human Beings and Machines

7. Complete information-sharing and Collaborative Decision-Making

9.
In order to establish future air traffic systems in a planned manner based on the CARATS, it is necessary to prepare a roadmap specifying measures to be taken through collaboration among the parties concerned and put short-term measures into action first, while carrying out R&D in a planned manner regarding long-term measures.

From this viewpoint, the MLIT prepared the CARATS Roadmap in March 2011.

The roadmap specifies 64 measure that needs to be taken in order to achieve the CARATS, and categorizes them into measures intended to improve operation (operational improvements (OI)) and measures relating to technology necessary for enabling such improvement (enablers (EN)).
Activities in implementation phase

- Development of implementation plans on short-term OIs and ENs
- Research and development plans on long and mid-term OIs and ENs
- Cost benefit analysis
- Implementation decision making
- Performance monitoring
- Progress review on roadmap
- Review of OIs and ENs and roadmap and performance measures
Recent Topics
Decision for Introduction of CARATS measures in FY 2013

- **UPR**
- **DARP (by CPDLC)**
- **Free routing**

**Continental**
- **UPR + DARP**
- **CPDLC**
- **Free-routing**

**Oceanic**
- **UPR + DARP**
- **CPDLC**

**Seamless operations among continental and oceanic airspace**

**Ultra upper sectors**
**Upper sectors**
**Lower sectors**

**International departures**
**Flying-over**
**Arrival to the domestic**

- **Issue climb instruction (by CPDLC)**
- **CDO (by CPDLC)**
- **Issue frequency change (by CPDLC)**
- **CFDT for multiple points (by CPDLC)**
- **Consolidation of terminal control airspace**
- **Dynamic sector composition**
- **Time-based metering**
  - **RECAT**
  - **Variable terminal control airspace**

**Fundamental System**
- **Integrated air traffic control data processing system (EN-1)**
- **Integrated display for weather observation data (EN-4-1)**
- **WAM for en-route (EN-9-2)**
Airspace re-formation
- West Japan: 2020
- East Japan: 2024

Dynamic sector composition
- Change of vertical boundary: 2020
- Change of vertical and horizontal boundary: 2026~

Continental CPDLC: 2021

UPR and DARP in the continental airspace
- UPR: 2025
- DARP: 2026~

Time-based metering
- Fixed metering fix: 2018
- Dynamic metering fix: 2021

RECAT (phase 1, 2): 2018

Variable terminal control airspace
- Operation using multiple fix point: 2019
- Operation by instruction of L/L: 2021
Future airspace structure

【Current - divided by geographical bases】

- Each ACCs divided by vertically
- ACC controls from the surface to upper
- TCAs are set depending on the location of airport

【Future - divided by aircraft movement, i.e., climb, cruise and descend phase】

- ACCs divided into upper and lower.
- TCAs consolidated or expanded

【Future airspace】

- ACCs divided by geographical bases
- ACC controls from the surface to upper
- TCAs are set depending on the location of airport
Continental CPDLC (service image)

**Utilization of private company**

- Newly-established station
- VDL-mode2 ground station
- VDL-mode2 ground station
- POA ground station
- ATC
- AOC
- DSP network
- Datalink service provider
- Central system
- AOC

**Consideration of service coverage**

- Current coverage of DSP
- Newly-expanded area (under discussion)

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MLIT

**VGSサービスカバレッジ 25,000円（計算値）**

About 200NM
Example of other activities
Example of Activities: Performance based navigation

Expansion of RNAV by using an aircraft equipping the advanced flight management system for navigation, and having high navigation capability. As a result, flight efficiency and safety are improved. Nationwide implementation of PBN is promoted by shift to higher precision RNAV.

Status of implementation of RNAV

A precise and flexible approach procedure

<table>
<thead>
<tr>
<th>SID/TR (Departure)</th>
<th>STAR (Arrival)</th>
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<tbody>
<tr>
<td>RNAV1: 27</td>
<td>RNAV1: 24</td>
</tr>
<tr>
<td>Basic-RNP1: 12</td>
<td>Basic-RNP1: 6</td>
</tr>
<tr>
<td>(# of Airports)</td>
<td>(# of Airports)</td>
</tr>
</tbody>
</table>

Approach

- RNAV (GNSS): 31 (RNAV: 16  RNP: 15)
- RNP AR Approach: 12
  (# of Airports)

As of JUNE1, 2014
Realizing Trajectory-based operation which optimizes a trajectory of an aircraft without depending on fixed airspace and routes. ⇒ An aircraft flies the trajectory which introduced time-based management while receiving support of a system. As a result, the aircraft keeps the efficient trajectory.

Example of Activities: Trajectory-based operation

- **Initial stage of trajectory-based operation**
  - 20 knots acceleration
  - 10 knots deceleration

- **Preparation of trajectory-based operation**
  - 20 knots deceleration
  - 10 knots acceleration
  - 30 knots deceleration

- **Implementation of time management at a crossing point** (2011)
  - Evasion of a thundercloud

- **Implementation of time management at several crossing point** (2019)
  - Adjustment of trajectory as required to flexibility thorough the support of system

- **Final stage of trajectory-based operation**
  - 2026
Example of Activities: Continuous descent operations

- Realizing CDO (continuous descent operations) which specifies the passage time and the passage altitude of a specific point and enables continuous descent without temporary level flight in descent and approach phase.
- Reduction of fuel consumption, CO2 emission and noise are expected.

- CDO is defined as the following three stages by procedures of operation.
  - Initial stage: CDO by radio communication (This is introduced at Kansai airport)
  - 2nd stage: CDO realized by the uplink of a 3D trajectory from the ATC system (This is applied in limited time zone because it is difficult to apply in the congestion time.)
  - 3rd stage: CDO realized by the uplink of a 4D trajectory which indicate time (This is applied in all the situations including the congestion time and congested airport.)
Realizing high-density operation by shortening an separation resulting from wake vortex

A separation can be shortened by predicting movement of wake vortex by observation of a wind.
A separation can be shortened by detecting and predicting wave vortex.
Example of Activities: Establishment of SWIM

Establishment of the network (SWIM: System Wide Information Management) which manages all the information concerning operation comprehensively, and can access required information when required.

2018- International standard format

2019- Initial operation

2026- harmonization of function

Various stakeholders
Owner, manager or user of various information (System)

- Governance
- Creation of additional value
- Service oriented architecture (SOA)
- Information sharing
- Security policy
- Effective use of current technology
- Standardization of protocol
- Effective use of COTS

SWIM network

 Various information

System of Airport administration

Aircraft

Ministry of Defense

Research institute

System of Airlines

System of JCAB

System of Meteorological Agency

Operator

Global information sharing

JCAB

Meteorological Agency

AIS & AIM info

WX (Weather info)

Information About Airport

AIS & AIM info

ATM (ATM info)

FPL (Flight Plan info)

Surveillance and Aircraft position

Various information

System of Defense

Operator

Airport administrator

SWIM network

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