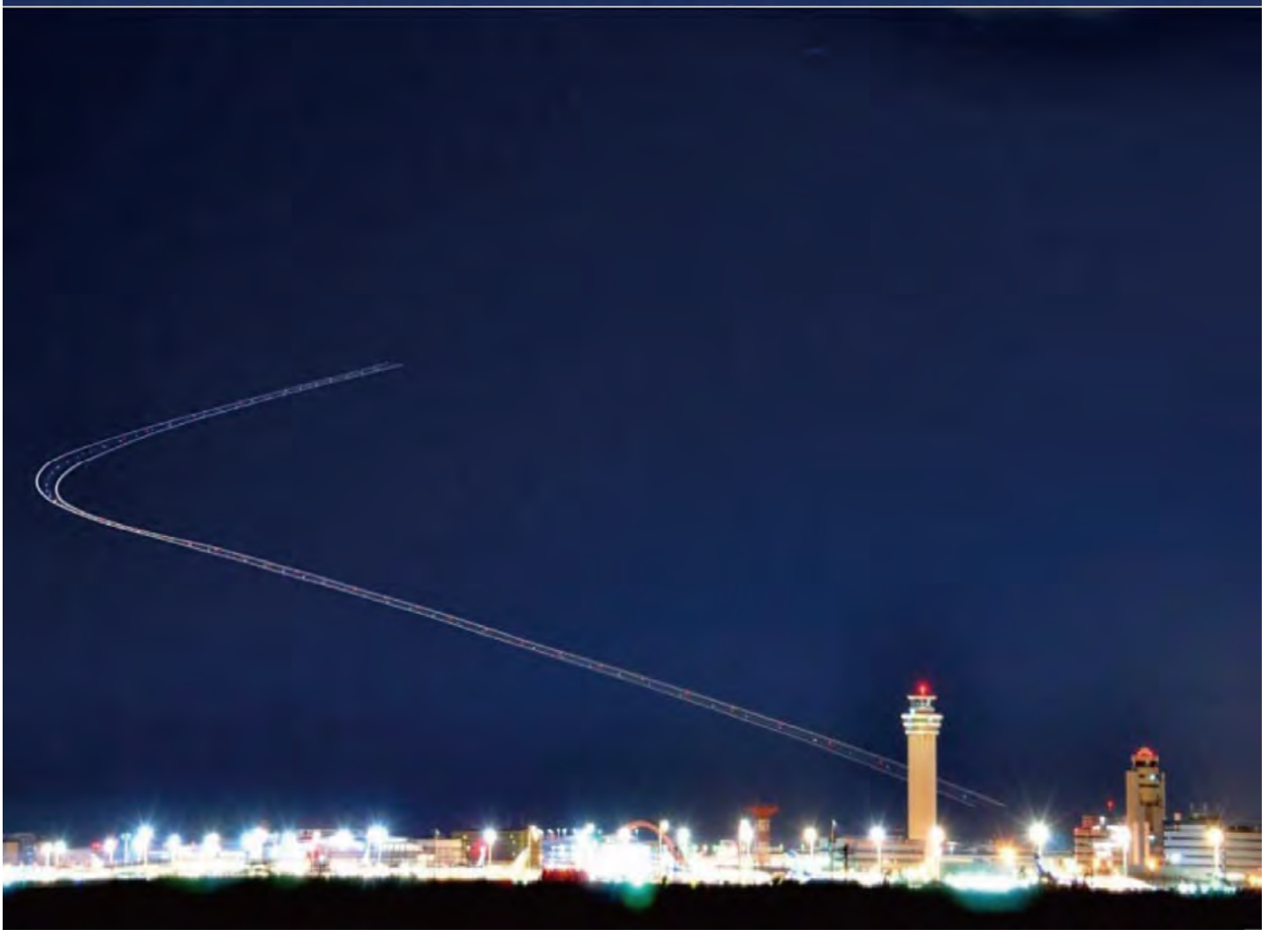
CARATS

Collaborative Actions for Renovation of Air Traffic Systems

CARATS Long-term Vision for Air Traffic Systems



Necessary Reforms based on the Envisioned Skies 15 Years from Now

Meet the growth in global air traffic demand

Economic growth in Asian States

An exploding growth in air traffic demand is projected in our neighboring States including South-east Asia due to the rapid economic growth.

Progress of globalization

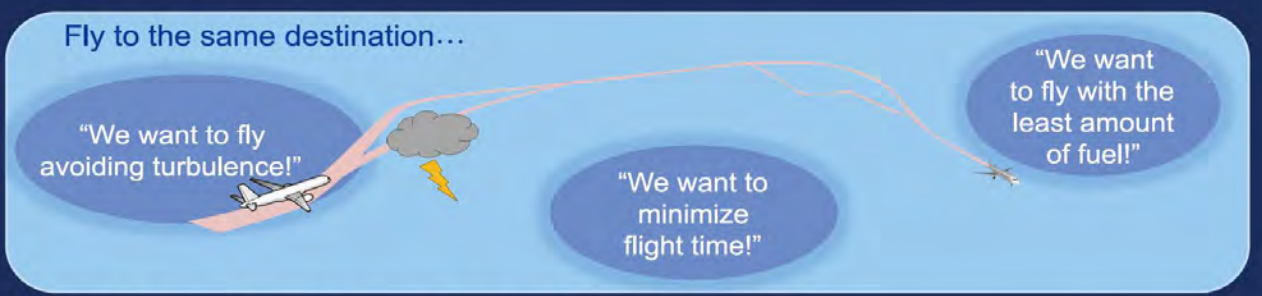
With the progress of economic globalization, significant increase in international flights to and from Japan is expected.

The number of aircraft flying across Japan is also expected to increase by1.5 times in the next two decades. In order to achieve continued economic growth in Japan and its neighboring States, air traffic control capacity to support the growing demand must be secured to provide aviation infrastructure for such economic activities.

Number of aircraft predicted to fly across Japanese airspace

Appropriate response to various needs

Various other needs that include improvements in user-friendliness and operational efficiency as well as achieving economical operations and addressing the growing concerns over global warming must be met appropriately.



Ensuring international interoperability

Unlike cars or trains, aircraft fly beyond national boundaries. Therefore, aviation infrastructure that supports air navigation services must be capable of providing seamless services to international flights.

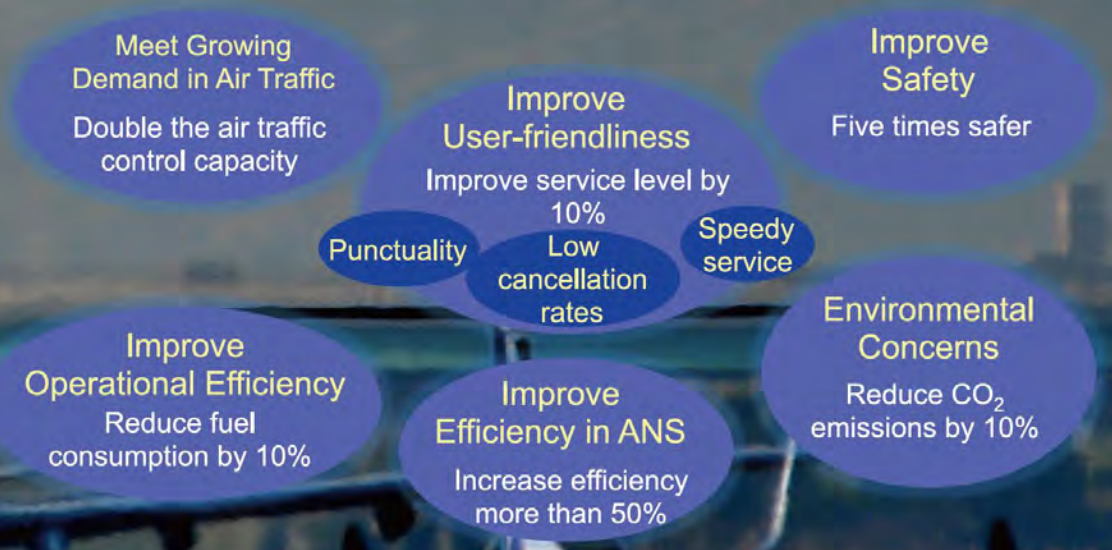
Industry-academia-government collaboration for the development and implementation of CARATS measures

In order to meet the growing demand in air traffic and other needs appropriately, a reform of air traffic systems is essential. In Japan, all the stakeholders have developed CARATS, the long-term vision for air traffic systems, through collaborative decision-making and have been making efforts to push forward with the reforms.

Purpose of CARATS

The goals to be achieved by 2025 within the framework of CARATS (Collaborative Actions for Renovation of Air Traffic Systems) had been set, and the measures for goals have been implemented step by step.

More specific measurable targets had been set for each goal, and the achievement of the targets are being measured to promote the implementation of CARATS measures effectively.



International collaboration with the U.S., Europe and other States

Meeting the growing demand for air traffic is viewed as an important issue for the international aviation community, and the ICAO has developed the Global ATM Operational Concept, which sets the basic direction for internationally-harmonized ATM foreseeing 2025 and beyond.

Based on that, the United States and European States have developed long-term visions for their regions (US: NextGen and Europe: SESAR).

In the midst of an ongoing process of air traffic system reforms worldwide including Japan, it is important for all States to implement the reforms in concert with other States to ensure interoperability, which may pose a big challenge to air navigation.

World Air Traffic Flow 2012 by ICAO

Direction of Renovation to Meet the Goals

In order to achieve the goals, drastic reforms of the conventional ATM concept and basic CNS techniques must be carried out.
Within the CARATS framework, 8 directions of reform are offered, with a focus on the transition to TBO (trajectory based operations).

Implementation of satellite navigation in all flight phases

- Know the exact location and time of the aircraft in all flight phases through satellite navigation
- Achieve accurate, highly-reliable and versatile navigation

Promotion of PBO (Performance Based Operation)

- Regulate the performance requirements for aircraft
- This enables air traffic controllers to provide high level ATC services to meet the requirements.

Realization of high-density aircraft operations at busy airports/ congested airspace

- Promotion of Performance Based Operation (PBO)
- Expansion of satellite navigation
- Effective use of airspace through dynamic airspace management
- Increasing ATC capacity by rearranging takeoff/ landing sequences
- Reducing aircraft spacing through effective time management

Image of how the time would be controlled effectively in the control room at a high-density airport

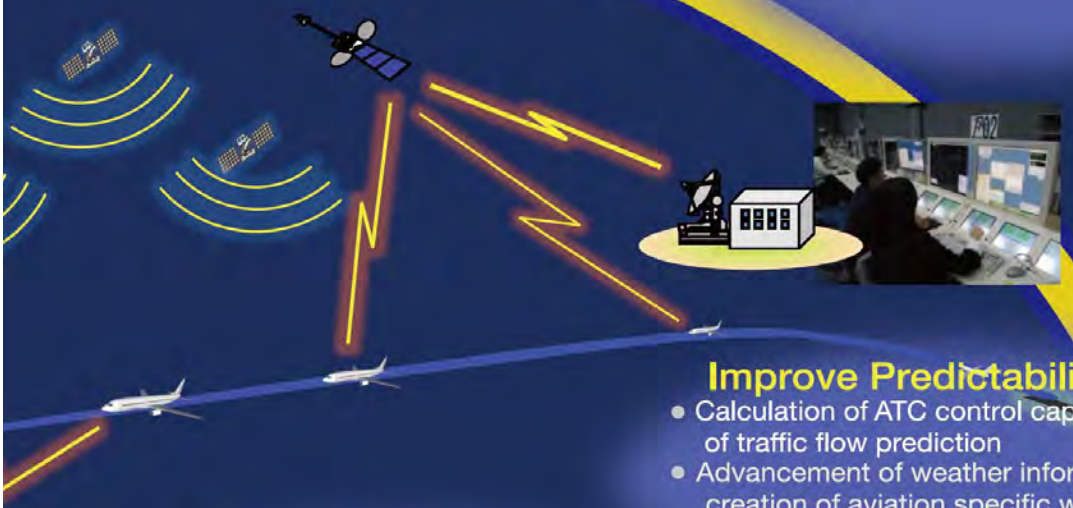
Airport surface moving map on the cockpit console

Improve the level of situationa the ground and on board an a

- Share information between the groun the aircraft to improve the level of awareness on aircraft location and a traffic situation.
- Maintain a safe distance between eac aircraft by monitoring with airborne surveillance radar

Make maximum use of human and machine capabilities

- Mechanically-assisted support, including automated regular communications
- Create an environment where pilots and traffic controllers can concentrate on value-added tasks.



Improve Predictability

- Calculation of ATC control capacity, advancement of traffic flow prediction
- Advancement of weather information, including creation of aviation specific weather forecast and utilization of data from on board weather radar

Ensure Information-Sharing for Collaborative Decision-Making

- Comprehensively manage all kinds of information on aircraft operations
- Construct an information network accessible to any interested person when needed
- Realize concerted air navigation through the global information-sharing

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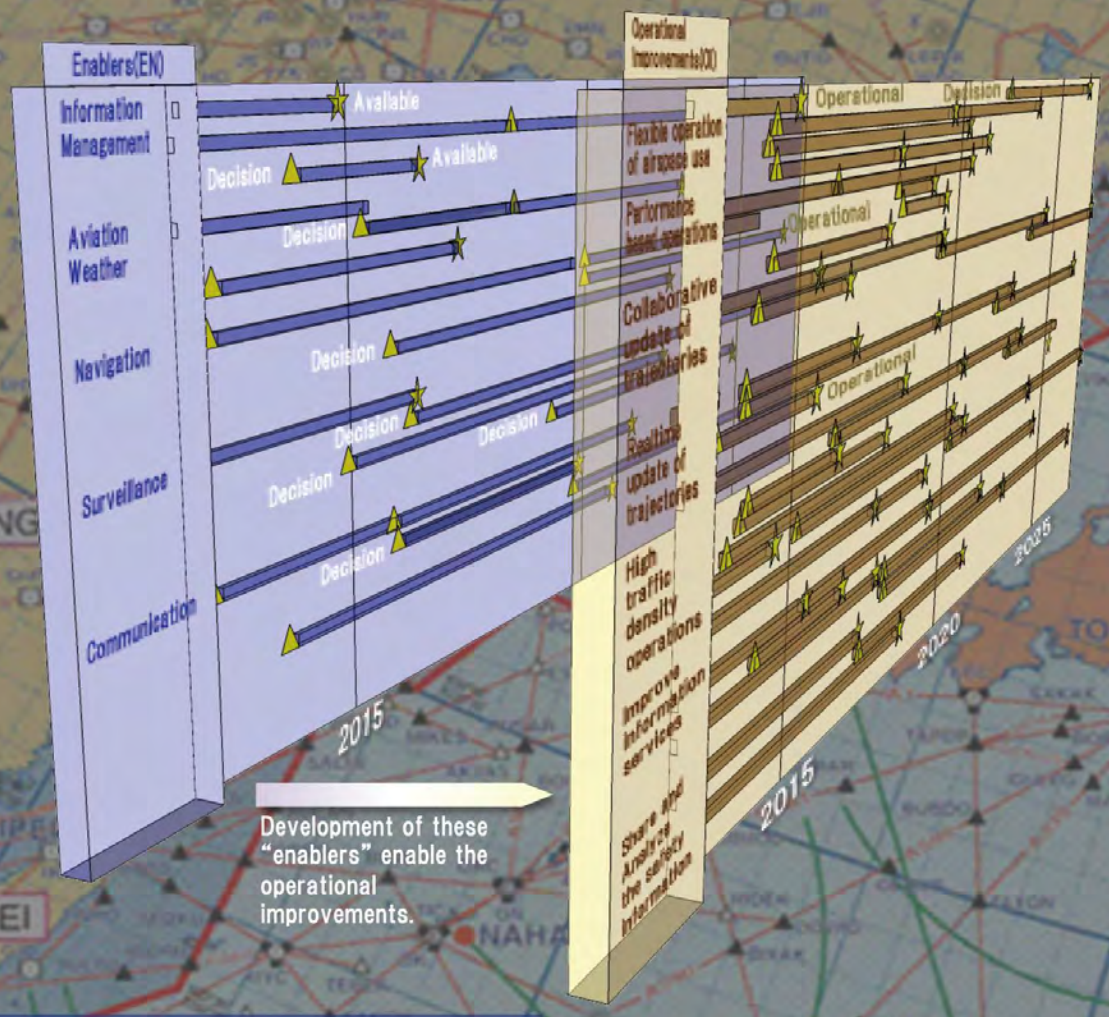
Realization of TBO (Trajectory Based Operation)

- Unified traffic management on all flight operations from departure to arrival
- Transition to ATM operations based on 4DT (4-dimensional trajectory) using time-based management for all flight phases

Overview of CARATS Measures (Roadmap)

Within the framework of CARATS, the measures for 8 types of reforms have been developed. These are defined as Operational Improvement (OI) whereas the technical factor enabling us to achieve the reforms are defined as Enabler (EN). JCAB has prepared roadmaps for the implementation of OI and EN respectively. Prior to the implementation, we verify effectiveness of measures including cost-effectiveness and make a review on them in response to changes in external environment.



Key

- ▲ Implementation decision
- ★ Start of operation
- Preparation period (OI)
- Preparation period (EN)

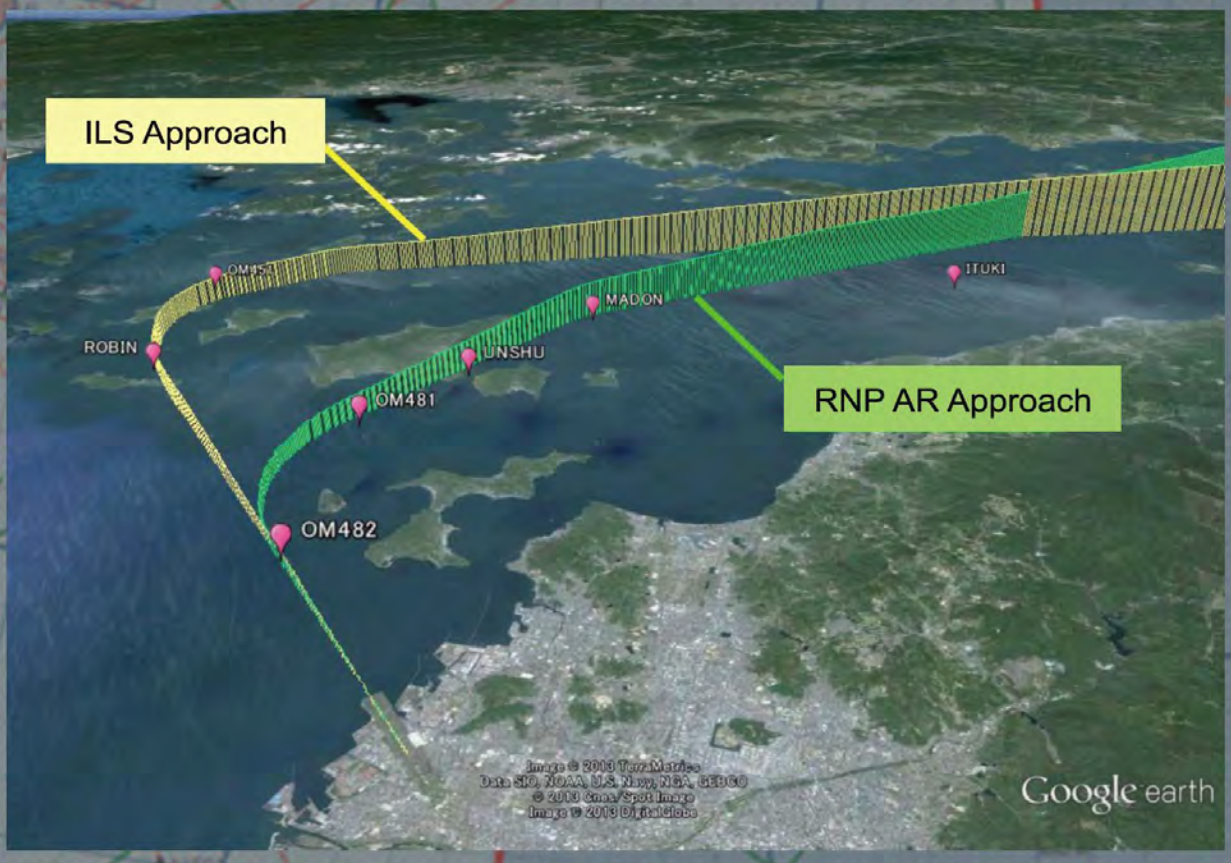
In order to realize one OI, some other OIs or ENs may be required in some cases. Or, one OI or EN could contribute to realizing some other OIs and ENs.
CARATS measures can be realized through mutual interaction among the measures and its roadmap is designed to achieve the targets by choosing appropriate combinations.

CARATS Measures : Example-1

Introduce precise and flexible approach procedures for departing and arriving aircraft (RNP AR Approach)

Overview of the measures

- Transition from the RNAV to RNP procedures are improve the efficiency and safety of aircraft operations as well as expanding airport capacity.
  - ✔ Lower flight cancellation rate due to less strict minimum weather conditions
  - ✔ Reduction in fuel consumption and CO2 emissions due to shorter flight paths
  - ✔ Reduction in noise pollution caused by arriving and departing aircraft over the residential areas by implementing RNP AR Approach.
- RNP AR approach has gradually been introduced since 2011. In the case of RNP AR approach at Matsuyama Airport as shown below, the flight path is shorter than the current ILS approach, showing improved operational efficiency.
- Curved precision approaches are planned to be implemented from 2021 onwards. GLS approaches (CAT-I) are planned to be implemented in 2020 and (CAT-II/III) after 2025, it will achieve further advancement.



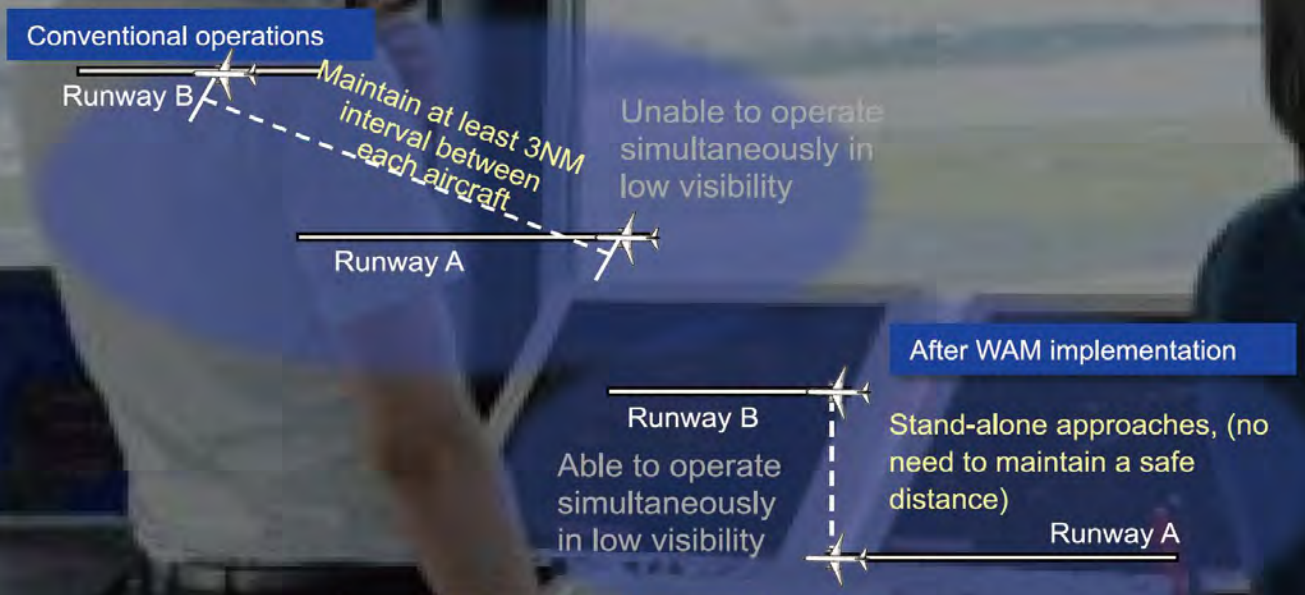
RNP AR approach procedures
One of the PBN (Performance Based Navigation) being implemented worldwide which enables curved precision approaches. Aircraft operators who would use this procedure must obtain a permit each time.

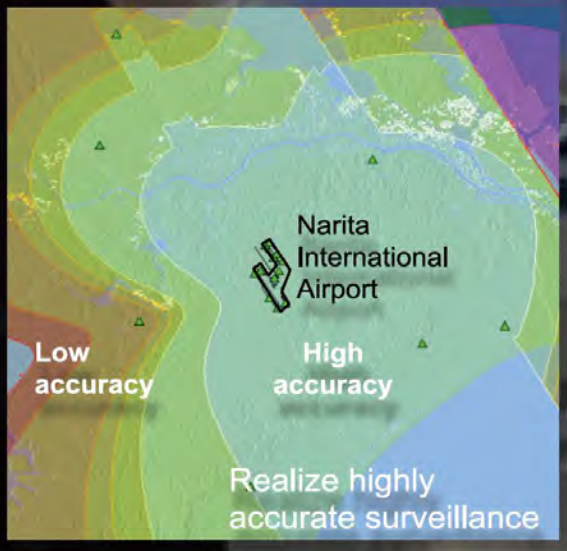
CARATS Measures : Example-2

Realizing simultaneous operations on parallel runways by improving monitoring capabilities

Overview of the measures

- Airports with parallel runways can increase its take-off/landing capacity by introducing simultaneous operations on parallel runways with high-precision surveillance systems, which enable to detect aircraft positions more accurately.
- A new surveillance systems called “Wide Area Multilateration (WAM)” enables Precision Runway Monitoring (PRM).
- In March 2015, Narita Airport has introduced WAM which enables air traffic controllers to perform simultaneous take-off operations at low visibility, minimizing the decline in the number of takeoffs at such situation.
- Based on the long term vision, JCAB will push forward with R&D so that simultaneous operations can be done at airports where parallel runways are more narrowly spaced than those of Narita Airport by augmenting WAM with ADS-B signal aiming for more precise and reliable ATC operations.



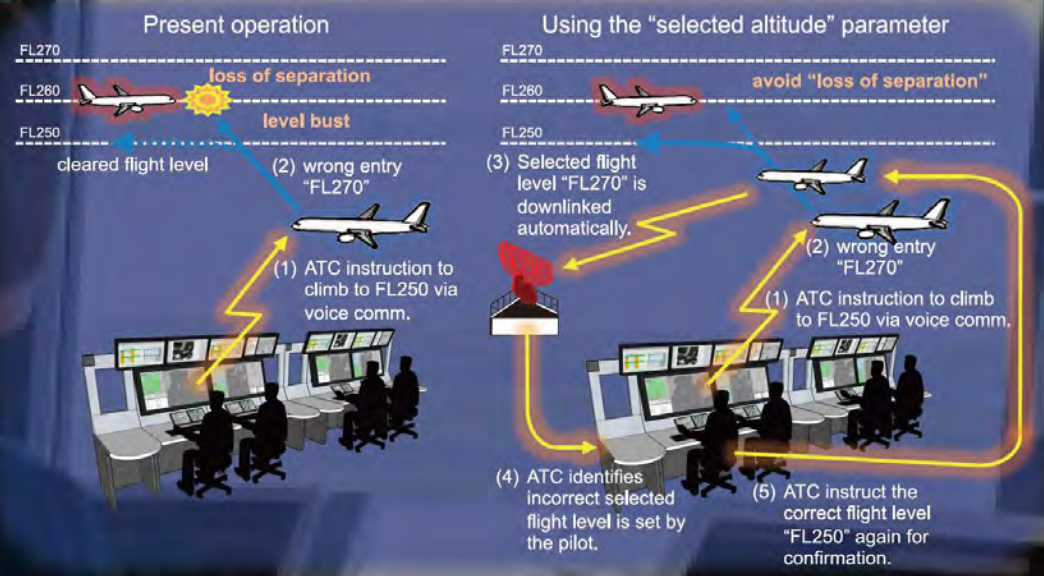


Improve ATC Operations by using Aircraft Movements Data

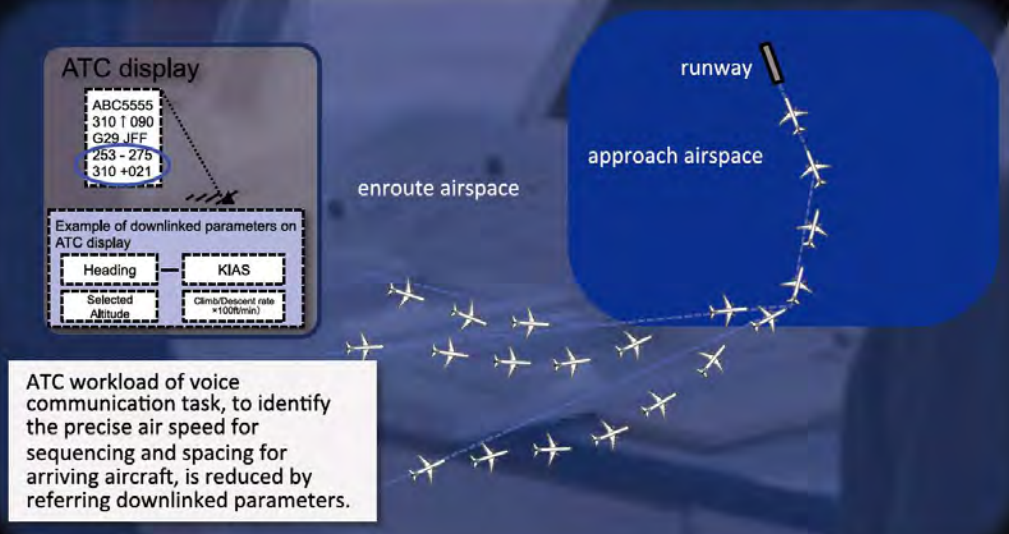
Overview of the measures

- As a new type of radar, SSR mode-S with data link functions, WAM, or ADS-B (automatic dependent surveillance broadcast) can receive signals from the aircraft such as its position, flying speed, parameters selected by a pilot and weather information, which would contribute to more efficient ATC operations and upgrading of ATC supporting system.
- Owing to these measures being planned to be implemented in 2020, the safety and predictability of air traffic as well as ATC capacity and operational efficiency are expected to improve.

Example : Use of selected altitude (downlink aircraft parameters) to improve safety



Example: Use of airspeed data (downlink aircraft parameters) to increase ATC capacity



ATC workload of voice communication task, to identify the precise air speed for sequencing and spacing for arriving aircraft, is reduced by referring downlinked parameters.

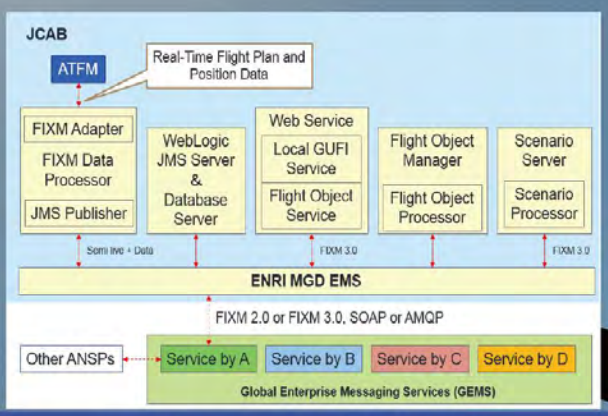
CARATS Measures : Example-3

Greater Information-Sharing for Collaborative Decision-Making through the Implementation of SWIM (System Wide Information Management)

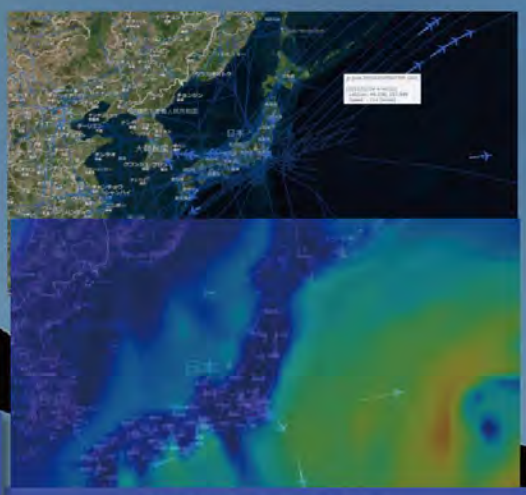
Overview of SWIM Implementation

- In order to implement the measures on Information-Sharing for Collaborative Decision-Making, wide range of mass data must be shared among as many stakeholders as possible. If all stakeholders share data with each other through the old-style interconnection, it costs them a lot of money to build the systems and circuits and do the test. Therefore, the cost-effective new information sharing system, SWIM has been invented.
- SWIM provides the environment where anyone can access the information on aircraft operations at any time. Furthermore, it ensures the reliability of data in order to maintain the trustworthiness of information for Collaborative Decision-Making.
- The implementation of SWIM is also aimed at improving interoperability with the surrounding States, and Mini-Global Demonstration has been conducted to build the comprehensive information management system for the next generation. The following States have participated in Mini Global Demonstration to share air traffic management information to demonstrate flexible and effective aircraft operations in various situations.

Participating States: Japan, USA, Canada, Australia, Singapore, Thailand, Brazil and others



Japan's system configuration for Mini Global Demonstration



Operations based on Mini Global Demonstration

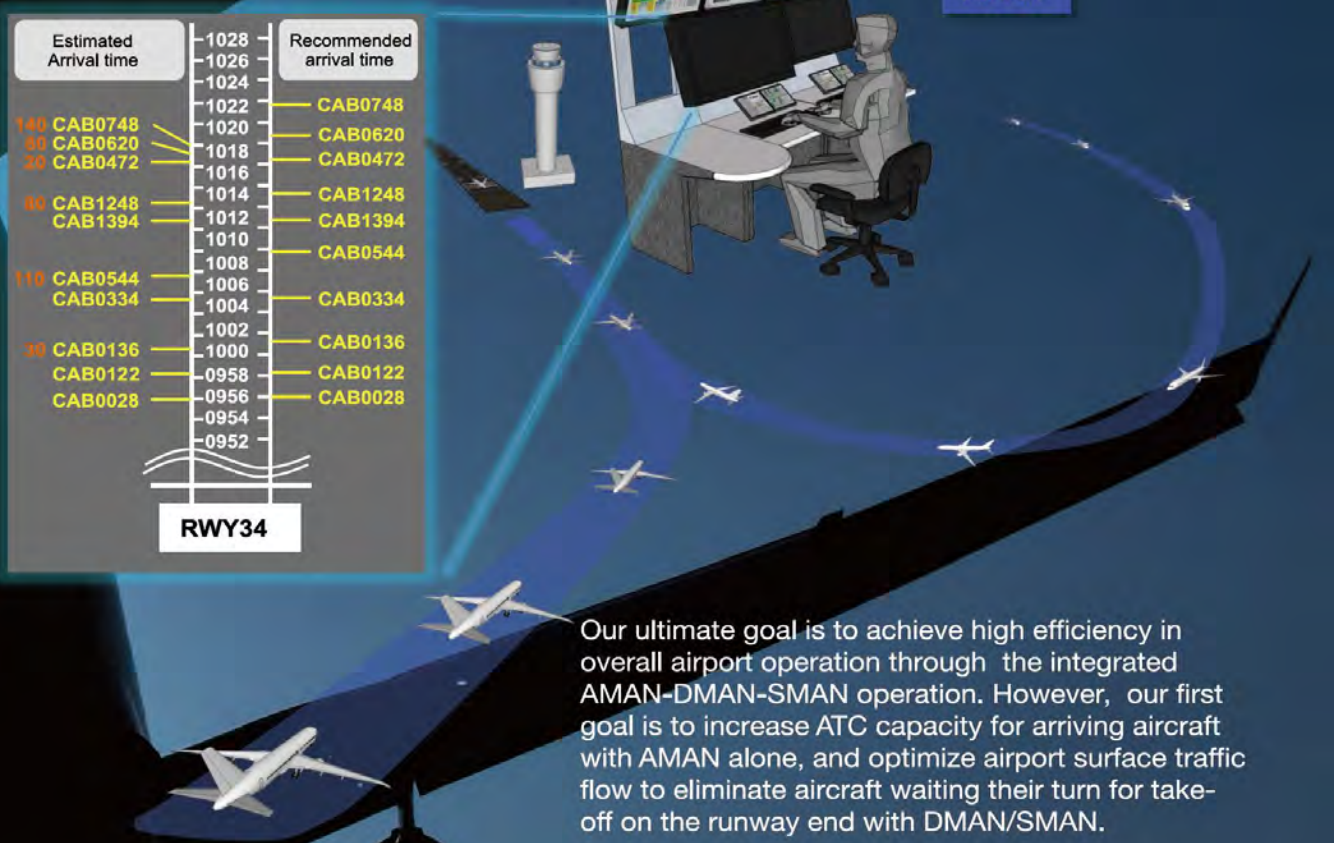
Measures Realized through SWIM - Airport-CDM -

- Airport Collaborative Decision Making (A-CDM) is a measure to increase the benefits of not only airport personnel but also of air passengers by achieving on time performance of flights, reducing fuel consumption and CO2 emissions through the maximum use of available resources, including administrators at airports, airline personnel as well as fleet of airplanes and aviation-related facilities.
- For the purpose of Airport CDM, all personnel involved in aircraft operations at airports must share very accurate information on take-offs and landings as well as various information on airport operations with each other. In order for them to use such information, a common operating system for information sharing with the same concept as SWIM should be built.
- In Japan, Haneda and Narita Airports in the Tokyo metropolitan area where air traffic demand has been constantly growing, have been promoting the measures including A-CDM with the concept of SWIM to improve the operational efficiency.

Improved efficiency in ATC operations (take-offs/landings) and surface management (AMAN/DMAN/SMAN)

Overview of the measures

- With the integrated AMAN (Arrival Management) DMAN (Departure Management) and SMAN (Surface Management) coordination, JCAB controls traffic flows effectively at airports including Haneda and Narita Airports where airport surface and runway operations are difficult and complicated.
- This enables the airports to maximize the use of its available resources including runways, and thus airport capacity have been increased to meet the ever-growing demand in air traffic in the Tokyo metropolitan area.



Our ultimate goal is to achieve high efficiency in overall airport operation through the integrated AMAN-DMAN-SMAN operation. However, our first goal is to increase ATC capacity for arriving aircraft with AMAN alone, and optimize airport surface traffic flow to eliminate aircraft waiting their turn for take-off on the runway end with DMAN/SMAN.

ATC Operations realized through AMAN/DMAN/SMAN

- Provide an instruction on taxiing route to a departing aircraft before pulling out of the parking spot.
- Trajectory-based efficient runway crossing operations
- Improved time-predictable
- Improved decision support systems including a scheduling tool for departing aircraft
- Greater information sharing in conjunction with Airport CDM
- Reducing the workloads of both pilots and air traffic controllers as well as avoiding human errors by using data linkage

Implementation of Measures and Continuous Improvement Process

CARATS measures need to be changed on a continuing basis to address the ever-changing external environment and user needs. Thus, appropriate improvements must be made in the measures depending on the situation after the implementation.

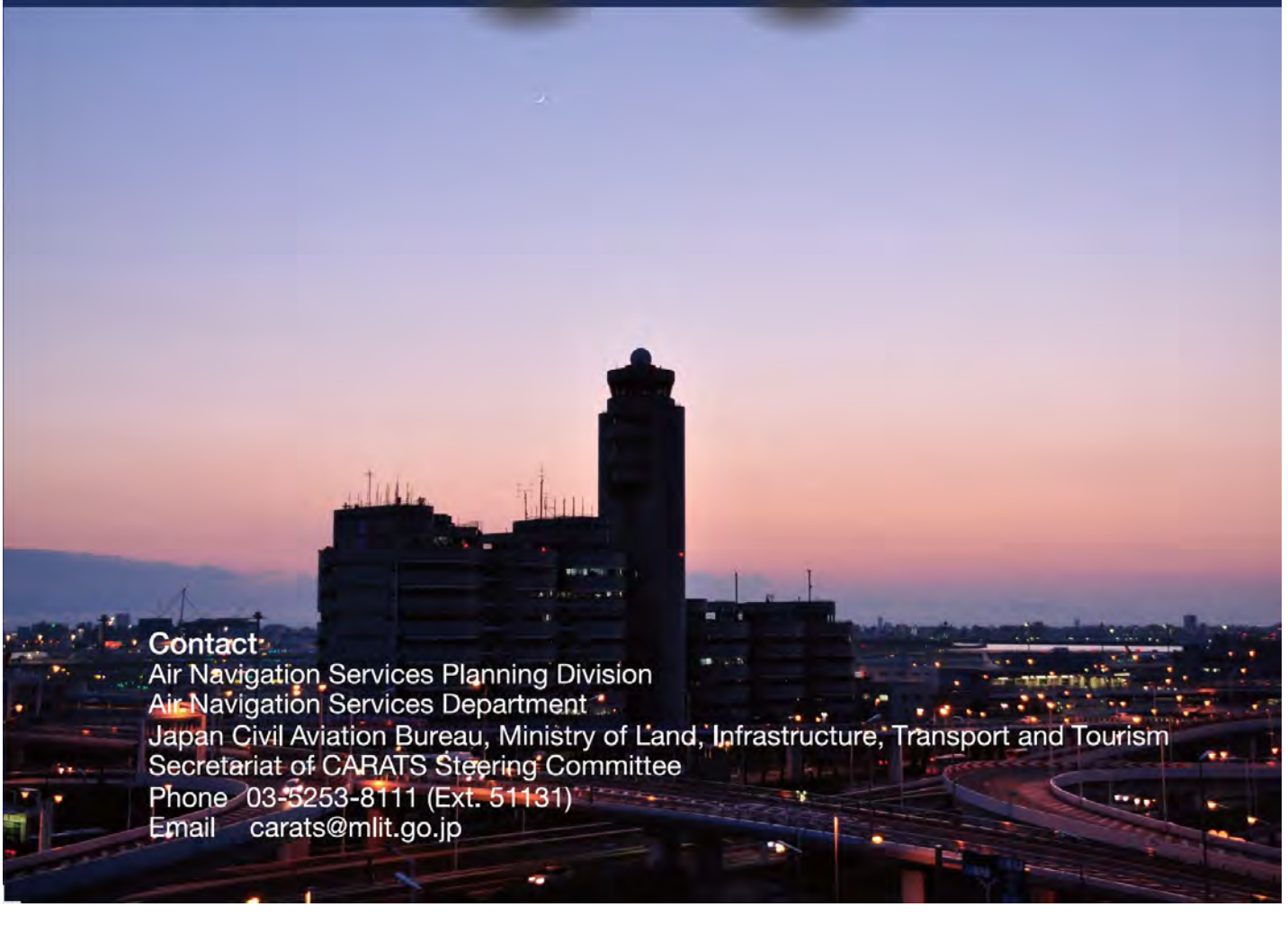
CARATS will help us realize a flexible air traffic system capable of adopting to future changes in external environment and user needs, by repeating the PDCA cycle by all stakeholders through government-academia-industry collaboration.

Improvements in CARATS measures based on evaluation results

Creation and revision of roadmaps/ discussing details of CARATS measures through government-academia-industry collaboration

Monitoring and evaluation of CARATS implementation and execution status, and CARATS indicator analysis

Implementation and execution of CARATS measures by individual stakeholders



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