



ENRI's R&D Long-term Vision

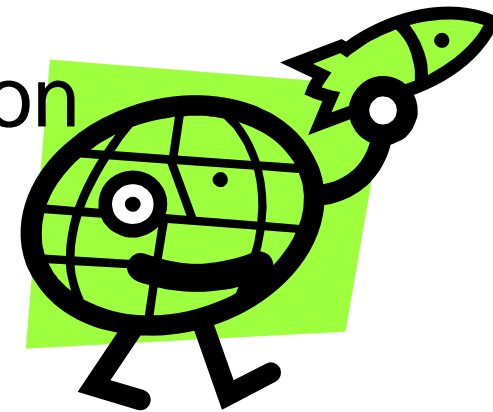
Sakae NAGAOKA

Director of Research Planning & Management,

ENRI

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- Air Traffic Control & Air Traffic Management
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- ENRI R&D Long-term Vision
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1. Brief Introduction of ENRI

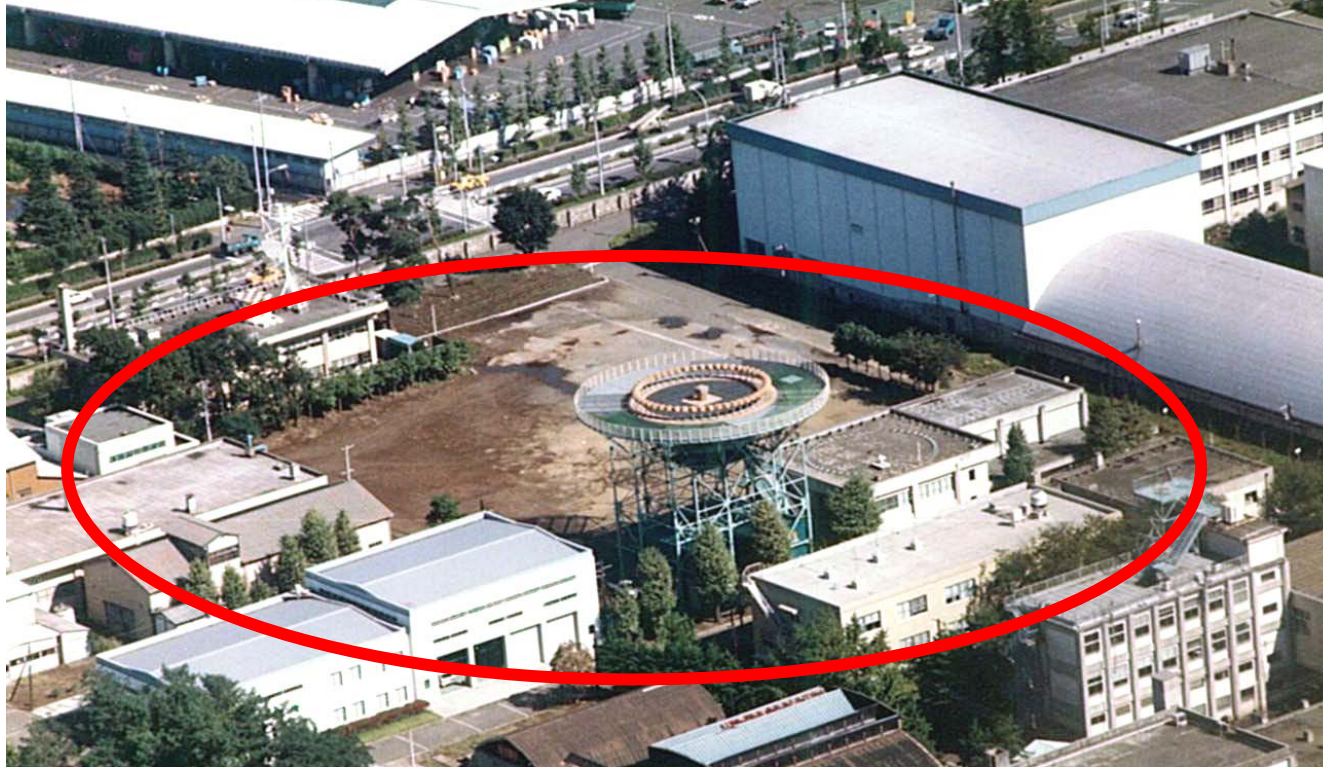
ENRI: Electronic Navigation
Research Institute

ENRI (Electronic Navigation Research Institute)



March 5

Contact Point...



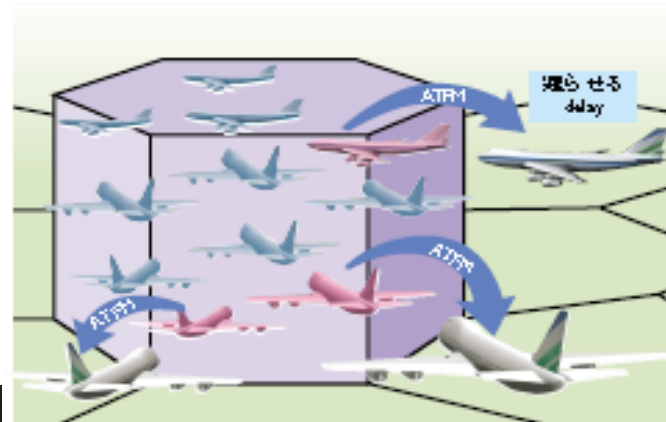
Electronic Navigation Research Institute
7-42-23 Jindaiji-Higashi, Chofu, Tokyo 182-0012 Japan
<http://www.emri.go.jp>

History of ENRI

- 1961 Electronic Navigation Section was organized in the Transport Technology Research Institute
- 1967 **Electronic Navigation Research Institute (ENRI)** was established in the Ministry of Transport
- 2001 ENRI became an **Independent Administrative Institution** controlled by the Min. of Land, Infrastructure & Transports

ENRI Major Services (1)

- R & D on Air Traffic Management



Safe Separation,
Flow Management,
ATM Performance



Real Time Simulation

ENRI Major Services (2)

- R&D on Electronic Navigation (Including CNS/ATM)

Obstacle Detection

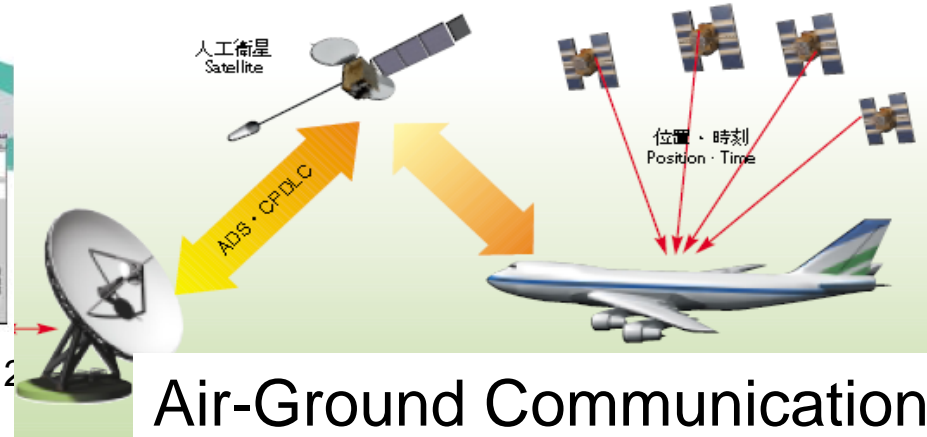
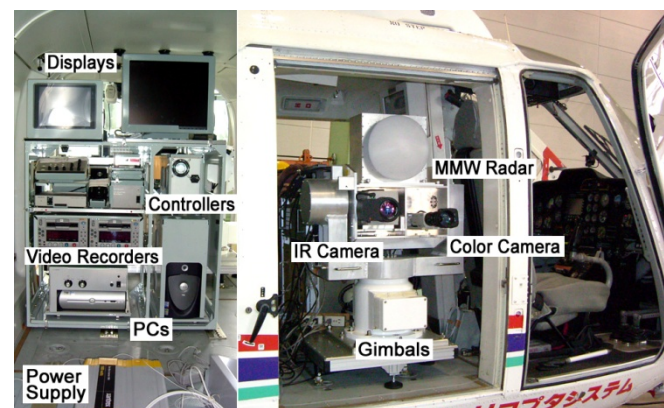
GNSS Applications



Ground Surveillance

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EIWAC 2



Air-Ground Communication

ENRI Major Services (3)

- Test & Evaluation on the Current systems associated with Electronic Navigation



VOR



ILS



TACAN

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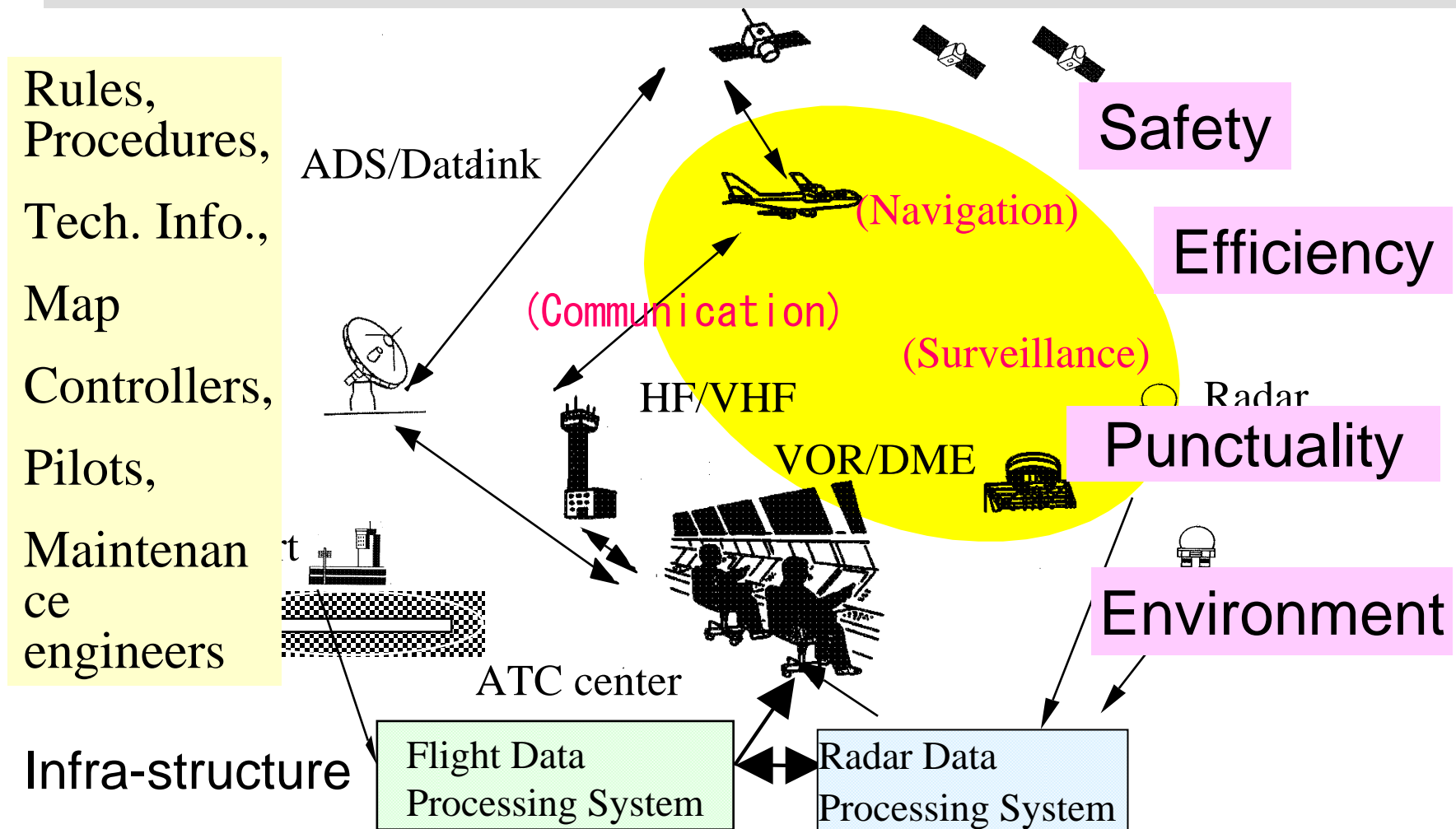


2. From ATC to ATM

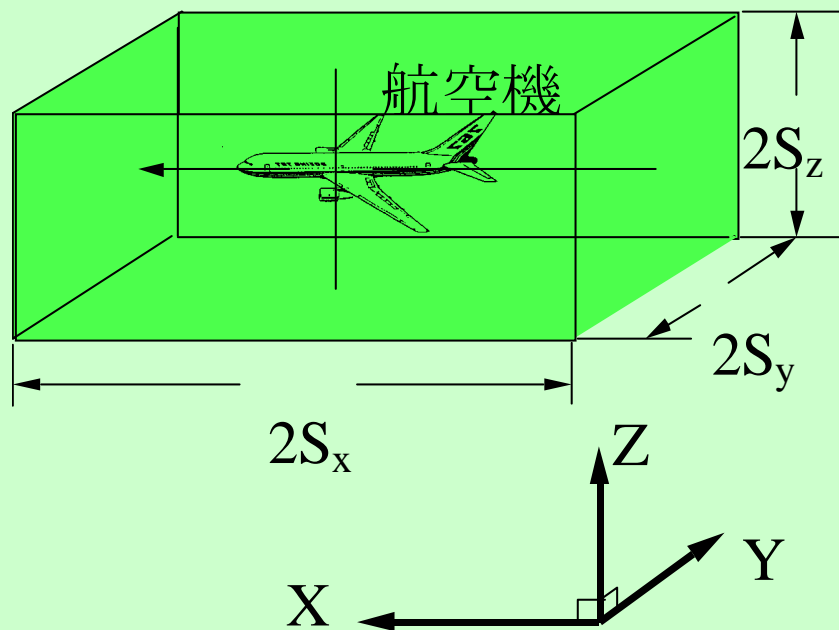
ATC: Air Traffic Control

ATM: Air Traffic Management

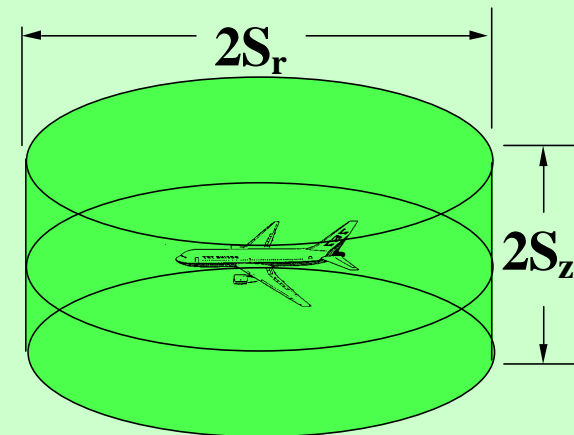
Air Traffic System



Air Traffic Control



Preventing Collision



Separation minima

Trajectory

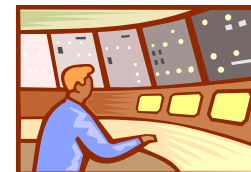
A description of the movement of aircraft, both in the air and on the ground, including position, time and, at least via calculation, speed and acceleration

$$P(x, y, z, t),$$
$$dP / dt,$$
$$d^2 P / dt^2$$

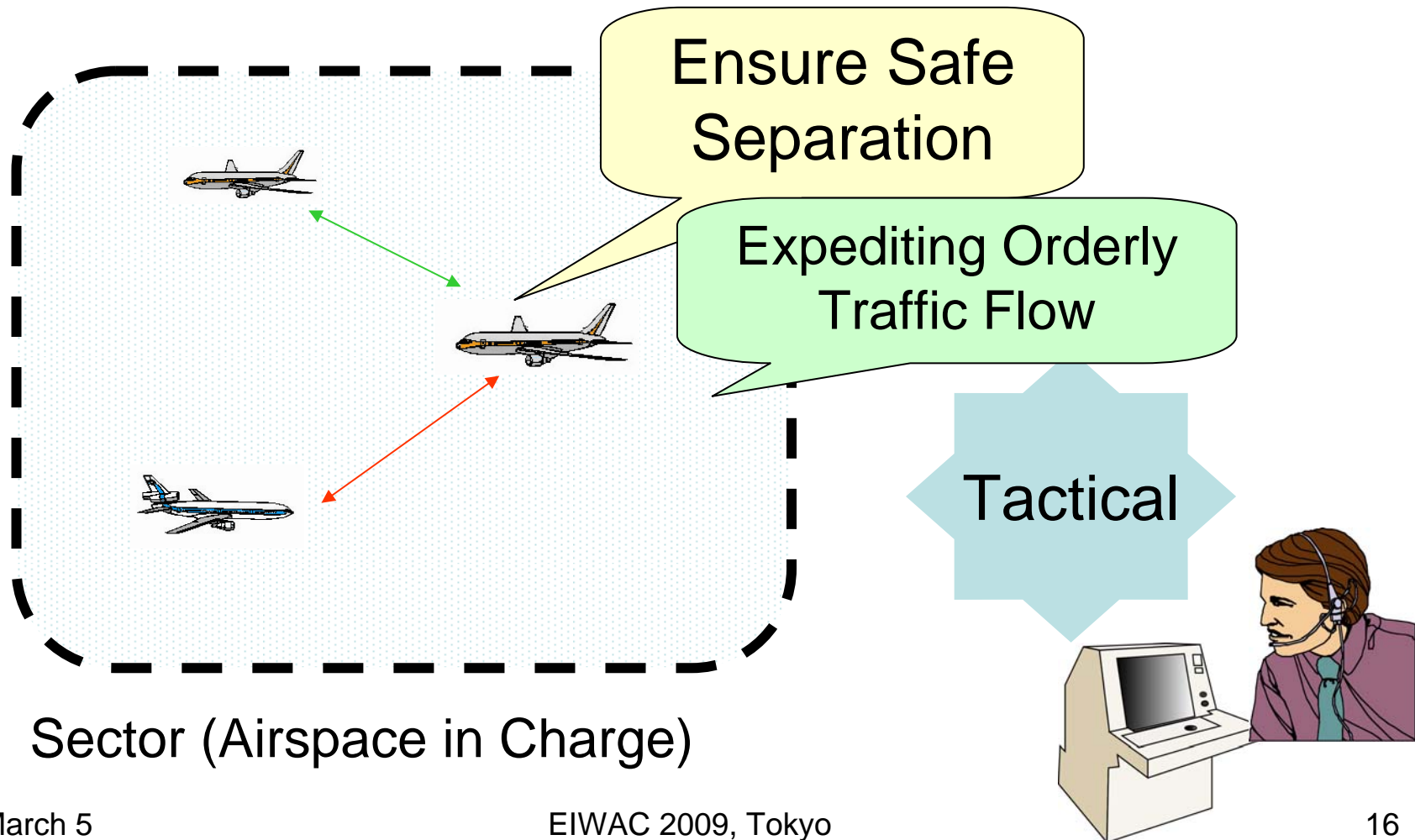


Air Traffic Management (ATM)

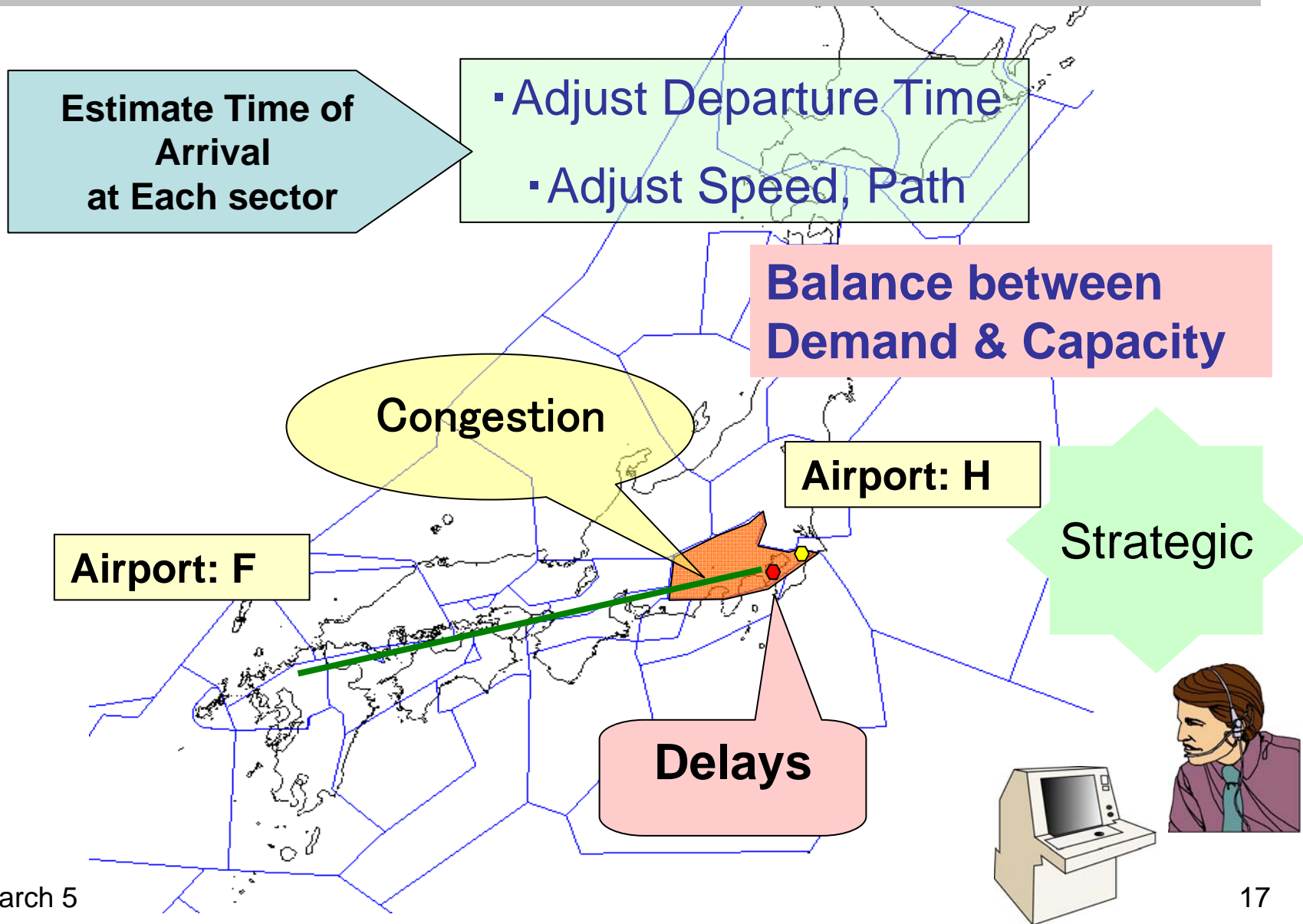
- Air Traffic Services (ATS)
- Air Traffic Flow Management (ATFM)
- Airspace Management (ASM)



Air Traffic Control (ATC)



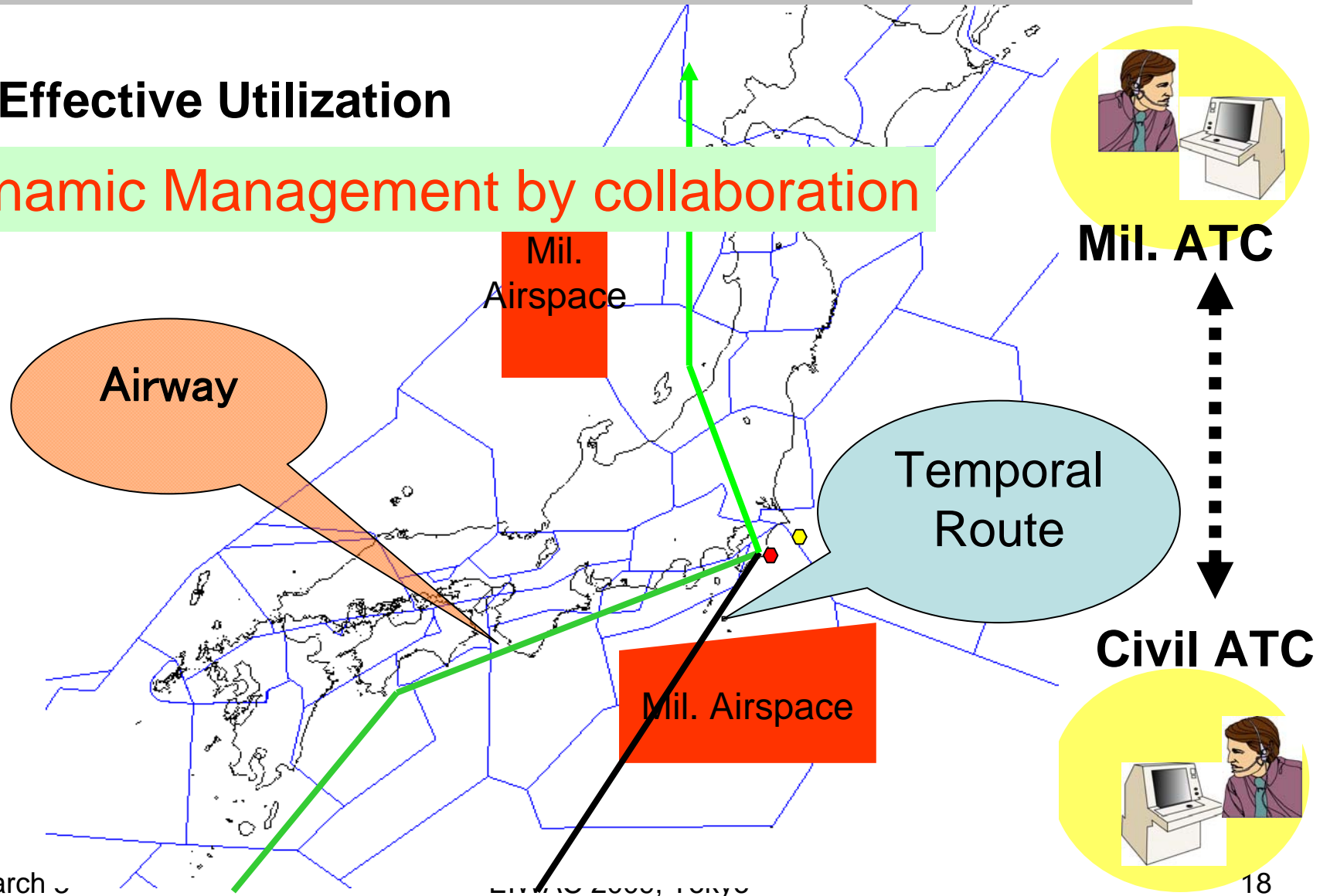
Air Traffic Flow Management (ATFM)



Airspace Management (ASM)

Effective Utilization

Dynamic Management by collaboration



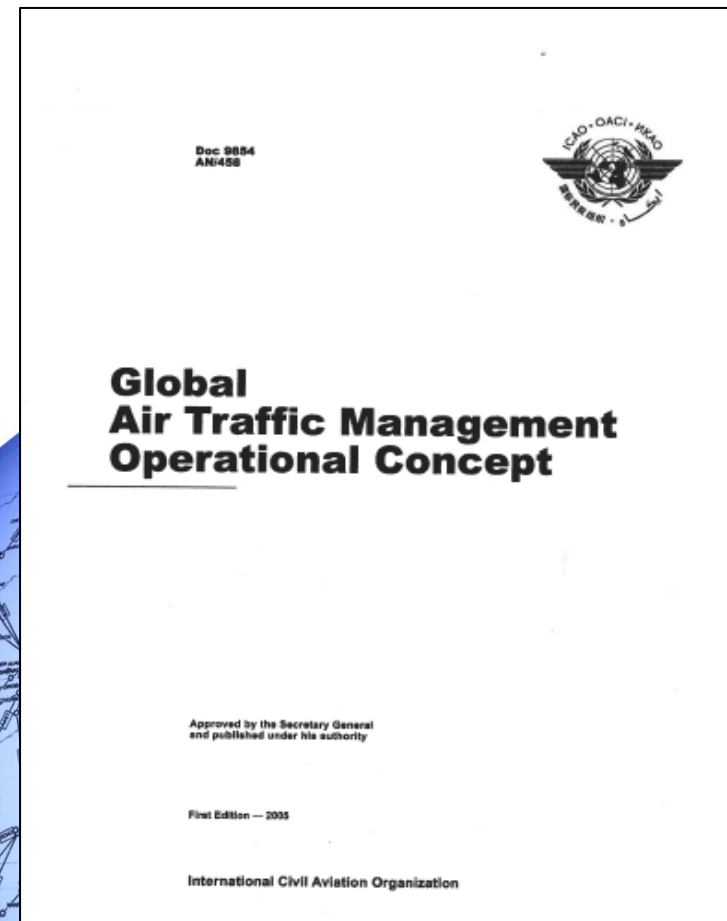
Future ATM Operational Concept

ICAO Global ATM Operational Concept



Global ATM Operational Concept (Vision)

- ATM is the dynamic, integrated management of air traffic and airspace – **safely, economically and efficiently** – through the provision of facilities and seamless services in collaboration with parties.



Shift of Definition

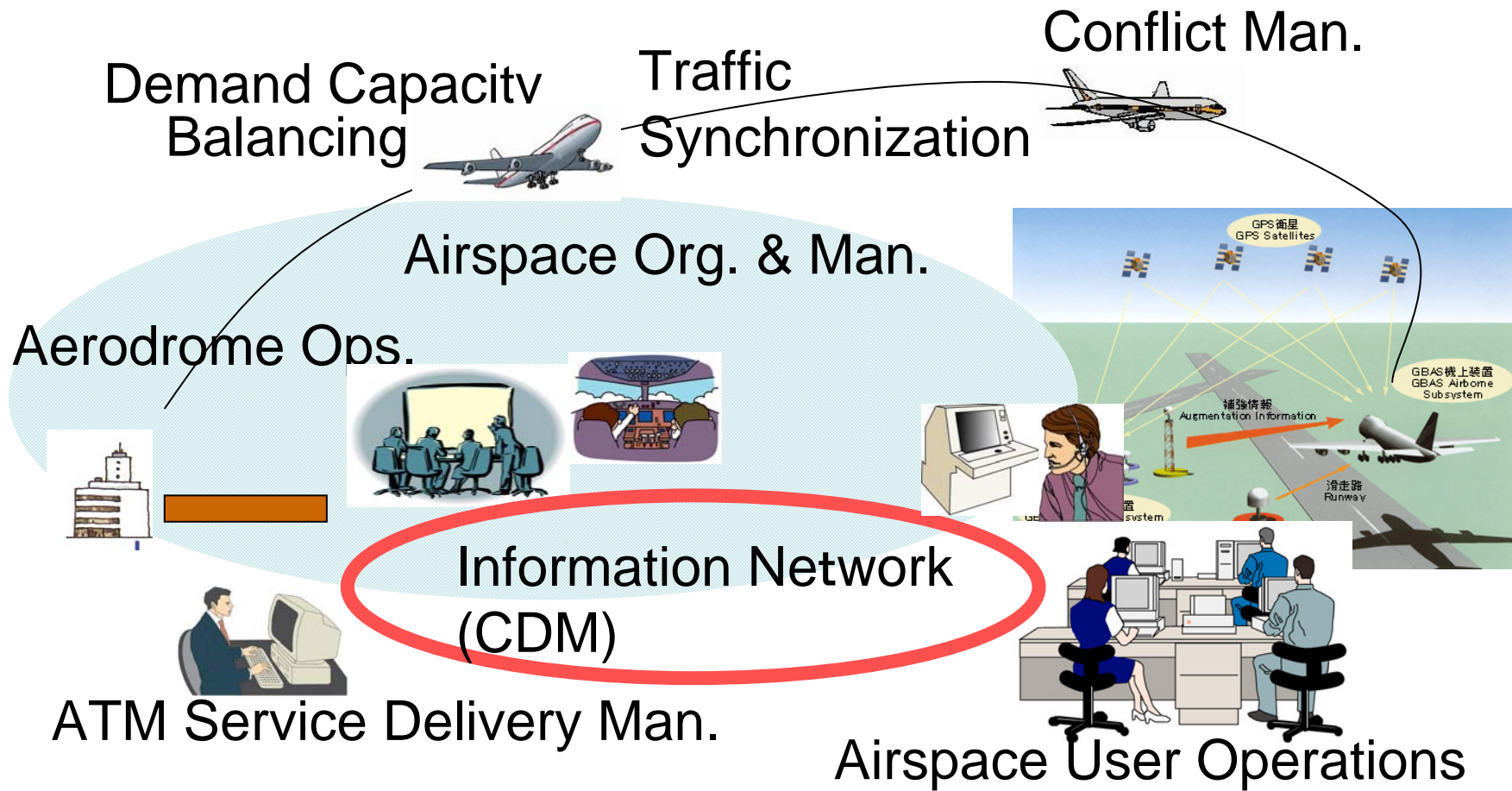
(ICAO PANS-ATM)

The aggregation of the airborne functions and ground based functions (ATS, ASM, ATFM) required to ensure the **safe and efficient** movement of aircraft during all phase of operations

(ICAO Doc 9854)

The dynamic, integrated management of air traffic and airspace
- **safely, economically and efficiently** -
through the provision of facilities and seamless services in collaboration with parties.

Global ATM Operational Concept



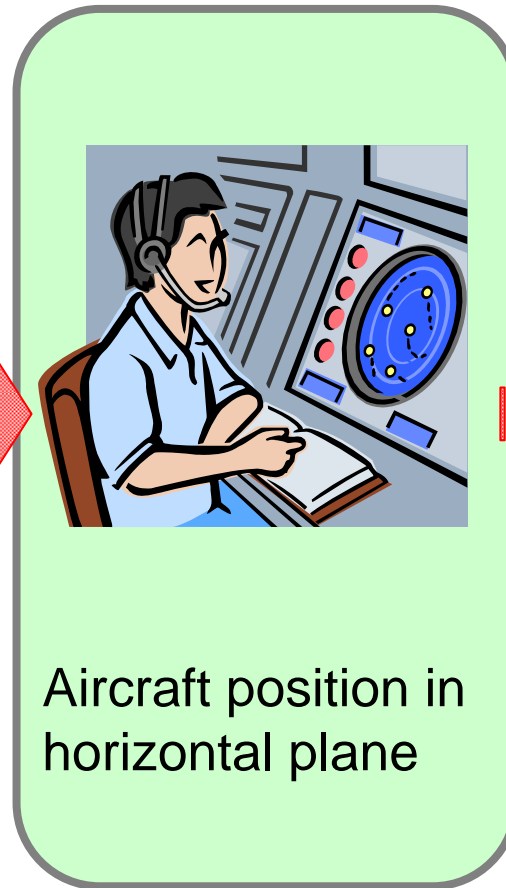
Paradigm Shift of ATM

Procedural



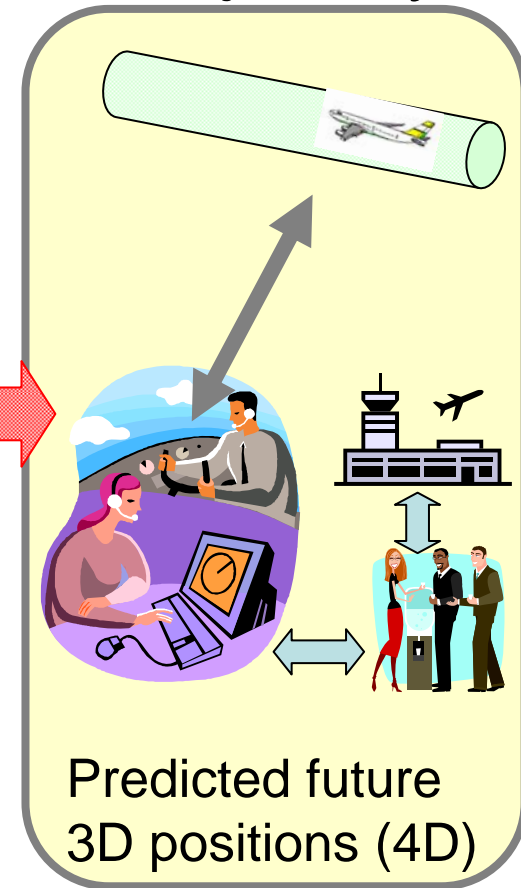
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Radar



EIWAC 2009, Tokyo

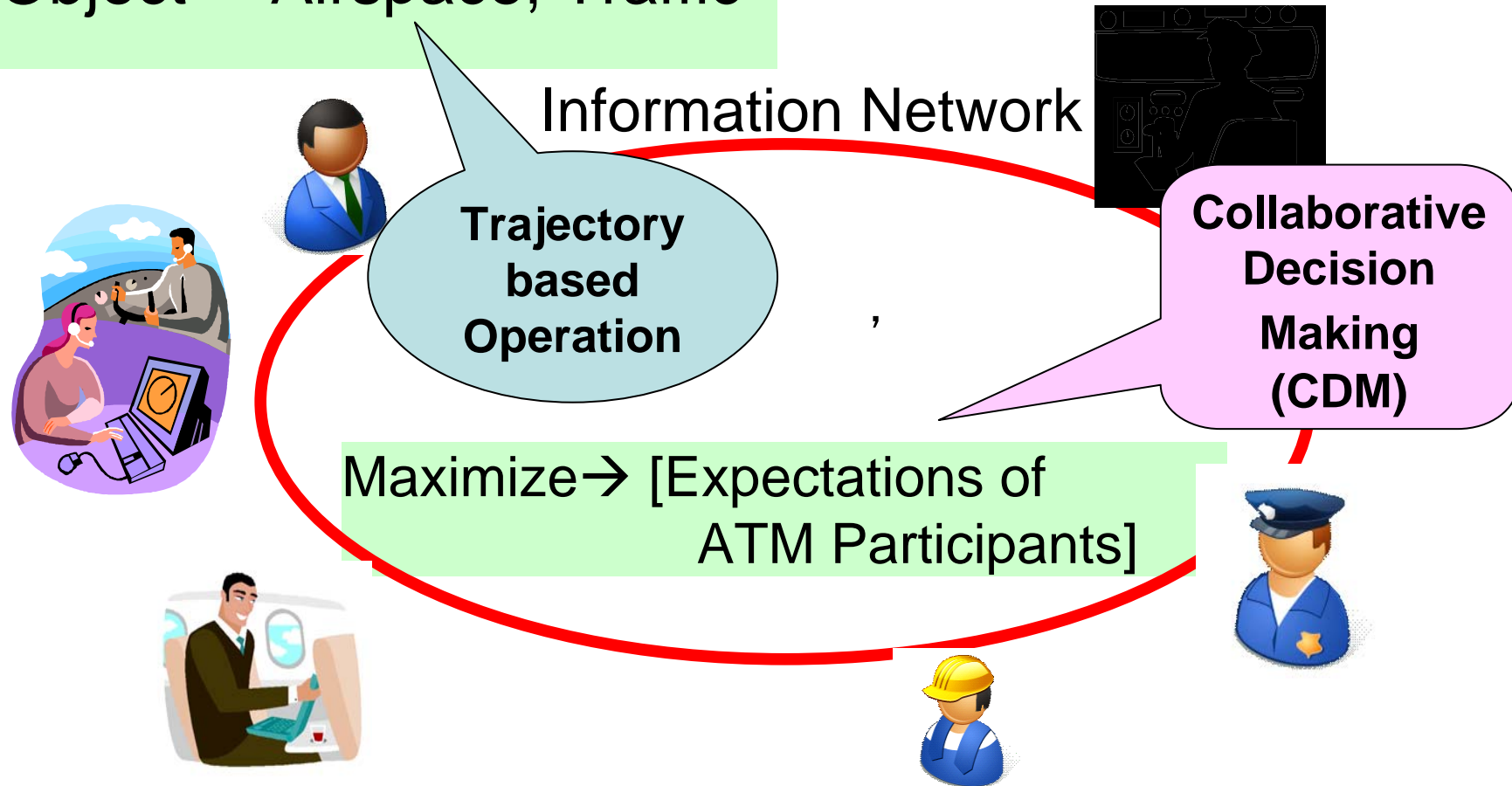
Trajectory



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Optimum Management

Object ⇒ Airspace, Traffic





ENRI R&D Long-term Vision

- Basis for Planning R&D Programs
- Indicator of our direction to go



Status of ENRI

Established in **1967**

~Pioneering Role in R&D of Electronic Navigation in Japan

2nd 5-year Programme (2006~)

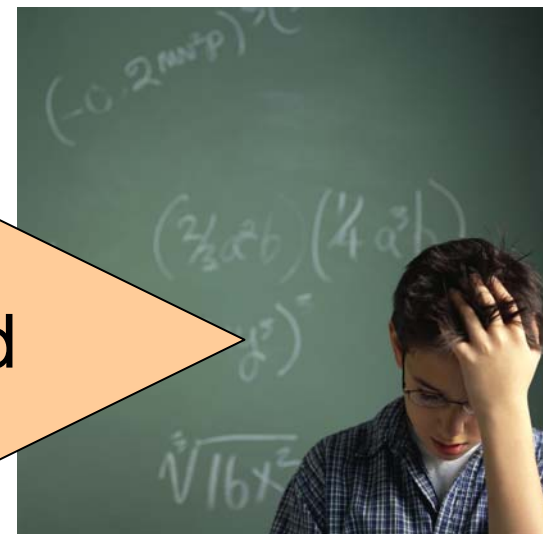
Core Research Institute for Supporting Aviation Authority through Research on ATM Systems



Need for Long-term Vision

- Satisfy the Needs of Aviation Administration and Society
- Play a Supplementary Role of the Aviation Administration
- Publicize Its Research Results Globally

Establish the Direction of
Long-term R&D Shared
by Researchers



What Research Is Required ?

■ Railroad Transportation is highly networked

Other mode of Transportation Are Equally Competing




Smooth and Efficient Services without Delays



Trajectory Management

Strategy



Future ATM Concept
(ICAO, SESAR, NextGen)

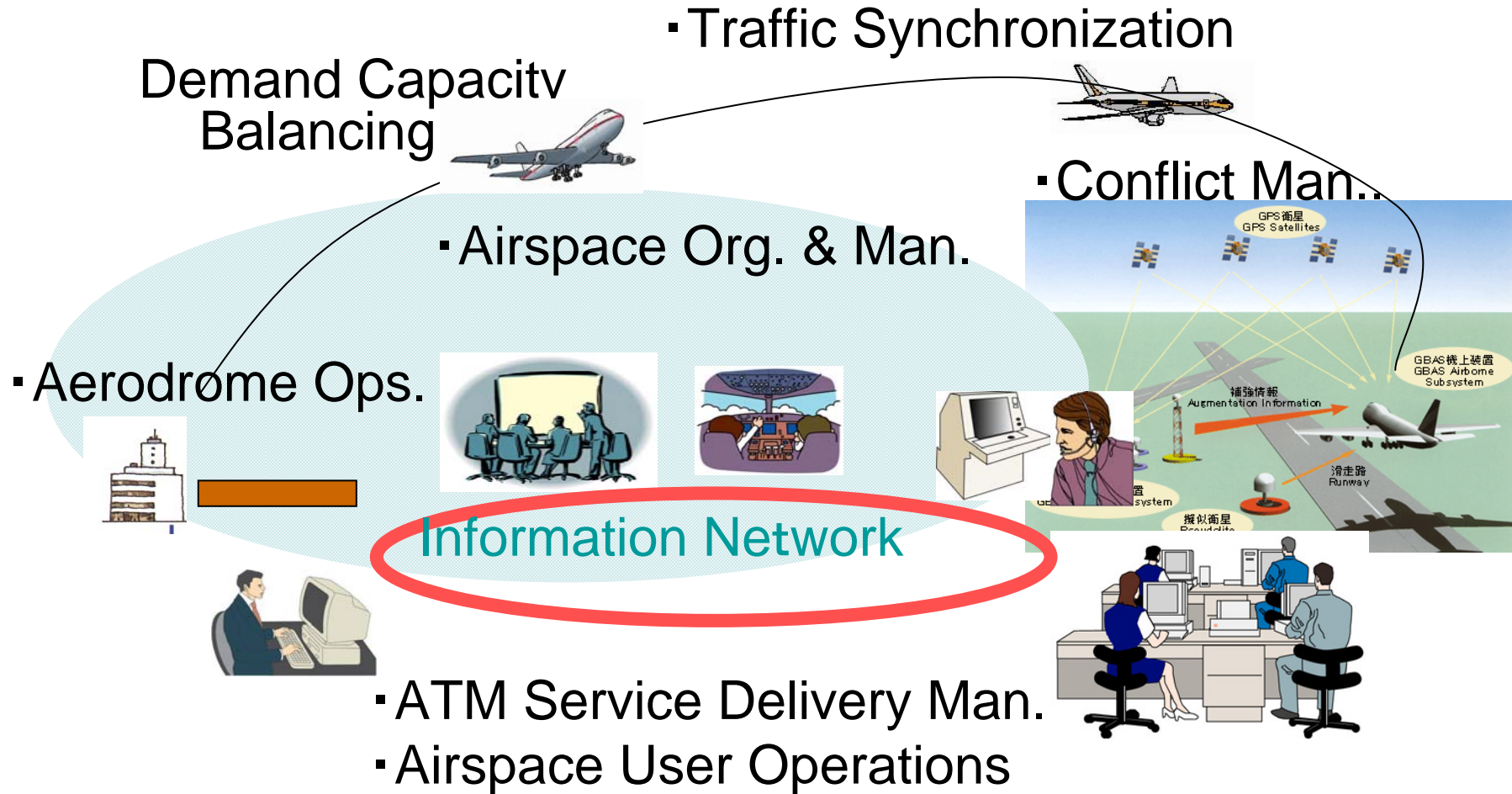


Common Language of
Operational Information



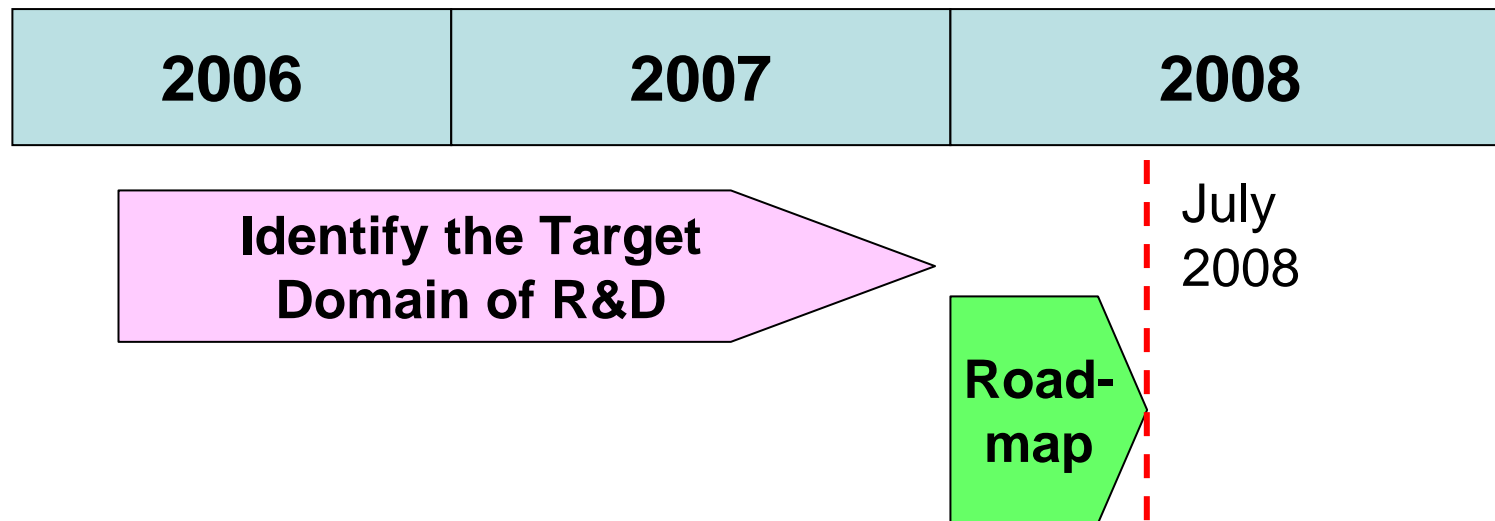
Trajectory Management

Global ATM Concept (ICAO)



Drafting Process

- July 2006: Established a Drafting Committee
 - International Trends
US, EUROPE etc.
 - Survey on Social Needs



Assumptions

- (1) The future vision described in the ICAO Global ATM Operational Concept will be realized in 2025.
 - (2) Around the target years, the vision should be realized in our country.
- To realize this, the associated R&D must be completed 5 years before the target year.

Manage What ?

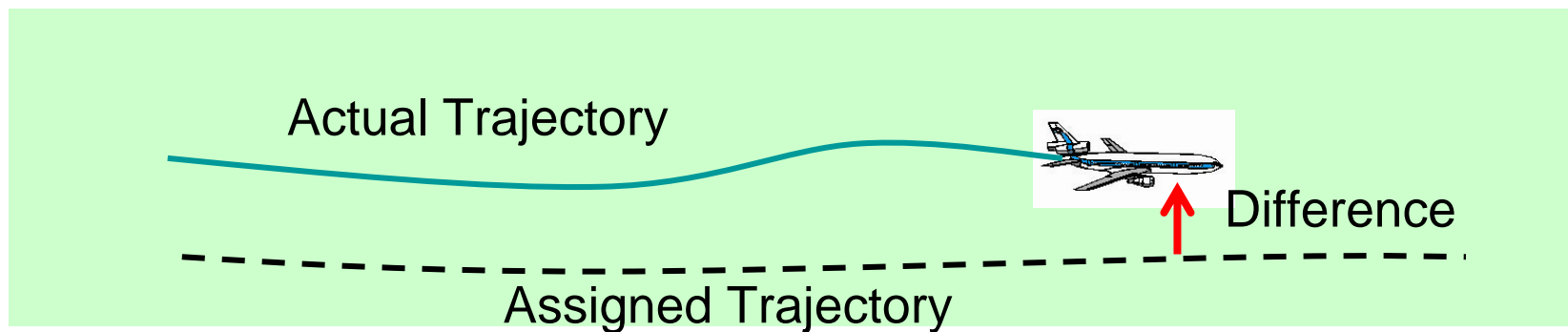
■ Operation

-> Min [|Actual Trajectory-Assigned Trajectory|]

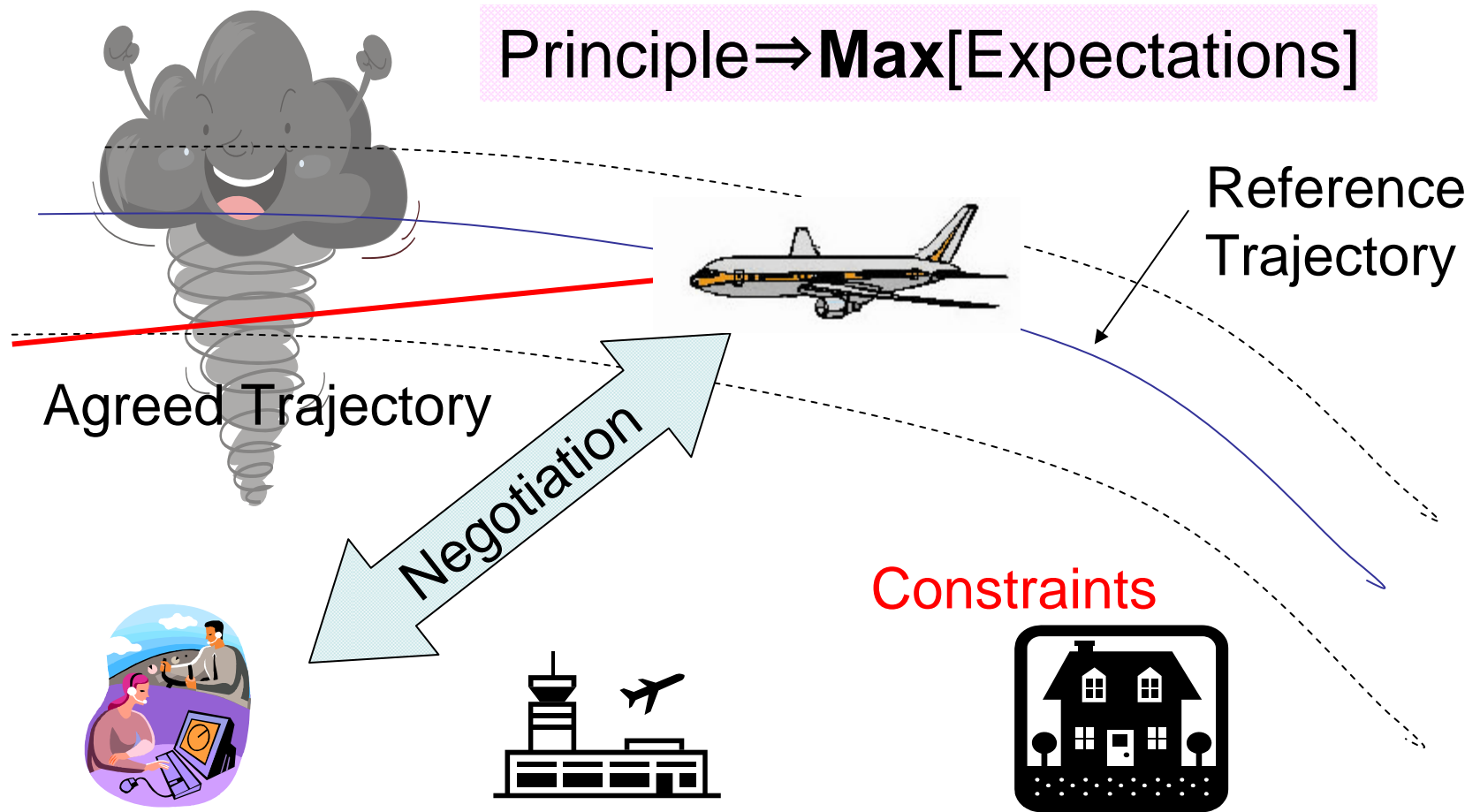
■ Assigned Trajectory

-> Max [Expectations of ATM actors]

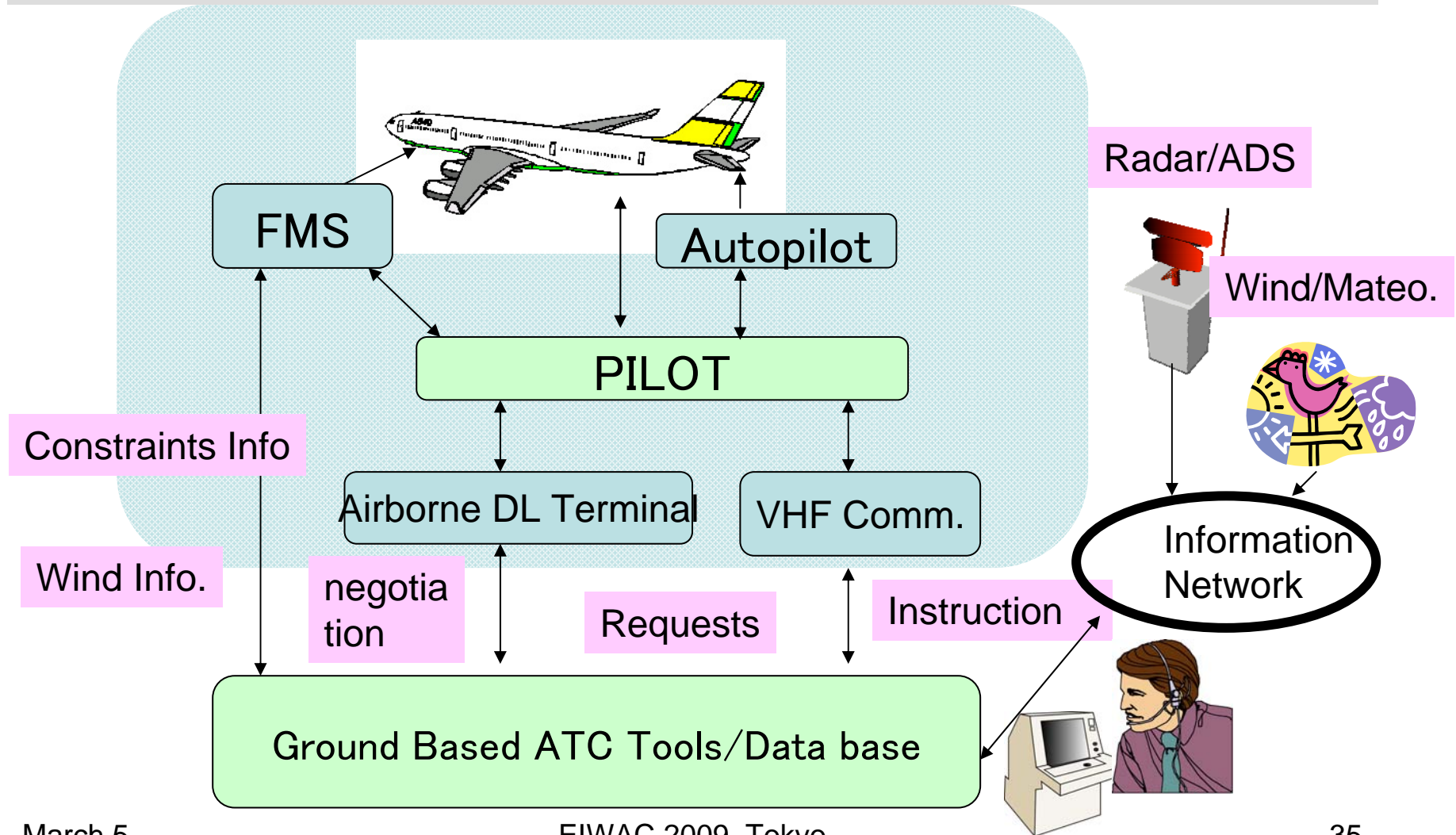
Collaborative
Decision Making



Assigned (Reference) Trajectory



4D Trajectory Management



Identified Major R&D Target Area

**Highly Accurate, Reliable
& Flexible Navigation
Technology**

**Functional Airspace
Configuration &
Trajectory Management**

**Advanced Ops. of
Airport/Airport Surface**

**ATM Performance Analysis
for Bottleneck Identification
& Efficiency Improvement**

**Information & Communications
Infrastructure for Collaborative
Decision Making in ATM**

ENRI R&D Roadmap

Major Domain

	Short Term				Middle Term				Long Term			
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ATM Performance Analysis for Bottleneck Identification and Efficiency Improvement	ATM Performance Evaluation & Analysis								Performance Analysis of Trajectory Management (TM)			
	Air Traffic Controller Workload Analysis				Techniques for Reducing Human Errors				Safety Assurance taking into account HF			
Functional Airspace Configuration & Trajectory Management	Evaluation Method for Terminal Airspace				Functional Terminal Airspace Design				Strategic & Integrated Airspace Design & Operations			
	Oceanic Airspace Operational Procedures				Promoting Dynamical Routes Operation							
	RNAV Route Safety Assessment				Development of Safety Analysis Tools				Assessment & Improvement of Safety for Total Flight Phase			
	Development of Trajectory Model				Use of Trajectory Prediction Model				Operational Efficiency Improvement by TM in High Density Airspace			
Information and communications infrastructure for collaborative decision making	Traffic Information (Info.) Exchange by Airborne Surveillance				Spacing Applications of Airborne Surveillance				Supplement of Trajectory Management (TM) by Airborne Surveillance			
	Dev. of Surveillance Data Link for ATCo				Flight Info. Exchange for TM							
	Aeronautical Tele-communications Network				Information (Info.) Management among Systems: SWIM							
	Evaluation of Air-ground High-speed Data Link Medium				Development (Dev.) of Aeronautical High-speed Communications Techniques							
	Methods of Surveillance Information Processing (Sensor fusion, Integration of associated Info. and TM)											
	Radio Environments & Interferences Issues (subjects common to each domain)											
Advanced operations of Airport/ Airport surface	Impl. of Multilateration for ATC Applications				Advanced Airport Operation by TM							
	Impl. of ASMGC				Dev. of Airport Surface Navigation				Use of CAT-IIIc GBAS			
Actual Use of CAT-I GBAS				Use of CAT-I/III GBAS								
Highly accurate, reliable, and flexible navigation technology	Requirement Review for GNSS Curved Approach				GBAS Dynamic Approach Paths Provision for TM							
	Performance Improvement of MSAS & Its Use for Precision Approach				Advanced ABAS				Use of CAT-I ABAS			

ATM Performance Analysis for Bottleneck Identification and Efficiency Improvement

2009-2012	2013-2016	2017-2020
ATM Performance Measurement & Analysis		Performance Analysis of Trajectory Management
ATCo Workload Analysis	Techniques for Reducing Human Errors	Safety Assurance taking into account Human Factors

Functional Airspace Configuration & Trajectory Management

2009-2012	2013-2016	2017-2020
Evaluation Method for Terminal Airspace	Functional Terminal Airspace Design	Strategic & Integrated Airspace Design & Operations
Oceanic Airspace Operational Procedures	Promoting Dynamic Routes Operation	
RNAV Route Safety Assessment	Development of Safety Tools	Assessment & Improvement of Safety for Total Flight Phase
Development of Trajectory Model	Use of Trajectory Prediction Model	Operational Efficiency Improvement by TM in High Density Airspace

Info. & Communications Infrastructure for Collaborative Decision Making in ATM

2009-2012	2013-2016	2017-2020
Traffic Information Exchange by Airborne Surveillance	Spacing Applications of Airborne Surveillance	Supplement of Trajectory Management (TM) by Airborne Surveillance
Development of Surveillance Data Link for ATCo	Flight Information Exchange for TM	
Aeronautical Telecommunication. Network	Information Management among Systems: SWIM	
Evaluation of A/G High-speed Data Link Medium	Development of Aeronautical High-speed Aeronautical Communication Technology	
Method of Surveillance Information Processing (Sensor fusion, Integration of associated information for trajectory management)		
Radio Environments & Interferences issues (Subjects common to each domain)		

Advanced Operations of Airport/ Airport Surface

2009-2011	2013-2016	2017-2020
Implementation of Multilateration for ATC Applications	Advanced Airport Operation with Trajectory Management	
Implementation of ASMGCS	Development of Airport Surface Navigation	Use of CAT-IIIc GBAS

Highly Accurate, Reliable & Flexible Navigation Technology

2009-2013	2014-2019	2020-2025
Actual Use of CAT-I GBAS	Use of CAT-II/III GBAS	Use of CAT-IIIc GBAS
Operational Study for GNSS Curved Approach	GBAS Dynamic Approach Paths Provision for Trajectory Management	
Performance Improvement of MSAS & Its Use for Precision Approach	Advanced ABAS	Use of CAT-I ABAS

Subjects to be Continued

- Measurement Techniques of Mental and Body Conditions (such as fatigue of operators, e.g., pilots and air traffic controllers)
- Antenna Characteristics
- Performance Maintenance and Management of Legacy Systems (e.g. ILS)
- Development of Various Support Systems for Safety and Efficiency Enhancement (e.g., Obstacle detection and warning such as debris on the airport surface)
- Operational Compatibility of the Existing Systems (e.g., ACAS) with trajectory based operation

ENRI R&D Roadmap

Showed the Horizon of ENRI's R&D towards 2020

Future R&D Programs will be planned based on the roadmap

Continuous Review & Redirection Processes may be required

Summary

■ Increasing Traffic Demand

⇒ ATM Modernization

■ ATM Ops Concept ⇒ R&D Vision

■ ENRI ⇒ R&D Roadmap (-2020)

■ Realization of Vision

⇒ Cooperation/Collaboration required



Thank you for your attention!

Questions?