



# The Overview of Trajectory Operations & The Phased Transition Plan in Japan

**NTT DATA**

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## Cooperate Overview

- Headquarters: Tokyo, Japan
- Turnover: JPY 1,301 billion.  
(USD 12.61 billion)
- Employees: 10,804 [Non-Consolidated]  
61,369 [Consolidated]
- Business Areas:  
Broad range of IT services including consulting, system integration and IT outsource.
- History:  
1967 - Started as a division in NTT  
Nippon Telegraph and Telephone Corporation  
1988 - Separated from NTT (May 23, 1988)  
1995 - Listed in Tokyo Stock Exchange (Code 9613)



## Aviation Domain Reference - NTT DATA in Japan

We have been developing and providing Air Traffic Control, Air Traffic Management and Air Space Management for JCAB(Japan Civil Aviation Bureau) for a long time. NTT Data also recently started sales and marketing to a global market.

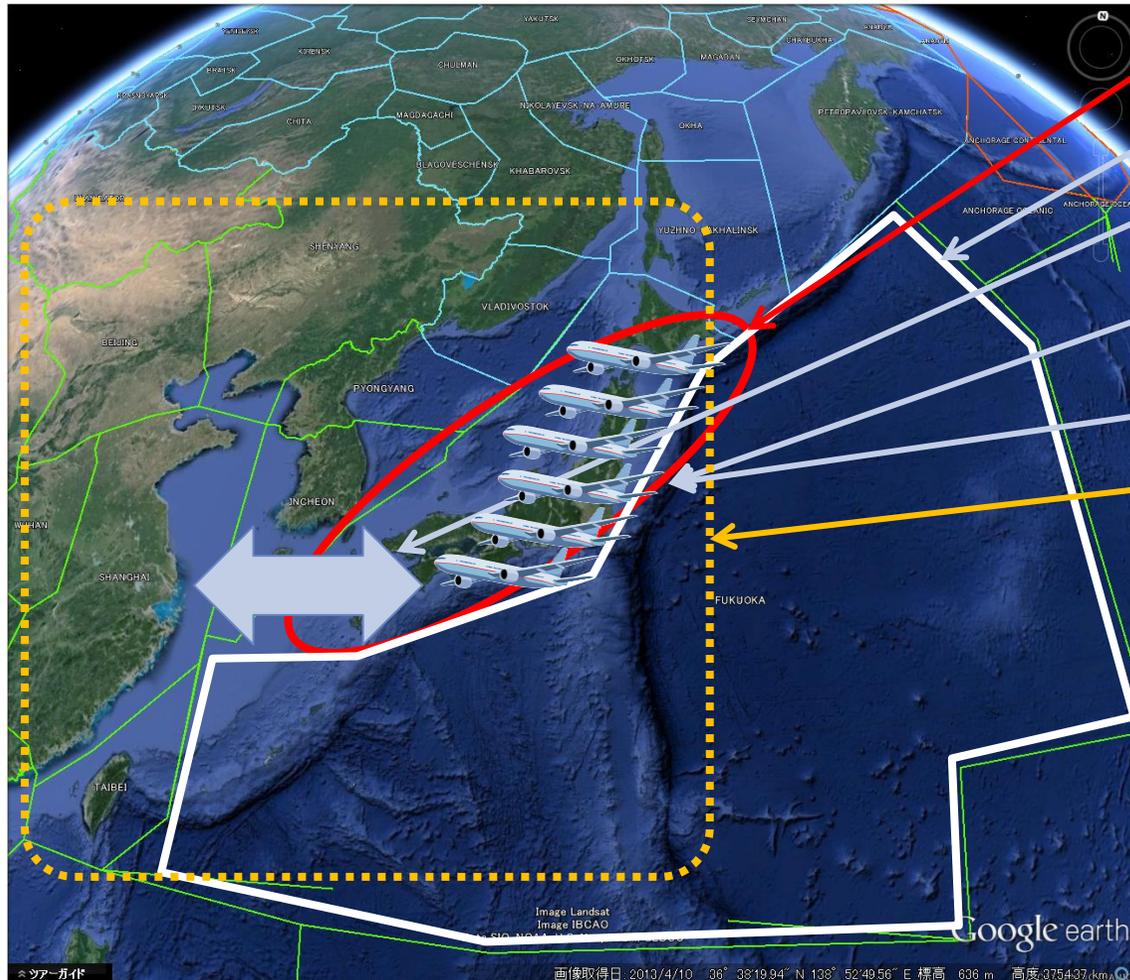
30 years of experience in the Aviation Domain.  
ATM, RDP and many other systems were provided to JCAB.

We had unix-based Flight Procedure Design system for more than 10 years. With the professional expertise, PANADES was developed in 2009 as package product and has globally been sold since 2010.

There are three ICAO IFPP advisors and one ATMRPP advisor in NTT DATA Group, and they have been participating in IFPP and ATMRPP meeting.

## 2. Characteristics of Air Traffic Pattern in Japan

We need to resolve very complex air traffic management, furthermore, we have to achieve safety, efficiency and punctuality simultaneously.



Narrow Terrestrial Area

Vast Oceanic Area

The Entrance of East Asia region

The Size of Aircraft almost Middle or Large

The Aircrafts Fly very Fast!!

The Air Traffic Demand increase

And...

Tokyo Olympic and Paralympic Games in 2020

Very Complex Situation in ATM!!

We need new resolution. => That is Trajectory Based Operation (TBO).

# 3. From GATMOC to GANP ed.4

Summary of relationship between GATMOC and GANP ed.4.

ICAO  
AN Conf.  
11th

Global Air Traffic Management Operational Concept (Doc. 9854)

GATMOC

NextGen

SESAR

CARATS

Others

The Corner Stone of  
Future ATM Operation

ICAO

Challenge Team

Technical Team

ASBU

Aviation System Block Upgrades

Block 0: 2013-  
Block 1: 2018-  
Block 2: 2023-  
Block 3: 2028-

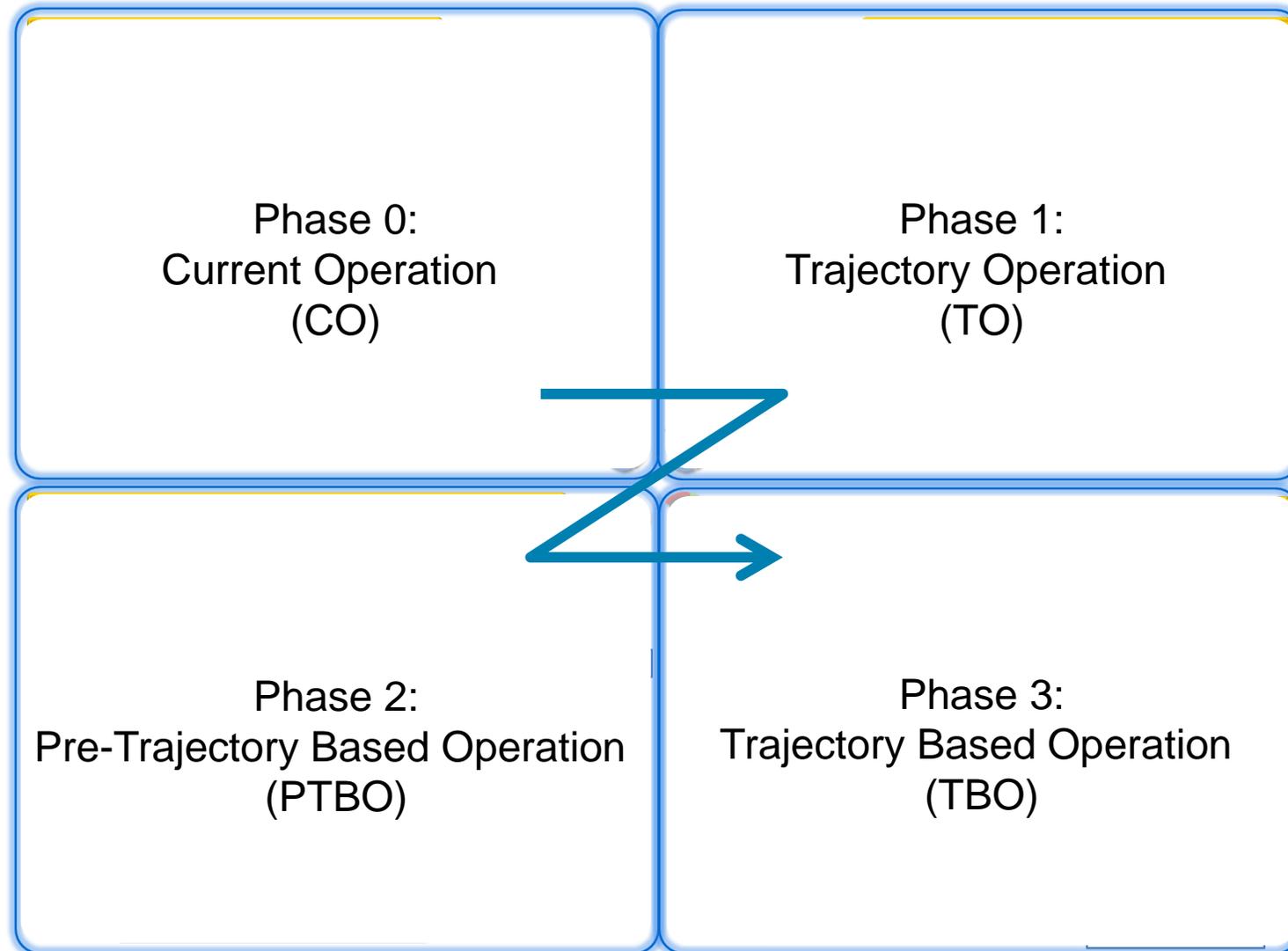
ICAO  
AN Conf.  
12th

Global Air Navigation Plan (Doc. 9750)

GANP

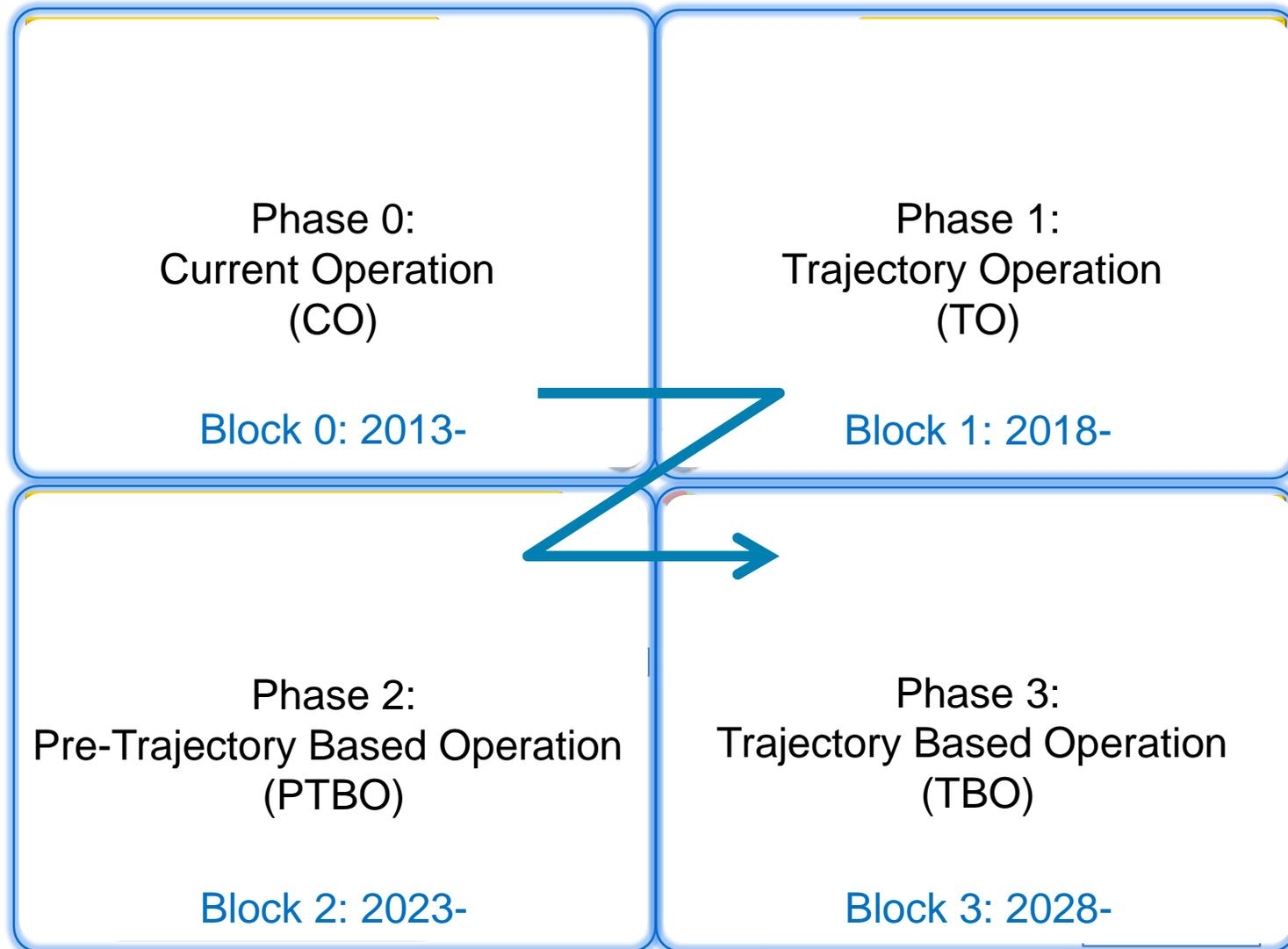
# 4. Transition Image of Trajectory Based Operation in Japan

There are four transition phases of Trajectory Based Operation in Japan.



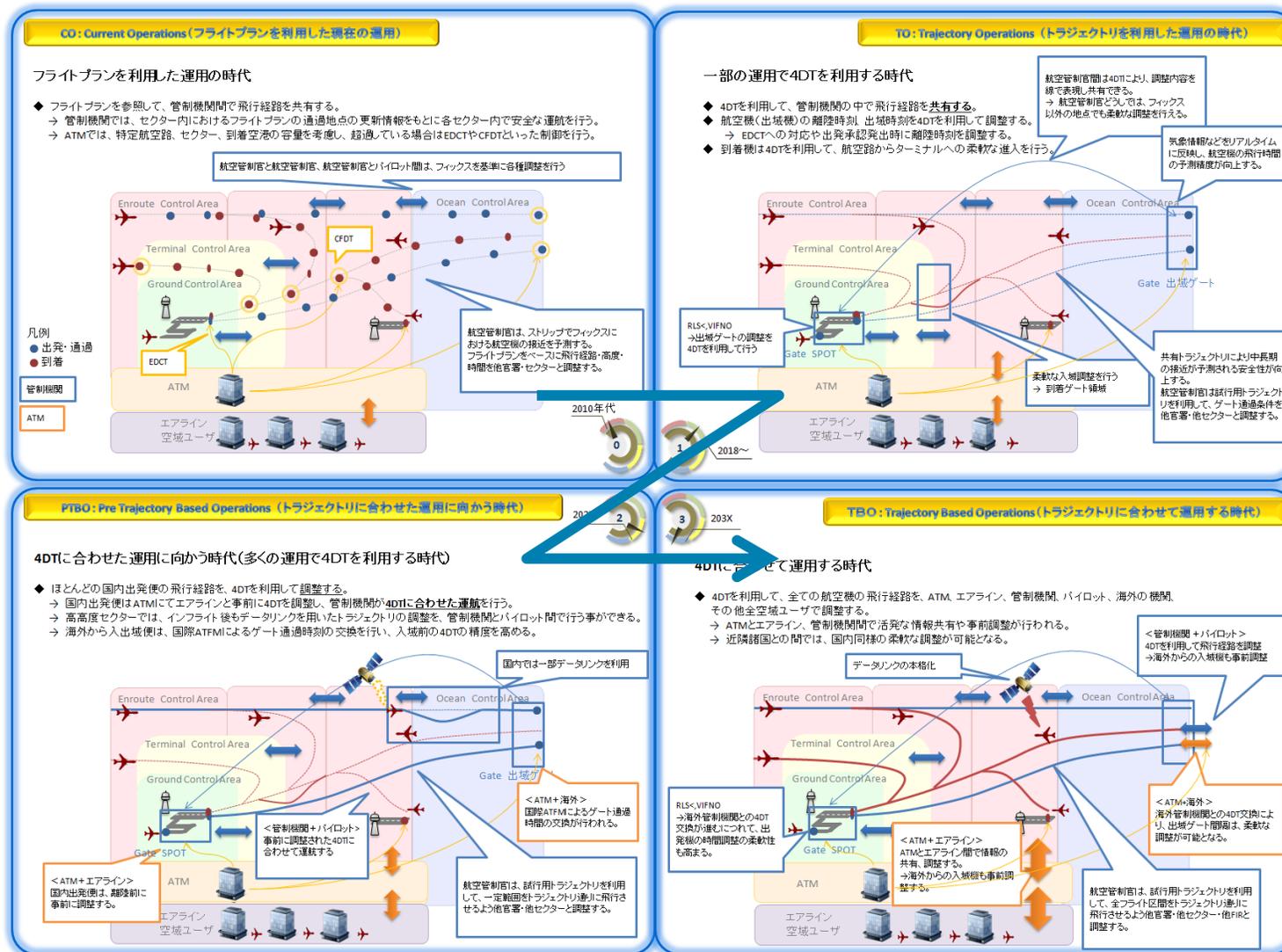
# 4. Transition Image of Trajectory Based Operation in Japan

The TBO transition phases in Japan correspond to ASBUs.



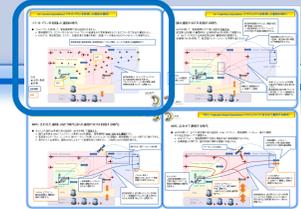
# 4. Transition Image of Trajectory Based Operation in Japan

This figure shows that the overview of phased transition of TBO in Japan.

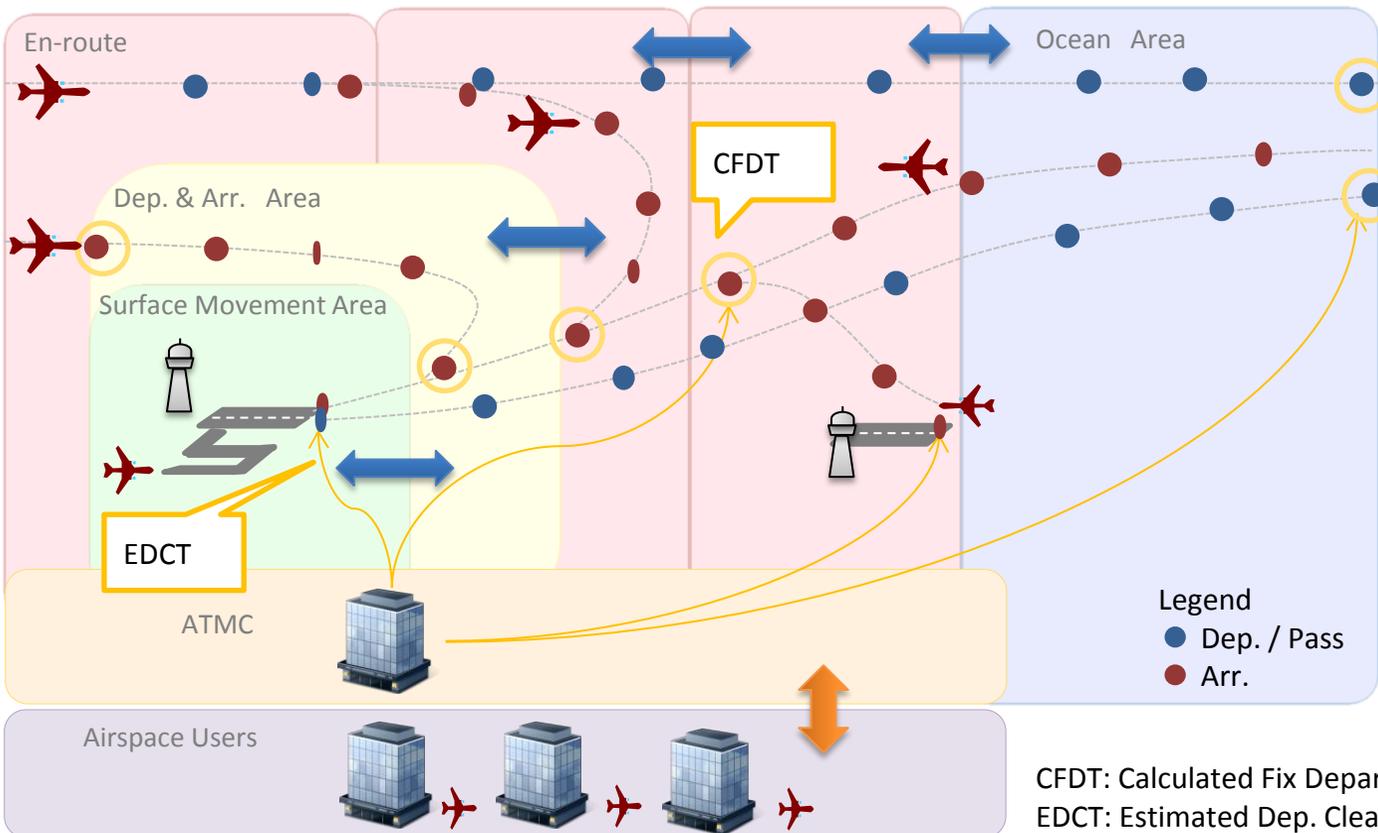


# 5-1. Phase 0 (CO: Current Operations)

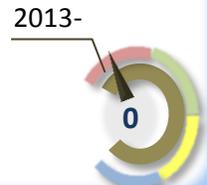
In current operation phase, we realize Time Based Flow Management by using typical ATFM measures and Japanese specific ATFM measure that is called by **SCAS** (Specifying Calculated fix departure time for Arrival Spacing).



## CO: Current Operations

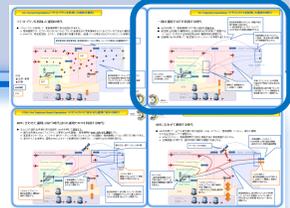


**RCAP** (Radar Control Advise Processor), including AMAN, MTCD etc. (since 2008)

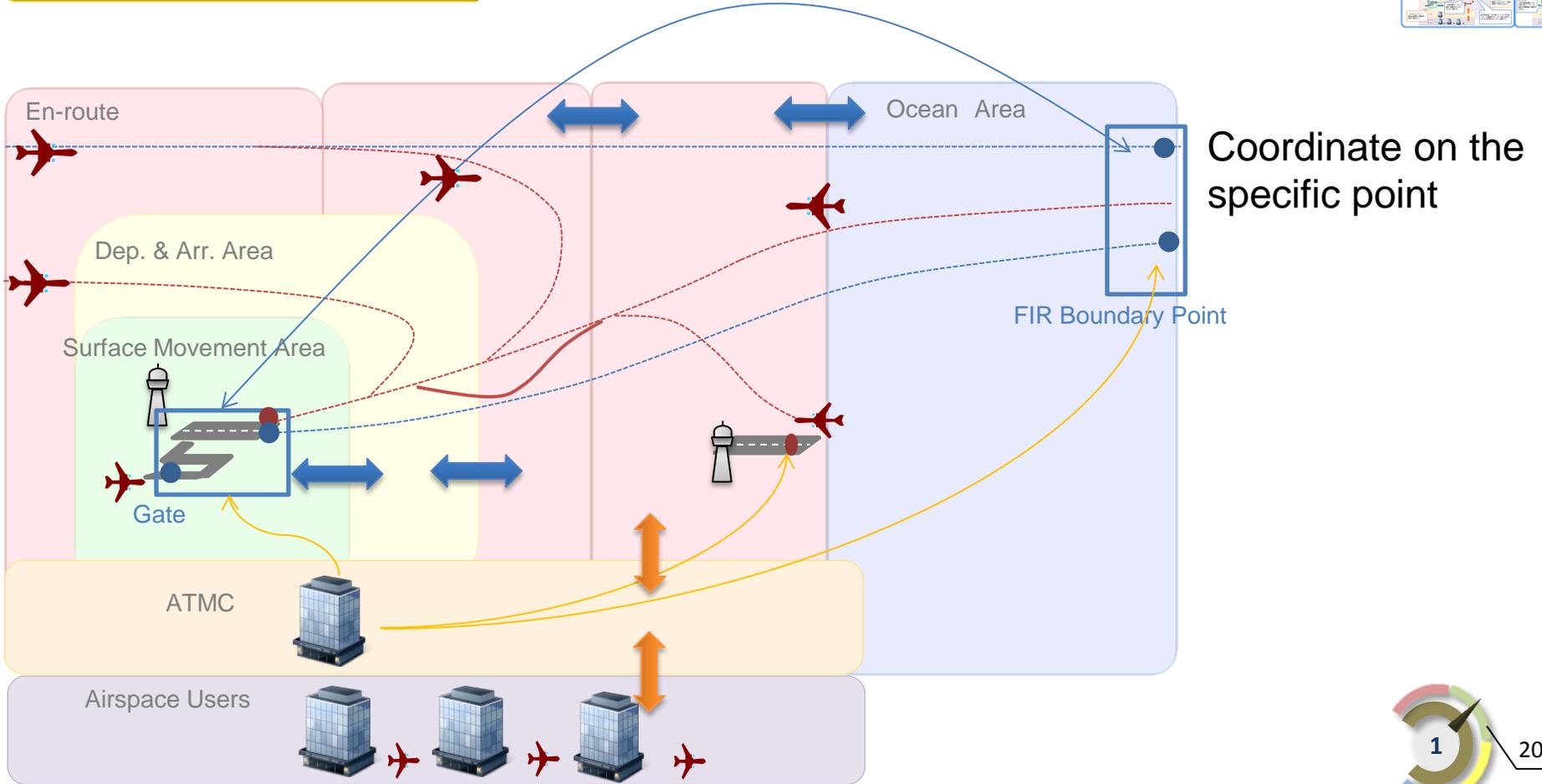


# 5-2. Phase 1 (TO: Trajectory Operations)

In trajectory operation phase, we will start to use 4D trajectory. In other words, this period is initial 4D trajectory operation phase.

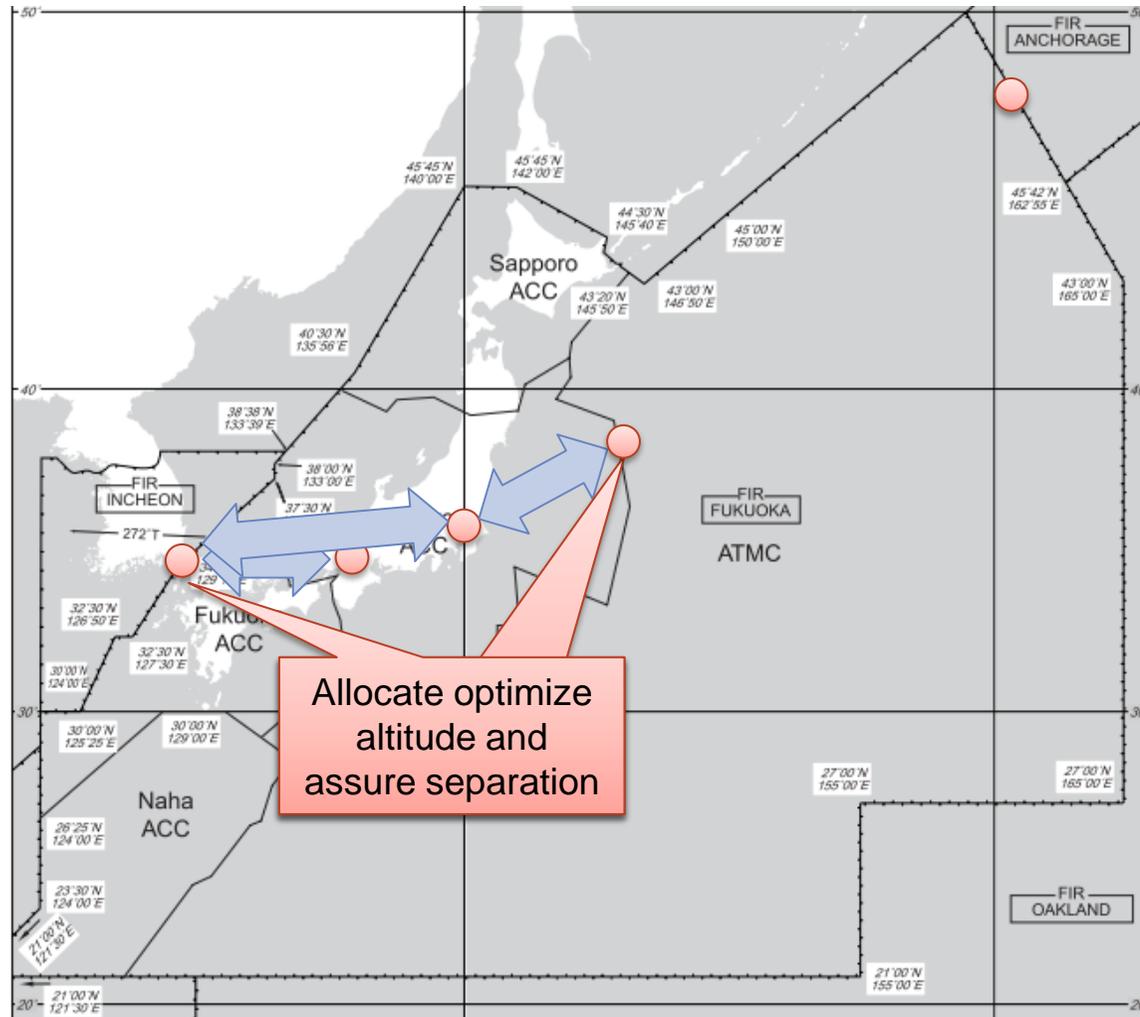


## TO: Trajectory Operations



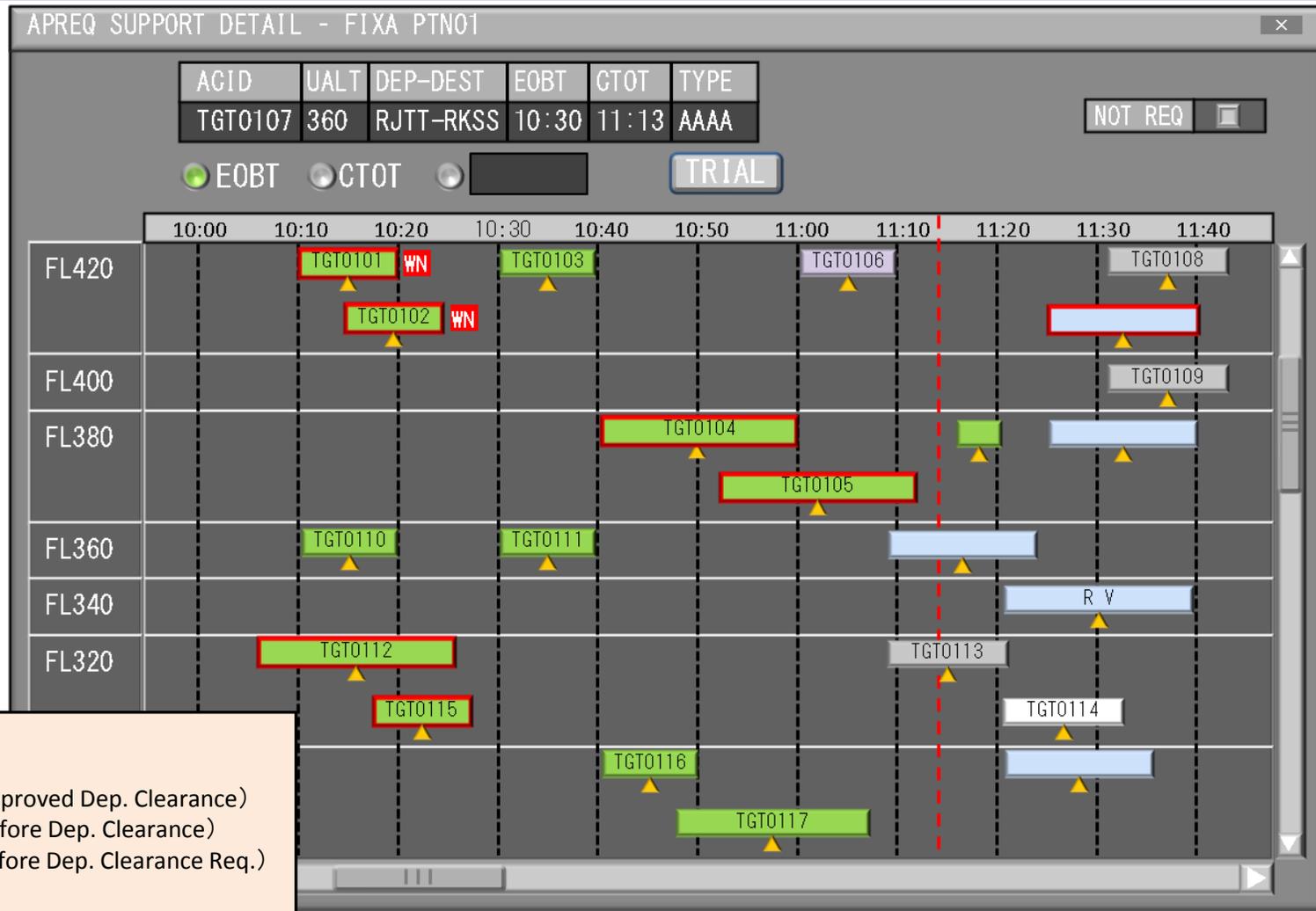
# 5-2-1. Focus on Coordination Point in Phase 1 (TO: Trajectory Operations)

In this phase, we will provide the function of supporting separation assurance efficiently for outbound flight to oceanic area or neighbor FIR.



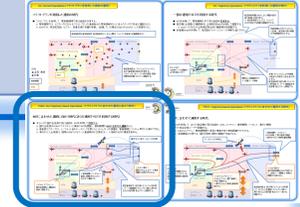
## 5-2-2. The Image of Support Window (Approval Request)

Controllers, who are in Aerodrome and ACC, share outbound flights information on the same support window. They can coordinate pre-departure flight's altitude and time at FIR boundary. Furthermore, they can coordinate by using negotiation trajectory.

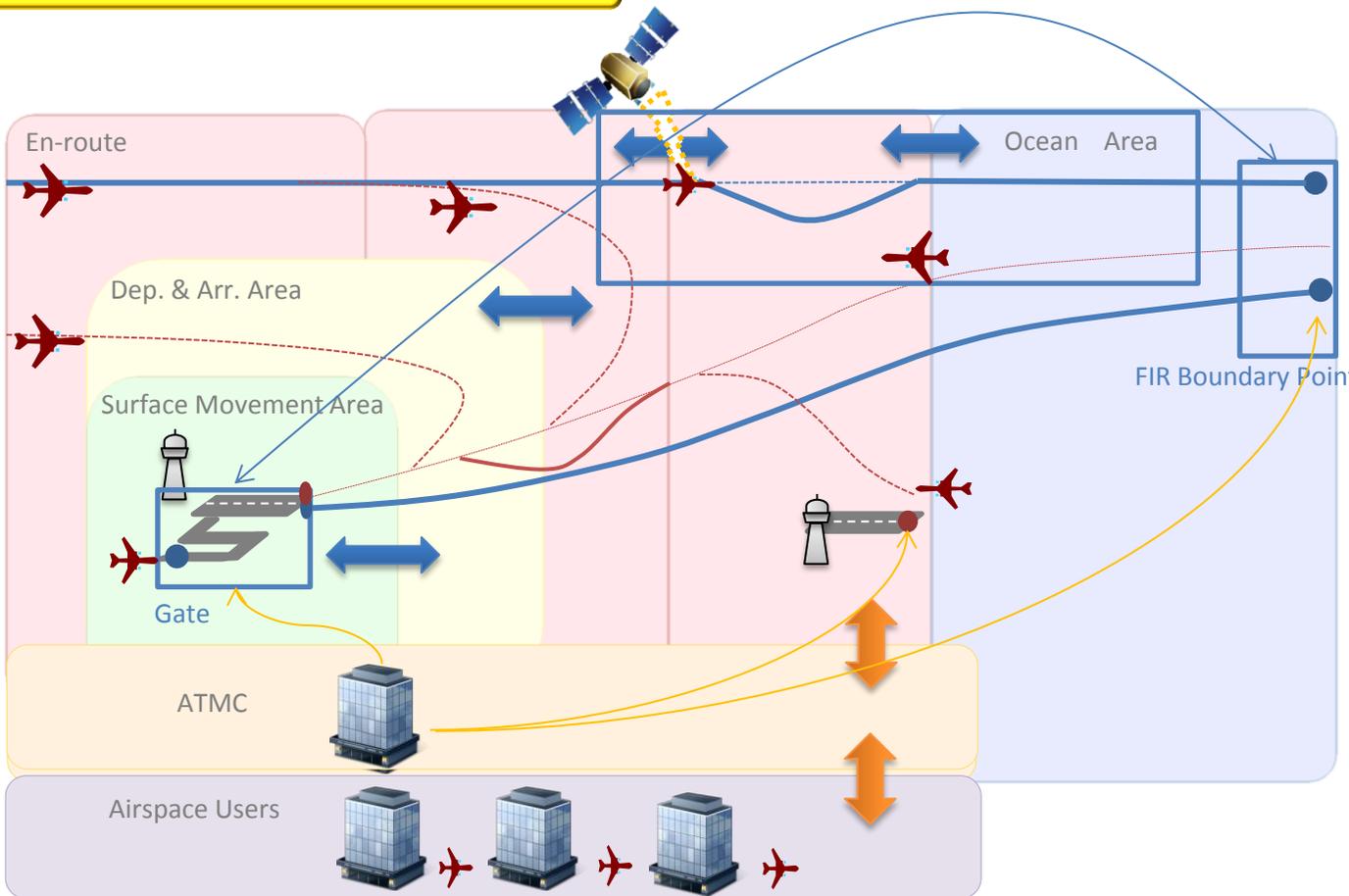


# 5-3. Phase 2 (PTBO: Pre-Trajectory Based Operations)

In pre-trajectory based operation phase, we will progress toward that in space at a time in the future must be tracked to separate based on TBO.



## PTBO: Pre Trajectory Based Operations

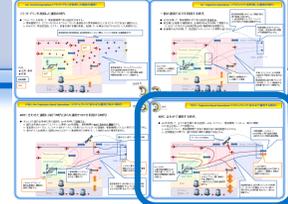


Trust the mechanism that A/C pass at specific points in accordance with plans.

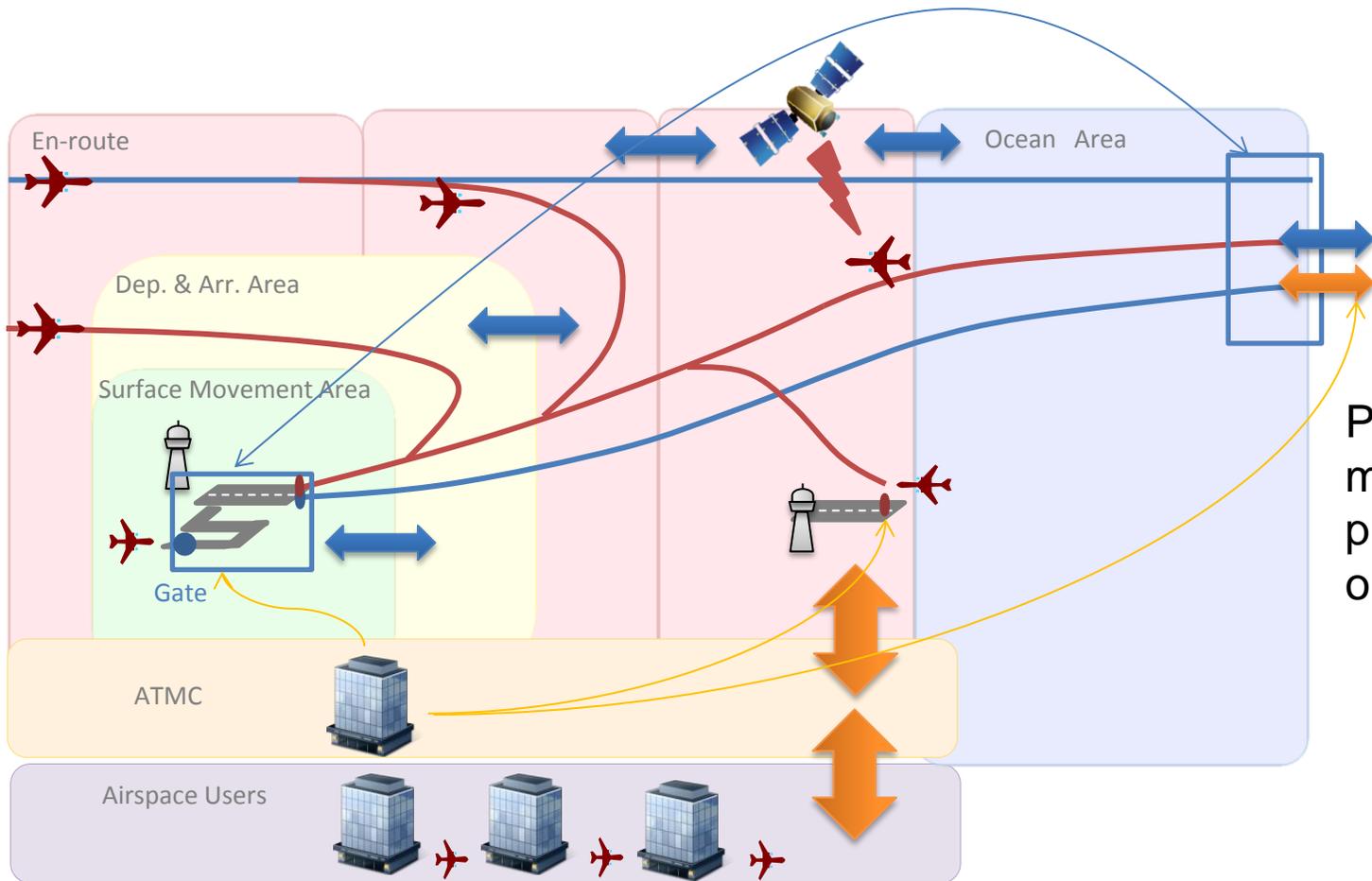


# 5-4. Phase 3 (TBO: Trajectory Based Operations)

In trajectory based operation phase, we will completely finish to transit to trajectory based operation.



## TBO : Trajectory Based Operations



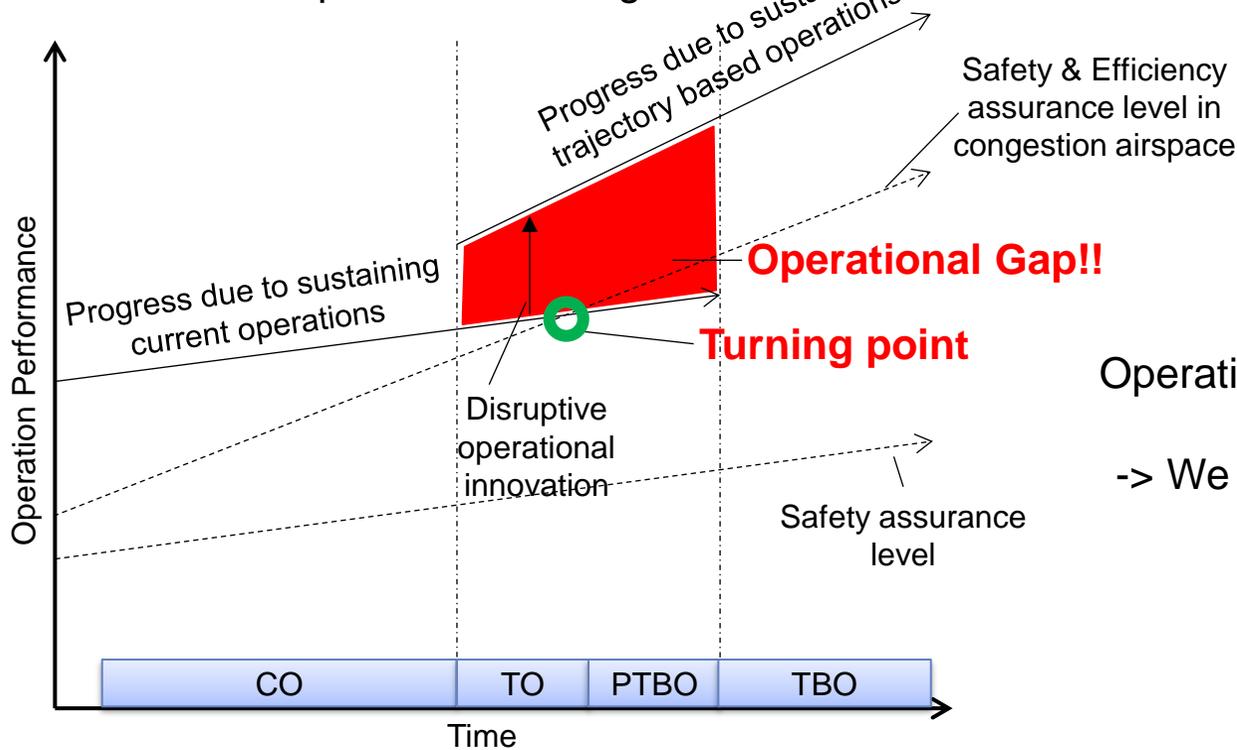
Premise that air traffic management and planning are based on 4D trajectory.



## 6. Why we need to take phased operational transition?

Changing from CO to TO is **Paradigm Shift**. This change is **Disruptive Innovation** for ATM operation. Between CO and TO has a gap of ATM operation. Therefore, we need to operational transition phase that is care about establishing trust to TBO.

The Impact of Sustaining and Disruptive Operational Change

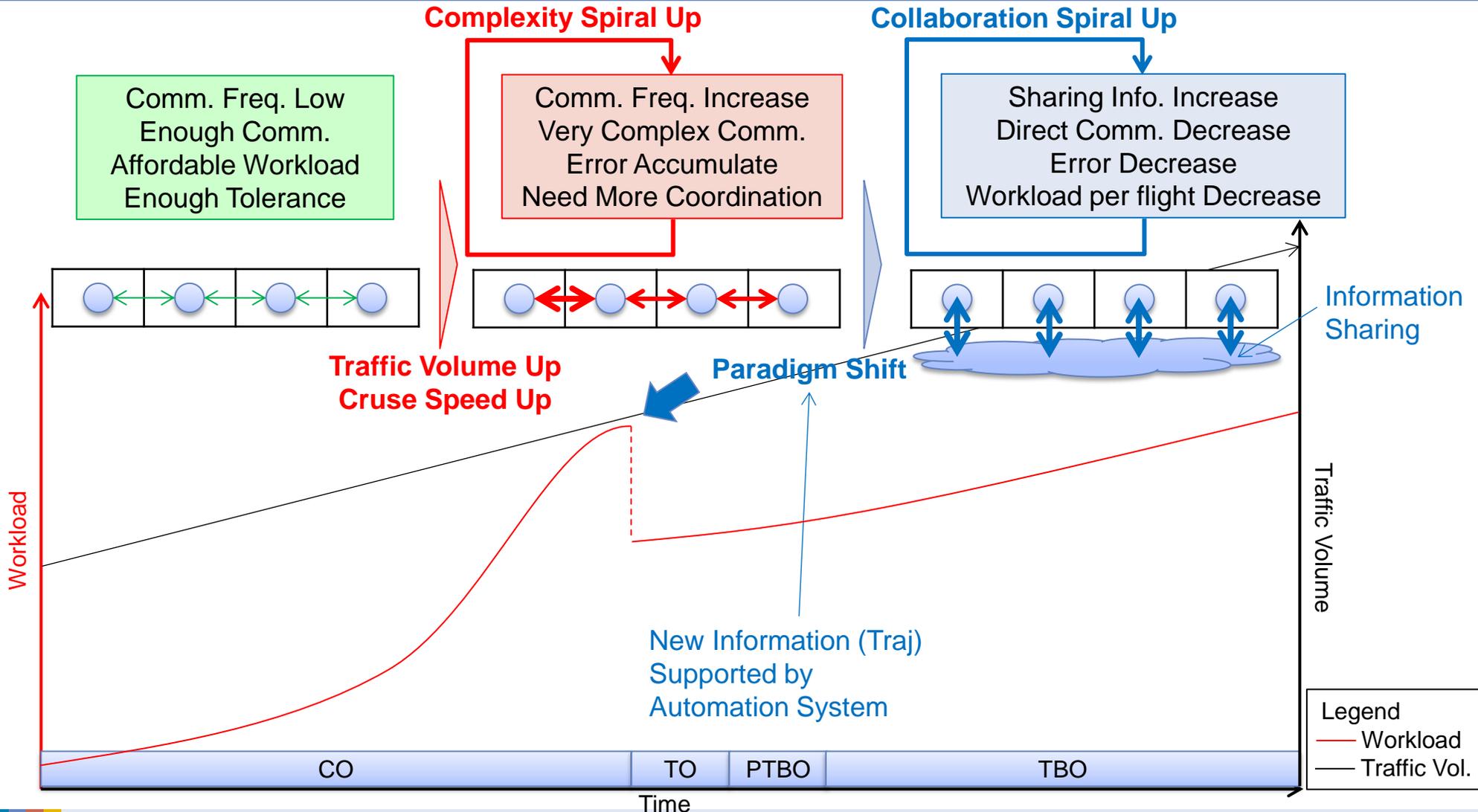


Operational Gap will be cause of anxiety for ATM community.  
-> We need phased operational transition.

This figure is inspired by  
“*The innovator’s dilemma*”  
that is presented by Christensen in 1997.

# 7. Change of Controller's Communication

When operation change from CO to TO, controllers will be able to collaborate between distant area just before departure by information sharing that is based on trajectory.



# 8. Comparison Trajectory Operation between U.S. and Japan in ASBU Block 1

Trajectory Operation in Japan seems to be included in U.S. concept.

## U. S.

Trajectory Operations is the concept of an air traffic management system in which every aircraft that is operating in or managed by the system is represented by a four-dimensional trajectory (4DT). Every managed aircraft known to the system has a 4DT either provided by the user or derived from a flight plan or type of operation. **Trajectory operations, or TOps, represent a mid-term implementation strategy to gain capacity and efficiency.**

(Source: Joint Planning Development Office, (2011), *JPDO Trajectory-Based Operations (TBO) Study Team Report*, p. 3)

Inclusive Relation

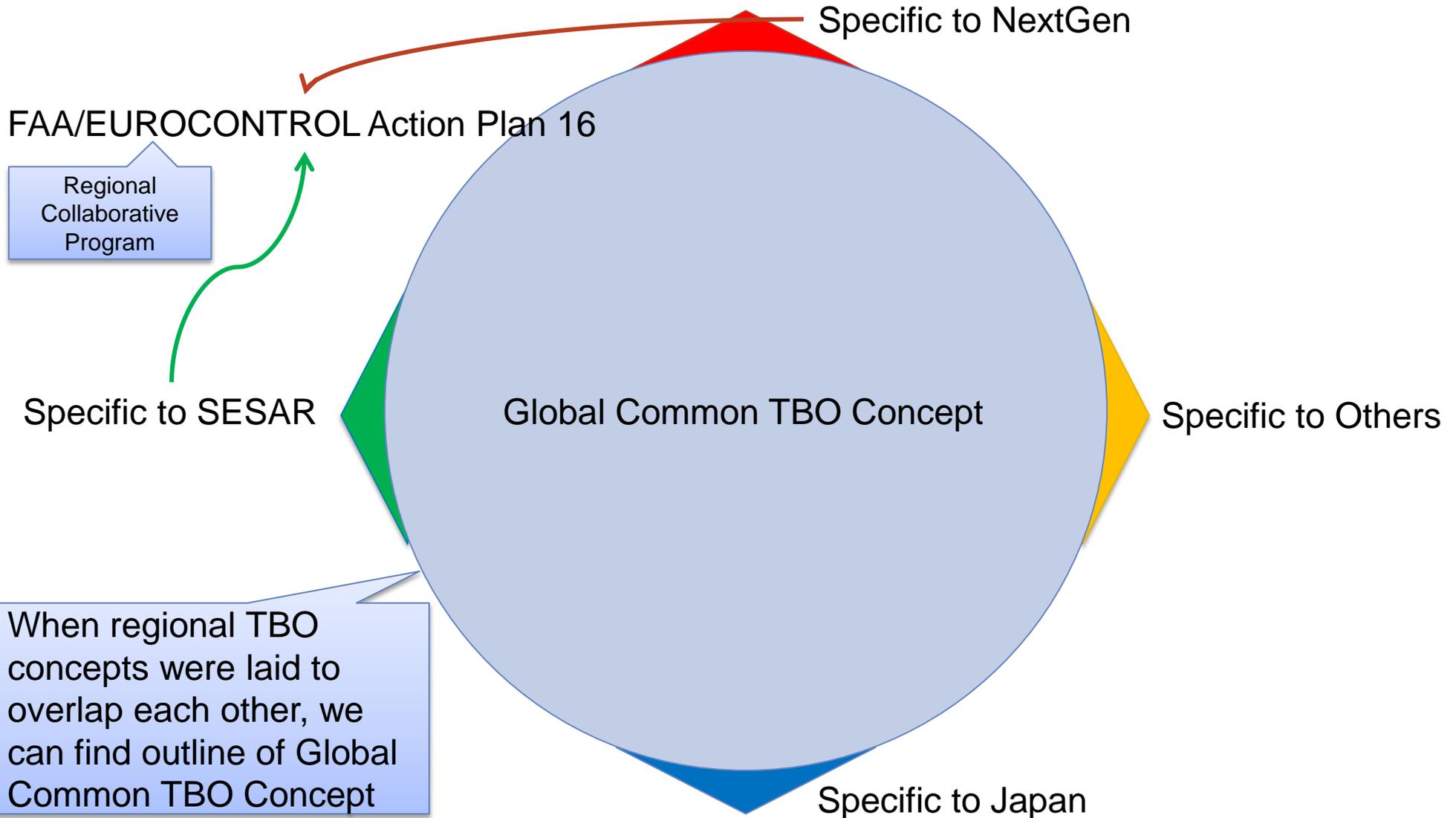
## Japan

Trajectory Operations is the concept of reserving outbound altitude and time at FIR boundary and take-off time are managed by 4D trajectory of pre-departure and in-flight aircraft. Controllers collaborate on specific reserved space of rectangular that is allocated passing estimated time. **Trajectory operations realize to maximize throughput at the crossing point of FIR and oceanic boundary.**

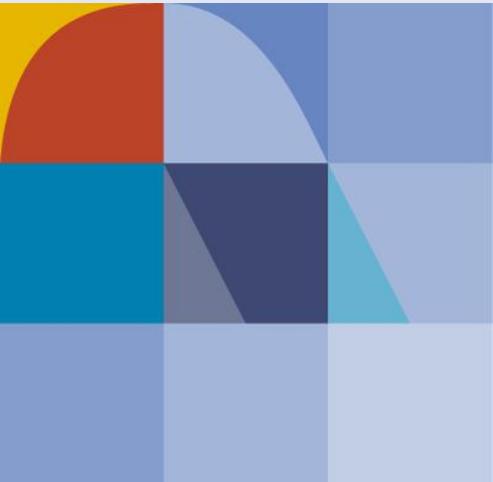
(TBD)

# 9. Comparison TBO Concept between Other Countries and Japan

Each regional TBO concept is almost same, therefore, we could clarify Global Common TBO Concept.



- We develop and deploy the automation system for realizing trajectory based operation in Japan.
- Also, we participate to FIXM TIM to support to develop trajectory data format.
- Considering trajectory data format is closely related to support developing trajectory based operational procedure.
- Furthermore, we support that JCAB participate to Mini Global Demonstration (SWIM).
- We would like to support JCAB for realizing Trajectory Based Operation in Japan.
- In addition, we are honor if we are able to contribute to establishing Global TBO Concept.



# NTT DATA

Global IT Innovator



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