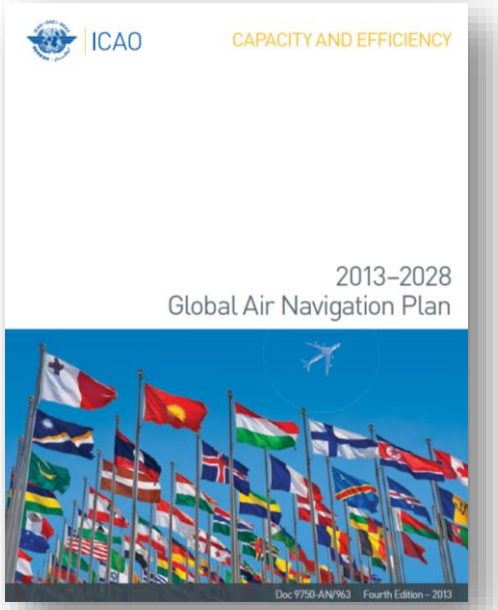
# SWIM in ASEAN Demonstration

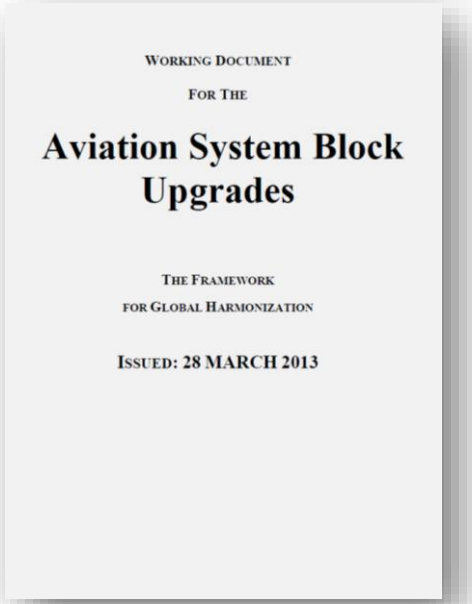
# Introduction

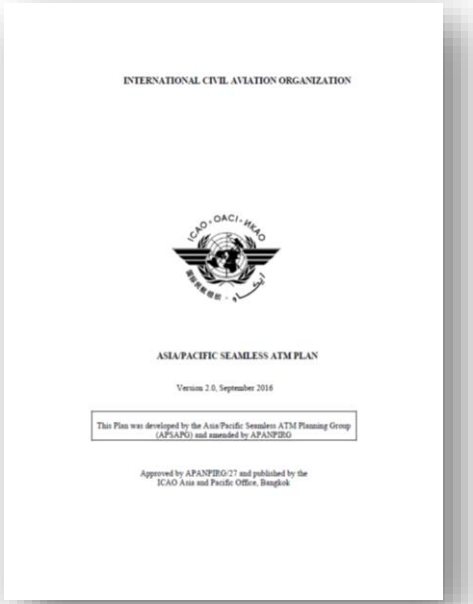
**SWIM**

*Key Driver*

- Greater ATM system interoperability
- Increased air navigation service efficiency





SWIM IN ASEAN DEMONSTRATION

# Introduction

USA proposed to assist in putting together a SWIM demonstration involving all AMSs

Planning out activities and milestones for the demonstration among Singapore, Thailand, and USA

**ATWG/34** | **ATTC/14** | **Inaugural Planning Session**

Oct 2016 | Jan 2016 | Mar 2017 | May 2017 | Aug 2017 | Oct 2017

Discussion between Singapore and Thailand started

**ICAO APAC SWIM TF/1**

Participant Package sent to AMSs and interested States

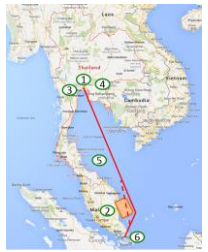
# Introduction

| 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|
| Dress Rehearsal | **Demonstration Bangkok** | Travel Day | Dress Rehearsal | **Demonstration Singapore** |

**Nov 2019 Demonstration 11-15 Nov 2019**

**Preparation**

2017 | 2018 | 2019



Operational scenarios design session between Singapore and Thailand Nov 2017

Apr 2018 **TIM/1**

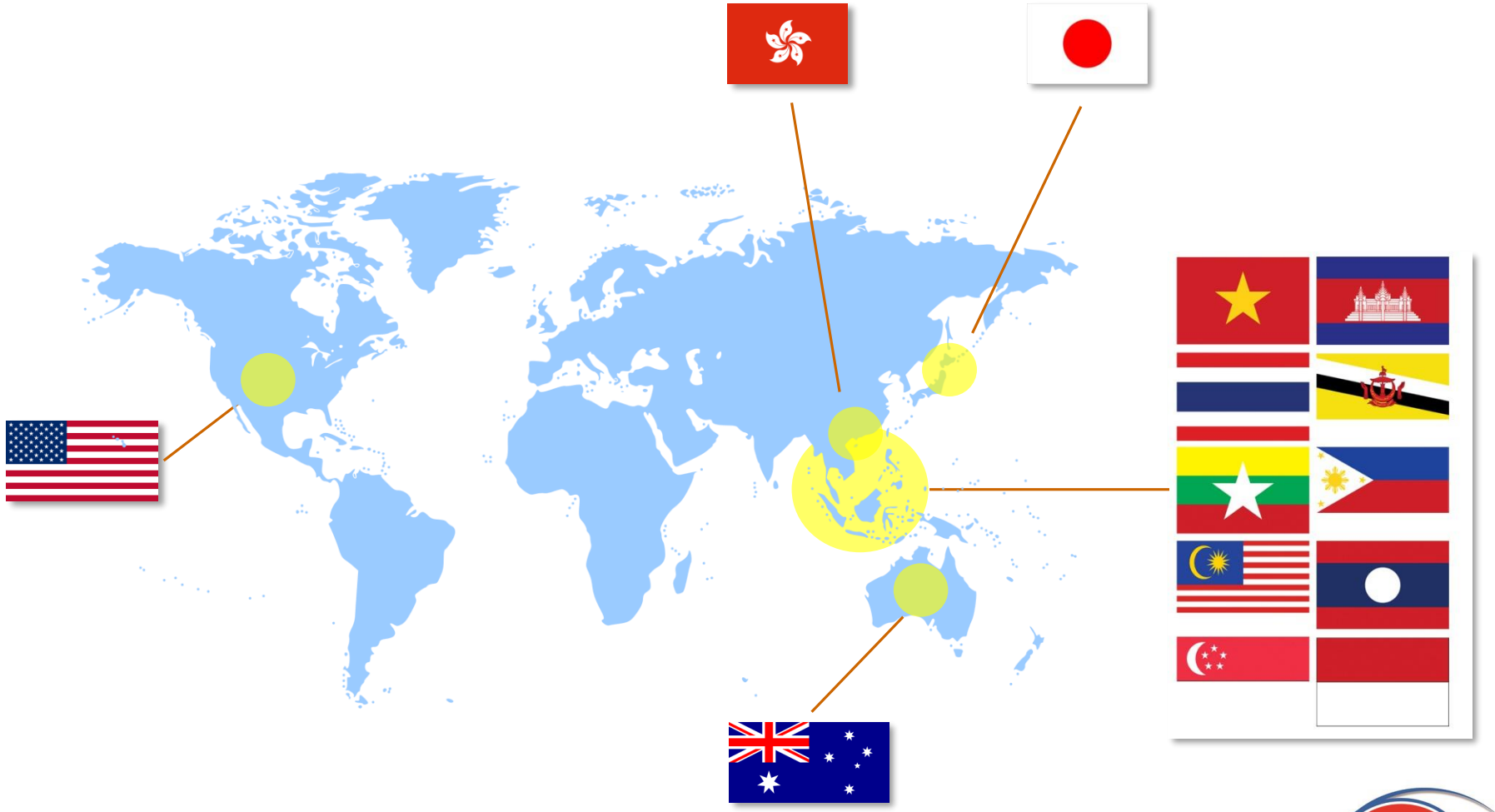
Sep 2018 **TIM/2**

Apr 2019 **TIM/2.5**

Aug 2019 **TIM/3**

SWIM IN ASEAN DEMONSTRATION

# Scope of the Demonstration



# Purpose of the Demonstration

- To demonstrate the principles of SWIM
- To show the potential benefits of SWIM
- To demonstrate a model of SWIM implementation for ASEAN and APAC region

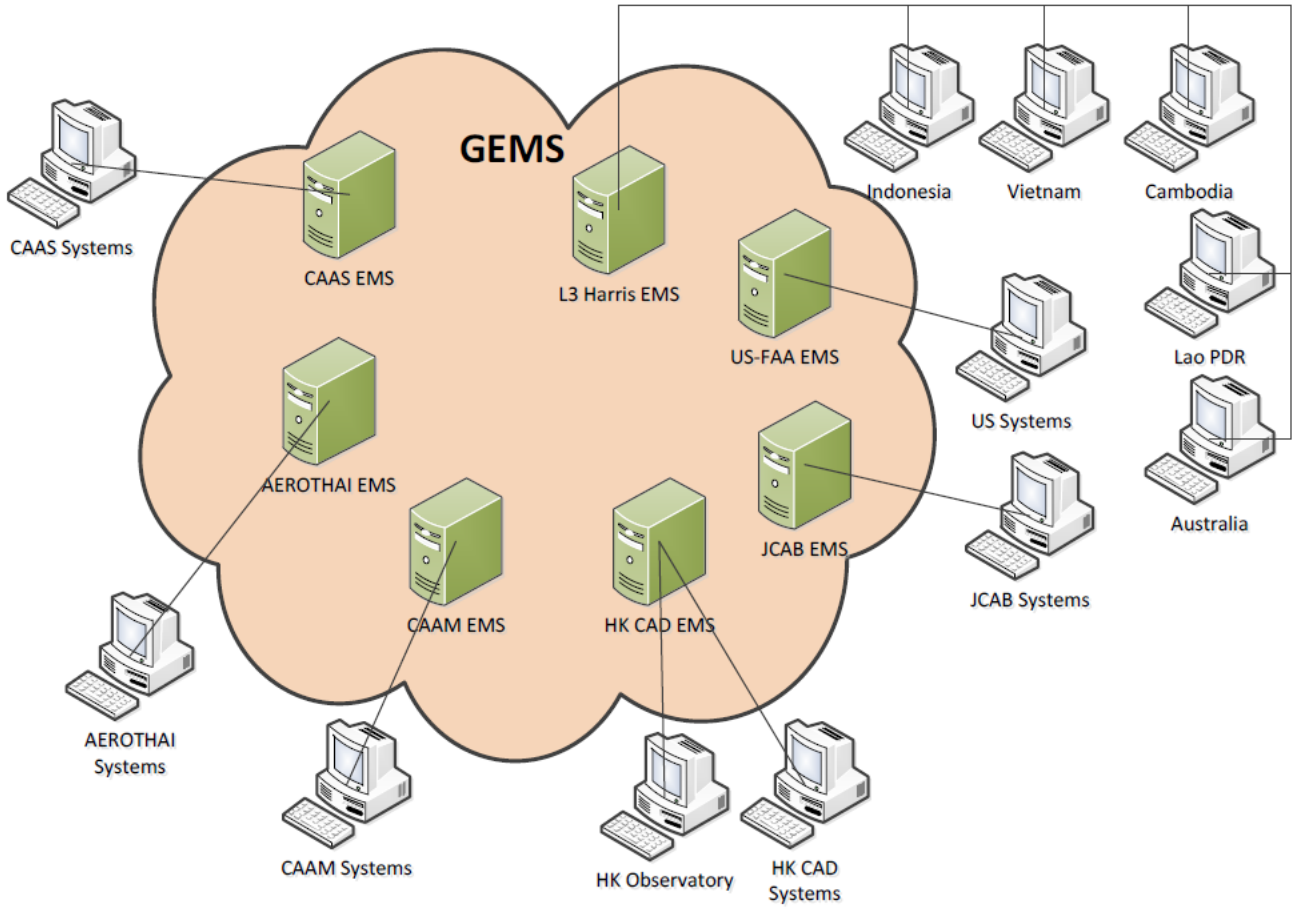
# Goals of the Demonstration

- Demonstrate operational values of SWIM, anchoring on scenarios based on Distributed Multi-Nodal ATFM Network concept
- Generate greater discussion among participants on SWIM and SWIM implementation in the region
- Achieve broad participation by ASEAN and Asia/Pacific aviation community
- Construct a Global Enterprise Messaging Service (GEMS) network

**Gain consensus for ASEAN and Asia/Pacific to move forward on SWIM**

# Demonstration
# Technical Infrastructure

# High-Level Technical Architecture

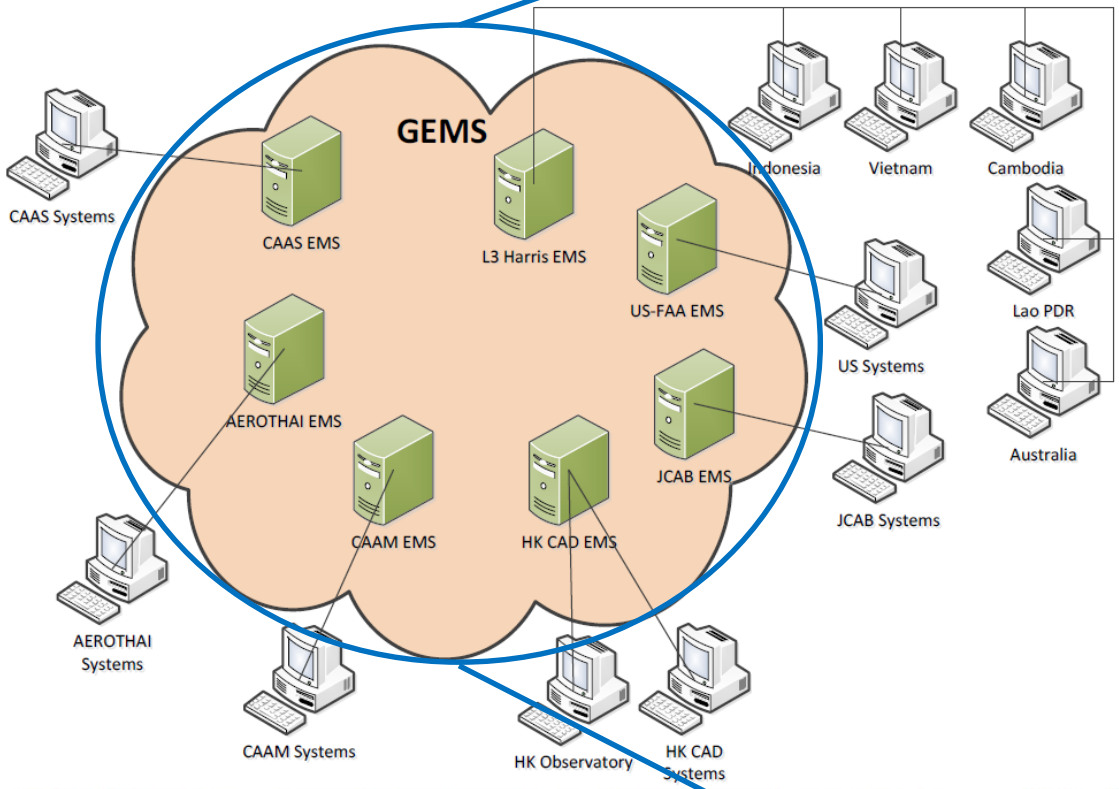



- A network of interconnected EMSs

**Global Enterprise Messaging Service (GEMS)**

- Network connectivity: VPN
- GEMS Working Group Governance and Business Rules for Inter-EMS Data Exchange
- Data will be exchanged through an EMS

# Enterprise Messaging Service




| Enterprise Messaging Service | |
|---|---|
| Governance | Validation |
| Routing | Security |

| Information Service | |
|---|---|
| Aeronautical information | Flight information |
| Meteorological information | ATFM Daily Plan information |

| Additional Service |
|---|
| GUFI service |
| Flight object management |
| Data transformation |

| Application |
|---|
| Data Governance Module |
| ATFM |
| Viewer |

# Standards Used for Information Exchange within this Demonstration

- Messaging
  - AMQP v1.0
  - Metadata :
    - Current operational concept: ATS message-based
    - Transition
    - Future operational concept: FF-ICE

- In demonstration :
  - Use both pre-recorded and simulated data
  - Use cases involving aeronautical information, flight information, and weather information sharing among stakeholders will be demonstrated
  - **AIXM V5.1, FIXM v4.1 with APAC Extension, IWXXM v2.0**

SWIM IN ASEAN
DEMONSTRATION

# Scenario Introduction

SWIM IN ASEAN
DEMONSTRATION

# Scenario Principles

**Demonstrating SWIM and its benefits to flight and ATM operations**

## Normal Flight Operations

- Gate-to-gate operations
- Airport CDM

***Enhanced flight information exchange***

## Restricted Flight Operations

- Military activity
- Weather hazard
- Conditional route (CDR)

***Cross-border ATFM, ASM, and collaboration***

**Current Operational Concept**

## Normal Flight Operations

- Special Use Airspace
- Weather hazard

***FF-ICE/1 Pre-Departure Negotiation***

**Future Operational Concept**

# Scenarios to be Demonstrated

## Normal Flight Operations

Airport CDM (A-CDM) Operations
*2 scenarios*

Departure-to-Arrival Trajectory Sharing
*2 scenarios*


## Current Operational Concept

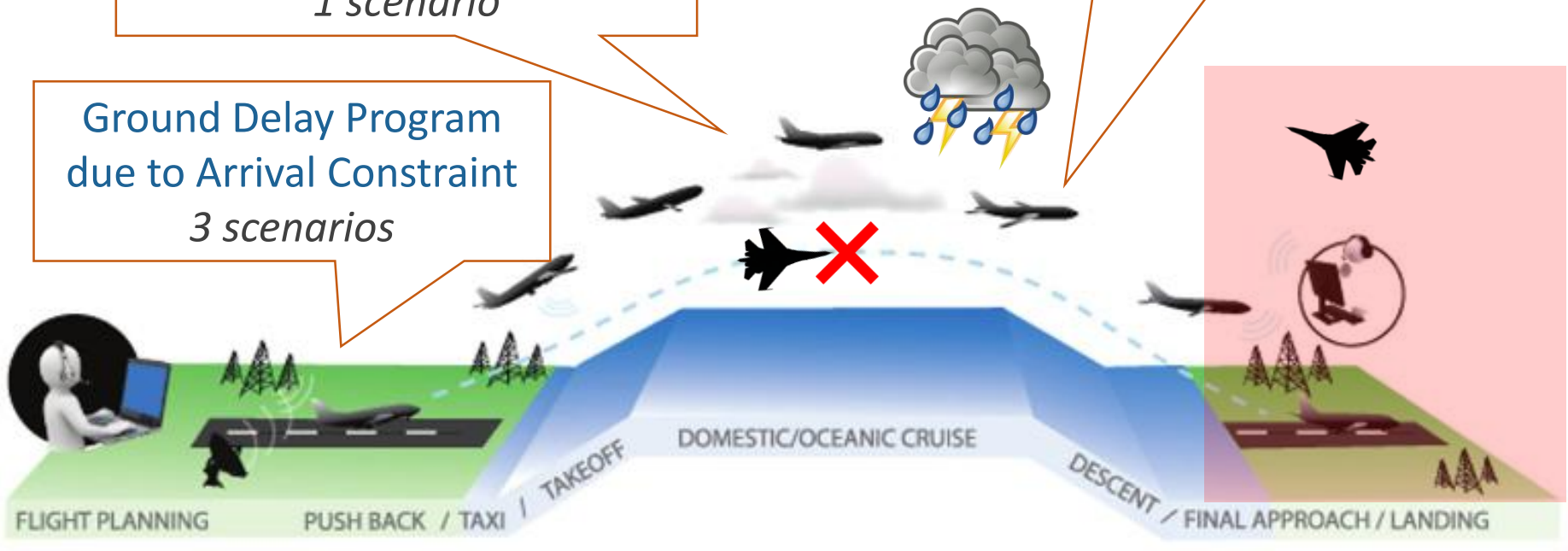
# Scenarios to be Demonstrated

## Restricted Flight Operations

Airspace Use Plan and CDR De-Activation
*1 scenario*

Airborne ATFM Measure due to Weather Constraint
*2 scenarios*

Ground Delay Program due to Arrival Constraint
*3 scenarios*



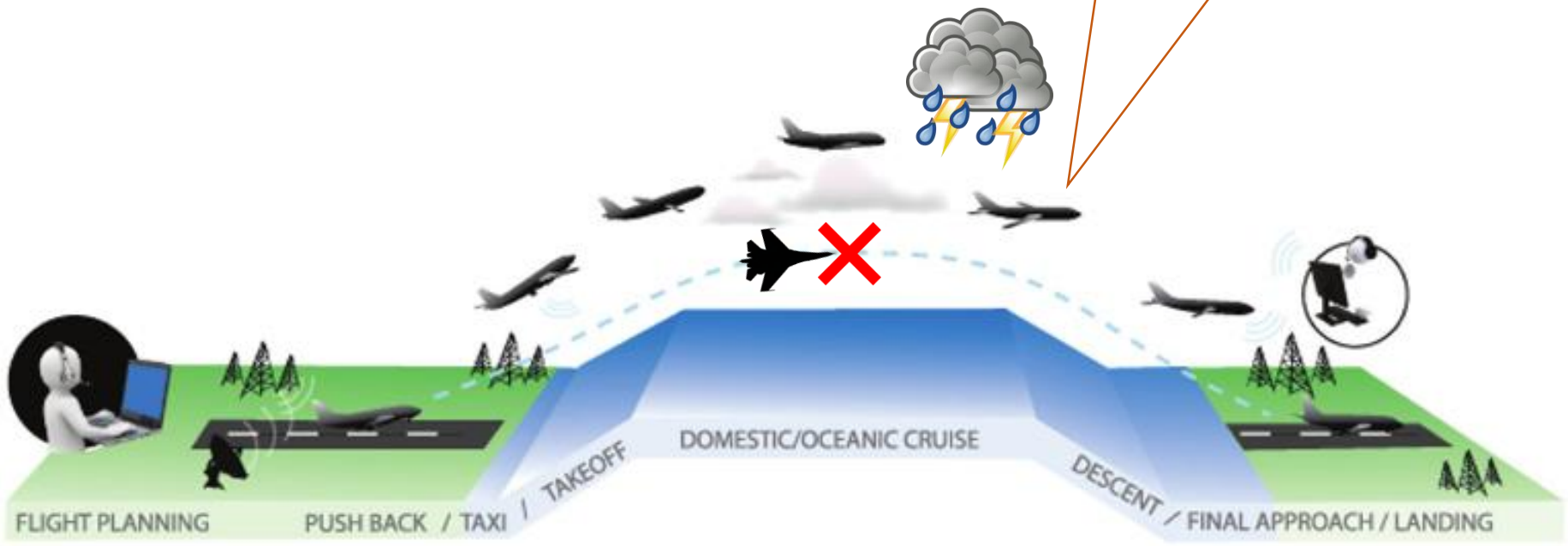

## Current Operational Concept

SWIM IN ASEAN DEMONSTRATION

# Scenarios to be Demonstrated

## Normal Flight Operations

FF-ICE/1: Pre-departure Negotiation
*1 scenario*




## Future Operational Concept

SWIM IN ASEAN DEMONSTRATION

# Lessons Learnt

SWIM IN ASEAN DEMONSTRATION

# Observations / Lessons Learnt

**More SWIM capable, the better !**

- Seamless information exchange among stakeholders is critical
  - Common situational awareness
  - Predictability
  - Collaborative decision making
- Increasing need for SWIM is a fact
  - Improve current operations
  - Enable advance operations
- More distinct operational benefits can be achieved with increasing SWIM implementation
- Participation of AU's FOC system via G/G SWIM tangibly contributes to improved ATM system performance

# Observations / Lessons Learnt

- Interconnected-EMSs is a candidate model of SWIM implementation for ASEAN and Asia/Pacific region
  - Use of open standards, utilization of open-source messaging protocols
  - GEMS metadata
    - Defined format and possible values
  - Message routing
    - Standardized solution required to prevent message looping
    - Messages irregularly-continuously routed among GEMS providers
  - Relation between headers
    - Requiring defined relation between header defining message type and other related header

GEMS_MESSAGE_TYPE = FPL



GEMS_XML_VERSION, GEMS_ACID, GEMS_DEP_AIRPORT, GEMS_ARR_AIRPORT

  - Required data elements of each message types

# Observations / Lessons Learnt

- Use of AIXM, FIXM, IWXXM plays an important role in achieving interoperability
  - Regional requirements - Extensions to XM Core
- Mediation is a key to bring diverse stakeholders with different technical capabilities on board
- Technical enhancement discussion without operational view is challenging
  - Clearly defined operational use cases
  - Clearly defined process

**Move forward on SWIM**

SWIM IN ASEAN DEMONSTRATION

# Thank You

SWIM IN ASEAN DEMONSTRATION

Ministry of Land, Infrastructure, Transport and Tourism
CIVIL AVIATION BUREAU 0F JAPAN

# *Transition to SWIM*

## *- Challenges of Japan -*

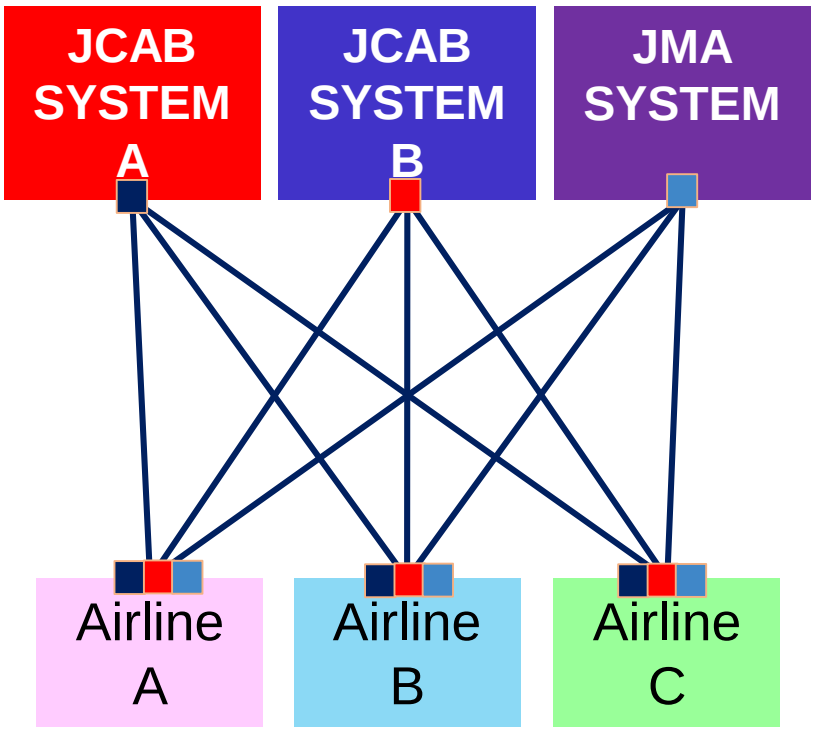
CARATS
Collaborative Actions for Renovation of Air Traffic Systems

Yukinobu RYU, JCAB
For IATA Webinar
4 December, 2019


Motivation
for
SWIM

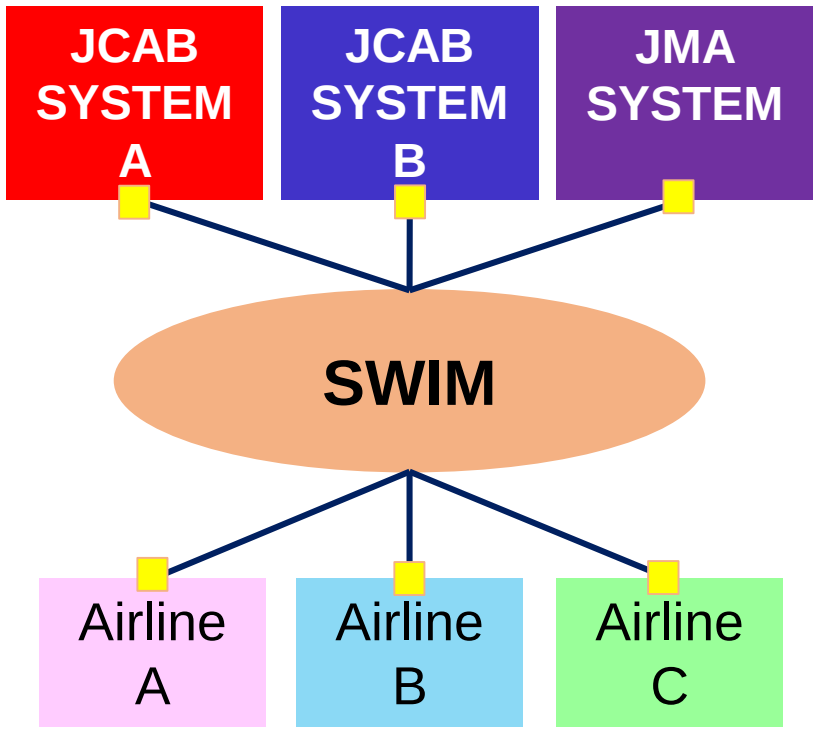
# Information exchange among stakeholders

## Today




- Old technologies
- Limited use of information
- Cost (will definitely increase)

## Tomorrow




- Timely technologies
- Expanded use of information
- Cost (will be reasonable)

***For this transition, our priorities are …***

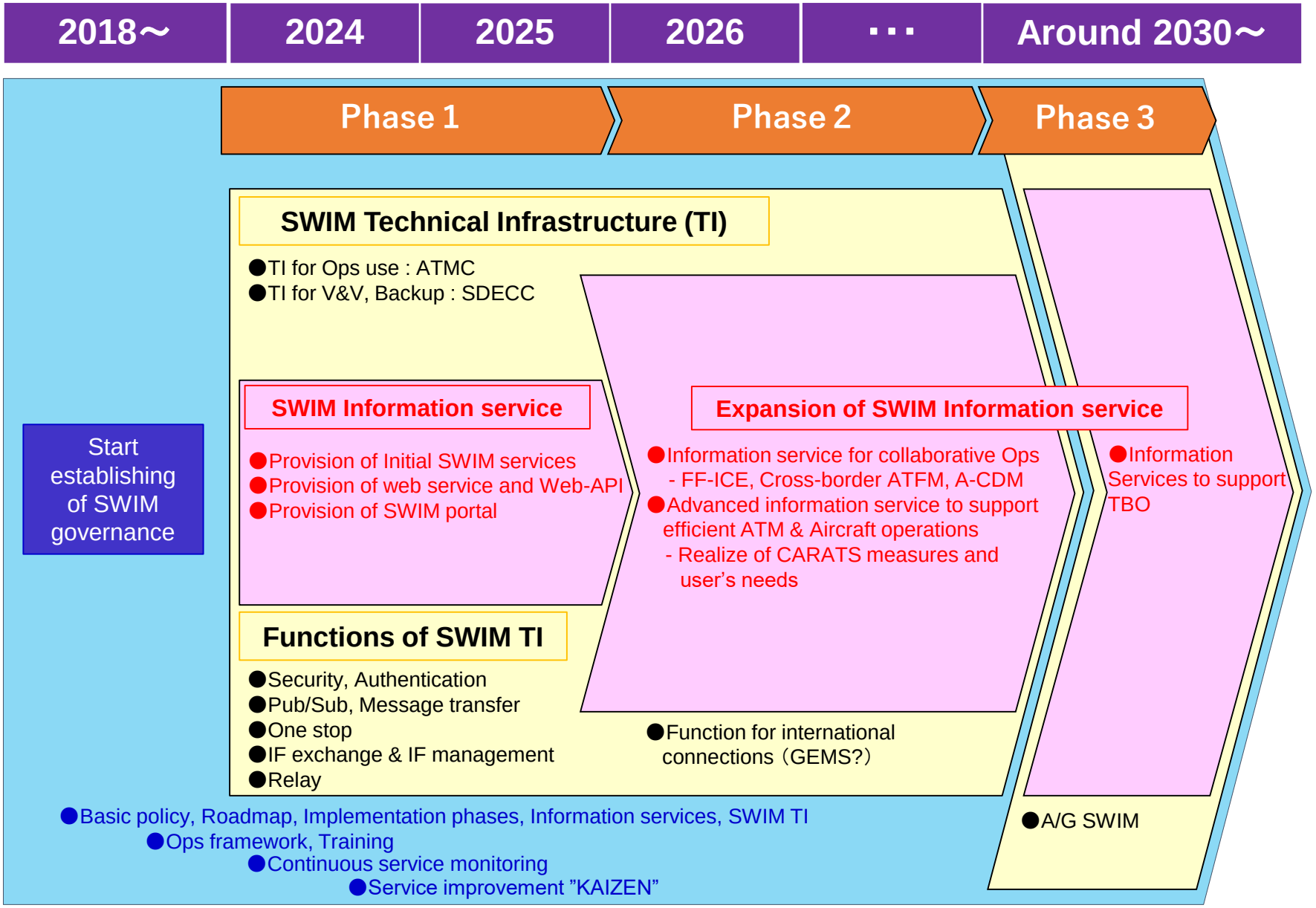
*1) to exchange FPL, NOTAM, MET information under the SWIM environment*
*2) to abolish point-to-point connections and necessary capabilities*
*3) to show operational benefit with/after transition (ex. FF-ICE)*

# SWIM implementation WG



- **Objective**
  - ✓ To get consensus among stakeholders for SWIM implementation in Japan
- **Members**
  - ✓ JCAB(ANSP, Regulator), JMA(Met services), Airlines, Airports, Vendors, JSDF and 3rd Party
- **Main discussion**
  - ✓ 1st meeting: Review of past activities – CARATS IM WG
  - ✓ 2nd meeting: Role of SWIM from the “TI” point of view
  - ✓ 3rd meeting: Phased implementation and initial services
  - ✓ 4th meeting: CBA & International harmonization
  - ✓ 5th meeting: Roadmap & “Agreed” Basic policy for SWIM implementation in Japan

# SWIM Implementation Roadmap



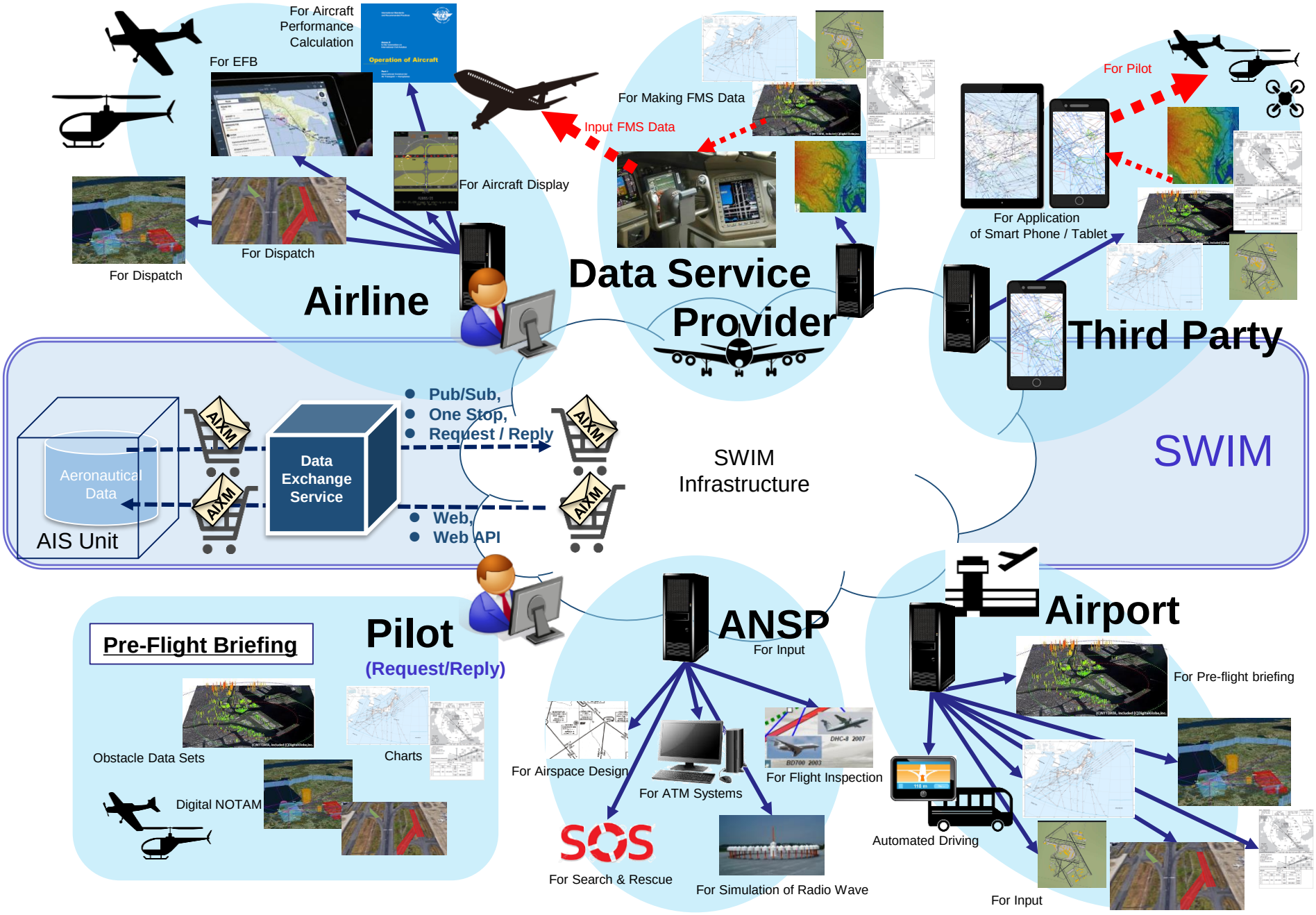
# SWIM Services



## 【"**Candidate**" SWIM services to be prepared for Phase-1】

| Service name | Description |
|---|---|
| Flight Plan filing service | in FIXM format (Web) |
| ATS information publication service | in FIXM format and API (Pub/Sub) |
| Automatic Terminal Information Service(ATIS) publication service/request service | ATIS service in XML format (Pub/Sub, R/R) |
| Common-PIREP publication service | Pilot Report service in XML format (Pub/Sub)<br>※FUKUOKA FIR only |
| Information service package request service (Message) | Mixture and extract service of aeronautical and weather information(Message-oriented) |
| Information service package request service (MAP/GIS) | Mixture and extract service of aeronautical and weather information (MAP/GIS-oriented) |
| Airport / Airspace profile service | "Snapshot" information service of Airport and Airspace situation (Web) |
| Airport slot & Parking gate request service | Web service |
| Oceanic airspace trial service | Trial service to improve aircraft operation in Oceanic airspace (Web) |

# AIM as SWIM Services



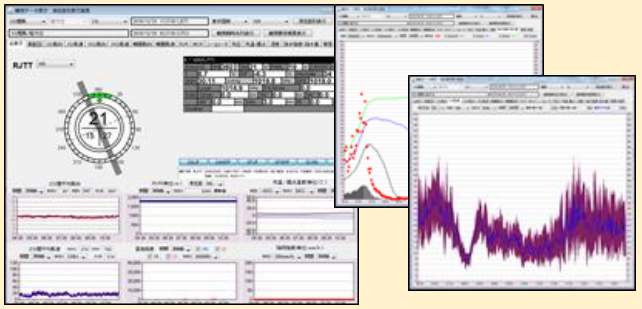
# MET as SWIM Services

## Providing aviation weather information for domestic aviation users via SWIM

【MetAir】

“MetAir” is a web service to provide METAR, TAF, SIGMET and other information, such as significant weather charts and satellite imageries.

【ALIS】



“ALIS” is a web service specialized for providing users with real-time observation data at aerodromes in Japan (updated every 6 seconds) via a network.

- JMA and JCAB, in reflecting users requirements, will consider implementing SWIM-based information services to provide wide variety of MET information.

# Questions?

# 中国民航首次初始四维航迹试飞验证

# The First I4D Flight Validation in China

蔡开泉，民航协同空管技术与应用重点实验室

Kaiquan CAI，Collaborative ATM Technology Lab, CAAC

2019/12/04

# 报告内容/OUTLINE

- I4D试飞验证背景概述/General Overview
- I4D试飞验证过程及结果/I4D Flight Validation
- 总结与展望/Conclusion & Outlook

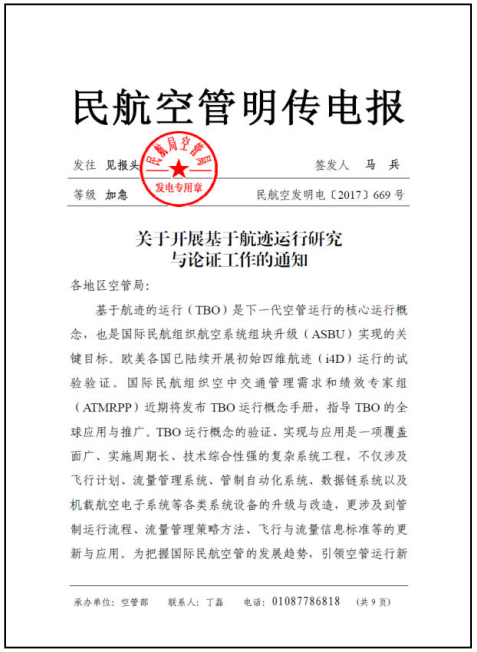
# I4D试飞验证背景概述/General Overview

## 民航局高度重视/High Attention from CAAC

- 2015年：启动I4D试飞验证项目，民航数据通信公司牵头
  2015：Launched the project of Initial 4D Trajectory(I4D) flight validation，led by ADCC

- 2017年：民航局空管局成立TBO研究与论证工作组
  2017：CAAC ATMB set up the TBO Taskforce

- 2019年：I4D试验验证列入民航局空管局重点任务
  2019: List the I4D project as the annual focal task



民航空管明传电报

发往 见报头　　签发人 马 兵

等级 加急　　民航空发明电〔2017〕669号

关于开展基于航迹运行研究与论证工作的通知

各地区空管局：

基于航迹的运行（TBO）是下一代空管运行的核心运行概念，也是国际民航组织航空系统组块升级（ASBU）实现的关键目标。欧美各国已陆续开展初始四维航迹（i4D）运行的试验验证。国际民航组织空中交通管理需求和绩效专家组（ATMRPP）近期将发布TBO运行概念手册，指导TBO的全球应用与推广。TBO运行概念的验证、实现与应用是一项覆盖面广、实施周期长、技术综合性强的复杂系统工程，不仅涉及飞行计划、流量管理系统、管制自动化系统、数据链系统以及机载航空电子系统等各类系统设备的升级与改造，更涉及到管制运行流程、流量管理策略方法、飞行与流量信息标准等的更新与应用。为把握国际民航空管的发展趋势，引领空管运行新

承办单位：空管部　联系人：丁磊　电话：01087786818　（共9页）

# I4D试飞验证背景概述/General Overview

## I4D项目目标与内容/I4D Project Scope

- 验证I4D运行概念及其性能

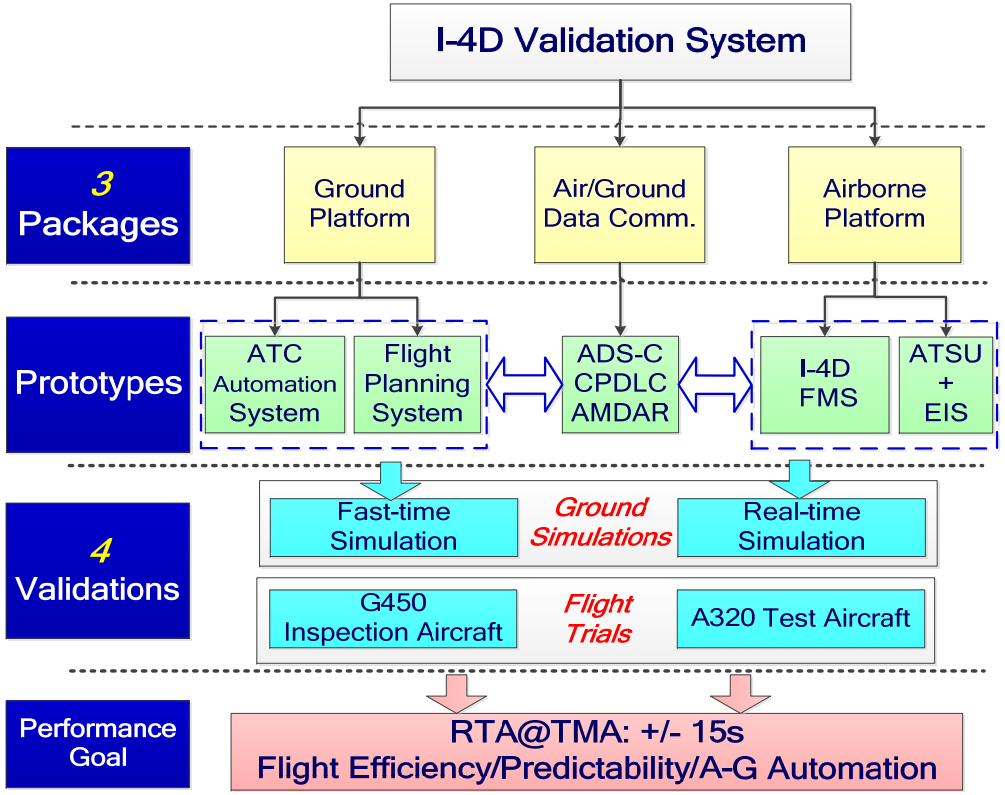
To Validate the I4D Concept and its performance

  - 所需到达时间/RTA
  - 空地航迹共享/EPP
  - 数字化管制/CPDLC

- 为I4D/TBO的应用做准备

To Prepare for Envisaged I-4D/TBO Operation

  - 系统开发/Prototypes Development & Test
  - 程序验证/ Operational Procedures Validation
  - 演示验证/I4D Demonstrations



# I4D试飞验证背景概述/General Overview

## 与空客合作开展飞行试验工作/Collaboration with AIRBUS


2016.9 北京/Beijing

2016.12 图卢兹/Toulouse


2018.09 图卢兹/Toulouse

# 报告内容/OUTLINE

- I4D试飞验证背景概述/General Overview
- I4D试飞验证过程及结果/I4D Flight Validation
- 总结与展望/Conclusion & Outlook

# I4D试飞验证过程及结果/I4D Flight Validation

## 试验方案/Test Scenario

- 验证内容/Test Items：

  CPDLC/ADS-C

  CTA+EPP

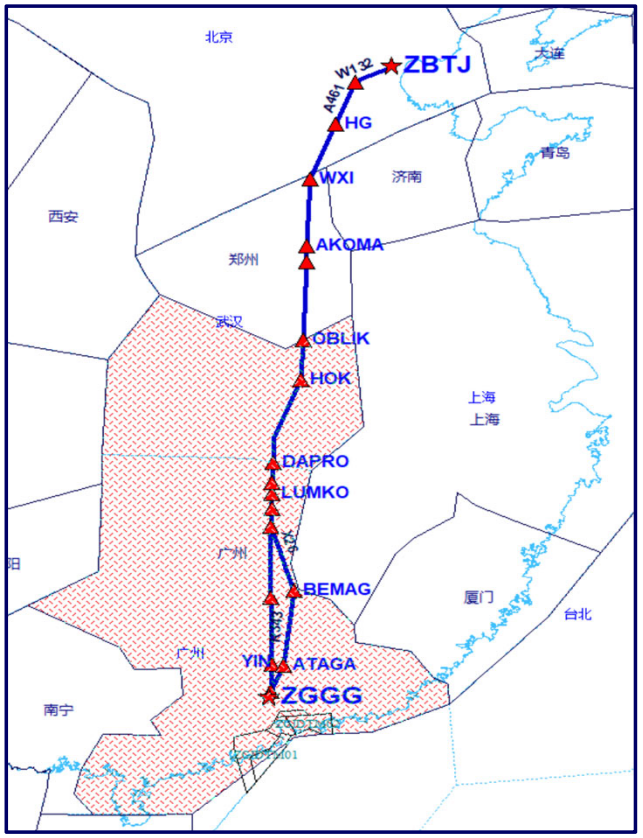
- 场景选取/Scenario：

  路线：天津-广州，往返/Route: Tianjin-Guangzhou

  验证区域：广州区管+进近/Area: Guangzhou ACC & APP

- 管制验证模式/Test Mode

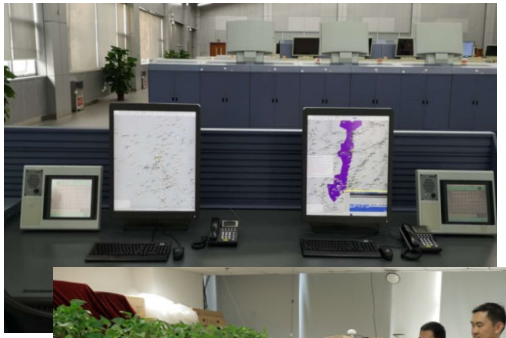
  I4D测试系统：静默工作/Shadow Mode

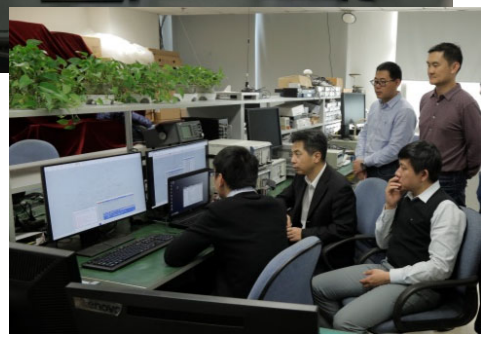


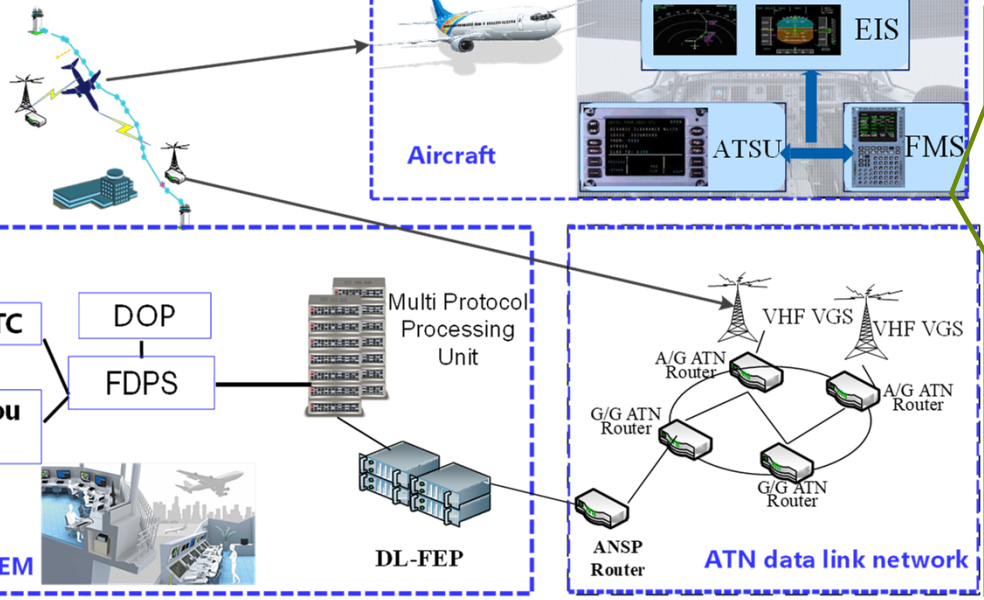
# I4D试飞验证过程及结果/I4D Flight Validation

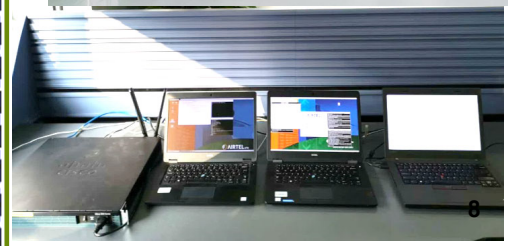
## I4D试验系统构成/I4D Test Systems

- Test aircraft with I4D avionics
- I4D ATC automation system
- ATN baseline2 based CPDLC/ADS-C







# I4D试飞验证过程及结果/I4D Flight Validation

## 飞行试验程序/Test Procedures

- 飞行途经6大管制单位，全程3800多公里

Fly through 6 ATC units, more than 12 control sectors, with a total mileage of more than 3,800 kilometers

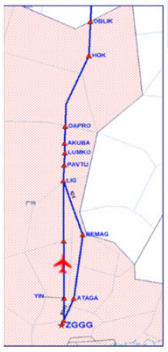
- 预设24个试验运行场景

24 test scenarios predefined

- 测试21条CPDLC、ADS-C等I4D管制指令

21 I4D instructions tested, covering ADS-C EPP reports test, CPDLC communication test, and CTA operation test.


| 序号 | 飞行阶段 | 雷达管制席操作 | I4D测试席操作 | 机组操作 |
|---|---|---|---|---|
| 1 | ZBTJ→OBLIK | 北京管制中心正常管制指挥 | 武汉测试席：航空器开车后建立ADS-C连接，持续监视EPP | 确认ADS-C连接 |
| 2 | 过OBLIK | 武汉高扇1：管制移交，8400米进入 | 武汉测试席：建立CPDLC连接，建立ADS Event合同 | Cm logon，请求建立CPDLC连接 |
| 3 | OBLIK→HOK | 武汉高扇1：右偏置5NM | 武汉测试席：发送偏置指令 | 回复确认WILCO |
| 4 | HOK→LKO→DAPRO | 武汉高扇2：管制移交，直飞DAPRO，爬升至9800米 | 武汉测试席：发送直飞指令、爬升指令 | 回复确认WILCO |
| 5 | 过DAPRO前3min | 广州高扇1：管制移交，保持9800米 | 广州测试席：与武汉完成管制移交 | |
| 6 | DAPRO→AKUBA | 广州高扇1：ATAGA进场点RTA协商 | 广州测试席：获取航空器ETA窗口；获取RTA时刻 | 自动发送ETA窗口，回复RTA是否可达 |



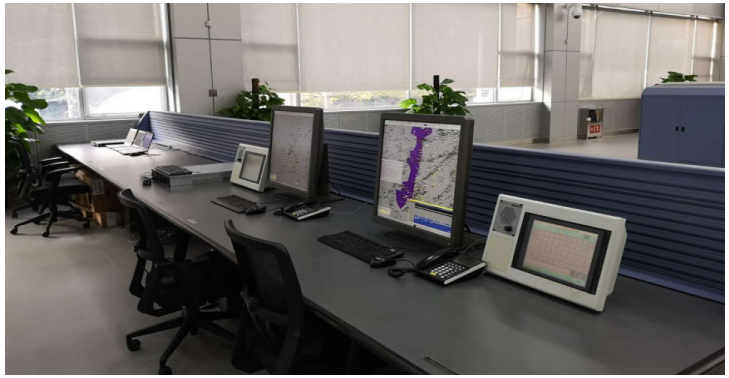

| 序号 | 飞行阶段 | 雷达管制席操作 | I4D测试席操作 | 机组操作 |
|---|---|---|---|---|
| 13 | FAF→YIN | 广州进近：正常指挥上升高度飞向YIN | 广州测试席：监视EPP更新数据 | |
| 14 | 过YIN点 | 广州高扇5：与进近管制移交 | 广州测试席：保持ADS-CCPDLC连接 | |
| 15 | YIN→BUBDA | 广州高扇5：指挥爬升至9500米，右偏置3nm | 广州测试席：发送爬升、偏置指令 | 回复确认WILCO |
| 16 | 过BUBDA | 广州高扇2：管制移交，保持9500米 | 广州测试席：监视EPP更新数据 | |
| 17 | BUBDA→P113 | 广州高扇2：HOK点RTA协商 | 广州测试席：获取航空器ETA窗口；获取RTA时刻 | 自动发送ETA窗口，回复RTA是否可达 |
| 18 | 过P113 | 广州高扇2：确认HKO点的RTA生效，指挥避让 | 广州测试席：确认HKO点的RTA生效 | |


| 序号 | 飞行阶段 | 雷达管制席操作 | I4D测试席操作 | 机组操作 |
|---|---|---|---|---|
| 7 | 过AKUBA | 广州高扇1：确认ATAGA点的RTA生效；指挥避让 | 广州测试席：确认ATAGA点的RTA生效 | |
| 8 | 过LIG点 | 广州高扇2：管制移交，保持9800米 | 广州测试席：持续监视EPP | |
| 9 | LIG→BEMAG | 广州高扇3：管制移交，保持9800米 | 广州测试席：持续监视EPP | |
| 10 | BEMAG→ATAGA | 广州高扇3：与广州进近进行管制移交，下降至4200米 | 广州测试席：持续监视EPP | 接收广州进近话音频率信息 |
| 11 | 过ATAGA前5min | 广州进近：发布标准进港程序 | 广州测试席：发送进港程序的指令，监视实际过点时刻 | 回复确认WILCO |
| 12 | ATAGA→FAF | 广州进近：指挥进港，雷达引导切盲降，飞至FAF终止进近 | 广州测试席：发布盲降许可、发布复飞许可 | 回复确认WILCO |


| 序号 | 飞行阶段 | 雷达管制席操作 | I4D测试席操作 | 机组操作 |
|---|---|---|---|---|
| 19 | 过LIG点 | 广州高扇1：管制移交，保持8900米 | 广州测试席：监视EPP更新数据 | |
| 20 | LIG→DARPO | 广州高扇1：指挥周边航空器避让 | 广州测试席：监视EPP更新数据 | |
| 21 | 过DARPO前3min | 武汉高扇2：广州高扇1管制移交，指挥周边航空器避让 | 武汉测试席：与广州进行管制移交，发送移交指令 | |
| 22 | DARPO→HOK | 武汉高扇1：与武汉高扇2管制移交 | 武汉测试席：监视EPP更新数据，监视过HOK时刻 | |
| 23 | HKO→OBLIK | 武汉高扇1：正常管制指挥，准备移交 | 武汉测试席：监视EPP数据，过OBLIK断开CPDLC连接 | |
| 24 | OBLIK→ZBTJ | 北京管制中心：正常雷达管制指挥 | 武汉测试席：监视EPP更新数据 | |

# I4D试飞验证过程及结果/I4D Flight Validation

## 试验飞行圆满成功/A successful I4D Flight on 20.03.2019



**Guangzhou ATC Center**


**A320 Test Aircraft**

# I4D试飞验证过程及结果/I4D Flight Validation

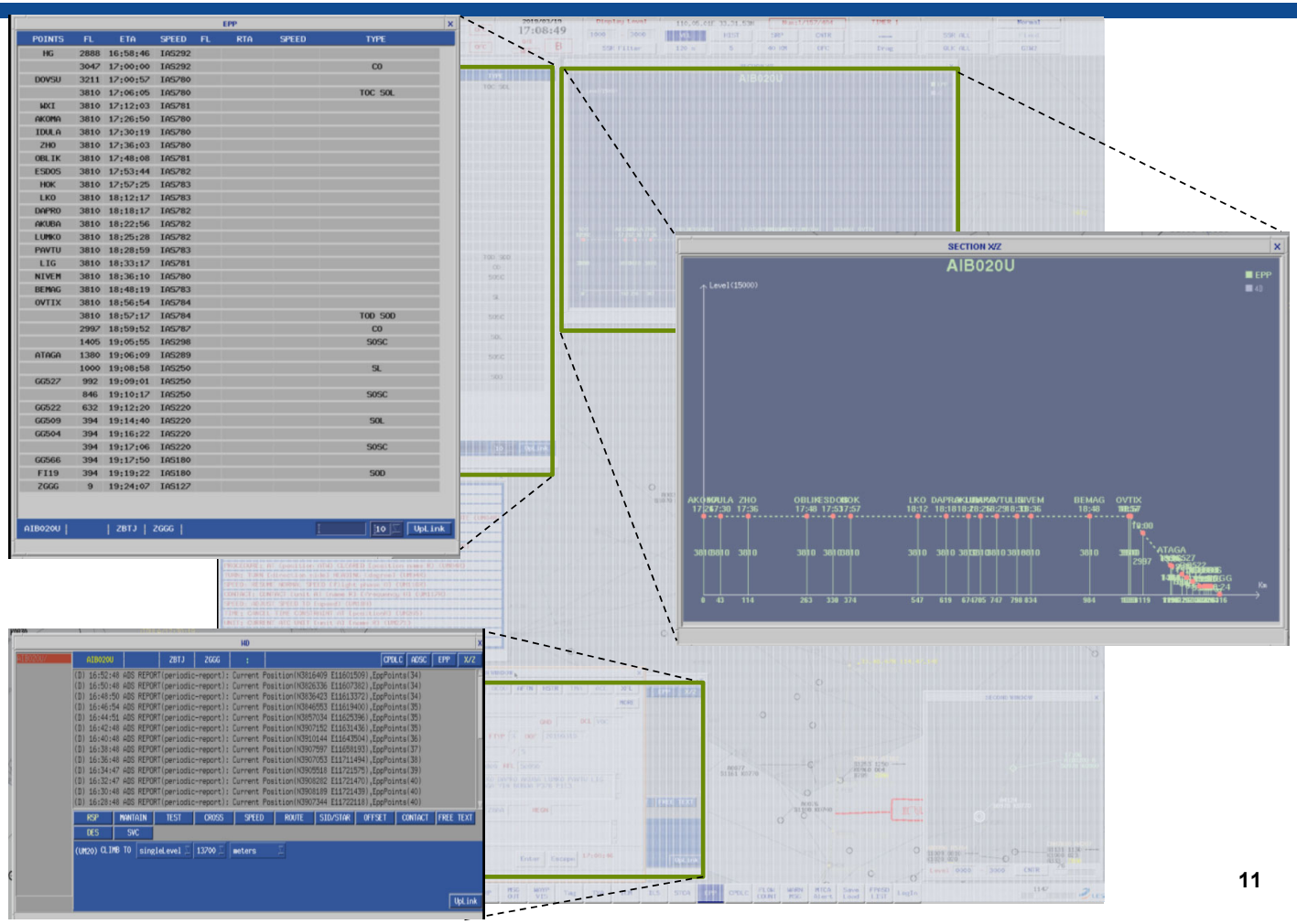
## 空地四维航迹共享能力
## EPP/4DT Downlink

- 试验中下传EPP最多包含42个航路点信息，涵盖起飞至降落过程中的全部航路点信息

42 waypoints can describe the flight plan from ZBTJ to ZGGG. The EPP data covered the whole projected 4 dimensional trajectory

- 每5分钟周期下传EPP数据，EPP数据质量稳定，获取全部152次有效EPP数据信息

The aircraft downloads EPP data every 5 minutes, and the data quality is stable



# I4D试飞验证过程及结果/I4D Flight Validation

## 空地航迹协商
## Air-ground trajectory negotiation by CPDLC

- 获取ATAGA、LUMKO、OBLIK的ETA时间窗口

Obtained the ETA windows of ATAGA, LUMKO, OBLIK

- 分配并上传航空器的过点时刻CTA

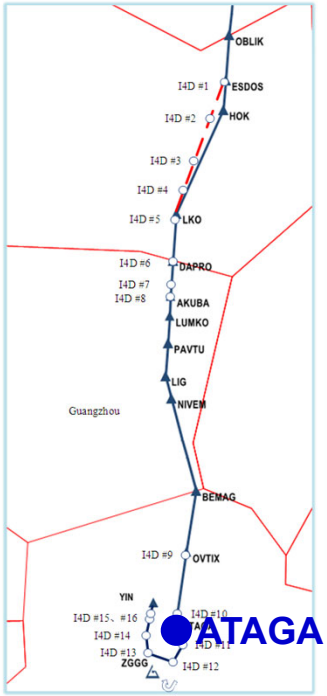
Uploaded CTA time from ATC for real-time trajectory negotiation

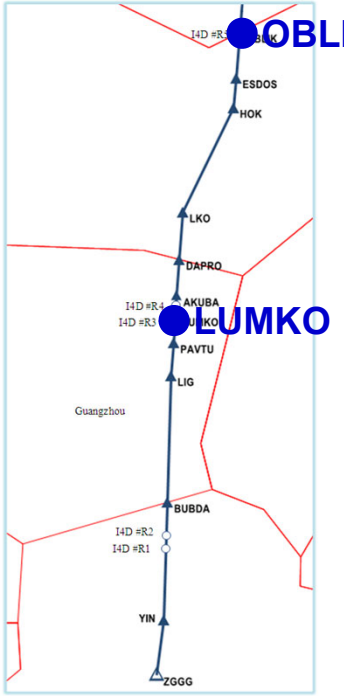
| 阶段 | RTA 协商 | | |
|---|---|---|---|
| | 测试位置 | 测试点 | 所属区域 |
| 去程 | 进近起始 | ATAGA | Guangzhou TMA |
| 返程 | 区内飞行 | LUMKO | Guangzhou ENR |
| 返程 | 区间移交 | OBLIK | Guangzhou ENR |

| Leg | RTA negotiation | | |
|---|---|---|---|
| | Type | Metering Fix | Affiliation |
| 1 | Enter TMA | ATAGA | Guangzhou TMA |
| 2 | Inside ENR | LUMKO | Guangzhou ENR |
| 2 | Transfer | OBLIK | Guangzhou ENR |

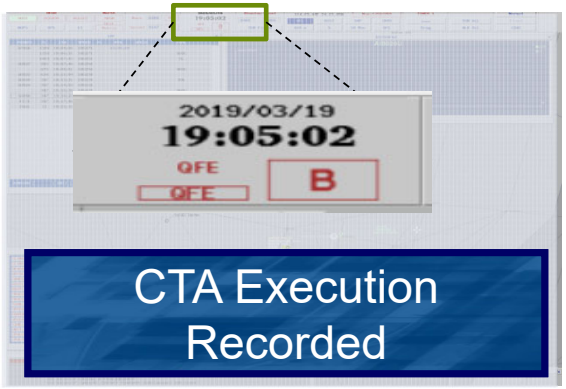
# I4D试飞验证过程及结果/I4D Flight Validation

## 航空器精准定时到达
## Accuracy of on-time arrival








| CTA Fix | CTA Execution (UTC 20th March) | | | | | |
|---|---|---|---|---|---|---|
| | *CTA Issued Distance to Fix* | *ETA window* | *CTA/ tolerance* | *Response Time to set CTA* | *Pilot Record* | *Radar Monitor* |
| **ATAGA** | 578km | 3:02:43-3:12:02 | 3:05:00 (10s) | 48s | +2s | -5s |
| **LUMKO** | 394km | 3:54:19-3:56:26 | 3:55:00 (10s) | 15s | 0s | -1s |
| **OBLIK** | 492km | 4:24:08-4:26:59 | 4:25:00 (10s) | 33s | +1s | -4s |

# 报告内容/OUTLINE

- I4D试飞验证背景概述/General Overview
- I4D试飞验证过程及结果/I4D Flight Validation
- 总结与展望/Conclusion & Outlook

# 总结与展望/Conclusion & Outlook

## 性能改进/Performance Gains

- 增强管制员的态势感知能力，以及流量预测的准确性

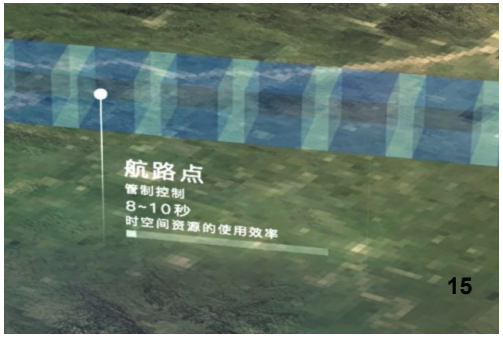
Increase of ATCO awareness and flow predictability thanks to EPP

- 数字化管制的方式能降低约30%以上的管制和飞行工作负荷

ATC workload & Pilot work load could reduce more than 30% thanks to the application of CPDLC/ADS-C

- 飞行过点时间精度控制在10秒以内

CTA executed with the time deviation less than 10s



# 总结与展望/Conclusion & Outlook

## 下一步的应用问题/Further Applications

- 机载系统和地面系统的升级

Aircraft equipage & ground system upgrades

- EPP在流量系统中的应用

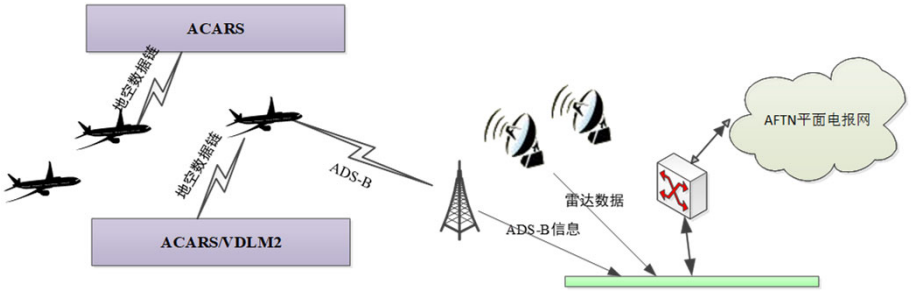
EPP application in AMAN/ATFM

- I4D向TBO演进的需求：协同信息环境

I4D to Full 4D: Collaborative Information Environment

- I4D/TBO运行标准制定的需求

Need for operation guidance and procedure standards






# 谢　谢!

# THANK YOU!