SWIM in ASEAN Demonstration
Introduction

Key Driver

- Greater ATM system interoperability
- Increased air navigation service efficiency
Introduction

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

**ATWG/34**
- **Oct 2016**: Discussion between Singapore and Thailand started

**ATTC/14**
- **Jan 2016**: Participant Package sent to AMSs and interested States
- **Mar 2017**: ICAO APAC SWIM TF/1
- **May 2017**: Inaugural Planning Session
- **Aug 2017**: Planning out activities and milestones for the demonstration among Singapore, Thailand, and USA
- **Oct 2017**
## Introduction

Operational scenarios design session between Singapore and Thailand Nov 2017

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<td>Demonstration Bangkok</td>
<td>Travel Day</td>
<td>Dress Rehearsal</td>
<td>Demonstration Singapore</td>
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2017

- Apr 2018 TIM/1

2018

- Sep 2018 TIM/2

2019

- Apr 2019 TIM/2.5
- Aug 2019 TIM/3

Nov 2019 Demonstration 11-15 Nov 2019
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
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

- 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**
Scenario Introduction
Scenario Principles

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

- **Normal Flight Operations**
  - Gate-to-gate operations
  - Airport CDM

- **Restricted Flight Operations**
  - Military activity
  - Weather hazard
  - Conditional route (CDR)

- **Normal Flight Operations**
  - Special Use Airspace
  - Weather hazard

**Enhanced flight information exchange**

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

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

**Current Operational Concept**

**Future Operational Concept**
Scenarios to be Demonstrated

**Normal Flight Operations**

- Departure-to-Arrival Trajectory Sharing
  - 2 scenarios

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

- 2 scenarios

Current Operational Concept
Scenarios to be Demonstrated

**Restricted Flight Operations**

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

- Ground Delay Program due to Arrival Constraint
  - 3 scenarios

- Airborne ATFM Measure due to Weather Constraint
  - 2 scenarios

Current Operational Concept
Scenarios to be Demonstrated

**Normal Flight Operations**

FF-ICE/1: Pre-departure Negotiation
1 scenario
Lessons Learnt
Observations / Lessons Learnt

• 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

More SWIM capable, the better!
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
Thank You
Motivation for SWIM
Information exchange among stakeholders

**Today**

- JCAB SYSTEM A
- JCAB SYSTEM B
- JMA SYSTEM

**Tomorrow**

- JCAB SYSTEM A
- JCAB SYSTEM B
- JMA SYSTEM

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)
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 Technical Infrastructure (TI)
- TI for Ops use: ATMC
- TI for V&V, Backup: SDECC

SWIM Information service
- Provision of Initial SWIM services
- Provision of web service and Web-API
- Provision of SWIM portal

Expansion of SWIM Information service
- Information service for collaborative Ops
  - FF-ICE, Cross-border ATFM, A-CDM
- Advanced information service to support efficient ATM & Aircraft operations
  - Realize of CARATS measures and user’s needs
- Function for international connections (GEMS?)

Functions of SWIM TI
- Security, Authentication
- Pub/Sub, Message transfer
- One stop
- IF exchange & IF management
- Relay
- Basic policy, Roadmap, Implementation phases, Information services, SWIM TI
- Ops framework, Training
- Continuous service monitoring
- Service improvement "KAIZEN"

Around 2030～

Phase 1
2018～
Start establishing of SWIM governance

Phase 2
2024
2025
2026

Phase 3
2026
・・・

Around 2030～

A/G SWIM

Information Services to support TBO
### "Candidate" SWIM services to be prepared for Phase-1

<table>
<thead>
<tr>
<th>Service name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight Plan filing service</td>
<td>in FIXM format (Web)</td>
</tr>
<tr>
<td>ATS information publication service</td>
<td>in FIXM format and API (Pub/Sub)</td>
</tr>
<tr>
<td>Automatic Terminal Information Service (ATIS) publication service/request service</td>
<td>ATIS service in XML format (Pub/Sub, R/R)</td>
</tr>
<tr>
<td>Common-PIREP publication service</td>
<td>Pilot Report service in XML format (Pub/Sub)</td>
</tr>
<tr>
<td></td>
<td>※FUKUOKA FIR only</td>
</tr>
<tr>
<td>Information service package request service (Message)</td>
<td>Mixture and extract service of aeronautical and weather information (Message-oriented)</td>
</tr>
<tr>
<td>Information service package request service (MAP/GIS)</td>
<td>Mixture and extract service of aeronautical and weather information (MAP/GIS-oriented)</td>
</tr>
<tr>
<td>Airport / Airspace profile service</td>
<td>“Snapshot” information service of Airport and Airspace situation (Web)</td>
</tr>
<tr>
<td>Airport slot &amp; Parking gate request service</td>
<td>Web service</td>
</tr>
<tr>
<td>Oceanic airspace trial service</td>
<td>Trial service to improve aircraft operation in Oceanic airspace (Web)</td>
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</tbody>
</table>
AIM as SWIM Services

- Pre-Flight Briefing
  - Obstacle Data Sets
  - Digital NOTAM

- Pilot (Request/Reply)
  - Charts

- ANSP
  - For Flight Inspection
  - For ATM Systems

- Airport
  - For Pre-flight briefing
  - Automated Driving

- Data Service Provider
  - Data Exchange Service
  - SWIM Infrastructure

- Third Party
  - Pub/Sub, One Stop, Request / Reply
  - Web, Web API

- SWIM
  - Data Service Provider
  - ANSP
  - Airport
  - Pilot (Request/Reply)
  - Data Service Provider

- Aeronautical Data
  - AIS Unit

- For EFB
  - For Aircraft Performance Calculation
  - For Making FMS Data

- For Aircraft Display
  - For Application of Smart Phone / Tablet

- For Dispatch
  - For Input
  - For Pilot

- For Making FMS Data
  - For Flight Inspection
  - For Simulation of Radio Wave

- For Search & Rescue
  - For Application of Smart Phone / Tablet

- For Application of Smart Phone / Tablet
Providing aviation weather information for domestic aviation users via SWIM

- **MetAir**: A web service to provide METAR, TAF, SIGMET and other information, such as significant weather charts and satellite imageries.

- **ALIS**: 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?
The First I4D Flight Validation in China

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
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
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
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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
### 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.

#### I4D试飞验证过程及结果/I4D Flight Validation

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<th>序号</th>
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<th>雷达管制操作</th>
<th>I4D管制操作</th>
<th>机组操作</th>
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I4D Flight Validation on 20.03.2019

Guangzhou ATC Center

A320 Test Aircraft
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.
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

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<th>阶段</th>
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<td>进近起始</td>
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<tr>
<td>返程</td>
<td>区内飞行</td>
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<tr>
<td>返程</td>
<td>区间移交</td>
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<th>Leg</th>
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</tr>
<tr>
<td>1</td>
<td>Enter TMA</td>
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<tr>
<td>2</td>
<td>Inside ENR</td>
</tr>
<tr>
<td>2</td>
<td>Transfer</td>
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</table>
### CTA Execution (UTC 20\textsuperscript{th} March)

<table>
<thead>
<tr>
<th>CTA Fix</th>
<th>CTA Issued Distance to Fix</th>
<th>ETA window</th>
<th>CTA/ tolerance</th>
<th>Response Time to set CTA</th>
<th>Pilot Record</th>
<th>Radar Monitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATAGA</td>
<td>578km</td>
<td>3:02:43-3:12:02</td>
<td>3:05:00 (10s)</td>
<td>48s</td>
<td>+2s</td>
<td>-5s</td>
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<td>LUMKO</td>
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<td>3:54:19-3:56:26</td>
<td>3:55:00 (10s)</td>
<td>15s</td>
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<td>-1s</td>
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<td>OBLIK</td>
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<td>4:24:08-4:26:59</td>
<td>4:25:00 (10s)</td>
<td>33s</td>
<td>+1s</td>
<td>-4s</td>
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</tbody>
</table>
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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
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!