

SWIM構築技術の分析と実証実験

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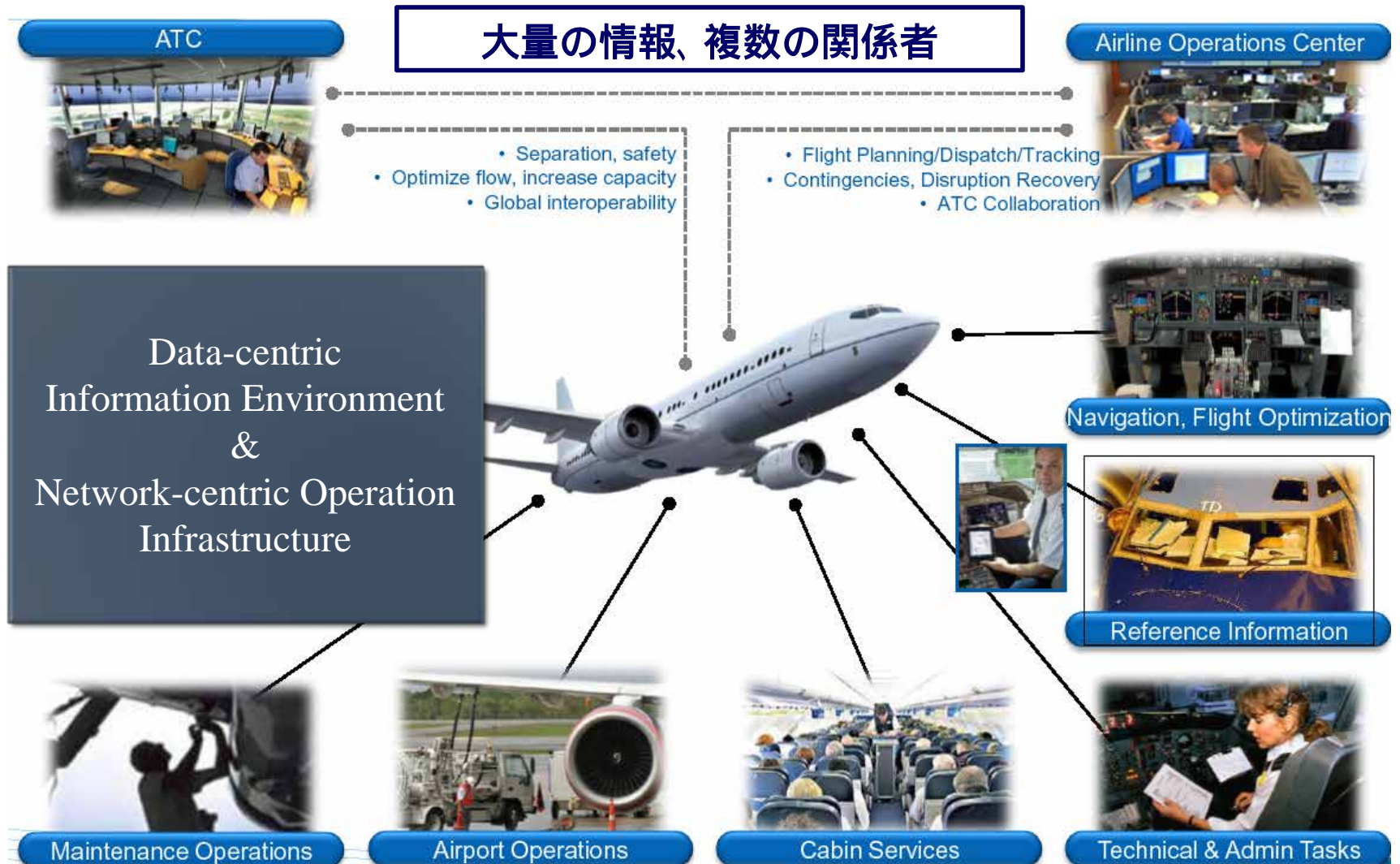
電子航法研究所

2015年6月4日

Agenda

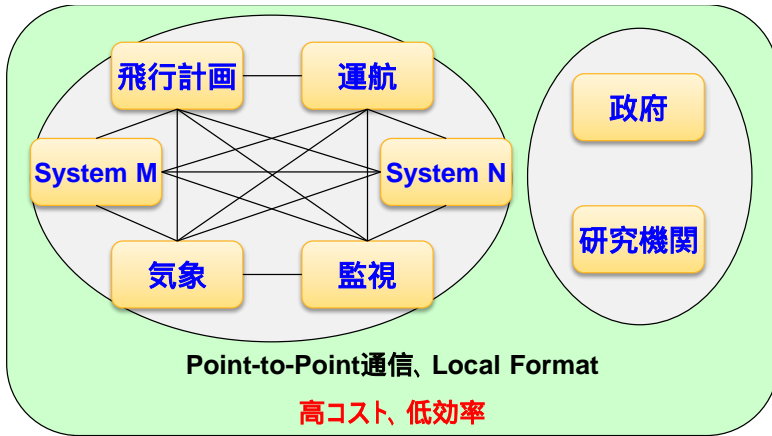
1. 背景
2. SWIMの概念
3. 欧米の比較
4. Mini Global Demonstration
5. 評価と課題
6. まとめ

背景：航空交通情報システム

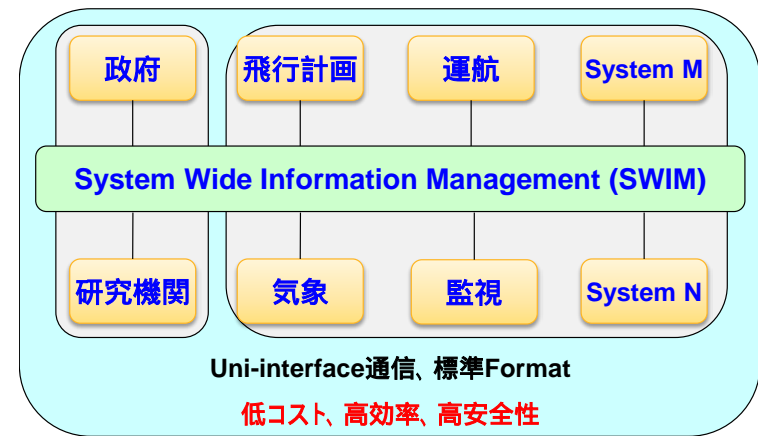


背景：技術動向

現在：Sum of Systems



将来：System of Systems



	通信	情報交換	サービス融合	アクセス	Security
現状	Point-to-Point	Local	個別運用、困難	特定少数	低
	接続された同士の間		異なる形式	個別管理	

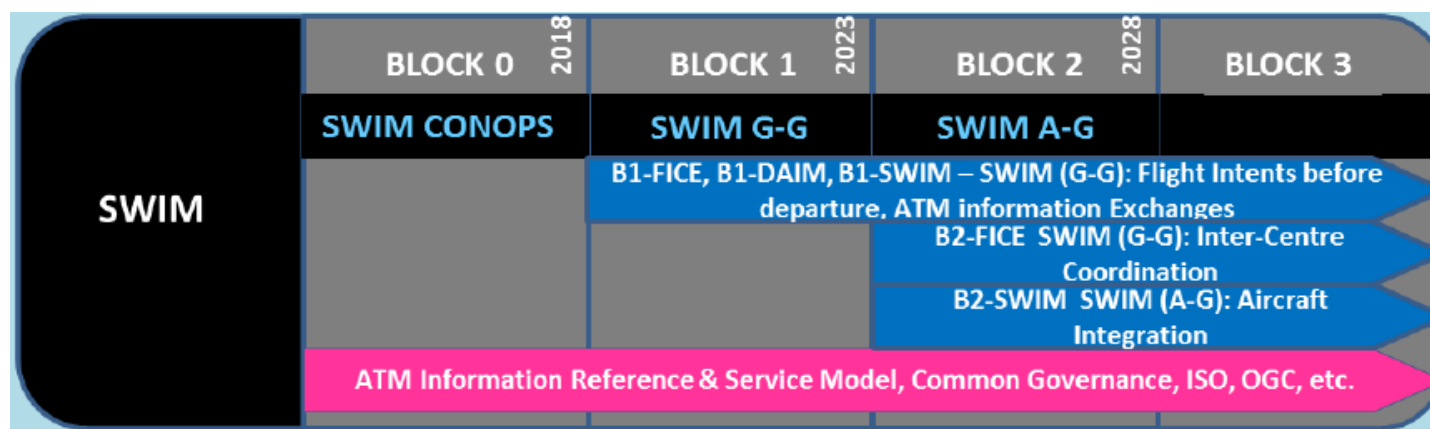
低コスト、高効率、高安全性

SWIM	Uni-interface	Global	標準化、容易	特定多数、または 不特定多数	高
	システムに接続する全員		同一形式	統一管理	

背景：国際動向

- ICAO: SWIMは将来ATMの情報共有基盤として採用された(2005)
- 欧米を中心としてSWIMに関する研究開発が進められている

Aviation System Block Upgrades (2014)



Infrastructure

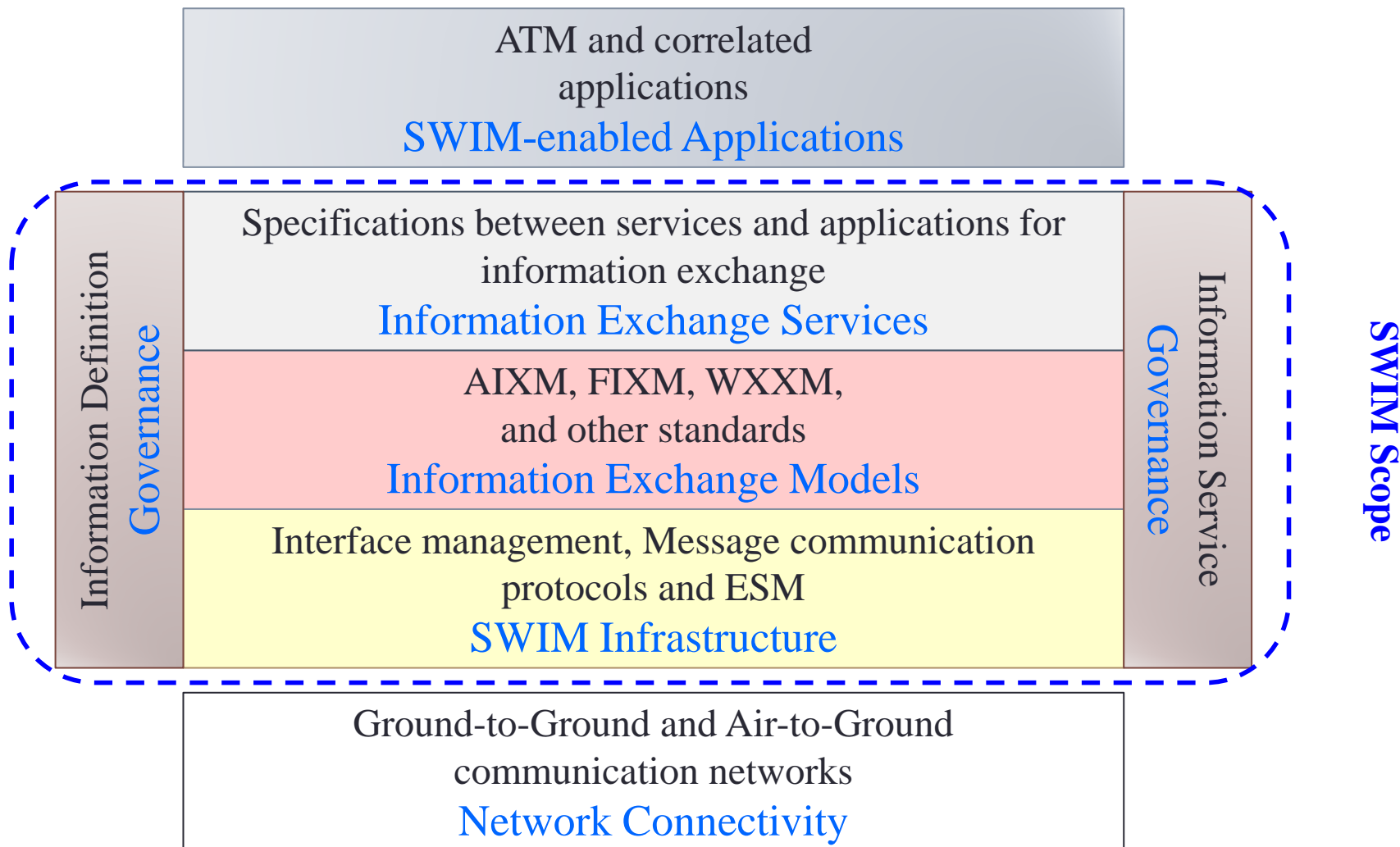
Ground-to-Ground

Air-to-Ground

- IMP (Information Management Panel) の設立によりSWIMの普及と実用化がさらに加速されている(2015)

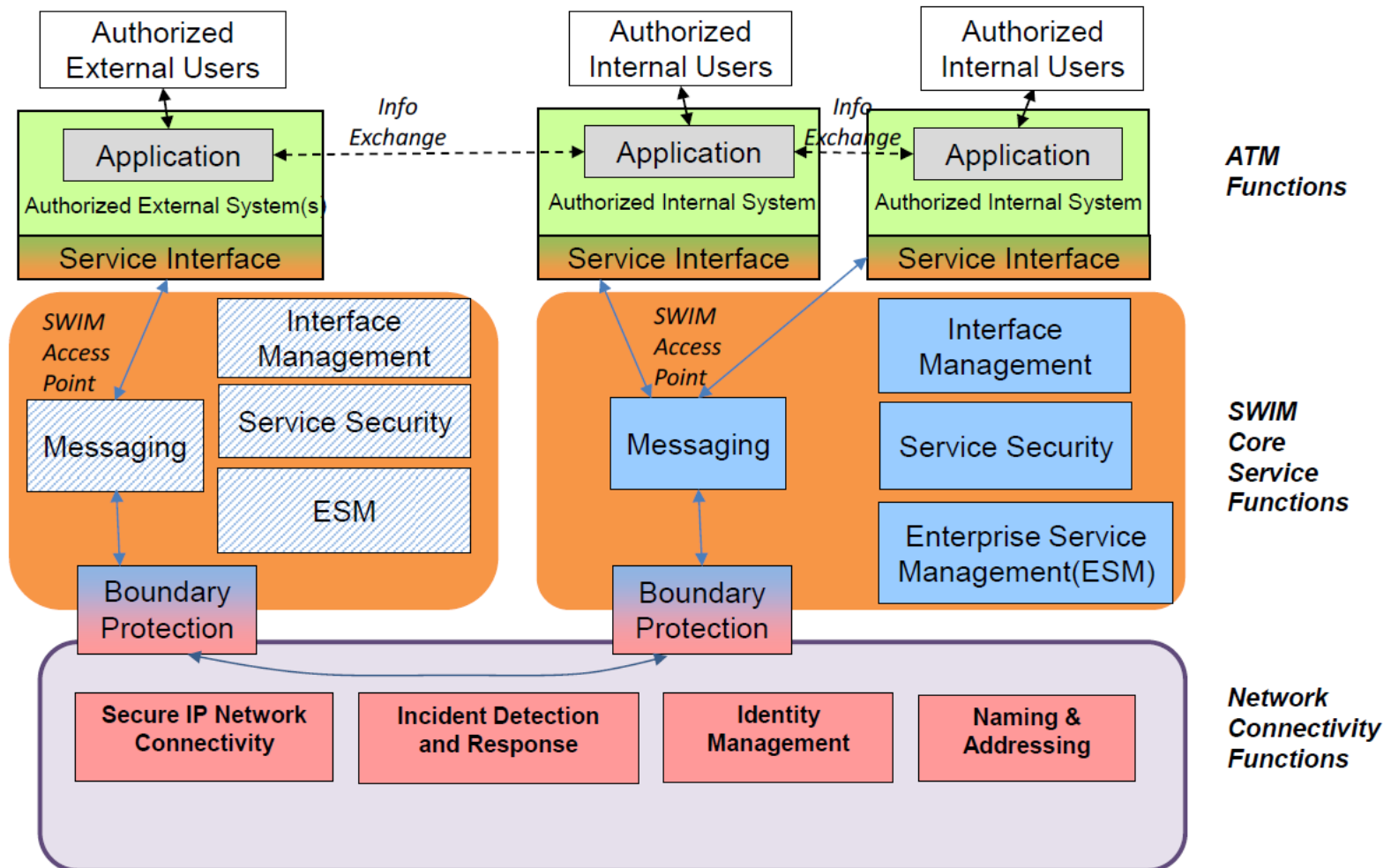
SWIM Concept

- **SWIM Framework**



SWIM Concept

- Functional Architecture



欧米の比較

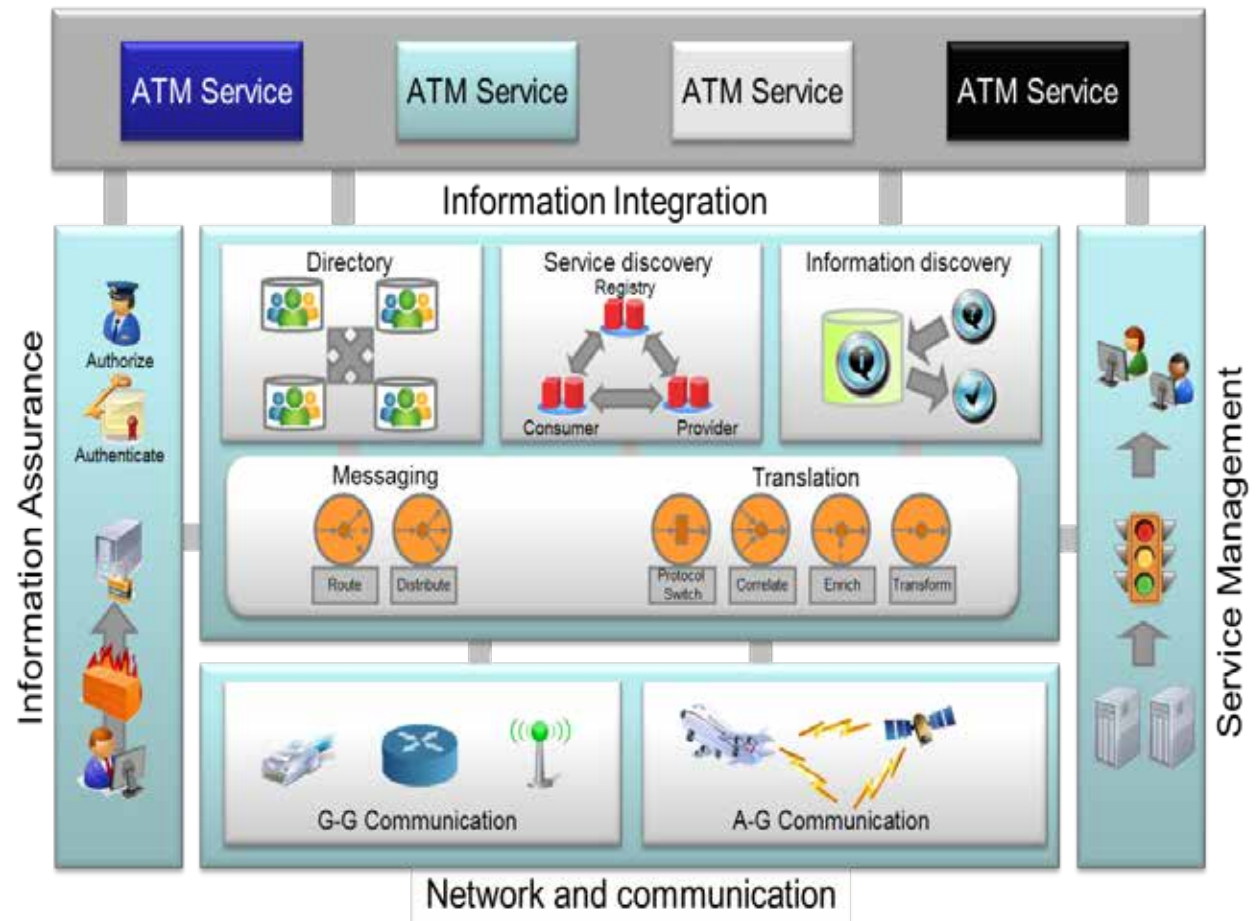
- 欧州：SESAR

ATM Services and Applications

Standards and Services for Information Exchange:
AIRM, ISRM

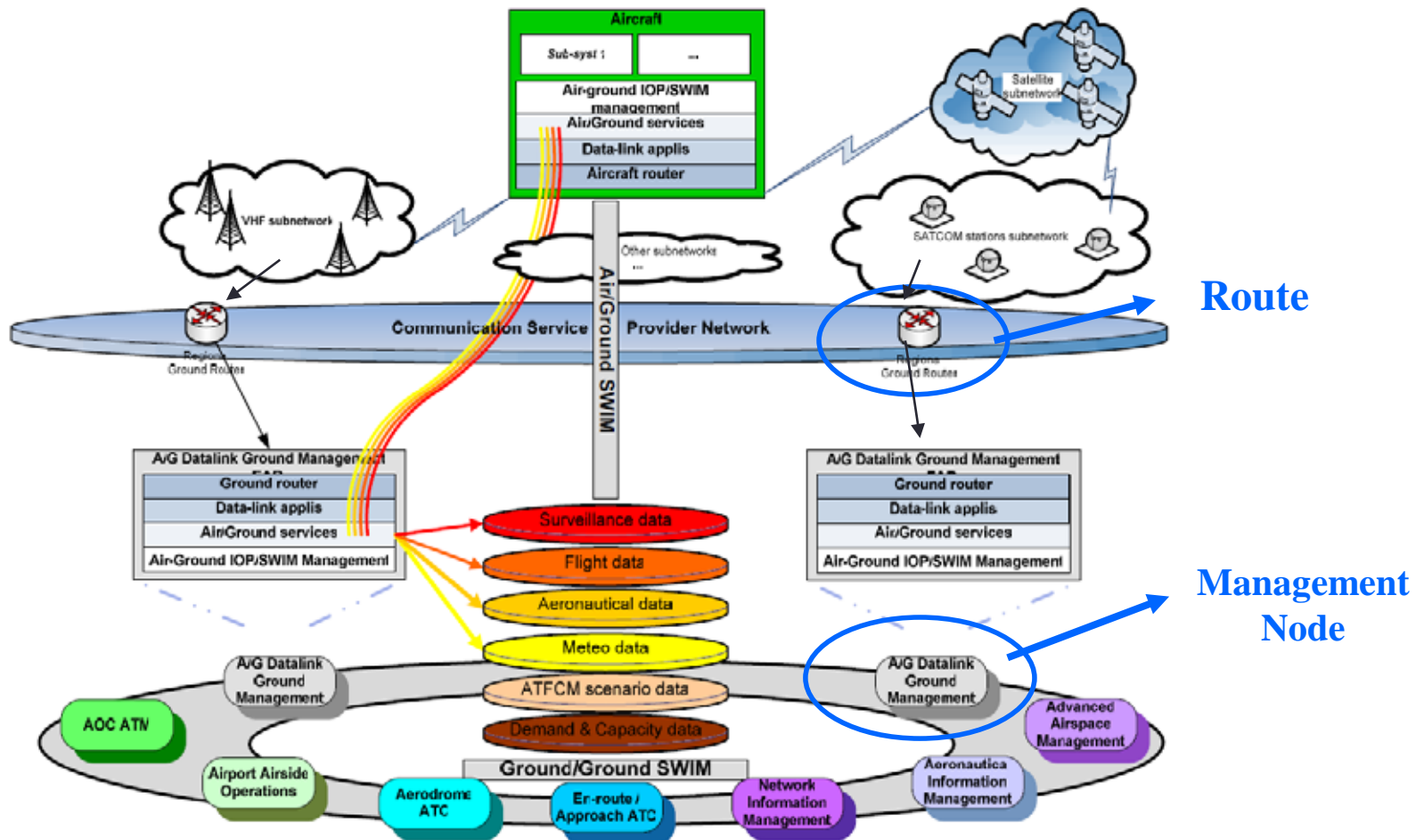
Messaging Infrastructure:
NM B2B Web Services

Network Infrastructure:
Pan European Network System (PENS)



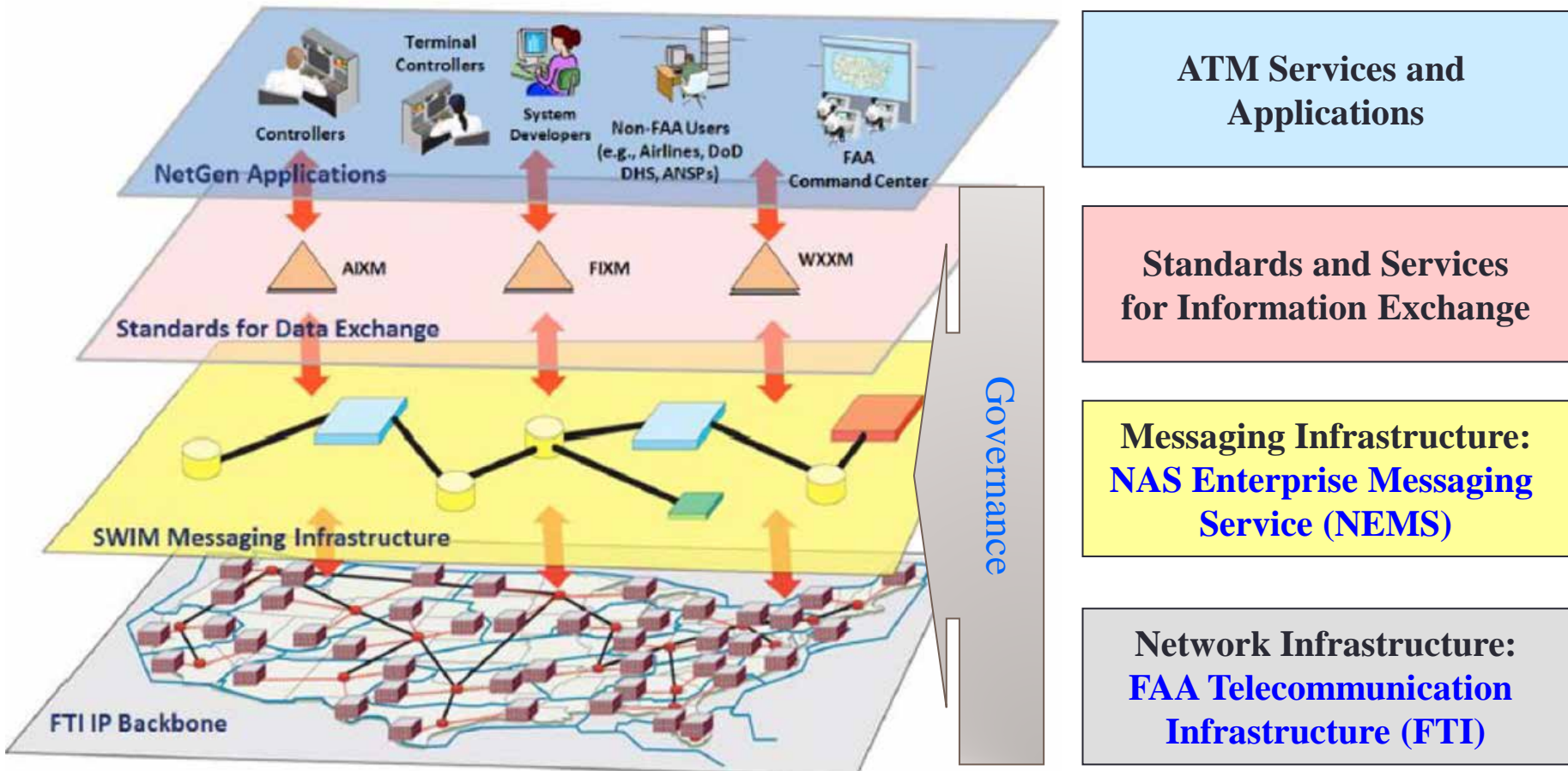
欧米の比較

- 欧州：SESAR



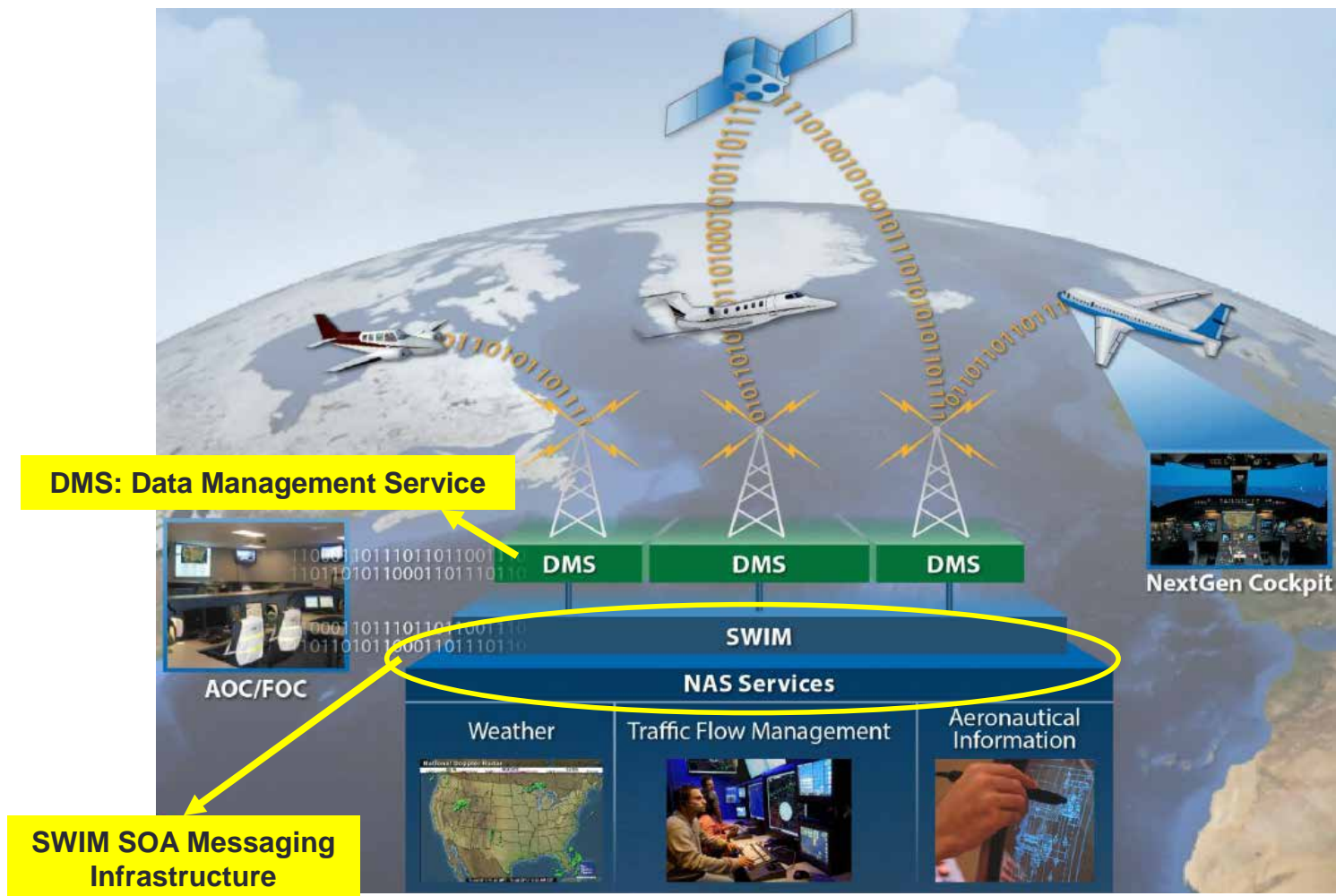
欧米の比較

- 米国: NextGen



欧米の比較

- 米国: NextGen



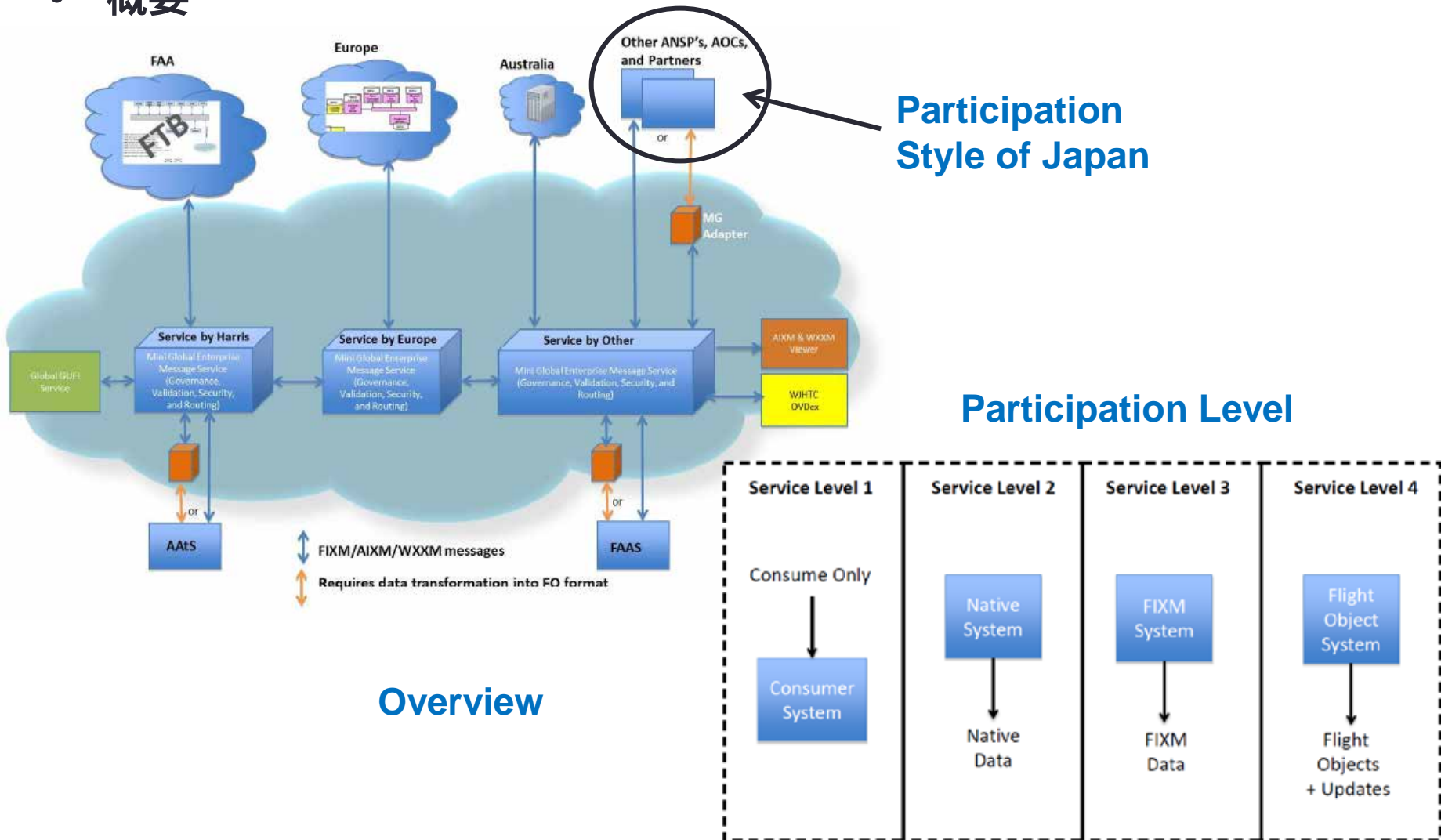
欧米の比較

- 比較

	NextGen	SESAR
Network Infrastructure	FAA Telecommunication Infrastructure (FTI)	Pan European Network System (PENS)
Messaging Infrastructure	NAS Enterprise Messaging Service (NEMS)	NM B2B Web Services (SOAP, REST)
Standards for Data and Information	AIXM, WXXM, FIXM	AIRM, ISRM
Approach	Top-down Centralized	Bottom-up Decentralized
Governance and Supervision	FAA	EUROCONTROL

Mini Global Demonstration

● 概要



Mini Global Demonstration

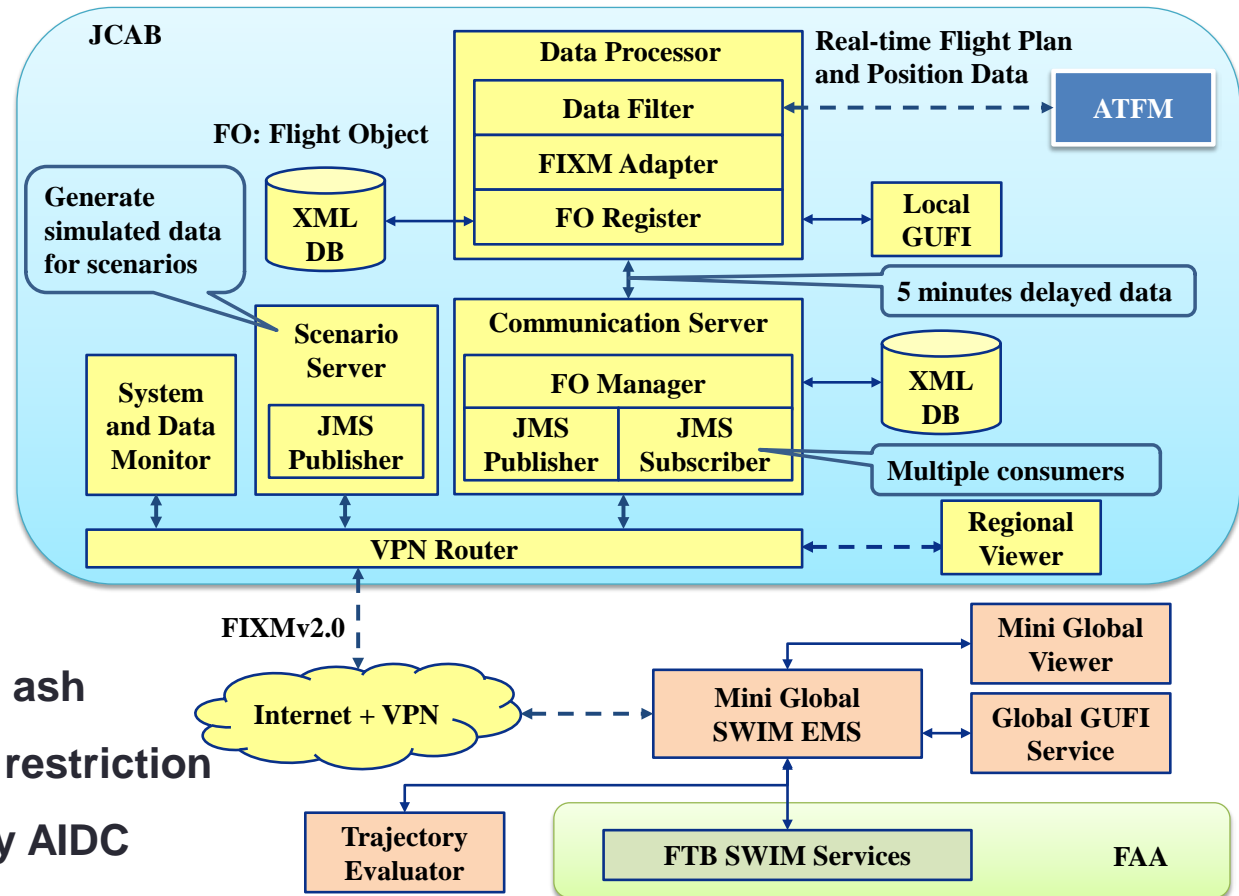
System Architecture

Semi-live data

- Flight_Information
- Flight_Clearance
- Flight_Route
- Departure
- Arrival
- Track

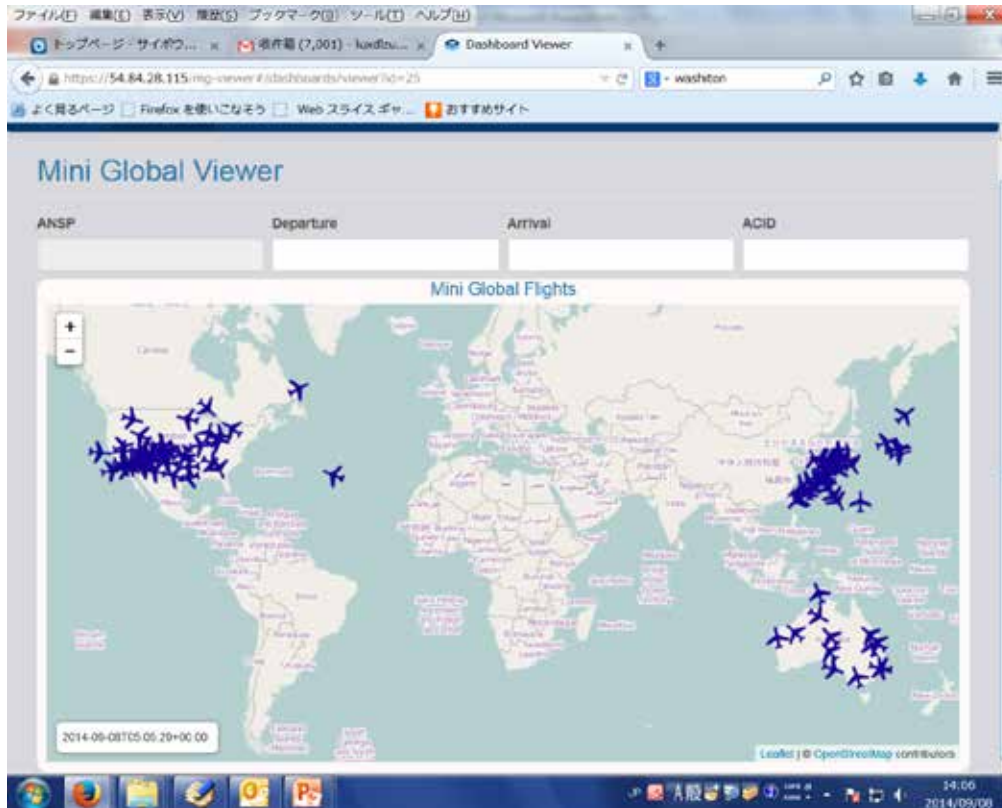
Simulated data

- SIGMET data for volcanic ash
- NOTAM data for airspace restriction
- Boundary coordination by AIDC
- Flight Plan, Departure and Track messages



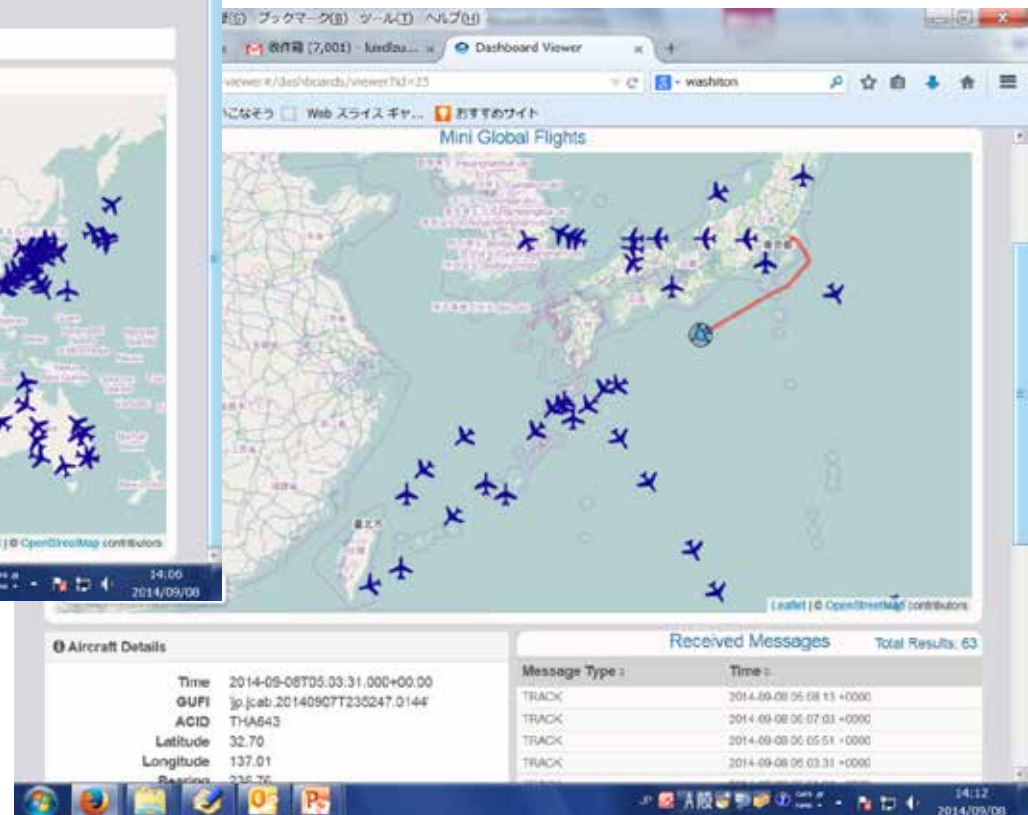
Mini Global Demonstration

- 準リアルタイムの飛行情報



日米豪のデータ

日本のデータ



Mini Global Demonstration

- 具体的な情報

The screenshot displays the MG-Viewer web application. The main interface is divided into several sections:

- Aircraft Details:** A table of flight parameters. A callout box highlights the **GUFID** field with the value `jp.job.20140907T235247.0144`.
- Message Type:** A list of received messages, all of type `TRACK`.
- Flight Route:** A table showing the flight path. A callout box highlights the **FLIGHT_ROUTE** message.
- Message Data:** A detailed view of the selected message, showing its XML structure.

Globally Unique Flight Identifier

Time	Value
Time	2014-09-08T03:34:00+00:00
GUFID	jp.job.20140907T235247.0144
ACID	FHA643
Latitude	32.70
Longitude	137.01
Bearing	238.76
Altitude	38000.0 FEET
Speed	NOT PROVIDED
Airline	THA
Departure Airport	RJAA
Departure Time	2014-09-08T03:00:00.000Z
Arrival Airport	VTBS
Arrival Time	NOT PROVIDED

Flight Route

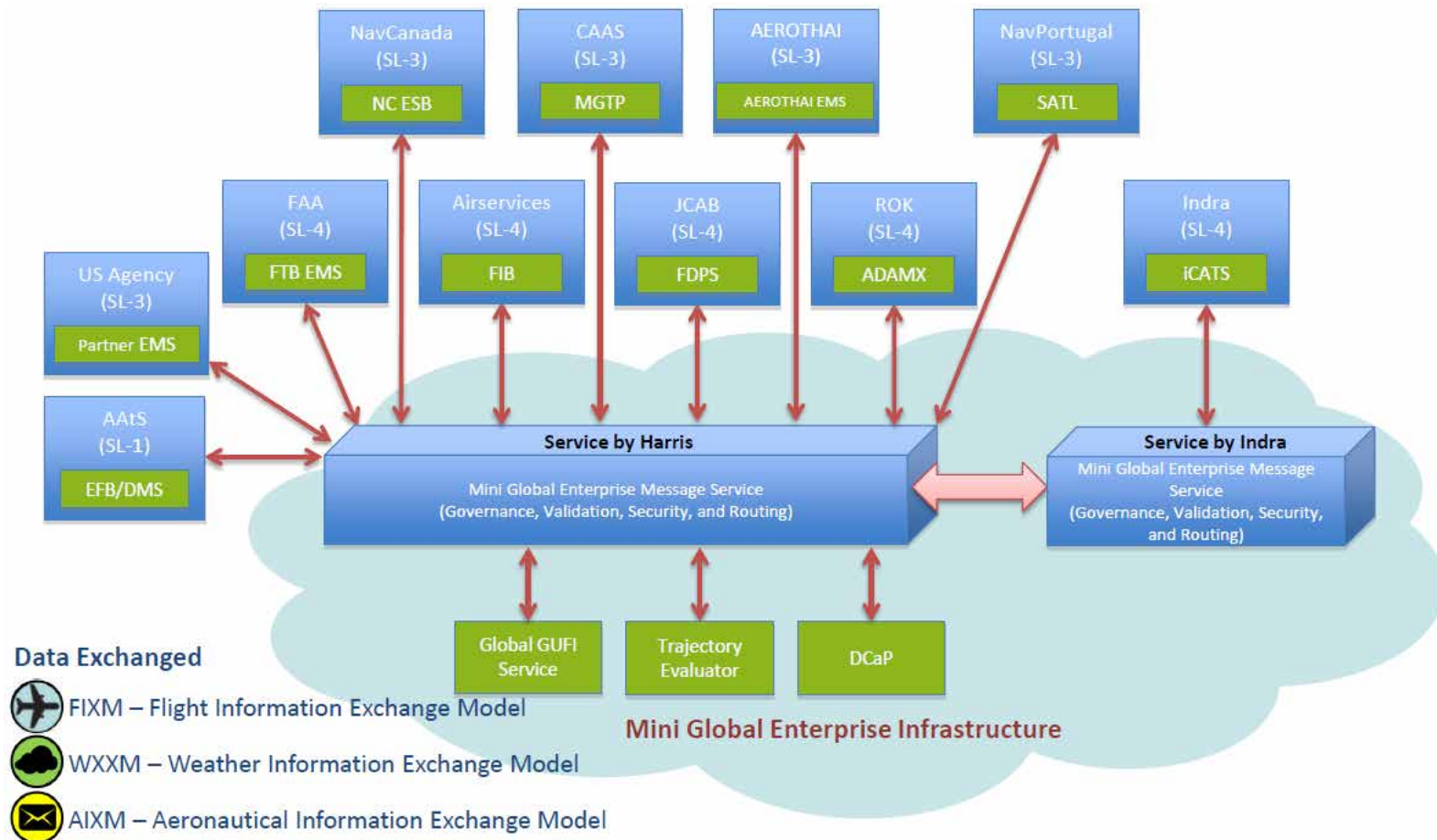
Message Type	Time	Route
FLIGHT_ROUTE	2014-09-08 03:38:03 +0000	RJAA.PAPAS.APPLE.GYANG.VANDM.FITTO.FAIRY.BOBOT.MAYON.KENNY.W
TRACK	2014-09-08 04:46:09 +0000	

```
1. <?xml version='1.0' encoding='UTF-8' standalone='yes'?>
2. <?xml:flight
3.   xmlns:csin='http://www.3.org/2001/XMLSchema-instance'
4.   xmlns:ff='http://www.flsm.aero/foundation/2.0'
5.   xmlns:fx='http://www.flsm.aero/flight/2.0'
6.   xmlns:fb='http://www.flsm.aero/base/2.0' flightType='SCHEDULED' source='JAH' system='GPS' car
7.   <route InitialFlightRules='IFR' flightDuration='P0Y0M0DT0H3M0.000S' airfileRouteStartTime='201
8.     <estimatedElapsedTime elapsedTime='P0Y0M0DT0H3M0.000S'
9.     <location
10.       <point>RJAA</point>
11.     </location>
12.     <estimatedElapsedTime
13.       <estimatedElapsedTime elapsedTime='P0Y0M0DT0H3M0.000S'
14.     <location
15.       <point>PAPAS</point>
16.     </location>
17.     <estimatedElapsedTime
18.       <estimatedElapsedTime elapsedTime='P0Y0M0DT0H3M0.000S'
19.     <location
20.       <point>APPLE</point>
21.     </location>
22.     <estimatedElapsedTime
23.       <estimatedElapsedTime elapsedTime='P0Y0M0DT0H3M0.000S'
24.     <location
25.       <point>GYANG</point>
26.     </location>
27.     <estimatedElapsedTime
```

FLIGHT_ROUTE Message

Mini Global Demonstration

• Demonstration System Architecture



Mini Global Demonstration

- 実施したシナリオ

- ∅ アジア太平洋のシナリオ

- Scenario 7a: Bangkok to Singapore
 - Scenario 4a: Singapore to Tokyo (CAAS and JCAB)
 - Scenario 8b: LAX to Sydney
 - Scenario 10a: Seoul to LAX (ROK, JCAB and FAA)
 - Scenario 1a: Tokyo to LAX (JCAB and FAA)
 - Scenario 10b: LAX to Seoul (FAA, JCAB and ROK)

- ∅ 大西洋のシナリオ

- Scenario 2: Ottawa to JFK
 - Aircraft Access to SWIM (AAtS)
 - EMS to EMS

- ∅ FAAのシナリオ

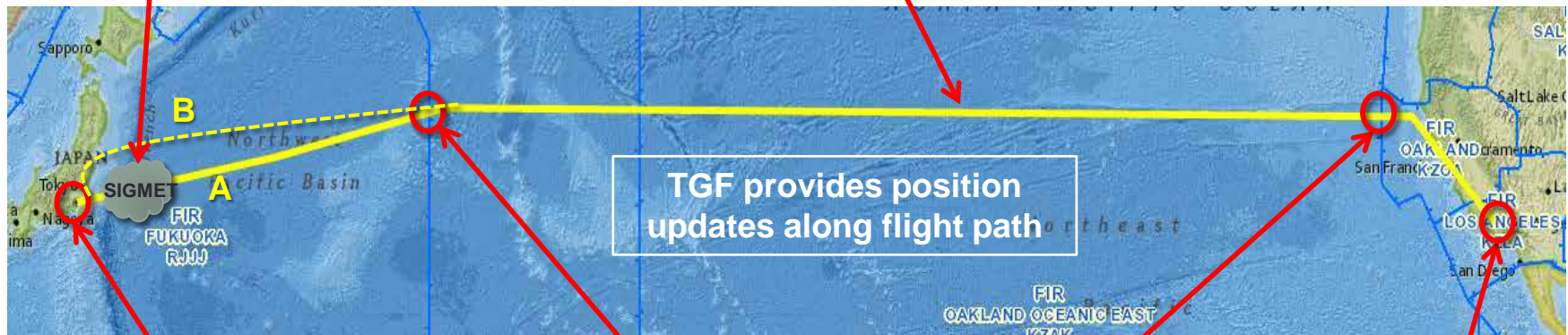
- Airborne Execution of Flow Strategies (AEFS)
 - Collaborative Information Management (CIM)

Mini Global Demonstration

• 具体的な例：Tokyo to Los Angeles

1. Publish SIGMET for Volcanic ash

6. Periodic FO updates (Flight Amendments, Track Information, Flight State) from FAA



2. Trajectory Evaluator used to assess original flight plan (A)

3. Publish revised flight plan (B)

4. Publish departure message

5. Boundary coordination using AIDC protocol in FIXM (ABI, CPL and ACP messages)

7. Handover from Oceanic to En-route airspace

8. Arrival into LAX

Mini Global Demonstration

- 従来の飛行計画と気象情報の評価

The screenshot displays the NCR Web Client interface, which is used for flight trajectory analysis. The main window shows a map of the United States with a green shaded area representing a flight trajectory. The interface is divided into several panels:

- Map Layers:** A list of layers on the left side, including "Base Maps" (Blue Marble, World), "Overlays" (airport, NEXRAD Current), and "query" layers (query_9, query_draw_9, query_sigmet_9, query_10, query_draw_10, query_sigmet_10).
- Trajectory Query Panel:** A panel on the right side containing a "Trajectory Query" section with fields for "Query Time" (2014-08-13T09:10:00), "Departure" (2014-08-13T09:10:00), "Speed (kts)" (300), "Altitude (ft)" (30000), "Vertical Buffer (ft)" (5000), and "Horizontal Buffer (nm)" (100). It also includes a "Saved Route" dropdown and a "Load Route" button.
- Trajectory String:** A text area displaying the trajectory data as a LINESTRING: `LINESTRING(-220.2189 35.5533, -217.27659005301 37.01171875, -204.18088692801 40.263671875, -181.6445588030 1`.
- Layers:** A section at the bottom right with checkboxes for "SELECT ALL", "Aeronautical" (artcc, notam, active_sua, runways, airport_config, sectors, sua, airport, avios), and "Traffic Management" (gs, afp, fercute, gdp, fca).
- Buttons:** "Run", "Clear", "Show", and "Publish" buttons are located at the bottom of the right panel.

The bottom of the screenshot shows the Windows taskbar with the system clock indicating 11:49 on 2014/08/14.

Mini Global Demonstration

- 飛行計画の変更と評価

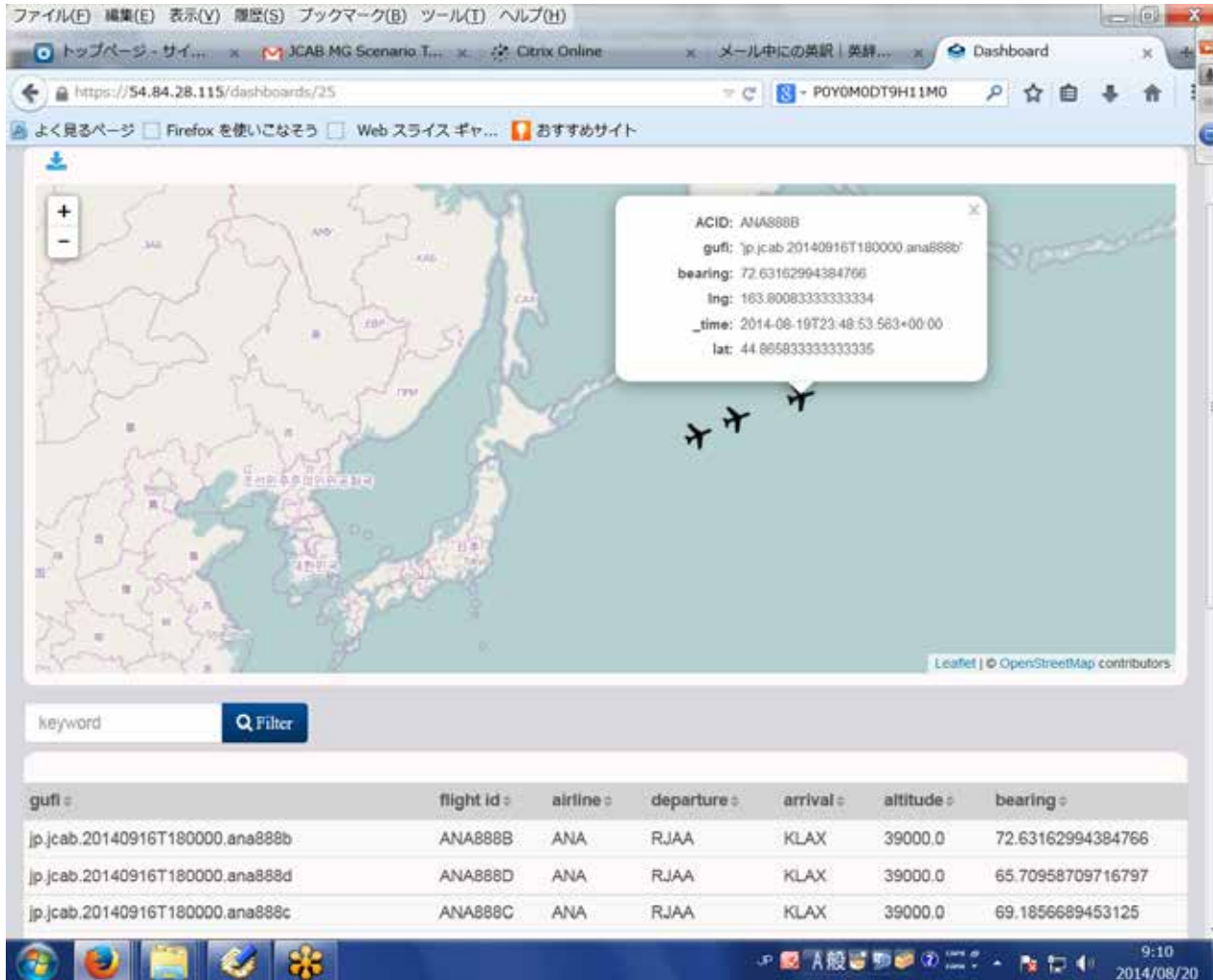
The screenshot displays the NCR Web Client interface, which is used for flight plan management and evaluation. The main window shows a map of the United States with a green shaded area representing a flight path or search area. The interface includes several panels:

- Map Layers:** A sidebar on the left showing various map layers such as "Base Maps", "Overlays", and "query_9" through "query_12".
- Trajectory Query:** A panel on the right containing configuration options for a query, including:
 - Query Time: 2014-08-13T09:10:00
 - Departure: 2014-08-13T09:10:00
 - Speed (kts): 300
 - Altitude (ft): 30000
 - Vertical Buffer (ft): 5000
 - Horizontal Buffer (nm): 100
 - Saved Route: (Dropdown menu)
 - Trajectory: `LINESTRING(-220.2189 35.5533, -216.39768380301 34.462890625, -211.5636994280 34.638671875, -207.0812775530 34.638671875)`
- Layers:** A section on the right with checkboxes for "Aeronautical" (arcc, nctam, active_sua, runways, airport_config, sectors, sua, airport, avos) and "Traffic Management" (gs, afp, reroute, gdp, fca).

The bottom of the interface features a Windows taskbar with the system clock showing 11:50 on 2014/08/14.

Mini Global Demonstration

- Boundary coordination



The screenshot shows a web browser window displaying a map of Japan. A tooltip is visible over the map, providing flight details for ANA888B. Below the map, there is a search bar and a table of flight data.

Tooltip Data:

- ACID: ANA888B
- gulfid: jp.jcab.20140916T180000.ana888b
- bearing: 72.63162994384766
- lng: 183.80083333333334
- _time: 2014-08-19T23:48:53.563+00:00
- lat: 44.86583333333335

Table Data:

gulfid	flight id	airline	departure	arrival	altitude	bearing
jp.jcab.20140916T180000.ana888b	ANA888B	ANA	RJAA	KLAX	39000.0	72.63162994384766
jp.jcab.20140916T180000.ana888d	ANA888D	ANA	RJAA	KLAX	39000.0	65.70958709716797
jp.jcab.20140916T180000.ana888c	ANA888C	ANA	RJAA	KLAX	39000.0	69.1856689453125

Mini Global Demonstration

- Handover from Oceanic to Enroute

The screenshot displays a web-based flight tracking interface. The main map shows a flight path over the Pacific Ocean, with a red line indicating the current track and blue arrows showing the aircraft's path. The aircraft is currently positioned over the ocean, near the coast of North America. The map includes labels for Washington, Oregon, Idaho, Nevada, and California. A timestamp of 2014-09-11T11:31:26+00:00 is visible in the bottom left corner of the map area.

Aircraft Details

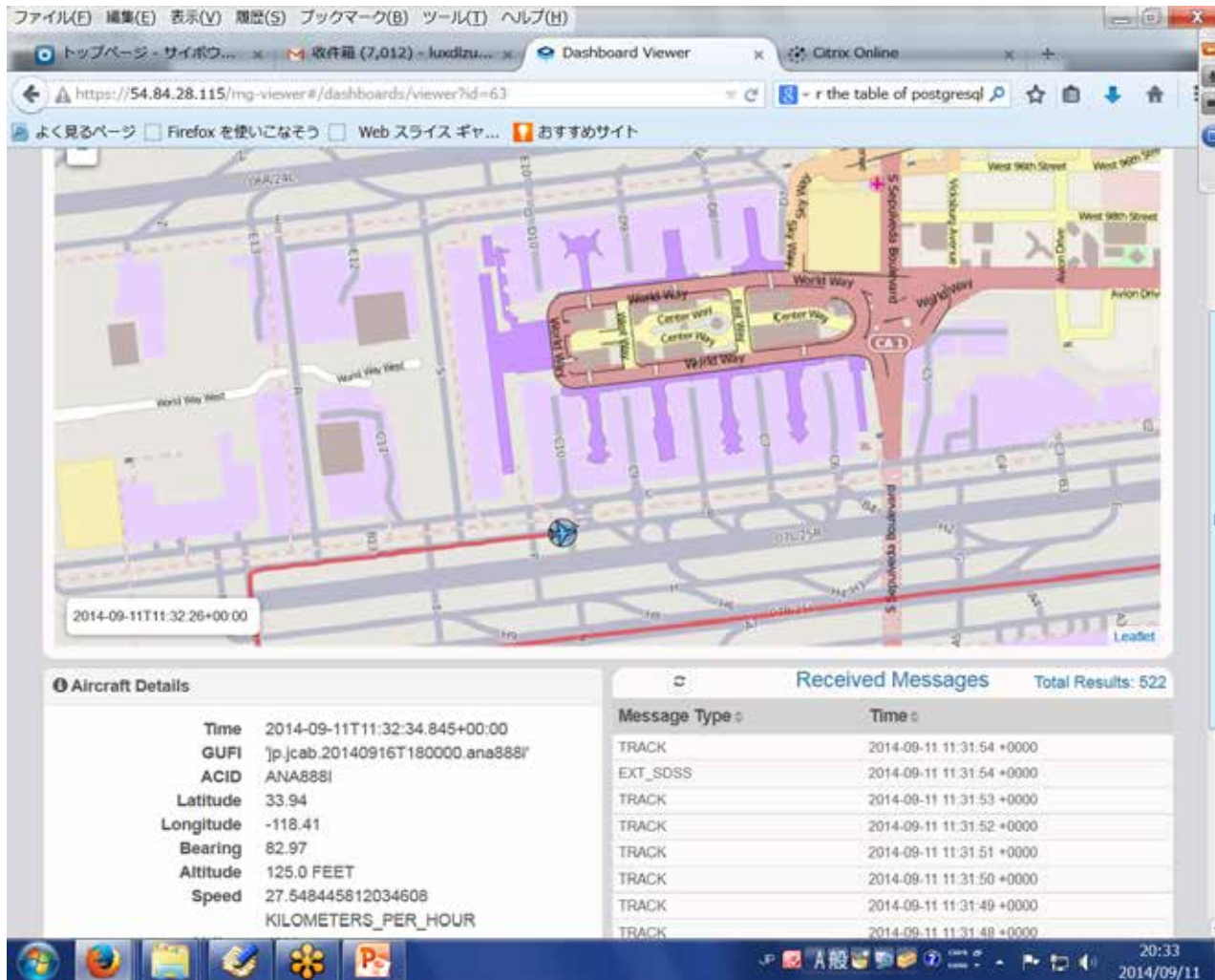
Time	2014-09-11T11:31:26.406+00:00
GUFID	jp.jcab.20140916T180000.ana888e
ACID	ANA888E
Latitude	39.74
Longitude	-125.80
Bearing	134.29
Altitude	33000.0 FEET
Speed	486.0 KNOTS
Airline	ANA

Received Messages Total Results: 179

Message Type	Time
TRACK	2014-09-11 11:29:38 +0000
TRACK	2014-09-11 11:29:26 +0000
TRACK	2014-09-11 11:29:14 +0000
TRACK	2014-09-11 11:29:02 +0000
TRACK	2014-09-11 11:28:50 +0000
TRACK	2014-09-11 11:28:38 +0000
TRACK	2014-09-11 11:28:26 +0000
TRACK	2014-09-11 11:28:14 +0000

Mini Global Demonstration

- Arrival



The screenshot shows a web browser window with the following details:

- Browser: Firefox
- Address Bar: <https://54.84.28.115/mg-viewer#/dashboards/viewer?id=63>
- Page Title: Dashboard Viewer
- Page Content: A map showing a flight path (red line) over a city grid. The path starts at the bottom left and moves towards the center. The map includes labels for streets like 'World Way', 'Center Way', and 'S. Sepulveda Boulevard'. A timestamp '2014-09-11T11:32:26+00:00' is visible on the map.

Below the map, there are two panels:

Aircraft Details

Time	2014-09-11T11:32:34.845+00:00
GUF1	'jp.jcab.20140916T180000.ana888'
ACID	ANA888
Latitude	33.94
Longitude	-118.41
Bearing	82.97
Altitude	125.0 FEET
Speed	27.548445812034608 KILOMETERS_PER_HOUR

Received Messages Total Results: 522

Message Type	Time
TRACK	2014-09-11 11:31:54 +0000
EXT_SDSS	2014-09-11 11:31:54 +0000
TRACK	2014-09-11 11:31:53 +0000
TRACK	2014-09-11 11:31:52 +0000
TRACK	2014-09-11 11:31:51 +0000
TRACK	2014-09-11 11:31:50 +0000
TRACK	2014-09-11 11:31:49 +0000
TRACK	2014-09-11 11:31:48 +0000

The Windows taskbar at the bottom shows the date and time: 20:33 2014/09/11.

評価と課題

(1) 評価

・ ネットワーク技術

性能要件	ネットワーク技術			
	専用ネットワーク	汎用ネットワーク	VPN on Internet	Cloud (仮想化技術)
Performance	5	2	3	4
Adaptability	2	5	4	4
Fault Tolerance	3	4	4	5
Maintainability	5	2	3	5
Security	2	3	4	5

n 評価基準

1: 弱い(not support)

2:

3: 普通(support)

4:

5: 強い(special functions)

評価と課題

(1) 評価

・ メッセージング技術

性能要件	Request / Reply			Publish / Subscribe			
	CORBA	ESB	Web Service (J2EE)	MOM (JMS)	Web Service Notification	ESB	DDS
Performance	4	4	3	3	3	4	5
Adaptability	4	5	5	4	4	5	4
Fault Tolerance	4	5	5	5	5	5	5
Maintainability	4	5	5	4	5	4	4
Security	4	5	5	3	5	5	3

評価と課題

(2) 課題

○ 情報共有

- 新旧データの変換
- 異なる情報品質の共存
- 異種サービスの連携

○ 通信基盤

- 異種データリアルタイム性の保証
- 異種システム間でシームレスな通信

○ 評価

- SWIMにおいて既存技術の評価
- 新たな環境に対する評価技術

まとめ

1. 背景

- 航空交通システムのグローバル化
- 飛行情報、航空情報、気象情報などの標準化

2. ニーズ

- データ中心情報環境
- ネットワーク中心運用基盤

3. 解決方法

- グローバルSWIMシステムの構築技術
- 実証実験システムの構築と評価技術

