Ministry of Land, Infrastructure, Transport and Tourism

Civil Aviation Bureau of Japan

MSAS Status and Future Plan

27-28 September 2021

JCAB, MLIT

Implementation Plan

- **MSAS V1: Initial Phase (Ops:2007 ～ 2020.3)**
  - Previous MSAS, Dual PRN Operation with MTSAT-2

Currently in Operation Phase

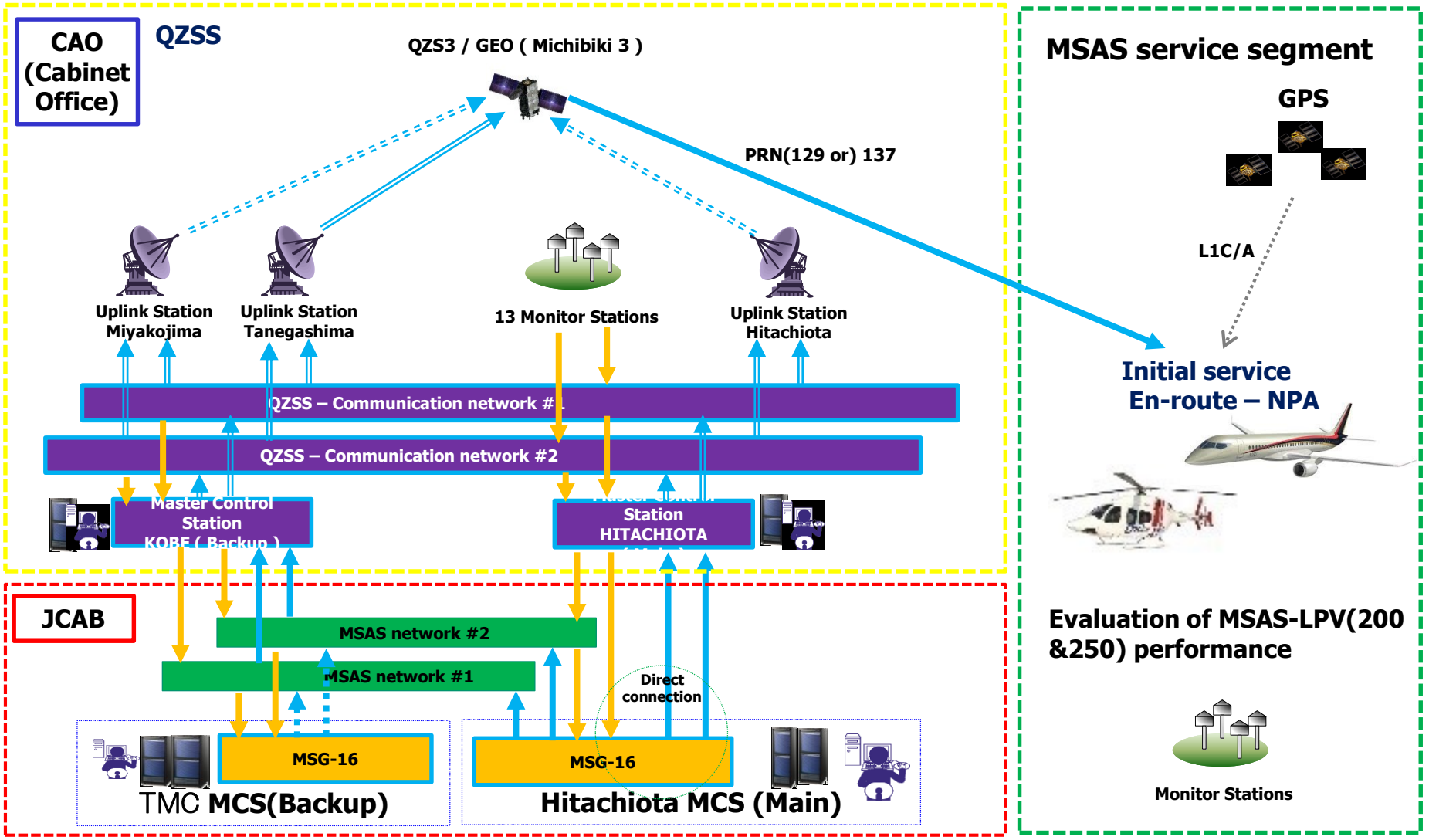
- **MSAS V2: System Update Phase (Ops:2020.4 ～)**
  - Current MSAS, Single PRN Operation with the QZS-3(GEO).
  - Evaluation of MSAS-LPV（250 & 200） performance(2019～)

Currently in Development Phase

- **MSAS V3: LPV implementation Phase (Dev:2020.4～ /Ops:2023 ～)**
  - LPV service provided with the QZS-3(GEO), QZS-6(GEO), and QZS-7(GEO).
  - Decision made with stakeholders at 2018.3.
  - JCAB has started development of MSAS v3 from 2020.4.

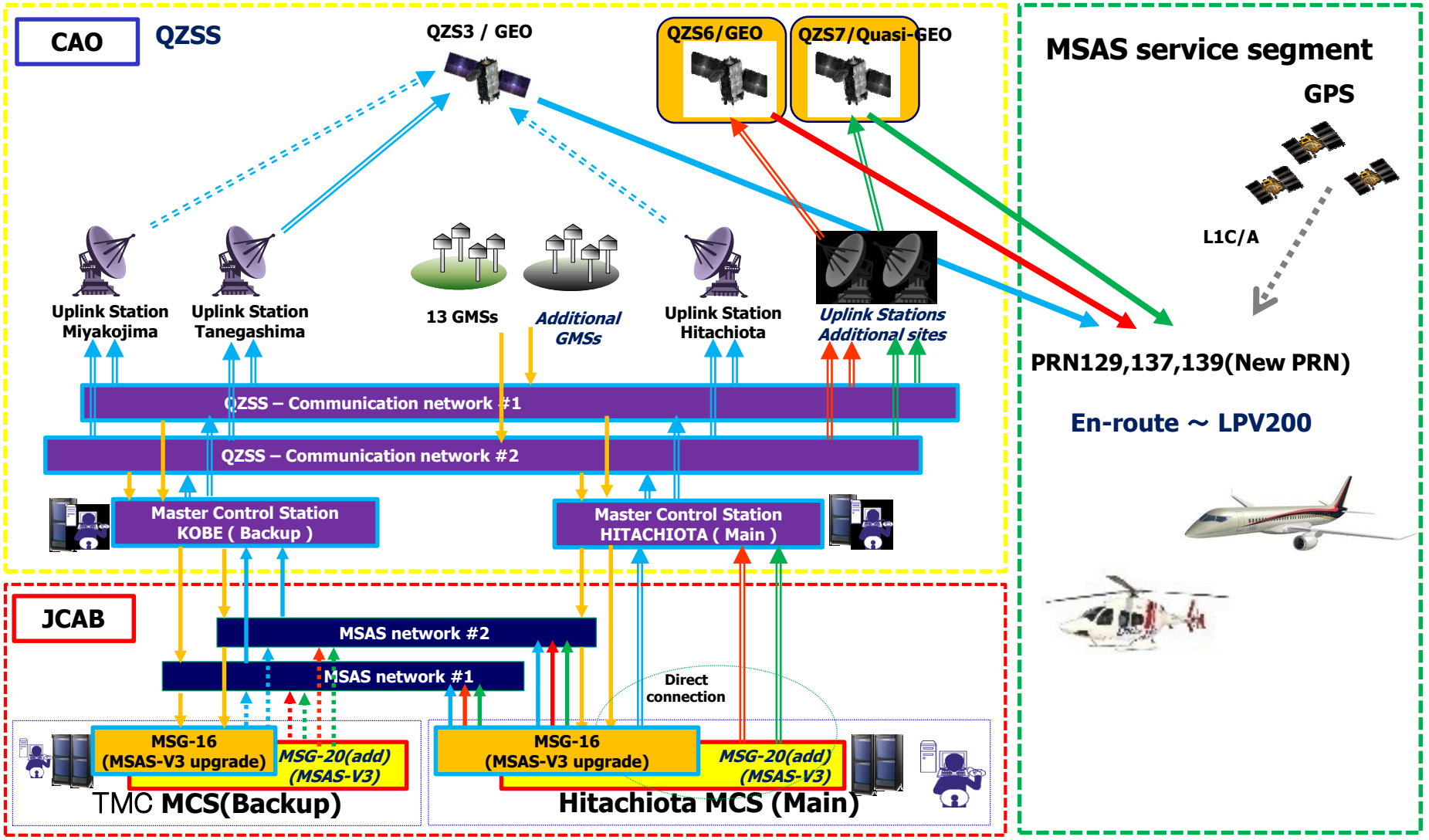
- **MSAS V4: DFMC Validation Phase (R&D：2017 ～)**
  - ENRI began DFMC SBAS experiment from 2017.8 with QZSS satellites.
  - In support of ICAO SARPs validation activity, the initial target performance is LPV 200

MSAS V2 System Diagram with QZS-GEO (Ops:2020.4 ～)



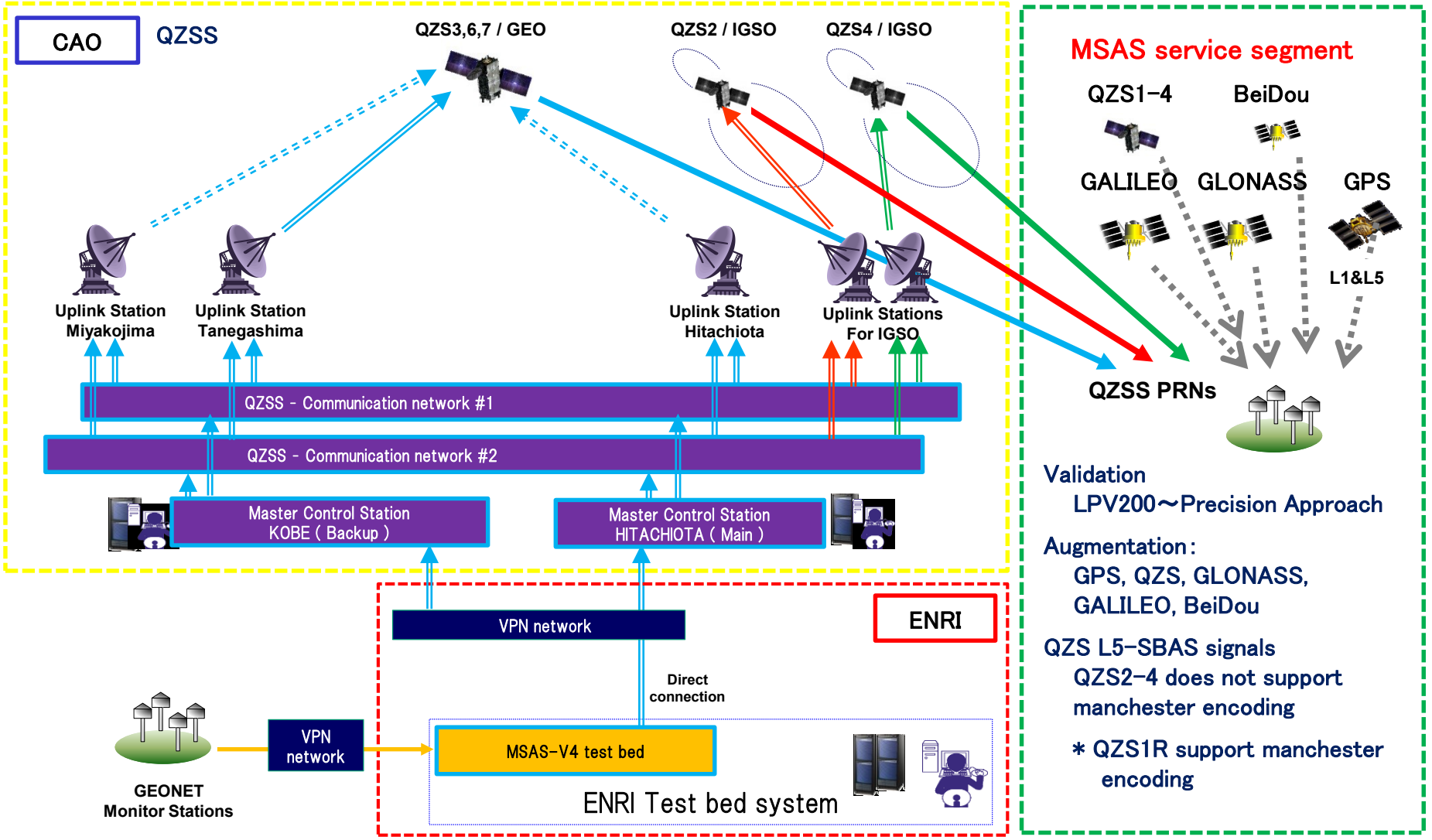
MSAS V3 Configuration

(Ops:after 2023～)



MSAS V4 validation Configuration

DFMC-MSAS proto-type(R&D 2017.8～)



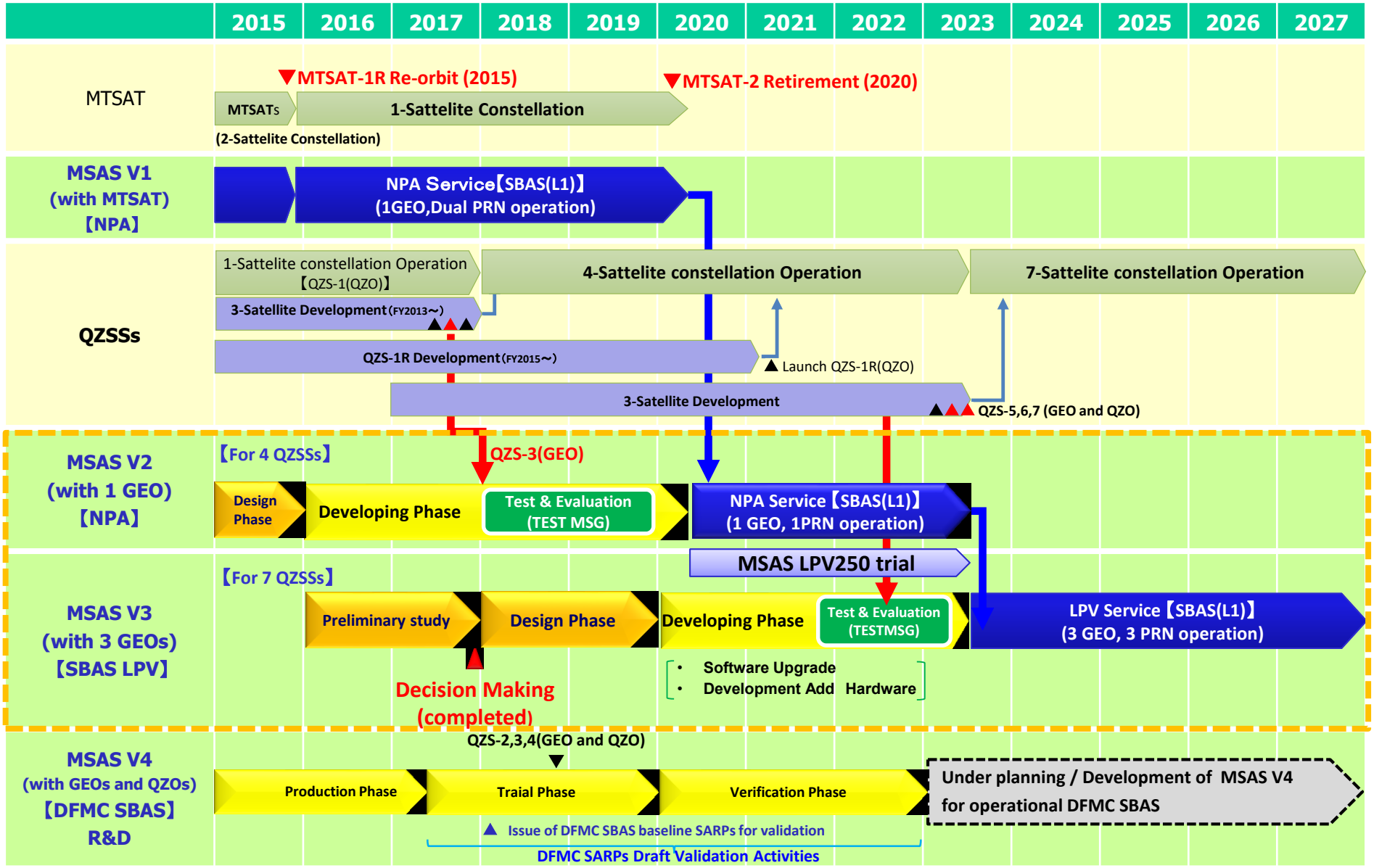
Validation
LPV200～Precision Approach

Augmentation:
GPS, QZS, GLONASS, GALILEO, BeiDou

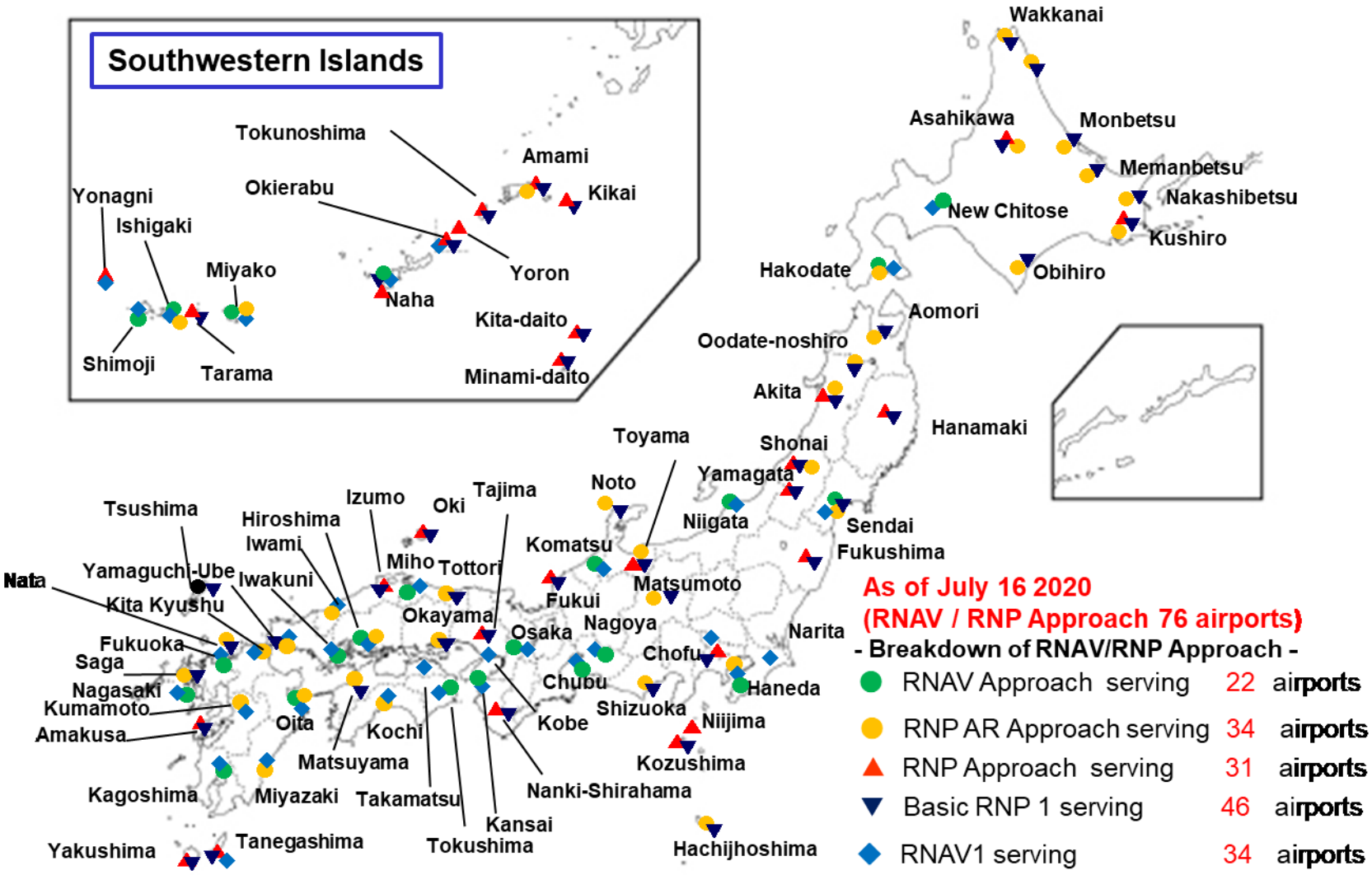
QZS L5-SBAS signals
QZS2-4 does not support manchester encoding

* QZS1R support manchester encoding

Future Plan
(Near-term schedule)



Current GNSS & PBN



Basic concept implementation in MSAS LPV

※ **Now planning**

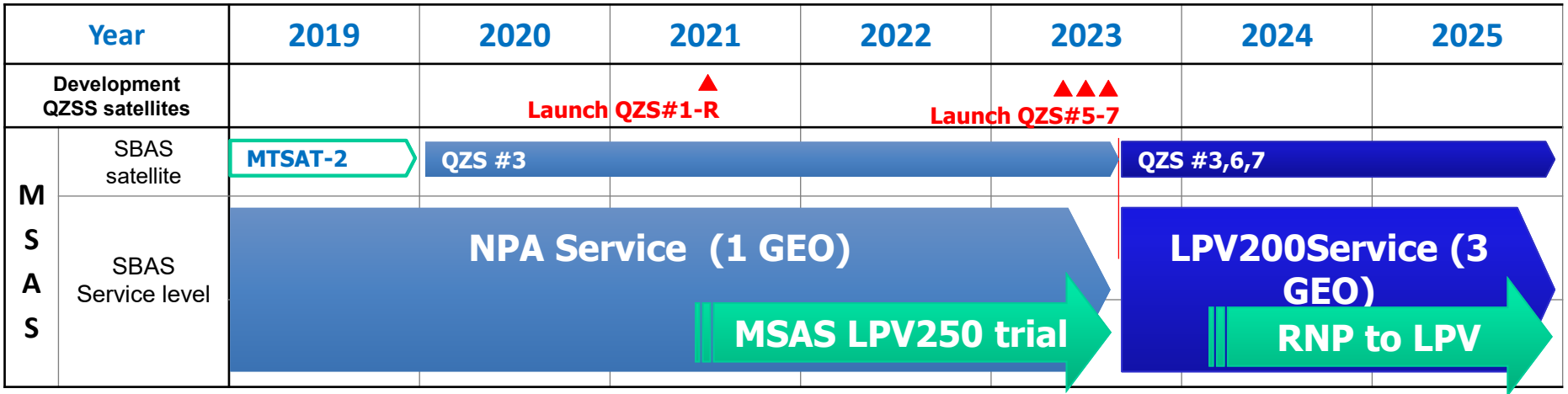
＜MSAS LPV trial operation＞ 2021～

・Using MSAS v2 (one GEO), LPV-250 approach will be introduced step by step from 2021 for the purpose of LPV method evaluation on Airline.

＜MSAS LPV full-scale operation＞ After 2023～

・ Using MSAS v3 (three GEOs), MSAS LPV-200 is scheduled to commence to operate all at once at all airports designed IFR approach, excluding 2 military control airports. (more than 80 airport)

・After operation of MSAS LPV-200, sequentially RNP to LPV will be designed.



MSAS performance demonstration Example

Evaluation point : Fukuoka airport（APV-I）
Analysis period : 10/8/2021 ～ 28/8/2021 (3W)

27-28/9/2021

Network Performance Assessment Center
Japan Civil Aviation Bureau

MSAS Performance Analysis

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1． SIS performance analysis (accuracy, integrity, availability, continuity)

Total SIS Performance during the period under analysis

10/8/2021 ～ 28/8/2021

Total Epoch		Accuracy (95%percentile)	Integrity	Availability	Availability	Continuity
1641583	H	0.81 m	100.00 %	100.00 %	**99.73 %**	100.00 %
	V	1.17 m	100.00 %	99.73 %		99.90 %

① Aug. 10 ～ Aug. 14

APV-1	H						V				
	Total Epoch	accuracy(95%)	integrity	Availability	Continuity		Total Epoch	accuracy(95%)	integrity	Availability	Continuity
2021/8/10	86394	0.73	100.00	100.00	100.00		86394.00	1.07	100.00	98.79	99.49
2021/8/11	86400	0.76	100.00	100.00	100.00		86400.00	1.04	100.00	100.00	100.00
2021/8/12	86400	0.82	100.00	100.00	100.00		86400.00	1.23	100.00	99.86	99.97
2021/8/13	86399	0.87	100.00	100.00	100.00		86399.00	1.42	100.00	100.00	100.00
2021/8/14	86400	0.90	100.00	100.00	100.00		86400.00	1.28	100.00	98.41	99.64
1week ave	86398.60	0.82	100.00	100.00	100.00		86398.60	1.21	100.00	99.41	99.82

MSAS Performance Analysis

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② Aug. 15 ～ Aug. 21

APV-1	H					V				
	Total Epoch	accuracy(95%)	integrity	Availability	Continuity	Total Epoch	accuracy(95%)	integrity	Availability	Continuity
2021/8/15	86400	0.87	100.00	100.00	100.00	86400.00	1.13	100.00	100.00	100.00
2021/8/16	86400	0.84	100.00	100.00	100.00	86400.00	1.14	100.00	100.00	100.00
2021/8/17	86400	0.85	100.00	100.00	100.00	86400.00	1.09	100.00	99.99	99.98
2021/8/18	86400	0.75	100.00	100.00	100.00	86400.00	1.22	100.00	100.00	100.00
2021/8/19	86400	0.80	100.00	100.00	100.00	86400.00	1.12	100.00	100.00	99.98
2021/8/20	86399	0.86	100.00	99.96	99.94	86399.00	1.05	100.00	100.00	100.00
2021/8/21	86400	0.90	100.00	100.00	100.00	86400.00	1.40	100.00	99.51	99.78
1week ave	86399.86	0.84	100.00	99.99	99.99	86399.86	1.16	100.00	99.93	99.96

③ Aug. 22 ～ Aug. 28

APV-1	H					V				
	Total Epoch	accuracy(95%)	integrity	Availability	Continuity	Total Epoch	accuracy(95%)	integrity	Availability	Continuity
2021/8/22	86400	0.73	100.00	100.00	100.00	86400.00	1.03	100.00	99.40	99.84
2021/8/23	86399	0.76	100.00	100.00	100.00	86399.00	1.07	100.00	99.61	99.90
2021/8/24	86400	0.75	100.00	100.00	100.00	86400.00	1.22	100.00	100.00	100.00
2021/8/25	86400	0.77	100.00	100.00	100.00	86400.00	1.23	100.00	100.00	100.00
2021/8/26	86392	0.78	100.00	100.00	100.00	86392.00	1.20	100.00	99.25	99.54
2021/8/27	86400	0.75	100.00	100.00	100.00	86400.00	1.28	100.00	100.00	100.00
2021/8/28	86400	0.85	100.00	100.00	100.00	86400.00	1.06	100.00	100.00	100.00
1week ave	86398.71	0.77	100.00	100.00	100.00	86398.71	1.16	100.00	99.75	99.90

MSAS Performance Analysis

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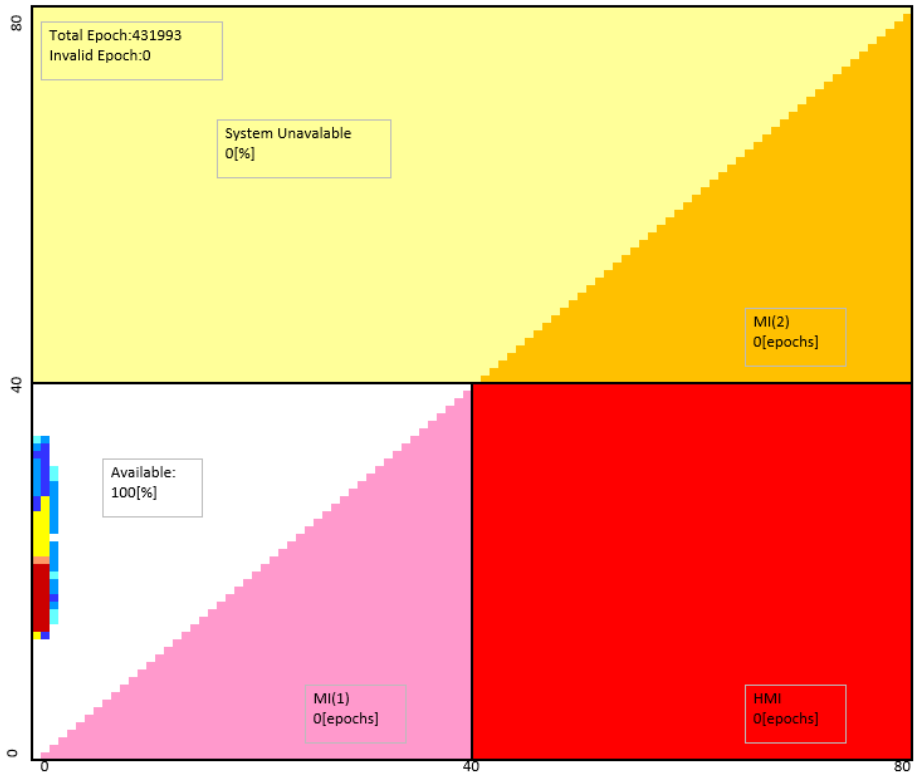
2． Stanford Chart　10/8/2021 ～ 28/8/2021

① Aug. 10 ～ Aug. 14



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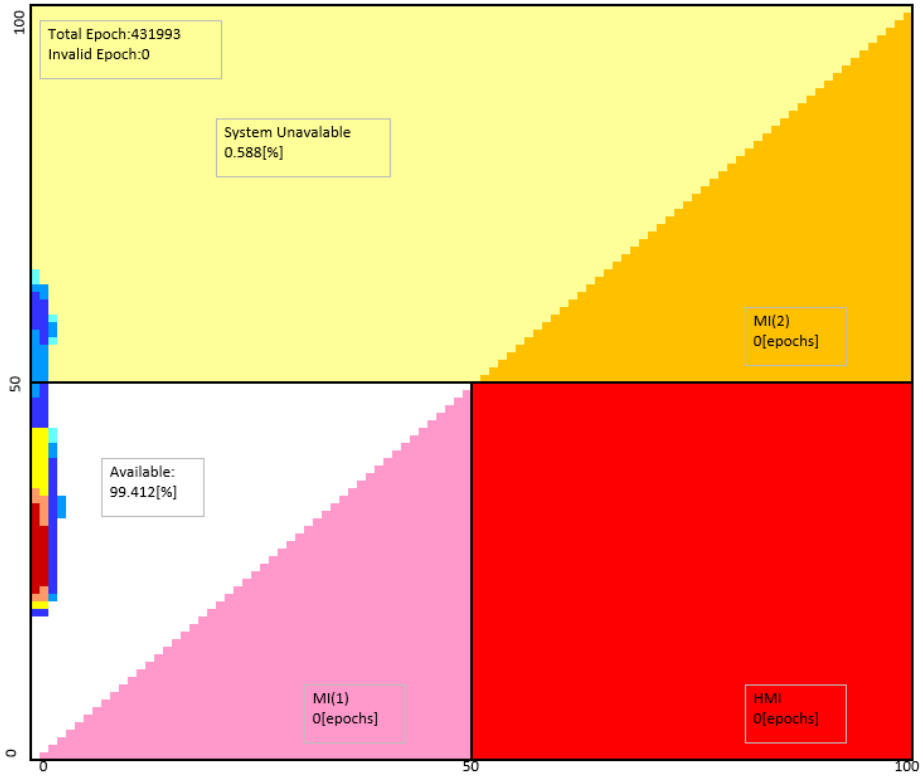

Vertical

MSAS Performance Analysis

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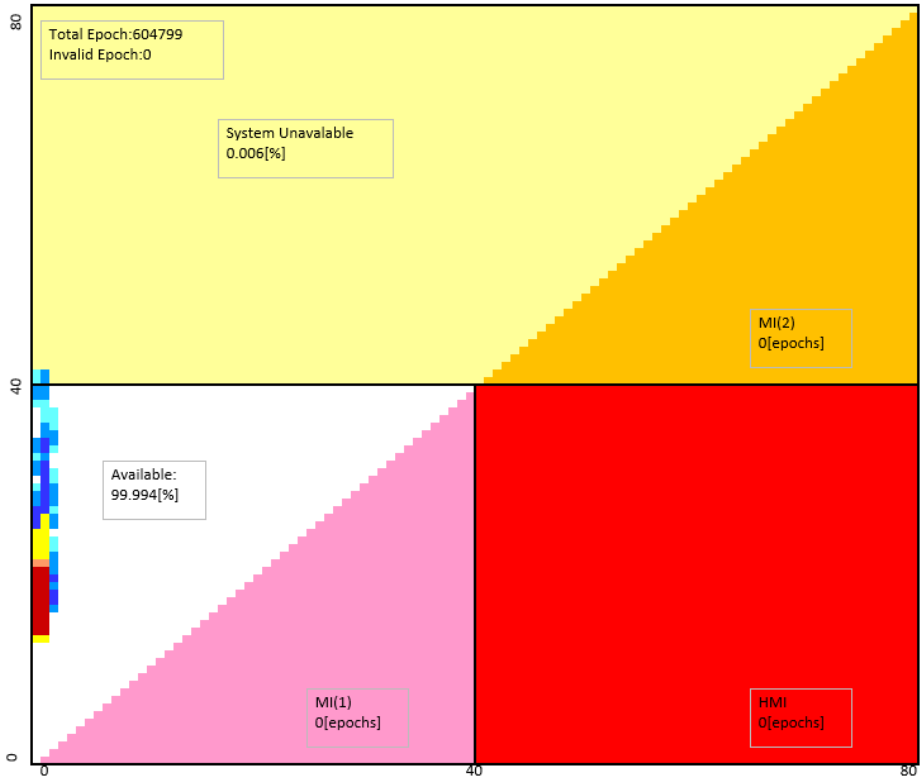
② Aug. 15 ～ Aug. 21



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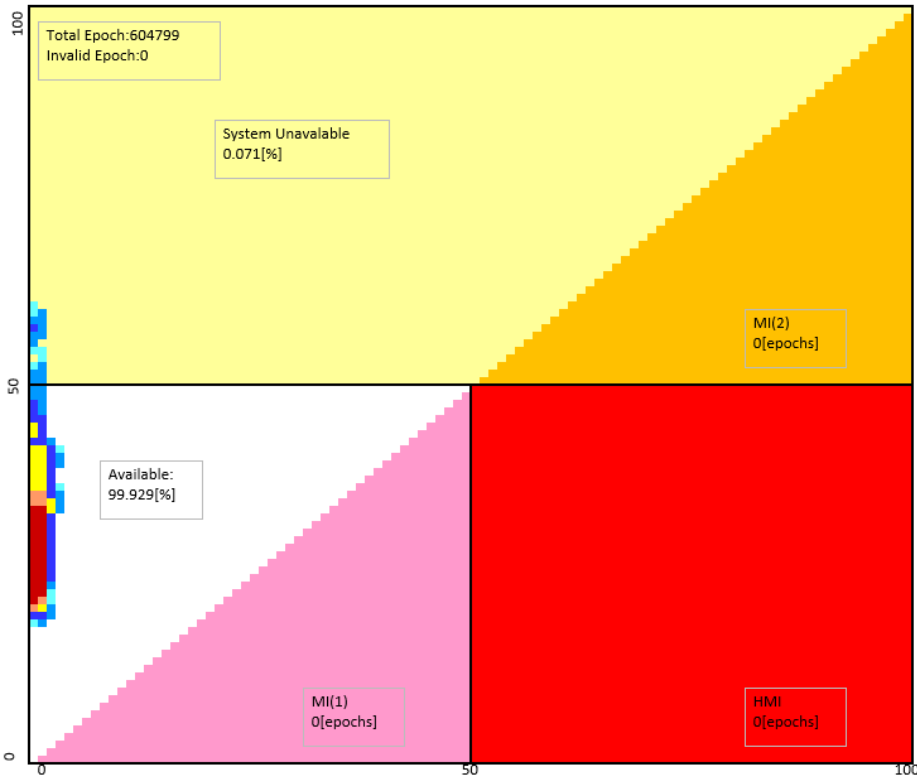

Vertical

MSAS Performance Analysis

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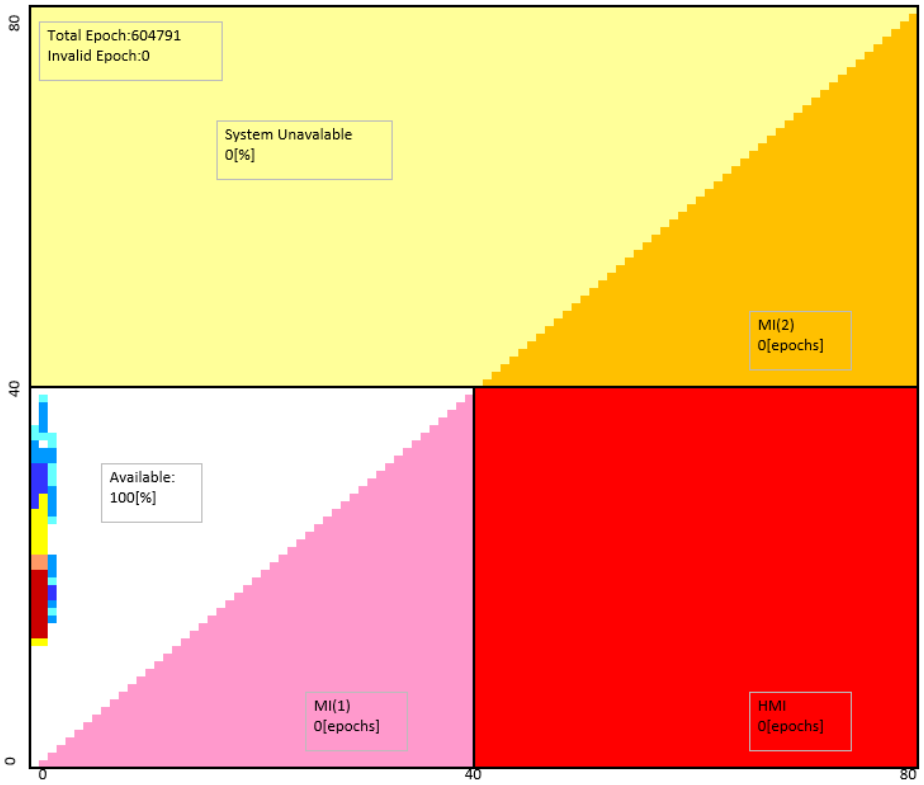
③ Aug. 22 ～ Aug. 28



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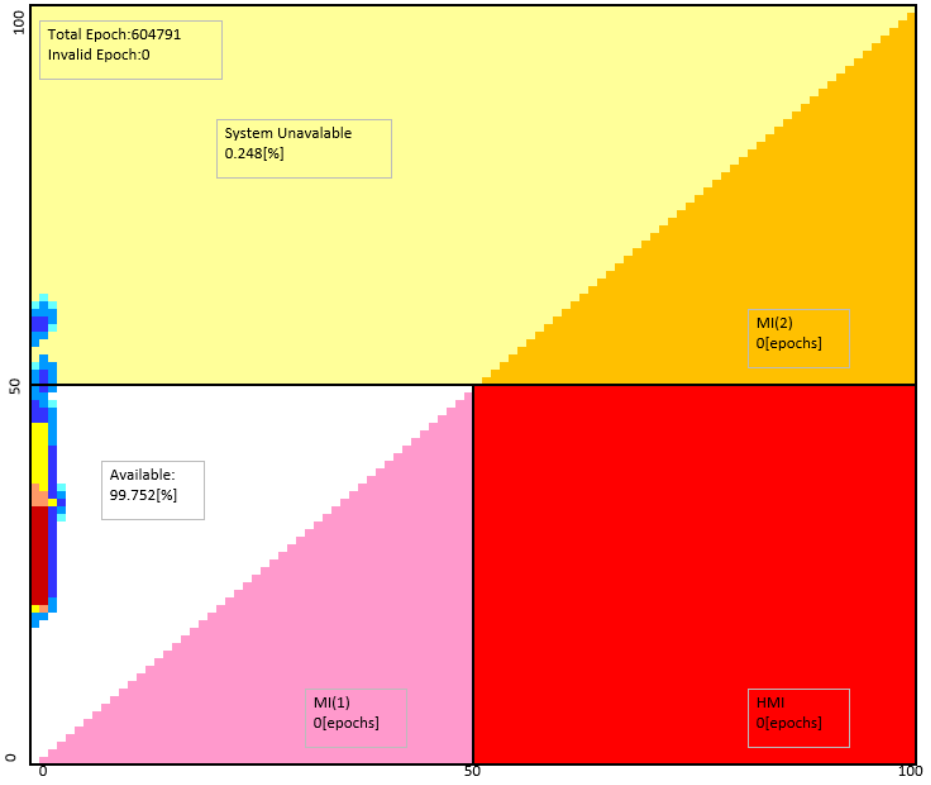
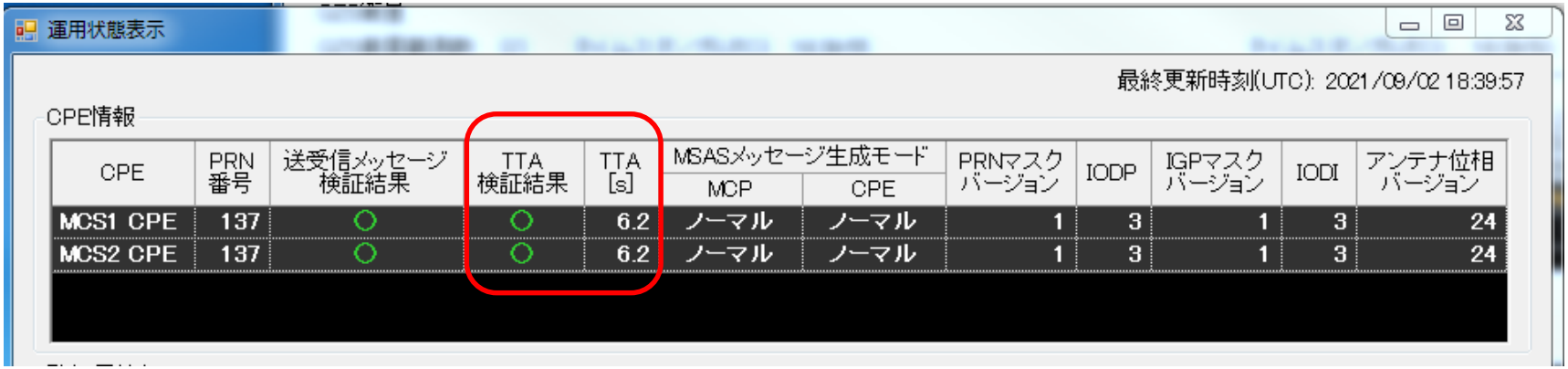


Vertical

3. Time to Aleart

Real-time monitoring by operator's monitoring window



MSAS Collection Data

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★From a Service Provider's Perspective

- MSAS broadcast messages
- MSAS operation log
- MSAS performance data at monitoring stations

★As an assessment for air operators

- Observation data（GPS , ADS-B , RF-spectrum）
- Observation data of external organization（GNSS, Space Weather）
- Prediction data（RAIM and MSAS）
- Analysis data（MSAS performance in a wide area , GPS and SBAS-GEO Satellite Health , RAIM/MSAS Predictive Performance）