

SCC11-IV-4

# Advanced EO system for the Japanese Small Satellite ASNARO

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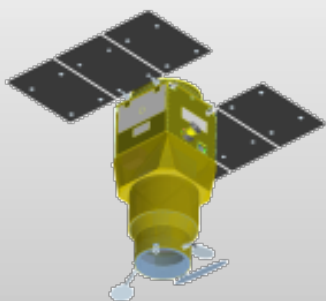
# Introduction

## ASNARO Project

### ASNARO System

#### Space Segment (USEF/NEC)

- *Spacecraft*



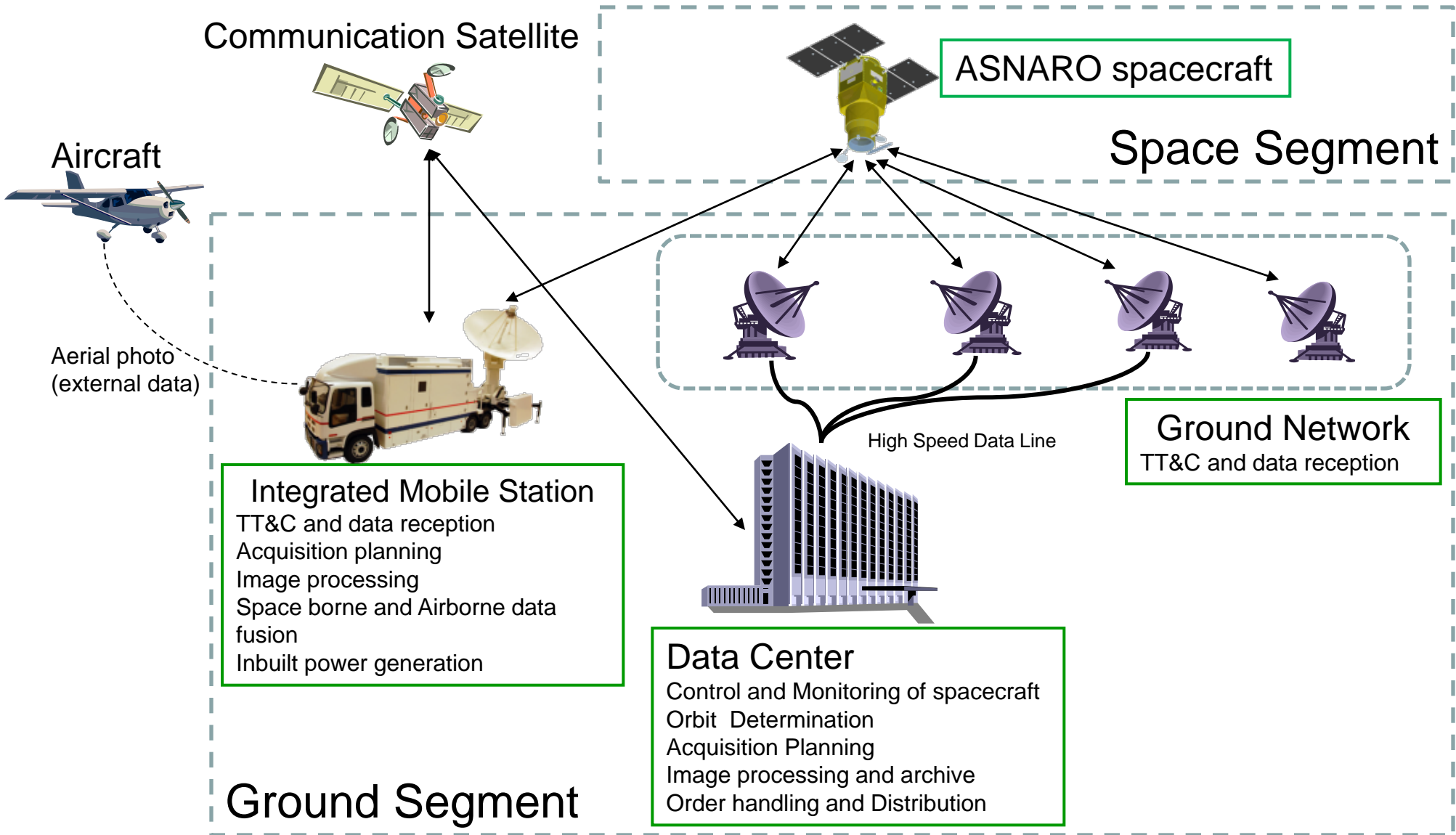
#### Ground Segment (PASCO)

- *Datacenter*  
- *Ground Network*  
- *Integrated mobile station*

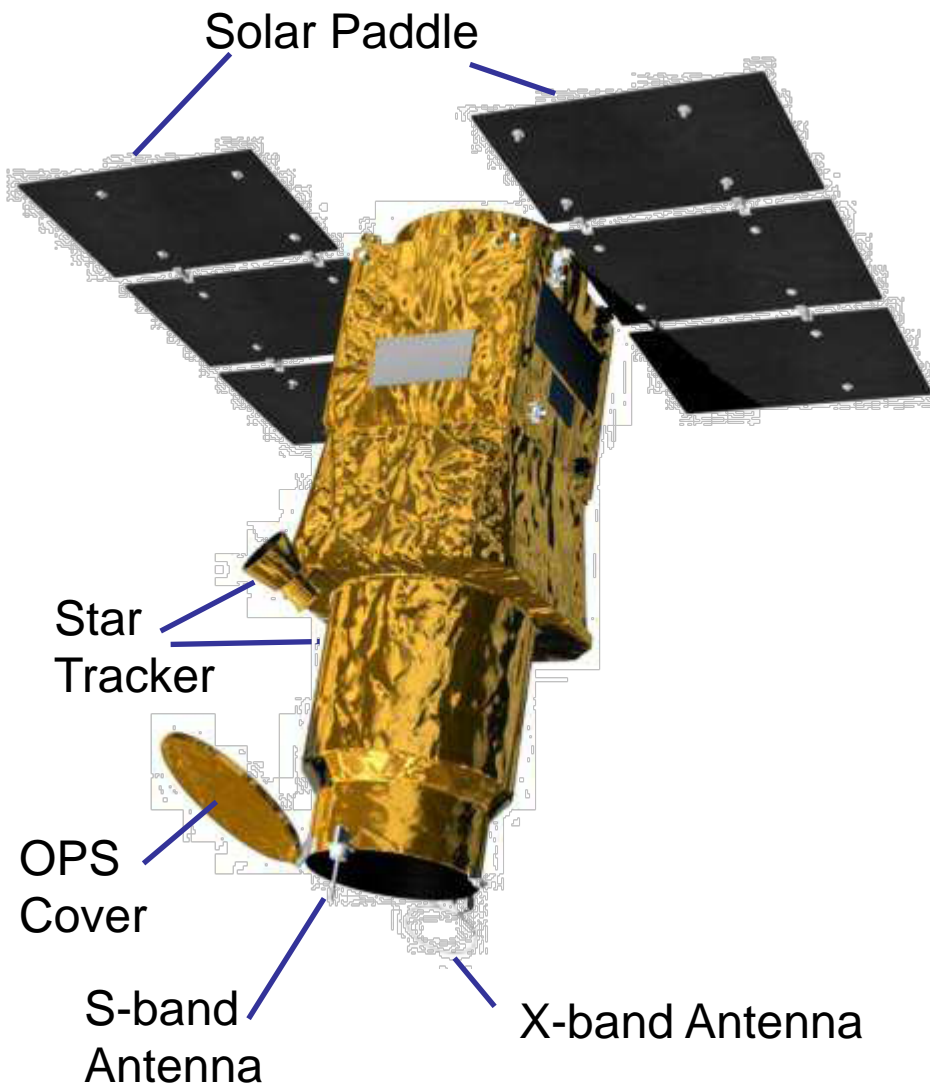


- ASNARO project is being promoted by the Ministry of Economy, Trade and Industry (METI) to develop Japanese first small EO satellite system (ASNARO System) and respond to demands from ASEAN nation.
- ASNARO system aims to provide the mission flexibility and product accuracy comparable to the large scale EO satellites.
- Space segment is being developed by USEF/NEC and Ground segment is being developed by PASCO
- Launch: Dec. 2012 by Dnepr

# Configuration of ASNARO System



# ASNARO spacecraft



Item	Specification
Optical Sensor GSD Swath	Pan/Multi <0.5m/2m(Pan/Multi, from 504km) 10km
Data Transmission	X-band 16QAM (Quadrature Amplitude Modulation), App. 800Mbps
Mass Memory Size	>60 Scenes (Snap Shot mode)
Coverage	+/- 45deg (from Nadir)
Orbit Altitude Inclination Local Time	Sun Synchronous Polar Orbit 504 km Nominal 97.4deg AM 11:00 at Descending Node
Mass	<500kg
Operational Period	>3 Years (5Years target)

# Development Concept of Ground Segment

## User oriented

- Global end-user can request a new acquisition with web service. Image products will be delivered within one hour after data acquisition.

## High speed

- Cloud computed image processing with original tuned methods is performed. Level 1 product is generated within 1 minute after downlink start.

## Automation

- From the user oriented ordering to final product delivery is fully automated. Number of the operators are only four persons.

## Compact

- Drastic downsizing is realized by adapting virtualization of computing system, storage and network. Whole system can be stored in only one rack, except data storage.

# Outline of the Data Center

## Main Function

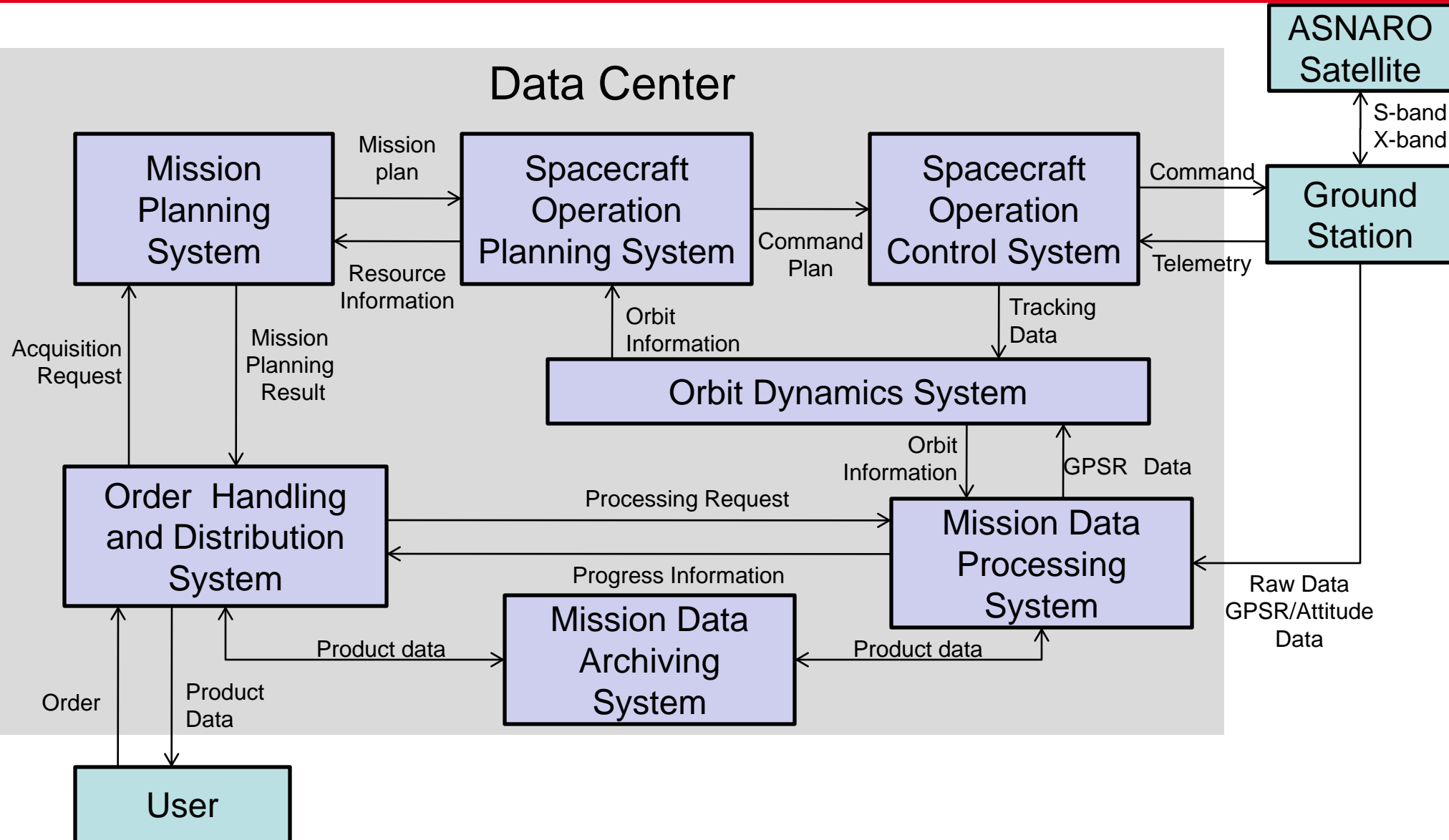
- Control and Monitoring of spacecraft
- Orbit Determination
- Acquisition Planning
- Image processing and archive
- Order handling and Distribution



## Performance

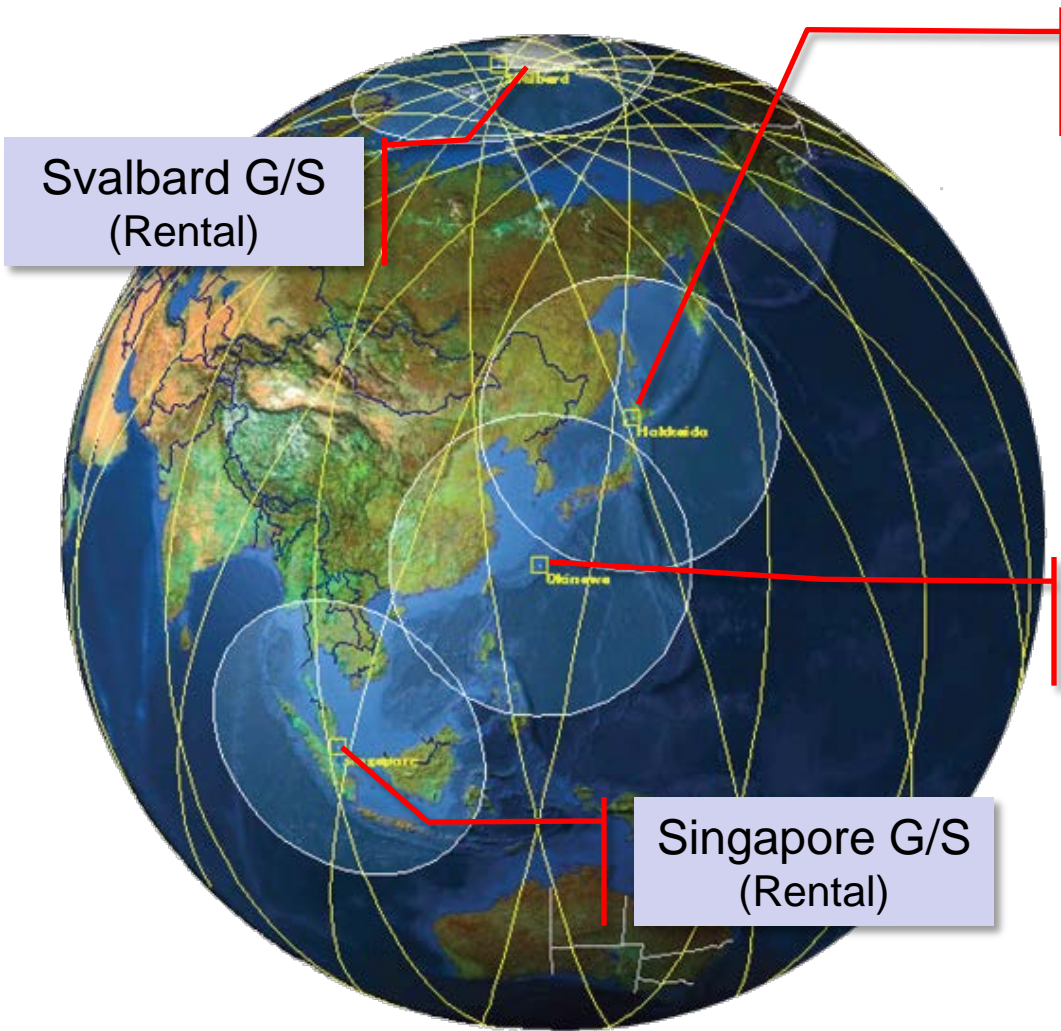
Item	Specification
Request Deadline	Nominal : Observation – (minus) 24h Urgency : Uplink – (minus) 30min
Acquisition Planning / TT&C	<15 minutes
Orbit Determination	<3 m
Time required for Delivery	online: 1 hour at earliest from Acquisition Processing time : <1minute @L1b
Archive capability	>200,000 Scenes(Snap Shot mode)
Number of Operators	4 persons

# Functional diagram of the Data center





# Outline of ASNARO Ground Network



Hokkaido G/S



Okinawa G/S



PASCO Hokkaido/Okinawa Ground Station

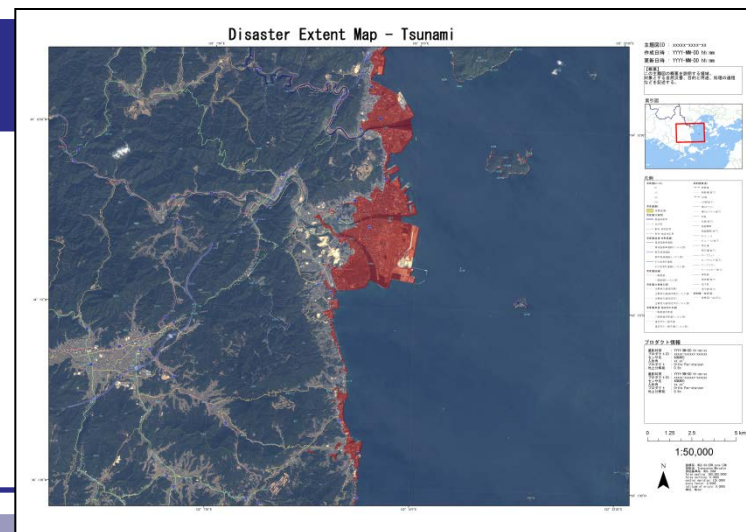
Communication cones of ground stations for ASNARO system



# Outline of the Integrated Mobile Station

## Main Function

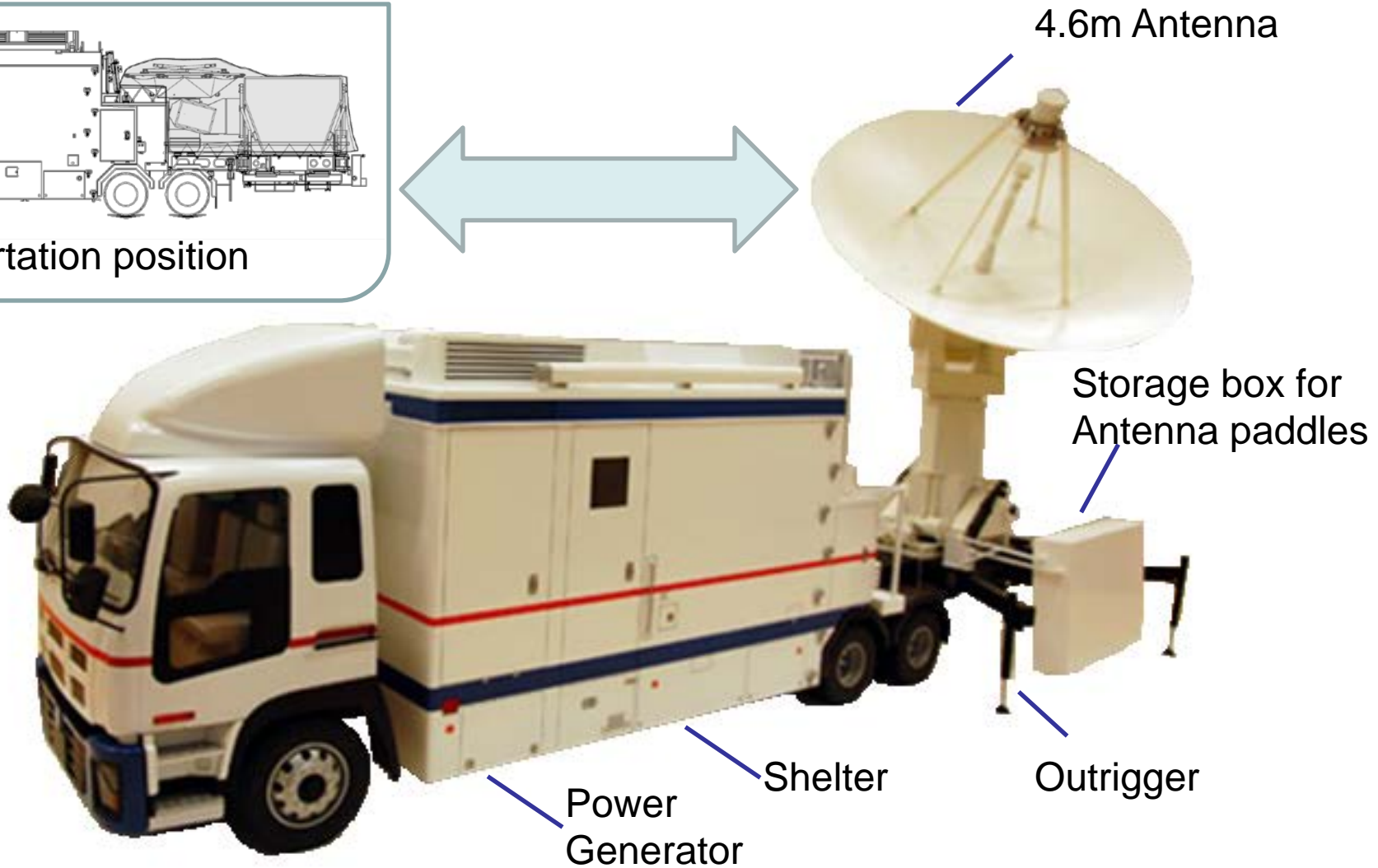
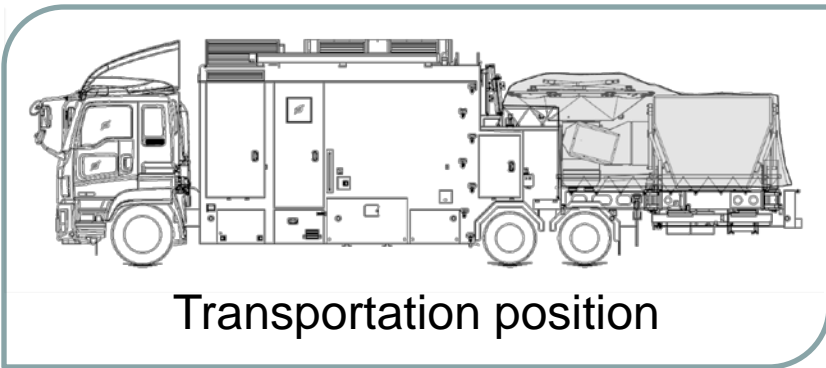
- TT&C and data reception
- Acquisition planning
- Image processing
- Spaceborne and Airborne data fusion
- Inbuilt power generation



## Performance

Item	Specification
G/T	13.7dB/K(S-band), 28db/K(X-band)
Communication Corn	App. 1,250km in radius (with elevation 15deg)
Antenna Diameter	4.6m
Weight	<20t
Dimension	Transportation position: 12m(L) x 2.5m(W) x 3.6m(H) Operational position: 12m(L) x 4.7m(W) x 7m(H)
Number of Operators	2 persons
Deployment Time	< 2hours

# Illustration of Integrated Mobile Station



Mock-up of the integrated Mobile Station (Operational position)

# Combination of functions in Integrated Mobile Station

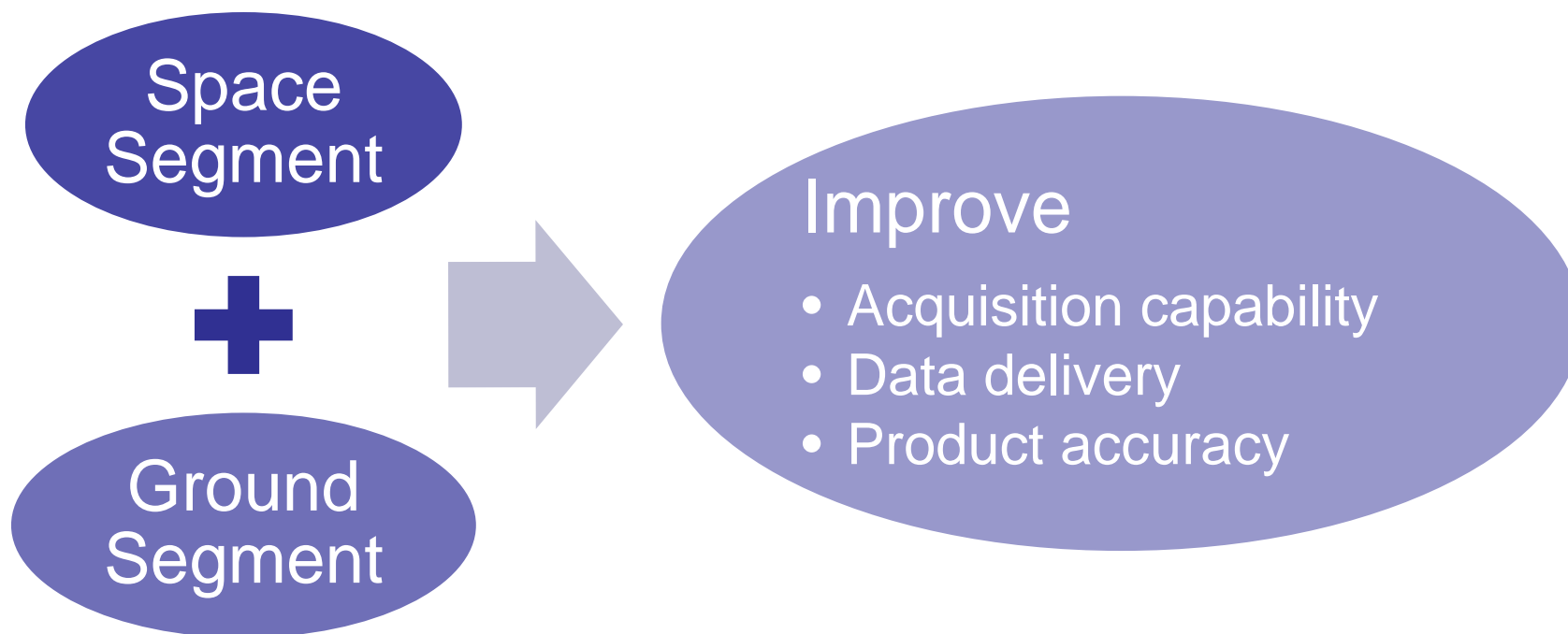
Function	Full Package	Mobile Disaster headquarter	Ground station & Processing Center	Small Satellite operation Center
TT&C and data reception	✓	✓	✓	✓
Control and Monitoring of spacecraft	✓			✓
Orbit Determination	✓			✓
Acquisition Planning	✓	✓	✓	
Image processing	✓	✓	✓	
Space borne and Airborne data fusion	✓	✓		
Inbuilt power generation	✓	✓	✓	

Can be operational at any remote region

## Innovative connectivity of the space and the ground segment

ASNARO system aims to provide the mission flexibility and product accuracy which are comparable to those of the large scale EO satellites.

The developed Innovative connectivity will improve acquisition capability, data delivery and product accuracy.



# Improved acquisition capability

The ground segment will have improvements for the acquisition efficiency, chances and success rate

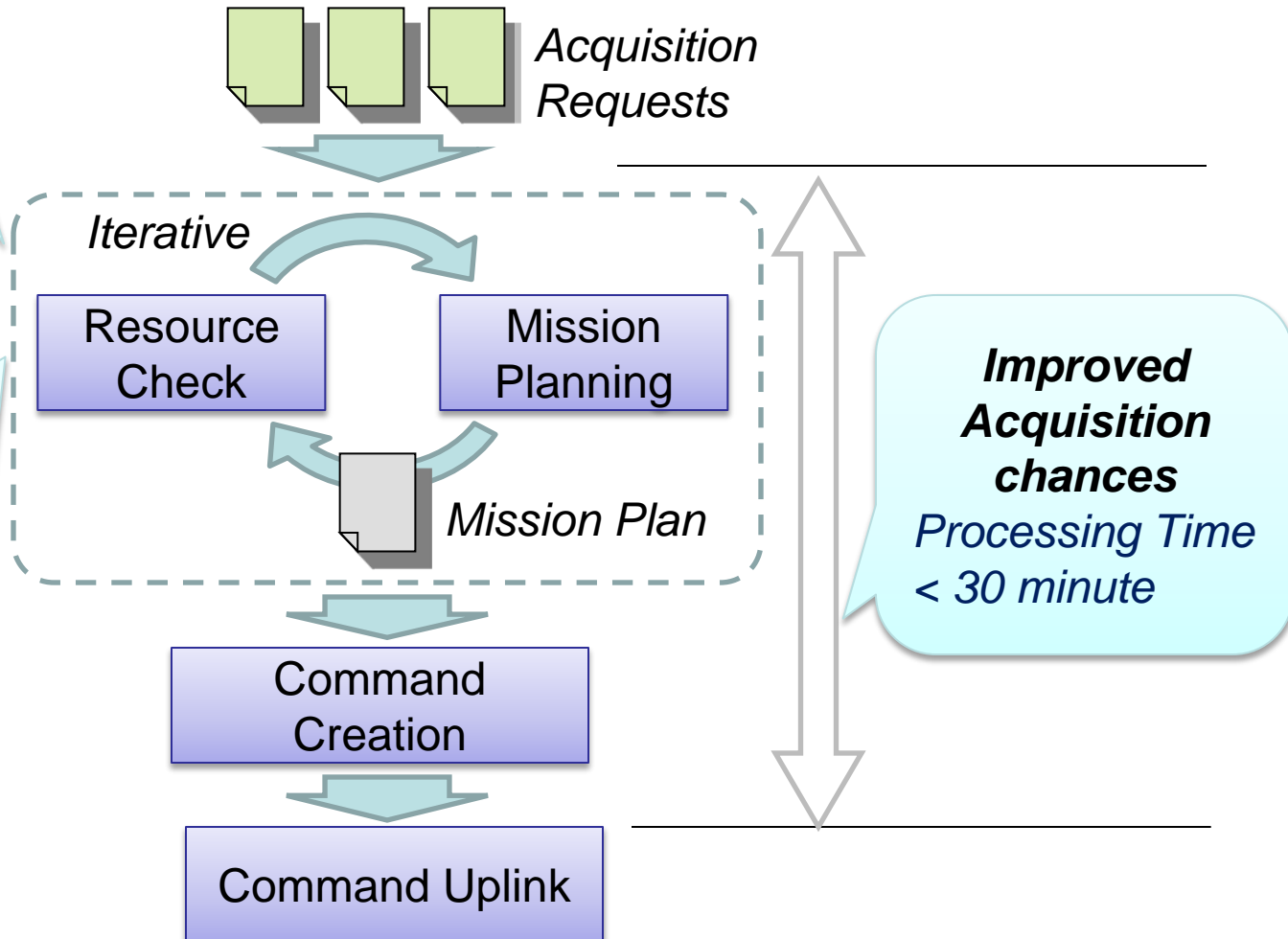
## Improved acquisition success rate

Reference Global Cloud Coverage prediction

## Improved Acquisition efficiency

Automatically selects optimum acquisition mode

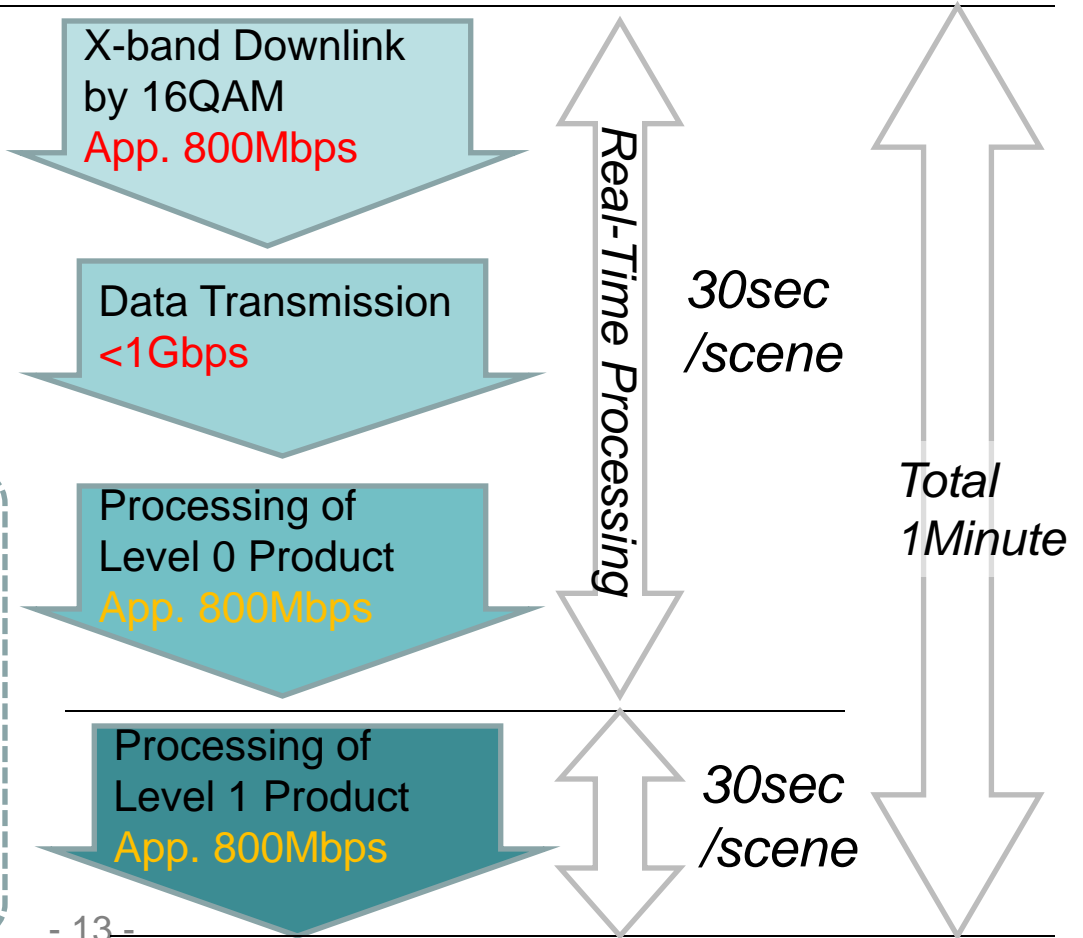
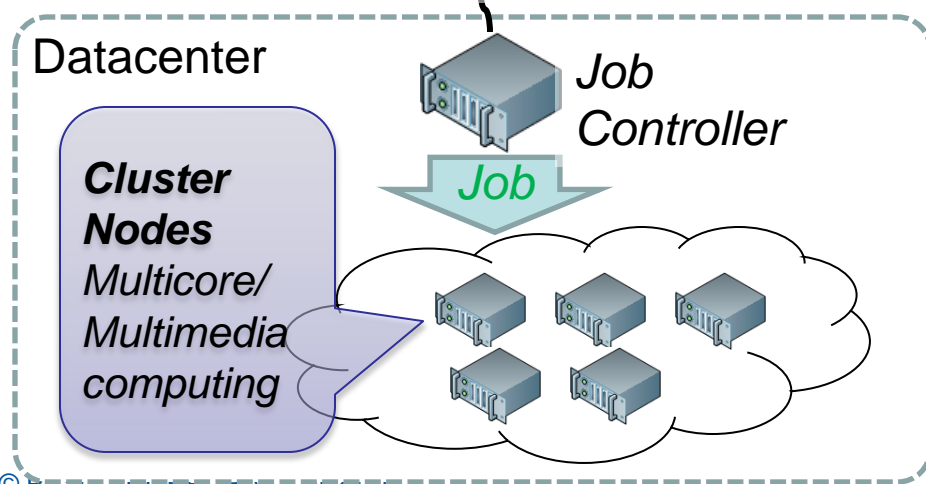
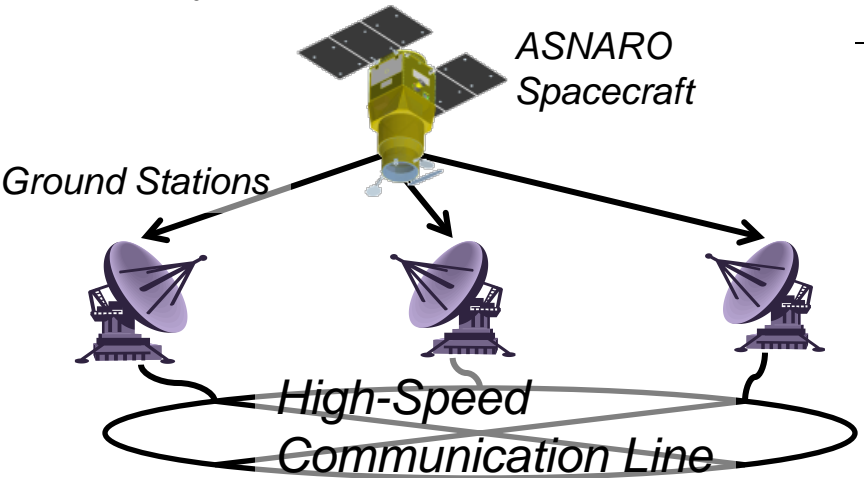
- Snap shot mode  
(10km x 10km)
- Strip map mode  
(10km x max 600km)
- Wide area mode
- Skew mode
- 3D mode
- High S/N mode





# Improved data delivery

ASNARO spacecraft perform image acquisition and downlink separately to reduce the power consumption. The ground segment recover at this point to improve data delivery



# Improved Product accuracy

To improve product accuracy, external information is used to perform correction processing in addition to orbit and attitude information from the satellite,

-High precision orbit determination data  
-High precision attitude data

-Alignment parameter generated by statistical calculation

Level 0 Product

Level 1 Processing

Level 1 Product

Reference Global GCP Data Base

ID	名称	世界測地系(測地成果2000)	経緯度	高度	X	Y	Z	精度
01	野村橋		緯度 43° 34' 15.6800"	経度 141° 20' 42.4190"	13系	X: 4979.264m	Y: 8845.989m	Z: 2.417m
02	野村		緯度 43° 37' 56.5310"	経度 141° 54' 37.2550"	13系	X: -4967.326m	Y: 51793.024m	Z: 148.419m
03	伊勢仁		緯度 47° 47' 03.8873"	経度 145° 0' 10.5468"	13系	X: -31173.379m	Y: 9182.842m	Z: 72.059m

# Conclusions

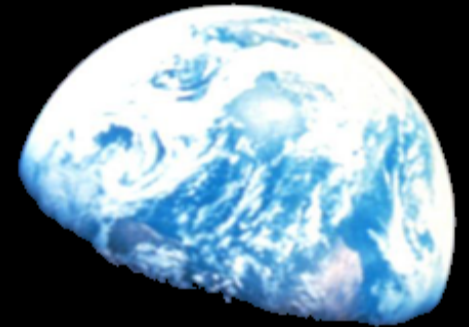
ASNARO project is an optical high resolution Earth imaging mission as a small satellite.

High performance functional layout of the Space Segment and Ground Segment is optimized and the total system is being built at the reduced costs.

ASNARO system will considerably facilitate the enlargement of space business in Japan and meet the growing Earth observation demands of the developing countries as well.

The whole concept is not only focusing for the satellite data distributions but also by providing total system including space and ground segments to the global market

Thank you for your attention



*For discussion, Please visit our booth*

# PASCO's 3 Key Technologies



## Geospatial Services (Mapping)

### Remote Sensing Survey System Engineering (GIS)

### Consultation (including Environmental Survey)

#### Ground Survey



#### Aerial Survey

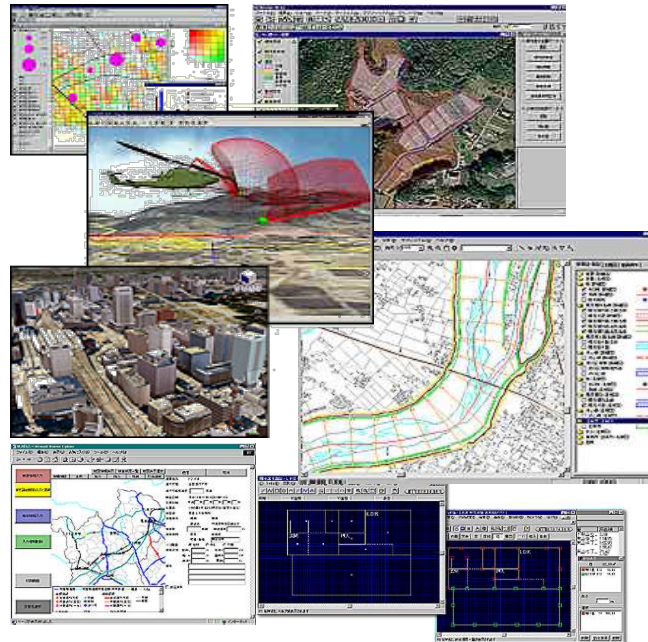
- 3D Laser Measurement System
- Multi-line & Large Format Sensors
- Hyperspectral Sensor survey etc.

#### Satellite Survey

- Optical Sensor's Survey
- SAR Sensor's Survey etc.

#### Ground Survey

- Precise Land Surveying (GPS)
- Ground Control Monuments, etc.



#### GIS Consultation

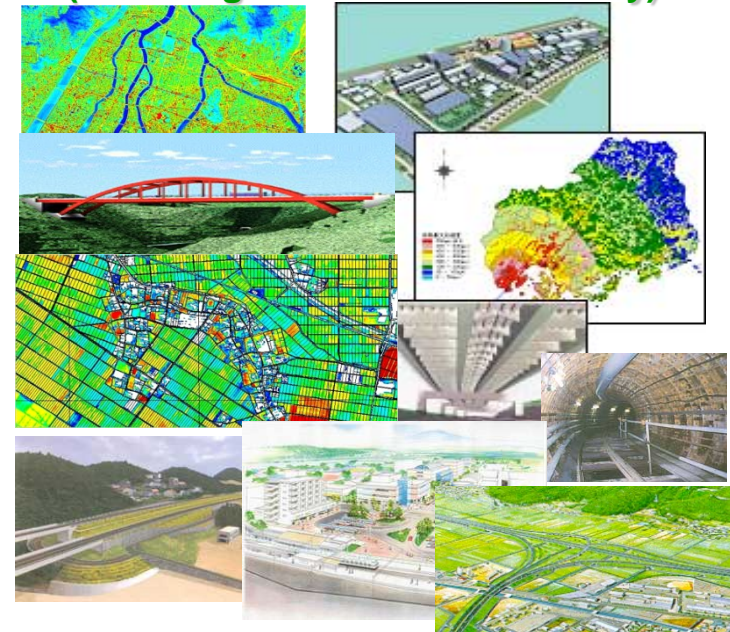
- GIS Implementation Planning
- Internet / WEB
- Integrated GIS / Corporate GIS
- Spatial Data Warehouse etc.

#### GIS Systems Development

- Systems Design
- Prototype Development
- Application Development etc.

#### GIS Software, data

- Integrated GIS System - PasCAL
- GIS data, etc.



#### Environment

- Heat Island Studies
- Forest Monitoring etc.

#### Disaster Management

- Change Detection for Earthquakes
- Landslide Survey etc.

#### Agriculture

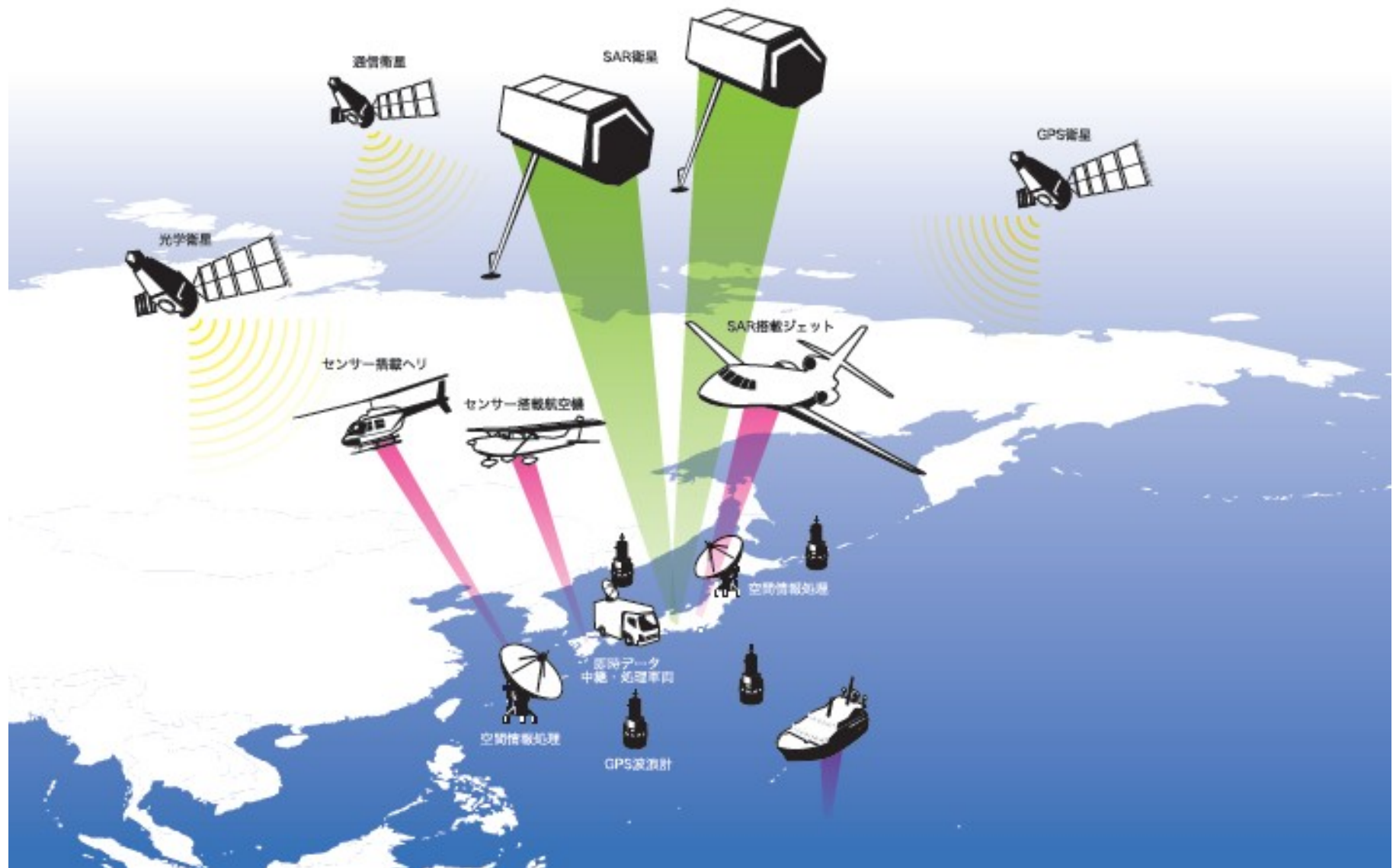
- Crop Identification
- Yield Estimation etc.

#### Urban

- Urban Planning
- Land Cover Mapping, etc.



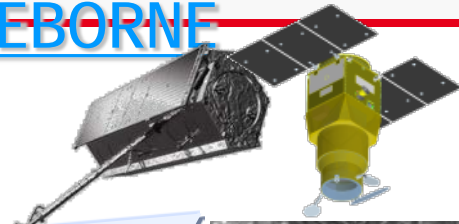
# PASCO's Sensing Technology



# PASCO's Sensing Technology

PASCO owns world's most advanced sensing technology

## SPACEBORNE



ASAR  
TerraSAR-X (TSX)

## AIRBORNE

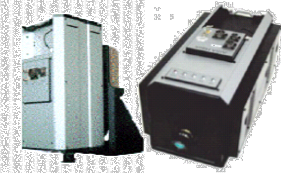
16 Airborne Sensors / Cameras

Digital Frame Camera  
[UltraCam-D (2) & UC-X (2)]



4 units

Hyperspectral Sensors (AISA)



1 units

Thermal Sensor (TABI)



1 units

## CLOSE RANGE

GPS/IMU



10 units

Multi-line Digital Sensor (ADS40)



3 units

LiDAR (ALS50)



4 units

RC30, Film Camera



3 units

REAL



MMS



Cyrax



RIEGL

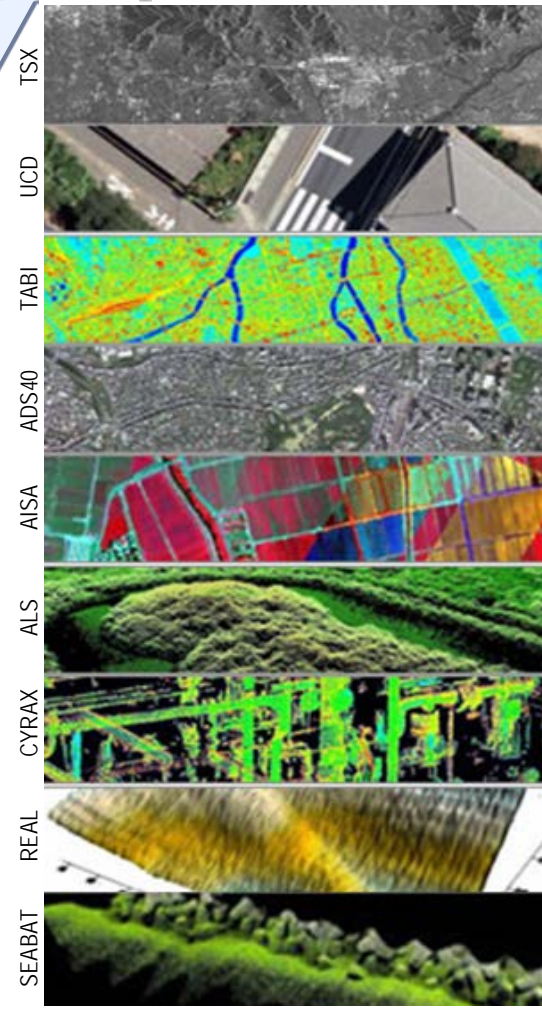


PS-Cruiser

SEABAT



## SEABOTTOM



TSX

UCD

TABI

ADS40

AISA

ALS

CYRAX

REAL

SEABAT