



# optemis



## EMERGENCY OBSERVATION CONSTELLATION PLANNING PLATFORM

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GISTDA Satellite Operation Center, Thailand

January 24<sup>th</sup> 2018, Sentinel Asia JPTM, Taipei



# GISTDA (Geo-Informatics and Space Technology Development Agency)

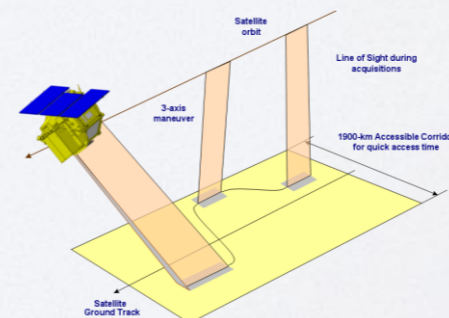
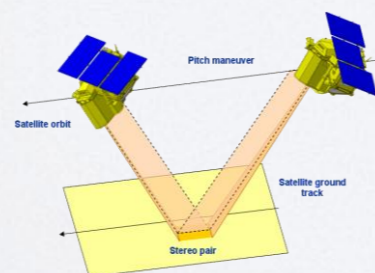
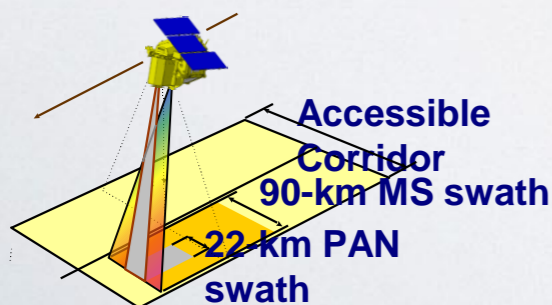
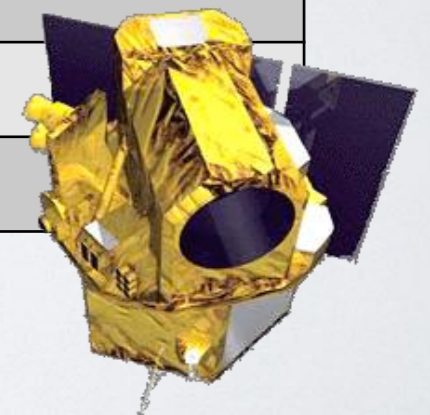
## THAICHOTE (THEOS) Earth Observation Satellite



- Optical Payload  
 2m Panchromatic, 15m MS  
 (22km swath)      (90km swath)
- 'Agile' satellite with high fine pointing accuracy
- Sun-synchronous orbit,  
 14 orbits/days, 4 access/day  
 over Thailand

THEOS-2 (50cm resolution) TBL 2020  
 THEOS-3 TBL 2021

THAICHOTE (THEOS)	
<i>Mission Type</i>	<i>Earth Observation</i>
<i>Launch date</i>	Oct 2008
<i>Mass</i>	715 kg
<i>Power</i>	840 W
<i>Orbit</i>	<i>LEO, Sun-synchronous, Polar</i>
<i>Inclination</i>	98.78 deg
<i>Altitude</i>	822 km
<i>LTAN</i>	10:30
<i>Orbital period</i>	101.4 minutes



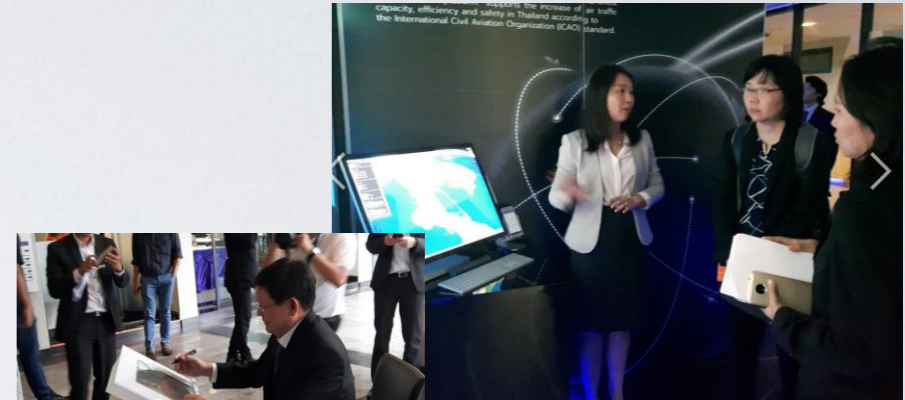


GISTDA ACADEMY

# STRATEGIC AND OPERATION AEROSPACE RESEARCH



# SOAR





# optemis

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[**O**peration **P**lanning Tool for **E**arth-observation **MIS**sion]



... satellite resources in space

**How to 'OPTIMIZE' ...**

... processes, response time

... workflow

... data utilization



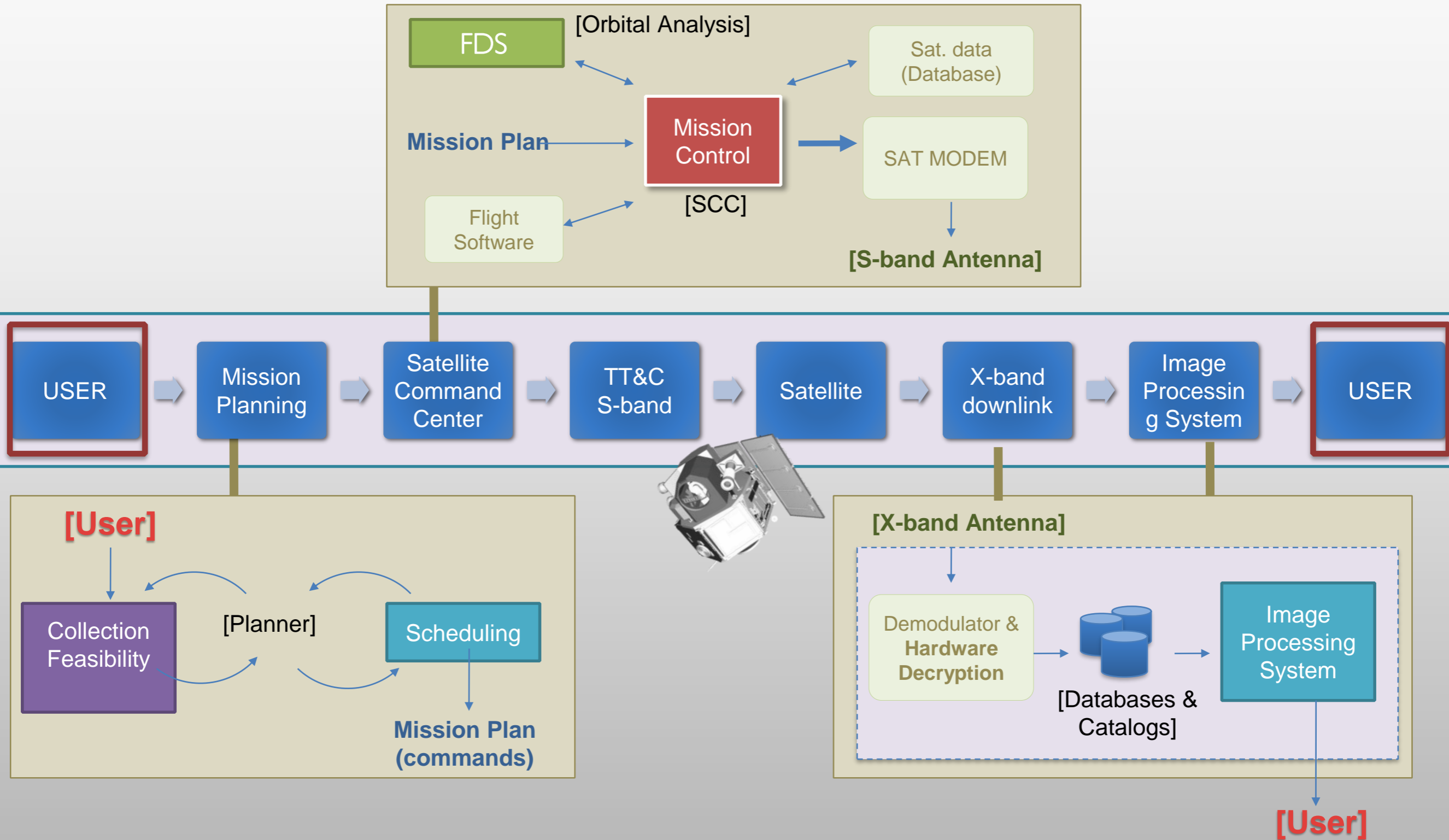
... data provider up to end users?

**How to 'SYNERGIZE' ...**

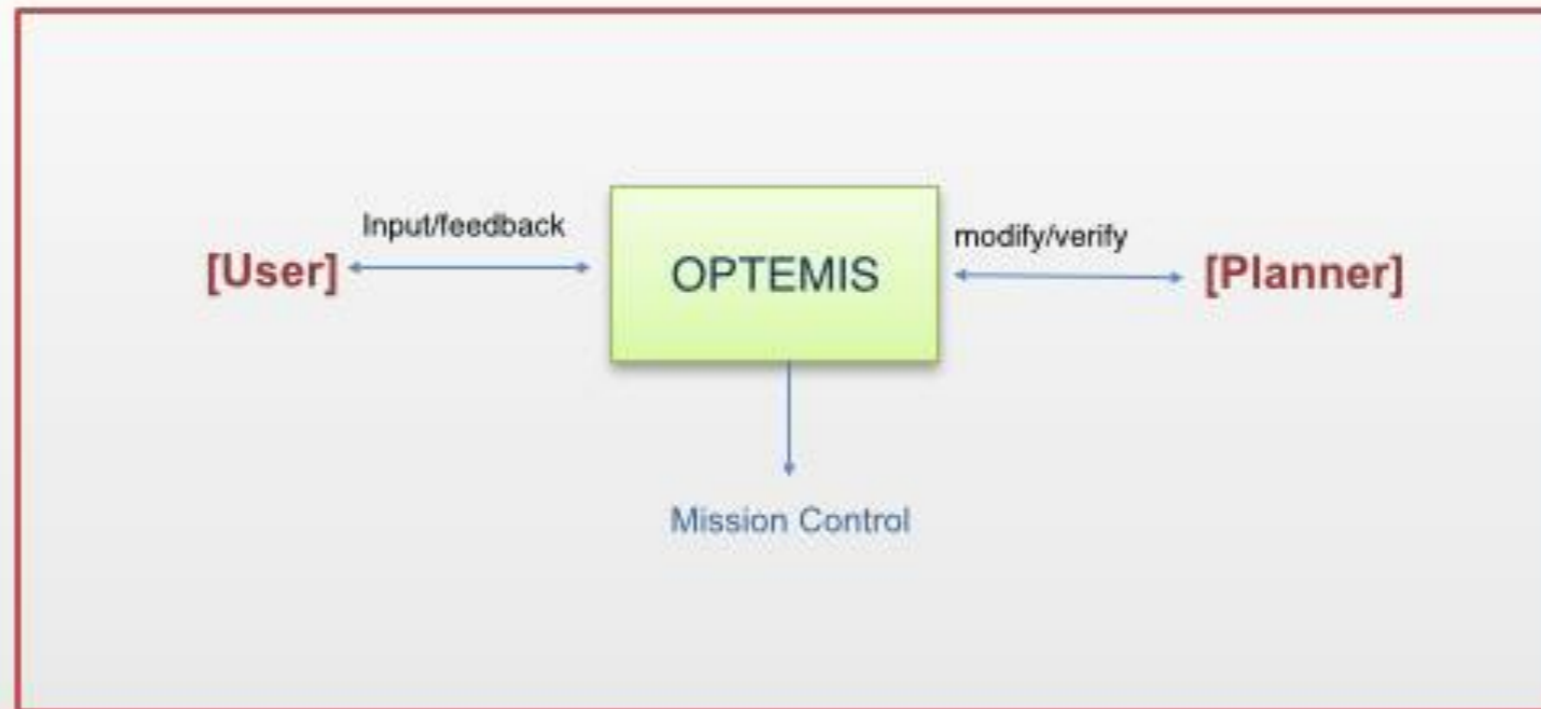
... agencies, organizations

... international collaborations

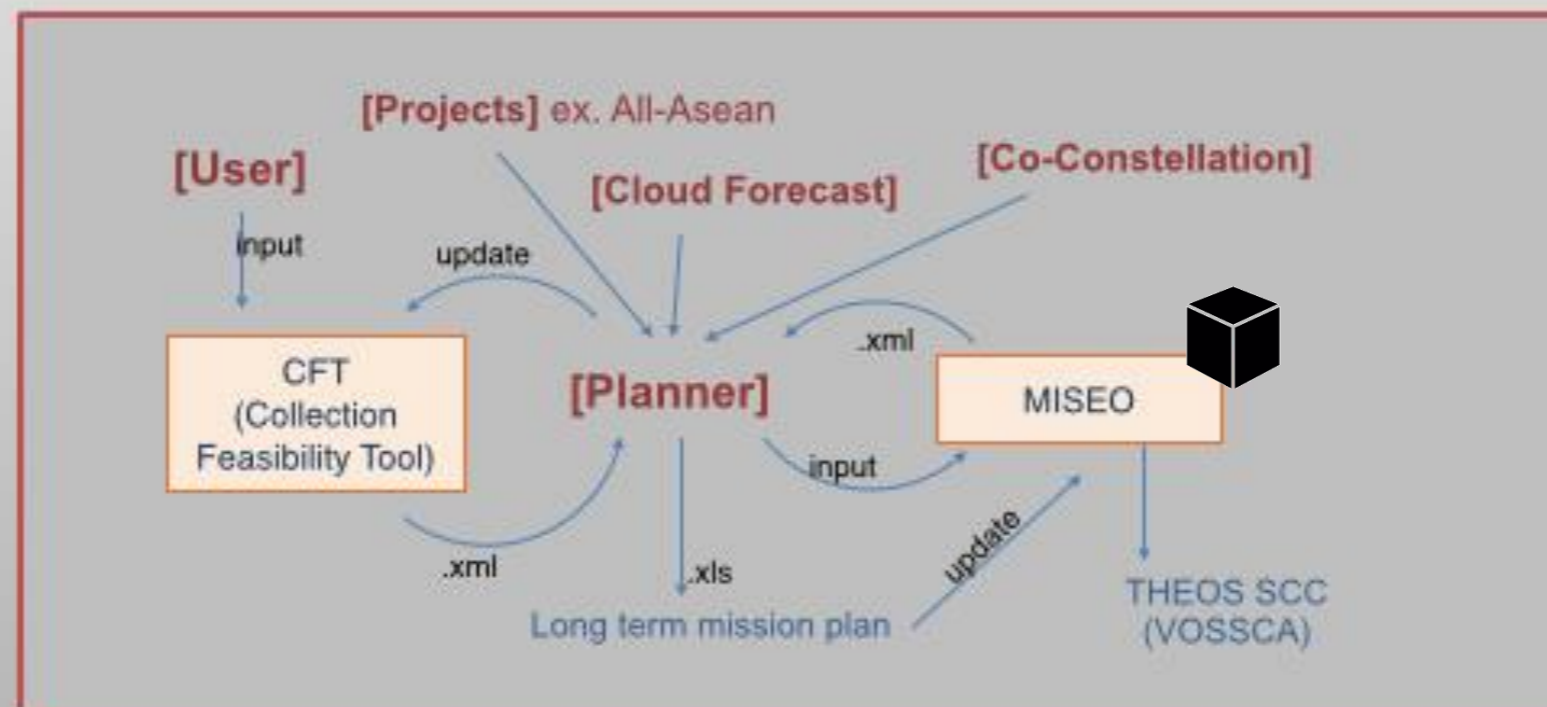
# Earth-Observation Satellite Operation



24 HOURS from requesting to data product



Uncluttering the Workflow

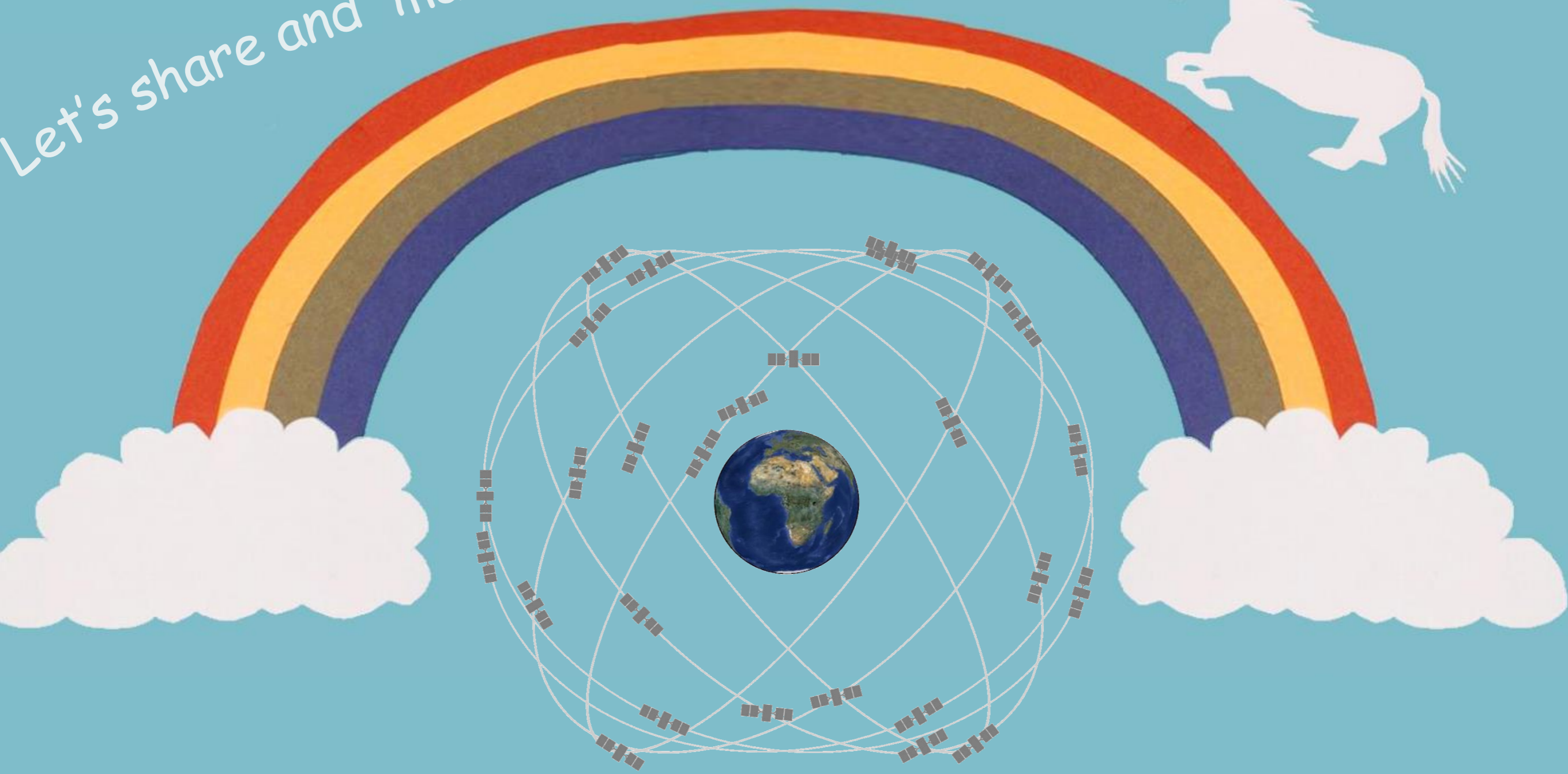








Let's share and make a CONSTELLATION!

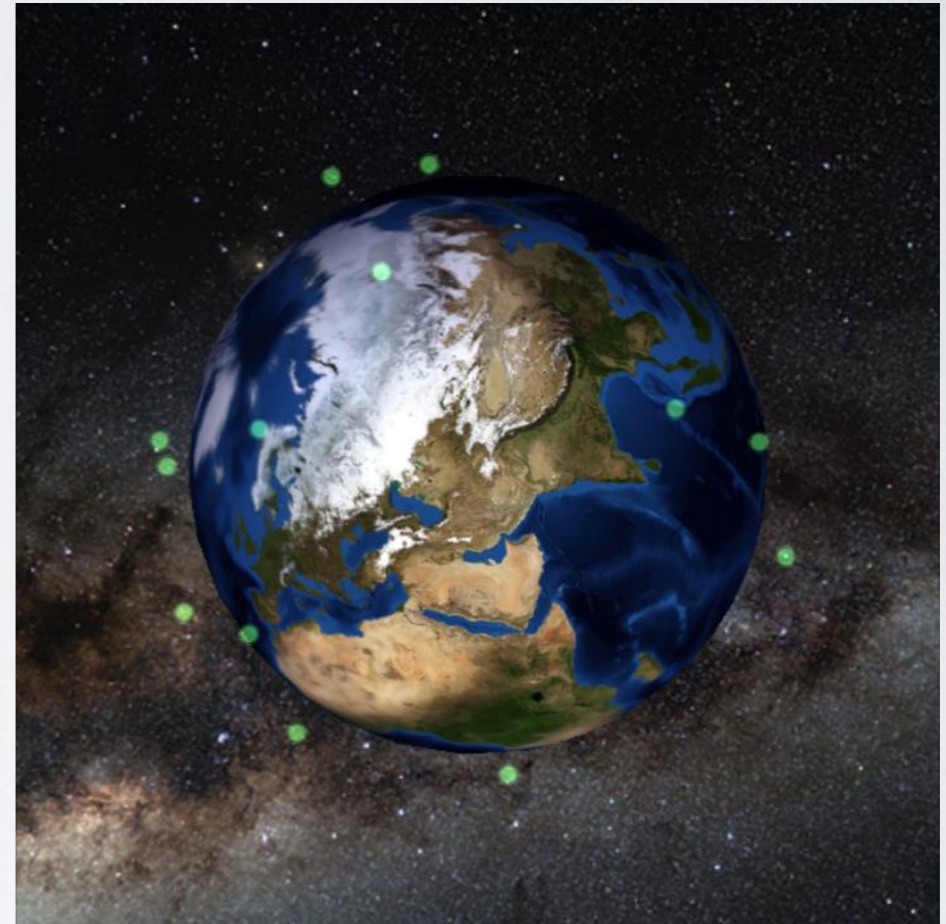


IDEAL



Homogeneous  
Coordinate

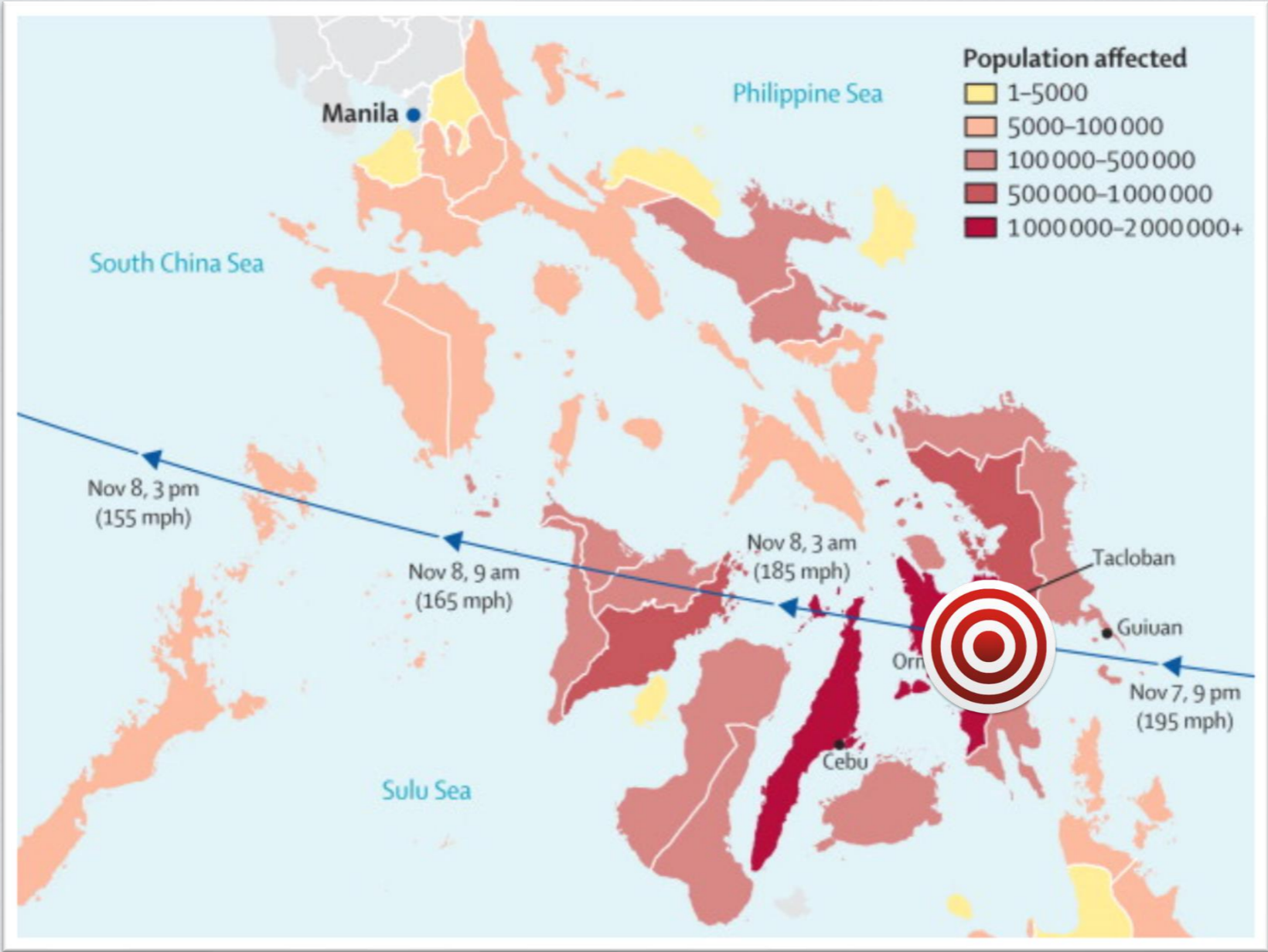
REALITY



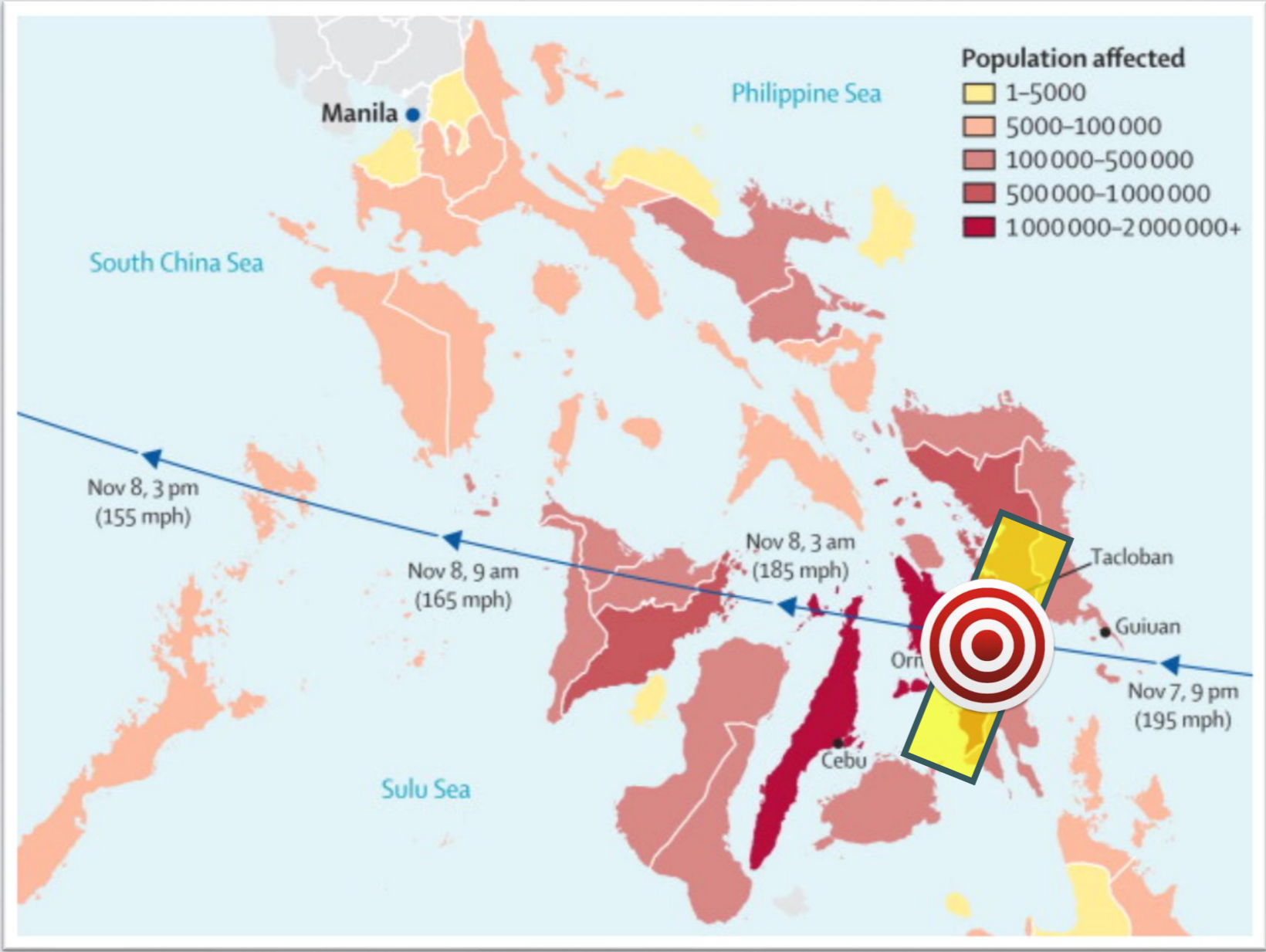
Non-homogeneous  
Non-coordinate



# Example: Disaster Acquisition Request

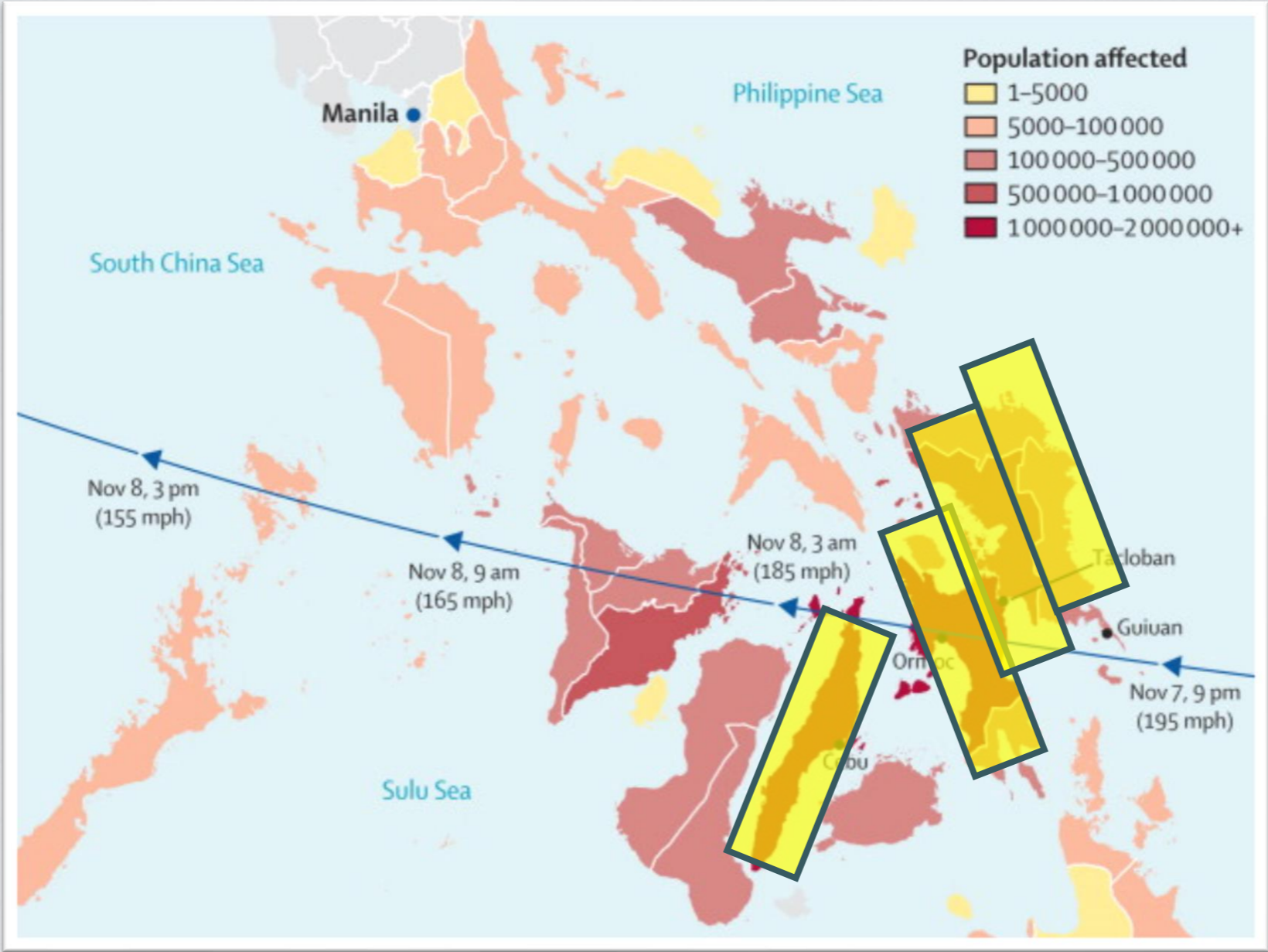


# Example: Disaster Acquisition Request





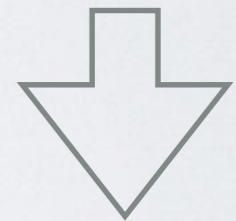
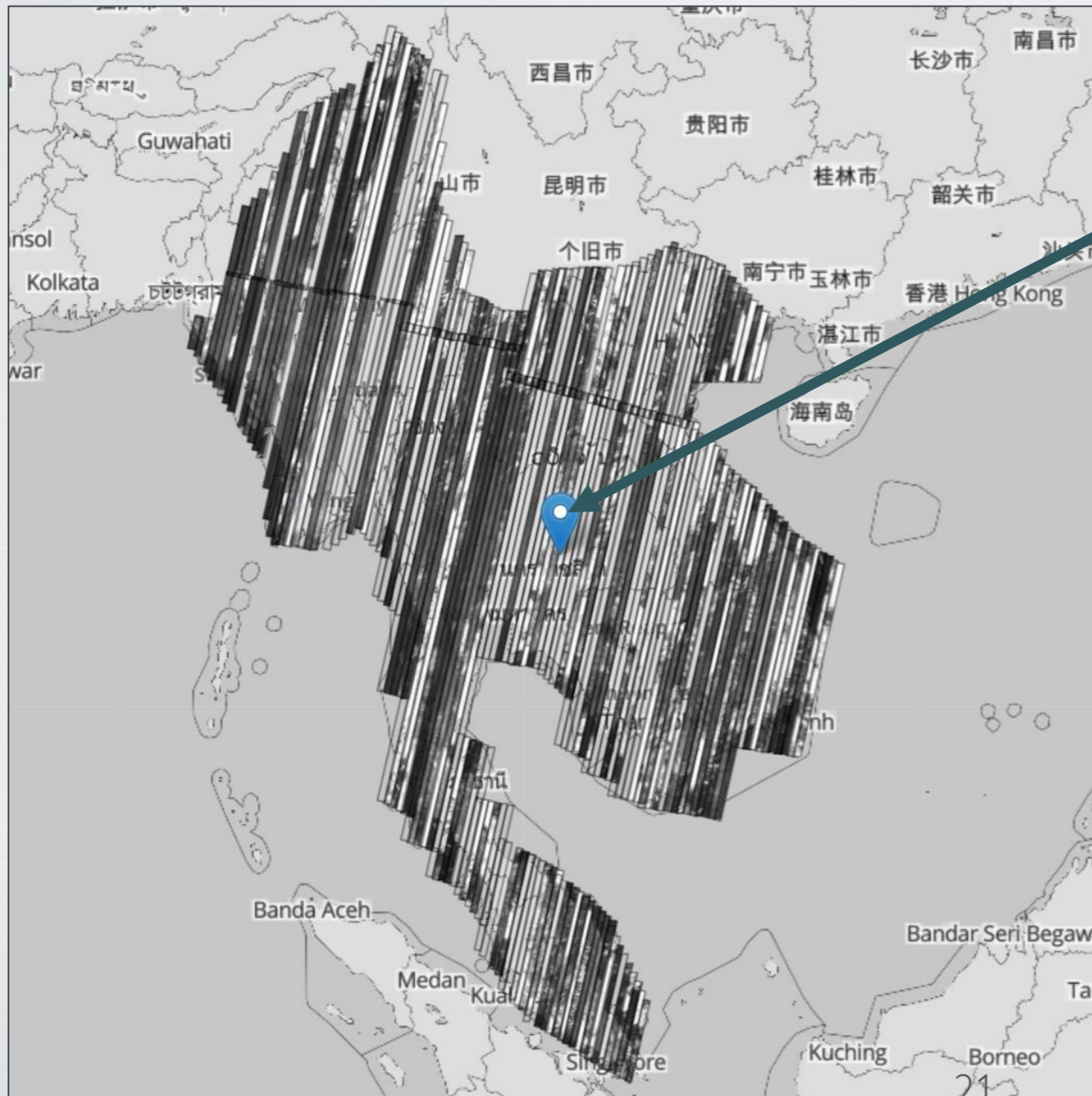
# Example: Disaster Acquisition Request



# Examples...

Requirements:

2m Multispectral image every 15 days...

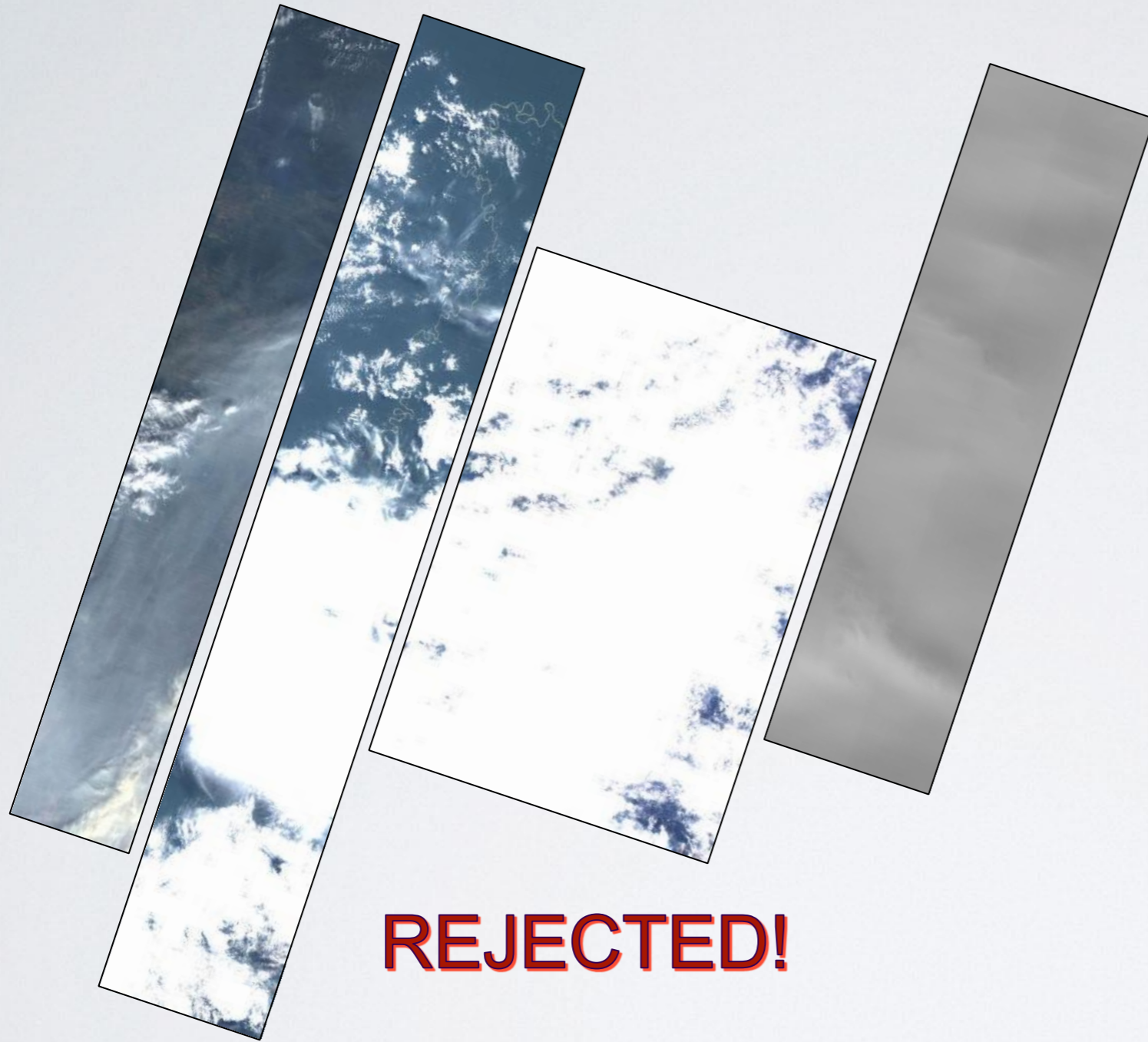


Acquisition schedule

The screenshot shows the 'Current Plan' interface of the Optemis software. It features a sidebar with navigation options like 'Polygon', 'Current Plan', 'New Plan', etc. The main area displays a table with columns for 'Date' and 'Plan'. The table lists acquisition dates from 02-Nov-2014 to 16-Jan-2015, with corresponding plan identifiers such as '11.VNM.T.01.10'. At the bottom, there are some Thai text labels: 'พื้นที่ ครอบคลุม' and 'พื้นที่ ครอบคลุม'.

Date	Plan
02-Nov-2014	11.VNM.T.01.10
12-Nov-2014	11.VNM.T.01.5, 11.VNM.T.01.9
14-Nov-2014	01.MMR.T.01.2, 01.MMR.T.01.1
17-Nov-2014	11.VNM.T.01.4, 11.VNM.T.01.6
20-Nov-2014	01.MMR.T.01.6
25-Nov-2014	02.MMR.T.02.2, 01.MMR.T.01.9, 01.MMR.T.01.8, 01.MMR.T.01.7, 01.MMR.T.01.5, 01.MMR.T.01.4
30-Nov-2014	01.MMR.T.01.3
16-Jan-2015	01.MMR.T.01.10
02.MMR.T.02.1, 02.MMR.T.02.3, 02.MMR.T.02.4, 02.MMR.T.02.3, 02.MMR.T.02.6, 02.MMR.T.02.7, 02.MMR.T.02.8, 02.MMR.T.02.9, 02.MMR.T.02.10, 02.MMR.T.02.11, 02.MMR.T.02.12	
02.MMR.T.02.13, 11.VNM.T.01.3, 11.VNM.T.01.2, 11.VNM.T.01.3, 11.VNM.T.01.4, 11.VNM.T.01.5, 11.VNM.T.01.6, 11.VNM.T.01.7, 11.VNM.T.01.8, 05.MMR.T.05.1, 05.MMR.T.05.2	
05.MMR.T.05.3, 05.MMR.T.05.4, 11.VNM.T.01.1, 11.VNM.T.01.2, 11.VNM.T.01.3	



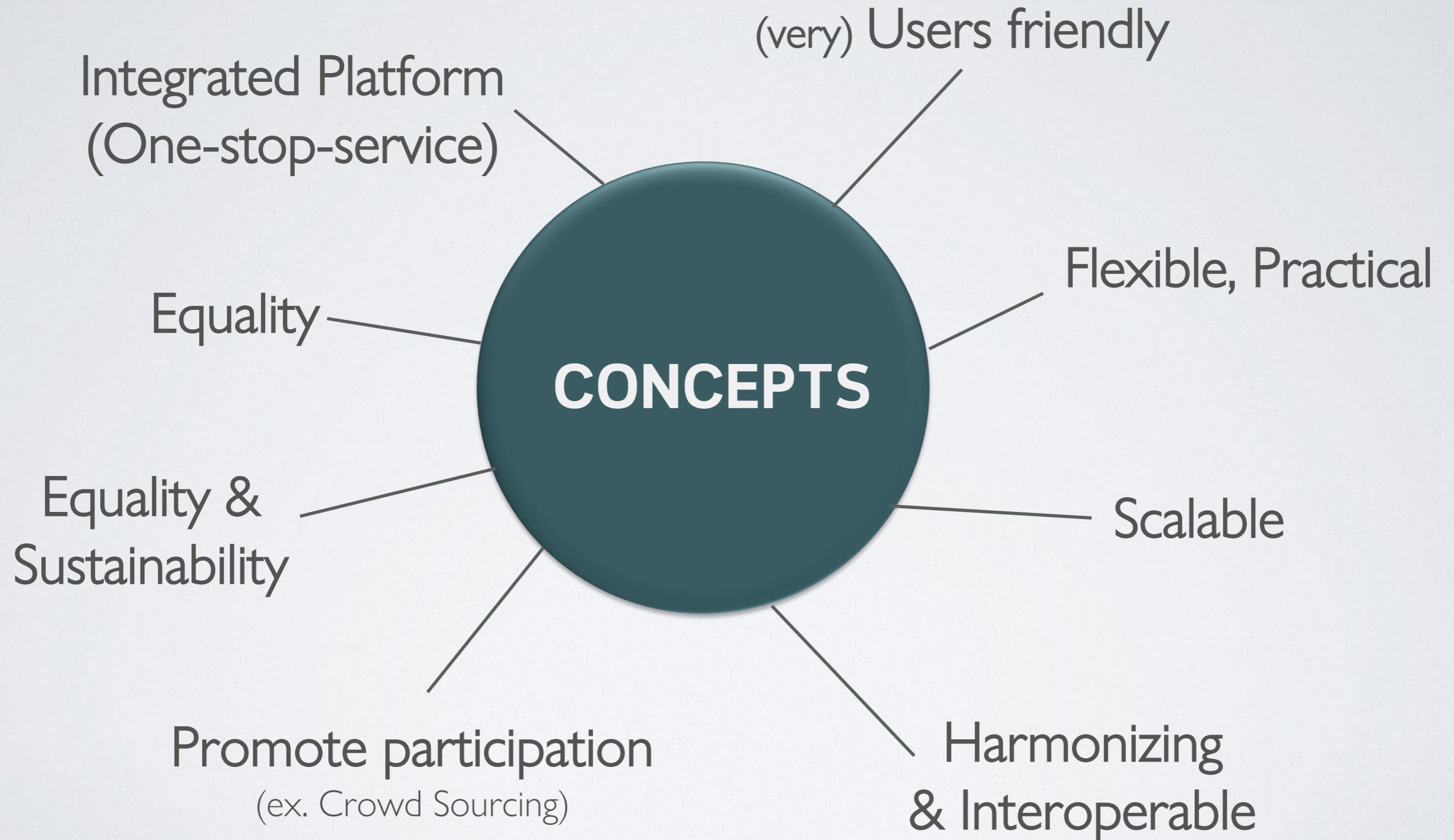


**REJECTED!**

User has downloaded, but could not be use because of cloud coverage.

## Objectives:

- To develop a platform to synergize the users, members, providers and coordinator.
- To optimize the resources





# Emergency Observation Flow

Plan for Sentinel Asia STEP3, SA Secretariat  
2<sup>nd</sup> SA Steering Committee, Jan 2017 Bangkok

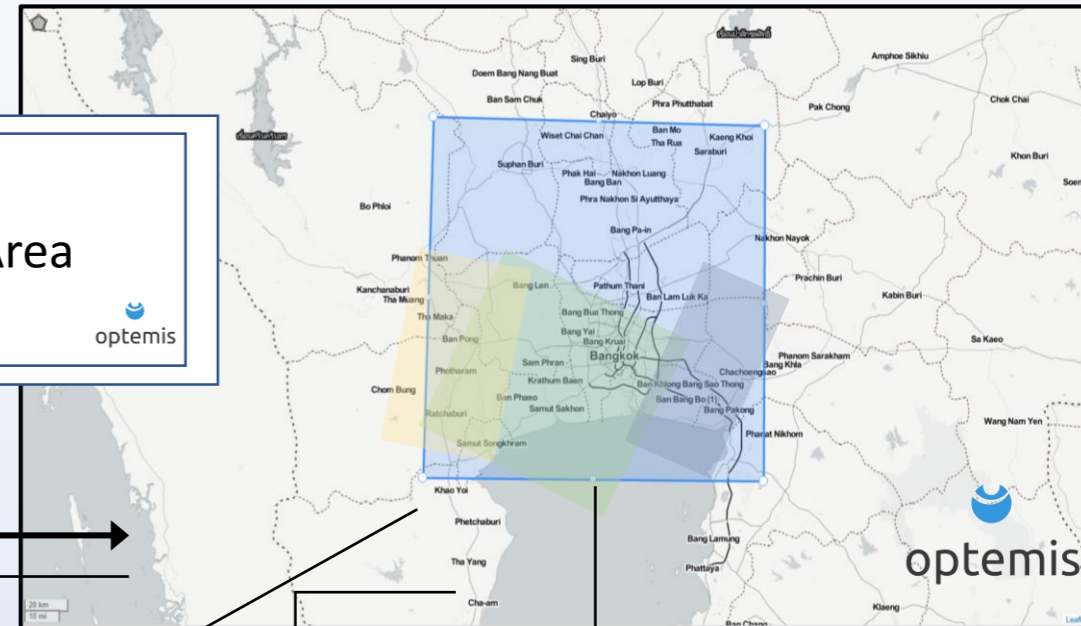


# DATA PROVISION - ONLINE SERVICES FRAMEWORK

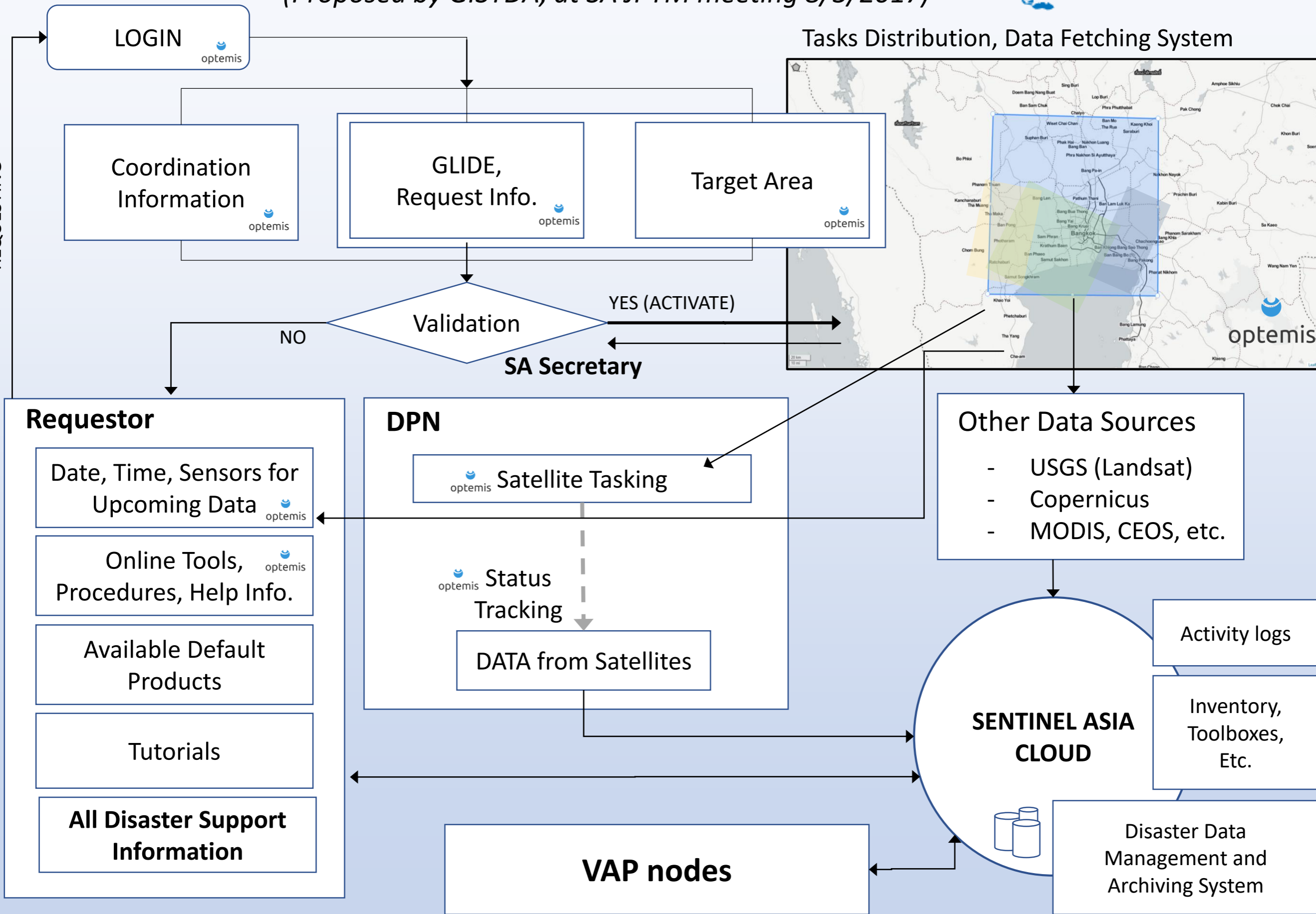
(Proposed by GISTDA, at SA JPTM meeting 8/3/2017)



## Tasks Distribution, Data Fetching System



REQUESTING



**Requestor**

- Date, Time, Sensors for Upcoming Data
- Online Tools, Procedures, Help Info.
- Available Default Products
- Tutorials
- All Disaster Support Information

**DPN**

- Satellite Tasking
- Status Tracking
- DATA from Satellites

**Other Data Sources**

- USGS (Landsat)
- Copernicus
- MODIS, CEOS, etc.

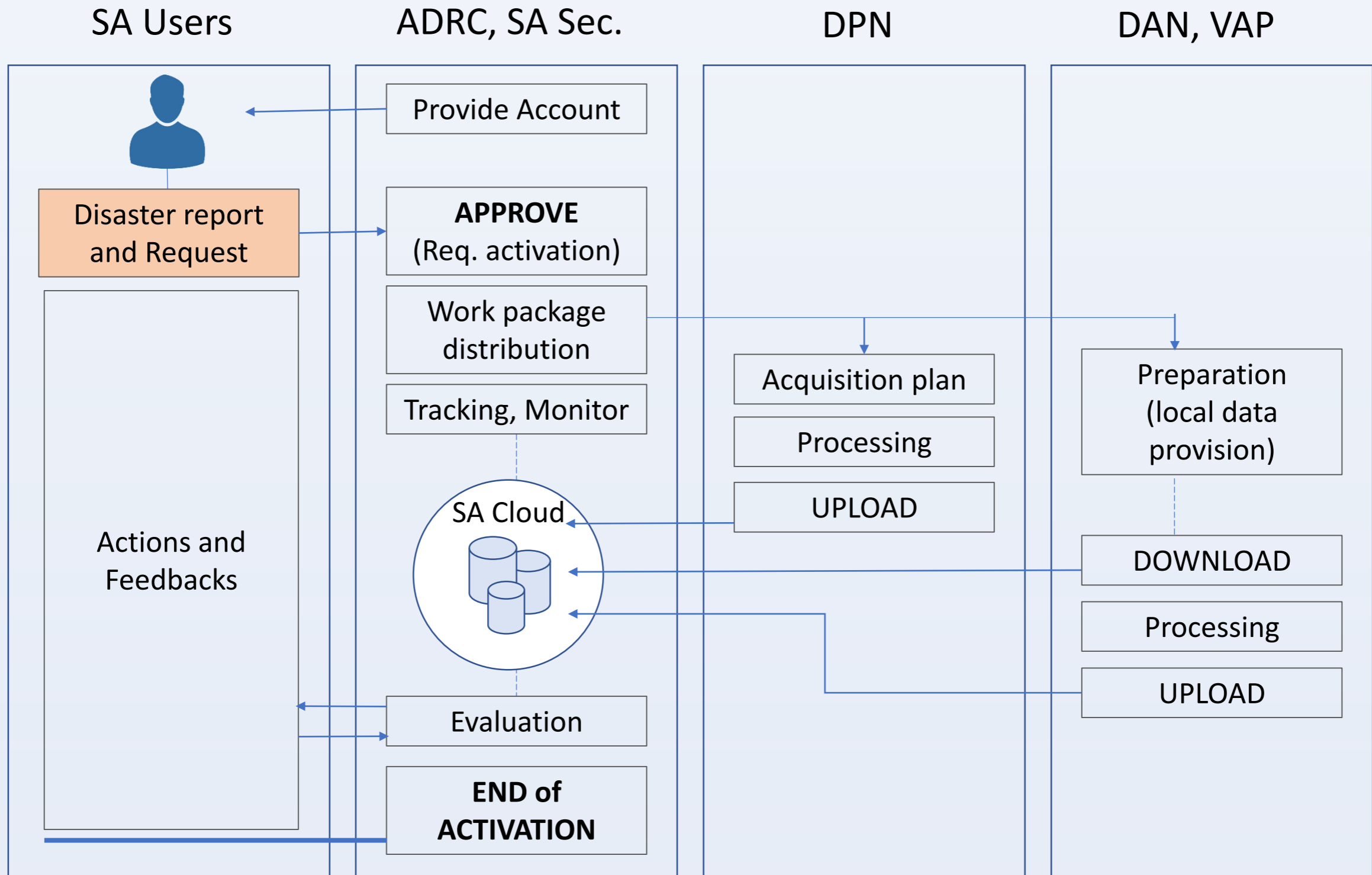
**SENTINEL ASIA CLOUD**

- Activity logs
- Inventory, Toolboxes, Etc.
- Disaster Data Management and Archiving System

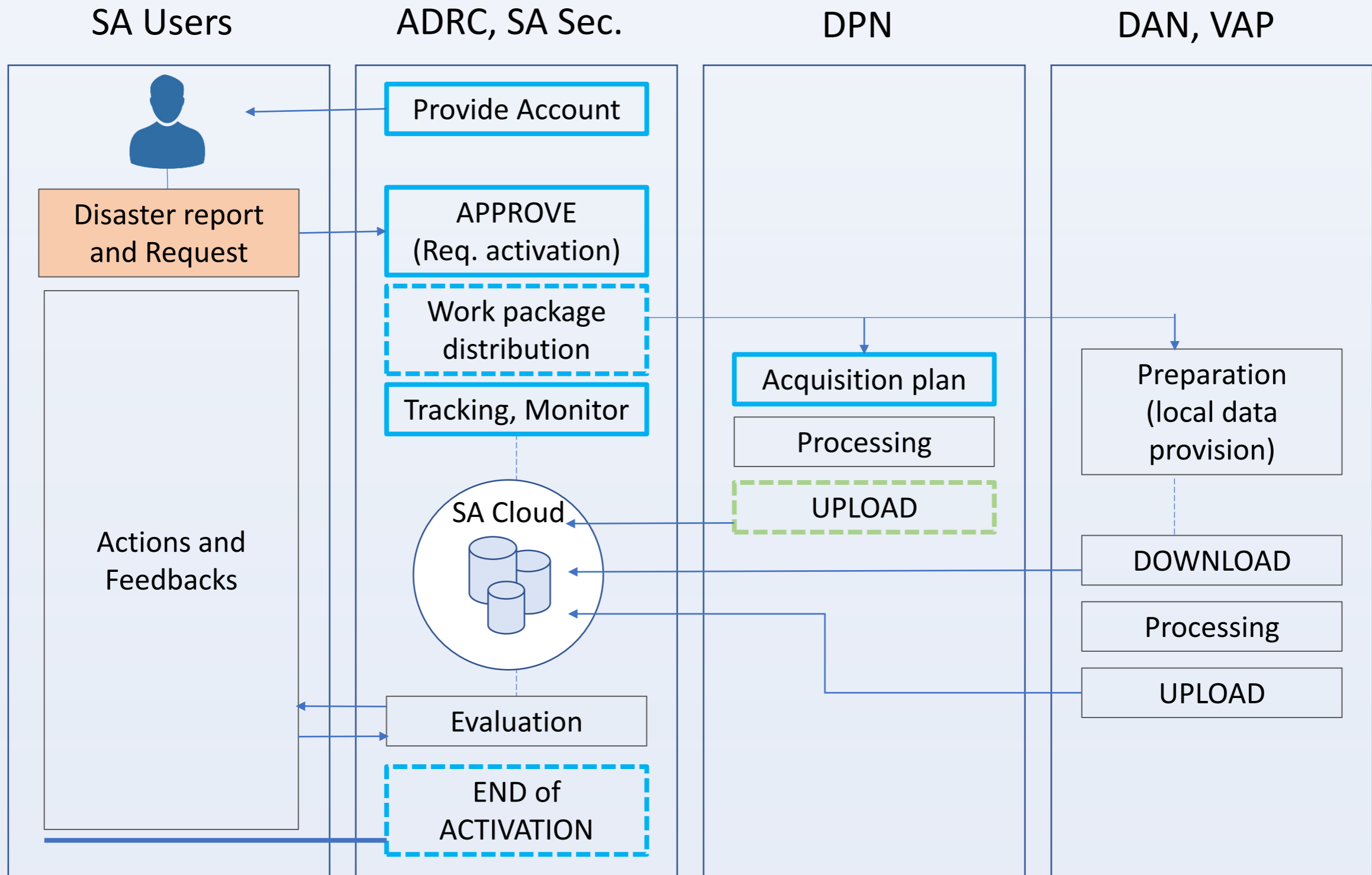
**VAP nodes**



# SA Procedures and Modules



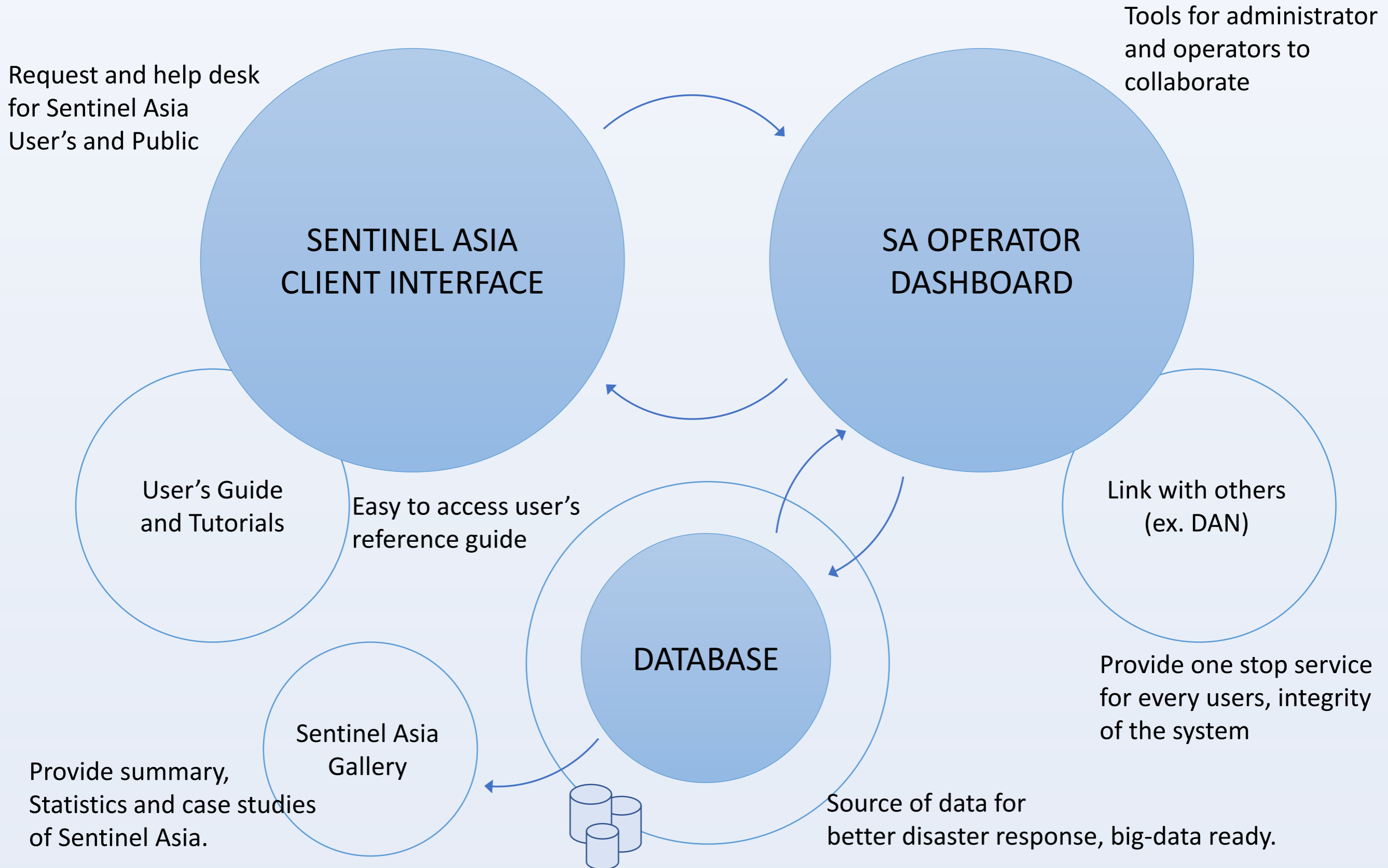
# SA Procedures and Modules ( optemis ready)





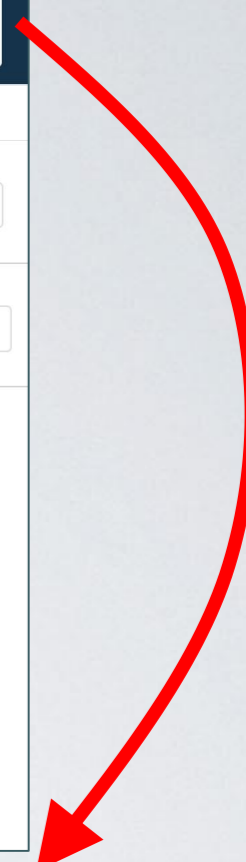
# OVERVIEW

## Emergency Request Platform



# Emergency Request User's Interface

The screenshot displays the 'Emergency Request User's Interface' for Sentinel-1A. It features a map of Southeast Asia with a blue box highlighting the Yangon region. To the right, the 'Send Request' form is visible, including sections for '1 Select a satellites' and '2 Feasibility Data'. The form includes fields for 'START' (15/11/2017) and 'END' (16/11/2017), a 'TYPE OF DISASTER' dropdown menu, and satellite selection options under 'OPTICAL' and 'SAR'.



အရေးပေါ်လေ့လာသူများတောင်းဆိုခြင်း (EOR) ပုံစံ

အမည်\* Panupat HORMA  
အီးမေးလ်လိပ်စာ\* panupat.h@jptmember.or.th  
ဖုန်းနံပါတ်\* 886229930  
အသေးစိတ်

အဆိုပါလေ့လာသူအဖွဲ့အစည်းအဖွဲ့ဝင်များ၏စီမံခန့်ခွဲသူ: End-user

မြန်မာဘာသာ (Burmese)

แบบฟอร์มคำขอใช้ภาพถ่ายดาวเทียมฉุกเฉิน (EOR)

ชื่อ-นามสกุล\* Panupat HORMA  
อีเมล\* panupat.h@gistda.or.th  
เบอร์\* +66886229930  
องค์กร\* JPT member

รายละเอียด

ปลายทางผู้รับข้อมูลที่เกี่ยวข้อง  
 กิจพาณิชย์  
 วัตถุประสงค์ส่งให้ทหาร  
 วัตถุประสงค์ในการขอถ่าย  
 ประเภทภัยพิบัติ\*

กำหนดขอบเขตเวลาในการอัพโหลดข้อมูลไปยัง SA WEB-portal\*  
 ภายใน 24 ชั่วโมง\*  
 ไม่เกิน 4 วัน  
 ไม่เกิน 10 วัน

วันเริ่ม\* 14/11/2017

ภาษาไทย (Thai)

Mẫu Yêu cầu Khắc phục Khiếu Nại (EOR)

Tên\* Satit Bumpenbun  
E-mail\* satit.bum@gistda.or.th  
Điện thoại\* 0982514865  
Cơ quan\* JPT member

Chi tiết

Người dùng cuối theo kế hoạch của thông tin quan sát được  
 Thăm hỏi  
 Thông tin sẽ được cung cấp

Mục đích của Yêu cầu\*  
 -- Select --

Loại thiên tai\*  
 -- Select --

Giới hạn thời gian để tải thông tin lên cổng Web SA\*  
 Dưới 24 giờ\*  
 Không quá 4 ngày  
 Không quá 10 ngày

Ngày bắt đầu\* Ngày cuối\*

Tiếng Việt (Vietnamese)

EMERGENCY OBSERVATION REQUEST (EOR) FORM

Name\* Panupat HORMA  
Email\* panupat.h@gistda.or.th  
Phone\* 886229930  
Organization\* JPT member

Details

Planned end-user of the observed information  
 Disaster  
 The information will be provide to other relevant organization/s.

Purpose of the Request\*  
 -- Select --

Type of Disaster\*  
 -- Select --

Time limit for information to be uploaded on the SA WEB-portal\*  
 Less than 24 hours\*  
 Not exceed 4 days  
 Not exceed 10 days

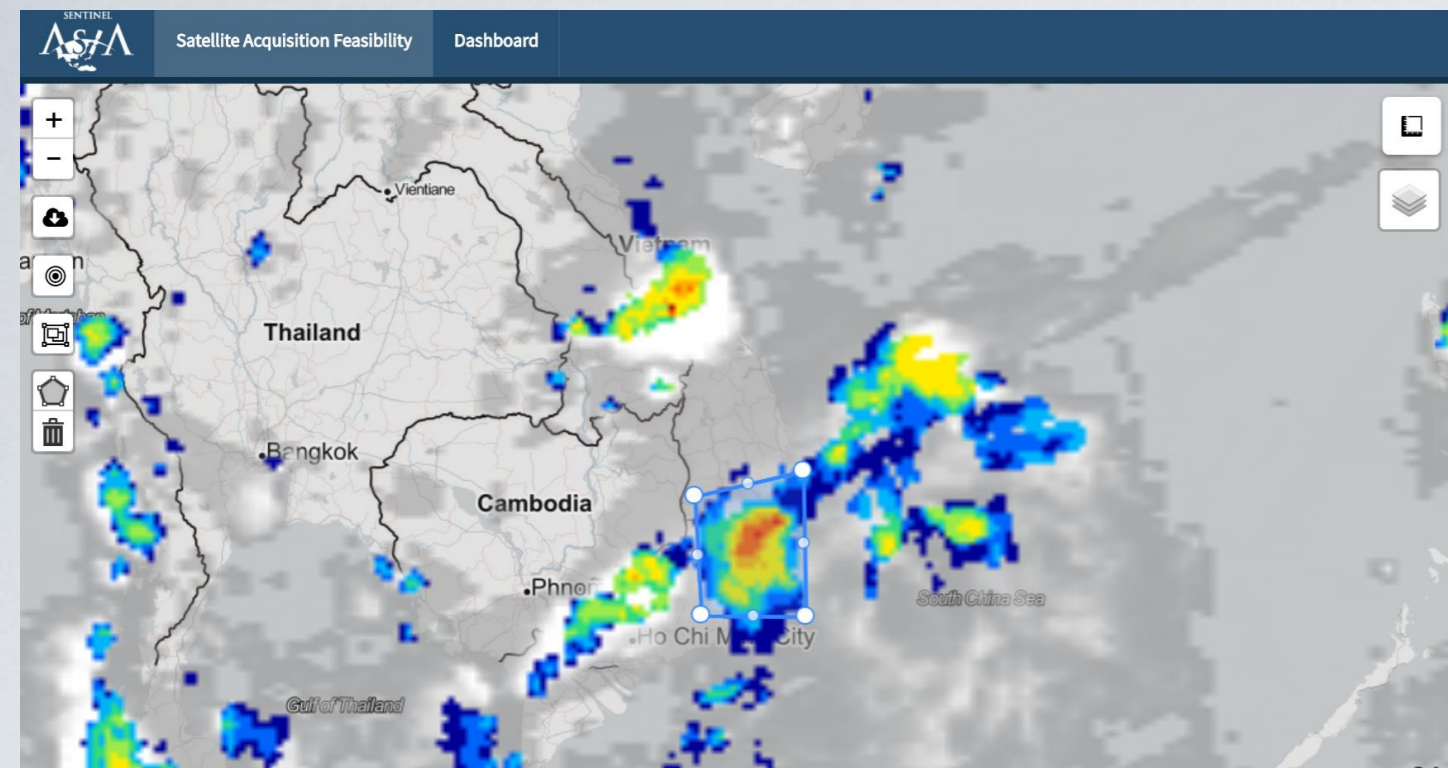
End Date\* 15/11/2017

English

## Multi-Language EOR Form



# Emergency Request User's Interface : Decision Aid Layers



Send Request  
Emergency Request Form

1 Select a satellites      2 Feasibility Data

START: 15/11/2017      END: 16/11/2017

TYPE OF DISASTER: All x

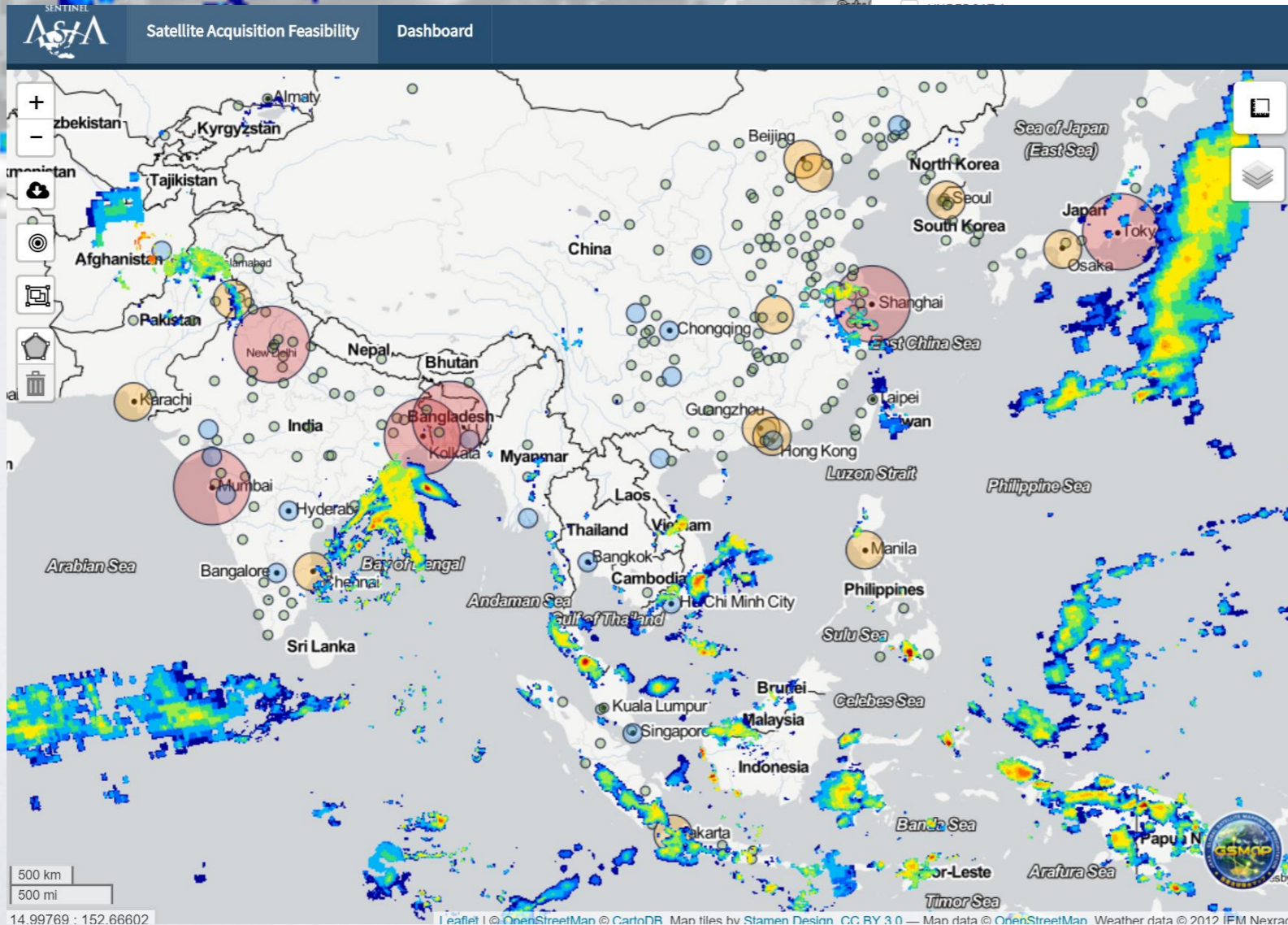
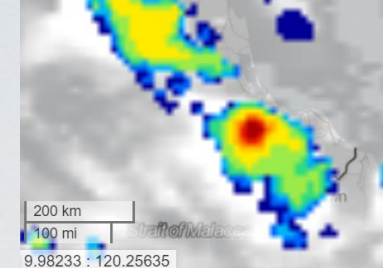
OPTICAL

- Low Resolution
  - AQUA
  - NPP
  - RESOURCESAT-2
  - TERRA
- Medium Resolution
  - LANDSAT-8
  - THAICHOTE

Cloud + Rain  
Forecast from GSMAP



# GSMAP



Send Request  
Emergency Request Form

1 Select a satellites      2 Feasibility Data

START: 15/11/2017      END: 16/11/2017

TYPE OF DISASTER: All x

OPTICAL

- Low Resolution
  - AQUA
  - NPP
  - RESOURCESAT-2
  - TERRA
- Medium Resolution
  - LANDSAT-8
  - THAICHOTE
  - VNREDSAT-1
- High Resolution
  - DUBAISAT-2
  - SENTINEL-2A

SAR

- ALOS-2
- SENTINEL-1A

▶ Compute     Check All    Clear

Rain +  
Populated Zone




# Emergency Request User's Interface : DEMONSTRATION

SENTINEL ASIA

Satellite Acquisition Feasibility Dashboard

User's Guide Logout

Draw polygon to send a request !  
Click  to draw polygon.

1 Select a satellites 2 Feasibility Data

START 15/11/2017 END 16/11/2017

TYPE OF DISASTER All x

OPTICAL

- Low Resolution
  - AQUA
  - NPP
  - RESOURCESAT-2
  - TERRA
- Medium Resolution
  - LANDSAT-8
  - THAICHOTE
  - VNREDSAT-1
- High Resolution
  - DUBAISAT-2
  - SENTINEL-2A

▶ Compute  Check All  Clear

SAR

- ALOS-2
- SENTINEL-1A

300 km 200 mi

15.56475 : 111.26953

Leaflet | © OpenStreetMap © CartoDB, Map tiles by Stamen Design, CC BY, 3.0 — Map data © OpenStreetMap



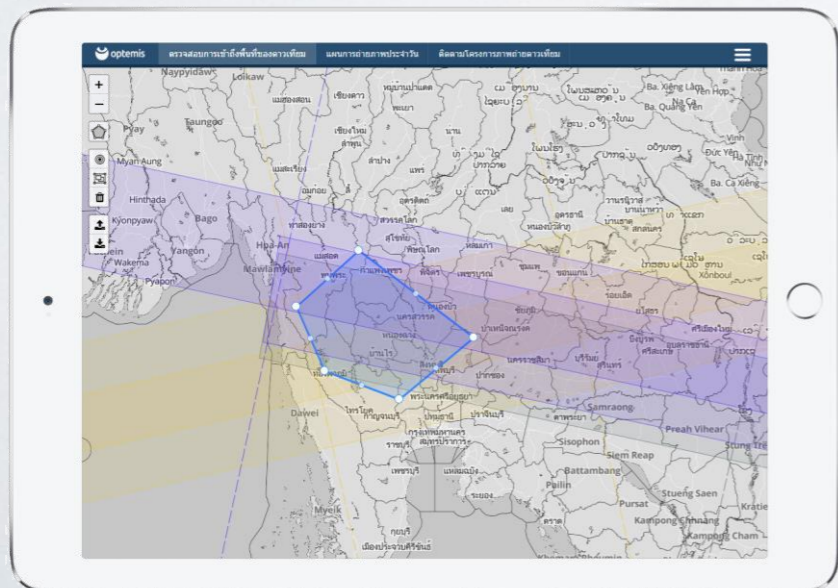
# Emergency Request User's Interface : Acquisition Feasibility

**SENTINEL ASIA** Satellite Acquisition Feasibility Dashboard User's Guide Logout

**Send Request**  
Emergency Request Form

1 Select a satellites      2 Feasibility Data

Satellite	Request ID	Start Time (UTC)	End Time (UTC+07:00)
RESOURCESAT-2	1	15/11/17 - 03:54:00 UTC	15/11/17 - 10:54:00 (UTC+07:00)
	2	17/11/17 - 03:36:00 UTC	17/11/17 - 10:36:00 (UTC+07:00)
THAICHOTE	1	15/11/17 - 04:06:30 UTC	15/11/17 - 11:06:30 (UTC+07:00)
	2	17/11/17 - 03:43:00 UTC	17/11/17 - 10:43:00 (UTC+07:00)
VNREDSAT-1	1	15/11/17 - 04:06:30 UTC	15/11/17 - 11:06:30 (UTC+07:00)
	2	17/11/17 - 03:43:00 UTC	17/11/17 - 10:43:00 (UTC+07:00)



Satellite accessible time can be estimate, so that every users, DAN, VAP, Requestors are able to know exactly when they will get the images.

Playform can be used remotely with minimal internet connection.

Sentinel Asia mobile platform



# Coordinator Dashboard

SAR Request Management dashboard showing a table of requests with columns for WORK ORDER, ORDER ID, DATE/TIME, SATELLITE, AREA, STATUS, PLANNED, TYPE, QTY, Created At, and Tool. The table contains three entries, each with a map view of the request area.

Manage Emergency Request dashboard showing Requestor Information (Name, Email, Phone, Organization) and Request Management (Start Date, End Date, Select DPN, Select DAN).

Acquisition requests management

Create an Account dashboard showing a form for user registration with fields for Name, Phone Number, Email, Password, Password Confirmation, Organization, and Role. Below the form is a table for Allowed Modules & Permissions.

Modules	Access	Read	Write	Edit	Delete
Constellation Parameter	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SA Members	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Users Account	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Acquisition Requests	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DPN Dashboard	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
DAN Dashboard	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SA User's management

Constellation Parameters dashboard showing a table of satellite parameters with columns for NORAD ID, SATELLITE NAME, SWATH, FOV/2, NADIR, SAR, PADDING L, PADDING R, ANGLE, HEX COLOR, STATUS, and TOOLS.

NORAD ID	SATELLITE NAME	SWATH	FOV/2	NADIR	SAR	PADDING L	PADDING R	ANGLE	HEX COLOR	STATUS	TOOLS
25994	TERRA	-	1165	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-	-	-	#4000FF	Active	<input type="checkbox"/> <input type="checkbox"/>
27424	AQUA	-	1165	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-	-	-	#01740F	Active	<input type="checkbox"/> <input type="checkbox"/>
33396	THAICHOTE	22	-	<input type="checkbox"/>	<input type="checkbox"/>	-	-	30	#000000	Active	<input type="checkbox"/> <input type="checkbox"/>
37387	RESOURCESAT-2	740	370	<input type="checkbox"/>	<input type="checkbox"/>	-	-	26	#F00000	Active	<input type="checkbox"/> <input type="checkbox"/>
37849	NPP	-	1530	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-	-	-	#FFC40F	Active	<input type="checkbox"/> <input type="checkbox"/>
39084	LANDSAT-8	-	925	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-	-	-	#04B404	Active	<input type="checkbox"/> <input type="checkbox"/>
39160	VNREDSAT-1	17.5	-	<input type="checkbox"/>	<input type="checkbox"/>	-	-	30	#F44336	Active	<input type="checkbox"/> <input type="checkbox"/>
39419	DUBAISAT-2	12.2	6.1	<input type="checkbox"/>	<input type="checkbox"/>	-	-	30	#00E6FF	Active	<input type="checkbox"/> <input type="checkbox"/>
39634	SENTINEL-1A	-	125	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	-	323	20	#0000FF	Active	<input type="checkbox"/> <input type="checkbox"/>

Constellation Management



Sentinel Asia mobile





# DEMONSTRATION

Optimized co-constellation mission planning algorithm,  
for disaster response. (meta-heuristic optimization, simulated annealing)

 Update TLEs  Kill threads



Requests Optimizer

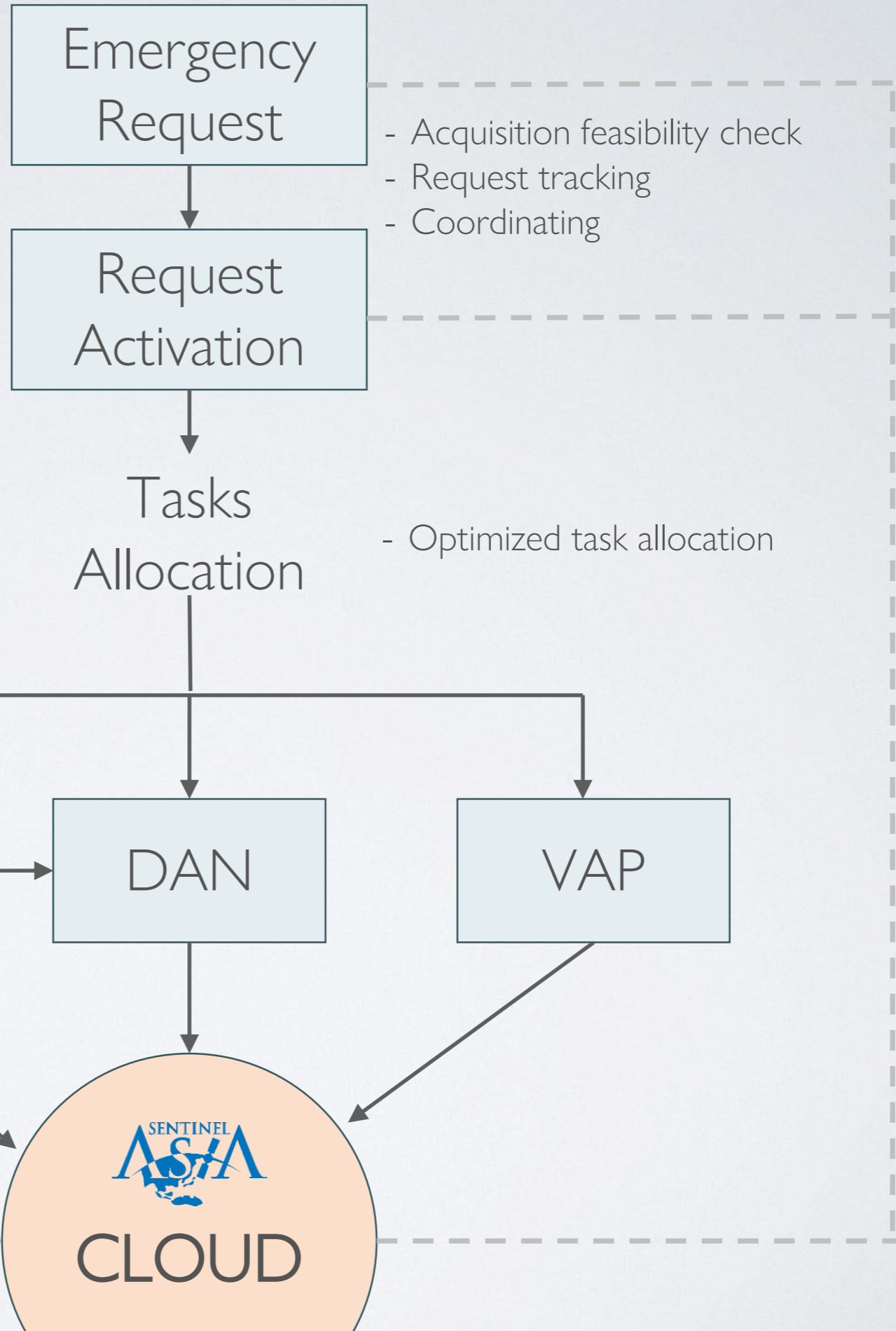
 Create Grid spacing (km):

Strips Mission schedule

 Compute Fast (s):  Slow (s):   Silent



# WORKFLOW



Scientists,  
Academics,  
Organizations, etc.

# CONCLUSION AND FUTURE WORKS

- EOS satellite mission is expensive, optimize mission planning should be highly considered. Co-constellation is also a way to optimize space sensor resources.
- This presentation gives the overview of the OPTEMIS mission planning system, its concept, current development/implementation status and its demonstration.
- EOS satellite is the sensor resource that is, by nature, easy to be shared globally. Viable balanced solutions for EOS co-constellation is presented.
- With a correct tool, to **sharing, collaborating and harmonizing satellite resources** is easily achievable.
- **OPTEMIS** can be used to manage and facilitate observation requests, satellites acquisition planning. Speed-up the workflow and let the end-users use the **satellite resources efficiently**.

**FUTURE WORKS:** Multi-language OPTEMIS, Real-time summary dashboard, Multi-sensor Tasking Harmonization



THANK YOU FOR LISTENING



optemis

[SentinelAsia.gistda.or.th](http://SentinelAsia.gistda.or.th)