Interconnection of THEOS data for research and education in Thailand

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Abstract:

Since THEOS (THailand Earth Observation Satellite), Thailand’s first Earth observation satellite on Low Earth Orbit (LEO), was launched on 1st October 2008, it assists environmental monitoring by providing satellite images that can be used not only in Thailand but also in other countries for many applications such as agriculture, geology, forestry, biodiversity conservation, regional planning, mapping. It also supports the disaster management in flood or earthquake.

Satellite Images are a powerful source of derivation information and can also greatly enhance research and education. Therefore, in order to encourage study of satellite image in Thailand and to create the direct connection between GISTDA (Geo-Informatics and Space Technology Development Agency) and universities, the cooperation agreement between GISTDA and UniNet has been established on 12 March 2010. The cooperative concepts are beneficial to GIS, remote sensing, image processing or other applications relating to satellite images. This association provides researchers the ability to access information expeditiously.

This paper explains a dynamic interconnection between researchers/students and THEOS system via Uninet and GISTDA networks. Researchers can send requests for specific image i.e. area, resolution and row angle of imaging. In return, products in different process levels applied for research are transmitted from THEOS system in Near-Real-Time mode to the destination as per specified. The developers or researcher can take the advantage of fast delivery data to improve their work. Thus, GISTDA can take these study requests to design the next Thailand’s earth observation satellite in the future.
Keywords: THEOS; UniNet; earth observation satellite; satellite image; environmental monitoring; natural resource; earth monitoring.

1. Introduction

1.1 THEOS

THEOS (THailand Earth Observation Satellite), the first high-resolution earth observation satellite for Thailand, has been established based on the cooperation agreement between both the Governments of Thailand and France. THEOS is fully operated by GISTDA (Geo-Informatics and Space Technology Development Agency), a public organization which assumes all responsibilities and activities for space technology and geo-informatics applications.

THEOS has a design life of five years. It was launched on 1st October 2008 into a sun-synchronous orbit at an altitude of 822 km at the equator. Environmental monitoring by THEOS can be used in many applications such as agriculture, geology, forestry, biodiversity conservation, regional planning, mapping. It can also support the disaster management in flood or earthquake.

1.2 UniNet

UniNet (Inter University Network) has been established in 1996. UniNet has provided hi-speed information network linked to universities, institutes, and campuses more than 200 sites over the country. Linking with foreign counties research network enables Thai universities/institutes to manage virtual classrooms with universities/institutes abroad. This project improves Thai education to be comparable to other countries. Apart from developing knowledge resource, UniNet also support the progress of universities/institutes network to cope well with Electronics Library Network and research networks like Access Grid, Multicast, IPv6, VCS and Self-Study Center.

2. Implementation Plan

2.1 THEOS Product

THEOS’s command and control of satellite are provided by the THEOS Control Ground Segment (CGS) in Thailand. THEOS provide earth imagery by transmitting data to Image Ground Segment (IGS) which will house the data reception and processing facilities. Image ground segments are located at Ladkarbang, Bangkok and Siracha, Chonburi with a receiving circle of 2,500 km.

User can request images for dedicated application from archiving imagery or new acquisition by indicating specific latitude - longitude of points in area, resolution, row angle and other parameters for imaging. The processing products are available in level 1A or 2A, product options namely:
• **Panchromatic products** provide 2 meter resolution and 8 bits information depth.
• **Multispectral products** provide 15 meter resolution and 8 bits information depth. All 4 bands are delivered as one file (red, green blue, near IR).
• **Pan-Sharpened products** combine the visual information of 4 multispectral bands with the spatial information of the panchromatic band.

![Sample THEOS data products](image)

**Figure 1** Sampled THEOS data products

The products will be sent back to user in CDs, DVDs or via FTP depending on user requests. The process duration for 1 request depends on many factors; archiving imagery or new acquisition, quality, imaging angle, priority, size of area, processing level, etc.

In nominal operation, the request should be sent before 15:00 Thailand Local time and the data can be provided within 24 hours for urgent request on FTP.

**2.2 Connection plan between GISTDA and UniNet**

To establish direct links between GISTDA and UniNet in order to encourage study and research of satellite images in Thailand, it have to connect 3 GISTDA’s stations which are linked together by MetroLAN(Internal link):

• **Ladkrabang** Bangkok is image ground segment.
• **Siracha** Chonburi is control ground segment and image ground segment
• **Chaengwattana** Bangkok is head quarter for user contact.
Considering THEOS data volume around 700 MB to 30 GB per request and bandwidth traffic, the data transfer performance is limited. In order to improve the efficiency of THEOS transfer data, we plan to connect directly from GISTDA to UniNet via fiber optic bandwidth 1 Gbps. Taking into account, the shortest distance of each connection, the link has been designed as shown on following:

- **Ladkrabang** can connect to **KMITL** (King Mongkut Institute of Technology Ladkrabang).
- **Siracha** can connect to **KU_SRC** campus (Kasetsart university Siracha campus)
- **Changwattana** can connect to **KU** (Kasetsart University main campus).
We set implementation plan into 2 phases;
the 1\textsuperscript{st} phase
\begin{itemize}
  \item Connection from Changwattana to KU has been implemented.
  \item Connection from Ladkrabang to KMITL is implementing.
  \item Connection from Siracha to BU is implementing instead of link to KU\_SRC due to connection between KU\_SRC and BU has traffic problem.
\end{itemize}

The 2\textsuperscript{nd} phase
\begin{itemize}
  \item Connection from Siracha to KU\_SRC will be implemented.
\end{itemize}
3. Conclusions

Satellite Images can greatly enhance research and education in GIS, remote sensing, image processing and other application relating to satellite images. GISTDA can provide worldwide geo-referenced image products and image reception-processing capabilities in Thailand and other countries. A bottleneck in commercial internet bandwidth limits data accesses from users. Another way to connect from GISTDA to universities/institutes is to connect by UniNet. UniNet provides internet access for universities and network infrastructure for research and also facilitates IT campus for distance learning.

Therefore, GISTDA and UniNet established the agreement to the interconnection encouraging research and education between GISTDA and UniNet. Apart from users’ benefits of using THEOS data in near real time, GISTDA also take this advantage to study requests for design next observation satellite for Thailand and control ground system in the future.
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