

Overview of AI3 Network: Design and Applications of Satellite Network

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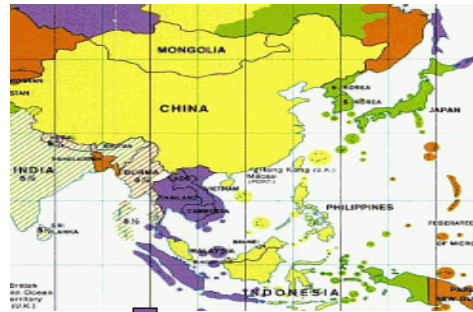
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Outline

- Presentation
 - Overview of AI3 activities
 - For sharing our experience.
- Outline
 - ① Introduction
 - ② Infrastructure design
 - ③ Operational information
 - ④ Achievements

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Partners Characteristics



UTC+5.75	UTC+6	UTC+6.5	UTC+7	UTC+8	UTC+9
Nepal	Bangladesh	Myanmar	Cambodia Laos Thailand Vietnam	Indonesia Malaysia Philippine Singapore	Japan

← 3.25h →

Countries

- 13 Countries

Timezones

- UTC+5.75~UTC+9

Religions

- Buddhism, Christianity, Hinduism, Islam ...

Languages

- Bengali, English, Filipino, Indonesian, Japanese, Khmer, Lao, Myanmar, Nepali, Thai, Vietnamese, Mongolian ...

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The features of AI3 network

- AI3 network is constructed on satellite link.
 1. **Wide area** infrastructure
 2. Installation easiness
 3. **Broadcast** capability
 4. **Alternative connection** to terrestrial link
 5. **Narrow bandwidth**

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Main Point

- AI3 succeeded to construct satellite Internet infrastructure in Asian region.
- We have various experiences:
 - to construct the infrastructure
 - to operate the satellite Internet infrastructure
 - to use the infrastructure
 - to promote the project
- Sharing the information

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(1) Infrastructure design

- Consideration
- Stage1. Ku-band
- Stage2. C-band
- Stage3. Participation of RO sites

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Design Principle

- Consideration
 - Dislike one-way support
 - Provides opportunity to grow up together
- Design Target
 - Partners use the infrastructure freely.
 - Partners claim their idea to design and operation.
 - Partners share responsibilities for operation.
 - Partners are required for operation
- In exchange for the right AI3 require partners operational duties.

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Constrains of Asian networking

- Geographical constrains:
 - Surrounded by sea
 - Land locked



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Our Base Design

- We employ satellite media
 - It provides us connectivity in the whole Asian area.
- AI3 network as Internet Exchange
 - Partners connected the AI3 network equal responsibility.



Covered area by JCSAT-3 satellite
Yellow – Ku-band (Asia zone)
Purple – C-band (Asia zone)

Stage1. Ku-band link

- Beginning of IP over satellite (1996)
 - Star topology network from Nara Institute of Science and Technology (NAIST), Japan
 - Employ satellite link for Bi-Directional connection
 - Communication Channel must be separated to different channel
 - Assign Autonomous System (AS#4717)
 - The signal have been stopped in 2003
- Partners
 - Asian Institute of Technology (AIT), Thailand
 - Hong Kong University of Science and Technology in China
 - Institut Teknologi Bandung (ITB), Indonesia

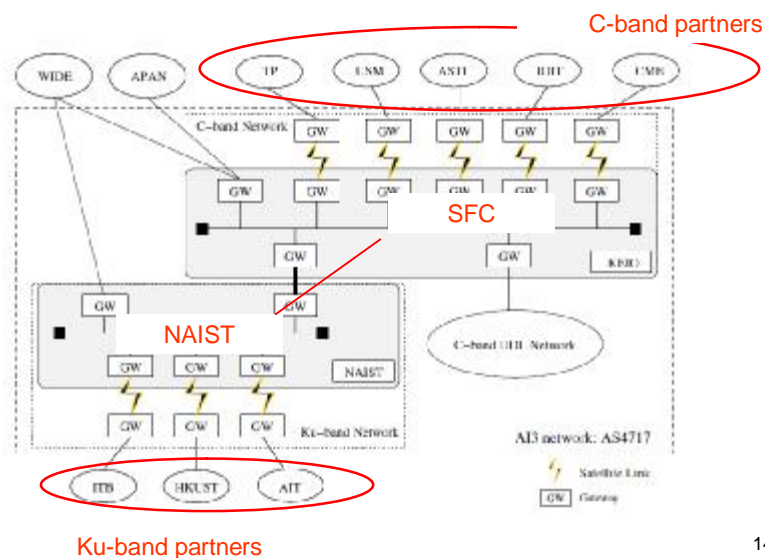
Stage2. C-band extension

- Constructing unique topology (1999)
 - Additional Freq. resource on C-band link
 - Constructing new terrestrial station at Keio Shonan Fujisawa Campus (SFC) in Japan
- Partners
 - Temasek Polytechnic (TP) in Singapore
 - University of Science Malaysia (USM)
 - Advanced Science and Technology Institute (ASTI) in Philippine
 - Institute of Information Technology (IOIT) in Vietnam

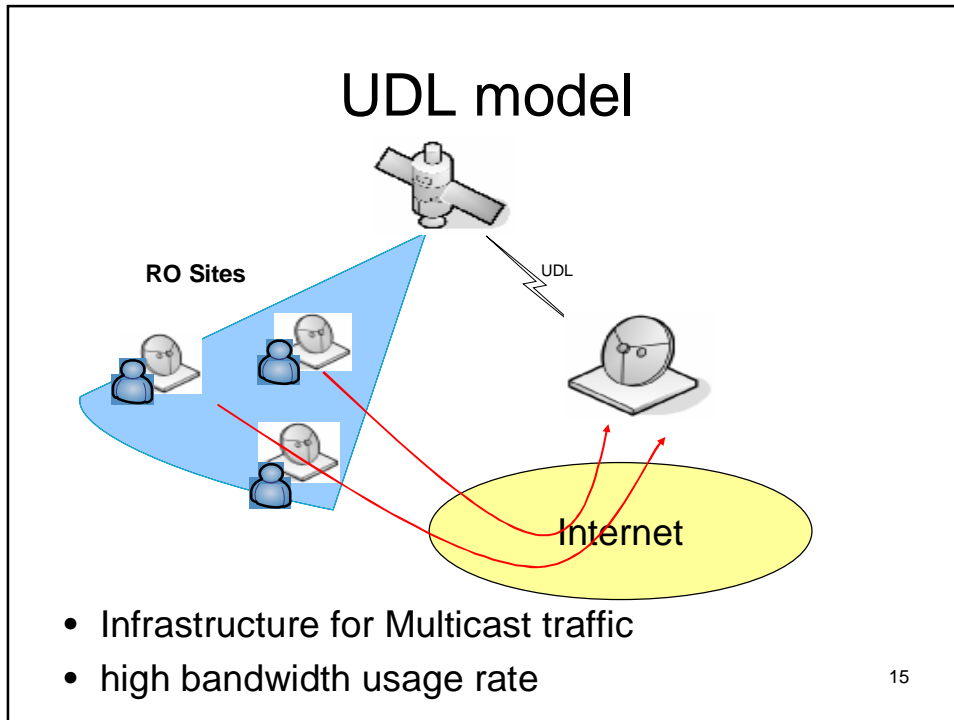
→ Break Through to develop **UDL** on satellite link

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Network topology



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Stage3. RO sites participation

- Receive Only (RO) sites
 - Partners connected to A13 network by UDL
 - New kind partners which only receive traffic from A13 infrastructure
 - Users for educational program
 - As a result, we includes 39 partners.

(2) Operational information

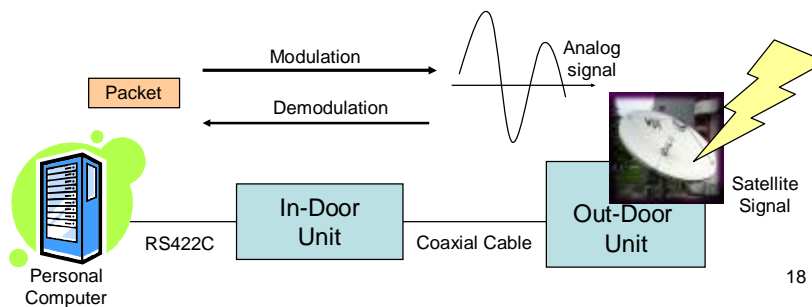
- Link Technology
- Utilization
- Monitoring
- Remote Operation
- Organization

- To operate and maintain the network

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Link Technology

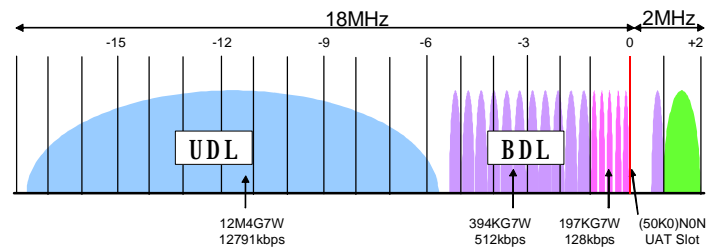
- Packets are transmitted on satellite signal.
Modulation Process:
 1. Computer sends binary data to modem via RS422C.
 2. Modem converts the data into electrical signal.
 3. Out-Door Unit transmits the signal to satellite.
- The link seems to be narrow and long delay link.
 - RTT 500ms



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Bandwidth Utilization

- Frequency allocation
 - Bandwidth is defined as the proportion of freq. bandwidth.
 - Frequency resource is shared the whole partners.
- Utilization
 - Traffic aggregation on UDL
 - Frequently allocation changing by monitoring link usage of each partner



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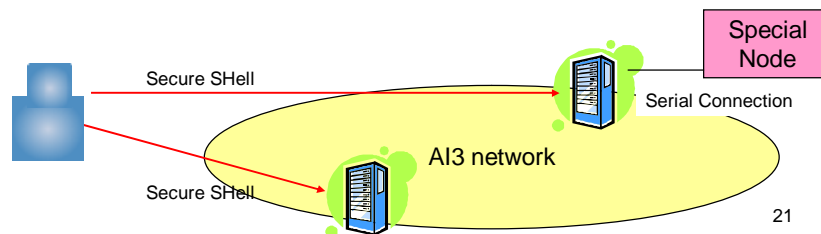
Monitoring

- Link status
 - Satellite signal
 - Radio signal strength from IDU information
 - Official signal monitoring by JSAT
- Network status
 - L3 connectivity
 - Transmitting ping echo from external network by Nagios
 - Routing stability
 - Shell script for checking routing system
- Service status
 - Applications (HTTP, DNS, E-mail)
 - Service scan by Nagios

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Remote Operation

- Secure Shell (SSH)
 - L3 connection from external to L3 nodes in AI3.
 - Limited access with public key cryptosystem
- Serial connection
 - Connection to special node (bridge, modem) via serial console server



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Organization

- Mailing list for daily operation
 - Online communication method for daily operation
 - Exchanging information frequently
- Meeting for information exchanging
 - Offline face-to-face communication for making decision and proposing ideas
 - Bi-annual meeting in partner univ.

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(3) Achievements

- Researches on the network
 - UDLR Standardization
 - Web Cache Backbone
 - Botnet Detection
- Application of the network
 - Distance Learning
 - Human Resource Development

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Web Cache Backbone

- AI3 developed AI3 Cache Bone
 - Reduce HTTP traffic on satellite link
 - HTTP was a dominant traffic load
 - Distributing cache data to partner sites
 - Employment of satellite signal feature
- Papers:
 - H. Inoue et al., “An adaptive WWW cache mechanism in the AI3 network”, INET 1997, Jun., 1997
 - K. Kanchanasut et al., “The AI3 Cachebone project.”, Internet Workshop, pp. 259-264, Feb., 1999

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UDLR standardization

- Unidirectional Link Routing (UDLR)
 - UDLR allows us to use UDL as similar to BDL.
 - Based on UDLR, RO sites can employ satellite link for their internet connection.
- Paper
 - E. Duros et al., “RFC 3077: A link layer tunneling mechanism for unidirectional links”, Mar., 2001

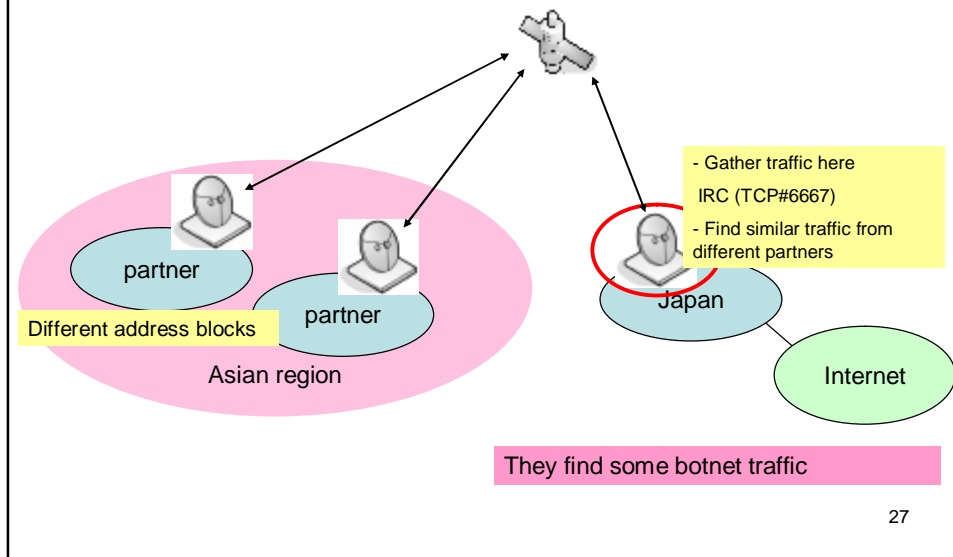
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Botnet detection (1)

- Botnet
 - Botnet is constructed with bot for evil purpose such as sending spam, cracking password and causing DoS attack.
 - Bot is a malicious program which tries to hijack computer control for constructing botnet.
- Assumption:
 - Bots receive control signal from master on network connection
 - Bots generates similar traffic
 - To gather traffic from wide area helps to find bot traffic by its similarity
- Paper:
 - M. Akiyama et al, “An proposal of metrics for botnet detection based on its cooperative behavior”, In SAINT 2007 Workshop, Jan., 2007

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Botnet detection (2)



Distance Learning

- SOI Asia Project
 - SOI Asia creates and transmits educational program as streaming video on AI3 infrastructure.
 - Their concerns are not only developing systems for the distance learning but also on developing human resource and relationships.
- Paper
 - S. Mikawa et al. “Multilateral distance lecture environment on the internet for asian universities”, The journal of Information and Systems in Education, Mar., 2006

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Human Resource Development

- A13 and SOI Asia project pay attention for human resource development
 - A13 network was designed as inter-networking with equal partnership.
 - Every partners has the same right of speak to the infrastructure operation.
 - Exchanging the information and opinion to operate the network
 - SOI Asia held workshop for educating network operators in partner sites
 - Operators have responsibility for their network.
 - It enhances autonomous distributed network operation.
- As a result, some partner equips enough skill to support other partners
 - AIT in Thailand supports Trivan Univ. in Nepal.
 - ITB in Indonesia supports Brawjaya Univ. in Indonesia

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Human Interchange

12 interns from 8 countries

- 1st batch :Jan – Apr 2006
 - Myanmar (USCY)
 - Indonesia (UNSRAT)
- 2nd batch :March – June
 - Laos (NUOL)
 - Nepal (TU)
- 3rd batch :May - Aug
 - Indonesia (UNIBRAW)
 - Bangladesh (BUET)
- 4th batch :July - Oct
 - Indonesia (ITB)
 - Cambodia (ITC)
- 5th batch :Sept - Dec
 - Indonesia (UNHAS)
 - Mongolia (MUST)
- 6th batch :Jan – Apr 2007
 - Indonesia (UNSYIAH)
 - Malaysia (USM)



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AI3 experiences

- Network Operation
 - Operating and maintaining the network
 - Expanding the infrastructure for new partners
- Application on the network
 - Research platform
 - i.e. Proxy, UDL, Multicast, Botnet detection
 - Distance learning
- Maintaining human relationship
 - AI3 Meeting
 - Human interchange

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Conclusion (1)

- AI3 succeeded to construct communication infrastructure.
- Our knowledge through activities
 - Experience for network operation
 - Results of research and development
 - Contribution of distance learning for developing region
 - Constructing human network

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Conclusion (2)

- Suggestions from our activities
 - Presenting application on the infrastructure is very important
 - Good relationship with partners is very important

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Thanks

- Please contact us if you are interested in AI3
 - <http://www.ai3.net/>
 - ai3-staff@wide.ad.jp
- Thank you for your attention.



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