第 XXIX 部

Asian Internet Interconnection Initiatives

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第 1 章 Introduction

The Internet has become a critical and dependable infrastructure for today's society. This was clearly seen when an earthquake in Taiwan on 26 December 2006 knocked out several undersea cables off Taiwan. Some Asian countries, including Taiwan, Singapore, Thailand, Philippines, and Indonesia, were severely affected. However, satellite connectivities were not affected by this disaster. Thus we can see this as a role of satellite Internet today, in addition to providing connectivities where terrestrial links are still scarce.

Asian Internet Interconnection Initiatives, or AI^3 (*ei-triple-ai*) in short, was established in 1995, in order to work for the Internet development in Asian region. When we started this project, we set some assumptions on what is required to accelerate the deployment process of the Internet: (1) a testbed network as a live demonstration and also as a technical showcase of the Internet technology is required because it always can persuade many people of the potential and possibility for the power of the Internet, (2) research for adapting and localizing the Internet to the region should be conducted simultaneously with the deployment, because the Internet is aiming to be an infrastructure for our society, and (3) human resource development locally in the region is vital for rapid deployment of the Internet because the human resource development process can reproduce more evangelists, supporters and participants for the Internet deployment.

With these assumptions, the AI^3 project

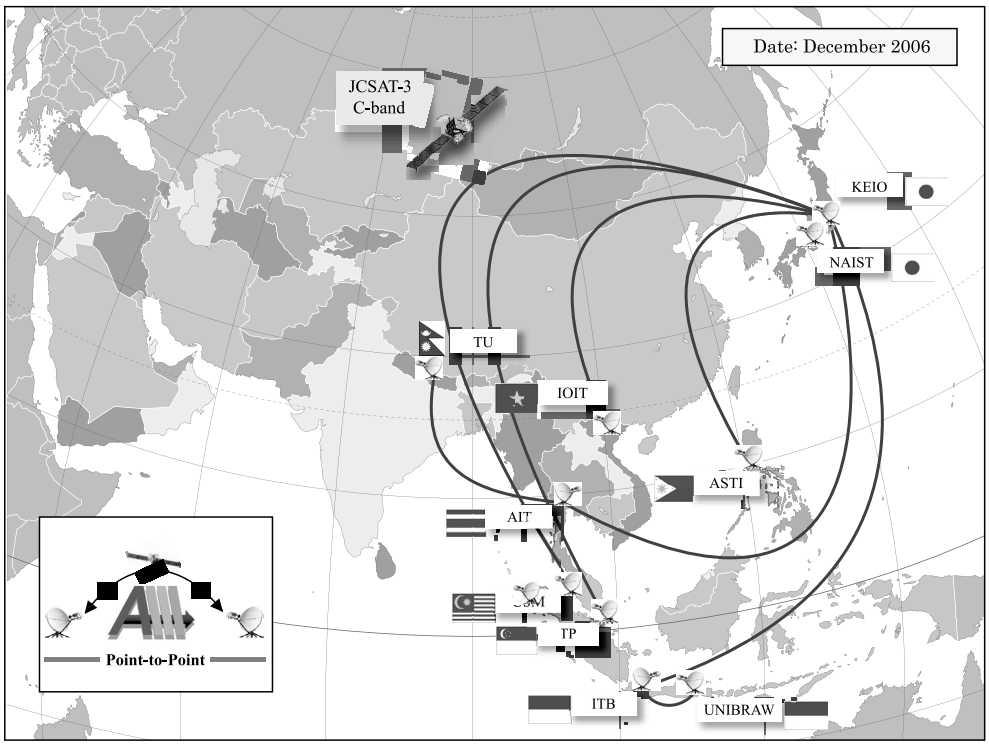


Fig. 1.1. AI^3 network test-bed (bidirectional links)

decided to start as a research consortium of leading research groups in universities in Asia. Because universities are in charge of human resource development, less restricted to have a testbed network, and a base of research activities, we expect we can find out there many researchers who are working actively on the Internet technologies.

In our 10 years of activities, AI^3 testbed network has been built to connect 24 universities in 12 countries in this region and still expanding. This network has been working on 24/7 basis and turned to be its communication infrastructure for members of this AI^3 project. In this report, we summarize the AI^3 project and its activities in both Internet development and our R&D process using AI^3 satellite Internet infrastructure in Asia.

第 2 章　Operation

AI^3 introduced several changes to its network besides providing the regular operation to AI^3 partners and SOI Asia Project. The changes were:

1. JCSAT-3 satellite maintenance
2. Unidirectional Link Feed replacement
3. IPv6 peering with APAN
4. Sony Feed replacement
5. M6bone connectivity
6. UDL 13 Mbps migration
7. IPv4 address renumbering

2.1 Network Topology

The network topology of AI^3 network test-bed did not change in 2006. The only changes were the addition of several SOI Asia sites on the unidirectional link (UDL). Figure 2.1 depicts the network topology at AI^3 NOC in Keio University Shonan Fujisawa Campus (SFC) and Nara Institute of Science and Technology (NAIST).

2.2 Network Monitoring

We monitor traffic flowing on our network using SNMP based and tcpdump based measurements, thus we monitor do not only the amount of traffic but also the types of the flowing traffic. Figures 2.2–2.4 show the typical daily traffic flowing on AI^3 network. When there are events

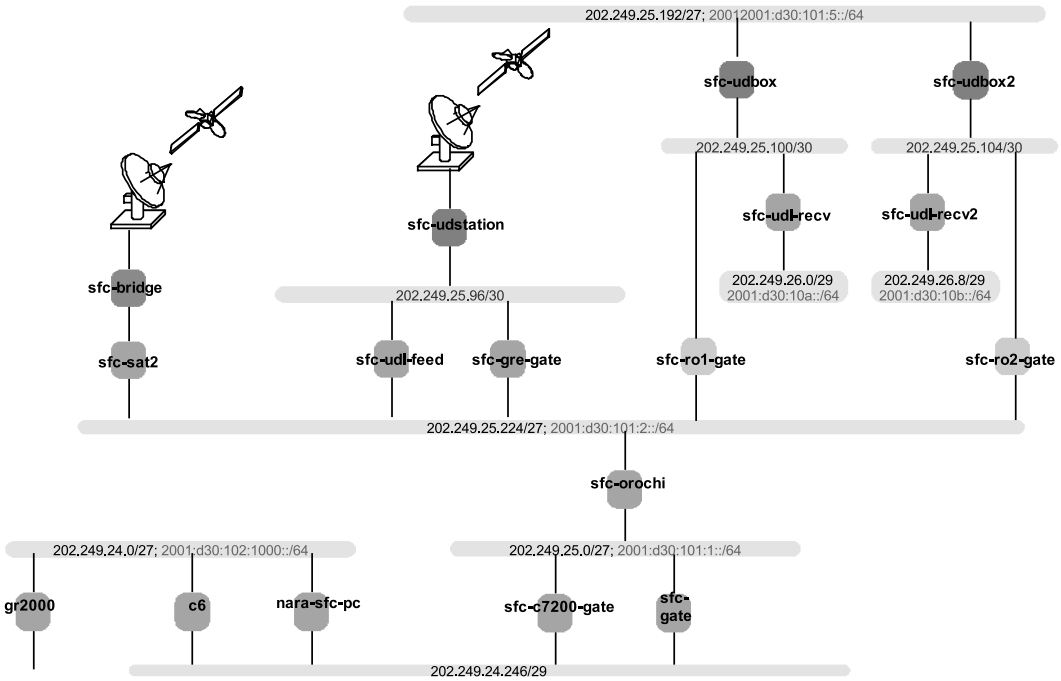


Fig. 2.1. AI^3 NOC topology

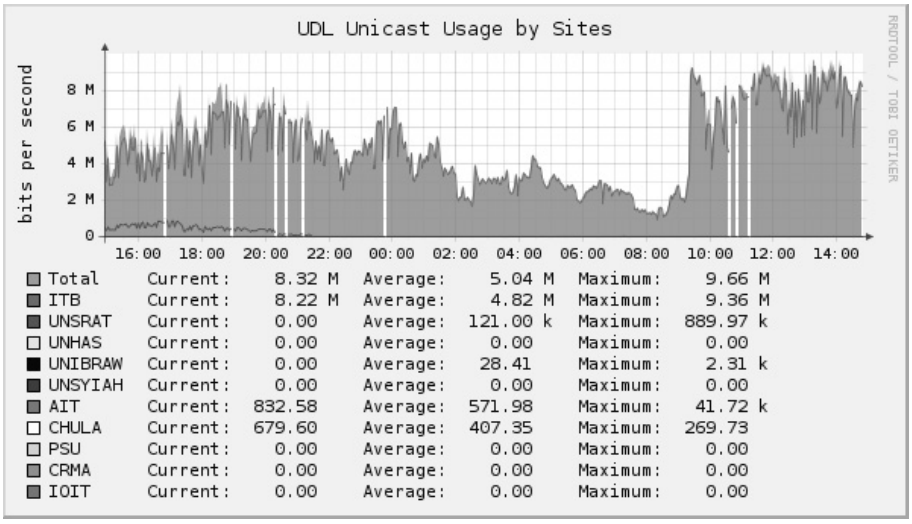


Fig. 2.2. Daily unicast traffic to partners

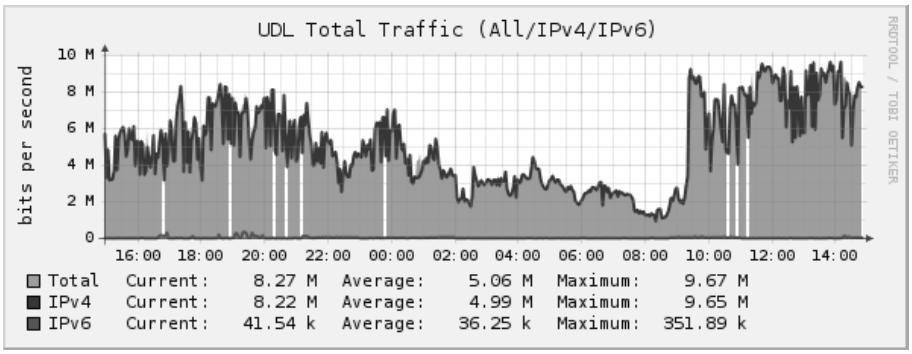


Fig. 2.3. Daily IPv4 vs IPv6 traffic

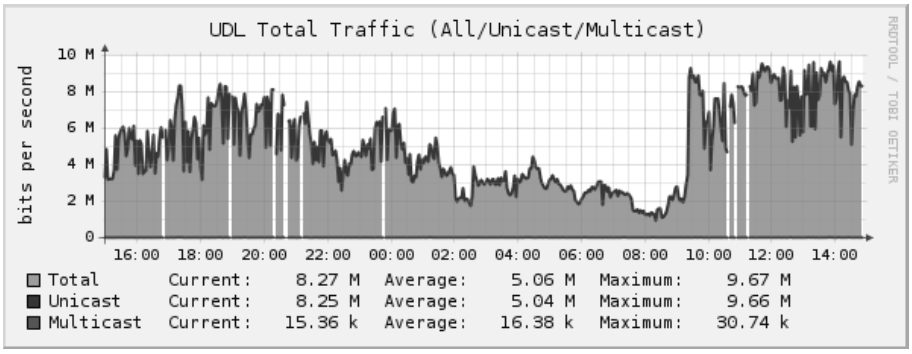


Fig. 2.4. Daily unicast vs multicast traffic

or experiments, we prioritize the traffic for such events, and the traffic will change. Figure 2.5 shows the traffic during the SOI Asia Global E-Workshop, which is typical for SOI Asia related events.

2.3 JCSAT-3 Satellite Maintenance

Our satellite provider, JSAT Corp., planned to perform JCSAT-3 satellite maintenance on 9 March 2006. All AI^3 earth stations had to stop transmissions during the maintenance. On 9 March 2006 all partners shut down their earth

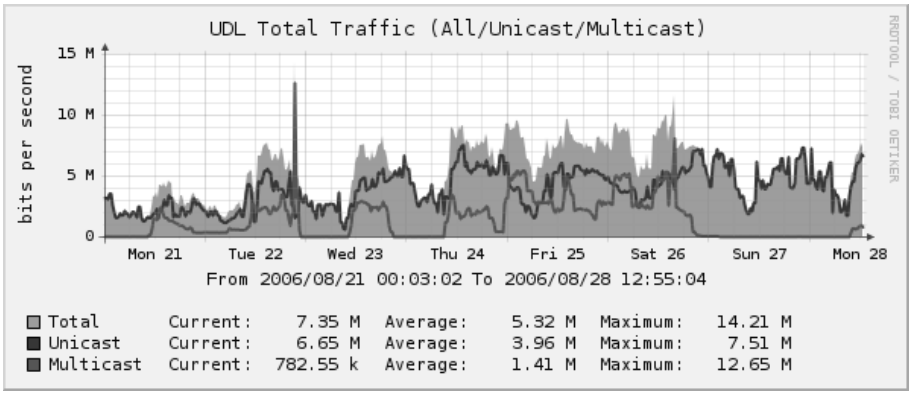


Fig. 2.5. Typical unicast vs multicast traffic during SOI Asia events

stations and all were successfully started their transmissions on 10 March 2006.

2.4 IPv6 Peering with APAN

AI^3 started IPv6 BGP peering with APAN on 1 June 2006, in addition to the already established IPv4 peering. The BGP speaker for this peering in AI^3 side is sfc-c7200-gate, which is a Cisco 7206VXR router. AI^3 receives all IPv6 routes from APAN and assigns local preference 100 to these routes so IPv6 routes via NSPIXP6 are still preferred.

2.5 SONY Feed Replacement

The feed of AI^3 unidirectional link (UDL), made by SONY, broke down on 20 June 2006 afternoon, disabling the UDL network operation. We immediately replace the SONY Feed with UDStation, a UDL feed made by UDCast, in the evening. This problem caused a UDL downtime for almost 5 hours.

2.6 M6bone Connectivity

AI^3 established its first connectivity to M6bone on 7 June 2006 using IPv6 tunnel between sfc-c7200-gate and RENATER. But the connectivity still had a problem due to bugs in the Cisco IOS. All problems were finally solved after installing Cisco IOS (C7200-ADVIPSERVICESK9-M), Version 12.4(9)T1, RELEASE SOFTWARE (fc2). The first successfull test was on 28 August 2006 where a multicast DVTS stream was sent from UPMC, France to AI^3 and the stream was relayed to UHSC, Cambodia using the unidirectional link.

2.7 UDL 13 Mbps Migration

We increased the bandwidth of our UDL from 9.6 Mbps into 12.761 Mbps, which is an increase of more than 30% on 24 July 2006. AI^3 bandwidth allocation after this migration is as shown in Figure 2.6. The bandwidth increase was performed after several measurements proved

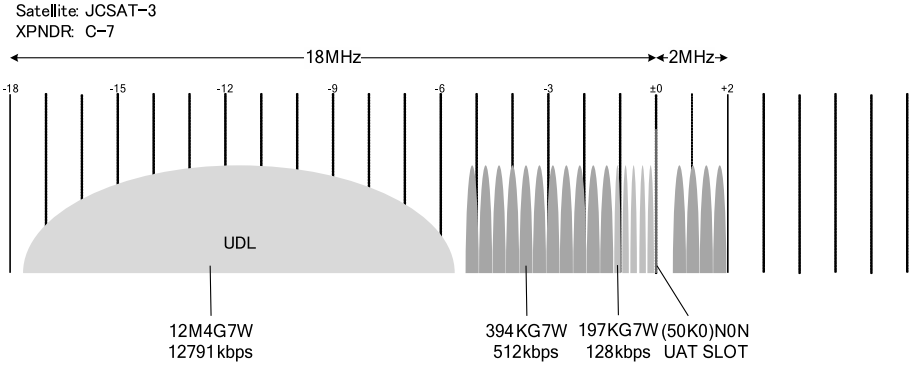


Fig. 2.6. AI^3 Frequency Allocation with 13 Mbps UDL

that the UDL feed (UDstation), and SONY and UDBox UDL receivers could communicate without any problems for this bandwidth. The migration took place between 15:00 and 16:00JST, and partners reported that they could receive the signals without any problems.

2.8 IPv4 Address Renumbering

We renumbered the IPv4 address of our UDL from a global IP address prefix (202.249.25.96/27) to a private IP address prefix (10.105/16) as a step toward further IPv6 deployment on UDL. This move released us from the limitation of IP address space on the UDL, so we can increase the number of sites connected to UDL. The renumbering process started on 30 October and finished on 12 November 2006.

2.9 IPv6 Address Assignment Policy

AI^3 has a policy to allocate its IPv6 address to non-partner organizations in Asia, but this policy has never been actually implemented. This year we revised the policy after receiving a request from Nepal Research and Education Network via our partner in Nepal, Tribhuvan University. The main points of the revised assignment policy are:

1. Delegation is only to organizations related to AI^3 partners
2. Delegation period is one year
3. Review every six months
4. No commercial use

第 3 章 Research and Development

3.1 Unidirectional Link Encapsulation

Universiti Sains Malaysia (USM) conducted an evaluation of Unidirectional Lightweight Encapsulation (ULE) with Robust Header Compression (ROHC). The ULE with ROHC is the extension to ULE. ULE with ROHC is combination of ULE encapsulation mechanism and ROHC header compression scheme, where the packet in a stream of IP/UDP will be compressed before the ULE encapsulation. By using ULE with ROHC, compressed packets can be used in order to increase the number of the ULE packet than can be encapsulated into the limited payload size of MPEG-2 TS. It will help to increase the efficiency of the packets transmission.

The evaluation of ULE with ROHC consists of two parts, theoretical analysis and simulation. USM first evaluated the ULE with ROHC using theoretical analysis and compared it to others encapsulation mechanism. Then USM conducted a simulation study the improvements of an ULE with ROHC may achieve in terms of Average Delay, Throughput, Packet Drop, Effect of BER on Throughput and Overhead of the packet is presented.

Link: `http://nrg.cs.usm.my/satellite_ule.htm`

3.2 Unidirectional Link Mesh

RFC 3077 states that a unidirectional link may have more than a single Feed. However, on a satellite link environment, having more than one Feed is difficult to achieve on a single channel. Therefore, in AI^3 we propose the use of several Feeds operating on different channels and Receivers are listening on all channels. This proposal is called Unidirectional Link Mesh (Figure 3.1).

Mesh topology is a topology on a satellite link network to create a single-hop between nodes on the network. Using unidirectional links (UDLs) is better than using point-to-point links to create a mesh topology in terms of efficient spectrum usage and modems needed.

This research implements an IP mesh network using unidirectional links with ULE protocols over DVB-S (Digital Video Broadcasting for Satellite). AI^3 will create a network test-bed for experiments, and the main participating partners are USM and Keio University SFC.

This research is on the bandwidth planning phase, where AI^3 assigns bandwidth for three Feeds, each with 1.5 Mbps. After this phase,

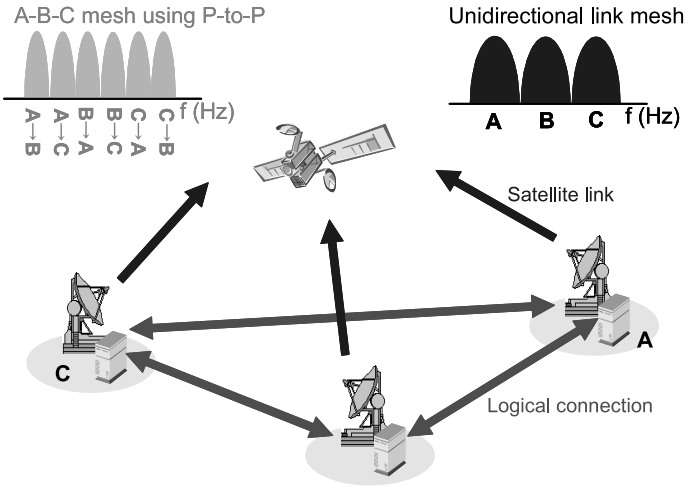


Fig. 3.1. Unidirectional Link Mesh

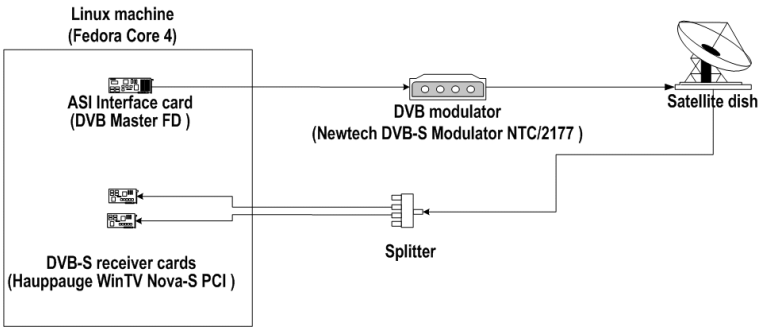


Fig. 3.2. Router configuration for UDL mesh

satellite bandwidth use will be reorganized, and several partners will have to reduce their transmission and reception bandwidths.

On the equipment side, we will use Linux as the routers running a Bidirectional ULE Encapsulator developed by USM. The configuration of a router on a UDL mesh with three Feeds is shown in Figure 3.2. We plan to install a multiplexer at Keio SFC for this research since Keio SFC is already transmitting a UDL.

3.3 Large Scale Satellite UDL

This research analyzes and improves the behavior of IPv6 on a satellite unidirectional link with a large number of receiving nodes (Figure 3.3). The focus is on the on-link IPv6 protocols such as NDP (Neighbor Discovery Protocol) and MLD (Multicast Listener Discovery). The traffic amount of these protocols depend on the number of nodes on the link, therefore we hypothesise that they are very prone to large scale unidirectional link. We are simulating these protocols on a link during transitions, e.g. a node goes up or down, and on stable conditions. The simulations are still underway.

3.4 Wide Area Multicast Network Monitoring

The objective of this research is to provide a method for visualizing multicast states in a certain network, such as: traffic path, bandwidth consumption, and path state of each multicast flow. Multicast routers duplicate packets onto multiple links without any congestion control it necessary to deliver the packets to all receivers. Also, multicast traffic paths can change according to the multicast routing state, such as from RPT (Rendezvous Point Tree) to SPT (Shortest Path Tree) on PIM-SM routing protocol. This research

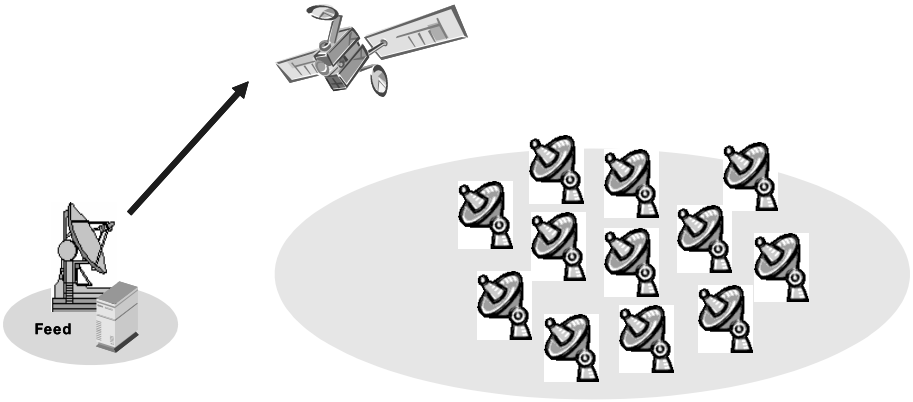


Fig. 3.3. Large scale satellite UDL

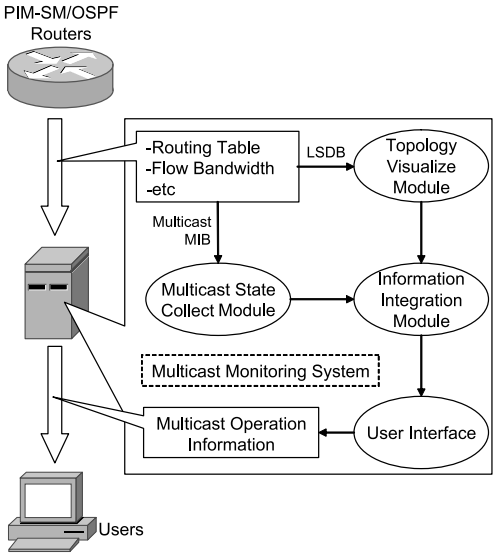


Fig. 3.4. System Design

proposes a multicast monitoring system in a wide area network, which can work by moniroting the reduced number of multicast routers.

This system focuses on networks using PIM-SM and OSPF as their multicast and unicast routing protocols. It retrieves the PIM-SM multicast routing information from several routers and infers an actual route of each multicast flow from the source to the router based on the topology information obtained from OSPF. The system then visualizes the results on a web page. Inferring multicast paths from the available information means that we can monitor the multicast states of a network by monitoring certain routers only, i.e., Rendezvous Point of Receiver side router. Figure 3.4 describes the overview of proposed multicast monitoring system.

We ran the multicast monitoring system in the AI^3 network and retrieved the visualization result shown in Figure 3.5. This result was obtained using three monitoring points, and the monitoring shows two multicast flows. The results of this research is expected to contribute to the operation of multicast-enabled services and their infrastructure.

3.5 ANGKOR Project

The project is a joint project between intERLab/AIT, AI^3, SOI Asia, University of Health Sciences of Cambodia (UHSC), Cambodia, and Pierre & Marie Curie University (UPMC), France, to provide real-time medical science classroom over heterogeneous networks. Research objectives for this project is to deliver high quality video using DVTS over IPv6 Multicast backbone from high speed to a narrow bandwidth satellite Internet (AI^3). The contribution from this research project is a relay for DVTS stream called DVRelay which reduce the bandwidth consumption of the stream in real-time without losing the high quality of the images. DVRelay thins out the video frames from 30 fps to 5 fps, without reducing the audio quality, in order to deliver the video via AI^3 UDL whose bandwidth is 13 Mbps.

3.6 Firmware-Level Vulnerabilities in Server and Desktop Platform

This is a research conducted by Dharmawan of

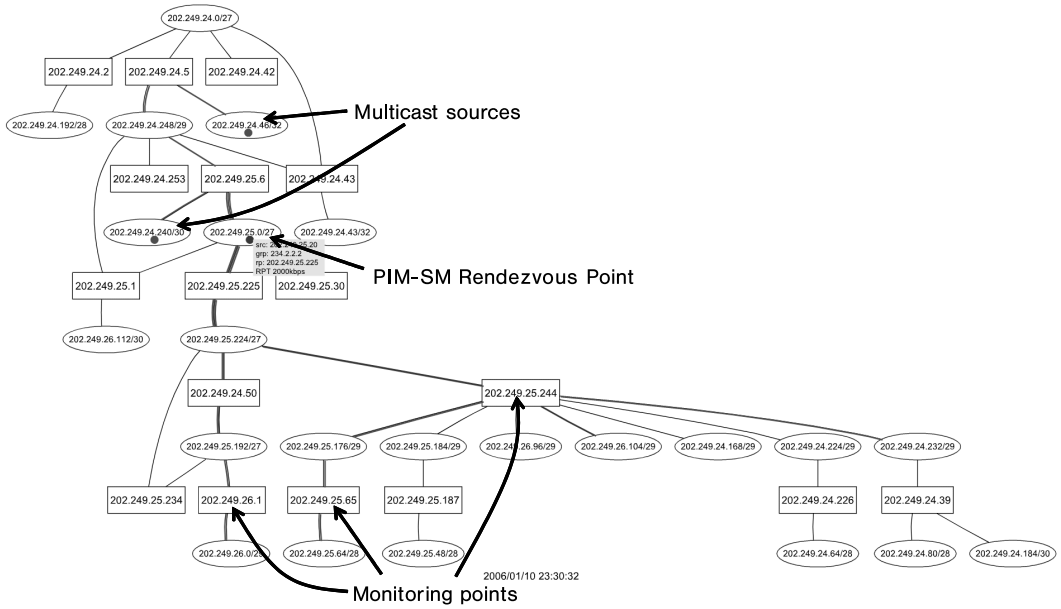


Fig. 3.5. Visualization Result in AI^3 Network

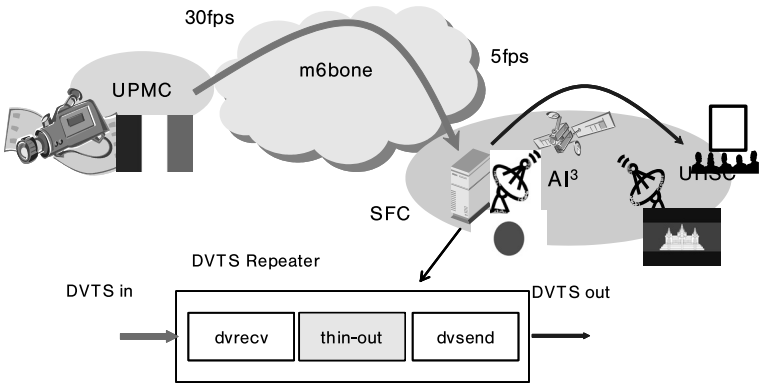


Fig. 3.6. Relaying DVTS stream from France to Cambodia

Institut Teknologi Bandung, Indonesia.

Servers and desktops are the building blocks of computer networks. Security threats that endure Operating System reinstallations and other common recovery methods after an attack in server or desktop are major threats. Vulnerabilities in firmware are the entry-point to this security threat. Our research focuses to find the possible attack mechanisms, prevention and recovery methods after a system is compromised and vulnerabilities in its firmware are exploited.

Firmware

Firmware is software embedded in the server and desktop hardware. This research focuses on motherboard BIOS (Figure 3.7) and PCI expansion ROM (Figure 3.8).

New Security Threats

There are two emerging security threats that come from the firmware in servers and desktop platforms:

1. BIOS-based rootkits.
2. New generation of BIOS viruses.

These threats are dangerous because:

- Can be independent of Operating System.
- Hard to detect.
- Hard to remove, because Operating System reinstallation won't do.
- In case of a BIOS-virus, it can cause

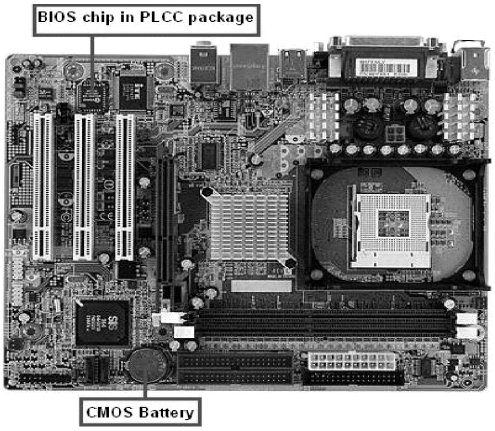


Fig. 3.7. Motherboard BIOS

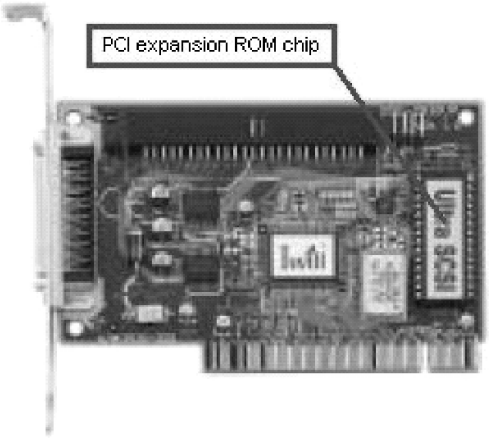


Fig. 3.8. PCI Expansion ROM

irreversible damage on the server or desktop platform.

- Detection mechanisms are still in research stage.

Possible Attack Mechanism

An attack is made possible by the following facts:

- "BIOS Reverse Engineering is documented in detail in Pinczakko's Guide to Award BIOS Reverse Engineering", `http://www.geocities.com/mamanzip/Articles/Award_Bios_RE/Award_Bios_RE_guide.html`
- "BIOS code injection is documented in detail in *Award BIOS Code Injection, Darmawan Mappatutu Salihun, CodeBreakers Magazine Vol. 1 No. 1, January 2006.*"
- "PCI Expansion ROM code injection is relatively unknown in security research community but surprisingly easy to implement because PCI Expansion ROM binary format is known and relatively simple."

Future Work

- Detection and defense against firmware-level rootkits and viruses.
- Cross OS "infection" methods and prevention.
- OS-level protection against malicious PCI Expansion ROM accesses.
- BIOS code "patcher" against erratic manufacturer implementation on BIOS code protection. (feasibility is under assessment)

3.7 IPv4/IPv6 Portable Squid Proxy Cache

AI^3 plans to conduct more migration to IPv6 and reduces the IPv4. In 2005, AI^3 stopped the operation of IPv4 multicast and started to use IPv6 multicast exclusively. As an effort to move the traffic from IPv4 to IPv6, we started to port the most popular web proxy cache application, Squid Proxy Cache, to enable hosts with IPv6 address to access web servers sitting on the IPv4 Internet.

The ported Squid is Squid 2.6-STABLE because this version is already stable and ready for production. The already tested functionalities of the ported Squid are:

- Internal DNS
- HTTP and HTTPS access
- Cache peering using ICP
- Access Control List

The target time to complete porting the IPv4/IPv6 portable Squid is by the end of March 2007.

第 4 章 Activities

4.1 Meetings

AI^3 holds two meetings in a year, that are also

attended by SOI Asia partners. In 2006, the Spring Meeting was held in Huahin, Thailand, 18–20 April 2006, while the Autumn Meeting was held in Bandung, Indonesia, 9–12 October 2006. All partner organizations, except Temasek Polytechnic, Singapore, sent their delegates to both meetings.

The main discussion topics in Spring Meeting were:

1. Status of the new UDL receiver equipment, UDBox
2. Status and strategy for migrating UDL to 13 Mbps
3. Possibilities to connect to M6bone
4. ANGKOR Project introduction and planning
5. UDL Mesh introduction and planning
6. Large scale UDL research introduction and planning

While in the Autumn Meeting, the main discussion topics were:

1. IPv4 address renumbering
2. M6bone connectivity status and directions
3. ANGKOR Project status and directions
4. UDL Mesh status and directions
5. Large Scale UDL research status and directions

4.2 AI^3 10th Anniversary

AI^3 celebrated its 10th anniversary of operation in 2006 jointly SOI Asia that celebrated its 5th anniversary by organizing a symposium. The symposium was held at the West Hall of Institut Teknologi Bandung, Indonesia on 11 October 2006, in conjunction with the AI^3 Autumn Meeting 2006. We invited representatives from the Government of Indonesia, Embassy of Japan in Indonesia, Indonesian Higher Education and Research Network (INHERENT), and VSNL, a cable company. The symposium included a real-time interaction between participants in Bandung and the invitees in Keio University, Mita Campus using DVTS. The guests included the President of Keio University, Yuichiro Anzai, and the former Minister of Internal Affairs and Communication, Heizo Takenaka. In this symposium, representatives from AI^3 and SOI Asia Partners signed a Bandung Declaration, which affirm the intentions to strengthen our partnerships for the future. After the symposium, a reception was held at Holiday Inn, Bandung.

We also made an Anniversary Web Book to commemorate the anniversaries of both AI^3 and SOI Asia and distributed the CDs to symposium participants. This web book includes messages from members of the projects, milestones, and highlights of the achievements of the projects. The URL is `http://www.ai3.net/2006anniversary/`.

4.3 SOI Asia Workshop 2006 "Global E-Workshop"

AI^3 staff supported to organize SOI Asia's "global-e-workshop" held from August 22 to August 26, 2006. Different from previous workshops which one or two operators from each site were traveling to join workshop at one host institution, this global-e-workshop aims to hold the workshop locally in each institution to increase the utilization of SOI Asia distance education environment, increase chance to new operators to be able to learn SOI Asia technology and having more frequent workshops for up-to-date technology training. Therefore, with global-e-workshop model, workshop teachers will be giving lecture from Japan or other capable sites through SOI Asia classroom environment. It is also minimized the requirements and the workshop participants can join the workshop at their local institutions using their existing SOI Asia classroom environment.

Our works were addressing the problems of conducting a real-time workshop, where the instructors and the participants are located in different places, and the participants should perform hands-on lab exercises using computers that are located in another place. To address this problem, we implemented a remote hands-on exercise environment using virtual machines and a low-bandwidth remote console access. In this

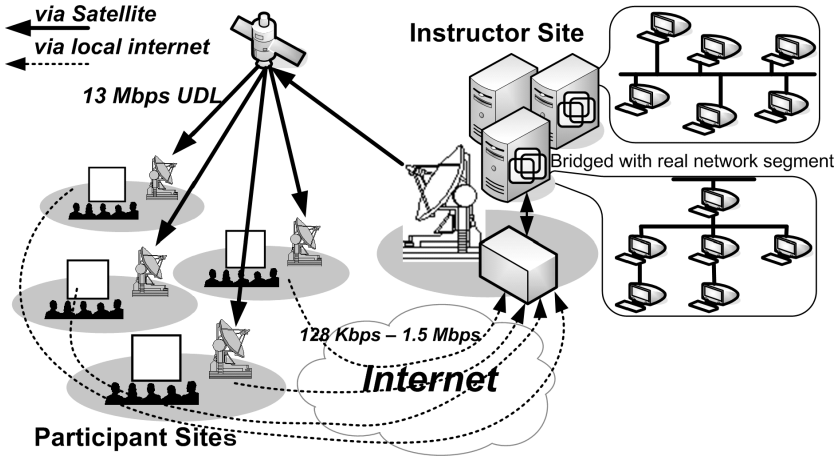


Fig. 4.1. Remote Hands-on Workshop Environment

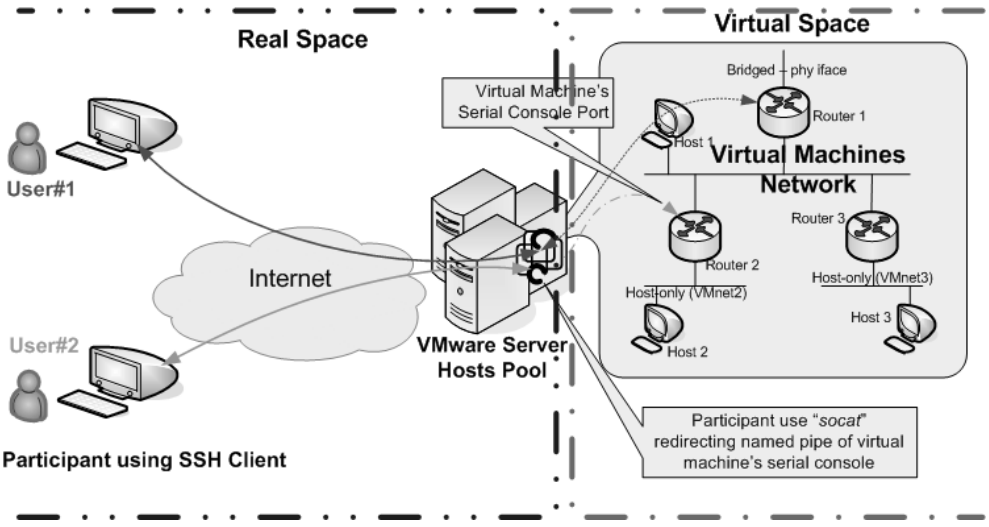


Fig. 4.2. Virtual Hands-on Environment

environment, the instructors can monitor each participant's exercise progress thus they can give specific feedbacks to the participants.

To realize the event we used two main approaches for providing remote hands-on environment over UDL network in order to reach all SOI Asia partners. First, we used virtualization technology to provide a hands-on exercise environment and this environment is to be accessed using the Internet. Second, we utilized the real-time applications of SOI Asia for interactions between instructors and participants: real-time audio and video, and character-based communications. In general our approach can be seen in illustration of remote hands-on environment on Figure 4.1 and Figure 4.2.

The real-time online workshop environment was successfully conducted and accomodated 42 participants from 19 organizations in 10 countries. We have evaluated the environment and found that it was easy to setup, while it can be used of other similar workshops in future too. The participants had a good user-experience in using this environment and 95% of them were agree for the continuation of this model in future.

4.4 Activities at Unibraw

4.4.1 Introduction

Brawijaya University (UNIBRAW) is located in the city of Malang, East Java, Indonesia. During

1957 through 1963, Brawijaya University was in her embryonic stage, and was called Kotapradja Malang University. She was then renamed as Brawijaya University on January 5th 1963.

When teaching began at Brawijaya University in 1961, there were only four faculties: Legal and Civil Sciences (now the Faculty of Law), Economics, Public and Business Administration (now the Faculty of Administrative Sciences), and Agriculture. In 1963 two more were established: Veterinary Sciences and Animal Husbandry (now the Faculty of Animal Husbandry), and Engineering.

In the late 1900s four more faculties were established, Medicine (1974), Fisheries (1982), Mathematics and Natural Sciences (1996), and Agricultural Technology (1998). Now Brawijaya University has 10 faculties catering both non-degree and degree programs.

Brawijaya University has joined to AI^3 community since 2004 continuing their active support to SOI Asia since early 2002. Currently, we have several network connectivity which are 768 Kbps fiber optic to the Internet via commercial ISP, 155 Mbps to INHERENT (Indonesia Higher Educational Research Network) that was newly built in August 2006, 128/512 Kbps VSAT connectivity via AI^3 network since 2005 and Schools Network around Malang area since 2003.

4.4.2 Campus VoIP Implementation and Integration

Voice over Internet Protocol (VoIP) technology is one of emerging technology toward convergence services into IP media. Since the IP infrastructure will be rapidly growing throughout any global network including in our campus, we tried to create implementation of this technology locally and create the prototype Integration in order to support future services. VoIP can be installed any location where IP network is available and have many kind of flexibilities. In contrast, it will be difficult for conventional telephone to have these kind of easiness.

- Network Configuration

  Network configuration/topology remains the same as the established network. It only needs to install a new machine to be a SIP proxy and this machine is connected to the Internet. The machine is supposed to use public IP in order to be available for an external connection, but in real condition for Brawijaya University campus, most of the IP network were Private IP address and interconnectivity with outside network done by NAT.

- SIP Proxy and SIP Gateway

  Based on the above condition, we implement the design using SIP Gateway and SIP Proxy to handle inter-connectivity between VoIP-VoIP domains and also VoIP-PSTN domains as in Figure 4.3. In the implementation level for SIP proxy and gateway, we used an opensource software application service called “Asterisk”.

- VoIP Client Configuration

  The VoIP client generally can be found to be hardware VoIP phone and software VoIP phone (SoftPhone). For hardware VoIP phone, we used product from Cisco and also from LinkSys. For SoftPhone we use X-Lite from `http://www.xten.com/` that can be download for free and can be run on Unix or Windows OS with easy configuration procedure which be look-alike as in Figure 4.4

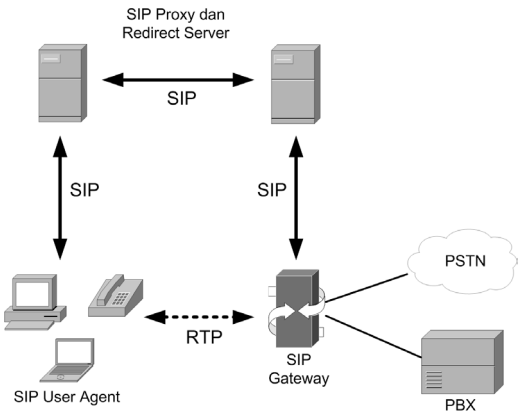


Fig. 4.3. SIP network

Fig. 4.4. SoftPhone:X-Lite

and Figure 4.5. The configuration for this client software is very easy. It only asks the user to fill telephone number, user name, password and SIP proxy IP address.

4.4.3 DVTS Implementation in Internal Campus network

DVTS (Digital Video T System) was introduced at late 2004 by wide project to overcome low resolution video. It provides high quality DV stream based on IEEE1394 interface encapsulated into IP. DVTS use around 30 Mbps bandwidth to send High Quality Digital Video Image on 30 frames per second.

The implementation purpose of this technology is about to be able to deliver/distribute high-quality digital stream from Multimedia-ready Class studio inside campus network. The efforts are for extending current centralize multimedia classroom, which is mainly for SOI Asia in Brawijaya University.

- Network Consideration

  Implementation of DVTS in Brawijaya Campus network still rely on existing networks. These networks are not yet support for IP multicasting and we plan on upgrading the network capability, therefore in current state implementation we use IP unicasting. Based on the implementation, we need to upgrade the network in step by step with consideration

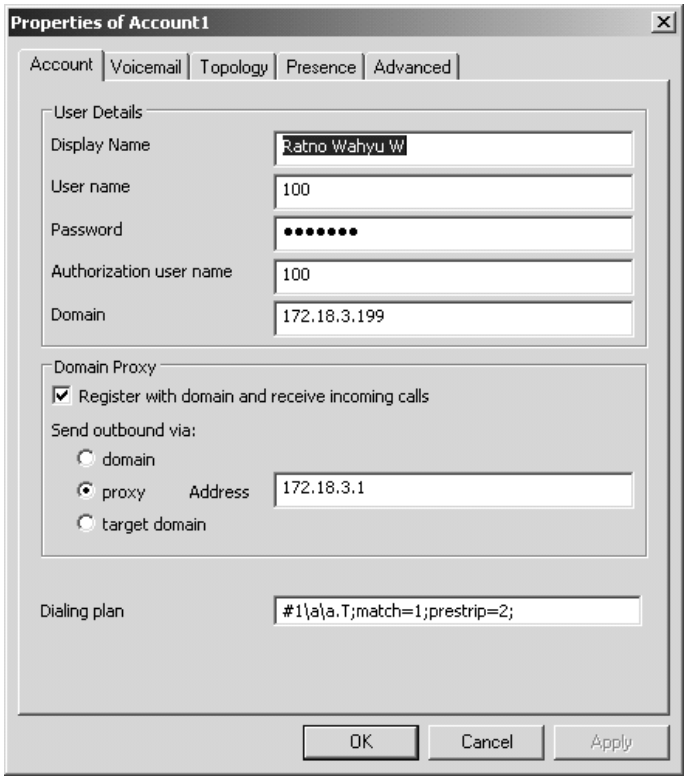


Fig. 4.5. SoftPhone:X-Lite Proxy configuration

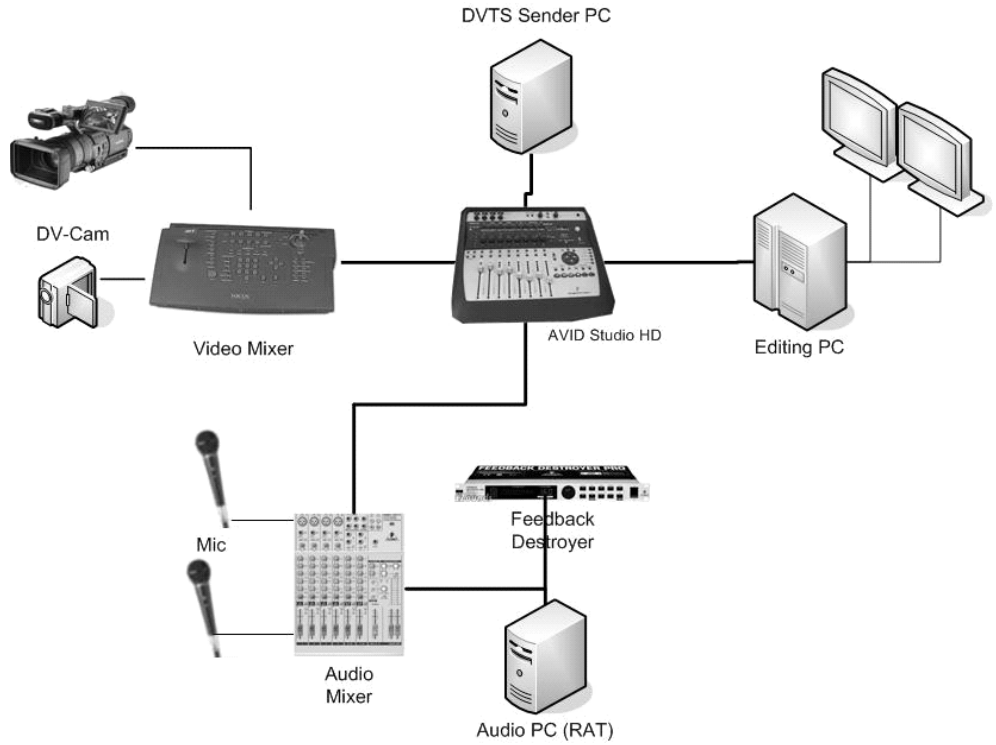


Fig. 4.6. DVTS implementation

preventing problem on satisfies services currently running in the network.

- Implementation

  For the first implementation, we use IPv4 technology with point to point configuration by using unicast address. No changes needed on currently running network by this configuration. All PC that will be used to receive DVTS stream must have DVTS application installed. The DVTS application that we used is DVTS for WindowsXP ver.0.0.1 Rev.1 from WIDE Project `http://www.sfc.wide.ad.jp/dvts/`. In Figure 4.6, is the illustration of our implementation for extending the stream from current SOI Asia class studio.

4.5 Activities at USM

4.5.1 Introduction

The School of Computer Sciences was established officially on the 1st of March 1995 after functioning for a period of 10 years as the Computer Science Section within the School of Mathematical and Computer Sciences. Even with only the status of a Section during that period, it had operated principally as an independent and autonomous unit. The period had witnessed various advances, developments and achievements of Computer Science pertaining to academic programmes, research and development, consultancy, community services and others. With the official recognition as a School in the University, Computer Science will continue its efforts to strengthen its curriculum and at the same time explore research areas that contribute significantly to the development of the nation.

4.5.2 Activities in 2006

1. International Conference of Distributed Frameworks for Multimedia Applications 2006 (DFMA 2006)
2. IPv6 Awareness Program 2006
3. IPv6 Application Programming
   - To expose the network programmers about the benefits of IPv6 in network applications

4. Temasek internship
   - Two from Temasek visit USM on an internship programme to learn how to setup UDL gateway and produce a setup guide for UDL gateway.
5. USM IPv6 Migration

   USM IPv6 migration task was finished at early of November 2006 and we are now using our own block of IPv6 address.

4.6 Activities at ITB

Institut Teknologi Bandung (ITB), was founded on March 2, 1959. The present ITB main campus is the site of earlier engineering schools in Indonesia. Although these institutions of higher learning had their own individual characteristics and missions, they left influence on developments leading to the establishment of ITB.

In 1920, Technische Hogeschool (TH) was established in Bandung, which for a short time, in the middle forties, became Kogyo Daigaku. Not long after the birth of the Republic of Indonesia in 1945, the campus housed the Technical Faculty (including a Fine Arts Department) of Universitas Indonesia, with the head office in Jakarta. In the early fifties, Faculty of Mathematics and Natural Sciences, also part of Universitas Indonesia, was established on the campus.

In 1959, the present lnstitut Teknologi Bandung was founded by the Indonesian government as an institution of higher learning of science, technology, and fine arts, with a mission of education, research, and service to the community.

Government Decree No. 155/2000 pertaining to The Decision on ITB as Legal Enterprise (Badan Hukum) has opened a new path for ITB to become autonomous. The status of autonomy implies a freedom for the institution to manage its own bussiness in an effective and efficient way, and to be fully responsible for the planning and implementation of all program and activity, and the quality control for the attainment of its institutional objective. The institution has also freedom in deciding their measures and taking calculated risks in facing tight competition and intense pressures.

Bandung, with a population of approximately one and a half million, lies in the mountainous area of West Java, at an altitude of 770 meters. The ITB main campus, to the north of the town centre, and its other campuses, cover a total area of 770,000 square meters.

4.6.1 Activities in 2006

1. March–June 2006 Pilot Project Distance Learning EL-3002 Lecture to Universitas Syah Kuala Banda Aceh
   - Dr. Armein Langi gave a four months Digital Signal Processing (DSP) live Course from ITB to Unsyiah using AI^3 infrastructure.
2. June, 19th 2006 DVTS Testing Kyushu University–ITB
   - The 1st DVTS testing that conducted by ITB
3. July 2006 ITB participated in APAN telemedicine conference
   - The 1st high speed connection from Indonesia (ITB) to APAN telemedicine WG members
4. July 2006 INHERENT (Indonesia Higher Educational Research Network) launching
   - The 1st videoconference broadcasted to INHERENT parnerts in Indonesia
5. September 18th, 2006 Seminar On Pedagogy and e-Learning (ITB, ITS, and University of Oulu)
6. November 2006 World Bank conference between World Bank in Japan, UI, and ITB
   - The topic is disaster mitigation
7. November 6th, 2006 World Telesurgery conference hosted by Columbia University in USA
   - ITB got reference from OSC (Ohio Super Computing)

第 5 章　Future Direction

AI^3 plans to achieve results in the following areas in 2007:

1. Simpler and redundance Network topology
2. Stable operation of multicast network
3. Migration to IPv6
4. UDL related research and development

5.1 Future Network Topology

The current AI^3 network is mainly using PC routers. These routers have been very stable in our 10 years of operations, and they are flexible in terms of introducing new services, such as for research and development. In 2007 we will introduce a Cisco router as the border router of AI^3 network in addition to the current router to provide redundancy. This router will be the main border router of AI^3. In addition, we will simplify the network from the current topology as was shown in Figure 2.1 to a new topology as in Figure 5.1. The planned changes on the network are:

1. The current border router (sfc-gate) will be the backup border router
2. The new cisco router (sfc-c7200-gate) will be the main border router
3. A link in SFC will be removed, including it's router (sfc-orochi)
4. Hosts on SFC will be relocated to a new link that is connected to both sfc-gate and sfc-c7200-gate

5.2 Stable Multicast Network

AI^3 plans to add its connectivity to M6bone by MBGP peering with WIDE network and APAN Tokyo XP using native IPv6 link (Figure 5.2), thus AI^3 will have redundant paths to reach M6bone. The current IPv6 tunnel that is used to MBGP peer with RENATER is using the path via U.S. to reach European network. We hope that peering with APAN Tokyo XP will allow us to use TEIN2 as the path to reach Europe.

As the operation of multicast network in AI^3 becomes more important, it is necessary for us to

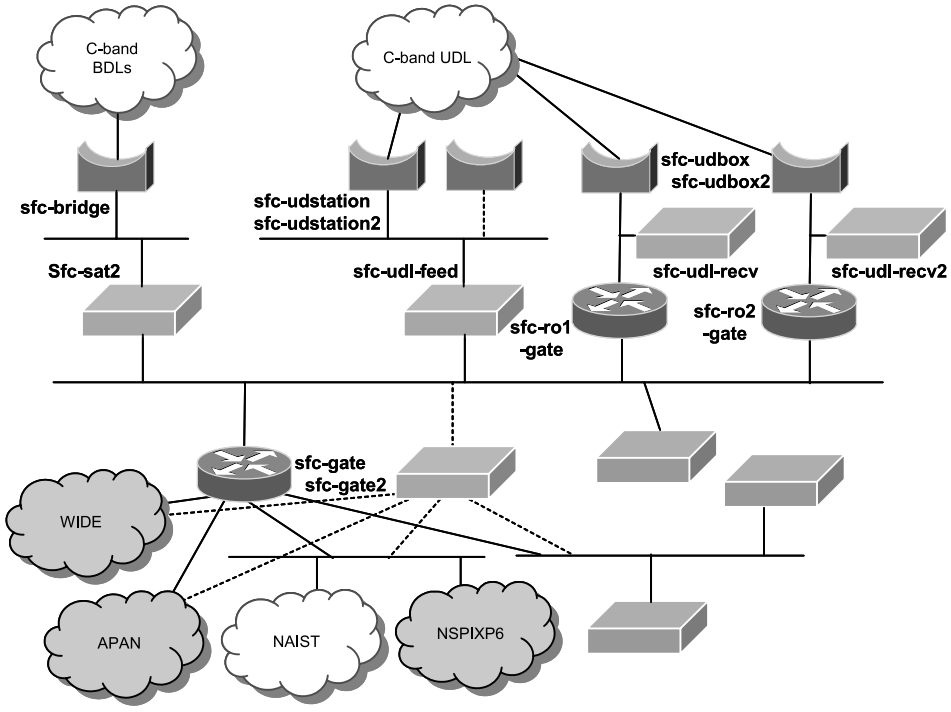


Fig. 5.1. AI^3 planned topology.

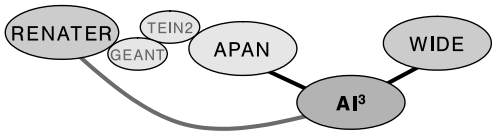


Fig. 5.2. AI^3 planned MBGP peerings.

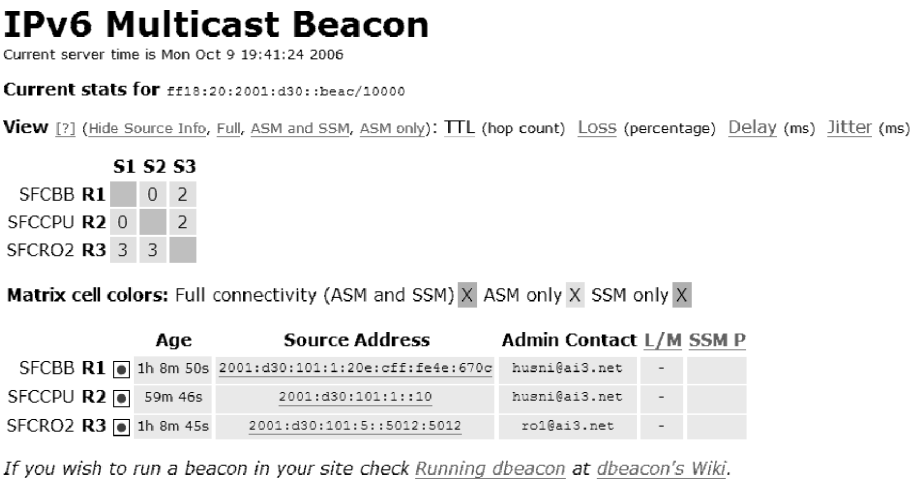
have monitoring systems for multicast network. We will deploy mbeacon to monitor multicast connectivity in AI^3 network. It is in the testing phase, and we will make it operational in 2007. Figure 5.3 shows the test page of the mbeacon in AI^3 network.

5.3 IPv6 Migration

We plan to further migrate our network to IPv6 in 2007. The main focus of this migration is the receive networks that are connected to UDL. The first step of this migration was the renumbering of UDL IPv4 address into private IPv4 address. The next steps are:

- install IPv6/IPv4 portable Squid
- migrate receive networks to IPv6 and renumber their IPv4 addresses to private IPv4 addresses
- run NAT service and IPv6-IPv4 translator to allow receive networks to connect to IPv4 network

Figure 5.4 shows the approach to further migrate the receive networks to IPv6.



IPv6 Multicast Beacon

Current server time is Mon Oct 9 19:41:24 2006

Current stats for ff18:20:2001:d30::beac/10000

View [?] (Hide Source Info, Full, ASM and SSM, ASM only): TTL (hop count) Loss (percentage) Delay (ms) Jitter (ms)

	S1	S2	S3
SFCBB **R1**		0	2
SFCCPU **R2**	0		2
SFCRO2 **R3**	3	3	

Matrix cell colors: Full connectivity (ASM and SSM) X ASM only X SSM only X

	Age	Source Address	Admin Contact	L/M	SSM P
SFCBB **R1**	1h 8m 50s	2001:d30:101:1:20e:cff:fe4e:670c	husni@ai3.net	-	
SFCCPU **R2**	59m 46s	2001:d30:101:1::10	husni@ai3.net	-	
SFCRO2 **R3**	1h 8m 45s	2001:d30:101:5::5012:5012	ro1@ai3.net	-	

If you wish to run a beacon in your site check Running dbeacon at dbeacon's Wiki.

Fig. 5.3. AI^3 mbeacon page.

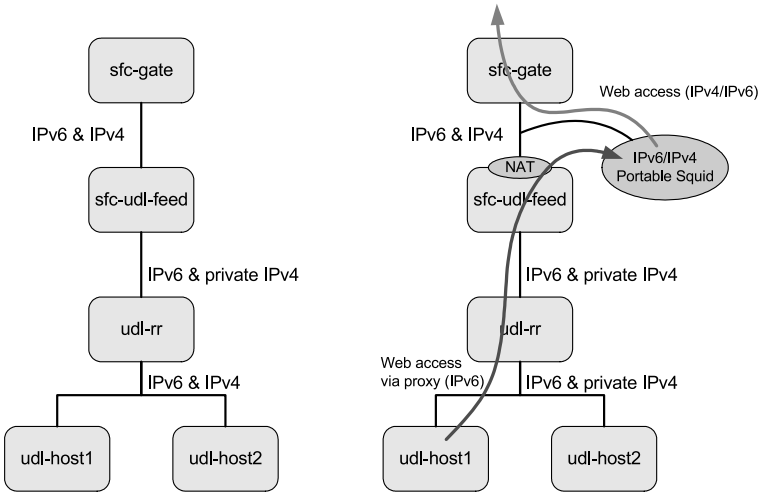


Fig. 5.4. AI^3 plan for IPv6 migration.

5.4 UDL Related Research and Development

We will continue the research on large scale UDL, UDL mesh, and the ANGKOR Project in the next year. The large scale UDL is in the simulation phase, and we plan to produce some results in 2007. Satellite bandwidth assignment work for the UDL mesh is planned to take place in the first half of 2007, and we will continue with some UDL mesh experiments using satellite links involving Universiti Sains Malaysia, Temasek Polytechnic, and Keio University SFC. ANGKOR Project will conduct more preliminary tests before sending medical classes from UPMC, France, to UHSC, Cambodia in 2007.