

School On Internet: An Online Education Project in Asia and Its IPv6 only Network Infrastructure

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Abstract

Online education is education training delivered primarily via the Internet to students at remote locations, which encompasses any kind of learning that, can be done exclusively online. Sometimes this learning is through free, self-study websites. Often, though, students learn through virtual universities such as the WIDE University and others. We are just going to focus about brief introduction and operating environment as well as the current IPv6 network Infrastructure of "school On internet" project under WIDE University running since September 1997. WIDE university is an experimental University to research about the new form of higher education on the Internet infrastructure whose sole objective is to share lectures within Asian countries by implementing latest internet and network technologies. It is a research project which consists of group of research team from twenty-six partner universities of thirteen Asian countries including Tribhuvan University, Nepal.

Keywords: Online, SOI/WIDE/AI3, IPV6, DVTS, VIC/RAT, Linux/FreeBSD, NAT-PT, TOTD, Proxy, Bandwidth

1. Introduction

"School of Internet" is the studying environment to learn about the Internet on the Internet. It is difficult for just one educational organization to gather enough teachers that can teach about this whole new subject and also provide sufficient educational environment for people who want to learn about the Internet systematically. The establishment of "School of Internet" will be an important guideline to set up this new educational field by coordination of different universities of Asia.

SOI ASIA Project utilizes satellite based Internet to provide Internet environments in a less expensive, easy to deploy, and more feasible way for the universities located in the regions where Internet environments are insufficiently developed; conducts research and development of the necessary technology for IT human resource development in Asia while using the environments; and proposes, through field experiments, a new educational methodology for universities in Japan as well as educational institutions abroad. As of April 2007, the SOI-ASIA project has 26 partner organizations in 13 Asian countries including Nepal.

2. Basic Working Principle

The Central control system of this online class is located in Shonan Fujisawa Campus, Keio University Japan. 26 universities of Asia are interconnected through satellite network and all member universities have client server control room and SOI lab to conduct virtual class using two

way video conferencing. Professors from different universities from the world and experts from different companies (like Intel corporation, etc..) are requested to provide class about new technologies[1]. Almost classes are conducted from SFC Japan but it can also be conducted from other universities also. The basic functions of SOI are[5]:

- Entrance registration
- Course registration and authorization
- Lecture archive and distribution
- Q&A and students communication
- Submitting reports
- Tests and grading
- Course survey
- Research
- Class and conference from distance

Tribhuvan University is one of the partner organizations of this project. Center for Information Technology (CIT), Institute of Engineering (IOE) is handling this project as a member. CIT has SOI server control room and SOI lab to conduct virtual classes. Series of lectures (e.g.: Advanced Internet Technology, Object Oriented Software Development, Disaster Management, Bio-energy etc...) are being conducted[6]. Each site has more than two formal operators well trained by the project with responsibilities to handle SOI server and conduct classes. Operators announce class time and course title to students, lecturers and professors through notices. The presentation is being broadcasted live from the central (any one member university, mostly from SFC Japan) to all universities and at

the end of the presentation; students can join to the question/answer section through audio and video conferencing. Students, teachers, professors from any universities, schools and campuses can join on this class.

2.1 Technical Part

This project is supported by several ministries of Japanese government, and ran mainly by WIDE Project, AI3 (Asian Internet Interconnection Initiatives) Project[4], Keio University and Asia-SEED Institute. The official lecture providing partners include Tokyo University of Fisheries and Marine Science, Agricultural Department of Tohoku University, Japan Advanced Institute of Science and Technology, Keio University and WIDE Project

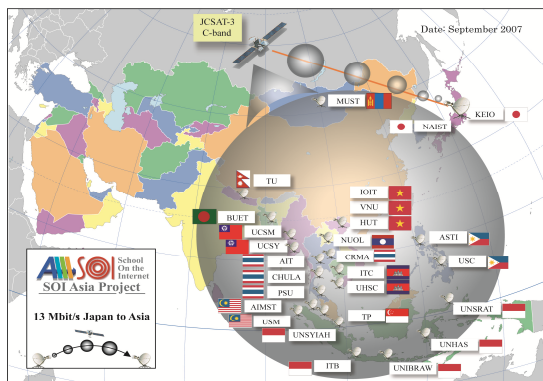


Figure 1 AI3/SOI Partner Universities [3]

In order to develop Internet infrastructure in low cost and short span in the partner sites, and develop distance education environment on the infrastructure, SOI Asia project designed with

- 1) Lecturer site 2) Gateway site and 3) Student site

The lecturer site can be built anywhere as long as it has sufficient bandwidth to carry lecture video and audio in good quality to the gateway site.

The Gateway site is at Keio University, Shonan Fujisawa Campus so that it has 10Gbps connection to Japanese network backbone and also has AI3 project's C-band satellite antenna that can deliver Ethernet packets in 13Mbps.

Receive-only satellite antenna has been used at the student site using UDLR (UniDirectional Link Routing, RFC3077) technology. This technology enables the Ethernet packets to go through 13Mbps AI3 link and come back through existing Internet infrastructure such as telephone line or ISDN. This technology is realized by using special UDLR box and normal router based on FreeBSD. By using this environment, it is possible to deliver good quality video and

audio to the student site, and get feedbacks from the student site through various applications based on their Internet infrastructure.

Mirror servers using Linux system are placed at the student site so that they can refer to their mirror servers when seeing the archived lectures, hence they don't have to connect to remote/overseas original server. Figure below shows the network configuration overview.

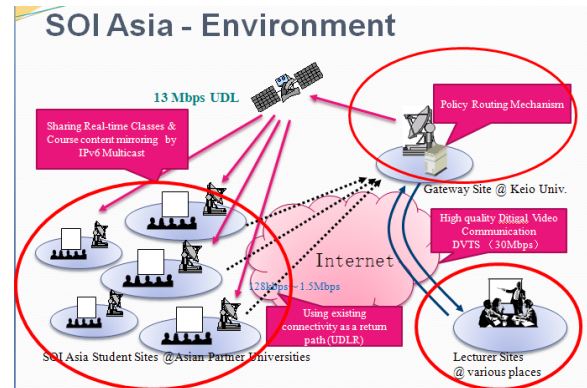


Figure 2 SOI-Asia Class Environment[3]

Application Configuration

Three points in application design:

- 1) The stream can be multicast so that we can deliver lecture stream to multiple partners in Asia
- 2) The stream can be delivered to places without existing Internet infrastructure and
- 3) Interactive session based on student site's Internet connection is possible.

DVTS (Digital Video Transport System, RFC3189) or Polycom (video conferencing system) has been chosen for the connection between the lecturer site and the gateway site, and Windows Media Player or VIC (Video Conference Tool) / RAT (Robust Audio Tool) for the connection between the gateway site and the student site. Various applications are being used such as VIC/RAT, Internet Relay Chat, Bulletin Board, MSN Messenger for the feedback from the student site to the lecturer site. The student site can decide which application they will use based on their Internet infrastructure.

2.2 IPv6 Only Operation in AI3/SOI-ASIA Network

After the shortage of IPv4 as well as other security related problems, new generation addressing mechanism has been designed. Then new IP version 6 has 128 bit length which

enabled to assign IP address to every atom of this universe. In the near future, everything needs to be identified in the globe by its IP address which can be possible only by IPv6 addressing. It means large address space and lots of added feature. But major problem is migrating current IPv4 network to IPv6 network. World's almost internet and networking researchers are involved on the implementation of IPv6 properly behind IPv4. WIDE project is the one who successfully implemented IPv6 on its network.

AI3 and SOI-Asia started its IPv6 network operation since November 2005. The network was operated in both IPv4 and IPv6 until 2007. Currently SOI-ASIA is moved to IPv6 operable network. It is good for us that we are in touch with this research project which enables us to implement and upgrade our network to IPv6. On July 2007, SOI had successfully completed workshop about upgrading its network to IPv6 only operation. Let's discuss in summary about how IPv6 network is implemented within SOI-ASIA network:

The major part is about to access IPv4 web via IPv6 client. SOI-Asia has combined following packages to access IPv4 host via Ipv6 client:

1. Trick Or Treat Daemon (TOTD) and BIND
2. IPv6 enabled proxy
3. Network Address Translation-Protocol (NAT-PT) enabled router

The following figure 3 shows about how to connect IPv4 host by Ipv6 Host. The major concept is generating fake IPv6 address of hosts by using TOTD package. TOTD is an IPv6 DNS proxy which converts IPv4 address into fake IPv6 address by adding some IPv6 prefix.

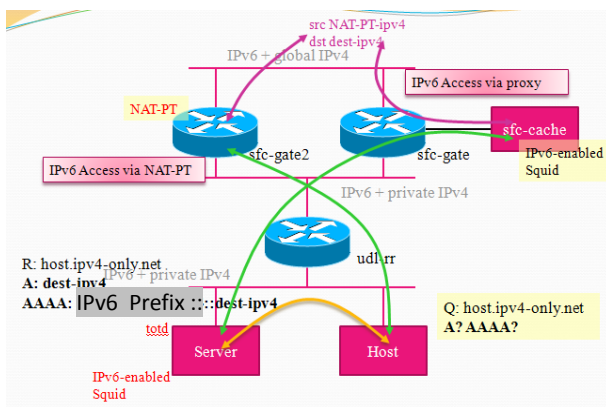


Figure 3 Connection of IPv4 host from IPv6 Host[6]

When a host try to connect to Ipv4 only network, the TOTD on the DNS server generate fake IPv6 Address. Like for

example: if a host is connecting to www.yahoo.com where yahoo.com has only ipv4 address. In the above figure, totd add an IPv6 prefix to the ipv4 address of yahoo.com which is 2001:d30:101:624::IPv4_Address_of_yahoo.com. This is the IPv6 address of yahoo.com. The major function of NAT-PT router is to translate IPv6 address to IPv4 and forward the traffic to the destination. Hence in IPv6 only network yahoo.com has fake IPv6 only address but on the global, it has its own Ipv4 only address. The above picture is the currently implemented IPv6 network of SOI-Asia project where SFC-gate2 is NAT-PT enabled router located in KEIO University Shonan Fujisawa campus Japan. This network is fully operated with IPv6.

3. Importance for Developing Countries

This is a call for a "Grand Challenge" project for achieving truly global connectivity. For over a decade, this project has hypothesized that the Internet could raise the quality of life in developing nations. Internet infrastructure is rapidly growing in Nepal. Growth in Information and Communication Technology would definitely improve the education quality. This is the age of globalization. So world's education standards must globalize. Such projects have major contribution to globalize world's education standards by conducting online live education which includes technologies of developed countries and share different countries education standards.

This is not to say the activity of the past decade has been a waste. The project has demonstrated the value of the Internet and raised awareness. The United Nations and the administrations of nearly all nations have acknowledged the potential of the Internet. The way has been paved, and it is time to act on what we have learned.

4. Conclusion

We have presented the working of online education on the basis of AI3/SOI-ASIA online project with its IPv6 Network infrastructure. Definitely we appreciate the contribution of SOI-ASIA Project which encouraged such developing countries like Nepal towards research and development through online education with latest IPv6 Network infrastructure. On the basis of SOI-ASIA education and technological environment, we are encouraged to implement such a latest technologies and environment towards information and communication sector of Nepal.

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