

FreeBSD and SOI-Asia Project

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Abstract

In this paper we describe usage of FreeBSD operating system for IPv6 Multicast routing platform in SOI-Asia Project. SOI-Asia project is platform to deliver realtime lecture via UniDirectional Link of satellite to several countries in Asia. Because of limited bandwidth in satellite, we use IPv6 multicast to deliver material of lecture and realtime video and audio lecture. We also describe human resources development of operational aspect of the project in several countries in Asia.

1 Introduction

In Asia countries there are high demands for wide-area Information and Communication Technology (ICT) infrastructure. Lack of human resource development make infrastructure development in Asian countries become slow. Today's Broadband Internet's infrastructure have been deployed in Asian countries but it usually only available in major cities. On the other hand, demand of ICT can be solved by satellite communications which have some advantages compare to broadband. They are: wide area coverage, quick installation, and independent from terrestrial infrastructure [3]. This infrastructure can give flexible usage especially for small city or village where there's no broadband connection.

2 What is SOI-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 develop-

ment 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 [4].

As of May 2005, this project has nineteen universities and research institutes partners in eleven countries in Asia, and has deployed receive-only satellite earth stations at each partner site to share the distribution of live lectures from Japan as well as archived lectures. This project is supported by several ministries of Japanese government and ran mainly by WIDE Project, AI3 (Asian Internet Interconnection Initiatives) Project, 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 [4].

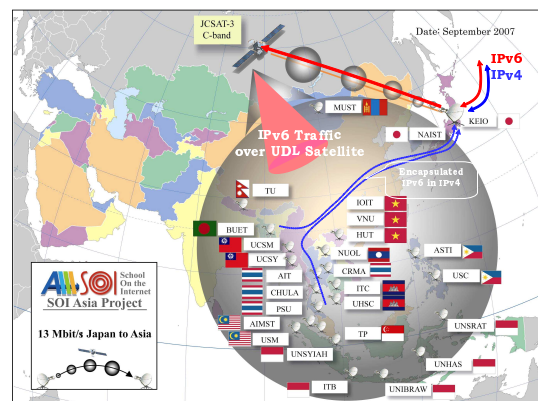


Figure 1: SOI-Asia Map

3 General Operation

Typical network in SOI-Asia's partner is shown on figure 2.

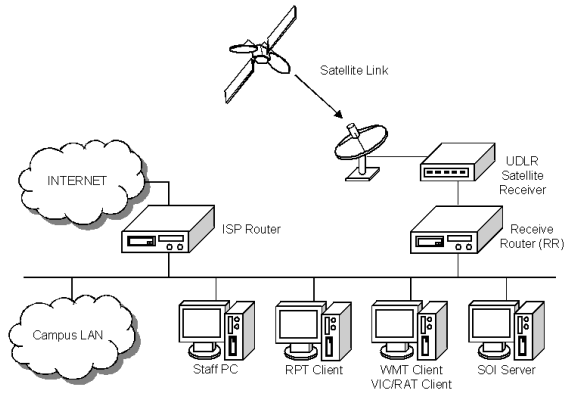


Figure 2: Typical SOI-Asia Network

We have UDLR satellite receiver, Receiver Router (RR), SOI-Server, and several hosts. We use Unidirectional satellite link because it is cheap and it does not need license from government. SOI-Asia employ unidirectional satellite link, therefore it can not accomodate traffic from SOI-Asia's partners (we will use partners in this paper) to Japan. Each partners must have own access to the Internet to be able to send traffic back to Japan.

3.1 UDLR

UDLR (UniDirectional Link Routing) is defined in RFC3077. UDLR basically emulates bidirectional link on two separate one-way link [5]. Figure 3 shows the operation of UDLR.

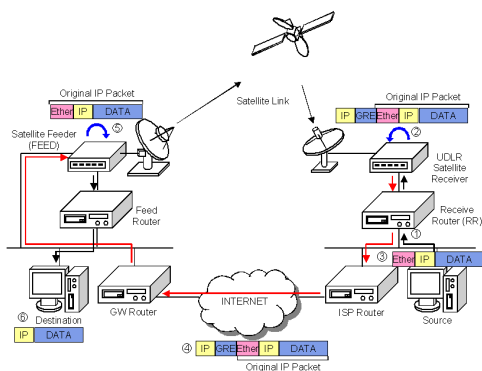


Figure 3: UniDirectional Link Routing

Link-Layer Tunelling Mechnism (LLTM) and

Broadcast Emulation are the core operation in UDLR.

LLTM is mechanism to deliver a data link frame from receiver to feed via other Internet infrastructure by encapsulate the data link frame in GRE packet. Figure 4 shows how LLTM works.

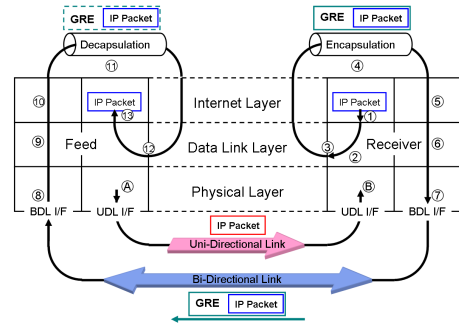


Figure 4: Link Layer Tunelling Mechanism

Broadcast emulation is another core operation from LLTM that emulates bi-directional access on UDL. Broadcast emulation is essential to make ARP works well on UDL. Figure 5 shows how broadcast emulation works.

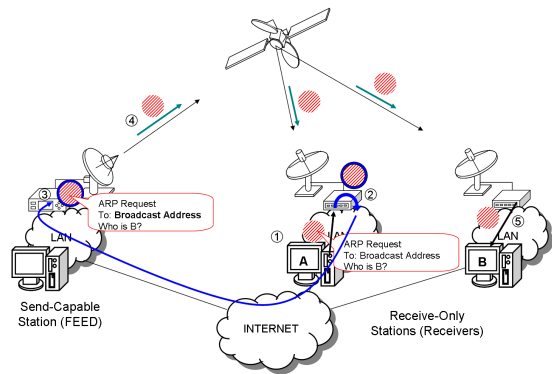


Figure 5: Broadcast Emulation

3.2 Basic Operation

After the basic infrastructure has been provided and works well, next step is to make IPv4 and IPv6 unicast and multicast routing protocol works. We

are using OSPFv2 for IPv4 unicast routing protocol and OSPFv3 for IPv6 unicast routing protocol on receive router (RR). SOI-Asia assign IPv6 /48 IPv6 global address to partners and also /29 IPv4 to partners. We also use IPv4 private address just only for private use (in SOI-Asia network only, it wont broadcast to Internet). We use zebra as routing protocol daemon. For easier installation we use packages instead of ports for partners. For multicast routing protocol we use PIM-SM routing protocol and xorp as routing daemon. Same case as zebra, for easier installation we use packages instead of ports. Example traffic taken SOI-Asia network shown in figure 6 and 7:

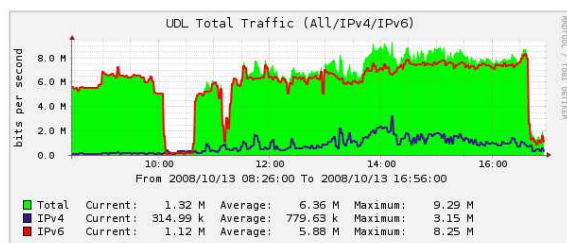


Figure 6: IPv4 vs IPv6 Traffic

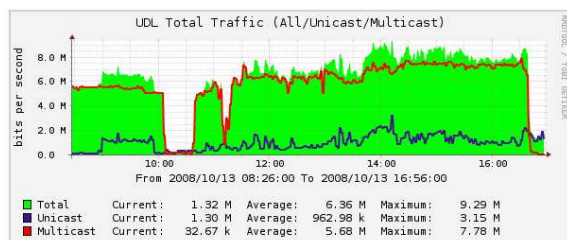


Figure 7: Multicast Traffic

4 Human Resources Development

Once a year we provide workshop for our partners to improve understanding and to solve problem that can occur in SOI-Asia operation. We have several workshop models. Firstly, in 2006 we have face to face workshop model. Every SOI-Asia operator from our partners come to the workshop venue. The face to face workshop well achieved its goal. One of the advantages of face to face model, the participants can learn everything from scratch even they can do experiment directly with physical devices. Secondly, we have remote computer laboratory. We employ number of virtual machines (vm) and configure each vm like SOI-Asia networks. Operator use their own connection to access the vm and practice the workshop's exercise in vm. Thirdly, in 2008 we changed the model from vm to cluster model. In this case we reserved hundreds StarBED cluster machines to emulate SOI-Asia networks [1]. The topics in workshop related to FreeBSD as mentioned below:

- TCP/IP basic
- Unicast routing using zebra
- Multicast routing using xorp

5 On-Going Works:dokodemo SOI and Customized FreeBSD ISO-Images

Currently we are working on making desktop Live-USB. The goal from this work is everyone can access our lecture from anywhere as long there is Internet connection. We provide VPN service for dokodemo SOI. We are currently making Desktop Live-USB using Linux. Another ongoing work is to make customized FreeBSD ISO-Images. From the past time, we always install receive router in partners side using vanilla FreeBSD ISO Images. We learn that it take much time to install and compile new kernel that support MROUTING and next we have to install zebra routing daemon and xorp multicast routing daemon. We are thinking to make customized FreeBSD ISO Image that include MROUTING kernel and if possible include zebra routing daemon and xorp routing daemon. Since xorp now support OSPF routing protocol we are considering unified routing daemon installation that considering to drop zebra routing daemon and use xorp as single routing daemon for both unicast

and multicast. We believe that above plan will save much time on new installation in our partners.

6 Conclusion

In this paper we have been described roles of FreeBSD in SOI-Asia project. We found that during SOI-Asia operation our receive router with FreeBSD works very well for both unicast and multicast routing platform.

Acknowledgments

The author would like to acknowledge to Prof Jun Murai, Prof Keiko Okawa, Achmad Husni Thamin, PhD., Shoko Mikawa, PhD., Toshiyuki Miyachi, PhD., Kotaro Kataoka, Patcharee Basu, and Achmad Basuki.

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