Presentation # 3035

MULTIPLATFORM INTEGRATION

Joko Wasito

PT. Arun NGL Co.

PO. Box 22 - Lhokseumawe

North Aceh

INDONESIA

62-645-652780 / 62-645-652784

e-mail : dxwasito@lse.mobil.com

I. INTRODUCTION.

I.1. Background (Before 1990)

The requirement for improved computer connectivity at the plantsite has been growing some time, but only in the past two years, with the installation of over 300 Personal Computers, have the potential benefits become large enough to justify initiating a project. In addition, similar projects were also in progress at many other major industrial sites, including Mobil refineries in US, Europe and Singapore.

PT. Arun consists of over 2000 regular employees distributed across a large number of offices at the plantsite and one head office in Jakarta. There are various computers in use to support the running of the plant, including **IBM AS/400's**, **HP3000's**, **Yewcom 8000**, **Intergraph**, a **Philips Telex Switch** and also **PABX's**. These support all the maintenance, operation, technical and accounting applications currently in use.

All connections between end users and these computers are achieved by individual dedicated wiring. This method of wiring is **inflexible**, **relatively unreliable**, **offers low transmission rates** and is also **relatively expensive**.

I.2. Problems.

Data-communications facilities within the plant are limited, and mainly provided by underground telephone twisted pair wiring. At this time any connection between a workstation (either a terminal or a Personal Computer) and a central mini-computer requires one separate physical cable. Many of the PC's were not connected at all. The problems with the 1990 situation were :

I.2.1. The installation of one dedicated cable to connect each user to each different computer they need to access is relatively expensive.

II.2.2. As this may not be justifiable, the overall effect is reduced access for occasional users. The benefits of electronic information is dependent on people being able to access and use it easily.

III.2.3. With dedicated cables there is no flexibility to relocate equipment without installing new cables. Furthermore, cable installation is disruptive, time consuming and difficult to plan for as people and office locations continually change.

IV.2.4. The use telephone wiring is subject to the availability of spare pairs of wires. It suffers from limited capacity, electromagnetic interference, earthing sensitivity, and moisture invasion.

V.2.5. There are several twin-axial cables in use for AS/400 which provide more reliable, high speed communications, but these can not be used to access other computers.

VI.2.6. The current technology and cabling do not have the flexibility to utilize newer technologies such as PC file servers.

VII.2.7. New applications that are developed must include the cost of connecting the applications users to the computers.

I.3. Future Trend.

The plantsite needs a standard way to connect PC's, computer terminals and computers together. There are six (6) reasons driving this requirement for connectivity :

I.3.1. All PT. Arun professionals will probably have a computer workstation (terminal or PC) on their desk. It is estimated over 500 workstations will be required.

II.3.2. Electronic Mail will become a common form of communication between professionals. The AS/400 Office will also route mail to external mailboxes belonging to Mobil PROFS/ OFFICE users.

I.3.3. The primary computer applications will be located on multiple host computers. These include the HP3000 and the IBM AS/400s, also several other computers (such as Intergaraph etc.) which will provide specific applications to restricted group of users.

II.3.4. There was a small but constant requirement for interactive access to Mobil's worldwide Data Utility Network (Dun), and this access will be provided through the AS/400 computer. This will be used to run program residing on US computers and to pick up PROFS mail.

I.3.5. The use of point to point cable connections will become increasingly difficult and costly to install and maintain and will provide inadequate connectivity and flexibility for future requirements. The cost of cabling can exceed the cost of the computer equipment. It is also limited in speed, flexibility and functionality. While a speed of 9.6 kbps or 19.2 kbps may be sufficient for terminals but inadequate for PC file transfers and graphics. Relocating a terminal or PC could be as costly as the initial installation, as additional cabling may need to be installed.

I.3.6. Arun Plantsite Network will permit the future connection to other network such as Mobil or Pertamina Network.

II. DESIGN.

II.1. General.

Physical Design of the Arun Network has a Topology Star with several building cascaded. The network is segmented into four (4) segments. Fiber Optic Cabling System is used for connecting between buildings or between main distribution hubs.

The Arun Network uses design feature Access/One. The Access/One Enterprise Wiring Hub is configured for distributing data through fiber optic multi-mode cable (24, 36 and 48 cores) and also Unshielded Twisted Pair Cable Category 3. The use of multi-mode fiber optic cable and also additional installations with different path (several main buildings) are used to have physical redundancy to the network. Currently, not all of the fibers are in use.

Remote links to Arun and Mobil Oil Indonesia Offices in Jakarta are using 38.4 kbps and 64 kbps satellite transmissions. A Microwave transmission of 512 kbps is used for connecting Plantsite and Community. Fiber Optic and UTP cabling are also used for linking the office buildings in community areas.

Broadband Channel CATV which was built earlier is not met the current standard, so it is not connected to the network. For connecting houses to the network remote access servers are used (limited users).

II.2. Technology / Hardware.

Basically, the Arun Network system was designed based on Ethernet 10BaseT System, and most of the network hardware is Ungermann-Bass Products (UB Networks).

The reasons for UB Network Selection was just because :

- Not many Product for connectivity in 1990

- UB components have processor and memory (intelligent module MCA/ISA) so they helped to solve the PC's memory problem since most of PT. Arun PCs were IBM PS/2
- Mobil Oil US has experienced in using the UB Network

II.2.1. Wiring System

II.2.1.1. Fiber Optic Cable

The fiber optic cables of 24, 36 and 48 cores are used for **Inter Building Connections** in Arun Plant Site. More than 1200 splicing points were made during the project. Multimode of 62.5 micron and ST Connectors are used.

The design is not only for computer network but also for CCTV, DCS, Wormald Fire Alarm System and Telecommunication.

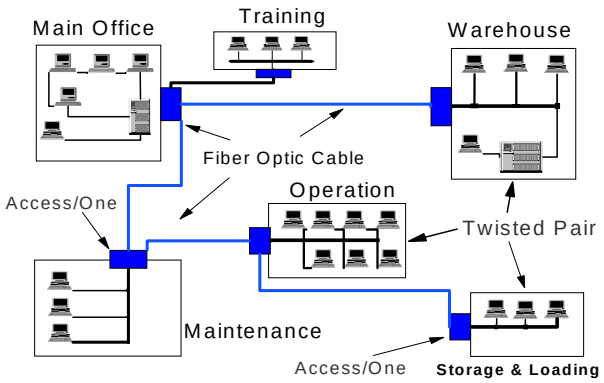


Figure 1. Typical Structured Wiring

II.2.1.2. Twisted Pair Cable

The Unshielded Twisted Pair Cable of cat. 3 is used for cabling system inside the building. Each room has one outlet which consists of one pair twisted pair cable. Cabling system standard is AT & T Standard.

II.2.1.3. Infra Red Transceiver

For temporary usage such as Shut Down Trailer or building which has one or two users an Infra Red Transceiver is used to substitute the cabling for connecting to the network.

II.2.2. Access/One Enterprise Hub's Components :

III.2.2.1.Supervisor Module.

Supervisor Module (ASM 700/710, SUPV 700/710) is an intelligent module that supervise and control all modules in one enclosure of Access/One, up to port level and in a real time. The system control is using control line which is located in backplane control bus in every enclosure. Supervisor controls the power supply and temperature in the enclosure. Beside from NetDirector (through the network), Supervisor can be controlled from the serial port which is in Supervisor module so if we have problem with the network we still can control the Supervisor through remote serial line. Supervisor is controlled by using UB proprietary and also SNMP protocols. It can report a failure in enclosure which is under its control to NetDirector node and fix it to assure the smooth operation of the entire network

Supervisor Module has a hot-card feature that can tell the NetDirector if there is any configuration changes and request of configuration setting (if needed) by using BOOTP protocol. This feature

allows NetDirector to do polling and detail monitoring so it can keep control the health and performance of the network.

Another Supervisor's feature is that it can be connected to one or more backbones as redundancy connection if the main connection fails or broken. If the backbone connection fails and no redundant connection in the system, Supervisor automatically switches to **" loop-back mode "**, and create a sub-network segment that can keep sound connection between nodes and hub.

In the Arun Network, Supervisor Module is installed in almost all Access/One enclosure. Due to some reason Supervisor Module is not installed in Access/One of several building (small buildings with less than 12 PCs, no HP terminal etc.). For small building Access Stax (a hub Ethernet Concentrator for 10baseT distribution) is used.

II.2.2.2. Network Interface Module.

The Network Interface Module (ASM 500/510, NET 500/510) has the same functions with Supervisor i.e. : connecting the Access/One enclosure to the backbone, but it can not supervise the enclosure like the Supervisor Module. The Network Interface Module function is as a backup of the Supervisor Module to keep the connection of the Access/One enclosure to the backbone.

Supervisor and Network Interface Modules are functioning as a Non-Learning Bridge which is just passing the packet completely and correctly. This stops misalignment, collision propagation, bad CRC etc. The advantage of using a buffered card is for resetting 4 half repeater count.

As hub and repeater characteristic, it can reduce **Inter Frame Gap (IFG)**, the time between end of transmission and start of next transmission frame. The gap can be shortened by repeater with reducing the gap while the repeater rebuild the preamble bits (preamble bits is initial mark of a frame and minimum 8 bytes length).

The failure to keep IFG that wide enough will result loosing the synchronization of receiver and assume frame as a collision. This phenomena limits 4 half repeater is connected serially before compromising or building back the packet for data transmission.

Network is designed to use the features of NET 500, but this module was not installed due to the following reasons :

- The network load become very high if this NET 500 is installed.
- The Supervisor Module reliability is high enough, in case of problem only half an hour is required to replace with the new one.

II.2.2.3. Ethernet Concentrator Module

Ethernet Concentrator Module (ASM 310/320, ECM 310/320) is a hub that directly connected to the nodes, 10BaseT device by using twisted pair cable. There is a AUI port on the Ethernet Concentrator that can be connected to other Ethernet Concentrator or bridge.

On the Ethernet Concentrator various configurations can be set up based on performance level required. Concentrator can be identified with digital identification and stored electronically. NetDirector can access this information for easy administration and inventory control. Ethernet Concentrator can monitor the bandwidth utilization per port, so it is possible to analyze network bandwidth for network development purposes. Error Detection Mechanism such as Link Integrity Test, Auto Polarity Detection / Correction and Jabber Inhibit gives easy error finding and deciding its solution.

Ethernet Concentrator characteristic is half repeater. Access/One Supervisor and Network Interface Cards does not add half repeater count. Supervisor and Network Interface rebuild the packet reset the 4 half repeater count to both data traffic directions.

II.2.2.4. Asynchronous Interface Module.

Asynchronous Interface Module (ASM 100, ASY 100) permits a connection from Ethernet Network to asynchronous device such as terminal, printer and modem by using **twisted pair cable** and build a virtual circuit. Asynchronous Interface supports TCP so it is possible to use Telnet commands with RFC standard.

Asynchronous Interface can automatically detect the correct network protocol, so simultaneously connections to different hosts and also movement from one host to another host can be done without doing any login or logout.

Asynchronous Interface also automatically configure the serial port by synchronizing the speed (auto baud), parity, circuit initialization, option for flexible signal behavior and block mode flow control for different device which is connected to the network. So communication configuration is transparent to users.

The use of the Asynchronous Interface is mainly for connecting HP3000 to the Network.

II.2.2.5. Fiber Optic Ethernet Concentrator Module.

Fiber Optic Ethernet Concentrator Module (ASM 800, FEC 800) has the same feature with Ethernet Concentrator but the media that be used is fiber optic cable instead of twisted pair cable. The longest distance that still can be connected is 2 km. In the Arun Network the sub-system of the fiber optic is used as a backbone, so the Fiber Optic Concentrator be used on the main hubs only.

II.2.2.6. Bridge and Router

- Local Ethernet Bridge (ASM 5300, LEB 5300) is a learning bridge that provide Ethernet Traffic Segmentation. Bridge supports IEEE 802.1d, spanning tree algorithm the bridge can define the most efficient path in a large network.

  Local Ethernet Bridge is using " adaptive learning algorithm " for regulating the traffic between the LAN. Bridge has also a capability to detect locations of network resources and filter the traffic. Adaptive Learning makes the Bridge to become intelligent backbone connection to the Access/One hub. Bridge can separate workgroup / department traffic from the entire traffic.

  As of other Access/One Module the Local Ethernet Bridge can be controlled from the NetDirector. Custom Filter can define the filter that used on the Bridge, and with Secure Mode only a specific traffic will pass the bridge so a specific network can be isolated and accessed by a limited users.

  This bridge is used for connecting the Intergraph segment with segment 147.

- Multi Protocol Ethernet Bridge/Router (MPET 5330) is connected to the four segments of the Arun Network and bridges or routes the data packet based on protocols

- Remote Multi Protocol Ethernet Bridge/Router (ASM 8320/8310, RR 8320/8310) is superset of Local Ethernet Bridge. The characteristic is multi protocol so it is capable to do bridging/routing for protocols IP, XNS, IPX, DECnet, AppleTalk. This Bridge/Router has serial ports that can be connected to a Modem for analog connection so it can function remotely.

- UB Routers are also used to connect **Plantsite - Community** and **Plantsite - Jakarta Office.**

- Cisco Router is used to connect the Arun Plantsite to **Mobil Oil Indonesia Office - Jakarta**.

II.2.3. PC's Network Interface

II.2.3.1. UB Network Adapter

The following Network Adapter is added / installed in every Personal Computer to connect to the network,

- Non PS/2 - PC - NIUpc/EOTP (Network Interface Unit for PC/Ethernet on Twisted Pair).
- PS/2 - PC - NIUps / EOTP.

Actually these two adapters are network processors since they own CPU and also local memory on the card, so it can reduce the load of the PC's CPU and PC's memory. These network adapter are very helpful for 80286 type of PCs, which have a very limited memory.

The NIU provide a connection to the network through on board transceiver 10BaseT and RJ-45 connector. The adapter also has AUI connector to connect to the Thick Ethernet. The Stacks that used is UB Monolitic and also UB ODI

II.2.3.2. Non UB Network Adapter

Non UB Network Adapters such as Etherlink III (3Com) are used for PCs with 486 and 586 processors. The consideration to change the network adapter type is just because of the high end PC has faster processor and bigger memory so the network communication load can be handled by PC's CPU and memory. The other reason is, that non UB network adapter price is only 10 % of UB product.

For notebook or PC that does not have expansion slot, xircom Ethernet adapter is used to connect to the network through the parallel communication port.

II.2.4. Hosts, Work Station, PCs and Terminals

II.2.4.1. HP3000

For connecting the Computer HP3000 to the Network a Module **Asynchronous ASY100** is installed in the Access/One Enclosure and connected to HP3000. This module has 8 output slots. The user PC that will access the HP3000 has to have TCP/IP protocol and runs Reflection Software. The Reflection Software from WRQ can also be used for transferring any files from HP3000 to PCs back and forth. Since this connection is using Asynchronous port on the HP3000 side the speed is low i.e. : 9600 bps. The Reflection Software has programming capability, so it can be programmed for searching any empty ports for users who accessing the machine.

Asynchronous Interface ASM 100 is used for connecting HP3000 to terminals and printers using the virtual circuit facilities (serial port).

II.2.4.2. Intergraph CADD Machine

Intergraph Servers is connected to the network by using Twisted Pair Cable through TPAU (Twisted Pair Access Unit) or Fiber Transceiver etc. Since the Intergraph is only accessed by limited users, the traffic to this segment is isolated and separated from the backbone, to reduce network load by using a local bridge LB5300. In the user PC has to be installed TCP/IP Protocol and Telnet.

PDME Application gives a capability for users/engineers to do reviewing, marking, adding and commenting on the electronic drawing and then the draftsman can fix them as required.

II.2.4.3. IBM AS/400

There are two ways for connecting PCs to IBM AS/400 :

- **Via Ethernet (TCP/IP)**
  For this type of connection, an Ethernet Adapter Card has to be installed on IBM AS/400 Machine. Accessing from the PC is using Terminal Emulation Telnet. An IP address is given to the IBM AS/400 machine. If TN5250 is used for the PC an UB socket must be used but DO5250 PC has to run windows and use Winsock (socket for windows). Since this PC runs terminal emulation, from application of AS/400 it can not print to local printer.

- **Netware SAA (IPX)**
  This method is using IPX Protocol. User interface for DOS is **WSF** and user interface for Windows is **RUMBA**. On the AS/400 is installed Token-ring Adapter. Since the Token-ring System on AS/400 is using SNA Protocol and the PC is using IPX Protocol it is required to have a protocol translation. The protocol translation is done by two gateways i.e. : APNSAA and APNRTR. The gateway consists of dedicated PC which is provided with two interface cards and each of them cabled to the AS/400 (Token-Ring port) and Access/One (ECM310).

  Netware provides a bridge software (Netware for SAA) which permits these two network share information. This type of connection has no problems with the local or sharing printing since it runs PC Support. Reflection for AS/400 Software has made easier access to IBM AS/400 (more reliable).

II.2.4.4. IBM RISC6000

This machine has AIX (UNIX) Operating System. An Ethernet Adapter Card is installed to this machine to make it accessible from PCs through the network by using TCP/IP Protocol. This Machine is also used as a Domain Name Server (DNS) for Internet.

II.2.4.5. Yewcom 8000

Yewcom 8000 System is a Computer System which is used to record data from Process Control System (DCS) of LPG Unit. It has HP1000 basis and in the early stage of project it was planned to be connected to the network, but since it has specific component (proprietary), so a lot of difficulties were found for connecting to the network. The plan was canceled.

II.2.5. Host to Host Connection

HP3000 to IBM AS/400

Both of these two machines are connected to the networks. Currently, only FTP is used for transferring files/data from HP3000 to IBM AS/400, processed by a special program in the AS/400 and then the results transferred back to the HP3000 machine for updating.

II.2.6. PC to PC or File Server Connection

A PC has to run TCP/IP and IPX/SPX to connect to the network. PC and File Server are connected to Module ECM310 in Access/One. Beside DOS Operating System user PC can also use other Operating System such as OS2 or Apple / Mac. To make the File Server is functioning (accessible) it has to run the Network Operating System . The Arun Network is using a Novell Netware V3.11 Operating System for 250 users. A preparation is being made for upgrading the Operating System to Novell Netware V4.11 for 1000 users. As a Network Operating System, Netware provides facilities **Printing Utility** (sharing/remote), **backup server**, **file management**, **Security** etc. A lot of third party Software that support the Netware such as **Smart UPS** (UPS that

can be monitored by using Netware), **Lanspool** (printing utility) and also **Lan Invent** which is used for inventory etc.

File transfer between PCs can be done by accessing a group directory for Department and Public Directory for Inter Department. If a PC run a LAN Work Place it will be able to use FTP Server and FTP Client for transferring file directly between two PCs. Another method is using "FASTLINK" where the drive in the PC Server can be attached to drive of PC Client.

III. Arun Network Protocols

There are 3 protocols that used for Arun Network i.e. : TCP/IP , IPX/SPX and Netbios/Netbeui. To connect to the Network and accessing any hosts, each user PC has to run several programs that activates the above three protocols.

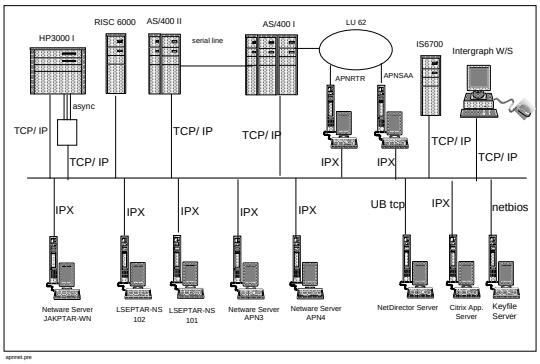


Figure 2. Protocols on Arun Network

III.1. TCP/IP

As we all know, TCP/IP can run on almost all hosts or systems such as UNIX, IBM AS/400 with its OS/400 Operating System, HP3000 with its MPE/iX Operating System and also IBM RISC 6000 with its UNIX (AIX) Operating System etc. TCP/IP has set anything up that related to any specific applications which have their own protocols such as : SMTP, FTP, Telnet and SNMP. This protocol is used to connect user PCs to hosts.

III.2. IPX/SPX

This protocol is used to connect user PCs to Novell Netware File Server and also Sharing Printers. IPX/SPX Protocol has five layers that allow a communication between user PC and Server.

III.3. NetBIOS / NetBEUI

This protocol is bundled in Windows 95 and used for peer to peer communication. Arun network has been using this facilities for **" Local Disk Sharing "** and also **" Printer Sharing "** to reduce the Network load.

IV. Network Management, Operation and Maintenance

IV.1. Network Management and Operation

The Main Application that used in the Network Management is **NetDirector -** Version 17.0 which is also UB Product. NetDirector is a multitasking application which runs on OS/2 Operating System Release. 1.3. NetDirector provides facilities for network monitoring, network

configuration setting, inventory and also multi-vendor network control from one console. A Personal Computer is used as a NetDirector Server and the maximum client that can manage the network is four. NetDirector uses **Simple Network Management Protocol (SNMP)** interactively. To support multi-vendor component, a **Management Information Base** has to be provided. The NetDirector also uses **Object Modeling Technology (OMT)** that enhances the SNMP capability. By using OMT, a new model can be made to SQL database so the device which is from other vendor / brand can be added and controlled by NetDirector.

NetDirector gives the possibilities for deciding which device and up to what logging level must be done. Logging information is very valuable since it provides a deep observation / monitoring of event on the network which is not observed / monitored during outside working hours.

ProTools Network Control Series Software with its product **Foundation Manager** is configured on a Personal Computer for observing the Network Traffic. The benefit from the ProTools can be obtained if the Foundation Manager Machine which will be used is located on one segment and additional Cornerstone Agent installed on the other segment.

This configuration allows the software and hardware are used for monitoring the network all the time and also provide important and deep information about the status and trend of the network.

An OpenView Network Management Software is also used for managing the HP3000 and HP Netserver.

A Novell LAN Analyzer is used for monitoring and analyzing the network traffics and condition so a proactive maintenance and future trend of the Network needs can be anticipated.

V. Network Performance Improvement

V.1. Segmentation / Routing

As mentioned earlier, the Arun Network is segmented into 4 segments i.e. : **Eth 144, Eth 145, Eth 146 and Eth 147**. The segmentation is required since the number of users or nodes is always increased. Due to the IP Addressing System, the number of nodes is limited up to 255 nodes for each segment. Currently, the number of users or nodes has almost reached 1000 users or nodes so four segment has to be implemented.

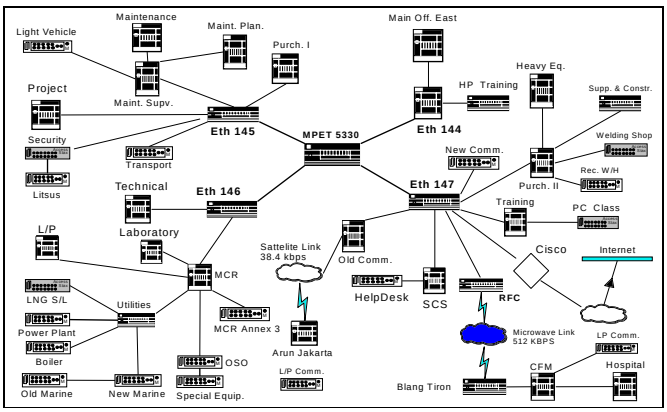


Figure 3. Arun Network Hub Segmentation

After implementing these four segmentation , the network average load level can be reduced up to less than 60 %.

Due to the changing of the IP Addressing system, by the end of this year (1997) the Arun Network will become 16 - 18 segments.

V.2. Switching

V.2.1. 10 MB Switching

An UB Switch (GeoRim) has just been installed for testing purposes before installing a bigger size of Switch (Cisco - Catalyst 5000). A significant improvement on the network quality has been observed during this testing period. By implementing this switching the traffic to a specific node such as server, host etc. will become a dedicated to that specific nodes or server. Non data traffic, false broadcasts and error packet are filtered therefore the probability level of failures in accessing any hosts is reduced.

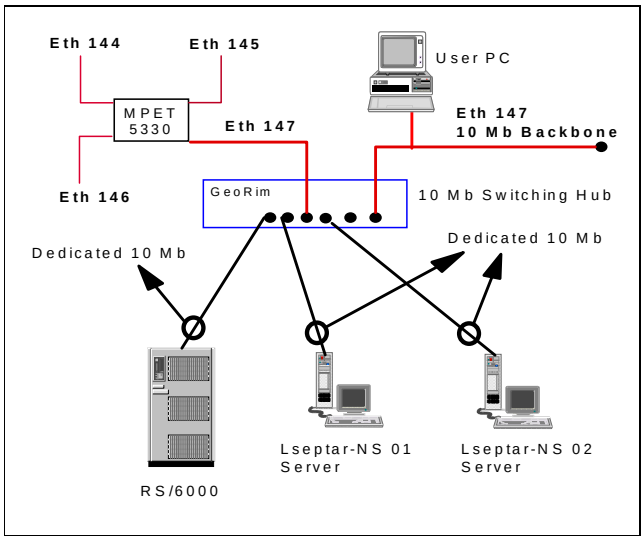
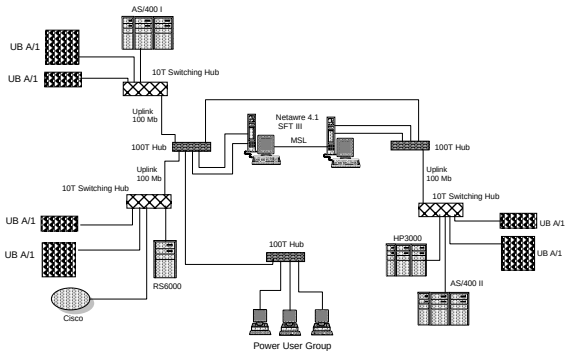


Figure 4. Switching

V.2.2. 10/100 MB Switching

The candidate project for improving the Network to meet the user's needs is by implementing 10/100 MB Switching. Not all users in Arun need a high speed data transmission therefore we still can use most of the current infrastructure. Only for specific users, a high speed road will be provided.



VI. Maintenance

Since PT. Arun Plantsite is a remote area we have been trying to minimize the dependency to outside supports. For getting a quick solution to any problems PT. Arun prepares necessary spare-parts, tools and also develops personnel for doing any repairs.

VII. Conclusion

1. For the time being it is not a problem for connecting many different Computer Brands into a network.
2. For Arun Network which was developed approximately six years ago, it has a problem on simplification of Network Management. This is because of the UB products are still not really “open” so it is still a problem to make UB TCP/IP and TCP/IP of other product to talk.