

INTERNSHIP REPORT
ON
FUNDAMENTAL OF NETWORKING

BY
Ahmad Muhammad Sina



Submitted to the
Department of Electrical and Electronic Engineering
Faculty of Sciences and Engineering
East West University

**In partial fulfillment of the requirements for the degree of Bachelor of Science
in Electrical and Electronic Engineering**

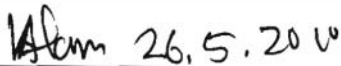
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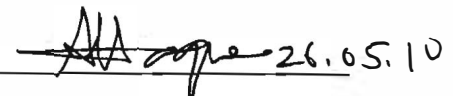
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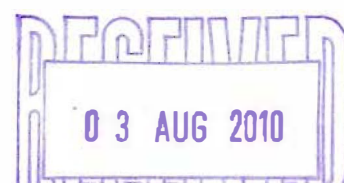
Department Chairperson

Handwritten signature of Dr. Khairul Alam in black ink, dated 26.5.2010.

Dr. Khairul Alam

Handwritten signature of Dr. Anisul Haque in black ink, dated 26.05.10.

Dr. Anisul Haque



Approval Letter

To whom it may concern

This is to certify that Ahmad Muhammad Sina having student ID 2005-1-80-005 has successfully completed the project work that was assigned to him as part of the internship program. I, Mr. Biplob Chakma (CTO, Mango Teleservices Limited) on behalf of MANGO TELESERVICES LIMITED, am recommending this work as the fulfillment for the requirement of EEE 499 Industrial Training at East West University. I wish his success.



Biplob
26/05/2010

Mr. Biplob Chakma

CTO

Mango Teleservices Limited

Acknowledgment

I wish to convey my heartfelt thanks and gratitude to almighty Allah to complete the Internship successfully and also those who all rendered their cooperation in making this report. Without their assistance I could not have completed my Internship.

I would like to thank Mr. Mir Masud Kabir (Managing Director, Mango Teleservices Limited) and Mr. Biplob Chakma (CTO, Mango Teleservices Limited) for giving me opportunity to do Internship at Mango Teleservices Limited.

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I am also very grateful to all of our teachers and fellow friends for their encouragement and cooperation throughout our Internship and academic life.

Finally, we are forever grateful to our parents for their patience and love.

Executive Summary

Mango Teleservices Limited is the only private sector IIG in Bangladesh. This report is based on my internship work in Mango Teleservices Limited. This report is to introduce ISO 9000 Quality Management System and the fundamental of networking. This report actually focuses on different processes of ISO 9000 Quality Management System, equipments used in networking and some basic of networking.

I worked at Mango Teleservices Limited as intern for 12 weeks. My work was divided into two parts. First 6 weeks I worked on ISO 9000 Quality Management System. I tried to define 18 processes among 22 processes from my own point of view with the help of different websites. These works are attached with this document.

Last 6 weeks I worked at Mango NOC. Here I learned about networking and network components. This report contains a detail description about some network components. I also learned about IP addressing, subneting, VLSM, NAT, routing protocols and some router configuration command. This report also contains a detailed overview of these topics.

While working with Mango Teleservices Limited, I have got a lot of opportunities to see and learn how the network components are functioning. I have tried my best to share this knowledge in this report. I would consider my effort to be successful if it has been of use to anyone.



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1. Introduction

1.1 Company profile:

Mango Teleservices Limited is the only private sector International Internet Gateway (IIG) operator of Bangladesh. Mango is committed to bringing best quality affordable internet to the masses of Bangladesh.

IIGs serve as a gateway for routing International incoming and outgoing Internet based data traffic. The gateway is connected with the existing Submarine cable as main link and with the Satellite Earth Station/VSAT as back up until another Submarine cable is available. All ISPs is connected to global internet through these IIGs.

Mango management runs according to the ISO standards. Mango has world class network, equipment, team and international carrier partners.

Mango organized the team by gathering the most outstanding talents of Bangladesh. Top management of Mango returned to Bangladesh from their overseas carriers and recruited the most skilled local engineers and the brightest engineering graduate.

Mango has three POPs in different location of Bangladesh.

1.2 History of the company:

Mango won its license through an open auction from Bangladesh Telecommunication Regulatory Commission (BTRC) on February 25, 2008(License no. BTRC/ LL/ IIG (6) Mango/ 2008-1) and started their operation on 21st August, 2008.

1.3: Slogan: CLIC (Connect Learn Innovate Collaborate)

1.4 Services

Mango Teleservices Ltd. is providing the following Services:

- I. Submarine Cable IP Bandwidth (SMCIPBW)
- II. Satellite IP Bandwidth (SATIPBW)

III. Secured IP Bandwidth (SECIPBW)[Submarine + Satellite]

1.5 Market Commitment:

Mango committed to provide the best quality affordable internet to the masses of Bangladesh and like to play the facilitator roll to all customers.

Mango always eager to Listen to their customers and solves their problems by working in collaboration.

Mango also committed to play proactive role of market catalyst to increase internet penetration and usage. It accommodates and supports all internet content & application related efforts in Bangladesh.

1.6 Mango Employees:

Mango has more than 20 engineers, who have graduated from the best institutions in Bangladesh and overseas. Senior engineers have relevant work experience in very reputed organizations.

Mango has more than 10 extremely qualified and seasoned executives and managers to manage its company affairs.

Mango employees are trained thoroughly to perform to world standards. Mango has internal training program called “Regular Improvement Program for Engineers (RIPE)” which ensure the high engineering standards.

1.7 Network & Equipment:

Mango Network is built with world class, carrier grade equipments from industry leading vendors. The Network architecture is built with maximum resiliency and very high capacity to accommodate 100 fold internet traffic growth of Bangladesh. Mango has selected the network architecture and network devices that can accommodate Terabit traffic switching and routing. The end customers can get Gigabit connectivity to its Network. Mango can accommodate multiple 10 Gigabit Internet connectivity. Mango Network is IPv6 and MPLS ready to help the Internet community of Bangladesh to leapfrog with IPv6 technology.

Mango is connected to the global internet in more than six points using SEA-ME-WE 4 submarine cable system and Satellite network. Its Tier-1 carrier connectivity is established through multiple IP-transit and IP peering arrangements with more than six carriers and provides true internet connectivity through multiple redundant routes and national IX (Internet Exchange) service for ISPs in Bangladesh.

1.8 Interface Specification: (Table 1)

SL#	Spec.	Bandwidth below 100Mb	Bandwidth above 100Mb
01	Cable	SM(single mode) single core Fiber	SM(single mode) Dual core Fiber
02	Connector	LC	LC
03	Interface	FE	GE
04	Interface Module	100 BASE-FX SFP	1000 BASE-FX SFP
05	Module(Wave-length)	1310 nm wavelength	1310 nm wavelength
06	Module(Power)	-9.5dBm(min), -3dBm(max)	-9.5dBm(min),3dBm(max)
07	Module Distance	10km	10km

1.9 Connectivity:

ISP Fiber Connectivity to Mango NOC

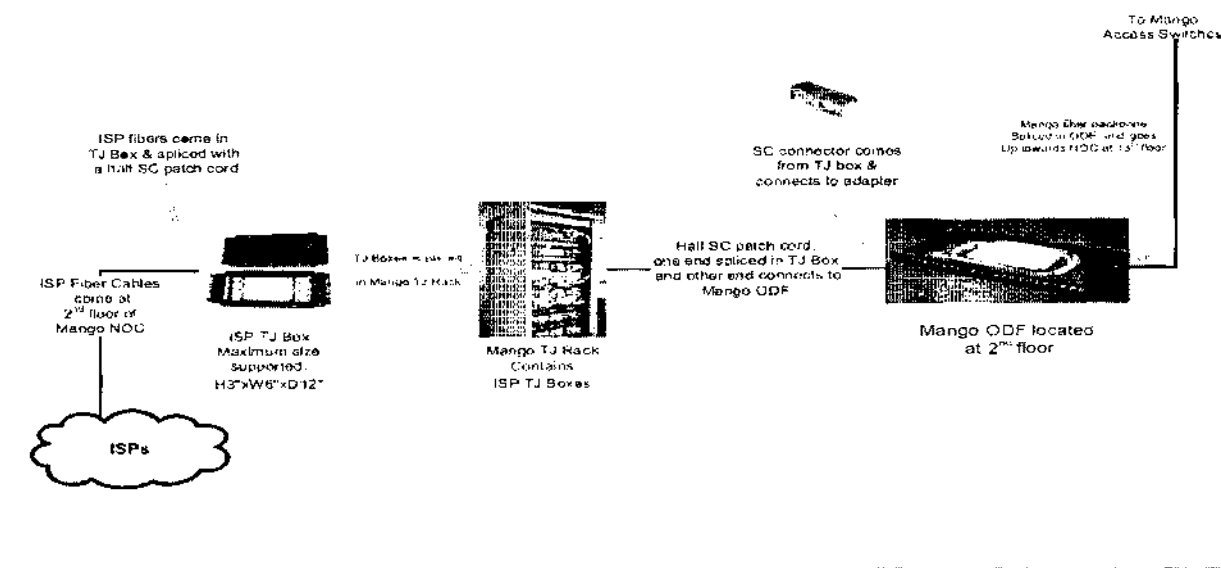


Figure-1: Connectivity of Mango

1.10 Tariff Plan

A. Submarine Cable IP Bandwidth (SMCIPBW)

Slab	Slab Bandwidth (Duplex)	Monthly Recurring Charge (MRC) (BDT/Mbps/Month)	Remarks
1	1-100 Mbps	18,000	
2	101-200 Mbps	17,750	In Addition to Slab 1
3	201-300 Mbps	17,500	In Addition to Slab 1 & 2
4	301-400 Mbps	17,250	In Addition to Slab 1, 2 & 3
5	401 & above	17,000	In Addition to Slab 1, 2, 3 & 4
One time Installation cost (Fast Ethernet port)			BDT 25,000
One time Installation cost (Gigabit Ethernet port)			BDT 40,000
Minimum Order Quantity			1 Mb (with minimum increment of 1 Mb)
Security Deposit			One Month MRC

B. Satellite IP Bandwidth (SATIPBW)

Slab	Slab Bandwidth (Simplex)	Monthly Recurring Charge (MRC) (BDT/Mbps/Month)	Remarks
1	1-10 Mbps	1,05,000	
2	11-20 Mbps	1,00,000	In Addition to Slab 1
3	21-30 Mbps	95,000	In Addition to Slab 1 & 2
4	31-40 Mbps	90,000	In Addition to Slab 1, 2 & 3
5	41 & above	85,000	In Addition to Slab 1, 2, 3 & 4
One time Installation cost (Fast Ethernet port)			BDT 35,000
One time Installation cost (Gigabit Ethernet port)			BDT 50,000
Minimum Order Quantity			1 Mb (with minimum increment of 256 Kbps)
Security Deposit			One Month MRC

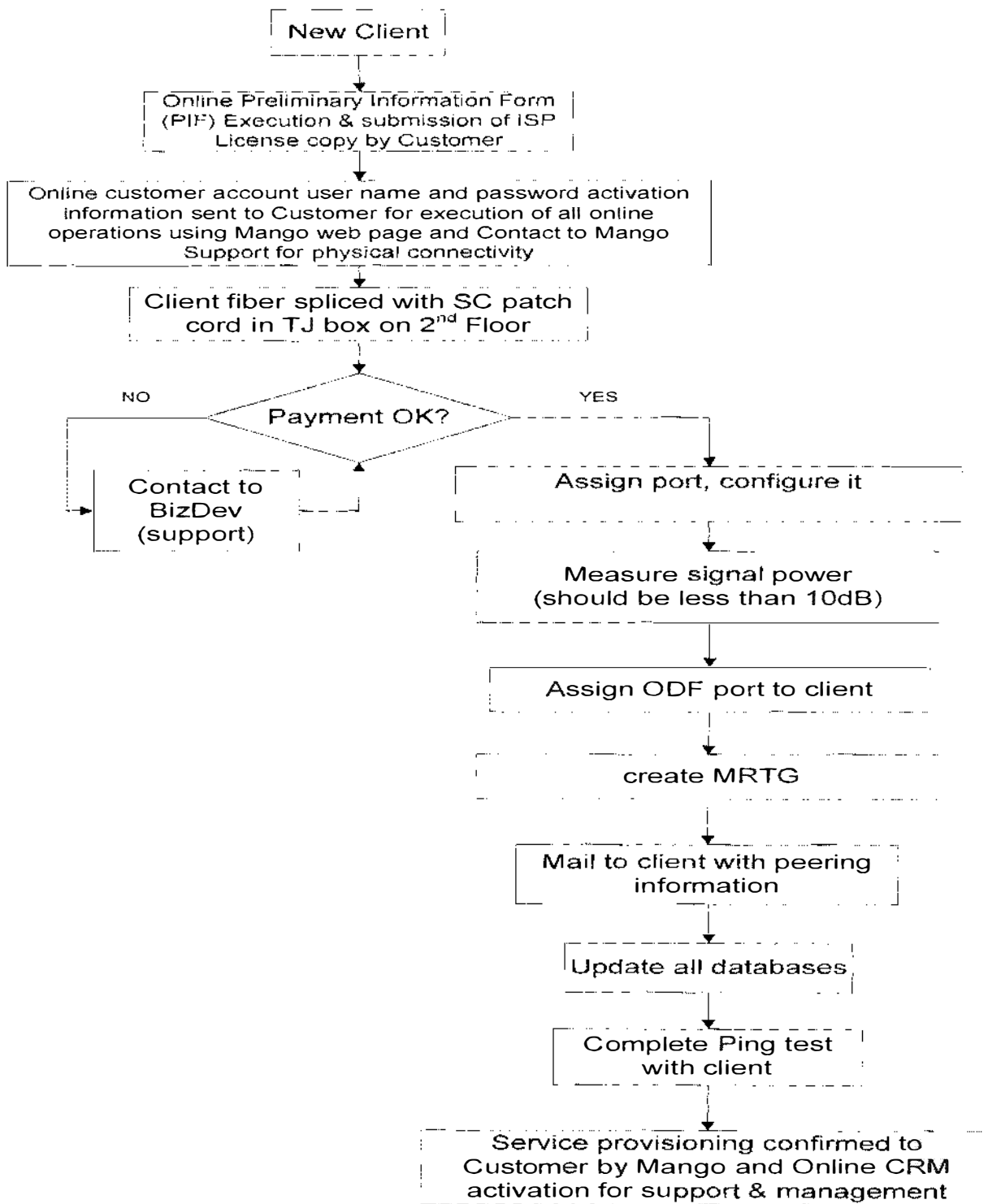
C. Secured IP Bandwidth (SECIPBW)

(90% SMCIPBW plus 10% SATIPBW for downlink and 90% SMCIPBW plus 2.5% SATIPBW for uplink)

Slab	Slab Bandwidth (Duplex)	Monthly Recurring Charge (MRC) (BDT/Mbps/Month)	Remarks
1	1-100 Mbps	28,445	
2	101-200 Mbps	27,621	In Addition to Slab 1
3	201-300 Mbps	26,796	In Addition to Slab 1 & 2
4	301-400 Mbps	25,972	In Addition to Slab 1, 2 & 3
5	401 & above	25,147	In Addition to Slab 1, 2, 3 & 4
One time Installation cost (Fast Ethernet port)			BDT 30,000
One time Installation cost (Gigabit Ethernet port)			BDT 45,000
Minimum Order Quantity			3 Mb (with minimum increment of 3 Mb)
Security Deposit			One Month MRC

Table 2: Tariff Plan

1.11 Mango Service Provisioning Process:



Flow chart 1: Mango Service Provisioning Process

1.12 Success:

- Mango provided emergency internet connectivity to Bangladesh Election Commission.
- Mango successfully restored total internet capacity after major disaster in the Asia – Europe Submarine Cable System on December 21, 2008
- Full Internet capacity restored for Bangladesh by Mango IIG after Submarine Cable system problem on April 17, 2010

1.13 Location:

Mango Teleservices Limited has three POP in different location of Bangladesh.

1. DHAKA IIG POP-1

Address:

82, Mohakhali C/A (12th floor), Dhaka 1212, Bangladesh

2. DHAKA IIG POP-2

Address:

105/1, Agamasi Lane, Dhaka 1000, Bangladesh

3. Chittagong IIG POP

Address:

361/A, Nandan Kanan Paradise Hill, 1st floor, Chittagong

Mango Teleservices Limited has a Corporate Office and a Registered Office in Dhaka.

- **Corporate Office**

Address:

82, Mohakhali C/A (12th floor), Dhaka 1212, Bangladesh

- **Registered Office**

Address:

8, Mohakhali C/A (3rd floor), Dhaka 1212, Bangladesh

1.14 Objective of the Internship:

- To know about Mango Teleservices Limited.
- To know about the business of Mango Teleservices Limited
- To know about the operation of Mango Teleservices Limited
- To acquire some knowledge about basic IP networking.

1.15 Scope:

This report actually provides a overview of ISO 9000 Quality Management System. It also contains description of some network equipments being used in Mango Teleservices Limited.

1.16 Methodology:

This report has been written on the basis of information collected from primary sources as well as secondary sources. The primary information has been collected from personal observation, discussion with employees and technicians. The secondary information has been taken from the company's website and other websites.



2 Detail of Internship Work

My internship in Mango Teleservices Limited was for 12 weeks. First 6 weeks I worked on ISO 9000 Quality Management System and last 6 weeks I worked at NOC of Mango Teleservices Limited.

2.1 ISO 9000 Quality Management System.

ISO stands for International Organization for Standardization. ISO is a network of the national standards institutes of 161 countries, one member per country, with a Central Secretariat in Geneva, Switzerland, that coordinates the system. ISO is a non-governmental organization that forms a bridge between the public and private sectors. On the one hand, many of its member institutes are part of the governmental structure of their countries, or are mandated by their government. On the other hand, other members have their roots uniquely in the private sector, having been set up by national partnerships of industry associations.

I worked on 18 processes of ISO 9000. Here is a brief discussion on it.

2.1.1 Quality Management Process

Quality management process is management activities and functions involved in determination of quality policy and its implementation through means such as quality planning and quality assurance. The organization should establish, document, implement, maintain and continually improve a Quality Management System. This should be achieved by identifying relevant processes, determining the sequence and criteria of these processes, ensuring information is available on the processes and by measuring and monitoring these processes.

Steps for the Quality management Process:

- 1) Management commitment should be written document.
- 2) Quality policy should depend on quality objectives and customer focus
- 3) Operation and planning meetings should be arranged.
- 4) A quality manual should be provided
- 5) A management representative should be appointed to communicate with employees.

- 6) Arrange training.
- 7) Performance should be measured efficiently.
- 8) Management reviews should be taken place.

2.1.2 Resource Management process

Resource Management process is the process of using a company's resources in the most efficient way possible. These resources can include tangible resources such as goods and equipment, financial resources, and labor resources such as employees.

Key points about resource management

1. Provision of resources
2. Training, awareness and competency
3. Facilities
4. Work environment

Resource can be three kinds

- Human resource
- Physical resource
- Financial resource

Discussion:

- Human resource: Human resource is scarcest and most crucial productive resource that creates the largest and longest lasting advantage for an organization

Focus:

- a) Set a policy to identifying and hiring best-qualified candidate
- b) Training must be organized to improve the recipient's performance
- c) Training must be evaluated to justify its effectiveness.
- d) Set some administrative rules.

- e) organization should fix a suitable work time for its employees
 - f) Set a suitable payroll.
 - g) Keep a good work environment.
- Equipments & infrastructure management process:
 - a. Acquire infrastructure as per need.
 - b. Maintenance policy should be established.
 - c. Purchase equipments in efficient way.
 - d. Quality of the product should be investigated.
 - Finance Management Process:
 - a. Acquire finance by taking loan, donations etc.
 - b. Flow of cash should be maintained efficiently.

2.1.3 Market research process

The market research process includes the systematic identification, collection, analysis and distribution of information for the purpose of knowledge development and decision making. The reasons and times at which a company or organization might consider performing marketing research varies, but the general purpose of gaining intelligence for decision making remains constant throughout. Any organization can follow the following steps in the market research process:

- a) Define Marketing Problems and Opportunities
- b) Set Objectives, Budget and Timetables
- c) Select Research Types, Methods and Techniques
- d) Design Research Instruments
- e) Collect the Data

- f) Organize and Analyze the Data
- g) Use Market Research Findings



There are two types of research:

- primary research
- Secondary research

Primary research: Primary Research involves collecting new information to meet the specific needs.

Primary Research can be two kinds:

Qualitative: Gathering descriptive information, usually representing verbal or narrative data through open-ended interviews or focus groups.

Quantitative: Gathering numerical information that can be analyzed statistically through surveys.

Secondary Research: Secondary Research involves analyzing information that already has been gathered for another purpose.

Secondary research is usually faster and less expensive. Gathering secondary research may be as simple as making a trip to a local library or business information center.

2.1.4 Product Design Process

Design is the process by which the needs of the customer or the marketplace are transformed into a product satisfying these needs. It is usually carried out by a designer or engineer but requires help from other people in the company.

Main focus:

- Manufacture - The product should made with own facilities.

- Customer need - produce a product according to the customer need.
- Purchasing – Ensure that the parts specified are in stock.
- Cost - The design must not cost too much to make.
- Transport - The product must be in right size for transporting.
- Testing - After producing a product it is very important to test it before it is launched to market.
- Sales- Company should set a suitable price for the new product.
- Disposal - It should be easy to dispose the product at the end of its life.

2.1.5 Production Process

Production process is concerned with transforming a range of inputs into those outputs that are required by the market.

There are two kinds of resources

- 1) Transforming resource: The tools which are used to carry out the transformation process are called transforming resource. It includes building, machinery, manpower and all kinds of physical resources.
- 2) Transformed resource: The raw materials and components which will be transformed into products are called transformed resource.

Production process can be many kinds

- 1) Job production: Job is a unique product. It exactly matches the requirements of the customers. Job production can be done by a single person or it could be a team work.

Main focus:

- a. Discuss with customer about what he needs
- b. Make a detail of the job requirements
- c. Make detail of job process

- d. Approve the job outline from the customer
- e. Start working on the job.

Benefits:

- a. It gives employees greater level of satisfaction
- 2) Batch production: When a specific group of components go through a production process together is called batch production.

Main focus:

- a. Product should be of similar kinds
- b. Product can be made from same machine with different settings

Benefits:

- a. Quick respond to customer order
 - b. Easy costing
 - c. Provide better information to management
- 3) Flow production: Batch production waits for the full batch to produce. But in flow production there is no wait for the full batch to produce. In flow production when a stage is completed I directly passed to the next stage. It maintains a chain of flow from start to end.

Main focus:

- a. Production line must works smoothly on each operation
- b. It should maintain a standard time length
- c. There should not be any movement of leakage in the process

Benefits:

- a. Minimized time and cost
- b. Easy to control
- c. No need for large storage space
- d. Raw materials quickly converted into sales.

2.1.6 Product Protection Plan/process

Warranties, extended warranties or mechanical breakdown insurance which is offered by a producer under some terms and conditions is called product protection plan or product protection process.

Collateral assurance about the sold product is called warranty. Warranty includes repair or replacement of sold products under certain terms and conditions.

So protecting the product after sell by offering warranty to achieve customer satisfaction is known as product protection process.

Main focus:

- a) There should be predetermined plan for product protection based on the nature of the product.
- b) There should be a written agreement between the buyer and seller which will contain the terms and conditions about product protection.
- c) Both buyers and sellers are bound to follow the terms and conditions of the agreement.
- d) Warranty will be void if the customers break the terms and conditions of the agreement.
- e) Product protection plan must have a time limit. No claim for warranty will be applicable after that time period.

- f) The agreement between the buyer and seller should be realistic and have an easy access.
- g) Company/ seller may offer extended warranty period on pay after the committed warranty period.
- h) Terms and conditions of warranty should be made based on the expected use and quality of the product.
- i) A company/seller must establish a customer care center.
- j) Customer support can be provided by emails.

2.1.7 Customer needs assessment process

Customers are the heart of a company. It can't sustain without customers. There are various kinds of customers and their needs are also different. Each of them has unique types of needs. It is very important to have a good understanding about those needs. It helps to serve customers successfully and to develop new product.

Customer needs assessment is a kind of survey and should focus on the following things:

- a. Average income of the customer
- b. Region of the customer
- c. Present product or service purchased by the customer
- d. Factors drive the customer most. Factors are money, service and reliability.

2.1.8 Customer communication process

Customer communication process is an essential requirement for a company, which really wants to get an in-depth understanding of that customers are really think about the company. It gives the company the ability to focus on each of its customers and to execute a marketing plan. A

company must remember one thing that every interaction with a customer is an opportunity to deliver value and build loyalty.

Main focus:

- a) Customer communication document should be a real time document.
- b) There should be an arrangement for online document production and distribution.
- c) There should be a facility for on-demand document retrieval.
- d) Customer self service should be reliable, secure and flexible.
- e) A company must not force a customer to stay with them.
- f) Make sure that customers are not confused about the product.
- g) Retention offers must be implemented.
- h) A company must help their customer to use their product.
- i) Communication strategy must be well defined.
- j) A company should send attractively branded emails to customer to increase brand recognition.

2.1.9 Internal communication process

Communication is a process for exchanging information with each other. Effective communication occurs when the receiver clearly understands the intended message that was sent.

Internal communications is a communication process that is held within an organization and between the members of that organization. The ultimate goal of internal communications is to enhance the organizational communication process and bring efficiency in the work processes in the organization.

Undergraduate Internship

Most of the organizations spend more time, money and effort on external communication plan. But they can't realize the importance of the internal communication. A good internal communication plan is a protective strategy for long-term business success.

Benefits:

- a) All employees working towards the same goals through clear direction for everyday activities.
- b) Create a common vision of work.
- c) Supportive and knowledge sharing work culture grows among the employees.
- d) Ensure the efficient use of resources.
- e) There grows a clear understanding between management and employees.

Some issues to take care about:

- a) There should exist an atmosphere of mutual trust
- b) There should be a two way flow of information between employees and management.
- c) Management should have a long term focus.
- d) Management should take steps to improve employee's understanding and response to each other's needs.
- e) Every employee has to have a clear understanding about the mission, goals and values of the business.
- f) Internal communication strategy should be integrated with the overall business strategy.
- g) Ensure that the information is available in timely manner.
- h) Information must have a easy access.
- i) Try to remove misunderstanding and miscommunication.
- j) Modified quality objectives must share with the employees.
- k) Employees must not miss any important meeting or training session.
- l) Revised safety protocols must be implemented.

2.1.10 Document control process

Good document control is the foundation of any successful process. In a company many documents are written such as office document, plans, procedures, contacts, drawing and others. It is important to maintain control over the distribution, updating and storage of those documents, to make sure that the workers will receive and use the proper and latest plans, references and related materials. An effective document control can reduce costs by helping eliminate wasted effort and materials due to the use of improper documents. It can help to achieve better customer satisfaction. It is fact that a well documented good product is better than an excellent product that is poorly documented.

Main focus:

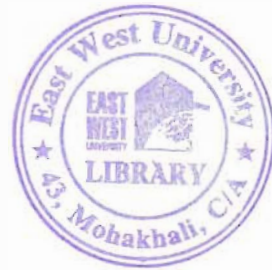
- a) Store and distribute documents electronically
- b) Ensure the security of the documents
- c) Documents should be revised if needed
- d) Documents should be reviewed by authorized personnel
- e) Document approval by management is needed
- f) The management must make sure that the correct documents are provided to the correct people.
- g) There should be a simple framework for document life cycle
- h) Documents should be understandable to all
- i) To avoid miscommunication obsolete documents must be removed
- j) Company should re-issue documents after a practical number of changes have been made
- k) To prevent the use of non-applicable documents company should maintain a master list of recent documents.

2.1.11 Record keeping process

Accurate record keeping is an essential part of a successful company. A company should keep previous records for its own benefit. Previous records can be very helpful. In crises time management can take help from these documents. All valuable information like financial reports, product quality records etc should be kept as record for further use.

Main focus:

- a) There should be a record database.
- b) Any important information should not be missed.
- c) Record can be kept on paper or electronically.
- d) The documents which are kept as record should have easy access.
- e) If records are kept electronically then the security of the system should be strong
- f) It is important to identify the importance of the documents which are going to be kept as record.



2.1.12 Planning process

Planning process is the most common activity in management. Planning is setting the direction for a work and then guides the system to follow the directions.

Main focus:

- a) A plan must have a goal
- b) Plan should be made according to the company resource
- c) A plan should ensure the proper utilization of resources
- d) Company should involve experienced people in the planning process
- e) Planning information should be written on paper

- f) Goals and objectives must be realistic
- g) Any critical missing step should be identified in planning process.

2.1.13 Training Process

Training is a key part of business growth and change. It is a means of communicating new knowledge and skills and changing attitudes. It can raise awareness and provide people with opportunity to explore their existing knowledge and skills. In a training a trainer and participant work together to transfer information from the trainer to the participant.

Main focus:

- a) The trainer should be highly experienced
- b) Those who are selected must attend the training session
- c) Training must be arranged for development purpose
- d) Make sure training is relevant to participants work
- e) Encourage participants to be responsible for their own learning
- f) Give participants the opportunity to practice new skills.

2.1.14 Internal audit process

Internal audit process is an independent, objective assurance and consulting activity which is designed to improve an organization's operations. The adequacy and effectiveness of internal control system is measured and evaluated here. It identifies weaknesses in business practices and management system and recommends improvements. It also identifies opportunities to reduce expenditures and increase revenues.

Main focus:

- a) Auditors should be professional, efficient and well disciplined
- b) A notice should be send to the auditee .

- c) Purpose and plan should be approved by the senior management
- d) An introductory meeting should be arranged to discuss objectives, timelines and important information.
- e) There should be well arranged fieldwork.
- f) The auditor must make a summary of fieldwork results and send it to the senior management for review.
- g) Copies of final and approved report should be distributed to operational managers.
- h) A follow-up must be performed.

2.1.15 Management Review process

In early 2006 management review process was introduced for people in senior manager positions and above. Management review is placed on the organization to establish a Quality Management System in a company. This policy provides the direction and authority for a performance review process that establishes goals and expectations. It is like stock taking. It is carried out at predetermined interval, based on what has been the complexity and nature of organization.

Management review process should focus on following key points:

- a) Improvement of the effectiveness of the quality management system and its processes.
- b) Improvement in product quality.
- c) Analyze customer's feedback
- d) Review internal and external audit results
- e) Performance investigation of employees.
- f) Organizations preparedness against changing environment.

- g) Take suggestion from previous management review.

2.1.16 Monitoring and measuring process

Monitoring and measuring process is to ensure that all the processes, which are implemented by the management, are under control and the output result is as planned. Determining the effectiveness and enforcement of all processes is also a big task of this process, which will help to find out the opportunity of improvement. By this process a company can obtain the highest effectiveness of the implemented processes.

Main focus:

- a) Management committee determines the controlling procedure of the process
- b) All commands by the management have to be obeyed during the time of implementation of the process.
- c) Statistic techniques can be applied in monitoring process
- d) All processes (processes that directly affect the customers' satisfaction) should be monitored and measured.
- e) The result of monitoring and measuring process can be compared with the planning results of that process.
- f) The result of the monitoring process should be recorded into a document.
- g) Monitoring and measuring should be done before yearly management review meeting.
- h) If any error is detected management can issue a corrective action report.

2.1.17 Nonconformance management process

Any product's Quality, Reliability and Safety depend to a great extent on its conformance to the specifications that have been tested, approved and proven safe at every aspect. For this reason,

proper handling of nonconformance of products is very important. So a company should establish and maintain procedure for defining responsibility and authority for handling and investigating nonconformance and for taking corrective and preventive actions.

Main focus:

- a) A company must develop a procedure for investigating nonconformance.
- b) Company should take steps to modify existing procedures as preventive action.
- c) A company must take the necessary actions to mitigate impact of nonconformance.
- d) Besides of scheduled audit surprise audits should be arranged.
- e) Auditors must be highly experienced on the related field.

2.1.18 Continual Improvement process

Continual Improvement process is a set of activities designed to bring gradual but continual improvement to a process through constant review. It is an incremental process of becoming a smarter, stronger and more successful organization.

Quality is a never ending quest and continual improvement process is a never ending effort to discover and eliminate the main causes of problems. So we can tell that the continual improvement process means making thing better today than yesterday.

Main focus

- a) Find out what is important for company's success.
- b) If existing process is not well enough for the company then corrective actions should be taken.
- c) All changes should be approved by the higher authority.
- d) A company should take customers opinion about the product.
- e) Company should arrange training to improve skill of the employees.

2.2 Technical Part

Last 6 weeks I worked at NOC. Here is a detail of my work.

2.2.1 Network components:

First I learned about some network components.

2.2.1.1 Bridge:

A network bridge, also known as a layer 2 switch, is a hardware device used to create a connection between two separate computer networks or to divide one network into two. Bridge filters data traffic at a network boundary. It reduces the amount of traffic on a LAN by dividing it into two segments. It is a layer two device. It inspects source and destination MAC address and frame size then makes forwarding decision.

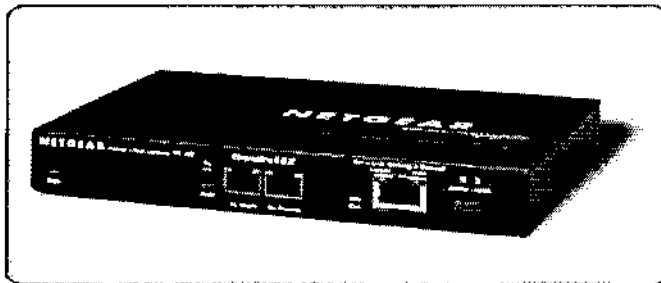


Figure-2: Bridge

2.2.1.2 HUB:

A hub is a device for connecting multiple twisted pair or fiber optic Ethernet devices together and making them act as a single network segment. Hubs work at the physical layer (layer 1) of the OSI model. The device is a form of multiport repeater. Repeater hubs also participate in collision detection, forwarding a jam signal to all ports if it detects a collision.

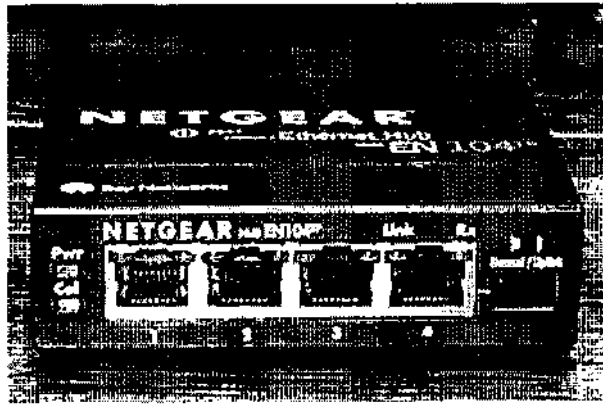


Figure-3: Hub

2.2.1.3 Switch:

A **network switch** is a small hardware device that joins multiple computers together within one local area network (LAN). Technically, network switches operate at layer two (Data Link Layer) of the OSI model. Network switches appear nearly identical to network hubs, but a switch generally contains more intelligence (and a slightly higher price tag) than a hub. Unlike hubs, network switches are capable of inspecting data packets as they are received, determining the source and destination device of each packet, and forwarding them appropriately. By delivering messages only to the connected device intended, a network switch conserves network bandwidth and offers generally better performance than a hub.



Figure-4: Switch

2.2.1.4 Router:

A **router** is a device that interconnects two or more computer networks, and selectively interchanges packets of data between them. Each data packet contains address information that a router can use to determine if the source and destination are on the same network, or if the data packet must be transferred from one network to another. Where multiple routers are used in a large collection of interconnected networks, the routers exchange information about target system addresses, so that each router can build up a table showing the preferred paths between any two systems on the interconnected networks. It is a layer 3 device.



Figure-5: Router

2.2.1.5 ODF:

Optical distribution frame is a fiber optic management unit used to organize the fiber optic cable connections. They have modularized design with sliding type trays inside and could be pre-installed with various kinds of fiber optic adapters and pigtails. The optical distribution frame is with standard 19 inch size and it is properly designed to control the bend radius of the cable inside the enclosure to avoid extra optical loss. They are ideal for indoor fiber optic cable connections storage, distribution and management.

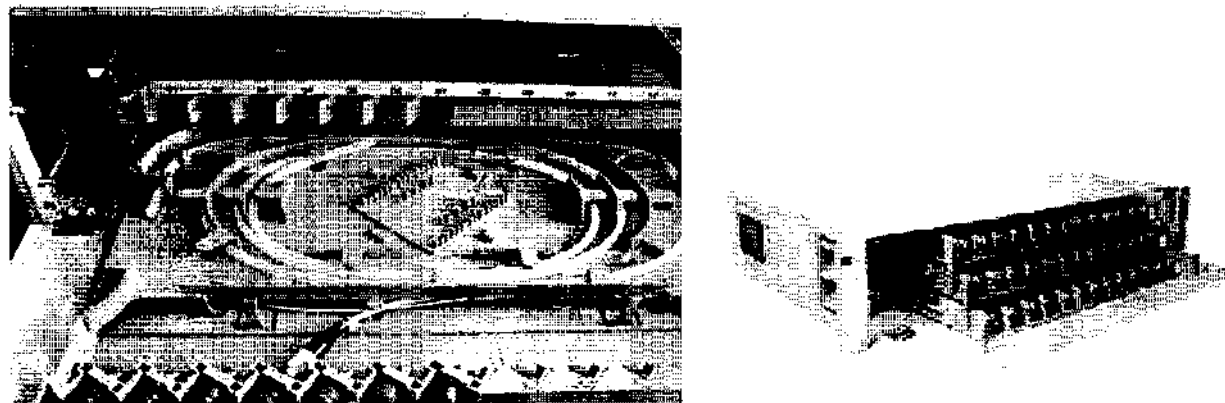


Figure-6: ODF

2.2.1.6 Cables:

Cable is the medium through which information usually moves from one network device to another. There are several types of cable which are commonly used with LANs. In some cases, a network will utilize only one type of cable, other networks will use a variety of cable types. The type of cable chosen for a network is related to the network's topology, protocol, and size. Understanding the characteristics of different types of cable and how they relate to other aspects of a network is necessary for the development of a successful network.

There are many kinds of cables but I will discuss about Unshielded Twisted Pair (UTP) Cable and Fiber Optic Cable here.

2.2.1.6a. Unshielded Twisted Pair (UTP) Cable

The quality of UTP may vary from telephone-grade wire to extremely high-speed cable. The cable has four pairs of wires inside the jacket. Each pair is twisted with a different number of twists per inch to help eliminate interference from adjacent pairs and other electrical devices. The tighter the twisting, the higher the supported transmission rate and the greater the cost per foot. The EIA/TIA (Electronic Industry Association/Telecommunication Industry Association) has established standards of UTP and rated six categories of wire.



Figure-7: Unshielded Twisted Pair (UTP) Cable

Categories of Unshielded Twisted Pair

Category	Speed	Use
1 (Cat1)	1 Mbps	Voice Only (Telephone Wire)
2 (Cat 2)	4 Mbps	LocalTalk & Telephone (Rarely used)
3 (Cat 3)	16 Mbps	10BaseT Ethernet
4 (Cat 4)	20 Mbps	Token Ring (Rarely used)
5 (Cat 5)	100 Mbps (2 pair)	100BaseT Ethernet
5 (Cat 5)	1000 Mbps (4 pair)	Gigabit Ethernet
5e (Cat 5e)	1,000 Mbps	Gigabit Ethernet
6 (Cat6)	10,000 Mbps	Gigabit Ethernet

Table 3: Categories of Unshielded Twisted Pair

2.2.1.6b. Fiber Optic Cable

Fiber optic cabling consists of a center glass core surrounded by several layers of protective materials. It transmits light rather than electronic signals eliminating the problem of electrical interference. This makes it ideal for certain environments that contain a large amount of

electrical interference. It has also made it the standard for connecting networks between two or more countries.

Fiber optic cable has the ability to transmit signals over much longer distances than coaxial and twisted pair. It also has the capability to carry information at vastly greater speeds. This capacity broadens communication possibilities to include services such as video conferencing and interactive services. The cost of fiber optic cabling is higher than copper cabling.

The center core of fiber cables is made from glass or plastic fibers. A plastic coating then cushions the fiber center, and Kevlar fibers help to strengthen the cables and prevent breakage. The outer insulating jacket is made of Teflon or PVC.



Figure-8: Fiber optic cable

There are two common types of fiber cables - single mode and multimode. Multimode cable has a larger diameter; however, both cables provide high bandwidth at high speeds. Single mode can provide more distance, but it is more expensive. On the other hand single mode cable can carry only a single frequency but a multimode cable can carry multiple frequencies at a time.

Ethernet Cable Summary

Specification	Cable Type
10BaseT	Unshielded Twisted Pair
10Base2	Thin Coaxial
10Base5	Thick Coaxial
100BaseT	Unshielded Twisted Pair
100BaseFX	Fiber Optic

10BaseBX	Single mode Fiber
100BaseSX	Multimode Fiber
1000BaseT	Unshielded Twisted Pair
1000BaseFX	Fiber Optic
1000BaseBX	Single mode Fiber
1000BaseSX	Multimode Fiber



Table 4: Ethernet Cable Summary

2.1.6c. Patch cable:

Patch cable or patch cord is an electrical or optical cable, used to connect one electronic or optical device to another for signal routing. Devices of different types are connected with patch cords.



Figure-9: Patch cable

2.2.1.7. Connectors:

2.2.1.7a RJ45:

RJ45 is a standard type of connector for network cables. RJ45 connectors are most commonly seen with Ethernet cables and networks.

RJ45 connectors feature eight pins to which the wire strands of a cable interface electrically. Standard RJ-45 pinouts define the arrangement of the individual wires needed when attaching connectors to a cable.

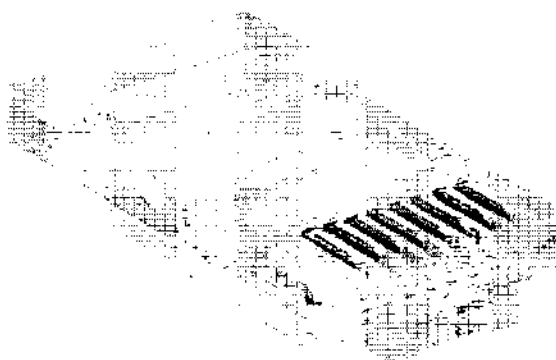


Figure-10: RJ45

2.2.1.7b RS-232:

In telecommunications, RS-232 (Recommended Standard 232) is a standard for serial binary single-ended data and control signals connecting between a *DTE* (Data Terminal Equipment) and a *DCE* (Data Circuit-terminating Equipment). It is commonly used in computer serial ports.



Figure-11: RS-232

2.2.1.7c SC (Subscriber Connector):

The SC connector is a fiber optic connector with a push-pull latching mechanism which provides quick insertion and removal while also ensuring a positive connection. SC is an abbreviation for Subscriber Connector.

The SC connector is also available in a duplex configuration. SC connector has a benefit in keyed duplex capability to support send/receive channels. These connectors are commonly used for most modern network applications. The SC is a snap-in connector that is extensively used in single-mode systems for its remarkable efficiency.

They are inexpensive, trouble-free, and robust. SC connectors give precise positioning via their ceramic ferrules. The square, snap-in connector latches with a simple push-pull motion and is keyed. They feature a 2.5mm ferrule and molded housing for shielding. Characteristically compared SC connectors are known for 1000 mating cycles and have an insertion loss of 0.25 dB.



Figure-12: SC connector

2.2.2 Fundamental of Computer network

Computer network:

A network is a collection of computers and devices connected by communications channels that facilitates communications among users and allows users to share resources with other users.

2.2.2.1 Types of network:

2.2.1a: LAN (Local Area Network):

A local area network (LAN) is a network that connects computers and devices in a limited geographical area such as home, school, computer laboratory, office building, or closely positioned group of buildings. Each computer or device on the network is a node. A LAN in turn often connects to other LANs, and to the Internet.

Ethernet LAN Diagram



Figure-13: LAN

2.2.2.1b: MAN (Metropolitan Area Network):

A metropolitan area network (MAN) is a network that connects two or more local area networks or campus area networks together but does not extend beyond the boundaries of the immediate town/city. Routers, switches and hubs are connected to create a metropolitan area network and provide up-link services to the Internet.

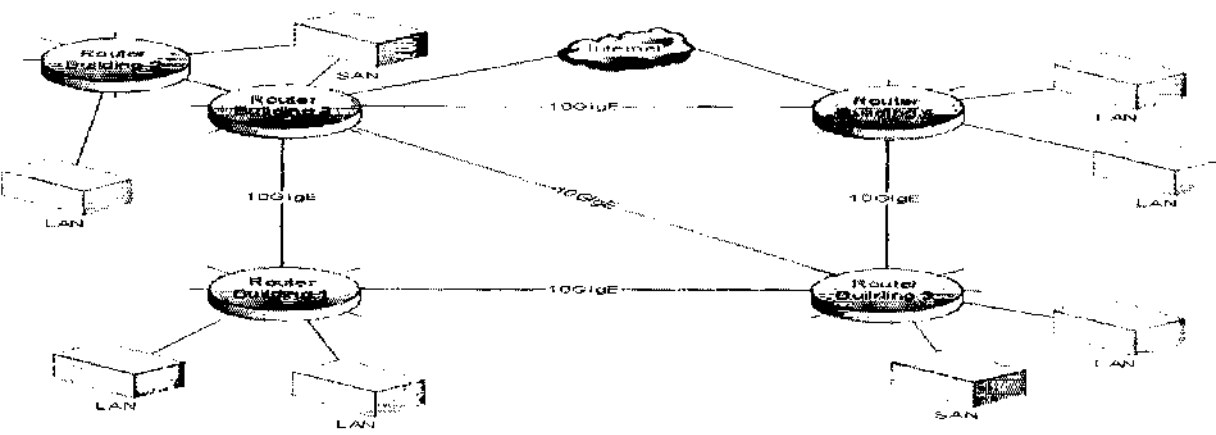


Figure-14: MAN

2.2.2.1c: WAN(Wide Area Network):

A wide area network (WAN) is a computer network that covers a large geographic area such as a city, country, or spans even intercontinental distances, using a communications channel that combines many types of media such as telephone lines, cables, and air waves. A WAN often uses transmission facilities provided by common carriers, such as telephone companies. WAN technologies generally function at the lower three layers of the OSI reference model: the physical layer, the data link layer, and the network layer.

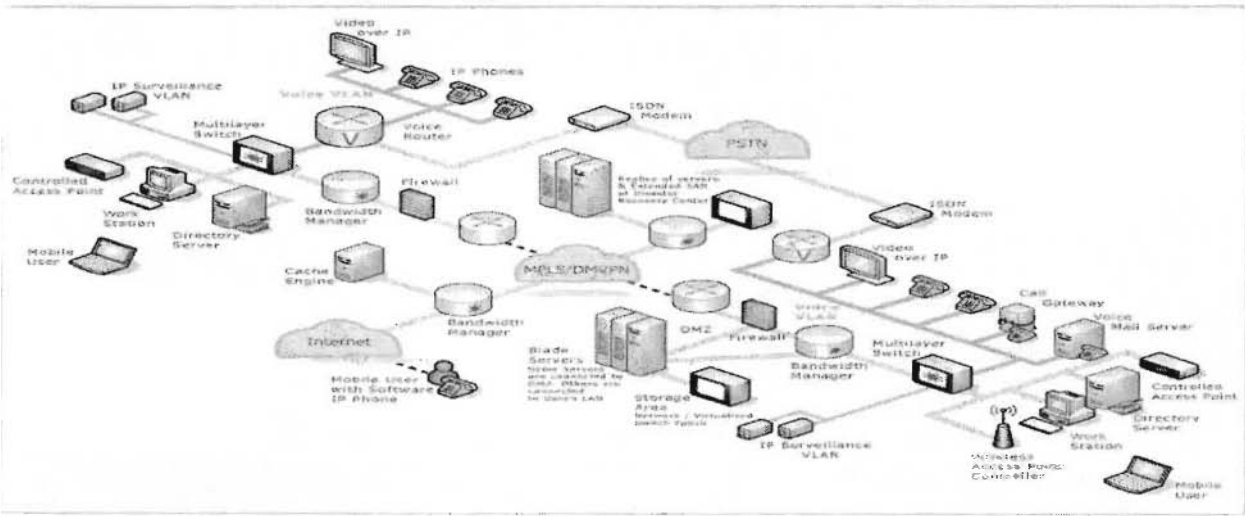


Figure-15: WAN

2.2.2.2 Network models

Network models define a set of network layers and how they interact. The most important two are:

- **TCP/IP Model**
- **OSI Network Model**

2.2.2.2a: OSI (Open System Interconnection) Network Model:

The Open System Interconnection Reference Model is an abstract description for layered communications and computer network protocol design. In its most basic form, it divides

network architecture into seven layers which, from top to bottom, are the Application, Presentation, Session, Transport, Network, Data Link, and Physical Layers.

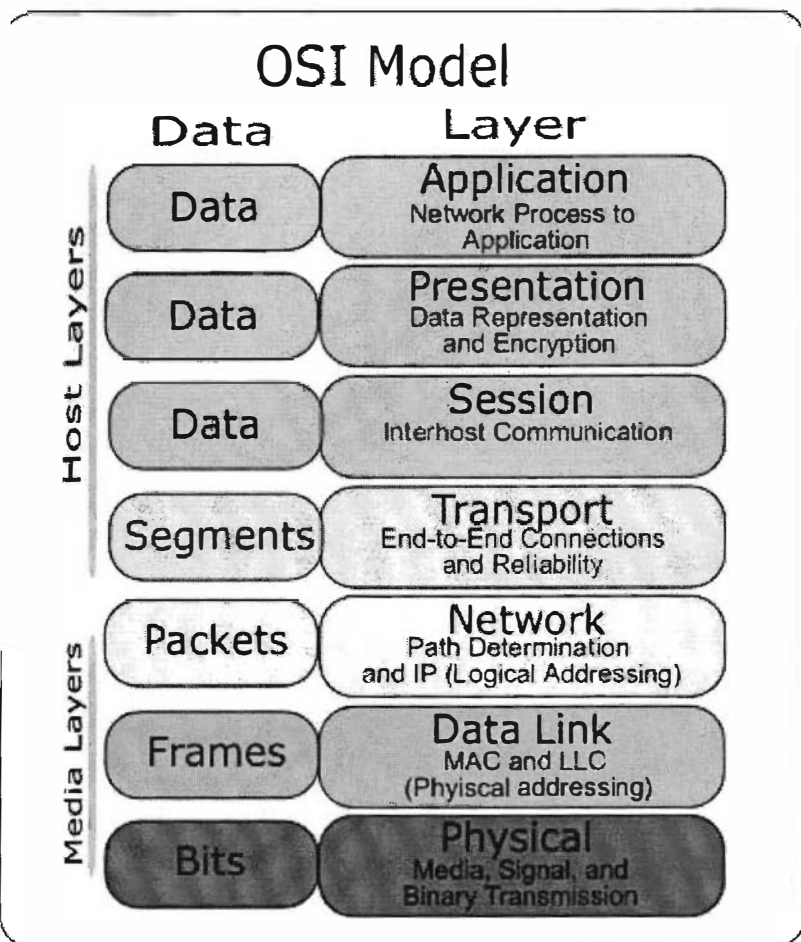


Figure-16: OSI Network Model

2.2.2.2b: TCP/IP model:

The TCP/IP model is a description framework for computer network protocols created in the 1970s by DARPA, an agency of the United States Department of Defense. It evolved from ARPANET, which were the world's first wide area network and a predecessor of the Internet. The TCP/IP Model is sometimes called the Internet Model or the DoD Model.

The TCP/IP model, or Internet Protocol Suite, describes a set of general design guidelines and implementations of specific networking protocols to enable computers to communicate over a

network. TCP/IP provides end-to-end connectivity specifying how data should be formatted, addressed, transmitted, routed and received at the destination. Protocols exist for a variety of different types of communication services between computers.

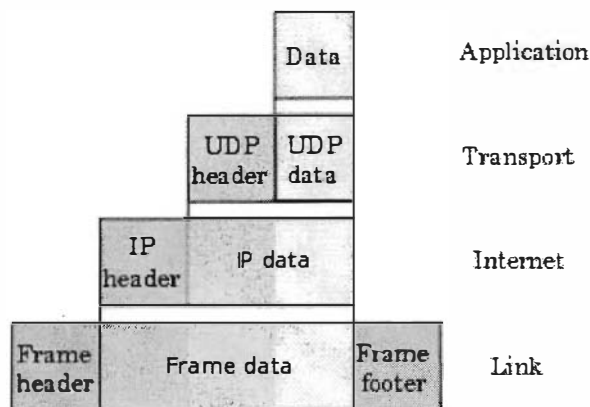


Figure-17: TCP/IP model

2.2.2.3: IP addressing and class:

An IP address is a numeric identifier assigned to each machine on an IP network. It designates the specific location of a device on the network. An IP address is a software address, not a hardware address—the latter is hard-coded on a Network Interface Card (NIC) and used for finding hosts on a local network. IP addressing was designed to allow a host on one network to communicate with a host on a different network, regardless of the type of LANs the hosts is participating in.

An IP address consists of 32 bits of information. These bits are divided into four sections, referred to as octets or bytes, each containing 1 byte (8 bits). You can depict an IP address using one of three methods:

- Dotted-decimal, as in 172.16.30.56
- Binary, as in 10101100.00010000.00011110.00111000
- Hexadecimal, as in AC.10.1E.38

Kinds of IP address : There are five class of IP addresses class A, class B, class C, class D and class E.

Class A:

The first bit of first octet is kept zero. Network Address range is 0-127 in first octet.

Ex: 114.1.1.1 (Network: Host: Host: Host)

Class B:

In a Class B network the first bit of the first byte must always be turned on, but the second bit must always be turned off. If other 6 bits all off and then all on, we can find the range for a Class B network:

0000000 = 128

0111111 = 191

Ex: Network: Network: Host: Host (136:123:14:25)

Class C:

For Class C networks the first 2 bits of the first octet as always turned on, but the third bit can never be on. Following the same process as the previous classes, convert from binary to decimal to find the range. Here's the range for a Class C network:

11000000 = 192

11011111 = 223

Ex: Network: Network: Network: Host (201:123:14:25)

Network Address Ranges: Classes D and E

The addresses between 224 and 255 are reserved for Class D and E networks. Class D (224–239) is used for multicast addresses and Class E (240–255) for scientific purposes, but I'm not going into these types of addresses in this book (and you don't need to know them).

2.2.2.3a Private IP Addresses

The people who created the IP addressing scheme also created what we call private IP addresses.

These addresses can be used on a private network, but they're not routable through the Internet. This is designed for the purpose of creating a measure of well-needed security, but it also conveniently saves valuable IP address space.

If every host on every network had to have real routable IP addresses, we would have run out of IP addresses to hand out years ago. But by using private IP addresses, ISPs, corporations, and home users only need a relatively tiny group of bona fide IP addresses to connect their networks to the Internet. This is economical because they can use private IP addresses on their inside networks.

Private IP Address range:

Class A 10.0.0.0 through 10.255.255.255

Class B 172.16.0.0 through 172.31.255.255

Class C 192.168.0.0 through 192.168.255.255

2.2.2.4 NAT (Network Address Translation):

Whether the network is the home or the corporate type, if it uses the private IP addresses then they have to translate their private inside addresses to a global outside address by using NAT. The main idea is to conserve Internet global address space, but it also increases network security by hiding internal IP addresses from external networks. In NAT terminology, the *inside network* is the set of networks that are subject to translation. The *outside network* refers to all other addresses—usually those located on the Internet.

There are different kinds of NAT:

Static NAT:

Designed to allow one-to-one mapping between local and global addresses. This requires one real Internet IP address for every host on network.

Dynamic NAT:

Dynamic NAT is designed to map an unregistered IP address to a registered IP address from out of a pool of registered IP addresses.

Overloading:

Overloading is a form of dynamic NAT that maps multiple unregistered IP addresses to a single registered IP address (many-to-one) by using different ports. Therefore, it's also known as *port address translation (PAT)*. By using PAT thousands of users can connect to the Internet using only one real global IP address.

2.2.5: Subnetting:

A **subnetwork**, or **subnet**, is a logically visible, distinctly addressed part of a single Internet protocol network. The process of **subnetting** is the division of a computer network into groups of computers that have a common, designated IP address routing prefix. Subnetting breaks a network into smaller realms that may use existing address space more efficiently, and, when physically separated, may prevent excessive rates of Ethernet packet collision in a larger network.

Default Subnet Mask

Class	Format	Subnet Mask
A	network.node.node.node	255.0.0.0
B	network.network.node.node	255.255.0.0
C	network.network.network.node	255.255.255.0

Table 4: Default Subnet Mask

Example:

In order to subnet a network, extend the natural mask using some of the bits from the host ID portion of the address to create a subnetwork ID. A Class C network of 204.17.5.0 which has a natural mask of 255.255.255.0 can be subnetted like this

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204.17.5.0 - 11001100.00010001.00000101.00000000

255.255.255.224 - 11111111.11111111.11111111.11100000

-----|sub|----

By extending the mask to be 255.255.255.224, three bits from the original host portion of the address and used them to make subnets. With these three bits, it is possible to create eight subnets. With the remaining five host ID bits, each subnet can have up to 32 host addresses, 30 of which can actually be assigned to a device since host ids of all zeros or all ones are not allowed .

Subnets :

204.17.5.0	255.255.255.224	host address range 1 to 30
204.17.5.32	255.255.255.224	host address range 33 to 62
204.17.5.64	255.255.255.224	host address range 65 to 94
204.17.5.96	255.255.255.224	host address range 97 to 126
204.17.5.128	255.255.255.224	host address range 129 to 158
204.17.5.160	255.255.255.224	host address range 161 to 190
204.17.5.192	255.255.255.224	host address range 193 to 222
204.17.5.224	255.255.255.224	host address range 225 to 254



2.2.2.6: VLSM:

A Variable Length Subnet Mask (VLSM) is a means of allocating IP addressing resources to subnets according to their individual need rather than some general network-wide rule. Of the IP routing protocols supported by Cisco, OSPF, Dual IS-IS, BGP-4, and EIGRP support "classless" or VLSM routes.

VLSM Example

netA: must support 14 hosts

Undergraduate Internship

NetB: must support 28 hosts

NetC: must support 2 hosts

NetD: must support 7 hosts

NetE: must support 28 hosts

Determine what mask allows the required number of hosts.

NetA: requires a /28 (255.255.255.240) mask to support 14 hosts

NetB: requires a /27 (255.255.255.224) mask to support 28 hosts

NetC: requires a /30 (255.255.255.252) mask to support 2 hosts

NetD*: requires a /28 (255.255.255.240) mask to support 7 hosts

NetE: requires a /27 (255.255.255.224) mask to support 28 hosts

The easiest way to assign the subnets is to assign the largest first. For example, you can assign in this manner:

NetB: 204.15.5.0/27 host address range 1 to 30

NetE: 204.15.5.32/27 host address range 33 to 62

NetA: 204.15.5.64/28 host address range 65 to 78

NetD: 204.15.5.80/28 host address range 81 to 94

NetC: 204.15.5.96/30 host address range 97 to 98

1.2.2.7 Routing:

Routing is the process of selecting paths in a network along which to send network traffic. In packet switching networks, routing directs packet forwarding, the transit of logically addressed packets from their source toward their ultimate destination through intermediate nodes.

Routing is of two kinds: a) Static routing

b) Dynamic routing

2.2.8 Routing protocols:

Static routing do not need any routing protocols but dynamic routing need a defined protocol. There are various kinds of routing protocols. Here is a little discussion on it.

Routing protocols are two kinds: a) Interior routing protocol.

b) Exterior routing protocols.

Algorithm used for dynamic routing:

a) Distance Vector Algorithm

b) Link State Algorithm

2.2.8a Distance Vector Algorithm:

In computer communication theory relating to packet-switched networks, a distance-vector routing protocol is one of the two major classes of routing protocols. A distance-vector routing protocol uses the Bellman-Ford algorithm to calculate paths.

A distance-vector routing protocol requires that a router informs its neighbors of topology changes periodically and, in some cases, when a change is detected in the topology of a network. Distance-vector routing protocols have less computational complexity and message overhead.

Distance Vector means that Routers are advertised as vector of distance and Direction. Direction is simply next hop address and exit interface and Distance means such as hop count.

Routers using distance vector protocol do not have knowledge of the entire path to a destination.

Examples of distance-vector routing protocols include RIPv1 and 2 and IGRP.

2.2.8b Link State Algorithm:

The link-state protocol is performed by every *switching node* in the network (routers). The basic concept of link-state routing is that every node constructs a *map* of the connectivity to the network, in the form of a graph, showing which nodes are connected to which other nodes. Each

node then independently calculates the next best logical *path* from it to every possible destination in the network. The collection of best paths will then form the node's routing table.

.2.2.9 Interior routing protocol:

.2.2.9a RIP (Routing Information Protocol):

The Routing Information Protocol is a dynamic routing protocol used in local and wide area networks. It uses the distance-vector routing algorithm.

.2.2.9b RIP version 1

RIP1 uses classful routing. The periodic routing updates do not carry subnet information, lacking support for variable length subnet masks (VLSM). This limitation makes it impossible to have different-sized subnets inside of the same network class. There is also no support for router authentication. The RIP version 1 works when there is only 16 hop counts (0-15). If there is more than 16 hops between two routers it fails to send data packets to the destination address.

.2.2.9c RIP version 2

Due to the deficiencies of the original RIP specification, RIP version 2 (RIPv2) was developed in 1993 and last standardized in 1998. It included the ability to carry subnet information, thus supporting Classless Inter-Domain Routing (CIDR). To maintain backward compatibility, the hop count limit of 15 remained.

.2.2.9d RIPng

RIPng (RIP next generation) is an extension of RIPv2 for support of IPv6, the next generation Internet Protocol.

.2.2.9e OSPF (Open Shortest Path First):

Open Shortest Path First is a dynamic routing protocol for use in Internet Protocol networks. Specifically, it is a link-state routing protocol and falls into the group of interior gateway

protocols, operating within a single autonomous system (AS). It can handle its own error detection and correction functions.

2.2.2.9f IGRP (Interior Gateway Routing Protocol):

Interior Gateway Routing Protocol (IGRP) is a distance vector interior routing protocol (IGP) invented by Cisco. It is used by routers to exchange routing data within an autonomous system.

IGRP is a proprietary protocol. IGRP was created in part to overcome the limitations of RIP when used within large networks. IGRP supports multiple metrics for each route, including bandwidth, delay, load, MTU, and reliability; to compare two routes these metrics are combined together into a single metric, using a formula which can be adjusted through the use of pre-set constants. The maximum hop count of IGRP-routed packets is 255 (default 100), and routing updates are broadcast every 90 seconds (by default).

2.2.2.9g EIGRP (Enhanced Interior Gateway Routing Protocol):

Enhanced Interior Gateway Routing Protocol (EIGRP) is a Cisco proprietary routing protocol loosely based on their original IGRP. EIGRP is an advanced distance-vector routing protocol, with optimizations to minimize both the routing instability incurred after topology changes, as well as the use of bandwidth and processing power in the router. Routers that support EIGRP will automatically redistribute route information to IGRP neighbors by converting the 32 bit EIGRP metric to the 24 bit IGRP metric.

2.2.2.10 Exterior routing protocols

BGP (Border Gateway Protocol) :

The Border Gateway Protocol (BGP) is the core routing protocol of the Internet. It maintains a table of IP networks or 'prefixes' which designate network reachability among autonomous systems (AS). It is described as a path vector protocol. BGP does not use traditional Interior Gateway Protocol metrics, but makes routing decisions based on path, network policies.

OSPF was created to replace the Exterior Gateway Protocol (EGP) routing protocol to allow fully decentralized routing in order to allow the removal of the NSFNet Internet backbone network. This is allowed the Internet to become a truly decentralized system. The major enhancement in RFC 2328 was support of Classless Inter-Domain Routing and use of route aggregation to decrease the size of routing tables.

3. Conclusion

In this report my main objective is to appraise the practical knowledge, information and understandings that I have acquired from working at Mango Teleservices Limited. Working environment at Mango is very friendly. Everyone in Mango Teleservices Limited is very helpful and cooperative. I have really enjoyed every moment at Mango. At last I would like to thank the mighty Allah again to give me the strength to do my internship work at Mango Teleservices Limited for last 3 months.

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