location of each component.

- A fault finding guide which give a list of symptoms, faults and possible causes and solutions it also provide a procedure in which all of the tests are placed in a logical order and the possible outcome of one test is used to select the next test to be made.

A component data book is usually available for each class of component for example diode and transistors. It provides performance data and lists of equivalents for all types of the component in common use.

QUALITY OF SERVICE (QoS)

Quality of service (QoS) defines how well or how efficiently data transmission takes place. QoS can be achieved by managing data traffic which will result in reduced packet loss, latency and jitter on a network. It also controls and manages network resources by setting priorities for specific types of data on the network. QoS is employed by most organisation to meet the traffic requirements of sensitive applications such as real time voice and video to prevent any form of degradation of quality occassioned by packet loss, delay and jitter.

QoS can be measure quantitatively by the use of several parameters such as Packet loss, Jitter, Latency, Bandwidth and mean opinion score.

- Packet loss: this usually occurs when the network links become congested, with routers and switches start to drop packets. When these packets are been dropped during real-time communication as in

Voice and video calls, these sessions then experiences jitter and gaps in speech. Packet dropping occurs when a queue or line of packets waiting to be sent overflows.

- Jitter: this is as a result of network congestion, timing drift and route change. when jitter occurs too frequently, it can degrade the quality of voice and video communication.

- Latency: this is the time it takes a packet to travel from its source to its destination. It should be as close to zero as possible. If a voice over IP call has a high amount of latency, the users may experience echo and overlapping audio.

- Bandwidth: this is the capacity of a network communication link to transmit the maximum amount of data from one point to another in a given amount.

QoS helps to optimizes the network performance by managing bandwidth and giving high priority applications with stricter performance requirement more resources than others.

- Mean opinion score (MOS): this is used to rate voice quality that uses a five-point scale with a five indicating the highest quality.

The absences of QoS results in the network data becoming disorganized, clogging to the point where performance degrades or in certain cases, the network would shut down completely. QoS is important to organization as it helps to provide stable services for customers to use. The QoS determines the Quality of Experience (QoE). If the services provided by an organization is not reliable, the customer's satisfaction and relationship is put at so much risk. An organization with poor QoS will have its data integrity and security most likely to be compromised.

Quality of Service Operation

When an organization uses its network to forward information to and fro endpoints in the network, the information or data is then formatted into what is called packets. Packets are the means by which computers organise data that are to be transferred over a network. Specialised tools called QoS tools have the responsibility of prioritizing packets so as to get the most out of the finite amount of bandwidth available in the network. This implies that the network can only forward so much information / data in a certain amount of time. As such QoS tools prioritize packet in a way that ensures that bandwidth is used to provide the best internet service possible in that fixed amount of time.

QoS tools look at for packet headers so as to prioritize packets. The packet headers are bits of information that tell the tools and other network components what the packet contains, where the packet is going to (the IP address of its destination) and what it will be used for. A QoS tool can read the packet header and determine that a packet is related to video streaming and then prioritize it over packets that are less time sensitive such as an email. The QoS tool can also alter a portion of the packet header to specify priority. QoS tools can be broken down into the following categories:

- Classification: this identifies traffic and marks it to ensure that other network devices can identify and prioritize it.
- Policing: this enforces a specific bandwidth and limit and drops any packets that don't adhere to the rule. This forms a part of the congestion avoidance.
- Queuing: this reserves bandwidth to hold packets

in a buffer to be processed later.

- Shaping: this is similar to policing except that it queues the excess traffic in a buffer instead of completely dropping them. It like queueing is a part of congestion management

- Weighted random early discard (WRED): this drops low priority data flows to preserve high-priority data from the negative effects of network congestion.

- Fragmentation and Compression: this lowers the bandwidth on a network to prevent delay and jitter.

Examples of popular QOS monitoring tools are Nagios Network Analyzer, OpenNMS, Ntopng, Bandwithd etc. In implementing QoS tools and strategies, the following steps should be adhered to by any organization:

- Planning: The organization should obtain a clear understanding of each department's service needs and requirements, choose a fitting model, and cultivate buy-in from stakeholders.

- Design: The organization should take note of all significant software and hardware changes, and then apply the desired QoS model to the specifics of its network architecture.

- Testing: The organization should test QoS settings and policies in a safe, controlled testing environment where bugs can be worked out.

- Deployment: The organization should roll-out its policies iteratively, in phases. It can be done by network segment or by separate QoS function (what each policy does).

- Monitoring and analysis: Policies should be

adjusted to improve performance according to performance data.

The three models used in implementing QoS are:

- Best Effort: this is a model where all the packets receives the same priority, and there is no guaranteed delivery of packets. It is usually applied when network does not have a configured QoS policy or when the infrastructure does not support QoS.
- Integrated Services (IntServ): this is a model that reserves bandwidth along a specific path on the network. The application request the network for resource reservation, and network devices monitor the flow of packets to make sure network resources can accept the packets.
- Differentiated Services (DiffServ): this is a model where network elements such as routers and switches are configured to service multiple classes of traffic with different priorities.

Quality of Service Mechanism

QoS mechanism falls into the following categories depending on the role it plays in managing the network:

- Classification and marking: These tools differentiate between applications and sort packets into different traffic types. Marking indicates each packet as a member of a network class which allows devices on the network to recognize the packet's class. Classification and marking are implemented on network devices such as routers, switches and access points.
- Congestion management: these tools uses packet classification and marking to determine which queue to place the packets in. Congestion managem

tools include priority queuing, first-in, first-out and low-latency queuing.
- Congestion avoidance; These tools monitors network traffic for congestion and drop low-priority packets when congestion occurs. Congestion avoidance tools include weighted random early detection and random early detection.
- Shaping; These tools manipulate traffic flowing into the network and prioritize real-time applications over less time-sensitive applications such as email and messaging. Traffic shaping tools include buffers, Generic Traffic Shaping and Frame-Relay Traffic Shaping.
- Link efficiency; These tools maximize bandwidth use and reduce delay for packets accessing the network. Link efficiency although not exclusively for QoS are used in conjunction with other QoS mechanism. Link efficiency tools include Real-time Transport Protocol, header compression, Transmission Control Protocol, header Compression and link compression.

Benefits of QoS

- It ensures the availability of an organization's network and the applications that run on that network.
- It provides the safe and efficient transfer of data over that network.
- It allows organizations to use their existing bandwidth more efficiently, instead of upgrading network infrastructure to expand bandwidth.
- Mission-critical applications have access to the resources they require.
- It allows administrators to change traffic better.

- It reduces cost for the organization by eliminating the need to purchase new network infrastructure
- User experience is been improved

Quality Control (QC)

Quality control is a procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of the client or customer. QC is similar to but not identical with quality assurance (QA). QA refers to the confirmation that specified requirements have been met by a product or service, while QC refers to the actual inspection of these elements.

The procedures followed to implement effective QC are:

- the organization must first decide which specific standards the product or service must meet
- then the extent of QC actions must be determined for example, the percentage of units to be tested from each lot.
- the real-world data must be collected, for example, the percentage of units that fail and the results is to be reported to the management personnel.
- then corrective action must be decided upon and taken for example, the defective units must be repaired or rejected, and poor services repeated at no extra charge, until the customer is satisfied. If there are too many units that have failed or too many instances of poor service, a plan must be devised to improve the production or service process; then the plan must be put into action.
- the QC process must be an on-going process to ensure that remedial efforts, if required, have