

Quality of Service (QoS)

Flow Characteristics

Traditionally, four types of characteristics are attributed to a flow: reliability, delay, jitter and bandwidth.

Reliability

- Reliability is an important characteristic of flow.
- Lack of reliability means losing a packet or acknowledgement which then requires retransmission.
- However, the sensitivity of application programs to reliability is not the same. For example, it is more important that electronic mail, file transfer, and internet access have reliable transmissions than audio conferencing or telephony.

Delay

- Source to destination delay is another flow characteristic.
- Applications can tolerate delay in different degrees.
- In this case, telephony, audio conferencing, video conferencing and remote log in need minimum delay while delay in file transfer or e-mail is less important.

Jitter

- Jitter is defined as the variation in delay for packets belonging to the same flow.
- High Jitter means the difference between delays is large and low jitter means the variation is small.
- For example, if four packets depart at times 0, 1,2,3 and arrive at 20, 21,22, 23, all have same delay, 20 units of time. On the other hand, if the above four packets arrive at 21,23,21, and 28 they will have different delays of 21, 22, 19 and 24.

Bandwidth

- Different applications need different bandwidths.
- In video conferencing we need to send million of bits per second to refresh a colour screen while the total number of bits in an email may not reach even a million.

Two types of QoS parameters have been defined:

- Those whose values are transmitted peer users via the Network service during the establishment phase of the network connection. During this transmission, a tripartite negotiation can take place between users and the network service provider to define a value for the QoS parameters.
- Those whose values are transmitted or negotiated between users and network service provider. For these QoS parameters, it is possible to obtain, by local means, [information](#) on the value to the supplier and values to each user of the network service.

The main QoS parameters are:

- **Time of establishment of the network connection.** Is the time that elapses between a network connection request and confirmation of the connection? This QoS parameter indicates the maximum time acceptable to the user.
- **Probability of failure of the establishment of the network connection.** This probability is established from the applications which have not been met in the normal time limit for establishing the connection.
- **Flow data transfer.** The flow rate defines the number of bytes transported over a network connection in a reasonably long time (a few minutes, a few hours or days). The difficulty in determining the speed of a connection network comes from the asynchronous transport packets. To obtain a value acceptable, observe the network on a sequence of several packages and consider number of bytes of data transported taking into account the elapsed time since the application or the data transfer indication.
- **Transit time when transferring data.** The transit time corresponds to elapsed time between a data transfer request and indicating transfer of data. This transit time is difficult to calculate because of the geographical distribution ends. The satisfaction of a quality service on the transit time may moreover contradict flow control.
- **Residual error rate.** Is calculated from the number of packets that arrive erroneous, lost or duplicated on the total number of transmitted packets. It is a rate Error packet. Also denotes the probability that a packet does not arrive correctly to the receiver.
- **Transfer Probability incident.** Is obtained by the ratio of the number of incidents listed on the total number of transfer taken. To have a correct estimate of this

probability, just consider the number of network disconnection relative to the number of transfer taken.

- **Probability of failure of the network connection.** Is calculated from the number of release and resetting of a network connection based on the number of transfer made.
- **Release time the network connection.** This is the maximum acceptable delay between a disconnection request and the actual release.
- Probability of failure upon release of the network connection. The number Liberation of failure required by the total number requested release.

The following three additional parameters used to characterize the quality of Service:

- **Protection of the network connection.** Determines the probability that the network connection be in working order throughout the period when it is opened by the user. There is ways to protect a connection by duplicating or having a Backup connection ready to be opened in case of failure. The value for a telephone network is 99.999%, the so-called five nines, equivalent to a few minutes of downtime per year. The protection is much lower for an IP network, with a value of the order of 99.9%, three or nine. This value arises besides problem for IP telephony, which requires stronger protection telephone connections.
- **Priority of the network connection.** Determines priority of access to a connection network, the holding priority of a network connection and priority of data connection.
- **Maximum acceptable cost.** Determines if the network connection is tolerable or not. The definition of the cost is quite complex since it depends on the use of resources for the establishment, maintenance and release of the connection network.