

COMP476
Networked Computer Systems

ATM & Performance

Service Parameters

- Continuous or bursty traffic
- Full duplex or half duplex
- Real time delay constraints
- Jitter
- Stream oriented or message oriented

Performance Characteristics
Delay

How long a bit remains in transit in a network

- Types of delay
 - propagation
 - switching
 - access
 - queuing

Performance Characteristics
Throughput

How many bits can enter a network in a unit time

- Measured in bits / second
- A measure of capacity more than speed

Delay and Throughput

Throughput and Delay are not completely independent.

- As traffic in a computer network increases, delays increase. A network that operates at close to 100% of its throughput capacity experiences severe delay.

$$D = \frac{D_0}{(1 - U)}$$

D_0 denotes the delay when the network is idle.

U is between 1 and 0 denoting the utilization.

D is the effective delay.

Service Paradigm

- Two broad distinctions:
 - Connection-oriented Service
 - Connectionless Service

Connection-oriented Service

- Operates similar to the telephone system.
- Requires a pair of computers to establish a connection before sending data.
- Communication does not have to be continuous
- The connection stays in place until either computer chooses to terminate the connection.

Connectionless Service

- Operates similar to the postal mail system.
- Accepts and delivers individual frames that each specify a destination.
- Computers do not need to establish a connection with one another before they communicate.
- The network system is responsible for transporting the frame to its prescribed destination.

Comparison

Issue	Connection oriented	Connectionless
Initial setup	required	not necessary
Destination address	only needed during initial setup	needed every packet
Packet sequencing	guaranteed	not guaranteed
Option negotiation	possible at setup	not available
Overhead	moderate	low

Examples

Connectionless

- Ethernet
- Token Ring
- FDDI
- Internet Protocol
- User Datagram Protocol

Connection Oriented

- ATM
- Transmission Control Protocol (TCP)

Asynchronous Transfer Mode

ATM uses a connection-oriented paradigm.

- ATM Technology can be used for public and private WANs and LANs.
- Each ATM connections provide a Quality of Service specification

ATM Quality of Service

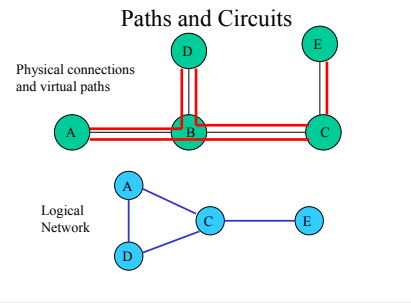
- Peak Cell Rate
- Sustained Cell Rate
 - (burstiness is PCR/SCR)
- Cell Delay Variance Tolerance (jitter)
- Cell Loss Ratio

Variable Bit Rate

- The physical transmitters always transmit bits at a constant rate.
- ATM applications can send as many cells as it wants. Therefore the amount of data transmitted is variable.
- Multiple different applications can send ATM cells over the same line.

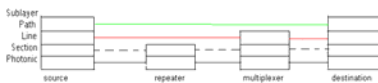
Virtual Paths and Virtual Circuits

- When a node wants to communicate, it must establish a virtual path to the destination.
- When the communication is complete, the virtual path is deleted.
- Virtual Paths are semi-permanent connections through the network.
- Virtual Circuits are built from collections of virtual paths.



Virtual Circuits on Virtual Paths

Virtual Paths are semi-permanent connections of the lines in an ATM network. Virtual Circuits are a connection of virtual paths.



ATM Cells

ATM uses fixed length 53 byte frames or cells

Generic Flow Control	Virtual Path Identifier		byte
Virtual Path Identifier	Virtual Circuit Identifier		1
Virtual Circuit Identifier			2
Virtual Circuit Identifier	Payload type	Cell loss priority	3
Header Error Control			4
48 bytes of data			5

ATM Layers

- ATM Adaptation Layers
 - Packs large packets of data into small cells.
 - Assembly and Reassembly.
- ATM
 - Transmits and routes cells between nodes
- SONET
 - Physical layer transmission of cells.
 - Synchronous transmission, a SONET frame is sent every time period even if it is empty.

ATM Adaptation Layers

- AAL type 1 Constant Bit Rate, R/T Good for phones
- AAL type 2 VBR, R/T good for compressed video
- AAL type 3 / 4 VBR, not R/T
- AAL type 5 (*simple and efficient AAL*)
- Available Bit Rate (tells application about bandwidth available)
- Unspecified Bit Rate (take what you get)

ATM classes

	Class A	Class B	Class C	Class D
Timing relation between source and destination	Required		Not Required	
Bit Rate	Constant		Variable	
Connection mode	Connection oriented			Connectionless

Figure 5.6: Service classification for AAL

Synchronous Optical Network

At the Physical level, ATM cells are transported in SONET frames.

