



Top-Down Network Design

Chapter Four

Characterizing Network Traffic

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Network Traffic Factors

- Traffic flow
- Location of traffic sources and data stores
- Traffic load
- Traffic behavior
- Quality of Service (QoS) requirements

User Communities

User Community Name	Size of Community (Number of Users)	Location(s) of Community	Application(s) Used by Community

Data Stores

Data Store	Location	Application(s)	Used by User Community(or Communities)

Traffic Flow

	Destination 1 MB/sec Path	Destination 2 MB/sec Path	Destination 3 MB/sec Path	Destination 1 MB/sec Path
Source 1				
Source 2				
Source 3				
Source 4				

Traffic Flow Example

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Library and Computing Center

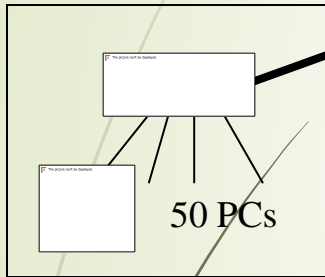
30 Library Patrons (PCs)
30 Macs and 60 PCs in
Computing Center

Server Farm

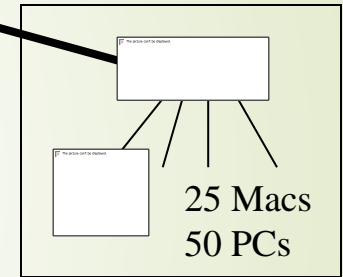
10-Mbps Metro
Ethernet to Internet

App 2	20 Kbps
App 3	96 Kbps
App 4	24 Kbps
App 9	80 Kbps
Total	220 Kbps

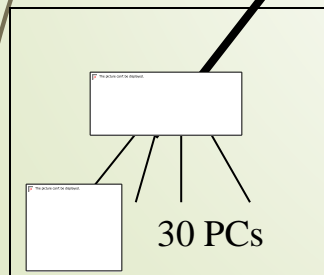
App 1	108 Kbps
App 2	60 Kbps
App 3	192 Kbps
App 4	48 Kbps
App 7	400 Kbps
Total	808 Kbps



Administration



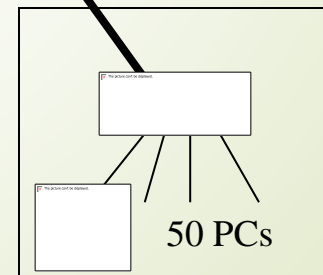
**Arts and
Humanities**



**Business and
Social Sciences**

App 1	30 Kbps
App 2	20 Kbps
App 3	60 Kbps
App 4	16 Kbps
Total	126 Kbps

App 1	48 Kbps
App 2	32 Kbps
App 3	96 Kbps
App 4	24 Kbps
App 5	300 Kbps
App 6	200 Kbps
App 8	1200 Kbps
Total	1900 Kbps



**Math and
Sciences**

Types of Traffic Flow

- Terminal/host
- Client/server
- Thin client
- Peer-to-peer
- Server/server
- Distributed computing

Traffic Flow for Voice over IP

- The flow associated with transmitting the audio voice is separate from the flows associated with call setup and teardown.
 - The flow for transmitting the digital voice is essentially peer-to-peer.
 - Call setup and teardown is a client/server flow
 - A phone needs to talk to a server or phone switch that understands phone numbers, IP addresses, capabilities negotiation, and so on.

Network Applications

Traffic Characteristics

Name of Application	Type of Traffic Flow	Protocol(s) Used by Application	User Communities That Use the Application	Data Stores (Servers, Hosts, and so on)	Approximate Bandwidth Requirements	QoS Requirements

Traffic Load

- To calculate whether capacity is sufficient, you should know:
 - The number of stations
 - The average time that a station is idle between sending frames
 - The time required to transmit a message once medium access is gained
- That level of detailed information can be hard to gather, however

Size of Objects on Networks

- Terminal screen: 4 Kbytes
- Simple e-mail: 10 Kbytes
- Simple web page: 50 Kbytes
- High-quality image: 50,000 Kbytes
- Database backup: 1,000,000 Kbytes or more

Traffic Behavior

➤ Broadcasts

- All ones data-link layer destination address
 - FF: FF: FF: FF: FF: FF
- Doesn't necessarily use huge amounts of bandwidth
- But does disturb every CPU in the broadcast domain

➤ Multicasts

- First bit sent is a one
 - 01:00:0C:CC:CC:CC (Cisco Discovery Protocol)
- Should just disturb NICs that have registered to receive it
- Requires multicast routing protocol on internetworks

Network Efficiency

- Frame size
- Protocol interaction
- Windowing and flow control
- Error-recovery mechanisms

QoS Requirements

- ATM service specifications
 - Constant bit rate (CBR)
 - Realtime variable bit rate (rt-VBR)
 - Non-realtime variable bit rate (nrt-VBR)
 - Unspecified bit rate (UBR)
 - Available bit rate (ABR)
 - Guaranteed frame rate (GFR)

QoS Requirements per IETF

- IETF integrated services working group specifications
 - Controlled load service
 - Provides client data flow with a QoS closely approximating the QoS that same flow would receive on an unloaded network
 - Guaranteed service
 - Provides firm (mathematically provable) bounds on end-to-end packet-queuing delays

QoS Requirements per IETF

- IETF differentiated services working group specifications
 - RFC 2475
 - IP packets can be marked with a differentiated services codepoint (DSCP) to influence queuing and packet-dropping decisions for IP datagrams on an output interface of a router

Summary

- Continue to use a systematic, top-down approach
- Don't select products until you understand network traffic in terms of:
 - Flow
 - Load
 - Behavior
 - QoS requirements

Review Questions

- List and describe six different types of traffic flows.
- What makes traffic flow in voice over IP networks challenging to characterize and plan for?
- Why should you be concerned about broadcast traffic?
- How do ATM and IETF specifications for QoS differ?