

# **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

<b>User Community Name</b>	<b>Size of Community (Number of Users)</b>	<b>Location(s) of Community</b>	<b>Application(s) Used by Community</b>

# Data Stores

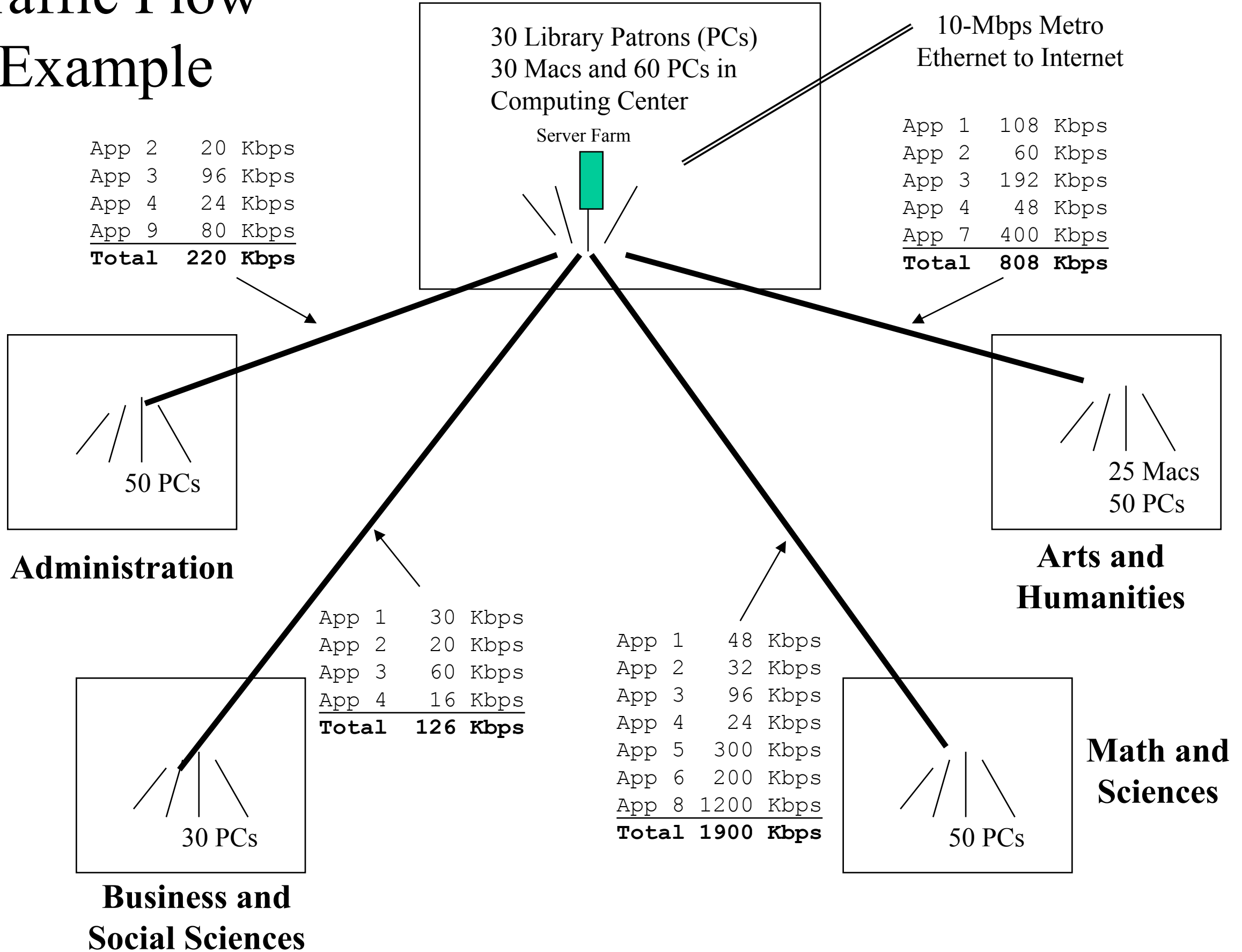
<b>Data Store</b>	<b>Location</b>	<b>Application(s)</b>	<b>Used by User Community(or Communities)</b>

# Traffic Flow

	<b>Destination 1 MB/sec</b>	<b>Destination 2 MB/sec</b>	<b>Destination 3 MB/sec</b>	<b>Destination MB/sec</b>
<b>Source 1</b>				
<b>Source 2</b>				
<b>Source 3</b>				
<b>Source <math>n</math></b>				

# Traffic Flow Example

## Library and Computing Center



# 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

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

# 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?