Network Planning & Design

Slide Set 7

Learning Outcomes

- Be familiar with the overall process of design and implementing a network
- Be familiar with techniques for developing a logical network design
- Be familiar with techniques for developing a physical network design
- Be familiar with network design principles

Outline

- **Introduction**
  - Traditional Network Design
  - Building Block Network Design
- **Needs Analysis**
  - Geographic Scope
  - Application Systems
  - Network Users
  - Categorizing Network Needs
  - Deliverables
- **Technology Design**
  - Designing Clients and Servers
  - Designing Circuits and Devices
  - Network Design Tools
  - Deliverables
- **Cost Assessment**
  - Request for Proposal
  - Selling the Proposal to Management
  - Deliverables

Traditional Network Design

- The traditional network design approach follows a structured systems analysis and design process similar to that used to build application systems.
  - The network analyst meets with users to determine the needs and applications.
  - The analyst estimates data traffic on each part of the network.
  - The analyst designs circuits needed to support this traffic and obtains cost estimates.
  - Finally, a year or two later, the network is implemented.

Traditional Network Design

- Three forces are making the traditional design approach less appropriate for many of today's networks:
  - 1. The underlying technology of computers, networking devices and the circuits themselves are rapidly changing.
  - 2. Network traffic is growing rapidly.
  - 3. The balance of costs has changed dramatically over the last 10 years.

Building Block Network Design

- While some organizations still use the traditional approach, many others use a simpler approach to network design, the building block approach.
- This approach involves three phases: needs analysis, technology design, and cost assessment (Fig. 11-1).
- When the cost assessment is initially completed, the design process returns to the needs analysis phase and cycles through all three phases again, refining the outcome of each phase.
- The process of cycling through all three design phases is repeated until a final design is decided on (Fig. 11-2).

Figure 11-1 Building Block Network

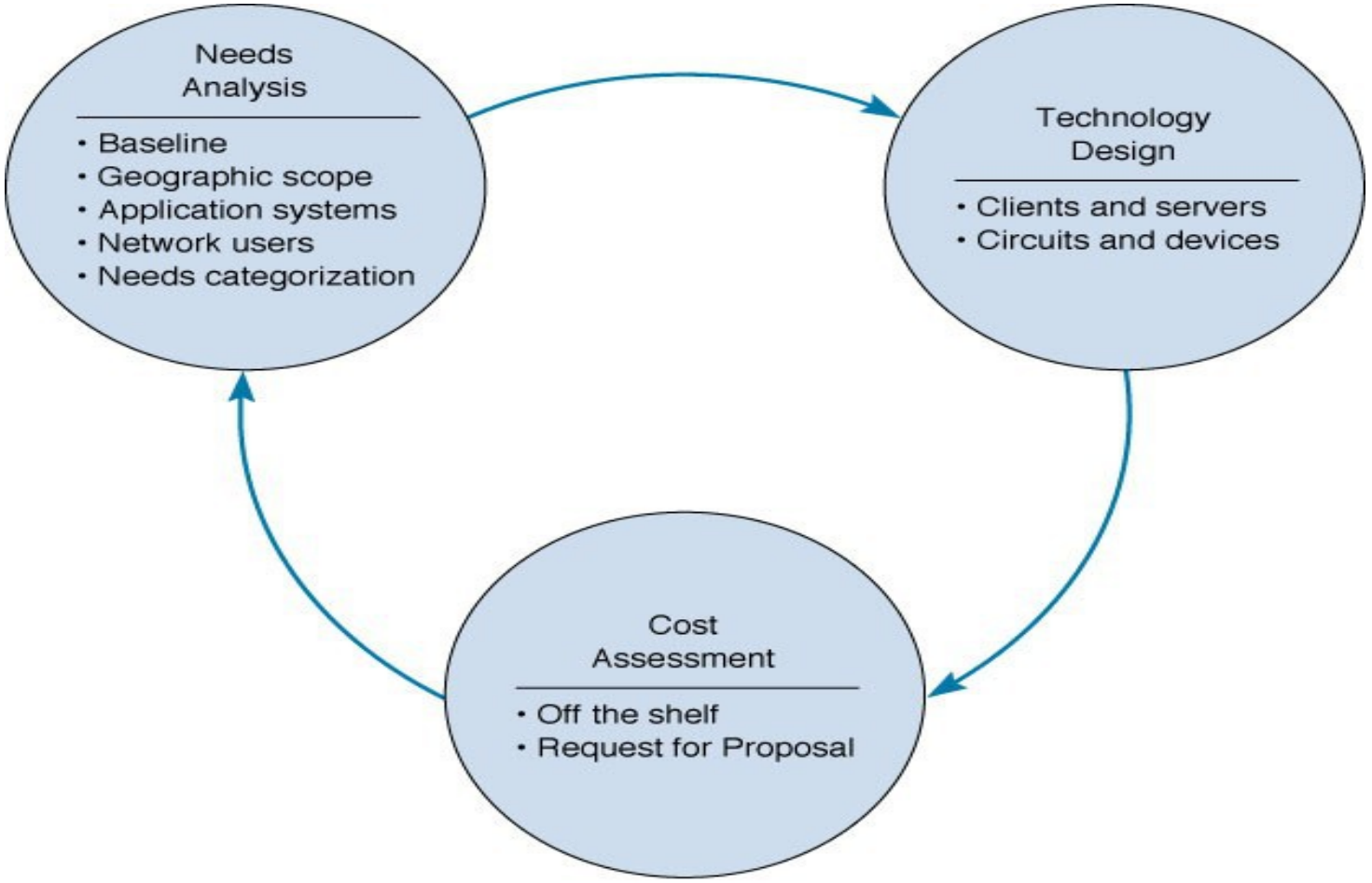
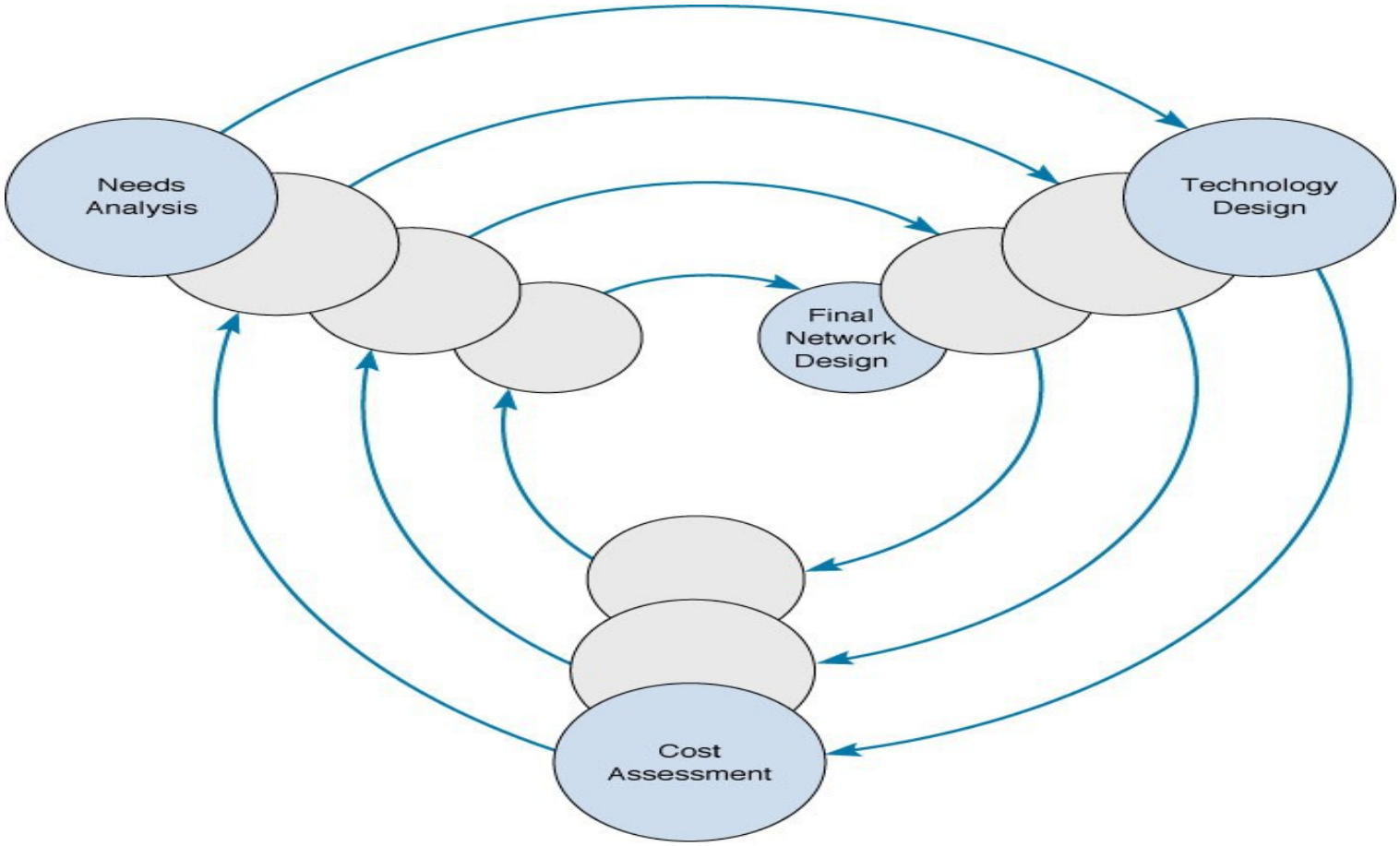


Figure 11-2 Reaching a Final Network Design



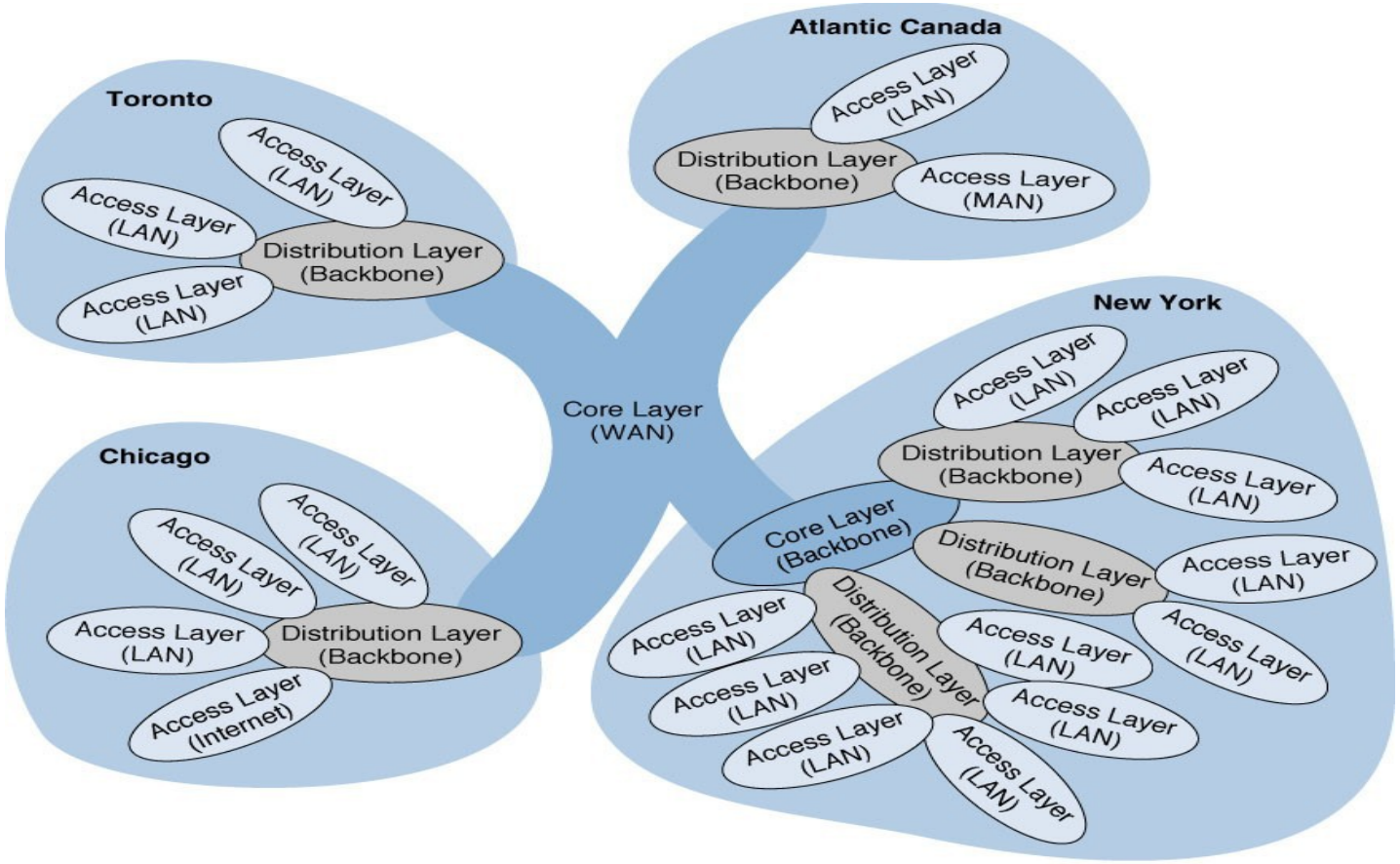
Needs Analysis

- The first step is to analyze the needs of network users along with the requirements of network applications.
- Most efforts today involve upgrades and not new network designs, so most needs may already be understood.
- LAN and BN design issues include improving performance, upgrading or replacing unreliable or ageing equipment, or standardizing network components to simplify network management.
- At the MAN/WAN level, circuits are leased and upgrades involve determining if capacity increases are needed.
- The object of needs analysis is to produce a logical network design, which describes what network elements will be needed to meet the organization's needs.

Geographic Scope (Figure 11-3)

- Needs analysis begins by breaking the network into three parts based on their geographic and logical scope:
  - The access layer which lies closest to the user
  - The distribution layer which connects the access layer to the rest of the network
  - The core layer which connects the different parts of the distribution layer together.

Figure 11-3 Geographic Scope



Application Systems

- The designers must review the applications currently used on the network and identify their location so they can be connected to the planned network (*baselining*).
- Next, applications expected to be added to the network are included.
- It is also helpful to identify the hardware and software requirements and protocol type for each application.

Network Users

- In the past, application systems accounted for the majority of network traffic. Today, much network traffic comes from Internet use (i.e. e-mail and WWW).
- The number and type of users that will generate network traffic may thus need to be reassessed.
- Future network upgrades will require understanding how the use of new applications, such as video, will effect network traffic.

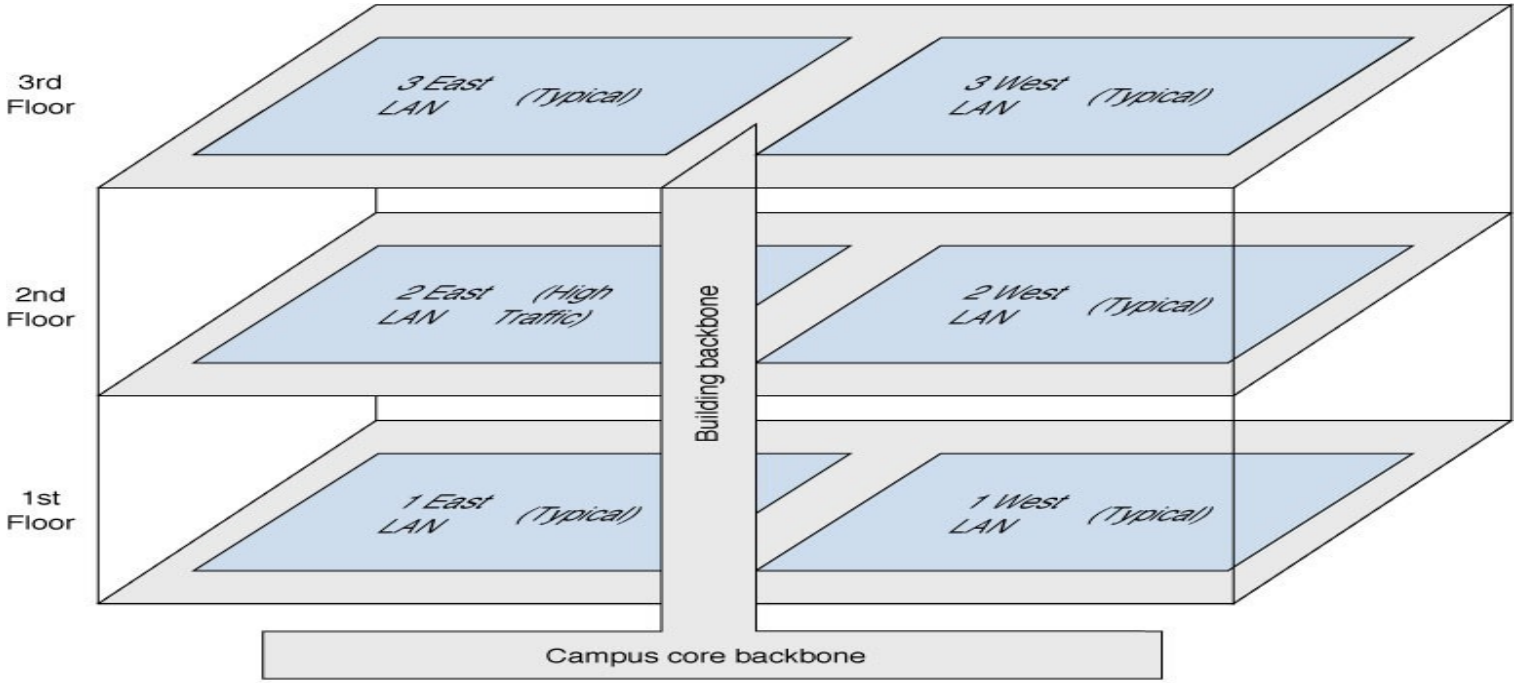
Categorizing Network Needs

- The next step is to assess the traffic generated in each segment, based on an estimate of the relative magnitude of network needs (i.e. *typical* vs. *high volume*). This can be problematic, but the goal is a relative understanding of network needs.
- Once identified, network requirements should be organized into *mandatory requirements*, *desirable requirements*, and *wish-list requirements*.

Deliverables

- The key deliverable for the needs assessment stage is a set of network maps, showing the applications and the circuits, clients, and severs in the proposed network, categorized as “typical” or “high volume”.

Fig. 11-4 Logical Network Design



Mandatory Applications

File server
–File sharing
Mail server
–E-mail
Web server
–Web applications for internal and external use

Wish-List Applications
–Desktop video conferencing (2 East and 2 West)

Technology Design

- After needs assessment has been completed, the next design phase is to develop a technology design (or set of possible designs) for the network.

Designing Clients and Servers

- For the technology design, the idea behind the building block approach is to specify the computers needed in terms of standard units.
- “Typical” users are allocated “base level” client computers, as are servers supporting “typical” applications.
- “High volume” users and servers are assigned “advanced” computers.
- The definition for a standard unit, however, keeps changing as hardware costs continue to fall.

Designing Circuits and Devices

- Two interrelated decisions in designing network circuits and devices are: 1) deciding on the fundamental technology and protocols and 2) choosing the capacity each circuit will operate at.
- Capacity planning means estimating the size and type of the “standard” and “advanced” network circuits for each type of network.
- This requires some assessment of the current and future circuit loading in terms of average vs. peak circuit traffic.

Estimating Circuit Traffic

- The designer often starts with the total characters transmitted per day per circuit, or if possible, the maximum number of characters transmitted per two second interval if peak demand must be met.
- While no organization wants to overbuild its network and pay for unneeded capacity, going back and upgrading a network often significantly increases costs.

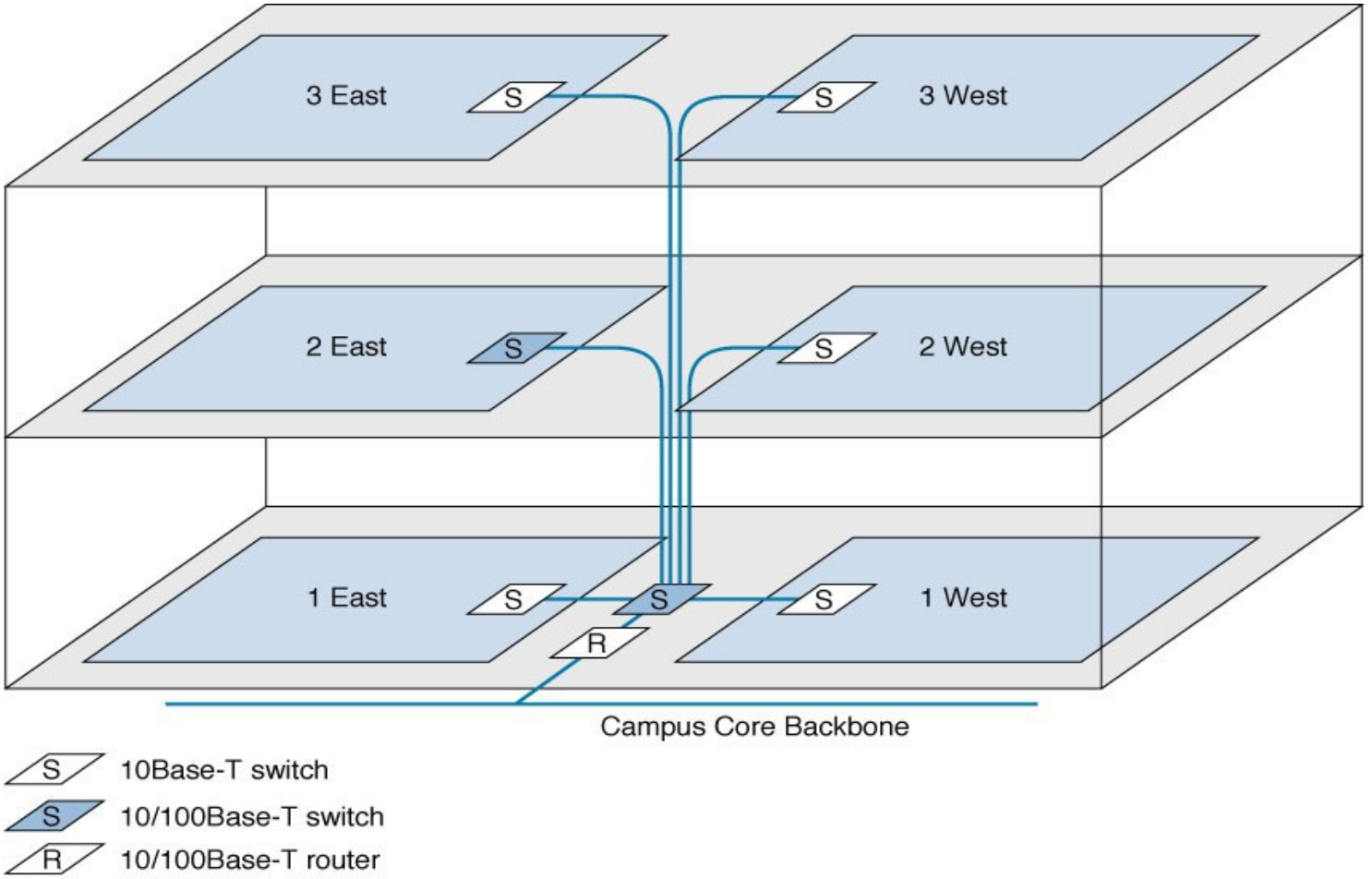
Network Design Tools

- Network modeling and design tools can perform a number of functions to help in the technology design process.
- Some modeling tools require the user to create the network map from scratch. Other tools can "discover" the existing network.
- Once the map is complete, the next step is to add information about the expected network traffic and see if the network can support the level of traffic that is expected. This may be accomplished through simulation models.
- Once simulation is complete, the user can examine the results to see the estimated response times and throughput.

Deliverables

- The key deliverables at this point are a revised set of network maps that include general specifications for the hardware and software required.
- In most cases the crucial issue is the design of the network circuits.

Fig. 11-5 Physical Network Design



Cost Assessment

- Cost assessment's goal is to assess the costs of various network alternatives produced as part of technology design. Costs to consider include:
  - Circuit costs for both leased circuits and cabling.
  - Internetworking devices such as switches and routers.
  - Hardware costs including servers, memory, NICs & UPSs.
  - Software costs for operating systems, application software and middleware.
  - Network management costs including special hardware, software, and training.
  - Test and maintenance costs for monitoring equipment and supporting onsite repairs.
  - Operations costs to run the network.

Request for Proposal (RFP)

- While some components can be purchased “off-the-shelf”, most organizations develop an RFP before making large network purchases.
- The RFP creates a competitive environment for providing network equipment and services.
- Once vendors have submitted network proposals, the organization evaluates them against specific criteria and selects the winner(s).
- Multi-vendor selections have the advantage of maintaining alternative equipment and services sources, but are also more difficult to manage.

Request for Proposal

- Background Information
  - Organizational profile; Overview of current network; Overview of new network; Goals of the new network
- Network Requirements
  - Choice sets of possible network designs (hardware, software, circuits); Mandatory, desirable, and wish list items, Security and control requirements; Response time requirements; Guidelines for proposing new network designs
- Service Requirements
  - Implementation time plan; Training courses and materials; Support services (e.g., spare parts on site); Reliability and performance guarantees
- Bidding Process
  - Time schedule for the bidding process; Ground rules; Bid evaluation criteria; Availability of additional information
- Information Required from Vendor
  - Vendor corporate profile; Experience with similar networks; Hardware and software benchmarks; Reference list

Selling the Proposal to Management

- An important hurdle to clear in network design is obtaining the support of senior management.
- Gaining acceptance from senior management lies in speaking their language and presenting the design in terms of easily understandable issues.
- Rather than focusing on technical issues such as upgrading to gigabit Ethernet, it is better to make a business case by focusing on organizational needs and goals such as comparing the growth in network use with the growth in the network budget.

Deliverables

- There are three key deliverables for this step:
  - 1. An RFP issued to potential vendors.
  - 2. After the vendor has been selected, the revised set of network maps including the final technology design, complete with selected components.
  - 3. The business case written to support the network design, expressed in terms of business objectives.