Business Data Communications and Networking

11th Edition

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Chapter 12

Network Management

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Outline

12.1 - Introduction

12.2 - Organizing the Mgmt Function

12.3 - Configuration Management

12.4 - Performance and Fault Management

12.5 - End User Support

12.6 - Cost Management

12.7 – Implications for Mgmt

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12.1 Introduction

- **Network management**
  - **Process of operating, monitoring and controlling the network to ensure that**
    - **Network working properly (efficient data exchange)**
    - **Providing value to its users**
- **A lack of planning and organization**
  - **Managers spend their time *firefighting* (reactive mode)**
    - **Dealing with breakdowns and immediate problems**
- **Main areas of network management function:**
  - **Configuration management**
  - **Performance and fault management**
  - **End user support**
  - **Cost management**

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12.2 Organizing the Network Mgmt Function

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Shift to LANs and the Internet

- **Large scale move from using mainframes and terminals to PCs, LANs and the Internet.**
  - **Future of network management lies in the successful management of multiple clients and servers over LANs, BN's, and Internet**
- **Focus on integration of organizational networks and applications. Main problems:**
  - **Not all LANs use the same architecture**
  - **More types of network technology used, the more complex network management becomes**
    - **Staff must be familiar with many different types of devices**

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Integrating LANs, WANs and Internet

- **Keys integrating them into one organization**
  - **Both LAN/Web and WAN managers to recognize that they no longer have total power**
    - **No more independent decision without considering the impact on other parts of network**
    - **Single overall goal that best meets the needs of the entire organizations**
    - **Require some managers to compromise on policies that may not be in the best interest of their own network**
  - **Must adopt a written charter to**
    - **Define its purpose, operational philosophy, and long range goals**
  - **Must develop individual procedures to implement policies**

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Integrating Voice & Data

- **Years ago, traditional voice and data networks (e.g., POTS and LANs) were handled by separate managers**
  - **Voice Communication Manager in Facilities Department:**
    - **Supervised telephone switchboard, coordinated installation and maintenance of the voice network**
  - **Data Communication Manager (IT department):**
    - **Installed own data circuit, installed and maintained computers**
- **Now, organizations realize benefits of integrating voice and data management function**
  - **Simplifies the network, and can lower network costs**
  - **Eliminates one department**
  - **Is now more typically found in network management**

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12.3 Configuration Management

- **Major functions:**
  - **Management of the network's hardware and software configuration**
  - **Documenting the configuration**
  - **Ensuring that documentation is updated when there is a change in the configuration**

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Configuring Network and Clients

- **Adding and deleting user accounts**
  - **New user addition**
    - **Categorized as a member of a group**
      - **With corresponding privileges**
    - **Given a standard login script**
      - **Commands to run when user logs in**
- **Updating software on client computers**
  - **Usually done automatically by Electronic Software Distribution (ESD) over the network at predefined time**
    - **Reduces cost of configuration management (long run)**
    - **Eliminates manual updates for each client**
    - **Produces accurate documents and reports**
    - **Being standardized: Desktop Management Interface (DMI)**

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Documenting Configuration

- **Includes information on**
  - **Network hardware and software**
  - **User and application profiles**
  - **Network documentation**
- **Documenting network hardware**
  - **Typically done via a set of diagrams documenting**
    - **Circuits, servers, devices, client computers**
  - **Must be supplemented with details on each device**
    - **Serial number, vendor, date of purchase, warranty information, repair history, phone number for repairs, etc**
    - **Any other info (e.g., contact info of managers)**

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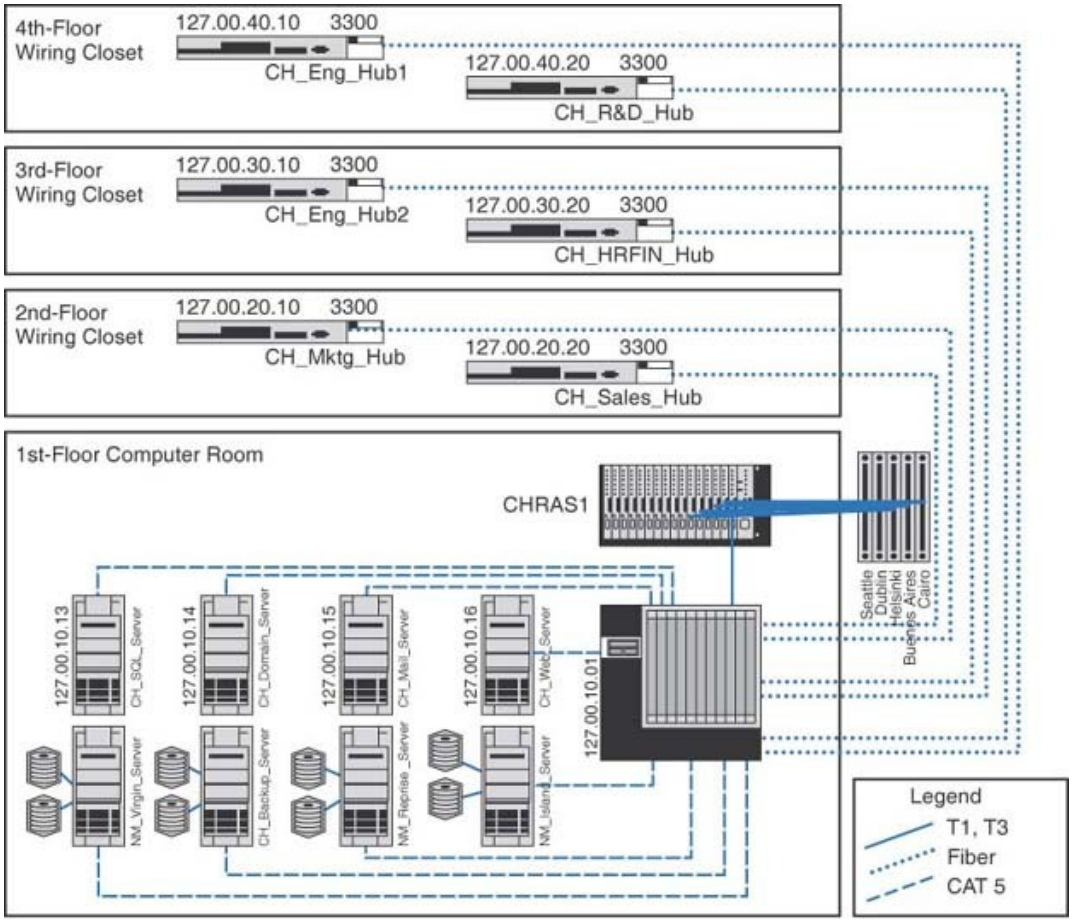
Network Configuration Diagram



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Documenting Configuration (Cont.)

- **Documenting software includes information on**
  - **Network OS and any special-purpose network software**
    - **Version, release date, etc**
  - **Can be helpful in negotiating site licenses**
- **Documentation of User & Application profiles**
  - **Used to identify access rights to files and directories**
- **Other network documentation**
  - **Manuals for hardware, software, standards and operations; vendor contracts, and licenses**
- **Documentation should include details about**
  - **Performance and fault management, maintenance guidelines, DRP, user support and cost management**

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12.4 Performance & Fault Mgmt

- **Performance management**
  - **Ensuring the network is operating as efficiently as possible**
- **Fault management**
  - **Preventing, detecting, and correcting faults in the network circuits, hardware, and software**
- **Both require**
  - **Network monitoring**
    - **Tracking the operation of network circuits and devices**
  - **Determining how heavily circuits and devices are being used**
  - **Ensuring circuits and devices are operating properly**

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Network Monitoring

- **Done by network management software**
- **Involves Network Operations Centers (NOCs)**
  - **A centralized place enabling managers to monitor the network and respond to problems before users complain**
- **Collect operational statistics from devices**
  - **Physical network statistics**
    - **Derived from modems, multiplexers, and circuits linking hardware devices**
  - **Logical network information:**
    - **Derived from performance measurement systems**
      - **User response times, traffic volume on a specific circuit, the destinations of network packets, and other indices showing the network's service level**

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Failure Control Function

- **Requires developing a central control process for problem reporting and troubleshooting**
  - **Maintain a central phone number for users to report problems**
  - **Establish a central troubleshooting group**
    - **Functions include contacting hardware, software vendors or common carriers**
- **Detecting and reporting network problems**
  - **By the help desk or NOC; by the user; and**
  - **By managed devices**
    - **Record data on messages processed and send this info back to a central database**
    - **Detect its own faulty parts and send alarms**

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Trouble Tickets

- **Reports that indicate network faults**
  - **Automatically produced by software packages**
- **Main reasons for trouble tickets**
  - **Problem tracking**
    - **To determine status for correcting problems**
      - **Responsible people, schedule, status, resolution, etc**
  - **Problem statistics**
    - **Used to generate various statistical reports (number of failures per card, circuit, hardware, etc.,)**
  - **Problem prioritizing**
    - **To ensure critical problems get higher priority**
  - **Management reports**
    - **To determine availability, product and vendor reliability, vendor responsiveness**

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Trouble Log

- **Purpose**
  - **To record problems that must be corrected and keep track of associated statistics**
- **Helpful for reviewing problem patterns on the network**
- **Can be used to identify which network components are the most problematic**
- **Example of a trouble log:**
  - **37 calls for software problems, 26 calls for modems, 49 calls for client computers, 2 calls for common carriers**

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Performance and Failure Statistics

- **Main performance statistics**
  - **Number of packets moved on a circuit and**
  - **Response time**
- **Failure statistics**
  - **Availability:**
    - **Percent of time the network available to users**
      - **Number of hours per month the network is available divided by the total of hours in a month (i.e., 720 hours)**
      - **Most networks: 99% to 99.5%**
  - **Downtime:**
    - **Percent of time network is not available**

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Failure Statistics

- **Mean time between failures (MTBF)**
  - **Number of hours or days of continuous operation**
  - **Indicates the reliability of a component**
- **Mean time to repair (MTTR)**
  - **Average number of minutes or hours until the failed device is operational again**

MTTRepair = MTTDiagnose + MTTRespond + MTTFix



Average number of minutes until the root cause is diagnosed (shows efficiency of NOC)

Average number of minutes until the service or vendor personnel arrives at location

Average number of minutes until problem is fixed (shows efficiency of repair people)

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Other Daily Statistics

- **Daily data about the normal operations**
  - **Number of errors per circuit**
  - **Volume of transmission per circuit, computer, etc.,**
  - **Usage rates; % of capacity used**
- **Used to identify devices or circuits that have higher than average rates (thus may be good candidate for upgrades)**
- **Used for predicting future growth patterns and failures**
  - **May be accomplished by establishing quality control charts that track network performance against an upper and a lower limits of a statistics**

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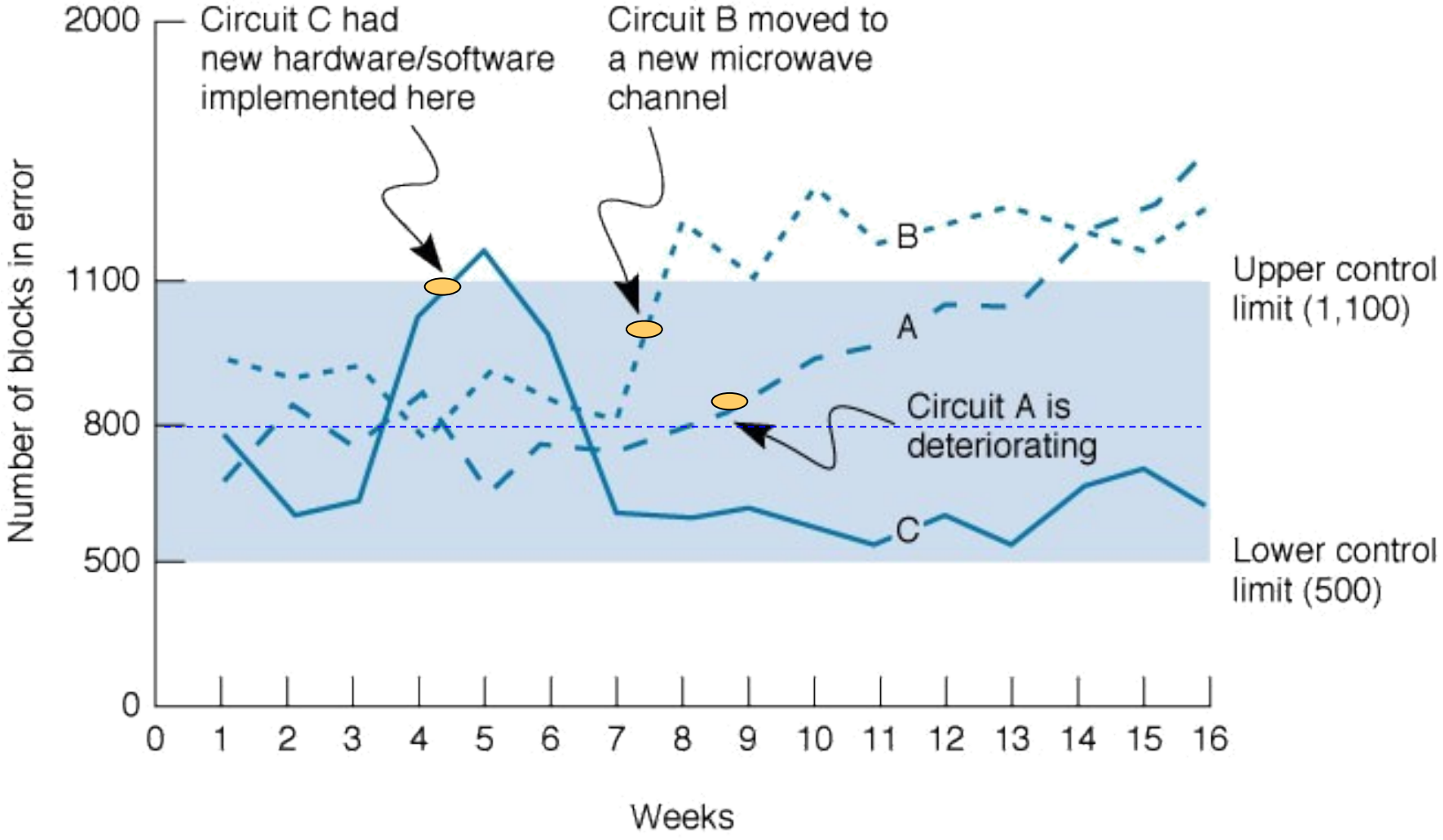
Quality Control Chart



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Improving Performance

- **General activities to improve performance that cut across the different types of networks:**
  - **Policy-based management**
  - **Server load balancing**
  - **Service-level agreements**

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Policy-Based Management

- **A new approach in managing performance**
- **Setting priority policies for network traffic in software**
  - **Take effect when the network becomes busy**
- **Example**
  - **Manager: Sets videoconferencing traffic as the highest priority**
    - **Since delays will have the highest impact on the performance of that application**
  - **Policy management software: Configures devices using QoS capabilities in TCP/IP and/or ATM**
    - **So that videoconferencing traffic gets the highest priority when device becomes busy**

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Service Level Agreements (SLAs)

- **Signed between the organization and its service providers (ISP or common carriers)**
- **Specify the exact type of performance and fault conditions that the organization will accept**
- **Also specify compensations the service provider must provide if it fails to meet the SLA**
- **Examples of SLA statements:**
  - **Availability must be 99% or higher**
  - **Mean Time Between Failures (MTBF) for T1 circuits must be 120 days or more**
  - **Maximum allocable response time must be lower than 2 minutes**

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12.5 End User Support

- **Solving the problems users encounter while using the network**
- **Main functions within end user support:**
  - **Resolving problems**
  - **End user Training**

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Resolving Problems

- **Major sources of problems with user equipment**
  - **Hardware device failures, generally easiest to fix**
  - **Lack of user knowledge on proper operation, also easier to fix**
    - **Solved by discussing the problem with user and taking the person through the process step by step**
  - **Problems with software, software settings or software incompatibility, generally hardest to fix**
    - **Could be result of a bug or software not functioning properly**
    - **May requires expertise with that specific software**
    - **May require software upgrades**

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Process of Resolving Problems

- **Assistance requested by user from the help desk**
- **Trouble ticket created and maintained by the trouble log**
- **Problem resolved by the receiving staff members**
  - **If not resolved, problem is escalated**
- **Levels of problem resolution process**
  1. **Help desk: Resolve about 85% of problems**
  2. **Staff members with specialized skills specific to the problem at hand: Brought in when help desk can't solve**
  3. **Technical specialists with a higher level of training: Contacted by level 2 to look into harder problems**

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Providing End User Training

- **An ongoing responsibility of network manager**
- **A key part in implementation of new networks**
- **Important to have ongoing training programs**
  - **Employees often change jobs within an organization and new employees require training**
- **Types of training**
  - **In-class**
    - **Focus on in-depth instructions for the most commonly used functions in the network**
  - **One-on-one instructions**
  - **Through documentation and training manuals provided**

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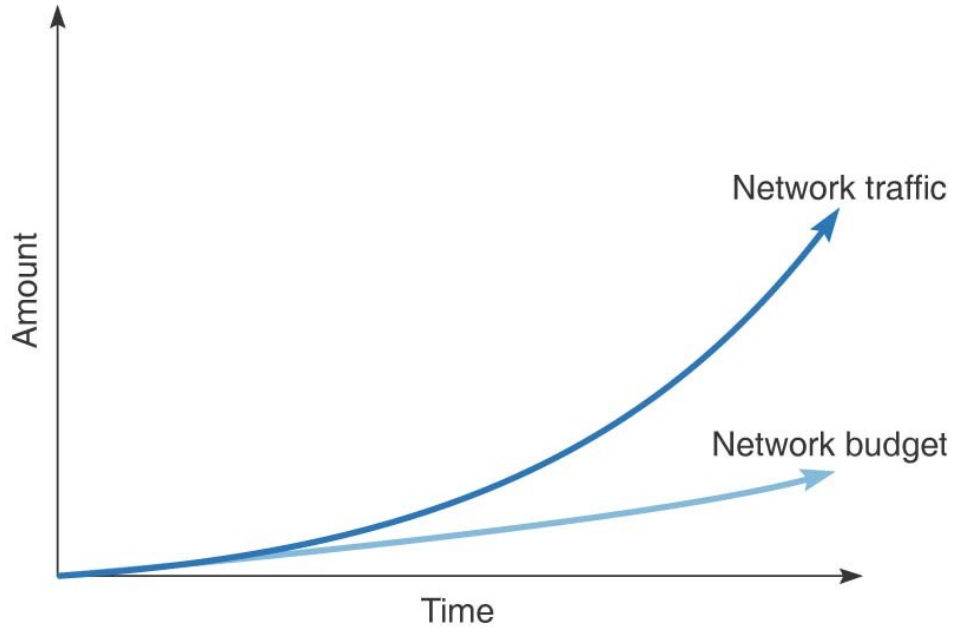
12.6 Cost Management

- **One of the most challenging areas over the past few years**
  - **Traffic growing more rapidly than the budget**
  - **Managers are forced to provide greater capacity at an ever lower cost per megabyte**



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Sources of Cost

- **Total Cost of Ownership (TCO)**
  - **A measure of how much it costs per year to keep one computer operating**
  - **Includes cost of**
    - **Repairs and software/hardware upgrades**
    - **Support staff (maintain, install, administer, etc)**
    - **Training and technical support**
    - **Time "wasted" by the user when problems occur**
  - **TCO of a Windows computer**
    - **TOO HIGH - $5,000 and $10,000 per computer per year**
    - **Main culprit in cost is inclusion of "wasted" time**

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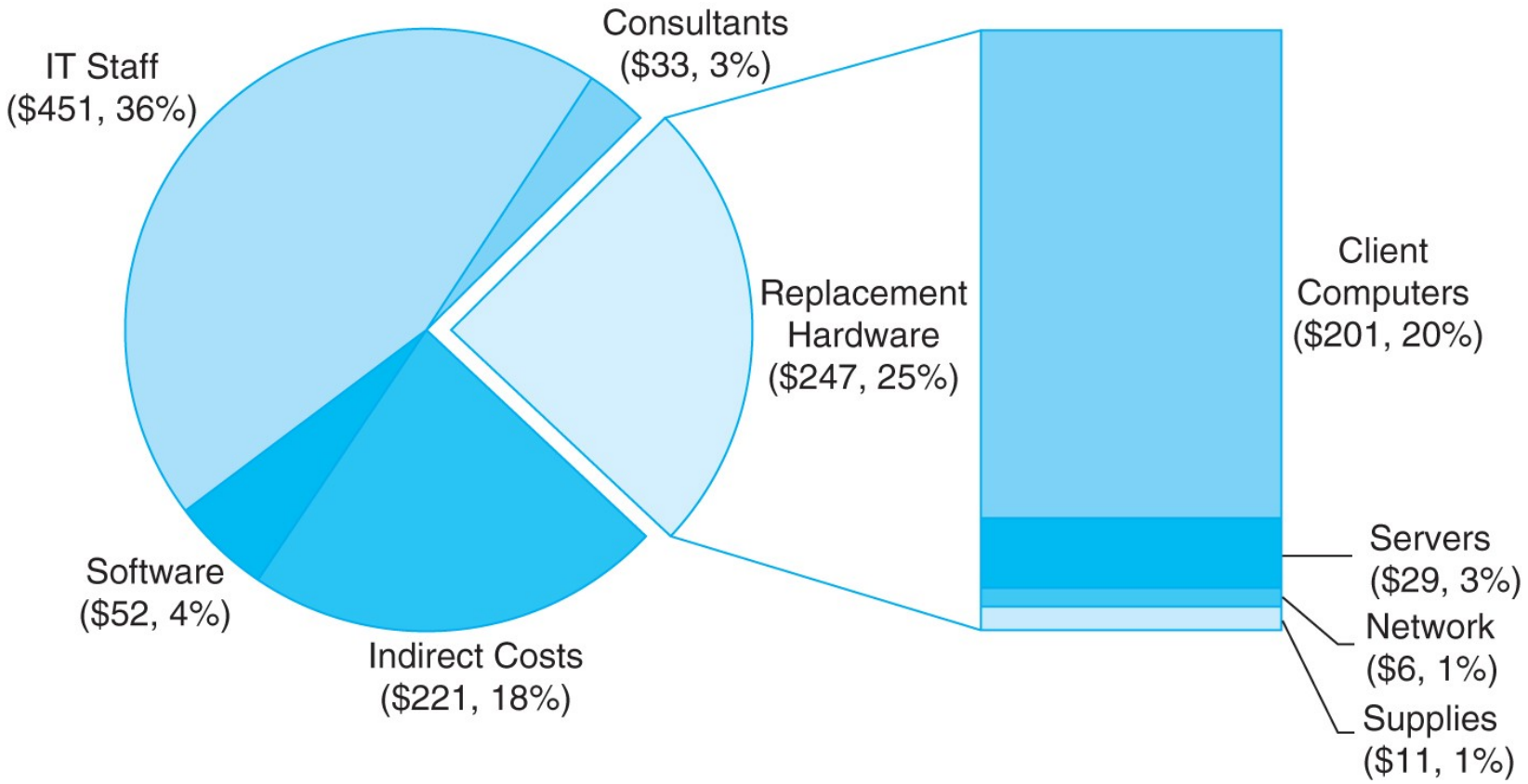
TCO per Client Computer for a School District



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Sources of Cost (Cont.)

- **Net Cost of Ownership (NCO)**
  - **An alternative to TCO; also called as “real TCO”**
  - **Measures only direct costs**
    - **Leaving out so-called “wasted” time**
  - **NCO costs per computer: between $1500-$3500**
    - **Net management for a 100-user network require an annual budget of between $150,000 - $350,000**
  - **Largest network budget items (with NCO):**
    - **Personnel cost, accounting for 50-70% of costs**
    - **WAN circuits**
    - **Hardware upgrades and replacement parts**
  - **Important message: Focus should be on ways to reduce personnel time, not hardware costs**

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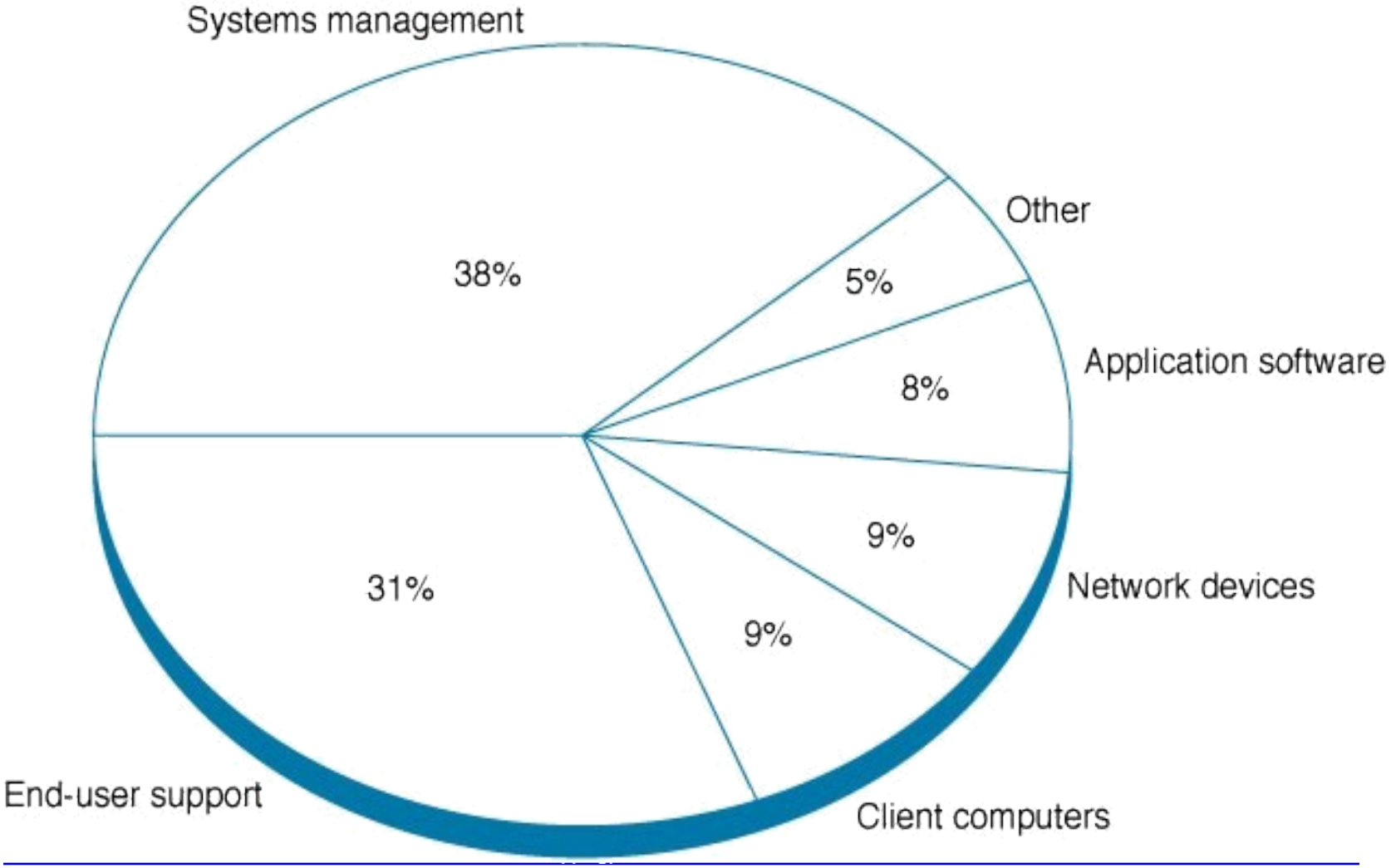
Network Management Personnel Costs



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Managing Network Budgets

- **Difficult to manage**
  - **Networks growing rapidly → requiring more staff and more equipment**
- **Use charge-back policies to counter increasing cost**
  - **Allocate costs associated with the network to specific users**
    - **Users must pay for their usage (by moving part of their budget) to the network group**
  - **Applicable to WAN and mainframe users as a cost accounting mechanism**
  - **Difficult to implement on LANs**

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Reducing Costs

- **Develop standard hardware/software configurations for client computers, servers, and network devices**
  - **Easier to diagnose and fix problems; Easier to learn**
- **Automate as much of the network management process as possible**
  - **Use of ESD, DHCP and a other network management tools**
- **Reduce the cost of installing new hardware/software**
  - **Reduce the staff time spent in installing; Work with vendors**
- **Centralize help desks**
  - **More specialists in one location→ faster problem resolution**

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12.7 Implications for Management

- **Network management requires**
  - **A good understanding of networking technologies**
  - **An ability to work with end users and management**
  - **An understanding of key elements driving network costs**
- **Requires special skill to explain the business value of the networks to senior management**
  - **Needed to justify increased cost of management**
- **Network management increasing its complexity**
  - **New, more intelligent technologies in managing networks**
  - **More reliable, but more expensive and requires new skills in designing, installing and managing**
    - **Difficulty in keeping the staff**

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