CHAPTER 1

Analyzing Business Goals and Constraints

This chapter serves as an introduction to the rest of the book by describing top-down network design. The first section explains how to use a systematic, top-down process when designing computer networks for your customers. Depending on your job, your customers might be other departments within your company, those to whom you are trying to sell products, or clients of your consulting business.

After describing the methodology, this chapter focuses on the first step in top-down network design: analyzing your customer's business goals. Business goals include the capability to run network applications to meet corporate business objectives, and the need to work within business constraints, such as budgets, limited networking personnel, and tight timeframes.

This chapter also covers what some people call the eighth layer of the Open Systems Interconnection (OSI) reference model: workplace politics. To ensure the success of your network design project, you should gain an understanding of any corporate politics and policies at your customer's site that could affect your project.

The chapter concludes with a checklist to help you determine if you have addressed the business issues in a network design project.

Using a Top-Down Network Design Methodology

According to Albert Einstein:

> The world we've made as a result of the level of thinking we have done thus far creates problems that we cannot solve at the same level at which we created them.

To paraphrase Einstein, network engineers and users have the ability to create network design problems that cannot be solved at the same level at which they were created. This predicament can result in networks that are hard to understand and troubleshoot. It can also result in networks that don't perform as well as expected, don't scale as the need for growth arises (as it almost always does), and don't match a customer's requirements. A solution to this problem is to use a systematic, top-down network design methodology that focuses on a customer's requirements, constraints, and goals.

Many network design tools and methodologies in use today resemble the "connect-the-dots" game that some of us played as children. These tools let you place internetworking devices on a palette and connect them with LAN or WAN media. The problem with this methodology is that it skips the steps of analyzing a customer's requirements and selecting devices and media based on those requirements.

Good network design must recognize that a customer's requirements embody many business and technical goals, including requirements for availability, scalability, affordability, security, and manageability. Many customers also want to specify a required level of network performance, often called a *service level*. Difficult network design choices and tradeoffs must be made when designing the logical network before any physical devices or media are selected.

When a customer expects a quick response to a network design request, a bottom-up (connect-the-dots) network design methodology can be used, if the customer's applications and goals are well known. However, network designers often think they understand a customer's applications and requirements only to discover, after a network is installed, that they did not capture the customer's most important needs. Unexpected scalability and performance problems appear as the number of network users increases. These problems can be avoided if the network designer uses top-down methods that perform requirements analysis before technology selection.

Top-down network design is a methodology for designing networks that begins at the upper layers of the OSI reference model before moving to the lower layers. It focuses

on applications, sessions, and data transport before the selection of routers, switches, and media that operate at the lower layers.

The top-down network design process includes exploring divisional and group structures to find the people for whom the network will provide services and from whom you should get valuable information to make the design succeed.

Top-down network design also is iterative. To avoid getting bogged down in details too quickly, it is important to first get an overall view of a customer's requirements. Later, more detail can be gathered on protocol behavior, scalability requirements, technology preferences, and so on. Top-down network design recognizes that the logical model and the physical design may change as more information is gathered.

Because top-down methodology is iterative, some topics are covered more than once in this book. For example, this chapter discusses network applications. Network applications are discussed again in Chapter 4, "Characterizing Network Traffic," which covers network traffic caused by application- and protocol-usage patterns. A top-down approach lets a network designer get "the big picture" first and then spiral downward into detailed technical requirements and specifications.

Analyzing Business Goals

Understanding your customer's business goals and constraints is a critical aspect of network design. Armed with a thorough analysis of your customer's business objectives, you can propose a network design that will meet with your customer's approval.

It is tempting to overlook the step of analyzing business goals, because analyzing such technical goals as capacity, performance, security, and so on is more interesting to many network engineers. Analyzing technical goals is covered in the next chapter. In this chapter, you will learn the importance of analyzing business goals, and you will pick up some techniques for matching a network design proposal to a customer's business objectives.

Working with Your Client

Before meeting with your customer to discuss business goals for the network design project, it is a good idea to research your client's business. Find out what industry the client is in. Learn something about the client's market, suppliers, products, services,

and competitive advantages. With the knowledge of your customer's business and its external relations, you can position technologies and products to help strengthen the customer's status in the customer's own industry.

In your first meeting with your customers, ask them to explain the organizational structure of the company. Your final internetwork design will probably reflect the corporate structure, so it is a good idea to gain an understanding of how the company is structured in departments, lines of business, vendors, partners, and field or remote offices. Understanding the corporate structure will help you locate major user communities and characterize traffic flow. Characterizing traffic flow is covered in Chapter 4, "Characterizing Network Traffic."

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Understanding the corporate structure will also help you recognize the management hierarchy. One of your primary goals in the early stages of a network design project should be to determine who the decision-makers are. Who will have the authority to accept or reject your network design proposal? Sometimes, this can be a rather complicated issue, as discussed in the section, "Politics and Policies," later in this chapter.

Ask your customer to state an overall goal of the network design project. Explain that you want a short, business-oriented statement that highlights the business purpose of the new network. Why is the customer embarking on this new network design project? For what will the new network be used? How will the new network help the customer be more successful in the customer's business?

After discussing the overall business goals of the network design project, ask your customer to help you understand the customer's criteria for success. What goals must be met for the customer to be satisfied? Sometimes success is based on operational savings because the new network allows employees to be more productive. Sometimes success is based on the ability to increase revenue or build partnerships with other companies. Make sure you know up front how "success" is defined by executives, managers, end users, network engineers, and any other stakeholders. Also, determine whether the customer's definition of success will change as yearly fiscal goals change.

In addition to determining the criteria for success, you should ascertain the consequences of failure:

- What will happen if the network design project fails or if the network, once installed, does not perform to specification?
- How visible is the project to upper-level management?
- Will the success (or possible failure) of the project be visible to executives?
- To what extent could unforeseen behavior of the new network disrupt business operations?

In general, gather enough information to feel comfortable that you understand the extent and visibility of the network design project.

You should try to get an overall view of whether the new network is critical to the business's mission. Investigate the ramifications of the network failing or experiencing problems. Chapter 2, "Analyzing Technical Goals and Constraints," discusses the details of performance and reliability analysis, but at this point in the design process, you should start addressing these issues. (Remember that top-down network design is iterative. Many network design requirements are addressed more than once.)

Changes in Enterprise Networks

Enterprise networks at many corporations have been undergoing major changes. The value of making vast amounts of corporate data available to employees, customers, and business partners has been recognized. Corporate employees, field employees, and telecommuters need access to sales, marketing, engineering, and financial data, regardless of whether the data is stored on centralized or distributed servers or mainframes. Suppliers and customers need access to inventory and ordering information.

Network applications have become mission critical. Despite this trend, large budgets for networking and telecommunications operations have been reduced at some companies. Many companies have gone through difficult reengineering projects to reduce operational costs, and are still looking for ways to manage networks with fewer people, reduce the recurring costs of WAN circuits, and use technology to increase worker productivity.

Until recently, telecommunications and voice networks were separate. Telecommunications engineers knew little about data networks, and networking engineers did not know the difference between a Time Division Multiplexer (TDM) and a Tandem Switching System (TSS). In today's environment, voice, data, and video networks are merging.

In traditional voice and data terminal/mainframe networks, data flow and throughput were predictable. Closed communications systems were the norm, and data sources were well known. In today's networks, Internet surfing is ubiquitous. It is hard to predict data flow and the timing of bursts of data when users are jumping from one Web site to another, possibly downloading videos or animation files.

In addition to Web surfing, increased outsourcing, alliances, partnerships, and virtual corporations have an affect on network data flow. Many companies are moving to a global network-business model, where the network is used to reach partners, vendors, resellers, sales prospects, and customers.

Another trend is *Virtual Private Networking* (VPN), where private networks make use of public service networks to get to remote locations or possibly other organizations. Customers getting involved in VPN projects have concerns about reliable and predictable performance, as well as data throughput requirements. VPN is covered in Chapter 5, "Designing a Network Topology."

Customers who still have a lot of old telecommunications and data-processing services are embarking on large network design projects. For example, geographically dispersed enterprises with large TDM-based WAN networks are migrating to Frame-Relay routed networks and ATM switched networks. Enterprises that depend on Systems Network Architecture (SNA) or other transaction-oriented protocols are migrating to Internet Protocol (IP) networks. These customers have concerns about security, speed, delay, and delay variation.

Other companies are embarking on network design projects to improve corporate communications, using such new applications as videoconferencing, LAN telephony, and distance learning. Corporations are also updating computer-aided design (CAD) and computer-aided manufacturing (CAM) applications with the goal of improving productivity and shortening product-development cycles.

Many companies are enhancing their networks so they can offer better customer support and new services. Some companies recognize the opportunity to resell WAN bandwidth once a network has been optimized to reduce wasted bandwidth.

Another typical business goal is to buy, or merge with, another company, or establish partnerships with other companies. This goal is often linked to the goal of expanding to new countries and continents. Scalability often is a concern for global businesses trying to keep up with worldwide market expansion and the increasing need for partnerships with remote resellers and suppliers.

Typical Network Design Business Goals

If you keep in mind the changes in business strategies and enterprise networking discussed in the previous section, it becomes possible to list some typical network design business goals:

- Increase revenue and profit
- Improve corporate communications
- Shorten product-development cycles and increase employee productivity
- Build partnerships with other companies
- Expand into worldwide markets
- Move to a global-network business model
- Modernize out-dated technologies
- Reduce telecommunications and network costs, including overhead associated with separate networks for voice, data, and video
- Expand the data readily available to all employees and field offices so they make better business decisions
- Improve security and reliability of mission-critical applications and data
- Offer better customer support
- Offer new customer services

Identifying the Scope of a Network Design Project

One of the first steps in starting a network design project is to determine its scope. Ask your customer if the design is for a new network or a modification to an existing one. Also ask your customer to help you understand if the design is for a single network segment, a set of LANs, a set of WAN or remote-access networks, or the whole enterprise network.

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Designers rarely get a chance to design a network from scratch. Usually a network design project involves an upgrade to an existing network. However, this is not always the case. Some senior network designers have developed completely new next-generation networks to replace old networks. Other designers have designed networks for a new building or new campus. Even in these cases, however, the new network usually has to fit into an existing infrastructure, for example, a new campus network that has to communicate with an existing WAN.

When analyzing the scope of a network design, you can refer to the seven layers of the OSI reference model to specify the types of functionality the new network design must address. Figure 1–1 shows the OSI reference model.

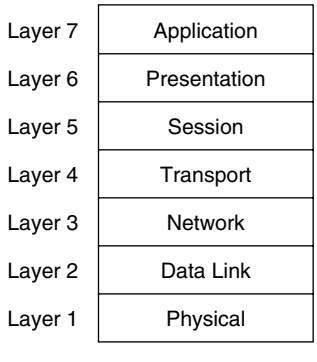

Figure 1–1 *The Open Systems Interconnection (OSI) reference model.*

In addition to using the OSI reference model, this book also uses the following terms to define the scope of a network and the scope of a network design project:

- **Segment**. A single network based on a particular Layer-2 protocol. May include hubs, repeaters, and multistation-access units (MAUs).
- **LAN**. A set of bridged or switched segments, usually based on a particular Layer-2 protocol (although mixed LANs are possible). May have one or more Layer-3 protocols associated with it.
- **Building network**. Multiple LANs within a building, usually connected to a building-backbone network.
- **Campus network**. Multiple buildings within a local geographical area (within a few miles), usually connected to a campus-backbone network.
- **Remote access**. Dial-in or dial-out solutions, either analog or digital.
- **WAN**. A geographically dispersed network including point-to-point, Frame Relay, ATM, and other long-distance connections.
- **Enterprise network**. A large and diverse network, consisting of campuses, remote access services, and one or more WANs. An enterprise network is also called an *internetwork*.

Explain to your customer any concerns you have about the scope of the project, including technical and business concerns. Subsequent sections in this chapter discuss politics and scheduling, which are tightly linked to the scope of a network design project. (Many network designers have learned the hard way what happens when you don't help your customers match the schedules of their projects to the scope.)

Identifying a Customer's Network Applications

At this point in the design process you have identified your customer's business goals and the scope of the project. It is now time to focus on the real reason networks exist: applications. The identification of your customer's applications should include both current applications and new applications. Ask your customer to help you fill out a chart, such as the one in Table 1–1.

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This chart identifies network applications. In Chapters 2 and 4, the Network Applications chart will be enhanced to include technical requirements and network-traffic characteristics. At this point, your goal is simply to identify network applications.

Table 1–1 Network Applications

Name of Application	Type of Application	New Application? (Yes or No)	Criticality	Comments

For "Name of Application," simply use a name that your customer gives you. This could be an industry-standard name, such as Lotus Notes, or it could be an application name that only means something to the customer, (especially for a home-grown application). For new applications, the name might be a code name for a software-development project.

For "Type of Application," you can use any appropriate text that describes the type of application, or you can classify the application as one of the following standard network applications:

- Electronic mail
- File sharing/access
- Groupware
- Web browsing
- Network game
- File transfer
- Database access/update
- Desktop publishing
- Push-based information dissemination
- Electronic whiteboard

- Remote terminal
- Terminal emulation
- Calendar
- Online directory (phone book)
- Medical imaging
- Distance learning
- Videoconferencing
- Internet or intranet voice
- Internet or intranet fax
- Point of sales (retail store)
- Sales order entry
- Electronic commerce
- Management reporting
- Financial modeling
- Sales tracking
- Human resources management
- Computer-aided design
- Computer-aided manufacturing
- Inventory control and shipping
- Process control and factory floor
- Telemetry

The preceding list includes user applications. The Network Applications chart should also include *system* applications (or, if you prefer, you can do a separate chart for system applications). System applications include the following types of network services:

- User authentication and authorization
- Host naming
- Remote booting
- Remote configuration download
- Directory services
- Network backup
- Network management
- Software distribution

In the "Criticality" column of the Network Applications chart, you can give each application a ranking from 1 to 3 with the following meanings:

1 - extremely critical
2 - somewhat critical
3 - not critical

Later, you can gather more specific information on mission-criticality, including precisely how much downtime is acceptable (if the customer can quantify availability requirements).

In the "Comments" column, add any observations relevant to the network design. For example, include any information you have about corporate directions, such as plans to stop using an application in the future, or specific rollout schedules and regional-use plans.

Analyzing Business Constraints

In addition to analyzing business goals and determining your customer's need to support new applications, it is important to analyze any business constraints that will affect your network design.

Politics and Policies

It has been said that there are two things not to talk about with friends—politics and religion. It would be nice if you could escape discussing office politics and technological religion (technology preferences) with a network design customer, but avoiding these topics puts your project at risk.

In the case of office politics, your best bet is to listen rather than talk. Your goal is to learn about any hidden agendas, turf wars, biases, group relations, or history behind the project that could cause it to fail. In some cases, a similar project was already tried and didn't work. You should determine if this has happened in your case and, if it has, the reasons why the project failed or never had a chance to come to fruition.

Pay attention to personnel issues that could affect the project. Which manager or managers started the project and how much do they have at stake? Are there any managers, network engineers, or users who want the project to fail for any reason?

Find out who your advocates and opponents are. In some cases, no matter how technically sound your network design is, there will be people who have a negative reaction to it.

Be sure to find out if your project will cause any jobs to be eliminated. Some network design projects involve automating tasks that were once done by highly paid workers. These workers will obviously have reasons to want the project to fail.

While working with a client, you will gain a feeling for the client's business style. One aspect of style that is important to understand is tolerance to risk. Is risk-taking rewarded in the company, or are most people afraid of change? Knowing the employment history of the decision-makers will help you select appropriate technologies. The employment history of the decision-makers affects their tolerance to risk and their biases toward certain technologies. Understanding these issues will help you determine if your network design should be conservative or if it can include new, state-of-the art technologies and processes.

It is important that you discuss with your customer any policies (religion) regarding protocols, standards, and vendors. Find out if the company has standardized on any transport, routing, desktop, or other protocols. Determine if there is any doctrine regarding open versus proprietary solutions. Find out if there are any policies on approved vendors or platforms. In many cases, a company has already chosen technologies and products for the new network and your design must fit into the plans.

Finally, ask your customer if there are any policies regarding distributed authority for network design and implementation. For example, are there departments that control their own internetworking purchases? Find out if departments and end users are involved in choosing their own applications. Make sure you know who the decision-makers are for your network design project.

In the rush to get to technical requirements, network designers sometimes ignore non-technical issues, which is a mistake. Many brilliant network designs have been rejected by a customer because the designer focused on the lower layers of the OSI reference model, and forgot about company politics and technical religion.

Budgetary and Staffing Constraints

Your network design must fit the customer's budget. The budget should include allocations for equipment purchases, software licenses, maintenance and support

agreements, testing, training, and staffing. The budget might also include consulting fees (including your fees) and outsourcing expenses.

Throughout the project, work with your customer to identify requirements for new personnel, such as additional network managers. Point out the need for personnel training, which will affect the budget for the project.

In general, it is a good idea to analyze the abilities of the networking staff. How much in-house expertise is there? Should you recommend any training or outsourcing for network operations and management? The technologies and protocols that you recommend will depend on the abilities of internal staff. It is not a good idea to recommend a complex routing protocol, such as Open Shortest Path First (OSPF), for example, if the engineering staff is just starting to learn internetworking concepts (unless you also recommend a comprehensive training plan).

To ensure the success of your project, determine who controls the network budget—the information systems (IS) department, network managers, or users' departments? How much control do users and groups have over network expenditures? Are there any departmental charge-back schemes?

Regardless of who controls the budget, one common network design goal is to contain costs. Chapter 2, "Analyzing Technical Goals and Constraints," discusses typical tradeoffs that must be made to meet the goal of affordability while achieving good performance and reliability.

If possible, work with your customer to develop a return on investment (ROI) analysis for the network design. Make a business case to the customer that explains how quickly the new network will pay for itself, due to reduced operational costs, improved employee productivity, or the enabling of higher revenue potential and market expansion.

Scheduling

An additional business-oriented topic that you should review with your customer is the timeframe for the network design project. When is the final due date and what are the major milestones? In most cases, management of the project schedule is the customer's obligation, not yours, but you should ask the customer to give you a copy of the schedule and to keep you informed about any slips in the schedule.

Many tools exist for developing a schedule that includes milestones, resource assignments, critical-path analysis, and so on. Take a look at these aspects of the schedule and voice your view on whether the schedule is practical, considering what you have learned about the scope of the project. During the technical-analysis stage and the logical- and physical-design phases of the project, be sure to keep the schedule in mind. As you iteratively develop a concrete understanding of the technical scope of the network design project, point out any concerns you have about the schedule.

BUSINESS GOALS CHECKLIST

You can use the following checklist to determine if you have addressed your client's business-oriented objectives and concerns:

- ☐ I have researched the customer's industry and competition.
- ☐ I understand the customer's corporate structure.
- ☐ I have compiled a list of the customer's business goals, starting with one overall business goal that explains the primary purpose of the network design project.
- ☐ The customer has identified any mission-critical operations.
- ☐ I understand the customer's criteria for success and the ramifications of failure.
- ☐ I understand the scope of the network design project.
- ☐ I have identified the customer's network applications (using the Network Applications chart).
- ☐ The customer has explained policies regarding approved vendors, protocols, or platforms.
- ☐ The customer has explained any policies regarding open versus proprietary solutions.
- ☐ The customer has explained any policies regarding distributed authority for network design and implementation.

- ☐ I know the budget for this project.
- ☐ I know the schedule for this project, including the final due date and major milestones, and I believe it is practical.
- ☐ I have a good understanding of the technical expertise of my clients and any relevant internal or external staff.
- ☐ I have discussed a staff-education plan with the customer.
- ☐ I am aware of any office politics that might affect the network design.

SUMMARY

This chapter covered typical network design business goals and constraints. It also talked about the top-down process for gathering information on goals, and the importance of using systematic methods for network design. Using systematic methods will help you keep pace with changing technologies and customer requirements. The next chapter covers analyzing technical goals and constraints.

This chapter also talked about the importance of analyzing your customer's business style, tolerance to risk, biases, and technical expertise. You should also work with your customer to understand the budget and schedule for the network design project to make sure the deadlines and milestones are practical.

Finally, it is important to start gaining an understanding of your client's corporate structure. Understanding the corporate structure will help you analyze data flow and develop a network topology, which usually parallels the corporate structure. It will also help you identify the managers who will have the authority to accept or reject your network design, which will help you prepare and present your network design appropriately.