THE YANKEE GROUP REPORT

The Road to a Five-Nines Network

Executive Summary

The enterprise network delivers almost all business information and corporate communications to end users. The impact of downtime has never been more acute and can cost companies millions of dollars (see Exhibit 1). Typically, high availability networking, which had been important only in the communications-intensive verticals such as financial services, has been a service provider network requirement for decades.

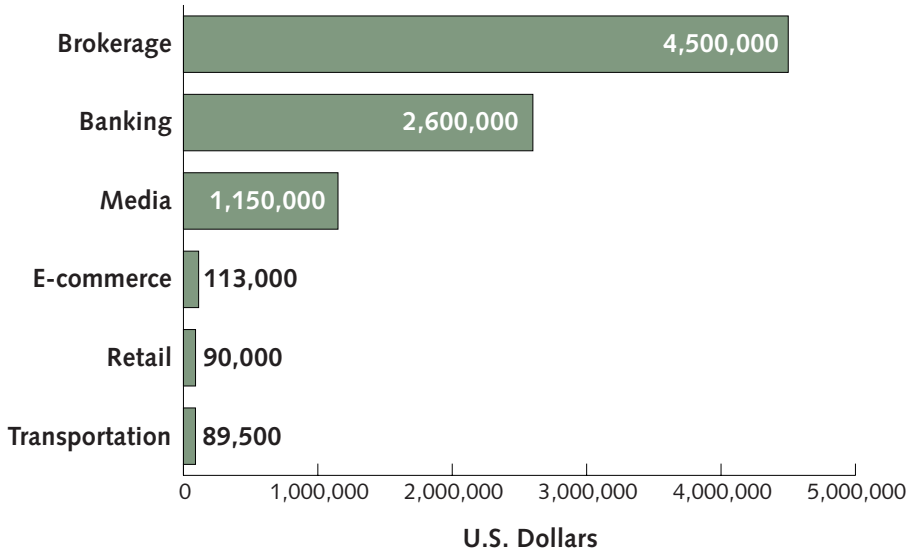
Many IT executives believed availability was not as important in verticals with lower average hourly downtime. However, this myth is being dispelled quickly. Vertical industries that have only recently become dependent on the network should use best practices and lessons learned from the verticals that have been relying on their networks for some time.

For example, downtime could have a more significant effect on retail and transportation than it does on finance and banking because retail and transportation rely on their networks so heavily.

During the next few years, the importance of the network will continue to grow and companies that do not run their networks with a lifecycle methodology will encounter problems. Enterprises will adopt many new technologies, such as IP communications and Web services, to boost productivity. However, companies will not be able to take full advantage of these technologies without delivering a five-nines network. (Five nines is an industry term used to describe 99.999 percent availability; it equates to 5 minutes and 15 seconds of unplanned downtime per year.)

This custom report examines the current causes of network downtime and how a rigorous network lifecycle can address the issue. Finally, we discuss how companies can use vendors' advanced services to make the five-nines network a reality.

Exhibit 1
The Costs of Network Downtime per Hour
Source: The Yankee Group, 2004



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I. Introduction

During the past 5 years, as the enterprise network matured from a necessary evil to the lifeline of the company, application technology evolved to take advantage of corporate networks. Most applications and services are networked, and virtually every bit of company information travels the enterprise network—making it the information backbone for every organization. The increased importance has changed the way organizations should build, manage, maintain and operate their networks. In the past, organizations typically built networks one device and node at a time, and managed them in an ad-hoc, undisciplined manner. This led to troubleshooting times that were longer than necessary, longer overall mean time to repair (MTTR) and unnecessary outages.

To determine the major causes of network outages and the impact on companies, the Yankee Group conducted a network downtime survey of 228 network managers in 2003. These were our key findings:

- **Thirty-one percent of network downtime is due to self-inflicted errors.** Poor configuration management processes (such as accidental misconfiguration, errors in device settings and deviations from company standards) were the main cause.

- **Organizations spend 80 percent of the network budget to maintain the status quo.** Because of increasing complexity and reliance on the network, the cost of running a network continues to grow. With lower overall budgets, the relative percentage used to "keep the lights on" will continue to increase, leaving little money for new projects. By lowering the overall cost of running a network, companies can meet budgetary goals and have more money to fund new projects.

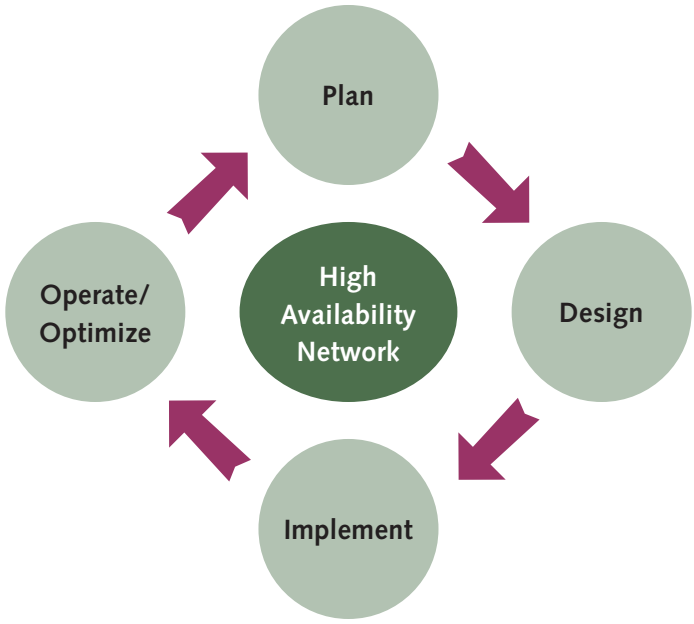
- **Shared passwords are used 73 percent of the time to manage network devices.** At the heart of network management discipline is the accountability of the network operations staff. Shared passwords limit accountability because they do not enable the tracking of changes, who made them and why. For companies looking to implement a configuration management strategy, this is one of the first areas to change. This also presents significant security issues, creating hours of downtime if the network is breeched. Most companies only discover this is a problem during a security assessment.

- **Networking projects are delivered late or cancelled 90 percent of the time.** Most companies tend to manage networks in an ad-hoc, haphazard manner. This normally results in a dearth of network information and a lack of understanding of the network architecture, which causes network managers to spend more time than necessary on troubleshooting and other tasks while they fall behind on other projects. Because most network staffs are continually behind, they often deliver new projects late or cancel them altogether. A robust network lifecycle will help companies manage their networks more efficiently—allowing more time for new projects.

Companies that historically have made their network a competitive differentiator, such as service providers, have developed a rigorous methodology for high-availability networking. Other companies that have come to rely on their network to run their business also should take a lifecycle (see Exhibit 2) approach to running their network.

The network lifecycle framework has four phases: planning, design, implementation and operate/optimize (PDIOO). Each phase is equally important and has its own set of needs and capabilities:

Exhibit 2
The High Availability Network Lifecycle
Source: The Yankee Group, 2004



- **The planning phase** normally includes an assessment to create a basic understanding the network current performance and architecture. Companies create a roadmap of tasks in this phase and use the output in the next phase.

- **The design phase begins once the assessment is complete.** Many companies may have a design in mind, but organizations should consider alternative designs before making a decision. Security, redundancy, scalability and the status of the current network should be kept in mind when developing a design.

- **The implementation phase** is vital to the PDIOO framework. It ensures the design and deployment delivers the desired value and functionality. Implementation includes network staging, configuration and testing plans. Acceptance testing is also part of this phase and is necessary for a smooth implementation and can minimize risk to the enterprise.

- **Operate/optimize** are the last two phases of PDIOO (combined into one step in our model). Operations planning protects the network investment and helps the network operations staff avoid problems, troubleshoot problems quickly and maximize the value of the network. Optimization delivers the best performance from the network, reducing network issues, thus lowering long term network costs.

Companies that follow this framework will simplify network operations, deliver a quality network and lower the total cost of running a network.

Other than the largest service providers, few companies have the in-house skills to implement such a lifecycle across all four phases (the optimization phase is particularly complex because networks change so dynamically). Networks that are not optimized can become unstable.

Enterprise Challenges

Through the 1990s and into the early 2000s, companies focused on building revenue and expanding the business. For the network staff, that meant deploying network infrastructure and increasing the footprint and capacity of the network as quickly as possible. The focus was on growth and the speed at which deployments occurred was the measure of success. Companies gave little thought to manageability or total cost of ownership because working capital was at an all-time high. If performance problems occurred, the company simply increased the bandwidth or purchased new equipment to add extra capacity. The management of networks was typically done node by node.

For the majority of companies, running a network this way was acceptable because organizations were just beginning to understand the impact a network could have on the corporation. Employees had just started to use e-mail, Web browsers and other basic networked applications—so the network was important but not mission critical to the business.

Today, the goals for business are not focused on rapid expansion. Operational efficiency, lowering costs and maximizing user productivity with technology are at the center. Because of this, IT executives' jobs have experienced as much or more change than any position in business during the past 5 years.

Technology groups once were concerned with benchmarking bandwidth, CPU utilization, drive capacity and other technology-related metrics. Now, they focus on metrics such as user productivity, application availability, performance and increased revenue. Network teams should understand how networks affect application performance. They can accomplish this only by using a network lifecycle model, which will enable the embedding of key performance metrics and the tuning and optimization of networks no matter what new applications or services the company chooses to deploy.

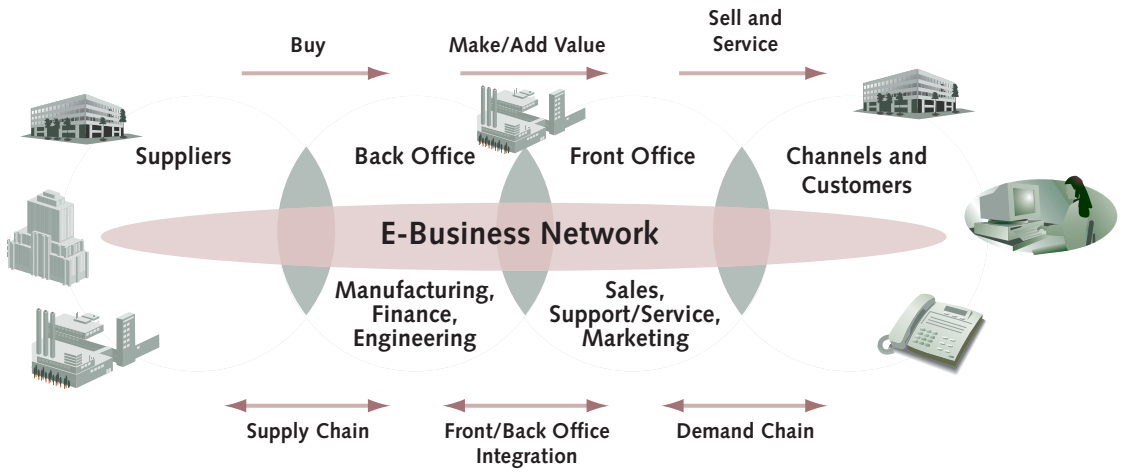
The Growing Importance of the Enterprise Network

Because they have allowed companies to extend beyond the traditional walls of the company, enterprise networks will continue to grow in importance. The extended enterprise reaches from a company's supply chain through the demand chain (see Exhibit 3), which enables suppliers, vendors, extranet partners and customers to access the network infrastructure. To support the extended enterprise, companies are beginning to integrate all their applications across it, which puts a premium on network availability.

As companies continue to extend their networks, there will be a continued increase in the interdependence across the network, systems, applications and business processes.

In the last decade, enterprises have shifted significant mission-critical applications from the mainframe to servers accessed over IP. Networks used to deliver only e-mail and Internet access; now all major business applications, such as SAP, PeopleSoft and Siebel, are network-based. Ensuring secure, high-quality access to these applications—no matter where the user is located—is the network manager's primary concern. Companies have invested heavily in these applications and now need to maximize their investment.

Exhibit 3
The Extended Enterprise
Source: The Yankee Group, 2004



The expanded role of the network will combine with these trends to drive the need for maximum uptime.

- **Voice, video and data convergence:** For most companies, convergence is more a matter of *when* than *if*. The value proposition of convergence initially was built on savings on toll charges, and moves, adds, changes and deletes (MACD) of users. A fully converged network promised to bring together all of a company's collaborative applications and provide a seamless unified communications environment for end users. Early adopters of convergence have seen an increase in user productivity of nearly 20 percent. However, companies can only achieve this through proper management of the infrastructure throughout the lifecycle.

- **Web services:** The Yankee Group defines Web services as methodologies for delivering application-to-application communications, with standardized programmatic interfaces independent of code, platform or architecture across an IP network. At its most basic definition, Web services are nothing more than computers talking to computers across networks. As companies use Web services to communicate with other organizations across the extended enterprise, they will place a premium on network availability.

- **On-demand computing:** This will deliver a new computing model (in which resources are pooled and allocated as needed by the specific applications and resources, regardless of location) for companies. This will help deliver the true real-time enterprise, with information available to any user over any device at any time. However, on-demand computing environments will require a network that managers can tune and adapt as needed.

- **Business process outsourcing:** Many companies have chosen to outsource areas of the business that are not core or strategic to the operations of the organization. This has caused an increase in business process outsourcing (BPO) during the past few years. Business are outsourcing processes such as human resources, accounting and IT. In a BPO environment, the network becomes the link between the organization and its business process—making the reliability of the network critical.

- **Implementation of business-impact assessment metrics:** As organizations strive to achieve the highest levels of data-center availability, companies need to focus on business impact metrics. These metrics include recovery time objective (RTO) for applications, recovery point objective (RPO) for data loss and recovery access objective (RAO) for users to access applications. Mission-critical applications have a very low RTO, RPO and ROA and downtime is unacceptable.

- **Radio frequency identification (RFID):** RFID refers to short-range communications between a tag and a reader. The technology can be used in any scenario in which goods, people or devices need to be identified. Many companies are starting to implement RFID throughout the entire supply chain to track inventory and drive operational excellence. This increases the need for a high-availability network. However, the security requirements increase the complexity of the implementation, making a lifecycle approach mandatory.

- **Intelligent networking:** The network's role will continue to evolve. In the past, the network supported some basic data services, today it needs to support real-time applications such as voice and video. In the future, the network will evolve to provide dynamic resource utilization to application virtualizations and services on the network. As this happens, the level of intelligence required to manage the network will require a lifecycle approach to achieve five nines of uptime.

It is clear that the future brings many challenges to the enterprise network team that were not there in the past. However, improving network availability and quality can have a big impact today because of all the business-critical applications that currently run over a company's network. Implementing a lifecycle to run a network can help companies maximize the business results for money already spent on business applications.

II. Downtime in the Enterprise Network

Downtime in corporate networks can have a significant adverse effect on company revenue. Downtime also can drive up unnecessary costs affecting the organization's overall profitability. With the increased role of the network, the impact of downtime will only continue to cost organizations increasing amounts of money. Because of this, network architects should strive to achieve a network with five-nines availability. This will require a change in the way network operations work. It will require a disciplined management approach similar to application development and management. With the ad-hoc management styles that are relics of the past, troubleshooting times are often long and network managers spend much of their day fighting fires. Because of this, an estimated 90 percent of network-related upgrades and projects are delivered late or canceled, so the network staff is always working in a reactive, defensive mode rather than being strategic and proactive. This approach is unacceptable. A disciplined management approach, similar to application development and management, is an absolute requirement. Only by deploying a rigorous methodology for managing networks across the PDIOO framework can network organizations achieve the desired five-nines goal.

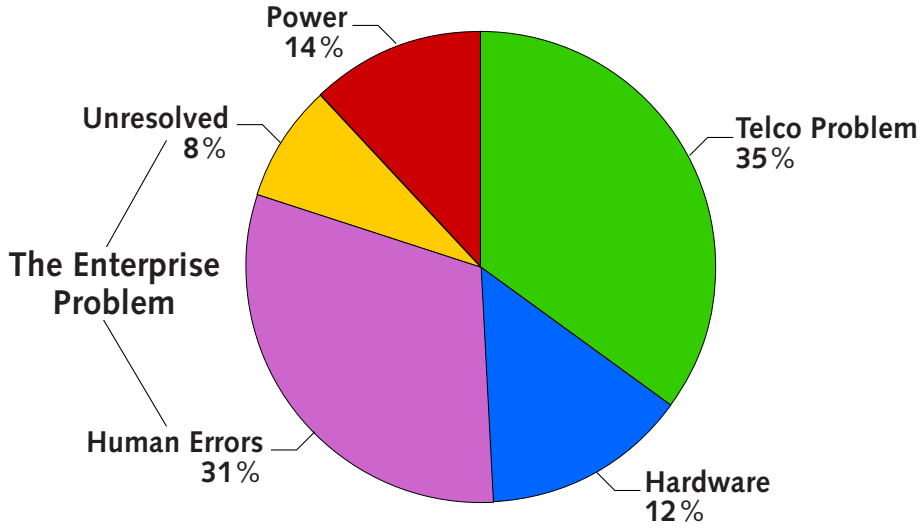
The Causes of Downtime

Network downtime has many causes, but one of the largest components is self-inflicted errors from configuration problems (see Exhibit 4).

There is no single root for all configuration errors; they can have many causes, including:

- Poor initial network design
- Improper training of network staff
- Poor network operations processes
- Ad-hoc management and configuration changes
- Not using standard hardware, software versions and configurations
- Lack of timely access to experts and knowledge bases for troubleshooting

Exhibit 4
Causes of Network Downtime
Source: Yhe Yankee Group 2002 Network Downtime Survey,



- Inadequate ability to correlate events
- Security as an afterthought or overlay to the current network, not integrated into the network design
- Security technology that doesn't match the security policy
- Lack of ongoing independent security audits to assure compliance
- Weak or improper use of fault-management tools
- Little to no use of configuration-management tools

A strong network management lifecycle can minimize or avert many of these errors.

Dealing with Downtime

Today, companies do not deal consistently with network downtime because the application space addresses it. Application developers have a much more rigid methodology throughout the application lifecycle. This includes functional definitions, defining the solution, pre-deployment testing, implementation and then post-deployment optimization. The network must take advantage of this kind of discipline to maximize uptime and provide network operations with a better understanding of how the network interfaces with applications. Using this approach, companies can develop better key performance metrics and benchmarks to undertake capacity planning and make the right network changes. Because high-availability networking has not been a primary

requirement for network operators until recently, many companies do not have the skill or knowledge to create the proper key performance metrics. This requires measuring availability and correlating it against business metrics. The key to measuring availability is acquiring the outage data, calculating the availability percentage, finding the root cause and documenting it. Although most companies might perform part of this correctly, few undertake all the steps required to make the data meaningful.

In addition, by not treating the network as a system, managers typically make changes device-by-device; making changes to correct one problem can cause other problems.

It is imperative that companies start implementing a robust network lifecycle to support many of today's mission-critical applications. These are examples of network dependant, mission-critical applications across a variety of verticals:

- **Quick delivery of patient information to doctors or caregivers to administer the required care in healthcare.** In this case, network downtime can cause a delay in providing the correct treatment to a patient, which puts the patient at risk. A high-availability network can streamline the day-to-day tasks facing doctors and nurses and enable them to focus more on patient care than administrative tasks.

- **Order entry and trade execution for brokerages.** In the fast-moving financial services market, delays of just a few seconds can mean millions of dollars in trade errors.

- **Electronic point of sale terminals in retail.** Many retail customers now pay electronically. Degraded network performance slows transaction times, causing long lines at checkout, increasing transaction costs and decreasing customer satisfaction. This may cause a customer to abandon a purchase—online or in-person—and go to a different retailer.

- **Extensive outsourcing, especially among semiconductor and hardware manufacturers.** This requires supply-chain partners to deliver a reliable stream of raw materials, components and finished goods to keep assembly lines moving. Network downtime can stop the flow of materials and can adversely affect both the top and bottom lines.

- **The development of e-government.** This has raised the need for five nines of network availability and integrated security. New laws that require access to government systems from external systems mean that availability, security and privacy must be considered in the design of the network. The high availability needs of e-government can only be met by adopting a lifecycle for running the network.

As companies continue to move more applications and voice traffic across their IP networks, a proper lifecycle is essential. Without it, companies will not benefit from the productivity-enhancing features that a converged infrastructure can deliver.

III. Implementing a Network Lifecycle

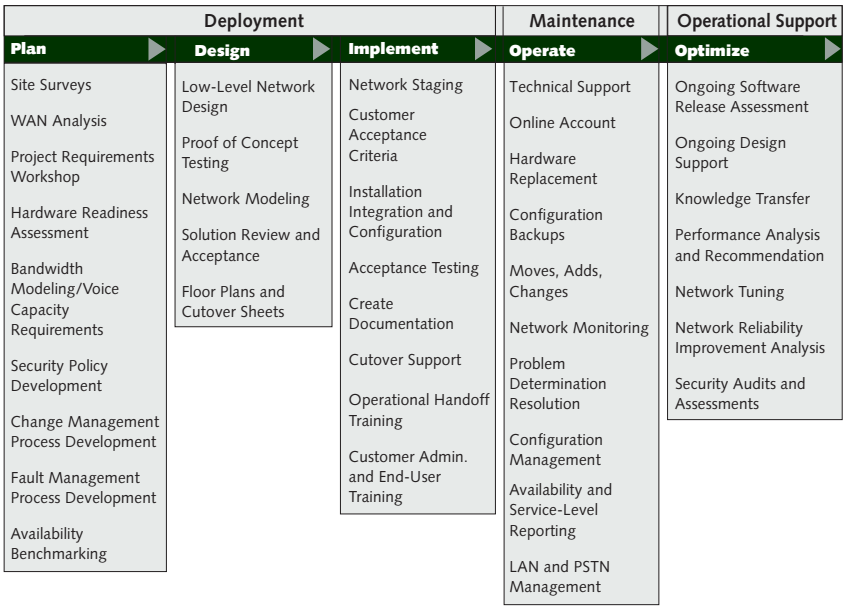
The Components of the Network Lifecycle

There are many tasks across the PDIOO framework involved in successfully deploying a network lifecycle to run a network (see Exhibit 5). Implementing all of the tasks requires a wide variety of skills. Many tasks require strong business skills, such as business case and metrics development; these are out of the scope of the traditional role of IT and telecom. Services such as audits and validations are often better performed by a third party that understands best practices. The third party can be a separate department within the organization, a consulting firm or services arm of a vendor; there should be no emotional tie to the current state of the network.

Many tasks require broad and deep technical skills. As a result, many companies have yet to deploy a lifecycle to run their network. It is simply too difficult for most companies to excel in all the required areas. Most companies will have the required skills to effectively perform many of the tasks across the PDIOO framework but few will have all of the skills.

Using third-party employees to enhance network staff can help enterprises implement a network lifecycle to increase network availability and reach five nines of availability. Companies should view PDIOO expertise as a way to bring parts of the PDIOO framework where they do not excel up to the levels needed to achieve five nines. This model is commonly used in custom application development and deployment; companies should consider it when optimizing networks. Savvy network managers will understand that using third-party services properly will free up valuable time for future planning or other tasks strategic to the company.

Exhibit 5
The Network Lifecycle Framework
Source: The Yankee Group and Cisco Systems, 2004



The transition to five nines cannot happen overnight. Implementing and running a network lifecycle is a continuous process that requires a commitment from the network operations department and the enterprise's partners, such as their equipment vendor and service provider. The enterprise and its partners must continually recalibrate the lifecycle with joint operations reviews and joint planning. A successful network lifecycle can deliver a high-performance, five nines network.

Third-party services for delivering a network lifecycle increase overall network uptime while lowering the overall cost of running a network and minimizing risk.

With an increasing number of mission-critical applications deployed over the corporate network, it is important that companies seek services from a trusted vendor to help bridge the skills gap.

IV. Case Study: Large Regional Hospital

The Situation

Three years ago, a large regional hospital was struggling with network performance. The hospital had recently lost—or was about to lose—several key members of its IT staff. At the time, the hospital was in the process of making upgrades for Year 2000 compliance. Using a key vendor's service to adopt a lifecycle management approach, the hospital recently completed a 3-year project to optimize the network and achieve Y2K compliance.

The network was previously upgraded to an ATM LAN to support the hospital's medical imaging system. The network supported approximately 200 devices and was spread across five primary campus locations.

Gaining a baseline to perform the Y2K upgrade was a challenge, based on the following problems:

- The hospital had not implemented network management tools or platforms. As a result, the network operations staff had a limited understanding of the current state of the network.

- The hospital had not deployed a central syslog server or clock synchronization. This made it difficult to track where errors occurred or correlate configuration changes to downtime.

- The network operations staff was poorly trained in troubleshooting network problems. Exacerbating this problem was a lack of quality tools.

To meet the ongoing needs of the business, the hospital knew it had to adopt a network lifecycle approach to managing the network.

The Problems with the Environment

The hospital had many problems with its existing network configuration. Although performance and capacity were not an issue, there were other problems, such as:

- No redundant connectivity between the data center and the rest of the network. A single hardware failure had the potential to take down the entire network.

- The wrong network protocols were deployed. The customer was running the RIP routing protocol, which was not suited for rapid convergence. A faster routing protocol, such as EIGRP, would provide the network with greater resiliency. In addition, because the customers' applications were deployed on Novell servers, the hospital had implemented IPX, which is more cumbersome to use than IP. As the hospital migrated to IP-based solutions, it would need to update the router configurations as well.

- Access to network devices, such as routers and switches, was not centrally managed via Radius or TACACS. This made implementing and enforcing changed control very difficult because there was no audit trail.

The hospital had a tight budget; it was a challenge to find funding for the network infrastructure. Rather than the network being the foundation for new applications, network implementations and changes had to support applications after the applications had been deployed. Because of this, the hospital had no network lifecycle to manage the existing network.

The customer was at the end of the lifecycle and was in the process of Y2K upgrades. The hospital was frequently calling on vendors to send support staff to the location to provide additional technical assistance. At this point, the hospital realized it did not have the required skill set to perform these upgrades, so it sought help to migrate the network.

The Solution

The hospital adopted a disciplined lifecycle management approach. It worked with an external vendor of PDIOO services to help bridge the gap between current knowledge and the level required to deploy and implement a full network lifecycle. The hospital chose a suite of packaged services to optimize the network from the external provider's PDIOO service offerings. The company relied very heavily on the outsourced engineers for assistance across the network lifecycle.

The entire joint solution took 3 years to implement. At the end of the process, the PDIOO services resulted in structured approach to network project planning. The professional services helped prepare network audits and quarterly reports and reviewed network outages or issues each quarter. Network downtime was virtually eliminated—less than two very short outages per year.

The professional services provided a disciplined and proactive network lifecycle implementation and management approach, including areas such as project planning, network audits, quarterly reports, root-cause analysis and resolution of network outages.

The Impact to the Hospital

The hospital gained a network with a high level of uptime, lower MTTR and knowledge transfer to ensure the process and best practices stay in place. Examples of where the vendor's professional services assisted in improving the network availability include design change, selection of the correct software versions for the routers, new design deployment, troubleshooting assistance and knowledge transfer sessions. These services fell across the entire lifecycle of the network.

The financial impact to the hospital from using packaged PDIOO services was $875,000 in savings from downtime avoidance, delivering an overall ROI of 244 percent.

V. Conclusions and Recommendations

A rigorous network lifecycle is crucial for today's extended enterprise. As companies continue to deploy network-centric technologies that directly affect the productivity of employees or the customer experience, a five-nines network is critical. Concerns over downtime are no longer limited to verticals such as financial services. All companies looking to make the most of their network resources should be concerned. Without adopting a lifecycle, the frequency of downtime and associated lost revenue will continue to escalate.

However, because few companies have the overall skill set needed to deploy and manage a five-nines network across the entire PDIOO framework they should seek services support. As the case study underscored, by avoiding downtime, services will save a corporation money.

To get started, the Yankee Group offers the following recommendations:

- **Adopt a network lifecycle as soon as possible.** The network should no longer be thought of as the plumbing or pipes of the company. It is a lifeline—especially for custom application development. A true network lifecycle approach can help reduce risks, lower the cost of running a network, reduce errors and lower the mean time to repair.

- **Strive for five nines.** Many companies outside the traditional network-dependant verticals work under the assumption that network availability is important but not critical. They settle for three nines. In many organizations, three nines may have been sufficient in the past. However, network availability is now important to all enterprises. CIOs, operations managers and network managers must make five nines a corporate goal.

- **Understand your strengths and weaknesses.** The skills required to run a network vary from company to company. Some network groups are strong in the design phase, but may be weak on the operations side. Companies should perform a skills assessment to help understand how services can help run a network.

- **Demand knowledge transfer from your vendor.** Vendor professional services can add tremendous value to your organization. However, the benefits are limited if the internal network staff does not learn how to continually improve the network on their own. Knowledge transfer is a key network vendor service.

- **Calculate the cost of downtime.** This report outlines the cost of downtime in general terms. The true cost of an outage is unique to each company. Network managers should work with their vendors and business units to develop key performance metrics and baselines to determine the cost of downtime. In addition, a company should calculate the frequency of outages to understand their impact over the course of a full year.

- **Calculate the cost of repair and support costs.** Network managers need to quantify all the components of network support and determine the costs associated with each task. Once a company adopts a network lifecycle, it can calculate the cost savings with a rigorous network management methodology.

- **Finally, end users should consider using process-integration procedures between strategic network vendors in key areas such as architectural planning and software change control.** Doing so ensures the internal and external teams acts as one team. Network integration and optimization requires organizational integration and optimization.

The Yankee Group is the global leader in communications and networking research and consulting. The company helps businesses understand the opportunities, risks and competitive pressures of developing, deploying and consuming products and services that drive communication or information exchange.

Now in its fourth decade, the Yankee Group is based in Boston with research staff throughout North America, Europe, Latin America and the Pacific Rim.

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