

# System Integrators Guide to Driving Business Growth through LAN Installation and Validation Best Practices

*System integrators (SIs) play a vital role in selecting, deploying, integrating and managing information technology (IT). But for those SIs specializing in LAN infrastructure deployments, employing traditional methods exposes their companies to undue risk, higher costs and potentially lower customer satisfaction.*

*The guide describes the LAN infrastructure activities associated with installation and upgrade projects – LAN design, installation and validation – and the corresponding best practices and tools, which if employed, can result in reduced callbacks, greater differentiation from the competition, increased repeat business, and greater customer satisfaction. The guide concludes with news from the field, where system integrators with different specialties share their stories.*

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## Introduction

Not all networks are alike, and system integrators know this better than anyone. As IT service providers, system integrators are tasked with modifying or creating new functionality for packaged or custom-developed applications. In addition, managing clients, staff, services, and business growth takes up more time than they have.

Some system integrators are thriving. They have found ways to streamline their business model, nurture their customer and client relationships, as well as garner new business. They are successful because they have implemented important components into their operations, services and business management practices.

This guide will give you an overview of how system integrators who specialize in local area network infrastructures are tackling the issues that slow their business down and, more importantly, guidance and tips on how they grow their business by optimizing installation practices.

## System integrators and value added resellers

Despite progress on making IT solutions plug-and-play, businesses often need help selecting, deploying, integrating, and managing IT. Businesses turn to outside, third party IT service providers to fill gaps between what they can do using internal IT resources and their IT goals. For example, internal IT resources may be insufficient to accomplish a large project within a desired time period. Or the internal IT staff may not have the in-house knowledge required to integrate and rollout new technology.

You can broadly classify IT service providers by the services they offer.

- **Business process management** companies specialize in the administration and management of IT-intensive business processes. For example, an enterprise may outsource procurement, finance, human resources or customer management to third-party service providers.
- **IT management and support** companies include third-party maintainers, field service technicians, and managed service providers. The IT service providers provide day-to-day management and operation of IT assets and processes.
- **Consultants** provide advisory services to help companies analyze and improve business operations and technology strategies.
- **System integrators and value added resellers** customize or develop IT solutions, assets and processes, and then integrate and deploy them with established infrastructure and processes. They implement designs conceived by consultants.

You can further sub-segment system integrators and value added resellers by specialty. The specialty could be a technology like printers, monitors, PCs, servers, storage hardware, security software, application infrastructure, network applications, networking equipment, enterprise applications, office productivity applications, VoIP and more. In addition, specialization could be by a particular vertical like automotive, financial services, telecommunications, military, government, education, health care, manufacturing, retail and more.

There are three broad system integrator and value added reseller sub-segments.

- **Developers:** these companies create new functionality for packaged or custom-developed applications. This is a software intensive specialty.
- **Integrators:** these companies link together various applications with established or planned IT infrastructure. This also is a software intensive specialty.
- **Installers:** these companies support the implementation and deployment of new applications or infrastructure. This may include hardware and software procurement, configuration, tuning, staging, installation, and interoperability testing.

System integrators and value added resellers who specialize in local area network (LAN) infrastructure are concerned with:

- **The physical layer:** the data communications cabling and cable management systems that connect a network device (servers, PCs, printers, POS terminals) to a LAN segment. The cabling media can be either twisted-pair structured wiring or optical fiber. You can also consider wireless networking technology, like access points, an element of the physical layer. It is very common today for devices to connect to the network via a combination of wired (10/100/1000BASE-T or 1000BASE-X) and wireless (802.11a/b/g) technology.
- **Networking devices:** the switches that interconnect LAN segments and the routers that interconnect LANs. Today many of these networking devices can perform both switching and routing functions.

In this paper we will include value add resellers (VARs) in the system integrator (SI) category. The amount of value-add that resellers offer varies significantly. Some VARs (big "R") derive most of their revenue from reselling activities while others (small "r") derive most of their revenue from value-added services. We are thinking of this second group when including VARs in the SI category.

## System integrator activities

LAN infrastructure system integrators offer a variety of services. Some system integrators specialize in one aspect, others offer turnkey solutions. We will discuss those aspects that pertain to LAN installation and troubleshooting

We segment the network installation and upgrade workflow into three activities:

- Design and planning
- Installation
- Validation

Typically a network owner may contract an SI to design, install and maintain the network to keep it running smoothly and troubleshoot problems when they occur.

The following diagram illustrates the typical network installation and network maintenance workflow.

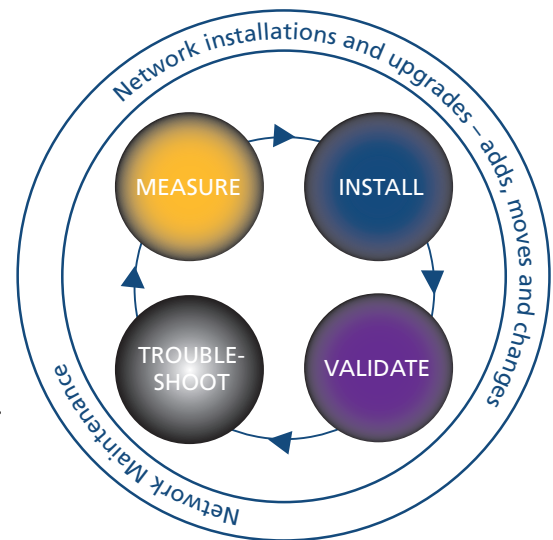


Figure 1 - Network installation and maintenance workflow

## LAN design and planning

Designing and planning can be as minimal as reviewing existing documentation and delivering a network diagram or, more often than not, it means spending a lot of time scoping out the job, assessing the existing infrastructure and creating a first iteration of planned changes for the client.

A network owner may hire a system integrator to serve as an IT consultant. In this consultancy role, the system integrator helps network owners analyze and improve their business processes and technology strategies. For example, a CIO may hire a system integrator to evaluate the costs and benefits of upgrading his call center telephone system from a PBX system to a voice over IP (VoIP) solution.

The system integrator may also design and plan the LAN infrastructure upgrade or technology rollout. For example, if the IT strategy entails upgrading several backbone LAN segments from 100MB Ethernet over twisted-pair cabling to Gigabit Ethernet over fiber, the system integrator will develop the project plan, schedule, budget, and bill of materials. They can spend anywhere from 10 hours to 3 weeks scoping out a project. The project plan includes maps of current topology, where the problems/solutions may be and what the client needs to consider. Many system integrators combine simple Word documents with Visio diagrams to give the customer a 'before and after' description in addition to a visual map of the completed job.

The traditional next step would be execution of the plan.

There is a better way. If the project were an upgrade, as in the Gigabit upgrade example above, it would be better to measure the performance of the existing network prior to the new cabling infrastructure upgrade. For example, you may discover that the existing twisted-pair cable may already support Gigabit speeds. If so, an upgrade to fiber is not immediately required – significantly reducing the overall project costs. For upgrade projects, it is important to understand what the existing network is truly capable of while you draft your project plan. Your plan may change based upon what you discover.

Another advantage of pre-deployment measurement is establishment of baseline performance. You can compare the baseline performance against the post-deployment performance for before and after analysis. The impact of the LAN upgrade can be clearly quantified.

### Design and planning tools

Tools are available to assist with pre-deployment LAN analysis during the design and planning phase of a project.

- Cable media qualification and certification testers can assess the cable plant's ability to support new technologies like Gigabit Ethernet and VoIP.
- Wireless LAN testers can analyze the Wi-Fi RF spectrum to identify interference sources. For example, you can identify sources of WLAN interference or discover how neighboring WLANs may influence your design. Specialized WLAN planning tools assist with the optimal placement of access points to maximize performance while minimizing cost.
- Ethernet performance measurement analyzers measure key characteristics including throughput, latency, frame loss and jitter. You can compare actual performance against your design thresholds to predict how a LAN will behave.

### Design and planning benefits

- **Differentiating services from the competition:** Most system integrators do not include this process into their business service model. Providing design, planning and consulting with the customer demonstrates you are offering a complete service package and sets you apart from other system integrators.
- **Grow repeat business:** By including planning, design and consulting as a pre-step in the total service model of LAN installation and maintenance, the system integrator sets the bar for expectations. Clients in turn will recognize this thorough and well thought out process by remaining a client.
- **Customer Satisfaction:** It sounds like a cliché, doesn't it? This is still extremely important. The system integrator customer satisfaction rate is based on increasing and maintaining network up time. By planning the project and consulting with the client the system integrator creates documentation and concrete recommendations the customer can rely on before, during and after the project.

### LAN installation

Network owners frequently employ system integrators to execute an installation or upgrade plan. Installing and upgrading today's mixed 802.3 and 802.11 networks is a challenge, especially when working on an unknown network. Installing or upgrading switches, APs, routers and configurations has become a large part of the system integrator's core business.

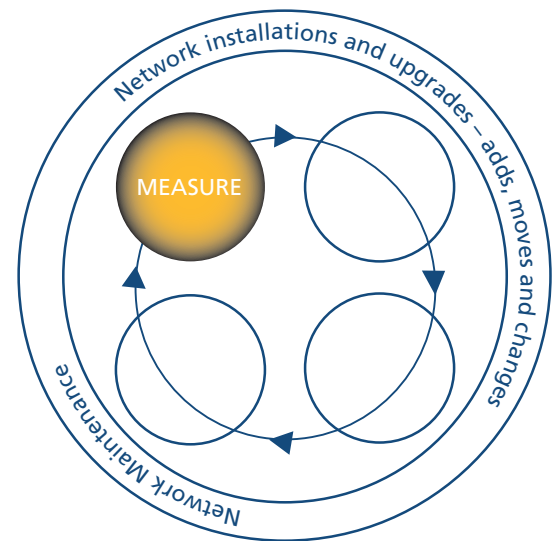


Figure 2 - Measure Ethernet performance when planning an upgrade

Especially for big projects, the network owner often does not have a large enough IT staff to complete all the installation and configuration tasks fast enough, while still supporting his current network and users. A typical installation project includes installing and terminating new data cabling between equipment closets and from closets to work areas. It includes installing new switches and access points and using patch cables to connect these devices to the LAN cable plant. Next is the configuration of these devices to ensure correct LAN operation. Common configuration settings include Ethernet negotiation, PoE delivery, subnet masking, VLAN membership, and QoS traffic prioritization. For many system integrators now working on combined voice and data networks, depending upon the size of the project, installing and configuring new infrastructure can take one day to several weeks.

The traditional practice would be the installation of the cabling (UTP or fiber optic media) and cable management hardware (trays, racks and panels). This is followed by the installation of the network devices (switches and access points). These devices are configured, and then connected to the physical plant via patch cables. Next, would be installation of any new datacenter equipment (servers, storage devices). Finally, the user devices are installed (PCs, terminals, printers, POS terminals). Everything is turned up and some tests are run from a PC to find out how the LAN is performing. Can the PC securely link to the network? Can it access key network services? How responsive is the network? How is network traffic being switched? Answering these questions can be difficult and time consuming, especially if there are problems. Moreover, if there is a problem, isolating the cause of the problem to understand what needs to be fixed can be difficult.

There is a better way. Rather than waiting until the entire LAN is built before assessing LAN performance, test and troubleshoot task-by-task during installation. Verify that each task is completed correctly before moving onto the next task. Following this practice, installers will find and fix problems earlier, before they become complex and difficult to isolate and solve. For example, after installing and terminating the cable, at minimum verify length, shorts, opens and wire mismatches. Troubleshoot any discovered problems then while it is easy to identify the cause. After installing and configuring the switches and access points, patch these devices into the network and then verify the configurations. From each network drop, verify switch slot and port assignment, Ethernet negotiation, speed and duplex, subnet mask, PoE delivery, VLAN ID and QoS settings. If there is a problem, fix it before moving on.

For upgrade projects where a network is already in place, measuring the current network's performance prior to the upgrade is useful for assessing whether the existing infrastructure can support a new technology rollout or the additional load of new users. It also serves as a pre-installation performance baseline for before-and-after analysis.

Creating a map of an existing network prior to any new installation gives you and your customer a reference point to refer to while the new work is being built and after it is complete. Keeping records of the work, and closing out each job by running a final report and creating a map of the network, gives you a deliverable the customer expects and a reference point for use later down the road.

### Installation tools

Tools are available to assist with verifying and troubleshooting configurations during the installation phase of a project.

- Cable verification testers can quickly measure basic characteristics including length, wiremap and faults. Qualification and certification testers can perform more in-depth cable measurements. Testers are available for both UTP and fiber optic cables.
- Network testers can quickly verify Ethernet link configurations, connectivity and service availability. Configuration details include speed and duplex, IP address and subnet mask, VLAN membership and PoE provisioning.

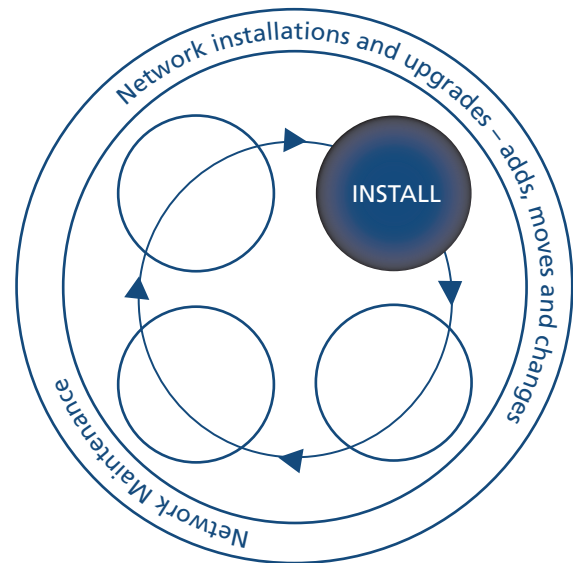


Figure 3 - Installing infrastructure and troubleshooting configurations

- Network analyzers furnish more extensive information, which can be very useful when troubleshooting discovered configuration problems. Analyzers may also feature more sophisticated tests to verify the availability of key services (DHCP, DNS or web). In addition, they may contain tools for changing switch or access point configurations locally.
- Wireless LAN testers verify 802.11 configurations including SSID, security, channel, and signal strength.
- Don't be satisfied with a partial view of your network. Your network analysis tool should include wired and wireless analysis. Combined analysis for these two technologies is essential to get a comprehensive view of your network from both sides of the access point, enabling quick problem resolution.

## Installation benefits

- **Raise customer satisfaction rates:** Since issues are being addressed during installation, the customer will not encounter as many unforeseen problems after the handover of the project. System integrators reduce their cost because they will not have return for extra service visits. The network is more stable which ensures the customer's employees are being productive. The customer can concentrate on their business goals without interruption. These aspects combined raise confidence in the system integrators abilities, and enhance customer satisfaction because their expectations are being met.
- **Reduce callbacks or repeat work:** When the system integrator tests and troubleshoots task-by-task during installation they are, in effect, leaving no stone unturned. By using this method, issues are addressed as the installation is taking place, not afterwards for the customer or their internal IT departments to try to resolve by calling the system integrator, thereby reducing the overall cost to the system integrator.
- **Future trouble tickets are resolved faster:** From memory or documenting the installation process, the system integrator now has a known point of reference to refer to when new trouble tickets arise. The issue may be associated to an action performed during the installation or it may be new. Either way, the system integrator has a point from which to begin addressing the trouble ticket. Eliminating even the smallest amount of guesswork enables them to resolve trouble tickets faster.
- **Increase customer base:** Satisfied customers keep coming back and often refer other business associates to resources they trust and recommend. Implementing thorough installation processes are not only for the network. When customers can experience the results of a job well done, they become a valued asset to the system integrator.

## LAN validation

What marks the end of an installation or upgrade project? How does the system integrator know if all expectations have been met? What documentation can be provided to the client to prove the project was completed successfully and that the LAN will perform as designed?

Historically, there was not an industry-recognized standard or best practice that defined what marks the conclusion of a project. Clients specified many different things. For example, project closure could be as simple as a functional test where the client sits down in front of a PC on a newly installed LAN segment and runs through a sequence of typical network activities – logging on, reading and sending email, opening a file, and surfing the web. Other clients required a report showing the actual performance of the LAN, but performance was defined in different ways – such as Ethernet throughput or service availability.

Today customers have to be shown how well their network is running. They want to see what performance they are getting for their IT investment. As the final step in completing a project, validating LAN performance as proof of a job well done is now an expected part of the business relationship. A newly installed network needs to be validated to prove the installation was done correctly, will operate trouble-free and that users will be satisfied with the performance.

LAN validation is the final task associated with a network installation or upgrade project. It consists of testing, measuring, and assessing those network installation aspects that are critical for acceptable LAN operation:

- Infrastructure configuration
- Network service availability and responsiveness
- Ethernet performance

System integrators and their clients benefit from LAN validation. Validation provides assurance that the LAN will perform as designed, resulting in fewer trouble tickets and more satisfied users. By providing confirmation of reliable network operation, validation helps to reduce the anxiety that comes from uncertainty. Network validation provides the system integrator with assurance that there will be fewer midnight phone calls.

A validated LAN exhibits fewer problems, resulting in fewer time-consuming and costly client callbacks. Validation reports serve as proof of a project successfully completed per the clients instructions and may serve as a means of verifying service level agreements (SLAs). Such documentation may be a contractual requirement.

This documentation can also help clarify who is responsible for a reported network problem. For example, if a network owner thinks the cause of a current web access problem is due to a switch improperly configured during installation, the owner and service provider can review the validation documents to confirm this claim.

System integrators can use LAN validation as a way to differentiate their service from others. In the competitive IT services market place, being able to demonstrate how your services are superior can be advantageous to winning new business.

By making LAN validation part of network installation and upgrade projects, system integrators have an opportunity to work with their clients to establish a best practice for defining project closure. It will be clear to both the system integrator and the client when the project is complete. It will be clear what documentation is required to demonstrate a successfully completed project.

### Validation tools

Tools are available to assist with the LAN validation phase of a project.

- Cable verification testers measure basic characteristics like length, wiremap and faults. Qualification testers evaluate whether the cabling has the bandwidth to specific applications. Cable certification testers guarantee that cabling installations comply with TIA/ISO standards.
- Network testers verify Ethernet link configurations.
- Network analyzers verify link configurations and may feature specialized tests to verify the availability of key network services (DHCP, DNS, and web) and measure their responsiveness. The ability to save the results for validation documentation is important.
- Ethernet performance testers measure key end-to-end link characteristics (throughput, frame loss, latency, and jitter). As above, the ability to save the results for validation documentation is important.
- Some tools incorporate some or all of the above capabilities in a single instrument to simplify and speed LAN validation and documentation.

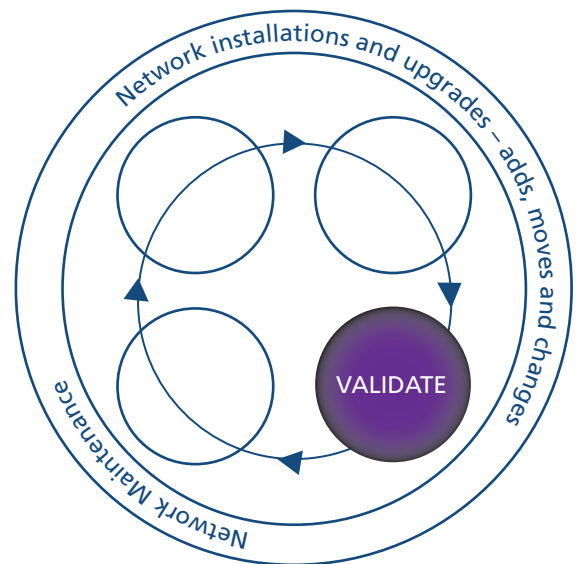


Figure 4 - Validate network installation and operation

## Validation benefits

- **Fewer time consuming and costly callbacks:** A validated LAN exhibits fewer problems resulting in less callbacks.
- **Proof a job well done:** Validation reports serve as proof of a project successfully completed per the clients' instructions. Such documentation may be a contractual requirement. This documentation can also help clarify who is responsible for a reported network problem. For example, if a network owner thinks the cause of a current web access problem is due to a switch improperly configured during installation, the owner and service provider can review the validation documents to confirm this claim.
- **Differentiate your service from others:** Demonstrate through business practices that services are superior to those who do not validate their work.

## LAN maintenance activities

Many system integrators also offer LAN maintenance services. They act as managed service providers and third-party maintainers. They troubleshoot problems with their clients existing LANs and keep those networks up and running.

Many system integrator customers call back, even if they have an internal IT department. Typically, system integrators cannot depend on the customer's internal IT departments. Internal staff may not have the time or skill set to deploy and use monitoring solutions. Often time, internal staff does not know what to look for or how to set thresholds. How many times has a system integrator walked onto a site where the client owns a network monitoring solution, and it is either not being used or it is set up incorrectly? Internal IT staff often does not have time to be proactive. Their small staff is spending what little time they have putting out fires. They lean on the system integrator for support. This support can take up as much as 40% of the system integrator's workweek. The other 60% is accommodating new clients and trouble shooting existing networks. When totaled, system integrators are spending a lot of time on discovery and not as much on fixing problems. Resolving each trouble ticket is usually a lengthy process, with the system integrator spending time on the road travelling to and from customer sites. Once there, they spend 80% of their time looking at devices and configurations rather than finding root cause.

Network analyzers can help the system integrator identify the cause of network problems so these problems can be solved quickly. System integrators can offset the cost of purchasing troubleshooting tools by building the acquisition cost into each contract.

## News from the field – stories from specialists

### Data and Voice

Terry Fishburn, president of Advanced Communications, provides services for business-to-business phone systems. His company installs and supports everything from the cable, phones and data networks to servers, switches, and routers. He has implemented a 'One Stop Shop' business practice that his customers prefer over the old style practice of working with separate vendors. With an active customer base of 2800 companies, Terry can get up to 50 calls a day from people asking for service on an assortment of issues.

"On a typical job we'll do a site survey, establish what's there and what needs to be done," says Terry. "We look at the scope of work. As for the install, the cables go in first. We set up the phone system, and then install the data infrastructure. After the cable install, we go in and certify everything to make sure we pass speed requirements for fiber and Cat 5/6 cabling. Because we are so thorough with our certification process, we don't really need to go back to troubleshoot cabling problems." Terry recognizes that cable certification alone is not enough to validate the LAN. He also needs to validate switch configurations and network operation.

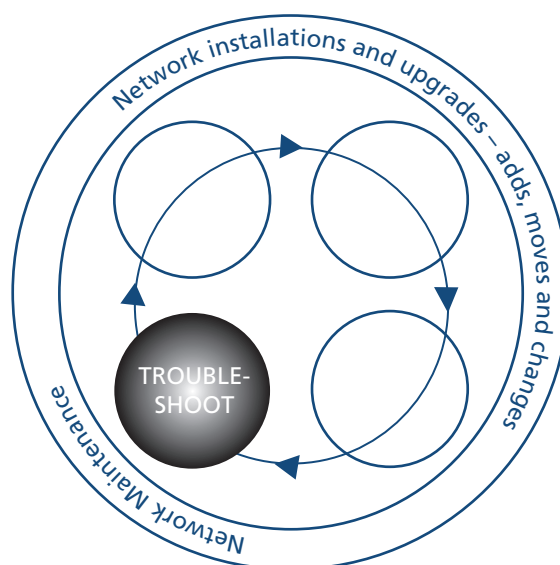


Figure 5 - Troubleshooting and maintaining the LAN



Concerning network maintenance, most of his callbacks are complaints that the network is slow. “We troubleshoot this complaint more than anything else,” says Terry. His team relies on gathering switch information via cumbersome switch troubleshooting practices. “We go through so many steps. We spend more time just looking at devices than pinpointing the problem.”

### VoIP

Toby Moske is an IT Network Engineer with Alanysis. Alanysis is a leader in VOIP network assessment and monitoring. They work with 30 various resellers. Toby spends a lot of his time working with PBX customers who do not have IP telephony expertise within their organization. He becomes their key contact to integrate voice into their existing data infrastructure. This role places Toby in situations that require fast problem resolution and time consuming customer service. Even if the customer has an internal IT department, Toby often finds himself servicing network issues because they are understaffed, or lack the particular knowledge to trouble shoot voice and data issues. They do not have the time or budget to implement pre-installation or validation practices.

“I would like to see more validation done,” says Toby. “There are tools that you can deploy for on-going monitoring. If you have one, you can deploy it and are better able to manage the account. I have learned internal IT departments do not do pre-deployment tests or network monitoring simply because they do not know what to monitor or which thresholds to set. They want to be proactive but they can’t because they are too busy putting out fires.”

### LAN restoration

Computech Consulting services clients ranging from veterinary clinics, law firms and doctors offices in six different states. Computech Consulting, based in Woods Cross, Utah, has a special business philosophy that keeps their customers coming back and offers new clients a fresh perspective from a value added reseller.

“We augment IT staff or go in as the key IT person on staff,” says Jennie Lassig of Computech. “Other companies re-sell and may install but don’t buy the network analysis tools to help increase their business. We consider ourselves a true VAR because we are providing the value behind the products. We recommend training or do it all. We increase customer satisfaction rates – not just push boxes.”

Lassig spends time to educate her team on the tools they use and offers her customers complete IT networking services. One of the most important aspects of the relationship with customers is providing reports on the customer’s current topology and any changes that were made to improve network performance. Computech uses many Fluke Networks tools, but one in particular helps them grow their business by shortening installation time and validating the work done. The EtherScope Series II Network Assistant provides Computech with the network analysis data they need and the leading edge that differentiates them from the competition.

Lassig receives calls for both wired and wireless issues. “On one job, the customer swore there were no unidentified APs on the site. With EtherScope, we performed a network discovery and found that a user had mounted an unknown AP and was transmitting unsecured,” says Lassig. On another occasion, “one of our customers called and said they had a tech on site for 2 days who couldn’t resolve a slow network problem. We went there with the EtherScope, and within two minutes, we found a network loop in the same switch. The switch did not have spanning tree enabled. We identified the problem and fixed the configuration. The customer was thrilled and we gained their trust and confidence in our technical expertise.”

### Military and government

Eric Skiff works with a team of six people for KINEX, an independent consulting company. Their work is comprised of network design, system administration and software development for several different military customers. They work almost exclusively within government topologies and engineering centers. Eric is an avid fan of network analysis tools and owns several protocol, network and cable analyzers. Eric has implemented several methods within pre-deployment base-lining, monitoring and validation to ensure his team succeeds and the company maintains a good record for their government contracts.

“We spend a lot of time in pre-deployment to scope out the job so we can see what we have to work with,” says Eric. “To kick off the planning phase, the first iteration is a report outlining what the customer has and where the problems are. I use a Visio map to show the

customer their current infrastructure and what we plan to change. If we take over and manage a site, I'll also bring in a network management solution to monitor and establish a baseline. That way, we'll have performance data collecting before we start making changes, and then once the job is complete, we'll be able to run before and after reports to evaluate the effectiveness of the solution."

"Validation is an important piece of our work. We run weekly reports to validate things like the performance on a link or the availability of key devices. We can show the customer why the report is valid and what we did. I use Fluke Network's EtherScope for wired and wireless analysis. I hook it up to the network to discover if there are any problems on the network, like conflicting APs, rogue devices, etc."

Eric has seen an improvement in his team's productivity and overall business growth from using IT tools. "We recently had a job with a customer who was switching their Internet connection to a large ISP. It was one of the hardest jobs I've ever seen. We inherited a big mess with no documentation. While testing the new ISP circuit, we found a perplexing connectivity problem where only the PCs provided by the ISP for testing behaved normally; our test systems were experiencing severely restricted throughput. After eliminating speed, duplex, routing, DNS, and other common configuration errors, we suspected an MTU problem so I used the RFC 2544 test on Fluke Networks' EtherScope. We watched as the test stepped through various packet sizes until we started seeing failure as we approached 1500 bytes. Once we restricted our test devices to use a smaller MTU, the network behaved normally. We determined that some upstream router managed by the ISP had an incorrect MTU setting (and was not allowing packet fragmentation). Now that we found the problem, it was easy to fix. The ISP checked their router configuration files, was able to hone in on the MTU settings, found the configuration error, and corrected it."

As far as business goes, Eric has no problem impressing prospective clients when he solves problems by bringing his analyzer with him at a first site visit. "I recently was on a job where I ran a discovery test from the EtherScope while conducting our initial meeting. It saves me time and gives me a nice graphical picture of what I'm going to be working with. By the time we were done, the tool had found several problems. It single-handedly opened the door to capture business with the client."

### Small system integrator

Mike Goodman is the owner and only engineer in his company, Castle Networks of Colorado. He provides design, installation, troubleshooting and maintenance services to 200 customers. In the winter, he works for commercial customers designing and installing data and voice systems. In the summer, he is focused predominantly on residential customers whose primary request is the installation of audio/video and security systems.

"Most of the time I am working on existing networks that are kluged together by others. I find many non-interoperable components in networks and see a lot of electromagnetic interference rather than there being anything wrong with the actual system," says Mike. Mike does pre-deployment base-lining during new and retrofit installations, adds, or moves. Validation is a key part of Mike's work model. He uses a cable analyzer to certify new installs, a cable verifier for wire mapping, and a network analyzer to diagnose connectivity on existing networks.

Mike reports to himself, so when he cannot fix a problem, he might lose a client. As a small business owner, he has realized that investing in cable and network tools makes good business sense. "Network troubleshooting is very quick with the EtherScope. Typically, I might have a two-hour service call in front of me. With the EtherScope, I can find the problem within the first half hour. Then all I have to do is make the correction or change. Test tools take the guesswork out of most configuration problems. I don't have any call backs when I use the EtherScope."



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