

Testing is Not an Option:

The Rationale for Enterprise IP Telephony Network Assurance and Testing

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Executive Summary

IT managers, CIOs and other enterprise decision makers have finally realized the benefits of deploying IP based communications solutions. The proliferation of converged networks opens the door to a new world of enhanced applications and services, as well as costs savings and productivity increases. IP PBXs, IP Centrex solutions and even hybrid systems that enable legacy enterprise equipment to be slowly upgraded while interoperating with new packet-based equipment are all contributing to a shift in the way enterprises handle their communication networks.

Like all major advances in technology, the converged network brings with it a unique set of challenges as well as opportunities. Careful planning throughout the purchase and implementation processes can help enterprises meet these challenges and prepare for them before they turn into quality of service issues. The best way to prepare for and combat the quality issues inherent in a converged network is to test that network thoroughly before rolling it out.

This paper outlines both the benefits and challenges of deploying a converged network in the enterprise. It discusses why testing is not an option for those tasked with implementing a new communications system in their company. And it describes in detail how testing addresses specific quality of service issues that can plague converged networks, so that enterprises can prepare for these issues before they have a chance to impact network quality.

About Robins Consulting Group

Robins Consulting Group (RCG) is a leading marketing communications consultancy providing an array of marketing and other services to the IP telephony industry. Marc Robins, an internationally recognized authority in the field of IP telephony and emerging new communications technologies, founded RCG in 2003. Prior to RCG, Mr. Robins served as vice president of publications and trade shows, associate group publisher and group editorial director at TMC, publisher of the trade magazine *Internet Telephony* and producer of the *Internet Telephony Conference & EXPO* trade shows, for which he also served as chief architect and conference co-chairman. For more information about Robins Consulting Group services, call 718-548-7245 or e-mail robinsconsult@optonline.net. This white paper was commissioned by Spirent Communications.

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1. A New Era in Communications: IP-PBXs and New Enterprise IP Telephony Solutions

IP telephony is no longer a pie-in-the-sky dream of technophiles and hobbyists. IP PBXs, gateways and other enterprise solutions that utilize IP to deliver a variety of services make up a substantial portion of communications equipment sales. IT Directors, CIOs and CTOs are rapidly discovering the benefits of converting to an IP-based network solution in some form or another, whether it be a pure-play IP PBX or a partial conversion from legacy PSTN to IP by adding gateways or perhaps upgrading an existing switch. A new age of enterprise communications has finally arrived.

1.1 The Converged Network Infrastructure: New Opportunities, New Challenges

Companies have finally figured out that their legacy phone systems cannot evolve to meet the needs of their companies, and the only logical solution is to invest in an IP-based infrastructure. These companies realize the countless applications that can be deployed over their versatile converged networks will boost employee productivity and save money. Not to mention the cost savings inherent in bypassing service providers to route network traffic in everything from campus settings to branch offices throughout the world.

But every great opportunity has its challenges, and as the person tasked with upgrading your company's communications system, you are quickly realizing that assessing your equipment options and making a purchasing decision are only a small part of implementing a solution.

Just weeks before the rollout of your new IP communications system, you had a scary vision. What if something went wrong? What if your network couldn't handle the volume of data being sent over it? Or worse, what if packets weren't being prioritized properly and ended up being lost or reassembled in the wrong order? What if the CEO of your company picked up his stylish new SIP handset and couldn't get a dial tone? Or maybe his call with an important investment firm was suddenly dropped after the sales manager began his previously scheduled videoconference with your affiliates in Bengal. You slowly began to realize that your work was far from over. Sure, choosing the proper converged IP telephony solution for your company based on features, compatibility and scalability had been a challenge, and luckily you had found a solution with all the specifications you had sought. But in your excitement over the opportunities the new system presented, you had forgotten just how important proper implementation was. The network backbone was the basis for your entire new communications infrastructure: How could you ensure it was ready for the volume of traffic you were about to introduce to it?

1.2 Holistic Testing: The Need to Gain Assurance Across TDM and Packet-Based Infrastructures

The solution to your potential network nightmare is now very clear. You will have to test your network and then test it again and again to ensure it meets the demands you are about to place on it. You will have to configure and then reconfigure your network, addressing the needs of your users and applications while juggling packets, TDM and analog traffic. Your company has never had access to the volume of communications solutions you are about to introduce to it. How will you ever simulate the load these demanding applications will place on your network? You need a solution

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that can replicate the countless scenarios you will be introducing to your network and help you to understand the process of prioritization and load balancing. You need a holistic testing approach, or your network runs the risk of becoming as fragmented as the voice packets in your CEO's important SIP phone call -- just before it gets dropped from the network entirely.

2. Migrating to VoIP: Key Issues and Considerations

The scenario outlined above is a very real and frightening prospect when making the leap to any type of IP-based communications solution. Your data network will need to serve double duty when you begin running real-time voice and video applications over it, whether you're converting to a pure IP solution or working with existing PSTN equipment and a gateway. If you don't ensure that your network and equipment are up to the task you run the risk of experiencing packet loss and jitter at a minimum, and complete network failure in the worst case scenario. To avoid these risks altogether, you must take a number of things into consideration before choosing and deploying your new enterprise communications system.

2.1 Reliable Communications Are Business Mission Critical

We have reached a stage in the information era where data network downtime is simply unacceptable. You know all too well that even within your current network configuration, loss of Web and e-mail access is a major blow to your company's productivity and has a crushing impact on internal and external communications. Increasingly, Web and e-mail presence provide a major interface with your customers and when these services aren't functioning, your customer service record is at stake, not to mention your revenue streams.

Up until now, you've had little to worry about when providing dial tone, voice mail and a solid IVR system to your company. Perhaps these applications have run virtually maintenance free with only occasional involvement from your IT staff. But now you've decided to marry your trusty voice applications with your data network, as well as add a number of new voice and video functions on top of them. It will be a relief to be able to roll out and manage all or most of these applications on the same network, and potentially through one simple interface. But you had better make sure your network is up to speed. Downtime for your voice applications is not only unacceptable -- it spells disaster for all facets of your company's business.

2.2 The Need to Fully Assess Existing Network Performance

So, you think you know what your voice and data networks are capable of? Perhaps you've been involved with their configuration and growth from the very beginning. You've watched your data network expand from a multi-floor to a campus configuration, and perhaps even to a worldwide branch office setup. Your voice systems have grown as well, although maybe in a more disparate fashion based on location and the size of your branch offices. How will your voice and data communications operate in tandem on such a broad scale? It's a daunting prospect, and one that should not be considered lightly. To successfully pair the two most important backbones of your company's communications, you will need to ensure your new converged network is capable of running at peak capacity and reliability at all times. You absolutely cannot guess or come up with a ballpark

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estimate of how much traffic will be sent over the network at any given time. You must carefully assess, analyze and test extensively before migrating to your new solution. You will undoubtedly have to make changes to your existing configurations, and when all is said and done you will be extremely grateful that you took the time to try to “break” your network before it broke down on you.

2.3 Important Interoperability Considerations

You’ve entered the world of converged communications and have a good handle on all the opportunities it affords in terms of leading applications and cost savings. But “convergence” is a relative term, and the IP telephony industry is still experiencing growing pains. Packet telephony standards and protocols are changing and expanding each day, and you must understand that Vendor A’s media gateway may not work with Vendor B’s SIP proxy server. The extent to which you should familiarize yourself with industry developments depends on the types of solution(s) you are implementing as well as the level of interoperability promised by the vendors selling you their equipment. Are you purchasing a full-service IP PBX that is “guaranteed” to work with your existing trunk lines, ACD and handsets? Or maybe you’re making a slow conversion and are planning to install a media gateway and some H.323 handsets to start. Whatever route you are planning to take, you absolutely must ensure that your data and voice equipment are interoperable with each other, as well as any legacy equipment you may be keeping in the mix. The alternative could mean costly last minute equipment purchases or worse – network failure. For more information on IP telephony standards, visit the International Telecommunications Union (ITU, <http://www.itu.int>) and the Internet Engineering Task Force (IETF, <http://www.ietf.org>).

2.4 The Impact of Network Security Solutions on Voice and Video Quality

Keeping a handle on the security of your data network is tough enough – now you also need to consider the impact of your security apparatus on your voice and video applications. Common firewall solutions, VPNs and SSL encryption make it relatively painless to block certain ports and maintain tight control over packet flow. Adding voice and real-time video to your data network adds a layer of complexity to packet traffic, and you had better be prepared to test and overhaul your existing security solution to meet these new demands. In fact, firewalls and other security measures can seriously affect the quality of voice and video traffic by introducing additional jitter and latency, in some cases making effective communications impossible. Failure to test could result in serious quality degradation for your voice and video calls. Some VoIP equipment providers offer a number of enterprise security solutions to handle IP telephony traffic routing within your company, and there are also vendors that specialize in session border controllers designed to handle the essential task of interfacing with your service provider.

2.5 The Impact of Software Upgrades and New Hardware in the Network

As mentioned previously, implementing your new IP telephony solution and enabling it to interoperate with your existing equipment is a huge task. Once you have your system up and running you are far from home free, however. Each time you decide to upgrade a software application or add new hardware within the network, you must understand the impact these changes will have on network performance. Pre-deployment or lab testing is essential in order to understand the impact

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new equipment and software will have on your network. The last thing you want to do is to make these changes “on the fly”. By testing in a lab or in pre-deployment, you will be able to avoid network service interruption, and help ensure that your network has the capacity to process its regular traffic flow while simultaneously undergoing a minor or substantial upgrade. Failure to take this into consideration before rolling out your new communications solution could once again spell disaster for your company.

2.6 Real-World Performance vs. Vendor Representations

You’ve been around the block more than once when it comes to buying IT equipment and you know the difference between vendor claims and sales tactics and actual equipment performance. This knowledge will certainly be useful as you make your converged communications purchasing decision, but know that there are other factors to consider before you make the leap. As stated earlier, the IP telephony market is young, and not every vendor has a solid history to base its sales on. This is unavoidable of course, but it can also lead to outstanding claims such as “guaranteed interoperability” with Product Type A or guarantees regarding load capacity or scalability. And sure, these products may have actually achieved interoperability with Vendor C’s Product Type A or scaled in the lab – at least once before, if not twice. But what happened when they were deployed in the real world? It’s vital to find this out.

2.7 Right Sizing the Equipment Investment

Another important consideration for you during your VoIP migration is the size of your technology investment. You need to accurately assess your current network configuration and make a dependable estimate of the amount of equipment and the scalability you will require from a new system. You already know what size budget you have to work with, but circumstances change, and you must ensure you purchase a system that is flexible enough to expand or be downgraded to match your company’s needs today – and certainly several years down the road. What are your company’s most pressing communication needs? How do you envision these needs changing as technology advances and the size of your company changes? Having a certain amount of foresight is a requirement as you begin the process of migrating into a new era of IP communications.

3. Gremlins in the Network: Quality of Service (QoS) Problems That Can Plague an Untested IP Telephony Deployment

Picture this: You’ve just rolled out your converged network solution and everything seems to be working fine. Then you slowly discover that your network has some issues – you can’t send packets over it after midnight, and look out if you expose it to bright lights or water.

Okay, so maybe your problems aren’t quite so cinematic. But the message here is pretty simple: An untested IP telephony deployment is not the cute furry pet you thought it was. A slew of quality of service issues brought on by improper testing or failure to test at all can turn your converged network into the equivalent of a small town overrun by mischievous reptilian monsters. And that’s no fun.

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3.1 Packet Loss

Back in the old days, when you were sending e-mail and HTTP traffic over your data network, a few lost packets were no big deal. As long as packet header information was in order, the packets would basically assemble themselves at the destination with no apparent change or loss to the end user. But a converged network deployment is an entirely different beast, and packet loss equals unacceptable degradation of voice and video traffic quality. It results in everything from a patchy call in which voices can be garbled to a completely botched call, in which signaling information is dropped and packets don't even make it to their destination. An untested network is the equivalent to letting your packets run amok throughout the network, and that's a very dangerous experiment.

3.2 Jitter

The time it takes for packets to travel from point to point within your converged network is measured in delay or latency levels. Voice and video applications have maximum latency levels that can be reached before a VoIP call crosses the line to an unacceptable quality level. Jitter is a variation of delay/latency levels over time, caused by actions like queuing and routing that affect the path of packets as they travel through the network. A congested network will generally have higher levels of jitter, but proper quality of service controls like queuing and bandwidth allocation can control the problem. Testing is essential for determining how much jitter your network will experience and how it should be handled. Most quality of service solutions include a jitter buffer, which is a hardware or software solution that actually adds small amounts of delay to packets received so they all appear to have equal and acceptable amounts of latency. This also ensures that packets are transmitted in the correct order.

3.3 Delay/Latency

Exceeding the acceptable delay/latency levels for your voice or video application can make for an unpleasant call in which parties are forced to pause each time they make a statement and wait for the other party to hear what they've said. This problem is easily solved by quality of service measures that monitor and buffer packets as they travel across the network, ensuring that they are transmitted with acceptable amounts of delay and in the proper order. The network must be thoroughly tested under varying traffic conditions to accurately determine the maximum level of latency that can occur, and to properly configure quality of service solutions to accommodate that level.

3.4 Echo

Few of us who have participated in packet voice calls have escaped the effects of echo. This phenomenon occurs when participants can hear their own voices coming out of the earpiece, and can make a voice call completely intolerable. Factors such as the volume and length of the echo and the impact of hardware like handsets and routers can contribute to the echo "level" or measurement of the echo. In a hybrid network, analog phones can be the source of echo, but a pure IP telephony configuration is also susceptible, since some calls will inevitably interface with a TDM network at some point. There are generally acceptable levels of echo for IP telephony calls, and echo cancellation and suppression are the most common ways to keep echo at an appropriate level within your network. Echo cancellers (digital signal processing solutions) are generally used in media gateways, IP PBXs and other next-generation customer premises equipment to control echo levels.

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3.5 Clipping

Clipping within VoIP calls occurs when either the beginning or end of words, or whole words, seem to be cut off during a conversation. This can occur when voice activity detectors and other solutions that work in tandem with echo cancellers are thrown out of sync. Echo cancellers deal with background noise and “double talk” in addition to echo. For instance, an absence of background noise during a call can confuse users into thinking a call has been dropped. But improper levels of background noise can result in annoying voice clipping. A careful balance must be struck, ensuring that proper levels of latency, jitter, packet loss and echo are maintained throughout the network at all times.

3.6 The Business Ramifications of an Untested Network Infrastructure

As stated above, each quality of service “gremlin” that impacts your network can lead to the proliferation of additional gremlins that further degrades voice quality. If you fail to uncover these gremlins through comprehensive testing in the lab or in pre-deployment testing, these gremlins will be free to run amok through your network, resulting in dropped calls, unacceptable quality levels, and general chaos throughout your enterprise communications. And that spells trouble for your entire business operation, negatively impacting productivity and efficiency, and ultimately your organization’s bottom line. By adopting a comprehensive testing program that tests your network infrastructure and takes the appropriate measures to ensure acceptable levels of service for all your applications, these Gremlins can be tamed, controlled and prevented from multiplying.

4. The Benefits of Testing a Converged Network Infrastructure

By now, the implications of deploying a converged network infrastructure should be clear. This solution will offer you a plethora of benefits in terms of cost savings, integrated applications and flexibility. It can also be the source of endless headaches as well as total enterprise communication failure if it is rolled out haphazardly. There is no room for compromise when it comes to testing your network infrastructure: Comprehensive lab testing, or at the very least pre-deployment testing, must be performed, and it must be done correctly for a number of reasons.

4.1 Optimizing Network Performance

You want your network to be running at peak performance at all times. And sure, merely migrating to a converged network architecture goes a long way toward ensuring applications are delivered to end users as efficiently as possible. But as you’ve learned, converged networks come with a unique set of difficulties and potential problems. Without proper testing, you run the risk of being inundated by the gremlins described above, or perhaps overcompensating for wild card problems in your network by allocating too many of your resources to quality of service assurance. Either way, your network will fail to operate efficiently. The only true way to achieve optimum performance is through careful testing.

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4.2 Maintaining Security

The security issues associated with packet telephony networks are numerous and can be quite complicated. While you may be able to identify potential problems before you roll out your network and establish solutions for dealing with them, there is no way to accurately guess which security problems will affect your particular network configuration. The only sensible way to identify these issues is to perform comprehensive testing in the lab or in pre-deployment testing to simulate real-world traffic on your network and analyze how it interoperates with your installed security solutions. Only then will you be able to identify vulnerabilities and successfully account for them. Failure to properly test for weak points in your new network architecture is a huge gamble, and puts your company's entire communications infrastructure at stake.

4.3 Driving Cost Efficiency

Optimizing your network's performance comes with a price. Money spent on proper testing is well spent, and could save you major bucks in the long haul. If testing is performed correctly, it will result in an efficient converged infrastructure that is scaled to accommodate the correct number of users and traffic load throughout your enterprise. If miscalculated, your new network could wind up being a costly mistake for your company. Failure to test is a major risk that will likely end up costing you more money to fix in the long run than the incremental costs of testing.

4.4 Growing The Bottom Line: Increasing Productivity and Profits

One of your major goals in deciding to switch to a converged network solution was to save your company money and offer new and exciting applications to end users, with the long-term result of increased productivity and profits. That goal is very easily achieved with today's IP telephony systems and services – as long as they are deployed efficiently. The message here is very simple: You will have to spend money, both on your converged solution and the proper testing of it, to save money. In the long run, your company will appreciate the productivity gains inherent in enhanced voice and Web applications, and may realize profits just as quickly. Your converged network is sure to provide tremendous communications cost savings, and can even contribute to new revenue sources. But the bottom line will only be realized if your network is rolled out properly, and that means testing it, breaking it and testing it again.

5. IP Telephony Network Assurance and Converged Network Testing Solutions From Spirent Communications

Spirent Communications (<http://www.spirent.com/enterprise>) is a leading player in the converged network testing and quality assurance space. The company offers network performance analysis products and services geared toward enterprise IP telephony, video and data network deployments. Spirent also offers a number of innovative testing services that help enterprises roll out converged network components in a timely and reliable fashion.

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5.1 Abacus 5000

The Abacus 5000 IP Telephony Migration Test System combines IP telephony and PSTN testing in a single platform. This solution offers real-time call statistics and protocol analyzers for identifying all types of quality of service “gremlins.” The system works by generating real voice streams and simulating enterprise traffic loads for an accurate analysis of voice quality impact. It also offers the ability to test interoperability of a number of devices and switching schemes, including analog, TDM and VoIP traffic. The call generation feature supports a number of popular IP telephony protocols, including SIP, H.323, Megaco/H.248, MGCP and RTP.

5.2 Avalanche

The Avalanche product line can be used to test network and security infrastructures ability to support voice, video and data traffic simultaneously. Avalanche can simulate large volumes of voice calls and web, mail and streaming clients. It includes the Analyzer reporting tool for simple display of all data generated during testing.

5.3 Reflector

The Reflector may be used in conjunction with the Avalanche system, and simulates the behavior of a large installation of web, mail and streaming servers. It can also terminate voice calls. The Reflector 220 is a scaled down portable version, designed for use with the Avalanche 220 in the field.

5.4 IP Telephony Assessment Service

Spirent’s new integrated IP Telephony Assessment Service offers analysis of both IP and PSTN networks in separate and converged configurations. The company first assesses the customer’s requirements in terms of desired applications and scalability as well as the type of network and services being implemented. A customized network analysis follows, which includes voice quality assessment and connectivity analysis based on location. A summary report features detailed call quality statistics and charts, as well as problem identification for additional testing. Follow up testing can address specific problems like latency and jitter.

6. Conclusion

It’s clear that the migration to a converged communications infrastructure will be a huge benefit to you and your company. An IP telephony based network offers a long list of benefits, new features and functionality. Ease of management, the ability to roll out complex voice applications on the fly, cost savings, increased employee productivity and new revenue opportunities for your company are just some of the great features a converged communication system has to offer you. And making the leap to this type of network doesn’t have to involve a complete overhaul of your existing systems – it can be done slowly, at a pace that you are comfortable with and that fits within your budget.

By now you should realize that your network is not going to configure itself. You are responsible for not only assessing your company’s needs in terms of equipment, scalability and flexibility, but also

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for ensuring that the solutions you choose meets these needs. The amount of traffic traveling over your new network will vary greatly, depending on how quickly your company grows, how quickly you decide to roll out next-generation applications, and how many end users decide to take advantage of those applications. Your network must be ready to handle that variation in traffic, otherwise you may be looking at complete communications failure – not a very cheerful thought.

Testing is without a doubt the most reliable way to ensure your network will operate successfully in its new configuration. It ensures a network can handle the amount of traffic that will be sent over it, that it can prioritize that traffic properly, that quality of service issues are accounted for in routing traffic and that potential security hazards are discovered and taken care of before it's too late. It can simulate traffic patterns on your network you never dreamed would exist and enable you to prepare for their eventuality. It can also play a role in ensuring your new communications equipment is interoperable in the real world, under varying conditions and in varying configurations.

The decision to roll out a converged communications solution is a solid investment and a no-brainer for you and your company. But to do so without properly testing your network first is an enormous gamble, and one that could hurt you and your company in the long run. Testing your new network before deployment is absolutely essential to its success. The alternative could be a nightmare for you, your company and worst of all – your customers.

Contact Spirent Communications

To learn more about Spirent Communications, visit their website at www.spirentcom.com/enterprise or contact a Spirent representative by calling 1-800-927-2660 or sending email at enterprise@spirentcom.com.