Taking the Risk out of VoIP Deployment and Ownership: Seven Best Practices for Convergence Success

A Shunra Software White Paper

Introduction

Voice-over-IP (VoIP) technology offers a wide range of benefits – including reduction of telecom costs, management of one network instead of two, simplified provisioning of services to remote locations, and the ability to deploy a new generation of converged applications. In pursuit of these benefits, however, every company must control costs and – even more importantly – control risk. No business can afford to have its voice services compromised. Revenue, relationships, and reputation all depend on people being able to speak to each other on the phone with "five 9's" reliability.

Thus, every company pursuing the benefits of VoIP must take steps to ensure that their converged network delivers acceptable call quality and non-stop availability. In particular, such companies must 1) validate the performance and stability of their initial VoIP deployment, and 2) put appropriate measures in place to safeguard that performance and stability as changes are made to the network environment over time.

This latter requirement is often overlooked amid concerns about initial deployment. But ongoing vigilance is essential for successfully maintaining a converged voice-and-data environment on an ongoing basis – especially in light of the highly dynamic character of today's enterprise networks. Many companies also overlook the potential impact that a real-time application like VoIP can have on their other networked applications and services. But this impact should not be underestimated. VoIP can and often does affect the way critical applications behave.

To fully protect itself against the risks associated with both initial VoIP deployment and long-term VoIP ownership, every company should have a robust virtual network test bed. Such a test bed is indispensable for modeling the performance of VoIP in the production environment, validating vendor claims, comparing alternative solutions, experimenting with proposed network enhancements, and actually experiencing the call quality that the planned VoIP implementation will deliver.

A virtual network test bed also provides the only reliable means of predicting the impact of change – including modifications to network architecture, the addition of remote offices, and the growth of application traffic – on call quality and stability. This change is an inevitable part of network ownership, and successful management of this change is an absolute requirement for long-term convergence success.

This white paper explains how companies can best apply virtual network test bed technology to both their initial VoIP deployment and their ongoing VoIP management challenges. Companies that adopt both the technology and the best practices described herein will be significantly better able to fulfill their service level objectives for VoIP and all their other critical networked applications – while drastically reducing the risks associated with VoIP downtime and/or sub-standard call quality.

The Rewards and Risks of VoIP

A variety of factors are driving the adoption of VoIP. Reduced telecommunications costs are obviously one of them. By bypassing carrier toll charges, companies can significantly cut their phone costs even as their call volume continues to rise. It is also less expensive to own one network rather than two. So, by moving to a converged voice-and-data network, IT organizations can reduce both their infrastructure costs and their overall management overhead. A converged network also reduces the expense of setting up new offices and supporting other types of organizational change – since only one wire has to be brought to the end-user's desktop.

In addition, VoIP- and multimedia-enabled networks offer companies the ability to implement a new generation of applications that can improve employee productivity and customer care. These include call centers, "follow me" messaging, and voice/video/whiteboard conferencing tools.

However, these benefits do not come without corresponding risks:

Voice quality and availability
The primary risk associated with VoIP is the potential that voice service may at times lose quality – or fail entirely – because of problems on the enterprise IP network. Wide area network (WAN) connections are particularly notorious for experiencing impairments that can threaten a real-time application like voice. Because daily business operations depend so much on people being able to pick up the phone at any moment and talk to each other, any such problems with voice service are entirely unacceptable.

Application contention
Convergence also introduces risks associated with the interaction of voice and data applications. As new business applications are rolled out onto the enterprise network, the increased traffic – especially if it is particularly "bursty" – may jeopardize voice quality. By the same token, those same applications may be adversely affected by the growing presence of prioritized VoIP traffic on the network. IT organizations therefore have to protect voice and data applications from each other as they contend for the same limited infrastructure resources.

MAC-related risks
Another risk arises because of moves, adds and changes (MACs) on the network. As organizations add locations, shift users, and make other modifications to the structure of the network and its traffic patterns, end-to-end voice service levels may be affected in unanticipated ways. The WAN connection to an overseas office, for example, may not be capable of supporting the additional VoIP traffic that will result when staffing levels at that office grow. IT organizations must take these factors into consideration as the number and distribution of end-users changes over time.

Innovative companies and early adopters of leading-edge applications can face additional risks as they introduce greater complexity into their real-time network environments. This complexity can drive greater unpredictability in end-to-end service levels for voice and data applications by creating more numerous and more subtle performance variables.

The bottom line is that VoIP raises new issues for IT organizations both at initial implementation and as changes take place in the enterprise environment over time. To deal with these new issues, IT organizations moving to a converged environment must therefore put in place new measures to maintain the performance and reliability of critical voice and data services.

The Role of the Virtual Network Test Bed in VoIP Deployment

Perhaps the most important and useful single solution for coping with the new challenges presented by VoIP and other real-time applications is the virtual network test bed. Essentially, such a test bed enables application developers, QA specialists, network managers and other IT staff to observe and analyze the behavior of network applications in an environment that accurately emulates conditions on the current and/or planned production network. This simulation encompasses all relevant attributes of the network, including:

- All network links and their impairments (physical distance and associated latency, bandwidth, jitter, packet loss, CIR, QoS/MPLS classification schemes, etc.)
- The number and distribution of end-users at each remote location
- Application traffic loads

During the implementation of VoIP, this virtual network test bed can be used in a variety of ways to ensure project success.

Evaluating the enterprise network

Virtual test beds provide an excellent means of evaluating the enterprise network's "VoIP-readiness." By plugging VoIP equipment into this virtual environment, testers can experience first-hand the quality of voice calls between any two locations on the network as it would be under current production conditions. Because these conditions can actually be "recorded" from the live environment, call quality can be evaluated under average circumstances and periods of peak activity (such as beginning-of-day or month-end spikes in application traffic) to ensure reliable service levels.

This testing environment also enables technicians to analyze the behavior of VoIP traffic and pinpoint potential problems. They can then experiment with possible "fixes" – such as additional bandwidth or changes in QoS settings – to see if they have the desired impact on

call quality. This predictive capability helps eliminate the risk of wasting money on unnecessary bandwidth or equipment.
A test bed can also reveal whether other applications on the network are adversely affected by either the presence of VoIP or any planned modifications to the network. VoIP can potentially disrupt existing applications when it's introduced onto the production network. MOS testing and other conventional pre-deployment VoIP QA measures don't predict these problems. A virtual network test bed will.

Having predictively discovered and pro-actively remedied all potential problems, the IT organization can have total confidence in its preparations for a VoIP rollout before unleashing any new traffic into the business-critical production environment – without having to worry about network impairments unexpectedly undermining voice quality.

Evaluating vendor equipment, network services, SLAs and management tools
The virtual test bed is extremely useful for evaluating the full range of new technology investments that companies make as part of a VoIP project or larger convergence initiative. For example, they can use the test bed to compare the performance of competing vendors' VoIP hardware under live conditions. Such comparisons are vital, since the different codecs and compression schemes that vendors use can affect call quality in different ways depending on the idiosyncrasies of each production network.

The test bed is also indispensable for determining specific service-level requirements for any wide area network (WAN) service provider. It's important that these specifications – which may include frame relay CIR and/or MPLS classes-of-service – be adequate for supporting acceptable voice quality. On the other hand, because such specifications come with a price tag attached, they should not be set unnecessarily high. By experimenting with these setting in a controlled environment, IT organizations can avoid winding up with either more or less network than they need.

Companies moving to a converged environment also typically acquire new management tools to more closely and effectively monitor the end-to-end performance of critical service in real time. Again, a virtual test bed provides the ideal environment for evaluating such tools and determining their suitability for the specific needs of the IT organization and the environment it must manage.

Hardware vendors, service providers, and software developers all make claims about how their solutions work – but buyers must validate those claims for themselves. Using a virtual network test bed, any IT organization can see exactly how well the solutions offered by multiple vendors will perform under production conditions – before making the final purchase.

Pre-deployment demos and acceptance testing

A third compelling use of the virtual test bed in the initial stages of VoIP deployment is the presentation of live demonstrations to business managers and end-users. Regardless of MOS scores or other technical assessments, the acceptability of call quality is ultimately subjective. One of the biggest fears of IT organizations deploying VoIP is that the end-user community will complain about call quality after a major investment has been made in a production roll-out. The way to avoid this risk is simply to allow business users to directly experience VoIP call quality well in advance of the roll-out. IT departments can do this by using a virtual network to provide hands-on (or "ears-on") acceptance testing prior to production roll-outs. If users express concerns in the testing environment, then IT can respond by making appropriate improvements. Once user buy-in is achieved, IT can move forward with confidence – and offer a ready reply to any later complaints.

The Ongoing Role of the Virtual Network Test Bed in Converged Environments

One of the most common mistakes IT organizations make when implementing VoIP is underestimating the long-term impact of convergence on operations. Often, there is an unspoken perception that if the momentous changes associated with the initial implementation can be weathered successfully, ongoing management issues will be a piece of cake.

This is simply incorrect. First of all, voice services never become less critical to the business or less sensitive to conditions in the production environment. Converged networks will always require additional attention because they are carrying an application for which there is no downtime tolerance. So no one should operate under the misconception that there is any "relaxing" to be done after a VoIP roll-out.

Second, change is a constant in today's enterprise environments. And change often has an unexpected, unpredictable impact on end-to-end application performance. The presence of real-time applications on a converged network only adds greater subtlety and unpredictability. That's why VoIP requires that even greater vigilance be applied to the ongoing management of the production network.

Here again, the virtual network test bed can play a crucial role.

Coping with changes in the production environment

The enterprise production environment is in a constant state of change. New users and new locations are added. Utilization of existing services increases. Network hardware and firmware gets upgraded. Companies switch service providers. All of these changes can adversely impact VoIP call quality either gradually over time – or in a sudden and unexpected way.

With a sufficiently sophisticated virtual network test bed, however, IT organizations can effectively plan and respond to such changes. Are traffic loads for specific applications projected to increase by 20% over the next year? Then it's a fairly straightforward matter to introduce those traffic levels into the testing environment and see how VoIP and other services are affected. Acquiring a new company? Again, the test bed provides the ideal environment for assessing what (if any) modifications need to be made to the network to deliver critical services to the acquired locations.

Validation/certification of new and upgraded/modified applications

One of the biggest threats to call quality is the introduction of new and/or modified applications onto the network. These applications can often have significant impact on the performance of applications and services already running on the network – including VoIP. Obviously, the type of application testing traditionally done by development teams (which is typically performed on a local area network (LAN) connection using only the application under development) is insufficient to predict the impact of such applications on voice quality – or other critical applications.

A virtual network test bed, on the other hand, makes it easy to validate the behavior of new or modified applications and assess their impact on existing services. And it is obviously far better to discover problematic contention issues before rollout than it is afterwards. The test bed is thus an essential resource for safeguarding the enterprise against such problems.

Simplified troubleshooting of intermittent problems

IT organizations can find it particularly annoying and difficult to deal with intermittent problems in the production environment that undermine application performance – and then disappear before they can be adequately diagnosed. IT departments can waste countless hours trying to pin down the root-cause of these sporadic problems. Virtual network test beds are very useful in these situations, because they enable technicians to "play back" network conditions at the moment the problem occurred. This allows them to more quickly and effectively analyze the problem and experiment with potential remedies in a controlled environment.

Contingency planning

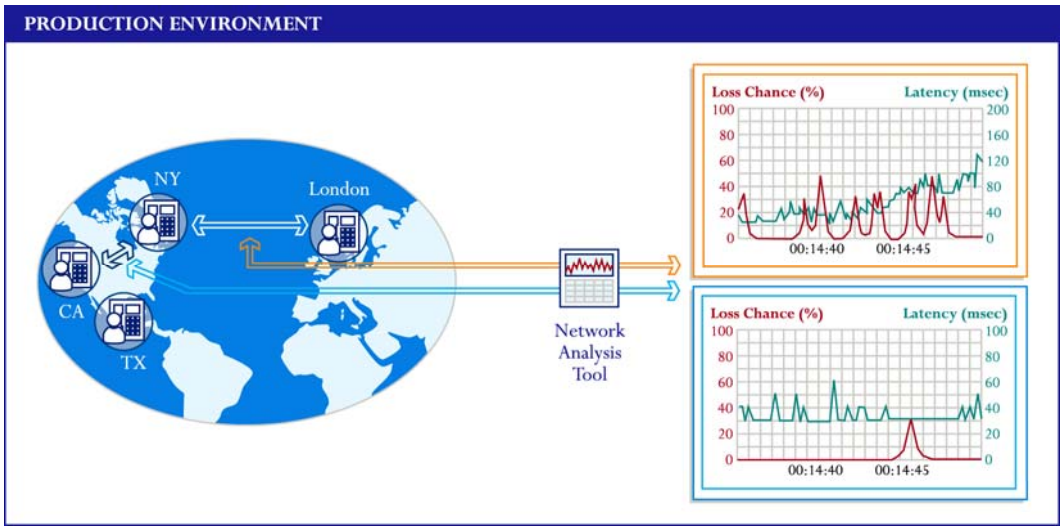
Another ongoing concern of IT organizations is contingency planning. To ensure business continuity, network managers make provisions to support critical services in the event of a disaster. They also have to validate the viability of these plans. A virtual testing environment is an ideal way to perform this validation, since it allows any number of contingency scenarios to be played out and examined. Such experimentation is especially important when increased physical distances between users and resources is introduced (since that distance adds end-to-end latency) and/or when lower-bandwidth connections may temporarily be called upon to support critical business services.

Seven Essential Best Practices for Convergence Success

The following seven best practices specifically highlight how IT organizations are using virtual network technology to ensure both the success of their initial VoIP implementations and their long-term ability to sustain high service levels despite the risks associated with data/voice/multimedia convergence.

1. Capture conditions on the network to define best-case, average-case and worst-case scenarios

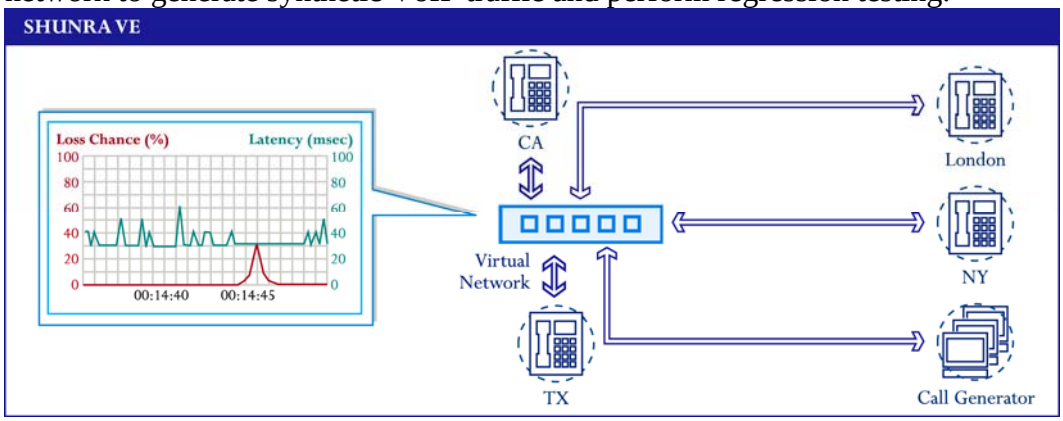
Conditions in a test lab won't reflect conditions in the real-world environment if they are not based on empirical input. And testing done on the production network (in addition to being unacceptably risky) can be misleading if it isn't performed under the full range of possible conditions that exist at different times of the day or month. That's why successful VoIP adopters "record" conditions on the production network over an extended period of time and then "play back" those conditions in the lab to define best-, average- and worst-case scenarios. By assessing VoIP performance under the *best-case* scenario (i.e. with only the minimal latencies generated by the actual physical distance between end-points), the project team can quickly determine whether implementation over the network as it exists today is even feasible. By assessing VoIP performance under the *average-case* scenario, the team can determine if there are problems that need to be addressed to ensure voice quality in general. And by assessing VoIP performance under the *worst-case* scenario, the team can take steps to protect voice services from being interrupted by problems which – even though they may not be common or currently present on the network – could realistically occur.



The pre-deployment testing process should be initiated by creating best-case, average-case, and worst-case scenarios based on conditions captured from the production network.

2. Use the virtual network to run VoIP services in the testing lab under those real-world scenarios

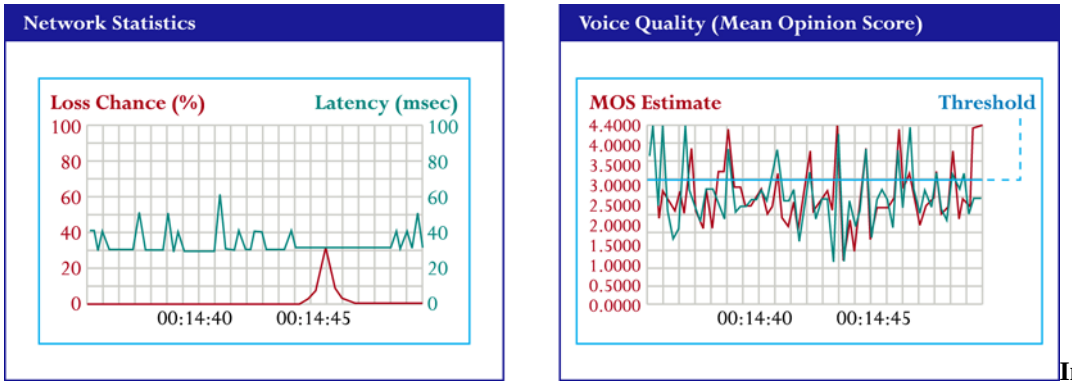
By recreating best-, average-, and worst-case scenarios in the test environment, the project team can actually listen to the quality of voice calls as they would be in the real world. A phone can be associated with each location, so that the quality of calls between any two points can be evaluated under the same conditions and impairments that the production network would introduce. A call generator can also be added to the virtual network to generate synthetic VoIP traffic and perform regression testing.



Once various scenarios are accurately defined, a virtual network can be created for testing VoIP quality between all end-points.

3. Analyze call quality with technical metrics

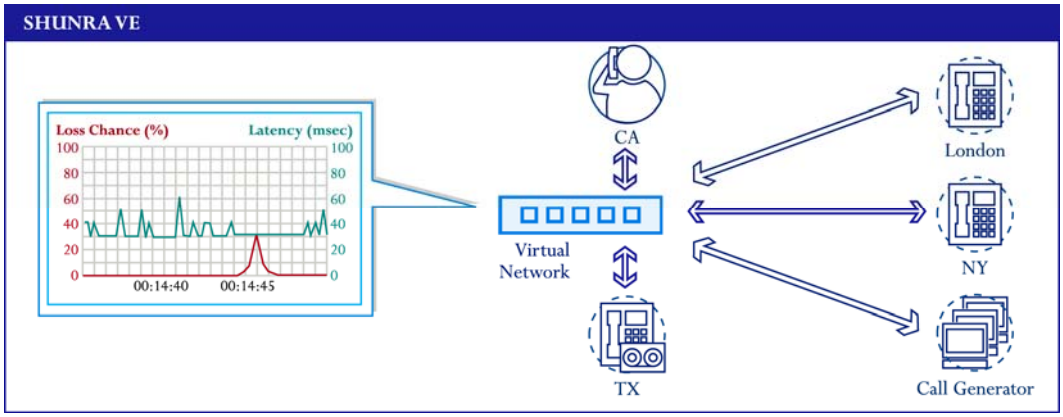
Once VoIP traffic is running in an appropriately defined virtual environment, the team can apply metrics such as MOS to determine where voice quality is acceptable and where it is not. Typically, there will be a close correlation between network conditions – such as delay, jitter and packet loss – and call quality. In fact, given the highly dynamic nature of today's networks, voice quality may vary substantially change during the course of a call.



In a virtual network environment, scenario conditions (left) can be closely correlated with perceived call quality (right).

4. Validate call quality by listening to "live" calls

Technical metrics alone can be misleading, since it is the perception of call quality by actual end-users that serves as the ultimate test of VoIP success. So the virtual environment should be used to enable the team to validate first-hand the audio quality on calls between any two points on the network under all projected network conditions. Using a call generator in conjunction with the virtual network, a tester can become the "nth" caller at any location. This information is typically documented on voice mail systems and is included in the call itself to ensure accurate documentation. For example, the tester might say "Hello. This is a message from the 101st caller from California to Texas under the average-case network scenario."



MOS measurements should be validated by having testers place and listen to call under all scenario conditions and between all network locations in the virtual environment.

5. **Repeat as necessary to validate quality remedies**

   A major advantage of a virtual environment is that various "fixes" can be tried and tested without disrupting the production network. Testing in the virtual environment should therefore be an iterative process, so that all "bugs" can be fully addressed and the roll-out of VoIP in the production environment can be performed with a very high degree of certainty.

6. **Bring in end-users for pre-deployment acceptance testing**

   Since voice quality is ultimately a highly subjective attribute, many VoIP implementation teams have found that it is worthwhile to bring in end-users for acceptance testing prior to production roll-out. This greatly reduces the chance of the dreaded "VoIP mutiny" syndrome, where end-users balk at call quality despite the best efforts of IT and the fact that call quality meets common industry standards. This pre-deployment acceptance testing is particularly important when the financial investments made in VoIP-enabling the network are significant.

7. **Continue applying the above best practices over time as part of an established change management process**

   To maintain VoIP quality over time, IT organizations must incorporate the above best practices into their change management practices. This is essential for ensuring that changes in the enterprise environment – the addition of new locations, the introduction of a new application onto the network, a planned relocation of staff – will not adversely impact end-to-end VoIP service levels. Such changes can easily affect VoIP performance in totally unexpected ways, so the only safeguard against the interruption of critical voice capabilities is to test call quality under the new projected conditions in the lab using a virtual network.

Taking Risk out of Convergence with a Virtual Test Bed

IT organizations face a wide range of investment decisions as they seek to evolve their enterprise computing environments to meet the needs of the business. The real question is therefore not just what a given technology can provide from a feature/function perspective. It's what gives them essential value to the business over time.

As noted above, virtual network technology is invaluable to any organization seeking the benefits of converged infrastructure. With a virtual network test bed, IT organizations can take the risk out of both their initial VoIP implementations and their ongoing management of converged infrastructure. They can also use this unique technology to avoid unnecessary infrastructure costs, save staff time, optimize service levels, and accelerate time-to-fix.

However, it's also important to note that – while a virtual network test bed will pay for itself by virtue of its support for VoIP and convergence alone – this technology also has many other uses that deliver substantial ROI. These uses include the development of more "network-friendly" applications, better planning of server moves and data center consolidations, and improved support for M&A activity.

These significant additional benefits make virtual network technology an extremely wise investment for IT organizations seeking to both ensure the success of a VoIP project in the near term and to optimize their overall operational excellence in the long term. By integrating virtual network technology into its total technology portfolio, businesses can reduce IT-related risks, avoid wasteful IT spending, and bring a new level of predictability to service levels across their ever-changing enterprise environments.

About Shunra

Shunra is the pioneer and market leader in predicting the behavior of services across today's complex networks. The Shunra VE solution lets users know exactly how their voice, video and business applications will perform in any network environment – before they are rolled out into production. Used by network experts, software developers and architects, and QA/testing professionals, Shunra VE gives users a way to apply a working model of the networked production environment to every phase of the application lifecycle – from design and development through QA and operations – so IT organizations can quickly and more efficiently uncover and resolve problems before they impact the business. This results in more timely, higher quality and cost-efficient delivery of IT services.

Solutions for Any Enterprise

More than 1600 customers, including hundreds of *Fortune* 1000 and Global *Forbes* 2000 organizations, from financial institutions to manufacturing companies, retail, energy, media companies, as well as independent hardware and software vendors and telecommunications service providers, have gained measurable returns from Shunra's solutions. Among them are: 3M, Boeing, Cisco, Dow Chemical, EMC, FedEx, General Electric, General Motors, JPMorgan Chase, Kelly Services, Merrill Lynch, Motorola, Nestlé, Pitney Bowes, and Vodafone.

Corporate Information

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