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A Summary of How Converged Network Analyzer Benefits Voice-over-IP (VoIP) Solutions

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Avaya Converged Network Analyzer Software Overview

The Avaya Converged Network Analyzer* (CNA) provides services in a wide area-networking environment that are analogous to those provided by the global aircraft traffic control system to all of the airplanes in the air and the companies that are responsible for them. These services include:

- **Monitor** all of the available "flight paths" between destinations to understand travel times, congestion delays, equipment failures and transport quality metrics
- **Assess** on a real-time basis to determine whether the VoIP application is receiving the appropriate levels of service from the network, based on both learned and defined business policy
- **Adapt** "in-flight" to changing conditions by directing that the VoIP application use alternate paths to the destination in order to achieve an acceptable level of service

These three general service areas reflect a philosophy of how the network should support the business applications throughout a distributed IT infrastructure:

- The network should, if requested, "set expectations" for an application that requests transport/delivery services
- The network must adapt to the demands of the applications that are currently running, in real time
- The network must notify "management" if established policy cannot be maintained

The Business Cases:

- "Add a 9" to IP Network Availability
- Eliminate Network Upgrades
- Reduce "Bad Minutes"
- Improve Quality for Offshore 1-800 Calls
- Increase WAN Visibility

Case 1: "Add a 9" to IP Network Availability

Problem Description

In order for a customer to migrate from their established circuit-switched voice environment to a VoIP solution, they must be convinced that, regardless of the new benefits that VoIP delivers, the system will provide a level of basic communications services equivalent to their current system.

Customers considering VoIP deployments expect to utilize their existing data networks. While the LAN environment may be adequate to support the demanding requirements for VoIP at a single site, the existing WAN is typically inadequate to deliver toll quality voice at all sites with the necessary network up–time expectations.

How can one increase the availability and reliability of an existing distributed IP network environment in order to ensure that a VoIP solution deployed over the network can deliver the required levels of service?

**Avaya, a leading global provider of business communications software, systems and services, has acquired RouteScience, a developer of adaptive networking software (ANS) for enterprises and service providers. ANS has been renamed Avaya Converged Network Analyzer (CNA) and is the first product under the new solution family called Application Assurance Networking (AAN).*

Who has the problem?

Every packet-switched network, private or public, experiences intermittent problems with availability and reliability, with variable durations.

Figure 1. Observed Path Availability – Unoptimized

Observed Path Availability – Unoptimized[1]	
Link Type	Availability (%)
Frame Relay	99.966%
Internet VPN	99.203%

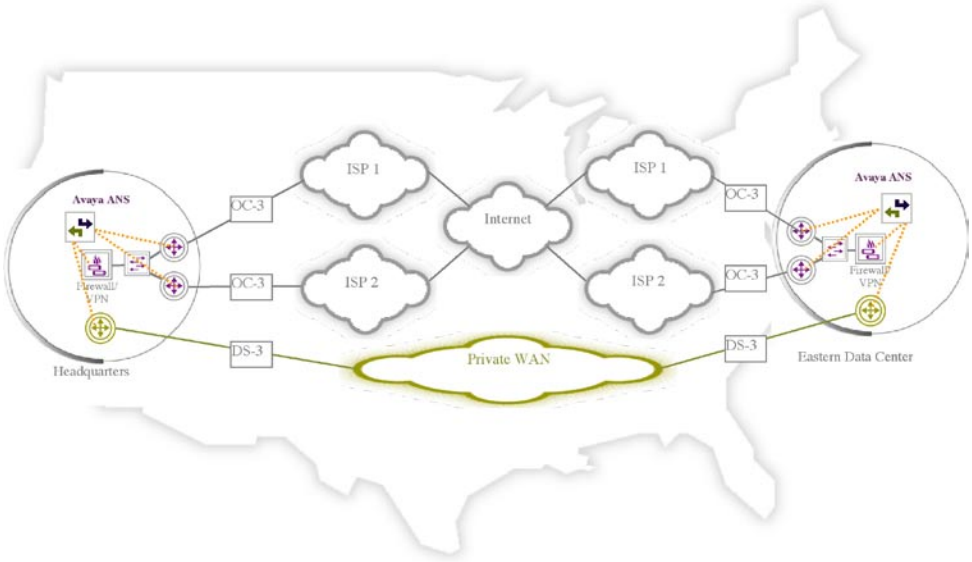
Figure 1 Summarizes the initial results of an evaluation for VoIP readiness conducted at a "Global 1000" international financial services firm in 2003, where they found that the average availability of their private Frame Relay circuits was "three nines," while the availability of VPN tunnels over public Internet links was only "two nines." Compared to the traditional "five nines" PSTN experience, neither of these packet-switched options is acceptable for VoIP.

- Deploy Avaya CNA at major connection points to the wide area network.
- Configure policy descriptions that capture VoIP applications performance, quality and availability requirements into CNA.
- Have CNA continuously adjust the network infrastructure to deliver service that meets VoIP requirements, and alert operators if policy is violated.

Customer Example

The financial services company referenced above had a hybrid WAN in place consisting of private Frame Relay links and redundant public ISP links (Figure 2). They initially deployed Avaya CNA to increase the quality of service to their external Web-based customers.

Figure 2 Diagram of Customer Network



[1] *From an evaluation at a global financial services firm, 2003 Solution*

When a VoIP pilot was proposed, comparisons were done over an 11 day period between the various IP paths that were available, in both unoptimized and Avaya CNA optimized mode.

During the test period, average utilization for each of the links was always less than 20%. This implies that available bandwidth was not a factor.

Figure 3. Observed Path Availability – Unoptimized vs. Avaya CNA Optimized

Observed Path Availability – Unoptimized vs. Avaya CNA Optimized	
Link Type	Availability (%)
Frame Relay	99.966%
Internet VPN	99.203%
Internet VPNs with Avaya CNA	99.907%
Internet VPNs + Frame Relay with Avaya CNA	99.997%

Figure 3 shows that Avaya CNA was able to increase the average availability of both the Internet VPN paths and the combined hybrid WAN, "adding a nine" in each case.

Deployment Implications

In order to achieve high availability between destinations, it is necessary to have more than one potential path between the destinations (as in all high availability models, there is the implicit concept of redundancy and choice).

The alternate paths can be multiple private Frame Relay circuits, multiple public ISP links, or a hybrid mix of private and public connections. The hybrid mix is what typically already exists in Fortune 1000 WAN configurations to support other application requirements.

The edge access routers that control the private and/or public WAN links must have their third-party control API enabled; this is the Border Gateway Protocol (BGP) facility (it is not necessary that the network use BGP for any other routing functionality).

Advantages/Benefits

Based on customer data, enabling CNA to control how applications receive services from the network infrastructure adds at least "one nine" of availability to the environment, as shown in the above example.

A highly available network infrastructure allows many more enterprises to effectively deploy VoIP.In addition to enabling VoIP, a highly available network infrastructure will also provide measurable increases in applications availability for all of the other distributed applications, which may be a catalyst to getting a deployment approved.

Case 2: Eliminate Network Upgrades

Problem Description

Frequently, when a readiness assessment is performed for a prospect that is considering a VoIP deployment, the IP network fabric is found to be inadequate to support VoIP due to link quality, unpredictable traffic patterns or available capacity. Minimum requirements for voice quality are typically:

- delays not exceeding 180 ms

- jitter not exceeding 20 ms
- packet loss, average less than 0.2%, never higher than 1%

Since most prospects are not interested in deploying a new network just for VoIP, the typical recommendation is to perform an upgrade to the network in order to meet these requirements, which involves direct costs and extensive planning.

VoIP consultants will always push to optimize the network for the voice traffic, suggesting changes such as:

- Adding more bandwidth and increasing the CIR on WAN links
- Upgrading all switches and routers to versions that support 802.1p/Q and DiffServ QoS features, respectively
- In all LANs, configuring a specific VLAN for VoIP
- Configuring very aggressive settings on LAN switches, which drain their resources and can cause them to fail more frequently
- Very specific configuration procedures on routers, that can in many cases conflict with already existing configurations
- Disabling some VoIP telephony features on Cisco routers that cause problems with Avaya equipment

However, many of these recommendations are in conflict with the needs of other applications on the network.

The systems operations IT group wants to deploy VoIP and the resulting business benefits without needing to interfere with the network infrastructure; router configuration changes frequently open up political control and responsibility issues.

At many remote locations of a distributed corporate environment, there may not be a local technical resource to perform an upgrade even if there is budget and interest in doing so.

Who has the problem?

Enterprise environments with WAN infrastructure that was not originally architected for VoIP traffic loads and service needs. According to some estimates, 70% to 90% of enterprise VoIP environments fall in this category.

Smaller branch office sites with low bandwidth private WAN infrastructure

Companies with independent (frequently competing) systems operations, network operations and voice communications IT groups

In particular, a major on-line financial services company has been evaluating a VoIP deployment. During their VoIP readiness assessment, the statement was made that, among other things, they would need to turn off EIGRP on their Cisco equipment in order for VoIP to work. Since this was not a reasonable option from their point of view, their conclusion was that “the only way VoIP will work in [their] environment is by using the Avaya CNA.”

Solution

Deploy Avaya CNA to raise the overall quality and performance of the existing network up to a level that will effectively support VoIP

Deployment Implications

There needs to be more than one network path.

Avaya CNA policy management requires access to the BGP API on the edge access routers.

Advantages/Benefits

- Eliminating network upgrades reduces TCO for the customer
- Easier deployment of VoIP solutions
- Eliminating project interdependencies (e.g., VoIP applications deployment tied to network reengineering) increases project success rates

Case 3: Eliminate 99% of "Bad Minutes"

Problem Description

Packet-switched networks, regardless of the amount of bandwidth or bandwidth management techniques employed, are subject to events that can negatively impact VoIP. Convergence of voice and data applications is one of the primary drivers for VoIP; the resulting mix of applications means contention for shared resources. This contention can lead to congestion, spikes in jitter, successive packet losses, and other "events" that wreak havoc on VoIP calls in progress. Calls that are impacted by these events have experienced a "bad minute," with the caller suffering degraded voice quality or even having the call drop. The typical network engineering response of "Just add more bandwidth" is not only expensive, but also fails to address the core issue: congestion and other events occur in IP networks regardless of the available bandwidth.

The mission-critical nature of voice communications, and the user expectation of traditional "toll-quality" service, makes these bad minutes an unacceptable side effect of using VoIP. These effects are more pronounced as VoIP calls leave the switched campus environment and traverse the corporate WAN. Internet-based VoIP traffic is even more prone to bad minutes, given the increased variability in traffic mix and greater number of networks potentially carrying the voice traffic between callers.

How can one increase the quality of VoIP calls that traverse a distributed IP network environment in order to ensure end user satisfaction with the VoIP solution?

Who has the problem?

Every packet-switched network environment is subject to events that result in bad minutes during VoIP calls, with variable durations and levels of severity.

All WAN environments, including fully private Frame Relay as well as hybrid private/public networks and single-link or multi-homed Internet environments, are susceptible to these bad minutes.

Figure 4. Observed Bad Minutes – Unoptimized

Observed Bad Minutes – Unoptimized	
Link Type	Bad Minutes
Frame Relay	5.4
Internet VPN	126.2

Figure 4 summarizes the actual bad minutes observed over 11 days during the previously referenced evaluation for VoIP readiness conducted at a Global 1000 international financial services firm in 2003:

Solution

Deploy Avaya CNA at all wide area network edge connection points that carry VoIP traffic.

Configure CNA to identify VoIP traffic and enforce VoIP optimization policy by applying specific voice application quality criteria.

Have CNA continuously adjust the network infrastructure to provide the best possible call quality across all available links, relative to that provided by any one individual link.

Figure 5 shows the significant reduction in bad minutes that Avaya CNA was able to deliver:

Figure 5. Observed Bad Minutes – Unoptimized vs. Avaya CNA Optimized

Observed Bad Minutes – Unoptimized vs. Avaya CNA Optimized[2]		
Link Type	**Bad Minutes**	**% Reduction**
Frame Relay	5.4	
Internet VPN	126.2	
Internet VPNs with Avaya CNA	14.7	88.4%
Internet VPNs + Frame Relay with Avaya CNA	0.4	99.7%

Avaya CNA identifies these VoIP-impacting events and takes corrective action in sub-second time. Calls in progress are preserved by these "in-flight" corrections, reducing the impact of network events on them from catastrophic (unintelligible or dropped) to barely perceptible.

Deployment Implications

In order to achieve higher call quality and fewer bad minutes, more than one path must be available between the destinations and sufficient measurements must be made down each path. Other general implications as described in the previous Cases.

Advantages/Benefits

Enabling CNA to control how voice traffic traverses the network infrastructure dramatically reduces the number of bad minutes experienced in a given time period. Users experience closer to "toll quality" communications experience over a lower cost service.

[2] *From an evaluation at a global financial services firm, 2003*

Case 4: Improve Quality for Offshore "1-800" Calls

Problem Description

Many US-based enterprises are considering outsourcing their customer support call centers to overseas locations (e.g. India, Malaysia, etc.) in order to take advantage of lower labor rates for technically skilled workers.

When an end user calls a "domestic" 800 toll-free number and describes their issue to a "call director" who then reroutes the call to an overseas call center, frequently there is a noticeable drop in perceived call quality.

Lower user satisfaction undermines much of the value of the labor cost savings of outsourcing. Typically, the recommended solution to this problem is to use a higher bandwidth network link; however, even links with very low average utilization can experience congestion patterns and exhibit high error rates, which have a dramatic impact on VoIP quality. This is especially true for overseas links.

Who has the problem?

Every enterprise considering call center outsource deployments requiring international connections.

Solution

Architect a network environment to provide two or more private and/or public links to the remote call center.

Deploy Avaya CNA at each end of the VoIP connection to monitor and assess the call quality in real time, and adapt the VoIP flows as necessary to maintain acceptable call quality levels.

Customer Example

Similar to the demands of VoIP over international links, a global company needed to offer long distance access to a distributed environment of IBM AS/400 application servers. Frame Relay circuits at 56K to 512K would be extremely expensive, but a conventional VPN solution over public IP did not offer sufficient quality.

Figure 6. Latency for a Connection Between the US and the Netherlands

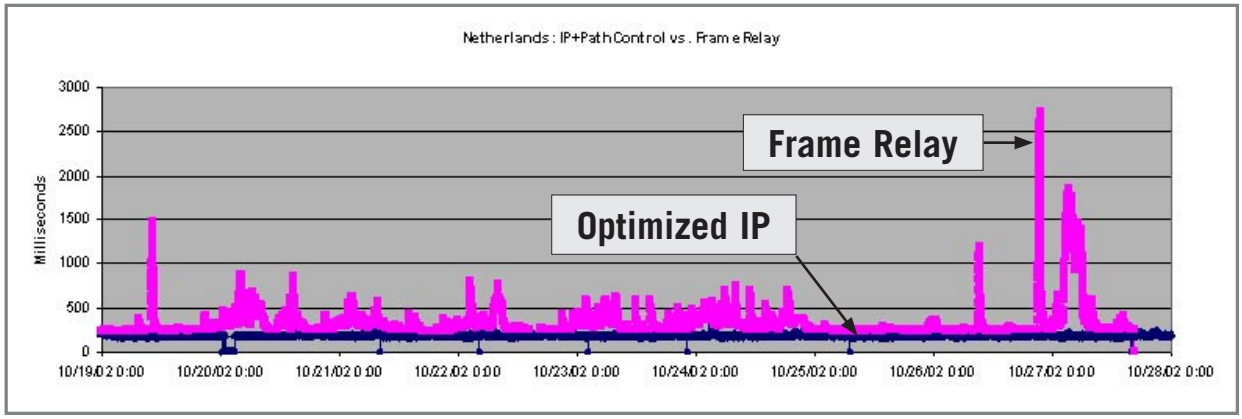


Figure 6 shows the measured results of a comparison between a Frame Relay circuit and a pair of VPN links running over the Internet optimized with Avaya CNA, for a connection between the US and the Netherlands.

The customer concluded that the CNA solution gave them 200% the effective bandwidth at 50% of the cost of Frame Relay, with equal or better performance.

Deployment Implications

There must be multiple paths between the two ends of the VoIP call so that CNA can adjust flows as necessary. Ideally, CNA should be installed at both ends of the connection. Other general implications as described in the previous Cases.

Advantages/Benefits

Maintain adequate call quality on overseas VoIP deployments.
Expand the market for overseas VoIP deployments.

Case 5: Increase WAN Visibility

Problem Description

VoIP deployment requires a robust IP network infrastructure, and VoIP deployment consultants and systems integrators use a variety of tools to assess that infrastructure.

However, existing tools do not have the Avaya combination of measurement techniques and ability to assess the end-to-end VoIP quality on all available paths through the network infrastructure.

Most of these assessment tools rely, in part or in total, on SNMP-based data collection, which limits its visibility into the WAN portion of the infrastructure.

As a result, the WAN is effectively “closed” to initial assessment and subsequent load balancing or other optimization efforts.

Who has the problem?

Consultants and systems integrators looking to deploy IP Telephony solutions. The problem is especially pronounced for planned deployments that include WAN links, including private Frame Relay circuits, public ISP links, or a hybrid mix of private and public connections.

Solution

Utilize Avaya CNA to assess the low level characteristics (round trip time, jitter, loss, clip, utilization) of the IP network to estimate the effective VoIP application behavior between major connection points to the wide area network.

Extract the summary results and underlying raw data from the dedicated system(s) to bolster the current VoIP assessment reports that are produced.

Note that performance-impacting events observed by CNA during the assessment can trigger automated e-mail to the consultant or systems integrator, quickly drawing their attention to performance problems.

Figure 7. Real-Time Network Data Transformed into Actionable Information

Deployment Implications

To get a representative view of the network's ability to deliver high-quality VoIP results, Avaya CNA needs to gather data 24x7 for between two and four weeks. Standard IBM Intel-based servers or Avaya proprietary platforms need to be racked and configured to run CNA and capture the results for the duration of the assessment. Short-term assessments can be performed with standard laptop or desktop PCs running the appropriate operating system and Avaya software. However, better results are obtained with dedicated monitoring for extended periods of time.

Advantages/Benefits

The VoIP application view that Avaya CNA provides is a more powerful metric for assessing network readiness than relying on SNMP data or raw RTT, loss, and jitter measures. Early identification of any latent problems in the prospective customer's IP network infrastructure means fewer post-deployment issues and leads to overall higher customer satisfaction.

Learn More

For more information on how Avaya can take your enterprise from where it is to where it needs to be, contact your Avaya Client Executive or Authorized Avaya BusinessPartner, or visit us at www.avaya.com

About Avaya

Avaya enables businesses to achieve superior results by designing, building and managing their communications infrastructure and solutions. For over one million businesses worldwide, including more than 90 percent of the FORTUNE 500®, Avaya's embedded solutions help businesses enhance value, improve productivity and create competitive advantage by allowing people to be more productive and create more intelligent processes that satisfy customers.

For businesses large and small, Avaya is a world leader in secure, reliable IP telephony systems, communications applications and full life-cycle services. Driving the convergence of embedded voice and data communications with business applications, Avaya is distinguished by its combination of comprehensive, world-class products and services. Avaya helps customers across the globe leverage existing and new networks to achieve superior business results.

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