Cisco vs. Shoreline:

The Impact of VoIP Architecture on Management, Functionality and TCO

A study commissioned by Shoreline Communications, Inc.

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1. Complexity vs. Simplicity

It was famed physicist Albert Einstein who once said: “Everything should be made as simple as possible, but not one bit simpler.”

Einstein, in essence, was campaigning against complexity. Complexity should always be suspect, especially with respect to IT systems. In a networked world, Byzantine complexity is often an indicator of an architecture that fundamentally is flawed or at best ill conceived.

Users investigating voice over IP (VoIP) architectures, especially when comparing Shoreline3, the distributed IP voice architecture of Shoreline Communications, Inc., to the Cisco Systems, Inc. AVVID (Architecture for Voice, Video and Integrated Data) will find that complexity emerges as the single greatest differentiator between the two IP Telephony approaches.

Shoreline Communications commissioned The Tolly Group to design and implement a simulation of an Enterprise VoIP-enabled network based on both Cisco System’s AVVID and Shoreline Communications Shoreline3 architectures and products.

Our mission was to provide intellectual and pragmatic analysis on the relative complexity and simplicity of the VoIP architectures and the implications Shoreline3 and AVVID hold for purchasing, implementing, managing and maintaining VoIP networks.

Testing shows that Shoreline’s Shoreline3 is a compact, distributed VoIP design that scales to fit enterprise needs and requires standard upfront and ongoing support. Engineers found Shoreline VoIP products simple to install and to configure.

By contrast, an overwhelming amount of evidence from our research shows that Cisco’s AVVID is enormously complex. AVVID’s complexity has significant implications for designing and deploying VoIP in an IP infrastructure. Even ordering AVVID VoIP products is a massively complex undertaking. Visitors to Cisco’s Web site encounter AVVID’s complexity as they begin to search for information. Cisco offers links to VoIP material on some 10 VoIP/PSTN platforms and Cisco’s VoIP configurator tool lists over 100 product numbers of devices and options that must be cobbled together that provide (basic) VoIP functionality.

Ironically, with an architecture that distributes the burden of creating hardware and software support over dozens of product teams, the fundamental Cisco AVVID architecture is not distributed at all. It implements a centralized, “HQ-as-the-center-of-the-universe” approach that requires always-available branch/region to HQ connectivity to deliver its set of telephony functions. In the absence

of that connectivity, remote locations running VoIP fallback to a "survival" mode (assuming that option was purchased and installed in the Cisco router) that allows users to limp along with dial tone and a handful of basic feature sets.

1.1 Historical Perspective

Vendors *always* gravitate to seeing new worlds through the lens of their old worlds. A switch/router maker like Cisco, for instance, views new functions as add-ons to switches and routers.

This type of approach to new technology dates back to IBM's heyday when SNA networking and mainframe computing platforms dominated Enterprises for decades. When PCs and LANs were introduced in the early 1980s, what did IBM do? The computer makers failed to embrace these technologies as the breakthroughs they were and forced them into the SNA/mainframe mold.

This resulted in disastrous versions of IBM's PC word-processing software (DisplayWrite) implemented on mainframes. It also saw efforts to turn fixed-function 3270 terminal controllers into quasi-LANs.

These approaches were overly complex, excessively expensive — and failed miserably. It is therefore not surprising to see Cisco, a company that has made billions selling switches and routers, see telephony as just an extension of the switch/router rather than as the separate, breakthrough application it is.

Like IBM before it, Cisco is trying to use its dominance in one market to force-feed a fundamentally flawed VoIP solution on its Enterprise customer base.

1.2 What Lies Ahead

In the chapters that follow, The Tolly Group will provide ample evidence that Shoreline's Shoreline3 architecture is a distributed VoIP solution that relies upon practical simplicity, while Cisco's AVVID is undermined by level after level of complexity that comes at great expense and pain to users.

1.3 Available Webcast

Users interested in listening to a Webcast presentation of the Shoreline3/AVVID analysis can go to **http://www.tolly.com/Shoreline.asp**

2. Fundamental Elements of Enterprise VoIP

Regardless of what brand VoIP solution your enterprise elects to deploy, there are a handful of fundamental functions that must be provided that are common to all VoIP architectures.

Any enterprise VoIP solution should provide four primary functions: call management, VoIP gateway service, PSTN (public switched telephone network) interfaces and voice mail/unified messaging. Vendors may refer to these functions in a slightly modified fashion, but essentially the functions are the same: Call management delivers the functions previously available in black-box PBX systems, such as call routing, calls on hold, etc. The VoIP gateway provides the analog voice to packetized voice conversion using various coding/encoding techniques. The PSTN interface offers a link from the IP infrastructure to the public switched telephone network to provide both connectivity to the analog world as well as provide an alternate path in the event there is congestion or an outage somewhere on the converged IP infrastructure. And voice mail/unified messaging delivers value-added IP telephony features/functions that are common to PBX systems.

These functions are central to the operation and deployment of any VoIP network. Therefore, it is imperative that as users investigate VoIP architectures and compare products, they continually ask themselves some basic questions that likely will have a profound effect on the cost of ownership of their network and effect the reliability and the voice quality of the entire system.

- Where is call management/call processing taking place?
- Where does the VoIP gateway function reside?
- Where is the PSTN interface located?

As The Tolly Group evaluated the Shoreline and the Cisco VoIP architectures, it became evident that asking these questions would reveal a great deal about the architectural differences between the rival VoIP architectures.

2.1 Design Approaches

Although VoIP solutions may offer common services and functionality, the architectural approach they use to provide those functions is at the very root of the differences that separate Shoreline's Shoreline3 and Cisco's AVVID.

When the International Telecommunication Union began defining standards for VoIP, it recognized three critical functions: a gatekeeper for call control, a gateway that converts packet and analog voice, and a terminal device (such as an IP phone or soft phone software).

Simply put, Shoreline built its architecture around distributed intelligence (call management). In effect, Shoreline has taken the gatekeeper and gateway functions and integrated them both into each of its ShoreGear products for true distributed call control.

Shoreline's approach to VoIP is to provide purpose-built voice switches that can be managed from a single, common Web interface. VoIP is an overlay application that rides on top of any QoS-enabled IP network infrastructure — Shoreline3 is not bound to a single network infrastructure. More importantly, Shoreline3's functionality is truly distributed with call control intelligence residing in each and every ShoreGear device. The company's ShoreGear voice switches all run Wind River's VxWorks real-time operating

system – the most widely adopted RTOS in the embedded software industry. Shoreline's distributed call control allows each ShoreGear voice switch to handle its own call setup/teardown including features such as conference, forward, and transfer. That means, for instance, in the event of a voice switch failure somewhere in the network, or in the event a part of the IP network fails, other sites with ShoreGear continue to hum along, without service interruption retaining their full complement of services.

Cisco's VoIP solution is part of AVVID – an architecture that attempts not only to solve the challenge of VoIP but of video as well. In terms of implementation, Cisco elected to retrofit its existing switch/router products lines with the software and hardware necessary to deliver VOIP. In essence, Cisco has split off the gatekeeper function into its Cisco CallManager — a Cisco application running on a dedicated Windows NT server that handles all call processing. Meanwhile, Cisco also has embedded its gateway functions into a broad array of products spread across multiple product lines.

That means that the Cisco CallManager is a single point of failure. So, when users in branch or regional offices place a call, the set up routine transits the IP network to headquarters to set up the call at the CallManager. This is where every VoIP phone in the enterprise obtains its "digital dial tone." Unless, of course, there is a network or system outage and the central CallManager is inaccessible.

Even with early adopters, the Cisco CallManager became an issue since it was, and remains, a single point-of-failure. Should the CallManager PC crash, voice communications halts. Should the IP network between corporate and remote offices fail, remote sites find themselves without digital dial tone.

Shoreline's VoIP design translates into interoperability

In a world of network infrastructure gorillas such as Cisco Systems, Nortel Networks, Hewlett-Packard Co., Extreme Networks, and others, Shoreline Communications has managed to remain vendor agnostic.

For users, that means Shoreline VoIP gear can be deployed on top of your existing LAN infrastructure and continue to operate continuously even as the underlying network infrastructure matures and new equipment is swapped into place. In contrast, since VoIP is integrated so closely with Cisco's IOS software, VoIP services may need to undergo updates every time a new release of IOS is flashed onto existing switches and routers.

Shoreline Communications' Distributed IP Voice Architecture (Shoreline3) treats telephony as an application that can be overlaid on anyone's enterprise infrastructure. That strategy stands in stark contrast to Cisco Systems' AVVID architecture to support voice and video traffic on top of Cisco-based network infrastructures. That means any user with third-party gear that entertains the idea of AVVID must accept the fact that they will be forced to deploy some number of Cisco switches to support VoIP.

As part of its hands-on evaluation of the Shoreline VoIP products, The Tolly Group verified that Shoreline VoIP products functioned flawlessly on LAN switches from Cisco Systems, Dell Computer, Extreme Networks, Hewlett-Packard and 3Com.

Cisco's centralized architecture did not offer an elegant solution to these problems. Elegant or not, effective or not – some alternative to being "dead in the water" was needed.

Cisco introduced the concept of clustering CallManager machines at the central (still not distributed) site. Thus even customers that did not need multiple CallManagers for reasons of scalability would be forced to buy the hardware and software (and maintenance no doubt) to provide back up capabilities in the event of a hard stop on the main Cisco CallManager PC.

End-User Call Management

One of the most powerful aspects of the Shoreline3 architecture is the degree of flexibility and manageability it puts into end-user hands.

Shoreline's ShoreWare Personal Call Manager is a Microsoft Windows application that provides an intuitive graphical user interface, enabling users to control voice communications functions and services.

Engineers installed a Polycom IP 100 phone and the Personal Call Manager software on an adjacent PC. Engineers then used the integrated Outlook address book on the PC and proceeded to dial local and remote users via one-touch operation from the Personal Call Manager software. The Personal Call Manager demonstrated seamless access to the Outlook address book data. Engineers were able to place a variety of local on-net and PSTN calls via the Outlook directory. Moreover, Personal Call Manager provides a history of placed calls, and whenever an incoming call arrived, a pop-up window appeared on the PC screen with caller ID or an audible alert signaled an incoming call (depending upon user preference), which included data on the caller's name, trunk identification and other data.

Engineers also set the Personal Call Manager to roll incoming calls automatically to voicemail, where they were stored and noted by an icon in the Windows 2000 Task Tray. All users need to do is click on the icon to playback the recorded message. Users can save, playback or forward the voicemail messages as WAV-file E-mail attachments. Voicemail messages appear in the same Inbox as the Outlook E-mail.

The software also provides a variety of call handling options. Users may leave standard "Out-of-office," "Extended absence," "In a meeting," or custom greetings. Engineers were able to quickly change call greetings and forward calls either to other extensions or to E-mail recipients.

Engineers were impressed with Personal Call Manager's capabilities. The software raises the awareness of users regarding voice calls and gives them the tools required to stay on top of voice communications even when they may not be at their IP phone.

For remote sites, retrofitted switch/routers with an IOS upgrade, called the Survivable Remote Site (SRS) Telephony feature, would survive with bare bones service if that feature happens to be installed on local switches or routers. SRS provides basic dial tone service to IP phones attached to a local Ethernet on the Cisco 2600 series and Cisco 3600 series multiservice routers, and Cisco IAD2420 routers, among other gear. You retain dial tone and call transfer functions, but that's about it.

Another architectural difference evolves around phones. Shoreline now supports analog phones and IP phones. Shoreline, in fact, supports standards-based Polycom phones, for instance. Cisco supports only IP phones, which conveniently drive demand for Catalyst ports and hence more Cisco infrastructure gear.

2.2 Architecture Matters

Shoreline's Shoreline3 is network agnostic. Shoreline treats telephony as an application that can be overlaid on anyone's enterprise infrastructure (See interoperability sidebar, Section 2.2.1).

Since there are no changes to the underlying network infrastructure, the challenges to using Shoreline3 are much less than AVVID. That's because, with Shoreline's Shoreline3, VoIP functionality is "pre-packaged" in its own purpose-built boxes so users do not have to disturb existing network gear. With Cisco's AVVID, you don't have to change the underlying Cisco network, but you do have to disturb it by installing new WAN interfaces, upgrading IOS or reconfiguring the box's VoIP options.

Another key difference is that with Shoreline you deploy VoIP services via a single platform and a single Web interface to manage all devices. Moreover, with Shoreline3, users deploy two types of purpose-built devices: a ShoreGear-24 (or smaller ShoreGear-12) that provides distributed call control functions and a ShoreGear-T1 that provides a high-density T1 interface (or E1 version as well) to a carrier central office. These products can be used either at headquarters (data center), at regional offices or at branch office sites. (For a more complete understanding of these Shoreline products, refer to section 2.2.2 Shoreline building blocks.)

That's not so with AVVID. First, AVVID requires a Cisco infrastructure. That's right, *requires*. Even if your switching core is from vendors like Nortel, Alcatel, Extreme Networks or Foundry Networks, you'll have to buy at least some Cisco switches and routers because Cisco's required VoIP software and hardware are implemented only as upgrades to proprietary Cisco devices. And while Shoreline3 gently layers VoIP atop the network, Cisco has taken an "invasive integration" approach to integrate VoIP as a network service into the core of its switch and router lines. This invasive approach means that users must determine which of some 10 hardware platforms, variants of products from the 17xx router all the way to the 60xx switch, is best suited to deploy VoIP at a given site.

So, at the data center, AVVID may be running on a Cisco Catalyst 65XX system, at the regional offices AVVID may be running on a Cisco Catalyst 42XX and at branch offices AVVID may be residing on a Catalyst 26XX. Consider, too, that each of these devices has its own array of WAN interfaces that come into play, complicating maintenance and support. And the deployment of VoIP onto these platforms may require an upgrade to Cisco's IOS operating system software, or to CatOS, an IOS variant running on some Cisco devices. So, the complexity grows. So, instead of one person deploying the Shoreline3 solutions, you now need a team of specialists to perform open-heart surgery just to get the Cisco switches to support AVVID, let alone to maintain them.

Even before you reach the deployment stage, there is an immense amount of complexity with AVVID even at the ordering stage. The likelihood is high that someone, somewhere will miss one of the many components required for any AVVID installation, thus introducing further delays to the process.

All you have to do to experience this complexity first hand is to venture up onto Cisco's Web site and fire up the Cisco Dynamic Configurator with a keyword of "VoIP" and you get over 80 different product numbers – not one of which is the Cisco

Shoreline's building blocks

Unlike the complex lineup of general-purpose LAN switches and ancillary VoIP products that retrofit Cisco products to support VoIP, Shoreline offers a simple building-block approach with a handful of products that are scalable to meet the needs of small businesses to large-scale enterprises.

ShoreGear-24
This product is the key building block of any Shoreline3-based VoIP network. The ShoreGear-24 is a 24-port voice switch that handles call set up, call processing and delivers essential voice services. The ShoreGear-24 supports both large and small enterprise sites with 24 ports: 16 telephone ports and 8 universal analog telephone or trunk ports or call control for 120 IP phones or 24 analog phones, faxes or modems. The 24 RJ-11 telephony ports can be used either to connect analog phones or, for smaller installations, up to 8 can be used as PSTN trunk lines. Installations requiring more RJ-11 ports simply plug in another ShoreGear unit into their infrastructure. (Note: trunk lines are shared across ShoreGear units.) It comes with a 10/100 Fast Ethernet interface for connecting to a LAN infrastructure. All VoIP traffic to/from each module travels across this connection, as does the "in-band," management traffic.

ShoreGear-12
This voice switch is a smaller, 12-port version of the ShoreGear-24.

ShoreGear Teleworker
This voice switch is a four-port version of the ShoreGear-12 and is designed for users telecommuting from an office in their home.

ShoreGear-T1
The ShoreGear-T1 provides a T1 interface for high-density trunking (more than a dozen trunk lines) to the central office (CO).

ShoreGear-E1 Voice Switch
Alternatively, the ShoreGear-E1 can be used as a voice-over-IP gateway to an existing PBX, bridging legacy systems to the Shoreline system.

ShoreWare software
ShoreWare is Shoreline's voice services software, including the ShoreWare Director browser-based interface, ShoreWare Distributed Call Control and ShoreWare Enterprise Server (a suite of enterprise services including auto attendant, PBX, voicemail and automated call distribution).

CallManager, a Catalyst 4000 or a Catalyst 6000.
http://www.cisco.com/pcgi-bin/front.x/apollo/servlet/ICITServlet

And we're just talking high-level design implications here. In the next Chapter, we'll dive down into some detail on the architectural considerations of using Shoreline3 versus AVVID at the different enterprise architecture levels: the data center, regional office and branch offices. Wait until you lean what AVVID has in store for you.

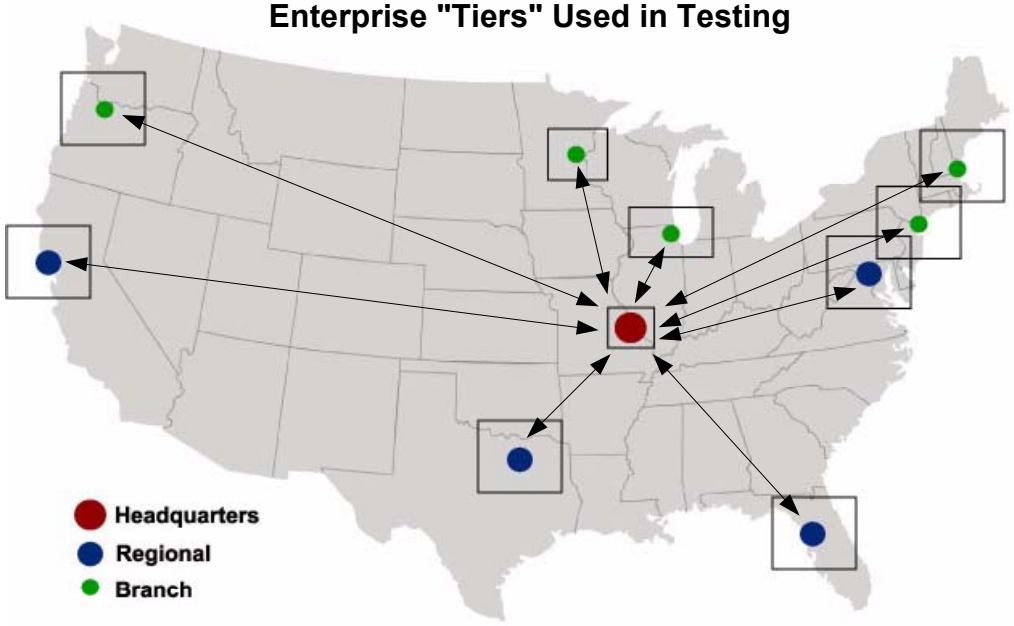
3. Multi-Tiered Architectural Issues

3.1 Deployment Exercise

In lieu of a full-scale deployment, for this project The Tolly Group conducted a mini-deployment of various key components in its own lab to extrapolate the operational and management characteristics of the proposed VoIP solutions. This provided empirical material that could be used to develop a clearer understanding of the costs and resource impact for each of the solutions for a full-scale deployment.

The Tolly Group examined deployment of ShoreGear voice switches supporting Shoreline3 and Cisco Catalyst switches supporting AVVID in three tiers of the enterprise: a headquarters (or data center) site serving 500 users, a regional office supporting 100 users and a branch office supporting 15 employees. Our goal was to understand the relative complexity of configuring the different brand products. In addition to needing standard call management functions, each of these locations required voice gateway functionality and WAN connectivity. *(Note: The Tolly Group's lab-based "deployment" called for the type of gear required for each installation type but did not involve procuring the full amount of VoIP phones or LAN switch ports – just a representative sampling from which we extrapolated the entire configuration requirements.)*

Enterprise "Tiers" Used in Testing



We found that there are two distinctly different levels of support required to configure VoIP networks based upon Shoreline's Shoreline3 or Cisco's AVVID. The Shoreline approach is like plugging LEGO blocks together. The vendor provides purpose-built modular components that can be plugged into the LAN infrastructure as needed. Deployment of

the Cisco VoIP solution likely will trigger hardware and software upgrades to existing Cisco switch/router systems with possible disruption to legacy systems as those upgrades take place. Furthermore, it demands that users master multiple user interfaces to contend with the configuration of different network components on different hardware platforms.

For a more complete understanding of the configuration differences between Shoreline3 and Cisco AVVID, refer to Appendix A, Lessons in Configuration, at the back of this report. In that appendix, The Tolly Group provides a step-by-step comparison of the effort required to configure VoIP gateways, configure IP phones and configure trunks using Shoreline3 and AVVID. Here, readers will view first hand the extra layers of complexity AVVID forces upon users to configure VoIP components.

3.2 Headquarters Tier

At this tier, The Tolly Group deployed products that support the three critical elements of VoIP: Call management, VoIP gateway functionality (for converting analog voice to packetized data and back) and PSTN interface support to handle connectivity to the public network.

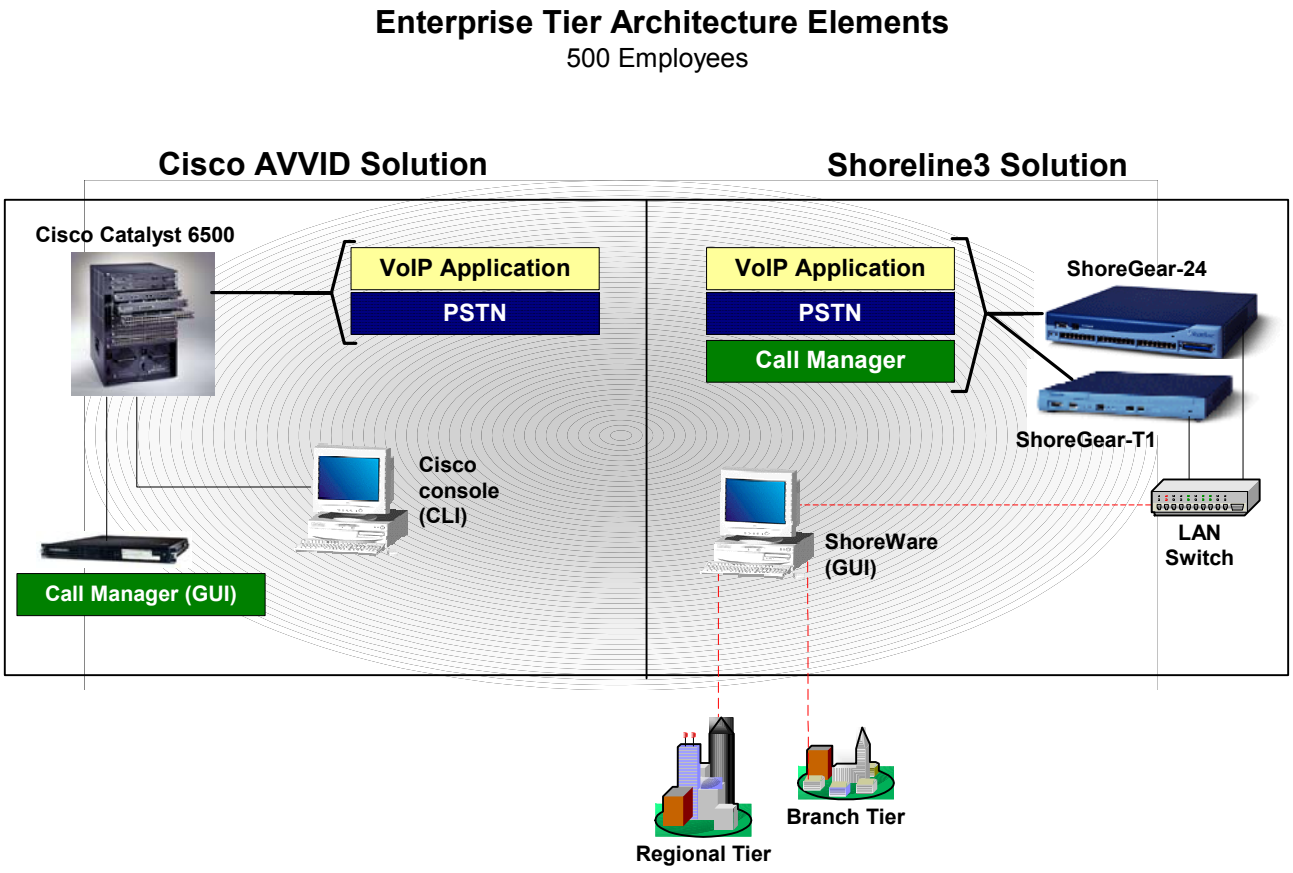


Figure 2. Cisco AVVID and Shoreline3 products used in Enterprise tier during configuration exercise.

The Tolly Group deployed the essential building block for all Shoreline VoIP networks -- a ShoreGear-24 voice switch, with 16 telephone ports and 8 universal trunk/analog telephone ports. For our VoIP configuration exercise, engineers utilized both the ShoreGear-24 and the ShoreGear-T1, which provides higher density trunking to the central office using T1 or PRI signaling. The ShoreGear-T1 can also be used as a gateway to legacy PBX systems. Both products rely upon the same Web-based user interface for configuration. Engineers also used Shoreline's ShoreWare Director software, a PSTN interface and VoIP gateway functionality. (See Figure 3.)

As with all of the ShoreGear products, engineers configured and managed the ShoreGear-24 with Shoreline's Web-based GUI, ShoreWare Director.

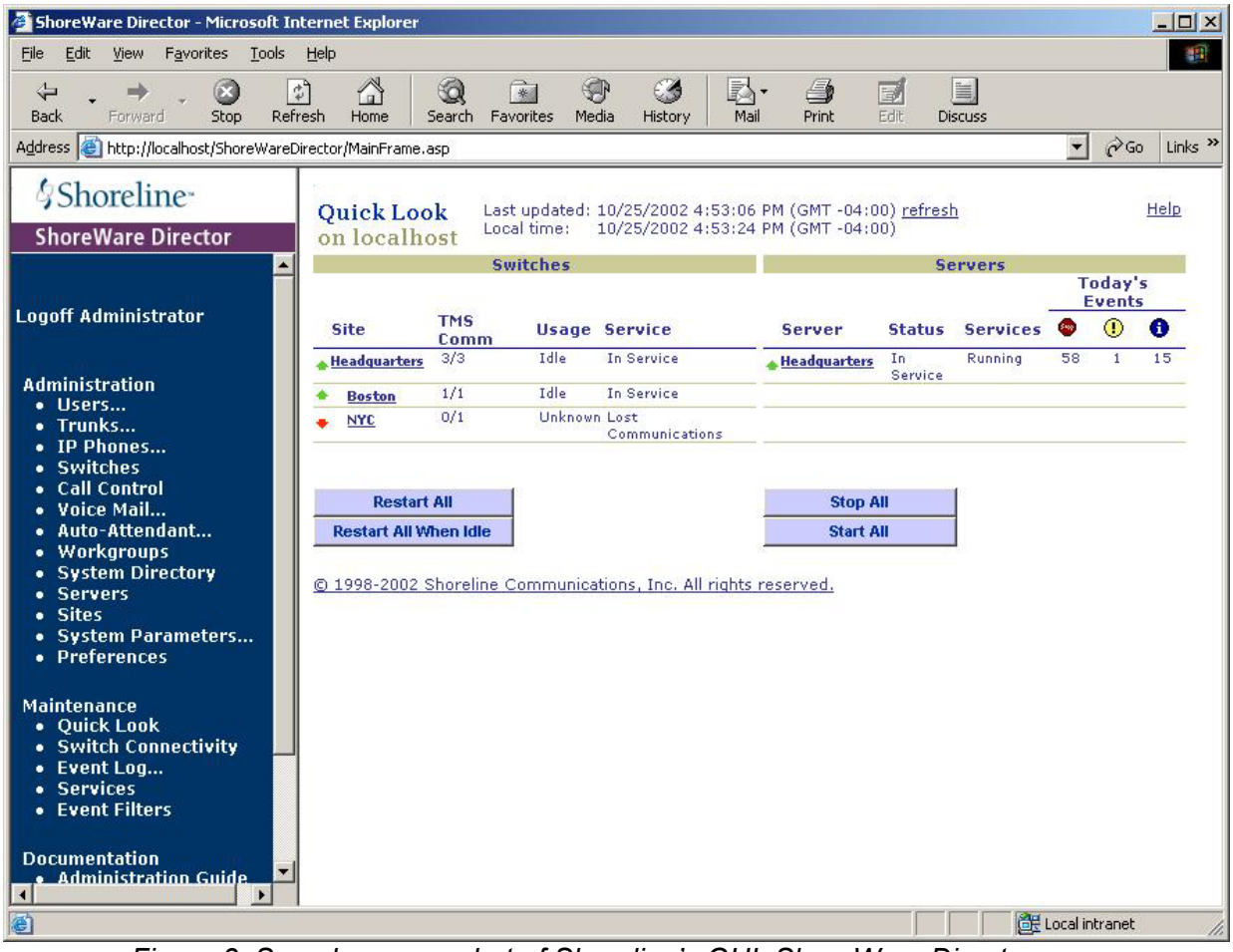


Figure 3. Sample screen shot of Shoreline's GUI, ShoreWare Director.

With Cisco's AVVID, the decision-making wasn't so simple. It started, of course with the Cisco CallManager. CallManager is the call-processing software component of the AVVID network. It runs on a Windows NT-class server and extends enterprise telephony features and functions to packet telephony network devices such as IP phones, software phones, and voice over IP (VoIP) gateways. CallManager provides basic call processing, signaling, and connection services to packet telephony devices. CallManager utilizes a user interface that is Web-like in appearance (See Figure 4).

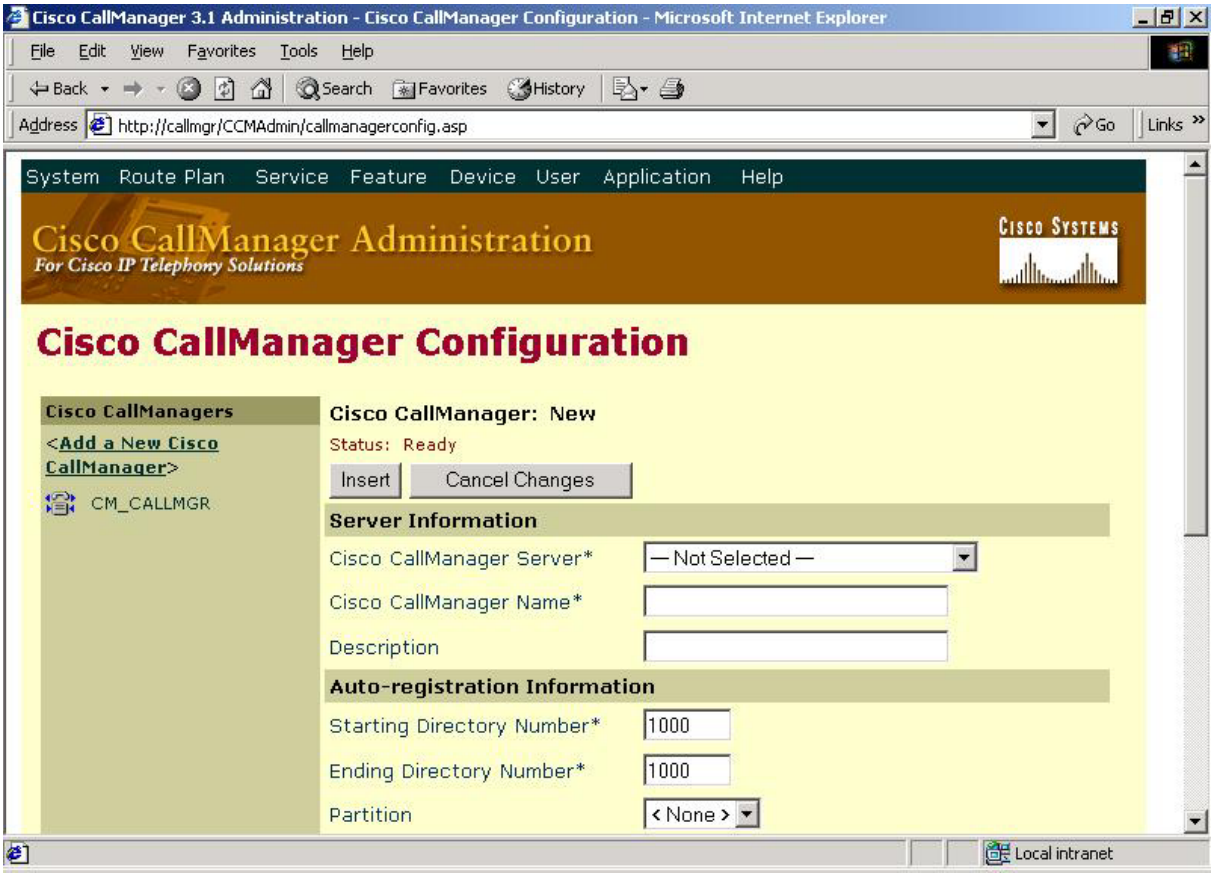


Figure 4. Sample screen shot of Cisco CallManager GUI.

For our testbed, we deployed a Cisco Catalyst 6500 as the data center switch and as the platform to "host" the VoIP support. However, to deploy VoIP, you need to add a FlexWAN module that provides the T1 connectivity to the PSTN. This you must configure using Cisco's legacy command line interface (CLI). (See Figure 5.) So, from a complexity standpoint, now you are managing two distinctly different user interfaces, considering that CallManager uses the Web-like user interface previously mentioned. Moreover, VoIP support is delivered as an extension to Cisco Internetworking Operating System (IOS) and, given the leading-edge nature of VoIP support, an IOS upgrade might be needed to get the latest functionality or to get most "bug free" operating environment. So, unless you are extremely current on your software updates, you likely will have to flash a new image of switch software along with snapping in interface cards that support VoIP. That's no small task considering how IT staffers must oversee the switch upgrade and it must be scheduled so as not to interfere with normal business operations. Even though a high-end device like the Catalyst 6500 supports hot-swappable blades, few network managers want to risk an IOS upgrade during prime-time business hours.

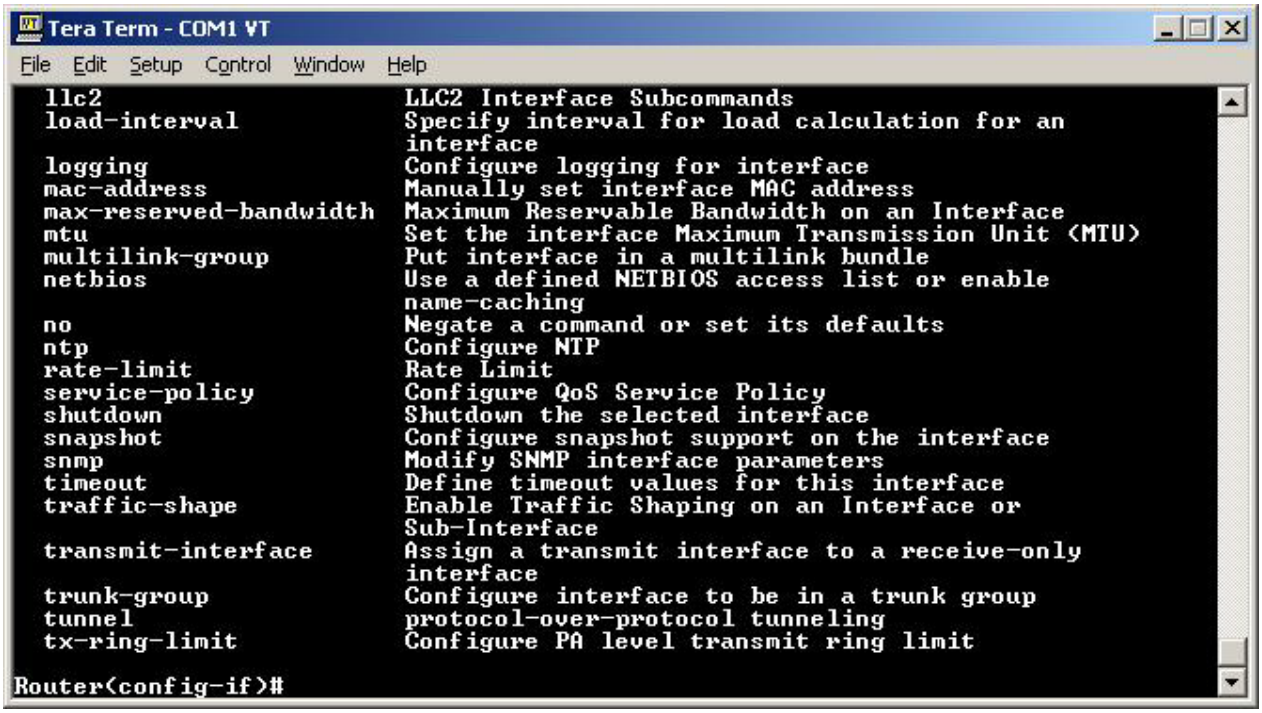


Figure 5. Sample screen shot of Cisco's command line interface.

3.3 Regional Tier

With the headquarters tier covered, we turned our attention to the regional tier with 50 employees at a single location. Here, it largely mirrors a small headquarters configuration, only this time we supported a Catalyst 4224 switch (see Figure 6). Again, we needed to select and configure a PSTN interface and conduct an IOS upgrade. One downside though is the Catalyst 4224 does not support hot swappable components so any IOS upgrade would require off hours scheduling. Moreover, at the regional level, we needed to install Cisco's SRS Telephony feature. Here, again, from a user interface perspective, we had to deal with Cisco's CLI interface.

Since the Catalyst 4224 is a 24-port switch, 75 to 100 additional switch ports (allowing for servers and other devices) would need to be provided by other Cisco or third-party Fast Ethernet switches.

Regarding the Shoreline configuration, we deployed a ShoreGear-24 exactly as we deployed a similar unit in the headquarters tier – meaning one device managed by a single GUI. A ShoreWare Director located at HQ managed all of the regional Shoreline gear "in-band" over the IP network using the same browser interface as illustrated earlier.

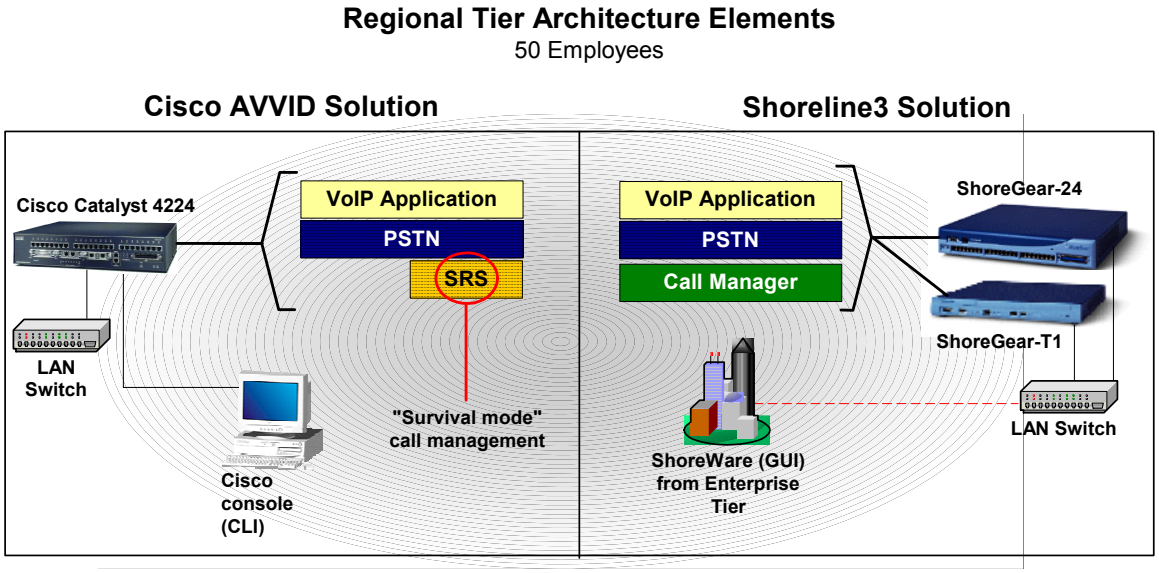


Figure 6. Cisco AVVID and Shoreline3 products used in Regional tier during configuration exercise.

3.4 Branch Office Tier

With the regional and headquarters tiers in place, we next configured a representative branch office with 10 employees. Here we deployed and configured a Cisco 2611 Multiservice Platform (with two 10BaseT ports) with a PSTN interface, a VoIP interface and a LAN interface (see Figure 7). Since the 2611 Multiservice Platform supports just two LAN interfaces, other workgroup switches would support local users and connect into the 2611 Multiservice Platform. Here, again, we configured the 2611 Multiservice Platform with the legacy CLI. By this time, we've configured our third platform and used two different user interfaces to accomplish the task of configuring Cisco AVVID.

By contrast, for the Shoreline deployment at the branch office, we used the same ShoreGear-24 configuration deployed at the regional and headquarters tiers, simply adjusting the number of ports supported. The ShoreGear-T1 was not required here for trunking, so instead we used available universal ports on the ShoreGear-24.

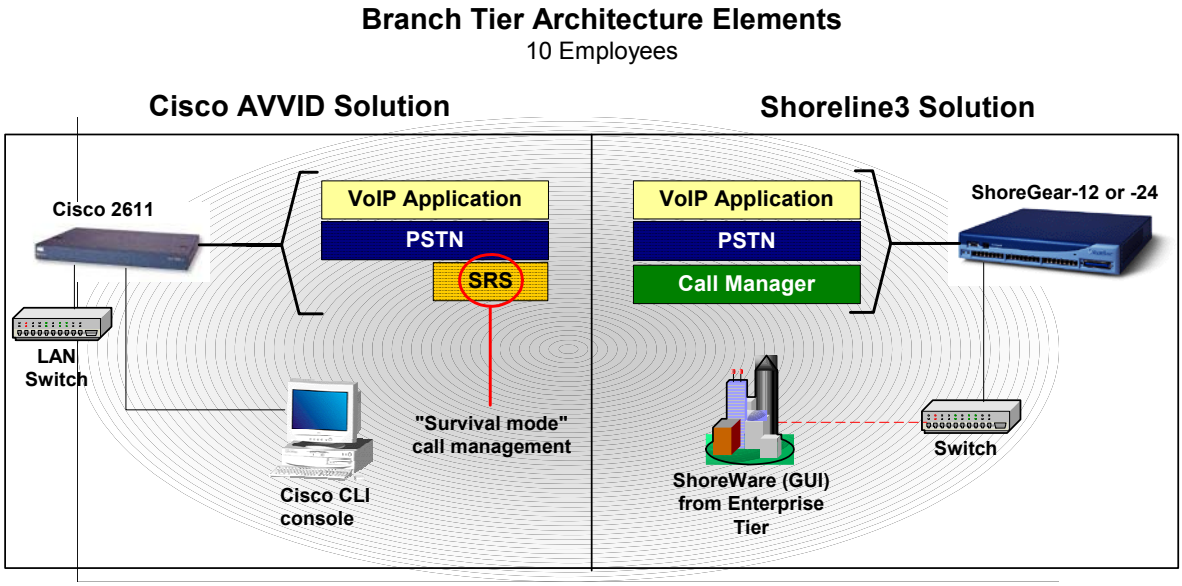


Figure 7. Cisco AVVID and Shoreline3 products used in Branch Office tier during configuration exercise.

3.5 Lessons in Configuration

During our multi-tier configuration exercise, it became obvious that Shoreline delivers a plug and play product that combines identical hardware and software that can be scaled from the smallest tier to the largest tier while maintaining consistent software functionality, true distributed call management and uniform user interfaces support.
With Cisco, AVVID may be implemented from tier to tier, but it demands significant changes to the underlying network fabric, even though each tier is running Cisco IOS. In essence, for the three tiers we evaluated, it became evident that we were dealing with three platforms all sharing the Cisco legacy CLI.

Moreover, think about the nightmare users will encounter as they prepare to support AVVID from a maintenance perspective. Users will have to stock a wide variety of hot spare blades and modules to cover the wide range of platforms that are supported beneath AVVID, not to mention that network managers must provide maintenance care and feeding of three very different hardware platforms.

By contrast, Shoreline's Shoreline3 requires network support staffs to stock just two inexpensive "building blocks" -- the ShoreGear-24 and ShoreGear-T1.

4. Cost Benefits of Shoreline3 over AVVID

The standard value proposition for most IT transactions is that the buyer has a checklist of features and functions with checks for one vendor product meeting or exceeding the requirements.
In the case of VoIP, there's more to examining the cost implications of any VoIP implementation than just the front-end capital expenditure.

After you sign on the dotted line, there are eternally recurring costs for adds/moves/changes. Moreover, the manner in which the system is designed can allow for significantly easier set up and maintenance, which translates over time to an even greater value and tip the scales in favor of a product that might not have faired as well for upfront costs.

In the comparison between Shoreline's Shoreline3 and Cisco's AVVID, it is necessary to look well beyond simple upfront functionality and to really zero in on the long-term support implications, and the soft costs that factor into the overall cost of ownership.

The following sections capture the essence of the cost benefits inherent in Shoreline's purpose-built ShoreGear VoIP product line versus Cisco Catalyst and other equipment that is retrofitted to support VoIP.

4.1 Lower Capital Outlay

While not simple to calculate given the way that Cisco intertwines its VoIP offerings with its LAN infrastructure products, the "bottom line" costs of the Cisco solution in various scenarios are easily 3 to 5 times as expensive as a comparable Shoreline solution. Moreover, the Shoreline VoIP solution will exist over any network infrastructure whereas AVVID requires a Cisco network. So, users with non-Cisco networks may be forced to "buy Cisco" just to support VoIP, and forced into deep, invasive network adjustments. Therefore, enterprise buyers will need to factor in the entire impact on the network from adding AVVID, not just the AVVID components themselves. In comparison Shoreline3 offers a minimal network burden.

Shoreline and AVVID offer stark contrast in deployment management

Any CTO, CFO or corporate executive that holds the purse strings need only confer with engineers who install and maintain VoIP equipment to gain an appreciation for the differences between Shoreline3 and AVVID and how they translate to real cost savings.

A true indicator about the amount of effort expended to install and configure VoIP components is to examine the comparable call management and voice gateway installation procedures.

On the Cisco CallManager side, users must endure at least five steps from unpacking through device configuration. By contrast, with the call management features loaded on the ShoreGear devices, users install ShoreWare software, define various sites and assign servers to those sites. Once the devices are operational, Shoreline's built-in network management signals management when a device is down. By contrast, on some Cisco management screens, device status info can be buried or require engineers to drill down through several screens to get at the data.

One of the key differences here is that users must switch over from a Web-like interface to Cisco's command-line interface to configure elements of a Catalyst switch, similar to the devices we used to support the IP phones configured on a VLAN on a local-attached Catalyst 4224 switch.

For the most part, the only interface that needs to be understood for using the Shoreline system is the Web interface and the end user is guided in installing the client assistant software on their own PC, as well as the directions to attach their extension into the overall system.

One of the key differentiators that surfaced time and again during our evaluation is that Shoreline3 is deployed as a VoIP application, which is not the same as Cisco's AVVID approach to deploying VoIP as part of the underlying network infrastructure. With Shoreline, a VoIP application manager can deploy the products in real time. With AVVID,
the complexity of integrating VoIP into the LAN infrastructure means the VoIP application manager either must train as a certified Cisco engineer, or enlist the assistance of qualified Cisco-certified engineers to perform the deployment during off hours so as not to interfere with production services.

4.2 Lower Installation Cost

The non-invasive, “overlay” approach allows the Shoreline VoIP solution to be implemented without the need to schedule downtime on core switches and routers. The hardware and software upgrades that are required to Cisco switch/routers to implement the Cisco VoIP solution are avoided when implementing Shoreline.

Furthermore, the single-image, browser-based interface to all Shoreline components – regardless of location – dramatically reduces (or eliminates) training requirements for installation.

The complexity of the AVVID approach also carries higher labor and training requirements, due to its complexity.

4.3 Lower Maintenance Costs

Whether upgrading or administering the Shoreline VoIP network or simply processing “moves/adds/changes,” Shoreline’s Shoreline3 architecture again delivers value. The non-invasive, “overlay” approach allows for maintenance without disturbing underlying network infrastructure. The browser-based interface allows for easy (and thus inexpensive) modifications to user profiles or system parameters

The major characteristics for maintenance and operations is in two parts. The first is the amount paid for support contracts and the second is the amount of resources required to perform add, drops and changes. In general, there is a complete turn in the user phone assignments about every four years and it is an ongoing process. For both systems the operational activities is essentially the movement of the phone (adding or changing a user has about the same effect as phone changes). For Cisco, the change must be handled by the system adminstrator on the CallManager since extension mobility is only available on limited types of Cisco IP phones. For Shoreline, the procedures that allow users to control their own extensions is continually available. The annual support costs for the Cisco devices will be about twice that of the Shoreline amount according to Tolly Group estimates.

Because the Shoreline solution can be built using just two physical building block devices – the ShoreGear-24 and the ShoreGear-T1, a supply of these devices can provide “hot spares” for your entire Enterprise, regardless at which enterprise tier the equipment resides. Contrast this with the Cisco AVVID solution, which forces your IT organization to stock, a myriad of hardware interface modules/boards for a multitude of platforms.

Also, the simplicity of the architecture – simple building blocks managed by a single Web interface – means that your IT organization does not incur the expense of AVVID users who must train users to support VoIP on as many as 10 hardware platforms, using different user interfaces to configure a variety of VoIP-related components.

4.4 Lower LAN Infrastructure Costs

Because Shoreline’s solution is infrastructure-agnostic, you can choose the best price/performance LAN switches — or mix and match them across your locations. It is an

established fact that Cisco's flagship Catalyst line does not lead the industry in price/performance.

4.5 Lower Revenue Lost Due to Downtime

Simply put – there is no single point of failure. Only Shoreline's fully distributed call management architecture can assure you that, cut off from HQ, your users will remain virtually fully functional (services like voice mail may be temporarily unreachable) Shoreline is addressing survivable voicemail in its next release. With Cisco a CallManager crash or an outage in your private IP network will dramatically reduce what your phone users can do.

4.6 Lower Intangible Costs

It's not the known costs that drive a VoIP project into cost overruns, it's the unknown hidden costs. Shoreline's open distributed approach ensures that users can deploy analog or IP-based phones. Cisco's IP phones support a "skinny" client control protocol that is proprietary, which translates into higher overall phone costs. Cisco also uses a proprietary approach to Power over Ethernet (PoE) that ultimately drives up prices and there is nothing clients can do about it.

Moreover, there's an intangible cost to using Cisco's SRS Telephony feature for enabling remote sites to retain minimal telephony services in the event a centralized CallManager is unavailable. Cisco licenses SRS on a *per user* basis, which adds to overall system cost, too.

5. Testing Observations

Competitive VoIP solutions may look awfully good to cost-conscious users, but the lower upfront capital expenditure may cause some to wonder if they are trading off upfront investment for lower performance.

The Tolly Group measured the voice quality performance and the latency of both the Shoreline ShoreGear products and the Cisco AVVID offerings.

Engineers utilized the Perceptual Evaluation of Speech Quality (PESQ) metric. PESQ is an enhanced perceptual quality measurement for voice quality in telecommunications. PESQ was specifically developed to be applicable to end-to-end voice quality testing under real network conditions, like VoIP, POTS, ISDN. PESQ measures one-way voice quality and takes into account coding distortions, errors, packet loss, delay and variable delay, and filtering in analog network components. It is considered a more accurate measurement of voice quality than Mean Opinion Scores (MOS) or other more subjective measurements.

PESQ scores range from -1 to 4.5, with the high range representing a perfect score. A PESQ score of 3.8 or higher is regarded as toll quality. The voice quality of the ShoreGear and Cisco devices tested as measured by PESQ shows that the voice quality of the Shoreline3 and AVVID networks is virtually identical, and well above the acceptable toll-quality watermark (see Figure 8).

Phone Pairs	*Voice Quality (PESQ)*	*One-Way Latency (ms)*
Shoreline IP 100	4.16	73.000
Cisco IP Phone 7910	4.20	69.500
Analog phones via Shoreline VoIP	4.01	27.250

Figure 8. Voice quality and latency results

5.1 Latency results

Latency is another important element of a VoIP infrastructure. Latency is an expression of how much time it takes for a packet of data to get from one designated point to another. One-way latency in the 125-ms to 150-ms range becomes perceptible to the human ear. Both devices under test fall comfortably below that level.

While using analog phones in a VoIP network, it is important to know that that the encoding and decoding of the analog call does not negatively impact the voice quality or add to the latency. In the case of the analog phones we examined for the Shoreline network, latency of under 30 milliseconds was less than half that of the Cisco IP Phone 7910.

6. A Simple Case of Complexity

The Tolly Group set out to chronicle the design differences between two VoIP architectures from Shoreline Communications and Cisco Systems. Our hands-on evaluation of products supporting each VoIP architecture revealed that the complexity of the Cisco AVVID network design and the simplicity of the Shoreline3 network infrastructure were the primary factors that separate the architectures.

More importantly, we learned through hands on configuration testing that there are enormous cost-of-ownership implications for using AVVID that will drive costs up, not only on the front end of any implementation, but during the lifetime of maintenance and support necessary to sustain the network.

AVVID's fundamental downside is that it requires an "invasive integration" approach to incorporating VoIP into an existing Cisco network. In effect, existing Cisco IP data switches and routers must be retrofitted to support VoIP. That means that Cisco has succeeded in "shoehorning" VoIP functionality into 10 platform varieties including the 17XX, 26XX, 3XXX, 42XX, and 60XX, each with their own hardware and software options.

Consider, too, that each of these platforms has sizable configuration options and available interfaces. The 26XX we used in testing only has 10 Mbit/s connectivity but it comes with 70 module options that could come into play when configuring a Cisco box for VoIP.

Short-term, the consequence of such a strategy is that users may be required to disrupt network operations with upgrades to core IOS software, add significant hardware components to marry VoIP to the network and require IT support staffs to master multiple user interfaces just to configure the VoIP network properly.

Longer-term support for AVVID promises to require a hefty investment, too. Since Cisco is ripping open the network infrastructure to accommodate VoIP, network staff must support up to 10 different hardware platforms and dozens of hardware interfaces. Consider what that means in terms of the maintenance costs for carrying backup spares for a wide gamut of interfaces. In contrast, Shoreline's building block approach enables network staffs to utilize several simple purpose-built devices that can be deployed and scaled all across the enterprise, thereby lowering support costs dramatically.

Moreover, Shoreline's ShoreGear products are managed by a single Web-based user interface, as opposed to Cisco's AVVID that requires a Web-like GUI on its highly-centralized CallManager and legacy CLIs for configuring various switches and other VoIP-related components.

Lastly, enterprise network managers must avoid downtime to keep business processes flowing. Cisco's AVVID utilizes a highly centralized call processing design that makes regional and branch office users susceptible to periods of outage or severe restriction of services when the centralized CallManager either fails or network connections suffer from congestion or disruption. While Cisco does offer a facility to restore partial service to remote sites, it provides bare bones capabilities.

This is where Shoreline's distributed Shoreline3 architecture shines. In the event that a ShoreGear device at the data center fails, regional and remote sites retain their telephony services since the same call processing services running on the ShoreGear at the data center also run on local ShoreGear in regional and branch offices. While Shoreline users may temporarily lose a connection to the data center over the IP network, they can still use PSTN facilities, or use the IP network to communicate with other company facilities since call processing occurs locally.

Hands-on testing conducted by The Tolly Group demonstrates that Shoreline's distributed overlay approach to VoIP services produces sizable benefits with regards to upfront installation, network configuration, ongoing support and downtime avoidance.

The testing evidence is conclusive. It doesn't take an Einstein to realize that Shoreline's ShoreGear and Shoreline3 architecture were "made as simple as possible, but not one bit simpler."

7. Appendices

7.1 Appendix A: Lessons in Configuration – Configuring a Gateway

Cisco Steps

1. Connect serially via HyperTerminal to router/switch/gateway device, configure Cisco device with all appropriate IP addresses.
2. Enter configure mode by “config term” command using CLI interface.
3. Set up interface context by “interface fast-ethernet slot/port” command.
4. Set the switch port to the appropriate VLAN and voice QoS by the commands:
5. Switchport access vlan *N.*
6. Switchport voice vlan dot1p.
7. Control Z (to write and exit).
    a. Launch Cisco Call Manager: Call Manager is a separate unit, no need to install anything
8. Add new Call Manager profile
9. Add routers/switches/gateways to the Call Manager profile.

Shoreline Steps

1. Connect serially via HyperTerminal to ShoreGear device, input it all appropriate IP addresses:
    a. Disable DHCP option on ShoreGear device.
2. Install ShoreWare Director server software on PC:
    a. Must have Windows 2000 Advanced Server with Service Pack 3 (Jet Service Pack)
3. Launch ShoreWare Director.
4. Create site profile.
5. Add ShoreGear switches to the site.

7.2 Appendix A: Lessons in Configuration – Configuring an IP Phone

Cisco Steps

1. Add phones to DHCP:
    a. Create reservations for IP phone addresses.
    b. Add appropriate options to phone reservations.
2. Plug in IP phone at user location
3. Add phone to Cisco Call Manager.
4. Specify phone type and model.
5. Assign extension to IP phone.

Shoreline Steps

1. Reserve a port on ShoreGear switch for IP phone.
2. Add phones to DHCP:
    a. Create reservations for IP phone addresses.
    b. Add appropriate options to phone reservations.
3. Plug in IP phone at user location
4. Add phone to ShoreWare Director.
5. Assign extension to the phone.

7.3 Appendix A: Lessons in Configuration – Configuring a Trunk

Cisco Steps

1. Set up serial connection or telnet to Cisco device.
2. Enter CLI of appropriate device to configure trunk.
3. Choose Loop start.
4. Identify the appropriate port for use by trunk.
5. Choose port direction.
6. Make audio signal adjustment.
7. Enable Caller ID.
8. Configure Dialed Number for auto attendant.

Shoreline Steps

1. Create trunk group in ShoreWare Director.
2. Create individual trunk.
    a. Choose port on ShoreGear switch
3. Assign parameters.
4. Assign necessary prefixes.