White Paper

Underpinning Unified Communications

The Three Essentials of Advanced IP Communications

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Executive Summary

This ten page White Paper explores why open standards, carrier grade reliability and resilience, and extensive scalability are essential characteristics of today's advanced IP communication and collaboration solutions. Such characteristics ensure cost effective and manageable growth and performance evolution as a platform for large, enterprise-grade unified communications.

The design and performance advantages of the HiPath 8000 from Siemens Enterprise Communications are assessed with this in mind and compared to solutions from several other leading suppliers including Avaya, Nortel, Cisco Systems, Alcatel-Lucent and NEC as well as from industry newcomer Microsoft.

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1. Evolution of IP Telephony Communications Systems

It has been ten years since the first commercial enterprise voice communications system ever designed to run over am Ethernet LAN infrastructure was shipped. There were significant quality and performance issues associated with the pioneer offering, but the IP Telephony (IPT) era had officially begun. More than a few industry pundits began counting the days when traditional circuit switched PBXs would be consigned to the trash heap and replaced by IPT communications systems designed to handle a mix of voice, data, and video communications. More than five years would lapse, however, before IPT offerings would achieve some semblance of mainstream market status, because issues such as performance, quality, reliability, and pricing delayed widespread customer acceptance of the new product technology.

The first generation of IPT communications systems consisted of a mix of architecture designs, with many models retaining significant hardware remnants of their circuit switched ancestors. More than a few of the early offerings lacked many of the features and functions available with the older technology PBX models. Proprietary hardware components, including call controllers, media gateways and desktop telephone instruments, also restricted the design flexibility. In retrospect it is not surprising that many first generation IPT customers continued to operate and use their system in a manner similar to their old circuit switched PBX.

Only recently have customers begun to realize and derive the significant benefits that can be derived from an IPT solution. Identifiable customer trends include: migration of legacy digital equipment for investment protection; increased deployment of nonproprietary hardware components for cost savings and operational reasons; a desire for enhanced system redundancy to improve service availability levels and support disaster recovery plans; network consolidation (system downsizing) to reduce costs, simplify management, and provide maximum uniformity of performance capabilities.

Despite the remarkable double digit growth of IP stations behind enterprise communications systems, a sizable number of customers with significant investments in legacy digital equipment are reluctant to install a new IPT communications system unless some of the existing common equipment and/or telephone instruments can be migrated forward. Customers also desire to have existing software licenses ported between systems from the same manufacturer. Current generation IPT communications systems that do not support legacy digital equipment limit customer migration options and are more expensive to implement. The optimal current generation IPT communications system is one that allows customers to migrate common equipment and analog/digital station equipment to an IP solution at their own pace.

For years customers complained about the proprietary nature of their PBX communications system, particularly common control and port interface equipment and telephone instruments. Customers wanted to pay lower prices for the equipment and have greater say in the hardware configuration design of their system. Use of third party equipment would also provide a greater degree of uniformity across the enterprise network regardless of the particular IPT communications system model deployed at any one location. Many customers prefer standardizing on a single supplier platform and deploying like equipment at distributed locations. Traditional PBXs were closed systems, and most early IPT communications systems were based on bundled hardware designs with few opportunities for customer-provided equipment. The open nature of today's latest generation of IPT communications systems allows customers to have a greater role in the hardware configuration in the equipment rooms and at the desktop.

A growing number of customers are also looking for a communications system that maximizes services availability and fully satisfies disaster plan requirements. Before the advent of IPT it was impossible for businesses to preserve ongoing operations of their communications system operations if the common control complex was inoperable and/or inaccessible. Traditional circuit switched PBXs based on direct physical copper wire connections between peripheral endpoints and centralized common equipment had numerous points of failure capable of disrupting telephony services to a few, many or all system subscribers. The distributed nature of IPT based on the logical connectivity of packet switching technology between two endpoints allows for fully distributed call processing control and survivable remote media gateways. Call processing and port interface elements are more easily duplicated and distributed to deliver a higher degree of service availability. Today's customers now require communications solutions with virtually nonstop call processing capabilities based on a variety of design options: multiple active servers; duplicated servers that can be geographically distributed across a LAN/WAN; emergency failover servers at local or remote locations.

Another significant industry trend among very large enterprise customers is network consolidation, the downsizing of multiple system networks through the replacement of small and medium line size systems by a centrally hosted system deployed at customer data center. The largest consolidated networks would consist of multiple distributed clusters intelligently networked to support a single system image for both call processing and management operations. The network consolidation option is made possible by leveraging a highly scalable, modular and distributed system design platform. The port capacity parameters and call processing ratings of soft switch IPT communications systems based on network-carrier designs are far beyond those of traditional PBX system models, and are necessary to support a consolidated network configuration of tens of thousands of user stations. Survivable remote gateways and emergency failover servers greatly lessen the risks of transmission signaling failures due to network access issues and/or host equipment failure. Major benefits of a consolidated network design include reduced capital and operating expenditures, simplified management operations, homogeneous performance levels at all enterprise locations, and shared applications resources.

2. Advanced IPT Communications System Identifiers

There are several identifiable characteristics that distinguish the most advanced IPT communications systems from the competition as a means to support customer deployment trends:

- Robust support of open industry standards
- Network carrier-grade redundancy, resiliency and reliability
- Port/location scalability

Open Industry Standards
Support of open industry standards increases the degree of architecture design flexibility and third party interoperability. It reduces dependence on proprietary hardware/software elements and can significantly contribute to minimizing design, engineering, and manufacturing costs: research and development can leverage existing design and interface specifications; multi-source competition for standardized system components can reduce cost of goods; and outsourcing activities are less risky.

From a customer perspective a standards-based IP communications system can help optimize investment protection and prolong useful operating life. Systems based on open industry standards are also lower risk investments, because there are more equipment options available from a greater number of sources to growth and expansion. Multiple equipment sources also decrease the risk of obsolescence, because it is
more likely that a particular component source will be available. A greater degree of customization is possible, because system elements can be "mixed and matched" at more affordable prices than with a proprietary system.

Standards contribute to a more modular IT-wide solution. For example, the successful implementation of unified communications solutions depend on interoperability of several subsystems from one or more manufacturers, such as the core communications system, voice processing (messaging, voice response, speech portals, et al), contact center, and desktop/mobile computing software programs. The emerging discipline of business process integration depends on subsystem interoperability across a wide variety of IT application environments, such as communications, manufacturing, supply chain management, finance and accounting, and sales. The only alternative to proprietary solutions on a customer by customer basis is for manufacturers to incorporate standards specifications into their system designs.

Network Carrier-Grade Redundancy, Resiliency and Reliability
Network service providers demand a communications system platform designed to satisfy the very highest levels of services availability. For this reason network carrier-grade systems must be based on a virtually
fail-proof architecture design with minimal, if any, single points of failure that can disrupt communications services. Reliability for a network carrier grade system, defined as the percent of service time availability, is typically 99.9999%. The reliability level for a communications system typically designed for customer premises cus-

tomers is usually an order of magnitude less. All of the elements incorporated into a network carrier grade communications system must be evaluated and selected to satisfy the highest quality test standards and hardware equipment as well as software programs.
The lofty reliability goal system designers and developers have established for several benchmarks for network carrier systems, include:

- Load sharing (active-active) server architecture for high availability and survivability
- Survivable remote gateways with call preservation for distributed network configurations
- Calls in progress are not affected and customer data is preserved in case of any single system failure
- High resiliency to system processing and traffic overloads with extremely rapid recovery times
- Smooth system upgrade and migration options without services disruption
- Fully integrated management system for monitoring, administration and maintenance operations

System scalability is usually among the most important product purchase evaluation factors for any customer who has plans for expanding their organization in the foreseeable future. There are two fundamental scaling issues:

- Technical performance growth as measured by port, call processing, and call handling capacities
- Enterprise-wide geographic coverage

Scalability
Technical performance growth was once a highly limiting factor for almost all digital PBXs that were constrained by an individual model's generic software and common equipment (port carrier cabinets, card slots, TDM bus design). Many suppliers of early generation IP-PBXs closely followed traditional digital PBX sizing parameters, with either multiple models segmented by line size and/or capacity limitations for the largest model. Converged system designs that incorporated circuit switched hardware elements were susceptible to this issue. The software-centric approach for today's IPT communications systems alleviates this problem, as does a modular architecture that allows for simple upgrade of servers to accommodate customer growth. A software-centric design makes it possible to cost efficiently support intermediate and large line size customers alike from both a capital and operations expenditure perspective.

A highly scalable system design is ideal for supporting customer network consolidation requirements. System scalability, in terms of system performance parameters and equipment configuration is the key factor to the scope of any network consolidation. A centralized data center housing the primary call processing and management system components serves as the network hub for geographically distributed gateways and dispersed user communications devices.

HiPath 8000 Bona Fides

The HiPath 8000 fully satisfies each of the three identifying characteristics many current marketed IPT communications systems do not.

Open Industry Standards
The HiPath 8000 was originally designed and developed using SIP for its fundamental architecture platform to implement call processing features and provide signaling interfaces to station and trunk endpoints. SIP is a peer-to-peer, multimedia communications signaling protocol that was developed to integrate with a variety of Internet services such as e-mail, web, voicemail, instant?messaging, multiparty conferencing & multimedia collaboration. It is transport protocol independent, but can run on variety of protocols, such as UDP, TCP, and SCTP. A unique advantage of SIP compared to H.323, a communications protocol utilized by many first generation IP telephony systems, is that it is an extensible text-based protocol designed to support multiple media session types. During the past few years SIP has supplanted H.323 as the most commonly deployed protocol standard for new IP communications systems. The SIP standard is also a key to the convergence of wired and wireless communications networks. Using SIP the HiPath 8000 can successfully operate as control and call processing node in the emerging Fixed Mobile Convenience (FMC) market.

In addition to SIP, HiPath 8000 supports a diverse variety of open industry common communications protocols and standards, including:

- MGCP and H.323 VoIP communications protocols
- Qsig and SIP-Q for multi-system networking
- ISDN BRI/PRI public network interfaces
- Computer Supported Telecommunications Applications (CSTA), an abstraction layer for telecommunications applications independent of signaling protocols and endpoint devices
- Electronic Numbering (ENUM) for the process of creating a domain name from a terminal number and resolving it to an Internet address
- Transport Layer Security (TLS) cryptographic protocol for secure Internet communications and Secure Real-time Transport Protocol (SRTP) for encrypted payload transmission.

From a strategic perspective, the most important evolving industry initiative supported by HiPath 8000 may be Services-Oriented Architecture (SOA). SOA is an IT strategic initiative to organize diverse and independent software operations embedded across multiple applications into interoperable, standards-based services to satisfy customer needs. It is implemented using standard protocols and conventional interfaces, including web services such as SOAP and XML. SOA can be used across communications systems and business processes, such as Customer Relationship Management (CRM), Supply Chain Management (SCM), and Data Warehousing. SOA will also play an important role in the integration and convergence of customer and public networks, both wired and wireless. HiPath 8000 is currently the only IP telephony system with embedded SOA capabilities.

Network Carrier Grade Redundancy, Resiliency and Reliability
HiPath 8000 has many inherent attributes that contribute to network carrier-grade redundancy, resiliency and reliability levels, such as:

- Fully duplicated and redundant server nodes based on design and quality specifications needed to satisfy a 99.9999% services availability level
- Linux-based operating system to optimize real time call processing operations and minimize security
- concerns.
- Load sharing inherently redundant server nodes that can be geographically distributed across a LAN/WAN
- to support resilient failover operations in case of a localized system or infrastructure failure.
- Several survivable remote media gateway options - RG 8700 family, RG 2700, HiPath 3000 SMG, HiPath
- 4000 SMG, and Mediatrix models - for small, medium and large distributed branch requirements.
- HiPath Edge Solution for full services survivability at one or more remote branch locations (up to 10,000 stations)

Scalability
HiPath 8000 has been designed to cost effectively support enterprise customers with line size requirements ranging from 300 to 100,000 user stations with optimal investment protection for growth scenarios. A mid-market customer who installs a single redundant server node configuration can easily add a second duplicate node as growth requirements dictate. Large campus and/or multiple premises configurations are also accommodated by the system's modular media gateway design. There is virtually no limit on the number of distributed gateways that can work behind a centralized control complex. For customers with one or more large remote facilities, the survivable RG 8716 can support up to 2,000 stations and the Edge Solution can support 10,000 stations. Siemens' global licensing program allows customers to reconfigure their network and support user licenses across locations to accommodate future growth and network expansion requirements.

HiPath 8000 Competitive Positioning

The HiPath 8000 enjoys several system design and performance advantages compared to the flagship models of several other leading suppliers: Avaya; Nortel; Cisco Systems; Alcatel-Lucent; and NEC.

Avaya
Avaya's S8000 Media Server family running Communications Manager software does not measure up to HiPath 8000 open standards support. SIP communications is supported, but only though the deployment of an optional peripheral server running SIP Enablement Services (SES). SIP station users do not have access to the full Communications Manager feature set. Communications Manager does not currently have embedded SOA capabilities; an optional Communications Process Manager server is required for SOA support of integrated business process applications.

Avaya's S8400 and S8500 models are both based on nonredundant control designs, even though the latter is capable of supporting large enterprise customers up to 2400 line stations. Only the very large line size model, the S8720 Media Server, is based on a duplicated server design, but each server in not inherently redundant like individual HiPath 8000 server nodes. Although the 8720 Media Servers can be geographically distributed there are latency restrictions that prohibit WAN-based signaling connections between the servers.

A major limitation of the Avaya S8000 Media Server Communications Manager family is scalability. Three distinct Media Servers serve mid-market, large, and very large enterprise customers, each with defined port capacity boundaries: a forklift call control upgrade is required to migrate to the next larger model. Enterprise customers with very large line size requirements (campus or network consolidation configuration) are constrained by the current S8720 port capacity parameter of 12,000 IP stations.

Nortel
Nortel's CS 10000 software does not measure up to HiPath 8000 open standards support. The Nortel CS 1000E supports SIP functionality, but SIP station users have access to a limited number of extension features using third party telephone instruments, only; Nortel's IP telephone instruments cannot currently be programmed to operate in SIP communications mode. Nortel has discussed plans for utilizing SOA Web services, but the open interface standard is not yet incorporated into its CS 1000E offering.

Redundancy is optional for the CS 1000E, and despite several recent enhancements the MG 1000E media gateway that can be used to house common control Call Server and Signaling Server components are not base on a redundant power supply design, a potentially fatal single point of failure. Although CS 1000E Signaling Servers are based on a Linux O/S and can be optionally deployed with a commercially off the shelf server, Call Server operations are based on a VX Works O/S and is based on proprietary hardware.

The CS 1000E may support most (if not all) legacy Meridian 1 port interface circuit cards in the new MG 1000Es, but Meridian 1 Intelligent Peripheral Equipment Modules (IPEMs) are not supported. The legacy equipment can also be used in a CS 1000M configuration without geographic distributed call control capabilities. It should also be noted that MG 1000E port card slots are half that of the older IPEM. In contrast the HiPath 8000 can support both HiPath 3000 and HiPath 4000 port carriers (including all port interface circuit cards) as Survivable Media Gateways (SMGs) for legacy equipment migration and/or digital station support.

Enterprise customers with very large line size requirements (campus or network consolidation configuration) may be constrained by the current CS 1000E port capacity of 16,000 IP stations. The network carrier-grade CS 2100 model is available for these customers, but there is no upgrade migration path from CS 1000E, forcing a customer to make an upfront decision on their long term IPT communications system platform. The CS 2100 is not cost effective as a mid-market solution and has limited survivable media gateway options for customers with distributed network requirements.

Cisco Systems
The Cisco Unified Communications Manager (CUCM) does not measure up to HiPath 8000 open standards support. The CUCM is currently available in both SIP and non-SIP versions. The SIP version, based on a Linux operating system platform, has some limitations on generic software feature support; the non-SIP version is based on a Windows operating system and is still being installed by a significant number of customers. All Subscriber Servers in a CUCM cluster must be based on the same O/S platform. Neither version currently embeds SOA capabilities into its architecture.

There are several CUCM design issues that negatively affect system redundancy and resiliency options. Large line size systems require a dedicated Publisher Server/TFTP to support database synchronization and signaling operations among Subscriber Servers. Although multiple Subscriber Servers can be configured to work in redundant mode, the Publisher/TFTP function is not redundant and is a potential single point of failure that can significantly affect overall system operations and performance. The largest system configurations also require dedicated servers for both Publisher and TFTP functions.

Survivable remote media requirements are supported using the Cisco Unified Survivable Remote Services Telephony (SRST) option, but it operates exclusively on Cisco IOS routers and is currently limited to 720 station users (360 stations, only, in secure communications mode) per router. The actual station capacity is dependent on the installed Cisco IOS router model. It should also be noted that implementation of the SRST option is likely to require upgrades to installed router software and memory, and that router and SRST software forklifts may be necessary to accommodate station growth requirements.

Customers who require CUCM Subscriber servers to be geographically distributed across a WAN for network failover resiliency purposes must provide dedicated high speed signaling connections based on call processing load (900 Kbps per 10,000 Busy Hour Calls) for Intra-Cluster Communications Signaling (ISSC) across server sites. Cisco also highly recommends that customers replicate key support services (TFTP, DNS, DHCP, and LDAP) and media resources (conference bridges and Music on Hold servers) at the secondary site.

A CUCM system can support up to 30,000 IP stations, but each active Subscriber server is limited to 7,500 IP stations. A fully configured CUCM at maximum port capacity requires four active Subscriber servers, two recommended back-up Subscriber servers for redundancy, a dedicated Publisher server, and a dedicated Trivial File Transfer Protocol Server. In addition to these eight servers, a fully operational and functional CUCM cluster would require additional servers to support such feature/functions as presence, conferencing, and Music on Hold (MOH). DNS, DHCP, and LDAP servers are also required to support the CUCM solution. If multiple CUCM clusters are networked to support customer port capacity and/or geographic requirements the resulting configuration provides very limited feature/function transparency across the clusters. There is also a subscriber capacity limit (5,000 stations) per Cisco Unified Communications Management Suite server supporting systems administration and control operations. The Siemens HiPath 8000 duplicated server node design is a far simpler and more cost effective design to accommodate very large line size customer requirements without periodic installation of additional server equipment.

Alcatel-Lucent
The Alcatel-Lucent OmniPCX Enterprise (OCE) does not measure up to HiPath 8000 open standards support. The OCE supports SIP functionality, but SIP station users have access to a limited number of extension features using third party telephone instruments; Alcatel-Lucent IP telephone instruments cannot currently be programmed to operate in SIP communications mode. OCE also does not currently support SOA capabilities in its basic system architecture.

The OCE system can be optionally configured with either duplicate LAN-based appliance servers or media gateway call server boards, but each of the individual server elements (appliance, board) is inherently nonredundant, unlike the HiPath 8000 server nodes. Single system control elements (appliance servers or server boards) cannot be geographically distributed across customer network facilities, although customers can intelligently network multiple systems deployed at individual sites. Failover resiliency across the systems, though, is not currently supported. The Personal Communications Server (PCS) option is available for remote local survivability requirements, but calls are not preserved when control signaling to the host system site is disrupted.

There are OCE port capacity limitations for customers with large system requirements. An OCE system utilizing the media gateway server blades is limited to 1,000 IP stations; the next release of the appliance server model will support 15,000 IP stations. Customers can scale their system beyond these port capacities only through a multiple system network configuration.

NEC
The NEC UNIVERGE SV7000 does not strongly conform to industry open standards. The operating system is proprietary and third party equipment (servers, media gateways) are not supported in the current configuration design. The SV7000 supports SIP, but station users have limited feature access. Current NEC IP phone models do not support SIP, although all-new SIP models are planned for announcement later this year; existing models will not be capable of upgrade. More importantly SV 7000 does not currently support SIP trunk interfaces or embedded SOA capabilities.

NEC has stated that it plans to support legacy NEAX 2400 equipment (Port Interface Modules and port circuit cards) in an upcoming SV7000, but there are no plans to support legacy NEAX 2000 equipment.
Duplicated UNIVERGE 7000 telephony and signaling servers (each programmable in active/passive mode) are available as an option, only. Dedicated conferencing servers are also required by the system, but multiple servers are required to satisfy redundancy requirements. Passive telephony/signaling server pairs cannot be installed at different customer facilities for geographic redundancy requirements, nor can multiple systems be configured to support network failover resiliency. The SV7000 survivable remote media gateway option (SR-MGC) does not currently support call preservation when control signaling to the host system site is disrupted, a major design weakness compared to most other systems including HiPath 8000.
The current capacity of the UNIVERGE 7000 is 16,000 stations. Multiple systems must be networked using NEC's proprietary Fusion Call Control Signaling (FCCS) option for customers requiring greater port capacities (very large campus or network consolidation configurations). A multiple system networking option adds to the complexity of the solution, and also adds to capital and operating expenditures.

Concluding Comments

The HiPath 8000 strongly satisfies each of the three defining characteristics of the current generation of advanced IPT communications systems. The defining characteristics are the foundation for cost effective and manageable system growth and performance evolution during its useful operation life and should be the most important system technical and performance criteria that customers use to evaluate and purchase their next IPT communications system. A system architecture significantly based on open industry standards will always prove to be more flexible and cost effective compared to systems that are less so. Today's two most important standards that customers should place at the top of their evaluation list are SIP and SOA, because each is necessary to achieve the highest degree of IT convergence and interoperability within a customer environment and the evolving IP Multimedia System (IMS) public network.

System redundancy, resiliency and reliability are the three basic system design attributes that determine services availability, the most important benchmark of any IT-based system. The fact that the HiPath 8000 is based on the latest generation network carrier SIP soft switch solution designed for virtually nonstop services support should carry great weight when customers evaluate various IP telephony systems. There has always been a reliability difference between products designed for

single customer requirements and network service providers typically supporting thousands of customers. The latter has always held their system supplier to higher reliability standards, because of the potentially disastrous affects of system failures. The redundant and resilient design attributes of the HiPath 8000, in addition to higher level manufacturing standards, should not be discounted when comparing overall system reliability between
IP telephony offerings.

HiPath 8000 scalability should fully satisfy the requirements of virtually any customer, regardless of their configuration demands. Scaling from a mid-market system to a very large enterprise solution with the highest level of investment protection is a major competitive advantage of the HiPath 8000. Through the simple addition of station equipment and media gateways the HiPath 8000 is more cost effective than competitive offerings that require addition of more servers or networked systems to satisfy customer growth requirements for the next five, ten or more years.

The HiPath 8000, a true soft switch IPT communications system based on open industry standards and a network carrier-grade architecture design with virtually unlimited scalability, is a smart customer choice as well as a rational and logical solution to minimize risk due to obsolescence. HiPath 8000 delivers today what most other systems are promising to support in the future.

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