WHITE PAPER

Voice-over-IP Profit Guide for Service Providers

Profit Opportunities in Next-Generation Networks

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1. Introduction

This is a guide for network service providers to make big profits with the Lucent MultiVoice™ for the MAX solution. In this guide, we answer an NSP's four key questions:

- How big is the market?
- What are the requirements to be successful?
- Why is the Lucent solution the best?
- How much profit can I make?

Few times in an NSP's business will an opportunity come along that is so compelling and integral to the future of your business. Lucent NSPs are preparing to roll-out Lucent MultiVoice and enter the voice-over-IP market aggressively. This guide follows the decision process that many of our NSPs will go through. Over the following pages we will highlight the key issues, concisely explain why Lucent is your best partner, and point you to specific sections at www.lucent.com for more detail.

2. NSP Opportunity Overview

The current voice communications market exceeds $600 billion, VoIP has been estimated to have a 10-to-1 cost advantage over traditional circuit-switched voice networks providing an immediate and significant NSP profit opportunity. This opportunity can be addressed with simple PC based voice solutions that have limited scalability and limited profit potential, or with fully integrated solutions that are highly profitable for the NSP because they deliver everything the customers want, both in the short and long term.

Lucent is the only vendor to deliver a complete end-to-end solution that addresses an NSPs voice/fax/data market requirements. Customers want all their network services from a single supplier because of the application integration and reduced management overhead, and the resulting cost savings. These customers can only be addressed with a complete, integrated solution.

This guide will explain what a complete solution entails and why Lucent is far ahead of any other supplier in meeting the VoIP needs of the NSP. With a Lucent infrastructure, NSP's will be able to roll-out VoIP services quickly and reach the break-even point in a few months.

The explosive profit potential for NSPs is dependent on the comprehensiveness of the Lucent MultiVoice solution. Being able to support the array of new applications requires a next-generation switching architecture, and that is available today from Lucent.
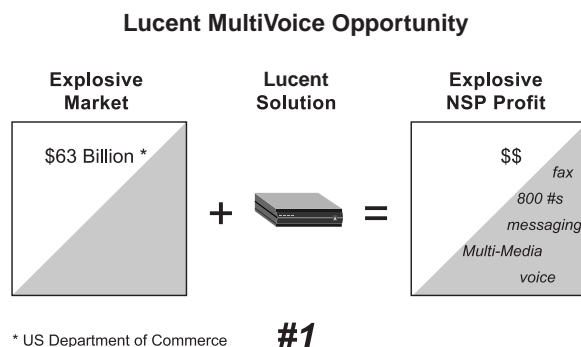
Lucent MultiVoice Opportunity

Figure 1 – The voice-over-IP market opportunity

3.   Explosive VoIP Market Growth

Few markets can match the potential of voice-over-IP services as packet networks replace the traditional circuit-switched telephone network. Today, over $600 billion is spent worldwide on telephony-based services. Of that figure, over $55 billion is spent on international services. This telephony market will be cannibalized by NSPs due to the tremendous cost advantage that voice-over-IP has over the traditional telephony infrastructure. The following industry quotes convey the magnitude of the IP advantage:

"VoIP is 27 times cheaper than PSTN voice."
– James Crowe CEO of Level 3

"Fully burdened packet voice will be 1/5 the cost structure of circuit voice in the near future."
– Business Comm. Review 8/98

This tremendous economic advantage coupled with the surging demand for new network services creates an explosive market opportunity.

Unstoppable Market Momentum

Mammoth replaceable Voice Market > $600 Billion

Undeniable cost advantage over PSTN > 10 to 1

Huge business demand for cost voice cost savings
and new high value network services

Explosive VoIP market growth
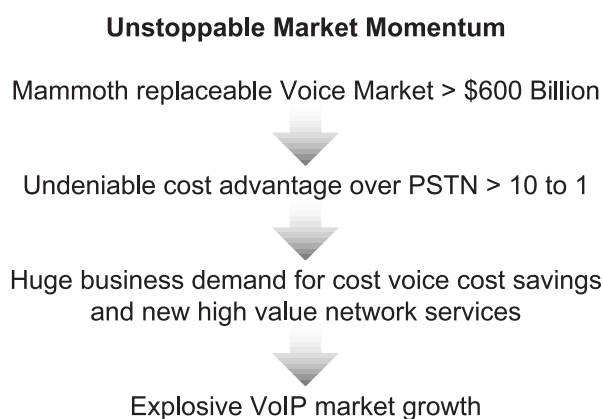
Figure 2 – The unstoppable market momentum of new VoIP services

Industry analysts universally agree that VoIP will be big, but the question is when, where and how? The following data points on the VoIP market provides some perspective:

- Internet telephony will account for 12.5 billion minutes of use by 2001 (InfoTest International)
- VoIP will represent 13 percent of global traffic by 2002 (Frost and Sullivan)
- VoIP will be an $8 billion business by 2003 (Killen and Associates)
- Public packet traffic (voice, fax, video, and data) will surpass traditional circuit switched traffic by 2000
- By 2002, 18.5 percent of all domestic phone traffic will be carried over data lines (Probe Research)
- 28 percent of all fax traffic will go over IP by 2001 (Probe Research)
- 2.8 million NSP subscribers will be using unified messaging services by 2001 (Probe Research)
- The toll free service market in the US is $33 billion in size and will be a primary target market for SS7 call redirection over IP networks by NSPs starting in 1999 (Thomas and Associates)
- VoIP represents a $63 billion global market (Department of Commerce)

There is no shortage of analyst predictions and market projections, but the bottom line is that VoIP is taking off and the opportunity will be huge. The next question is, "What is required to take advantage of this major opportunity?"

$ in Billions

$ 150

$ 24

$.2

'98   '02   '10
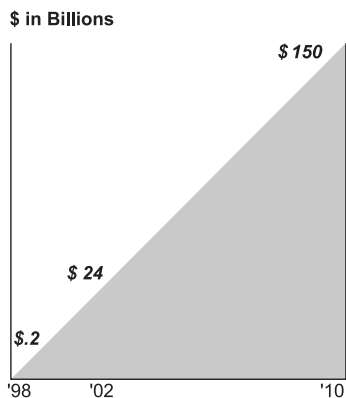
Sources:
IDC projects VoIP to grow from $200 million in 1996 to $24.4 billion in 2002.
Probe Research projects VoIP to be a $24 billion market by 2002, and $150 billion by 2010.

Figure 3 – The explosive VoIP market

4.   VoIP Market Solution Requirements

The VoIP market is very diverse – from simple best efforts calling over the Internet for residential users, to more comprehensive business solutions. This document focuses on the business applications, because they comprise 80-90 percent of the market potential and have the most extensive requirements. The following visual gives a snapshot of the complete requirements, followed by more complete descriptions.

VoIP Complete Requirements

End-to-End VoIP Layers

Compatible Infrastructure
(Must have compatible termination & settlement worldwide)

Carrier-Class Architecture
(Must be scalable architecture to handle complex app's and volumes)

Application Solutions
(Real solutions that subscribers will pay)

Gateway Architecture
(Open architecture with advanced feature set, built on strong core)

Toll Quality Voice
(Must be equal PSTN call quality)

Integrated VoIP Access Switch
(Must be advanced & widely deployed for compatible service delivery)

Core Switching Integration
(Required to seamlessly link VoIP access to backbone/SS7)

Network Management/QOS Support
(Carrier wide absolution QOS for tiered service guarantees)

Carrier Signaling Integration
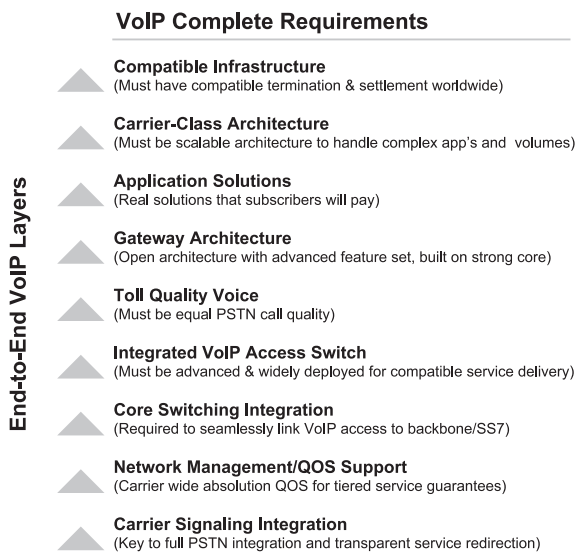(Key to full PSTN integration and transparent service redirection)

Figure 4 – The complete requirements for a successful and scalable VoIP implementation

Compatible Infrastructure

The choice of VoIP gateway and its infrastructure of compatible equipment is a key determinant in a service provider's growth potential and profitability. Service providers planning to support voice or fax calls outside of their service areas must be able to interoperate with many other voice gateways, and Lucent provides the broadest level of interoperability and market coverage available today. Because Lucent and other vendors are working hard to develop full interoperability between H.323 gateways and gatekeepers, this effort will take time. As *Business Communications Review* magazine (10/98) has pointed out, "At the moment, VoIP gateways suffer from a nearly complete lack of interoperability," and people "that think compliance with H.323 standards and interoperability among H.323-compliant systems will come quickly are probably overly optimistic."

The more installed gateways a service provider can work with, the more worldwide calling areas it can support. The more VoIP consortiums it can partner with, the more customers it can reach. The service provider will also encounter fewer troubleshooting problems as its VoIP network grows.

Additionally, as mergers and acquisitions become increasingly common in the industry, a service provider's VoIP infrastructure becomes a key asset as partnerships are formed and networks are rapidly integrated. To win in the VoIP market, service providers must partner with a company that can offer scalable solutions that provide true interoperability with the largest number of ISPs, POPs, and telephony standards around the world—before and after standards for interoperability are fully agreed upon.

Carrier-Class Architecture

Growing service providers entering the VoIP market need voice gateway, gatekeeper, and network management platforms that scale smoothly to meet planned network growth. To minimize network support costs and network complexity, service providers require a VoIP platform that can support their full range of call volume requirements – from the smallest rural POPs to the largest central offices. At the same time, this VoIP platform must have the proven carrier-class hardware and operating system to support the rigorous demands of real-time voice and data calls.

Application Solutions

Service providers need flexibility and choice provided by a wide range of well-integrated applications from third-party developers. This flexibility allows NSPs to choose a range of "best of class" solutions for their market, thereby allowing them to differentiate their services and respond quickly to market opportunities.

These third-party applications must provide robust interoperability with voice gateways for smooth network expansion and rapid, trouble-free service delivery. The full range of billing, fax, unified messaging, multimedia and voice VPN applications must be offered so that the service provider has maximum flexibility in growing its business.

VOIP Gateway and GateKeeper Software

A VoIP platform must have a strong, standards-based core for reliability and flexibility, while supporting APIs and advanced feature sets for an open and extensible architecture. Support for standards such as RADIUS, CDR accounting and RAS provide smooth integration with existing service provider networks. Efficient and flexible interoperability with a range of CODECs should be supported by the gateway. Support is also needed for UNIX and NT gatekeeper platforms for scalable cost effectiveness. Support for gatekeeper redundancy and overlapping call areas give the necessary redundancy for high-uptime voice and fax services.

Toll-Quality Voice

A network's Quality of Service (QoS) level is crucial to any voice- or fax-over-IP implementation. Without a network that provides the low latency, low jitter and required bandwidth that voice calls require, the user experience is likely to be unsatisfactory and the service unsuccessful. The key challenge in providing high-quality voice services is the end-to-end network delay. To provide an experience comparable to the PSTN, the end-to-end delay must be less than 200 milliseconds. A review of the end-to-end components of IP-based calling reveals that in a typical application, voice compression/decompression, cross-network packet forwarding, and standard jitter buffering each range between 0 to 60 milliseconds. In contrast, congestion delays can frequently add up to 200 ms. The dominant issue in voice call quality and end-to-end delay is therefore network congestion. Controlling the level of network congestion is consequently the key to providing acceptable Quality of Service for VoIP services.

To meet end-user quality expectations, a voice-over-IP gateway must support true telco-class voice features. These toll-quality voice services are achieved through several key gateway features, including: silence detection and comfort noise generation, DTMF detection and passthrough, ANI and PIN-based authentication, and echo-cancellation and phone number/IP address translation.

Integrated Voice and Data Access Switch

In the competitive service provider market, only the integrated voice and access platforms yield the cost-effectiveness that will be competitive in the long run. By integrating in a single voice/data access switch all the requirements for a complete range of data and voice call termination, the switch eliminates the need for separate data and voice networks. When the need for two networks is eliminated, also eliminated are the space, power, spares, and management and support requirements of separate and costly voice equipment. By applying the economies inherent in voice/data switches, service providers are able to maintain a feature-rich, and very cost-competitive position against incumbent telephone companies and service providers that rely upon collections of separate voice and data equipment.

Core Switching Integration

Backbone, or core switch integration, gives efficient and effective control over all segments of an end-to-end voice service for any next-generation telephone company. With seamless integration from network access point to egress point, the service provider can offer the highest possible quality VoIP access service with the richest possible feature set. In these carrier VoIP applications, the core switching equipment must provide scalability to millions of calls with the same call completion and robustness that people have come to expect from telephone services.

Network Management and Quality of Service Support

To meet and maintain the high-uptime requirements of voice and fax, service providers require comprehensive, integrated voice and data management and QoS reporting capabilities. Additionally, to truly measure the customer's experience of QoS, the network management system must offer control and support for the local network segment as well as end-to-end services system.

Carrier Signaling Integration

As IP voice networks rapidly evolve and gain market share, the degree to which they can interoperate smoothly with the advanced features in the existing SS7-based world telephone network will become of primary concern. Important services such as toll-free number termination will increasingly move from the traditional circuit-switched network to the IP network. VoIP access switches and core network switches that support the most advanced SS7 features will allow service providers to enter new and valuable markets with the extremely competitive cost structures of IP networks. Companies that have standardized on products with less-robust SS7 capabilities will be unable to compete.

5. The Lucent MultiVoice Solution

Independent voice/data networks will become rare, as service providers and corporations move to realize savings on network infrastructure, economies of scale in bandwidth aggregation and the efficiencies of packet-based voice communications. Lucent packet-based networks developed by ISP consortiums and next-generation telephone companies are already beginning to offer services that rival traditional circuit-based offerings at a fraction of their cost while providing innovative enhanced services. In all of these applications—from smaller ISPs to the largest global carriers—Lucent MultiVoice is becoming the VoIP platform of choice because it offers the most complete solution.

MultiVoice – The Complete Voice/Fax-over-IP Solution

- **Fully Integrated, Carrier-Class Product Line** – MultiVoice for the MAX avoids network access duplication and simplifies network support by supporting voice, fax, analog modem and digital access using the same scalable chassis design.

- **Proven Reliability** – The Lucent MAX is the world's leading ISP access concentrator platform with over 8 million ports in use, providing access services to well over 30 million people daily.

- **Transparent PSTN/VoIP Integration for Toll-Quality Voice Services** – Lucent has the market-leading expertise in access call concentration, IP routing, SS7 call control and backbone switching to offer unparalleled integration of circuit-switched and packet-switched networks.

- **Interoperability through Industry Standards Support** – Extensive support for existing and evolving industry standards allows smooth integration with public and private networks.

- **MultiVoice Alliance Program for Differentiated Services** – The Lucent MultiVoice Alliance Program (MAP) provides NSPs with "best-in-class" third-party applications for the delivery of well-differentiated VoIP and FoIP services.

Lucent VoIP Architecture

| Compatible Infrastructure |
| Carrier-Class Architecture |
| Application Solutions |
| VoIP Gateway Architecture |
| Toll Quality Voice |
| Core Switching Integration |
| Network Mgmt./QoS Support |
| Carrier Signaling Integration |

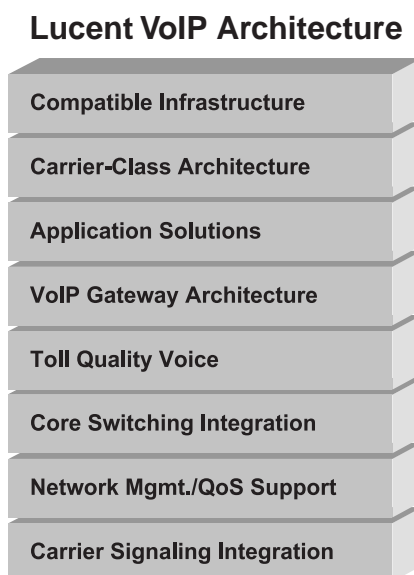*Figure 5 – The Lucent VoIP architecture*

MultiVoice for the MAX combines all the key components to provide a robust infrastructure for long-term competitive advantage.

Compatible Infrastructure – Immediate Worldwide Voice Compatibility

Only Lucent has the worldwide coverage of an installed base with more than 80,000 MAX concentrators used by more than 2,500 ISPs. The integrated MAX voice/data platform allows service provers to rapidly expand voice-over-IP services while avoiding the interoperability issues associated with today's evolving H.323 voice standards.

Lucent Carrier-Class Architecture

The Lucent MAX series of access concentrators are proven platforms that meet today's most stringent central office standards for power, performance and safety, including all applicable Network Equipment Building System (NEBS) Level 3 and European Telecommunications Standards Institute (ETSI) requirements. Dual, load-balancing power supply options on the MAX 6000 and MAX TNT products further ensure high levels of uptime and reliability. The proven Lucent TAOS operating system used in all MAX products furnishes the reliable access routing and worldwide circuit signaling support required in today's global voice and data networks.

MultiVoice Applications – Software Solutions Alliance Program

The Lucent MultiVoice Alliance Program (MAP) brings together leading third-party developers to provide NSPs with "best-in-class" applications for the delivery of innovative voice- and fax-over-IP services. By closely coordinating new feature development, Lucent and these third-party providers help NSPs rapidly deliver feature-rich, high profit IP-based service solutions.

The MultiVoice Alliance Program specifically benefits NSPs by providing:

• An array of "best in class" solutions that allow swift deployment of well-differentiated, profitable new services.

• Complementary, well-integrated solutions that have been developed by leading third-party developers working in concert with Lucent engineering groups.

• Ongoing product development efforts between third parties and Lucent for rapid product enhancement that meets new customer requirements while maximizing the service provider's profit potential.

The MultiVoice Alliance Program offers an expanding range of new products that give NSPs valuable revenue opportunities. Offerings will include:

Billing/Provisioning
Software billing solutions available today from MAP members allow NSPs to expand their business via usage-based billing. Both prepaid and postpaid billing applications are available.

Faxing
Internet-based fax solutions allow NSPs to offer fax-over-IP services with significant cost-savings for corporate and end-user customers. Store-and-forward and real-time fax solutions are available. Other opportunities include fax-to-email, broadcast fax and fax-on-demand services.

Multimedia Applications
IP-based multimedia applications allow NSPs to add innovative value-added services that take advantage of the voice and data capabilities of the Internet. New services that offload the traditional call centers allow NSPs to realize significant profits while providing substantial savings to customers.

Unified Messaging

Unified messaging services allow NSP customers to access voice, fax and email messages from a single "in-box". These future offerings can fulfill the promise of multiple services running on a single network architecture – simplifying and cost-reducing the task of managing separate voice and data networks.

Settlement

NSPs can terminate voice or fax calls worldwide by using a public or private clearinghouse. These clearinghouses provide both call routing and payment settlement services to their partners. Private clearinghouses use the Lucent MultiVoice Access Manager and a billing system for inter-carrier settlement. This solution is available today. Public clearinghouses are implementing the Open Settlement Protocol (OSP) for call routing and settlement. These solutions will be available in the near future.

MultiVoice VoIP Gateway – High-performance Slot Cards and Feature-Rich Voice Software

MultiVoice for MAX platforms incorporate new high-performance DSP-based voice/fax processing cards that offload the concentrator's CPU to provide the high-quality voice compression and low-latencies required in voice and real-time fax call processing. The MultiVoice for the MAX software option has rich VoIP and fax-over-IP support for H.323 gateway phone-to-phone and PC-to-phone applications. Just as important as the VoIP gateway is a resilient call management solution that supports the common operating systems used in today's service provider POPs. The MultiVoice Access Manager H.323 gatekeeper for Windows NT and UNIX provides distributed, redundant, voice and real time fax call management across the entire network. Access Manager redundancy support allows identification of primary and secondary gatekeepers for each gateway with automatic load balancing across gateways from the gatekeeper. This call distribution between multiple gateways improves both network and gateway performance, resulting in fewer rejected calls and better utilization of network bandwidth.

Toll-Quality Voice Services – Transparent PSTN Functionality

The circuit- and packet-based network standards supported by MultiVoice results in a smooth, transparent integration of voice-over-IP and the Public Switched Telephone Network (PSTN). At the MultiVoice access gateway interface, incoming voice calls are encoded and compressed using any one of three different ITU-T H.323 standard coder/decoders (CODECs). After processing and encapsulation, the voice calls are forwarded via IP packets to 10/100 Ethernet, or to frame relay, providing a seamless transition from circuit-switched to packet-switched networks. The full functionality of the traditional PSTN is maintained with support of DTMF and G3 fax signaling, and broad US and international carrier network signaling compatibility. For smooth integration of dialing schemes, MultiVoice Access Manager supports translation of standard telephone numbers and/or private dialing plan numbers to IP Addresses for VoIP call routing across a network. Toll-quality voice services are further ensured via silence detection and comfort noise generation features that let users know that the call is active, while at the same time reducing network bandwidth requirements. MultiVoice managed delay variation (jitter) and echo cancellation, when combined with a well-managed backbone network, complete the "sound and feel" of the traditional telephone call experience using voice-over-IP services.

Lucent MAX Voice and Data Access Switch

Lucent MultiVoice is becoming the VoIP platform of choice as NSPs move to realize significant savings on network infrastructure, economies of scale in bandwidth aggregation and the efficiencies of packet-based voice communications. Lucent MultiVoice for the MAX provides true, comprehensive integrated services support. The MAX platform can be used to support the MultiVoice application for voice and fax-over-IP services or it can be used to support V.90 modem data calls, ISDN, frame relay, and even DSL services all in the same carrier class chassis. Lucent offers the service provider a single platform chassis that can meet all their network access requirements. This integrated solution allows simple, cost-effective and rapid adjustment of service support by varying the type or density of slot cards supported. No change in the main network infrastructure – LAN or WAN – is necessarily required. No painful learning process need be endured, nor network reorganization performed, to add a new service. The same proven, reliable access and routing platform can be applied across a range of services.

Lucent Core Switching Integration

Lucent provides a smooth integration of voice and data access into the core switched network of the world's data communications infrastructure. With the clean integration between the integrated voice/data access switches and the market-leading frame relay and ATM backbone switches, Lucent offers "Absolute" QoS and unparalleled scalability. Already Lucent's backbone switches have the proven capacity to scale to millions of calls per hour, and are the choice of leading Telcos and PTTs around the world. The integration of these backbone switches with the MultiVoice-enabled MAX concentrators offer service providers a smooth upgrade path that supports the highest levels of reliability and Quality of Service.

NavisAccess Network Management and QoS

The NavisAccess network management solution is a powerful network-wide SNMP management application with service provisioning, performance monitoring, fault detection, and accounting features optimized for service provider applications. Available for both Windows NT and UNIX platforms, the NavisAccess management system is a scalable management platform for provisioning and managing voice and data services. For the many existing Lucent customers comfortable with the traditional MAX interface, standard Telnet support is also available.

Lucent uniquely offers three levels of QoS to assist service providers in addressing network delay and QoS issues. NSPs can choose the solution that best meets their customer requirements, business needs, and network environment.

- **Best Effort** – Today's Internet is based on a straightforward "Best Effort" model, where every application receives the same level of service. As the Internet matures, the "Best Effort" approach will remain suitable only for basic, low cost Internet access and time-insensitive applications, such as email transfer.

- **Relative QoS** – Relative QoS assigns a priority (and optionally pre-provisioned bandwidth) to data traffic flowing through a router. The MultiVoice gateway supports QoS based on the Type of Service (ToS) field in the IP packet header. This field provides an indicator of the relative packet delay and packet drop sensitivity of the data, thereby allowing VoIP packets to have a higher priority than delay-insensitive packets. This level of QoS provides a dramatic improvement over the "Best-Effort" basis, with significant increase in bandwidth efficiency and utilization. For many Internet service providers, this solution—combined with a well-engineered backbone network and low-congestion peering points will provide an entirely satisfactory and very profitable voice service. Service providers can obtain higher levels of QoS by using Lucent core network switches that support frame relay and ATM-based provisioned bandwidth.

- **"Absolute" QoS** – For guaranteed toll-quality VoIP calls with true carrier-class scalability, Lucent supports "Absolute" QoS with "on-demand" dynamic bandwidth. "Absolute" QoS provides the guaranteed bandwidth, guaranteed latencies, and scalability required for Telco-level VoIP implementations. Enabled by the MPSL-based IP Navigator technology that is part of the Lucent core frame relay and ATM switches, "Absolute" QoS provides service levels that can be based on source or destination IP addresses, ToS values, or IP protocol ID. Edge routing determines the best path to destination while the switched core provides QoS and bandwidth guarantees. "Absolute" QoS links the MultiVoice gateways with the IP Navigator for complete end-to-end guaranteed quality.

Lucent Signaling System 7 (SS7) Support – Market Leading PSTN Integration

Implementations of the MultiVoice for the MAX will provide the option of gatekeeper-based (H.323) or SS7-based call routing. However, comprehensive carrier-class SS7 support is being integrated into MultiVoice products as a benefit of the Lucent acquisition of the market leader in SS7 technology Stratus Computer. Stratus SS7 systems are installed at all seven RBOCs, at the three largest interexchange carriers, and in most of the top 30 telecommunications companies worldwide. The same SS7 software expertise that developed the Lucent/Stratus products managing every AT&T toll-free call is now being applied to the MultiVoice product line. This industry-leading SS7 support will give service providers ongoing competitive advantage they need for advanced service offerings and comprehensive integration with the traditional phone network.

6. Competitive Analysis

This section logically reviews each of the VoIP market requirements and compares Lucent MultiVoice to the competitive approaches in the marketplace.

Compatible, Scalable Infrastructure

Lucent

MultiVoice for the MAX concentrator systems offer a worldwide interoperable installed base with NSP partnering opportunities that provide the most rapid growth path to new, global voice and fax services.

Other Access Switches

No other access concentrator company can match Lucent in the number of digital access switches that are already 100 percent digital (ISDN, or T1/E1 interfaces and digital modems) installed and deployed around the world. While some access switch vendors are announcing voice support, their worldwide coverage or "voice ready" infrastructure is extremely small – providing fewer partnering opportunities and less comprehensive global coverage, as well as a steep learning curve for support of any new platform.

PC-Based Gateways

Standalone PC-based VoIP gateways have been developed by a number of small, regional start-up companies who act as systems and software integrators to offer a product that can initiate and terminate voice calls. These systems are extremely limited in their scalability and deployment and typically require service providers to learn new interfaces, and support a voice network independently from their dial-up data network.

Without a large worldwide base of service providers familiar with the PC-based gateways, purchasers must learn about a new system and convince other service providers to purchase the same product. Then, before they can pass their calls to a large number of partner networks, they must wait for truly interoperable H.323 standards to be developed and proven.

Scalable and Proven Carrier-Class Architecture

Lucent

Only Lucent has a carrier-class architecture that has been developed using feedback from thousands of service providers, and proven in worldwide installations providing services to tens of millions of people. Worldwide signaling support and homologation allow rapid deployment of these services.

Other Access Switches

No other access switch vendor has the same level of experience in providing a broad array of scalable solutions that meet the needs of service providers. Since Lucent introduced the industry's first integrated access switch, other vendors have followed with similar products. However, no other vendor combines the proven scalable VoIP product line with options and software that truly meet the needs of the voice services provider. Some access switch vendors – because they are so far behind Lucent – are integrating gateway software based on a PC operating system running on a slot card in their system – effectively pushing the solution down to the level of a PC-based gateway in terms of robustness.

PC-Based Gateways

PCs are unsuitable for scalable, high-uptime, voice services. Compared to the highly-optimized real-time operating systems used in access switches, general purpose PC operating systems provide neither the robustness nor the trouble-free operation that is required in any service providers applications. The PC chassis and slot cards are independently designed by suppliers requiring independent driver software and updates. This forces service providers or their suppliers to be systems integrators of products not truly designed for the scalability and uptime requirements of real-time voice services.

Application Solutions

Lucent

The Lucent MultiVoice open API design and MultiVoice Alliance Program have resulted in a large number of third-party application providers developing applications that extend the functionality of the MultiVoice platforms beyond what competing providers offer.

Other Access Switches

Other access switch solutions cannot match Lucent's range of third-party program participants or are attempting to lock service providers into their own proprietary hardware based gatekeeper solution to the exclusion of other software vendors.

PC-based Gateways

Most PC-based VoIP gateway developers are attempting to provide functionality themselves or are working with one or two third-party vendors to broaden their solutions set. However, without the technical resources to build best-of-class solutions themselves, nor the financial resources to hire and support third-party development activities, most of these solutions will not continue to evolve quickly.

Standards-based, Feature-Rich VOIP Gateway and GateKeeper Software

Lucent

Lucent outperforms the competition by providing robust, feature-rich gateway and gatekeeper solutions. This includes support for a software-based gatekeeper that can be deployed on standard, general purpose NT or UNIX computing platforms for maximum NSP flexibility.

Other Access Switches

Other access switch manufacturers don't meet the feature richness that MultiVoice for the MAX provides. Close examination of other offerings reveals that they don't have the same breadth of offerings in CODECs supported, don't provide the same level of support for RADIUS, and don't have the level of open gatekeeper support for smooth integration into existing network systems. Some vendors even attempt to lock service providers in to their proprietary gatekeeper platforms, forcing the entire network to be standardized on their hardware equipment, with no flexibility or options for differentiation. Some switch vendors also attempt to force service providers into separate voice/data network management solutions, further burdening the network manager with application costs and educational expenses.

PC-based Gateways

PC-based gateways typically don't offer the feature richness, nor the comprehensive standards support of the MultiVoice gateway solutions. Without support for standard protocols like RADIUS, or industry-standard CODECs, these products frequently don't integrate well into existing access solutions; and service providers are forced to duplicate much of their authentication, authorization and accounting infrastructure. Additionally, PC gatekeepers frequently lack support for the most robust real-time operating systems as well as the scalability and redundancy that is required for toll-quality voice.

Toll-quality Voice

Lucent

MultiVoice for MAX has many unique features that help service providers offer telco-quality voice services. At the gateway, MultiVoice offers 3 CODECs today (with more to follow) as well as IP address to phone number translation, silence detection, and comfort noise generation to efficiently emulate the existing telephone call experience. Additionally, DTMF detection and generation further support interoperability with the PSTN. On the network side, MultiVoice support for priority setting on the voice packets, as well as support for the RTP/RTCP protocols for sequenced audio packets further contribute to the high level of service quality.

Other Access Switches

Very few access switch vendors offer the same toll-quality voice services as MultiVoice. However, many have "announced" features that may eventually provide similar capabilities, but which will not be available for many months.

Summary

In each of the VoIP requirements, Lucent clearly is the market leader. The following figure graphically portrays this advantageous position. For updates and more detailed analysis see the "competitive analysis section" on the Lucent Web site at www.lucent.com.
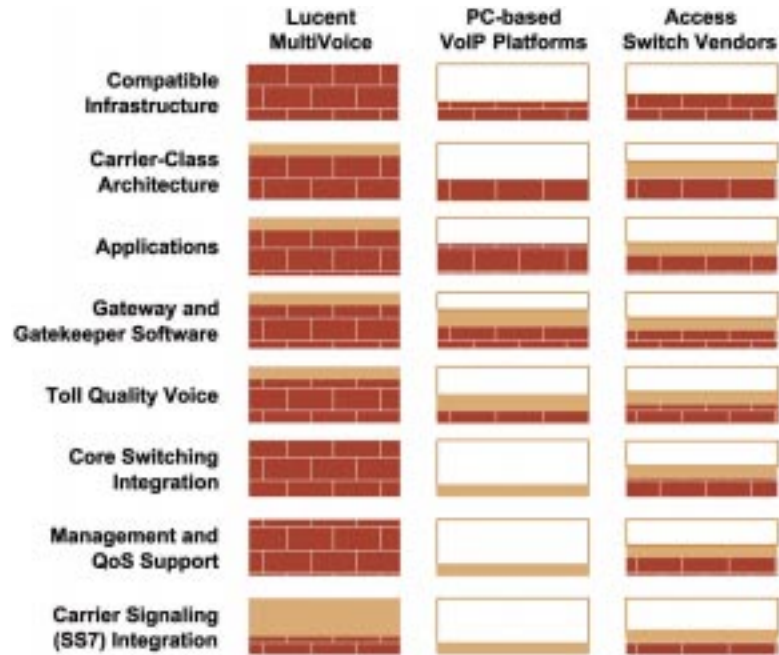
Figure 6 – Lucent market position

7. Lucent Market Positioning

Lucent is in a powerful position to be the leader in telephony over IP because Lucent is already the leader in all the key infrastructure components required to deploy a high quality VoIP solution.

The need for a compatible network of VoIP POPs, Partners, and overall QOS infrastructure is mandatory. As you can see in Figure 7, Lucent has the largest NSP customer base and switching infrastructure and is well positioned for continued VoIP leadership.

The Lucent VoIP Market Equation

| Largest NSP Customer Base | **+** | Largest Access Switch Installed Base | **=** | Many Worldwide NSP Partners, Largest Potential VoIP Infrastructure |
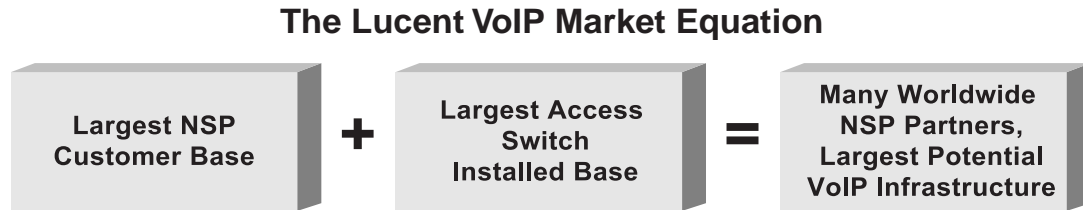
Figure 7 – The Lucent VoIP market equation

Each of the key components will now be described in detail so NSPs can fully understand the magnitude of the alliance potential that the Lucent VoIP opportunity presents.

In order to provide universal high quality VoIP, a service provider must support call termination anywhere. That means being part of a compatible partners alliance with which to terminate various voice services. There are three key segments of partners, and each group is important to handling each part of the call (see Figure 8).

Lucent has the Largest NSP Customer Base
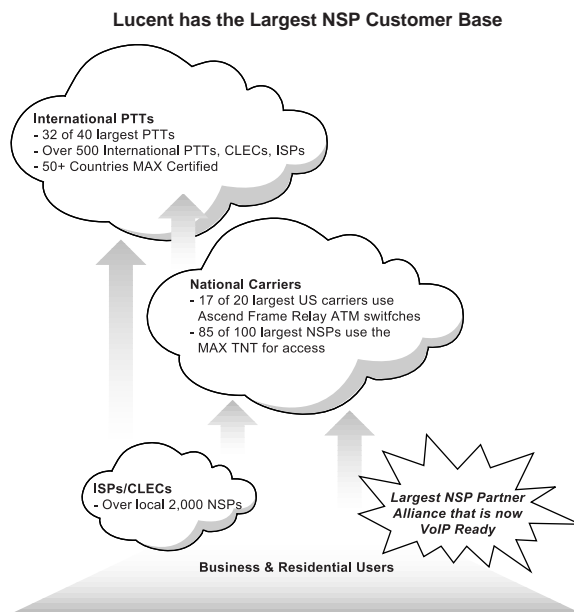
Figure 8 – Large NSP customer base translates into worldwide network of VoIP partners

- **Local NSPs –** Lucent has over 2,000 local ISPs and CLECs in the US. These local NSPs have compatible MAX switches in over 15,000 switching centers around the country.

- **Nationwide Carriers –** The Lucent frame relay/ATM market share leadership provides backbone interoperability for supporting high-value voice services. In fact, 17 of the 20 largest US carriers have Lucent core switching. Added to this, 85 of the 100 largest NSPs nationwide have over 10,000 carrier class MAX TNTs installed to act as VoIP connection partners and port wholesalers.

- **International PTTs and NSP Partners –** International calling is the "sweet spot" for VoIP initially because of the very high per-minute rates, so international call termination coverage is essential for any service provider. Lucent has been the leader internationally for many years as these figures testify: over 500 NSP partners in over 100 countries; MAX & TNT homologated with the local PTTs in over 45 countries; and 32 of the 40 largest PTTs sell and support Lucent switches.

- The next key component of the Lucent MultiVoice equation is the "compatible infrastructure." To deliver high value telephony services, an NSP needs not only partners, but needs partners that have an installed base of compatible switching gear, sufficient bandwidth, and SS7 interfaces to handle high volume traffic and complex applications. Figure 9 shows the key components required for universal compatibility:
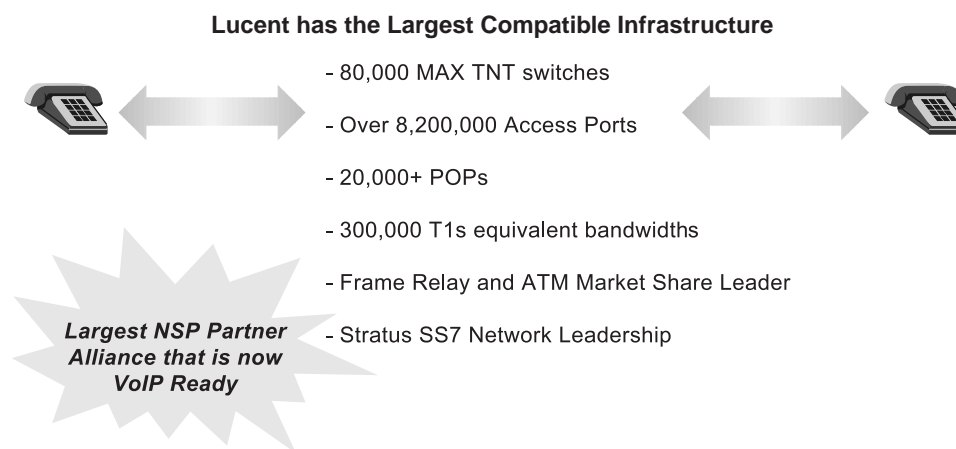
Lucent has the Largest Compatible Infrastructure

- 80,000 MAX TNT switches

- Over 8,200,000 Access Ports

- 20,000+ POPs

- 300,000 T1s equivalent bandwidths

- Frame Relay and ATM Market Share Leader

- Stratus SS7 Network Leadership

Largest NSP Partner Alliance that is now VoIP Ready

Figure 9 – The largest 100 percent compatible infrastructure

- **Local Switching Infrastructure –** Lucent has over 80,000 MAX and TNT units worldwide, installed in over 20,000 POPs. Today there are over 8,200,000 access ports installed running over 300,000 T1 lines. This infrastructure can be leveraged to create the largest VoIP network in the world.

- **Core Switching Infrastructure –** To handle all the local traffic and meet all the QoS, provisioning, and billing requirements, Lucent delivers the largest frame relay and ATM installed base of switches. Added to this installed base is the world's market share leader of network management and provisioning to support data/voice access management. This guarantees that telephony applications will be compatibly supported.

- **SS7 Carrier Signaling Infrastructure –**The Lucent SS7 systems are installed in all of the RBOCs, the three largest IXCs, and most of the largest PTTs overseas. This universal compatibility is a key requirement for transparent transfer of calls from the PSTN to the IP network. Other key applications like toll-free calling redirect are now open to Lucent NSP partners because the AT&T toll-free service is based on Lucent SS7 systems.

Now that we have provided substantiation for Lucent's leadership market position in partners and infrastructure, you can see why the VoIP market potential for Lucent and our new VoIP NSPs is immense. Lucent is not only the market share leader in the access switch market, but is also well-positioned with VoIP upgrade advantages. Many other companies in the access switch market do not have the same level of telephony engineering experience as Lucent, and they have not designed in voice compatibility for the next generation of IP telephony integration. Lucent has this level of integration and it provides service providers with the advantage of being able to enter the VoIP market at a low incremental cost.

Many companies in the access switch market don't offer compelling migration paths to VoIP services because their products are not upgradable to handle VoIP support. Competitive concentrators that can be upgraded with a VoIP are still lacking the core switching, SS7, and PTT certifications to terminate any meaningful volume of calls.

Lucent Access Leadership to VoIP Leadership
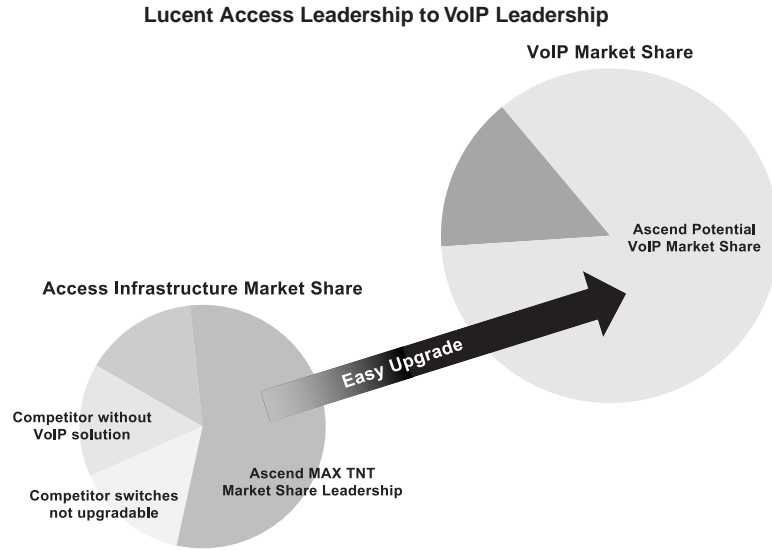
Figure 10 – Lucent Access Leadership is translating to VoIP Leadership

The key to winning the VoIP deployment market is the upgradability of current switches and compatibility of core infrastructure. Lucent is believed by many to have ten times the VoIP upgradable switch potential over any other vendor. This is extremely important to an NSP evaluating their options because it provides the short term coverage and compatibility needed for rapid ROI and longer term guarantee of belonging to the right partnership that will be the winners in the VoIP market.

8. NSP Profit Opportunities

The immediate revenue and profit opportunities for fast-moving Internet service providers and carriers that offer VoIP services are immense. There are four areas of "NSP Business Advantages for Deploying Lucent MultiVoice", as seen in Figure 11.

NSP Business Advantages for Deploying Lucent VoIP

New Applications
- additional revenue streams from new and existing clients

Higher Revenues
- introduce transaction billing (cents-per-minute vs. flat rate)

Customer Loyalty
- expands relationship to all communication needs

Network Optimization
- full day utilization of network data and voice

Figure 11 – NSP business advantages of deploying Lucent MultiVoice

New Applications – The cost savings and competitive advantages of new applications deployed by businesses are fueling demand. NSP growth and profitability depends on rapid rollout of new applications to meet customer needs. Lucent MultiVoice delivers the broadest range of high value applications, i.e. telephone-to-telephone, telephone to/from computer, fax-to-fax, fax to/from computer and/or Web, Web-browser-to-telephone, and many others.

Higher Revenues – New VoIP services result in added revenues, but these new services can be billed differently than flat rate Internet access. The introduction of transaction based billing on a per minute basis changes the NSP's business model significantly. Additionally, by charging for higher levels of guaranteed service/security, the ramp rate for profitability per minute goes up significantly.

Customer Loyalty – Customers want high value services from their NSP and the trend is towards concentration of services from one supplier. VoIP is a powerful application to make further inroads with a current customer. The downside is that if an NSP does not offer the new services, other NSPs will penetrate their customer base and start taking customers away. But, for aggressive NSPs, the same model can be used to attack competitor customer bases.

Network Optimization – Independent voice/data networks will become increasingly rare as organizations move to realize significant savings on network infrastructure, economies of scale in bandwidth aggregation and the efficiencies of packet-based voice communications.

All of these advantages translate into higher revenues and profits for NSPs. But the key issues for NSPs is finding the break-even point. Lucent MultiVoice is unique in having the infrastructure in place to easily add voice functionality and thereby incrementally rollout new voice services. Frost & Sullivan is a leading market research firm that studied the economics of NSPs deploying Lucent MultiVoice. As seen in Figure 12, the economics are quite impressive. This study was very conservative in that it utilized product retail prices, fully burdened costs, and included significant SG&A expenses to launch/support these new services. Although most NSPs would not invest this heavily in SG&A, the return-on-investment is still very compelling. For all scenarios that are larger than a few POPs, the ROI is less than five months.

NSP VoIP Return-on-Investment (detailed)
(Frost & Sullivan Study 8/98*)

VoIP ROI Scenarios	2 Yr ROI	Break Even
#1 U.S. to Germany	686%	3 months
#2 U.S. to Japan	390%	5 months
#3 three nodes in U.S.	60%	16 months
#4 nine nodes in U.S.	465%	4 months

*Study detail was very conservative in climates and used fully
fully burdened cost, retail prices, and industry average pricing models.

Figure 12 – NSP VoIP return-on-investment

Reaching Break Even Quickly

An NSP can break even very quickly with MultiVoice for the MAX. The previous analysis by Frost & Sullivan took a very conservative approach to deploying VoIP, more like starting up an entirely new business. But in most cases an NSP will already be in business selling Internet access services. This is the scenario we will concentrate on.

The assumption used here is that an NSP would make an incremental investment to the current business by installing a MAX 6000 with just one MultiVoice Gateway card containing 16 DSPs. As you can see in Figure 14, the analysis is very straightforward. By dividing the total monthly cost of the system by the number of days in a month and the number of DSP channels, we arrive at the "total cost per day per DSP channel" of $3.30. Even though international calling rates run from 15-35 cents per minute, we are using an average for domestic and international rates per minute of 5 cents. By dividing the cost per VoIP channel per day by cents, we get about an hour of calling needed to reach break even. The bottom line on all this calculation is this: "if an NSP can fill a pipe for one hour a day, it covers its infrastructure costs, and the other 23 hours are all profit".

Break Even at 1 hour a day,
the other 23 are all profit potential

24 hour potential
per channel per day

MAX 6000 with one MultiVoice
card including 16 DSPs

23 hours per
day per DSP
for potential
NSP Profit

Costs per month
- MAX 6000 with 16 DSPs*   1,000
- T1 line to PSTN   300
- Internet Connection   300
      total per month   1,600
      total per DSP/month   100
      total per DSP/day   3.30
- at .05 per minute calling rate   /.05

- total minutes to break even   66   *1 hour/day*

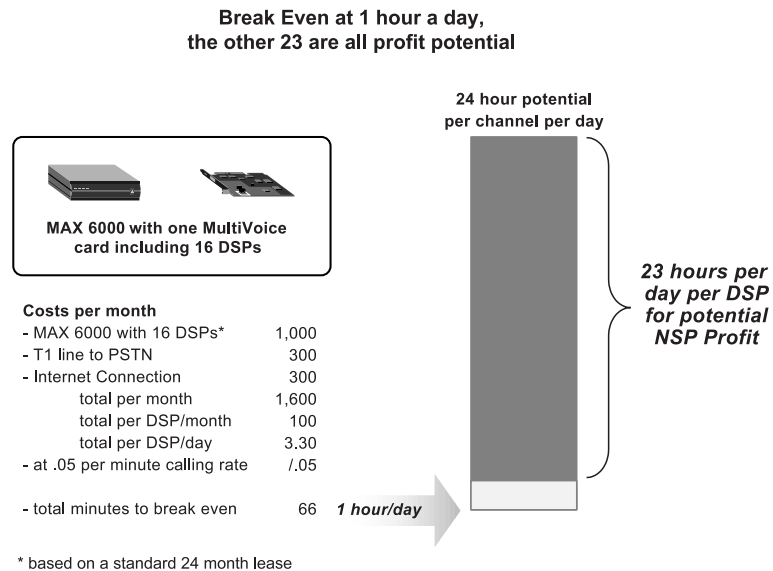* based on a standard 24 month lease

Figure 13 – Break even at one hour a day
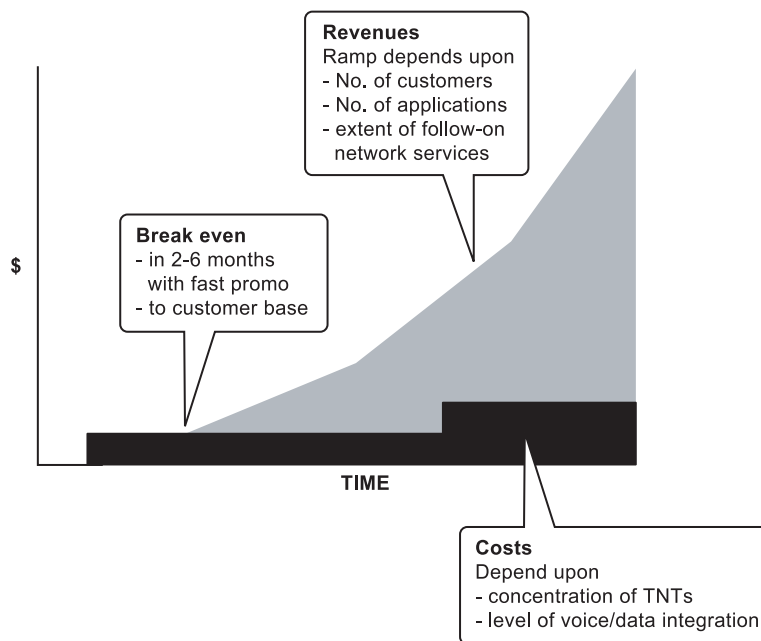
NSP Return-on-Investment Summary

Figure 14 – *MultiVoice MAX return on investment*

Every NSP's business model is different, so it's difficult to generalize about how profitable an NSP can be with Lucent MultiVoice. There are many issues that will be specific to each NSP in the way they roll out VoIP services. Figure 14, distills all this complexity down to a few key issues that will determine the level of profitability.

- **Costs –** In most traditional ISP scenarios, the density of deployment (# of ports and geographic footprint) determines the potential profitability of any given POP. The other large cost optimization factor will be the extent of integration that the NSP can achieve by utilizing the MAX to concentrate and gateway all services (data, voice, fax, messaging, etc.).

- **Revenues –** Historically, most NSP's profitability has been purely based on how many customers they can sell and keep, because of the prevalence of flat-fee pricing. But, with telephony services over IP, the model gets more interesting because of the multiple services and applications that can be sold to a customer utilizing the same backbone network to carry these services. And once an NSP is delivering high quality voice and fax services to a customer, more network integration and follow-on services, such as messaging and conferencing, really integrate a customer into a full service business model. Most NSPs forget to evaluate the added revenues they will receive by terminating calls from other Lucent VoIP partners through call settlement services. If an NSP is one of the few Lucent NSPs in a local area, much of the in-bound terminating traffic will go to the Lucent NSP.

- **Break even** – Somewhere between the time an NSP installs the MultiVoice for the MAX, and a widely profitable VoIP venture is establishing the break-even point that concerns many NSPs. In most cases, it does not take many business and residential customers to fill a voice pipe for one hour a day. Most NSPs utilize very attractive lease terms on the MAX and since most NSPs are quite familiar with the MAX, start-up time is very short.

9.   Summary

The world is changing quickly, and billions of voice dollars are going to be moving quickly to IP-based networks. Rarely does an NSP face an opportunity as significant as this, with products as well suited to the application as the Lucent MultiVoice product line. NSPs know that leading this new wave of Internet services will be their key to accelerated growth and greater market share over the next decade.

Reasons to Choose Lucent

- Explosive VoIP market growth
- Lucent VoIP is the best overall solution
- Lucent NSP alliance is biggest/best
- Lucent application roll-out is superior
- NSPs profitability picture is clear with Lucent
- VoIP market opportunity window is NOW

In this Profit Guide we have tried to address your concerns, explain why we are a better partner, and discuss your keys to profitability. Throughout the guide we have also provided pointers to more in-depth information at our Web site. But, the quickest way to get this story presented in a very specific fashion for your business is to call Lucent directly and talk about how you can easily upgrade to the future of the Internet.

For additional information, or to arrange for a visit from a Lucent Technologies representative, please call: 800-621-9578

Or, visit our Web site at http://www.lucent.com, click on Solution, then Integrated Carrier Network Solutions.

Appendix – Competitive Analysis Detailed Matrix

A Comparison between the Classes of Competitors of MultiVoice for the MAX

There are two general classes of voice/fax-over-IP systems that are being sold to service providers: integrated access switches and PC-based products. A general overview of these two voice/fax-over-IP approaches follows:

	Lucent	Switch Vendors	PC Platforms
Compatible, Scalable Infrastructure			
Total Number of Installed, 100% Digital Access Ports	8,200,000+	500,000+	1,000+
Total Number of 100% Digital Access Concentrators	100,000+	10,000+	500+
Compatible US ISP Installed Base, VoIP via Simple Upgrade	2,000+	100+	100+
Compatible International ISP Installed Base, VoIP via Upgrade	500+	100+	Dozens of ISPs
Worldwide Homologation	45+ Countries	NA for Telcos	Very Limited
Public Settlement Clearing Houses (via OSP)	YES – Planned	Limited	Limited
Private and Settlement Provider Support	Yes	Limited	Very Limited
Strong Worldwide Service Provider Partner Network	Yes	No	No
Worldwide Customer Support Infrastructure	Yes	Yes	Very Limited
Scalable, Carrier-Class Architecture	Yes	Limited	No
Scalable System Support – 8 ports to 672+ Ports	Yes	Limited	No
Scalable Circuit Support – ISDN BRI to DS3 (128K to 45Mb)	Yes	Limited	No
NEBS Level 3, NTSI Certification for Central Office Applications	Yes	Limited	No
Proven Call and IP Routing Code Tested Worldwide	Yes	Yes	No
Optional Dual, Load-Sharing Power Supplies	Yes	Yes	Limited
Backbone Circuit Redundancy Options	Yes	Yes	No
Ethernet, Frame Relay, Packet Interfaces	Yes	Limited	Limited
ISDN, T1, E1/PRI, E1/R2 and DS3	Yes	Limited	Very Limited
Proven Real-Time Operating System	Yes	Yes	No

	Lucent	Switch Vendors	PC Platforms
Application Solutions			
Prepaid Voice Calling Support	Yes	Yes	Limited
Post Paid Voice Calling Support	Yes	Yes	Yes
PC to Phone/Phone to PC Communications	Yes	Limited	Limited
Store-and-Forward Fax via 3rd Party Applications	Yes	Limited	Limited
Real-Time Fax	Yes	Yes	Limited
Unified Messaging via Third-Party Applications	Yes – Planned	Yes – Planned	Limited
Voice VPN Support	Yes	Yes	Limited
Open APIs with Third-Party Support	Yes	Limited	Limited
VoIP Gateway and Gatekeeper Software			
H.323 Compliance	Yes	Yes	Yes
Open API Supported by Vendor	Yes	Very Limited	Very Limited
RADIUS Support	Yes	Limited	Yes
CDR Support (Call Accounting/Detail Records)	Yes	Yes	Yes
Telephone Number Aliases (e.g. shortened call numbers)	Yes	Limited	Limited
UNIX and NT-based Gatekeeper	Yes	Limited	No
Web-based Administration Interface	Yes	Limited	Limited
Gatekeeper Redundancy Support	Yes	Very Limited	Very Limited
Scalable Gatekeeper Network (up to 256+ Gatekeepers)	Yes	No	Very Limited
Gatekeeper Support for Overlapping Coverage Areas	Yes	Very Limited	Very Limited
DS0 Drop and Insert Support for Corporate PBX Integration	Yes	Very Limited	Limited
RAS (Registration, Administration and Status) Protocol Support	Yes	Limited	Limited
IPDC Inter-Gatekeeper Protocol Support	Yes	No	No
Gateway ad User Database Support	Yes	Limited	Limited
Toll-Quality Voice			
ToS Configuration and Control	Yes	Limited	Yes
Expanded Voice CODEC Support	Yes	Limited	Limited
Silence Detection and Comfort Noise Generation	Yes	Limited	Limited
DTMF Detection and Generation	Yes	Yes	Yes
DTMF Tone Pass-Through	Yes	Limited	Yes
ANI Authentication	Yes	Limited	Limited
PIN Authentication Option	Yes	Limited	Yes

	Lucent	Switch Vendors	PC Platforms
Toll-Quality Voice, continued			
IP Address to Phone Number Translation (IP to E.164)	Yes	Yes	Yes
Support for RTP/RTCP for Sequenced Audio Packets	Yes	Yes	Yes
Hybrid-line Echo Cancellation Support	Yes	Yes	Yes
Integrated, Automatic Load-balancing between Gateways	Yes	Limited	Limited
Broad CODEC Support (G.711, G.723.1, G.729.A)	Yes	Limited	Yes
Integrated Access Switch			
Support for VoIP	Yes	Yes	Yes
Support for Real-Time Fax-over-IP	Yes	Yes	Limited
API Support for Store-and-Forward Fax-over-IP	Yes	Limited	Limited
Support for Dial Modem Data Access (to V.90)	Yes	No	Limited
Support for ISDN Dial Data Access	Yes	No	Limited
Support for Frame Relay Access	Yes	No	Limited
Support for DSL-based Access	Yes	No	No
Integrated, Field-Proven, Real-time Operating System	Yes	No	Limited
Integrated IP Routing	Yes	Limited	Limited
Integrated 10 and 10/100 Ethernet Support	Yes	Limited	Limited
Integrated Optional Dual, Load Sharing Power Supplies	Yes	Yes	Limited
Integrated API for Third Party Applications Support	Yes	Limited	Limited
Core Switching Integration			
Backbone Switch Technology and Market Leadership	Yes	No	Limited
Carrier Class Extensibility for Support of Millions of Calls per Hour	Yes	No	Very Limited
End-to-end QoS Support, Integrating IP, Frame Relay and ATM	Yes	No	Very Limited
Mapping of ToS Priority Levels into Frame Relay VCs	Yes	No	Limited
Mapping of ToS Priority Levels into ATM VCs	Yes	No	Limited
Mapping of ToS Priorities to MPLS flows for Absolute QoS	Yes	No	Very Limited
End-to-End QoS Management Support	Yes	No	Very Limited

	Lucent	Switch Vendors	PC Platforms
Network Management and QoS Support			
Ease of Provisioning – GUI or Traditional Telnet	Yes	Limited	Limited
UNIX and NT versions of Network Management System	Yes	Very Limited	Limited
Integrated VoIP and Data Network Management	Yes	Very Limited	Limited
ToS Quality of Service Management	Yes	Very Limited	Limited
Absolute Quality of Service Management Systems	Yes	No	Very Limited
Basic SS7 Interoperability	Yes – Planned	Limited	Limited
Advanced SS7 Support	Yes – Planned	No	Very Limited
E1/R2 Signaling Support	Yes	Very Limited	Limited
Q.831 for Call Signaling and Call Setup	Yes	Yes	Yes
Worldwide Signaling Support	Yes	Very Limited	Limited
Homologation in over 40 Countries	Yes	No	Very Limited

Note: All specifications subject to change without notice.

"NO" – indicates that no vendors in this class of product support this capability to our knowledge
"Very Limited" – indicates that support for this capability is rare in this class of product
"Limited" – indicates that some vendors in this class of product support this capability
"Yes" – indicates that almost all vendors in this class of product support this capability