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Contents

Edify Electronic Workforce on Compaq ProLiant Servers

Abstract: This white paper documents the results of a comprehensive call center benchmark test run at Compaq labs. The goal of this benchmark is to demonstrate a simulated call center/IVR environment and benchmark a test customer inquiry/call routing application running on Edify's Electronic Workforce, Compaq ProLiant Servers, and Natural MicroSystems Alliance Generation voice and call processing boards.

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Edify Electronic Workforce on Compaq ProLiant Servers
White Paper prepared by Communications Industry Solutions Segment

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Executive Summary

Today's call center administrators need and demand powerful, flexible solutions that provide easy integration, scalability, and security. Current call center revenues are tied directly to the effectiveness of automated services and customer interactions and to the customer satisfaction generated by these interactions. When customer self service, telesales and/or problem resolution calls are interrupted, huge revenue losses can often result. Companies depend more than ever on information systems to handle mission-critical applications and require solutions that keep their businesses running with a continuous and effective flow of information.

A successful call center can only grow larger and more complex over time. As a result, it is necessary for call centers to utilize highly flexible, scalable, and cost effective systems and make sure these systems can be fully integrated to provide a complete call center solution.

Previously, high-end call center systems were based on proprietary hardware, which locked customers into expensive upgrade paths, and were limited in their flexibility and expandability. With Electronic Workforce/LS, Edify delivers the only NT-optimized IVR solution for advanced call centers that is based on industry-standard hardware—for superior price/performance and a lower cost of ownership.

Edify's software-only approach provides call centers with the automated piece of their total call center solution allowing a call center to reduce cost by automating customer interactions. Furthermore, Edify's Electronic Workforce uses an open object-oriented development environment that supports easy integration with other third party "best of class" solutions including industry leading assisted services solutions and CTI middleware. Call Center managers can now build a complete NT based call center solution (automated services, assisted service, and CTI middleware) on industry standard hardware, achieving reliability, scalability and next generation service at a lower cost.

This white paper summarizes the results of a Compaq conducted performance benchmark for Edify's Electronic Workforce/LS. A typical phone-based customer service application was defined and tested for a period of 24 continuous hours to identify the performance and capacity characteristics of Edify's Electronic Workforce/LS product for interactive voice response. The application was tested at 96 ports, 192 ports, and 288 ports per server. These benchmarks proved Electronic Workforce/LS capable of scaling up to 11,505 transactions during the busy hour and up to 276,112 transactions during a 24-hour day.

The Edify software works with state-of-the art voice and call processing boards from Natural MicroSystems. The Alliance Generation (AG) Quad T1/E1 boards plug into the PCI bus of the Compaq ProLiant Server and deliver maximum performance, high capacity, and the flexibility to adapt to changing requirements.

Compaq ProLiant Servers offer excellent reliability, for example: redundant power supplies, redundant cooling fans, hot-pluggable devices, and ECC memory. Compaq ProLiant Servers provide scalability and the standard of quality and reliability customers have come to expect from Compaq to protect their applications and data.

The results described in this white paper demonstrate that the combination of Compaq ProLiant Servers, Edify Electronic Workforce, and Natural MicroSystems voice and call processing boards provides customers a solid base on which to easily build and deploy a highly available, scalable, and secure call center environment.

The Compaq-Edify Partnership

Compaq Computer Corporation and Edify Corporation have recently announced a marketing alliance to provide advanced Windows NT-based open solutions to large call centers, and Compaq has named Edify a preferred Solutions Alliance Partner. This relationship was formed as an answer to the demand for highly scalable non-proprietary solutions that enable advanced call centers to handle high call volumes while enjoying the freedom to quickly and cost-effectively integrate new technologies.

The extensive scalability of Edify Electronic Workforce/LS highlights the synergy between Compaq and Edify products and their commitment to jointly develop, test, certify, and market new call center solutions that scale beyond proprietary solutions.

The work that Compaq has already done with strategic partners such as Microsoft and Genesys Telecommunications Laboratories, Inc. also benefits this relationship. Both Windows NT operating systems and Microsoft SQL Server databases have been optimized and tuned to run on Compaq ProLiant Servers, allowing you to focus on the Edify application. In addition, both Compaq and Edify have worked with other third party call center solutions providers, such as Genesys Telecommunications Laboratories, Inc., to test and implement joint solutions in call centers.

Installation support for both Windows NT and SQL Server is included in the easy to use SmartStart program that ships with each Compaq ProLiant Server. SmartStart enables customers to automate the installation of these programs thereby reducing installation error and load time.

The Open Telecommunications Advantage

Adding to the synergy between Compaq and Edify is the Open Telecommunications solutions platforms from Natural MicroSystems, a Compaq Solutions Alliance Partner. Open Telecommunications solutions platforms leverage industry-standard bus architectures, hardware components, operating systems, and application development tools, supporting the need to get scalable solutions to market quickly and cost-effectively.

The AG Quad T1/E1 voice and call processing boards are the hardware component of Edify Electronic Workforce/LS. They feature two T1 or E1 integrated digital trunk interfaces for up to 48 or 60 ports, respectively, of voice processing in a single PCI slot. A powerful embedded on-board control processor dynamically assigns resources as needed, reducing processing overhead.

High Availability

Compaq understands that system availability is critical to the success and operation of a call center and any loss of availability translates into a loss of time and money. To protect the customer from such losses, Compaq offers many features that ensure Compaq servers provide maximum uptime with minimal maintenance requirements.

Compaq has also been working closely with Microsoft during the development of Microsoft Cluster Server. When combined with Compaq ProLiant Server, this product provides an uncompromisingly high level of data, application, and server availability to run business-critical software applications, such as the Edify Electronic Workforce.

The Edify Solution

Edify saw the desirability of moving beyond single-purpose applications like interactive voice response (IVR) or web database access, and developed a powerful platform that enables rapid creation of a wide range of self-service solutions. This platform, the Edify Electronic Workforce, is specifically designed to incorporate the phone self-service features found in standalone IVR systems as well as Internet and intranet systems. The Electronic Workforce provides a flexible, robust, and open environment that supports the creation and management of enterprise-level self-service solutions.

The Electronic Workforce addresses the needs of organizations deploying self-service solutions through:

- **Multiple interaction channels.** Edify self-service applications can be deployed over a wide range of communication media. This flexibility allows users to access and interact with their organization's system using the means that are most convenient for them. Supported devices include: Web browsers, phones, fax machines, electronic mail, alphanumeric pagers, personal computer, and kiosks.

- **Broad integration with back-office systems.** The Electronic Workforce integrates with a wide variety of database, client/server, desktop, and legacy systems. It pulls data from a variety of sources and seamlessly presents it to customers and employees—in whatever form best suits their purposes. This integration allows developers to create and build self-service solutions for the enterprise, rather than forcing duplication of applications to leverage information in different back-office systems.

- **Feature-rich applications.** The Electronic Workforce provides the tools to create sophisticated application logic. These tools allow developers to create feature-rich applications that move beyond simple Web or phone access to back-office information systems. Electronic Workforce solutions can be easily designed to deliver personalized information, adding targeted marketing information at the same time.

- **Rapid application development.** The Electronic Workforce is uniquely designed to minimize development and maintenance time, and therefore the total cost of ownership. The Electronic Workforce includes an object-oriented development environment that is 100% visual. No low-level coding is required to create and adapt self-service applications.

- **Robust deployment.** The Electronic Workforce gives developers the confidence to build mission-critical applications of any size. Its open architecture provides the scalability, manageability, security and reliability necessary for large-scale deployment. The Electronic Workforce operates on one or more networked nodes, allowing customers to expand capacity as the number of applications or users increases. Edify provides an integrated administration and monitoring tool for large systems, handling single or multiple server solutions.

The Electronic Workforce design philosophy is centered around open standards-based computing. It runs on Windows NT, allowing developers to leverage existing internal skills and systems, and is designed to work with industry-standard hardware. This philosophy benefits customers through investment protection and a lower cost of ownership.

Electronic Workforce Overview

The Edify Electronic Workforce is a platform for creating virtually any self-service solution. The product has three main components: Workforce Objects, prebuilt software objects; Workforce Application Builder, an object assembly environment designed for visually developing applications; and Workforce Application Server, a runtime environment for application management and deployment.

Workforce Objects—Powerful Automation Capability

At the heart of Edify's technology are Workforce Objects: high-function, prebuilt software objects that can be combined to create feature-rich self service applications. These applications fulfill the role of live customer service representatives by dynamically handling and responding to customer inquiries in place of less efficient manual operation.

Workforce Objects have both depth and breadth: each has high-level functionality, and each can be smoothly integrated with other objects to build across-the-board self-service solutions. The Electronic Workforce architecture is also designed for support of objects built using industry-standard object models such as Microsoft COM. Workforce Objects segment the functionality necessary to integrate the different media and systems in a self-service application. Developers avoid the underlying complexity of system integration, allowing faster, more sophisticated conceptual design and deployment of the solution.

Workforce Object capabilities can be combined to handle a variety of tasks over multiple media to a broad range of back-office systems. Workforce Objects provide:

- **information access**—seamless integration with a wide variety of database, client/server, desktop, and legacy systems to provide total information access

- **communications access**—seamless integration with web browsers, phones, fax machines , e-mail, pagers, personal computers, kiosks, and more

- **process automation**—business rules and workflow operations including time- and event-driven services, conditional application execution, dynamic data manipulation, and analysis and personalization

By combining Workforce Objects, developers can quickly create integrated, proactive, feature-rich applications that span various media and systems. Electronic Workforce applications can manipulate, transform, and personalize information in real time or based on a user-defined time or event. This power lets developers create sophisticated self-service applications that meet complex user needs.

Workforce Application Builder—Visual Object Assembly

Workforce Application Builder is the only 100% visual development environment that allows developers to define and customize self-service applications. The Workforce Application Builder allows organizations to quickly and easily assemble Workforce Objects to perform services on behalf of their customers, employees, or business partners.

Workforce Application Builder features a visual development paradigm (pioneered and patented by Edify) that uses object icons and a grid-based workspace instead of a programming language. This award-winning approach dramatically differentiates Edify's technology from other approaches. The visual nature of Workforce Application Builder requires no coding, and its self-documenting environment makes applications easier to develop and maintain. Sophisticated applications that could take months—or even years—to develop with other approaches can be deployed in a matter of weeks or even days.
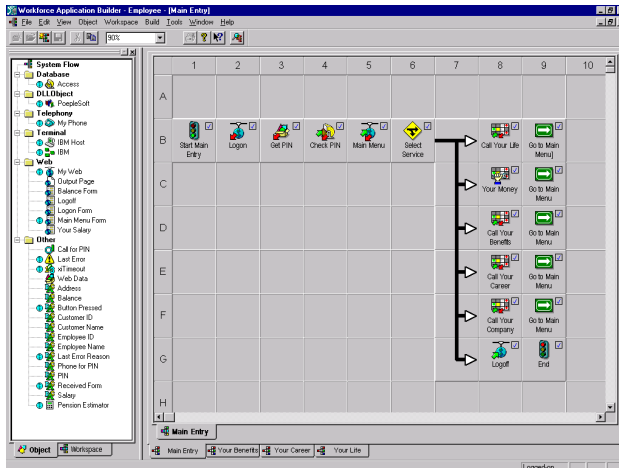

Figure 1.   Workforce Application Builder screen

Workforce Application Builder also features fully integrated customization tools for defining connectivity to databases, mainframes, and any third-party application or application programming interface. With these tools developers can:

- design the user interface for web and phone applications

- define the means to link Electronic Workforce self service applications with a variety of back-office systems including enterprise legacy and client/server systems

- monitor, administer, and report on all aspects of the self-service application during runtime

Workforce Application Server: Robust Deployment Across the Enterprise

To simplify the management and delivery of applications, the Electronic Workforce provides a comprehensive and reliable runtime environment. The Workforce Application Server is the control center for managing the delivery of self-service applications. This powerful, robust runtime environment schedules resources and activities, manages resource usage, tracks application status, handles resource contention, and responds to changing conditions. The Workforce Application Server fully integrates with leading firewall solutions, such as Hewlett-Packard's VirtualVault, to ensure that self service applications deployed with the Electronic Workforce are secure, end to end. It has the power to robustly support large self-service solutions across the enterprise.

With the powerful combination of Workforce Objects, the Workforce Application Builder and the Workforce Application Server, the Electronic Workforce enables developers to build differentiated self-service applications for today's competitive business environment. The following customer scenario illustrates how the Electronic Workforce delivers feature-rich applications that provide broad data access and communication media support and excel at creating application logic to create value-added self service solutions.
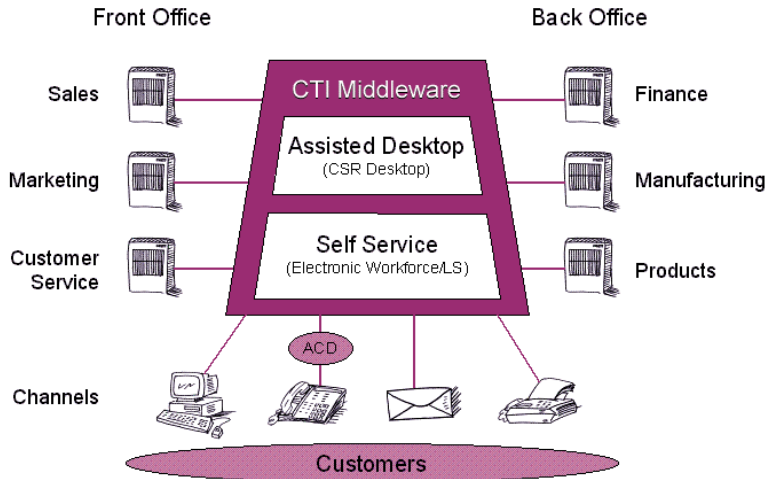
Figure 2.   Electronic Workforce/LS integrates seamlessly into today's advanced call centers

Table 1. Electronic Workforce Interface Capabilities and Platform Requirements

Capabilities	
Telephony	*Differentiated Applications*
• Place, receive, and transfer calls	• Personalized
• Recognize and send DTMF tones	• Proactive notification
• Record and play voice prompts or messages	• Workflow automation
• Support multiple languages	• Cross selling
• Interpret ANI and DNIS	• Screen pop
• Switch call to provide loopback transfer	• Call routing
• Recognize speech	• Web Call Me™
• Send dynamic Faxes	
Channel Support	*Connectivity*
• Telephone	• Leading ACDs and PBXs using analog, T1, E1, ISDN, and CTI
• Web	• Genesys Suite
• CSR Desktop	• Front-office systems, including Vantive, Scopus and Clarify
• Electronic mail	• Back-office systems, including legacy, client server, database server
• Pager	• Edify's Electronic Banking System and Employee Service System
• Fax	• Web servers, including Microsoft and Netscape®
	• COM enabled software

Minimum Hardware Requirements

The minimum hardware requirements for installing Edify Electronic Workforce are:

- Windows NT compatible platform

- Intel Pentium Pro processor 200 MHz

- Windows NT 4.0 Workstation or Server

- 128-MB memory

- 1-GB available disk space

- Natural MicroSystems AG Quad T1/E1 voice and call processing board

- SuperVGA 1024 X 768 video for development workstation

Installation and Configuration

Basic installation begins with Compaq SmartStart and then the Edify Electronic Workforce hardware and software. You can use the examples listed in this document to assist in selecting appropriate hardware and the following sizer tools to assist you in selecting and configuring your database(s):

- Compaq ProLiant Server Sizer for Microsoft SQL Server, available at
  http://www.compaq.com/solutions/enterprise/database-mssqlserver.html

- Oracle System Sizer, available at
  http://www.compaq.com/solutions/enterprise/database-oracle.html

Use SmartStart to configure Compaq hardware, install Compaq support software, automatically update Compaq drivers, and simplify the installation and optimization of Microsoft Windows NT Server 4.0 and an Oracle or Microsoft SQL database. See the Compaq SmartStart documentation for specific installation instructions.

After installing the operating system and an Oracle or Microsoft SQL database, the Electronic Workforce application can be installed. Refer to the Edify Electronic Workforce installation guides for detailed instructions.

The following White Papers, available at http://www.compaq.com/support/techpubs/whitepapers, may also be helpful for installation and configuration, and to enhance performance:

Compaq ProLiant 7000 Server Technology

Compaq SmartStart

Disk Subsystem Performance and Scalability

Backup Basics

Compaq DLT Library Technology

Insight Asynchronous Management for Windows NT

Configuration and Tuning of Oracle7 Server for Windows NT on Compaq Servers

Configuration and Tuning of Microsoft SQL Server 6.5 for Windows NT on Compaq Servers

Configuration and Tuning of Sybase System 11 for Windows NT on Compaq Servers

Compaq ProLiant 6500/7000 vs. Sun Ultra Enterprise 450

Performance Testing

This section summarizes the configuration and performance results of recent internal Compaq performance benchmarks using Edify Electronic Workforce. These tests were performed using Compaq ProLiant Servers loaded with Natural MicroSystems AG Quad T1 voice boards. The servers were configured using Microsoft Windows NT Server 4.0 and Microsoft SQL Server 6.5.

This information can be used when formulating configuration recommendations for customers installing Edify Electronic Workforce on Compaq platforms running Windows NT. Actual performance may vary depending upon switch, server configuration, server OS, other network traffic, customer database configuration, and so on.

Note: This application is run in a lab to simulate a real world IVR Call Center environment utilizing telephony and database subsystems. As with any applications, it may not fit your particular needs and may be changed at your discretion. Support for this particular application is limited; it is recommended that an original application for testing or for a particular environment be written by in-house and/or by Edify Professional Services personnel.
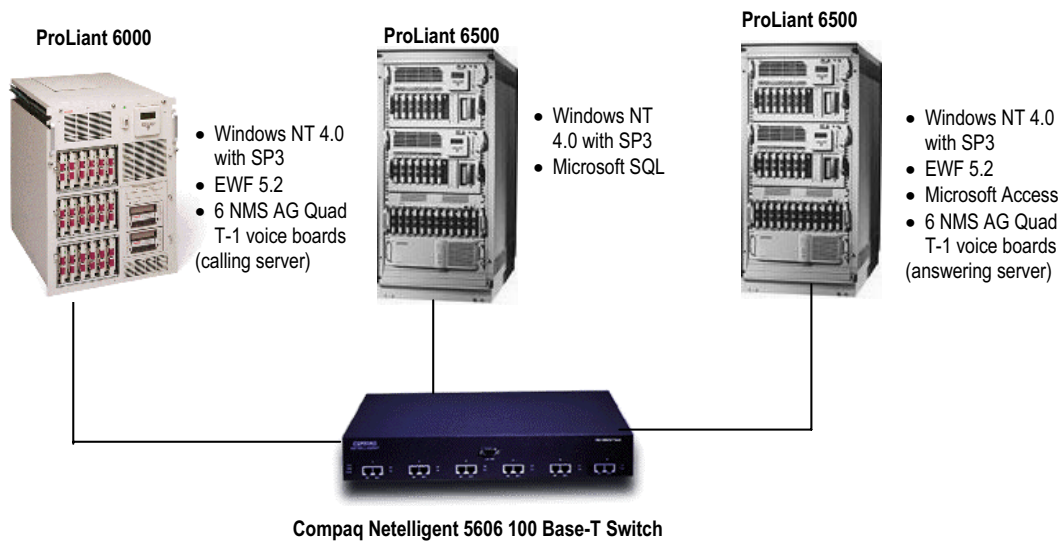
Benchmark Configuration

The following applications were used during these benchmark performance tests:

- Electronic Workforce 5.2

- Microsoft SQL Server 6.5

- Microsoft Access 97

The benchmarks were run on Compaq ProLiant servers configured as shown in Table 2.

Table 2. IVR Test Configuration

Server #	Description	Software Components
1	ProLiant 6000, 256-MB RAM, 1P, 10/100 Base T-NIC, 6 Natural MicroSystems AG Quad T-1 voice boards (calling server)	• Windows NT 4.0 with Service Pack 3 • Electronic Workforce 5.2
2	ProLiant 6500, 256-MB RAM, 10/100 Base T-NIC (database server)	• Windows NT 4.0 with Service Pack 3 • Microsoft SQL 6.5
3	ProLiant 6500, 512-MB RAM, 4P, 10/100 Base T-NIC, 6 Natural MicroSystems AG Quad T-1 voice boards (answering server)	• Windows NT 4.0 with Service Pack 3 • Electronic Workforce 5.2 • Microsoft Access

ProLiant 6000

ProLiant 6500

ProLiant 6500

- Windows NT 4.0 with SP3
- EWF 5.2
- 6 NMS AG Quad T-1 voice boards (calling server)

- Windows NT 4.0 with SP3
- Microsoft SQL

- Windows NT 4.0 with SP3
- EWF 5.2
- Microsoft Access
- 6 NMS AG Quad T-1 voice boards (answering server)

Compaq Netelligent 5606 100 Base-T Switch

Figure 3. IVR Test Configuration

The configuration for performance testing was as follows:

- The tested application was designed to simulate a real world call center application.

- A small Edify call generation application was built to generate and simulate inbound calls. This application was run on the ProLiant 6000 as shown in Figure 3. Generated calls were received and handled by a customer inquiry/call routing application (called "System_Integration application") running on the ProLiant 6500 as shown in Figure 3. This receiving application was the application tested in this benchmark.

- 288 lines were connected in a back-to-back system. Multiple T1s with 48 lines per T1 were connected to 6 Natural MicroSystems AG Quad T-1 voice boards plugged into 6 Compaq 6500 PCI slots. For the purposes of this test no PBX (switch) was used.

- Microsoft SQL database was used on a dedicated remote server to simulate a real call center scenario.

- Microsoft Access was used to confirm ANI and call path information for the application and write reports data for generating Edify reports. In a real call center environment it is recommended that you write the reports data to the remote database due to size limitations of Access.

Note: Be aware that in the "real world," network traffic may impact performance.

Application Description

This benchmark simulates a typical IVR customer inquiry/call routing application. The application: waits for calls, answers calls, receives ANI/DNIS information, routes calls based off ANI/DNIS, accepts DTMF tones for input, plays voice prompts, queries a remotely connected Microsoft SQL Server database for the pertinent customer information, and ends the call.

This application is intended to demonstrate the scalability of an Edify application running on industry standard Compaq servers running Windows NT and utilizing Natural MicroSystems voice boards. For detailed information on this application, see the section "System_Integration Application Overview" later in this paper.

Note: This application is run in a lab to simulate a real world IVR Call Center environment utilizing telephony and database subsystems. As with any applications, it may not fit your particular needs and may be changed at your discretion. Support for this particular application is limited; it is recommended that an original application for testing or for a particular environment be written by in-house and/or by Edify Professional Services personnel.

Definitions

- **Transaction**: For the purposes of this Benchmark transactions are defined as a complete call from the time it is answered to the time it ends. Each call or transaction generates three reads from a local database and five writes to the remote database, so each call generates eight statements. The average call duration for each transaction was approximately 80 seconds in length .All calls were answered within one ring cycle (approximately 3 seconds).

- **Answer In Call**: This term refers to the length of time each complete transaction took.

- **Answer Time**: This refers to the amount of time it took the application to answer incoming calls.

Performance Results

Table 3. Summary of Performance Results

Number of Ports	96	192	288
Test Time	24 hours	24 hours	24 hours
% Processor Time 0	35	69.298	86
% Processor Time 1	32	69.747	83
% Processor Time 2	39	69.228	80
% Processor Time 3	40	69.017	81
Average Processor Time (%)	36.5	69.3225	82.5
Average Answer In Call Time (sec)	80	80	81
Average Answer Time (sec)	3	3	3.11
Total # of Transactions	95040	206160	276112
Average Transactions per hour	3960	8590	11505
Total # database reads/writes	760320	1649280	2208896
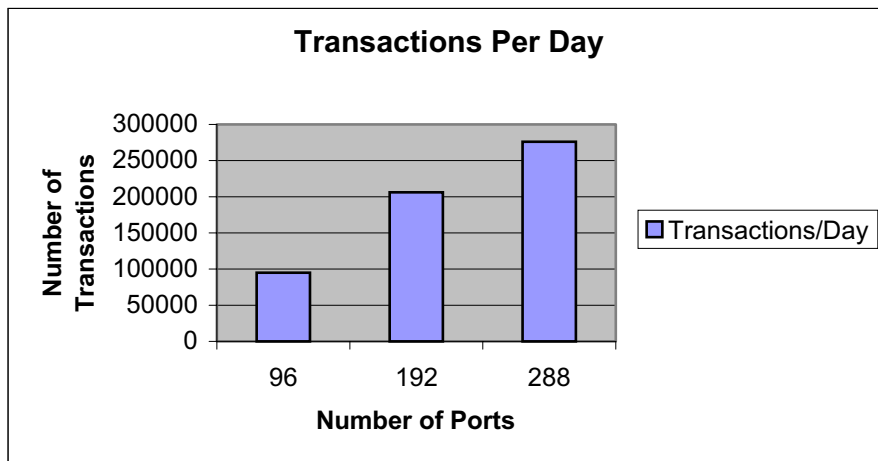
Figure 4.   Transactions Per Day (24 hours)

Figure 4 shows the number of transactions (calls) per day. One call processed all the way through is considered a transaction.

Based on performance testing over a 24-hour period, the server was able to answer 3,960 per hour (95040 total) using 96 ports, 8,590 calls per hour (206,160 total) using 192 ports, and 11,505 calls per hour (276,112 total) when 288 ports were used. By increasing the number of ports from 96 to 192, call volume more than doubled. By increasing the number of ports from 192 to 288, call volume handled by a single server increased again by over 30%.
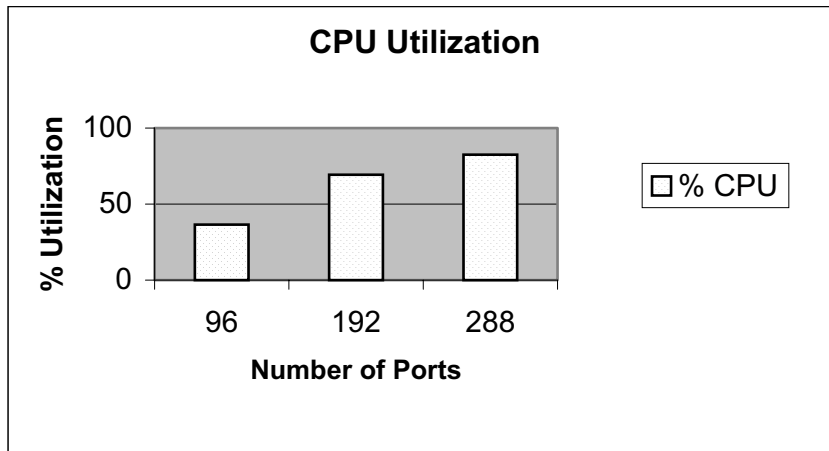
CPU Utilization

Figure 5.   CPU Utilization

Figure 5 shows the CPU Utilization over the 24-hour test period. You can see that an increase in the number of ports increases the CPU utilization rate, however even using 288 ports, the rate still remains at an acceptable and sustainable level.
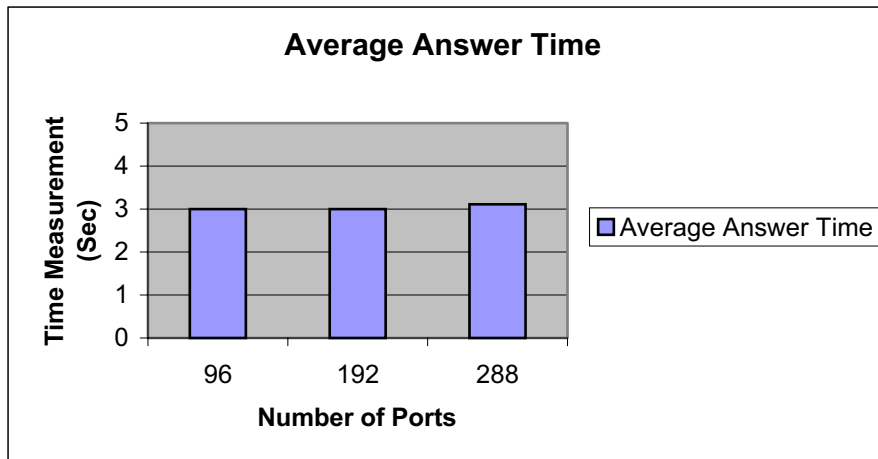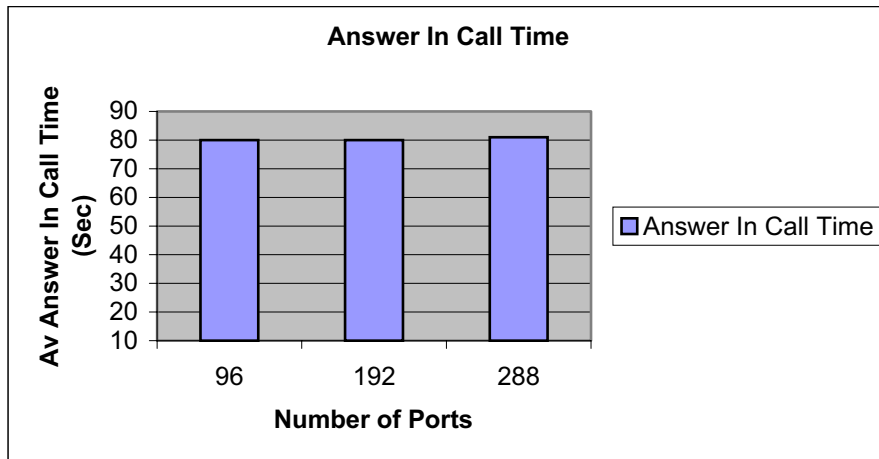
Average Answer Time

Figure 6.   Average Answer Time

Figure 6 shows the average call answer time when tested using 96 ports, 192 ports, then 288. You can see that the Edify application running on the tested configuration maintains a consistent average answer time even as the number of ports and number of transactions that the application is handling increases. Increasing the number of ports does not dramatically affect the average answer time and that all calls were answered within 1 ring cycle.

Figure 7.   Answer In Call Time

Figure 7 shows the average Answer In call time. As the number of ports increases to 288 (and subsequent number of transactions increases from 3,960 per hour to 11,505 per hour) the Edify application performs consistently with only a three-second difference in total call time. This is the duration of the call. The difference of the call length during testing was only three seconds, averaging 78 seconds using 96 and 192 ports, and 81 seconds using 288 ports.
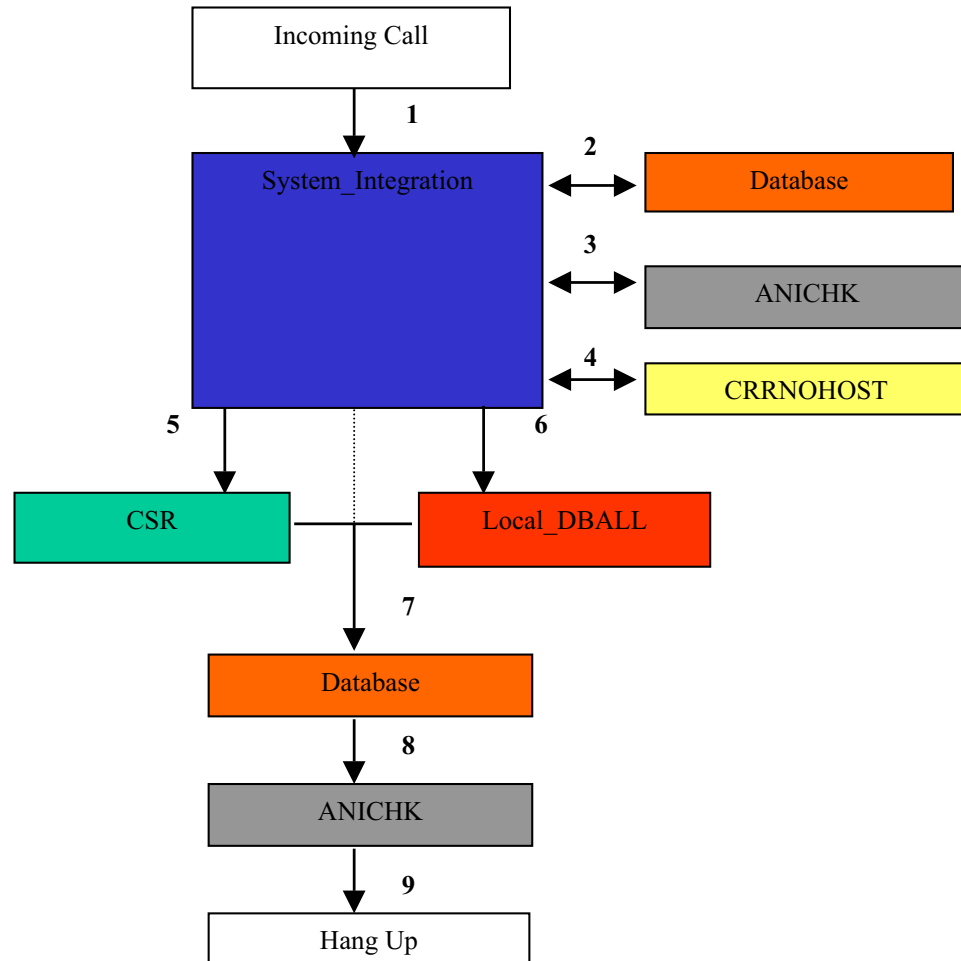
System_Integration Application Overview

The System_Integration application is an IVR customer inquiry / call routing application.

System_Integration is used as the answering application. From this application there are three calls to three separate applications: ANICHK, CRRNOHOST, and Local_DBALL. Two separate databases are also accessed to read and write information during the course of the call.

Flow of the call

Figure 8. Flow of the call diagram

Figure 8 shows the call flow using the System_Integration application.

1. The call is answered by the System_Integration application; ANI and DNIS are hardcoded in the application due to back-to-back configuration. Generally this would be information that is received from the switch (PBX) or CO.

2. The answering application loads module information from a local Access Database "System_Integration.mdb."

3. System_Integration calls ANICHK; ANICHK plays a synchronization DTMF tone to the calling application. It then prompts the user for input. "1" is the value used in testing (this is where confirmation of the calling number is done).

    The caller is then passed back to the System_Integration application and a prompt indicating "Checking account information" is played.

4. System_Integration makes a call to the application CRRNOHOST. (This application has been modified from its original customer specific format. In the original application this would be where ANI/DNIS and customer information is accessed and read back into the application from the Terminal).

    System_Integration then performs a comparison of information of the ANI/DNIS obtained at the beginning of the call and the call path information loaded from the local database. This information determines the routing of the call to the proper CSR determined by the ANI+DNIS and call path information.

5. System_Integration simulates the transfer of the call to the CSR (due to the back-to-back configuration a flash transfer is not possible; in a real world environment this would perform the flash transfer to the PBX or CO, if supported).

6. The application gathers system and call information, preparing to write to the Remote database. This is where System_Integration calls the application Local_DBALL.

7. System_Integration writes proprietary call information (Transaction, Record, Path and Exception information) to the database.

8. The application System_Integration plays a prompt "Back From Database." This prompt along with the "Back from Host" are purely for testing to be able to confirm audibly the flow of the call. After the prompt there is another synchronizing DTMF tone played.

9. Finally there is the Hang-up, at which point the system report information is written to the database defined within reports.

The application then prepares to receive another incoming call.

Minor Statistics

Telephony (per call)

Average incall time: 75 - 85 seconds

Average answer time: Varies depending on number of database resources or other limiting environment conditions. Generally within one ring cycle.

Database: (per call)

Number of Statements: 8

Number of Rows Fetched: 8

Number of Items Fetched: 8

Number of Commits: 0

Number of Rollbacks: 0

Summary

Performance testing demonstrated that Edify Electronic Workforce/LS on a Compaq ProLiant 6500 with Natural MicroSystems AG Quad T1 voice and call processing boards scales to 288 ports per server.

The tested Edify IVR customer inquiry/call routing application scaled well, performing consistently as the number of ports increased from 96 to 288. Edify application performance and Compaq CPU utilization remained at acceptable and sustainable levels even at the maximum 288 port configuration for a full 24-hour test time.

This study validates that the Electronic Workforce/LS software allows call centers to scale Edify IVR applications up to 288 ports per server. This allows call centers to reduce their server footprint and further reduce their cost of ownership while enjoying the benefits of an open, integrated system.

The combination of Compaq's processing power, Edify's high capacity IVR software and Natural MicroSystems high density boards gives customers what they need to be successful in today's call center environment: excellent scalability and flexibility, confirming that open NT-based IVR call center solutions can now meet the call volume demands of large call centers.