

**HIGHLY AVAILABLE SERVERS
MARKET ASSUMPTIONS**

1998 to 2003

*All Rights Reserved - copyright © 1999 Harvard Research Group, Inc.
Reproduction without permission is prohibited.*

Table of Contents

<u>Executive Summary</u>	<u>3</u>
<u>Introduction</u>	<u>4</u>
<u>AEC Definitions</u>	<u>4</u>
<u>Worldwide Revenue by Geography</u>	<u>7</u>
<u>Worldwide Revenue by Industry</u>	<u>8</u>
<u>Worldwide Revenue by AEC</u>	<u>9</u>
<u>Worldwide Shipments by AEC</u>	<u>9</u>
<u>World Wide Revenue by OS</u>	<u>11</u>
<u>Worldwide Shipments by OS</u>	<u>11</u>
<u>Forecast Methodology</u>	<u>13</u>
<u>General Assumptions</u>	<u>15</u>
<u>Vertical Industries</u>	<u>17</u>
<u>Banking</u>	<u>18</u>
<u>Securities/Financial Services</u>	<u>21</u>
<u>Retail/Distribution</u>	<u>24</u>
<u>Government</u>	<u>27</u>
<u>Gaming</u>	<u>28</u>
<u>Healthcare</u>	<u>30</u>
<u>Travel</u>	<u>33</u>
<u>Telecommunications</u>	<u>34</u>
<u>Insurance</u>	<u>39</u>
<u>Manufacturing</u>	<u>40</u>
<u>Other</u>	<u>42</u>
<u>Geographies</u>	<u>.</u>
<u>North America</u>	<u>43</u>
<u>Latin America</u>	<u>44</u>
<u>Major European Countries EMEA</u>	<u>45</u>
<u>Scandinavia</u>	<u>49</u>
<u>Other Europe</u>	<u>54</u>
<u>Japan</u>	<u>55</u>
<u>China</u>	<u>57</u>
<u>Asia/Pacific</u>	<u>59</u>

EXECUTIVE SUMMARY

High Availability (HA) is a necessity for an increasing number of organizations. The quest for the right High Availability Solution is being driven in part by a new generation of applications such as Customer Relationship Marketing, Data Warehouse / Data Mining, Supply Chain Management (SCM), and Enterprise Resource Planning (ERP), and by the growth in the number of customer facing applications. These applications bring end users closer to the Corporate Information Resource than at any previous time in the history of IT, and in many cases interactively. Some of the key forces behind the development of this new generation of software applications are e-commerce, the increasingly global nature of the competitive business environment, and an increase in end-user requirements for information availability and integrity. A number of these new customer-facing applications, built using a Web centric paradigm, are early drivers of growth in the incipient e-commerce market.

Any outage in a real-time on-line web centric environment has the potential for significant revenue loss, as well as losses in customer loyalty, customer retention, and even stock value. For example, a string of outages at eBay resulted in a significant revenue loss and a 9% (\$16.81) drop in eBay's stock price.

Further enhancing the demand for HA servers is the fast pace at which business, government and individual enterprises are adopting Internet, intranet, and extranet technologies. This dynamic has already begun to change the way users and enterprises interact (i.e., customer facing applications), spawning new approaches to old problems. The very nature of these new applications make users acutely dependent upon access to and the integrity of the information service, and an environment where the pain associated with the loss of service far outweighs the pain of switching to a more reliable service provider.

Harvard Research Group believes that in the not so distant future, all IT organizations or Information Providers will have to deliver a highly available computing environment or run the risk of being driven out of business by their competition and dissatisfied former customers. Server manufacturers, database vendors, and software application solution providers have all come to understand that some level of enhanced availability is now a required benefit. Providing enhanced availability through HA functionality is the ante to get into the game – if you can't ante up you can't play.

INTRODUCTION

This report presents a market forecast of Highly Available server use. The forecast includes systems that are modified or enhanced after shipment thereby placing them in a higher Availability Environment Classification. When a Highly Available system is initially shipped from the manufacturer it has the software and hardware capabilities to place it in a given Availability Environment Classification. Many times after systems are delivered they are modified or managed in such a way as to place them in a higher Availability Environment Classification than they were at the time of shipment. Additional components, such as back-up power sources, may be added as well as clustering software and RAID storage devices to further enhance system availability.

AVAILABILITY ENVIRONMENT CLASSIFICATIONS (AEC)

HRG has defined availability in terms of the impact of an outage on the activity of the business and consumer (end user) of the service. The five Availability Environments (AE) below define availability in terms of the impact on the both the business and the end user or consumer. Each successive level incorporates all the functionality of the previous level. When a failure and subsequent system recovery response has occurred the system is assumed to not be at its original Availability Environment Classification until the failure has been corrected and any failed components have been replaced or repaired. In some cases, there may be system redundancies that support fail over capabilities in the event of an additional failure. The minimum requirement for a system to be considered highly available is that there is a backup copy of data available on a redundant disk and a log-based or journal file system exists for identification and recovery of incomplete transactions -- this represents the AE 1 Availability Environment Classification.

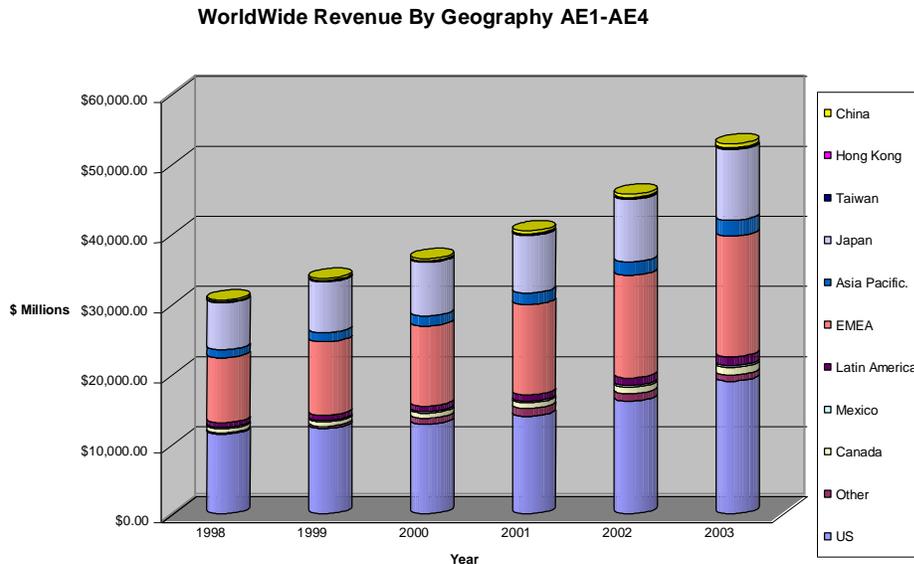
- **AE4** – Business functions that demand continuous computing and where any failure is transparent to the user. This means no interruption of work; no transactions lost; no degradation in performance; and continuous 24x7 operation.
- **AE3** – Business functions that require uninterrupted computing services, either during essential time periods, or during most hours of the day and most days of the week throughout the year. This means that the user stays on-line. However, the current transaction may need restarting and users may experience some performance degradation.
- **AE2** - Business functions that allow minimally interrupted computing services, either during essential time periods, or during most hours of the day and most days of the week throughout the year. This means the user will be interrupted but can quickly relog on. However, they may have to rerun some transactions from journal files and they may experience some performance degradation.
- **AE1** – Business functions that can be interrupted as long as the availability of the data is insured. To the user work stops and an uncontrolled shutdown occurs. However, data

availability is ensured. A backup copy of data is available on a redundant disk and a log-based or journal file system is being used for identification and recovery of incomplete transactions.

- **AE-0** – Business functions that can be interrupted and where the availability of the data is not essential. To the user work stops and uncontrolled shutdown occurs. Data may be lost or corrupted.

* **Disaster Recovery** capability is a horizontal availability feature that is applicable to any of the Availability Environments (AEs). It provides for remote backup of the information system and makes it safe from disasters such as an earthquake fire, flood, hurricane, power failure, vandalism, or an act of terrorism.

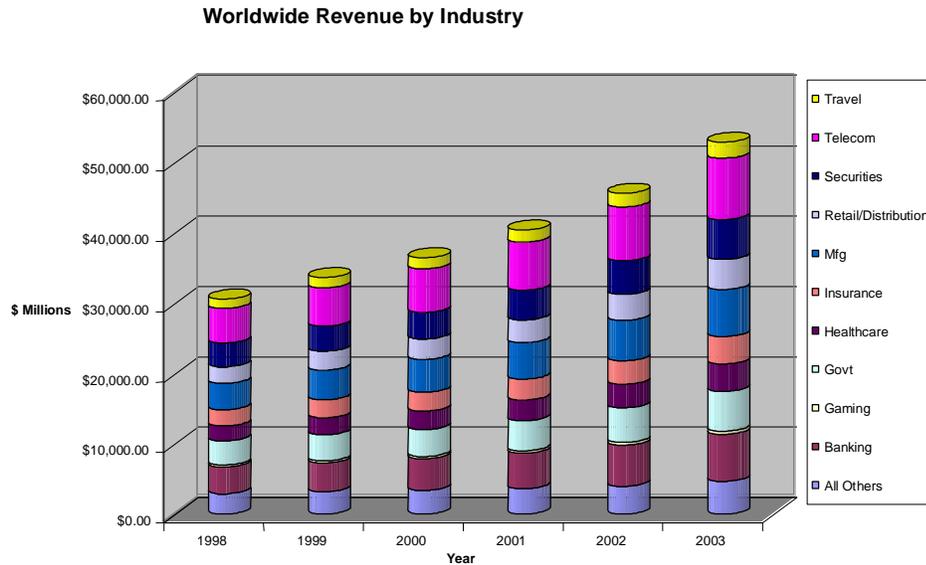
Worldwide Revenue by Geography (AE1 - AE4)



The top five high availability revenue geographies remain the same throughout the forecast period. They are:

1. United States
 2. EMEA
 3. Japan
 4. Asia/Pacific
 5. Latin America
- China, while not in the top five, is projected to experience the highest growth with a compounded annual growth rate (CAGR) of 15.4% over the forecast period.
 - Within the EMEA segment Germany is the largest consumer of high availability systems and projected to grow at CAGR of 8.6% from revenue of \$2.29 billion in 1998 to \$4.8 billion in 2003.
 - The highest growth segment in EMEA is the Mediterranean and East African segments which are projected to experience a 14.5% CAGR over the forecast period, growing from \$371 million in 1998 to \$605 million by 2003.

Worldwide Revenue by Industry (AE1 - AE4)



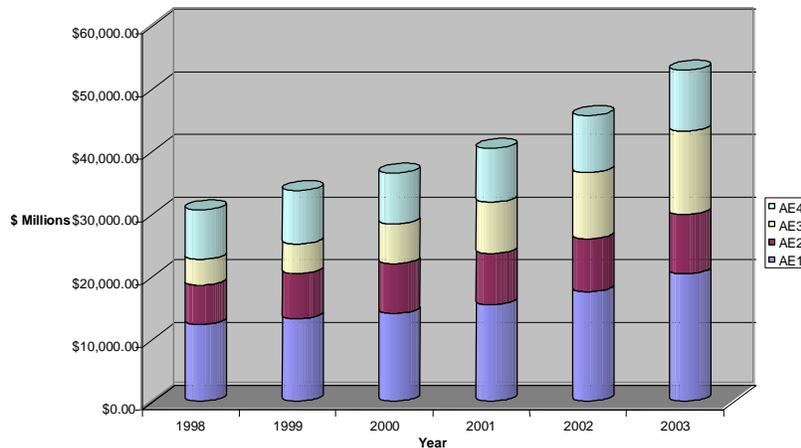
- The top five industries for high availability revenue for the forecast period change slightly between 1998 and 2003. They are:

Rank	1998	2003
1	Telecommunications	Telecommunications
2	Banking	Manufacturing
3	Manufacturing	Banking
4	Government	Securities
5	Securities	Government

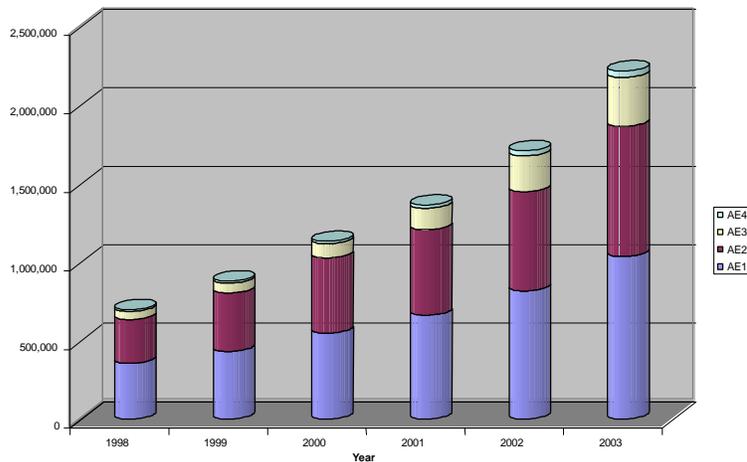
- During the forecast period Manufacturing with a CAGR of 12.2% moves ahead of Banking with its CAGR of 11.7% by the year 2003. A similar story plays out between Government (CAGR 10.5%) and Securities (CAGR 11%)
- The highest growth industry segment is Healthcare, which is projected to grow at a CAGR of 13% over the forecast period, going from \$2.2 billion in 1998 to \$3.9 billion in 2003.
- The lowest growth industry segment is Government at a CAGR of 10.5% over the forecast period, going from \$3.4 billion in 1998 to \$5.7 billion in 2003.

Worldwide Revenue & Shipments by AE

Worldwide Revenue by Availability Environment



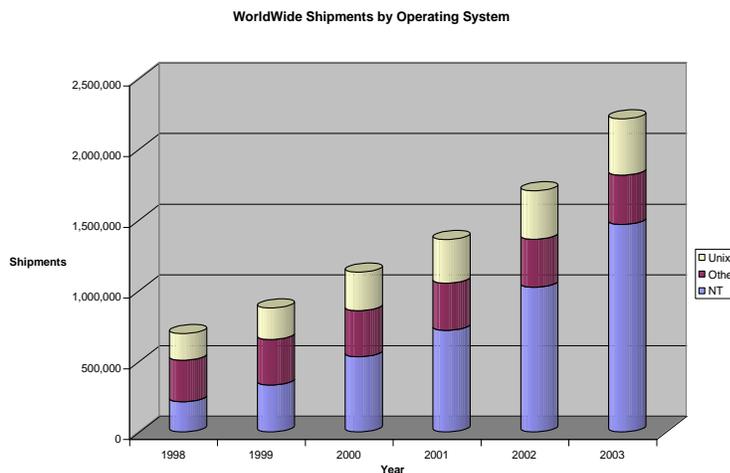
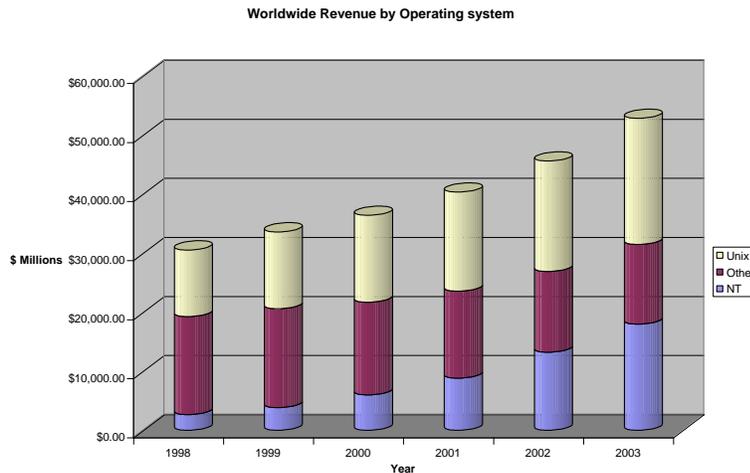
Worldwide Shipments by Availability Environment



- The highest growth Availability Environment for both revenue and shipments is AE3 with revenue CAGR of 26.5% and a shipment CAGR of 42.9%.
- Much of the growth in AE3 comes at the expense of AE2 shipments and revenue as the baseline clustering capabilities are enhanced to include AE3 functionality. During the forecast period AE3 shipment CAGR is the lowest of the four environments at 24%.
- The AE4 segment is forecasted to have the second highest shipment growth at a CAGR of 32%. AE4 shipments are predicted to grow from 10,335 units in 1998 to over 41,000 units in 2003.

- Revenue growth for the AE4 segment is expected to be the lowest of the four segments due to continuing price pressure from commodity-based solutions in both the AE3 and AE4 segments. The projected CAGR for AE4 revenue of 4.2% will take revenue from \$7.9 billion in 1998 to just over \$9.7 billion in 2003.

Worldwide Revenue & Shipments by OS (AE1 - AE4)



- The highest growth Operating System segment for both revenue and shipments is NT with revenue CAGR of 46.5% and a shipment CAGR of 47%. NT shipments are forecasted to grow from 213,803 units in 1998 to over 1,497,000 units in 2003. NT revenue is expected to go from \$2.66 billion in 1998 to almost \$18 billion by 2003.
- Much of the growth in NT will come at the expense of the Other (proprietary) segment. Other operating system revenue is forecasted to decrease at a CAGR of 4.1% during the period from 1998 to 2003, falling from \$16.6 billion in 1998 to \$13.5 billion in 2003.
- Shipments of system in the Other (proprietary) segment will increase slightly at a CAGR of 3.5%, growing from approximately 293,000 units in 1998 to almost 350,000 units in 2003.

- The UNIX segment of the market will continue to sustain significant growth in both revenue and shipments. Unix is forecasted to have a shipment CAGR of 16.2% and revenue CAGR of 13.6%. Unix shipments are expected to grow from approximately 188,000 units in 1998 to 399,000 units in 2003. Corresponding revenue will go from around \$11.3 billion in 1998 to \$21.3 billion in 2003.

FORECAST METHODOLOGY

Harvard Research Group's methodology for forecasting HA server consumption takes into account the Availability Environment Classification of systems when they are shipped, as well as all hardware and software add-ons such as:

- RAID disk subsystems
- Uninterruptible power supplies (UPS)
- High-speed system interconnects
- High availability middle-ware
- HA enabling or clustering software.

Improvements in system availability based on the application of best practices for managing a structured computing environment have also been considered.

HRG did the following in preparing this forecast:

- Conducted in-depth interviews with users, resellers, computer manufacturers, independent software vendors, and industry experts.
- Conducted a thorough review and in-depth reading of all available and relevant secondary materials including: Web searches, vendor and user Web Sites, White Papers, Academic Research Papers, Product sales and marketing literature, Magazines, newspapers, news letters, press releases, and industry briefings.
- HRG analyzed trends in Gross Domestic Product (GDP) related revenues over the forecast period for each of the geographies and for each industry within a given geography.
- HRG researched and analyzed the propensity for the consumption of NT, Unix and Proprietary OSs on a geographic basis and also on an industry by geography basis for the forecast period
- HRG researched and analyzed the likeliness that a given industry in one geography would differ in terms of consumption of HA and OS for that same industry in a different geography for AE1, AE2, AE3, and AE4.
- HRG considered each of the various HA enabling techniques in light of industry and geographic propensities to consume each. The various techniques were then considered in terms of their likely impact on the consumption of HA solutions for each of the AE classifications on a geographic as well as industry by geography basis.
- During the course of preparing this HA demand side forecast model and reports HRG has continually revised, compared, and analyzed vendor claims vs the reality as experienced by users and as captured both statistically and anecdotally through HRG's ongoing HA focused primary research activities.

- HRG during the course of preparing this forecast model examined on an in-depth basis each industry and the HA relevant dynamics which would either drive or constrain growth in the consumption of HA solutions for each of the operating environments under examination.
- Considered to be one of the more significant dynamics over the forecast period regardless of industry or geography is the potential over time for Unix to replace Proprietary OSs and also for NT to replace Unix. HRG has determined that there are some significant differences in operating system adoption between geographies and industries within geographies based on both available infrastructure and local mind set (conservative as compared to less risk averse).
- HRG considered the potential for higher cost HA solutions to succumb to lower cost HA solutions based on the continued downward price performance pressure and the effects of that market dynamic on competing manufacturers, VAR's, and SI's.
- HRG has analyzed, summarized and distilled all available information into a set of overall and industry specific / application specific /geographic specific assumptions, constraints and opportunities for growth in the shipment and use of HA capable servers.
- The assumptions were then driven against the base-line server forecasts resulting in HRG's Highly Available Server Market Forecast Model.

GENERAL ASSUMPTIONS

- The percentages of U.S. vs. worldwide Highly Available Server / System revenues and shipments reflect the base-line data that was input into the HRG Forecast Model.
- The operating system segmentation includes Unix, NT, and Other; where Other includes Open VMS, MVS, OS/400, GCOS, MPE/IX and all other non-NT and non-Unix OS.
- The forecast model and underlying methodologies assume steady worldwide economic growth throughout the forecast period.
- Throughout the forecast model and underlying assumptions we have strictly adhered to the published HRG definitions for AE-0 thru AE4. Availability Environment definitions can be found on page 14.

UNIX

- ⇒ The demand for Unix based HA servers will continue to expand at a rapid pace.
- ⇒ Most highly available UNIX systems shipments will be clustered systems.
- ⇒ IA64 will accelerate the use of clustered UNIX systems along with the availability of higher speed and higher bandwidth interconnects technologies.
- ⇒ UNIX clustering technology is maturing and server vendors will continue to provide added value through enhanced functionality and management.
- ⇒ Some vendors of clustered and clusterable UNIX servers will begin to bundle the clustering capability into the base operating system.

NT

- ⇒ NT Server and Microsoft Cluster Server (MSCS) are beginning to gain a modicum of acceptance as a highly available platform.
- ⇒ The Win2000 version of MSCS should ensure a more widespread acceptance as a mission critical HA platform.
- ⇒ The appearance of several new hardware fault-tolerant servers solutions for Windows NT will also help accelerate its acceptance as a HA platform
- ⇒ Scalability will continue to inhibit Windows NT Server adoption within high-end mission critical server markets.

OTHER (PROPRIETARY NON-UNIX & NON-NT)

- ⇒ Proprietary-based server shipments will increase slightly over the forecast period.
- ⇒ Proprietary-based server revenue will decrease as vendors continue to reduce price to compete with lower cost NT and UNIX-based platforms.
- ⇒ Most of the support for proprietary systems will be driven by an increased demand for S/390 and PCM platforms.
- ⇒ Installed base requirements, solution exclusivity, scalability and AE4 capability will be the major requirements supporting the need for proprietary based systems.
- ⇒ The appearance of several new hardware fault-tolerant servers solutions for Windows NT will accelerate the decline of proprietary AE4 platforms

Cross Industry Applications drive the requirement for High Availability Servers. These are the types of applications that cross vertical industry boundaries and provide key infrastructure building blocks used to support solutions like as call centers, billing and customer relationship marketing. The most notable cross industry application today is E-commerce or E-business. The Cross Industry Applications that touch the vertical industries HRG researched for this forecast include:

- EDI
- Business to Business Message Server
- Business to business Web Server
- E-Commerce Server
- Call Center
- Customer Service
- Supply Chain Management
- Enterprise Resource Planning
- X.400
- Network / Systems Management.

With **Year 2000** just around the corner HRG expects that demand for servers to be lower than normal for the three months before and after January 1, 2000. Then demand should pick up rapidly as companies begin to shift Y2K spending to more business critical requirements.

HA MARKET ASSUMPTIONS

VERTICAL INDUSTRIES AND APPLICATIONS

Vertical Industry Applications are applications that are specific to a given vertical industry. For example MRP II is specific to manufacturing, Home Location Register (HLR) and Local Number Probability (LNP) are specific to the telecommunications vertical industry, and so on....

Harvard Research Group examined the following vertical industries for the 1998 - 2003 Highly Available Server Forecast:

- Banking
- Securities
- Retail / Distribution
- Government
- Gaming
- Healthcare
- Travel
- Telecommunication
- Insurance
- Manufacturing
- Other

These vertical industries were chosen because HRG believes that they have the greatest requirements for High Availability Servers / Solutions as compared to other industries. HRG also considers cross industry applications as key contributors to HA growth for most vertical industries.

Banking

HRG Assessment:

- ⇒ *Conservative market*
- ⇒ *High Consumption of AE3 and AE4 for applications in the "Critical Path"*
- ⇒ *On-going consolidation among top banks*
- ⇒ *Globalization of the economy brings mixed impacts but truly benefits only the largest banks*
- ⇒ *Slow to adopt Unix as a replacement for proprietary OS. Adoption curve for NT will track Unix adoption curve but over a somewhat compressed time line.*

Overall the number of US banked households is expected to steadily increase over the forecast period. However, we expect that the growth in transactions will be modest in comparison because most new customers will use few financial services. The movement among banks to implement Internet banking is a dominant trend in 1999 and beyond. Data mining is an application that is driving an increase in HA requirements. By some estimates almost 50% of the top banks in the US are currently doing data mining and by the end of the forecast period most banks of any significant size will have a data mining solution in place. Discretionary spending on data mining will grow significantly over the forecast period, opening a new incremental sales opportunity.

Banks are beginning to focus more on the customer rather than the account. This will increase the demand for HA as customers interact more directly with systems. The continuing number of bank mergers and acquisitions will result in the need for new or consolidated systems. In addition, much of the banking industry is faced with an aging IT infrastructure. Banks increasingly will require assistance from external organizations to develop new systems and to migrate older legacy applications to new platforms.

Advancing information technologies - such as image and workflow technology, data warehousing, client/server implementations, and GroupWare, as well as rapidly advancing application development technologies, such as object-oriented development - are being adopted quickly in banking and will in turn drive the consumption of HA enhanced servers across all Availability Environment Classifications.

Online banking, or banking over the Internet, is still very new. Financial services, such as mortgage and loan applications, are being brought to the Internet and will see increased utilization as ease of use improves and security concerns are addressed. This will drive a greater requirement for HA servers.

As more banks rollout their web sites to provide banking functionality to their customers the demand for HA servers will increase. The functionality provided by banks though is only a piece of the puzzle. Online bill paying, another growth area is today largely being handled by third parties processing requests from a banks' customers. The payee of those bills often don't have the capability to receive payments over the Internet. The future of online bill paying will extend beyond banks and allow their customers to connect their bank accounts to accounts they have with many of their service providers, such as telephone, television, electric, and gas service. Incentive for such corporations to provide this kind of service to customers may not exist today as many of them have

geographic monopolies, but as more industries undergo deregulation, competition may provide that incentive, and thereby result in a new area for HA server growth.

EFT/POS

- Debit card usage at Point Of Sale (POS) will increase in the near term, especially among consumers brought into the banking system through Government payment policies (e.g. welfare cards).
- Longer term, Internet transactions and smart cards are expected to supplant debit cards.

Card Management

- HRG expects to see an increase in the implementation of credit card management solutions as a direct result of the increased number of cards in circulation and the resultant growth in transaction volumes.
- HA is a prerequisite for real-time balance verification, fraud detection and transaction posting.

Funds Transfer

- 24 x 7 AE4 class availability, throughput, and transaction integrity are essential to funds transfer.
- HRG expects to find increasingly significant Windows NT presence beyond the year 2000 as the reliability, scalability, and availability of Windows 2000 Server improves over time.

Home and Internet Banking

- The Banking industry lags the Travel/hospitality, Retail, and Manufacturing industries in the adoption of e-commerce.
- Bill presentment and payment is expected to fuel banking use of the Internet. Currently less than 10% of US banks offer web-based services such as online banking or bill payments
- Low transaction costs encourage home banking, however this application is currently experiencing low market penetration and low rates of end-user adoption.
- Extremely low transaction costs make Internet banking very attractive to banks.
- The banks' ability to retain control of its customer data favors Internet banking over home banking.
- Customer adoption of Internet banking is expected to be driven by increases in Web use by banked households.

- The Internet bank “Wingspan.com” is forecast to garner 1 million new accounts in its first year
- Once it takes hold Internet banking will contribute significantly to the sales of secure HA Web servers.

Smart Card

- The sale of servers that are required to support the utilization of smart cards is expected to contribute to the growth of HA worldwide. The proliferation of smart cards will also lead to increased transaction volumes and larger HA servers.
- Stored-value cards with moderately secure authentication have experienced their greatest market penetration in Europe.
- In the U.S., royalty structures, regulatory initiatives and the need to augment conventional infrastructure has delayed smart card adoption.
- In developing countries, where there is less infrastructure, smart cards are expected to proliferate rapidly.
- The industry focus for smart cards has been telecom, transportation, debit and credit purchasing, and healthcare
- Financial non-banks increasingly will use smart cards to capture the debit-card market from the more traditional banks seizing a portion of these banks' future cash, check, and credit card payment market opportunities.
- Telecommunication companies will likely be the smart card network providers this will drive the consumption of an increasing number of Unix based HA servers.
- In Europe payment cards have been smart for some time and many European countries are following the example set by France and standards are gaining momentum (i.e., the VIS1.1 specification from Visa).

Cash Management

- The predictability of service is highly valued in back-office operations such as cash management. These types of applications will remain mostly Unix and proprietary legacy system based and furthermore HRG expects that these systems will be upgraded or HA enhanced over time.
- HRG does not expect to see significant HA Windows NT penetration until well beyond the year 2000.

Securities/Financial Services

HRG Assessment:

- ⇒ *Conservative market in terms of replacing existing infrastructure*
- ⇒ *Little room for unproven solutions = an uphill battle for NT until beyond year 2000*
- ⇒ *High Consumption of AE3 and AE4 for "Critical Path" solutions*
- ⇒ *Globalization of the economy is a key driver of HA enhanced Server consumption*
- ⇒ *Adoption curve for NT will be slow. Unix is heavily entrenched. NT's weakness in HA functionality will slow adoption.*

The percent of IT spending by *traditional* securities and brokerage firms has gone from 3% in 1996 to 21% in 1998 and is expected to reach 37% by 2000, according to the Securities Industry Association (SIA). By the end of 1998 there were approximately 50,000 online trades occurring daily, almost 14% of securities traded. That number is expected to grow 25-30% over the next few years and may eventually reach 50% of all trades. As a result a large portion of IT spending will be directed at the Internet and e-commerce. According to a Securities Industry Association study, spending on Internet, intranet, and extranet technology will account for 37% of a firms' total IT budget by 2002. Total Spending on IT is expected to increase 7.1% each year from 1998 to reach \$24.2 billion in 2002.

In no other industry is real-time customer data more critical than in the Securities/Financial industry. A delay of 15-minutes or less can result in the loss of millions of dollars to both traders and their customers.

The Internet offers a great opportunity for enhanced competitive advantages in the securities and financial services industry. Increased competitiveness among exchanges will increasingly lead to greater requirements for information availability, timeliness of information, and competitive pricing. This will only increase over time as technological innovation further supports on-line real time information flows and currency exchange on a global basis.

Companies like Merrill Lynch, Paine Webber, and Prudential Securities have been letting customers access research data and their account balances for the past several years. The Securities Industry's embracing of the Internet has accelerated because of the success of Web-based startups. HRG believes that the Securities/Financial Services industry is right at the top in expenditures for Internet and e-commerce technology.

Trading of securities over the Internet has seen incredible growth over the past 2 years. Securities trading firms have benefited immensely from the increased reach to new customers that the Internet provides. New customers can easily create new brokerage accounts over the Internet, and begin trading securities over the Internet as well in a matter of days. The need for HA servers in this market is extremely high. The uptime of their servers is critical to the success of these firms. Customers may not be able to switch to a new brokerage with just a click (unless, of course, they already have multiple accounts with different brokerages), but down time during a trade could cost them real dollars, and could cost the brokerage firm in law suits. A slow down in online trading may occur as the fad of "trading" drops off and the serious "investors" stay on board, but

new traders will continue to increase the volumes of trades that these firms must be able to handle.

- Fault-tolerance and disaster recovery are key concerns. (The World Trade Center bombing focused attention on disaster tolerance). According to Lee Congdon, SVP Strategic Integration and Architecture at NASD, "If this stuff doesn't work we are the front page of the Wall Street Journal"
- According to William Bautz, Chief technology Officer at NYSE, "There's no tolerance" for not being able to get an order through. "If investors think they are getting bad pricing, They'll go somewhere else"
- Research has shown that delays in downloading and accessing the web forces 1/3 of online purchasers to give up or go elsewhere.
- The impending year 2000 transition is a big issue; the majority of US securities firms have year 2000 plans in place. The Securities industry has spent about \$5B on Y2K remediation and has passed a key SIA test in April 1999.
- Strong Unix and proprietary focus on servers, Windows NT increasingly dominating client systems.
- Transaction volumes will increase consistent with increased participation in stock markets worldwide. For example, E*Trade wants to go from 500,000 accounts today to 1.5M accounts over the next two years.
- New entrants to market will favor Windows NT due to cost of purchase considerations. The cost of ownership could be higher if the actual cost of downtime is considered.

Dealing System

- Increasing demand for these systems due to influx of new investors in US stock market, increased international commerce, more travel and tourism.
- Reliant upon real-time data feeds and historical DSS. Often runs on Windows-based trader workstations.
- HA a prerequisite for back-end trading distribution platform, but not for workstations.
- In order to meet the unexpected spikes in demand for online trading, and stay out of the headlines with another outage, the market leaders will enhance their back-end scalability and availability. For example, E*Trade doubled it accounts to 676,000 in one year and AmeriTrade added 82,000 accounts in one quarter
- Steady growth is expected in Windows NT penetration as institutions (Banker's Trust, etc.) embrace Windows NT.

- US Options exchanges are being threatened by the emergence of an all-electronic options market that claims it will cut cost of trading by 30%. The online International Securities Exchange, slated to open in January 2000, is being backed by an \$80M investment from a group of Internet Brokers.

Market Data Feeds

- Time-sensitive and mission-critical
- Primarily Unix based, Windows NT strong on client side of client/server applications
- Need HA to ensure real-time information feeds from news, commodities and financial sources

Exchange Trading Automation

- Real-time process, must be extremely available
- Strong Unix presence, some exchanges going with Windows NT trading workstations but back-end systems are predominately Unix or proprietary.

Clearance and Settlement Systems

- Moderate HA should suffice (AE2 & AE3) since these need not be real-time apps.
- Expect growth and near-term Unix focus because of increasing volume of transactions.
- Cost of purchase issues will begin to drive Windows NT growth, as scalability issues are resolved with the availability of Windows 2000 Data Center Edition in 2002.

Risk Management

- HA is critical in the derivatives industry.
- Traditional proprietary and Unix application, but Windows NT growing
- Significant amount of Windows NT (e.g. TEMPEST Trader).

Retail/Distribution

HRG Assessment:

- ⇒ *Aggressive market: willing to try anything that provides a real competitive advantage or reaches a target market of one.*
- ⇒ *Moderate consumption of AE3 and AE4*
- ⇒ *On-line retail will increase demand for high availability.*
- ⇒ *New interactive point-of-sale applications will increase demand for NT servers.*

The applications that are driving the consumption of HA servers in the Retail / Distribution vertical market are Supply Chain Management, Data Warehousing, Customer Loyalty / Customer Retention (e.g. "Shaw's Card") systems, and Customer Relationship Marketing. In the cases where real time data capture and manipulation are critical to the success and profitability of organizations in this vertical, Highly Available Servers will be a requirement. As the market increasingly drives product and price competition and as retailers work to achieve a target market of one, we expect to see the requirement for Highly Available servers increase.

NT is expected to proliferate in Retail/Distribution primarily in areas where HA is not a critical requirement until beyond the year 2002. NT's HA capabilities are limited and will not be improved significantly until Windows 2000 Datacenter Edition is available in 2002.

The Retail Marketplace is characterized by low margins and in many cases fairly conservative management practices which will inhibit the acceptance of, and requirement for, HA systems in stores or at the Point of Sale. However, back office inventory and revenue tracking systems are a different story as these are the systems that provide companies such as Toys R Us with significant competitive advantage in tracking spontaneous or near spontaneous shifts in market demand.

We expect to see strong growth in retail sales over the Internet that will drive the requirement for secure HA web servers and which will have a dampening effect on revenue realization by the more traditional less responsive retail players.

Purchasing of goods over the Internet will continue to increase in both the business-to-business and business-to-consumer markets. The purchase of physical goods over the Internet will benefit shipping companies, like UPS, the U.S. Postal Service, and many others. These carriers themselves are offering online services such as package tracking, that indicate a growing need for HA servers. The purchase of digital goods, such as music or software, over the Internet will benefit Internet service providers as customers will want more bandwidth and faster connections for their downloads.

The business-to-business markets for e-commerce, e-business, e-services, etc. that are deploying solutions Intranets and Extranets worldwide will experience significant growth in the years to come. Enterprise Resource Planning (ERP), Supply Chain Management (SCM) and Customer Relationship Management (CRM) functions are being deployed

over the Internet as services performed by web-servers. These mission critical areas will drive a fast growing need for HA servers.

The business-to-consumer markets will also experience significant growth as retailers get ever more creative about how to use the Internet to sell goods to their customers. Areas such as buying clothing, that seem unlikely to flourish over the Internet are being implemented by animation, modeling, and clicking and dragging pieces of clothing onto a 3 dimensional mannequin that has your body dimensions. The need for HA servers in the B-to-C market will be driven mostly by seasonal buying where the traffic to a retailers site could spike dramatically, and potentially crash the server.

- Based on recent conversations and an in-depth review of the trades it is readily apparent that VARs are rapidly embracing NT.
- The integration of EFT/POS functions to collect EFT/POS data and retain ownership of the EFT process to obtain maximum benefit from the process Peak loads (Christmas, end of quarter.) can govern purchase behavior and require HA

Order Management

- Overall decrease in hardware spending as a portion of total IT budget
- Strong move towards client/server and web
- VARs are enamored of Windows NT but users are still waiting for proof that it is capable of supporting mission critical business applications.
- Anticipate integration of EFT/POS functions to collect data and retain ownership of EFT process
- Peak loads (e.g. holiday or seasonal purchases, limited-time sales) can govern purchase behavior and create value proposition for HA

Pharmacy Claims Processing

- Online systems are required for POS claims processing, drug utilization review, eligibility verification, and drug interaction applications. This is an area where HA could become a requirement.
- Expect slower growth in USA because of current penetration levels, consolidation caused by increasing prevalence of HMOs and managed care.
- Increasing numbers of transaction will lead to larger servers with a HA requirement Unix should be favored for several years.
- Internet, EDI, and Government mandates will foster use of new electronic systems

Warehouse Management

- Warehouse applications are moving towards paperless ordering, billing, inventory control.
- Increasingly time-sensitive due to JIT purchases, supply chain management, MRP, Buy Vs Build, etc.
- Dependable inventory management will be key to profit for many firms.
- System responsiveness and reliability are key drivers.

Customer Relationship Marketing

- Strong growth in “customer care” systems.
- Data warehousing and database marketing to enable “target market of one.”
- Information must be online and accessible when customers call in from anywhere in the world.
- Service will be a key differentiator in attracting and retaining customers.
- Almost 2/3 of revenue comes from existing customers as compared to 1/3 for new customers
- It costs 5-6x as much to attract a new customer than to retain an existing customer

Government

HRG Assessment:

- ⇒ *Conservative market in terms of “ stick with what you know works.”*
- ⇒ *High Consumption of AE3 and AE4 in secure programs*
- ⇒ *Adoption curve for NT will be slow.*
- ⇒ *Continued utilization of proprietary and mainframe style AE3 and AE4 servers that are able to provide real-time modeling capabilities in areas directly related to national security..*

Growth in spending is very often dependent upon the incumbent party. Defense spending which has previously been a sacred cow is now increasingly coming under scrutiny and as the pressure increases in this area we expect to see spending become more rational and as a result somewhat constrained as compared to the past.

HRG anticipates that government purchases will focus predominantly on upgrades to existing administrative systems. However, as new requirements for Emergency and Civil Defense related systems emerge we fully expect that voters will require either significant upgrades in systems availability or else the whole sale replacement of older less highly available servers with newer AE3 and A-E4 servers. We fully expect to see the continued utilization of proprietary and mainframe style AE3 and AE4 servers that are able to provide real-time modeling capabilities in areas directly related to national security. So called "Black Projects" are likely to continue to drive the consumption of Highly Available OLTP capable servers for the foreseeable future there by contributing to the growth of AE3 and AE4 revenues and shipments.

Government services are being deployed over the Internet in an effort to bring efficiencies and cost savings to their operations, examples include: taxation, social services, and campaigning. The need for HA servers varies with the area of application. High need will likely occur in taxation assistance and processing in the first quarter of the year in the U.S.

Computer Aided Dispatch and (911) Emergency Service

- HA is mandatory for fire, police, EMS dispatching where lives are at stake there is little or no tolerance for down time.
- Larger back-end systems are predominately AE4 systems at least for larger governments. However many small vendors are currently providing Unix and Windows NT based CAD systems (AE2-AE4) to small departments or small state and local governments.

Gaming

HRG Assessment:

- ⇒ *Conservative due to potential lawsuits, pending legislation and the issues of collecting gambling debts.*
- ⇒ *High growth, high margin business becoming more on-line.*
- ⇒ *High consumption of AE3 and AE4*
- ⇒ *Not gamblers when it comes to the reliability of their systems or data integrity.*

This vertical industry includes applications such as gaming systems, customer loyalty systems, card-operated slot machines, and casino reservations systems. We expect that brisk growth will continue in this industry worldwide. The servers that are used to support gaming operations are for the most part proprietary and Unix back-end systems. We also expect that there will be significant, although not yet quantifiable, Internet impact due to on-line gambling. Windows NT is expected to begin to dominate in the Internet gaming market but not until the end of our forecast period. E-gaming or gambling over the Web while currently a small part of the worldwide gaming market is expected to grow and should require AE3 and AE4 levels of availability depending on the stakes and the size of the Jack Pots.

- There are currently about 280 casino web sites and is growing at a rate of 10 new sites per month. Online gambling is expected to grow from \$530M in 1998 to \$10B by 2002, most from the US
- Online gambling on Asia is predicted to be at \$10B annually by 2004
- Lawsuits, pending legislation and the difficulty of collecting gambling debts have slowed online gambling. Both the US and Australia are considering taxing online gambling.

Betting/Lottery

- Increasing demand due to growth in number of casinos and patrons, and ubiquitous presence of lotteries and Keno.
- HA is mandatory, because service outages are prohibitively expensive
- Web-based gaming sites, which are becoming increasingly popular, require 24 x 7 uptime.
- Windows NT growing rapidly, especially in new installations

Gaming (non-gambling)

Online gaming is a booming area for teens and young adults who enjoy playing networked games over the Internet. This benefits Internet service providers, and their consumption of HA servers should continue to increase to serve their growing customer base.

Healthcare

HRG Assessment:

- ⇒ *Conservative market*
- ⇒ *Moderate Consumption of AE3 and AE4*
- ⇒ *Adoption curve for NT will be slow in the US for mission critical or “life critical” apps as Unix is heavily entrenched in this Industry. However, NT is making significant headway in Europe.*
- ⇒ *Web access for health related information is growing rapidly. In the US it is forecasted that the present rate of 1 million hits per year will grow to 10 million within the next 3 years.*
- ⇒ *The money available is huge as all of the industrialized countries spend on average 8 to 9 percent of Gross Domestic Product on healthcare (US is the exception as it spends 14%). More of these funds will be diverted to Information Technology to reduce inefficiencies, and to increase quality and productivity.*
- ⇒ *Newer applications require highly reliable systems.*

The opportunities for new applications are becoming disproportionately greater in healthcare than in other industries. Healthcare has not had the external pressures to become efficient so even though it is labor intensive it operates much akin to a cottage industry. Consequently the degree of automation is significantly behind that in financial services, manufacturing, retail supply chain, and other industries. However, healthcare in the industrialized countries is starting to be subjected to pressures from customers, who want to be treated as customers-not patients, and want better quality at lower costs.

Also as healthcare customers become more knowledgeable about diagnosis and treatments as a result of the information available through the Internet, they start to expect more than is presently available.

Technology is also starting to have its impact through the broader use of telemedicine. Many of the capabilities of telemedicine have been restricted to large institutions because of the capital and operating costs. However, with the advent of much cheaper computers, telecommunications, and computer accessories, telemedicine can now be brought to the patient at home or in a doctor’s office.

Quality, cost pressures, informed customers, new capabilities in telemedicine, and the Internet are creating new opportunities. The uses of electronic processing for claims and prescriptions will not only create a demand for computing resources but for high availability computing resources. With volumes of billions of transactions going on-line, the workload will be so large that down time would cause colossal recovery problems. Because of this both Internet links and the computer processing at both ends will require high availability systems.

Electronic patient record systems will require high availability, not because of the volume as in the case of claims, but because of the need for 7x24 availability. Electronic patient records will require instant access at any time, and from every healthcare

provider location. As in the previous case this will put demand not only on the Internet links, but also on the equipment at both ends, the assessor and the repository.

With the systematic changes to claims, prescriptions and patient records the rapid growth of the Internet for information will put demands on repositories and Internet links. Although downtime is not life threatening as in the case of patient records the volume will require high availability to assure customer satisfaction. The repository sites will not build customer loyalty (a major source of their revenue) if they experience serious breakdowns as did eBay and MCI recently.

Assumptions

- The major cost drivers in healthcare are; billing, patient records, claims processing, and the current labor intensity of clinical care.
- It is estimated that processing records, insurance claims and laboratory results account for about one-third of the total healthcare costs in the United States. The magnitude of these costs even prevails in countries with significantly different cultures and healthcare systems such as Denmark*. (*Evans and Wurster, 1997)

Insurance Claims

- It is estimated that in the United States 4.4 billion insurance claims, and 2.5 billion prescriptions are processed annually*. (*CIBC Oppenheimer, 1998). Each of these involves 2 to 8 transactions per item and most are done manually.
- Only about 60% of the insurance claims are processed electronically and to date web processing accounts for only about 2 per cent of all of the transactions.
- Recently Medicare, the largest insurer in the United States, has approved claim processing via the Internet and a number of States have authorized electronic processing of prescriptions. With these regulatory changes it is reasonable to assume that the efficiency of the Internet will be used to handle these huge volumes of data.

Patient Records

- The healthcare industry has made little effort to use the benefits of information and knowledge based systems to improve quality and efficiency. Almost all record keeping through the entire spectrum of care including doctor's offices, clinics, home care and hospitals is paper based. A systematic electronic patient record would provide the infrastructure required to improve quality and outcomes while reducing the current dependency on labor.

- The availability of the Internet, the informed patient, the need for reduced costs will all contribute to a much wider use of electronic patient record systems. Since electronic patient records will reduce wrongly prescribed drugs, insurance fraud, and clinical errors, their use will grow rapidly as the benefits become apparent and all providers and patients demand equal results.

Travel

HRG Assessment:

- ⇒ *Conservative market at the high –end (TPF/ACP) more experimental at low –end (e.g., Travelocity) overall attitude is “stick with what you know works.” (e.g., Sabre)*
- ⇒ *Moderate Consumption of AE3 and AE4*
- ⇒ *Increasingly Global nature of the Travel industry and the economy in general will heat up the demand for HA enhanced Servers*
- ⇒ *NT adoption will be slow. Unix And proprietary solutions are entrenched in this Industry. NT’s scalability, availability, and security weaknesses will slow adoption at the high-end of this industry.*

The Travel Industry is rapidly growing and presents good HA opportunities. Increasing passenger traffic and elevated security requirements drive need for reliable logistics systems. The emerging CRS and Internet-based travel services are gaining acceptance and are expected to curtail growth of traditional travel agencies. IN 1998 the U.S. airline industry carried over 611 million passengers. That number is expected to increase to well over 650 million passengers in 1999, and one billion passengers a year by 2008.

Air passenger traffic has more than doubled over the last 20 years, from more than 253 million passengers in 1978 to 611 million last year while prices have declined by 36%. These increases are a result of deregulation.

- Travel and hospitality is a rapidly growing business, speed and efficiency of customer service is the key differentiator between common carriers. HA supports this differentiation.
- Increasing business and pleasure travel drives strong growth in ticket and boarding pass generation, seat allocation, etc.
- Gate allocation, crew allocation, and cargo routing require HA
- Increased security requirements driving better baggage ID & handling systems, access systems
- Electronic ticketing replacing paper forms. Information must be on-line and available.
- Once entrenched in distribution and infrastructure, opportunity may exist for HA to penetrate reservations, etc.

Telecommunications

HRG Assessment:

- ⇒ *Conservative market tending to use only proven solutions*
- ⇒ *Deregulation is driving competition and need for cost reduction.*
- ⇒ *High Consumption of AE3 and AE4*
- ⇒ *Telecommunications companies and service providers are reluctant to move from Unix environment to an unproven NT environment.*
- ⇒ *NT is expected to remain in non-service delivery, non-critical application areas until NT has proven its reliability and scalability.*
- ⇒ *Globalization of Telecommunications will heat up requirements for HA enhanced Servers world-wide*
- ⇒ *NT adoption will be slow. Unix is heavily entrenched in this Industry. NT's weakness in terms of availability, scalability, and security will slow its wide spread adoption.*

The Vertical Industry that we call telecommunications could also logically be viewed a horizontal industry in that it provides infrastructure, support and services to all other industries and as a result derives significant revenues from these industries. Increasingly all industries are coming to depend on the Web and E-commerce as means to increase market reach and competitiveness. The Telecommunications market includes wireline, wireless, and intelligent or "Off Switch" networks as well as the more traditional switch based offerings. HRG views the telecommunications market as the one key area of highest use and growth of use for HA servers in the AE2 through AE4 range.

As the satellite based telecommunication industry gains momentum we are witnesses to the birth of an entirely new group of telecommunications companies. These companies are leveraging both the "Off Switch" benefits of Intelligent Networking solutions and the digital transmission facilities that Satellite based communications provide. These new and newly restructured companies have very real requirements for fault tolerant / AE4 / 7x24 solutions due to the direct and potentially negative impact that a service outage could have on their clients. Furthermore, the increasingly competitive nature of the telecommunications industry as it moves to implement LNP solutions is driving AE4 requirements.

Telecommunications companies and service providers in general are reluctant to move from the proven Unix environment to the newer unproven NT based offerings regardless of claims and warranties. It is possible; however, that the cost of purchase of more expensive Unix servers may influence this attitude in favor of NT. However, HRG believes but we believe that this will not become a significant trend until well past 2002.

The USA Telecommunications Act of 1996 and the EC Green paper for Telecommunications in Europe were put in place to remove regulatory barriers that prevent telecommunications companies from competing in each others markets thereby opening the door for network interconnection."

The deregulation of the telecommunications industry is driving competition and fostering the need for cost reduction. However, due to the "bet your business" nature of most telecommunication applications that are on the service delivery critical path, NT is very

likely to remain in non-service delivery application areas until NT has proven its reliability and scalability. Don't expect to see significant inroads made by NT into IN or AIN application areas until well past 2002, if then.

The growing use of cellular phones (and now smart phones – e.g. Sprint PCS) and pagers across all industries is driving the need for more capacity, bandwidth, and availability. Availability is especially critical in the face of increased competition that is resulting from industry deregulation and the resulting implementation of LNP on a global basis.

Some examples of the types of applications that are more likely to require enhanced levels of availability follow:

Call Location

Call location is a prerequisite for roaming, call blocking, forwarding, which traditionally has been integrated with Unix and proprietary telecommunication switching systems. We expect that the increased use of this application will boost System Signaling 7 (SS7) traffic and back-end processing requirements which in turn will drive the increased consumption of HA enhanced servers which will support this application in an "Off Switch" implementation.

Messaging

This application type includes voicemail, paging services, and call forwarding. Currently the industry is experiencing rapid growth in the utilization of paging and call forwarding services as provided by local telephone companies. These applications will drive the consumption of HA enhanced servers primarily in the AE2 and AE3 ranges.

Card Billing

The applications which comprise card billing and fraud management due to their mission critical nature require HA and rapid throughput. Due to the fact that transactions are directly related to dollars it is only normal that the majority of servers used to support these applications are AE3 or AE4 Unix servers or servers running a proprietary OS. We expect to see transaction volumes steadily increase in keeping with the anticipated increased use of phone cards and cellular services (phone, fax, e-mail, and paging).

HLR IS41 & HLR GSM

Home Location Register (HLR) is that database which is the basis for providing mobility management. The HLR contains information about subscribers that is critical to the delivery of mobile communication service. Information about which services a customer is subscribed to reside in this database. If the database is unavailable users will be affected because the services that they subscribe to will be unavailable. HLR is one of those applications that require an AE 4 or fault tolerant server. The majority of the servers that this application runs on are Unix based.

Local Number Portability (LNP North America & LNP Europe)

LNP allows customers to keep their phone numbers when they change companies without changing locations. One example of an LNP implementation, "Bell Atlantic's LNP system uses intelligent network systems and a remote database. This database stores the "ported" phone numbers of customers who have changed local phone companies, as well as "location routing numbers," which are assigned to each competing local telephone company's switch that handles calls."

The implementation of LNP capabilities provides an attractive high growth opportunity for HA server providers, which should not begin to abate until around the year 2000 in the United States and the year 2001 in Europe. The rest of the world expected to lag Europe by 4-18 months depending on the current telecommunications infrastructure in place. The clear majority of LNP installations are expected to be UNIX based through out the forecast period.

The FCC mandated wireless Local Number Portability (LNP) by June 30, 1999. The start date for the mandate was October 1997.

Spending in the US is expected to ramp significantly throughout 1998 and begin to tail off through 1999 and 2000 once the end of the time frame for the FCC's Mandate has been achieved.

Investment in LNP in Europe is lags the US by roughly one year. This means that Spending for LNP based implementation is expected to ramp through 1998 and 2000. Spending for LNP will significantly decrease in 2001 and 2002 with Europe following in decline in 2002 and 2003.

Virtual Private Network

A Virtual Private Network uses a public data network to transport private data reliably and securely. It is considered virtual because it appears to the user organization as a genuine private network with exclusive use of resources.

VPN will tend to drive the increased mobility of the workforce and utilization of telecommuting as well as increased requirements for organizational flexibility as companies reinvent and reconfigure themselves so as to better satisfy clients and stave off competitors. VPNs allow businesses to take advantage of geographic market shifts without having to incur extraordinary infrastructure costs.

VPN service providers will be required to provide highest levels of availability during hours of business operation or AE4 - (some business will determine that they can make due with reduced levels of availability - this will vary on a business by business basis).

Prepaid Calling Card

This application currently is finding wide spread adoption in developing areas such as South America, parts of Asia, and what used to be the Soviet Block or Soviet Union. Prepaid calling cards allow subscribers the ability to access telecommunication services without the need for a fixed location "home base or residence" or a credit history of record. What is required it the ability of the Telecommunications company to support

the application and the subscriber's ability to prepay. Prepaid calling cards provide high quality telecommunications access to subscribers in areas where the telecommunications infrastructure is underdeveloped or just beginning to be developed (areas where public telecommunications devices such as pay phones are the norm and where personal telecommunications devices are the exception to the rule).

While this application does not require significant levels of availability and can be serviced by SCPs, which are at AE1 or AE2, HRG believes as subscribers become more sophisticated and the competition for the "Prepaid Calling Card" dollars heats up service providers are likely to differentiate themselves from the pack by offering higher levels of availability. The provider with the best choice and the most reliable service at a competitive price will likely win out over their competition. Therefore, toward the end of the forecast period HRG expects to find steadily increasing requirements for enhanced availability in support of this application.

Drivers: Rapid growth of wireless; Increased carrier revenue from subscribers without credit history; Increased toll revenue in carriers network; Limited carrier / subscriber liability; Carrier focus on higher value network services; and it is perceived as a "Core" service by subscribers

Personal Number/ Single Number

This application while much touted as a new "killer application" has had a very slow start in terms of subscriber demand. HRG expects the adoption of the personal Number / Single Number AIN application to take longer than expected and to never quite achieve the wide spread adoption that others have predicted for it.

Drivers for this application are the subscriber can be reached any time any where, and it significantly facilitates the capture of revenue through improved customer and prospect access to sales, marketing and product professionals within a given subscribing business entity.

Constraints are: A subscriber can be reached any time any where (this can be seen as both good and bad); If the subscriber is a business and the number is assigned to a sales person who is then hired by the competition how is account control assured.

The ubiquity of access that this application imposes means it requires higher than normal levels of availability and in many or perhaps even most cases (as with HLR and LNP) it would be most desirable if the database(s) used to drive this application were memory resident. The requirement for greater than average availability levels as well as the potential for memory residence clearly will be best satisfied by an "off the switch " or SCP based implementation. Such an implementation will provide the capacity and scalability that this application is likely to require. Furthermore, only an SCP based implementation will provide the flexibility in configuring such an offering that subscribers are most likely to come to expect and by the end of the forecast period come to demand.

Caller Name Delivery (CND)

Privacy issues will serve to constrain the adoption of this application by providers while security issues will tend to drive its acceptance. HRG expects to find a fairly even split between those consumers who find CND to be an invasion of privacy and a constraint to unfettered telecommunications and those who find it be a addition to their arsenal of tools for fending off unwanted solicitations and calls.

Drivers: Customers frustrated by telemarketing calls; Customers wanting additional convenience and security; Wireless subscribers can avoid paying for trivial calls; and Carriers focus on higher value network services.

HRG does not view this application by itself as driving a significant requirement for enhanced levels of availability.

Telephony Gateway

This application is the newest of the group and was developed / is being developed in response to the overloading of the public telecommunications networks by today's crop of Internet / E-mail / Web fanatics. Currently an ISP subscriber can dial a local number and tie up a circuit in their local telephone office for hours at a time. This activity's impact on the public telecommunication network is further exacerbated because most dedicated Web users have more than one telephone line at their residence (at one point we had five lines coming into our house). This means increased utilization of the local office capacity to the point where capacity is likely to be exceeded in the near future.

This application should require an AE3 or AE4 level platform (especially if used by businesses).

Insurance

HRG Assessment:

- ⇒ *Conservative market in terms of “traditionally a CISC and proprietary OS stronghold” or “one of the last to go on the web.”*
- ⇒ *Moderate Consumption of AE3 and AE4*
- ⇒ *Globalization of the economy has little impact on the demand for HA enhanced Servers*
- ⇒ *Adoption curve for NT will be slow. Unix and proprietary systems are entrenched in this Industry. NT's inherent scalability weakness, lack of security, and unproven nature will slow adoption.*

The insurance industry has traditionally been paper bound and fairly conservative - this is changing. In the new more competitive insurance industry companies and agencies are moving increasingly to a paperless environment through the implementation of image management technologies and on-line claims processing applications. As the members of the insurance industry move to become more competitive it is becoming apparent that the reliability and availability of the computing infrastructure which supports the new insurance industry will incorporate ever-increasing numbers of HA enhanced servers. We expect to see the majority of this requirement met by AE2 and AE3 systems. Unix (as in all of the other industries we have examined for this forecast) will be the HA platform OS of choice because it has been proven to be industrial strength and also because the applications that are required are currently available for Unix.

- The insurance industry has traditionally been a CISC and proprietary OS stronghold.
- We also anticipate growth in the insurance industry due to insurance company diversification into financial management and financial services as insurance companies strive to improve their bottom lines.
- Currently only 6% of companies that issue bills such as insurance, utilities, lending institutions, communications, and credit card companies offer Internet billing. It is estimated Insurance companies could save \$6-15M/year via Internet billing.
- The top 500 Insurance Companies spend about 3% of revenue on IT with 15% of that directed at technology and products.
- Insurance industry spending IT spending is predicted to grow to \$22.5B by 2002
- The conservative nature of the Insurance Industry has made it one of the last to go on the web. Only 5% of Insurance Company revenue currently comes from e-business

Manufacturing

HRG Assessment:

- ⇒ *Conservative market on-going quest for greater efficiencies and increased productivity while controlling expenditures*
- ⇒ *Consumption of AE3 and AE4 primarily in the process and in capital intensive manufacturing segments*
- ⇒ *Globalization of the economy and resultant competitive pressures are heating up the demand for HA enhanced Servers*
- ⇒ *Slow NT adoption. Unix is established this Industry (e.g., CA-ASK Manman on HP/UX). NT's scalability and availability weaknesses will slow adoption.*

Competition is increasing as chain partners and competitors avail themselves of the benefits of the Internet. This in turn will continue to drive the requirement for HA enhanced servers discrete and process manufacturing and in all areas of manufacturing related organizations that are members of the supply chain. For the purposes of this forecast we have aggregated process and discrete manufacturing. Key Manufacturing applications that are driving the consumption of HA servers are:

- **MRPII**
- **ERP**
- **Supply Chain Management (SCM)**
- **Shop Floor Control**
- **Build to Order**
- **Production Runs of One**
- **On-line Just In Time Material Distribution, Handling, and Warehousing**
- **Internet based EDI links to Supply Chain Partners**
- **On-line E-Commerce**
- **On-line e-commerce payments**
- **Order Management**

Purchasing of goods over the Internet will increase in both the business-to-business and business-to-consumer markets. Business-to-business e-commerce, e-business, e-services, etc. worldwide will experience significant growth in the years to come. Enterprise Resource Planning (ERP), Supply Chain Management (SCM) and Customer Relationship Management (CRM) functions are being deployed over the Internet as services performed by web-servers. These mission critical areas will drive an increased requirement for HA servers.

The business-to-consumer markets will also experience significant growth as retailers get ever more creative about how to use the Internet to sell goods to their customers. Areas such as buying clothing, that seem unlikely to flourish over the Internet are being implemented by animation, modeling, and clicking and dragging pieces of clothing onto a 3 dimensional mannequin that has your body dimensions. The need for HA servers in the B-to-C market will be driven mostly by seasonal buying where the traffic to a retailers site could spike dramatically, and potentially crash the server. This will result in

an increased requirement for HA servers in the manufacturing sector as a direct result of IT SCM manufacturing practices.

Other

This Industry category includes vertical markets such as transportation, utilities, and services that are not directly addressed by this forecast.

HA MARKET ASSUMPTIONS

GEOGRAPHIES

North America

HRG Assessment:

- ⇒ *Good infrastructure – “state-of-the-art” in some metro areas*
- ⇒ *Technical expertise is good*
- ⇒ *Significant IT budgets*
- ⇒ *Early adopters of new technologies*
- ⇒ *Large installed base of AE3 and AE4 UNIX and Proprietary solutions*
- ⇒ *Pent up demand for AE3 and AE4 NT based solutions will be released once NT has proven itself in real world enterprise level environments.*
- ⇒ *Business as usual in established installed base*
- ⇒ *Ecommerce and other web applications are growing fast and will significantly alter the demand for AE3 and AE4 servers.*

The US economy is growing with real GDP increasing by an annualized rate of 4.5% in the first quarter of 1999. Private consumption and investment were particularly strong.

Two major growth areas during the past few years of continuous growth, low inflation, and full employment have been telecommunications and financial services. During this time ecommerce, both business to business and consumer based, have been growing rapidly. These three areas have major potential for expansion of HA server consumption and adding new high availability applications.

The outlook is for continuing growth although at a slower pace and with a decline in IT purchases as we near the end of 1999 in anticipation of, and preparation for, the year 2000. HRG expects this to last into the first quarter of 2000.

However, because of the Internet, IT and related spending will shift dramatically. One indication of this impending shift is the consumption of cable modems. One analyst group has forecast that shipments of cable modems will increase from 320,000 in 1998 to 839,000 in 1999 and 2,000,000 in the year 2000.

Another key dynamic will be the impact of wireless telephone communications. A recent study indicates that wireless "premium" to landline rates in North America now stand at about 3 to 1. The study identified 3:1 as an important benchmark where wireless penetration and usage enter a new phase where wireless will begin to displace landline.

Latin America

HRG Assessment:

- ⇒ *Marginal and in some areas non-existent infrastructure*
- ⇒ *Some technical expertise, but on a learning curve*
- ⇒ *Relatively small and constrained IT budgets*
- ⇒ *Cautious buyers*
- ⇒ *Major projects often get embroiled in politics*
- ⇒ *Small installed base of HA servers will be eclipsed by NT based systems because of simplicity and price.*
- ⇒ *Infrastructure and technical expertise will also contribute to the bias to NT systems.*

The problems in Asia may have made vendors shy about eastern markets and as a result they have set their sights on Latin American as an alternative. While the financial crisis threw Brazil and the rest of Latin America into a tailspin in early 1999, the Brazilian economy is stabilizing, interest rates are declining, inflation appears under control, and the currency is strengthening.

- Brazil is the largest economy in Latin America and one of the 10 largest in the world.
- The privatization of Brazil's telecom agency, Embratel and its subsequent sale to a consortium made up of MCI and Telefonica de Espana bodes well for the South American wireless market.
- According to an industry report the \$7.1B Latin American cellular and PCS service market will more than triple by 2004. The compound annual growth rate of the wireless industry in each country where the study was conducted, Argentina, Brazil, Chile, Colombia, Mexico and Venezuela is projected to grow steadily at least until 2004.
- The Latin American information technology (IT) services market grew 14.8% from 1997 to 1998, reaching 8.45B, and is expected to surpass \$13.9B by 2002.
- The market for Internet Connectivity and content services is growing rapidly in Latin America. There are approximately 1.3M Internet users in Brazil, 221,000 in Argentina, and 228,000 in Mexico. Latin America has grown from 200,000 online users in 1995 to 2.5M in 1998.

Major European Countries EMEA: Germany, UK, France

HRG Assessment:

- ⇒ *Good and in some locations “state-of-the-art” infrastructure*
- ⇒ *Good to Excellent Technical expertise*
- ⇒ *IT budgets are constrained due to economic pressure*
- ⇒ *Conservative buyers*
- ⇒ *Business as usual in established installed base.*
- ⇒ *Web and web related applications will drive applications to AE 3 and AE 4 level. Particularly in healthcare where there is a growing emphasis to use IT to solve quality, service and cost issues.*
- ⇒ *New applications requiring AE3 and AE4 data availability and integrity will likely be Unix based rather than proprietary or NT.*

In terms of technology usage, Western Europe is by far ahead of Central and Eastern Europe, and also the Middle East. While the technology strengths vary among the Western European countries, they share some similar growth dynamics in regard to Internet usage, and economic and governmental forces that effect consumer and corporate spending. Countries that are part of the EU have to reform their government's involvement in industry in order to meet EU guidelines for membership.

The EMU members are required by the Stability and Growth Pact to keep their general government deficits below 3% of the GDP. Either or both of two methods will be used by governments to lower their deficits: Increasing revenue by way of raising tax rates, and decreasing costs by way of privatization. Either method could have a negative effect in the short term due to increased pressure on corporations being privatized. These corporations will need to adapt to new competition forces in the marketplace, and if they are faced with rising tax rates it may hinder their ability to make capital improvements.

The UK and Scandinavia have led the way in terms of early adoption/evaluation of integrating the Internet into their businesses. France and Germany are not far behind in that regard.

In most of the Western European countries, the manufacturing industry is shrinking for a variety of reasons, and the service industries are mostly growing, although at different rates. Germany's service industry is experiencing some difficulties, perhaps due to a wider jump in shifting their economic paradigm away from manufacturing, their strongest, yet quickly declining sector.

Eastern European countries are being effected by Russia's 1998 decision to devalue and default. The effects of economic and political uncertainty will continue to hinder industrial growth, as will rising inflation. The banking sector in these countries is struggling due to the prevailing conditions. Banks are struggling to survive.

While France and Germany comprise the main proponents of the EU, the Central European countries are struggling to reform their governments and make their way through negotiations to become part of the Union.

Germany

- Germany's economy is the EU's largest economy.
- By 1960 the West German economy had grown to the size of those of France and the UK; from the 1960s into early 90s it maintained its position as the third-largest economy after the US and Japan, and the second-largest exporter after the US.
- Germany's economy is dominated by the manufacturing industry. They've focused on this area since WWII and excelled.
- The Internet is still small in Germany because of the usage costs. These are likely to come down as competition increases.
- "Deutsche Telekom (DT) became a joint-stock company in 1989. Until January 1998 it maintained the monopoly in fixed handset voice transmission, which has now been liberalized under EU legislation. The 1996 Telecommunications Law established competitive structures and liberalization has brought a bewildering array of new service providers with widely varying tariff structures. In the first year of operation of the liberalized market, DT lost 30% of its peak-time long-distance-call business. It introduced price cuts of 60% in January 1999 to meet savage competition from 200 new telecomm suppliers and perhaps 1,300 companies operating in the non-licensed sectors of the industry. DT has been involved in strenuous arguments with the regulator over network access charges for competitors, including access to the local loop. Other points of contention concern number portability and line charges for Internet service providers. Only dominant firms with a market share of more than 25% will be obliged to offer a universal service throughout Germany."
- "Unemployment in western Germany rose from 5.5% in 1991 to 10.4% in the first quarter of 1998, mainly owing to the loss of manufacturing jobs."
- "Germany is finding it difficult to create new jobs in the service sector."

United Kingdom

- London is one of the 3 largest financial centers, and is the largest international financial center in the world.
- "The UK has a flourishing business services sector, partly reflecting synergies with the financial sector in London. London is a leading center for law and consultancy, both of which contribute significantly to the country's overseas earning. Growth has also been boosted by the increasing importance of information technology and the growing tendency of companies to contract out non-core services."
- "The London Stock Exchange (LSE) has also seen its dominance challenged by up-and-coming, and often cheaper, exchanges abroad. Growing competition from other EU exchanges, coupled with the UK's decision to remain outside EMU at the outset, have encouraged the LSE to conclude an alliance with one of its traditional competitors, the Frankfurt-based Deutsche Borse (DB). Six other EU stock exchanges are due to join the alliance once negotiations between the LSE and the DB are completed."
- The UK produced 1.7m cars in 1997, which ranks it 4th after Germany (4.7m), France (2.2m), and Spain (2m).
- British Telecom was privatized in 2 stages in 1984 and 1991, making the UK one of the first EU countries to liberalize its telephone services.
- Global One, the international joint venture of Deutsche Telekom, France Telecom, and Sprint, implemented 11 new global transit switches and over 6 giga bits per second of transmission capacity on its end-to-end multi-service ATM backbone network. The switches, located at 11 different sites in Germany, France, Japan, UK, and USA, provide Global One with a new, very high performance global transit layer for its ATM backbone network architecture.

France

- The French economy is dominated by agriculture. They are second only to the US.
- The French workweek is 35 hours. Many French companies have been subsidized by the government and were not profitable or growing.
- EU has criteria for what the economy should be like, in order for the countries' currencies to transition well to the Euro. The economies of the member countries have to be in very close to each other before the economies can be merged. I.e. the governments' deficits must be 3% of the GDP. This is forcing governments

with deficits higher than this to privatize in an effort to get in line with the 3% figure.

- The government is encouraging competition but it is also increasing taxes so companies may not have the capital to invest in the technology they need to become efficient and competitive.
- Part of Frances economy of the past included export of weaponry, and that has drastically been reduced in the 90's, thus putting pressure on their manufacturing industry.
- The net effect of these factors is that the decision to purchase servers is going to be a difficult one, and may result in slower growth for the country.
- France Telecom was broken up in '97 in a similar fashion to the AT&T breakup.
- In 1998, 600,000 computers were connected to the Internet, compared with 1.4M in Germany and 1.6M in the U.K.
- France's inflation will remain among the lowest in the EU.

Scandinavia: Norway, Sweden, Finland, Denmark

HRG Assessment:

- ⇒ *Good to Adequate infrastructure*
- ⇒ *Reasonable level of technical expertise*
- ⇒ *Small or constrained IT budgets*
- ⇒ *Conservative buyers*
- ⇒ *Business as usual in established installed base.*
- ⇒ *New applications requiring AE3 and AE4 data availability and integrity will probably be Unix based rather than proprietary or NT.*
- ⇒ *NT based systems will appeal to small IT budgets in smaller (newer) enterprises*

Norway

- Main export is oil, ranked 2nd to Saudi Arabia.
- 60% of population have personal computers.
- It is the least most densely populated European country
- They have an excellent communications infrastructure.
- They don't want to be part of the EU, and due to their strength in oil exports, they can stand on their own economically. They're also afraid that the EU will impede their fishing industry.
- A beneficial side effect of not having to change their economy to fall within EU prescribed limits is that Norway's economy has been stronger in the past decade than most other European countries.

Sweden

- The Social Democratic Party (SDP) made Sweden an EU member, but there are still many skeptics in the ranks who argue that membership is undermining the traditional welfare state, and this matter is one cause of division between the party.
- In 1996, there were 682 telephone connections for every 1000 inhabitants, the highest number per head in the world.
- There are over a dozen companies offering fixed-line networks, although Telia (the national telco) dominate the domestic market.
- 40% of population and 80% of households own at least one mobile phone.

- Ericsson generates approx. 15% of Sweden's exports, and competes with Nokia of Finland and Motorola of U.S.
- The 500 largest Swedish IT companies had combined sales of almost \$51 billion in 1997, and had sales growth of 25% over the previous year. Ericsson alone did \$23 billion in 1998, with China being the largest market, followed by the US and the UK.
- Highly computerized society. In 1998, 40% of all Swedes had access to the Internet.
- There's been a recent move by a significant number of Swedish companies relocating their headquarters to other EU countries. The low corporate tax rate of 28% isn't the problem as much as the 30% that corporations have to pay on top of each employee's salary.
- Sweden also has a strong automotive sector with Volvo, Saab, and Scania although stakes in their car divisions are being bought. Their truck divisions are strong and provide higher margins.
- Sweden's pharmaceutical companies, Astra and Pharmacia also hold a significant position in Sweden's economy, although Pharmacia has merged with Upjohn (US) and Astra is in the process of merging with Zeneca (UK).
- All Swedish banks offer banking services via telephone. The next logical step is to offer the services over the Internet. This should make for a good market for highly available servers.
- Sweden is a prime market for IT technology and highly available servers. Their user base is large and technically competent. Their economy is under control and faces competitive pressures to reduce costs given the heavy tax burden of employing people. Although they are part of the EU, they aren't part of the EMU, and therefore are not tied to the Euro yet. They might become tied in the next 2 years, which could cause some amount of economic upheaval, and could adversely affect Swedish companies' ability to invest in new equipment.

Denmark

- Earlier in the century Denmark was primarily an agricultural economy, but during the post-war period, particularly since the 1960s, the economy has diversified and the manufacturing and services sectors have grown. Manufacturing now accounts for around 16% of total employment, compared with only 1.5% for agriculture, with the vast majority-as in many other OECD countries- employed in the service sector. Services now account for 72% of GDP compared with less than 20% for

the manufacturing sector. Manufactured goods, however, account for close to 75% of total Danish exports, compared with 12% for agricultural products.

- Although the state sector is slowly being scaled back as the government strives to cut the public debt (see Economic policy), Denmark has one of the largest state sectors in the OECD, with government consumption accounting for some 25.6% of GDP in 1997. This share is, however, similar to that found in the other Nordic countries. Private consumption, meanwhile, is still low by OECD standards, averaging just over half of GDP in the 1990s (compared with over 70% in the US).
- Denmark is the third largest exporter of oil in Europe.
- Shipping: Among the major Danish companies in the services field is the Maersk shipping line, which competes with the US Sealand company for the title of largest container shipping line in the world. Denmark has the fourth-largest merchant fleet in the EU.
- Production: Manufacturing: "Despite a small domestic market, Denmark can boast a number of world- leading companies, such as Carlsberg (the brewer), Lego (the toy manufacturer) and Bang & Olufsen (the upmarket audio-visual group). The manufacturing industry is the country's largest industrial sector with a 27% share of total turnover. Excess grain, similarly, provided the basis for the Danish brewing industry, and Carlsberg has developed into one of the three largest brewing companies in Europe.
- The agricultural sector has also affected other industrial export sectors. Food-processing equipment and packaging were based on the requirements of the food sector; and the pharmaceutical sector has drawn on agricultural products, such as animal glands, for some of its own products (Novo Nordisk is one of the world's leading producers of insulin).
- Almost every household in Denmark has access to a telephone and 25% of households also have a cable system for television and radio. A similar number have parabolic antennae for the reception of satellite television. Denmark implemented the EU-wide telecomm directive in July 1996, a full 18 months ahead of deadline. This has broken the monopoly previously enjoyed by the state-owned Telecomm Company, Tele Denmark, and enables non-Danish telecomm companies to offer a competing service.
- Most industrial firms in Denmark are small: fewer than 900 companies employ more than 100 people; average employment over the whole manufacturing sector is only 18 per entity.

Finland

- In 1997 the Finnish economy, with a nominal GDP of \$119.8bn, ranked 15th out of 18 west European economies in size. This placed Finland behind its Nordic neighbors Denmark, Norway and Sweden. In terms of GDP per head (measured on the basis of purchasing power parity), Finland was placed 11th out of 18 countries, just below Italy but above the UK and Sweden. In 1997 private consumption accounted for around 53% of GDP, which was well below the average of nearly 60% in Western Europe. In contrast, government consumption accounted for approximately 21% of GDP, 3 percentage points higher than the west European average.
- The structure of Finland's economy has evolved along similar lines as that of most other developed countries: whereas the importance of the primary sector (agriculture, fishing and mining) and the secondary sector (industry and construction) has gradually declined, the services sector has expanded. While the primary and secondary sectors, for example, still accounted for 7% and 35% of GDP respectively in 1990, their share had slipped slightly to 5% and 33% by 1997. The continued relative importance of the secondary sector is mainly a reflection of the strong growth experienced in the electrical and electronic goods industry: between 1990 and 1996 production here increased nearly threefold. Whereas most of Finland's 1,700-plus electrical engineering companies are small, the largest-Nokia-has emerged as the world's biggest producer of mobile telephone sets and a leading supplier of telephone networks. Nokia has contributed approximately 1 percentage point to Finland's estimated 5% growth in 1998.
- Finland's energy consumption per head is one of the highest in the world. The main reasons for this are the long winters, which create substantial demand for domestic heating, and the energy requirements of industry (especially in the pulp and paper sectors), which are well above the OECD average. At the same time Finland is an energy-poor country, with only very limited reserves of oil, coal or natural gas, so that the bulk of its energy has to be imported.
- The population has been slow to accept a service culture, and many of the new jobs in the service industry are created by the manufacturing sector, which out-sources services related to production.
- Finland's telecommunications industry and infrastructure have benefited far earlier than those of most other countries have from deregulation. Competition in the mobile telephone market was introduced in 1990, and the markets for national long-distance and international services were deregulated in 1994 and 1995 respectively. By mid-1998 slightly more than half the Finnish population had a mobile telephone connection-a world record-with Sweden (46.1%) and Norway (43.5%) coming second and third. In comparison, the percentage share was 23.3%

in the US and 14.3% in Germany. Both analogue and digital mobile and fixed-line telephone networks exist in Finland, with the country at the leading edge of technological developments. The same applies to Internet connections: by mid-1997 Finland already had 400,000 Internet connections; of these, only one-third belonged to the Finnish university and research network. This was the highest figure per head in the world.

- Nokia has become the world's largest producer of mobile telephones and a leading supplier of mobile and fixed telecommunications networks. The company has a global presence: with a workforce of 42,000 people worldwide and selling its products in more than 130 countries, Nokia is listed on five European bourses and on the New York Stock Exchange.

Other Europe

HRG Assessment:

- ⇒ *Inadequate and in some case non-existent infrastructure*
- ⇒ *Limited technical expertise*
- ⇒ *Small and /or severely constrained IT budgets*
- ⇒ *Cautious buyers*
- ⇒ *Seller beware contract environment*
- ⇒ *Specific high profile projects will probably be Unix based rather than proprietary or NT.*
- ⇒ *NT based systems will appeal to small IT budgets*

Eastern and central Europe are in a state of flux. Opportunities that exist will be on a case by case basis as political and economic unrest diverts attention away from productivity improvement and information technology.

Japan

HRG Assessment:

- ⇒ *Good infrastructure*
- ⇒ *Good levels of technical expertise*
- ⇒ *Constrained IT budgets due to overall economic environment in Japan*
- ⇒ *Conservative buyers – tendency to buy only Japanese goods and services*
- ⇒ *Business as usual in established installed base.*
- ⇒ *Web and web related applications will drive new applications to AE3 and AE4 level.*
- ⇒ *New applications requiring AE3 and AE4 data availability and integrity will likely be Unix based rather than proprietary*

Manufacturing is the primary driver in Japan's economy and accounts for more than one-quarter of current-price GDP. Agriculture and distribution are extensively regulated and as a result suffer from low productivity.

Japan's economic recovery depends upon restored confidence in the financial sector and a corporate restructuring. The Japanese government has adopted a stimulus package that is expected to grow GDP by 0.8% in 2000. Because private-sector demand is expected to remain weak throughout the forecast period, the government will have to maintain public spending at high levels in order to maintain the upward momentum of growth. Even so, most industries are predicted to maintain a very cautious attitude towards undertaking new capital investment, primarily due to continue over capacity and uncertain profits.

However, with the third largest economy in the world in terms of GDP, Japan and its 127M population offer considerable market opportunities. Two areas set for particularly fast growth in 1999-2003 are healthcare and financial services.

- The Japanese government plans to improve Japan's airport infrastructure, partly in order to cope with the likely exponential increase in air travel within Asia in the early years of the next century. Planned are two new airports, and building a second runway for the Kansai International Airport.
- Japan's heavy dependence on imported energy supplies-has resulted in mass investments in the development of nuclear energy. Japan has approximately 51 nuclear power plants in operation.
- Japan's telecommunications and other information technologies lag behind that of Western industrialized countries. According to OECD estimates, the number of Internet hosts per 1,000 inhabitants in Japan is still only about 15.3% of the US level. The proportion of homes and offices with personal computers is only about one-fifth that of the US.

- Japan's pharmaceutical industry is expected to expand as a result of the acceptance of foreign clinical data in approving foreign pharmaceuticals and medical devices. In addition, the government is expected to cut the approval period needed for new drugs from 18 months to 12 months starting in April 2000.

China

HRG Assessment:

- ⇒ *Inadequate or non-existent infrastructure*
- ⇒ *Limited technical expertise- but on a learning curve*
- ⇒ *Small IT budgets*
- ⇒ *Cautious buyers*
- ⇒ *Seller beware contract environment*
- ⇒ *Specific high profile projects will probably be Unix based rather than proprietary or NT.*
- ⇒ *NT based systems will appeal to small IT budgets.*
- ⇒ *Governments will interfere with the normal progression of technological development for political reasons such as in the case of the recent control put on the Internet in China.*

The Chinese Economic Area (CEA) - China, Hong Kong, and Taiwan represent one of the largest emerging markets in the world. The tremendous growth experienced by China, Hong Kong and Taiwan during the last few years is expected to continue out into the next millennium.

China proper has been aggressively pursuing economic reforms and with its population of over 1.2 billion has been able to sustain an average 6% growth in its economy over the last 30 years. China is the second largest economy in the world with a combined GDP exceeding \$5 Billion in 1998 and is expected to become the largest in the early 21st century. The Chinese government reforms are expected to result in GDP growth of 7% in 1999, slowing in 2000, and then growing to 7.9% by 2003. The government is expected to support the growth in GDP by promoting investment spending and private consumption.

In order to sustain its economic expansion, the CEA countries are investing heavily in improving their infrastructure, particularly in the areas of transportation, energy and telecommunications. For example, China has budgeted over \$24 billion for investment in the telecommunication sector through the year 2000. Much of this investment will focus on fiber optic, satellite, mobile communications, and advanced switching systems and include such key product areas as central office switches, private branch exchanges, paging networks, cellular networks, network computer equipment, and CATV equipment.

China's IT market is expected to top \$43B by 2003 and according to the China State Economic and Trade Commission, its computer industry has been expanding at an annual rate of more than 50%. China has spent almost \$3 billion trying to grow the computer industry's output from 1% to 3-4% of its GNP. As part of that goal, China is in the process of setting up nine "Silicone Valleys" for high-technology companies to do computer research and development.

China is also in the middle of a program to renovate and expand the state-owned heavy industrial base. Hundreds of industrial enterprises have been authorized to

either import new technology and equipment directly or enter into joint ventures with foreign companies.

Significant Drivers:

- The Telecommunication industry is growing rapidly in China and the number of subscribers to pagers and to mobile telephones is growing rapidly.
- China is also actively involved in launching commercial satellites for foreign operators. China is predicted to command 23% of the Mobil Satellite Cellular service market.
- China is also the fastest growing GSM market in the world. Analyst estimate that there are 9.8M GSM subscribers in the country, and that figure is growing by 1M per month.
- The China State Administration for Radio, Film, and TV believes that Cable TV will be a \$12B industry in five years and the market for appliances and equipment will be \$3-4B. Communications including data broadcasting, and computer networking, will total \$4-5B.
- According to Beijing-based BDA (china) LTD, the Chinese Internet market is predicted to grow from just over 2M users now to 33M users by 2003.
- China's pharmaceutical industry has grown significantly as the result of the use of traditional Chinese medicines among overseas Chinese and increased access to chemicals for producing Western medicines.
- China posses large reserves of ferrous and Ferro-alloy minerals that provide for an active iron and steel industry. China is a world leader in the production of some 17 minerals, including phosphate, tungsten, molybdenum and titanium. China is actively moving to boost output and attract foreign investment and technology to exploit its mineral deposits.
- China has two nuclear power plants, and plans to build several more.
- Estimates place the Hong Kong cellular market at 1.1 million by 2006.
- Taiwan intends to become a regional communications center and will substantially upgrade and expands its local digital switching and tool systems, construction of optical fiber subscriber loops and the development of an ISDN network. Taiwan is also upgrading its mobile communications and packet switching networks.

Asia/Pacific

HRG Assessment:

- ⇒ *Inadequate infrastructure*
- ⇒ *Limited technical expertise-but on a learning curve*
- ⇒ *Small or constrained IT budgets*
- ⇒ *Cautious buyers*
- ⇒ *Seller beware contract environment*
- ⇒ *Specific projects will probably be Unix based rather than proprietary or NT*
- ⇒ *NT based systems will appeal to smaller more constrained IT budgets.*

The ASEAN region consisting of Brunei, Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam is one of the most dynamic economic areas in the world. The rapid growth, expanding purchasing power, and falling market access barriers are helping these countries swiftly progress from economies based upon agriculture and natural resources to one based upon manufacturing, distribution, and services. As a result the ASEAN region is a significant driving force for the entire Asia/Pacific region. This region is expected to have a combined population of 686 million, and a combined GDP of \$1.1 trillion.

The Asian economic crisis, which hit in 1997 and spread to other emerging markets in 1998, is not yet over, but there are signs of recovery in most economies in the region. However, employment is not rising due to excess manufacturing capacity, which discourages investment growth. In addition, consumers are still seem reluctant to spend money at a time when jobs and wages are not secure.

- According to the bank of Tokyo it appears as though Asia has bottomed out and picked up a little. The four tigers – Hong Kong, Singapore, Korea, and Taiwan are expected to grow GDP 1.5%.
- The Asia Pacific pager market is expected to see a 93.1% increase in subscriber numbers over the next five years. During that same period, China, South Korea, Taiwan, India and Thailand are all expected to see increased numbers of subscribers, while Japan, Hong Kong, Malaysia, and Australia are expected to contract.