

**HIGHLY AVAILABLE SERVERS
MARKET ASSUMPTIONS**

2000 to 2005

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Table of Contents

<u>Introduction</u>	<u>3</u>
<u>AEC Definitions</u>	<u>3</u>
<u>Worldwide Revenue by Geography</u>	<u>5</u>
<u>Worldwide Revenue by Industry</u>	<u>6</u>
<u>Worldwide Revenue by AE</u>	<u>7</u>
<u>Worldwide Shipments by AE</u>	<u>7</u>
<u>World Wide Revenue by OS</u>	<u>9</u>
<u>Worldwide Shipments by OS</u>	<u>9</u>
<u>Forecast Methodology</u>	<u>11</u>
<u>General Assumptions</u>	<u>13</u>
<u>Vertical Industries</u>	<u>18</u>
<u>Banking</u>	<u>18</u>
<u>Securities/Financial Services</u>	<u>23</u>
<u>Retail/Distribution</u>	<u>27</u>
<u>Government</u>	<u>30</u>
<u>Gaming</u>	<u>32</u>
<u>Healthcare</u>	<u>34</u>
<u>Travel</u>	<u>38</u>
<u>Telecommunications</u>	<u>39</u>
<u>Insurance</u>	<u>44</u>
<u>Manufacturing</u>	<u>45</u>
<u>Other</u>	<u>39</u>
<u>Geographies</u>	<u>47</u>
<u>North America</u>	<u>47</u>
<u>Latin America</u>	<u>48</u>
<u>EMEA</u>	<u>49</u>
<u>Scandinavia</u>	<u>53</u>
<u>Other Europe</u>	<u>58</u>
<u>Japan</u>	<u>59</u>
<u>China</u>	<u>60</u>
<u>Asia/Pacific</u>	<u>62</u>

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.

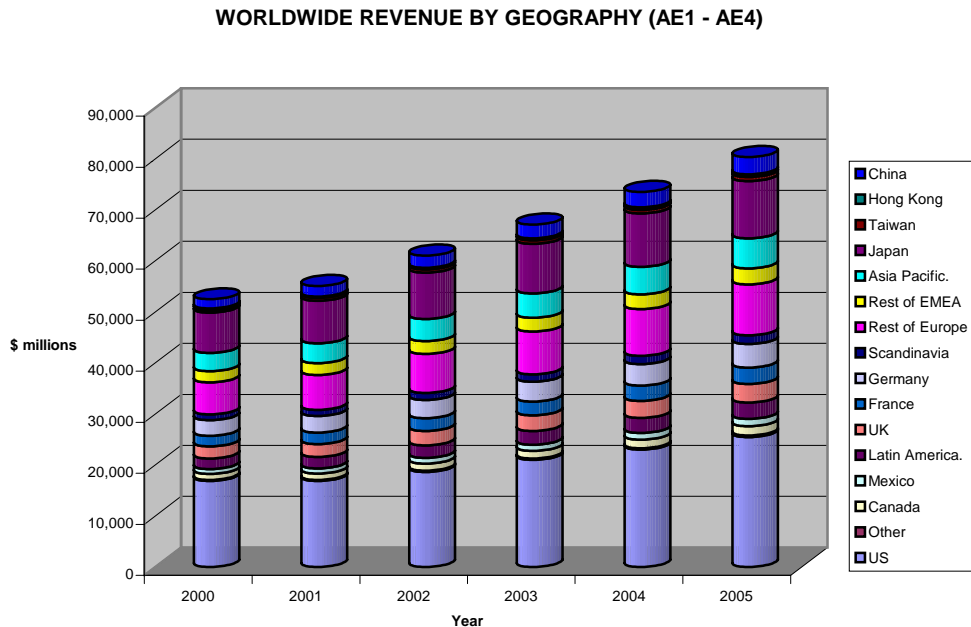
AVAILABILITY ENVIRONMENT CLASSIFICATIONS (AEC)

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)

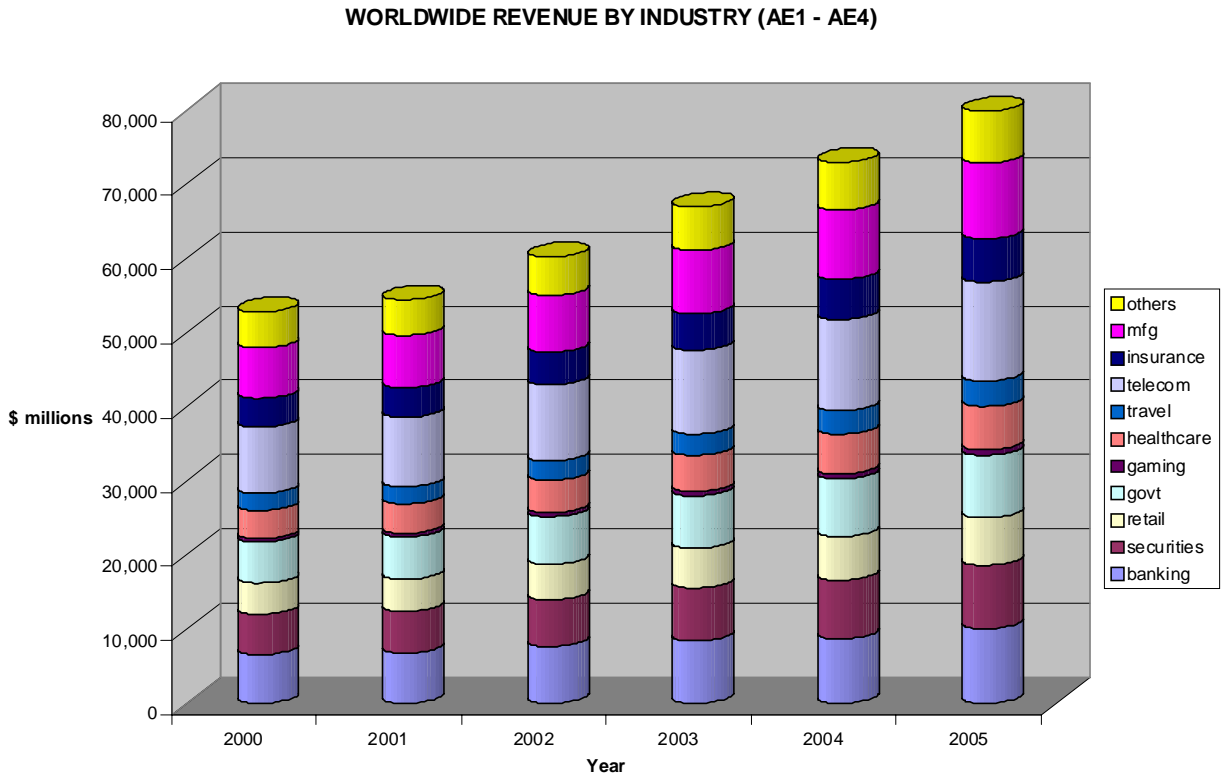


The top five high availability revenue geographies remain the same throughout the forecast period. They are:

1. United States
2. EMEA
3. Japan
4. Rest of Europe
5. Asia/Pacific
6. Latin America

- China, while not in the top five, is projected to experience the highest growth, growing 89% over the forecast period to \$3.4 billion.
- Within the EMEA segment Germany is the largest consumer of HA servers, projected to grow 49% from revenue of \$3.07 billion in 2000 to \$4.56 billion in 2005. The fastest growing consumer is the UK, slated to grow 56% to \$3.66 billion in 2005.

WORLDWIDE REVENUE BY INDUSTRY (AE1 - AE4)

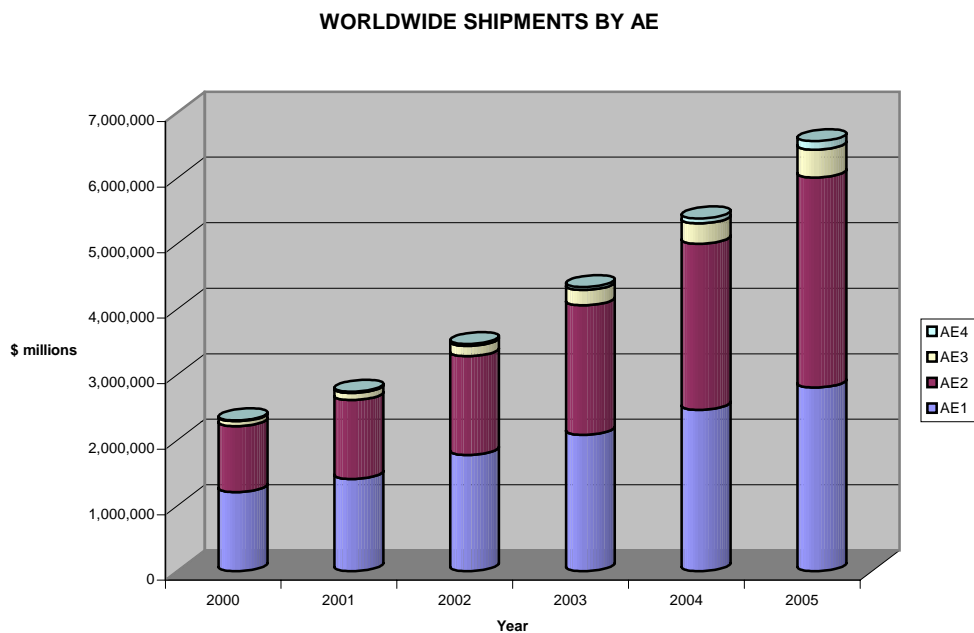
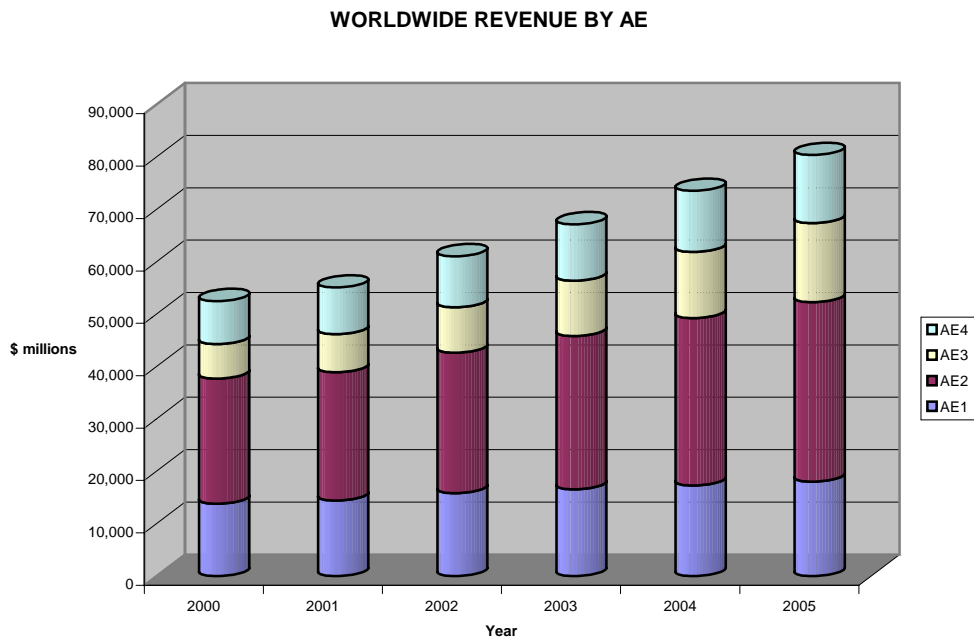


- The top five industries for high availability revenue for the forecast period change slightly between 2000 and 2005. They are:

Rank	2000	2005
1	Telecommunications	Telecommunications
2	Manufacturing	Manufacturing
3	Banking	Banking
4	Government	Securities
5	Securities	Government

- During the forecast period Securities with a growth of 59% moves ahead of Government with its growth of 55%.
- The highest growth industry segment is Securities, which is projected to grow 59% over the forecast period, going from \$5.45 billion in 2000 to \$8.65 billion in 2005.
- The lowest growth industry segment is Telecommunication, growing 51% over the forecast period, going from \$8.92 billion in 2000 to \$13.45 billion in 2005.

WORLDWIDE REVENUE & SHIPMENTS BY AE

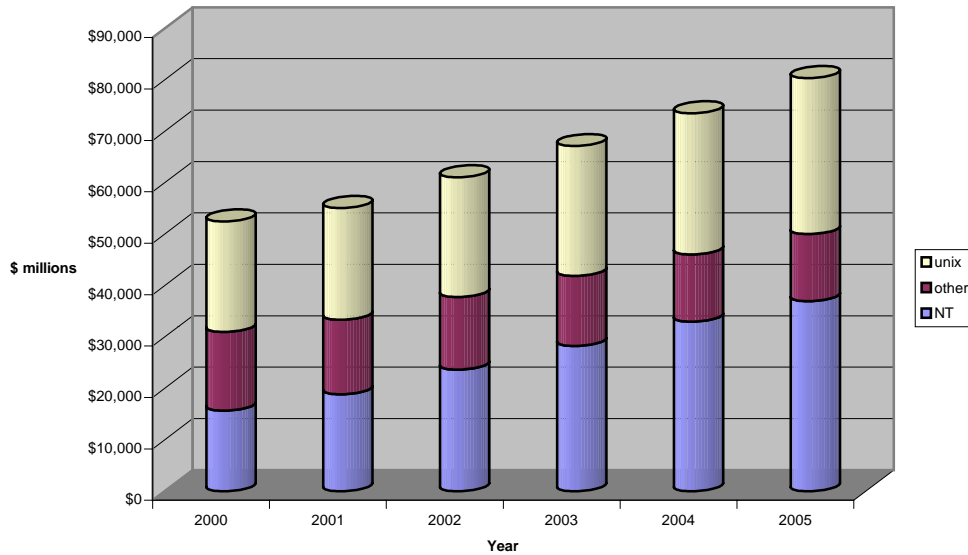


- The highest growth Availability Environment for revenues is AE3 with revenue growth of 130% from 2000 to 2005. In terms of shipments, AE4 leads with a growth of 901% over the forecast period.

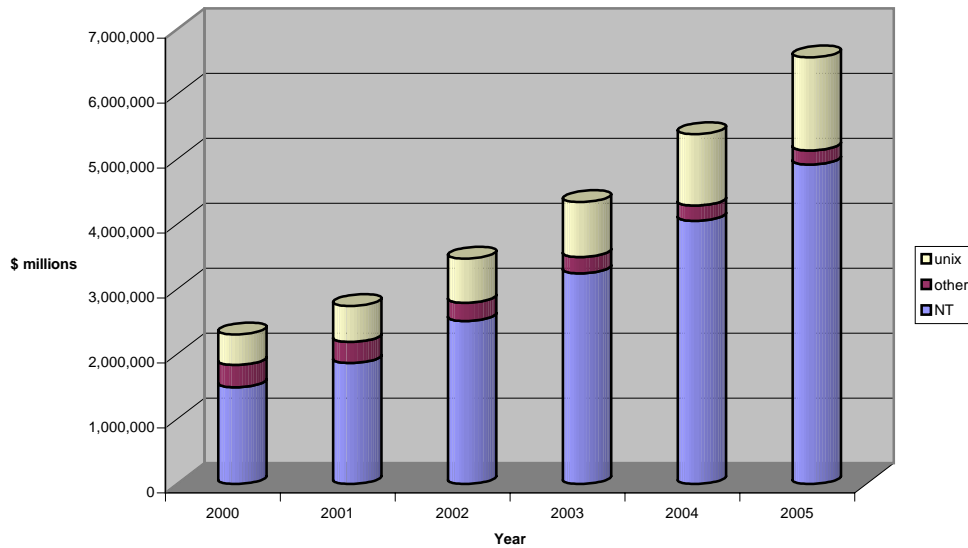
- Much of the growth in AE3 comes at the expense of AE2 shipments and revenue as the baseline clustering capabilities are enhanced to include AE3 functionality. During the forecast period AE1 shipment growth is the lowest of the four environments growing 132% over the forecast period.
- Revenue growth for the AE1 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 growth of 31% for AE1 revenue will take revenue from \$13.79 billion in 2000 to just over \$18 billion in 2005.

WORLDWIDE REVENUE & SHIPMENTS BY OS (AE1 - AE4)

WORLDWIDE REVENUE BY OS (AE1 - AE4)



WORLDWIDE SHIPMENTS BY OS (AE1 - AE4)



- The highest growth Operating System segment for both revenue and shipments is NT / W2K with revenue growth of 135% and a shipment growth of 230%. NT / W2K shipments are forecasted to grow from 1,491,237 units in 2000 to over 4,915,604 units in 2005. NT / W2K revenue is expected to go from \$15.69 billion in 2000 to almost \$37 billion by 2005.

- Much of the growth in NT / W2K will come at the expense of the Other (proprietary) segment. Other operating system revenue is forecasted to decrease by 15% during the period from 2000 to 2005, falling from \$15.283 billion in 1998 to \$13.06 billion in 2003.
- Shipments of system in the Other (proprietary) segment will decrease by 36% over the forecast period, going from 340,805 units in 2000 to 217,301 units in 2005.
- The UNIX segment of the market will continue to sustain significant growth in both revenue and shipments. Unix is forecasted to have a shipment growth of 204% and revenue growth of 41%. Unix shipments are expected to grow from 470,786 units in 2000 to 1,431,755 units in 2005. Corresponding revenue will go from \$21.489 billion in 2000 to \$30.353 billion in 2005.

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 / W2K, 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 reviewed, 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 / W2K 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 and its variants (including Linux), NT / W2K, and Other; where Other includes Open VMS, OS/390, OS/400, GCOS, TPF, MPE/IX and all other non-NT / W2K and non-Unix OS.
- Throughout the forecast model and underlying assumptions we have strictly adhered to the published HRG definitions for AE0 through AE4. Availability Environment definitions can be found on page 3.

UNIX

- The demand for Unix based HA servers will continue to grow 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 interconnect technologies.
- UNIX clustering technology is maturing and server vendors will continue to provide added value through the enhancement of both functionality and management.
- Some vendors of clustered and clusterable UNIX servers will begin to bundle the clustering capability into the base operating system.
- Low-cost open source OS are gaining market share in the low-end server segment, and economic slowdown is a driving factor behind this new popularity. Linux is growing faster than Windows 98/NT / W2K in this segment. Linux is also making in-roads in the high-end segment fueled by increasing support from industry heavy weights, such as IBM, Oracle, Sun, Dell, etc.
- Achieving “critical mass following” and availability of adequate qualified support professionals are the key challenges Linux faces today.

NT / W2K

- NT / W2K Server and Microsoft Cluster Server (MSCS) are beginning to gain acceptance as highly available platforms.
- The Windows 2000 Advanced Server's and Datacenter Server's clustering capabilities should ensure a more widespread acceptance of Windows 2000 as a mission critical HA platform.
- The appearance of several new hardware fault-tolerant servers solutions for Windows NT / W2K will also help accelerate its acceptance as an HA platform
- Lack of scalability continues to inhibit Windows NT / W2K Server adoption within high-end mission critical server markets.

OTHER (PROPRIETARY NON-UNIX & NON-NT / W2K)

- Proprietary-based server shipments will decrease over the forecast period.
- Proprietary-based server revenue will decrease as vendors continue to reduce price to compete with lower cost NT / W2K 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 driving the need for proprietary systems.
- The appearance of several new hardware fault-tolerant servers solutions for Windows NT / W2K 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 that are used to support solutions such as call centers, billing, and customer relations 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.

Hardware spending has slowed in 2001 due to economic downturn. However, due to strong long-term trends in Internet usage and emphasis on productivity building, conditions should improve by mid-2002.

VERTICAL INDUSTRIES

Banking

HRG Assessment:

- ⇒ *Conservative market.*
- ⇒ *High levels of information systems investment.*
- ⇒ *Showing signs of greater tolerance and experimentation with new technologies.*
- ⇒ *High Consumption of AE3 and AE4 for applications in the “Critical Path”.*
- ⇒ *On-going consolidation among top banks.*
- ⇒ *Trend towards replacement of mainframes with client server architectures.*
- ⇒ *Globalization of the economy brings mixed impacts but truly benefits only the largest banks.*
- ⇒ *Active investment in networks to overcome infrastructure limitations to global operations.*
- ⇒ *Increased competition among niche/boutique banks (AAA, BMW, UPS etc).*
- ⇒ *Slow to adopt Unix as a replacement for proprietary OS. Adoption curve for NT / W2K 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 fewer financial services. Instead, there will be growth in the number of households using electronic banking over the Internet. Estimates of households using online banking in the United States expect that number to more than double in the next four years, from 18.6 million households in 2001 to 43.5 million in 2005. Electronic bill payment and presentment is also expected to skyrocket during the same period—shooting from just 2.8 million U.S. households this year to 40.2 million in 2005. Data mining 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.

Large banks are acutely conscious of missed opportunities at the outset of the Internet boom that allowed a number of smaller competitors to invade in this space. They are taking few chances when it comes to emerging media, such as wireless and interactive digital TV. Their efforts at development in these areas will be a definite driver for HA systems.

Banks are beginning to focus more on the customer, over the account, as service becomes key in differentiating between banks. To this end the increase in Computer Telephony Integration and Customer Relationship Management technologies will increase the demand for HA as customers interact more directly with systems. A continuation of the current rate 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 will increasingly require assistance from external organizations in order 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 quickly adopted in the banking sector, and will in turn drive the consumption of HA enhanced servers as well as RAID and other storage devices 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 develop their web sites towards providing Internet banking functionality to their customers, the demand for HA servers will increase. This functionality provided by banks, though, is only a piece of the puzzle. Online bill payment, another high growth area, is largely being handled by third parties who process requests from banks customers, while the payee of these bills often does not have the capability to receive payments over the Internet. The future of online bill payment will extend beyond banks and allow their customers to connect their bank accounts to accounts they have with their service providers, such as telephone, television, electric, and gas services. As they currently hold geographic monopolies, incentive for such corporations to provide this kind of service to customers may not exist today; however, as more industries undergo deregulation, increased competition should provide that incentive, thereby resulting in a new arena for HA server growth.

ELECTRONIC MARKETPLACES / AUTOMATED SCM

- Companies and individuals are rapidly moving towards automated supply chains and electronic marketplaces to minimize costs.
- Peer-to-Peer auctions are expected to reach a volume of 1 million by 2005, contributing to total online consumer sales of \$300 billion.
- This is dwarfed by corporate spending in electronic marketplaces estimated to reach \$2.7 trillion by 2004.
- This growth provides incentives for banks to cooperate with online marketplaces such as eBay, Ariba and CommerceOne in order to offer a variety of instruments for completing transactions. Banks would also be valued as a trusted brand name, as a means of access to a current customer base, and for the procurement leverage they would provide to any marketplace by virtue of their size.

Electronic Fund Transfer/Point Of Sale

- Debit card usage at Point Of Sale (POS) will increase in the short term, especially among consumers brought into the banking system through Government payment policies (e.g. welfare cards).

- Over a longer period, 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 / W2K 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.
- 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 increased Web use by banked households.
- As it takes hold, Internet banking will contribute significantly to the sales of secure HA Web servers.

Smart Cards

- Stored-value cards with moderately secure authentication have experienced greatest market penetration in Europe.
- While Europe has had more success with the propagation of smart cards, the U.S. has been slow to adopt the technology. In the U.S. the concept has had its greatest success in the form of the American Express Blue card with approximately 5-6 million users. Visa and Master Card have launched their own initiatives in conjunction with different banks.
- In the U.S., royalty structures, regulatory initiatives, and the need to augment conventional infrastructure has delayed smart card adoption. Additionally there is a high level of comfort and trust in the paper check as a transaction instrument (68 billion used last year). This will be overcome slowly by demographic shifts, as younger consumers tend to be more comfortable with debit cards and smart cards as payment instruments.
- It is estimated that currently, 40-45% of POS terminals are in need of upgrade. Reterminalization efforts offer an ideal opportunity to enable smart card acceptance.
- 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.
- In developing countries, where there is less legacy infrastructure, smart cards are expected to proliferate rapidly.
- The industry focus for smart cards has been in the telecommunications, transportation, debit and credit purchasing, and healthcare industries.
- Non-bank financial institutions will increasingly use smart cards to capture the debit-card market from more traditional banks, thus seizing a portion of these banks' future cash, check, and credit card payment opportunities.
- Telecommunications companies will likely be the smart card network providers of choice. This will drive the consumption of increasing numbers of Unix based HA servers.
- In Europe payment cards have been smart for some time and, as many European countries are following the example set by France, various 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. HRG expects that these systems will be upgraded or HA enhanced over time.
- HRG does not expect to see significant HA Windows NT / W2K penetration until well beyond the year 2001.

Securities/Financial Services

HRG Assessment:

- ⇒ *Extremely aggressive in the use of Information technology. Broker-dealers spend five times the corporate average.*
- ⇒ *Conservative market in terms of reliability of applications and hardware.*
- ⇒ *Little room for unproven solutions makes it an uphill battle for NT / W2K until well beyond 2001.*
- ⇒ *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 / W2K will be slow. Unix is heavily entrenched. NT / W2K's weakness in HA functionality will slow adoption.*

According to a Securities Industry Association (SIA) report, the level of IT spending by *traditional* securities and brokerage firms will go from \$18.4 billion in 1998 (a 26.5% increase over 1996) to \$24.2 billion in 2002. In fact it is estimated that 80% of current equipment expenditure is related to IT. At 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. Online brokerage accounts are expected to grow to 14 million by 2002. As a result a large portion of IT spending will be directed towards the Internet and E-Commerce. According to a Securities Industry Association study spending on Internet, intranet, and extranet technology will account for 37% of firms' total IT budgets by 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 an excellent 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 allowing customers access to research data and account balances for the past several years. The Securities Industry's embrace of the Internet has accelerated because of the success of Web-based startups. At the same time, the speed of technological evolution is forcing online brokerages to reevaluate their technology infrastructure and upgrade to improve their availability. HRG believes that the Securities/Financial Services industry is 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 market that the Internet provides. New customers can easily create new brokerage accounts over the Internet and begin trading securities in a matter of days. Thus the need for HA servers in this market is extremely high, as 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 can cost them real dollars, and could see lawsuits brought against the brokerage firm.

A slow down in online trading has occurred as the fad of "day trading" has dropped off and only the serious investors have remained on board. The hi-tech stock meltdown over the last year has made a major contribution to this sharp reduction in "day trading". While this is bound to impact the bottom line of security trading firms, most will have no option but to maintain investment in technology as they compete for a smaller share of a smaller market on the basis of either price or features.

- There is a great deal of competition between different exchanges for volume trades that are executed through them. Traditional powerhouses such as the New York Stock Exchange face increasing competition, not only from other exchanges, like NASDAQ, but also from smaller, alternative trading systems. ECNs (electronic communications networks) like Instinet, Island, and Archipelago are excellent examples.
- A number of these alternatives offer after hours trading that enables traders to access global markets as well as to make trades that take advantage of the newest information. Although usage of these networks remains low at the moment due to a catch-22 situation involving buy and sell-side critical masses, they are expected to grow widely in the future. To maintain their current positions, other exchanges will be forced to offer extended hours as well. The resultant increase in potential for downtime is likely to increase demand for highly available equipment.
- These exchanges also offer quick, efficient electronic matching of requests and bids, in order to rapidly execute trades at the best possible price for all parties involved. This could prove an advantage over traditional exchanges that, like the NYSE, still employ market makers and trading pits. Exchanges are attempting to overcome this by enhancing the efficiency of their current processes. The NYSE recently concluded a major technology overhaul, involving the installation of fiber-optic cables and wireless technology that is designed to work in conjunction with handheld devices and flat screen displays in order to improve the efficiency and speed of information transfer.
- U.S. based exchanges have recently finished upgrading systems to meet the challenges of decimalization. This has reduced the spreads in stock trades while standardizing data formats for international trades. The next challenge before the industry is T+1 (Trade day plus one) or STP (Straight Through Processing). This is to speed up the execution and settlement cycle for trades to one day after the execution of the trade. The current standard is T+3 or three days after the execution of the trade. STP involves the standardization of data formats to allow the automated completion of trades. While this has proved relatively simple in the case of simple trades involving stocks, it is more difficult when dealing with more exotic instruments such as international trades, options, and derivatives. Organizations such as the Global Straight-Through-Processing Association (GSTPA) and Omgeo

are currently working on this issue. This drive to minimize trade-processing time will spur demand for highly available infrastructure.

- Fault-tolerance and disaster recovery are key concerns. (The World Trade Center bombing focused attention on disaster recovery). According to Lee Congdon, SVP for 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.
- There is a strong focus on Unix and proprietary servers, with Windows NT / W2K increasingly dominant in client systems.
- New entrants to the market will favor Windows NT / W2K, due to cost of purchase considerations. The total cost of ownership could be higher if the actual cost of downtime is considered.

Dealing System

- 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.
- Steady growth is expected in Windows NT / W2K penetration as institutions (Banker's Trust, etc.) embrace Windows NT / W2K.
- US Options exchanges are being threatened by the emergence of an all-electronic options market that claims it will cut the cost of trading by 30%. The online International Securities Exchange is being backed by an \$80 million investment from a group of internet brokers.

Market Data Feeds

- Time-sensitive and mission-critical.
- Primarily Unix based, with Windows NT / W2K strong on the 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 / W2K 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 / W2K growth, as scalability issues are resolved with the acceptance of Windows 2000 Data Center Edition.

Risk Management

- HA is critical in the derivatives industry.
- Traditional proprietary and Unix application, but Windows NT / W2K growing
- Significant amount of Windows NT / W2K (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 / W2K servers.*

The applications that are driving the consumption of HA servers in the Retail / Distribution market are Supply Chain Management, Data Warehousing, Customer Loyalty or 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 industry, 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 / W2K is expected to proliferate beyond the year 2002, primarily in areas where HA is not a critical requirement. It will take time for business to build trust in the scalability and reliability of Windows Datacenter 2000.

The Retail marketplace is characterized by low profit margins and in many cases fairly conservative management practices which will inhibit the acceptance of, and requirement for, HA systems in stores or at 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 the significant competitive advantage created by the capability to track spontaneous or near spontaneous shifts in market demand.

We expect to see strong growth in retail sales over the Internet beyond 2001 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.

Retailers are increasingly deploying applications such as Enterprise Resource Planning (ERP), Supply Chain Management (SCM) and Customer Relationship Management (CRM) functions. The key factors behind this adoption are the problem of fulfillment for online retailers and commonly held negative perceptions of customer service over the Internet. These mission-critical applications will drive a fast growing need for HA servers.

The business-to-consumer markets will experience significant growth as retailers try to improve on negative perceptions of customer service on the web. Online spending in sectors such as apparel, leisure travel, computer hardware, hotel reservations, consumer electronics, etc. will flourish. The need for HA servers in the B-to-C market will be driven mostly by seasonal buying, when traffic to a retail site can spike dramatically, potentially crashing the server.

- Based on recent conversations as well as an in-depth review of trade publications, it is readily apparent that VARs are rapidly embracing NT / W2K.
- EFT/POS applications will in many cases require a Highly Available back-end server, mostly to compensate for the high volume of transactions during peak processing periods, such as holiday and end of quarter.

Order Management

- Overall decrease in hardware spending as a portion of total IT budget.
- Strong movement towards client/server and web.
- VARs are enamored of Windows NT / W2K but users are still waiting for proof that it is capable of supporting mission critical business applications.
- Peak load demands (e.g. holiday or seasonal purchases, limited-time sales) can be utilized to influence purchase behavior by setting a high watermark for availability requirements.

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 due to current penetration levels, as well as consolidation caused by increasing prevalence of HMOs and managed care.
- An increasing volume of transactions will lead to larger servers with HA requirements. Unix will remain favored for several years.
- Internet, EDI, and Government mandates will foster the use of new electronic systems.

Warehouse Management

- Warehouse applications are moving towards paperless ordering, billing, and inventory control.

- Increasing time-sensitivity due to JIT purchases, supply chain management, MRP, Buy Vs Build, etc.
- Dependable inventory management will increase profits for many firms.
- System responsiveness and reliability are of key importance.

Customer Relationship Marketing

- Strong growth in “customer care” systems.
- Customer profiling, data warehousing and database marketing to achieve a “target market of one.”
- Information must be online and accessible, as customers will call in from anywhere in the world, at any time of day.
- Service will be a key factor in attracting and retaining customers.
- Almost 2/3 of revenue comes from existing customers, as compared to only 1/3 from new customers.
- It costs 5 to 6 times as much to attract a new customer as it does to retain an existing one.

Government

HRG Assessment:

- ⇒ *Conservative market in terms of “stick with what you know works”.*
- ⇒ *Involves higher levels of public accountability and legislated requirements.*
- ⇒ *High Consumption of AE3 and AE4 in secure programs*
- ⇒ *Adoption curve for NT / W2K 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, previously a sacred cow, is increasingly coming under scrutiny. As pressure increases in this area we expect to see spending become more rational and as a result somewhat constrained as compared to the past. Federal IT expenditure is expected to reach \$49.1 billion in 2005. While the rate of federal expenditure is slowing, state and local spending has picked up steam and is expected to account for approximately \$52.5 billion dollars by 2003.

Government purchases up to this point have predominantly focused on upgrades to existing administrative systems. Most activities that involve the Internet have focused on simple transaction and on the transfer of content to another channel of access. A notable success has been the electronic tax-filing program. However, public officials are still only slowly improving services by allocating resources to projects that tap the advantages of the Internet.

Government action has been seen in the following areas:

- **Data Warehousing and Knowledge Management:** To overcome the common occurrence of bureaucratically divided departments and help create a single point of user contact, widespread data sharing is essential. Not only is this important in civic administration, it is vital in the armed forces, where access to information is critical. Data Warehousing and Knowledge Management systems have become even more attractive due to the loss of knowledgeable and experienced personnel that the downsizing of government involves.
- **E-Procurement:** While governments do not need to show profits, they must minimize costs. Electronic procurement systems allow government bodies to more wisely spend public resources, either by aggregating multiple bodies to negotiate better prices from a single vendor, or through price comparisons and bidding across a broad range of vendors.
- **Section 508:** Mandating accessibility of federal computer systems to all disabled workers.
- **Wireless:** A number of government departments, notably the armed forces, are involved in the development of portable computing (vehicle-based or individual-

based) to support mission critical tasks. These implementations will require an extremely high level of availability.

- Security: due the large volume of classified, personal and public data that is archived by various government bodies, it is imperative that they enact security measures adequate to maintaining data integrity. While some departments are undertaking this task themselves, others, like NASA, are turning to third party ASP's to provide an adequate level of security.

These changes will either require significant upgrades in systems availability or the wholesale replacement of older, less highly available servers with newer AE3 and AE4 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, thereby contributing to the growth of AE3 and AE4 revenues and shipments. The need for HA servers in other areas will vary application to application.

Larger back-end systems are predominately AE4 systems at least for larger governments. However many small vendors are currently providing Unix and Windows NT / W2K based CAD systems (AE2-AE4) to small departments or small state and local governments.

Computer Aided Dispatch and (911) Emergency Service

- HA is mandatory for fire, police, and EMS dispatching. Where lives are at stake there is little or no tolerance for down time.

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 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. CRM applications will become as important as the distinctive sort of ambience that casinos use to draw customers. Harrah's CRM implementation allowed it to increase sales by 14% in the first year. Other operators will have no option but to increase their efforts in this direction

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 / W2K 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 on the size of Jackpots.

- It is estimated that some 1,400 casino Web sites generated revenue of \$1.5 billion last year from online gaming, a figure that is estimated to grow to \$5 billion by 2003.
- Online gambling in Asia is predicted to reach \$10 billion in annual revenue 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.
- Regulatory approval for online gaming in the U.S. is quite nebulous. While Nevada has recently passed legislation allowing casinos to provide online gaming, it has imposed severe restrictions on the clientele allowed to use these services while holding casinos responsible for meeting such requirements. Several states have been aggressive in shutting down not only online gaming but also U.S. based entities aiding international gambling websites, whether it is through publicity or hosting and technical services.
- In 1983 slot revenues surpassed once-dominant table game revenues for the first time. By 1997, slot revenues accounted for 62.6% of total gaming revenue in Nevada, while table games accounted for only 37.4%. Slot machines have continued to become increasingly sophisticated as there has been a remarkable shift from mechanical to electronic machines.

Recent developments in slot machines include:

- The development of networked Megabucks games which allow the linkage of slot machines across properties and geographies to provide for bigger jackpots.
- Ticket payment systems that allow operators to program machines to make payments in the form of printed tickets that can be exchanged for cash or used at other games.
- Multi game machines that allow users to play different games at the same terminal without having to move to different locations in the playing area.

Betting/Lottery

- Increasing demand due to growth in number of casinos and patrons, along with the 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 / W2K 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 a growing customer base.

Healthcare

HRG Assessment:

- ⇒ *Conservative market*
- ⇒ *IT Budgets are stagnant, with an average of about 2.5% of operating expenses and 8% of capital spending earmarked for IT.*
- ⇒ *Moderate Consumption of AE3 and AE4.*
- ⇒ *Adoption curve for NT / W2K will be slow in the US for mission critical or “life critical” apps as Unix is heavily entrenched in this Industry. However, NT / W2K 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% of Gross Domestic Product on healthcare (the 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.*

Opportunities in new applications are disproportionately greater in healthcare than in other industries. Healthcare has not yet seen external pressures to become highly efficient, and even though it is quite labor intensive it operates much akin to a cottage industry. Consequently the degree of automation is significantly behind that of the financial services, manufacturing, telecommunications, and retail supply chain industries. However, healthcare in the industrialized countries is beginning to fall subject to pressure from customers who want to be treated as customers, not patients, demanding better quality care at lower costs.

As healthcare customers become more knowledgeable about diagnosis and treatments as a result of the information available through the Internet they will begin to expect more than is presently available. A three month long survey conducted in 2000 showed that 46.7% of consumers carried out some form of healthcare related research on line. In addition, online healthcare sales are expected to grow at a CAGR of 101%, from \$600 million in 2000 to \$9.8 billion in 2004.

The impact of technology is also beginning to be seen in the broader use of telemedicine. Many of the capabilities of telemedicine have been restricted to large institutions, because of 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 all creating new opportunities. Managed health providers are leading the push towards outpatient treatment and disease management in the push for greater cost reductions. It is estimated that by the year 2050, 75% of surgical procedures will be performed on an outpatient basis. This push has led to the development of remote monitoring equipment and to the increased popularity of services aimed at prevention.

Disease management has aroused considerable interest, with revenues increasing from \$150 million in 1998 to \$600 million in 2000. In some cases, disease management systems have led to a decrease of up to 30% in hospital admissions. One application of this technology appeared in the news recently, as Vice President Cheney was fitted with a cardioverter defibrillator to monitor his heart condition.

However, due in part to its highly personal nature, a key characteristic of the medical technology industry is its exposure to potentially significant product liability claims. Medical device companies have recently faced increased product liability risks for alleged injuries resulting from the use of their products. Although most companies protect themselves with product liability insurance, total coverage for widely used products is usually beyond their financial means. Thus, as many firms must assume a good portion of the risk themselves, high availability will become a minimum requirement.

The increased uses of electronic processing for claims and prescriptions will not only create a demand for computing resources but for high availability computing resources as well. With billions of transactions going on-line, the workload will be so monstrous and continuous that downtime would cause colossal recovery problems. Because of this, Internet links and computer processing at both ends will require high availability systems.

Electronic patient record systems will require high availability, not because of high volume, as in the case of claims, but due to the need for 7x24 availability. Electronic patient records must be instantaneously accessible at any time, from every healthcare provider location. Just as in claims processing, this will place a heavy demand on Internet links and on the equipment at both ends, assessor and repository.

With these systematic changes to claims, prescriptions, and patient records processing, the rapid growth of the Internet as a source of information will put new, heightened demands on repositories and Internet links. Although downtime is not life threatening, as it is in the case of patient records, the sheer volume will require high availability in order to assure customer satisfaction. Repository sites will not be capable of building customer loyalty (a major source of their revenue) if they experience serious and regular breakdowns.

To aid in the electronic exchange of information, the Health Insurance Portability and Accountability Act (HIPAA) was passed in 1996. This law has three major parts:

- (1) Portability of benefits;
- (2) Fraud and abuse; and
- (3) Administrative simplification, privacy and security.

It is the third part of this law that will generate the highest compliance burden for providers, payers, and employers. HIPAA requires the standardization of the electronic

transmission of health insurance, claims and patient data, and establishes data privacy and security standards that must be followed.

The burden for meeting HIPAA is estimated to be even greater than that of accommodating Y2K, involving a continuous information technology and security management commitment in both time and personnel.

Assumptions

- The major costs in healthcare are billing, patient records, claims processing, and the labor-intensive nature 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 general magnitude of these costs prevails even in countries with healthcare systems that differ significantly from that of the United States, 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, most of which are processed manually.
- Only about 60% of insurance claims are processed electronically. To date, web processing accounts for only about 2 per cent of all transactions.
- Medicare, the single 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 eventually 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 system would provide the infrastructure required to improve the quality of care, while reducing the current dependence on labor.
- The availability of the Internet, the informed patient, and the need for reduced costs will all contribute to a much wider use of electronic patient record systems. Because

electronic patient records will reduce incorrectly prescribed drugs, insurance fraud, and clinical errors, their use will grow rapidly as their benefits become apparent, with all providers and patients demanding equally satisfactory 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*
- ⇒ *Consumer demand for online travel content is growing. Consumption of HA enhanced servers will heat up over the coming years, as companies embrace the Internet to meet this demand.*
- ⇒ *NT / W2K adoption will be slow. Unix and proprietary solutions are entrenched in this industry. NT / W2K's scalability, availability, and security weaknesses will slow adoption at the high-end of this industry.*

The Travel Industry is growing rapidly, and presents excellent HA opportunities. Increasing passenger traffic and elevated security requirements are driving the 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 one billion passengers a year by 2008, while prices have declined by 36%. This is a result of deregulation.

- Almost a third of B2C transactions in the US in January 2001 were carried out at travel sites.
- Travel and hospitality is a rapidly growing business. The speed and efficiency of customer service is the key differentiation between common carriers. HA supports this differentiation.
- Increased business and pleasure travel drives strong growth in ticket and boarding pass generation, seat allocation, etc.
- Gate allocation, crew allocation, and cargo routing all require HA.
- Increased security requirements drive better baggage ID & handling systems, access systems
- Electronic ticketing is replacing paper forms. As all major airlines roll out auto check-in kiosks, information must be on-line and available.
- By 2005, the Internet will be the dominant channel for reservation-making, fueling consumption of AE3 and AE4 servers.
- Although several airlines have tested Smart Cards, the chip technology will not be widely deployable until carriers upgrade and link back end data systems to support them.

Telecommunications

HRG Assessment:

- ⇒ *Conservative market tending to use only proven solutions.*
- ⇒ *Deregulation is driving competition and need for cost reduction.*
- ⇒ *Aggressive investment and spending in all areas of wireless technology*
- ⇒ *High consumption of AE3 and AE4*
- ⇒ *Linux gaining significant market-share for new applications (e.g. IP telephony, other Internet related apps)*
- ⇒ *NT / W2K is expected to remain in non-service delivery, non-critical application areas until NT / W2K has proven its reliability and scalability. Increasing mission-critical support for NT / W2K failover*
- ⇒ *Globalization of Telecommunications will heat up requirements for HA enhanced servers world-wide*
- ⇒ *Mobile Internet & pervasiveness of computers makes high availability more important than ever before*
- ⇒ *Bundling of services driven by convergence of voice, data, video*
- ⇒ *NT / W2K adoption curve is changing.. Although Unix is heavily entrenched in this industry, and NT / W2K's weakness in terms of availability, scalability, and security have slowed its wide-spread acceptance, NT / W2K adoption is increasing due to lower TCO and greater mission-critical support*

Although we group Telecommunications as a vertical industry, it could also logically be called a horizontal one. It provides infrastructure, support, and services to all other industries and as a result garners significant revenue from all of them. Increasingly all industries are coming to depend on the Web and E-commerce as a 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 a key area, with the highest use and growth of use for HA servers in the AE2 through AE4 range for the forecast period.

As Internet and digital entertainment penetrate non-urban areas around the world, the satellite based telecommunication industry is rapidly gaining momentum, resulting in 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 real requirements for fault tolerant AE4 / 7x24 solutions due to the very 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 will continue to drive AE4 requirements.

Fierce competition- due to the deregulation of the telecommunications industry- and a general economic slowdown are fostering the need for cost reduction. Although NT / W2K is less expensive, it has largely remained in non-service delivery application areas due to the "bet your business" nature of most telecommunication applications and NT /

W2K's unproven reliability and scalability. We believe that, while NT / W2K is still not the best choice for AE4 applications, there is an unmistakable trend towards NT / W2K gaining an increasing share of next-generation mission-critical applications. The main drivers for this trend are greater mission-critical support for fail over, reliable Real Time Operating System (RTOS) extensions to NT / W2K, a "pull" from IT managers and developers due to wide application support, and a flatter learning curve than most other systems.

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 across international borders, thereby opening the door for network interconnection.

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

There is a growing interest, among customers and service providers both, in the bundling of services. Customers want the convenience of having a single source of billing and support, while providers want to gain more customers and realize the cost reductions possible through synergies.

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 and forwarding, which traditionally have been integrated via Unix and proprietary telecommunication switching systems. We expect that the increased use of Call Location applications will boost System Signaling 7 (SS7) traffic and back-end processing requirements which in turn will drive the increased consumption of HA enhanced servers to support this application in an "Off Switch" implementation.

Unified Messaging

Traditionally, individual messaging applications such as e-mail, voice mail, call forwarding, and fax and pager messaging, have driven consumption of HA enhanced servers in the AE2 and AE3 ranges. There is now a growing market for Unified Messaging, i.e. access to many messaging services from a single, centralized unit such as a PC, phone, or wireless device. Due to this aspect of "centralization", there is a more stringent requirement for high availability than ever before. We expect Unified Messaging to drive consumption of HA servers up the scale.

Card Billing

Mission critical applications that comprise card billing and fraud management require both HA and rapid throughput. Due to the fact that transactions are directly responsible for dollars it is only normal that the majority of servers used to support these applications are AE3 or AE4, either Unix servers or servers running a proprietary OS. We expect to see a steady rise in transaction volumes, keeping with the anticipated increase in use of phone cards and cellular services (phone, fax, e-mail, and paging). Bundling of services will further increase the HA requirements.

HLR IS41 & HLR GSM

Home Location Register (HLR) is the database that provides the basis for mobility management. The HLR contains information about subscribers that is critical to the delivery of mobile communication services. Information about customer subscriptions resides in this database, and if it is unavailable users will be directly affected as the services they subscribe to will be unavailable. HLR is one of those applications that require an AE4 or fault tolerant server, and the majority of servers that run this application 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, one which will not subside in the United States until sometime in 2002, and will continue in Europe through 2003. The rest of the world is expected to lag Europe in demand by 4 to 18 months, depending on the current telecommunications infrastructure already in place. The clear majority of LNP installations are expected to be UNIX based throughout the forecast period.

FCC and WTB have granted a request to delay wireless Local Number Portability (LNP) implementation until November 2002.

Spending on LNP in the US was high in 2000 and is expected to tail off through 2001 and 2002, once the end of the time frame for the FCC's Mandate has been achieved.

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 in order to better satisfy clients and stave off competitors. VPNs allow businesses to take advantage of geographic market shifts without having to incur the extraordinary costs of rebuilding infrastructure.

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

Prepaid Calling Card

Prepaid Calling Cards continue to see widespread adoption in developing areas such as South America, parts of Asia, Eastern Europe, and the Former 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 is 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, such as in 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 AE1 or AE2, HRG believes that as subscribers become more sophisticated and the competition for the Prepaid Calling Card market heats up, service providers are likely to attempt to differentiate themselves from the pack by offering higher levels of availability. The provider with the widest variety and the most reliable service at a competitive price will likely win out over their competition. Therefore, towards 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

Personal Number or Single Number, while much touted as a new "killer application", has seen 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 never quite to achieve the wide spread adoption that others have predicted for it.

The primary appeal of this application is the capability of subscribers to be reached anywhere, at any time, although this is not always desirable. A Personal or Single number may ease customer outreach and the maintenance of customer databases. However, if a business were to assign such a number to a contact person who then moved over to the competition, client accounts would be compromised as their primary point of contact--this phone number--would now be owned by a competing company.

The ubiquity of access that this application imposes requires higher than normal levels of availability. 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 Switch " or SCP based implementation. Such an implementation can 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 will come to expect and which, by the end of the forecast period, they will come to demand.

VOIP

Voice over IP (VOIP) is a subset of IP Telephony in which voice, fax, and related signals are transmitted over privately managed packet-switched IP-based networks, in addition to the public Internet. Advantages of VOIP over PSTN include savings in long distance phone calls, especially international calls; support for multimedia and multi-service applications; and the ability to eliminate points of failure, consolidate accounting systems and combine operations. Although VOIP has witnessed tremendous growth in the past three years, the following issues continue to prevent VOIP from exploding as the next-generation telephony infrastructure:

- Legacy PSTN switched systems and IP-based digital voice services must be seamlessly integrated.
- A need for enhanced services, which are equivalent to or better than services provided by PSTN networks, over an IP network.

HRG believes that while VOIP will continue to grow rapidly, its growth will not be exponential until 2003.

As VOIP gains popularity and creates user dependence it will be expected to perform at the same high availability standards as PSTN, thus driving consumption of AE3 and AE4 (depending on use in business).

Insurance

HRG Assessment:

- ⇒ *Conservative market, one of the last to go on the web. However, it has slowly started moving towards the Internet.*
- ⇒ *Moderate Consumption of AE3 and AE4. Consumption will increase by 2004*
- ⇒ *Globalization of the economy has little impact on the demand for HA enhanced Servers*
- ⇒ *Dependence on global outsourcing will increase as insurance companies embrace the web*
- ⇒ *Adoption curve for NT / W2K will be slow. Unix and proprietary systems are entrenched in this Industry. NT / W2K's inherent scalability weakness, lack of security, and unproven nature will slow adoption.*

The insurance industry has traditionally been paper bound and fairly conservative, but this is changing. In the new and more competitive insurance industry companies and agencies are increasingly moving 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 that 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 due both to its durability and to the fact that all of the applications that are required are currently available for Unix.

- The insurance industry has traditionally been a CISC and proprietary OS stronghold.
- By 2003, one stop financial shops, consolidations of insurance, banking, and investment services under one roof, will become prevalent. This convergence will drive high consumption of AE3 and AE4 servers.
- Currently only 15% of companies that issue bills, such as insurance, utilities, lending institutions, communications, and credit card companies, offer Internet billing. This number is estimated to reach 43% by 2005. It is estimated that the insurance industry could save \$6-15 million per year via Internet billing.
- The top 500 insurance companies spend about 5% of revenue on IT, with 15% of that directed at technology and products.
- Insurance industry spending on IT is predicted to be \$32B by 2001
- Insurance Malls (e-Intermediaries), one of the fastest growing segments in insurance E-Commerce, will increase consumption of AE3 and AE4.
- The conservative nature of the insurance industry has made it one of the last to go on the web. Only 9% of insurance company revenue in 2000 came 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*
- ⇒ *Spending on E-Business infrastructure by discrete manufacturing companies will double between 1999 and 2003*
- ⇒ *E-procurement will be a key driver for companies to adopt or expand e- business processes, which in turn will drive HA consumption.*
- ⇒ *Globalization of the economy and resultant competitive pressures are heating up the demand for HA enhanced Servers*
- ⇒ *Unix is established in this Industry (e.g., CA-ASK Manman on HP/UX). NT / W2K is gaining popularity in the low end of HA enhanced servers. NT / W2K's scalability and availability weaknesses will slow adoption for mission critical applications.*

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 for 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 follow:

- **MRPII**
- **ERP**
- **Supply Chain Management (SCM)**
- **E-Procurement**
- **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**
- **E-Commerce**
- **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 worldwide growth in the years to come. Enterprise Resource Planning (ERP), Supply Chain Management (SCM), E-Procurement, 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 become ever more creative about how to use the Internet to sell goods to their customers. Online consumers are increasingly buying "high-touch" products such as clothes, health

and beauty products, sporting goods, flowers, and toys. 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.

GEOGRAPHIES

North America

HRG Assessment:

- ⇒ *Good infrastructure – “state-of-the-art” in some metropolitan areas*
- ⇒ *Technical expertise is good.*
- ⇒ *Significant IT budgets which have become more conservative due to IT meltdown.*
- ⇒ *Innovators and early adopters of new technologies.*
- ⇒ *Large installed base of AE3 and AE4 UNIX and Proprietary solutions.*
- ⇒ *Pent up demand for AE3 and AE4 NT / W2K based solutions will be released once NT / W2K has proven itself in real world enterprise level environments.*
- ⇒ *Business as usual in established installed base.*
- ⇒ *E-Commerce and other web applications are growing fast and will significantly alter the demand for AE3 and AE4 servers.*

The IT meltdown has led to a broader economic downturn in the US economy. The US economy is growing with real GDP at an annualized rate of 1.3% in the first two quarters of 2001, compared to last year's growth rate of 3.1%. Private consumption and investment have been on the fall too. Hardware spending will bear the brunt of the downfall. HRG believes, however, that long-term Internet trends are strong and that conditions should improve by the end of 2002.

Telecom and financial services- two major areas of HA spending in the pre-slowdown period- still have major potential for expansion of HA server consumption and new high availability applications. While financial services spending has not been hard hit by the slowdown, the same cannot be said about the Telecommunications industry. The Telecommunications boom of past few years- mainly driven by deregulation and the emergence of the Internet- has resulted in “bandwidth glut”. Telecommunications spending will not live up to its potential until the end of 2002; the time required for excess equipment inventories to wear down.

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 3 million in 2000 to 9.8 million by 2003.

Another key dynamic will be the impact of wireless telephone communications. A recent survey indicates that wireless minutes as a percentage of wireline minutes will increase from 19% in 2000 to 71% in 2005.

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 / W2K and Linux based systems because of simplicity and price.*
- ⇒ *Infrastructure and technical expertise will also contribute to the bias to NT / W2K systems.*

The emerging development pattern in Latin America, coupled with events in Asia, marks a major and enduring shift in the geography of international economic development. While a 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 digital divide within Latin America, between developed countries like Brazil, Argentina, and Mexico, and other countries is widening.
- The privatization of Brazil's telecom agency, Embratel, and its subsequent sale to a consortium of MCI and Telefonica de Espana bodes well for the South American wireless market.
- The wireless market in Latin America has strong potential for growth, as demand for phone service is strong while the existing wireline infrastructure is weak. According to one analyst firm, wireless phone revenue will balloon from \$20.7 billion in 2001 to nearly \$40 billion in 2005.
- IT equipment, including services, PCs and peripherals, in Latin America represents more than US\$35 billion in annual IT spending, and the future looks even brighter.
- The market for Internet Connectivity and content services in Latin America is growing rapidly. In 2000, there were approximately 2.5 million Internet users in Brazil, 0.3 million in Argentina, and 1.8 million in Mexico. Internet users in Latin America are expected to grow from around 11 million in 2000 to around 29 million by 2003.

EMEA: Europe, Middle East, and Africa

Europe

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 / W2K.*

In terms of technology usage, Western Europe is by far ahead of Central and Eastern Europe, and the Middle East. While the strength of technology infrastructure varies among the Western European countries, they share similar growth dynamics in regard to both Internet usage and the economic and governmental forces that effect consumer and corporate spending. Countries that are part of the EU must 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 through raising tax rates, and decreasing costs by way of privatization. These methods could have a negative short-term effect due to increased pressures on the privatized corporations. These corporations will need to adapt to new competitive forces in the marketplace, and if they are faced with rising tax rates it may hinder their ability to invest in 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 while the service industries are mostly growing, although at different rates. Germany's service industry is experiencing some difficulties, perhaps due to the wider shift away from manufacturing, their strongest yet most rapidly declining sector.

Eastern European countries were strongly affected by Russia's 1998 decision to devalue and default. The effect of economic and political uncertainty continues to hinder industrial growth, as does continually rising inflation. The banking sector in these countries is struggling as a result.

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

Germany

- Germany's economy is the EU's largest economy.
- By 1960 the West German economy had grown to the size of France and the UK. From the 1960s into early 1990s it maintained its position as the world's 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 have focused on and excelled in this area since WWII.
- The Internet is still small in Germany, due to high 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 wide 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 the competition from 200 new telecommunications suppliers and perhaps 1,300 companies operating in non-licensed sectors of the industry. DT has been involved in arguments with regulators 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 8.4% in the first three quarters of 2000, mainly owing to a loss in manufacturing jobs.
- Germany is finding it difficult to create new jobs in the service sector.

United Kingdom

- London is one of the world's 3 largest financial centers, and is the largest center of international finance in the world.
- The UK has a flourishing business services sector, partly reflecting synergies with the financial sector in London. London is as well 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 seen its dominance challenged by up-and-coming, often cheaper, exchanges abroad. Growing competition from other EU exchanges, combined 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.

- 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 gigabits 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, the UK, and the US, 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, in which they are second only to the US.
- The French workweek is 35 hours. Many French companies have been subsidized by the government and are not growing or profitable.
- The EU has certain criteria for what the economy should look like, in order for the countries' currencies to transition well to the Euro. The economies of member countries must be very close to each other before they 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 French government is encouraging competition, but is also increasing taxes so companies may not have the capital to invest in the technology they need to become efficient and competitive.
- France's economy of the past included the exports of weaponry. This has drastically been reduced in the 1990's, thus putting pressure on their manufacturing industry.
- France Telecom was broken up in '97 in a fashion quite similar to the breakup of AT&T.
- Internet penetration in France stands at 17.8%, behind the UK and Germany. However, France has the most frequent users, with 32% of Internet users logging on daily. France also leads the way in mobile communications, with 50% of French owning a wireless device.
- France's inflation will remain among the lowest in the EU.
- 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.

Scandinavia: Norway, Sweden, Finland, Denmark

HRG Assessment:

- ⇒ *Good to Adequate infrastructure.*
- ⇒ *Iceland, Finland, Sweden, and Norway, along with the United States, are the world leaders in Internet and computer use per capita.*
- ⇒ *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 / W2K.*
- ⇒ *NT / W2K based systems will appeal to small IT budgets in smaller (newer) enterprises.*

Norway

- Its main export is oil, of which it is the world's second largest producer, ranking only behind Saudi Arabia. Yet Norway is independent of OPEC and sets its own oil policy, sometimes contrary to OPEC objectives. It is also heavily involved in metals mining and manufacturing
- 63% of the population had personal computers in 2000, and 45% were using the Internet on a regular basis.
- It is the least densely populated European country.
- They have an excellent communications infrastructure.
- Norway does not want to be part of the EU, and because of their strength in oil exports, they can stand on their own economically. They are also afraid that EU membership will interfere with their fishing industry.
- A benefit to their not having to change their economy to fall within EU parameters is that Norway's economy has in the past decade become stronger than those of most other European nations.
- However, high taxes and the fact that it is not a member of the EU (and therefore doesn't use the Euro) means that there are more constraints on Internet and E-Commerce growth in Norway than in the rest of Scandinavia.

Sweden

- The Social Democratic Party (SDP) made Sweden an EU member, but there are still many skeptics who argue that membership is undermining their traditional welfare state, a matter that has caused great division within the party.
- In 1997, there were 679 telephone connections for every 1000 inhabitants, the highest per capita rate in the world.
- There are over a dozen companies offering fixed-line networks, although Telia (the national telecommunications company) dominates the domestic market.
- Mobile phone penetration is approximately 60%.
- Ericsson generates approximately 15% of Sweden's exports, and is in fierce competition with Nokia of Finland and Motorola of the US.
- Ericsson posted \$32 billion in sales in 2000, with Western Europe their largest market, followed by Asia/Pacific and Latin America.
- Sweden is a highly computerized society. In December 2000, Over 50% of Swedish adults (3.9 million people) were active Internet users and 63% of the population owned a computer.
- Recently, a significant number of Swedish companies have relocated their headquarters to other EU countries. The low corporate tax rate of 28% isn't the problem as much as the 30% tax that corporations must pay on top of each employee's salary.
- Sweden has a strong automotive sector with Volvo, Saab, and Scania, although large shares of their car divisions have been transferred to other companies. Saab is now controlled by General Motors and Volvo by Ford. Their truck divisions are strong and provide higher margins than do their car divisions.
- Sweden's pharmaceuticals 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 these same 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, and their economy is under control and facing competitive pressures to reduce costs, given the heavy tax burden of employment. Although they are members of the EU they are not yet part of the EMU, and are therefore not yet tied to the Euro, although this may change in the next 2 years. If it does it will cause economic upheaval, which could adversely affect the ability of Swedish companies to invest in new equipment.

Denmark

- Early in the 20th century Denmark was a primarily agricultural economy; however, during the post-war period and particularly since the 1960s, the economy has diversified and the manufacturing and services sectors have grown. Manufacturing now accounts for approximately 16% of total employment, compared with only 1.5% for agriculture, with the vast majority of the remainder, 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. Metal manufacturing contributed 39% to Danish exports while Food, Beverage, Tobacco and Chemicals contributed 18% and 13% respectively.
- Although the state sector is slowly being scaled back as the government strives to cut the public debt, 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 similar to that found in the other Scandinavian nations. 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.
- 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.
- Despite a small domestic market, Denmark can boast a number of the world's 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 consumer with a 27% share of total turnover. Excess grain, as an example, 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 agricultural sector, and the pharmaceuticals sector has utilized 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 59% of the population has television receivers. A similar proportion has parabolic antennae for the reception of satellite television. Denmark implemented the EU-wide telecommunications directive in July 1996, a full 18 months ahead of the deadline. This has broken the monopoly previously enjoyed by the state-owned telecommunications Company, Tele Denmark, and enables non-Danish telecommunications companies to offer a competing service.

- Most industrial firms in Denmark are small: fewer than 900 companies employ more than 100 people, and average employment over the whole manufacturing sector is only 18 per entity.

Finland

- The Finnish economy was expected to reach a GDP of \$121.98 billion in 200, ranking it 15th out of European economies in size. This placed Finland behind its Scandinavian 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 apace. The primary and secondary sectors, for example, still accounted for 7% and 35% of GDP respectively in 1990, and 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 in that sector 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 largest 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 primary 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, and thus the bulk of its energy has to be imported.
- The Finnish population has been slow to accept a service culture, and many of the newer jobs in the service industry have actually been created by the manufacturing sector, which often out-sources production related services.
- Finland's telecommunications industry and infrastructure have seen the benefits of deregulation far sooner than have most other nations. Competition in the mobile telephone market was introduced in 1990, while the markets for national long-distance and international services were deregulated in 1994 and 1995 respectively. By September 2000, 73.7% of the Finnish population had a mobile telephone connection, the world's second highest proportion behind Iceland (75.8%). In comparison, the percentage share was 40% in the US. Both analog and digital

mobile and fixed-line telephone networks exist in Finland, with the country at the leading edge of technological developments. It's estimated that 1.9 million people, or 44% of the Finnish adult population, will use the Internet for at least one hour a week in 2000.

- 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 60,173 people worldwide product sales in more than 130 countries, Nokia is listed on five European bourses and on the New York Stock Exchange.

Other Europe

HRG Assessment:

- ⇒ *Inadequate, decaying, 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 / W2K.*
- ⇒ *NT / W2K 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:

- ⇒ *Highly developed infrastructure and industrial base.*
- ⇒ *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 corporate restructuring. The Japanese government did achieve its goal of 0.8% growth in fiscal year 2000; however, the outlook for 2001 is gloomy due to the impact of economic turmoil in the US. 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 achieve an upward momentum in growth. Most industries are predicted to maintain a very cautious attitude towards undertaking new capital investment, primarily due to continued overcapacity and uncertain profits.

However, with the third largest economy in the world in terms of GDP, Japan and its population of 127 million offer considerable market opportunities. Three areas set for particularly fast growth in the forecast period are healthcare, wireless, and financial services.

- The Japanese government has announced the introduction of a new five-year plan, termed “e-Japan”, aimed at increasing Internet access and encouraging competition in the country's telecommunications industry. This program aims to increase adoption of the Internet by breaking the monopolistic powers of NTT DoCoMo.
- Japan's heavy dependence on imported energy supplies has resulted in huge investments in the development of nuclear energy. Japan has approximately 51 nuclear power plants currently in operation.
- Japan's telecommunications and other information technologies lag behind that of Western industrialized countries. The proportion of homes and offices with personal computers is about half that of the US.
- Japan's pharmaceutical industry is expected to expand as a result of the acceptance of foreign clinical data in the approval of foreign pharmaceuticals and medical devices.

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 / W2K.*
- ⇒ *NT / W2K 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 controls 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 well into the next millennium.

China proper has been aggressively pursuing economic reforms. With its population of over 1.2 billion people, it 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 \$1.7 Trillion in 2000, and it is expected to become the world's largest early in the 21st century. Chinese governmental reforms supporting GDP growth by promoting investment spending and private consumption are expected to result in GDP growth of 8% in 2001 and 9% in 2002.

In order to sustain their economic expansion, the CEA countries are investing heavily in improving their infrastructure, particularly in the areas of transportation, energy, and telecommunications. For example, China budgeted over \$24 billion for investment in the telecommunications sector through the year 2000. Much of this investment focused on fiber optic, satellite, mobile communications, and advanced switching systems and included 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 \$43 billion by 2003. According to the China State Economic and Trade Commission, 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 "Silicon Valleys" for high-technology companies to inhabit for 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 either to import new technology and equipment directly, or to enter into such ventures jointly with foreign companies.

- The Telecommunication industry is growing in China as the number of subscribers to pagers and mobile telephones increases 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 the fastest growing GSM market in the world. Analysts estimate that there are around 82 million GSM subscribers in the country
- The China State Administration for Radio, Film, and Television believes that Cable TV will be a \$12 billion industry by 2003 and the market for appliances and equipment will be \$3-4 billion. Communications including data broadcasting and computer networking will total \$4-5 billion.
- According to Beijing-based BDA (China) LTD, the Chinese Internet market is predicted to grow from just over 7.25 million users in 2000 to 33 million users by 2003.
- China's pharmaceutical industry has grown significantly due to both the use of traditional Chinese medicines among overseas Chinese and an increased access to chemicals for the production of Western medicines.
- China possesses large reserves of ferrous and Ferro-alloy minerals that provide the basis 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 units by 2006.
- Taiwan intends to become a regional communications center and will substantially upgrade and expand 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.*
- ⇒ *Growing digital divide.*
- ⇒ *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 / W2K.*
- ⇒ *NT / W2K based systems will appeal to smaller more constrained IT budgets.*
- ⇒ *Millions of SMEs. Tremendous opportunity for low-cost Linux vendors to provide Internet services.*

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 progress swiftly from economies based upon agriculture and natural resources to those based upon manufacturing, distribution, and services. As a result the ASEAN region is a significant driving force in the entire Asia/Pacific region. This region is estimated to have a current combined population of 686 million, and a current combined GDP of \$1.1 trillion. Combined GDP is expected to grow at a rate of 3 to 5% through 2002, and at a higher rate until the end of forecasting period.

Asia's faster than expected recovery from the economic crisis of 1997 has been encouraging, but incomes and living standards still have a way to go to reach pre-1997 levels. Exports and public spending have driven recovery in the real economy so far; private consumption and investment are beginning to track upward as well. In the wake of slower global growth, there will be a decline in economic growth in 2001 in most East Asian countries, but a rebound is likely in 2002.

- E-commerce is expected to serve as an important engine of growth for development across the region. According to one analysis group, the Asia-Pacific region (excluding Japan) is forecast to exceed 240 million Internet users by 2005 and, although this represents more than a 30 percent compound annual growth rate from the 64 million users in 2000, there remains plenty of room for continued growth.
- The total number of cellular subscribers in the Asia Pacific region passed 188 million in 2000. The cellular/PCS market is expected to double by 2003.