HP-UX 11i version 2 September 2004 overview

HP Business Critical Systems Marketing

Version 1.9

Introduction to HP-UX 11i version 2 September 2004

When ship released in September, 2003, HP-UX 11i version 2 was the newest version of HP-UX 11i for the Intel® Itanium® architecture. It was a full-fledged enterprise release of HP-UX 11i with the full range of HP systems management and availability software products. The September, 2003 release of HP-UX 11i version 2 was a major transition point for HP-UX 11i onto the Intel Itanium architecture, which offers large improvements in price/performance and performance scalability compared to current architectures. It is important to note that HP-UX 11i version 2 on the Intel Itanium Processor Family preserved the investments of HP-UX customers and partners across PA-RISC, the current generation architecture, to Intel Itanium, the next-generation architecture.

In September, 2004 HP introduced an update to HP-UX 11i version 2 that is applicable to both the PA-RISC and Itanium architectures. This release is on a common DVD media for both the Itanium and PA-RISC architecture. For installation, the correct binaries will be identified and installed automatically depending on whether the hardware is PA-RISC or Itanium.

HP's enterprise computing business has always placed a premium on customer and partner investment protection. Nowhere is this more evident than in the planning that has gone into the transition to the Intel Itanium architecture. HP-UX 11i version 2 September 2004 implemented the full range of compatibility between HP-UX 11i on
PA-RISC and Itanium:

- Common "look and feel"
- Application build environment compatibility (source code compatibility)
- Data compatibility
- Binary compatibility

Groundbreaking aspects of HP-UX 11i version 2 September 2004

HP-UX 11i version 2 and HP-UX 11i version 2 September 2004 offer some highly significant industry firsts:

- The partition manager can manage HP-UX 11i, Linux, and Windows® running in separate hardware-based partitions (September 2004 added this capability for PA-RISC HP-UX 11i)
- 128-way performance scaling for both PA-RISC and the Intel Itanium architectures (September 2004 only)
- iCAP (instant capacity on demand) and Pay-per-Use for both PA-RISC and the Intel Itanium architecture (September 2004 only)

Overall, HP-UX 11i version 2 September 2004 represents functional equivalence between HP-UX 11i on PA-RISC and on Itanium.

HP-UX 11i version 2 September 2004 delivers on traditional HP-UX 11i strengths

HP-UX 11i version 2 September 2004 delivers and builds on the traditional HP-UX 11i strengths of performance, scalability, manageability, availability, security, interoperability, connectivity, and application development. More detail on version 2 September 2004 attributes in all of these areas is given below.

Performance and scalability

HP-UX 11i version 2 September 2004 is specifically designed and engineered for performance scalability up to 128 CPUs, greater than what was previously available on the PA-RISC version.

Additionally, HP-UX 11i version 2 September 2004 supports instant capacity on demand (iCOD), whereby additional processors can be brought online nearly instantaneously when the system load requires it. [iCOD is further discussed in the section on Availability]. Additional performance and scalability features of the v2 September 2004 release stream include the following:

- Support for all 2002 Itanium 2-based platforms (rx5670, rx2600); support for 2003 and 2004 Itanium 2-based platforms
- Support for HP 9000 (PA-RISC) rp24xx, rp54xx, rp74xx, rp84xx, and Superdome
- Support for 128-way performance scaling for both Integrity (Integrity) and HP 9000
- (PA-RISC)
- Support for 1 Terabyte of physical memory on PA-RISC
- ccNUMA (Cache Coherent Non-Uniform Memory Architecture) and cell-local memory for Superdome performance scalability. In Superdome systems, cell boards contain both CPUs and memory. The memory on the cell boards in a Superdome system constitutes the main memory of that server. Relative to the CPUs on a Superdome cell, there are three levels of memory latency based on where the memory is located relative to the cell: cell local, crossbar local, and system global (on the other side of the crossbar switch). The latency on the same cell access is fast and latency between cells is slow. HP-UX 11i version 2 September 2004 takes advantage of ccNUMA machines, and much of this can be done with good default behavior of NUMA-aware scheduler and memory management. The allocation of application code and data across the different levels of memory has a great effect on application performance. Cell-local memory allows applications to explicitly select local memory for application code and data, thus minimizing memory latency impacts on application performance.
- VxFS/VxVM/CVM 3.5 (VERITAS File System, VERITAS Volume Manager, VERITAS Cluster Volume Manager) with up to 1024 ACLs (access control lists), 2 TB maximum file size, and 4 TB maximum file system size (and a virtually unlimited architectural file system size)
- Performance improvements in Aries dynamic code translation over HP-UX 11i version 1.6.

Manageability

HP-UX 11i version 2 for HP Integrity and HP 9000 servers offers a broad set of integrated system management tools. These tools provide an efficient mechanism for managing HP-UX 11i servers, whether it is one local server or hundreds of local and remote servers.

Systems management solutions for HP-UX 11i were built to address the specific requirements of an HP-UX 11i infrastructure. At their core—the central point of administration—is HP Systems Insight Manager (SIM), a powerful, multi-system tool that incorporates the best of HP Insight Manager 7, HP Toptools, and HP Servicecontrol Manager technology. HP SIM delivers inventory, fault, and remote management to all your HP systems—as well as role-based security.

HP Systems Insight Manager (SIM) is a true multi-system management tool delivering inventory, fault, and remote management as well as role-based security. For the HP-UX 11i environment, it can be extended with software deployment, configuration, and workload management to offer a complete resource lifecycle management solution, which also allows the central administration of the HP Virtual Server Environment.

New and updated features in HP-UX 11i version 2 September 2004 include:

- HP-UX Partition Manager support for HP-UX 11i, Windows, and Linux running in separate partitions: Launched within Systems Insight Manager, Partition Manager creates and manages nPartitions, the hard partitions created on HP-UX 11i high-end servers. Partition Manager provides a Web-interface "big picture" of hard partitions and hardware. Status lights clearly indicate action on remote systems, and smart action menus adjust as the user selects a new element to manage. "Big-picture views" allow administrators to easily select hardware elements to partition simply by clicking. Partition Manager allows management of HP-UX 11i, Windows and Linux partitions within HP Integrity and some HP 9000 servers.
- Ignite-UX: Flexible tool for rapidly deploying and recovering HP-UX 11i systems. For HP-UX 11i version 2 September 2004, there are improved software selection capabilities and the ability to configure security profiles at installation time (install-time security).
- Software Distributor-UX: Sophisticated toolset for distributing, installing, and updating HP software products.

Other system management tools that are part of HP-UX 11i version 2 September 2004 for HP 9000 and HP Integrity include Update-UX, Patch Assessment Tool, Security Patch Check, System Administration Manager (SAM), HP-UX Bastille, HP-UX Webmin-based Admin, Serviceguard Manager, Process Resource Manager (PRM), HP-UX Workload Manager (WLM) and GlancePlus Pak.

Availability

Availability is a recognized strength of HP-UX 11i. HP-UX 11i version 2 September 2004 incorporates many standard features for excellent single-system availability, such as online component replacement and automatic de-allocation of at-risk components. HP-UX 11i v2 September 2004 also has a comprehensive Serviceguard suite of high-availability products and disaster tolerant solutions to ensure continuous application availability while maintaining data integrity:

- nPars or hard partitions to allow resource boundaries to be redefined without rebooting complex or non-affected nPartitions in the server
- PCI and PCI-X Doorbell for one-touch online I/O card add or replacement (but not removal); servers supporting the PCI and PCI-X Doorbells were introduced in fall 2003.
- Dynamic processor resilience (DPR) for automatic off-lining (online deconfiguration of) a CPU if it generates cache errors at a predetermined unacceptable rate that has been determined to be a predictor of future failure. Moreover, the server can be configured to automatically activate a spare iCOD CPU to take the place of the deconfigured CPU.
- Dynamic memory resilience (DMR) to provide automatic online de-allocation if a memory location exhibits persistent errors; automatic memory deconfiguration during reboot is also supported
- Faster system boot — the ability to use multiple processors during the boot process in order to compress dump and accelerate time-consuming steps such as self-tests and I/O discovery
- Faster system memory dump through greater parallelism and user selective dump
- iCOD (instant Capacity on Demand) and Pay per Use
- iCOD for version 2 supports activation and deactivation of iCOD CPUs on Itanium or PA-RISC systems. Key features include:
- Uses portal instead of e-mail to obtain codewords for the activation of additional CPUs (faster and more convenient than e-mail)

- Instantly activates an iCOD CPU without reboot when an already active CPU fails or is proactively deconfigured by DPR because of anticipated failure
- Pay per Use:
    - o Charges are based on CPU % utilization
    - o Uses Smartmeter, a Linux workstation that can monitor up to 200 copies of HP-UX 11i and pushes data to HP every 24 hours
- Auto port aggregation (APA) allows the grouping of up to four physical Gigabit Ethernet or thirty-two Fast Ethernet links into one virtual high-bandwidth connection. APA supports true load balancing and failure recovery capabilities and distributes traffic evenly across the aggregated links. APA provides automatic link failure detection and recovery that isolate both the application and the transport from any link failure condition by automatically switching data flows to a backup link in case of an individual link failure. This is achieved by allowing each of the links in the failover group (also known as link aggregation) to appear as one logical link to the network layer and above.
- Dynamically loadable kernel modules for file system (CDFS) enables adding a CD file system to a running UNIX system without rebooting the system or rebuilding the kernel.
- HP-UX Workload Manager (WLM) 2.1 now offers support for Itanium 2-based servers as well as support for PA-RISC-based servers. HP-UX WLM 2.1 includes support for automatic re-allocation of resources between processor sets (pSets), in addition to the existing ability to re-allocate CPU resources between PRM groups or vPars. In addition, WLM 2.1 adds a passive mode and a monitoring GUI, and it improves Serviceguard and chargeback support. Finally, WLM 2.1 adds support for BEA WebLogic through a new toolkit.
- autoFS 2.3 for more robust automatic mounting of file systems
- Reduced system reboots thru additional dynamic kernel tunables. Dynamic kernel tunables are kernel parameters that can be changed by a system administrator without a system reboot, and the changes are persistent across reboots. HP-UX 11i version 2 provides seven additional dynamically tunable kernel parameters in 11i v2 for a total of 31 dynamically tunable kernel parameters. It is estimated that the dynamically tunable kernel parameters reduce by 50% the number of reboots caused by kernel parameter modification. Dynamically tunable kernel parameters include: dbc_max_pct, dbc_min_pct, nfile, nflocks, semmns, semmni, maxfiles
- Dynamic variable page sizing tuning—Based on application-program heuristics and size, HP-UX 11i dynamically, and by default, selects appropriately large page sizes for each memory object it accommodates. This use of larger pages conserves translation lookaside buffer (TLB) entries and reduces the occurrence of costly TLB misses. This capability improves the performance of many applications, particularly those with large reference sets and large amounts of contiguous memory (e.g., databases).
- Serviceguard A.11.16 and its suite of high availability and disaster tolerant solutions on HP-UX 11i v2 offer capabilities to support a robust HP-UX 11i platform including:
    - o a unique, scalable solution for continuous application availability with Serviceguard Extension for RAC integrated and partner tested with BEA Weblogic, ATT and Nortel networks scaling across partitions, servers, data centers and continents
    - o faster failover to maximize application availability with Serviceguard Extension for Faster Failover delivering 3x improvement in failover time for specific Serviceguard configurations
    - o investment protection for platform migration through mixed cluster support enabling failover between HP 9000 and HP Integrity systems.

- simplified and secure cluster management with Serviceguard Manager configuration and role-based access enhancements
- greater flexibility with disaster tolerant solutions through more configurations, data replication and extended distance support

Security

HP-UX 11i is recognized as the most secure Common Criteria EAL4-CAPP certified UNIX operating systems available. Newly available is HP-UX 11i security containment. To help businesses conform to new regulations and combat the increasingly complex threats of attackers, HP is incorporating the next generation of security features -- security containment -- into the mainstream HP-UX 11i v2 Operating Environment.

HP-UX 11i v2 security containment introduces four core technologies: compartments, fine-grained privileges, role based access control and audit. These combine to provide a highly secure operating environment without requiring applications to be modified to take advantage of these new features. For more information, please go to HP-UX 11i v2 security containment: www.hp.com/go/securitycontainment .

Install Time Security (ITS) provides the system administrator preconfigured security alternatives and makes HP-UX 11i v2 September 2004 more secure out-of-the-box when the administrator selects higher security levels. HP-UX Bastille is now included in the HP-UX 11i version 2 operating environments. Customers can use Bastille to create a custom security configuration post-install by running Bastille's interactive "security interview," and then optionally create security-configured golden images using Ignite-UX.

Key HP-UX 11i version 2 offerings in security include the following:

- HP-UX 11i v2 security containment provides for compartments within a single-instance of the operating system to isolate applications and resources. When combined with the virtual server environment, Secure Resource Partitions enable secure application stacking that can lead to a reduced number of servers in the IT infrastructure and lower TCO.
- HP-UX Secure Shell provides secure network data access using industry-standard cryptography.
- HP-UX Bastille, included with HP-UX 11i operating environments, helps automate the system lock-down process by assisting administrators in making security trade-off decisions.
- HP-UX 11i version 2 September 2004 includes multiple install-time security levels, which allow rapid deployment of systems with selectable out-of-the-box security levels—including levels that are suitable for high-threat environments, such as network DMZs.
- HP-UX 11i version 2 provides cryptographically strong true random number generation in the form of a /dev/random interface, which greatly reduces the startup time for the secure shell (ssh) and helps improve security of network connections.
- HP-UX 11i version 2 provides support for industry-standard shadow passwords (/etc/shadow) in addition to the previously supported trusted mode (/tcb) shadow passwords.
- With HP-UX 11i version 2 the stack buffer overflow protection features first included in HP-UX 11i version 1 are now enabled by default. Many security-related parameters may be easily configured using the security configuration file.

- HP-UX IPFilter protects intranet hosts with stateful packet inspection to guard against internal attacks. Dynamic Connection Allocation (DCA) is added to throttle malicious attempts to deny service by flooding systems with spurious IP packets.
- HP-UX IPSec provides a manageable infrastructure for secure communication over IP-based networks.
- The HP-UX LDAP-UX Integration feature eases deployment into directory-based environments, interoperating both with the Netscape Directory Server for HP-UX 11i, as well as with other directories, such as Microsoft® Active Directory Server.
- The HP-UX Host-based Intrusion Detection System feature performs real-time intrusion detection, correlating data from kernel audit streams, system log files, and other sources; detecting potential attacks; and generating real-time preventive alerts. It also operates in conjunction with HP-UX IPFilter to prevent detected IP attacks.
- Kerberos server version 3 features a GUI-based administrative tool, multi-threading capability, high-availability support of a secondary (backup) server that will become the primary server in the event of the primary server crashing or going down, as well as automatic incremental database propagation to enhance data integrity and the performance of data synchronization, Additionally, the Kerberos server in HP-UX 11i version 2 is LDAP-enabled, such that the KDC key repository can use any standard-based LDAP directory.
- The security patch check tool identifies and recommends desirable security patches, thus allowing system administrators to more easily keep their systems up-to-date with the latest security patches mentioned in the HP-UX 11i security bulletins released by HP. This tool helps automate the otherwise tedious process of selecting the appropriate security patches for a given system.

HP-UX 11i version 2 September 2004 Virtualization

As business cycles vary and demand ebbs and flows, the underlying infrastructure must respond accordingly. Just as increased exertion results in expansion of the lungs to absorb a greater volume of air to meet the body's increased oxygen requirements, the underlying technology infrastructure of a business must scale to meet the demands made upon it. Once the body's period of exertion is over, the air intake is reduced and the lungs contract as they continue to serve the needs of the body until the demand is increased again. In a similar way, the ability to expand and contract to meet demand without additional resources being required is a fundamental, underlying principle of an adaptive enterprise. To support its Adaptive Enterprise vision, HP is developing an underlying infrastructure that has been specifically created to reduce cost and complexity while increasing IT responsiveness. A key pillar of the HP Adaptive Enterprise is virtualization.

Virtualization is an approach to IT that pools and shares resources so utilization is optimized and supply automatically meets demand.

One key solution for enabling an infrastructure of this nature is the HP-UX 11i Virtual Server Environment (VSE), which offers an increased RoI through the optimization of server resource utilization in real time according to business priorities. In addition to increasing server utilization, the HP-UX 11i Virtual Server Environment also enables the rapid deployment of computing resources, improves availability, and significantly reduces costs.

This section outlines the capabilities and benefits of the HP Virtual Server Environment and explains how and why it is an important building block for an adaptive enterprise.

HP Virtual Server Environment—server resource optimization

The HP-UX 11i VSE is composed of seamlessly integrated server virtualization products built around the only goal-based policy engines available for UNIX®, that is, HP-UX Workload Manager and HP Global Workload Manager (gWLM). The VSE assesses whether the performance of a single server—or cluster of servers—is meeting predefined service-level objectives (SLOs), and it then dynamically adjusts server resources by managing free pools of resources and/or moving resources out of under-utilized virtual servers. The SLOs assessed by VSE fall into three categories:

1. Resource utilization: An application or application group can be assigned a minimum and maximum percentage or share of CPU cycles, and it is also assigned a priority based on business needs. This percentage or share—also known as CPU entitlement—can be dynamically and automatically adjusted within the predefined range according to application priority, based on the utilization of the current entitlement.
2. Performance: A direct measurement of the performance of the workload—e.g., a response time of less than 1 second or a throughput of 5,000 transactions per minute. Degradation in performance will result in the VSE dynamically allocating additional resources to maintain the SLO.
3. Application load: A measurement of the load placed on an application—i.e., the number of users or processes, or the queue length. As load increases, the VSE will automatically reassign resources to handle the additional workload.

Management of SLOs in the fashion outlined above improves return on IT. The VSE ensures higher levels of server utilization and increased agility since server resources are automatically adjusted on demand to meet changing business priorities and application usage levels.

Traditionally, servers have been acquired and deployed on an application basis. For example, an SAP project would require dedicated servers for development, test, production, and disaster-recovery environments. An Oracle® customer relationship management (CRM) project would most likely require the acquisition and deployment of new, dedicated servers for each of those environments at additional expense. The planning, budget, and procurement cycles—as well as the capital expenditure incurred—would have a direct impact on the time to market and return on investment of the project. Delays in implementation might even erase any competitive advantage that may have existed when the project began. In addition, research shows that the majority of servers would be underutilized most of the time.

VSE enables an environment where:

- All the SAP and CRM server resources could be placed in a dynamic resource pool, with each request for resources being evaluated and allocated according to business priorities
- Underutilized server resources could be reassigned to alternate application instances without compromising security or availability
- An unforeseen transaction peak would result in additional resources being added to the pool and assigned to meet the need as opposed to requests for service being denied
- Disaster recovery no longer requires a set of under-utilized, standby systems
- New applications can be deployed with defined SLOs without having to acquire additional hardware and without initiating a new procurement cycle.

The HP-UX 11i Virtual Server Environment enables all of those benefits through the virtualization or abstraction—of server resources so that they are no longer seen as independent, dedicated boxes with processors and memory, but rather as a pool of dynamic computing resources available to your entire organization. As business requirements fluctuate, resource requirements are analyzed and orchestrated across multiple systems using dynamic provisioning, allocation, and management technologies in accordance with agreed upon service-level objectives. The VSE automatically grows and shrinks based on the needs of hosted applications. Resource usage is thus optimized across the business while IT spending is contained.

VSE encompasses a number of fully integrated, complementary components that enhance the functionality and flexibility of your server environment. These include:

- An intelligent policy engine, HP-UX Workload Manager (HP-UX WLM) or HP Global Workload Manager (gWLM), which performs real-time assessment of resource usage and advises and acts based on SLOs and business priorities to adjust the supply of resources according to demand
- Resource management technologies—HP Process Resource Manager (PRM), Secure Resource Partitions and psets that enable granular processor, memory, and I/O allocation to be managed between multiple applications competing for resources within a single system or virtual partition, thus eliminating resource contention
- Flexible Virtual Partitions (vPars) that combine software fault isolation and security with the ability to share resources with other vPars within a system, thus increasing utilization and reducing cost (instant ignition [Ignite-UX] of operating systems within new vPars offers quick provisioning of new environments for development, test, QA, or disaster recovery as required)
- Utility Pricing solutions from HP—Instant Capacity (iCAP), Temporary Instant Capacity (TiCAP), and Pay-per-Use (PPU)—that enable dormant processors and memory to be dynamically activated and paid for as required
- Clustering solutions (HP Serviceguard, Extended Campus Clusters, Metrocluster, and Continentalclusters) that enable the implementation of cost-effective failover and disaster-tolerant environments without the acquisition of redundant hardware
- HP geographically dispersed cluster solutions such as Serviceguard Extension for RAC (SGeRAC) extend clustering capability from a single data center solution to a transparent “virtual application environment” between two data centers up to 100 km apart in an active-active environment with no redundant hardware.

The core functionality of the VSE is delivered by the intelligent policy engine, HP-UX Workload Manager or HP Global Workload Manager, which continuously assesses whether a server environment is meeting its SLOs and advises administrators or adjusts resources automatically when SLOs are not met. This base functionality is enhanced by the VSE’s ability to orchestrate the real-time allocation of all virtual server resources—virtual partitions, utility pricing solutions, and cluster solutions—assigned to executing applications, users, and processes.

Seamless integration between these components provides continuous availability and performance of mission-critical applications such as Enterprise Resource Planning (ERP), Supply Chain Management (SCM), and Customer Relationship Management (CRM).

Furthermore, additional application-transparent toolkits allow for closer integration between HP-UX WLM and specific applications such as BEA WebLogic and Oracle. These toolkits ensure that application-specific resource demands, such as BEA queue length and number of free threads or number of active Oracle users, are assessed by HP-UX WLM; that the system administrator is advised of the situation and of potential remedies; and that HP-UX WLM in turn acts on the relevant VSE component so as to meet the SLO.

To get a virtualized BEA WebLogic Server or Oracle database environment deployed quickly, HP has also developed the Virtual Server Environment Reference Architectures. They are a pre-tested and qualified software stack consisting of best-of-breed infrastructure components designed to substantially reduce the design, testing, installation, and integration processes for these two applications.

Virtualization is a major inflection point for computing. It represents a trend towards clusters of servers becoming much more self-managing than ever before. It frees system administrators from much of the drudgery involved in managing servers and allows them to operate at a higher level at which they can work with business management to set Service Level Objectives which are congruent with the overall objectives of the enterprise.

HP-UX 11i version 2 Interoperability

HP-UX 11i version 2 has world-class interoperability and works well in mixed environments, including both Linux and Windows. HP-UX 11i is the only UNIX that fully supports UNIX-Windows Single Logon. HP-UX 11i support for UNIX-Windows Single Logon includes:

- Authentication of Windows NT® clients by HP-UX 11i servers— provides the industry's best file- and print-sharing services.
- Authorization of Windows 2000 clients against HP-UX 11i servers— issues authentication so that Windows 2000 clients may access resources such as files that reside on the HP-UX 11i server.
- Authentication of HP-UX 11i clients against Windows NT servers—HP-UX 11i client systems use a Windows NT system for authentication using Pluggable Authentication Module (PAM).
- Authentication of HP-UX 11i clients against Windows 2000 servers—HP-UX 11i systems use a Windows 2000 system for authentication via Kerberos and LDAP client.
- HP-UX/ADS group integration using LDAP-UX capability. This allows integration of HP-UX 11i groups and Active Directory groups without the overhead of dual management. LDAP-UX can be configured to identify group members using the same method as Active Directory.

HP-UX 11i version 2 Connectivity

HP-UX 11i v2 has leading connectivity features. Noteworthy connectivity capabilities include:

- PCI-X two-port Gigabit Ethernet (2p GigE) and Fibre Channel/Gigabit Ethernet Combo adapters — HP-UX 11i version 2 has the first UNIX server vendor branded high-performance PCI-X dual-port Gigabit Ethernet and Fibre Channel/Gigabit Ethernet combo adapters. The 2p GigE and Combo adapters provide more flexibility for I/O configuration and eliminate the I/O slot constrain in entry-level servers. They are also the perfect products for system consolidation solutions. In addition, these adapters enable customers to implement I/O card HA (high availability) failover without consuming multiple I/O slots. HP-UX 11i is the first UNIX vendor to deliver what the market needs for more I/O connectivity in these two products. Furthermore, these two products are the first PCI-X based UNIX server I/O networking adapters, which demonstrates the HP-UX 11i leadership in the server I/O market space. (2p GigE—early 2004, Combo—2H 2003).
- Infiniband and Hyperfabric2—HP will deliver industry-standard Infiniband IPC solutions on the Intel Itanium Processor Family with superior performance. Geared towards both high-performance technical computing and the commercial database space, this solution offers high bandwidth, low latency, as well as a rich set of RAS and QoS features meeting the needs of enterprise customers from the low to the high end. HP will also continue to offer industry-leading HP Hyperfabric solutions, with enhanced features including link failover support and support for a large number of users, offering immense value to enterprise customers who are looking to deploy this solution in the commercial database space.
- 2-port, 2-gigabit Fibre Channel PCI-X card—HP will provide increased connectivity to Fibre Channel (FC) storage products though two high-speed 2 gigabit/second FC ports

on a single PCI-X card. This card will extend HP's leadership in Fibre Channel by complementing the existing single-port 2 gigabit/second Fibre Channel, A6795A.

- 2-port Ultra320 SCSI PCI-X card—HP will provide an industry-leading parallel SCSI performance with two 320 megabyte/second SCSI ports on a single PCI-X card. This card will provide compatibility to a wide range of existing SE and LVD storage products.
- 4-port Ultra160 SCSI RAID card. HP will deliver a 4-port PCI RAID card with high performance of 160 megabytes/second per port and support for RAID levels 0, 1, 0+1, 5 plus HP's patented RAID ADG, which provides the highest level of data protection while still delivering a high level of disk capacity utilization.
- iSCSI v1.0. HP will deliver a cost-effective host-based solution to provide iSCSI connectivity over standard Ethernet network interface cards. iSCSI enables SCSI operations to be performed over existing network fabrics using the TCP/IP protocol. iSCSI allows systems to connect to Fibre Channel storage area networks using iSCSI to FC routers and directly to iSCSI storage devices as they become available.

HP-UX 11i version 2 Network and Internet services

HP-UX 11i v2 offers a complete host of networking and internet services including:

- Internet Express is a collection of over 30 open source Internet, Web, and security services that have been tested and qualified on HP-UX. Internet Express allows for a lower cost of software ownership and application deployment. The content of Internet Express is very rich. It includes Jabber instant messenger; MySQL and PostgreSQL databases; many mail servers such as UW-IMAP, Fetchmail, Majordome, and Qmail; as well as security services such as Dante SOCKS server, Squid, OpenLDAP, OpenSSL, and Cyrus SASL. Internet Express is an easily installed, configured, and administered product. The 30+ components are configured through the Web-based Webmin administration utility. Webmin is also used to tune kernel attributes for Internet service performance. Webmin is a standard tool provided as a part of the HP-UX Apache offering. Some Internet Express components are distributed as part of HP-UX 11i OE. Other components are in a standalone Internet Express CD distributed as part of the HP-UX 11i OE media kit.
- IPv6 is the next generation of IP, providing a very large address space (64 bits), manageability, and security. IPv6 will provide the addressing space required for the always-on infrastructure where every device can have a globally routable IP address for ease of routing and for security. In the next few years, millions of mobile devices will be used around the world. With IPv6, mobile users will access their home network and Internet anywhere, anytime. HP provides a smooth transition from IPv4 to IPv6. Dual stacks facilitate IPv6 deployment, allowing existing applications to coexist on both IPv4 and IPv6 networks. Application modification is required only when the application needs to take advantage of the new IPv6 features.
- Mobile IP isa a collection of IETF protocols that allow transparent routing of IP datagrams to a mobile node that is roaming on the Internet. Each mobile node is always identified by a permanent home address, regardless of its current point of attachment to the Internet.
- Mobile IPv6 is the Mobile IP solution for the next generation of Internet, which will be based on the IPv6 protocol. Mobile IPv6 is not a part of the HP-UX 11i version 2 release but will be available via Web download in the second half of calendar year 2003. The major advantages of Mobile IPv6 include:

- A stable IP address while moving from network to network
- Simplicity in the mobile node configuration, since the mobile node can keep the same address while accessing different networks
- Built-in route optimization protocol that will improve the overall mobility performance
- Secure communication with any correspondent node on the Internet, even in the absence of a global PKI (Public Key Infrastructure)
- Wireless TCP—The characteristics of wireless networks are very different from wired networks. With wireless networks, performance is degraded considerably by the lower bandwidths in wireless links. HP's Wireless TCP provides a solution to these problems by adapting the TCP protocol in a low-bandwidth wireless environment and improving the overall wireless TCP performance. HP has optimized its TCP layer to maximize wireless traffic throughput. Numerous open IETF standards and features were added to HP's transport, including:
- Window scale and time-stamp options (RFC 1323)
- Large initial window (RFC 2414)
- Selective ack (RFC2018)
- Path MTU discovery (RFC1191)
- Fast retransmit and fast recovery (RFC 2581)
- Support of larger-than-default IP MTU size
- Smoothed RTO algorithm
- HP-UX Apache Web Server Suite is comprised of HP-UX Apache-based Web Server,
- HP-UX Tomcat-based Servlet Engine, HP-UX XML Web Server Tools, and HP-UX Webmin-based Administration. Integrated with the HP-UX 11i Operating Environment, HP-UX Web Server Suite provides the enterprise with HTTP Web serving that is unmatched by other operating-system Web servers. Apache, as part of the HP-UX 11i operating environment, is particularly strong in Internet and Web application services and holds a leadership position in RAS (reliability, availability, and serviceability). Customers can enjoy flexible security configuration, strong programming options, authentication for external directories, and easy remote administration of the Web server. HP Apache includes a default Web page that contains links to HP-supplied documentation and third-party documentation. Features include Worker Threaded Model support for improved performance; support for Java™ servlets and JSPs through Tomcat; scripting support for Perl, PHP, and CGI; Webmin GUI administration; and support for PA-RISC IPv6. The HP-supplied documentation includes a set of user and admin guides for Apache, SSL, Tomcat, PHP, and Webmin. The admin guides cover configuration issues specific to HP Apache-based Web server. The documentation includes FAQ with tuning information and migration guide.

HP-UX 11i version 2 Application Development

HP-UX 11i version 2 supports application development on HP-UX 11i and on Linux and Windows. Application developers can develop and debug their applications on Linux or Windows and then, when the applications are ready for deployment, easily deploy them on HP-UX 11i version 2 where they can benefit from the mission-critical capabilities of HP-UX 11i version 2.

- HP-UX Internet Express provides standard-based Web services from the open source community to facilitate application development. The Web services components in Internet Express include SOAP, UDDI4J, Xalan (C++), Xerces (C++), and Horde application framework. Also included are OpenLDAP, PerlLDAP, Mozilla LDAP SDK-C, OpenSSL, MySQL, and PostgreSQL. These open source–based applications and infrastructure components were carefully selected, tested, and qualified on HP-UX.

- Linux Porting Kit enables easy porting of Linux-based applications to HP-UX 11i with the latest Linux APIs and compiler tool chains. A scanner tool called Software Transition Kit helps identify porting issues and recommends changes to the developer via either html or text report (based on developer's reference). HP also provides an online Linux porting guide with documentations in best practices on porting, common porting issues, and a Linux network driver porting guide with sample codes and technical tips. The HP Linux Porting Kit is available for free via Web download or CD.
- Linux Runtime Environment, first available with HP-UX 11i version 2, is an HP-UX 11i industry-unique Linux compatibility solution allowing an Intel Itanium Processor Family Linux application to run on HP-UX 11i without porting and recompilation overhead. It facilitates migration of Linux applications to HP-UX 11i by enabling Itanium-based systems using Linux executables to run on Itanium-based HP-UX 11i systems. Customer benefits include the availability of Linux applications on HP-UX, deployment of Linux applications on HP-UX 11i mission-critical systems, elimination of continuous porting effort due to application evolvement, and lower cost of software ownership.
- Performance improvements in Aries dynamic code translator (executes PA-RISC binaries on Itanium-based systems) versus version 1.6
- HP-UX Java version 1.4.1 offers the first release of 64-bit Java technology on HP-UX 11i for the Intel Itanium Processor Family as well as Java 32-bit technology. Java 1.4.1 contains many new features, including:
- Improved performance features via improved profiling infrastructure and APIs (faster reflection, object serialization, and new I/O)
- Choice of 3 garbage collection (GC) technologies, giving the flexibility of specific GC algorithms for application needs
- Full-speed debugging with the Hotspot Server compiler
- HP-specific performance enhancements, used to publish industry-leading SPECjbb benchmark scores
- Continued support of HPJmeter performance analysis tool and HPJtune garbage collection analysis tool
- Improved out-of-box availability, leveraging new features from 11.23 HP-UX
- Application binary compatibility with previous HP-UX 11i releases for the Intel Itanium Processor Family (versions 1.5 and 1.6)
- Application source code compatibility with HP-UX 11i on PA-RISCBinary compatibility for HP-UX 11i PA-RISC binaries through the Aries dynamic code translation technology
- Software Transition Kit to assist with application migration from Sun, Linux, and HP-UX 11i version 1; assistance also provided for 32- to 64-bit application migration and for the transition from PA-RISC to the Intel Itanium Processor Family
- C/C++/Fortran90 optimizing compilers that deliver excellent application performance on the Intel Itanium Processor Family and are tuned for the Intel Itanium 2 processors
- Open source tools, including the GNU C/C++ compilation system and a wide collection of additional open source tools
- Consolidation of the ANSI C and ANSI C++ compilers into a single compiler technology base. This improves the ability of HP-UX 11i developers to mix the usage of C and C++ in the same application, and should accelerate the deployment of new language capabilities in the future.

The Challenges of Architecture Transition

No discussion of HP-UX 11i version 2 can be complete without some discussion of the challengess that can be involved in architectural transitions. When computer systems were first being introduced into enterprises, it was unclear that there would eventually be transitions across generations of computer architectures that would dramatically alter the computing landscape. However, as time and technology have progressed, it has become clearer that approximately every 10 to 20 years there will be a transition that alters the computing landscape dramatically. These transitions are fueled by advances in computing technologies in hardware and software. One such relatively recent transition was the shift from Complex Instruction Set Computing (CISC) to RISC. Another such transition was the rise of desktop computing.

Architectural transitions are potentially times of great challenge to computer vendors, their partners, and their customers. The challenge inherent in these transitions is very well illustrated by the computer systems and applications that did not make the transition to a new computing paradigm. And over the past several decades the transitional challenge to enterprises has increased dramatically as computer systems, applications, and data have become an innate part of business and commerce. More than ever, it is important for those who guide the computing destiny of their enterprises to educate themselves on the lifecycle of computing architectures.

A brief history of HP-UX and the PA-RISC architecture

In addition to the functionality of HP-UX 11i version 2, HP-UX 11i version 2 should be viewed within the context of HP-UX and the PA-RISC architecture as well as Moore's first and second laws. This section and the next section provide the necessary background.

The HP PA-RISC architecture and HP-UX, the HP version of UNIX, entered the computing market in the late 1980s. Both rose to prominence based on their combined strengths. HP-UX was the first UNIX for commercial applications from a major computer vendor. PA-RISC was the first commercially available RISC architecture.

HP-UX 11i is based on HP-UX 11.00, which began shipping in November 1997. HP-UX 11.00 was the first version of HP-UX to feature a full 64-bit kernel and is able to execute both 32-bit and 64-bit applications simultaneously. HP-UX 11.00 is also available in a 32-bit kernel version as well, for older PA-RISC systems that are not 64-bit capable.

With HP-UX 11.00, HP-UX rose to true enterprise operating system status. Its performance, scalability, manageability, availability, connectivity, security, and application availability made HP-UX 11.00 the choice of many Fortune 1000 companies. HP itself—a multi-national, multi-billion dollar company—switched its corporate computer systems to HP-UX systems in the late 1990s after running on mainframes for the previous 30 years. During this period of time, HP-UX was enhanced to scale with multiple processors, to support hundreds of gigabytes of main memory, and to support multi-terabyte file systems. File systems from VERITAS became the standard file system shipped with all HP-UX systems. HP introduced for HP-UX a suite of high-availability products that supported the automatic transfer of applications and users from a failed system to a backup system (without the reboot of the backup system). HP-UX system management products enhanced the productivity of system administrators, provided the management of multiple systems from a single console, and supported the distribution of operating system and application software automatically over a network.

HP-UX 11i, an enhanced version of HP-UX 11.00, began shipping in December 2000. HP-UX 11i was noteworthy in several respects, including:

- HP-UX 11i featured binary compatibility with HP-UX 11.00. Applications could be moved from HP-UX 11.00 to HP-UX 11i without modification and without recompiling or relinking.
- HP-UX 11i introduced the HP-UX 11i Operating Environments: Foundation, Enterprise, and Mission Critical. The HP-UX 11i Operating Environments introduced a degree of operating system and layered software product integration not available from any other Unix system vendor. This integration has saved countless enterprises from performing this integration themselves.
- HP-UX 11i provided support for the high-end HP Superdome server. Superdome, with up to 16 hard partitions, support for up to 64 processors, and support for up to 256 gigabytes of main memory, was a giant leap forward for high-end UNIX serving.

The aging of the RISC architectures

As the years passed, HP-UX continued to receive enhancements and new capabilities and the suite of application solution software available from third parties grew ever larger. In contrast, PA-RISC—like other RISC architectures (Sun SPARC, IBM PowerPC)—began to fall victim to Moore's Law. Moore's Law, formulated by Gordon Moore of Intel Corporation, states that, with the foreseeable rate of advancement in integrated circuit technologies, integrated circuit densities will double every 18 to 24 months.* For example, in 1971 the Intel 4004 processor contained 2,250 transistors. The Intel Itanium 2 processor introduced in mid-2002 contains 221,000,000 transistors.

*Moore's Law is sometime mis-stated as asserting the processor performance doubles every 18 to 24 months. As originally formulated, Moore's Law states that processor component densities double every 18 to 24 months, not that performance will double.

Electronic components became smaller and supported faster switching times, which in turn fueled faster processor clocks. Processors became faster due to the higher clock rates and also contained many more components due to the higher densities.

RISC architectures benefited from the higher clock speeds but began to have difficulty taking full advantage of the much greater component densities. An early trend was to use the higher component counts to create what are known as multiple functional units. Previously, it had generally been possible to have only one functional unit. So, for example, it became possible to have multiple arithmetic units instead of just one. Multiple functional units made it possible to execute multiple instructions simultaneously and in parallel. Superscalar RISC processors—that is, RISC processors with the ability to execute multiple instructions simultaneously—began to arrive in the early 1990s. Part of the implementation of these processors was to include logic that examined the incoming stream of instructions for parallel instruction execution opportunities.

Of course, in order to derive full benefit from the ability to execute multiple instructions simultaneously, RISC processors had to consistently find valid opportunities to execute instructions in parallel. As it turned out, analyzing a stream of instructions and locating parallel processing opportunities with a high probability of being valid is an extremely complicated task. It was determined that while the space required for the functional units grew linearly with the number of functional units, the amount of chip space required for predictive circuitry increased as a square of the number of functional units. Additionally, even though the predictive algorithms for branching were correct as much as 85% of the time, up to 40% of applications execution time was spent recovering from branch mispredictions.

This task was made more complicated by the enforced hierarchical nature of object-oriented programming languages such as C++ and Java, which became popular for application development in the 1990s. Because of the enforced hierarchical nature of these languages, the applications that were developed using them contained many more branching opportunities than applications developed using previous-generation languages. The result was that by the second half of the 1990s, RISC architectures were frequently using less than half of the processing power that was available to them. The branching possibilities of these applications had outrun the abilities of the processors to find parallel processing opportunities. HP concluded that the emerging issues with RISC architectures had created the opportunity for the creation of a next-generation architecture to address these issues.

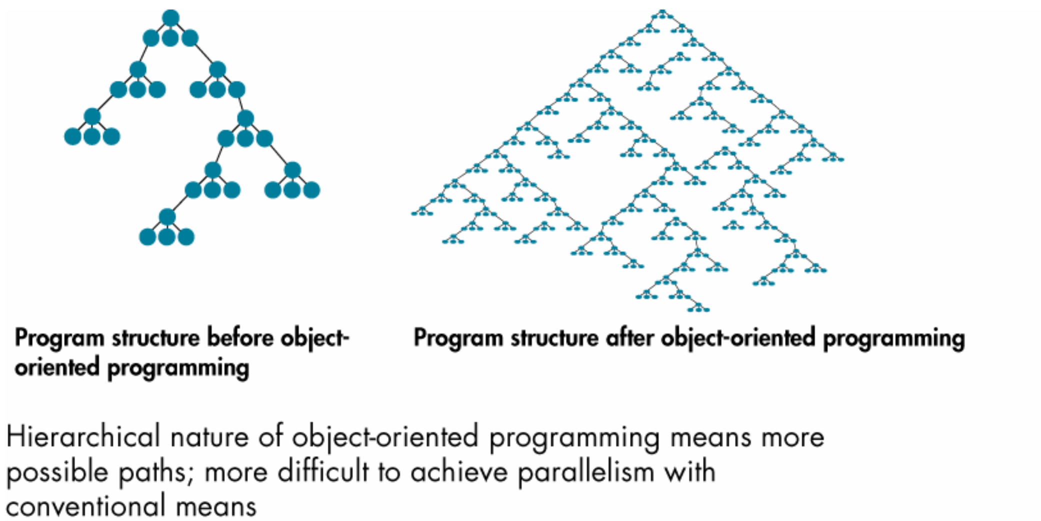

Figure 1. The “bad news” of object-oriented programming

The birth of the Intel Itanium Processor Family

HP Labs, which was responsible for the creation of the PA-RISC architecture and had remained active in computer architecture research under HP Labs chief scientist Joel Birnbaum (who had played a leading role in the creation of the PA-RISC architecture), recognized the performance wall that PA-RISC and other RISC architectures were beginning to hit. A way needed to be found to harness the power of the processors that could be created with state-of-the-art IC manufacturing techniques and would have the ability to execute multiple instructions simultaneously.

To solve this problem, HP Labs developed a concept of parallel processing that eventually came to be known as EPIC or Explicitly Parallel Instruction Computing. With EPIC, the primary notion is to process components of an application in parallel, even if the application designer did not design the application as a parallel processing application. With EPIC, multiple possible branches of an application are executed simultaneously and in parallel despite the fact that only one of the branches will ultimately be useful or prove to be true.

EPIC was invented by HP. But to become reality, EPIC required implementation. This meant two things: (1) creating processors that implemented the EPIC architecture, and (2) creating compilers that would generate efficient code for the new processors.

As chip fabrication technologies have become more sophisticated, the cost of chip fabrication facilities has increased dramatically. In fact, Gordon Moore of Intel quantified this characteristic with Moore's second law, which states that the capital requirements of every new generation of processors are twice the capital requirements of the previous generation. Consequently, the resulting chips must be sold either at very high prices or at very high volumes in order to recoup the investment. Given the steady advance of commoditization in computing, the idea of recouping investment through high prices seemed remote. The other alternative of using volume manufacturing to recoup investment seemed far more feasible. Hence, in 1994 HP formed a partnership with the leader in volume computer processor manufacturing, Intel Corporation, for the design and manufacture of processors based on the EPIC architecture. As the world's leading processor manufacturer, Intel had the resources and proven ability to manufacture and market processors on a volume basis—while HP had proven capabilities as an innovator in high-performance computing architectures. Design of the first Intel Itanium processor took far longer than anticipated, and the first Intel Itanium processors based on the EPIC architecture—and systems based on the Intel Itanium processor—were introduced in May 2001.

With HP/Intel teams designing processors based on the EPIC architecture, different teams of engineers at HP took on the task of creating compilers that would generate efficient code for the new processors. Two qualities of EPIC made this task different: predication and speculation.

Predication is probably the primary distinguishing characteristic of the EPIC architecture. Predication is defined in the dictionary as the process of affirming or denying an assertion using logic or reasoning. Within EPIC, predication describes the simultaneous execution of multiple program branches to determine which one will be true. Branches that prove to be false are discarded. While this may seem a profligate use of hardware resources, the steadily declining cost of processor logic actually makes this a very cost-effective way of increasing performance. Predication overcomes the difficulty in RISC architectures of identifying parallel processing opportunities. With predication, the approach to parallelism changes from attempting to discover parallel processing opportunities to executing multiple branches in parallel. The approach changes from losing valuable processor cycles through misprediction and the inability to fully utilize all resources to fully utilizing all resources to locate the true branch.

The second distinguishing characteristic of the EPIC architecture is speculation. Speculation means the prefetching of information that may or may not be needed for program execution. In previous-generation architectures processing generally waited until information was needed before retrieving it from memory. However, the gap between processor speed and memory speed remains relatively great, with the result that waiting until information is needed prior to launching the retrieval process results in many lost processor cycles. With EPIC, the philosophy is to fully utilize the available memory bandwidth and retrieve data that may be needed for processing. In this way the delays due to waiting for something to arrive from memory are minimized. Although this approach results in much information being retrieved that is ultimately not needed, the important point is that far fewer processor cycles are lost waiting for information to arrive from memory—and performance is dramatically enhanced.

The philosophy of EPIC is to place the responsibility for identifying parallel processing opportunities at compile time as opposed to run time, hence the terminology of "explicitly parallel." Predication and speculation result in some interesting changes to compiler design and the binary code that is emitted. Intel Itanium compilers, if they are to emit efficient code, must emit multiple streams of instructions (for the different branches that need to be executed) and position retrievals of data from memory in advance of when the application might request the data. Because of the need to emit multiple code streams, compiled application programs for Itanium are larger than for RISC architectures. Fortunately, application programs normally consume only a small fraction of the mass storage for a system, so the increase in space requirements should not be noticeable. Additionally, the cost of mass storage continues to plummet.

A third distinguishing characteristic of the Intel Itanium architecture is encryption/decryption performance. The Intel Itanium processor offers higher encryption/decryption performance than any other processor on the market. The very high encryption/decryption performance of the Intel Itanium processor is due primarily to the 128-bit width of its registers, the number of registers available, and very fast floating-point performance. These are important characteristics since encryption and decryption algorithms involve numerous calculations with very large numbers. In today's increasingly connected world, in which cyber crime can be accurately described as an epidemic, the Intel Itanium processor's encryption/decryption performance can be critical to secure processing of transactions across the Web.

The final distinguishing characteristic of the Intel Itanium architecture is not a technical aspect but an economic manufacturing characteristic. Intel Itanium processors are manufactured using the same fabrication facilities as IA-32 processors and, therefore, benefit from the same manufacturing economies of scale.

In summary, Intel Itanium processors promise higher performance and lower prices. More details on performance of the Intel Itanium Processor Family can be found in the HP white paper entitled "Intel Itanium Processor Family Performance Tuning" available at www.hp.com.

Laying the groundwork for a smooth transition

As a computer vendor, HP has always strived for investment protection for its customers and partners. This objective is based on the understanding that investments in application software and associated software frequently dwarf the investments in computer systems. With HP-UX, HP had a franchise with tremendous investments by customers and partners—not to mention HP itself. At the same time, HP recognized that the PA-RISC architecture (along with other RISC architectures) was falling victim to Moore's first law.

As the inventor of EPIC and a partner in the design of the Intel Itanium architecture, HP was able to influence the design of the Intel Itanium architecture to provide as much compatibility with PA-RISC as possible without compromising the performance potential of the Intel Itanium processor. As it turned out, it was possible to provide a great deal of compatibility between the PA-RISC and Intel Itanium architectures. Key aspects of the compatibility between the two architectures include the following:

- There is 1-to-1 mapping of performance-sensitive machine-level instructions between the PA-RISC and Intel Itanium architectures.
- The PA-RISC virtual memory architecture is used for the Intel Itanium processor.
- Data formats are identical between PA-RISC and Intel Itanium architectures.
- Floating-point instructions within the Intel Itanium architecture are a superset of PA-RISC floating-point instructions.
- Multimedia instructions for the Intel Itanium processor are a superset of the PA-RISC multimedia instructions.
- Graphics acceleration for the Intel Itanium processor is the same as PA-RISC graphics acceleration.

The combination of HP influence in the Intel Itanium architecture design, innovation in dynamic code translation, and HP's approach to language compilers resulted in very strong compatibility between the PA-RISC and Itanium architectures. HP provides four major types of HP-UX application compatibility between the PA-RISC and Itanium architectures:

- Binary compatibility (PA-RISC binaries execute transparently on Itanium-based systems)

- Data compatibility (no conversions are required to move data between PA-RISC and Itanium-based systems)
- Application build environment compatibility (PA-RISC applications can be converted to run natively on the Intel Itanium Processor Family with a recompile using existing makefile and script files; no source code or build environment changes are required)
- Compatibility in systems management and tuning

Binary compatibility

The aforementioned similarities between the PA-RISC and Intel Itanium architectures provide a foundation for an audacious undertaking—that is, developing technology that allows PA-RISC binary executables to execute on the Intel Itanium architecture without modification, recompilation, or relinking. In 1997, three years after the creation of the partnership with Intel, HP began the project that created the Aries dynamic code translation technology. The goal of the Aries project was to create code translation technology that would execute PA-RISC binaries automatically and transparently on Itanium-based systems, thus providing the ultimate investment protection for HP-UX customers. The creation of the Aries dynamic code translation technology has earned HP a number of patents. The Aries dynamic code translation technology is an integrated component of every version of HP-UX 11i on the Intel Itanium Processor Family.

Being able to execute PA-RISC applications without modification, recompilation, or relinking has obvious advantages when moving applications from the PA-RISC to the Intel Itanium architecture. However, there are other some more subtle advantages as well. Based on previous architectural transition experiences, it is certain that there will be customers who are unable to recompile their applications to execute natively on the new architecture. This can occur for a couple of reasons: the application was purchased from a software vendor that has gone out of business and the source code has been lost; or the application is homegrown, but the source code has been lost, the source code no longer matches the executable version, or the expertise to maintain the application has been lost. For these situations, binary compatibility is the only hope for moving to a new architecture.

Application build environment compatibility

HP-UX 11i version 2 provides application build environment compatibility from HP-UX 11i on PA-RISC. Application developers and independent software vendors (ISVs) can move their application build environment from their PA-RISC-based systems to Itanium-based systems and can then use those build environments without modification (save for using compilers that emit binary code for the Intel Itanium architecture) to generate binaries for the Intel Itanium architecture. The application build environment compatibility consists of 1) source code compatibility, 2) makefile compatibility, and 3) script file compatibility.

Source code compatibility between the PA-RISC and Intel Itanium architectures is obtained with HP compiler technology, which divides each compiler into two components:

1) A front-end component that reads the source code and emits meta-code.
2) A back-end component that reads the meta code emitted by the front-end component and generates performance-optimized binary code for the specific architecture

The HP compiler structure begins with a language-dependent front end that includes components for lexical analysis, plus syntax and semantic analysis of the incoming source code. Each front end produces an intermediate, stack-based representation of the program for further use by the compiler code generator and optimizers.

Using the strategy of front-end and back-end compiler components, HP is able to use a common front end that provides source code compatibility—and different back-end components that generate binary code optimized for either the PA-RISC or the Intel Itanium architecture.

System management and tuning compatibility

HP-UX 11i on the Intel Itanium Processor Family provides systems management and performance tuning compatibility with HP-UX 11i on PA-RISC. This is true for several reasons:

1) Itanium-based systems running HP-UX 11i use the same virtual memory architecture as HP-UX 11i PA-RISC systems.
2) Itanium-based systems running HP-UX 11i have the same system management products as HP-UX 11i PA-RISC systems.

Because of this compatibility, the vast majority of HP-UX 11i on PA-RISC system administrator expertise can be leveraged directly for system management of HP-UX 11i on the Intel Itanium Processor Family.

The rollout of HP-UX 11i on the Itanium Processor Family

In 1999, HP began preparing HP-UX for the support of the Intel Itanium Processor Family. Early work began with a limited distribution release of HP-UX (HP-UX B.11.10) but after the release of HP-UX 11i, in December 2000, the HP-UX work done for the Intel Itanium Processor Family was merged with the HP-UX 11i code stream. This action had several results:

- The version of HP-UX 11i for Itanium-based systems would have the same look and feel as HP-UX 11i for
PA-RISC-based systems.
- HP-UX on Itanium-based systems would have the same robustness as the enterprise-ready HP-UX 11i that was shipping for PA-RISC.
- The foundation was laid for the eventual complete merging of the operating source code streams between the PA-RISC and Intel Itanium architectures.

The initial version of HP-UX 11i for Itanium-based systems was given the name HP-UX 11i version 1.5 and was released in July 2001. This version of HP-UX 11i initially supported a 2-way I2000 workstation product; the HP Server rx4610, which can hold up to 4 processors; and the HP Server rx9610, which can hold up to 16 processors. HP-UX 11i version 1.5 also marks the beginning of the extension of HP-UX 11i functionality and layered software products from the PA-RISC architecture to the Intel Itanium architecture. This extension will take place in phases. HP-UX 11i version 1.5 is the first phase, and HP-UX 11i version 1.6 is the second phase. The third and final phase is planned to occur with HP-UX 11i version 2.

HP-UX 11i version 1.5 was released in July 2001, with HP-UX 11i functionality and an operating environment containing a subset of the independent software units (ISUs) available for HP-UX 11i on PA-RISC. Additional ISU products and operating environments will be added on a continuous basis until all of the ISU products available for HP-UX 11i on PA-RISC are also available for HP-UX 11i on the Intel Itanium Processor Family.

It is important to note that, in every sense, HP-UX 11i on the Intel Itanium Processor Family is HP-UX 11i and not something newly invented or created for the Intel Itanium architecture. HP-UX 11i on the Intel Itanium Processor Family is a recompilation of HP-UX 11i for PA-RISC.

Created from the same source code as HP-UX 11i on PA-RISC, the Integrity version of HP-UX 11i benefits directly from the years of investment that HP has made in HP-UX 11i on PA-RISC.

In a sense, HP-UX 11i on the Intel Itanium Processor Family is much like a new model of car that possesses a revolutionary power plant. Much remains familiar, such as the operation and the basic functionality, but underneath is a new engine that delivers much more power for much less cost.

Summary and Conclusion

HP ushered in the era of RISC architectures with PA-RISC in the late 1980s. As a result HP, which was originally an instrumentation and measurement company, became one of the leading computer systems vendors in the world. As an innovator in computer architectures, HP invented the concept of explicitly parallel instruction computing (EPIC) and then teamed with Intel Corporation to develop the Intel Itanium architecture and the Intel Itanium processor.

The entire Intel Itanium Processor Family is perfectly complemented by the HP-UX 11i operating environment. HP-UX 11i for Intel Itanium processors is the result of a carefully planned and thought-out strategy to seamlessly move this environment, HP-UX customers, and HP-UX ISVs to this new architecture.

The Intel Itanium Processor Family is poised to become the dominant computing architecture for the next 20 years. HP customers and partners will realize tremendous value from the planning and investments that HP has made as they move easily to this new generation of computing.

HP-UX 11i Release Names and Release Identifiers

With HP-UX 11i, HP delivers a highly available, secure, and manageable operating system that meets the demands of end-to-end Internet-critical computing. HP-UX 11i supports enterprise, mission-critical, and technical computing environments. HP-UX 11i is available on both PA-RISC systems and Itanium-based systems.

Each HP-UX 11i release has an associated release name and release identifier. The uname (1) command with the -r option returns the release identifier. The following table shows the releases available for HP-UX 11i.

Table 1. HP-UX 11i Releases

Release name	Release identifier	Supported processor architecture
B.11.11	HP-UX 11i v1	PA-RISC
B.11.20	HP-UX 11i v1.5	Intel Itanium
B.11.22	HP-UX 11i v1.6	Intel Itanium
B.11.23	HP-UX 11i v2 (September 2003)	Intel Itanium
B.11.23	HP-UX 11i September 2004	Intel Itanium and PA-RISC

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For more information

www.hp.com/go/hpux11i