



hp NonStop Kernel
operating system



a product description
from hp

features at a glance

- Continuous application availability with uncompromising data integrity
- Linear scalability from two to 4,080 processors with easy global distribution of applications, databases, and devices to meet changing business conditions
- Concurrent support of high transaction volumes and complex mixed workloads
- Robust support for common standards, including Java™, CORBA, SQL, ODBC, JDBC, HTTP, TCP/IP, and application programming interfaces
- Lowest TCO and superior long-term investment protection

hp operating system for critical business applications

The HP NonStop™ Kernel operating system provides the unique software foundation for HP NonStop servers—the servers that underpin many of the world's most critical applications, including the vast majority of the world's securities, credit card, point-of-sale (POS), and automated teller machine (ATM) transactions, as well as the zero latency enterprise (ZLE) systems being implemented for competitive advantage by leading companies in numerous industries.

The proven openness, well-known reliability, and virtually unlimited scalability of NonStop servers are all enabled by the NonStop Kernel operating system, which combines the scalability of shared-nothing parallel processing with industry-leading application availability, uncompromising data integrity, and support for key industry-standard application programming interfaces (APIs) and services, including Java, CORBA, Open Database Connectivity (ODBC), Simple Object Access Protocol (SOAP), XML, and more.

With the NonStop Kernel operating system, customers can leverage parallel processing to achieve maximum flexibility and application throughput, making it possible to quickly adapt to changing business conditions. For example, the NonStop Kernel operating system enables critical business application processing to be transparently distributed across multiple processors and even multiple systems, either centralized locally or geographically distributed anywhere in the world. This is accomplished without application code changes or relocation of I/O devices because the NonStop Kernel message-based architecture efficiently connects all local and remote devices and

processes between as few as two through as many as 4,080 loosely coupled processors working in parallel. Growth within a single server, an HP NonStop ServerNet Cluster, or the entire network can occur without disrupting application and database processing.

At the same time, the NonStop Kernel operating system delivers multiple levels of fault isolation and takeover capabilities for application and database survivability on both a local and a global scale. For example, due to the NonStop Kernel operating system, NonStop S-series servers can detect, isolate, and recover from hardware component and software failures without affecting applications and their users.

NonStop Kernel operating system and the NonStop architecture

NonStop servers are designed around a tightly integrated hardware and software architecture that provides “active-active” hardware fault tolerance and software process-pair fault tolerance. In this architecture, workloads are divided among many independent processors to minimize the fault domain should a hardware, system software, or application software failure occur. All critical hardware and software components have logical pairs so that if one component fails, another can immediately take over its work. This advanced parallel architecture combines with the high-bandwidth and low-latency advantages of ServerNet connection technology to enable systems with exceptional performance, continuous availability, ironclad data integrity, and extensive business flexibility.

architected for flexibility

The NonStop Kernel operating system uses a message-based internal architecture assisted by ServerNet hardware features to connect anywhere from two to 16 independent processors within each high-performance node. A copy of the NonStop Kernel operating system resides in every processor to implement software fault tolerance, monitor and synchronize all processors, coordinate resource sharing, and provide access control for all ServerNet connected devices. Each processor has its own memory and uses ServerNet technology (including direct memory access with address bounds checking) to access I/O devices, other processors, and other NonStop servers (see figure 1).

The HP Expand software option can be used to transparently and efficiently interconnect up to 255 local or geographically distributed NonStop S-series server nodes using a variety of technologies, including high-performance ServerNet fabrics or conventional telecommunication networks.

Significantly, each NonStop Kernel instance treats system services and applications as a global object environment. Services and applications can therefore run efficiently on any processor or group of processors within the entire distributed NonStop system, regardless of the physical location of I/O devices.

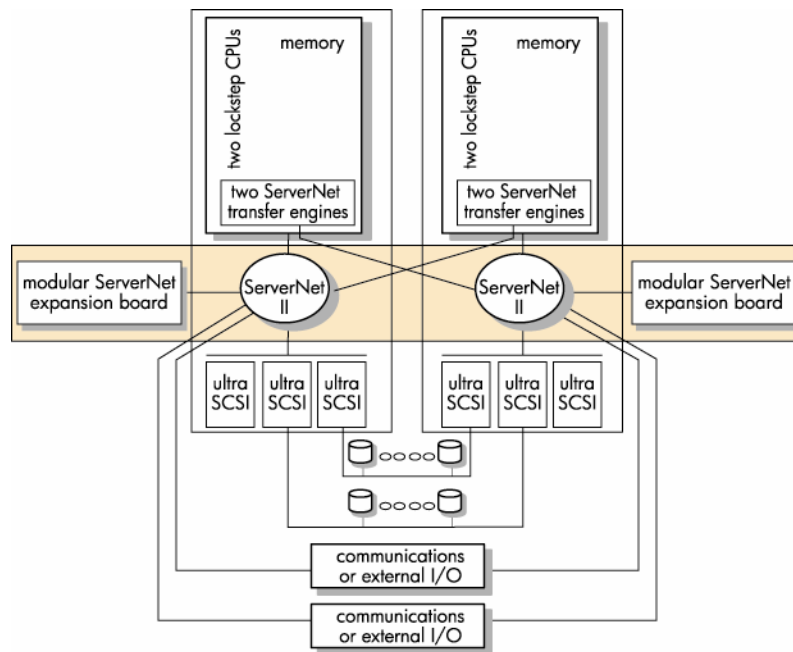


Figure 1. Basic two-processor NonStop S-series computing module with individual instances of the NonStop Kernel operating system.

architected for ultimate availability and data integrity

The NonStop Kernel operating system uses HP process-pair technology to create processes that run in pairs on different processors, thus establishing primary and backup processes for all critical system tasks. Backup processes, represented by the "A" and "B" ovals in figure 2, require only minimal processing power, so every processor is able to handle a full workload. The NonStop Kernel operating system automatically coordinates processing and status information between the primary and the backup process, and can immediately transfer all processing resources to the backup process if either a hardware or a software failure stops the primary process. As a result of this instant takeover, I/Os in process are completed, open files remain open, and database queries complete without interruption.

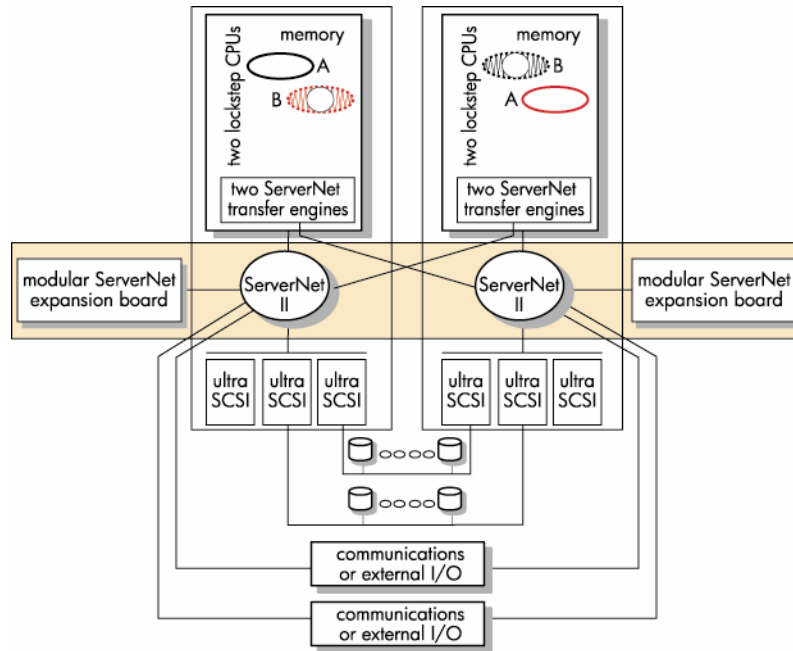


Figure 2. The NonStop Kernel operating system implements application-level software fault tolerance by coordinating primary processes A and B and backup processes A and B in different processors.

architected for openness and interoperability

The NonStop Kernel operating system is designed to work in a heterogeneous environment, permitting interoperability with a variety of systems. It provides the option of using standard compliant interfaces for application development and production. These services facilitate using NonStop servers as the fault-tolerant focal point for coordinating business applications that span Microsoft® Windows NT Server, UNIX®, IBM z/OS, and other systems. The NonStop Kernel operating system can extend the system advantages of NonStop servers—including continuous availability, data integrity, distributed data and processing, and linear scalability—to every level of application processing.

architected for performance

As the foundation of a vertically integrated hardware and software platform, the NonStop Kernel operating system works closely with other system components to achieve maximum efficiency for complex computing operations. For example, ZLE operations place considerable pressure on a system. Operations include real-time extract, transform, and load (ETL), large-scale online transaction processing (OLTP), and enterprise application integration (EAI) tasks; real-time analysis and reporting; batch extracts; complex direct querying; and online database maintenance—all of which occur simultaneously. The tight integration between the HP NonStop SQL database management system and the NonStop Kernel operating system enables absolute control over such a concurrent mixed-workload environment, making the NonStop SQL database unique in effectively handling all types of workloads executing concurrently

across a potentially very large cluster. NonStop Kernel software plays a critical role in allocating processor, disk, and I/O resources in such an environment where competing priorities have to be dynamically monitored and processes deemed to be of the highest priority need to be given precedence. Additionally, many key NonStop SQL database operations take place at the operating system level, which, in turn, leads to performance efficiencies that have a positive impact on very large database (VLDB) and real-time database performance.

unmatched scalability in the real world

Designed to support commercial processing, the NonStop Kernel operating system offers efficient and economical system expansion in order to handle the largest and fastest-growing applications. Beginning with an entry-level two-processor NonStop S-series server, the NonStop Kernel operating system allows for expansion in small economical increments of two processors up to massive server complexes comprising up to 4,080 NonStop S-series processors.

Servers can be connected across a campus with NonStop ServerNet Clusters or globally with HP Expand wide area communication clustering technologies. The NonStop ServerNet Cluster offering uses the same high-performance, low-latency ServerNet technology between servers that is used within NonStop S-series servers. This is the best-performing physical and electrical layer for data transmission available with NonStop S-series servers, as well as within the commercial server industry.

The combination of ServerNet technology and the NonStop Kernel operating system enables both the total cross-section data bandwidth and the total number of processors to increase as needed to accommodate the most demanding and data-intensive applications. Regardless of how large the system grows, the NonStop Kernel operating system distributes the workload among the available processors, making efficient use of system resources and achieving exceptionally high aggregate throughput from parallel processing. The NonStop Kernel operating system and its compilers automatically create a fully reentrant code execution environment that makes replication and parallel processing highly efficient. Therefore, no matter how large and how distributed the configuration, all users and applications can efficiently access files, databases, processes, and hardware resources from anywhere in the system.

linear scalability

The number of processors is only part of the scalability picture. The other part is the added contribution from each additional processor. Symmetric multiprocessing (SMP) systems, for example, begin with good single-processor performance, but with each additional processor there is a marked loss of contribution as a result of the SMP architecture. This creates a fixed throughput limit and declining financial return on investment (ROI) as each processor is added to the system. Because NonStop servers and the NonStop Kernel operating system utilize a shared-nothing architecture, there are no such constraints.

Documented results from large transaction processing and database benchmark tests using the NonStop Kernel operating system show that even with more than 112 processors, each additional processor can execute at least 98.2 percent of the throughput of the first processor. There is no evidence of a throughput limitation in large-scale configurations, and the ROI from each additional NonStop processor remains consistent. The NonStop Kernel operating system therefore supports virtually unlimited application growth.

single system image

Even when NonStop servers are expanded to include thousands of processors on a global scale, the NonStop Kernel operating system presents a single image that enables applications to interact with the entire network as if it were a single system. No matter how large the configuration or how geographically dispersed the system resources, the single image ensures that all users have immediate access to any application or database authorized for their use anywhere in the world. This means that a system manager can distribute processing functions and data according to the requirements of the business, taking into consideration such things as local staffing needs and national boundaries.

The single system image provided by the NonStop Kernel operating system also supports system management from a single location or from multiple locations. This capability provides flexibility in locating the operations staff; assigning cooperative, distributed, or centralized management responsibilities; and establishing remote, operatorless computing sites.

continuous availability in the real world

NonStop S-series servers can provide an unprecedented level of application availability because of ServerNet technology combined with the NonStop Kernel dynamic system configuration and hardware service management (TSM) subsystems.

growth without outages

NonStop S-series servers can grow from a single cabinet two-processor fault-tolerant system to eight system cabinets and up to 36 disk and I/O expansion cabinets with *no downtime*. Each fully configured HP NonStop S76000 or S86000 server would have 256 gigabytes of main memory and 25.3 terabytes of disk space. New disk drives and communications equipment can be dynamically added to the configuration without requiring downtime because of the dynamic system configuration facility. Similarly, existing mirrored disks can be upgraded to larger capacity disks with no application downtime. Other products such as the HP NonStop SQL/MP relational database can migrate data to the newly added or upgraded disks from existing databases while simultaneously supporting high-volume application transaction processing.

transparent takeover

The NonStop Kernel operating system in each NonStop S-series processor can automatically detect processing failures in other processors and remove the faulty processor from the configuration. The NonStop Kernel operating system then immediately and transparently transfers the workload to other processors, providing continuous service to applications. The vast majority of the time, users are never even remotely aware of any system difficulties.

Similarly, if any ServerNet path fails, the NonStop Kernel operating system automatically uses an alternate ServerNet path and continues processing transparently to the application. Simultaneously, the service management subsystem can begin low-level problem diagnostic procedures on the ServerNet path to further isolate the problem and optionally notify one of the global support centers that field service is needed.

The following three important features of the NonStop Kernel operating system maximize system availability for NonStop S-series servers:

- *Automatic system monitoring.* The service management subsystem provides automatic monitoring and diagnosis of processors, ServerNet components, I/O devices, power subsystems, and cabinet environments. The service management subsystem can automatically initiate diagnostics without disrupting application availability, take corrective actions as needed, and automatically contact an HP support center to report potential problems and initiate on-site service calls for critical repairs.
- *Online system configuration facilities.* The NonStop Kernel operating system includes built-in instrumentation to provide comprehensive online configuration changes. The dynamic system configuration facility allows the system configuration to be changed, extended, or removed online without system downtime. Magnetic disks, tape drives, communication lines, system cabinets, and I/O expansion cabinets can be added online using dynamic system configuration.
- *Distributed management facilities.* The NonStop Kernel operating system includes the distributed systems management facility, which provides the foundation for system and network management applications. Using distributed systems management, NonStop S-series servers can participate in open, standards-based operations management environments, such as HP OpenView software, that are compatible with SNMP or Common Management Information Protocol (CMIP)/Common Management Information Services (CMIS) systems.

data and transaction integrity in the real world

The NonStop Kernel operating system is the result of years of expertise in implementing highly distributed computing solutions that provide unmatched data and transaction integrity. No operating system alone can reliably detect electronic hardware data integrity errors, especially transient, nonrepeatable errors that may only affect a single data field or instruction bit anywhere in the system. The result of such undetected errors could be devastating in today's computerized world. Therefore, to ensure a high standard of data integrity, the NonStop S-series servers implement hardware checking for both transient and repeatable data errors in the processors, main memories, caches, data paths, ServerNet components, and communication and data storage devices.

The NonStop Kernel operating system tightly integrates with this hardware error-checking foundation and implements on top of it such advanced error-containment techniques as "fail-fast" to prevent hardware-induced data corruption from being propagated into application databases or out to other computer systems via communications networks. The NonStop Kernel operating system also integrates with the built-in environmental sensing and service processors of NonStop S-series servers to provide automatic system restart and recovery features that protect application databases against such events as power outages or potential errors that might be caused by extreme temperature variations.

The NonStop Kernel operating system extends fault-tolerant concepts to ensuring the integrity of business applications. As discussed earlier, when an application error is detected, the NonStop Kernel software halts the primary process and instantly moves application processing to the backup process. Customer experiences have shown that in the great majority of cases, the backup process will not encounter the same fault, and processing thus continues safely.

database integrity

The NonStop Kernel operating system supports several database products running on NonStop S-series servers, including the Enscribe file system and the NonStop SQL/MP

and NonStop SQL/MX relational database management systems. To ensure database integrity, the NonStop Kernel operating system integrates closely with NonStop Transaction Management Facility (NonStop TMF) software, which provides distributed two-phase commit protection for database changes globally across all affected NonStop servers.

NonStop TMF software is designed to help protect a database from intentional or accidental damage. With NonStop TMF software, a failure in an application, system, or network component does not result in a corrupted database because of a partially completed database update. Before an update changes the database, an “image” of every affected record or row is captured in memory and written to an audit log. If any part of an update fails or is programmatically aborted, NonStop TMF software automatically backs out the change in its entirety, returning the database to its state just prior to the start of that change.

support for open system services

The NonStop Kernel operating system provides an industry-standard POSIX-compliant software foundation for application portability, interoperability, manageability, and client/server computing in a multivendor environment. NonStop Kernel software is designed to support multiple operating system interfaces consisting of APIs and system software tools (see figure 3). These applications automatically benefit from the advantages of scalability, reliability, and performance of NonStop servers.

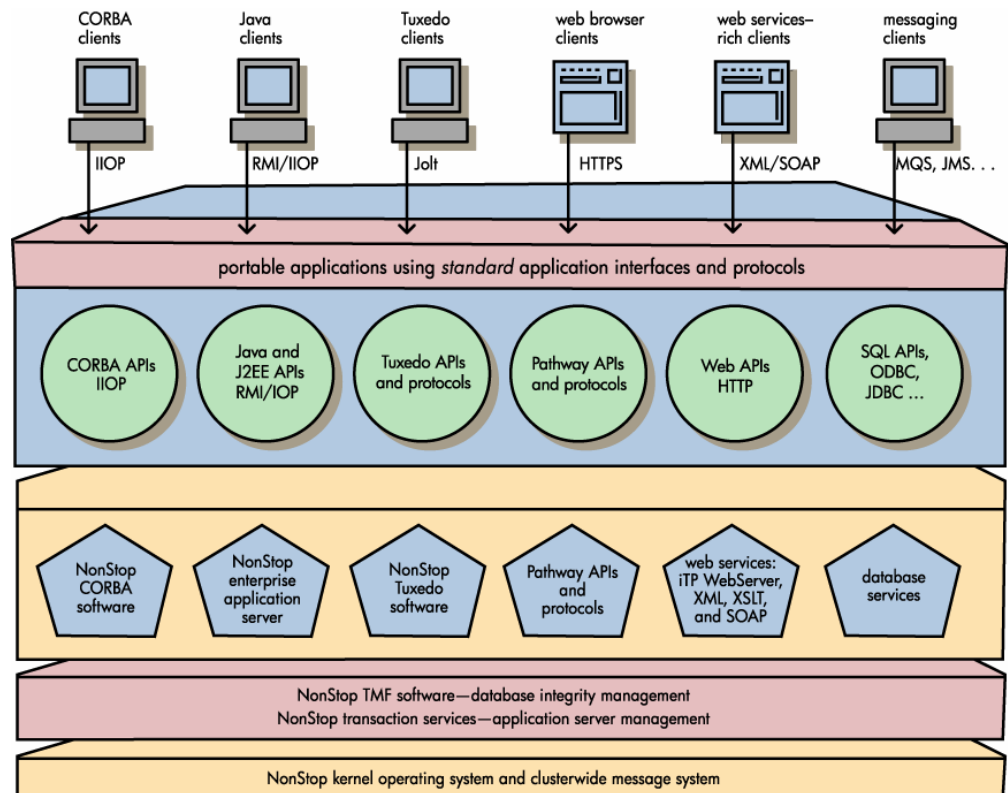


Figure 3. The NonStop Kernel operating system is designed to support different APIs that allow many popular business applications to run on NonStop servers.

The NonStop Kernel operating system incorporates an Open System Services (OSS) environment based on the OSF/1 source code that provides compliance with POSIX APIs. These APIs enable popular applications and middleware products such as Java, CORBA, and BEA's Tuxedo transaction processing monitor to be offered on the NonStop S-series servers.

Additionally, the NonStop Kernel operating system includes HP Guardian services to maintain upward compatibility for the thousands of customer business applications that are in production from earlier NonStop servers without recompilation.

business-critical Java support

In order for Java components and applications to benefit from the scalability, availability, and manageability advantages of a NonStop server environment, the NonStop Kernel operating system integrates with and supports a full range of Java oriented services. These include a high-performance, 100% Pure Java compliant Java Virtual Machine (JVM), made scalable for enterprise environments; a J2EE-based enterprise application server engineered specifically for Java application reliability, scalability, and manageability; ultra-reliable Java Message Services (JMS); robust Java Database Connectivity (JDBC); and comprehensive support for Web services.

internet, web services, and client/server computing

The NonStop Kernel operating system supports open system Internet-based, Web services, and client/server computing by allowing applications to communicate with one another across high-performance ServerNet connections, local campus connections, or wide area communications protocol connections using a variety of middleware products, including CORBA, Java, JDBC, EAS, Tuxedo, HP iTP WebServer, NonStop SQL/MP and NonStop SQL/MX, ODBC, SOAP, XML, Extensible Style Language Transformations (XSLT), and others.

Using NonStop Kernel services, a large application can be subdivided into processes that allow the virtually unlimited computing power of NonStop S-series servers and ServerNet technology to be applied to a tiered or split-processing application. For example, an application might consist of one class of processes to handle POS devices and another class of processes to handle complex application logic and relational database access. Distributed parallel processing support is ideal for Internet, Web services, and client/server environments, where the requesters may be located on workstations, personal computers, or intelligent devices such as ATMs and POS terminals.

processor platform portability

The NonStop Kernel operating system is designed with a modular structure to minimize and isolate the hardware-specific layers from customer applications. This design ensures that customer application investments can easily migrate to new hardware technologies, such as the ServerNet architecture. The NonStop Kernel operating system has a proven history of hardware architecture portability. The capabilities of the NonStop Kernel operating system were expanded in 1991 from supporting only CISC-based processors to include RISC-based processors, while maintaining binary application compatibility

for all customers. For NonStop S-series servers, the NonStop server architecture seamlessly replaces the conventional I/O channel and bus designs of previous NonStop servers with new high-performance ServerNet technology, while maintaining upward compatibility for existing customer applications. The NonStop Kernel operating system is currently being updated for a future generation of NonStop servers based on the Intel® Itanium™ Processor Family, codeveloped with Hewlett-Packard.

investment protection and lowest TCO

The NonStop Kernel operating system has proven its ability to take advantage of new industry-standard hardware technologies for processing, storage, and networking, providing improved price/performance and long-term investment protection for HP customers.

Most NonStop S-series server configurations are typically created by incremental growth over a period of time and often have different financial depreciation and technology life cycles. The NonStop Kernel operating system and other NonStop products protect customer investments by providing intergenerational scalability among combinations of NonStop series servers using the NonStop Kernel operating system to form a single processing environment. This flexibility allows customers to configure the right combination of NonStop servers to satisfy the most demanding business and performance requirements.

The NonStop Kernel operating system also protects long-term application investments by migrating applications to the latest generation of NonStop S-series servers with little or no modification effort.

Of particular significance, NonStop servers provide the lowest total cost of ownership (TCO) among enterprise-class servers, according to a 2002 study by Standish Group International, an independent research and advisory firm. The reliability, linear scalability, growth without outages, manageability, and openness provided by the NonStop Kernel operating system are pivotal enablers of this industry-leading TCO advantage.

specifications

standard S-series package (product number SN73)

The SN73 package includes many value-added products, the Enscribe file system, and Distributed Systems Management (DSM)/Software Configuration Management (SCM) to simplify system software installation and maintenance. The SN73 package is required when ordering NonStop S-series servers.

The SN73 product set contains the NonStop Kernel operating system, which provides low-level functions, including ServerNet technology and processor interfaces; interprocess communication and fault-tolerant process pair technology; and memory, time, and process management. The SN73 product set also includes the Enform report generator, text editors, print formatters, print spooler, fast sort, and file backup and restore; and application development and maintenance services such as the Data Definition Language (DDL), TAL and pTAL compilers, binder and nld utility, code debuggers, common runtime libraries, and national language support. SN73 also includes the Enscribe file system for key, entry, and relative record sequence files;

NonStop TMF software for file integrity and recovery; communications support for TCP/IP; and asynchronous (ATP6100) protocols.

The SN73 package includes an unlimited user license for OSS runtime POSIX APIs, utilities, and OSH (Korn) shell. The iTP WebServer product is provided for HTTP, HTML, and Common Gateway Interface (CGI) access.

The SN73 package simplifies system software installation with the DSM/SCM software configuration manager and the dynamic system configuration features of the Subsystem Control Facility (SCF). The TSM service manager product is included for local and remote hardware diagnostic and maintenance functions.

service and support

Support for the NonStop Kernel operating system is available under a support contract. A 90-day warranty against defects is included with the initial system purchase.

ordering information

<i>product ID</i>	<i>description</i>
SN73	Standard NonStop S-series package. Basic license package, including the NonStop Kernel operating system,* OSS runtime environment and file system, Enscribe file system, NonStop TMF software, TCP/IP, Backup/Restore, ANSI and IBM labeled tape support, tape catalog, event management subsystem, SNMP, FastSort, Enform, TGAL, TForm, text editors, DDL, TACL shell, OSH Korn shell, TAL and pTAL compilers, HP Visual Inspect software, subsystem control facility, trace/ptrace, TSM, the system software configuration management (DSM/SCM) subsystem, and iTP WebServer software. Requires NonStop S-series server. Order one per system.

* The NonStop Kernel operating system cannot be ordered separately. It is only available as part of software packages, such as product SN73.

For more information, go to www.hp.com/go/nonstop.

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