White paper
accelerate and consolidate the data center

with the innovation and dynamic scalability of the Fujitsu M10 server family

Table of Contents

Table of Contents

Introduction

1 Introduction

With the pace of business continuing to accelerate, enterprises are finding it difficult to deliver the right information at the right time to the right people. These dynamic business priorities place increasing pressure on underlying IT infrastructure that already struggles to meet user demand. For applications and services to deliver near-real-time access to information and results, systems must be fast and accurate, capable of storing, accessing, and processing massive amounts of data quickly and reliably to facilitate an accelerated decision-making process. As a result, savvy IT managers are looking for solutions that replace minor technology improvements with real server innovation that helps overcome barriers to success.

1.1 Innovation Matters

The last decade saw tremendous growth in the value of IT infrastructure to the business. As economic uncertainty moved to the forefront, many IT departments were forced to rely on small, incremental technology improvements to keep the business operating. Today, many organizations recognize that solving big problems requires big ideas—ideas that can only be realized with technological innovation.

- *Change is the new constant.* For years, companies worked hard to accurately forecast growth. With limited insight into business needs, IT infrastructure often was unprepared to deliver new capabilities. Today, many enterprises continue to struggle with systems that cannot scale on a moment's notice—or scale high enough—to support more users, applications, and services.
- *Fast processing is essential.* Turning data into actionable information requires extensive computational work. Many IT managers find that their existing systems are unable to process increasing volumes of information in shorter time frames.
- *Latency is a critical issue.* Many core business applications, such as customer relationship and supply chain management, require near-real-time response from underlying infrastructure. Massive data sets must be analyzed quickly. Unfortunately, many popular scale-out data models fail to consistently deliver the right results to the right people at the right time.
- *Memory matters.* Often overlooked, memory systems play a critical role in system and infrastructure performance. In environments with large (multi-terabyte or petabyte) distributed data stores, disk drive technology often limits throughput. While flash-memory storage offers better throughput than traditional disk drives, it is significantly slower than in-system memory. In an ideal environment, applications could store nearly all (or entire) data sets in memory to accelerate performance.
- *Business continuity requires infrastructure reliability.* In today's hyper-competitive environment, companies depend on their data center systems to quickly deliver accurate results. When systems fail or are compromised, the business suffers. High levels of reliability, availability, serviceability, and security are important.

Fujitsu Server and Processor Innovation

2 Fujitsu Server and Processor Innovation

For nearly a century, companies have relied on Fujitsu technology to run their businesses. With the capability to inspire and deliver technology breakthroughs that can help organizations achieve their business objectives, it is no wonder that Fujitsu is one of the top five server vendors in the world. Indeed, many of today's data centers are built on solid and dependable Fujitsu servers, from previous-generation PRIMEPOWER® servers to newer SPARC® Enterprise M-Series servers.

One of the reasons many IT departments trust Fujitsu solutions is the company's history of technology advancement. Many IT departments built their infrastructure on Fujitsu PRIMEPOWER servers. Once the workhorse of the data center, PRIMEPOWER servers continue to play a role in many environments, even though a single-core-per-socket design, inability to run modern operating systems, and lack of upgrade capabilities limit their effectiveness for today's demanding workloads. For many companies, the addition of Fujitsu SPARC Enterprise M-Series servers added a new dimension to the data center. Incorporating the first dual-core SPARC64® processor, early versions of these servers offered increased scaling with similar performance per processor core. Subsequent advancements in processor design, achieved in the SPARC64 VII and VII+ processors, delivered more processor cores and large cache sizes without fundamentally changing the underlying architecture. With the Fujitsu M10 server family, Fujitsu continues its long-standing tradition of delivering innovative server technology that companies can use to move their businesses forward.

2.1 The Fujitsu M10 Server

Big problems and big data require big ideas. Fujitsu M10 servers offer the biggest technology advancement for SPARC® servers in more than a decade. Not content with a mere incremental advancement, Fujitsu designed the M10 servers with a flexible and modular architecture that holds the promise for dramatic reinvention of the data center. Four-processor building blocks allow the system to scale dynamically from 1 up to 64 processors, 1024 cores, and 2048 threads, along with up to 32 TB of memory and 76.8 TB of storage. An embedded PCI controller and CPU-to-CPU interconnects deliver unprecedented scalability and low latency. These capabilities allow Fujitsu M10 servers to handle the same workload with half the number of cores compared to previous-generation PRIMEPOWER and SPARC Enterprise M-Series systems, providing excellent savings in software licensing and power and cooling costs. The result: an extensible platform that can solve big business problems in a compact footprint. Figure 2.1 shows the M10-4S flagship server of the Fujitsu M10 server family.

Figure 2.1: The Fujitsu M10-4S server

2.2 Innovative Software-on-Chip Design

At the center of the Fujitsu M10 server design is the new, 16-core Fujitsu SPARC64 X processor. Designed with high performance in mind, the SPARC64 X processor uses an innovative software-on-chip (SWoC) design to accelerate business-critical operations. Processes that are typically handled by software or ASICs are moved into the processor hardware to accelerate execution. This advanced processor inherits the robust technologies found in previous SPARC64 processors while offering high operating frequencies, multicore and multithreading capabilities, and high memory throughput. Enhancements extend beyond these microarchitecture improvements to include significant instruction set enhancements.

- *Accelerated computation.* A decimal floating-point arithmetic unit executes decimal floating-point arithmetic processing within the hardware for faster computation—without the latency introduced by software-based solutions that must convert numbers to and from binary form.
- *Parallel processing enhancements.* A High Performance Computing Arithmetic Computational Extension (HPC-ACE), an extended instruction set architecture, offers extension registers and single instruction multiple data (SIMD) technology to support parallelization.
- *Cryptographic processing performance improvements.* Built-in cryptographic capabilities enable encryption and decryption tasks to be moved into the processor for accelerated response times.

2.3 Accelerated Computation for Fast Response Times

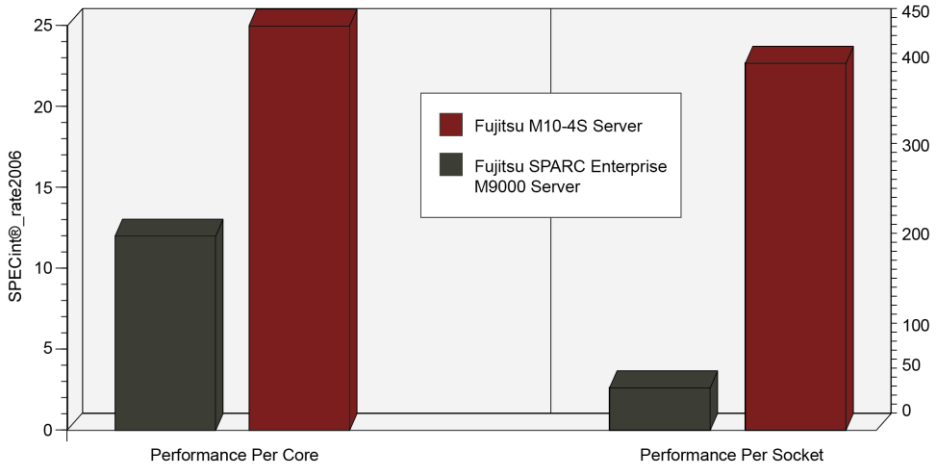
Many business applications require the highest levels of processing performance and response. For many of these applications, slow storage systems and small memory capacities can pose barriers to success. The innovative architecture of the Fujitsu M10 server reduces the likelihood of processors being forced to wait for data. A high-speed interconnect delivers massive bandwidth and consistent, low latency between components. Implemented as point-to-point connections that use packet-switching technology, the interconnect can transmit multiple data streams to accelerate response times.

A high-performance memory subsystem helps increase throughput, with DDR3 DIMMs with four-way memory interleaving enhancing system performance. Memory mirroring capabilities can be activated, allowing the memory subsystem to duplicate and compare data stored in memory. In the event of a memory DIMM error, the system can use the alternate memory bus and DIMM set to ensure processing continues and response times are unaffected. By storing entire data sets in fast and highly available memory, applications are less likely to wait for the data needed to complete critical operations.

The SWoC design, massive memory capacity, and low-latency throughput of Fujitsu M10 servers lead to faster processing and improvements in performance. Testimony to Fujitsu's engineering excellence, Fujitsu M10 servers deliver approximately twice the performance per CPU core and a 7.5-fold enhancement per socket performance compared to previous-generation servers with SPARC64 VII+ processors as measured on the SPEC® CPU2006 benchmark, which tests the ability of a server's processor and memory system to deliver performance for compute-intensive applications.

Figure 2.2 illustrates the performance per core characteristics of Fujitsu M10 servers.

Figure 2.2: Performance per core results



2.4 A SWoC Design that Handles Big and Fast Data

Big data isn't simply a hot trend, it is a driving force in many enterprise processes and IT budgets. While it is relatively easy to collect vast quantities of data, it is much more difficult to turn it into actionable information, especially in real time. Many of the core business applications used for analysis spend a lot of time moving and testing data and performing a great deal of decimal arithmetic. Such applications can benefit from running on Fujitsu M10 servers, as several SWoC features transparently accelerate application execution.

For example, the SWoC capabilities of the Fujitsu M10 server accelerate the copy and compare instructions that are used by the standard system libraries to accelerate memory copy and compare functions. Furthermore, the SPARC64 X processors in Fujitsu M10 servers include IEEE 754 compliant DPD (decimal) and Oracle® NUMBER arithmetic support, enabling business applications to run at full speed and produce credible results. Because these decimal instructions are built into the SWoC design of processor, they are available to applications such as Oracle Database 12c (with patch 17279207). Other vendors could add support to applications over time.

2.5 Built-in Cryptography that Helps Keep Information Secure

With employees, partners, and customers more connected than ever before, security can no longer be an afterthought. Many organizations want to take advantage of encryption technology, but are concerned about the impact these security mechanisms can have on system, application, and service performance. The Fujitsu M10 server makes it possible to encrypt all traffic flowing into and out of enterprise applications, without the significant performance degradation caused by off-chip implementations.

Unlike other systems that experience bottlenecks during encryption and decryption processing, the M10 servers ensure encryption and decryption happen quickly. In the SPARC64 X processor, cryptographic capabilities are built into silicon. This allows encryption and decryption tasks to be handled at wire speed–up to 163 times the performance than previous implementations–without the need for additional and expensive cryptographic accelerator hardware on the server motherboard or an add-on adapter. Applications can access these capabilities through the cryptographic framework built into the Oracle Solaris® 11 operating system through the libsoftcrypto library. This standards-based API offers access to the broad range of encryption and decryption standards implemented in the processor, such as Advanced Encryption Standard (AES), Data Encryption Standard (DES), Triple Data Encryption Standard (3DES), and Secure Hash Algorithm (SHA) functions. Applications can also benefit by using Oracle Database 11g R1 with appropriate patches.

Figure 2.3 illustrates the encryption and decryption performance characteristics of Fujitsu M10 servers on the OpenSSL benchmark. These results show how the SWoC design of Fujitsu M10 servers realizes scalable performance. Because each thread occupies one processor core, applications can expect to experience a linear performance improvement as the number of cores increases in the system.

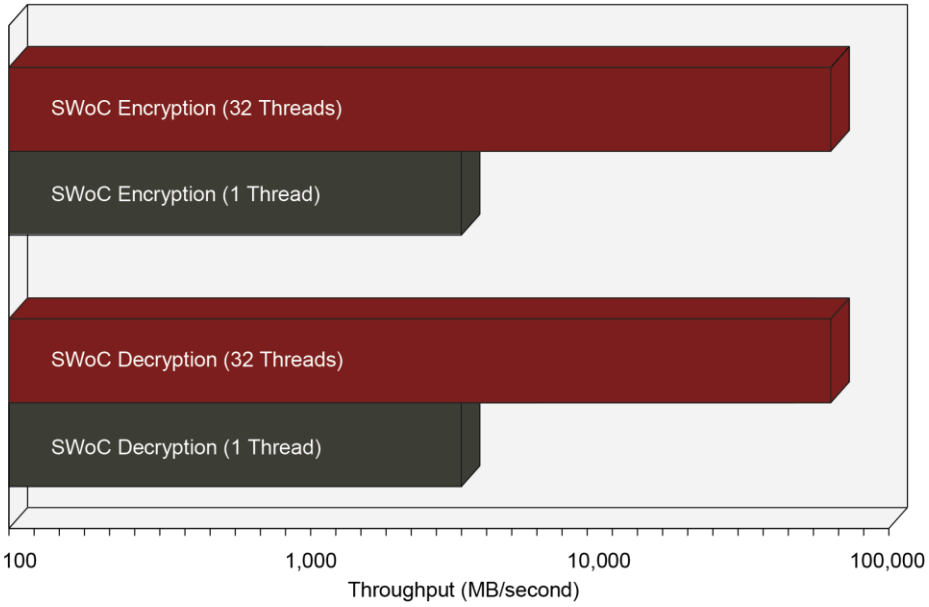


Figure 2.3: OpenSSL benchmark results

2.6 Dynamic Scalability for Greater Agility

Predicting which business segments will experience periods of exponential growth is exceedingly difficult. To compensate, IT departments tend to over-provision the resources used for business-critical functions. The modular building block design and capacity on demand capabilities of Fujitsu M10 servers simplify the task of allocating and managing computing resources. Per-core activation licensing allows IT organizations to activate only the processor cores they need today and add more cores and four-processor modules when needed to accommodate additional workloads and users. Using two expansion racks, up to 16 interconnected building blocks can be deployed without disruption, delivering the scale-out configuration needed for distributed parallel processing.

Built-in virtualization capabilities further extend the scalability of the system. Included with each Fujitsu M10 server, Oracle VM Server for SPARC allows multiple virtual environments to be created on a system. IT staff can dynamically reconfigure computing, I/O, and cryptographic resources to provide virtual environments with the resources they need to support applications and users. This flexibility, combined with up to 1024 processor cores and massive amounts of high-speed memory, help IT departments support small to large workloads without the forklift upgrades required by other solutions. Figure 2.4 and Figure 2.5 illustrate the scalability of Fujitsu M10 servers on compute-intensive and memory-intensive workloads.

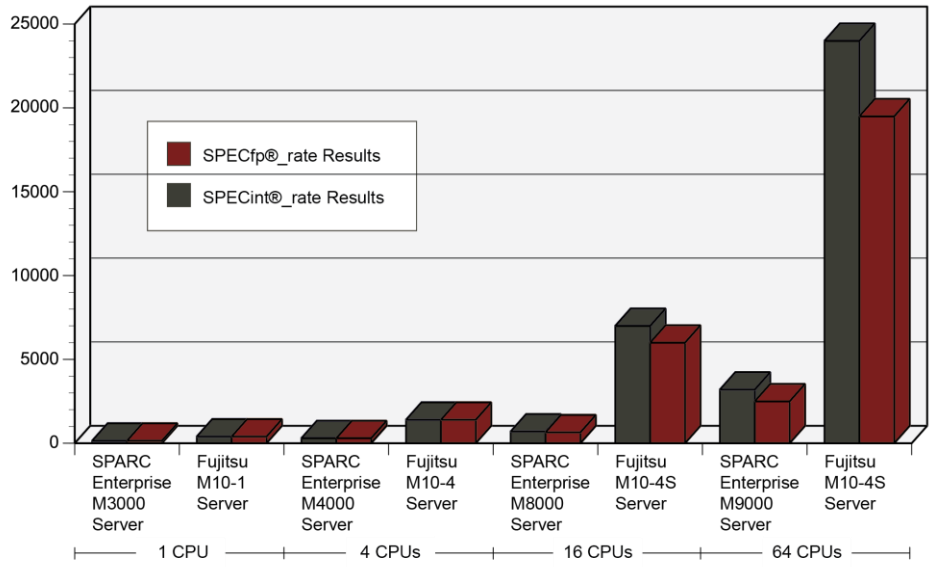


Figure 2.4 Fujitsu SPARC Enterprise and M10 Server SPECint®_rate and SPECfp®_rate results

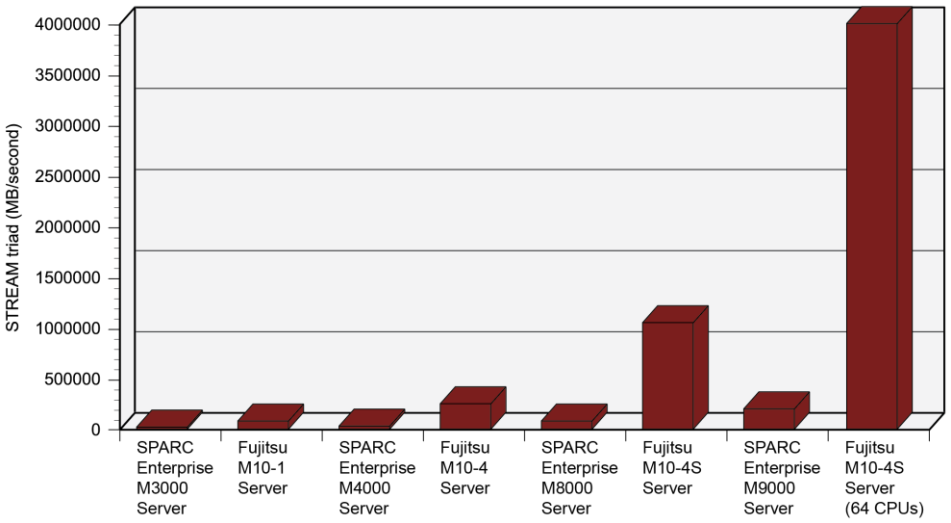


Figure 2.5 Fujitsu SPARC Enterprise and M10 Server STREAM results

2.7 Reliability that Keeps Businesses Running

Delays in processing or response can have a significant impact on the bottom line. Understanding the need for business continuity, the SPARC64 X processor and Fujitsu M10 server design builds on Fujitsu's heritage of mainframe-class reliability, availability, and serviceability (RAS) technology. This data center in a box architecture includes many features that help ensure silent errors to not corrupt decision making and that unscheduled downtime is not required to work around failing hardware or software components.

- No single points of failure, including redundant interconnect paths with cyclical redundancy checking (CRC) capabilities to minimize the risk of errors and data corruption
- Memory protection with ECC, helping to protect all data stored in main memory
- Memory Extended-ECC support, providing single DRAM chip failure correction capabilities that support continuous operation during memory device failures
- Memory patrol scanning, preventing the use of faulty areas of memory before they can cause system or application errors
- User selectable memory mirroring, to improve data reliability and availability
- A built-in sealed Liquid Loop Cooling system that maintains server internal temperatures, minimizing the likelihood of premature hardware failures due to excessive heat without the operational complexity of traditional external liquid cooling systems
- Predictive self-healing capabilities, enabling the operating system to work with the server hardware to predict failing components and minimize the impact of potentially serious issue before they impact operation

Putting the Fujitsu M10 Server to Work for Your Business

3 Putting the Fujitsu M10 Server to Work for Your Business

The processors, system interconnects, and memory and I/O subsystems of Fujitsu M10 servers work in concert to create a scalable, high-performance platform that supports a broad range of workloads, from consolidation of general-purpose enterprise workloads to the fastest, largest, and most secure database processing applications.

3.1 Enterprise Applications, Business Intelligence and Analytics, and Databases

Companies around the world depend on Oracle enterprise applications and large-scale database deployments. Fujitsu M10 servers are designed to optimize single-threaded application performance and handle big data. The extreme system memory capacity and unique high-speed FTL interconnect of Fujitsu M10 servers delivers in-memory processing and true real-time processing that cannot be achieved in other systems. For example, Fujitsu M10 servers have been shown to accelerate both traditional and in-memory database applications.

Oracle Database 12c

Working in collaboration, Fujitsu and Oracle have coordinated engineering efforts to enable databases and the applications that use them to benefit from the single-threaded performance optimizations of Fujitsu M10 servers. Intelligence built into the Oracle software takes advantage of SWoC enhancements to deliver up to 2.4x overall improvement for single-threaded or response-time-sensitive database management system (DBMS) environments. Organizations that migrate from Oracle Database 11g R2 to Oracle Database 12c with appropriate patch set exceptions (PSE) can experience:

- Up to 20 percent performance improvement (up to 10 percent improvement without PSEs installed)
- The performance of three or more additional cores on a 16-core server (up to 10 additional core equivalents on 64-core servers) without purchasing hardware upgrades or adding software licensing fees
- Up to 30 percent improvement in transaction rates and response times

Oracle TimesTen In-Memory Database

Enterprises with stringent response time demands often use Oracle TimesTen In-Memory Database. This memory-optimized relational database offers a rich set of features, including persistence and recoverability mechanisms, to deliver near-instant responsiveness and very high levels of throughput to business-critical database-intensive applications. Because these time-sensitive databases fit entirely in server memory, they are ideally suited to the massive memory capacity and low-latency characteristics of Fujitsu M10 servers. Internal testing shows that a single, 16-core Fujitsu M10-4S processor delivers 6.7x the Oracle TimesTen In-Memory Database performance of two 8-core processors in a SPARC Enterprise M4000 server.

3.2 Data Center Consolidation

Competitive pressures continue to push the boundaries of existing data centers. As IT organizations attempt to keep pace, many IT managers expand existing infrastructure and increase compute capacity by adding servers. Over time, this strategy results in sprawling and hard-to-manage infrastructure that consumes valuable data center floor space and creates excessive power and cooling demands. While modernizing and consolidating the data center offers opportunities for increased efficiency, new systems must be agile and scale on demand to help ensure more work can be performed and new applications and services can be deployed with minimal business disruption.

Fujitsu M10 servers are designed for modern, consolidated, mission-critical environments, providing the features organizations need to make better use of data center resources.

- *Dynamic scalability and capacity on demand.* As IT organizations run more workloads on a system, they need assurance that the server will continue to deliver processing performance. Modular and powerful Fujitsu M10 servers can scale from low-cost rack servers to systems with thousands of processor cores that can support hundreds or thousands of workloads on a single system. Additional cores, processors, and even four-processor building blocks can be activated when needed, delivering additional processing capacity on demand as peak conditions strike or more workloads are added to the system.
- *Scalable performance.* Fujitsu M10 servers typically can outperform previous-generation servers by a factor of two on a core-to-core comparison basis. This means fewer cores can perform the same amount of work. For example, a Fujitsu M10-1 server is equivalent to a SPARC Enterprise M5000 server, while a Fujitsu M10-4S server with one building block can do the work of a SPARC Enterprise M9000 server configured with 32 processors.

- *Consolidation density*. Many IT organizations avoid consolidation projects out of concern for application performance. Fujitsu M10 servers not only deliver physical infrastructure performance, they also offer high-performance virtual environments. With the capability to partition servers into multiple virtual environments with fine-grained resource control, IT organizations can better utilize infrastructure resources and ensure applications receive the compute, memory, and I/O resources they need to run and support users. Because all Fujitsu M10 servers run Oracle Solaris, organizations can virtualize their data center using Oracle Solaris Zones and Oracle VM Server for SPARC, two technologies that can be used separately or together to create high-density deployments.
- *Workload mobility*. While large-scale infrastructure can be invaluable, it is often inflexible. Consolidating and virtualizing infrastructure onto Fujitsu M10 servers offers IT organizations the flexibility they need to rapidly provision and repurpose resources, and move workloads to avoid problematic systems or use underutilized equipment. Entire virtual environments, including applications and workloads, can be moved to other systems–including your processor entitlements–in the event capacity limits are reached or to take advantage of idle resources during times of peak demand.
- *Investment protection*. With excellent binary compatibility, Oracle Solaris makes it easy to transition to Fujitsu M10 servers. IT staff can continue to use the tools with which they are familiar, and run older, unsupported versions of Oracle Solaris on virtualized Fujitsu M10 servers, protecting application investments and streamlining the upgrade and consolidation process. Existing Oracle Solaris applications can run unmodified and automatically take advantage of Fujitsu M10 server technology advancements.

Conclusion

4 Conclusion

Understanding the economic, market, and technological challenges that continue to burden IT organizations, Fujitsu has developed an innovative server architecture that can help businesses move forward. Indeed, Fujitsu continues to invest in technology and develops innovations that solve real-world problems for companies in any industry. As businesses grow and evolve, they can benefit from the large, low-latency memory system and low-latency crossbar node interconnect of Fujitsu servers to satisfy the demands placed on IT infrastructure by compute-intensive workloads. In the near future, applications are expected to exploit additional capabilities of the unique Fujitsu SWoC server design, such as larger floating-point register files and SIMD instructions that can further accelerate application performance.

Whether your business is looking to replace aging servers or legacy mainframe environments, Fujitsu M10 servers deliver the scalability and reliability your business needs with a state-of-the-art UNIX® environment with a broad application ecosystem. With a commitment to enterprise computing and technology innovation, Fujitsu stands ready to help your business adapt to dynamic market conditions and capitalize on the advantages server technology brings to your IT infrastructure.

About Fujitsu

Fujitsu is the leading Japanese information and communication technology (ICT) company offering a full range of technology products, solutions and services. Approximately 170,000 Fujitsu people support customers in more than 100 countries. We use our experience and the power of ICT to shape the future of society with our customers. Fujitsu Limited (TSE:6702) reported consolidated revenues of 4.4 trillion yen (US$47 billion) for the fiscal year ended March 31, 2013. For more information, please see http://www.fujitsu.com.

Contact
FUJITSU LIMITED
Website: www.fujitsu.com
2013-11-26 WW-EN