Sun Fire X4450 and Sun Fire X4150 Servers
Synapse Mobile Networks Equipment Identity Register (EIR) System
Intel Multi-Core Processors

Stopping Illegal Mobile Phone Usage - With the Latest High Performance Servers

Mobile phone theft is a growing problem. In the UK a mobile handset is stolen every three minutes, impacting the lives of an estimated two million consumers per year[1]. When lost and stolen phones end up in the wrong hands, consumers and service providers bear the brunt of unauthorized service charges. Seeking to minimize the financial impact from this fraud, service providers are deploying Equipment Identification Register (EIR) solutions used to implement a global blacklist. When a phone disappears, operators can block it within seconds.

Synapse Mobile Networks*, a leading supplier of mobile device and user management systems, ported its EIR application to an Intel® architecture-based platform running the Sun® Solaris™ operating system. This was a straightforward code migration that required some driver modifications, no application code changes and produced a prototype within one week. With this platform, Synapse demonstrated high EIR performance. This solution brief provides the results of the Synapse migration, illustrating how mobile operators can minimize server sprawl and reduce utility and administration costs by deploying services on the latest servers.

Sun microsystems — www.sun.com

synapse mobile networks — www.synap.se

intel — www.intel.com/go/ipservices

[1]Wireless Consumer Alliance http://www.wirelessconsumers.org/site/pp.asp?c=giJYJ3OOF&b=14068

Platform Migration: Opportunities and Challenges

Synapse's Equipment Identification Register (EIR) is a standardized node within a GSM network that is responsible for barring stolen or malfunctioning devices. The basic functionality of the EIR is to respond to the network "checkIMEI" request by looking up the IMEI – International Mobile Equipment Identity device serial number – and responding whether to 'allow', 'monitor' or 'bar' phone service. This network element is deployed by service providers, who are looking for dense and energy-efficient solutions that can support more subscribers and services.

An EIR services checkIMEI requests from wireless network elements, mobile switching centers (MSC) and serving gateway support nodes (SGSN), as shown in Figure 1. It also allows the service providers to monitor the network, perform maintenance and support customers. An EIR may transmit end-user requests to an automatic device management system (ADMS) that enables subscribers to send and update mobile settings over-the-air and receive software upgrades.

In order to optimize data center space utilization and minimize utility costs, equipment makers are adopting the latest server platforms featuring multi-core processors, which provide opportunities to increase performance density. Adding cores to processors can significantly boost computing performance with little or no increase in power consumption.

Synapse's Equipment Identification Register (EIR) code base ran on the Solaris operating system, which has a strong reputation for reliability, scalability and service. However, the improved EIR software design with 64-bit processing and advanced multi-threading capabilities did not translate into the desired performance gains on the existing platform. The challenge was to port the application to a higher performance platform that would preserve the code base, thereby maintaining the high quality and availability of the system and at the same time improve the performance and capacity of the system. Synapse decided on Sun Fire™ servers that are equipped with powerful Intel® Quad-Core processors running the Solaris operating system.

"The Sun Fire 4450 is the best four-socket x64 server in terms of performance, density and power efficiency. In addition, it offers memory scalability from 2GB up to 128GB and as much as 50 percent lower energy consumption than competitive servers, resulting in lower energy and cooling costs," says Sun Product Manager Rebecca Tong.

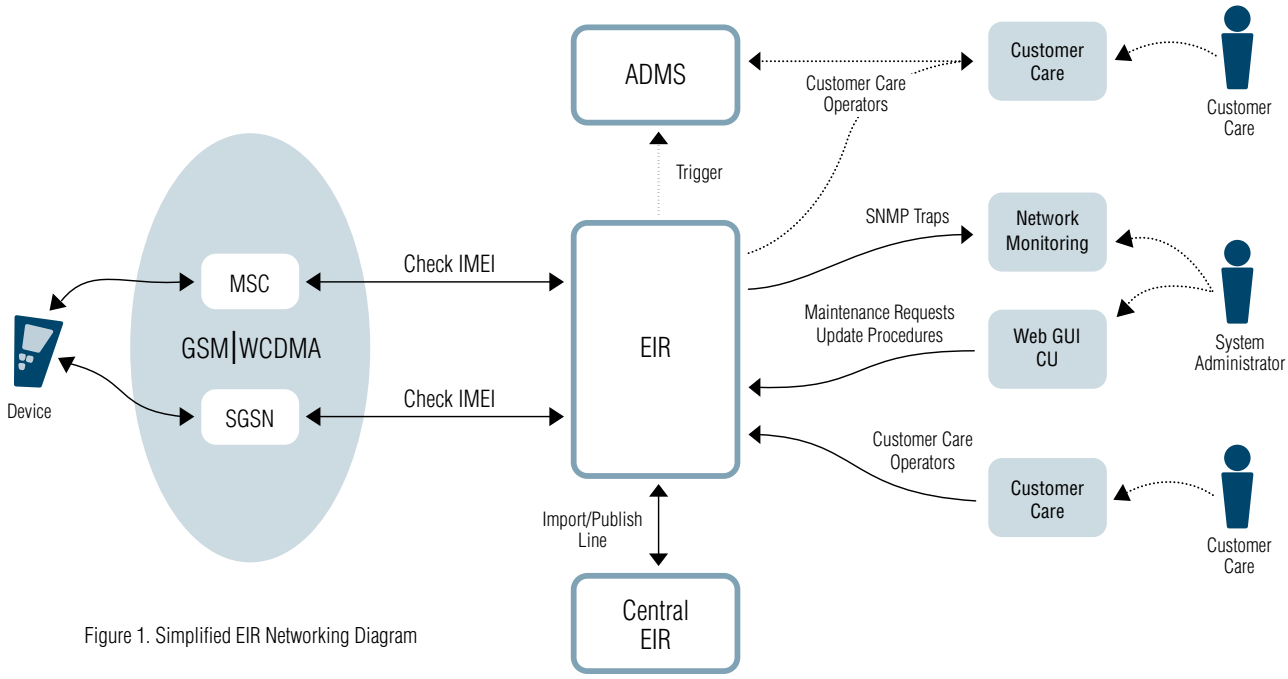

Figure 1. Simplified EIR Networking Diagram

Synapse Ports to Sun Fire Servers

As part of selling turn-key solutions to mobile operators, Synapse is responsible for platform architecture decisions, including the choice of server platform. Their server selection process benchmarks compute performance and application porting effort. Sun Fire servers delivered on both, providing five times greater performance than the prior platform and requiring only one week to port the application. The combination of Sun Solaris and Intel® Architecture Processors is consistent with Synapse's platform strategy of deploying best of breed commercial off-the-shelf hardware and operating system platforms to enable the lowest possible cost of ownership.

EIR system performance depends on processing out-of-band signaling transactions quickly – signaling system number 7 (SS7) – and accessing an external database that contains lists of lost and stolen handsets. The information retrieved from the database is sent back in messages called Transactional Capabilities Application Part (TCAP), and the performance of an EIR system is indicated by its TCAP bandwidth.

It was relatively easy for Synapse to port their EIR application to Sun Fire Servers. The EIR software was recompiled, but no application code changes were required. In rebuilding their software platform for Intel® Xeon® processors, Synapse used the GNU Compiler Collection (GCC) for compilation and the Sun Solaris Runtime Linker. Since the majority of the application is written in Erlang, a byte compiled language, the software porting effort was concentrated in the following areas:

Erlang Virtual Machine (VM) - Erlang is an open-source, general-purpose programming language and runtime environment with built-in support for concurrency, distribution, fault tolerance and incremental code loading. Since the Erlang VM already ran on Intel® platforms, the majority of the effort was verifying some Synapse-specific features.

Oracle Berkeley Database (DB) - The Oracle Berkeley DB family of open source, embeddable databases provides developers with fast, reliable, local persistence with zero administration. Often deployed as "edge" databases, the Oracle Berkeley DB family provides very high performance, reliability, scalability and availability for application use cases that do not require SQL. Again, since the Berkeley DB is widely used on Intel platforms, this was primarily a verification task.

Erlang Linked-In Drivers - Similar to device drivers, the Synapse EIR platform has linked-in drivers to provide high-performance interfaces to the database and SS7 subsystems. This porting required some additional work due to the little-endian format (byte ordering) of the Intel® processors.

SS7 Device Drivers - New Intel architecture/Solaris drivers, provided by the hardware vendor, required verification.

"After a successful and minimal effort porting to servers powered by Intel® Xeon® processors, the EIR from Synapse delivers outstanding system performance. The TCAP requests served, over 9000[1] checkIMEI transactions/sec on a single node, is approximately equal to the aggregated EIR traffic load generated by all mobile switches in a 50 million subscriber 3GSM network," says Per Bergqvist, CEO of Synapse Mobile Networks. By comparison, other commercial EIRs typically quote between 1000 and 2000 transactions/sec/node.

Lessons Learned

Synapse was impressed with the relative ease of porting their Solaris-based EIR application to a higher performance platform. Other mobile network and telecom applications such as automatic device management, roaming service center and other revenue generating services can benefit from a similar migration. The porting process is straightforward because Sun has maintained binary compatibility between operating system releases for nearly a decade, enabling existing Solaris applications to run unmodified on Solaris 10. This means that Solaris applications developed ten years ago will run on Solaris 10 unchanged, taking full advantage of new and advanced Solaris features. With Solaris 10, Sun now guarantees source code compatibility between SPARC and Intel Xeon processors, ensuring applications can run across platforms with a simple recompile.

With Solaris source code compatibility, it's easier to take advantage of the combination of Sun's experience in telecom and Intel's energy-efficient microprocessor technology. Equipment makers and mobile operators can make a smooth transition to a higher performance system while preserving their code base. And by choosing standards-based Intel architecture, developers have a wide choice of vendors for components and subsystems, with the advantage of cost-effective pricing and interoperability.

Added Benefits from Solaris

The Solaris 10 Operating System integrates a number of high availability and storage system features that can simplify system administration and eliminate the need to acquire some storage management components separately. It has built-in features that can help increase availability of EIR systems such as predictive self-healing operations. This technology enables systems to accurately predict component failures and mitigate many serious problems before they actually occur. This fault management technology includes the following capabilities:

- **Auto Diagnosis and Recovery:** automatically detects, diagnoses and isolates faulty or suspect components for faster time to service, which can virtually eliminate downtime.
- **Persistent CPU Offlining:** allows the system to restore availability by configuring itself around the failed component(s) during a reboot.
- **Memory Page Retirement:** helps enable the system to detect potential memory chip failures and automatically migrates data from a suspect memory address range.

EIR systems comprise large external storage devices that maintain large databases. Solaris includes capabilities that simplify storage management such as ZFS and RAID-Z (similar to RAID-5). ZFS is a free, open-source file system that does away with many complicated storage administration concepts and automates many common administrative tasks, including:

- **Powerful, Single Commands:** reduce the effort to create/grow storage pools and add/remove file systems, which is a significant improvement over traditional file systems and volume managers that often require system administrators to use tedious multi-step processes.
- **File System/Volume Manager Model:** eliminates the need for volume manager software, disk striping and mirroring and eases administration by removing the constraints associated with directories and subdirectories, letting administrators virtualize disks and manage data across physical volumes.
- **New Data Replication Model (RAID-Z):** uses variable stripe width to eliminate write holes that can occur when a loss of power occurs between data and parity updates.

Solaris also supports Dynamic Tracing (DTrace), a framework for troubleshooting systemic problems in real time on production systems. DTrace is designed to quickly identify the root cause of system performance problems. It safely and dynamically instruments the running operating system kernel and applications without rebooting the kernel and recompiling - or even restarting - applications. DTrace can be used to visually monitor performance on a per CPU core basis and track down performance bottlenecks. This can help system administrators and developers identify the reasons for suboptimal system and application performance.

Servers Deliver Performance, Density and Energy Efficiency

The Sun Fire X4150 and X4450 powered by Quad-Core Intel Xeon processors demonstrate Sun's unique design principles, in terms of performance, expandability, and energy efficiency for Solaris, Linux*, Windows* and VMware* applications. They provide maximum compute density, leading storage capacity, networking connectivity and integrated system management and monitoring capabilities.

The Sun Fire X4150 is a rack optimized 2-socket 1RU server supporting up to 8-CPU cores, 8 SAS disk drives, and up to 64 GB memory (with 4 GB DIMMs). The Sun Fire X4450 provides double the density of competitor systems in a 4-socket 2RU form factor including with up to 16-CPU cores, 16 SAS disk drives and up to 128 GB memory (with 4 GB DIMMs). Both these servers feature the enterprise reliability features expected from Sun including dual-redundant high efficiency power supplies and cooling fans, hot swappable and RAID enabled disk drives, 4 onboard Gigabit Ethernet ports and Integrated Lights Out Management.

Compute Density Multiplies

The latest Intel multi-core processors, based on the Intel® Core™ microarchitecture, provide high performance, greater energy efficiencies and compatibility, resulting in better performance per watt. The Quad-Core Intel® Xeon® processor 5300 series doubles the compute density over previous Intel® Dual-Core processors[i]. Its performance per watt is three times greater than the industry-leading Dual-Core Intel® Xeon® processor in the same power envelope[1,ii].

Embedded Intel Dual and Quad-Core processors, with extended lifecycle support, provide breakthrough performance and energy efficiency for compute-intensive embedded, storage and communications platforms. These CPUs and associated chipsets support high I/O bandwidth and are ready for 10 Gigabit networks.

Denser and More Energy-Efficient Infrastructure

It's easier than ever for mobile operators to boost the performance of Solaris-based applications by migrating them to energy-efficient servers based on Intel multi-core processors. These platforms also benefit from open architecture, which promotes a wide range of commercial off-the-shelf hardware and software building blocks. This helps lower hardware and software costs, which can increase service provider's margins. With the relatively easy migration of applications on Solaris, operators can deploy the latest infrastructure technology faster and lower the cost of bringing new services on-line.

[1] Performance tests and ratings are measured using specific computer systems and/or components and reflect approximate performance of Intel® products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, visit http://www.intel.com/performance/resources/benchmark_limitations.htm

[i] Quad-Core Intel® Xeon® Processor 5300 Series for Embedded Computing, Product Brief

[ii] Quad-Core Intel® Xeon® Processor 7300 Series, Product Brief