White Paper
SAP* Mobile Platform 3.0
Intel® Xeon® Processor E5 Family
Enterprise-class Security

SAP* Mobile Platform 3.0 Scaling on Intel® Xeon® Processor E5 v2 Family

Delivering Incredible Experiences to Mobile Users

Executive Summary

With bring your own device (BYOD) practices in the enterprise and the dramatic increase of smartphones and tablets, mobile applications have become an integrated aspect of an enterprise's mission-critical software services. Mobile applications are no longer an option, but a requirement, and IT must have the resources to support them.

The SAP* Mobile Platform 3.0 meets this need. The platform simplifies building, deploying, and managing mobile services by providing a foundation of valuable tools for developers and IT in a single deployment. These tools are designed to help optimize user experiences under a full range of mobile application workloads. To understand SAP Mobile Platform's capability to continuously provide a consistently positive experience to mobile users at scale, SAP and Intel engineers ran representative workloads on an SAP Mobile Platform system while simulated user requests were increased.

The SAP Mobile Platform 3.0 testing ran on a server powered by an Intel® Xeon® processor E5-2697 v2.[1] Simulated workloads and data payloads also ran on servers based on Intel® Xeon® processors. The load tests revealed the SAP Mobile Platform software and server can easily scale across demanding loads—up to thousands of requests per second—with less than 0.1 second impact—faster than the blink of an eye—on the mobile user's experience.

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SAP Mobile Platform Software

The SAP* Mobile Platform, optimized for Intel® Xeon® processors, allows enterprises to develop, deploy, secure, operate, and manage their mobile applications using a single, scalable infrastructure. The SAP Mobile Platform software provides two sets of environments and tools: one for developers, providing foundational tools to help keep costs low through accelerated, in-house creation of enterprise and consumer applications; and one for IT professionals responsible for maintaining the user experience, offering effective management of the applications and system.

The capabilities of the SAP mobile application management software allow IT to leverage existing investments and skill sets to speed time to market, transform business, and significantly reduce total cost of ownership (TCO). The SAP mobile applications management platform offers the following:

- Automatically scale application delivery to changing workloads, helping ensure high-availability of mission-critical applications.
- Maximize visibility across all applications, including authentication and connectivity information.
- Seamlessly integrate with mobile device management to secure devices and content.

Intel® Processors for Servers and Mobile Devices

Intel Xeon processors power much of the world's servers in the cloud and the enterprise. Intel® Atom™ processors, designed for exceptional energy efficiency and multi-core performance, are at the center of many of today's powerful mobile devices, such as smartphones and tablets.

Intel® Xeon® Processor E5-2600 v2 Family

At the heart of a modern data center, the Intel® Xeon® processor E5 family powers some of the most advanced business-critical systems on the planet. Over the last 20 years, SAP and Intel have worked closely together to optimize SAP software to take advantage of the advanced features Intel delivers in Intel Xeon processor silicon, including scalable performance, power efficiency, hardware-enhanced security, and built-in virtualization support. SAP optimized the SAP Mobile Platform software for Intel Xeon processors to enable the level of performance needed to support large numbers of mobile users.

Each generation of Intel Xeon processor introduces new capabilities and offers greater advantages for IT to meet their demands. Balanced server platforms based on the Intel® Xeon® processor E5-2600 v2 family allow IT to achieve a high level of operational excellence and enable modernized services delivery, such as highly scalable mission-critical mobile applications. Compared to the previous-generation Intel Xeon processor, Intel Xeon processor E5-2600 v2 family advantages include:

- 50 percent more cores—from 8 to 12—per socket
- 50 percent larger last-level cache—from 20 MB to 30 MB
- More integrated I/O resources
- Intel® Turbo Boost Technology 2.0[2]
- Low-leakage process technology

This new generation of Intel Xeon processor delivers 30 percent more active power[3] than previous-generation Intel Xeon processor, intelligently adapts power and resources to changing workloads, and cuts idle power by 30 percent,[4] enabling greater workload consolidation, increased scalability, and lower TCO than ever before.

Intel® Atom™ Processor—Smartphones with Intel Inside®

The company that revolutionized computing is now powering smartphones and tablets with the Intel Atom processor. Smartphones with Intel Inside® provide the power to be productive and enjoy life on the move. With multi-core performance and exceptional energy efficiency, the advanced Intel Atom processor inside today's smartphones enables fast web browsing, highly responsive apps, and effortless multi-tasking for hours without a charge.

Understanding System Behavior at Scale

Responses across the entire mobile application infrastructure—from back-end SAP applications, through the SAP Mobile Platform, to the end user mobile device—impact the delivery of SAP mobile applications. Lagging response at any tier can diminish the user experience, limiting the effectiveness of the service and impacting user productivity.

Central to user experiences is the ability of the SAP Mobile Platform server to continue to supply resources as the number of users (or requests-per-second) increases. Resource limitations create choke points, which can cascade into dramatic application response delays. Compute resources, caching, system memory, and I/O all play a critical role in keeping up with user requests at scale (Figure 1 and Figure 2). Keeping those resources in balance is important to the overall health of the infrastructure.

Understanding the behavior and capabilities of SAP Mobile Platform servers based on the Intel Xeon processor E5-2600 v2 family will help SAP effectively recommend to its customers the best practices to design and deploy highly capable infrastructures that scale well and continue to deliver high performance to prevents the resource imbalances of less capable and well-designed systems.

SAP Mobile Platform Testing Overview[5,6]

SAP together with an Intel® software engineering team tested the performance and scalability of the SAP Mobile Platform, running on a typical 2-socket server with Intel Xeon processor E5-2697 v2 CPUs. The testing measured system resources and response times for a variety of tasks as simulated user loads increased on the SAP Mobile Platform.

1. With no simulated user load (the Single-user test), a real user completed several tasks on and Intel Atom processor-powered Lenovo K900* smartphone. Device time measurements were captured for a baseline evaluation.
2. As an increasing number of user tasks were sent to the SAP Mobile Platform (the Multi-user test), measurements were taken to provide data on scalability of the overall system.
3. At full simulated user load (the Mixed-user test), a real user simultaneously completed several tasks on the Lenovo K900 smartphone. Device time measurements were captured to evaluate the user experience at scale.
4. Correlating the data provided insight into the mobile user experience.

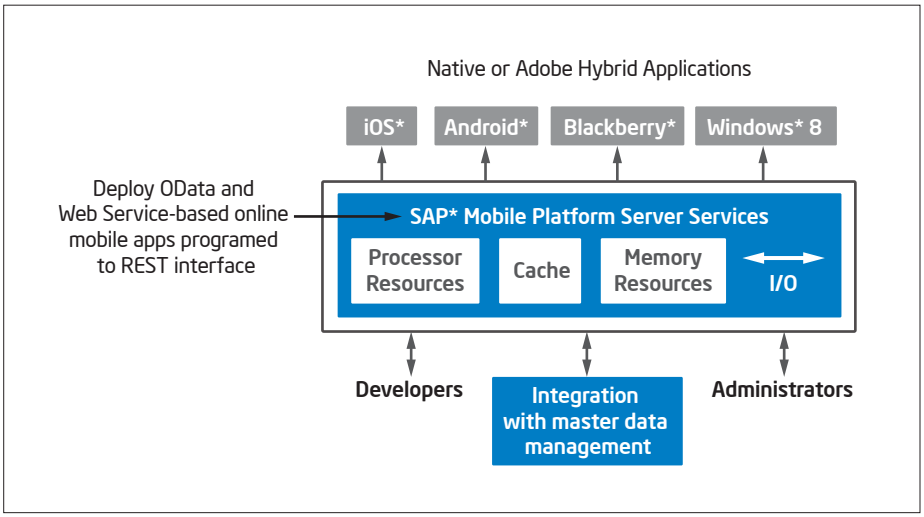

Figure 1. SAP Mobile Platform architecture

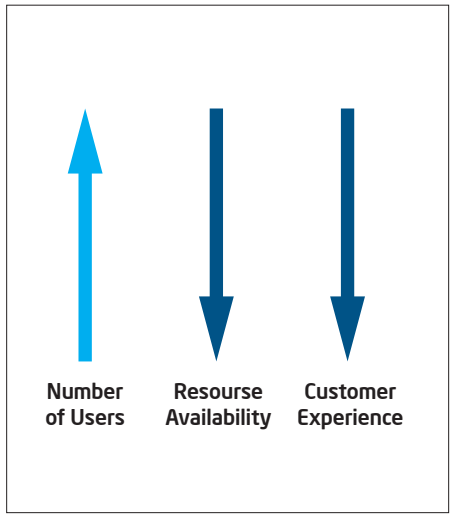

Figure 2. Potential platform loading risk for under-resourced systems at scale

Test Configuration

Figure 3 illustrates the test configuration. Elements of the test protocol included:

- The mobile device passed requests to the SAP Mobile Platform over the corporate Wi-Fi* network.
- Load servers passed simulated user requests to the SAP Mobile Platform for processing.
- The SAP Mobile Platform server processed the requests, accessing the back-end data server to retrieve and write records.
- Back-end data responses were consistently delayed an additional 100 ms to simulate real-world response conditions in business transactions.

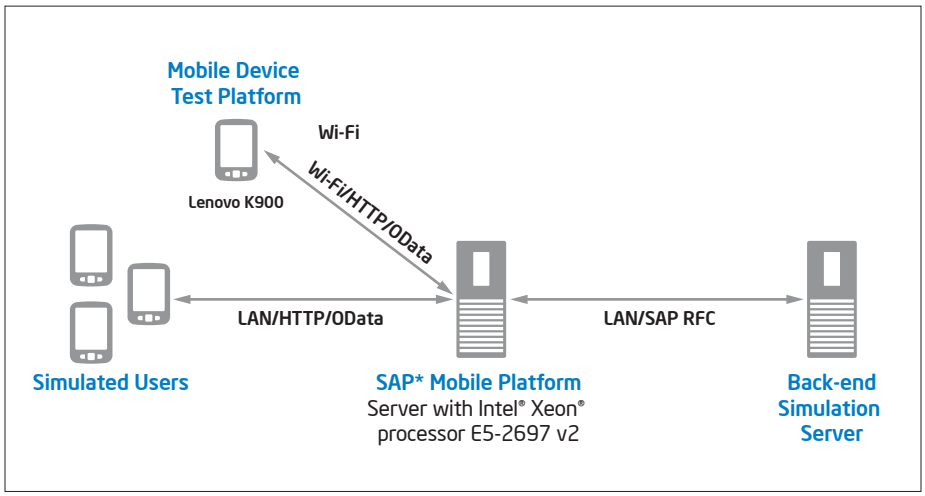

Figure 3. Test System

Test Scenarios

User Load Simulation

From SAP's work with customers, the types of application workloads simulated in these tests typically see a rate of requests per second from under a thousand to several thousand requests per second. Depending on how one looks at the number of requests users make in a given time, requests per second can extrapolate to number of users. For example, 1,000 requests per second from users making an average of 2 requests per minute would mean the load comprises 30,000 concurrent users. 5,000 requests per second at 2 requests per minute per user indicate 150,000 concurrent users are accessing the system. These are user loads SAP sees only for very large customers, and the testing here extrapolates to such very large user loads with excellent server response under such loads. Readers should make their own determinations concerning user load simulation for their own applications when considering the results from the following tests.

TABLE 1. TEST SCENARIOS

SCENARIO	TASKS COMPLETED	DATA
Single-user tests ▪ K900* Smartphone ▪ No simulated load	▪ Get 300 records ▪ Get 1 record ▪ Update 1 record ▪ Delete 1 record ▪ Add single record	▪ K900 end-to-end time (ms) ▪ Back-end (database server) time (ms) (including 100 ms delay) ▪ SAP Mobile Platform time (ms) ▪ SAP Mobile Platform CPU utilization (%) ▪ SAP Mobile Platform average CPU time (ms)
Multi-user tests ▪ Varying simulated load	▪ Get 300 records ▪ Get 100 records ▪ Get 50 records ▪ Get 5 records ▪ Get 1 record	▪ Throughput (requests per second) ▪ Round-trip time through the system (ms) ▪ Average back-end time (ms), including 100 ms delay ▪ SAP Mobile Platform process time (ms) ▪ SAP Mobile Platform CPU utilization (%) ▪ SAP Mobile Platform CPU time (ms)
Mixed-user tests ▪ K900 Smartphone with full simulated load	**All Single-user tasks** Mixture of the following Multi-user tasks: ▪ 25% get 100 records ▪ 50% get 5 records ▪ 25% update 1 record	▪ All Single-user data ▪ All Multi-user data

Test Scope

Table 1 describes the test scenarios used and data captured. The data set used for testing comprised an SAP training database containing records from an SAP flight reservation software system. The record size is approximately 2.3 kB in size. The records are sent to the client in compressed format.

TABLE 2. SINGLE-USER TEST RESULTS

TASK	ON-DEVICE VISUALIZATION (MS)[c]	ROUND TRIP OUTSIDE DEVICE[b]		TOTAL END-TO-END RESPONSE TIME THE USER EXPERIENCES (MS)[a]
		EST. PLATFORM TIME (MS)[e]	AVG. BACK END (MS)[d]	
Get 300 Records	204	60	461	725
Get Single Record	7	14	160	181
Update Single Record	0	14	293	307
Delete Single Record	0	14	77	91
Add Single Record	0	14	91	105

[a](Measured) From initiation of request to completion on the device, including visualization, if any.
[b](Measured) Includes SAP* Mobile Platform, back-end database, and network (Wi-Fi) times.
[c](Calculated) Parsing and display processing (End-to-End minus Round Trip Outside Device). Some tasks did not have visualization.
[d](Average of Measured) Actual back-end times were not measured for the Single-user and Mixed-user tests. The platform time from the multi-user test was used to calculate the back-end time.
[e](Estimated) SAP* Mobile Platform time can be closely estimated from known and measured quantities (Round Trip Outside Device minus Avg. Back End).

Performance Test Results

Key Findings

The test results reveal that a mobile user's experience is nearly unaffected by heavy loads on the SAP Mobile Platform. The SAP Mobile Platform, running on the Intel Xeon processor E5-2697 v2 family, can maintain performance with resource capacity to service multiple thousands of mobile users at once. The Intel Atom processor-based tablet also delivered exceptionally fast response. The overall impact to the mobile user is less than 0.2 second delay comparing the no-load condition to the full-load condition. *The delay is literally faster than the blink of an eye.*

The following describes the test results in more detail.

Single-user Testing

Mobile users in this use case will execute multiple tasks in sequence, first evaluating many records, and then identifying one or more records to change, delete, or update. Thus, the Single-user tests comprised several executions of a sequence of 'get 300 records,' then 'get 1 record,' followed by actions on single records (update and delete), and finally adding a new record. The measurements were averaged from several executions performed by a real user on a Lenovo K900 smartphone with the Intel Atom processor. The results in Table 2 provide a baseline comparison.

Multi-user Testing

Multi-user testing shows how the SAP Mobile Platform responds to increasing user loads. Users typically request smaller sets of records to fine tune their updates; payload gradually decreases in size. Thus, the testing simulated an increasing number of users requesting 300 records, 100 records, 50 records, 5 records, and finally 1 record.

Figure 4 shows that processor utilization scales linearly for a variety of requests, never reaching saturation with multiple thousands of requests per second, which is well within the expectations of this type of application and workloads.

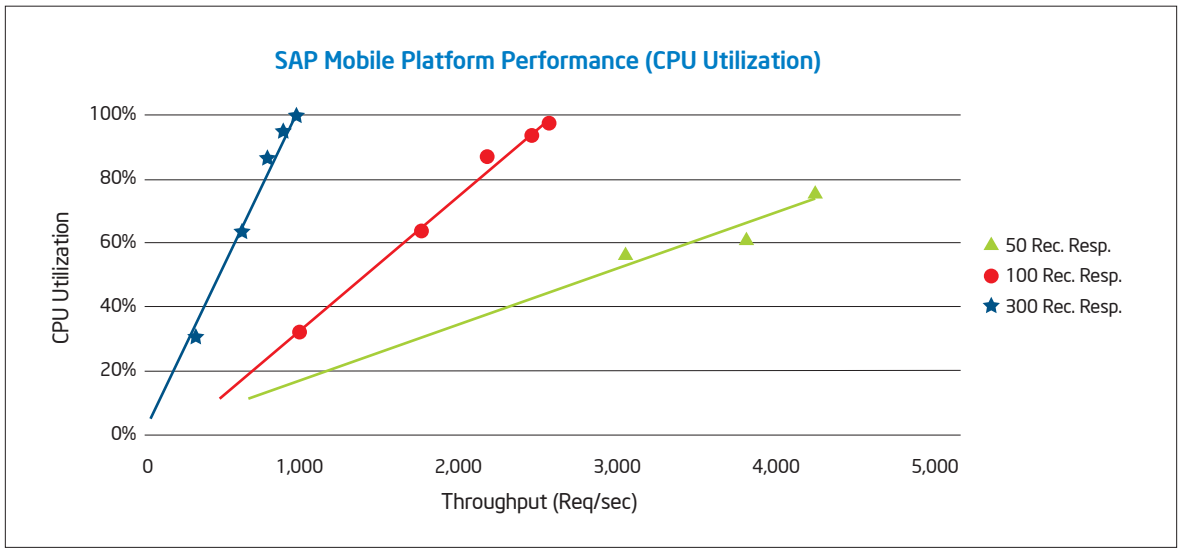

Figure 4. Multi-user requests results (CPU utilization)

TABLE 3. MIXED-USER TO SINGLE-USER TEST RESULTS

TASK	ON-DEVICE VISUALIZATION (MS)	SMP (MS)		BACKEND (MS)	E2E TIME (MS)		IMPACT ON END-USER EXPERIENCE (MS)
		NO LOAD	FULL LOAD		NO LOAD[a]	FULL LOAD	
Get 300 Records	204	60	193	461	725	858	133
Get Single Record	7	14	35	160	181	202	21
Update Single Record	0	12	12	293	305	305	0
Delete Single Record	0	14	45	77	91	122	31
Add Single Record	0	14	22	91	105	113	8

[a]This column reconciles with the Single-user test section above.

Mixed-user Testing

Since the single user is only one of many users also performing similar tasks, Mixed-user testing combined the Single-user tests with the Multi-user loads (see Figure 5). However, the simulated Multi-user tasks were mixed in the following percentages to generate full load on the system, as might be expected in real usage:

- 25 percent get 100 records
- 50 percent get 5 records
- 25 percent update 1 record

Table 3 shows the measured results for the full user experience with both no user load and a full load of simulated users.

The critical metric here is the End-to-End Impact on the user between No Load (which is equal to the Single-user testing) and Full Load (with the generated mixed load described above).

The results reveal that *a user experiences less than 0.2 second delay* for the worst-case testing between no users and a full set of users also accessing the system. *This delay is literally faster than the blink of an eye.*

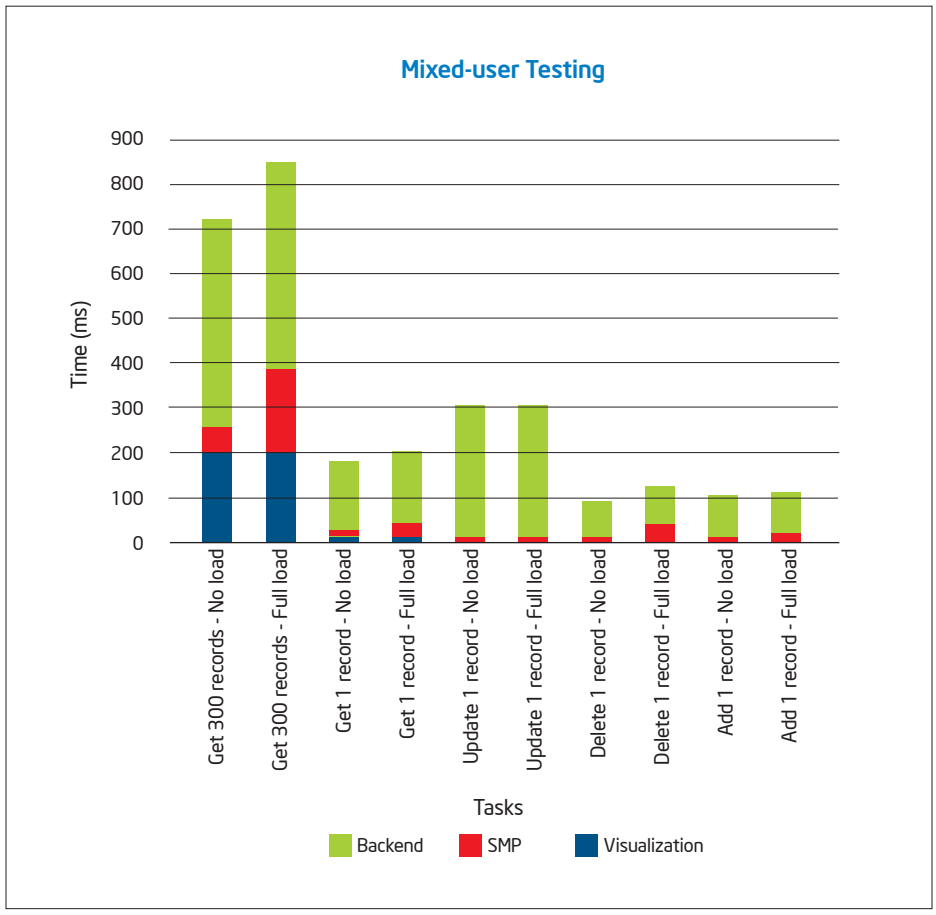

Figure 5. Mixed-user Testing

Conclusion and Guidelines

Typical use cases of the SAP Mobile Platform require the system to support many hundreds to several thousands of concurrent mobile users. Testing by SAP and Intel shows that the SAP Mobile Platform 3.0 running on a server based on the Intel Xeon processor E5-2697 v2 can scale to hundreds of thousands of users with minimal impact on an individual user's mobile experience. With the optimizations for the Intel Xeon processor, the SAP Mobile Platform and Intel Xeon processor E5-2600 v2 family provide the performance and resources to support scalability to a large number of users for the types of workloads the SAP Mobile Platform often sees.

For more information on the SAP Mobile Platform, visit the SAP Mobile Platform site at www54.sap.com/pc/tech/mobile/software/solutions/overview/index.html.

For more information on Intel Xeon processor E5 family, visit the Intel Xeon processor E5 site at www.intel.com/content/www/us/en/processors/xeon/xeon-processor-5000-sequence.html.

You may also contact your SAP or Intel representative.

Appendix—Test Configurations

Table 4 lists the server configurations, and Table 5 lists the mobile device's specifications used in the testing.

TABLE 4. SERVER CONFIGURATIONS FOR SAP* MOBILE PLATFORM TESTING

SYSTEM	LOAD SIMULATION SERVERS	BACK-END SIMULATION SERVER	SAP MOBILE PLATFORM SERVER
CPU/Sockets	Intel® Xeon® Processor X5660/2 sockets	Intel® Xeon® Processor X5660/2 sockets	Intel® Xeon® Processor E5-2697 v2, 2 sockets
CPU Cores/Threads	6/12	6/12	12/24
CPU Speed	2.8 GHz	2.8 GHz	2.7 GHz
Memory Capacity	48 GB	48 GB	64 Gb
Operating System	Windows Server* 2008 R2 Datacenter	Windows Server* 2008 R2 Datacenter	Windows Server* 2008 R2 Datacenter
Software	Apache JMeter* 2.9	Apache Tomcat* 7.0	SAP Mobile Platform 3.0
Network Interface	Single-port, 1 Gbps	Single-port, 1 Gbps	Single-port, 1 Gbps

TABLE 5. MOBILE DEVICE

Device Platform	Lenovo K900* Smartphone
CPU/Sockets	Intel® Atom™ Processor Z2580/1 socket
CPU Cores/Threads	2/4
CPU Speed	2.0 GHz
Memory Capacity	2 GB
Memory Speed	LPDDR2
Operating System	Android* 4.2 (Jelly Bean)
Display	HD 5.5" IPS
Graphics	Intel® GMA Graphics/533 MHz
Network	Wi-Fi* (IEEE 802.11 a/b/g/n)

[1] Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families: Go to: Learn About Intel® Processor Numbers

[2] Requires a system with Intel® Turbo Boost Technology. Intel Turbo Boost Technology and Intel Turbo Boost Technology 2.0 are only available on select Intel® processors. Consult your system manufacturer. Performance varies depending on hardware, software, and system configuration. For more information, visit http://www.intel.com/go/turbo

[3] Source: Intel internal measurements: [SPECpower_ssj2008* based on Xeon E5-26xxv2 (12C, 2.5GHz, 130W. Idle power based on, Intel® Xeon ® processor E5- 26xx v2 (12C, 2.5GHz, 95W), 28 March 2013]. Results have been simulated and are provided for informational purposes only. Results were derived using simulations run on an architecture simulator or model. Any difference in system hardware or software design or configuration may affect actual performance. Intel product plans in this presentation do not constitute Intel plan of record product roadmaps. Please contact your Intel representative to obtain Intel's current plan of record product roadmaps. For more information go to http://www.intel.com/performance

[4] Source: Intel internal measurements: [idle power, Intel® Xeon ® processor E5- 26xx v2 (12C, 2.5GHz, 95W), 28 March 2013]. Results have been simulated and are provided for informational purposes only. Results were derived using simulations run on an architecture simulator or model. Any difference in system hardware or software design or configuration may affect actual performance. Intel product plans in this presentation do not constitute Intel plan of record product roadmaps. Please contact your Intel representative to obtain Intel's current plan of record product roadmaps. For more information go to http://www.intel.com/performance

[5] Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products.

[6] See Appendix for configuration information. For more information go to http://www.intel.com/performance

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