Samsung's 5ᵗʰ Generation Green Memory Solution
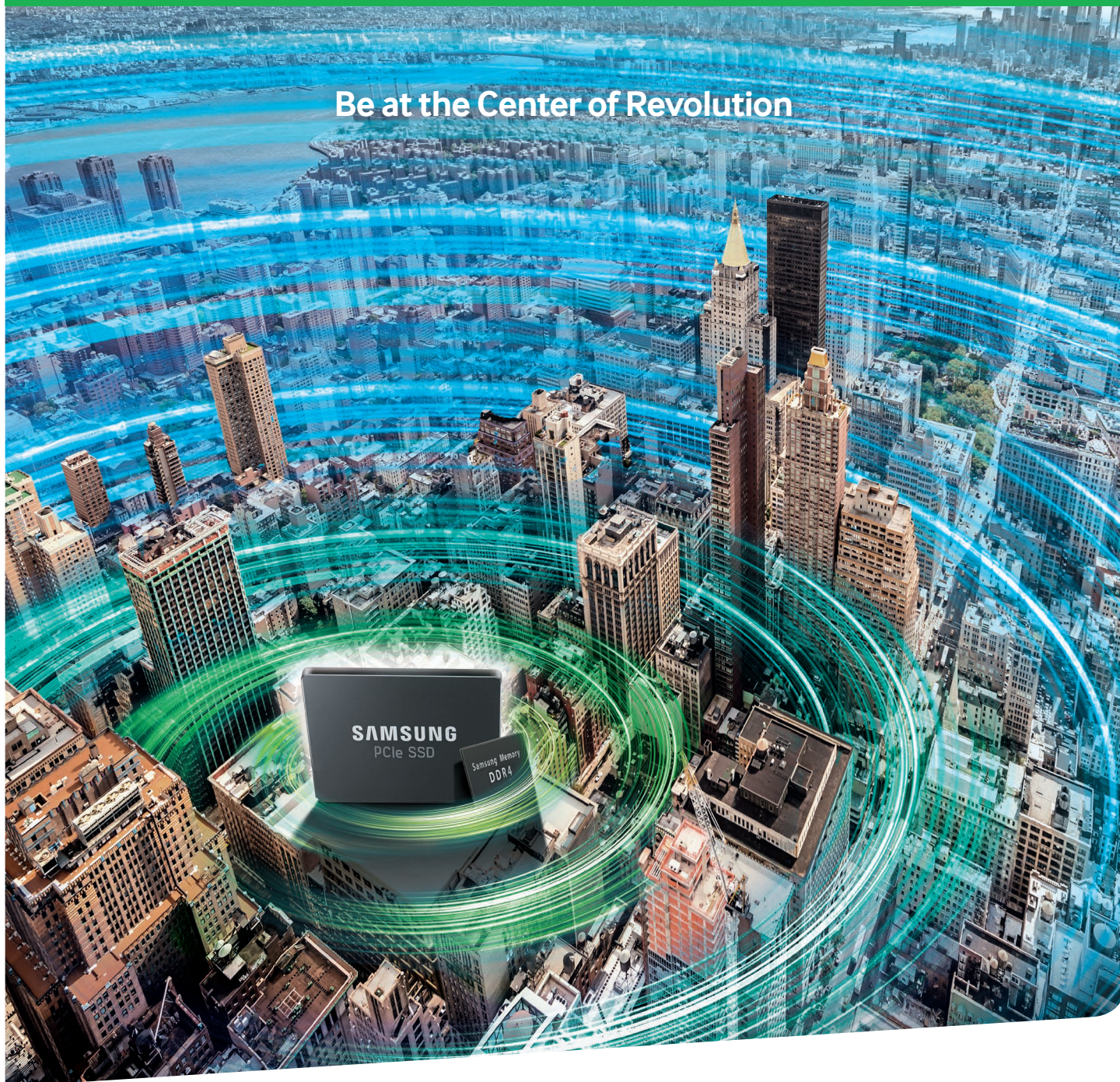
The optimal next-generation memory solution for the data center

Be at the Center of Revolution

SAMSUNG

Leverage the smart solution for big data

Increase data center storage and performance while controlling costs

Data centers are facing serious challenges caused by an exponential growth in data traffic, while having to contain ever-increasing costs and comply with environmental regulations. A surge in the use of mobile devices such as smartphones, notebooks and tablet PCs, has been leading the enormous rise in global data demand. Massive amounts of information, commonly called "big data," accumulate over time and are difficult to handle or analyze using typical database management tools. To keep pace, IT departments must provide more storage capacity while controlling expenses.

Effectively handle the big data explosion

Data traffic has been growing every year, and with the proliferation of smartphones and other personal devices over the past several years, it has grown at a much higher rate than in prior years.

To help illustrate how much data is consumed, consider the following comparison: with 3.3ZB, the amount of data traffic consumed in 2013, every person in the world could have watched 100 HD movies.

■ Traffic Data in DC (ZettaByte=10^{21} Bytes)
■ Datacenter Capacity (MillionSquareFeet)
■ Datacenter Investment : Server & Storage (BS)
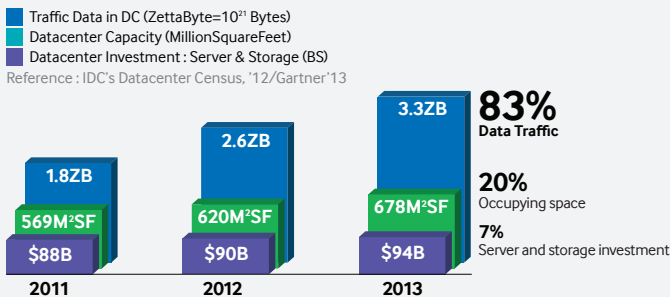Reference : IDC's Datacenter Census, '12/Gartner'13

Figure 1. Increase in data traffic 2011-2013

While data traffic was rising by 50% annually, (or 83% from 2011 to 2013) the amount of land allotted for data centers increased by only 20%, and the cost of purchasing servers and storage grew by just 7%.

Conventional data center storage, budgets, energy supplies and management tools just aren't keeping up with big data demand forecasts, which show an anticipated rise from 3.3ZB of traffic in 2013 to 3.7 times that amount in 2016. At the same time, data center capacity will increase only 1.7 times, and server and storage investment 1.2 times during the same period. These figures point to unavoidable future issues surrounding data traffic congestion.

■ Traffic Data in DC (ZettaByte=10^{21} Bytes)
■ Datacenter Capacity (MillionSquareFeet)
■ Datacenter Investment : Server & Storage (BS)
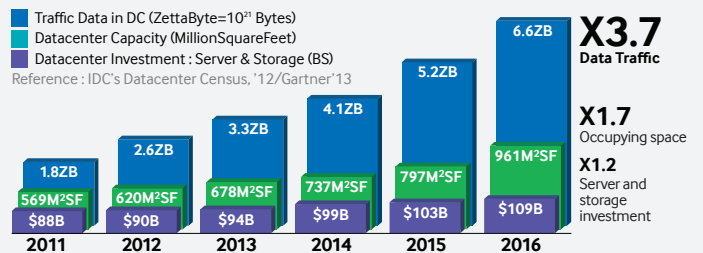Reference : IDC's Datacenter Census, '12/Gartner'13

Figure 2. Projected increase in data traffic 2011-2016

In addition to the increase in data traffic, cloud computing and virtualization are gaining traction; data centers must keep pace with these emerging approaches to effective data management. And, with the constant loads placed on systems in data centers, the need for accelerated speed, higher quality and greater reliability increases as large data platforms enter the mainstream.

Leverage the four keys to data center success

A 2012 survey1 of CIOs revealed four major issues confronting data centers:

- **Delivery of an adequate power supply for operation**
- **Limited space that cannot keep up with the expanding amount of data**
- **Limited budget**
- **Management issues concerning overall operation and security**
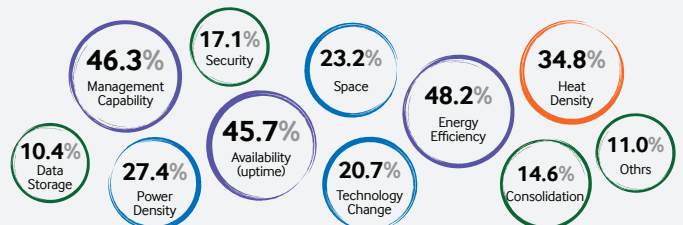
Data Center Users' Group Special Report '12

figure 3. Major data center concerns

The following solutions can effectively resolve major data center issues:

Issue	Potential solution
Power supply delivery	Use less energy while maintaining the same performance or output.
Limited space	Provide greater performance and store larger amounts of data without having to increase the amount of space.
Limited budget	Adopt smart solutions that reduce costs while reaping the same benefits.

SAMSUNG

Discover new ways to optimize speed, performance and efficiency

Enhance data center performance with an innovative Green Memory Solution

The majority of the growth in data center workloads can be attributed to data traffic generated by storage, production and development data in a virtualized environment. The increased traffic is causing data center managers to look for new ways to reduce power consumption while maintaining the same output. They must also demonstrate greater performance and store larger amounts of data without increasing the space used. The same or better results must be achieved at a lower cost, while "software-defined" methodologies are implemented for more effective data management.

Rethink traditional options for improving data center performance

When faced with the dilemma of how to improve data center performance, many IT managers first consider upgrading their server CPUs. But, a better option is available. Tests show that switching to a highly efficient memory and storage solution offers superior data center results in terms of performance, energy efficiency and cost savings. Samsung Green Memory increases performance, allows more concurrent users and improves energy efficiency much more effectively.

Consider the following example, which compares a typical, traditional server solution and a highly efficient memory solution involving upgraded DRAM and solid state drives (SSDs). An application server with a 128GB DRAM and 960GB SSD shows higher performance than a conventional solution that uses a 64GB DRAM and 1,200GB HDD.

A Conventional memory solution
1.8Ghz CPU
64GB DRAM
1,200GB HDD

B CPU-upgraded memory solution
2.6GHZ CPU
64GB DRAM
1,200GB HDD

C upgraded memory solution
1.8GHZ CPU
128GB DRAM
960GB SSD

Figure 4. Comparison of conventional, CPU-upgraded and efficient memory solutions

The number of possible concurrent users increases from 3,970 users in the conventional solution to 6,360 with the highly efficient Samsung Green Memory Solution. This comparison shows a staggering 60% increase in the number of users. In other words, with this upgraded memory solution, 2,390 more users can be served.

unit(Performance)

A : Conventional memory solution
B : CPU-upgraded memory solution
C : upgraded memory solution

3,970 **A**
5,900 **B**
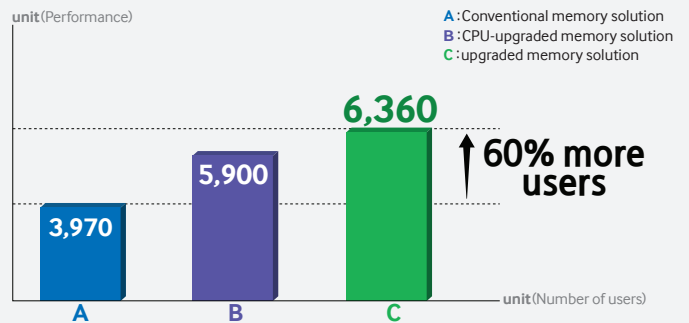6,360 **C**

↑ 60% more users

unit(Number of users)

Figure 5. Comparison of the number of users for conventional, CPU-upgraded and efficient virtualized memory solutions

In terms of power consumption, the highly efficient memory solution adds only about 10% more energy consumption compared to the conventional solution. That amounts to only 27 watts to support additional 2,390 server users.

unit(power consumption)

A : Conventional memory solution
B : CPU-upgraded memory solution
C : upgraded memory solution

261 **A**
87 watt
348 **B**
27 watt
289 **C**

extra service for 1,930 people
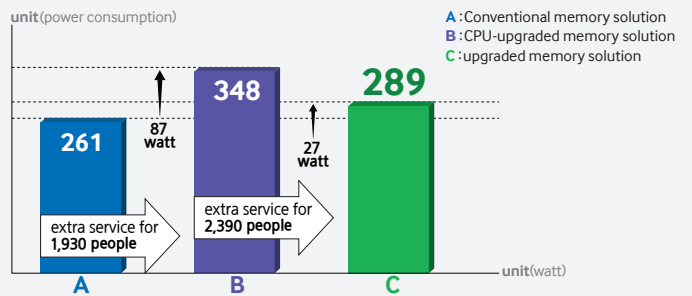extra service for 2,390 people

unit(watt)

Figure 6. Comparison of energy consumption for conventional, CPU-upgraded and efficient virtualized memory solutions

Moving to a highly efficient Green Memory Solution also offers significant benefits for the data center by increasing performance 60% while raising the energy efficiency level by more than 30%, with only a 26% additional cost. As shown here, choosing the Green Memory Solution offers the highest return on the investment in terms of efficiency.

A : Conventional memory solution
C : upgraded memory solution

26% Cost increase
60% Performance Up
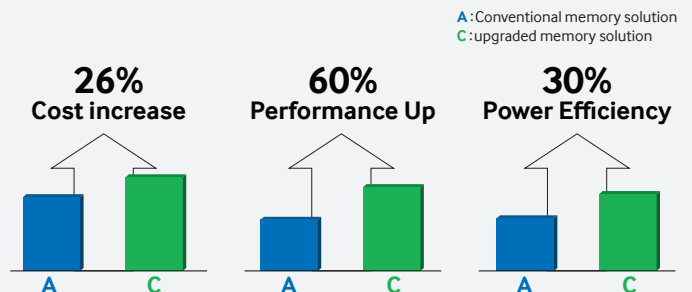30% Power Efficiency

A   C   A   C   A   C

Figure 7. Internal test results comparing a highly efficient new memory solution featuring upgraded DRAM and SSDs with a traditional server solution involving a CPU upgrade

SAMSUNG

Significantly improve performance and speed with greater reliability using Green Memory Technology

Take advantage of continuous Samsung improvements in speed, process, reliability and more

Boost processing speeds with less power consumption using DDR4 and SSD technology

Samsung's 5th Generation Green Memory Solution DRAM (DDR4) enhances performance and offers high-speed operations. In addition to DDR4, another key element of the Samsung Solution is SSD technology. SSDs deliver five times the throughput of conventional HDDs, which are mechanically driven and can result in data transfer delays. Because SSDs are semiconductor-based memory drives, they respond to random information up to hundreds of times faster than HDDs and are about 300 times quicker in processing IOPS and 100 times faster in latency compared to HDDs. With these benefits, SSDs can help significantly improve the performance of servers in a virtualized environment.

Experience higher quality and reliability

Samsung's new Green Memory has been thoroughly tested for performance and accuracy using stringent quality testing standards. In internal lab tests, the Samsung Green SSD reliability rate is approximately two million hours of Mean Time Between Failures (MTBF). This rate is three times better than the MTBF rate of traditional HDDs.

Conserve space

Samsung's compact Green Memory enables data centers to place more servers on a rack, which saves considerable space and increases the capacity for cloud computing and virtualization.

Reduce the total cost of ownership (TCO)

By implementing a Green Memory Solution with the same cost as a conventional system, the number of servers can be greatly reduced, the amount of power consumed shrinks and the memory can cover substantially more users concurrently.

Leverage Samsung's years of research and development in innovative memory products for a more efficient data center

Samsung developed its Green Memory technology to address the increased performance demands and energy efficiency concerns that data centers face when operating more powerful systems. Since entering the Green Memory marketplace in 2009, Samsung has concentrated much of its R&D resources in low-power design technology. As a result, Samsung has become a leader in the green memory industry sector.
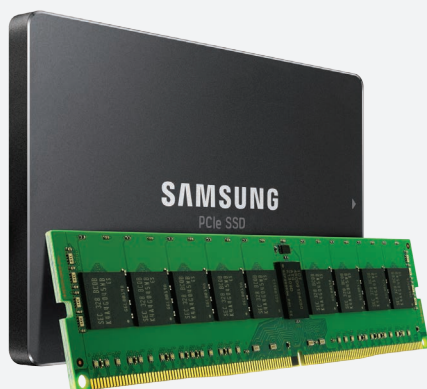
Enable performance at the core with Samsung's 5th Generation Green Memory Solution

Samsung's 5th Generation Green Memory Solution is a next-generation offering that combines powerful DDR4 and PCIe SSD technologies to provide a high-performance, yet cost-effective solution for today's increasing data traffic. The solution consists of a 2y-nm DDR4 Dynamic RAM (DRAM) and a 20 nanometer (nm)-class PCIe SSD. Samsung's 5th Generation Green Memory Solution helps optimize the performance of cloud computing and virtualized environments, effectively handling big data demands while reducing overall data center costs.

Move up to DDR4's improved performance, speed and reliability with lower power consumption

A key component of Samsung's 5th Generation Green Memory Solution is DRAM (DDR4), which offers excellent performance, while enabling high-speed operations, low energy consumption and greater reliability.

Samsung disproved the assertion that DRAM has reached an evolutionary wall with DDR4, which can run at a speed of 2,133 Mbps, well beyond the existing memory limit of 1,866 Mbps. Clearly, DDR4 performs well beyond previous generations of memory. Because it can operate at such a high speed, system performance is improved nearly 15%. DDR4 features advanced DRAM design technology, therefore, Samsung has been able to significantly improve its speed, while reducing noise levels.

A key strength of DDR4 is that it reduces power consumption 24% compared to DDR3, by operating at a voltage of 1.2 V and adopting a Pseudo Open Drain interface. This means that, even with its increased performance, DDR4 boasts lower power consumption.
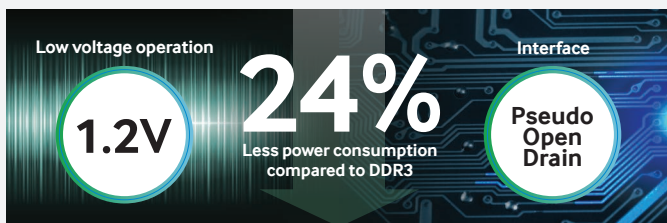

Figure 8. Lower energy consumption with increased performance

In addition to power and performance improvements, DDR4's reliability has improved significantly. DDR4 is designed to call attention to errors that occur during data transfer so that they can be resolved.

Reduce latency and improve bandwidth while increasing energy efficiency with SSDs

Samsung's 5th Generation Green Memory Solution presents a 5th Generation Green SSD that will lead to considerable storage innovation. SSD improvements include reduced latency for higher performance, improved bandwidth for faster speed, and greater energy efficiency.

A limitation of conventional SATA SSDs is that they are impossible to physically connect directly to the CPU. Therefore, data must be transferred through a Platform Controller Hub (PCH). With this mechanism, data experiences bottlenecks, similar to the way that traffic jams up near toll gates on an expressway.
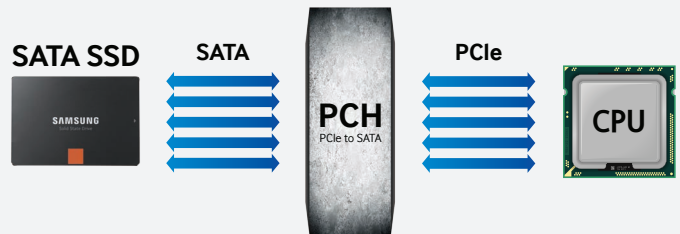

Figure 9. Data transfer through a PCH

Samsung 5th Generation Green SSD can reduce latency by 83% with a direct connection to the CPU. It also increases bandwidth more than 5 times (from 600MB/s to 4GB/s) by utilizing an ultra-high speed interface technology, PCI Express 3.0.
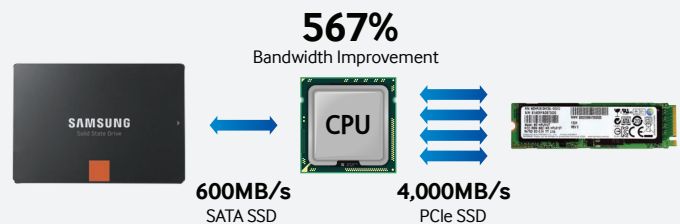

Figure 10. Improvement in bandwidth by direct CPU connection

Just like Samsung Green DDR4, the 5th Generation Green SSD also achieved a significant advancement in energy efficiency. With a low-power process control block (PCB), low-power controller, and low-power NAND design, energy efficiency has improved by more than 140%. This improvement means that, compared to an existing SSD, the 5th Generation Green SSD can process much more work within the same power budget.

Get the optimal solution for improved TCO in the data center

Improve TCO and heighten efficiency

So, what are the benefits that a data center can gain from using Samsung's 5th Generation Green Memory Solution, in terms of efficiency and total cost of operation (TCO)?

Consider the following TCO example2 with a server-oriented system, in which, the investment is $32M per ten thousand servers, power consumption is 26M Kw and the number of concurrent users is 40M. By applying a Green Memory Solution with the same cost, the number of servers can be decreased to 7,880, and the amount of consumed power reduced to only 2,300 Kw. Moreover, the memory can now serve up to 65M concurrent users.
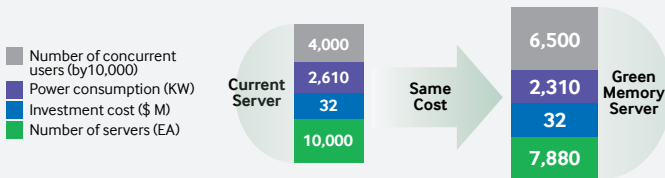

Figure 11. Comparison of efficiency and TCO

If the power consumption level in the existing server operation must be adjusted, with just an increase in investment of $4M, a staggering 73M concurrent users can be covered by the use of 8,900 Green Memory systems.
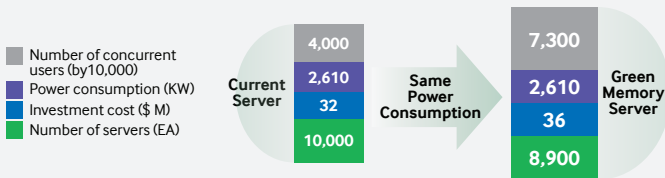

Figure 12. Power consumption comparison

In a case where the only limitation is space, even greater benefits can be realized with the same number of servers. When the investment increases by $9M, an astounding 83M users can connect simultaneously. This increase more than doubles the benefit when compared to the previous system.

As previously mentioned, according to expert projections, data traffic is expected to increase exponentially, resulting in the potential for a major future data crisis. However, by using Green Memory instead of conventional memory, space utilization can be expanded 3.35 times, and the amount of storage can be doubled. This calculation demonstrates that a Green Memory system is the optimal choice for replacing servers and expanding storage in the data center.
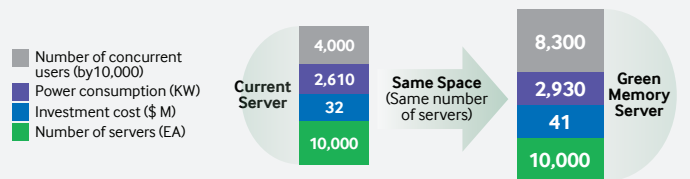

Figure 13. Comparison with increased investment

In addition, the Green Memory system is the right choice for future generations of humanity. With the amount of power saved by a Green Memory system, every person in the world could use their cell phones for 1.8 years. Moreover, the Green Memory system cuts CO_2 emissions, so its effects are similar to planting millions of trees in an area that is 4.6 times bigger than Singapore.

SAMSUNG
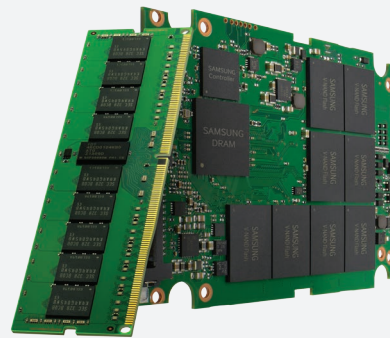
A smart investment for ensuring a successful data center future

Meet the big data explosion head-on with efficiency and performance

A future big data traffic jam is looming, as modern data centers contend with increasing operational power needs, limited space that can't keep pace with an expanding amount of data, constrained budgets, and management concerns around operations and security. Samsung's 5th Generation Green Memory Solution provides the optimal efficiency, power and ROI to meet these issues head-on. Samsung's 5th Generation Green Memory Solution enables data centers to process large amounts of data while using less energy and lowering costs, without increasing space requirements.

Features and benefits

Feature	Benefit
Reduced power requirements	Uses less energy while maintaining the same performance level (or output)
Space optimization	Provides higher performance and the ability to store greater amounts of data without having to increase the amount of space
Cost reduction	Enables data centers to reap the same benefits as those using current systems, with less cost
Optimized for virtualized server environment	Optimizes the performance of cloud-enabled and virtualized environments by allocating sufficient memory for multiple virtual machines

Green DDR4 Specification

Type	Ranks per DIMM and Data Width	DIMM Capacity(GB)		Speed (MT/s); Voltage (V); Slot Per Channel (SPC) and DIMM Per Channel (DPC)					
				1 Slot Per Channel	2 Slots Per Channel		3 Slots Per Channel		
				1DPC	1DPC	2DPC	1DPC	2DPC	3DPC
		4GB	8GB	1.2V	1.2V	1.2V	1.2V	1.2V	1.2V
RDIMM	SRx4	8GB	16GB	2,133	2,133	1,866	2,133	1,866	1,600
RDIMM	SRx8	4GB	8GB	2,133	2,133	1,866	2,133	1,866	1,600
RDIMM	DRx8	8GB	16GB	2,133	2,133	1,866	2,133	1,866	1,600
RDIMM	DRx4	16GB	32GB	2,133	2,133	1,866	2,133	1,866	1,600
LRDIMM	QRx4	32GB	64GB	2,133	2,133	2,133	2,133	2,133	1,600
LRDIMM 3DS†	8Rx4	64GB	128GB	2,133	2,133	2,133	2,133	2,133	1,600

†Grantley intercept at platform refresh (Broadwell)

Green PCIe SSD Specification

Model Name		VS953
Interface		PCIe Gen3 x4
Density(GB)		480, 960
Form factor		2.5 in. (w/7mmt)
Power-loss protection		Yes
Schedule		2014 Q3
Performance	Seq. read	up to 1,300MB/s
	Seq. write	up to 1,000MB/s
	Ran. read	270K IOPS
	Ran. write*	25K IOPS

* Sustained 4KB random write IOPS
* Contents of the above is forecasting capability

SAMSUNG

Legal and additional information

About Samsung Electronics Co., Ltd.

Samsung Electronics Co., Ltd. is a global leader in technology, opening new possibilities for people everywhere. Through relentless innovation and discovery, we are transforming the worlds of televisions, smartphones, personal computers, printers, cameras, home appliances, LTE systems, medical devices, semiconductors and LED solutions. We employ 236,000 people across 79 countries with annual sales of US$187.8 billion. To discover more, please visit www.samsung.com.

For more information

For more information about Samsung's 5th Generation Green Memory Solution, visit www.samsung.com/greenmemory

1. Emerson's Data Center Users' Group Special Report '12

2. Power usage effectiveness (PUE)=1.5, 2013 June Spot price based on CPU, memory, storage and power)

Samsung Electronics Co., Ltd.
416, Maetan 3-dong,
Yeongtong-gu
Suwon-si, Gyeonggi-do 443-772,
Korea

www.samsung.com

2013-12