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Research Report

The New IBM Z and LinuxONE Families: Size, Flexibility, Power

The new "application centric" version of Virtual Wisdom enables IT managers to better understand application behavior across multi-tenancy environments, hybrid data centers and cloud environments.

Executive Summary

The prayers of information technology (IT) executives looking to pack a tremendous amount of Z and Linux computing power into a flexible, traditional rack design have just been answered. IBM has announced, and is now delivering, low-end IBM Z (z/OS-based z14 Model ZR1) and IBM LinuxONE servers (Linux-based Rockhopper II) in highly customizable industry standard rack configurations. The basic frames have 16U (a "U" is 1.75 inches) of free space, allowing a myriad of configurations (26 capacity levels x 6 Control Programs = 156 possible settings). Hallelujah!

Highlights:

- Industry standard 19" rack found in most data centers
- 16 U of free space (allows customers to populate space with server, switch or storage elements)
- Feature-based sizing (4, 12, 24, 30 CPUs)
- 88-8000 millions of instructions per second (MIPS)
- 40 logical partitions (LPARs)
- RAIM memory (64 GB to 8 TB)
- Additional Virtual Flash Memory
- New PCI Gen 3 IBM zHyperLink bus
- 3 logical channel subsystems (LCSS -- channel speeds to subsystems such as storage and peripherals) with 3 subsets per LCSS)

These new server designs will help IBM overcome server foot-print objections, and they will allow for highly customized configurations. With very large memory and improved bus speeds, these speed demon servers will dramatically improve OLTP (transaction processing) performance while also reducing batch processing windows. Overlay this new design with IBM's best-in-industry security (including Secure Service Containers) and the industry has just seen the arrival of a formidable server environment packed into an industry standard enclosure.

Market/Competitive Positioning

IBM's z14 architecture runs the z/OS operating environment and is known for its transaction and batch processing capabilities, as well as for running real-time transactional analytics (see this report). It is also known for its ability to protect all data being processed using "pervasive encryption".

IBM's LinuxONE architecture runs the Linux operating environment, and is known to be an excellent choice as a Linux secure data server, as well as a powerful consolidation server (it can run thousands of virtual servers with hundreds of thousands of containers!). It is also known for its openness (standard operating system, standard applications, standard databases, that can be deployed on an open cloud architecture).

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Both environments use the same rack architecture – so the operating environment each supports (z/OS, z/TPF, z/VM, z/VSE, and Red Hat RHEL Linux, SUSE SLES Linux, or Canonical Ubuntu Linux) is what constitutes the major difference between these systems.

The primary competitor for these systems is x86-based architecture.

The major difference between z14/LinuxONE processors and x86 processors is the way these servers process work. "Z processors" offer far more cache than x86 processors, and more cache means that z14 and LinuxONE can host more virtual machines and handle variable workloads more efficiently. x86 processors are best suited to processing large numbers of threads (units of work).

Z14 ZR1 and LinuxONE Rockhopper II Side by Side

Our general rule-of-thumb is that if a workload runs in a steady, sustained fashion, it can best be served by an x86 server which has been designed to methodically process large numbers of threads. However, if the workload is variable, then it is best served by the large cache, very fast processors like the ones found in Z14 ZR1 and LinuxONE servers. (Also note that multiple workloads can be placed in cache, greatly increasing utilization rates).

Another major difference between Z-based servers and x86-based servers is utilization rates. Z-based servers (z14 ZR1 and LinuxONE) can run at 100% utilization sustained – while many x86-based server environments run at 40% utilization to leave headroom for spikes in workloads. This means that it may take twice as many x86 servers to execute the same workloads as Z-based servers. And under-utilization has a ripple effect as can be seen in this 2011 report which showed how it cost almost a million dollars more to run the same workload on x86 servers as compared with Z architecture. The key culprits in the extraordinary price differential between x86 servers and Z-based servers were the need for more software licenses, more systems and more networking equipment on x86-based solutions.

A Closer Look at the Product Offerings

IBM positions its z14 Model ZR1 as being built for "digital trust, secure cloud" environments because it can make use of IBM's pervasive encryption, a process that creates a new barrier to data breaches by ensuring that only those authorized to view data are allowed to do so by using their encryption keys to decrypt data. Enterprises must continue to protect their network endpoints; but pervasive encryption creates a new defensive perimeter at the data level. IBM mentions "cloud" in its descriptor because the company is highly focused on capturing new digital workloads on the platform, applications that create value, growth and competitive advantages such as cloud microservices.

The first thing we noticed about the z14 ZR1 (aside from the major change in footprint) was the amount of available memory. In larger Z Systems (machine type 3906), the memory maximum is 32 TB. With the z14 ZR1, the memory maximum is 8 TB. This speaks to the market for which the ZR1 is intended – an entry level market that requires as little as 88 MIPS (millions of instructions per second), to as many as 1570 MIPS (which can be expanded to 8,000 MIPS under z/OS).

The next thing we noticed was that IBM has replaced its Flash Express offering (a PCI-E based I/O card for attaching solid state storage to the CPU, expanding memory) with a new, faster offering known as Virtual Flash Memory (faster, more capacity).

When Moore's Law (a finding that processor capacity was doubling every 18 months) came to an end, systems makers started to focus on tuning their system designs – looking for ways to speed data delivery to multiple processors as well as speed up bus and network performance to overcome latency. A few years ago IBM introduced zHyperLink as a storage attach link designed to deliver extreme low latency I/O access for Db2 for z/OS transaction processing and improve active log throughput. With the new ZR1 as well as with the new Rockhopper II, IBM has further lowered latency using a PCI-E Gen 3 connection that performs at 16 GBps, allowing z14 ZR1 and LinuxONE servers to connect to high speed FICON storage systems. Systems administrators can exploit 3 logical channel subsystems (LCSSs) and configure 3 sub-channel sets per LCSS, providing additional high speed channel access to compute resources.

IBM's LinuxONE Rockhopper II is positioned for "security, scale and flexibility". It can operate with between 1 and 4 microprocessors, 2 special assist processors (SAPs), support between 4 and 30 Linux cores – and can be configured with up to 2 additional SAPs. Most noteworthy is the 16U of available frame space – giving customers the ability to use that space to create the exact configuration needed to most optimally serve a wide range of workloads. Storage, HMC, additional servers or switches can be placed in this 16U of space, creating a wide range of customized system designs.

On LinuxONE Rockhopper II IBM has also concentrated on easy setup with simplified logical partitioning using IBM's Dynamic Partition Manager. Further the company has introduced an HMC Mobile application for iPhone and Android with new mobile capabilities such as push notification for systems administrators and secure monitoring from anywhere using mobile devices.

Both environments support IBM Secure Service Containers (SSCs) that allow secure containers to be created. (Containers are executable software environments that include code, runtime, systems tools, system libraries and settings that can run on their own instance of an operating environment as a virtual appliance). SSCs make it possible for z14 ZR1 and

LinuxONE servers to: 1) restrict administrator access; 2) encrypt all data in-flight as well as at rest; and, 3) create a tamper proof boot sequence that completely eliminates the possibility of accidentally launching malware. (Note: SSCs run on Linux – which means a ZR1 would need to run a Linux instance in order to take advantage of SSC functionality).

The Rockhopper II LinuxONE server also support the basic principles of IBM's pervasive encryption, making it, in our opinion, the most secure commercial Linux server environment in the market.

Summary Observations

With the new z14 ZR1 there is no longer an IBM "BC" class (low end Z environment). There is instead a new system design, one that has been designed for traditional 19" rackmount datacenters. This is a huge step in the right direction for IBM's z architecture, it makes it appear to be part of the flock of 19" racks in the data center.

With all of these improvements, expect IBM to continue to find new opportunities and new customers for its new line of rack mount servers

Using the same design, there is now a 19" rack mounted LinuxONE – and again, it makes this architecture appear to the casual observer as an industry standard rack design.

Neither architecture, however, is a mundane industry standard server. Both architectures are highly flexible in design, offering customers 16U of space to build custom designs. Both architectures offer a substantial amount of memory to speed transaction, batch and data processing. Solid state memory has been expanded; bus speeds have been significantly improved; and I/O latency between storage and compute nodes has been tremendously lowered. With all of these improvements, expect IBM to continue to find new opportunities and new customers for its new line of rack mount servers.

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