• At a glance - The IBM zEnterprise EC12 is designed to provide:
- Up to 25% faster uniprocessor performance as compared to z196
- Up to 50% system capacity performance improvement over z196 80-way
- 101 cores to configure (versus 80 on z196)
- 161 capacity settings (versus 125 on z196)
- Up to 3 TB RAIM memory
  o In cache, IBM has expanded Level 2 cache by 33%, and has doubled the cache in Levels 3 and 4 from 24 MB to 48 MB, and from 192MB to 384MB respectively. [Cache serves data to the processor] (with faster processors and more cache IBM is now able to serve more data to the process, thus delivering more compute power).
  o Instruction set improvements and new facilities enable certain workloads to execute more quickly (for instance, new Java workload performance can increase by 45%; DB2 by 30%; and PL/1 workload performance will also increase significantly as PL/1 exploits the new decimal format conversion facility).
- Radiator-based / Air-cooled system design
- z/Architecture® enhancements designed to enable performance improvements in Linux , Java , and DB2
- New manageability, availability and security offerings:
  o The new management improvements include IBM zAware (embedded firmware that provides advanced analytics-based monitoring for Sysplex environments)
  o Enhancements that enable mainframes to manage System x more effectively by improving mainframe Unified Resource Manager (the mainframe hybrid computing environment) interaction with System x Systems Director;
  o To improve availability, IBM introduced Flash Express (a new tier of solid state disk-based memory that absorbs paging challenges as customers transition from one mode of operations such as batch processing to another mode such as interactive processing);
  o In security IBM has introduced a new version of its cryptography card (the Crypto Express 4S) with new security extensions including PKCS#11 compliance.
  o For hybrid environments, IBM has introduced a new zBX enclosure (the zBX Model 003)
- OSA-Express4S 1000BASE-T included in PCIe Gen2 I/O infrastructure
- 8 GBps host bus supporting PCIe Gen2 I/O infrastructure
- Crypto Express4S with new FIPS 140-2 Level 4 certification and PKCS #11 support for digital signatures
- Flash Express to handle paging workload spikes and improve availability
- Non-raised floor (NRF) option for flexibility in data center integration
- Continuation of optional water cooling and DC power
- Optional overhead power and overhead cabling
- Hypervisor updates
- Storage manager updates
- The proprietary service state package

CMOS 13S is a 32 nanometer CMOS logic fabrication process.

- 32 nm SOI technology
- 6 new cores per chip
- Core-dedicated co-processors
- 48 MB edram on-chip shared
- Processor core features
  - 2nd generation out-of order design
  - Speed and feed improvements
  - Micro-architecture innovations

• From a cost perspective, IBM is reducing $/MIPS (dollars / millions of instructions / sec.) consistent with reductions of the past.
- The cost for processing existing workloads on standard, general purpose z workloads is going down.
- IBM is offering a cost reduction of @20% on the $/MIPS on its specialty engines (IFLs, zIIP, and zAAP processors).
- Maintenance costs are also decreasing from 2-20%.

• To see how fast IBM can move data between the system and external devices such as storage subsystems and tightly coupled zBX blade environments, key technology findings are:
- At the microprocessor level (hexa-core) the new 120-core design delivers massive scale across all workloads and enables cost saving consolidation opportunities.the speed of the z microprocessor has been increased from 5.2 GHz to 5.5 GHz, and new instructions have been added to streamline execution for certain workloads.
  NOTE: The zEC12 is the fastest superscalar processor in the industry, enabling it to get more work done than any other processor while new instructions and facilities streamline the execution of certain workloads.
- Additionally, the number of processors has increased from 80 up to 101 configurable cores.
- IBM has added more on-chip cache (described earlier) to speed data serving to these processors. IBM's cache improvements have *doubled the amount of on-chip data that can be fed to the processor* leading to significantly faster transaction and data processing.
- Memory has remained the same as the predecessor z196 at 3TB of RAIM (redundant array of independent memory).
  NOTE: 3TB is a lot of memory capacity — plenty for most of today's most challenging enterprise.

• To further improve performance, IBM notes that the new z microprocessor offers second generation out-of-order design (a means to keep the microprocessor busy by executing jobs when they become available, even if they are out of order).
• Further, IBM has added multi-level branch prediction (a means to speed processing using a predictive method).
• To optimize workload performance, IBM has introduced:
- A transactional execution facility that improves parallelism and scalability
  NOTE: This is designed to help eliminate software locking overhead that can impact performance
- A runtime instrumentation facility that helps reduce Java overhead
- Page frames have been increased to 2GB (enabling faster paging for DB2 buffer pools and Java heaps).
  o IBM has increased the page frames to 2GB (page frame size is important because larger frames improv performance in DB2 database buffer pools and speed the execution of Java heaps); optimized IMS performance (IMS is IBM's information management system database management environment), leads to a 30% performance improvement in processing; IBM announced that it is planning to release a new PL/1 compiler that should deliver a large performance boost from the PL/1 decimal format conversions utility.

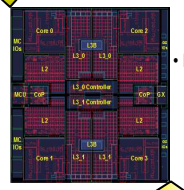
• As for the internal throughput rate, the maximum System z MIPS rating has changed from 52286 to 78426.
NOTE: The zEC12 can now do 50% more work than its predecessor.
• I/O bandwidth remains the same at 288 GBps
NOTE: This continues to be the fastest internal throughput rate in the industry as of this timeframe (this is particularly important for read/writes to attached storage and for internal program-to-program communications).
• IBM has also improved its best-in-the-industry, EAL Level 5+ position with PR/SM and also with the availability of a new cryptographic card known as Crypto Express4S.
- This card improves security with new algorithms and with the addition of new PKCS #11 coprocessor firmware (it helps meet security requirement of the European Union and public sector clients).
• A new, updated zBX blade chassis environment, signaling that IBM plans to continue to aggressively pursue hybrid workload opportunities by improving the management of hybrid zEnterprise/zBX mainframe/blade environment.

Architecture extensions for software exploitations
- Hardware Transactional Memory
- Runtime instrumentation

Up to 30% improvement in throughput for DB2 for z/OS operational analytics†

Up to 45% improvement for Java workloads†

The **zBX** is available as an *optional* machine to work along with the zEC12 server.



Up to 27% improvements in CPU intensive int and float C/C++ applications†

More than 30% improvement in throughput for SAP workloads†

† Source IBM August 2012

Performance Comparison (ITR – MIPS Rating)

z9 EC up to 54-way: 193 to 18,505 PCIs[1]
z10 EC up to 64-way: 214 to 31,826 PCIs[1]
z196 up to 80-way: 240 to 52,286 PCIs[1]
zEC12 up to 101-way: 240 to 78,500 PCIs[2]

1) LSPR data based on z/OS 1.11
2) LSPR data based on z/OS 1.13

Flash Express (FC 0402) introduces **Solid State Drive (SSD) technology** to the System z family. Flash Express is *easy* to configure requires no special skills and provides rapid time to value.

Independent Research Firm - Key Cost / Pricing Findings:
• Existing customers running traditional workloads should expect to see traditional hardware price points decline in a range consistent with the past several years
• The introduction of IBM's Technology Upgrade Pricing will deliver a 2-7% lower MLC (monthly license charge) software pricing for equivalent capacity;
• Offers a cost reduction of @20% on the $/MIPS on its specialty engines (IFLs, zIIP, and zAAP processors). (IBM is reducing costs by preserving the 120 PVU [processor value unit] rating to help reduce IFL software costs).
- This reduction shows that IBM is getting even more aggressive when it comes to capturing new workloads on Z.
• Offers a minimum 2% price/performance decrease in maintenance for traditional workload environments running standard MIPS with a greater discount offered with growth upgrades — and a 20% maintenance reduction for customers running IFL (Integrated Facility for Linux — a Linux specialty processor) MIPS
• Is continuing to attract new customers with cost-reduced, packaged mainframe/-application software solutions (known as "**Solution Editions**") that offer aggressive pricing and terms for first-in-enterprise customers
• Is offering a no-fee carry-forward of zManager blade entitlements and zBX upgrades to its zEnterprise customers.

EC12 Innovative Features (brief details):
•The new IBM System z Advanced Workload Analysis Reporter (IBM zAware) is an integrated, self-learning, analytics solution that helps identify unusual behaviors of workloads running on z/OS LPARs.
- IBM zAware is intended to help you to accelerate problem determination and improve service levels.
- It uses machine learning to help your organization gain visibility into system behavior, helping you to optimize service, respond to problems quicker, and increase availability.
• For companies that require superior availability and performance, Flash Express is uniquely designed to automatically strengthen availability and performance, even during periods that stress your system paging, such as during collection of system diagnostics, start of day processing, or other transitional periods.
• Cryptographic hardware on the IBM zEnterprise EC12 can help to protect data privacy and sensitive custom applications.
- IBM has iintroduced the new Crypto Express4S card, IBM's latest tamper-resistant cryptographic coprocessor.
  o The card is suited to applications requiring high-speed security-sensitive cryptographic operations for data encryption and digital signing, and secure management and use of cryptographic keys.
• With the zBX infrastructure, IBM zEnterprise EC12 can support a multi-platform environment having mainframe, UNIX™ , and x86 technologies in a single system.
- The zBX can also support the IBM WebSphere DataPower Integration Appliance XI50 for zEnterprise which can be used to help simplify, govern, secure, and integrate XML and IT services by providing connectivity, gateway functions, data transformation, protocol bridging, and intelligent load distribution. Unified Resource Manager brings System z governance to the distributed side, transforming the way resources are managed and deployed. It provides infrastructure awareness to optimize the system resources in accordance with the policies assigned to that particular workload.
• IBM zEnterprise EC12 is designed with an environmental focus to help improve data center efficiencies. It has a new radiator-based air-cooled system designed for more efficient cooling and improved maintenance. For clients looking to build economical disaster recovery data centers, IBM zEnterprise EC12 has optional water cooling and High Voltage DC power which allow a bold step into the future of cooler computing without changing the footprint.

Each book contains a Multi-Chip Module (MCM), which hosts the redesigned **CMOS 13S1** processor units, storage control chips, and connectors for I/O.

zEC12 has **five model** offerings ranging from **1 to 101 configurable processor units (PUs).** The first four models (H20, H43, H66, and H89) have 27 PUs per book, and the high Capacity model (the HA1) has four 30 PU books. Model HA1 is estimated to provide **up to 50% more system capacity** than the z196 Model M80, keeping the same memory and power requirements. This comparison is based on the Large Systems Performance Reference (LSPR) mixed workload analysis.

Model #	Max # of books	Radiator-cooled FC	Water-cooled FC
H20	One book	FC 1095	FC 1099
H43	Two books	FC 1096	FC 1100
H66	Three Books	FC 1097	FC 1101
H89	Four Books	FC 1098	FC 1102
HA1	Four Books	FC 1106	FC 1145

The zEC12 expands the **subcapacity settings** offer with three subcapacity levels for the first 20 processors,giving a total of 161 distinct capacity settings in the system, and providing for a range of over 1:320 in processing power. The zEC12 delivers scalability and granularity to meet the needs of medium-sized enterprises, while also satisfying the requirements of large enterprises having very demanding, mission-critical transaction and data processing requirements. The zEC12 continues to offer all the **specialty engines** available on previous System z systems.

zEC12 provides improvements to the PR/SM HiperDispatch function: HiperDispatch provides work alignment to logical processors, and alignment of logical processors to physical processors where this alignment optimizes cache utilization, minimizes inter-book communication, and optimizes z/OS work dispatching, with the end result of increasing throughput.
• zEC12 provides for the definition of up to 32 HiperSockets™. [HiperSockets provide for memory communication across logical partitions, without the need of any I/O adapters, with VLAN capability].
NOTE: HiperSockets have been extended to bridge to an ensemble internode data network.
BLADES There are two types of blades that can be installed and operated in the IBM zEnterprise BladeCenter Extension (zBX):
Optimizer Blades:
– IBM WebSphere DataPower Integration Appliance XI50 for zEnterprise blades.
IBM Blades:
– A selected subset of IBM POWER7 blades
– A selected subset of IBM BladeCenter HX5 blades
These blades have been thoroughly tested to ensure compatibility and manageability in the IBM zEnterprise System environment:
IBM POWER7 blades are virtualized by PowerVM® Enterprise Edition, and the virtual servers run the AIX® operating system.
IBM BladeCenter HX5 blades are virtualized using an integrated hypervisor for System x and the virtual servers run Linux on System x (Red Hat Enterprise Linux - RHEL and SUSE Linux Enterprise Server - SLES) operating systems.
NOTE: Enablement for the blades is specified with an entitlement feature code to be configured on the zEC12s.

- Up to four IBM 42U Enterprise racks.
- Up to eight BladeCenter chassis with up to 14 blades each with up to two chassis per rack.
- Blades, up to 112 (blades varies according to function)

zEC12 Processor Book Assignment

Model	Total PUs (cores)	1st Book - LG06				2nd Book - LG15			3rd Book - LG10			4th Book - LG01		
		Avail PUs	Std SAPs	Spare PUs	Rsvd PU	Avail PUs	Std SAPs	Spare PUs	Avail PUs	Std SAPs	Spare PUs	Avail PUs	Std SAPs	Spare PUs
H20	27	20	4	2	1	-	-	-	-	-	-	-	-	-
H43	54	21	4	1	1	22	4	1	-	-	-	-	-	-
H66	81	22	4	0	1	22	4	1	22	4	1	-	-	-
H89	108	22	4	0	1	22	4	1	22	4	1	23	4	0
HA1	120	25	4	0	1	25	4	1	25	4	1	26	4	0