

IBM Z Functional Matrix

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IBM Z

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IBM Z Functional Matrix

This IBM® Redpaper™ publication provides a list of features and functions that are supported on IBM Z™, including the IBM z14™(z14), IBM z13™(z13®), IBM z13s™(z13s™), IBM zEnterprise® EC12 (zEC12), and IBM zEnterprise BC12 (zBC12).

This publication is divided into the following functional areas:

- ▶ Application programming interfaces (Table 1 on page 2)
- ▶ Cryptographic features (Table 2 on page 3)
- ▶ I/O characteristics (Table 3 on page 7)
- ▶ On Demand (Table 4 on page 12)
- ▶ IBM Parallel Sysplex® (Table 5 on page 14)
- ▶ Performance (Table 6 on page 15)
- ▶ IBM Processor Resource/Systems Manager™ (PR/SM™) (Table 7 on page 17)
- ▶ Reliability, availability, and serviceability (RAS) (Table 8 on page 19)

Note: This publication is not intended to include services, requests for price quotation (RPQs), or specific quantities or measurements that are related to performance, memory size, bandwidth, and so on. The intention of this publication is to provide a comparison of the standard and optional features for the various IBM Z configurations. For more information about the features and functions that are listed in the tables, see the system-specific reference guide documentation.

This Redpaper publication helps readers understand the connectivity alternatives that are available when planning and designing their IBM Z infrastructures.

The following key is used in the tables in this Redpaper publication:

- ▶ S: Standard
- ▶ O: Optional
- ▶ n: Not supported
- ▶ CF: Carry forward only

Application programming interfaces (APIs)

IBM Z allows independent system management software vendors and customers to develop system management applications that provide integrated hardware and software system management solutions by using the console programming interfaces. Detailed information that includes console API objectives, architecture, data structures, usage, and console managed object definitions and identifications is provided. An API is a set of routines, protocols, and tools that are used for building software applications.

The API interfaces provide the capability to use object-based, industry-standard programming interfaces instead of building home-grown, release-specific programs for collecting the hardware information that is needed to provide an integrated hardware and software system management solution. The firmware support for APIs is listed in Table 1.

Table 1 Firmware support for APIs

Application programming interface (API)	z14	z13	z13s	zEC12	zBC12
Ability to use APIs to access Unified Resource Manager function	S	S	S	S	S
Hardware Management Console Common Information Model (CIM)	n	S	S	S	S
Hardware Management Console Web Services (Web Services) ^a	S	S	S	S	S
Simple Network Management Protocol (SNMP)	S	S	S	S	S
Secure Service Container (SSC)	S	S ^b	S	n	n

a. Web Services are disabled by default for security reasons.

b. For more information about feature support, check the latest z13 HMC driver-level information.

Cryptographic features

The hardware cryptographic services that are provided in IBM Z are intended to cover the full range of cryptographic operations that are needed for modern world applications, both from the functional and performance standpoints.

The Trusted Key Entry (TKE) workstation is another optional feature that consists of an IBM-specific workstation that is aimed at providing a highly secure environment for the centralized management of the Crypto Express features, in one or more systems, to which the TKE workstation has TCP/IP connectivity.

The following types of hardware cryptographic features are available to be installed in IBM Z:

- ▶ The CP Assist for Cryptographic Functions (CPACF): This feature is implemented as a functional extension to IBM Z.
- ▶ The Crypto Express feature: This optional feature is plugged into the system's I/O extensions.

The cryptographic features, functions, and attributes are listed in Table 2.

Table 2 *Cryptography*

Cryptographic features, functions, or attributes	z14	z13	z13s	zEC12	zBC12
Secure Hash Standard SH1	S	S	S	S	S
Secure Hash Standard SH2	S	S	S	S	S
Secure Hash Standard SH3	S	n	n	n	n
CP Assist Cryptographic Function (CPACF)^a					
CPACF feature enablement	O	O	O	O	O
Advanced Encryption Standard (AES) AES-128; AES-192, 256;	S	S	S	S	S
Data Encryption Standard (DES); TDES	S	S	S	S	S
Message authentication code (MAC)	S	S	S	S	S
True Random Number Generation (TRNG)	S	n	n	n	n
Deterministic Random Number Generation (DRNG)	S	S	S	S	S
Pseudo Random Number Generator (PRNG)	S	S	S	S	S
Crypto Express features					
Common Crypto-Express features functionality (CPACF must be enabled)					
Cipher Message with CFB (KMF)	S	S	S	S	S
Cipher Message with Counter (KMCTR)	S	S	S	S	S
Cipher Message with OFB (KMO)	S	S	S	S	S
Common Cryptographic Architecture (CCA)	S	S	S	S	S
Concurrent internal code changes on segment 3 to add/update a CCA application	S	S	S	S	S
Concurrent internal code changes on segment 3 to add/update EP11	n	n	n	n	n
Compute Intermediate Message Digest (KIMD)	S	S	S	S	S
Elliptic Curve Cryptography (ECC)	S	S	S	S	S
Enable/Disable the encrypt DEA key or encrypt AES key function using the Support Element (SE)	S	S	S	S	S
Europay MasterCard Visa (EMV)	S	S	S	S	S
Protected key CPACF for high-performance data encryption	S	S	S	S	S
Remote key loading for ATM/POS	S	S	S	S	S

Cryptographic features, functions, or attributes	z14	z13	z13s	zEC12	zBC12
RSA – Optimal Asymmetric Encryption Padding (OAEP) method with SHA-256	S	S	S	S	S
Secure Keyed-Hash Message Authentication Code (HMAC)	S	S	S	S	S
TR-31 wrapping method for secure key exchange	S	S	S	S	S
Crypto Express6 features^a					
Crypto Express6 feature	O	O	O	n	n
AES GMAC, AES GCM, AES XTS, CMAC	S	S	S	n	n
ECDSA, ECDH	S	S	S	n	n
Enterprise Public Key Cryptography Standards #11 (EP11)	S	S	S	n	n
Max, domains	85	85	40	n	n
Max. operational key part registers	512	512	512	n	n
Payment Card Industry (PCI) Hardware Security Module (HSM) PCI-HSM	S	n	n	n	n
Prime Number Generator (PNG)	S	S	S	n	n
Secure AES Galois Counter Mode (GCM) encryption mode	S	S	S	n	n
True Random Number Generation (TRNG)	S	n	n	n	n
Visa Data Secure Platform P2PE	S	S	S	n	n
Visa Format Preserving Encryption	S	S	S	n	n
Crypto Express5 features^a					
Crypto Express5 feature	CF	O	O	n	n
AES GMAC, AES GCM, AES XTS, CMAC	S	S	S	n	n
ECDSA, ECDH	S	S	S	n	n
Enterprise Public Key Cryptography Standards #11 (EP11)	S	S	S	n	n
Max, domains	85	85	40	n	n
Max. operational key part registers	512	512	512	n	n
Prime Number Generator (PNG)	S	S	S	n	n
Secure AES Galois Counter Mode (GCM) encryption mode	S	S	S	n	n
Visa Data Secure Platform P2PE	S	S	S	n	n
Visa Format Preserving Encryption	S	S	S	n	n
Crypto Express4S features^a					

Cryptographic features, functions, or attributes	z14	z13	z13s	zEC12	zBC12
Crypto Express4S feature	n	n	n	O	O
Enterprise Public Key Cryptography Standards #11 (EP11)	n	n	n	S	S
Max. domains (TKE LIC minimum 7.3)	n	n	n	16	16
Max. operational key part registers (TKE LIC minimum 7.3)	n	n	n	100	100
Crypto Express3 features^a					
Crypto Express3 feature	n	n	n	CF	CF
Crypto Express3-1P feature	n	n	n	n	CF
Max. domains	n	n	n	n	16
Max. operational key part registers	n	n	n	n	100
TKE					
TKE additional smart cards	O	O	O	O	O
TKE Smart Card Reader	O	O	O	O	O
TKE Rack Mounted (FC0086) ^a or TKE Tower (FC0085) ^a	O	n	n	n	n
TKE 9.0 Licensed Internal Code	S	n	n	n	n
Key material copy to alternative zone	S	n	n	n	n
Save TKE data directory structure with files to USB	S	n	n	n	n
Create key parts without opening a host	S	n	n	n	n
Heartbeat audit record	S	n	n	n	n
Audit Log for Privileged Mode Access ID	S	n	n	n	n
Secure key entry on EP11	S	n	n	n	n
X.509 certificates manager for domains	S	n	n	n	n
Domain mode management	S	n	n	n	n
Set clock	S	n	n	n	n
Domain-specific Host Crypto Module Audit Log management	S	n	n	n	n
Domain-specific roles and authorities	S	n	n	n	n
TKE workstation (FC0847) ^a or TKE 1U Rack Mounted (FC0097) ^a or TKE Tower (FC0098) ^a	n	O	O	n	n
TKE 8.1 Licensed Internal Code or	n	S	S	n	n
TKE 8.0 LIC (superseded by TKE 8.1 LIC)	n	CF	CF	n	n

Cryptographic features, functions, or attributes	z14	z13	z13s	zEC12	zBC12
Domain Cloning	S	S	S	n	n
Certificate Authority Wizards (smart card wizards creating for TKE zone and for configuration migrations)	S	S	S	n	n
Coordinated Master Key roll from TKE	S	S	S	n	n
Migration wizard on TKE for Crypto Express5S ^b	S	S	S	n	n
Migration wizard for EP11	S	S	S	n	n
TKE workstation (FC0842) ^a	CF	CF	CF	O	O
Migration wizard for EP11	S	S	S	S	S
Migration wizard on TKE for Crypto Express4S configuration data	n	n	n	S	S
Migration wizard on TKE for Crypto Express3 configuration data	n	n	n	S	S
TKE 7.3 Licensed Internal Code	CF	CF	n	S	S
TKE 7.2 Licensed Internal Code	n	n	n	CF	CF
TKE workstation (FC0841) ^a	n	n	n	CF	CF
Migration wizard on TKE for Crypto Express3 configuration data	n	n	n	S	S
TKE 7.1 Licensed Internal Code	n	n	n	S	S

a. This feature is optional. If it is present, the related functionality is characterized hereafter.

b. If data from this module is to be collected and later applied to a Crypto Express5, the Key Part Holder (KPH) smart cards used in the process must have been created on TKE 8.1 or TKE 8.0 because of the stronger security that is embedded in the Crypto Express5 module.

I/O characteristics

The system input/output (I/O) operations for IBM Z are handled by the channel subsystem (CSS). The role of the CSS is to control communication between internal or external channels and control units and devices. From a central processor standpoint, the CSS is independent of the processors of the mainframe host. Therefore, I/O within a mainframe host can be done asynchronously. This requirement is critical in a system that is designed to handle massive numbers of concurrent transactions.

The current mainframe technology of IBM provides large servers with the ability to handle a high volume of transactions and I/O operations in parallel. Because of this ability, IBM Z configurations can serve many network nodes that are geographically dispersed across the world while handling a high volume of input and output operations to disk storage, printers, and other attached computers. The I/O characteristics are listed in Table 3 on page 7.

Table 3 I/O characteristics

I/O features, functions, or attributes	z14	z13	z13s	zEC12	zBC12
Cancel Subchannel (XSCH)	S	S	S	S	S
Dynamic I/O configuration	S	S	S	S	S
Dynamic reconnect	S	S	S	S	S
Fiber Quick Connect (FQC)	O	O	O	O	O
I/O cages ^a	n	n	n	O ^b	n
I/O drawers ^a	n	O ^c	O ^c	O ^c	O ^c
Nondisruptive I/O removal	S	S	S	S	S
PCIe I/O drawers ^a	O	O	O	O	O
System-initiated CHPID reconfiguration	S	S	S	S	S
IBM z/OS® discovery and autoconfig (zDAC)	S	S	S	S	S
Integrated Console functions at HMC					
Integrated 3270 console	S	S	S	S	S
Integrated ASCII console	S	S	S	S	S
Java Applets based implementations	n	S	S	S	S
Secure 3270	S	n	n	n	n
Logical Channel Subsystems (LCSS): up to 256 CHPIDs per LCSS					
Multiple image facility (MIF)	S	S	S	S	S
Support of LCSS (max. supported)	S(6)	S(6)	S(3)	S(4)	S(2)
Subchannel sets per LCSS (max. supported)	S(4)	S(4)	S(3)	S(3)	S(2)
IBM zHyperLink functionality					
CHPID Type HYL					
zHyperLink read support	S	n	n	n	n
zHyperLink Express					
zHyperLink Express (FC 0431)	O	n	n	n	n
IBM FICON®^d functionality					
CHPID Type FC					
FICON cascaded directors (max 2)	S	S	S	S	S
FICON multihop cascaded directors (max 4)	S	S ^e	S	n	n
FICON CTC	S	S	S	S	S
FICON Dynamic Routing (FIDR)	S	S	S	n	n
FICON purge path extended	S	S	S	S	S

I/O features, functions, or attributes	z14	z13	z13s	zEC12	zBC12
Forward Error Correction (FEC) for FICON Express16S	S	S	S	n	n
High-Performance FICON for IBM z® Systems (zHPF)	S	S	S	S	S
High FICON (zHPF) Extended Distance II	S	S	S	n	n
MIDAW facility	S	S	S	S	S
Number of devices per FICON channel	32 K	32 K	32 K	24 K	24 K
CHPID Type FCP					
FCP channels – T10-DIF support	S	S	S	S	S
FCP full-fabric connectivity to SCSI storage devices	S	S	S	S	S
FCP program directed restart	S	S	S	S	S
FCP SCSI IPL	S	S	S	S	S
FCP support for IBM z/VM®, IBM z/VSE® and Linux on z Systems® (attach to SCSI devices)	S	S	S	S	S
N_Port ID Virtualization (NPIV) for FCP	S	S	S	S	S
WWPN prediction tool for virtual ports	S	S	S	S	S
WWPN prediction tool for physical ports	S	S	S	S	S
FICON Express16S+ (4, 8, 16 Gbps)					
10 KM LX (2 ports) FC0427	O	n	n	n	n
SX (2 ports) FC0428	O	n	n	n	n
FICON Express16S (4, 8, 16 Gbps)					
10 KM LX (2 ports) FC0418	CF	O	O	n	n
SX (2 ports) FC0419	CF	O	O	n	n
FICON Express8S (2, 4, 8 Gbps)					
10 KM LX (2 ports) FC0409	CF	O	O	O	O
SX (2 ports) FC0410	CF	O	O	O	O
FICON Express8 (2, 4, 8 Gbps)					
10 KM LX (4 ports) FC3325	n	CF	CF	O	O
SX (4 ports) FC3326	n	CF	CF	O	O
FICON Express4 (1, 2, 4 Gbps)					
10 KM LX (4 ports) FC3321	n	n	n	CF	CF
SX (4 ports) FC3322	n	n	n	CF	CF

I/O features, functions, or attributes	z14	z13	z13s	zEC12	zBC12
Open Systems Adapter functionality^d					
640 TCP/IP address	S	S	S	S	S
Checksum offload	S	S	S	S	S
Display OSAINFO for z/OS	S	S	S	S	S
Inbound workload queuing for z/OS	S	S	S	S	S
Large send	S	S	S	S	S
Link aggregation for z/VM	S	S	S	S	S
OSA dynamic LAN idle	S	S	S	S	S
OSA-Express Network Traffic Analyzer	S	S	S	S	S
PCI-IN (PCIe Interconnect)	O	O	O	O	O
Virtual MAC address support	S	S	S	S	S
VLAN mgmt - GVRP support	S	S	S	S	S
Supported CHPID types					
CHPID type OSC for integrated console controller (ICC) at all 1000BASE-T Ethernet features	S	S	S	S	S
OSA-ICC support for Secure Sockets Layer	S	S	S	n	n
CHPID type OSD (for QDIO) supported on all OSA-Express features	S	S	S	S	S
QDIO data connection isolation	S	S	S	S	S
QDIO Diagnostic Synchronization facility	S	S	S	S	S
QDIO Optimized latency mode for the z/OS environment	S	S	S	S	S
QDIO Layer 2/Layer 3	S	S	S	S	S
CHPID type OSE for non QDIO at all 1000BASE-T Ethernet features	S	S	S	S	S
CHPID type OSM for intranode management network (INMN) at all 1000BASE-T Ethernet features	S	S	S	S	S
CHPID type OSN for network control program (NCP) at all OSA-Express 1000BASE-T Ethernet and OSA-Express3 GbE features	n	S	S	S	S
CHPID type OSX for IEDN at all 10 GbE features	S	S	S	S	S
Open Systems Adapter-Express6S (OSA-Express6S)					
10 Gigabit Ethernet LR (1 port) FC0424	O	n	n	n	n
10 Gigabit Ethernet SR (1 port) FC0425	O	n	n	n	n

I/O features, functions, or attributes	z14	z13	z13s	zEC12	zBC12
1000BASE-T Ethernet (2 ports /1 CHPID) FC0426	O	n	n	n	n
Gigabit Ethernet LX (2 ports/1 CHPID) FC0422	O	n	n	n	n
Gigabit Ethernet SX (2 ports/1 CHPID) FC0423	O	n	n	n	n
Open Systems Adapter-Express5S (OSA-Express5S)					
10 Gigabit Ethernet LR (1 port) FC0415	CF	O	O	O	O
10 Gigabit Ethernet SR (1 port) FC0416	CF	O	O	O	O
1000BASE-T Ethernet (2 ports /1 CHPID) FC0417	CF	O	O	O	O
Gigabit Ethernet LX (2 ports/1 CHPID) FC0413	CF	O	O	O	O
Gigabit Ethernet SX (2 ports/1 CHPID) FC0414	CF	O	O	O	O
Open Systems Adapter-Express4S (OSA-Express4S)					
10 Gigabit Ethernet LR (1 port) FC0406	n	CF	CF	CF	CF
10 Gigabit Ethernet SR (1 port) FC0407	n	CF	CF	CF	CF
1000BASE-T Ethernet (2 ports/1 CHPID) FC0408	CF	CF	CF	O	n
Gigabit Ethernet LX (2 ports/1 CHPID) FC0404	n	CF	CF	CF	CF
Gigabit Ethernet SX (2 ports/1 CHPID) FC0405	n	CF	CF	CF	CF
Open Systems Adapter-Express3 (OSA-Express3)					
10 Gigabit Ethernet LR (2 ports/2 CHPID) FC3370	n	n	n	CF	CF
10 Gigabit Ethernet SR (2 ports/2 CHPID) FC3371	n	n	n	CF	CF
1000BASE-T 2 port (1 port per CHPID) FC3369	n	n	n	n	CF
1000BASE-T 4 port (2 ports per CHPID) FC3367	n	n	n	CF	CF
Gigabit Ethernet (GbE) LX 4 port (2 ports per CHPID) FC3362	n	n	n	CF	CF
Gigabit Ethernet (GbE) SX 4 port (2 ports per CHPID) FC3363	n	n	n	CF	CF
IBM HiperSockets™					
32 HiperSockets	S	S	S	S	S
Completion queue function	S	S	S	S	S
IPv6 support	S	S	S	S	S
Integration with intraensemble data network (IEDN)	S	S	S	S	S
Layer 2 support	S	S	S	S	S

I/O features, functions, or attributes	z14	z13	z13s	zEC12	zBC12
Multiple Write facility	S	S	S	S	S
Network Traffic Analyzer	S	S	S	S	S
Flash Express					
Flash Express FC0403 ^f	n	O	O	O	O
Shared Memory Communications					
10 GbE RoCE Express2 FC0412	O	n	n	n	n
10 GbE RoCE Express FC0411	CF	O	O	O	O
Shared Memory Communications-Remote Direct Memory Access (SMC-R) ^g .	S	S	S	S	S
Shared Memory Communications-Direct Memory Access (SMC-D)	S	S	S	n	n
zEnterprise Data Compression Express (zEDC)					
zEnterprise Data Compression Express FC0420	O	O	O	O	O

- a. At least one PCIe I/O drawer, I/O drawer, or I/O cage is required, depending on the system.
- b. Up to one I/O cage, not offered on new builds, miscellaneous equipment specification (MES), or RPQ only.
- c. Up to two I/O drawers, not offered on new builds, MES, or RPQ only.
- d. This feature is optional. If it is present, the related functionality is characterized hereafter.
- e. Check the latest z13 HMC driver level information for feature support.
- f. Virtual Flash Memory replaces FC0403 on z14 and later platforms. For more information, see *IBM z14 Technical Guide*, SG24-8451.
- g. FC0411 or FC0412 must be present.

On-demand functions

Capacity Upgrade on Demand (CUoD) is an inherent capability of the current IBM Z architecture. It allows you to concurrently add capacity and features to the IBM Z hardware. Concurrence depends on the existing hardware.

Customer Initiated Upgrade (CIU) is a tool that supports clients ordering permanent and temporary upgrades for their IBM Z hardware. It helps to provide CUoD. CUoD upgrades can be ordered through CIU, but can also be ordered by using the standard IBM Sales/MES order process.

All CIU upgrades support CUoD. Not all CUoD capabilities are available through CIU. For example, a new drawer for IBM Z hardware can be ordered and installed concurrently. This capability is part of the CUoD capabilities of IBM Z. However, it cannot be ordered by using CIU. For more information, see the CIU column in Table 4 on page 12.

Capacity for Planned Event (CPE), Capacity Backup (CBU), and On/Off Capacity on Demand (OoCoD) are temporary upgrade capabilities that allow clients to temporarily add capacity to their processor. These upgrades are all part of CUoD. Only one CUoD upgrade capability is available through CIU, which is On/Off CoD.

The available on-demand functions are listed in Table 4.

Table 4 On-demand functions

On-Demand function	CIU	z14	z13	z13s	zEC12	zBC12
Capacity Upgrade on Demand (COuD)						
API for capacity provisioning management (CPM)	n/a	S	S	S	S	S
Capacity Backup (CBU)	O	O	O	O	O	O
Capacity for Planned Event (CPE)	O	O	O	O	O	O
CIU-Express with extended staging	O	O	O	O	O	O
Concurrent memory upgrades	O	O	O	O	O	O
Concurrent permanent processor upgrade	O	O	O	n	O	n
Concurrent processor book/CPC drawer add	n	O	O	n	O	n
Concurrent upgrades while temporary capacity is active	O	O	O	O	O	O
Flexible memory ^a	n	O	O	n	O	n
High Water Mark (HWM) Increase total model capacity and IFLs without changing the active model capacity and IFLs	O	O	O	O	O	O
On/Off Capacity on Demand (OOCO D)	S	O	O	O	O	O
Plan ahead memory	n	O	O	O	O	O
Up to 8 installed or active (On/Off CoD, CBU, CPE) records at any specific time	O	S	S	S	S	S
Capacity Backup (CBU): Temporary upgrade						
Ability to replenish an ordered record to extend the expiration date, add processing resources, order tests, and restore real activation		S	S	S	S	S
Ability to select the contract length 1 - 5 years		S	S	S	S	S
Automatic deactivation at expiration date		S	S	S	S	S
CPs, IFLs, ICFs, zAAP ^a s, zIIPs, and SAPs		O	O	O	O	O
Manufacturing installation of up to four CPE and CBU records, when ordered		S	S	S	S	S
Maximum of 15 test activations (free and purchased) per CBU record		S	S	S	S	S
Number of free test activations equates to the number of years purchased with the CBU record		S	S	S	S	S
Replenishment/Reuse record		S	S	S	S	S
Subcapacity CBU processors		O	O	O	O	O

On-Demand function	CIU	z14	z13	z13s	zEC12	zBC12
Uninstalled LICCC records can be staged on the Support Element		O	O	O	O	O
Capacity for Planned Event (CPE): Temporary upgrade						
CPs, IFLs, ICFs, zAAP ^a s, zIIPs, and SAPs		O	O	O	O	O
Manufacturing installation of up to four CPE and CBU records when ordered		S	S	S	S	S
Nondisruptive hardware CP capacity setting changes		S	S	S	S	S
Select model capacity and type/quantity of engines based on business needs		S	S	S	S	S
On/Off Capacity on Demand (On/Off CoD): Temporary upgrade						
Ability to replenish an ordered record		S	S	S	S	S
Administrative On/Off CoD testing		S	S	S	S	S
API for On/Off CoD activation		S	S	S	S	S
Automatic deactivation at expiration date		S	S	S	S	S
Automatic renewal to extend expiration date		O	O	O	O	O
CPs, IFLs, ICFs, zAAP ^a s, zIIPs, and SAPs		O	O	O	O	O
On/Off CoD test		S	S	S	S	S
On/Off CoD with extended staging		O	O	O	O	O
Post-paid upgrades with spending limits controlled by tokens		O	O	O	O	O
Prepaid upgrades controlled by tokens		O	O	O	O	O
Replenishment/Reuse record		S	S	S	S	S
Subcapacity engine support		S	S	S	S	S
Uninstalled LICCC records can be staged on the Support Element		O	O	O	O	O

a. zAAPs are not supported on z14, z13, and z13s (zAAP workload runs on zIIPs with z14, z13, and z13s).

Parallel Sysplex was introduced with the coupling facility (CF) and coupling links for high-speed communication, with IBM MVS™ V5.1 operating system support with the mainframe models in 1994. With the IBM Parallel Sysplex technology, you can harness the power of up to 32 z/OS systems, yet make these systems behave as a single, logical computing facility. Also, the underlying structure of the Parallel Sysplex remains virtually transparent to users, networks, applications, and even operations.

To realize these benefits, the z/OS Parallel Sysplex combines two critical capabilities: Parallel processing and enabling read/write data sharing across multiple systems with full data integrity.

This combination makes the z/OS Parallel Sysplex unique from every other system, solution, and architecture that is available today. The Parallel Sysplex matrix is listed in Table 5 on page 14.

Table 5 Parallel Sysplex

Parallel Sysplex	z14	z13	z13s	zEC12	zBC12
BCPii interface	S	S	S	S	S
CFLevel=22	S	n	n	n	n
CFLevel=21	n	S	S	n	n
CFLevel=20	n	S	n	n	n
CFLevel=19	n	n	n	S	S
CFLevel=18	n	n	n	S	n
Coupling facility dynamic dispatch	S	S	S	S	S
Coupling Facility Thin Interrupt	S	S	S	S	S
Coupling facility shared CPs	S	S	S	S	S
Integrated Coupling Facility (ICF)	O	O	O	O	O
128-bit TOD clock	S	S	S	S	S
z/VM guest coupling	S	S	S	S	S
Coupling Links features for Parallel Sysplex clustering					
HCA3-O LR fanout for 1xIFB (4 ports/16 CHPIDs) FC0170	O	O	O	O	O
HCA3-O fanout for 12x IFB (2 ports/16 CHPIDs) FC0171	O	O	O	O	O
HCA2-O LR fanout for 1x IFB (2 ports/16 CHPIDs) FC0168	n	n	n	CF	CF
HCA2-O fanout for 12x IFB (2 ports/16 CHPIDs) FC0163	n	n	n	CF	CF
Integrated Coupling Adapter (ICA SR) (2 ports/8 CHPIDs) FC0172	O	O	O	n	n
Coupling Express Long Reach (2 ports/8 CHPIDs) FC0433	O	O ^a	O	n	n
Integrated Coupling Adapter (2 port/16 CHPIDs) FC0172	O	O	O	n	n
Internal Coupling link (IC)	S	S	S	S	S
ISC-3 (2 ports/ 2 CHPIDs) FC0217 + FC0218	n	n	n	CF	CF
Server Time Protocol (STP)^b					
Graphical setup and configuration at the HMC	S	n	n	n	n
Additional stratum level (4)	S	n	n	n	n
Continuous availability of NTP servers	S	S	S	S	S
HMC used as an NTP server ^c	S	S	S	S	S
NTP server with pulse per second (PPS) ^d	S	S	S	S	S

Parallel Sysplex	z14	z13	z13s	zEC12	zBC12
NTP client	S	S	S	S	S
Improved STP recovery and availability when an Internal Battery Feature (IBF) is installed on one or more servers in the CTN	S	S	S	S	S
Going away signal to improve recovery	S ^e	S ^e	S ^e	S	S
Enhanced Console Assisted Recovery	S	S	S	n	n
Save STP configuration and time information across power-on resets (POR) or power outages for a single or dual server STP-only CTN	S	S	S	S	S
z/OS messaging when events occur related to accessing an ETS	S	S	S	S	S

- a. For more information about feature support, see the latest z13 HMC driver level information.
- b. This feature is optional. If it is present, the related functions are characterized hereafter.
- c. The HMC must be at level 2.10.1 for an STP-only CTN to obtain its external time source from an NTP server defined on the HMC.
- d. Not available when the HMC is used as NTP server.
- e. Available on HCA-30 Coupling.

Performance

The IBM Mainframe was the computing workhorse for large organizations for many years. These organizations realized that they can reduce their total cost of ownership (TCO) by tuning the workloads that are running on the mainframe. TCO can be significantly reduced by implementing various performance and other enhancements that are provided by new releases of IBM mainframe.

Workload capacity performance is sensitive to three major factors: Instruction path length, instruction complexity, and memory hierarchy.

The IBM Z configurations are designed to deliver the highest levels of performance and capacity for large-scale consolidation and growth. Attributes and design points of the z Systems that contribute to overall performance and throughput are listed in Table 6.

Table 6 Performance

Performance	z14	z13	z13s	zEC12	zBC12
16 floating point registers	S	S	S	S	S
64-bit addressing	S	S	S	S	S
Branch and set authority facility	S	S	S	S	S
Compare and move extended facility	S	S	S	S	S
Data software compression	S	S	S	S	S
Data hardware compression (CMPSC)	S	S	S	S	S

Performance	z14	z13	z13s	ZEC12	ZBC12
Data hardware compression (zEDC)	O	O	O	O	O
IBM DB2® Sort facility	S	S	S	S	S
Dedicated move page engine	S	S	S	S	S
Dynamic CF dispatching	S	S	S	S	S
Dynamic Address Translation (DAT)	S	S	S	S	S
Enhanced Move Page/VM	S	S	S	S	S
Extended translation facility	S	S	S	S	S
Extensions for virtual machine (VM)	S	S	S	S	S
Flexible memory configurations	O	O	O	O	O
Floating point instruction ^a	S	S	S	S	S
Hardware decimal floating point facility	S	S	S	S	S
HFP square root instruction ^a	S	S	S	S	S
HiperDispatch function	S	S	S	S	S
Immediate and relative instruction ^a	S	S	S	S	S
Large Page Support	S	S	S	S	S
1 MB large page support (pageable) ^b	S	S	S	S	S
2 GB large page support ^b	O	O	O	O	O
Logical string assist	S	S	S	S	S
Long displacement facility	S	S	S	S	S
Max. number of cores per processor unit ^c	10	8	8	6	6
Move page	S	S	S	S	S
Runtime Instrumentation	S	S	S	S	S
Out of Order Instruction Execution	S	S	S	S	S
Perform locked operation facility	S	S	S	S	S
Plan ahead memory	O	O	O	O	O
Processor frequency (Ghz)	5.2	5.0	4.3	5.5	4.2
Server/Application State Protocol (SASP) support for load balancing across virtual servers	S	S	S	S	S
Start Interpretive Execution (SIE)	S	S	S	S	S
Superscalar	S	S	S	S	S
Suppression on protection facility	S	S	S	S	S
Simultaneous Multi Threading (SMT) on zIIPs, IFLs, and SAPs	S	S	S	n	n

Performance	z14	z13	z13s	zEC12	zBC12
Single Instruction Multiple Data (SIMD)	S	S	S	n	n
IBM z Systems® Application Assist Processors ^d (zAAPs)	n	n	n	O	O
IBM z Integrated Information Processors (zIIPs)	O	O	O	O	O
Transactional Memory	S	S	S	S	S
Trimodel addressing	S	S	S	S	S
zHyperLink support	O	n	n	n	n
Maximum supported memory (in TB) ^e	32	10	4	3	0.496

a. For more information, see *Principles of Operation*, SA22-7832.

b. Requires min. z/OS 1.13 + PTFs.

c. The maximum number of cores is not available on all PUs at one module.

d. zAAP workload is eligible for zIIPs on z14, z13, z13s, zEC12, and zBC12.

e. The maximum amount of memory depends on the number of CPC drawers. The values in this row pertain to the maximum number of CPC drawers.

Processor Resource/Systems Manager (PR/SM)

IBM introduced PR/SM in 1988 with the IBM 3090 processors. It consists of hardware electronics and microcode that is built into IBM mainframes that support logical partitions (LPARs). LPARs allow you to run multiple system images on a single processor complex. Each image includes a full complement of CPUs (dedicated or shared), main storage, expanded storage, and channels. Channels can be shared across images by using the multiple image facility (MIF) feature.

The PR/SM functionality ensures the highest level of optimized resources usage and an unparalleled utilization in the IT world of the IBM Z near to 100%. The main characteristics of PR/SM for the z14, z13, z13s, zEC12, and zBC12 are listed in Table 7.

Table 7 PR/SM

PR/SM	z14	z13	z13s	zEC12	zBC12
128-bit TOD clock	S	S	S	S	S
Absolute capping support of PUs (all types)	S	S	S	S	n
Absolute capping support of an LPAR Group	S	S	S	n	n
Add/delete logical partition name	S	S	S	S	S
Automatic Reconfiguration Facility (ARF)	S	S	S	S	S
Defined capacity I/O	S	S	S	S	S
Dynamic Memory Management	S	S	S	n	n
Dynamic storage reconfiguration	S	S	S	S	S
Dynamic PU reassignment	S	S	S	S	S

PR/SM	z14	z13	z13s	zEC12	zBC12
EAL5 certification ^a	S	S	S	S	S
Dynamic Partition Manager (DPM)	S	S	S	n	n
HSA size (in GB)	192	96	40	32	16
Hypervisor support for virtualization: z/VM	S	S	S	S	S
Hypervisor support for virtualization: KVM	S	S	S	n	n
Individual management of PU types	S	S	S	S	S
Logical partition time offset	S	S	S	S	S
LPAR group capacity limit	S	S	S	S	S
LPAR management time report	S	S	S	S	S
LPAR preferred path	S	S	S	S	S
Max number of configurable processors	170	141	20	101	13
Max number of CPs	170	141	6	101	6
Max number of supported LPARs	85	85	40	60	30
Max number of supported LCSS	6	6	3	4	2
Max number of subchannel sets per LCSS	4	4	3	3	2
Simultaneous multithreading (SMT) for IFLs, zIIPs, and SAPs	S	S	S	n	n
Single Instruction Multiple Data (SIMD)	S	S	S	n	n
Single storage pool	S	S	S	S	S
Secure Service Container (SSC)	S	S ^b	S	n	n
Intelligent Resource Directory (IRD)					
Channel subsystem priority queuing	S	S	S	S	S
Dynamic Channel Path Management (DCM)	S	S	S	S	S
LPAR CPU management	S	S	S	S	S

a. Common Criteria EAL5 certification for the security of the LPARs that run under the control of PR/SM is in process.

b. Check the latest z13 HMC driver level information for support.

Reliability, availability, and serviceability (RAS)

The IBM Z design is focused on providing higher availability by reducing planned and unplanned outages, which is commonly known as *RAS*. RAS can be accomplished by using improved concurrent replace, repair, and upgrade functions for processors, memory, drawers, and I/O. RAS also extends to the nondisruptive capability for installing Licensed Internal Code (LIC) updates.

As an extension to the RAS capabilities, environmental controls are implemented in the system to help reduce power consumption and meet cooling requirements. Continuous improvements in RAS are associated with new features and functions to ensure that IBM Z machines deliver exceptional value.

The main RAS features of the z14, z13, z13s, zEC12, and zBC12 are listed in Table 8.

Table 8 RAS functionality

RAS	z14	z13	z13s	zEC12	zBC12
50/60 Hz power	S	S	S	S	S
DC power	O	O	O	O	O
Ability to display and track historical power, temperature, and utilization data	S	S	S	S	S
Alternative HMC	O	O	O	O	O
Alternative Support Element	S	S	S	S	S
Bolt down kit for low-raised floor and high-raised floor installation	O	O	O	O	O
Bolt down kit for nonraised floor installation	O	O	O	n	O
Concurrent channel adapter add	S	S	S	S	S
Concurrent book/processor drawer add	S	S	n	S	n
Concurrent PCI I/O drawer add	S	S	S	S	S
Concurrent I/O drawer add (not available on z14)	n	S ^a	S ^a	S	S
Dynamic Fabric repair (CP-SC and SC-SC)	S	S	S	S	S
Concurrent PU conversions	O	O	O	O	O
Console Integration (CI)	S	S	S	S	S
Digitally signed firmware provided by the HMC and SE	S	S	S	S	S
Dynamic change to partition cryptographic coprocessor configuration	S	S	S	S	S
Dynamic add of a logical processor to an LPAR	S	S	S	S	S
Dynamic LCSS add without preplanning	S	S	S	S	S
Dynamic memory bit lane sparing	S	S	S	S	S
Dynamic memory sparing ^b	S	S	S	S	S
Dynamic oscillator switchover	S	S	S	S	S
Dynamic partition add without preplanning	S	S	S	S	S
Dynamic subchannel set add without preplanning	S	S	S	S	S
Enhanced application preservation	S	S	S	S	S
Enhanced drawer availability (EDA) for processor drawer, (or EBA for zEnterprise)	S	S	n	S	n

RAS	z14	z13	z13s	zEC12	zBC12
Fault tolerant design	S	S	S	S	S
FCP program directed IPL	O	O	O	O	O
FICON channel link error problem analysis	S	S	S	S	S
FICON dynamic routing (FIDR)	S	S	S	n	n
FICON forward error correction (FEC) for FICON Express16S	S	S	S	n	n
FICON link incident reporting	O	O	O	O	O
FICON SAN Fabric I/O Priority for WLM	S	S	S	n	n
FICON multihop cascaded directors (max number of directors)	4	4	4	2	2
Fixed HSA	S	S	S	S	S
HMC and SE IPv6 support	S	S	S	S	S
HMC FCP Problem Determination panels	S	S	S	n	n
HMC instant messenger	S	S	S	S	S
I/O interface reset	S	S	S	S	S
Internal Battery Feature (IBF)	O	O	O	O	O
IPL from alternative subchannel set	S	S	S	S	S
LICCC memory upgrade	S	S	S	S	S
LICCC processor upgrade	S	S	S	S	S
Memory RAIM	S	S	S	S	S
Monitor and track power consumption, internal temperature, and utilization data of the CPC using monitor dashboard task on the HMC	S	S	S	S	S
Multipath IPL - with z/OS	S	S	S	S	S
Nondisruptive I/O removal	S	S	S	S	S
N+1 power supplies	S	S	S	S	S
Partial CP restart	S	S	S	S	S
Partial memory restart	S	S	S	S	S
Power - balanced power	O	O	O	O	O
Power - dual power feeds	S	S	S	S	S
Power - plan ahead power cords	O	O	O	O	O
Power consumption estimator tool (IBM Resource Link®)	S	S	S	S	S

RAS	z14	z13	z13s	zEC12	zBC12
Precheck function to detect conflicts between a new permanent upgrade and any active temporary resources	S	S	S	S	S
Processor drawer degradation mode	S	S	S	n	n
PU sparing (if spare available, config dependent)	S	S	S	S	S
SAP reassignment	S	S	S	S	S
Sparing for storage protect keys ^b	S	S	S	S	S
Subspace group facility	S	S	S	S	S
Subsystems storage protect	S	S	S	S	S
Symbol Error Correction Code (ECC) on L4 cache	S	S	S	n	n
Symbol Error Correction Code (ECC) on L3 cache configuration array	S	S	S	n	n
System-initiated CHPID reconfiguration	S	S	S	S	S
System-managed CF structure duplexing	S	S	S	S	S
Top exit I/O cabling	O	O	O	O	O
Top exit power cabling	O	O	O	O	O
Water manifold for processor cooling as FRU	S	S	S	n	n
Worldwide port name (WWPN) tool to help with preplanning and setting up SAN environment before installation	S	S	S	S	S
Concurrent maintenance					
Books (including memory DIMMs) ^c	n	n	n	S	n
Channel - Adapter	S	S	S	S	S
Cooling units (water cooled ^d or air cooled)	S	S	S	S	S
CPC drawer (including memory DIMMs)	S ^e	S ^e	S ^e	n	n
Enhanced driver maintenance	S	S	S	S	S
Hardware Management Console (HMC)	S	S	S	S	S
Flash Express cards	n	O	O	O	O
Virtual flash memory	O	n	n	n	n
IFB-MP	S	S	S	S	S
I/O drawer	n	S	S	S	S
Oscillator	S	S	S	S	S
PCIe I/O drawer	S	S	S	S	S
PCI-IN (PCIe Interconnect)	S	S	S	S	S

RAS	z14	z13	z13s	zEC12	zBC12
Point of Load (POL) - CPC drawer power regulators	S	S	S	n	n
Single Chip Modules (SCM)	S	S	S	n	n
Support Element (SE)	S	S	S	S	S
Concurrent MCL apply					
CFCC ^f	S	S	S	S	S
Channel features					
CE LR	S	S ^g	S	n	n
Crypto-Express	S	S	S	S	S
FICON-Express	S	S	S	S	S
Flash Express	n	S	S	S	S
IC	S	S	S	S	S
ICA SR	S	S	S	n	n
IFB	S	S	S	S	S
ISC-3	n	n	n	S	S
OSA-Express	S	S	S	S	S
zHyperLink	S	n	n	n	n
Hardware Management Console (HMC)	S	S	S	S	S
Processor types					
CP	S	S	S	S	S
SAP	S	S	S	S	S
ICF	S	S	S	S	S
IFL	S	S	S	S	S
IFP	S	S	S	S	S
zIIP	S	S	S	S	S
Support Element (SE)	S	S	S	S	S
PU core engineering data	S	S	S	S	S

a. I/O drawers can be added by using a carry forward from older systems only.

b. Sparing can be done with steering or marking technology.

c. Applies to multiple book systems only.

d. z14, z13, and zEC12 only.

e. Applies to multiple processor drawer systems only.

f. Might require reactivation of CFCC.

g. Check the latest z13 HMC driver level information for support.

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