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IBM Z Functional Matrix

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IBM Z Functional Matrix

This IBM® Redpaper publication can help you quickly understand the features, functions, connectivity options, and certifications that are available with the IBM z17™, IBM z16™, IBM z15®.

This publication covers the following topics:

Note: The intention of this publication is to compare the standard and optional features for various IBM Z® configurations. It does *not* include information about services, requests for price quotation (RPQs), or specific quantities or measurements that are related to performance, memory size, bandwidth, and so on.

For more information about the features and functions that are listed in the tables of this publication, see the system-specific reference documentation.

The following keys are used in the tables in this IBM Redpaper publication:

- S: Standard
- O: Optional
- n: Not supported
- na: not applicable
- CF: Carry forward only

Application programming interfaces

System management applications that provide integrated hardware and software management solutions are supported through the console programming interfaces. Detailed information that includes console application programming interface (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 the APIs is listed in Table 1.

Table 1 Firmware support for APIs

API[a]	IIBM z17	IBM z16	IBM z15
Hardware Management Console (HMC) Web Services (Web Services)[b]	S	S	S
Simple Network Management Protocol (SNMP)	S	S	S
Secure Service Container (SSC)	S	S	S
Base Control Program internal interface (BCPii)	S	S	S
Ability to use APIs to access the Unified Resource Manager function	n	n	n
HMC Common Information Model (CIM)	n	n	n

a. Consult the HMC Web Services API documents: *Hardware Management Console Web Services API (V2.15.0)*, SC27-2638 for IBM z15: *Hardware Management Console Web Services API (V2.16.0)*, SC27-2642 for IBM z16: *Hardware Management Console Web Services API (V2.17.0),* SC27-2647 for IBM z17, *Hardware Management Console Web* You can find the documents on IBM Resource Link®, IBM user ID required.

b. Web Services are disabled by default for security reasons and must be enabled by the user.

Cryptographic features

The hardware cryptographic services that are provided with IBM Z platforms are intended to cover the full range of industry-standard cryptographic operations.

The Trusted Key Entry (TKE) workstation is another optional feature that consists of an IBM specific workstation that provides 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 with IBM Z platforms:

- CP Assist for Cryptographic Functions (CPACF) is implemented as a set of cryptographic instructions in IBM Z firmware to improve performance when encrypting and decrypting data.
- The Crypto Express PCIe feature is an optional feature that is plugged into the PCIe I/O drawers or PCIe+ IO drawers.

The cryptographic functions for CPACF are listed in Table 2.

Table 2 CPACF cryptography functions

Cryptographic functions	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Secure Hash Standard SHA1	S	S	S	S	S
Secure Hash Standard SHA2 (224, 256, 384, and 512)	S	S	S	S	S
Secure Hash Standard SHA3 (224, 256, 384, and 512)	S	S	S	S	S
GHASH	S	S	S	S	S
SHAKE support for 128-bit and 256-bit	S	S	S	S	S
CP Assist Cryptographic Function[a]					
Advanced Encryption Standard (AES) AES-128; AES-192, and AES-256	S	S	S	S	S
Data Encryption Standard (DES) and triple DES (TDES)	S	S	S	S	S
Message authentication code (MAC)	S	S	S	S	S
True Random Number Generation (TRNG)	S	S	S	S	S
Deterministic Random Number Generation (DRNG) (NIST SP-800-90A SHA-512 based)	S	S	S	S	S
Pseudo Random Number Generator (PRNG)	S	S	S	S	S
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
Elliptic Curve Cryptography (ECC)	S	S	S	S	S
Odessa, Elliptic Curve Diffie-Hellman (ECDH) - Support for NIST P256, NIST P386, NIST P 521	S	S	S	S	S
Odessa for Ed25519 and Ed448 curves	S	S	S	na	na
ECDH for X25519 and X448 curves	S	S	S	na	na

a. The enablement feature (Feature Code 3863) for CPACF is a no-charge option.

The Crypto Express functions are listed in Table 3.

Table 3 Crypto Express functions

Crypto functions	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Common Cryptographic Architecture (CCA)	S	S	S	S	S
Concurrent internal code changes on segment 3 to add or update a CCA application	S	S	S	S	S
Compute Intermediate Message Digest (CIMD)	S	S	S	S	S
Enable or disable the encrypt DEA key or encrypt AES key function by 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
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 Automation Toggling without operating system toleration[a]	S	S	S	n	n

a. Provides a method to serially config on/off Crypto features. Requires Crypto Express adapters to be configured redundantly.

The optional Crypto Express features are listed in Table 4.

Table 4 Crypto Express features

Crypto Adapters features, functions, or attributes	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Maximum domains supported	85	85	40	85	40
Maximum operational key part registers support	512	512	512	512	512
Crypto Express8S features					
Crypto Express8S feature Feature Code 0908 (2xHSMs) Crypto Express8S feature Feature Code 0909 (1xHSM)	O	O	O	n	n
Quantum-safe cryptography	S	S	S	n	n
Quantum-safe APIs	S	S	S	n	n

Crypto Adapters features, functions, or attributes	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
AES Galois Message Authentication Code (GMAC), AES Galois Counter Mode (GCM), AES XEX Tweakable Block Ciphertext Stealing (XTS), and cipher-based MAC (CMAC)	S	S	S	S	S
Key generation for NIST, Ed, and X-Curves	S	S	S	na	na
Enterprise Public Key Cryptography Standards #11 (EP11)	S	S	S	na	na
Maximum domains	85	85	40	85	40
Maximum operational key part registers	512	512	512	512	512
Payment Card Industry (PCI) Hardware Security Module (HSM) PCI-HSM	S	S	S	S	S
Prime Number Generator (PNG)	S	S	S	S	S
Secure AES GCM encryption mode	S	S	S	na	na
TRNG	S	S	S	na	na
Visa Data Secure Platform Point to Point Encryption (P2PE)	S	S	S	na	na
Visa Format Preserving Encryption	S	S	S	na	na
Module-Lattice-Based Digital Signature (ML-DSA), formally known as CRYSTALS-Dilithium	S	S	S	n	n
Module-Lattice-Based Key-Encapsulation Mechanism (ML-KEM), formally known as CRYSTALS-Kyber	S	S	S	n	n
Crypto Express7S features					
Crypto Express7 feature 1-HSM Feature Code 0899 Crypto Express7 feature 2-HSM Feature Code 0898	CF	CF	CF	O	O
AES GMAC, AES GCM, AES XTS, and CMAC	S	S	S	S	S
EP11	S	S	S	S	S
Maximum domains	85	85	40	85	40
Maximum operational key part registers	512	512	512	512	512
PCI-HSM	S	S	S	S	S
PNG	S	S	S	S	S
Secure AES GCM encryption mode	S	S	S	S	S

Crypto Adapters features, functions, or attributes	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
TRNG	S	S	S	S	S
Visa Data Secure Platform P2PE	S	S	S	S	S
Visa Format Preserving Encryption	S	S	S	S	S
Module-Lattice-Based Digital Signature (ML-DSA), formally known as CRYSTALS-Dilithium	S	S	S	n	n
Crypto Express6S features					
Crypto Express6 feature Feature Code 0893	n	CF	CF	CF	CF
AES GMAC, AES GCM, AES XTS, and CMAC	n	S	S	S	S
Elliptic Curve Digital Signature Algorithm (ECDSA) and ECDH	n	S	S	S	S
EP11	n	S	S	S	S

The TKE Workstation features are listed in Table 5.

Table 5 Trusted Key Entry -TKE

TKE Workstation[a, b] features, functions, or attributes	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
TKE additional smart cards (10 pack) Feature Code 0900	CF	O	O	O	O
TKE smart card reader Feature Code 0891	CF	O	O	O	O
TKE Tower or TKE workstation	O	O	O	O	O
TKE Rack-Mounted	O	O	O	O	O
TKE 10.1 Licensed Internal Code (LIC)	S	n	n	n	n
TKE 10.0 Licensed Internal Code (LIC)	CF[c]	S	S	S	S
TKE 9.2 Licensed Internal Code	CF[c]	S	S	S	S
PCI-compliant with CCA 6.3	S	S	S	S	S
TKE 9.1 Licensed Internal Code or TKE 9.0 LIC (superseded by TKE 9.1 LIC)	n	CF	CF	CF	CF
	n	CF	CF	CF	CF
Key material copy to alternative zone	S	S	S	S	S

TKE Workstation[a, b] features, functions, or attributes	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Save TKE data directory structure with files to USB	S	S	S	S	S
Create key parts without opening a host	S	S	S	S	S
Audit Log for Privileged Mode Access ID	S	S	S	S	S
Secure key entry on EP11	S	S	S	S	S
X.509 certificates manager for domains	S	S	S	S	S
Domain mode management	S	S	S	S	S
Set clock	S	S	S	S	S
Domain-specific Host Crypto Module Audit Log management	S	S	S	S	S
Domain-specific roles and authorities	S	S	S	S	S
Domain Cloning	S	S	S	S	S
Certificate authority wizards (smart card wizards for the TKE zone and for configuration migrations)	S	S	S	S	S
Coordinated Master Key roll from TKE	S	S	S	S	S

a. This feature is optional.
b. TKE must be at a later or the same level as the latest Crypto Express feature that is installed in the systems (see Table 6).
c. The TKE does not check the IBM Z processor level. It is the version of the newest HSM on your IBM z17 that determines what level of TKE must be used.

Table 6 on page 8 shows the supported Crypto Express feature codes and the TKE-related LIC release.

For some functions, requirements must be considered, for example, the characterization of a Crypto Express adapter in EP 11 mode always requires a TKE.

The TKE is unaware of where the host crypto module is installed, that is, the TKE does not consider whether a Crypto Express is installed in an IBM z17, IBM z16, or IBM z15. Therefore, the TKE release LIC must support the specific crypto module.

Table 6 TKE compatibility matrix

TKE workstation	TKE Release LIC	9.0	9.1	9.2	10.0	10.1
	Hardware Feature Code[a]	0085 or 0086	0085 or 0086	0087 or 0088	0057 or 0058	0057 or 0058
	Licensed Internal Code Configuration Control (LICCC)	0879	0880	0881	0882	0883
	Smart Card Reader	0885 0891	0891	0891	0891	0886[b]
	Smart Card	0884 0892	0900	0900	0900	0889
Manage Host Crypto Module	CEX8C (CCA)	no	no	no	Yes	Yes
	CEX8P (EP11)	no	no	no	Yes	Yes
	CEX7C (CCA)	no	no	Yes	Yes	Yes
	CEX7P (EP11)	no	no	Yes	Yes	Yes
	CEX6C (CCA)	Yes	Yes	Yes	Yes	Yes
	CEX6P (EP11)	Yes	Yes	Yes	Yes	Yes
	CEX5C (CCA)	Yes	Yes	Yes	Yes	Yes
	CEX5P (EP11)	Yes	Yes	Yes	Yes	Yes

a. TKE Hardware features can be carried forward and upgraded to support the latest Crypto Express feature that is installed in the system.
b. FC 0886 - Smart Card Reader with Smart Cards in one FC.

I/O characteristics and features

The system input/output (I/O) operations for the IBM Z platform 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 IBM Z platform. Therefore, I/O within IBM Z servers can be done asynchronously. This requirement is critical in a system that is designed to handle massive numbers of concurrent transactions.

IBM Z technology can handle a high volume of transactions and I/O operations in parallel. Because of the ability to do parallel I/O operations, IBM Z configurations can serve many different devices, such as disk storage, printers, other attached computers, and networks.

The I/O characteristics are listed in Table 7.

Table 7 I/O characteristics

I/O features, functions, or attributes	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Cancel Subchannel (XSCH)	S	S	S	S	S
Dynamic I/O configuration	S	S	S	S	S
Dynamic I/O configuration for stand-alone CF[a]	S	S	S	S	S
Dynamic I/O configuration for stand-alone Linux on Z and z/TPF[b]	S	S	S	n	n
Dynamic reconnect	S	S	S	S	S
Fiber Quick Connect (FQC)	O	O	S	O	O
Nondisruptive I/O removal	S	S	S	S	S
PCIe I/O drawers[c]	n	n	n	n	n
PCIe+ I/O drawer[c]	O	O	O	O	O
PCIe+ Gen3 Fanout	n	S	S	S	S
PCIe+ Gen4 Fanout	S	n	n	n	n
System-initiated CHPID reconfiguration	S	S	S	S	S
IBM z/OS® Discovery and Auto Configuration (zDAC)	S	S	S	S	S
Logical Channel Subsystems (LCSSs): up to 256 CHPIDs per LCSS					
Multiple Image Facility (MIF)	S	S	S	S	S
Support of LCSS (maximum supported)	S(6)	S(6)	S(3)	S(6)	S(3)
Subchannel sets per LCSS (maximum supported)	S(4)	S(4)	S(3)	S(4)	S(3)

a. Dynamic I/O for stand-alone CF is available with IBM z15 Driver Level 41, or IBM z16 Driver Level 51, and IBM z17 central processor complexes (CPCs). Requires Hardware Configuration Definition (HCD) and I/O configuration program (IOCP) program temporary fixes (PTFs).

b. Dynamic I/O for stand-alone Linux on Z and z/TPF running in a partition on any supported IBM Z server. This configuration continues to support stand-alone CF Dynamic I/O activations. IBM z16 CPC requires proper firmware level (Bundle S24 or higher).

c. At least one PCIe I/O drawer or PCIe+ I/O drawer is required, depending on the system (except for certain configurations that are used as a stand-alone Coupling Facility (CF)).

Storage connectivity

Storage connectivity is provided on the IBM Z platform through IBM FICON® Express and the IBM zHyperLink Express features.

FICON Express features follow the established Fibre Channel (FC) standards to support data storage and access requirements.

zHyperLink Express was created to provide fast access to data through direct, low-latency connections between the IBM Z platform and storage. A zHyperLink channel does not replace a FICON channel, but complements it. FICON remains the main data driver and is mandatory for zHyperLink usage.

The supported storage connectivity functions for FICON are listed in Table 8.

Table 8 FICON storage connectivity functions

Functions	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
CHPID Type FC					
FICON multihop cascaded directors (maximum 4)	S	S	S	S	S
FICON channel-to-channel (CTC)	S	S	S	S	S
FICON Dynamic Routing (FIDR)	S	S	S	S	S
FICON purge path extended	S	S	S	S	S
Forward Error Correction (FEC) for FICON Express16S and later	S	S	S	S	S
High-Performance FICON for IBM Z (zHPF)	S	S	S	S	S
High FICON (zHPF) Extended Distance II	S	S	S	S	S
Modified indirect address word (MIDAW) facility	S	S	S	S	S
Number of devices per FICON channel	32 K	32 K	32 K	32 K	32 K
IBM Fibre Channel Endpoint Security (Feature Code 1146)[a]	O, CF	O	O	O	n
CHPID Type FCP - Fibre Channel Protocol					
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[b]®, and Linux on IBM Z (attach to SCSI devices)	S[b]	S[b]	S[b]	S	S

Functions	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
N_Port ID Virtualization (NPIV) for FCP	S	S	S	S	S
Worldwide port name (WWPN) prediction tool for virtual ports	S	S	S	S	S
WWPN prediction tool for physical ports	S	S	S	S	S
IBM Fibre Channel Endpoint Security (Feature Code 1146)[a]	O[e]	O[c]	O[d]	O[c]	n

a. Requires Feature Code 3863 (CPACF enablement). Subject to export regulations.
b. IBM z16 A01 is the last IBM Z supported by IBM z/VSE 6.2. IBM z16 A02, IBM z16 AGZ and IBM z17 are not supported by IBM z/VSE 6.2. (See 21 Century Software VSE[n] V6.3). IBM z17 support provided by VSE[n] V6.3.1
c. FICON Express32S, FICON Express16SA - Encryption of Data in Flight and Endpoint Authentication. FICON Express16S+ supports Endpoint Authentication only.
d. This feature (Feature Code 1146) is supported by FICON Express32S (FCs 0461 and 0462); new build IBM z16 A02 and IBM z16 AGZ servers; and FICON Express16S+ (Facts 0427 and 0428) as carry forward. FICON Express16SA is not supported on IBM z16 A02 or IBM z16 AGZ.
e. With z17, this feature (Feature Code 1146) is supported by FICON Express32-4P, FICON Express32S and FICON Express16SA only.

The optional FICON Express features are listed in Table 9.

Table 9 IBM FICON features

IBM FICON features	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
FICON Express32-4P[a] (8, 16, or 32 Gbps)					
10KM LX (four ports) Feature Code 0387	S	n	n	n	n
SX (four ports) Feature Code 0388	S	n	n	n	n
FICON Express32S[b] (8, 16, or 32 Gbps)					
10 KM LX (two ports) Feature Code 0461	CF	O	O	n	n
SX (two ports) Feature Code 0462	CF	O	O	n	n
FICON Express16SA[a] (8 or 16 Gbps)					
10 KM LX (two ports) Feature Code 0436	CF	CF	n	O	n
SX (two ports) Feature Code 0437	CF	CF	n	O	n
FICON Express16S+[a] (4, 8, or 16 Gbps)					
10 KM LX (two ports) Feature Code 0427	n	CF	CF	CF	O
SX (two ports) Feature Code 0428	n	CF	CF	CF	O
FICON Express16S (4, 8, or 16 Gbps)					

IBM FICON features	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
10 KM LX (two ports) Feature Code 0418	n	n	n	CF	CF
SX (two ports) Feature Code 0419	n	n	n	CF	CF
FICON Express8S (2, 4, or 8 Gbps)					
10 KM LX (two ports) Feature Code 0409	n	n	n	CF	CF
SX (two ports) Feature Code 0410	n	n	n	CF	CF

a. ALL four ports on this FICON Express feature must be defined as the same CHPID type (FC or FCP).
b. Both ports on this FICON Express feature must be defined as the same CHPID type (FC or FCP).

The supported zHyperLink functions and optional features are listed in Table 10.

Table 10 IBM zHyperLink functions and features

zHyperLink CHPID type HYL	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
zHyperLink read support	S	S	S	S	S
zHyperLink write support[a]	S	S	S	S	S
zHyperLink Express features					
zHyperLink Express (Feature Code 0431)	n	CF	CF	CF	CF
zHyperLink Express1.1 (Feature Code 0451)	n	O	O	O	O
zHyperLink Express2.0 (Feature Code 0351)	S[b]	n	n	n	n

a. Support for zHyperLink writes requires compatible levels of IBM Storage DS8000® hardware and firmware R8.5.1 or later, and IBM Db2® 12 with PTFs.
b. IBM z17 performs hyperlink reads and writes for larger blocks of data than on prior machines, enabling new use cases.

Network connectivity

High-speed network connectivity between the IBM Z platform and external networks is supported by the Network Express, the Open Systems Adapter-Express (OSA-Express) features, and Remote Direct Memory Access (RDMA) over Converged Ethernet Express (Network Express) features. Internal connections for IBM Z platforms are provided through fast memory-to-memory communications by using HiperSockets and Internal Shared Memory (ISM).

Network connectivity functions are listed in Table 11.

Table 11 Network connectivity functions

Functions	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
640 TCP/IP addresses	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
PCIe Interconnect (PCI-IN)	O	O	O	O	O
Virtual MAC address support	S	S	S	S	S
VLAN management - Generic VLAN Registration Protocol (GVRP) support	S	S	S	S	S
Promiscuous mode[a]	S[b]	S	S	S	S
Supported CHPID types					
CHPID type OSC for integrated console controller (ICC) for all 1000BASE-T Ethernet features	n	S	S	S	S
CHPID type OSC for ICC for OSA-Express7S 1.2 GbE SX/LX features	S	S	S	n	n
OSA-ICC support for Secure Sockets Layer (SSL)	S	S	S	S	S
CHPID type OSH using enhanced QDIO[c] (EQDIO) functions for Network Express features	S	n	n	n	n
CHPID type OSD (for Queued Direct I/O (QDIO) supported on all OSA-Express features	S[d]	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 and Layer 3	S	S	S	S	S
CHPID type OSE for non-QDIO for all 1000BASE-T Ethernet features	n	S	S	S	S
PCI Functions (see next page)					

Functions	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
NETH[e] for SMC-R or PCIe based networking for Linux on Z[b]	S	n	n	n	n
NETD[f]	S	n	n	n	n

a. For z15 and z16, promiscuous mode capability is defined for an adapter in the operating system. This is no longer possible for the new Network Express adapters. Promiscuous mode capability with IBM z17 moved to the new function type NETH function. Whether a NETH virtual function supports promiscuous mode is now an attribute of the PCIe function in the I/O configuration.
b. A NETH Virtual function promiscuous mode support is now an attribute of the PCIe function in the I/O configuration.
c. OSH channels use Enhanced QDIO (aka EQDIO) architecture. They are the replacement for the OSD adapters. EQDIO requires OS Updates: (z/OS 2.5 or higher and z/VM 7.3 or higher).
d. IBM z17 users that require the QDIO architecture (CHPID type OSD) must use the OSA Express 7S or OSA-Express7S 1.2 features.
e. A single PCHID can be defined as both OSH and NETH provided OSH channel is not using link aggregation.
f. PCHID defined as NETD indicates that the Network Express adapter will be used in PF Access Mode and requires the PCI function type to be defined. NETD requires a PF or a VF keyword on the FUNCTION statement.

The optional Network Express and OSA Express features are listed in Table 12.

Table 12 Network connectivity features

Features	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Network Express					
Network Express 25G LR Feature Code 0527	O	n	n	n	n
Network Express 25G SR Feature Code 0526	O	n	n	n	n
Network Express LR 10G Feature Code 0525	O	n	n	n	n
Network Express SR 10G Feature Code 0524	O	n	n	n	n
Open Systems Adapter-Express7S 1.2 (OSA-Express7S 1.2)					
25-Gigabit Ethernet Long Reach (LR) (one port) Feature Code 0460[a]	O/CF	O	O	n	n
25-Gigabit Ethernet Short Reach (SR) (one port) Feature Code 0459[b]	O/CF	O	O	n	n
10-Gigabit Ethernet LR (one port) Feature Code 0456	O/CF	O	O	n	n

Features	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
10-Gigabit Ethernet SR (one port) Feature Code 0457	O/CF	O	O	n	n
1000BASE-T Ethernet (two ports and one CHPID) Feature Code 0458	n	O	O	n	n
Gigabit Ethernet LX (two ports and one CHPID) Feature Code 0454	O/CF	O	O	n	n
Gigabit Ethernet SX (two ports and one CHPID) Feature Code 0455	O/CF	O	O	n	n
Open Systems Adapter-Express7S (OSA-Express7S)					
25-Gigabit Ethernet SR1.1 (one port) Feature Code 0449[b]	n	CF	n	O	n
25-Gigabit Ethernet SR (one port) Feature Code 0429[b]	n	n	n	CF	O
10-Gigabit Ethernet LR (one port) Feature Code 0444	CF	CF	n	O	n
10-Gigabit Ethernet SR (one port) Feature Code 0445	CF	CF	n	O	n
1000BASE-T Ethernet (two ports with one CHPID) Feature Code 0446	CF[b]	CF	n	O	n
Gigabit Ethernet LX (two ports and one CHPID) Feature Code 0442	CF	CF	n	O	n
Gigabit Ethernet SX (two ports and one CHPID) Feature Code 0443	CF	CF	n	O	n
Open Systems Adapter-Express6S (OSA-Express6S)					
10-Gigabit Ethernet LR (one port) Feature Code 0424	n	CF	CF	CF	O
10-Gigabit Ethernet SR (one port) Feature Code 0425	n	CF	CF	CF	O
1000BASE-T Ethernet (two ports and one CHPID) Feature Code 0426	n	CF	CF	CF	O
Gigabit Ethernet LX (two ports and one CHPID) Feature Code 0422	n	CF	CF	CF	O
Gigabit Ethernet SX (two ports and one CHPID) Feature Code 0423	n	CF	CF	CF	O
Open Systems Adapter-Express5S (OSA-Express5S)					
10-Gigabit Ethernet LR (one port) Feature Code 0415[c]	n	n	n	CF	CF
10-Gigabit Ethernet SR (one port) Feature Code 0416[c]	n	n	n	CF	CF

Features	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
1000BASE-T Ethernet (two ports and one CHPID) Feature Code 0417	n	n	n	CF	CF
Gigabit Ethernet LX (two ports and one CHPID) Feature Code 0413	n	n	n	CF	CF
Gigabit Ethernet SX (two ports and one CHPID) Feature Code 0414	n	n	n	CF	CF

a. Requires a 25 GbE switch. Does not negotiate to 10 Gbps.
b. 1000BASE-T Ethernet FC 0446 is only available as Carry Forward from IBM z15 only.
c. Requires a 10 GbE switch. Does not negotiate to a lower speed.

Optional IBM Shared Memory Communications features and functions are listed in Table 13.

Table 13 IBM Shared Memory Communications features and functions

Features	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
10 GbE RoCE Express3 SR Feature Code 0440	n	O	O	n	n
10 GbE RoCE Express3 LR Feature Code 0441	n	O	O	n	n
25 GbE RoCE Express3 SR Feature Code 0452	n	O	O	n	n
25 GbE RoCE Express3 Long Reach (LR) Feature Code 0453	n	O	O	n	n
25 GbE RoCE Express2.1 Feature Code 0450	n	CF	CF	O	O
10 GbE RoCE Express2.1 Feature Code 0432	n	CF	CF	O	O
25 GbE RoCE Express2 Feature Code 0430	n	CF	CF	CF	CF
10 GbE RoCE Express2 Feature Code 0412	n	CF	CF	CF	CF
10 GbE RoCE Express Feature Code 0411	n	n	n	CF	CF
Shared Memory Communications-Remote Direct Memory Access (SMC-R)[a]	S	S	S	S	S
Shared Memory Communications-Direct Memory Access (SMC-D)	S	S	S	S	S
Shared Memory Communications V2 (SMC-R and DV2)[b]	S	S	S	S	S

a. On IBM z16 and prior, requires one OSA Express feature that is defined for TCP communications.
b. SMC Version 2 (SMCv2) defines the specifications that enable the multiple-IP subunit capability for SMC.

Supported HiperSockets functions and attributes are listed in Table 14.

Table 14 IBM HiperSockets functions

Functions and attributes	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
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)	n	n	n	n	n
Layer 2 support	S	S	S	S	S
Multiple Write facility	S	S	S	S	S
Network Traffic Analyzer	S	S	S	S	S
OSA Automation Toggling without operating system toleration[a]	S	S	S	n	n

a. Provides a method to serially config on/off OSA features. Requires OSA Express adapters to be configured redundantly.

On-demand functions

Capacity Upgrade on Demand (CUoD) is an inherent capability of the IBM Z architecture that adds concurrent capacity and features to the platform, depending on the physically available hardware.

Customer Initiated Upgrade (CIU) is a tool that supports ordering permanent and temporary upgrades for their IBM Z hardware. CIU helps to provide CUoD. CUoD upgrades can be ordered through CIU or by using the standard IBM Sales or miscellaneous equipment specification (MES) order process.

Although 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 the IBM Z platform. However, it cannot be ordered by using CIU.

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

The available on-demand functions are listed in Table 15 on page 18.

Table 15 On-demand functions

On-demand function	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
CUoD					
API for capacity provisioning management (CPM)	S	S	S	S	S
CBU	O	O	O	O	O
CPE[a]	n	CF	n	O	O
CIU-Express with extended staging	O	O	O	O	O
Concurrent memory upgrades	O	O	O	O	O
Concurrent permanent processor upgrade	O	O	O	O	O
Concurrent processor CPC drawer add[c]	O	O[b]	O[c]	O	O
Concurrent upgrades while temporary capacity is active	O	O	O	O	O
Flexible memory	O	O	n	O	n
High Water Mark (HWM) Increase total model capacity and Integrated Facility for Linux (IFL) processors without changing the active model capacity and IFL processors.	O	O	O	O	O
OOCoD	O	O	O	O	O
Plan-ahead memory	n	n	n	n	n
Up to 8 installed or active (OOCoD, CBU, or CPE[e]) records at any specific time	S	S	S	S	S
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
Central processors (CPs), IFL processors, Integrated Coupling Facility (ICF) processors, zIIPs, and SAPs	CF	CF	S	O	O
Manufacturing installation of up to four Flex Capacity and CBU records, when ordered	S	S	S	S	S
Maximum of 15 test activations (no-charge 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 and Reuse record	S	S	S	S	S

On-demand function	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Subcapacity CBU processors	O	O	S	O	O
Uninstalled LICCC records can be staged on the SE	O	O	O	O	O
CPE: Temporary upgrade					
CPs, IFL processors, ICF processors, zIIPs, and SAPs	n	CF	S	O	O
Manufacturing installation of up to four CPE[d] and CBU records when ordered	n	S	S	S	S
Nondisruptive hardware CP capacity setting changes	n	S	S	S	S
Select model capacity and type and quantity of engines based on business needs	n	S	S	S	S
OOCoD: Temporary upgrade					
Ability to replenish an ordered record	S	S	S	S	S
Administrative OOCoD testing	S	S	S	S	S
API for OOCoD 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
OOCoD - CPs, IFL processors, ICF processors, IBM Z Integrated Information Processors (zIIPs), and System Assistance Processors (SAPs)	O	O	O	O	O
OOCoD test	S	S	S	S	S
OOCoD with extended staging	O	O	O	O	O
Post-paid upgrades with spending limits controlled by tokens[e]	O	O	O	O	O
Pre-paid upgrades controlled by tokens[f]	O	O	O	O	O
Replenishment and Reuse record	S	S	S	S	S
Subcapacity engine support	S	S	O	S	S
Uninstalled LICCC records can be staged on the SE	O	O	O	O	O
System Recovery Boost Upgrade (temporary records and pre-paid)					
System Recovery Boost Upgrade - zIIP records for temporary capacity boost	n	O	n	O	n
Tailored Fit Pricing for IBM Z® hardware					
Tailored Fit Pricing for IBM Z - Hardware Consumption solution	O	O	O	O	O

On-demand function	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Ability to select the contract length (1 - 5 years)	S	S	S	S	S
Flexible Capacity for cyber resilience					
Flexible Capacity for cyber resilience[g]	O	O	O	n	n

a. Only supported on IBM z17 when carried forward from IBM z15.
b. IBM z16 A01 and IBM z17 Concurrent CPC Drawer is restricted going from 1-> 2 drawers and from 2 -> 3 drawers. 4-CPC drawer machines are factory only.
c. With IBM z16 A02 and AGZ Max32 with the plan-ahead feature, a second CPC drawer may be added concurrently when upgrading to a Max68.
d. With IBM z16 A01, CPE has been replaced by Flex Capacity. CPE can be carried forward but cannot be ordered for IBM z16 A01. CPE is not supported on IBM z16 A02 and IBM z16 AGZ, and IBM z17.
e. Post-paid; Requires contract. CP only
f. Pre-paid; Requires contract. CP only.
g. Production capacity shift cross-site between IBM z16 and IBM z17 machines for disaster recovery (DR) test, planned maintenance, proactive outage avoidance, and actual DR scenarios.

IBM Parallel Sysplex

IBM Parallel Sysplex® is a clustering technology that you can use to operate and manage up to 32 z/OS systems as a single system image (SSI) from a single point of control. The underlying structure of the Parallel Sysplex remains transparent to users, networks, applications, and operations.

To realize these benefits, 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 z/OS Parallel Sysplex unique from every other system, solution, and architecture that is available today.

Parallel Sysplex CF levels, connectivity features, and Server Time Protocol (STP) functions are listed in Table 16.

Table 16 Parallel Sysplex CF levels, connectivity features, and STP functions

Parallel Sysplex	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
CFLevel=26	S	n	n	n	n
Dedicated CPs in a CF image	n	S	S	S	S
Virtual Flash Memory in a CF image	n	S	S	S	S
CFLevel=25[a]	n	S	S	n	n
Structure Full Recovery	S	S	S	n	n

Parallel Sysplex	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Cache and Lock structures retry enhancements	S	S	S	n	n
Additional Cache Structure Metrics	S	S	S	n	n
CF Support for 224 tasks	S	S	S	n	n
CFLevel=24	n	n	n	S	S
CFCC Fair Latch Manager	S	S	S	S	S
CFCC Message Path Resilience enhancement	S	S	S	S	S
CF Monopolization Avoidance	S	S	S	S	S
CFLevel=23	n	n	n	n	n
CFLevel=22	n	n	n	n	n
System-managed CF structure duplexing	S	S	S	S	S
Coupling Facility dynamic dispatch ON/OFF	n	n	n	S	S
Coupling Facility Thin Interrupt	S	S	S	S	S
Coupling facility shared processors	S	S	S	S	S
ICF	O	O	O	O	O
z/VM guest coupling	S	S	S	S	S
Coupling Links features for Parallel Sysplex clustering					
Integrated Coupling Adapter (ICA SR) (two ports and eight CHPIDs) Feature Code 0172	n	CF	CF	CF	CF
Integrated Coupling Adapter (ICA SR1.1) (two port and eight CHPIDs) Feature Code 0176	n	O	O	O	O
Integrated Coupling Adapter (ICA SR2.0) (two port and eight CHPIDs) Feature Code 0216	O	n	n	n	n
Coupling Express2 Long Reach - (two ports and 4 CHPIDs) Feature Code 0434	n	O	O	n	n
Coupling Express3 LR 10G (two ports and 4 CHPIDs) Feature Code 498	O	n	n	n	n
Coupling Express3 LR 25G (two ports and 4 CHPIDs) Feature Code 499	O	n	n	n	n
Internal Coupling (IC) link[b]	S	S	S	S	S
Server Time Protocol (STP)[c]					
External Time Source direct Ethernet connectivity to platform (Network Time Protocol (NTP) and Precision Time Protocol (PTP))	S	S[d]	S[d]	n	n

Parallel Sysplex	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
STP Improved Security Chrony NTP, Network Time Security (NTS) for NTP and PTP, and PTP authentication	S[e]	n	n	n	n
Graphical setup and configuration at the HMC	S	S[d]	S[d]	S[f]	S[f]
Coordinated Timing Network (CTN) Dynamic Split or Merge	S	S	S	S	S
Additional stratum level (4)	S	S	S	S	S
Continuous availability of NTP servers	S	S	S	S	S
HMC used as an NTP server[g]	S	S	S	S	S
NTP server with pulse per second (PPS)[h]	S	S	S	S	S
NTP client	S	S	S	S	S
IEEE 1588 PTP support as External Time Source[i]	S	S	S	S[j]	S[k]
PTP server with pulse per second (PPS)	S	S	S	S	S
Going away signal to improve recovery	S	S	S	S	S
Sysplex Time with PTP direct to CPC	O	O	O	n	n
n-mode Power STP imminent Disruption signal[l]	S	S	S	n	n
Enhanced Console Assisted Recovery	S	S	S	S	S
Save STP configuration and time information across power-on resets (PORs) 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. Enhancements for CFCC Level 25. CFCC Level 25 includes enhancements from previous CFCC levels. Require OS support.
b. 64 per CPC for IBM z17, IBM z16™ and IBM z15, up from 32 per CPC for previous generations. Total Coupling CHPIDs that are allowed are 384 for IBM z15, IBM z16 and IBM z17, and 256 for earlier servers.
c. The STP feature is optional and does not need to be in a sysplex environment.
d. Setting up STP for IBM z16 requires HMC 2.16.0.
e. Requires IBM z17 HMC (HMC 2.17.0).
f. Setting up STP for IBM z15 requires HMC 2.15.0 or later.
g. The HMC must be at level 2.15.0 or later for an STP-only CTN to obtain its external time. This feature is not available when the HMC is used as NTP server.
h. Not available when the HMC is used as NTP server.
i. Requires a PTP-capable infrastructure (including networking support). Requires PPS.
j. For IBM z15, PTP Server connectivity is provided through an SE management network connection.
k. Available only if PTS or Current Time Server (CTS) and Backup Time Server (BTS) are IBM z16 CPCs. Other CPCs in the Timing Network (including Arbiter) can be a mix of IBM z16 or legacy CPCs.

l. Must be configured (opt-in). Requires that both PTS and BTS are on IBM z16 and IBM z17.

Performance

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

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 IBM Z platform that contribute to overall performance and throughput are listed in Table 17.

Table 17 Performance

Performance	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
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 hardware compression (**CMPSC**)	S	S	S	S	S
IBM Integrated Accelerator for IBM zEnterprise® Data Compression Express (zEDC)	S	S	S	S	S
IBM Integrated Accelerator for IBM zSort	S	S	S	S	S
IBM Z Integrated Accelerator for AI	S	S	S	n	n
Dedicated move page engine	S	S	S	S	S
Dynamic CF dispatching	n[a]	n[a]	n[a]	S	S
Dynamic Address Translation (DAT)	S	S	S	S	S
Enhanced Move Page for virtual machines (VMs)	S	S	S	S	S
Extended translation facility	S	S	S	S	S
Extensions for VMs	S	S	S	S	S
Flexible memory configurations[b]	O	O	n	O	n
Floating point instruction[c]	S	S	S	S	S
Hardware decimal floating point facility	S	S	S	S	S
Hexadecimal floating point (HFP) square root instruction[c]	S	S	S	S	S
HiperDispatch function	S	S	S	S	S
Immediate and relative instruction[c]	S	S	S	S	S

Performance	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Large Page Support	S	S	S	S	S
1 MB large page support (pageable)	S	S	S	S	S
2 GB large page support	O	O	O	O	O
Level 1 cache size (Instruction (i) and Data (d) in KB)	128(i) 128(d)	128(i) 128(d)	128(i) 128(d)	128(i) 128(d)	128(i) 128(d)
Level 2 cache size (Instruction and Data in MB)	36[d]	32[d]	32[d]	4/4	4/4
Level 3 cache size (in MB)	360[e]	256[f]	256[f]	256	256
Level 4 cache size (in MB)[g]	2880	2048	2048[h]	960	960
Logical string assist	S	S	S	S	S
Long displacement facility	S	S	S	S	S
Number of PU cores per processor unit[i]	8/16	8/16	8/16	12	12[j]
DPU[k] I/O Processor engine (1 per PU core)	S	n	n	n	n
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 (PLO)	S	S	S	S	S
Plan ahead memory	n	n	n	n	n
Processor frequency (Ghz)	5.5	5.2	4.6	5.2	4.5
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 multithreading (SMT) on zIIPs, IFL processors, and SAPs	S	S	S	S	S
Single Instruction Multiple Data (SIMD)	S	S	S	S	S
System Recovery Boost[l]	S	S	S	S	S
z/OS Recovery Process Boost	S	S	S	S	S
System Recovery Boost Upgrade (Feature Code 6802)	n	O	O	O	O
zIIPs	O	O	O	O	O
Transactional Memory	S[m]	S	S	S	S

Performance	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Trimodal addressing (24-, 31-, and 64-bit addressing) support	S	S	S	S	S
zHyperLink Express1.1 (FC 0451)	n	n	n	S	S
zHyperLink Express (FC 0431)	n	S	S	n	n
zHyperLink Express2.0 (FC 0351)	S	n	n	n	n
Maximum supported memory (in TB)[n]	64	40	16[o]	40	16
zEDC					
zEDC Feature Code 0420[p]	n	n	n	n	n
On-chip IBM Integrated Accelerator for zEDC	S	S	S	S	S
Sort Accelerator					
On-core Sort Accelerator	S	S	S	S	S
Artificial Intelligence (AI)					
On-core Integrated Accelerator for Artificial Intelligence (AIU)	S[q]	S	S	n	n
IBM Spyre™ Accelerator[r] PCI Adapter	O	n	n	n	n
Virtual Flash Memory (VFM)					
Virtual Flash Memory (VFM)	O[s]	O	O	O	O

a. Only **DYNDISP THIN** is supported on IBM z16 and IBM z17. Coupling Facility Dynamic Dispatching ON/OFF is not supported on IBM z16 and IBM z17, and if it is specified, a warning message indicates that the CF image will use **DYNDISP THIN** instead.
b. Flexible Memory is an option for multi-drawer systems to alleviate memory requirements when a CPC drawer is replaced (concurrently).
c. For more information, see *Principles of Operation*, SA22-7832.
d. IBM z16 has a unified L2 cache, with 32 MB semi private to each core. IBM z17 has a unified L2 cache with 36 MB semi private to each core.
e. Virtual L3 and L4 caches. For IBM z17, L3 and L4 caches are logical constructions.
f. Virtual L3 and L4 caches. For IBM z16, L3 and L4 caches are logical constructions.
g. At the CPC drawer level. A multiple-CPC system uses SMP connectivity for L4 cache coherency at the system level.
h. IBM z16 A02 and the IBM z16 AGZ L4 cache sizes are 1024 MB for Max5 and Max16, and 2048 MB for Max32 and Max68.
i. Eight cores per PU chip and 16 cores per (dual-chip module (DCM) maximum. The maximum number of cores is not available on all PUs chips or DCMs.
j. Twelve cores by design with 7 - 11 active cores.
k. There is one DPU in every IBM z17 Tellumii processor chip.
l. For more information about use cases for recovery process boosts, see *Introducing IBM Z System Recovery Boost*, REDP-5563. Requires operating system opt-in.
m. Non-Constrained Transactional Execution Support is limited on the IBM z17.
n. The maximum amount of memory depends on the system configuration and the number of CPC drawers.
o. The maximum memory is 8 TB for one CPC drawer and 16 TB for two CPC drawers.

p. For the IBM z17 server generation (M/T 9175), IBM z16 server generation (M/T 3931 and M/T 3832) and for the IBM z15 server generation (M/T 8561 and 8562), Feature Code 0420 PCIe Feature (zEDC) has been replaced by the on-chip IBM Integrated Accelerator for zEnterprise Data Compression.
q. IBM z17 implements the Telum II 2nd generation on-core Integrated Accelerator for Artificial Intelligence.
r. Statement of general direction: The IBM Spyre AI Accelerator is planned to be available starting in 4Q 2025, in accordance with applicable import/export guidelines.
s. Six Features of 512 MB each - Total of 6TB of VFM.

Processor Resource/Systems Manager

IBM Processor Resource/Systems Manager (PR/SM) consists of hardware and microcode that is built into the IBM Z platform to support the sharing of available hardware resources in logical partitions (LPARs). With LPARs, you can run multiple system images on a single CPC. Each image includes a full complement of CPUs (dedicated or shared), memory, and channels (for storage and network connectivity). Channels can be shared across images by using the MIF feature.

The PR/SM function ensures the highest level of optimized resources usage (near to 100%). The main characteristics of PR/SM are listed in Table 18.

Table 18 PR/SM characteristics

PR/SM characteristics	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
128-bit time of day (TOD) clock (Extended TOD clock facility)[a]	S	S	S	S	S
Absolute capping support of PUs (all types)	S	S	S	S	S
Absolute capping support of an LPAR group	S	S	S	S	S
Add or delete an LPAR 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	S	S
Dynamic Storage Reconfiguration	S	S	S	S	S
Dynamic PU reassignment	S	S	S	S	S
EAL5 certification	S[b]	S	S	S	S
Hardware system area (HSA) size (in GB)	884	256	160	256	160
Hypervisor support for virtualization: z/VM	S	S	S	S	S
Hypervisor support for virtualization: KVM	S	S	S	S	S
Individual management of PU types	S	S	S	S	S
LPAR time offset	S	S	S	S	S

PR/SM characteristics	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
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
Maximum number of configurable processors	208	200	68	190	65
Maximum number of CPs	208	200	6[c]	190	6
Maximum number of supported LPARs	85	85	40	85	40
Maximum number of supported LCSS	6	6	3	6	3
Maximum number of subchannel sets per LCSS	4	4	3	4	3
SMT for IFL processors, zIIPs, and SAPs	S	S	S	S	S
SIMD	S	S	S	S	S
Single storage pool	S	S	S	S	S
SSC	S	S	S	S	S
Secure Execution for Linux[d]	S	S	S	S	S
Dynamic Partition Manager (DPM)	O	O	O	O	O
Intelligent Resource Directory (IRD)					
CSS priority queuing	S	S	S	S	S
Dynamic Channel Path Management (DCMs)	S	S	S	S	S
LPAR CPU management	S	S	S	S	S
Processor types					
CP	O	O	O	O	O
SAP[e]	O	S,O	S	S,O	S,O
ICF	O	O	O	O	O
IFL	O	O	O	O	O
IFP[f]	O	S	S	S	S
zIIP	O	O	O	O	O

a. The Extended-TOD-Clock Facility is a hardware facility that provides a 128-bit TOD clock.
b. Certification is pending for IBM z17.
c. For Max5, the maximum number of CPs is five.
d. Secure Execution for Linux for second-level Linux guests (Feature Code 0115).
e. SAPs are standard. The initial number of SAPs is model-dependent. Additional SAPS cannot be added to the IBM z17. Additional (optional) SAPs can be added through Feature Code 1963 on IBM z16 A01, Feature Code 1949 on IBM z15. IBM z17, IBM z16 A02, and IBM z16 AGZ do not support additional SAPs.

f. Two IFPs are standard and not defined by the customer. IFPs are used for infrastructure management.

Reliability, availability, and serviceability

The IBM Z design is focused on providing higher availability by reducing planned and unplanned outages, which is commonly known as *reliability, availability, and serviceability* (RAS). RAS can be accomplished by using improved concurrent replace, repair, and upgrade functions for processors, memory, and I/O. RAS also extends to the non-disruptive capability for installing 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 the IBM Z platform delivers exceptional value.

The main RAS features of IBM z17, IBM z16, and IBM z15 are listed in Table 19.

Table 19 RAS features

RAS	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
50/60 Hz power	S	S	S	S	S
Three-phase AC power	S	S	S	S	O
DC power	n	n	n	n	n
Ability to display and track historical power, temperature, and utilization data	S	S	S	S	S
Alternative HMC[a]	S	S	S	S	S
Alternative SE	S	S	S	S	S
Hardware Management Appliance (HMA)	S	O	S	O[b]	O[b]
Remote Code Load	S	S	S	n	n
Bolt-down kit for low-raised floor and high-raised floor installation [c]	O	O	O[d]	O	O
Bolt-down kit for non-raised floor installation[c]	O	O	O[d]	O	O
Concurrent channel adapter add	S	S	S	S	S
Concurrent processor drawer add	S	S[e]	S[f]	S[e]	n
Concurrent PCIe+ I/O drawer add	S	S[g]	S[g]	S[g]	S[g]
Dynamic Fabric repair	S	S	S	S	S
Concurrent PU conversions	S	O	O	O	O
Console Integration (CI)	S	S	S	S	S

RAS	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Digitally signed firmware that is provided by the HMC and SE	S	S	S	S	S
Dynamic change to partition a 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 planning	S	S	S	S	S
Dynamic memory bit lane sparing	S	S	S	S	S
Dynamic memory sparing[h]	S	S	S	S	S
Dynamic oscillator switchover	S	S	S	S	S
Dynamic partition add without planning	S	S	S	S	S
Dynamic subchannel set add without planning	S	S	S	S	S
Enhanced application preservation	S	S	S	S	S
Enhanced drawer availability (EDA) for a processor drawer[i]	S	S	S	S	S
Two DCMs on a 3932 Max5	n	n	S	n	n
Fault-tolerant design	S	S	S	S	S
FCP program directed IPL	S	O	S	O	O
IBM FICON channel link error problem analysis	S	S	S	S	S
FIDR - FICON Dynamic Routing	S	S	S	S	S
FICON forward error correction (FEC) for FICON[j]	S	S	S	S	S
FICON link incident reporting	S	S	S	S	S
FICON SAN Fabric I/O Priority for Workload Manager (WLM)	S	S	S	S	S
FICON multihop cascaded directors (maximum number of directors)	4	4	4	4	4
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	S	S
HMC instant messenger	S	S	S	S	S
I/O interface reset	S	S	S	S	S
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

RAS	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
Memory RAIM	S	S	S	S	S
Monitor and track power consumption, internal temperature, and utilization data of the CPC by using the 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 distribution union (PDU) power option	S	O	O[k]	O	S
Bulk Power Assembly (BPA) power option	n	O	na	O	na
Balanced Power - Plan ahead (BPA models only)	n	O[l]	na	O	na
Power - dual power feeds	S	S	S	S	S
Power - Plan ahead power cords[m]	O	O	O	O	n
Power consumption estimator tool (IBM Resource Link)	S	S	S	S	S
Manage Power Service State (HMC) (CPC power redundancy check)	S	S	S	S	S
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	S	S
PU sparing (if a spare is available, which is config dependent)	S	S	S	S	S
SAP reassignment	S	S	S	S	S
Sparing for storage protect keys	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 L2, L3, and L4 cache	S[n]	S[n]	S[n]	S	S
System-initiated CHPID reconfiguration	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 a field-replaceable unit (FRU)	S	S	n	S	n

RAS	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
WWPN tool to help with planning and setting up a SAN environment before installation	S	S	S	S	S
IBM Z Connectivity Mapping Tool[o]	O,S	O,S	O,S	O,S	O,S
Concurrent maintenance					
Channel - Adapter	S	S	S	S	S
Cooling units (water-cooled)[p] Water Cooling Unit (WCU)	n	n	n	S	n
Cooling units (air cooled)[q] Radiator Cooling Unit (RCU)	S	S	n	S	n
CPC drawer (including memory DIMMs)[i]	S	S	S	S	S
Enhanced driver maintenance	S	S	S	S	S
HMC[r]	n	S	S	S	S
IFB-MP	na	na	na	na	na
Oscillator	S	S	S	S	S
PCIe+ I/O drawer[g]	S	S	S	S	S
PCI-IN	S	S	S	S	S
Point of Load (POL) - CPC drawer power regulators[s]	S	S	S	S	S
Single-Chip Module (SCM)	na	na	na	S	S
Dual Chip Module (DCM)	S	S	S	na	na
SE	S	S	S	S	S
Concurrent MCL apply					
CFCC[t]	S	S	S	S	S
Channel features					
CE LR[u]	n	n	n	O	O
CE2 LR[v]	n	O	O	na	na
CE3 LR[t]	O	n	n	n	n
RoCE Express[t]	n	S	O	O	O
Crypto-Express[t]	O	O	O	O	O
FICON-Express	O	O	O	O	O
IC	OS	O	O	O	O
ICA SR / ICA SR 1.1	n	OS	O	O	O
ICA SR 2.0	O	n	n	n	n

RAS	IBM z17 ME1	IBM z16 A01	IBM z16 A02 IBM z16 AGZ	IBM z15 T01	IBM z15 T02
HCA3 features	na	na	na	na	na
OSA-Express	S	S	S	S	S
OSA Express7S 1.2 (OSC or OSD)	O	n	n	n	n
zHyperLink / zHyperLink 1.1	n	O	O	O	O
zHyperlink 2.0	O	n	n	n	n
HMC[w]	n	O	O	O	O
SE	S	S	S	S	S
PU core engineering data	S	S	S	S	S

a. With HMA (Feature Code 0129), two HMCs are always available. Stand-alone HMC is not supported on IBM z17.
b. HMC running on the SE hardware. Available with an initial order only, no MES.
c. This feature applies to a raised-floor environment. This feature supplies the kit of parts that are designed to help secure the frames and their contents from damage when exposed to vibrations and shocks, such as in a seismic event.
d. The rack or cabinet may be securely bolted to the floor, ceiling, or walls, or to adjacent racks or cabinets in a long and heavy row of racks or cabinets.
e. On IBM z16 A01, a field addition (MES) of the fourth CPC drawer is not supported (upgrades from IBM z16 A01 Max39 to Max82 or Max125 only). For IBM z15 T01, a field addition of fourth or fifth CPC drawers is not supported (upgrades from IBM z15 T02 Max31 to Max65 or Max108 only). A CPC reserve feature must be present in the initial order for supported upgrades.
f. With the plan-ahead feature, a second drawer may be concurrently added to IBM z16 A02 and IBM z16 AGZ when upgrading to a Max68.
g. IBM z17, IBM z16, and IBM z15, are housed in an industry standard, 19-inch format frame. A new PCIe+ I/O drawer (capable of hosting up to 16 PCIe features) was designed and built to fit the 19-inch rack. IBM z17, IBM z16 and IBM z15 do not support a PCIe I/O drawer (capable of hosting 32 PCIe features). Adding a PCIe+ I/O drawer is concurrent.
h. Sparing can be done with steering or marking technology.
i. Applies to systems with two or more processor drawers.
j. All FICON features that are newer than FICON EXPRESS16S have FICON Error Correction (FEC) implemented.
k. IBM z16 A02 is powered by IBM Z intelligent power distribution units (iPDUs).
IBM z16 AGZ is powered by the client's provided PDUs. (IBM Z firmware has no control over or communication with the client PDUs).
l. Balanced Power is available with PDU models.
m. Available for BPA models only.
n. For IBM z16 and IBM z17, L3 and L4 levels are implemented as virtual shared victim caches.
o. The Connectivity Mapping Tool is used with IBM z17. It replaces the CHPID Mapping tool used in prior IBM Z servers up to IBM z16.
p. IBM z15 T01 only. WCU is not offered for IBM z16 / IBM z17.
q. Exchanging the RCU is not concurrent. Within the RCU, The Radiator Pump Unit (RPU) and the Cooling Fan Assembly (CFA) are concurrent-replaceable.
r. Stand-alone HMC is not supported on IBM z17.
s. Point Of Load (POL) is a CPC drawer power distribution system. Replacement is concurrent for models with two or more CPC drawers, using EDA.
t. A CF partition restart might be required.
u. Requires planning for maintenance and redundant adapters.
v. Requires planning for maintenance and redundant adapters.

w. HMA is the only feature supported by the IBM z17. Rack-mount and Desktop HMCs are not supported.

IBM Z Platform Certifications

The table below shows the IBM Z Platform Certifications obtained from these independent Certification Authorities:

- BSI (Bundesamt für Sicherheit in der Informationstechnik) in Germany
- NIAP-CCEVS (CC Evaluation and Validation Scheme) in the U.S
- OCSI (Organismo di Certificazione della Sicurezza Informatica) in Italy
- NIST (National Institute of Standards and Technology) in the U.S.

The table's links direct you to websites hosting the respective certificates, available for download. Note that these certifications typically come after IBM Z products become generally available.

Table 20 IBM Z certifications

IBM Z Certifications	**IBM z17**[a]	**IBM z16** (Driver 51C Bundle 4B)	**IBM z15** (Driver 41C Bundle S21b)
All the IBM Z models are designed for Common Criteria Evaluation Assurance Level 5+ (EAL5+) certification for security of logical partitions. This means that the IBM Z is designed to prevent an application running on one operating system image on one LPAR from accessing application data running on a different operating system image on another LPAR on the server.	na	BSI-DSZ-CC-1186-2023	BSI-DSZ-CC-1133-2020 and BSI-DSZ-CC-1160-2021
z/VM Evaluation Assurance Level 4 (EAL4+).	na	Certificate	
z/VM System SSL Module has been validated as conforming to the Federal Information Processing Standard (FIPS) 140-2.	na	Certificate	
Crypto 8S (CEX8S) 4770 FIPS 140-2 Level 4 PCI HSM	na	Certificate number 4558 PCI PTS Website[b]	
Crypto7S (CEX7S) 4769 FIPS 140-2 Level 4 PCI HSM	na		Certificate number 4079 PCI PTS Website0[b]

IBM Z Certifications	IBM z17[a]	IBM z16 (Driver 51C Bundle 4B)	IBM z15 (Driver 41C Bundle S21b)
Crypto6S (CEX6S) 4768 FIPS 140-2 Level 4 PCI HSM	na		

a. IBM z17 certifications will be added to this document as they become available.
b. Once the PCI link opens, enter the Crypto xS number (4768,4769 or 4770) in the search field and press enter.

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