IBM Z with z/OS Resilience Best Practices Guide

Experienced Technical Architect or Designer

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Introduction

Cyber-Resilience characteristics delivered by IBM Z® are critical to large business enterprises, ensuring that their IT enterprise maintain the highest levels of continuous availability for critical business workloads. Independent resilience and security comparisons done by the Information Technology Intelligent Consulting (ITIC) reports in 2020 and 2021[1] continue to cite IBM Z and Power Systems™ as the highest rated servers in the industry!

The IBM Z server, built on a resilient foundation that includes hardware, software, firmware, middleware, and cyber-resilience, provides the level of resiliency required for systems of record, not only for core CICS®* and IMS™* workloads, but also for newer technologies like machine learning and analytics applications, as well as a web infrastructure that supports high transaction rates for 24-7-365 operations.

IBM Z installations typically introduce a z/OS® Parallel Sysplex® as an initial step to achieving continuous availability. Redundant system resources can then recover at the point of an incident and enable a rapid cross-system restart. For planned outages, existing CPU resource can absorb the workload. Another step to improve resiliency is enabling workloads to share databases and other logical resources in a Parallel Sysplex with much faster recovery times, eliminating or reducing any outage with little or no data loss.

Continuous Availability is achieved by mitigating both planned and unplanned outages. Recovery objectives for data center component failures are often expressed in seconds or minutes, depending on the technology used and how well the installation's system recovery actions are automated. Disaster recovery (DR) is also critical to handling events that result in a full data center outage.

IBM Z installations with the highest levels of system and application availability institute a culture of best practices that include the configuration of the system and subsystem environments, business, and systems management, all focused on sustaining continuous availability for their business.

This document offers best practices for achieving continuous availability and disaster recovery. Given common requirements stated by many companies to approach or reach (and maintain) business workloads with the highest levels of resilience, the Best Practices information is intended to help all those involved in maintaining consistency and to address your company's IT resilience goals. The information continues the focus on IBM Z resilience documented in "How Resilient Is Your IBM Z System of Record?"[2] which describes the IBM Z Resiliency Maturity Model used to map the progression for IBM Z clients with different levels of

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[1] See ITIC 2020 Global Server Hardware, Server OS Reliability Report at https://www.ibm.com/downloads/cas/DV0XZV6R and ITIC 2021 Global Server Hardware, Server OS Security Report at https://www.ibm.com/downloads/cas/AWAL0AXY
[2] "How Resilient Is Your IBM Z System of Record?", https://techchannel.com/Enterprise/07/2019/ibm-z-system-of-record

resiliency requirements. Key high-level points are provided, along with links to IBM Redbooks®
and other materials.

It is our hope that IT Systems Architects, Developers, Technical Specialists, and Site Reliability
Engineers will leverage the best practices resources in assuring that their platform can achieve
continuous availability.

Best Practices for maintaining the highest levels of system Resilience

1. Review how the Health Checker for z/OS is being used on your system. The Health
   Checker validates many configuration-related best practices to avoid unintentional
   problems that could impact system resilience. For the best coverage, it is important to
   activate all checks and pay particular attention when an exception is raised. It is critical
   that all checks be activated, whether using IBM default comparison metrics, or values
   that better reflect your business workloads. **See Note 1.**

2. Implement IBM's Resilience strategy focused on the highest levels of resilience by:

   a. Keeping the servers up by trying to eliminate planned and unplanned outages.

   b. Keeping applications available if a Logical Partition (LPAR) is down for whatever
      reason, such as to perform maintenance.

   c. Providing rapid recovery, possibly down to seconds, if there is a site disaster.

   d. Test your Disaster Recovery site regularly, including switching to the recovery site and
      returning to the primary site.

   e. Automate as much of the recovery as possible, eliminating manual steps that can slow
      down recovery time in the event of a workload or system outage. Ensure redundant
      IBM Z, z/OS environments are established for failover or automated recovery. **See
      Note 2**.

   f. Ensure IBM Z infrastructure, data and storage are replicated to a second or third data
      center, depending on your business' requirements for very short RTO and RPO metrics
      (e.g., to meet compliance requirements).

   g. Ensure sufficient resources including processors, memory, and capacity to run
      production workloads to guarantee successful failover or recovery from a storage
      failure.

   To accomplish this:

   a. Deploy Parallel Sysplex architecture for site-level availability while exploiting the
      integrated performance and RAS components in z/OS

   b. Deploy GDPS® disaster recovery and continuous availability solutions for cross-site
      availability and the best data replication solutions.

   c. Deploy GDPS HyperSwap® capability to drive data availability for disk subsystem
      problems

d. Greatly reduce recovery time for planned outages as well as if there is a site disaster through System Recovery Boost, available with IBM z15™ onward

e. Implement resilience best practices prescribed by the major z/OS data managers, like Db2® and VSAM, and the major transaction managers, like CICS and IMS. Implement resilience best practices prescribed by the major z/OS data managers, like Db2 and VSAM, and the major transaction managers, like CICS and IMS. **See Note 3.**

f. There are multiple options for distributing Coupling Facility (CF) instances across IBM Z servers. In large production sysplexes, it is recommended to configure a remote standalone CF (SACF) server with sufficient failure isolation to avoid losing data in the event of a CEC failure. To avoid a Power-On Reset (POR) for any I/O configuration change, Hardware Configuration Definition (HCD) and firmware introduced the capability to perform a hardware-only dynamic activation for remote standalone coupling facilities (SACFs) with z14 GA2 and following servers. **See Note 8** for additional information.

3. Perform resiliency assessments at a regular cadence in alignment with your Business Continuity plan. (Consider leveraging your zForward credits for assessments)

   a. Review how your systems are exploiting key technologies in IBM Z and z/OS and consider deploying technologies to improve your systems' reliability, availability and performance.

4. Ensure you are capturing SMF 98.1 records to facilitate diagnostic evaluation of transient performance problems, using the IBM Z Workload Interaction Navigator (zWIN), an IBM Z Software product.

5. Take advantage of Instant Recovery for a combination of key platform capabilities, including:

   a. Single server availability with IBM Z architecture and design, including the many unique reliability, availability, and serviceability (or, "RAS") characteristics integrated throughout the stack.

   b. Site-level availability with Parallel Sysplex architecture.

   c. Cross-site availability with GDPS continuous availability and disaster recovery solutions.

   d. Data availability for disk subsystems with GDPS HyperSwap technology.

6. Resolve your Batch resiliency requirements using IBM Batch Resilience (IZBR)

7. Establish rigorous test environments, starting with development testing, up through Quality Assurance testing, to ensure all elements work together reliably. Further improve your IBM Z application delivery through load and stress testing with workloads that mimic real production workloads. This testing may require additional capacity to scale up the test environment, as an extension of your Quality Assurance test environment. Contact your IBM Account or Sales team to discuss this need. See Note 4.

8. Leverage Lab Services for training and expertise on use of diagnostic tooling, such as RMF™ Monitor III, OMEGAMON®, z/OS Runtime Diagnostics and the IBM Z Workload Interaction Correlator and Navigator (zWIC/zWIN). See Note 5.

9. Ensure that your Parallel Sysplex environment follows Best Practices. See Note 6.

10. Exploit critical Resilience software products to enable availability aspects of your business IT environment. **See Note 7.**

Notes:

1. The IBM Health Checker reviews component configurations to meet best practices. The Health Checker is a base component of z/OS, and therefore "free". It is set up by default to execute at a stated frequency, with exceptions raised as z/OS system messages. Exception details are available via SDSF, OMEGAMON for z/OS and some ISV products. IBM Z customers should consider running the Health Checker for z/OS (with checks enabled) at least weekly, or after every change window at a minimum.

   For installations that have not customized the health checks for their system environments (to avoid false positives), IBM Z Lab Services can incorporate helping clients with z/OS Health Checker setup as a part of the Resiliency Rapid Tech Assessment, possibly using zForward credits to pay for the service

2. Invest in redundancy in your hardware structure when considering redundancy in the rest of your system design.

   a. Have at least one extra card of each I/O type (FICON®, OSA, Crypto, Coupling, etc.) to allow for service on the card that is fully concurrent.

   b. Pay attention to your partitions; I/O redundancy is measured at the operating system level. Having redundant I/O cards, but all the cards for a given partition in one I/O domain or I/O drawer defeats your redundancy strategy.

   c. Concurrent Drawer Repair is a powerful tool for hardware availability. I/O commands can be routed through the other drawer and processor workload will also be moved. Of course, this requires you have a second drawer available. A single drawer solution does not benefit from concurrent drawer repair.

   d. Completely automate recovery tasks to avoid manual steps when recovering from an outage. Many site recovery steps are implemented by GDPS. But workload, data replication and other steps can be automated using your automation product, whether it be IBM's System Automation or an equivalent ISV product.

3. The IBM Redbook ["Getting Started with IBM Z Resiliency"](#) is an excellent resource for Resilience configuration best practices for z/OS and the major subsystems (transaction managers like CICS, IMS, WebSphere®, and data managers like Db2, DL/I, VSAM).

4. In support of Load and Stress testing, stress test drivers are available from IBM, including IBM Rational® Performance Tester or IBM Workload Simulator for z/OS in support of simulation setup and testing. IBM Consulting offers a performance and stress test framework called IBM IGNITE Quality and Test, which utilizes Rational Test products.

5. Recommendations on the use of z/OS SMF 98 (High Frequency Throughput Statics) can be found at [Recommendations For z/OS SMF98 Records (ibm.com)](#). Information on the IBM Z Workload Navigation Navigator can be found at [IBM z/OS Workload Interaction Navigator - Overview | IBM](#).

6. Parallel Sysplex: There are several Redbooks and other references with helpful advice on setting up a Parallel Sysplex environment with the highest levels of Resilience. Some include:

   a. Parallel Sysplex Best Practices,
      https://www.redbooks.ibm.com/abstracts/sg247817.html?Open
   b. Scaling the Sysplex on IBM Z,
      https://www.redbooks.ibm.com/abstracts/crse0305.html?Open
   c. Parallel Sysplex Achieving Highest Levels of Availability,
      https://www.redbooks.ibm.com/abstracts/sg246061.html?Open
   d. Parallel Sysplex Application Considerations,
      https://www.redbooks.ibm.com/abstracts/sg246523.html?Open
   e. ABC's of z/OS System Programming: Volume 5 (Sysplex topics),
      https://www.redbooks.ibm.com/abstracts/sg246985.html?Open
   f. A draft "Parallel Sysplex Check List" is available at
      https://www.ibm.com/downloads/cas/W54PP4LN … contains detailed advice on the configuration of all z/OS Parallel Sysplex features and components.

      In addition, for internal IBM users, see the list of IBM Z Resilience assets contained in box note, https://ibm.ent.box.com/file/842376972176

7. Exploit critical Resilience software products to enable availability aspects of your business IT environment. For example:
   a. Base systems management (Resilience Maturity levels 1, 2)

      1. IBM Z Monitoring Suite: Simplify the monitoring and management of z/OS environments, offering a single point of control for many system elements.

      2. IBM Z Service Management Suite: A single point of control for comprehensive management of your z/OS enterprise, including monitoring, control and automation

      3. IBM Z Storage Management Suite: provides extensive capabilities to monitor and manage z/OS storage hardware and software resources, including private, hybrid or cloud storage for z/OS.

      4. IBM Z Service Automation Suite: Automates and controls a large range of system elements spanning both the hardware and software resources of enterprises in a sysplex.

b. Advanced management products (Resilience Maturity levels 3, 4)

1. IBM Z App Perf Management Connect: Helps customers achieve full end-to-end application monitoring and enable faster problem isolation to reduce downtime by providing transaction tracking information from z/OS subsystems to APM solutions, including Instana (an IBM Company) and AppDynamics

2. IBM Z Performance Capacity Analytics: End to end near-time collection, curation and reporting for simplified performance, cost and capacity management

3. IBM Z Anomaly Analytics: Enables problem identification, isolation and resolution on IBM Z through analysis of structured and unstructured operational data … including the ability to search, visualize and analyze large amounts of structured and unstructured operational data across IBM Z environments, including log, event and service request data and performance metrics.

8. To perform a hardware-only dynamic activation for remote standalone coupling facilities (SACFs), the activation can be driven by a z/OS system by invoking a hardware activation service on the remote SACF. It is best practice to use the hardware-only dynamic activate for SACF processors. The z/OS HCD Planning document, GA32-0907, describes this process in more detail.

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