



7 Reasons  
to Host Your  
Mainframe  
SAN on  
**Brocade**  
**Gen 7**

BROUGHT TO YOU BY:

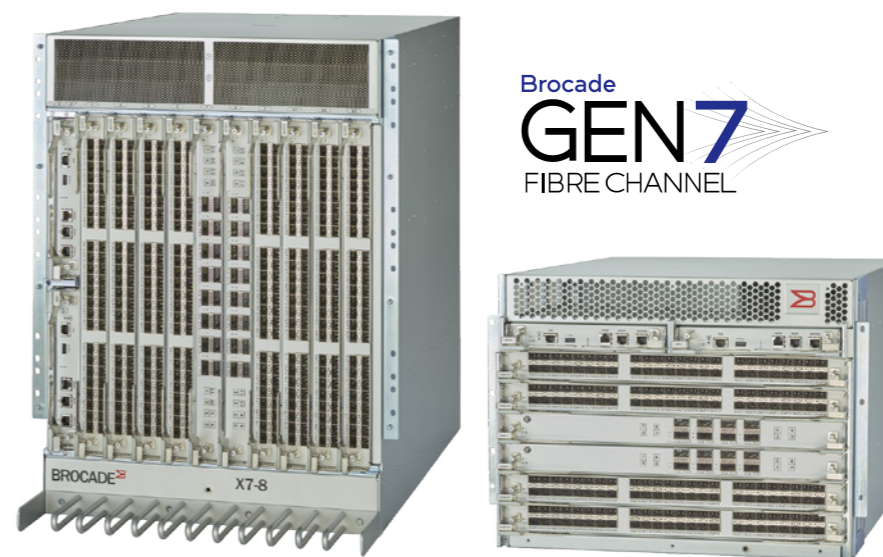
**BROCADE**   
A Broadcom Company

IBM Z® mainframe with Brocade FICON technologies clearly build the most mature and powerful compute and storage solutions available today. Enterprises have long viewed the mainframe as essential to their business including the connectivity to their critical business data. The new Brocade Gen 7 FICON solutions provide the reliability, availability, security, scalability and performance that have always been at the forefront of technology innovation that allows the IBM Z platform to accomplish the enterprise's core strategic data-centric goals.

As IBM developed the z15™ to align with the evolving needs of enterprise transformation, openness and security became key capabilities to expand. And with the z15, the company has done just that.

Brocade®, a Broadcom Company, has produced several first-to-market technological innovations, including Gen 7 64 Gbp/s Fibre Channel for Flash storage, Gen 6 32 Gbp/s Fibre Channel with integrated port and network sensors, Gen 5 16 Gbp/s Fibre Channel with Forward Error Correction, FICON Dynamic Routing, z/OS® Health Checker integration and Read Diagnostic Parameters functionality. Leveraging the IBM Z I/O team partnership, Brocade has also produced significant mainframe storage networking market exclusives such as inter-chassis links (ICLs) and Port Decommissioning. This shared dedication to the success and growth of the mainframe storage network can also be seen in newer endeavors, including Fabric I/O Priority and FICON multihop topologies.

As the flash era of the 2010s extends into the 2020s and continues to disrupt the traditional mainframe storage networking mindset, Brocade and IBM have released a series of enhanced features that address the demands of the data center. These technologies leverage the fundamental capabilities of Gen 7 Fibre Channel (FC) and extend them to the applications driving the world's most crucial systems. This e-book summarizes seven reasons to use Gen 7 to host your mainframe SAN.



Learn FICON  
from the Experts

**Free FICON education** WBT modules ranging from FICON introduction to FICON administration.

# 1

## Enhancing FICON SAN Performance, Security and Flexibility

### Inter-Chassis Links

ICLs provide short-distance, chassis-to-chassis connectivity for Gen 6 and Gen 7 FICON directors for use with FICON and/or FCP mainframe solutions (see Figure 1). This technology is used to build a powerful storage networking core without sacrificing device ports for inter-switch link (ISL) connectivity.

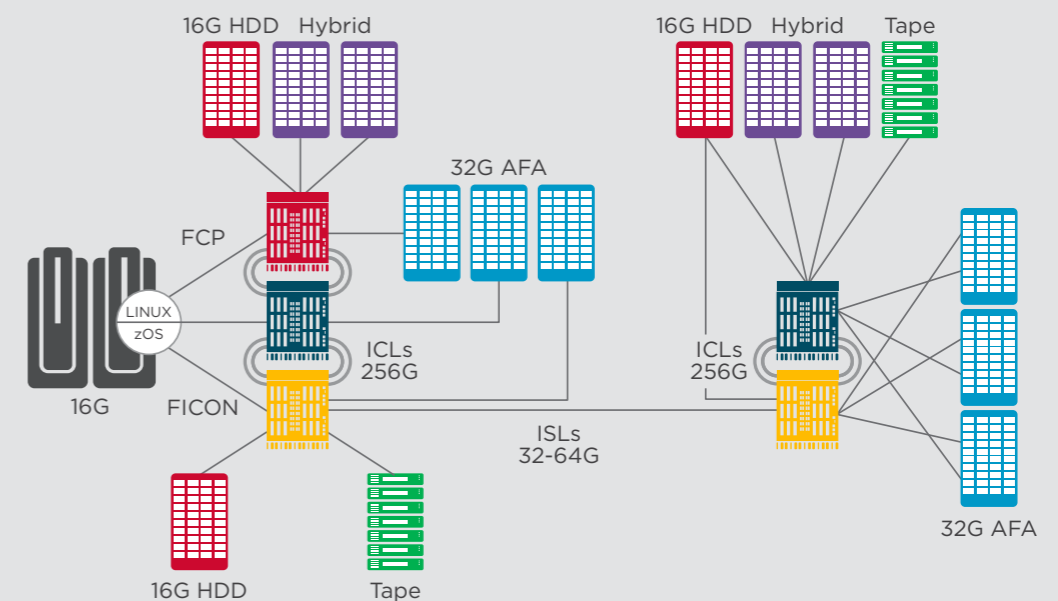
ICLs minimize the latency between multiple chassis to provide the lowest-latency switching via the chassis backplane instead of using comparable ISLs. Trunking at the FC frame level is automatically enabled between four ICLs, which maximizes the load balancing and availability characteristics of the interconnected chassis. When used with FICON Dynamic Routing, the I/O at an FC Exchange level are also evenly distributed across the ICL infrastructure for optimal I/O routing and maximum performance. Because the ICL connection is not considered to be a FICON “hop of concern” in multichassis cascaded topologies, ICLs provide configuration flexibility for large deployments.

### Brocade Traffic Optimizer

Utilizing analytics gathered from self-learning capabilities, Brocade FICON SANs automatically apply priorities for specific data traffic to help guarantee performance levels and monitor for traffic pattern shifts. Learning traffic behavior enables the network to make smarter decisions on traffic prioritization, congestion avoidance and adjustment to ensure optimal network performance

FIGURE 1

### Inter-Chassis Links vs. Inter-Switch Links



for applications and storage. When something does change, the Brocade autonomous SAN technology will isolate the port traffic for the misbehaving device to a virtual channel in the fabric and allow all other traffic to go around to maintain optimal performance.

The Brocade Gen 7 Traffic Optimizer feature automatically classifies and separates traffic with similar characteristics to optimize performance for most common SAN configurations. It identifies and isolates traffic flows to prevent negative impact to overall SAN performance and ensures that the application data traffic traverses the network at optimum performance.

## Fast and Secure Data Transfer

In-flight compression optimizes network performance both within the on-premise data center and across long-distance links. Data is compressed at the source and uncompressed at the destination. Performance varies by data type, but Brocade uses an efficient algorithm to generally achieve 2:1 compression with minimal performance impact. In-flight compression reduces the amount of data, and the total bandwidth, necessary for data to be transmitted from one location to another across ISL, ICL, FC over IP (FCIP) and IP Extension (IPEX) links.

For enhanced data security, in-flight data encryption helps secure the data center by minimizing the risk of unauthorized access to I/O traffic within the data center and over long-distance links. It is switch-to-switch encryption, not device or data-at-rest encryption. Data is encrypted at the source and decrypted at the destination. Encryption and decryption are performed in hardware using the AES-GCM-256 algorithm, minimizing any impact on performance. In-flight data encryption can be used in conjunction with in-flight data compression (see Figure 2).

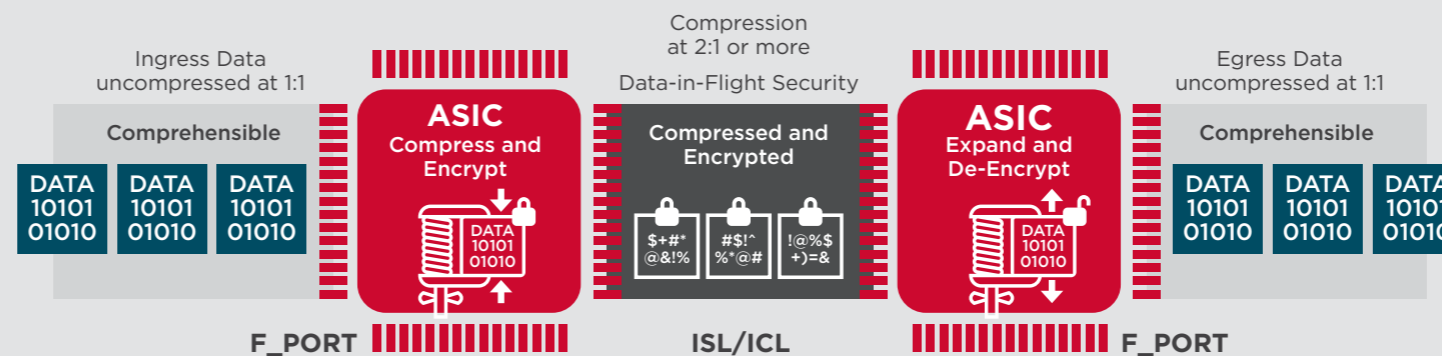
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## Simplifying FICON Setup and Management

### Using SANnav SAN Management Software

Brocade designed SANnav Management Portal and SANnav Global View software tools to increase the efficiency and productivity of IT administrators when managing their SAN environments, including simplifying FICON SAN setup, monitoring and management. Architected with a modern GUI, SANnav streamlines common workflows such as configuration, device connectivity/zoning, SAN deployment, troubleshooting and reporting.

### In-Flight Compression and Encryption



While SANnav Management Portal works at a local level to streamline common workflows and troubleshooting, SANnav Global View aggregates health, performance, and inventory data from multiple SANnav Management Portal instances utilizing the same intelligent dashboards (see Figure 3).

The benefits of deploying Brocade SANnav within your FICON environment include:

**Accelerated deployment**—Streamlined workflows for the deployment of new applications, switches, hosts and targets including FICON specific workflows such as the setup of FICON Logical Switches and I/O Port Decommission

**Actionable insights**—Advanced analysis of key metrics provides insights to quickly identify and isolate problems

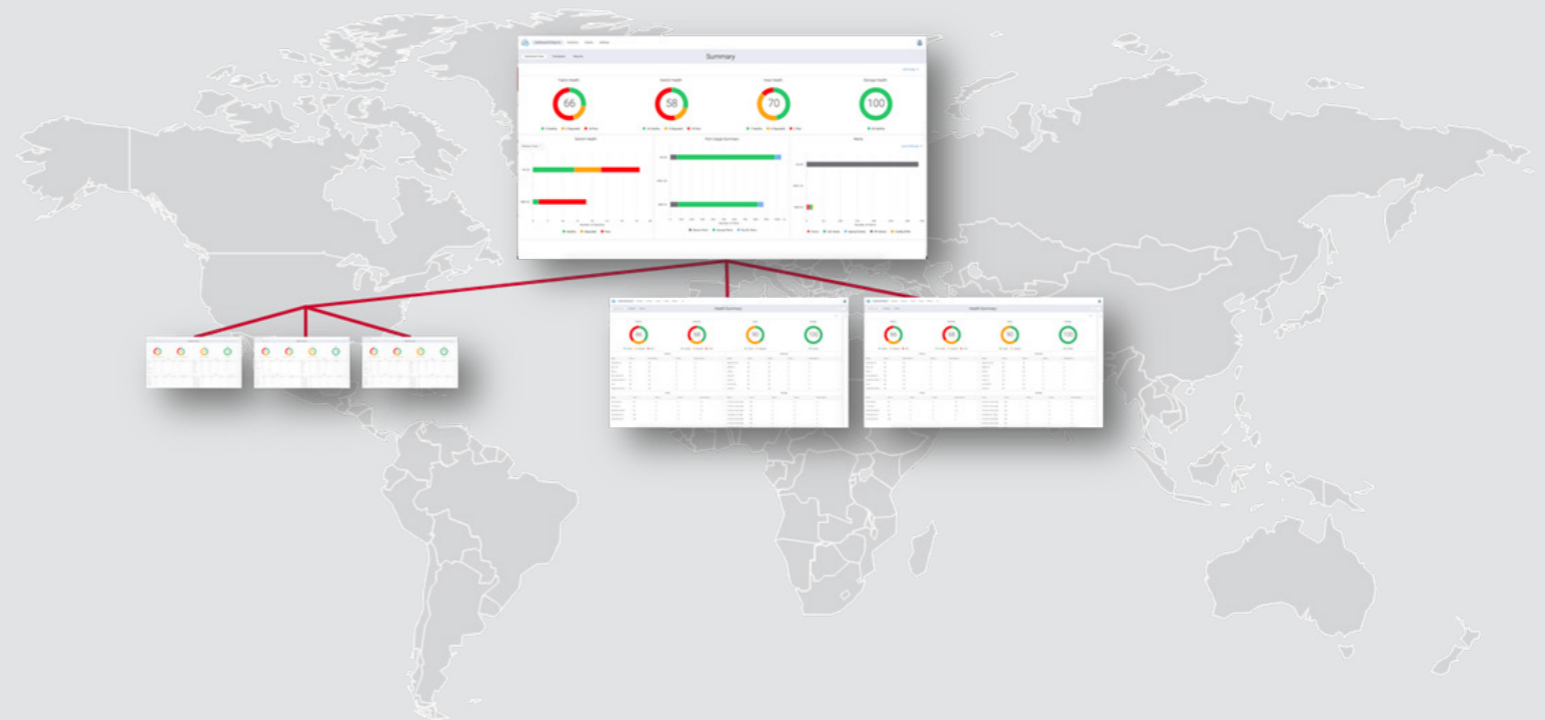
**Contextual visualization**—Contextual searching and filtering isolate points of interest in simple-to-understand topology views

**Automation**—Manual processes are reduced through automated data collection, reporting and identification and reconfiguration of out-of-compliance fabrics and switches

**Best practices**—Single-click deployment of more than 20 years of storage networking monitoring best practices

**Increased operational stability**—Real-time monitoring and alerting of key metrics, development of baseline I/O performance, and identification of anomalies helps avoid common network problems and accelerate problem identification and resolution

## SANnav Global View and Management Portal for Worldwide FICON Administration



## FICON Logical Switch

With the FICON Logical Switch feature, creating a logical switch within your SAN with all of its required FICON characteristics is easier than ever before. You can create a new FICON logical switch or modify an existing logical switch into a FICON logical switch on all platforms that support Virtual Fabrics in Fabric OS 8.1.0 or above. A FICON logical switch can be provisioned with both ISLs and XISLs. FICON logical switch simplifies the process of establishing a logical switch in the FICON environment by providing auto-configuration for the following parameters:

- Insistent Domain ID (IDID) mode is set to on
- Routing policy is set to device-based routing (but can be changed later to exchange-based routing or EBR)
- Area mode is set to zero-based addressing
- SCC security policy is auto-defined with only its own WWN
- The created SCC policy is activated
- The fabric-wide consistency policy is set to strict SCC policy
- High integrity fabric mode is enabled

### Introducing the FICON Virtual Switch

Simplify the setup, automation and management of FICON Virtual Switch with Brocade Fabric OS 9.0.

## 3 Automating Workflows to Increase FICON Integrity

### Port Decommission

Port Decommission is an autonomic, integrated function that greatly simplifies daily port/path maintenance while ensuring a safe switching I/O infrastructure. Routine port maintenance that once required significant administrative overhead as well as complex operations coordination can now be executed seamlessly without operator intervention.

IBM Tivoli® System Automation for z/OS (SA z/OS) once played an important role in building the end-to-end automation of IBM autonomic computing and in years past was designed to automate I/O, processor and system operations. It could make multisystem operational changes to channels, ESCON Directors, FICON switches and I/O devices while protecting access to critical system resources. However, SA z/OS V3.5 was the last version of System Automation to support the I/O Operations (IOOPs) module and has been out of service as of September 2019.

Now that IOOPs is no longer available, Brocade customers can use Port Decommissioning to bridge the gap that the removal of the IOOPs System Automation capability created.

Brocade SANnav tools greatly simplify this process. Upon receiving an indication to remove a port or path from active service, SANnav coordinates the activities with both the host I/O subsystem and the fabric. After z/OS sends a confirmation that it has migrated the active workload from the designated port/path, SANnav removes the port from operation and indicates it is ready for maintenance (see Figure 4).

Once the maintenance operations have been completed, the port/path is returned to full operational status through a Port Recommission function. As with the decommission operation, SANnav coordinates and communicates the recommission action with z/OS to ensure the operation occurs error-free.

## 4

# Increasing Speed, Scale and Performance of FICON Configurations

## Multihop Topologies

The movement to disperse mainframe data centers geographically has forced the evolution of FICON SAN topologies. Simple “one-hop” cascaded systems have given way to “multihop” variations that exploit Brocade ICL, ISL Trunking and FCIP channel extension technologies, while maintaining the integrity of the traditional FICON “hop of concern” provision. Advanced diagnostic capabilities, such as the IBM Health Checker for z/OS and the Fibre Channel Read Diagnostic Parameters function, provide the technology to deliver I/O traffic with the deterministic reliability required for mainframe storage networks in extended topologies.

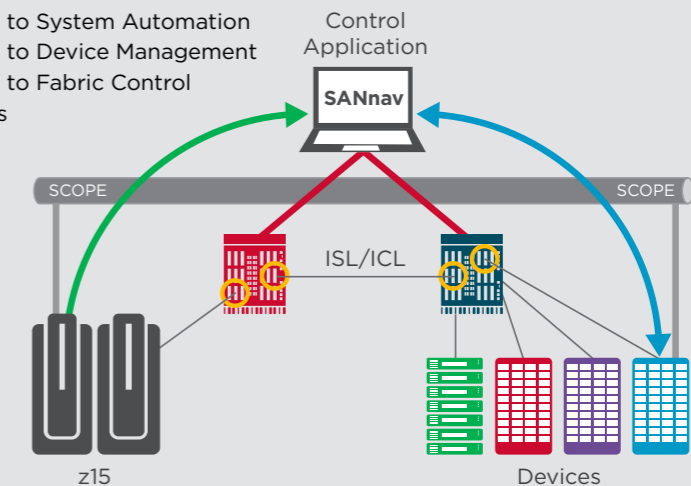
Multihop topologies include two-, three- and four-site disaster recovery and business continuity configurations (see Figure 5).

FIGURE 4

## SANnav Simplifies the Safe Decommissioning of Ports

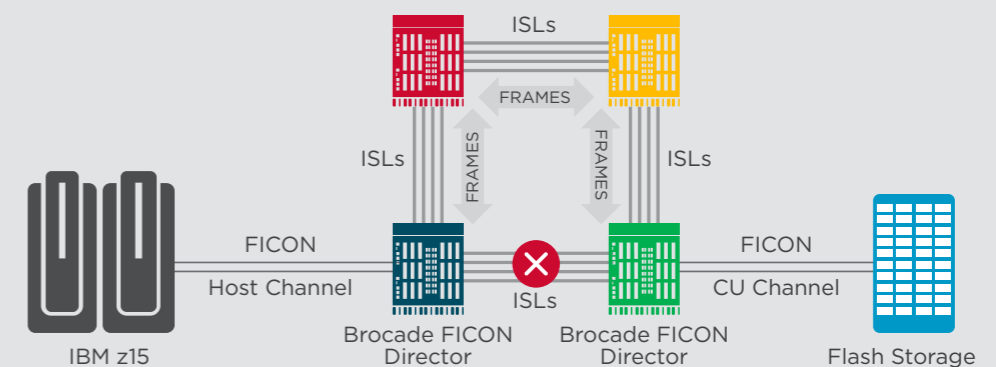
### Communication Flows

- Application to System Automation
- Application to Device Management
- Application to Fabric Control
- Target Ports



FIGURES 5

## A Three-Hop Example of a Multihop Topology



Each topology is designed to address specific business requirements as well as regulatory provisions. In addition, the supported topologies are verified to operate with the same level of predictability and deterministic reliability found in cascaded solutions.

## Availability Note

Brocade and IBM are currently validating the most effective topology solutions for mainframe environments to ensure that performance and reliability requirements of IBM Z solutions are maintained with each supported configuration. See your Brocade representative for full details or visit the [Brocade FICON resource page](#).

## FICON Dynamic Routing (FIDR)

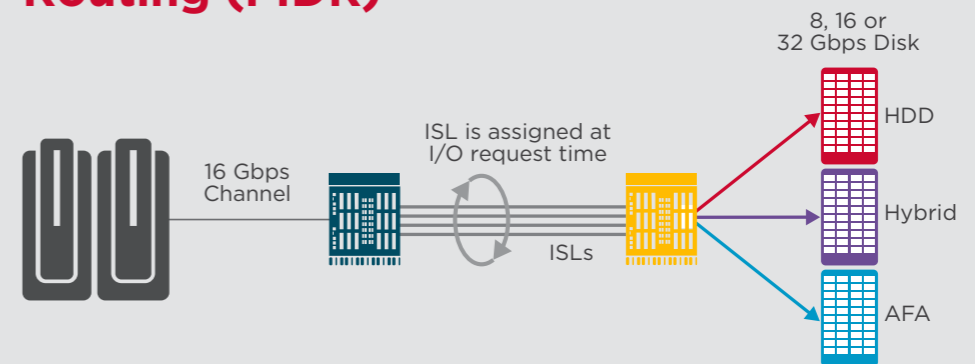
The introduction of the z15 enhanced several performance optimizations to improve overall throughput in the mainframe storage network. FICON Dynamic Routing allows FICON devices to utilize both static and dynamic SAN routing policies such as the Brocade Exchange-Based Routing (EBR) protocol.

FIDR enables organizations to use SAN dynamic routing policies across cascaded FICON directors to simplify configuration and capacity planning, and to provide persistent and repeatable performance and higher resiliency (see Figure 6). In peer-to-peer remote copy configurations, the sharing of switches is simplified, and hardware costs can be reduced by allowing FICON and SCSI over Fibre Channel protocol (FCP) to share the same storage network infrastructure.

The benefits of FICON Dynamic Routing are highlighted in the IBM technical reference [“FICON Dynamic Routing \(FIDR\): Technology and Performance Implications,”](#) co-authored by Brocade.

FIGURE 6

## FICON Dynamic Routing (FIDR)



## Unmatched Mainframe Technology Innovation and Leadership

The Brocade X7 complements IBM Z mainframes by offering the industry's fastest, most reliable and scalable FICON infrastructure.

[Learn more about Brocade Gen 7](#)



## Strengthening FICON Availability/Resiliency

### IBM Health Checker for z/OS Integration

The IBM Health Checker for z/OS extracts information from the FICON director through the CUP interface to identify and report the shared components of specific I/O path group throughout the mainframe storage network. The resulting analysis of these path groups provides system administrators with the insight necessary to ensure members of a path group are not susceptible to single-point-of-failure conditions.

In addition to analyzing for single-points-of-failure within a path group, IBM Health Checker for z/OS leverages the FICON CUP interface to assess performance characteristics, or flow, of the members of a path group. The flow information provided includes utilization characteristics, operational conditions and diagnostic error statistics. This unique solution also incorporates the Brocade Fabric OS (FOS) bottleneck detection mechanism, which provides alerts to z/OS when fabric anomalies are detected to avoid or correct flow bottlenecks.

### Integrated FICON SAN Diagnostics

Keeping pace with the ever-growing complexity of FICON storage networks, Brocade and IBM co-developed in-band diagnostic mechanisms that enrich the view of SAN components, primarily the optical transceivers. The IBM Z solutions include functionality that allows the FICON SAN to extract information about the optical transceivers attached to the IBM Z device and the Z platform to extract the same information on the transceivers installed in the SAN.

Knowing the information on the transceivers allows the new FC-standard Read Diagnostic Parameters (RDP) command to perform

an enhanced path evaluation and automatically differentiate between cable hygiene errors and failing components such as the optics. The RDP function provides the optical characteristics of each end of the link, including optical signal strength and environmental operating metrics, without requiring manual insertion of optical measurement devices. The RDP operation is performed periodically throughout the mainframe storage network to proactively detect marginal conditions before they affect production operations.

### Forward Error Correction

Gen 7 FC includes an integrated Forward Error Correction (FEC) technology to provide reliable signal integrity at ever-increasing data rates (i.e., 64 GFC/256 GFC). FEC allows FICON channels to operate at higher speeds, over longer distances, with reduced power and higher throughput while retaining traditional RAS levels. FEC is designed for controlling errors in data transmission over unreliable or noisy communication channels, which allows the receiver to detect and correct a number of errors in the I/O flow without retransmission.

Brocade includes Gen 7 Fibre Channel FEC technology with all of the latest generation Brocade FICON director and switch solutions. The IBM FICON Express16SA channel leverages this technology to ensure z/OS FICON solutions achieve the highest level of end-to-end reliability and performance in the industry.

## Brocade is a Premier Leader in Mainframe Connectivity

33+ years of partnership with IBM and mainframe connectivity  
with over 6,000 FICON Directors WW.

## 6

# Automating Diagnostic Tests Into FICON SAN

## ClearLink D\_Port Diagnostics and the IBM I/O Exerciser

Brocade's ClearLink® Diagnostics enables storage administrators to quickly run a battery of automated diagnostic tests, in a single step, to identify and isolate optic and cable problems while also measuring and validating frame latency and the distance between the switch links—either prior to deployment or when physical layer issues are suspected. With ClearLink Diagnostics, only the ports attached to the link being tested need to go offline, leaving the rest of the ports to operate online.

ClearLink diagnostics are started from the Brocade switch to run the electrical and optical loopback tests. Optics and cable problems can be quickly identified and resolved, significantly reducing fabric deployment time and ensuring reliable connections. ClearLink Diagnostics can be used for optical and electrical loopback testing of normal 16, 32 or 64Gb/s transceivers as well as SmartOptics 16Gb/s DWDM 40km SFP+ and SmartOptics 16Gb/s ER 40km SFP+.

Storage administrators can integrate with the IBM I/O Exerciser® for IBM Z (ESAIO) with ISL evaluation accomplished through Brocade's ClearLink Diagnostics. Using both of these synergistic tools exploits advanced optical connector functions and supports full-path evaluation prior to production deployment. Together, these tools help identify cabling or definition errors by validating that all the paths are defined and have good signal strength.

## 7

# Extending and Enhancing FICON Business Continuity Solutions

## Cyber Resilient Networks in IBM Z Mainframe Environments

Networks play a critical role in modern IBM Z mainframe environments, providing fast and efficient movement of data both across the data center and around the globe. Brocade enables cyber resilient networks using FICON, FCIP and IP Extension technology to ensure reliable and secure data movement between mainframes, storage arrays, tape libraries, and other backup solutions regardless of their location.

Cyberresilient networks provide:

- Encryption in flight and at rest that protects the business by making data unreadable and unusable when data is exposed or exfiltrated
- High availability, ensuring that data can be used when networking components fail or are compromised
- Data transfer automation that transparently uses cloud resources creating multiple redundant data copies for disaster recovery

Brocade technology is critical in building Cyber Resilient solutions for mainframe environments with emphasis on high availability, encryption and data transfer automation between local and global site

Specific Brocade extension features that enable and enhance more resilient, efficient and secure data movement include:

- Secure data transmission, which applies encryption to selected data across the WAN to achieve comprehensive encryption of data in flight
- Data compression, which maximizes network efficiency while reducing data transport costs
- Load balancing and transparent failover, which shares traffic across all available logical network elements, removing any single points of network failure with self-healing systems to provide maximum protection and reliable data delivery

## Gen 7 Is Designed to Propel Enterprises Forward

The world runs on the mainframe and the mainframe collaborates with storage networking to propel the most crucial systems and applications in the world. Mainframe and FICON SAN are ubiquitous whether running in well-established banks, healthcare providers, government organizations or large retail enterprises. Even more sophisticated startups and newer companies should consider deploying the IBM Z system with storage networking. Every organization will benefit from how IBM has embraced openness and

the tightest security within the z15 while connecting it to its storage resources through a Gen 7 FICON SAN. These systems will operate cohesively and under extremely stringent conditions in order to provide the everyday services and operations enjoyed by billions.

Brocade and the IBM Z I/O team share an extraordinary relationship that has yielded countless enhancements to the world of enterprise computing. This three-decade old bond has stood the test of time, as well as the turmoil of the high-tech marketplace, to produce reliable solutions for these critical systems.

Brocade builds on three decades of mainframe leadership to deliver the industry's highest performance and most reliable and scalable FICON infrastructure. With seamless FICON connectivity and support for innovative features that Brocade offers, organizations can achieve the full potential from new flash storage coupled with IBM z15 and future mainframe technology.

➤ **Learn more about Brocade Gen 7 at**  
[www.broadcom.com/solutions/data-center/storage-fabrics-technology](http://www.broadcom.com/solutions/data-center/storage-fabrics-technology).

### Broadcom Mainframe Connectivity Is in its DNA

Broadcom's mainframe legacy is the aggregated technologies of Brocade, McDATA, CNT and InRange.