



Brocade Fibre Channel Routing (FCR) Technology Overview and Fundamentals

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Table of Contents

Introduction	3
Meta-SAN Overview	4
Fibre Channel Routing (FCR) Overview	7
Phantom Domains and Devices.....	10
Introduction to Brocade Fibre Channel Routing (FCR) Products	11
FCR Router Support Limitations & Scalability	14
FCR Implementation	14
Backbone ID.....	15
Configuring Brocade Interfabric Links (IFLs)	16
Configuration of LSAN Zones on 2nd Fabric.....	17
FCR Large Implementation Customer Study	17
Conclusion	20
FCR Terminology Glossary.....	21
Author Biography	24

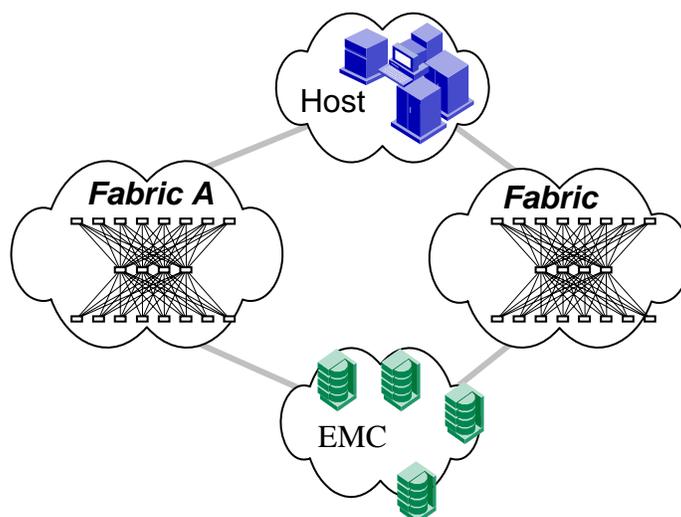
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INTRODUCTION

The current growth of SAN fabrics in most large environments has exceeded or will exceed the scalability limits of implemented SAN solution(s). The business growth of the SAN is increasing tied to the mandatory need to store data for extended periods of time (regulatory demands) and is also influenced by the type of data being stored (records, images, etc).

The rapid growth and increasing complexity of enterprise SANs have been the driving force behind the adoption of multi protocol SAN routers. As organizations continue to expand, they require more comprehensive solutions than traditional FC fabrics can provide. SAN extension has become a primary concern for many enterprise SAN customers. Brocade has developed routing services that increase SAN functionality, scalability and flexibility.

A SAN (Storage Area Network) connects a group of servers to their shared storage devices (disk arrays, virtual tape libraries, tape drives, etc) through an interconnection of fabric that would typically include switches and links. Brocade has introduced several new products that enhance SAN internetworking through Fibre Channel Routing (FCR) technologies.



Merging SAN fabrics has been complex and time consuming for SAN administrators and SAN engineers. We can now expand Brocade SAN fabrics without merging fabrics through the proper implementation of Fibre Channel Routing (FCR) hardware and services.

Meta-SAN Overview

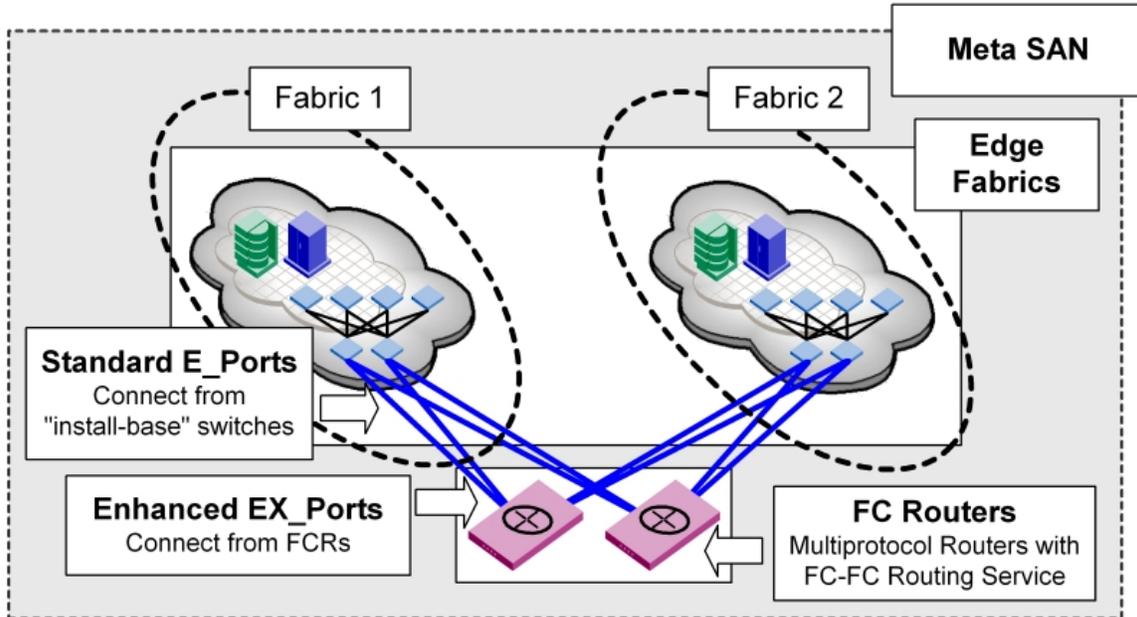
When single SAN switches are connected to each other they form a SAN "fabric". When they are connected through an FCR approach they form a different SAN. This results in a "Routed" SAN called a "Meta-SAN."

A Meta-SAN is a collection of SAN devices, switches, edge fabrics, Logical Storage Area Networks (LSANs), and Routers that comprise a physically connected but logically partitioned storage network. A simple Meta-SAN can be constructed using an EMC Select 7500, Connectrix ED-48000B with a Connectrix PB-48K-18I blade to connect two or more separate fabrics. Additional EMC Select 7500s, Connectrix ED-48000B with Connectrix PB-48K-18I blades, can be used to increase the available bandwidth between fabrics, and for redundancy.

Each edge fabric in the Meta-SAN remains a SAN island and will be referred to an edge fabric. Edge fabrics maintain separate fabric services such as name services, zoning databases, routing tables, domain ID spaces, etc.

This ability to maintain separate services greatly reduces management problems like domain and zoning conflicts that would otherwise be a concern when merging a fabric.

Diagram: Meta-SAN Overview



We will never eliminate the need to increase port counts and share resources across geographical and functional boundaries. Moreover, our need to ensure secure connectivity for selected resources—especially in heterogeneous environments—further compounds the troubleshooting, fault isolation, and management challenges posed by large SANs.

FC routing addresses these issues by enabling organizations to connect devices in different SANs without merging the fabrics. In this way, organizations can share resources across multiple SANs and scale beyond current SAN port count support constraints.

In addition, they can more easily support multiple firmware revisions and connect devices between SANs purchased from and supported by different OEMs, or from different SAN platform vendors, as business needs dictate.

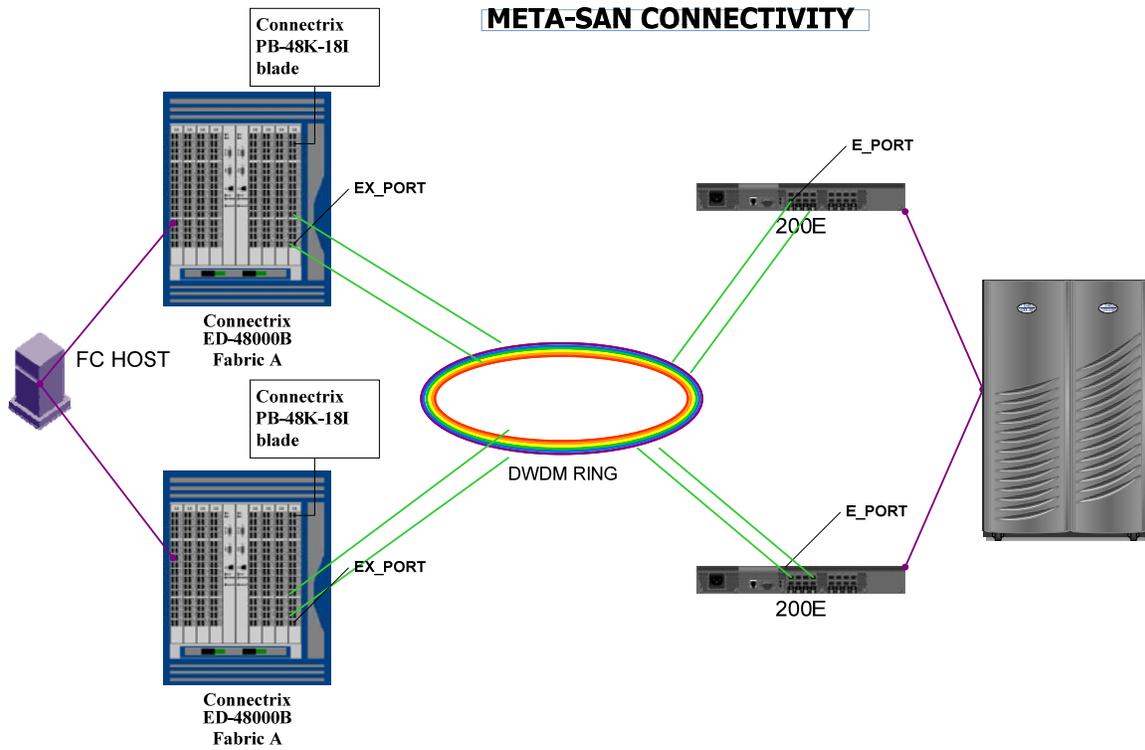
This level of SAN connectivity offers organizations a powerful tool to reduce or even eliminate disruptions associated with many common operational events, such as:

- Migration to new SAN infrastructure, where FC routing can be used to migrate SANs and devices from 1 or 2 Gbit/sec to 4 Gbit/sec systems.
- Data center consolidation, where the Connectrix PB-48K-18I blade and EMC Select 7500 Router can enable data movement between locations, adding particular value when FC routing is combined with FCIP.
- Mutual data center backup or mirroring, where the Connectrix PB-48K-18I blade and EMC Select 7500 Router enable two major data centers to act as backup facilities for each other. This application often involves FCIP, and the tight integration of FCIP and FC routing is usually a value-add for the customer.
- Storage and application rebalancing between fabrics, where the Connectrix PB-48K-18I blade and EMC Select 7500 Router can connect devices in previously isolated SANs
- Data migration between test/development SANs and production SANs, enabling data movement between physically or logically separated environments.
- Data migration or sharing between SANs containing different firmware releases.
- Data migration between Brocade and McDATA fabrics.

Benefits of META-SAN CONNECTIVITY

- Scalability - Growing SAN environments much more efficiently and maximizing the value of high-end resources.
- Security - Connecting devices in different SANs without merging the SANs, organizations can support secure, selective resource sharing through LSANs
- Centralization- Centralization makes it easier to manage equipment from multiple vendors which increases operational flexibility and enables the deployment of a best-in-class environment.

EXAMPLE OF EMC META-SAN DISTANCE CONNECTIVITY



Notice in the EMC Meta-SAN diagram above:

1. Fabric is HA (Redundant Fabric with Dual IFLs)
2. Symmetrically organized by port number and slot number.
3. Host and Storage are in different locations.

Fibre Channel Routing (FCR) Overview

The need to create Fibre Channel SANs that can grow in a scalable, cost-effective manner is a basic business requirement. For example, organizations with multiple SAN islands need to connect them into a more unified, centrally managed SAN environment. Unfortunately, many organizations have avoided merging their SAN islands in fear that the administrative workload, risk, and expense would not justify the benefits of enhanced connectivity.

However, the ability to seamlessly integrate Brocade FC routing into existing SAN fabrics and realize the benefits of centralized management while maintaining fabric separation is changing that perception. Running on the Connectrix PB-48K-18I blade and EMC Select 7500 switch, FC routing enables devices located on separate SAN fabrics to communicate without the need to merge the fabrics into a large SAN environment. By using this service, organizations can interconnect devices without having to redesign and reconfigure their entire environment, thereby eliminating the potential downtime risks and costs.

The resulting routed network consists of multiple individual SAN fabrics forming one storage network connectivity model, known as a "Meta-SAN." In this way, FC routing offers key strategic advantages:

- Simplifying SAN design, implementation, and management through centralization
- Providing a seamless and secure means to share resources across multiple SANs without physically merging those SANs
- Creating a more unified SAN environment with easier interconnection and support for SANs and SAN resources purchased from different storage vendors
- Reducing disruptions created by events such as data migration, storage or server consolidation, migration to production environments, and application rebalancing between fabrics

When devices on different fabrics are allowed to communicate through FC routing, the resulting connectivity group is known as a Logical SAN (LSAN). LSANs enable selective and secure resource sharing across multiple SANs by leveraging existing zoning tools and methodologies.

In addition to optimizing resource utilization, this approach helps improve scalability by:

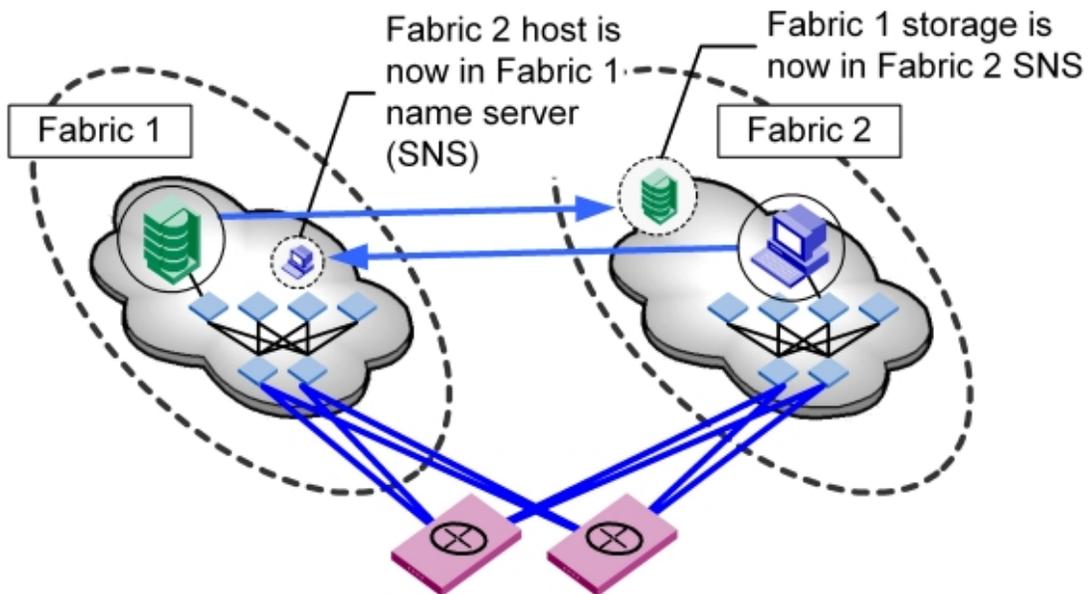
- Minimizing the risk and complexity of large fabrics
- Right-sizing SANs based on application and business requirements
- Simplifying management and fault isolation
- Protecting and extending current technology investments since LSANs require no changes to existing SAN switches or attached edge devices but do leverage existing zoning tools

The Brocade FC-FC routing service (FCRS) provides connectivity between two or more fabrics without the need to merge the fabrics. This allows the creation of Logical Storage Area Networks (LSAN) that provide connectivity that can span fabrics without actually merging the fabrics.

This service is implemented on the router as an “EX” port. The fact that FCR can connect fabrics without merging the fabrics has advantages in terms of scalability, network management, change management, availability and serviceability.

It is important to note that the act of projecting a node into another fabric is called exporting. When a host is exported from Fabric 1 into Fabric 2, it also must be imported into Fabric 2 from Fabric 1.

To create an LSAN, both exporting and importing must occur, so these statements are functionally equivalent in normal cases.



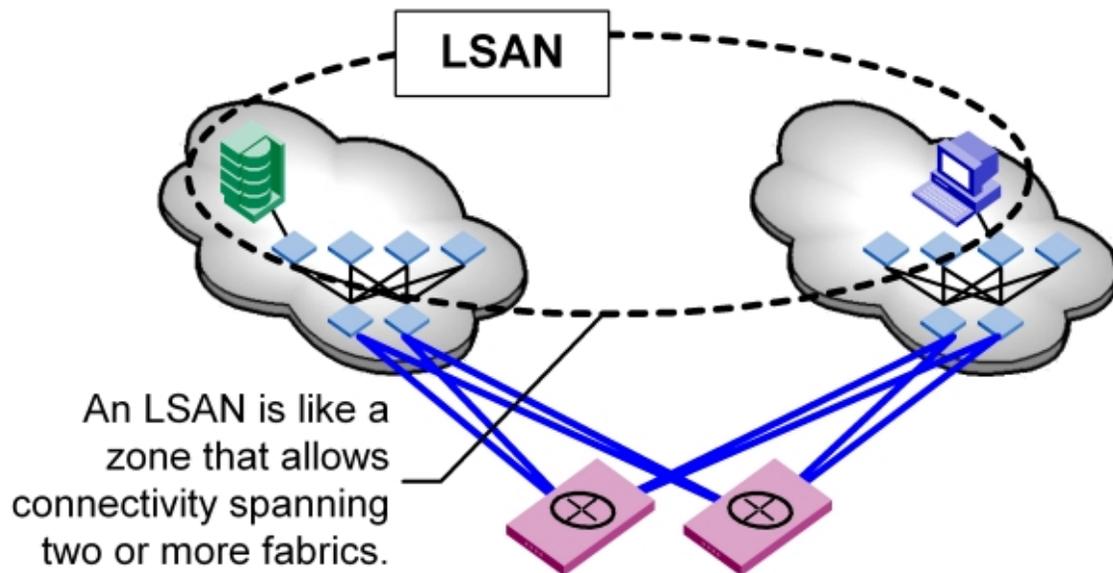
An LSAN must be created on both sides of the router. LSAN zones are indistinguishable to an edge fabric from any other kind of zone, which is why they are compatible with previous Brocade Fabric Operating System (Fabric OS) versions.

There are just two distinguishing features of an LSAN zone.

- First, they must begin with the prefix “LSAN_” so that routers will recognize them.
- Second, they must contain only port WWNS or aliases of devices intended for inter-fabric sharing.

This is because Fibre Channel Port IDs (PIDs) are not unique identifiers in a Meta SAN. The same PID can exist in multiple edge fabrics, so a router would not know what the administrator wanted to do if PIDs were used to create LSAN zones. This constraint, however, does not preclude the use of PID-based zoning in edge fabrics for other zones. Those zones continue to work as usual.

When a set of devices on different edge fabrics are allowed to communicate through an FC router in this way, the resulting connectivity group is an LSAN.



Many different LSANs can exist in a Meta SAN in the same way that many zones can exist within a single fabric. Indeed, many different LSANs can exist between any given set of fabrics. Devices can be members of multiple LSANs, and LSANs can overlap with traditional zoning mechanisms on local fabrics as well.

Fiber Channel Routing is somewhat equivalent to an IP router, like a firewall, since when the FCR services are “on” they use a DENY all approach. The SAN administrator must use an ACL approach through the use of zoning to allow traffic to flow between fabrics.

Since FCR has some significant new terminology that SAN Administrators and SAN Engineers may not be familiar with, it is important to clarify the terminology we will use in this article. This terminology is clarified in the FCR Terminology Glossary in the back of this article.

PHANTOM DOMAINS AND DEVICES

The router introduces a new model where a phantom topology is presented. It consists of phantom domains and phantom devices and does not correlate directly to physical entities. The phantom topology is presented via protocols such as Fabric Shortest Path First, Name Server, Management Server, etc. It is important to understand that this is automatically done by the routers' FC-NAT protocols.

All devices that are translated between fabrics are "hung off of" xlate domains. To maximize FC NAT address space, translated devices are given FC PIDs using both the area and port bytes, so to the human eye xlate addresses may look like NL_Port devices in destination fabrics even if they are really N_Ports in their source fabrics.

While these PIDs are "made up" by the router, whatever PID is used for any given device exported into any given edge fabric is persistent. Even simultaneously rebooting every host, storage, and network device in the Meta SAN - including all routers - will not cause any xlate PIDs to change.

NOTE: Translation table can be saved and loaded using the configUpload / configDownload commands

Please review the Glossary for a detailed overview of PHANTOM DOMAINS.

FCR REVIEW

The Brocade FC-FC routing service (FCRS) provides connectivity between two or more fabrics without merging the fabrics. This allows the creation of Logical Storage Area Networks (LSAN) that can provide connectivity to span fabrics. LSAN is a zone that spans fabrics and allows connectivity without actually merging the fabrics. This service is implemented on the router as an "EX" port.

The fact that FCR can connect fabrics without merging the fabrics has advantages including:

- scalability
- network management
- change management
- availability
- serviceability
- economical

FCR routing is:

- Logically connected to SAN islands and shares resources across multiple fabrics
- Maintained through administration and fault isolation of separately managed fabrics
- Supported by any tool that supports zoning

FCR Solves problems like:

- Scaling SANs for number of ports
- Scaling SAN's over distance
- Allowing the combination of SANs that do not have direct E_port interoperability

In summary, Fibre Channel Routing logically connects devices in multiple SAN fabrics to share storage resources from any fabric regardless of distance, with the administration and fault isolation benefits of separately managed fabrics.

Introduction to Brocade Fibre Channel Routing (FCR) Products

The industry-leading Brocade family of fabric switches connects servers and storage devices through Fibre Channel SAN fabrics. These high-speed, robust storage networks enable organizations to access and share data in a high-performance, highly available, manageable, and scalable manner.

The Brocade family of products are fully forward and backward compatible to protect existing investments. This enables organizations to migrate from 1 and 2 Gbit/sec to 4 Gbit/sec SAN environments and deploy a highly scalable core-to-edge storage networking infrastructure. Products range in size from 8 to 256 ports and can function as standalone switches or in a large storage network.

The Connectrix PB-48K-18I FC Routing and FCIP blade coupled with the EMC Select 7500 FC Router and FCIP switch augments this family by providing a solid range of storage networking capabilities uniquely constructed to maximize the value of SANs. They provide new connectivity options by supporting FC routing and FCIP services to increase SAN functionality and versatility both within the data center and across geographic distances.

The primary advantage of this approach is the ability to connect devices between two or more fabrics without merging those fabrics, whether that is across native FC or FCIP—thereby providing a more flexible storage networking foundation for implementing value-added services across the data center infrastructure.

Product Review

EMC Select 7500 Switch, Connectrix PB-48K-18I Blade (For Connectrix ED-48000B Director)

Highlights

- Unified SAN architecture
- Dual GigE FCIP ports for connecting to IP networks
- 1, 2, or 4 Gbit/sec Fibre Channel routing ports to connect Fibre Channel SAN fabrics or storage devices
- Superior performance:
 - Industry-first 4 Gbit/sec Fibre Channel routing
 - Optimizations for high-latency, low-bandwidth WANs
 - Line-rate performance for high-speed WANs
 - Hardware-based compression
- Efficiency:
 - Efficient encapsulation of Fibre Channel into IP
- High scalability:
 - 16 4 Gbit/sec Fibre Channel routing ports, 2 GigE FCIP ports
 - 8 FCIP tunnels per port



***Connectrix PB-48K-18I
Director Multi Protocol Blade***

EMC Select 7500 SAN Router



Connectrix PB-48K-18I Blade

(For Connectrix ED-48000B Director)
EMC Select 7500 Switch

HARDWARE OVERVIEW

Connectrix PB-48K-18I Blade (Connectrix ED-48000B Director)

- Enterprise solution for SAN director:
 - Sixteen 1, 2, and 4 Gbit/sec Fibre Channel routing ports
 - Two Gigabit Ethernet FCIP ports
 - Onboard blade processor
 - High availability
 - Hot-swappable
 - Hot code activation for Fibre Channel routing (FCIP may have disruption)
- FCIP distance extension
- Hardware compatibility:
 - Supported with the following:
 - Connectrix ED-48000B Director and control processors
 - Connectrix ED-48000B blades:
 - FC4-16, 16-port 1, 2, and 4 Gbit/sec blade
 - FC4-32, 32-port 4 Gbit/sec blade
- Two blades per chassis:
 - 32 ports of Fibre Channel routing
 - 4 ports of FCIP (32 virtual FCIP tunnels)
- High availability:
 - A standby control processor takes over for a failed active control processor and becomes active (traffic forwarding continues during failover)

EMC Select 7500 Switch

- Standalone solution for enterprise and midrange SAN environments:
 - Sixteen 1, 2, and 4 Gbit/sec Fibre Channel routing ports
 - Two Gigabit Ethernet FCIP ports
 - Fixed configuration
 - Onboard processor
 - Redundant fans
 - Redundant power supply
 - Hot code activation for Fibre Channel routing (FCIP may have disruption)
- FCIP distance extension

FCR ROUTER SUPPORT LIMITATIONS & SCALABILITY

FC Router Support Limitation	Fabric OS v5.1
Max. edge fabrics/ MetaSAN	16
Max. switches / edge fabric	26
Max. front domains /edge fabric	10
Max. translate domains / edge fabric	17
Max. total domains / edge fabric	53
Max. local switches / backbone fabric	5
Max. translate domain / backbone	16
Max. total domains / backbone fabric	21
Max SilkWorm EMC Select 7500/Connectrix PB-48K-18I / MetaSan	10
Max. hops between edge switches	12
Max. EX_Ports per edge fabric per SilkWorm EMC Select 7500/Connectrix PB-48K-18I	4
Max. EX_Ports per SilkWorm EMC Select 7500/Connectrix PB-48K-18I	32
Max. local WWNs / edge fabric	1000
Max. local WWNs / backbone fabric	1000
-- Connecting to 1 edge fabric ONLY	1024
-- Connecting to 2 or more edge fabrics.	256
Max. imported devices / edge fabric	500
Max. local and remote WWNs / edge fabric	1300
Max device DB entries /MetaSan	5000
Max. LSAN zones / MetaSan	1000
Max. entries / LSAN Zone	64

- Note these are current as of FOS release 5.1.x
- EMC partner should verify these supported limitations at the time of your FCR design or implementation.

FCR Implementation

When implementing an FCR configuration either on the Connectrix PB-48K-18I blade or the EMC Select 7500 it is important to know that FC routing has two typical implementation high level steps.

1. Physical connectivity between the fabrics. (EX_Ports and IFLs)
2. Logical connectivity between FC devices. (LSAN zoning)

Basic review of switch configuration

Configure the switch for basic operating parameters.

- Domain ID
- Switchname
- IP Address/Subnet
- Fabric ops parameters
- NTP
- License keys
- Switchstatus
- Configupload
- SAN Health

NOTE: An FCR topology can be installed non-disruptively. In other words, none of the layer 2 switches would need to be rebooted in order to configure Ex-ports.

There are some additional config parameters for an FCR configuration with (Connectrix ED-48000B with Connectrix PB-48K-18I blade(s))

- Chassisconfig set to 5
- 4 power supplies needed
- Firmware upgraded to 5.1.0
- Interopmode off

Backbone ID (IMPORTANT)

If your configuration has only one backbone fabric, then this task is not required because the backbone fabric ID in this situation defaults to a value of 1.

All switches in a backbone fabric must have the same backbone fabric ID. The backbone fabric ID is required to be unique from the perspective of every attached edge fabric. Fabric ID changes made on a switch are not propagated to other switches in the backbone fabric. Rather, the backbone fabric administrator is responsible for ensuring that all switches in the backbone have the same fabric ID. Because fabric IDs are used heavily by the routing protocol between the Fibre Channel Routers, using the wrong fabric ID can affect both edge-to-edge and backbone-to-edge routing.

Commands to configure Backbone ID

- Fcrdisable
- Fcrconfigure
- Fcrenable

CONFIGURING BROCADE INTERFABRIC LINKS (IFLs)

Before configuring an IFL, be aware that you cannot configure both IFLs (EX_Ports, VEX_Ports) and ISLs (E_Ports) from a single EMC Select 7500 or Connectrix PB-48K-18I blade to the same edge fabric.

Configuring an interfabric link involves disabling ports and cabling them to other fabrics, configuring those ports for their intended use, and then enabling the ports.

Steps to configure FCR

Before you begin, DO not attach the cable to both EDGE fabrics.

(This could cause your desired EX_Port to be up as an E_port and possibly segment)

- portCfgEXPort
- portCfgShow
- Attach cable to edge fabric
- portCfgPersistentEnable
- switchshow (verify Connectivity)
- portcfgexport (verify EX Port)
- fcrfabricshow to view any edge fabric's switch names & ensure links are working as expected.
- Configure LSANS below

CONFIGURATION OF LSAN ZONES ON 1ST FABRIC

a. nsshow to list the WWN of the host. The port WWN must be used for LSANs

i. Record Host port WWN

b. Create the LSAN Zone

i. zoneCreate "Isan_ZoneName", "WWN"

ii. Creates LSAN_Zone & adds Host

c. Add Target member(s) to the LSAN Zone

i. zoneAdd "Isan_ZoneName", "WWN"

ii. Adds Target to Zone

d. Create the LSAN Zone Configuration

i. cfgCreate "Zone_Cfg", "Isan_Zone Name"

e. Verify that the Created LSAN Zones are correct

i. cfgShow

f. Enable the LSAN Zone Configuration

i. cfgenable "zone_cfg"

g. Complete Steps A – F on the 2nd Fabric

CONFIGURATION OF LSAN ZONES ON 2nd FABRIC

- a. nsshow to list the WWN of the host/targets on the 2nd fabric. The port WWN must be used for LSANs
 - i. Record Host / Target port WWN(s)
- b. Create the LSAN Zone
 - i. zoneCreate "Isan_ZoneName", "WWN"
 - ii. Creates LSAN_Zone
FID2Domain5:admin> zonecreate "Isan_zone_fabric2"
- c. Add members to the LSAN Zone (This example adds the Host, Target A & B)
 - i. zoneAdd "Isan_ZoneName", "WWN"
 - ii. Adds Host, Target A, and Target B to LSAN_Zone
FID2Domain5:admin> zoneadd "Isan_zone_fabric2",
"10:00:00:00:c9:2b:c9:0c;50:05:07:61:00:5b:62:ed;50:05:07:61:00:49:20:b4"
- d. Verify that the Created LSAN Zones are correct
 - i. cfgShow
- e. Create the LSAN Zone Configuration
 - i. cfgCreate "Zone_Cfg", "Isan_Zone Name"
- f. Enable the LSAN Zone Configuration
 - i. cfgenable "zone_cfg"

VERIFY LSAN ZONING

- a. Login as admin to the router/blade
- b. IsanZoneShow -s
 - i. Displays the LSAN
- c. fcrPhyDevShow
 - i. Displays the physical devices in the LSAN
- d. fcrProxyDevShow
 - i. Displays the Proxy Devices in the LSAN

FCR Large Implementation Customer Study

Case Study Overview:

Customer : US Government
SAN Usage : Shared Services and DR
Ports : 17,000 +
Directors: 40 +
Switches : 500 +
Routers : 8
Devices : 2000+
Users : 6000+

Problems to be addressed:

1. Several departments had significantly different SAN designs that required either redesign or maintenance
2. No Meta-SAN Connectivity
3. Technical expertise varied from department to department
4. No centralized SAN expertise
5. Customers' growth became unmanageable
6. No Shared Services
7. No Tiering approach
8. Routine performance issues
9. Host and Storage vendor interoperability
10. Space issues
11. Power issues
12. Classification of data very important
13. No unified SAN management standards with regarding zoning, switch naming, port assignments, etc
14. No significant documentation of the SAN
15. Lack of general SAN knowledge

Solutions:

1. Standardize SAN Design for specific departments
2. Implement Meta-SAN connectivity
(FCR through Connectrix PB-48K-18I and EMC SELET 7500)
3. Departments "hand over" SAN management to "centralized" SAN group
4. Government placed a Brocade Onsite Engineer
5. Growth became manageable through sound SAN management
6. Shared Services became a mandated approach for departments
7. Three tiers were designed (Host, Storage and Connectivity)
8. Implemented significant security and DR capabilities
9. Upgraded to 4 gig design and implemented tiering
10. Ensure SAN interoperability
11. Customer purchased dense Brocade OEM blade switches and Brocade Directors
12. Connectrix ED-48000B directors are the most efficient SAN directors in industry
13. Customer had two classifications of data and required separate HA SANS
14. Specified unified naming conventions for zoning, switch naming and ensure proper port assignments
15. Provided concise documentation through SAN Health, Connectrix Manager, On Site Engineer, etc.
16. Provided monthly on site training for customer by OSE

Customer used a tiered approach to host, switch and storage connectivity.

What is TIERING?

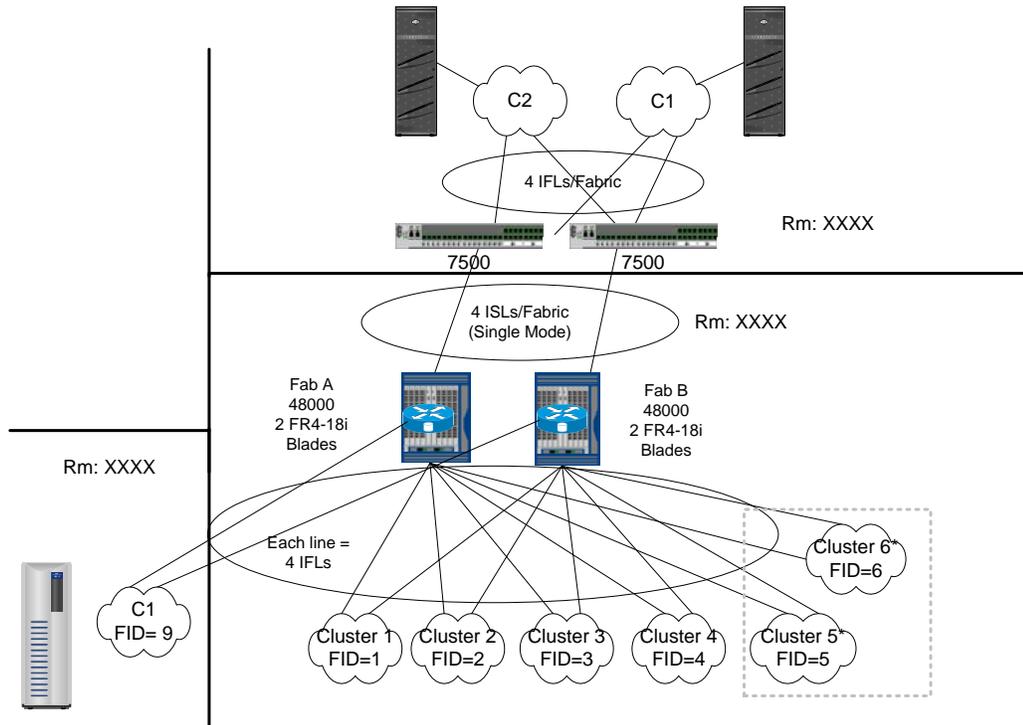
Tiering is the orderly process of grouping particular SAN devices by function, and then attaching these devices to particular switches or groups of switches based on that function.

The tiered approach at a customer site:

Tier Number	Description of Tier
Tier 1	SAN Switches in Chassis (BLADE SWITCHES)
Tier 2	SAN Switches in SAN Aggregation Cabinets (Brocade Connectrix ED-48000B and Brocade 24000)
Tier 3	SAN Inter-Cluster / Multi-Service Transport (SAN device connectivity via Connectrix PB-48K-18I director blades)

The customer has now been migrated to FCR routing. Notice in the sanitized drawing below, the customer has numerous clusters in just one Meta-SAN that are connected via SW EMC Select 7500's and dual Connectrix PB-48K-18I.

CUSTOMER META-SAN OVERVIEW



NOTE: Each cluster has a separate Fabric ID (FID) and several Inter Fabric Links (IFL) for HA redundancy.

The customer now has a well designed, scalable Meta-SAN that allows flexibility and room for growth.

Conclusion

Brocade solutions for FC routing were an industry first in the 4 Gig/sec market. Brocade solutions are fully complementary with EMC SAN solutions including the industry leading CLARiiON® and EMC Symmetrix® platforms.

FCR implementation is relatively non-complex if done correctly, requiring only basic SAN planning.

No need to be concerned with:

- Domain IDs
- Name servers
- Fabric Parameters
- Legacy switches

The major benefits of Fibre Channel routing are:

- No need for difficult, time consuming fabric merging plans
- Reduced risk especially in production environments (no fabric merges)
- Scalability of one edge fabric does not affect other edge fabrics
- Enables the creation of Logical SANs (LSANs)
- Combines selective connectivity with flexible management
- Can connect different Fabric OS versions and different Fibre Channel parameters
- Isolates the faulty conditions to prevent propagation
- Planned capability
- Interoperate in multi-vendor SANs

FCR Terminology Glossary

Backbone Fabric: A capability that enables scalable Meta SANs by allowing the networking of multiple routers that connects to the backbone fabric via E_Port interfaces. Devices attached to routers via F_Port or FL_Port, or imported via the iSCSI Gateway Service, are also considered part of the backbone. A backbone fabric is an intermediate network that connects two or more edge fabrics. It consists of at least one EMC Select 7500, Connectrix ED-48000B with a Connectrix PB-48K-18I blade and possibly a number of Fabric OS-based Fibre Channel switches. It also enables hosts and targets in one edge fabric to communicate with devices in the other edge fabrics. A backbone fabric also enables hosts and targets in one edge fabric to communicate with devices in other edge or backbone fabrics.

Backbone-to-Edge Routing - Fibre Channel routers can connect to a common fabric—known as a backbone fabric—via E_Ports. A backbone fabric can be used as a transport fabric that interconnects edge fabrics. Fibre Channel routers also enable hosts and targets in edge fabrics to communicate with devices in the backbone fabric—this is known as backbone-to-edge routing.

From the edge fabric's perspective, the backbone fabric is just like any other edge fabric. For the edge fabric and backbone fabric devices to communicate, the shared devices need to be presented to each other's native fabric. To do so, at least one translate phantom domain (switch) is projected into the backbone fabric. This translate phantom switch represents the entire edge fabric. The shared physical device in the edge has a corresponding proxy device on the translate phantom domain switch. Each edge fabric has one and only one xlate switch to the backbone fabric. The backbone fabric device communicates with the proxy devices whenever it needs to contact the shared physical device in the edge. The FC-FC routing service receives the frames from the backbone switches destined to the proxy device, and redirects the frame to the actual physical device.

E_Port: A standard Fibre Channel mechanism that enables switches to network with each other.

Edge Fabric: A Fibre Channel fabric connected to a router via one or more EX_Ports. This is where hosts and storage are typically attached in a Meta-SAN.

Edge-to-Edge Routing - Occurs when devices in one edge fabric communicate with devices in another edge fabric through one or more Fiber Channel routers.

EX_Port: The type of E_Port used to connect a router to an edge fabric. An EX_Port follows standard E_Port protocols and supports FC-NAT but does not allow fabric merging across EX_Ports.

Exported Device: A device that has been mapped between fabrics. A host or storage port in one edge fabric can be exported to any other fabric through LSAN zoning.

Fabric: A collection of Fibre Channel switches and devices, such as hosts and storage.

Fabric ID (FID): Unique identifier of a fabric in a Meta-SAN. Every EX_Port and VEX_Port uses the FID property to identify the fabric at the opposite end of the IFL. You should configure all of the EX_Ports and VEX_Ports attached to the same edge fabric with the same FID. The FID for every edge fabric must be unique from each backbone fabric's perspective.

FCIP Tunneling Service: A service that enables SANs to span longer distances than could be supported with native Fibre Channel links. FCIP is a TCP/IP-based tunneling protocol that allows the transparent interconnection of geographically distributed SAN islands through an IP-based network.

Fibre Channel: The primary protocol for building SANs. Unlike IP and Ethernet, Fibre Channel is designed to support the needs of storage devices of all types.

Fibre Channel Network Address Translation (FC-NAT): A capability that allows devices in different fabrics to communicate when those fabrics have addressing conflicts. This is similar to the “hide-behind” NAT used in firewalls.

Fibre Channel Router Protocol (FCRP): A Brocade-authored standards-track protocol that enables LSAN switches to perform routing between different edge fabrics, optionally across a backbone fabric.

FC-FC Routing Service: A service that extends hierarchical networking capabilities to Fibre Channel fabrics. It enables devices located on separate fabrics to communicate without merging the fabrics. It also enables the creation of LSANs.

Inter-Fabric Link (IFL): A connection between a router and an edge fabric. Architecturally, these can be of type EX_Port-to-E_Port or EX_Port-to-EX_Port. The former method is supported in the first release.

Logical Storage Area Network (LSAN): A logical network that spans multiple fabrics. The path between devices in an LSAN can be local to an edge fabric or cross one or more Routers and up to one intermediate backbone fabric. LSANs are administered through LSAN zones in each edge fabric.

LSAN Zone: The mechanism by which LSANs are administered. A Router attached to two fabrics will “listen” for the creation of matching LSAN zones on both fabrics. If this occurs, it will create phantom domains and FC-NAT entries as appropriate, and insert entries for them into the nameservers on the fabrics. LSAN zones are compatible with standard zoning mechanisms.

Meta-SAN: The collection of all devices, switches, edge and backbone fabrics, LSANs, and Routers that make up a physically connected but logically partitioned storage network. In a data network, this would simply be called “the network.” However, an additional term is required to specify the difference between a single-fabric network (“SAN”), a multifabric network without cross-fabric connectivity (for example, a “dual-redundant fabric SAN”), and a multifabric network with connectivity (“Meta SAN”).

Phantom Domains: The Fibre Channel Router emulates two levels of phantom domains. The first set of phantom domains are known as front phantom domains. There is one front phantom domain from FCR to an edge Fabric.

The second level of phantom domains is known as a “translate phantom domain.” The EX_Ports also present translate phantom domains in edge fabrics as being topologically behind the front domains; if the translate phantom domain is in a backbone fabric, then it is topologically present behind the Fibre Channel router because there is no front domain in a backbone fabric. The translated phantom domain is a router virtual domain that represents an entire fabric. Device connectivity can be achieved from one fabric to another over the backbone or edge fabric through this virtual domain—without merging the two fabrics.

Translate phantom domains are sometimes referred to as “translate domains,” or “xlate domains.” If a Connectrix PB-48K-18I blade is attached to an edge fabric using an EX_Port, it will create translate phantom domains in the fabric corresponding to the imported edge fabrics with active LSANs defined. If you import devices into the backbone fabric, then a translated phantom domain is created in the backbone device (in addition to the one in the edge fabric).

Proxy Devices: An EMC Select 7500 or Connectrix ED-48000B with a Connectrix PB-48K-18I blade achieves interfabric device connectivity by creating proxy devices (hosts and targets) in attached fabrics that represent real devices in other fabrics.

For example, a host in Fabric 1 can communicate with a target in Fabric 2 as follows:

- A proxy target in Fabric 1 represents the real target in Fabric 2.
- Likewise, a proxy host in Fabric 2 represents the real host in Fabric 1.

The host discovers and sends Fibre Channel frames to the proxy target. The EMC Select 7500 or Connectrix ED-48000B with a Connectrix PB-48K-18I blade receives these frames, translates them appropriately, and then delivers them to the destination fabric for delivery to the target.

The target responds by sending frames to the proxy host. Hosts and targets are exported from the edge SAN to which they are attached and, correspondingly, imported into the edge SAN reached through Fibre Channel routing.

Proxy ID:- The port ID of the proxy device. A proxy device is a virtual device presented into a fabric by a Fibre Channel router, and represents a real device on another fabric. When a proxy device is created in a fabric, the real Fibre Channel device is considered to be imported into this fabric. The presence of a proxy device is required for inter-fabric device communication. The proxy device appears to the fabric as a real Fibre Channel device, has a name server entry, and is assigned a valid port ID. The port ID is only relevant on the fabric in which the proxy device has been created.

Router: A device that enables Brocade routing services.

Multiprotocol routing services: Available on the Connectrix PB-48K-18I blade and the EMC Select 7500 Router, that includes the FC-FC Routing Service, and the FCIP Tunneling Service.

NR_Port: A port used as a source and destination address for frames traversing a backbone fabric. A normal E_Port (not an EX_Port) is used to connect a Router to a backbone. An NR_Port appears to the rest of the backbone as a standard N_Port connected to the Router domain.

VE_Port: Virtual E_Port; an FCIP tunnel without routing is a VE_Port.

VEx_Port: The type of VE_Port used to connect a router to an edge fabric. A VEx_Port follows standard E_Port protocols and supports FC-NAT but does not allow fabric merging across VEX_Ports.

Author Biography

Joe Holbrook has been in the computer field since 1993 when he was exposed to several UNIX systems on board a US Navy ship (USS JFK, CV-67) while on active duty.

He has updated his career from the UNIX world to specialize in EMC SANs and Disaster Recovery specializations. Joe has worked as a consultant/employee for numerous companies including Hewlett Packard, EMC, Northrup Grumman, CSC, Ibasis.net, Chematch.com, SAIC and Siemens Nixdorf.

He currently works for Brocade Communications as a Brocade Solutions Consultant where he is specialist in Fiber Channel SANS implementation. He also recently worked on a long term engagement for Brocade Communications as an onsite engineer at a large US Government site that had over 17,000 SAN ports with a large FC routing architecture.