2. Brocade Product Introduction and Roadmap

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BROCADE
The intelligent platform for networking storage

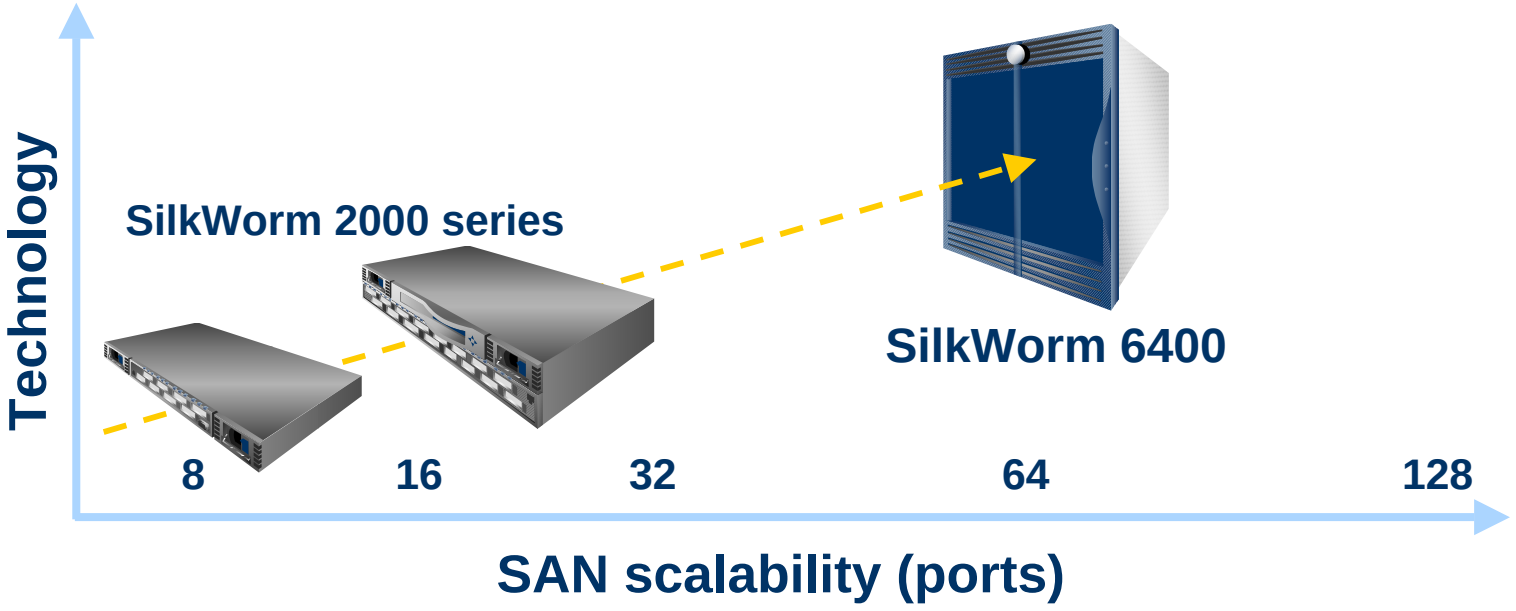
SilkWorm Product Family

Why 90% Market Share?

- Interoperability: Standard Leadership
  - Extensive Server/Storage Interoperability Matrix
- High Reliability
- High Scalability
- Performance: Wire-Speed, Cut-Through Routing on Every Port
- Ease of Mgmt: Auto Configuring E, F, FL Ports
  - Automatic discovery of Fabric resources (names, zones, routes)
  - Common Fabric OS and configurable software features
  - In-band and out-of-band management

SilkWorm 1 Gb/sec Product Family

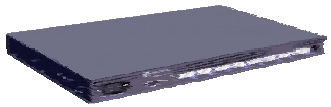
- 8- and 16- port fabric switches (SilkWorm 2000 series)
- 90% of fabric SANs worldwide are based on Brocade
- 64-port Integrated Fabric (SilkWorm 6400)
- Network model = modular, pay-as-you grow expansion
- Easy implementation and low administration cost



SilkWorm 2000 Series

Full Fabric

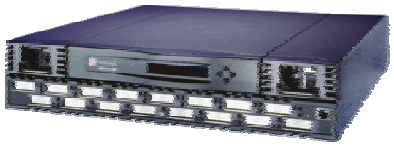
Entry Level
- Fixed PSU
- Fixed Media
- No FRUs



SilkWorm 2050

Entry Level
- Fixed PSU
- GBIC flexibility
- No FRUs

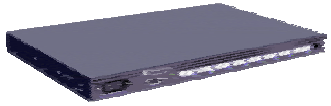
SilkWorm 2250



SilkWorm 2800

SilkWorm 2400

Entry Fabric

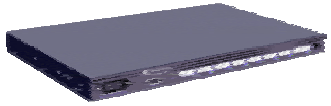


SilkWorm 2040

SilkWorm 2240

High Availability
- Removable media
- Swappable PSUs
- Swappable FANs
- Redundant components
- Multiple FRUs

Entry Loop

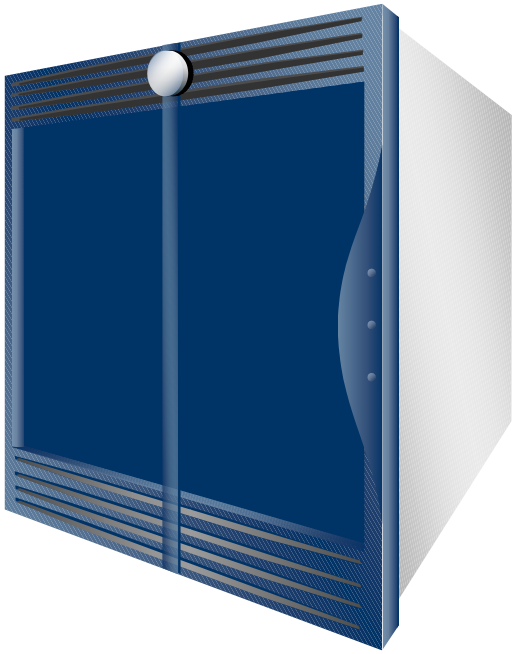


SilkWorm 2010

SilkWorm 2210

SilkWorm 6400
64-Port Integrated Fabric

- High-port-count integrated fabric
  - 64 ports at less than 50% the cost of comparable products
  - 6 Brocade switch modules preconfigured in a highly available fabric
  - Single 14U enclosure; precabled interconnect
  - Fully networkable as a node in larger SANs
- Full Fabric OS support based on R2.4
  - Fabric Manager software for integrated management
  - QuickLoop, Fabric Watch, Zoning, WEB TOOLS



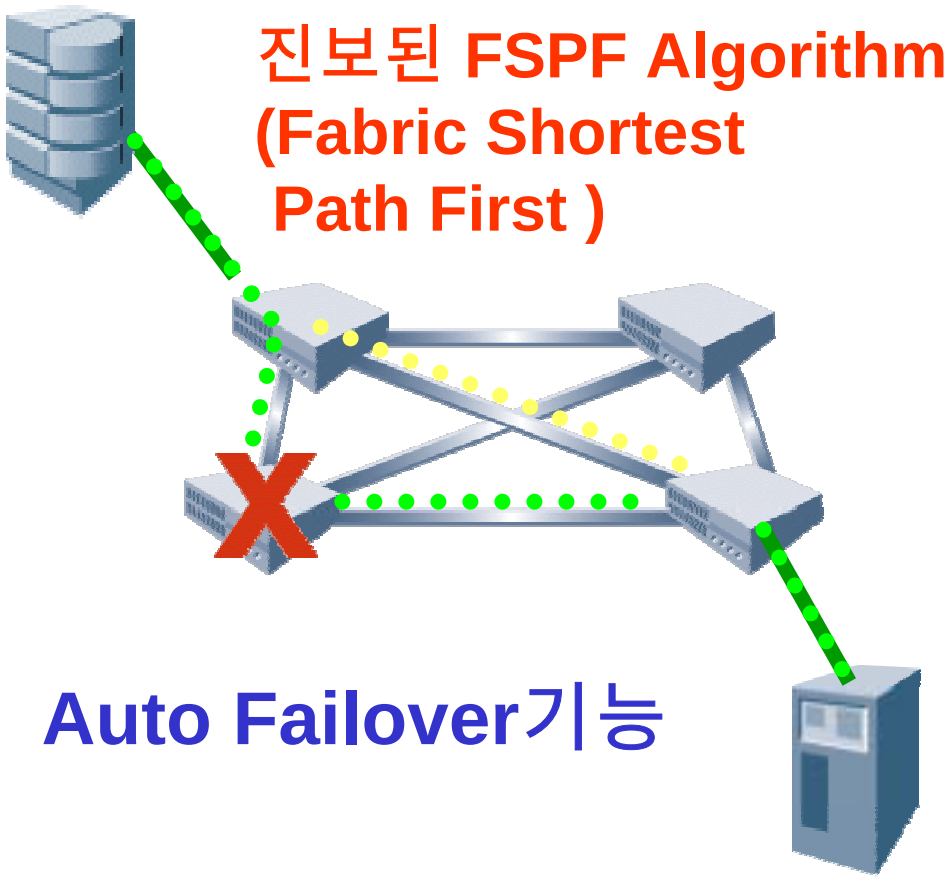
Mcdata Director – HA 문제점

SW장애 발생시 스위치 전체에 치명적인 영향

- 진정한 의미의 **HA**는 소프트웨어, 사용자의 실수에 대하여 시스템 가동시간을 보장할 수 있을때 실현됨.

- 또한 진정한 **HA**는 단일 **Fabric**이 아닌 이중화된 **Fabric**에서만 가능함.

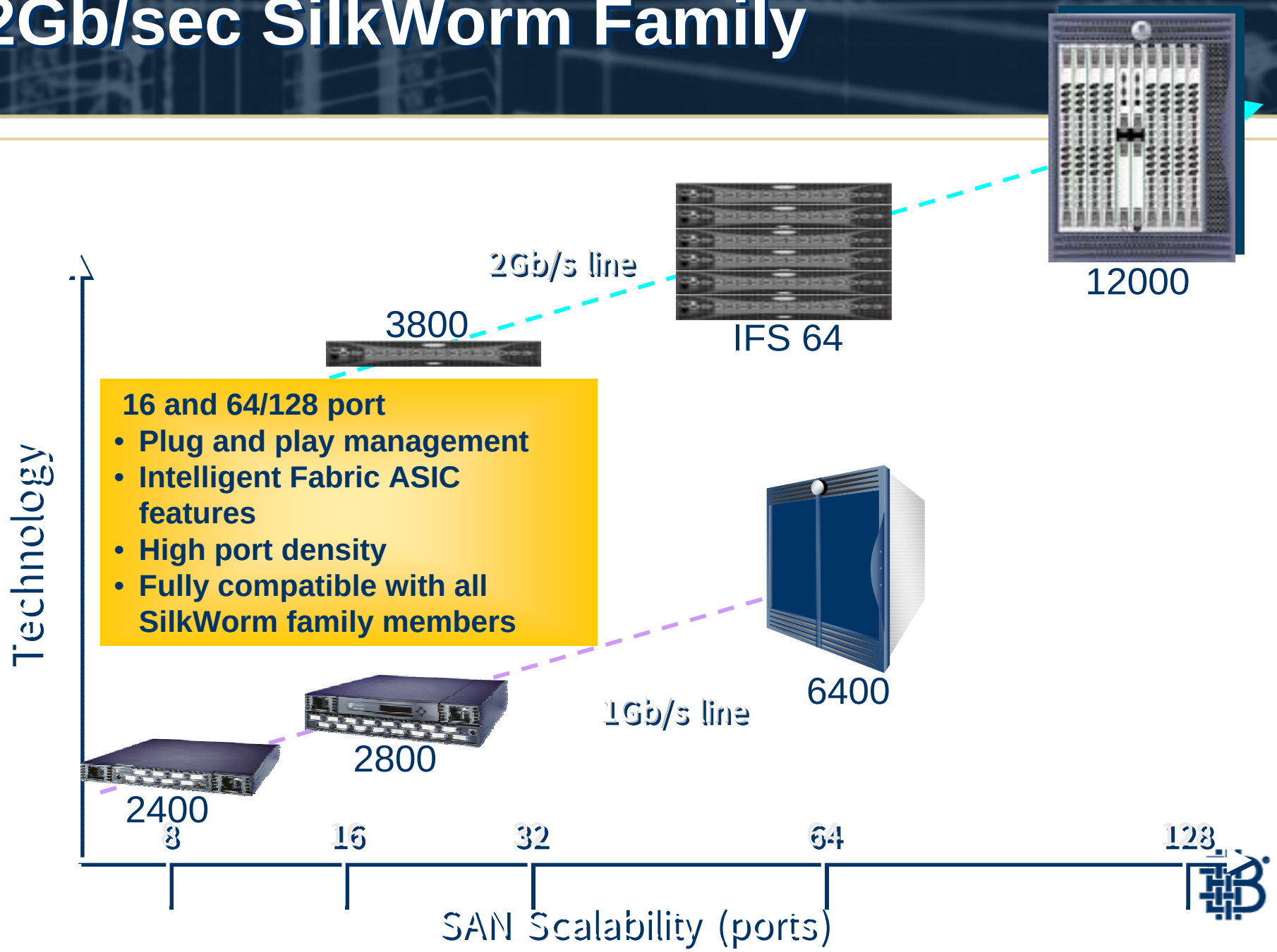
Brocade 다중화된 SAN의 안정성



- Automatic Fail Over
- 장애감지 150ms
- 장애처리 500ms
- 대체경로 제공 700ms

업무가 중단 없이
계속됨.

2Gb/sec SilkWorm Family



SilkWorm 3800

All the proven features & benefits of the SilkWorm 2800 PLUS ……

- 3rd Generation ASIC
  - Wire-speed Frame Filtering
  - 2 Gb/Sec Performance at full bandwidth
  - 8Gb/ Sec Trunk” between Switches
- 16 auto-sensing ports
- 1U standard rack mount with slide rails
- SFP Connectors
- Fabric OS 3.0
- Enhanced management tools
- Advanced Fabric Services
  - Advanced Hardware Enforced Zoning
  - ISL Trunking
  - End-to-end performance monitoring

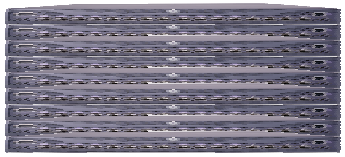
When Battling McData's HA

- No application down time, for any reason.
  - HA is not just about hot code-load, or redundant chassis components
  - It must include all aspects of RAS
    - Reliability (raw failure rates, MTBF)
    - Availability (system-level architecture affects overall application availability)
    - Serviceability (MTTR and ability to detect and repair failures before the application availability is affected)
  - Application availability = Non disruptive data flow
- True HA can't be achieved unless you ensure uptime against software failure, human error or physical locality
- The "REAL" HA solution is achieved when IFS 64 is deployed in a Dual Fabric Architecture

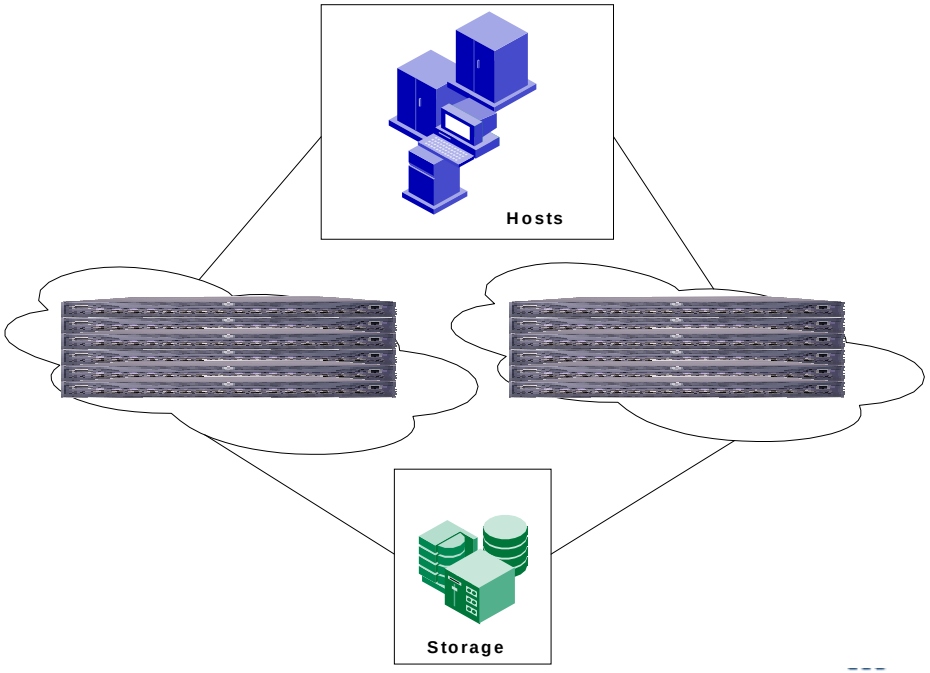
High Availability Integrated Fabric Solution

- 64/96 Port Integrated Fabric Solution (IFS)
- Deployed in the same architecture as the Brocade 6400
- Improved performance over Brocade 6400 by utilizing Trunking

64 Ports in a 6U Form Factor



96 Ports in a 10U Form Factor



IFS as a Competitive Response

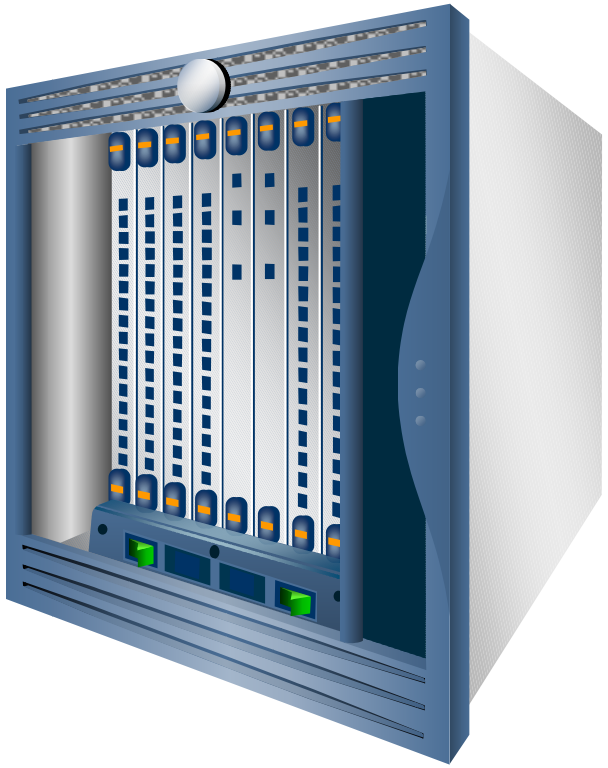
- When Battling High Port Count
  - Integrated Fabric Solution can be deployed in both 64 port and 96 port configurations
  - Cost about 30% less than the McData ED-6064

Advantages of Integrated Fabric Solutions

- Higher Density
- 2 Gb/sec Bandwidth
- ISL Trunking Enabled by NEW of 3rd Gen ASIC
- Deployment flexibility
- Utilizes qualified HW
- Easily scaled: Replace cores and Can grow to a big Core / Edge
- Controlled and secure pay as you need increase in performance & port count
- Improved manageability by using Fabric Manager 3.0

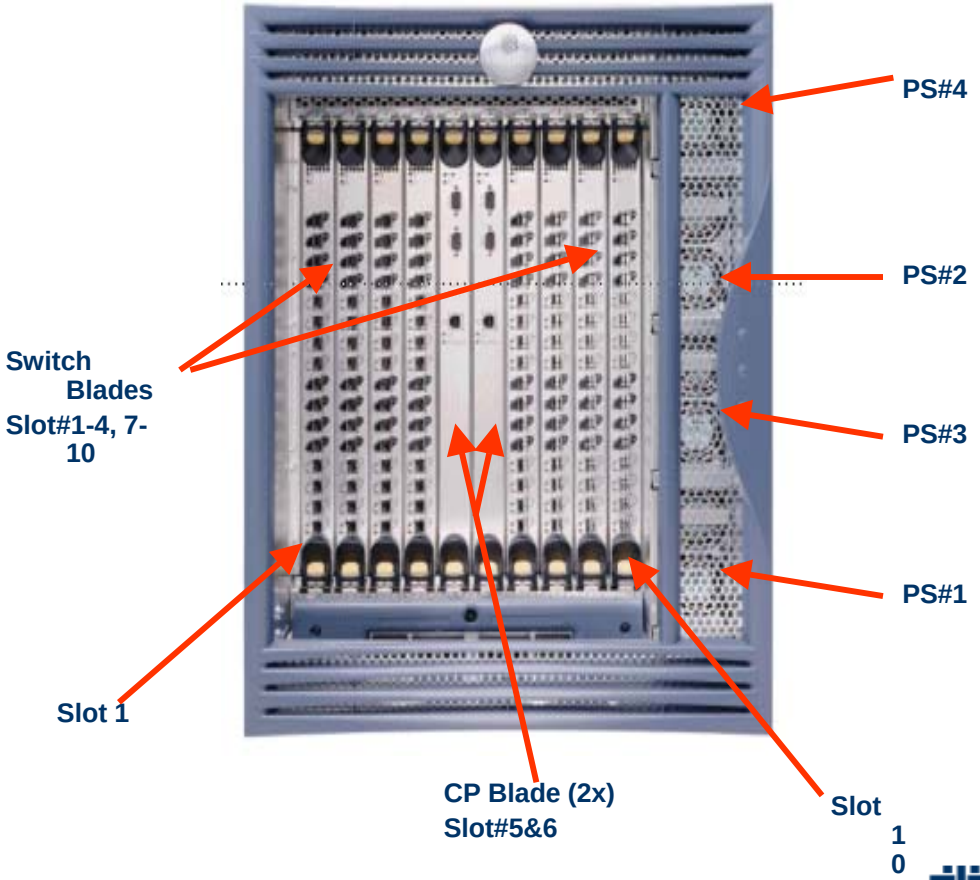
SilkWorm 12000 Core Fabric Switch

- Flexible, modular architecture
  - Scalable 64/128-port design
  - 2 Gbit/sec ports; autosensing
  - Third-generation Brocade ASIC
  - High port density – 14U enclosure
- Designed for 99.999% availability
  - Redundant, hot-swappable components
  - Non-disruptive software updates
  - Redundant, 64-port switch configuration
- Intelligent fabric services
- Multiprotocol architecture
- Generally available Q1 2002

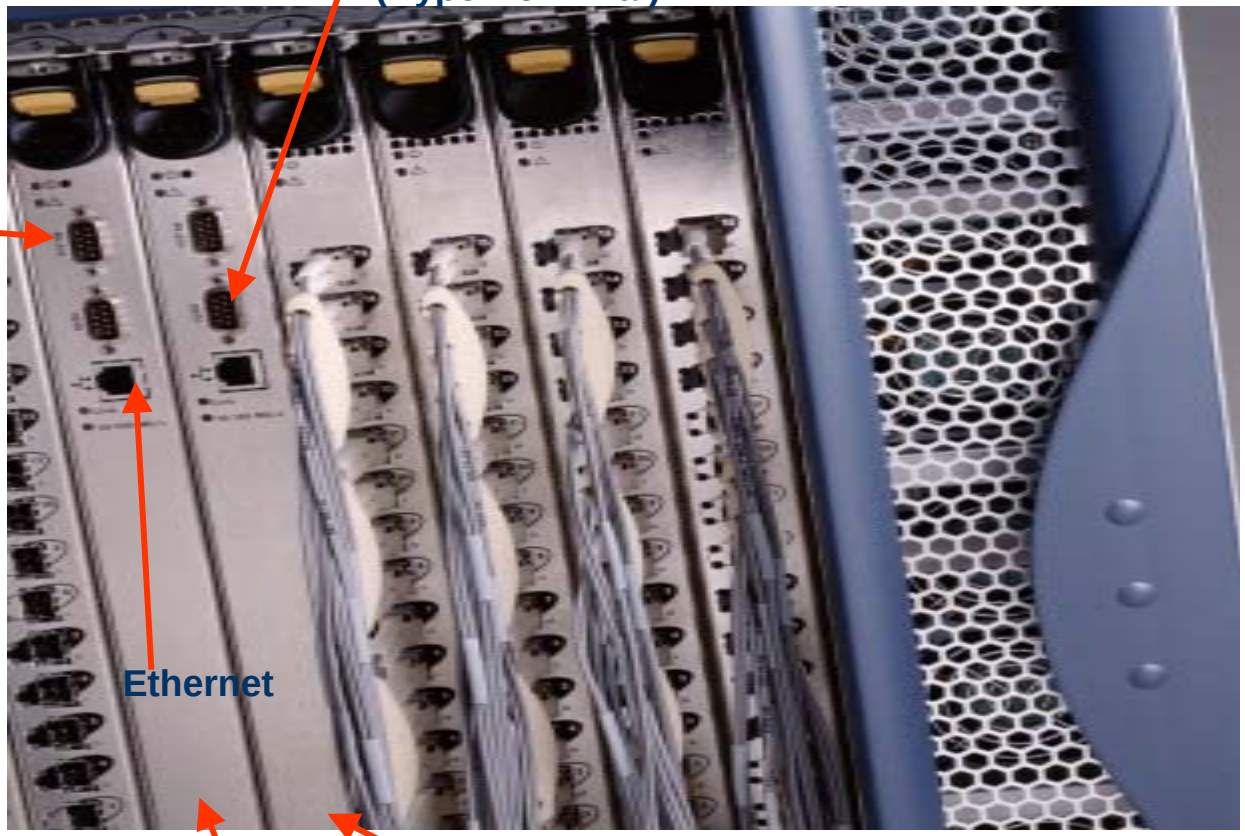


System Assembly

- Hot swap of:
  - **Switching blades**
  - **Power Supplies**
  - **Blowers**
  - **CPs (starting to remove active CP will cause immediate fail over so that CP is standby when removed)**

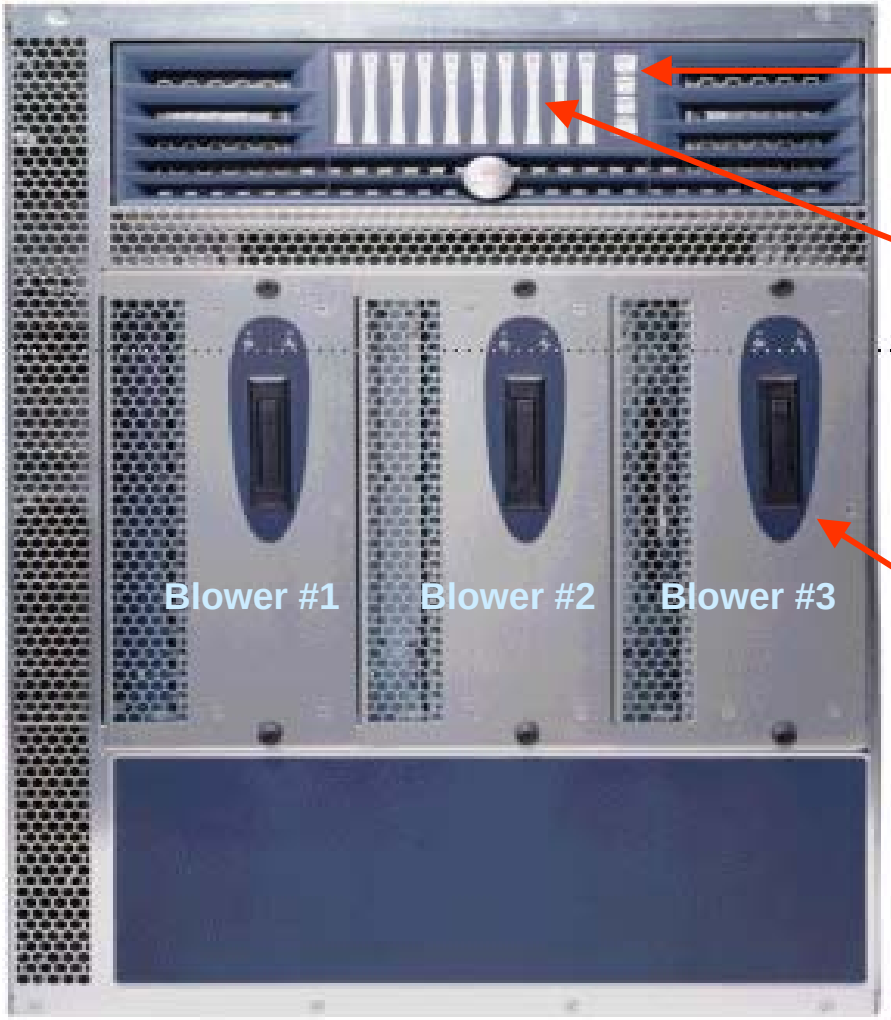


System Assembly- Cable Side View – cont.



System Assembly- With Door

System Assembly- Blower Side View



PS LEDs (4x)

WWN Board
(x20 System LEDs)

Blower Subsystem
(3x)

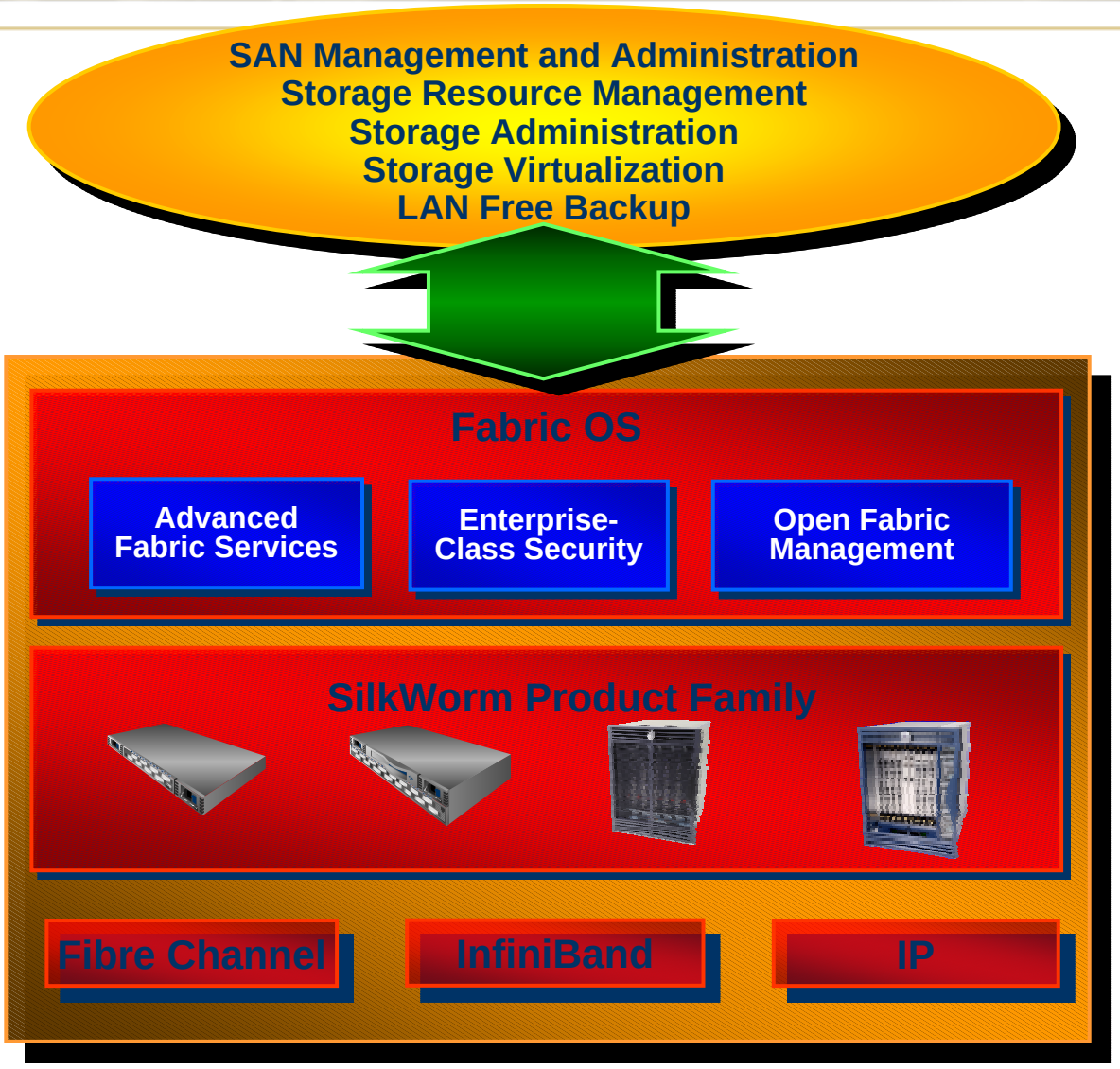
Brocade Intelligent Fabric Service Architecture

Brocade Intelligent Fabric 서비스 아키텍처

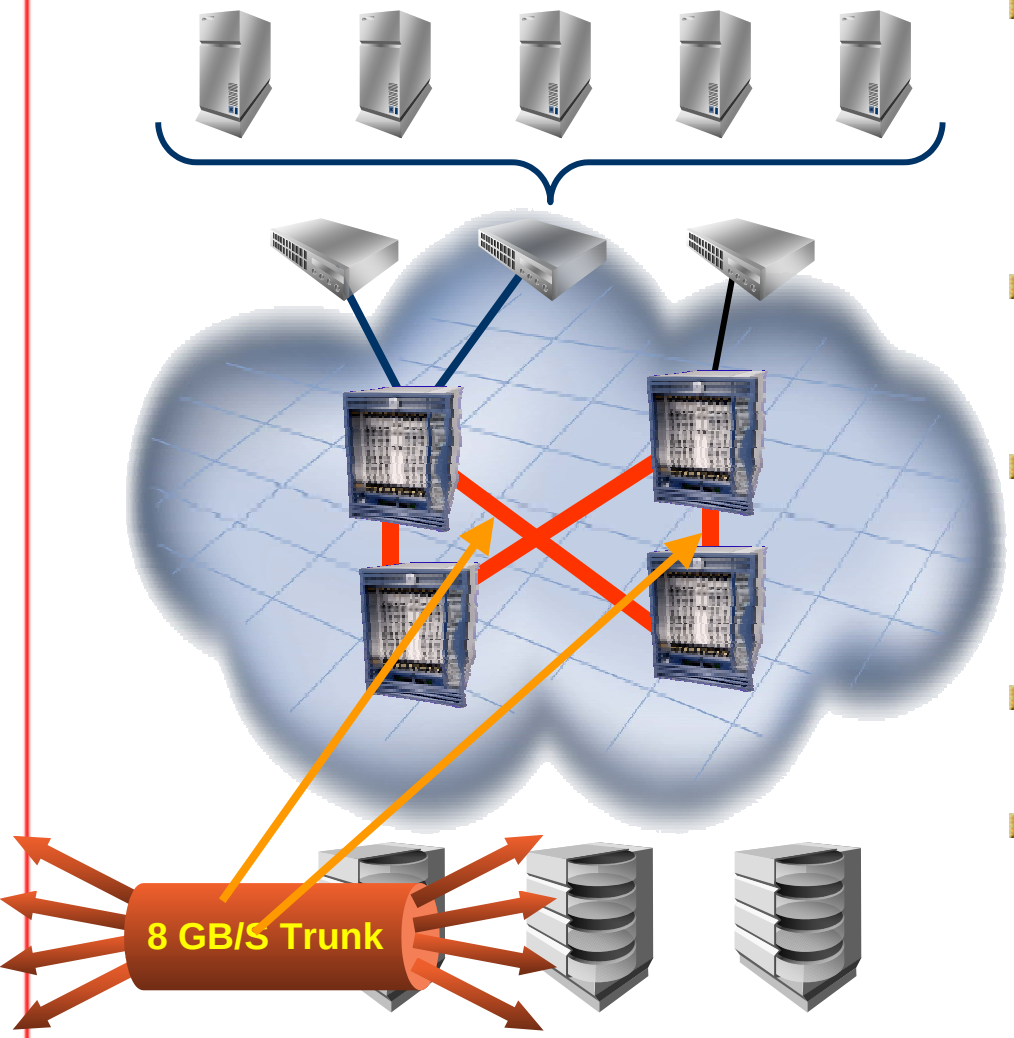
애플리케이션

인텔리젼트 스위칭 플래폼

멀티 프로토콜 지원



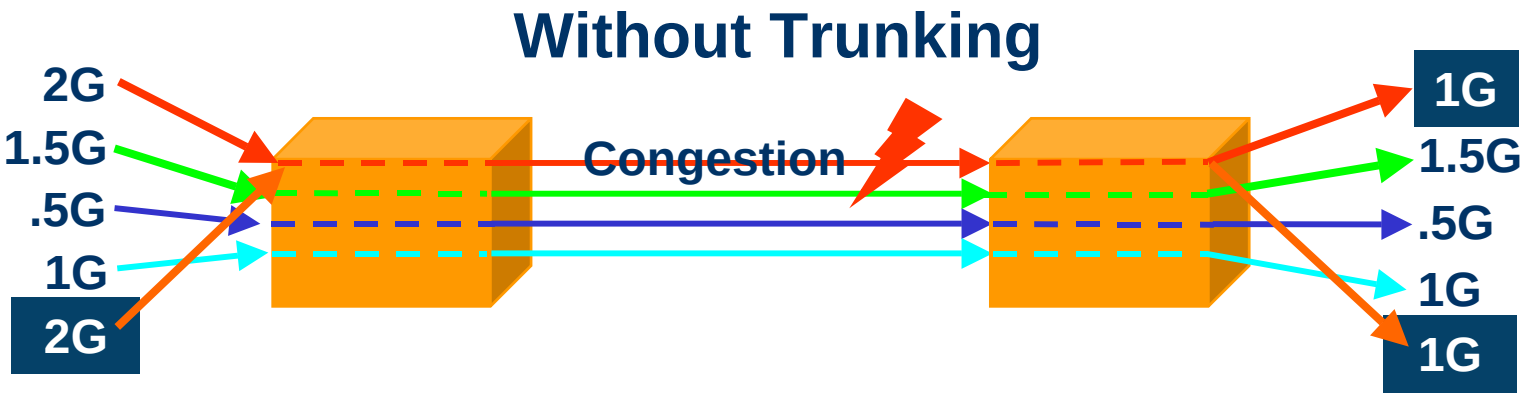
새로운, 보다 진보된 Fabric 서비스: ISL(Interswitch Link) Trunking



- **ISL Trunking**
  - 8 Gb/sec logical links
  - Aggregate edge traffic
  - Zero management
- **Simplify network design and management**
- **Simplifies ongoing administration (manage one link versus four links)**
- **Maximizes fabric performance**
- **Provides increased high availability in case of link failures**

새로운, 보다 진보된 Fabric 서비스:
Multiple Inter-Switch Links (ISLs) Today

- Routes are assigned to ISLs in a round-robin fashion
- Traffic for each route stays on its link
- Some routes can experience congestion while others are under-utilized

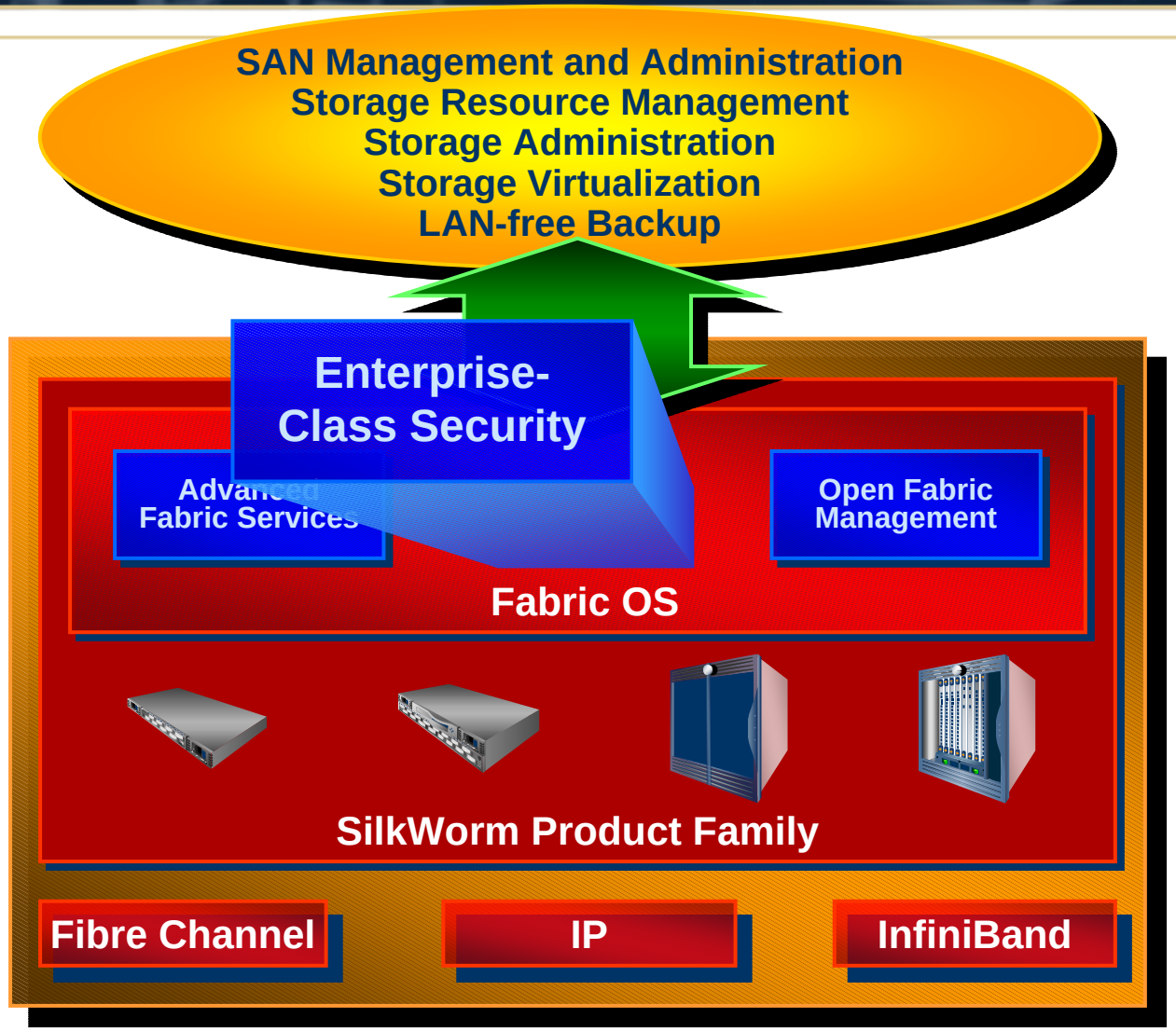


8Gbps Fibre Channel with ISL Trunking

- Simplify network design and administration
- Assure predictable performance under load

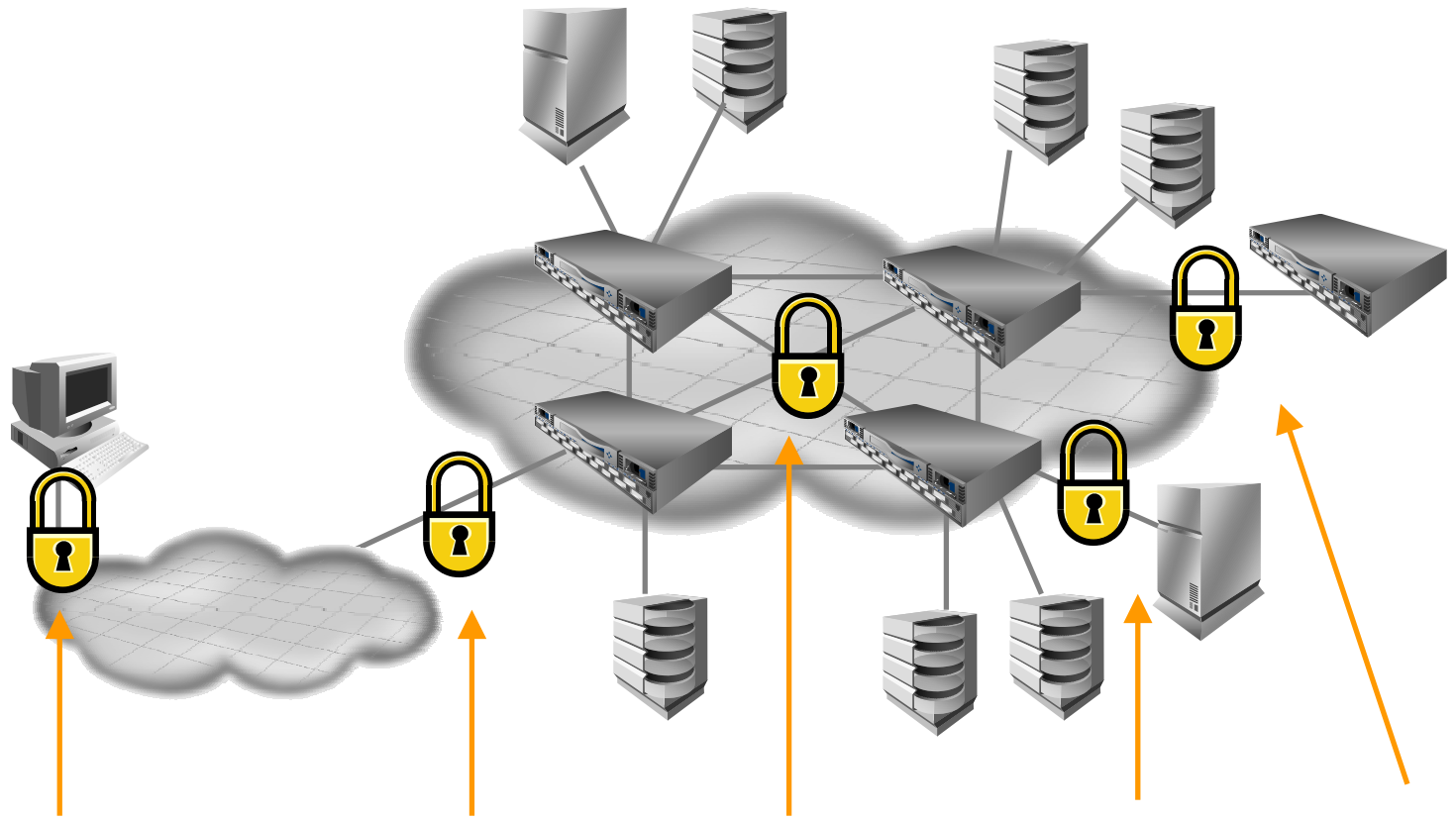
- Aggregate traffic onto fewer logical links
- Automatically created when switches are connected
- Managed as a single logical 8Gbps ISL
- Fault-tolerant – will withstand failure of individual links
- Supports redundant trunks between switches

Enterprise급 보완

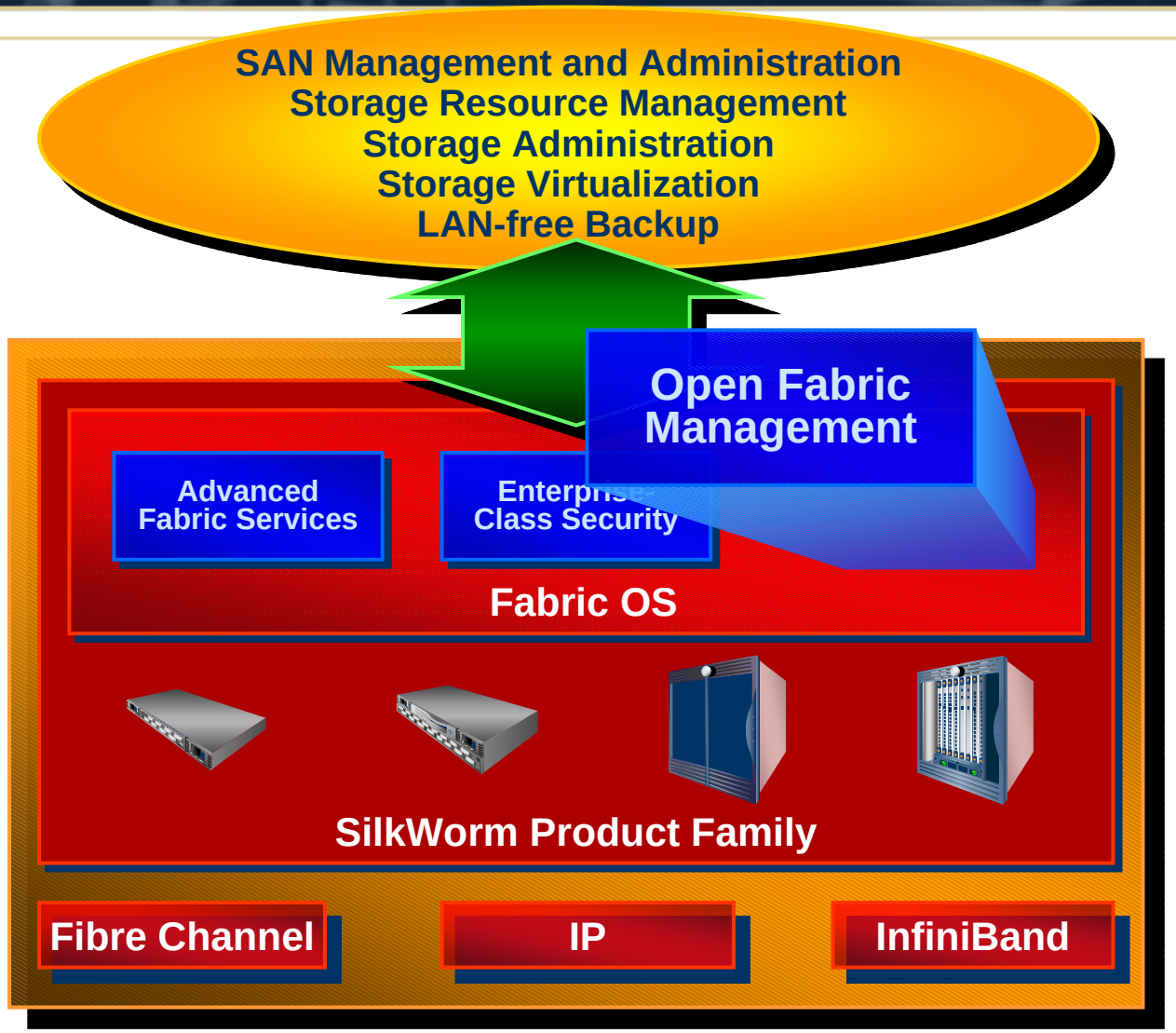


Intelligent
스위칭
플래폼

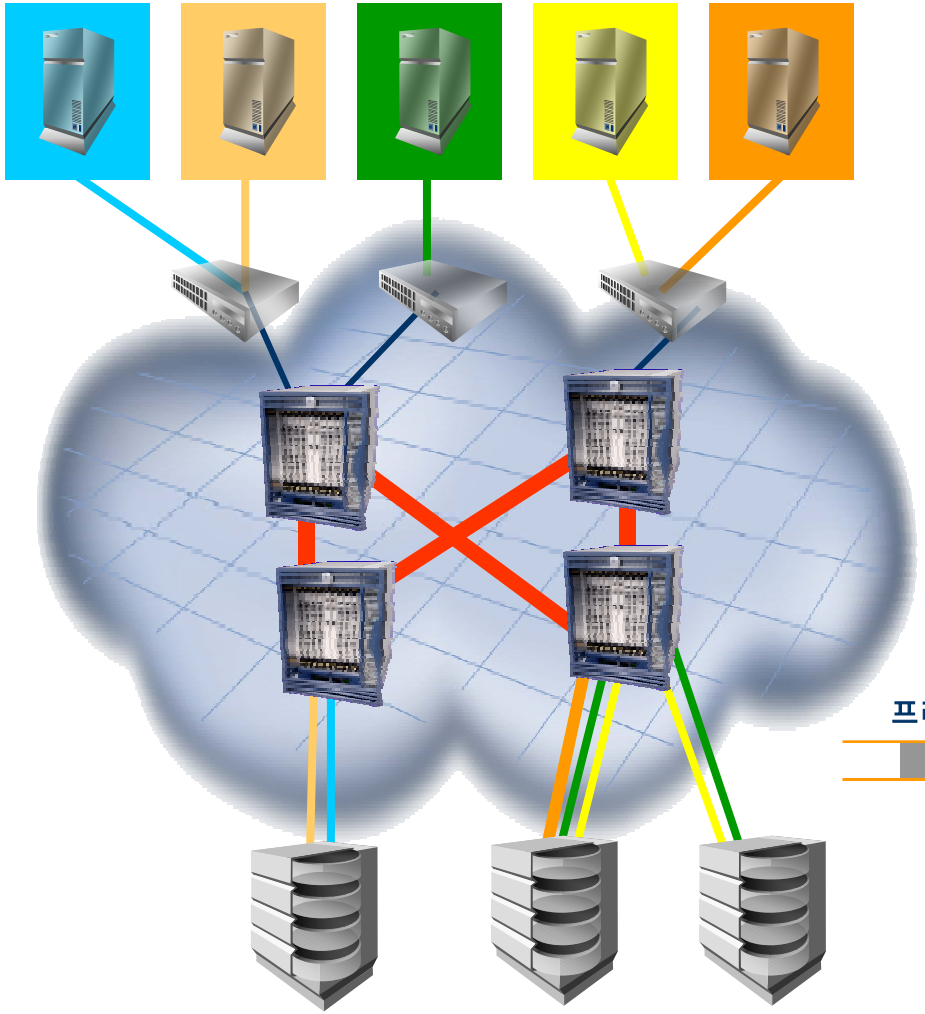
A Secure SAN 구현
(Fabric OS 2.6부터 상위 버젼에서 지원)



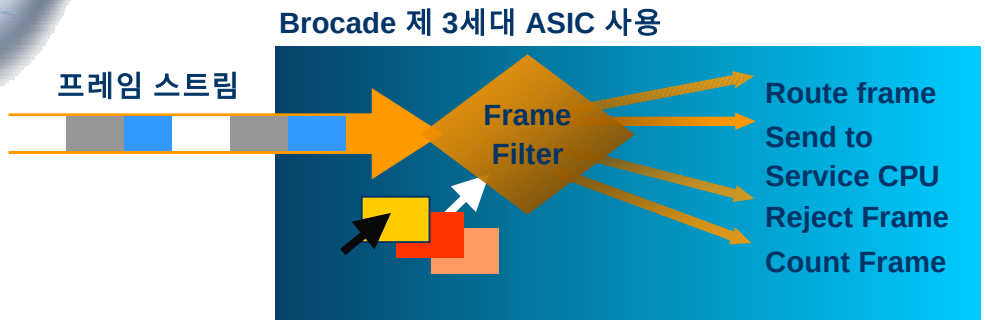
Open Fabric 관리



새로운, 보다 진보된 Fabric 서비스:
Frame Filtering을 바탕으로 진보된 Zoning 실현



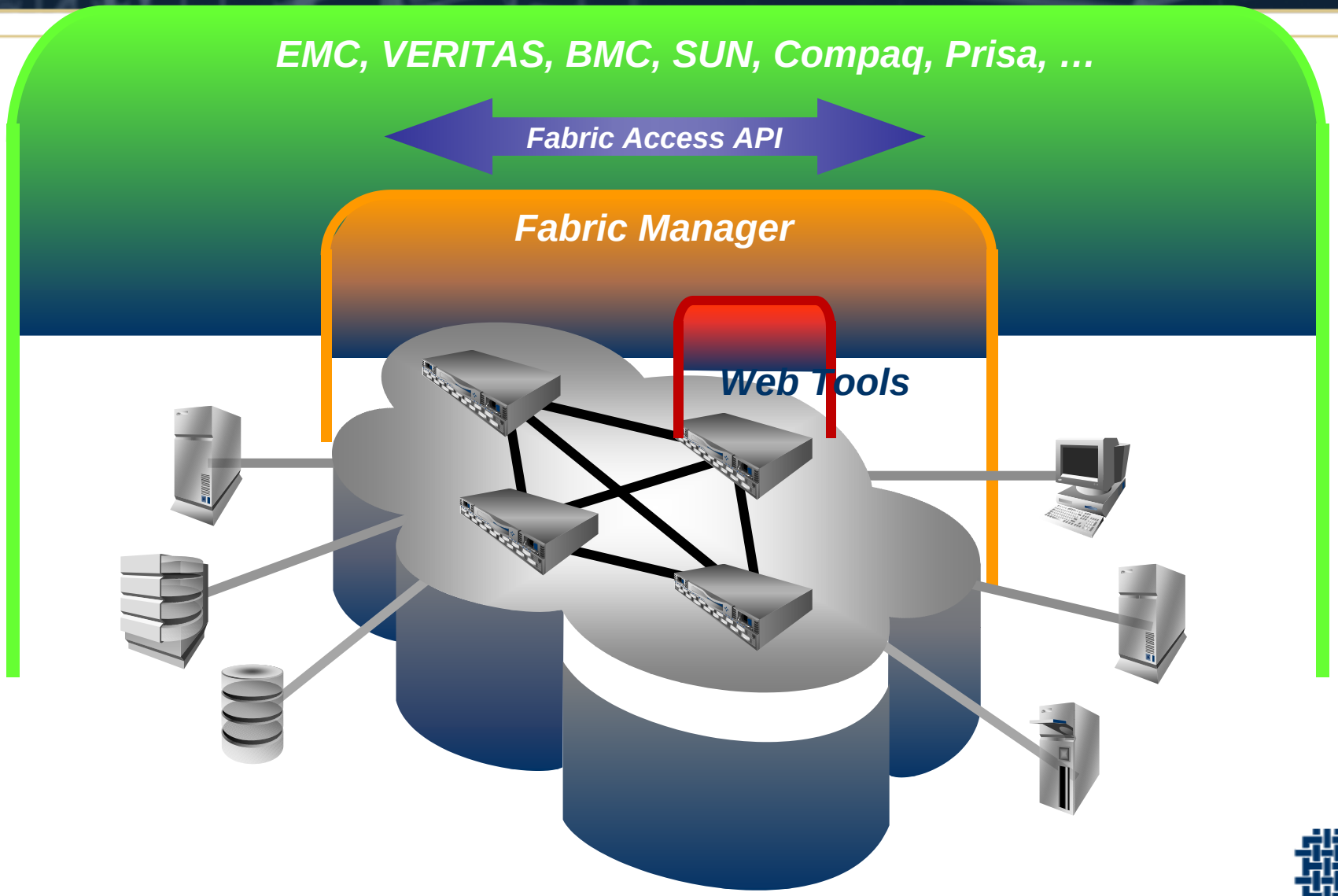
- LUN단위 Zoning
- Hardware based WWN Zoning
- WWN anti-spoofing security
- 프로토콜단위 zoning
  - IP 프로토콜 분리
  - 특별한 목적을 가진 ULP 트래픽



Filters for LUN Zones; Protocol Zones; WWN; Future

Filtering in ASIC Level
No Performance Degradation

Brocade SAN 관리 도구:



Competitive Analysis - McDATA

BROCADE

The intelligent platform for networking storage

McData Product Strengths

- **Broadest Released Product Line**
  - –ES-1000,ES-3016/3032 & ED-6064
  - –Nice looking products
- **Highest rack density currently available**
- **Hot-code load**
  - –Non-disruption of data during code load
  - –Incorporated into the entire product line
- **Common code base across product line**

McData Counter Point

….there are holes in their armor:

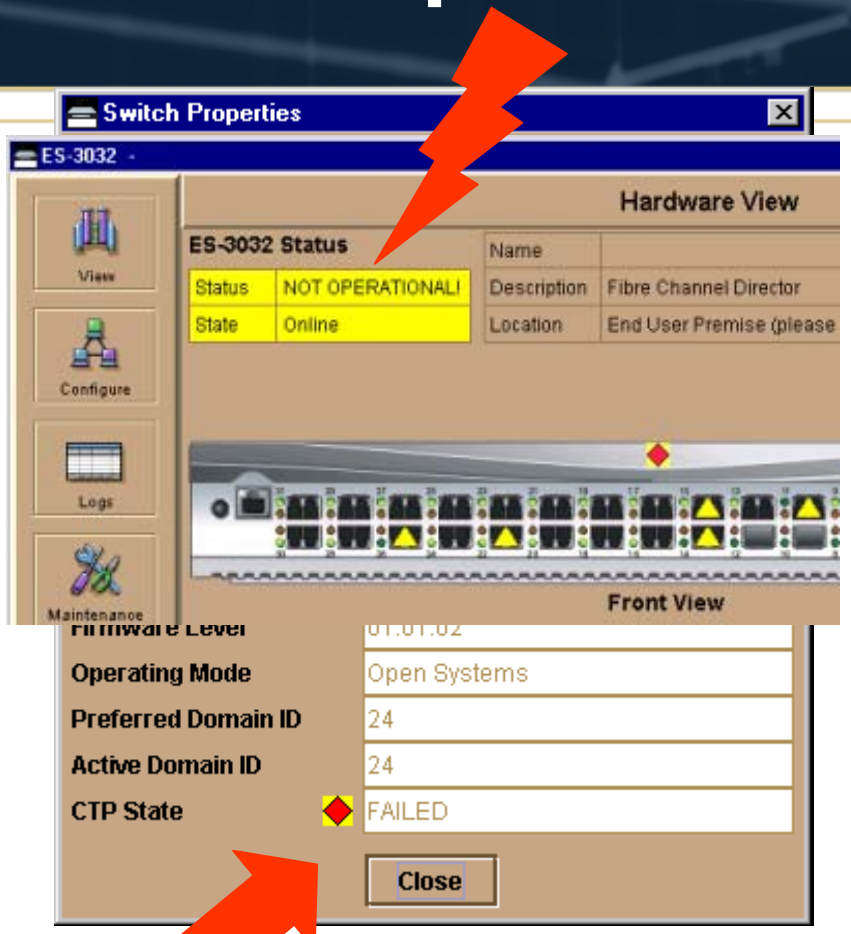
- **Common SW code & architecture has resulted in flaws & failures across product line**
- **Key deficiencies in loop & zoning**
- **Exposed failures exposes hole in HA story, they are a HW HA, but the SW is not HA**
- **Entire product line is 1Gb NOT 2Gb**
  - New hardware & software required for 2Gb (NOT just SW upgrade)
  - Both director port cards & CPU cards will need replacing
  - Have never demonstrated 2Gb technology publicly

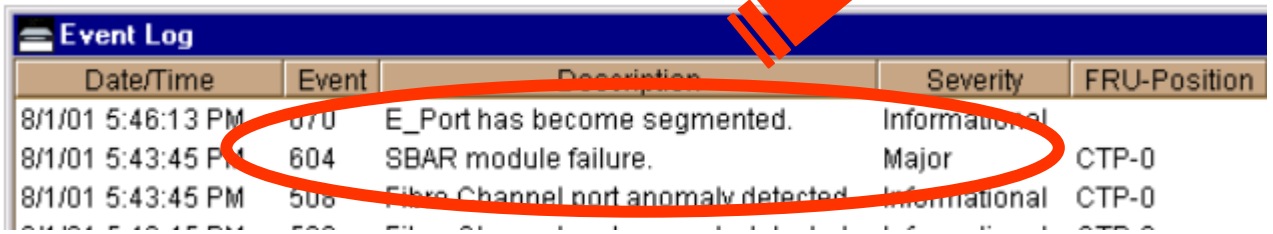
Key McData Headshots

1. Not HA SW– easily caused catastrophic failures
2. NOT optimized for storage consolidation due to unbalanced/unfair access
3. Routing Problems Lead to congestion
4. Limited Scalability due to ISL limitations
5. No hardware zoning for secure SANs
6. No loop support

McData: No HA SW, No Multi-protocol

- **FC-IP is not safe on McData**
  - Servers configured for standard IP over FC causes crossbar failure
  - Even if not using FC-IP installing the wrong drivers will bring down SAN
- **Catastrophic failure in a simple configuration**
  - Affects ALL new McData products
- **Business application fail without access to storage**
- **Network collapses must reboot switches to recover**





McDATA “HA” Director’s crashes

Event Log

Date/Time	Event	Description	Severity	FRU-Pos
8/1/01 6:13:40 PM	070	E_Port has become segmented.	Informational	
8/1/01 6:13:15 PM	070	E_Port has become segmented.	Informational	
8/1/01 6:12:34 PM	070	E_Port has become segmented.	Informational	
8/1/01 6:12:01 PM	070	E_Port has become segmented.	Informational	
8/1/01 6:11:22 PM	604	SBAR module failure.	Major	SBAR-1
8/1/01 6:11:22 PM	508	Fibre Channel port anomaly detected.	Informational	GSF1-0
8/1/01 6:11:21 PM	508	Fibre Channel port anomaly detected.	Informational	GSF1-0
8/1/01 6:11:20 PM	508	Fibre Channel port anomaly detected.	Informational	GSF1-0
8/1/01 6:11:19 PM	508	Fibre Channel port anomaly detected.	Informational	GSF1-0
8/1/01 6:11:18 PM	508	Fibre Channel port anomaly detected.	Informational	GSF1-0
8/1/01 6:11:15 PM	604	SBAR module failure.	Major	SBAR-0
8/1/01 6:11:15 PM	508	Fibre Channel port anomaly detected.	Informational	GSF1-0

Fabric Collapses

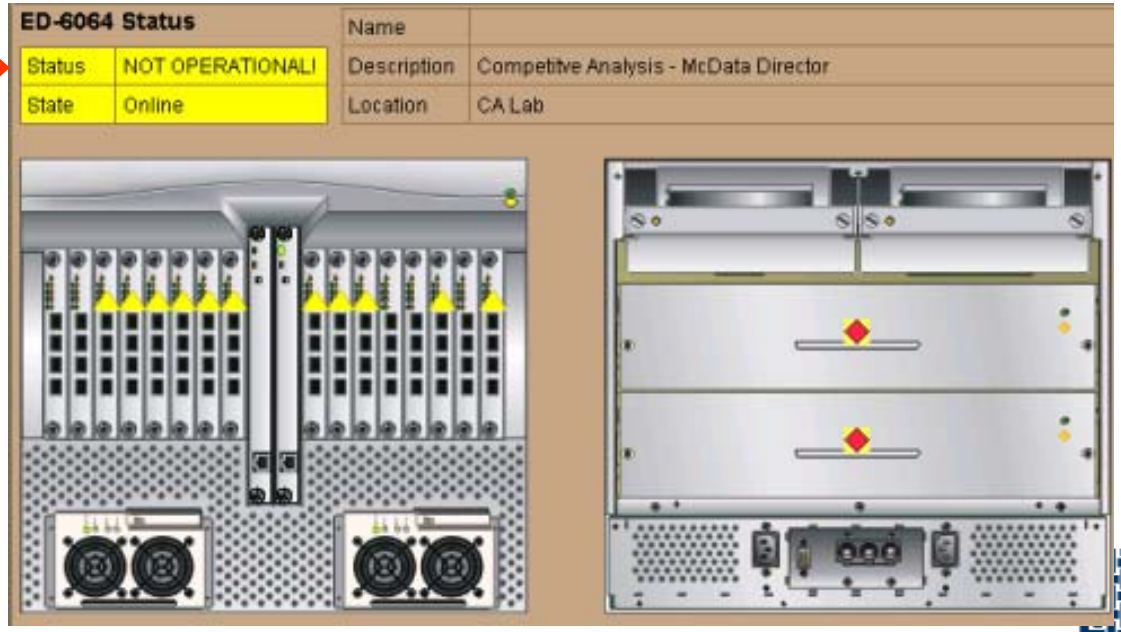
2nd “Redundant” Crossbar failure

1st SBAR failure

Complete director failure

Critical business apps are down!

HW may be HA, but SW is not



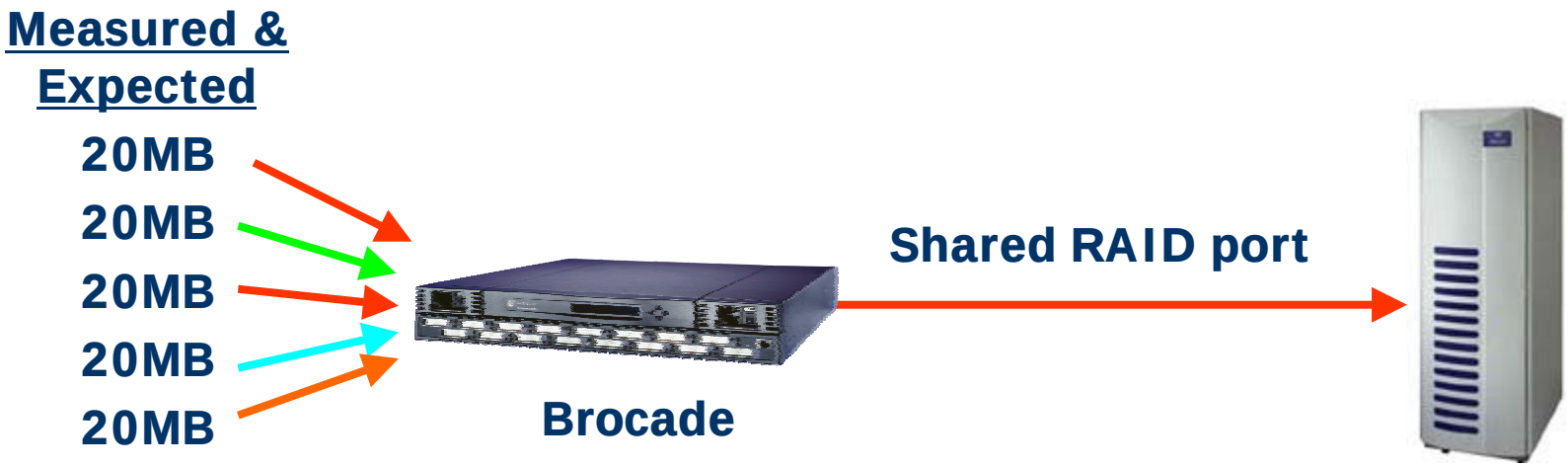
Not Optimized for Storage Consolidation

- **Primary purpose of a SAN is to share resources**
  - Administrators expect balanced/equal access to shared storage
- **McData does not balance access**
  - Crossbar arch lead to head-of-queue blocking & imbalance
  - No way to manage or control this problem

    For example: 5 servers sharing a storage port on a RAID
    - Equal access would be approx 100MBs/5 or 20MB/sec
    - Crossbar results in imbalanced & un-manageable access levels
    - Also failing servers may cause complete starvation of other devices

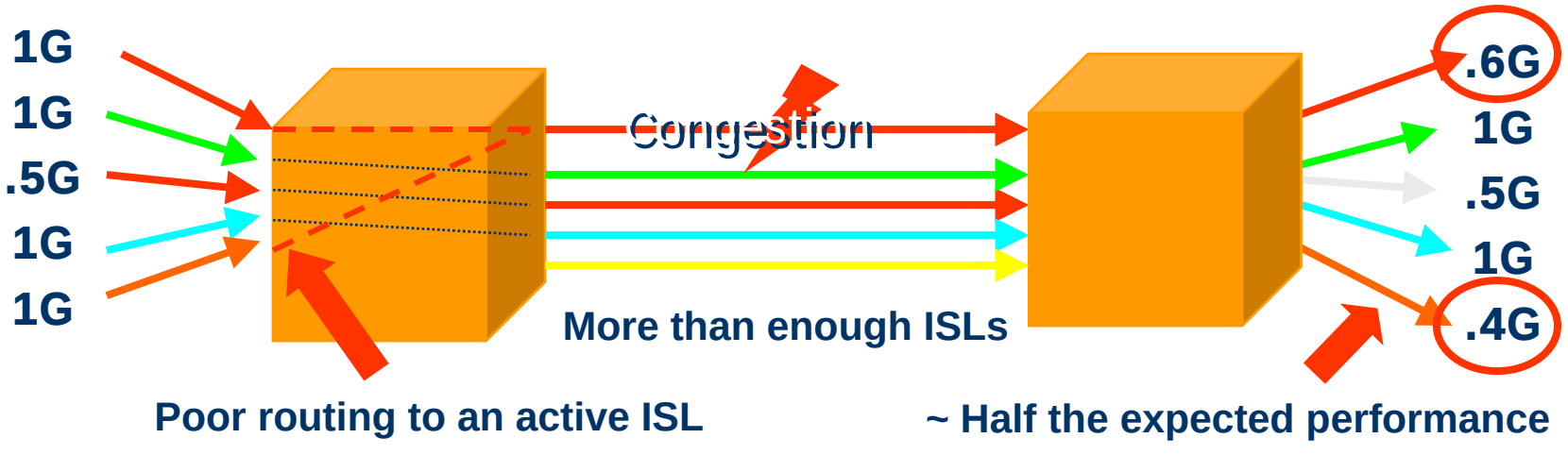
Brocade Virtual Channels -Ensures balanced access for all

- **Brocade's virtual channel architecture ensures fair & equal access to these shared resources**
  - Ensures no starvation of any server, all have equal access
  - Ensures that no "bad" servers slow down other servers
  - Thresholds can be set if desired for SNMP notification



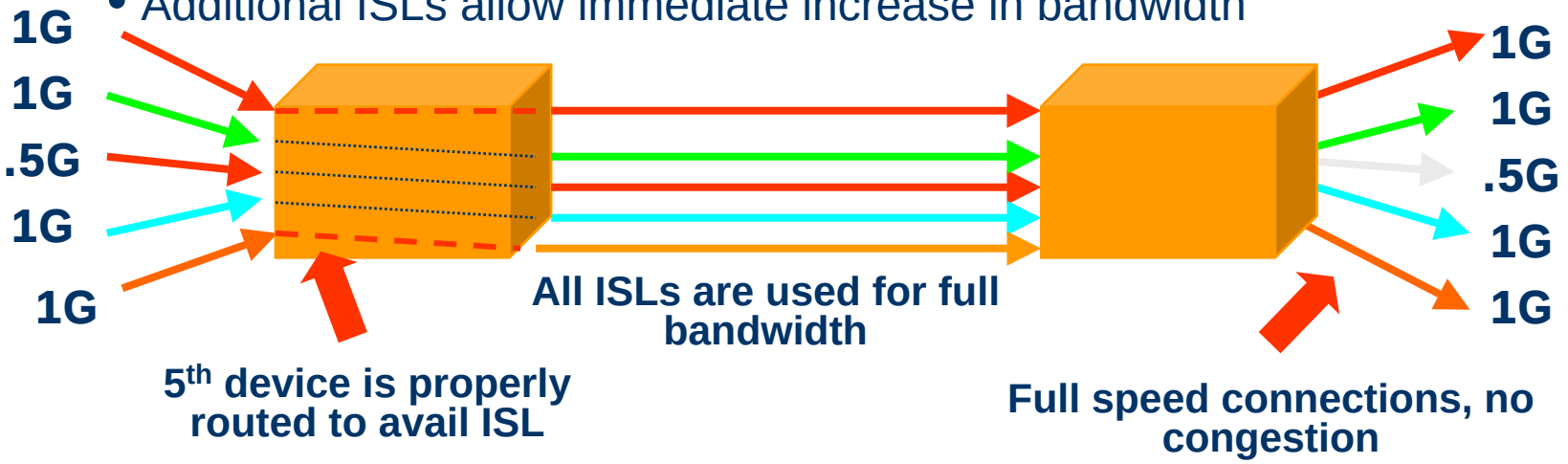
McData – Not intelligent networking

- **McData is new to networking with mixed results**
  - Typically supports only three ISLs producing potential 21:1 congestion between two 64 port directors or switches
  - Bigger directors require more ISLs to prevent congestion due to the higher number of potential devices going across the network
- **Serious Routing problem – limits performance**
  - Not always evenly routing devices to available ISLs to optimize bandwidth & availability, some idle others congested
    - Yellow links are unused, even though red link is congested



Brocade Intelligent Network Scalability

- **Brocade is the scalable choice**
  - Brocade authored the FC routing standard allowing networking
  - Silkworm Switches were designed to be networked from day one
  - Intelligently utilizes all ISLs to ensure maximum bandwidth
  - Potential congestion ONLY:
    - when the number of devices exceeds the number of ISLs & the combined bandwidth exceeds 1Gb/sec
    - Can be monitored with WebTools & FabricWatch for alerts
    - Additional ISLs allow immediate increase in bandwidth



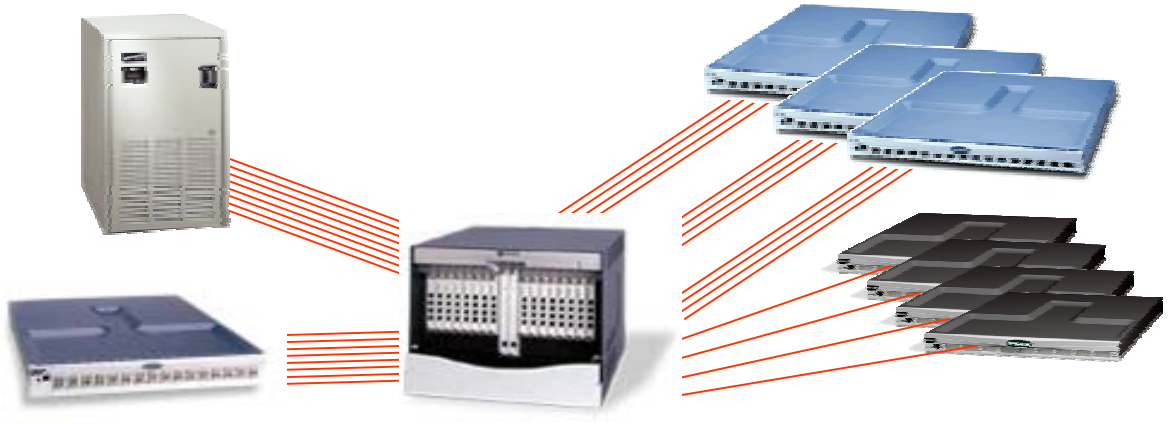
Brocade Scalability on Steroids - Trunking

- **Brocade trunking with new 2Gb ASIC switches**
  - Allows a full load balanced 8 Gb/s on 4 Trunked ISLs
  - Full utilization & less chance of congestion
- **Easier management due to higher balanced bandwidth & self-healing trunks**

No congestion until 8Gb bandwidth is exceeded, regardless of the # of devices!

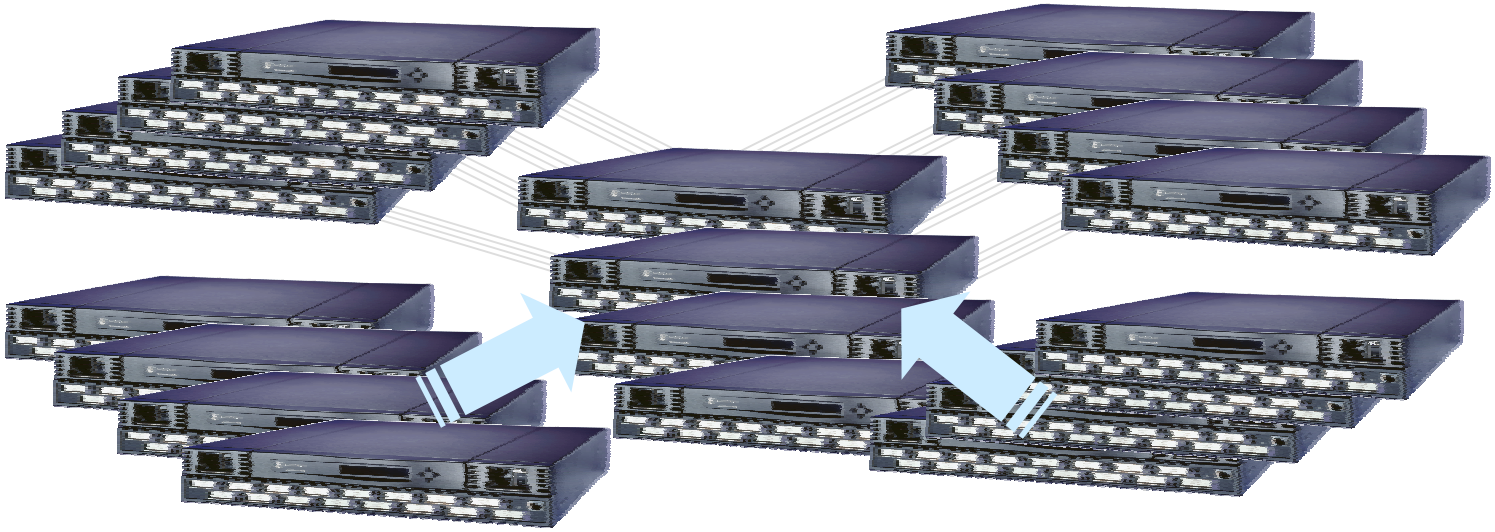
Limited Scalability

- **Cannot support more than 32 ISLs**
  - Loop switches are cut off from the fabric & network unstable
  - Management software becomes unusable due to missing info
    - Topology & zoning no longer shown correctly
  - McData builds congestive networks to get around this (few ISLs)
- **Director cannot be used as a 64-port core**
  - Limited to 32 ISLs, a small network of 84 edge ports shown
    - 3:1 edge-core congestion, more ISLs for less congestion
    - Cannot add more switches to core, or fabric/mgmt will destabilize



Brocade Proven Scalability

- **Proven SANs**
  - Large OEM qualified solutions & real world implementations
  - Hundreds of ports & highly networked
  - Manageable via WebTools & SNMP, thresholds for monitoring
- **Building Larger Networks**
  - Redundant core arch provides HA & high bandwidth
  - Start with 96 ports & easily scale to 192 ports & beyond
  - Easily drop in 2Gb into the core for higher speed core



No HW Zoning – Unsafe for Mixed SANs

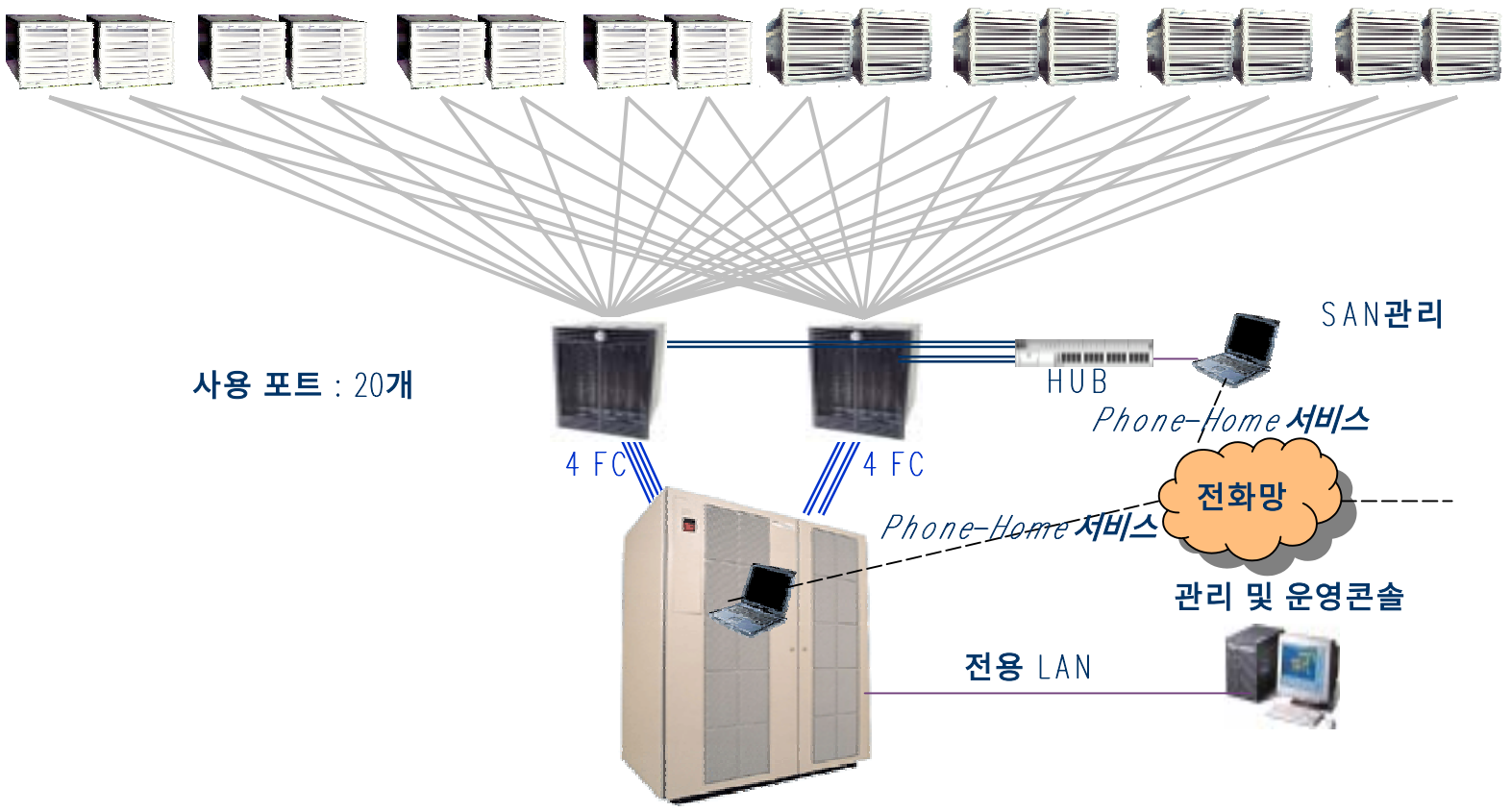
- **McData is NOT safe for heterogeneous SANs**
  - No HW on McData old or new products
  - Mixed NT & Unix environments are at risk without HW zoning
- **Soft Zoning – less secure**
  - Software lookup only, no actual blocking
    - Like a unlisted phone number…phone can still ring
  - Admin should manually reboot servers after changes
  - Volumes mounted can may still be accessed if not rebooted
  - Not secure for accidental or malicious access to data
- **Hardware Zoning – more secure**
  - ASIC hardware blocking of data & software lookup
    - Like caller ID blocking, no access even if the # is known
  - Invalid data (from outside the zone) is blocked
  - Only completely secure method for heterogeneous SAN
  - Brocade has HW zoning for the enterprise

No Loop Support on Switches

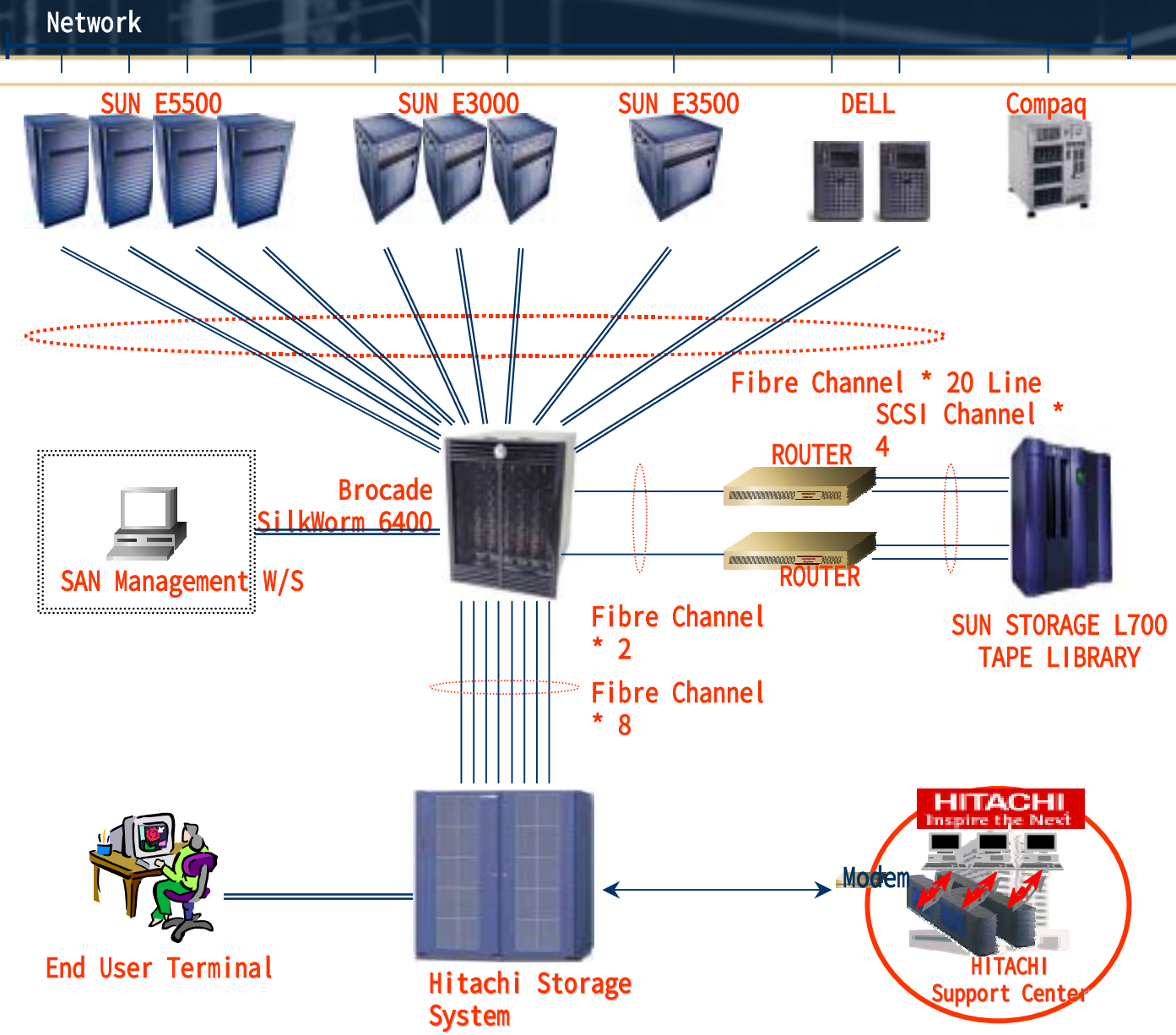
- **Loop support is required in the SAN**
  - Existing native Solaris & HPUX servers
  - Legacy storage systems
  - Existing & new tape libraries for backup
- **McData fabric products do not support loop**
  - New switch ASIC did not fix this key limitation
- **Attempt to resolve with another box (ES-1000)**
  - Low availability (only 99.9%)
  - Only a single non-redundant ISL connection to fabric
  - Low performance due to shared ISL (100MB total)
- **Brocade offers full loop support on all products**
  - Support existing loop without an additional box
  - Allows loop devices to access fabric storage and tape
  - Support loops in the core for sharing resources such as tape

Customer References

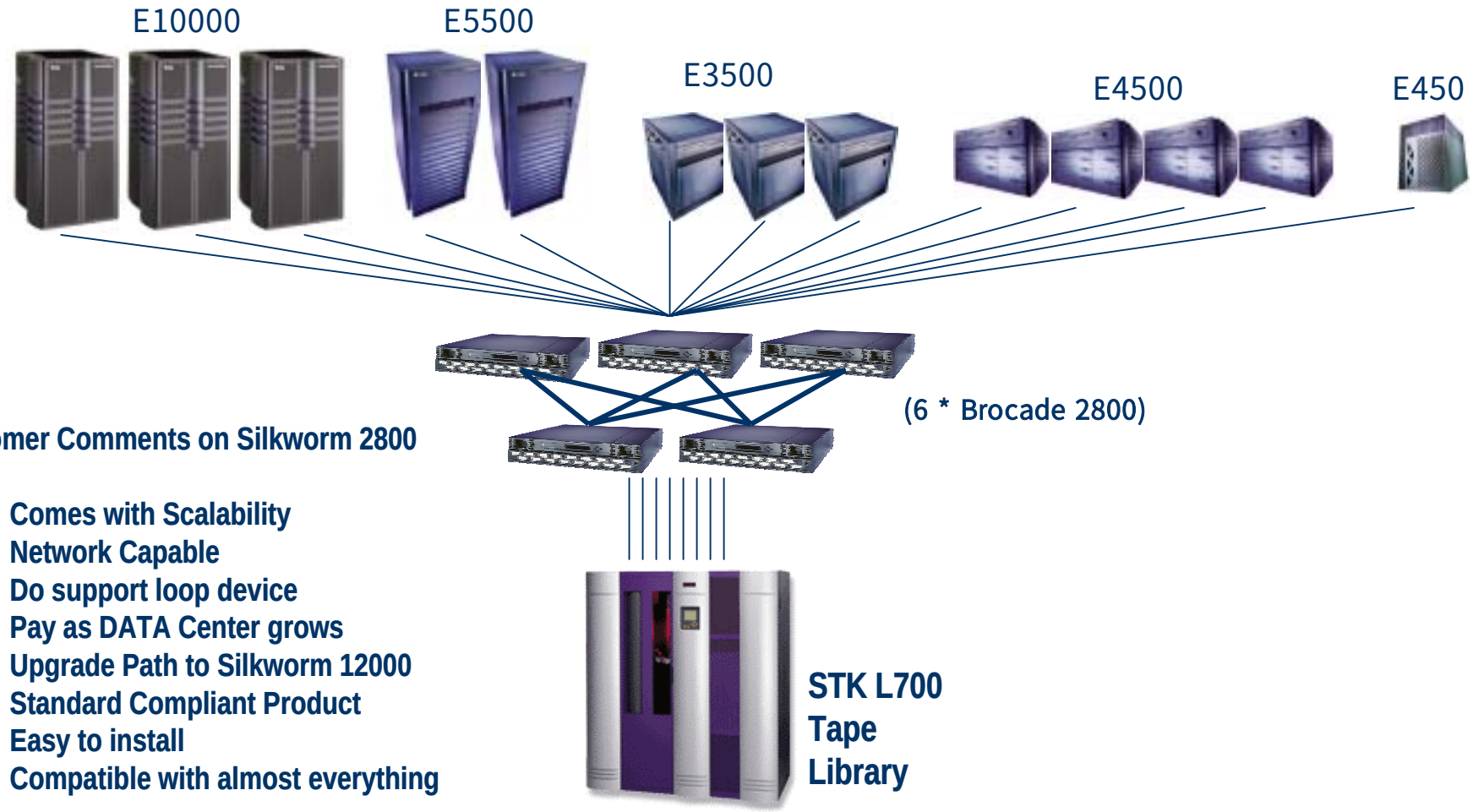
국내 S통신사 SAN 스토리지 구성도



수자원공사 SAN 구성도 (Silkworm 6400)



국내 Credit 카드사 LANfree Backup SAN 구성도



Customer Comments on Silkworm 2800

1. Comes with Scalability
2. Network Capable
3. Do support loop device
4. Pay as DATA Center grows
5. Upgrade Path to Silkworm 12000
6. Standard Compliant Product
7. Easy to install
8. Compatible with almost everything

BROCADE

Thank You