SPEAKERS

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About the FCIA

- The Fibre Channel Industry Association (FCIA) is a mutual benefit, non-profit, international organization of manufacturers, system integrators, developers, vendors, and industry professionals, and end users
    - Promotes the advancement of Fibre Channel technologies and products that conform to the existing and emerging T11 standards
    - Maintains resources and supports activities to ensure multi-vendor interoperability for hardware, interconnection, and protocol solutions
    - Provides promotion and marketing of FC solutions, educational awareness campaigns, hosting public interoperability demonstrations, and fosters technology and standards conformance
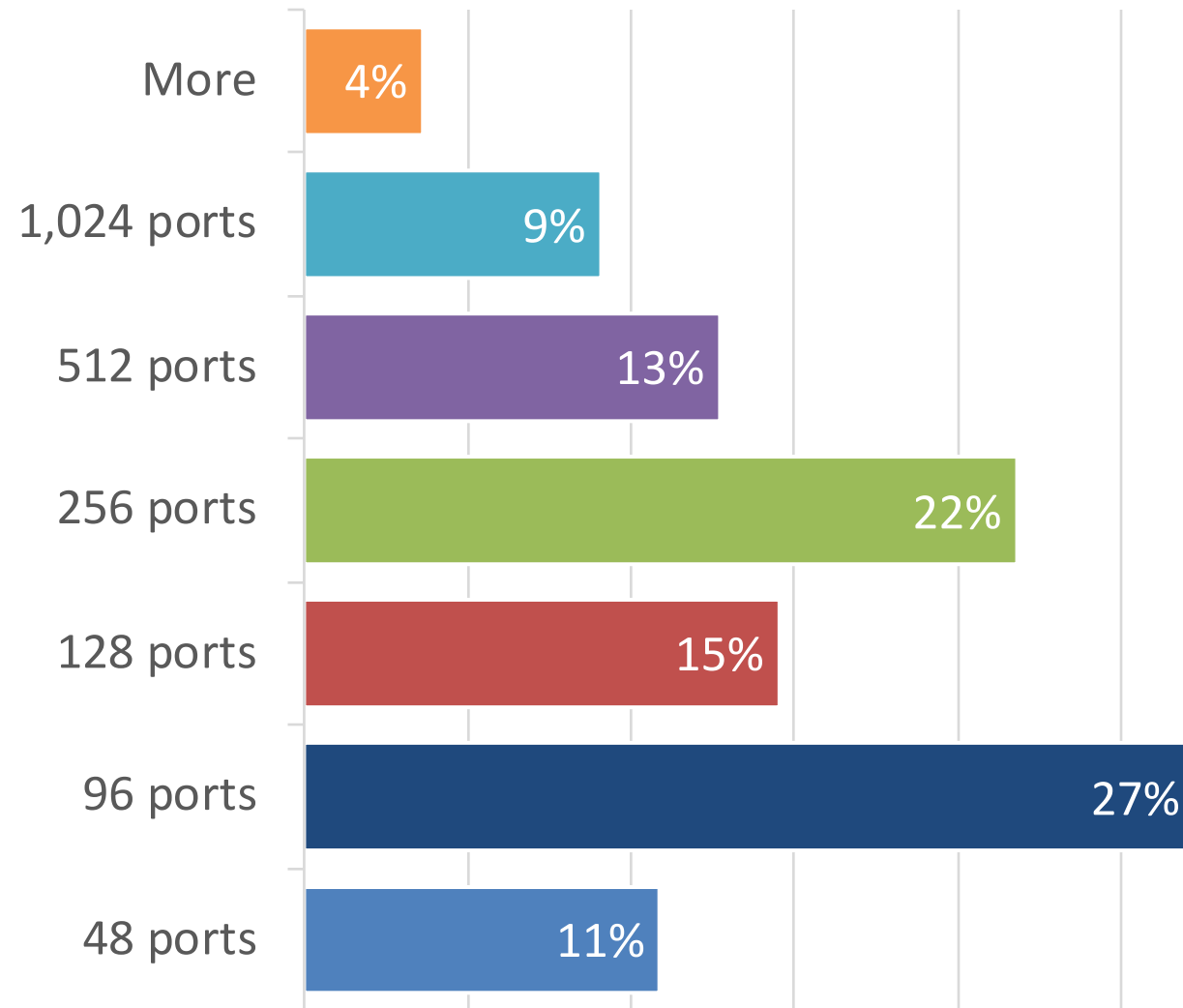
https://fibrechannel.org/

3

Agenda

- Survey
- Lossless via buffer credits
- Topology
- ISL oversubscription
- Mesh example
- Fabric Services
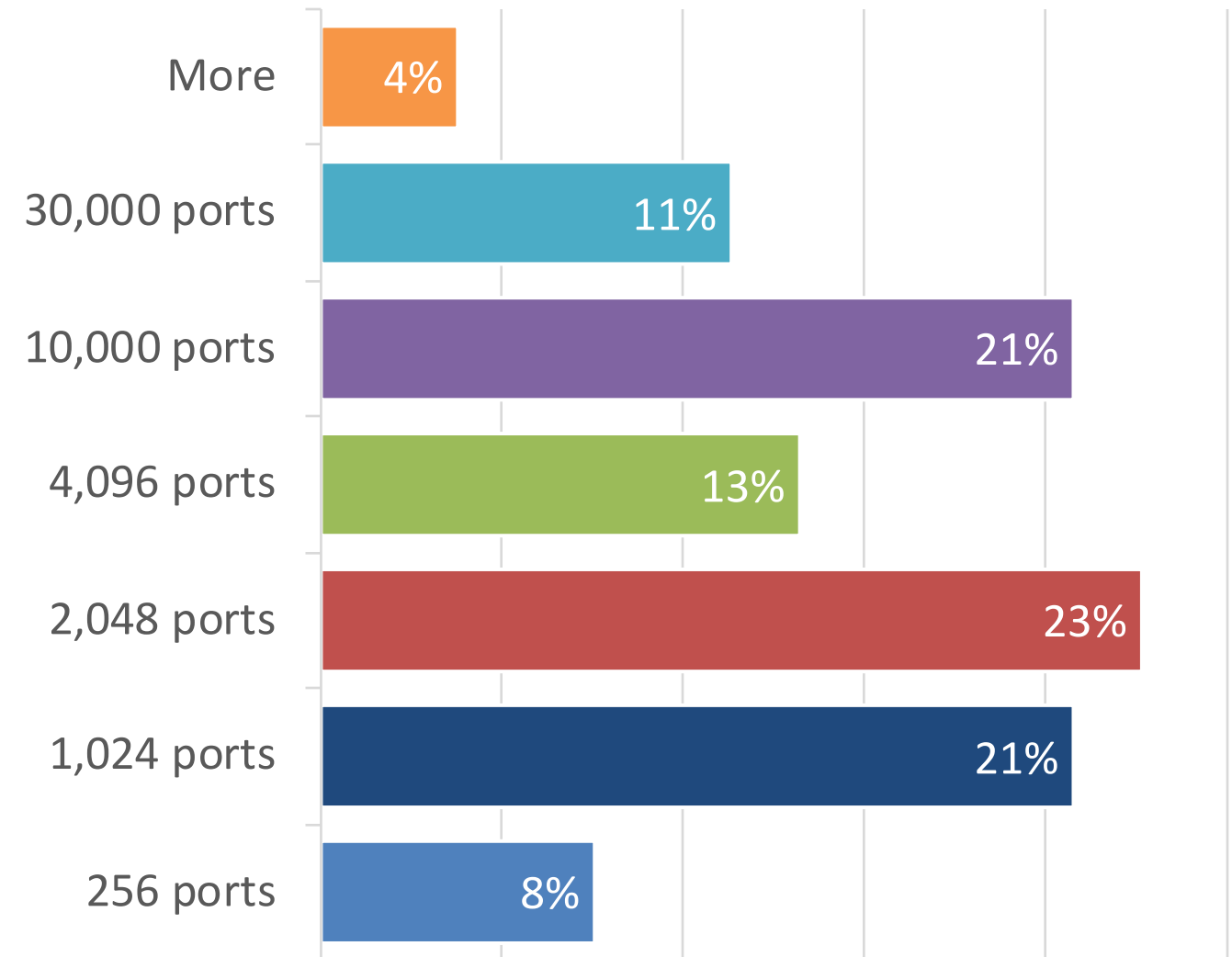- Zoning
- Deterministic Performance

Fibre Channel Flexibility

Storage vendor internal survey, 2019

Typical Fabric

Ports	Percentage
More	4%
1,024 ports	9%
512 ports	13%
256 ports	22%
128 ports	15%
96 ports	27%
48 ports	11%

Largest Fabrics

Ports	Percentage
More	4%
30,000 ports	11%
10,000 ports	21%
4,096 ports	13%
2,048 ports	23%
1,024 ports	21%
256 ports	8%

FCIA
FIBRE CHANNEL INDUSTRY ASSOCIATION

Lossless & Buffer Credits

Do you think your customers know what Buffer-to-Buffer credits are?
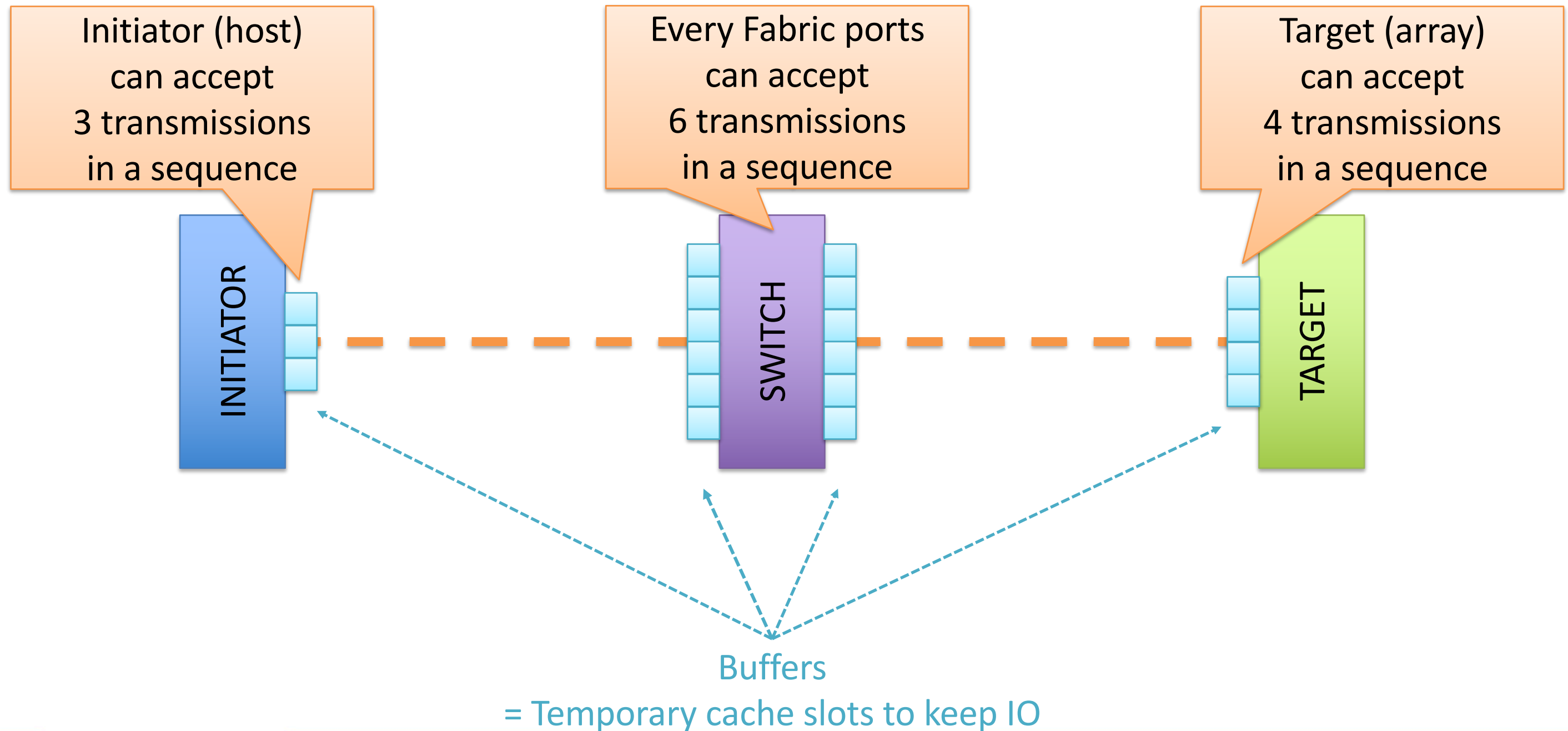
Yes
18%

No
82%

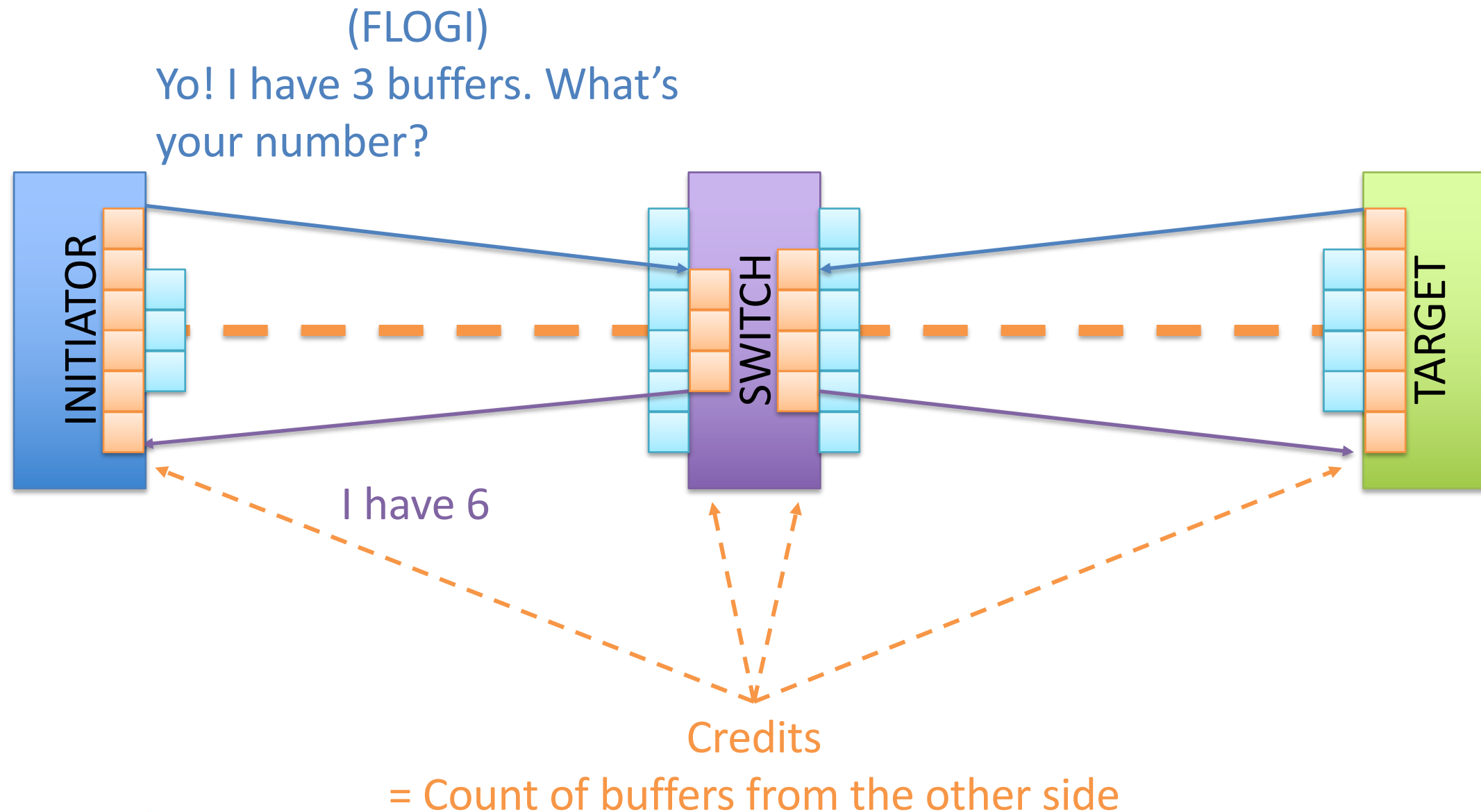**FIBRE CHANNEL BUFFERS AND CREDITS enable LOSSLESS COMMUNICATION**

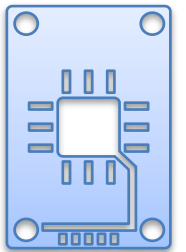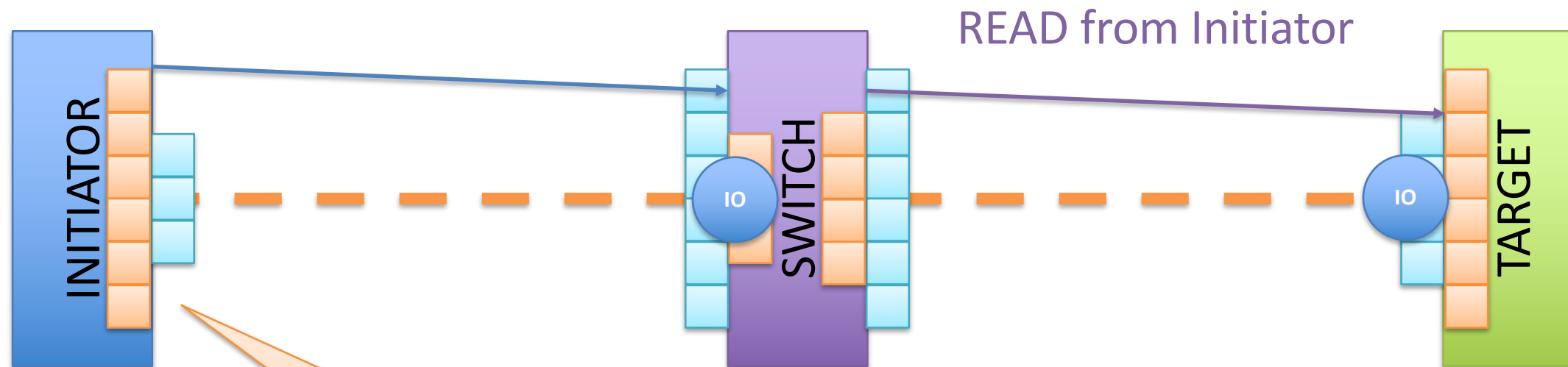Source: Storage Vendor internal survey, 2019

Buffers and Credits

Initiator (host)
can accept
3 transmissions
in a sequence

Every Fabric ports
can accept
6 transmissions
in a sequence

Target (array)
can accept
4 transmissions
in a sequence

INITIATOR

SWITCH

TARGET

Buffers
= Temporary cache slots to keep IO

Buffers and Credits

(FLOGI)
Yo! I have 3 buffers. What's your number?

INITIATOR

SWITCH

TARGET

I have 6

Credits
= Count of buffers from the other side

Buffers and Credits

Yo Target! Get me some data (aka READ)

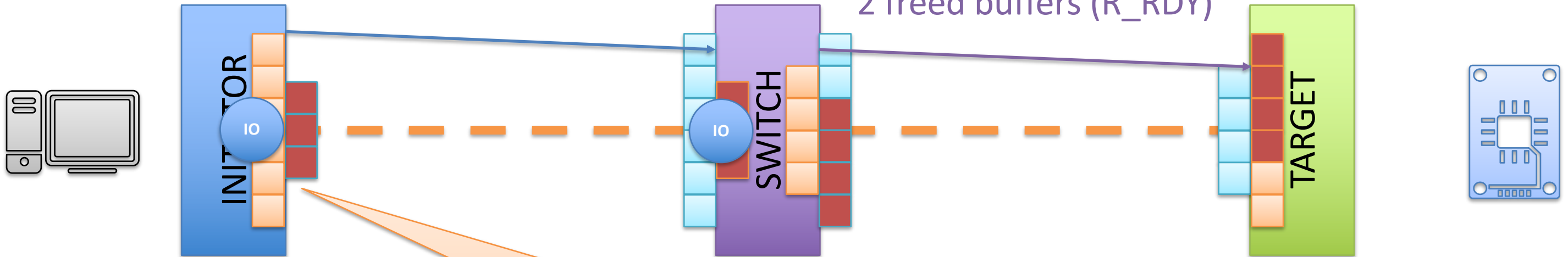READ from Initiator

INITIATOR

SWITCH

IO

IO

TARGET

Now, what happens next?
All buffers and credits are used!

Buffers and Credits

Oh, that was good!
I have 2 buffers now!
(R_RDY)

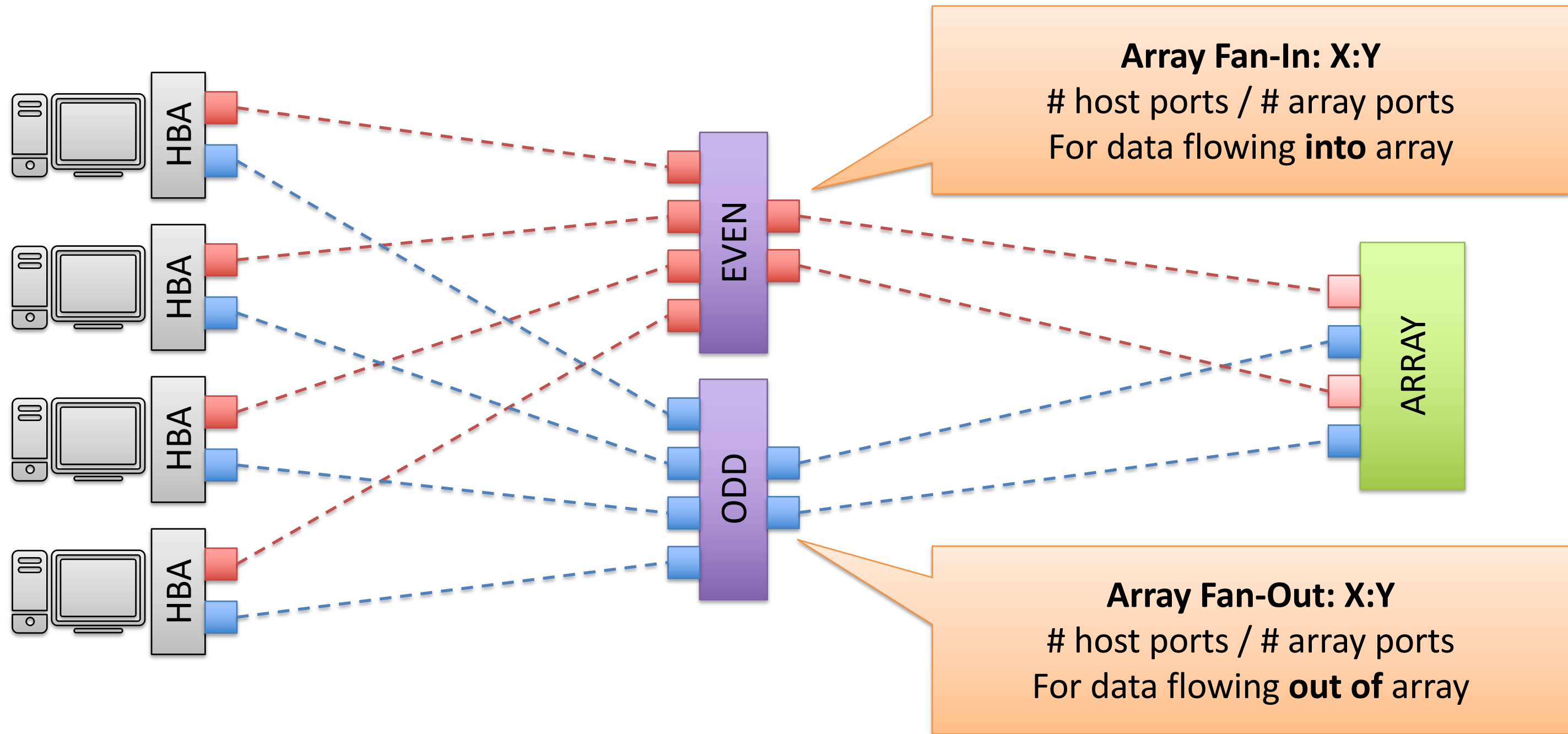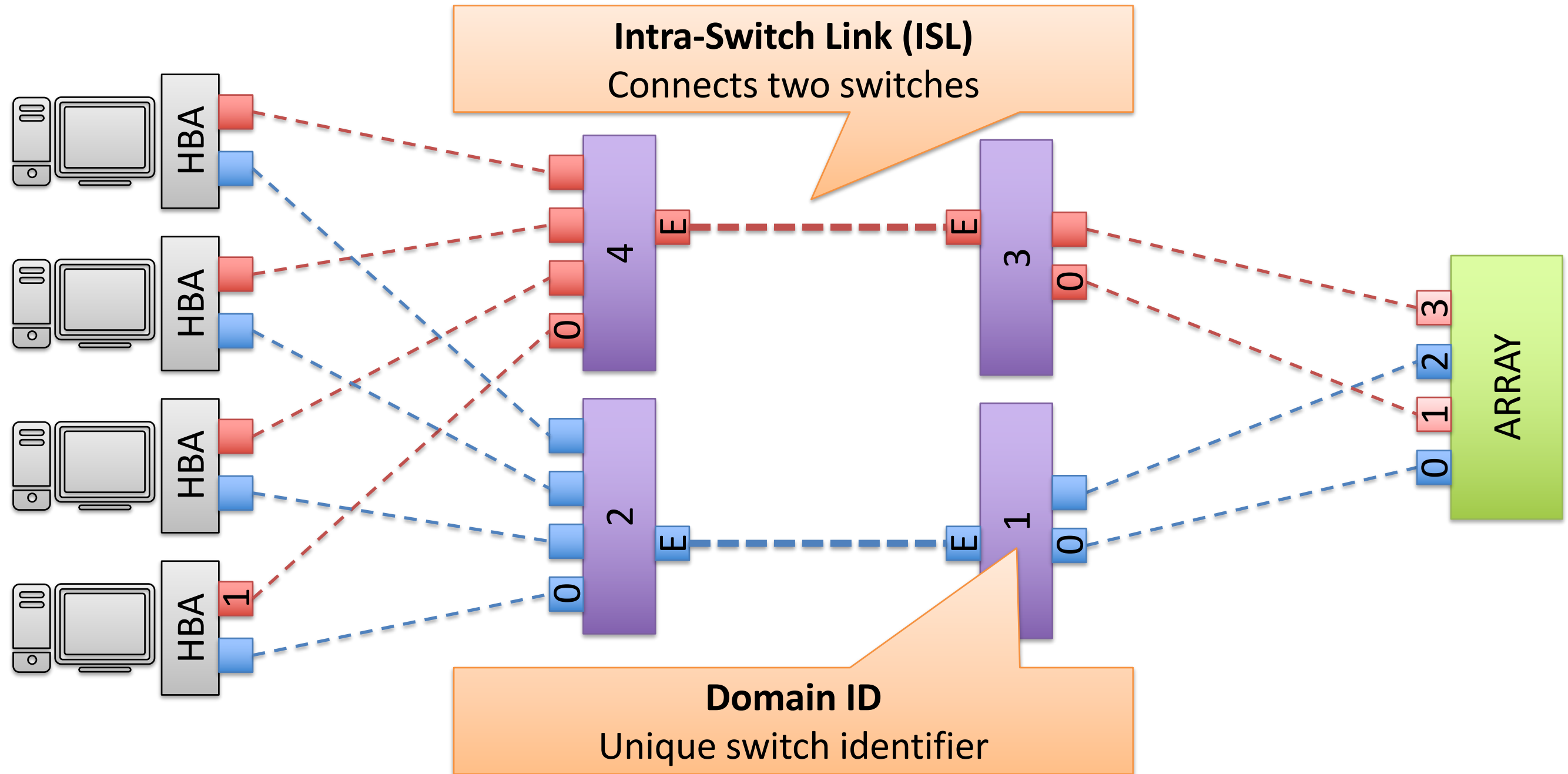2 freed buffers (R_RDY)

INITIATOR

SWITCH

TARGET

Host processed/received Two IOs
Two more are waiting.
Everyone knows the count
LOSSLESS COMMUNICATION

Topology

Switched Fabric

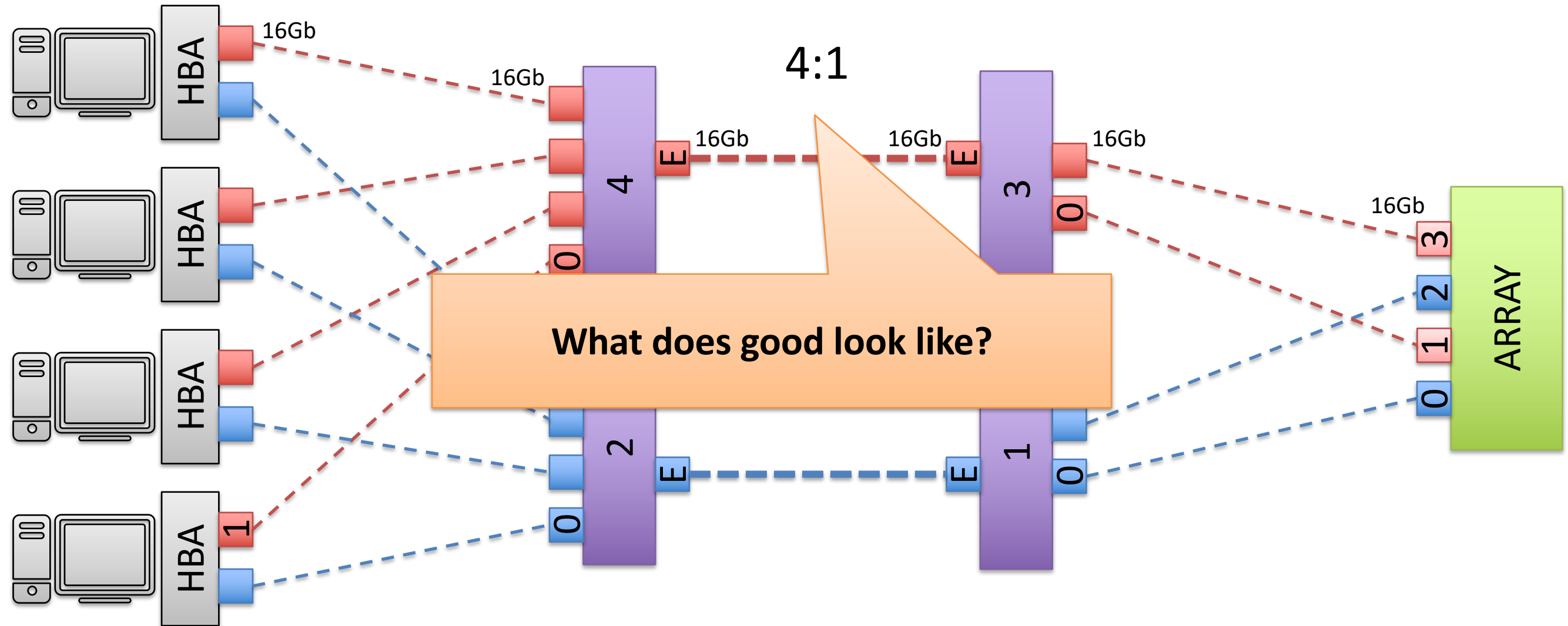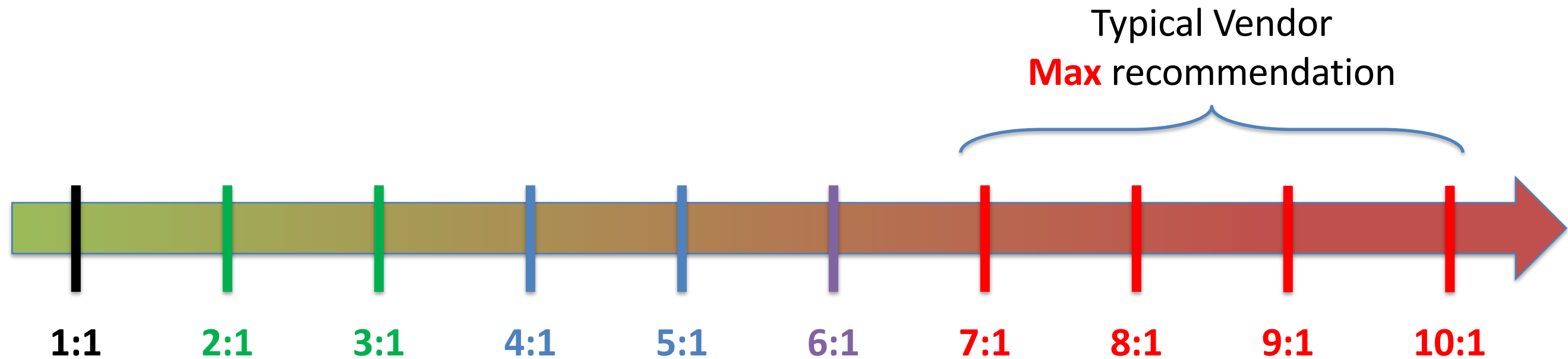Array Fan-In: X:Y
host ports / # array ports
For data flowing **into** array

Array Fan-Out: X:Y
host ports / # array ports
For data flowing **out of** array

Domain & ISL

Intra-Switch Link (ISL)
Connects two switches

Domain ID
Unique switch identifier

ISL Oversubscription

4:1

What does good look like?

ISL Oversubscription

Typical Vendor
Max recommendation

1:1 2:1 3:1 4:1 5:1 6:1 7:1 8:1 9:1 10:1

Workload Considerations:

Think through congestion sensitivity and traffic direction

	Block Size	Read/Write	Random/Seq	ISL Oversubscription
OLTP (Database)	8KB	25R/75W	80R/20S	Lower
OLAP (Warehouse)	64KB	75R/25W	20R/80S	Higher
IoT	Mix (small)	5R/95W	5R/95S	Higher
VDI	4-16KB	50R/50W	100R	Mid

Decrease ISL Oversubscription

2:1

Trunk ISLs
Load balance and share
Buffers and Credits
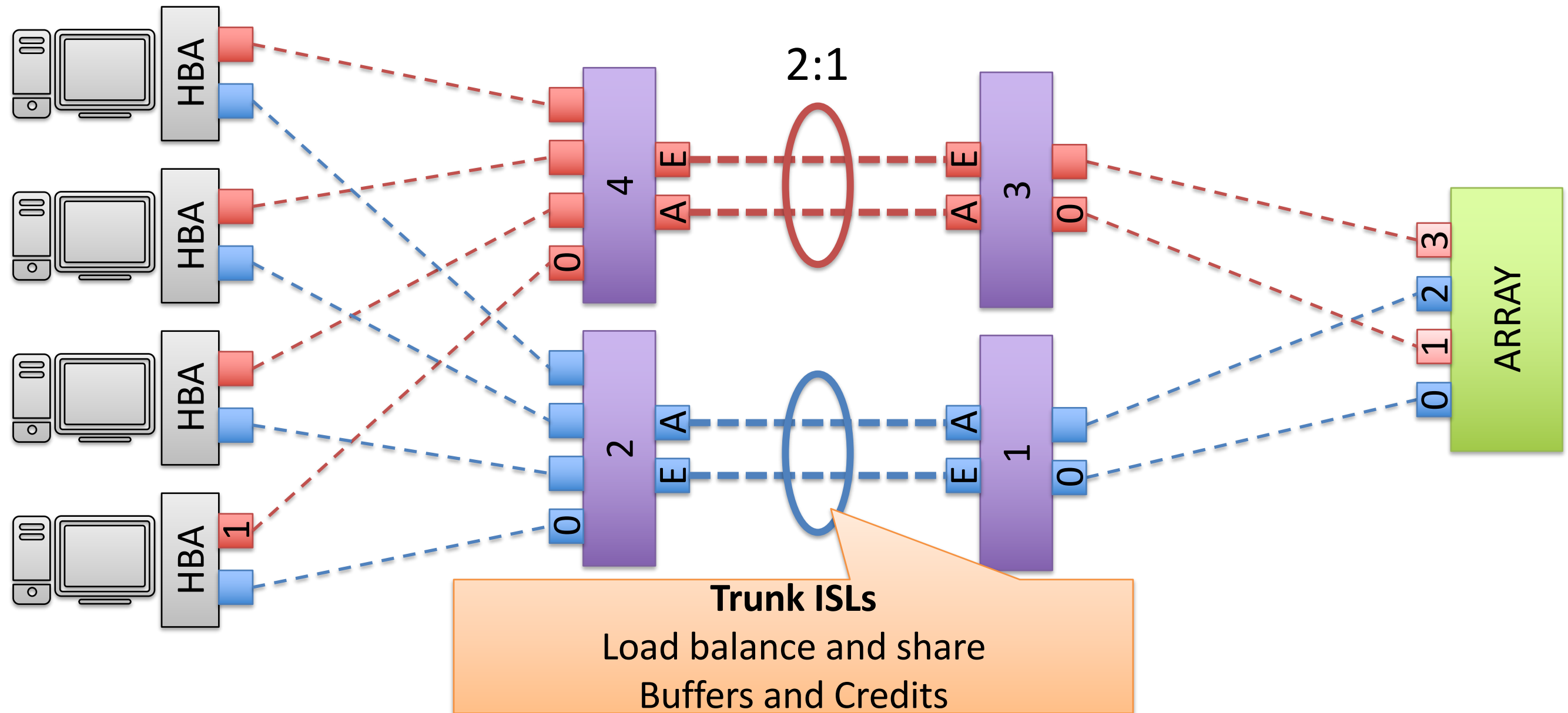
Scalable Topologies

Core-Edge
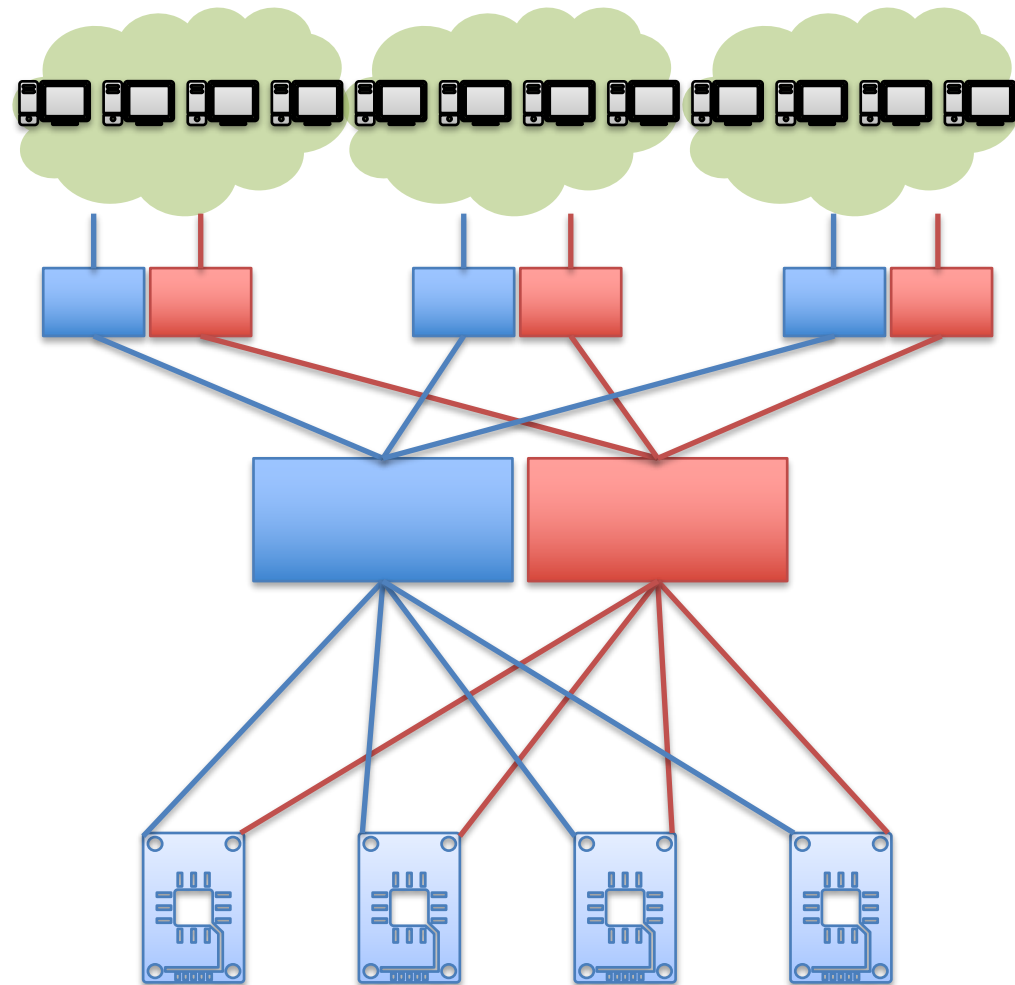
Edge-Core-Edge

Hosts
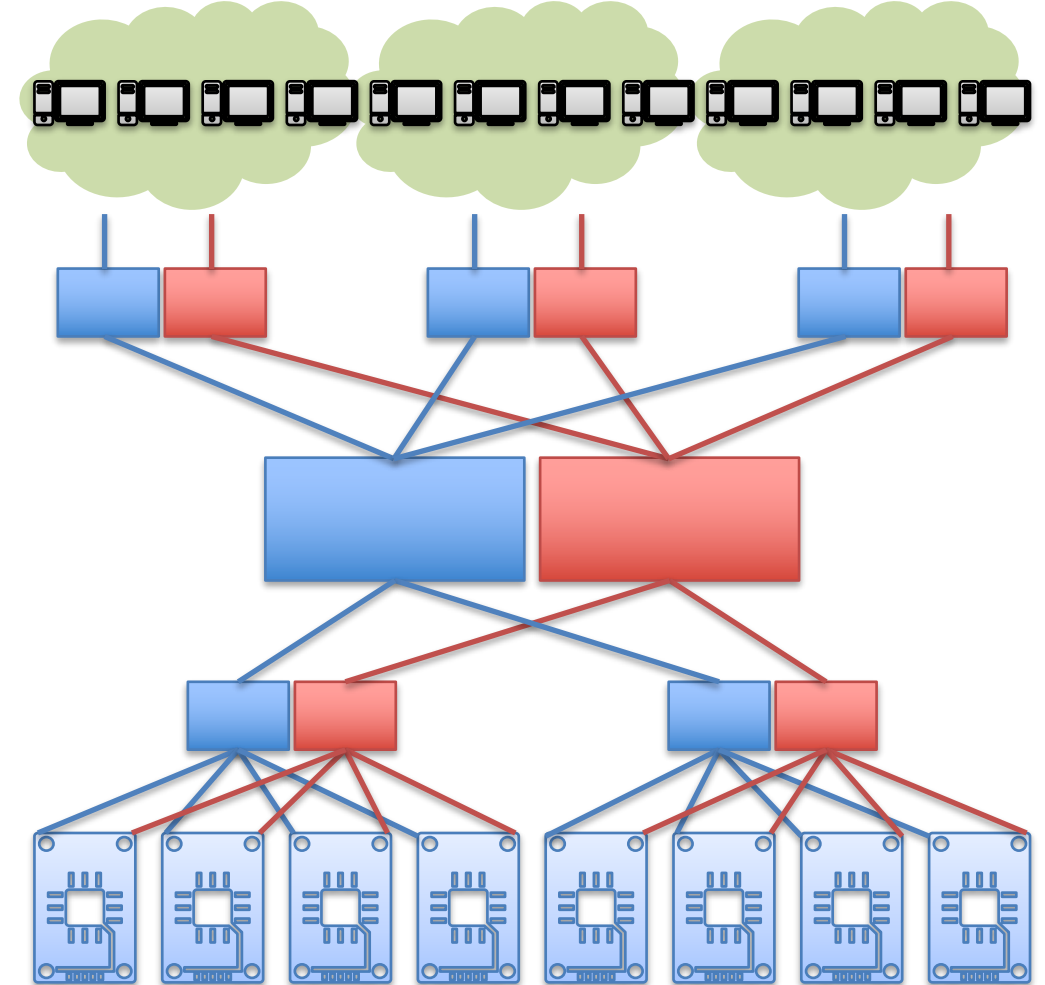
Edge Switches

Core Switches

Edge Switches

Storage Arrays

Guaranteed Delivery, Performance, at Scale

Port Count:
2,208


Keep an eye on ISL Oversubscription
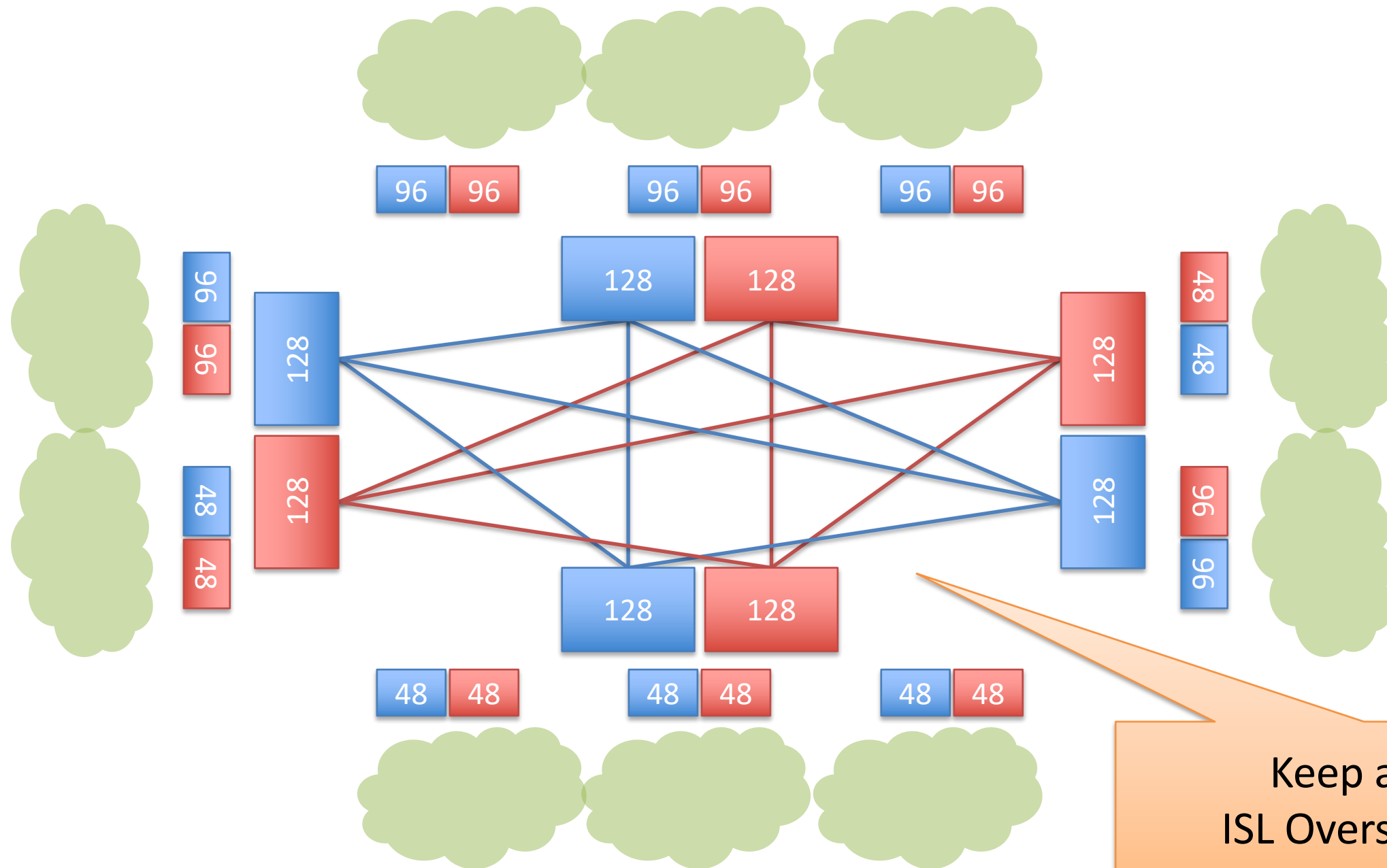
Fabric Services & Zoning

Fabric Services

- ## Discovery Services
  - Fibre Channel provides a name service that ports can discover all of the other ports they have access too.

- ## Fabric Shortest Path First routing (FSPF)
  - Fabric Shortest Path First (FSPF) is a routing protocol used in Fibre Channel networks. It calculates the best path between switches, establishes routes across the fabric and calculates alternate routes in event of a failure or topology change.

- ## Zoning
  - Fibre Channel zoning is the partitioning of a Fibre Channel fabric into smaller subsets to restrict interference, add security, and to simplify management.

Name/Discovery Services

- As each port logs in, the port name and location is stored in a database in the Fabric

- Ports can query the Fabric to discover what ports it can see

- Initiators then can scan the targets to discover available storage devices

WWN1, Location, …
WWN2, Location, …
WWN3, Location, …
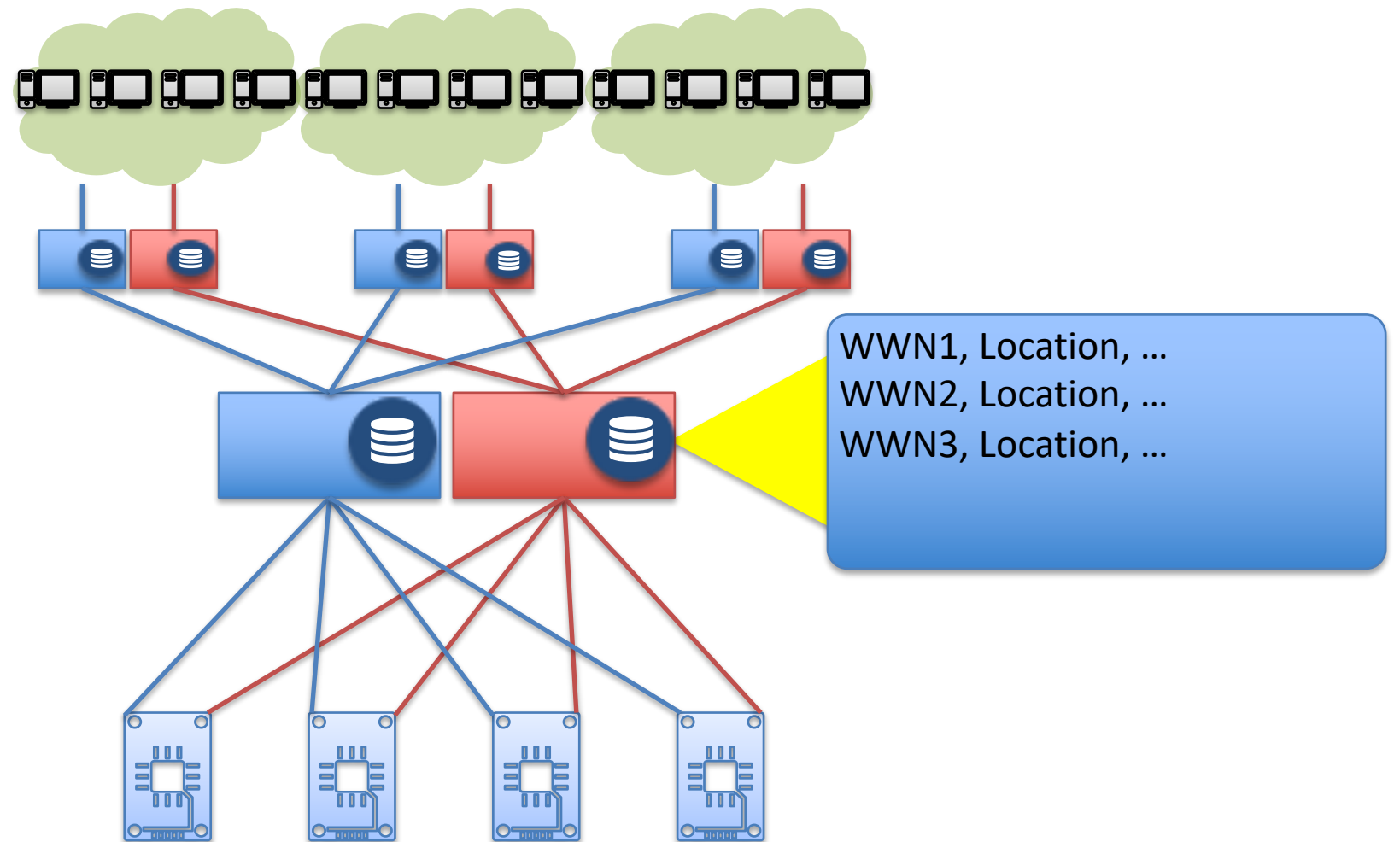
FSPF: Protocol

- A Hello protocol to establish two-way communication with a neighbor switch

- Initial topology database synchronization protocol

- Topology database maintenance protocol

- The topology database identifies available paths between ports
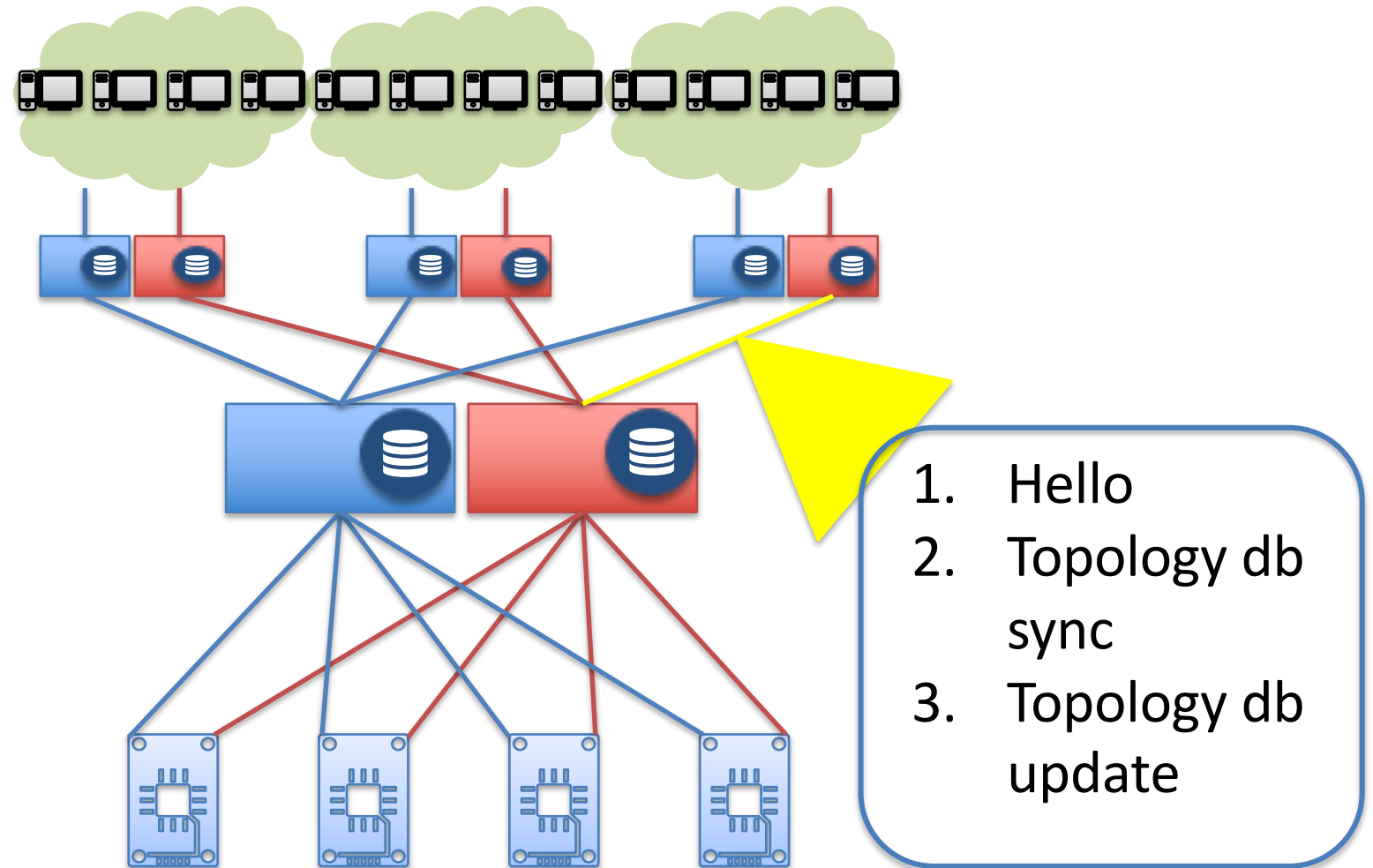
1. Hello
2. Topology db sync
3. Topology db update

FSPF: Path Selection

- Fibre Channel uses a least cost approach to determine paths to be used to forward frames
  - Weighted by ISL speed

- Frames are delivered in order

- Frames may be load balanced or trunked over ISLs
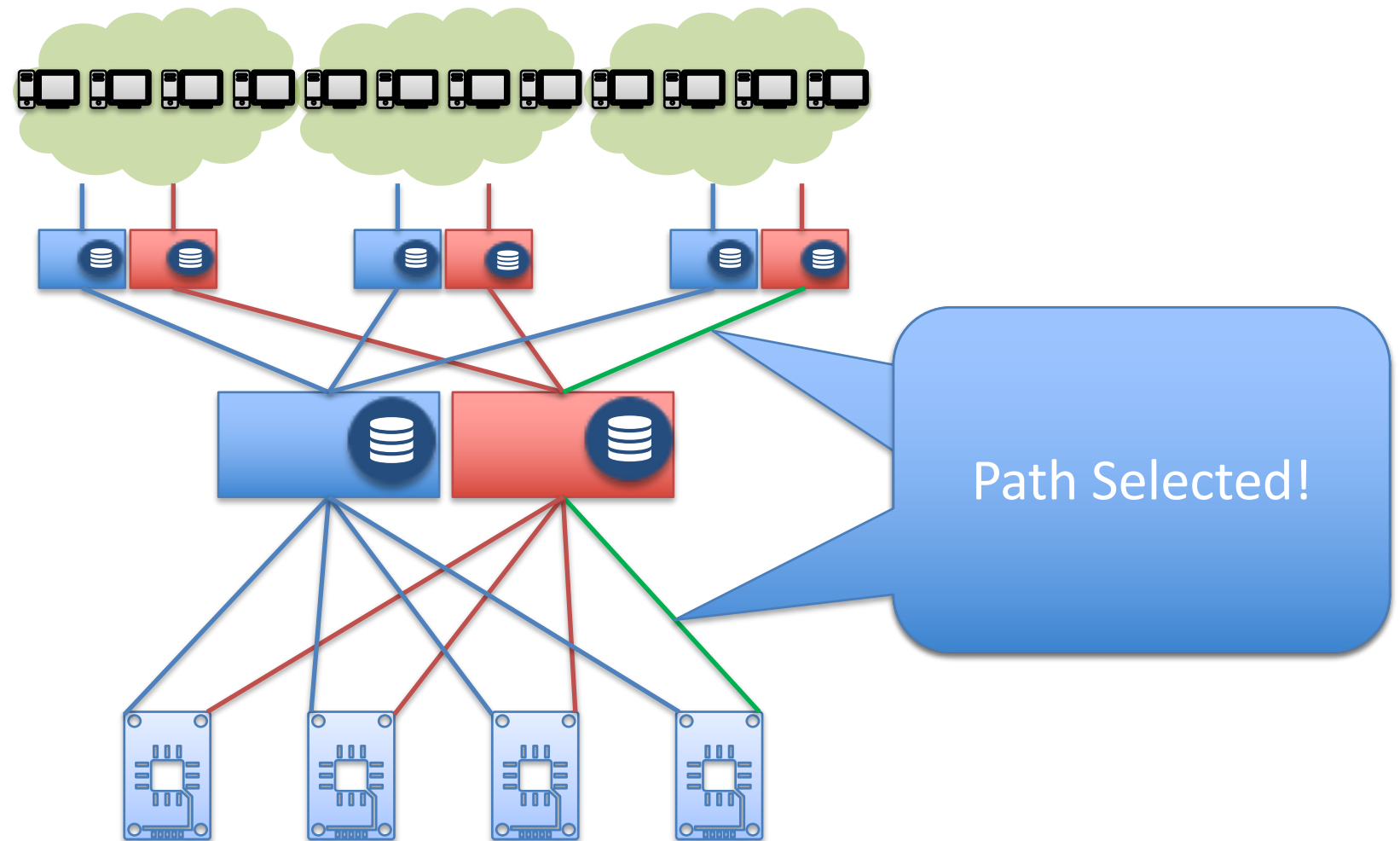
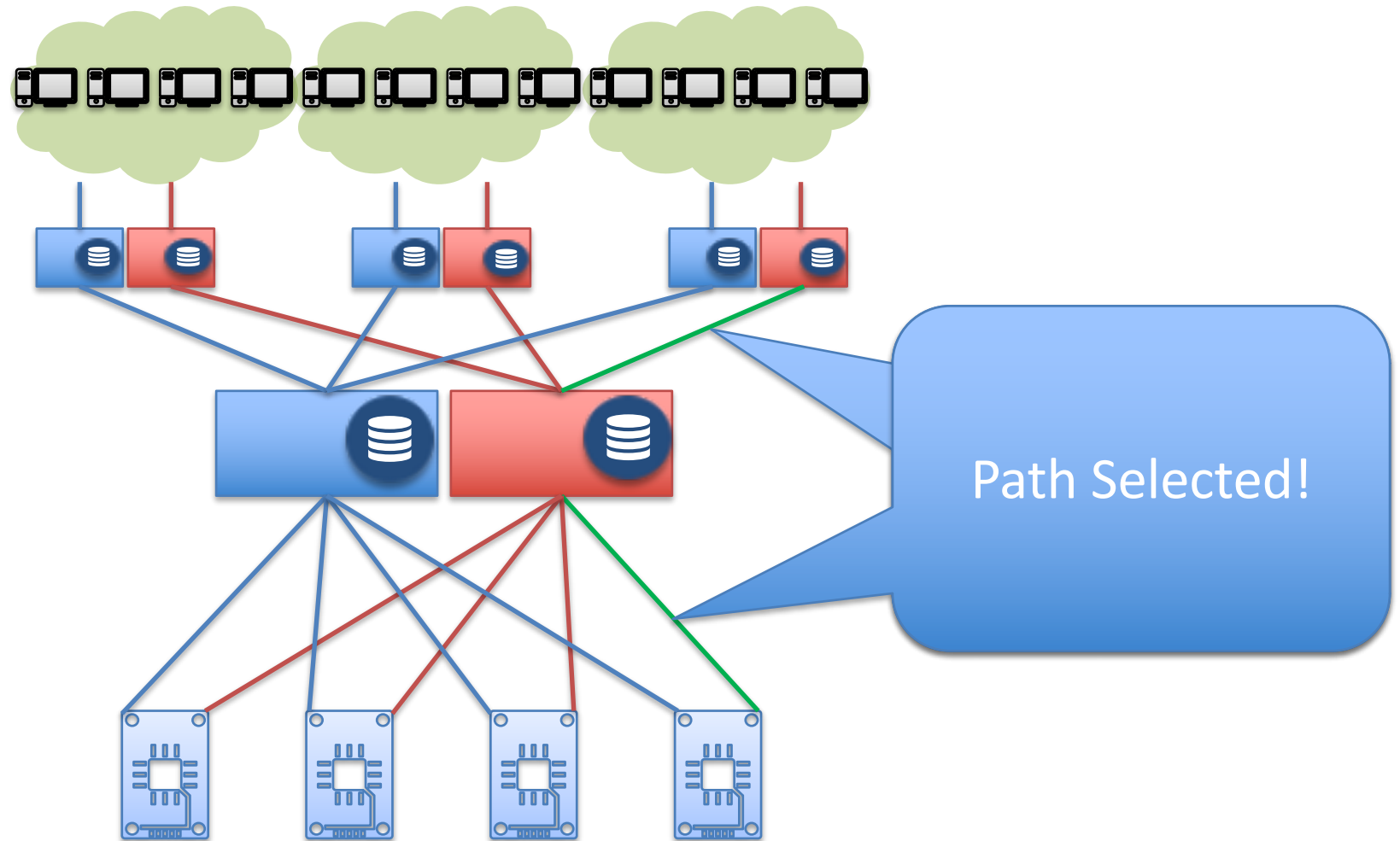Path Selected!

FSPF: Path Selection

- Fibre Channel uses a least cost approach to determine paths to be used to forward frames
  - Weighted by ISL speed

- Frames are delivered in order

- Frames may be load balanced or trunked over ISLs

- Backup path also selected

Path Selected!

Zoning

- Zoning allows specific groups of devices to communicate with each other

- Individual zones limit communication between the devices to devices that "care" about each other

- In Fibre Channel switches, the "Fabric Zone Server" controls zoning

Red Zone

Green Zone

Purple Zone

Blue Zone
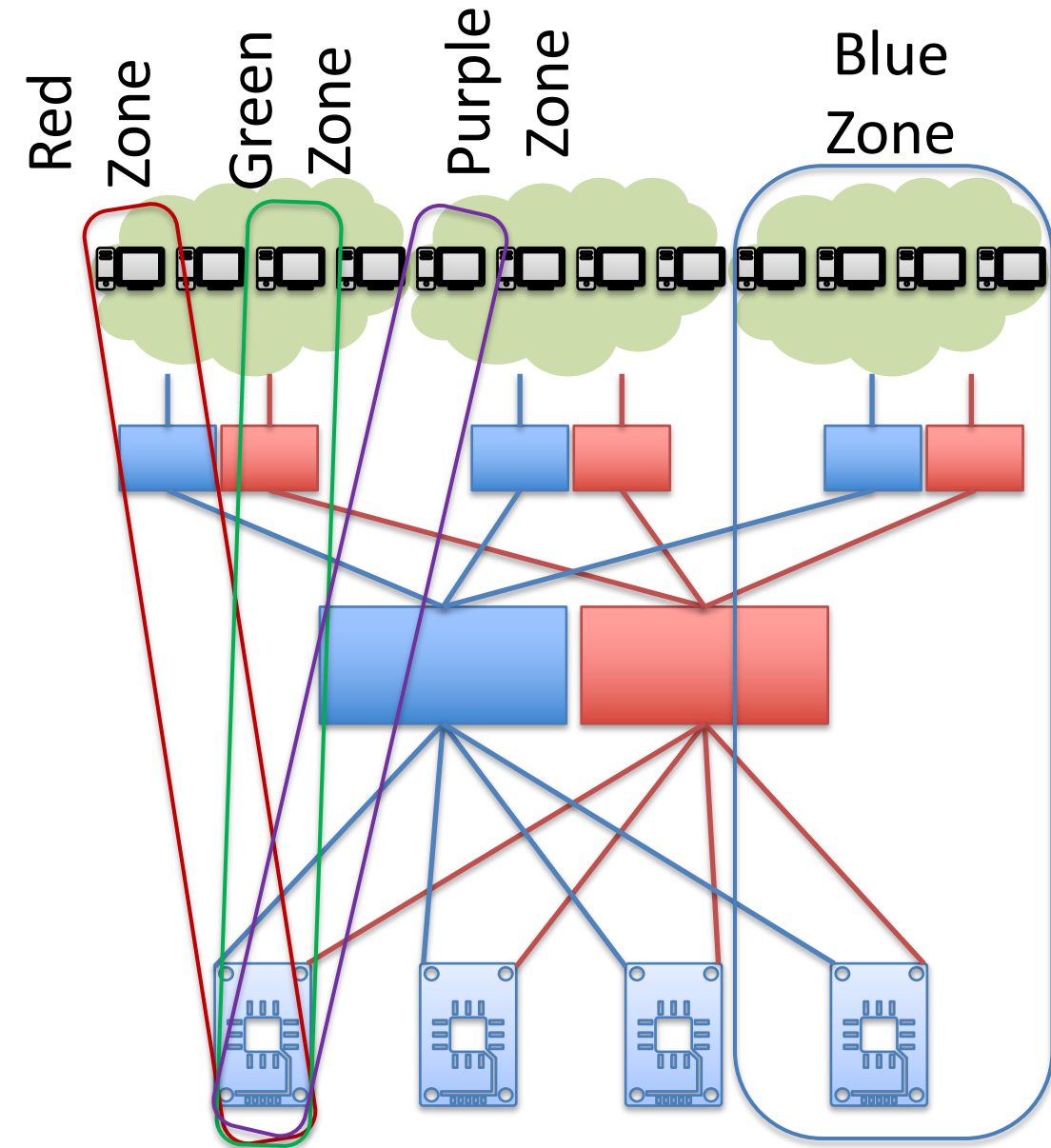
Zoning Terminology

- Zone Set – A collection of zones
- Active Zone Set – The Zone Set currently enforced by the Fabric
- Zone – A "container" with members representing end devices
- Member
  - In a zoneset a **member** is a zone
  - In a zone a **member** represents an end device or group of end devices
- Zone Alias – A name that represents one or more FC devices
- Default Zone
  - Contains all devices not a member of any zone in the active zone set
  - This group of devices may be permitted to communicate or denied
- Basic Zoning Mode
  - Zoning changes done w/o fabric wide lock
  - Lock obtained once changes sent to fabric
  - Less efficient zone data structure
- Enhanced Zoning Mode
  - All zoning changes occur only after a fabric wide lock is obtained. Ends with a commit of changes.
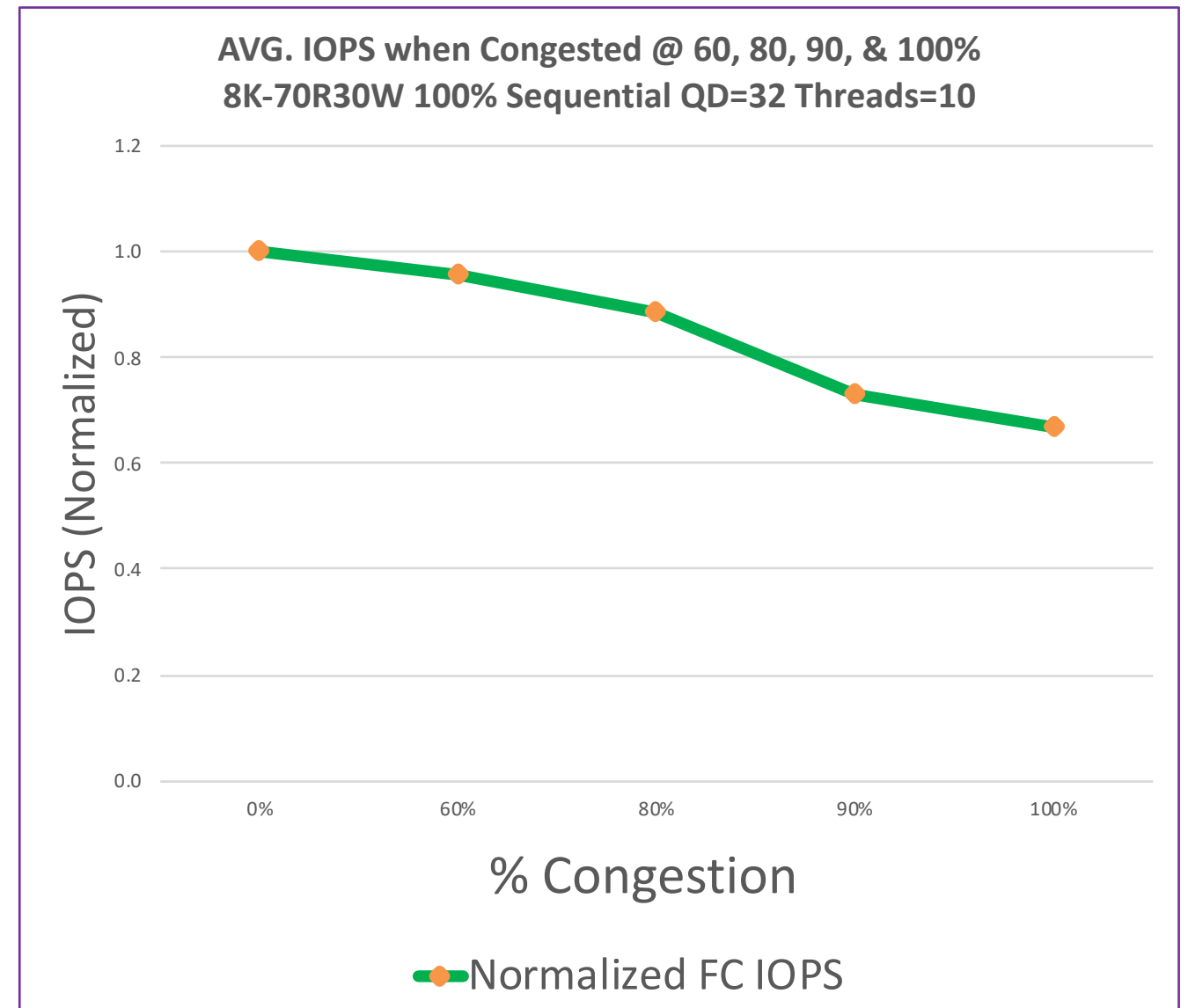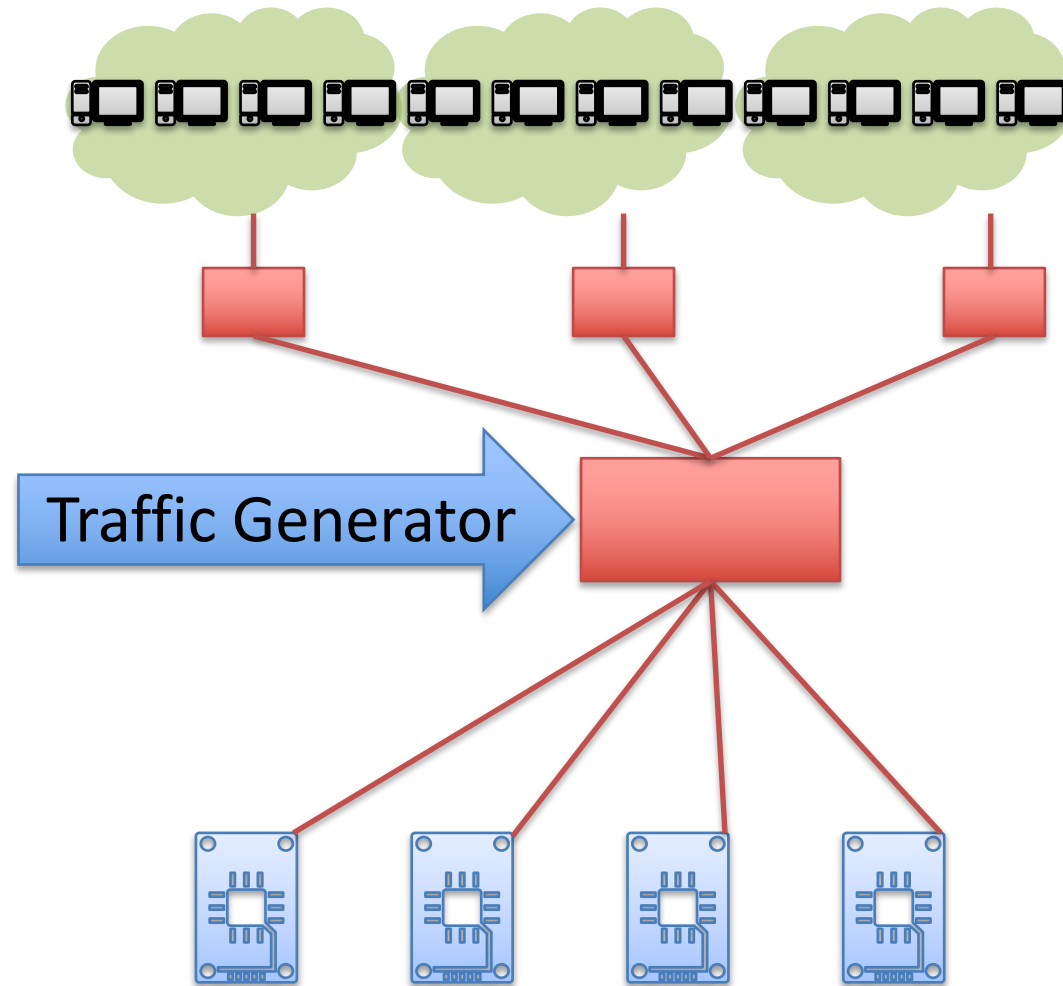 - More efficient zone data structure

See also: Fibre Channel Zoning Basics on-demand webcast: http://bit.ly/FCZONING

Fibre Chanel Zoning webcast slides: http://bit.ly/32nEFoc

Deterministic Performance

Fibre Channel

Great performance in busy data center networks.

AVG. IOPS when Congested @ 60, 80, 90, & 100%
8K-70R30W 100% Sequential QD=32 Threads=10

IOPS (Normalized)

% Congestion

Normalized FC IOPS

Questions?

More Great Resources

- **Fibre Channel Performance: Congestion, Slow Drain, and Over-Utilization, Oh My!**
    - Watch: https://www.brighttalk.com/webcast/14967/295141
    - Q&A Blog: https://fibrechannel.org/fibre-channel-performance-qa/
- **Intro to Incast, Head of Line Blocking and Congestion Management**
    - Watch: https://www.brighttalk.com/webcast/663/356343
    - Q&A Blog: http://sniansfblog.org/storage-congestion-on-the-network-qa/

Our Next FCIA Webcast:

FC SAN Workloads

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for date and time

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    - FC-NVMe
    - Long Distance Fibre Channel
    - Fibre Channel Speedmap
    - FCIP (Extension): Data Protection and Business Continuity
    - Fibre Channel Performance
    - FICON
    - Fibre Channel Cabling
    - 64GFC
    - FC Zoning Basics

Thank You