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The bridge to possible

SAN Analytics and SAN Insights

Real-time and Always-on NVMe and SCSI Visibility at Scale

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BRKDCN-3645

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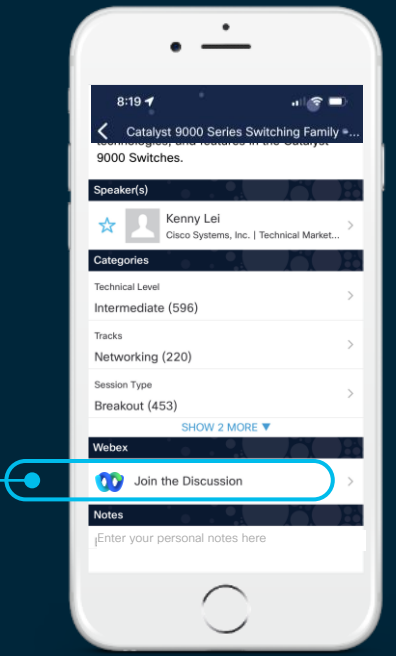

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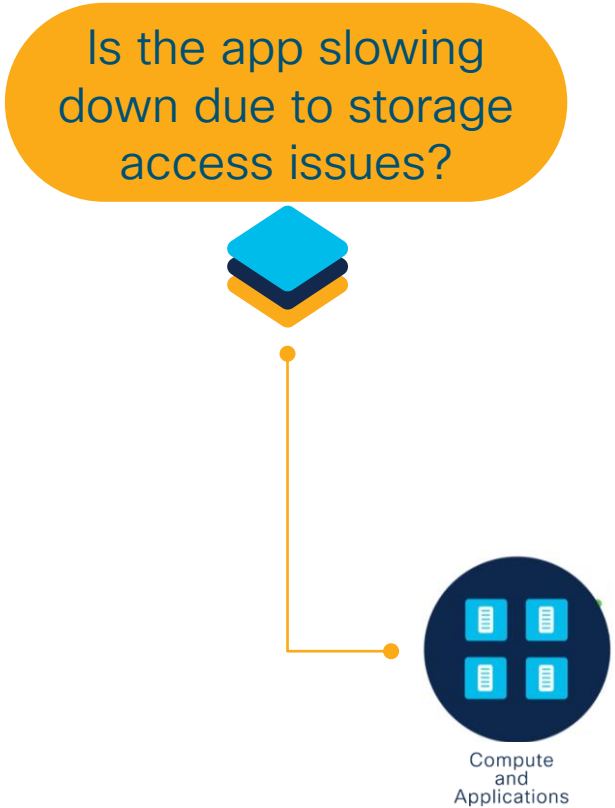
Agenda

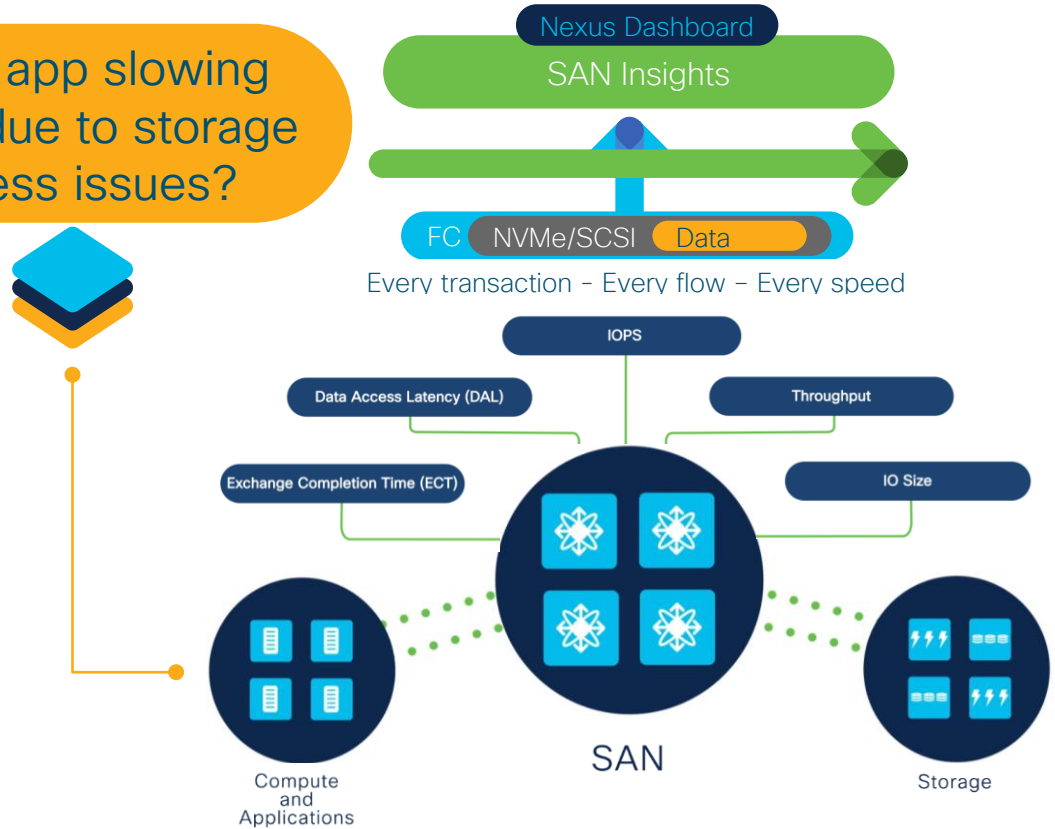
- SAN Analytics Solution Overview
- SAN Analytics Architecture
- Deployment
- I/O Flow Metrics
- Use-cases and case studies
- Summary

NVMe and SCSI I/O Visibility Using SAN Analytics



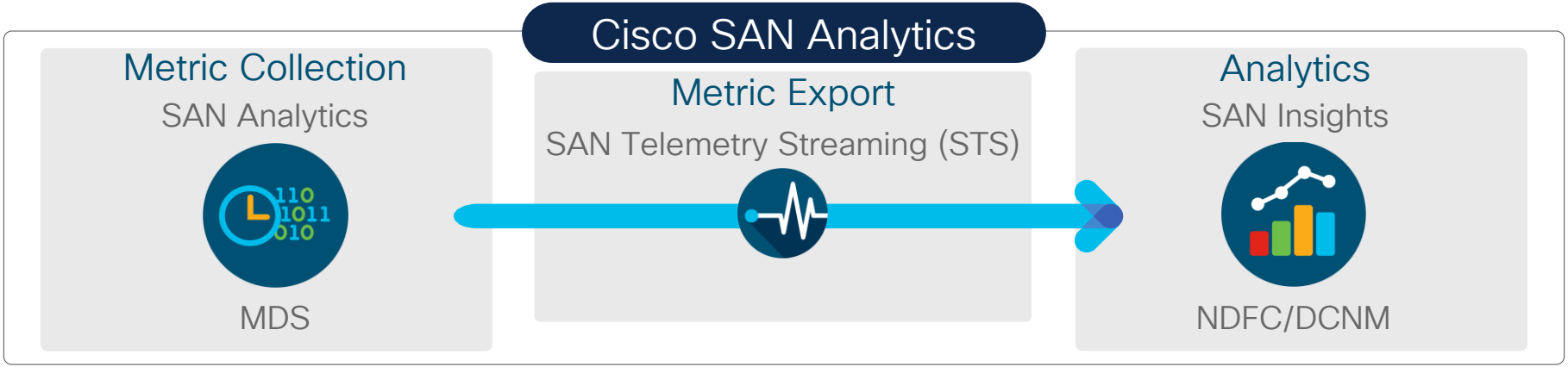
NVMe and SCSI I/O Visibility Using SAN Analytics

Is the app slowing down due to storage access issues?



Solution Components

‘Cisco SAN Analytics’ is the umbrella name for the overall solution



‘SAN Analytics’ is also the name of the feature to enable flow metric collection on MDS switches (NX-OS command: `feature analytics`)

‘SAN Telemetry Streaming’ is an efficient mechanism to export metrics from MDS switches (NX-OS command: `feature telemetry`)

‘SAN Insights’ is an analytics and visualization engine within NDFC/DCNM

Cisco 32G SAN Analytics – Architecture

Traffic Inspection

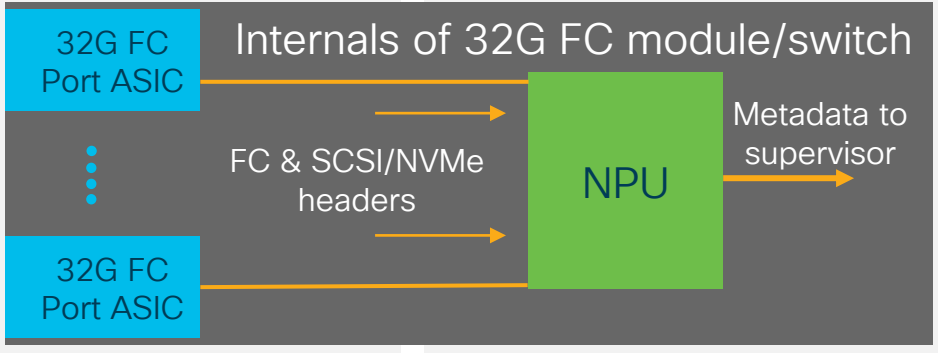
- Inbuilt tap in 32G FC port-ASIC
- Traffic inspection capability on all ports
- Zero impact to switching functionality
- Inspects only FC & SCSI/NVMe headers, not data

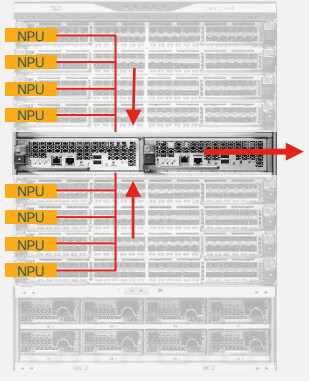
Metric Calculation

- Network Processing Unit (NPU) on 32G FC products
- Receives headers of specific frames from port-ASIC
- Extracts metrics from headers
- Stores metrics in multiple views

Metric Export

- SAN Telemetry Streaming (STS) exports flow metrics to external receivers
- Extremely efficient mechanism
- Works using existing mgmt. port
- On-switch CLI and remote RESTful access available





External Receivers: DCNM SAN Insights Or Virtual Instruments or any other 3rd party app

2022

Cisco SAN Analytics

using

Cisco MDS 64G Switches

2017

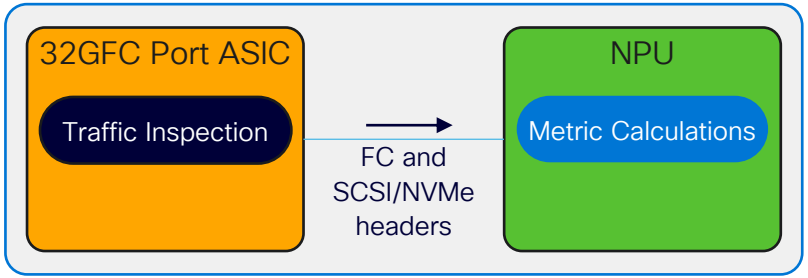
Cisco SAN Analytics

using

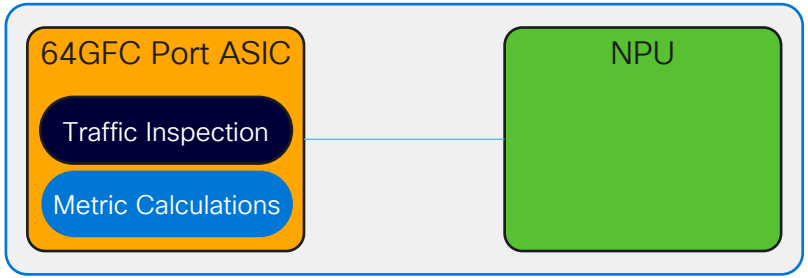
Cisco MDS 32G Switches

Cisco SAN Analytics Architecture

Using Cisco MDS 32G switches



Using Cisco MDS 64G switches



Cisco SAN Analytics

Using
Cisco MDS 64G switches

Analytics for Billions of IOPS

Traffic inspection and metric calculation in ASIC

Software Programmability

On-board Network Processing Unit

Additional flow metrics

Host Response Latency, First Burst,
Optimized Read

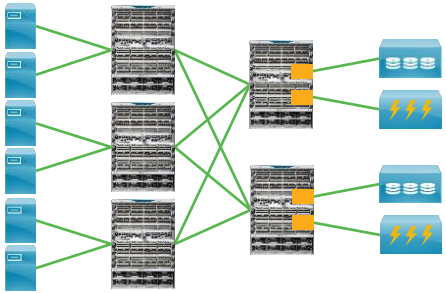
Investment Protection

1GbE streaming port on the 64GFC module

Analytics enabled port(s)

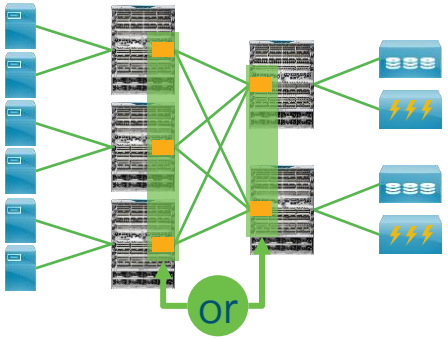
Deployment Models

Storage Ports



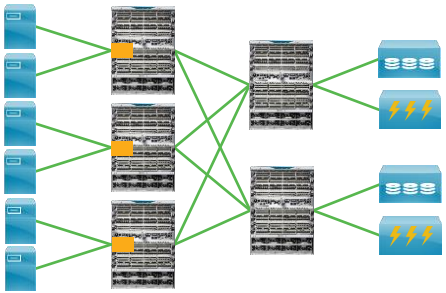
Closest to storage

ISL Ports



High capacity 64G ISLs

Host Ports

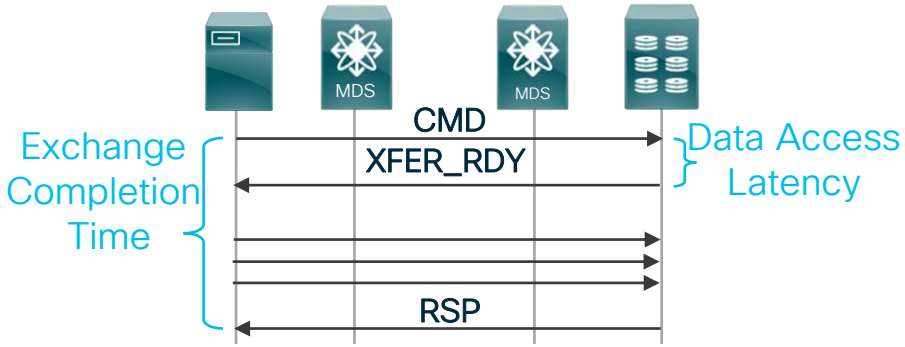


Closest to apps

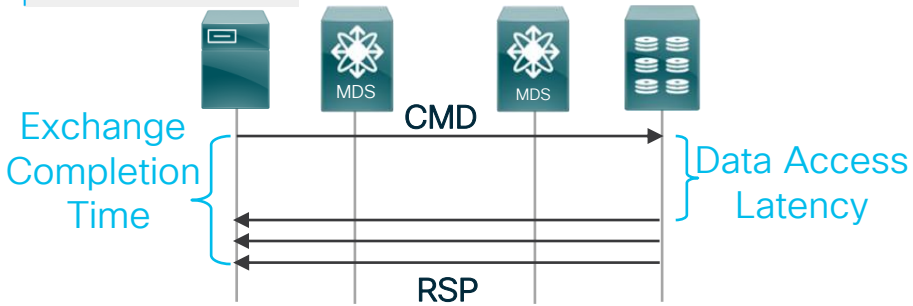
- Inspection of traffic at least once in the end-to-end data path is enough
- Avoid double inspection of traffic
- Design for uniform utilization of the NPU
- Most customers are enabling analytics on storage ports

80+ Metrics per SCSI or NVMe Flow

Write CMD



Read CMD

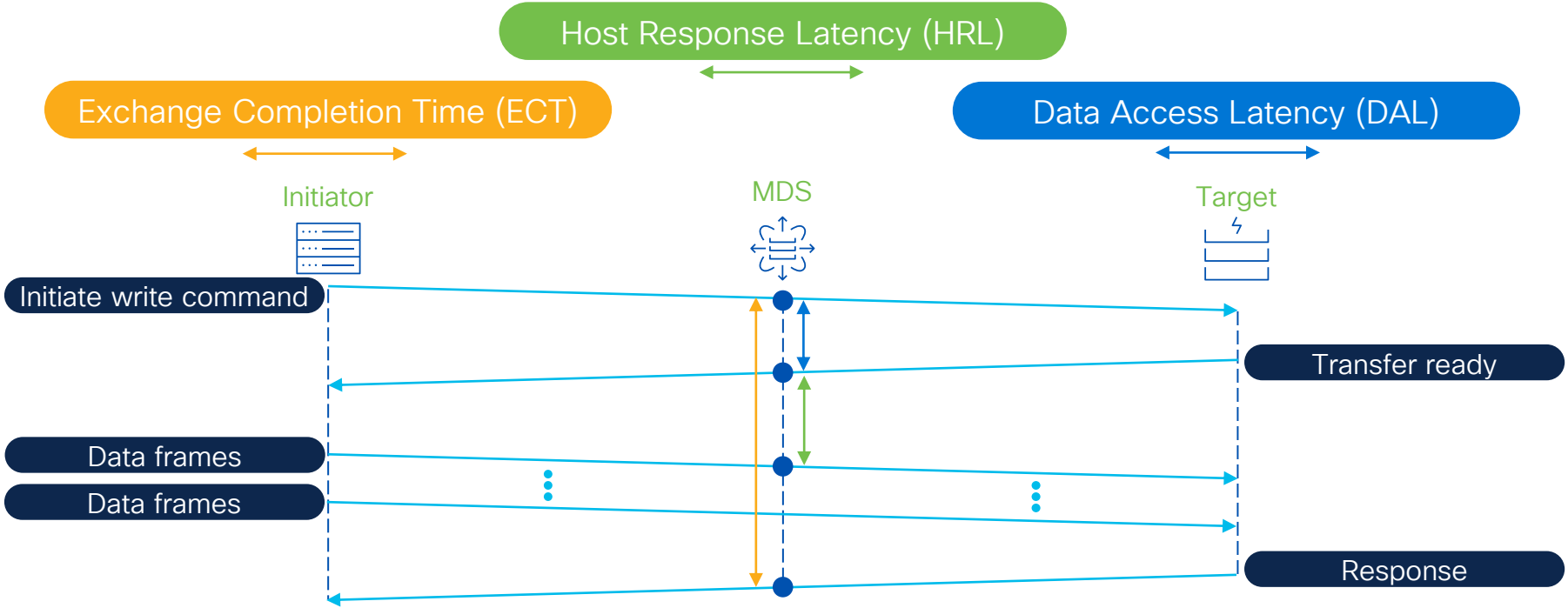


- Exchange Completion time
- Data Access Latency
- Outstanding IO
- IOPS
- I/O Size
- Failed exchanges, IO retransmissions
- Error conditions (Aborts, Rejects, etc.)
- Check conditions, queue-full, etc.

Measured at Initiator-Target-LUN/Namespace (ITL or ITN) level

Cisco SAN Analytics Flow Metrics

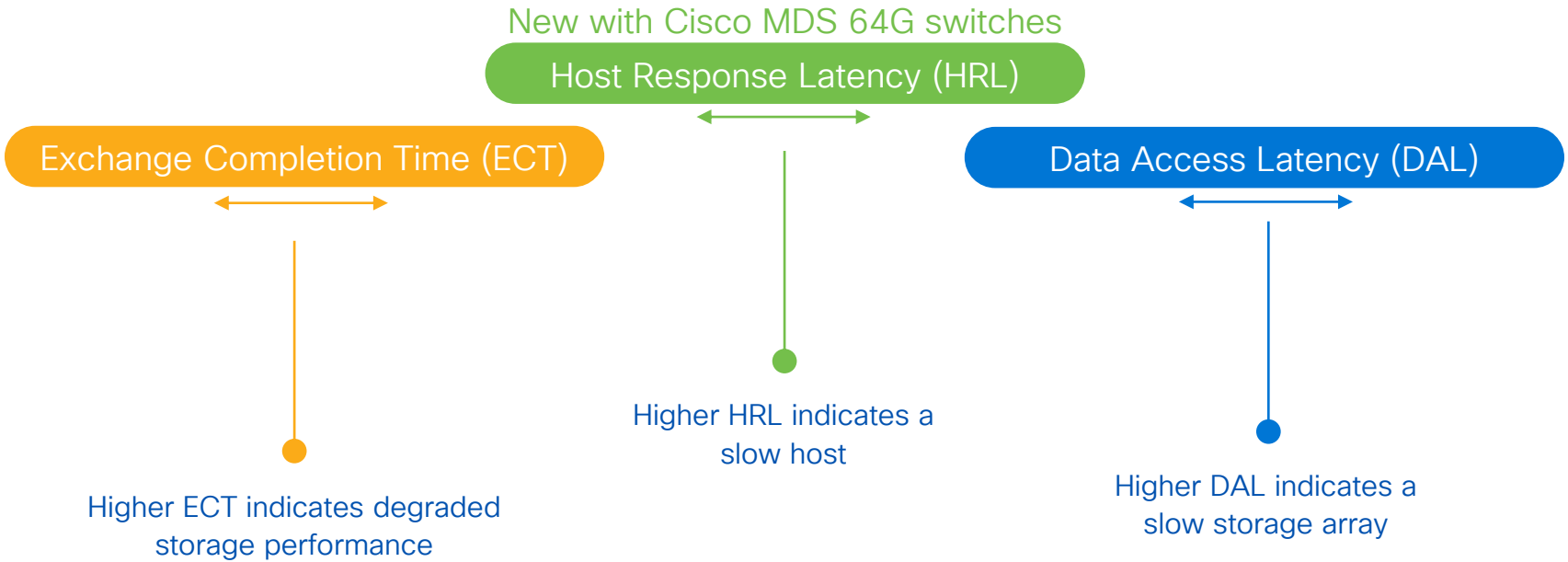
Write I/O Operation



HRL is available only on 64G MDS switches. ECT and DAL are available on 32G MDS as well.

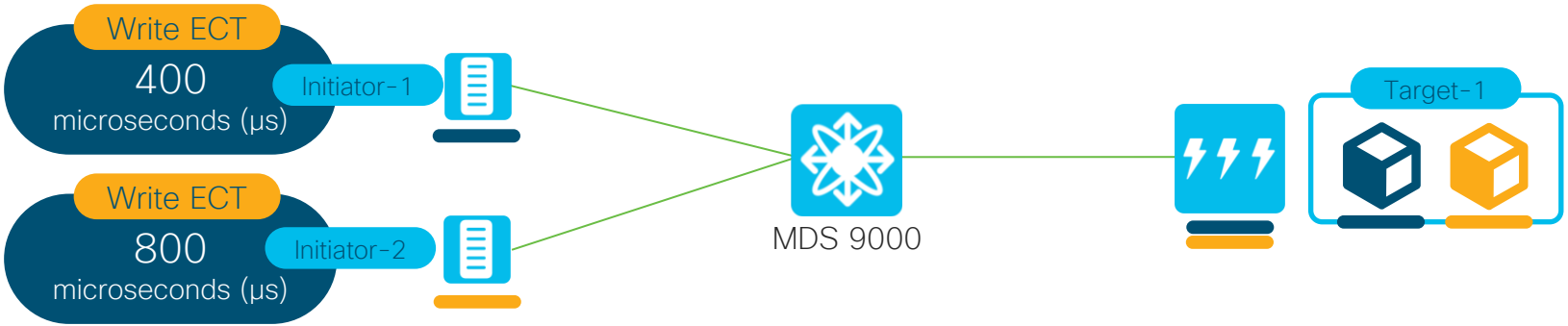
Cisco SAN Analytics Flow Metrics

Write I/O Operation

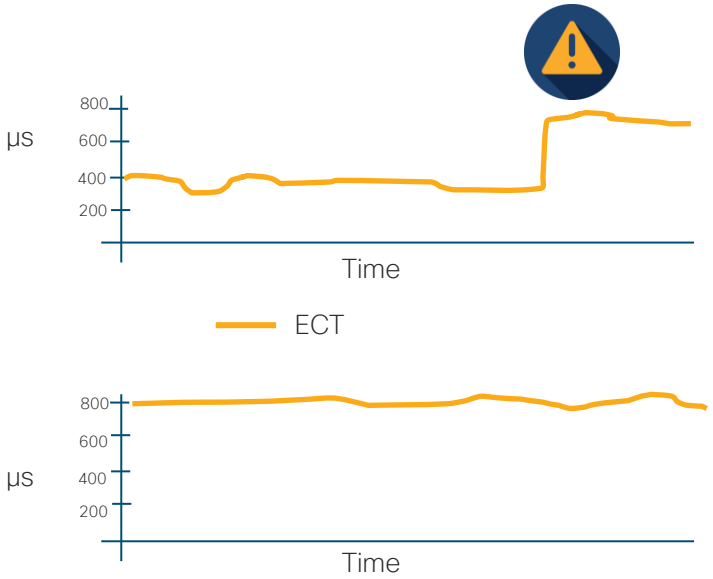


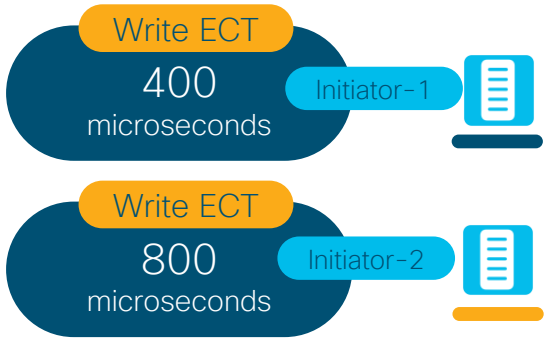
Pin-pointing Storage I/O Performance Issues

Which server is performing better ?



Pin-pointing Storage I/O Performance Issues



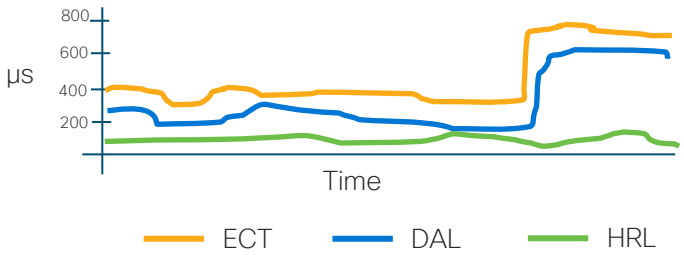


Which server is performing better ?

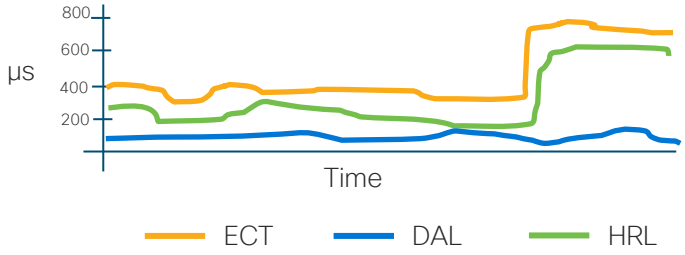
Pin-pointing Storage I/O Performance Issues

Where is the bottleneck ?

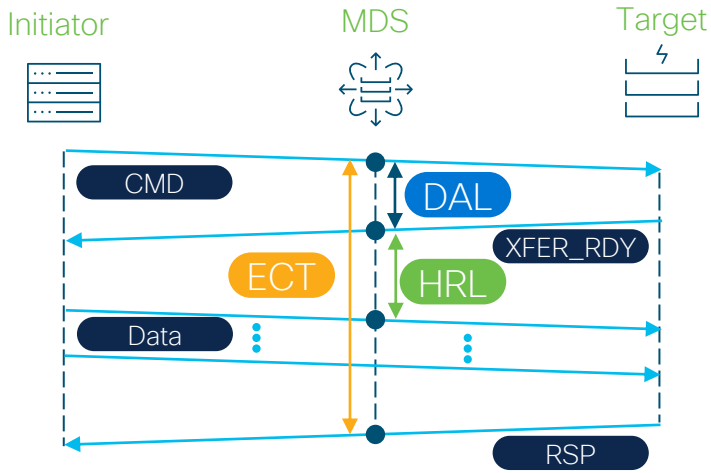
Storage performance is degraded due to delay caused by storage array



Storage performance is degraded due to delay caused by host



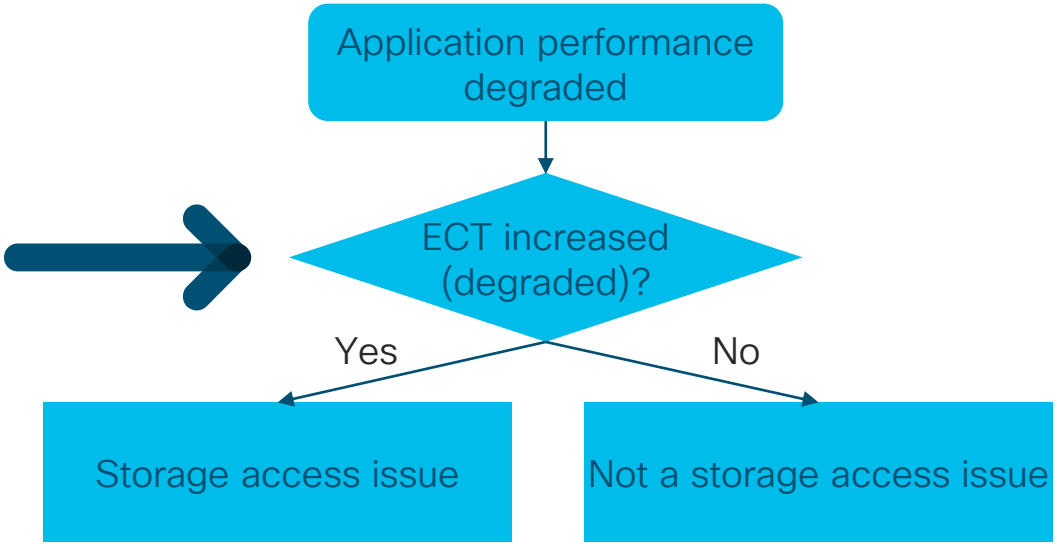
Write transaction



Using ECT, DAL, and HRL for pin-pointing the delays

1st level pin-pointing

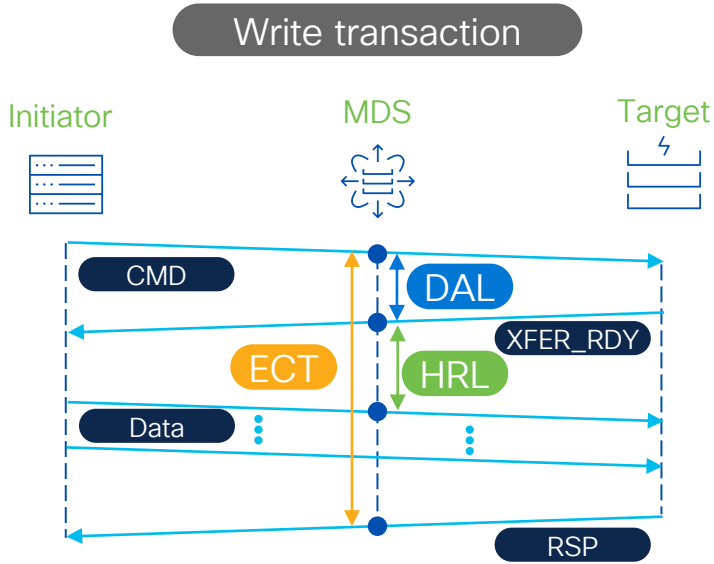
- Increase in ECT may directly lead to application slowdown and is the first level of pin-pointing towards storage access issue



Using ECT, DAL, and HRL for pin-pointing the delays

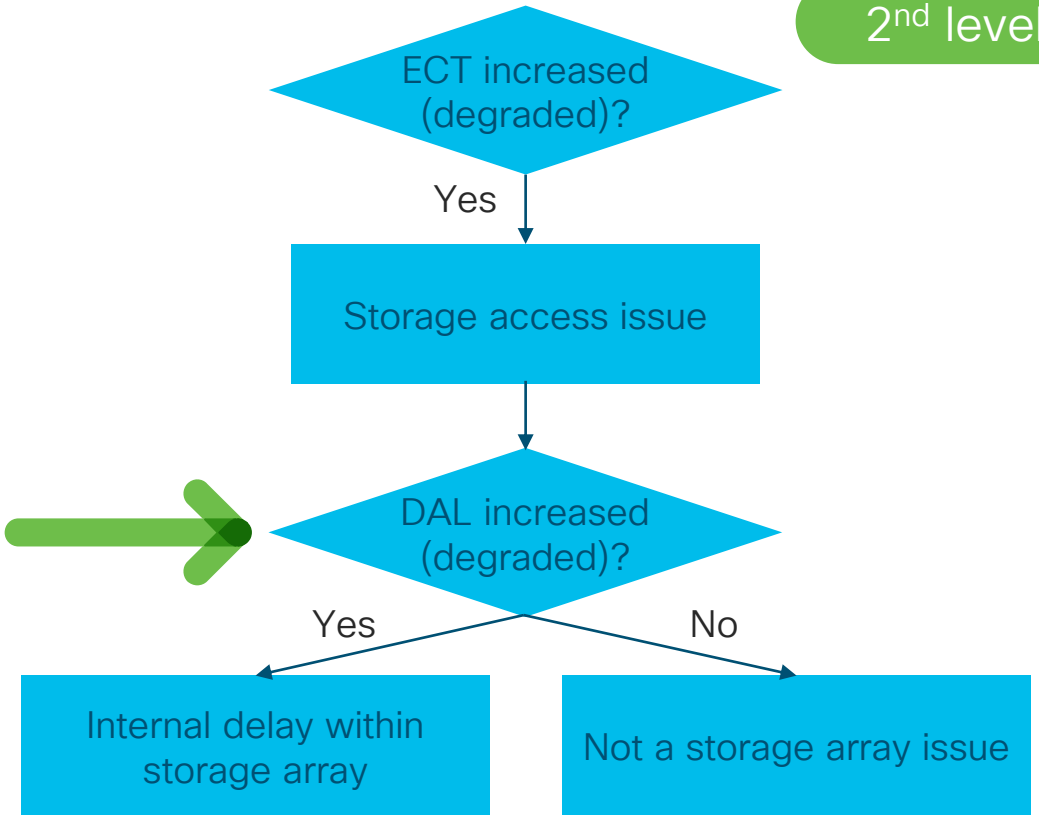
2nd level pin-pointing

- ECT may increase (degrade) due to
  - Internal delay within storage array
  - Delay in the fabric (SAN Congestion)
  - Internal delay within host

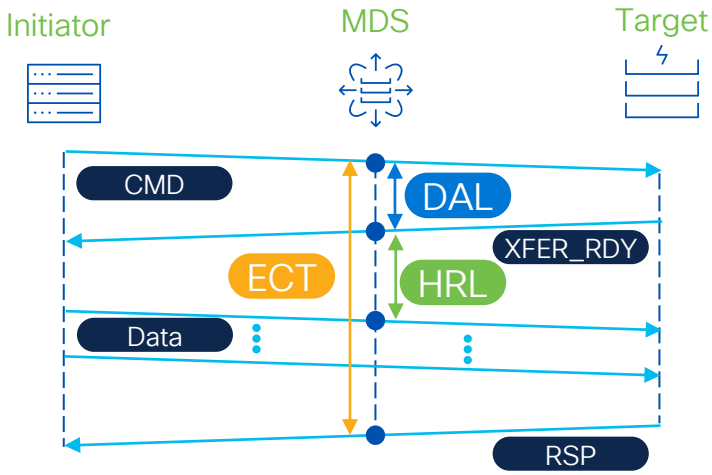


Using ECT, DAL, and HRL for pin-pointing the delays

2nd level pin-pointing

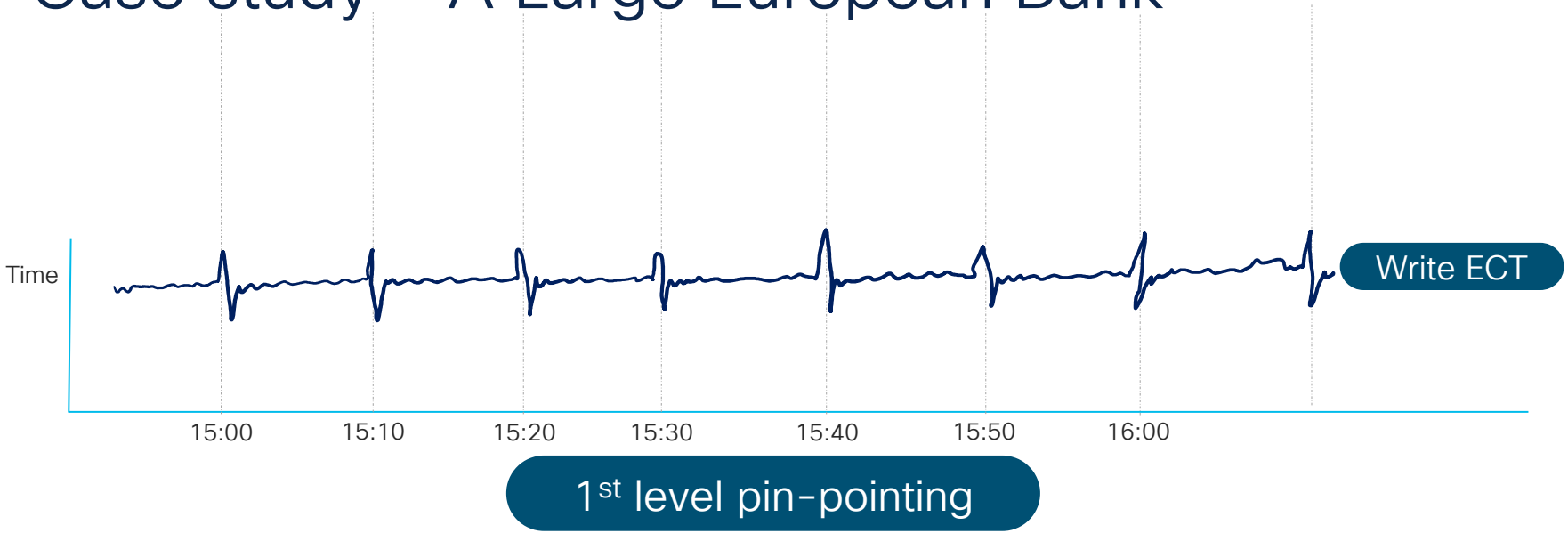


Write transaction



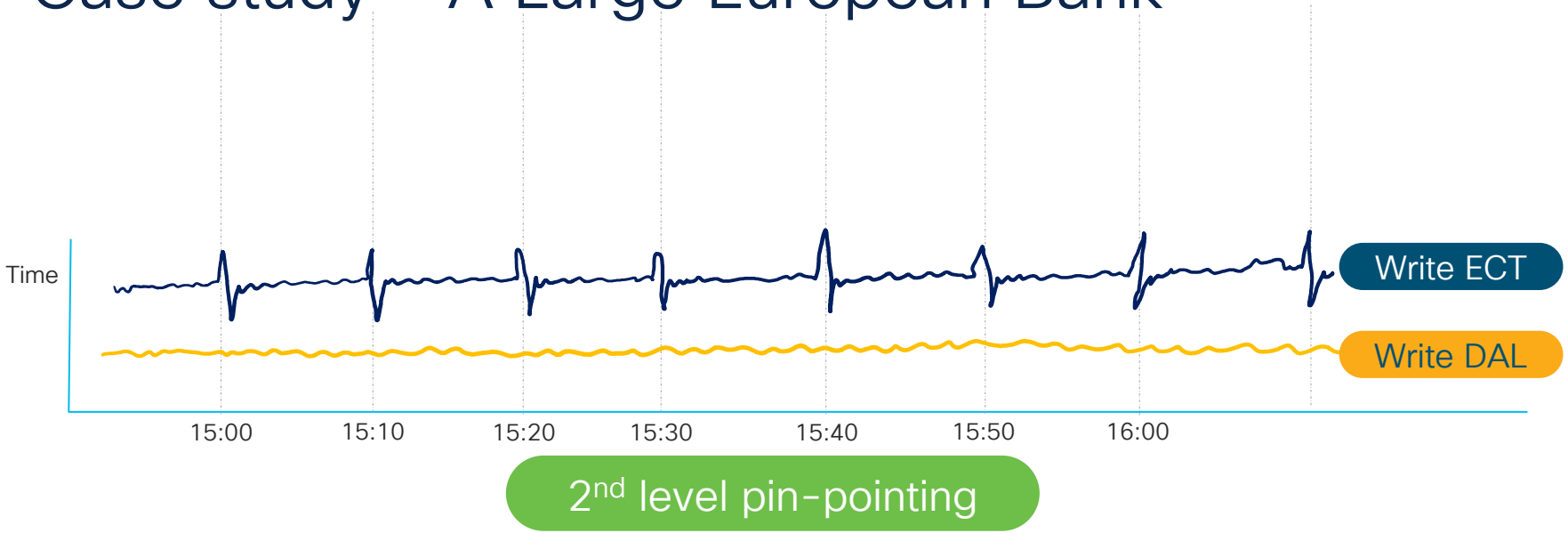
- Delay in the fabric (SAN Congestion)
- Internal delay within host (HRL)

Case study – A Large European Bank



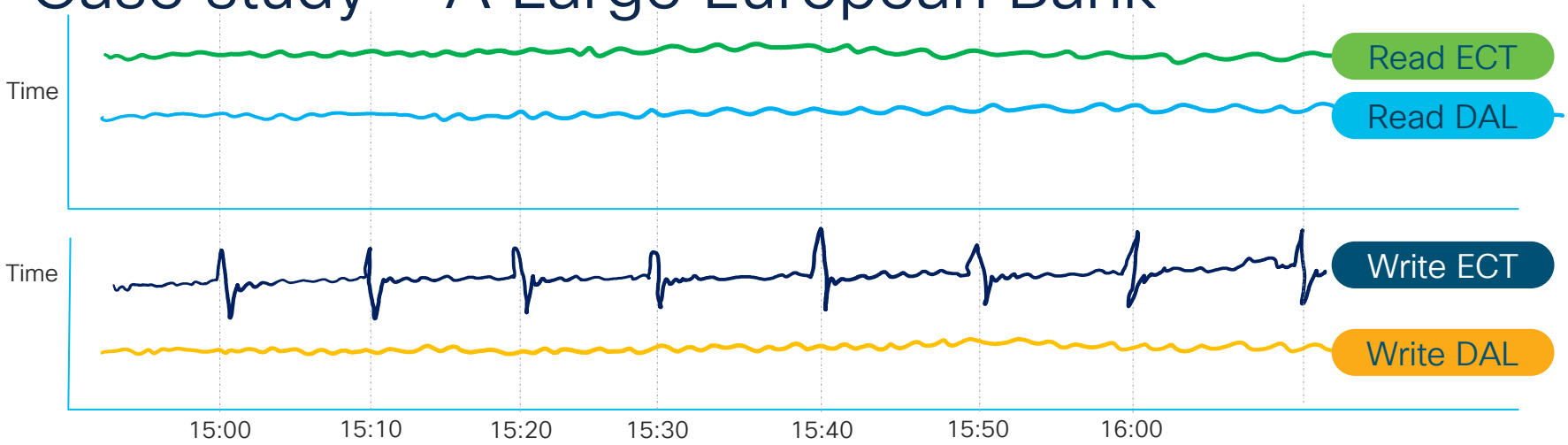
- Write ECT spikes followed by dips
  - May be the cause of application performance issues
- Frequency – every 10 minutes

Case study – A Large European Bank



- Write ECT spike followed by dip. Frequency – every 10 minutes
- DAL is stable (no change)
  - Not a storage array issue

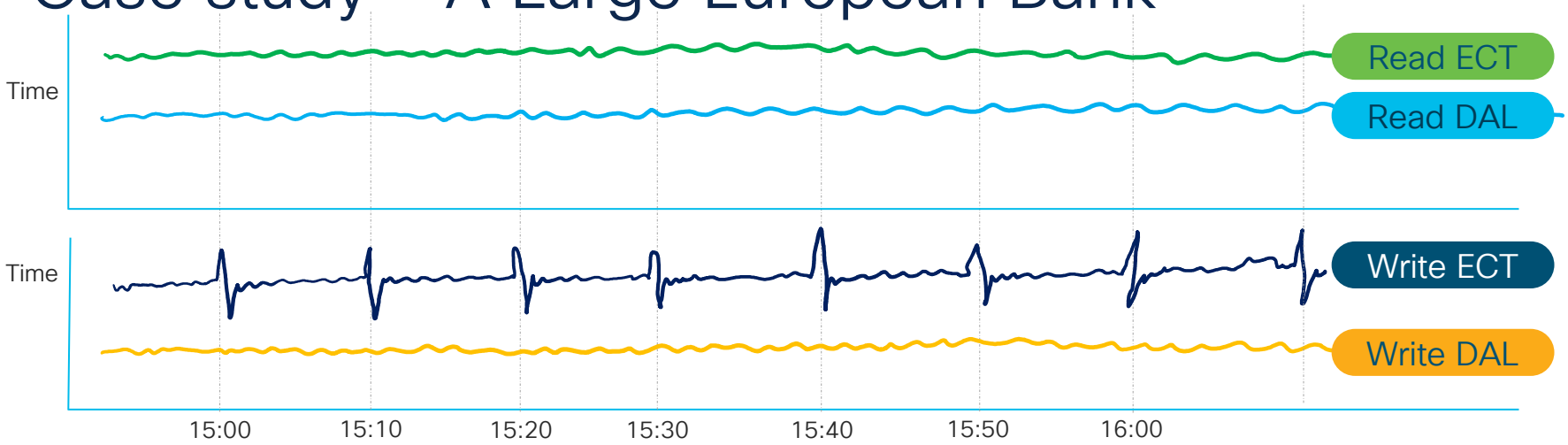
Case study – A Large European Bank



3rd level pin-pointing

- Write ECT spike followed by dip. Frequency – every 10 minutes
- DAL is stable (no change). Not a storage array issue
- No changes in Read ECT and DAL. No fabric congestion observed.
  - No indication of fabric delay. Indication of delay within host.

Case study – A Large European Bank

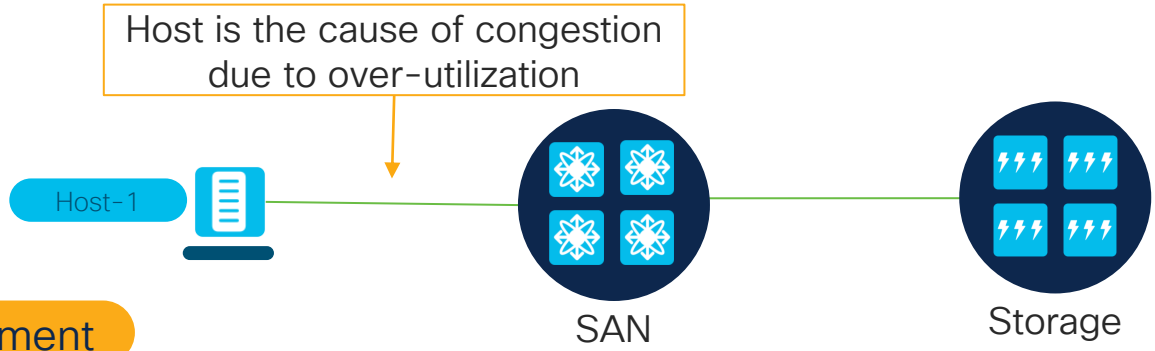


3rd level pin-pointing

- Write ECT spike followed by dip. Frequency – every 10 minutes
- DAL is stable (no change). Not a storage array issue
- No changes in Read ECT and DAL. Not a fabric issue
- Delay within host ➔ Resulted in detection of an unpatched Oracle app on host

Culprit VM – Congestion due to Over-utilization

Case Study – Many customers use this approach today

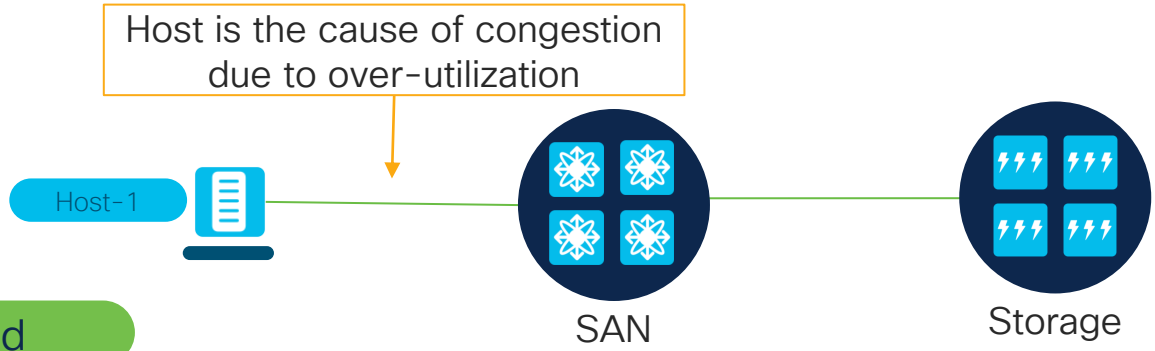


Problem statement

- Host-1 is virtualized. It uses LUN/Namespace/volumes from many storage arrays that are connected via SAN.
- Host-1 is the cause of congestion due to over-utilization
- Goal – Which VM and volumes are the top contributors to high link utilization?

Culprit VM – Congestion due to Over-utilization

Case Study – Many customers use this approach today

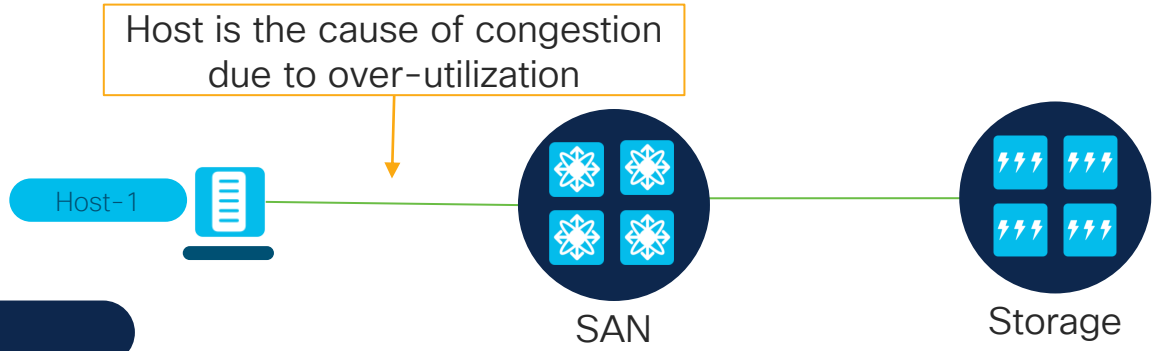


Background

- Network link utilization depends on I/O throughput
- Find I/O throughput using SAN Analytics at flow granularity
  - VM-I-T-L: If VE ID is supported (VE = Virtual Entity (Container or VM))
  - ITL: If VE ID is not supported (Most deployments)
- Traffic towards Hosts (Initiators) is mostly read I/O throughput, whereas traffic towards storage arrays (targets) is mostly write I/O throughput

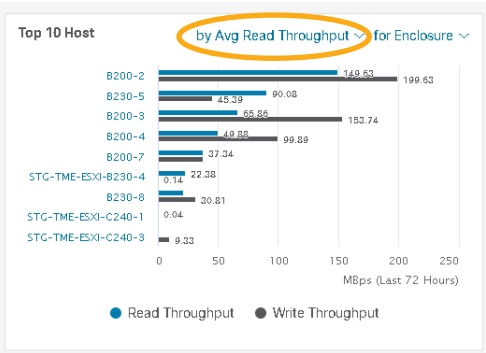
Culprit VM - Congestion due to Over-utilization

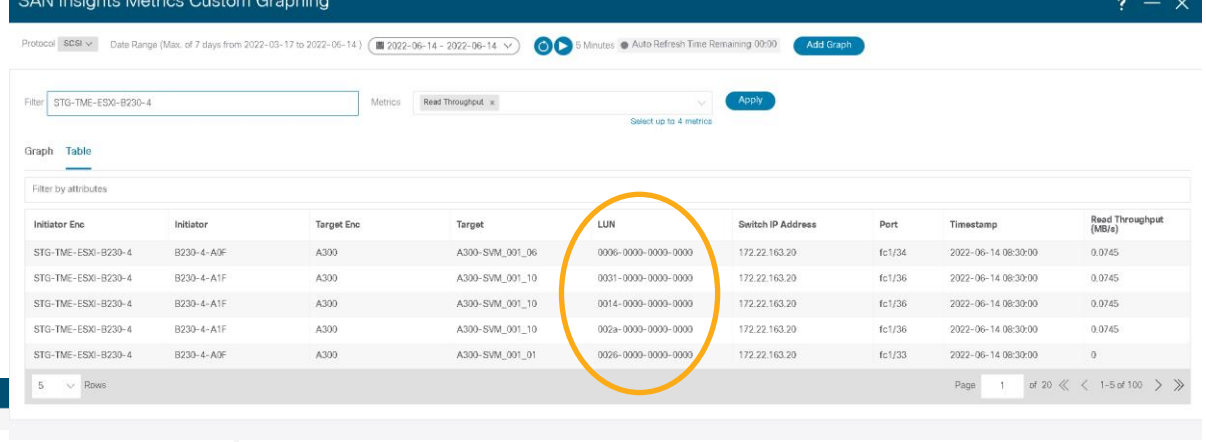
Case Study – Many customers use this approach today

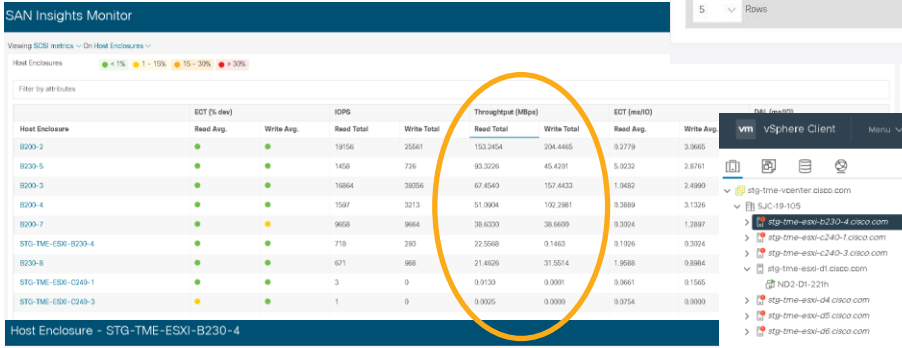


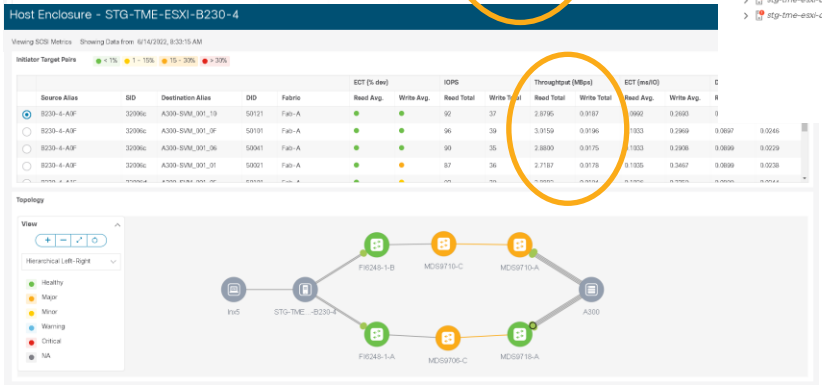
Solution

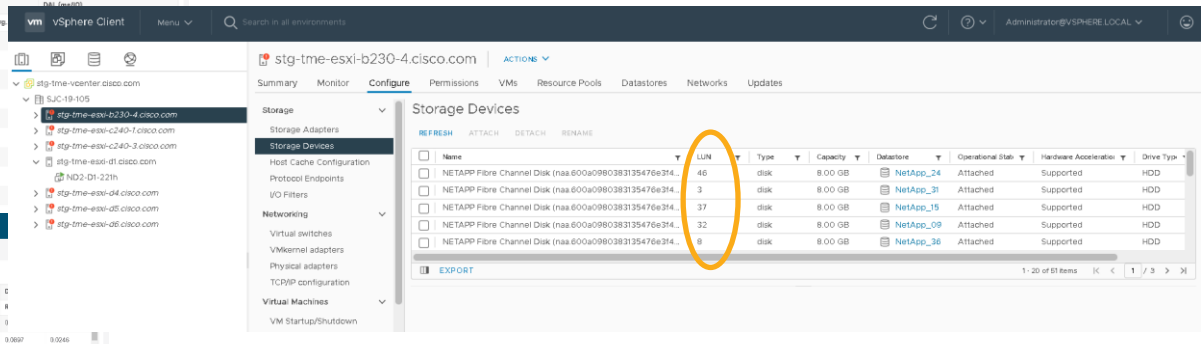
- Use SAN Analytics to find
  - Storage arrays and storage ports that send most traffic to Host-1
  - LUN/Namespace/volume that send most traffic to Host-1
- Then, use vCenter to find the VM that's using that LUN/Namespace/volume
- Next steps: Move the VM to another host or add more HBA to Host-1 or increase the speed of Host-1 link, etc.





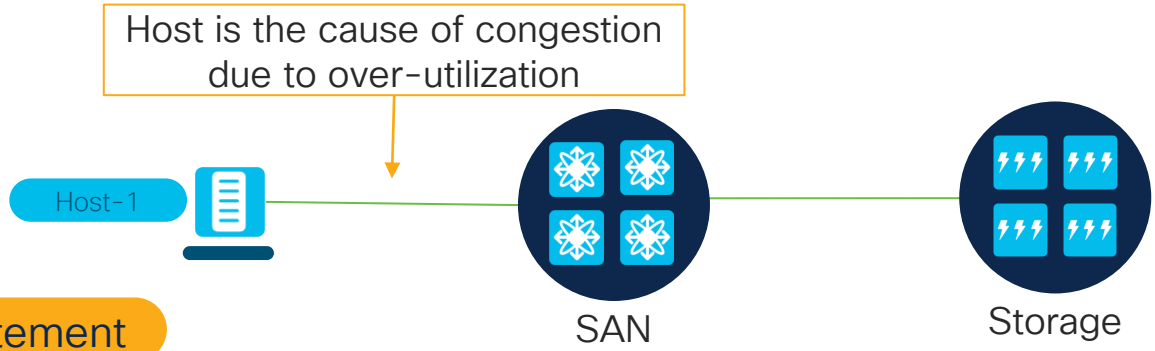






MPIO issues - Congestion due to Over-utilization

Case Study - A university in the mid-west

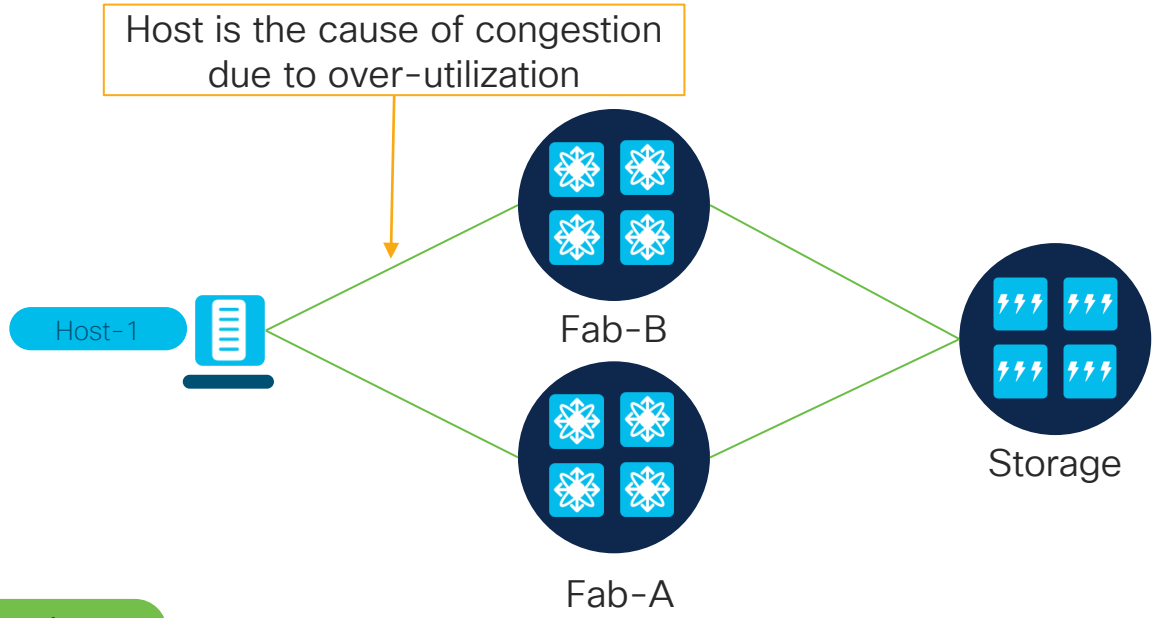


Problem statement

- Host-1 is the cause of congestion due to over-utilization
- Goal - Find the root cause and solve the problem

MPIO issues - Congestion due to Over-utilization

Case Study - A university in the mid west

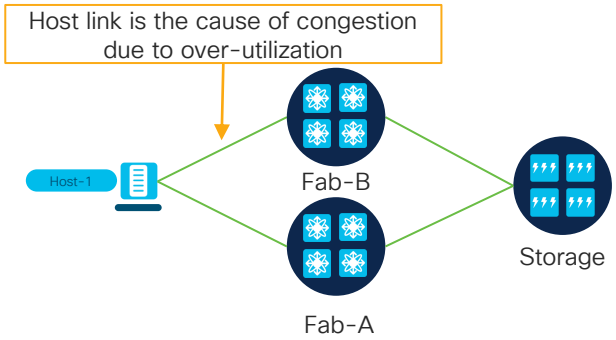


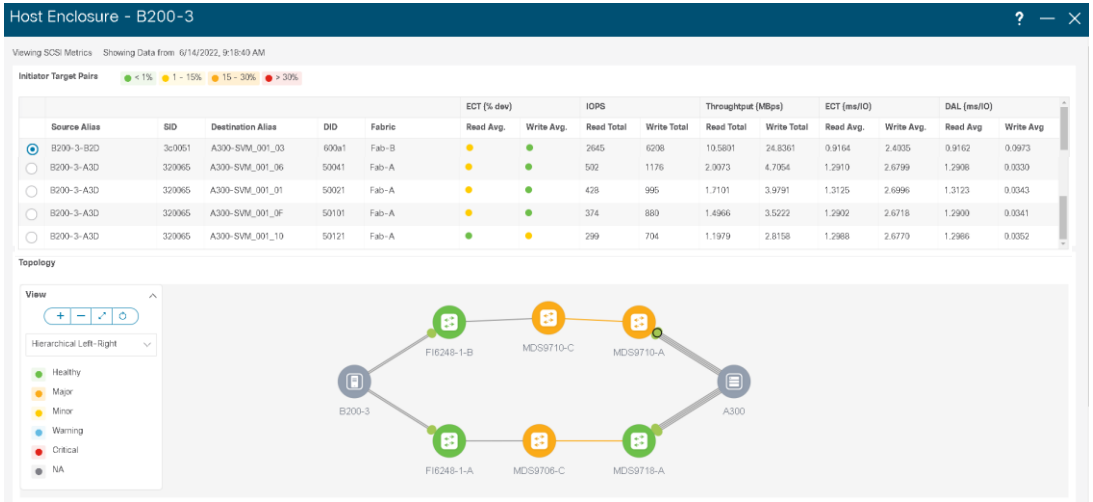
Background

- Hosts connect to the storage arrays via two redundant SAN (Fab-B and Fab-A)

MPIO issues – Congestion due to Over-utilization

Case Study – A university in the mid west





Solution

- Use SAN Insights to find I/O throughput per path
- I/O throughput on Fab-B is much higher than Fab-A – Indicates incorrect MPIO config
- Solution – After changing MPIO config, I/O throughput on Fab-A and Fab-B is uniform, no over-utilization of a single link

Predicting SAN Congestion

Case Study – A trading company selectively upgraded SAN in phases using predictive capabilities of SAN Insights

Problem statement

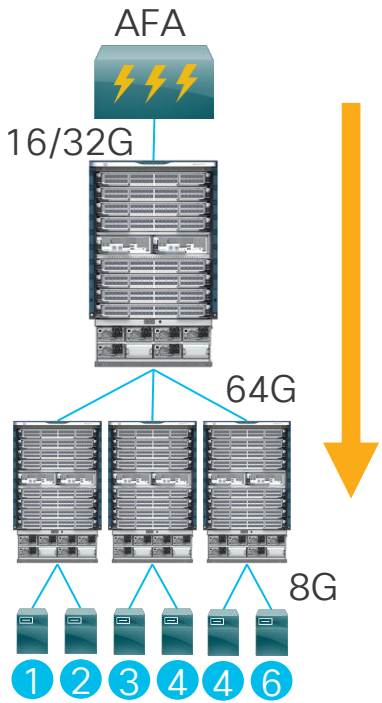
- Large SAN environment with thousands of ports per fabric. Many fabrics.
- Upgraded to all-flash storage, without upgrading the host speed at the same time
- Observed increased occurrences of congestion due to over-utilization of host links
- Aware that the ultimate solution was to upgrade end-to-end connectivity
- But resources weren't enough for an overnight upgrade
- Goal – Among thousands, which server to upgrade first?

Predicting SAN Congestion

Case Study – A trading company selectively upgraded SAN in phases using predictive capabilities of SAN Insights

Background

- In this example
  - 1 storage port connected at 32GFC speed
  - 6 hosts connected at 8GFC speed
- Question: Which host-links are more likely to get over-utilized? One, All, Few None?
- Host-links with larger I/O size are more likely to get over-utilized
- Did you know? – A host with 1% egress link utilization can cause 100% ingress link utilization?
  - Depends how large the I/O size is
  - SAN Analytics shows I/O size at I, T, IT, ITL flow granularity



Predicting SAN Congestion

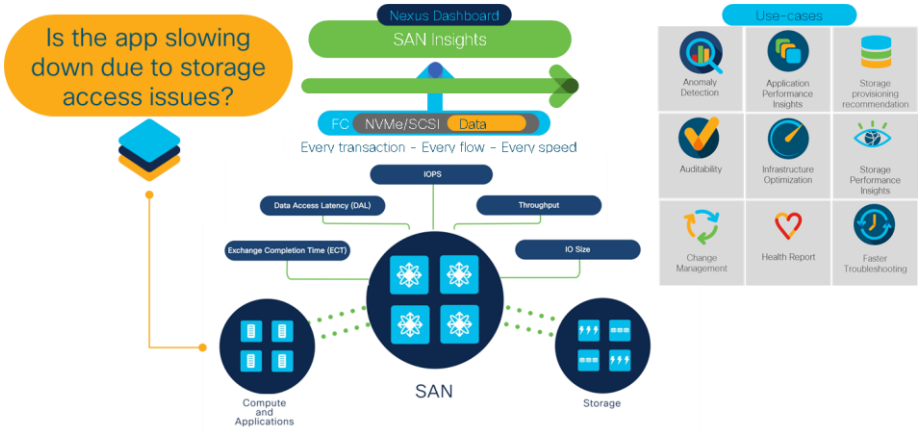
Case Study – A trading company selectively upgraded SAN in phases using predictive capabilities of SAN Insights

Solution

- The trading company enabled SAN Analytics on storage ports
- Collected the peak and average read and write I/O size for all hosts
  - Peaks are important.
- Made a sorted list and started upgrading the hosts first that have larger read I/O size
- The data collected by SAN Analytics gave them predictive insights for an informed upgrade plan.
  - Without SAN Analytics they would have run into many more congestion issues

Summary of Case Studies of SAN Analytics

- A European bank detected an unpatched application server
- Many organizations are able to pin-point the root cause of congestion to a VM
- A mid-west university was able to solve congestion because of MPIO mis-config
- A trading company predicted SAN congestion and planned an upgrade to not get affected



Technical Session Surveys

- Attendees who fill out a minimum of four session surveys and the overall event survey will get Cisco Live branded socks!
- Attendees will also earn 100 points in the Cisco Live Game for every survey completed.
- These points help you get on the leaderboard and increase your chances of winning daily and grand prizes.

See you tomorrow at 8 AM

Level 2, Lagoon B

Detecting, Alerting, Identifying and Proactively Preventing

SAN Congestion

Thursday, Jun 16, 8:00 AM PDT

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Related sessions

Session ID	Title	Time and Venue	Speaker
BRKDCN-3241	Detecting, Alerting, Identifying and Proactively Preventing SAN Congestion	Thursday, Jun 16, 8:00 AM - 8:45 AM PDT Level 2, Lagoon B	Paresh Gupta
BRKDCN-3645	SAN Insights - Real-time and always-on NVMe visibility at scale	Wednesday, Jun 15, 10:30 AM - 11:15 AM PDT Level 2, Lagoon H	Paresh Gupta
BRKDCN-3812	Dos and Don'ts of Deploying NVMe Over Fabrics	Tuesday, Jun 14, 2:30 PM - 3:15 PM PDT Level 2, Lagoon H	Kamal Bakshi
PSODCN-2355	Real-time NVMe and SCSI visibility using Cisco SAN Analytics	Wednesday, Jun 15, 2:00 PM - 2:30 PM PDT Level 3, South Seas H	Kiran Ranabhor
BRKDCN-2489	IP Fabric for Storage Networks Best Practice and Design	Wednesday, Jun 15, 4:00 PM - 4:45 PM PDT Level 3, South Seas D	Nemanja Kamenica
BRKDCN-1119	Introduction to NDFC: Simplifying Management of Your Data Center	Monday, Jun 13, 9:30 AM - 10:15 AM PDT Level 2, Lagoon G	Parth Patel

Thank you


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ALL IN