

# LiveNX Training Student Guide



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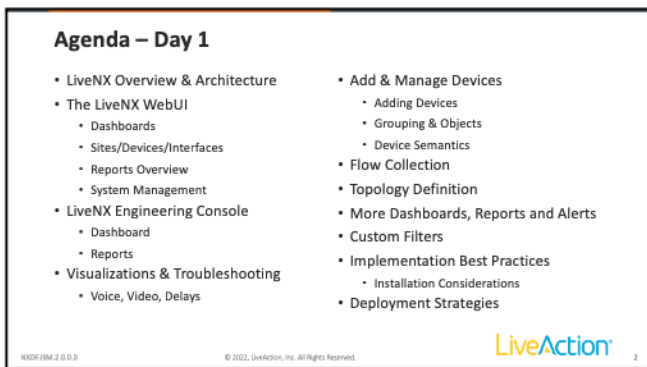
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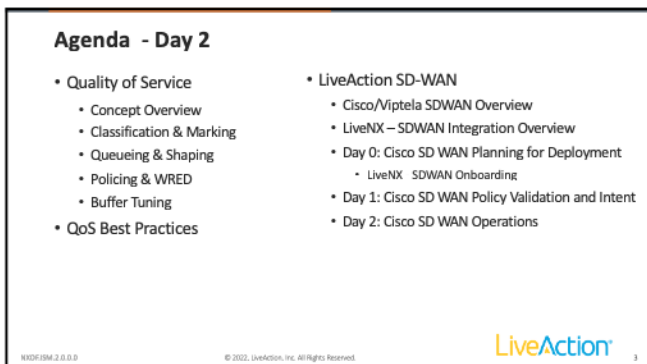
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# LiveNX Training Student Guide

## Class Logistics

- Daily Schedule
  - Start
  - Breaks
  - Finish
- Equipment
  - Laptops
  - Internet Access
  - eLab Access

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## Your Trainer...

Nate Richie  
Senior Consulting Engineer, Advanced Services Team  
Interim Manager, Advanced Services Team

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## Prerequisites

- You already:
  - Have a basic knowledge of applications, networking, and protocols...
  - Understand TCP/IP, network addressing, and subnet masks
  - Know basic router & switching concepts
  - Manage NetFlow devices within your environment



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## And you are...

- Name ?
- What do you do at your company ?
- Have you used LiveAction Products?
- What Product Certs do you maintain? (Brag if you must;-)
- What was your first car?

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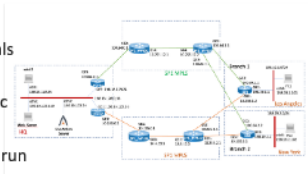
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## Our Training Infrastructure

- Each attendee will connect to a dedicated "Training Pod"
- The Instructor will provide credentials for each attendee
- All Pods are monitoring similar traffic flows.
- We'll connect over the Internet and run a Browser and Eng Console locally.
- Initial device configuration has been performed on all Training Pods.



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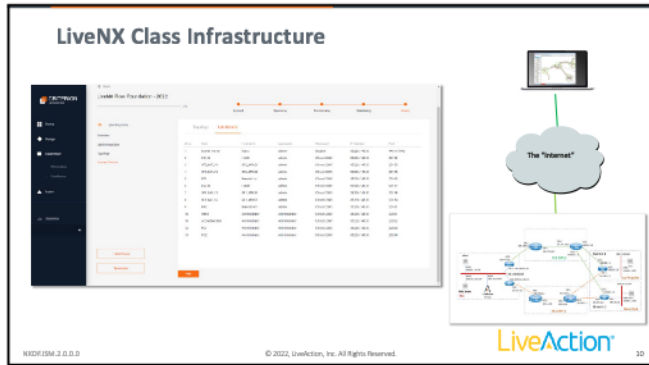
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# LiveNX Training Student Guide



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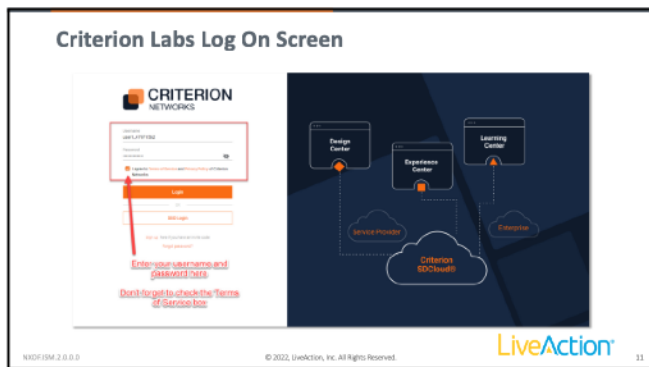
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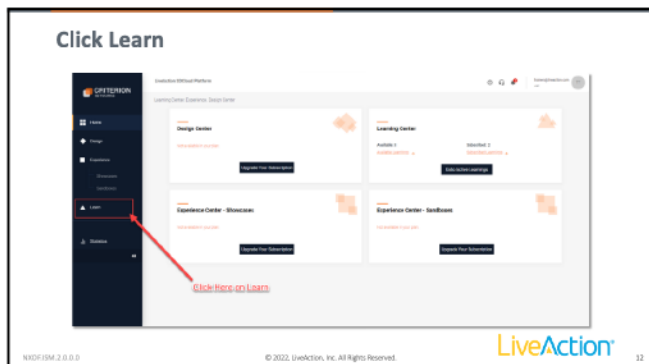
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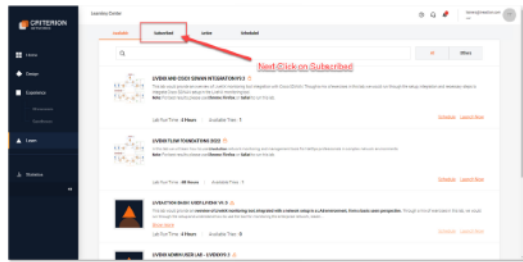
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## Click Subscribed



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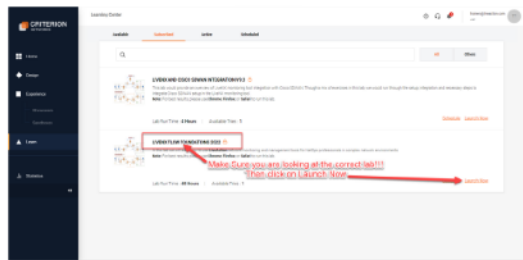
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## Select the Correct Lab and Click Launch Now



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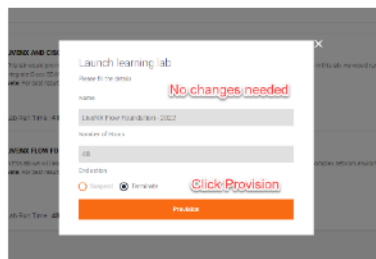
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## Click Provision



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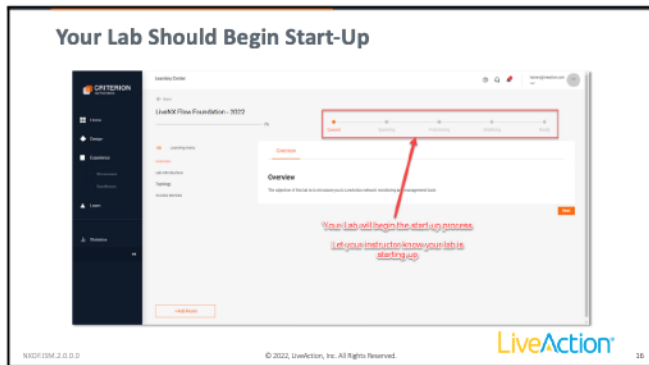
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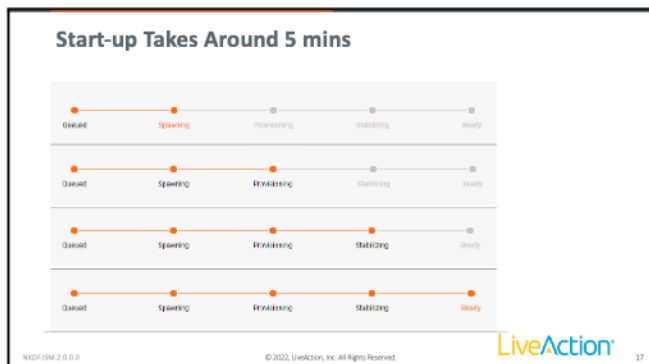
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## LAB 0: Setup and Get Connected

- Turn on / Plug-in, and verify network & internet connectivity.
- Note the addressing and credentials provided by your instructor.
- Install and run:
  - LiveNX Engineering Console
    - <https://cloudkeys.liveaction.com/downloads>
- You may now ping your LiveNX Server....



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## LiveNX

### System Overview & Architecture

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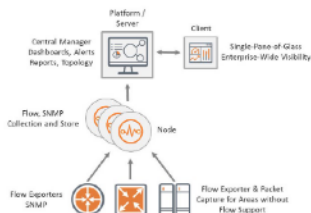
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## Architecture Overview

- **Distributed Computing Architecture**
  - High-performance database
  - Large-scale distributed analytics platform
  - Capable of handling 1M+ flows/sec
  - Monitor 40,000+ devices across distributed deployment
  - Visualize up to 1,000 active interfaces per device
  - 3-layer architecture – client, server, node
- **Engineering Console**
  - Single Pane of Glass (SPoG) over entire network
  - Limiting user data access by groups per node
  - Browser: Windows (32/64-bit), or Mac OSX
- **Server**
  - Central management of nodes
  - Virtual install – HyperV/VMware/KVM
- **Collector Node**
  - Hold data store, automatic data management
  - Node management policy set at server
  - Virtual install – HyperV/VMware/KVM



```
graph TD
    Client[Client] --> Platform[Platform / Server]
    Platform --> Node[Node]
    Node --> Collector[Collector Node]
    Node --> Exporters[Flow Exporters SNMP]
    Exporters --> Exporters2[Flow Exporters & Packet Capture for Areas without Flow Support]
```

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# LiveNX Training Student Guide

## System Requirements

<http://www.liveaction.com/support/specifications/>

- **Server Platform Specifications:**
  - VMware ESXi v5.0 or higher – VMware Hardware Version 8 (vmx-8)
- **Network Hardware – At least two Physical NICs on ESXi**
  - Support up to 10 Gbps
  - Virtual NICs on OVA are utilizing E100

Proof Of Concept (POC)	Small Deployment	Medium Deployment	Large Deployment	Physical Deployment
<= 25 Devices or <= 25k Flows/sec.	<= 100 Devices or <= 50k Flows/sec.	100-500 Devices or <= 100k Flows/sec.	500-1000 Devices or <= 150k Flows/sec.	Upto 1000 Devices or <= 500k Flows/sec.
Min Requirements: <ul style="list-style-type: none"><li>• 8 vCPU Xeon or 17</li><li>• 16 Gb RAM</li><li>• Max Heap Size 8GB</li><li>• 500GB Data Disk</li></ul>	Min Requirements: <ul style="list-style-type: none"><li>• 16 vCPU Xeon or 17</li><li>• 32 Gb RAM</li><li>• Max Heap Size 16GB</li><li>• 2TB Data Disk</li></ul>	Min Requirements: <ul style="list-style-type: none"><li>• 16 vCPU Xeon or 17</li><li>• 64 Gb RAM</li><li>• Max Heap Size 31GB</li><li>• 4TB Data Disk</li></ul>	Min Requirements: <ul style="list-style-type: none"><li>• 32 vCPU Xeon or 17</li><li>• 64 Gb RAM</li><li>• Max Heap Size 31GB</li><li>• 8TB Data Disk</li></ul>	Min Requirements: <ul style="list-style-type: none"><li>• 64 vCPU Xeon Gold 5218</li><li>• 768 Gb RAM</li><li>• Max Heap Size 384GB</li><li>• 32TB Data Disk</li><li>• (16TB usable with RAID 10)</li></ul>

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## Network Devices Supported

<http://www.liveaction.com/specifications/>

Cisco Device Support – SNMP & Flow
ASR 9000 Series Router
Cisco AnyConnect Network Visibility Module on Windows and Mac OS X Platforms
Cisco ASA 3500 Series Firewalls
Cisco Catalyst Series Switches 2500, 3650, 3850 & 4500-X 6500, 6800, 9000 are supported** (limited LiveNX Ops Monitor support on Layer 3 routeable interfaces and VLANs depending upon Cisco hardware capabilities.)
Cisco ISR Series Routers: 800, 900, 1700, 1800, 1900, 2600, 2600NM, 2800, 2900, 3600, 3700, 3800, 3900, 4200, 4300, 4400, 4500, 7200, 7600** ASR 1001x, 1002x Series Routers, CSR 1000v**
Cisco Meraki MX Security Appliance
Cisco Nexus Switches (Nexus 3000, 7000, 6000 & 9000 Series)
Cisco NetFlow Generation Appliance
Cisco SD-WAN vEdge, Cisco IOS XE SD-WAN Edge Devices

Multi-Vendor Device Support – Flow
Achronix Nantanta Series Routers
Alcatel-Lucent Routers
Barracuda Firewall
Brocade Series Routers
Checkpoint Firewall
Citrix NetScaler Load Balancer
Extreme Network Switches
F5 Load-Balancer
Gigamon GigaSMART
Hewlett-Packard Enterprise ProCurve Series Switches
Juniper Network Visibility Solution
Juniper MX Series Routers
Map nProbe
Palo Alto Networks Firewalls
Riverbed SteelHead WAN Optimization Controllers
Silver Peak WAN Optimization Controllers
Sophos Firewall
Ziften ZFlow

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## Bandwidth Overhead – Server/Node

- Data is stored on the **Collector Nodes**
- Server requests data from Node(s) on demand
  - In case of loss of communication, server may initiate to reestablish communications
- Minimal synchronization communication between the Server and Node(s).
  - "Keep alive" (not really... more a "I have new data")
- Bandwidth is proportional to the number of devices being monitored by each Node
- End user actively monitoring LiveNX also increases bandwidth.

Examples of Node/Server Bandwidth	Devices Per Node	Node to Server Traffic (Avg./Peak)	Server to Node Traffic (Avg./Peak)
	100	125Kbps/1.2Mbps	5Kbps-25Kbps
	500	625Kbps/1.75Mbps	25Kbps-125Kbps
	1000	1.25Mbps/2.25Mbps	50Kbps/250Kbps

Note: These are typical bandwidth estimates that LiveAction would expect to see. Each network is different so results may vary.

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## LiveNX Flow Capabilities

LiveNX is a *flow collector*

- Supports NetFlow V5/V9, FNF, sFlow, jFlow, IPFIX, and other multi-vendor flow types
- Provides unique end-to-end flow visualization for a holistic view of the network
- Provides hop-by-hop color-coded application and flow path analyses for network and application performance issues
- Visually shows mis-marked DSCPs for traffic priority
- Easily enables Cisco advanced flow technologies
- Topology can be exported to Visio
- Keep all raw data as long as there is sufficient disk space

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## LiveNX Communication with Devices

LiveNX uses SSH or Telnet access to read IOS configurations, as well as to make desired configuration changes to the device(s);

- QoS Configurations
- Netflow Configurations
- IP SLA Configurations
- Policy Based Routing

LiveNX does not save the router configuration in our database!

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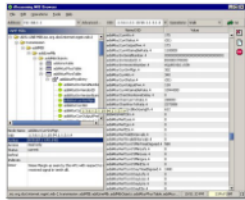
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## LiveNX Communication with Devices

- LiveNX uses SNMP v2 or v3 RO (Read Only) access to devices
- Polling for reading the MIB (Management Information Base)
  - CBQoS MIB
  - IP SLA MIB
  - LAN MIBs
  - Routing MIBs
- Updates statistics according to user configured polling intervals



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## LiveNX Network Protocol Requirements

Protocol	Port Number	Direction	Description
TCP	7000	Eng Console to NX Server	Engineering Console Access to Platform
TCP	443	Web Browser to NX Server	User Access to Web UI of Platform
TCP	7026	Server to Node (Bidirectional)	Server <-> Node Communication
UDP	2055	Network devices to nodes	Netflow Export
UDP	161	NX Node/Server to Network Devices	SNMP Polling of Network Devices

Required network protocols for normal operation of the LiveNX platform. This can be used as the basis for any firewall rules required.

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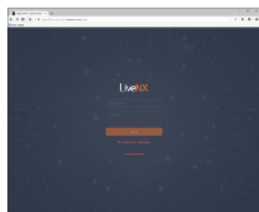
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## From Any Browser... from Anywhere!

<https://<LiveNXserverIP>>

- Create and View Dashboards
- Manage and View:
  - User Management
  - Devices (accept or reject information from devices – cannot configure)
  - Alerts
  - Reports



Visualization Philosophy: Shows what you ask it to show

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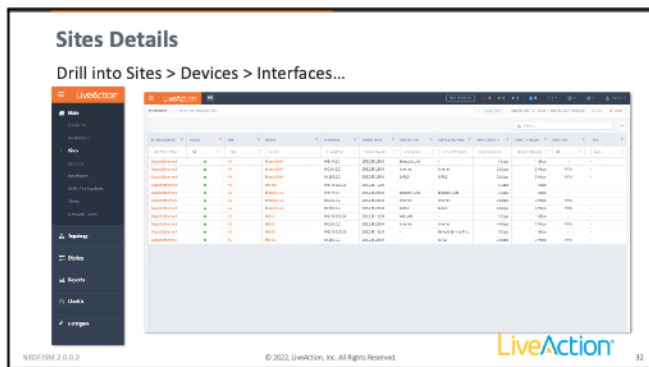
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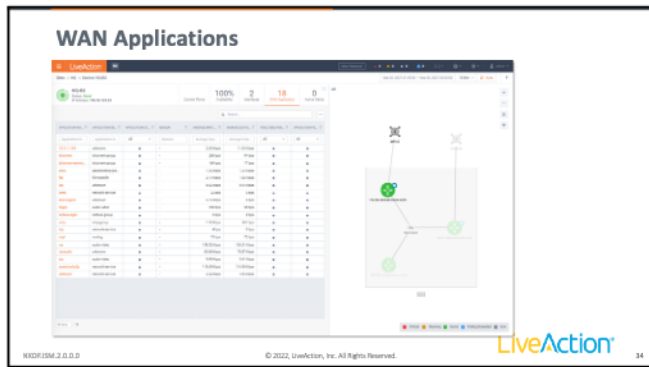
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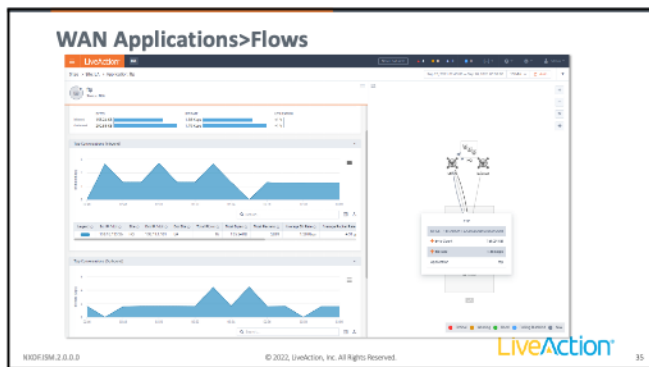
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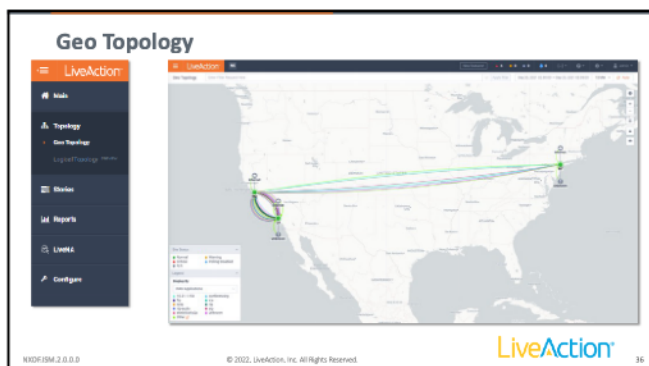
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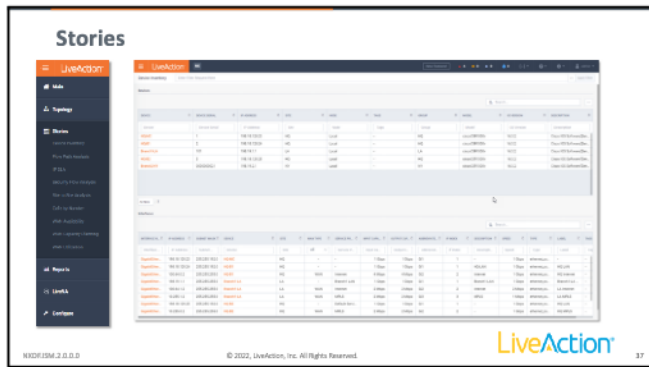
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### WebUI Reporting – Tools



Include Report Elements  
Copy URL to Clipboard  
Print/Download (opens new URL)  
Re open Run Report Dialog  
Return to Reports Entry Page

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### Report Groups



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### WebUI Reporting – Create & Groups of Reports

Schedule Group to run Now, Hourly, Daily, Weekly, or Monthly

Advanced Report Group can be emailed to one or multiple users

Advanced Reports allow the creation of groups of reports



Multiple Reports

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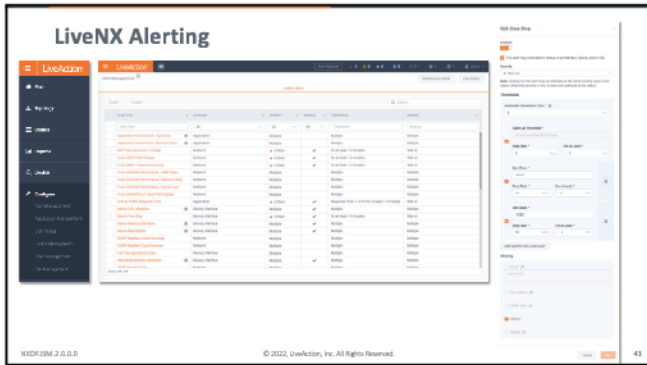
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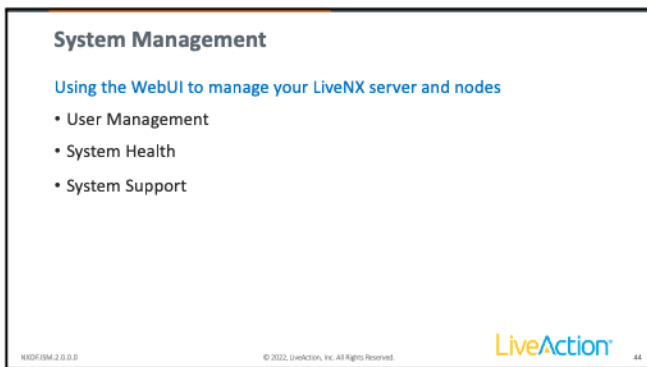
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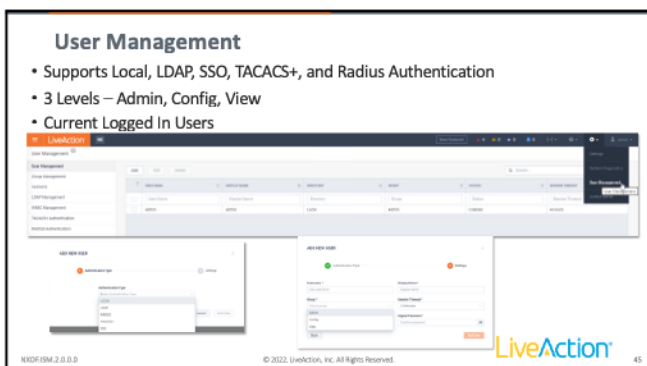
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## User Management

Local or LDAP

- Multiple Roles (privilege levels)
- LDAP Server configuration under LDAP Management tab
- See who is currently logged in and Active under the Sessions tab



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## User Groups

- User Groups can be used to segment, or limit, the access of users in the group
  - Specific Sites
  - Specific Devices
  - Specific Regions
- Select entity pages can also allowed/omitted
- Select Reports can be allowed/omitted
- Users can be added from the Group Config page
- Users can only be in ONE group

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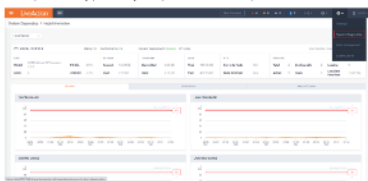
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## System Health

- Under the Settings gear choose System Diagnostics
- Here you can monitor many system health statistics for either the server or nodes:
  - CPU / Memory / Disk Space / Flow Statistics / Etc



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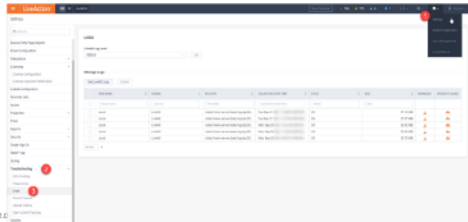
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## What to do when you need support

- Often the support team will ask for diagnostic information
- Under (1) Settings (top right), you will find (2) Troubleshooting in the Menu
- Here you can collect diagnostic information as well as (3) system logs



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## LAB 1: Using the Web UI

- View & Create Reports
- Look at Stories
- User Management
- View/Modify Alerts
- System Information



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## The LiveNX Engineering Console



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## The LiveNX Client is... Your Device Configuration Tool

- A Java client application
- Runs on a standard Windows 32/64-bit PC
  - LiveAction's Mac client runs on OSX .9+.
- View & Configure:
  - Devices (can access CLI and configure your devices)
  - Alerts
  - Reports

Visualization Philosophy: Shows all, remove what you don't need to see

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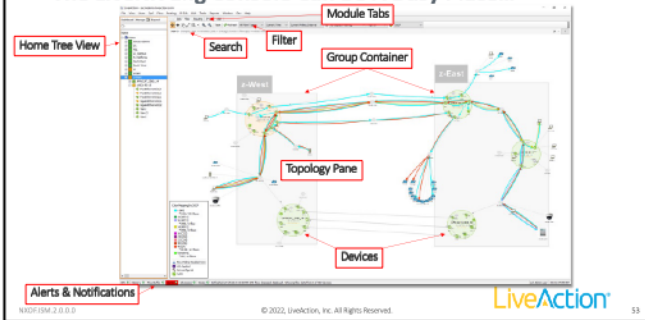
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## The LiveNX Eng Console Can Be A Busy Place...



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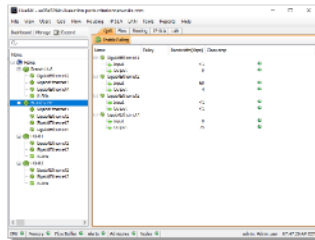
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## The Home Tree-view

- Groups
  - Devices
    - Interfaces
- Select Home to view all Groups/Devices in the Topology Pane
- Select & Modify Devices & Interfaces
- Right-click Zoom-to...



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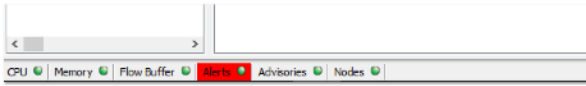
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## Immediate Feedback...

Look at the bottom of the screen for information about:

- CPU
- Memory
- Buffer
- Alerts
- Advisories
- Nodes



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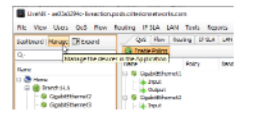
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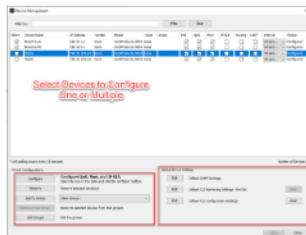
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## Main Configuration Tool

Click **Manage** to open **Device Management** window



We will use the **Configuration** capabilities extensively in the class



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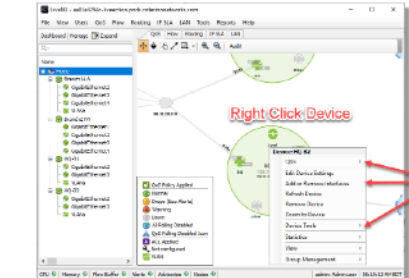
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## Configuration of Flow



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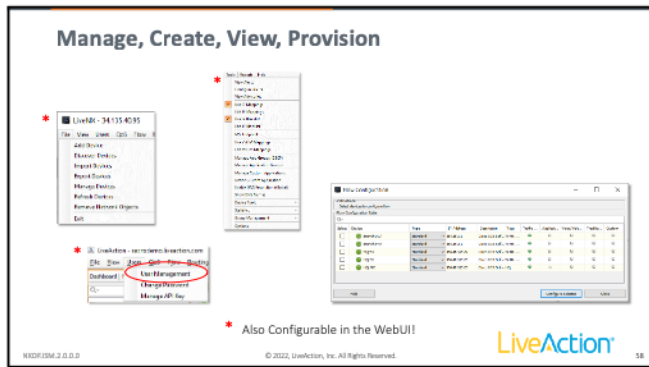
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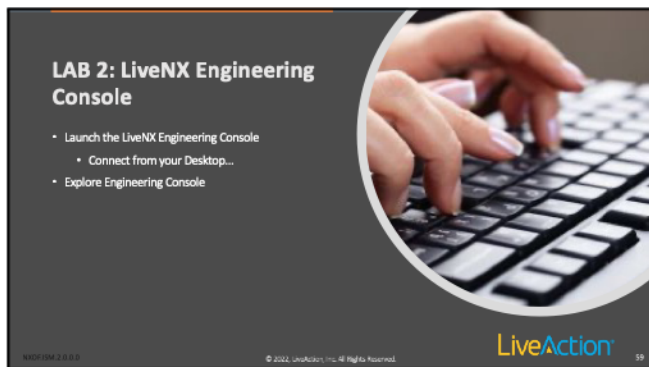
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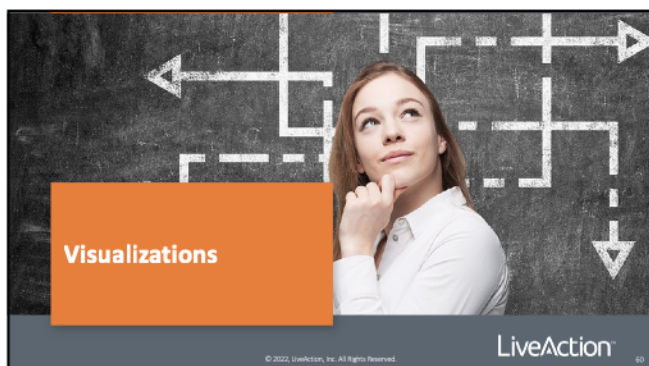
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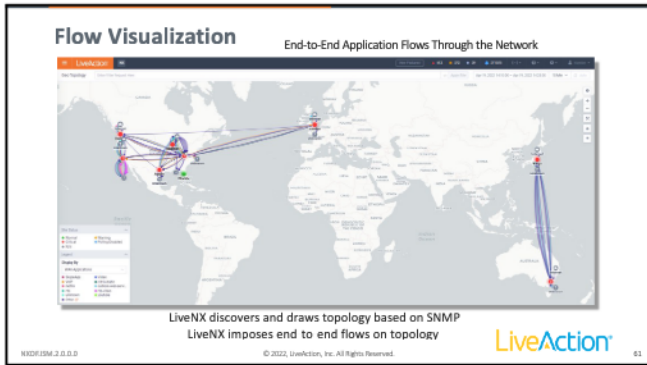
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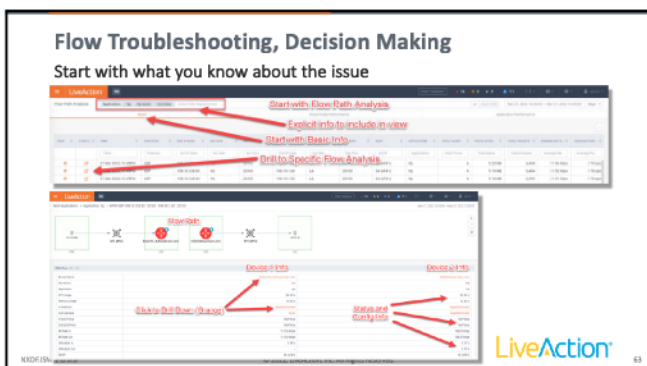
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### Eliminate the Detractors!

The screenshot shows a table with various columns. Red boxes highlight the 'Page Filters' section at the top, the 'Time Range' section on the right, and the 'Column Filters' section in the middle. The table contains data with various status indicators (green, yellow, red) and numerical values.

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### The Search Field

The screenshot shows the search field with a dropdown menu open, displaying filter options such as 'Site', 'Service Provider', 'Application', 'Tag', 'Device', 'Interface', 'Interface Type', and 'Region'. The search field is labeled 'Enter Filter Object and Value'.

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### Search Functions and Flex Search

The screenshot shows the search field with a dropdown menu open, displaying filter options such as 'Site', 'Service Provider', 'Application', 'Tag', 'Device', 'Interface', 'Interface Type', and 'Region'. The search field is labeled 'Enter Filter Object and Value'.

Create a simple page search, and convert to more powerful Flex-Search

- 1) Enter Page Filter Terms
- 2) Click </> to view the equivalent Flex-Search String

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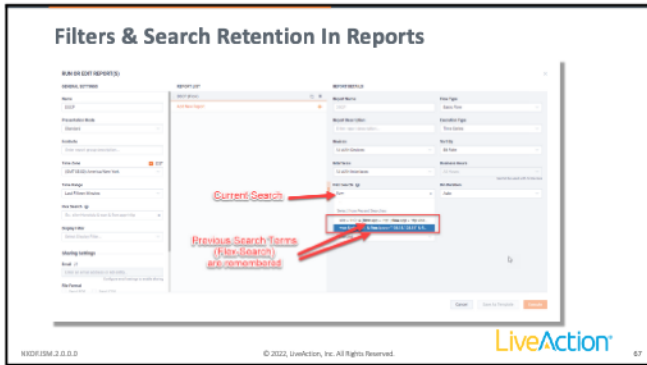
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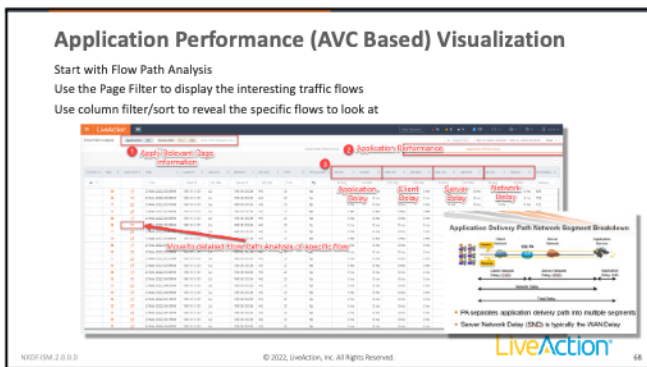
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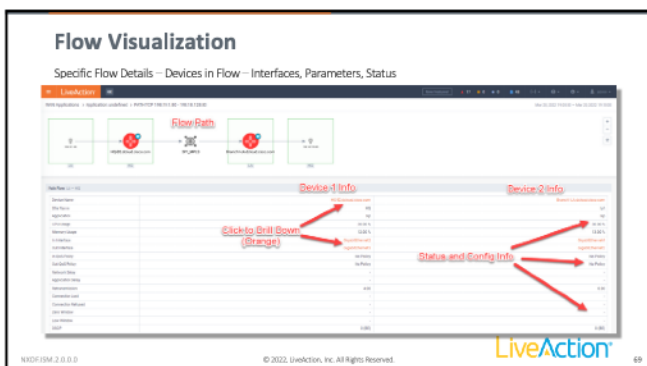
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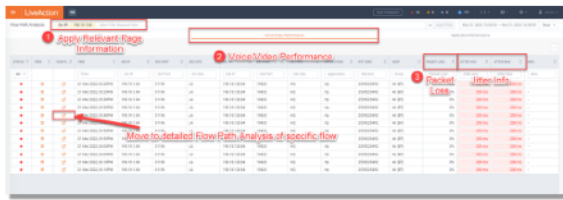
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## Voice/Video Performance (MediaNet Based) Visualization

Start with Flow Path Analysis (If no data – review the Page Information used)  
Use the Page Filter to display the interesting traffic flows  
Use column filter/sort to reveal the specific flows to look at



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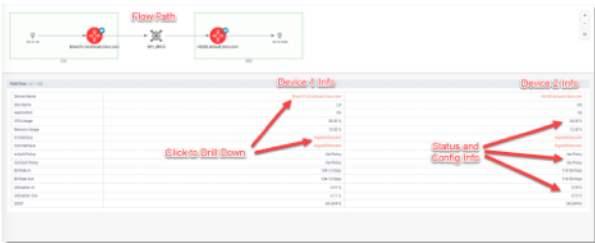
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## Flow Visualization

Specific Flow Details – Devices in Flow – Interfaces, Parameters, Status



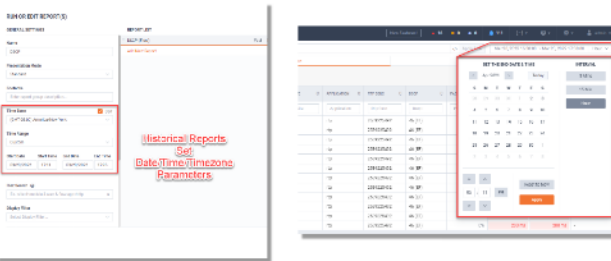
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## Flow History– Reports and Stories



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### LiveNX WebUI – Perspective

LiveNX through the WebUI acts as a framework to help you visually monitor and troubleshoot your network devices...

- Structured around three levels:
  - Sites (Level 1)
  - Devices (Level 2)
  - Interfaces (Level 3)
- You can view traffic as:
  - Site to Site
  - By Device
  - Flow – by DSCP, Application (or App Group), Source AND/OR Destination (site, IP, Port), Tag

Tags are your best friend – Let them support your work in LiveNX

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### Understanding LiveNX – Semantic Data

The information in LiveNX is structured in dependent layers – in the same way you will rely on these layers as you monitor and troubleshoot.

Each layer will use Tags, key words that accumulate similar items on the same layer.

Layers below inherit the tags from above.

Best Practice:  
Use S prefix for Site level tags, D for Device level tags, I for Interface Level tags.

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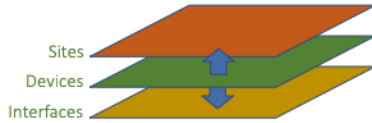
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## Adding Devices to LiveNX

- Adding Devices to LiveNX is more than adding devices. It involves making sure that Sites and Interfaces are configured too.
- By adding devices, we begin the process of adding semantic data, across the three layers within LiveNX.



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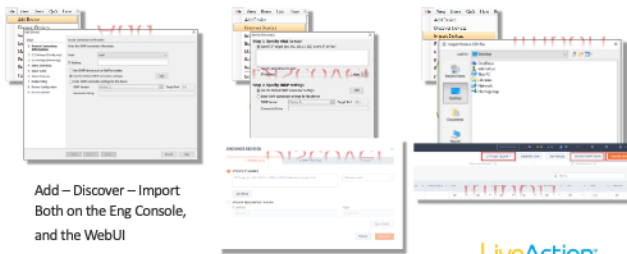
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## Device Management

LiveNX contains many “wizards” to guide you through the process...



Add – Discover – Import  
Both on the Eng Console,  
and the WebUI

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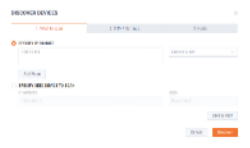
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## Device Discovery

Scan and find connected devices

- From within Device Management, under Configure
- Use an IP Address range
- SNMP settings & Credentials
- Is the collection Node Local or...
- Returns a dialog with suggested devices to add.



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## Device Discovery... Simple Steps

Allows you to Devices and Interfaces into LiveNX for gathering Flow data

The screenshot shows three overlapping windows from the LiveNX interface. The top window is titled 'Scan the Address/GUID'. The middle window is titled 'Results table - Only Devices' and shows a table with columns for IP, MAC, and Name. The bottom window is titled 'Select Interfaces' and shows a table with columns for Interface, IP, and MAC. The LiveNX logo is visible in the bottom right corner.

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## Working Topology – Device Needs Semantic Data

The screenshot shows the 'Working Topology' interface in LiveNX. A device configuration dialog is open, showing fields for Name, IP, MAC, and other details. A red arrow points to the 'Add/Create Semantic Data' button. Text on the screen says: 'Click on Device name to open config dialogue' and 'Adding a new site here creates that site for use later. You can also add sites in Site Management in Configure under Main Menu.' The LiveNX logo is visible in the bottom right corner.

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## Devices Belong to Sites – Adding Sites And Semantics

The screenshot shows the 'Adding Sites And Semantics' interface in LiveNX. It includes a 'Setting Up Sites' table and a 'Add Semantic Data' dialog. A red arrow points to the 'Add Semantic Data' button. Text on the screen says: 'Add Semantic Data - Greater Flexibility in monitoring Troubleshooting'. The LiveNX logo is visible in the bottom right corner.

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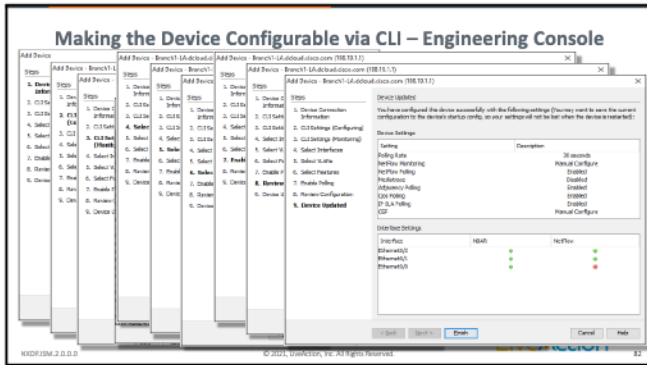
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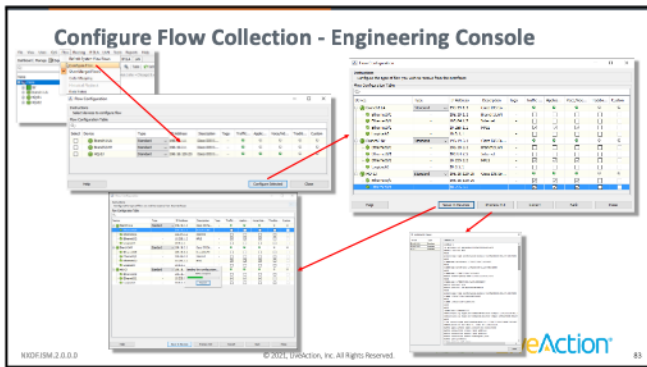
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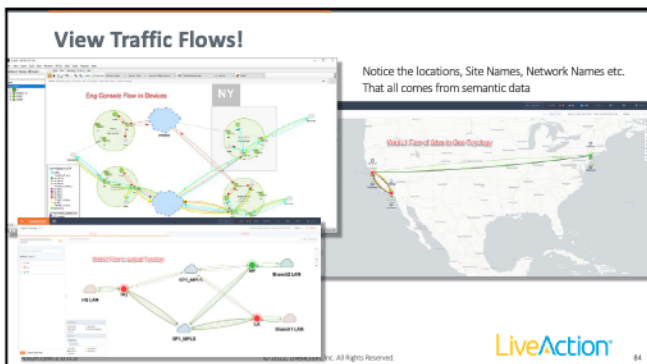
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## Topology Basics – Grouping in Engineering Console

\*Grouping only visually applied in LiveNX Eng Console (WebUI Uses Sites – You need to use BOTH)  
\*Sites and Groups can be configured in BOTH WebUI and Engineering Console.

Devices appear on the topology within their shaded groups.

Devices appear collapsed in their groups on the device tree.

Grouping makes device management easier!

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## Topology Basics

Devices reporting issues will change colors to prompt for investigation.

Quickly identify many problem sites visually

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## Merge Clouds\*

A "Merged" cloud is when you combine separate networks that logically form one cloud, i.e; MPLS

Once merged... flows will properly draw through the topology

\*Merge Clouds only applied in LiveNX Engineering Console

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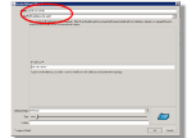
### Topology Basics – Add Network Object\*

Do it the EASY way!


**Step 1**  
Right-Click on Flow Endpoint



**Step 2**  
Select the Object Shape



**Step 3**  
Flows now connect



\*Merge Clouds only applied in LiveNX Engineering Console

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### LAB 3 & 4: Making the Topology Work

- Add additional device(s)
- Enable / Configure Flow collection
- Remove an Interface
- Device Semantics
- Creating / Modify Groups
- Merge Clouds
- Network Objects



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### Reports & Alerts

Using LiveNX WebUI



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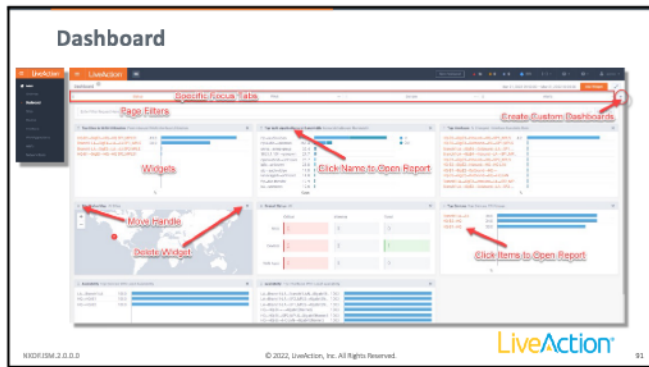
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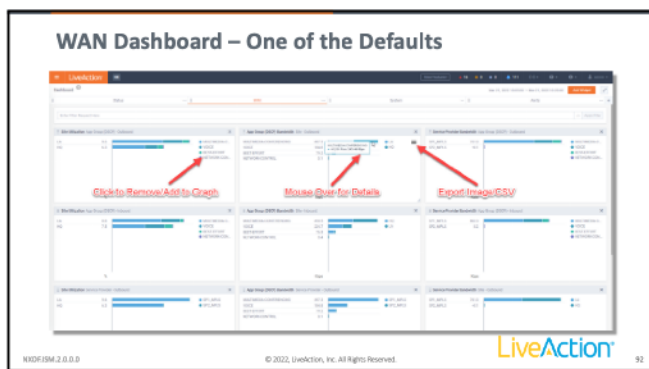
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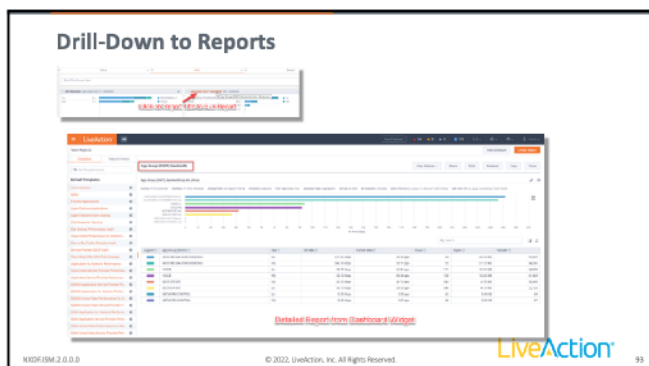
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## Creating Reports

### Multiple Roads Lead to Reports

From Navigation Menu

From Any Dashboard Item

Drill Down From Entity Pages

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## Creating a Report

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## Flow Report - Directionality

Data Volumes can be viewed by ingress, egress, both on one chart, or combined (single number). You can choose between how the data is presented in reports

Configured in Report Settings

Inbound and Outbound Separated

Inbound and Outbound Combined

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### Automatic Granularity - Report Length / Data Bin

- Granularity is on Flow Data
- Flow Reports are generated from the RAW Store
- Raw Flow Store
  - Short time-range (un-aggregated) or 1 min Bin
- Long-Term Flow Store
  - Longer time-range (aggregated) or 5 min Bin

Bin Size can be selected – Beware!

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### Long Term Data Storage

How is Long Term Store populated?

The Flow Source configuration alters what devices/interfaces are included for Long Term Report Processing.

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### Commonly Used Reports

<ul style="list-style-type: none"> <li>Application (Flow)</li> <li>Top Conversations (Flow)</li> <li>Interface Bandwidth (Flow)</li> <li>DSCP (Flow)</li> <li>Application DSCP Audit (Flow)</li> </ul>	<ul style="list-style-type: none"> <li>Top Interface Bandwidths (SNMP)</li> <li>Interface Bandwidth (SNMP)</li> <li>Interface Utilization (SNMP)</li> <li>Interface Errors (SNMP)</li> <li>Top Class Drops (SNMP)</li> </ul>
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Different data sources will provide different perspectives of your network

They can also give you different counts for what might look like the same number

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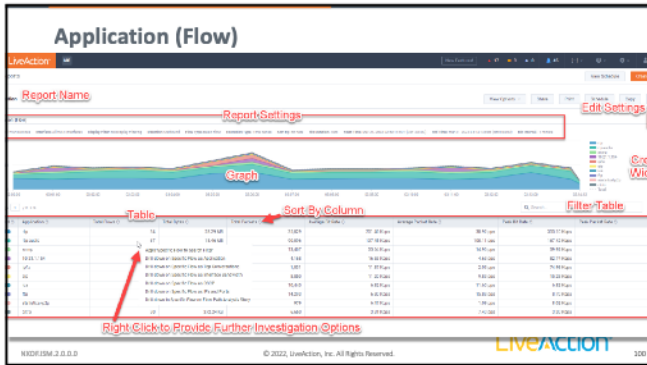
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# LiveNX Training Student Guide



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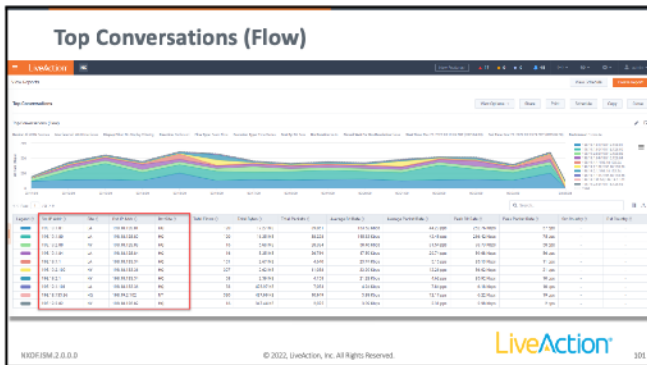
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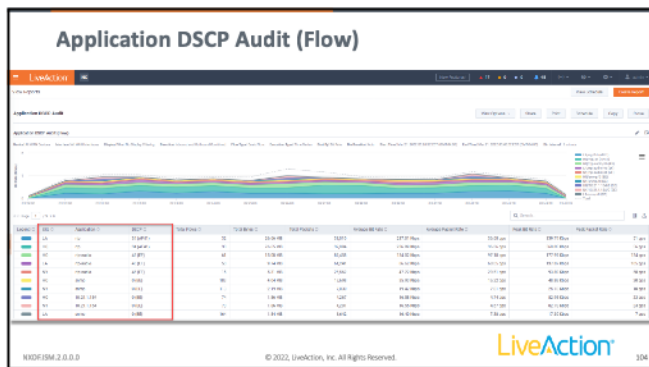
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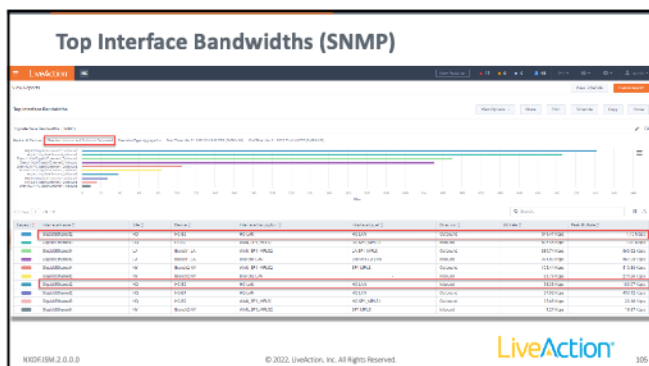
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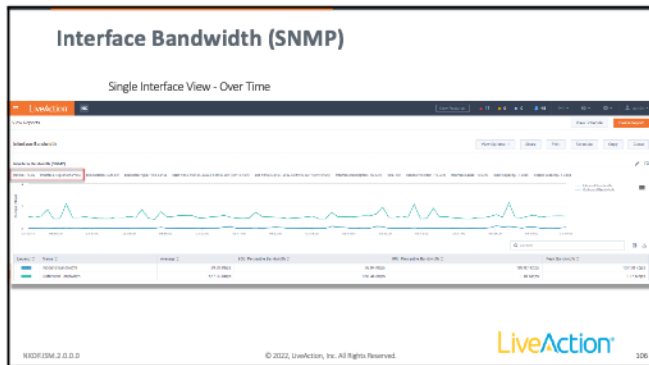
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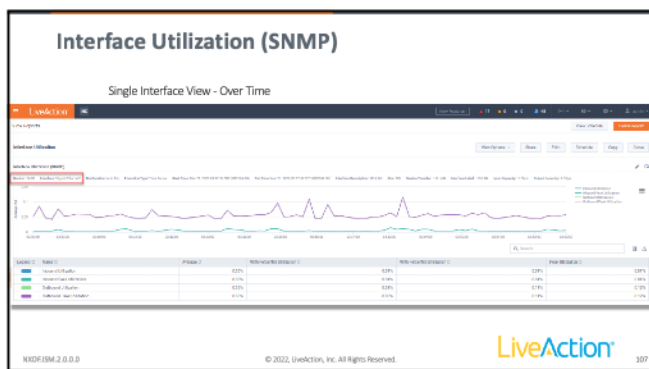
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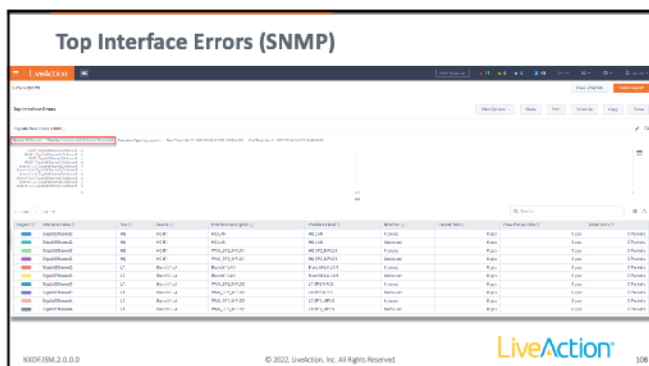
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## Flow Collection

- The industry standard for flow type is "IPFIX"
  - Cisco uses sflow for certain device types, such as Nexus 5k Switch
- Netflow is a brand name for Cisco Flow
  - Like Jaguar is a brand name for an automobile
- Juniper uses a flow type called "jflow"
- LiveNX can ingest most types of flow technology
- If a Flow Export is v5, v9, or IPFIX LiveNX can gather that information!

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## Configure NetFlow Monitoring (LiveNX Engineering Console)

- Two types of Cisco Netflow – Traditional and Flexible
  - Traditional - an older flow type that uses a set record that cannot be configured
  - Flexible - newer flow type that allows for more granular record configuration
- Traditional Netflow should only be used if Flexible is not available!
  - LiveNX can discover what type of Netflow is supported and configure it for you!
  - LiveNX will not let you configure both Traditional and Flexible on the same interface

Index	Name	Type	IP Source	Destination	Type	Flow-Counter Type	Session-Table Type	Flow-Table Type	Status
1	Flow-1	Traditional	10.10.10.1	10.10.10.2	IPFIX	IPFIX	IPFIX	IPFIX	OK
2	Flow-2	Flexible	10.10.10.1	10.10.10.2	IPFIX	IPFIX	IPFIX	IPFIX	OK
3	Flow-3	Flexible	10.10.10.1	10.10.10.2	IPFIX	IPFIX	IPFIX	IPFIX	OK
4	Flow-4	Flexible	10.10.10.1	10.10.10.2	IPFIX	IPFIX	IPFIX	IPFIX	OK

Remember: Configuration of devices is achieved through Engineering Console – or other configuration tools!

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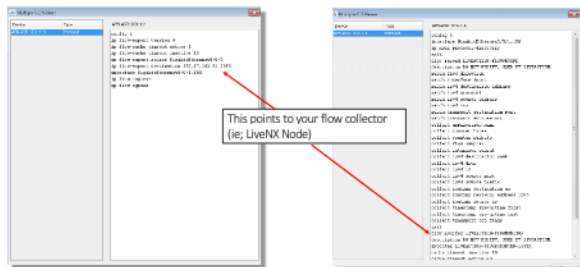
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## Traditional v. Flexible Netflow - Preview CLI



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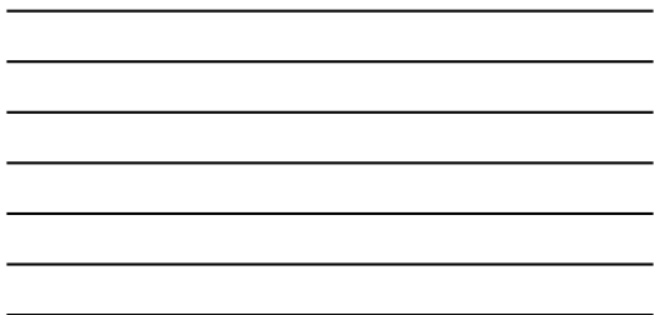
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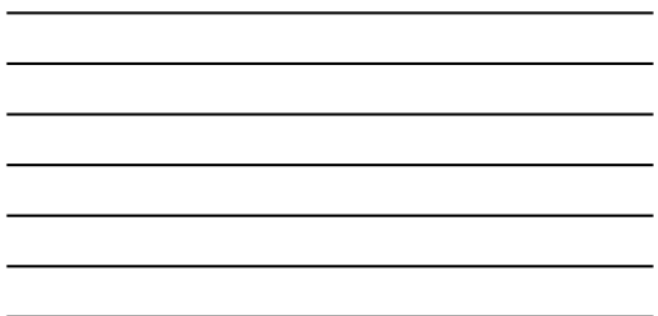
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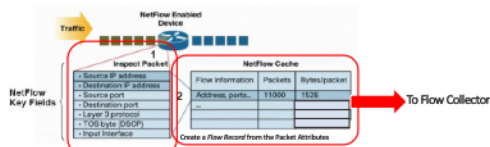


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## NetFlow Collects Statistics on Packets as they pass...



1. A flow is unidirectional
2. Defined by inspecting a packet's **key fields** (common properties) and identifying the values
3. If the set of key field values is unique, create a flow record or cache entry

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## Netflow

By analyzing the data across interfaces and exporting the Netflow data to LiveAction, a network administrator can determine:

- Traffic source and destination
  - Class of service
  - Protocol
  - Ports
  - etc...
- per device.



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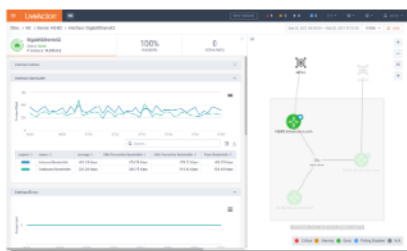
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## Netflow Interface View



View quantity & type of traffic traversing a specific interface

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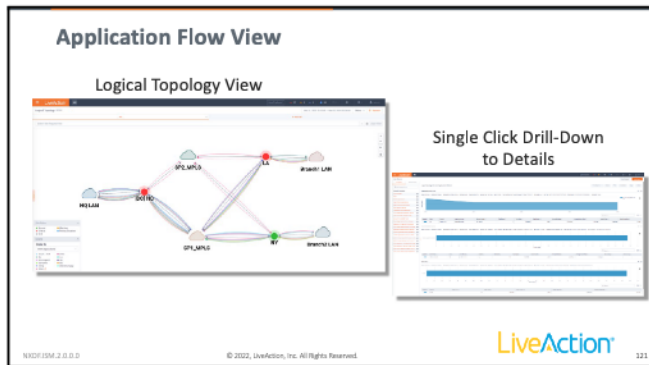
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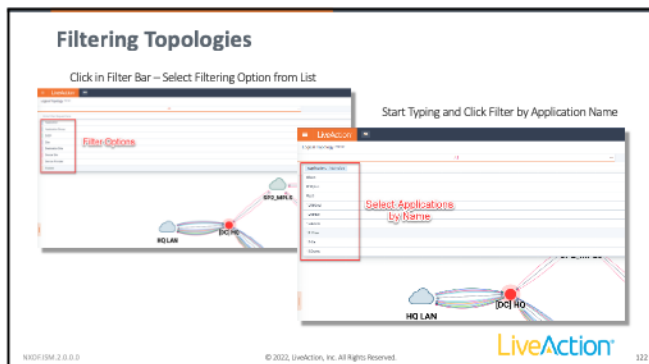
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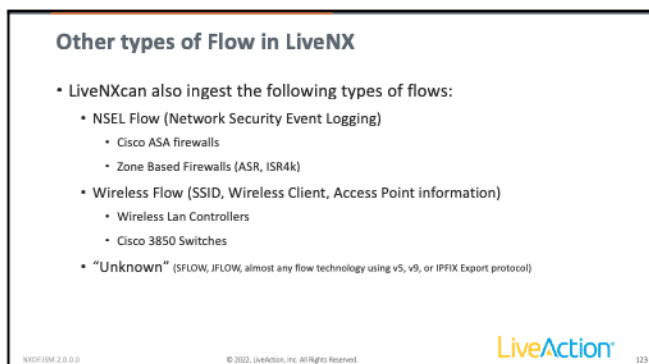
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## Netflow Performance Monitors; AVC & Medianet

- AVC and Medianet use a Netflow Performance Engine that captures advanced metrics about a flow
- AVC (Application Visibility and Control) is Application Response Time (ART) for TCP applications
  - LiveNX leverages AVC to assist users with troubleshooting TCP performance in the network such as application delay, application response time, and network delay.
- Medianet is a Media Monitoring (MMON) engine that collects voice and video performance parameters, such as jitter and loss, in a network
  - LiveNX leverages Medianet to assist users with understanding RTP (Video, Teleconference, VOIP) Performance

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## Netflow Performance Monitors; AVC and Medianet

- AVC \* and Medianet \* are available on:
  - Cisco Integrated Services Routers Generation 2 (ISR G2)
  - Cisco ASR 1000 Series Aggregation Service Routers (ASR 1000s)
  - Cisco ISR 4k routers.
  - Cisco Wireless LAN Controllers
- LiveNX's AVC and Medianet Templates may be pushed to supported devices through its' GUI

\* Separate License Purchase From Cisco

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## Network Based Application Recognition (NBAR2)

- NBAR2 uses the Service Control Engine (SCE) with advanced classification techniques called PDLs (Packet Description Language Modules). This engine inspects packets through the actual payload of the traffic.
  - Much more accurate classification of traffic rather than only based-upon IP and port number
- NBAR2 is Cisco's standard cross platform protocol classification mechanism.
  - supports <1400 application and sub application definitions.
- Cisco updates NBAR2 protocol packs regularly to match new application definitions.
  - LiveNX recommends updating protocol packs as they come out.
- [http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/QoS\\_nbar/prot\\_lhb/config\\_library/nbar-prot-pack-library.html](http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/QoS_nbar/prot_lhb/config_library/nbar-prot-pack-library.html)

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- For example, Most web traffic is HTTP
- IANA Port for HTTP is 80
- NBAR2 can still define the Application

- [illegible]

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[illegible][illegible]

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[illegible]

**Define Custom Application**

Name:

Description:

IP Address:

Port:  Layer 4 Protocol:

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[illegible]

## Using Flows for QoS

- Quality of Service (QoS) refers to the capability of a network to prioritize provide better service to selected network traffic over various applications
- Without QoS policies, each packet is given equal access to network resources.
  - For example, Voice and Video applications are delay and jitter sensitive. If a FTP transfer and a Voice transfer are both being processed through the same interface at the same time, then the Voice transfer could have to wait until the FTP packets are processed. This could result in dropped voice packets and complaints by the those utilizing the voice application.
- Using QoS a network administrator could prioritize those Voice packets over the FTP packets, ensuring good quality for those utilizing the Voice application.

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## Differentiated Service Control Point (DSCP)

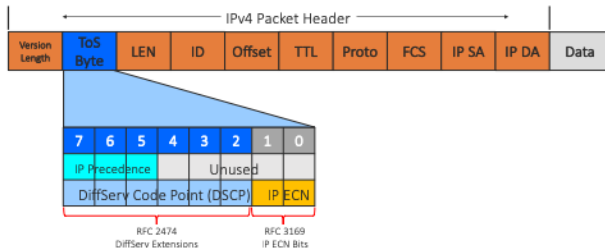
- Depending on your network, you would define which traffic needs priority, then mark the traffic with the correct DSCP values.
- These values may then be used to give priority to traffic throughout the network, specifying **Per-Hop-Behaviour**.

Application	PHB	DSCP	RTT
Network Control	CS6	48	RFC 2474
VoIP Telephony	EF	46	RFC 2474
Broadcast Video	CS5	40	RFC 2474
Multimedia Conferencing	AF41	36	RFC 2597
Real Time Interactive	CS4	32	RFC 2474
Multimedia Streaming	AF31	26	RFC 2597
Call Signaling	CS3	24	RFC 2474
Low Latency Data	AF21	18	RFC 2597
OWM	CS2	16	RFC 2474
High Throughput Data	AF11	10	RFC 2597
Best Effort	DF	0	RFC 2474
Low Priority Data	CS1	8	RFC 2474

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## Packets & DSCP Markings

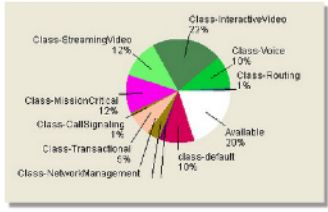


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### QoS Techniques

- After setting DSCP Markings in your network you can easily conform the traffic to your network needs with:
  - Queuing
  - Shaping
  - Policing



Class	Percentage
Class-StreamingVideo	12%
Class-MissionCritical	12%
Class-CallSignaling	1%
Class-Transactional	5%
Class-NetworkManagement	5%
Class-InteractiveVideo	23%
Class-Voice	10%
Class-Routing	1%
Available	20%
class-default	10%

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### LAB 6 & 7: Working With Flow and Customizing Filters

- Discover Flows
- Identify Flows
- Create Custom Filters



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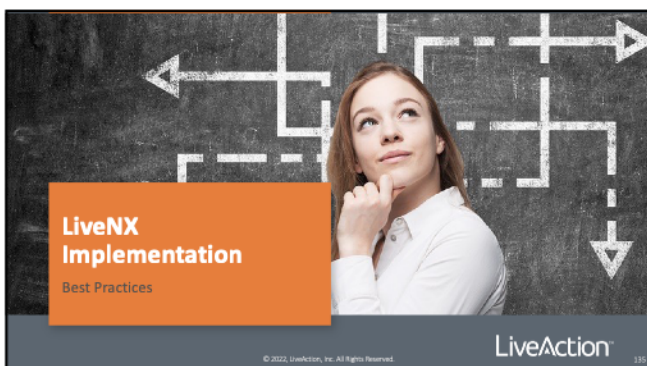
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### LiveNX Implementation

Best Practices

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## System Requirements

<http://www.liveaction.com/support/specifications/>

- Server Platform Specifications:
  - VMware ESXi v5.0 or higher – VMware Hardware Version 8 (vmx-8)
- Network Hardware – At least two Physical NICs on ESXi
  - Support up to 10 Gbps
  - Virtual NICs on OVA are utilizing E100

Proof Of Concept (POC)	Small Deployment	Medium Deployment	Large Deployment	Physical Deployment
<= 25 Devices or <= 25k Flows/sec.	<= 100 Devices or <= 50k Flows/sec.	100-500 Devices or <= 100k Flows/sec.	500-1000 Devices or <= 150k Flows/sec.	Upto 1000 Devices or <= 500k Flows/sec.
Min Requirements: • 8 vCPU Xeon or 17 • 16 Gb RAM • Max Heap Size 8GB • 500GB Data Disk	Min Requirements: • 16 vCPU Xeon or 17 • 32 Gb RAM • Max Heap Size 16GB • 2TB Data Disk	Min Requirements: • 16 vCPU Xeon or 17 • 64 Gb RAM • Max Heap Size 31GB • 4TB Data Disk	Min Requirements: • 32 vCPU Xeon or 17 • 64 Gb RAM • Max Heap Size 31GB • 8TB Data Disk	Min Requirements: • 64 vCPU Xeon Gold 5218 • 768 Gb RAM • Max Heap Size 384GB • 32TB Data Disk (16TB usable with RAID 10)

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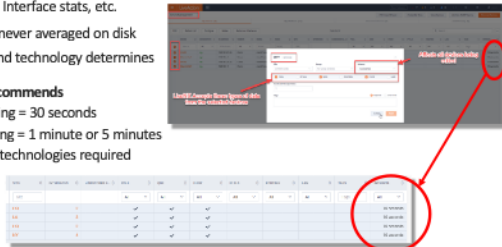
## Disk Sizing- SNMP

### SNMP

- QoS, IPSLA, Interface stats, etc.
- Raw data - never averaged on disk
- Poll rates and technology determines utilization

### LiveAction Recommends

- Router polling = 30 seconds
- Switch polling = 1 minute or 5 minutes
- Poll fewest technologies required



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## Disk Sizing

### SNMP

- QoS, IPSLA, Interface, etc. stats
- Raw data - never averaged on disk
- Poll rates and technology determines utilization

### Short Term Flow = 90% of storage

- Raw data - never averaged on disk
- Flow/ Sec determines utilization
- Long Term Flow
- 5 minute averaged on disk
- Capacity Planning data
- WAN data is default data sent here

Drive Recommendations
o Local drive preferred
Minimum equivalent to SATA 6 Gb/s performance
20000 IOPS or 10000 IOPS for better performance
RAID 10 for better performance
SSD for better performance
o SAN and NAS
Most performance and latency specification of local drive
Support sustained writes at high speed
Support sequential reads at high speed for sequential blocks

We typically see:  
1 year SNMP + Long-Term Flow  
<=  
1 Month of Short-Term Flow

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## Disk Sizing

### SNMP

Each LiveNX node supports ~76TB disk space. Recommended way is to add each disk of 10TB

Number of Devices	100	200	500	2000
SNMP/Month	23 - 45GB	56 - 113GB	112 - 225GB	225 - 450GB

Full rates and technology determines utilization - This is assuming 25% of devices are 30 Second Poll/ 75% 60 Second Poll

### Short Term Flow

Flow Type Rate, B/Sec/sec	< 250/sec	< 1000/sec	< 2000/sec	< 8000/sec
Short Term Flow/Month	75TB	375	675	375

### Long Term Flow

Flow Type Rate, B/Sec/sec	< 250/sec	< 1000/sec	< 2000/sec	< 8000/sec
Long Term Flow/Month	75B	300B	600B	300B

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## NetFlow Bandwidth Overhead – Someone ALWAYS Asks!

Device Type	Flows/Sec	Full Duplex User Bandwidth (in Gbps)	NetFlow Bandwidth Average	NetFlow Bandwidth Peak
WAN Router	63	156-308Mbps	28Kbps (1%)	54.8Kbps (4%)
WAN Router	34	503K-1.1MMbps	16Kbps (0%)	42.4Kbps (3%)
WAN Router	27	820K-2.0Mbps	28Kbps (2%)	39Kbps (2%)
WAN Router	337	121-38Mbps	80Kbps (04%)	137Kbps (10%)
WAN Router	365	131-22Mbps	163Kbps (14%)	235Kbps (10%)
WAN Router	474	180-123Mbps	280Kbps (10%)	394Kbps (10%)
Internet Router	593	175-113Mbps	317Kbps (14%)	438Kbps (10%)
Core Switch	633	1140-122Mbps	470Kbps (10%)	578Kbps (10%)
Core WAN Router	212000	14.4-20Mbps	134Mbps (10%)	126Mbps (10%)

Bandwidth	<768Kbps	1.544Mbps	3Mbps	10Mbps or higher
Overhead	3%	2%	1%	<.5%

Note: the percentages represent the percent of bandwidth utilized by Flow compared to rest of the end-user bandwidth. Each of these examples has Flow configured bi-directionally on only the WAN interface.

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## Disk Retention

Settings > Data Store Management > Nodes Data Store:

Admin can set:

- Data Retention policy
- Manual Purge
- Backup
- Mounting

Disk full = Automatic Purging

Provision Enough Disk Space!

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# LiveNX Training Student Guide

### Search – Data Bin

- LiveAction stores all data in the raw in the short term database
- LiveAction stores all data in the long term database with 5 minute average
- 1 minute bin < 1 hours search
- 5 minute bin >= 1 hours search

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### Device Semantics...

Have a plan for Semantic Data  
Create a three-tier model

Verify Consistency

Apply Site Device Interface (three-tier model)

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### NetFlow Best Practices

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## NetFlow Best Practices

- Use LiveAction to deploy NetFlow
- Use Flexible NetFlow when possible\*
- Use NBAR2 and standardized on Protocol Pack
- Use NetFlow v9 or IPFIX
- Enable Flow on the fewest interfaces possible
- Medianet and AVC on WAN interfaces only for routers
- Use good IOS for Medianet and AVC

\*with good/modern IOS

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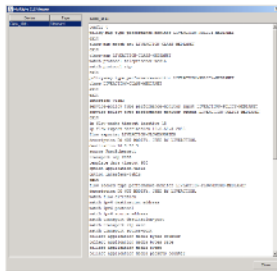
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## NetFlow – Configuration Management



Use Best Practice NetFlow templates built into LiveAction

Note: LiveAction Support has configuration guides for enabling flow for platforms that may not be part of this configuration wizard.

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## NetFlow – Flexible NetFlow

Application/NBAR2 Data

Flow ID	Flow Type	Flow Count	Flow Size	Flow Duration	Flow Start Time	Flow End Time	Flow Duration (ms)	Flow Count (per second)	Flow Size (bytes)	Flow Duration (seconds)	Flow Count (per minute)	Flow Size (bytes)	Flow Duration (minutes)	Flow Count (per hour)	Flow Size (bytes)	Flow Duration (hours)	Flow Count (per day)	Flow Size (bytes)	Flow Duration (days)
1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001
1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002
1003	1003	1003	1003	1003	1003	1003	1003	1003	1003	1003	1003	1003	1003	1003	1003	1003	1003	1003	1003
1004	1004	1004	1004	1004	1004	1004	1004	1004	1004	1004	1004	1004	1004	1004	1004	1004	1004	1004	1004
1005	1005	1005	1005	1005	1005	1005	1005	1005	1005	1005	1005	1005	1005	1005	1005	1005	1005	1005	1005
1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006	1006
1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007
1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
1009	1009	1009	1009	1009	1009	1009	1009	1009	1009	1009	1009	1009	1009	1009	1009	1009	1009	1009	1009
1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010

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## NetFlow – NBAR2

audio-over-http internet-audio-streaming internet-video-streaming skype msn-messenger netflix linkedin pandora rhapsody dropbox call-of-duty twitter youtube facebook espn-browsing espn-video skydrive salesforce wikipedia http hulu instagram yahoo-mail	apple-app-store apple-ios-updates apple-services mac-os-x-updates itunes itunes-audio itunes-video facetime	gmail google-docs google-earth google-play google-plus google-services gtalk gtalk-video gtalk-voip gtalk-chat	cisco-jabber-audio cisco-jabber-control cisco-jabber-im cisco-phone cisco-phone-audio h323 mgcp ms-lync ms-lync-audio ms-lync-video rtsp sip skinny telepresence-control webex-media webex-meeting webex-app-sharing
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This is a sample of the applications found on a LiveAction Customer's Network via NBAR2

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## NetFlow – NetFlow v9 or IPFIX

- IPFIX = IP Flow Information Export
- You can think of IPFIX as IETF Standard NetFlow v10
- NetFlow v9 and IPFIX are template based – Allows extensions for inserting extra data into the Flow records
- IPFIX allows for more fields and that can be variable in length
- IPFIX allows a vendor proprietary information

Example IPFIX variable fields:

URL	URI
thumbnails.huluim.com	827:2 ads:2 248:3 829:2 pixeltr=1608579339;fp=0;fpa=P0-322201277-1287906563231;ns=0;url=http%3A%2F%2Fw.2 quant.swf:2 981:3 crossdomain.xml:3 913:2 914:2 461:2 cgi-bin:6 915:3 ad:2 462:2 adedge:2 839:2 quant.jp:2 spt:3 761:2 notice.do:2 _vti_bin:2 jaction:2 images:10 pixeltr=1382204851;fp=0;fpa=P0-322201277-1287906563231;ns=0;url=http%3A%2F%2Fw.2 features:4 shows:6 adServer:2 captions.xml:3 pagead:9 499:3 live-streams:2 b:3
us.bc.yahoo.com	B:1

NetFlow v9 - RFC3954  
IPFIX - RFC5101

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## NetFlow – Where to Enable Flow?

**The Fewest Interfaces Possible!**

**Why?**

- Most Efficient
- Lowers CPU, bandwidth consumption, disk space

**Routers**

- Usually WAN Interfaces Only

**Switches**

- Watch CPU if lots of interfaces are enabled with Flow
- If switch only supports ingress Flow, use fewest interfaces that provides required visibility
- If switch support ingress/egress Flow, typically only uplinks required

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## NetFlow – AVC/Medianet

- AVC/Medianet enabled on fewest interfaces possible
  - Enable only on WAN interfaces for routers
  - L2/L3 uplinks only on switches
- Modify Interesting traffic class-maps where applicable
  - class-map match-any LIVEACTION CLASS-AVC
  - match access-group name LIVEACTION-ACL-AVC
  - class-map match-any LIVEACTION-CLASS-MEDIANET
  - match protocol rtp
  - match protocol telepresence-media

Note: LiveAction Support can provide additional details and IOS data.

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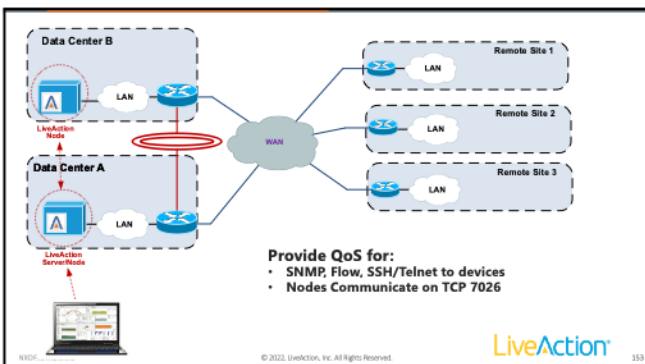
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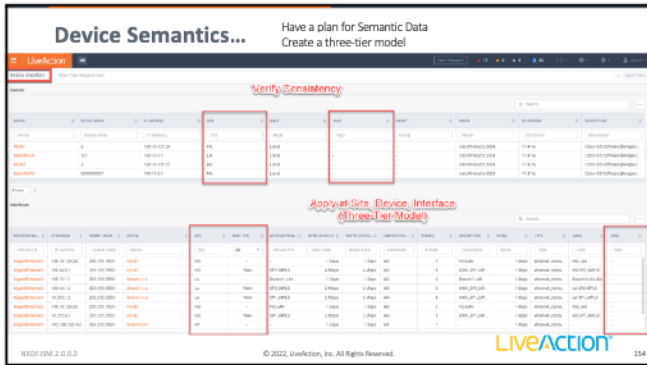
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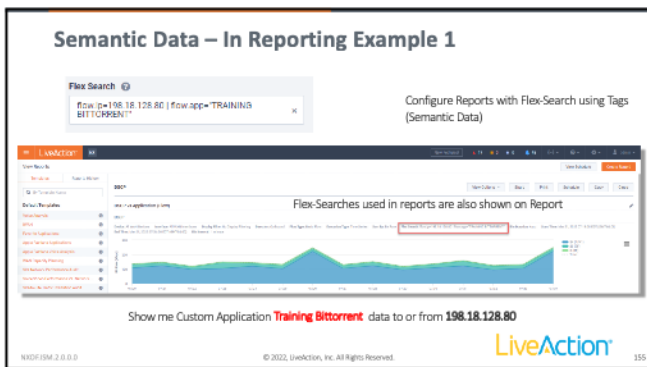
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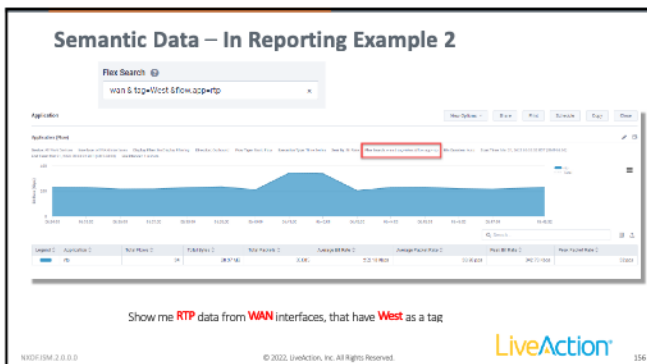
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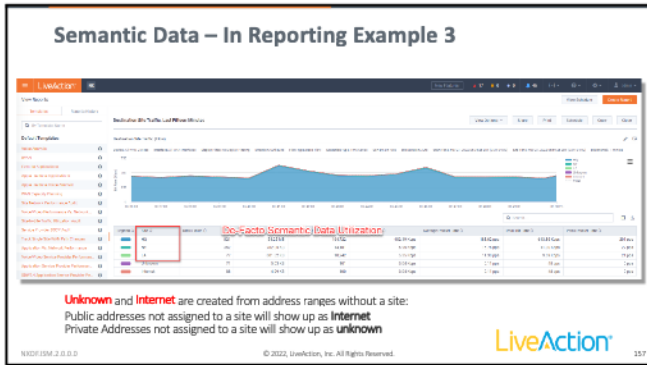
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### Semantic Data - Sites

- Descriptors of the Site
- Tags
- Data Center
- IP Address Ranges
- Geographical Location (Region, Country, City, etc)

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## Agenda - Day 2

- Quality of Service
  - Concept Overview
  - Classification & Marking
  - Queueing & Shaping
  - Policing & WRED
  - Buffer Tuning
- QoS Best Practices
- LiveAction SD-WAN
  - Cisco/Viptela SDWAN Overview
  - LiveNX – SDWAN Integration Overview
  - Day 0: Cisco SD WAN Planning for Deployment
    - LiveNX - SDWAN Onboarding
  - Day 1: Cisco SD WAN Policy Validation and Intent
  - Day 2: Cisco SD WAN Operations

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## Agenda - Day 2

- Quality of Service
  - Concept Overview
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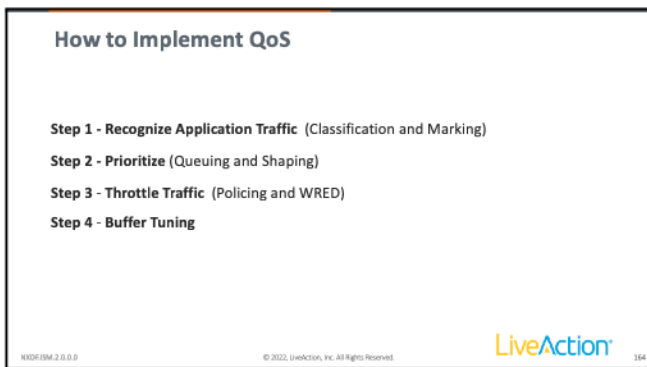
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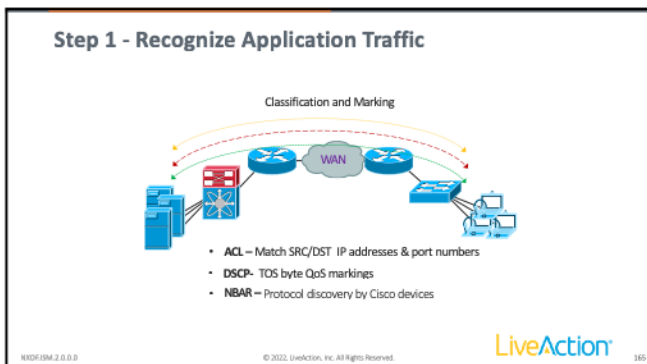
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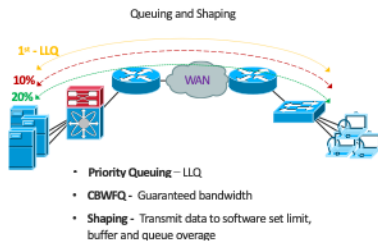
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### Step 2 – Prioritize



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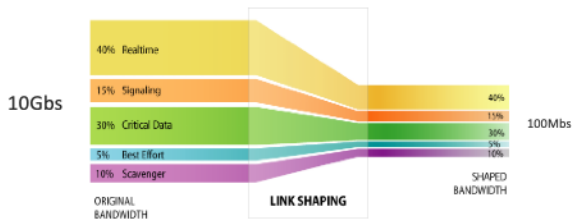
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### Shaping (or Scaling)



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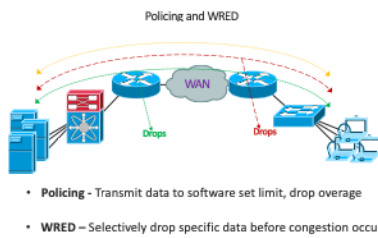
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### Step 3 –Throttle Traffic



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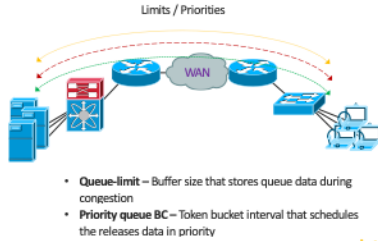
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#### Step 4-Buffer Tuning (advanced)



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#### LiveNX QoS Baseline

- Configuring QoS Control on the network is very important, but if you do not have a good understanding of your current network traffic... implementing QoS *could* cause issues.
- You can baseline your network performance with NBAR2 reports or Netflow reports *before* implementing QoS Control
- Baselining allows you to see current traffic trends and understand if your policy will meet your network needs.

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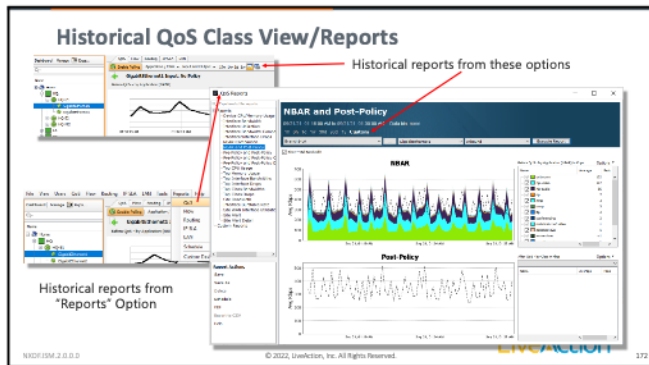
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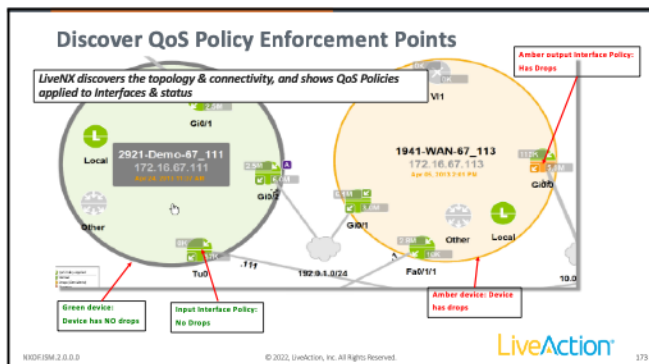
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## QoS ACL

- What is an ACL (access control list)?
- In the Cisco IOS, an access control list is a record that can be used to identify traffic, which can even be used to manage traffic.
- After identifying that traffic, an administrator can specify various actions that can happen to that traffic.
- You can use an ACL as a packet sniffer to list packets that meet a certain requirement. For example, if there is specific traffic on your network that you want to match for a QoS policy, you can use an ACL to identify that traffic to better control it

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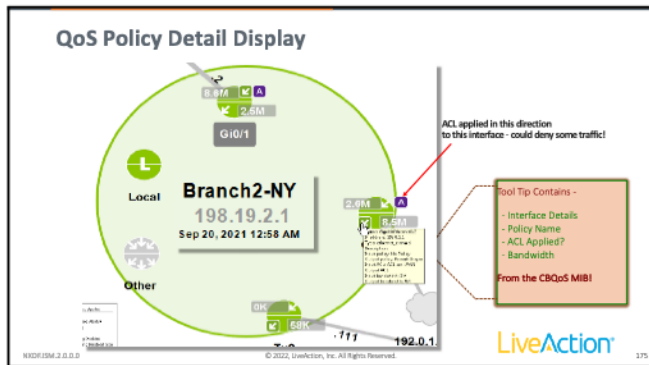
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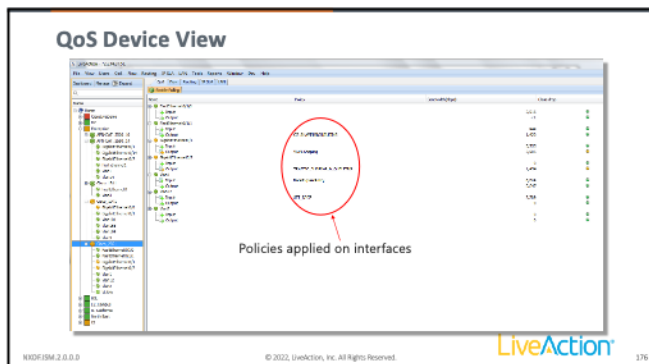
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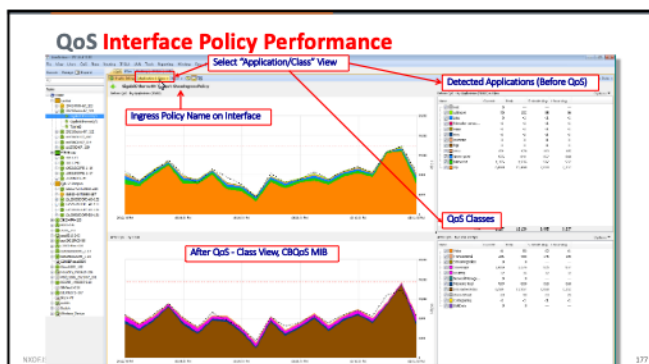
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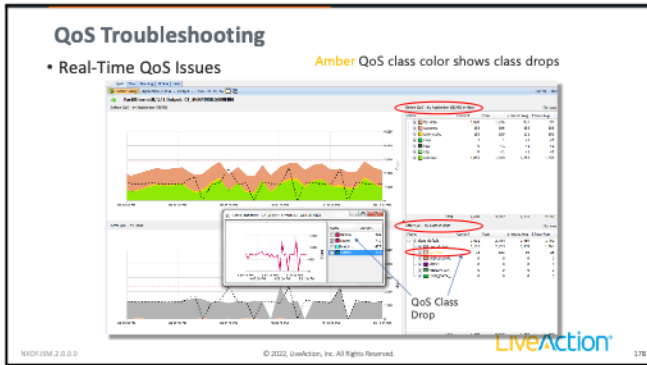
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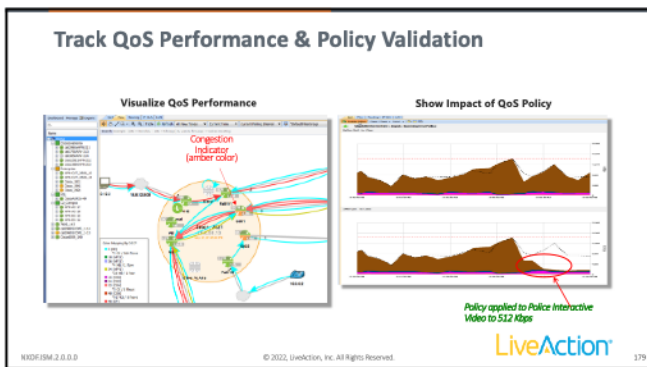
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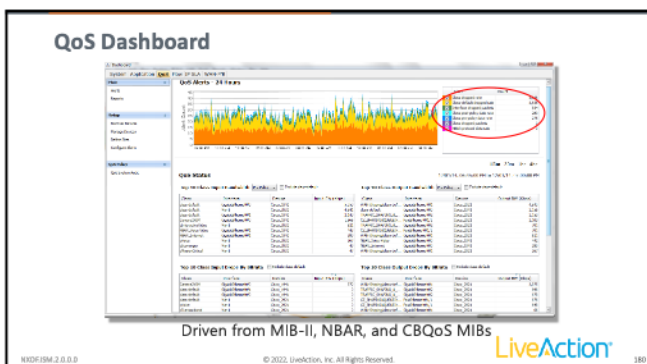
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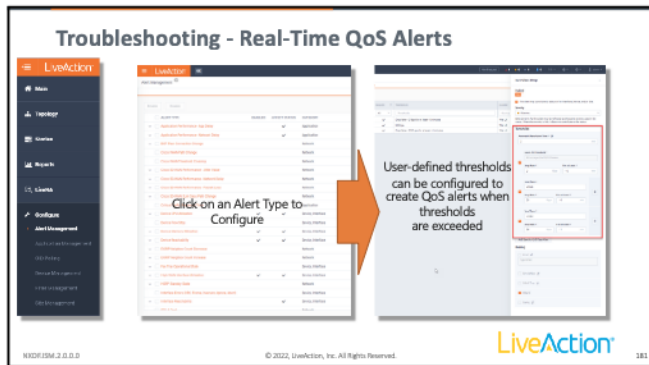
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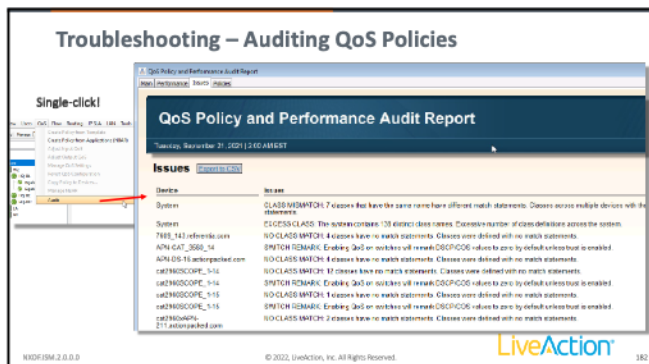
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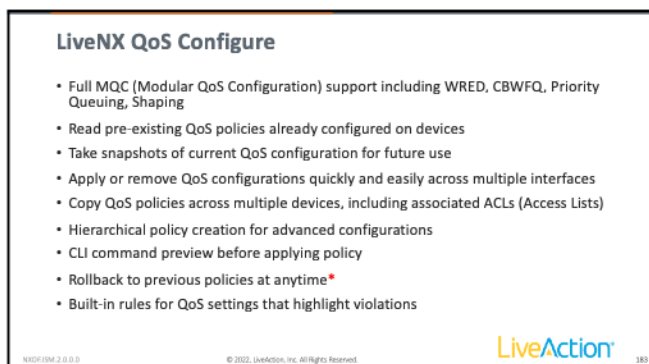
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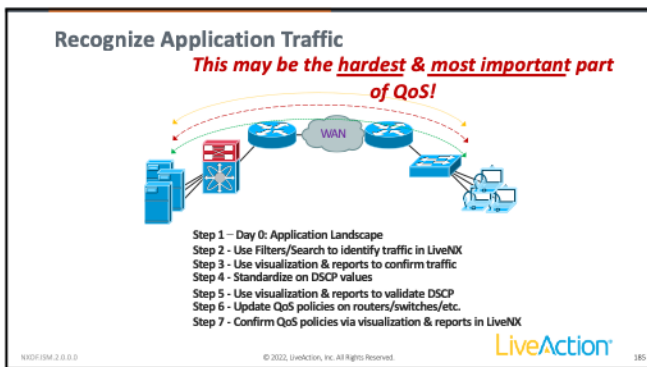
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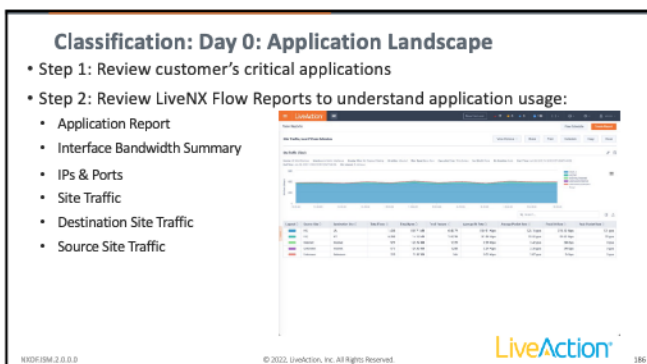
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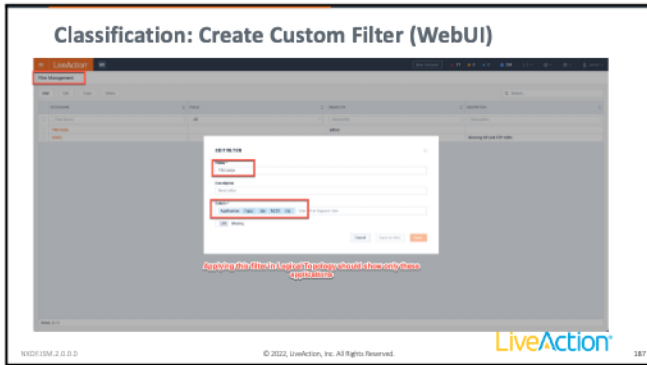
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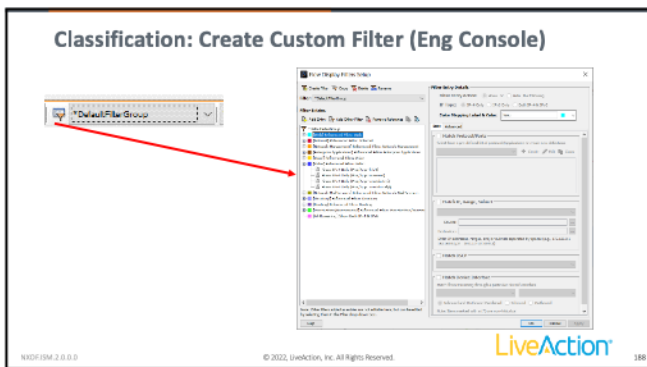
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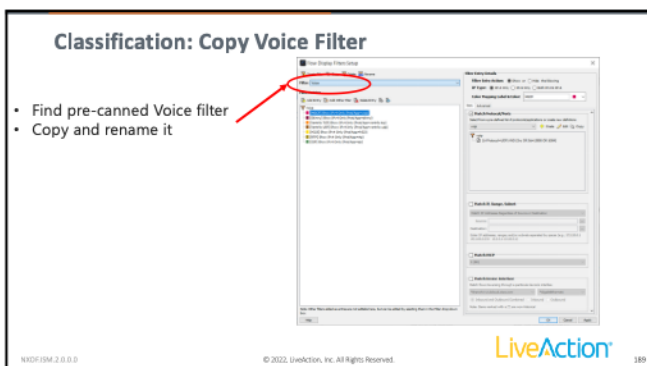
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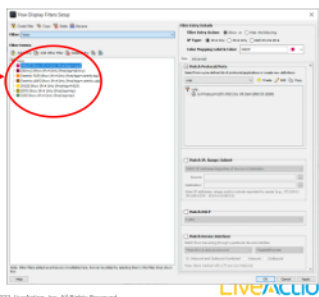
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### Classification: Delete Unused Entries

Delete unused Entries

- VoIP
- Ventrilo TCP
- Ventrilo UDP



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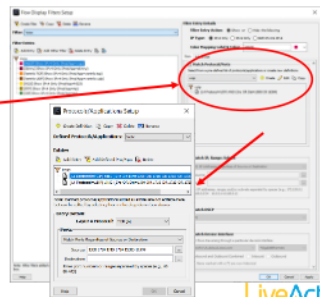
### Classification: Add/Edit Entries

Edit Entries:

- h323
- RTP
- SIP

Add Entry:

- MGCP



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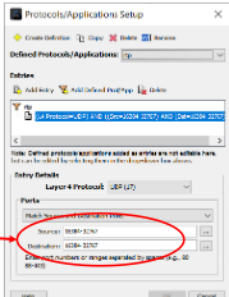
### Classification: Edit Entries

MGCP  
TCP/UDP = Src or Dst = 2427 2727  
TCP = Src or Dst = 2428

H323  
TCP/UDP = Src or Dst = 1718 1719 1720

SIP  
TCP/UDP = Src or Dst = 5060 5061 5062

RTP  
UDP = Src AND Dst = 16384-32767



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**Classification: Voice Filter is ~95 accurate**

- MGCP
- Skinny
- h323
- RTP
- SIP

*Note: There will likely be a false positive or two with this Filter*

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**Classification: Voice Filter is ~99 accurate**

Add CallManager Server(s) IP address to Filter For:

- MGCP
- Skinny
- h323
- SIP

If feasible, add voice subnets to:

- RTP

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**Classification: Display Filter Colors**

Color Legend to Display Filter Colors

- MGCP
- Skinny
- h323
- RTP
- SIP

Selective Views  
Always be aware of what you are viewing!

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### Classification: IPs & Ports Report

Use this report to validate Filter's Accuracy.

NBAR2 is your Friend!

If NBAR doesn't fulfil your needs use Custom Applications

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### Marking: Selecting DSCP Values

Class Type	Class	DSCP	DSCP
Voice / IP Telephony	EF (46)	EF (46)	EF (46)
Interactive Video / Multimedia Conferencing	CS5 (40)	CS5 (40)	AF41 (34) AF42 (34) AF43 (38)
Streaming Video	CS4 (32)	AF31 (26) AF32 (28) AF33 (30)	AF31 (26) AF32 (28) AF33 (30)
Real Time Interactive	CS6 (48)	CS3 (24)	CS4 (32)
Broadcast Video	CS3 (24)	CS3 (24)	CS6 (48)
IP Routing / Network Control	CS2 (16)	CS2 (16)	CS2 (16)
Network Management	CS1 (8)	CS1 (8)	CS1 (8)
Transactional Data / Low-Latency Data	AF41 (34) AF42 (38) AF43 (38)	AF41 (34) AF42 (38) AF43 (38)	AF21 (10) AF22 (12) AF23 (14)
Bulk Data / High Throughput Data	AF31 (26) AF32 (28) AF33 (30)	AF31 (26) AF32 (28) AF33 (30)	AF31 (26) AF32 (28) AF33 (30)
Scavenger / Low-Priority Data	BE (0)	BE (0)	BE (0)

These are just Cisco's recommendations – all values are arbitrary!  
You can use any of the 64 values, but you will see these most often.

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### Marking: DSCP Visualization

Look for BE traffic, Why is there any BE VoIP traffic?

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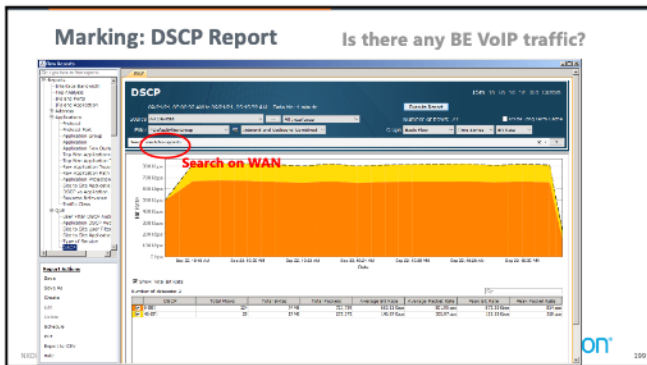
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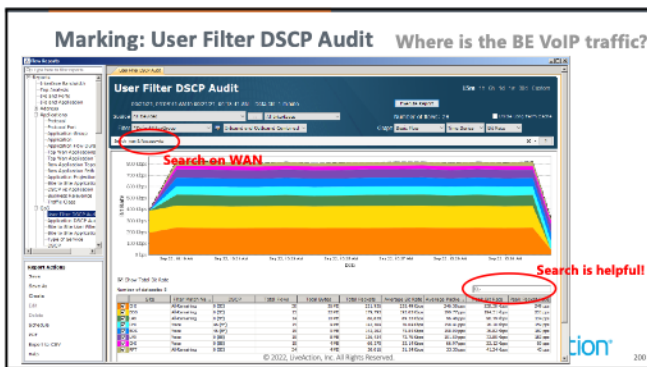
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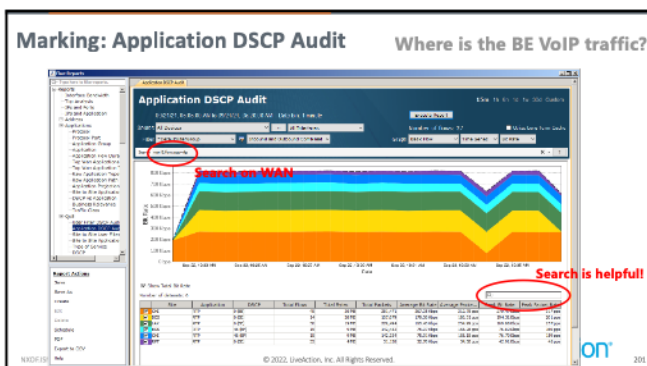
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### Marking: IPs & Ports Report

Search on WAN & EF

Is there any Rogue EF traffic?

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### Marking: How to Mark

To Classify: Use ACLS, DSCP, & NBAR2. Then mark with appropriate DSCP.

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### Classify: Where to Mark

Mark on LAN Ingress, Flow marked end-to-end

Note: Best Practice

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**Classify: Where to Mark** **Note: Try not to do this!**

If you mark on WAN Egress, Flow will look like this and will not report well in LiveNX. This is due to IOS order of operation

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**Classify: Where to Mark**  
Policing can be used to mark traffic, it is best to do this type of configuration on LAN ingress too

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**Classify: Next Steps?**

1. Use same visualization & reports to validate polices
2. Repeat these steps for all important applications

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**Lab: 1 & 2 Config & Classify / Mark**

- Run Reports
- Recognize application traffic
- Mark
- Validate DSCP values



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**Step 2:  
Queueing & Shaping**



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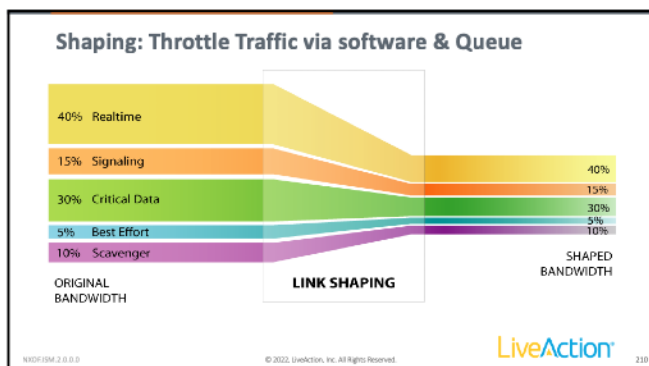
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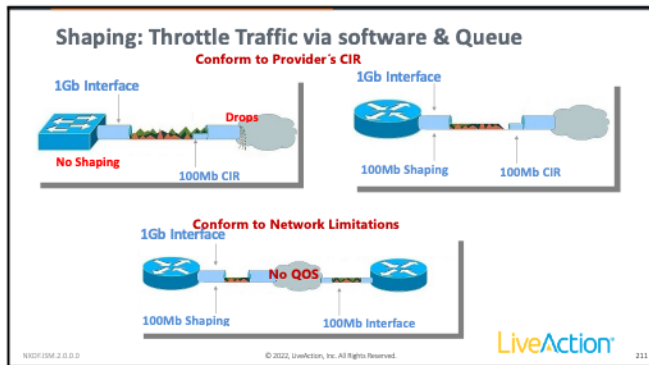
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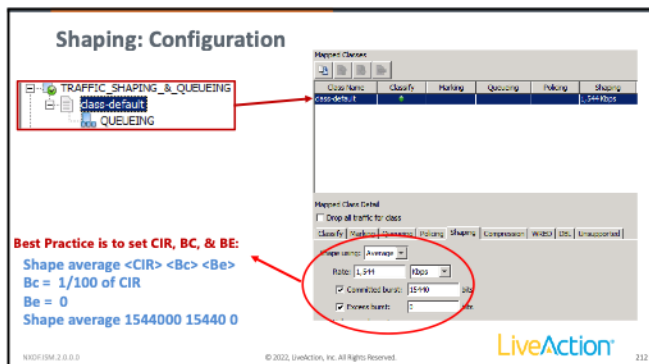
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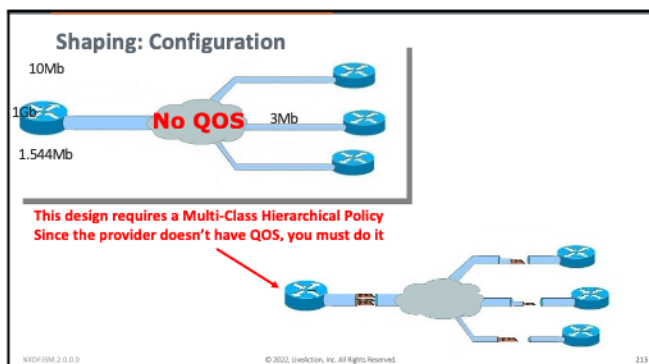
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### Shaping: Configuration

Classify | Matching | Queuing | Policing | Shaping | Congestion

Match on: Any

Match: ACL Name: REMOTE\_3Mb\_ACL

Access Rule Entries

```
permit ip 192.168.1.0 0.0.0.255 192.168.2.0 0.0.0.255
```

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### Queuing: Selecting Bandwidth Allocations

Class Type	4 Class	8 Class	32 Class
Voice / IP Telephony		10%	10%
Interactive Video / Multimedia Conferencing		23%	10%
Streaming Video			10%
Real-Time Interactive		10%	13%
Broadcast Video			10%
Call Signaling		2%	2%
IP Routing / Network Control			2%
Network Management / Operations, Administration, Management (OAM)		5%	2%
Transactional Data / Low-Latency Data		24%	10%
Bulk Data / High-Throughput Data			5%
Scavenger / Low-Priority Data		1%	1%
Best Effort		25%	25%

These are Cisco's SRND recommendations, these are good starting points. LiveNX is great at helping with this!

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### Queuing: Understanding Traffic

This is how one voice call looks:

1x G.711 Call is ~82 Kbps  
1x G.729 call is ~24.6 Kbps  
Consistent pps = no burst

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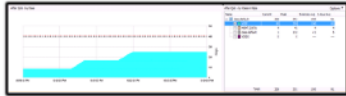
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## Queueing: Understanding Traffic

This is how 3 voice calls look:



- 1x G.711 Call is ~82 Kbps
- 2x G.711 Call is ~164 Kbps
- 3x G.711 Call is ~246 Kbps

Etc...

**No Burst = No Buffer Tuning**

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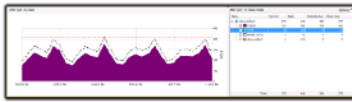
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## Queueing: Understanding Traffic

This is how one video conference call looks:



Resolution	1080p			720p		
	Best	Better	Good	Best	Better	Good
Quality	30	30	30	30	30	30
Frame Rate	30	30	30	30	30	30
Bandwidth	4Mb	3.5Mb	3Mb	2.25Mb	1.5Mb	1Mb
Max Burst (DR + AUR)	128K	128K	128K	128K	128K	128K

**Overprovision Video Queues by 20% & Tune Buffers**

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## Queueing: Understanding Traffic

Know critical apps SLA Targets!

Parameter	VOIP	Traditional Video	HD / Immersive Video
Bandwidth	8-90Kbps	384-768 kbps + network overhead	1.5 - 12.6 Mbps + network overhead
Latency	150ms	400-450ms	150ms
Jitter	30ms	30-50ms	10ms
Loss	1%	1%	0.05%

**Treat with Care!**

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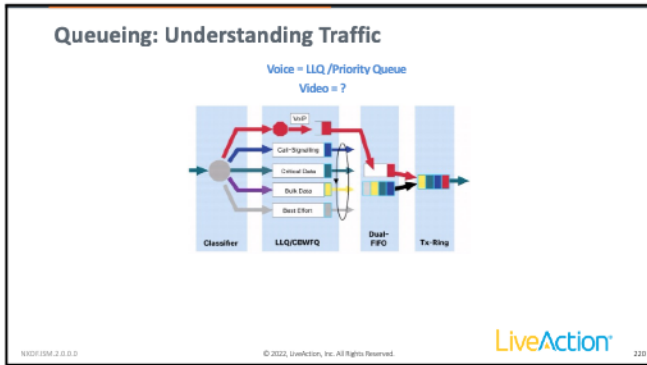
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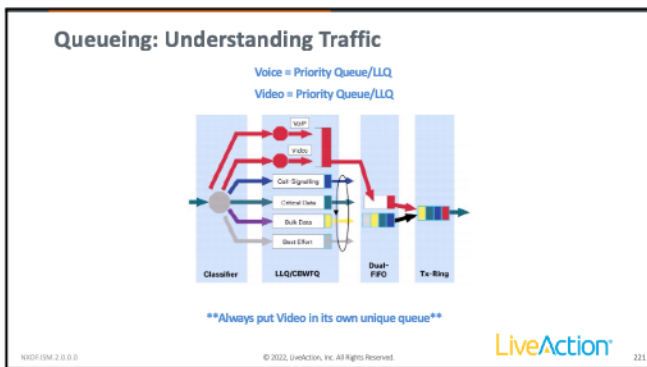
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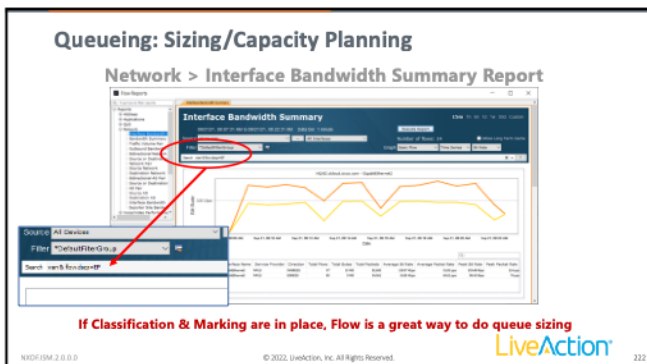
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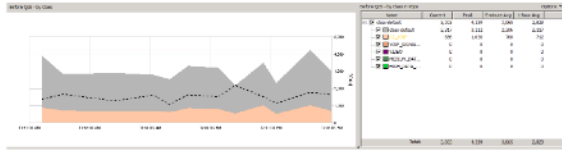
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## Queueing: Sizing/Capacity Planning

## Pre-Policy QoS Report is a Great QoS Sizing Report



**This report shows the volume of bandwidth of each queue before QoS is actually applied**

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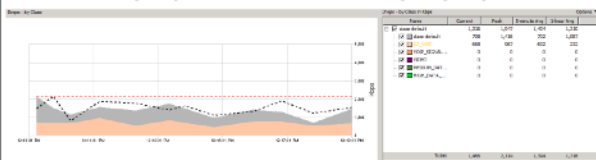
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## Queueing: Capacity Planning

### QoS Drop Report can also be a QoS Capacity Report



**This report shows the volume of traffic dropped after QoS is applied. This can be good for finding gross sizing errors. But is not the whole story, fixing drops may also required buffer tuning too!**

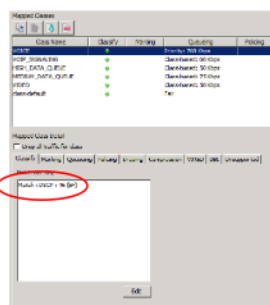
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## Queueing: Configuration



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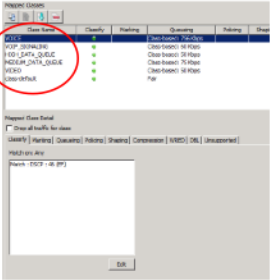
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### Queueing: Configuration

Order Queues based on priority. Queues are match in a top-down order, so this helps ensure priority traffic is matched by the appropriate queue if there are configuration mistakes. It does not change the priority of traffic transmission.



Queue Name	Classify	Shaping	Queueing	Priority	Drop
Voice	Class-based	Class-based	Class-based	10 Kbps	
Video	Class-based	Class-based	Class-based	10 Kbps	
Everything else	Class-based	Class-based	Class-based	10 Kbps	
Default	Fair				

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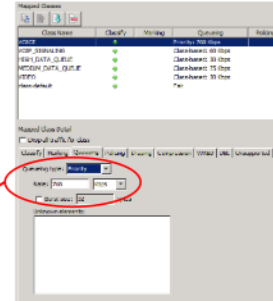
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### Queueing: Configuration

Voice = Priority Queue  
Video = Priority Queue (usually)  
Everything else = Class based  
Default = Fair Queue (optional\*)  
*\*There will be more drops with fair-queue*



Queue Name	Classify	Shaping	Queueing	Priority	Drop
Voice	Class-based	Class-based	Class-based	10 Kbps	
Video	Class-based	Class-based	Class-based	10 Kbps	
Everything else	Class-based	Class-based	Class-based	10 Kbps	
Default	Fair				

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### Lab: 3 & 4 Queueing and Shaping

- Prioritization (Queueing & Shaping)
  - Capacity Planning Reports
  - Configure Queueing
  - Configure Shaping
  - Create Validating Policy



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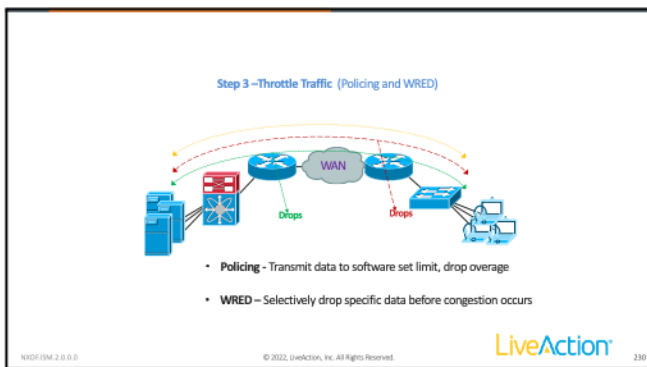
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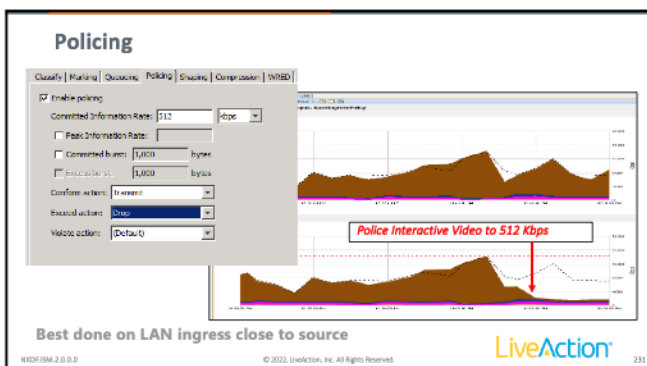
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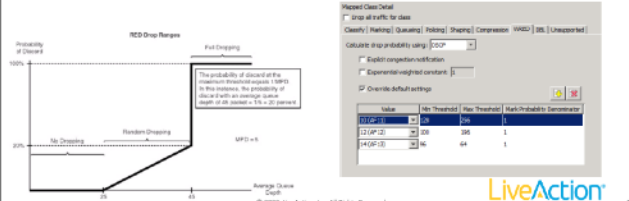
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## WRED – Weighted Random Early Detection

- WRED allows you to randomly start dropping data before the queue is full, to try to avoid congestion (tail drop).
- Min Thresholds is when random drops begin. Max Threshold = Tail Drop.
- What is a Queue? It's a "holding tank" for when there is too much data to be sent
- Default queue depth is 64 packet. When queue is full, "tail drop" begins
- Can provide "queue in queue" like functionality



The graph shows the probability of dropping packets based on the average queue depth. It is divided into three regions: No Dropping, Random Dropping, and Full Dropping. The Min Threshold is 10, and the Max Threshold is 64. The Mark Probability Denominator is 64.

The configuration window shows the following settings:

Value	Min Threshold	Max Threshold	Mark Probability Denominator
10 (AF 1)	10	64	64
10 (AF 2)	10	64	64
10 (AF 3)	10	64	64

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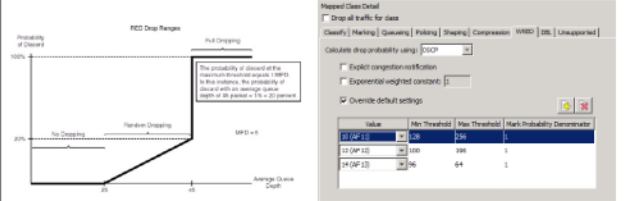
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## WRED - Warning!

- Will cause more drops (harm) than normal, if not tuned correctly
- Typically, only effective if multiple DSCP values are in a Queue



The graph shows the probability of dropping packets based on the average queue depth. It is divided into three regions: No Dropping, Random Dropping, and Full Dropping. The Min Threshold is 10, and the Max Threshold is 64. The Mark Probability Denominator is 64.

The configuration window shows the following settings:

Value	Min Threshold	Max Threshold	Mark Probability Denominator
10 (AF 1)	10	64	64
10 (AF 2)	10	64	64
10 (AF 3)	10	64	64

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## Lab: 5 Throttling & Policing

- Throttling Traffic (Policing & WRED)
  - Implement Scavenger Queue
  - Police Queue



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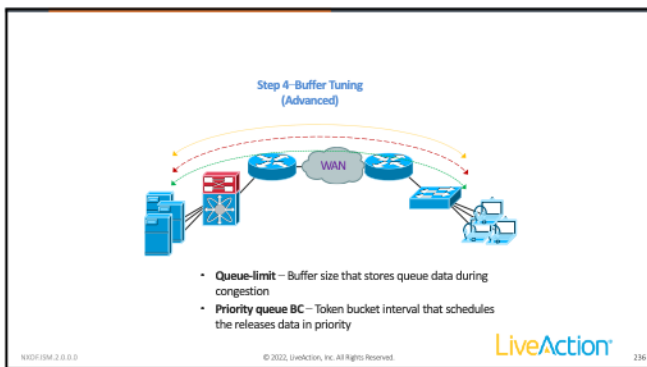
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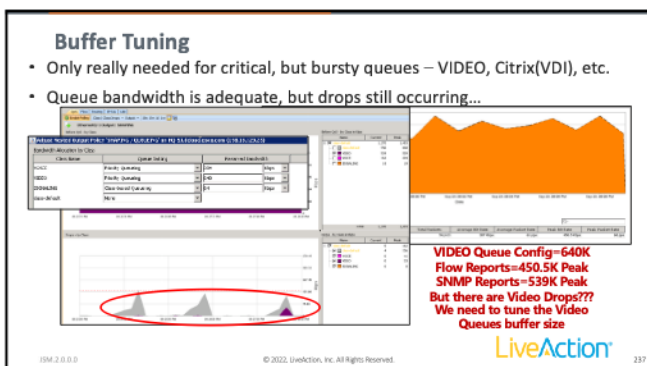
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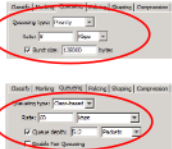
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### Lab: 6 Buffer Tuning

Interface's hold queue >= total of all queues queue limit  
Show interface shows the size of the hold-queue  
Output queue: 72/1000/1732089236 (size/max total/drops)

```
policy map C2_QUEUEING
class C2_VOIP
priority 8 128000
exit
class VOIP_SIGNALING
bandwidth 60
queue-limit 512
```



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### Lab: 6 Buffer Tuning

- Buffer Tuning
  - Video Queue Performance Tuning



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### QoS Deployment Strategies

REVIEW



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**QoS Deployment Strategies**

- Step 1 - Deploy QoS in Phases
- Step 2 - Use NetFlow Tools to Understand Bandwidth Usage
- Step 3 - Understand Application Details
- Step 4 - Get Business' Buy-In
- Step 5 - Understand the Network
- Step 6 - Have a Plan
- Step 7 - Use QoS Management Tools
- Step 8 - K.I.S.S.

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**Step 1 : Implement QoS in Phases!**

Do the WAN  
THEN do the LAN

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**Step 2 - Use NetFlow Tools to Understand Bandwidth Usage**

Flow ID	Destination	Protocol	Source IP	Destination IP	Source Port	Destination Port	Bytes	Packets	Flows
100	10.0.0.0/24	TCP	10.0.0.1	10.0.0.2	80	80	1000000	10000	100
101	10.0.0.0/24	TCP	10.0.0.1	10.0.0.3	80	80	500000	5000	50
102	10.0.0.0/24	TCP	10.0.0.1	10.0.0.4	80	80	250000	2500	25
103	10.0.0.0/24	TCP	10.0.0.1	10.0.0.5	80	80	125000	1250	12
104	10.0.0.0/24	TCP	10.0.0.1	10.0.0.6	80	80	62500	625	6
105	10.0.0.0/24	TCP	10.0.0.1	10.0.0.7	80	80	31250	312	3
106	10.0.0.0/24	TCP	10.0.0.1	10.0.0.8	80	80	15625	156	1
107	10.0.0.0/24	TCP	10.0.0.1	10.0.0.9	80	80	7812	78	0
108	10.0.0.0/24	TCP	10.0.0.1	10.0.0.10	80	80	3906	39	0
109	10.0.0.0/24	TCP	10.0.0.1	10.0.0.11	80	80	1953	19	0
110	10.0.0.0/24	TCP	10.0.0.1	10.0.0.12	80	80	976	9	0
111	10.0.0.0/24	TCP	10.0.0.1	10.0.0.13	80	80	488	4	0
112	10.0.0.0/24	TCP	10.0.0.1	10.0.0.14	80	80	244	2	0
113	10.0.0.0/24	TCP	10.0.0.1	10.0.0.15	80	80	122	1	0
114	10.0.0.0/24	TCP	10.0.0.1	10.0.0.16	80	80	61	0	0
115	10.0.0.0/24	TCP	10.0.0.1	10.0.0.17	80	80	30	0	0
116	10.0.0.0/24	TCP	10.0.0.1	10.0.0.18	80	80	15	0	0
117	10.0.0.0/24	TCP	10.0.0.1	10.0.0.19	80	80	7	0	0
118	10.0.0.0/24	TCP	10.0.0.1	10.0.0.20	80	80	3	0	0
119	10.0.0.0/24	TCP	10.0.0.1	10.0.0.21	80	80	1	0	0
120	10.0.0.0/24	TCP	10.0.0.1	10.0.0.22	80	80	0	0	0
121	10.0.0.0/24	TCP	10.0.0.1	10.0.0.23	80	80	0	0	0
122	10.0.0.0/24	TCP	10.0.0.1	10.0.0.24	80	80	0	0	0
123	10.0.0.0/24	TCP	10.0.0.1	10.0.0.25	80	80	0	0	0
124	10.0.0.0/24	TCP	10.0.0.1	10.0.0.26	80	80	0	0	0
125	10.0.0.0/24	TCP	10.0.0.1	10.0.0.27	80	80	0	0	0
126	10.0.0.0/24	TCP	10.0.0.1	10.0.0.28	80	80	0	0	0
127	10.0.0.0/24	TCP	10.0.0.1	10.0.0.29	80	80	0	0	0
128	10.0.0.0/24	TCP	10.0.0.1	10.0.0.30	80	80	0	0	0
129	10.0.0.0/24	TCP	10.0.0.1	10.0.0.31	80	80	0	0	0
130	10.0.0.0/24	TCP	10.0.0.1	10.0.0.32	80	80	0	0	0
131	10.0.0.0/24	TCP	10.0.0.1	10.0.0.33	80	80	0	0	0
132	10.0.0.0/24	TCP	10.0.0.1	10.0.0.34	80	80	0	0	0
133	10.0.0.0/24	TCP	10.0.0.1	10.0.0.35	80	80	0	0	0
134	10.0.0.0/24	TCP	10.0.0.1	10.0.0.36	80	80	0	0	0
135	10.0.0.0/24	TCP	10.0.0.1	10.0.0.37	80	80	0	0	0
136	10.0.0.0/24	TCP	10.0.0.1	10.0.0.38	80	80	0	0	0
137	10.0.0.0/24	TCP	10.0.0.1	10.0.0.39	80	80	0	0	0
138	10.0.0.0/24	TCP	10.0.0.1	10.0.0.40	80	80	0	0	0
139	10.0.0.0/24	TCP	10.0.0.1	10.0.0.41	80	80	0	0	0
140	10.0.0.0/24	TCP	10.0.0.1	10.0.0.42	80	80	0	0	0
141	10.0.0.0/24	TCP	10.0.0.1	10.0.0.43	80	80	0	0	0
142	10.0.0.0/24	TCP	10.0.0.1	10.0.0.44	80	80	0	0	0
143	10.0.0.0/24	TCP	10.0.0.1	10.0.0.45	80	80	0	0	0
144	10.0.0.0/24	TCP	10.0.0.1	10.0.0.46	80	80	0	0	0
145	10.0.0.0/24	TCP	10.0.0.1	10.0.0.47	80	80	0	0	0
146	10.0.0.0/24	TCP	10.0.0.1	10.0.0.48	80	80	0	0	0
147	10.0.0.0/24	TCP	10.0.0.1	10.0.0.49	80	80	0	0	0
148	10.0.0.0/24	TCP	10.0.0.1	10.0.0.50	80	80	0	0	0
149	10.0.0.0/24	TCP	10.0.0.1	10.0.0.51	80	80	0	0	0
150	10.0.0.0/24	TCP	10.0.0.1	10.0.0.52	80	80	0	0	0
151	10.0.0.0/24	TCP	10.0.0.1	10.0.0.53	80	80	0	0	0
152	10.0.0.0/24	TCP	10.0.0.1	10.0.0.54	80	80	0	0	0
153	10.0.0.0/24	TCP	10.0.0.1	10.0.0.55	80	80	0	0	0
154	10.0.0.0/24	TCP	10.0.0.1	10.0.0.56	80	80	0	0	0
155	10.0.0.0/24	TCP	10.0.0.1	10.0.0.57	80	80	0	0	0
156	10.0.0.0/24	TCP	10.0.0.1	10.0.0.58	80	80	0	0	0
157	10.0.0.0/24	TCP	10.0.0.1	10.0.0.59	80	80	0	0	0
158	10.0.0.0/24	TCP	10.0.0.1	10.0.0.60	80	80	0	0	0
159	10.0.0.0/24	TCP	10.0.0.1	10.0.0.61	80	80	0	0	0
160	10.0.0.0/24	TCP	10.0.0.1	10.0.0.62	80	80	0	0	0
161	10.0.0.0/24	TCP	10.0.0.1	10.0.0.63	80	80	0	0	0
162	10.0.0.0/24	TCP	10.0.0.1	10.0.0.64	80	80	0	0	0
163	10.0.0.0/24	TCP	10.0.0.1	10.0.0.65	80	80	0	0	0
164	10.0.0.0/24	TCP	10.0.0.1	10.0.0.66	80	80	0	0	0
165	10.0.0.0/24	TCP	10.0.0.1	10.0.0.67	80	80	0	0	0
166	10.0.0.0/24	TCP	10.0.0.1	10.0.0.68	80	80	0	0	0
167	10.0.0.0/24	TCP	10.0.0.1	10.0.0.69	80	80	0	0	0
168	10.0.0.0/24	TCP	10.0.0.1	10.0.0.70	80	80	0	0	0
169	10.0.0.0/24	TCP	10.0.0.1	10.0.0.71	80	80	0	0	0
170	10.0.0.0/24	TCP	10.0.0.1	10.0.0.72	80	80	0	0	0
171	10.0.0.0/24	TCP	10.0.0.1	10.0.0.73	80	80	0	0	0
172	10.0.0.0/24	TCP	10.0.0.1	10.0.0.74	80	80	0	0	0
173	10.0.0.0/24	TCP	10.0.0.1	10.0.0.75	80	80	0	0	0
174	10.0.0.0/24	TCP	10.0.0.1	10.0.0.76	80	80	0	0	0
175	10.0.0.0/24	TCP	10.0.0.1	10.0.0.77	80	80	0	0	0
176	10.0.0.0/24	TCP	10.0.0.1	10.0.0.78	80	80	0	0	0
177	10.0.0.0/24	TCP	10.0.0.1	10.0.0.79	80	80	0	0	0
178	10.0.0.0/24	TCP	10.0.0.1	10.0.0.80	80	80	0	0	0
179	10.0.0.0/24	TCP	10.0.0.1	10.0.0.81	80	80	0	0	0
180	10.0.0.0/24	TCP	10.0.0.1	10.0.0.82	80	80	0	0	0
181	10.0.0.0/24	TCP	10.0.0.1	10.0.0.83	80	80	0	0	0
182	10.0.0.0/24	TCP	10.0.0.1	10.0.0.84	80	80	0	0	0
183	10.0.0.0/24	TCP	10.0.0.1	10.0.0.85	80	80	0	0	0
184	10.0.0.0/24	TCP	10.0.0.1	10.0.0.86	80	80	0	0	0
185	10.0.0.0/24	TCP	10.0.0.1	10.0.0.87	80	80	0	0	0
186	10.0.0.0/24	TCP	10.0.0.1	10.0.0.88	80	80	0	0	0
187	10.0.0.0/24	TCP	10.0.0.1	10.0.0.89	80	80	0	0	0
188	10.0.0.0/24	TCP	10.0.0.1	10.0.0.90	80	80	0	0	0
189	10.0.0.0/24	TCP	10.0.0.1	10.0.0.91	80	80	0	0	0
190	10.0.0.0/24	TCP	10.0.0.1	10.0.0.92	80	80	0	0	0
191	10.0.0.0/24	TCP	10.0.0.1	10.0.0.93	80	80	0	0	0
192	10.0.0.0/24	TCP	10.0.0.1	10.0.0.94	80	80	0	0	0
193	10.0.0.0/24	TCP	10.0.0.1	10.0.0.95	80	80	0	0	0
194	10.0.0.0/24	TCP	10.0.0.1	10.0.0.96	80	80	0	0	0
195	10.0.0.0/24	TCP	10.0.0.1	10.0.0.97	80	80	0	0	0
196	10.0.0.0/24	TCP	10.0.0.1	10.0.0.98	80	80	0	0	0
197	10.0.0.0/24	TCP	10.0.0.1	10.0.0.99	80	80	0	0	0
198	10.0.0.0/24	TCP	10.0.0.1	10.0.0.100	80	80	0	0	0
199	10.0.0.0/24	TCP	10.0.0.1	10.0.0.101	80	80	0	0	0
200	10.0.0.0/24	TCP	10.0.0.1	10.0.0.102	80	80	0	0	0
201	10.0.0.0/24	TCP	10.0.0.1	10.0.0.103	80	80	0	0	0
202	10.0.0.0/24	TCP	10.0.0.1	10.0.0.104	80	80	0	0	0
203	10.0.0.0/24	TCP	10.0.0.1	10.0.0.105	80	80	0	0	0
204	10.0.0.0/24	TCP	10.0.0.1	10.0.0.106	80	80	0	0	0
205	10.0.0.0/24	TCP	10.0.0.1	10.0.0.107	80	80	0	0	0
206	10.0.0.0/24	TCP	10.0.0.1	10.0.0.108	80	80	0	0	0
207	10.0.0.0/24	TCP	10.0.0.1	10.0.0.109	80	80	0	0	0
208	10.0.0.0/24	TCP	10.0.0.1						



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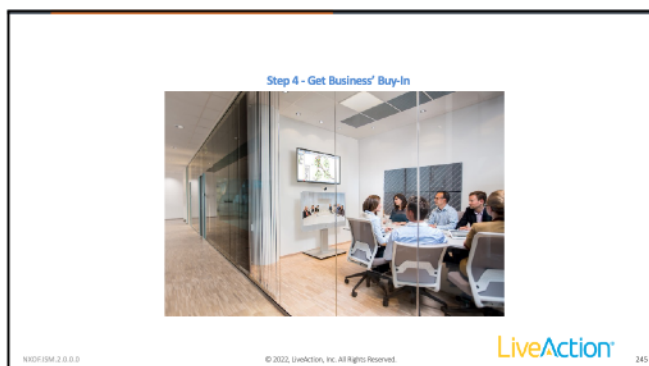
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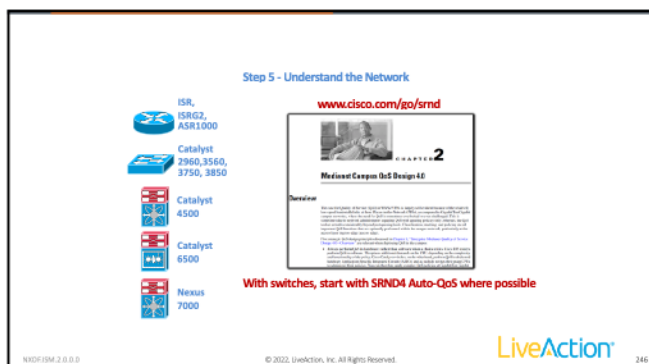
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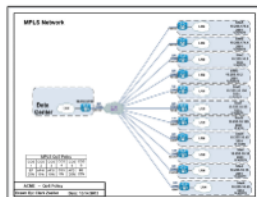
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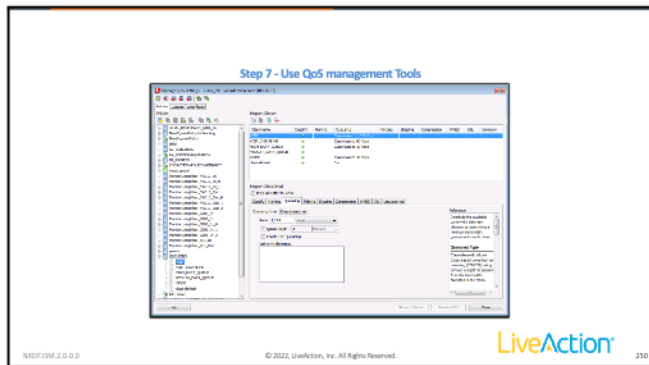
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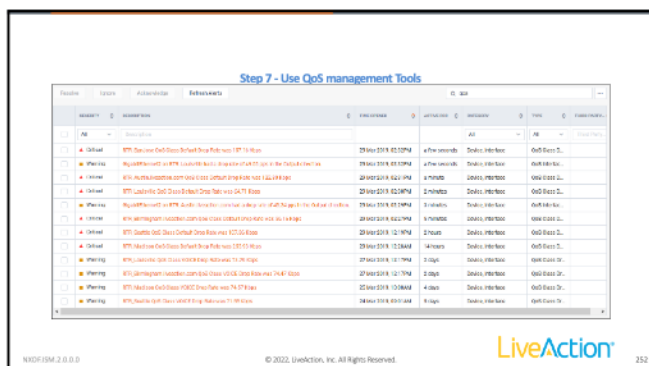
# LiveNX Training Student Guide



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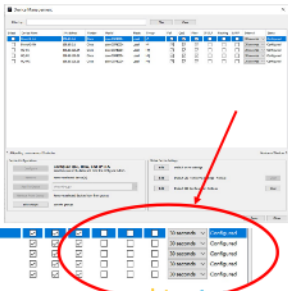


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## SNMP Polling Interval

**LiveAction Recommends**

- Router polling = 30 seconds
- Switch polling = 1 minute or 5 minutes
- Poll fewest technologies required



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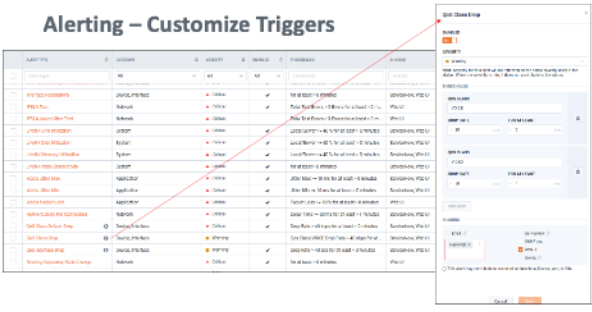
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## Alerting – Customize Triggers



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## Lab 6: Finish The Labs

- Including Lab 7: QoS Alerts



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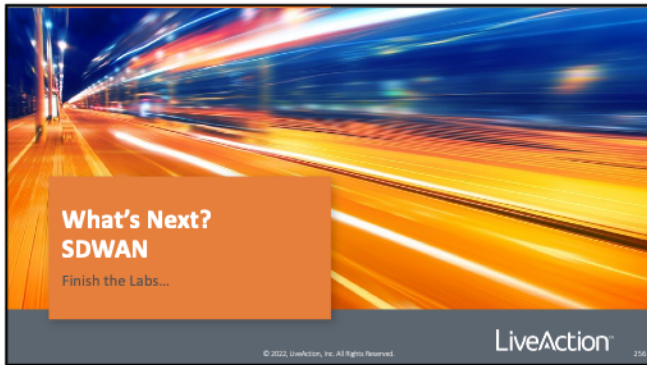
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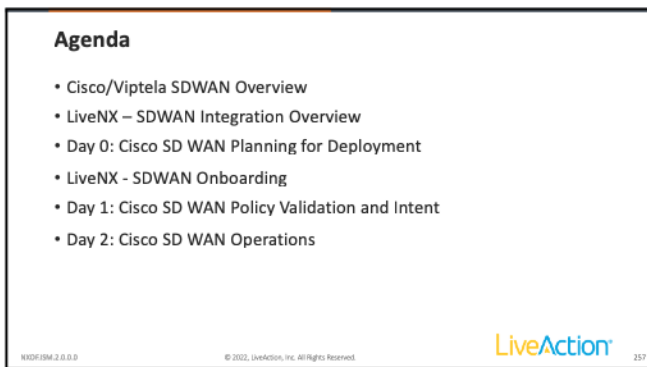
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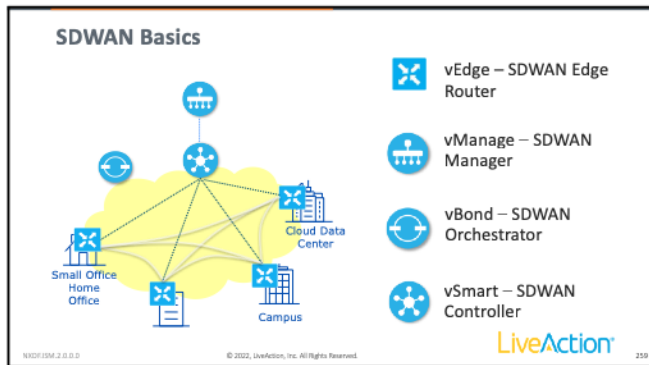
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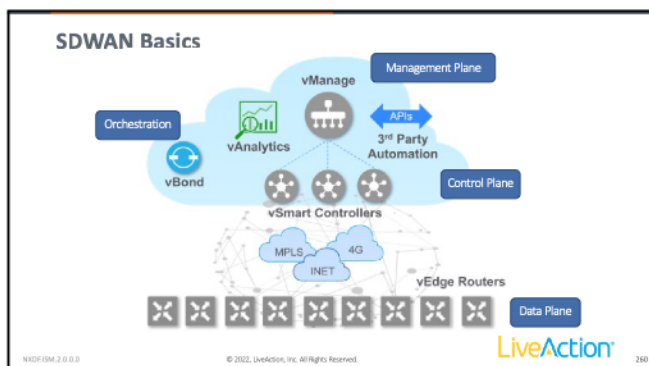
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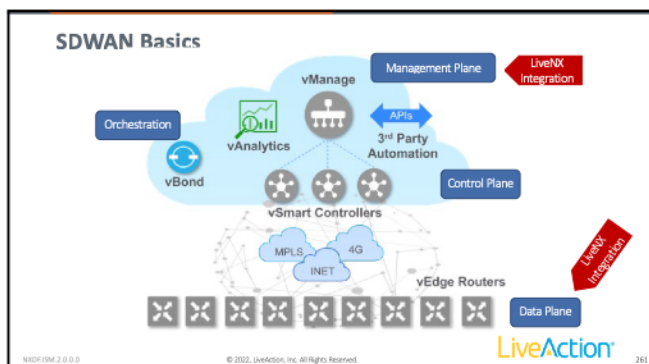
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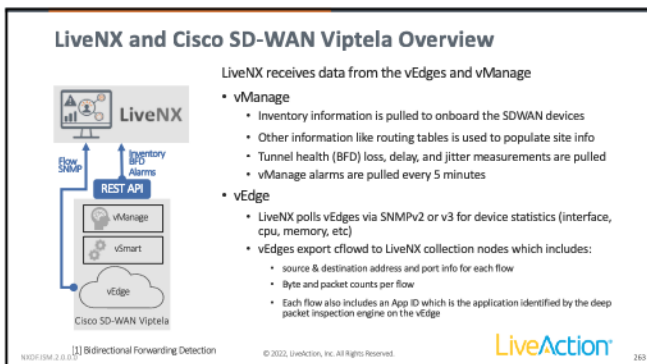
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### Network Preparation - Summary

**Required Tasks**

- Collect management IP range for the Cisco SD-WAN (Viptela) vEdge routers
- Enable SNMP v2/v3 RO access for LiveNX monitoring
- Collect SNMP v2/v3 community/password
- Configure centralized data policy to enable Flow on LAN Interfaces
- Set Flow active timeout = 60 sec
- Set Flow inactive timeout = 15 sec
- Collect vManage hostname/IP address, username and password
  - Used for polling northbound API's from vManage (Inventory, BFD, Alarms, etc)

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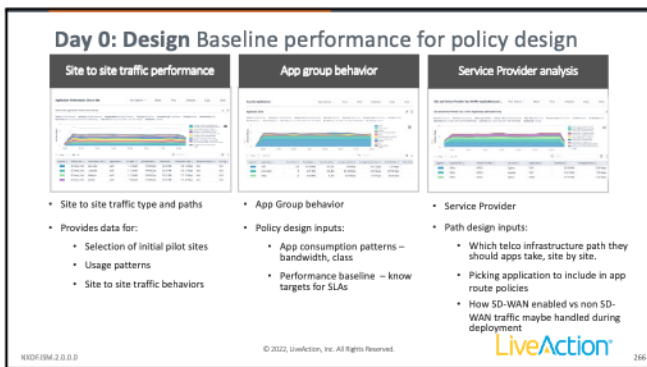
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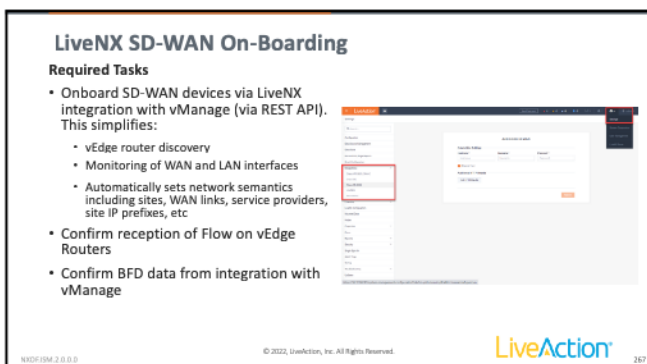
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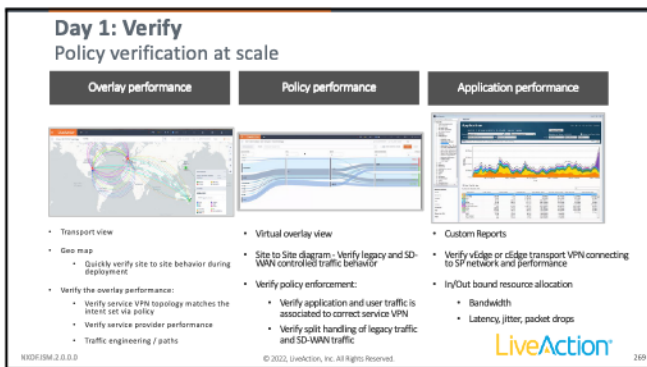
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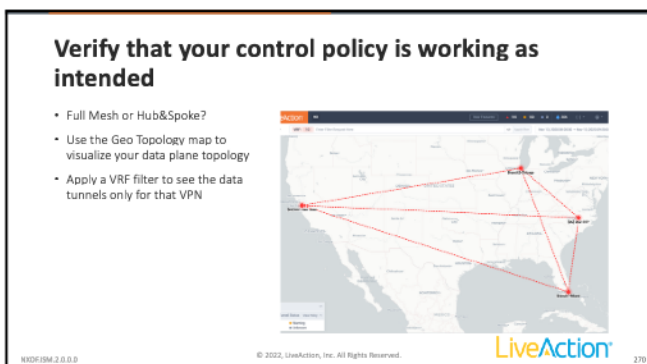
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## Verify Application Aware Routing Policy

- Use the Sankey Diagram to visualize which traffic is going over which WAN transport
- Launch from Site-to-Site story or from the Geo Topology Map

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## Use the Playback feature to verify traffic steering

- Does critical traffic get steered to the alternate WAN transport when the preferred tunnel suffers an outage or brownout
- Set the time interval at the top of the diagram to capture the problem event
- Use the playback at the bottom to visualize the traffic moving between transports

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Day 2  
Scale and Operate

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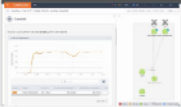
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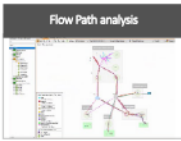
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## Day 2: Scale and Operate


Performance insights for optimization and rapid troubleshooting

**Enterprise visibility**

- Enterprise visibility - multi-vendor
- NOC Operation workflows
  - alerting, dashboards, reports, capacity planning, integrations
- Situational awareness:
  - Sites
  - Applications
  - Service Providers

**Flow Path analysis**

- Visual path analytics
- Verification of policy changes at scale
- Understand app path switching
  - site to site tunnel performance correlated to service provider and policy thresholds

**Deep packet analysis**

- LiveWire and Omniscience packet capture and analysis appliance
- Packet drill down
- Delivers intuitive visualization and robust forensics for faster incident resolution of network issues
- application performance issues and security investigations

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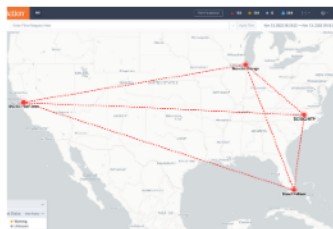
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## Use the Geo Topology to monitor tunnel status

- Here we see all tunnels are red
- LiveNX is using the loss/latency/jitter statistics to show SLA violations



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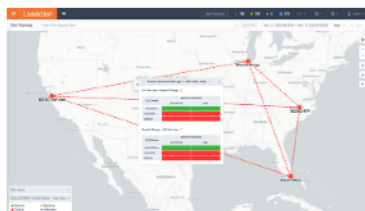
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## Use the Geo Topology to monitor tunnel status

- Here we see all tunnels are red
- LiveNX is using the loss/latency/jitter statistics to show SLA violations
- Click on a data tunnel to drill into the tunnel status for each SLA class



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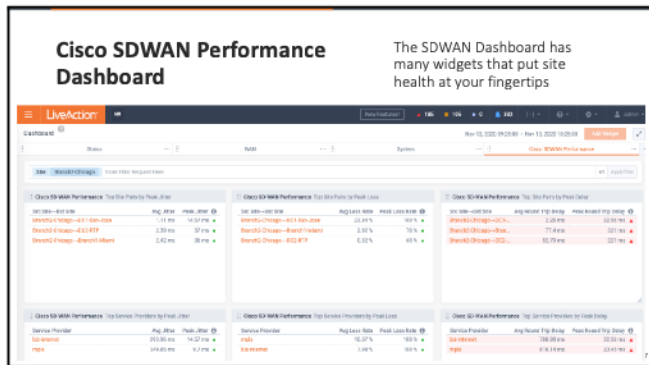
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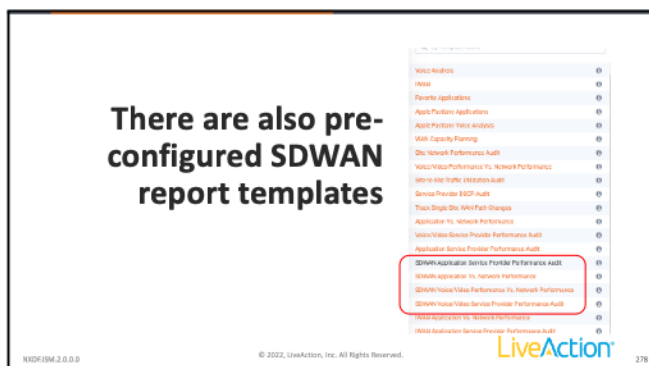
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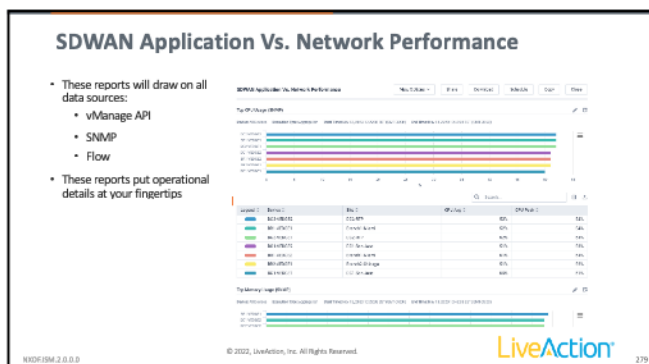
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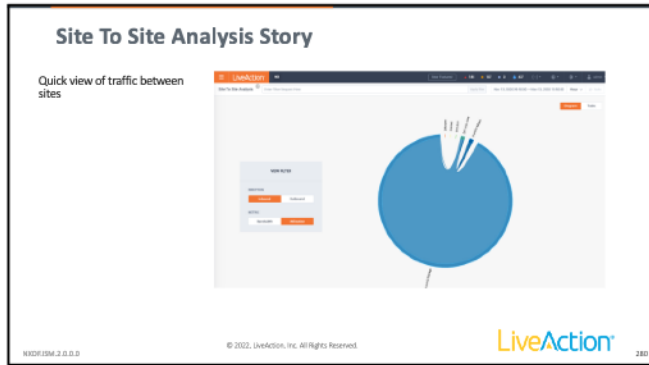
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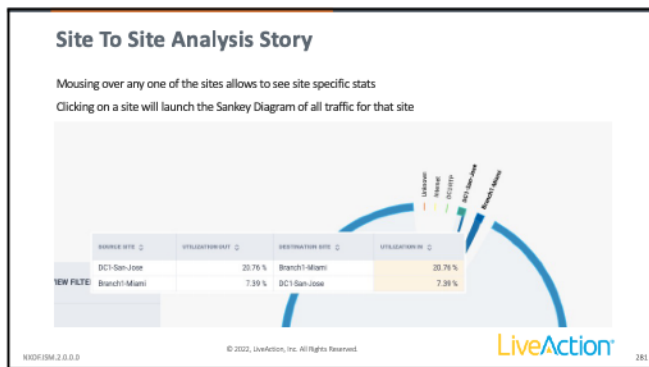
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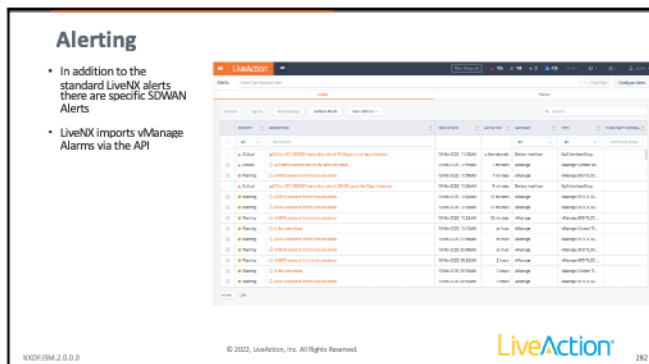
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## Alert Configuration

- All the Cisco SD-WAN Integrations alerts are the ones imported from the vManage alarms
- Any vManage alarms to be displayed must be enabled here
- It is recommended to only enable the vManage alarms that are of particular interest

[illegible]

HXDEISM-2.0.0

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## Cisco SD-WAN SLA Class Path Change Alert

- SDWAN specific alert generated by LiveNX based on the loss/latency/jitter measurements (NOT imported from vManage)
- Should be fired when a tunnel has an SLA class change

[illegible]

HYDROISM.2



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## Launch the SDWAN Learning Labs...

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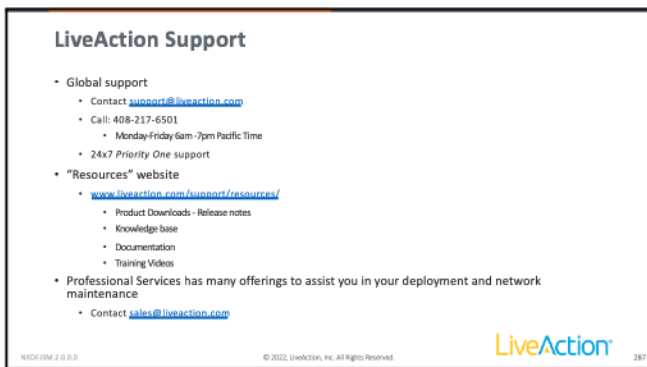
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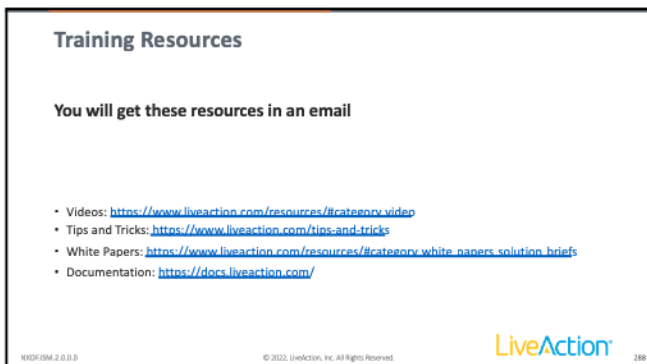
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### Course Evaluation

We'll use this information to improve our courses and teaching methods. Please enter as much comment material as you'd like... the more info you add, the better we'll get!

Point your browser to: (This is also in the email!)

<http://www.surveymzmo.com/s3/2657898/312e4e3f5212>

Please select Instructor and Course info...

- Course: Intro to LiveNX
- Instructor Name: David Lau

Thank You in advance for your participation!

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