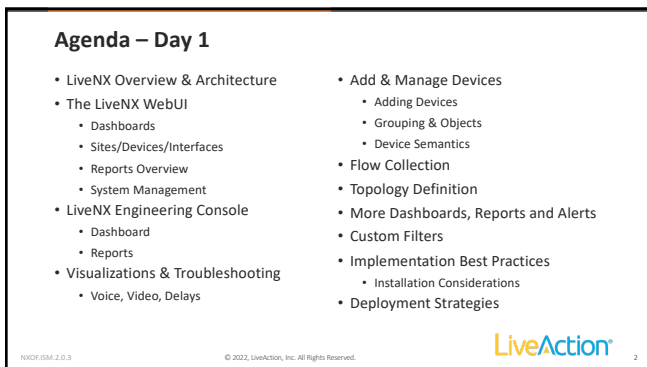


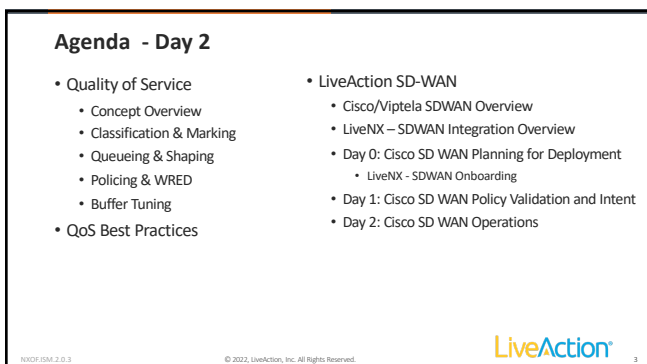
LiveNX Training Student Guide



1



2



3

Class Logistics

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

4

Your Trainer...

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

5

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



6

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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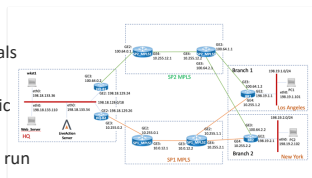
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Our Training Infrastructure

- 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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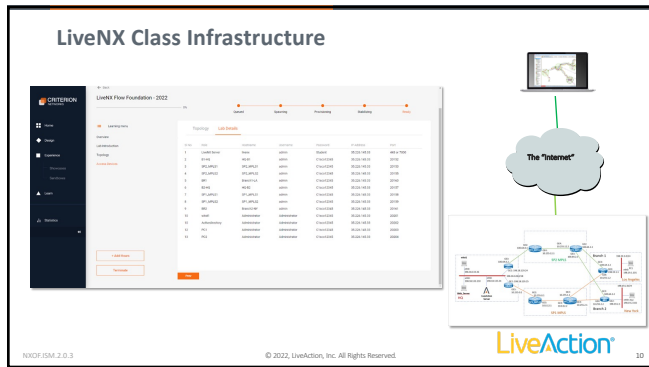
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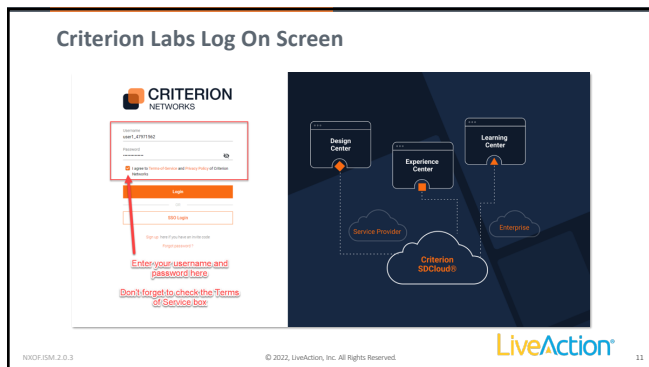
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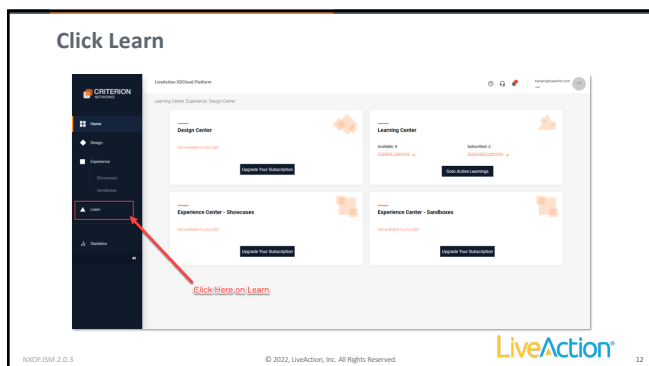
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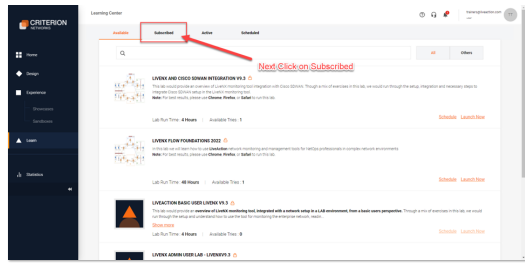


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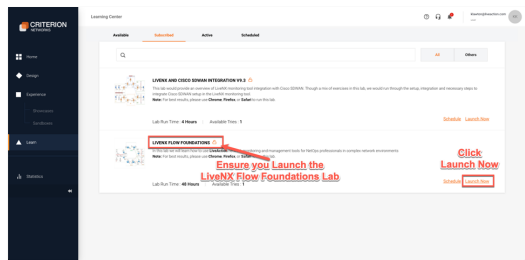
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Click Subscribed



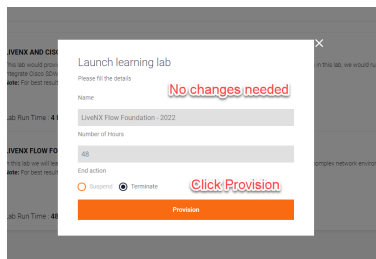
13

Select the Correct Lab and Click Launch Now

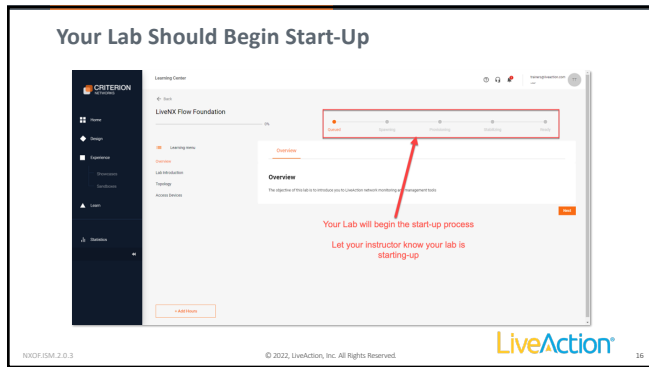


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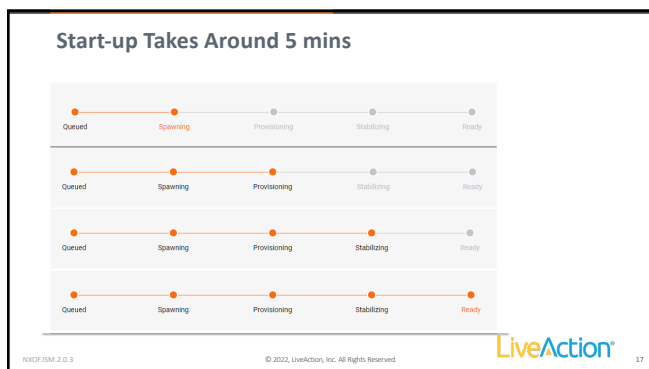
Click Provision



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Course Component	Site	Description
Student Guide	https://www.liveaction.com/support/training-resources/	Your copy of the slides to follow the presentation/make notes
Lab Workbook Pt 1	https://www.liveaction.com/support/training-resources/	Day 1 Lab Workbook: Lab Exercises
Lab Workbook Pt 2	https://www.liveaction.com/support/training-resources/	Day 2 Lab Workbook: Lab Exercises
LiveNX Engineering Console (Mac or Windows)	https://www.liveaction.com/support/training-resources/	Client Access to be installed for some exercises
Website for Access to Hands-On Labs	https://portal.criterionnetworks.com/	You will be given your specific login information by the instructor

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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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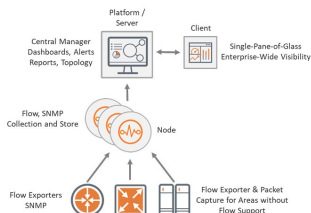
LiveNX System Overview & Architecture

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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/Vicor, Hyper-V, KVM
- **Collector Node**
 - Hold data store, automatic data management
 - Node management policy set at server
 - Virtual Install - HyperV/Vicor, Hyper-V, KVM



```
graph TD
    Client[Client] --> Platform[Platform / Server]
    Platform --> Node[Node]
    Node --> FlowExporters[Flow Exporters SNMP]
    Node --> FlowCapture[Flow Exporter & Packet Capture for Arrows 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">• 8 vCPU Xeon or i7• 16 Gb RAM• Max Heap Size 8GB• 500GB Data Disk	Min Requirements: <ul style="list-style-type: none">• 16 vCPU Xeon or i7• 32 Gb RAM• Max Heap Size 16GB• 2TB Data Disk	Min Requirements: <ul style="list-style-type: none">• 16 vCPU Xeon or i7• 64 Gb RAM• Max Heap Size 31GB• 4TB Data Disk	Min Requirements: <ul style="list-style-type: none">• 32 vCPU Xeon or i7• 64 Gb RAM• Max Heap Size 31GB• 8TB Data Disk	Min Requirements: <ul style="list-style-type: none">• 64 vCPU Xeon Gold 5218• 32 vCPU Xeon or i7• 768 Gb RAM• Max Heap Size 384GB• 32TB Data Disk• 16TB usable with RAID 10)

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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 5500 Series Firewalls
Cisco Catalyst Series Switches 2900, 3650, 3850 & 4500-X 6500, 6800, 9000 are supported.** (limited LiveNX QoS Monitor support on Layer 3-routable interfaces and VLANs depending upon Cisco hardware capabilities.)
Cisco ISR Series Routers: 800, 900, 1700, 1800, 1900, 2600, 2600XM, 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

Adtran NetVanta Series Routers
Alcatel-Lucent Routers
Barracuda Firewall
Brocade Series Routers
Checkpoint Firewall
Citrix NetScaler Load Balancer
Extreme Network Switches
F5 Load-Balancer
Gigamon GigaSWIRT
Hewlett-Packard Enterprise ProCurve Series Switches
Ixia's Network Visibility Solution
Juniper MX Series Routers
Ntop 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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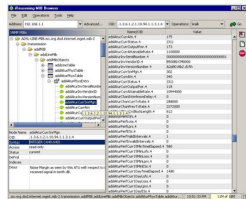
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LiveNX Communication with Devices

- 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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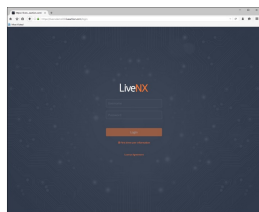
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From Any Browser... from Anywhere!

<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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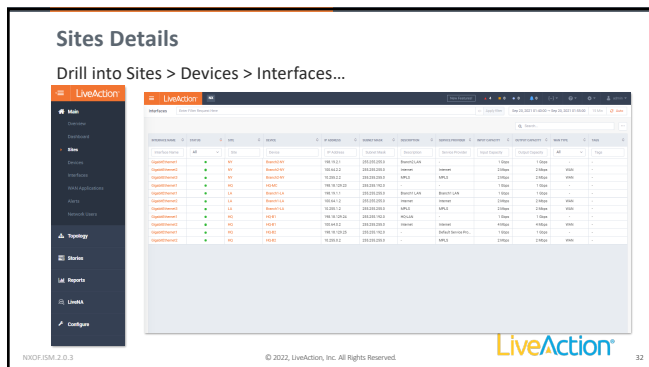
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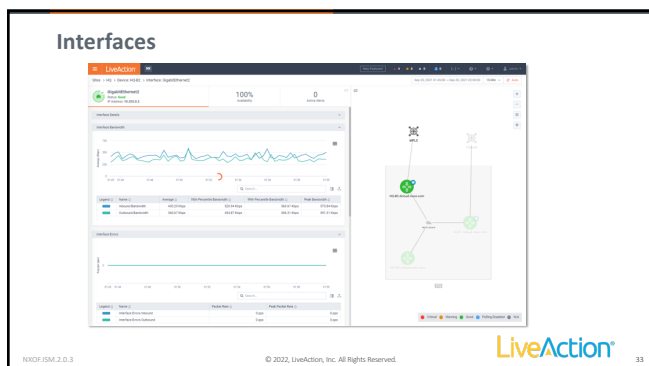
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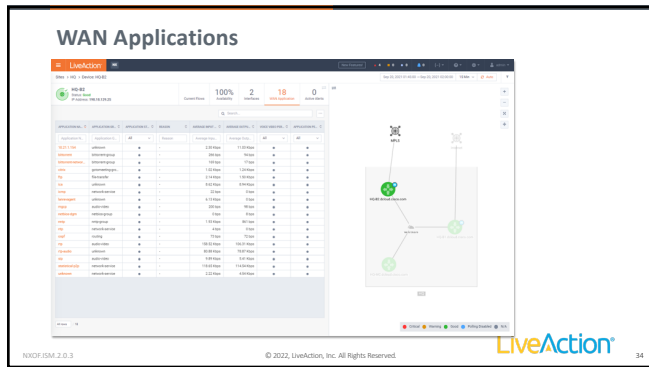
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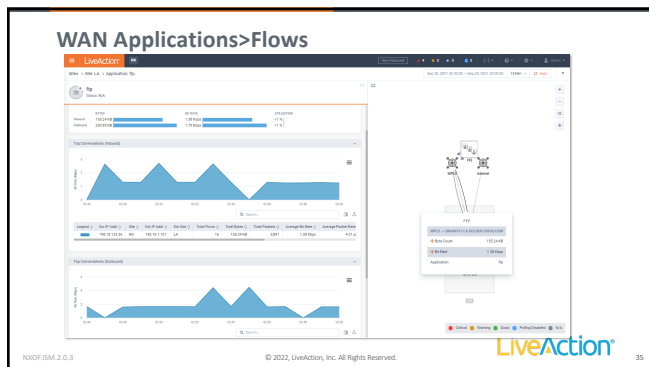
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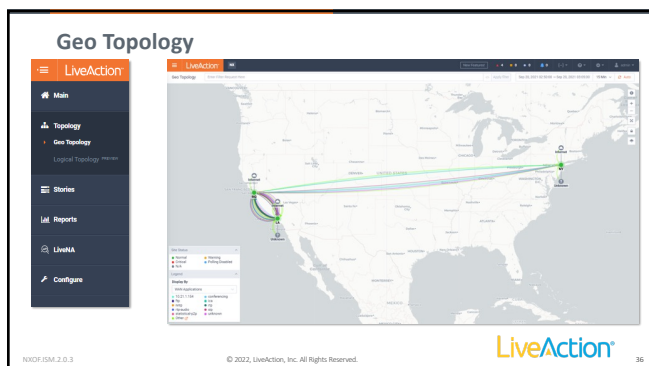
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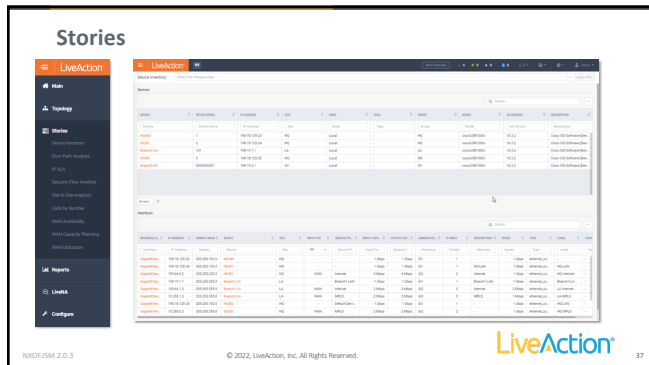
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[Include Report Elements](#)
[Copy URL to Clipboard](#)
[Print/Download \(opens new URL\)](#)
[Re-open Run Report Dialog](#)
[Return to Reports Entry Page](#)

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[illegible]

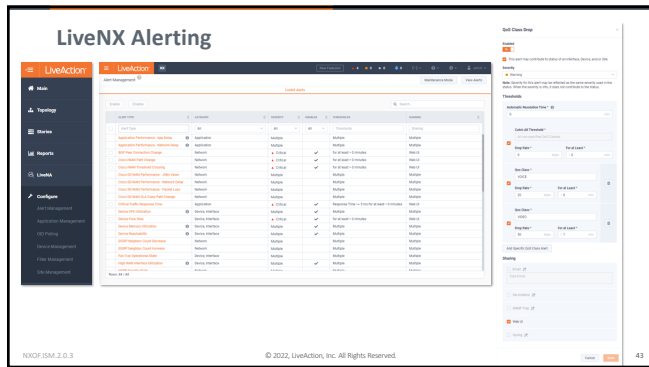
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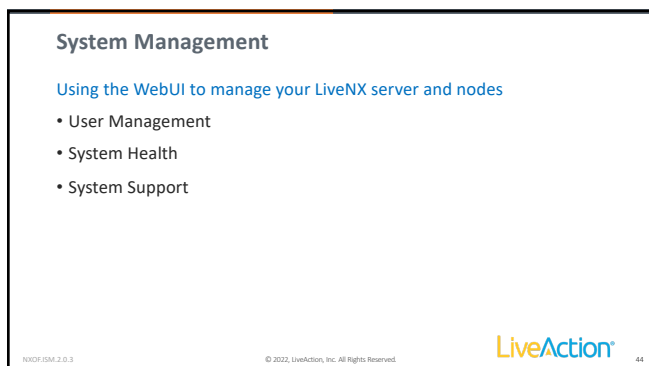
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Multiple Reports

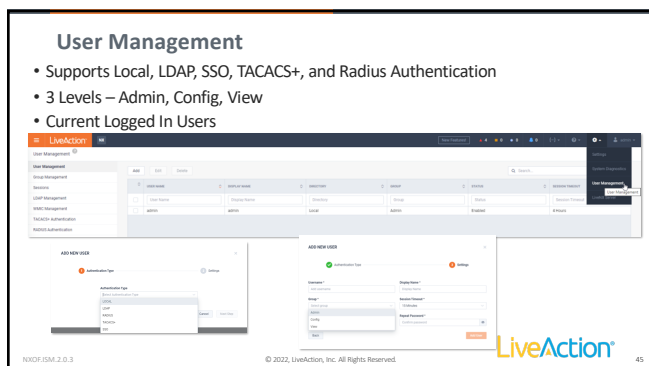
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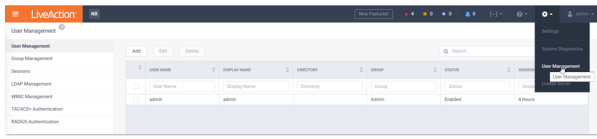


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User Management

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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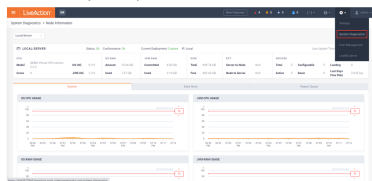
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System Health

- 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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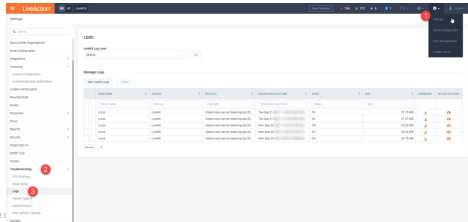
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What to do when you need support

- 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

LiveNX/ISAM 3.0.3

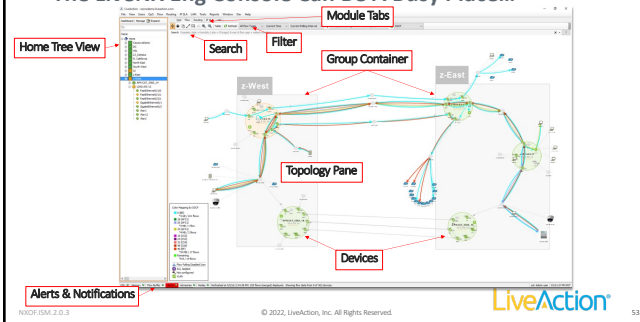
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The LiveNX Eng Console Can Be A Busy Place...



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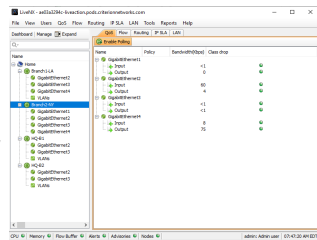
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The Home Tree-view

- 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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Immediate Feedback...

Look at the bottom of the screen for information about:

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



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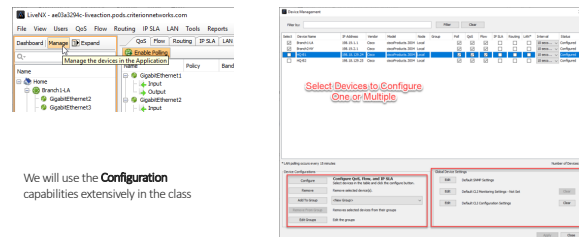
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Main Configuration Tool

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



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

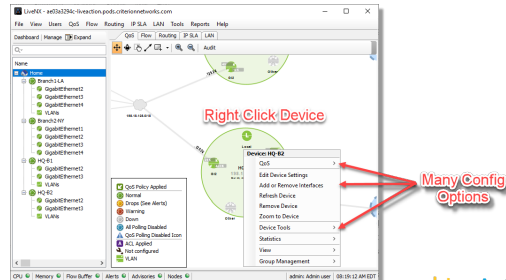
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Configuration of Flow



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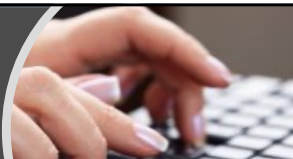
The screenshot displays the LiveAction web interface. On the left, the 'Manage' menu is visible, with 'LiveNetX - 34135.40195' selected. The main content area shows the configuration for this device, including sections for 'Flow Configuration' and 'Flow Configuration Table'. The 'Flow Configuration Table' lists various flows with columns for Name, Status, Type, IP Address, Description, Type, Action, Auth, AuthType, AuthType, Traffic, and Count. The table contains several entries, including 'BGP-100', 'BGP-101', 'BGP-102', 'BGP-103', 'BGP-104', 'BGP-105', 'BGP-106', 'BGP-107', 'BGP-108', 'BGP-109', 'BGP-110', 'BGP-111', 'BGP-112', 'BGP-113', 'BGP-114', 'BGP-115', 'BGP-116', 'BGP-117', 'BGP-118', 'BGP-119', 'BGP-120', 'BGP-121', 'BGP-122', 'BGP-123', 'BGP-124', 'BGP-125', 'BGP-126', 'BGP-127', 'BGP-128', 'BGP-129', 'BGP-130', 'BGP-131', 'BGP-132', 'BGP-133', 'BGP-134', 'BGP-135', 'BGP-136', 'BGP-137', 'BGP-138', 'BGP-139', 'BGP-140', 'BGP-141', 'BGP-142', 'BGP-143', 'BGP-144', 'BGP-145', 'BGP-146', 'BGP-147', 'BGP-148', 'BGP-149', 'BGP-150', 'BGP-151', 'BGP-152', 'BGP-153', 'BGP-154', 'BGP-155', 'BGP-156', 'BGP-157', 'BGP-158', 'BGP-159', 'BGP-160', 'BGP-161', 'BGP-162', 'BGP-163', 'BGP-164', 'BGP-165', 'BGP-166', 'BGP-167', 'BGP-168', 'BGP-169', 'BGP-170', 'BGP-171', 'BGP-172', 'BGP-173', 'BGP-174', 'BGP-175', 'BGP-176', 'BGP-177', 'BGP-178', 'BGP-179', 'BGP-180', 'BGP-181', 'BGP-182', 'BGP-183', 'BGP-184', 'BGP-185', 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[illegible]

LAB 2: LiveNX Engineering Console

- Launch the LiveNX Engineering Console
 - Connect from your Desktop...
- Explore Engineering Console



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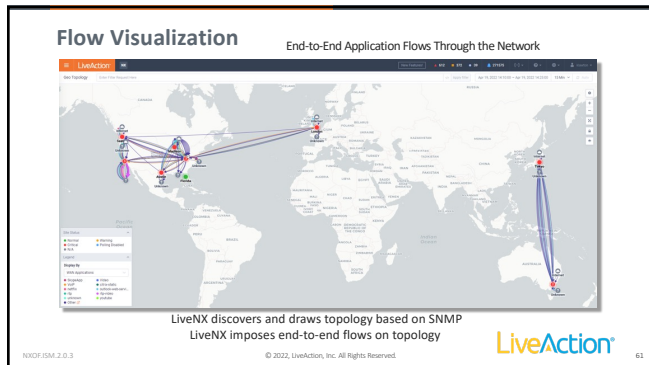
59

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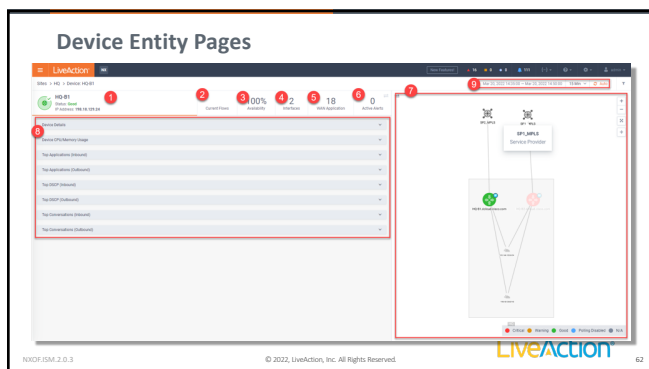
Visualizations

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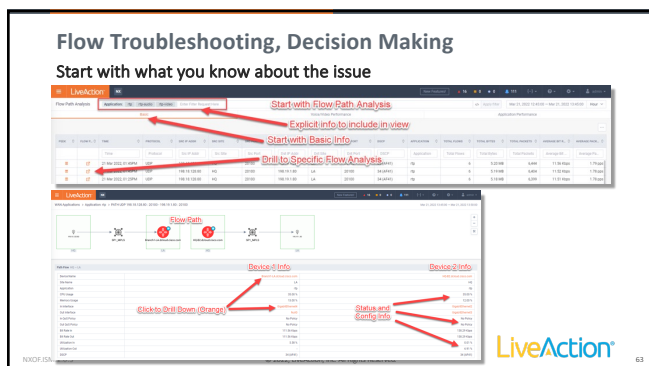
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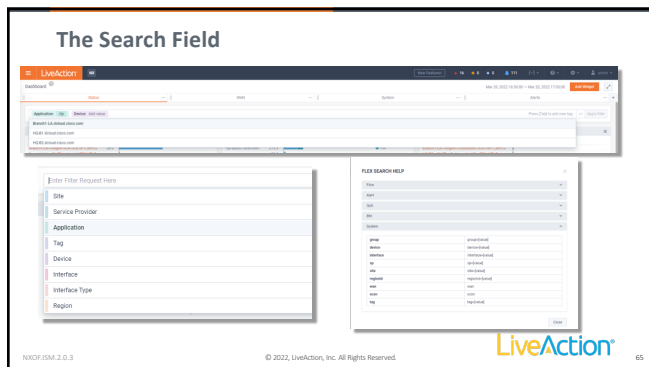
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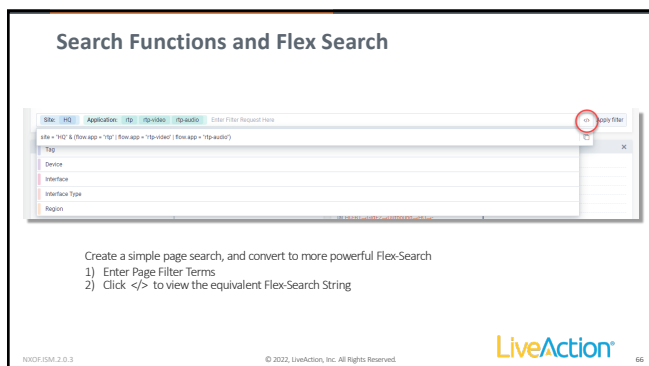
63



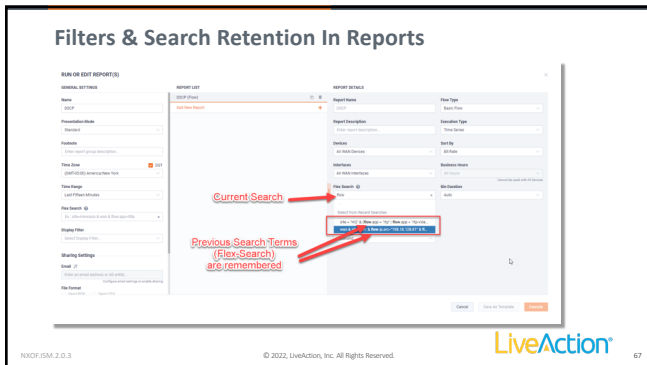
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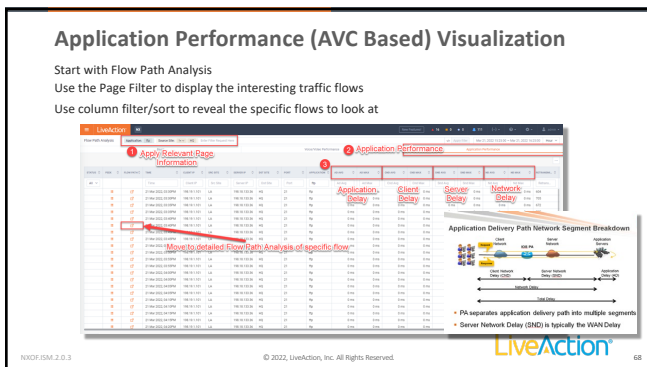
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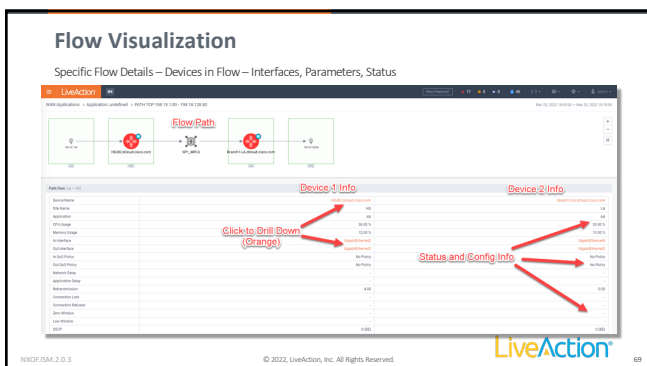
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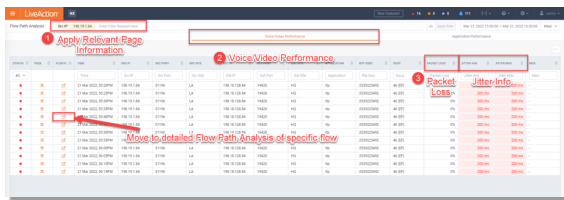
68



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Voice/Video Performance (MediaNet Based) Visualization

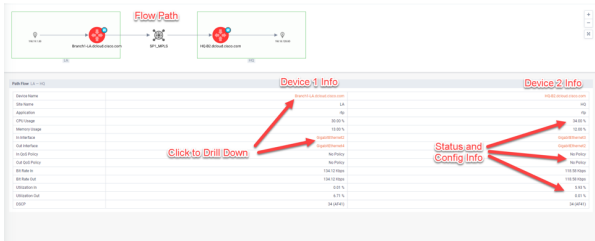
Start with Flow Path Analysis (If no data – review the Page Information used)
Use the Page Filter to display the interesting traffic flows
Use column filter/sort to reveal the specific flows to look at



70

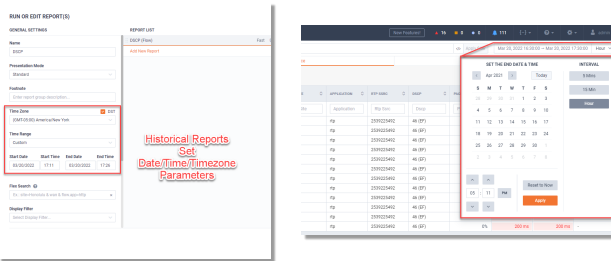
Flow Visualization

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.

Sites: City, Business Unit, Size, Type, IP Range/CIDR

Devices: Router, Firewall, etc

Interfaces: LAN, WAN, SP-name, MPLS, Internet, etc

Flows

Packets

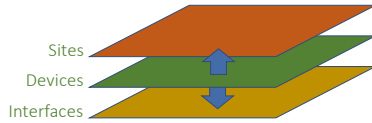
Best Practice:
Use S prefix for Site level tags, D for Device level tags, I for Interface Level tags.

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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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Device Management

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

The image shows three screenshots of the LiveNX Device Management wizards. The first screenshot is labeled 'Add' and shows the 'Add Device' wizard. The second screenshot is labeled 'Discover' and shows the 'Discover Device' wizard. The third screenshot is labeled 'Import' and shows the 'Import Device' wizard. Below the screenshots, the text reads: 'Add — Discover — Import Both on the Eng Console, and the WebUI'.

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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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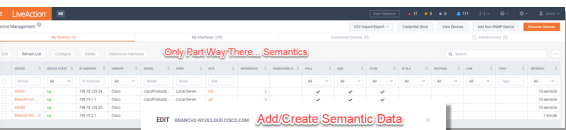
Device Discovery... Simple Steps

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



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Working Topology – Device Needs Semantic Data

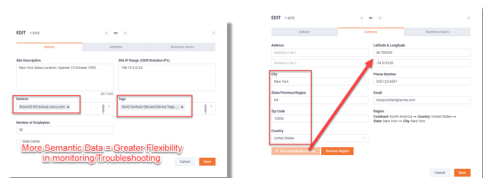


Click on Device name to open config dialogue

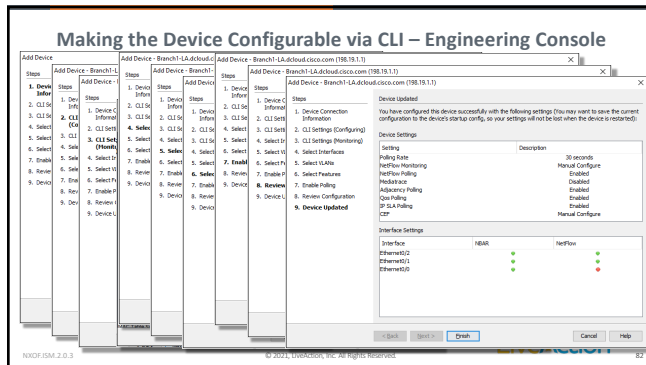
Adding a new site here creates that site for use later. You can also add sites in **Site Management** in **Configure** under **Main Menu**.

80

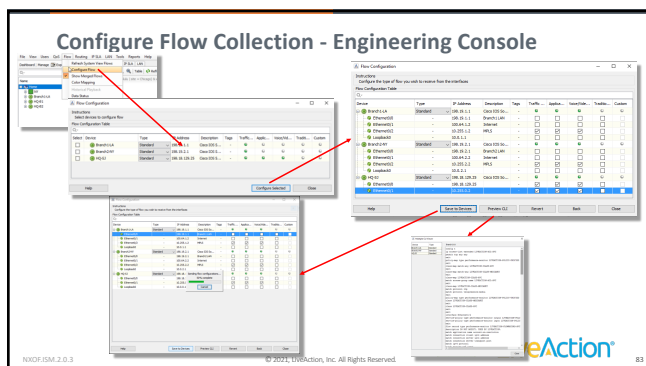
Devices Belong to Sites – Adding Sites And Semantics



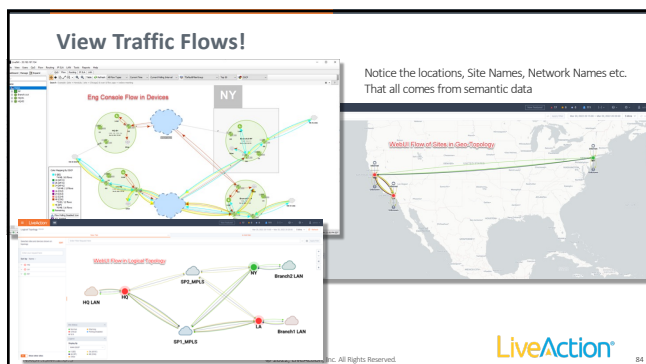
81



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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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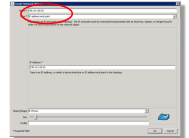
Topology Basics – Add Network Object*

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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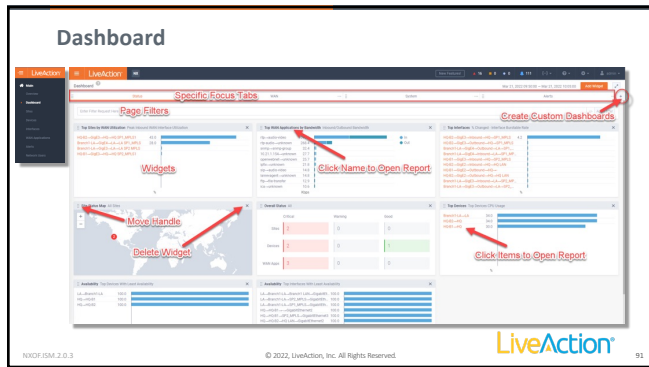


Reports & Alerts

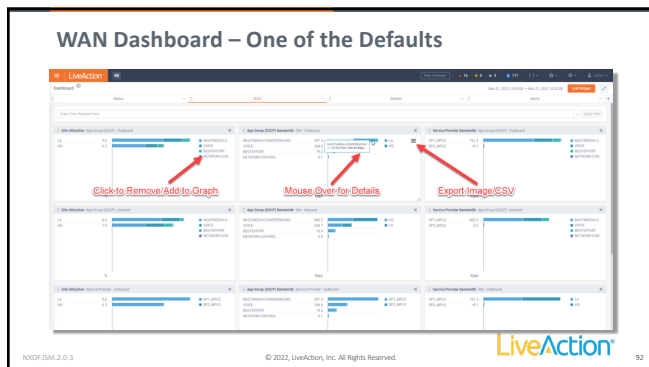
Using LiveNX WebUI

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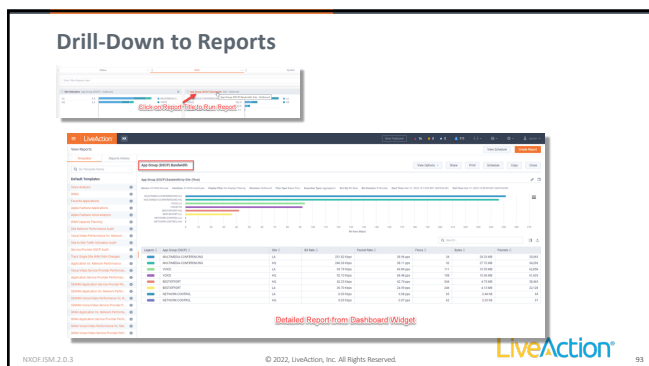
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Creating Reports

Multiple Roads Lead to Reports

From Navigation Menu

From Any Dashboard Item

Drill Down From Entity Pages

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Creating a Report

Apply to All Reports in this single/multi-report request

Editable Fields

List of Reports in this single/multi-report request

Details of Report highlighted in the list

Caution

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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

Direction

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

- Application (Flow)
- Top Conversations (Flow)
- Interface Bandwidth (Flow)
- DSCP (Flow)
- Application DSCP Audit (Flow)
- Top Interface Bandwidths (SNMP)
- Interface Bandwidth (SNMP)
- Interface Utilization (SNMP)
- Interface Errors (SNMP)
- Top Class Drops (SNMP)

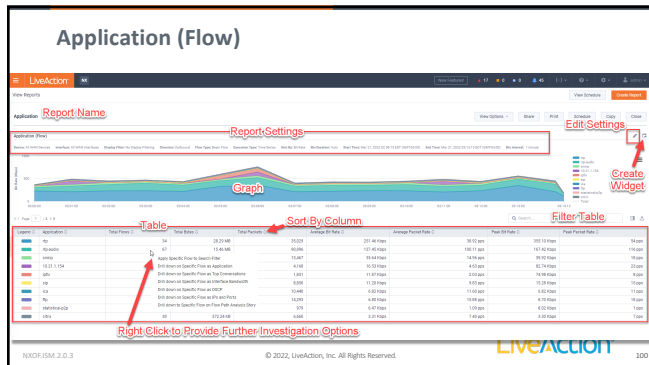
Different data sources will provide different perspectives of your network

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

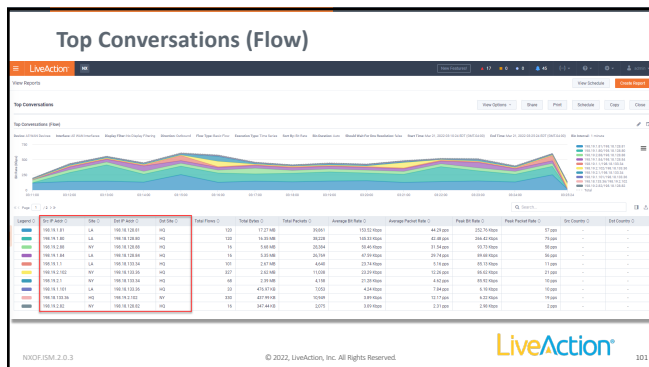
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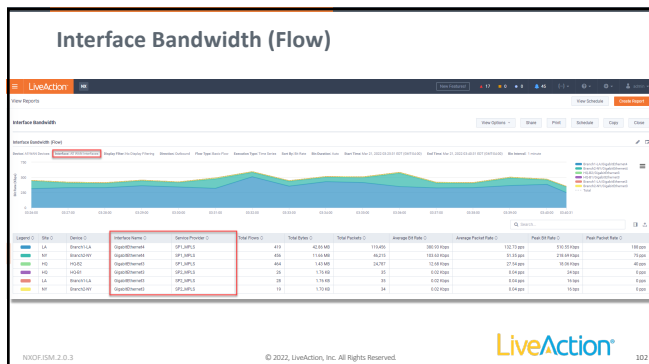
LiveNX Training Student Guide



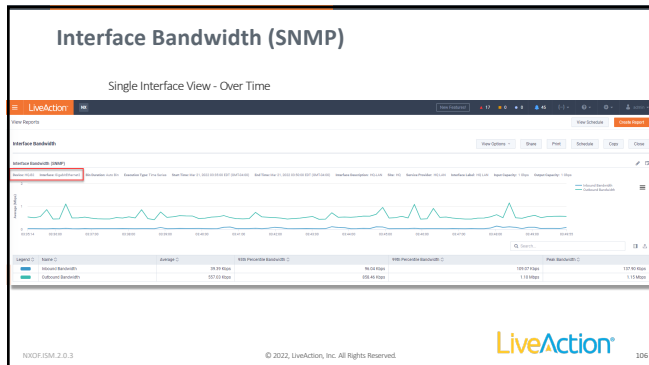
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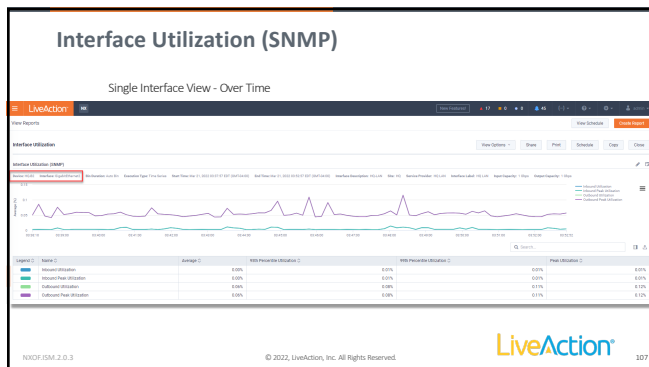
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Top Interface Errors (SNMP)

Single Interface View - Over Time

Category	Name	Unit	Value
Interface Errors	GigabitEthernet0/0/0/24	Count	100.00
Interface Errors	GigabitEthernet0/0/0/24	Count	100.00
Interface Errors	GigabitEthernet0/0/0/24	Count	100.00

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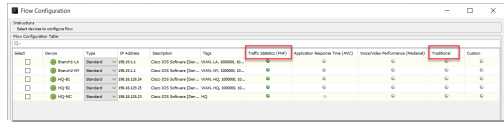
Flow Collection

- The industry standard for flow type is “IPFIX”
 - Cisco uses sflow for certain devices 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

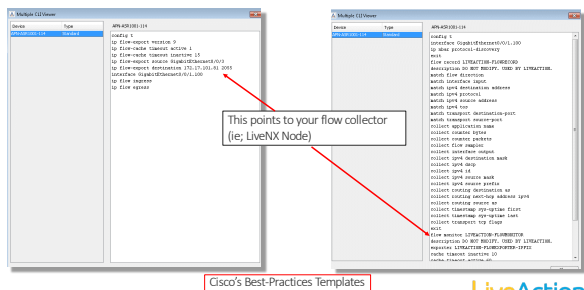


- Traditional Netflow should only be used if Flexible is not available!
 - LiveNX can discover what type of Netflow is supported and configure it for you!
 - LiveNX will not let you configure both Traditional and Flexible on the same interface

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

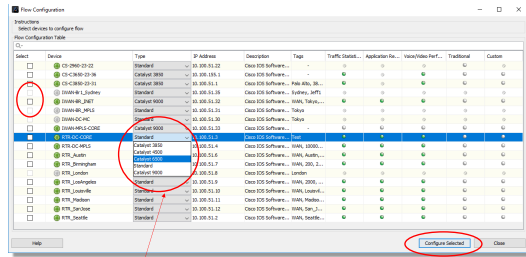
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Traditional v. Flexible Netflow - Preview CLI



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Enable Flow Collection Within LiveNX Engineering Console



Easily Setup Flow Configurations at the Device Level

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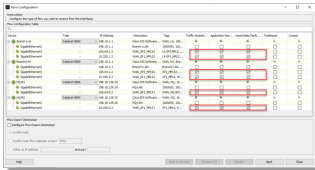
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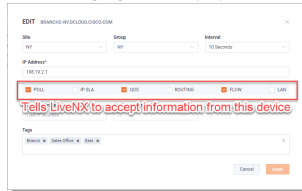
Enable Flow Collection on Interfaces

Engineering Console
Configuring device on what to report
And LiveNX to accept the reports

WebUI
Configuring LiveNX to accept reports



Setup Flow Configurations at the Interface Level



NIOPF-ISM-2.0.3

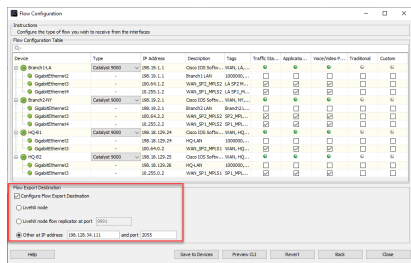
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Re-Direct Collected Flows...

- Ability to specify alternate target for Flow Collectors
- LiveNX Node
- LiveNX Flow Replication on Port#
- Other IP / Port (Gigamon, Smplicator, SolorWinds...)



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

NetFlow Key Fields

- Source IP address
- Destination IP address
- Source port
- Destination port
- Layer 3 protocol
- 10s byte counter
- Input interface

NetFlow Cache

Flow Information	Packets	Bytes/packet
Address, ports	11000	1528

Create a Flow Record from the Packet Attributes

To Flow Collector

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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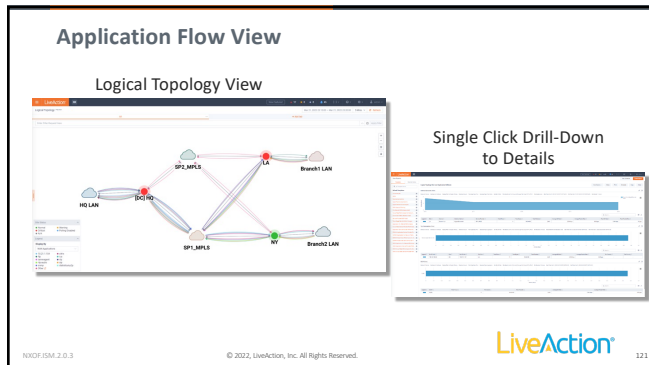
119

Netflow Interface View

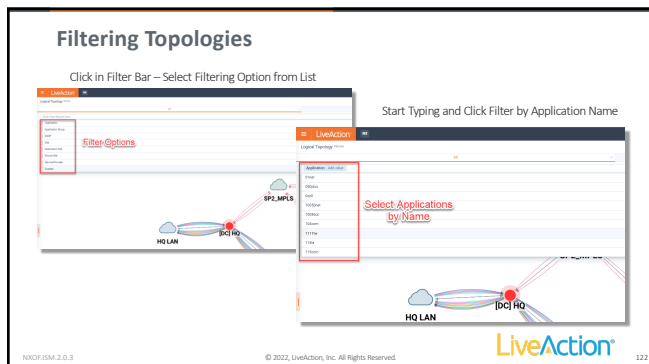
View quantity & type of traffic traversing a specific interface

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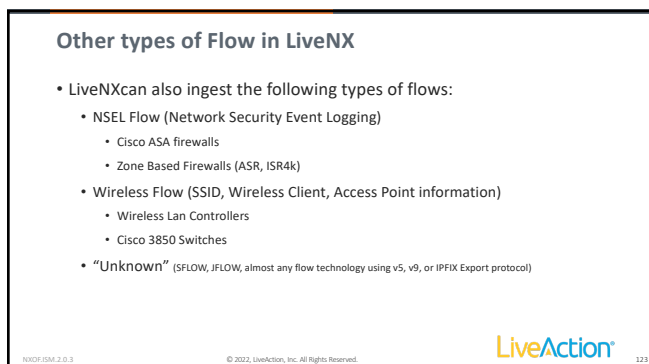
120



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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_lib/config_library/nbar-prot-pack-library.html

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NBAR2

• How does Deep Packet Inspection help?

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

Protocol	Sr IP Addr	Sr Port	Dest IP Addr	Dest Port	Application
TCP	192.168.15.122	80	192.168.15.122	80	http
TCP	192.168.15.122	80	192.168.15.122	80	http
TCP	192.168.15.122	80	192.168.15.122	80	http
TCP	192.168.15.122	80	192.168.15.122	80	http
TCP	192.168.15.122	80	192.168.15.122	80	http

- LiveNX uses NBAR2 in Flow records for detailed application information
- You can use NBAR2 definitions for granular QoS configuration
- If your application is not known, you can set a NBAR application on the CLI
- If NBAR2 is supported, LiveNX will push the configuration to the devices during Netflow configuration

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IANA.Org

- If LiveNX is *not* able to get the NBAR2 application definitions from the device:
 - Uses the IANA (Internet Assigned Numbers Authority) definitions for Applications.

Service Name and Transport Protocol Port Number
Service Name: http
Transport Protocol: TCP
Port Number: 80
Application: http

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Custom Application Label

- What if you have your own custom applications in the Network?
- You can go into LiveNX and define applications based on Protocol, Ports or IP Address and see the application name you desire

Define Custom Application

Name: LiveActionClient

Description: This port is used for LiveAction Clients Communication

IP Address: Specify IP ranges (ex: 192.168.1.1-200) or one IP per line

Port: 7000 Layer 4 Protocol: TCP

OK Cancel

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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	L3 Classification	DSCP	IETF
Network Control	CS6	48	RFC 2474
VoIP Telephony	EF	46	RFC 3246
Broadcast Video	CS5	40	RFC 2474
Multimedia Conferencing	AF41	34	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
OAM	CS2	16	RFC 2474
High-Throughput Data	AF11	10	RFC 2597
Best Effort	DF	0	RFC 2474
Low Priority Data	CS1	8	RFC 2474

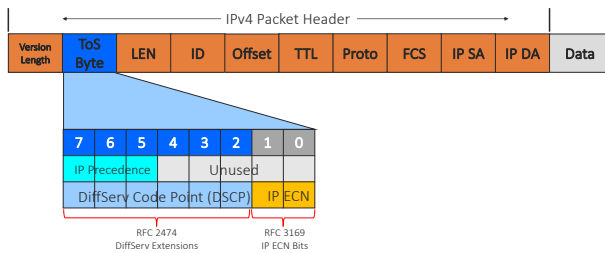
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Packets & DSCP Markings



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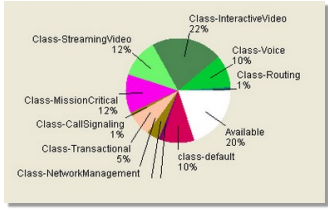
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QoS Techniques

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



Class	Percentage
Class-InteractiveVideo	22%
Class-Voice	10%
Class-Routing	1%
Available	20%
class-default	10%
Class-NetworkManagement	5%
Class-Transactional	1%
Class-CallSignaling	1%
Class-MissionCritical	12%
Class-StreamingVideo	12%

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LAB 6 & 7: Working With Flow and Customizing Filters


- Discover Flows
- Identify Flows
- Create Custom Filters



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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 i7 • 16 Gb RAM • Max Heap Size 8GB • 500GB Data Disk	Min Requirements: • 16 vCPU Xeon or i7 • 32 Gb RAM • 2TB Data Disk	Min Requirements: • 16 vCPU Xeon or i7 • 64 Gb RAM • Max Heap Size 16GB • 4TB Data Disk	Min Requirements: • 32 vCPU Xeon or i7 • 64 Gb RAM • Max Heap Size 31GB • 8TB Data Disk	Min Requirements: • 64 vCPU Xeon Gold 5218 • 768 Gb RAM • Max Heap Size 584GB • 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

RAW 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

- Local drive preferred
 - Minimum equivalent to SATA 6 Gb/s performance
 - 7,200 RPM hard or 10,000 RPM for better performance
 - RAID 10 for better performance
 - SSD for better performance
- SAN and NAS
 - Meet 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 RAW 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	1000
SNMP/Month	22-46GB	56-112GB	112-225GB	225-450GB

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

RAW Flow

Raw Flow Rate (K flows/sec)	< 250/sec	< 500/sec	< 1000/sec	< 2000/sec
Raw Flow/Month	75TB	375TB	675TB	375TB

Long Term Flow

Long Term Flow Rate (K flows/sec)	< 250/sec	< 500/sec	< 1000/sec	< 2000/sec
Long Term Flow/Month	75TB	300TB	600TB	300TB

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NetFlow Bandwidth Overhead – Someone ALWAYS Asks!

Device Type	Flows/Sec	Full Display User Bandwidth for 4 sec	NetFlow Bandwidth Average	NetFlow Bandwidth Peak
WAN Router	83	158.50Mbps	28Kbps (1%)	34.88Kbps (4%)
WAN Router	34	505K-1.1Mbps	16Kbps (1%)	42.4Kbps (1%)
WAN Router	27	820K-2.6Mbps	2.2Kbps (2%)	36Kbps (1%)
WAN Router	287	721-28Mbps	85Kbps (04%)	127Kbps (03%)
WAN Router	366	737-72Mbps	163Kbps (04%)	239Kbps (03%)
WAN Router	474	880-123Mbps	280Kbps (03%)	396Kbps (03%)
Internet Router	993	775-113Mbps	317Kbps (04%)	438Kbps (03%)
Core Switch	633	1340-153Mbps	478Kbps (03%)	578Kbps (03%)
Core WAN Router	222,000	914.4-25Mbps	133Mbps (02%)	128Mbps (02%)

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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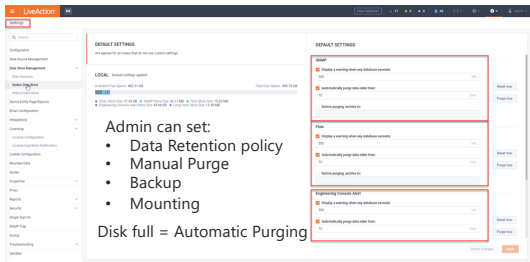
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Disk Retention

Settings > Data Store Management > Nodes Data Store:



Provision Enough Disk Space!

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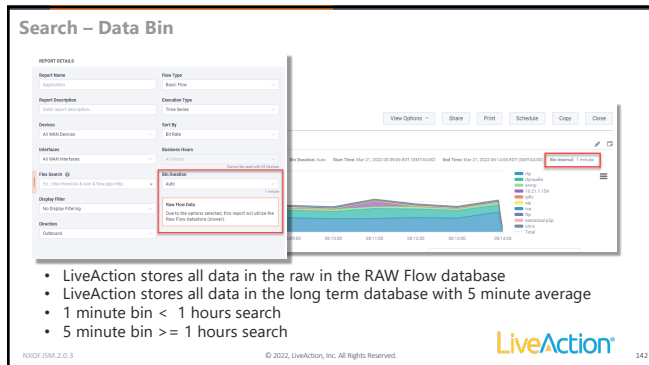
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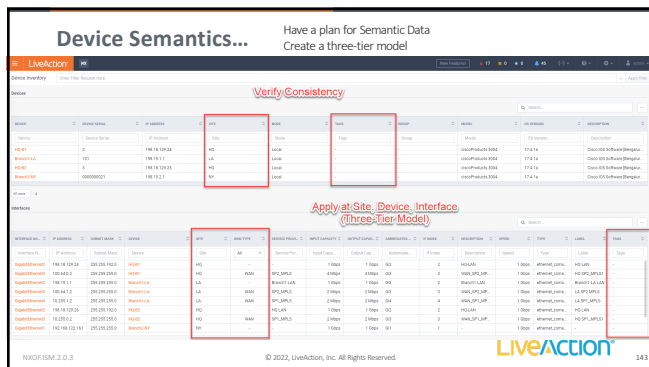
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LiveNX Training Student Guide



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NetFlow Best Practices

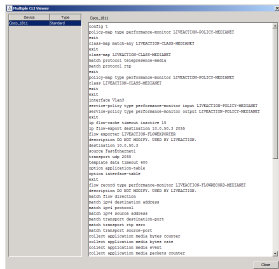
- Use LiveAction to deploy NetFlow
- Use Flexible NetFlow when possible*
- Use NBAR2 and standardized on Protocol Pack
- Use NetFlow v9 or IPFIX
- Enable Flow on the fewest interfaces possible
- Medianet and AVC on WAN interfaces only for routers
- Use good IOS for Medianet and AVC

*with good/modern IOS

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NetFlow – Configuration Management



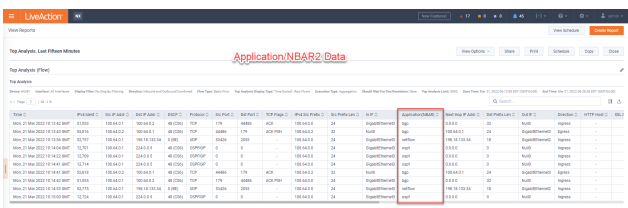
Use Best Practice NetFlow templates built into LiveAction

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



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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
---	--	---	--

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 pixel(r=1608579339;fpam=0;fpa=P0-322201277-1287906563231;ns=0;url=http%3A%2F%2Fw2.quant.swf;2 981:3 crossdomain.xml:3 913:2 914:2 461:2 cgi-bin%5 915:2 ad:2 462:2 adedge:2 839:2 quant.js:2 api:3 761:2 notice.do:2 _vti_bin:2 jaction:2 images:10 pixel(r=1182204851;fpam=0;fpa=P0-322201277-1287906563231;ns=0;url=http%3A%2F%2Fw2.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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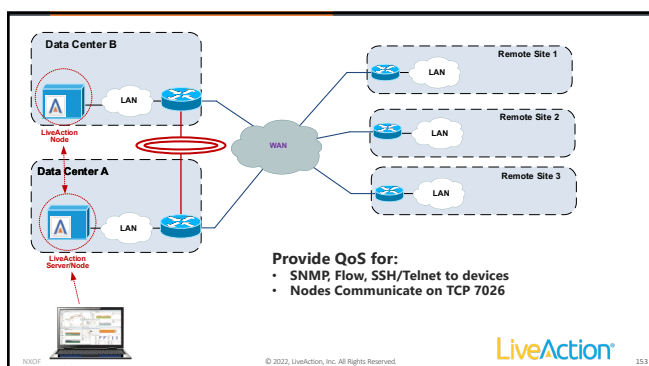
151

Other Best Practices

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Device Semantics... Have a plan for Semantic Data
Create a three-tier model

Verify Consistency

Apply at Site, Device, Interface (Three-Tier Model)

The screenshot shows the 'Device Semantics' interface in LiveAction. It features a table with columns for 'Device', 'IP Address', 'Subnet', 'Device', 'Type', 'Model', 'Vendor', 'OS', 'Version', 'Status', 'Location', and 'Tags'. Red boxes highlight the 'Device', 'IP Address', 'Subnet', 'Device', and 'Type' columns. Another red box highlights the 'Status' column. A red box also highlights the 'Tags' column. The interface includes a search bar and a 'Filter' button. The footer shows 'NIOPF ISM 2.0.3' and '© 2022, LiveAction, Inc. All Rights Reserved.'.

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Semantic Data – In Reporting Example 1

Flex Search: flow.ip=198.18.128.80 | flow.app=TRAINING BITTORRENT

Configure Reports with Flex-Search using Tags (Semantic Data)

Flex-Searches used in reports are also shown on Report

The screenshot shows the 'Reporting' interface in LiveAction. It features a line chart with a blue area representing data over time. The x-axis is labeled 'Time' and the y-axis is labeled 'Value'. A red box highlights the 'Flex-Searches used in reports are also shown on Report' text. The interface includes a search bar and a 'Filter' button. The footer shows 'NIOPF ISM 2.0.3' and '© 2022, LiveAction, Inc. All Rights Reserved.'.

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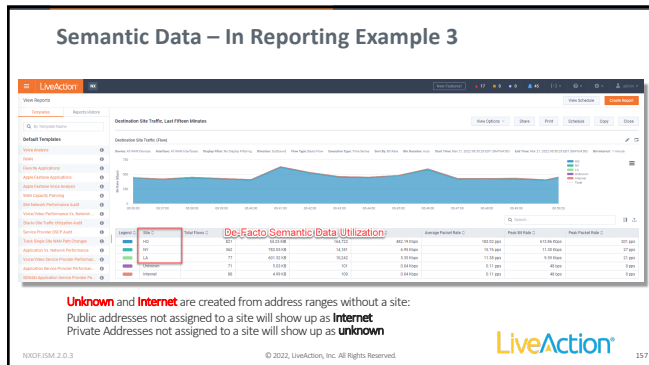
Semantic Data – In Reporting Example 2

Flex Search: wan & tag=West & flow.app=ftp

Application (Flow)

The screenshot shows the 'Reporting' interface in LiveAction. It features a line chart with a blue area representing data over time. The x-axis is labeled 'Time' and the y-axis is labeled 'Value'. A red box highlights the 'Application (Flow)' text. The interface includes a search bar and a 'Filter' button. The footer shows 'NIOPF ISM 2.0.3' and '© 2022, LiveAction, Inc. All Rights Reserved.'.

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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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LiveNX Training

Day 2
03 April 2022

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Agenda - Day 2

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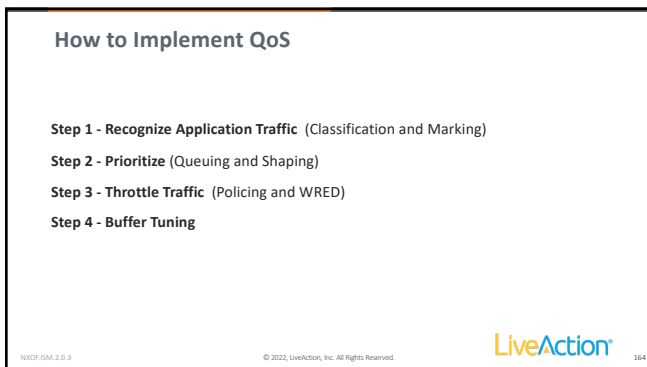
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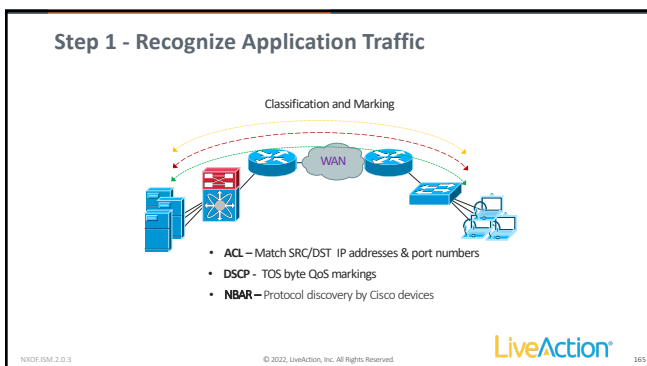
162



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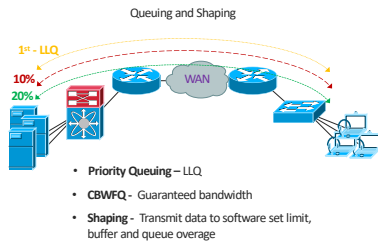


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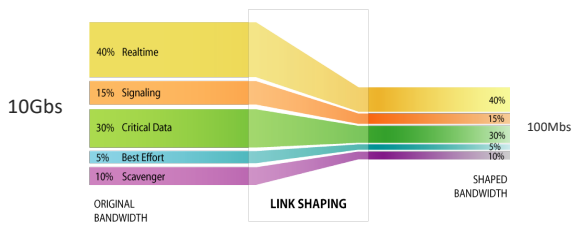
Step 2 – Prioritize



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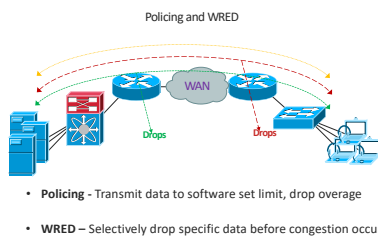
Shaping (or Scaling)



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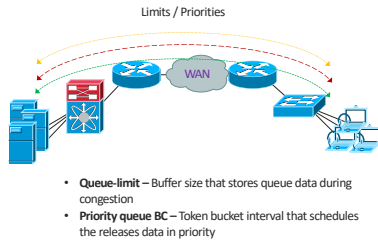
Step 3 –Throttle Traffic



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Step 4-Buffer Tuning (advanced)



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QoS Monitoring & Configuration

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LiveNX QoS Baseline

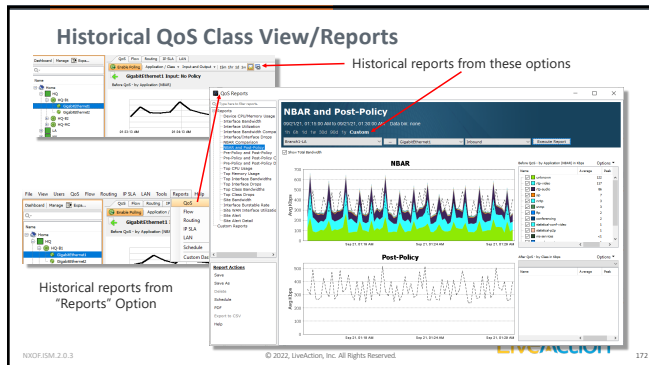
- Configuring QoS Control on the network is very important, but if you do not have a good understanding of your current network traffic... implementing QoS *could* cause issues.
- You can baseline your network performance with NBAR2 reports or Netflow reports *before* implementing QoS Control
- Baselining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

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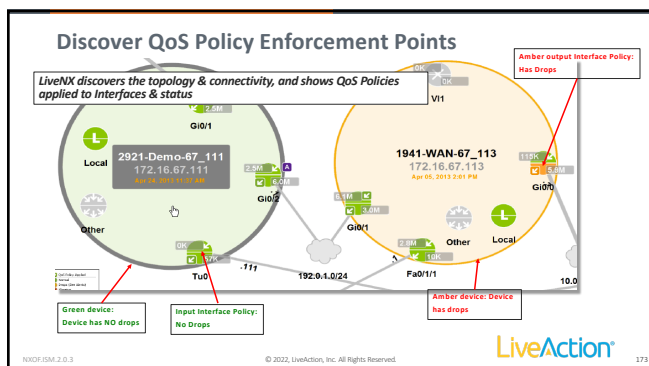
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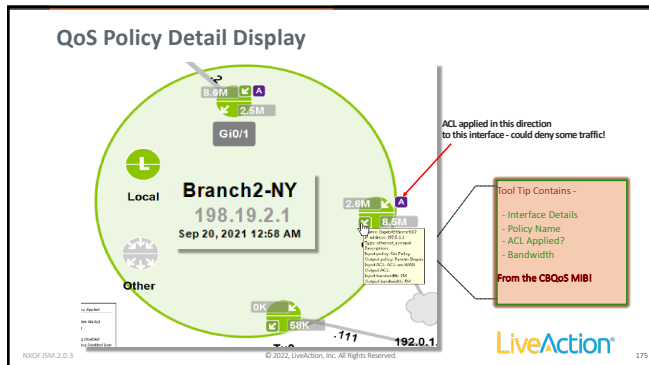


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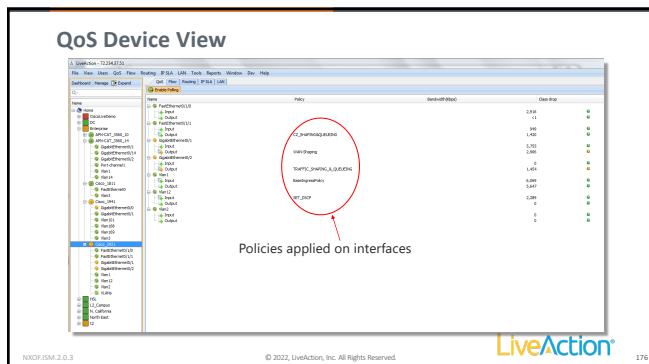
QoS ACL

- 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

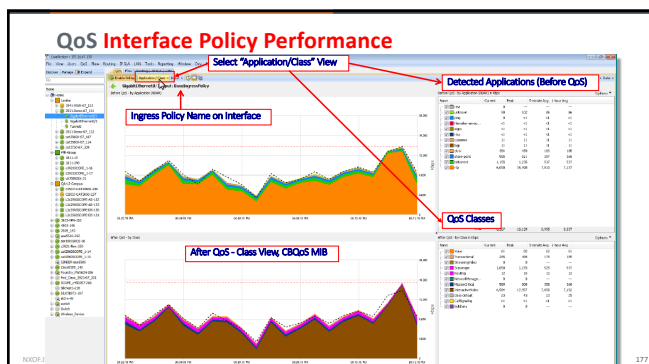
174



175



176



177

QoS Troubleshooting

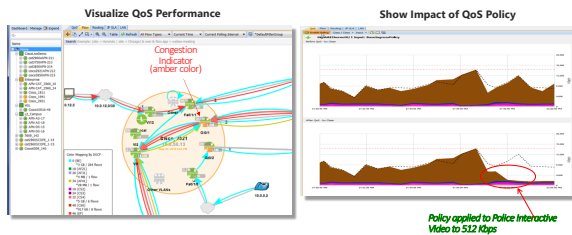
- Real-Time QoS Issues

Amber QoS class color shows class drops



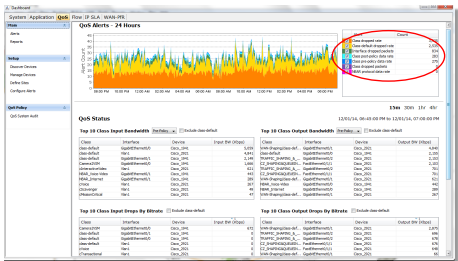
178

Track QoS Performance & Policy Validation



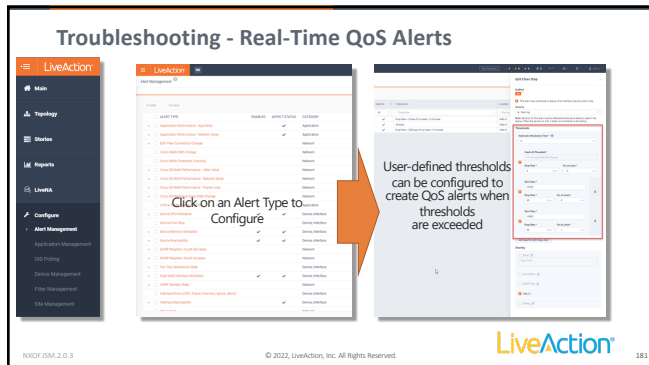
179

QoS Dashboard

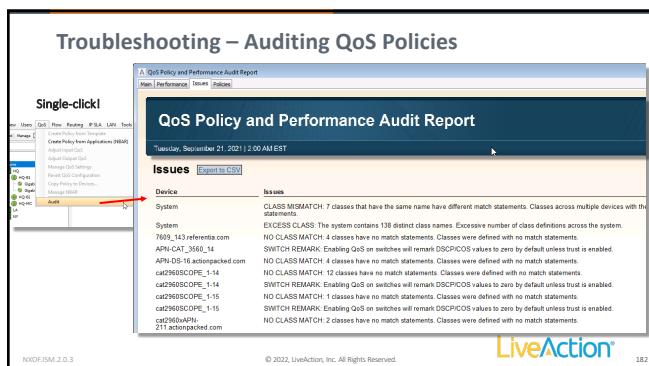


Driven from MIB-II, NBAR, and CBQoS MIBs

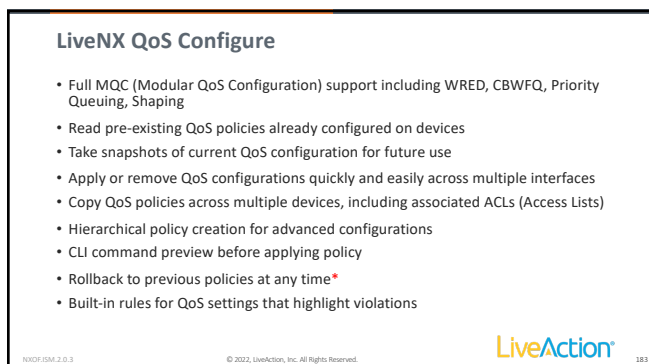
180



181



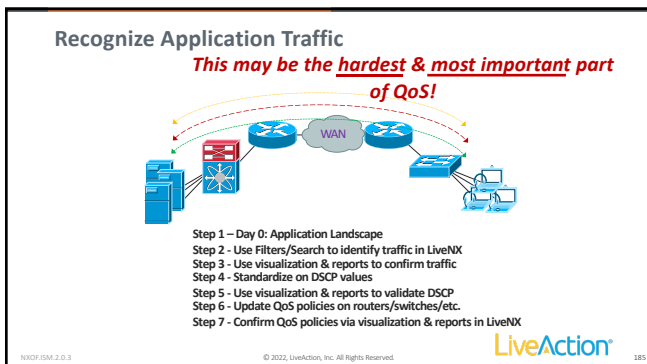
182



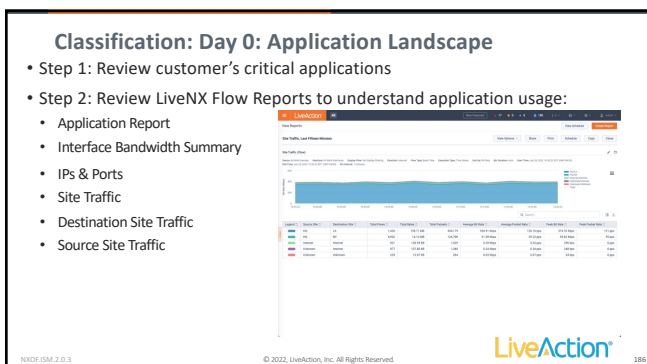
183



184

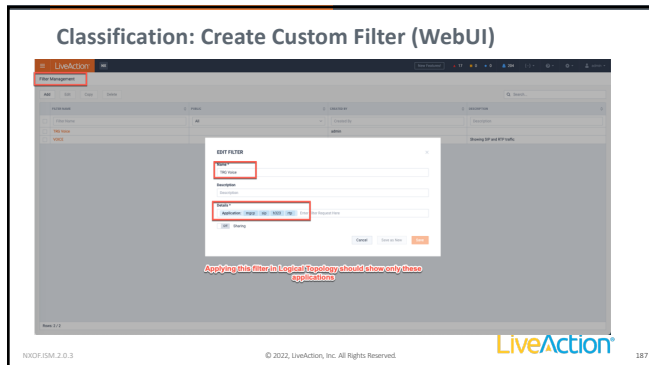
[illegible]

185

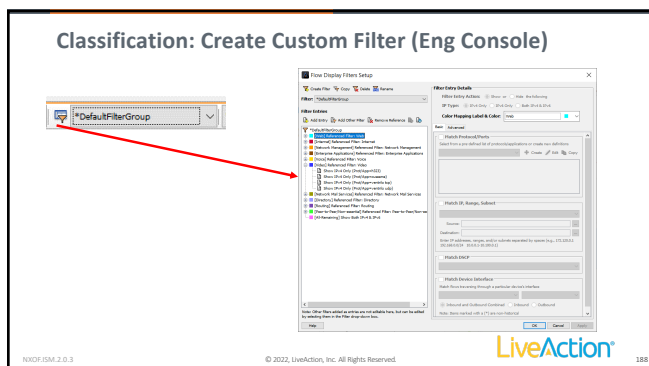
[illegible]

186

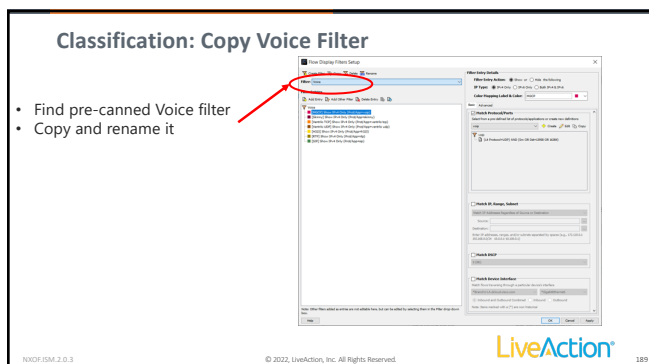
[illegible]



187



188

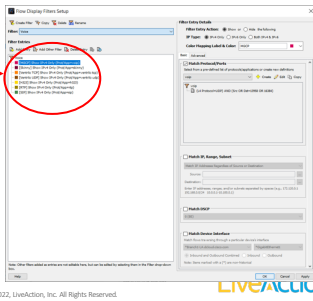


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Classification: Delete Unused Entries

Delete unused Entries

- VoIP
- Ventrilo TCP
- Ventrilo UDP



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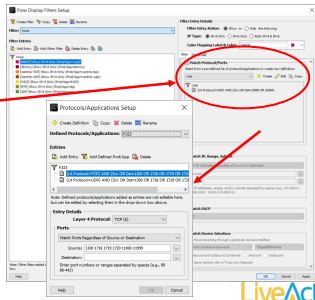
Classification: Add/Edit Entries

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

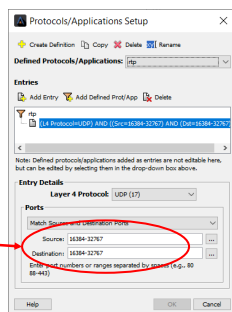
TCP/UDP = Src or Dst = 1718 1719 1720

SIP

TCP/UDP = Src or Dst = 5060 5061 5062

RTP

UDP = Src AND Dst = 16384-32767



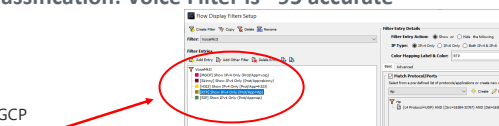
NIOP/ISM 3.0.3

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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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[illegible]

193

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

The screenshot shows the 'Voice Display Filters Setup' dialog box. The 'Filter For' tab is selected. Under 'Filter For', the 'IP Address' section is expanded, showing a list of IP addresses. A red circle highlights the 'IP Address' section. A red arrow points from the 'IP Address' section to the 'Filter For' tab. Another red arrow points from the 'Filter For' tab to the 'Filter For' section.

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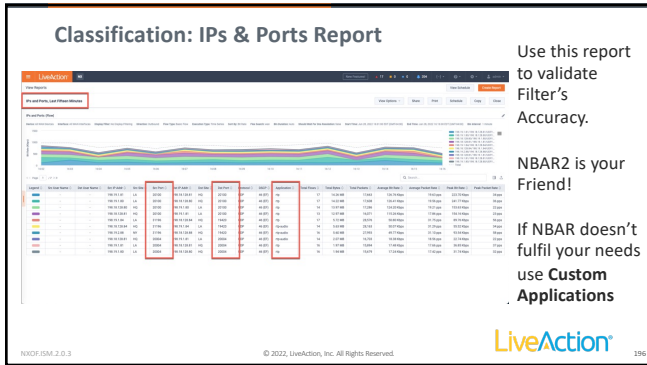
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[illegible]

194

[illegible]

195



196

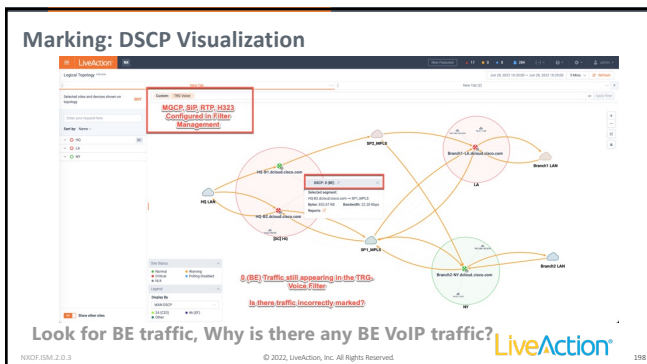
Marking: Selecting DSCP Values

Class Type	4 Class	8 Class	12 Class
Cisco Name / AFCSQNA Name			
Voice / IP Telephony	EF (46)	EF (46)	EF (46)
Interactive Video / Multimedia Conferencing	CS5(40) CS4 (32)	CS5 (40) CS4 (32)	AF41 (34) AF42 (36) AF43 (38)
Streaming Video			AF31 (26) AF32 (28) AF33 (30)
Real Time Interactive			CS4 (32)
Broadcast Video			CS5(40)
Cell Signaling	CS6 (48)	CS3 (24)	CS3 (24)
IP Routing / Network Control	CS3 (24)	CS2 (16)	CS6 (48)
Network Management	CS2 (16)		CS2 (16)
Transactional Data / Low-Latency Data	AF41 (34) AF42 (36) AF43 (38) AF31 (26) AF32 (28) AF33 (30)	AF41 (34) AF42 (36) AF43 (38) AF31 (26) AF32 (28) AF33 (30)	AF21 (18) AF22 (20) AF23 (22)
Bulk Data / High Throughput Data	AF21 (18) AF22 (20) AF23 (22) AF11 (10) AF12 (12) AF13 (14)	AF21 (18) AF22 (20) AF23 (22) AF11 (10) AF12 (12) AF13 (14)	AF11 (10) AF12 (12) AF13 (14)
Scavenger / Low-Priority Data	BE (0)	CS1 (8)	CS1 (8)
Best Effort		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.

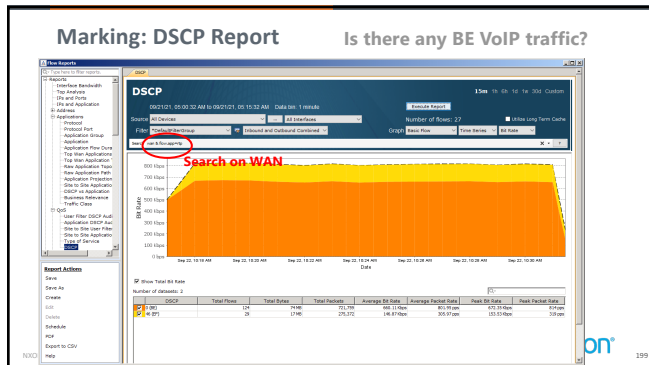
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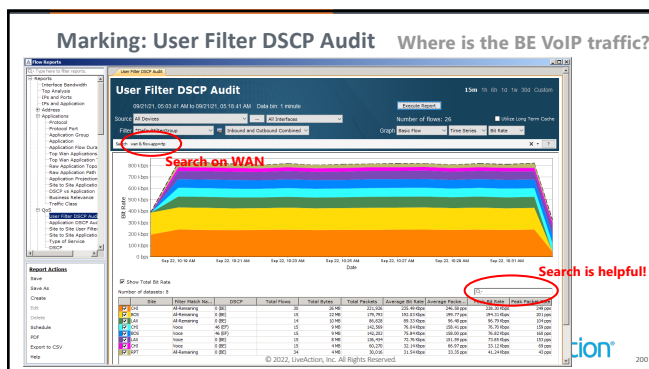


198

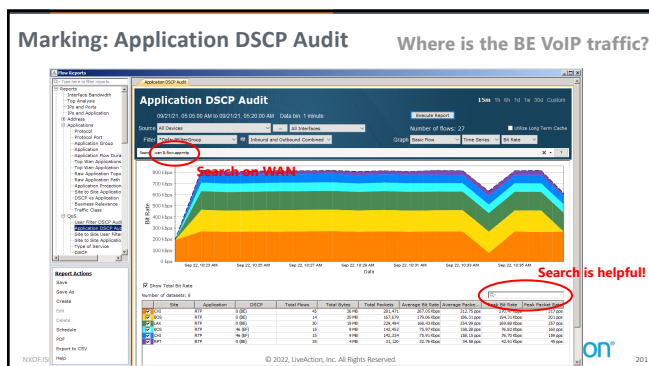
LiveNX Training Student Guide



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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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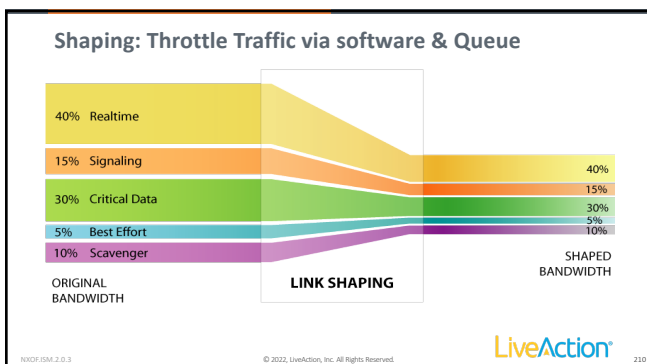
208

**Step 2:
Queueing & Shaping**

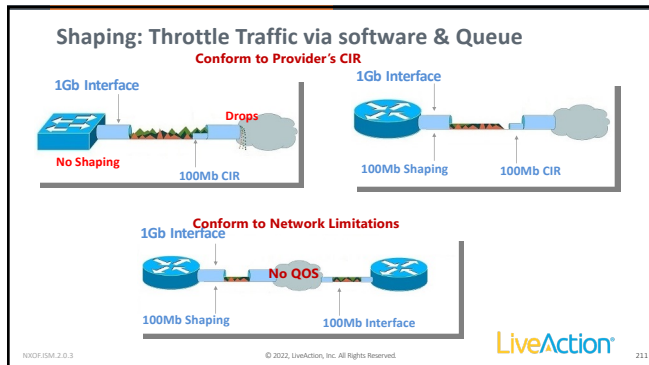


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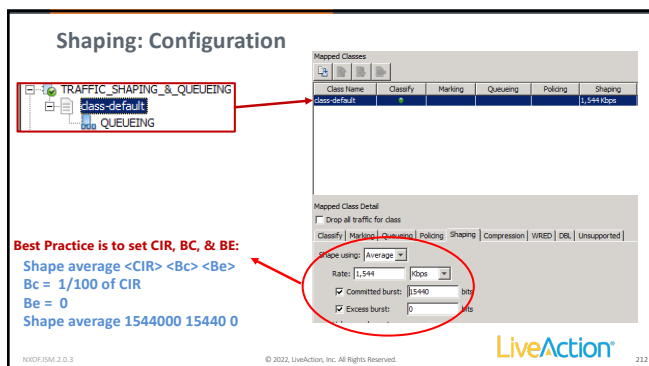
209



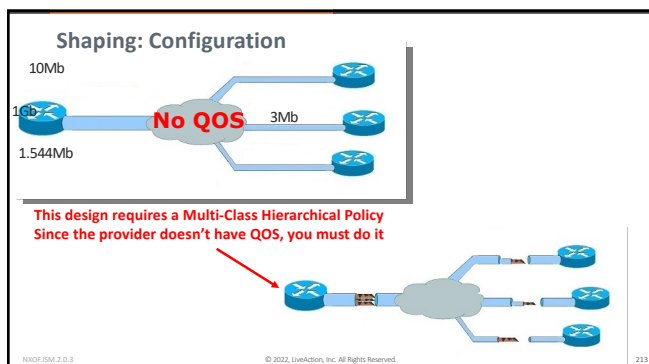
210



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Shaping: Configuration

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Queueing: Selecting Bandwidth Allocations

Class Type	4 Class	8 Class	32 Class
Voice / IP Telephony		10%	10%
Interactive Video / Multimedia Conferencing		23%	10%
Streaming Video	13%		10%
Real-Time Interactive		10%	13%
Broadcast Video			10%
CAT 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	1%		5%
Scavenger / Low-Priority Data		1%	1%
Best Effort	15%	25%	25%

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

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Queueing: Understanding Traffic

This is how one voice call looks:

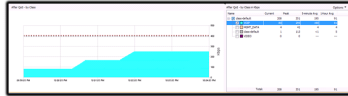
1x G.711 Call is ~82 Kbps
1x G.729 call is ~24.6 Kbps
Consistent pps = no burst

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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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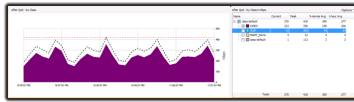
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Queueing: Understanding Traffic

This is how one video conference call looks:



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

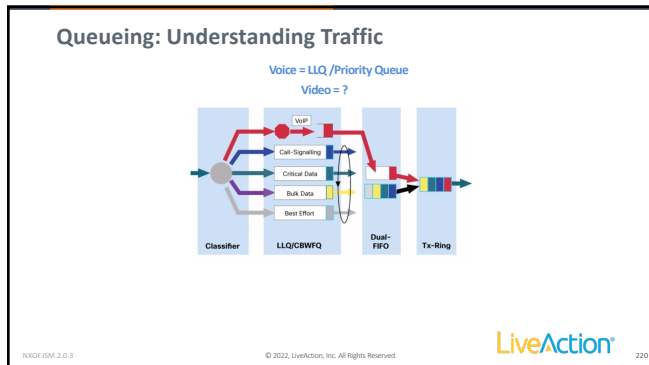
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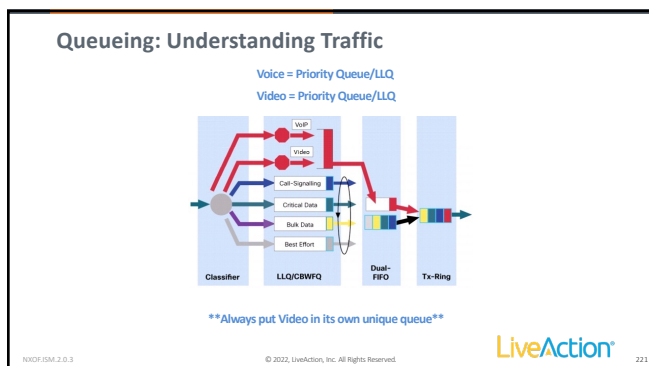
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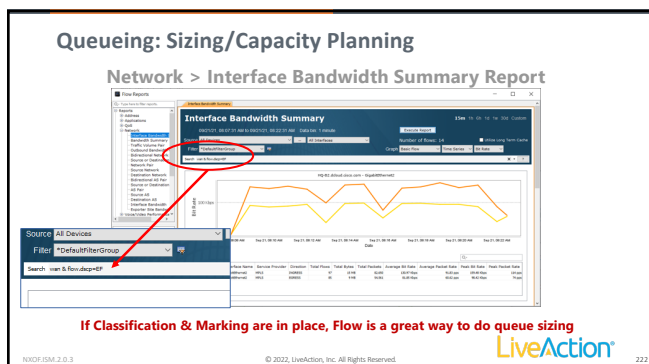
219



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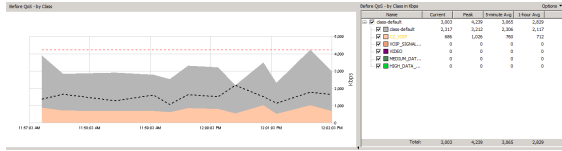
221



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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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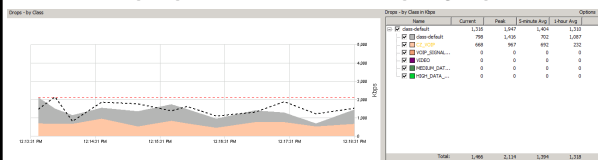
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Queueing: Capacity Planning

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

Match on DSCP

Class Name	Classify	Marking	Queueing	Policing
VOP_SCHULING	Match on DSCP	Class-based: 60 Kbps		
VOP_DATA_QUEUE		Class-based: 50 Kbps		
VOP_DATA_QUEUE		Class-based: 75 Kbps		
VOP_VIDEO		Class-based: 50 Kbps		
Queue-Default		Fair		

Match - DSCP - 46 (PT)

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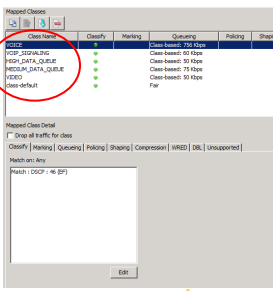
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Queueing: Configuration

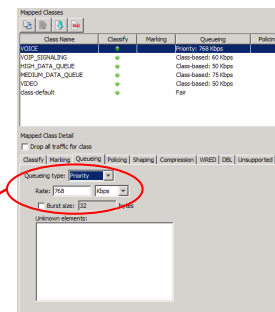
Order Queues based on priority.
Queues are match in a top-down order, so this helps ensure priority traffic is matched by the appropriate queue if there are configuration mistakes. It does not change the priority of traffic transmission.



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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*



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Lab: 3 & 4 Queueing and Shaping

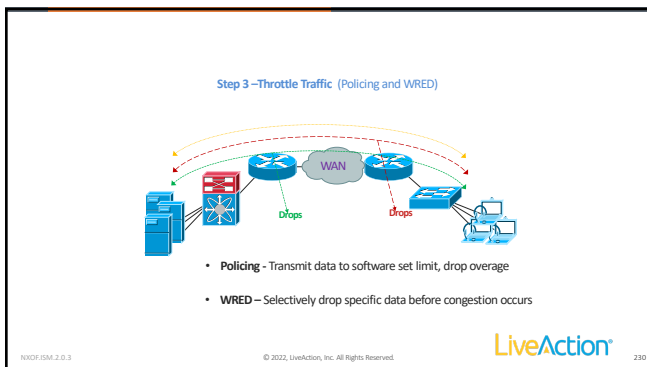
- Prioritization (Queueing & Shaping)
 - Capacity Planning Reports
 - Configure Queueing
 - Configure Shaping
 - Create Validating Policy



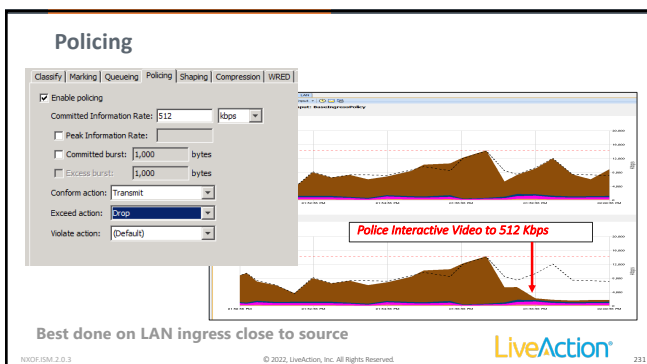
228



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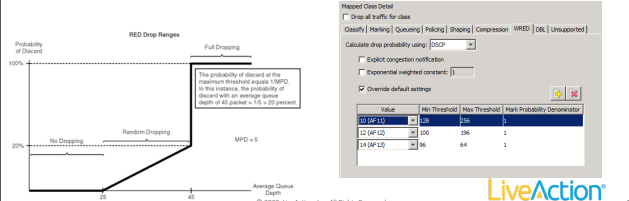
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WRED – Weighted Random Early Detection

- 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 discarding packets based on the average queue depth. It is divided into three regions: No Dropping (0 to 25 packets), Random Dropping (25 to 45 packets), and Full Dropping (45 to 64 packets). A callout box states: 'The probability of discard at the maximum threshold equals 1/MPD. In this instance, the probability of discard with an average queue depth of 45 packet = 1/5 = 20 percent.' The configuration interface shows the 'Mapped Class Detail' for WRED with the following table:

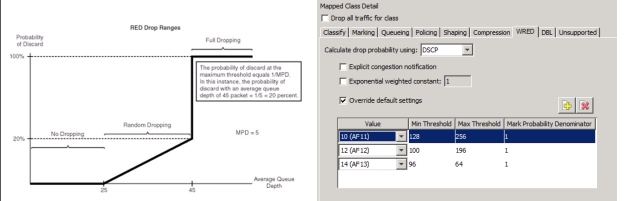
Value	Min Threshold	Max Threshold	Mark Probability Denominator
10 (AF 11)	0	25	5
12 (AF 12)	25	45	1
14 (AF 13)	45	64	1

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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 and configuration interface are identical to the previous slide, showing the WRED drop ranges and the configuration table for DSCP values 10, 12, and 14.

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Lab: 5 Throttling & Policing

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

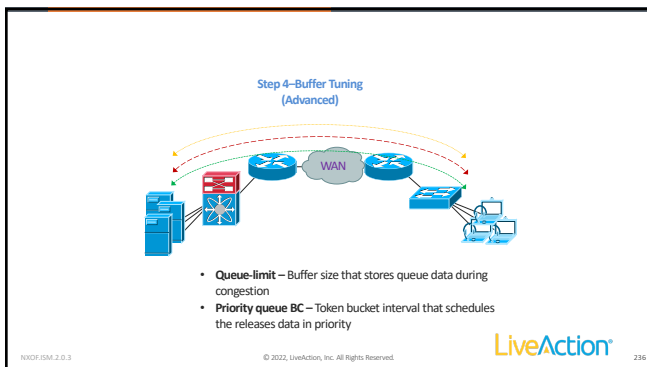


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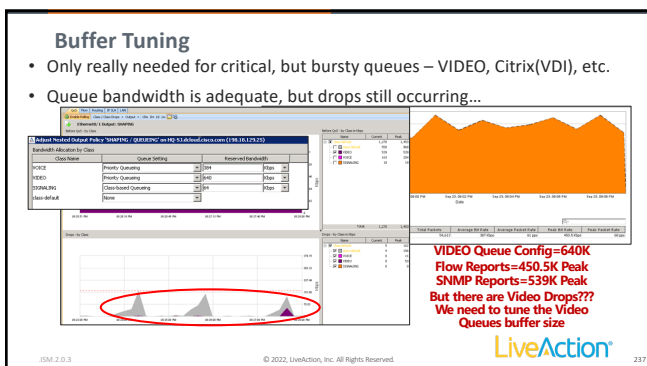
234



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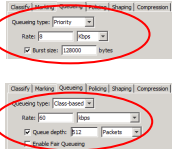


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Lab: 6 Buffer Tuning

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

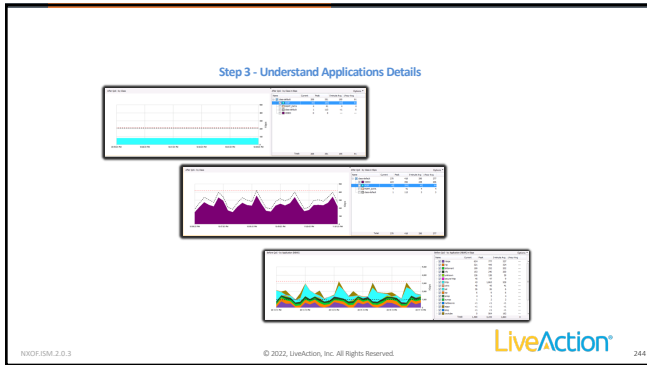
Legend	Application	Total Pkts	Total Bytes	Total Packets	Average Bk Rate	Average Pkts Rate	Peak Bk Rate	Peak Pkts Rate
Standard	Standard	175	41.18 MB	231,333	895.00 Mbps	276.00 pps	435.70 Mbps	530 pps
Standard	Standard	148	37.18 MB	60,584	280.00 Mbps	97.00 pps	342.30 Mbps	70 pps
Standard	Standard	147	37.07 MB	59,840	280.00 Mbps	97.78 pps	348.90 Mbps	66 pps
Standard	Standard	87	20.77 MB	8,979	280.00 Mbps	86.00 pps	288.00 Mbps	40 pps
Standard	Standard	20	25.02 MB	4,108	230.00 Mbps	66.00 pps	300.00 Mbps	45 pps
Standard	Standard	154	4.08 MB	65,720	35.00 Mbps	73.00 pps	46.22 Mbps	80 pps
Standard	Standard	140	4.02 MB	11,848	37.00 Mbps	76.00 pps	170.30 Mbps	80 pps
Standard	Standard	140	5.00 MB	24,238	10.00 Mbps	20.12 pps	37.11 Mbps	77 pps
Standard	Standard	120	1.22 MB	1,428	12.00 Mbps	2.00 pps	14.80 Mbps	2 pps
Standard	Standard	60	621.01 KB	8,712	6.10 Mbps	6.88 pps	11.62 Mbps	10 pps

*Use minute by minute reporting (no Averaging)

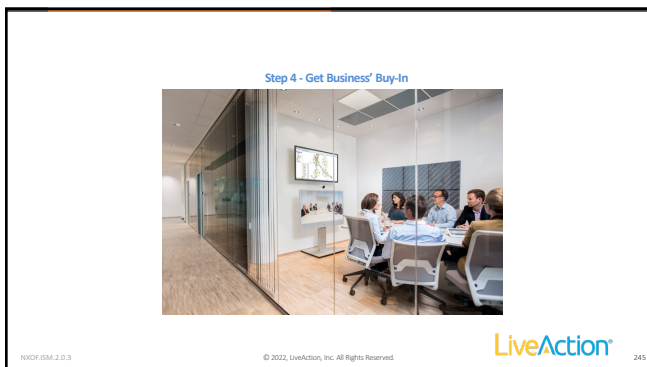
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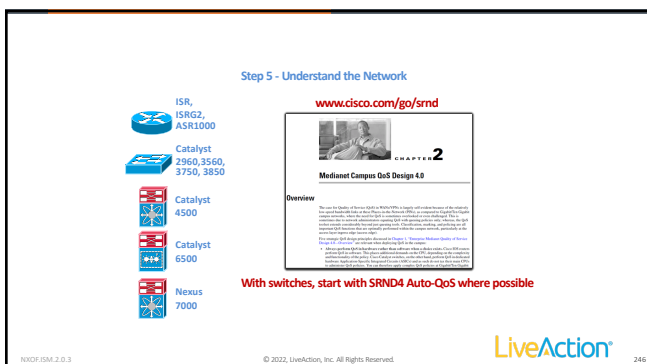
243



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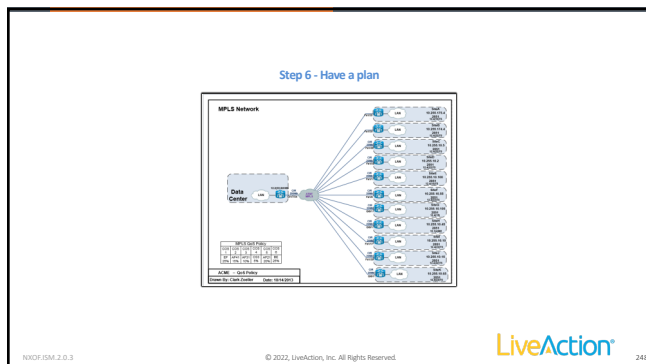
246

Step 6 - Have a plan

ID	Device Name	Device Type	Device ID	Device Model	Device OS	Device Version	Device Status	Device Location	Device Notes
1000000001	1000000001	1000000001	1000000001	1000000001	1000000001	1000000001	1000000001	1000000001	1000000001
1000000002	1000000002	1000000002	1000000002	1000000002	1000000002	1000000002	1000000002	1000000002	1000000002
1000000003	1000000003	1000000003	1000000003	1000000003	1000000003	1000000003	1000000003	1000000003	1000000003
1000000004	1000000004	1000000004	1000000004	1000000004	1000000004	1000000004	1000000004	1000000004	1000000004
1000000005	1000000005	1000000005	1000000005	1000000005	1000000005	1000000005	1000000005	1000000005	1000000005
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1000000007	1000000007	1000000007	1000000007	1000000007	1000000007	1000000007	1000000007	1000000007	1000000007
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1000000009	1000000009	1000000009	1000000009	1000000009	1000000009	1000000009	1000000009	1000000009	1000000009
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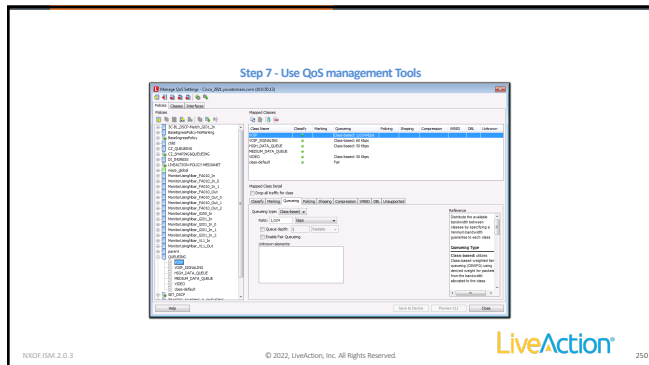
Step 6 - Have a plan

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1000000006	1000000006	1000000006	1000000006	1000000006	1000000006	1000000006	1000000006	1000000006	1000000006
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1000000008	1000000008	1000000008	1000000008	1000000008	1000000008	1000000008	1000000008	1000000008	1000000008
1000000009	1000000009	1000000009	1000000009	1000000009	1000000009	1000000009	1000000009	1000000009	1000000009
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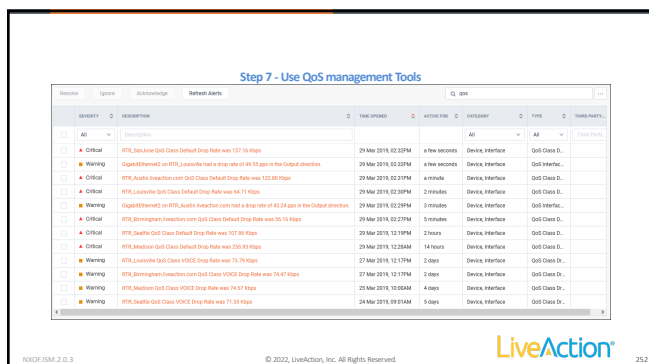
LiveNX Training Student Guide



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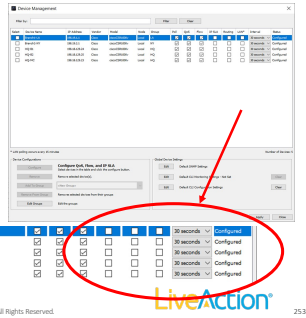


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SNMP Polling Interval

LiveAction Recommends

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



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Alerting – Customize Triggers

ADDITION	REVISION	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Lab 6: Finish The Labs

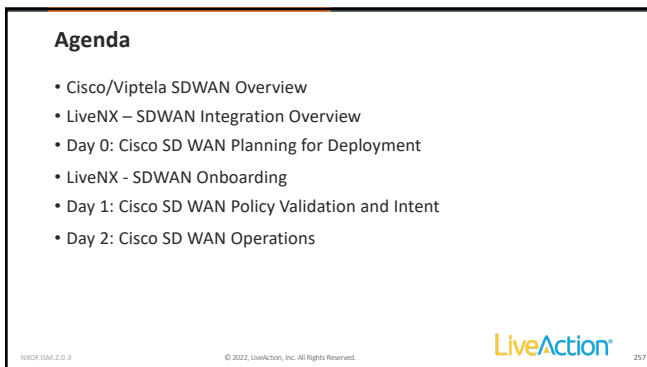
- Including Lab 7: QoS Alerts



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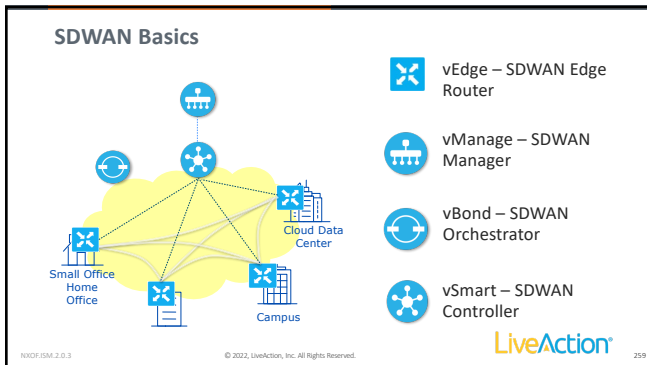
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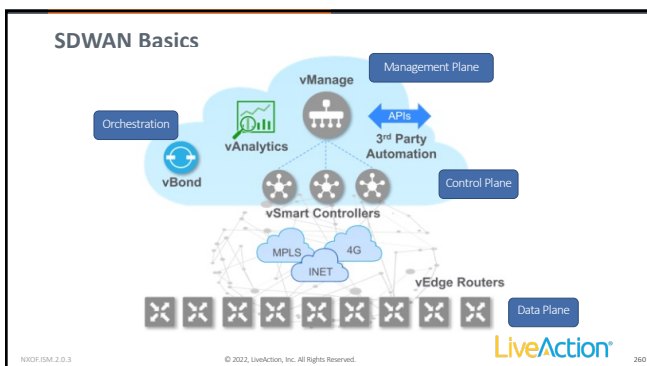
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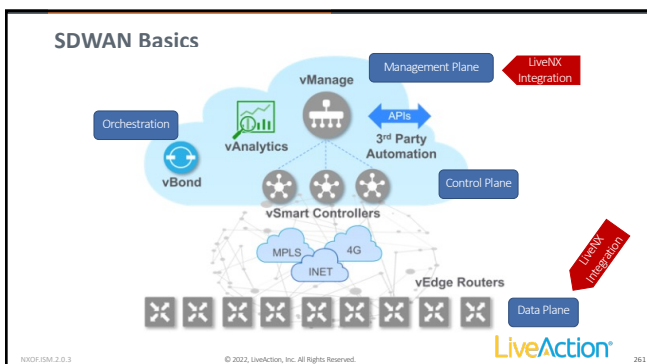
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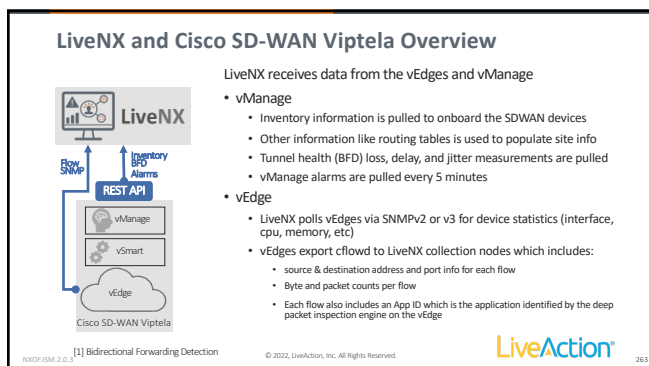
260



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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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Day 0: Design Baseline performance for policy design

Site to site traffic performance

- Site to site traffic type and paths
- Provides data for:
 - Selection of initial pilot sites
 - Usage patterns
 - Site to site traffic behaviors

App group behavior

- App Group behavior
- Policy design inputs:
 - App consumption patterns – bandwidth, class
 - Performance baseline – know targets for SLAs

Service Provider analysis

- Service Provider
- Path design inputs:
 - Which telco infrastructure path they should apps take, site by site.
 - Picking application to include in app route policies
 - How SD-WAN enabled vs non SD-WAN traffic maybe handled during deployment

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LiveNX SD-WAN On-Boarding

Required Tasks

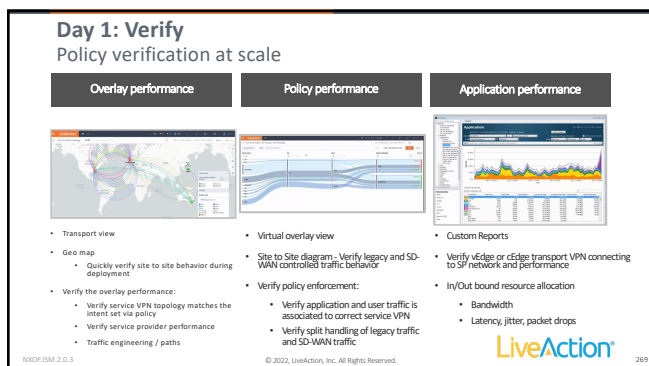
- Onboard SD-WAN devices via LiveNX integration with vManage (via REST API). This simplifies:
 - vEdge router discovery
 - Monitoring of WAN and LAN interfaces
 - Automatically sets network semantics including sites, WAN links, service providers, site IP prefixes, etc
- Confirm reception of Flow on vEdge Routers
- Confirm BFD data from integration with vManage

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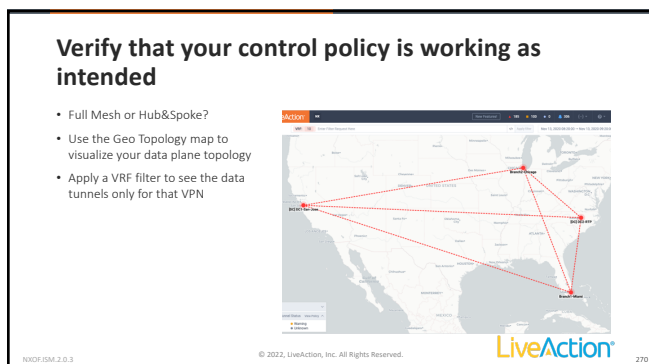
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Verify Application Aware Routing Policy

- 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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Day 2: Scale and Operate

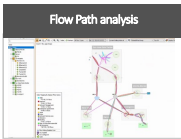
Performance insights for optimization and rapid troubleshooting

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

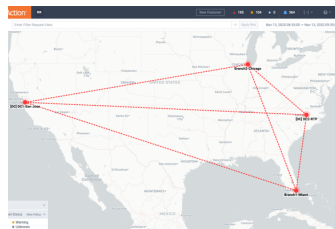


- LiveWire and Omniscapture packet capture and analysis appliance
- Packet drill down
- Delivers intuitive visualization and robust forensics for faster incident resolution of network issues
- application performance issues and security investigations

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Use the Geo Topology to monitor tunnel status

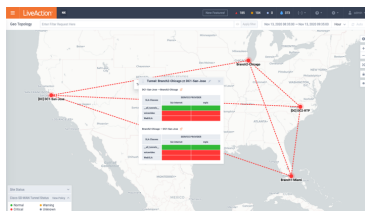
- Here we see all tunnels are red
- LiveNX is using the loss/latency/jitter statistics to show SLA violations



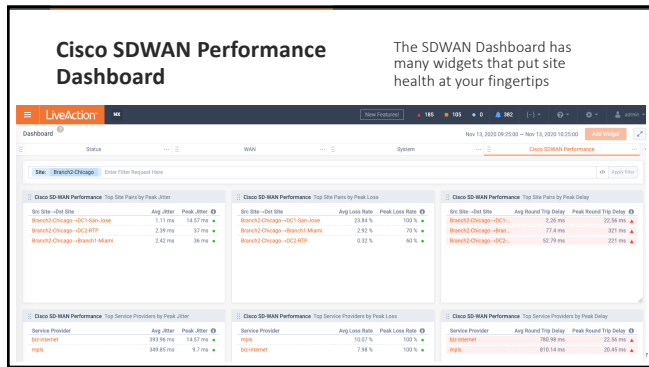
275

Use the Geo Topology to monitor tunnel status

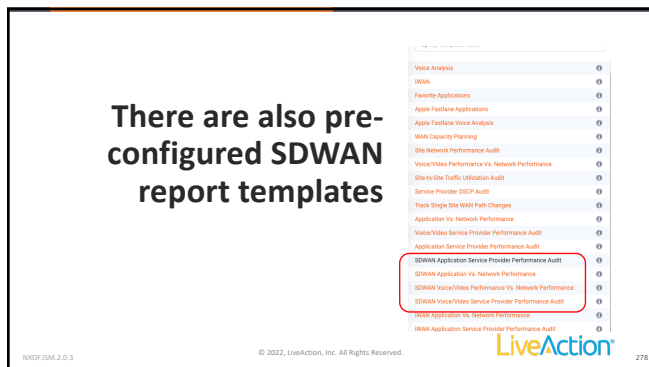
- Here we see all tunnels are red
- LiveNX is using the loss/latency/jitter statistics to show SLA violations
- Click on a data tunnel to drill into the tunnel status for each SLA class



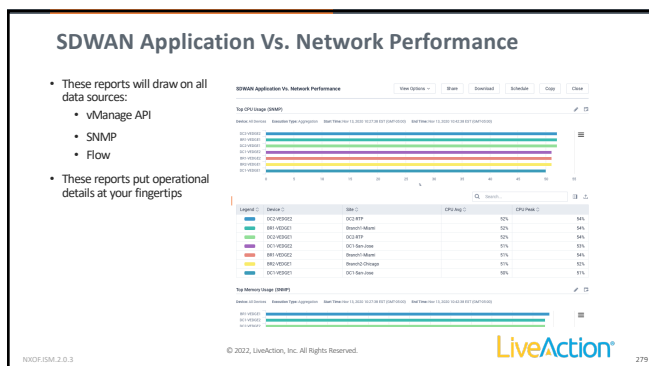
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Site To Site Analysis Story

Quick view of traffic between sites

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Site To Site Analysis Story

Mousing over any one of the sites allows to see site specific stats
Clicking on a site will launch the Sankey Diagram of all traffic for that site

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Alerting

- In addition to the standard LiveNX alerts there are specific SDWAN Alerts
- LiveNX imports vManage Alarms via the API

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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

The screenshot shows the AWS IAM console 'Groups' page. The 'Groups' tab is selected, showing a list of IAM groups. The table has columns for Name, Status, Policies, and Description. There are 10 groups listed, each with a status of 'Active' and a description of its permissions.

Name	Status	Policies	Description
AWS-ReadOnlyAccess	Active	1	Read-only access to all AWS resources in your account.
AWS-ReadOnlyAccess-2	Active	1	Read-only access to all AWS resources in your account.
AWS-ReadOnlyAccess-3	Active	1	Read-only access to all AWS resources in your account.
AWS-ReadOnlyAccess-4	Active	1	Read-only access to all AWS resources in your account.
AWS-ReadOnlyAccess-5	Active	1	Read-only access to all AWS resources in your account.
AWS-ReadOnlyAccess-6	Active	1	Read-only access to all AWS resources in your account.
AWS-ReadOnlyAccess-7	Active	1	Read-only access to all AWS resources in your account.
AWS-ReadOnlyAccess-8	Active	1	Read-only access to all AWS resources in your account.
AWS-ReadOnlyAccess-9	Active	1	Read-only access to all AWS resources in your account.
AWS-ReadOnlyAccess-10	Active	1	Read-only access to all AWS resources in your account.

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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]

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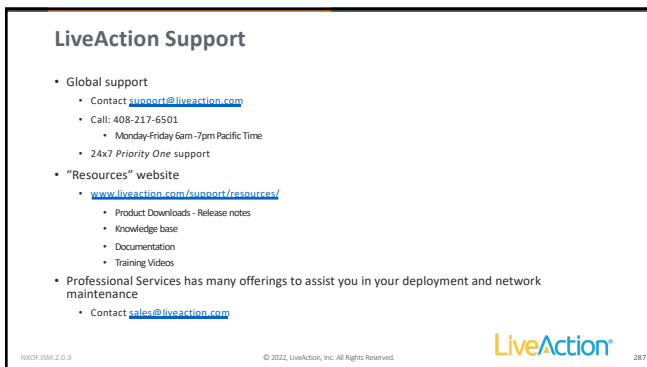
Launch the SDWAN Learning Labs...

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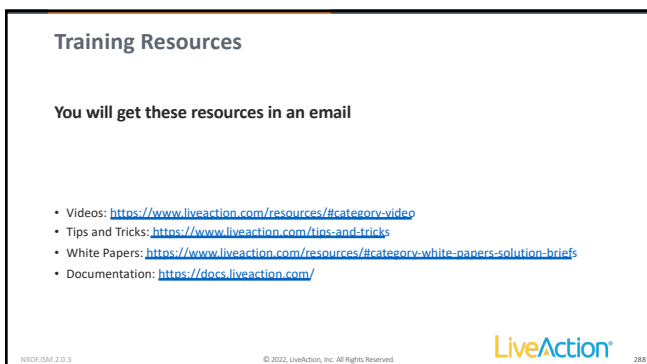
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Course Evaluation

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!)

<https://survey.alchemer.com/s3/6997006/LiveAction-Training-Survey>

Thank You in advance for your participation!

10/20/2021 10:04:30 A.M. 3.0.0.3

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