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Agenda – Day 1

- LiveNX Architecture Review
- The LiveNX WebUI
 - Dashboards
 - Sites/Devices/Interfaces
 - Reports
 - Stories
 - Scheduling
 - Custom Reports
 - System Management
- Visualizations & Troubleshooting
 - Voice, Video, Delays
- Flow Collection Overview
- LiveNX Client
 - Dashboard
 - Reports
- Topology Navigation
- Add & Manage Devices
 - Topology Navigation
 - Grouping & Objects
 - Device Semantics
- QoS Overview

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Agenda - Day 2

- Implementation Best Practices
 - Installation Considerations
- Deployment Strategies
- Quality of Service
 - Concept Overview
 - Classification & Marking
 - Shaping & Queueing
 - Policing & WRED
 - Buffer Tuning
- QoS Best Practices
- LiveAction SD-WAN
 - Concept Overview
 - SD-WAN Fundamentals
 - SD-WAN Deployment
 - SD-WAN Operations
- Troubleshooting
 - IWAN Cheat Sheet

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Prerequisites

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



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Company Overview

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Simplify the Network

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History



2006



2014



7000+



2017
LivingObjects
Service Providers



2018
Packet Capture
& Analytics

Investors




10

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Complete Solution



LiveNX
For Enterprises



LiveSP
For Service Providers



**LiveCapture
Omnipeek**
Packet Capture and Analytics



Insight
Predictive Analytics



LiveAgent
End Point Visibility



LiveUX
User Experience
Monitoring



LiveNCA
Network Configuration and
Automation

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Driven by our patented Visualization engine

Enterprise Visibility



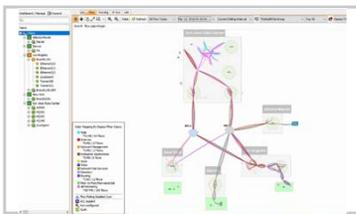
Transport View



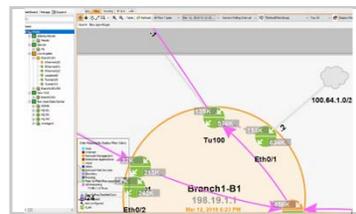
Virtual Overlay View



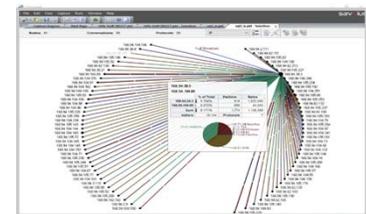
Visual Path Analytics



Site Specific Details



Packet Analytics



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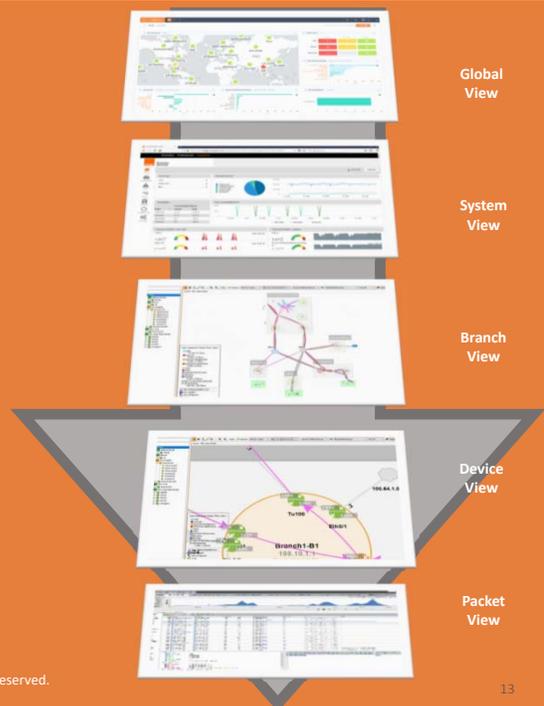
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LiveAction Technology 2019

- Single Pane of Glass
- Tool consolidation
- Consistent Look and Feel
- Accessed via tabs on LiveNX or LiveSP
- All products connected via Single Sign On and delivered in common distribution



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Browse to... www.LiveAction.com

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LiveNX
Overview & Architecture

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Architecture Overview

- Distributed Computing Architecture**
 - Large scale distributed analytics platform
 - Monitor 40,000+ devices across distributed deployment
 - Visualize up to 1,000 active interfaces per device
 - 3-layer architecture – **client, server, node**
- Client**
 - 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 - HyperVisor, Hyper-V, KVM
- Collector Node**
 - Hold data store, automatic data management
 - Node management policy set at server
 - Virtual install - HyperVisor, Hyper-V, KVM

The diagram illustrates the LiveNX architecture. At the top, a 'LiveNX Client' (Java JRE & Browser) connects to a 'LiveNX Server Central Manager (includes 1 Node)'. Below the manager is a 'LiveNX Server' which is 'High-performance database capable of handling 1M+ flows/sec' and 'Queries data from additional managed nodes'. The server is connected to a row of 'Collector Nodes' (indicated by orange triangles). These collector nodes are connected to a network of 'LiveNX Nodes' (represented by server racks and network devices). A legend indicates that an orange triangle represents a 'Collector Node'. The LiveNX Nodes are noted to 'Require the same specifications as LiveNX Server dependent on interface flows'. The LiveAction logo is in the bottom right corner.

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Simple License Models and Pricing

- Single-server
- Multiple Collector Nodes*
 - Collect from 200-500 devices (flow dependent)
- Based-upon number of *monitored devices**

This diagram shows a simplified version of the LiveNX architecture. It features a 'LiveNX Server Central Manager' at the top, connected to a 'LiveNX Server' which is connected to a row of 'Collector Nodes'. These collector nodes are connected to a network of 'LiveNX Nodes'. A red arrow points from the text 'Based-upon number of monitored devices*' to the collector nodes. A legend indicates that an orange triangle represents a 'Collector Node'. The LiveAction logo is in the bottom right corner.

* Consumes a license

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System Requirements

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

LIVENX 8
LIVENX 8 DEPLOYMENT OPTIONS

LiveNX 8.x components can be deployed via the following method: Virtual, Physical and Cloud

Component	Virtual Appliance Option
Server	All-in-one Server OVA
Client	Client software for Mac OS, Win 32-bit and 64-bit
Node (optional)	Node OVA
LiveAnalytics Node (optional)	LiveAnalytics OVA

VIRTUAL DEPLOYMENT
LIVENX-SERVER OVA – DETAILS

LiveNX Server is primarily deployed on ESXi and is fully operational right out of the box. The Server operating system runs on a Linux platform.

Custom Deployment	Small Deployment	Medium Deployment	Large Deployment
Used for less than 25 devices or less than 25k flows/sec.	Used for less than 100 devices or less than 50k flows/sec	Used for 100 to 500 devices or less than 100k flows/sec	Used for 500 to 1000 devices or less than 150k flows/sec
Proof of Concept Deployments – Installation for non-server installations (Laptops, Desktops)	Installation for server environments with Hyper-V Manager/VMware ESX/ Hypervisor	Installation for server environments with Hyper-V Manager/VMware ESX/ Hypervisor	Installation for server environments with Hyper-V Manager/VMware ESX/ Hypervisor
Specifications: 8vCPU Xeon or i7 16GB RAM LiveNX Server Max Heap Size 8GB 500GB Data Disks *	Specifications 16vCPU Xeon or i7 32GB RAM LiveNX Server Max Heap Size 16GB 2TB Data Disks *	Specifications 16vCPU Xeon or i7 64GB RAM LiveNX Server Max Heap Size 31GB 4TB Data Disks *	Specifications 32vCPU Xeon or i7 64GB RAM LiveNX Server Max Heap Size 31GB 8TB Data Disks *

* ie Data Disk Size is minimum recommendation.
Each LiveNX **node** supports ~76TB disk space. Recommended way is to add each disk of 10TB.
Server IOPS Recommendation LiveNX 7.1 – 1000 IOPS Read and 4500 IOPS Write



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Network Devices Supported

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

CISCO DEVICE SUPPORT – SNMP & FLOW

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 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 Nexus Switches (Nexus 3000, 7000, 6000 & 9000 Series)
ASR 9000 Series Routers	Cisco NetFlow Generation Appliance	Cisco AnyConnect Network Visibility Module on Windows and Mac OS X Platforms
Cisco SD-WAN vEdge, Cisco IOS XE SD-WAN Edge Devices	Cisco ASA 5500 Series Firewalls	Cisco Meraki MX Security Appliance

*Recommend IOS versions 12.3 or higher or 15.0 or higher for use with the software (IOS XE 2.6.0 or higher for ASR 1000 series). Earlier IOS versions may also work but are not officially supported. General-release IOS versions are recommended, although early-and limited-release versions will also work with LiveNX.

MULTI-VENDOR DEVICE SUPPORT – FLOW

Adtran NetVanta Series Routers	Extreme Network Switches	Ntop nProbe
Alcatel-Lucent Routers	Gigamon GigaSMART	Palo Alto Networks Firewalls
Brocade Series Routers	Hewlett-Packard Enterprise Procurve Series Switches	Riverbed SteelHead WAN Optimization Controllers
Barracuda Firewall	Ixia's Network Visibility Solution	Silver Peak WAN Optimization Controllers
Checkpoint Firewall	Juniper MX Series Routers	Sophos Firewall
F5 Load-Balancer	Citrix NetScaler Load Balancer	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
- Performance Routing

LiveNX does not save the router configuration in our database!

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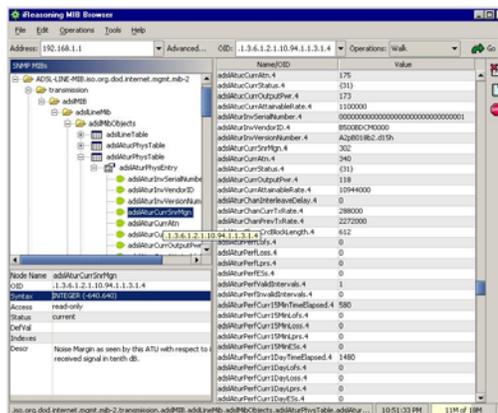


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LiveNX Communication with Devices

- 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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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 Client
- You may now ping YOUR LiveNX Server...



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LiveNX Web UI

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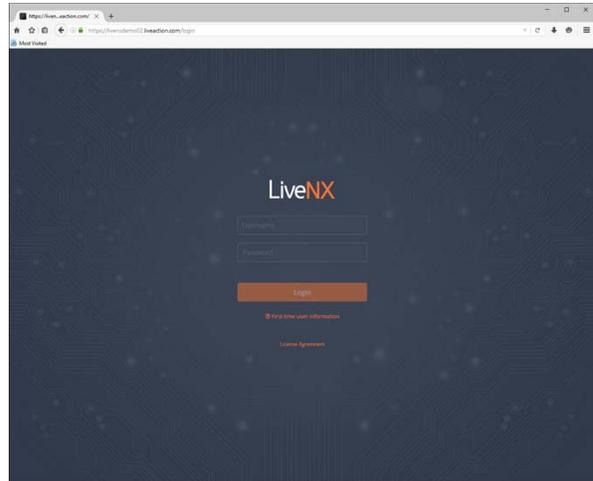
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From Any Browser... from Anywhere!

<https://<LiveNXserverIP>>

- Create and View Dashboards
- Configure:
 - User Management
 - Devices *
 - Alerts
- View:
 - Reports
 - Device Detail
 - Interface Detail



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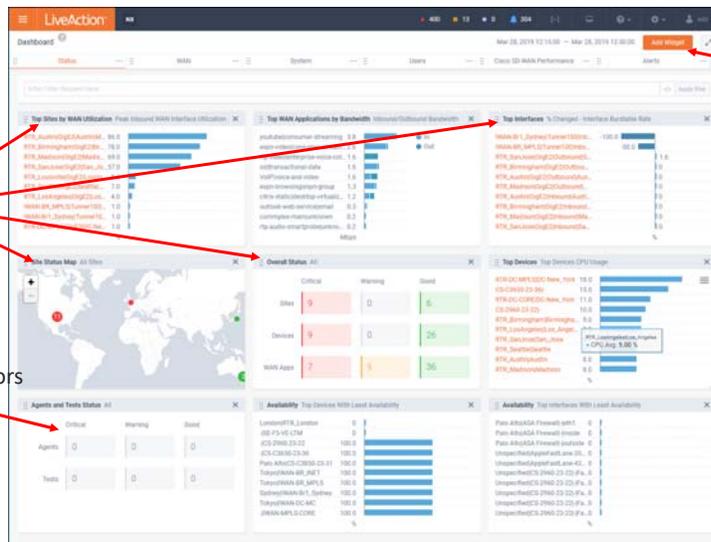
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Customizable Dashboards



Lots of default building-block widgets

At-a-Glance indicators

Build your own custom dashboard by adding widgets

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Sites Details

Drill into Sites > Devices > Interfaces...

INTERFACE N.	IP ADDRESS	SUBNET MASK	DEVICE	SITE	WAN	SERVICE PH.	SPEED CAP.	ACTUAL CAP.	ASSOCIATED	# WIRE	DESCRIPTION	STATUS
Ethernet0/0	-	-	HQ-MC	San_Jose	WAN	Default Serv.	10 Mbps	10 Mbps	-	-	-	-
Loopback0/0	10.0.0.103	255.255.255.0	HQ-MC	San_Jose	-	-	-	-	Lo0	6	-	8 Mbps
Ethernet0/2	-	-	Branch01-01	Los_Angeles	-	-	-	-	-	-	-	-
Ethernet0/1	-	-	Branch01-01	Los_Angeles	Internet	-	2 Mbps	2 Mbps	-	-	-	-
Ethernet0/0	-	-	Branch01-01	Los_Angeles	Branch1 LAN	-	10 Mbps	10 Mbps	-	-	-	-
Tunnel0/0	172.16.1.1	255.255.255.0	Branch01-01	Los_Angeles	WAN	NET	10 Mbps	10 Mbps	Tu100	7	DMVPN over	10 Mbps
Tunnel0/1	172.16.2.1	255.255.255.0	Branch01-01	Los_Angeles	WAN	MPLS	2 Mbps	2 Mbps	Tu101	8	DMVPN over	2 Mbps
Loopback0/0	10.0.0.1	255.255.255.0	Branch01-01	Los_Angeles	-	-	-	-	Lo0	6	-	8 Mbps
Ethernet0/1	-	-	HQ-01	San_Jose	-	Default Serv.	10 Mbps	10 Mbps	-	-	-	-
Ethernet0/0	-	-	HQ-01	San_Jose	-	Default Serv.	10 Mbps	10 Mbps	-	-	-	-
Tunnel0/0	172.16.1.254	255.255.255.0	HQ-01	San_Jose	WAN	DMVPN over	10 Mbps	10 Mbps	Tu100	7	DMVPN over	10 Mbps
Loopback0/0	10.0.0.101	255.255.255.0	HQ-01	San_Jose	-	-	-	-	Lo0	6	-	8 Mbps
Ethernet0/1	-	-	HQ-02	San_Jose	-	-	-	-	-	-	-	-
Ethernet0/0	-	-	HQ-02	San_Jose	-	Default Serv.	10 Mbps	10 Mbps	-	-	-	-
Tunnel0/1	172.16.2.254	255.255.255.0	HQ-02	San_Jose	WAN	DMVPN over	5 Mbps	5 Mbps	Tu101	8	DMVPN over	5 Mbps
Loopback0/0	10.0.0.102	255.255.255.0	HQ-02	San_Jose	-	-	-	-	Lo0	5	-	8 Mbps

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Interfaces

Legend	Name	80 Rate	90th Percentile Bandwidth	95th Percentile Bandwidth	99th Percentile Bandwidth	Peak 95 Rate
Inbound Bandwidth	615.31 Kbps	684.63 Kbps	714.10 Kbps	714.47 Kbps		
Outbound Bandwidth	18.50 Kbps	26.68 Kbps	28.63 Kbps	32.62 Kbps		

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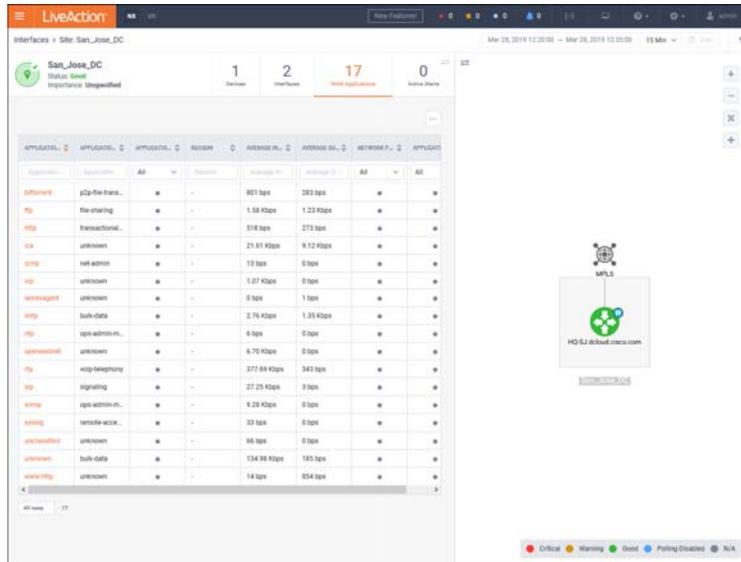
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Wan Applications



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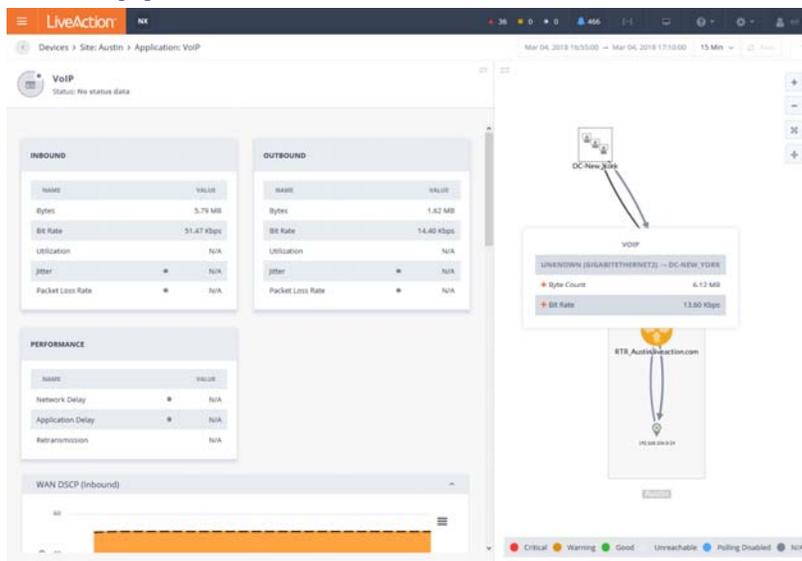
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Wan Applications>Flows



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Geo Topology

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- MAIN
- TOPOLOGY
 - Geo Topology
 - Logical Topology PREVIEW
- STORIES
- REPORTS
- INSIGHT
- CONFIGURE

The screenshot shows the 'Geo Topology' interface in LiveAction. It features a map of the United States with three green location markers: 'LA' in California, 'San_Jose_DC' in the Washington D.C. area, and 'New_York' in New York. A sidebar on the left contains navigation options: MAIN, TOPOLOGY (with Geo Topology selected), STORIES, REPORTS, INSIGHT, and CONFIGURE. The top of the interface shows the LiveAction logo and a date range of 'Nov 21, 2019 06:23:00 - Nov 21, 2019 06:23:00'.

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Stories

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- MAIN
- TOPOLOGY
- STORIES
 - WAN Interface Capacity
 - Device Inventory
 - Security Flow Analysis
 - Site to Site Analysis
 - WAN Availability Story
- REPORTS
- INSIGHT
- CONFIGURE

The screenshot shows the 'Device Inventory' interface in LiveAction. It displays a table with columns for Device, Service, IP Address, Site, Type, Logs, Status, Model, OS Version, and Description. Below the table is an 'Interfaces' section with a table showing IP Address, Subnet, Device, Site, WAN, WAN Type, WAN Speed, WAN Capacity, Address, IP Class, and Description.

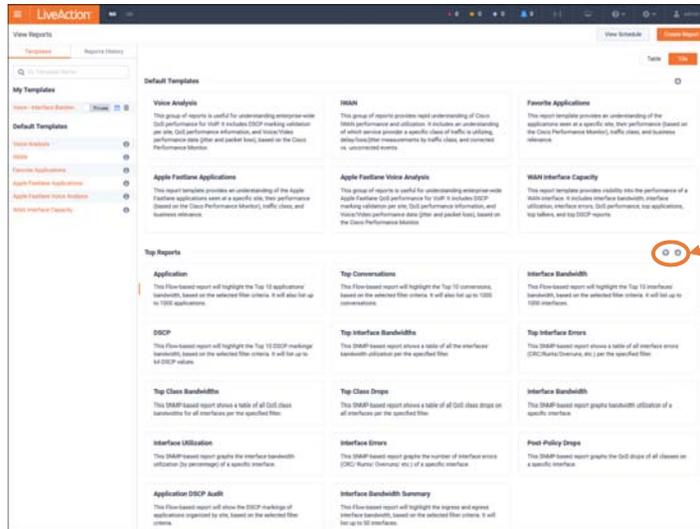
Device	Service	IP Address	Site	Type	Logs	Status	Model	OS Version	Description
Branch1-LA	101	198.18.1.1	LA	Local	-	-	cisco3940	15.5(3)M	Cisco IOS Softw...
HQ-S1	3	198.18.129.25	San_Jose_DC	Local	-	-	cisco3945	15.5(3)M	Cisco IOS Softw...
Branch2-NY	000000021	198.18.2.1	New_York	Local	-	-	cisco3945	15.5(3)M	Cisco IOS Softw...

Interface	IP Address	Subnet	Device	Site	WAN	WAN Type	WAN Speed	WAN Capacity	Address	IP Class	Description	Speed
Optical0/0/0	198.18.1.1	255.255.255.0	Branch1-LA	LA	-	Branch1 LAN	100 Mbps	100 Mbps	GG/0	1	Branch1 LAN	100 Mbps
Optical0/0/0	10.255.1.2	255.255.255.0	Branch1-LA	LA	-	WAN	MPLS	1 Mbps	GG/2	3	MPLS	1 Mbps
Optical0/0/0	198.18.129.25	255.255.255.0	HQ-S1	San_Jose_DC	-	-	-	-	GG/0	1	-	100 Mbps
Optical0/0/0	10.255.0.2	255.255.255.0	HQ-S1	San_Jose_DC	WAN	MPLS	100 Mbps	100 Mbps	GG/1	2	-	100 Mbps
Optical0/0/0	198.18.2.1	255.255.255.0	Branch2-NY	New_York	-	-	-	-	GG/0	1	Branch2 LAN	100 Mbps
Optical0/0/0	10.255.2.2	255.255.255.0	Branch2-NY	New_York	WAN	MPLS	1.54 Mbps	1.54 Mbps	GG/2	3	MPLS	1 Mbps

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View ANY Report Defined in LiveNX



Move Tables

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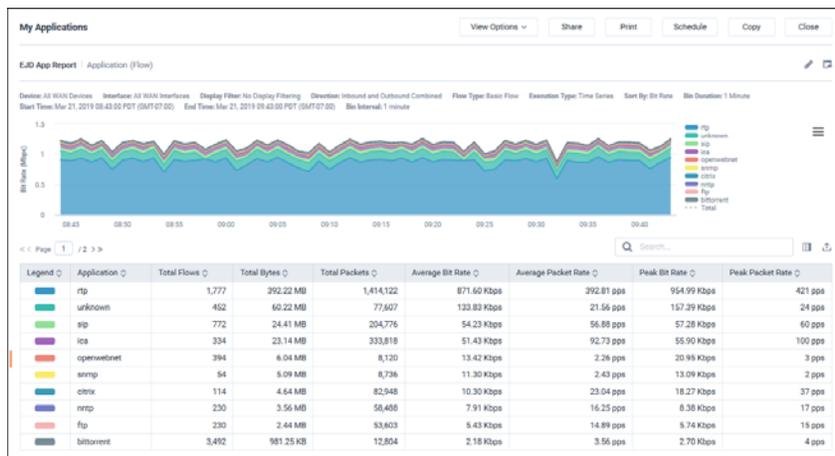
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Run Reports...



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WebUI Reporting – Tools

View Recent Reports History

Sort Indicator

Show/Hide Content

Delete History Reports

LOTS of stuff here...
but, it's SO intuitive,
right? 😊

Include Report Elements

Copy URL to Clipboard

Print/Download (opens new URL)

Re-open Run Report Dialog

Return to Reports Entry Page

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Report Groups

VOICE ANALYSIS

REPORTS INCLUDED

- DSCP
- User Filter DSCP Audit
- Application DSCP Audit
- Top Class Drops
- Jitter/Loss Outbound
- Jitter/Loss Inbound

TIME ZONE: (GMT+08:00) America/Los Angeles 🗲

TIME RANGE: Last Fifteen Minutes

SHARING:

DISPLAY FILTER: *Cisco Voice SITE: All Sites

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WebUI Reporting – Create & Groups of Reports

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

Advanced Report Group can be emailed to one or multiple users

Note: Email server set up via Java Client

Advanced Reports allow the creation of groups of reports

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LiveNX Alerting



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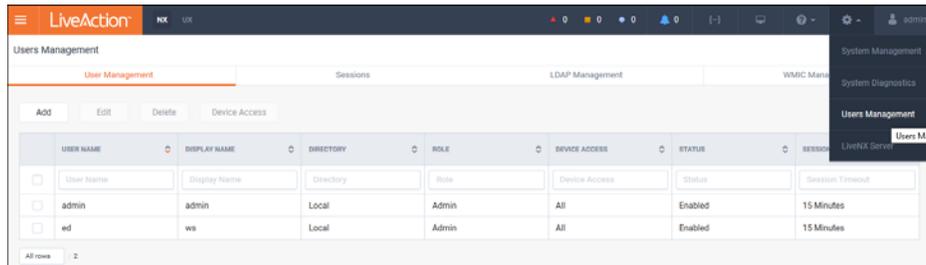
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User Management

Why add more users?

- Because you need to provide different levels of User Privilege to different personnel.
- Supports Local or AD-LDAP Authentication



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LAB: Using the Web UI

- View & Create Reports
- User Management
- View/Modify Alerts
- Create/Edit Dashboard



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The LiveNX Client

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The LiveNX Client is... Your Engineering Console

- A Java client application... **REQUIRES** Java JRE 1.8 or greater.
 - Runs on a standard Windows 32/64-bit PC with Webstart for Windows.
 - LiveAction's Mac client runs on OSX .9+.
- View & Configure:
 - Devices
 - Alerts
 - Reports
- The main interface to visualize network topologies & traffic flows.

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Download & Launch the Client...

<https://www.liveaction.com/download/links/>

The screenshot shows the LiveAction website with a table of download links. A red circle highlights the 'LiveNX 8.1.1' row. Overlaid on the website are several windows: 'Starting application...', 'Verifying application.', 'Do you want to run this application?' (with 'LiveAction Client' details), 'Client Login' (with fields for Username and Password), and 'Server Configuration' (with fields for Server and Port).

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The LiveNX Client is a Busy Place...

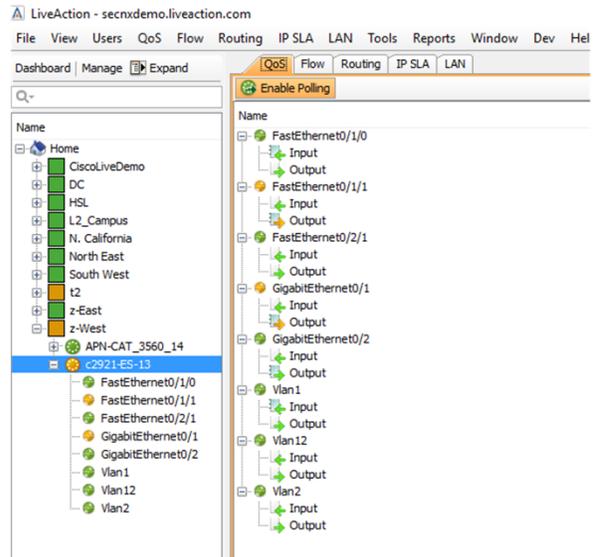
The screenshot shows the LiveNX Client interface with several components labeled with red boxes: 'Home Tree View' (left sidebar), 'Search' (top search bar), 'Filter' (top filter bar), 'Module Tabs' (top tabs), 'Group Container' (top right area), 'Topology Pane' (main central area showing a network diagram), 'Devices' (bottom right area), and 'Alerts & Notifications' (bottom status bar).

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The Home Tree-view

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



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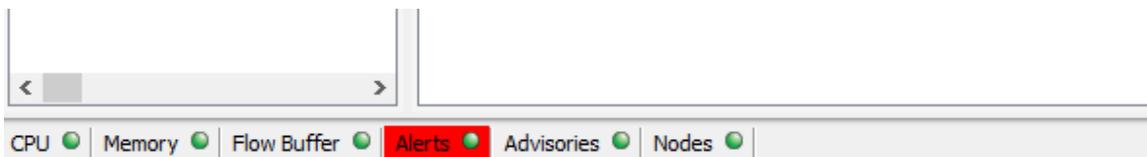
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Immediate Feedback...

Look at the bottom of the screen for information about:

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



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Immediate Results!

Select any Interface to generate real-time graphs



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Manage, Create, View, Provision

* LiveAction - secnxdemo.liveaction.com

- File
- View
- Users
- QoS
- Flow
- Routing
- Add Device
- Discover Devices
- Import Devices
- Export Devices
- Manage Devices
- Refresh Devices
- Remove Network Objects
- Exit

* Tools | Reports | Window | Dev | Help

- View Alerts
- Configure Alerts
- View Advisories
- Use IP Mappings
- Edit IP Mappings
- Use IP Blacklist
- Edit IP Blacklist
- MSI Endpoints
- Use VSOM Mappings
- Edit VSOM Mappings
- Manage App Groups (OSCP)
- Manage Application Groups
- Manage Custom Applications
- Define Custom Application
- Enable DNS Resolution (Global)
- Show DNS Names
- Device Tools >
- Statistics >
- Group Management >
- Options

* LiveAction - secnxdemo.liveaction.com

- File
- View
- Users
- QoS
- Flow
- Routing
- Dashboard
- Q-
- User Management
- Change Password
- Manage API Key

* Flow Configuration

Instructions: Select devices to configure flow

Select	Device	Type	IP Address	Description	Tags	Traffic...	Applic...	Voice/Ad...	Tradit...	Custom
<input type="checkbox"/>	Branch-1-LA	Standard	198.19.1.1	Cisco IOS S...	-	<input checked="" type="checkbox"/>				
<input type="checkbox"/>	Branch-2-NY	Standard	198.19.2.1	Cisco IOS S...	-	<input checked="" type="checkbox"/>				
<input type="checkbox"/>	HQ-SJ	Standard	198.18.129.25	Cisco IOS S...	-	<input checked="" type="checkbox"/>				

* Configure in the WebUI!

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LAB: LiveNX Client

- Launch the LiveNX Desktop Client
 - Connect from YOUR Desktop...
- Explore Topology visualization



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A photograph of a young woman with long brown hair, wearing a white button-down shirt. She is looking upwards and to the right with a thoughtful expression, her hand resting on her chin. The background is a dark chalkboard with a white maze drawn on it, featuring several arrows pointing in different directions. An orange rectangular box is overlaid on the bottom left of the image, containing the word "Visualizations" in white text.

Visualizations

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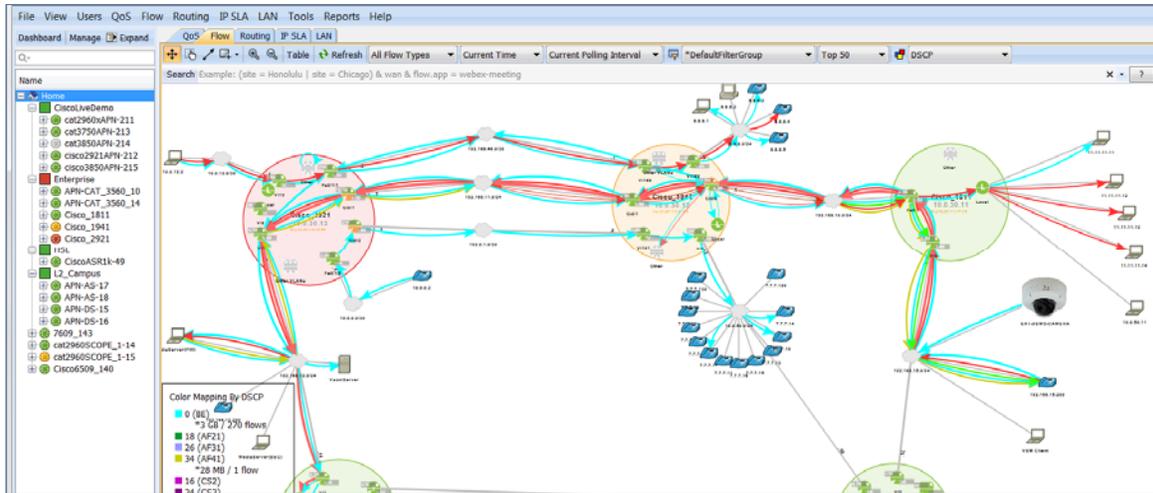
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Flow Visualization

End-to-End Application Flows Through the Network



LiveNX discovers and draws topology based on SNMP
LiveNX imposes end-to-end flows on topology



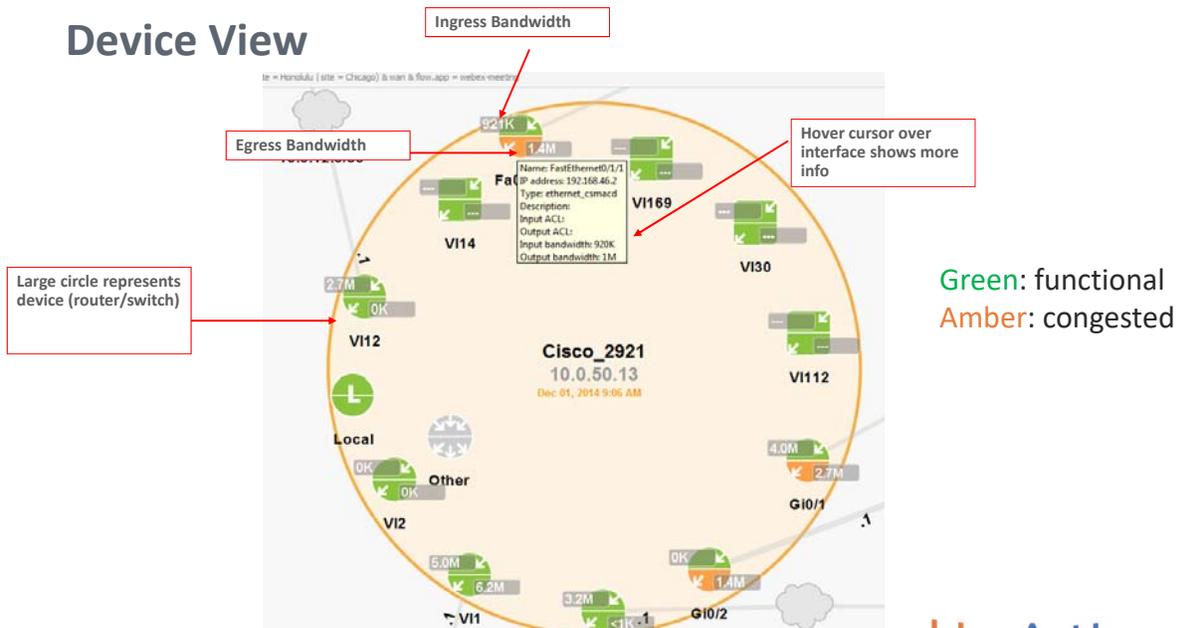
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Device View



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Flow Troubleshooting, Decision Making

Traffic started out as EF (red) and gets de-classified as BE (blue) after SP cloud

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Eliminate the Detractors!

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The Search Field

Search Example: (site = Honolulu | site = Chicago) & wan & flow.app = webex-meeting

Search

Pre-populates with type-ahead...
ALL available fields/records

Protocol	Src IP Addr	Src Port	Dest IP Addr	Dest Port	T+	Application
UDP	192.168.12.2	53	192.168.15.200	53		dns
UDP	192.168.12.2	53	192.168.15.200	58,674		dns
TCP	192.168.12.2	80	192.168.15.200	57,943		ms-office-365
UDP	192.168.12.2	53	192.168.15.200	56,023		dns
UDP	192.168.15.200	23,030	192.168.12.2	55,542		unclassified
UDP	192.168.12.2	53	192.168.15.200	52,636		dns
TCP	192.168.12.2	3,389	192.168.15.200	52,255		ms-ribt
UDP	192.168.12.2	53	192.168.15.200	52,227		dns
TCP	192.168.12.2	443	192.168.15.200	50,861		ssl
UDP	192.168.12.2	53	192.168.15.200	50,345		dns
TCP	192.168.12.2	61,680	192.168.15.200	48,219		unclassified
UDP	192.168.12.2	61,623	192.168.15.200	37,555		unclassified
TCP	192.168.12.2	61,681	192.168.15.200	25,431		unclassified
UDP	192.168.15.200	24,404	192.168.12.2	24,576		RTP**
TCP	192.168.12.2	61,677	192.168.15.200	24,457		skype
UDP	192.168.12.2	44,436	192.168.15.200	24,404		RTP**
UDP	192.168.12.2	55,542	192.168.15.200	23,030		unclassified
TCP	192.168.12.2	61,678	192.168.15.200	20,155		unclassified
UDP	192.168.12.2	31,196	192.168.15.200	19,420		ftp
UDP	EXT-DEMO-CAME...	1,024	Vsom...	18,096		ftp
UDP	10.0.0.2	16,388	7.7.7.130	16,384		unclassified
UDP	10.0.12.2	16,388	8.8.8.5	16,384		unclassified
UDP	10.0.12.2	16,384	8.8.8.2	16,384		unclassified
UDP	10.0.0.2	16,384	7.7.7.11	16,384		HSA-TESTING**
UDP	10.0.0.2	16,390	7.7.7.10	16,384		unclassified
UDP	10.0.12.2	16,390	8.8.8.1	16,384		unclassified

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Search Functions – Order of Operation

Search Example: (site = Honolulu | site = Chicago) & wan & flow.app = webex-meeting

Search

1st - Filter applied

2nd- Search applied to pulldowns' results

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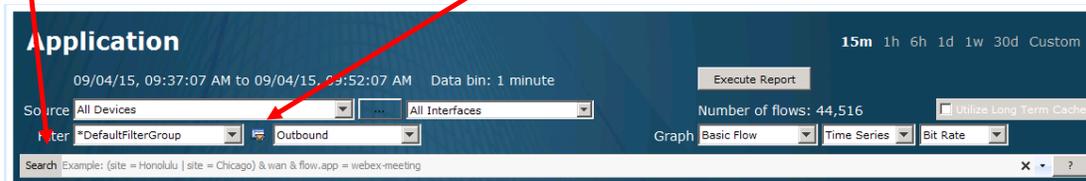
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Filters & Search Retention



Search strings are cached and are reusable in Topology Pane and Reports

All Filters can be used in both the Topology Pane as well as Reports



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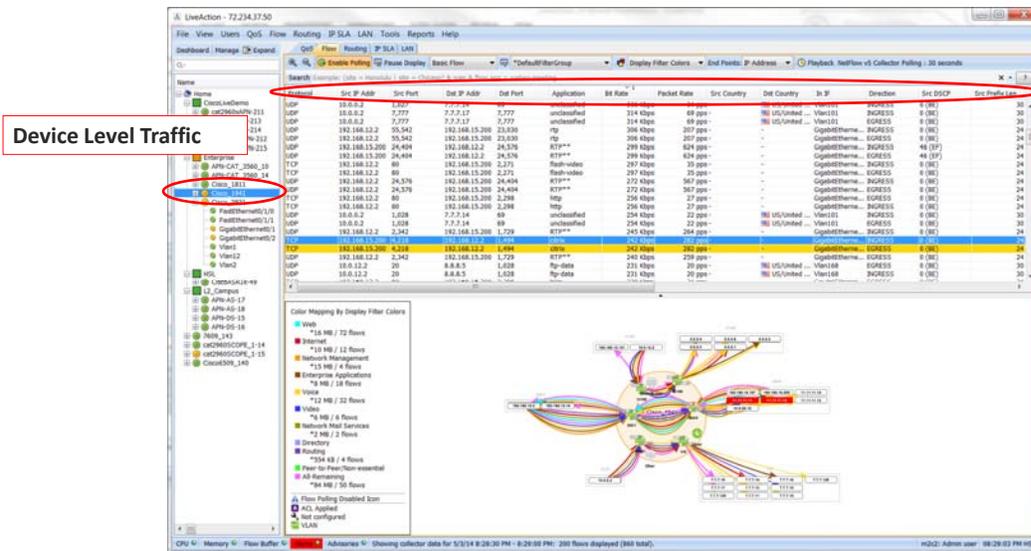
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Flow Visualization



Device Level Traffic

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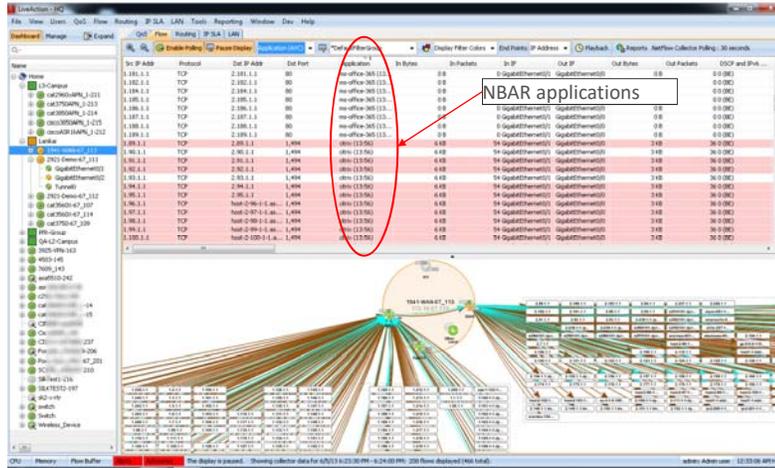
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AVC Flow Visualization

Application Performance

- NBAR2 application recognition and performance metrics
- Alert on application performance with AVC with color-coded status



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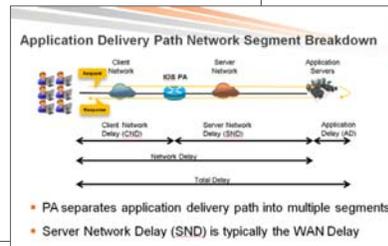
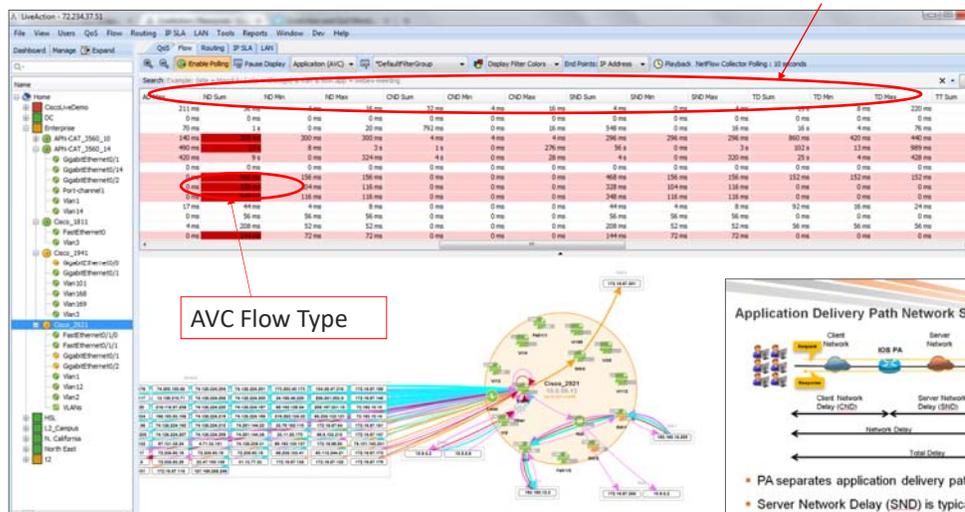
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Flow Visualization

Network Delays and Application Delays Reported by AVC flows



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Application Path Analysis

The screenshot displays the LiveAction interface for Application Path Analysis. On the left, a 'Basic Flow Table' lists various applications and their flows. The main window shows a detailed 'Application (AVC) Flow Path Analysis' for a specific flow, including device names, CPU usage, and various policies. On the right, a network diagram shows the path of traffic through several core switches (Core_2921, Core_1941, Core_3811) with green arrows indicating the active path and gray arrows indicating disabled paths.

Path view based on AVC flows Drill down to reports

- DSCP along path
- Historical flows
- Gray arrows mean AVC flows not enabled



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Medianet Flow Path Analysis

Pinpoint Root Cause

The screenshot displays the LiveAction interface for Medianet Flow Path Analysis. The network diagram shows traffic paths between core switches (Core_3811, Core_1941, Core_2921). Red arrows indicate where traffic is not reaching, and green arrows indicate where traffic is being dropped. A legend explains that gray means the device is not exporting PerfMon. The 'Medianet Flow Path Analysis' window provides detailed performance metrics for the selected path, including CPU usage, DSCP, and packet loss percentages.



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Flow Visualization Over Time...

Flow Playback / DVR

Time	Protocol	Src IP Addr	Src Port	Dst IP Addr	Dst Port	Application	In IP	Out IP	Director
Apr 29, 2014 5:...	ICMP	192.168.15.200	-	192.168.12.2	2,048	ping	GigabitEthernet0/1	Vlan1	EGRESS
Apr 29, 2014 5:...	ICMP	192.168.15.200	-	192.168.12.2	2,048	ping	GigabitEthernet0/1	Vlan1	INGRESS
Apr 29, 2014 6:0...	ICMP	192.168.12.2	-	192.168.15.200	-	ping	Vlan1	GigabitEthernet0/1	EGRESS
Apr 29, 2014 6:0...	ICMP	192.168.12.2	-	192.168.15.200	-	ping	Vlan1	GigabitEthernet0/1	INGRESS
Apr 29, 2014 6:0...	TCP	192.168.12.2	80	192.168.15.200	55,436	http	Vlan1	GigabitEthernet0/1	INGRESS
Apr 29, 2014 6:0...	TCP	192.168.12.2	80	192.168.15.200	55,436	http	Vlan1	GigabitEthernet0/1	EGRESS
Apr 29, 2014 5:...	TCP	192.168.12.2	80	192.168.15.200	2,306	rtmpe	Vlan1	GigabitEthernet0/1	EGRESS
Apr 29, 2014 5:...	TCP	192.168.12.2	80	192.168.15.200	2,306	rtmpe	Vlan1	GigabitEthernet0/1	INGRESS
Apr 29, 2014 5:...	TCP	192.168.12.2	61,680	192.168.15.200	48,219	skype	Vlan1	GigabitEthernet0/1	INGRESS
Apr 29, 2014 5:...	TCP	192.168.12.2	61,680	192.168.15.200	48,219	skype	Vlan1	GigabitEthernet0/1	EGRESS
Apr 29, 2014 5:...	TCP	192.168.15.200	48,219	192.168.12.2	61,680	skype	GigabitEthernet0/1	Vlan1	INGRESS
Apr 29, 2014 5:...	TCP	192.168.15.200	48,219	192.168.12.2	61,680	skype	GigabitEthernet0/1	Vlan1	EGRESS
Apr 29, 2014 6:0...	TCP	192.168.12.181	554	192.168.15.111	51,755	rtsp	Vlan1	FastEthernet0/1/1	INGRESS
Apr 29, 2014 6:0...	TCP	192.168.12.181	554	192.168.15.111	51,755	rtsp	Vlan1	FastEthernet0/1/1	EGRESS
Apr 29, 2014 6:0...	TCP	192.168.15.200	4,218	192.168.12.2	1,494	ctrix	GigabitEthernet0/1	Vlan1	INGRESS
Apr 29, 2014 6:0...	TCP	192.168.15.200	4,218	192.168.12.2	1,494	ctrix	GigabitEthernet0/1	Vlan1	EGRESS
Apr 29, 2014 6:0...	TCP	192.168.12.2	1,494	192.168.15.200	4,218	ctrix	Vlan1	GigabitEthernet0/1	INGRESS

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Identify Issues

View the traffic transiting the Device...
What you expect... does it make sense?

Find anomalous behavior... use Device Playback... Too much to strange ports? Identifiable addresses? Gremlins/Glitches?

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LAB: Working with Flows

- Identify Flows
- Troubleshoot Performance issues



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Flow Collection

- Netflow is a brand name for Cisco Flow
 - Like Jaguar is a brand name for an automobile
- The industry standard for flow type is “IPFIX”
 - Cisco uses sflow for certain device types, such as Nexus 5k Switch
- 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 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

Device	Type	IP Address	Description	Tags	Traffic Statistics (FNF)	Applic...	Vo...	Traditional	Custom
APN-ASR1001-114	Standard	172.17.1.114	Cisco IOS Software...	-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GigabitEthernet0/0/1.100	-	10.155.155.2	alex-subinterface	-	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GigabitEthernet0/0/3	-	172.17.1.114	-	-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Port-channel34	-	-	-	-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Port-channel34.4	-	10.155.123.1	-	-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- 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

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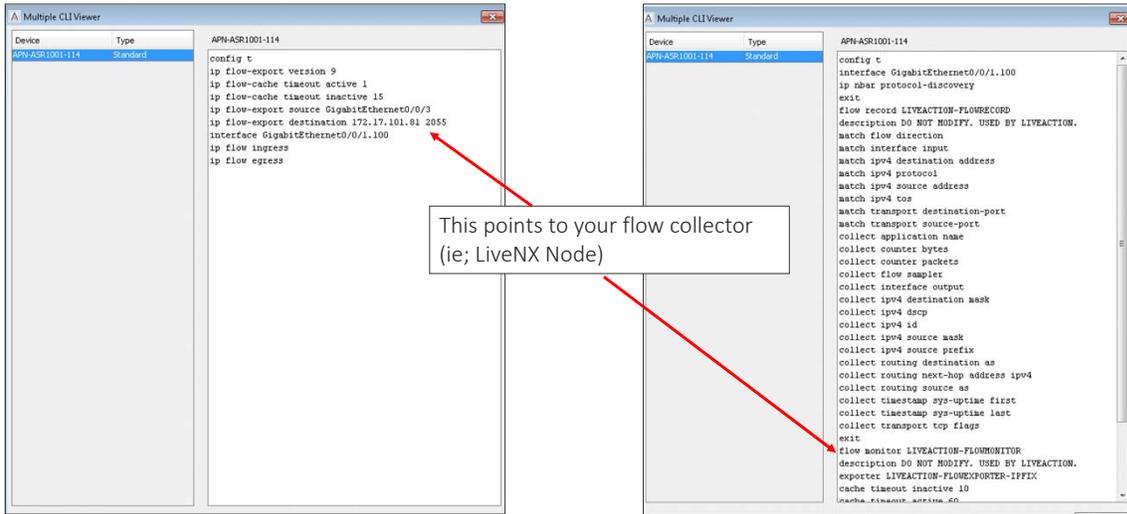
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Traditional v. Flexible Netflow - Preview CLI



Cisco's Best-Practices Templates



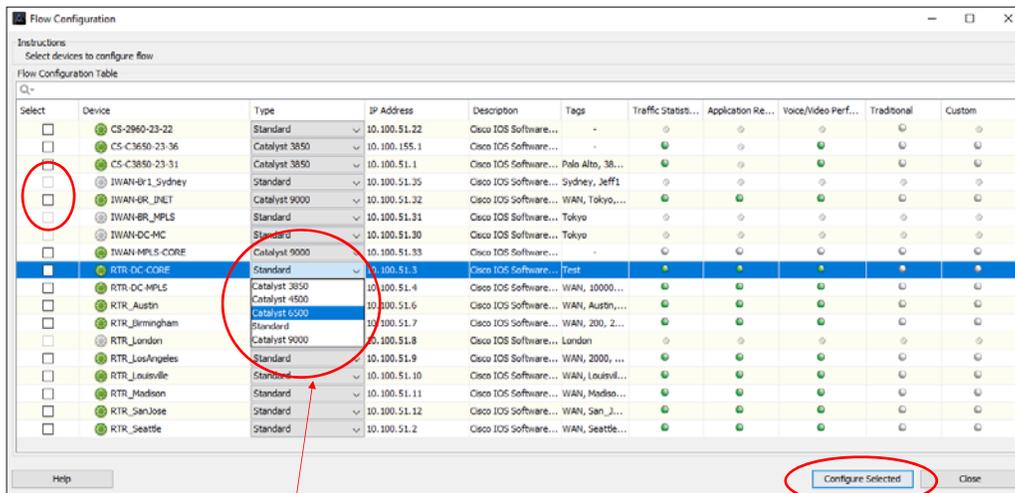
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Enable Flow Collection Within LiveNX Console



Easily Setup Flow Configurations at the Device Level



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Enable Flow Collection on Interfaces

Instructions
Configure the type of flow you wish to receive from the interfaces

Flow Configuration Table

Device	Type	IP Address	Description	Tags	Traffic	Applica...	Voice/Vide...	Traditio...	Custom
Cisco_2921	Standard	10.0.50.13	Cisco IOS So...	WAN, ...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FastEthernet0/1/0	-	10.0.0.1	-	-	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FastEthernet0/1/1	-	192.168.46.2	To-Ver...	-	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GigabitEthernet0/1	-	192.168.11.2	Link to 1941	-	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GigabitEthernet0/2	-	192.0.1.1	WAN,	-	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vlan1	-	192.168.12.1	-	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vlan12	-	10.0.12.1	-	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vlan2	-	192.168.100.1	-	-	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Setup Flow Configurations at the *Interface* Level

```

Oto_2021
conf t
ip address-list extended LIVEACTION-ACL-AVC
permit 4 any any
exit
interface GigabitEthernet0/1
no name enable
exit
class-map match-any LIVEACTION-CLASS-AVC
exit
class-map LIVEACTION-CLASS-AVC
match access-group name LIVEACTION-ACL-AVC
exit
policy-map type name name_global
class LIVEACTION-CLASS-AVC
exit
interface Vlan12
name enable
exit
flow record type name LIVEACTION-FLOWRECORD-AVC
description DO NOT MODIFY, USED BY LIVEACTION.
collect application name
collect src all
collect counter client bytes
collect counter client packets
collect counter server bytes
collect counter server packets
collect interface input
collect interface output
collect ipv4 srcip
exit
flow monitor type name LIVEACTION-FLOWMONITOR-AVC
description DO NOT MODIFY, USED BY LIVEACTION.
replicate LIVEACTION-FLOWEXPORTER
name LIVEACTION-FLOWMONITOR-AVC

```

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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, Samplicator, SolorWinds...)

Instructions
Configure the type of flow you wish to receive from the interfaces

Flow Configuration Table

Device	Type	IP Address	Description	Tags	Traffic Status...	Application R...	Voice/Video Perf...	Traditional	Custom
RTR-OC-CORE	Standard	10.100.51.3	Cisco IOS Software... Test	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GigabitEthernet2	-	192.168.15.2	-	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GigabitEthernet3	-	192.168.10.3	-	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
RTR_Austin	Standard	10.100.51.6	Cisco IOS Software... WAN, Austr...	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GigabitEthernet2	-	192.168.1.25	Conn-MPLS-Provider MPLS, 200, 2...	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GigabitEthernet3	-	192.168.106.254	Conn-Admnet-PC	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
RTR_Louisville	Standard	10.100.51.10	Cisco IOS Software... WAN, Louisv...	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GigabitEthernet2	-	192.168.1.5	Conn-MPLS-Provider MPLS, MPLS, ...	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
GigabitEthernet3	-	192.168.10.1.254	Conn-Admnet-PC	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Flow Export Destination

Configure Flow Export Destination

LiveNX node

LiveNX node flow replicator at port 9991

Other at IP address and port

Help Save to Devices Previous CL2 Revert Back Close

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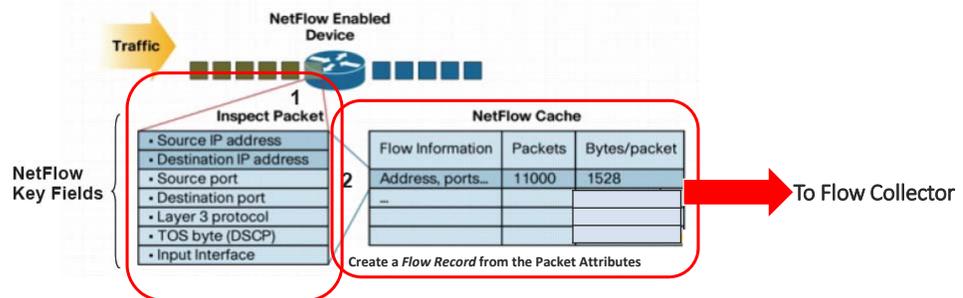
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NetFlow Collects *Statistics* on Packets as they pass...



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

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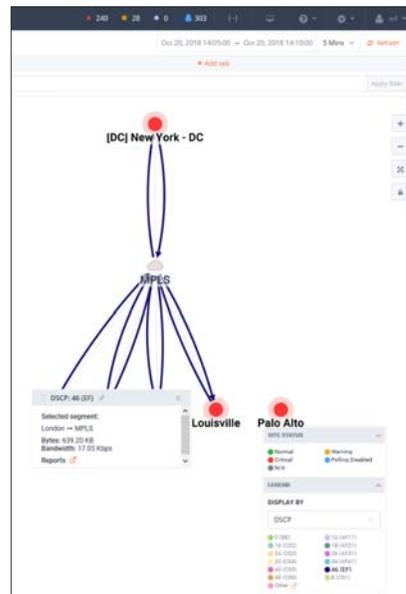
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Netflow

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

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

per device.



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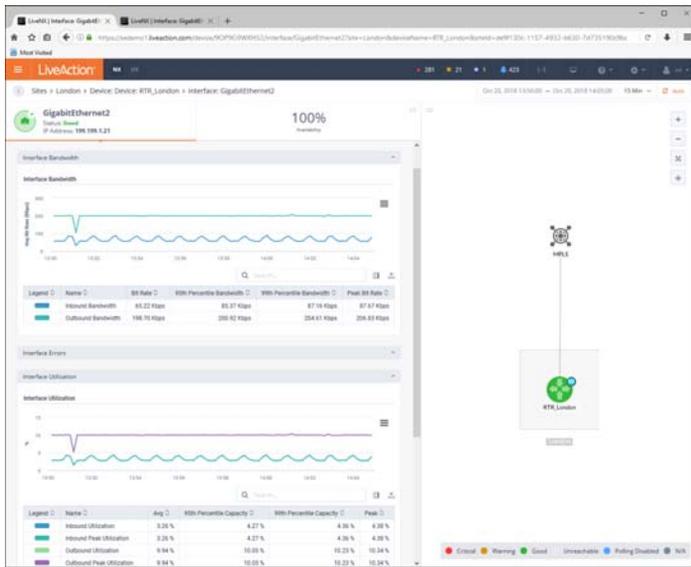
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Netflow Interface View



View quantity & type of traffic traversing a specific interface



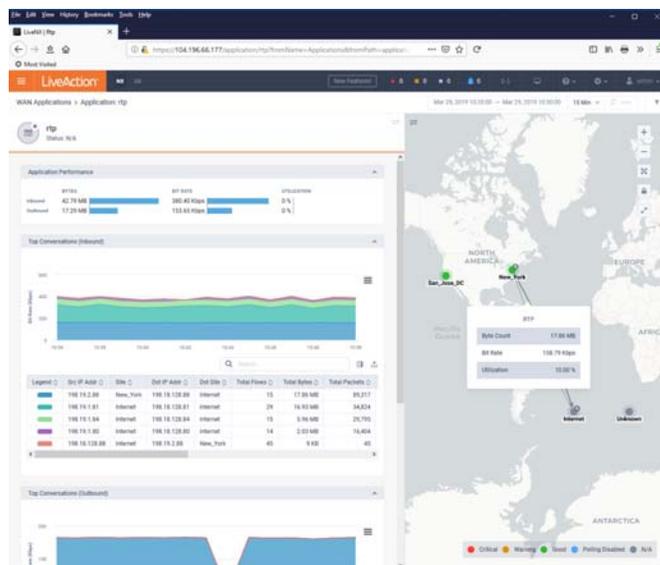
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Application Flow View



End-to-end quantity of traffic for selected applications



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Other types of Flow in LiveNX

- LiveNX can also ingest the following types of flows:
 - NSEL Flow (Network Security Event Logging)
 - Cisco ASA firewalls
 - Zone Based Firewalls (ASR, ISR4k)
 - Wireless Flow (SSID, Wireless Client, Access Point information)
 - Wireless Lan Controllers
 - Cisco 3850 Switches
 - PfR (Performance Routing Threshold Crossing Alerts)
 - “Unknown” (SFLOW, JFLOW, almost any flow technology using v5, v9, or IPFIX Export protocol)

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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

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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	Src IP Addr	Src Port	Dst IP Addr	Dst Port	Application
TCP	192.168.15.123	55,436	192.168.12.123	80	http
TCP	192.168.15.123	4,157	192.168.12.123	80	http
TCP	192.168.12.123	80	192.168.15.123	4,267	http
TCP	192.168.12.123	80	192.168.15.123	4,157	http
TCP	192.168.15.123	4,298	192.168.12.123	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

Last Updated: 2016-02-26

Expert(s): TCP/UDP: Joe Touch; Eliot Lear, Allison Mankin, Markku Kojo, Kumiko Ono, Mark Lars Eggert, Alexey Melnikov, Wes Eddy, and Alexander Zimmermann; SCTP: Allison Mankin and Michael Tuexen; DCCP: Eddie Kohler and Yoshifumi Nishida

Reference: [RFC6335](#)

Protocol	Src IP Addr	Src Port	Dst IP Addr	Dst Port	Application
ICMP	TEST (192.168.1.1)	0	10.0.12.2	769	icmp
TCP	192.168.12.123	445	192.168.15.123	1,701	microsoft-ds*
TCP	192.168.15.123	1,701	192.168.12.123	445	microsoft-ds*
TCP	192.168.15.123	58,192	192.168.12.123	80	ms-office-365
TCP	192.168.12.123	80	192.168.15.123	58,192	ms-office-365
TCP	192.168.12.123	3,389	192.168.15.123	52,255	ms-wbt
TCP	192.168.15.123	52,255	192.168.12.123	3,389	ms-wbt
UDP	10.253.60.14	3,218	10.253.60.255	137	netbios-ns
TCP	192.168.15.123	3,637	192.168.12.123	1,305	pe-mike*
TCP	192.168.12.123	1,305	192.168.15.123	3,637	pe-mike*
UDP	10.0.0.2	7,777	7.7.7.17	5,555	personal-agent*
UDP	10.0.12.2	7,777	8.8.8.3	5,555	personal-agent*



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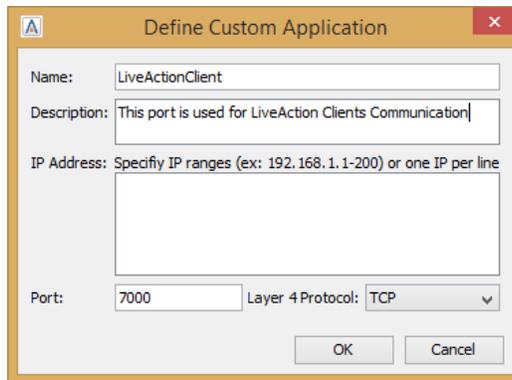
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Custom Application Label

- 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



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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		IETF RFC
	PHB	DSCP	
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-Troughput Data	AF11	10	RFC 2597
Best Effort	DF	0	RFC 2474
Low-Priority Data	CS1	8	RFC 3662



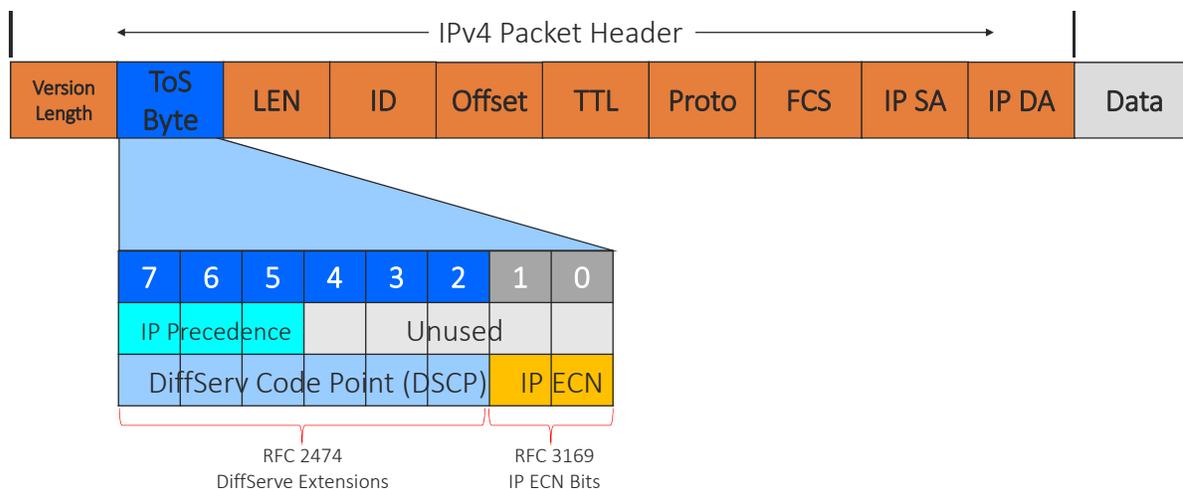
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Packets & DSCP Markings



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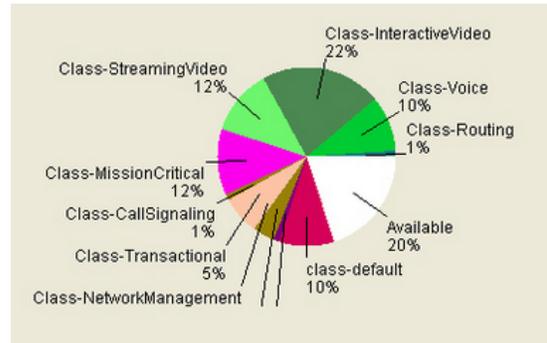
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QoS Techniques

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



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LAB: Marking, Shaping, Policing



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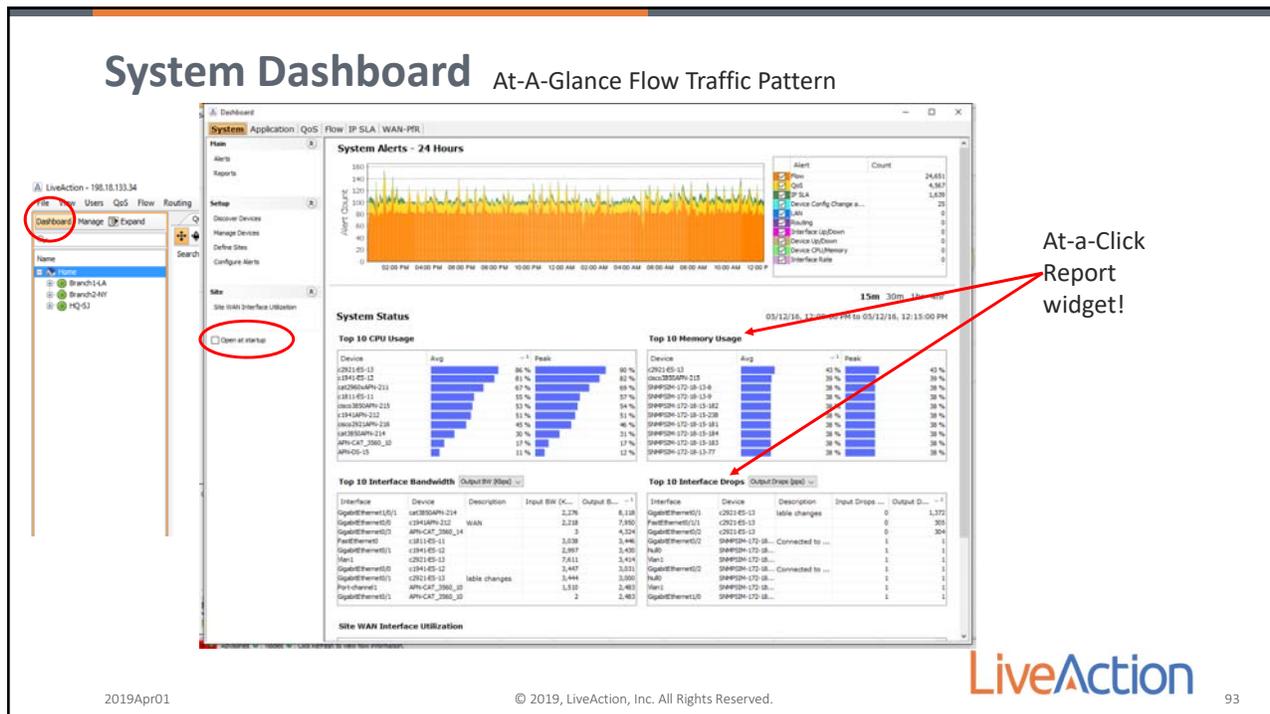
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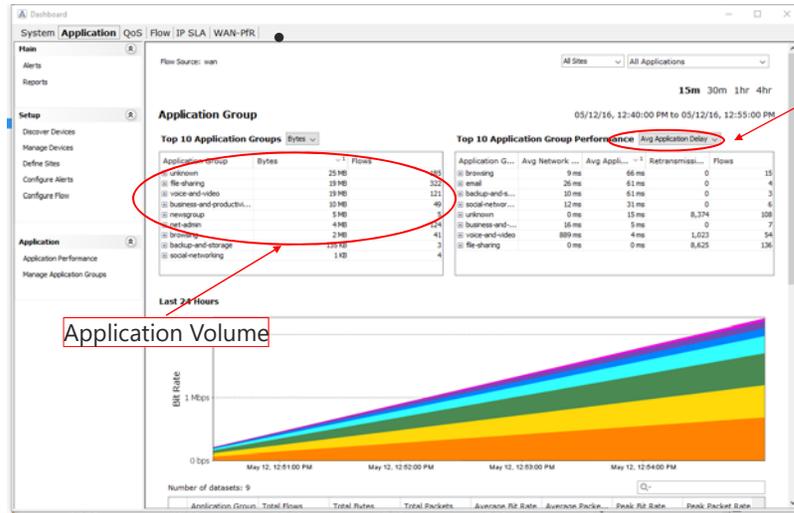
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Application Dashboard

Instant Application
Performance
Visibility
Driven by AVC Flows



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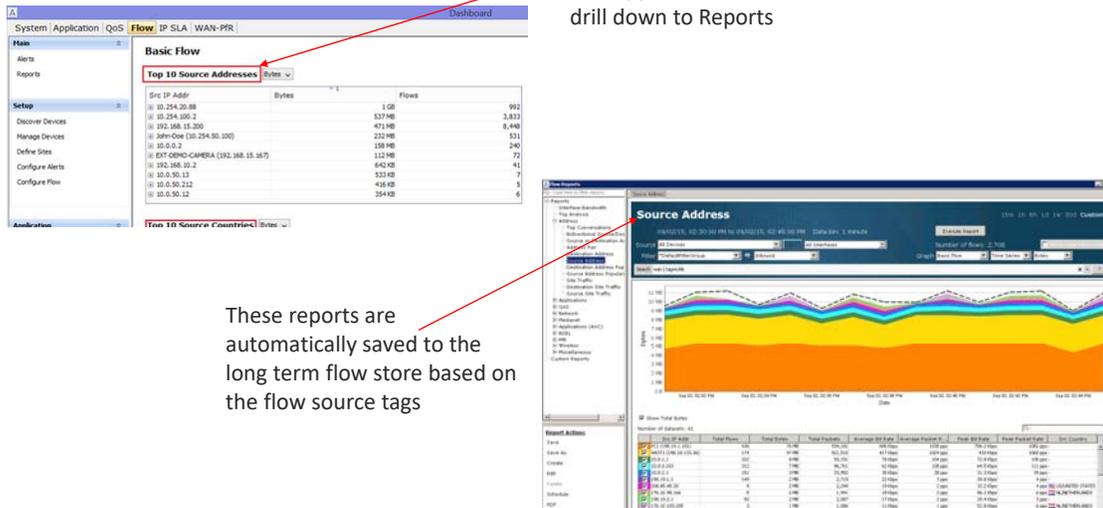
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Report Drill-downs

The data widgets in the Flow
and Application dashboard
drill down to Reports



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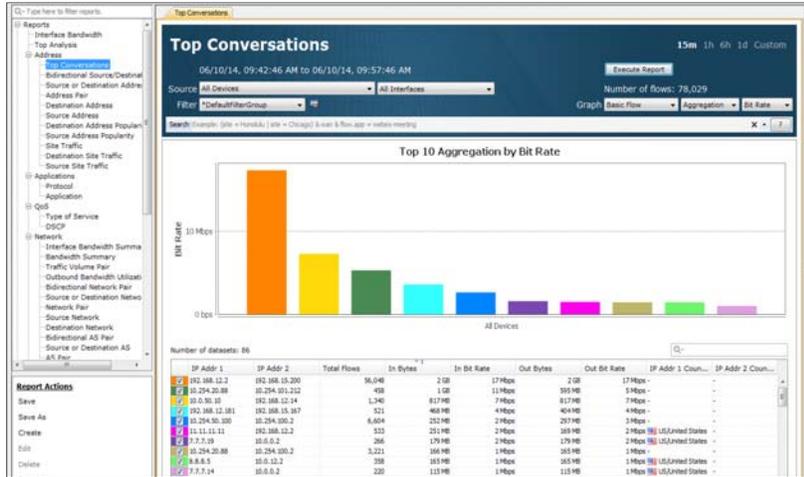
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Flow - Top Conversations (Top Talkers)



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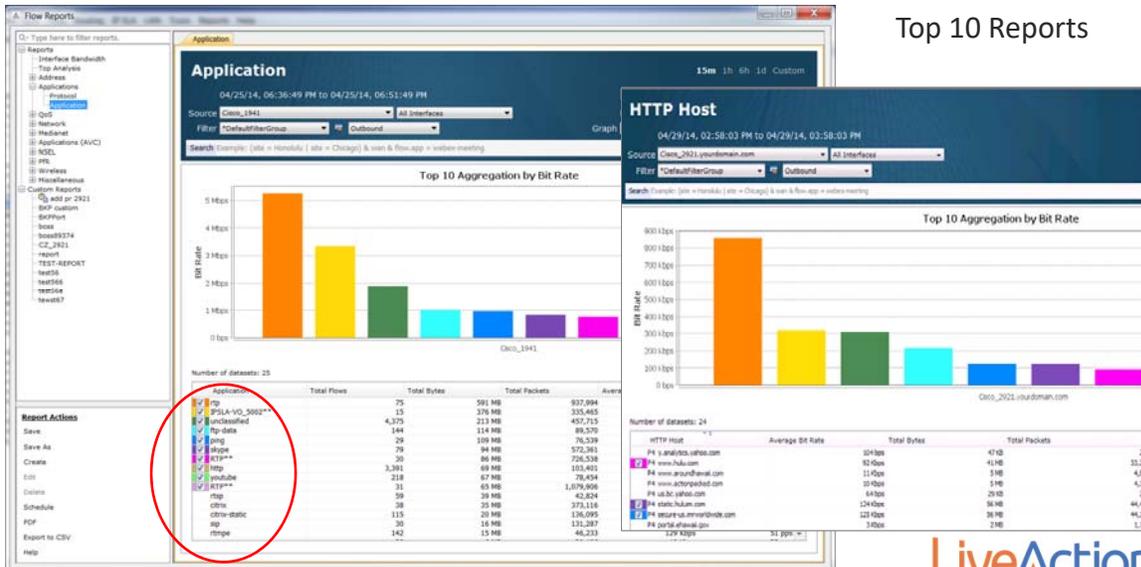
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Top Applications & Most Visited Websites



Top 10 Reports

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Flow Reports – Raw Data

Time	Protocol	Src IP Addr	Src Port	Dst IP Addr	Dst Port	Application	In IF	Out IF	Direction	Src DSCP	Bit Rate
Sep 4, 2015 10:1...	UDP	192.168.15.200	58,674	192.168.12.2	53	dns	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	464 bps
Sep 4, 2015 10:1...	TCP	192.168.15.200	2,171	192.168.12.2	80	http*	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	9 Kbps
Sep 4, 2015 10:1...	TCP	192.168.15.200	2,190	192.168.12.2	80	http*	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	8 Kbps
Sep 4, 2015 10:1...	TCP	192.168.15.200	2,172	192.168.12.2	80	http*	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	8 Kbps
Sep 4, 2015 10:1...	TCP	192.168.15.200	2,208	192.168.12.2	443	secure-http*	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	22 Kbps
Sep 4, 2015 10:1...	TCP	192.168.15.200	2,234	192.168.12.2	80	http*	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	320 bps
Sep 4, 2015 10:1...	TCP	192.168.15.200	2,220	192.168.12.2	443	secure-http*	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	21 Kbps
Sep 4, 2015 10:1...	TCP	192.168.15.200	4,278	192.168.12.2	80	http	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	789 bps
Sep 4, 2015 10:1...	TCP	192.168.15.200	4,288	192.168.12.2	80	http	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	1 Kbps
Sep 4, 2015 10:1...	TCP	192.168.15.200	4,289	192.168.12.2	80	http	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	1 Kbps
Sep 4, 2015 10:1...	UDP	192.168.12.2	31,196	192.168.15.200	19,420	rtp	Vlan1	GigabitEthernet0/1	EGRESS	0 (BE)	79 Kbps
Sep 4, 2015 10:1...	UDP	192.168.12.2	13,958	11.11.11.12	13,958	VoIP13958	Vlan1	GigabitEthernet0/1	EGRESS	46 (EF)	73 Kbps
Sep 4, 2015 10:1...	UDP	192.168.12.2	13,958	11.11.11.13	13,958	VoIP13958	Vlan1	GigabitEthernet0/1	EGRESS	46 (EF)	73 Kbps
Sep 4, 2015 10:1...	UDP	192.168.12.2	13,958	11.11.11.14	13,958	VoIP13958	Vlan1	GigabitEthernet0/1	EGRESS	46 (EF)	73 Kbps
Sep 4, 2015 10:1...	UDP	10.0.0.2	7,648	7.7.7.18	7,648	CriticalApp**	FastEthernet0/1/0	GigabitEthernet0/2	EGRESS	46 (EF)	377 Kbps
Sep 4, 2015 10:1...	ICMP	192.168.15.200	0	192.168.12.2	2,048	ping	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	511 Kbps
Sep 4, 2015 10:1...	UDP	10.0.0.2	16,386	7.7.7.129	16,384	undclassified	FastEthernet0/1/0	GigabitEthernet0/2	EGRESS	46 (EF)	60 Kbps
Sep 4, 2015 10:1...	TCP	192.168.15.200	4,085	192.168.12.2	8,797	undclassified	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	24 Kbps
Sep 4, 2015 10:1...	TCP	192.168.12.2	80	192.168.15.200	4,287	http	Vlan1	GigabitEthernet0/1	EGRESS	0 (BE)	50 Kbps
Sep 4, 2015 10:1...	TCP	192.168.15.200	4,299	192.168.12.2	80	Maxis_Server**	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	2 Kbps
Sep 4, 2015 10:1...	UDP	192.168.12.2	53	192.168.15.200	61,148	dns	Vlan1	GigabitEthernet0/1	EGRESS	16 (CS2)	4 Kbps
Sep 4, 2015 10:1...	TCP	192.168.12.2	15,255	192.168.15.200	4,111	undclassified	Vlan1	GigabitEthernet0/1	EGRESS	0 (BE)	320 bps
Sep 4, 2015 10:1...	TCP	192.168.15.200	4,268	192.168.12.2	80	http	GigabitEthernet0/1	Vlan1	INGRESS	0 (BE)	1 Kbps
Sep 4, 2015 10:1...	UDP	10.253.60.14	3,206	10.253.60.255	137	netbios-ns	GigabitEthernet0/0	GigabitEthernet0/1	EGRESS	0 (BE)	998 bps
Sep 4, 2015 10:1...	TCP	192.168.12.2	80	192.168.15.200	4,273	http	Vlan1	GigabitEthernet0/1	EGRESS	0 (BE)	13 Kbps
Sep 4, 2015 10:1...	UDP	10.0.12.2	1,027	8.8.8.2	1,604	citrix-static	Vlan12	FastEthernet0/1/1	EGRESS	0 (BE)	37 Kbps
Sep 4, 2015 10:1...	UDP	10.0.0.2	1,027	7.7.7.14	69	tftp*	FastEthernet0/1/0	GigabitEthernet0/2	EGRESS	0 (BE)	359 Kbps

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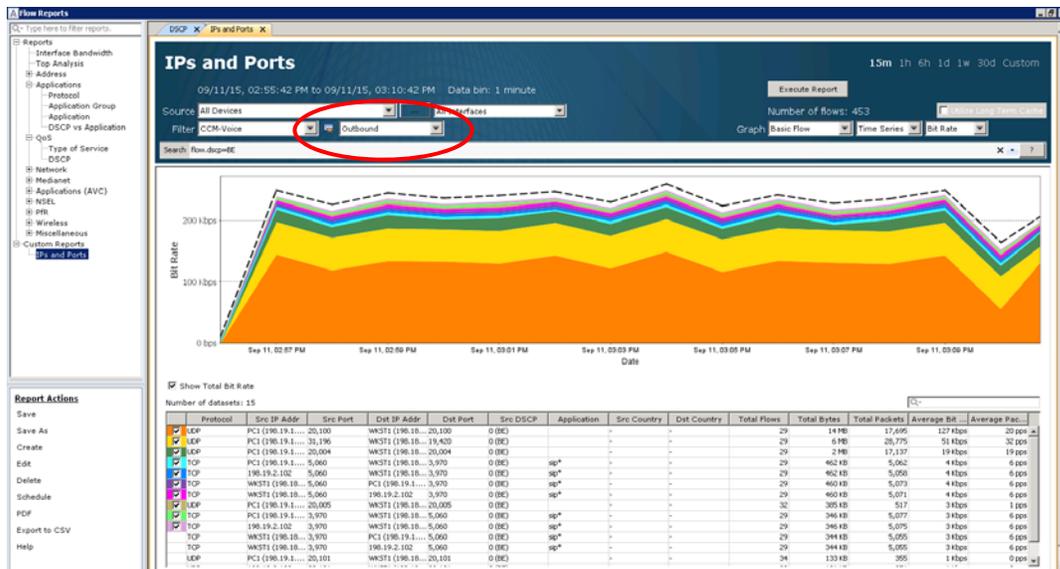
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Flow Report - Directionality



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Flow Report - Directionality

The screenshot shows the 'Application' section of the LiveAction interface. The 'Data bin' is set to '1 minute'. The 'Filter' is set to 'Outbound'. A dropdown menu is open, showing 'Inbound', 'Outbound', and 'Inbound and Outbound'. A table of flow data is displayed below, with the 'Direction' column circled in red. The table has three columns: 'In IF', 'Out IF', and 'Direction'.

In IF	Out IF	Direction
GigabitEthernet0/1	Vlan 1	INGRESS
GigabitEthernet0/1	Vlan 1	INGRESS
Vlan 12	FastEthernet0/1/	EGRESS
GigabitEthernet0/1	Vlan 1	INGRESS
GigabitEthernet0/1	Vlan 1	INGRESS
GigabitEthernet0/1	Vlan 1	INGRESS
Vlan 1	GigabitEthernet0/1	EGRESS
Vlan 1	GigabitEthernet0/1	EGRESS
GigabitEthernet0/1	Vlan 1	INGRESS
GigabitEthernet0/1	Vlan 1	INGRESS
GigabitEthernet0/1	Vlan 1	INGRESS
Vlan 1	GigabitEthernet0/1	EGRESS
Vlan 1	GigabitEthernet0/1	EGRESS
GigabitEthernet0/1	Vlan 1	INGRESS

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Automatic Granularity - Report Length / Data Bin

LiveNX stores all data *in the raw* in the short term database

The screenshot shows the 'Application' section of the LiveAction interface. The 'Data bin' is set to '1 minute'. The 'Filter' is set to 'Outbound'. Below the screenshot, there is a red text box with the following text:

15m to <1h = 1 Minute Bin
1h to 30d = 5 Minute Bin

If selected, the long term Flow store will be used for the report – If the data is available.

The second screenshot shows the 'Application' section of the LiveAction interface. The 'Data bin' is set to '5 minutes'. The 'Filter' is set to 'Inbound and Outbound'. The 'Utilize Long Term Cache' checkbox is checked. Below the screenshot, there is a red text box with the following text:

Utilize Long Term Cache

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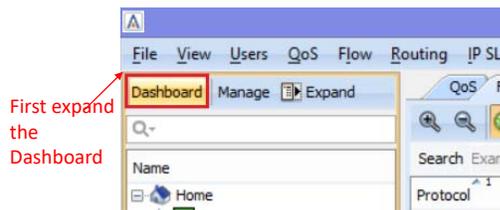
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Long Term Data Storage (2)

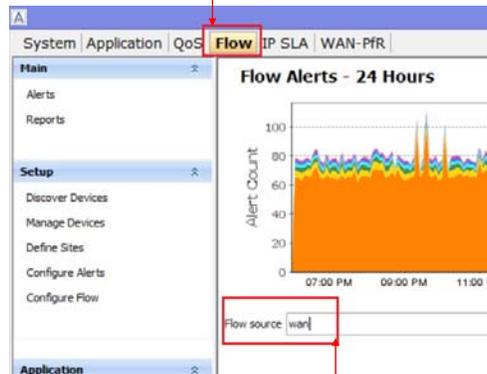
How is data populated?

The Dashboard Flow Source alters what devices and interfaces are processed in Long Term Report Processing.

You can find the Flow source on the Flow tab of the Dashboard.



Then select the Flow Tab



You can configure the "Flow source" to use tags for either Device, Interface, WAN, Site, or Tag

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Commonly Used Reports

- Top Applications
- Top Talkers/IP addresses
- Top DSCP
- WAN Bandwidth Utilization by application
- IPs and Ports

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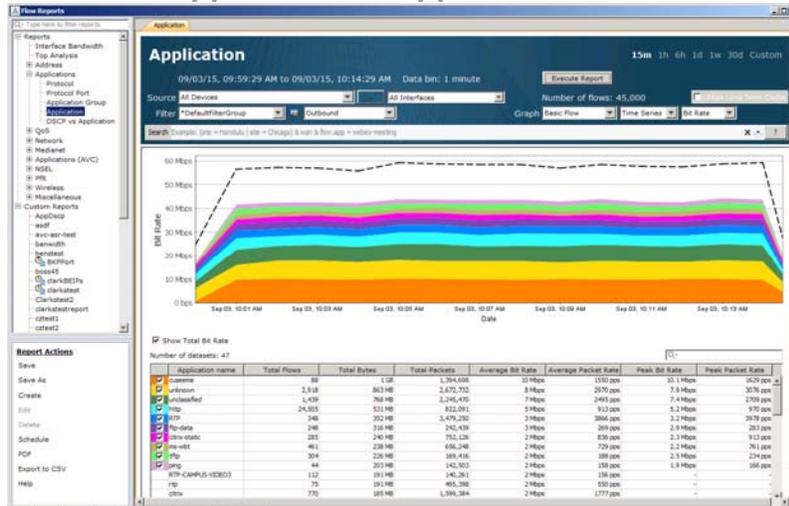
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Use Case 1 – Top Applications Applications > Application



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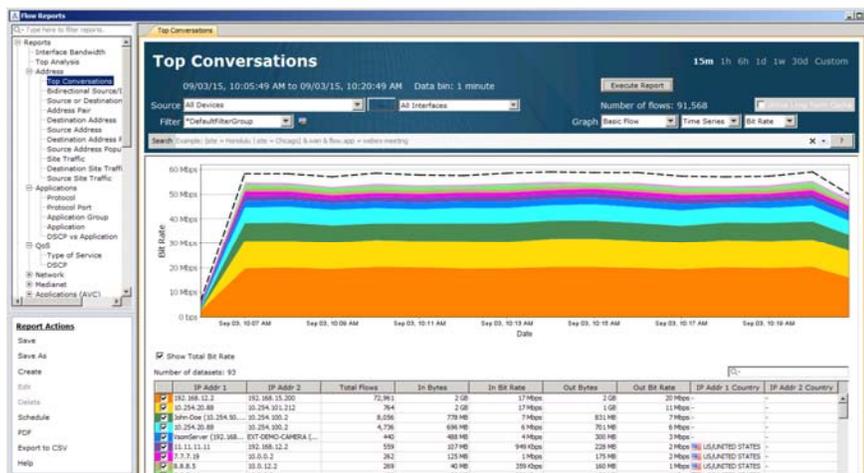
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Use Case 2 – Top Talkers Address > Top Conversations



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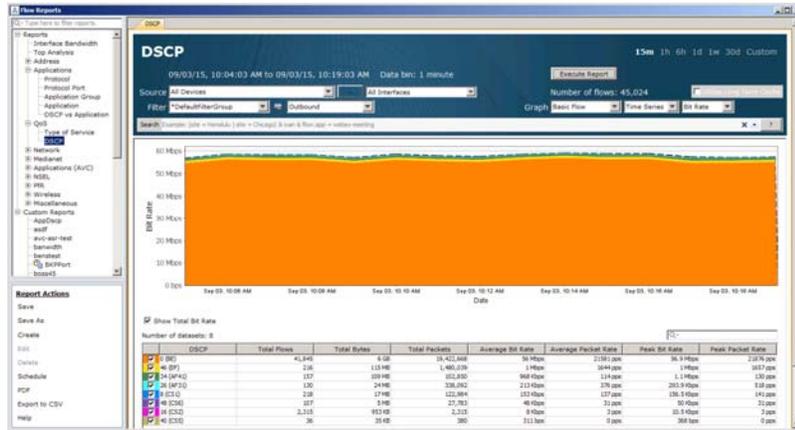
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Use Case 3 – Top DSCP

QoS > DSCP



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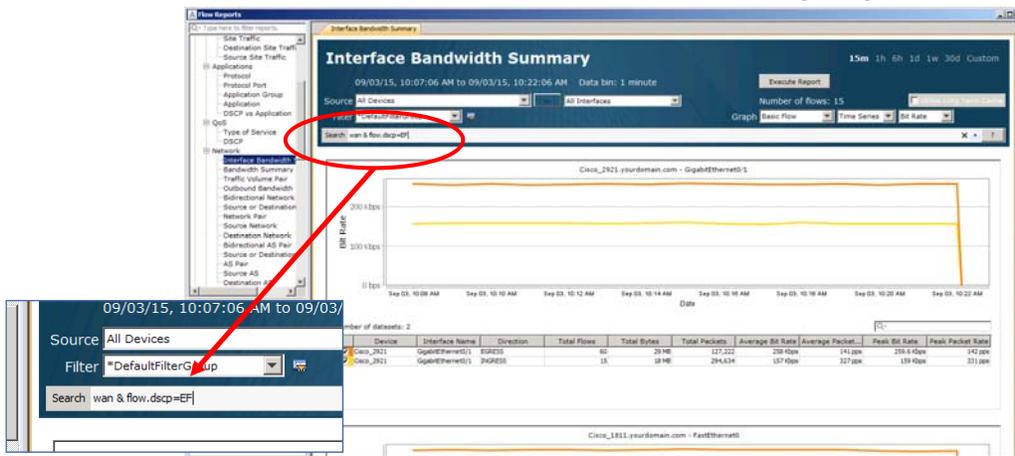
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Use Case 4 – Top DSCP

Network > Interface Bandwidth Summary Report



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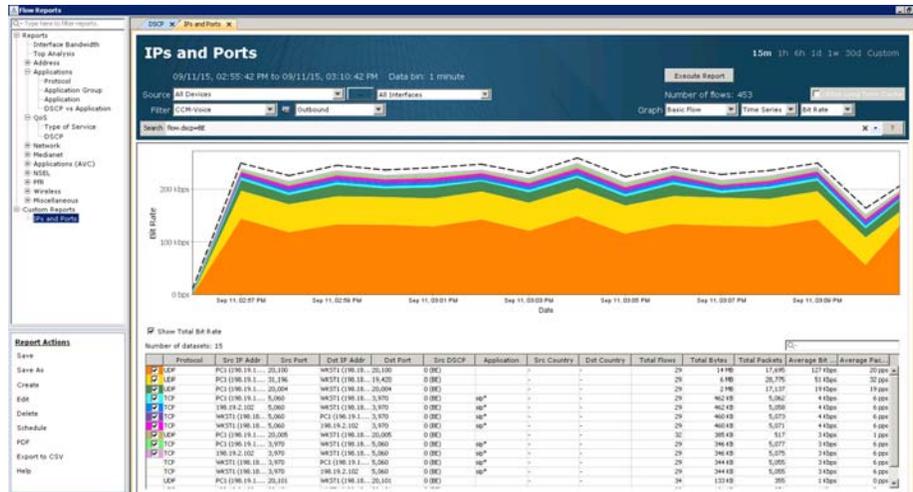
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Use Case 5 – IPs and Ports

IPs and Ports Report



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LAB: Reporting and Alerting

- View & Create Reports
- Configure Alerts



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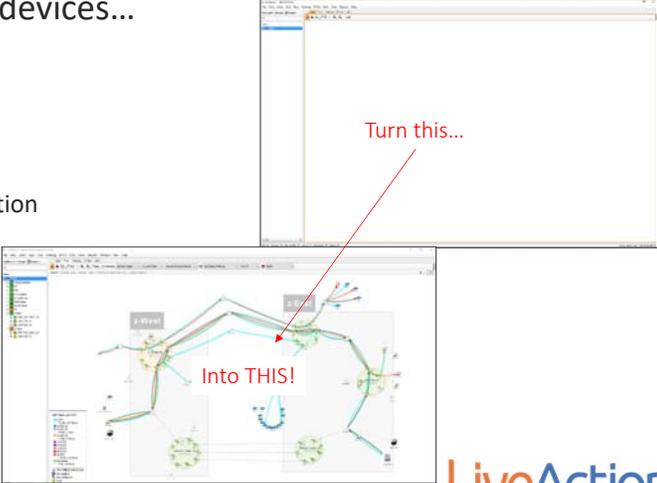


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LiveNX Topology – A Blank Slate

LiveNX acts as a framework to help you visually manage and troubleshoot your network devices...

- Add devices
 - Routers & switches
- Configure interfaces
 - Enable SNMP & Flow collection
- Identify end-points
 - Various icons
- Create Groups
- Filter flows...

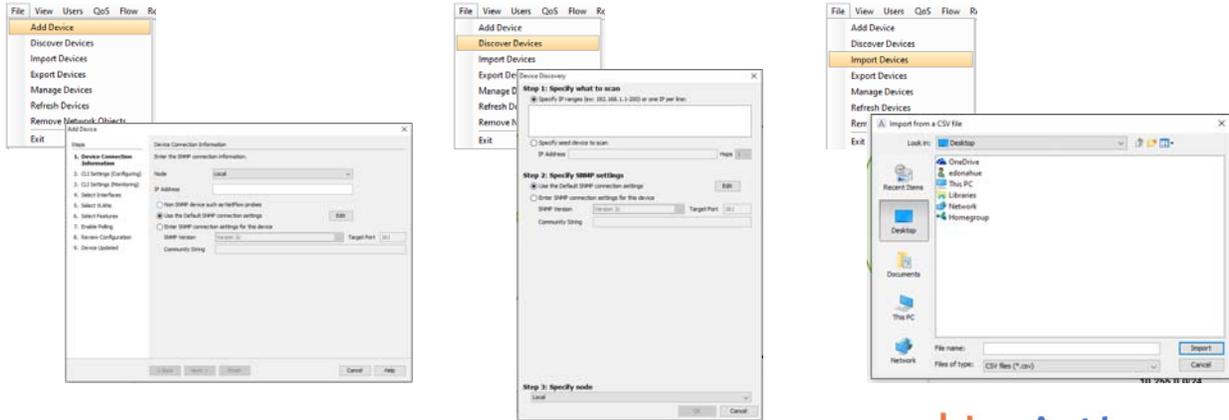


The screenshot shows a network topology diagram with various nodes and connections. A red arrow points from a text box labeled "Turn this..." to a specific part of the diagram. Another text box labeled "Into THIS!" points to a different part of the diagram. The LiveAction logo is visible in the bottom right corner of the screenshot.

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Adding Devices

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



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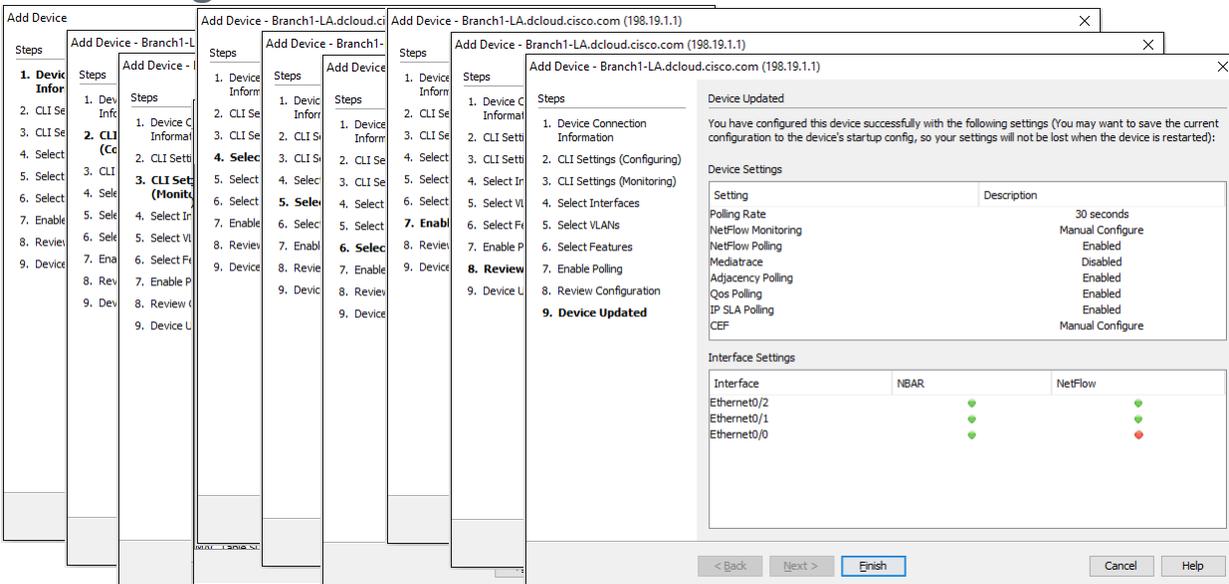
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Adding Devices



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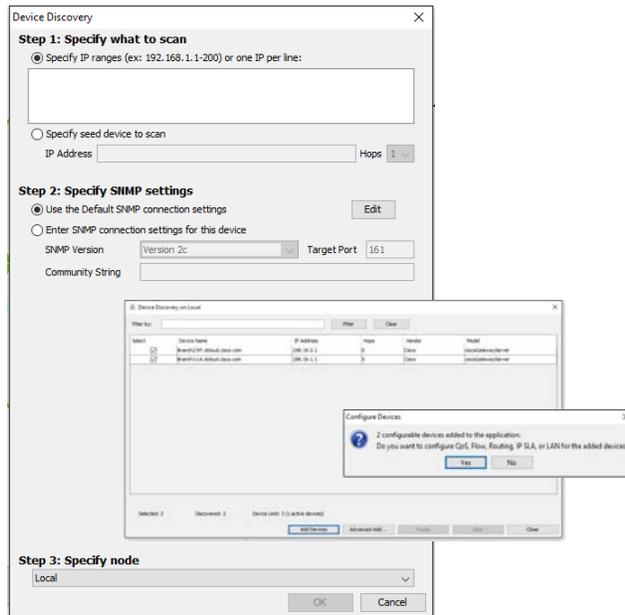
Device Discovery

Scan and find connected devices

- Use a “seed” device
- SNMP settings & Creds
- Is the collection Node Local or...



Returns a dialog with suggested devices to add.



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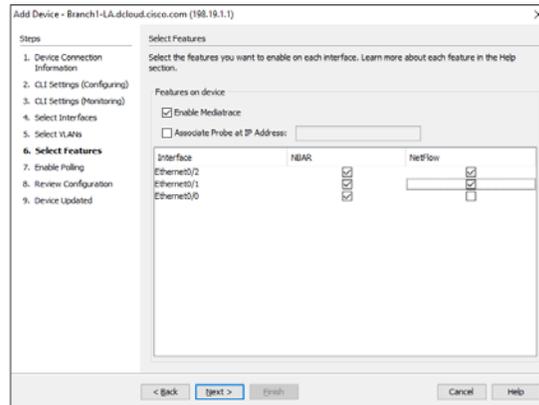
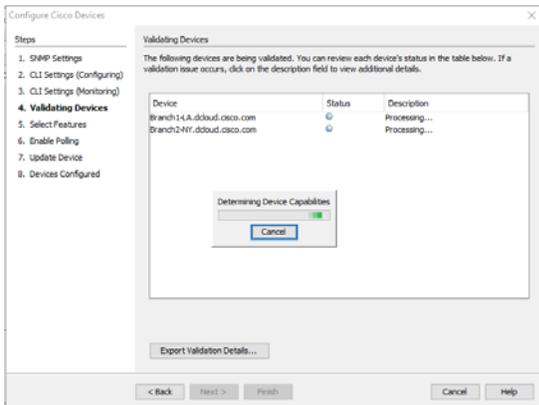
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Device Discovery... Configure Cisco Devices

Allows you to pre-configure specific features on recognized devices.*



*Creates a config t script to push



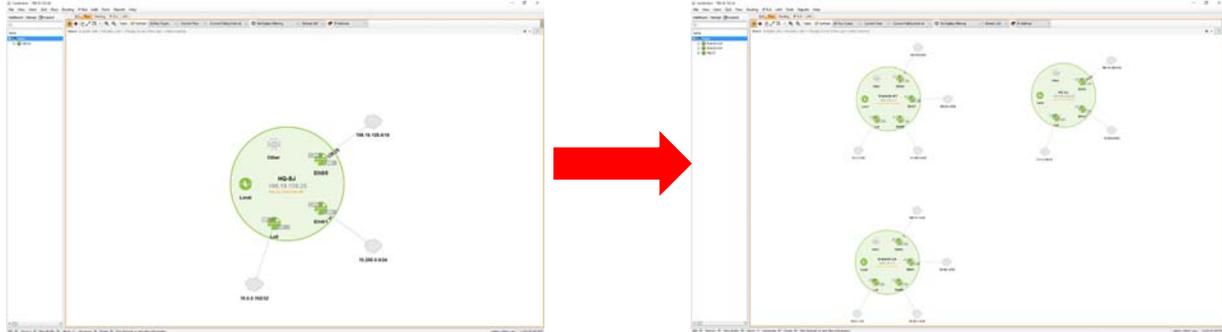
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Working Topology... Almost



Devices installed... But no Flows?

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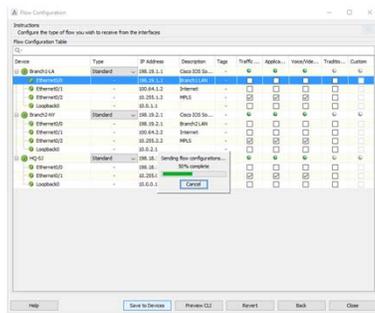
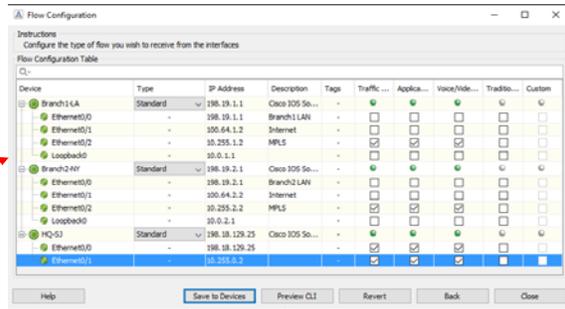
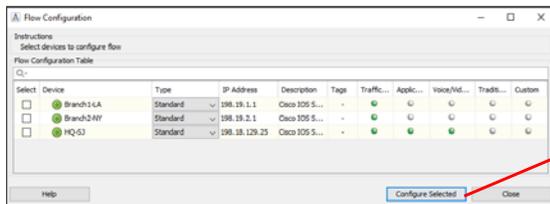
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Configure Flow Collection



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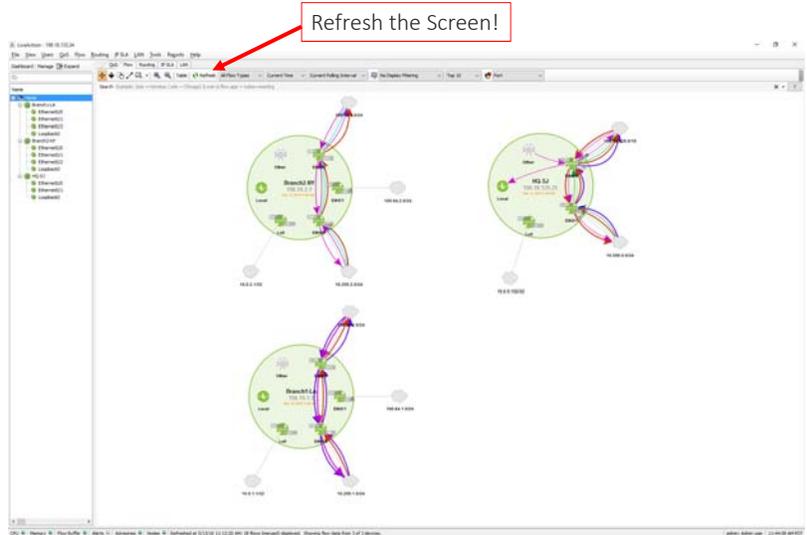
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View Traffic Flows!



Pretty colors and lines/arrows... but still not connected!



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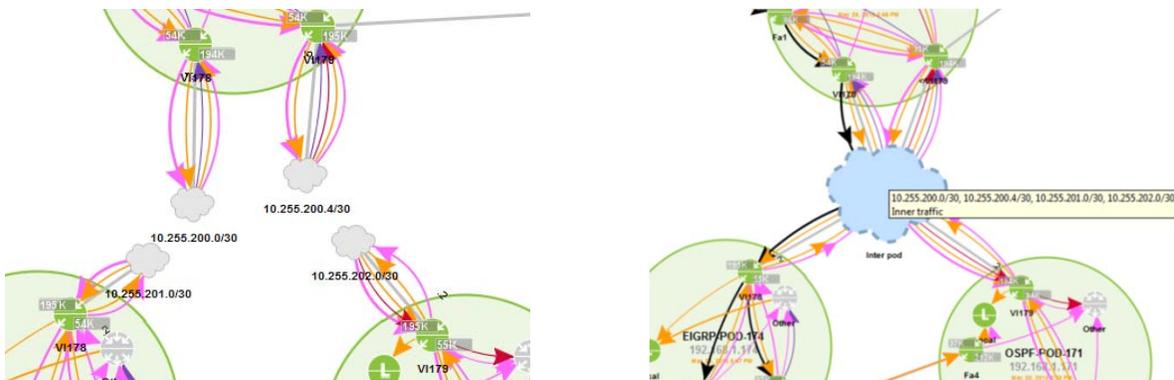
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Merge Clouds

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



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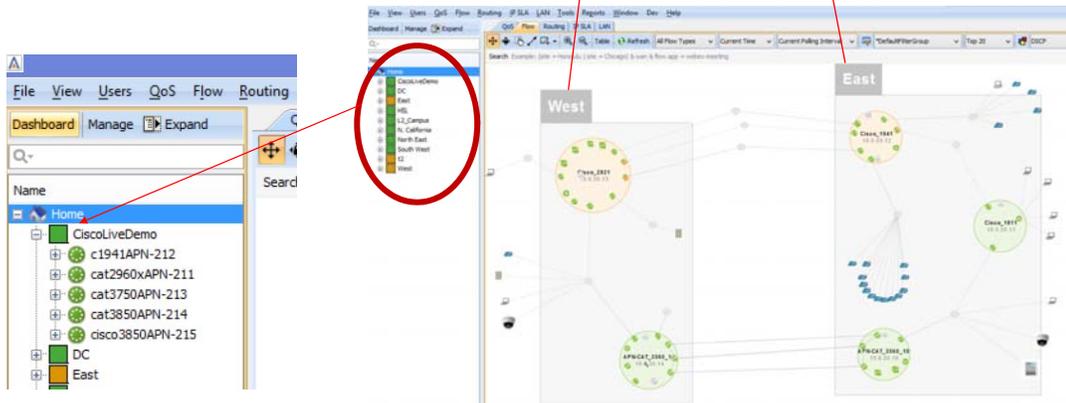
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Topology Basics - Grouping

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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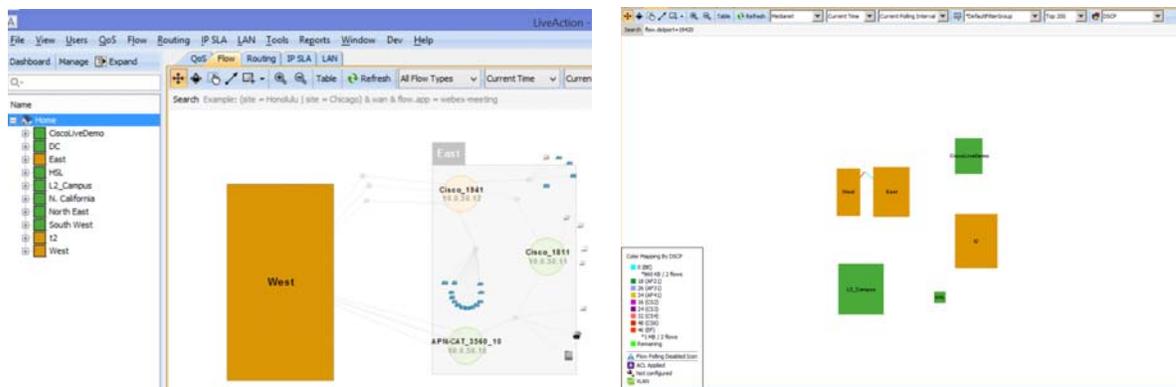
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Topology Basics

Devices reporting issues will change colors to prompt for investigation.

Quickly identify many problem sites visually



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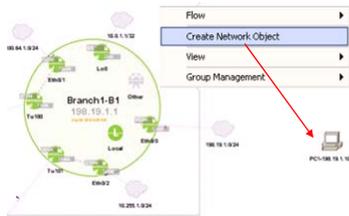
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Topology Basics – Add Network Object

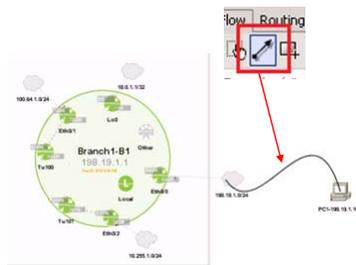
Associate Network Objects with IP Addresses help to visualize devices such as PCs, Servers, IP Phones, Laptops...

Step 1
Right-Click and create
Network Object



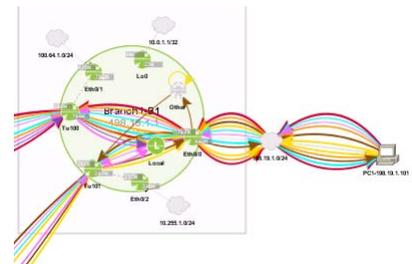
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Step 2
Draw connection to cloud



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Step 3
Flows now connect



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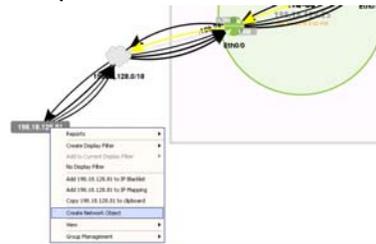
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Topology Basics – Add Network Object

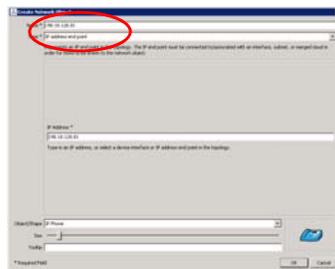
Do it the EASY way!

Step 1
Right-Click on Flow
Endpoint



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Step 2
Select the Object Shape



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Step 3
Flows now connect



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Device Semantics

Set Interface Labels, Destination, Speeds, Capacities...

The screenshot displays the LiveAction web interface for device management. A table lists various devices with columns for Name, IP Address, Node, Label, Capacity, WAN, Service Provider, Site, Site IP, and Tags. A red box highlights the 'Label' and 'Capacity' columns. A modal window titled 'Interface Details' is open, showing fields for Interface name, IP address, Description, Interface type, and Capacity. Another modal window titled 'Details' is also open, showing CPU and Memory usage.

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Auto-Semantic Discovery via WebUI

**RAPID DEVICE DISCOVERY THROUGH
AUTO-SEMANTIC DISCOVERY FOR FAST
DEPLOYMENT TIMES**

The legacy way of inputting device name, IP address, interface type, etc. into LiveNX manually was time consuming and labor intensive. LiveNX 6.2 introduces new Auto-Semantics capabilities that associate devices to sites, link capacity, site IP mapping, service provider, etc. and auto populates LiveNX so you can be up and using the platform faster.

The screenshot displays the LiveAction web interface for device management. The 'Configure' page for Device Management is shown, featuring a table of discovered devices. The table has columns for Name, IP Address, Node, Interface, and Site. Several devices are listed with their respective IP addresses and node names.

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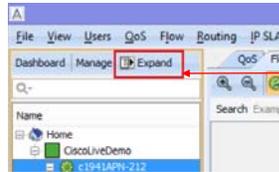
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Managing Data Storage

LiveNX creates *pointers* as data is collected into the database.



Expand to see device semantic information

Name	IP Address	Node	Label	Capacity	WAN	Service Pro...	Site	Site IP	Tags
Home									
<ul style="list-style-type: none"> <ul style="list-style-type: none"> c1941APN-212 GigabitEthernet0/0 GigabitEthernet0/1 Van100 	<ul style="list-style-type: none"> 10.0.50.212 10.254.255.212 10.254.253.212 10.254.254.212 	Local			<input checked="" type="checkbox"/>		RTP		<ul style="list-style-type: none"> USA

Device or Interface

WAN Tagged Interfaces

Site or configured Tags



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LAB: Customize Topology



- Device Semantics
- Creating / Modify Groups
- Network Objects



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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
- Baselineing allows you to see current traffic trends and understand if your policy will meet your network needs.

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Historical QoS Class View/Reports

The screenshot displays the 'QoS Reports' window in LiveAction. On the left, a menu lists various report types such as 'Device CPU/Memory Use', 'Interface Bandwidth', and 'Pre-Policy and Post-Policy'. The main area shows a report for 'Class_1941' on 'GigabitEthernet0/1' interface, comparing 'Before QoS - by Application (NBAR) in Kbps' and 'After QoS - by Class in Kbps'. Two line graphs show bandwidth usage over time, with a table on the right listing application/class names, average, and peak values.

Historical reports from these options

Historical reports from "Reports" Option

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Discover QoS Policy Enforcement Points

The diagram illustrates a network topology with two main devices: '2921-Demo-67_111' (IP 172.16.67.111) and '1941-WAN-67_113' (IP 172.16.67.113). It shows interfaces like Gi0/1, Gi0/2, Tu0, and Fa0/1/1 connected via a central cloud. A legend indicates that green devices have no drops, while amber devices have drops. Callouts point to specific interfaces and devices with their respective QoS policy statuses.

LiveNX discovers the topology & connectivity, and shows QoS Policies applied to interfaces & status

Green device: Device has NO drops

Input Interface Policy: No Drops

Amber device: Device has drops

Amber output Interface Policy: Has Drops

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QoS ACL

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

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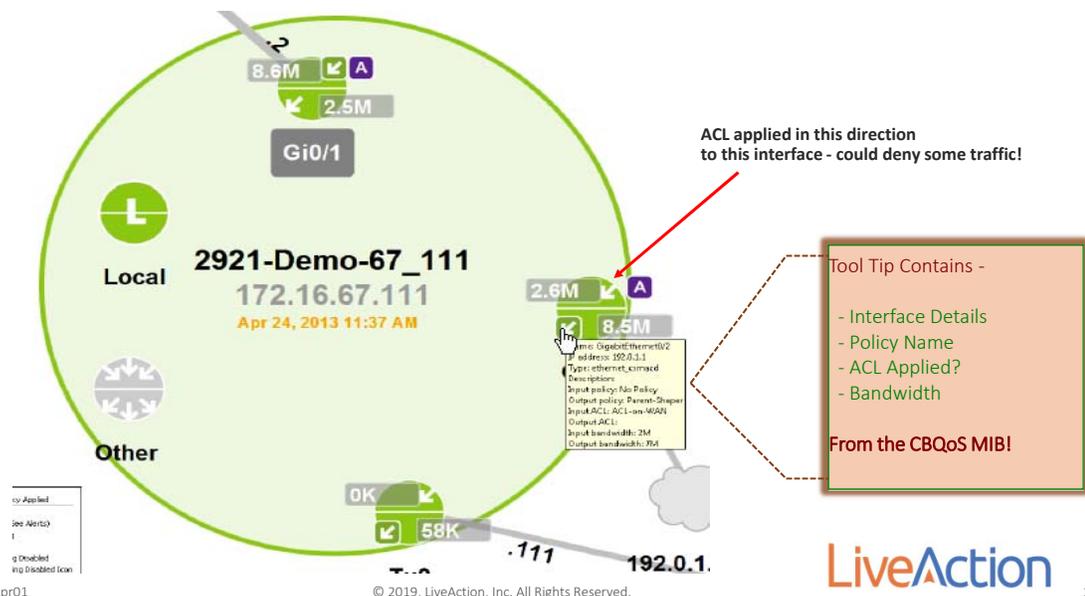
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QoS Policy Detail Display



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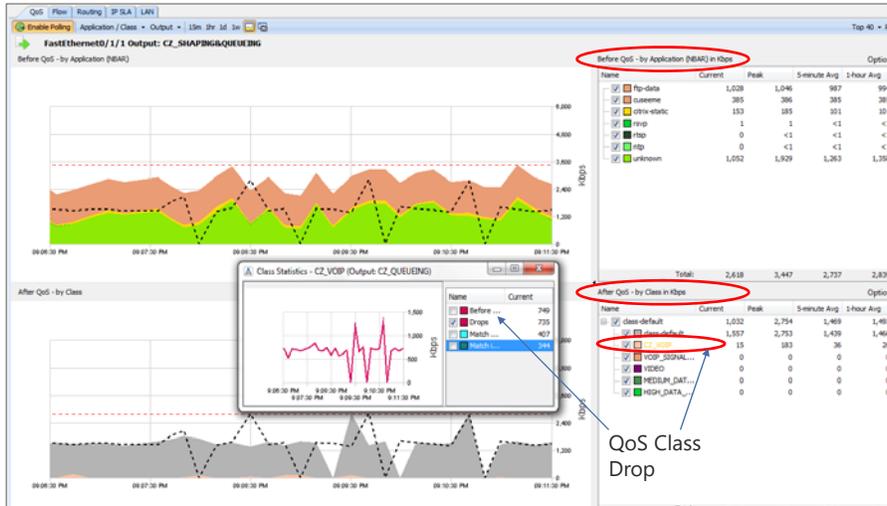
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QoS Troubleshooting

- Real-Time QoS Issues

Amber QoS class color shows class drops



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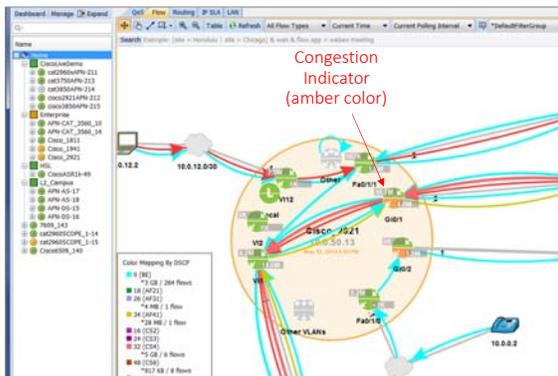
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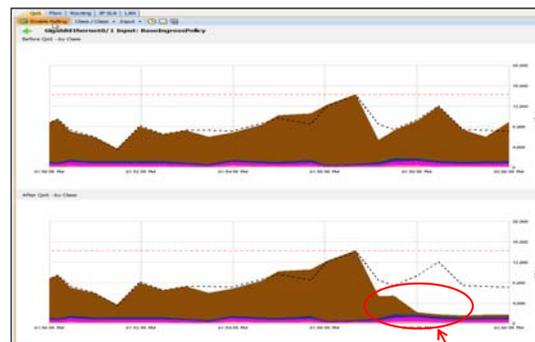
138

Track QoS Performance & Policy Validation

Visualize QoS Performance



Show Impact of QoS Policy



Policy applied to Police Interactive Video to 512 Kbps

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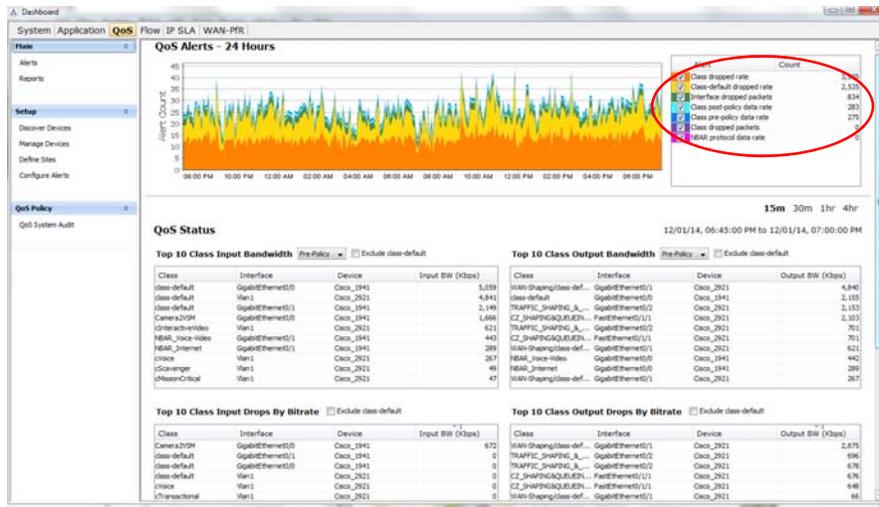
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QoS Dashboard



Driven from MIB-II, NBAR, and CBQoS MIBs



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Troubleshooting - Real-Time QoS Alerts

The screenshot shows the 'Configure Alerts' dialog box in the LiveAction interface. The 'Device/QoS Triggers' tab is selected, and several warning alerts are configured:

- Device Down:** A device becomes unavailable.
- CPU and Memory:**
 - A device's CPU usage reaches or exceeds (\geq) 97 %.
 - A device's memory usage reaches or exceeds (\geq) 95 %.
- Config Change:**
 - The running config changed time is later than the startup config changed time.
 - The device configuration has been changed by LiveAction.
- Interface Down:** An interface becomes unavailable.
- QoS Drops:** (Section header, no specific alerts listed).

To the right, a summary table shows the status of various alerts:

Alert	Count
Flow	53,020
QoS	3,187
IP SLA	608
Device CPU/Memory	25
Interface Up/Down	0
Device Config Change	0
Device Up/Down	0
Routing	0
LAN	0
Interface Rate	0

User-defined thresholds can be configured to create QoS alerts when thresholds are exceeded



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Troubleshooting – Auditing QoS Policies

Single-click!

Device	Issues
System	CLASS MISMATCH: 7 classes that have the same name have different match statements. Classes across multiple devices with the statements
System	EXCESS CLASS: The system contains 138 distinct class names. Excessive number of class definitions across the system.
7609_143.referentia.com	NO CLASS MATCH: 4 classes have no match statements. Classes were defined with no match statements.
APN-CAT_3560_14	SWITCH REMARK: Enabling QoS on switches will remark DSCP/COS values to zero by default unless trust is enabled.
APN-DS-16.actionpacked.com	NO CLASS MATCH: 4 classes have no match statements. Classes were defined with no match statements.
cat2960SCOPE_1-14	NO CLASS MATCH: 12 classes have no match statements. Classes were defined with no match statements.
cat2960SCOPE_1-14	SWITCH REMARK: Enabling QoS on switches will remark DSCP/COS values to zero by default unless trust is enabled.
cat2960SCOPE_1-15	NO CLASS MATCH: 1 classes have no match statements. Classes were defined with no match statements.
cat2960SCOPE_1-15	SWITCH REMARK: Enabling QoS on switches will remark DSCP/COS values to zero by default unless trust is enabled.
cat2960xAPN-211.actionpacked.com	NO CLASS MATCH: 2 classes have no match statements. Classes were defined with no match statements.

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LiveNX QoS Configure

- Full MQC (Modular QoS Configuration) support including WRED, CBWFQ, Priority Queuing, Shaping
- Read pre-existing QoS policies already configured on devices
- Take snapshots of current QoS configuration for future use
- Apply or remove QoS configurations quickly and easily across multiple interfaces
- Copy QoS policies across multiple devices, including associated ACLs (Access Lists)
- Hierarchical policy creation for advanced configurations
- CLI command preview before applying policy
- Rollback to previous policies at anytime*
- Built-in rules for QoS settings that highlight violations

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LAB: Quality-of-Service

- Investigate ways QoS can help our gateways be more efficient!



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A photograph of a woman with long brown hair, wearing a white shirt, looking upwards and to the right with a thoughtful expression, her hand resting on her chin. The background is a dark chalkboard with a white maze drawn on it, featuring several arrows pointing in different directions.

**LiveNX
Implementation**
Best Practices

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Server / Collector Node Sizing

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

LIVENX 8 DEPLOYMENT OPTIONS	
Component	Virtual Appliance Option
Server	All-in-one Server OVA
Client	Client software for Mac OS, Win 32-bit and 64-bit
Node (optional)	Node OVA
LiveAnalytics Node (optional)	LiveAnalytics OVA

Custom Deployment	Small Deployment	Medium Deployment	Large Deployment
Used for less than 25 devices or less than 25k flows/sec.	Used for less than 100 devices or less than 50k flows/sec	Used for 100 to 500 devices or less than 100k flows/sec	Used for 500 to 1000 devices or less than 150k flows/sec
Proof of Concept Deployments – Installation for non-server installations (laptops, Desktops)	Installation for server environments with Hyper-V Manager/VMware ESX/ Hypervisor	Installation for server environments with Hyper-V Manager/VMware ESX/ Hypervisor	Installation for server environments with Hyper-V Manager/VMware ESX/ Hypervisor
Specifications: 8vCPU Xeon or I7 16GB RAM LiveNX Server Max Heap Size 8GB 500GB Data Disks *	Specifications 16vCPU Xeon or I7 32GB RAM LiveNX Server Max Heap Size 16GB 2TB Data Disks *	Specifications 16vCPU Xeon or I7 64GB RAM LiveNX Server Max Heap Size 31GB 4TB Data Disks *	Specifications 32vCPU Xeon or I7 64GB RAM LiveNX Server Max Heap Size 31GB 8TB Data Disks *

Virtual Platform
VMware ESXi v5.0+ – VMware Hardware Version 8 (vmx-8)
Network Hardware – At least 2 Physical NICs on ESXi
– Support up to 10Gbps
– Virtual NICs on OVA are utilizing E1000

LIVENX CLIENT SIZING – DETAILS
The client application can be launched via Web Start directly from the LiveNX Web Server or Mac. For large scale deployments, the client application installer is recommended as it can s
Operating System Specification
Windows 10 or Mac OSX 64-bit OS
4 Cores
8 GB RAM
Web browser: IE11 and higher, Firefox, Chrome and Safari

OTHER COMPONENTS
• Java JDK "1.8.0_181"
• NodeJS "v8.9.4"
• InfluxDB "1.6.1"
• MongoDB "3.6.3"

PHYSICAL DEPLOYMENT PLATFORM – DETAILS
Base Hardware Model – Dell R440 1U Chassis
Processors – 2 x Intel Xeon Gold 5118 (24 CPU Total)
RAM – 96 GB DDR3; Heap-Size – 64GB
Storage – 4 x 8 TB 7200-RPM disks in RAID 10
IDRAC support



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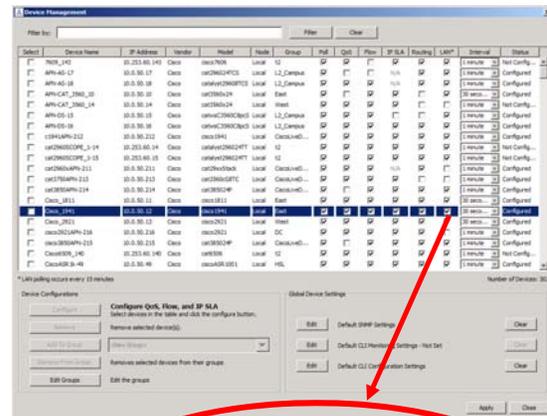
Disk Sizing- SNMP

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



<input type="checkbox"/>	Cisco_1811	10.0.50.11	Cisco	cisco1811	Local	East	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30 seco...	Configured
<input type="checkbox"/>	Cisco_1941	10.0.50.12	Cisco	cisco1941	Local	East	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30 seco...	Configured
<input type="checkbox"/>	Cisco_2921	10.0.50.13	Cisco	cisco2921	Local	West	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30 seco...	Configured



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NetFlow Bandwidth Overhead – Someone ALWAYS Asks!

Device Type	Flows/Sec	Full-Duplex User Bandwidth Avg.-Peak	NetFlow Bandwidth Average	NetFlow Bandwidth Peak
WAN Router	.61	158-309Kbps	2Kbps (1%)	14.8Kbps (4%)
WAN Router	34	505K-1.1Mbps	16Kbps (3%)	42.4Kbps (3%)
WAN Router	27	820K-2.6Mbps	22Kbps (2%)	36Kbps (1%)
WAN Router	197	~21-39Mbps	85Kbps (.04%)	117Kbps (.03%)
WAN Router	366	~37-72Mbps	161Kbps (.04%)	219Kbps (.03%)
WAN Router	474	~80-125Mbps	280Kbps (.03%)	396Kbps (.03%)
Internet Router	593	~75-115Mbps	317Kbps (.04%)	418Kbps (.03%)
Core Switch	633	~146-335Mbps	470Kbps (.03%)	578Kbps (.01%)
Core WAN Router	22,000	~4-4.2Gbps	11Mbps (.02%)	12Mbps (.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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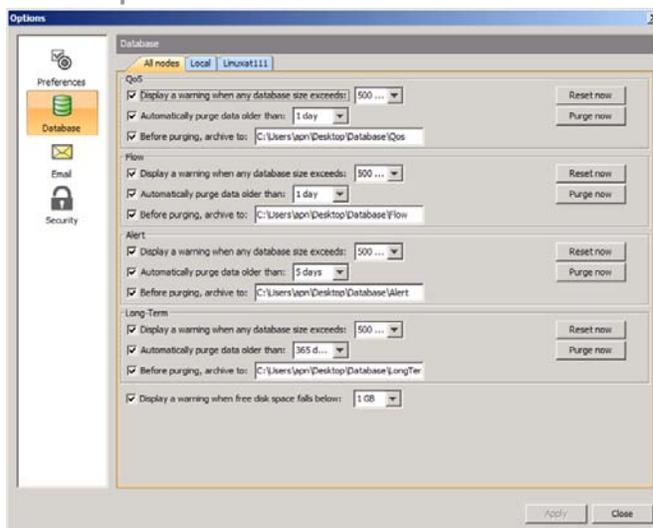
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Disk Retention

Tools > Options > Database:



Admin can set:

- Data Retention policy
- Manual Purge
- Backup
- Mounting

Disk full = Automatic Purging

Provision Enough Disk Space!

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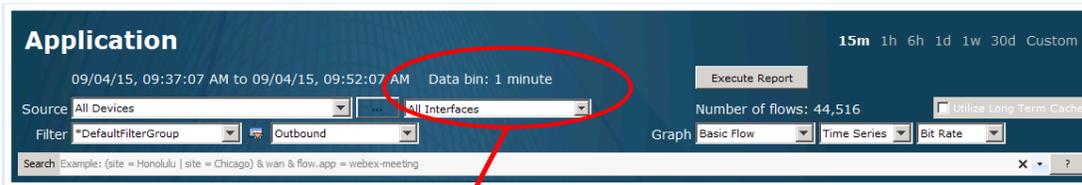
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Search – Data Bin



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

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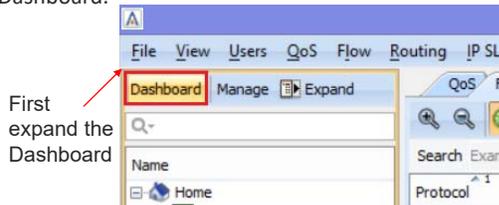
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Long Term Report Management

Populating data in the data store...

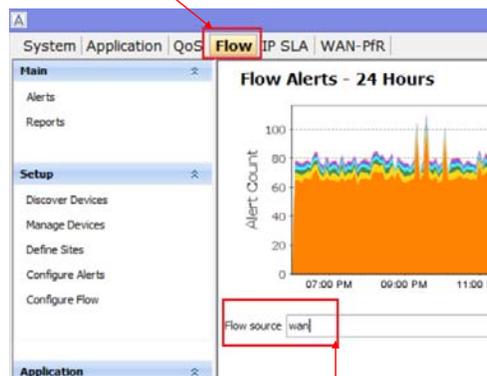
The Dashboard *Flow Source* alters the what devices and interfaces are processed in the Long Term Report Processing.

You can find the Flow source on the Flow tab of the Dashboard.



First expand the Dashboard

Then select the Flow Tab



You can configure the "Flow source" to use tags for either Device, Interface, WAN, Site, or Tag

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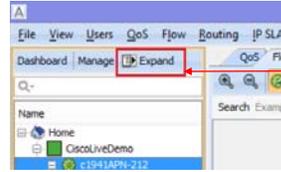
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Device Semantics...

The Flow Source is a flex string that can only be set as only as Device, Interface, WAN, Site or Tags.



Expand to see device information

Name	IP Address	Node	Label	Capacity	WAN	Service Pro...	Site	Site IP	Tags
ControlLiveDemo									
c1941APN-212	10.0.50.212	Local			<input checked="" type="checkbox"/>		RTP		USA
GigabitEthernet0/0	10.254.255.212				<input checked="" type="checkbox"/>				
GigabitEthernet0/1	10.254.253.212				<input checked="" type="checkbox"/>				
Van100	10.254.254.212				<input checked="" type="checkbox"/>				USA

Device or Interface

WAN Tagged Interfaces

Site or configured Tags

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NetFlow Best Practices

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NetFlow Best Practices

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

*with good/modern IOS

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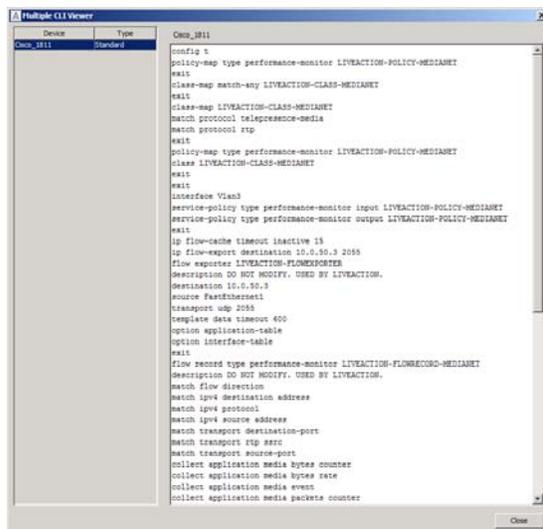
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NetFlow – Configuration Management



```
Device      Type
Cisco_3811  Standard

Cisco_3811
config t
policy-map type performance-monitor LIVEACTION-POLICY-MEDIANET
exit
class-map match-any LIVEACTION-CLASS-MEDIANET
exit
class-map LIVEACTION-CLASS-MEDIANET
match protocol telepresence-media
match protocol rtsp
exit
policy-map type performance-monitor LIVEACTION-POLICY-MEDIANET
class LIVEACTION-CLASS-MEDIANET
exit
interface Vlan3
service-policy type performance-monitor input LIVEACTION-POLICY-MEDIANET
service-policy type performance-monitor output LIVEACTION-POLICY-MEDIANET
exit
ip flow-cache timeout inactive 15
ip flow-export destination 10.0.30.3 2055
flow exporter LIVEACTION-FLOWEXPORTER
description DO NOT MODIFY, USED BY LIVEACTION.
destination 10.0.30.3
source FastEthernet1
transport udp 2055
template data timeout 600
option application-table
option interface-table
exit
flow record type performance-monitor LIVEACTION-FLOWRECORD-MEDIANET
description DO NOT MODIFY, USED BY LIVEACTION.
match flow direction
match ipv4 destination address
match ipv4 protocol
match ipv4 source address
match transport destination-port
match transport ip size
match transport source-port
collect application media bytes counter
collect application media bytes rate
collect application media event
collect application media packets counter
```

Use Best Practice NetFlow
templates built into LiveAction

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

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NetFlow – Flexible NetFlow

Application/ NBAR2 Data

Time	Protocol	Src IP Addr	Src Port	Dest IP Addr	Dest Port	Application	IP	Out IP	Direction	Src DSCP	DSCP and IPv4 T.	Bit Rate	Src ID
Sep 3, 2015 8:43...	UDP	10.0.12.2	16,388	8.8.8.8	16,384	undisclosed	Vlan12	GigabitEthernet1/1	EGRESS	0 (0)	0 (0)	91 Kbps	
Sep 3, 2015 8:43...	UDP	10.0.0.2	16,384	7.7.7.11	16,384	tcp.testing*	GigabitEthernet1/0	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	83 Kbps	
Sep 3, 2015 8:43...	UDP	192.168.12.2	31,196	192.168.15.200	18,400	rtp	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	79 Kbps	
Sep 3, 2015 8:43...	UDP	10.0.0.2	16,388	7.7.7.120	16,384	undisclosed	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	60 Kbps	
Sep 3, 2015 8:43...	TOP	192.168.12.2	80	192.168.15.200	4,297	http	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	17 Kbps	
Sep 3, 2015 8:43...	TOP	192.168.12.2	80	192.168.15.200	4,290	http	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	47 Kbps	
Sep 3, 2015 8:43...	TOP	192.168.15.200	2,313	192.168.12.2	80	http*	GigabitEthernet1/0	Vlan1	INGRESS	0 (0)	0 (0)	13 Kbps	
Sep 3, 2015 8:43...	TOP	192.168.15.200	2,314	192.168.12.2	443	secure-http*	GigabitEthernet1/0	Vlan1	INGRESS	0 (0)	0 (0)	1 Kbps	
Sep 3, 2015 8:43...	TOP	192.168.15.200	4,290	192.168.12.2	80	http	GigabitEthernet1/0	Vlan1	INGRESS	0 (0)	0 (0)	2 Kbps	
Sep 3, 2015 8:43...	TOP	192.168.12.2	80	192.168.15.200	2,313	http*	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	4 Kbps	
Sep 3, 2015 8:43...	TOP	192.168.15.200	1,935	192.168.12.2	1,935	undisclosed	GigabitEthernet1/0	Vlan1	INGRESS	0 (0)	0 (0)	1 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.15.200	1,935	192.168.12.2	1,935	undisclosed	GigabitEthernet1/0	Vlan1	INGRESS	0 (0)	0 (0)	1 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.12.2	80	192.168.15.200	52,255	ms-ml	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	736 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.12.2	80	192.168.15.200	50,192	ms-office-365	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	53 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.15.200	50,192	192.168.12.2	80	ms-office-365	GigabitEthernet1/0	Vlan1	INGRESS	0 (0)	0 (0)	951 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.15.200	4,292	192.168.12.2	80	http	GigabitEthernet1/0	Vlan1	INGRESS	0 (0)	0 (0)	2 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.12.2	80	192.168.15.200	4,292	http	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	40 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.12.2	80	192.168.15.200	4,295	http	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	26 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.12.2	80	192.168.15.200	4,302	http	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	32 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.15.200	4,304	192.168.12.2	80	http	GigabitEthernet1/0	Vlan1	INGRESS	0 (0)	0 (0)	2 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.15.200	2,126	192.168.12.2	443	secure-http*	GigabitEthernet1/0	Vlan1	INGRESS	0 (0)	0 (0)	237 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.12.2	443	192.168.15.200	2,126	secure-http*	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	2 Kbps	
Sep 3, 2015 8:44...	UDP	10.0.0.2	1,628	7.7.7.14	68	ntp*	FastEthernet1/0	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	360 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.12.2	61,678	192.168.15.200	20,155	undisclosed	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	321 Kbps	
Sep 3, 2015 8:44...	UDP	192.168.12.2	2,342	192.168.15.200	1,709	rtsp**	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	190 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.12.2	61,677	192.168.15.200	24,697	rtsp**	Vlan1	GigabitEthernet1/0	EGRESS	0 (0)	0 (0)	1 Kbps	
Sep 3, 2015 8:44...	UDP	192.168.15.200	4,297	192.168.12.2	80	http	GigabitEthernet1/0	Vlan1	INGRESS	0 (0)	0 (0)	1 Kbps	
Sep 3, 2015 8:44...	TOP	192.168.15.200	4,295	192.168.12.2	80	http	GigabitEthernet1/0	Vlan1	INGRESS	0 (0)	0 (0)	1 Kbps	

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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;fpan=0;fpa=P0-322201277-1287906563231;ns=0;url=http%3A%2F%2Fw:2 quant.swf:2 981:3 crossdomain.xml:3 913:2 914:2 461:2 cgi-bin:6 915:2 ad:2 462:2 ad:2 462:2 ad:2 839:2 quant.js:2 api:3 761:2 notice.do:2 _vti_bin:2 jaction:2 images:10 pixel;r=1182204851;fpan=0;fpa=P0-322201277-1287906563231;ns=0;url=http%3A%2F%2Fw:2 features:4 shows:6 adServer:2 captions.xml:3 pagead:9 499:3 live-streams:2 b:3
us.bc.yahoo.com	B:1

NetFlow v9 - RFC3954
IPFIX – RFC5101

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NetFlow – Where to Enable Flow?

The Fewest Interfaces Possible!

Why?

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

Routers

- Usually WAN Interfaces Only
- Usually Tunnel Interfaces Only for IWAN/DMVPN

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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Alerting

LiveAction Prefers the following Defaults:

- Tick - A device becomes unavailable
- Tick - CPU Utilization
- Tick - Memory Utilization
- Tick - Commands sent for monitor-only
- Tick - Device config has been changed via LiveAction
- Tick - Interface becomes unavailable
- Tick - An interface has errors (CRC, Frame, etc)
- Un-Tick - Interface drop rate errors
- Tick - Class drop rate exceeds = 0Kbps
- Tick - Class-default drop exceeds = 1500Kbps

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Provide QoS for:

- **SNMP, Flow, SSH/Telnet to devices**
- **Nodes Communicate on TCP 7026**

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Semantic Data

Dashboard | Manage | Expand

Name	IP Address	Node	Label	Capacity	WAN	Service Provi...	Site	Site IP	Tags
Cisco_2921	10.0.50.13	Local					San-Francisco	192.168.15.0/24, 10.0.12.0/24	Enhanced, USA
FastEthernet0/1/0	10.0.0.1			100.0 Mbps	<input type="checkbox"/>				
FastEthernet0/1/1	192.168.46.2		Link to 8.8.8.0	3.0 Mbps	<input checked="" type="checkbox"/>	SP1			To-Verizon
GigabitEthernet0/1	192.168.11.2		To-Box_Jelly	3.0 Mbps	<input checked="" type="checkbox"/>	SP2			To-TimeWarner
GigabitEthernet0/2	192.0.1.1		testing	1.0 Gbps	<input type="checkbox"/>				
Vlan1	192.168.12.1				<input type="checkbox"/>				
Vlan12	10.0.12.1			100.0 Mbps	<input type="checkbox"/>				
Vlan2	192.168.100.1			100.0 Mbps	<input type="checkbox"/>				
VLANs									

Label, Capacity, WAN, Service Provider, Site, Site IP

Semantic data makes LiveAction come "alive"!

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Semantic Data – example 1

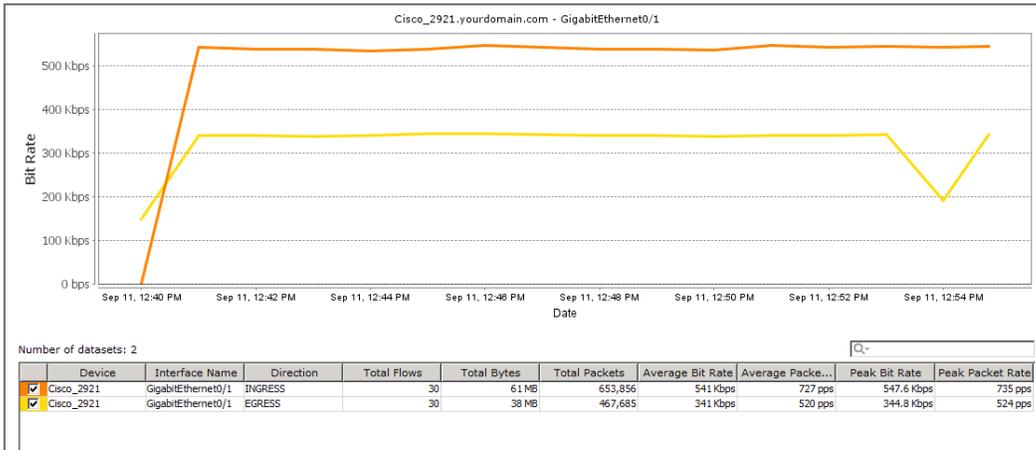
Search `site=San-Francisco | site=Chicago | site= New_York & wan & flow.dstport=19420`

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Semantic Data – example 2

Search wan & tag=Enhanced & flow.app=RTP



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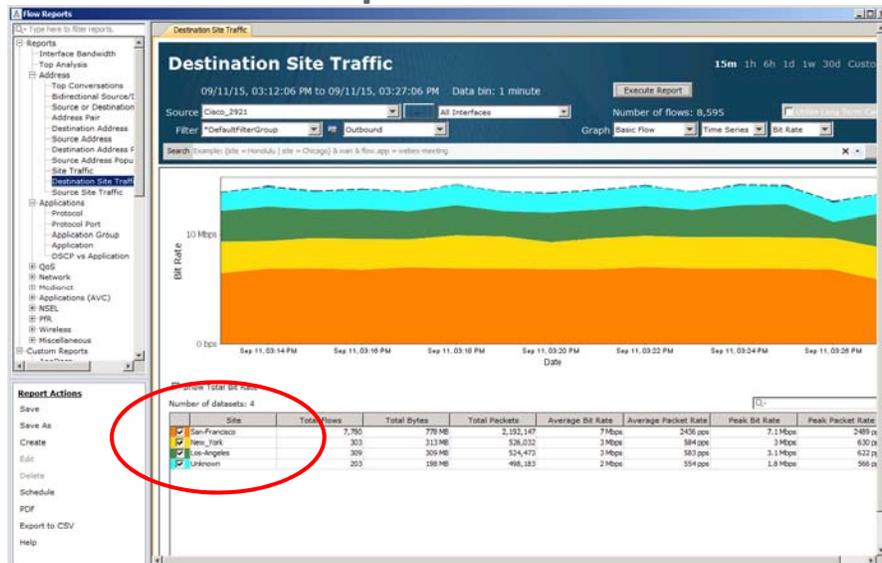
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Semantic Data – example 3



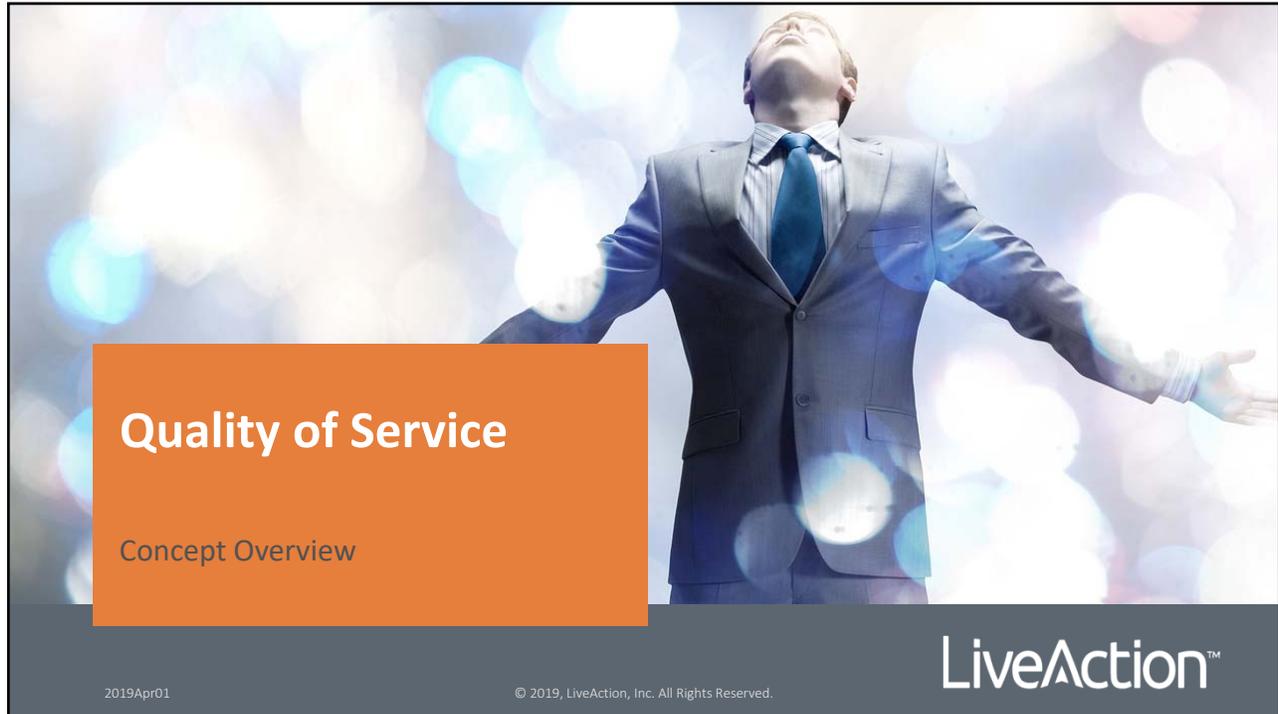
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Quality of Service

Concept Overview

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How to Implement QoS

- Step 1 - Recognize Application Traffic** (Classification and Marking)
- Step 2 - Prioritize** (Queuing and Shaping)
- Step 3 - Throttle Traffic** (Policing and WRED)
- Step 4 - Buffer Tuning**

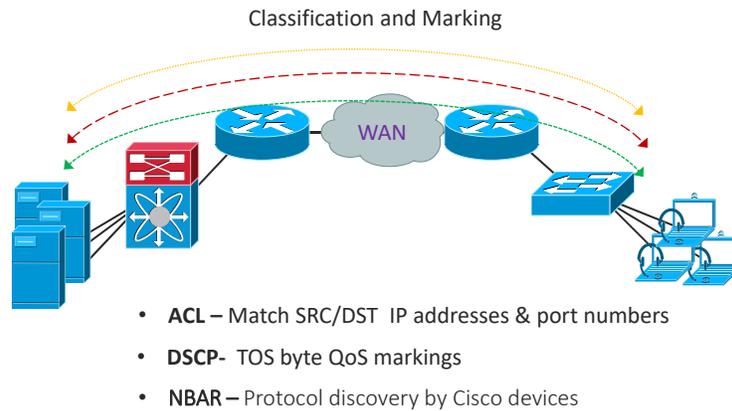
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Step 1 - Recognize Application Traffic



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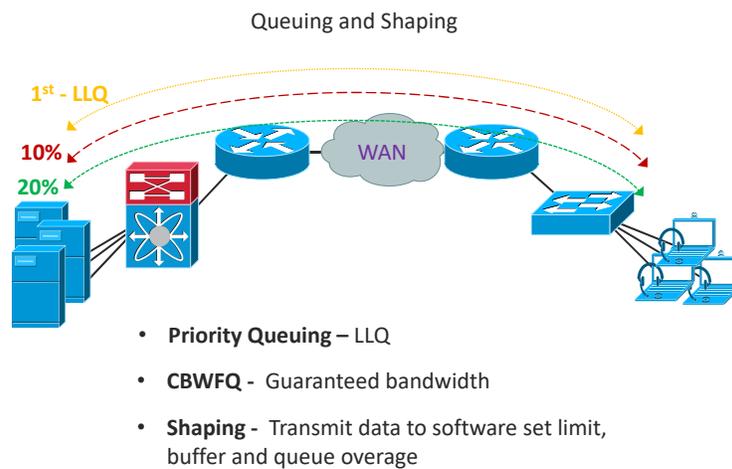
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Step 2 – Prioritize



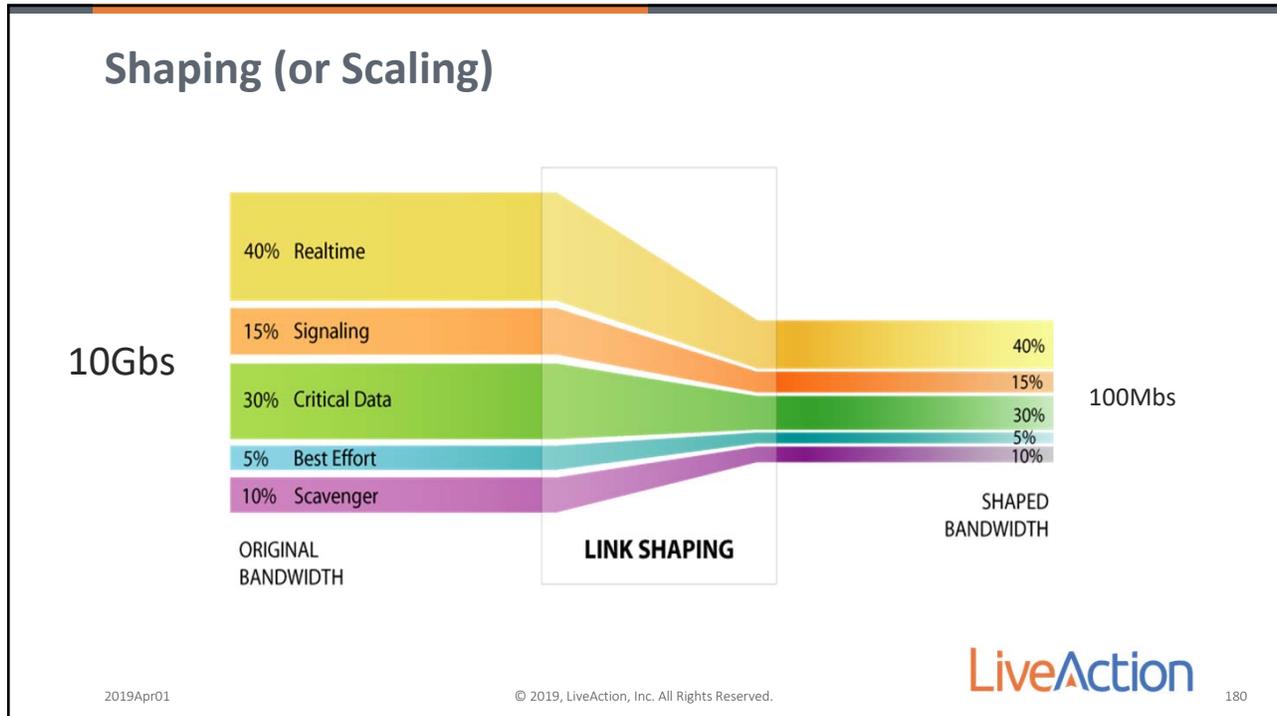
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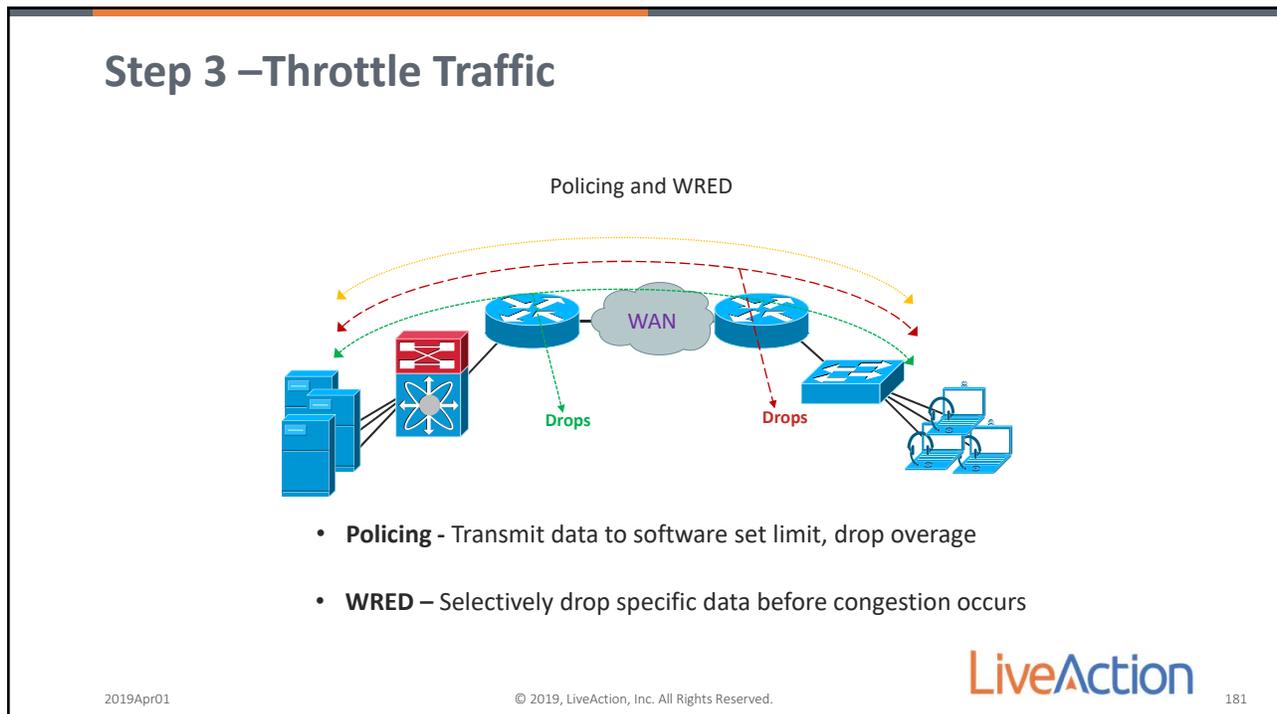
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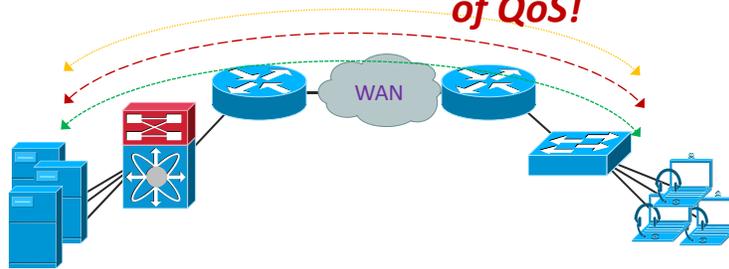
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Recognize Application Traffic

This may be the hardest & most important part of QoS!



- Step 1 – Day 0: Application Landscape
- Step 2 - Use Filters/Search to identify traffic in LiveNX
- Step 3 - Use visualization & reports to confirm traffic
- Step 4 - Standardize on DSCP values
- Step 5 - Use visualization & reports to validate DSCP
- Step 6 - Update QoS policies on routers/switches/etc.
- Step 7 - Confirm QoS policies via visualization & reports in LiveNX



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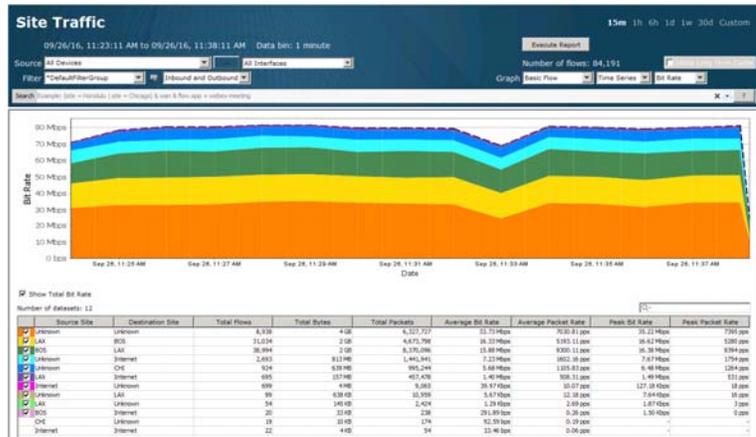
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Classification: Day 0: Application Landscape

- Step 1: Review customer's critical applications
- Step 2: Review LiveNX Flow Reports to understand application usage:
 - Application Report
 - Interface Bandwidth Summary
 - IPs & Ports
 - Site Traffic
 - Destination Site Traffic
 - Source Site Traffic



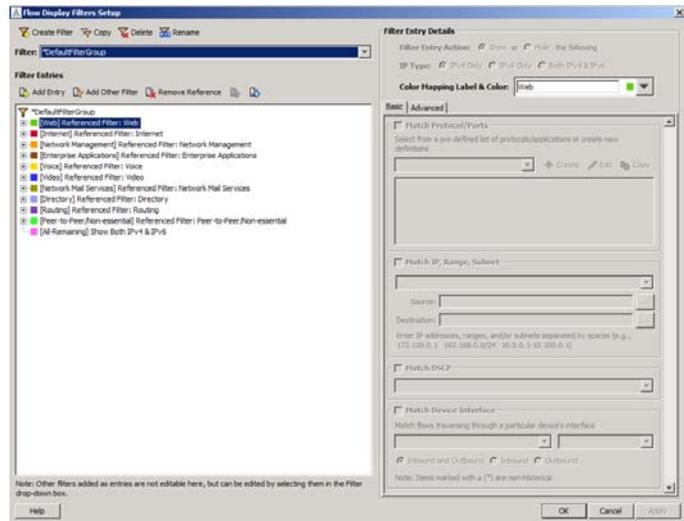
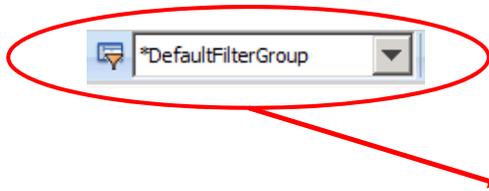
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Classification: Create Custom Filter



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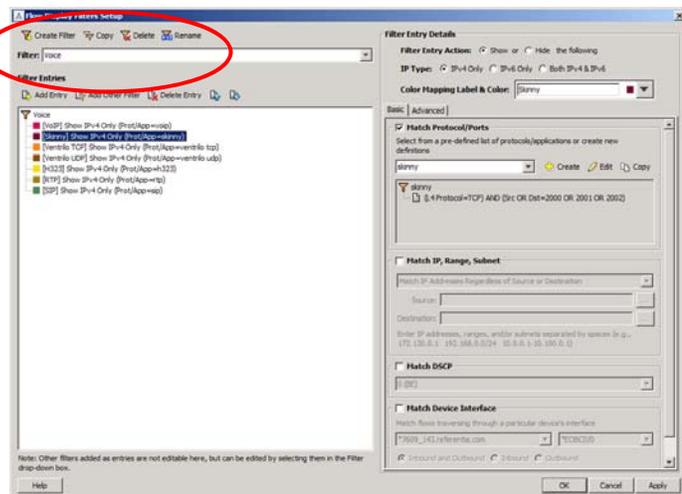
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Classification: Copy Voice Filter

- Find pre-canned Voice filter
- Copy and rename it



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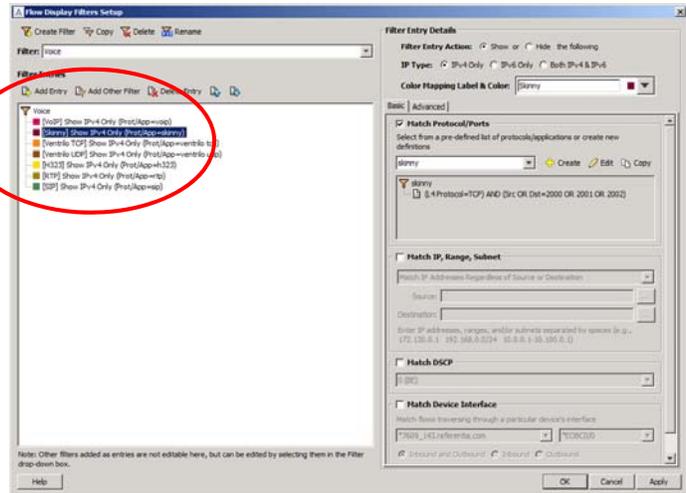
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Classification: Delete Unused Entries

Delete unused Entries

- VoIP
- Ventrilo TCP
- Ventrilo UDP



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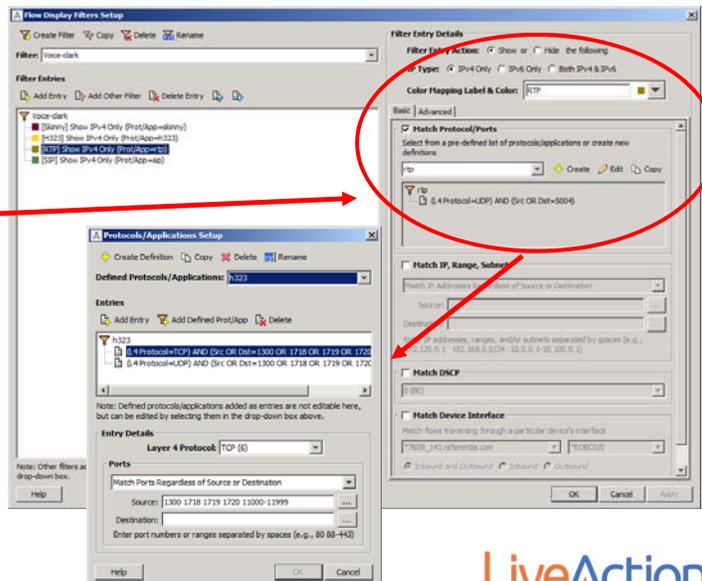
Classification: Add/Edit Entries

Edit Entries:

- h323
- RTP
- SIP

Add Entry:

- MGCP



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Classification: Edit Entries

MGCP

TCP/UDP = Src or Dst = 2427 2727

TCP = Src or Dst = 2428

H323

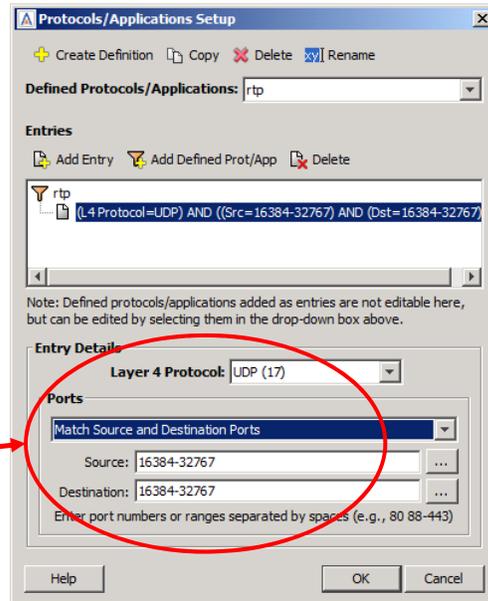
TCP/UDP = Src or Dst = 1718 1719 1720

SIP

TCP/UDP = Src or Dst = 5060 5061 5062

RTP

UDP = Src **AND** Dst = 16384-32767



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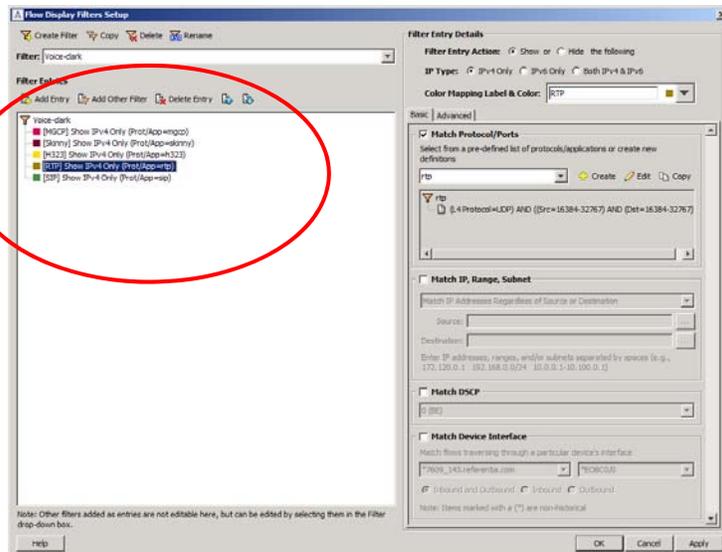
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Classification: Voice Filter is ~95 accurate

- MGCP
- Skinny
- h323
- RTP
- SIP



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

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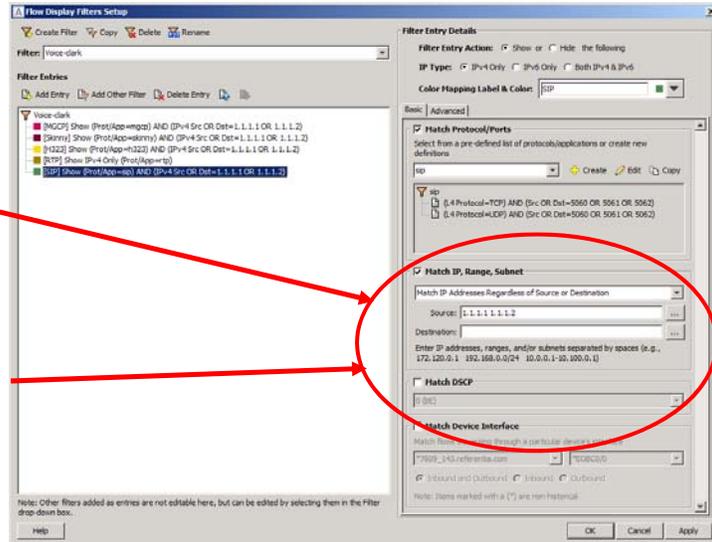
Classification: Voice Filter is ~99 accurate

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

- MGCP
- Skinny
- h323
- SIP

If feasible, add voice subnets to to:

- RTP



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Classification: Display Filter Colors



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Classification: IPs & Ports Report

Use this report to validate Filter's Accuracy.

NBAR2 is your Friend!

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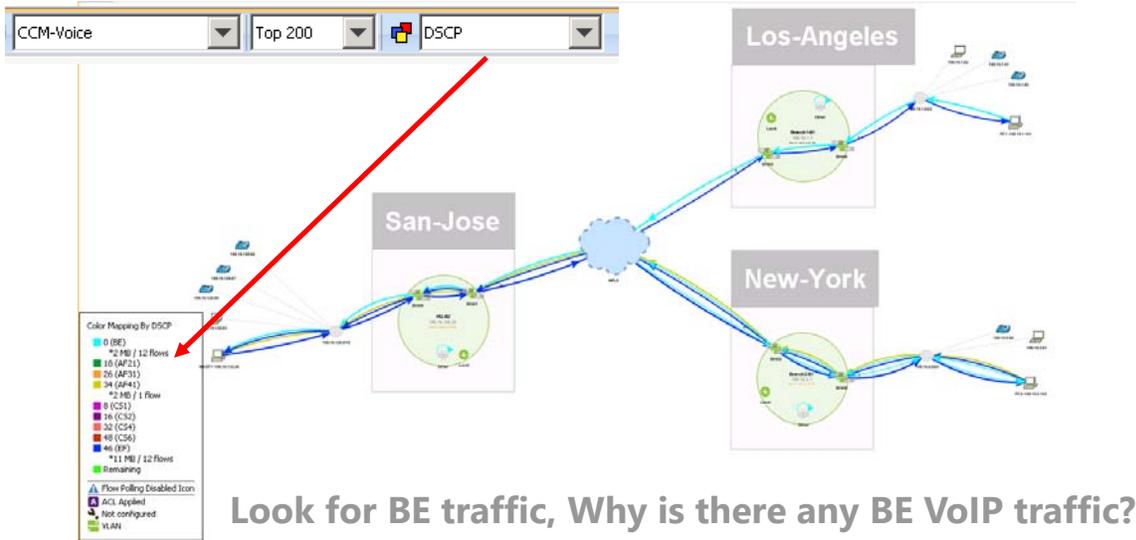
Marking: Selecting DSCP Values

Class Type	4 Class	8 Class	12 Class
Cisco Name/ RFC4594 Name			
Voice / IP Telephony		EF (46)	EF (46)
Interactive Video / Multimedia Conferencing	EF (46)	CS5 (40) CS4 (32)	AF41 (34) AF42 (36) AF43 (38)
Streaming Video	CS5(40)		AF31 (26) AF32 (28) AF33 (30)
Real-Time Interactive	CS4 (32)	AF31 (26) AF32 (28) AF33 (30)	CS4 (32)
Broadcast Video			CS5(40)
Call Signaling	CS6 (48)	CS3 (24)	CS3 (24)
IP Routing / Network Control	CS3 (24)	CS2 (16)	CS6 (48)
Network Management	CS2 (16)	CS6 (48)	CS2 (16)
Transactional Data / Low-Latency Data			AF21 (18) AF22 (20) AF23 (22)
Bulk Data / High Throughput Data	AF41 (34) AF42 (36) AF43 (38)	AF41 (34) AF42 (36) AF43 (38)	AF11 (10) AF12 (12) AF13 (14)
	AF31 (26) AF32 (28) AF33 (30)	AF21 (18) AF22 (20) AF23 (22)	
	AF21 (18) AF22 (20) AF23 (22)	AF11 (10) AF12 (12) AF13 (14)	
	AF11 (10) AF12 (12) AF13 (14)		
Scavenger / Low-Priority Data		CS1 (8)	CS1 (8)
Best Effort	BE (0)	BE (0)	BE (0)

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

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Marking: DSCP Visualization



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

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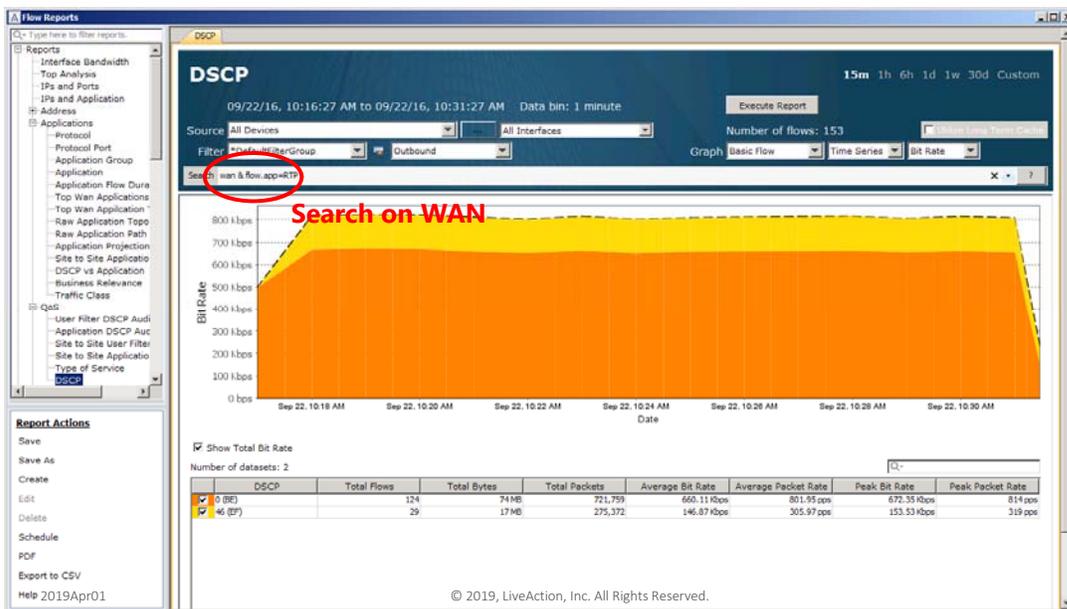
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Marking: DSCP Report

Is there any BE VoIP traffic?



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on

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Marking: User Filter DSCP Audit Where is the BE VoIP traffic?

User Filter DSCP Audit

09/22/16, 10:17:39 AM to 09/22/16, 10:32:39 AM Data bin: 1 minute

Source: All Devices All Interfaces Number of flows: 153

Filter: wan & flow.app=RTP

Graph: Basic Flow Time Series Bit Rate

Search on WAN

Search is helpful!

Site	Filter Match	Na...	DSCP	Total Flows	Total Bytes	Total Packets	Average Bit Rate	Average Packe...	Peak Bit Rate	Peak Packet...
CHI	All-Remaining	0 (BE)		30	35 MB	221,536	235.49 Kbps	246.58 pps	238.30 Kbps	249 pps
BOS	All-Remaining	0 (BE)		15	22 MB	179,793	192.03 Kbps	199.77 pps	194.31 Kbps	201 pps
LAX	All-Remaining	0 (BE)		14	10 MB	86,838	89.33 Kbps	96.48 pps	96.79 Kbps	104 pps
CHI	Voice	46 (EF)		15	9 MB	142,569	76.04 Kbps	158.41 pps	76.70 Kbps	159 pps
BOS	Voice	46 (EF)		15	9 MB	142,232	75.84 Kbps	158.00 pps	76.82 Kbps	160 pps
LAX	Voice	0 (BE)		15	8 MB	136,434	72.76 Kbps	151.59 pps	73.85 Kbps	153 pps
CHI	Voice	0 (BE)		15	4 MB	60,270	32.14 Kbps	66.97 pps	33.12 Kbps	69 pps
RPT	All-Remaining	0 (BE)		24	4 MB	30,036	21.54 Kbps	33.25 pps	41.24 Kbps	43 pps

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Marking: Application DSCP Audit Where is the BE VoIP traffic?

Application DSCP Audit

09/22/16, 10:21:51 AM to 09/22/16, 10:36:51 AM Data bin: 1 minute

Source: All Devices All Interfaces Number of flows: 154

Filter: wan & flow.app=RTP

Graph: Basic Flow Time Series Bit Rate

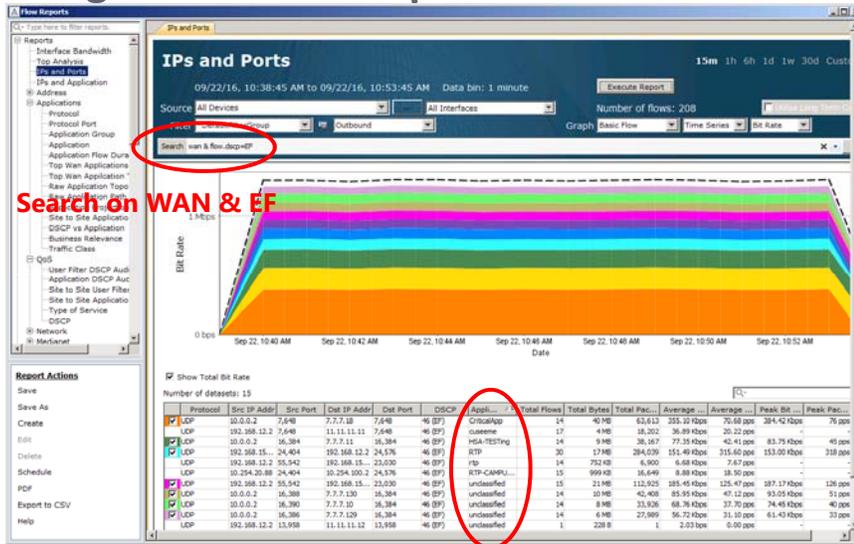
Search on WAN

Search is helpful!

Site	Application	DSCP	Total Flows	Total Bytes	Total Packets	Average Bit Rate	Average Packe...	Peak Bit Rate	Peak Packet...
CHI	RTP	0 (BE)	45	30 MB	281,471	287.03 Kbps	312.79 pps	270.47 Kbps	317 pps
BOS	RTP	0 (BE)	14	20 MB	167,679	179.06 Kbps	186.31 pps	194.31 Kbps	201 pps
LAX	RTP	0 (BE)	30	19 MB	229,494	160.43 Kbps	254.99 pps	169.86 Kbps	237 pps
BOS	RTP	46 (EF)	15	9 MB	142,452	75.97 Kbps	158.38 pps	76.82 Kbps	160 pps
CHI	RTP	46 (EF)	15	9 MB	142,334	75.91 Kbps	158.15 pps	76.70 Kbps	159 pps
RPT	RTP	0 (BE)	35	4 MB	31,120	32.76 Kbps	34.58 pps	42.91 Kbps	45 pps

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Marking: IPs & Ports Report



Is there any Rogue EF traffic?



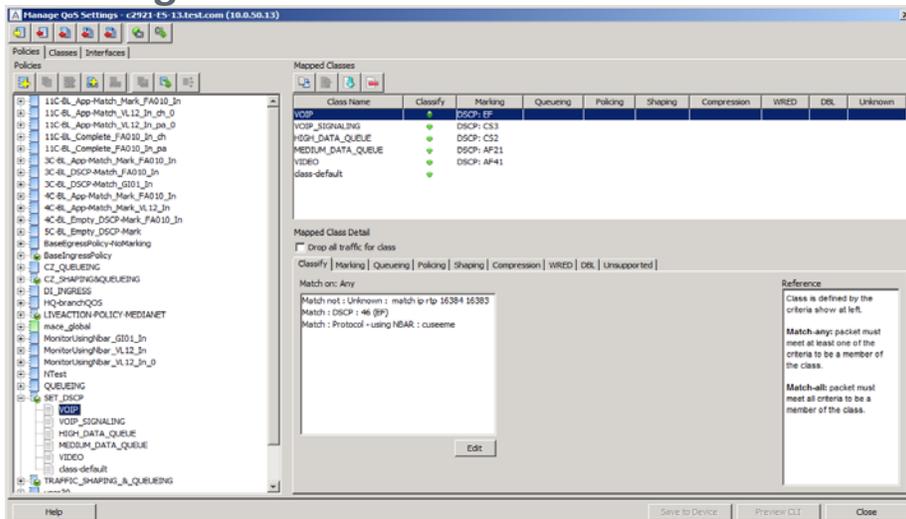
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Marking: How to Mark



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



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Classify: Where to Mark

Note: Best Practice

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

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Detailed description: This network diagram illustrates a best practice for flow classification. It shows two zones, z-West and z-East, connected by a central spine. In the z-West zone, there are two core switches: c2921-ES-10 (IP 10.0.50.13) and APH-CAT_3560_1 (IP 10.0.50.14). In the z-East zone, there are two core switches: c1941-ES-10 (IP 10.0.50.12) and APH-CAT_3560_1 (IP 10.0.50.10). A red arrow points from the left edge of the z-West zone towards the c2921-ES-10 switch, indicating that traffic should be marked at LAN ingress. Another red arrow points from the c2921-ES-10 switch towards the c1941-ES-10 switch, showing the flow being marked end-to-end. The LiveAction logo is in the bottom right corner.

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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

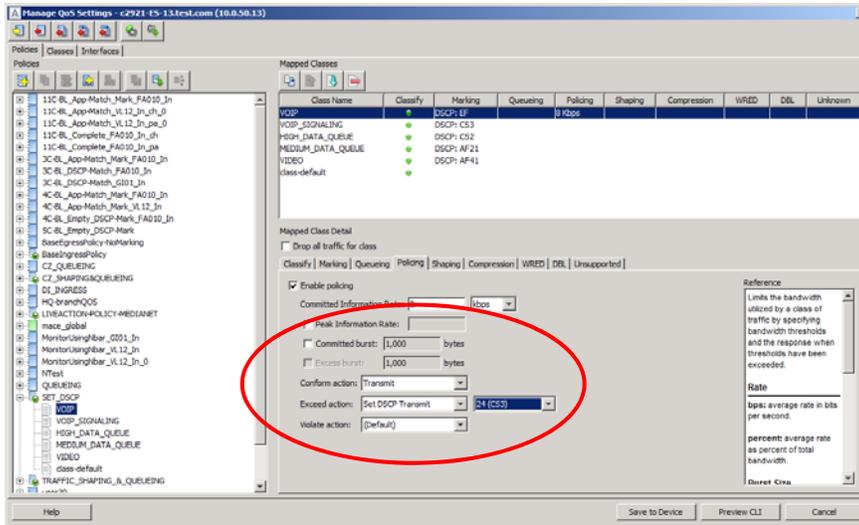
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Detailed description: This network diagram illustrates a bad practice for flow classification. It uses the same network topology as the previous slide. A red arrow points from the c2921-ES-10 switch towards the left edge of the z-West zone, indicating that traffic is being marked on WAN egress. A cyan arrow points from the left edge of the z-West zone towards the c2921-ES-10 switch, showing the flow direction. The text notes that this method will not report well in LiveNX due to the IOS order of operation. The 'ion' logo is in the bottom right corner.

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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: Classify / Mark

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



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Queueing & Shaping

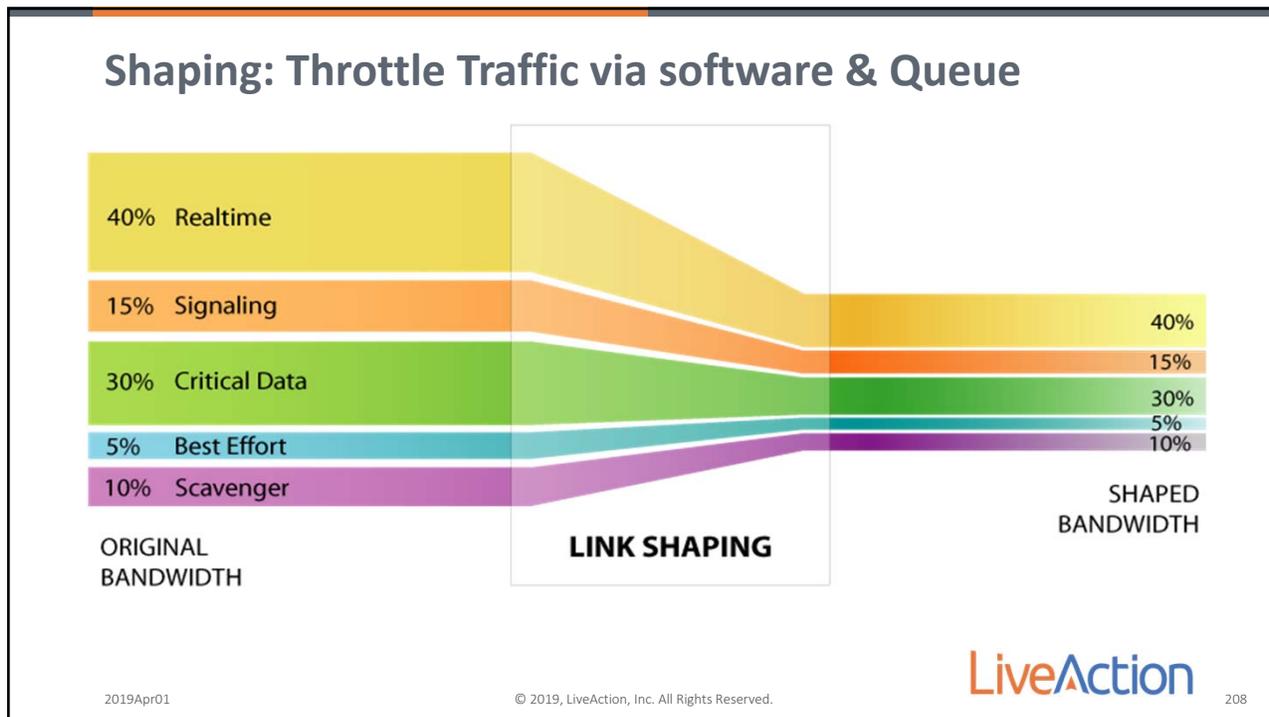


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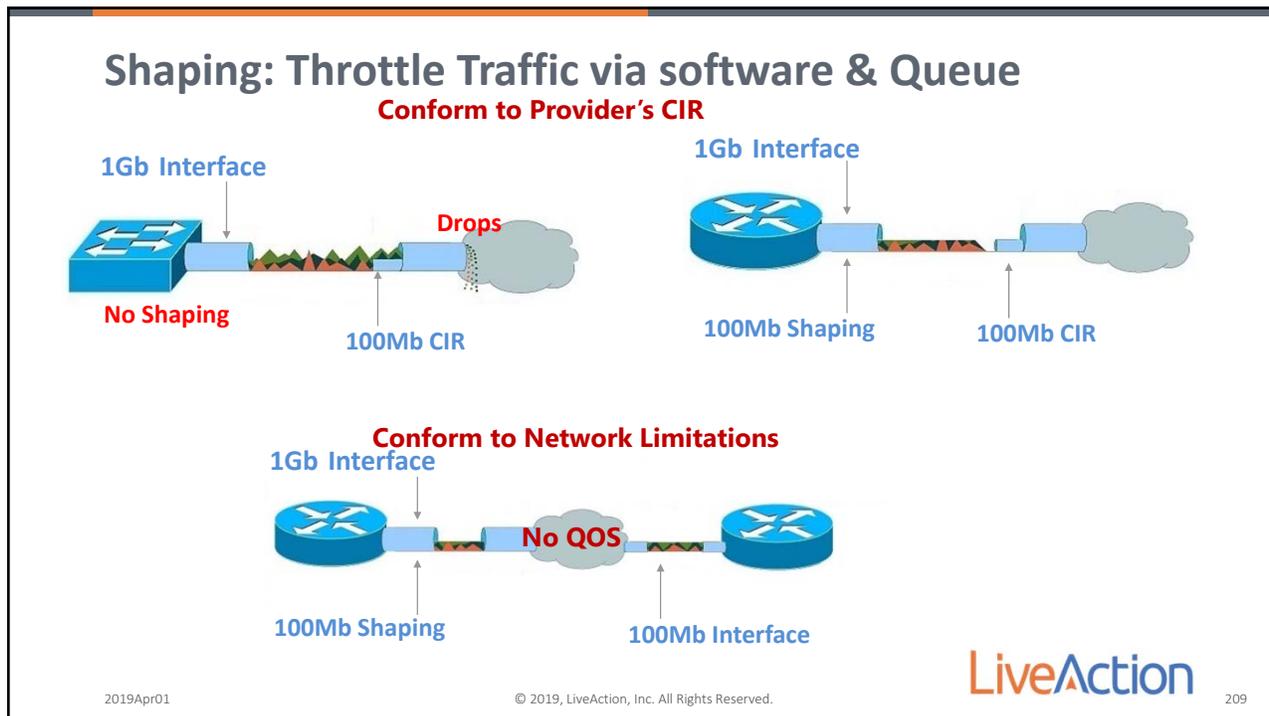
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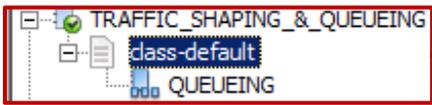


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Shaping: Configuration



Best Practice is to set CIR, BC, & BE:
 Shape average <CIR> <Bc> <Be>
 Bc = 1/100 of CIR
 Be = 0
 Shape average 1544000 15440 0

Class Name	Classify	Marking	Queueing	Policing	Shaping
class-default					1,544 Kbps

Mapped Class Detail

Drop all traffic for class

Classify | Marking | Queueing | Policing | **Shaping** | Compression | WRED | DBL | Unsupported

Shape using: Average

Rate: 1,544 Kbps

Committed burst: 15440 bits

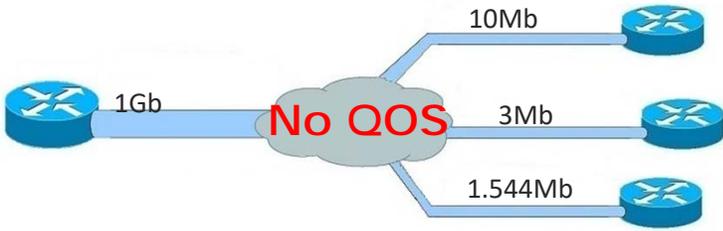
Excess burst: 0 bits

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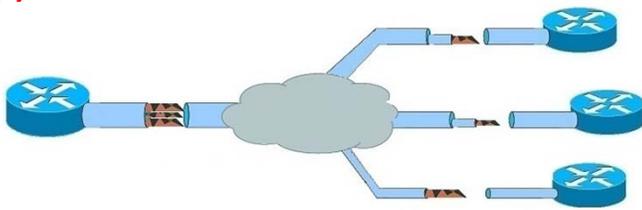
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Shaping: Configuration



This design requires a Multi-Class Hierarchical Policy
Since the provider doesn't have QOS, you must do it



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Shaping: Configuration

MULTI-CLASS-HEIRARCHICAL-SHAPING

- REMOTE_10Mb
- QUEUEING
- REMOTE_3Mb**
- QUEUEING
- REMOTE_1.544Mb
- QUEUEING
- class-default

Classify | Marking | Queueing | Policing | Shaping | Compress

Match on: Any

Match : ACL Name : REMOTE_3Mb_ACL

Access Rule Entries

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

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Queueing: Selecting Bandwidth Allocations

Class Type Cisco Name/ RFC4594 Name	4 Class	8 Class	12 Class
Voice / IP Telephony	≥33%	10%	10%
Interactive Video / Multimedia Conferencing		23%	10%
Streaming Video		10%	13%
Real-Time Interactive		10%	10%
Broadcast Video		2%	2%
Call Signaling	Remaining	2%	2%
IP Routing / Network Control		5%	2%
Network Management / Operations,Administration,Management (OAM)		24%	10%
Transactional Data / Low-Latency Data		5%	5%
Bulk Data / High Throughput Data		1%	1%
Scavenger / Low-Priority Data	≤5%	25%	25%
Best Effort	≤25%	25%	25%

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

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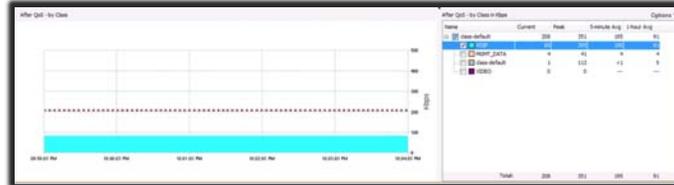
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Queueing: Understanding Traffic

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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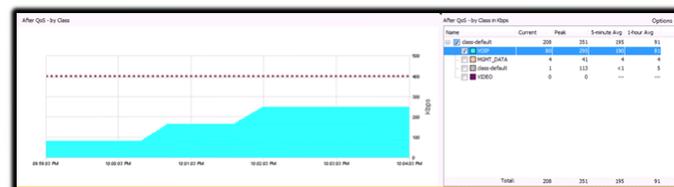
ActionPacked **LiveAction** Presentation

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Queueing: Understanding Traffic

This is how 3 voice calls look:



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

No Burst = No Buffer Tuning

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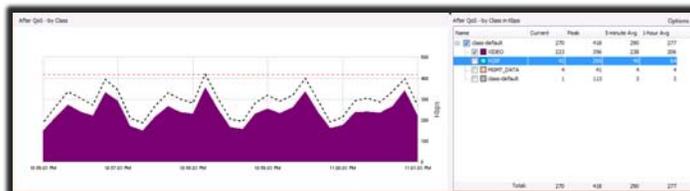
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Queueing: Understanding Traffic

This is how one video conference call looks:



Resolution	1080p			720p		
	Best	Better	Good	Best	Better	Good
Quality	30	30	30	30	30	30
Frame Rate	4Mb	3.5Mb	3Mb	2.25Mb	1.5Mb	1Mp
Bandwidth	128K	128K	128K	128K	128K	128K
Max Burst						

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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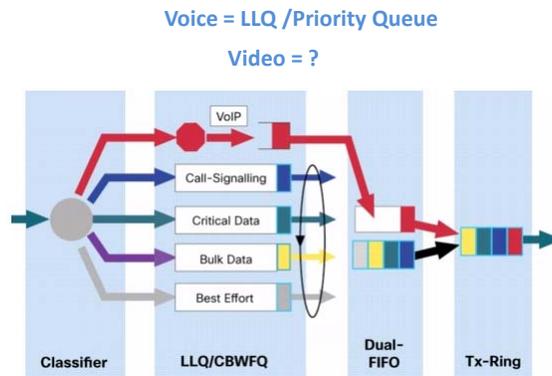
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Queueing: Understanding Traffic



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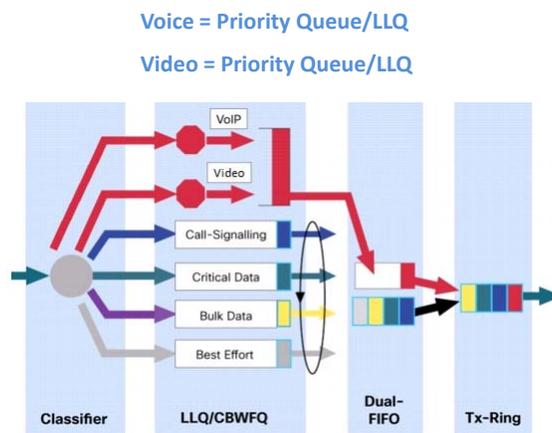
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Queueing: Understanding Traffic



****Always put Video in its own unique queue****

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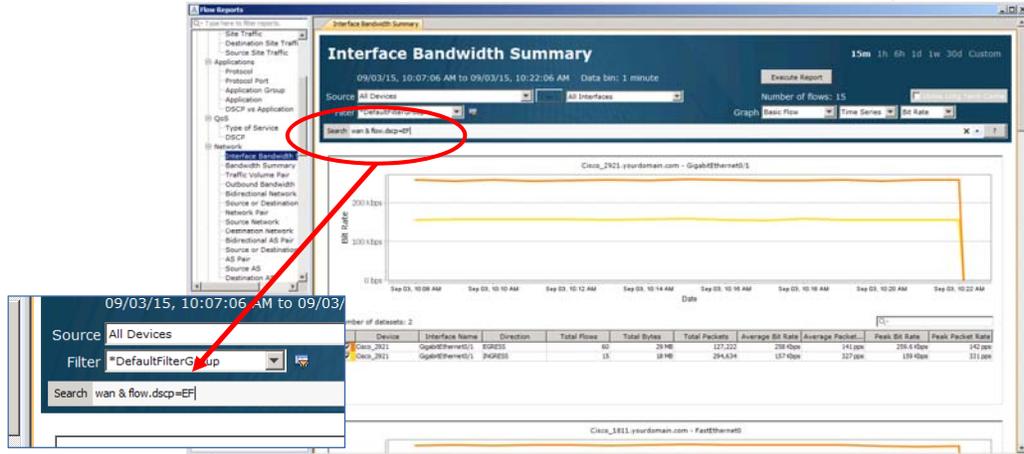
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Queueing: Sizing/Capacity Planning

Network > Interface Bandwidth Summary Report



If Classification & Marking are in place, Flow is a great way to do queue sizing



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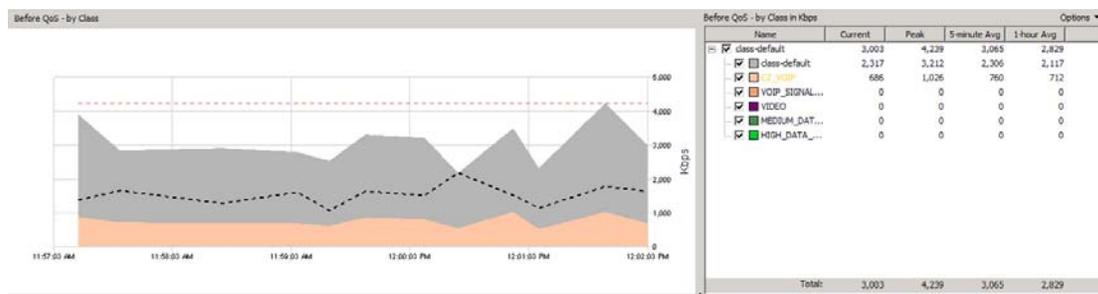
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Queueing: Sizing/Capacity Planning

Pre-Policy QoS Report is a Great QoS Sizing Report



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



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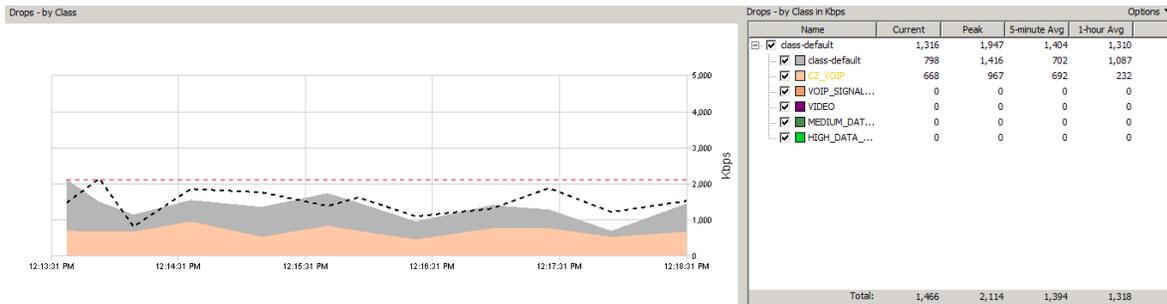
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Queueing: Capacity Planning

QoS Drop Report can also be a QoS Capacity Report



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



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Queueing: Configuration

Match on DSCP

The screenshot shows the 'Mapped Classes' configuration page. A table lists various classes with their respective configurations. The 'Match on DSCP' text is positioned to the left of the 'Match on DSCP : 46 (EF)' entry in the 'Mapped Class Detail' section, with a red arrow pointing to it.

Class Name	Classify	Marking	Queueing	Policing
VOICE	●		Priority: 768 Kbps	
VOIP_SIGNALING	●		Class-based: 60 Kbps	
HIGH_DATA_QUEUE	●		Class-based: 50 Kbps	
MEDIUM_DATA_QUEUE	●		Class-based: 75 Kbps	
VIDEO	●		Class-based: 50 Kbps	
class-default	●		Fair	

Mapped Class Detail
 Drop all traffic for class
 Classify | Marking | Queueing | Policing | Shaping | Compression | WRED | DBL | Unsupported |
 Match on: Any
 Match : DSCP : 46 (EF)
 Edit



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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.

Class Name	Classify	Marking	Queueing	Polcing	Shapi
VOICE	●		Class-based: 756 Kbps		
VOIP_SIGNALING	●		Class-based: 60 Kbps		
HIGH_DATA_QUEUE	●		Class-based: 50 Kbps		
MEDIUM_DATA_QUEUE	●		Class-based: 75 Kbps		
VIDEO	●		Class-based: 50 Kbps		
class-default	●		Fair		

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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*

Queueing type: **Priority**

Rate: 768 Kbps

Burst size: 32 bytes

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Lab

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



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A photograph of two business men shaking hands on a modern, glass-walled balcony overlooking a city skyline at sunset. The scene is reflected on the wet floor. The man on the left is wearing a red shirt and the man on the right is wearing a white shirt and a dark suit. The background shows a city skyline with a prominent skyscraper, likely the Empire State Building, under a bright, hazy sky. The floor is wet and reflects the scene above.

Throttle Traffic

Policing & WRED

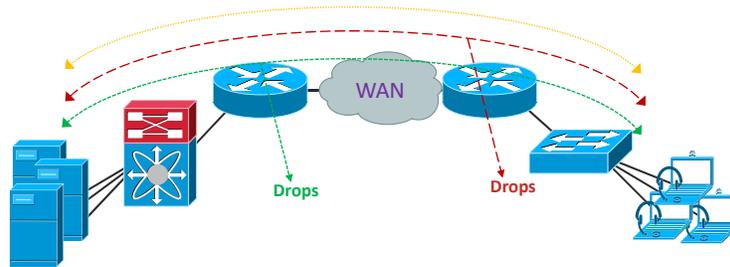
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Step 3 –Throttle Traffic (Policing and WRED)



- **Policing** - Transmit data to software set limit, drop overage
- **WRED** – Selectively drop specific data before congestion occurs

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Policing

Classify | Marking | Queueing | Policing | Shaping | Compression | WRED

Enable policing

Committed Information Rate:

Peak Information Rate:

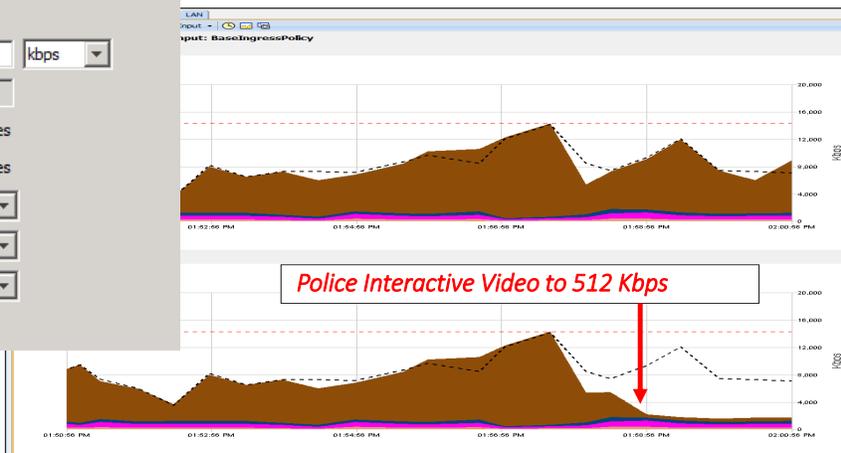
Committed burst: bytes

Excess burst: bytes

Conform action:

Exceed action:

Violate action:



Best done on LAN ingress close to source

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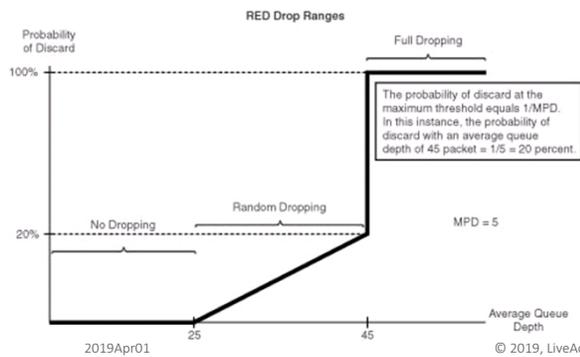
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WRED – What It IS...

- WRED = Weighted Random Early Detection
- 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
- 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.
- The "W" stands for weighted – allows a queue to reference DSCP values and assign each a different depth before the random drops begin.
- Can provide "queue-in-queue" like functionality



Mapped Class Detail

Drop all traffic for class

Classify | Marking | Queueing | Policing | Shaping | Compression | WRED | DBL | Unsupported

Calculate drop probability using: DSCP

Explicit congestion notification

Exponential weighted constant: 1

Override default settings

Value	Min Threshold	Max Threshold	Mark Probability Denominator
10 (AF11)	128	256	1
12 (AF12)	100	196	1
14 (AF13)	96	64	1

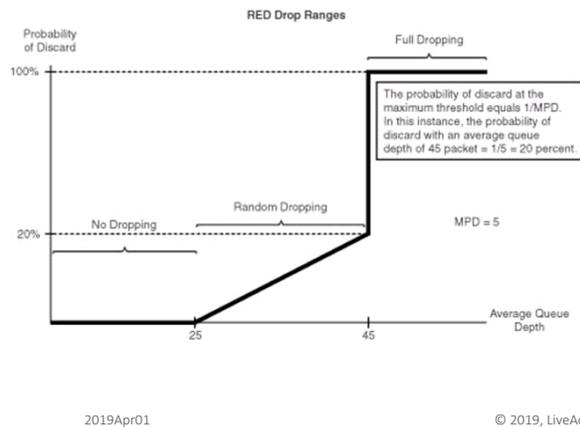
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WRED - Warning!

- Will cause more drops (harm) than normal, if not tuned correctly
- Typically only effective if multiple DSCP values are in a Queue
- Only 1% of customers are sophisticated enough to use WRED effectively



Mapped Class Detail

Drop all traffic for class

Classify | Marking | Queueing | Policing | Shaping | Compression | WRED | DBL | Unsupported

Calculate drop probability using: DSCP

Explicit congestion notification

Exponential weighted constant: 1

Override default settings

Value	Min Threshold	Max Threshold	Mark Probability Denominator
10 (AF11)	128	256	1
12 (AF12)	100	196	1
14 (AF13)	96	64	1

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Lab

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



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A photograph of a man in a dark suit and white shirt standing on a stage, presenting to an audience. He is holding a microphone and gesturing with his right hand. The audience is seated in the foreground, seen from behind. The background is a large screen displaying a blue and white network diagram with various nodes and connections. An orange rectangular box is overlaid on the bottom left of the image, containing the text 'Buffer Tuning'. The LiveAction logo is visible in the bottom right corner of the image area.

Buffer Tuning

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Step 4—Buffer Tuning (Advanced)

- **Queue-limit** – Buffer size that stores queue data during congestion
- **Priority queue BC** – Token bucket interval that schedules the releases data in priority

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Buffer Tuning

- Only really needed for critical, but bursty queues – VIDEO, Citrix(VDI), etc.
- Queue bandwidth is adequate, but drops still occurring...

Class Name	Queue Setting	Reserved Bandwidth
VOICE	Priority Queueing	384 kbps
VIDEO	Priority Queueing	640 kbps
SIGNALING	Class-based Queueing	64 kbps
class-default	None	

VIDEO Queue Config=640K
Flow Reports=450.5K Peak
SNMP Reports=539K Peak
But there are VIDEO Drops???
We need to tune the Video Queues buffer size

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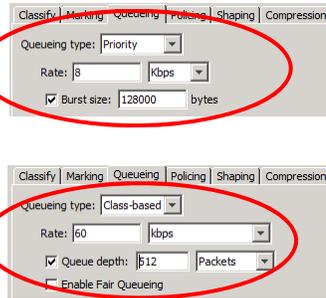
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Buffer Tuning

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 CZ_QUEUEING  
class CZ_VOIP  
priority 8 128000  
exit  
class VOIP_SIGNALING  
bandwidth 60  
queue-limit 512
```



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Lab

- Buffer Tuning
 - Video Queue Performance Tuning



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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.

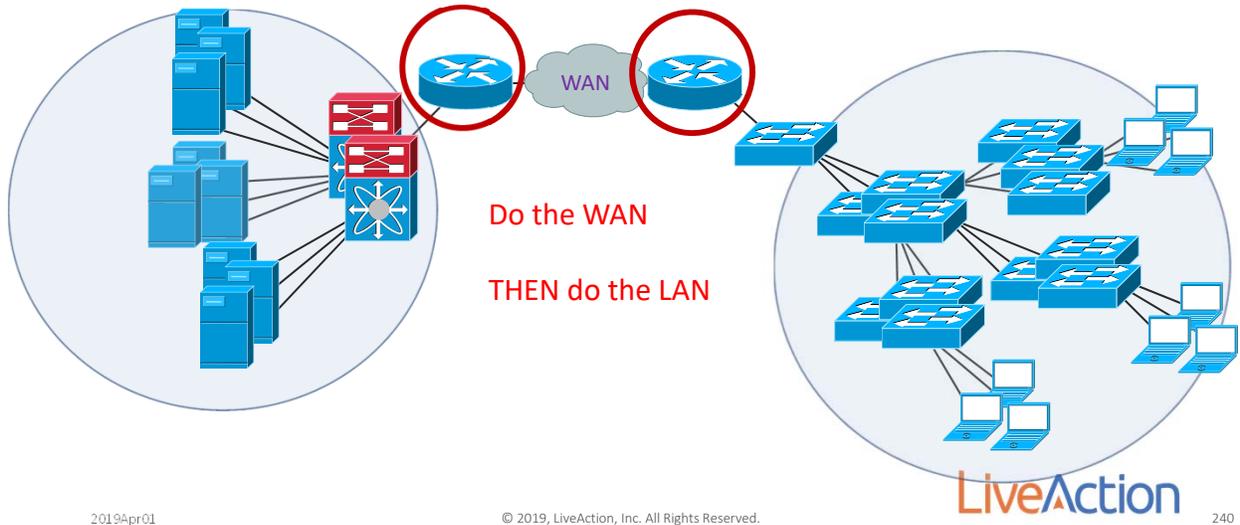
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Step 1 : Implement QoS in Phases!



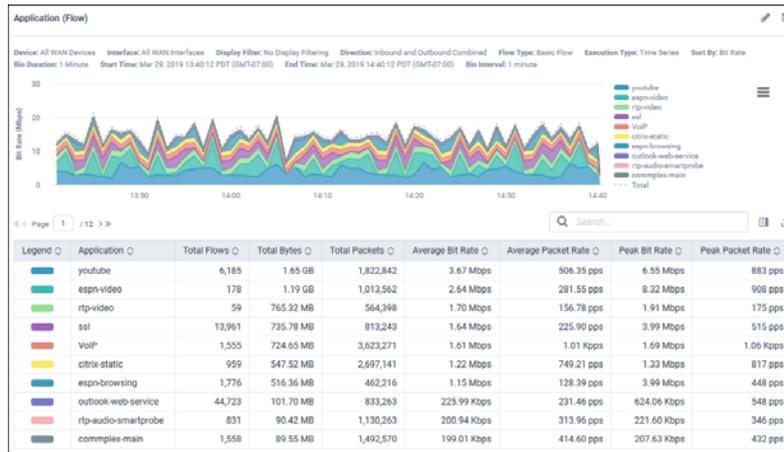
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Step 2 - Use NetFlow Tools to Understand Bandwidth Usage



*Use minute by minute reporting (no Averaging)

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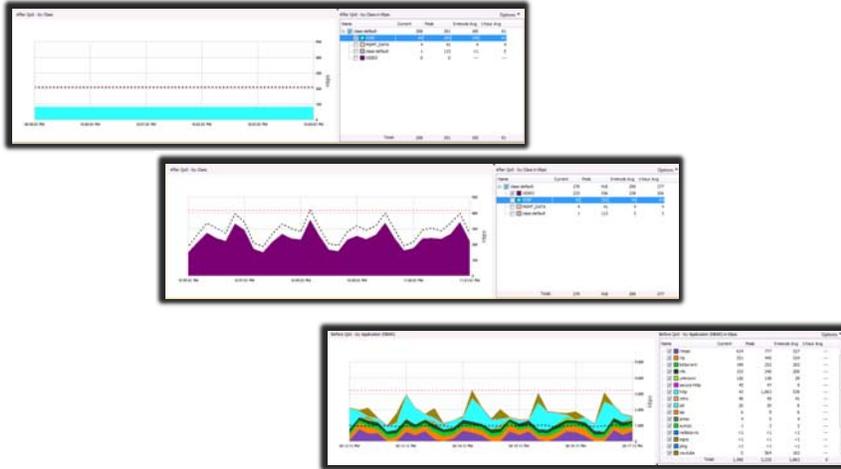
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Step 3 - Understand Applications Details



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Step 4 - Get Business' Buy-In



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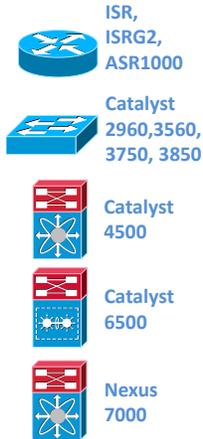
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Step 5 - Understand the Network



www.cisco.com/go/srnd



With switches, start with SRND4 Auto-QoS where possible

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Step 6 - Have a plan

A	B	C	D	E	F	G	H	I	J
Site	Device Name	Device Type	IP Address	IOS Version	Line Card Model(s)	Interface	AT&T CIR	AT&T COS1 (Priority)	AT&T
Louisville	PGS-LOUISVILLE-RTR	CISCO2821	10.255.253.52	C2800NM-IPVOICE-MZ-124-8A	WIC-1DSU-T1-V2 NM-HDV VWIC-1MFT-T1 PVDM-12 PVDM-12		1.5Mbps	1.5Mbps	
Louisville	PGS-LOUISVILLE-RTR	CISCO2921	10.255.253.52	C2900-UNIVERSALK9-MZ-SPA-152-4-MA	HWIC-4T1/E1		3Mbps	3Mbps	20% (600K)
Lexington	PGS-LEXINGTON-RTR	CISCO2821	10.255.253.54	C2800NM-IPVOICE-MZ-124-8A	WIC-1DSU-T1-V2 NM-HDV VWIC-1MFT-T1 PVDM-12 PVDM-12		1.5Mbps	1.5Mbps	
Lexington	PGS-LEXINGTON-RTR	CISCO2921	10.255.253.54	C2900-UNIVERSALK9-MZ-SPA-152-4-MA	HWIC-4T1/E1		3Mbps	3Mbps	20% (600K)
London	PGS-LONDON-RTR	CISCO2821	10.255.253.50	C2800NM-IPVOICE-MZ-124-8A	WIC-1DSU-T1-V2 NM-HDV VWIC-1MFT-T1 PVDM-12 PVDM-12		1.5Mbps	1.5Mbps	
London	PGS-LONDON-RTR	CISCO2921	10.255.253.50	C2900-UNIVERSALK9-MZ-SPA-152-4-MA	HWIC-4T1/E1		3Mbps	3Mbps	20% (600K)
Manchester	PGS-MANCHESTER-3825-R	CISCO3825	10.255.253.65	C3825-IPVOICE-MZ-124-8A	WIC-1DSU-T1-V2 WIC-1DSU-T1-V2 WIC-1DSU-T1-V2 NM-HDV VWIC-1MFT-T1 PVDM-12 NM-HDV VWIC-1MFT-T1 PVDM-12 PVDM-12		3Mbps	3Mbps	
Manchester	PGS-MANCHESTER-RTR	CISCO2921	10.255.253.65	C2900-UNIVERSALK9-MZ-SPA-152-4-MA	HWIC-4T1/E1		4.5Mbps	4.5Mbps	20% (600K)
Jacksonville	PGS-JACKS-2821-RTR	CISCO2821	10.255.253.35	C2800NM-IPVOICE-MZ-124-8A	WIC-1DSU-T1-V2 WIC-1DSU-T1-V2 NM-HDV VWIC-1MFT-T1		1.5Mbps	1.5Mbps	

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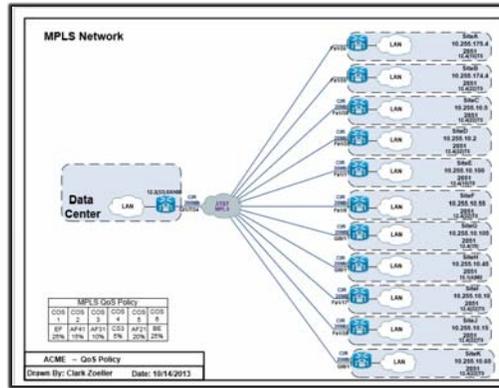
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Step 6 - Have a plan



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Step 6 - Have a plan

Task Name	% Complete	Task Mode	Duration	Start	Finish	Predict
ACME High QoS Project	10%	MG	1 day	Tue 10/1/13	Tue 10/1/13	
Data Collection	63%	MG	1 day	Tue 10/1/13	Tue 10/1/13	
Collect AT&T Documentation	100%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Collect Avaya Documentation	100%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Create QoS Spreadsheets	100%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Create QoS Network Diagram	35%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
MPLS WAN Overview	100%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
MPLS Head-End Details	90%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
MPLS Remote-Site Details	90%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
ACME High Bandwidth WAN Overview	10%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
ACME High Bandwidth WAN Details - 6500	0%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
ACME High Bandwidth WAN Details - 4500	0%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
ACME High Bandwidth WAN Details - 2960	0%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
ACME High Bandwidth WAN Details - 3560/3750	0%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Collect Bandwidth Statistics	50%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Deploy Monitor only QoS Policies	100%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Review Monitor only QoS Statistics	0%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Collect Business' Input	33%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Talk to Branches	100%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Talk to IT App owners to get IP/Port info	0%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Review bandwidth reports for critical Apps	0%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Design	3%	✓	1 day	Tue 10/1/13	Tue 10/1/13	
Define Application Recognition Policy	50%	✓	1 day	Tue 10/1/13	Tue 10/1/13	

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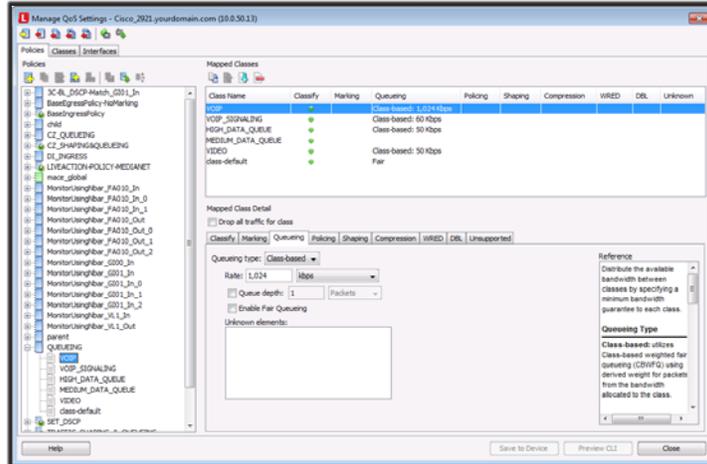
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Step 7 - Use QoS management Tools



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Step 7 - Use QoS management Tools



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Step 7 - Use QoS management Tools

SEVERITY	DESCRIPTION	TIME OPENED	ACTIVE FOR	CATEGORY	TYPE	THIRD PARTY...
Critical	RTR_SanJose QoS Class Default Drop Rate was 157.16 Kbps	29 Mar 2019, 02:32PM	a few seconds	Device, Interface	QoS Class D...	
Warning	GigabitEthernet2 on RTR_Louisville had a drop rate of 49.55 pps in the Output direction.	29 Mar 2019, 02:32PM	a few seconds	Device, Interface	QoS Interfac...	
Critical	RTR_Austin.liveaction.com QoS Class Default Drop Rate was 122.80 Kbps	29 Mar 2019, 02:31PM	a minute	Device, Interface	QoS Class D...	
Critical	RTR_Louisville QoS Class Default Drop Rate was 64.71 Kbps	29 Mar 2019, 02:30PM	2 minutes	Device, Interface	QoS Class D...	
Warning	GigabitEthernet2 on RTR_Austin.liveaction.com had a drop rate of 43.24 pps in the Output direction.	29 Mar 2019, 02:29PM	3 minutes	Device, Interface	QoS Interfac...	
Critical	RTR_Birmingham.liveaction.com QoS Class Default Drop Rate was 55.16 Kbps	29 Mar 2019, 02:27PM	5 minutes	Device, Interface	QoS Class D...	
Critical	RTR_Seattle QoS Class Default Drop Rate was 107.86 Kbps	29 Mar 2019, 12:19PM	2 hours	Device, Interface	QoS Class D...	
Critical	RTR_Madison QoS Class Default Drop Rate was 255.93 Kbps	29 Mar 2019, 12:28AM	14 hours	Device, Interface	QoS Class D...	
Warning	RTR_Louisville QoS Class VOICE Drop Rate was 73.79 Kbps	27 Mar 2019, 12:17PM	2 days	Device, Interface	QoS Class Dr...	
Warning	RTR_Birmingham.liveaction.com QoS Class VOICE Drop Rate was 74.47 Kbps	27 Mar 2019, 12:17PM	2 days	Device, Interface	QoS Class Dr...	
Warning	RTR_Madison QoS Class VOICE Drop Rate was 74.57 Kbps	25 Mar 2019, 10:00AM	4 days	Device, Interface	QoS Class Dr...	
Warning	RTR_Seattle QoS Class VOICE Drop Rate was 71.55 Kbps	24 Mar 2019, 09:01AM	5 days	Device, Interface	QoS Class Dr...	



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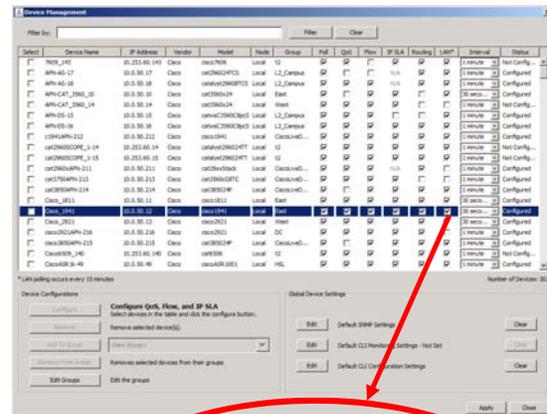
250

250

SNMP Polling Interval

LiveAction Recommends

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



<input type="checkbox"/>	Cisco_1811	10.0.50.11	Cisco	cisco1811	Local	East	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30 seco...	Configured
<input type="checkbox"/>	Cisco_1941	10.0.50.12	Cisco	cisco1941	Local	East	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30 seco...	Configured
<input type="checkbox"/>	Cisco_2921	10.0.50.13	Cisco	cisco2921	Local	West	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30 seco...	Configured



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Alerting – Customize Triggers

ALERT TYPE	CATEGORY	SEVERITY	ENABLED	THRESHOLDS	SHARING
Alert Type	All	All	All	Thresholds	Sharing
Interface Reachability	Device, Interface	Critical	✓	for at least = 0 mseconds	ServiceNow, Web UI
IPSLA Test	Network	Critical	✓	Total Test Errors > 3 Errors for at least > 0 m...	Web UI
IPSLA Voice/Jitter Test	Network	Critical	✓	Total Test Errors > 3 Errors for at least > 0 m...	Web UI
LiveNX CPU Utilization	System	Critical	✓	Local/Server >= 40 % for at least > 0 minutes	ServiceNow, Web UI
LiveNX Disk Utilization	System	Critical	✓	Local/Server >= 60 % for at least > 0 minutes	ServiceNow, Web UI
LiveNX Memory Utilization	System	Critical	✓	Local/Server >= 40 % for at least > 0 minutes	ServiceNow, Web UI
LiveNX Node Connectivity	System	Critical	✓	for at least > 0 minutes	ServiceNow, Web UI
Media Jitter Max	Application	Critical	✓	Jitter Max >= 10 ms for at least > 0 minutes	ServiceNow, Web UI
Media Jitter Min	Application	Critical	✓	Jitter Min >= 10 ms for at least > 0 minutes	ServiceNow, Web UI
Media Packet Loss	Application	Critical	✓	Packet Loss >= 10 % for at least > 0 minutes	Web UI
Network Delay Per Connection	Network	Critical	✓	Delay Time >= 50 ms for at least > 1 minutes	ServiceNow, Web UI
QoS Class Default Drop	Device, Interface	Critical	✓	Drop Rate > 40 kbps for at least > 0 minutes	ServiceNow, Web UI
QoS Class Drop	Device, Interface	Warning	✓	Qos Class VOICE Drop Rate > 40 kbps for at ...	ServiceNow, Web UI
QoS Interface Drop	Device, Interface	Warning	✓	Drop Rate > 40 pps for at least > 0 minutes	ServiceNow, Web UI
Routing Adjacency State Change	Network	Critical	✓	for at least > 0 minutes	Web UI

QoS Class Drop

ENABLED

SEVERITY Warning

Note: Severity for this alert will be reflected as the same severity used in the status. When the severity is info, it does not contribute to the status.

THRESHOLDS

QOS CLASS VOICE

DROP RATE FOR AT LEAST

> 20 kbps > 0 min

QOS CLASS VIDEO

DROP RATE FOR AT LEAST

> 50 kbps > 1 min

SHARING

Email support@... 1

ServiceNow SNMP Web UI Syslog

This alert may contribute to status of an Interface, Device, and/or Site.

Cancel Save

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Finish the Labs...

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**What's Next?
SDWAN**

Finish the Labs...

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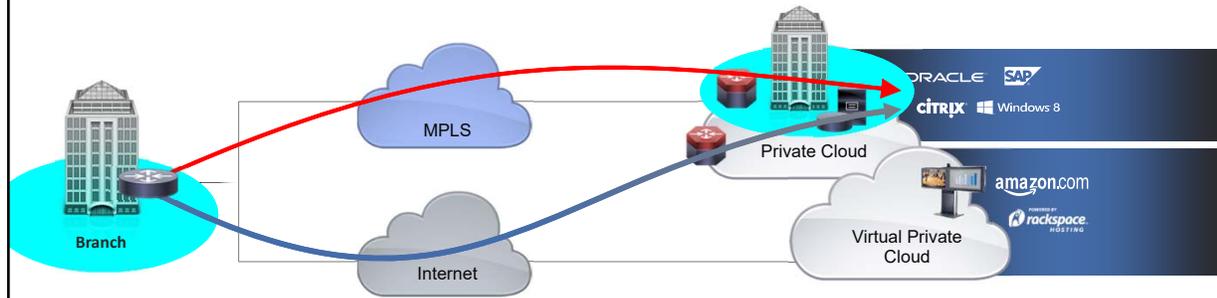


**SD-WAN
Concept Overview**

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WHY IWAN/SDWAN?



- Fully utilize WAN bandwidth – seamlessly load-balance traffic circuits on backup circuits
- Maximize application performance – routing based on network performance

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LiveAction LiveNX for IWAN/SDWAN Management

How Can LiveAction Help Manage the SD-WAN Environment?

- **Baseline network and application performance**
- **Monitor QoS performance**
- **Visualize and mitigate application issues with QoS graphical control (w/NBAR)**
- **Visualize PfR intelligent path control so network admin can visually validate how PfR works**
- **Accelerate troubleshooting of network brownouts**
 - What caused the brown-out?
 - How PfR reroutes traffic and protects application performance during the brown-out?
 - Which applications are affected by a brown-out?
 - Which service provider is having a brown-out issue?
 - What traffic is moved from one provider to another?
- **Graphically and easily define QoS policies so PfR can use them to load balance or protect application performance during a fail over**

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IWAN Monitoring: CLI vs. LiveNX

CLI

```

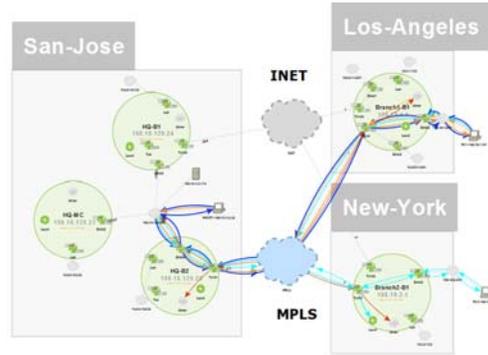
# show
Present WAN Interface: 18 Ribs
Present Channel (primary): tunnel100 in Border 10.0.1.1
Backup Channel: 23
Destination Site ID: 10.0.0.103
Class-Sequence in use: default
Class Name:
#M Added: 00:00:10 ago
Reason for Route Change: Uncontrolled to Controlled Transition

-----
Out-Site-Prefix: 196.16.128.0/18  OSPF: ef [46] Traffic class id:7
TC Learned: 100kb ago
Present State: Controlled
Current Performance Status: in-policy
Current Service Provider: wls since 00:16:29
Previous Service Provider: INET for 16.30 sec
#M Used:
Present WAN Interface: 31 Ribs
Present Channel (primary): tunnel101 in Border 10.0.1.1
Backup Channel: 12
Destination Site ID: 10.0.0.103
Class-Sequence in use: 10
Class Name: VOICE-VIDEO using policy user-defined
priority 2 packet-loss-rate threshold 5.0 percent
priority 2 byte-loss-rate threshold 10.0 percent
#M Added: 00:00:10 ago
Reason for Route Change: Backup to Primary path preference transition

-----
Out-Site-Prefix: 196.16.128.0/18  OSPF: af31 [26] Traffic class id:5
TC Learned: 100kb ago
Present State: Controlled
Current Performance Status: in-policy
Current Service Provider: wls since 00:17:37
Previous Service Provider: INET for 18.0 sec
#M Used:
Present WAN Interface: 27 Ribs
Present Channel (primary): tunnel101 in Border 10.0.1.1
Backup Channel: 11
Destination Site ID: 10.0.0.103
Class-Sequence in use: 20
Class Name: CRITICAL using policy user-defined
priority 2 packet-loss-rate threshold 10.0 percent
priority 2 byte-loss-rate threshold 10.0 percent
#M Added: 00:00:10 ago
Reason for Route Change: Backup to Primary path preference transition

-----
Total Traffic Classes: 4 Site: 4 Internet: 0
Transit-RTT
    
```

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SD-WAN Fundamentals

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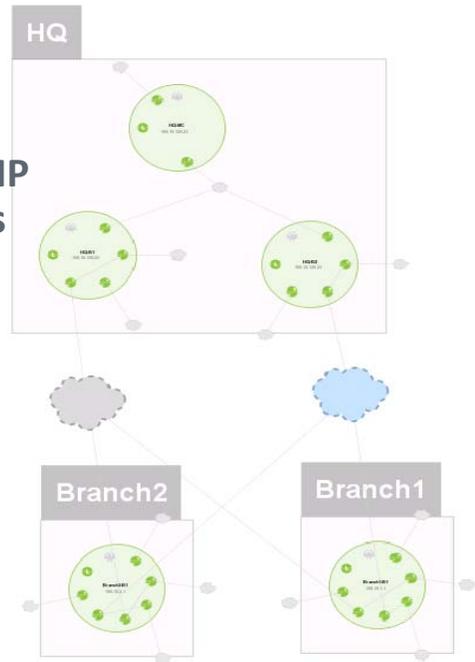
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Configure SD-WAN devices in LiveNX

- Add all MCs and BRs routers
- Add routers using their PfR Loopback IP
- Add all user created Tunnel Interfaces
- Add PfR Loopback interfaces
- Add all physical WAN interfaces
- (optional) Add LAN interfaces



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Flow Configuration

Flow Configuration

Instructions
Configure the type of flow you wish to receive from the interfaces

Flow Configuration Table

Device	Type	IP Address	Description	Tags	Traffic Statistic...	Application Resp...	Voice/Video ...	Traditional	Custom
Branch1-B1	Standard	198.19.1.1	Cisco IOS ...	WAN, ...	<input checked="" type="checkbox"/>				
Ethernet0/0	-	198.19.1.1	Branch1 LAN	LAN	<input type="checkbox"/>				
Ethernet0/1	-	100.64.1.2	Internet	-	<input type="checkbox"/>				
Ethernet0/2	-	10.255.1.2	MPLS	-	<input type="checkbox"/>				
Loopback0	-	10.0.1.1	-	-	<input type="checkbox"/>				
Tunnel100	-	172.16.1.1	DMVPN ove... INET, ...	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tunnel101	-	172.16.2.1	DMVPN ove... MPLS,...	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Buttons: Help, Save to Devices, Preview CLI, Revert, Back, Close

- Enable Flow on Tunnel Interfaces
- (optional) Enable Flow on DIA interfaces

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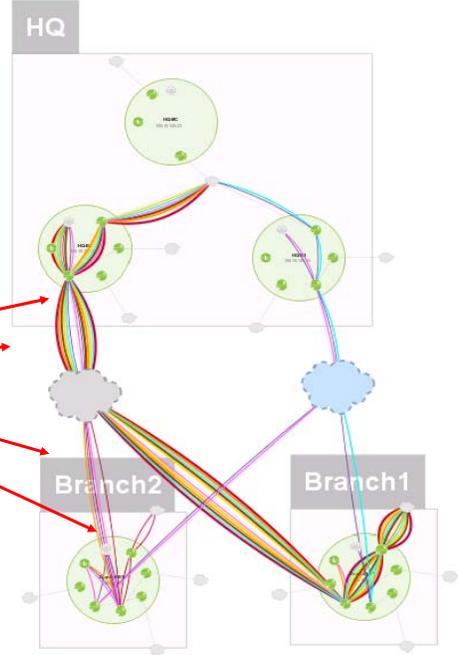
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Flow Configuration

Flow on only Tunnels still provides complete visibility of WAN



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Ensure that PfRv3 NetFlow is Enabled

- Please ensure that Pfrv3 NetFlow is enabled to send performance updates to LiveNX.
- Enabling the “collector” command at the Hub Master Controller will propagate the setting throughout the domain automatically.

```
domain <DOMAIN>
  vrf default
    master hub
      source-interface Loopback0
      collector <LiveNX-IP-Address> port 2055
```

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PfRv3 Flow

PfR log data is sent to LiveNX as Flow information

The screenshot shows the LiveAction interface with the 'PFR' dropdown menu highlighted in a red circle. The interface displays a table of flow data with columns for Protocol, Out IP, In by, In Packets, Out Prefix Len, QoS Classificatio..., Policy QoS Class..., Src Site ID, Dst Site ID, In IP, Packet Loss Perc..., Bytes Loss Perc..., and One Way Delay. The table contains several rows of data, including UDP flows over Tunnel100 interfaces.

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Network Semantics

- LiveNX network semantics to better understand and troubleshoot your network.
- Identify:
 - Group
 - WAN links
 - Label
 - Capacity
 - Service Providers
 - Sites and Site IP settings
 - Device and Interface Tags
- Usage: Search, Reporting, Dashboard

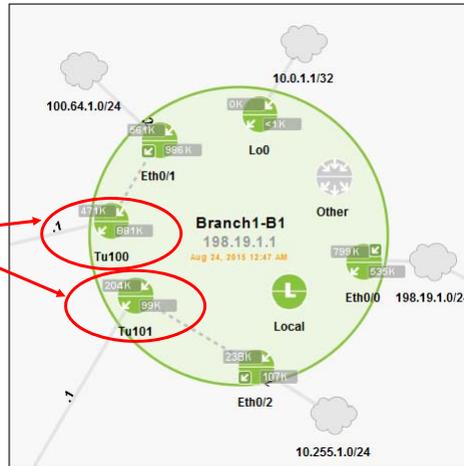
The screenshot shows the LiveAction interface with a table of network elements. The table has columns for Name, IP Address, Node, Label, Capacity, WAN, Service Pro..., Site, Site IP, and Tags. The table contains several rows of data, including GigabitEthernet0/0, GigabitEthernet0/1, and WAN100 interfaces. Red boxes highlight specific fields in the table.

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Interface Semantics

- Interface Semantics
 - WAN Tag
 - Label
 - Capacity of Link (Example: 10Mbps)
 - Service Provider (Example: Sprint or AT&T)
 - Interface Tags – User Defined



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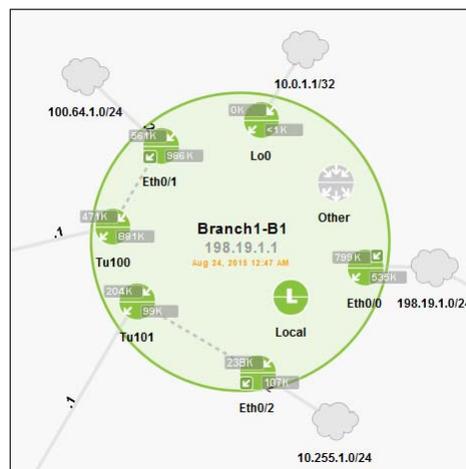
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Device Semantics

- Group – to group devices together (Example: West)
- Site (Example: Los-Angeles)
 - Datacenter tag
- Site IP settings
 - Example: 198.19.1.0/24, 10.0.1.1/32
- Device Tags – User Defined



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Network Semantics

Dashboard | Manage | Expand

Name	IP Address	Node	Label	Capacity	WAN	Service Provi...	Site	Site IP	Tags
Home									
West									
Cisco_2921	10.0.50.13	Local					San-Francisco	192.168.15.0/24, 10.0.12.0/24	Enhanced, USA
FastEthernet0/1/0	10.0.0.1			100.0 Mbps	<input type="checkbox"/>				
FastEthernet0/1/1	192.168.46.2		Link to 8.8.8.0	3.0 Mbps	<input checked="" type="checkbox"/>	SP1			To-Verizon
GigabitEthernet0/1	192.168.11.2		To-Box_Jelly	3.0 Mbps	<input checked="" type="checkbox"/>	SP2			To-TimeWarner
GigabitEthernet0/2	192.0.1.1		testing	1.0 Gbps	<input type="checkbox"/>				
Vlan1	192.168.12.1				<input type="checkbox"/>				
Vlan12	10.0.12.1			100.0 Mbps	<input type="checkbox"/>				
Vlan2	192.168.100.1			100.0 Mbps	<input type="checkbox"/>				
VLANs									

Label, Capacity, WAN, Service Provider, Site, Site IP

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Network Semantics – AND!!!

- LiveNX will automatically populate semantics values!!!
 - Rapid Device Discovery / Auto-Semantic Discovery
 - Associate devices to sites, link capacity, site IP mapping, service provider, etc. and auto populates LiveNX so you can be up and using the platform faster.

Name	IP Address	Node	Label	Capacity	WAN	Service Pr...	Site	Site IP	Tags
Los-Angeles							Los-Angeles		
Branch-81	198.19.1.1	Local					Los-Angeles	198.19.1.0/24, 172.16.2.1, 172.16...	
Ethernet0/0	198.19.1.1				<input type="checkbox"/>				LAN
Ethernet0/1	100.64.1.2				<input type="checkbox"/>				
Ethernet0/2	10.255.1.2				<input type="checkbox"/>				
Loopback0	10.0.1.1				<input type="checkbox"/>				
Tunnel100	172.16.1.1		DMZ	10.0 Mbps	<input checked="" type="checkbox"/>	DMZ			
Tunnel101	172.16.2.1		MPLS	2.0 Mbps	<input checked="" type="checkbox"/>	MPLS	New-York	172.16.2.2, 198.19.2.0/24, 10.0.2...	
Branch-82	198.19.2.1	Local					New-York	172.16.2.2, 198.19.2.0/24, 10.0.2...	
Ethernet0/0	198.19.2.1				<input type="checkbox"/>				LAN
Loopback0	10.0.2.1				<input type="checkbox"/>				
Tunnel100	172.16.1.2		DMZ	10.0 Mbps	<input checked="" type="checkbox"/>	DMZ			
Tunnel101	172.16.2.2		MPLS	2.0 Mbps	<input checked="" type="checkbox"/>	MPLS	San-Jose	10.16.2.229, 172.16.1.254, 172.16...	
San-Jose							San-Jose	10.16.2.229, 172.16.1.254, 172.16...	
HQ-81	198.18.129.24	Local					San-Jose	10.16.2.229, 172.16.1.254, 172.16...	
Ethernet0/0	198.18.129.24				<input type="checkbox"/>				LAN
Loopback0	10.0.0.0/1				<input type="checkbox"/>				
Tunnel0	172.16.1.254		DMZ	10.0 Mbps	<input checked="" type="checkbox"/>	DMZ			
HQ-82	198.18.129.25	Local					San-Jose	10.16.2.229, 172.16.1.254, 172.16...	
Ethernet0/0	198.18.129.25				<input type="checkbox"/>				LAN
Loopback0	10.0.0.0/1				<input type="checkbox"/>				
Tunnel0	172.16.1.254		DMZ	10.0 Mbps	<input checked="" type="checkbox"/>	DMZ			
Tunnel101	172.16.2.294		MPLS	5.0 Mbps	<input checked="" type="checkbox"/>	MPLS	San-Jose	10.16.2.229, 172.16.1.254, 172.16...	
HQ-MC	198.18.129.23	Local					San-Jose	10.16.2.229, 172.16.1.254, 172.16...	
Ethernet0/0	198.18.129.23				<input type="checkbox"/>				
Loopback0	10.0.0.103				<input type="checkbox"/>				

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Another way to Setup the Semantics? Pfrv3

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Network Semantic Usage Examples

Search **sp = MPLS**

Search **site = Los-Angeles & wan**

Application Name	Total Flows	Total Bytes	Total Packets	Average Bit Rate	Average Packet Rate	Peak Bit Rate	Peak Packet Rate
IPsec	58	44 MB	328,054	390 kbps	732 pps	408.8 kbps	761 pps
VPN	58	30 MB	215,756	175 kbps	220 pps	151.4 kbps	244 pps
SSH	29	7 MB	26,467	54 kbps	52 pps	43.4 kbps	53 pps
FTP	29	4 MB	26,899	50 kbps	20 pps	52 kbps	22 pps
HTTP	5	9 KB	211	61 kbps	0 pps	1.1 kbps	3 pps
SMTP	1	3 KB	111	43 kbps	0 pps	619 kbps	2 pps
IMAP	1	2 KB	46	18 kbps	0 pps	272 kbps	0 pps
IMAP-SSL	1	1 KB	26	10 kbps	0 pps	162 kbps	0 pps
POP	15	1 KB	33	1.0 kbps	0 pps	184 kbps	0 pps
IMAP-SSL	1	1 KB	17	10 kbps	0 pps	56 kbps	0 pps
IMAP	1	2 KB	9	2 kbps	0 pps	0 kbps	0 pps

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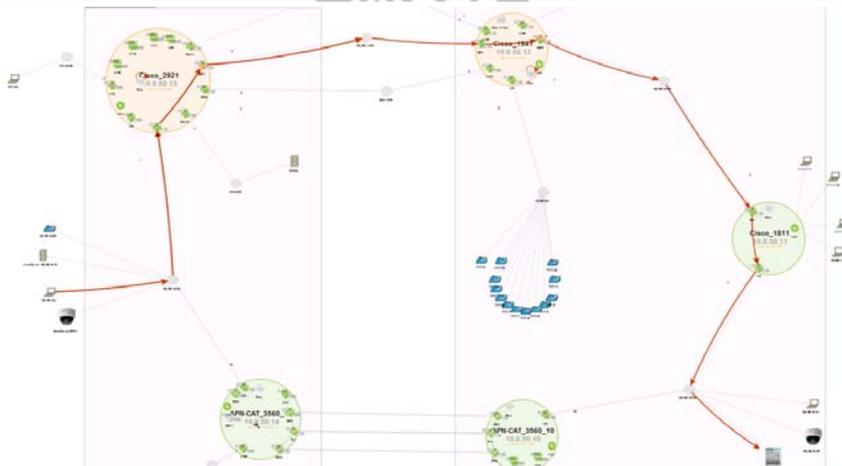
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Semantic Data – Example 1

Search site=San-Francisco | site=Chicago | site= New_York & wan & flow.dstport=19420



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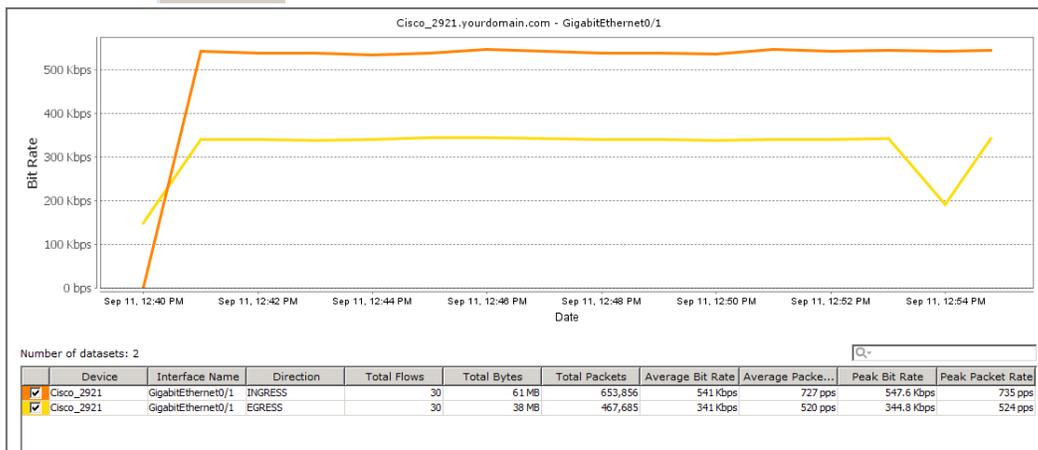
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Semantic Data – Example 2

Search wan & tag=Enhanced & flow.app=RTP



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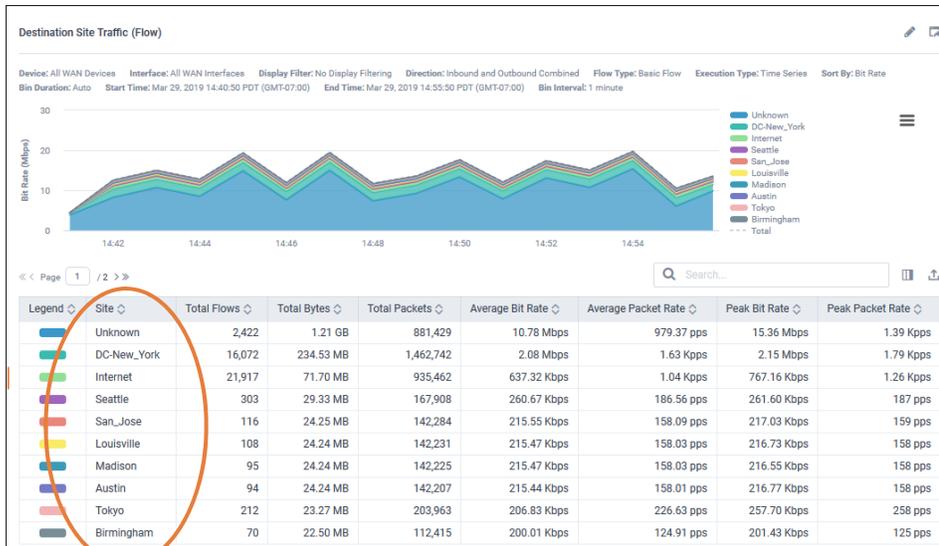
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Semantic Data – Example 3



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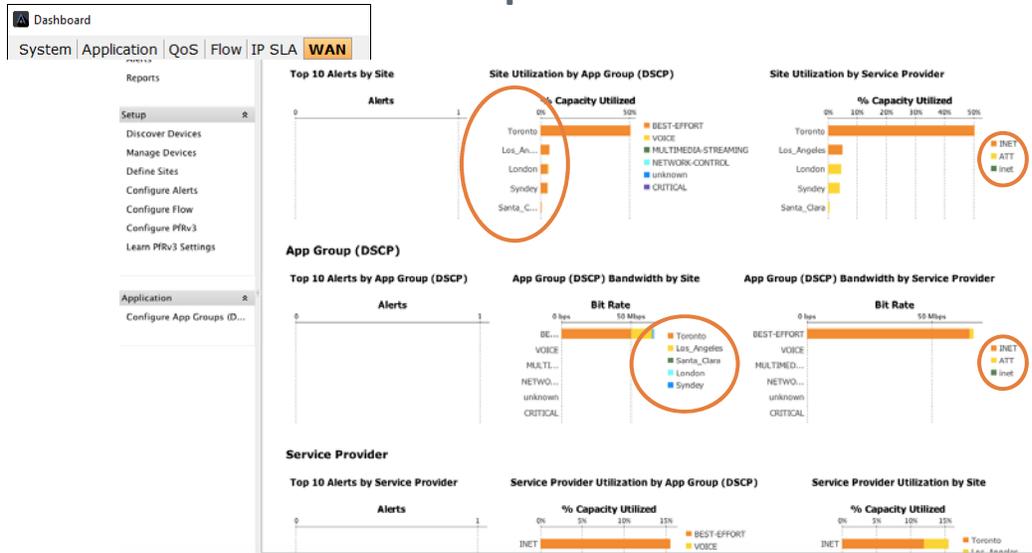
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Semantic Data – Example 4



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Define Application Groups (DSCP)

- LiveNX allows customers to define application groups to align with DSCP settings within their network so that the WAN-PfR dashboard or drill-down reports can show application names instead of DSCP values.
- This is done by selecting “Configure App Groups (DSCP)” off the WAN-PfR dashboard or under “Tools”, “Manage App Groups (DSCP)”.



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Define Application Groups (DSCP)

For built in PfR performance profiles in IOS/IOS-XE use the SLA dropdown selector. The performance settings will be automatically populated.



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Filter Traffic to Visualize Path Changes

- PfRv3 uses smartprobes to determine the performance of various service provider links. These probes may add clutter on the LiveNX topology view, since PfR will create corresponding smartprobes for every traffic class learned.
- Smartprobes use the following ports by default:
 - Source port: 18000
 - Destination port: 19000
- Hiding the smartprobe traffic allows the network engineer to focus his/her attention on the user application traffic.



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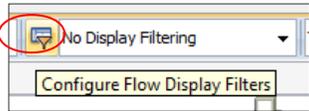
Filter PfR Smart Probe data

The screenshot displays two windows from the LiveAction interface. The 'Filter Entry Details' window on the left shows a list of filter entries under 'Filter Entry Details'. A red box highlights the 'PFRSmartProbes' entry. The 'Protocols/Applications Setup' window on the right shows a list of defined protocols/applications. A red arrow points from the 'PFRSmartProbes' entry in the first window to the 'PFRSmartProbes' entry in the second window. The 'PFRSmartProbes' entry in the second window is expanded, showing the filter rule: '(L4 Protocol=UDP) AND ((Src=18000) AND (Dst=19000))'. Below this, the 'Entry Details' section shows 'Layer 4 Protocol' set to 'UDP (17)' and 'Ports' set to 'Match Source and Destination Ports'. The 'Source' port is '18000' and the 'Destination' port is '19000'.

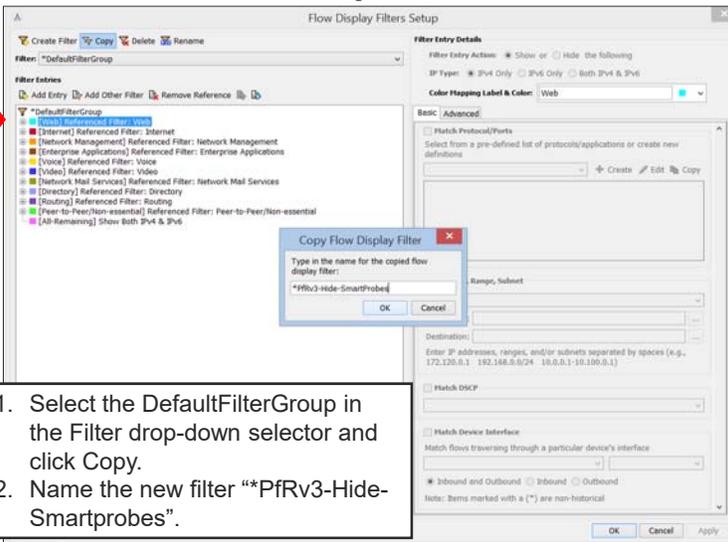


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Create a Custom Filter to Hide Smartprobes



Click on the Configure Flow Display Filters button



1. Select the DefaultFilterGroup in the Filter drop-down selector and click Copy.
2. Name the new filter “*PfrV3-Hide-SmartProbes”.

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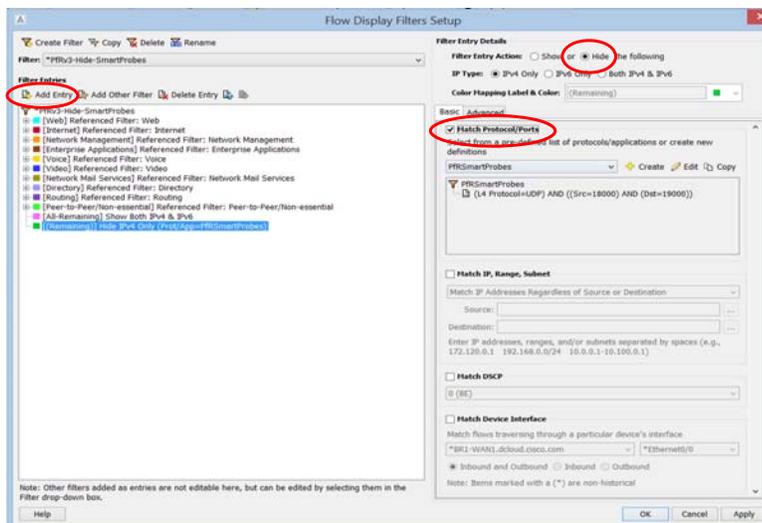
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Create a Custom Filter to Hide Smartprobes

1. Click “Add Entry”.
2. In the upper right-hand corner of the dialog select “Hide” in the “Filter Entry Action:” section.
3. Click the checkbox to “Match Protocol/Ports” and click “Create” to add a definition.
4. Name the new definition “PfrSmartProbes” and click “OK”.



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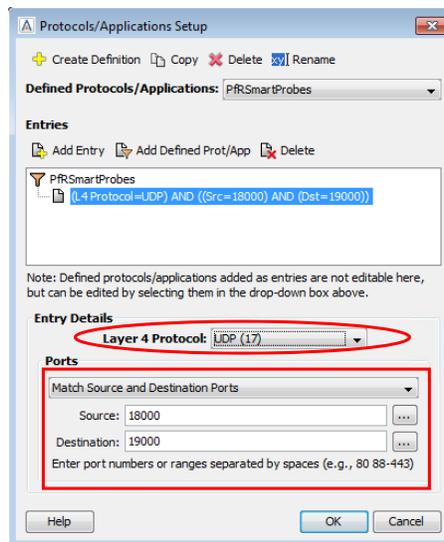
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Create a Custom Filter to Hide Smart Probes

1. In the Protocols/Applications Setup dialog. Set the “Layer 4 Protocol” to “UDP (17)”.
2. Under the “Ports” settings choose “Match Source and Destination Ports” from the drop-down menu.
3. Set the “Source” port to “18000” and the “Destination” port to “19000” and click “OK”.

“Note: These are the default ports for the smartprobes. If you change the default settings, please set the port numbers accordingly.”



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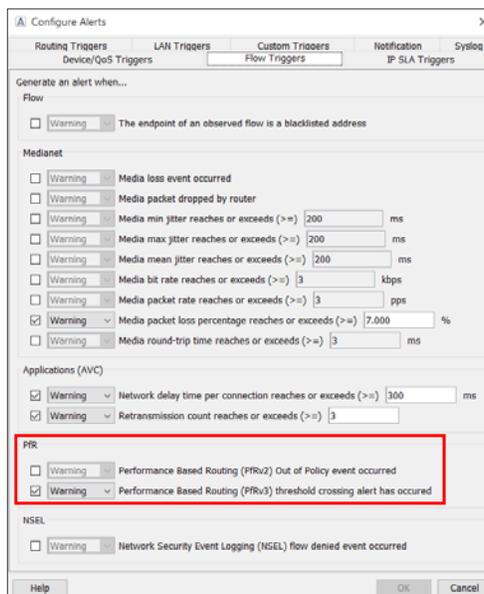
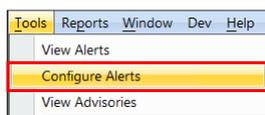
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Set Pfrv3 Alerts



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IWAN/SDWAN Cheat Sheet

- Validate they used the loopback interface for management on all IWAN routers and MC too (same loopback as PfR's Router ID)
- Manage the loopback, tunnels, physical wan interfaces minimally (easiest way in bulk is export/import the config via CSV)
- Do not manage Tunnel 0
- Check tunnel interfaces' MTU, if it is set to 1400, then set "snmp-server packetsize 1372"
- Enable FnF on Tunnel interfaces
- Set pollers to 30 seconds on routers (switches stay at 1 minute)
- Have them provide you a show run of the domain MC "show run | sec domain"
- Validate collector command is set up on the MC
- Validate that PfR flow is being received
- You set up the PfR application groups from the PfR dashboard
- Go to alerts and check the flow tab and make sure that PfRv3 is ticked, go to the notification tab and make sure in-application alerts are active
- Learn PfR semantics from the PfR dashboard
- Update *DefaultFilterGroup to hide Pfr Smartprobe

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LAB: SD-WAN Deployment



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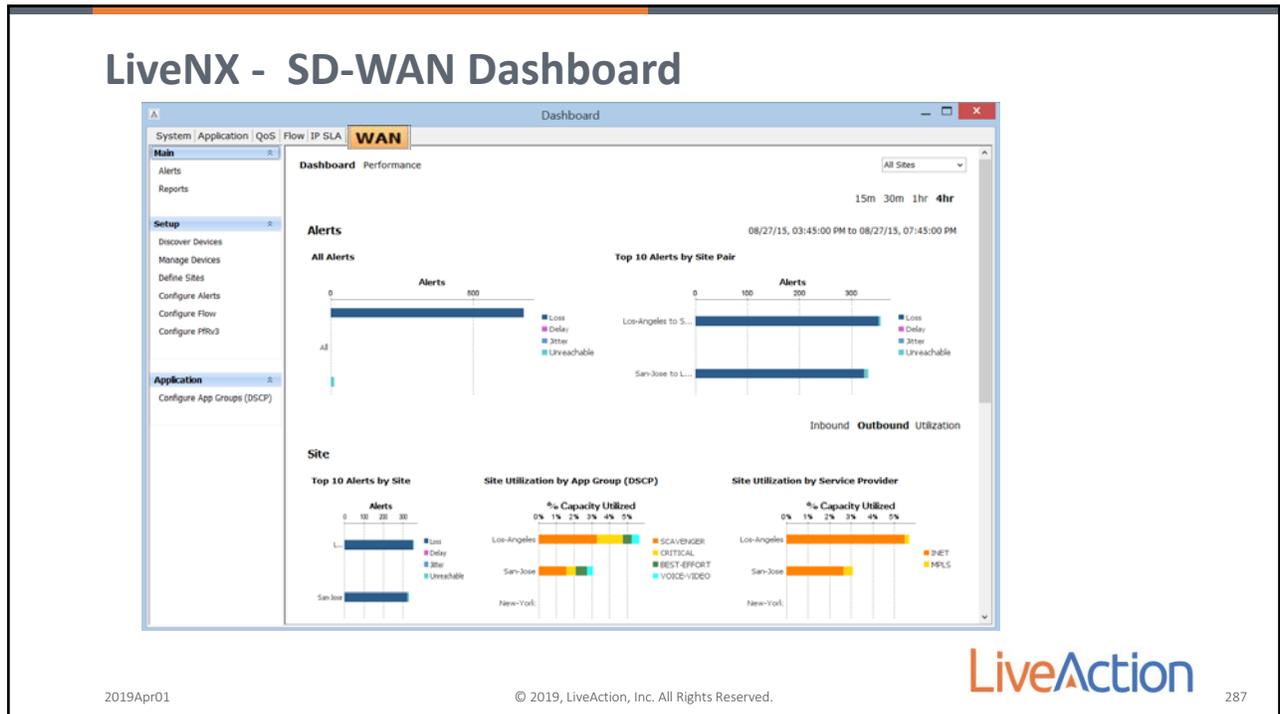


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LiveNX - SD-WAN Dashboard - Performance



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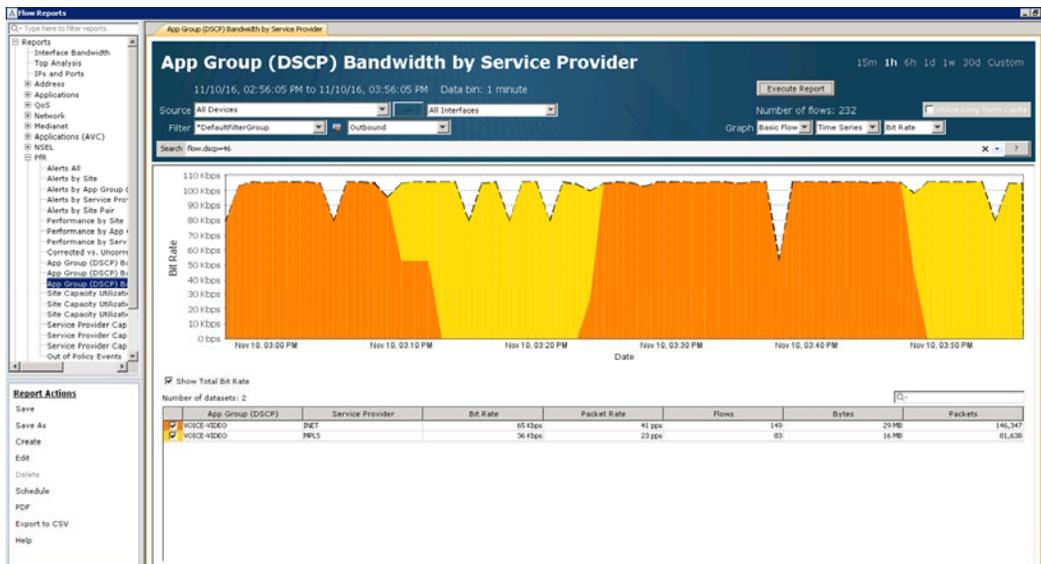
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LiveNX - SD-WAN Reporting



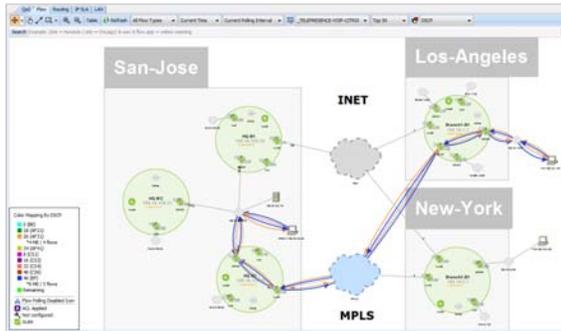
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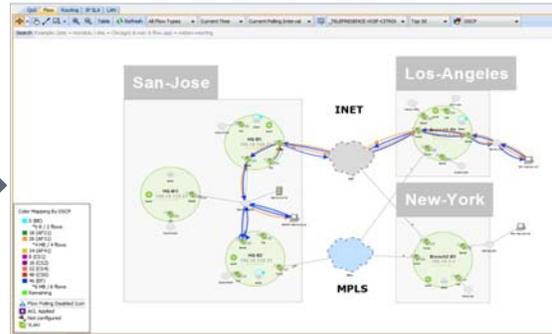
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LiveNX - SD-WAN Visualization

Before Brown-Out
High Priority Traffic over MPLS Path



After Brown-Out
High Priority Traffic Over INET Path



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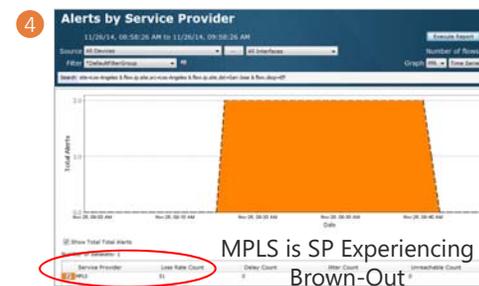
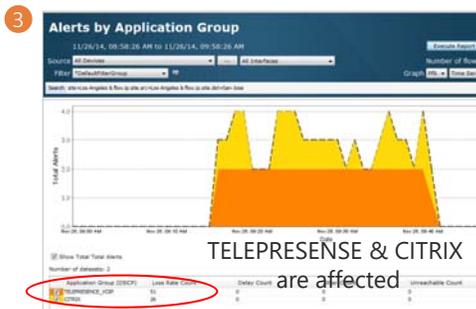
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LiveNX - Diagnosing a Brown-Out Issue



Dashboard Shows Loss From LA->SJC



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How can LiveNX Help Manage the SD-WAN Environment?

- Help select pilot sites before SD-WAN deployment
- Baseline network and application performance
- Monitor QoS performance
- Visualize SD-WAN intelligent path control so network admin can visually validate how SD-WAN works
- Accelerate troubleshooting of network brownouts
 - What caused the brown-out?
 - How SD-WAN reroutes traffic and protects application performance during the brown-out?
 - Which applications are affected by a brown-out?
 - Which service provider is having a brown-out issue?
 - What traffic is moved from one provider to another?

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SD-WAN Pre-deployment

Pick Pilot Sites

- Based on Utilization
- Based on the type of applications

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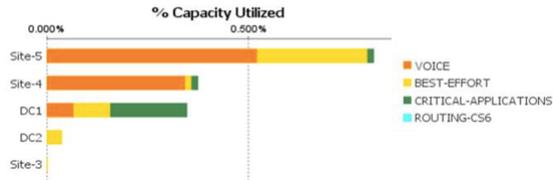
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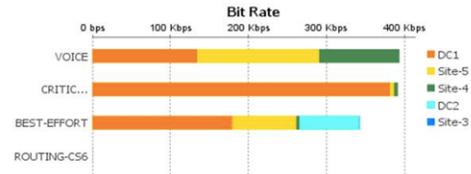
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WAN Dashboard

Site Utilization by App Group (DSCP)



App Group (DSCP) Bandwidth by Site



- Based off of utilization (% capacity), Site-5 is using the most resources
- Voice is also being utilized the most.
- Which applications are taking up the most bandwidth
- What is the site breakdown per application

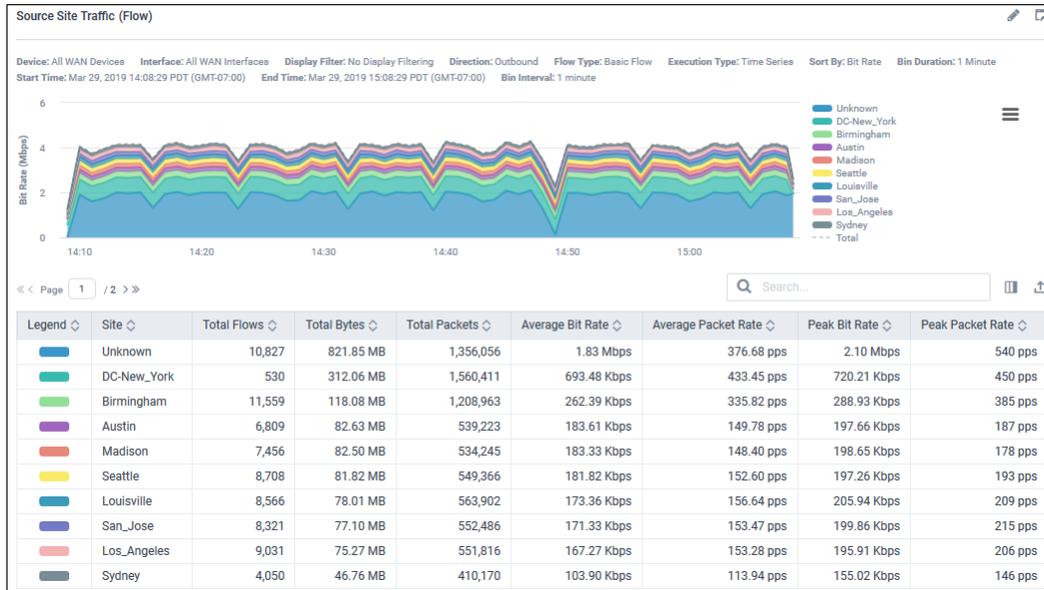
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Breakdown of the biggest Sites in terms of Usage

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Application (Flow)

Device: All WAN Devices Interface: All WAN Interfaces Display Filter: No Display Filtering Direction: Inbound and Outbound Combined Flow Type: Basic Flow Execution Type: Time Series Sort By: Bit Rate

Bin Duration: 1 Minute Start Time: Mar 29, 2019 13:40:12 PDT (GMT-07:00) End Time: Mar 29, 2019 14:40:12 PDT (GMT-07:00) Bin Interval: 1 minute

<< Page 1 / 12 >>

Legend	Application	Total Flows	Total Bytes	Total Packets	Average Bit Rate	Average Packet Rate	Peak Bit Rate	Peak Packet Rate
■	youtube	6,185	1.65 GB	1,822,842	3.67 Mbps	506.35 pps	6.55 Mbps	883 pps
■	espn-video	178	1.19 GB	1,013,562	2.64 Mbps	281.55 pps	8.32 Mbps	908 pps
■	rtp-video	59	765.32 MB	564,398	1.70 Mbps	156.78 pps	1.91 Mbps	175 pps
■	ssl	13,961	735.78 MB	813,243	1.64 Mbps	225.90 pps	3.99 Mbps	515 pps
■	VoIP	1,555	724.65 MB	3,623,271	1.61 Mbps	1.01 Kpps	1.69 Mbps	1.06 Kpps
■	cit	Apply VoIP to Search Filter		2,697,141	1.22 Mbps	749.21 pps	1.33 Mbps	817 pps
■	es	Apply Specific Flow to Search Filter		462,216	1.15 Mbps	128.39 pps	3.99 Mbps	448 pps
■	ou	Drill down on VoIP as Application		833,263	225.99 Kbps	231.46 pps	624.06 Kbps	548 pps
■	rtp	Drill down on VoIP as DSCP		1,130,263	200.94 Kbps	313.96 pps	221.60 Kbps	346 pps
■	co	Drill down on VoIP as Interface Bandwidth		1,492,570	199.01 Kbps	414.60 pps	207.63 Kbps	432 pps
		Drill down on VoIP as Bidirectional Source/Destination Pair						
		Drill down on VoIP as IPs and Ports						

Drilldown to the applications on an interesting site

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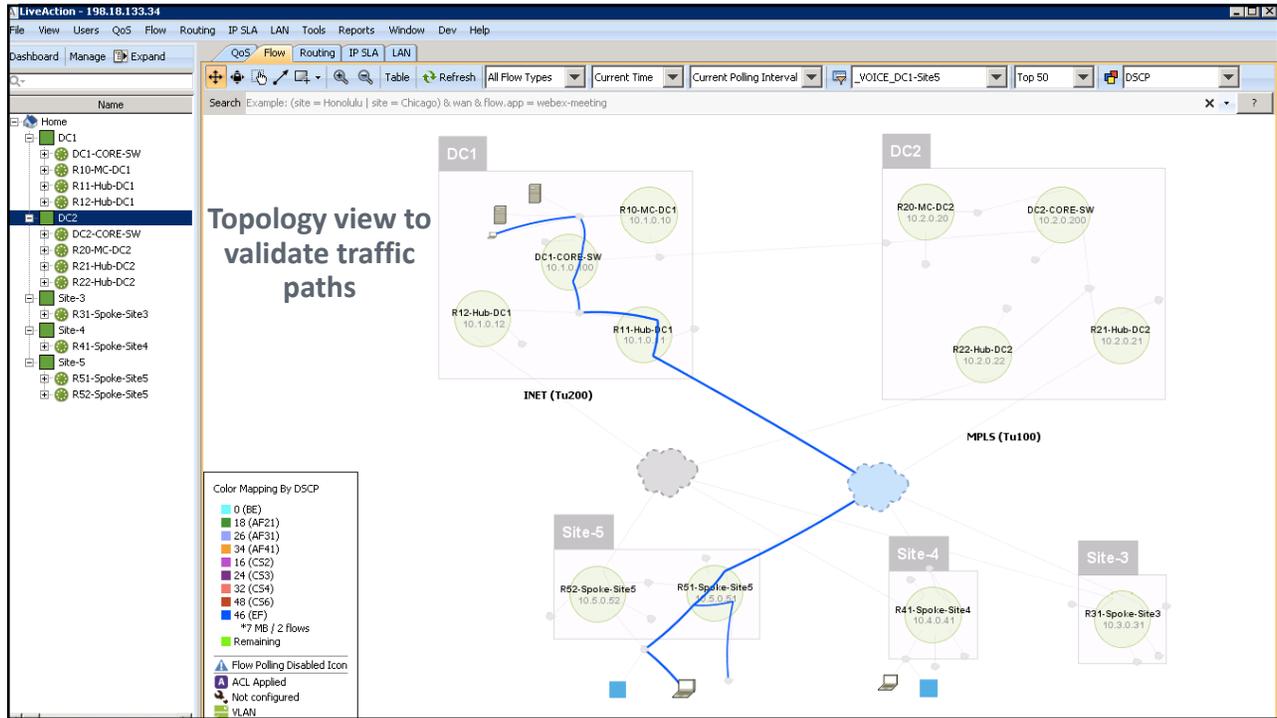
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During SD-WAN Deployment

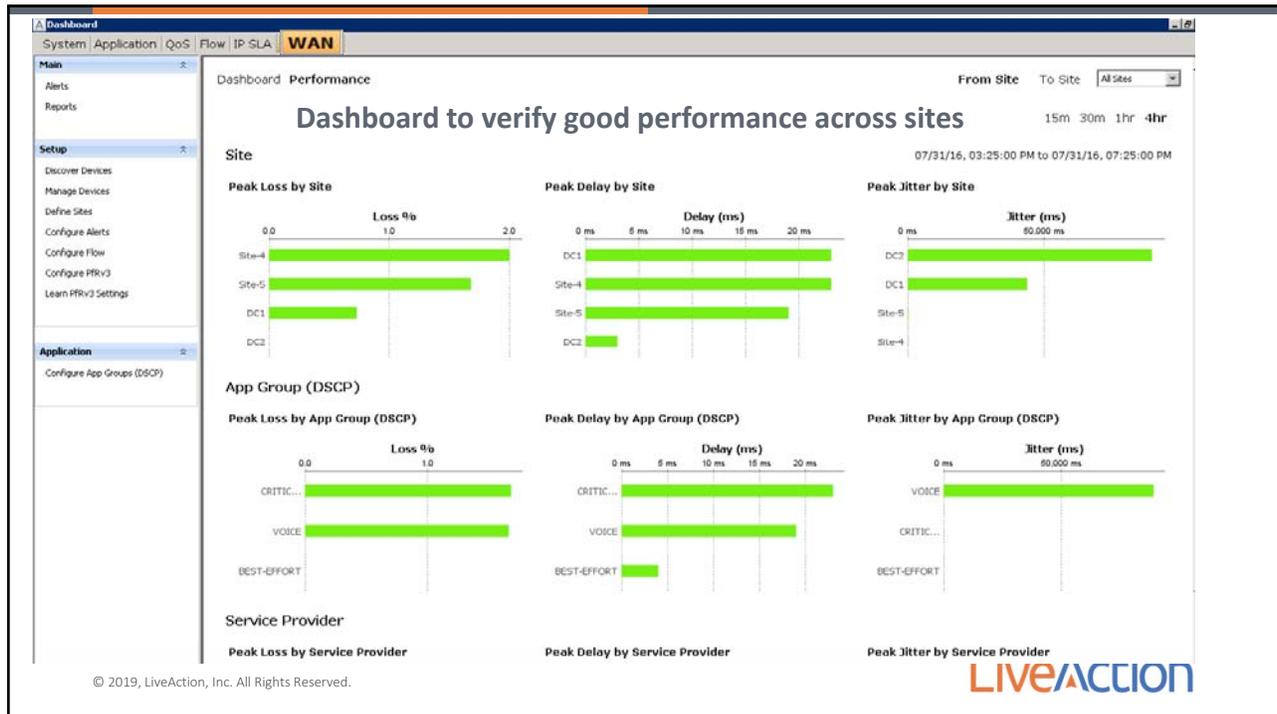
- Validate policies
 - Is traffic load balanced?
 - Where are my critical Applications going? (Either searching by appname or DSCP value)
- Verify Performance from the IWAN Dashboard
- Is PfR needing to move the traffic?

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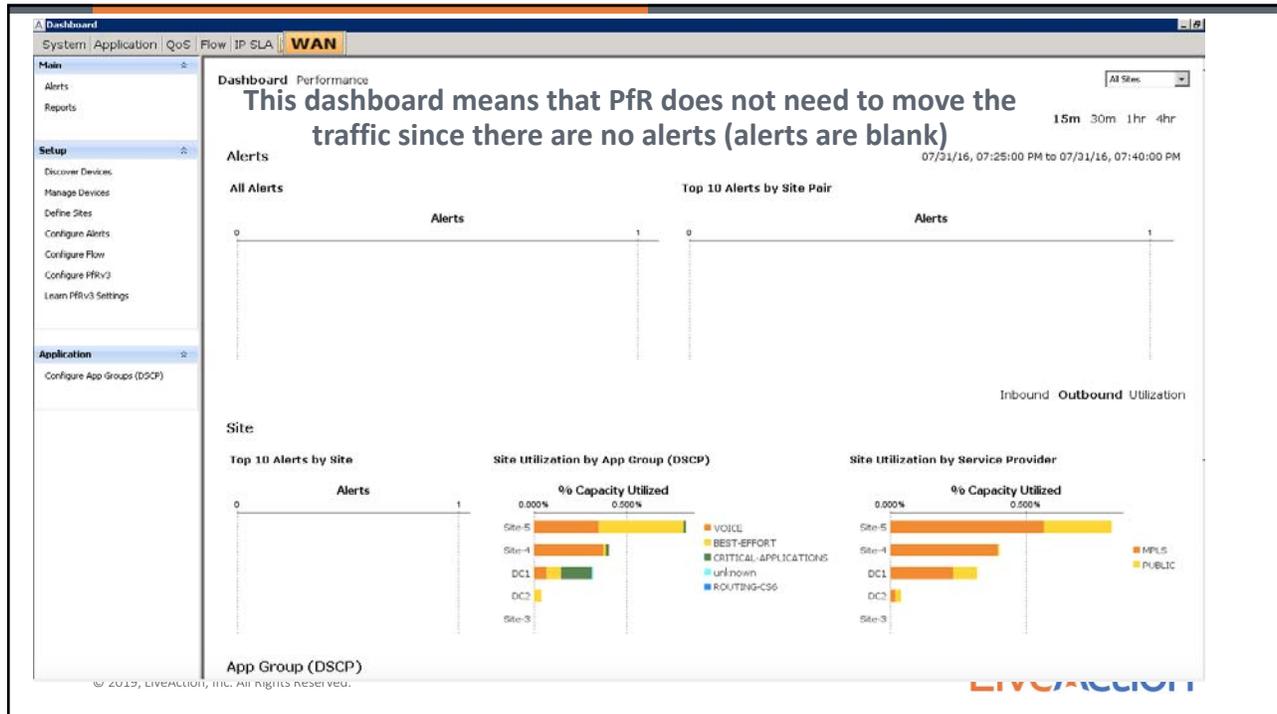
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Abnormal Events Notification

- You want to be notified of any abnormal events that can potentially impact services
- When that happens, you want to quickly find out if sites and services are impacted – validate PfR is doing its job

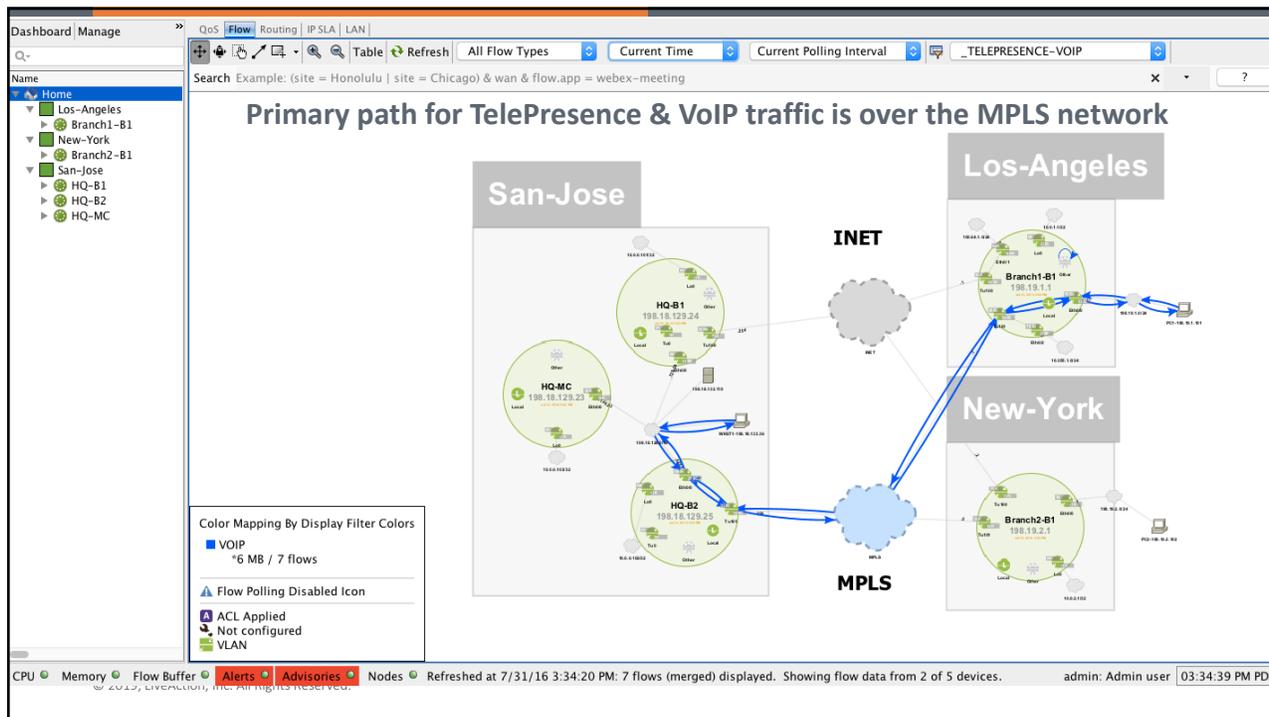
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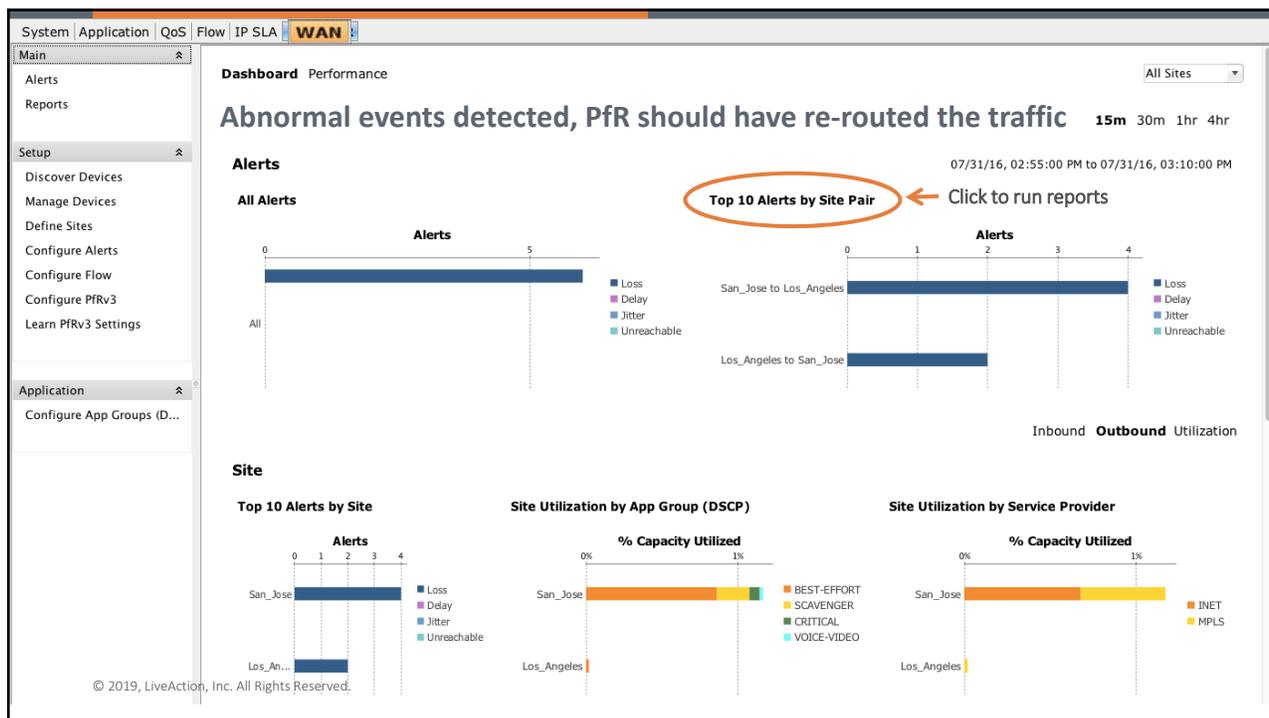
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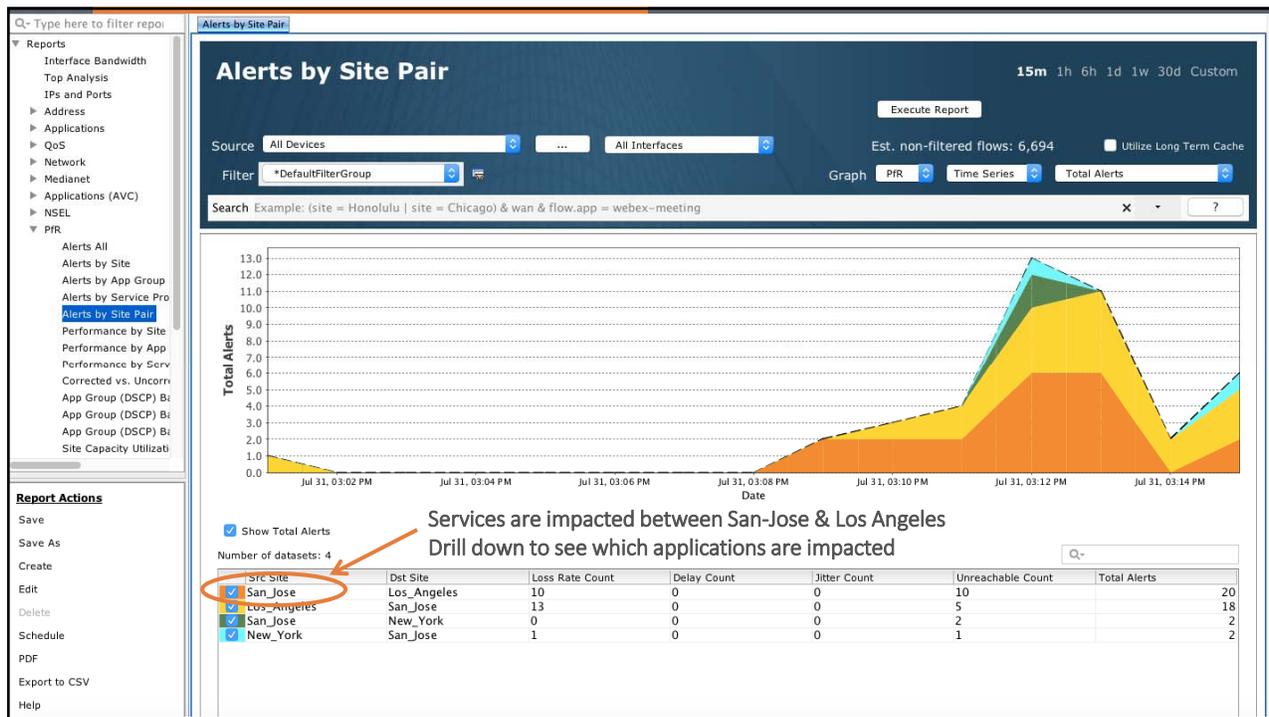
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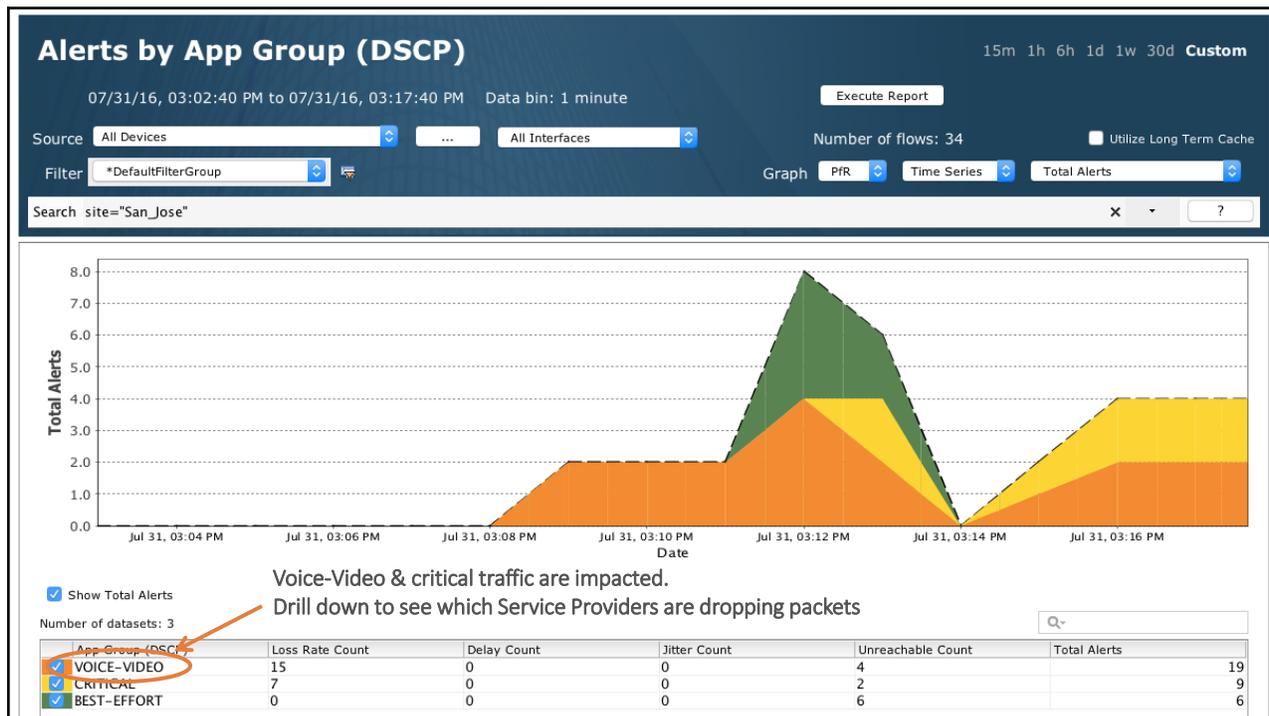
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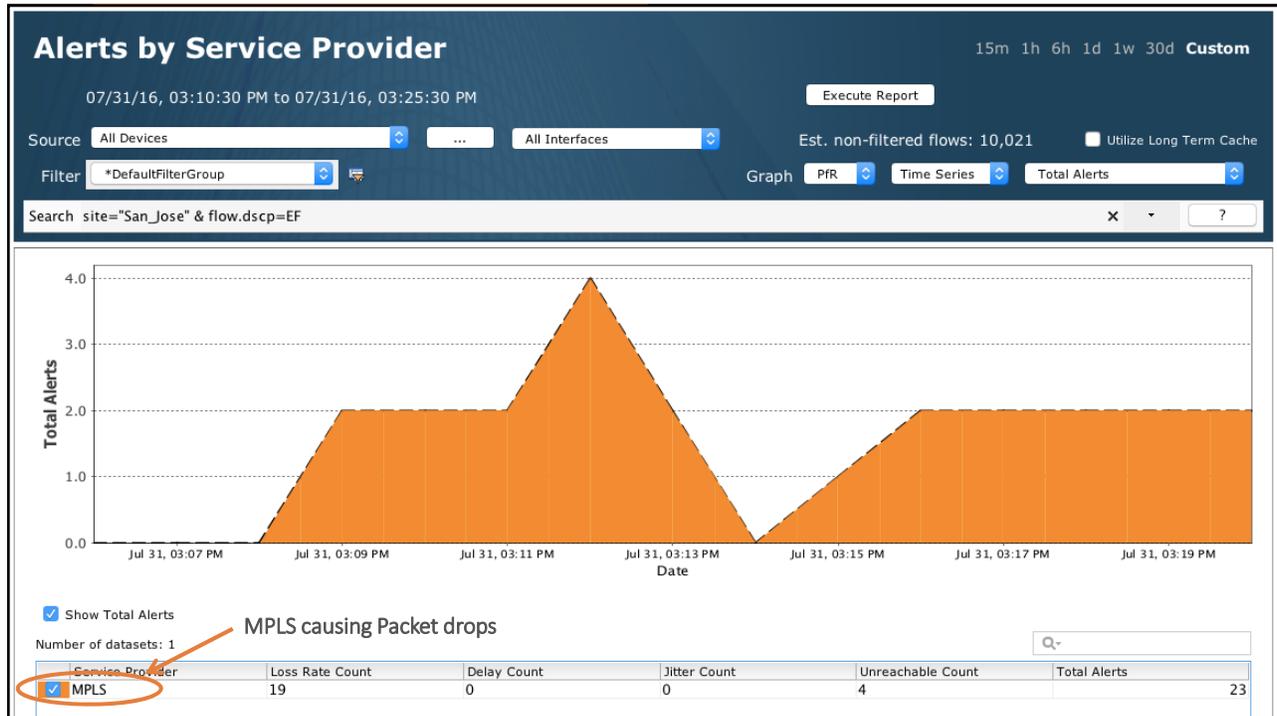
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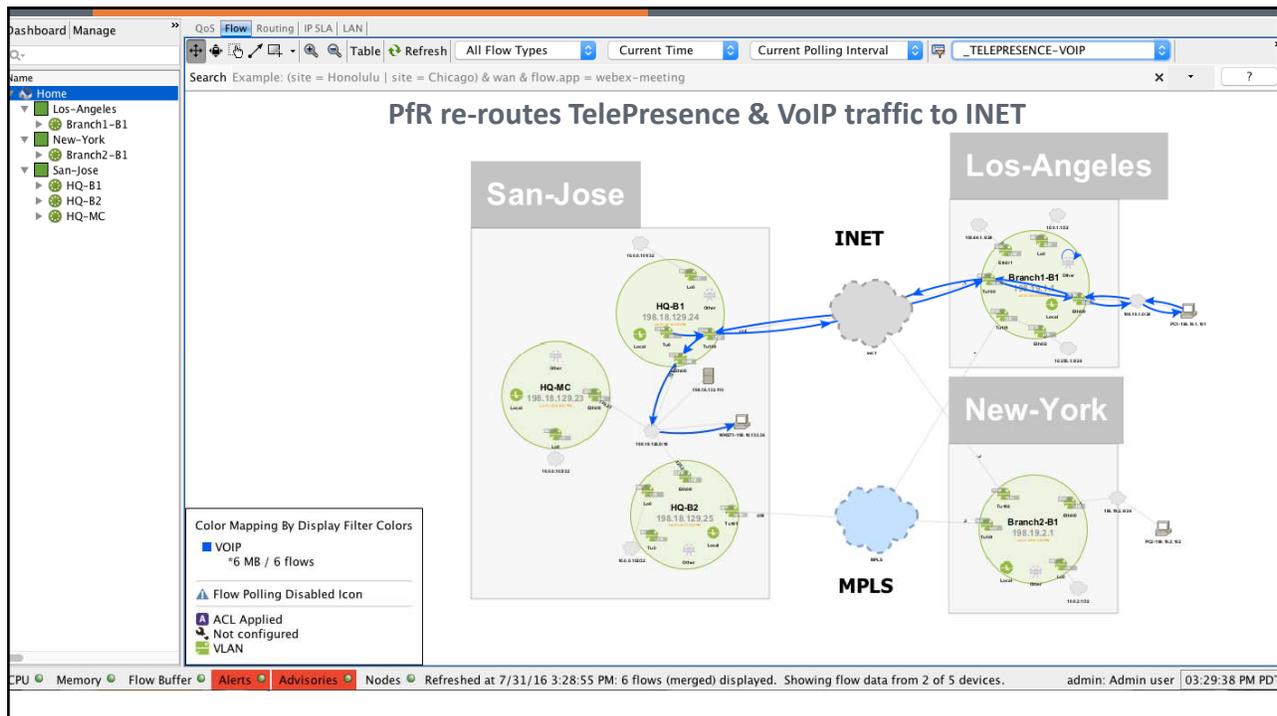
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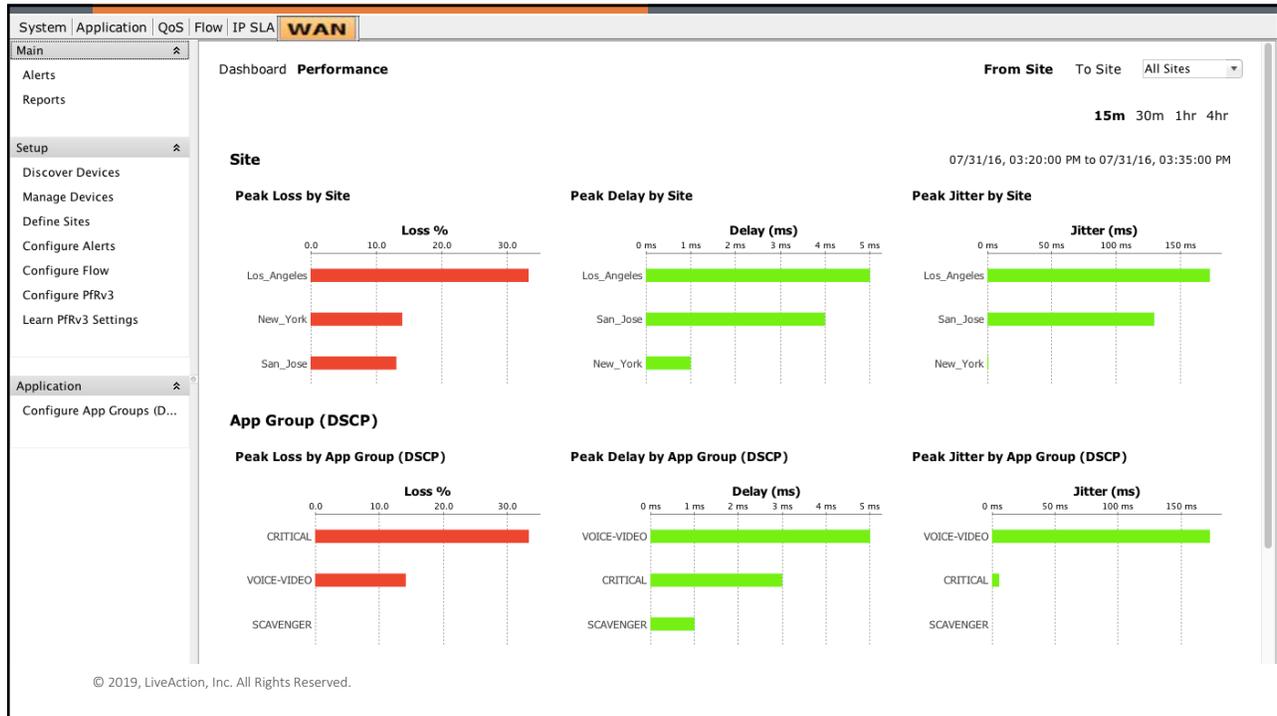
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Lab: SD-WAN Troubleshooting





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SD-WAN QoS with DMVPN

- LiveNX can be used to configure QoS in DMVPN environments
 - Per-Tunnel QoS at DMVPN Head-End
 - Branch Hierarchical QoS with point-to-multipoint DMVPN
- *Note: LiveNX's DMVPN Per-Tunnel QoS configuration and monitoring capabilities can be used with or without SD-WAN.*

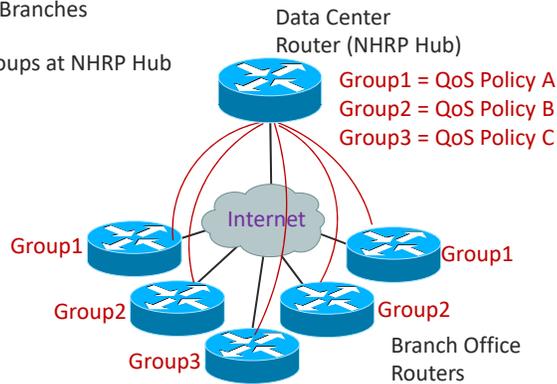
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Per-Tunnel QoS at DMVPN Head-End

Step 1 – Assign NHRP Groups to Branches

Step 2 – Map QoS policies to Groups at NHRP Hub



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Configuring Per-Tunnel QoS

Manage QoS Settings - HQ-B1.dcloud.cisco.com (198.18.129.24)

Policies Classes Interfaces

4C-BL_App-Match_Mark_ET00_In
4C-MN-WAN-EDGE
DMVPN-BJET-SHAPER
4C-MN-WAN-EDGE
SYSTEMS
LIVEACTION-POLICY-UNIFIED
MPLS
ToBranches

Mapped Classes

Class Name	Classify	Marking	Queueing	Policing	Shaping	Compression	WRED	DBL	Unknown
Class-Default					10,000 kbps				

Mapped Class Detail

Drop all traffic for class

Classify | Marking | Queueing | Policing | Shaping | Compression | WRED | DBL | Unsupported

Shape using: Average

Rate: 10,000 kbps

Committed burst: 256 bits

Excess burst: 0 bits

Unknown elements:

Reference

Control the flow of traffic and eliminate bottlenecks by delaying packets and conforming to a specified bit rate.

Rate

Peak: allows the transmission rate to burst higher than the shaping rate.

Average: sets the maximum transmission rate to the shaping rate.

Burst Size

Committed burst: the Committed Burst size used to calculate the

Help Save to Device Preview CLI Close

Create Hierarchical QoS Policy for each NHRP Group. This example shows a parent shaper for branches with 10Mbps circuits.

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Apply Policy to NHRP Group

Manage QoS Settings - HQ-B1.dcloud.cisco.com (198.18.129.24)

Interfaces

- Ethernet0/0
 - Input : 4C-BL_App-Match_Mark_E100_In
 - Output : <none>
- Ethernet0/1
 - Input : <none>
 - Output : <none>
- Ethernet0/2
 - Input : <none>
 - Output : <none>
- Ethernet0/3
 - Input : <none>
 - Output : <none>
- Loopback0
 - Input : <none>
 - Output : <none>
- Vu10
 - Input : <none>
 - Output : <none>
- Tunnel0
 - Input : <none>
 - Output : <none>
- Tunnel100
 - Input : <none>
 - Output : <none>
- NHRP Group "INTERNET" : DMVPN-BET-SHAPER

Interface name:

IP address:

IP address mask:

Interface description:

Pre-classify

Link Fragmentation:

Maximum delay: ms

Interleave

Help Save to Device Preview CLI Close

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Per-Tunnel QoS Monitoring at the Head-End

- Per-Tunnel QoS monitoring was not supported via the CBQoS MIB in the past
- Monitoring in LiveNX can be performed using NetFlow and network semantics

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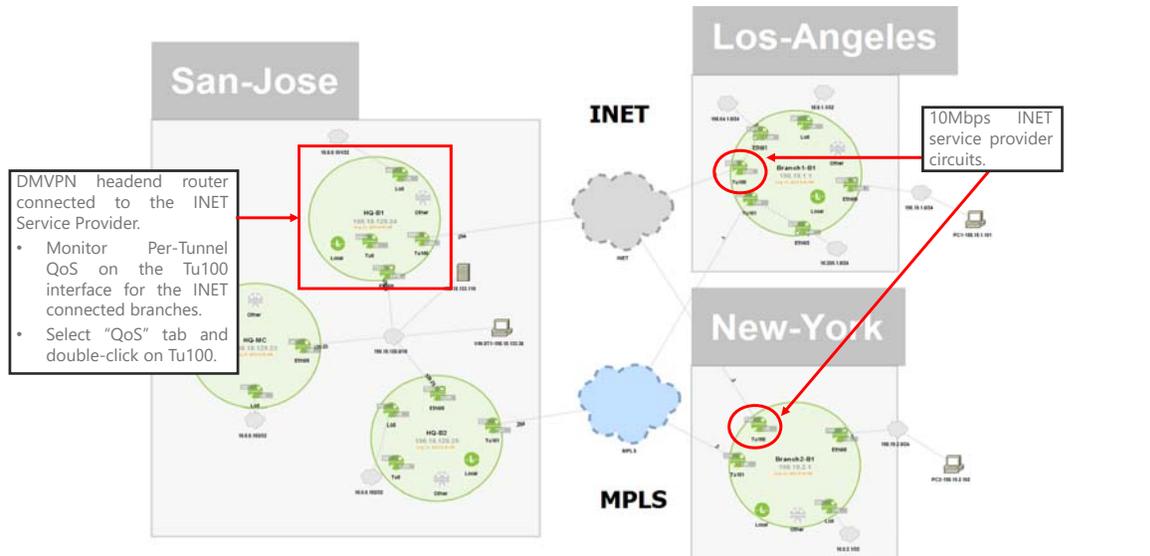
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DMVPN Per-Tunnel QoS Topology Example



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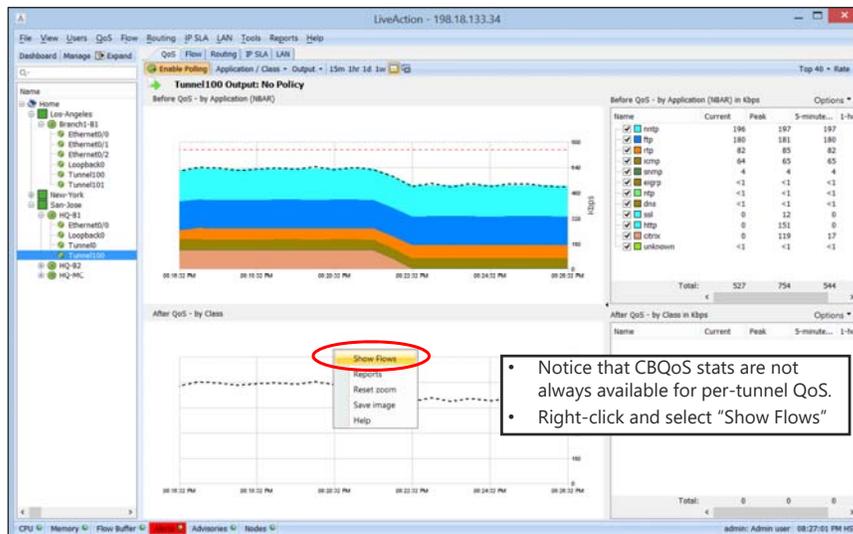
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Per-Tunnel QoS Monitoring



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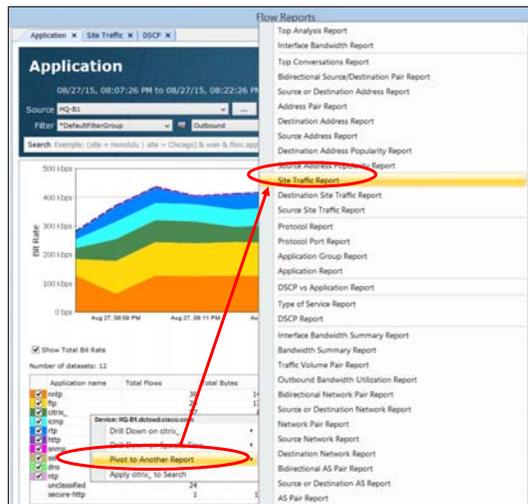
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Per-Tunnel QoS Monitoring

- LiveNX will automatically run the Application report for the tunnel interface.
- Right-click in the table and select "Pivot to Another Report".
- Select the "Site Traffic Report".

Note: Site and Site IP semantics are needed for this workflow.



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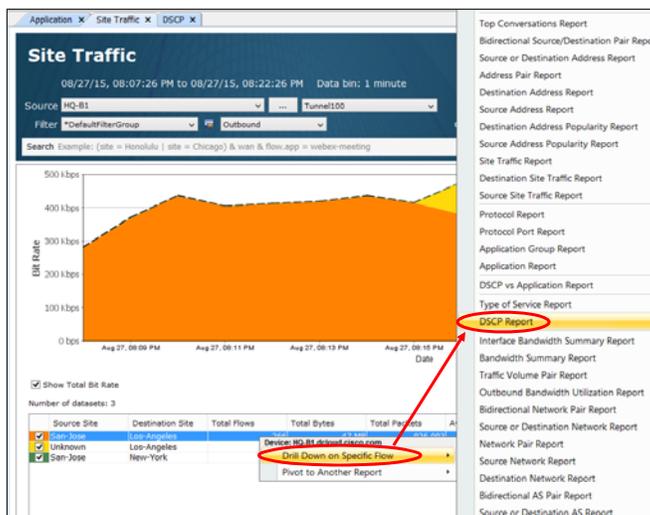
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Per-Tunnel QoS Monitoring

- The "Site Traffic" report will show site-to-site traffic from the DMVPN head-end.
- Right-click on the site-to-site communication of interest and "Drill Down on Specific Flow".
- Select the "DSCP Report".



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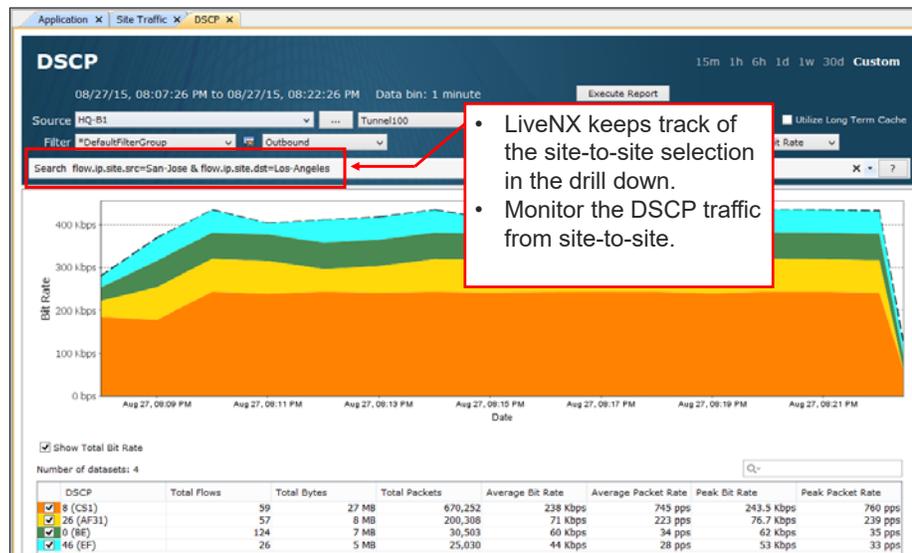
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Per-Tunnel QoS Monitoring



- LiveNX keeps track of the site-to-site selection in the drill down.
- Monitor the DSCP traffic from site-to-site.

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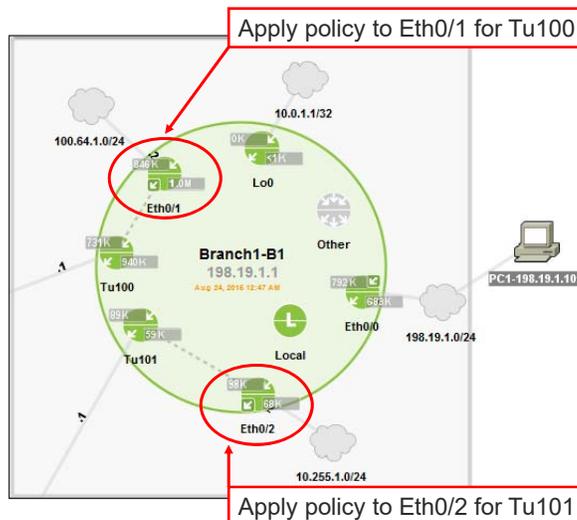
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Branch QoS Configuration for DMVPN

- DMVPN is a point-to-multipoint technology.
- Outbound QoS shaping policies must be applied to the physical interface of the tunnel at the branch.
- *Side note: Recall Remote Ingress Shaping can be applied to the LAN interface: Eth0/0 to protect critical apps inbound to the site.*



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 - Call: 408-217-6501
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- Professional Services has many offerings to assist you in your deployment and network maintenance
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