Real Time Topology Based Flow Visualization

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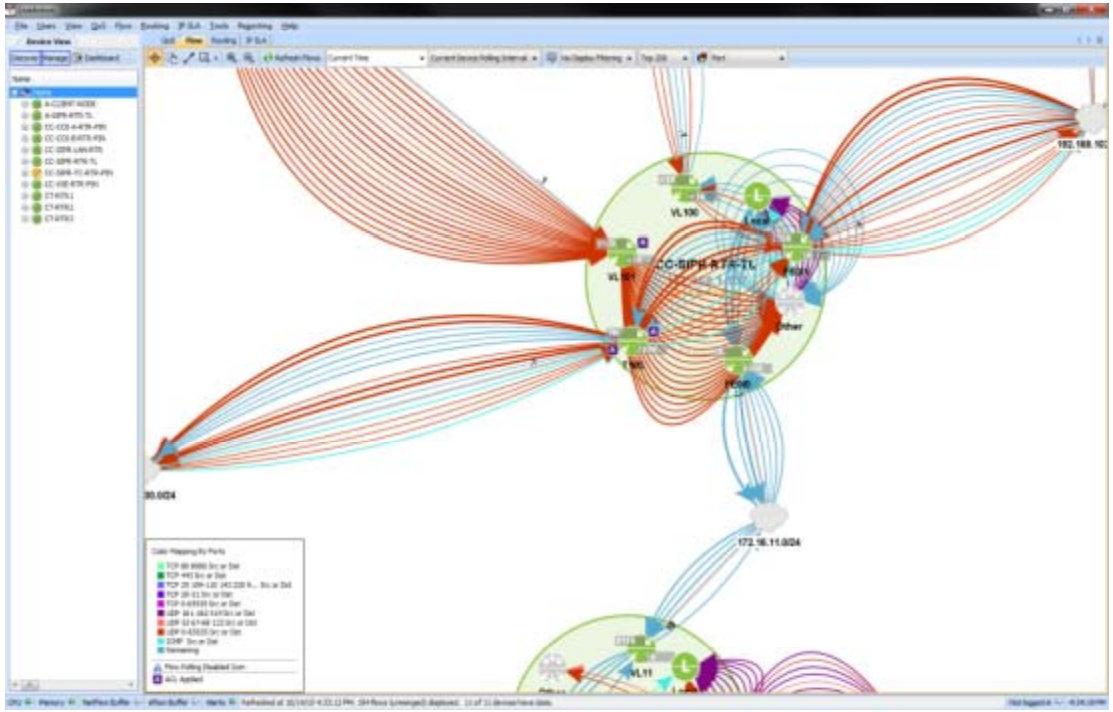
Referentia Systems Incorporated

Flocon 2011, Salt Lake City, UT

Agenda

- **Flow Visualization Tool Overview**
- **Visualizations and Design Issues**
- **Use Cases**



NOTE: Networks shown in this presentation are simulated, not actual DoD networks, traffic or addresses.

Beginnings

- **Initial Goal**
  - Network Quality of Service Monitor and Control
  - Tactical Military Networks
  - Easy to use for E3-E5 (Sergeant)

- **Working With**
  - Office of Naval Research
  - U.S. Marines
    - Marine Forces Pacific (MARFORPAC)
    - 3rd Marine Expeditionary Force (III MEF)

Tool Overview

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Quality of Service

Routing Visualizations

Flow

Service Level Agreement

Network Management

Network Situational Awareness

Computer Network Defense

Configuration

Monitoring

Historical Analysis

Visualization

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Quality of Service

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Historical Analysis

Visualization

Why Topology Based Visualization Model

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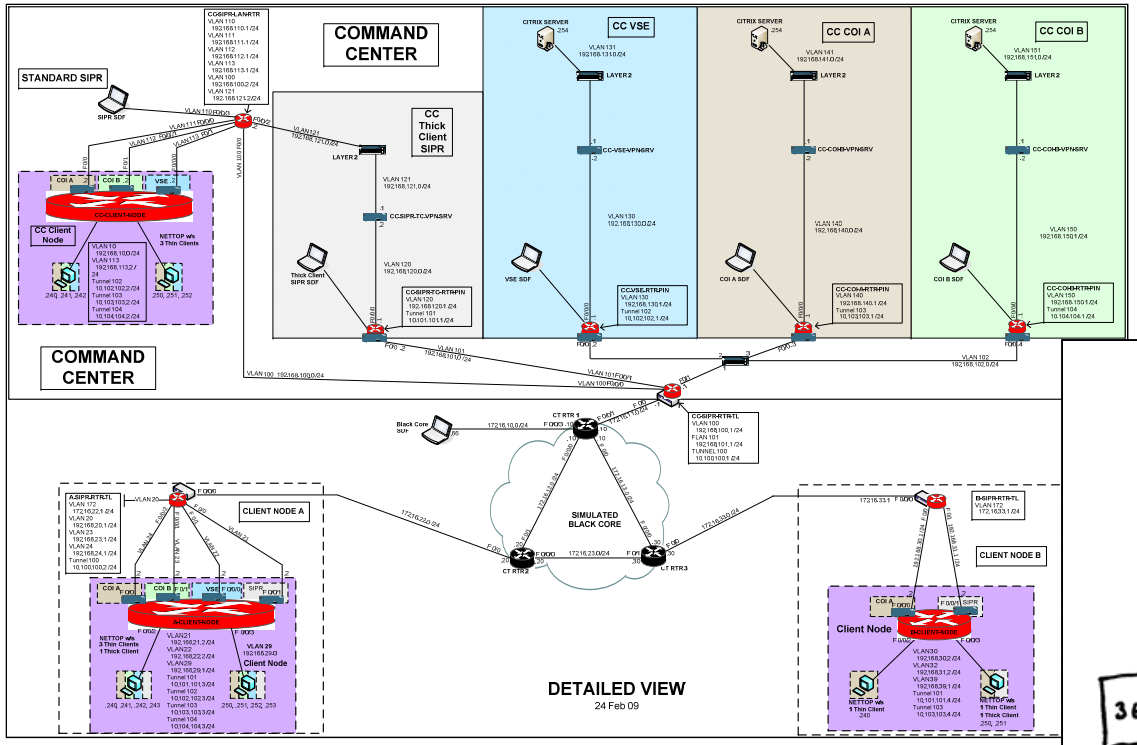
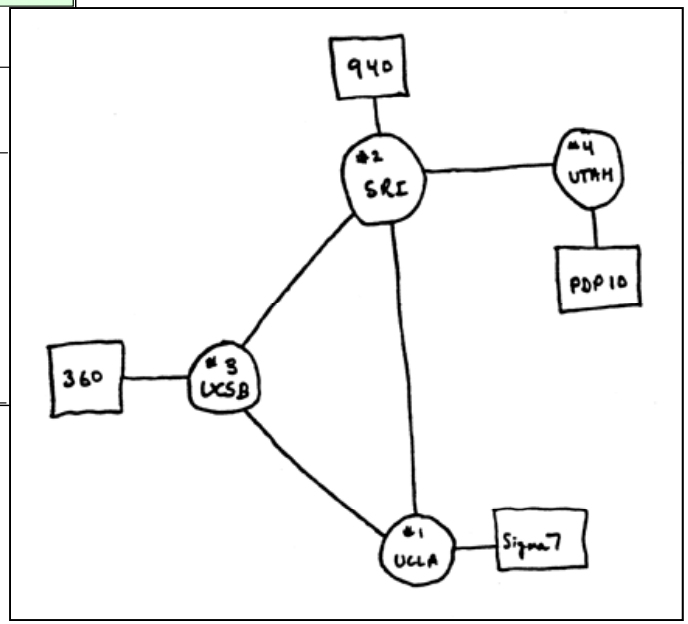


Visio Diagrams

Hand Drawings



- **Can't interactively explore**
- **No correlation to live network data**
- **Not always accurate or kept current**

Mental Model

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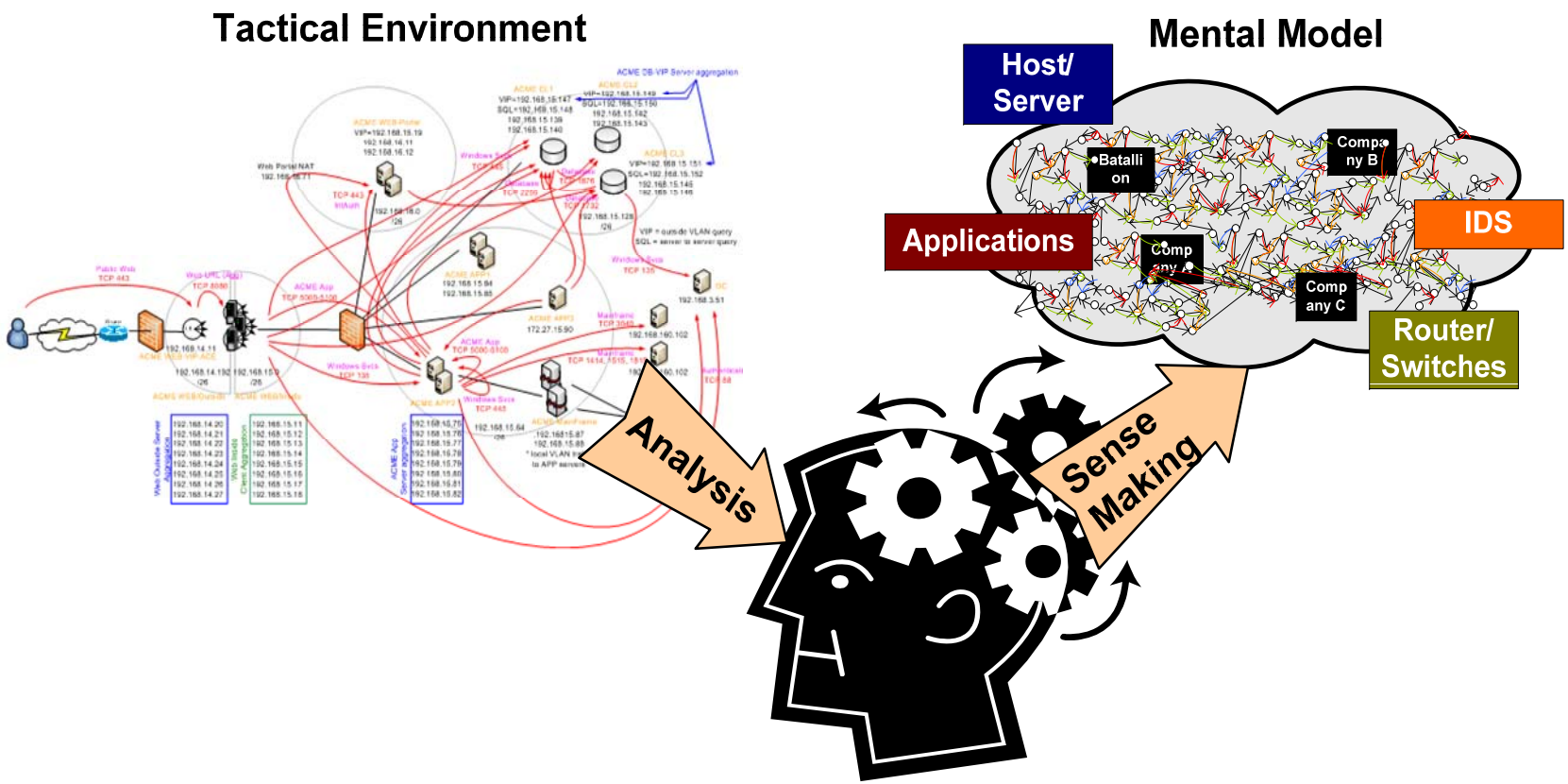
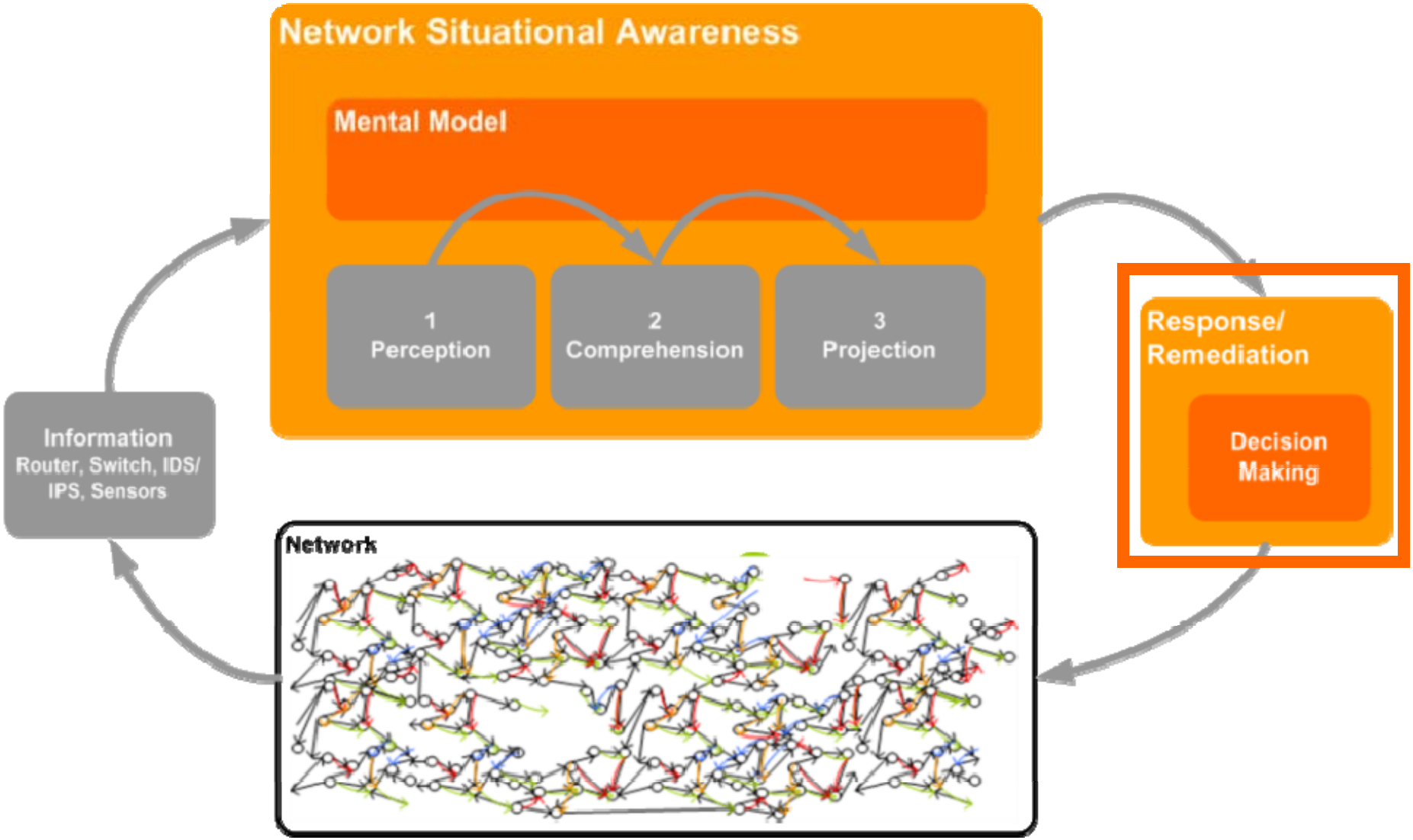


- **Accuracy and fidelity of the model**
- **Ability to explore the model**
- **Interact with the model**

Mental Model and Situational Awareness



DMTF CIM Model

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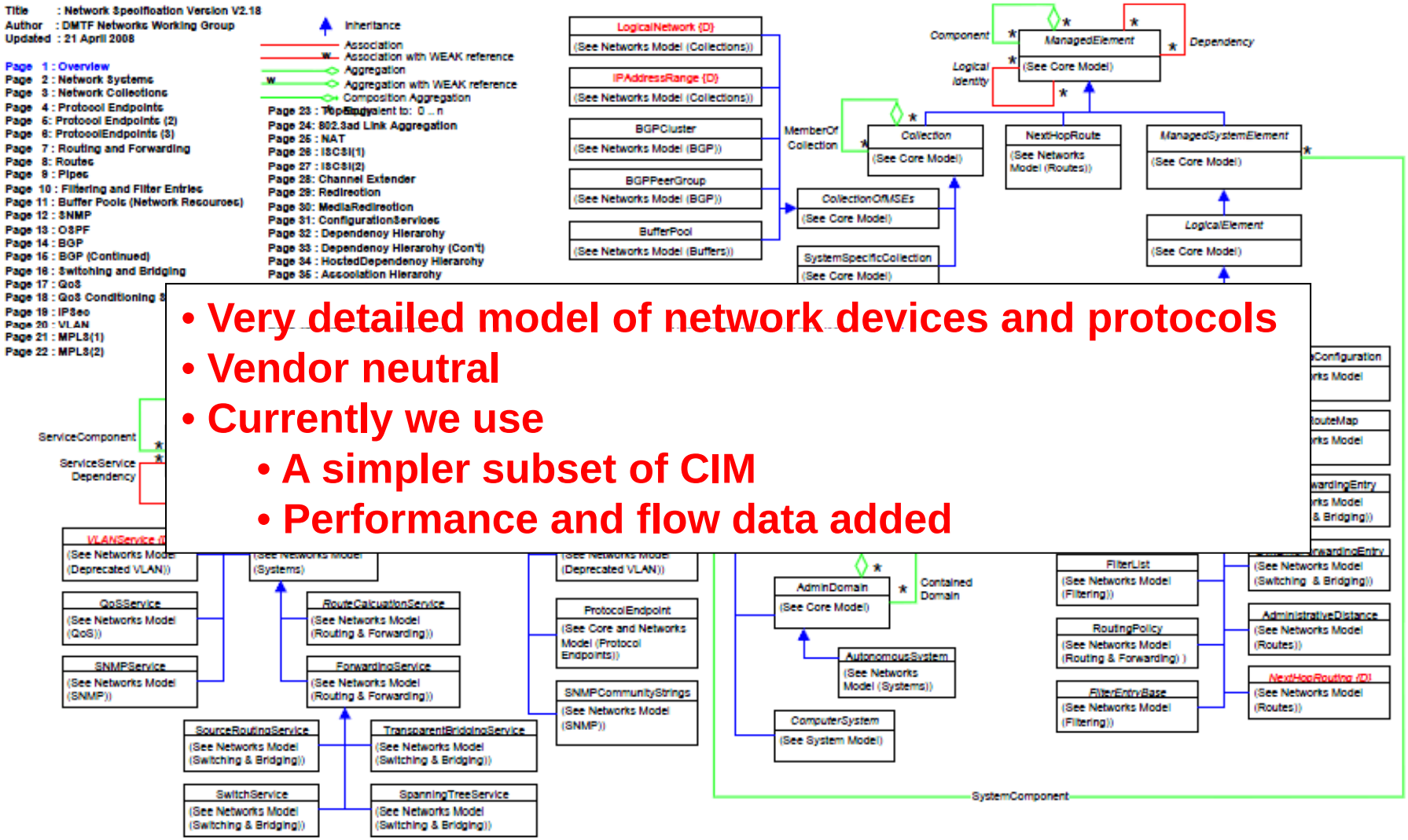
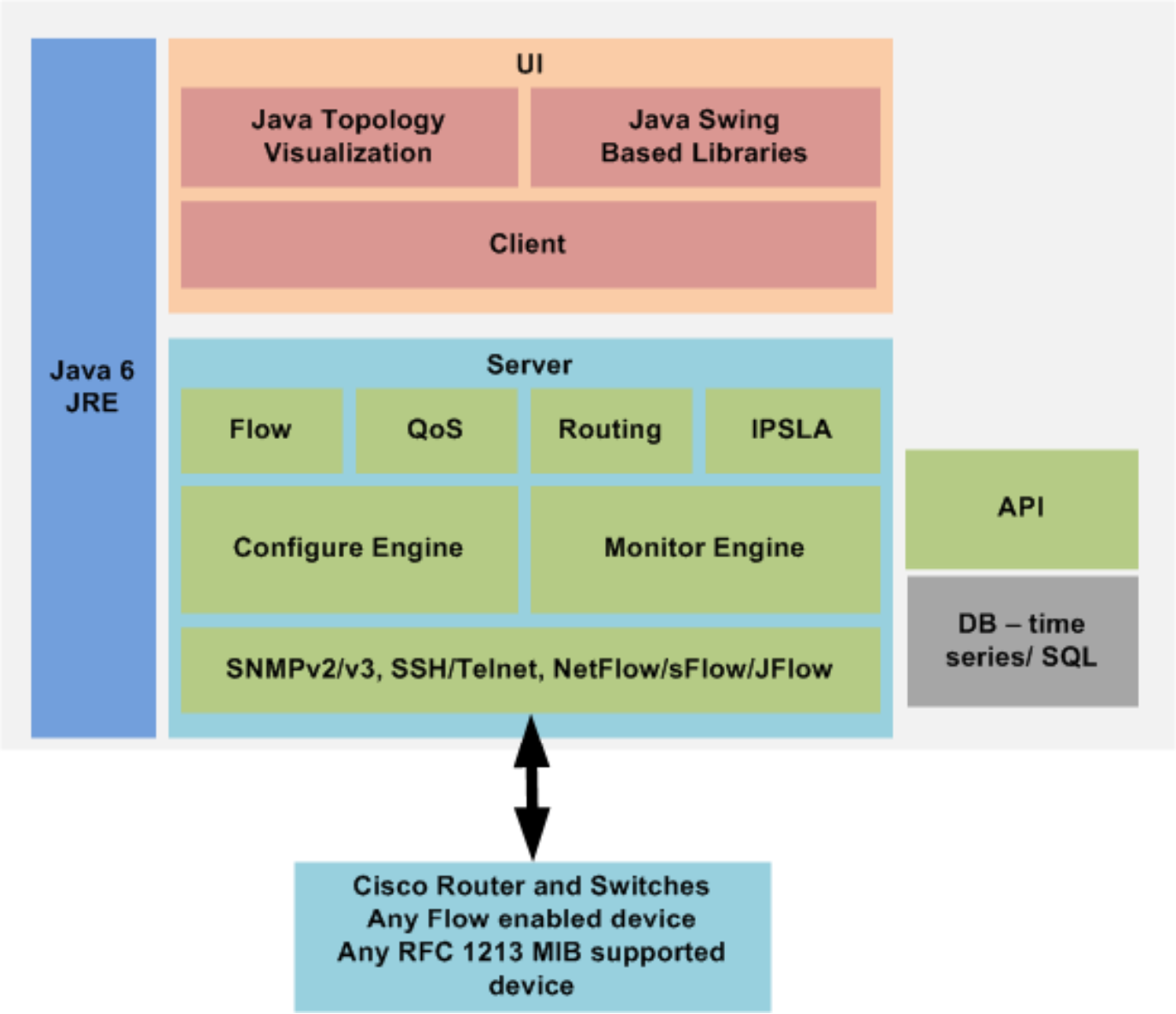


- Very detailed model of network devices and protocols
- Vendor neutral
- Currently we use
  - A simpler subset of CIM
  - Performance and flow data added

Tool Design


Java 6
JRE
UI
Java Topology
Visualization
Java Swing
Based Libraries
Client
Server
Flow
QoS
Routing
IPSLA
Configure Engine
Monitor Engine
SNMPv2/v3, SSH/Telnet, NetFlow/sFlow/JFlow
API
DB – time
series/ SQL
Cisco Router and Switches
Any Flow enabled device
Any RFC 1213 MIB supported
device

Topology Based Flow Visualization

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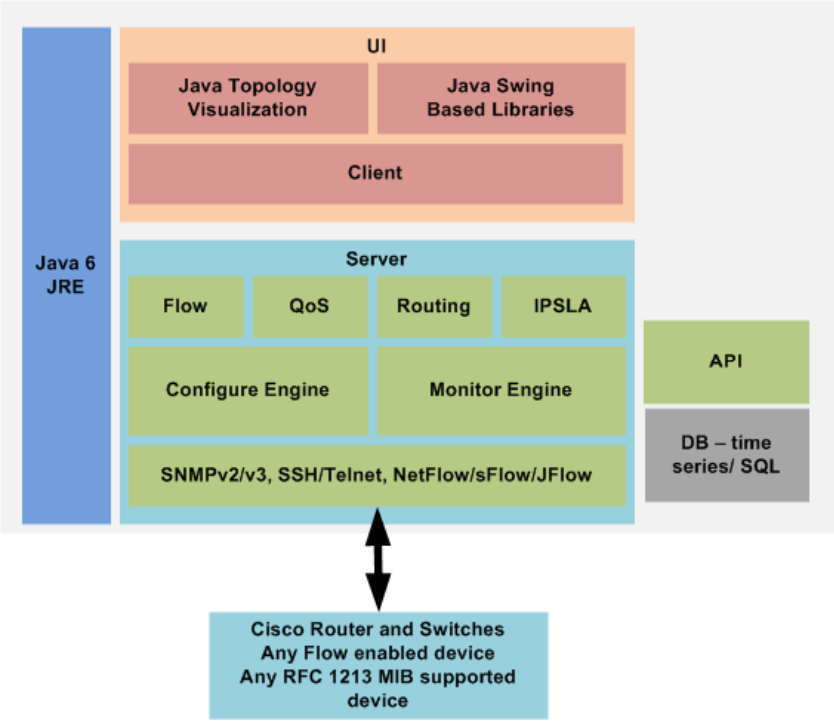
- **Flow Collector**
  - Not generator like Argus or YAF
  - Time series storage
  - Netflow v5-v9, sFlow, Jflow
  - Cisco Flexible Netflow setup



- **Flow Visualization**
  - Topology from real networks
    - Discovery
    - Model creation from config
    - Node and edge displays
  - Flow Projection
    - “Real Time” – as real time as NetFlow can be
    - Projection of flows onto topology

What is it for ?

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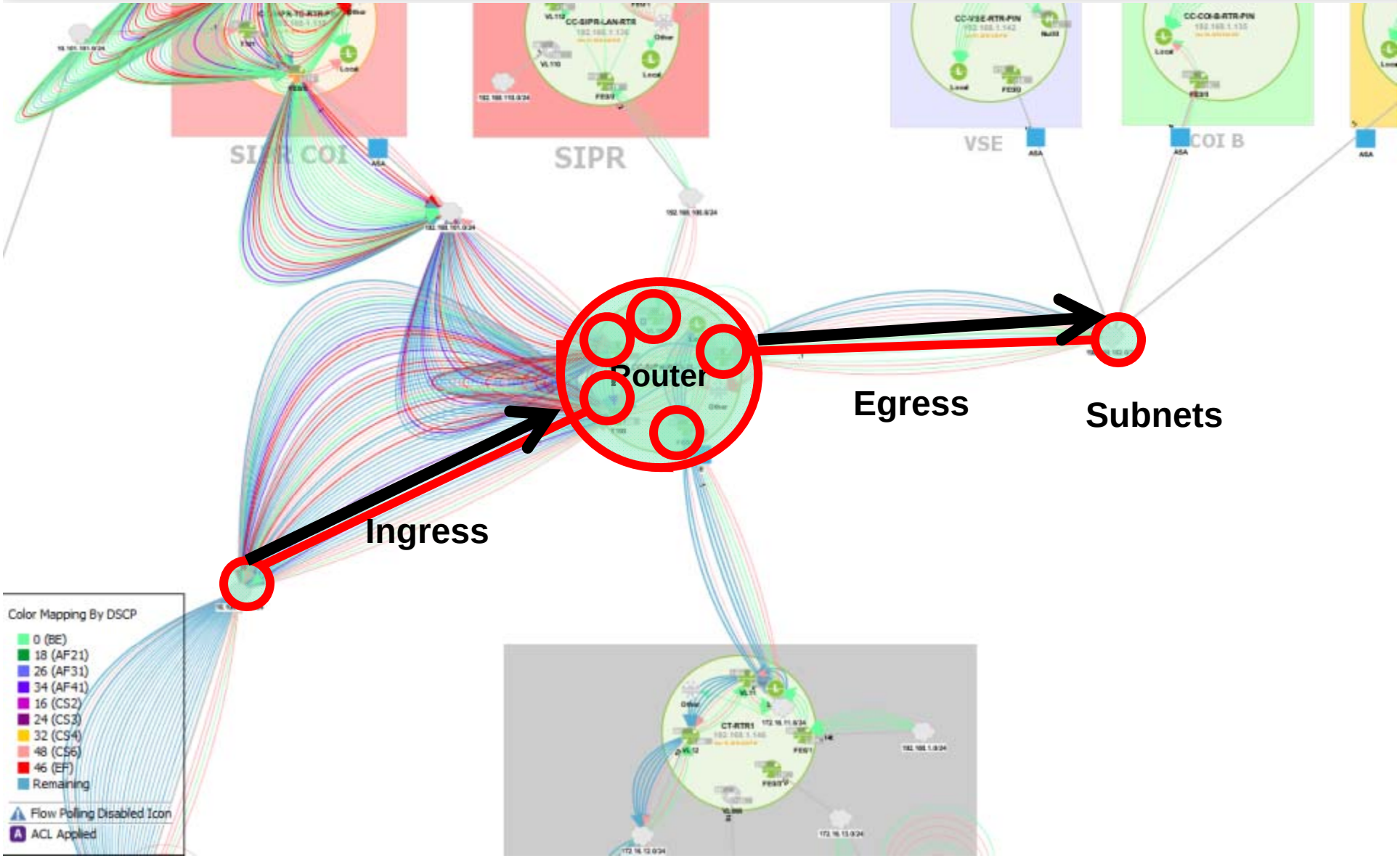
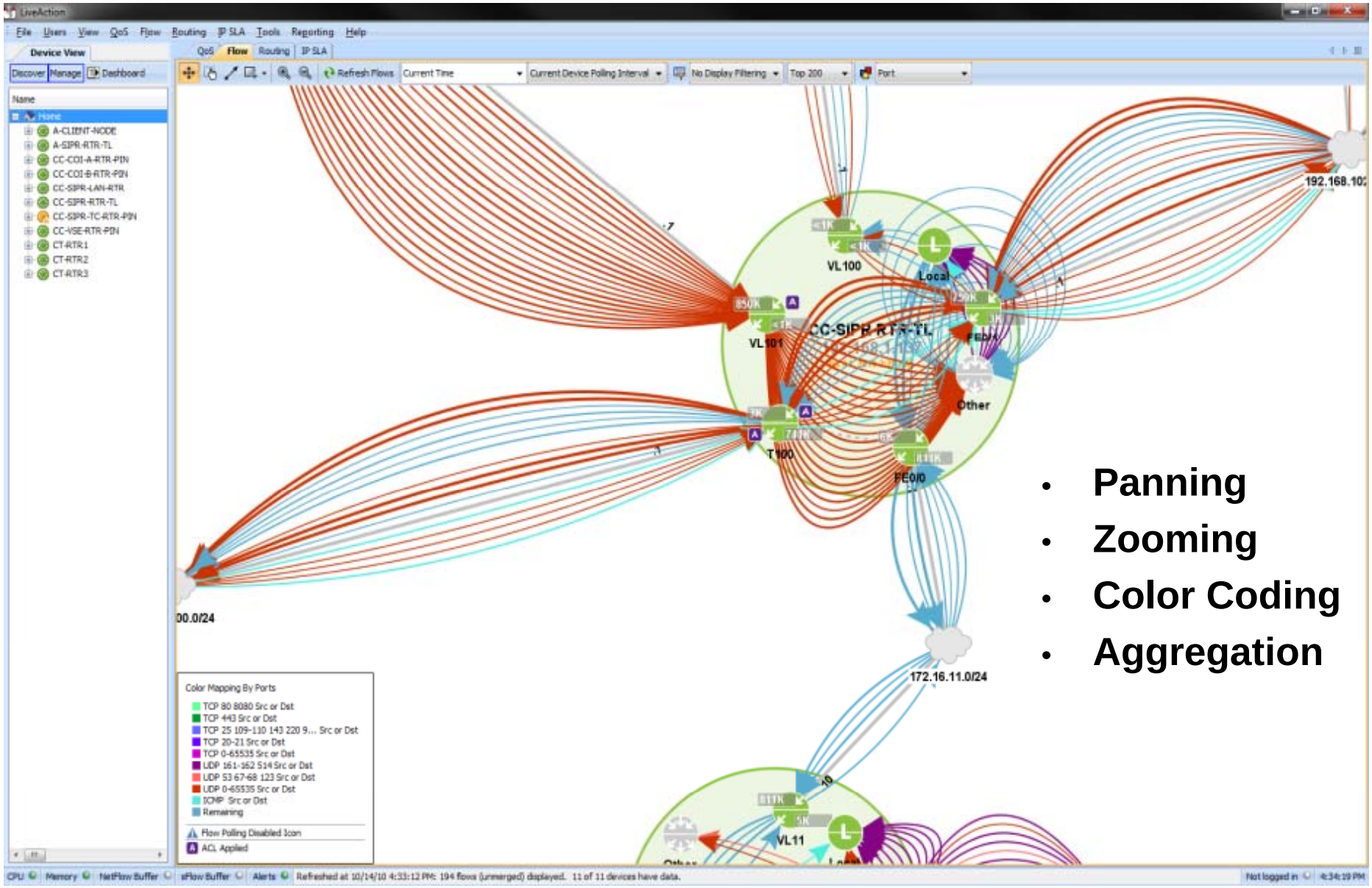
- **Network Management**
  - Its really hard to know what's going on in a router
  - Let alone across routers in a network
  - Where problem locations are, where to fix
- **Network SA**
  - Knowing how flows are routed
  - Knowing direction, load sharing
  - Flow – Routing – QoS – SLA
- **CND**
  - **Doesn't solve finding needle in haystack problem**
  - **Doesn't do pattern analysis**
  - Can be used with sensors to alert and monitor events
  - Response planning and actions
  - Compliments forensic analysis

Flow System View



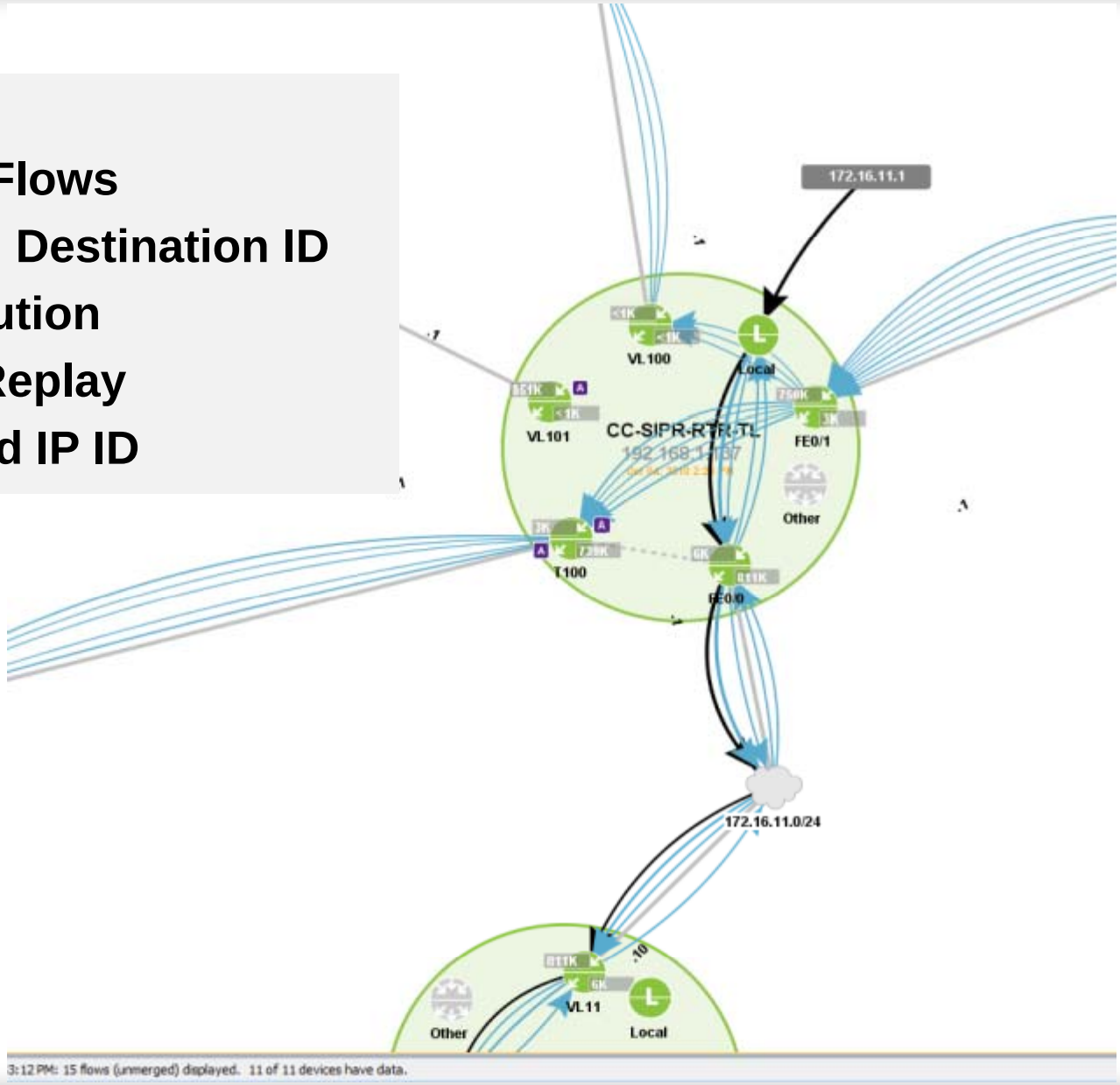
Flow System View



- **Panning**
- **Zooming**
- **Color Coding**
- **Aggregation**

Flow System View

- **Filtering**
- **Tracing of Flows**
- **Source and Destination ID**
- **DNS Resolution**
- **Historical Replay**
- **Black Listed IP ID**



Device Topology View

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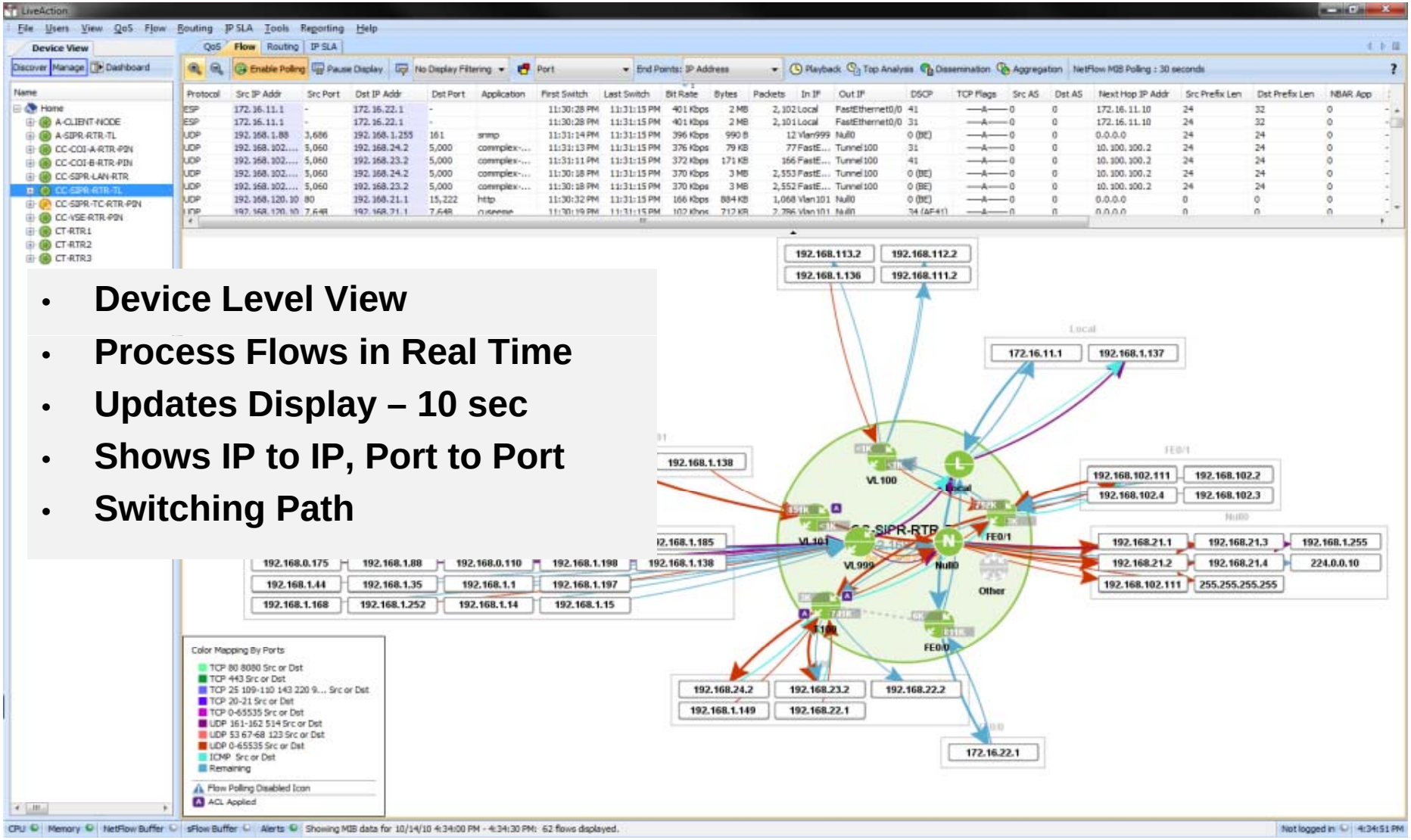
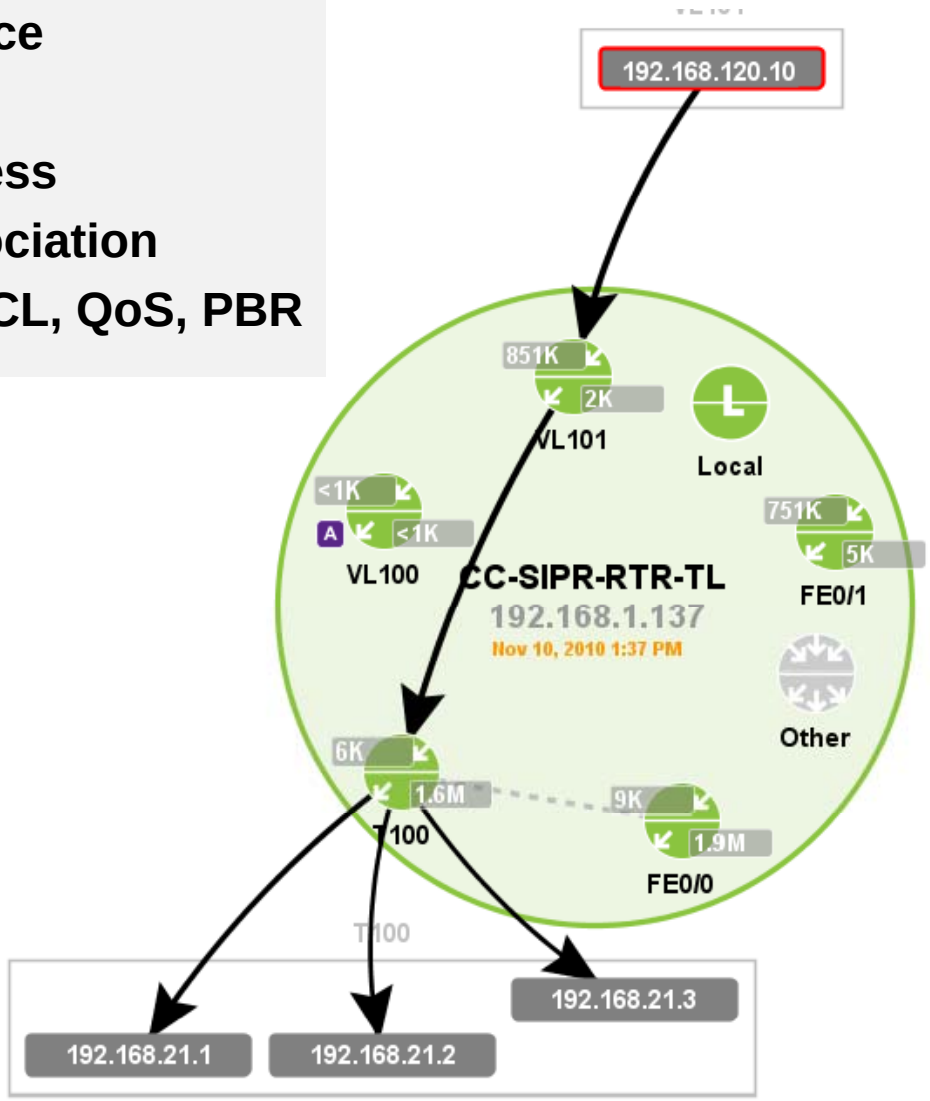


- **Device Level View**
- **Process Flows in Real Time**
- **Updates Display – 10 sec**
- **Shows IP to IP, Port to Port**
- **Switching Path**

Individual Flow

- Isolation down to particular source
- Aggregation along shared path
- Highlighting of black listed address
- Tunnel to physical interface association
- Indicators for policies such as ACL, QoS, PBR



Device Topology View

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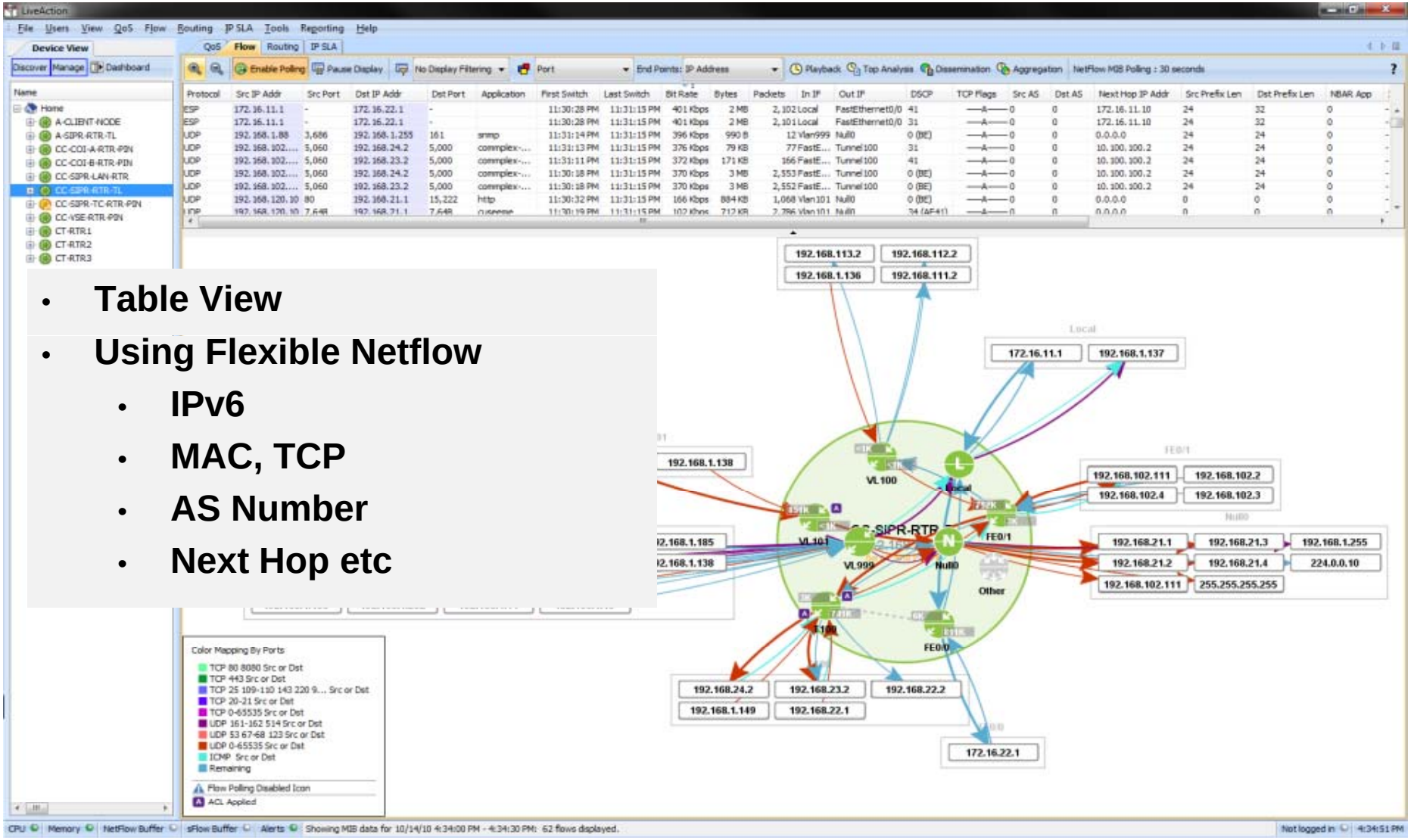

Display Updates and NetFlow Behavior

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- **Static display easier, real time* is harder**
- **How long to leave flows displayed**
  - Process flow records as they come in
  - Update/Refresh rate of the display – 10 sec
  - Aging of the flows out of the display
  - Router – active/inactive timer settings

Active Timer 1 min
Inactive Timer 10 sec

Poll	Aging	Time																													
10 sec	2 min	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
40 sec flow		real flow				X																									
							aging																								
2 min flow		real flow						X						X																	
									aging						aging																
4 min flow		real flow						X						X						X						X					
								X	aging					X	aging					X	aging					X	aging				

Flow Display and Processing Issues

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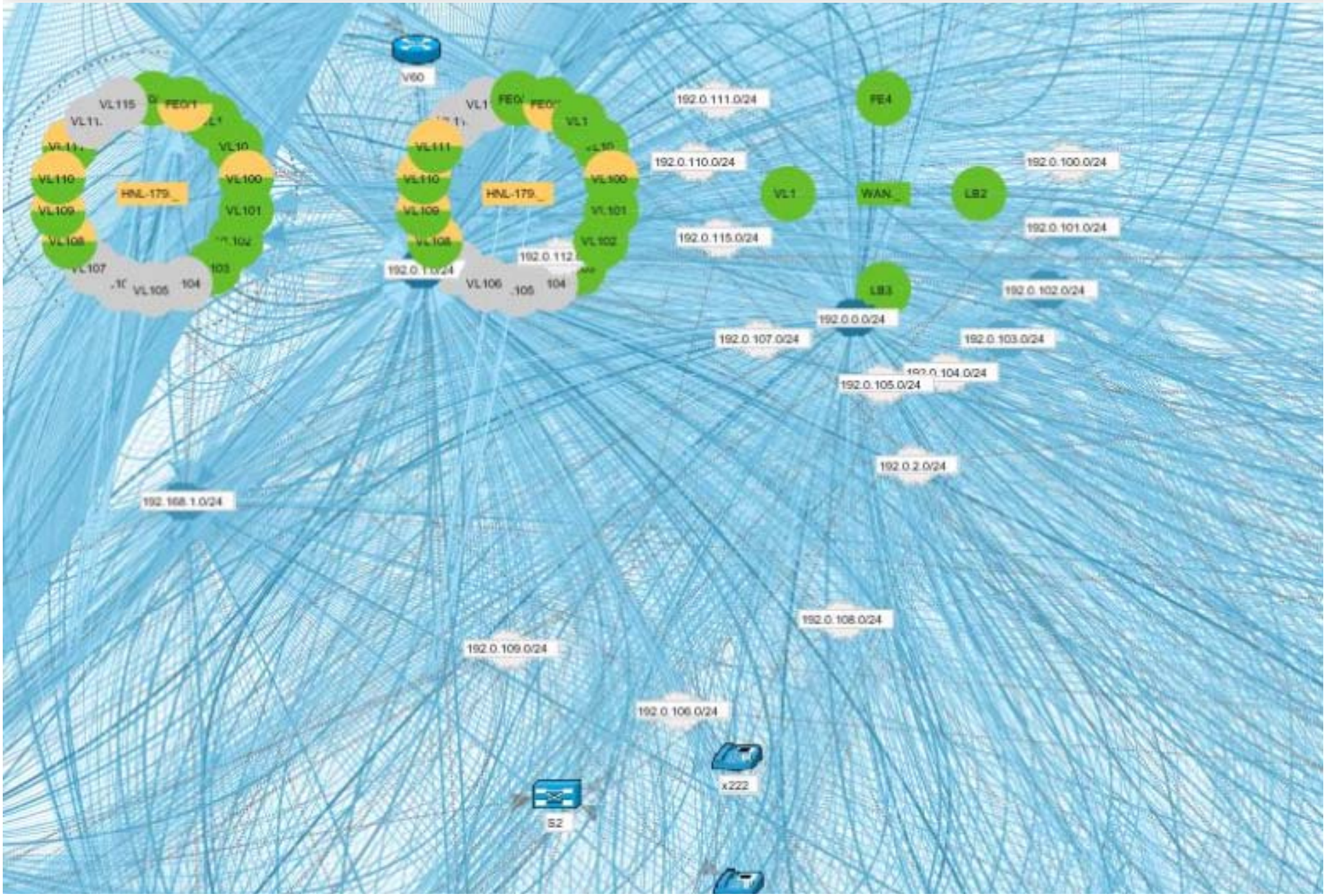

Flow Display and Processing Issues

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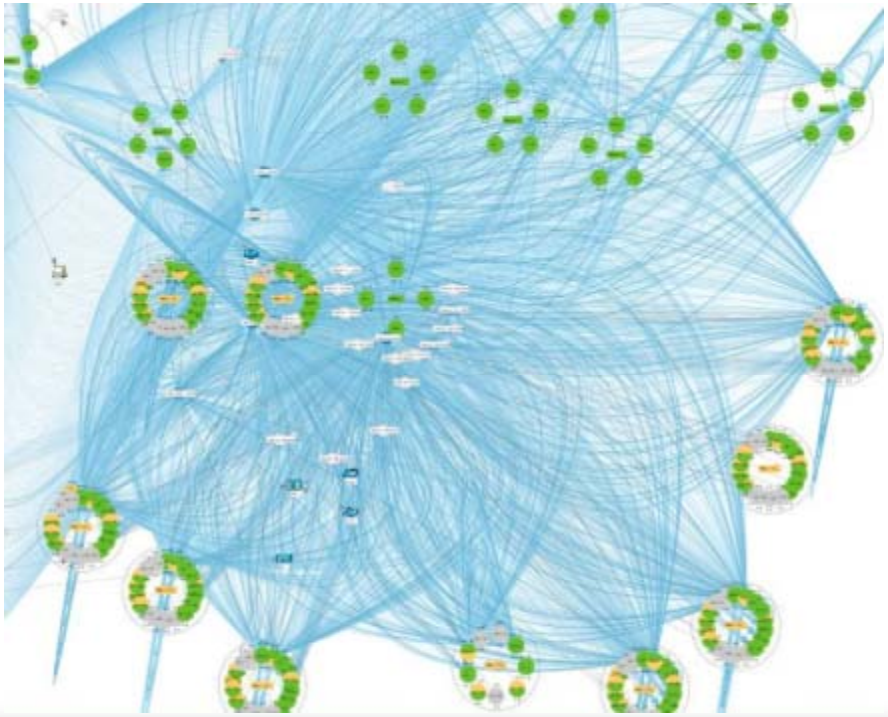
- Issues
  - Shear number of flows
  - Efficient storage and retrieval for display
  - Temporal aspect of flows
  - Display layer performance
- Top N or Bottom N Flows
  - Reduce amount of displayed items
  - Aggregation of same flow records
- Merging
  - Merge flows based on attributes
  - DSCP, IP address, Rate, Bytes
  - Match based
- Filtering
  - Basic - src/dst ip, port, dscp etc
  - Advanced – BGP AS, next hop, ..



NetFlow Specific Issues

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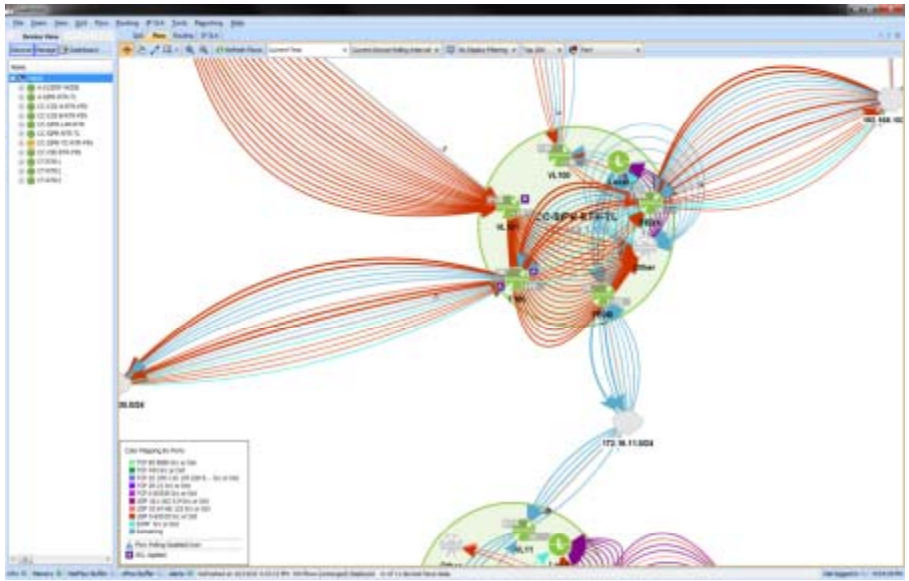
- **Flow Data**
  - Router sourced or consumed flows
  - Index to interface number mapping, Null/Local
  - Not always correct, MIB issues
- **Differences**
  - ASA vs Router vs Switch
  - Intra VLAN, Layer 3
  - NetFlow and sFlow
  - SNMP based flow
- **Time Related**
  - Flow time outs – active/inactive
  - Flow time stamps
- **NetFlow configuration**
  - Flexible NetFlow



Visualization - Scanning

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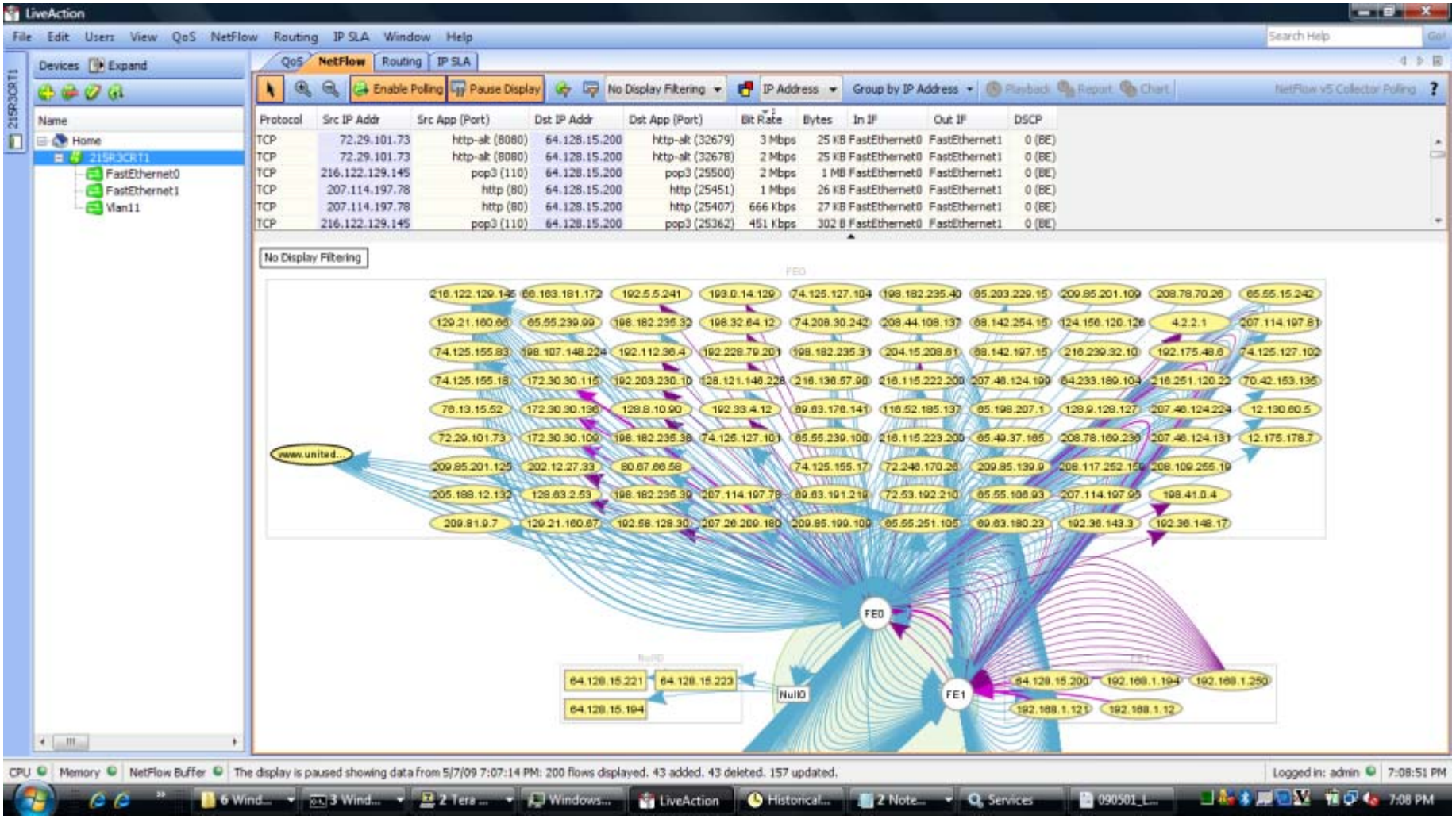

Visualization - VoIP Call Tracing

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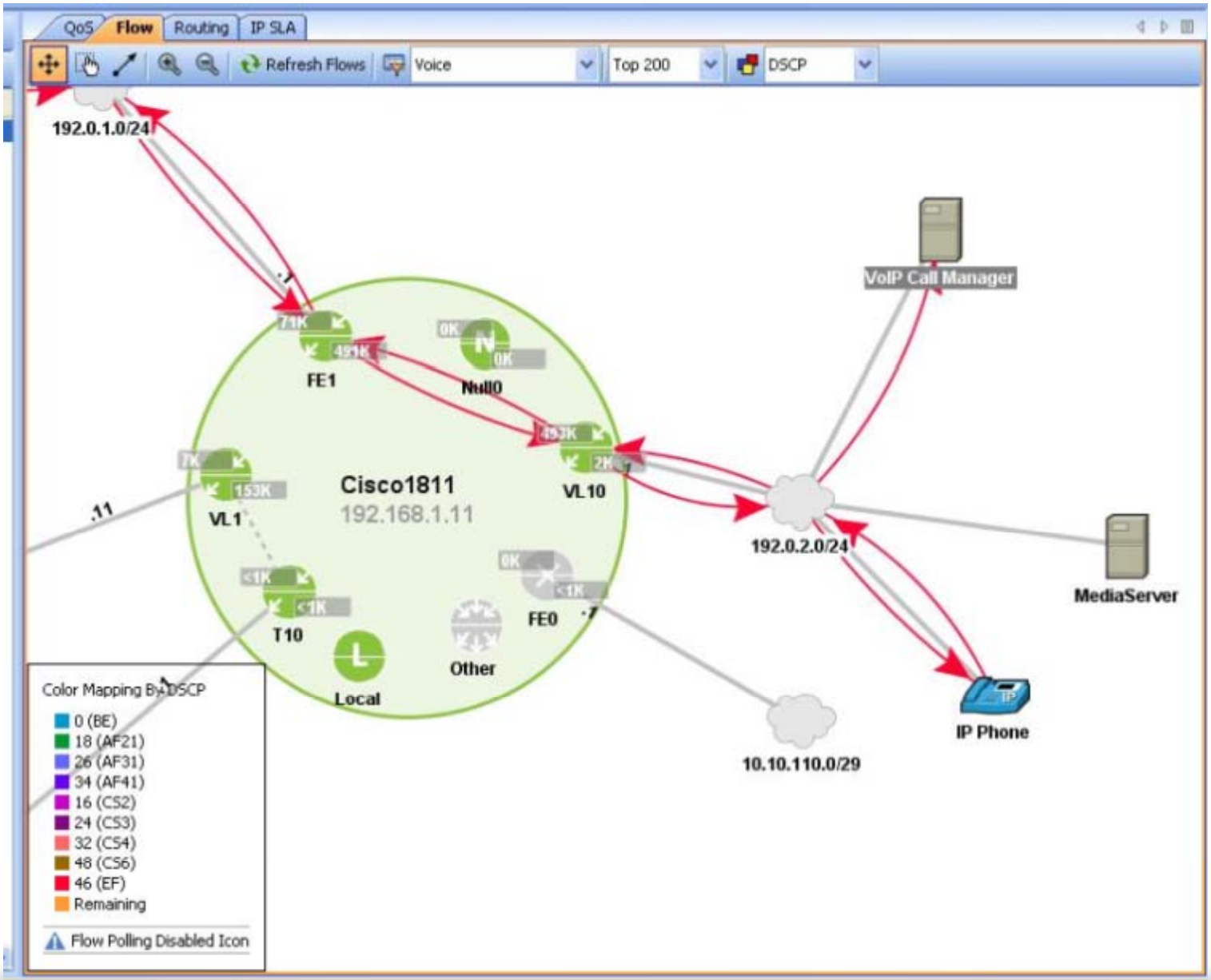

Visualization - Multicast Traffic

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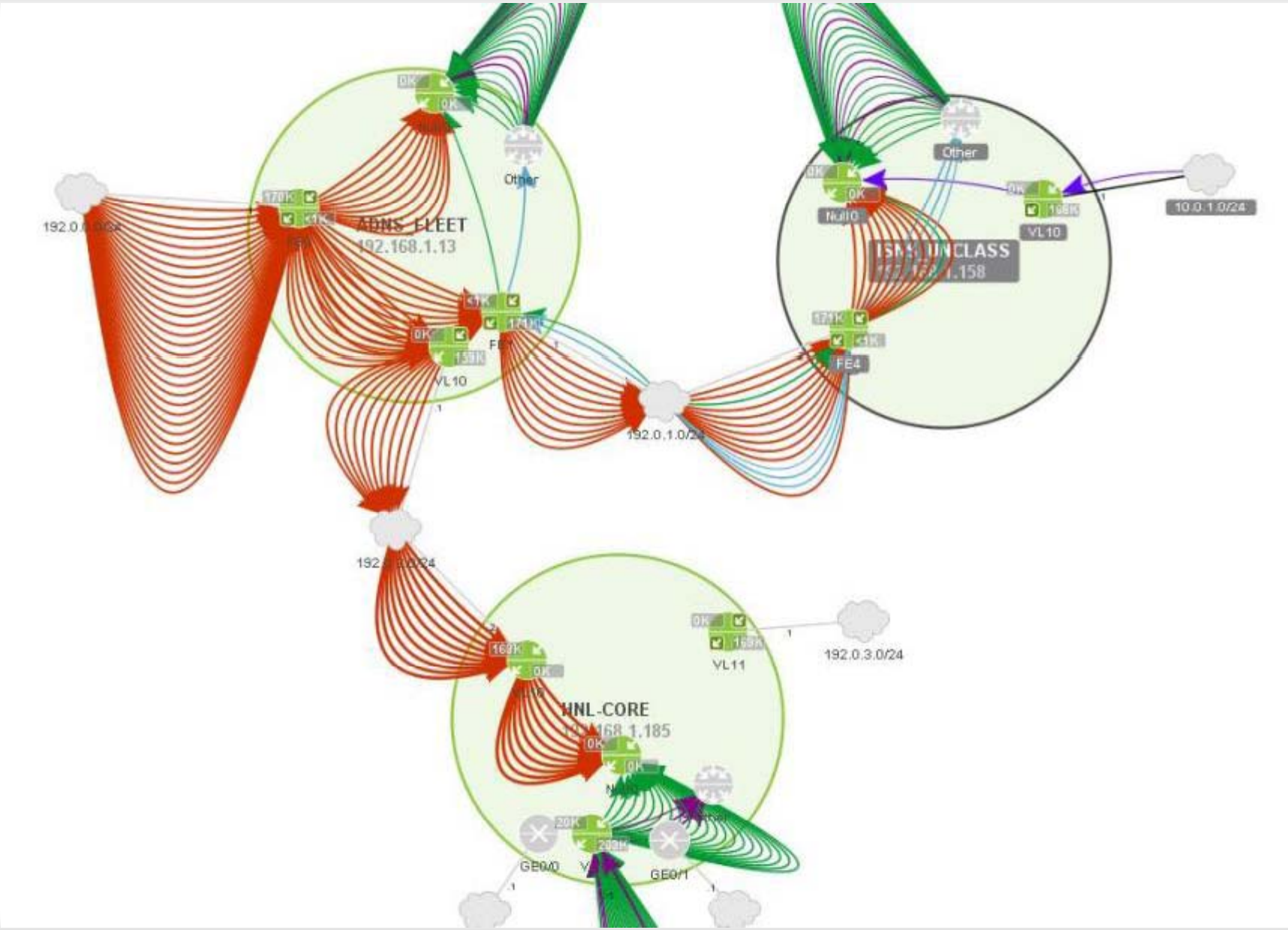
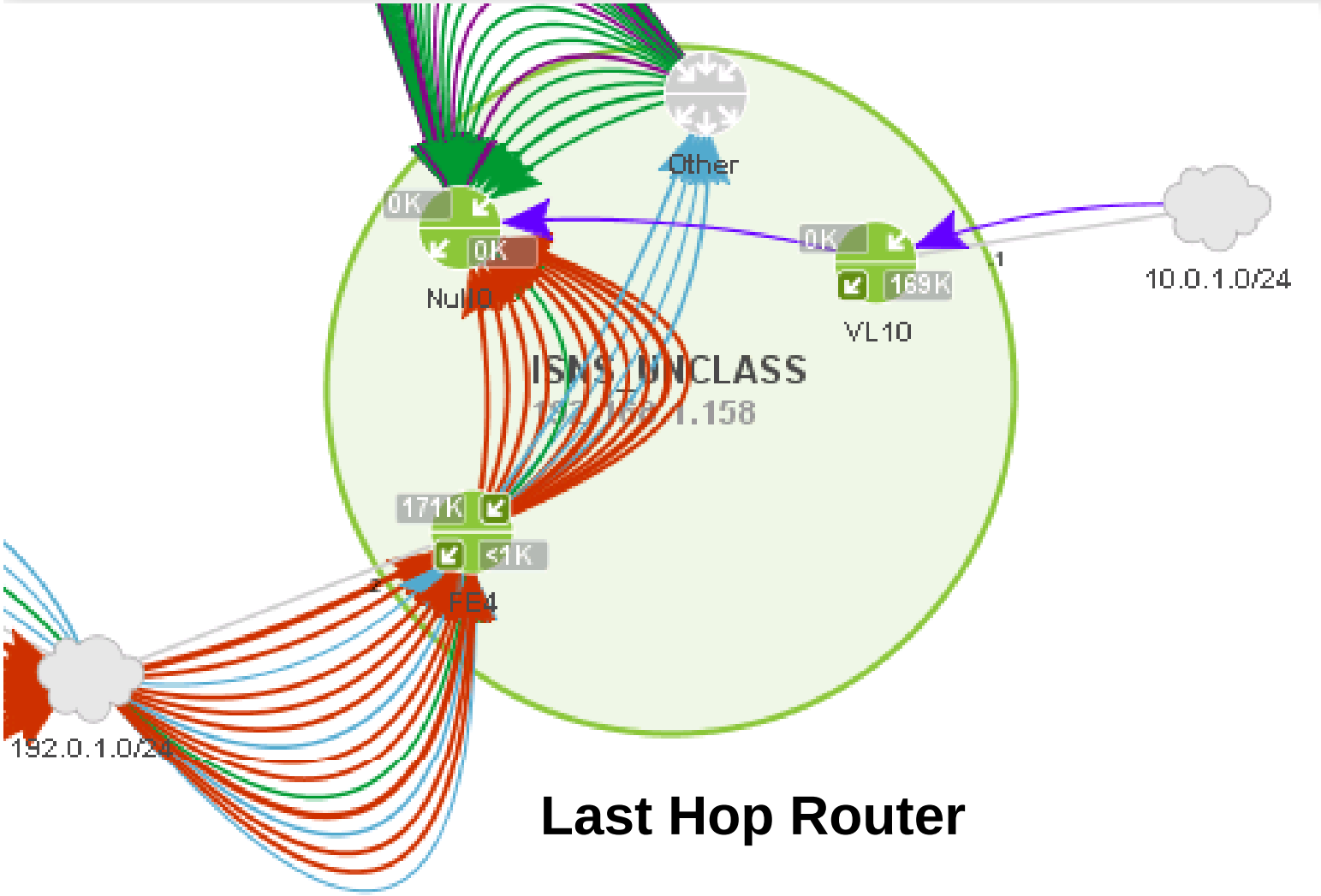


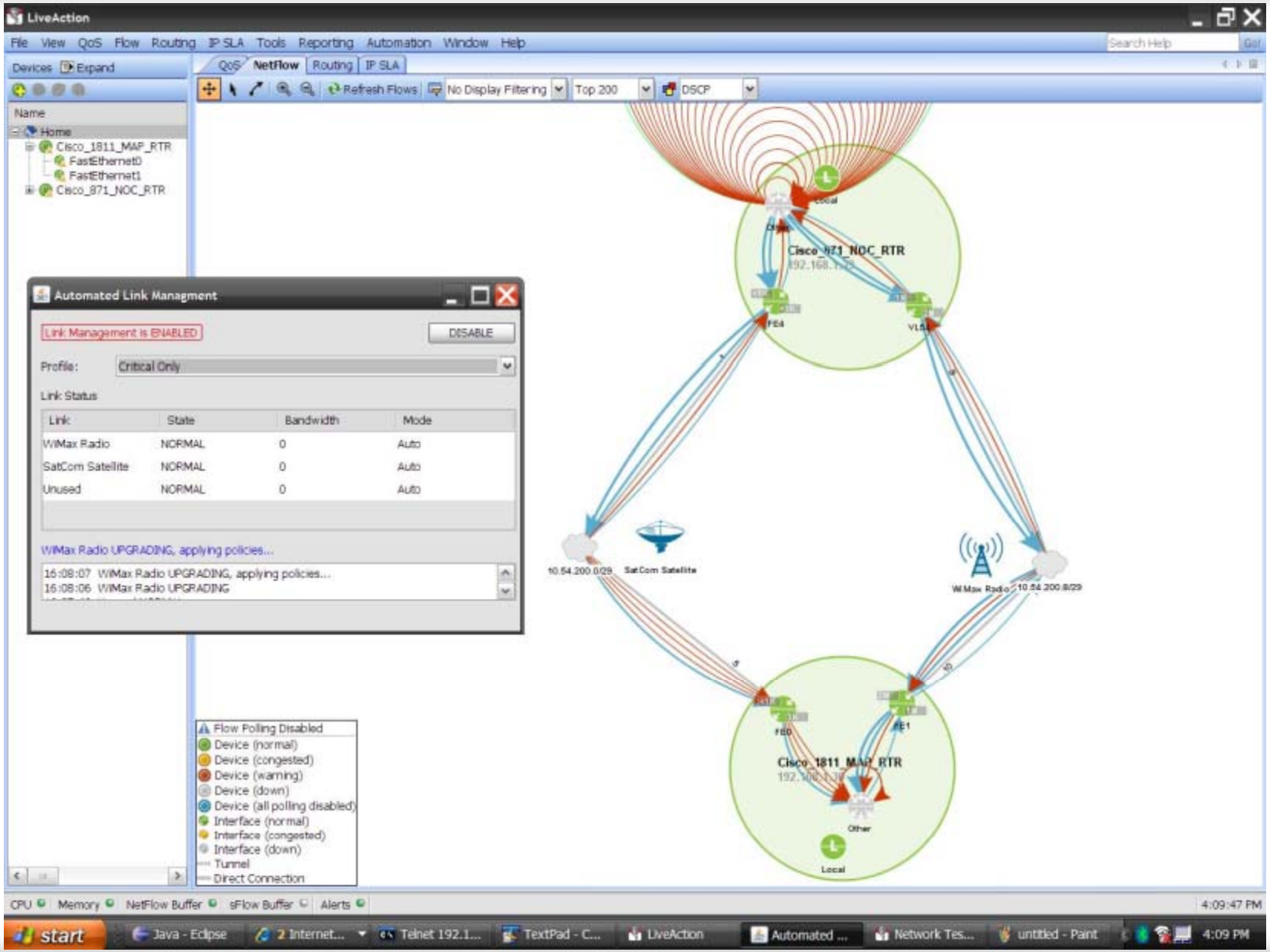
Visualization - Multicast Traffic



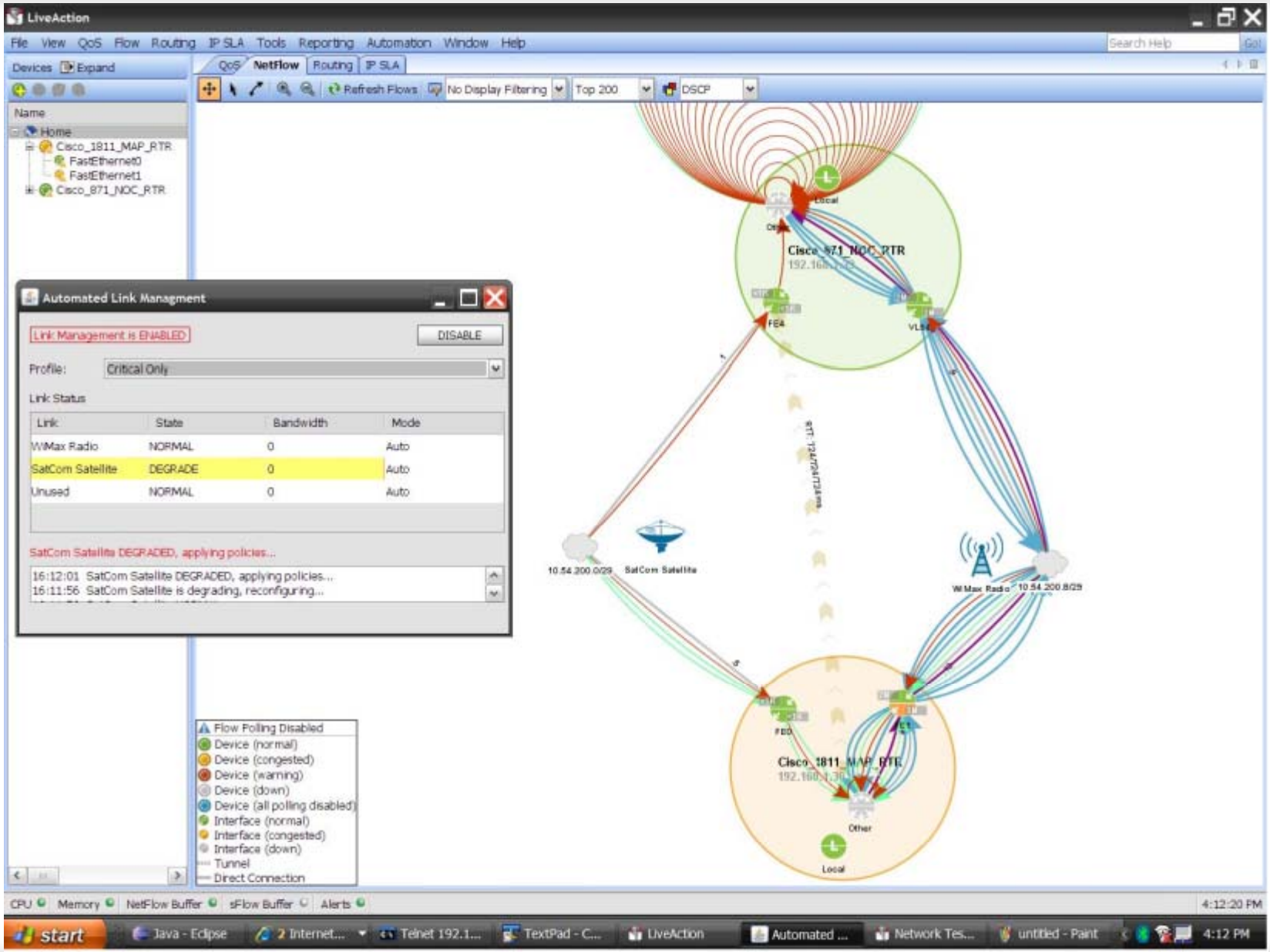
Last Hop Router

- **Egress flows not showing**
- **Traffic shown as going to Null but really router CPU**

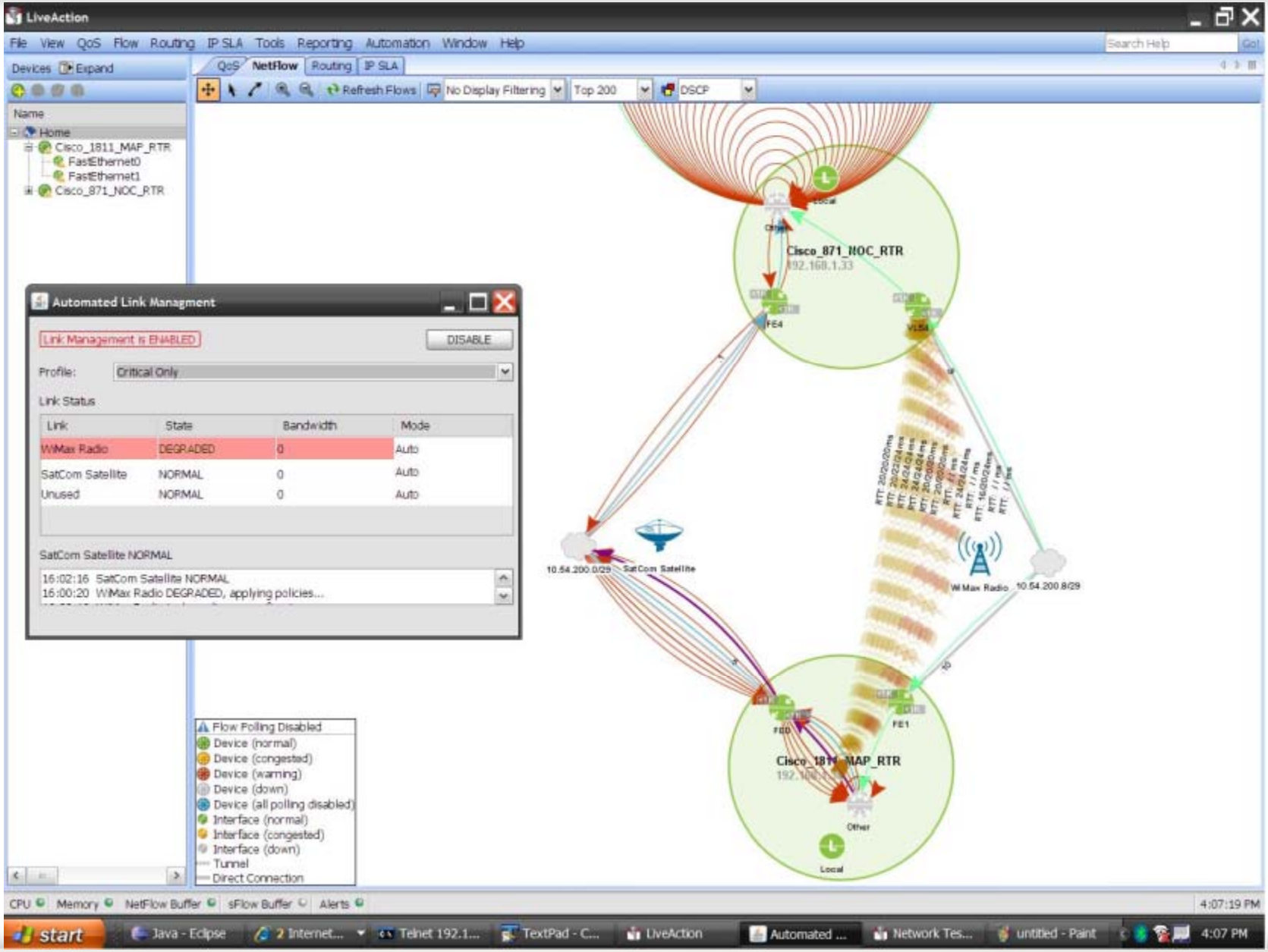
Visualization - Load Sharing



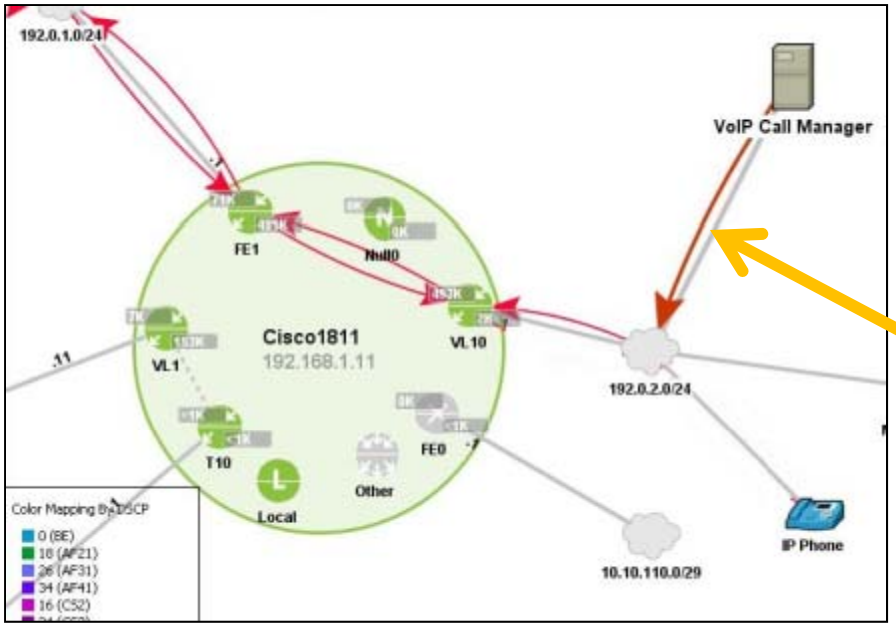
Visualization - Load Sharing



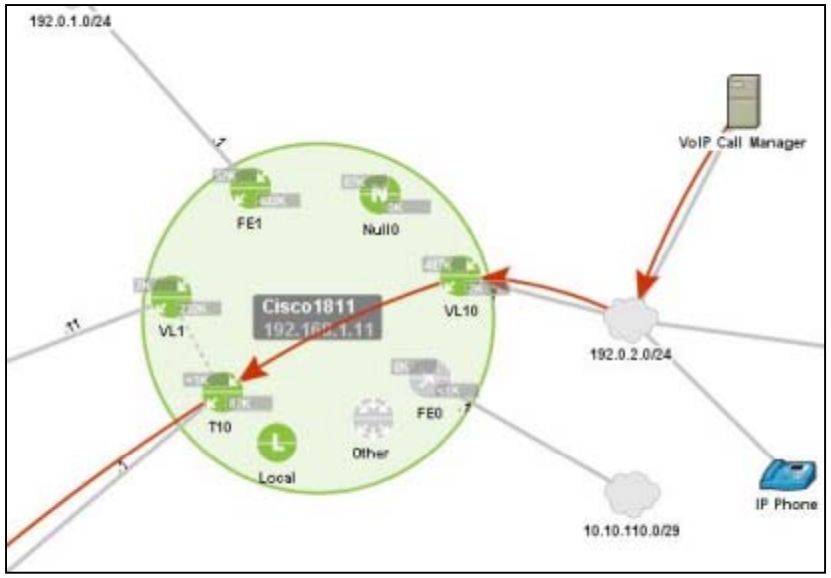
Visualization - Load Sharing



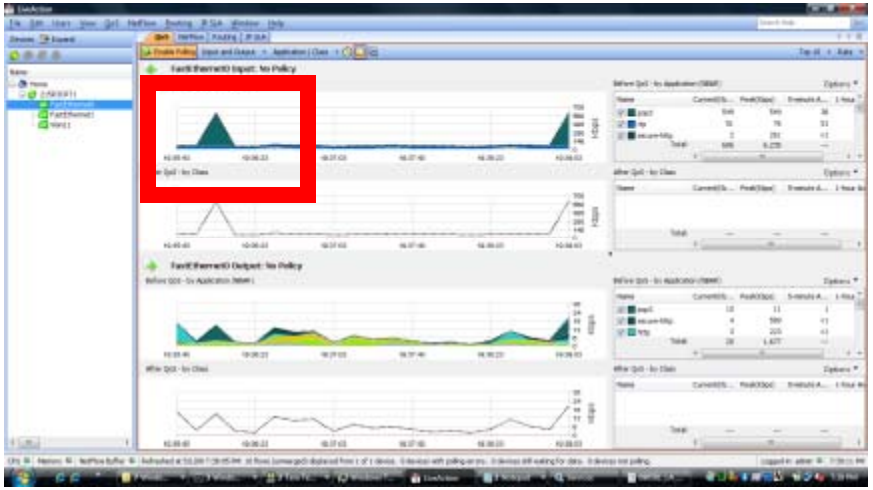
Interactions with Flows

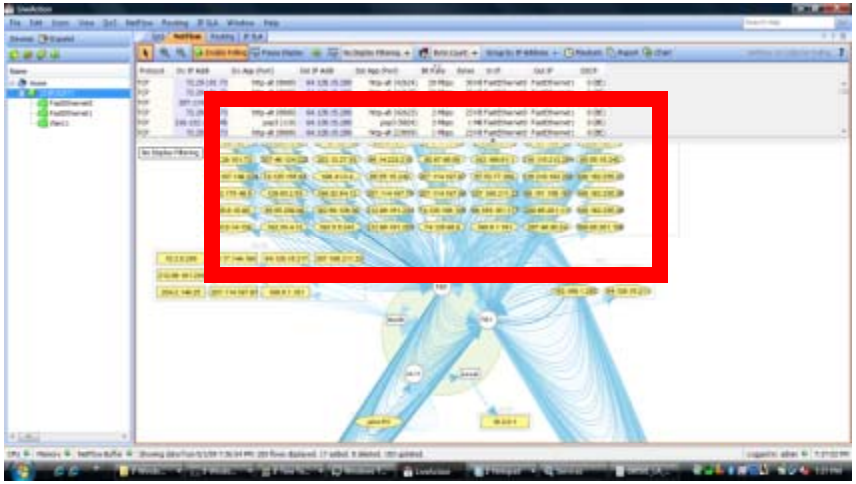


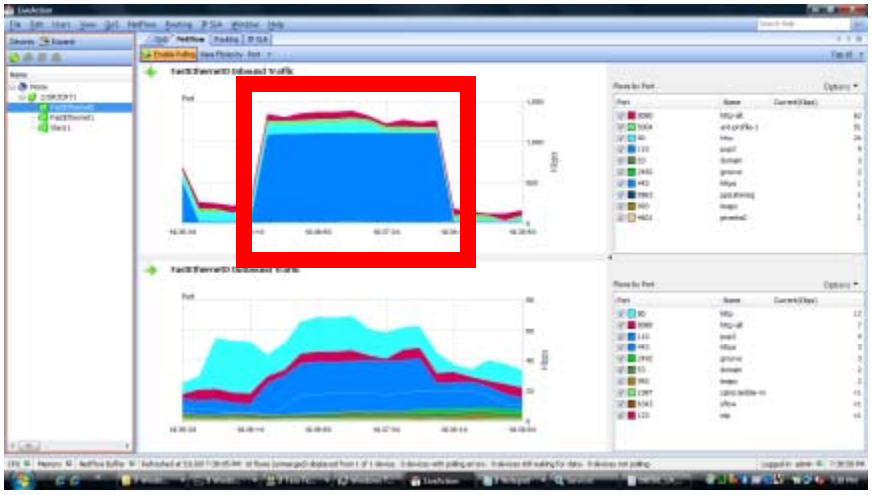
1) Identify flow visually
2) Create ACL
3) ACL for PBR



Correlating Flow with & QoS and Flow Based Graphs







Investigating Inbound Traffic Spike

- **FA0 interface showed spike in flows**
- **Inbound flow graphed**
- **Correlated to QoS statistics graph**

Flow with other Network Visualization

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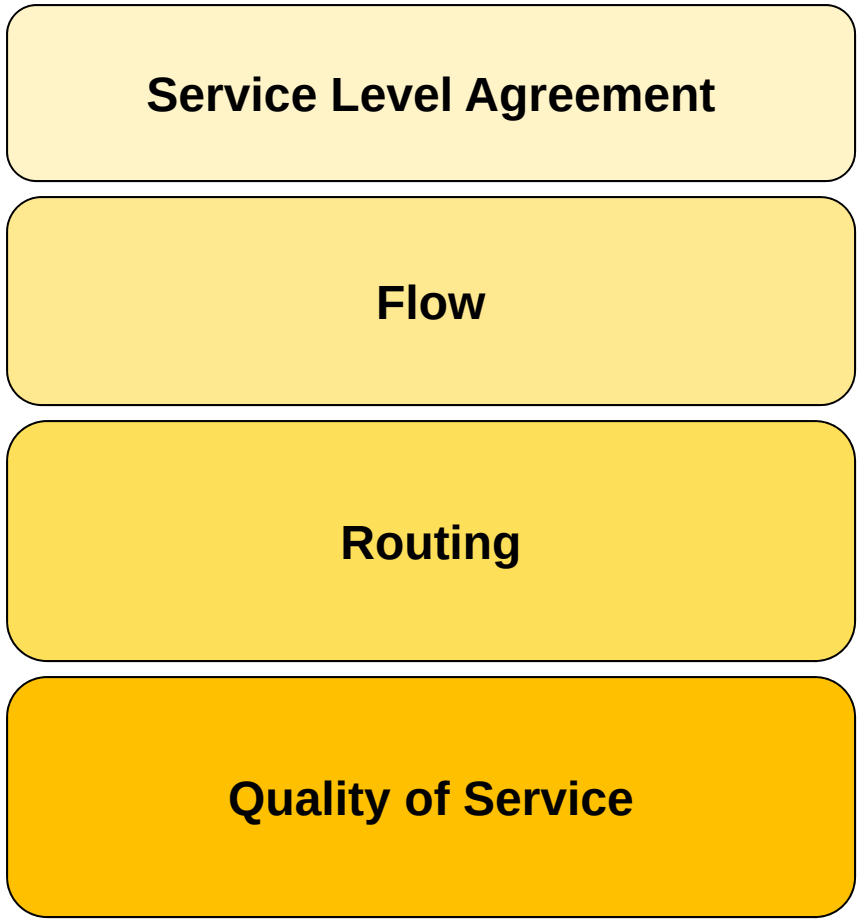
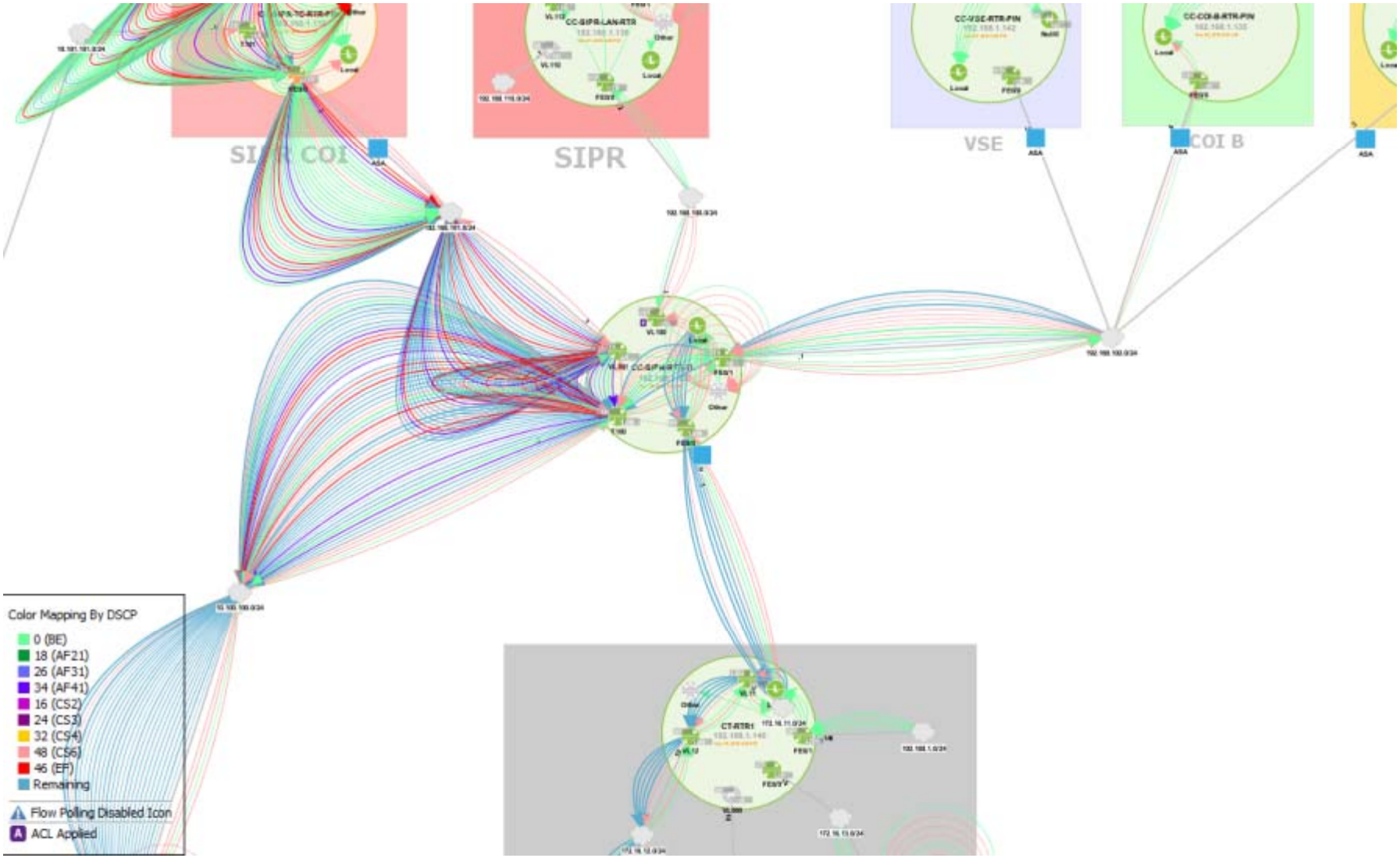
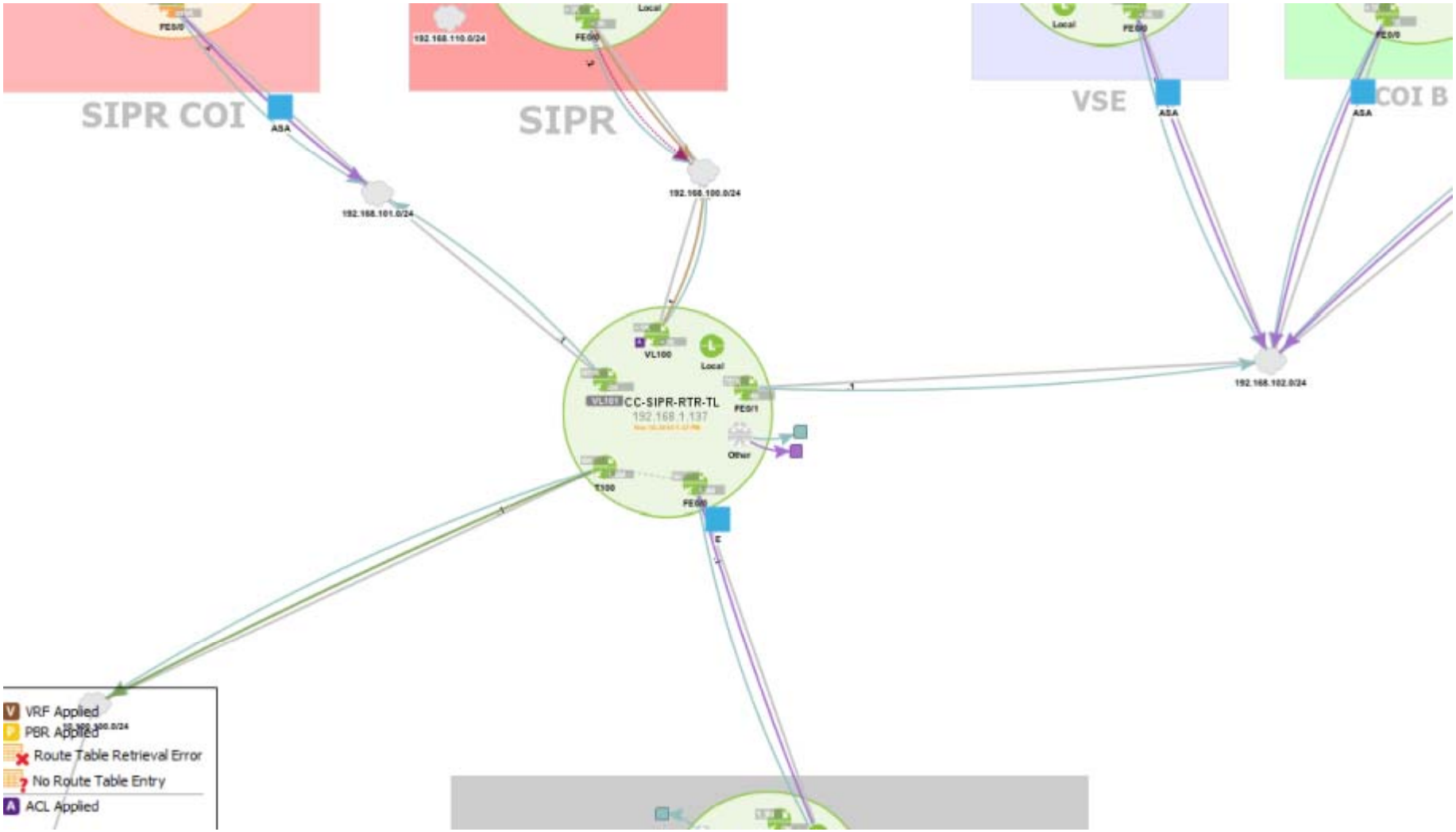


Flow Layer Visualization



Routing Layer VIsualization



Quality of Service and Ping Visualization

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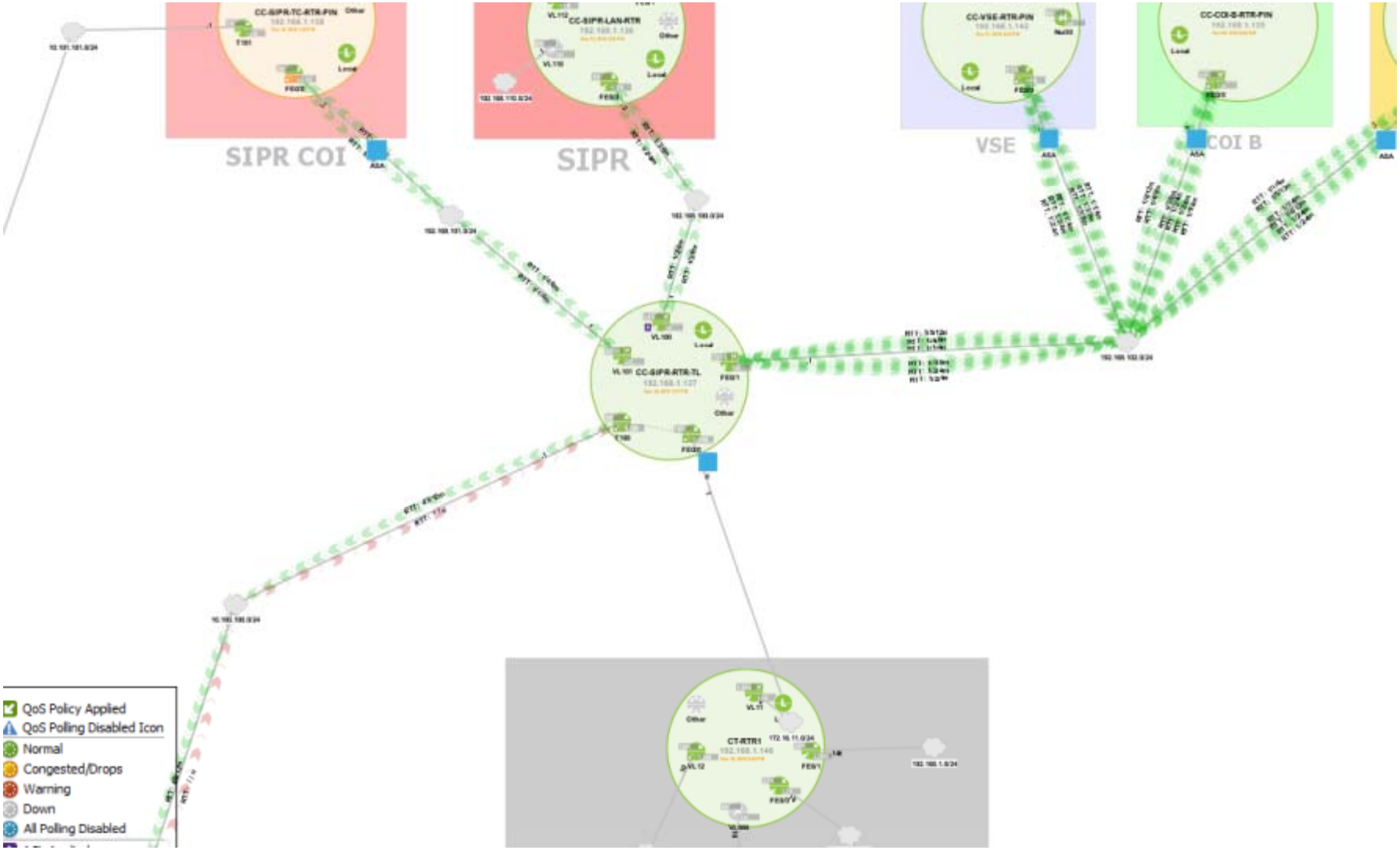
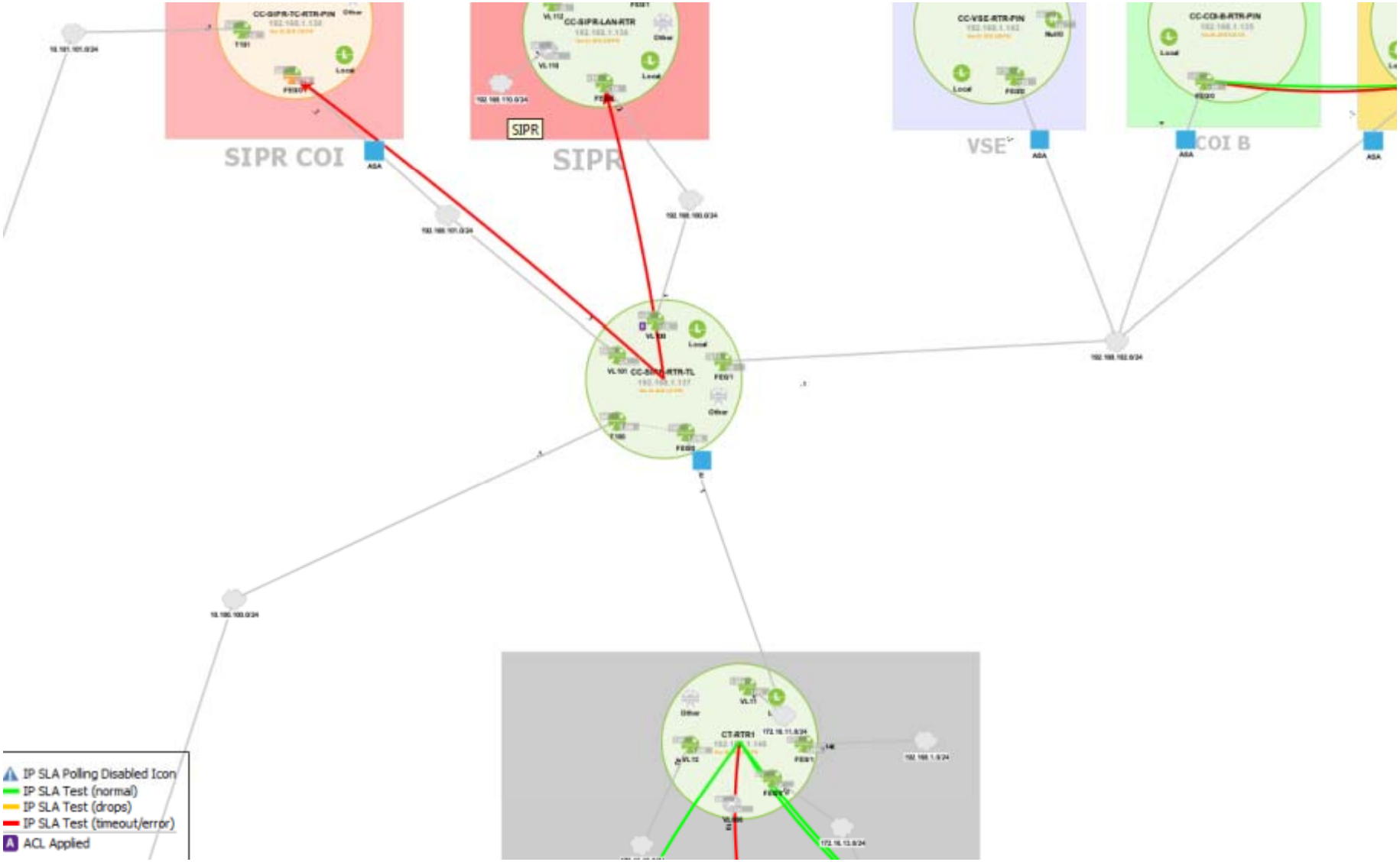


Service Level Agreement Visualization



Flow with other Network Visualization

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Service Level Agreement

Latency, Jitter, Loss, MOS

Flow

Actual Path, Load Sharing

Routing

Route Path, Asymmetric, Summarization

Quality of Service

Priority, BW, Queues, Drops

Usage : Talisman Saber Exercises US Marines

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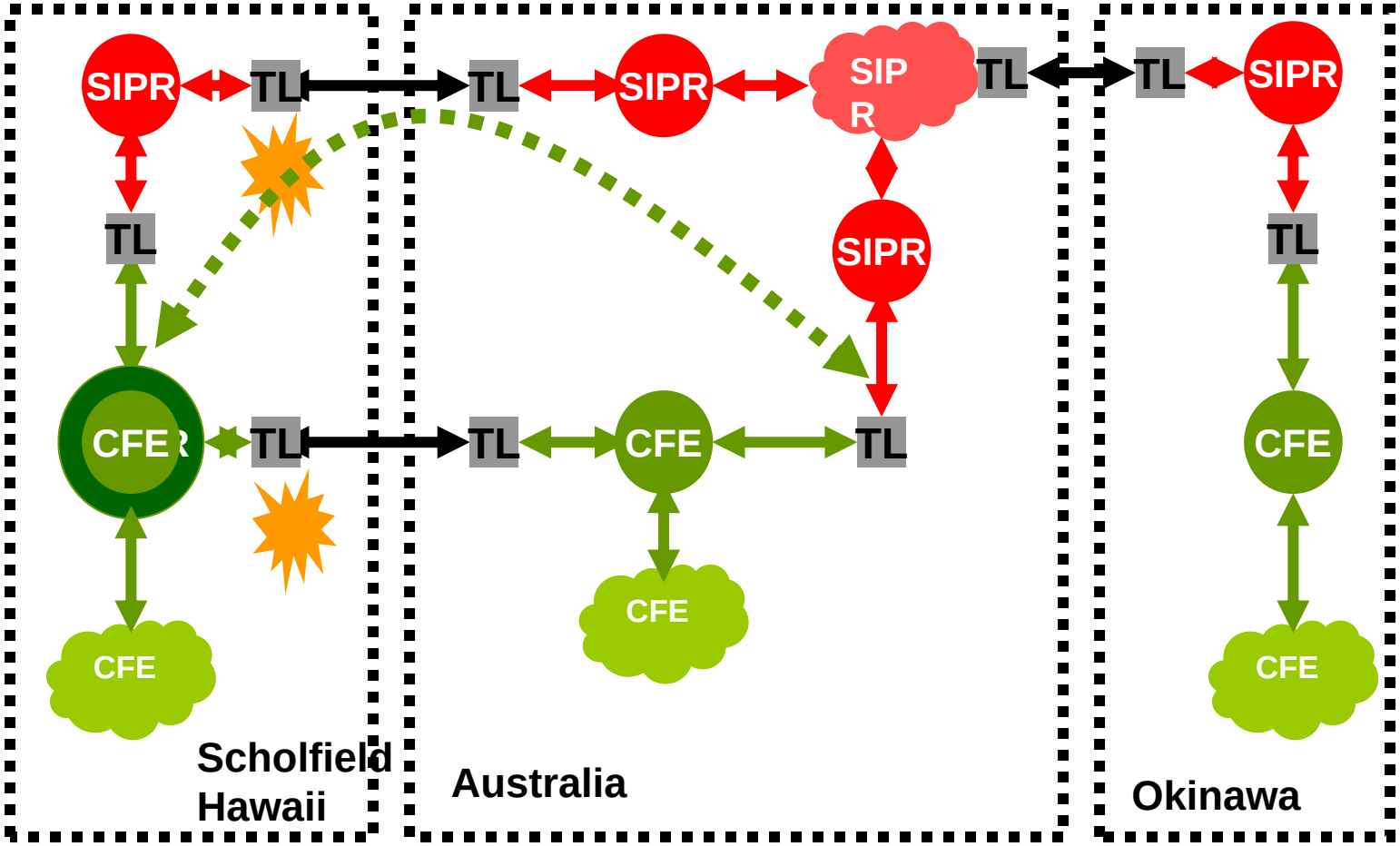
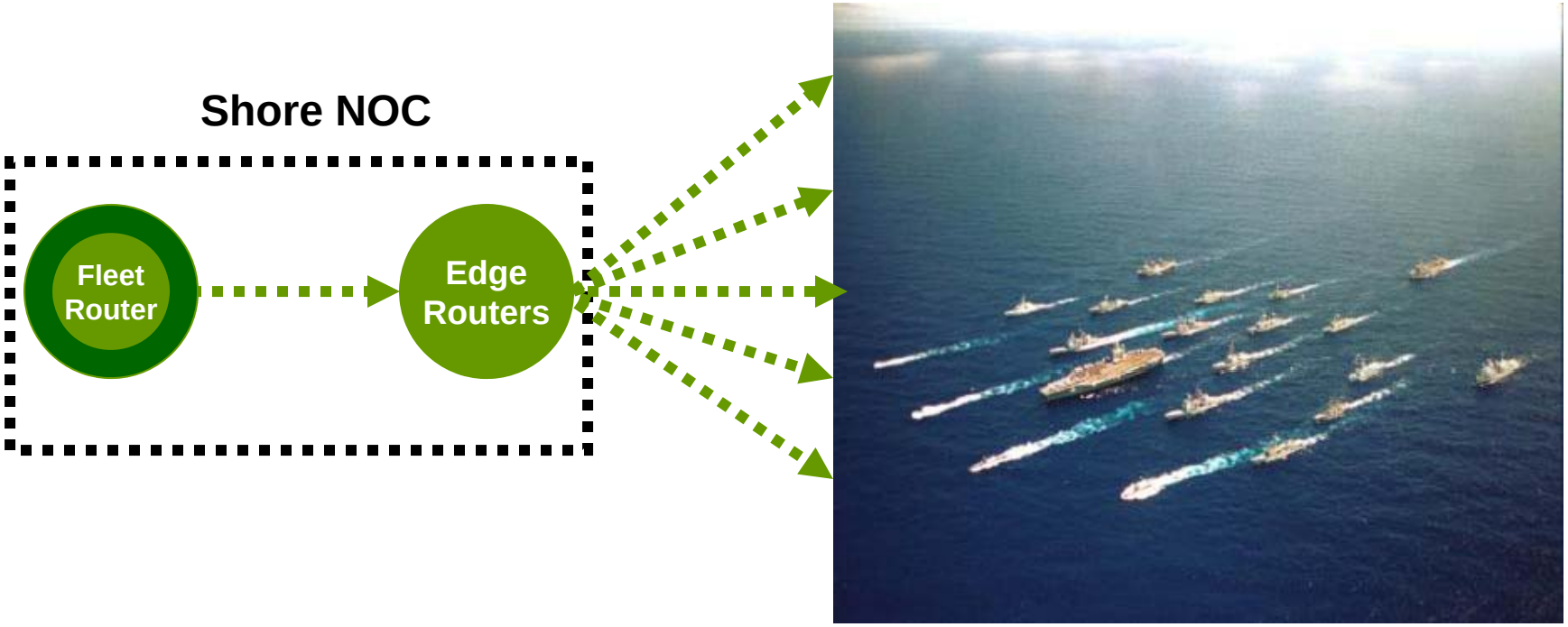


Marines III MEF

Usage: US Navy Exercises



- **Fleet monitoring of operational traffic**
  - **Traffic over satcom**
  - **Voice from ship to shore**
- **CND exercise**
  - **Monitoring red team attacks**
  - **Working with sensors**

Issues and Limitations

- **Not Good At**
  - Showing large quantities of flows
  - Finding needle in hay stack
  - Pattern or algorithm analysis
- **Usage Issues**
  - Access to routers
  - Over WAN usage
  - Flow from multiple routers
  - Bandwidth in monitoring

Summary

- **Future Work**
  - Additional Network SA
  - Distributed Architecture
  - Cisco Flexible Netflow

- **For More Information**
  - jsmith@referentia.com
  - www.actionpacked.com