Network Management in Mobile Networks:

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CSE Mobile Solutions
Service Provider Sales Emerging Markets

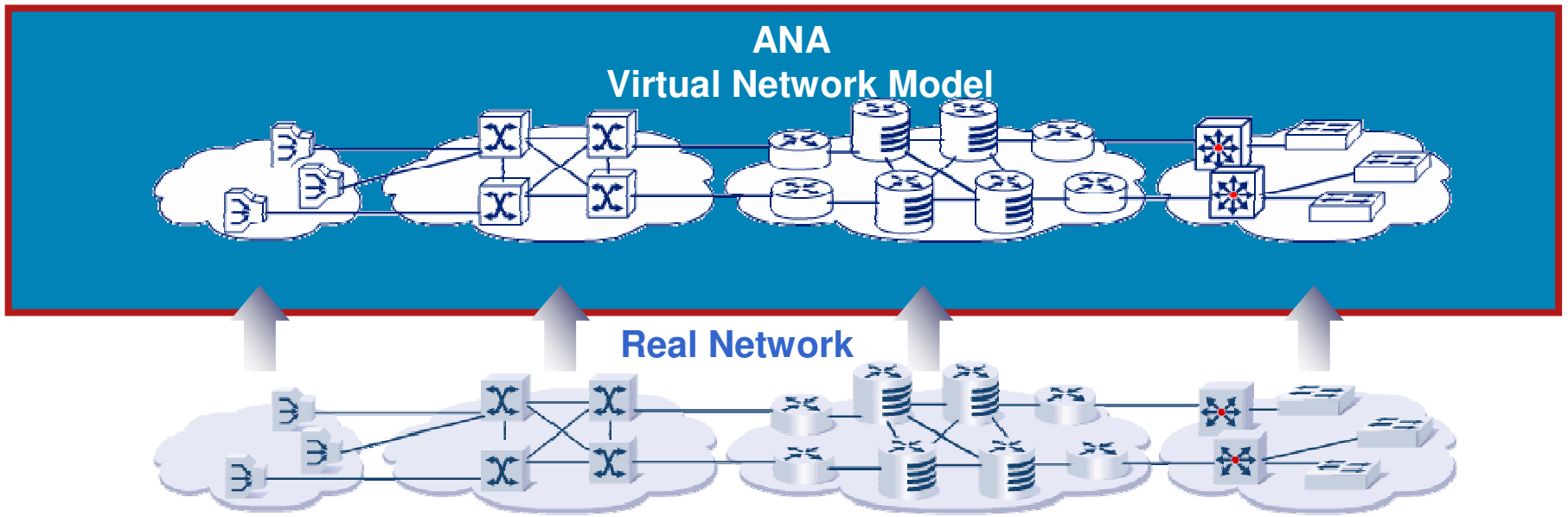
Agenda

- Cisco Active Network Abstraction (ANA) Overview and Update
- ANA 3.x Overview
- ANA 4.0 Overview
- ANA Evolution – Releases & Roadmap
- Cisco IP Solution Center(ISC) Overview And Update
- ISC MPLS VPN Provisioning
- ISC Evolution – Releases & Roadmap
- Cisco Assurance Management Solution (AMS)

Cisco Active Network Abstraction (ANA) Overview and Update

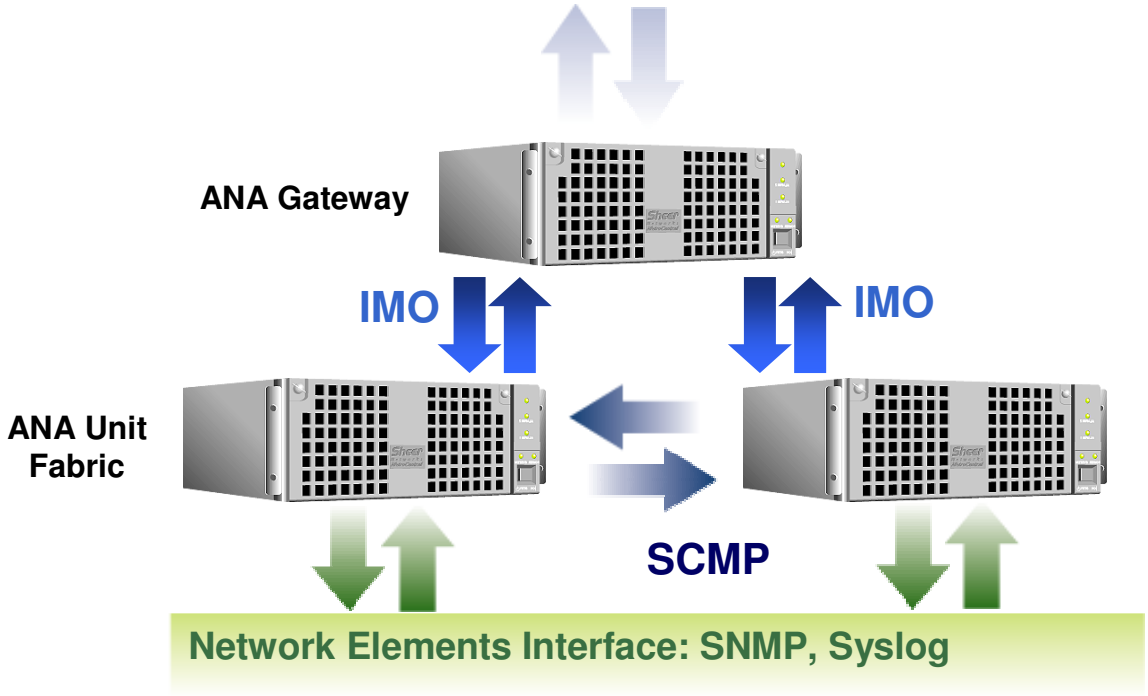
Cisco Active Network Abstraction (ANA) The Principle

- Cisco's ANA creates and maintains an abstract virtual model of any given network:
  - Virtual Network Elements (NE)
  - Virtual links
  - Virtual Services



Cisco ANA Architecture and Interfaces

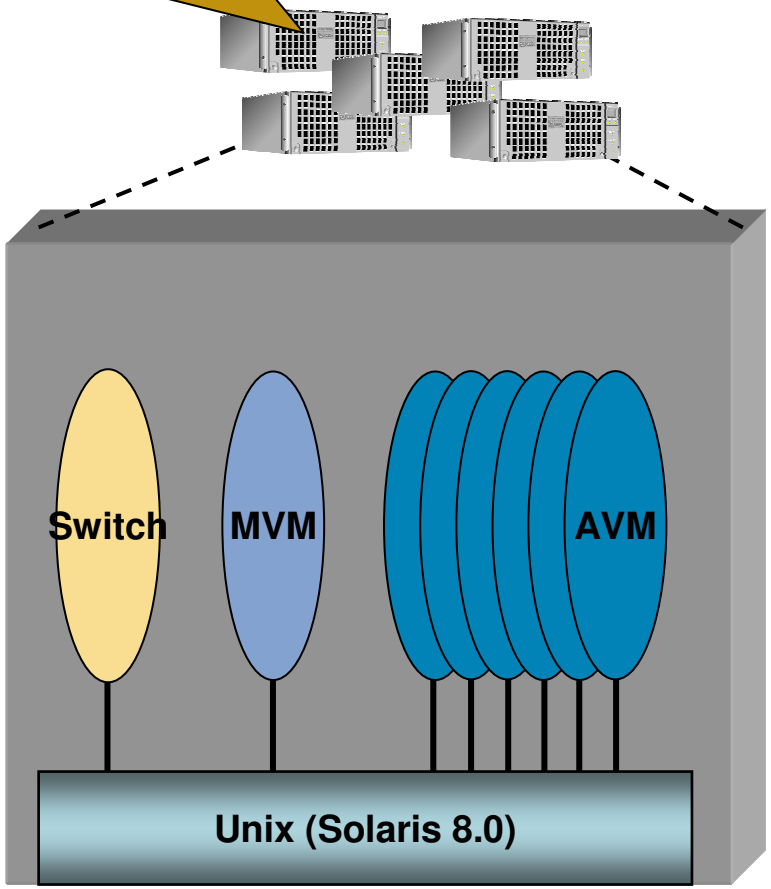
GUI Clients (Network Vision, Event Vision, Config Builder)
OSS/BSS North Bound Interfaces: SNMP, CORBA, BQL/XML, WSDM
Element Inventory, Network Topology, Connectivity Services



Cisco ANA Servers

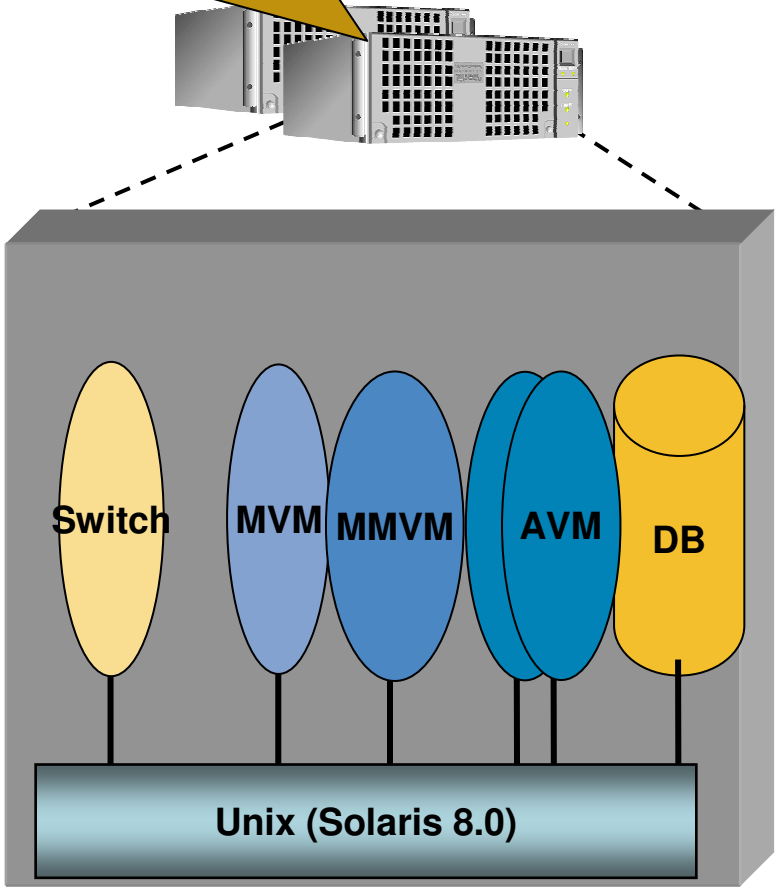
ANA Unit

- Maintains NE and Topology Info



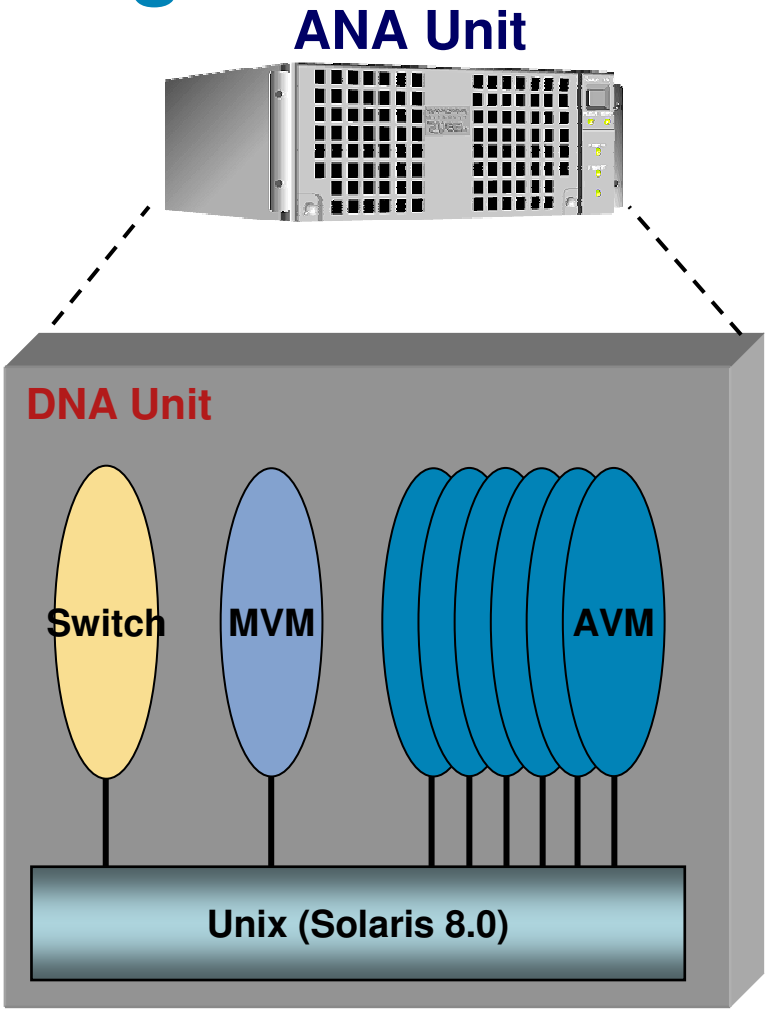
ANA Gateway

- Integration platform and Oracle DB repository
- Handles GUI Maps and business information

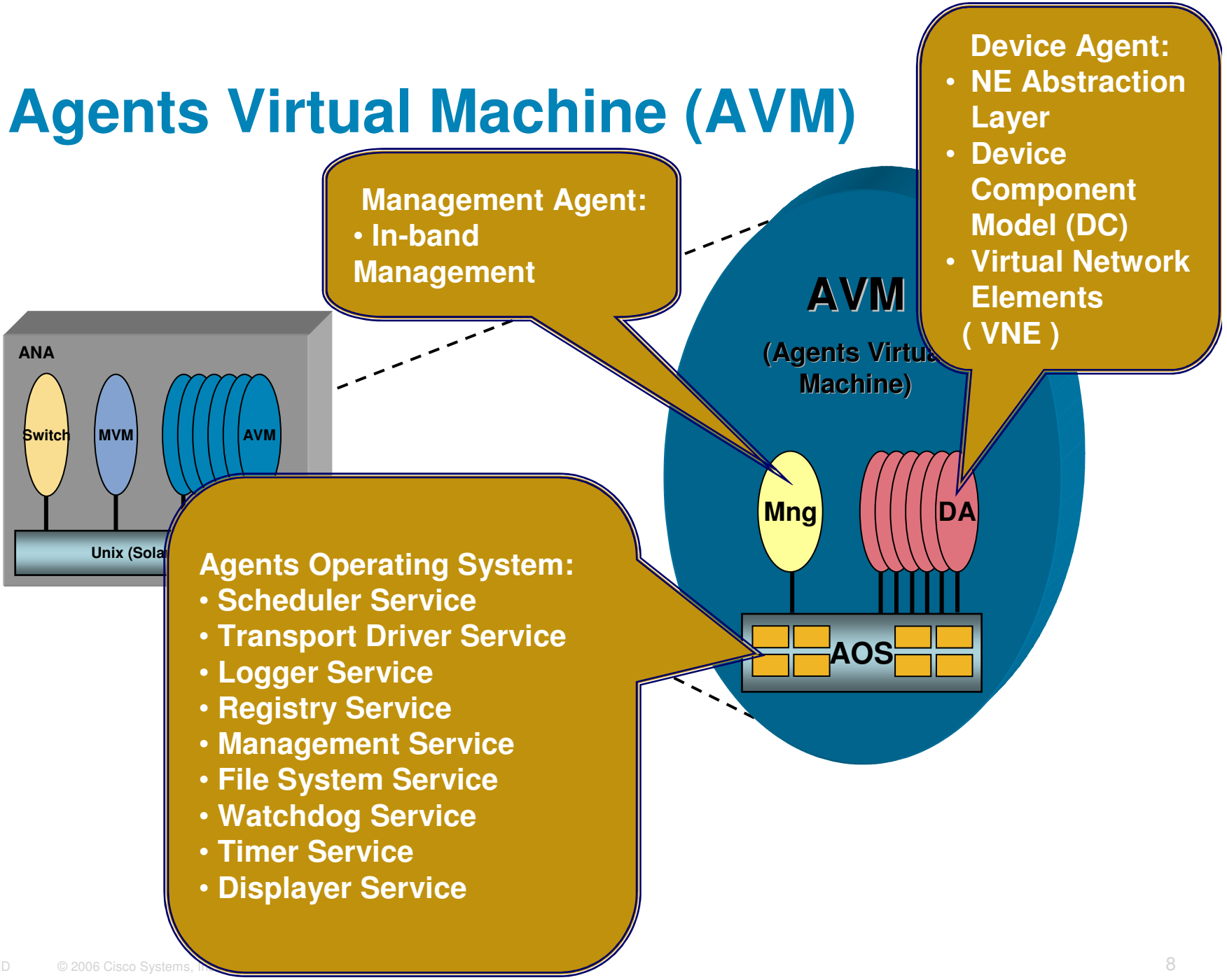


Cisco ANA Unit Block Diagram

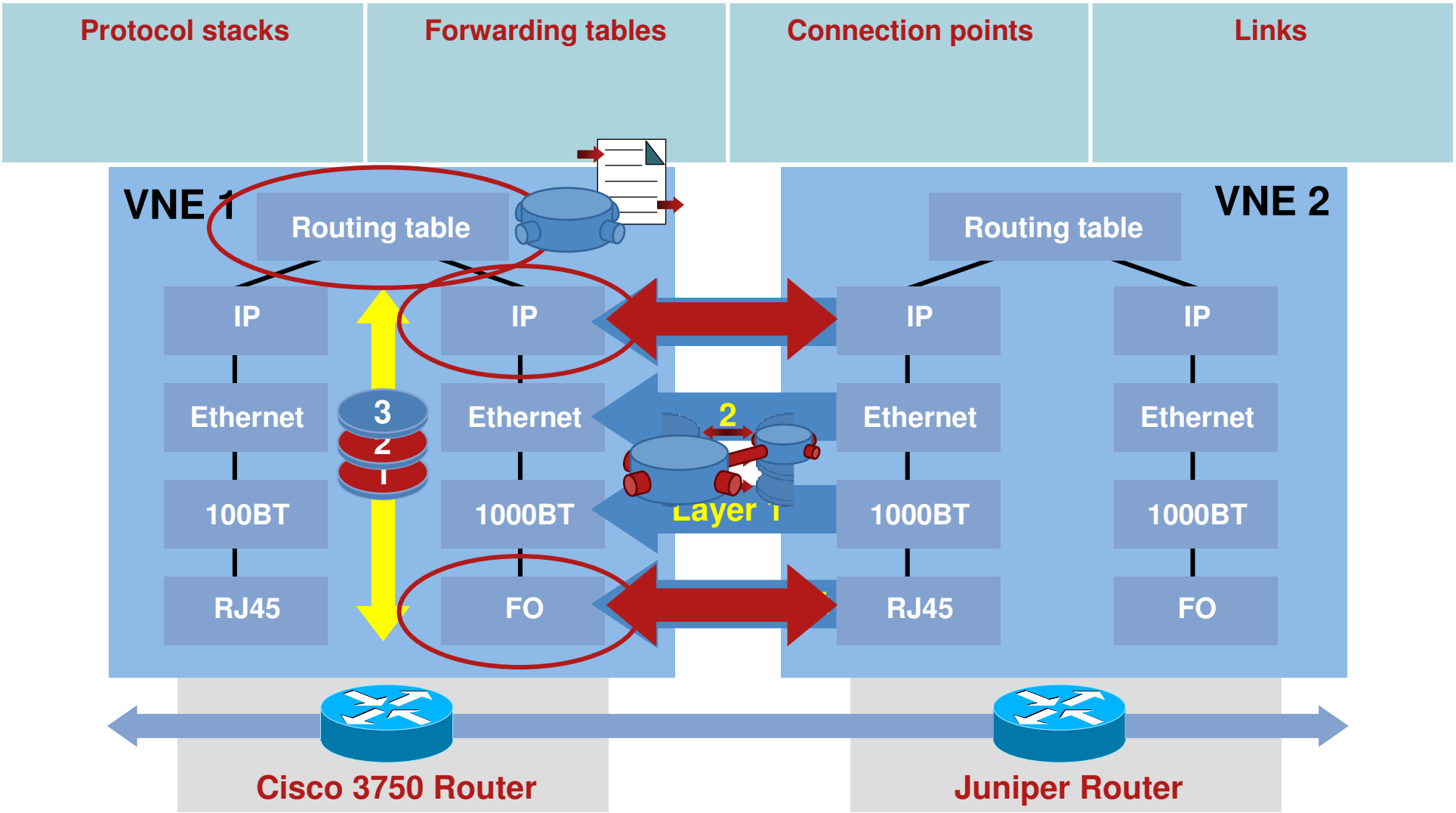
- Modular, scalable, high-performance, distributed network-knowledge engine
- Responsible for assurance, fulfillment, and transaction processing
- Main DNA Unit processes:
  - AVM – Agent Virtual Machine (VM)
  - MVM – Management VM
  - Switch – Transport Uplink Switch
  - **AVM types:**
  - **ANA System AVMs**
  - **IP Core Network**
  - **MPLS VPN**
  - **Access Network**



Agents Virtual Machine (AVM)

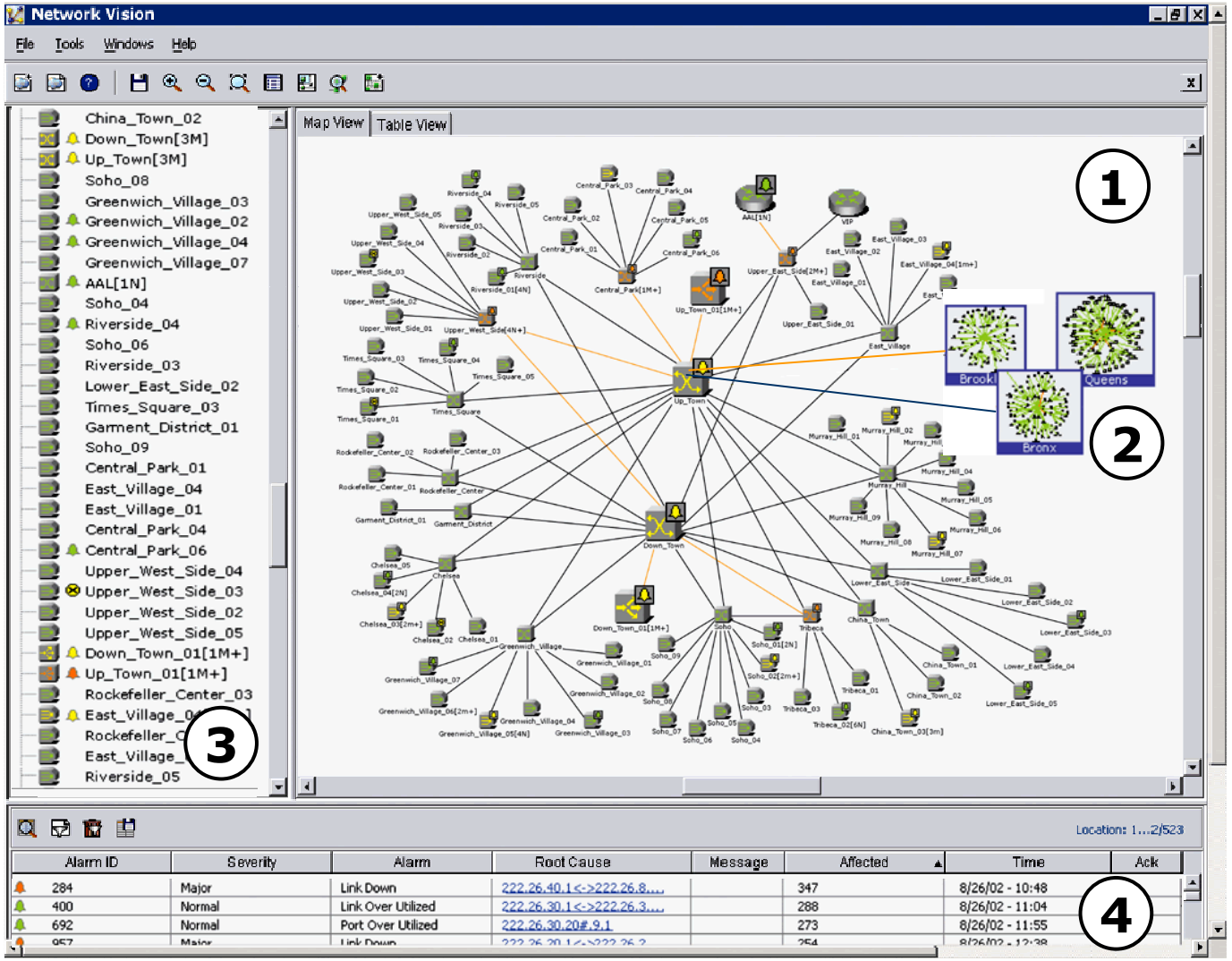


The Device Component (DC) Model Building VNEs from Atomic Components



ANA 3.x Overview

Network Vision GUI:
Network Maps Device Topology Discovery



1. Topological view of the network Devices and connectivity
2. Aggregation hierarchy of Sub-networks
3. Device hierarchy tree
4. Context-sensitive alarm viewer

Network Vision GUI: Service Maps IP/VPN Topology Discovery

- Present logical views of network services
  - Service entities
  - Connections and dependencies
  - Service paths

1

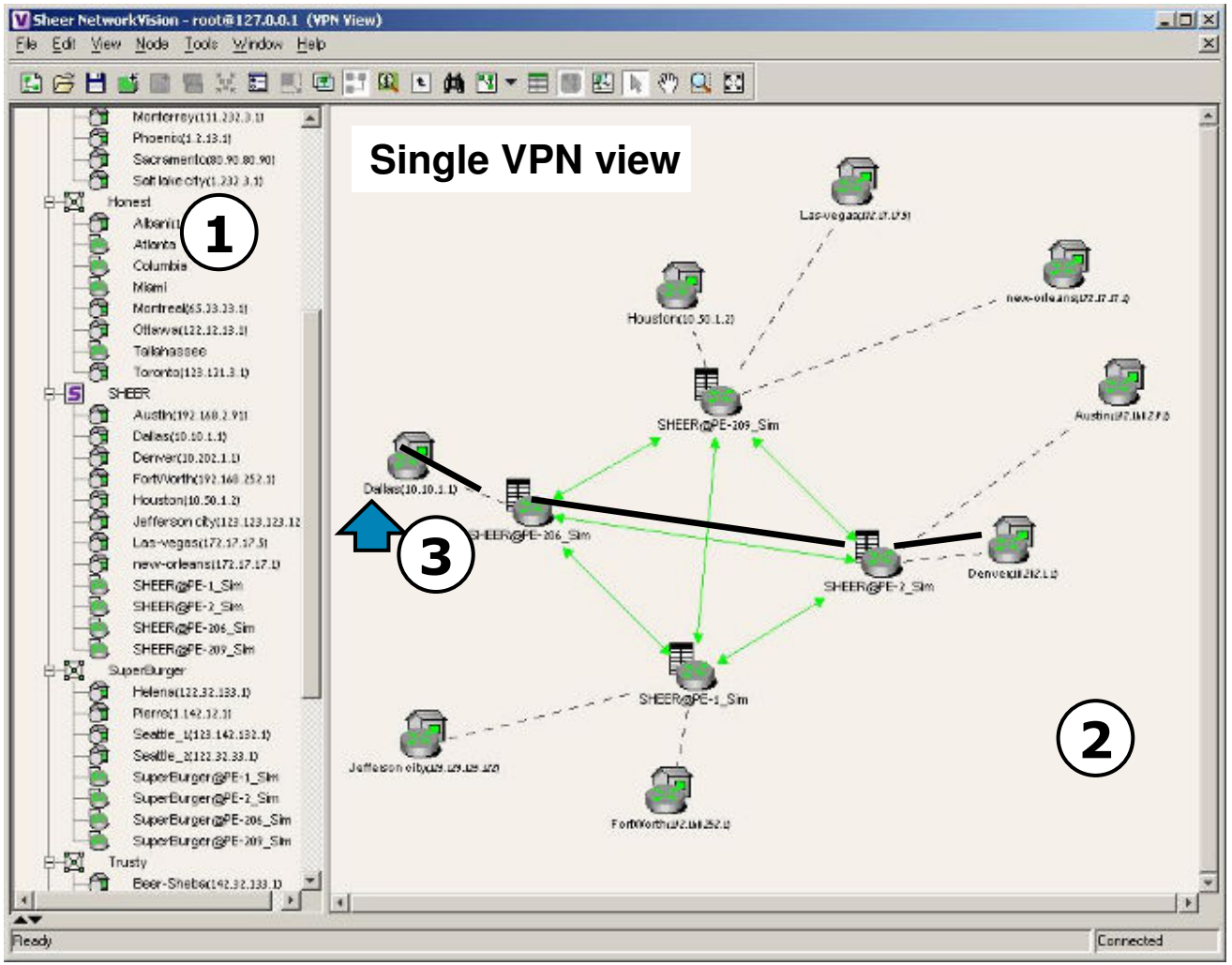
VPNs and components list

2

VPN layer view complete with
- CEs
- PEs
- Their respective relationships

3

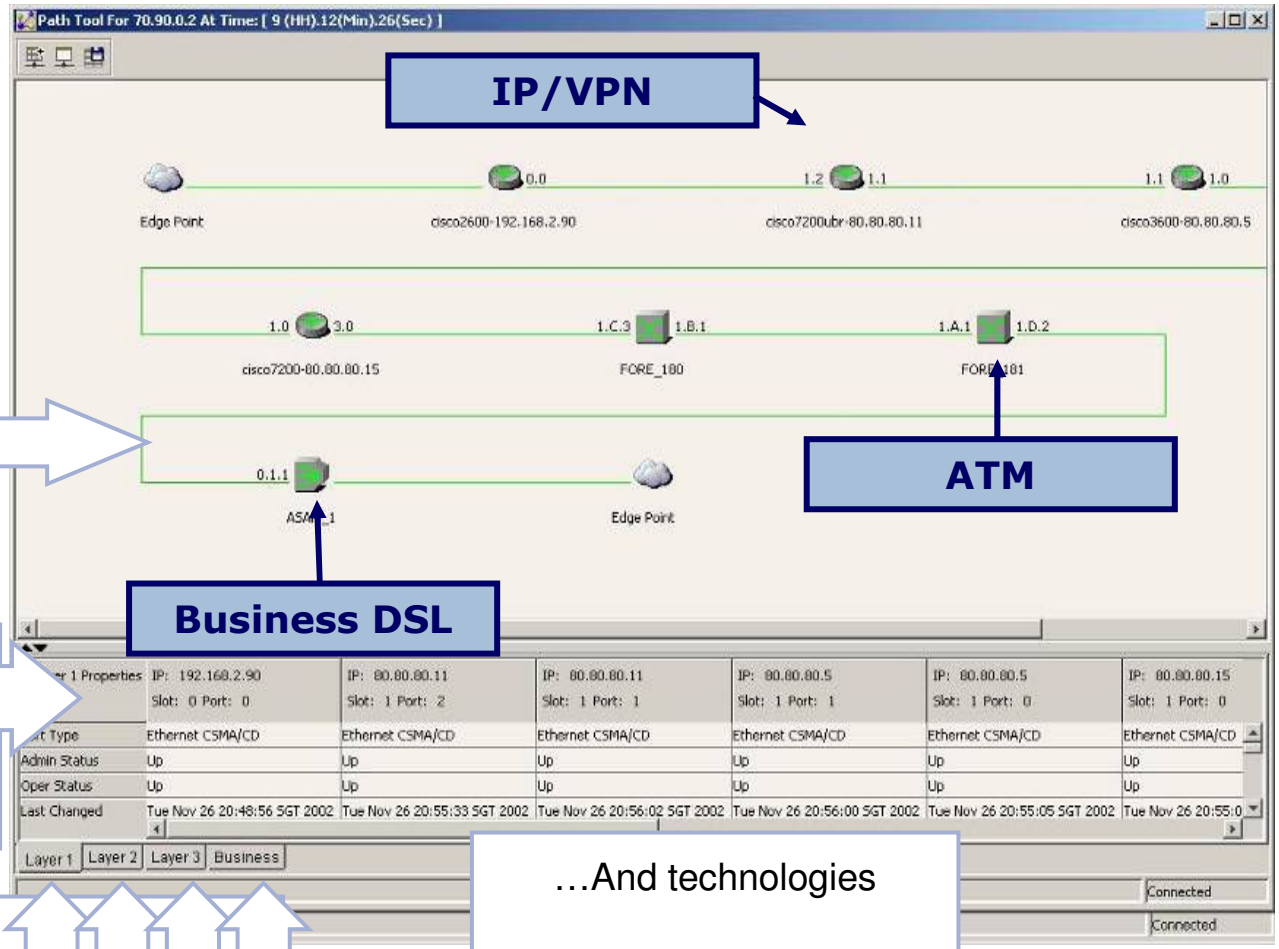
Physical point-to-point connection available through PathTracer



Network Vison GUI: PathTracer End-to-end Service View

- Real-time path tracing across technologies and network layers
  - Subscriber to ISP
  - Point-to-point lines
  - VPN site-to-site

All the nodes across the path



…with relevant properties
- **Physical and logical configuration**
- **Traffic counters**
- **Configuration consistency**

Through all layers 1, 2, 3, Business…

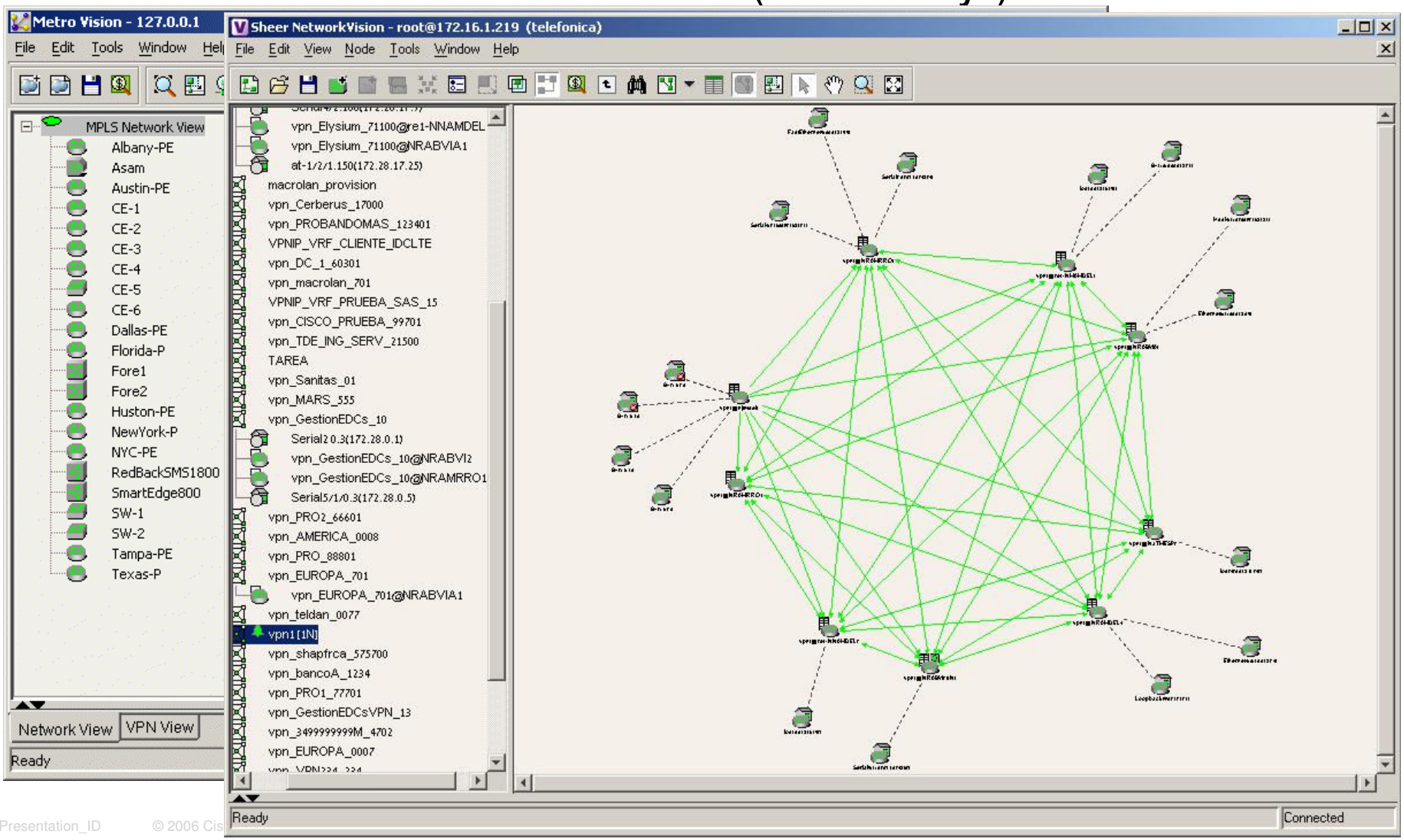
…And technologies

Topology Auto-Discovery

- Continuous, real-time discovery of physical & logical connectivity
- Discovery via Signature Analysis algorithm: compiling and matching unique interface signatures, based on information such as:
  - MIB connectivity advertisements (e.g. CDP, PNNI)
  - Network attributes (e.g. Subnet, MAC & ARP analysis)
  - Reachability (e.g. VRF Route-Target compatibility)
  - Traffic signatures (patented)

Topology Auto-Discovery (cont.)

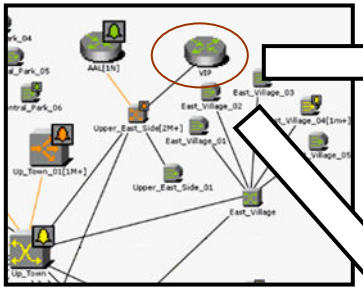
- Network View and VPN View (Discovery)



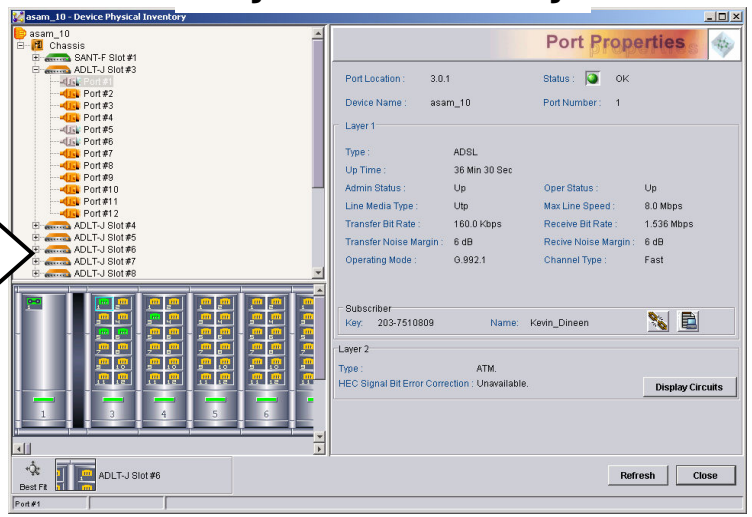
Device Drill-Down
Physical and logical inventory

Zoom into any selected device, to view its inventory (continuously discovered in near-real-time)

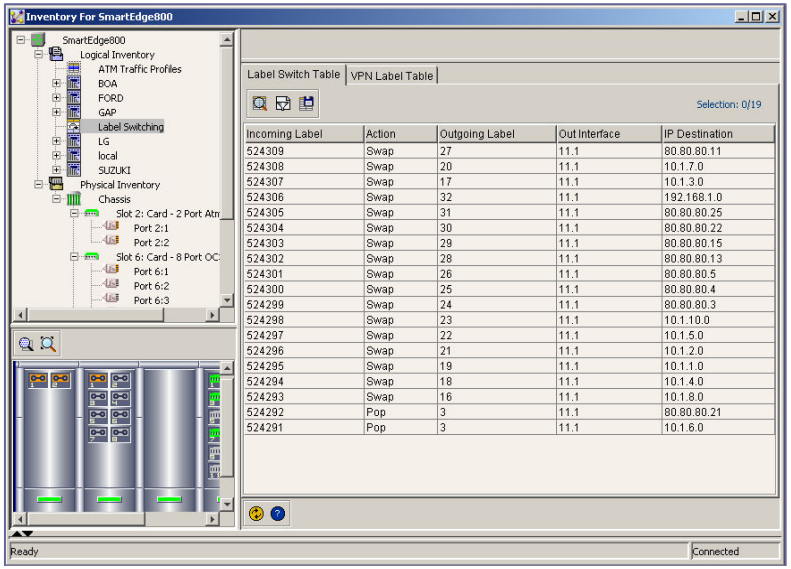
- **Physical inventory:**
  - Chassis
  - Shelves
  - Cards
  - Ports & parameters
  - More…
- **Logical inventory:**
  - Circuit tables
  - Traffic profiles
  - Routing tables
  - VRFs
  - Label-switching tables
  - IP pools
  - More…
- Network-to-business mapping
  - Supports user-defined
  - Business Objects containers for network resources



Physical inventory

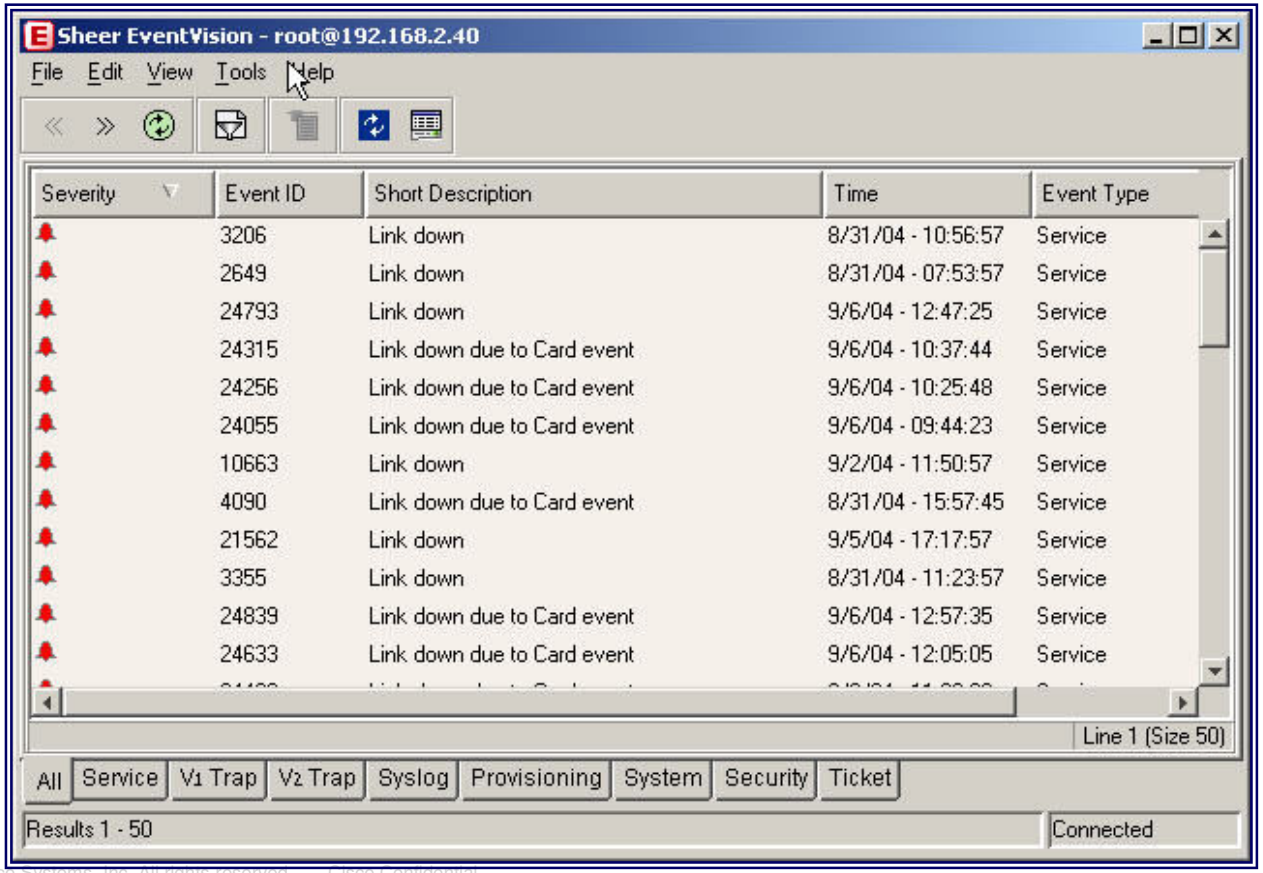


Logical inventory

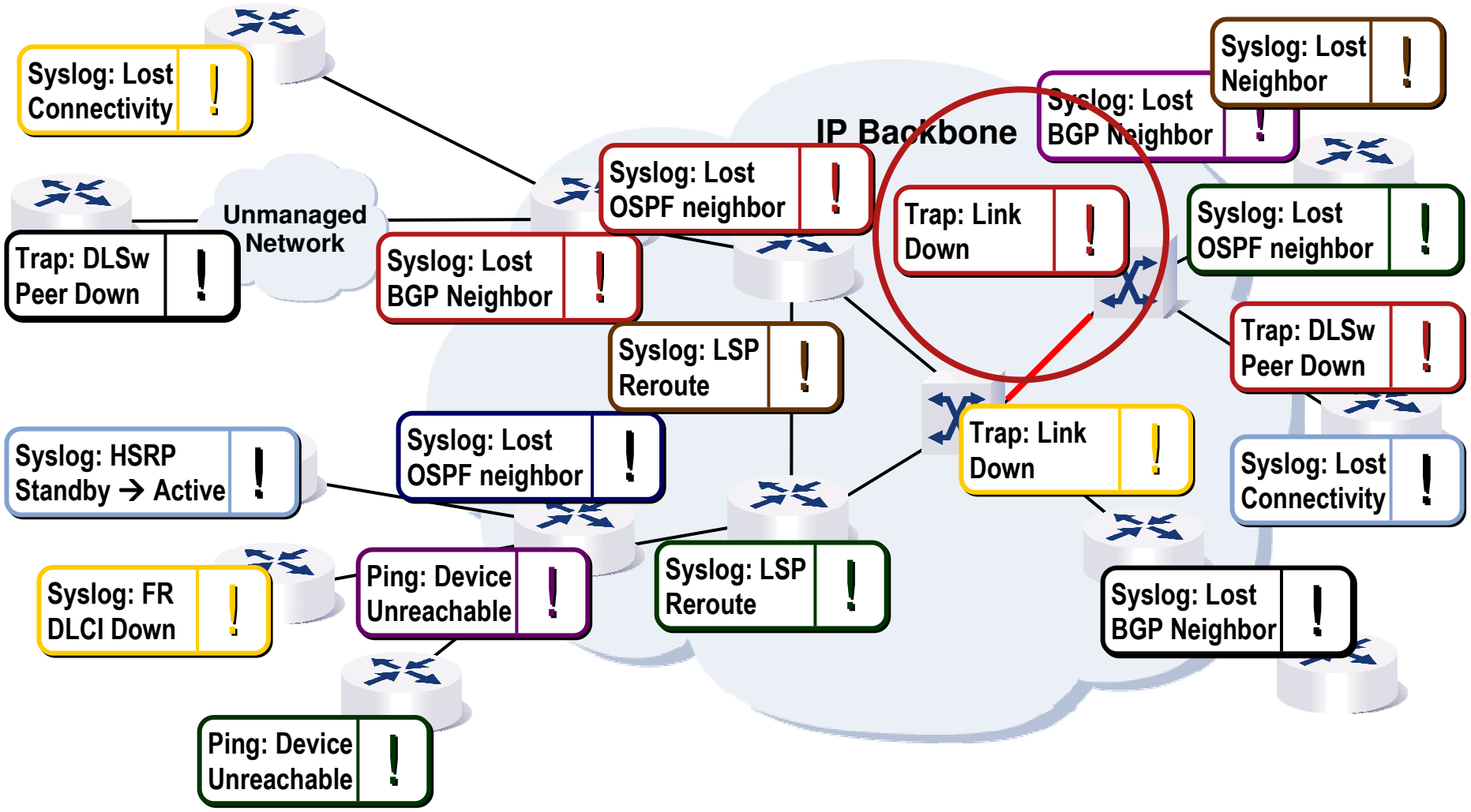


EventVision GUI

- ANA EventVision is a tool, which serves as a browser for viewing all current and past events database.



Fault management : Complexity of relations between Events

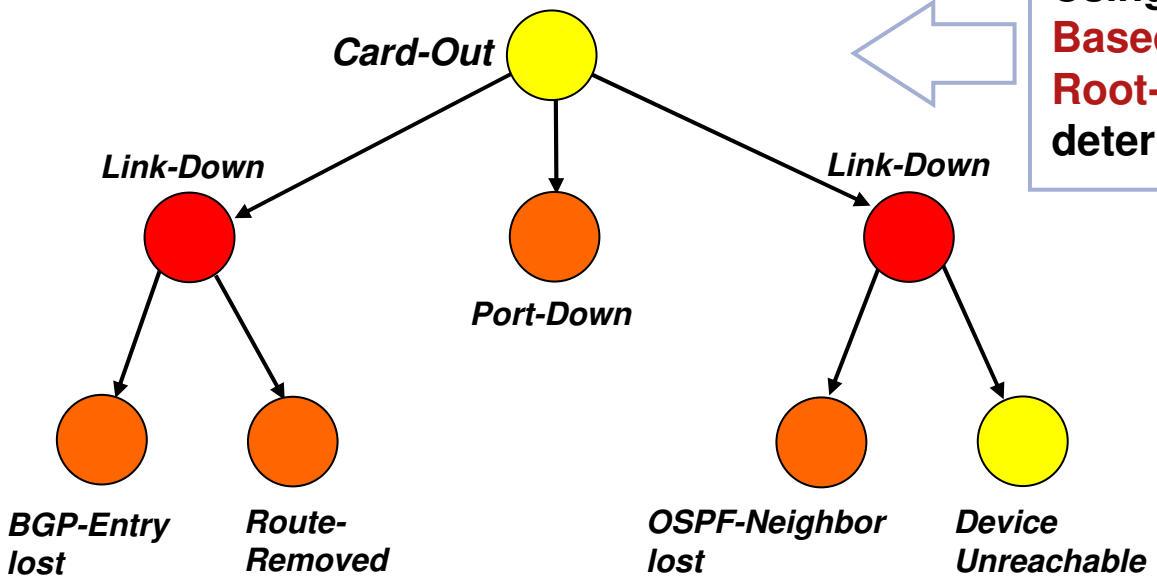


ANA-based Fault Analysis

- ANA works with virtual network as a reference model
- Reduces trouble-ticket flooding
  - Can correlate hundreds of alarms to a single root-cause ticket
  - Can handle multiple concurrent root causes
- No rules to write
  - Correlation logic is automatically determined by Network relationships (physical & logical)
  - True multi-layer, multi-domain correlation

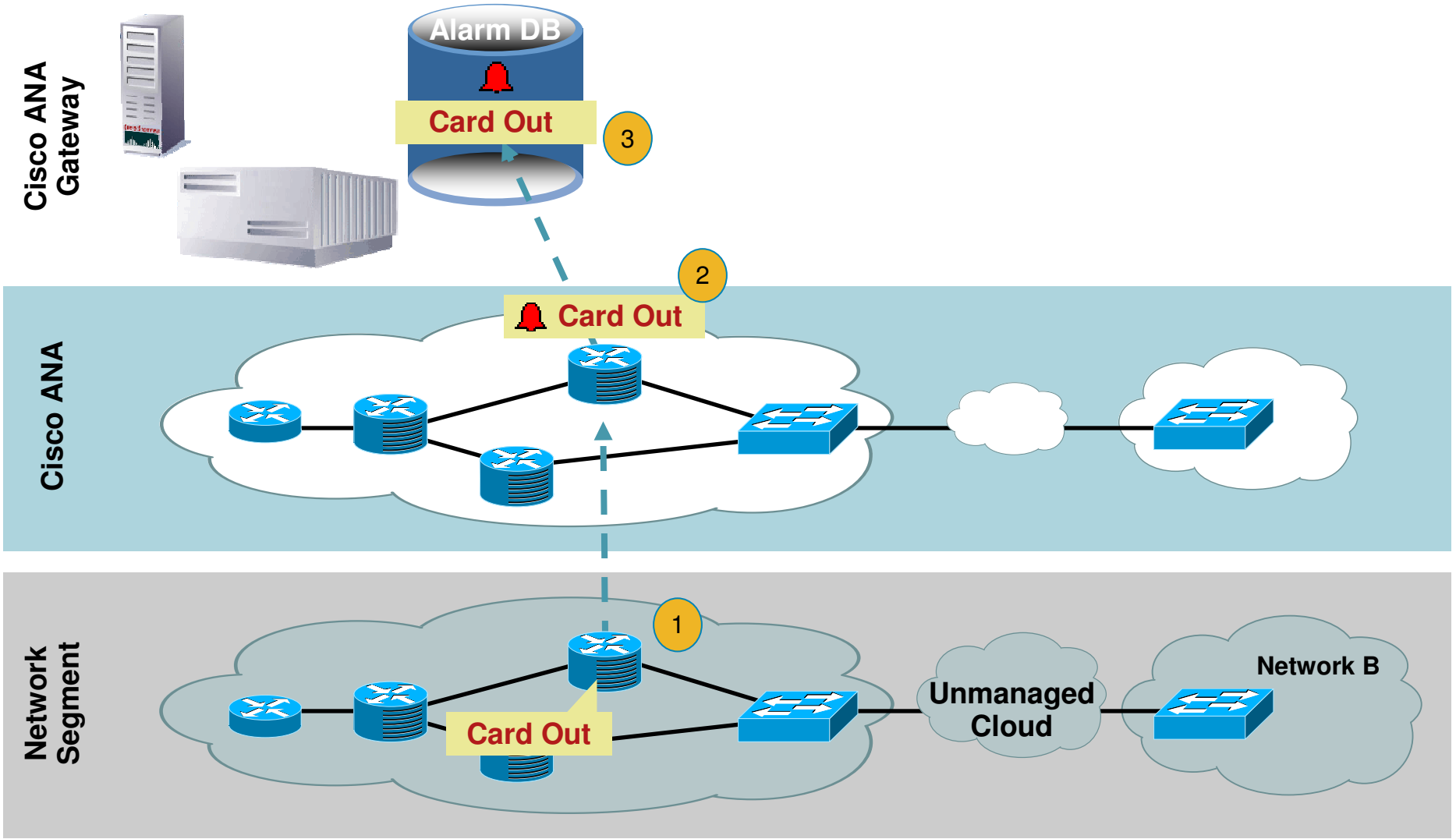
Topology-based Alarm Correlation and Root-Cause Analysis

- Cisco ANA identifies the relationship between root-cause alarms and consequent alarms
- Dynamically building a multi-level alarm correlation tree
- The Alarm Viewer displays only the topmost root alarm, and enables drill-down for the full hierarchy of consequent alarms

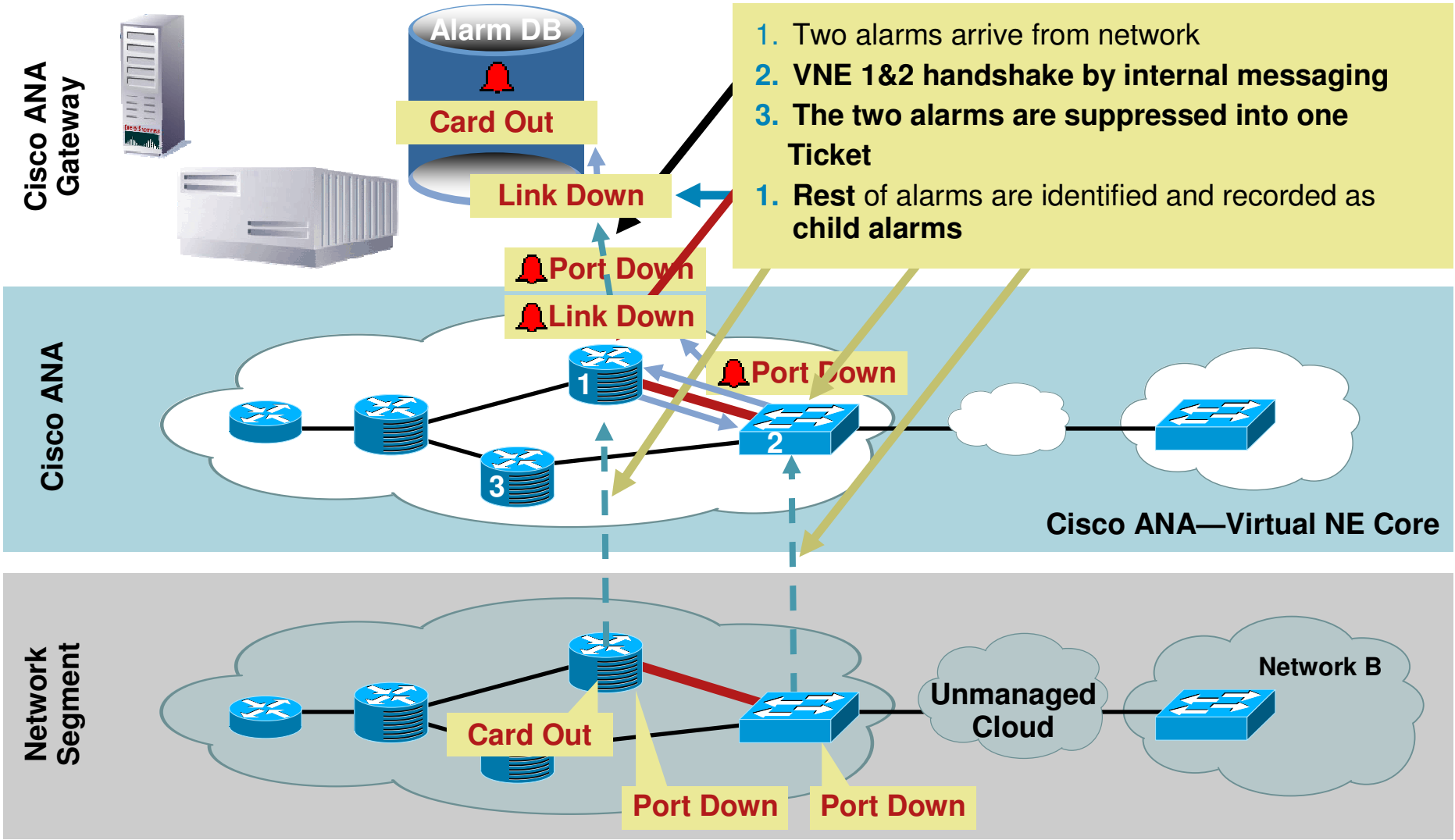


Using Cisco ANA's topology-Based alarm correlation and Root-Cause Analysis we can determine the source.

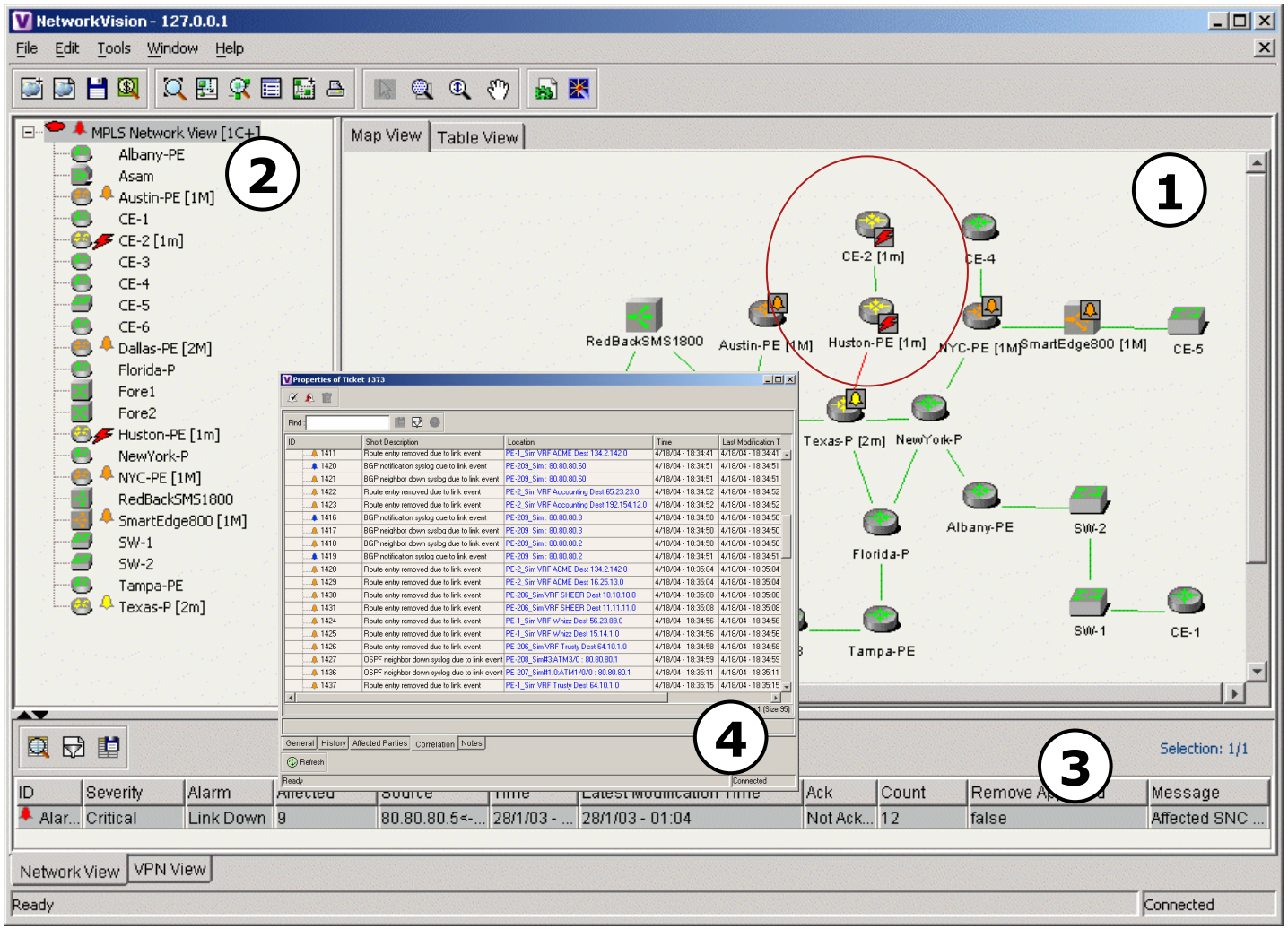
Topology-based Alarm Correlation and Root-Cause Analysis



Topology-based Alarm Correlation and Root-Cause Analysis



NOC friendly
Cisco Fault Management



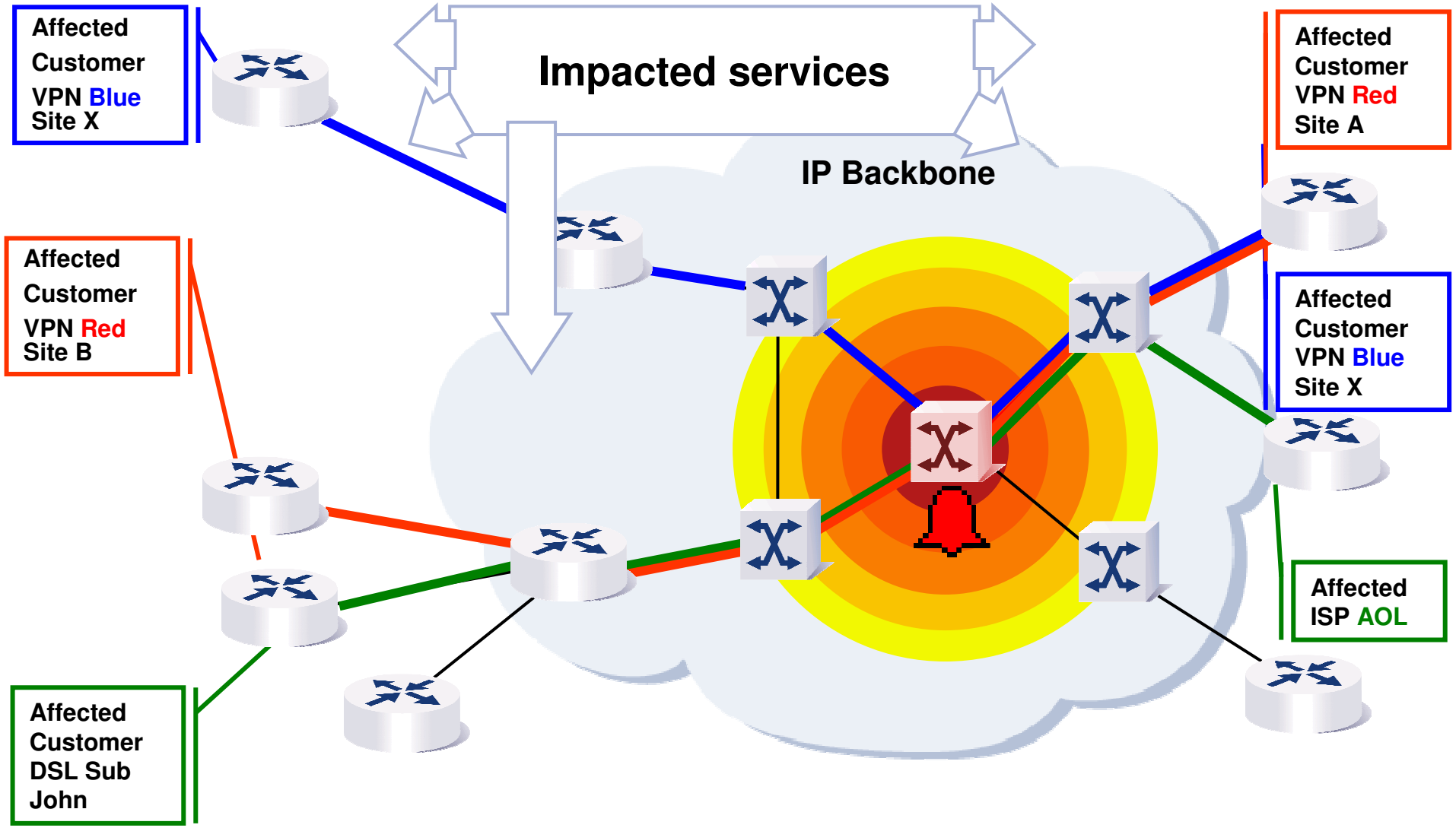
1 Network health at a glance

2 Device hierarchy with status propagation

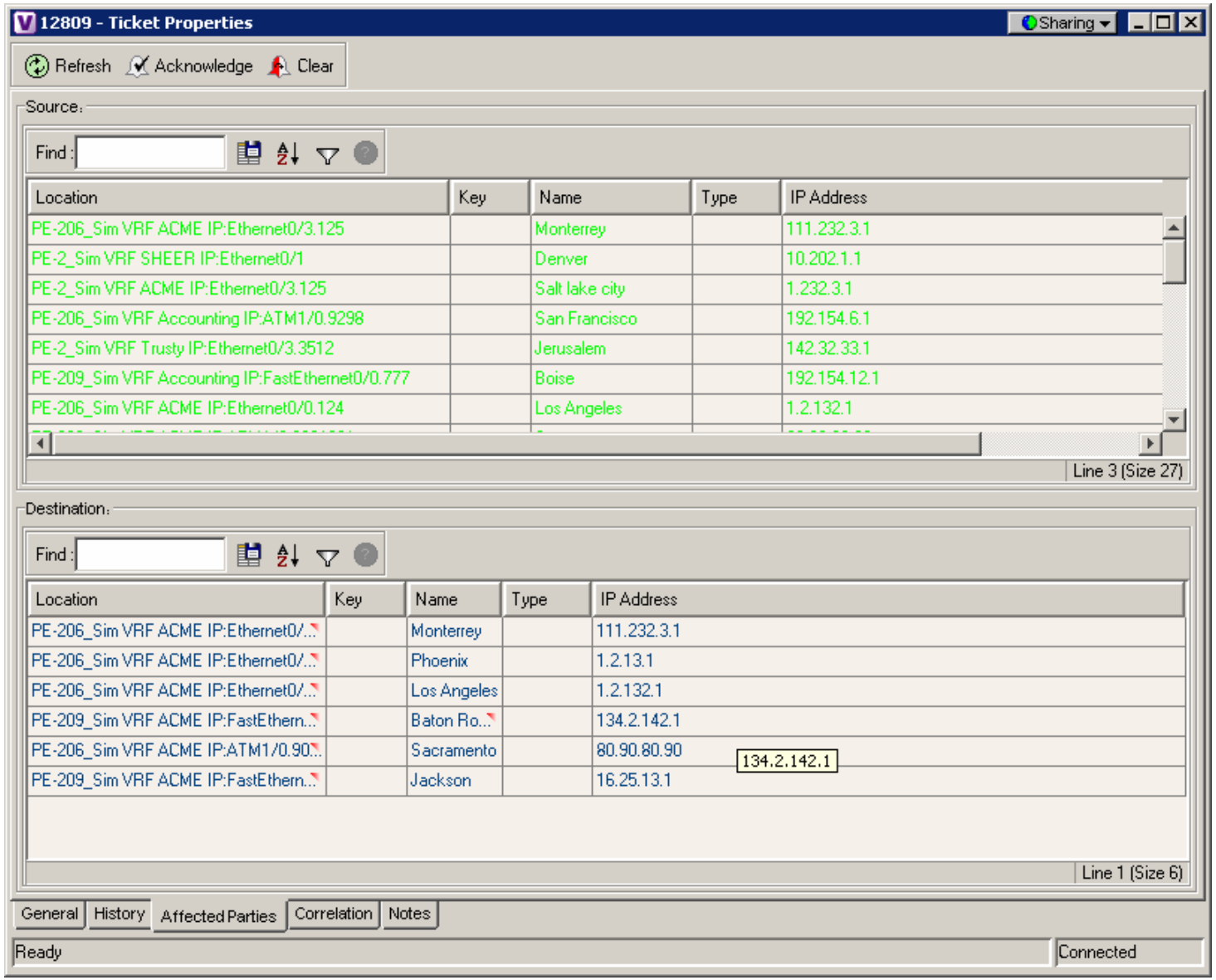
3 Main alarm Viewer: only topmost root alarms

4 Alarm drill-down window. Multiple consequent (child) alarms

Impact Analysis (Affected Services)



Impact Analysis (Affected Services)



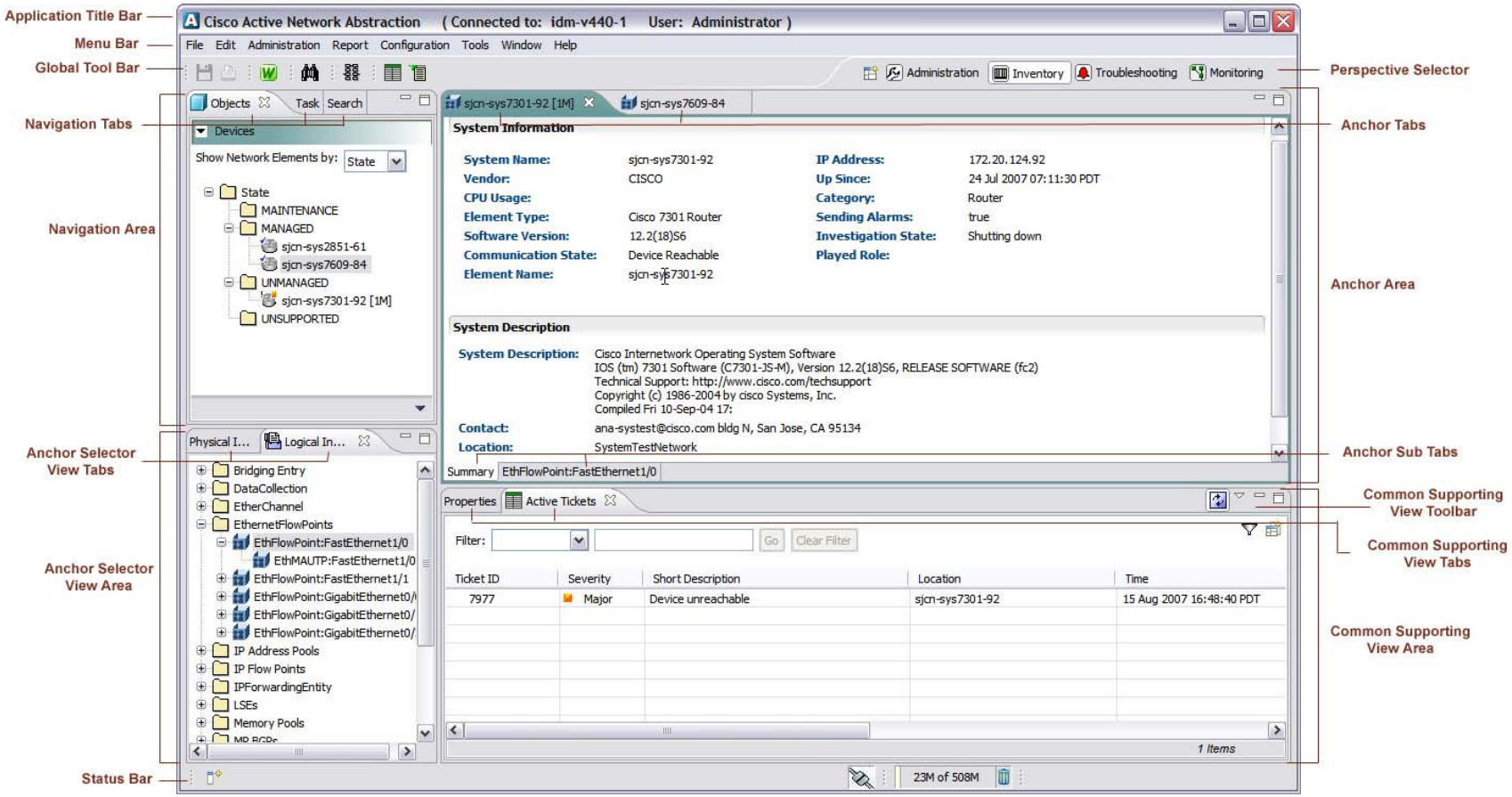
ANA 4.0 Overview

ANA 4.0 New Features

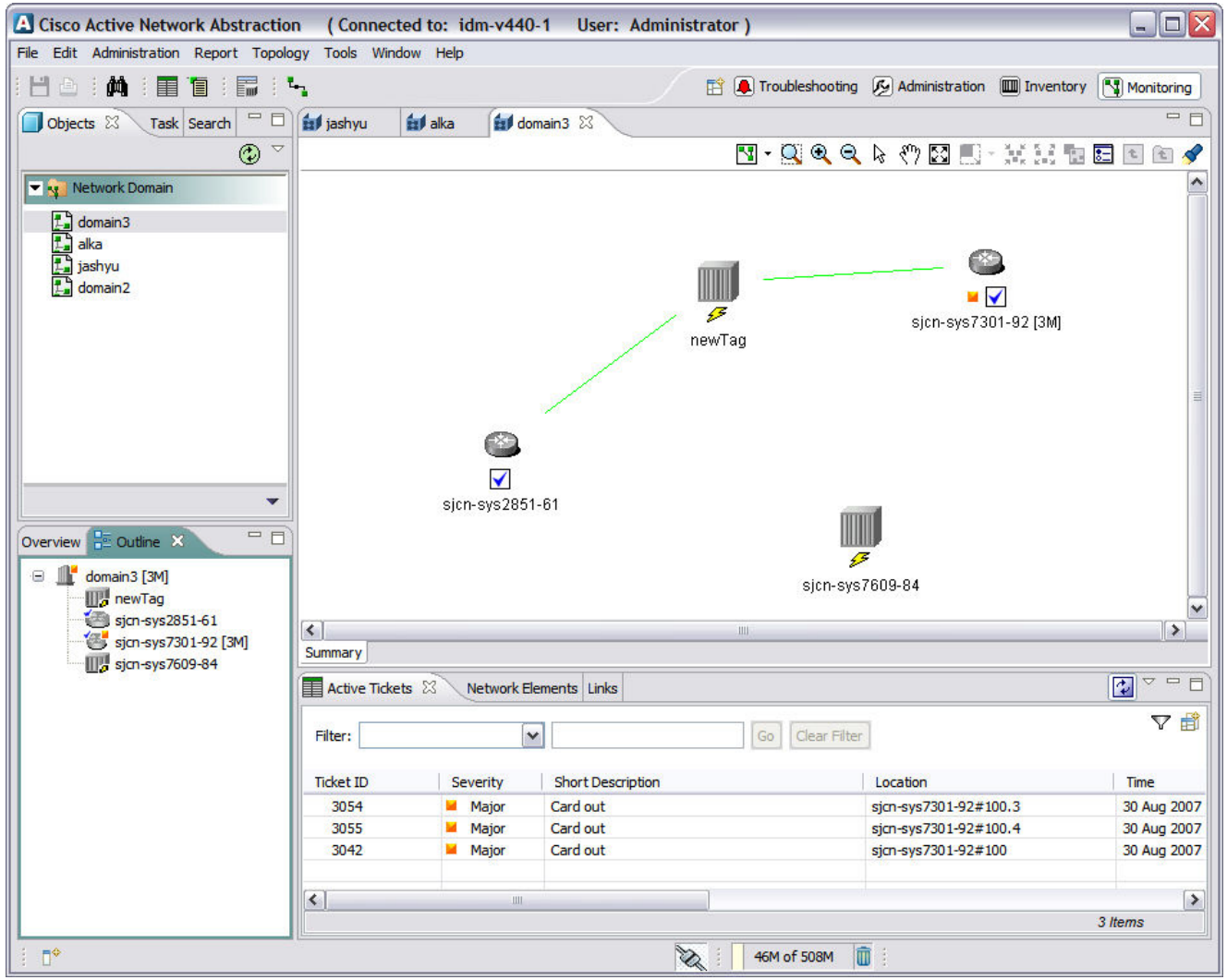
- Single Client GUI
- Network Auto Discovery Module
- NE Configuration Archive
- Command Builder Enhancements
- Inventory reporting
- Network Element Image management
- SNMP NBI Trap Forwarding
- WSDM NB API

ANA 4.0 Single Client

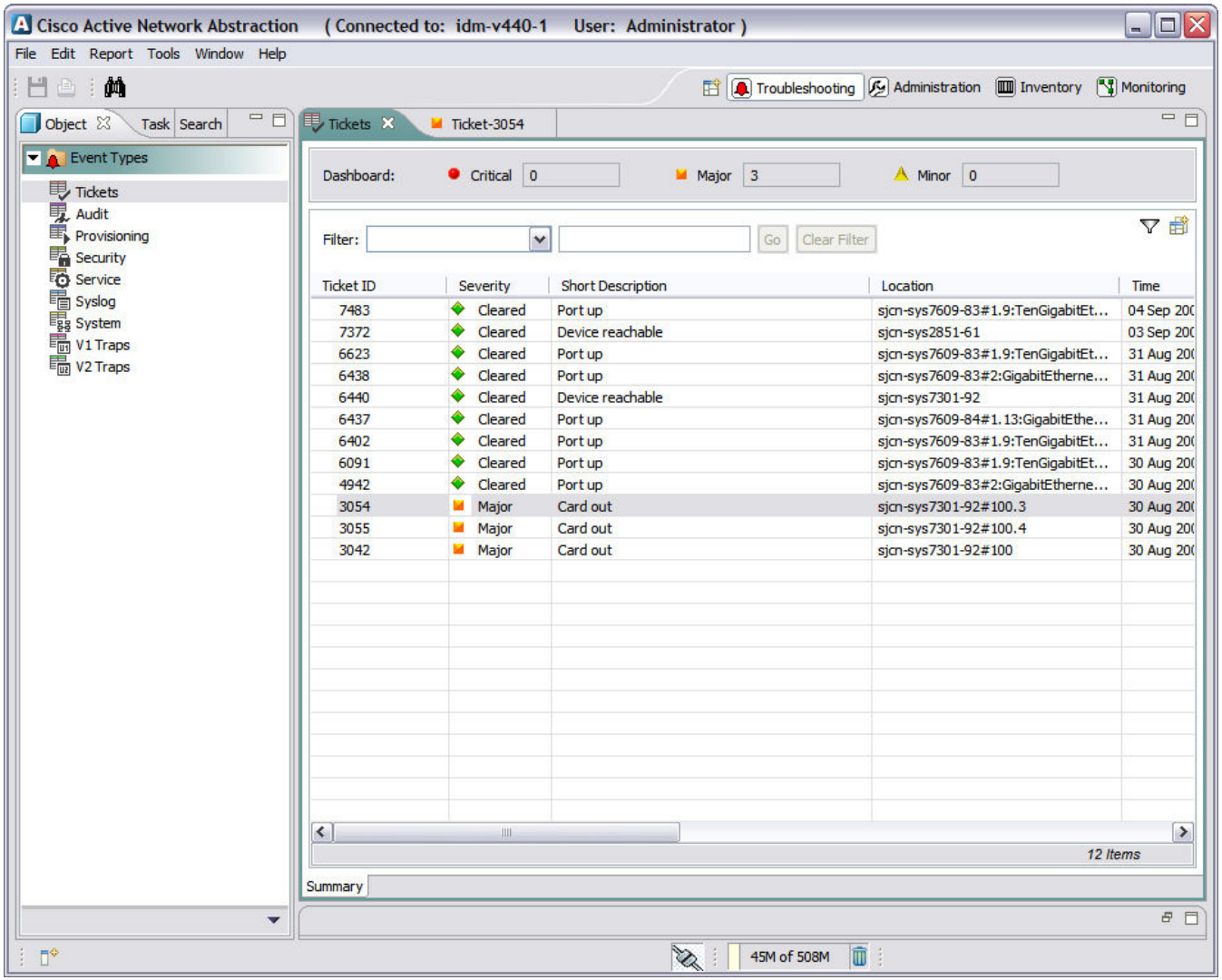
Administration, Monitoring, Troubleshooting, and Inventory.



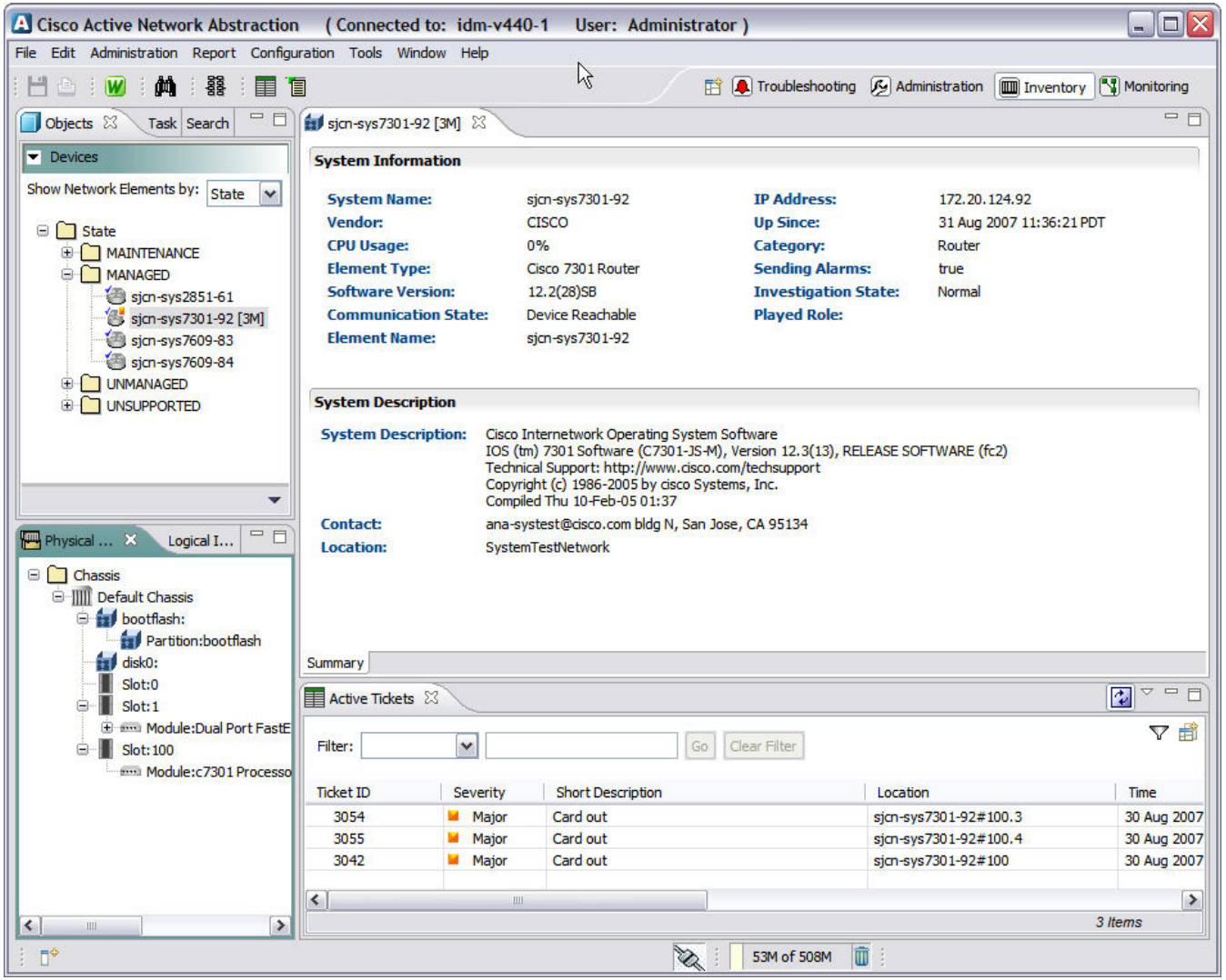
ANA 4.0 Monitoring Example



ANA 4.0 Troubleshooting Example



ANA 4.0 Inventory Example



Network Auto Discovery Module

- Discovers devices in the customer network
- Requires input of default credentials and user preferred discovery methods and limits
- Supports multiple user configurable discovery methods including:
  - CDP
  - ILMI
  - ELMI
  - Routing Table Discovery
  - BGP
  - OSPF
  - HSRP
  - Ping Sweep (Range of addresses or starting address)
  - Cluster
- Output provided in ANA seedfile format – for input into the ANA system

NE Configuration Archive

- Stores user configurable number of configuration files of network elements in an archive
- Provides GUI for
  - Setting up configuration archive parameters
    - Automatic archive on configuration change notification
    - Number of archives per NE to store
  - Viewing summary of versions per NE
  - Configuration files details (full configuration or via configlets)
  - Comparison of configuration files
  - Out of Sync Summary Reports
  - Restoration of configuration file version to the NE
  - Search facility that provides ability to search archived files for specific criterion

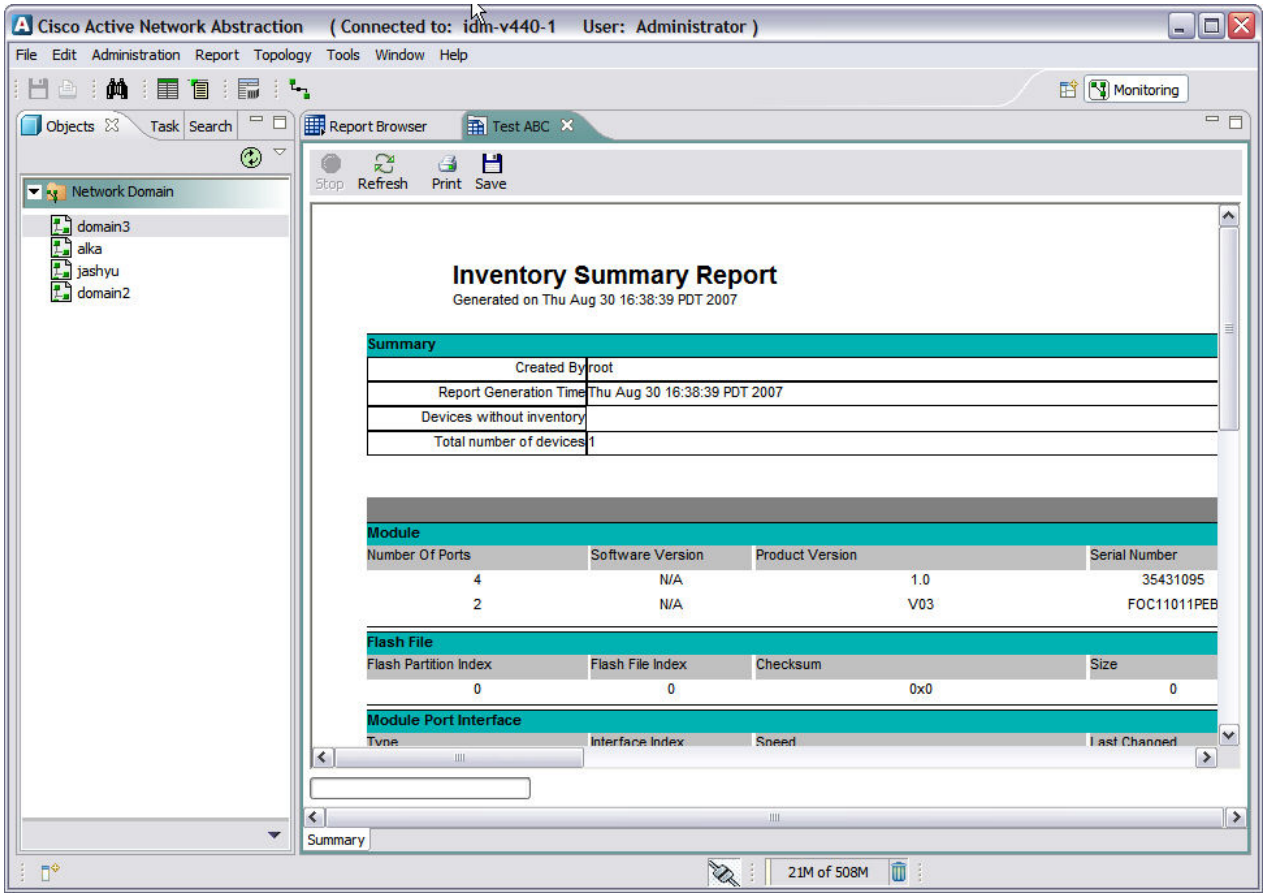
Command Builder Enhancements

- Ability to create and apply activation scripts across multiple NEs at the same time
- Ability to schedule application of the activation scripts

Inventory Reporting

- Provides an “Inventory Summary Report” containing physical inventory and a subset of logical inventory information for a user selected set of network elements
- Reports can be scheduled or generated on demand
- Exportable in PDF, CSV (XLS), HTML and XML formats

ANA 4.0 Invenotry Report Example



Network Element Image Management

- ANA 4.0 (IOS and IOS XR)
- Image Distribution
  - Scheduled or On Demand image update to one or more NE with ability to:
    - Specify order and method (sequential or parallel)
    - Stop on Failure
    - Activate image immediately or Schedule activate for later
    - Do not activate image
- Image Repository Management
  - Download image from Cisco.com to local ANA repository
  - Add, remove and browse images in the repository
  - Edit and update image attributes in the repository
- Image Analysis
  - Choose an image from the repository and verify its compatibility against a set of devices.

SNMP NBI Trap Forwarding

- Provides ability to configure ANA to forward all events in the system to be forwarded as SNMP traps to designated northbound system(s)

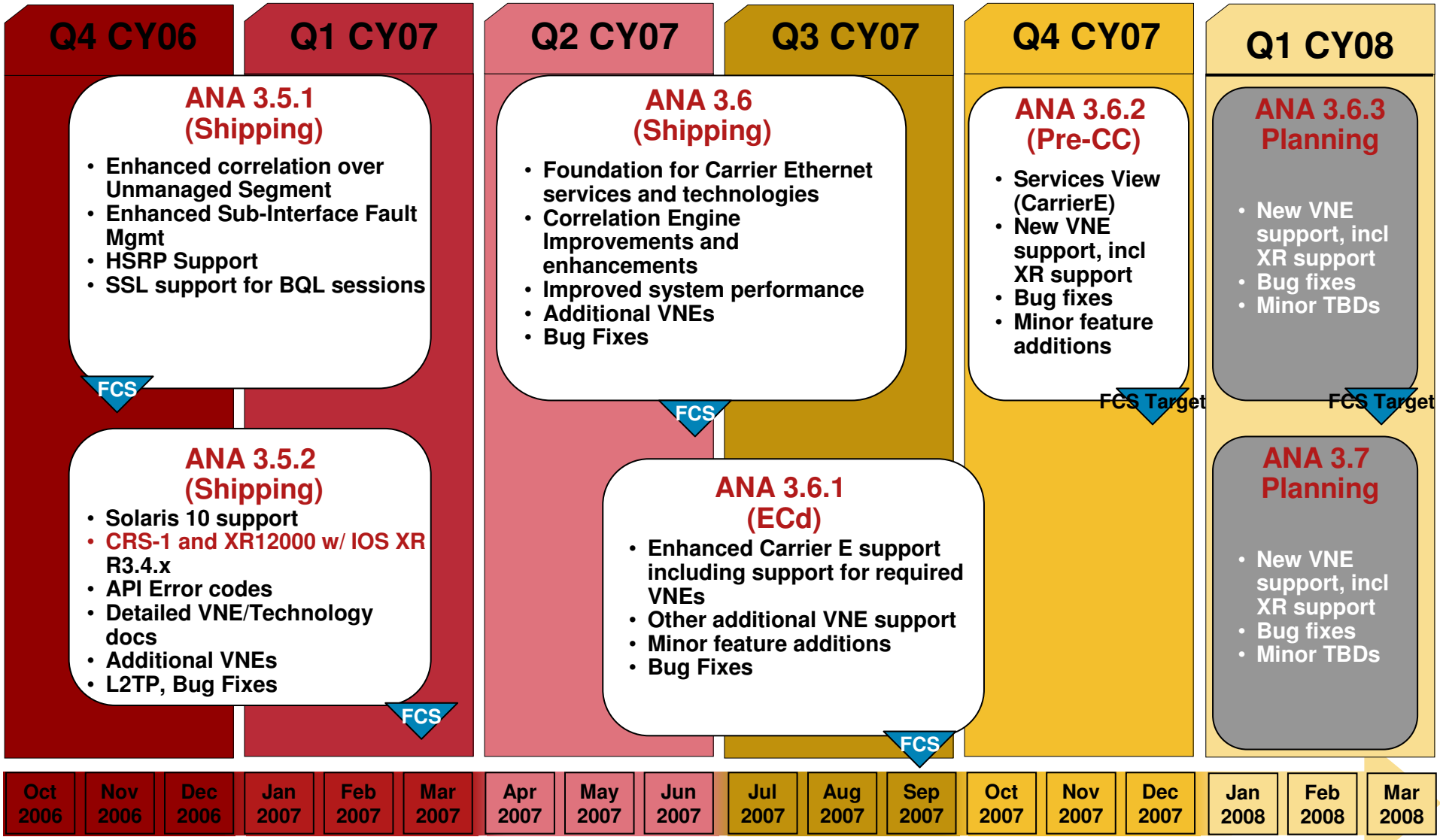
WSDM NB API
(Web Services Distributed Management)

- Supports the ability of a northbound system to:
  - Retrieve physical and logical inventory information including topology link information
  - Retrieve alarm/event information
  - Subscribe to change notifications for inventory and alarm/event data
  - Execute template activation scripts and workflows

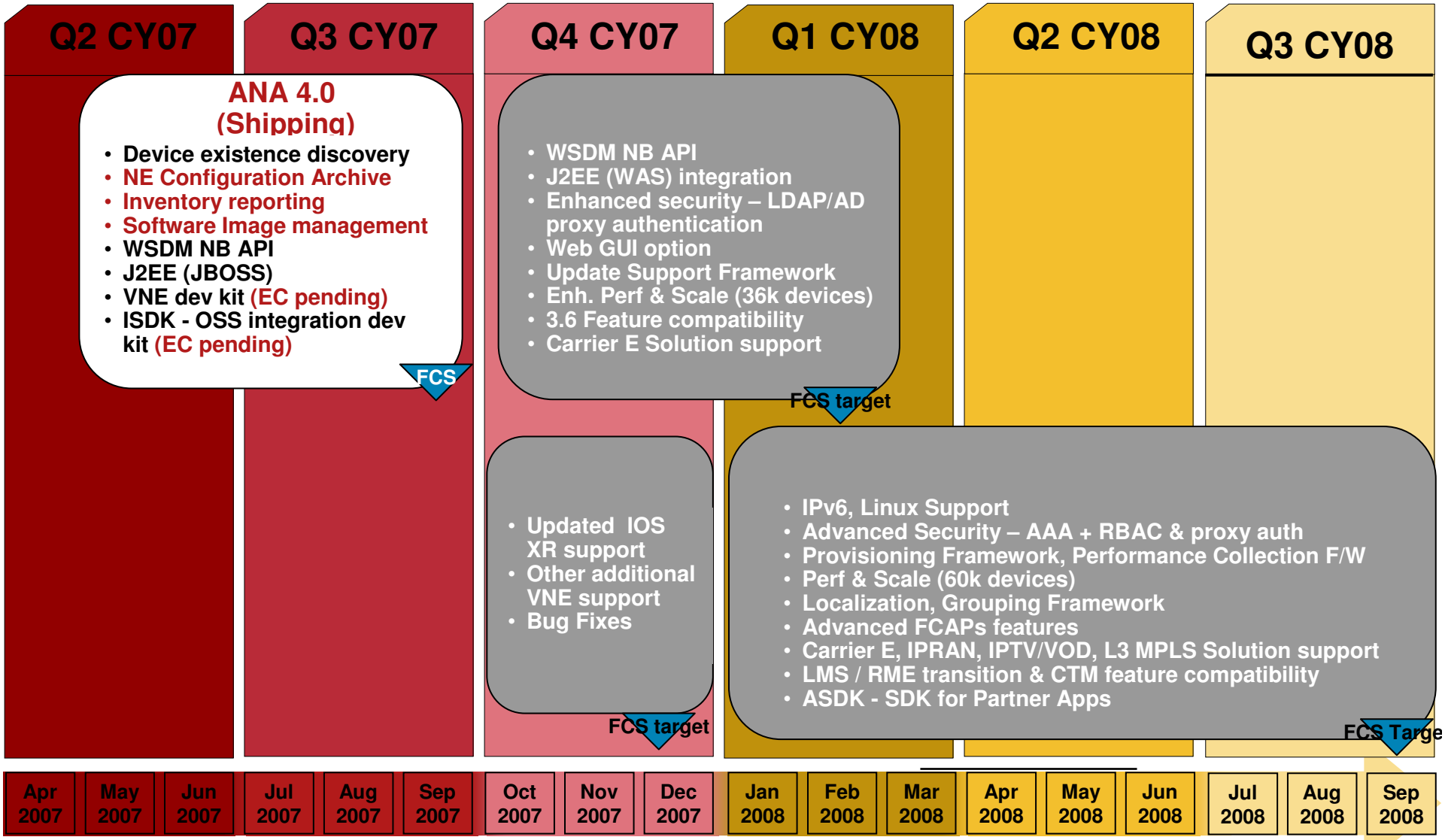
Cisco Active Network Abstraction

Evolution – Releases & Roadmap

Cisco ANA 3.x Roadmap



Cisco ANA 4.x Roadmap



Cisco IP Solution Center (ISC) Overview And Update

Mobile Core Networks
Key Provisioning Requirements

- Robust MPLS L3 and L2 VPN provisioning

  Automatic, carrier-class provisioning

  Reduce Provisioning Failures due to error-prone manual procedures

- Traffic Engineering for provisioning and protection management

  Superior node and link protection for delay-sensitive core traffic (e.g. signalling and voice)

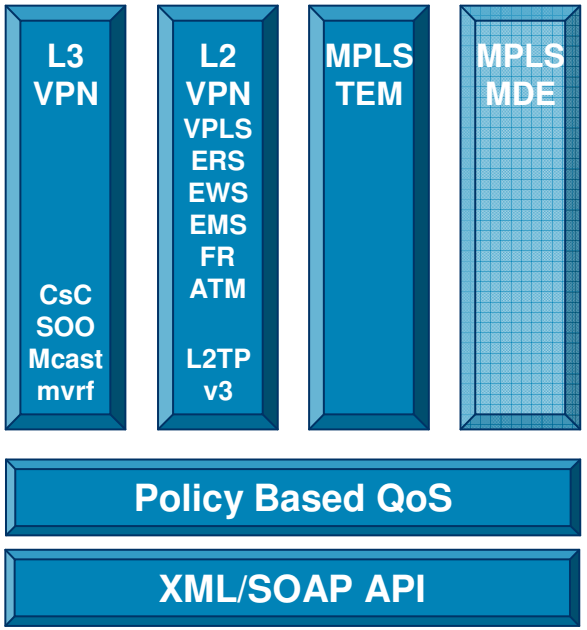
- Fast recovery and restoration

  Sub-50ms recovery with managed FRR back-up for mission-critical traffic

- Fast diagnosis and repair of MPLS VPN services

  Industry-leading MPLS OAM Diagnostic tool.

Cisco ISC 4.1 Overview
IP Solutions Center Service Modules



- IP Solutions Center is a Family of Management Applications for Planning, Provisioning, and Troubleshooting MPLS and Metro Ethernet networks.

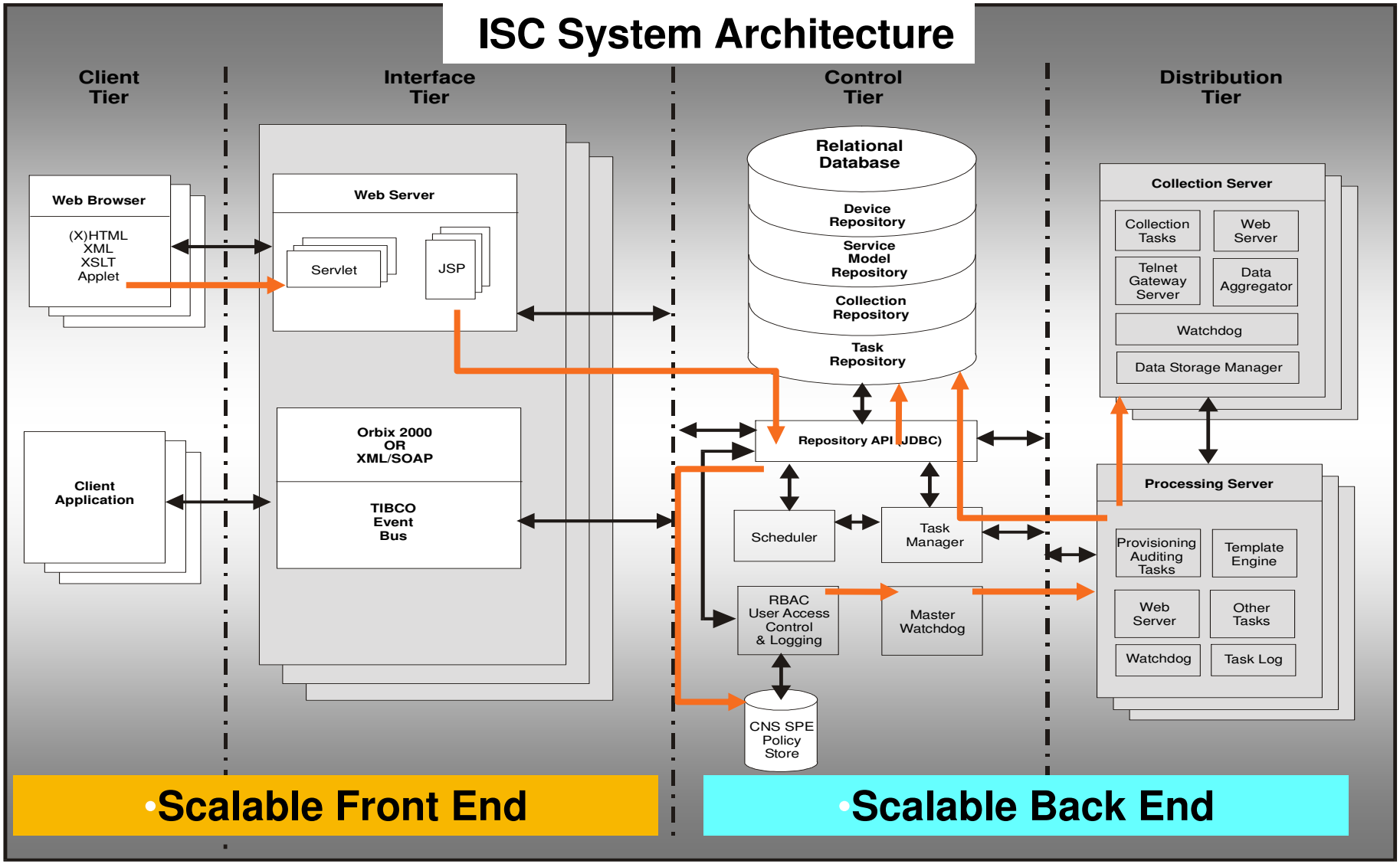
  ISC:MPLS simplifies, integrates and automates the management of IP VPN and QoS.

  ISC:L2VPN and ISC:Metro Ethernet simplify, integrate and automate the management of IP VPN, Metro Ethernet, ATM, FR, and QoS.

  ISC:TEM leverages MPLS TE to enable network convergence and offers advanced MPLS-TE management functionality, including network optimization and bandwidth protection.

  ISC:MDE MPLS Diagnostic Expert improves Service availability and MTTR through advanced Diagnostics MPLS Core, Aggregation and Access networks.

System Architecture

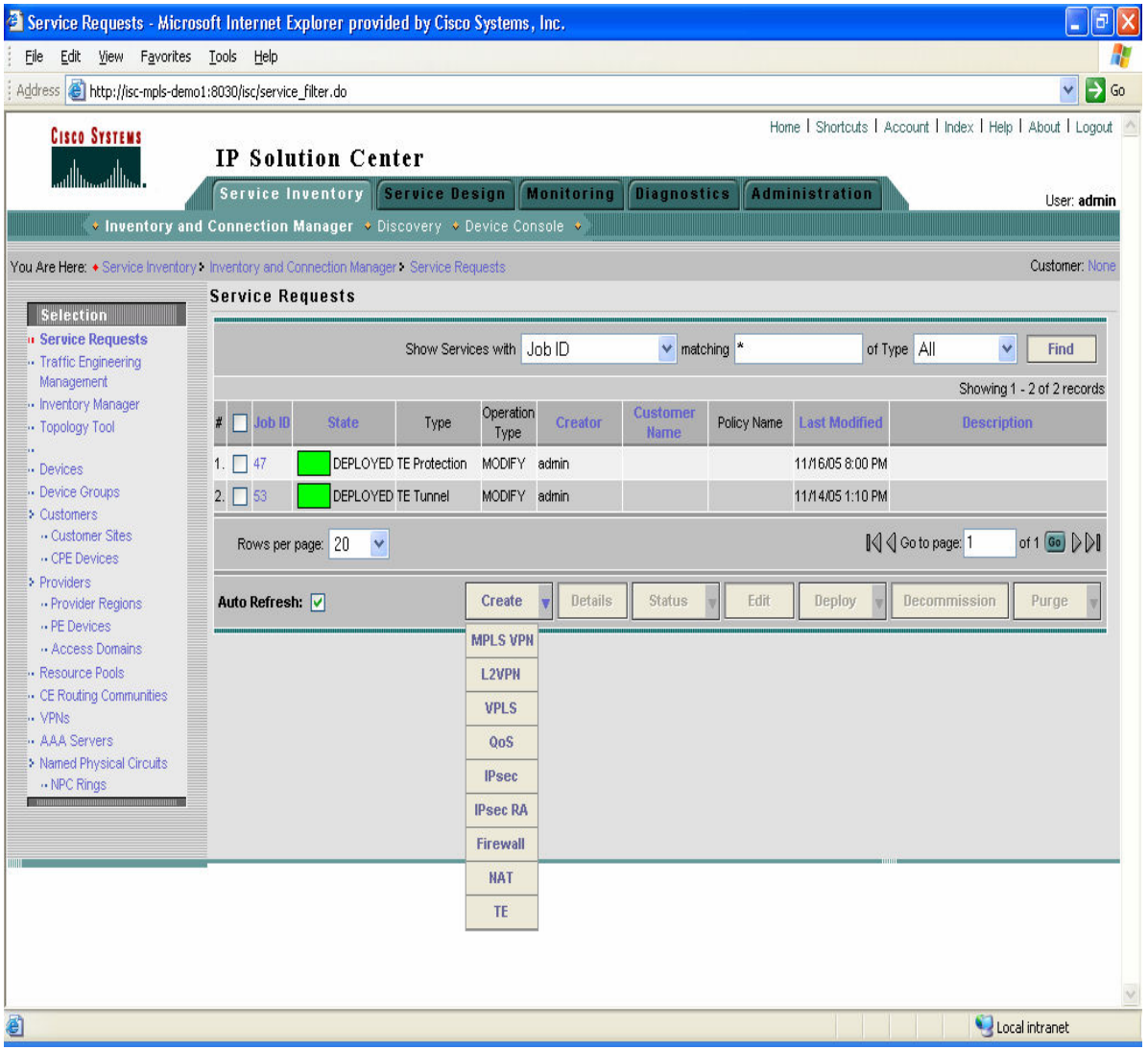


GUI - Top Level Organization

- Scalable distributed/ redundant architecture
- Centralized system resource management
- **Network/Service auto-discovery and inventory** mgmt
- **Topology tool with Physical and Service maps**
- Resource/User partitioning
- Web GUI
- Monitoring
- Scheduling
- Role based Access Control
- User audit trail
- Open XML API interface

GUI – Service Inventory and Service Requests

- Three kinds Of Users:
  1. Service Operator
  2. Network Operator
  3. Administrator
- Service Operator Creates Services by Service requests
- Network Operator Designs Service
- Administrator Manages The System
- Service Operator Will See Only the Service Inventory Tab.
- All Works Need To Be Done by Service Operators Are Listed In This Tab's Table Of Content.



MPLS Management Problems Addressed

- Provisioning
  - Complexity of MPLS VPN Service activation
  - Accuracy of configuration
  - Partitioning of provisioning tasks
  - Role Base Access Control
- Verification
  - Verification of configuration
  - Customer VPN routing verification
- Troubleshooting
  - Automation of root cause analysis
  - Complex configuration and core verification

MPLS VPN Provisioning Features

- **Resource Management**

  Manage AS, Regions, IP address pools, RD/RT Pools, VLAN pools, Provider administrative domains.

- **Design and Assign Policies**

  CERC (CE Routing Communities)

  Hub-n-spoke, full mesh, partial mesh VPN

  Pre-provisioning checks for design validity

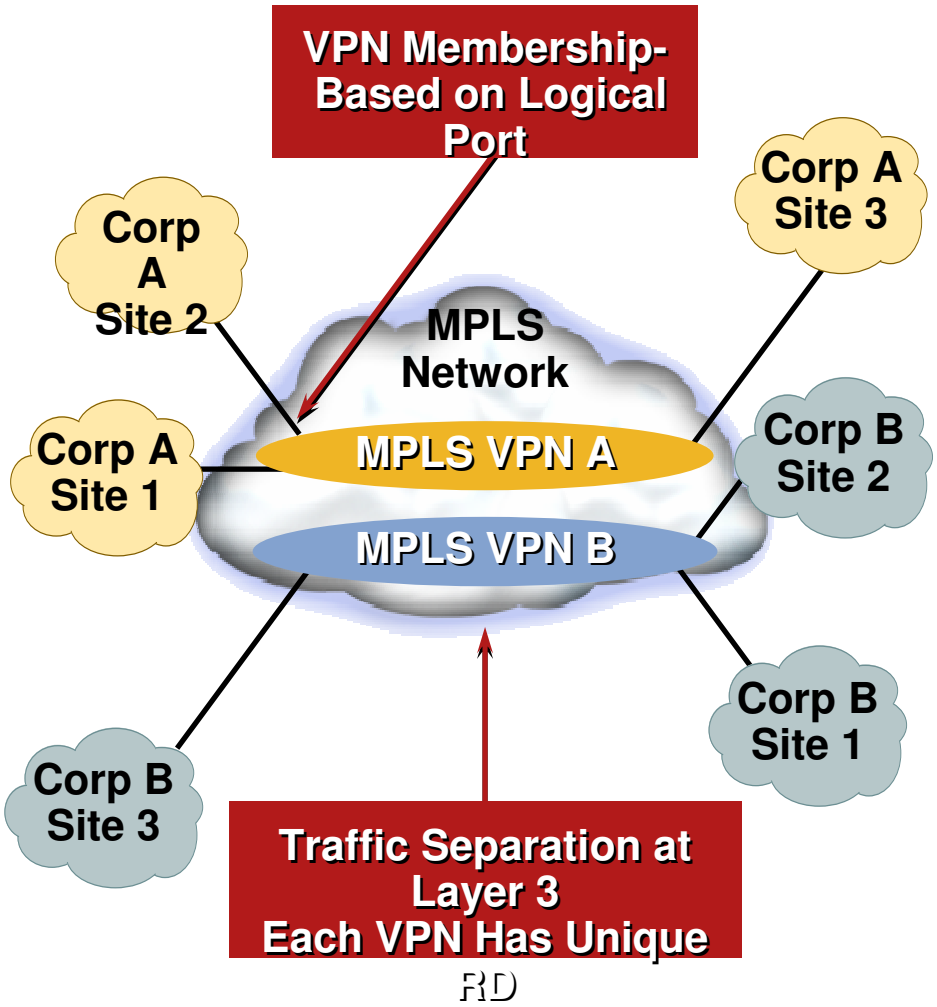
  Profile based design of services

  Routing protocol configuration for attachment circuits – RIP, OSPF, static, EIGRP, ISIS

- **Post Provisioning Verification**

  Smart Configuration and Routing audits; VRF Pings to validate VPN configuration.

  On demand Audits for configuration troubleshooting



MPLS VPN Verification and Diagnostic Features

- **Configuration verification**

  Accurate verification of service activation configuration

- **Post Provisioning Verification**

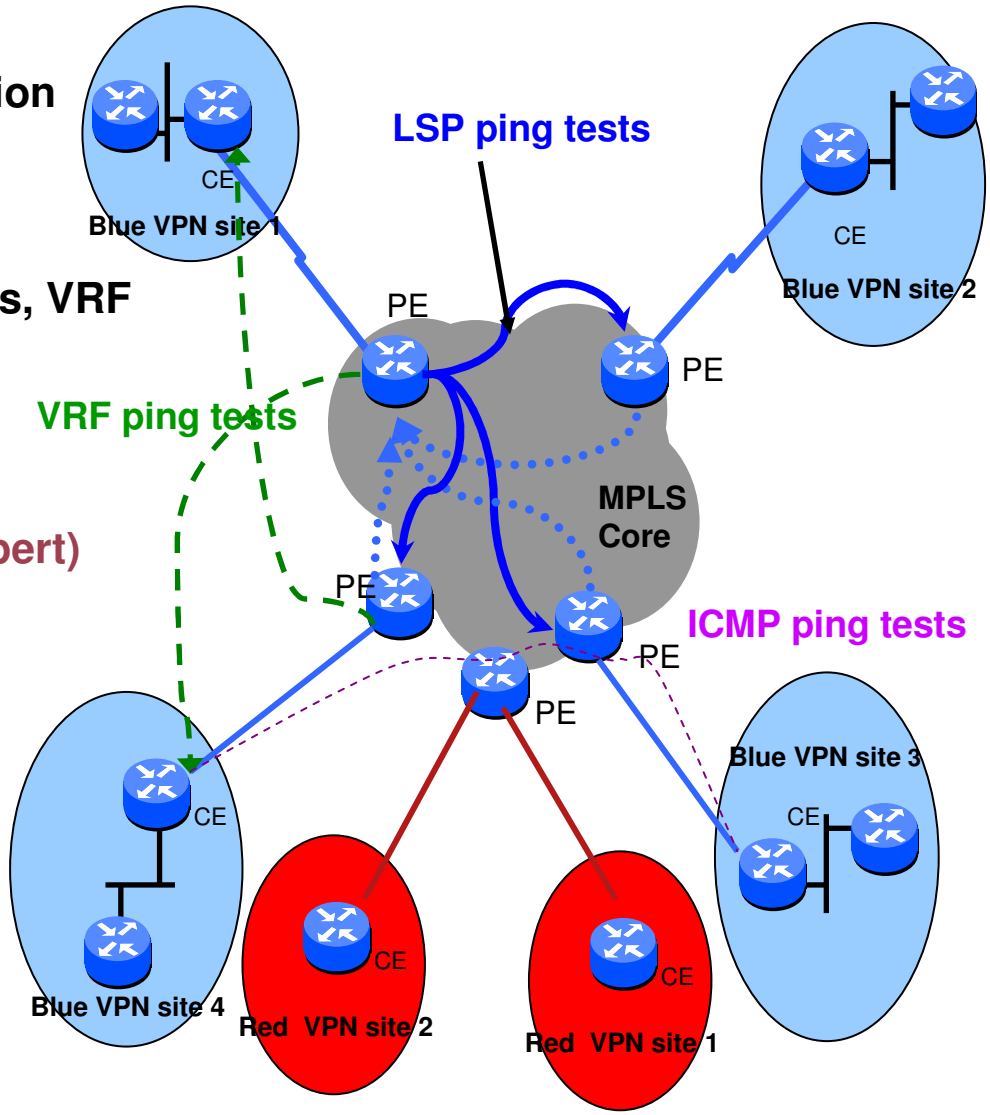
  Smart Configuration and Routing audits, VRF Pings to validate VPN configuration.

  On demand Audits for configuration troubleshooting

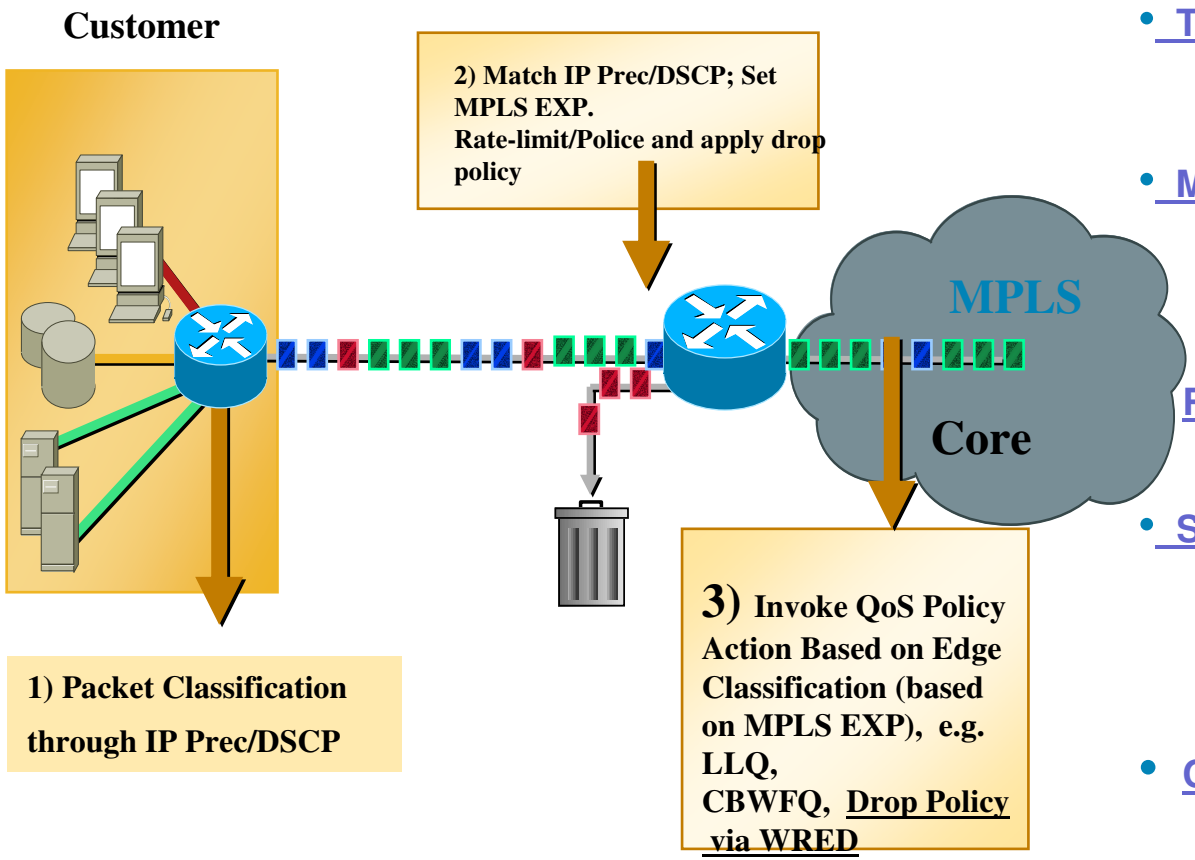
- **Diagnostic support (MPLS Diagnostics Expert)**

  New ISC Module – supports:

  - **Drill down to root cause**
  - **Control/data plane analysis**
  - **Summarised and detailed views**
  - **VRF Ping, LSP Ping, LSP trace,**



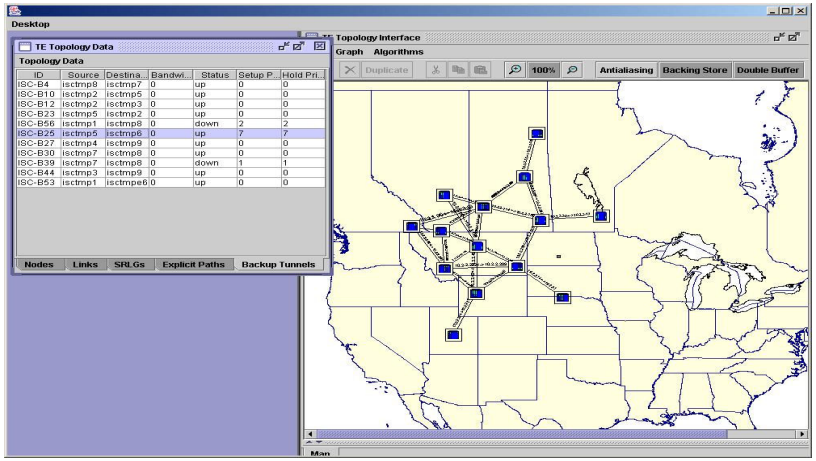
QoS Provisioning Features until ISC 4.x

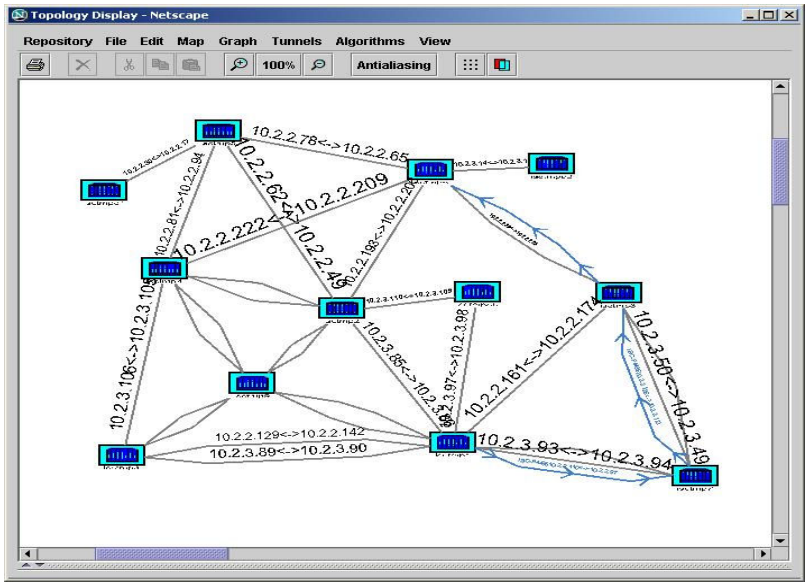


- Traffic Classification
  - Protocol ID, Src/Dest Addrs., Src/Dest Ports, Port Ranges, DSCP, IP Prec, L2 CoS
- Marking
  - DSCP between 0 & 63
  - IP Precedence between 0 & 7
  - MPLS Exp between 0 & 7 (when core has MPLS network)
- Rate-limiting
  - Class-based Single/Dual Rate Policer (MQC) and CAR (non-MQC)
- Shaping
  - CB-shaping (MQC), Interface-based GTS (non-MQC)
  - FRTS in the context of Frame-Relay
  - ATM Shaper (vbr-rt, vbr-nrt, abr, cbr ubr)
- Congestion Management
  - CBWFQ (for Data) + PQ (for voice)
  - WFQ (for Data) + PQ (for voice)
- Congestion Avoidance
  - WRED with DSCP & IP Precedence
- Link Efficiency
  - LFI over MLPPP
  - LFI over Frame-Relay, cRTP

ISC MPLS TE
MPLS TE Planning & Configuration

- Discovery and Audit
  - –MPLS TE topology, validation of placed tunnels
- Bandwidth Protection
  - –Compute placement of Fast Reroute backup tunnels to protect critical network elements
  - –Protect bandwidth against link, node, or SRLG (Shared Risk Link Group) failures
- Optimal DS-TE primary tunnel routing
  - –Compute and place new primary tunnel demands
- Provisioning
  - –Primary DS-TE tunnels, FRR for bandwidth protection and resiliency

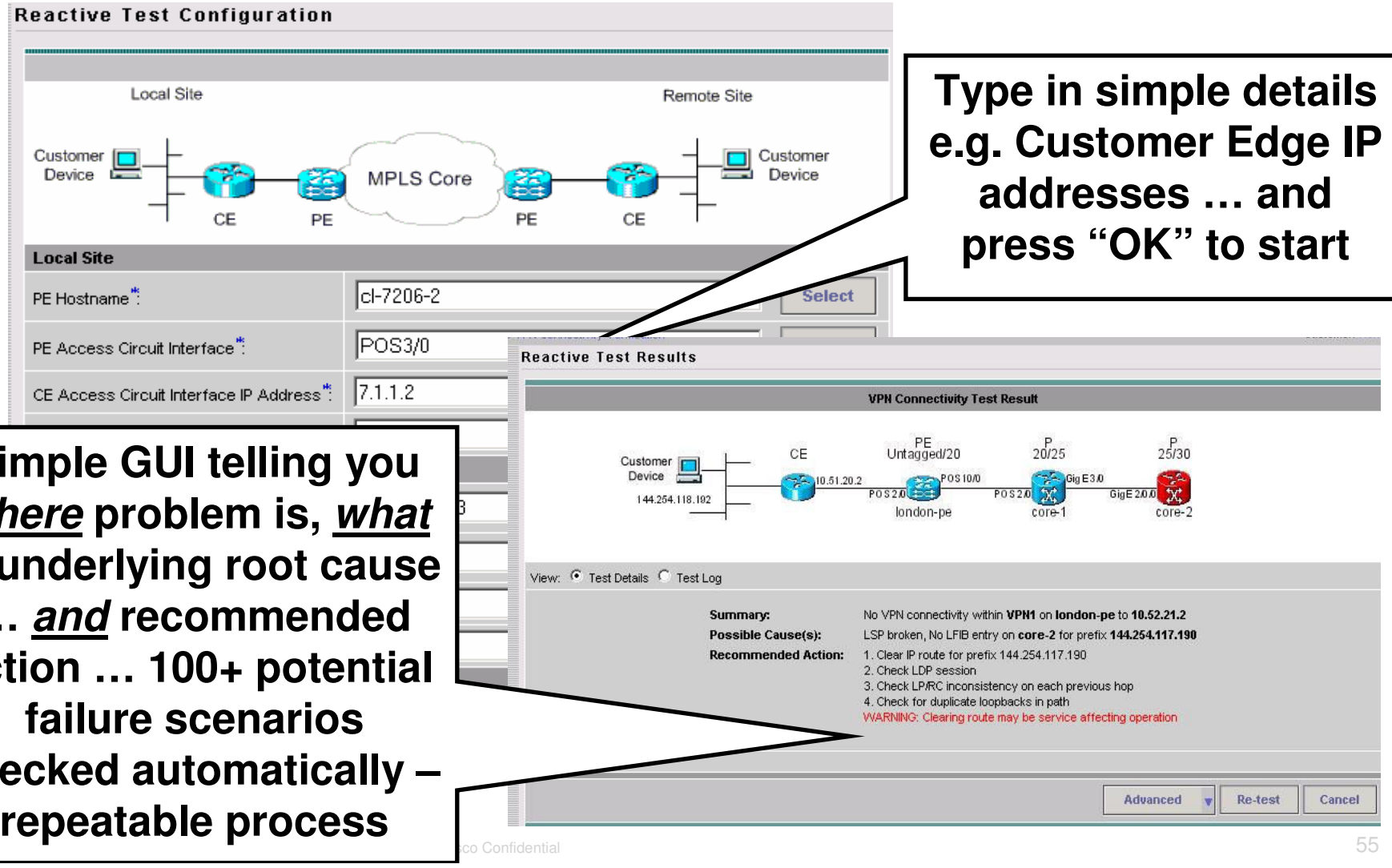




ISC MPLS Diagnostics Expert Automated Diagnosis of Problems in an MPLS Network

- **Edge: > 30 Unique Scenarios … including**
  - **Config issues e.g. Route Target Mismatches between Ingress/Egress PE**
  - **Interface not associated with VRF; VRF route limit exceeded**
  - **Inconsistencies – e.g. Route installed into BGP table but not VRF**
  - **Mismatches between FIB/LFIB; Routes not distributed into MP-BGP**
- **Core: > 30 Unique Scenarios … including**
  - **Config issues – *"finger trouble"* e.g. CEF/VPNv4 Address family disabled**
  - **Label allocation/installation issues; RP/LC inconsistencies**
  - **LSP Blackholes; Packets too big for Interface MTU**
- **Access Circuits: > 40 Unique Scenarios … including**
  - **Config issues - Interface admin down, Line protocol down**
  - **CE/PE connectivity – including automated execution of ATM & FR OAM**
  - **Packets being dropped in switched (ATM/FR) circuit**

Intelligent IOS MPLS Instrumentation & Cisco MPLS Diagnostics Expert



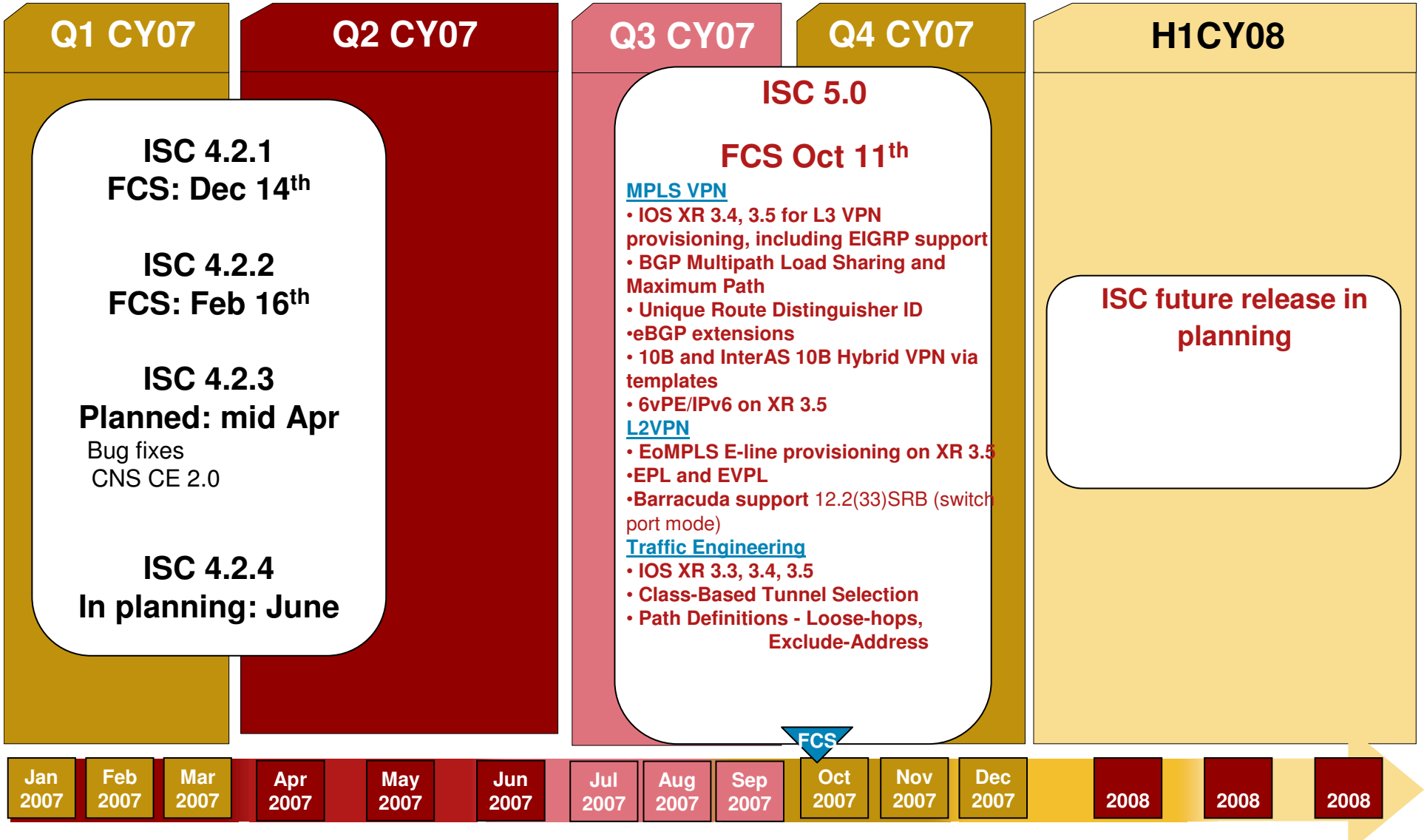
Type in simple details e.g. Customer Edge IP addresses … and press "OK" to start

Simple GUI telling you *where* problem is, *what* is underlying root cause … *and* recommended action … 100+ potential failure scenarios checked automatically – repeatable process

Cisco IP Solutions Center

Evolution – Releases & Roadmap

ISC Provisioning and TEM Application Roadmap



CRS & XR Management Package

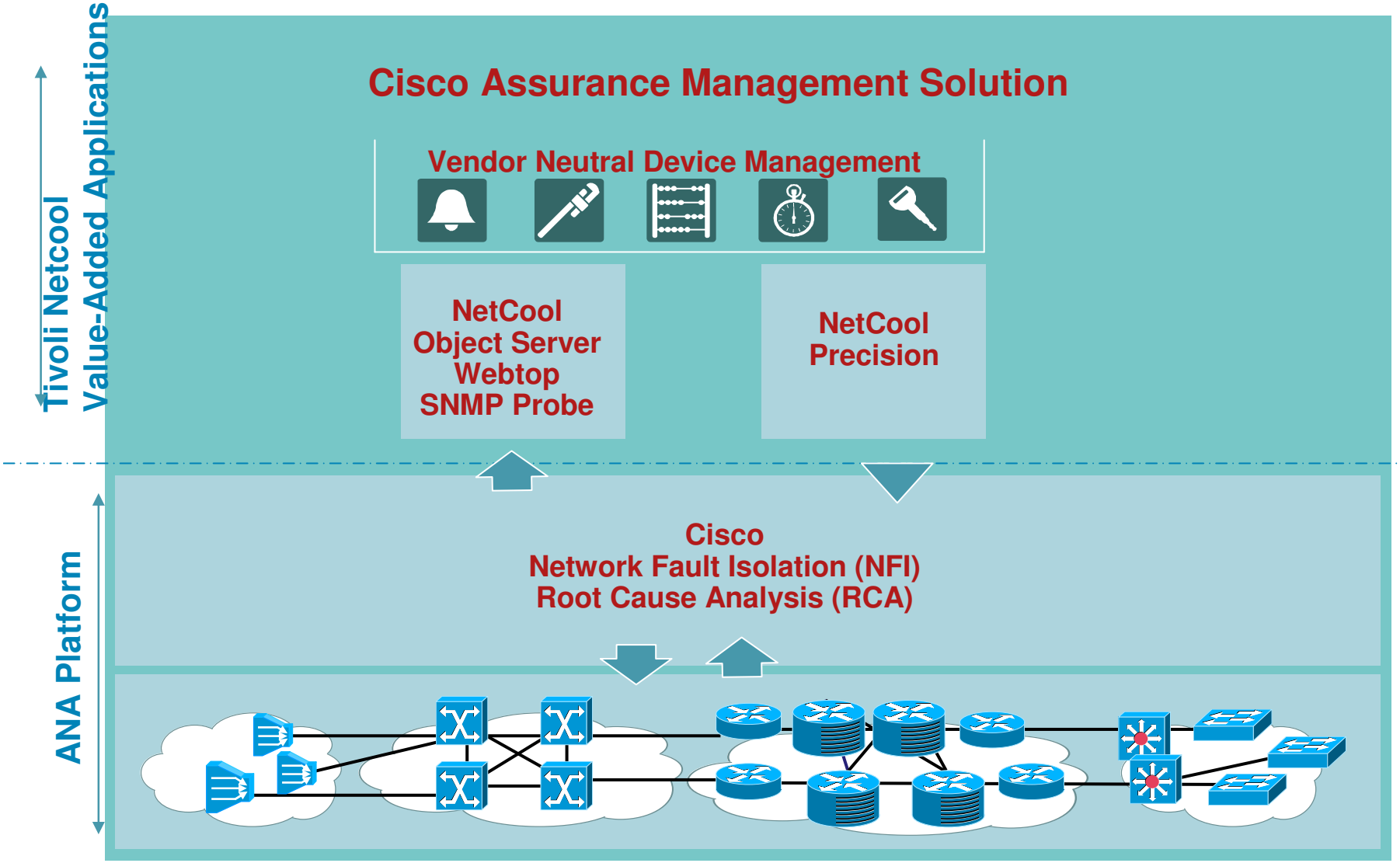
- Device Management for CRS and XR12K; opportunity for extension to edge & aggregation
- Joint program by NMTG, CRS and CA Advanced Services
- Worldwide availability for ‘any customer buying CRS, XR12K Hardware’ – not limited to top SPs
- Cisco build a new Virtual Network Element (VNE) for the CRS-1 and XR12000 to run on ANA 3.5.2
- Initial support will be for IOS XR R3.4.x with the commitment to upgrade the VNE as new versions of IOS XR are released

CRS & XR Management Package

- VNE for CRS-1 and XR12000
  - IOS XR R3.4.x
  - Logical & Physical Inventory
  - Fault collection and Display
- Solaris 10 Support
- NB Mediation Layer for WSDM compatibility with ANA 4.0

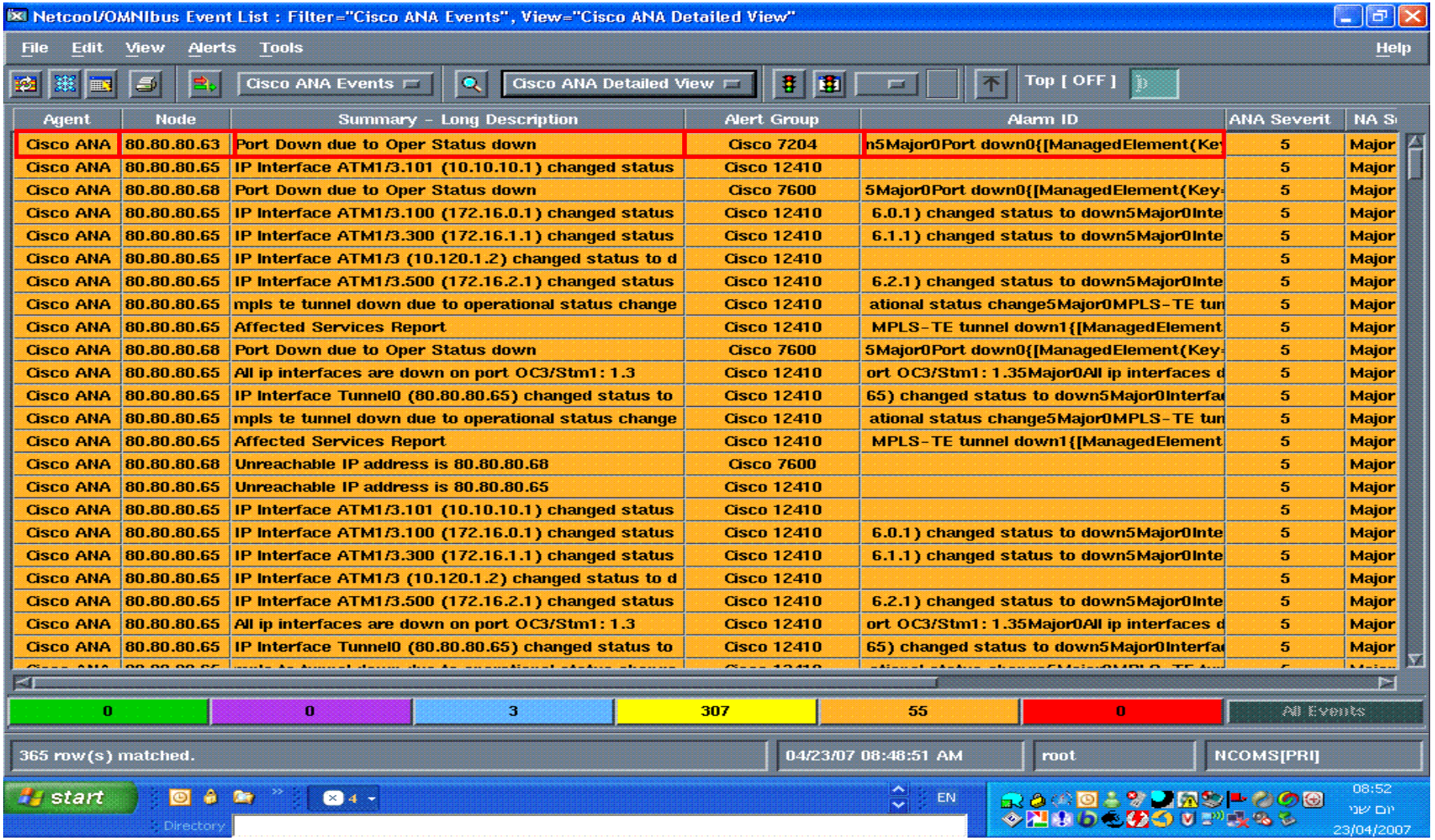
Cisco “Assurance Management Solution” Overview

Cisco Assurance Management Solution (AMS)
Bundle of IBM Tivoli/Netcool with Cisco ANA



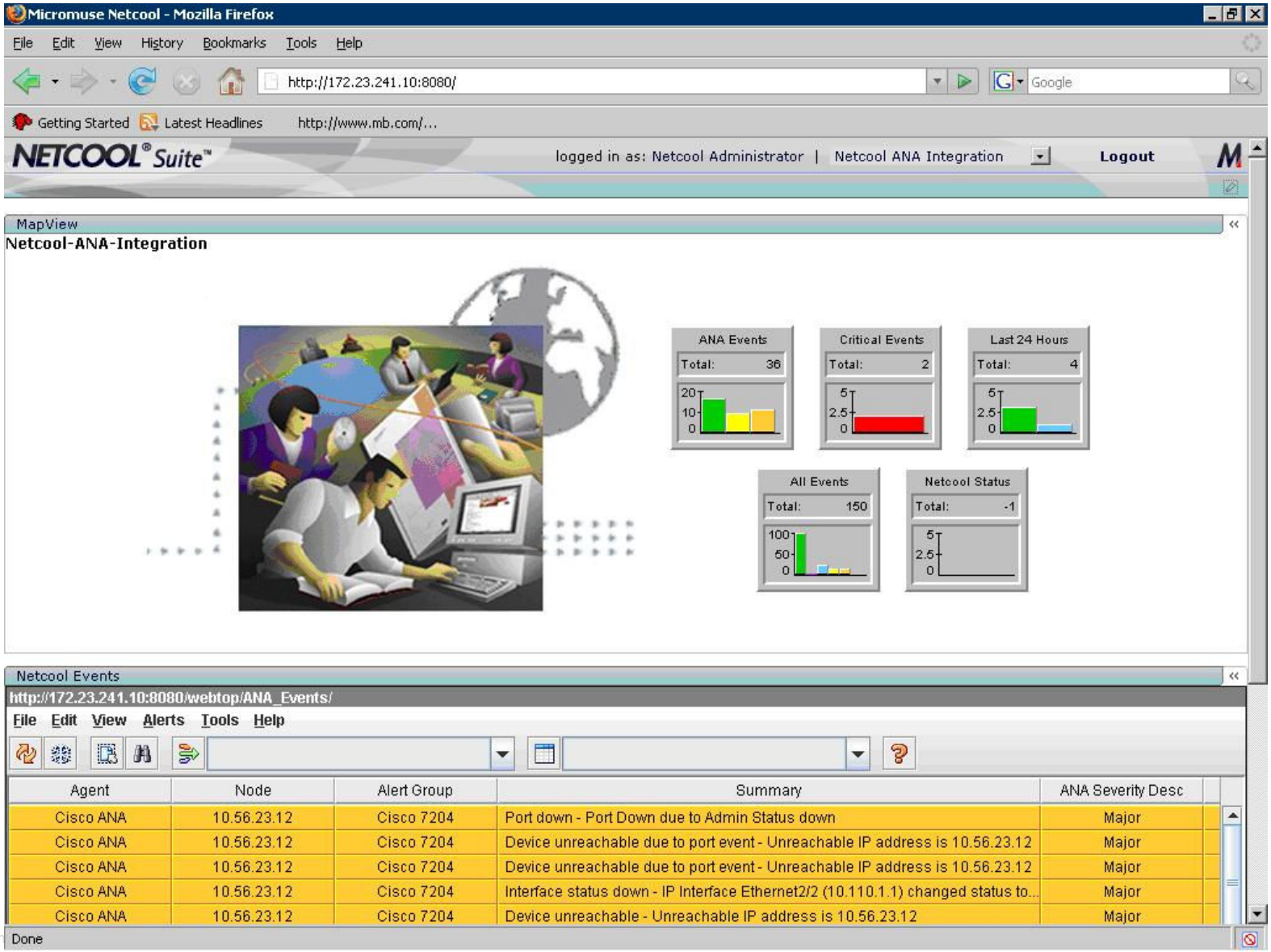
Assurance Management Solution - MoM

NetCool/Omnibus Desktop Event View



Assurance Management Solution - MoM

Netcool Omnibus – Webtop Event View



Cisco AMS Roadmap