13 Smart Automations to Monitor Your Cisco IOS Network

BRKNMS-2465

Abstract

Is there too much manual monitoring of your network?
Have you ever needed a metric beyond a single MIB value?
Need to temporarily monitor services during critical time windows?
Are you worried about maintaining the accuracy of your already configured monitoring?

Your Cisco IOS® Network provides a wealth of advanced device manageability instrumentation (DMI) and Embedded Automation Systems (EASy) to design and implement your own Network Automations.

Learn how Network Automation allows you to automate manual tasks, better operate existing network services and even enable new and innovative networking solutions.

This Breakout Session uncovers embedded Network Automation capabilities you can use to interact with your network elements for the purpose of implementing network testing, verification and service assurance in a more effective, efficient and robust way. Network Automation fundamentals as well as the choice and use of appropriate practices are illustrated through a combination of presentation and best practice examples. The topic is relevant for network planners and administrators, engineers and system integrators for both enterprises and service providers. …

Welcome Aboard …

This Session **is about:**

- HOW to monitor on your device
- Using Network Automation
- Based on features embedded within the devices
- Practical examples

This Session **is NOT about:**

- An introduction to NMS concepts
- An in-depth session on 1 single feature
- Engineering details of IOS
- NMS applications
- WHAT to monitor for specific devices or services

Agenda

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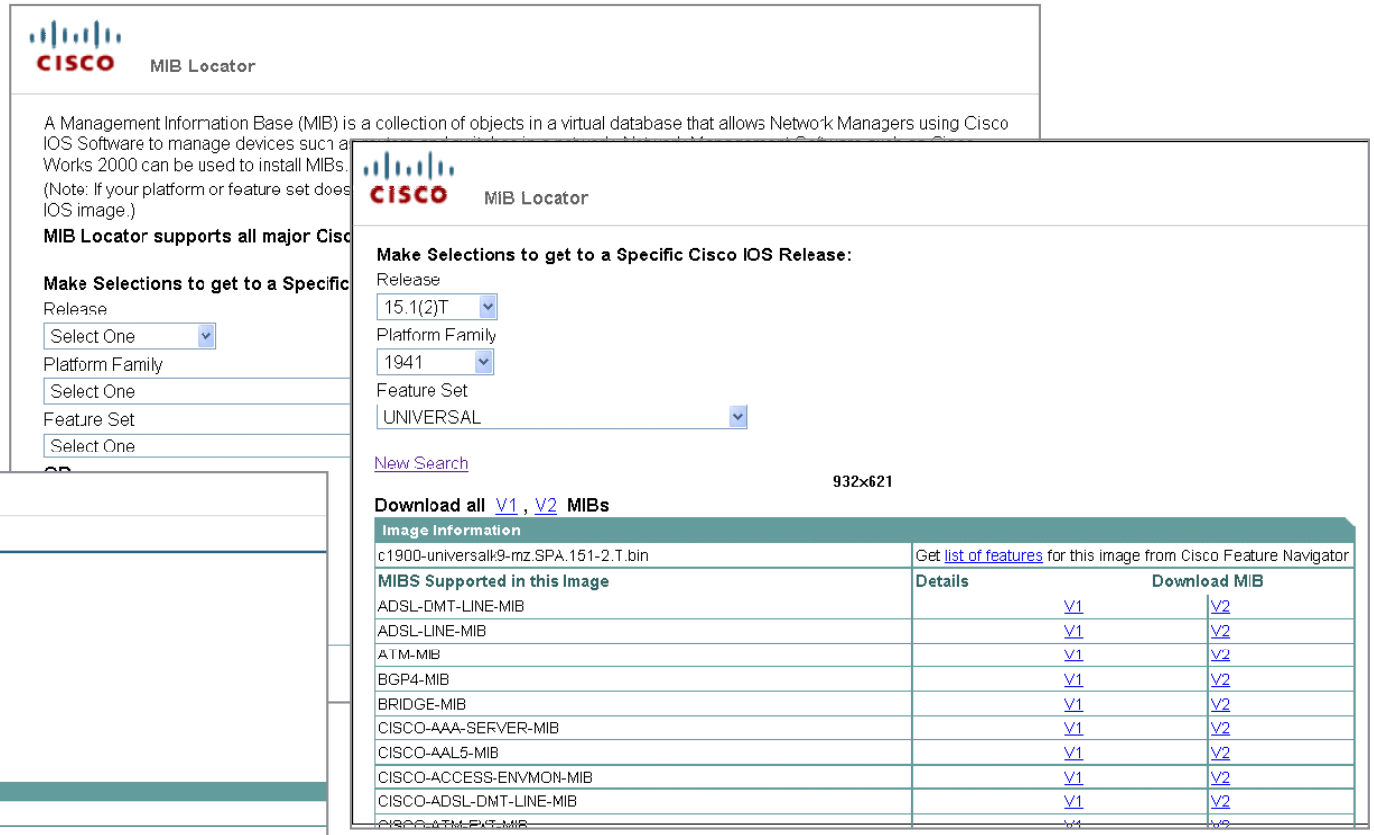
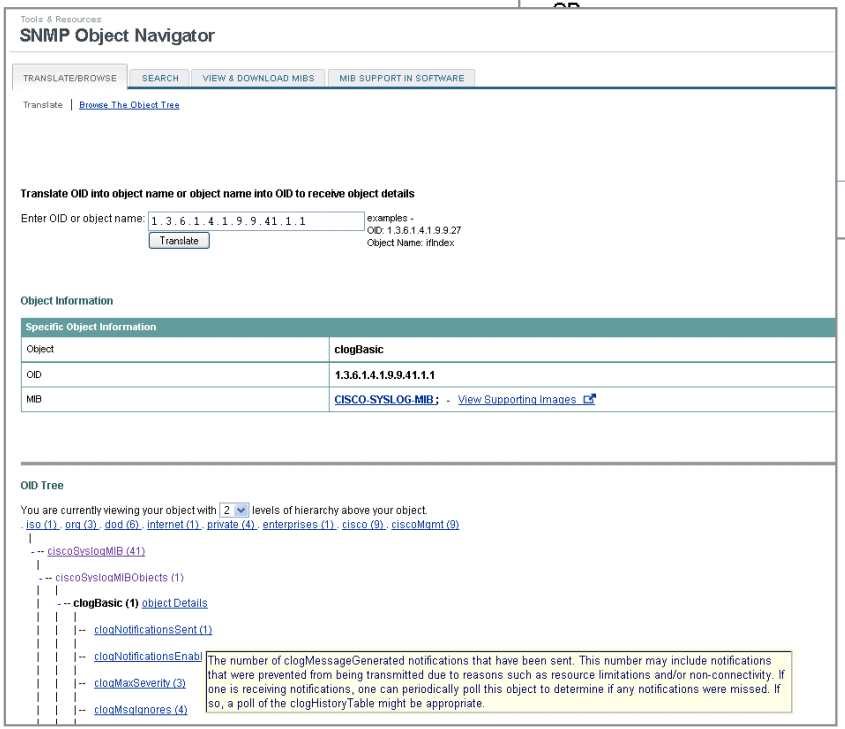
Where to Start with MIBs

Where to start with MIBs ?

MIB Locator:
http://www.cisco.com/go/mibs





SNMP Object Navigator:
http://www.cisco.com/go/mibs

Which OIDs are actually being used ?

Example: CiscoView polling

```
Router#show snmp statistics oid

time-stamp     #of times requested  OID
16:16:50 CET Jan 12 2005      97 sysUpTime
16:16:50 CET Jan 12 2005      9  cardTableEntry.7
16:16:50 CET Jan 12 2005      9  cardTableEntry.1
16:16:50 CET Jan 12 2005      4  cardTableEntry.9
16:16:50 CET Jan 12 2005      16 ifAdminStatus
16:16:50 CET Jan 12 2005      16 ifOperStatus
16:16:50 CET Jan 12 2005      6  ciscoEnvMonSupplyStatusEntry.3
16:16:50 CET Jan 12 2005      17 ciscoFlashDeviceEntry.2
16:16:50 CET Jan 12 2005      8  ciscoFlashDeviceEntry.10
16:16:50 CET Jan 12 2005      2  ltsLineEntry.1
16:16:50 CET Jan 12 2005      2  chassis.15
16:16:27 CET Jan 12 2005      11 ciscoFlashDeviceEntry.7
16:16:27 CET Jan 12 2005      2  cardIfIndexEntry.5
16:16:24 CET Jan 12 2005      1  ciscoFlashDevice.1
```

Available from: IOS 12.0(22)S, 12.4(20)T

MIB Persistence – 1/3

- Feature which can make ifIndex persist across reboots (In Switches is on by default)
- ifIndex persistence means that the mapping between the ifDescr (or ifName) and ifIndex object values from the IF-MIB is retained across reboots.
- Useful:

  SNMP: monitoring the interfaces counters

  NetFlow: reporting of the interface ifIndex

  RMON: events/alarms based on specific interfaces
- 25 bytes of NVRAM used by this feature per interface.

Applying ifIndex persistence to all interfaces

```
Router(conf)# snmp-server ifindex persist
Router(config-if)# snmp-server ifindex persist
```

Applying ifIndex persistence to an specific interface

MIB Persistence – 2/3

Now there is a show command:

```
Router# show snmp mib ifmib ifindex
 Ethernet0/0: Ifindex = 1
 Loopback0: Ifindex = 39
 Null0: Ifindex = 6
:

Router# snmp mib ifmib ifindex loopback 0
 Loopback0: Ifindex = 39
```

Introduced in 12.0(7)S, 12.2(2)T

http://www.cisco.com/en/US/customer/products/sw/iosswrel/ps1839/products_feature_guide09186a0080087b0d.html

MIB Persistence – 3/3

```
Router(config)# snmp-server ifindex persist
Router(config)# snmp mib persist event
Router(config)# snmp mib persist expression
Router(config)# snmp mib persist circuit
Router(config)# snmp mib persist cbqos
```

EVENT-MIB

EXPRESSION-MIB

CIRCUIT-MIB

CISCO-CLASS-BASED-QOS-MIB

- You must perform a *copy running starting* command to persist the newly assigned ifIndex values.

copy running start!

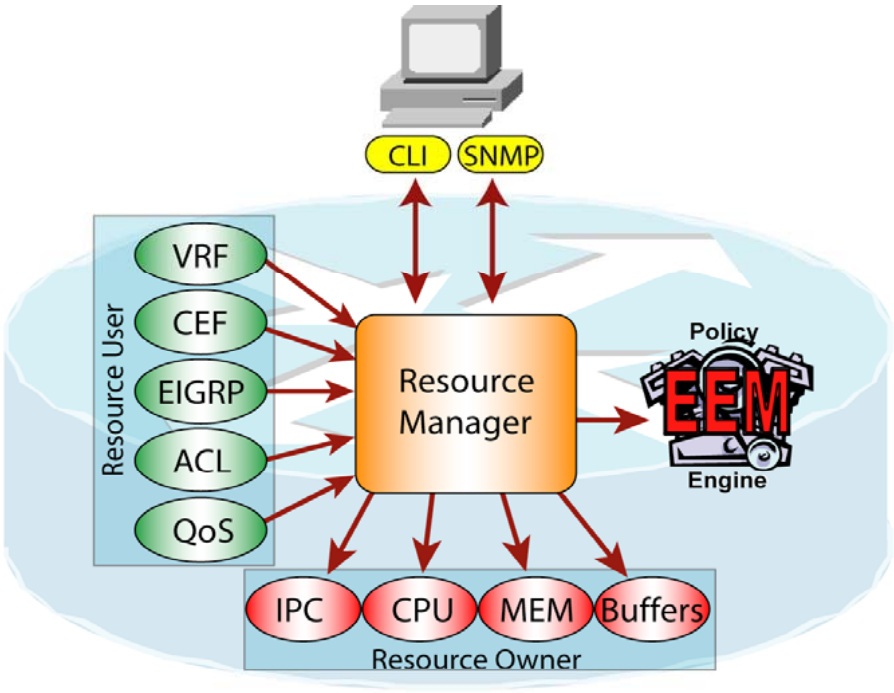
```
Router # dir nvram:ifInde          ble
  Directory of nvram:/i ndex-table
      2   -rw-   283   <no date>  ifIndex-table
  126968 bytes total (114116 bytes free)
```

2

Monitoring Resource Consumption

Embedded Resource Manager (ERM)

- The ERM framework tracks resource depletion and resource dependencies across processes and within a system
- Monitor thresholds for CPU, buffer, and/or memory
- For system or line card
- ERM can define "group", i.e. group of different CPU processes
- CISCO-ERM-MIB
- Interface into EEM



Available from: IOS 12.2(33)SRB, 12.4(15)T
Platforms: UC520, 800, x8xx ISR,x900x ISR, 65xx, 72xx, 73xx, 75xx, 76xx, 10xxx

Example – Monitoring Resources

Problem: During the planning cycle, we would like to understand if total CPU usage reaches critical levels

Solution: Define an ERM policy to notify upon resource depletion

```
resource policy
 policy my-erm-policy-1 type iosprocess
  system
    cpu total
     critical rising 90 interval 15 falling 20 interval 10 global
     major rising 70 interval 15 falling 15 interval 10 global
     minor rising 60 interval 15 falling 10 interval 10 global
!
```

➔ If **Total** CPU usage count rises above 90% at an interval of 15s, a Critical Up notification is sent

```
Feb 17 13:32:18.283: %SYS-4-CPURESRISING: System is seeing global
cpu util 62% at total level more than the configured minor limit 60%
```

Example – Monitoring Multiple Processes

Problem: In order to detect resource consumption caused by brute force login attempts, we want to keep an eye on CPU utilization by the login processes

Solution: Define an ERM policy to notify upon critical / suspicious levels

```
resource policy
  policy my-login-policy type iosprocess
    system
      cpu process
        critical rising 30 interval 10 falling 20 interval 10
        major rising 20 interval 10 falling 10 interval 10
        minor rising 10 interval 10 falling 5 interval 10
  user group my-login-group type iosprocess
    instance "SSH Process"
    instance "SSH Event handler“
    :
    policy my-login-policy
```

➔ Syslog if **Group** CPU Usage Count Rises Above 10% at an Interval of 10s

```
*Aug 25 12:56:26.089: %SYS-4-CPURESRISING: Resource group my-login-group is
seeing local cpu util 16% at process level more than the configured minor limit
10%

*Aug 25 12:56:41.089: %SYS-6-CPURESFALLING: Resource group my-login-group is no
longer seeing local high cpu at process level for the configured minor limit
10%, current value 0%
```

3

Custom MIB Variables and Notifications

Expression MIB

- Allows you to create new SNMP objects based upon existing MIB variables and formulas
- Interesting when combined with the EVENT-MIB
- EXPRESSION MIB proposed by Cisco to IETF DISMON Working Group, accepted standard track RFC-2982
  - Based on IETF draft, again in the DISMON Working Group, and numbered in Cisco's namespace
- 3 Phases:
  - MIB Introduction, SNMP Only - 12.0(5)T
    - However "show command" exists
    - However "debug command" exists
  - Introduction of Scriptable Interface
  - Introduction of CLI Support - 12.4(20)T

See: http://www.cisco.com/en/US/docs/ios/netmgmt/configuration/guide/nm_cfg_snmp_sup.html
Available from: IOS 12.0(5)T (EXPRESSION-MIB), 12.3(7)T (SNMPset in TCL script), 12.4(20)T (CLI)

Event-MIB

- The EVENT MIB provides a superset of the capabilities of the RMON alarm and event
- EVENT MIB can monitor
  - any MIB object (existence)
  - any integer/counter (boolean, threshold)
- EVENT-MIB sends an SNMP notification in response to a trigger (like RMON) but add the concept of setting a MIB object (integers)
- EVENT-MIB can specify which variables to add to the notification
- RFC 2981-compliant introduced in 12.2(4)T
- Configuration support via CLI added in 12.4(20)T

See: http://www.cisco.com/en/US/docs/ios/netmgmt/configuration/guide/nm_cfg_snmp_sup_ps6441_TSD_Products_Configuration_Guide_Chapter.html#wp1125529
Available from: IOS 12.2(4)T (EVENT-MIB), 12.3(7)T (SNMPset in TCL script), 12.4(20)T (CLI)
Platforms: x8xx ISR,x900x ISR, 72xx, 73xx, 76xx

EXPRESSION-& EVENT-MIB

- Simply capacity planning example: if my link utilization is above 50% for an hour, it's time to upgrade the link
- Steps:
  1. Create an Expression

  Utilization = (Δ ifInOctets + Δ ifOutOctets) * 8 * 100 / hour / ifSpeed

  2. Create an Event

  If utilization > 50% → generate an Event

Expression-MIB

Event-MIB

EXPRESSION-& EVENT-MIB

- Simply capacity planning example: Calculate link utilization on all the interfaces in the router

```
Router# show running | beg expression
snmp mib expression owner administrator name exp3
  expression ($1*800)/$2
  enable
  object 1
    id ifInOctets
    wildcard
  object 2
```

```
NMS% snmpwalk -c public -v 2c <router> expValueCounter32Val
SNMPv2-SMI:: expValueCounter32Val.7.109.97.114.105.115.111.108.4.101.120.112.51.0.0.1 =
Counter32: 214800
SNMPv2-SMI:: expValueCounter32Val.7.109.97.114.105.115.111.108.4.101.120.112.51.0.0.2 =
Counter32: 0
SNMPv2-SMI:: expValueCounter32Val.7.109.97.114.105.115.111.108.4.101.120.112.51.0.0.4 =
Counter32: 0
SNMPv2-SMI:: expValueCounter32Val.7.109.97.114.105.115.111.108.4.101.120.112.51.0.0.5 =
Counter32: 0
```

4

What if it’s neither in ERM nor a MIB?

Service Planning

Adding a Custom MIB Variable

- **Problem:** Collect data via SNMP, even if there is no MIB support currently available.

- **Solution:** Expression-MIB provides the capability to process data into more relevant information via SNMP
  - Expression-MIB can be configured using SNMP directly since 12.0(5)T.
  - Initially Cisco Implementation was based on OID 1.3.6.1.4.1.9.10.22 but current Cisco implementation is based on RFC2982-MIB, OID 1.3.6.1.2.1.90.
  - In 12.4(20)T Expression-MIB feature is enhanced to add CLIs to configure expressions.

- Expression-MIB can gather data from Command Line Interface (CLI show commands), even if there is no MIB support

- EEM 3.1 provides similar capability without the need to involve Expression-MIB or Event-MIB

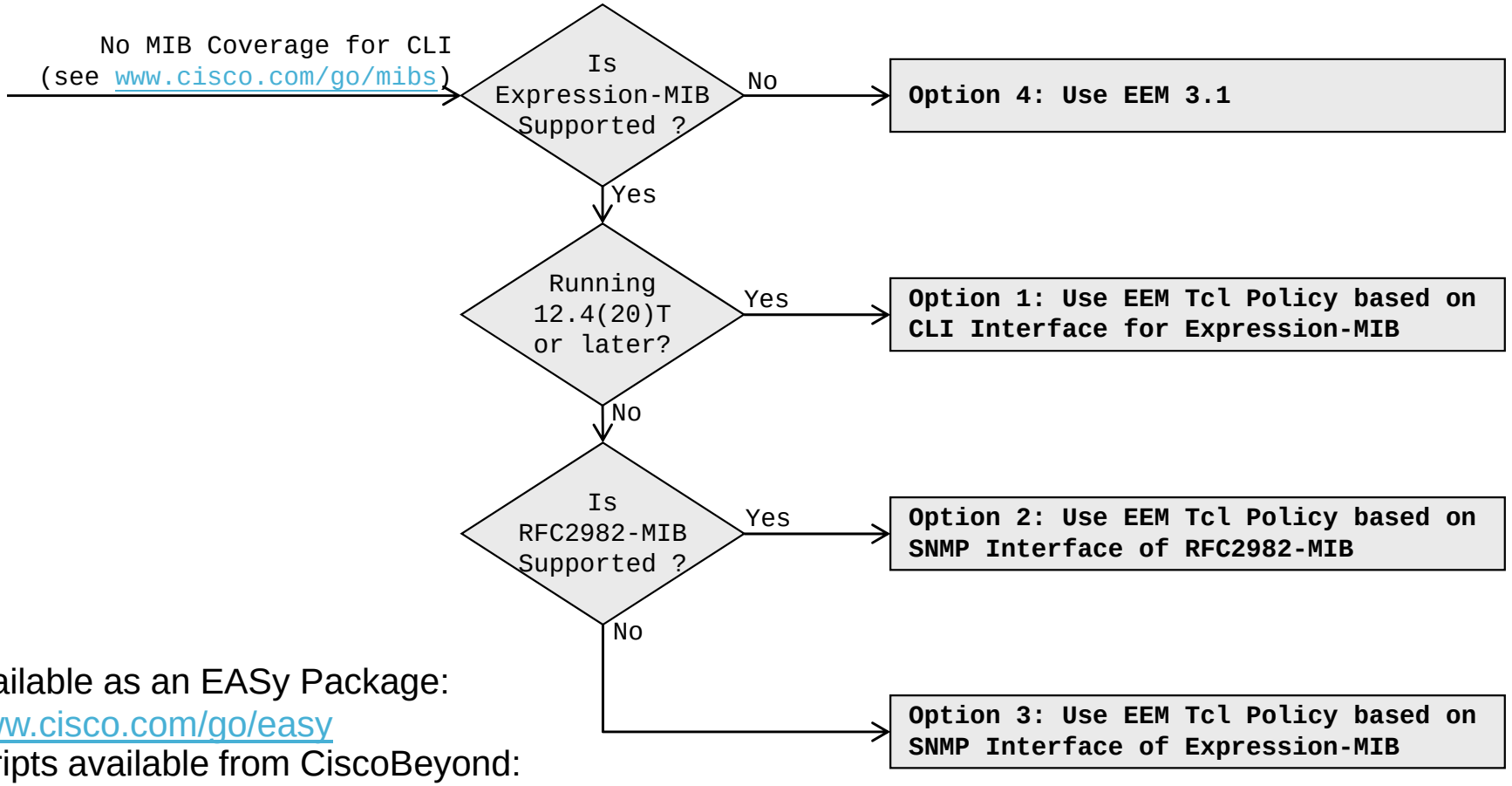
See: http://www.cisco.com/en/US/docs/ios/netmgmt/configuration/guide/nm_cfg_snmp_sup.html

Service Planning

Custom MIB Polling

Problem: Sometimes there is a show command – but no MIB support. What if we still want to collect the Information via SNMP ?

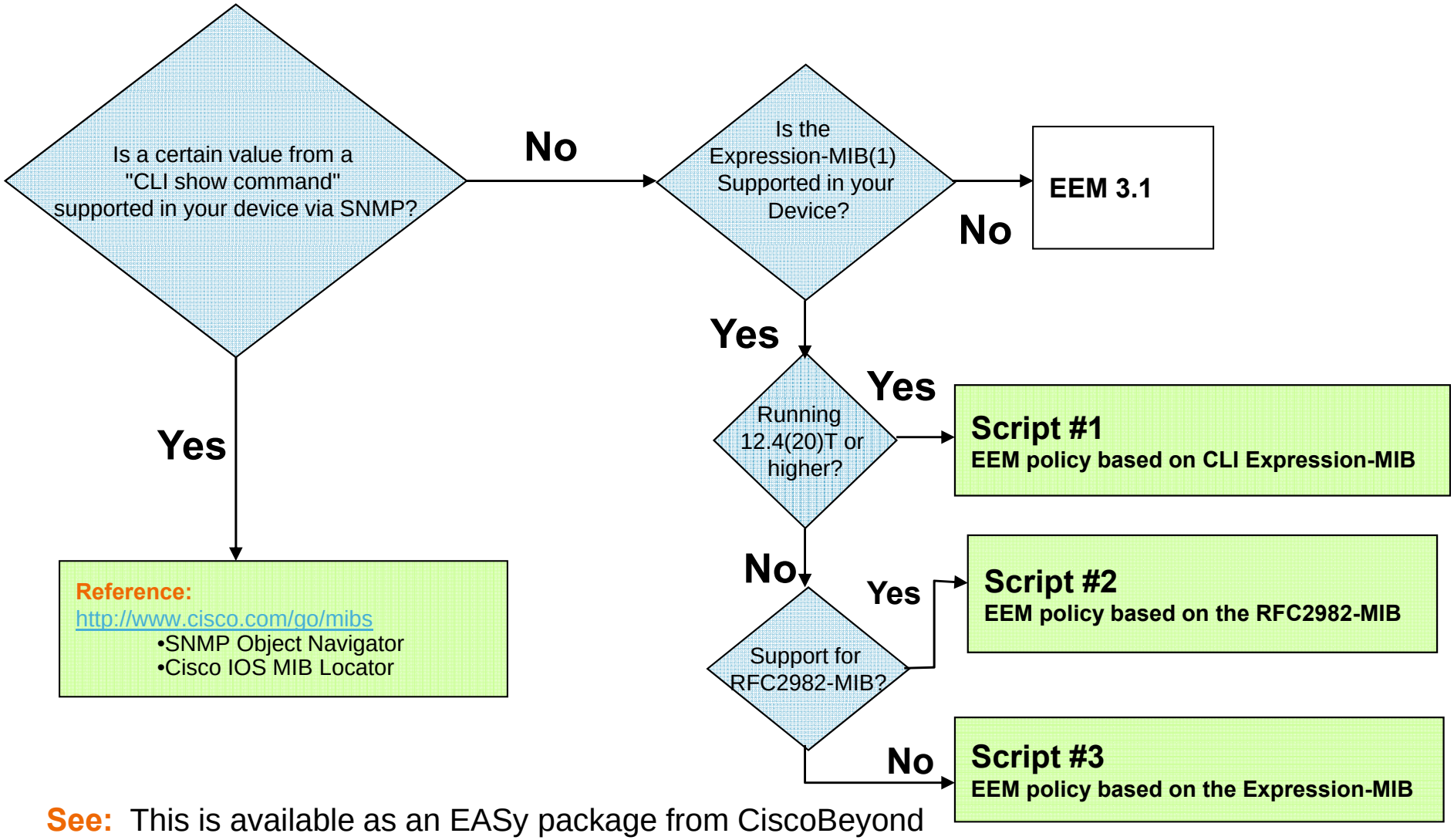
Solution: Automate Custom MIB Polling via EEM and Expression-MIB or RFC2982-MIB depending on Cisco IOS Version



See: Available as an EASy Package:
http://www.cisco.com/go/easy
See: Scripts available from CiscoBeyond:
http://forums.cisco.com/eforum/servlet/EEM?page=eem&fn=script&scriptId=1961
For the ASR 1000, http://forums.cisco.com/eforum/servlet/EEM?page=eem&fn=script&scriptId=2283

Service Planning

Adding a Custom MIB Variable

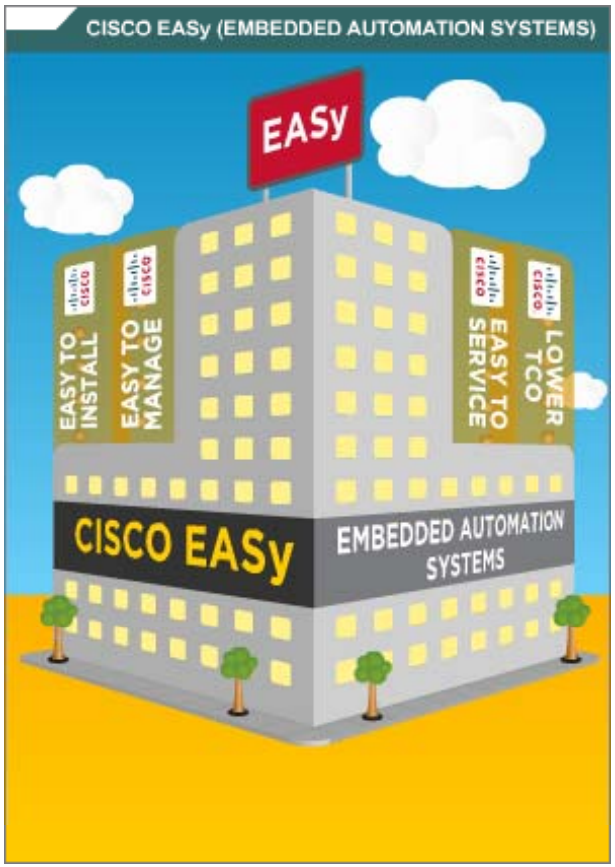


See: This is available as an EASy package from CiscoBeyond
http://forums.cisco.com/eforum/servlet/EEM?page=eem&fn=script&scriptId=1961

For the ASR 1000 version
http://forums.cisco.com/eforum/servlet/EEM?page=eem&fn=script&scriptId=2283

Service Planning

Custom MIB – EASy Package



Embedded Automation Systems (EASy)

Custom MIB EASy Package:

- **Periodically evaluate a show command**
- **Update a custom MIB Variable**
- **Trigger Syslog and/or custom actions**

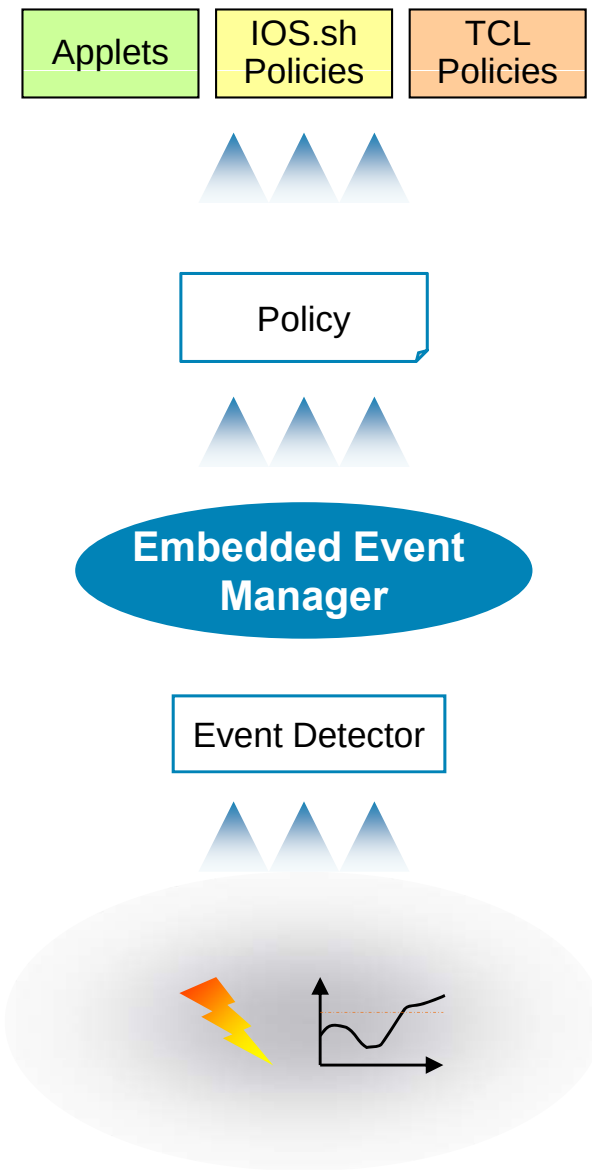
To use the Package:

1. Browse and Download EASy Package
   www.cisco.com/go/easy
2. Make Sure to also download EASy Installer
3. Watch VOD and/or read documentation
   www.cisco.com/go/easy
4. Customize and tailor to your needs
5. Install and Use

5

Events and Automations

Embedded Event Manager (EEM)



3. An EEM Policy is activated that initiates a pre-defined set of actions

2. An EEM Event Detector receives notification

1. Something happens on the  causing an Event to trigger

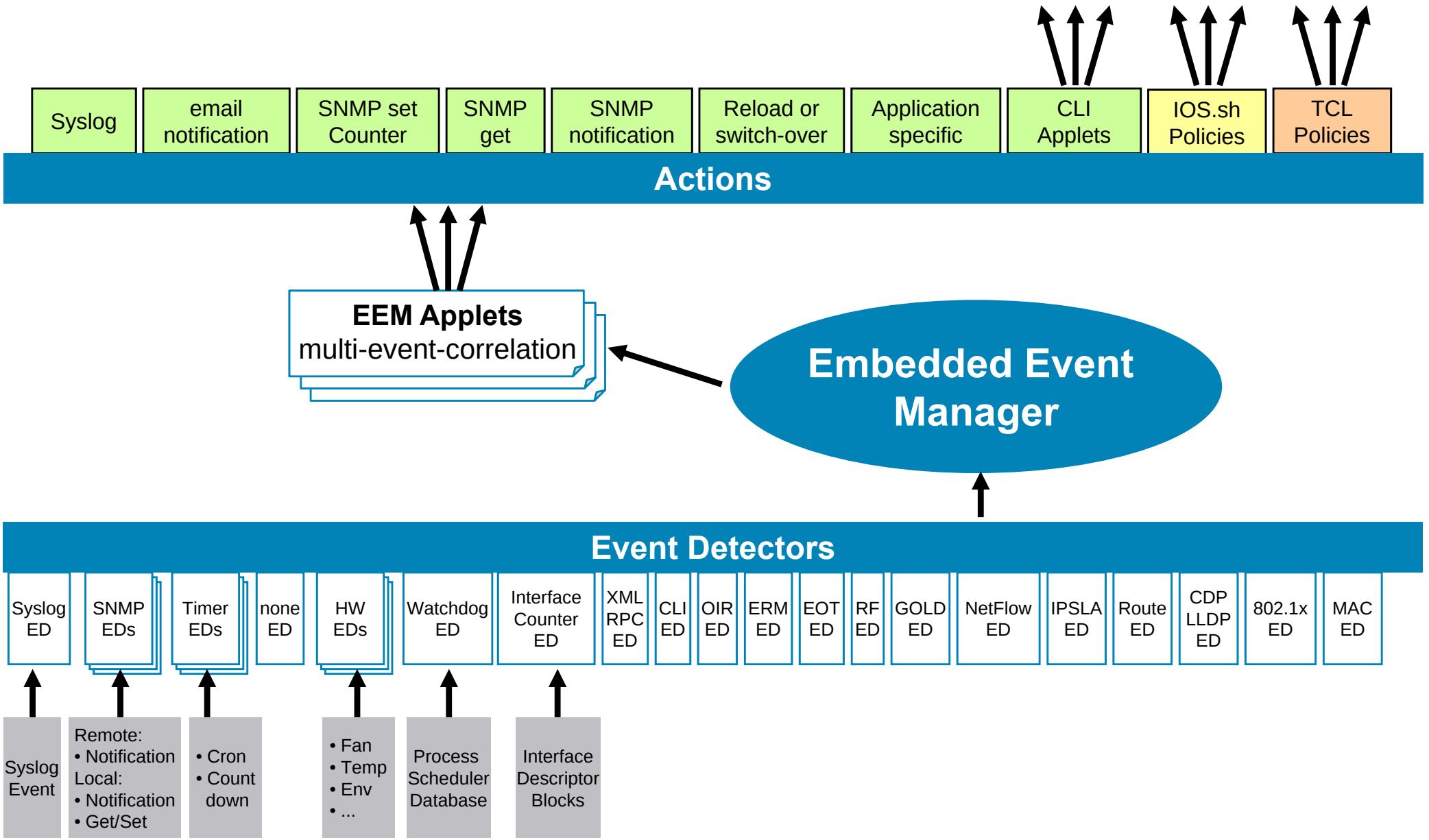
Embedded Event Manager (EEM) Versions

- Embedded monitoring of different components of the system via a set of software agents (event detectors)
- Event detectors (ED) notify EEM when an event of interest occurs; based on this, a policy will trigger an action to be taken
- Advantages: Local programmable actions, triggered by specific events – growing set of detectors and actions:
  - EEM 1.0 introduced in 12.0(26)S, 12.3(4)T
  - EEM 2.0 introduced in 12.2(25)S
  - EEM 2.1 introduced in 12.3(14)T
  - EEM 2.2 introduced in 12.4(2)T
  - EEM 2.3 introduced in 12.4(11)T
  - EEM 2.4 introduced in 12.4(20)T
  - EEM 3.0 introduced in 12.4(22)T
  - EEM 3.1 introduced in 15.0(1)M
  - EEM 3.2 introduced in 12.2(52)SE
  - stay tuned ...

Adds multi-event correlation

Adds programmatic Applets

EEM Architecture



EEM Applets and Policies

CLI Applets	IOS.sh Policies	TCL Policies
▪ Part of the Cisco IOS Configuration	▪ Separate ASCII File `my-policy.sh`	▪ Separate ASCII File `my-policy.tcl`
▪ Based on CLI Commands	▪ Based on Cisco IOS CLI and Shell Commands	▪ Based on Cisco IOS CLI and Safe TCL Commands
▪ Simple Actions	▪ Effective shell-like simple scripting	▪ Flexible and powerful scripting capabilities
▪ Programmatic Applet Extensions	▪ Registered via the Cisco IOS Config	▪ Registered via the Cisco IOS Config

Packaging Embedded Automations

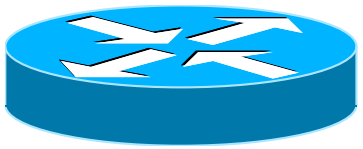
Problem: Automations may consist of multiple elements – how to deploy them in a professional and efficient manner ?

Solution I: Write detailed requirements and step-by-step instructions

Solution II: Create an installable EASy package

- Package Description
- Pre-Requisite Verification
- Pre-Installation Config
- Pre-Installation Exec
- Environment Variables
- Configuration
- Files
- Post-Requisite Verification
- Post-Installation Config
- Post-Installation Exec
- Uninstall

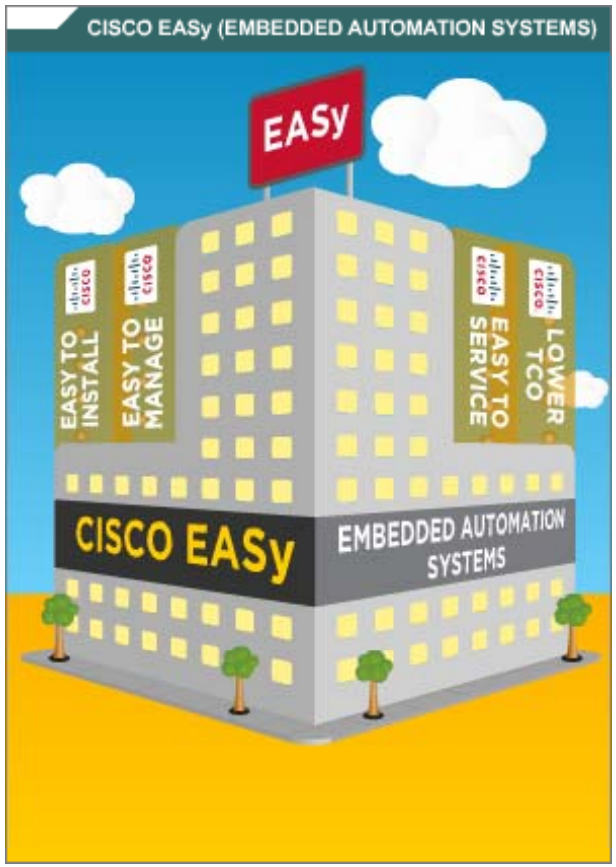
EASy Installer + MyPackage.tar = Menu Guided Installation



```
Router# easy-installer tftp://10.1.1.1/mypackage.tar flash:/easy
-----------------------------------------------------------------
Configure and Install EASy Package ‘mypackage-1.03'
-----------------------------------------------------------------
1. Display Package Description
2. Configure Package Parameters
3. Deploy Package Policies
4. Exit

Enter option: 2
```

See: http://www.cisco.com/go/easy
See: http://www.cisco.com/en/US/prod/collateral/iosswrel/ps6537/ps6555/ps10777/application_note_c27-574650.html

Embedded Automation Systems



Embedded Automation Systems (EASy)

1. Browse and Download EASy Packages
   www.cisco.com/go/easy
2. Make Sure to also download EASy Installer
3. Browse Other Embedded Automations
   www.cisco.com/go/ciscobeyond
4. Learn About The Technology Under The Hood
   www.cisco.com/go/instrumentation
   www.cisco.com/go/eem
   www.cisco.com/go/pec
5. Discuss, Ask Questions, Suggest Answers
   supportforums.cisco.com
6. Upload your own Examples to CiscoBeyond
   www.cisco.com/go/ciscobeyond
7. Engage via ask-easy@cisco.com

Example: Integrating CleanAir and Security

Problem: A new rogue WLAN device in sensitive areas should be detected by Cisco CleanAir and automatically focus/pan/zoom a security camera.

Solution: Use Network Automation based on Cisco IOS Embedded Event Manager to receive an SNMP Notification from WLC and trigger the Video Operations Manager via HTTP

1. Rogue WLAN Device added
2. Rogue Device detected by CleanAir AP
3. WLC sends SNMP Notification
4. EEM triggers upon SNMP Notification
5. EEM notifies VSOM via HTTP
6. Security Camera Focus/Pan/Zoom

6

Periodically Exporting Data

Quickly export SNMP Statistics?

Problem: Sometimes we need data from one or multiple MIBs, but

- we may not want to (re-)configure an NMS
- don't want to constantly poll
- need to gather data during temporary loss of connectivity

Solution: Use Bulk File MIB to define the data we need and periodically transfer it to a convenient location

- group data from multiple MIBs
- single, common polling interval
- buffer data
- transfer using RCP, FTP, TFTP
- format ASCII or Binary

Feature Name: Periodic MIB Data Collection and Transfer Mechanism

Available from: IOS 12.0(24)S, 12.2(25)S, 12.3(2)T, IOS XE 2.1, IOS XR 3.2
Platforms: ASR1k, x8xx ISR, x900x ISR, 72xx, 73xx, 76xx, 10xxx, ME3400, C4k, C6k, …
See: http://tools.cisco.com/Support/SNMP/do/BrowseOID.do?local=en&translate=Translate&objectInput=1.3.6.1.2.1.2

Configuration – Example

1. Define Lists of relevant OIDs (Names for IF-MIB, ASN.1 for all others)

```
Router(config)# snmp mib bulkstat object-list my-if-data
Router(config-bulk-objects)# add ifIndex
Router(config-bulk-objects)# add ifDescr
Router(config-bulk-objects)# add ifAdminStatus
Router(config-bulk-objects)# add ifOperStatus
Router(config-bulk-objects)# exit
```

2. Specify Polling Schema

```
Router(config)# snmp mib bulkstat schema my-if-schema
Router(config-bulk-sc)# object-list my-if-data
Router(config-bulk-sc)# poll-interval 1
Router(config-bulk-sc)# instance exact interface FastEthernet0
Router(config-bulk-sc)# exit
```

3. Configure the Transfer Mechanism – and enable it !

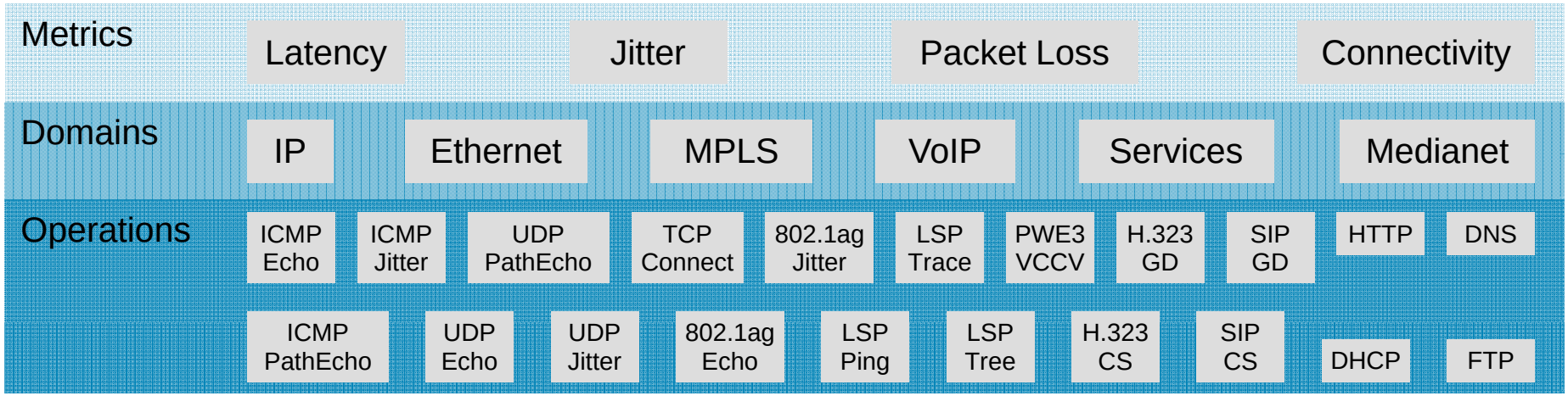
```
Router(config)# snmp mib bulkstat transfer my-fa0-transfer
Router(config-bulk-tr)# schema my-if-schema
Router(config-bulk-tr)# transfer-interval 5
Router(config-bulk-tr)# url primary tftp://10.10.10.10/folder/
Router(config-bulk-tr)# retain 30
Router(config-bulk-tr)# buffer-size 4096
Router(config-bulk-tr)# enable
```

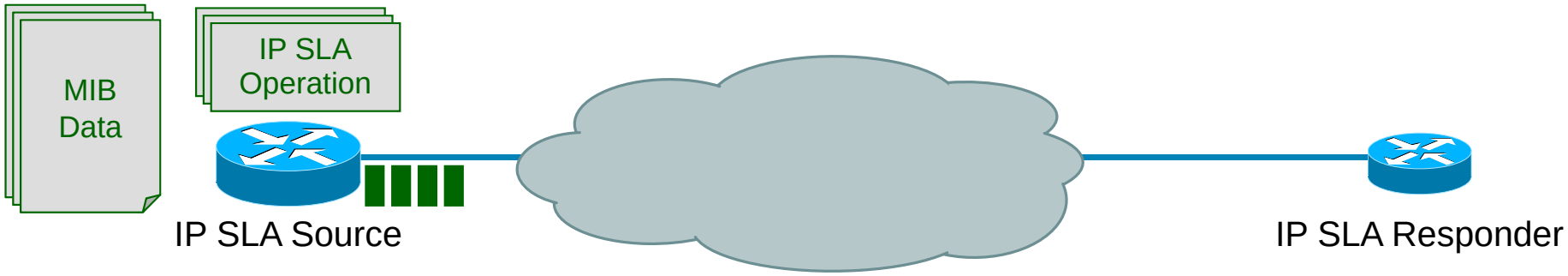
7

Service Level Agreements – Basics

IP Service Level Agreements (IP SLA)

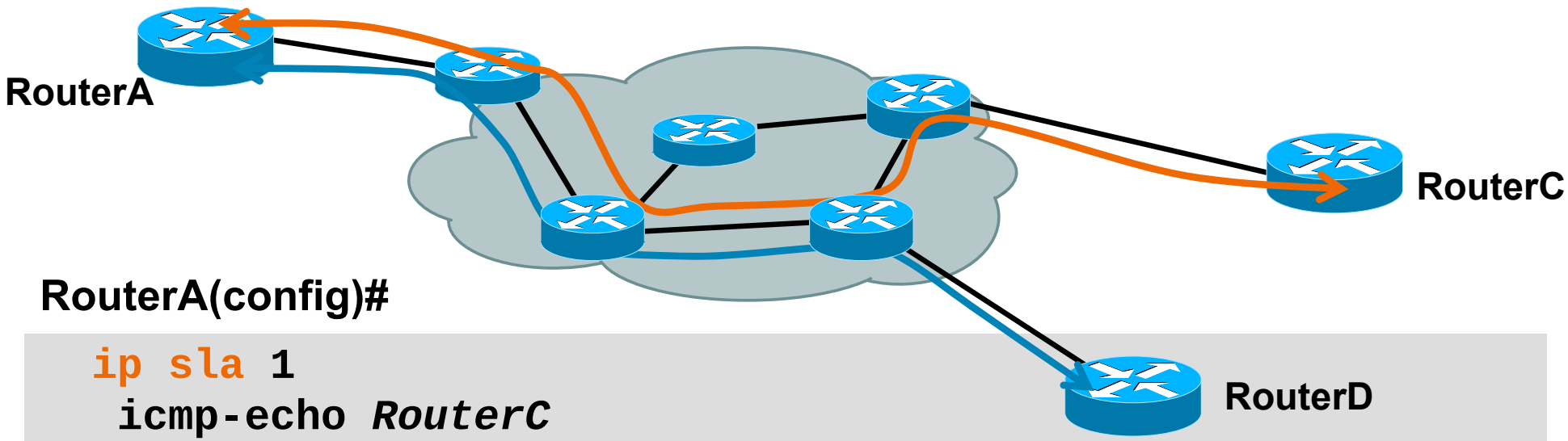
- Active probing by injecting synthetic test traffic
- Experience and Adoption across markets and technology domains
- Vast range of Cisco and 3rd Party NMS tool support





See: www.cisco.com/go/ipsla

IPSLA – ICMP and UDP Jitter Examples



RouterA(config)#

```
ip sla 1
 icmp-echo RouterC
 timeout 500
 frequency 10
ip sla schedule 1 start-time now
```

```
ip sla 10
 udp-jitter RouterD 16384 num-packets 1000 interval 20
 request-data-size 172
 tos 20
 frequency 60
ip sla schedule 10 start-time now
```

IPSLA – ICMP Echo Operation

```
Router#show ip sla sta mon 1
Round trip time (RTT)   Index 1
         Latest RTT: 1 ms
Latest operation start time: *05:26:00.226 UTC Fri Jan 4 2008
Latest operation return code: OK
Number of successes: 1
 Number of failures: 0
Operation time to live: 188 sec

Router#sh ip sla sta 1 detail
Round trip time (RTT)   Index 1
         Latest RTT: 1 ms
Latest operation start time: *05:26:30.224 UTC Fri Jan 4 2008
Latest operation return code: OK
Over thresholds occurred: FALSE
Number of successes: 2
Number of failures: 0
Operation time to live: 155 sec
Operational state of entry: Active
Last time this entry was reset: Never
```

IPSLA – UDP Jitter Operation

```
Router#sh ip sla statistics 10
Round trip time (RTT)   Index 10
         Latest RTT: 1 ms
Latest operation start time: *05:43:28.720 UTC Fri Jan 4  2008
Latest operation return code: OK RTT Values
         Number Of RTT: 10
         RTT Min/Avg/Max: 1/1/1 ms
Latency one-way time milliseconds
         Number of one-way Samples: 0
         Source to Destination one way Min/Avg/Max: 0/0/0 ms
         Desination to source one way Min/Avg/Max: 0/0/0 ms
Jitter time milliseconds
         Number of Jitter Samples: 9
         Source to Destination Jitter Min/Avg/Max: 20/20/23 ms
         Destination to Source Jitter Min/Avg/Max: 22/21/24 ms
Packet Loss Values
         Loss Source to Destination: 0           Loss Destination to
Source: 0
         Out Of Sequence: 0      Tail Drop: 0    Packet Late
Arrival: 0
Number of successes: 1
Number of failures: 0
Operation time to live: 3567 sec
```

Design Decisions and Factors

- Topology
  - partial mesh based on traffic matrix
  - full mesh
  - hub and spoke
- Scheduling
  - minimize the number of concurrent operations
  - minimize resource competition
- Use the same operation across various classes of service to generate comparable metrics.

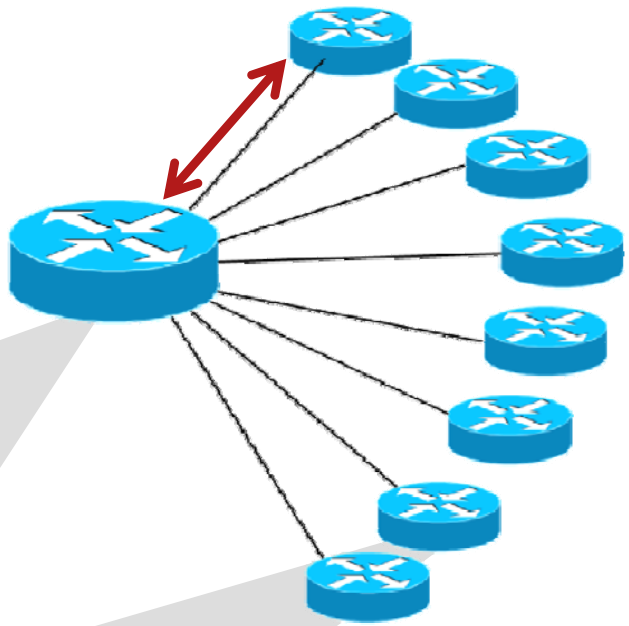
Auto IP SLA – Don‘t touch your IP SLA

New 15.1T

Some IP SLA Topologies …

- … are naturally Hub and Spoke
- … have a large number of Spokes with similar IP SLA requirements
- … consist of dynamically joining / disappearing Spokes

```
ip sla auto template type ip udp-jitter my-ipsla-
template
  parameters
    request-data-size 64
    num-packets 1000
ip sla auto schedule my-ipsla-schedule
  frequency 45
  start-time now
ip sla auto endpoint-list type ip my-ipsla-endpoints
  discover
    ageout 36000
ip sla auto group type ip my-ipsla-group
  schedule my-ipsla-schedule
  template udp-jitter my-ipsla-template
  destination my-ipsla-endpoints
```



```
ip sla responder auto-register 10.10.10.2 endpoint-list my-ipsla-endpoints
```

8

Dynamic Service Level Agreements

Example: Network Automation with IPSLA – 1/4

Problem

- Need to monitor IP SLA
- Trigger actions upon violation of SLA

Solutions

- IP SLAs Thresholds
- Using EEM and the EOT Event Detector
- Using EEM 3.x and the IP SLA Event Detector

Example: Network Automation with IPSLA – 2/4

Solution 1: Using IP SLA reaction triggers:

```
RouterA(config)#
ip sla 10
 icmp-echo 3.3.3.3
 frequency 10
ip sla reaction-configuration 10 react timeout threshold-type consecutive 3
  action-type trapAndTrigger
ip sla schedule 10 life forever start-time now
ip sla reaction-trigger 10 20


logging on
ip sla logging trap
snmp-server host nms_server version 2c public
snmp-server enable traps syslog
```

Sending SNMP trap with IP SLAs embedded threshold

Example: Network Automation with IPSLA – 3/4

IP SLA

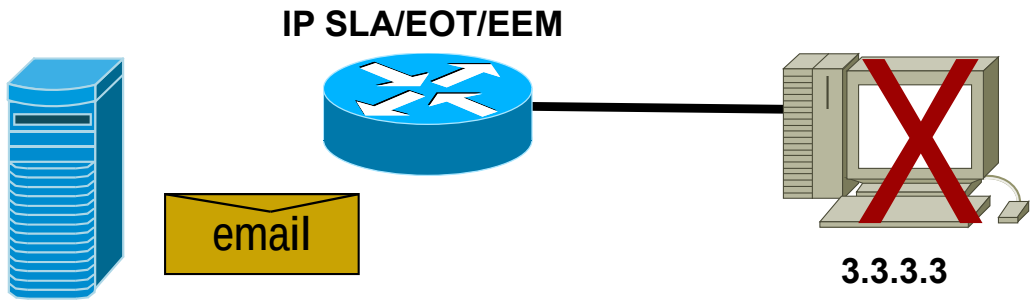
```
ip sla 10
 icmp-echo 3.3.3.3
 timeout 500
 frequency 3
ip sla schedule 10 life forever start-time now
```

Embedded Object Tracking (EOT)

```
track 10 rtr 10 reachability
delay down 10 up 20
```

Environment Variables

($_* variables to be defined)



EEM Applet

```
event manager applet email_server_unreachable
 event track 10 state down
 action 1.0 syslog msg "Ping has failed, server unreachable!"
 action 1.1 cli command "enable"
 action 1.2 cli command "del /force flash:server_unreachable"
 action 1.3 cli command "show clock | append server_unreachable"
 action 1.4 cli command "show ip route | append server_unreachable"
 action 1.5 cli command "more flash:server_unreachable"
 action 1.6 mail server "$_email_server" to "$_email_to" from "$_email_from" subject "Server Unreachable: ICMP-Echos
    Failed" body "$_cli_result"
 action 1.7 syslog msg "Server unreachable alert has been sent to email server!"
```

Example: Network Automation with IPSLA – 4/4

Solution 3: Using Embedded Event Manager 3.0 IP SLA Event Detector:

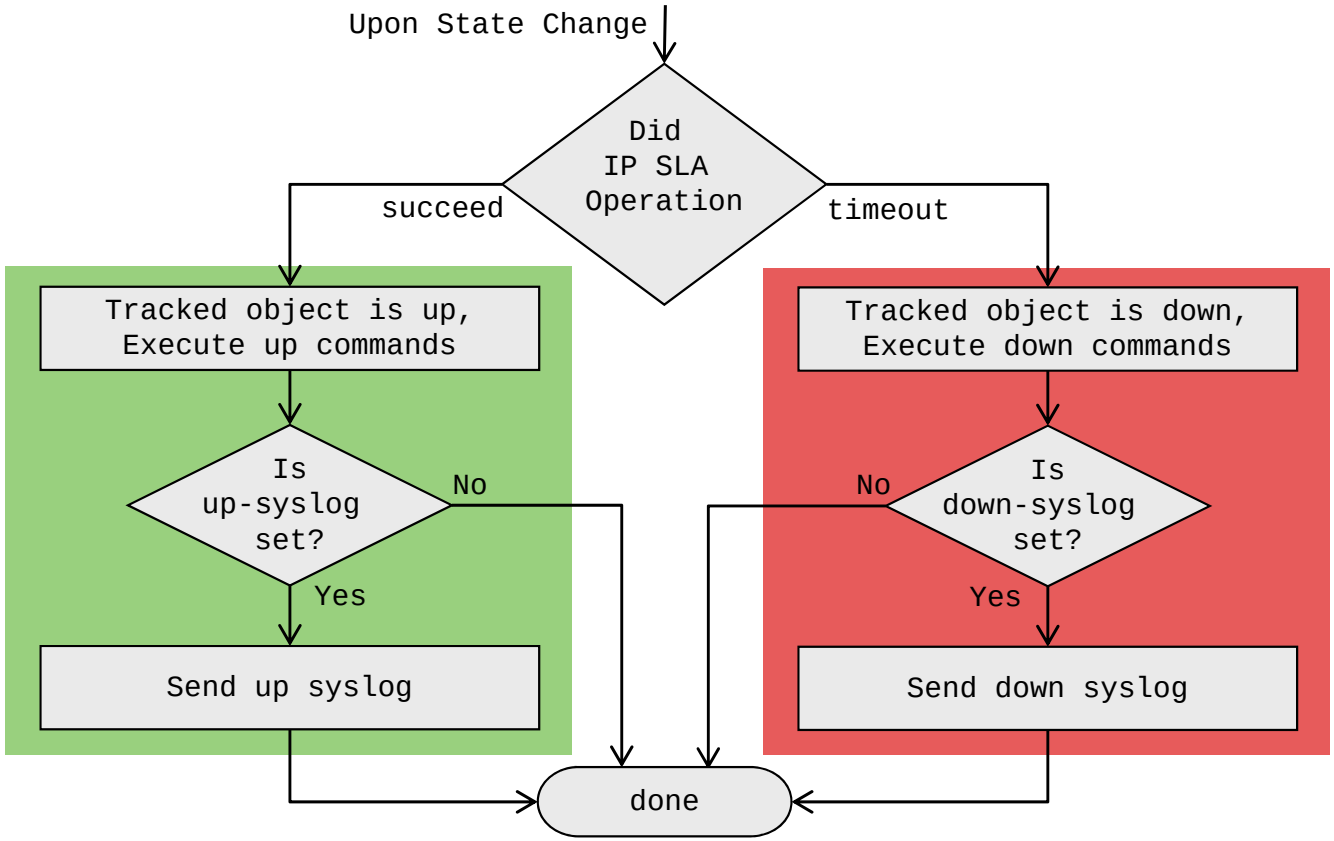
```
Router(config)# ip sla 10
Router(config-ip-sla)# icmp-echo 3.3.3.3

Router(config)# ip sla enable reaction-alerts

Router(config)#ip sla reaction-config 1 react Timeout
   action-type none threshold-type consecutive 3

Router(config)# ip sla schedule 10 start now

Router(config}# event manager applet test
router(config-applet)# event ipsla operation-id 10 reaction-type Timeout
router(config-applet)# action 1.0 syslog priorities emergencies
   msg “IP SLA operation $_ipsla_oper_id to server XYZ has timed out”
```

Trigger an Embedded Event Manager Applet when the IP SLA operation threshold is crossed

EASy Package: Custom High-Availability

Problem: We need a failover from primary to secondary link – but with flexibility and custom notification beyond what a simple routing protocol based solution provides

Solution: Automate based on IP SLA, EOT and Embedded Event Manager

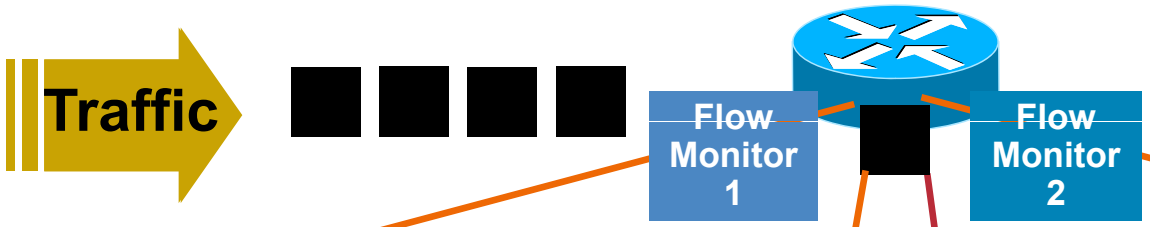


See: Available as an EASy Package:
http://www.cisco.com/go/easy

9

Application Aware Traffic Flows

Flexible Netflow



Key Fields	Packet 1
Source IP	3.3.3.3
Destination IP	2.2.2.2
Source Port	23
Destination Port	22078
Layer 3 Protocol	TCP - 6
TOS Byte	0
Input Interface	Ethernet 0

Non-Key Fields
Packets
Bytes
Timestamps
Next Hop Address

Key Fields	Packet 1
Source IP	3.3.3.3
Dest IP	2.2.2.2
Input Interface	Ethernet 0
SYN Flag	0

Non-Key Fields
Packets
Timestamps

Traffic Analysis Cache

Source IP	Dest. IP	Source Port	Dest. Port	Protocol	TOS	Input I/F	…	Pkts
3.3.3.3	2.2.2.2	23	22078	6	0	E0	…	1100

Security Analysis Cache

Source IP	Dest. IP	Input I/F	Flag	…	Pkts
3.3.3.3	2.2.2.2	E0	0	…	11000

Flexible NetFlow

Configuration – Example

1. Configure the Exporter

```
Router(config)# flow exporter my-exporter

Router(config-flow-exporter)# destination 1.1.1.1
```

2. Configure the Flow Record

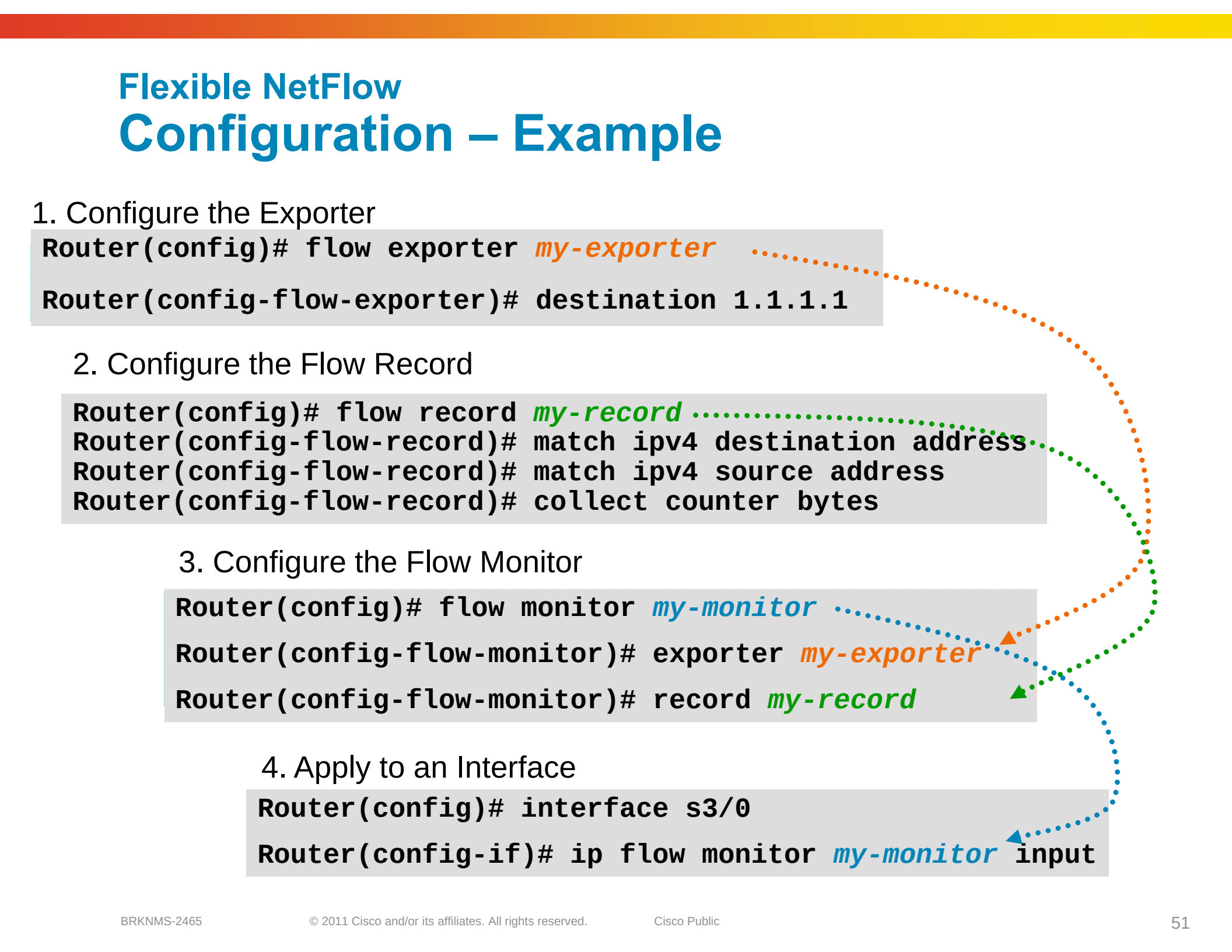
```
Router(config)# flow record my-record
Router(config-flow-record)# match ipv4 destination address
Router(config-flow-record)# match ipv4 source address
Router(config-flow-record)# collect counter bytes
```

3. Configure the Flow Monitor

```
Router(config)# flow monitor my-monitor

Router(config-flow-monitor)# exporter my-exporter

Router(config-flow-monitor)# record my-record
```

4. Apply to an Interface

```
Router(config)# interface s3/0

Router(config-if)# ip flow monitor my-monitor input
```



Flexible Flow Record: Key Fields

Flow
Sampler ID
Direction
Interface
Input
Output
Layer 2
Source VLAN
Dest VLAN
Dot1q VLAN
Dot1q priority
Source MAC address
Destination MAC address

NEW

IPv4	
IP (Source or Destination)	Payload Size
Prefix (Source or Destination)	Packet Section (Header)
Mask (Source or Destination)	Packet Section (Payload)
Minimum-Mask (Source or Destination)	TTL
Protocol	Options bitmap
Fragmentation Flags	Version
Fragmentation Offset	Precedence
Identification	DSCP
Header Length	TOS
Total Length	

IPv6	
IP (Source or Destination)	Payload Size
Prefix (Source or Destination)	Packet Section (Header)
Mask (Source or Destination)	Packet Section (Payload)
Minimum-Mask (Source or Destination)	DSCP
Protocol	Extension Headers
Traffic Class	Hop-Limit
Flow Label	Length
Option Header	Next-header
Header Length	Version
Payload Length	

Flexible Flow Record: Key Fields

NEW

Routing
src or dest AS
Peer AS
Traffic Index
Forwarding Status
IGP Next Hop
BGP Next Hop
Input VRF Name

NEW

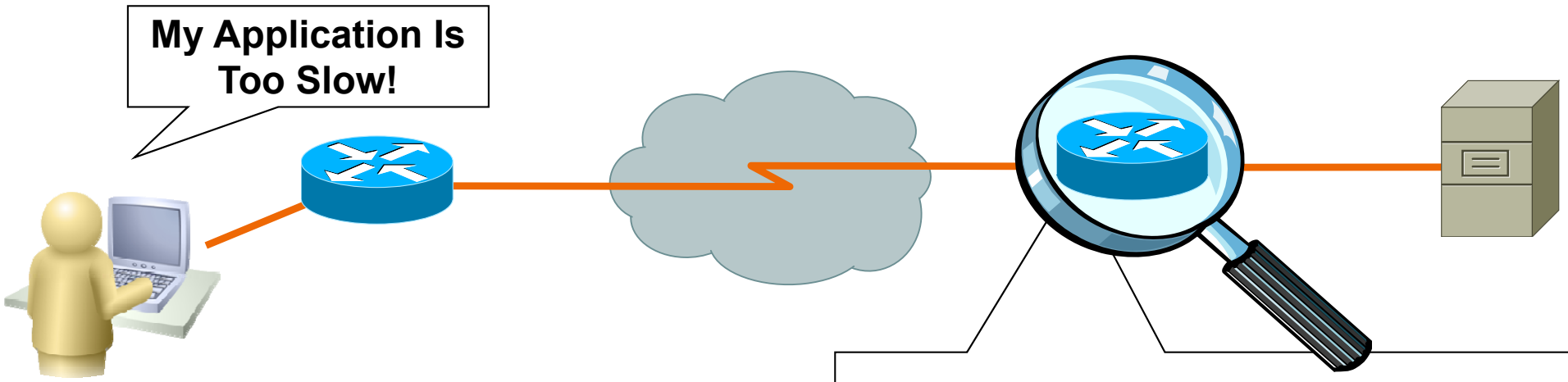
Transport	
Destination Port	TCP Flag: ACK
Source Port	TCP Flag: CWR
ICMP Code	TCP Flag: ECE
ICMP Type	TCP Flag: FIN
IGMP Type*	TCP Flag: PSH
TCP ACK Number	TCP Flag: RST
TCP Header Length	TCP Flag: SYN
TCP Sequence Number	TCP Flag: URG
TCP Window-Size	UDP Message Length
TCP Source Port	UDP Source Port
TCP Destination Port	UDP Destination Port
TCP Urgent Pointer	

Application
Application ID*

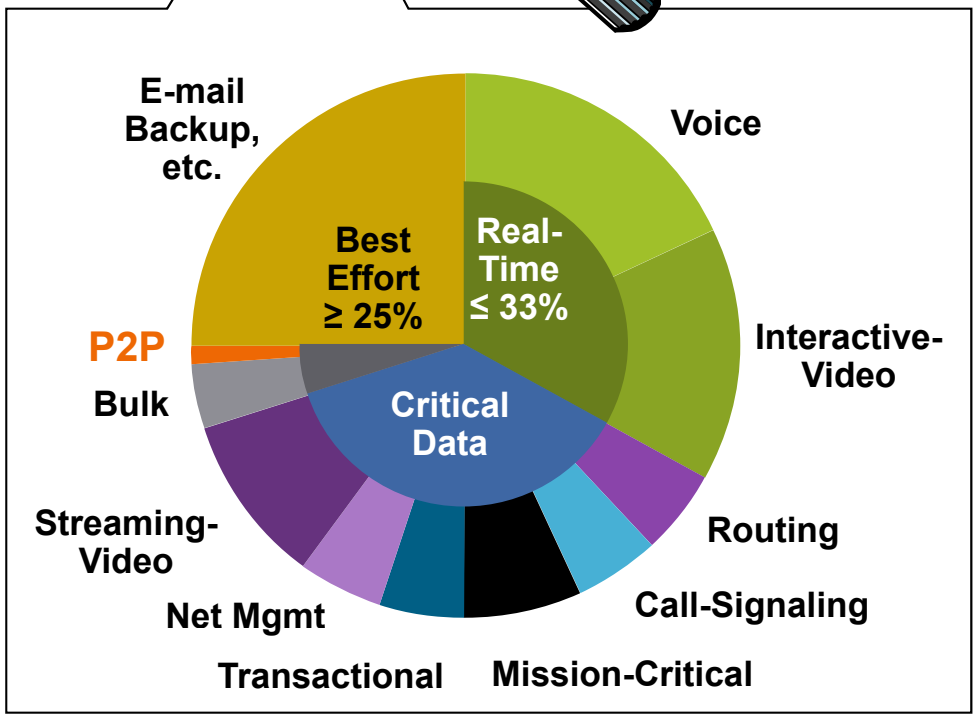
Multicast
Replication Factor*
RPF Check Drop*
Is-Multicast

***: IPv4 Flow only**

Network Based Application Recognition



- Full-packet, stateful inspection identifies traffic type
- Protocol discovery analyzes multi-packet behavior and application signatures
- Layers 4-7
- Enables application of QoS policies to traffic flows

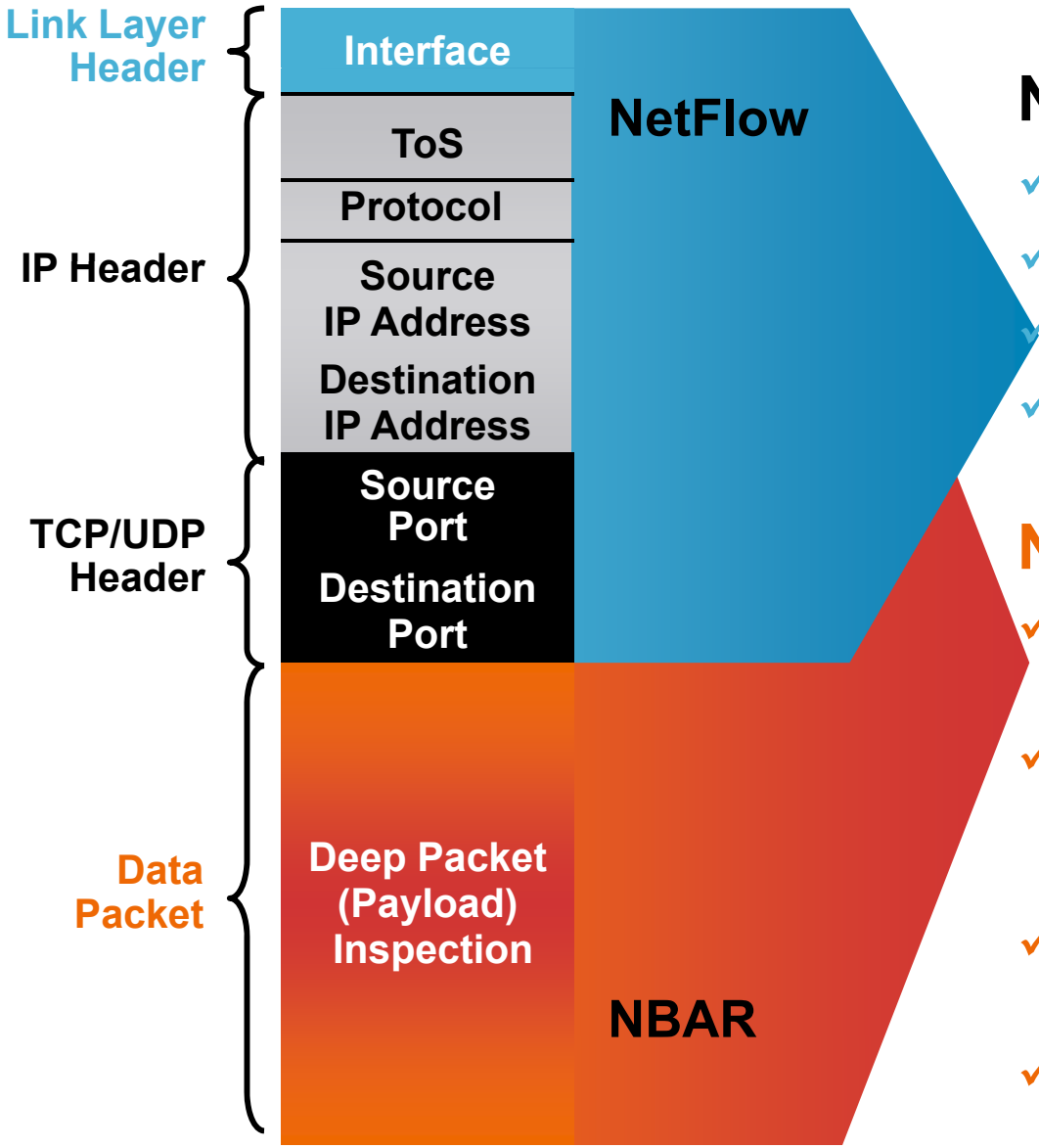


Link Utilization

NBAR – Supported Protocols

Enterprise Applications	Security and Tunneling	Network Mail Services	Internet
Citrix ICA	GRE	IMAP	FTP
PCAnywhere	IPINIP	POP3	Gopher
Novadigm	IPsec	Exchange	HTTP
SAP	L2TP	Notes	IRC
Routing Protocols	MS-PPTP	SMTP	Telnet
BGP	SFTP	**Directory**	TFTP
EGP	SHTTP	DHCP/BOOTP	NNTP
EIGRP	SIMAP	Finger	NetBIOS
OSPF	SIRC	DNS	NTP
RIP	SLDAP	Kerberos	Print
Network Management	SNNTP	LDAP	X-Windows
ICMP	SPOP3	**Streaming Media**	**Peer-to-Peer**
SNMP	STELNET	CU-SeeMe	BitTorrent
Syslog	SOCKS	Netshow	Direct Connect
RPC	SSH	Real Audio	eDonkey/eMule
NFS	**Voice**	StreamWorks	FastTrack
SUN-RPC	H.323	VDOLive	Gnutella
Database	RTCP	RTSP	KaZaA
SQL*NET	RTP	MGCP	WinMX 2.0
MS SQL Server	SIP	**Signaling**	
	SCCP/Skinny	RSVP	
	Skype		

NetFlow and NBAR



NetFlow

- ✓ Monitors data in Layers 2 - 4
- ✓ Determines applications by port
- ✓ Utilizes a seven-tuple for flow
- ✓ Flow information who, what, when, where

NBAR

- ✓ Examines data from Layers 3 - 7
- ✓ Utilizes Layers 3 and 4 plus packet inspection for classification
- ✓ Stateful inspection of dynamic-port traffic
- ✓ Packet and byte counts

Example: Application Flow Aware – 1/4

Problem: We want to be aware of application traffic flows (ie.: who, when, where, what)

Solution: Use Flexible Netflow and NBAR Integration

1. Configure flexible Netflow to match Application Name, Source- and Destination Address

```
flow exporter <my-exporter>
         destination 10.10.10.1
:
flow record <my-record>
         match ipv4 source address
         match ipv4 destination address
         match application name
         collect counter bytes
:
flow monitor <my-monitor>
         record <my-record>
         exporter <my-exporter>
:
interface <my-interface>
         ip flow monitor <my-monitor> input
:
```

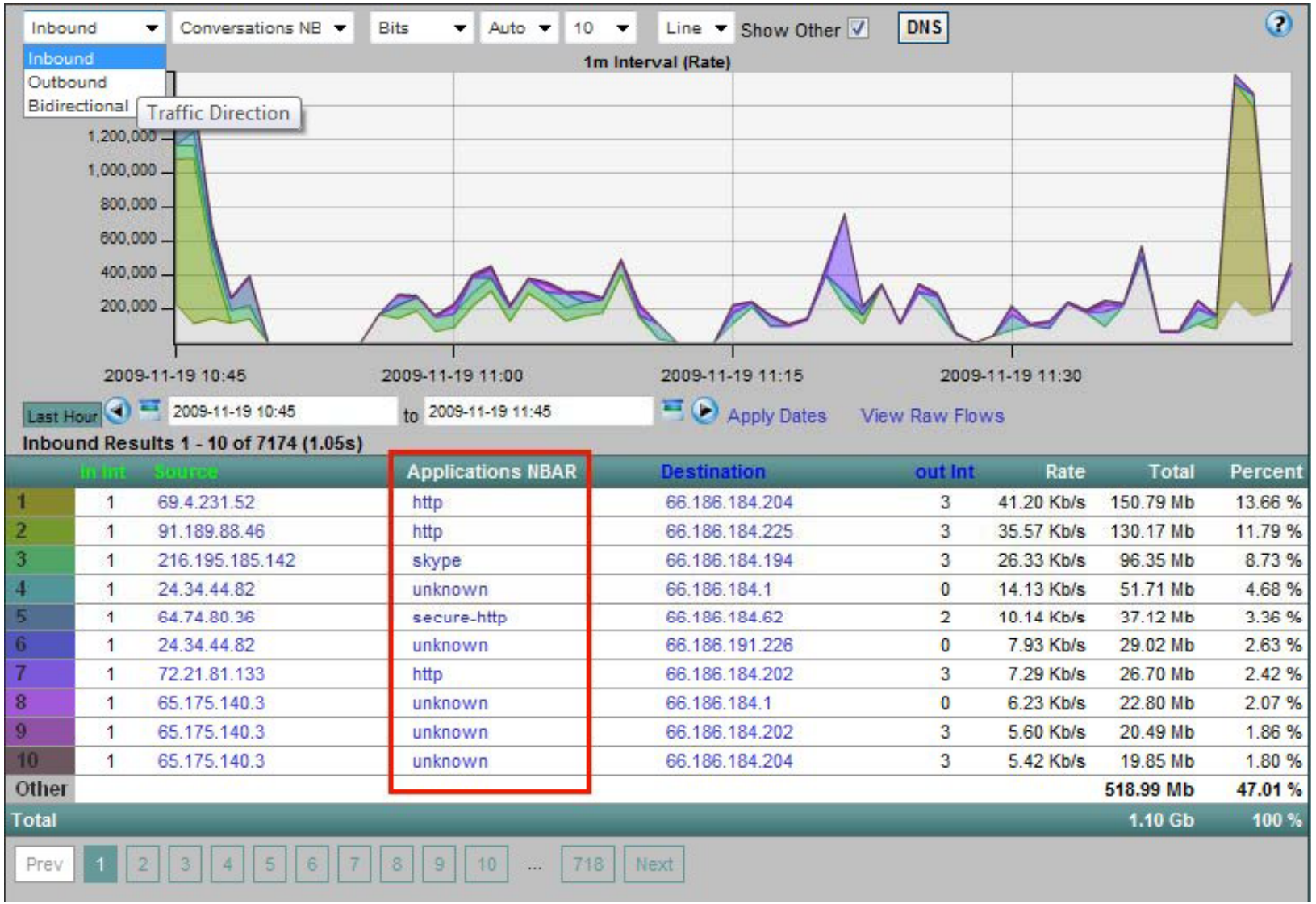
Example: Application Flow Aware – 2/4

2. Then either handle within IOS and/or …

```
router# show flow monitor <my-monitor> cache
  Cache type:                                 Normal
  Cache size:                                   4096
  Current entries:                                 2
  High Watermark:                                  9

  Flows added:                                  4464
  Flows aged:                                   4463
    - Active timeout      (  1800 secs)             0
    - Inactive timeout    (    15 secs)          4463
    - Event aged                                    0
    - Watermark aged                                0
    - Emergency aged                                0

IPV4 SRC ADDR    IPV4 DST ADDR    APP NAME                 bytes
===============  ===============  ======================  ==========
10.55.146.53     10.51.89.177     nbar ssh                   10484
10.51.81.117     10.51.89.177     nbar icmp                   1000
```

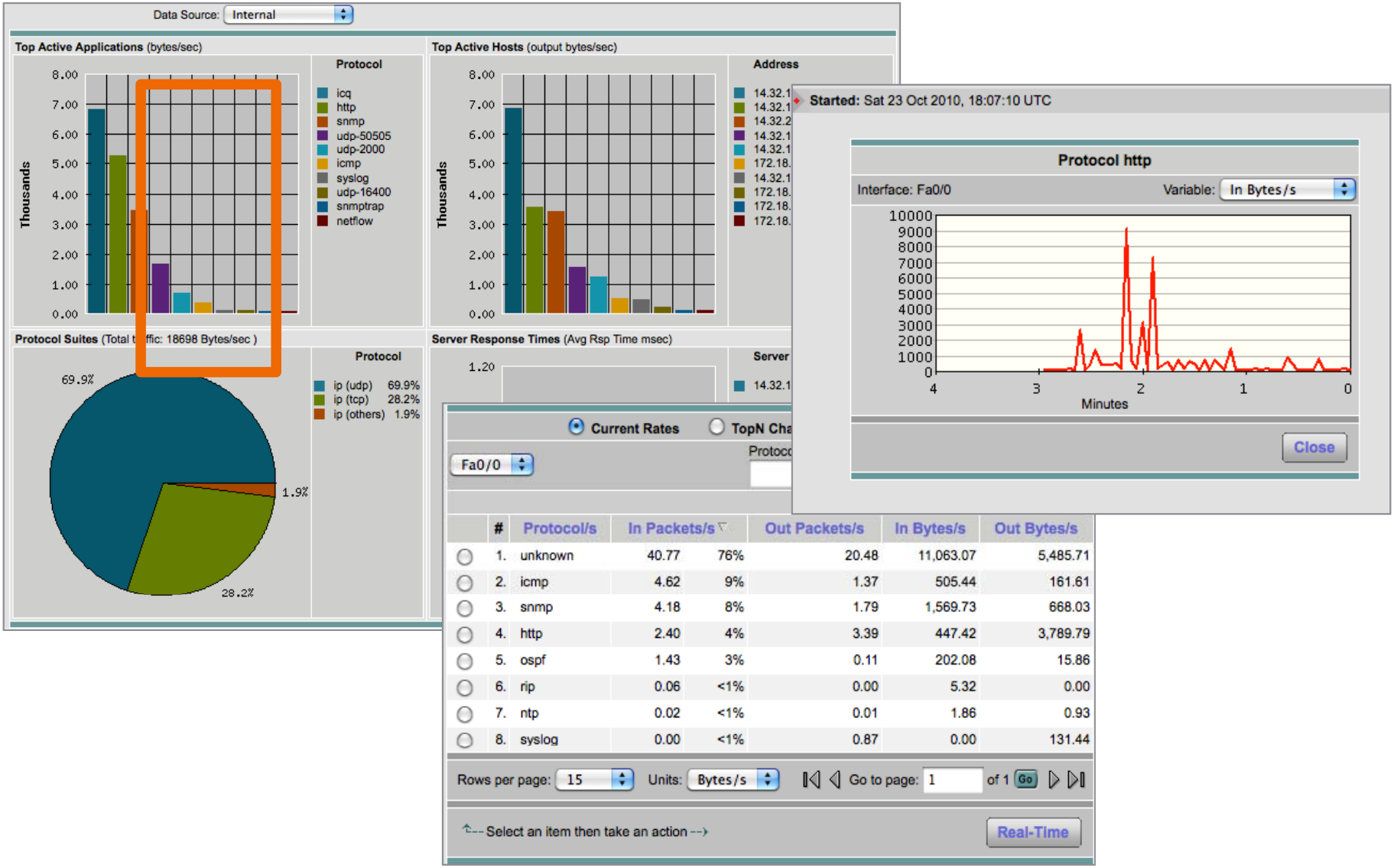
Example: Application Flow Aware – 3/4

3. Export to your favorite Reporting System (Screenshot courtesy of Plixer)



Example: Application Flow Aware – 4/4

3. Export to your favorite Reporting System (Screenshots from Cisco NME-NAM)



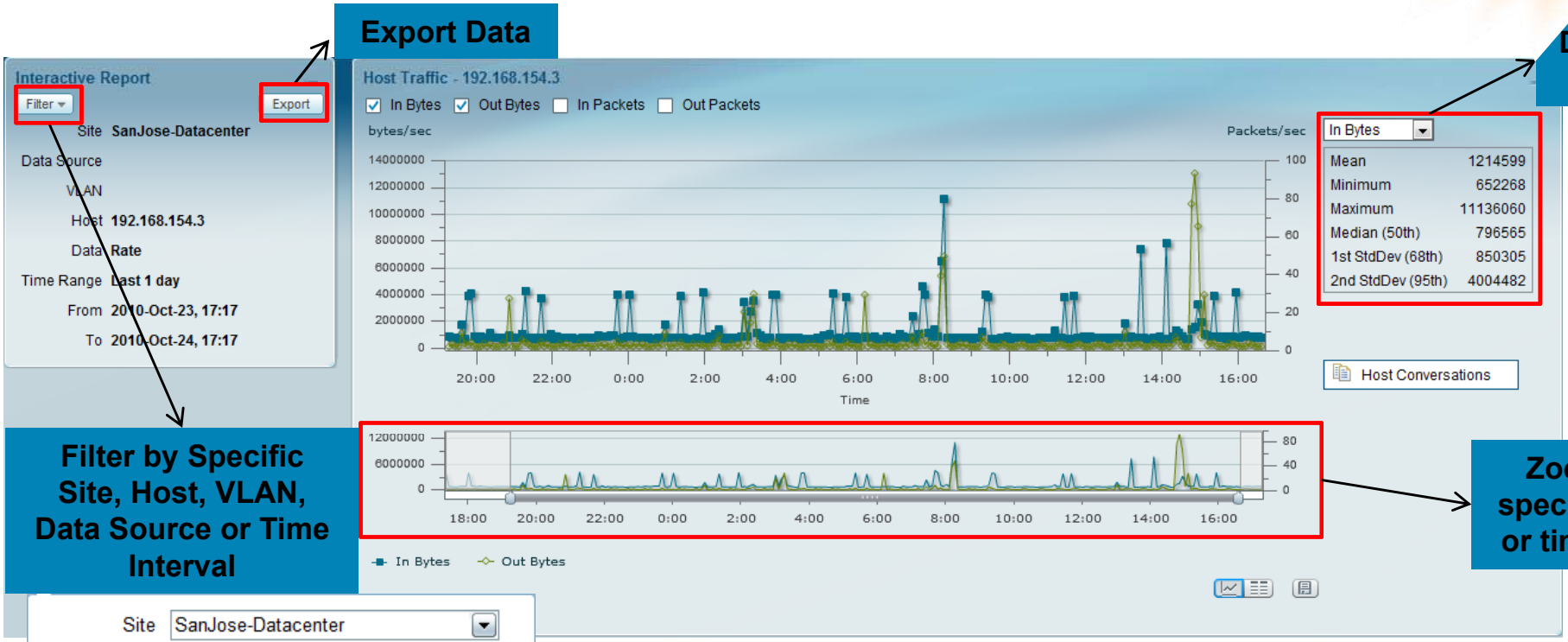
10

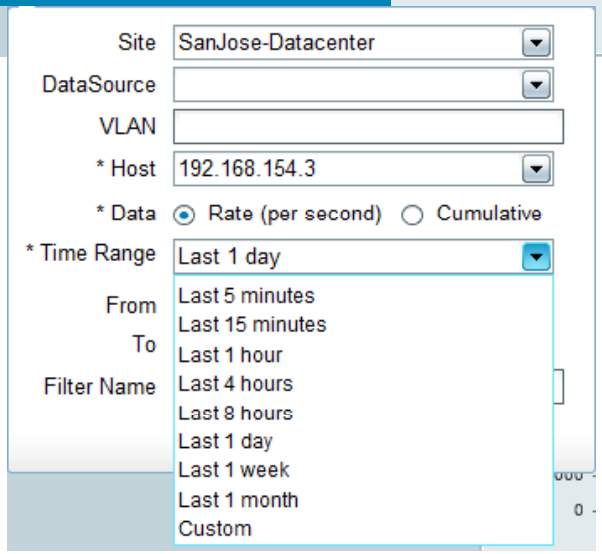
Trending and Forecasting

NAM 5.0 Interactive Reports

Analyze Performance/Usage Trends and [illegible]

New
Jan 2011





- Analyze data over last month or more
- Define custom time interval for analysis
- Export data in raw format for consumption by external management application
- Drill-down to analyze related trends to support planning decisions

Cisco Visual Networking Inde

New

Problem: Sometimes we need trending and forecasting info beyond our current reach and/or where there is no IOS-based network yet

Solution: Visual Networking Index

- Global initiative to analyze and forecast IP network growth
- Mobile and PC-based data collection
- Graphical data summaries publicly available
- Individual network usage reports available to service provider participants

See: www.ciscovnipulse.com

11

Test Your Monitoring

Is Monitoring Actually Working ?

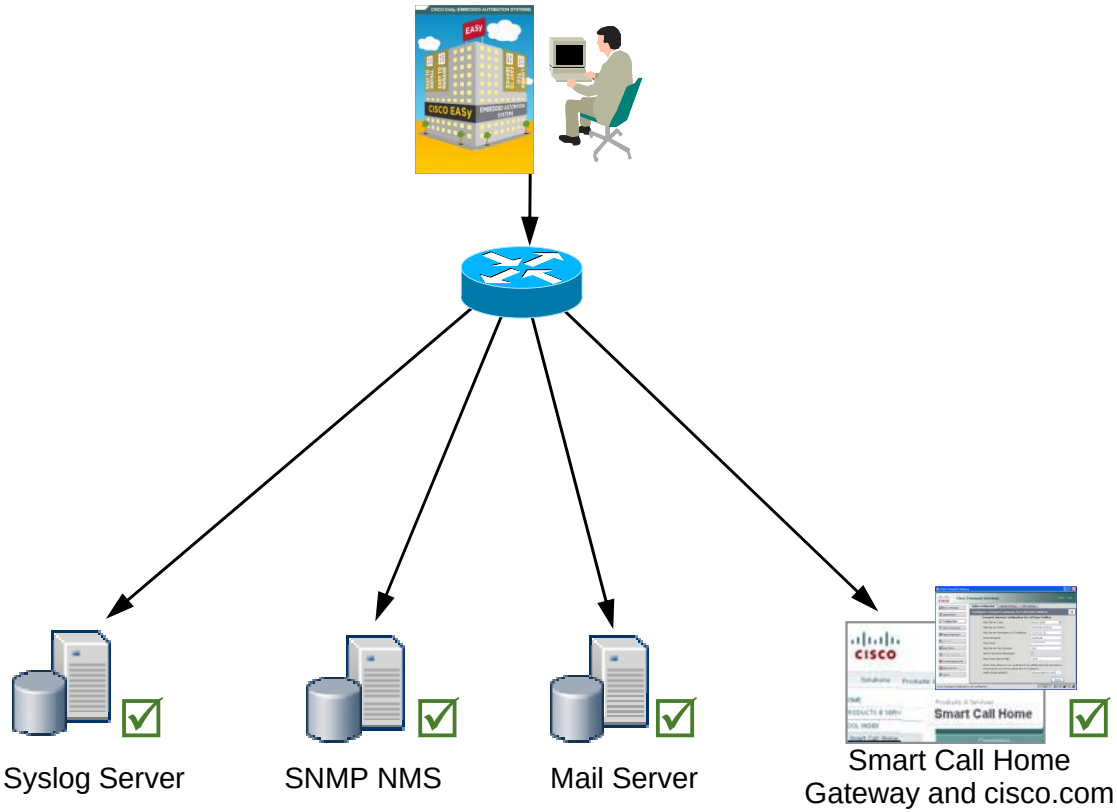
Problem: Monitoring relies on a number of protocols to be configured and functional end-to-end, not just on the local node.

Solution: Use the EASy NMS Tester Package – which generates test messages for each configured monitoring protocol

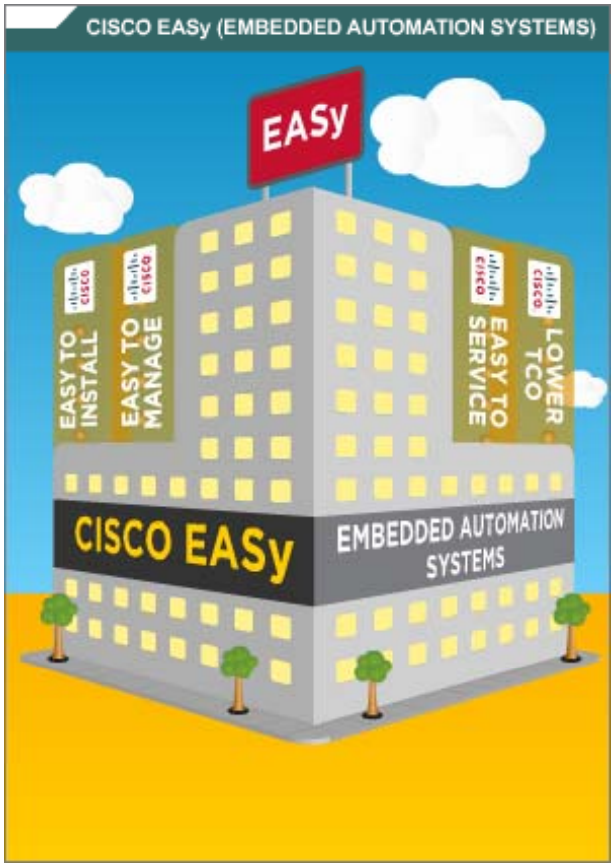
1) Install and Configure EASy NMS Tester Package

2) NMS Tester Package will generate Test Messages

3) Verify Test Messages



NMS Tester – EASy Package



Embedded Automation Systems (EASy)

NMS Tester EASy Package can validate:

- **Syslog**
- **SNMP**
- **Email**
- **Smart Call Home**

To use the Package:

1. Browse and Download EASy Package
   www.cisco.com/go/easy
2. Make Sure to also download EASy Installer
3. Watch VOD and/or read documentation
   www.cisco.com/go/easy
4. Customize and tailor to your needs
5. Install and Use

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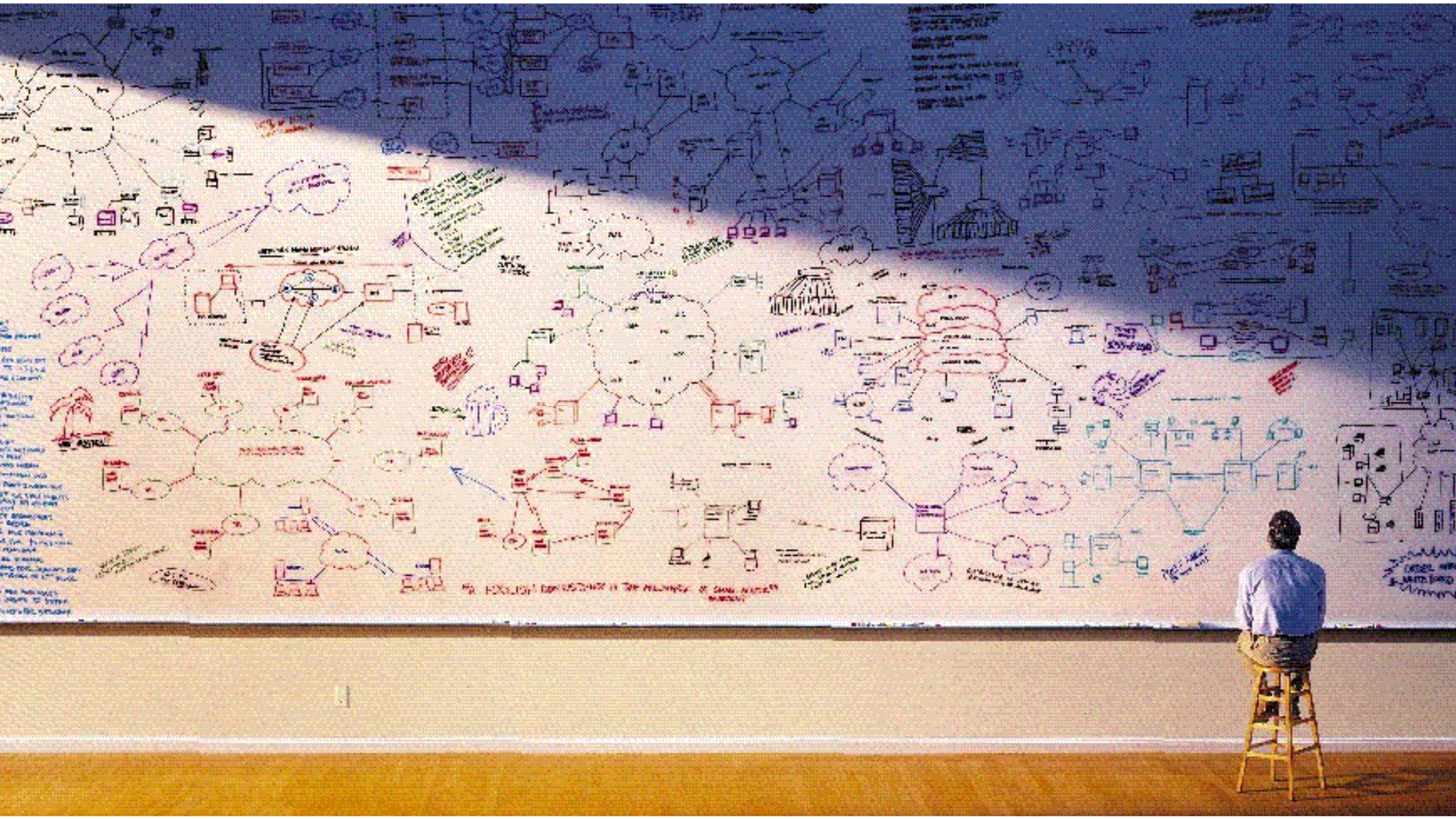
Validating Design Assumptions

Where do YOU Document Design Assumptions?



Example: Low-TTL Traffic Monitoring

Problem: How much and what Low-TTL traffic do we actually have?

Solution: Use Flexible Netflow and Embedded Event Manager 3.0 to detect traffic flows with TTL < 5

1. Configure flexible Netflow to match on TTL, Source- and Destination Address

```
flow record <my-record>
        match ipv4 ttl
        match ipv4 source address
        match ipv4 destination address
:
flow monitor <my-monitor>
        record <my-record>
:
```

-Top (unexpected) Talkers with low-TTL traffic ?
- Deviation from Normal ?
- Senders with many low-TTL flows ?
- Take Actions (block suspicious senders) ?

2. Configure the Netflow Event Detector in EEM to notify upon a new flow record

```
event manager applet my-ttl-applet
        event nf monitor-name "my-ttl-monitor" event-type create event1
              entry-value "5" field ipv4 ttl entry-op lt
        action 1.0 syslog msg “Low-TTL flow from $_nf_source_address"
```

3. Syslog message and/or use `show flow monitor <my-monitor> cache` command

```
*Dec  2 17:39:31.221: %HA_EM-6-LOG: my-ttl-applet: Low-TTL flow from 192.168.2.248
```

Example: NBAR Effectiveness Monitoring

Problem: Application protocols as well as user behavior are changing, hence the traffic mix changes too. We need to periodically assess how effective the NBAR deployment is – especially when using CBQoS with match protocol.

Solution: Automate the comparison between 'unknown' versus 'total' traffic

```
Router# show ip nbar protocol-discovery top-n 5 Serial0/0

                Input                     Output
  Protocol      Packet Count              Packet Count
                Byte Count                Byte Count
                5 minute bit rate (bps)   5 minute bit rate (bps)
  ---------- ------------------------ ------------------------
    :               :                         :
  unknown                205                                204
                         14976                              10404
                         0                                  0
  Total                  41304                              40944
                         2649809                            2619839
                         3000                               3000
```

Upon low % of traffic recognized by NBAR, it's time to check for new PDLMs …

$$NBARrecognized(\%) = \frac{[(total - unknown) \times 100]}{[total]}$$

See: Available as an EASy Package:
http://www.cisco.com/go/easy
See: Scripts available from CiscoBeyond:
http://forums.cisco.com/eforum/servlet/EEM?page=eem&fn=script&scriptId=2101

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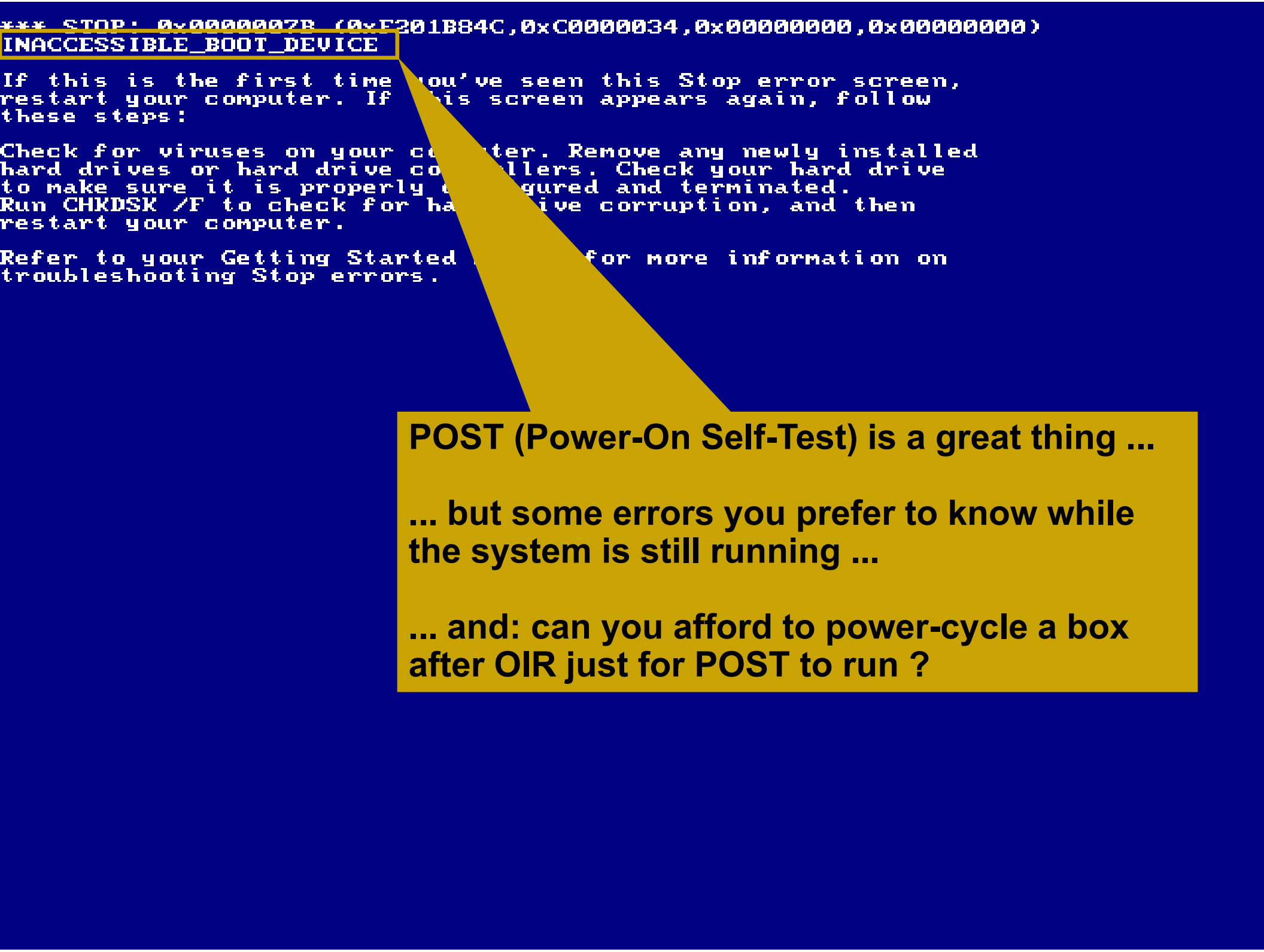
Preventive Maintenance

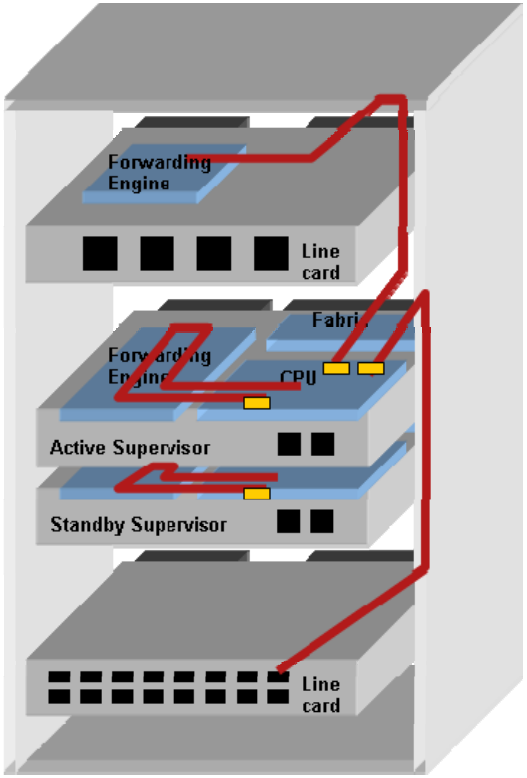

*** STOP: 0x0000007B (0xF201B84C,0xC0000034,0x00000000,0x00000000)
INACCESSIBLE_BOOT_DEVICE
If this is the first time you've seen this Stop error screen,
restart your computer. If this screen appears again, follow
these steps:
Check for viruses on your computer. Remove any newly installed
hard drives or hard drive controllers. Check your hard drive
to make sure it is properly configured and terminated.
Run CHKDSK /F to check for hard drive corruption, and then
restart your computer.
Refer to your Getting Started for more information on
troubleshooting Stop errors.
POST (Power-On Self-Test) is a great thing ...
... but some errors you prefer to know while the system is still running ...
... and: can you afford to power-cycle a box after OIR just for POST to run ?

Generic OnLine Diagnostics (GOLD)

CLI and scheduling for Functional Runtime Diagnostics

- Bootup Diagnostics (upon bootup and OIR)
- Periodic Health Monitoring (during operation)
- OnDemand (from CLI)
- Scheduled Testing (from CLI)
- Test Types include:
  - Packet switching tests
    - Are supervisor control plane & forwarding plane functioning properly?
    - Is the standby supervisor ready to take over?
    - Are linecards forwarding packets properly?
    - Are all ports working?
    - Is the backplane connection working?
  - Memory Tests
  - Error Correlation Tests
- Complementary to POST

Good Practice: schedule all non-disruptive tests periodically



Available from: CatOS 8.5(1), IOS 12.2(14)SX
Platforms: CBS 3xxx, Cat 3560, 3750, 6500, ME6524, 72xx, 10k, CRS

Example: The effect of wear and tear – 1/2

Problem: Repeated insertion and removal of Modules can lead to wear and tear damage on connectors. This in turn can cause failures … how do you find out during operation, without power-cycling the box ?

Solution: Use GOLD to verify functionality of a mis-behaving module

1) Let's see which GOLD tests are available and scheduled for our Module:

```
Router# show diagnostic content module 3
Module 3:

  Diagnostics test suite attributes:
    M/C/* - Minimal level test / Complete level test / Not applicable
      B/* - Bypass bootup test / Not applicable
      P/* - Per port test / Not applicable
    D/N/* - Disruptive test / Non-disruptive test/ Not applicable
      S/* - Only applicable to standby unit / Not applicable
      X/* - Not a health monitoring test / Not applicable
      F/* - Fixed monitoring interval test / Not applicable
      E/* - Always enabled monitoring test / Not applicable
      A/I - Monitoring is active / Monitoring is inactive

  ID   Test Name                                 Attributes   (day hh:mm:ss.ms)
  ==== ===================================== ============ =================
    1) TestScratchRegister -------------> *B*N****A    000 00:00:30.00
    2) TestSPRPInbandPing --------------> *B*N****A    000 00:00:15.00
  :
   18) TestL3VlanMet ------------------> M**N****I    not configured
  :
```

See: http://www.cisco.com/en/US/docs/switches/lan/catalyst6500/ios/12.2SX/configuration/guide/diagtest.html

Example: The effect of wear and tear – 2/2

2) Now let's run TestL3VlanMet on-demand for Module 3:

```
Router# diagnostic start module 3 test 18
:
00:09:59: %DIAG-SP-3-MINOR: Module 3: Online Diagnostics detected a
Minor Error. Please use 'show diagnostic result <target>' to see
test results.
```

3) Then check the test results:

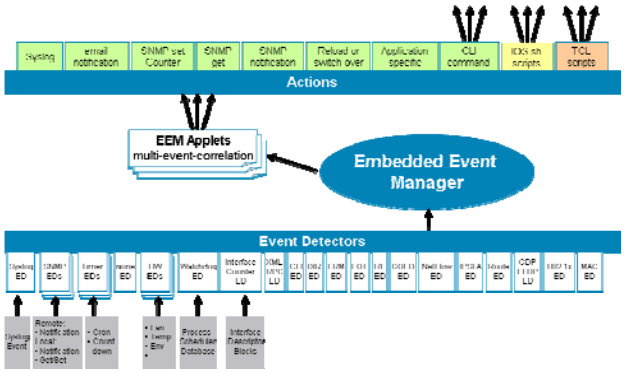
show diagnostics result module 3 detail

```
Router# show diagnostic result module 3
Module 3: CEF720 48 port 1000mb SFP  SerialNo : xxxxxxxx

  Overall Diagnostic Result for Module 3 : MINOR ERROR
  Diagnostic level at card bootup: minimal

  Test results: (. = Pass, F = Fail, U = Untested)
    1) TestTransceiverIntegrity:
   Port  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
   ------------------------------------------------------------------------
         U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U

   Port 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
   ------------------------------------------------------------------------
         U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U  U

:
:
   18) TestL3VlanMet ------------------> F
```

GOLD and Embedded Event Manager

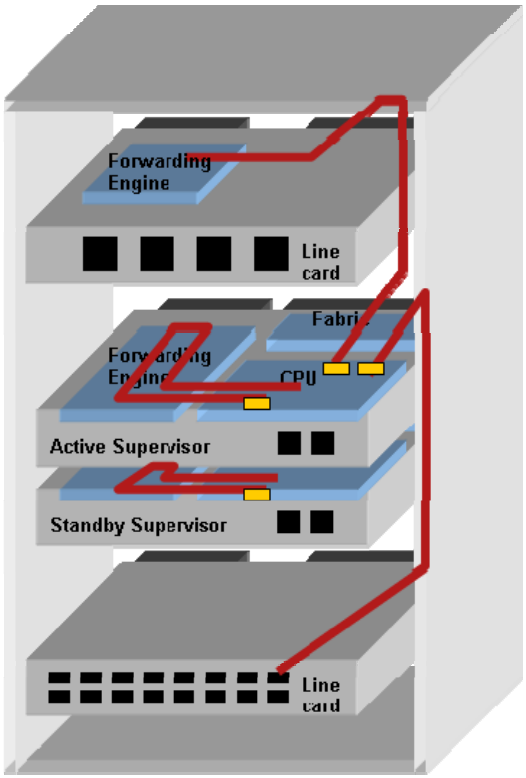
Combine GOLD and

Embedded Event Manager



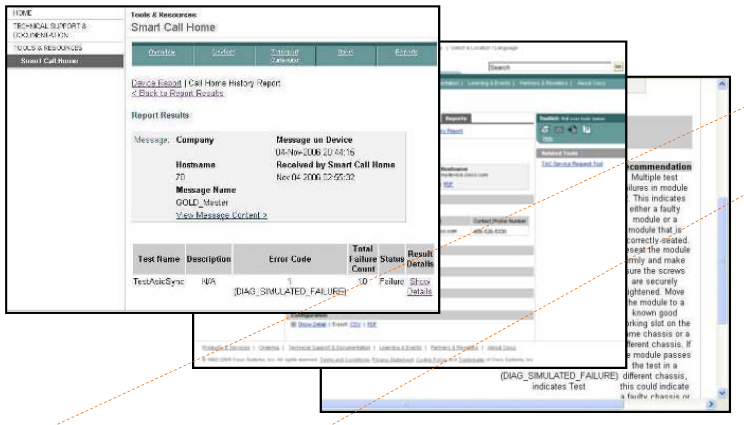
- GOLD Event Detector: to trigger EEM actions based on GOLD test results
  (custom alerts, failover, diagnostics, ...)

- OIR or CLI Event Detector: to trigger an on-demand GOLD test as post-validation of deployment or maintenance work



GOLD and Smart Call Home

- Personalized Reports
  - Messages, diagnostics and recommendations
  - Inventory and configuration for all Call Home devices
  - Security alerts, Field notices, and End-of-Life notices
  - Configuration Sanity Analysis
  - PDF and XLS Export



Products & Services

Smart Call Home

Overview | Registration Management | Reports

Device Report | Call Home History Report | Global Summary Report | Registration Summary Report

< Back to Report Results

Message Details

Message:	Company	Generated on device at
	CISCO SYSTEMS, INC.	04-Jan-2007 06:07:43 AM (Local Time Zone)
	Hostname	**Processed by Smart Call Home at**
	Prod_-Cat6503-01	01-Mar-2009 10:36:29 AM(PST)
	Message Name	
	Diagnostic	
	View Message Header >	
	View Device Output >	

Overall Results within Analysis Period

Service Request	Technology	Sub-Technology	Problem Code
610856247 for USI1149012H	Other	Smart Call Home Demo Only - Do Not Use	HARDWARE_FAILURE

Problem Details

WS-C6509-E with Host Name Prod_-Cat6503-01 and Supervisor WS-SUP720-3BXL reported GOLD Diagnostics test failure:

TestL3VlanMet on module WS-X6548-RJ-45 in slot 2 in USI1149012H
TestIngressSpan on module WS-X6548-RJ-45 in slot 2 in USI1149012H
TestEgressSpan on module WS-X6548-RJ-45 in slot 2 in USI1149012H
TestFirmwareDiagStatus on module WS-X6548-RJ-45 in slot 2 in USI1149012H
TestLoopback on module WS-X6548-RJ-45 in slot 2 in USI1149012H

Recommendation

There were multiple test failures in module 2 that very possibly have a single root cause.
Take the following steps to resolve the failure:
- Multiple test failures in module 2. This indicates either a faulty module or a module that is incorrectly seated.
- Reseat module 2 firmly and make sure the screws are securely tightened.
- Move the module to a known good working slot on the same chassis or a different chassis. If the module passes the test in a d
could indicate a faulty chassis or a module that is inserting an indirect fault.
- Rerun the test using the 'diagnostic start' command to ensure that the test continues to fail.
- If the problem continues to occur, replace module 2
The recommendation for each individual test failure is listed in the individual result below in case further troubleshooting is requ

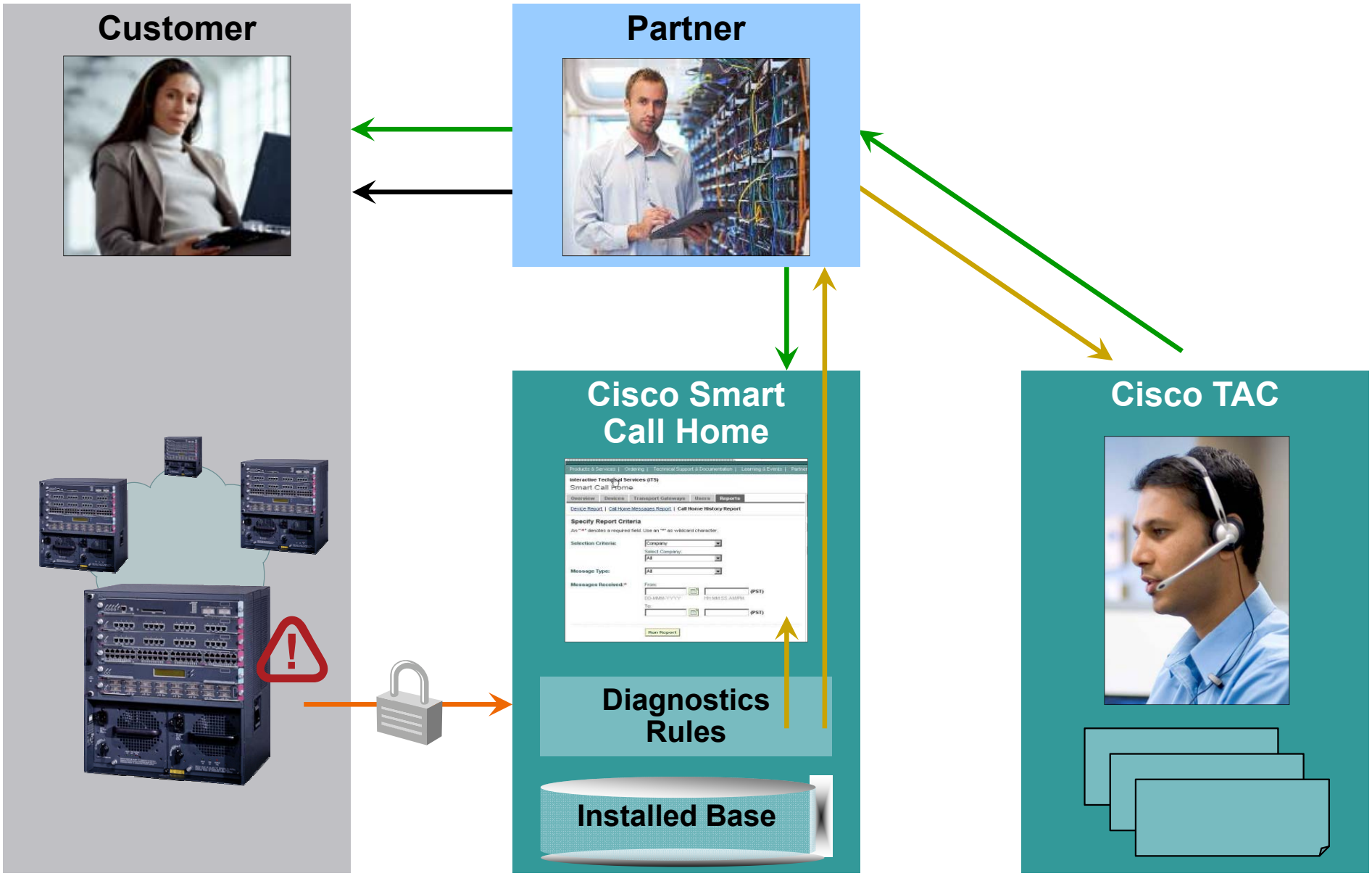
Individual Results within Analysis Period

Device	Test Name	Recommendation	Count
USI1149012H	TestLoopback Show Details	Show Recommendation	1
USI1149012H	TestL3VlanMet		1
			1
			1

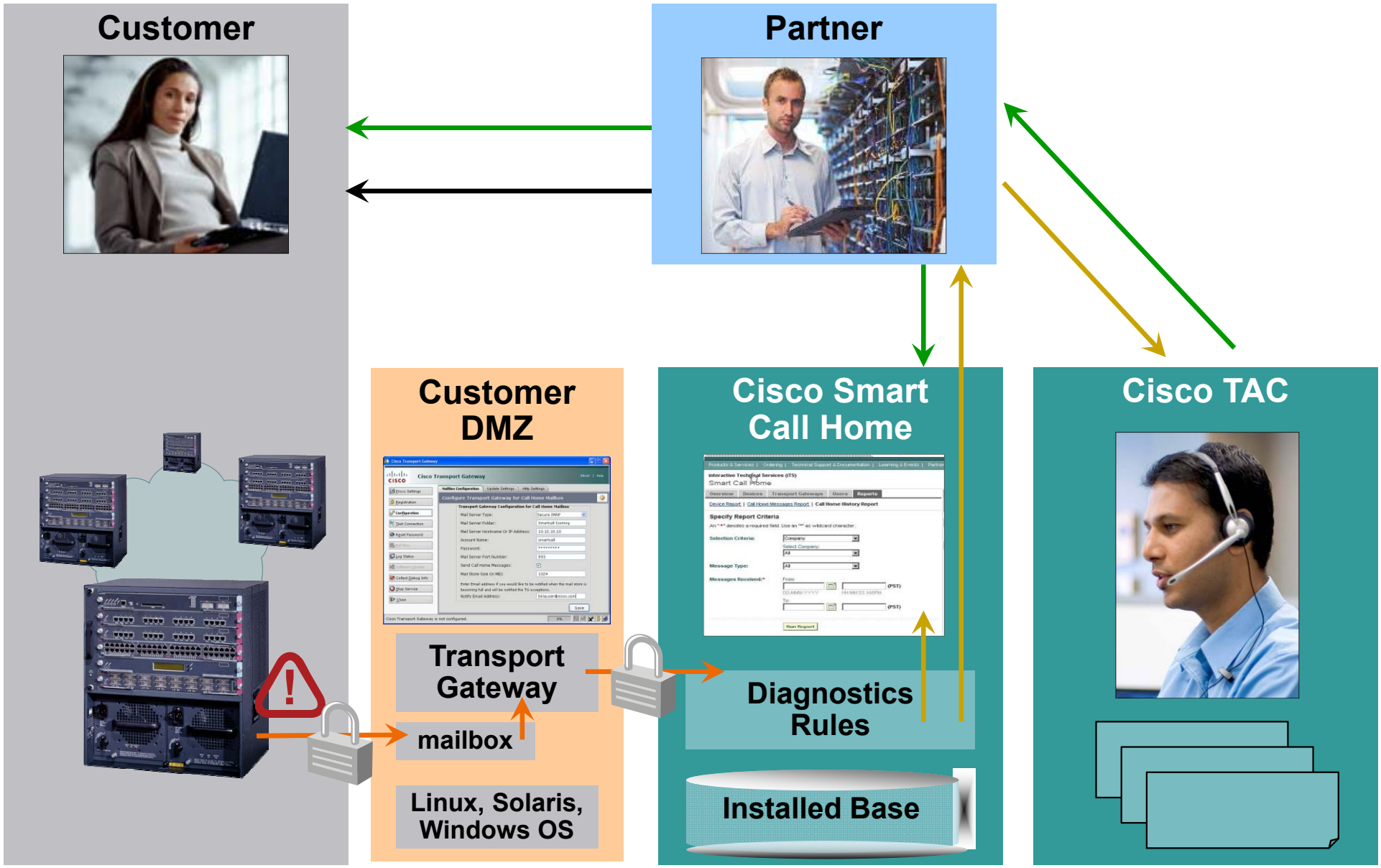
Recommendation

There were multiple test failures in module 2 that very possibly have a single root cause.
Take the following steps to resolve the failure:

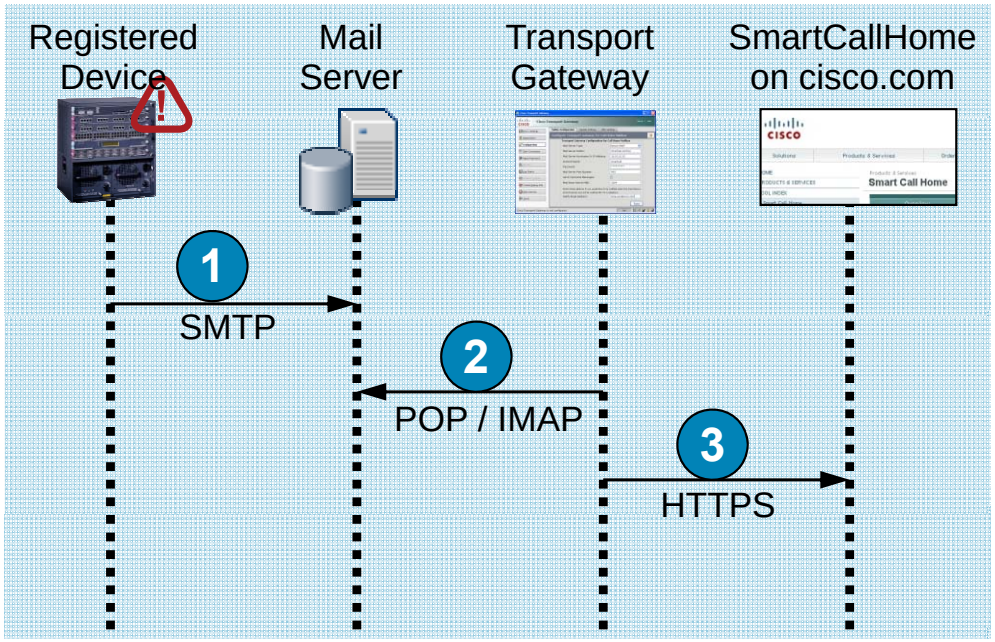
Smart Call Home – Proactive Engagement

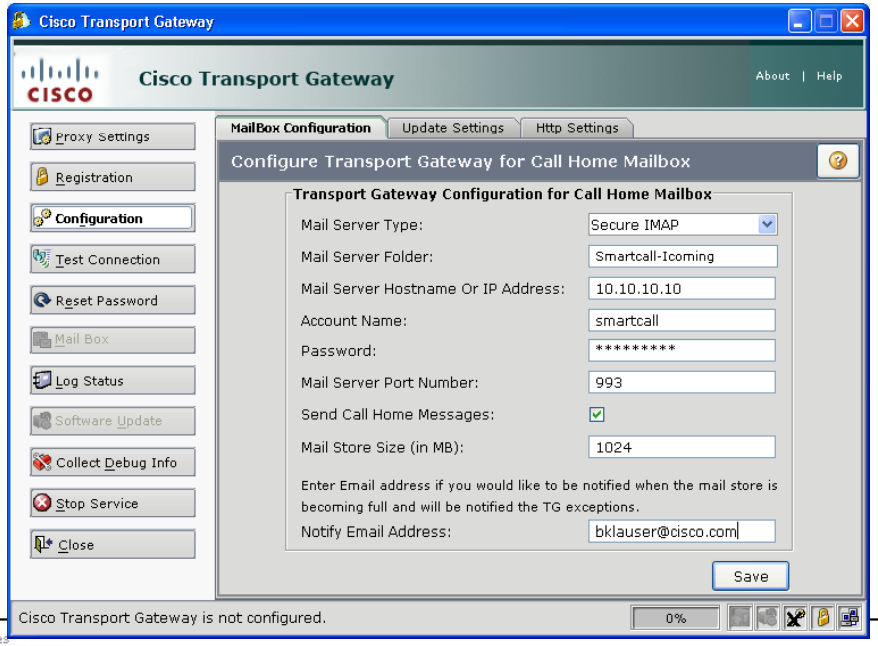


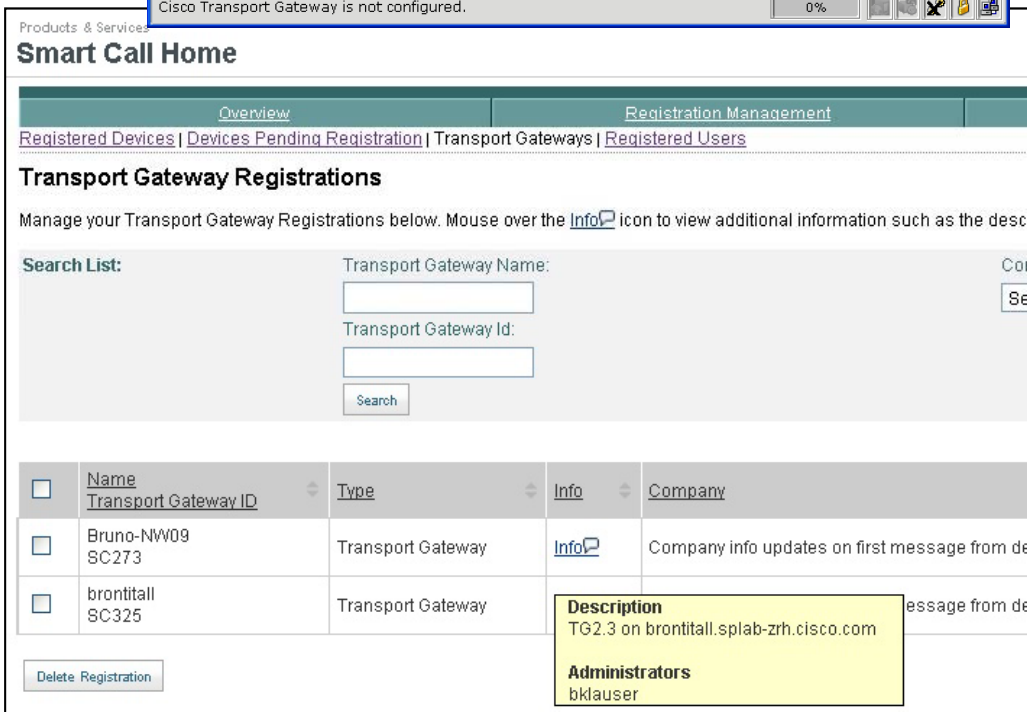
Smart Call Home – Proactive Engagement



Smart Call Home – Transport Gateway



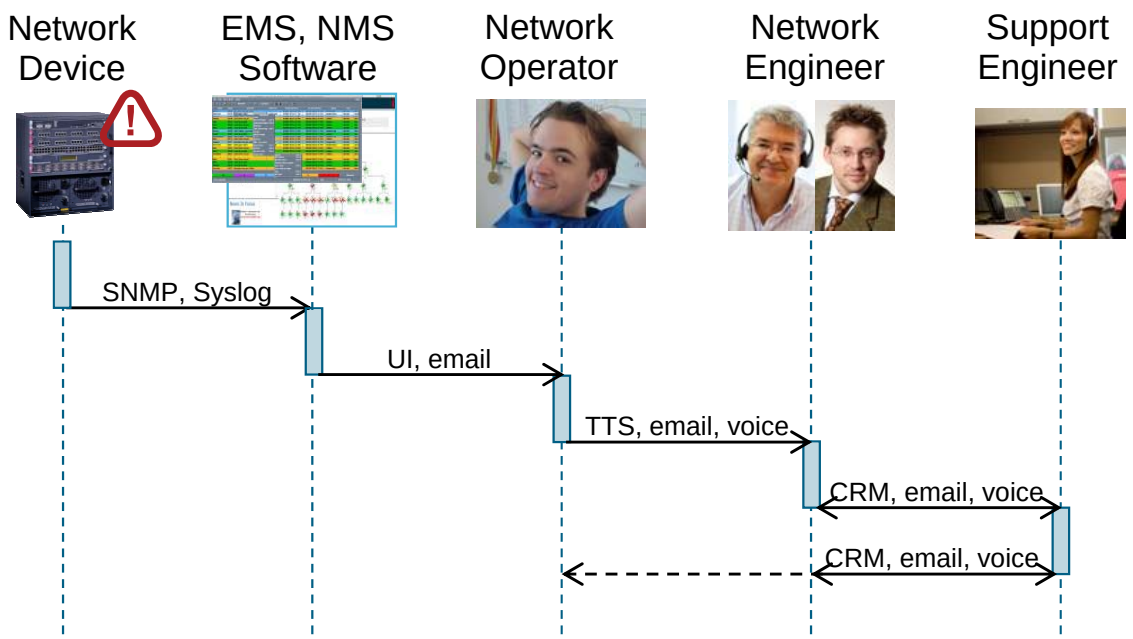




- Platform Support
  - Redhat Linux
  - Solaris
  - Microsoft Windows
- Free Download and Install Guide

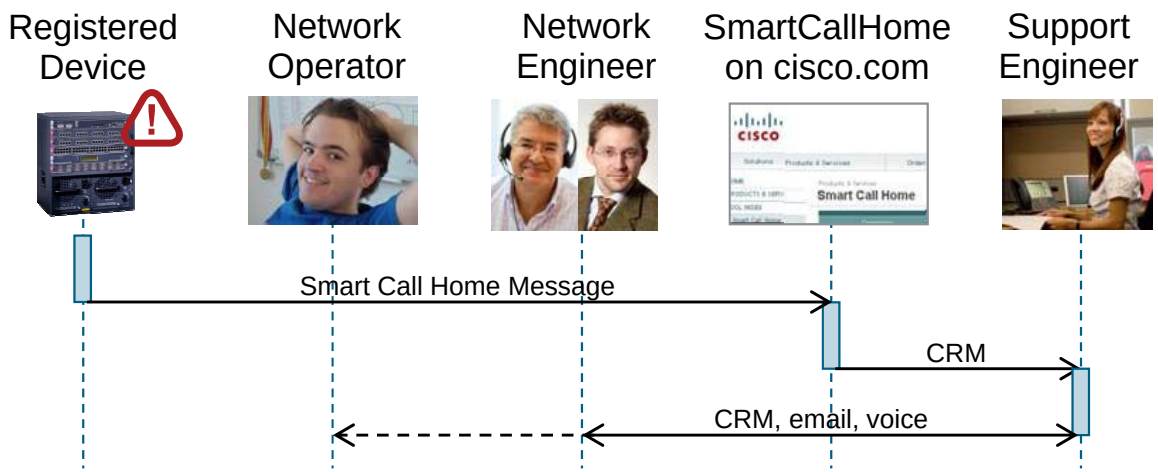
  www.cisco.com/go/smartcall

Smart Call Home



From

- Late Surprises
- Multiple Manual Escalation Steps
- Iterative Problem Isolation
- Phone, Email based Data Exchange



To

- Early Warnings
- Automated Flow
- Pinpoint Detailed Events
- Reporting and Exports

In Summary …

Recap – Automations to Monitor

1	SNMP Basics – Where to Start
2	Monitoring Local Resources – Embedded Resource Manager (ERM)
3	What if there is no MIB – Event- and Expression MIB
4	What if there is no MIB – Custom MIB
5	Events and Automations – EASy and Embedded Event Manager (EEM)
6	Periodically Exporting Data – Bulk Statistics
7	Service Level Agreements Basics – IP SLA and Auto IP SLA
8	Dynamic Service Level Agreements – IP SLA and Events
9	Application Aware Traffic Flows – Flexible Netflow and NBAR Integration
10	Trending and Forecasting – NAM and Visual Networking Index (VNI)
11	Is It All Working? – EASy NMS Tester Package
12	Validating Design Assumptions
13	Preventive Maintenance – GOLD and Smart Call Home

For Your Reference

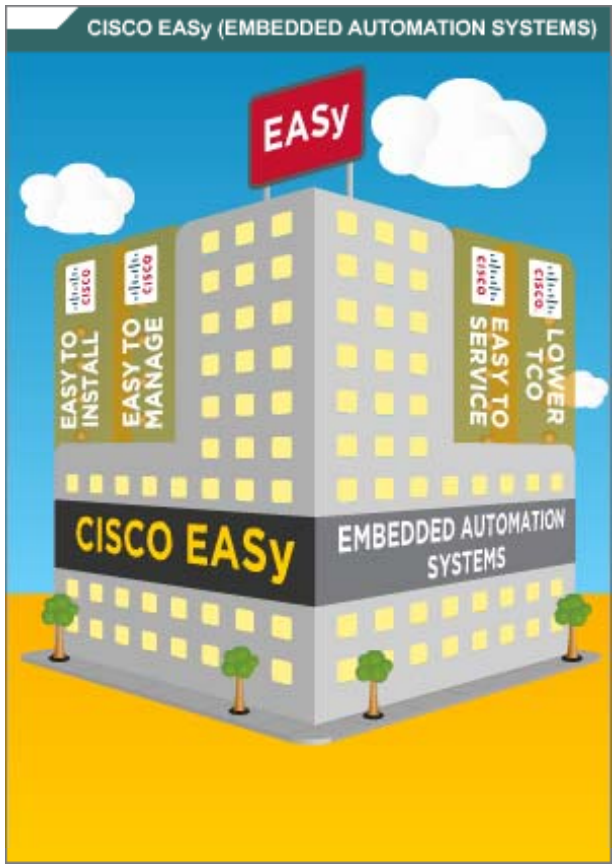
Instrumentation

Device Manageability Instrumentation (DMI) www.cisco.com/go/instrumentation

- Embedded Event Manager (EEM): www.cisco.com/go/eem
- Cisco Beyond – EEM Community: www.cisco.com/go/ciscobeyond
- Embedded Menu Manager (EMM): http://tinyurl.com/emm-in-124t
- Embedded Packet Capture (EPC): www.cisco.com/go/epc
- Flexible NetFlow: www.cisco.com/go/netflow and www.cisco.com/go/fnf
- GOLD: http://www.cisco.com/en/US/products/ps7081/products_ios_protocol_group_home.html
- IPSLA (formerly SAA, formerly RTR): www.cisco.com/go/ipsla
- Network Analysis Module: http://www.cisco.com/go/nam
- Network Based Application Recognition (NBAR): www.cisco.com/go/nbar
- Security Device Manager (SDM): http://www.cisco.com/go/sdm
- Smart Call Home: www.cisco.com/go/smartcall
- Web Services Management Agents (WSMA): http://tinyurl.com/wsma-in-150M
- Cisco Configuration Engine (CCE): www.cisco.com/go/ciscoce

- **Feature Navigator: www.cisco.com/go/fn**
- **MIB Locator: www.cisco.com/go/mibs**

Embedded Automation Systems



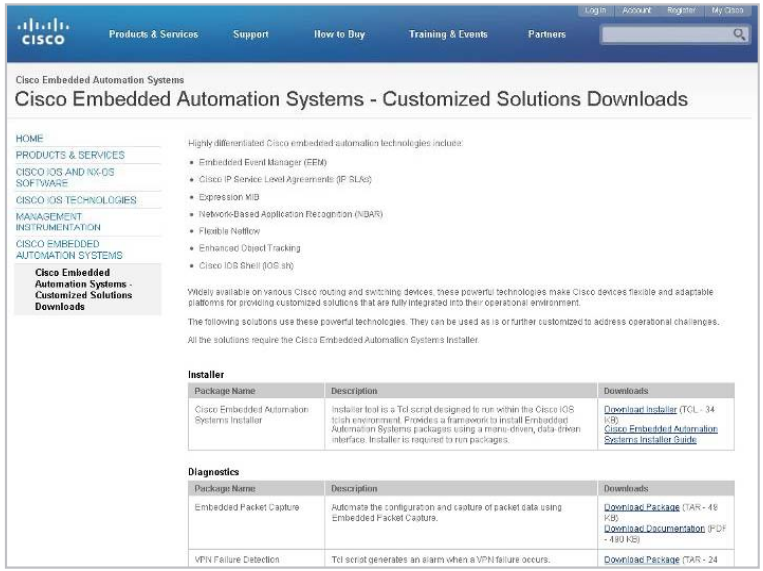
Embedded Automation Systems (EASy)

1. Browse and Download EASy Packages
   www.cisco.com/go/easy
2. Make Sure to also download EASy Installer
3. Browse Other Embedded Automations
   www.cisco.com/go/ciscobeyond
4. Learn About The Technology Under The Hood
   www.cisco.com/go/instrumentation
   www.cisco.com/go/eem
   www.cisco.com/go/pec
5. Discuss, Ask Questions, Suggest Answers
   supportforums.cisco.com
6. Upload your own Examples to CiscoBeyond
   www.cisco.com/go/ciscobeyond
7. Engage via ask-easy@cisco.com

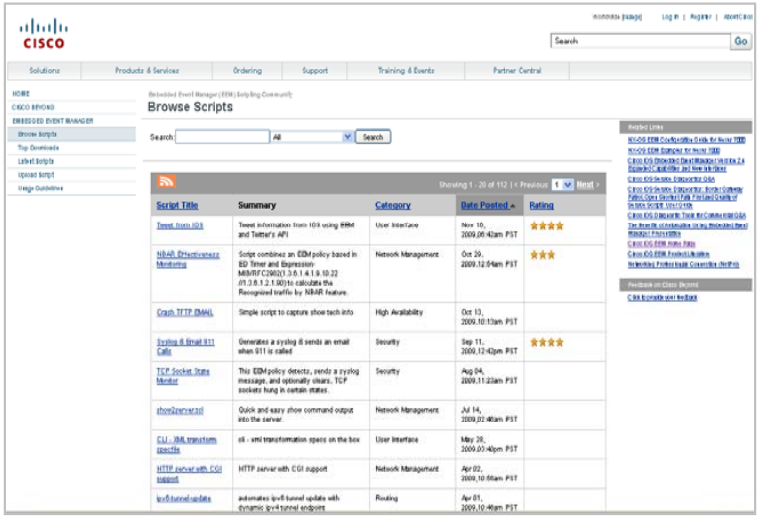
For Your Reference

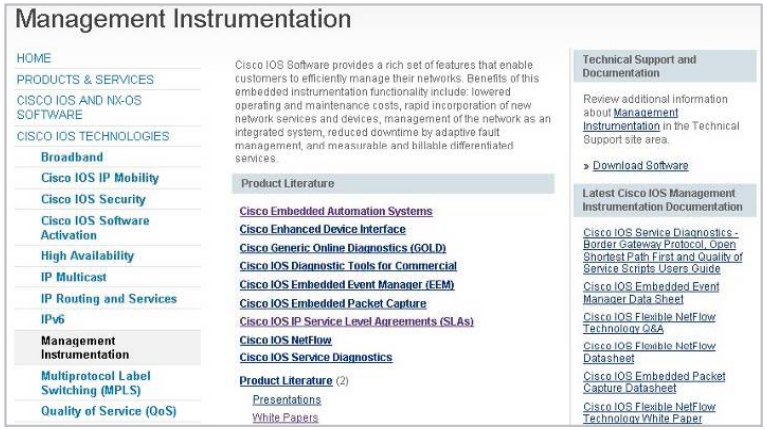
Embedded Automation Systems

www.cisco.com/go/easy

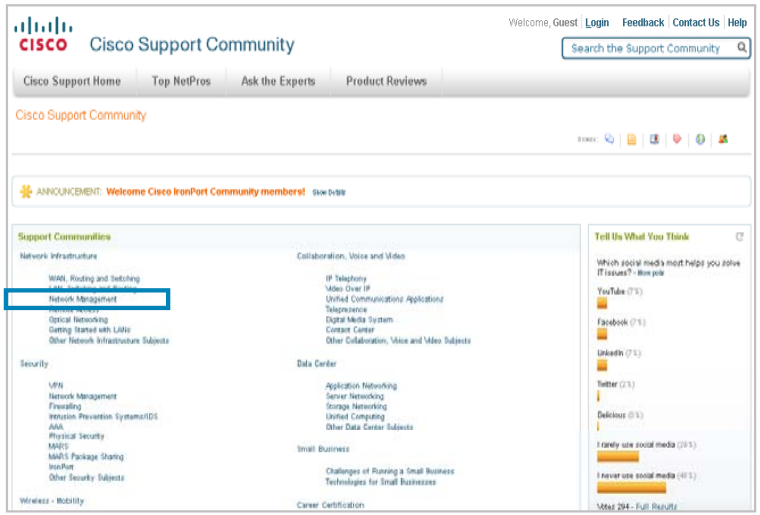


www.cisco.com/go/ciscobeyond





www.cisco.com/go/instrumentation



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For Your Reference

TechWise TV Episode 73

Best Of 2010

Featuring Cisco Solutions Experts Robb Boyd and Jimmy Ray Purser and Borderless Networks Host Jennifer Geisler

Special Guests:
- **Joe Clarke**
- **Tracy Jiang**
- **Matt Lambert**
- **Bruno Klauser**
- **David Lin**

Recorded at CiscoLive 2010

For Geeks from Geeks

Small, real, practical, engaging examples

Cult Status of Robb and Jimmy Ray ☺

See: http://www.cisco.com/en/US/solutions/ns340/ns339/ns638/ns914/html_TWTV/twtv_episode_73.html

For Your Reference

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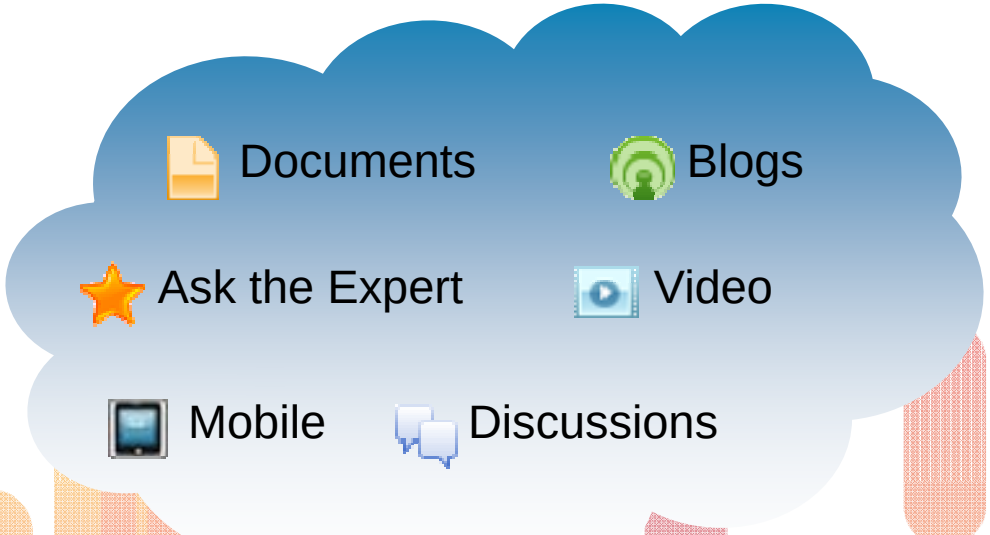

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Network Automation @ CiscoLive 2011

Session Catalogue

The content catalogue is a preliminary guide to the sessions taking place at Cisco Live 2011, London and are therefore subject to change. Please refer to schedule builder for the full session listing and schedule.

Switch to Basic Search

Search for items containing: Automation
Leave search field blank to see all records
in the: Title
Type: Show All
Level: Show All
Session Group: Show All
Search

Show Descriptions | Print View

All | Type | Technical Level | Session Group: | Day

Session ID	Title	Type
BRKCDN-2005	Building Innovative Solutions with Embedded Automation Technologies	Cisco Developers Program - 2 hour
BRKCRS-2929	Industrial Automation Switching	Technical Breakout - 90 mins
BRKIPM-2090	Implementing Network Automations	Technical Breakout - 90 mins
BRKNMS-2464	13 Smart Automations to Configure Your Cisco IOS Network	Technical Breakout - 2 hours
BRKNMS-2465	13 Smart Automations to Monitor Your Cisco IOS Network	Technical Breakout - 2 hours
BRKNMS-2466	13 Smart Automations to Troubleshoot Your Cisco IOS Network	Technical Breakout - 2 hours
LABNMS-1262	Implementing Network Automation Module 0 - Basics	Lab: Self-Paced
LABNMS-1263	Implementing Network Automation Module 1 - Planning	Lab: Self-Paced
LABNMS-1264	Implementing Network Automation Module 2 - Deployment	Lab: Self-Paced
LABNMS-1265	Implementing Network Automation Module 3 - Monitoring	Lab: Self-Paced
LABNMS-1266	Implementing Network Automation Module 4 - Troubleshooting	Lab: Self-Paced
LABNMS-1422	Network Automation Solutions using Cisco IOS EEM	Lab: Self-Paced
LABNMS-2001	Advanced Network Automation and Solutions using Cisco IOS EEM	Lab: Instructor Led - 2 hours
TECNMS-2234	Designing and Implementing Network Automation	Technical Seminar - 8 hours

1. Navigate to http://bit.ly/cSMV3N
2. Search for ‚Automation‘
3. Enjoy !

Network Management and Operations Sessions

Session ID	Session	Day
LABNMS-2001	Network Automation and Solutions using Cisco IOS EEM	Tuesday
BRKMPL-3004	Advanced Network Management for MPLS & Carrier Ethernet Networks	Tuesday
BRKNMS-2840	Managing the Security in Borderless Networks	Tuesday
BRKNMS-2006	Energy Management	Tuesday
BRKNMS-2008	Service Assurance in an Enterprise Environment	Tuesday
BRKNMS-2003	CiscoWorks LMS	Tuesday
BRKNMS-2464	13 Smart Automations to Configure Your Cisco IOS Network	Tuesday
BRKNMS-2002	IOS strategy and evolution	Wednesday
BRKNMS-2007	Monitoring, Troubleshooting and Diagnosing Real-Time Video Collaboration Services	Wednesday
BRKNMS-2009	Simplify the Deployment of Cisco Platforms and Technologies	Wednesday
PNLNMS-1196	Introduction to Enterprise Network Management	Wednesday
BRKNMS-2005	DataCenter & Virtualization Management Overview	Wednesday
BRKNMS-2465	**13 Smart Automations to Monitor Your Cisco IOS Network**	**Wednesday**
BRKNMS-2658	Securely Managing Your Networks and SNMPv3	Wednesday
BRKNMS-2031	SYSLOG Design, Methodology and Best Practices	Wednesday
BRKNMS-2466	13 Smart Automations to Troubleshoot Your Cisco IOS Network	Wednesday
BRKNMS-3132	Advanced NetFlow	Thursday
LABNMS-2001	Network Automation and Solutions using Cisco IOS EEM	Thursday
LABNMS-1145	Introduction to IOS Software Activation Lab (aka Licensing)	Walk In
LABNMS-1262	Introduction to Implementing Network Automation Mobule 0 - Basics	Walk In
LABNMS-1263	Introduction to Implementing Network Automation Module 1 - Planning	Walk In
LABNMS-1264	Introduction to Implementing Network Automation Module 2 - Deployment	Walk In
LABNMS-1265	Introduction to Implementing Network Automation Module 3 - Monitoring	Walk In
LABNMS-1266	Introduction to Implementing Network Automation Module 4 - Troubleshooting	Walk In
LABNMS-1422	Introduction to Network Automation Solutions using Cisco IOS EEM	Walk In
LABNMS-2011	Flexible NetFlow Quickstart	Walk In

Conclusion

- Not all Monitoring Tasks are Equal
- Network Automation …
  … is a Paradigm Change
  … offers opportunities far beyond OPEX savings
  … is EASy to adopt now

How will You use Network Automation?

BRKNMS-2465

Recommended Reading

Please browse on-site Cisco Store for suitable reading.

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  1. Scan the Access Code
     (See http://tinyurl.com/qrmelist for software, alternatively type in the access URL)
  2. Login
  3. Complete and Submit the evaluation

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