LET’S
BUILD
TOMORROW
TODAY
13 Smart Automations to Monitor Your Cisco IOS Network

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BRKNMS-2465
Welcome Aboard

This Session IS:

• Automating Custom Behavior in Your Network
• Linking Software Applications and Networks
• Using Network Automation
• Practical Examples

This Session is NOT:

• An Introduction to NMS Concepts
• An In-Depth Session on One Single Feature
• Engineering Details of IOS
• NMS applications
An Analogy

Highly motivated individuals
Full control over every single detail

Highly skilled and trained crew
Human brain in every control loop

Specialized distributed crew
Reasonable control within boundaries

From: Detailed control by a single central authority
Towards: Collaborative operations of a partially autonomic system
“Civilization advances by extending the number of important operations which we can perform without thinking of them.”

Alfred North Whitehead, 1911

(Mathematician and Philosopher, Author of “An Introduction to Mathematics” and “Principia Mathematica”)
## Agenda

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Quickly Export SNMP Statistics
Data Collection Manager / Bulk File MIB
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 or Data Collection Manager 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
```
Configuration – Data Collection Manager 2.0

**Solution:** Use Data Collection Manager 2.0 from IOS 15.2(2)T onwards: simplified command line, adds proxy collection from remote devices, adds transfer using SCP and FlexibleNetflow

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

   ```
   bulkstat data my-data type snmp
   object 1.3.6.1.4.1.9.9.48.1.1.1.2
   object 1.3.6.1.4.1.9.9.48.1.1.1.5
   ```

2. **Specify Instances and Polling Schema**

   ```
   bulkstat instance my-data-sources type snmp
   range start 1 end 5
   bulkstat data-group my-data-group
   interval polling 1
   collect type snmp data my-data instance my-data-sources
   ```

3. **Configure the Transfer Mechanism – and enable it!**

   ```
   bulkstat profile my-data-profile
   file transfer url primary flash:/bulk-memory-data/
   file size 10240
   interval transfer raw 60
   data-group my-data-group
   enable
   ```
Is Your Monitoring Actually Working?

EASy NMS Tester Package
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
EASy NMS Tester 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
Your Network Embedded Automations
Embedded Event Manager (EEM) and EASy
Embedded Event Manager (EEM)

**Actions**
- Syslog
- email notification
- SNMP set Counter
- SNMP get
- SNMP notification
- Reload or switch-over
- Application specific
- CLI Applets
- IOS.sh Policies
- TCL Policies

**Embedded Event Manager**

**EEM Applets**
- multi-event-correlation

**Event Detectors**
- Syslog ED
- SNMP EDs
- Timer EDs
- none ED
- HW EDs
- Watchdog ED
- Interface Counter ED
- XML RPC ED
- CLI ED
- OIR ED
- ERM ED
- EOT ED
- RF ED
- GOLD ED
- NetFlow ED
- IPSLA ED
- Route ED
- CDP LLDP ED
- 802.1x ED
- MAC ED

**Cisco live!**

- Syslog Event
- Remote: • Notification Local: • Notification • Get/Set
- • Cron • Count down
- • Fan • Temp • Env • ...
- Process Scheduler Database
- Interface Descriptor Blocks

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Example: EEM Applets – Loops, Variables

**Problem:** None in Particular

**Solution:** Have fun exploring EEM Applet capabilities

```
event manager applet 99-bob
  description written by bklauser inspired by http://www.99-bottles-of-beer.net
  event none
  action 100 set b 99
  action 110 while $b gt 1
  action 120  puts "$b bottles of beer on the wall, $b bottles of beer."
  action 130  decrement b
  action 140  puts "Take one down, pass it around, "
  action 150  puts "$b bottles of beer on the wall.\n"
  action 160  end
  action 170  puts "$b bottle of beer on the wall, $b bottle of beer."
  action 180  puts "Take one down, pass it around, "
  action 190  puts "no more bottles of beer on the wall.\n"
  action 200  puts "No more bottles of beer on the wall, "
  action 210  puts "no more bottles of beer."
  action 220  puts "Go to the store and buy some more, "
  action 230  puts "99 bottles of beer on the wall.\n"
! alias exec sing event manager run 99-bob
```

Packaging Network Automations

**Problem:** Cisco IOS Embedded Automation Systems often include multiple configuration items, files, checks and procedures – how to ensure they are deployed consistently?

**Solution:** Cisco EASy provides a simple packaging mechanism and open-source EASy Installer. A developer guide is available online to assist with the creation of EASy packages.

- 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

See: [http://www.cisco.com/go/easy](http://www.cisco.com/go/easy)

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
   supportforums.cisco.mobi

6. Upload your own Examples to CiscoBeyond
   www.cisco.com/go/ciscobeyond

7. Engage via ask-easy@cisco.com
Monitoring Resources

Embedded Resource Manager (ERM)
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%
```
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
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.

```plaintext
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-CPURESISING: 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%
Monitoring Resources – II
Combining ERM and EEM (and onePK)
Monitor Memory Usage – Total Memory Threshold

**Problem:** Get an email whenever Total Memory usage is > 80%

**Solution:** Combine ERM + EEM to trigger an event:

```
resource policy
policy my-memory-policy global
   system
       memory processor
           critical rising 80 interval 5
   user global my-memory-policy

event manager applet my-memory-email-trigger
   event resource policy my-memory-policy
   action 100 mail server <server> to <to> from <from> subject "Warning: Memory too high"
```
Monitor Memory Usage – Detecting Memory Spikes

**Problem:** Monitoring Total Memory is nice, how about big spikes below the Threshold?

**Solution:** Use EEM to periodically check memory usage, calculate $\Delta$ and detect spikes

```
event manager applet my-memspike
  event timer watchdog time 30
  action 100 set _last_saved "0"
  action 102 cli command "enable"
  action 103 cli command "show mem stat | in Processor"
  action 104 regexp "Processor\s+[0-9A-F]\s+[0-9]\s+\([0-9]*\)\s+" "$cli_result" _ma _used
  action 105 handle-error type ignore
  action 106 context retrieve key savekey
  action 107 handle-error type exit
  action 108 if $used gt "$_last_saved"
  action 109 subtract $used $_last_saved
  action 110 if $result gt "$memthresh"
  action 111 syslog msg "WARNING: Memory jumped more than $memthresh bytes: $result"
  action 112 end
  action 113 end
  action 114 set _last_saved "$used"
  action 115 context save key savekey variable "$_last_saved"
```

_ma : total available memory
_used : currently used memory

Calculate delta from last run

Check against Threshold in global variable memthres (ie.: 50000 bytes)
A Network “Top”

- Use onePK to build a live process monitor similar to UNIX `top`
- The same app can connect to multiple devices to display the top processes across the entire network
Collecting Remote and Peer Information

Combining EEM, SNMP and HTTP
Receive Remote Information

**Problem:** Sometimes we want to receive remote information on a Router / Switch and be able to react to it locally – for example a notification from a UPS System.

**Solution:** Use Network Automation based on Cisco IOS Embedded Event Manager leveraging the EEM SNMP Notification Event Detector

- Router / Switch can received SNMP Notifications
- Execute (trigger) EEM Policy to take local action
- Policy can query varbind info
- Supports Incoming or Outgoing Notifications
- Outgoing only for locally generated Notifications

```bash
Router(config)# event manager applet catch-a-trap
router(config-applet)# description test snmp notification unmanaged service
router(config-applet)# event snmp-notification oid 1.3.6.1.6.3.1.1.4.1.0
  oid-val "1.3.6.1.6.3.1.1.5.3" op eq src-ip-address 10.51.89.176
  direction incoming
router(config-applet)# action 010 ...
routing(config-applet)# action 020 ...
```
Receive Remote Information – Example

**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

---

Real-World Example
7

Sharing Information
I Tweet, Therefore I am
Format and Share Remote Information – 1/2

**Problem:** How to actively gather and share information from a router and from a few devices behind the router – across organizational and technical borders?

**Solution 1:** Initiate a project to make use of SNMP, Syslog, Event Management Software, Reporting, Provisioning and CRM Systems ...

**Solution 2:** Use Cisco IOS Network Automation to collect and post the information

Using Cisco IOS Embedded Event Manager and Tcl:

1. Import the http package into EEM policy
   ```tcl
   namespace import ::http::*
   ```
2. Collect the information required
3. Build a query for the http POST operation
   ```tcl
   set my_query [::http::formatQuery "status" $my_info]
   ```
4. POST the information to a website
   ```tcl
   set my_reply [::http::geturl $my_server_url -query $my_query]
   ```
Format and Share Remote Information – 2/2

Good Morning: Fan Running successfully. Thursday 20091210 at 07:45:01 UTC
about 2 hours ago from API

Pseudorandom factoid: SNMP sysobjectID is 1.4.1.9.1.642
about 10 hours ago from API

Pseudorandom factoid: image file is flash:c161x-advipservicesk-mz.150-1.M.bin
12:45 PM Dec 8th from API

Print Server is now down. Saturday 20091205 at 21:24:51 UTC
1:20 PM Dec 8th from API

Print Server is now up and alive (Toner levels: B80% C90% M70% Y70%). Saturday 20091205 at 21:18:00 UTC
1:13 PM Dec 8th from API

See: http://twitter.com/EASyDMI
Note: it is NOT recommended to use a public site or feed other than for demo purpose
What a Router knows best: Topology
Visualize the Network Topology

- The network knows its topology from routing protocols and link-layer neighbor protocols (e.g., CDP, LLDP, etc.)
- About 75% of all problems require some knowledge of the topology in order to determine root cause
- Leveraging onePK, the network can store the topology in a way that can be retrieved using a single command
- The topology is always up-to-date and always accurate
The Topology-Aware Network

1. Connect to a device running the Topology-Aware Network app
2. Issue the custom, “topology send” command
3. Router sends current topology image to user

The whole process takes a few seconds!
How to Verify a Path?
APIC-EM Path Visualization and ACL Analysis
**APIC-EM Path Visualization and ACL Analysis**

**Problem:** How to discover an end-to-end path for a specific application?

**Solution:** Leverage SDN: APIC Enterprise Module for Path Visualization and ACL Analysis

APIC-Enterprise Module is the Cisco Enterprise SDN Controller for Campus, WAN, Access
Includes Path Visualization and ACL Analysis Apps
APIC-EM Path Visualization and ACL Analysis

Hop-by-hop Details specific to 5-tuple Path
APIC-EM Path Visualization and ACL Analysis

Quickly identify ACL conflicts and shadows
Let the Network do some Homework – I
Generic Online Diagnostics (GOLD)
POST (Power-On Self-Test) is great ...

... but some errors you prefer to know while the system is up and running ...

... and: can you afford to power-cycle after OIR just for POST to run ?
Generic Online Diagnostics (GOLD)

**Problem:** How to detect wear and tear issues before they cause an outage? Hardware aging as well as repeated insertion and removal of modules can lead to wear and tear damage on connectors. This 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

- Bootup Diagnostics (upon bootup and OIR)
- Periodic Health Monitoring (during operation)
- OnDemand (from CLI)
- Scheduled Testing (from CLI)
- Test Types include:
  - Packet switching tests
  - Memory Tests
  - Error Correlation Tests
- Complementary to POST

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

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

- **CDP/LLDP, OIR or CLI Event Detector**: to trigger an on-demand GOLD or TDR test as post-validation of deployment or maintenance work
Example: Preventive Failover and Recovery

**Problem:** How to initiate preventive Maintenance in a HA Environment?

**Solution 1:** Manually change topology after a low priority Syslog warning has been seen (and understood)

**Solution 2:** Use Cisco IOS Network Automation to schedule a HSRP failover upon GOLD hardware diagnostics result

1. Cisco IOS Generic Online Diagnostics (GOLD) detects a potential hardware problem
2. GOLD Event is detected by Embedded Event Manager (EEM) – which schedules an HSRP Failover upon next maintenance window
3. HSRP Failover to Standby node
4. Preventive maintenance / replacement activity can now take place on Primary node
Let the Network do some Homework – II
Smart Call Home (SCH)
Smart Call Home – Deployment Options

- **Platform Support**
  - Redhat Linux
  - Solaris
  - Microsoft Windows

- **New in 15.2(2)T: Anonymous Reporting**

- **New in 15.2(2)T: HTTP Proxy Support**

- **See** [www.cisco.com/go/smartcall](http://www.cisco.com/go/smartcall)
Smart Call Home – Reactive → Proactive

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
How to Govern Network Optimization?

Connected Analytics for Network Deployments
Connected Analytics for Network Deployments (CAND)

**Problem:** Where to Focus my Network Planning and Optimization? How to identify and preempt emerging Network Issues?

**Solution:** Subscribe to Connected Analytics for Network Deployments (CAND) to get insights and actionable recommendations specific to your Network

**CAND**

- Collects Network Data and Service Request Data
- Analyses for Trends and Outlier
- Derives KPIs and Benchmarks
- Visualizes At-a-Glance

Subscription-based Software, available to Customers under SNTC or NOS Contracts
## CAND – Network Deployment KPIs

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<th>Network Disruption Index</th>
<th>A measure of a severity of network disruption</th>
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<td><strong>Data Source</strong></td>
<td>Cisco Service Request Data</td>
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| **Algorithm Derived From** | • Service request severity  
                           |   • Time to resolution  
                           |   • Escalation level  
                           |   • Outages           |
| **Benchmark**            | Against yourself, peers, and industry with trend report |
| **KPI Granularity**      | Network vs. HW/SW/Operations                 |
| **Scale**                | 1-10                                         |

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<th>Network Consistency Index</th>
<th>A measure of how devices performing similar functions are similarly deployed</th>
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<td><strong>Data Source</strong></td>
<td>Customer Network Data</td>
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</tbody>
</table>
| **Algorithm Derived From** | • Device hardware choices  
                           |   • Device software choices  
                           |   • Technology configurations |
| **Benchmark**            | Against yourself and peers                                                     |
| **KPI Granularity**      | Network vs. HW/SW/Features                                                      |
| **Scale**                | 1-1000                                                                      |

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<th>Network Complexity Index</th>
<th>A measure of number of features enabled with different complexity weights</th>
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<tbody>
<tr>
<td><strong>Data Source</strong></td>
<td>Customer Network Data</td>
</tr>
</tbody>
</table>
| **Algorithm Derived From** | • Features enabled  
                           |   • Feature complexity weight by domain experts in Cisco                     |
| **Benchmark**            | Indication of network technology enablement                                 |
| **KPI Granularity**      | Network vs. Families/Roles                                                  |
| **Scale**                | 1-1000                                                                      |
CAND – Use Case Examples

Where are the Outliers and Anomalies?

- Collection CAND DEMO CUSTOMER (19662)
- Features
  - C2000
  - C3000
  - C4000
  - C4060
  - C4500
  - C7603
  - ZM93
  - 8500/VSA
  - 8660
  - C2000
  - C4000
  - C4060
  - C4500
  - 8663 CATALYST
  - 2910
  - 1600
  - 2600
  - 3700
  - 7203
  - 2200
  - C3000
  - C600
  - 8500

- Network Availability Index

Any Feature, Device, SW causing Issues?

- Dashboard
  - Key Performance Indicators
  - Library
  - Connected Analytics for Revenue
  - Key Performance Indicators
  - Network Complexity Index
  - Network Correlation Index
  - Network Disruption Index
  - Support Case Management
  - All Support Cases
  - Defects
  - PMAs

- Defects
  - Defect Count: Critical: 14, High: 26%

- Compare with Peers and Industry

- Severity
  - 7
  - 6
  - 5
  - 4
  - 3
  - 2
  - 1
  - 0

- Features
  - C2000: 7
  - C3000: 6
  - C4500: 4
  - C6000: 42
Data Beyond Your Network …
Cisco VNI and RIPE ATLAS
What if Your Cisco Network is not there yet?

**Problem:** You may need network data and statistics from locations beyond your own network

**Solution:** Current and historical Performance Metrics provided by RIPE ATLAS

“With your help, the RIPE NCC is building the largest Internet measurement network ever made. RIPE Atlas employs a global network of probes that measure Internet connectivity and reachability, providing an unprecedented understanding of the state of the Internet in real time.”

- Weather Map Reports
- Detailed Probe Reports
- Standard and User Defined Measurements
- REST API 😊
- Contribute to a Bigger Cause 😊

See: [https://atlas.ripe.net](https://atlas.ripe.net)
What if Your Cisco Network is not there yet?

**Problem:** You may need network data and statistics *before* deploying into a specific location

**Solution:** Trending and Forecasting information provided by Cisco Visual Networking Index

Global initiative to analyze and forecast IP network growth

- Fixed Internet, Managed IP and Mobile data collection
- Business vs. Consumer
- Customizable Filters
- Graphical reports and data summaries publicly available

See: [www.ciscovnipulse.com](http://www.ciscovnipulse.com)
Cisco Visual Networking Index

Free Resources at [www.ciscovnipulse.com](http://www.ciscovnipulse.com)

Empowering consumers with individual and global IP networking analytics and projections.

Cisco GIST Visualizations

This web experience visualizes the global speed tests and averages since the inception of the GIST mobile application in 2008.

[Learn More](#)

Cisco VNI Forecast App

The widely used and quoted Cisco Visual Networking Index (VNI) Forecast is now available in a fun and easy-to-use mobile application.

[Learn More](#)

Cisco VNI Forecast Widget

This widget allows you to define specific parameters of Cisco VNI Forecast data and create custom views/charts that may be used in public/private articles, blogs, and websites, etc.

[Learn More](#)

Cisco Data Meter

The Cisco Data Meter enables smartphone and tablet users to easily monitor their cellular and Wi-Fi data usage. View global and regional mobile usage metrics and download the free application.

[Learn More](#)
Summary and Close
## Agenda Recap

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<td>6</td>
<td>Combining EEM, SNMP and HTTP</td>
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<td>7</td>
<td>I Tweet, Therefore I am</td>
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<td>8</td>
<td>What a Router knows best: Topology</td>
</tr>
<tr>
<td>9</td>
<td>APIC-EM Path Visualization and ACL Analysis</td>
</tr>
<tr>
<td>10</td>
<td>Generic Online Diagnostics (GOLD)</td>
</tr>
<tr>
<td>11</td>
<td>Smart Call Home (SCH)</td>
</tr>
<tr>
<td>12</td>
<td>Connected Analytics for Network Deployments (CAND)</td>
</tr>
<tr>
<td>13</td>
<td>Cisco VNI and RIPE ATLAS</td>
</tr>
</tbody>
</table>
The Last Session of a Series – and a First Session

CiscoLive Europe 2009, Barcelona
BRKNMS-2004 13 Smart Ways to Configure Your Cisco IOS Network

CiscoLive Europe 2010, Barcelona
BRKNMS-2000 13 Smart Ways to Configure Your Cisco IOS Network

CiscoLive Europe 2011, London
BRKNMS-2464 13 Smart Automations to Configure Your Cisco IOS Network
BRKNMS-2465 13 Smart Automations to Monitor Your Cisco IOS Network
BRKNMS-2466 13 Smart Automations to Troubleshoot Your Cisco IOS Network

CiscoLive Europe 2012, London
BRKNMS-2464 13 Smart Automations to Configure Your Cisco IOS Network
BRKNMS-2465 13 Smart Automations to Monitor Your Cisco IOS Network
BRKNMS-2466 13 Smart Automations to Troubleshoot Your Cisco IOS Network

CiscoLive Europe 2013, London
BRKNMS-2465 13 Smart Automations to Monitor Your Cisco IOS Network
BRKNMS-2466 13 Smart Automations to Troubleshoot Your Cisco IOS Network

CiscoLive Europe 2014, Milan
BRKNMS-2465 13 Smart Automations to Monitor Your Cisco IOS Network
BRKNMS-2466 13 Smart Automations to Troubleshoot Your Cisco IOS Network

CiscoLive Europe 2015, Milan
BRKNMS-2465 13 Smart Automations to Monitor Your Cisco IOS Network
Application Economy and Software-Defined

Integration of applications with the network takes time

Examples
Telephony
Connected Analytics
Mobility, Location
Management

SRST, Call Manager Express
DNA, Agents, Collectors
802.11*, CleanAir, Location
MIBs, Netflow, IPSLA, …

Call Manager
Connected Analytics, Prime
WLC, MSE, ISE/AAA, CMX
NMS FCAPS, Prime *, et al

Architectural Patterns:
Distributed Agents
Central Control Functions

In The Software-Defined Era
Cisco ACI empowers Apps via
Containers and APIs
Infrastructure
Policies and Apps Controllers

An EcoSystem powered by Cisco ACI enables Fast IT
Complete Your Online Session Evaluation

• Give us your feedback to be entered into a Daily Survey Drawing. A daily winner will receive a $750 Amazon gift card.

• Complete your session surveys though the Cisco Live mobile app or your computer on Cisco Live Connect.

Don’t forget: Cisco Live sessions will be available for viewing on-demand after the event at CiscoLive.com/Online
Continue Your Education

- Demos in the Cisco campus
- Walk-in Self-Paced Labs
- Table Topics
- Meet the Engineer 1:1 meetings
- Related sessions
# Network Programmability: Cisco Education Offerings

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Cisco Certification</th>
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</thead>
<tbody>
<tr>
<td>Integrating Business Applications with Network Programmability (NIPBA);</td>
<td>Learn networking concepts, and how to deploy and troubleshoot programmable network architectures with these self-paced courses.</td>
<td>Cisco Business Application Engineer Specialist Certification</td>
</tr>
<tr>
<td>Integrating Business Applications with Network Programmability for Cisco ACI (NPIBAACI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developing with Cisco Network Programmability (NPDEV);</td>
<td>Learn how to build applications for network environments and effectively bridge the gap between IT professionals and software developers.</td>
<td>Cisco Network Programmability Developer Specialist Certification</td>
</tr>
<tr>
<td>Developing with Cisco Network Programmability for Cisco ACI (NPDEVACI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Designing with Cisco Network Programmability (NPDES);</td>
<td>Learn how to expand your skill set from traditional IT infrastructure to application integration through programmability.</td>
<td>Cisco Network Programmability Design Specialist Certification</td>
</tr>
<tr>
<td>Designing with Cisco Network Programmability for Cisco ACI (NPDESACI)</td>
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</tr>
<tr>
<td>Implementing Cisco Network Programmability (NPENG);</td>
<td>Learn how to implement and troubleshoot open IT infrastructure technologies.</td>
<td>Cisco Network Programmability Engineer Specialist Certification</td>
</tr>
<tr>
<td>Implementing Cisco Network Programmability for Cisco ACI (NPENGACI)</td>
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</table>

For more details, please visit: [http://learningnetwork.cisco.com](http://learningnetwork.cisco.com)

Questions? Visit the Learning@Cisco Booth or contact ask-edu-pm-dcv@cisco.com
Network Programming and Automation provide

- Flexibility and Agility to
- Create Sustainable Innovation
- Deliver Application-Centric Services
- Solve Real-Life Operational Challenges

What will YOU Program?
APIC-EM related Sessions @ CiscoLive!
<table>
<thead>
<tr>
<th>POD#</th>
<th>Signage</th>
<th>Demo</th>
<th>Owner</th>
<th>Note</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Italtel SDN-Driven Multi-Vendor Management</td>
<td>Italtel</td>
<td>APIC-EM/Italtel</td>
<td>Ecosystem Partner</td>
</tr>
<tr>
<td></td>
<td>Call Management Enhanced by Cisco APIC-EM</td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>IBM SkyConnect Powered by Cisco APIC-EM</td>
<td>IBM SkyConnect (Lufthansa)</td>
<td>APIC-EM/IBM</td>
<td>Customer</td>
</tr>
<tr>
<td></td>
<td>Innovative Customer Application Enabled by Cisco SDN</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>Collaboration Simplified with SDN</td>
<td>Dynamic QOS for CUCM (Jabber)</td>
<td>APIC-EM</td>
<td>Collaboration</td>
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<tr>
<td></td>
<td>Enhanced Collaboration Quality of Experience with APIC-EM</td>
<td></td>
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<tr>
<td>4</td>
<td>Automated WAN Management</td>
<td>IWAN App</td>
<td>APIC-EM</td>
<td>WAN Automation</td>
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<tr>
<td></td>
<td>Deploy, Configure and Manage WANs Easily with SDN</td>
<td>NG-PnP</td>
<td></td>
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<tr>
<td>5</td>
<td>SDN-Enhanced Operational Support</td>
<td>Technical Services</td>
<td>Technical Services</td>
<td>Services</td>
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<tr>
<td></td>
<td>Get More Value from Support Services with APIC-EM</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>6</td>
<td>Path Visualization using APIC-EM</td>
<td>Smart Troubleshooting</td>
<td>APIC-EM</td>
<td>Troubleshooting</td>
</tr>
<tr>
<td></td>
<td>Simplify Troubleshooting and License Management</td>
<td>Smart Licensing</td>
<td></td>
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<tr>
<td>8</td>
<td>Real-time Network Security Using SDN</td>
<td>TrustSec Readiness</td>
<td>APIC-EM</td>
<td>Security</td>
</tr>
<tr>
<td></td>
<td>Platform Run-Time Analysis and TrustSec Readiness Assessment</td>
<td>RTI/Integrity Assurance</td>
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</table>
# CLUS 2015: SDN/APIC-EM Whisper Suite Demonstrations

<table>
<thead>
<tr>
<th>Demo POD#</th>
<th>Demo Details</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Programmable LISP Overlays with Cisco APIC-EM</strong></td>
<td>APIC-EM/CTO</td>
</tr>
<tr>
<td></td>
<td>• Automated Dynamic &amp; Programmable Overlay and VPN Provisioning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Policy Groups, Mobility, Multihoming, IPv6 Transition support</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Hybrid HW and SW support with End-to-end Path Engineering</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>Analytics Service in APIC-EM</strong></td>
<td>APIC-EM/CTO</td>
</tr>
<tr>
<td></td>
<td>• Provides data-driven insights for Policy-level decision making</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ability to make Intelligent and Real-time config changes</td>
<td></td>
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<tr>
<td></td>
<td>• Use cases include Root-cause Analysis, Predictive Analysis etc.</td>
<td></td>
</tr>
<tr>
<td>Customer</td>
<td>Tuesday</td>
<td>Wednesday</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>9am – 10am</td>
<td>CDW</td>
<td>Lockheed Martin</td>
</tr>
<tr>
<td>10am – 11am</td>
<td>UNL</td>
<td>Kohl’s</td>
</tr>
<tr>
<td>11am – 12pm</td>
<td>Presidio</td>
<td>Fairfax County Public Schools</td>
</tr>
<tr>
<td>12pm – 1pm</td>
<td>Univ. of Stuttgart, Germany</td>
<td>Federal Reserve Bank</td>
</tr>
<tr>
<td>1pm – 2pm</td>
<td>Kaiser</td>
<td>HMS Host/CDW</td>
</tr>
<tr>
<td>2pm – 3pm</td>
<td>DB Systel</td>
<td>Agilent</td>
</tr>
<tr>
<td>3pm – 4pm</td>
<td>Molina HealthCare</td>
<td>Dimension Data</td>
</tr>
<tr>
<td>4pm – 5pm</td>
<td>Morgan Stanley</td>
<td>Wegams</td>
</tr>
<tr>
<td>5pm – 6pm</td>
<td>AXA</td>
<td>Staples</td>
</tr>
</tbody>
</table>
# CLUS 2015: APIC-EM Related Breakout / Tectorial Sessions

<table>
<thead>
<tr>
<th>Session ID</th>
<th>Session Name</th>
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</thead>
<tbody>
<tr>
<td>BRKCRS-3011</td>
<td>APIC-EM (Application Policy Infrastructure Controller - Enterprise Module) - SDN in the Enterprise</td>
</tr>
<tr>
<td>TECSDN-3600</td>
<td>TECSDN-3600 - APIC Enterprise Module - SDN in the Enterprise</td>
</tr>
<tr>
<td>BRKARC-3004</td>
<td>BRKARC-3004 - APIC-EM: Controller Workflow and Use Cases</td>
</tr>
<tr>
<td>DEVNET-1126</td>
<td>APIC-EM API</td>
</tr>
<tr>
<td>BRKNMS-1036</td>
<td>SDN Led IT Operations Management with APIC-EM and Prime Infrastructure</td>
</tr>
<tr>
<td>PSOSDN-2003</td>
<td>IWAN management via APIC-EM (SDN Controller)</td>
</tr>
<tr>
<td>PSONMS-2003</td>
<td>APIC-EM: Branch Deployment Automation</td>
</tr>
<tr>
<td>PSODEV-1004</td>
<td>How Businesses are Navigating the Shift to Programmable Networks</td>
</tr>
</tbody>
</table>

*PS – This is just a subset of sessions related to the APIC-EM*
1. SDN Full Stack Developer POD: Getting your solution certified with Interoperability Verification Testing for APIC-EM and Cisco Open SDN Controller
3. Mini Workshop: Calling REST APIs from Python
4. Mini Workshop: Parsing JSON in Python
5. Learning Labs: APIC-EM APIs with Python
6. Learning Labs: Coding 101: REST API Basics
7. Learning Labs: Coding 102: Calling REST APIs from Python
8. Learning Labs: Coding 201: Parsing XML with Python
9. Learning Labs: Coding 202: Parsing JSON with Python
Thank you