Cisco Embedded Automation Systems - EASy
Overview

January 2010
Why Embedded Automations?
Demand for Automation and Differentiation

- Connect Managed Network Services
- Customize Device Manageability Instrumentation (DMI)
- Program Embedded Automation Systems (EASy)
- Compute Cloud, XaaS, Computing
- Transaction Experience SLA
- Quality of Service SLA
- Increase in:
  - Application awareness
  - Real-time management
  - Custom requirements
  - Programmability

Business Value/Revenue Potential

An Analogy

Airplane Router
Instruments Embedded Automations
21,000 Sensors OIDs in MIBs

With increasing scale, complexity, differentiation, and availability requirements, operators rely on embedded automations.

From: Full Control by a Single Central Authority
To: Operating a System of Self-Managing Components
# Device Manageability Instrumentation

## Fault
- **802.3ah**—Link monitoring and remote fault indication
- **802.1 ag**—Continuity check, L2 ping, trace, AIS
- **MPLS OAM**—LSP ping, LSP trace, VCCV
- **IP OAM**—Ping, trace, BFD, ISG per session
- **EEM**—Embedded Event Manager
- **EVENT-MIB**—OID-based triggers, events, or SNMP Set, IETF DISMON
- **EXPRESSION-MIB**—OID expression-based triggers, IETF DISMON
- ...  

## Configuration
- **E-LMI**—(service parameter and status signaling)
- **E-DI**—(Enhanced Device Interface, CLI, Perl, IETF Netconf)
- **EMM**—Embedded Menu Manager
- **NETCONF**—(XML PI)
- **CNS and WSMA**
- **TR-069**
- **KRON**—command scheduler
- **Config change**—logging and notifications
- **Config replace and rollback**
- **Diff**—context diff utility
- **MIB persistence**
- ...  

## Performance
- **IP SLA**—delay, jitter, packet loss, MPLS health monitoring, advanced object tracking
- **CBQoS MIB**—(class-based QoS)
- **NBAR**
- **RMON**
- **EPC**—Embedded Packet Capture
- **ERM**—Embedded Resource Manager
- **GOLD**—Generic Online Diagnosis
- **Smart Call Home**
- ...  

## Accounting
- **Flexible NetFlow**—IETF IPFIX
- **BGP policy accounting**—includes AS information
- **Periodic MIB bulk data collection and transfer**
- ...  

## Security
- **Auto Secure**—one-touch device hardening
- **LDP Auth**—message authentication
- **Routing Auth**—MD5 authentication, BGP, OSPF
- ...  

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Device Manageability Instrumentation Has Evolved

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Cisco IOS® Device Manageability Instrumentation (DMI)
Questions During a Service Lifecycle

Is there room for yet another service?
- How do we perform today?
- Are there existing issues?
- Will we meet specs?
- Resource consumption?
- What is my current traffic?
- ...

How to configure?
- One or many nodes?
- CLI, scripts, automation?
- Can we afford downtime?
- Quality and security?
- ...

Is it working as specified?
- Configuration?
- Control plane?
- Data plane?
- Were my design assumptions right?
- ...

What if something goes wrong?
- How to be prepared?
- How to diagnose?
- Make use of smart services?
- Could we offer even tighter SLAs?
- Automate remedy and mitigation?
- ...

Service Planning

Deployment & Activation

Testing & Verification

Troubleshooting & Optimization

Service Assurance

Are we meeting SLA?
- Will we breach any SLAs?
- What is our performance?
- How to identify applications?
- ...

What if something goes wrong?
What Are Embedded Automations?
Embedded Automation Systems (EASy)

Combine…

- A formerly reactive task outside the network
  - Based on your service lifecycle model
  - Real-life situations that are cumbersome or hard to solve

- Device manageability instrumentation
  - To measure or trigger with the network
  - At the source in near real-time
  - Such as Flexible NetFlow, IP SLA, NBAR, MIBs, and many others

- Embedded automation capability
  - To implement your custom logic
  - Such as Embedded Event Manager (EEM), Cisco IOS® Safe-Tcl scripting, and Embedded Menu Manager (EMM)
Types of Embedded Automation Systems

- **Type 1:** Automation of manual operational tasks
  - Example: Low-TTL traffic monitoring
  - Example: NBAR/CBQoS effectiveness monitoring
  - Example: CPE-driven automated port reconfiguration

- **Type 2:** Automation of previously unsolvable challenges
  - Example: Packet capture based on NBAR ↔ Flexible NetFlow correlation
  - Example: Automated embedded diagnostics
  - Example: Performance-based topology/policy changes

- **Type 3:** Use of automation to architect new solutions
  - Example: Highly available mobile access router (HAMAR)
  - Example: Resilient Layer 2 DC interconnect
  - Example: High-throughput geo-redundant FW clustering
Anatomy of an EASy Package

- The actual embedded automation itself
  Useful embedded automation for real-life situations
  Can be type 1, 2, or 3 automation

- A menu-guided installation
  Making installation a simple and reliable experience
  Download the latest EASy Installer separately

- Introduction slides
  Illustrating the purpose and concept

- A short video
  Taking you through the installation and use
Example 1: NBAR Effectiveness Monitoring

- **Problem:** Application protocols as well as user behavior are changing; hence the traffic mix changes too; we need to permanently assess how effective the NBAR deployment is—especially when using CBQoS with match protocol.

- **Solution:** Automate the comparison between “unknown” versus “total” traffic.

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

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Input Packet Count</th>
<th>Input Byte Count</th>
<th>Output Packet Count</th>
<th>Output Byte Count</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>205</td>
<td>14976</td>
<td>204</td>
<td>10404</td>
</tr>
<tr>
<td></td>
<td>14976</td>
<td>0</td>
<td>10404</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>41304</td>
<td>2649809</td>
<td>40944</td>
<td>2619839</td>
</tr>
<tr>
<td></td>
<td>2649809</td>
<td>3000</td>
<td>2619839</td>
<td>3000</td>
</tr>
</tbody>
</table>
```

- Upon low percentage of traffic recognized by NBAR, it’s time to check for new PDLMs...

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

Available as an EASy package: [http://www.cisco.com/go/easy](http://www.cisco.com/go/easy)
Example 2: Connectivity Verification

- **Problem:** We need a failover from the primary to the 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

```
Upon State Change

Did IP SLA operation

Succeed

Tracked object is up; execute up commands

Is up-syslog set?

Yes

Send up syslog

No

Tracked object is down; execute down commands

Is down-syslog set?

Yes

Send down syslog

No

Time out

Done
```

Available as an EASy package: [http://www.cisco.com/go/easy](http://www.cisco.com/go/easy)
Example 3: 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 the Cisco IOS® Software version.

Available as an EASy package: [http://www.cisco.com/go/easy](http://www.cisco.com/go/easy)
How Can I Engage?
Learn

1. Browse and download EASy packages:
   www.cisco.com/go/easy

2. Make sure to also download EASy Installer
   http://cisco.com/assets/prod/ios-nxos/easy-installer.tcl

3. Make sure to download EASy Installer Guide

4. Browse other embedded automations:
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5. Learn about the technology under the hood:
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- Discuss, ask questions, provide suggestions and answers:
  supportforums.cisco.com
- Upload your own examples to Cisco® Beyond:
  www.cisco.com/go/ciscobeyond
Contribute

- You’ve just built the smartest embedded automation on Planet Earth?
- You’ve got a really good use case?
- Or a great idea with a half-baked solution?
- Want to suggest additions to existing EASy packages?
- Or volunteer your scripting skills to improve an EASy package?

→ Contact ask-easy@cisco.com