Cisco Embedded Automation Systems - EASy
Connectivity Verification

January 2010

Objective

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- **Problem:** Be able to detect loss of network connectivity and fail over to the secondary interface
- **Solution:** Use IP SLA with Enhanced Object Tracking and the Embedded Event Manager to test network connectivity; fail over to a redundant interface when the primary network no longer passes traffic

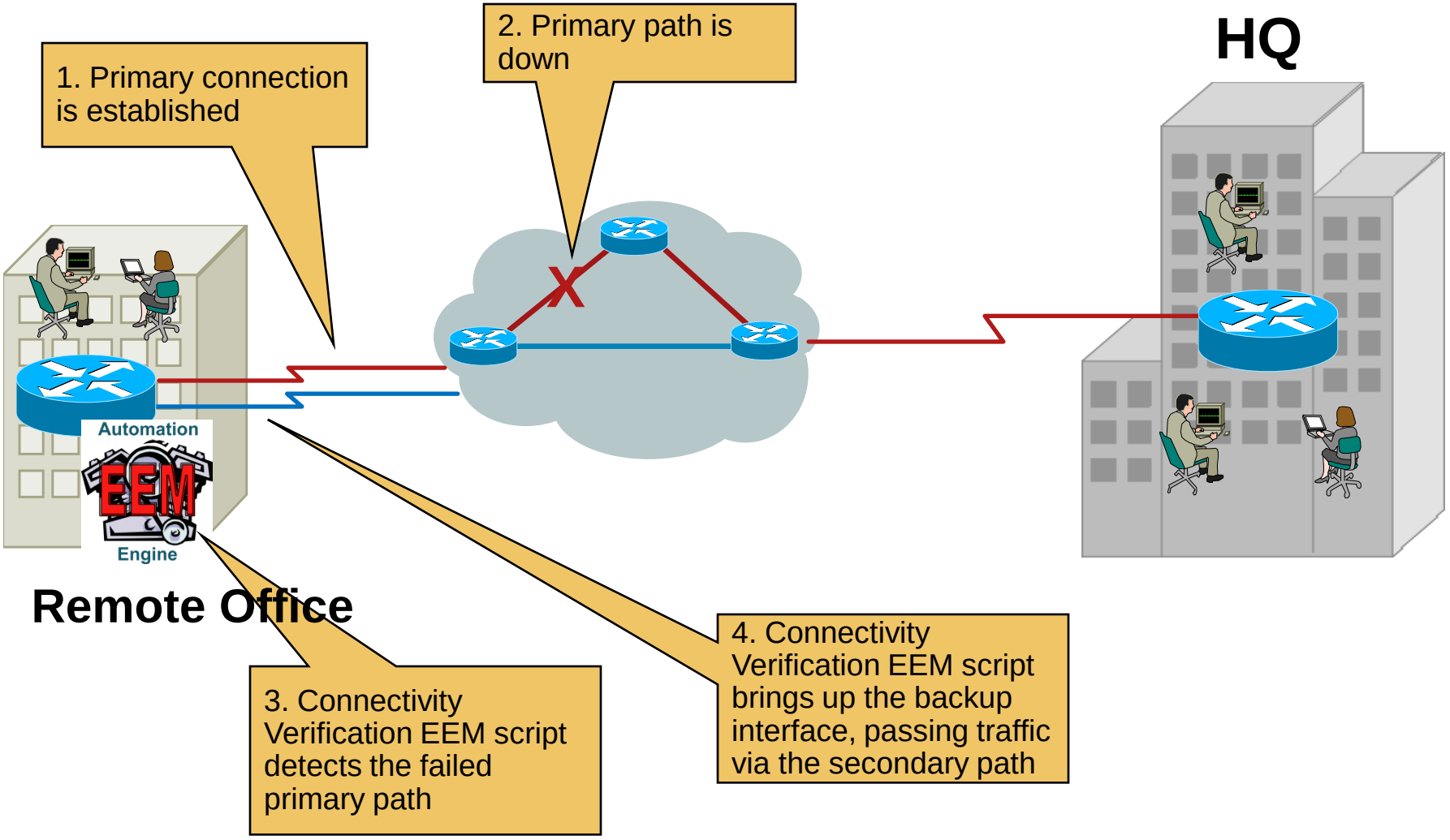
See: http://www.cisco.com/en/US/docs/ios/ipsla/configuration/guide/12_4t/sla_12_4t_book.html

Overview

Overview

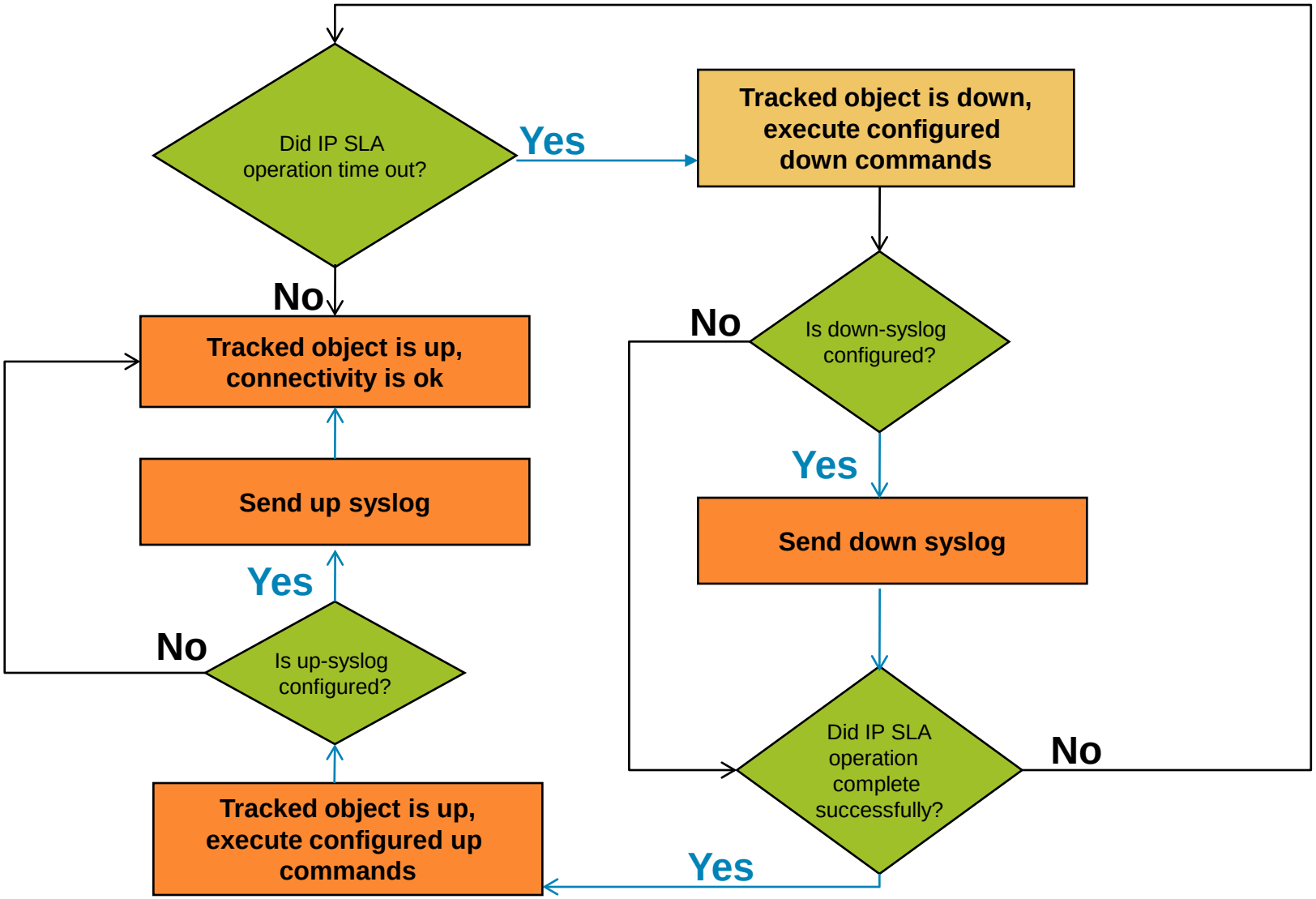
Application or Service	High availability
Technology	IP SLA, Enhanced Object Tracking
Problem	The primary network may go down without taking down the local interface. You need to be able to detect when the network is no longer capable of passing traffic, and fail over to a secondary interface.
Impact	Network availability.
Non-EASy Solution	IP SLA and Enhanced Object Tracking. Pros: Cisco IOS® Software configuration only, no script required. Cons: Secondary interface needs to be permanently up and backup route triggered by routing statements. Limited commands available to bring up secondary interface, to control timing, and to notify users of such events.
Benefit of EASy Solution	Ensures high network availability with configurable actions upon the detection of a failed primary network.
Category	**Network Management** – Capacity Planning – **Routing** – QoS – **High Availability** – User Interface – **Diagnostics** – Security

Background



Pseudo Code

Pseudo Code



Pseudo Code: Core Script

```
set prio_array(emergencies) "emerg"
set prio_array(alerts) "alert"
set prio_array(critical) "crit"
set prio_array(errors) "err"
set prio_array(warnings) "warning"
set prio_array(notifications) "notice"
set prio_array(informational) "info"
set prio_array(debugging) "debug"

if { [catch { set prev_state [context_retrieve EASYIPSLACTXT prev_state] } errmsg] } {
    set prev_state "Up"
}

set output [run_cli [list "show track $easy_ipsla_track_idx | incl Reachability is"]]
if { $output == "" } {
    action_syslog priority err msg "ERROR: Did not get output from 'show track
$easy_ipsla_track_idx | incl Reachability is'"
    return -code ok
}
if { ! [regexp {Reachability is (\w+)} $output -> status] } {
    action_syslog priority err msg "ERROR: Output from 'show track $easy_ipsla_track_idx
| incl Reachability is' is not in expected format (output = '$output')"
    return -code ok
}
if { $status == $prev_state } {
    set prev_state $status
    catch { context_save EASYIPSLACTXT prev_state } errmsg
    return -code ok
}
```

Retrieve previously saved state

Obtain the current state from the output of “show track”

If the current state is the same as the previous state, just exit

Pseudo Code: Core Script, cont.

```
set cmds $easy_ipsla_down_cmds
set slg $easy_ipsla_down_syslog
set prio $prio_array($easy_ipsla_down_slg_prio)

if { $status == "Up" } {
    set cmds $easy_ipsla_up_cmds
    set slg $easy_ipsla_up_syslog
    set prio $prio_array($easy_ipsla_down_slg_prio)
}

set cout ""
if { [catch {run_cli [split $cmds ";"]} result] } {
    set cout "Failed to run commands: '$result'"
} else {
    set cout $result
}

if { $slg != "" } {
    append slg " (cmd output: $cout)"
    action_syslog priority $prio msg $slg
}

set prev_state $status
catch { context_save EASYIPSLACTXT prev_state } errmsg
```

Determine the correct command set to run based on the current tracked object state

The commands are separated by ";", so split them out and run them

Sending a syslog message is required; append any output from the configured commands

Finally, save the current state and exit

Overview of Components

Components: Connectivity Verification

- Event detector

  Status of the tracked object configured by the user

- EEM actions

  Configurable actions using Cisco IOS® Software command-line interface (CLI) commands

- EEM outputs (optional)

  Configurable syslog messages notifying events

Environment Variables Connectivity Verification

- EEM environment variables for the Connectivity Verification script

easy_ipsla_track_idx	Tracked object ID
easy_ipsla_down_cmds	Semicolon-separated list of commands to run when the tracked object goes down
easy_ipsla_up_cmds	Semicolon-separated list of commands to run when the tracked object comes back up
easy_ipsla_down_syslog	Syslog message to send when the tracked object goes down (or empty for no message)
easy_ipsla_up_syslog	Syslog message to send when the tracked object comes back up (or empty for no message)
easy_ipsla_down_slg_prio	Priority of the syslog message sent when the tracked object goes down
easy_ipsla_up_slg_prio	Priority of the syslog message sent when the tracked object comes back up

Installation and Verification

Preparing for Installation

- **Prerequisites:**

  Any Cisco IOS® Software based hardware platform with support for EEM, IP SLA, and enhanced object tracking

  easy_installer.tcl script should be copied to router flash

  Optional step to copy the package file to router flash

  The package file can remain on a TFTP server

- **Configuration:**

  Optional CLI configuration to create an alias for the easy_installer.tcl script

- **EASy Installer:**

  Ensure that the EASy Installer is available:

```
Router#sh run | inc easy
alias exec easy_installer tclsh flash:/easy/easy_installer.tcl
```

Installing the Package

```
Router#sh run | inc easy
alias exec easy_installer tclsh flash:/easy/easy_installer.tcl
```

```
Router# easy-installer tftp://223.255.254.254/easy/easy-ipsla-tracker.tar


------------------------------------------------------------------------

Configure and Install EASy Package 'easy-ipsla-tracker-1.0'

------------------------------------------------------------------------

1. Display Package Description
2. Configure Package Parameters
3. Deploy Package Policies
4. Configure IP SLA
5. Exit

Enter option:
```

Installing the Package—Example

Enter option: 1 [Display Package Description]

```
This package provides an EEM solution to watch an IP SLA collector, then
run CLI commands if the collector goes down (and again when the collector
comes back up).  This is done via Enhanced Object Tracking.

This package also offers a simple way to configure a new IP SLA collector
(ICMP Echo only) and tracked object if one does not al

Hit enter to continue...
```

!! If you want to change any parameter, you might need to uninstall the package and install it again

Enter option: 2 [Configure Package Parameters]

```
------------------------------------------------------------------------
    -

IP SLA and Object Tracking Configuration Menu

------------------------------------------------------------------------
    -

1. Use existing tracked object
2. Configure new IP SLA ICMP echo collector and tracked object
3. Return to main menu

Enter option: 1
Enter ID number of existing tracked object: 1
```

Installing the Package—Example, cont.

```
------------------------------------------------------------------------

IP SLA and Object Tracking Configuration Menu

------------------------------------------------------------------------

1. Use existing tracked object
2. Configure new IP SLA ICMP echo collector and tracked object
3. Return to main menu

Enter option: 3

Enter the commands you want to run when the IP SLA collector
goes down.  Enter each command on a separate line.  All
commands will be run in enable mode.  Hit enter on a line
by itself to stop entering commands:

config t
interface fastethernet0
no shut
end
```

Installing the Package—Example, cont.

```
Send syslog message when collector is down (y/n) [y]:
Enter message to send when collector is down: Object unreachable
Enter priority for the down syslog message (one of emergencies, alerts,
    critical
, errors, warnings, notifications, informational, debugging)
    [informational]:
Commands:

config t
interface fastethernet0
no shut
end

Syslog message when collector is down : Object unreachable
Syslog priority                       : informational

Are you satisfied with these settings (y/n) [y]:
```

Installing the Package—Example, cont.

```
Enter the commands you want to run when the IP SLA collector
comes back up. Enter each command on a separate line. All
commands will be run in enable mode. Hit Enter on a line
by itself to stop entering commands:

config t
interface fastethernet0
shut
end

Send syslog message when collector is up (y/n) [y]:
Enter message to send when collector is up: Object reachable
Enter priority for the up syslog message (one of emergencies, alerts,
    critical,
errors, warnings, notifications, informational, debugging) [informational]:
Commands:

config t
interface fastethernet0
shut
end

Syslog message when collector is up : Object reachable
Syslog priority                     : informational

Are you satisfied with these settings (y/n) [y]:
```

Installing the Package—Example, cont.

Enter option: 3 [Deploy Package Policies]

```
------------------------------------------------------------------

Configure and Install EASy Package 'easy-ipsla-tracker-1.0'

------------------------------------------------------------------

1. Display Package Description
2. Configure Package Parameters
3. Deploy Package Policies
4. Configure IP SLA
5. Exit

Enter option: 3
Specify the directory to store EEM user policies: easy


INFO: Package easy-ipsla-tracker-1.0 successfully installed.


Hit Enter to continue...
```

Installing the Package—Example, cont.

- Listing the installed packages

```
Router#easy_installer --list
EASy packages installed:

easy-ipsla-tracker-1.0 Track an IP SLA operation, and run CLI commands
    on state changes


Hit Enter to continue...
```

Verifying the Installation

```
Router# show event manager policy registered
No.  Class     Type    Event Type          Trap  Time Registered           Name
1    applet    user    track               Off   Thu Apr 25 05:49:08 2002  easy-
ipsla-down-tracker
 track 1 state down
 maxrun 20.000
 action 1 cli command "enable"
 action 2 cli command "config t"
 action 3 cli command "interface fastethernet0"
 action 4 cli command "no shut"
 action 5 cli command "end"
 action 6 syslog priority informational msg "Object unreachable (cmd output: $_c
li_result)"

2    applet    user    track               Off   Thu Apr 25 05:49:08 2002  easy-
ipsla-up-tracker
 track 1 state up
 maxrun 20.000
 action 1 cli command "enable"
 action 2 cli command "config t"
 action 3 cli command "interface fastethernet0"
 action 4 cli command "shut"
 action 5 cli command "end"
 action 6 syslog priority informational msg "Object reachable (cmd output: $_cli
_result)"
```

Uninstallation

- Instructions to uninstall the package and verify its removal:

```
Router#easy_installer --uninstall --prefix flash:/easy --pkgname easy-
    ipsla-tracker
Uninstalling easy-ipsla-tracker...DONE!

INFO: Uninstall of easy-ipsla-tracker completed successfully.
Configuration was changed, do you want to save the running config to
    startup? (y
/n) [y]
```

Operation

During Operation

- Simulate loss of primary connection via CLI

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int vlan 1
Router(config-if)#shut
Router(config-if)#end
Router#
*Apr 25 06:07:54.177: %SYS-5-CONFIG_I: Configured from console by console
*Apr 25 06:07:55.401: %LINK-5-CHANGED: Interface Vlan1, changed state to adminis
tratively down
*Apr 25 06:07:56.401: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, cha
nged state to down
Router#
*Apr 25 06:08:03.117: %TRACKING-5-STATE: 1 ip sla 1 reachability Up->Down
*Apr 25 06:08:03.193: %SYS-5-CONFIG_I: Configured from console by  on vty0 (EEM:
easy-ipsla-down-tracker)
*Apr 25 06:08:03.201: %HA_EM-6-LOG: easy-ipsla-down-tracker: Object unreachable
(cmd output:
Router#)
Router#
```

During Operation, cont.

- Simulate recovery of primary connection via CLI

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int vlan 1
Router(config-if)#no shut
Router(config-if)#end
Router#
Router#
*Apr 25 06:11:47.773: %SYS-5-CONFIG_I: Configured from console by console
*Apr 25 06:11:49.317: %LINK-3-UPDOWN: Interface Vlan1, changed state to up
*Apr 25 06:11:50.317: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, cha
nged state to up
*Apr 25 06:11:58.117: %TRACKING-5-STATE: 1 ip sla 1 reachability Down->Up
*Apr 25 06:11:58.185: %SYS-5-CONFIG_I: Configured from console by  on vty0 (EEM:
easy-ipsla-up-tracker)
*Apr 25 06:11:58.193: %HA_EM-6-LOG: easy-ipsla-up-tracker: Object reachable (cmd
 output:
Router#)
*Apr 25 06:12:00.169: %LINK-5-CHANGED: Interface FastEthernet0, changed state to
 administratively down
```

Further Enhancements and References

Future Enhancements

- Support for the IP SLA ED in EEM 3

  To provide more granularity than simple object tracking; for example, one could trigger the EEM policy when a certain number of failures have occurred out of a total number of attempts

- Improving the efficiency of the timer ED

  Could change timer ED to a syslog ED, but syslog messages such as “%TRACKING-5-STATE” are not available on platforms such as the Cisco® Catalyst® 6000 Series

- Specifying commands to run with quotes