Cisco Embedded Automation Systems - EASy

Custom-MIB Polling and Data Collection

January 2010

Objective

Objective

- **Problem:** Be able to collect data via SNMP, even if no MIB support is currently available
- **Solution:** The Expression-MIB provides the ability to allow data to be processed into more relevant information via SNMP

  The Expression-MIB can be configured using SNMP directly since 12.0(5)T

  The initial Cisco® implementation was based on OID 1.3.6.1.4.1.9.10.22, but the current Cisco implementation is based on RFC2982-MIB, OID 1.3.6.1.2.1.90

  In 12.4(20)T, the Expression-MIB feature is enhanced to add a command-line interface (CLI) to configure expressions
- Expression-MIB provides a way to gather data available only via a CLI, even if no MIB support is currently available
- Embedded Event Manager (EEM) 3.1 will provide this capability without the need to involve the Expression-MIB

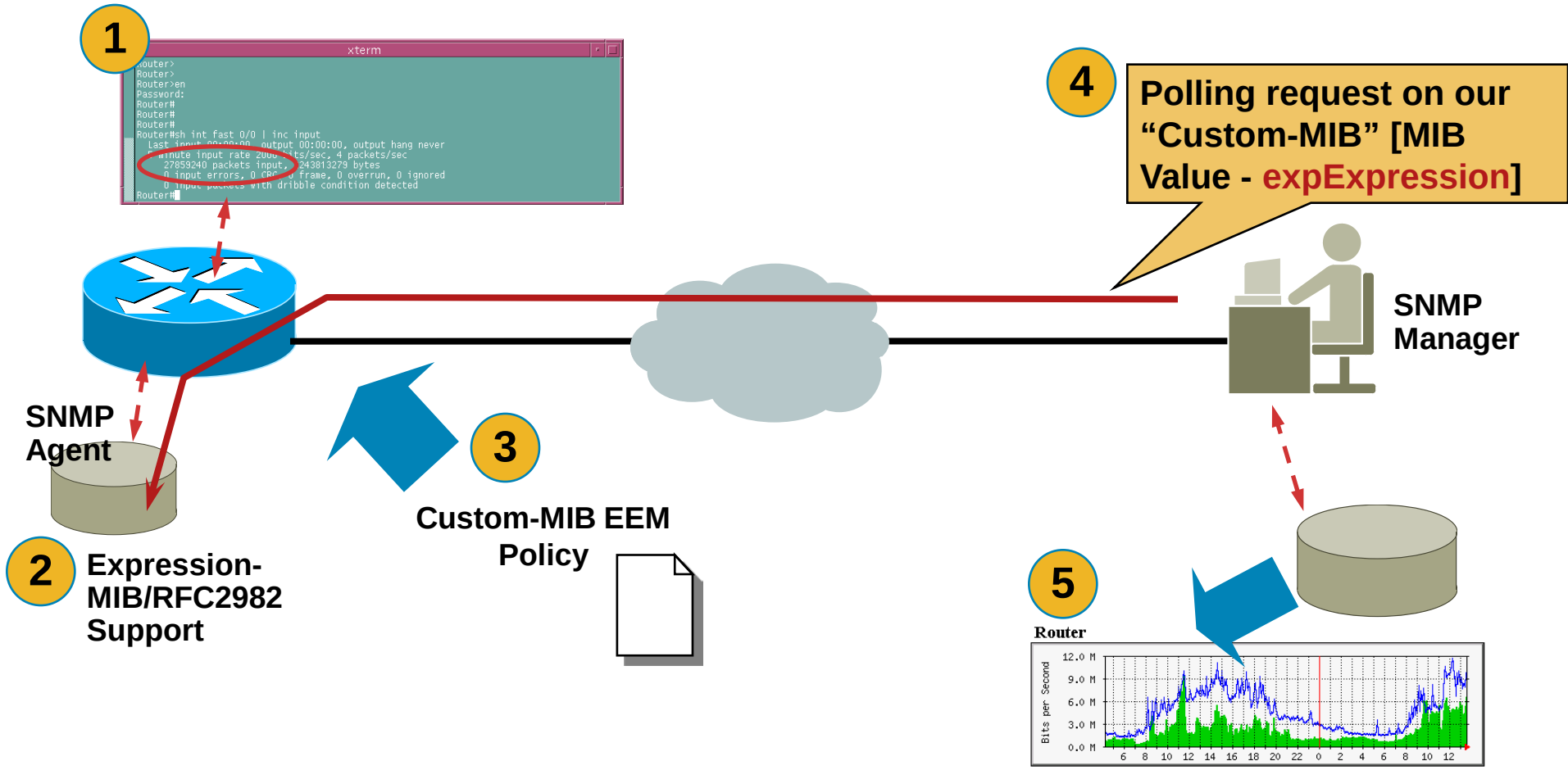
See: http://www.cisco.com/en/US/docs/ios/netmgmt/configuration/guide/nm_cfg_snmp_sup.html

Objective, cont.

Application or Service	Network management monitoring
Technology	Simple Network Monitoring Protocol (SNMP)
Problem	Gather data from a specific show command via SNMP
Impact	Better monitoring of the device via SNMP
Non-EASy Solution	Perform the EEM policy logic under the NMS station
Benefit of EASy Solution	100% manageability of the device via SNMP vs. CLI or XML-PI
Category	**Network Management** – Capacity Planning – Routing – QoS – High Availability – User Interface – Diagnostics – Security

Background

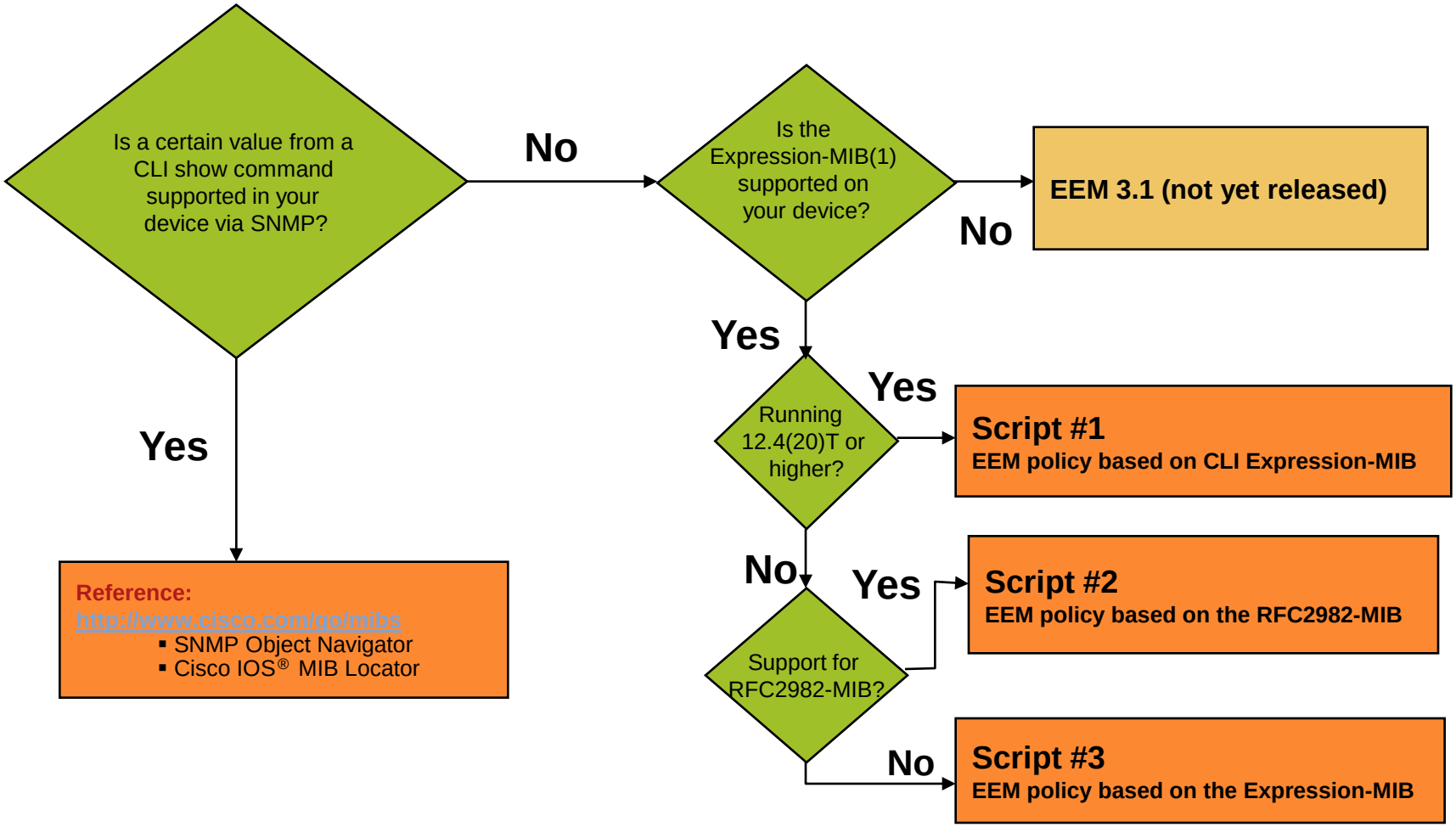
- Is a certain value from a show command supported in a specific MIB?



Pseudo Code

Custom-MIB EEM Policy

Background: Custom-MIB EEM Script



See: Scripts are available in CiscoBeyond, http://www.cisco.com/go/ciscobeyond

Pseudo Code: Analysis of Script #1

- Section within “Core Script”

Script #1
EEM policy based on the CLI Expression-MIB

```
lappend capture_cmd_list "enable“
lappend capture_cmd_list "config t"
lappend capture_cmd_list "snmp mib expression owner $exp_owner name
    $exp_name“
lappend capture_cmd_list "expression $matched_word“
lappend capture_cmd_list "exit “
lappend capture_cmd_list “enable "
```

- Script #1 is based in CLI configuration
- Scripts #2 and #3 are based on SNMP configuration; for it, enable “snmp-server manager” in the device and run SNMP hidden commands from the device itself

Pseudo Code: Analysis of Script #2

- Section “Core Script”

Script #2
EEM policy based on the RFC2982-MIB

In this case,
- **Device IP address ($ip_address) and**
- **ReadWrite SNMP community string ($rw_community)**
  WILL need to be given as environment variables:
  event manager environment ip_address *x.x.x.x*
  event manager environment rw_community *private*

```
   lappend capture_cmd_list "enable"
   lappend capture_cmd_list "config t"
   lappend capture_cmd_list "snmp-server manager"
   lappend capture_cmd_list "snmp set v2c $ip_address $rw_community oid
1.3.6.1.2.1.90.1.2.1.1.9.5.99.105.115.99.111.7.99.117.115.116.111.109.49 integer
6"
   lappend capture_cmd_list "snmp set v2c $ip_address $rw_community oid
1.3.6.1.2.1.90.1.2.1.1.9.5.99.105.115.99.111.7.99.117.115.116.111.109.49 integer
5"
   lappend capture_cmd_list "snmp set  v2c $ip_address $rw_community
oid  1.3.6.1.2.1.90.1.2.1.1.3.5.99.105.115.99.111.7.99.117.115.116.111.109.49 s
$matched_word"
    }
```

$exp_owner=cisco(5)

$exp_name=custom1(7)

Hexadecimal to ASCII:
99.105.115.99.111 <-> “cisco” (exp_owner, exp_name)
99.117.115.116.111.109.49 <-> “custom1”
Note: exp_owner and exp_name are hardcoded at the moment (part of the enhancements).

Pseudo Code: Analysis of Script #3

- The only difference with scripts #1 and #2 is under Core Script implementation in this section. Expression-MIB is based on OID 1.3.6.1.4.1.9.10.22

Script #3
EEM policy based on the Expression-MIB

In this case,
- **Expression name ($exp_name),**
- **Device IP address ($ip_address), and**
- **ReadWrite SNMP community string ($rw_community)**

WILL need to be given as environment variables:

event manager environment exp_name *cisco*
event manager environment ip_address *x.x.x.x*
event manager environment rw_community *private*

```
for {set i 0} {$i < $num_elem} {incr i 1} {
        set new_oid [str2hdec $exp_name$i]
  lappend capture_cmd_list "snmp set v2c $ip_address $rw_community oid
        1.3.6.1.4.1.9.10.22.1.2.3.1.3$new_oid  integer 6"
  lappend capture_cmd_list "snmp set v2c $ip_address $rw_community oid
        1.3.6.1.4.1.9.10.22.1.2.3.1.3$new_oid integer 5"
  lappend capture_cmd_list "snmp set v2c $ip_address $rw_community oid
        1.3.6.1.4.1.9.10.22.1.2.3.1.2$new_oid gauge [expr   $i+1]"
  lappend capture_cmd_list "snmp set v2c $ip_address $rw_community oid
        1.3.6.1.4.1.9.10.22.1.3.1.1.2.[expr $i+1] string [lindex $found [expr   $i*2+1]]"
  lappend capture_cmd_list "snmp set v2c $ip_address $rw_community oid
        1.3.6.1.4.1.9.10.22.1.2.3.1.3$new_oid integer 1"
}
```

$exp_name in hexadecimal

expExpressionIndex = 1

Overview

Custom-MIB Components

Components

- Event detector

  CountDown

  We make it possible to set the frequency through an environment variable for the script to run; this value will be the frequency with which our Custom-MIB value is updated

- EEM actions

  Extract the Custom-MIB value from the show command, and in particular based on the regular expression to match

  The value is assigned to a variable called $match_word

  $match_word is being assigned to the snmp Expression-MIB variable

- EEM outputs (optional)

  It is possible to get a syslog message each time the Custom-MIB is updated

  Comment this action if not required; for example:

  "# Dump the NOK message in the log

  #action_syslog priority info msg $nok_msg"

Note: Minimum requirement implies support for Expression-MIB, since 12.0(5)T

Environment Variables

EEM Environment Variables

- event manager environment countdown_entry <frequency>
  - Defines the frequency with which our Custom-MIB variable will be updated
- event manager environment match_cmd <show command>
  - Defines the show command from which to extract the value to assign to our Custom-MIB variable
- event manager environment match_pattern <regular_expression>
  - Defines the regular expression to match the specific value we want to poll via SNMP
- event manager environment nok_msg <body> *(optional)*
  - Defines the body for the syslog message that will be sent each time the policy is executed
- event manager environment exp_owner *(only for Script #1$&#2)*
  - Defines the owner of the Custom-MIB value
- event manager environment exp_name *(hard coded for Script #2)*
  - Defines the name of the expression within the Custom-MIB value
- event manager environment ip_address x.x.x.x *(only for Script #2&#3)*
  - Defines the managed IP address in the Cisco® device
- event manager environment rw_community *private (only for Script #2&#3)*
  - Defines the SNMP ReadWrite community string for the Cisco device

Installation and Verification

Installing the Package

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

--debug option will add debugging information when executing

```
Router# easy_installer flash:/easy/custom_mib.tar flash:/easy/custom-mib

The EASy PREFIX is already set to flash:/easy.

Do you want to use flash:/easy/custom-mib as the new EASy package PREFIX? (y/n)
    [n]

----------------------------------------------------------------
Configure and Install EASy Package 'custom-mib-1.1'
----------------------------------------------------------------

1. Display Package Description
2. Configure Package Parameters
3. Deploy Package Policies
4. Verify Installed Package
5. Exit

Enter option:
```

Installing the Package, cont.

Enter option: 1 [Display Package Description]

```
The package is able to extract a value from a show command using a
    configured regular expression, and make that value accessible via SNMP
    using the EXPRESSION-MIB or RFC 2982 MIB depending on the IOS running.

Hit enter to continue...
```

Enter option: 2 [Configure Package Parameters]

```
Configure EEM Environment Variables for 'custom-mib-1.1'

Enter the frequency with which to run the show command [60]:
Enter the show command to execute [show interface fast 0/0]:
Enter the regular expression to extract the custom value [.([0-9]+).*packets
    input]:
Enter message to send via syslog if the expression is found [Expression
    found]:
Enter a local IP address to poll with SN
Enter a read-write SNMP community for th
...
```

!! If you want to change any parameter, you might need to reinstall the package **or** manually modify the environment variable and run "event manager update user policy name *POLICY_NAME*"

Enter option: 3 [Deploy Package Policies]

```
…
INFO: Package custom-mib-1.1 successfully installed.
```

Verifying the Installation

- Listing the installed packages:

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

custom-mib-1.1      Make a custom value accessible via SNMP

Hit enter to continue...
```

- Uninstalling the package:

--debug option will add debugging information when executing

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

INFO: Uninstall of custom-mib completed successfully.
```

Verifying the Installation, cont.

- Verifying the variables:

```
Router#sh run | inc envir
event manager environment __easy_PREFIX flash:/easy/custom-mib1
event manager environment countdown_entry 60
event manager environment match_cmd show int fa 0/0
event manager environment match_pattern .([0-9]+).*packets input
event manager environment nok_msg Expression found
event manager environment ip_address 10.48.71.24
event manager environment rw_community private
event manager environment custom-mib_mode SNMP_EXPRESSION
```

Enter option: 4 [Verify Package Policy]

- Verifying registered scripts:

```
Router# show event manager policy registered
No.  Class   Type    Event Type   Trap  TimeRegistered      Name


1    script  user timer watchdog  Off   Tue Apr 16 ..  tm_customMIB_SNMP_ExpressionMIB.tcl
name {watchdog} time 60.000
nice 0 queue-priority normal maxrun 240.000 scheduler rp_primary
```

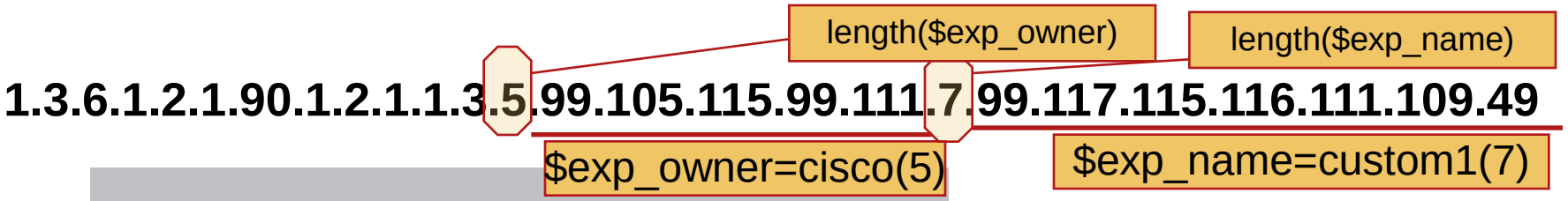
Operation

Custom-MIB EEM Policy

Verification: CLI/SNMP Access

Scripts #1 and #2
EEM policy based on the RFC2982-MIB

- Via CLI: *show management expression*
- Via SNMP: Custom-MIB OID is customized, indexed by the owner and expression name




```
Router#sh int fas 0/0 | inc input
  Last input 00:00:00, output 00:00:00, output hang never
  5 minute input rate 2000 bits/sec, 2 packets/sec
     27956252 packets input, 2259686526 bytes
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 input packets with dribble condition detected
Router#
```

Read-only community string

Router name or IP address of our device

expExpression
1.3.6.1.2.1.90.1.2.1.1.3

```
NMS% snmpwalk -c public -v 2c Router 1.3.6.1.2.1.90
SNMPv2-SMI::mib-2.90.1.2.1.1.3.5.99.105.115.99.111.7.99.117.115.116.111.109.49 = STRING: "27956184"
SNMPv2-SMI::mib-2.90.1.2.1.1.4.5.99.105.115.99.111.7.99.117.115.116.111.109.49 = INTEGER: 1
SNMPv2-SMI::mib-2.90.1.2.1.1.5.5.99.105.115.99.111.7.99.117.115.116.111.109.49 = ""
SNMPv2-SMI::mib-2.90.1.2.1.1.6.5.99.105.115.99.111.7.99.117.115.116.111.109.49 = INTEGER: 0
SNMPv2-SMI::mib-2.90.1.2.1.1.7.5.99.105.115.99.111.7.99.117.115.116.111.109.49 = OID: SNMPv2-
    SMI::zeroDotZero
SNMPv2-SMI::mib-2.90.1.2.1.1.8.5.99.105.115.99.111.7.99.117.115.116.111.109.49 = Counter32: 0
SNMPv2-SMI::mib-2.90.1.2.1.1.9.5.99.105.115.99.111.7.99.117.115.116.111.109.49 = INTEGER: 1
SNMPv2-SMI::mib-2.90.1.3.1.1.2.5.99.105.115.99.111.7.99.117.115.116.111.109.49.0.0.0 = Counter32:
    27956184
```

expValueCounter32Val
1.3.6.1.2.1.90.1.3.1.1.2

Custom-MIB EEM Policy

Verification: CLI/SNMP Access

Script #3
EEM policy based on the Expression-MIB

- via CLI: *show management expression*
- via SNMP: Custom-MIB OID is customized, indexed by the owner and expression name

1.3.6.1.4.1.9.10.22.1.3.1.1.2.3

expExpressionIndex

```
Router#sh int fas 0/0 | inc input
  Last input 00:00:00, output 00:00:00, output hang never
  5 minute input rate 2000 bits/sec, 2 packets/sec

     35859852 packets input, 2259686526 bytes
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 input packets with dribble condition detected
Router#
```

Read-only community string

Router name or IP address of our device

```
NMS%  snmpwalk -c public -v 2c Router 1.3.6.1.4.1.9.10.22
SNMPv2-SMI::enterprises.9.10.22.1.2.3.1.2.99.105.115.99.111 = Gauge32: 3
SNMPv2-SMI::enterprises.9.10.22.1.2.3.1.3.99.105.115.99.111 = INTEGER: 2
SNMPv2-SMI::enterprises.9.10.22.1.3.1.1.1.3 = STRING: "cisco"
SNMPv2-SMI::enterprises.9.10.22.1.3.1.1.2.3 = STRING: "35859863"
SNMPv2-SMI::enterprises.9.10.22.1.3.1.1.3.3 = INTEGER: 1
SNMPv2-SMI::enterprises.9.10.22.1.3.1.1.4.3 = ""
SNMPv2-SMI::enterprises.9.10.22.1.3.1.1.5.3 = INTEGER: 0
SNMPv2-SMI::enterprises.9.10.22.1.3.1.1.6.3 = OID: SNMPv2-SMI::zeroDotZero
SNMPv2-SMI::enterprises.9.10.22.1.3.1.1.7.3 = Counter32: 0
...
SNMPv2-SMI::enterprises.9.10.22.1.4.1.1.2.3.0.0.0 = Counter32: 35859863
```

expExpressionIndex

expExpression
1.3.6.1.4.1.9.10.22.1.3.1.1.2.3

expValueCounter32Val
1.3.6.1.4.1.9.10.22.1.4.1.1.2

Future Enhancements and References

Future Enhancements

- Custom-MIB script currently can extract one unique value from a show command; there are two main improvements that can be made:

  Allow wildcarding: It can be implemented when CSCsx08089 is fixed

  Extract more than one value out of a show command (with two or more different regular expressions)

- Script #2 will be enhanced to enter as environment variables exp_owner and exp_name

References

Embedded Automation Systems: www.cisco.com/go/easy

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 Packet Capture (EPC): www.cisco.com/go/epc
- GOLD: http://www.cisco.com/en/US/products/ps7081/products_ios_protocol_group_home.html
- Flexible NetFlow: www.cisco.com/go/netflow and www.cisco.com/go/fnf
- IP SLA (aka SAA, aka RTR): www.cisco.com/go/ipsla
- Network Analysis Module: http://www.cisco.com/go/nam
- NBAR: www.cisco.com/go/nbar
- Security Device Manager (SDM): http://www.cisco.com/go/sdm
- Smart Call Home: www.cisco.com/go/smartcall
- Feature Navigator: www.cisco.com/go/fn
- MIB Locator: www.cisco.com/go/mibs

Software Application Support Services

- www.cisco.com/go/services/applicationsupport

Network Management Applications

- www.cisco.com/go/nms

News—Podcast Series

- Cisco Network Management Podcasts: www.cisco.com/go/nmpodcasts