



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

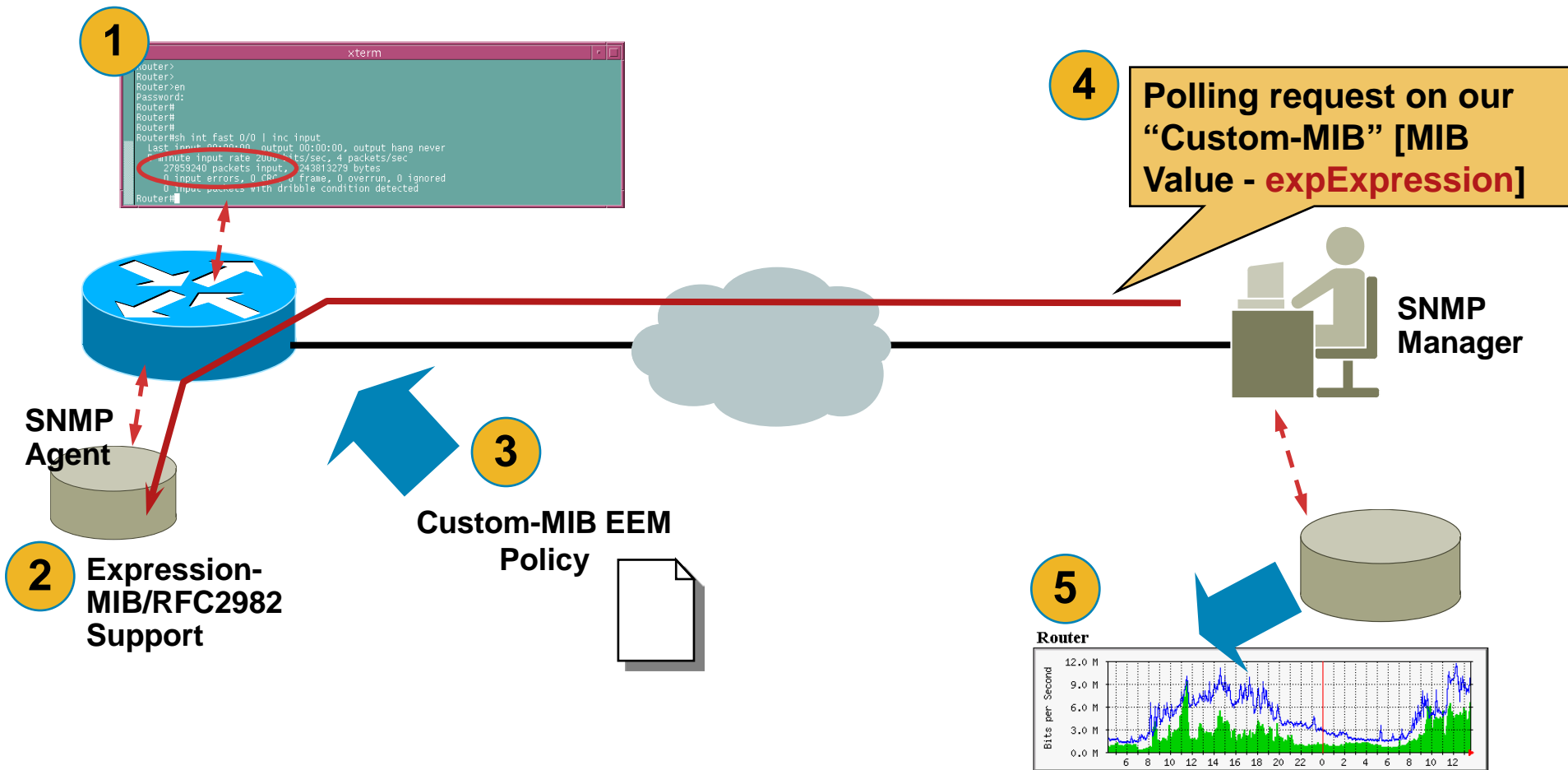
See: http://www.cisco.com/en/US/docs/ios/netmgmt/configuration/guide/nm_cfg_snmp_sup.html

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?

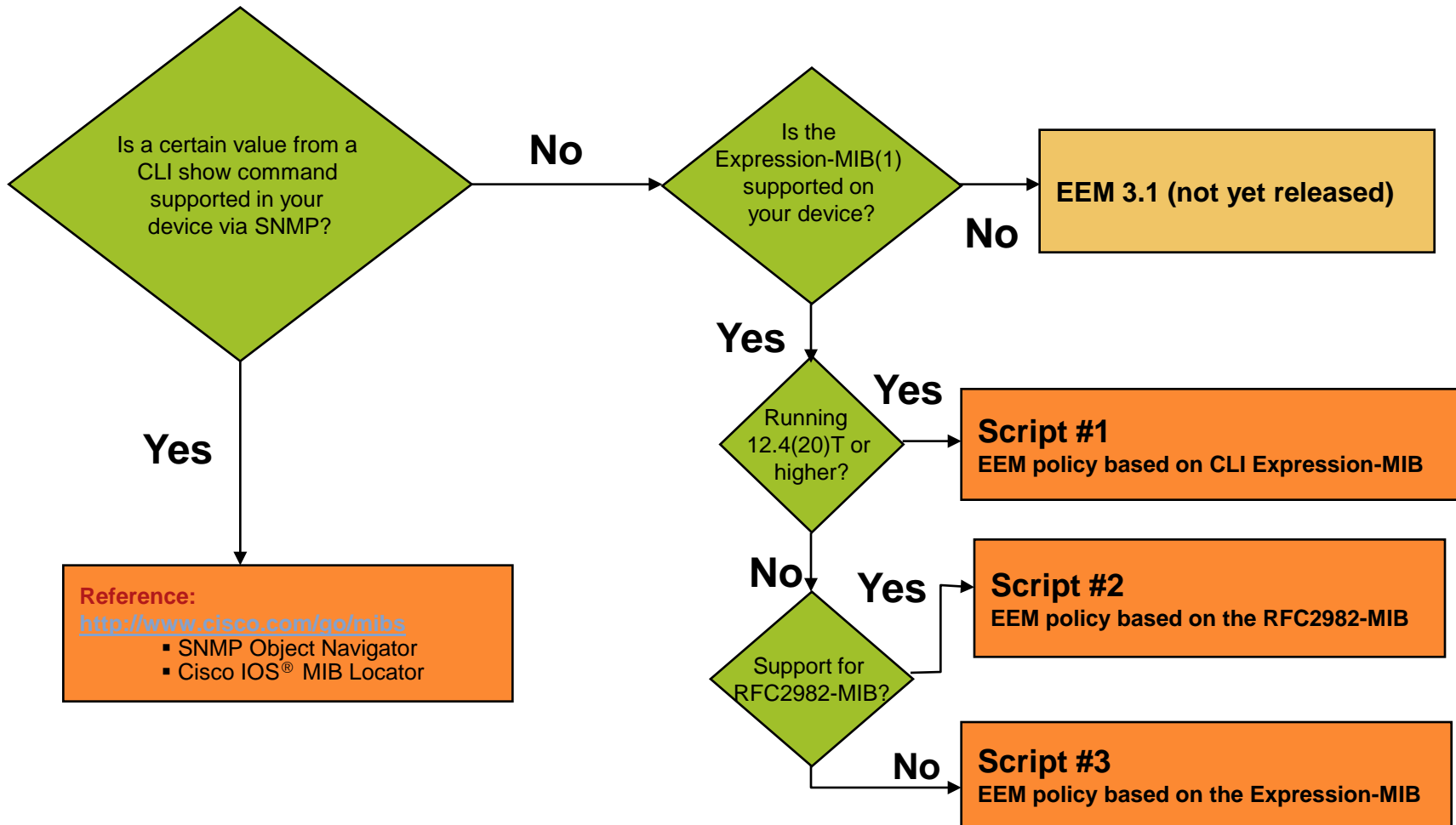


Pseudo Code

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 [index $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$)`
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)`
Defines the managed IP address in the Cisco® device
- `event manager environment rw_community private (only for Script #2)`
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 0/1]:

Enter the regular expression to extract the custom value [show interface fast 0/1: input].([0-9+).*packets

Enter message to send via syslog if the expression is found [Expression found]:

Enter a local IP address to poll with SNMP [192.168.1.1]:

Enter a read-write SNMP community for the device [community]:

...

!! 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

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

length(\$exp_owner) length(\$exp_name)

\$exp_owner=cisco(5) \$exp_name=custom1(7)

```
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
```

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

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