Objective
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- **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

## Objective, cont.

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<th>Network management monitoring</th>
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<td>Simple Network Monitoring Protocol (SNMP)</td>
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<td>Problem</td>
<td>Gather data from a specific show command via SNMP</td>
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<td>100% manageability of the device via SNMP vs. CLI or XML-PI</td>
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Background

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

1. Is a certain value from a show command supported in a specific MIB?
2. Expression-MIB/RFC2982 Support
3. Custom-MIB EEM Policy
4. Polling request on our “Custom-MIB” [MIB Value - expExpression]
5. Polling request on our “Custom-MIB” [MIB Value - expExpression]
Pseudo Code

Custom-MIB

EEM Policy
Background: Custom-MIB EEM Script

Is a certain value from a CLI show command supported in your device via SNMP?

Yes

Is the Expression-MIB(1) supported on your device?

No

EEM 3.1 (not yet released)

Yes

Running 12.4(20)T or higher?

Yes

Script #1
EEM policy based on CLI Expression-MIB

No

Support for RFC2982-MIB?

Yes

Script #2
EEM policy based on the RFC2982-MIB

No

Script #3
EEM policy based on the Expression-MIB

Reference:
http://www.cisco.com/go/mibs
  - SNMP Object Navigator
  - Cisco IOS® MIB Locator

See: Scripts are available in CiscoBeyond, http://www.cisco.com/go/ciscobeyond
Pseudo Code: Analysis of Script #1

- Section within “Core Script”

```python
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”

```python
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"
}
```

Hexadecimal to ASCII:

99.105.115.99.111 -> “cisco” (exp_owner, exp_name)
99.117.115.116.110.49 -> “custom1”

Note: exp_owner and exp_name are hardcoded at the moment (part of the enhancements).

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
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

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

```plaintext
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 $rw_community oid
    1.3.6.1.4.1.9.10.22.1.2.3.1.3$new_oid 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 found: [Expression found]:
Enter a local IP address to poll with SNMP [10.48.71.24]:
Enter a read-write SNMP community for this device [private]:
...

!! 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 Time Registered 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

- 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

```bash
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#
```

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: 27956184
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-2.90.1.2.1.1.10.5.99.105.115.99.111.7.99.117.115.116.111.109.49 = INTEGER: 0
SNMPv2-SMI::mib-2.90.1.2.1.1.11.5.99.105.115.99.111.7.99.117.115.116.111.109.49 = INTEGER: 0
SNMPv2-SMI::mib-2.90.1.2.1.1.12.5.99.105.115.99.111.7.99.117.115.116.111.109.49.0.0.0 = Counter32: 27956184

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*
Custom-MIB EEM Policy

Verification: CLI/SNMP Access

- **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
```

**Script #3**

EEM policy based on the Expression-MIB

- **Read-only community string**
- **Router name or IP address of our device**
- **expExpressionIndex**
- **expExpression**
- **expValueCounter32Val**

```
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#
```
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](http://www.cisco.com/go/easy)


- Cisco® Beyond—EEM Community: [www.cisco.com/go/ciscobeyond](http://www.cisco.com/go/ciscobeyond)
- NBAR: [www.cisco.com/go/nbar](http://www.cisco.com/go/nbar)
- Smart Call Home: [www.cisco.com/go/smartcall](http://www.cisco.com/go/smartcall)
- Feature Navigator: [www.cisco.com/go/fn](http://www.cisco.com/go/fn)
- MIB Locator: [www.cisco.com/go/mibs](http://www.cisco.com/go/mibs)

Software Application Support Services

- [www.cisco.com/go/services/applicationsupport](http://www.cisco.com/go/services/applicationsupport)

Network Management Applications

- [www.cisco.com/go/nms](http://www.cisco.com/go/nms)

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