SNMPv2 Overview

Network Mgmt/Sec.

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Outline

- intro
- SMI
- protocol (changes)
- MIB (changes)
- conclusion

bibliography (RFCS)

- 1901 - Intro to Community-Based v2
- 1902 - SMI
- 1903 - Textual Conventions
- 1904 - Conformance Statements
- 1905 - Protocol
- 1906 - Transport Mappings (ipx is ok ...)
- 1907 - MIB
- 1908 - Coexistance v1/v2

focus areas:

- managers can have managers - may enhance scalability
  - note: inform request PDU
- getbulkrequest for one stop table retrieval
  - actually may not be one-stop, just less overhead
- security (total failure, hence stick with community until v3)
- anti-simplicity? (see previous page)

SMI

- basically additive vis-a-vis v1
- focus on:
  - object definitions
  - tables
  - notification definitions
  - information modules

SMIv2 extends basic OID tree

- directory(1)
- mgmt(2)
- expmt(3)
- private(4)
- security(5)
- snmpv2(6)

snmpV2(6) has sub-branches

- snmpDomains (1) - transports
- snmpProxys(2) - never mind
- snmpModules(3) - module identities
- “Collections of related objects are defined in MIB modules” - rfc1906
- snmpMIB {snmpModules 1} defined in rfc1906 (#1 MODULE-IDENTITY)
  - snmpMIBObjects lives under here (start with

ve haf objects ...

- OBJECT-TYPE macro redefined with a few changes
  - changes to application types
  - changes to access/view
  - status now: current | obsolete | deprecated
  - table index changes
  - optional UNITS clause, text for units associated with object (celsius, whatever)

data types

- integers may now include enumerated values red(0), green(1), blue(2)
- Counter32 - nonnegative that may be incremented, not decremented
  - initial value not meaningful
- Counter64 - max is 2**64-1
- Unsigned32 == Gauge32
- Gauge32 - may increase/decrease, latch at max
- BITS - enumeration of named bits (bit flags)

MAX-ACCESS (was ACCESS)

- no write-only
- from least access to most access
  - not-accessible
  - accessible-for-notify - for traps
  - read-only
  - read-write (can replace write-only too)
  - read-create, read/write/create (for rows)
    - » use set to create row instance; for example

tables

- still:
  - row defined by SEQUENCE {type,type,type}
  - table is SEQUENCE OF rows
- tables fall into two categories:
  - agent controlled - manager cannot create/delete
    - » likely to be read-only rows
  - manager can create/delete rows
- **base conceptual row**: basically row index
- AUGMENTS can be used to add table extensions
  - vendor-specific objects added to normal table

tables, cont

- may use object for index that is not part of table
  - text description part must explain how this works
- table creation/deletion done via so-called RMON-polka (use RowStatus variable)
  - done with state machine/set and get operations
  - RowStatus has read-create access value
  - called the **status column** for the row

status value over-simplified

- can have following values:
  - 1. active - manager enables row
  - 2. notInService - not available (manager can set)
  - 3. notReady - not available yet
  - 4. createAndGo - autoset to active
  - 5. createAndWait - create and wait agent to setup/more complex setup (manager needed)
  - 6. destroy - manager deletes row, etc.

from rfc1906

- **sysDescr** OBJECT-TYPE
  SYNTAX DisplayString ...
  MAX-ACCESS read-only
  STATUS current
  DESCRIPTION “A textual description of the entity. blah blah ...”
  ::= {system 1}

notification-type macro

- used for traps, RFC1573 (son of interfaces)
  - linkUp NOTIFICATION-TYPE
    OBJECTS
    {ifIndex,ifAdminStatus,ifOperStatus}
    STATUS current
    DESCRIPTION “...ifOperStatus not down...”
  - ::= {snmpTraps 4}
- OBJECTS are communicated to manager upon trap

information modules

- 3 kinds of information modules
  - 1. MIB modules which include OBJECT-TYPE and NOTIFICATION-TYPE
  - 2. Compliance statements for said MIB modules, using OBJECT-GROUP and MODULE-COMPLIANCE macros
  - 3. AGENT-CAPABILITIES, state what agents can do
- All info modules must start with MODULE-IDENTIFY macro (documentation)
- OBJECT-IDENTITY used to doc objects as well

MODULE-IDENTITY

- someMIB MODULE-IDENTITY
  LAST-UPDATED string
  ORGANIZATION string
  CONTACT-INFO string
  DESCRIPTION string
  REVISION string
  DESCRIPTION string
  ::= { snmpModules 1492 }

conformance documentation

- to define acceptable lower bounds of implementation && actual level of implementation
- four macros:
  - OBJECT-GROUP
  - NOTIFICATION-GROUP
  - MODULE-COMPLIANCE
  - AGENT-CAPABILITIES

OBJECT/NOTIFICATION GROUP

- OBJECT-GROUP: vendor lists OBJECTS that are supported.
  - agents may not return a value for objects not implemented (unlike in v1)
- NOTIFICATION-GROUP MACRO
  - simply list and describe traps supported

MODULE COMPLIANCE, etc.

- MODULE COMPLIANCE MACRO - statement of modules included in system
- AGENT-CAPABILITIES MACRO - document level of support agent claims for a given MIB group
  - may allow manager to tune itself to agent

protocol

- SEQUENCE
  - version (value is 1)
  - community OCTET STRING
  - data ANY
- similar to SNMPv1 although a few new messages
- one LESS PDU format (trap like all the others)

protocol PDU types

- get-request
- get-next-request
- **get-bulk-request**
- response
- set-request
- **inform-request**
- snmpV2-trap
- **report** (never mind) - used in sec documents and then dropped

encapsulation of PDUs

note below nested in (version, community, X)

type	id	data1	data2	var. bindings

data1, data2 depend on type of PDU
variable bindings may be multiple OID, data

PDU formats, cont.

- Response-PDU returns error-status and error-index for data1/data2
- GetBulkRequest-PDU - nas non-repeaters and max-repetitions for data1/data2
- variable bindings may include:
  - OID and NULL used in retrieval requests
  - noSuchObject, noSuchInstance,endOfMibView

format., cont.

- noSuchObject - OID requested does not match
- noSuchInstance - OID exists, but no such column object
  - e.g., non-existant row or row is not ready yet
- endOfMibView - you walked off the end

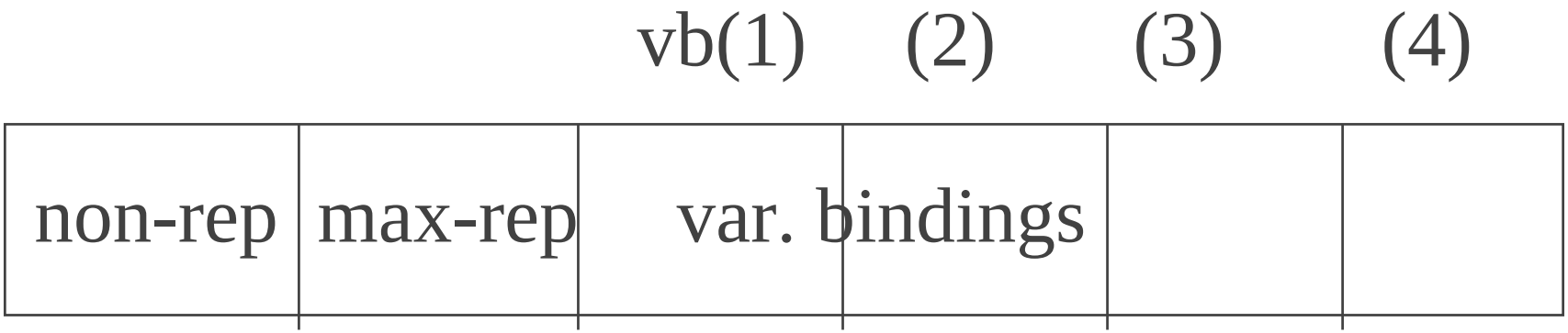
get-request, and get-next-request

- similar to V1, but
- in V1 request for all variable bindings must be atomic; i.e., either all or none
- in V2, can be incomplete
  - return noSuchObject, noSuchInstance, endOfMibView possible for individual items

get-bulk-request

- not really possible to say “hey table, come over here”
- however it is possible to essentially ask for objects row by row and optimize the overall transaction (get/response)
- similar to get-next in that it uses lexicographical ordering
- get-bulk includes a list of variables in variable-bindings AND 2 variables
- **non-repeaters** - # of variables in beginning of var. binds. which have single lex.. successor
- **max-repetitions** - count of lexicographical variables to be returned for rest of var. binding list

get-bulk PDU remainder



if non-rep == 1, applies to vb(1)

if max-rep == 2, applies to v2(2), on and asks for 2 lexico. variables beyond for each remaining variable

conceptual example:

- assume non-rep == 0, and max-rep == 2
- get-bulk(tcpConnState, tcpConnLocalAddress, tcpConnLocalPort, tcpConnRemAddress, tcpConnRemport)
- would allow us to fetch tcp connection table two rows at a time
- if request is too big, agent will send back as much data as it can

set-request

- only difference with v1 is with responses
- still atomic (all variables are set or none)
- basically more error codes possible

snmpv2-Trap PDU

- different format from v1 BUT
- same format as other v2 messages
- var.bindings includes
  - sysUpTime.0
  - snmpTrapOID.0 (which trap)
  - OBJECTS of interest as specified
  - agent specific OBJECTS of interest

Inform-Request PDU

- sent by one manager to another to provide it with data (view as download)
- X can tell Y about Z
- OIDs of interest are passed to local app
- the response must be echoed in toto
- I have not seen this used (... yet ...)

transport mappings

- basically SNMPv2 can use more than IP/UDP including:
- IPX
- Appletalk
- OSI
- we don’t care much, but IPX has used SNMP ... sans UDP/IP

interoperability with v1

- agents will speak v1 and/or v2
- managers may speak v2
  - and must talk to v1 agents
- obviousally a manager that speaks v1 will not have much luck with a v2 agent ...

SMI interoperability

- key idea: MIB files should be refined to put in SMI/v2 garp BUT
- implementations do not have to change
- Changes should include
  - OBJECT definitions
  - TRAP definitions
  - Compliance definitions
  - Capabilities definitions

protocol interoperability

- manager must speak both kinds
  - can try snmp v2/v1 with agent and simply use whatever works
  - if agent doesn't speak v2, it won't respond (other than with error message)
  - manager can internally map v2 operations into v1 equivalents
    - » getbulk turned into getnext

snmpv2 MIB

- snmpv2 MIB describes behavior of entity
- includes 3 groups
  - **system** group extended to allow agent to dynamically describe configurable objects
  - **snmp** group extensions
  - **MIB objects** group - deals with traps and allows > 1 manager to cooperate

system group

- original plus a few new objects (object resource table mostly)
- sysORLastChange(8) - time of last OR change
- sysORTable(9)
  - sysOREntry(1)
    - sysORIndex
    - sysORID - OID
    - sysORDescr - string description
    - sysORUptime - time when row was instantiated
- RO table of objects that can be dynamically configured

snmp group

- additions and deletions
- RO except for snmpEnableAuthenTraps
- basically SMALLER and hopefully more useful
- next slide for revised group

snmp group revised

- snmpInPackets
- snmpInBadVersions - version # wrong
- snmpInBadcommunityNames
- synmpInBadCommunityUses
- snmpInASNParseErrs
- snmpEnableAuthenTraps (RW)
- snmpSilentDrops - no response
- snmpProxyDrops - no response

MIB objects group

- for control of MIB objects (duh)
- snmpMibObjects {snmpMIB 1)
  - snmpTrap
    - » snmpTrapOID - current trap OID (being sent)
    - » snmpTrapEnterprise - enterprise OID
  - snmpset
    - » snmpSerialNo - basically test and set variable to support concurrent access (global and course and advisory lock ...)

interface group MIB

- RFC 1573 improves interfaces group from RFC 1213, uses SMIv2
- fix problems with 1213 and notes problems in some cases
- ifNumber can be problematic in terms of dynamic devices (no kidding)
  - value should not change until reboot
- interfaces may have sub-layers
  - virtual circuits on circuit-oriented devices

interfaces, cont

- packet-oriented may be nonsense for bit-oriented devices
- interface byte count insufficient - may wrap on fast devices
- speed limited to 2**32-1 (2.2Gbps) insufficient (OC-48 is 2.448 gbps)
- multicast/broadcast need to be counted explicitly
- new ifType values

more

- four new tables including:
  - ifXTable - extensions
  - ifStackTable - the stack
  - ifTestTable - tests
  - ifRcvAddressTable
- old ifInNUcastPkts, ifOutNUcastPkts deprecated
- ifOutQLen and ifSpecific deprecated

ifXEntry

- ifName - string
- ifInMulticastPkts - Counter32
- ifInBroadcastPkts - same
- ifOutMulticastPkts - same
- ifOutBroadcastPkts - same
- ifHCInOctets - Counter64 “high-capacity”
- ifHCInMulticastPkts - 64
- ifHCInBroadcastPkts - 64

cont.

- ifHCOutOctets
- ifHCOutUcastPkts
- ifHCOutMulticastPkts
- ifHCOutBroadcastPkts
- ifLinkUpDownTrapEnable
- ifHighSpeed - Gauge32
- ifPromiscuousMode TruthValue
- ifConnectorPresent TruthValue (true(1), falue(2))

if stack table, etc.

- describe architecture of stack
- can theoretically create/destroy entries (and interfaces)
- test table - manager can test objects here if they exist
- rcv address - per interface list of addresses, should include unicast/multicast/bcast

conclusions

- how wide spread?
- much ado about nothing?
- get-bulk is useful
  - HPOV and full Inet/bgp routing tables
- more clarity and certain ambiguities removed (a good thing)
- not clear much of a win in MIB land -- primarily structural