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Application Management MIB

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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Abstract

This memo defines a standards track portion of the Management Information Base (MIB) for use with network management protocols in the Internet Community. In particular, it defines objects used for the management of applications. This MIB complements the System Application MIB, providing for the management of applications' common attributes which could not typically be observed without the cooperation of the software being managed.

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1. Introduction and Overview

This document furthers the work begun in the systems application MIB [31].

The development of the "Host Resources MIB" [10], "Network Services Monitoring MIB" [23], "Mail Monitoring MIB" [24], "Relational Database Management System (RDBMS) Management Information Base (MIB) using SMIv2" [12], "Entity MIB using SMIv2" [20], and "Applicability of Standards Track MIBs to Management of World Wide Web Servers" [21] provides us with a base of experience in making a variety of applications visible to management; this specification abstracts out the common aspects of applications management and provides a generic base usable for the management of almost any application.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [22].

Due to the design decision to not require application instrumentation, many important topics were not handled in system application MIB [31]. The following topics are within the scope of this document:

- Support for generic application throughput measurements;

- Providing MIB definitions that allow managed entities to report what they considered to be units of work;

- Providing support for generic application response time monitoring capabilities; (Note that APIs for this purpose have already been developed, an example of such an API is to be found in the "Application Response Measurement (ARM) API Guide, Version 2" [1].)

- Provide explicit support for the management of applications distributed within a single managed system ("local" distribution);

- Address generic resource management issues, including:

  - files in use;

  - I/O statistics (from the application's perspective, not at the operating system or device driver level);

  - application-layer networking resource usage

- Facilities for the control of applications, including:

  - Stopping application elements

  - Suspending and resuming application elements;

  - Requesting reconfiguration (e.g., SIGHUP).

Note that these issues are addressed at least in part by other (non-IETF) standards work, including "ITU-T Recommendation X.744 | ISO/IEC IS 10164-18:1996" [3] and "IEEE P1387.2, POSIX System Administration - Part 2: Software Administration" [2].

2. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

An overall architecture, described in RFC 2571 [26].

Mechanisms for describing and naming objects and events for the purpose of management. The first version of this Structure of Management Information (SMI) is called SMIv1 and described in STD 16, RFC 1155 [4], STD 16, RFC 1212 [6] and RFC 1215 [7]. The second version, called SMIv2, is described in STD 58, RFC 2578 [15], RFC 2579 [16] and RFC 2580 [17].

Message protocols for transferring management information. The first version of the SNMP message protocol is called SNMPv1 and described in STD 15, RFC 1157 [5]. A second version of the SNMP message protocol, which is not an Internet standards track protocol, is called SNMPv2c and described in RFC 1901 [14] and RFC 1906 [19]. The third version of the message protocol is called SNMPv3 and described in RFC 1906 [19], RFC 2572 [27] and RFC 2574 [29].

Protocol operations for accessing management information. The first set of protocol operations and associated PDU formats is described in STD 15, RFC 1157 [5]. A second set of protocol operations and associated PDU formats is described in RFC 1905 [18].

A set of fundamental applications described in RFC 2573 [28] and the view-based access control mechanism described in RFC 2575 [30].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the mechanisms defined in the SMI.

This memo specifies a MIB module that is compliant to the SMIv2. A MIB conforming to the SMIv1 can be produced through the appropriate translations. The resulting translated MIB must be semantically equivalent, except where objects or events are omitted because no translation is possible (use of Counter64). Some machine readable information in SMIv2 will be converted into textual descriptions in SMIv1 during the translation process. However, this loss of machine readable information is not considered to change the semantics of the MIB.

3. Architecture

Object-oriented modeling techniques like subclassing and multiple inheritance can be emulated in the SNMP information model through the use of tables with common indexes.

The challenge for the developer of management applications is to recognize those situations in which various aspects of a single logical resource are represented in several different tables, possibly defined in different MIBs.

Most of the management information defined here may pertain to any number of applications in a managed system. The simplest way of supporting this requirement within the SNMP information model is to use tables. This means that the management information for a particular resource may be found in one or more rows of one or more tables; the fact that this information pertains to a single resource may be inferred from the index values used, possibly with the support of mapping tables. This also means that a single table may contain management information relevant to a number of applications. This has significant implementation implications; see the implementation issues section below for more information.

3.1. Relationships to other MIBs

This section outlines the relationships of the components of this MIB (usually in the form of common indexing structures) to:

- the systems applications MIB [31]
- the host resources MIB [10]
- the network services monitoring MIB [23]

3.1.1. Relationship to the System Application MIB

The system application MIB defines attributes for management of applications which can be realized without instrumenting the application itself. This specification extends that framework to include additional attributes which will typically require instrumentation within the managed resource. The sysApplRunElmtIndex is the key connection between these two MIBs; it is essential that implementations of this MIB and of the system applications MIB running concurrently on a given platform employ a consistent policy for assigning this value to identify running application elements.

3.1.2. Relationship to the Host Resources MIB

The Host Resources MIB [10] supplies information on the hardware, operating system, installed and running software on a host.

The Host Resources MIB has three hardware groups ("hrSystem", "hrStorage" and "hrDevice") and three software groups ("hrSWRun", "hrSWRunPerf" and "hrSWInstalled"). Of these, the software groups are of greatest significance to this MIB.

The software groups define management information on the software used in the system. The information provided is grouped into (1) the currently running, (2) the performance and (3) the installed applications.

The index "hrSWRunIndex" used in the "hrSWRunTable" and other tables to identify running software by process identifier (or equivalent) relates information in the Host Resources MIB to information in the System Applications MIB and this MIB. It is essential that the values assigned to hrSWRunIndex from the Host Resources MIB be consistent with the values used for sysApplRunElmtIndex.

3.1.3. Relationship to NSM

The Network Services Monitoring MIB [23] is defined as the base set of attributes for managing network applications. The Application MIB includes information normally obtainable only from the managed resource itself, rather than the supporting system. Due to differences in index representation, the relationship between the Network Services Monitoring MIB and the Application MIB is not formally defined.

4. MIB Structure

This MIB is organized into several groups, which in turn are organized into tables to provide the monitoring and control of information relevant to the management of applications. The groups model:

- the service-level view of applications
- information on open channels (files, connections, transaction streams) in use by applications
- historical information on former channels
- process-level status and control information

These groups are organized into various tables. Information for a particular running managed application appears in the form of entries in the appropriate tables. The tables are:

- the tables providing a service-level view, including:
  - the service name to service instance table
  - the service instance to service name table
  - the service instance to running application element table
  - the running application element to service instance table
- the tables providing information on I/O channels, including:
  - the table of open channels
  - the table of open files
  - the open connections table
  - the transaction statistics tables
- historical information on I/O channels
- the running application element status and control group
  - the running application element status table
  - the running application element control table

In order to support SNMPv1, SNMPv2, and SNMPv3 environments, in cases where counter objects may potentially advance very rapidly, where sixty-four bit counters have been used thirty-two bit counters reporting the low-order thirty-two bits of the value have also been defined.

Since rows in most of these tables will come and go with the running application elements whose information is contained in them, sysUpTime.0 is not appropriate as a discontinuity indicator for counters in these tables. By defining separate discontinuity indicators for the rows in these tables, entries can come and go as needed without causing other objects to appear to have discontinuities. As required by [15], the discontinuity indicators for the various information objects in these tables are identified in

the relevant DESCRIPTION clauses. Note that a discontinuity in one of these counters does not imply a sysUpTime.0 discontinuity, nor does a sysUpTime.0 discontinuity imply a discontinuity in any of these counters.

4.1. The service-level tables

The service-level tables permit the identification of one or more instances of named services on a system, and the association of running application elements to these services.

Service names are represented as human-readable strings, using values assigned by IANA where possible. The allocation of unique values for service instance identifiers is a local administrative issue; the values allocated must be constant for the lifetime of the service instance, and re-use of values should be avoided.

It is important to understand that a service is not the same thing as a protocol. Rather, some services may be at least partially described by the protocol(s) used to provide that service.

In deciding what should or should not be considered a service, the following factors merit consideration:

- is there an identifiable set of resources associated with providing this service?

- is there a reasonably long-lived server or client process?

Following this reasoning, one can see where SMTP and HTTP service providers would be good candidates for classification as services for purposes of application management, where finger probably would not. Of course, implementors of this MIB are free to define additional services. An applicability statement may be an appropriate vehicle for standardizing how a specific service's information is reported using this MIB.

4.1.1. The service name to service instance table

The service name to service instance table uses the service name as its primary key, and the service instance identifier as its secondary key. It facilitates the identification and lookup of the instances of a given service in a system.

4.1.2. The service instance to service name table

The service instance to service name table uses the service instance identifier as its primary key, and the service name as its secondary key. Given a service instance identifier, it facilitates the lookup of the name of the service being provided.

4.1.3. The service instance to running application element table

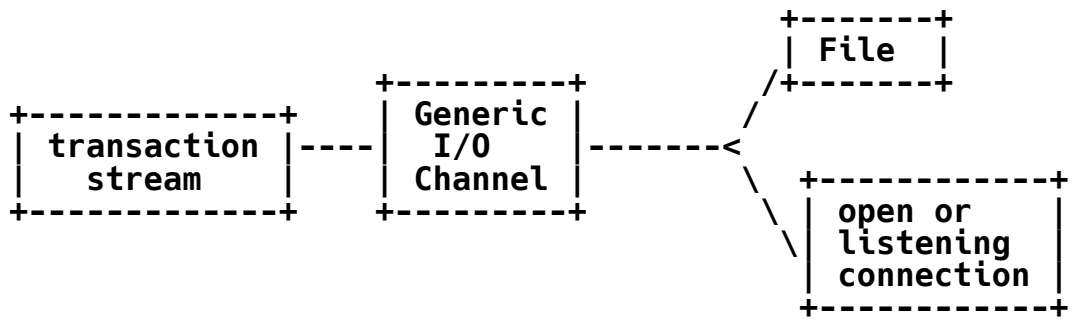
The service instance to running application element table uses the service instance identifier as its primary key, and the running application element index as its secondary key. This facilitates the identification of the set of running application elements providing a given instance of a service.

4.1.4. The running application element to service instance table

The running application element to service instance table uses the running application element index as its primary key and the service instance identifier as its secondary key. It identifies the set of services provided by a given running application element.

4.2. The I/O channel group

Information processed by an application can be modeled using the concept of a channel. Two kinds of channels, for example, are files and network connections.



For each entry in the open channel table, there will be a corresponding entry in either the open file table or the open connection table.

The information flowing on a channel may be structured as transactions. When the information flow on a channel is being monitored as a transaction stream, an entry in the transaction stream table will represent this fact and the associated information about

that stream.

To facilitate traversal of these tables and retrieval of information relevant to a specific running application element or service instances, the initial indexes of these tables are the same. In each case, the first index determines whether the second index is interpreted as a running application element identifier or as a service instance identifier. The third index serves to uniquely identify a channel (and consequently, an open connection or file) in the context of a running application element or service instance.

The transaction stream summary table contains per-stream summaries of transaction statistics. The transaction flow statistics table contains statistics broken into both transmit and receive counts for requests and responses on each stream. The transaction kind statistics table contains information further broken down by transaction kind.

The transaction tables have a common structure for their indexing, with additional indexes added for increasing detail. The initial three indexes are the same as all the other tables in this group, serving to uniquely identify each transaction stream.

4.2.1. The open channels table

The following information is available in this table:

- time at which the channel was opened
- number of read requests
- number of bytes read
- time at which most recent read operation was initiated
- number of write requests
- number of bytes written
- time at which most recent write operation was initiated

4.2.2. The open files table

The open files table contains one entry for each file in use by a manageable running application element. (See "Definitions of System-Level Managed Objects for Applications" [31] for a detailed definition of a running application element.) The purpose of this table is to identify the files in use and to record information

peculiar to files not already covered in the open channel table.

If multiple running application elements open the same file, there will be an entry for each running application element opening that file. Similarly, if a running application element opens a file multiple times, there will be an entry in this table for the file corresponding to each open.

The task of combining the information for file activity from this table (organized by running application element) into per-application statistics can be accomplished by a manager using the System Application MIB's [31] sysApplInstallPkgTable to find the installed application, the sysApplRunTable to find the running instances of that application, and the sysApplElmtRunTable to find the relevant values of sysApplElmtRunIndex. The manager, armed with a set of values for sysApplElmtRunIndex, is now able to retrieve the relevant portions of the applOpenFileTable and other tables in this MIB.

The following information is available in this table:

- file name
- file size
- current mode (read/write) of this file

By convention, the names "stdin", "stdout" and "stderr" are used when these streams cannot be resolved to actual file names.

4.2.3. The open connections table

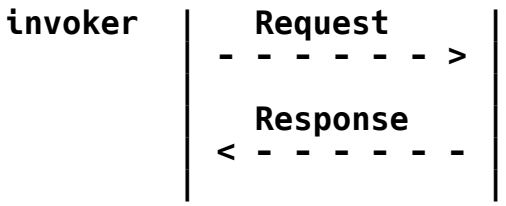
This table provides information on channels that are open connections or listeners.

The following information is available for each connection:

- identification of the transport protocol in use
- near-end address and port
- far-end address and port
- identification of the application layer protocol in use

4.2.4. The transaction stream summary table

The transaction stream summary table contains per-stream summaries of transaction statistics. The simple model of a transaction used here looks like this:



Since in some protocols it is possible for an entity to take on both the invoker and performer roles, information here is accumulated for transmitted and received requests, as well as for transmitted and received responses. Counts are maintained for both transactions and bytes transferred. The information represented in this table includes:

- identification of the underlying connection or file used for this transaction stream
- a human-readable description of this stream
- a human-readable description of this stream's notion of what a unit of work is
- the cumulative amount of time spent (as an operation invoker) waiting for responses (from queueing of request to arrival of first response)
- the cumulative amount of time spent (as an operation invoker) receiving responses (time from the arrival of the first response to the arrival of the last response in a series of responses to a particular request)
- the cumulative amount of time spent (as an operation performer) handling requests (time from receipt of request to queueing of first outgoing response)
- the cumulative amount of time spent (as an operation performer) sending responses (time from queuing of first response to the last response in a series of responses to a particular request)

- the cumulative number of transactions initiated (as an invoker)

- the cumulative number of transactions processed (as a performer)

4.2.5. The transaction flow statistics table

The transaction flow statistics table contains statistics broken into both transmit and receive counts for requests and responses on each stream. In addition to the service instance / running application element and transaction stream identifier indexes, rows in this table are indexed by flow direction (transmit or receive) and role (requests and responses). The information in this table includes:

- the number of transactions processed

- the number of bytes processed

- the time at which the most recent transaction was processed in this flow

4.2.6. The transaction kind statistics table

The transaction kind statistics table contains summary information organized by direction, request/response, and transaction kind for each stream. The indexing of this table is like that of the transaction flow table, with the addition of a transaction kind index.

- number of transactions processed

- number of bytes processed

- the time at which the most recent transaction of this kind in this direction in this stream was processed

4.3. The former channel group

The former channel group has several tables. The former channel control table controls the retention of history information by a running application element or service instance. The remaining tables parallel the structure of the channel group, with one significant difference in indexing structure. The closed channel index is independent from the open channel index.

4.3.1. The former channel control table

The former channel control table provides control over the accumulation of information on former connections for running application elements and service instances. For each one, this table, indexed by the running application element or service instance index, controls whether information on former channels is accumulated, how many of these history records are retained, how long these are retained (within the lifetime of the process), and a count of history entries that were deleted before their expiration time in order to make room for new entries.

4.3.2. The former channel table

The former channel table provides historical information on channels that have been closed. The number and lifetime of these entries is controlled, for each running application element or service instance, by the former channel control table. Most of the information in this table corresponds to information in the open channel table.

For the connection or file-specific aspects of a given former channel, an entry will exist in the former connection table or in the former file table.

4.3.3. The former connection table

For formerly open channels that were connections, connection-specific historical information is kept in the former connection table. For each entry in the former connection table, there will be an identically indexed entry in the former channel table.

4.3.4. The former file table

For formerly open channels that were files, file-specific historical information is kept in the former file table. For each entry in the former file table, there will be an identically indexed entry in the former channel table.

4.3.5. The transaction history tables

Two tables provide per-transaction-kind breakdowns for channels carrying transaction-structured flows. These tables are analogous to the transaction flow and kind statistics tables, with similar index structures.

4.4. The running element status and control group

The running application element status and control group has two tables.

4.4.1. The running application element status table

This table provides information for a running application element. Indexed by the sysApplElmtRunIndex, an entry in this table reports useful information on that running element's resource usage. Entries in this table contain:

- current heap usage for this running application element
- current number of open network connections for this running application element
- the most recent error status message issued by this running application element

Note that other information, such as the current number of open files for this running application element, is available from the sysapplElmtRunTable in [31].

4.4.2. The running application element control table

This table provides rudimentary control over a running application element. Indexed by the sysApplElmtRunIndex, an entry in this table gives a manager with appropriate permissions the ability to suspend and resume processing by this running element, the ability to request reconfiguration, and the ability to terminate the running element.

Variables in this table include:

- a suspend/resume control
- a reconfiguration request control
- a termination request control

5. Definitions

```
   APPLICATION-MIB DEFINITIONS ::= BEGIN

   IMPORTS
       MODULE-IDENTITY, OBJECT-TYPE,
           Counter64, Counter32, Gauge32,
           mib-2, Unsigned32, zeroDotZero   FROM SNMPv2-SMI

       DateAndTime, TEXTUAL-CONVENTION,
           TestAndIncr, TDomain,
           TimeStamp, TruthValue            FROM SNMPv2-TC

       SnmpAdminString                      FROM SNMP-FRAMEWORK-MIB

       MODULE-COMPLIANCE, OBJECT-GROUP
                                            FROM SNMPv2-CONF

       LongUtf8String, sysApplElmtRunIndex  FROM SYSAPPL-MIB;

   applicationMib MODULE-IDENTITY
       LAST-UPDATED "9811171815Z"
       ORGANIZATION "Application MIB Working Group"
       CONTACT-INFO
          "http://www.ietf.org/html.charters/applmib-charter.html

           Randy Presuhn
           BMC Software, Inc.
           965 Stewart Drive
           Sunnyvale, CA 94086
           USA

           Telephone: +1 408 616-3100
           Facsimile: +1 408 616-3101
           EMail: randy_presuhn@bmc.com
          "
       DESCRIPTION
          "This MIB defines objects representing generic aspects of
           applications that are of interest to management but typically
           require instrumentation within managed application elements.
          "
       ::= { mib-2 62 }


   --
   --      Registration hierarchy for this MIB
   --
   applicationMibObjects OBJECT IDENTIFIER ::=
                            { applicationMib 1 }
```

```
   applicationMibConformance OBJECT IDENTIFIER ::=
                            { applicationMib 2 }


   --
   --      Groups defined in this MIB
   --
   applServiceGroup OBJECT IDENTIFIER ::=
                            { applicationMibObjects 1 }

   applChannelGroup OBJECT IDENTIFIER ::=
                            { applicationMibObjects 2 }

   applPastChannelGroup OBJECT IDENTIFIER ::=
                            { applicationMibObjects 3 }

   applElmtRunControlGroup OBJECT IDENTIFIER ::=
                            { applicationMibObjects 4 }


   Unsigned64TC ::= TEXTUAL-CONVENTION
       STATUS current
       DESCRIPTION
           "A non-negative 64-bit bit integer, without counter
            semantics."
       SYNTAX Counter64

   ApplTAddress ::= TEXTUAL-CONVENTION
       STATUS       current
       DESCRIPTION
             "Denotes a transport service address.

             For snmpUDPDomain, an ApplTAddress is 6 octets long,
             the initial 4 octets containing the IP-address in
             network-byte order and the last 2 containing the UDP
             port in network-byte order.  Consult 'Transport Mappings
             for Version 2 of the Simple Network Management Protocol
             (SNMPv2)' for further information on snmpUDPDomain."
       SYNTAX       OCTET STRING (SIZE (0..255))
```

```
   -- ****************************************************************
   --
   --      applServiceGroup -
   --
   --      The service-level tables permit the identification of one
   --      or more instances of named services on a system, and the
   --      association of running application elements to services.
   --
   -- ****************************************************************


   -- ****************************************************************
   --
   --      The service name to service instance table
   --
   -- ****************************************************************

   applSrvNameToSrvInstTable OBJECT-TYPE
           SYNTAX            SEQUENCE OF ApplSrvNameToSrvInstEntry
           MAX-ACCESS        not-accessible
           STATUS            current
           DESCRIPTION
              "The service name to service instance table uses
               service name as its primary key, and service instance
               identifier as its secondary key.  It facilitates the
               identification and lookup of the instances of a given
               service in a system."
           ::= { applServiceGroup 1 }

   applSrvNameToSrvInstEntry OBJECT-TYPE
           SYNTAX            ApplSrvNameToSrvInstEntry
           MAX-ACCESS        not-accessible
           STATUS            current
           DESCRIPTION
              "An applSrvNameToSrvInstEntry identifies an instance of
               a given service.  The allocation and reservation
               of unique values for applSrvIndex is an administrative
               issue.

               An applSrvNameToSrvInstEntry exists for the lifetime of
               that instance of that service; the index values may not
               change during that lifetime.  "
           INDEX { applSrvName, applSrvIndex }
           ::= { applSrvNameToSrvInstTable 1 }
```

```
   ApplSrvNameToSrvInstEntry ::= SEQUENCE
           {
                   applSrvInstQual SnmpAdminString
           }


   applSrvInstQual         OBJECT-TYPE
           SYNTAX          SnmpAdminString
           MAX-ACCESS      read-only
           STATUS          current
           DESCRIPTION
              "The value of applSrcInstQual provides additional
               information about this particular instance of this
               service.

               Although not used for indexing purposes, the value of
               this attribute should be sufficiently unique to be
               helpful to an administrator in distinguishing among
               service instances.  "
           ::= { applSrvNameToSrvInstEntry 1 }


   -- ***************************************************************
   --
   --      Service instance to Service Name table
   --
   -- ***************************************************************

   applSrvInstToSrvNameTable OBJECT-TYPE
           SYNTAX            SEQUENCE OF ApplSrvInstToSrvNameEntry
           MAX-ACCESS        not-accessible
           STATUS            current
           DESCRIPTION
              "The service instance to service name table uses
               service instance identifier as its primary key, and
               service name as its secondary key.  Given a service
               instance identifier, it facilitates the lookup of the
               name of the service being provided."
           ::= { applServiceGroup 2 }
```

```
   applSrvInstToSrvNameEntry OBJECT-TYPE
           SYNTAX            ApplSrvInstToSrvNameEntry
           MAX-ACCESS        not-accessible
           STATUS            current
           DESCRIPTION
              "An applSrvInstToSrvNameEntry maps a service instance
               identifier back to a service name."
           INDEX { applSrvIndex, applSrvName }
           ::= { applSrvInstToSrvNameTable 1 }

   ApplSrvInstToSrvNameEntry ::= SEQUENCE
           {
                   applSrvName     SnmpAdminString
           }

   applSrvName         OBJECT-TYPE
           SYNTAX     SnmpAdminString
           MAX-ACCESS read-only
           STATUS     current
           DESCRIPTION
              "The human-readable name of a service.  Where
               appropriate, as in the case where a service can be
               identified in terms of a single protocol, the strings
               should be established names such as those assigned by
               IANA and found in STD 2 [13], or defined by some other
               authority.  In some cases private conventions apply
               and the string should in these cases be consistent
               with these non-standard conventions.   An applicability
               statement may specify the service name(s) to be used.
              "
           ::= { applSrvInstToSrvNameEntry 1 }

   -- ************************************************************
   --
   --      The service instance to running application element table
   --
   -- ************************************************************

   applSrvInstToRunApplElmtTable OBJECT-TYPE
           SYNTAX            SEQUENCE OF ApplSrvInstToRunApplElmtEntry
           MAX-ACCESS            not-accessible
           STATUS                current
           DESCRIPTION
              "The service instance to running application element
               table uses the service instance identifier as its primary
               key, and the running application element index as its
               secondary key.  This facilitates the identification
```

```
            of the set of running application elements providing a
            given instance of a service."
        ::= { applServiceGroup 3 }

   applSrvInstToRunApplElmtEntry OBJECT-TYPE
        SYNTAX                ApplSrvInstToRunApplElmtEntry
        MAX-ACCESS            not-accessible
        STATUS                current
        DESCRIPTION
           "An applSrvInstToRunApplElmtEntry identifies a running
            application element providing an instance of a service.
            Note that there may be multiple running application
            elements involved in the provision of an instance of
            a service."
        INDEX { applSrvIndex, sysApplElmtRunIndex }
        ::= { applSrvInstToRunApplElmtTable 1 }

   ApplSrvInstToRunApplElmtEntry ::= SEQUENCE
        {
                applSrvIndex       Unsigned32
        }

   applSrvIndex        OBJECT-TYPE
        SYNTAX      Unsigned32 (1..'ffffffff'h)
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "An applSrvIndex is the system-unique identifier of
             an instance of a service.  The value is unique not only
             across all instances of a given service, but also across
             all services in a system.

             Re-use of values for this index should be avoided.
             No two service instances in a given system shall
             concurrently have the same value for this index.

             The value zero is excluded from the set of permitted
             values for this index.  This allows other tables to
             potentially represent things which cannot be associated
             with a specific service instance.
            "
        ::= { applSrvInstToRunApplElmtEntry 1 }
```

```
   -- ************************************************************
   --
   --      The running application element to service instance table
   --
   -- ************************************************************

   applRunApplElmtToSrvInstTable OBJECT-TYPE
           SYNTAX           SEQUENCE OF ApplRunApplElmtToSrvInstEntry
           MAX-ACCESS            not-accessible
           STATUS                current
           DESCRIPTION
              "The running application element to service instance
               table uses the running application element index as
               its primary key and the service instance identifier as
               its secondary key.  It identifies the set of services
               provided by a given running application element."
           ::= { applServiceGroup 4 }

   applRunApplElmtToSrvInstEntry OBJECT-TYPE
           SYNTAX                ApplRunApplElmtToSrvInstEntry
           MAX-ACCESS            not-accessible
           STATUS                current
           DESCRIPTION
              "An applRunApplElmtToSrvInstEntry serves to identify an
               instance of a service being provided by a given running
               application element.  Note that a particular running
               application element may provide multiple services."
           INDEX { sysApplElmtRunIndex, applSrvInstance }
           ::= { applRunApplElmtToSrvInstTable 1 }

   ApplRunApplElmtToSrvInstEntry ::= SEQUENCE
           {
                   applSrvInstance         Unsigned32
           }

   applSrvInstance    OBJECT-TYPE
           SYNTAX     Unsigned32 (1..'ffffffff'h)
           MAX-ACCESS read-only
           STATUS     current
           DESCRIPTION
              "An applSrvInstance is the system-unique identifier of an
               instance of a service.  The value is unique not only
               across all instances of a given service, but also across
               all services.

               Re-use of values for this index should be avoided.
               No two service instances in a given system shall
               concurrently have the same value for this index.
```

```
                The value zero is excluded from the set of permitted
                values for this index.  This allows other tables to
                potentially represent things which cannot be associated
                with a specific service instance.

                This attribute is semantically identical to
                applSrvIndex."
            ::= { applRunApplElmtToSrvInstEntry  1 }


    -- ****************************************************************
    --
    --      applChannelGroup - group with tables for I/O
    --
    --      In this group, the common abstraction is the Channel.
    --      Channels are realized as files or connections.
    --      The information flowing on a channel can always be
    --      measured in terms of a byte stream.  Furthermore, for many
    --      channels, this information may also be measured in terms
    --      of transactions.
    --
    --      For all of these tables, the first two indexes determines
    --      whether what is being measured is for a single running
    --      application element or for an instance of a service.
    --
    --      The second index identifies the running application element
    --      or service instance.
    --
    --      The third index is the channel id, which uniquely identifies
    --      a channel within the context of a running application element
    --      or service instance.
    --
    --      Any remaining indexes are table-specific.
    --
    -- ****************************************************************


    -- ****************************************************************
    --
    --      applOpenChannelTable - Table of Open Channels
    --
    -- ****************************************************************

    applOpenChannelTable OBJECT-TYPE
            SYNTAX       SEQUENCE OF ApplOpenChannelEntry
            MAX-ACCESS   not-accessible
            STATUS       current
```

```
            DESCRIPTION
               "The applOpenChannelTable reports information on open
                channels for running application elements
                and for service instances.  This table is
                indexed by applElmtOrSvc, applElmtOrSvcId, and
                applOpenChannelIndex. This effectively groups all
                entries for a given running application element
                or service instance together.  ApplChannelIndex uniquely
                identifies an open channel (and, consequently, a file
                or connection) within the context of a particular
                running application element or service instance.

                Some of the information in this table is available
                through both sixty-four and thirty-two bit counters.
                The sixty-four bit counters are not accessible in
                protocols that do not support this data type."
            ::= { applChannelGroup 1 }

    applOpenChannelEntry OBJECT-TYPE
            SYNTAX       ApplOpenChannelEntry
            MAX-ACCESS   not-accessible
            STATUS       current
            DESCRIPTION
               "An applOpenChannelEntry indicates that a channel has been
                opened by this running application element or service
                instance and is still open.  Note that if a file has been
                opened multiple times, even by the same process, it will
                have multiple channel entries."
            INDEX           { applElmtOrSvc, applElmtOrSvcId,
                              applOpenChannelIndex }
            ::= { applOpenChannelTable 1 }

    ApplOpenChannelEntry  ::= SEQUENCE
            {
                    applElmtOrSvc                   INTEGER,
                    applElmtOrSvcId                 Unsigned32,
                    applOpenChannelIndex            Unsigned32,
                    applOpenChannelOpenTime         TimeStamp,
                    applOpenChannelReadRequests     Counter64,
                    applOpenChannelReadRequestsLow  Counter32,
                    applOpenChannelReadFailures     Counter32,
                    applOpenChannelBytesRead        Counter64,
                    applOpenChannelBytesReadLow     Counter32,
                    applOpenChannelLastReadTime     DateAndTime,
                    applOpenChannelWriteRequests    Counter64,
                    applOpenChannelWriteRequestsLow Counter32,
                    applOpenChannelWriteFailures    Counter32,
                    applOpenChannelBytesWritten     Counter64,
```

```
                applOpenChannelBytesWrittenLow     Counter32,
                applOpenChannelLastWriteTime       DateAndTime
        }

   applElmtOrSvc      OBJECT-TYPE
           SYNTAX     INTEGER { service(1),
                                element(2) }
           MAX-ACCESS not-accessible
           STATUS     current
           DESCRIPTION
              "The applElmtOrSvc attribute serves as an index for tables
               that can hold information both for individual running
               application elements as well as for service instances.

               If the value is service(1), the row contains information
               gathered at the level of a service.

               If the value is element(2), the row contains information
               for an individual running application element."
           ::= { applOpenChannelEntry 1 }

   applElmtOrSvcId    OBJECT-TYPE
           SYNTAX     Unsigned32 (1..'ffffffff'h)
           MAX-ACCESS not-accessible
           STATUS     current
           DESCRIPTION
              "The applElmtOrSvcId attribute is used as an index in
               conjunction with the applElmtOrSvc attribute.

               When the value of applElmtOrSvc is service(1), this
               attribute's value corresponds to that of applSrvIndex,
               when the value of applElmtOrSvc is element(2), this
               attribute's value corresponds to sysApplElmtRunIndex."
           ::= { applOpenChannelEntry 2 }

   applOpenChannelIndex OBJECT-TYPE
           SYNTAX       Unsigned32
           MAX-ACCESS   not-accessible
           STATUS       current
           DESCRIPTION
              "This attribute serves to uniquely identify this open
               connection in the context of the running application
               element or service instance.  Where suitable, the
               application's native descriptor number should be used."
           ::= { applOpenChannelEntry 3 }
```

```
   applOpenChannelOpenTime OBJECT-TYPE
           SYNTAX          TimeStamp
           MAX-ACCESS      read-only
           STATUS          current
           DESCRIPTION
              "This attribute records the value of sysUpTime.0
               when this channel was opened and this entry was added to
               this table.  This attribute serves as a discontinuity
               indicator for the counter attributes in this entry
               and for any corresponding entries in the
               applOpenConnectionTable, applOpenFileTable, and the
               applTransactionStreamTable."
           ::= { applOpenChannelEntry 4 }

   applOpenChannelReadRequests OBJECT-TYPE
           SYNTAX              Counter64
           UNITS               "read requests"
           MAX-ACCESS          read-only
           STATUS              current
           DESCRIPTION
              "This attribute reports the number of read requests
               for this channel.  All read requests for this channel
               by this entity, regardless of completion status, are
               included in this count.

               Read requests are counted in terms of system calls,
               rather than API calls.

               Discontinuities in this counter can be detected by
               monitoring the applOpenChannelOpenTime value for this
               entry."
           ::= { applOpenChannelEntry 5 }

   applOpenChannelReadRequestsLow OBJECT-TYPE
           SYNTAX                  Counter32
           UNITS                   "read requests"
           MAX-ACCESS              read-only
           STATUS                  current
           DESCRIPTION
              "This attribute reports the low thirty-two bits of
               applOpenChannelReadRequests.

               Discontinuities in this counter can be detected by
               monitoring the applOpenChannelOpenTime value for this
               entry."
           ::= { applOpenChannelEntry 6 }
```

```
   applOpenChannelReadFailures OBJECT-TYPE
           SYNTAX              Counter32
           UNITS               "failed read requests"
           MAX-ACCESS          read-only
           STATUS              current
           DESCRIPTION
              "This attribute reports the number of failed read
               requests.

               Discontinuities in this counter can be detected by
               monitoring the applOpenChannelOpenTime value for this
               entry."
           ::= { applOpenChannelEntry 7 }

   applOpenChannelBytesRead OBJECT-TYPE
           SYNTAX           Counter64
           UNITS            "bytes"
           MAX-ACCESS       read-only
           STATUS           current
           DESCRIPTION
              "This attribute reports the number of bytes read from
               this channel.  Only bytes successfully read are included
               in this count.

               Discontinuities in this counter can be detected by
               monitoring the applOpenChannelOpenTime value for this
               entry."
           ::= { applOpenChannelEntry 8 }

   applOpenChannelBytesReadLow OBJECT-TYPE
           SYNTAX              Counter32
           UNITS               "bytes"
           MAX-ACCESS          read-only
           STATUS              current
           DESCRIPTION
              "This attribute corresponds to the low thirty-two bits
               of applOpenChannelBytesRead.

               Discontinuities in this counter can be detected by
               monitoring the applOpenChannelOpenTime value for this
               entry."
           ::= { applOpenChannelEntry 9 }

   applOpenChannelLastReadTime OBJECT-TYPE
           SYNTAX              DateAndTime
           MAX-ACCESS          read-only
           STATUS              current
```

```
            DESCRIPTION
               "This attribute reports the time of the most recent read
                request made by this entity, regardless of completion
                status, for this open channel.

                If no read requests have been made the value of this
                attribute shall be '0000000000000000'H "
            DEFVAL { '0000000000000000'H }
            ::= { applOpenChannelEntry 10 }

   applOpenChannelWriteRequests OBJECT-TYPE
            SYNTAX                Counter64
            UNITS                 "write requests"
            MAX-ACCESS            read-only
            STATUS                current
            DESCRIPTION
               "This attribute reports the number of write requests for
                this channel made by this entity.  All write requests
                for this channel, regardless of completion status, are
                included in this count.

                Write requests are counted in terms of system calls,
                rather than API calls.

                Discontinuities in this counter can be detected by
                monitoring the applOpenChannelOpenTime value for this
                entry."
            ::= { applOpenChannelEntry 11 }

   applOpenChannelWriteRequestsLow OBJECT-TYPE
            SYNTAX                   Counter32
            UNITS                    "write requests"
            MAX-ACCESS               read-only
            STATUS                   current
            DESCRIPTION
               "This attribute corresponds to the low thirty-two bits
                of applOpenChannelWriteRequests.

                Discontinuities in this counter can be detected
                by monitoring the applOpenChannelOpenTime value for
                this entry."
            ::= { applOpenChannelEntry 12 }

   applOpenChannelWriteFailures OBJECT-TYPE
            SYNTAX                Counter32
            UNITS                 "failed write requests"
            MAX-ACCESS            read-only
            STATUS                current
```

```
            DESCRIPTION
               "This attribute reports the number of failed write
                requests.

                Discontinuities in this counter can be detected
                by monitoring the applOpenChannelOpenTime value for
                this entry."
            ::= { applOpenChannelEntry 13 }

   applOpenChannelBytesWritten OBJECT-TYPE
            SYNTAX              Counter64
            UNITS               "bytes"
            MAX-ACCESS          read-only
            STATUS              current
            DESCRIPTION
               "This attribute reports the number of bytes written to
                this channel.  Only bytes successfully written (without
                errors reported by the system to the API in use by the
                application) are included in this count.

                Discontinuities in this counter can be detected by
                monitoring the applOpenChannelOpenTime value for this
                entry."
            ::= { applOpenChannelEntry 14 }

   applOpenChannelBytesWrittenLow OBJECT-TYPE
            SYNTAX                 Counter32
            UNITS                  "bytes"
            MAX-ACCESS             read-only
            STATUS                 current
            DESCRIPTION
               "This attribute corresponds to the low thirty-two bits
                of applOpenChannelBytesWritten.

                Discontinuities in this counter can be detected by
                monitoring the applOpenChannelOpenTime value for this
                entry."
            ::= { applOpenChannelEntry 15 }

   applOpenChannelLastWriteTime OBJECT-TYPE
            SYNTAX               DateAndTime
            MAX-ACCESS           read-only
            STATUS               current
            DESCRIPTION
               "This attribute reports the time of the most recent write
                request made by this running application element or
                service instance, regardless of completion status, for
                this open channel.
```

```
            If no write requests have been made, the value
            of this attribute shall be '0000000000000000'H "
        DEFVAL { '0000000000000000'H }
        ::= { applOpenChannelEntry 16 }

-- ************************************************************
--
--      applOpenFileTable - Table of Open Files
--
-- ************************************************************

applOpenFileTable  OBJECT-TYPE
        SYNTAX     SEQUENCE OF ApplOpenFileEntry
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
           "The applOpenFileTable reports information on open files
            for service instances or application elements.  This
            table is indexed by applElmtOrSvc and applElmtOrSvcId,
            effectively grouping all entries for a given running
            service instance or application element together, and
            by applOpenChannelIndex, uniquely identifying an open
            channel (and, consequently, a file) within the context
            of a particular service instance or application element.

            Elements in this table correspond to elements in the
            applOpenChannelTable that represent files.  For rows in
            the applOpenChannelTable that do not represent files,
            corresponding rows in this table will not exist."
        ::= { applChannelGroup 2 }

applOpenFileEntry   OBJECT-TYPE
        SYNTAX      ApplOpenFileEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
           "An applOpenFileEntry indicates that a file has been
            opened by this running application element and is
            still open.  Note that if a file has been opened
            multiple times, even by the same process, it will have
            multiple entries."
        INDEX       { applElmtOrSvc, applElmtOrSvcId,
                      applOpenChannelIndex }
        ::= { applOpenFileTable 1 }
```

```
   ApplOpenFileEntry  ::= SEQUENCE
           {
                   applOpenFileName                LongUtf8String,
                   applOpenFileSizeHigh            Unsigned32,
                   applOpenFileSizeLow             Unsigned32,
                   applOpenFileMode                INTEGER
            }

   applOpenFileName   OBJECT-TYPE
           SYNTAX     LongUtf8String
           MAX-ACCESS read-only
           STATUS     current
           DESCRIPTION
             "This attribute reports the name of this open file.
              Wherever practical, a fully qualified path name should
              be reported.

              The values 'stdin', 'stdout', and 'stderr' are reserved
              in accordance with common usage when the fully qualified
              path name cannot be determined."
           ::= { applOpenFileEntry 1 }

   applOpenFileSizeHigh OBJECT-TYPE
           SYNTAX       Unsigned32
           UNITS        "2^32 byte blocks"
           MAX-ACCESS   read-only
           STATUS       current
           DESCRIPTION
             "This file's current size in 2^32 byte blocks.

              For example, for a file with a total size of 4,294,967,296
              bytes, this attribute would have a value of 1; for a file
              with a total size of 4,294,967,295 bytes this attribute's
              value would be 0."
           ::= { applOpenFileEntry 2 }

   applOpenFileSizeLow OBJECT-TYPE
           SYNTAX      Unsigned32
           UNITS       "bytes"
           MAX-ACCESS  read-only
           STATUS      current
           DESCRIPTION
              "This file's current size modulo 2^32 bytes.

               For example, for a file with a total size of
               4,294,967,296 bytes this attribute would have a value
               of 0; for a file with a total size of 4,294,967,295
               bytes this attribute's value would be 4,294,967,295."
```

```
            ::= { applOpenFileEntry 3 }

   applOpenFileMode   OBJECT-TYPE
            SYNTAX     INTEGER { read(1),
                                 write(2),
                                 readWrite(3) }
            MAX-ACCESS read-only
            STATUS     current
            DESCRIPTION
               "This attribute reports the current mode of this file from
                the perspective of this running application element.

                These values have the following meanings:

                    read(1) - file opened for reading only
                    write(2) - file opened for writing only
                    readWrite(3) - file opened for read and write.

                These values correspond to the POSIX/ANSI C library
                function fopen() 'type' parameter, using the following
                mappings:

                    r -> read(1)
                    w -> write(2)
                    a -> write(2)
                    + -> readWrite(3)
              "
            ::= { applOpenFileEntry 4 }


   -- ****************************************************************
   --
   --      applOpenConnectionTable - Open Connection Table
   --
   -- ****************************************************************

   applOpenConnectionTable OBJECT-TYPE
            SYNTAX          SEQUENCE OF ApplOpenConnectionEntry
            MAX-ACCESS      not-accessible
            STATUS          current
            DESCRIPTION
               "The applOpenConnectionTable provides information about
                open and listening connections from the perspective
                of a running application element or service instance.
                Entries in this table are indexed by applElmtOrSvc,
                applElmtOrSvcID, and by applOpenChannelIndex, which
                serves to uniquely identify each connection in the
                context of a service instance or running application
```

```
                element.

                For each row in this table, a corresponding row will
                exist in the applOpenChannel table.  For rows in the
                applOpenChannelTable which do not represent open or
                listening connections, no corresponding rows will exist
                in this table."
            ::= { applChannelGroup 3 }

    applOpenConnectionEntry OBJECT-TYPE
            SYNTAX          ApplOpenConnectionEntry
            MAX-ACCESS      not-accessible
            STATUS          current
            DESCRIPTION
               "An applOpenConnectionEntry indicates that a running
                application element or service instance has an open
                connection.  The entry has information describing that
                connection.

                In the case of a TCP transport, the element
                applOpenConnectionNearEndAddr and that row's
                applOpenConnectionFarEndAddr would correspond
                to a tcpConnEntry.  For a UDP transport, a
                similar relationship exists with respect to
                a udpEntry."
            INDEX           { applElmtOrSvc, applElmtOrSvcId,
                              applOpenChannelIndex }
            ::= { applOpenConnectionTable 1 }

    ApplOpenConnectionEntry  ::= SEQUENCE
            {
                    applOpenConnectionTransport     TDomain,
                    applOpenConnectionNearEndAddr   ApplTAddress,
                    applOpenConnectionNearEndpoint  SnmpAdminString,
                    applOpenConnectionFarEndAddr    ApplTAddress,
                    applOpenConnectionFarEndpoint   SnmpAdminString,
                    applOpenConnectionApplication   SnmpAdminString
            }

    applOpenConnectionTransport OBJECT-TYPE
            SYNTAX              TDomain
            MAX-ACCESS          read-only
            STATUS              current
```

```
            DESCRIPTION
               "The applOpenConnectionTransport attribute identifies the
                transport protocol in use for this connection.  If it is
                not practical to determine the underlying transport, this
                attribute's value shall have a value of {0 0}."
            DEFVAL { zeroDotZero }
            ::= { applOpenConnectionEntry 1 }

   applOpenConnectionNearEndAddr OBJECT-TYPE
            SYNTAX                ApplTAddress
            MAX-ACCESS            read-only
            STATUS                current
            DESCRIPTION
               "The applOpenConnectionNearEndAddr attribute reports the
                transport address and port information for the near end
                of this connection.

                If the value is not known, the value has a  length
                of zero."
            DEFVAL { "" }
            ::= { applOpenConnectionEntry 2 }

   applOpenConnectionNearEndpoint OBJECT-TYPE
            SYNTAX                SnmpAdminString
            MAX-ACCESS            read-only
            STATUS                current
            DESCRIPTION
               "The applOpenConnectionNearEndpoint attribute reports the
                fully-qualified domain name and port information for the
                near end of this connection.

                The format of this attribute for TCP and UDP-based
                protocols is the fully-qualified domain name immediately
                followed by a colon which is immediately followed by
                the decimal representation of the port number.

                If the value is not known, the value has a  length
                of zero."
            DEFVAL { "" }
            ::= { applOpenConnectionEntry 3 }

   applOpenConnectionFarEndAddr OBJECT-TYPE
            SYNTAX               ApplTAddress
            MAX-ACCESS           read-only
            STATUS               current
```

```
            DESCRIPTION
               "The applOpenConnectionFarEndAddr attribute reports the
                transport address and port information for the far end
                of this connection.

                If not known, as in the case of a connectionless
                transport, the value of this attribute shall be a
                zero-length string."
            DEFVAL { "" }
            ::= { applOpenConnectionEntry 4 }

   applOpenConnectionFarEndpoint OBJECT-TYPE
            SYNTAX              SnmpAdminString
            MAX-ACCESS          read-only
            STATUS              current
            DESCRIPTION
               "The applOpenConnectionFarEndpoint attribute reports
                the fully-qualified domain name and port information
                for the far end of this connection.

                The format of this attribute for TCP and UDP-based
                protocols is the fully-qualified domain name immediately
                followed by a colon which is immediately followed by
                the decimal representation of the port number.

                If not known, as in the case of a connectionless
                transport, the value of this attribute shall be a
                zero-length string."
            DEFVAL { "" }
            ::= { applOpenConnectionEntry 5 }

   applOpenConnectionApplication OBJECT-TYPE
            SYNTAX               SnmpAdminString
            MAX-ACCESS           read-only
            STATUS               current
            DESCRIPTION
               "The applOpenConnectionApplication attribute identifies
                the application layer protocol in use.  If not known,
                the value of this attribute shall be a zero-length
                string.

                When possible, protocol names should be those used in
                the 'ASSIGNED NUMBERS' [13].  For example, an SMTP mail
                server would use 'SMTP'."
            DEFVAL { "" }
            ::= { applOpenConnectionEntry 6 }
```

```
   -- ************************************************************
   --
   --      applTransactionStreamTable - common
   --      information for transaction stream monitoring
   --
   -- ************************************************************

   applTransactionStreamTable OBJECT-TYPE
           SYNTAX             SEQUENCE OF ApplTransactionStreamEntry
           MAX-ACCESS         not-accessible
           STATUS             current
           DESCRIPTION
              "The applTransactionStreamTable contains common
               information for transaction statistic accumulation."
           ::= { applChannelGroup 4 }

   applTransactionStreamEntry OBJECT-TYPE
           SYNTAX             ApplTransactionStreamEntry
           MAX-ACCESS         not-accessible
           STATUS             current
           DESCRIPTION
              "An applTransactionStreamEntry contains information for
               a single transaction stream.  A transaction stream
               can be a network connection, file, or other source
               of transactions."
           INDEX           { applElmtOrSvc, applElmtOrSvcId,
                             applOpenChannelIndex }
           ::= { applTransactionStreamTable 1 }

   ApplTransactionStreamEntry ::= SEQUENCE {
           applTransactStreamDescr       SnmpAdminString,
           applTransactStreamUnitOfWork  SnmpAdminString,
           applTransactStreamInvokes     Counter64,
           applTransactStreamInvokesLow  Counter32,
           applTransactStreamInvCumTimes Counter32,
           applTransactStreamInvRspTimes Counter32,
           applTransactStreamPerforms    Counter64,
           applTransactStreamPerformsLow Counter32,
           applTransactStreamPrfCumTimes Counter32,
           applTransactStreamPrfRspTimes Counter32 }

   applTransactStreamDescr OBJECT-TYPE
           SYNTAX          SnmpAdminString
           MAX-ACCESS      read-only
           STATUS          current
           DESCRIPTION
              "The applTransactStreamDescr attribute provides a
               human-readable description of this transaction stream.
```

```
            If no descriptive information is available, this
            attribute's value shall be a zero-length string."
        DEFVAL { "" }
        ::= { applTransactionStreamEntry 1 }

   applTransactStreamUnitOfWork OBJECT-TYPE
        SYNTAX              SnmpAdminString
        MAX-ACCESS          read-only
        STATUS              current
        DESCRIPTION
           "The applTransactStreamUnitOfWork attribute provides a
            human-readable definition of what the unit of work is
            for this transaction stream.

            If no descriptive information is available, this
            attribute's value shall be a zero-length string."
        DEFVAL { "" }
        ::= { applTransactionStreamEntry 2 }

   applTransactStreamInvokes OBJECT-TYPE
        SYNTAX              Counter64
        UNITS               "transactions"
        MAX-ACCESS          read-only
        STATUS              current
        DESCRIPTION
           "Cumulative count of requests / invocations issued.

            Discontinuities in this counter can be detected
            by monitoring the corresponding instance of
            applOpenChannelOpenTime."
        ::= { applTransactionStreamEntry 3 }

   applTransactStreamInvokesLow OBJECT-TYPE
        SYNTAX              Counter32
        UNITS               "transactions"
        MAX-ACCESS          read-only
        STATUS              current
        DESCRIPTION
           "This counter corresponds to the low thirty-two
            bits of applTransactStreamInvokes.

            Discontinuities in this counter can be detected
            by monitoring the corresponding instance of
            applOpenChannelOpenTime."
        ::= { applTransactionStreamEntry 4 }
```

```
   applTransactStreamInvCumTimes OBJECT-TYPE
           SYNTAX                Counter32
           UNITS                 "milliseconds"
           MAX-ACCESS            read-only
           STATUS                current
           DESCRIPTION
              "The applTransactStreamInvCumTimes attribute reports the
               cumulative sum of the lengths of the intervals measured
               between the transmission of requests and the receipt of
               (the first of) the corresponding response(s).

               Discontinuities in this counter can be detected
               by monitoring the corresponding instance of
               applOpenChannelOpenTime."
           ::= { applTransactionStreamEntry 5 }

   applTransactStreamInvRspTimes OBJECT-TYPE
           SYNTAX                Counter32
           UNITS                 "milliseconds"
           MAX-ACCESS            read-only
           STATUS                current
           DESCRIPTION
              "The applTransactStreamInvRspTimes attribute reports the
               cumulative sum of the lengths of the intervals measured
               between the receipt of the first and last of multiple
               responses to a request.

               For transaction streams which do not permit multiple
               responses to a single request, this attribute will be
               constant.

               Discontinuities in this counter can be detected
               by monitoring the corresponding instance of
               applOpenChannelOpenTime."
           ::= { applTransactionStreamEntry 6 }

   applTransactStreamPerforms OBJECT-TYPE
           SYNTAX              Counter64
           UNITS               "transactions"
           MAX-ACCESS          read-only
           STATUS              current
           DESCRIPTION
              "Cumulative count of transactions performed.

               Discontinuities in this counter can be detected
               by monitoring the corresponding instance of
               applOpenChannelOpenTime."
           ::= { applTransactionStreamEntry 7 }
```

```
   applTransactStreamPerformsLow OBJECT-TYPE
           SYNTAX                Counter32
           UNITS                 "transactions"
           MAX-ACCESS            read-only
           STATUS                current
           DESCRIPTION
              "This counter reports the low thirty-two bits of
               applTransactStreamPerforms.

               Discontinuities in this counter can be detected
               by monitoring the corresponding instance of
               applOpenChannelOpenTime."
           ::= { applTransactionStreamEntry 8 }

   applTransactStreamPrfCumTimes OBJECT-TYPE
           SYNTAX                Counter32
           UNITS                 "milliseconds"
           MAX-ACCESS            read-only
           STATUS                current
           DESCRIPTION
              "The applTransactStreamPrfCumTimes attribute reports the
               cumulative sum of the interval lengths measured between
               receipt of requests and the transmission of the
               corresponding responses.

               Discontinuities in this counter can be detected
               by monitoring the corresponding instance of
               applOpenChannelOpenTime."
           ::= { applTransactionStreamEntry 9 }

   applTransactStreamPrfRspTimes OBJECT-TYPE
           SYNTAX                Counter32
           UNITS                 "milliseconds"
           MAX-ACCESS            read-only
           STATUS                current
           DESCRIPTION
              "For each transaction performed, the elapsed time between
               when the first response is enqueued and when the last
               response is enqueued is added to this cumulative sum.

               For single-response protocols, the value of
               applTransactStreamPrfRspTimes will be constant.

               Discontinuities in this counter can be detected
               by monitoring the corresponding instance of
               applOpenChannelOpenTime."
           ::= { applTransactionStreamEntry 10 }
```

```
   -- ****************************************************************
   --
   --      applTransactFlowTable
   --
   -- ****************************************************************

   applTransactFlowTable OBJECT-TYPE
           SYNTAX        SEQUENCE OF ApplTransactFlowEntry
           MAX-ACCESS    not-accessible
           STATUS        current
           DESCRIPTION
              "The applTransactFlowTable contains entries, organized by
               application instance or running application element,
               direction of flow, and type (request/response) for each
               open transaction stream.

               The simple model of a transaction used here looks like
               this:

                   invoker   |   Request      | performer
                             | - - - - - - - >|
                             |                |
                             |   Response     |
                             |< - - - - - - - |
                             |                |

               Since in some protocols it is possible for an entity
               to take on both the invoker and performer roles,
               information here is accumulated for transmitted and
               received requests, as well as for transmitted and
               received responses.  Counts are maintained for both
               transactions and bytes transferred."
           ::= { applChannelGroup 5 }

   applTransactFlowEntry OBJECT-TYPE
           SYNTAX        ApplTransactFlowEntry
           MAX-ACCESS    not-accessible
           STATUS        current
           DESCRIPTION
              "An applTransactFlowEntry reports transaction throughput
               information for requests or response in a particular
               direction (transmit / receive) for a transaction stream.

               Entries in this table correspond to those in the
               applTransactionStreamTable with identical values for the
               applElmtOrSvc, applElmtOrSvcId, and applOpenChannelIndex.

               For all counter objects in one of these entries,
```

```
            the corresponding (same value for applElmtOrSvc,
            applElmtOrSvcId, and applOpenChannelIndex)
            applOpenChannelOpenTime object serves as a discontinuity
            indicator.  "
        INDEX           { applElmtOrSvc,
                          applElmtOrSvcId,
                          applOpenChannelIndex,
                          applTransactFlowDirection,
                          applTransactFlowReqRsp }
        ::= { applTransactFlowTable 1 }

   ApplTransactFlowEntry ::= SEQUENCE {
                  applTransactFlowDirection INTEGER,
                  applTransactFlowReqRsp    INTEGER,
                  applTransactFlowTrans     Counter64,
                  applTransactFlowTransLow  Counter32,
                  applTransactFlowBytes     Counter64,
                  applTransactFlowBytesLow  Counter32,
                  applTransactFlowTime      DateAndTime }

   applTransactFlowDirection OBJECT-TYPE
        SYNTAX            INTEGER { transmit(1),
                                    receive(2) }
        MAX-ACCESS        not-accessible
        STATUS            current
        DESCRIPTION
            "The applTransactFlowDirection index serves to identify
             an entry as containing information pertaining to the
             transmit (1) or receive (2) flow of a transaction
             stream."
        ::= { applTransactFlowEntry 1 }

   applTransactFlowReqRsp OBJECT-TYPE
        SYNTAX         INTEGER { request(1),
                                 response(2) }
        MAX-ACCESS     not-accessible
        STATUS         current
        DESCRIPTION
           "The value of the applTransactFlowReqRsp index indicates
            whether this entry contains information on requests
            (1), or responses (2)."
        ::= { applTransactFlowEntry 2 }

   applTransactFlowTrans OBJECT-TYPE
        SYNTAX        Counter64
        UNITS         "transactions"
        MAX-ACCESS    read-only
        STATUS        current
```

```
            DESCRIPTION
                "The applTransactFlowTrans attribute reports the number
                 of request/response transactions (as indicated by
                 the applTransactFlowReqRsp index) received/generated
                 (as indicated by the applTransactFlowDirection index)
                 that this service instance or running application
                 element has processed for this transaction stream.

                 Discontinuities in this counter can be detected
                 by monitoring the corresponding instance of
                 applOpenChannelOpenTime."
            ::= { applTransactFlowEntry 3 }

    applTransactFlowTransLow OBJECT-TYPE
            SYNTAX           Counter32
            UNITS            "transactions"
            MAX-ACCESS       read-only
            STATUS           current
            DESCRIPTION
                "This attribute corresponds to the low thirty-two
                 bits of applTransactFlowTrans.

                 Discontinuities in this counter can be detected
                 by monitoring the corresponding instance of
                 applOpenChannelOpenTime."
            ::= { applTransactFlowEntry 4 }

    applTransactFlowBytes OBJECT-TYPE
            SYNTAX        Counter64
            UNITS         "bytes"
            MAX-ACCESS    read-only
            STATUS        current
            DESCRIPTION
               "The applTransactFlowBytes attribute reports the number
                of request/response (as indicated by the
                applTransactFlowReqRsp index) bytes received/generated
                (as indicated by the applTransactFlowDirection index)
                handled by this application element or service instance
                on this transaction stream.

                All application layer bytes are included in this count,
                including any application layer wrappers, headers, or
                other overhead.

                Discontinuities in this counter can be detected
                by monitoring the corresponding instance of
                applOpenChannelOpenTime."
            ::= { applTransactFlowEntry 5 }
```

```
   applTransactFlowBytesLow OBJECT-TYPE
           SYNTAX           Counter32
           UNITS            "bytes"
           MAX-ACCESS       read-only
           STATUS           current
           DESCRIPTION
              "This attribute corresponds to the low thirty-two
               bits of applTransactFlowBytes.

               Discontinuities in this counter can be detected
               by monitoring the corresponding instance of
               applOpenChannelOpenTime."
           ::= { applTransactFlowEntry 6 }

   applTransactFlowTime OBJECT-TYPE
           SYNTAX       DateAndTime
           MAX-ACCESS   read-only
           STATUS       current
           DESCRIPTION
              "The applTransactFlowTime attribute records the time of
               the processing (receipt or transmission as indicated
               by the applTransactFlowDirection index) by this
               running application element or service instance of
               the most recent request/response (as indicated by
               the applTransactFlowReqRsp index) on this transaction
               stream.

               If no requests/responses been received/transmitted by
               this entity over this transaction stream, the value
               of this attribute shall be '0000000000000000'H "
           DEFVAL { '0000000000000000'H }
           ::= { applTransactFlowEntry 7 }

   -- ****************************************************************
   --
   --      applTransactKindTable - transaction statistics broken down
   --      according to the kinds of transactions in each direction
   --      for a transaction stream.
   --
   -- ****************************************************************

   applTransactKindTable   OBJECT-TYPE
           SYNTAX SEQUENCE OF ApplTransactKindEntry
           MAX-ACCESS      not-accessible
           STATUS          current
```

```
            DESCRIPTION
               "The applTransactKindTable provides transaction statistics
                broken down by kinds of transaction.  The definition of
                the kinds of transactions is specific to the application
                protocol in use, and may be documented in the form of an
                applicability statement.  "
            ::= { applChannelGroup 6 }

   applTransactKindEntry OBJECT-TYPE
            SYNTAX        ApplTransactKindEntry
            MAX-ACCESS    not-accessible
            STATUS        current
            DESCRIPTION
               "An applTransactKindEntry reports information for a
                specific service instance or running application
                element's use of a specific transaction stream in
                a particular direction in requests or responses
                (as indicated by the applTransactFlowReqRsp index)
                broken down by transaction kind, as indicated by the
                applTransactKind index.

                Discontinuities in any of the counters in an entry can
                be detected by monitoring the corresponding instance of
                applOpenChannelOpenTime."

            INDEX           { applElmtOrSvc,
                              applElmtOrSvcId,
                              applOpenChannelIndex,
                              applTransactFlowDirection,
                              applTransactFlowReqRsp,
                              applTransactKind }
            ::= { applTransactKindTable 1 }

   ApplTransactKindEntry ::= SEQUENCE
            {
                    applTransactKind                SnmpAdminString,
                    applTransactKindTrans           Counter64,
                    applTransactKindTransLow        Counter32,
                    applTransactKindBytes           Counter64,
                    applTransactKindBytesLow        Counter32,
                    applTransactKindTime            DateAndTime
            }

   applTransactKind   OBJECT-TYPE
            SYNTAX     SnmpAdminString (SIZE (1 .. 32))
            MAX-ACCESS not-accessible
            STATUS     current
            DESCRIPTION
```

```
            "The applTransactKind index is the human-readable
             identifier for a particular transaction kind within
             the context of an application protocol.  The values
             to be used for a particular protocol may be identified
             in an applicability statement."
         ::= { applTransactKindEntry 1 }

   applTransactKindTrans OBJECT-TYPE
         SYNTAX        Counter64
         UNITS         "transactions"
         MAX-ACCESS    read-only
         STATUS        current
         DESCRIPTION
            "The applTransactKindTrans attribute reports the number
             of request/response (as indicated by the
             applTransactFlowReqRsp index) transactions
             received/generated (as indicated by the
             applTransactFlowDirection index) handled by this
             application instance or application element on this
             transaction stream for this transaction kind.

             Discontinuities in this counter can be detected
             by monitoring the corresponding instance of
             applOpenChannelOpenTime."
         ::= { applTransactKindEntry 2 }

   applTransactKindTransLow OBJECT-TYPE
         SYNTAX           Counter32
         UNITS            "transactions"
         MAX-ACCESS       read-only
         STATUS           current
         DESCRIPTION
            "The applTransactKindTransLow attribute reports
             the low thirty-two bits of applTransactKindTrans.

             Discontinuities in this counter can be detected
             by monitoring the corresponding instance of
             applOpenChannelOpenTime."
         ::= { applTransactKindEntry 3 }

   applTransactKindBytes OBJECT-TYPE
         SYNTAX        Counter64
         UNITS         "bytes"
         MAX-ACCESS    read-only
         STATUS        current
         DESCRIPTION
            "The applTransactKindBytes attribute reports the number
             of request/response (as indicated by the
```

```
                applTransactFlowReqRsp index) bytes received/generated
                (as indicated by the applTransactFlowDirection index)
                handled by this application element on this transaction
                stream for this transaction kind.

                All application layer bytes are included in this count,
                including any application layer wrappers, headers, or
                other overhead.

                Discontinuities in this counter can be detected
                by monitoring the corresponding instance of
                applOpenChannelOpenTime."
            ::= { applTransactKindEntry 4 }

    applTransactKindBytesLow OBJECT-TYPE
            SYNTAX          Counter32
            UNITS           "bytes"
            MAX-ACCESS      read-only
            STATUS          current
            DESCRIPTION
               "The applTransactKindBytesLow attribute corresponds
                to the low thirty-two bits of applTransactKindBytes.

                Discontinuities in this counter can be detected
                by monitoring the corresponding instance of
                applOpenChannelOpenTime."
            ::= { applTransactKindEntry 5 }

    applTransactKindTime OBJECT-TYPE
            SYNTAX      DateAndTime
            MAX-ACCESS  read-only
            STATUS      current
            DESCRIPTION
               "The applTransactKindTime attribute records the time of
                the processing (receipt or transmission as indicated
                by the applTransactFlowDirection index) by this
                running application element or service instance of
                the most recent request/response (as indicated by
                the applTransactFlowReqRsp index) of this kind of
                transaction on this transaction stream.

                If no requests/responses of this kind been
                received/transmitted by this running application element
                or service instance over this transaction stream, the
                value of this attribute shall be '0000000000000000'H "
            DEFVAL { '0000000000000000'H }
            ::= { applTransactKindEntry 6 }
```

```
   -- ************************************************************
   --
   --      applPastChannelGroup - logged information on former channels.
   --      These tables control the collection of channel history
   --      information and represent the accumulated historical data.
   --
   -- ************************************************************

   applPastChannelControlTable OBJECT-TYPE
           SYNTAX           SEQUENCE OF ApplPastChannelControlEntry
           MAX-ACCESS       not-accessible
           STATUS           current
           DESCRIPTION
              "The applPastChannelControlTable controls the
               accumulation of history information about channels
               from the perspective of service instances and running
               application elements.  Entries in this table are indexed
               by applElmtOrSvc and applElmtOrSvcId, giving control
               of channel history accumulation at the level of each
               service instance and running application element."
           ::= { applPastChannelGroup 1 }

   applPastChannelControlEntry OBJECT-TYPE
           SYNTAX           ApplPastChannelControlEntry
           MAX-ACCESS       not-accessible
           STATUS           current
           DESCRIPTION
              "An applPastChannelControlEntry provides the ability
               to control the retention of channel history information
               by service instances and running application elements."
           INDEX          { applElmtOrSvc, applElmtOrSvcId }
           ::= { applPastChannelControlTable 1 }

   ApplPastChannelControlEntry  ::= SEQUENCE
           {
                   applPastChannelControlCollect   INTEGER,
                   applPastChannelControlMaxRows   Unsigned32,
                   applPastChannelControlTimeLimit Unsigned32,
                   applPastChannelControlRemItems  Counter32
           }

   applPastChannelControlCollect OBJECT-TYPE
           SYNTAX             INTEGER { enabled (1),
                                        frozen (2),
                                        disabled (3) }
           MAX-ACCESS         read-write
           STATUS             current
           DESCRIPTION
```

```
            "When the value of applPastChannelControlCollect is
             'enabled', each time the corresponding running
             application element or service instance closes
             an open channel a new entry will be added to the
             applPastChannelTable.

             When the value of applPastChannelControlCollect
             is 'frozen', no new entries are added to the
             applPastChannelTable for this running application
             element or service instance, and old entries are not
             aged out.

             When the value of applPastChannelControlCollect
             is 'disabled', all entries are removed from
             applPastChannelTable for this running application or
             service instance, and no new entries are added."
         DEFVAL { enabled }
         ::= { applPastChannelControlEntry 1 }

   applPastChannelControlMaxRows OBJECT-TYPE
         SYNTAX             Unsigned32
         UNITS              "channel history entries"
         MAX-ACCESS         read-write
         STATUS             current
         DESCRIPTION
            "The maximum number of entries allowed in the
             applPastChannelTable for this running application element
             or service instance.  Once the number of rows for this
             running application element or service instance in the
             applPastChannelTable reaches this value, when new
             entries are to be added the management subsystem will
             make room for them by removing the oldest entries.
             Entries will be removed on the basis of oldest
             applPastChannelCloseTime value first."
         DEFVAL          { 500 }
         ::= { applPastChannelControlEntry 2 }

   applPastChannelControlTimeLimit OBJECT-TYPE
         SYNTAX               Unsigned32
         UNITS                "seconds"
         MAX-ACCESS           read-write
         STATUS               current
         DESCRIPTION
            "The maximum time in seconds which an entry for this
             running application element or service instance
             may exist in the applPastChannelTable before it
             is removed.  Any entry that is older than this value
             will be removed (aged out) from the table, unless the
```

```
                applPastChannelControlCollect is set to 'frozen'.

                Note that an entry may be aged out prior to reaching
                this time limit if it is the oldest entry in the table
                and must be removed to make space for a new entry so
                as to not exceed applPastChannelControlMaxRows, or if the
                applPastChannelControlCollect is set to 'disabled'."
            DEFVAL          { 7200 }
            ::= { applPastChannelControlEntry 3 }

    applPastChannelControlRemItems OBJECT-TYPE
            SYNTAX              Counter32
            UNITS               "channel history entries"
            MAX-ACCESS          read-only
            STATUS              current
            DESCRIPTION
               "The applPastChannelControlRemItems attribute reports the
                number of applPastChannelControlTable entries for this
                running application element or service instance that
                were deleted in order to make room for new history
                entries.

                This count does NOT include entries deleted for the
                following reasons:
                    - the corresponding applPastChannelControlCollect
                      attribute has been set to 'disabled'

                    - the entry has been in the table longer that the
                      time limit indicated by the corresponding
                      applPastChannelControlTimeLimit.
              "
            ::= { applPastChannelControlEntry 4 }


    -- ****************************************************************
    --
    --      applPastChannelTable - Table of former channels
    --
    -- ****************************************************************

    applPastChannelTable   OBJECT-TYPE
            SYNTAX          SEQUENCE OF ApplPastChannelEntry
            MAX-ACCESS    not-accessible
            STATUS        current
            DESCRIPTION
               "The applPastChannelTable provides history information
                about channels from the perspective of running
                application elements and service instances.
```

```
            Entries in this table are indexed by applElmtOrSvc,
            applElmtOrSvcId, and by applPastChannelIndex, which
            serves to uniquely identify each former channel in the
            context of a running application element or service
            instance.

            Note that the value of applPastChannelIndex is
            independent of the value applOpenChannelIndex had when
            this channel was open.

            Entries for closed channels for a given running
            application element or service instance can
            be added to this table only if its entry in the
            applPastChannelControlTable has the value 'enabled'
            for the attribute applPastChannelControlCollect.

            Entries for closed channels are removed under the
            following circumstances:

                - the running application element or service
                  instance no longer exists

                - the corresponding applPastChannelControlCollect
                  attribute has been set to 'disabled'

                - the entry has been in the table longer that the
                  time limit indicated by the corresponding
                  applPastChannelControlTimeLimit and the value of
                  applPastChannelControlCollect is not 'frozen'

                - this is the oldest entry for the running
                  application element or service instance in
                  question and the addition of a new element would
                  otherwise cause applPastChannelControlMaxRows to
                  be exceeded for this running application element
                  or service instance.

                - a value of applPastChannelIndex has been re-used.
                  Note that under normal circumstances, this is
                  unlikely.

            Removal/replacement of an entry under the
            last two conditions causes the corresponding
            applPastChannelControlRemItems to be incremented."
        ::= { applPastChannelGroup 2 }
```

```
   applPastChannelEntry   OBJECT-TYPE
           SYNTAX         ApplPastChannelEntry
           MAX-ACCESS     not-accessible
           STATUS         current
           DESCRIPTION
             "An applPastChannelEntry indicates that a running
              application element or service instance once had an open
              channel, which is now closed.  The entry has information
              describing that channel."
           INDEX       { applElmtOrSvc, applElmtOrSvcId,
                         applPastChannelIndex }
           ::= { applPastChannelTable 1 }

   ApplPastChannelEntry  ::= SEQUENCE
           {
                   applPastChannelIndex           Unsigned32,
                   applPastChannelOpenTime        DateAndTime,
                   applPastChannelCloseTime       DateAndTime,
                   applPastChannelReadRequests    Unsigned64TC,
                   applPastChannelReadReqsLow     Unsigned32,
                   applPastChannelReadFailures    Unsigned32,
                   applPastChannelBytesRead       Unsigned64TC,
                   applPastChannelBytesReadLow    Unsigned32,
                   applPastChannelLastReadTime    DateAndTime,
                   applPastChannelWriteRequests   Unsigned64TC,
                   applPastChannelWriteReqsLow    Unsigned32,
                   applPastChannelWriteFailures   Unsigned32,
                   applPastChannelBytesWritten    Unsigned64TC,
                   applPastChannelBytesWritLow    Unsigned32,
                   applPastChannelLastWriteTime   DateAndTime
           }

   applPastChannelIndex      OBJECT-TYPE
           SYNTAX            Unsigned32 (1..'ffffffff'h)
           MAX-ACCESS        not-accessible
           STATUS            current
           DESCRIPTION
              "This attribute serves to uniquely identify this closed
               channel in the context of the running application
               element or service instance.  This attribute has no
               other semantics.

               Note that the value of applPastChannelIndex is
               independent of the value applOpenChannelIndex had when
               this channel was active.

               In issuing this index value, the implementation must
               avoid re-issuing an index value which has already been
```

```
                assigned to an entry which has not yet been deleted due
                to age or space considerations.

                The value zero is excluded from the set of permitted
                values for this index in order to permit other tables to
                possibly represent information that cannot be associated
                with a specific entry in this table.  "
            ::= { applPastChannelEntry 1 }

    applPastChannelOpenTime OBJECT-TYPE
            SYNTAX          DateAndTime
            MAX-ACCESS      read-only
            STATUS          current
            DESCRIPTION
               "This attribute records the time when this channel was
                originally opened.  Note that this information is quite
                different from applOpenChannelOpenTime, which is used
                for the detection of counter discontinuities."
            ::= { applPastChannelEntry 2 }

    applPastChannelCloseTime OBJECT-TYPE
            SYNTAX           DateAndTime
            MAX-ACCESS       read-only
            STATUS           current
            DESCRIPTION
               "This attribute records the time when this channel
                was closed."
            ::= { applPastChannelEntry 3 }

    applPastChannelReadRequests OBJECT-TYPE
            SYNTAX              Unsigned64TC
            UNITS               "read requests"
            MAX-ACCESS          read-only
            STATUS              current
            DESCRIPTION
               "This attribute records the number of read requests for
                this channel made by this running application element or
                service instance.  All read requests for this channel by
                this running application element or service instance,
                regardless of completion status, are included in this
                count.  Read requests are counted in terms of system
                calls, rather than API calls."

            ::= { applPastChannelEntry 4 }
```

```
   applPastChannelReadReqsLow OBJECT-TYPE
           SYNTAX             Unsigned32
           UNITS              "read requests"
           MAX-ACCESS         read-only
           STATUS             current
           DESCRIPTION
              "This attribute corresponds to the low thirty-two bits
               of applPastChannelReadRequests."
           ::= { applPastChannelEntry 5 }

   applPastChannelReadFailures OBJECT-TYPE
           SYNTAX              Unsigned32
           UNITS               "failed read requests"
           MAX-ACCESS          read-only
           STATUS              current
           DESCRIPTION
              "This attribute reports the number of failed read
               requests."
           ::= { applPastChannelEntry 6 }

   applPastChannelBytesRead OBJECT-TYPE
           SYNTAX           Unsigned64TC
           UNITS            "bytes"
           MAX-ACCESS       read-only
           STATUS           current
           DESCRIPTION
              "This attribute reports the number of bytes read from this
               channel by this running application element or service
               instance.  Only bytes successfully read are included in
               this count. "
           ::= { applPastChannelEntry 7 }

   applPastChannelBytesReadLow OBJECT-TYPE
           SYNTAX              Unsigned32
           UNITS               "bytes"
           MAX-ACCESS          read-only
           STATUS              current
           DESCRIPTION
              "This attribute corresponds to the low thirty-two bits
               of applPastChannelBytesRead."
           ::= { applPastChannelEntry 8 }

   applPastChannelLastReadTime OBJECT-TYPE
           SYNTAX              DateAndTime
           MAX-ACCESS          read-only
           STATUS              current
```

```
            DESCRIPTION
               "This attribute reports the time of the most recent read
                request made by this running application element or
                service instance regardless of completion status, for
                this former channel.

                If no read requests have been made , the value of this
                attribute shall be '0000000000000000'H "
            DEFVAL { '0000000000000000'H }
            ::= { applPastChannelEntry 9 }

   applPastChannelWriteRequests OBJECT-TYPE
            SYNTAX               Unsigned64TC
            UNITS                "write requests"
            MAX-ACCESS           read-only
            STATUS               current
            DESCRIPTION
               "The applPastChannelWriteRequests attribute reports
                the number of write requests, regardless of completion
                status, made by this running application element or
                service instance for this former channel.

                Write requests are counted in terms of system calls,
                rather than API calls."
            ::= { applPastChannelEntry 10 }

   applPastChannelWriteReqsLow OBJECT-TYPE
            SYNTAX              Unsigned32
            UNITS               "write requests"
            MAX-ACCESS          read-only
            STATUS              current
            DESCRIPTION
               "This attribute corresponds to the low thirty-two
                bits of applPastChannelWriteRequests."
            ::= { applPastChannelEntry 11 }

   applPastChannelWriteFailures OBJECT-TYPE
            SYNTAX               Unsigned32
            UNITS                "failed write requests"
            MAX-ACCESS           read-only
            STATUS               current
            DESCRIPTION
               "This attribute reports the number of failed write
                requests."
            ::= { applPastChannelEntry 12 }
```

```
   applPastChannelBytesWritten OBJECT-TYPE
           SYNTAX              Unsigned64TC
           UNITS               "bytes"
           MAX-ACCESS          read-only
           STATUS              current
           DESCRIPTION
              "This attribute reports the number of bytes written to
               this former channel by this running application element
               or service instance.  Only bytes successfully written
               (no errors reported by the API in use by the application)
               are included in this count."
           ::= { applPastChannelEntry 13 }

   applPastChannelBytesWritLow OBJECT-TYPE
           SYNTAX              Unsigned32
           UNITS               "bytes"
           MAX-ACCESS          read-only
           STATUS              current
           DESCRIPTION
              "This attribute corresponds to the low thirty-two bits of
               applPastChannelBytesWritten."
           ::= { applPastChannelEntry 14 }

   applPastChannelLastWriteTime OBJECT-TYPE
           SYNTAX               DateAndTime
           MAX-ACCESS           read-only
           STATUS               current
           DESCRIPTION
              "The applPastChannelLastWriteTime attribute reports
               the time of the most recent write request made by
               this running application element or service instance,
               regardless of completion status, for this former
               channel.

               If no write requests have been made the value of this
               attribute shall be '0000000000000000'H "
           DEFVAL { '0000000000000000'H }
           ::= { applPastChannelEntry 15 }

   -- ************************************************************
   --
   --      applPastFileTable - information specific to former files
   --
   -- ************************************************************
```

```
   applPastFileTable  OBJECT-TYPE
           SYNTAX     SEQUENCE OF ApplPastFileEntry
           MAX-ACCESS not-accessible
           STATUS     current
           DESCRIPTION
              "The applPastFileTable supplements the
               applPastChannelTable for entries corresponding to
               channels which were files.  The indexing structure is
               identical to applPastChannelTable.  An entry exists in
               the applPastFileTable only if there is a corresponding
               (same index values) entry in the applPastChannelTable
               and if the channel was a file.

               Entries for closed files are removed when the
               corresponding entries are removed from the
               applPastChannelTable."
           ::= { applPastChannelGroup 3 }

   applPastFileEntry   OBJECT-TYPE
           SYNTAX      ApplPastFileEntry
           MAX-ACCESS  not-accessible
           STATUS      current
           DESCRIPTION
             "An applPastFileEntry provides additional, file-specific
              information to complement the corresponding
              applPastChannelEntry for a channel which was a file."
           INDEX       { applElmtOrSvc, applElmtOrSvcId,
                         applPastChannelIndex }
           ::= { applPastFileTable 1 }

   ApplPastFileEntry ::= SEQUENCE
           {
                   applPastFileName                LongUtf8String,
                   applPastFileSizeHigh            Unsigned32,
                   applPastFileSizeLow             Unsigned32,
                   applPastFileMode                INTEGER
           }


   applPastFileName   OBJECT-TYPE
           SYNTAX     LongUtf8String
           MAX-ACCESS read-only
           STATUS     current
           DESCRIPTION
             "This attribute records the last known value of
              applOpenFileName before the channel was closed."
           ::= { applPastFileEntry 1 }
```

```
   applPastFileSizeHigh OBJECT-TYPE
           SYNTAX       Unsigned32
           UNITS        "2^32 byte blocks"
           MAX-ACCESS   read-only
           STATUS       current
           DESCRIPTION
             "This attribute records the value of applOpenFileSizeHigh
              at the time this channel was closed.

              For example, for a file with a total size of
              4,294,967,296 bytes, this attribute would have a value
              of 1; for a file with a total size of 4,294,967,295
              bytes this attribute's value would be 0."
           ::= { applPastFileEntry 2 }

   applPastFileSizeLow OBJECT-TYPE
           SYNTAX      Unsigned32
           UNITS       "bytes"
           MAX-ACCESS  read-only
           STATUS      current
           DESCRIPTION
              "This attribute records the value of applOpenFileSizeLow
               at the time this channel was closed.

               For example, for a file with a total size of
               4,294,967,296 bytes this attribute would have a value
               of 0; for a file with a total size of 4,294,967,295
               bytes this attribute's value would be 4,294,967,295."
           ::= { applPastFileEntry 3 }

   applPastFileMode   OBJECT-TYPE
           SYNTAX     INTEGER { read(1),
                                write(2),
                                readWrite(3) }
           MAX-ACCESS read-only
           STATUS     current
           DESCRIPTION
              "This attribute records the value of applOpenFileMode
               at the time this channel was closed.  "
           ::= { applPastFileEntry 4 }

   -- ****************************************************************
   --
   --      applPastConTable - information specific to former connections
   --
   -- ****************************************************************
```

```
   applPastConTable OBJECT-TYPE
           SYNTAX    SEQUENCE OF ApplPastConEntry
           MAX-ACCESS not-accessible
           STATUS     current
           DESCRIPTION
              "The applPastConTable supplements the applPastChannelTable
               for entries corresponding to channels which were
               connections.  The indexing structure is identical
               to applPastChannelTable.  An entry exists in the
               applPastConTable only if there is a corresponding
               (same index values) entry in the applPastChannelTable
               and if the channel was a connection.

               Entries for closed connections are removed when
               the corresponding entries are removed from the
               applPastChannelTable."
           ::= { applPastChannelGroup 4 }

   applPastConEntry   OBJECT-TYPE
           SYNTAX      ApplPastConEntry
           MAX-ACCESS  not-accessible
           STATUS      current
           DESCRIPTION
             "An applPastConEntry provides additional,
              connection-specific information to complement the
              corresponding applPastChannelEntry for a channel which
              was a connection."
           INDEX       { applElmtOrSvc, applElmtOrSvcId,
                         applPastChannelIndex }
           ::= { applPastConTable 1 }

   ApplPastConEntry ::= SEQUENCE
           {
                   applPastConTransport       TDomain,
                   applPastConNearEndAddr     ApplTAddress,
                   applPastConNearEndpoint    SnmpAdminString,
                   applPastConFarEndAddr      ApplTAddress,
                   applPastConFarEndpoint     SnmpAdminString,
                   applPastConApplication     SnmpAdminString
           }

   applPastConTransport OBJECT-TYPE
           SYNTAX       TDomain
           MAX-ACCESS   read-only
           STATUS       current
```

```
            DESCRIPTION
               "The applPastConTransport attribute identifies the
                transport protocol that was in use for this former
                connection.  If the transport protocol could not be
                determined, the value { 0 0 } shall be used."
            DEFVAL { zeroDotZero }
            ::= { applPastConEntry 1 }

   applPastConNearEndAddr OBJECT-TYPE
            SYNTAX         ApplTAddress
            MAX-ACCESS     read-only
            STATUS         current
            DESCRIPTION
               "The applPastConNearEndAddr attribute reports the
                transport address and port information for the near
                end of this former connection.

                If the information could not be determined, the value
                shall be a zero-length string."
            DEFVAL { "" }
            ::= { applPastConEntry 2 }

   applPastConNearEndpoint OBJECT-TYPE
            SYNTAX          SnmpAdminString
            MAX-ACCESS      read-only
            STATUS          current
            DESCRIPTION
               "The applPastConNearEndpoint attribute reports the
                fully-qualified domain name and port information for the
                near end of this former connection.

                The format of this attribute for TCP and UDP-based
                protocols is the fully-qualified domain name immediately
                followed by a colon which is immediately followed by
                the decimal representation of the port number.

                If the information could not be determined, the value
                shall be a zero-length string."
            DEFVAL { "" }
            ::= { applPastConEntry 3 }

   applPastConFarEndAddr OBJECT-TYPE
            SYNTAX        ApplTAddress
            MAX-ACCESS    read-only
            STATUS        current
            DESCRIPTION
               "The applPastConFarEnd attribute reports the transport
                address and port information for the far end of this
```

```
                former connection.

                If not known, as in the case of a connectionless
                transport, the value of this attribute shall be a
                zero-length string."
            DEFVAL { "" }
            ::= { applPastConEntry 4 }

    applPastConFarEndpoint OBJECT-TYPE
            SYNTAX        SnmpAdminString
            MAX-ACCESS    read-only
            STATUS        current
            DESCRIPTION
               "The applPastConFarEndpoint attribute reports the
                transport address and port information for the far
                end of this former connection.

                The format of this attribute for TCP and UDP-based
                protocols is the fully-qualified domain name immediately
                followed by a colon which is immediately followed by
                the decimal representation of the port number.

                If not known, as in the case of a connectionless
                transport, the value of this attribute shall be a
                zero-length string."
            DEFVAL { "" }
            ::= { applPastConEntry 5 }

    applPastConApplication OBJECT-TYPE
            SYNTAX         SnmpAdminString
            MAX-ACCESS     read-only
            STATUS         current
            DESCRIPTION
               "The applPastConApplication attribute identifies the
                application layer protocol that was in use.  Where
                possible, the values defined in [13] shall be used.
                If not known, the value of this attribute shall be a
                zero-length string."
            DEFVAL { "" }
            ::= { applPastConEntry 6 }


    -- ************************************************************
    --
    --      applPastTransStreamTable - historical
    --      information for transaction stream monitoring
    --
    -- ************************************************************
```

```
   applPastTransStreamTable OBJECT-TYPE
           SYNTAX             SEQUENCE OF ApplPastTransStreamEntry
           MAX-ACCESS         not-accessible
           STATUS             current
           DESCRIPTION
              "The applPastTransStreamTable contains common
               information for historical transaction statistics."
           ::= { applPastChannelGroup 5 }

   applPastTransStreamEntry OBJECT-TYPE
           SYNTAX             ApplPastTransStreamEntry
           MAX-ACCESS         not-accessible
           STATUS             current
           DESCRIPTION
              "An applPastTransStreamEntry contains information for
               a single former transaction stream.  A transaction
               stream could have been a network connection, file, or
               other source of transactions."
           INDEX           { applElmtOrSvc, applElmtOrSvcId,
                             applPastChannelIndex }
           ::= { applPastTransStreamTable 1 }

   ApplPastTransStreamEntry ::= SEQUENCE {
           applPastTransStreamDescr        SnmpAdminString,
           applPastTransStreamUnitOfWork   SnmpAdminString,
           applPastTransStreamInvokes      Unsigned64TC,
           applPastTransStreamInvokesLow   Unsigned32,
           applPastTransStreamInvCumTimes  Unsigned32,
           applPastTransStreamInvRspTimes  Unsigned32,
           applPastTransStreamPerforms     Unsigned64TC,
           applPastTransStreamPerformsLow  Unsigned32,
           applPastTransStreamPrfCumTimes  Unsigned32,
           applPastTransStreamPrfRspTimes  Unsigned32 }
   applPastTransStreamDescr OBJECT-TYPE
           SYNTAX          SnmpAdminString
           MAX-ACCESS      read-only
           STATUS          current
           DESCRIPTION
              "The applPastTransStreamDescr attribute provides a
               human-readable description of this transaction stream.

               If no descriptive information is available, this
               attribute's value shall be a zero-length string."
           DEFVAL { "" }
           ::= { applPastTransStreamEntry 1 }
```

```
   applPastTransStreamUnitOfWork OBJECT-TYPE
           SYNTAX               SnmpAdminString
           MAX-ACCESS           read-only
           STATUS               current
           DESCRIPTION
              "The applPastTransStreamUnitOfWork attribute provides a
               human-readable definition of what the unit of work is
               for this transaction stream.

               If no descriptive information is available, this
               attribute's value shall be a zero-length string."
           DEFVAL { "" }
           ::= { applPastTransStreamEntry 2 }

   applPastTransStreamInvokes OBJECT-TYPE
           SYNTAX            Unsigned64TC
           UNITS             "transactions"
           MAX-ACCESS        read-only
           STATUS            current
           DESCRIPTION
              "Cumulative count of requests / invocations issued
               for this transaction stream when it was active."
           ::= { applPastTransStreamEntry 3 }

   applPastTransStreamInvokesLow OBJECT-TYPE
           SYNTAX               Unsigned32
           UNITS                "transactions"
           MAX-ACCESS           read-only
           STATUS               current
           DESCRIPTION
              "This object corresponds to the low thirty-two
               bits of applPastTransStreamInvokes."
           ::= { applPastTransStreamEntry 4 }

   applPastTransStreamInvCumTimes OBJECT-TYPE
           SYNTAX                Unsigned32
           UNITS                 "milliseconds"
           MAX-ACCESS            read-only
           STATUS                current
           DESCRIPTION
              "The applPastTransStreamInvCumTimes attribute reports the
               cumulative sum of the lengths of the intervals times
               measured between the transmission of requests and the
               receipt of (the first of) the corresponding response(s)."
           ::= { applPastTransStreamEntry 5 }
```

```
   applPastTransStreamInvRspTimes OBJECT-TYPE
           SYNTAX                Unsigned32
           UNITS                 "milliseconds"
           MAX-ACCESS            read-only
           STATUS                current
           DESCRIPTION
              "The applPastTransStreamInvRspTimes attribute reports the
               cumulative sum of the lengths of the intervals measured
               between the receipt of the first and last of multiple
               responses to a request.

               For transaction streams which do not permit multiple
               responses to a single request, this attribute will be
               zero."
           ::= { applPastTransStreamEntry 6 }

   applPastTransStreamPerforms OBJECT-TYPE
           SYNTAX              Unsigned64TC
           UNITS               "transactions"
           MAX-ACCESS          read-only
           STATUS              current
           DESCRIPTION
              "Total number of transactions performed."
           ::= { applPastTransStreamEntry 7 }

   applPastTransStreamPerformsLow OBJECT-TYPE
           SYNTAX                Unsigned32
           UNITS                 "transactions"
           MAX-ACCESS            read-only
           STATUS                current
           DESCRIPTION
              "This objecy reports the low thirty-two bits of
               applPastTransStreamPerforms."
           ::= { applPastTransStreamEntry 8 }

   applPastTransStreamPrfCumTimes OBJECT-TYPE
           SYNTAX                Unsigned32
           UNITS                 "milliseconds"
           MAX-ACCESS            read-only
           STATUS                current
           DESCRIPTION
              "The applPastTransStreamPrfCumTimes attribute reports the
               cumulative sum of the lengths of the intervals measured
               between receipt of requests and the transmission of the
               corresponding responses."
           ::= { applPastTransStreamEntry 9 }
```

```
   applPastTransStreamPrfRspTimes OBJECT-TYPE
           SYNTAX                 Unsigned32
           UNITS                  "milliseconds"
           MAX-ACCESS             read-only
           STATUS                 current
           DESCRIPTION
              "For each transaction performed, the elapsed time between
               when the first response is enqueued and when the last
               response is enqueued is added to this cumulative sum.

               For single-response protocols, the value of
               applPastTransStreamPrfRspTimes will be zero."
           ::= { applPastTransStreamEntry 10 }


   -- ************************************************************
   --
   --      applPastTransFlowTable
   --
   -- ************************************************************

   applPastTransFlowTable OBJECT-TYPE
           SYNTAX        SEQUENCE OF ApplPastTransFlowEntry
           MAX-ACCESS    not-accessible
           STATUS        current
           DESCRIPTION
              "The applPastTransFlowTable contains entries, organized by
               application instance or running application element,
               direction of flow, and type (request/response) for each
               former transaction stream.

               The simple model of a transaction used here looks like
               this:

                   invoker  |   Request     | performer
                            | - - - - - - > |
                            |               |
                            |   Response    |
                            | < - - - - - - |
                            |               |

               Since in some protocols it is possible for an entity
               to take on both the invoker and performer roles,
               information here is accumulated for transmitted and
               received requests, as well as for transmitted and
               received responses.  Counts are maintained for both
               transactions and bytes transferred."
           ::= { applPastChannelGroup 6 }
```

```
   applPastTransFlowEntry OBJECT-TYPE
           SYNTAX        ApplPastTransFlowEntry
           MAX-ACCESS    not-accessible
           STATUS        current
           DESCRIPTION
              "An applPastTransFlowEntry records transaction throughput
               information for requests or response in a particular
               direction (transmit / receive) for a transaction stream.

               Entries in this table correspond to those in the
               applPastTransStreamTable with identical values
               for the applElmtOrSvc, applElmtOrSvcId, and the
               applPastChannelIndex."
           INDEX           { applElmtOrSvc,
                             applElmtOrSvcId,
                             applPastChannelIndex,
                             applPastTransFlowDirection,
                             applPastTransFlowReqRsp }
           ::= { applPastTransFlowTable 1 }

   ApplPastTransFlowEntry ::= SEQUENCE {
                   applPastTransFlowDirection INTEGER,
                   applPastTransFlowReqRsp    INTEGER,
                   applPastTransFlowTrans     Unsigned64TC,
                   applPastTransFlowTransLow  Unsigned32,
                   applPastTransFlowBytes     Unsigned64TC,
                   applPastTransFlowBytesLow  Unsigned32,
                   applPastTransFlowTime      DateAndTime }

   applPastTransFlowDirection OBJECT-TYPE
           SYNTAX              INTEGER { transmit(1),
                                         receive(2) }
           MAX-ACCESS          not-accessible
           STATUS              current
           DESCRIPTION
               "The applPastTransFlowDirection index serves
                to identify an entry as containing information
                pertaining to the transmit (1) or receive (2) flow
                of a past transaction stream.  This index corresponds
                to applTransactFlowDirection."
           ::= { applPastTransFlowEntry 1 }

   applPastTransFlowReqRsp OBJECT-TYPE
           SYNTAX          INTEGER { request(1),
                                     response(2) }
           MAX-ACCESS      not-accessible
           STATUS          current
           DESCRIPTION
```

```
            "The value of the applPastTransFlowReqRsp index indicates
             whether this entry contains information on requests
             (1), or responses (2).  This index corresponds to
             applTransactFlowReqRsp."
         ::= { applPastTransFlowEntry 2 }

   applPastTransFlowTrans OBJECT-TYPE
         SYNTAX        Unsigned64TC
         UNITS         "transactions"
         MAX-ACCESS    read-only
         STATUS        current
         DESCRIPTION
             "The applPastTransFlowTrans attribute reports the number
              of request/response (as indicated by the
              applPastTransFlowReqRsp index) transactions
              received/generated (as indicated by the
              applPastTransFlowDirection index) handled on this
              transaction stream."
         ::= { applPastTransFlowEntry 3 }

   applPastTransFlowTransLow OBJECT-TYPE
         SYNTAX           Unsigned32
         UNITS            "transactions"
         MAX-ACCESS       read-only
         STATUS           current
         DESCRIPTION
             "This attribute corresponds to the low thirty-two
              bits of applPastTransFlowTrans."
         ::= { applPastTransFlowEntry 4 }

   applPastTransFlowBytes OBJECT-TYPE
         SYNTAX        Unsigned64TC
         UNITS         "bytes"
         MAX-ACCESS    read-only
         STATUS        current
         DESCRIPTION
            "The applPastTransFlowBytes attribute reports the number
             of request/response (as indicated by the
             applPastTransFlowReqRsp index) bytes received/generated
             (as indicated by the applPastTransFlowDirection index)
             handled on this transaction stream.

             All application layer bytes are included in this count,
             including any application layer wrappers, headers, or
             other overhead."
         ::= { applPastTransFlowEntry 5 }
```

```
   applPastTransFlowBytesLow OBJECT-TYPE
           SYNTAX           Unsigned32
           UNITS            "bytes"
           MAX-ACCESS       read-only
           STATUS           current
           DESCRIPTION
              "This attribute corresponds to the low thirty-two
               bits of applPastTransFlowBytes."
           ::= { applPastTransFlowEntry 6 }

   applPastTransFlowTime OBJECT-TYPE
           SYNTAX       DateAndTime
           MAX-ACCESS   read-only
           STATUS       current
           DESCRIPTION
              "The applPastTransFlowTime attribute records the time of
               the processing (receipt or transmission as
               indicated by the applPastTransFlowDirection index)
               of the last request/response (as indicated by the
               applPastTransFlowReqRsp index) on this transaction
               stream.

               If no requests/responses been received/transmitted by
               this entity over this transaction stream, the value
               of this attribute shall be '0000000000000000'H "
           DEFVAL { '0000000000000000'H }
           ::= { applPastTransFlowEntry 7 }

   -- ****************************************************************
   --
   --      applPastTransKindTable - transaction statistics broken down
   --      according to the kinds of transactions in each direction
   --      for a transaction stream.
   --
   -- ****************************************************************

   applPastTransKindTable   OBJECT-TYPE
           SYNTAX SEQUENCE OF ApplPastTransKindEntry
           MAX-ACCESS      not-accessible
           STATUS          current
           DESCRIPTION
              "The applPastTransKindTable provides transaction
               statistics broken down by kinds of transaction.
               The definition of the kinds of transactions is
               specific to the application protocol in use, and may be
               documented in the form of an applicability statement.  "
           ::= { applPastChannelGroup 7 }
```

```
   applPastTransKindEntry OBJECT-TYPE
           SYNTAX        ApplPastTransKindEntry
           MAX-ACCESS    not-accessible
           STATUS        current
           DESCRIPTION
              "An applPastTransKindEntry reports historical data for a
               specific service instance or running application
               element's use of a specific transaction stream in
               a particular direction in requests or responses
               (as indicated by the applPastTransFlowReqRsp index)
               broken down by transaction kind, as indicated by the
               applPastTransKind index."
           INDEX           { applElmtOrSvc,
                             applElmtOrSvcId,
                             applPastChannelIndex,
                             applPastTransFlowDirection,
                             applPastTransFlowReqRsp,
                             applPastTransKind }
           ::= { applPastTransKindTable 1 }

   ApplPastTransKindEntry ::= SEQUENCE
           {
                   applPastTransKind               SnmpAdminString,
                   applPastTransKindTrans          Unsigned64TC,
                   applPastTransKindTransLow       Unsigned32,
                   applPastTransKindBytes          Unsigned64TC,
                   applPastTransKindBytesLow       Unsigned32,
                   applPastTransKindTime           DateAndTime
           }

   applPastTransKind   OBJECT-TYPE
           SYNTAX      SnmpAdminString (SIZE (1 .. 32))
           MAX-ACCESS  not-accessible
           STATUS      current
           DESCRIPTION
              "The applPastTransKind index is the human-readable
               identifier for a particular transaction kind within
               the context of an application protocol.  The values
               to be used for a particular protocol may be identified
               in an applicability statement.  This index corresponds
               to applTransactKind."
           ::= { applPastTransKindEntry 1 }

   applPastTransKindTrans OBJECT-TYPE
           SYNTAX        Unsigned64TC
           UNITS         "transactions"
           MAX-ACCESS    read-only
           STATUS        current
```

```
            DESCRIPTION
               "For this transaction stream, this attribute records
                the total number of transactions of the type
                identified by the indexes.  The type is characterized
                according to the receive/transmit direction
                (applPastTransFlowDirecton), whether it was a request
                or a response (applPastTransFlowReqRsp), and the
                protocol-specific transaction kind (applPastTransKind).
                stream for this transaction kind."
            ::= { applPastTransKindEntry 2 }

    applPastTransKindTransLow OBJECT-TYPE
            SYNTAX           Unsigned32
            UNITS            "transactions"
            MAX-ACCESS       read-only
            STATUS           current
            DESCRIPTION
               "The applPastTransKindTransLow attribute reports
                the low thirty-two bits of applPastTransKindTrans."
            ::= { applPastTransKindEntry 3 }

    applPastTransKindBytes OBJECT-TYPE
            SYNTAX        Unsigned64TC
            UNITS         "bytes"
            MAX-ACCESS    read-only
            STATUS        current
            DESCRIPTION
               "For this transaction stream and transaction kind, the
                applPastTransKindBytes attribute reports the number
                of bytes received or generated (as indicated by
                the applPastTransFlowDirection index) in requests or
                responses (as indicated by the applPastTransFlowReqRsp
                index).

                All application layer bytes are included in this count,
                including any application layer wrappers, headers, or
                other overhead."
            ::= { applPastTransKindEntry 4 }

    applPastTransKindBytesLow OBJECT-TYPE
            SYNTAX           Unsigned32
            UNITS            "bytes"
            MAX-ACCESS       read-only
            STATUS           current
            DESCRIPTION
               "The applPastTransKindBytesLow attribute corresponds
                to the low thirty-two bits of applPastTransKindBytes."
            ::= { applPastTransKindEntry 5 }
```

```
   applPastTransKindTime OBJECT-TYPE
           SYNTAX       DateAndTime
           MAX-ACCESS   read-only
           STATUS       current
           DESCRIPTION
              "The applPastTransKindTime attribute records the time of
               the processing (receipt or transmission as
               indicated by the applPastTransFlowDirection index)
               of the last request/response (as indicated by the
               applPastTransFlowReqRsp index) of this kind of
               transaction on this transaction stream.

               If no requests/responses of this kind were
               received/transmitted over this transaction stream, the
               value of this attribute shall be '0000000000000000'H "
           DEFVAL { '0000000000000000'H }
           ::= { applPastTransKindEntry 6 }


   -- ************************************************************
   --
   --      applElmtRunControlGroup - monitor and control running
   --      application elements
   --
   -- ************************************************************

   applElmtRunStatusTable OBJECT-TYPE
           SYNTAX         SEQUENCE OF ApplElmtRunStatusEntry
           MAX-ACCESS     not-accessible
           STATUS         current
           DESCRIPTION
              "This table provides information on running application
               elements, complementing information available in the
               correspondingly indexed sysApplElmtRunTable [31]."
           ::= { applElmtRunControlGroup 1 }

   applElmtRunStatusEntry OBJECT-TYPE
           SYNTAX         ApplElmtRunStatusEntry
           MAX-ACCESS     not-accessible
           STATUS         current
           DESCRIPTION
             "An applElmtRunStatusEntry contains information to support
              the control and monitoring of a single running application
              element."
           INDEX { sysApplElmtRunIndex }
           ::= { applElmtRunStatusTable 1 }
```

```
   ApplElmtRunStatusEntry ::= SEQUENCE {
           applElmtRunStatusSuspended              TruthValue,
           applElmtRunStatusHeapUsage              Unsigned32,
           applElmtRunStatusOpenConnections        Unsigned32,
           applElmtRunStatusOpenFiles              Gauge32,
           applElmtRunStatusLastErrorMsg           SnmpAdminString,
           applElmtRunStatusLastErrorTime          DateAndTime }

   applElmtRunStatusSuspended OBJECT-TYPE
           SYNTAX             TruthValue
           MAX-ACCESS         read-only
           STATUS             current
           DESCRIPTION
              "The applElmtRunStatusSuspended attribute reports
               whether processing by this running application element
               has been suspended, whether by management request or by
               other means."
           ::= { applElmtRunStatusEntry 1 }

   applElmtRunStatusHeapUsage OBJECT-TYPE
           SYNTAX             Unsigned32
           UNITS              "bytes"
           MAX-ACCESS         read-only
           STATUS             current
           DESCRIPTION
              "The applElmtRunStatusHeapUsage reports the current
               approximate heap usage by this running application
               element."
           ::= { applElmtRunStatusEntry 2 }

   applElmtRunStatusOpenConnections OBJECT-TYPE
           SYNTAX                   Unsigned32
           UNITS                    "connections"
           MAX-ACCESS               read-only
           STATUS                   current
           DESCRIPTION
              "The applElmtRunStatusOpenConnections attribute reports
               the current number of open connections in use by this
               running application element."
           ::= { applElmtRunStatusEntry 3 }

   applElmtRunStatusOpenFiles OBJECT-TYPE
           SYNTAX             Gauge32
           UNITS              "files"
           MAX-ACCESS         read-only
           STATUS             current
           DESCRIPTION
              "The applElmtRunStatusOpenFiles attribute reports the
```

```
            current number of open files in use by this running
            application element."
        ::= { applElmtRunStatusEntry 4 }

   applElmtRunStatusLastErrorMsg OBJECT-TYPE
        SYNTAX                SnmpAdminString
        MAX-ACCESS            read-only
        STATUS                current
        DESCRIPTION
           "The applElmtRunStatusLastErrorMessage attribute reports
            the most recent error message (typically written to
            stderr or a system error logging facility) from this
            running application element.  If no such message has yet
            been generated, the value of this attribute shall be a
            zero-length string."
        DEFVAL { "" }
        ::= { applElmtRunStatusEntry 5 }

   applElmtRunStatusLastErrorTime OBJECT-TYPE
        SYNTAX                DateAndTime
        MAX-ACCESS            read-only
        STATUS                current
        DESCRIPTION
           "The applElmtRunStatusLastErrorTime attribute reports the
            time of the most recent error message in
            applElmtRunStatusLastErrorMsg.

            If no such message has yet been generated, the value
            of this attribute shall be '0000000000000000'H "
        DEFVAL { '0000000000000000'H }
        ::= { applElmtRunStatusEntry 6 }


   -- ***************************************************************
   --
   --      applElmtRunControlTable - control running application
   --      elements
   --
   -- ***************************************************************

   applElmtRunControlTable OBJECT-TYPE
        SYNTAX          SEQUENCE OF ApplElmtRunControlEntry
        MAX-ACCESS      not-accessible
        STATUS          current
```

```
            DESCRIPTION
               "This table provides the ability to control application
                elements, complementing information available in the
                correspondingly indexed sysApplElmtRunTable [31]."
            ::= { applElmtRunControlGroup 2 }

   applElmtRunControlEntry OBJECT-TYPE
            SYNTAX          ApplElmtRunControlEntry
            MAX-ACCESS      not-accessible
            STATUS          current
            DESCRIPTION
               "An applElmtRunControlEntry contains information to
               support the control of a single running application
               element."
            INDEX { sysApplElmtRunIndex }
            ::= { applElmtRunControlTable 1 }

   ApplElmtRunControlEntry ::= SEQUENCE {
                    applElmtRunControlSuspend       TruthValue,
                    applElmtRunControlReconfigure   TestAndIncr,
                    applElmtRunControlTerminate     TruthValue }

   applElmtRunControlSuspend OBJECT-TYPE
            SYNTAX             TruthValue
            MAX-ACCESS         read-write
            STATUS             current
            DESCRIPTION
               "Setting this variable to 'true' requests the suspension
                of processing by this running application element.
                Setting this variable to 'false' requests that processing
                be resumed.  The effect, if any, will be reported by the
                applElmtRunStatusSuspended attribute."
            DEFVAL { false }
            ::= { applElmtRunControlEntry 1 }

   applElmtRunControlReconfigure OBJECT-TYPE
            SYNTAX                TestAndIncr
            MAX-ACCESS            read-write
            STATUS                current
            DESCRIPTION
               "Changing the value of this variable requests that the
                running application element re-load its configuration
                (like SIGHUP for many UNIX-based daemons).

                Note that completion of a SET on this object only implies
                that configuration reload was initiated, not necessarily
                that the reload has been completed."
            ::= { applElmtRunControlEntry 2 }
```

```
   applElmtRunControlTerminate OBJECT-TYPE
           SYNTAX              TruthValue
           MAX-ACCESS          read-write
           STATUS              current
           DESCRIPTION
              "Setting the value of applElmtRunControlTerminate to
               'true' requests that the running application element
               terminate processing and exit in an orderly manner.
               This is a 'polite' shutdown request.

               When read, this object's value will be 'false' except
               when orderly termination is in progress.

               Note that completion of a SET on this object only implies
               that termination was initiated, not necessarily that the
               termination has been completed."
           DEFVAL { false }
           ::= { applElmtRunControlEntry 3 }


   -- ****************************************************************
   --
   --      Conformance requirements
   --
   -- ****************************************************************

   applicationMibGroups OBJECT IDENTIFIER ::=
                           { applicationMibConformance 1}

   applicationMonitorGroup OBJECT-GROUP
       OBJECTS { applSrvInstQual,
                 applSrvName,
                 applSrvIndex,
                 applSrvInstance,
                 applOpenChannelOpenTime,
                 applOpenChannelReadRequestsLow,
                 applOpenChannelReadFailures,
                 applOpenChannelBytesReadLow,
                 applOpenChannelLastReadTime,
                 applOpenChannelWriteRequestsLow,
                 applOpenChannelWriteFailures,
                 applOpenChannelBytesWrittenLow,
                 applOpenChannelLastWriteTime,
                 applOpenFileName,
                 applOpenFileSizeHigh,
                 applOpenFileSizeLow,
                 applOpenFileMode,
                 applOpenConnectionTransport,
```

```
                applOpenConnectionNearEndAddr,
                applOpenConnectionNearEndpoint,
                applOpenConnectionFarEndAddr,
                applOpenConnectionFarEndpoint,
                applOpenConnectionApplication }
        STATUS current
        DESCRIPTION
            "This group represents the basic capabilities of this MIB."
        ::= { applicationMibGroups 1 }

    applicationFastMonitorGroup OBJECT-GROUP
        OBJECTS { applOpenChannelReadRequests,
                  applOpenChannelBytesRead,
                  applOpenChannelWriteRequests,
                  applOpenChannelBytesWritten }
        STATUS current
        DESCRIPTION
            "This group comprises 64-bit counters mandatory in
             high-throughput environments, where 32-bit counters
             could wrap in less than an hour."
        ::= { applicationMibGroups 2 }

    applicationTransactGroup OBJECT-GROUP
        OBJECTS { applTransactStreamDescr,
                  applTransactStreamUnitOfWork,
                  applTransactStreamInvokesLow,
                  applTransactStreamInvCumTimes,
                  applTransactStreamInvRspTimes,
                  applTransactStreamPerformsLow,
                  applTransactStreamPrfCumTimes,
                  applTransactStreamPrfRspTimes,
                  applTransactFlowTransLow,
                  applTransactFlowBytesLow,
                  applTransactFlowTime,
                  applTransactKindTransLow,
                  applTransactKindBytesLow,
                  applTransactKindTime }
        STATUS current
        DESCRIPTION
            "This group comprises objects appropriate from monitoring
             transaction-structured flows."
        ::= { applicationMibGroups 3 }

    applicationFastTransactGroup OBJECT-GROUP
        OBJECTS { applTransactStreamInvokes,
                  applTransactStreamPerforms,
                  applTransactFlowTrans,
                  applTransactFlowBytes,
```

```
                applTransactKindTrans,
                applTransactKindBytes }
        STATUS current
        DESCRIPTION
            "This group comprises 64-bit transaction counters required in
             high-throughput environments, where 32-bit counters could
             wrap in less than an hour."
        ::= { applicationMibGroups 4 }

    applicationHistoryGroup OBJECT-GROUP
        OBJECTS { applPastChannelControlCollect,
                applPastChannelControlMaxRows,
                applPastChannelControlTimeLimit,
                applPastChannelControlRemItems,
                applPastChannelOpenTime,
                applPastChannelCloseTime,
                applPastChannelReadReqsLow,
                applPastChannelReadFailures,
                applPastChannelBytesReadLow,
                applPastChannelLastReadTime,
                applPastChannelWriteReqsLow,
                applPastChannelWriteFailures,
                applPastChannelBytesWritLow,
                applPastChannelLastWriteTime,
                applPastFileName,
                applPastFileSizeHigh,
                applPastFileSizeLow,
                applPastFileMode,
                applPastConTransport,
                applPastConNearEndAddr,
                applPastConNearEndpoint,
                applPastConFarEndAddr,
                applPastConFarEndpoint,
                applPastConApplication}
        STATUS current
        DESCRIPTION
            "This group models basic historical data."
        ::= { applicationMibGroups 5 }

    applicationFastHistoryGroup OBJECT-GROUP
        OBJECTS { applPastChannelReadRequests,
                applPastChannelBytesRead,
                applPastChannelWriteRequests,
                applPastChannelBytesWritten}
        STATUS current
```

```
        DESCRIPTION
            "This group comprises additional 64-bit objects required
             for recording historical data in high-volume environments,
             where a 32-bit integer would be insufficient."
        ::= { applicationMibGroups 6 }

    applicationTransHistoryGroup OBJECT-GROUP
        OBJECTS { applPastTransStreamDescr,
                  applPastTransStreamUnitOfWork,
                  applPastTransStreamInvokesLow,
                  applPastTransStreamInvCumTimes,
                  applPastTransStreamInvRspTimes,
                  applPastTransStreamPerformsLow,
                  applPastTransStreamPrfCumTimes,
                  applPastTransStreamPrfRspTimes,
                  applPastTransFlowTransLow,
                  applPastTransFlowBytesLow,
                  applPastTransFlowTime,
                  applPastTransKindTransLow,
                  applPastTransKindBytesLow,
                  applPastTransKindTime }
        STATUS current
        DESCRIPTION
            "This group represents historical data for transaction-
             structured information streams."
        ::= { applicationMibGroups 7 }

    applicationFastTransHistoryGroup OBJECT-GROUP
        OBJECTS { applPastTransFlowTrans,
                  applPastTransFlowBytes,
                  applPastTransKindTrans,
                  applPastTransKindBytes,
                  applPastTransStreamPerforms,
                  applPastTransStreamInvokes }
        STATUS current
        DESCRIPTION
            "This group contains 64-bit objects required for historical
             records on high-volume transaction-structured streams,
             where 32-bit integers would be insufficient."
        ::= { applicationMibGroups 8 }

    applicationRunGroup OBJECT-GROUP
        OBJECTS { applElmtRunStatusSuspended,
                  applElmtRunStatusHeapUsage,
                  applElmtRunStatusOpenConnections,
                  applElmtRunStatusOpenFiles,
                  applElmtRunStatusLastErrorMsg,
                  applElmtRunStatusLastErrorTime,
```

```
                applElmtRunControlSuspend,
                applElmtRunControlReconfigure,
                applElmtRunControlTerminate }
        STATUS current
        DESCRIPTION
            "This group represents extensions to the system application
             MIB."
        ::= { applicationMibGroups 9 }

    applicationMibCompliance MODULE-COMPLIANCE
        STATUS current
        DESCRIPTION "The compliance statement for the application MIB."
        MODULE
            MANDATORY-GROUPS { applicationMonitorGroup,
                               applicationHistoryGroup,
                               applicationRunGroup }

                OBJECT applPastChannelControlCollect
                    MIN-ACCESS read-only
                    DESCRIPTION
                        "This object should be limited to read-only
                         access in environments with inadequate
                         security."

                OBJECT applPastChannelControlMaxRows
                    MIN-ACCESS read-only
                    DESCRIPTION
                        "This object should be limited to read-only
                         access in environments with inadequate
                         security."

                OBJECT applPastChannelControlTimeLimit
                    MIN-ACCESS read-only
                    DESCRIPTION
                        "This object should be limited to read-only
                         access in environments with inadequate
                         security."

                OBJECT applElmtRunControlSuspend
                    MIN-ACCESS read-only
                    DESCRIPTION
                        "This object should be limited to read-only
                         access in environments with inadequate
                         security."
```

```
            OBJECT applElmtRunControlReconfigure
                MIN-ACCESS read-only
                DESCRIPTION
                    "This object should be limited to read-only
                     access in environments with inadequate
                     security."

            OBJECT applElmtRunControlTerminate
                MIN-ACCESS read-only
                DESCRIPTION
                    "This object should be limited to read-only
                     access in environments with inadequate
                     security."

        GROUP applicationTransactGroup
        DESCRIPTION
            "The applicationTransactGroup is required when the
             information stream processed has a transaction
             structure. "

        GROUP applicationTransHistoryGroup
        DESCRIPTION
            "The applicationTransHistoryGroup must be implemented
             if applicationTransactGroup and applicationHistoryGroup
             are implemented."

        GROUP applicationFastMonitorGroup
        DESCRIPTION
           "The applicationFastMonitorGroup is mandatory when
            the applicationMonitorGroup is implemented and its
            counts group may exceed what can be represented in 32 bits."

        GROUP applicationFastTransactGroup
        DESCRIPTION
           "The applicationFastTransactGroup is mandatory when
            the applicationTransactGroup is implemented and its
            counts may exceed what can be represented in 32 bits."

        GROUP applicationFastHistoryGroup
        DESCRIPTION
           "The applicationFastHistoryGroup is mandatory when
            the applicationHistoryGroup is implemented and its
            counts may exceed what can be represented in 32 bits."
```

```
            GROUP applicationFastTransHistoryGroup
            DESCRIPTION
               "The applicationFastTransHistoryGroup is mandatory when
                the applicationTransHistoryGroup is implemented and its
                counts may exceed what can be represented in 32 bits."
        ::= { applicationMibConformance 2 }

    END
```

6. Implementation Issues

Unlike the system application MIB [31], in many environments support for much of this MIB requires instrumentation built into the managed resource. Some tables may be implemented by a single monitor process; for others, the implementation may be distributed within the managed system with the resources being managed.

As a practical matter, this means that the management infrastructure of the managed system must support different subagents taking responsibility for different rows of a single table. This can be supported by AgentX [25], as well as some other subagent protocols such as [8], [9], and [11].

The sysApplRunElmtIndex is the key connection between this MIB and the systems application MIB. Implementations of these two MIBs intended to run concurrently on a given platform must employ a consistent policy for assigning this value to running application elements.

Some of the objects defined in this MIB may carry a high run-time cost in some environments. For example, tracking transaction elapsed time could be expensive if it required two kernel calls (start and finish) per transaction. Similarly, maintaining tables of per-transaction information, rather than aggregating information by transaction type or transaction stream, could have significant storage and performance impacts.

Unless a collision-free mechanism for allocating service instance indexes is in place, the structure of the service-level tables makes an index-reservation mechanism necessary. AgentX [25] is an example of a subagent protocol capable of satisfying this requirement.

7. Intellectual Property

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9. Security Considerations

By making potentially sensitive information externally accessible, the capabilities supported by the MIB have the potential of becoming security problems. How security fits into SNMP frameworks is described in [26], and a specific access control model is described in [30].

The tables in this MIB are organized to separate sensitive control capabilities from less sensitive usage information. For example, the objects to control application suspend/resume are separated from those to handle reconfiguration, which in turn are distinct from those for termination. This recognizes the need to support configurations where the level of authorization needed by a manager to do a "reconfigure" might be substantially less than the level needed to terminate an application element. By keeping these in

separate columns, we make it possible to set up access control that allows, for example, "reconfigure" but not "kill".

The MIB is structured to be useful for managers with read-only access rights. In some environments, it may be approprate to restrict even read-only access to these MIBs.

The capabilities supported by this MIB include several that may be of value to a security administrator. These include the ability to monitor the level of usage of a given application, and to check the integrity of application components.

10. References

[1] ARM Working Group, "Application Response Measurement (ARM) API Guide, Version 2", September, 1997.

[2] IEEE P1387.2, POSIX System Administration - Part 2: Software Administration. (Draft)

[3] ITU-T Recommendation X.744 | ISO/IEC IS 10164-18:1996, Information Technology - Open Systems Interconnection - Systems Management: Software Management Function, 1996.

[4] Rose, M. and K. McCloghrie, "Structure and Identification of Management Information for TCP/IP-based Internets", STD 16, RFC 1155, May 1990.

[5] Case, J., Fedor, M., Schoffstall, M. and J. Davin, "Simple Network Management Protocol", STD 15, RFC 1157, May 1990.

[6] Rose, M. and K. McCloghrie, "Concise MIB Definitions", STD 16, RFC 1212, March 1991.

[7] Rose, M., "A Convention for Defining Traps for use with the SNMP", RFC 1215, March 1991.

[8] Rose, M., "SNMP MUX Protocol and MIB", RFC 1227, May 1991.

[9] Carpenter, G. and B. Wijnen, "SNMP-DPI Simple Network Management Protocol Distributed Program Interface", RFC 1228, May 1991.

[10] Grillo, P. and S. Waldbusser, "Host Resources MIB", RFC 1514, September 1993.

[11] Carpenter, G., Curran, K., Sehgal, A., Waters, G. and B. Wijnen, "Simple Network Management Protocol Distributed Protocol Interface Version 2.0", RFC 1592, March 1994.

[12] Brower, D., Purvy, R., Daniel, A., Sinykin, M. and J. Smith, "Relational Database Management System (RDBMS) Management Information Base (MIB) using SMIv2", RFC 1697, August 1994.

[13] Reynolds, J. and J. Postel, "Assigned Numbers", STD 2, RFC 1700, October 1994.

[14] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Introduction to Community-based SNMPv2", RFC 1901, January 1996.

[15] McCloghrie, K., Perkins, D. and J. Schoenwaelder, "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.

[16] McCloghrie, K., Perkins, D. and J. Schoenwaelder, "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.

[17] McCloghrie, K., Perkins, D. and J. Schoenwaelder, "Conformance Statements for SMIv2", STD 58, RFC 2580, April 1999.

[18] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Protocol Operations for Version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1905, January 1996.

[19] Case, J., McCloghrie, K., Rose, M. and S. Waldbusser, "Transport Mappings for Version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1906, January 1996.

[20] McCloghrie, K. and A. Bierman, "Entity MIB using SMIv2", RFC 2037, October 1996.

[21] Kalbfleisch, C., "Applicability of Standards Track MIBs to Management of World Wide Web Servers", RFC 2039, November 1996.

[22] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[23] Freed, N. and S. Kille, "Network Services Monitoring MIB", RFC 2248, January 1998.

[24] Freed, N. and S. Kille, "Mail Monitoring MIB", RFC 2249, January 1998.

[25] Daniele, M., Francisco, D. and B. Wijnen, "Agent Extensibility (AgentX) Protocol", RFC 2257, January, 1998.

[26] Harrington, D., Presuhn, R. and B. Wijnen, "An Architecture for

describing SNMP Management Frameworks", RFC 2571, May 1999.

[27] Case, J., Harrington D., Presuhn R. and B. Wijnen, "Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)", RFC 2572, May 1999.

[28] Levi, D., Meyer, P. and B. Stewart, "SNMPv3 Applications", RFC 2573, May 1999.

[29] Blumenthal, U. and B. Wijnen, "User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)", RFC 2574, May 1999.

[30] Wijnen, B., Presuhn, R. and K. McCloghrie, "View-based Access Control Model for the Simple Network Management Protocol (SNMP)", RFC 2575, May 1999.

[31] Krupczak, C. and J. Saperia, "Definitions of System-Level Managed Objects for Applications", RFC 2287, February 1998.

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