

Network Working Group
Request for Comments: 2564
Category: Standards Track

C. Kalbfleisch
Verio, Inc.
C. Krupczak
Empire Technologies, Inc.
R. Presuhn
BMC Software, Inc.
J. Saperia
IronBridge Networks
May 1999

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.

Copyright Notice

Copyright (C) The Internet Society (1999). All Rights Reserved.

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.

Table of Contents

1. Introduction and Overview	2
2. The SNMP Management Framework	4
3. Architecture	5
3.1. Relationships to other MIBs	5
3.1.1. Relationship to the System Application MIB	5
3.1.2. Relationship to the Host Resources MIB	6
3.1.3. Relationship to NSM	6
4. MIB Structure	6
4.1. The service-level tables	8
4.1.1. The service name to service instance table	8
4.1.2. The service instance to service name table	9
4.1.3. The service instance to running application element table	9
4.1.4. The running application element to service instance table	9

4.2. The I/O channel group	9
4.2.1. The open channels table	10
4.2.2. The open files table	10
4.2.3. The open connections table	11
4.2.4. The transaction stream summary table	12
4.2.5. The transaction flow statistics table	13
4.2.6. The transaction kind statistics table	13
4.3. The former channel group	13
4.3.1. The former channel control table	14
4.3.2. The former channel table	14
4.3.3. The former connection table	14
4.3.4. The former file table	14
4.3.5. The transaction history tables	14
4.4. The running element status and control group	15
4.4.1. The running application element status table	15
4.4.2. The running application element control table	15
5. Definitions	16
6. Implementation Issues	80
7. Intellectual Property	80
8. Acknowledgements	81
9. Security Considerations	81
10. References	82
11. Authors' Addresses	84
12. Full Copyright Statement	86

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

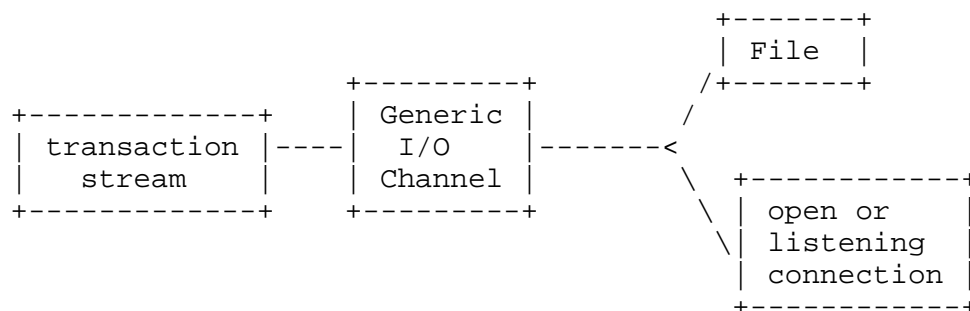
The service instance to running application element table uses the service instance identifier as its primary key, and the running application element index as its secondary key. This facilitates the identification of the set of running application elements providing a given instance of a service.

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

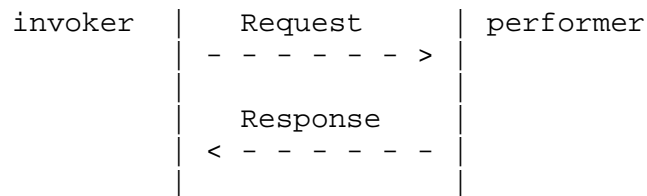
This table provides information on channels that are open connections or listeners.

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 queueing 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 `sysAppElmtRunIndex`, 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 `sysappElmtRunTable` in [31].

4.4.2. The running application element control table

This table provides rudimentary control over a running application element. Indexed by the `sysAppElmtRunIndex`, 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, sysAppElmtRunIndex  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 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 applSrvInstQual 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 }

applSrvInstToRunAppElmtEntry OBJECT-TYPE
 SYNTAX ApplSrvInstToRunAppElmtEntry
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION
 "An applSrvInstToRunAppElmtEntry 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, sysAppElmtRunIndex }
 ::= { applSrvInstToRunAppElmtTable 1 }

AppelSrvInstToRunAppElmtEntry ::= 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."
 ::= { applSrvInstToRunAppElmtEntry 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 }
```

AppOpenChannelEntry ::= 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 sysAppElmtRunIndex."
    ::= { 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 }
```

AppOpenFileEntry ::= SEQUENCE

```
{
    appOpenFileName                LongUtf8String,
    appOpenFileSizeHigh            Unsigned32,
    appOpenFileSizeLow            Unsigned32,
    appOpenFileMode                INTEGER
}
```

appOpenFileName 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."

::= { appOpenFileEntry 1 }

appOpenFileSizeHigh 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."

::= { appOpenFileEntry 2 }

appOpenFileSizeLow 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 }

AppOpenConnectionEntry ::= 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

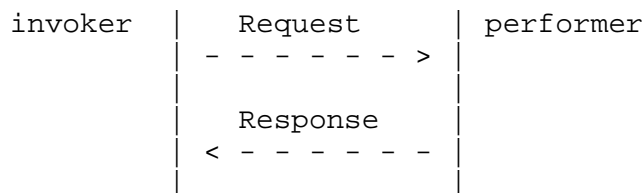
MAX-ACCESS not-accessible

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:



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 than 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 than 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
--
-- *****

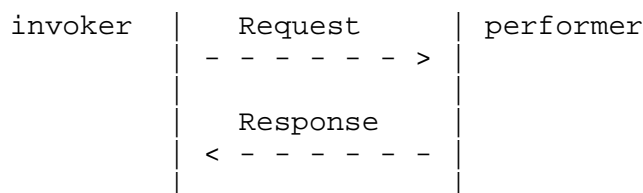
```

```

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:



```

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 (applPastTransFlowDirection), 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 sysAppElmtRunTable [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 { sysAppElmtRunIndex }

::= { applElmtRunStatusTable 1 }

```

AppElmtRunStatusEntry ::= 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 sysAppElmtRunTable [31]."

```
::= { appElmtRunControlGroup 2 }
```

```
appElmtRunControlEntry OBJECT-TYPE
```

```
SYNTAX AppElmtRunControlEntry
```

```
MAX-ACCESS not-accessible
```

```
STATUS current
```

DESCRIPTION

"An appElmtRunControlEntry contains information to support the control of a single running application element."

```
INDEX { sysAppElmtRunIndex }
```

```
::= { appElmtRunControlTable 1 }
```

```
AppElmtRunControlEntry ::= SEQUENCE {
```

```
    appElmtRunControlSuspend TruthValue,
```

```
    appElmtRunControlReconfigure TestAndIncr,
```

```
    appElmtRunControlTerminate TruthValue }
```

```
appElmtRunControlSuspend 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 appElmtRunStatusSuspended attribute."

```
DEFVAL { false }
```

```
::= { appElmtRunControlEntry 1 }
```

```
appElmtRunControlReconfigure 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."

```
::= { appElmtRunControlEntry 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

The IETF takes no position regarding the validity or scope of any intellectual property or other rights that might be claimed to pertain to the implementation or use of the technology described in

this document or the extent to which any license under such rights might or might not be available; neither does it represent that it has made any effort to identify any such rights. Information on the IETF's procedures with respect to rights in standards-track and standards-related documentation can be found in BCP-11. Copies of claims of rights made available for publication and any assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementors or users of this specification can be obtained from the IETF Secretariat.

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights which may cover technology that may be required to practice this standard. Please address the information to the IETF Executive Director.

8. Acknowledgements

This document was produced by the Application MIB working group.

The editor gratefully acknowledges the comments and contributions of the following individuals:

Harrie Hazewinkel
Carl Kalbfleisch
Cheryl Krupczak
David Partain
Jon Saperia
Juergen Schoenwaelder
Kenneth White

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 appropriate 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.

11. Authors' Addresses

Carl Kalbfleisch
Verio, Inc.
1950 Stemmons Freeway
2004 INFOMART
Dallas, TX 75207
USA

Phone: +1 972-238-8303
Fax: +1 972-238-0268
EMail: cwk@verio.net

Cheryl Krupczak
Empire Technologies, Inc.
541 Tenth Street, NW Suite 169
Atlanta, GA 30318
USA

Phone: +1 770-384-0184
EMail: cheryl@empiretech.com

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

Phone: +1 408-616-3100
Fax: +1 408-616-3101
EMail: randy_presuhn@bmc.com

Jon Saperia
IronBridge Networks
55 Hayden Avenue
Lexington, MA 02173
USA

Phone: +1 781-402-8029
Fax: +1 781-402-8090
EMail: saperia@mediaone.net

12. Full Copyright Statement

Copyright (C) The Internet Society (1999). All Rights Reserved.

This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this paragraph are included on all such copies and derivative works. However, this document itself may not be modified in any way, such as by removing the copyright notice or references to the Internet Society or other Internet organizations, except as needed for the purpose of developing Internet standards in which case the procedures for copyrights defined in the Internet Standards process must be followed, or as required to translate it into languages other than English.

The limited permissions granted above are perpetual and will not be revoked by the Internet Society or its successors or assigns.

This document and the information contained herein is provided on an "AS IS" basis and THE INTERNET SOCIETY AND THE INTERNET ENGINEERING TASK FORCE DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.

