Job Monitoring MIB

(This cover page is *not* part of the Internet-Draft)

From: Tom Hastings
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Version: 0.82~~1~~
File: ftp://ftp.pwg.org/pub/jmp/mibs/jmp-mib.doc .pdf jmp-mibr.doc .pdf .pdr

Status: Fifth~~Fourth~~ draft MIB that corresponds to the changes agreed to at the JMP meeting, on Friday, 5/16/97. ~~at the JMP meeting, 04/04/97 in Austin.~~The major changes were to eliminated duplicates between the Job State table and the Attribute table, and to move all mandatory integer attributes to the Job Table, leaving only the **jobOwner** string attribute as MANDATORY in the Attribute table. The Job State table has been renamed back to the Job table, since it has more than just state now. ~~Harry Lewis's changes to eliminate the Queue and Completed tables and to replace the Job table with the Job ID and Job State table have been incorporated.~~ See the change history in the separate file: changes.doc .pdf. ~~The Internet-Draft was not posted in time and with these changes, we did not present any MIB document at the IETF meeting on 04/08/97 in Memphis. Instead we presented slides on the current status explaining the tables, which are: General, Job ID, Job State, and Attributes.~~

I've also produced a variation on this document which has all variable font (**jmp-mibv.doc .pdf**) without revision marks. This is the version that the JMP should use to make comments. It has line numbers.

The MIB has been greatly simplified so that now there are only 17~~13~~ objects in the MIB. There are 71~~78~~ attributes: ~~, of which only~~ 1 is~~8 are~~ MANDATORY and 70 are OPTIONAL.

I've removed the issues from the document and placed them in a separate document: issues.doc .pdf. There are very few issues remaining. I've added a few issues from the e-mail since the last meeting.

The actual specifications of each object needs line-by-line review. We did *not* have time for such review at the 11/08/96 or the 01/08/97 meeting as indicated in the minutes. The group wanted to wait until this specification is re-formatted into a MIB.

I've moved the full ISO DPA specifications to a separate document. I've also copied map-summ.doc into another document so we can compare the Job Monitoring objects with the job submission protocols and keep the object names updated in that summary.

We moved more objects into the Resource Table, now called the Attribute Table, since more than resources are in it. I've not used revision marks for such moves, but only for changes within each description of what had been an object and what now is an enum.

INTERNET-DRAFT
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Status of this Memo

Abstract

This Internet-Draft specifies a set of 1713 SNMP MIB objects for (1) monitoring the status and progress of print jobs (2) obtaining resource requirements before a job is processed, (3) monitoring resource consumption while a job is being processed and (4) collecting resource accounting data after the completion of a job. This MIB is intended to be implemented (1) in a printer or (2) in a server that supports one or more printers. Use of the object set is not limited to printing. However, support for services other than printing is outside the scope of this Job Monitoring MIB. Future extensions to this MIB may include, but are not limited to, fax machines and scanners.

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Job Monitoring MIB

1. Introduction

The Job Monitoring MIB consists of a 65-object General Group, a 2-object Job Submission ID Group, a 74-object Job State Group, and a 2-object Attribute Group. Each group is a table. The General Group contains general information that applies to all jobs in a job set. The Job Submission ID table maps the job submission ID that the client uses to identify a job to the jmJobIndex that the Job Monitoring Agent uses to identify jobs in the Job State and Attribute tables. The Job State table contains the mandatory integer job state and status objectscopies of three salient attributes for each job's current state. The Attribute table consists of multiple entries per job that specify (1) job and document identification and parameters, (2) requested resources, and (3) consumed resources during and after job processing/printing. One MANDATORY attribute and 70 OPTIONAL attributes are defined as textual conventions.

The Job Monitoring MIB is intended to be instrumented by an agent within a printer or the first server closest to the printer, where the printer is either directly connected to the server only or the printer does not contain the job monitoring MIB agent. It is recommended that implementations place the SNMP agent as close as possible to the processing of the print job. This MIB applies to printers with and without spooling capabilities. This MIB is designed to be compatible with most current commonly-used job submission protocols. In most environments that support high function job submission/job control protocols, like ISO DPA[2], those protocols would be used to monitor and manage print jobs rather than using the Job Monitoring MIB.

1.1 Types of Information in the MIB

The job MIB is intended to provide the following information for the indicated Role Models in the Printer MIB[1] (Refer to RFC 1759, Appendix D - Roles of Users).

User:

- Provide the ability to identify the least busy printer. The user will be able to determine the number and size of jobs waiting for each printer. No attempt is made to actually predict the length of time that jobs will take.
- Provide the ability to identify the current status of the user's job (user queries).
- Provide a timely indicationnotification that the job has completed and where it can be found.
- Provide error and diagnostic information for jobs that did not successfully complete.

Operator:

Provide a presentation of the state of all the jobs in the print system.

Provide the ability to identify the user that submitted the print job.

Provide the ability to identify the resources required by each job.

Provide the ability to define which physical printers are candidates for the print job.

Provide some idea of how long each job will take. However, exact estimates of time to process a job is not being attempted. Instead, objects are included that allow the operator to be able to make gross estimates.

Capacity Planner:

Provide the ability to determine printer utilization as a function of time.

Provide the ability to determine how long jobs wait before starting to print.

Accountant:

Provide information to allow the creation of a record of resources consumed and printer usage data for charging users or groups for resources consumed.

Provide information to allow the prediction of consumable usage and resource need.

The MIB supports printers that can contain more than one job at a time, but still be usable for low end printers that only contain a single job at a time. In particular, the MIB supports the needs of Windows and other PC environments for managing low-end networked devices without unnecessary overhead or complexity, while also providing for higher end systems and devices.

1.2 Types of Job Monitoring Applications

The Job Monitoring MIB is designed for the following types of monitoring applications:

1. monitor a single job starting when the job is submitted and finishing a defined period after the job completes. The Job Submission ID table provides the map to find the specific job to be monitored.

2. monitor all 'active' ~~of the~~ jobs in a queue, which this specification ~~is~~ generalize~~d~~s to a "job set". End users may use such a program when selecting a least busy printer, so the MIB is designed for such a program to start up quickly and find the information needed quickly without having to read all (completed) jobs in order to find the active jobs. System operators may also use such a program, in which case it would be running for a long period of time and may also be interested in the jobs

that have completed. Finally such a program may be co-located with the printer to provide an enhanced console and logging capability.

3. collect resource usage for accounting or system utilization purposes that copy the completed job statistics to an accounting system. It is recognized that depending on accounting programs to copy MIB data during the job-retention period is somewhat unreliable, since the accounting program may not be running (or may have crashed). Such a program is expected to keep a shadow copy of the entire Job **Attribute** table including ~~**canceled** and~~ **completed, canceled, and aborted** jobs which the program updates on each polling cycle. Such a program polls at the rate of the persistence of the **Attribute** table. The design is not optimized to help such an application determine which jobs are **completed,** ~~or~~ **canceled,** or **aborted**. Instead, the application SHALL query each job that the application's shadow copy shows was not **complete,** ~~or~~ **canceled,** or **aborted** at the previous poll cycle to see if it is now **complete** or **canceled**, plus any new jobs that have been submitted.

The MIB provides a set of objects that represent a compatible subset of job and document attributes of the ISO DPA standard[2] and the Internet Printing Protocol (IPP)[3], so that coherence is maintained between these two protocols and the information presented to end users and system operators by monitoring applications. However, the job monitoring MIB is intended to be used with printers that implement other job submitting and management protocols, such as IEEE 1284.1 (TIPSI)[4], as well as with ones that do implement ISO DPA. So nothing in the job monitoring MIB ~~SHALL~~ requires implementation of the ISO DPA or IPP protocols.

The MIB is designed so that an additional MIB(s) can be specified in the future for monitoring multi-function (scan, FAX, copy) jobs as an augmentation to this MIB.

2. Terminology and Job Model

This section defines the terms that are used in this specification and the general model for jobs.

NOTE - Existing systems use conflicting terms, so these terms are drawn from the ISO 10175 Document Printing Application (DPA) standard[2]. For example, PostScript systems use the term *session* for what we call a *job* in this specification and the term *job* to mean what we call a *document* in this specification~~paper~~. PJL systems use the term *job* to mean what we call a *job* in this specification. PJL also supports multiple *documents* per job, but does not support specifying per-document attributes independently for each document.

A *job* is a unit of work whose results are expected together without interjection of unrelated results. A *client* is able to specify *job instructions* that apply to the job as a

whole. Proscriptive instructions specify how, when, and where the job is to be printed. Descriptive instructions describe the job. A job contains one or more *documents*.

A *job set* is a set of jobs that are queued and scheduled together according to a specified scheduling algorithm for a specified device or set of devices. For implementations that embed the SNMP agent in the device, the MIB job set normally represents *all* the jobs known to the device, so that the implementation only implements a single job set which MAY be identified with a hard-coded value **1**. If the SNMP agent is implemented in a server that controls one or more devices, each MIB job set represents a job queue for (1) a specific device or (2) set of devices, if the server uses a single queue to load balance between several devices. Each job set is disjoint; no job SHALL be represented in more than one MIB job set.

A *document* is a sub-section within a job. A document contains print data and *document instructions* that apply to just the document. The *client* is able to specify document instructions separately for each document in a job. Proscriptive instructions specify how the document is to be processed and printed by the *server*. Descriptive instructions describe the document. Server implementation of more than one document per job is optional.

A *client* is the network entity that *end users* use to submit jobs to *spoolers*, *servers*, or *printers* and other *devices*, depending on the configuration, using any job submission protocol.

A *server* is a network entity that accepts jobs from clients and in turn submits the jobs to *printers* and other *devices*. A server MAY be a printer *supervisor* control program, or a print *spooler*.

A *device* is a hardware entity that (1) interfaces to humans in human perceptible means, such as produces marks on paper, scans marks on paper to produce an electronic representations, or writes CD-ROMs or (2) interfaces to a network, such as sends FAX data to another FAX device.

A *printer* is a *device* that puts marks on media.

A *supervisor* is a server that contains a control program that controls a printer or other device. A supervisor is a client to the printer or other device.

A *spooler* is a server that accepts jobs, spools the data, and decides when and on which printer to print the job. A spooler is a client to a printer or a printer supervisor, depending on implementation.

Spooling is the act of a *device* or *server* of (1) accepting jobs and (2) writing the job's attributes and document data on to secondary storage.

Queuing is the act of a *device* or *server* of ordering (queuing) the jobs for the purposes of scheduling the jobs to be processed.

A *monitor* or *job monitoring application* is the network entity that End Users, System Operators, Accountants, Asset Managers, and Capacity Planners use to monitor jobs using SNMP. A monitor MAY be either a separate application or MAY be part of the client that also submits jobs.

An *agent* is the network entity that accepts SNMP requests from a *monitor* and implements the Job Monitoring MIB by instrumenting a *server* or a *device*.

A *proxy* is an agent that acts as a concentrator for one or more other agents by accepting SNMP operations on the behalf of one or more other agents, forwarding them on to those other agents, gathering responses from those other agents and returning them to the original requesting monitor.

A *user* is a person that uses a client or a monitor.

An *end user* is a user that uses a client to submit a print job.

A *system operator* is a user that uses a monitor to monitor the system and carries out tasks to keep the system running.

A *system administr*ator is a user that specifies policy for the system.

A *job instruction* is an instruction specifying how, when, or where the job is to be processed. Job instructions MAY be passed in the job submission protocol or MAY be embedded in the document data or a combination depending on the job submission protocol and implementation.

A *document instruction* is an instruction specifying how to process the document. Document instructions MAY be passed in the job submission protocol separate from the actual document data, or MAY be embedded in the document data or a combination, depending on the job submission protocol and implementation.

An *SNMP information object* is a name, value-pair that specifies an action, a status, or a condition in an SNMP MIB. Objects are identified in SNMP by an OBJECT IDENTIFIER.

An *attribute* is a name, value-pair that specifies an instruction, a status, or a condition of a job or a document that has been submitted to a server or device. A particular attribute NEED NOT be present in each job instance. In other words, attributes are present in a job instance only when there is a need to express the value, either because (1) the client supplied a value in the job submission protocol, (2) the document data contained an embedded attribute, or (3) the server or device supplied a default value. An agent SHALL represent an attribute as an entry (row) in the Attribute table in this MIB in which entries are present only when necessary. Attributes are identified in this MIB by an enum.

Job monitoring using SNMP is (1) identifying jobs within the serial streams of data being processed by the server, printer or other devices, (2) creating "rows" in the job table for

each job, and (3) recording information, known by the agent, about the processing of the job in that "row".

Job accounting is recording what happens to the job during the processing and printing of the job.

3. System Configurations for the Job Monitoring MIB

This section enumerates the three configurations in~~for~~ which the Job Monitoring MIB is intended to be used. To simplify the pictures, the *devices* are shown as *printers*. See Goals section.

The diagram in the Printer MIB[1] entitled: "One Printer's View of the Network" is assumed for this MIB as well. Please refer to that diagram to aid in understanding the following system configurations.

3.1 Configuration 1 - client-printer

In the **client-printer** configuration, the **client**(s) submit jobs directly to the printer, either by some direct connect, or by network connection. The **client-printer** configuration can accommodate multiple job submitting **clients** in either of two ways:

1. if each **client** relinquishes control of the Print Job Delivery Channel after each job (or after a number of jobs)
2. if the printer supports more than one Print Job Delivery Channel

The job submitting **client** and/or **monitoring application** monitor jobs by communicating directly with an agent that is part of the printer. The agent in the printer SHALL keep the job in the Job Monitoring MIB as long as the job is in the Printer, and longer in order to implement the **completed** state in which monitoring programs can copy out the accounting data from the Job Monitoring MIB.

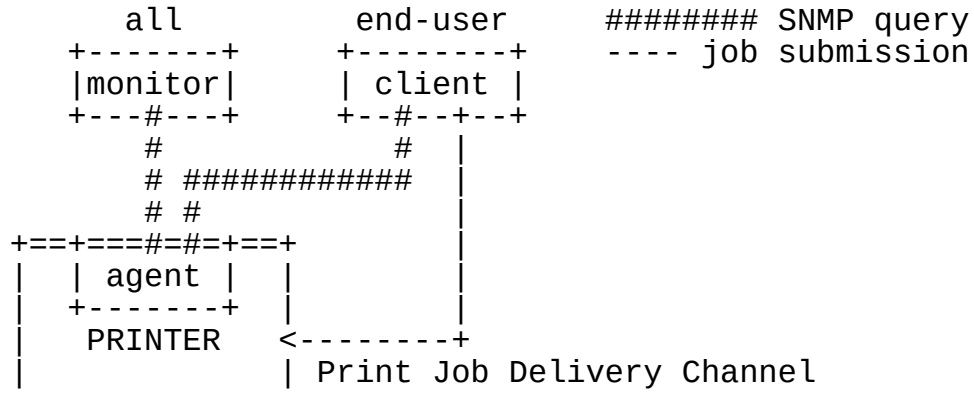


Figure 3-1 - Configuration 1 - client-printer - agent in the printer

The Job Monitoring MIB is designed to support the following relationships (not shown in Figure 3-1):

1. Multiple **clients** MAY submit jobs to a **printer**.
2. Multiple **clients** MAY monitor a **printer**.
3. Multiple **monitors** MAY monitor a **printer**.
4. A **client** MAY submit jobs to multiple **printers**.
5. A **monitor** MAY monitor multiple **printers**.

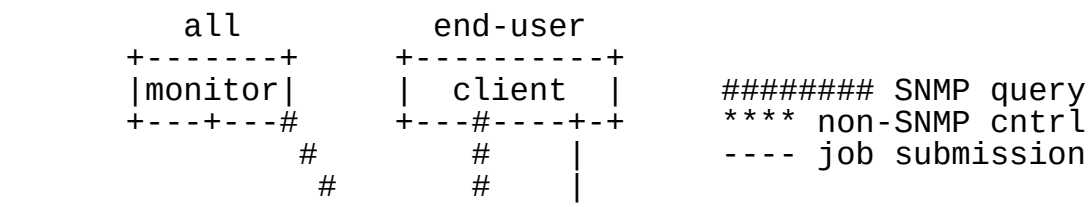
3.2 Configuration 2 - client-server-printer - agent in the server

In the **client-server-printer** configuration 2, the **client**(s) submit jobs to an intermediate **server** by some network connection, *not* directly to the **printer**. While configuration 2 is included, the design center for this MIB is configurations 1 and 3,

The job submitting **client** and/or **monitoring application** monitor job by communicating directly with:

1. a Job Monitoring MIB agent that is part of the **server** (or a front for the server)

There is no SNMP Job Monitoring MIB agent in the printer in configuration 2, at least that the client or monitor are aware. In this configuration, the agent SHALL return the current values of the objects in the Job Monitoring MIB both for jobs the server keeps and jobs that the server has submitted to the printer. In configuration 2, the server keeps a copy of the job during the time that the server has submitted the job to the printer. Only some time *after* the printer completes the job, SHALL the server remove the representation of the job from the Job Monitoring MIB in the server. The agent NEED NOT access the printer, except when a monitor queries the agent using an SNMP Get for an object in the Job Monitoring MIB. Or the agent can subscribe to the notification events that the printer generates and keep the Job Monitoring MIB update to date. The agent in the server SHALL keep the job in the Job Monitoring MIB as long as the job is in the Printer, and longer in order to implement the **completed** state in which monitoring programs can copy out the accounting data from the Job Monitoring MIB.



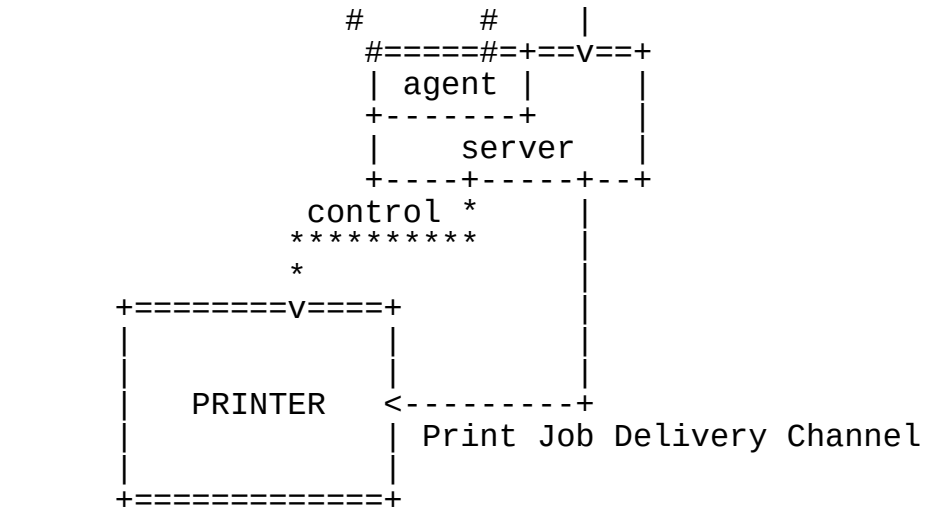


Figure 3-2 - Configuration 2 - client-server-printer - agent in the server

The Job Monitoring MIB is designed to support the following relationships (not shown in Figure 3-2):

1. Multiple **clients** MAY submit jobs to a **server**.
2. Multiple **clients** MAY monitor a **server**.
3. Multiple **monitors** MAY monitor a **server**.
4. A **client** MAY submit jobs to multiple **servers**.
5. A **monitor** MAY monitor multiple **servers**.
6. Multiple **servers** MAY submit jobs to a **printer**.
7. Multiple **servers** MAY control a **printer**.

3.3 Configuration 3 - client-server-printer - client monitors printer agent and server

In the **client-server-printer** configuration 3, the **client**(s) submit jobs to an intermediate **server** by some network connection, *not* directly to the **printer**.

The job submitting **client** and/or **monitoring application** monitor jobs by communicating directly with:

1. the server using some protocol to monitor jobs in the server that does not contain the Job Monitoring MIB AND
2. a Job Monitoring MIB agent that is part of the **printer** to monitor jobs after the server passes the jobs to the printer. In such configurations, the server deletes its copy of the job from the server after submitting the job to the printer usually almost immediately (before the job does much processing, if any)**.**

There is no SNMP Job Monitoring MIB agent in the server in configuration 3, at least that the client or monitor are aware. In this configuration, the agent (in the printer) SHALL

keep the values of the objects in the Job Monitoring MIB that the agent implements updated for a job that the server has submitted to the printer. The agent SHALL obtain information about the jobs submitted to the printer from the server (either in the job submission protocol, in the document data, or by direct query of the server), in order to populate some of the objects the Job Monitoring MIB in the printer. The agent in the printer SHALL keep the job in the Job Monitoring MIB as long as the job is in the Printer, and longer in order to implement the **completed** state in which monitoring programs can copy out the accounting data from the Job Monitoring MIB.

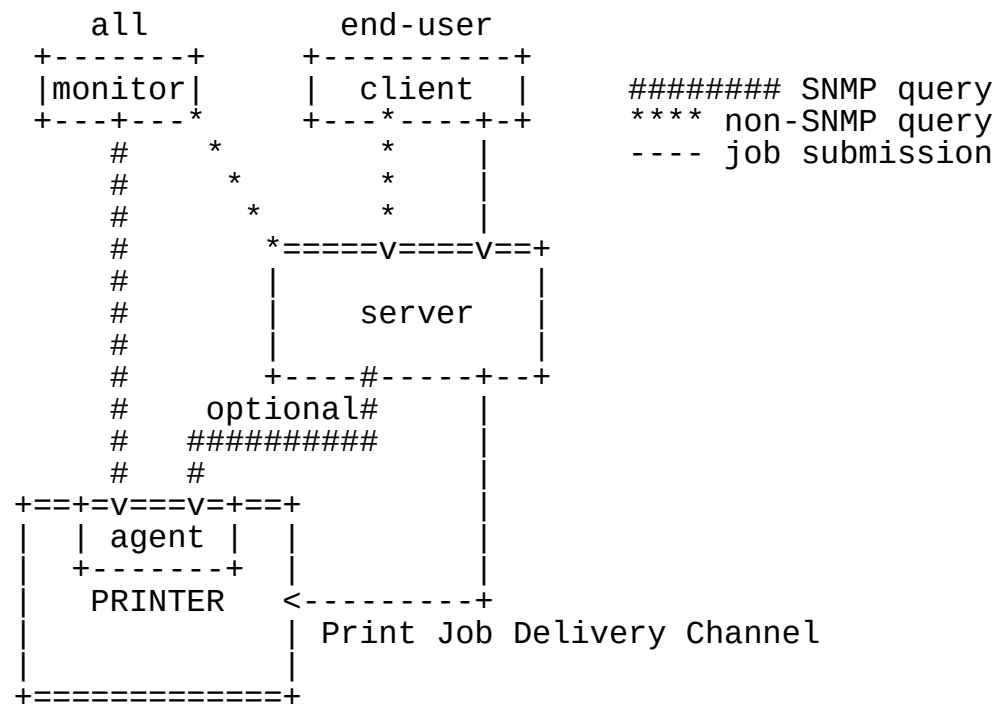


Figure 3-3 - Configuration 3 - client-server-printer - client monitors printer agent and server

The Job Monitoring MIB is designed to support the following relationships (not shown in Figure 3-3):

1. Multiple **clients** MAY submit jobs to a **server**.
2. Multiple **clients** MAY monitor a **server**.
3. Multiple **monitors** MAY monitor a **server**.
4. A **client** MAY submit jobs to multiple **servers**.
5. A **monitor** MAY monitor multiple **servers**.
6. Multiple **servers** MAY submit jobs to a **printer**.
7. Multiple **servers** MAY control a **printer**.

4. Conformance Considerations

In order to achieve interoperability between job monitoring applications and job monitoring agents, this specification includes the conformance requirements for both monitoring applications and agents.

4.1 Conformance Terminology

This specification uses the verbs: "SHALL", "SHOULD", "MAY", and "NEED NOT" to specify conformance requirements according to RFC 2119 as follows:

- "SHALL": indicates an action that the subject of the sentence must implement in order to claim conformance to this specification
- "MAY": indicates an action that the subject of the sentence does not have to implement in order to claim conformance to this specification, in other words that action is an implementation option
- "NEED NOT": indicates an action that the subject of the sentence does not have to implement in order to claim conformance to this specification. The verb "NEED NOT" is used instead of "may not", since "may not" sounds like a prohibition.
- "SHOULD": indicates an action that is recommended for the subject of the sentence to implement, but is not required, in order to claim conformance to this specification.

4.2 Agent Conformance Requirements

A conforming agent:

1. SHALL implement *all* MANDATORY groups and attributes in this specification.
2. ~~SHALL implement *each* CONDITIONALLY MANDATORY attribute, if the server or device that the agent is instrumenting has the feature represented by the CONDITIONALLY MANDATORY attribute..~~
2. NEED NOT implement any OPTIONAL attributes, whether the agent is able to obtain the information from the server or device.
3. NEED NOT implement both forms of an ~~time~~ attribute if it implements an ~~time~~ attribute that permits a choice of Integer and Octets forms, though implementing both forms may help management applications by giving them a choice of representations, since the representation are equivalent.~~and is recommended *not* to provide both forms for a particular time attribute.~~ See page 56.

   NOTE - This MIB, like the Printer MIB, is written following the subset of SMIv2 that can be supported by SMIv1 and SNMPv1 implementations.

4.2.1 MIB II System Group objects

The Job Monitoring MIB agent SHALL implement all objects in the system group of MIB-II (RFC 1213)[5], whether the Printer MIB[1] is implemented or not.

4.2.2 MIB II Interface Group objects

The Job Monitoring MIB agent SHALL implement all objects in the Interfaces Group of MIB-II (RFC 1213)[5], whether the Printer MIB[1] is implemented or not.

4.2.3 Printer MIB objects

If the agent is instrumenting a device that is a printer, the agent SHALL implement all of the mandatory objects in the Printer MIB[1] and all the objects in other MIBs that conformance to the Printer MIB requires, such as the Host Resources MIB (RFC 1514)[6]. If the agent is instrumenting a server that controls one or more networked printers, the agent NEED NOT implement the Printer MIB and NEED NOT implement the Host Resources MIB.

4.3 Job Monitoring Application Conformance Requirements

A conforming job monitoring application:

1. SHALL accept all objects in all MANDATORY groups and all MANDATORY ~~and CONDITIONALLY MANDATORY~~ attributes that are required to be implemented by an agent according to Section 4.2 and SHALL either present them to the user or ignore them.
2. SHALL accept *all* OPTIONAL attributes, including enum and bit values specified in this specification~~standard~~ and additional ones that may be registered with IANA and SHALL either present them to the user or ignore them. In particular, a conforming job monitoring application SHALL not malfunction when receiving any standard or registered enum or bit values. See Section 7 entitled "IANA Considerations" on page 21.
3. SHALL accept either form of time attribute, if it supports a time attribute, since agents are free to implement either time form. See page 56.

5. Job Identification

There are a number of attributes that permit a user, operator or system administrator to identify jobs of interest, such as **jobOwner**, **jobName**, etc. In addition, there is a Job Submission ID object that allows a monitoring application to quickly locate and identify a particular job of interest that was submitted from a particular client by the user invoking

the monitoring application. The Job Monitoring MIB needs to provide for identification of the job at both sides of the job submission process. The primary identification point is the client side. The Job Submission ID allows the monitoring application to identify the job of interest from all the jobs currently "known" by the server or device. The Job Submission ID can be assigned by either the client's local system or a downstream server or device. The point of assignment will be determined by the job submission protocol in use.

The server/device-side identifier, called the **jmJobIndex** object, will be assigned by the server or device that accepts the jobs from submitting clients. The MIB agent SHALL use the job identifier assigned by the server or device to the job as the value of the **jmJobIndex** object that defines the table rows (there are multiple tables) that contain the information relating to the job. This object allows the interested party to obtain all objects desired that relate to this job. The MIB provides a mapping table that maps each Job Submission ID to the corresponding **jmJobIndex** value, so that an application can determine the correct value for the jmJobIndex value for the job of interest in a single Get operation. See the **jmJobIDGroup** on page 77.

The **jobName** attribute provides a name that the user supplies as~~n~~ a job attribute with the job. The **jobName** attribute is not necessarily unique, even for one user, let alone across users.

6. Internationalization Considerations

There are a number of objects in this MIB that are represented as coded character sets. The data type for such objects is **OCTET STRING**. Such objects could be in different coded character sets and could be localized in the language and country, i.e., could be localized. However, for the Job Monitoring MIB, most of the objects are supplied as job attributes by the client that submits the job to the server or device and so are represented in the coded character set specified by that client. Therefore, the agent is *not* able to provide for different representations depending on the locale of the server, device, or user of the job monitoring application. The only exception is job submission protocols that pass job or document attributes as OBJECT IDENTIFIERS or enums. For those job and document attributes, the agent SHALL represent the corresponding objects in the Job Monitoring MIB as coded character sets in the current (default) locale of the server or printer as established by the system administrator or the implementation.

For simplicity, this specification assumes that the clients, job monitoring applications, servers, and devices are all running in the same locale. However, this specification allows them to run in any locale, including locales that use two-octet coded character sets, such as ISO 10646 (Unicode). Job monitors applications are expected to understand the coded character set of the client (and job), server, or device. No special means is provided for the monitor to discover the coded character set used by jobs or by the server or device.

This specification does *not* contain an object that indicates what locale the server or device is running in, let alone contain an object to control what locale the agent is to use to represent coded character set objects.

This MIB also contains objects that are represented using the **DateAndTime** textual convention from SNMPv2-TC (RFC 1903). The job management application SHALL display such objects in the locale of the user running the monitoring application.

7. IANA Considerations

During the development of this standard, the Printer Working Group (PWG) working with IANA will register additional enums while the standard is in the proposed and draft states according to the procedures described in this section. IANA will handle registration of additional enums after this standard is approved in cooperation with an IANA-appointed registration editor from the PWG according to the procedures described in this section:

7.1 IANA Registration of enums

This specification uses textual conventions to define enumerated values (enums) and bit values. Enumerations (enums) and bit values are sets of symbolic values defined for use with one or more objects or attributes. All enumeration sets and bit value sets are assigned a symbolic data type name (textual convention). As a convention the symbolic name ends in "**TC**" for textual convention. These enumerations are defined at the beginning of the MIB module specification.

This working group has defined several type of enumerations for use in the Job Monitoring MIB and the Printer MIB[1]. These types differ in the method employed to control the addition of new enumerations. Throughout this document, references to "type n enum", where n can be 1, 2 or 3 can be found in the various tables. The definitions of these types of enumerations are:

7.1.1 Type 1 enumerations

Type 1 enumeration: All the values are defined in the Job Monitoring MIB specification (RFC for the Job Monitoring MIB). Additional enumerated values require a new RFC.

NOTE - There are no type 1 enums in the current draft.

7.1.2 Type 2 enumerations

Type 2 enumeration: An initial set of values are defined in the Job Monitoring MIB specification. Additional enumerated values are registered after review by this working group. The initial versions of the MIB will contain the values registered so far. After the

MIB is approved, additional values will be registered through IANA after approval by this working group.

The following type 2 enums are contained in the current draft :

1. **JmTimeStampTC**
2. **JmFinishingTC**
3. **JmPrintQualityTC**
4. **JmTonerEconomyTC**
5. **JmPrinterResolutionTC**
6. ~~**JmTonerDensityTC**~~
6. **JmMediumTypeTC**
7. **JmJobStateTC**
8. **JmAttributeTypeTC**

7.1.3 Type 3 enumeration

Type 3 enumeration: An initial set of values are defined in the Job Monitoring MIB specification. Additional enumerated values are registered without working group review. The initial versions of the MIB will contain the values registered so far. After the MIB is approved, additional values will be registered through IANA without approval by this working group.

NOTE - There are no type 3 enums in the current draft.

7.2 IANA Registration of type 2 bit values

This draft contains the following type 2 bit value textual-conventions:

1. **JmJobServiceTypesTC**
2. **JmJobStateReasons1TC**
3. **JmJobStateReasons2TC**
4. **JmJobStateReasons3TC**
5. **JmJobStateReasons4TC**

These textual-conventions are defined as bits in an Integer so that they can~~may~~ be used with SNMPv1 SMI. The **jobStateReasons*n*** (*n*=1..4) attributes are defined as bit values using the corresponding **JmJobStateReasons*n*TC** textual-conventions.

The registration of **JmJobServiceTypesTC** and **JmJobStateReasons*n*TC** bit values SHALL follow the procedures for a type 2 enum as specified in Section 7.1.2.

7.3 IANA Registration of Job Submission Id Formats

In addition to enums and bit values, this specification assigns numbers to various job submission ID formats. See **jmJobSubmissionID** on page 78. The registration of

jmJobSubmissionID format numbers SHALL follow the procedures for a type 2 enum as specified in Section 7.1.2.

8. Security Considerations

8.1 Read-Write objects

All objects are read-only greatly simplifying the security considerations. If another MIB augments this MIB, that MIB might allow objects in this MIB to be modified. However, that MIB SHALL have to support the required access control in order to achieve security, not this MIB.

8.2 Read-Only Objects In Other User's Jobs

The security policy of some sites may be that unprivileged users can only get the objects from jobs that they submitted, plus a few minimal objects from other jobs, such as the **jmJobKOctetsRequested** and **jmJobKOctetsCompleted** objects**,** so that a user can tell how busy a printer is. Other sites might allow all unprivileged users to see all objects of all jobs. It is up to the agent to implement any such restrictions based on the identification of the user making the SNMP request. This MIB does not require, nor does it specify how, such restrictions would be implemented. A monitoring application SHOULD enforce the site security policy with respect to returning information to an unprivileged end user that is using the monitoring application to monitor jobs that do not belong to that user, i.e., the **jobOwner** attribute in the **jmAttributeTable** does not match the user's user name. See the **JmAttributeTypeTC** textual convention on page 53 and the **jmAttributeTable** on page 86.

An operator is a privileged user that would be able to see all objects of all jobs, independent of the policy for unprivileged users.

9. Returning Objects With No Value In Mandatory Groups

If an object in a mandatory group does not have an instrumented value for a particular job submission protocol or the job submitting client did not supply a value (and the accepting server or device does not supply a default), this MIB requires that the agent SHALL follow the normal SNMP practice of returning a distinguished value, such as a zero-length string, an **unknown(2)** value for an enum, or a (**-2**) for an integer value.

10. Notification and Traps

This MIB does not specify any traps. For simplicity, management applications are expected to poll for status. The resulting network traffic is not expected to be significant.

765 ## 11. MIB specification

766 The following pages constitute the actual Job Monitoring MIB.

```
Job-Monitoring-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, experimental,
    Integer32                                          FROM SNMPv2-SMI
    TEXTUAL-CONVENTION                                 FROM SNMPv2-TC
    MODULE-COMPLIANCE, OBJECT-GROUP                    FROM SNMPv2-CONF;
    -- The following textual-conventions are needed
    -- to implement certain attributes, but are not
    -- needed to compile this MIB.  They are
    -- provided here for convenience:
    -- DateAndTime                                     FROM SNMPv2-TC
    -- PrtAlertCodeTC, PrtInterpreterLangFamilyTC      FROM Printer-MIB

-- Use the experimental (54) OID assigned to the Printer MIB[1] before
-- it was published as RFC 1759.
-- Upon publication of the Job Monitoring MIB as an RFC, delete this
-- comment and the line following this comment and change the
-- reference of { temp 104 } (below) to { mib-2 X }.
-- This will result in changing:
-- 1 3 6 1 3 54 jobmonMIB(105)    to:
-- 1 3 6 1 2  1 jobmonMIB(X)
-- This will make it easier to translate prototypes to
-- the standard namespace because the lengths of the OIDs won't
-- change.
temp OBJECT IDENTIFIER ::= { experimental 54 }

jobmonMIB MODULE-IDENTITY
    LAST-UPDATED "9705420240000Z"
    ORGANIZATION "IETF Printer MIB Working Group"
    CONTACT-INFO
        "Tom Hastings
        Postal:  Xerox Corp.
                 Mail stop ESAE-231
                 701 S. Aviation Blvd.
                 El Segundo, CA 90245

        Tel:     (301)333-6413
        Fax:     (301)333-5514
        E-mail:  hastings@cp10.es.xerox.com"
    DESCRIPTION
        "The MIB module for monitoring job in servers, printers, and
        other devices.

        File: jmp-mib.doc,  .pdf,  .txt,  .mib
        Version: 0.821"
    ::= { temp 105 }
```

```
806
807  -- Textual conventions for this MIB module
808
809
810  JmTimeStampTC ::= TEXTUAL-CONVENTION
811      STATUS      current
812      DESCRIPTION
813          "The simple time at which an event took place.  The units SHALL
814          be in seconds since the system was booted.
815
816          NOTE - JmTimeStampTC is defined in units of seconds, rather than
817          100ths of seconds, so as to be simpler for agents to implement
818          (even if they have to implement the 100ths of a second to comply
819          with implementing sysUpTime in MIB-II[5].)
820
821          NOTE - JmTimeStampTC is defined as an Integer32 so that it can
822          be used as a value of an attribute, i.e., as a value of the
823          jmAttributeValueAsInteger object (see page 88).  The TimeStamp
824          textual-convention defined in SMNPv2-TC is defined as an
825          APPLICATION 3 IMPLICIT INTEGER tag, not an Integer32, so cannot
826          be used in this MIB as one of the values of
827          jmAttributeValueAsInteger."
828      SYNTAX      INTEGER(0..2147483647)
829
830
831
832
833  JmJobSourcePlatformTypeTC ::= TEXTUAL-CONVENTION
834      STATUS      current
835      DESCRIPTION
836          "The source platform type that can submit jobs to servers or
837          devices in any of the 3 configurations."
838
839      -- This is a type 2 enumeration.  See Section 7.1 on page 21.
840      SYNTAX      INTEGER {
                        other(1),
                        unknown(2),
                        sptUNIX(3),             -- UNIX(tm)
                        sptOS2(4),              -- OS/2
                        sptPCDOS(5),            -- DOS
                        sptNT(6),               -- NT
                        sptMVS(7),              -- MVS
                        sptVM(8),               -- VM
                        sptOS400(9),            -- OS/400
                        sptVMS(10),             -- VMS
                        sptWindows95(11),       -- Windows95
                        sptNetWare(33)          -- NetWare
```

```
    }



JmFinishingTC ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
        "The type of finishing."

    -- This is a type 2 enumeration.  See Section 7.1 on page 21.
    SYNTAX      INTEGER {
        other(1),
            -- Some other finishing besides one of the specified or
            -- registered values.

        unknown(2),
            -- The finishing is unknown.

        none(3),
            -- Perform no finishing.

        staple(4),
            -- Bind the document(s) with one or more staples. The
            -- exact number and placement of the staples is site-
            -- defined.

        stapleTopLeft(5),
            -- Place one or more staples on the top left corner of
            -- the document(s).

        stapleBottomLeft(6),
            -- Place one or more staples on the bottom left corner
            -- of the document(s).

        stapleTopRight(7),
            -- Place one or more staples on the top right corner of
            -- the document(s).

        stapleBottomRight(8),
            -- Place one or more staples on the bottom right corner
            -- of the document(s).

        saddleStitch(9),
            -- Bind the document(s) with one or more staples (wire
            -- stitches) along the middle fold.  The exact number
            -- and placement of the stitches is site-defined.
```

```
            edgeStitch(10),
                -- Bind the document(s) with one or more staples (wire
                -- stitches) along one edge.  The exact number and
                -- placement of the staples is site-defined.

            punch(11),
                -- This value indicates that holes are required in the
                -- finished document. The exact number and placement of
                -- the holes is site-defined  The punch specification
                -- MAY be satisfied (in a site- and implementation-
                -- specific manner) either by drilling/punching, or by
                -- substituting pre-drilled media.

            cover(12),
                -- This value is specified when it is desired to select
                -- a non-printed (or pre-printed) cover for the
                -- document. This does not supplant the specification of
                -- a printed cover (on cover stock medium) by the
                -- document itself.

            bind(13)
                -- This value indicates that a binding is to be applied
                -- to the document; the type and placement of the
                -- binding is site-defined.

854     }
855
856
857
858
859
860 JmPrintQualityTC ::= TEXTUAL-CONVENTION
861     STATUS      current
862     DESCRIPTION
863         "Print quality settings."
864
865     -- This is a type 2 enumeration.  See Section 7.1 on page 21.
866     SYNTAX      INTEGER {
            other(1),     --  Not one of the specified or registered
                          --  values.
            unknown(2),   --  The actual value is unknown.
            draft(3),     --  Lowest quality available on the printer.
            normal(4),    --  Normal or intermediate quality on the
                          --  printer.
            high(5)       --  Highest quality available on the printer.
867     }
868
```

```
JmPrinterResolutionTC ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
        "Printer resolutions.

        The values are type2 enums that represent single integers or
        pairs of integers.  The latter are to specify the resolution
        when the x and y dimensions differ.  When two integers are
        specified, the first is in the x direction, i.e., in the
        direction of the shortest dimension of the medium, so that the
        value is independent of whether the printer feeds long edge or
        short edge first."

    -- This is a type 2 enumeration.  See Section 7.1 on page 21.
    SYNTAX      INTEGER {
         other(1),          --  Not one of the specified or registered
                            --  values.
         unknown(2),        --  The actual value is unknown.
         normal(3),         --  Normal resolution.
         res100(4),         --  100 x 100 dpi
         res200(5),         --  200 x 200 dpi
         res240(6),         --  240 x 240 dpi
         res300(7),         --  300 x 300 dpi
         res360(8),         --  360 x 360 dpi
         res600(9),         --  600 x 600 dpi
         res720(10),        --  720 x 720 dpi
         res800(11),        --  800 x 800 dpi
         res1200(12),       --  1200 x 1200 dpi
         res1440(13),       --  1440 x 1440 dpi
         res1800(14),       --  1800 x 1800 dpi
         res100x200(15),    --  100 x 200 dpi
         res300x600(16),    --  300 x 600 dpi
         res600x300(17),    --  600 x 300 dpi
         res360x720(18),    --  360 x 720 dpi
         res720x360(19),    --  720 x 360 dpi
         res400x800(20),    --  400 x 800 dpi
         res800x400(21),    --  800 x 400 dpi
         res600x1200(22),   --  600 x 1200 dpi
         res1200x600(23),   --  1200 x 600 dpi
         res720x1440(24),   --  720 x 1440 dpi
         res1440x720(25),   --  1440 x 720 dpi
         res1800x600(26)    --  1800 x 600 dpi
    }
```

```
890
891  JmTonerEconomyTC ::= TEXTUAL-CONVENTION
892      STATUS      current
893      DESCRIPTION
894          "Toner economy settings."
895
896      -- This is a type 2 enumeration.  See Section 7.1 on page 21.
897      SYNTAX      INTEGER {
                         off(0),         --  Off.  Normal.  Use full toner.
                         on(1)           --  On.  Use less toner than normal.
898      }
899
900
901
902
903
904  JmMediumTypeTC ::= TEXTUAL-CONVENTION
905      STATUS      current
906      DESCRIPTION
907          "Identifies the type of medium."
908
909      -- This is a type 2 enumeration.  See Section 7.1 on page 21.
910      SYNTAX      INTEGER {
                       other(1),
                           -- The type is neither one of the values listed in this
                           -- specification nor a registered value.

                       unknown(2),
                           -- The type is not known.

                       stationery(3),
                           -- Separately cut sheets of an opaque material.

                       transparency(4),
                           -- Separately cut sheets of a transparent material.

                       envelope(5),
                           -- Envelopes that can be used for conventional mailing
                           -- purposes.

                       envelopePlain(6),
                           -- Envelopes that are not preprinted and have no windows.

                       envelopeWindow(7),
                           -- Envelopes that have windows for addressing purposes.

                       continuousLong(8),
```

```
            -- Continuously connected sheets of an opaque material
            -- connected along the long edge.

        continuousShort(9),
            -- Continuously connected sheets of an opaque material
            -- connected along the short edge.

        tabStock(10),
            -- Media with tabs.

        multiPartForm(11),
            -- Form medium composed of multiple layers not pre-attached
            -- to one another;  each sheet MAY be drawn separately from
            -- an input source.

        labels(12),
            -- Label-stock.

        multiLayer(13)
            -- Form medium composed of multiple layers which are pre-
            -- attached to one another, e.g. for use with impact
            -- printers.

    }
```

```
JmJobStateTC ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
        "The current state of the job (pending, processing,
        completedheld, etc.).

        Management applications shall be prepared to receive all the
        standard job states.  Agents instrumenting servers and devices
        are not required to generate all job states, only those that are
        indicated as 'mandatory' in the enum definitions below.  The
        remaining job states are 'conditionally mandatory', i.e., an
        agent for a server or device shall implement each of the
        remaining states if server or device jobs have states with the
        same semantics.  See Section  entitled '' on page for additional
        job state semantics, legal job state transitions, and
        implementation considerations.

        Companion textual conventions (JmJobStateReasonsnTC, n=1..4) and
        corresponding attributes (jobStateReasonsn) provide additional
```

~~information about job states. While the job states cannot be added to without impacting deployed clients that take actions upon receiving job state values, it is the intent that additional **JmJobStateReasons*n*TC** enums can be defined without impacting deployed clients. In other words, the **JmJobStateReasons*n*TC** TCs are intended to be extensible. See page .~~

~~The following job state standard values are defined:~~The following figure shows the normal job state transitions:

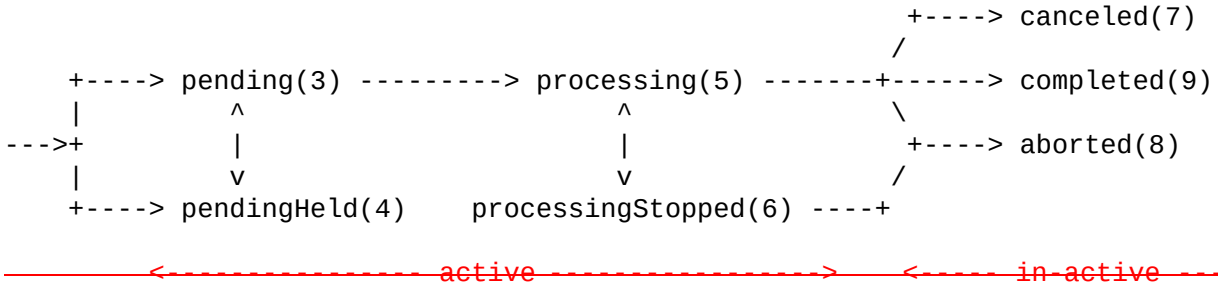


Figure 4 - Normal Job State Transitions

Normally a job progresses from left to right. Other state transitions are unlikely, but are not forbidden. Not shown are the transitions to ~~T~~the **canceled** state ~~can be entered~~ from the **pending**, **pendingHeld**, **processing**, and~~or~~ **processingStopped** states.

Jobs in the **pending**, **processing**, and **processingStopped** states are called 'active', while jobs in the **pendingHeld**, **canceled**, **aborted**, and **completed** are called 'in-active'."

```
    -- This is a type 2 enumeration.  See Section 7.1 on page 21.
    SYNTAX      INTEGER {
          other(1),
              -- The job state is not one of the defined states.

          unknown(2),
              -- The job state is not known, or its state is
              -- indeterminate.

          pending(34),
              -- The job is a candidate to starta candidate for
              -- processing, but is not yet processing.

          pendingHheld(43),
              -- The job is not yet a candidate for processing for
              -- any number of reasons but will return to the
```

```
        -- pending state as soon as the reasons are no longer
        -- present.  The job's jmJobStateReasons1 object
        -- and/or jobStateReasonsn (n=2..4) attributes SHALL
        -- indicate why the job is no longer a candidate for
        -- processing.  The reasons are represented as bits
        -- in the jmJobStateReasons1 object and/or
        -- jobStateReasonsn (n=2..4) attributes. -- Some
        -- reasons are used in other states to give added
        -- information about the job state.  See the
           JmJobStateReasonsn1TC (n=1..4) textual convention
           on page (60) for the specification of each reason
           and in which states the reasons are intended to be
           used.

    processing(55),                              MANDATORY
        -- Either:
        --
        -- 1.  The job is using, or is attempting to use, one
        -- or more document transforms which include (1)
        -- purely software processes that are, such as
        -- interpreting a PDL, and (2) hardware devices that
        -- are interpreting a PDL, , but is not yet making
        -- marks on a medium, and/or performing finishing,
        -- such as stapling, etc.
        --
        -- OR
        --
        -- 2. (configuration 2) the server has made the job
        -- ready for printing, but the output device is not
        -- yet printing it, either because the job hasn't
        -- reached the output device or because the job is
        -- queued in the output device or some other spooler,
        -- awaiting the output device to print it.
        --
        --
        -- If an implementation does not distinguish between
        -- processing and printing, then the processing state
        -- shall be implemented.
        -- When the job is in the processing state, the
        -- entire job state includes the detailed status
        -- represented in the device MIB indicated by the
        -- hrDeviceIndex value of the job's physicalDevice
        -- attribute, if the agent implements such a device
        -- MIB.
        --
        -- Implementations MAY, though they NEED NOT, include
           additional values in the job's jmJobStateReasons1
           object to indicate the progress of the job, such
           as adding the jobPrinting value to indicate when
```

the device is actually making marks on a medium.

~~**printing(6),**~~
~~-- The job is printing, i.e., making marks on a~~
~~-- medium.~~
~~--~~
~~-- If an implementation does *not* distinguish between~~ ~~**processing** and **printing**, then the **processing** state~~ ~~shall be implemented.~~

processingStopped~~needsAttention~~(~~6~~7 ~~MANDATORY~~
),
-- The job has stopped while processing for any
-- number of reasons and will return to the
-- **processing** state as soon as the reasons are no
-- longer present.
--
-- The job's **jmJobStateReasons1** object and/or the
-- job's **jobStateReasons*n*** (***n*=2..4**) attributes MAY
-- indicate why the job has stopped processing. ~~is~~
-- ~~using one or more devices, but has encountered a~~
-- ~~problem with at least one device that requires~~
-- ~~human intervention before the job can continue~~
-- ~~using that device. Examples include running out~~
-- ~~of paper or a paper jam.~~
--
-- For example, if the output device is stopped, the
-- **device~~S~~topped** value MAY be included in the job's
-- **jmJobStateReasons1** object.
--
-- NOTE - When an output device is stopped, the
-- device~~s~~ usually indicate its~~their~~ condition in
human readable form locally at the device. The
management application can obtain more complete
device status remotely by querying the appropriate
device MIB using the job's **deviceIndex**
attribute(s), if the agent implements such a
device MIB~~.~~

canceled(~~7~~8), ~~MANDATORY~~
-- A client has canceled the job and ~~I~~the job is
-- either: (1) in the process of being terminated by
-- the server or device or (2) has completed
-- terminating~~ the job, either because the client~~
-- ~~canceled the job or because a serious problem was~~
-- ~~encountered by a document transform while~~
~~processing the job~~. The job's **jmJobStateReasons1**
object~~attribute~~ SHOULD~~shall~~ contain either the
canceledByUser or **canceledByOperator** value~~the~~

```
                ~~reasons that the job was canceled.  The job shall~~
                ~~remain in the **canceled** state for the same period~~
                ~~of time as if the job had completed, before~~
                ~~transiting to the **unknown** state.  See the~~
                ~~**completed** state description.~~

            **aborted(8)**,
                -- The job has been aborted by the system, usually
                -- while the job was in the **processing** or
                -- **processingStopped** state.

            **completed(9)**                                ~~MANDATORY~~
                -- The job has ~~(1)~~ completed successfully or with
                -- warnings or errors after processing~~/printing~~ and
                -- all of the media have been successfully stacked in
                -- the appropriate output bin(s).
                --
                -- ~~The job has completed successfully or with~~
                -- ~~warnings or errors.~~  The job's **jmJobStateReasons1**
                -- object~~attribute~~ SHOULD~~shall~~ contain one of:
                -- **completedSuccessfully**, **completedWithWarnings**, or
                -- **completedWithErrors** values~~the reasons that the job~~
                -- ~~has entered the **completed** state~~.
                --
                    ~~The length of time that a job may be in the~~
                    ~~**completed** state, before transitioning to **unknown**,~~
                    ~~is specified by the value of the~~
                    ~~**jmGeneralJobPersistence** object.  In addition, the~~
                    ~~agent shall maintain all of the attributes in the~~
                    ~~**jmAttributeTable** for at least the time specified~~
                    ~~in the **jmGeneralAttributePersistence** object, so~~
                    ~~that a management application accounting program~~
                    ~~can copy all the attributes to an accounting log.~~

970     }
971
972
973 **JmAttributeTypeTC** ::= TEXTUAL-CONVENTION
974     STATUS      current
975     DESCRIPTION
976         "The type of the attribute which identifies the attribute.
977
978         Some attributes represent information about a job, such as a
979         file-name, or a document-name, or submission-time or completion
980         time.  Other attributes represent resources required, e.g., a
981         medium or a colorant, etc. to process the job before the job
982         start processing OR to indicate the amount of the resource that
983         is being consumed while the job is processing, e.g., pages
```

completed or impressions completed. If both a required and a consumed value of a resource is needed, this specification assigns two separate attribute enums in the textual convention.

Most attributes apply to all three configurations covered by this MIB specification (see section 3 on page 14). Those attribute that apply to a particular configuration are indicated as '**Configuration *n*:**'.

Conformance of Attribute Implementation

A very few ~~Some~~ attributes are MANDATORY for conformance, and the rest are OPTIONAL~~CONDITIONALLY MANDATORY~~. An agent SHALL instrument any MANDATORY attribute. If the server or device does not provide access to the information about the MANDATORY attribute, the agent SHALL return the '**unknown**' value. For attributes represented by a counting integer, the unknown value is (**-2**) and for attributes represented by an enum, the unknown value is (**2**), as in the Printer MIB[1]. For attributes represented by an OCTET STRING, the unknown value is a zero-length string, unless specified otherwise.

~~An agent shall instrument any CONDITIONALLY MANDATORY attribute if the server or device provides access to the information about the attribute to the agent. If the server or device does *not* provide access to the information about the CONDITIONALLY MANDATORY attribute, the agent need *not* create the row in the **jmAttributeTable**.~~

~~The mandatory attributes are the ones required to have copies in the **jmJobStateTable** and to remain in the **jmAttributeTable** longer.~~ The MANDATORY attributes are:

jobOwner(2015)

The attributes not labeled as MANDATORY are OPTIONAL. An agent MAY, but NEED NOT, implement any OPTIONAL attributes.

NOTE - The table of contents lists all the attributes in order to help see the order of enum assignments which is the order that the GetNext operation can be used to get attributes. The table of contents also indicates the MANDATORY attributes as: (MANDATORY).

NOTE - The enum assignments are grouped logically with values assigned in groups of 20, so that additional values may be registered in the future and assigned a value that is part of their logical grouping.

~~**Attribute Creation**~~

~~An agent shall create a row in the **jmAttributeTable** for each attribute that is (1) supplied with a job when the job is accepted by a server or device or that (2) the server or device supplies as a default either when the job is accepted or later during processing. The agent SHALL create the MANDATORY attributes when the job is accepted. The agent MAY create the remaining attributes when the agent has the information.~~

Datatypes and Attribute Naming Conventions

The datatype of each attribute is indicated on the first line(s) of the description. Some attributes have several different data type representations. When the data types can be represented in a single row in the **jmAttributeTable**, the data type name is not included as the last part of the name of the attribute. When the data types cannot be represented by a single row in the **jmAttributeTable**, ~~E~~each such representation is considered a separate attribute and is assigned a separate name and enum value. For these attributes, the name of the datatype is the last part of the name of the attribute: **Name**, **Index**, **DateAndTime**, **TimeStamp**, etc.

NOTE: No attribute name exceeds 31 characters.

Single-Value (Row) Versus Multi-Value (MULTI-ROW) Attributes

Most attributes SHALL have only one row per job. However, a few attributes can have multiple values per job or even per document, where each value is a separate row in the **jmAttributeTable**. Unless indicated with '**MULTI-ROW:**' in **JmAttributeTypeTC**, an agent SHALL ensure that each attribute item occurs only once in the **jmAttributeTable** for a job. Attributes that are permitted to appear multiple times in the **jmAttributeTable** for a job are indicated with '**MULTI-ROW:**' in their specification in the **JmAttributeTypeTC**. However, such '**MULTI-ROW**' attribute items SHALL *not* contain duplicates for 'intensive' (as opposed to 'extensive') attributes.

For example, a job or document(s) may use multiple PDLs. However, each distinct **documentFormat~~Type~~** attribute value ~~entry~~ SHALL appear in the **jmAttributeTable** only once for a job since the interpreter language is an intensive attribute item, even though the job has a number of documents that all use the same PDL.

As another example of an intensive attribute that can have multiple entries, if a document or job uses

multiple types of media, there SHALL be only one row in the **jmAttributeTable** for each media type, not one row for each document that uses that medium type.

On the other hand, if a job contains two documents of the same name, there can be separate rows for the **documentName** attribute item with the same name, since a document name is an extensive attribute item. The specification indicates that the values NEED NOT be unique for such '**MULTI-ROW:** attributes'

Value Represented As Integer Or Octets

In the following definitions of the enums, each description indicates whether the value of the attribute SHALL be represented using the **jmAttributeValueAsInteger** or the **jmAttributeValueAsOctets** objects by the initial tag: '**INTEGER:**' or '**OCTETS:**', respectively. Some attributes allow the agent a choice of either an integer and/or an octets representation, depending on implementation. These attributes are indicated with '**INTEGER:**' and/or '**OCTETS:**' tags. A very few attributes require~~use~~ both objects at the same time to represent a pair of values (see **mediumConsumed~~Name~~(17~~165~~)**) ~~and so have both tags~~. These attributes are indicated with '**INTEGER:**' and/or '**OCTETS:**' tags. See the **jmAttributeGroup** starting on page 85 for the descriptions of these objects.

Consumption Attributes

A number of attributes record consumption. Such attribute names end with the word '**Completed**' or '**Consumed**'. If the job has not yet consumed what that resource is metering, the agent either: (1) SHALL return the value **0** or (2) SHALL *not* add this attribute to the **jmAttributeTable** until the consumption begins. In the interests of brevity, the semantics for **0** is specified once here and is *not* repeated for each **xxxxYyyyCompleted** and **xxxxYyyyConsumed** attribute specification.

Index Value Attributes

A number of attributes are indexes in other tables. Such attribute names end with the word '**Index**'. If the agent does not (yet) know the index value for a particular index attribute for a job, the agent either: (1) SHALL return the value **0** or (2) SHALL *not* add this attribute to the **jmAttributeTable** until the index value is known. In the interests of brevity, the semantics for **0** is specified once here and is *not* repeated for each index attribute specification.

```
1131        ~~Attribute Naming Conventions~~
1132
1133        ~~Attribute names often end in the data type, especially when~~
1134        ~~there are more than one data type for the same information.~~
1135        ~~Thus the suffixes are used: **Name, Index, DateAndTime, TimeStamp,**~~
1136        ~~etc.~~
1137
1138        ~~NOTE: No attribute name exceeds 31 characters.~~
1139
1140        The standard attribute types defined so far are:"
1141
1142      -- This is a type 2 enumeration.  See Section 7.1 on page 21.
1143      SYNTAX      INTEGER {
          -- jmAttributeTypeIndex              Datatype
              -- Description - including 'OCTETS:' or 'INTEGER:' to
              -- specify whether the value SHALL be represented in the
              -- jmAttributeValueAsOctets or the jmAttributeValueAsInteger
              -- object, or both, respectively.

          other(1),                           -- Integer32(-2..2147483647)
                                              -- AND/OR
                                              -- OCTET STRING(SIZE(0..63))
              -- INTEGER:  and/or  OCTETS:  An attribute that is not in
              -- the list and/or that has not been approved and registered
              -- with IANA.

          unknown(2),                         -- Integer32(-2..2147483647)
                                              -- OR
                                              -- OCTET STRING(SIZE(0..63))
              -- INTEGER:  or  OCTETS:  An attribute whose semantics are
              -- not known to the agent.


          -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
          -- Job State attributes
          --
          -- The following attributes specify the state of a job.
          -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

          ~~jobState(3),~~                    ~~-- JmJobStateTC (pg )~~
              ~~-- INTEGER:  The current state of the job (**pending**,~~
              ~~-- **processing**, **held**, etc.).  The final value for this~~
              ~~-- attribute shall be either **completed** or **canceled**, before~~
              ~~-- the agent removes the job from the table.~~
              ~~--~~
              ~~-- Management applications shall be prepared to receive all~~
              ~~-- the standard job states.  Servers and devices are not~~
              ~~-- required to generate all job states, only those which are~~
              ~~-- appropriate for the particular implementation.~~
```

-- --
-- NOTE - Companion textual conventions,
-- **JmJobStateReasons*n*TC (*n*=1..4** - see page) and
-- corresponding attributes (- see page) provides
-- additional information about job states. While the job
-- states cannot be added to without impacting deployed
-- clients, it is the intent that additional
-- **JmJobStateReasons*n*TC** enums can be defined without
-- impacting deployed clients.

jobStateAssociatedValue(4), -- **Integer32(-2..2147483647)**
-- INTEGER: The value of the most relevant attribute
-- associated with the job's current state.
--
-- Which attribute depends on the job's current state (as
-- specified by the value of the **jmJobState/jobState**
-- object/attribute) as follows:
--
-- **jmJobState** Associated Attribute Page
-- **/jobState**
--
--
--
-- NOTE - The **jobStateAssociatedValue** attribute selects from
-- amongst seven mandatory attributes that attribute that is
-- most relevant to the job's current state. the
-- **jobStateAssociatedValue** attribute is provided as an
-- efficiency improvement, so that an application can obtain
-- the most relevant attribute for each job's current state
-- (1) without first having to determine the job's state or
-- (2) having to request all seven mandatory attributes in
-- the same GetNext operation that obtains the next job in
-- the next conceptual row in the **jmAttributeTable**.
--
--
--
--
--
--

jobStateReasons1(5), -- **JmJobStateReasons1TC** (pg)
-- OCTETS: Additional information about the job's current
-- state that augments the **jmJobState/jobState**
-- object/attribute. The **jobStateReasons1** attribute
-- identifies the reason or reasons that the job is in the
-- **held, pending, processing, needsAttention, canceled**, or
-- **completed** state. The agent shall indicate the particular
-- reason(s) by setting the value of the **jobStateReasons1**
-- attribute. When the job does not have any reasons for
-- being in its current state, the agent shall set the value

```
        -- of the jobStateReasons1 attribute to 0.
        --
        -- While the job states cannot be added to without impacting
        -- deployed clients, it is the intent that additional
        -- JmJobStateReasons1TC bit values can be defined without
        -- impacting deployed clients.  In other words, the
        -- JmJobStateReasons1TC TC is intended to be extensible.
        --
        -- Companion job state reasons TCs: JmJobStateReasons2TC,
        -- JmJobStateReasons3TC, JmJobStateReasons4TC, are
        -- defined/reserved for additional 31*3 = 93 job state
        -- reasons for use with the corresponding attributes:
        -- jobStateReasons2, jobStateReasons3, and jobStateReasons4.
        -- This is a type 2 bit definition.  See section  on page .
        --
    jobStateReasons2(36),           -- JmJobStateReasons2TC (pg 64)
        -- INTEGEROCTETS:  Additional information about the job's
        -- current state that augments the jmJobState/jobState
        -- object/attribute.  See the description under the
        -- jJmJobStateReasons1TC textual-conventionattribute on page
           60.

           This is a type 2 bit definition.  See section  on page .

    jobStateReasons3(47),           -- JmJobStateReasons3TC (pg 70)
        -- INTEGEROCTETS:  Additional information about the job's
        -- current state that augments the jmJobState/jobState
        -- object/attribute.  See the description under
        -- jJmJobStateReasons1TC textual-conventionattribute  on
           page 60.

    jobStateReasons4(58),           -- JmJobStateReasons4TC (pg 70)
        -- INTEGEROCTETS:  Additional information about the job's
        -- current state that augments the jmJobState/jobState
        -- object/attribute.  See the description under
        -- jJmJobStateReasons1TC textual-conventionattribute  on
           page 60.

    numberOfInterveningJobs(9),     -- Integer32(-2..2147483647)
        -- INTEGER:  The number of jobs that are expected to be
        -- processed before this job is processed according to the
        -- implementation's queuing algorithm if no other jobs were
        -- to be submitted.  In other words, this value is the job's
        -- queue position.  The agent shall return a value of 0 for
        -- this attribute when this job starts processing (since
        -- there are no jobs in front of the job).

    deviceAlertCode(610),           -- PrtAlertCodeTC (Printer-MIB)
        -- INTEGER:  The device alert code when the job is stopped
```

```
    -- because the device needs attention, i.e., needs human
    -- intervention.  When the device is a printer, this device
    -- alert code SHALL be the printer alert code defined by the
    -- Printer MIB[1] using the PrtAlertCodeTC textual
    -- convention or equivalent.

processingMessage(711),          -- OCTET STRING(SIZE(0..63))
    -- OCTETS:  MULTI-ROW:  A coded character set message that
    -- is generated during the processing of the job as a simple
    -- form of processing log to show progress and any problems.
    --
    -- There is no restriction on the same message in multiple
    -- rows.


-- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
-- Job Identification attributes
--
-- The following attributes help an end user, a system
-- operator, or an accounting program identify a job.
-- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

jobOwner(2015),                  -- OCTET STRING(SIZE(0..63))
                                 -- (MANDATORY)
    -- OCTETS:  The coded character set name of the user that
    -- submitted the job.  The method of assigning this user
    -- name will be system and/or site specific but the method
    -- must insure that the name is unique to the network that
    -- is visible to the client and target device.
    --
    -- This value SHOULD be the authenticated name of the user
    -- submitting the job.
    --
    -- In order to assist users to find their jobs for job
    -- submission protocols that don't supply a
    -- jmJobSubmissionID, the agent SHOULD maintain the jobOwner
    -- attribute for the time specified by the
    -- jmGeneralJobPersistence object, rather than the (shorter)
    -- jmGeneralAttributePersistence object.

jobAccountName(2116),            -- OCTET STRING(SIZE(0..63))
    -- OCTETS:  Arbitrary binary information which MAY be coded
    -- character set data or encrypted data supplied by the
    -- submitting user for use by accounting services to
    -- allocate or categorize charges for services provided,
    -- such as a customer account name.
    --
    -- NOTE: This attribute NEED NOT be printable characters.
```

```
    serverAssignedJobName(2212),     -- OCTET STRING(SIZE(0..63))
        -- OCTETS:  Configuration 3 only:  The human readable string
        -- name of the job as assigned by the server that submitted
        -- the job to the device that the agent in instrumenting
        -- with this MIB.
        --
        -- NOTE - This attribute is intended for enabling a user to
        -- find his/her job that a server submitted to a device
        -- after the user submitted the job to the server when the
        -- jmJobSubmissionIDGroup is not supported by the job
        -- submission protocolimplemented.

    jobName(2313),                   -- OCTET STRING(SIZE(0..63))
        -- OCTETS:  The human readable string name of the job as
        -- assigned by the submitting user to help the user
        -- distinguish between his/her various jobs.  This name does
        -- not need to be unique.
        --
        -- This attribute is intended for enabling a user or the
        -- user's application to convey a job name that MAY be
        -- printed on a start sheet, returned in a query result, or
        -- used in notification or logging messages.
        --
        -- In order to assist users to find their jobs for job
        -- submission protocols that don't supply a
        -- jmJobSubmissionID, the agent SHOULD maintain the jobName
        -- attribute for the time specified by the
        -- jmGeneralJobPersistence object, rather than the (shorter)
        -- jmGeneralAttributePersistence object.
        --
        -- If this attribute is not specified when the job is
        -- submitted, no job name is assumed, but implementation
        -- specific defaults are allowed, such as the value of the
        -- documentName attribute of resource item of the first
        -- document in the job or the fileName attribute resource
        -- item of the first document in the job.
        --
        -- The jobName attribute is distinguished from the
        -- jobComment attribute, in that the jobName attribute is
        -- intended to permit the submitting user to distinguish
        -- between different jobs that he/she has submitted.  The
        -- jobComment attribute is intended to be free form
        -- additional information that a user might wish to use to
        -- communicate with himself/herself, such as a reminder of
        -- what to do with the results or to indicate a different
        -- set of input parameters were tried in several different
        -- job submissions.

    jobServiceTypes(2414),           -- JmJobServiceTypesTC (pg 59)
```

```
        -- INTEGER:  Specifies the type(s) of service to which the
        -- job has been submitted (print, fax, scan, etc.).  The
        -- service type is bit encoded with each job service type so
        -- that more general and arbitrary services can be created,
        -- such as services with more than one destination type, or
        -- ones with only a source or only a destination.  For
        -- example, a job service might scan, faxOut, and print a
        -- single job.  In this case, three bits would be set in the
        -- jobServiceTypes attribute, corresponding to the
        -- hexadecimal values: 0x8 + 0x20 + 0x4, respectively,
        -- yielding: 0x2C.
        --
        -- Whether this attribute is set from a job attribute
        -- supplied by the job submission client or is set by the
        -- recipient job submission server or device depends on the
        -- job submission protocol.  This attribute SHALL be
        -- implemented if the server or device has other types in
        -- addition to or instead of printing.
        --
        -- One of the purposes of this attribute is to permit a
        -- requester to filter out jobs that are not of interest.
        -- For example, a printer operator may only be interested in
        -- jobs that include printing.  That is why this attribute
        -- is in the job identification category.

    jobSourceChannelIndex(2517),     -- Integer32(0..2147483647)
        -- INTEGER:  The index of the row in the associated Printer
        -- MIB[1] of the channel which is the source of the print
        -- job.
        --
        -- NOTE - the Job Monitoring MIB points to the Channel row
        -- in the Printer MIB[1], so there is no need for a port
        -- attribute in the Job Monitoring MIB, since the PWG is
        -- adding a prtChannelInformation object to the Channel
        -- table of the draft Printer MIB.

    jobSourcePlatformType(2618),     -- JmJobSourcePlatformTypeTC
                                     -- (pg 26)
        -- INTEGER:  The source platform type of the immediate
        -- upstream submitter that submitted the job to the server
        -- (configuration 2) or device (configuration 1 and 3) that
        -- the agent is instrumenting.  For configuration 1, this is
        -- the type of the client that submitted the job to the
        -- device;  for configuration 2, this is the type of the
        -- client that submitted the job to the server; and for
        -- configuration 3, this is the type of the server that
        -- submitted the job to the device.

    submittingServerName(2719),      -- OCTET STRING(SIZE(0..63))
```

```
        -- OCTETS:  For configuration 3 only:  The administrative
        -- name of the server that submitted the job to the device.

    submittingApplicationName(2820)  -- OCTET STRING(SIZE(0..63))
    ,
        -- OCTETS:  The name of the client application (not the
        -- server in configuration 3) that submitted the job to the
        -- server or device.

    jobOriginatingHost(29),          -- OCTET STRING(SIZE(0..63))
        -- OCTETS:  The name of the client host (not the server host
        -- name in configuration 3) that submitted the job to the
        -- server or device.

    deviceNameRequested(3021),       -- OCTET STRING(SIZE(0..63))
        -- OCTETS:  The administratively defined coded character set
        -- name of the target device requested by the submitting
        -- user.  For configuration 1, its value corresponds to the
        -- Printer MIB[1]: prtGeneralPrinterName object (added to
        -- the draft Printer MIB) for printers.  For configuration 2
        -- and 3, its value is the name of the logical or physical
        -- device that the user supplied to indicate to the server
        -- on which device(s) they wanted the job to be processed.

    queueNameRequested(3122),        -- OCTET STRING(SIZE(0..63))
        -- OCTETS:  The administratively defined coded character set
        -- name of the target queue requested by the submitting
        -- user.  For configuration 1, its value corresponds to the
        -- queue in the device that the agent is instrumenting.  For
        -- configuration 2 and 3, its value is the name of the queue
        -- that the user supplied to indicate to the server on which
        -- device(s) they wanted the job to be processed.
        --
        -- NOTE - typically an implementation SHOULD support either
        -- the deviceNameRequested or queueNameRequested attribute,
        -- but not both.

    physicalDeviceIndex(3223),       -- hrDeviceIndex (see HR MIB)
                                     -- AND/OR
                                     -- OCTET STRING(SIZE(0..63))
        -- INTEGER:  MULTI-ROW:  The index of the physical device
        -- MIB instance requested/used, such as the Printer MIB[1].
        -- This value is an hrDeviceIndex value.  See the Host
        -- Resources MIB[6].
        -- AND/OR
        -- OCTETS:  MULTI-ROW:  The name of the physical device to
        -- which the job is assigned.

    physicalDeviceName(24),          -- OCTET STRING(SIZE(0..63))
```

```
        -- OCTETS:  MULTI-ROW:  The name of the physical device to
        -- which the job is assigned.

    numberOfDocuments(3325),          -- Integer32(0..2147483647)
        -- INTEGER:  The number of documents in this job.  If this
        -- attribute is not present, the number of documents SHALL
        -- be 1.

    fileName(3426),                   -- OCTET STRING(SIZE(0..63))
        -- OCTETS:  MULTI-ROW:  The coded character set file name of
        -- the document.
        --
        -- There is no restriction on the same file name in multiple
        -- rows.

    documentName(3527),               -- OCTET STRING(SIZE(0..63))
        -- OCTETS:  MULTI-ROW:  The coded character set name of the
        -- document.
        --
        -- There is no restriction on the same document name in
        -- multiple rows.

    jobComment(3628),                 -- OCTET STRING(SIZE(0..63))
        -- OCTETS:  An arbitrary human-readable coded character text
        -- string supplied by the submitting user or the job
        -- submitting application program for any purpose.  For
        -- example, a user might indicate what he/she is going to do
        -- with the printed output or the job submitting application
        -- program might indicate how the document was produced.
        --
        -- The jobComment attribute is not intended to be a name;
        -- see the jobName attribute.

    documentFormatIndex(3729),        -- Integer32(0..2147483647)
        -- INTEGER:  MULTI-ROW:  The index in the
        -- prtInterpreterTable interpreter language family index in
        -- the Printer MIB[1] of the page description language (PDL)
        -- or control language interpreter prtInterpreterLangFamily
        -- object, that this job requires/uses.  A document or a job
        -- MAY use more than one PDL or control language.
        --
        -- NOTE - As with all intensive attribute items where
        -- multiple rows are allowed, there SHALL be only one
        -- distinct row for each distinct interpreterPDL; there
        -- SHALL be no duplicates.
        --
        -- NOTE - This attribute type is intended to be used with an
        -- agent that implements the Printer MIB and SHALL not be
        -- used if the agent does not implement the Printer MIB.
```

```
        -- Such ans agent SHALL use the documentFormatType attribute
           instead.

    documentFormatType(3830),          -- PrtInterpreterLangFamilyTC
                                       -- AND/OR
                                       -- OCTET STRING(SIZE(0..63))
        -- INTEGER:  MULTI-ROW:  The interpreter language family
        -- corresponding to the Printer MIB[1]
        -- prtInterpreterLangFamily object, that this job
        -- requires/uses.  A document or a job MAY use more than one
        -- PDL or control language.
        --
        -- NOTE - This attribute is represented by a type 2 enum
        -- defined in the draft Printer MIB[1], but is not in RFC
        -- 1759.
        --
        -- AND/OR
        --
        -- OCTETS:  MULTI-ROW:  The document format registered as a
        -- MIME type, i.e., the name of the MIME type.
        --
        -- NOTE - IPP[3] uses MIME type keywords to identify
        -- document formats.


    -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
    -- Job Parameter attributes
    --
    -- The following attributes represent input parameters
    -- supplied by the submitting client in the job submission
    -- protocol.
    -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

    jobPriority(5031),                 -- Integer32(1..100)
        -- INTEGER:  The priority for scheduling the job. It is used
        -- by servers and devices that employ a priority-based
        -- scheduling algorithm.
        --
        -- A higher value specifies a higher priority. The value 1
        -- is defined to indicate the lowest possible priority (a
        -- job which a priority-based scheduling algorithm SHALL
        -- pass over in favor of higher priority jobs). The value
        -- 100 is defined to indicate the highest possible priority.
        -- Priority is expected to be evenly or 'normally'
        -- distributed across this range. The mapping of vendor-
        -- defined priority over this range is implementation-
        -- specific.

    jobProcessAfterDateAndTime(5132    -- DateAndTime (SNMPv2-TC)
```

```
),
    -- INTEGER:  The calendar date and time of day after which
    -- the job SHALL become a candidate to be scheduled for
    -- processing.  If the value of this attribute is in the
    -- future, the server SHALL set the value of the job's
    -- jmJobState/jobState object/attribute to pendingHheld and
    -- add the jobProcessAfterSpecified bit value to the job's
    -- jmJobStateReasons1 objectattribute and SHALL not schedule
    -- the job for processing until the specified date and time
    -- has passed.  When the specified date and time arrives,
    -- the server SHALL remove the jobProcessAfterSpecified bit
    -- value from the job's jmJobStateReasons1 objectattribute
    -- and, if no other reasons remain, SHALL change the job's
    -- jmJobState objectand the job's jobState attribute to
    -- pending so that the job becomes a candidate for being
    -- scheduled on devices(s).
    --
    -- The agent SHALL assign an empty value to the
    -- jobProcessAfterDateAndTime attribute when no process
    -- after time has been specified, so that the job SHALL be a
    -- candidate for processing immediately.

jobHold(52),                        -- Integer32(0..1)
    -- INTEGER:  If the value is 1, a client has explicitly
    -- specified that the job is to be held until explicitly
    -- released.  Until the job is explicitly released by a
    -- client, the job SHALL be in the pendingHeld state with
    -- the jobHoldSpecified value in the jmJobStateReasons1
    -- attribute.

jobHoldUntil(5333),                 -- OCTET STRING(SIZE(0..63))
    -- OCTETS:  The named time period during which the job SHALL
    -- become a candidate for processing, such as 'no-hold',
    -- 'evening', 'night', 'weekend', 'second-shift', 'third-
    -- shift', etc., as defined by the system administrator.
    -- Until that time period arrives, the job SHALL be in the
    -- pendingHheld state with the jobHoldUntilSpecified value
    -- in the jmJobStateReasons1 objectattribute.

outputBinIndex(5434),               -- Integer32(0..2147483647)
                                    -- AND/OR
                                    -- OCTET STRING(SIZE(0..63))
    -- INTEGER:  MULTI-ROW:  The output subunit index in the
    -- Printer MIB[1] of the output bin to which all or part of
    -- the job is placed in.
    -- AND/OR
    -- OCTETS:  the name of the output bin to which all or part
       of the job is placed in.
```

```
    outputBinName(35),                  -- OCTET STRING(SIZE(0..63))
        -- OCTETS:  MULTI-ROW:  The name of the output bin to which
        -- all or part of the job is placed in.

    sides(5536),                        -- Integer32(-2..1)
        -- INTEGER:  MULTI-ROW:  The number of sides that any
        -- document in this job requires/used.

    finishing(5637),                    -- JmFinishingTC (pg 27)
        -- INTEGER:  MULTI-ROW:  Type of finishing that any document
        -- in this job requires/used.


    -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
    -- Image Quality attributes (requested and consumed)
    --
    -- For devices that can vary the image quality.
    -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

    printQualityRequested(7038),        -- JmPrintQualityTC (pg 28)
        -- INTEGER:  MULTI-ROW:  The print quality selection
        -- requested for document in the job for printers that allow
        -- quality differentiation.

    printQualityUsed(7139),             -- JmPrintQualityTC (pg 28)
        -- INTEGER:  MULTI-ROW:  The print quality selection
        -- actually used by documents in the job for printers that
        -- allow quality differentiation.

    printerResolutionRequested(72),     -- JmPrinterResolutionTC
                                        -- (pg 29)
        -- INTEGER:  MULTI-ROW:  The print quality selection
        -- requested for document in the job for printers that allow
        -- quality differentiation.

    printerResolutionUsed(73),          -- JmPrinterResolutionTC
                                        -- (pg 29)
        -- INTEGER:  MULTI-ROW:  The print quality selection
        -- actually used by documents in the job for printers that
        -- allow quality differentiation.

    tonerEcomonyRequested(7440),        -- JmTonerEconomyTC (pg 30)
        -- INTEGER:  MULTI-ROW:  The print quality selection
        -- requested for documents in the job for printers that
        -- allow toner quality differentiation.

    tonerEcomonyUsed(7541),             -- JmTonerEconomyTC (pg 30)
        -- INTEGER:  MULTI-ROW:  The print quality selection
        -- actually used by documents in the job for printers that
```

```
    -- allow toner quality differentiation.

tonerDensityRequested(7642),      -- Integer32(1..20)
    -- INTEGER:  MULTI-ROW:  The toner density requested for
    -- documents in this job for devices that can vary toner
    -- density levels.  Level 1 is the lowest density and level
    -- 20 is the highest density level.  Devices with a smaller
    -- range, SHALL map the 1-20 range evenly onto the
    -- implemented range.

tonerDensityUsed(7743),           -- Integer32(1..20)
    -- INTEGER:  MULTI-ROW:  The toner density used by documents
    -- in this job for devices that can vary toner density
    -- levels.  Level 1 is the lowest density and level 20 is
    -- the highest density level.  Devices with a smaller range,
    -- SHALL map the 1-20 range evenly onto the implemented
    -- range.


-- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
-- Job Progress attributes (requested and consumed)
--
-- Pairs of these attributes can be used by monitoring
-- applications to show 'thermometers' of progress to users.
-- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

jobCopiesRequested(9044),         -- Integer32(-2..2147483647)
    -- INTEGER:  The number of copies of the entire job that are
    -- to be produced.

jobCopiesCompleted(9145),         -- Integer32(-2..2147483647)
    -- INTEGER:  The number of copies of the entire job that
    -- have been completed so far.

documentCopiesRequested(9246),    -- Integer32(-2..2147483647)
    -- INTEGER:  The total count of the number of document
    -- copies requested.  If there are documents A, B, and C,
    -- and document B is specified to produce 4 copies, the
    -- number of document copies requested is 6 for the job.
    --
    -- This attribute SHALL be used only when a job has multiple
    -- documents.  The jobCopiesRequested attribute SHALL be
    -- used when the job has only one document.

documentCopiesCompleted(9347),    -- Integer32(-2..2147483647)
    -- INTEGER:  The total count of the number of document
    -- copies completed so far for the job as a whole.  If there
    -- are documents A, B, and C, and document B is specified to
    -- produce 4 copies, the number of document copies starts a
```

```
        -- 0 and runs up to 6 for the job as the job processes.
        --
        -- This attribute SHALL be used only when a job has multiple
        -- documents.  The jobCopiesCompleted attribute SHALL be
        -- used when the job has only one document.

    jobKOctetsRequested(48),          -- Integer32(-2..2147483647)
        -- INTEGER:  The total number of K (1024) octets being
        -- requested to be processed in the job, including document
        -- and job copies.  The agent shall round the actual number
        -- of octets up to the next highest K.  Thus 0 octets shall
        -- be represented as 0, 1-1024 octets shall be represented
        -- as 1, 1025-2048 shall be represented as 2, etc.
        --
        -- The server/device may update the value of this attribute
        -- after each document has been transferred to the
        -- server/device or the server/device may provide this value
        -- after all documents have been transferred to the
        -- server/device, depending on implementation.  In other
        -- words, while the job is in the held state with the
        -- jobStateReasons1 attribute containing a documentsNeeded
        -- or preProcessing value, the value of the
        -- jobKOctetsRequested attribute depends on implementation
        -- and may not correctly reflect the size of the job.
        --
        -- In computing this value, the server/device shall include
        -- the multiplicative factors contributed by (1) the number
        -- of document copies, and (2) the number of job copies,
        -- independent of whether the device can process multiple
        -- copies of the job or document without making multiple
        -- passes over the job or document data and independent of
        -- whether the output is collated or not.  Thus the
        -- server/device computation is independent of the
        -- implementation and shall be:
        --
        --      (1) Document contribution:  Multiply the size of each
        --      document in octets by the number of document copies
        --      of that document.
        --
        --      (2) Add each document contribution together.
        --
        --      (3) Job copy contribution:  Multiply the job size by
        --      the number of job copies.
        --
        --      (4) Round up the result to the next higher K (1024
        --      multiple).

    jobKOoctetsTransferred(9449),     -- Integer32(-2..2147483647)
        -- INTEGER:  The number of K (1024) octets transferred to
```

```
        -- the server or device that the agent is instrumenting.
        -- This count is independent of the number of copies of the
        -- job or documents that will be produced, but is just a
        -- measure of the number of bytes transferred to the server
        -- or device.
        --
        -- The agent SHALL round the actual number of octets
        -- transferredcompleted up to the next higher K.  Thus 0
        -- octets SHALL beis represented as 0, 1-10243 octets, SHALL
        -- BEis represented as 1, 10254-20487 SHALL beis 2, etc.
        -- When the job completes, the values of the
        -- jmJobKOctetsRequested object and the
        -- jobKOctetsTransferred attributes SHALL be equal.
        --
        -- NOTE - The jobKOctetsTransferred can be used in the
        -- numerator with the jmJobKOctetsRequested objectattribute
        -- in the denominator in order to produce a "thermometer"
        -- that indicates the progress of the job for agents that do
           not implementinstrument the
           jmJobKOctetsProcessedCompleted objectattribute.

    jobKOctetsCompleted(50),          -- Integer32(-2..2147483647)
        -- INTEGER:  The number of K (1024) octets currently
        -- processed by the server or device, including document and
        -- job copies.  For printing, the completed count only
        -- includes processing (interpreting) if the implementation
        -- distinguishes between the processing and printing states;
        -- otherwise, the completed count includes both processing
        -- (interpreting) and marking combined together.  For
        -- scanning, the completed count only includes scanning, if
        -- the implementation distinguishes between the processing
        -- and (to be registered) scanning states; otherwise the
        -- completed count includes both scanning and processing
        -- (formatting).
        --
        -- The agent shall round the actual number of octets
        -- completed up to the next higher K.  Thus 0 octets is
        -- represented as 0, 1-1023, is represented as 1, 1024-2047
        -- is 2, etc.  When the job completes, the values of the
        -- jobKOctetsRequested and the jobKOctetsCompleted
        -- attributes shall be equal.
        --
        -- For multiple copies generated from a single data stream,
        -- the value shall be incremented as if each copy was
        -- printed from a new data stream without resetting the
        -- count between copies.  See the pagesCompletedCurrentCopy
        -- attribute that is reset on each document copy.
        --
        -- NOTE - The jobKOctetsCompleted can be used in the
```

```
        -- numerator with the jobKOctetsRequested attribute in the
        -- denominator in order to produce a "thermometer" that
        -- indicates the progress of the job.


    -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
    -- Impression attributes
    --
    -- For a print job, an impression is the marking of the
    -- entire side of a sheet.  Two-sided processing involves two
    -- impressions per sheet.  Two-up is the placement of two
    -- logical pages on one side of a sheet and so is still a
    -- single impression.  See also jmJobImpressionsRequested and
    -- jmJobImpressionsCompleted objects in the jmJobTable on page
    -- 85.
    -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

    impressionsSpooled(11051),       -- Integer32(-2..2147483647)
        -- INTEGER:  The number of impressions spooled to the server
        -- or device for the job so far.

    impressionsSentToDevice(11152),  -- Integer32(-2..2147483647)
        -- INTEGER:  The number of impressions sent to the device
        -- for the job so far.

    impressionsInterpreted(11253),   -- Integer32(-2..2147483647)
        -- INTEGER:  The number of impressions interpreted for the
        -- job so far.

    impressionsRequested(54),        -- Integer32(-2..2147483647)
        -- INTEGER:  The number of impressions requested by this job
        -- to produce.

    impressionsCompleted(55),        -- Integer32(-2..2147483647)
        -- INTEGER:  The total number of impressions completed by
        -- the device for this job so far.  For printing, the
        -- impressions completed includes interpreting, marking, and
        -- stacking the output.  For other types of job services,
        -- the number of impressions completed includes the number
        -- of impressions processed.

    impressionsCompletedCurrentCopy(11356   -- Integer32(-2..
    ),                                      -- 2147483647)
        -- INTEGER:  The number of impressions completed by the
        -- device for the current copy of the current document so
        -- far.  For printing, the impressions completed includes
        -- interpreting, marking, and stacking the output.  For
        -- other types of job services, the number of impressions
        -- completed includes the number of impressions processed.
```

```
    --
    -- This value SHALL be reset to 0 for each document in the
    -- job and for each document copy.

fullColorImpressionsCompleted(114),   -- Integer32(-2..
                                      -- 2147483647)
    -- INTEGER:  The number of full color impressions completed
    -- by the device for this job so far.  For printing, the
    -- impressions completed includes interpreting, marking, and
    -- stacking the output.  For other types of job services,
    -- the number of impressions completed includes the number
    -- of impressions processed. Full color impressions are
    -- typically defined as those requiring 3 or more colorants,
    -- but this MAY vary by implementation.
    --
highlightColorImpressionsCompleted(115),  --  Integer32(-2..
                                          --  2147483647)
    -- INTEGER:  The number of highlight color impressions
    -- completed by the device for this job so far.  For
    -- printing, the impressions completed includes
    -- interpreting, marking, and stacking the output.  For
    -- other types of job services, the number of impressions
    -- completed includes the number of impressions processed.
    -- Highlight color impressions are typically defined as
    -- those requiring black plus one other colorant, but this
    -- MAY vary by implementation.


-- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
-- Page attributes
--
-- A page is a logical page.  Number up can impose more than
-- one page on a single side of a sheet.  Two-up is the
-- placement of two logical pages on one side of a sheet so
-- that each side counts as two pages.
-- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

pagesRequested(13057),            -- Integer32(-2..2147483647)
    -- INTEGER:  The number of logical pages requested by the
    -- job to be processed.

pagesCompleted(13158),            -- Integer32(-2..2147483647)
    -- INTEGER:  The total number of logical pages completed for
    -- this job so far.

pagesCompletedCurrentCopy(13259   -- Integer32(-2..2147483647)
),
    -- INTEGER:  The number of logical pages completed for the
    -- current copy of the document so far.  This value SHALL be
```

```
        -- reset to 0 for each document in the job and for each
        -- document copy.


    -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
    -- Sheet attributes
    --
    -- The sheet is a single piece of a medium, whether printing
    -- on one or both sides.
    -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

    sheetsRequested(15060),          -- Integer32(-2..2147483647)
        -- INTEGER:  The total number of medium sheets requested to
        -- be processed for this job.

    sheetsCompleted(15161),          -- Integer32(-2..2147483647)
        -- INTEGER:  The total number of medium sheets that have
        -- completed marking and stacking for the entire job so far
        -- whether those sheets have been processed on one side or
        -- on both.

    sheetsCompletedCurrentCopy(15262  -- Integer32(-2..2147483647)
    ),
        -- INTEGER:  The number of medium sheets that have completed
        -- marking and stacking for the current copy of a document
        -- in the job so far whether those sheets have been
        -- processed on one side or on both.
        --
        -- The value of this attribute SHALL be reset to 0 as each
        -- document in the job starts being processed and for each
        -- document copy as it starts being processed.


    -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
    -- Resources attributes (requested and consumed)
    --
    -- Pairs of these attributes can be used by monitoring
    -- applications to show 'thermometers' of usage to users.
    -- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

    mediumRequestedType(17063),      -- JmMediumTypeTC (pg 30)
                                     -- AND/OR
                                     -- OCTET STRING(SIZE(0..63))
        -- INTEGEROCTETS:  MULTI-ROW:  The type of the medium that
        -- is required by the job.
        -- AND/OR
        -- OCTETS:  the name of the medium that is required by the
           job.
```

```
mediumRequestedName(64),          -- OCTET STRING(SIZE(0..63))
    -- OCTETS:  MULTI-ROW:  The name of the medium that is
    -- required by the job.

mediumConsumedName(17165),        -- OCTET STRING(SIZE(0..63))
                                  -- AND
                                  -- Integer32(-2..2147483647)
    -- OCTETS: MULTI-ROW:  The name of the medium
    -- AND
    -- INTEGER:  the number of sheets that have been consumed so
    -- far whether those sheets have been processed on one side
    -- or on both.  This attribute SHALL have both values.

colorantRequestedIndex(17266),    -- Integer32(0..2147483647)
                                  -- AND/OR
                                  -- OCTET STRING(SIZE(0..63))
    -- INTEGER:  MULTI-ROW:  The index (prtMarkerColorantIndex)
    -- in the Printer MIB[1] of the colorant requested.
    -- AND/OR
    -- OCTETS:  the name of the colorant requested.

colorantRequestedName(67),        -- OCTET STRING(SIZE(0..63))
    -- OCTETS:  MULTI-ROW:  The name of the colorant requested.

colorantConsumedIndex(17368),     -- Integer32(0..2147483647)
                                  -- AND/OR
                                  -- OCTET STRING(SIZE(0..63))
    -- INTEGER:  MULTI-ROW:  The index (prtMarkerColorantIndex)
    -- in the Printer MIB[1] of the colorant consumed.
    -- AND/OR
    -- OCTETS: the name of the colorant consumed.

colorantConsumedName(69),         -- OCTET STRING(SIZE(0..63))
    -- OCTETS:  MULTI-ROW:  The name of the colorant consumed.


-- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
-- Time attributes (set by server or device)
--
-- This section of attributes are ones that are set by the
-- server or device that accepts jobs.  Two forms of time are
-- provided.  Each form is represented in a separate attribute.
-- See section 4.2 on page 18 and section 4.3 on page 19 for the
-- conformance requirements for agents and monitoring
-- applications, respectively.  The two forms are:
--
-- DateAndTime is an 8 or 11 octet binary encoded year,
-- month, day, hour, minute, second, deci-second with
-- optional offset from UTC.  See SNMPv2-TC.
```

```
--
-- NOTE: DateAndTime is not printable characters; it is
-- binary.
--
-- JmTimeStampTC is the time of day measured in the number of
-- seconds since the system was booted.  See page 26.
-- ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

jobSubmissionToServerDateAndTime(19070),  -- JmTimeStampTC (pg 26)
                                          -- AND/OR
                                          -- DateAndTime (SNMPv2-TC)
    -- INTEGER:  Configuration 2 and 3:  The time
    -- AND/OR
    -- OCTETS:  tConfiguration 2 and 3:  The date and time that
    -- the job was submitted to the server.

jobSubmissionToDeviceDateAndTime(19171),  -- JmTimeStampTC (pg 26)
                                          -- AND/OR
                                          -- DateAndTime (SNMPv2-TC)
    -- INTEGER:  Configuration 1 and 3:  The time
    -- AND/OR
    -- OCTETS:  tConfiguration 1 and 3:  The date and time that
    -- the job was submitted to the device.

timeSinceJobWasSubmittedToDevice(192),   -- Integer32(0..
                                         -- 2147483647)
    -- INTEGER:  The time in seconds since the job was submitted
    -- to the device.

jobSubmissionToDeviceTimeStamp(72),    -- JmTimeStampTC (pg )
    -- INTEGER:  The time that the job was submitted.

jobStartedBeingHeldTimeStamp(19373  -- JmTimeStampTC (pg 26)
),
    -- INTEGER:  The time that the job started being held, i.e.,
    -- the time that the job entered the pendingHheld state most
    -- recently.  If the job has never entered the pendingHheld
    -- state, then the value SHALL be 0 or the attribute SHALL
    -- not be present in the table.

jobStartedProcessingDateAndTime(19474),  -- JmTimeStampTC (pg 26)
                                         -- AND/OR
                                         -- DateAndTime (SNMPv2-TC)
    -- INTEGER:  The time
    -- AND/OR
    -- OCTETS:  tThe date and time that the job started
    -- processing.

timeSinceStartedProcessing(195),  -- Integer32(-2..2147483647)
```

```
            -- INTEGER:  The time in milliseconds since the job started
            -- processing.

        jobStartedProcessingTimeStamp(75),  -- JmTimeStampTC (pg )
            -- INTEGER:  The time that the job started processing.

        jobCompletedDateAndTime(19676),  -- JmTimeStampTC (pg 26)
                                         -- AND/OR
                                         -- DateAndTime (SNMPv2-TC)
            -- INTEGER:  The time
            -- AND/OR
            -- OCTETS:  tThe date and time that the job completed
            -- processing and the medium is completely stacked in the
            -- output bin, i.e., when the job entered the completed,
            -- canceled, or aborted –state.

        jobCompletedTimeStamp(77),       -- JmTimeStampTC (pg )
            -- INTEGER:  The time that the job completed processing and
            -- the medium is completely stacked in the output bin, i.e.,
            -- when the job entered the completed state.

        timeSinceCompleted(197),         -- Integer32(-2..2147483647)
            -- INTEGER:  The time in milliseconds since the job
            -- completed processing and the medium was completely
            -- stacked in the output bin, i.e., since the job entered
            -- the completed, canceled, or aborted state.

        jobProcessingCPUTime(19878)      -- Integer32(-2..2147483647)
            -- INTEGER:  The amount of CPU time that the job has been
            -- processing in seconds, i.e., in the processing job state.
            -- If the device stops and/or the job enters the
            -- processingStopped stateneeds attention, that elapsed time
            -- SHALL not be included.  In other words, the
            -- jobProcessingCPUTime value SHOULD be relatively
            -- repeatable when the same job is submitted again.

    }


JmJobServiceTypesTC ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
        "Specifies the type(s) of service to which the job has been
        submitted (print, fax, scan, etc.).  The service type is
        represented as an enum that is bit encoded with each job service
        type so that more general and arbitrary services can be created,
```

such as services with more than one destination type, or ones with only a source or only a destination. For example, a job service might **scan**, **faxOut**, and **print** a single job. In this case, three bits would be set in the **jobServiceTypes** attribute, corresponding to the hexadecimal values: **0x8** + **0x20** + 0**x**4, respectively, yielding: **0x2C**.

Whether this attribute is set from a job attribute supplied by the job submission client or is set by the recipient job submission server or device depends on the job submission protocol. With either implementation, the agent SHALL return a non-zero value for this attribute indicating the type of the job.

One of the purposes of this attribute is to permit a requester to filter out jobs that are not of interest. For example, a printer operator MAY only be interested in jobs that include printing. That is why the attribute is in the job identification category.

The following service component types are defined (in hexadecimal) and are assigned a separate bit value for use with the **jobServiceTypes** attribute:

other 0x1
The job contains some document production instructions that are not one of the identified types.

unknown 0x2
The job contains some document production instructions whose type is unknown to the agent.

print 0x4
The job contains some document production instructions that specify printing

scan 0x8
The job contains some document production instructions that specify scanning

faxIn 0x10
The job contains some document production instructions that specify receive fax

faxOut 0x20
The job contains some document production instructions that specify sending fax

getFile 0x40

```
        The job contains some document production instructions that
        specify accessing files or documents

    putFile                                 0x80
        The job contains some document production instructions that
        specify storing files or documents

    mailList                                0x100
        The job contains some document production instructions that
        specify distribution of documents using an electronic mail
        system.


    These bit definitions are the equivalent of a type 2 enum except
    that combinations of them MAY be used together.  See section 7.1.2
    on page 21."

    SYNTAX      INTEGER(0..2147483647)   -- 31 bits, all but sign bit
```

```
JmJobStateReasons1TC ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
        "This textual-convention is used with the jmJobStateReasons1
        objectattribute to provides additional information regarding the
        jmJobState/jobState object values/attribute. The
        jobStateReasons1 attributes identifies the reason or reasons
        that the job is in the held, pending, processing, printing,
        needsAttention, canceled, or completed state.  The server shall
        indicate the particular reason(s) by setting the value of the
        jobStateReasons1 attribute.  While the job states cannot be
        added to without impacting deployed clients, it is the intent
        that additional JmJobStateReasons1TC enums can be defined
        without impacting deployed clients.  In other words, the
        JmJobStateReasons1TC is intended to be extensible.

        When the job does not have any reasons for being in its current
        state, the server shall set the value of the jobStateReasons1
        attribute to zeros.

        Companion job state reasons TCs: JmJobStateReasons2TC,
        JmJobStateReasons3TC, JmJobStateReasons4TC, are defined/reserved
        for additional 31*3 = 93 job state reasons.  This is a type 2
        bit definition.  See section  on page .
```

The following standard values are defined (in hexadecimal) as *powers of two,* since multiple values MAY be used at the same time.

NOTE - The Job Monitoring MIB contains a superset of the IPP values[3] for the IPP 'job-state-reasons' attribute, since the Job Monitoring MIB is intended to cover other job submission protocols as well. Also some of the names of the reasons have been changed from 'printer' to 'device', since the Job Monitoring MIB is intended to cover additional types of devices, including input devices, such as scanners.~~÷~~

NOTE - For easy of understanding the order of the reasons is presented in the order in which the reason is most likely to occur.

other **0x1**

The job state reason is not one of the standardized or registered reasons.

unknown **0x2**

The job state reason is not known to the agent or is indeterminent.

jobIncoming~~documentsNeeded~~ **0x4**

The job has been accepted by the server or device, but the server or device is ~~in the held state because the server or device is~~expected ~~waiting for~~ (1) additional operations to finish creating the job and/or (2) is accessing/accepting document data~~the job's files to start and/or finish being transferred before the job can be scheduled to be processed~~.

jobOutgoing **0x8**

Configuration 2 only: The server is transmitting the job to the device.

jobHold~~Specified~~~~Set~~ **0x~~10~~8**

The ~~job is in the **held** state because the client specified that the job is to be held~~value of the job's **jobHold(52)** attribute (see page 48) is **TRUE**, either set when the job was created or subsequently by an explicit modify job operation. The job SHALL NOT be a candidate for processing until this reason is removed and there are no other reasons to hold the job.

jobHoldUntil~~Specified~~ **0x~~2040000~~**

The value of the job's **jobHoldUntil(~~5333~~)** (see page 48) attribute specifies a time period ~~was specified for a named time period~~ that is still in the future, either set when the job was

created or subsequently by an explicit modify job operation. The job SHALL NOT be a candidate for processing until this reason is removed and there are no other reasons to hold the job. ~~The job remains in the held state until the time period arrives and there are no other reasons to hold the job.~~

jobProcessAfterSpecified **0x4010**

The value of the job's **jobProcessAfterDateAndTime(5132)** (see page 48) attribute specifies a time~~job is in the **held** state because the client specified a time specification reflected in the value of the job's attribute~~ that is still in the future, either set when the job was created or subsequently by an explicit modify job operation. The job SHALL NOT be a candidate for processing until this reason is removed and there are no other reasons to hold the job.

~~**requiredRr**~~**resourcesAreNot~~Not~~Ready** **0x8020**

~~The job is in the **held** state because A~~at least one of the resources needed by the job, such as media, fonts, resource objects, etc., is not ready on any of the physical devices for which the job is a candidate. This condition MAY be detected when the job is accepted, or subsequently while the job is pending or processing, depending on implementation.

deviceStoppedPartly **0x100**

One or more, but not all, of the devices to which the job is assigned are stopped. If all of the devices are stopped (or the only device is stopped), the **deviceStopped** reason SHALL be used.

deviceStopped **0x200**

The device(s) to which the job is assigned is (are all) stopped.

jobPrinting **0x400**

The output device is marking media. This attribute is useful for servers and output devices which spend a great deal of time processing when no marking is happening and then want to show that marking is now happening.

jobC~~c~~anceledByUser **0x800~~200~~**

The job ~~is in the **canceled**, state having~~ was~~been~~ canceled by the user, i.e., by a user whose name is the same as the value of the job's **jobOwner** attribute.

jobC~~c~~anceledByOperator **0x1000~~400~~**

The job was~~is in the **canceled** state having been~~ canceled by the operator, i.e., by a user whose name is different than the value of the job's **jobOwner** attribute.

abortedBySystem **0x2000800**
The job wasis in the **canceled**, state having been aborted by the system. NOTE - this reason is needed only when the job is not placed in the **aborted** job state.

jobCompletedSsuccessfullyCompletion **0x40040**
The job is in the **completed** state havingcompleted successfully.

jobCcompletedWithWarnings **0x80080**
The job is in the **canceled** or **completed** states having completed with warnings.

jobCcompletedWithErrors **0x10000100**
The job is in the **canceled** or **completed** states having completed with errors (and possibly warnings too).

The following additional job state reasons have been added to specify sub-states of the **held** or **completed** states that may be used to represent job states that are in ISO DPA[2] and other job submission protocols:

jobPreProcessing 0x4000The job has been created on the server or device but the submitting client is in the process of adding additional job components and no documents have started processing. The job maybe in the process of being checked by the server/device for attributes, defaults being applied, a device being selected, etc.

jobPaused **0x20000800**
The job has been indefinitely suspended by a client issuing an operation to suspend the job so that other jobs may proceed using the same devices. The client MAY issue an operation to resume the paused job at any time, in which case the agent SHALL remove the **jobPaused** values from the job's **jmJobStateReasons1** object and the server or device places the job in the held or pending states and the job is eventually resumed at or near the point where the job was paused.

jobInterrupted **0x40000010000**
The job has been interrupted while processing by a client issuing an operation that specifies another job to be run instead of the current job. The server or device will automatically resume the interrupted job when the interrupting job completes.

jobRetained **0x80000020000**
The job is being retained by the server or device with all of the job's document data (and submitted resources, such as fonts,

logos, and forms, if any). Thus a client could issue an operation to resubmit the job (or a copy of the job). ~~after processing and all of the media have been successfully stacked in the output bin(s).~~

~~The job (1) has completed successfully or with warnings or errors, (2) has been aborted while printing by the server/device, or (3) has been canceled by the submitting user or operator before or during processing. The job's jobStateReasons1 attribute shall contain the reasons that the job has entered the completed state.~~

~~While the jobRetained state reason is , all of the job's document data (and submitted resources, such as fonts, logos, and forms, if any) are retained by the server or device; thus a client could issue an operation to resubmit the job (or a copy of the job).~~ When a client could no longer resubmit the job, such as after the document data has been discarded, the agent SHALL remove the **jobRetained** value from the **jmJobStateReasons1** object.

These bit definitions are the equivalent of a type 2 enum except that combinations of bits~~them~~ may be used together. See section 7.1.2 on page 21. The remaining bits are reserved for future standardization and/or registration."

SYNTAX **INTEGER(0..2147483647)** **--** 31 bits, all but sign bit

JmJobStateReasons2TC ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION
"This textual-convention is used with the **jobStateReasons2** attribute to provides additional information regarding the **jmJobState**~~**/jobState**~~ object~~/attribute~~. See the description under **JmJobStateReasons1TC** on page 60.

The following standard values are defined (in hexadecimal) as *powers of two,* since multiple values may be used at the same time:

cascaded **0x1**
A~~fter nthe~~ outbound gateway has transmitted ~~retrieves~~ all of the job's job and document attributes and data to another spooling system.~~, it stores the information into a spool directory. Once it has done this, it sends the supervisor a job-processing event~~

~~with this **job-state-reason** which tells the supervisor to transition to a new job state.~~

deletedByAdministrator **0x2**

The administrator has deleted the job.~~issued a **Delete** operation on the job or a **Clean** operation on the server or queue containing the job; therefore the job MAY have been canceled before or during processing, and will have no retention-period or completion-period.~~

discardTimeArrived **0x4**

The job has been deleted ~~(**canceled** with the **job-retention-period** set to **0**)~~ due to the fact that the time specified by the job's **job-discard-time** has arrived~~ [if the job had already completed, the only action that would have occurred is that the **job-retention-period** would be set to **0** and the job is deleted]~~.

postProcessingFailed **0x8**

The post-processing agent failed while trying to log accounting attributes for the job; therefore the job has been placed into the **completed** state with the **jobRretained jmJobStateReasons1** ~~objectattribute~~ value for a system-defined period of time, so the administrator can examine it, resubmit it, etc.~~ The post-processing agent is a plug-and-play mechanism which the system and the customer uses to add functionality that is executed after a job has finished processing.~~

submissionInterrupted **0x10**

Indicates that the job was not completely submitted for the following reasons: (1) the server has crashed before the job was closed by the client,~~. The server SHALL put the job into the **completed** state (and SHALL not print the job).~~ (2) the server or the document transfer method has crashed in some non-recoverable way before the document data was entirely transferred to the server,~~. The server SHALL put the job into the **completed** state (and SHALL not print the job).~~ (3) the client crashed or failed to close the job before the time-out period. Whether the server or device puts the job into the **pendingHeld** or **aborted** state depends on implementation.~~The server SHALL close the job and put the job into the **held** state with **job-state-reasons** of **submission-interrupted** and **job-hold-set** and with the job's **job-hold** attribute set to **TRUE**. The user may release the job for scheduling by issuing a job submission or management protocol operation.~~

maxJobFaultCountExceeded **0x20**

The job has ~~been~~ faulted ~~and returned by the server~~ several times and has exceeded the administratively defined fault count limit~~that the **job-fault-count** exceeded the device's (or~~

~~server's, if not defined for the device) **cfg-max-job-fault-count**. The job is automatically put into the **held** state regardless of the **hold-jobs-interrupted-by-device-failure** attribute. This **job-state-reasons** value is used in conjunction with the **job-interrupted-by-device-failure** value.~~

devicesNeedAttentionTimeOut **0x40**

One or more document transforms that the job is using needs human intervention in order for the job to make progress, but the human intervention did not occur within the site-settable time-out value~~ and the server/device has transitioned the job to the **held** state~~.

needsKeyOperatorTimeOut **0x80**

One or more devices or document transforms that the job is using need a specially trained operator (who may need a key to unlock the device and gain access) in order for the job to make progress, but the key operator intervention did not occur within the site-settable time-out value~~ and the server/device has transitioned the job to the **held** state~~.

jobStartWaitTimeOut **0x100**

The server/device has stopped the job at the beginning of processing to await human action, such as installing a special cartridge or special non-standard media, but the job was not resumed within the site-settable time-out value and the server/device has transitioned the job to the **pendingHh~~eld~~** state. Normally, the job is resumed by means outside the job submission protocol, such as some local function on the device.

jobEndWaitTimeOut **0x200**

The server/device has stopped the job at the end of **processing~~/printing~~** to await human action, such as removing a special cartridge or restoring standard media, but the job was not resumed within the site-settable time-out value and the server/device has transitioned the job to the **completed** state. Normally, the job is resumed by means outside the job submission protocol, such as some local function on the device, whereupon the job SHALL transition immediately to the **completed~~canceled~~** state.

jobPasswordWaitTimeOut **0x400**

The server/device has stopped the job at the beginning of processing to await input of the job's password, but the human intervention did not occur within the site-settable time-out value~~ and the server/device has transitioned the job to the **held** state. Normally, the password is input and the job is resumed by means outside the job submission protocol, such as some local function on the device~~.

deviceTimedOut **0x800**
A device that the job was using has not responded in a period specified by the device's site-settable attribute.

connectingToDeviceTimeOut **0x1000**
The server is attempting to connect to one or more devices which may be dial-up, polled, or queued, and so may be busy with traffic from other systems, but server was unable to connect to the device within the site-settable time-out value ~~and the server has transitioned the job to the **held** state~~.

transferring **0x2000**
The job is being transferred to a down stream server or device.

queuedInDevice **0x4000**
The job has been queued in a down stream server or device.

jobCleanup **0x8000**
The server/device is performing cleanup activity as part of ending normal processing.

processingToStopPoint **0x10000**
The requester has issued an operation to interrupt the job and the server/device is processing up until the specified stop point occurs.

jobPasswordWait **0x20000**
The server/device has selected the job to be next to process, but instead of assigning resources and started the job processing, the server/device has transitioned the job to the **pendingHh**eld state to await entry of a password (and dispatched another job, if there is one). ~~The user resumes the job either locally or by issuing a remote operation and supplying a **job-password=*secret-code*** input parameter that must match the job's **job-password** attribute.~~

validating **0x40000**
The server/device is validating the job *after* accepting the job. ~~The job state may be **held, pending,** or **processing.**~~

queueHeld **0x80000**
The operator has held the entire job set or queue ~~by means outside the scope of the Job model~~.

jobProofWait **0x100000**
The job has produced a single proof copy and is in the **pendingHh**eld state waiting for the requester to issue an operation to release the job to print normally, obeying ~~the~~ any

~~**job-copies** and **copy-count** ~~job and document copy attributes that were originally submitted.

heldForDiagnostics **0x200000**

The system is running intrusive diagnostics, so that~~e~~ all jobs are being held.

serviceOffLine **0x400000**

The service/document transform is off-line and accepting no jobs. All **pending** jobs are put into the **pendingHh**~~**Hh**~~**eld** state. This could be true if its input is impaired or broken.

noSpaceOnServer **0x800000**

T~~he job is held because t~~here is no room on the server to store all of the job. For example, there is no room for the document data~~ or a scan-to-file job~~.

pinRequired **0x1000000**

The System Administrator settable device policy is (1) to require PINs, and (2) to hold jobs that do not have a pin supplied as an input parameter when the job was created. The requester SHALL either (1) enter a pin locally at the device or issue a remote operation supplying the PIN in order for the job to be able to proceed.

exceededAccountLimit **0x2000000**

The account for which this job is drawn has exceeded its limit. This condition SHOULD be detected before the job is scheduled so that the user does not wait until his/her job is scheduled only to find that the account is overdrawn. This condition MAY also occur while the job is processing either as processing begins or part way through processing.

An overdraft mechanism SHOULD be included to be user-friendly, so as to minimize the chances that the job cannot finish or that media is wasted. For example, the server/device SHOULD finish the current copy for a job with collated document copies, rather than stopping in the middle of the current document copy.

heldForRetry **0x4000000**

The job encountered some errors that the server/device could not recover from with its normal retry procedures, but the error is worth trying the job later, such as phone number busy or remote file system in-accessible. For such a situation, the server/device SHALL ~~add the **held-for-retry** value to the job's **jobStateReasons2 attribute** and~~ transition the job from the **processing** to the **pendingHh**~~**Hh**~~**eld**, rather than to the **aborted**~~**completed**~~ state.

The following values are from the X/Open PSIS draft standard:

canceledByShutdown **0x8000000**

The job was canceled because the server or device was shutdown before completing the job. Whether the job is placed in the **pendingHeld** or **aborted** state, depends on implementation. ~~The job SHALL be placed in the **pending** state [if the job was not started, else the job SHALL be placed in the **terminating** state].~~

deviceUnavailable **0x10000000**

This job was aborted by the system because the device is currently unable to accept jobs. Whether the job is placed in the **pendingHeld** or **aborted** state, depends on implementation. ~~This reason [SHALL be] used in conjunction with the reason **abortedyystem**. The job SHALL be placed in the **pending** state.~~

wrongDevice **0x20000000**

This job was aborted by the system because the device is unable to handle this particular job; the spooler SHOULD try another device or the user should submit the job to another device. Whether the job is placed in the **pendingHeld** or **aborted** state, depends on implementation. ~~This reason [SHALL be] used in conjunction with the reason **abortedBySystem**. The job SHALL be **pending** if the queue contains other physical devices that the job could print on, and the spooler is capable of not sending the job back to a physical device that has rejected the job for this job-state-reasons value. Otherwise, [the job] SHALL be placed in the **completed** state with the **jobRetained** value set in the **jobStateReasons1** attribute.~~

badJob **0x40000000**

This job was aborted by the system because this job has a major problem, such as an ill-formed PDL; the spooler SHOULD not even try another device. ~~This reason SHALL be used in conjunction with the reason **aborted** by-system. The job SHALL be placed in the **terminating** state.~~

These bit definitions are the equivalent of a type 2 enum except that combinations of them may be used together. See section 7.1.2 on page 21."

SYNTAX **INTEGER(0..2147483647)** **--** 31 bits, all but sign bit

```
JmJobStateReasons3TC ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
        "This textual-convention is used with the jobStateReasons3
        attribute to provides additional information regarding the
        jmJobState/jobState object/attribute.  See the description under
        JmJobStateReasons1TC on page 60.

        The following standard values are defined (in hexadecimal) as
        powers of two, since multiple values may be used at the same
        time:

    jobInterruptedByDeviceFailure          0x1
        A device or the print system software that the job was using has
        failed while the job was processing.  The server or device is
        keeping the job in the pendingHheld state until an operator can
        determine what to do with the job.

    These bit definitions are the equivalent of a type 2 enum except
    that combinations of them may be used together.  See section 7.1.2
    on page 21.  The remaining bits are reserved for future
    standardization and/or registration."

    SYNTAX      INTEGER(0..2147483647)   -- 31 bits, all but sign bit



JmJobStateReasons4TC ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
        "This textual-convention is used in the jobStateReasons4
        attribute to provides additional information regarding the
        jmJobState/jobState object/attribute.  See the description under
        JmJobStateReasons1TC on page 60.

        The following standard values are defined (in hexadecimal) as
        powers of two, since multiple values may be used at the same
        time:

    none yet defined.

        These bit definitions are the equivalent of a type 2 enum except
        that combinations of them may be used together.  See section
        7.1.2 on page 21.  These bits are reserved for future
        standardization and/or registration."

    SYNTAX      INTEGER(0..2147483647)   -- 31 bits, all but sign bit
```

-- The following tables 1-4 show the **JmJobStateReasons*n*TC** values
-- (*n*=1..4) and the job states for which they are applicable:

-- Table 1 - **JmJobStateReasons1TC**: Legal Job States for each Job State
-- Reason

--	Descriptive Name	Allowed job states
--	documents-needed(1)	held
--	job-hold-set(2)	held
--	job-process-after-specified(3)	held
--	required-resources-not-ready(4)	held
--	successful-completion(5)	completed
--	completed-with-warnings(6)	completed
--	completed-with-errors(7)	completed
--	canceled-by-user(8)	canceled
--	canceled-by-operator(9)	canceled
--	aborted-by-system(10)	canceled
--	logfile-pending(11)	canceled
--	logfile-transferring(12)	canceled
--	jobPreProcessing(45)	held
--	jobPaused(46)	held
--	jobInterrupted(47)	held
--	jobRetained(48)	canceled, completed
--	jobHoldUntilSpecified(49)	held

-- Table 2 - **JmJobStateReasons2TC**: Legal Job States for each Job State
-- Reason

--	Descriptive Name	Allowed job states
--	cascaded(13)	canceled
--	deleted-by-administrator(14)	canceled
--	discard-time-arrived(15)	canceled
--	postprint-failed(16)	canceled, completed
--	submission-interrupted(17)	canceled
--	max-job-fault-count-exceeded(18)	canceled
--	devices-need-attention-time-out(19)	held, canceled
--	needs-key-operator-time-out(20)	held, canceled
--	job-start-wait-time-out(21)	canceled

--	Descriptive Name	Allowed job states
--	job-end-wait-time-out(22)	canceled
--	job-password-wait-time-out(23)	held, pending
--	device-timed-out(24)	held, canceled
--	connecting-to-device-time-out(25)	held, canceled
--	transferring(26)	processing
--	queued-in-device(27)	processing
--	job-cleanup(28)	processing
--	processing-to-stop-point(29)	processing
--	job-password-wait(30)	held, processing
--	validating(31)	held, pending, processing
--	queue-held(32)	held
--	job-proof-wait(33)	held
--	held-for-diagnostics(34)	held
--	service-off-line(35)	held
--	no-space-on-server(36)	held
--	pin-required(37)	held, canceled
--	exceeded-account-limit(38)	held, canceled
--	held-for-retry(39)	held
--	canceledByShutdown(40)	canceled
--	deviceUnavailable(41)	pending
--	wrongDevice(42)	canceled
--	badJob(43)	canceled

-- Table 3 - **JmJobStateReasons3TC**: Legal Job States for each Job State Reason

--	jobInterruptedByDeviceFailure(44)	held

```
jobmonMIBObjects  OBJECT IDENTIFIER  ::= { jobmonMIB 1 }

-- The General Group (Mandatory)

-- The jmGeneralGroup consists entirely of the jmGeneralTable.

-- Implementation of every object in this group is MANDATORY.
-- See Section 4 entitled 'Conformance Considerations' on page 18.

jmGeneral  OBJECT IDENTIFIER ::= { jobmonMIBObjects 15 }

jmGeneralTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF JmGeneralEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The jmGeneralTable consists of information of a general nature
        that are per-job-set, but are not per-job.  See Terminology and
        Job Model on page 11 for the definition of a job set."
    ::= { jmGeneral 1 }

jmGeneralEntry  OBJECT-TYPE
    SYNTAX      JmGeneralEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Information about a job set (queue).

        An entry SHALL exist in this table for each job set."
    INDEX  { jmJobSetIndex }
    ::= { jmGeneralTable 1 }

JmGeneralEntry ::= SEQUENCE {
    jmGeneralNumberOfActiveJobs        Integer32(0..2147483647),
    jmGeneralOldestActiveJobIndex      Integer32(0..2147483647),
    jmGeneralNewestActiveJobIndex      Integer32(0..2147483647),
    jmGeneralJobPersistence            Integer32(0..2147483647),
    jmGeneralAttributePersistence      Integer32(0..2147483647),
    jmGeneralJobSetName                OCTET STRING(SIZE(0..63))
}

jmGeneralNumberOfActiveJobs OBJECT-TYPE
    SYNTAX      Integer32(0..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The current number of 'active' jobs in the jmJobIDTable,
        jmJobStateTable, and jmAttributeTable, i.e., the total number of
```

```
1803            jobs that are in the pending, processing, or processingStopped
1804            neither the completed nor the canceled states.  See JmJobStateTC
1805            on page 31 for the exact specification of the semantics of the
1806            job states.
1807
1808            If there are no active jobs, the value of this object SHALL be
1809            0."
1810        ::= { jmGeneralEntry 1 }
1811
1812    jmGeneralOldestActiveJobIndex  OBJECT-TYPE
1813        SYNTAX      Integer32 (0..2147483647)
1814        MAX-ACCESS  read-only
1815        STATUS      current
1816        DESCRIPTION
1817            "The jmJobIndex of the oldest active job that is still in one of
1818            the 'active' states (pending, processing, or processingStopped).
1819            In other words, the index of the 'active' job that has been in
1820            the , i.e., the job in the job tablesjmJobStateTable and
1821            jmAttributeTable that has been there the longest and .has
1822            neither completed nor been canceled.
1823
1824            When a job transitions from one of the 'active' states (pending,
1825            processing, processingStopped) to one of the 'in-active' states
1826            (pendingHeld, completeds, or is canceled, or aborted), with a
1827            jmJobIndex value that matches this object, the agent SHALL
1828            advance (or wrap - see jmGeneralNewestActiveJobIndex) the value
1829            to the next oldest 'active' job, if any.
1830
1831            On the other hand, when a job transitions from one of the 'in-
1832            active' states to one of the 'active' state, the agent SHALL
1833            reduce (or wrap) the value of this object, if the job's
1834            jmJobIndex is smaller than the current value.
1835
1836            If there are no active jobs, the agent SHALL set the value of
1837            this object to 0."
1838        ::= { jmGeneralEntry 2 }
1839
1840    jmGeneralNewestActiveJobIndex  OBJECT-TYPE
1841        SYNTAX      Integer32 (0..2147483647)
1842        MAX-ACCESS  read-only
1843        STATUS      current
1844        DESCRIPTION
1845            "The jmJobIndex of the newest active job that is in one of the
1846            'active' states (pending, processing, or processingStopped).  In
1847            other words, the index of the 'active' job that has been most
1848            recently added to the job tables., i.e., the job in the
1849            jmJobStateTable and jmAttributeTable that has been added most
1850            recently and has neither completed nor been canceled.
1851
```

When a new job is accepted by the server or device that the agent is instrumenting, the agent SHALL assign the next available value to the job's **jmJobIndex** that is used for storing job information in the **jmJobIDTable**, the **jmJobTable**, and the **jmAttributeTable**. ~~**increment** this object **by 1** and store the job attributes in the row specified by the incremented value.~~ If the value would exceed the implementation-defined maximum value for **jmJobIndex**, the agent SHALL set the value back to **1**, i.e., wrap around to the beginning of the job tables.

It is recommended that the largest value for **jmJobIndex** be much larger than the maximum number of jobs that the implementation can contain at a single time, so as to minimize the pre-mature re-use of **jmJobIndex** value for a newer job while clients retain the same 'stale' value for an older job.

Each time ~~When~~ a new job is accepted by the server or device that the agent is instrumenting AND that job is to be 'active' (**pending**, **processing**, or **processingStopped**, but not **pendingHeld**), the agent SHALL copy the value of the job's **jmJobIndex** to the **jmGeneralNewestActiveJobIndex** object. If the new job is 'in-active' (**pendingHeld** state), the agent SHALL not change the value of **jmGeneralNewestActiveJobIndex** object.

When all jobs become 'inactive', i.e., enter the **pendingHeld**, **completed**, ~~or~~ **canceled**, or **aborted** states, the agent SHALL set~~leave~~ the value of this object to **0**~~unchanged~~. Whenever a job changes from 'in-active' to 'active' (from **pendingHeld** to **pending** or **processing**), the agent SHALL update the value of either the **jmGeneralOldestActiveJobIndex** or the **jmGeneralNewestActiveJobIndex** objects, or both, if the job's **jmJobIndex** value is outside the range between **jmGeneralOldestActiveJobIndex** and **jmGeneralNewestActiveJobIndex**.

When the server or device is power-cycled, the agent SHALL remember the next **jmJobIndex** value to be assigned~~the value of this object shall be persistent~~, so that new jobs are not assigned the same **jmJobIndex** as recent jobs before the power cycle. ~~Therefore, the agent shall return the value **0** only on the first power-up of the server or device.~~

NOTE - Applications that wish to efficiently access all of the active jobs MAY use **jmGeneralOldestActiveJobIndex** value to start with the oldest active job and continue until they reach the index value equal to **jmGeneralNewestActiveJobIndex**, skipping over any **pendingHeld**, **completed**, ~~or~~ **canceled**, **or aborted** jobs that might intervene.

```
            If an application detects that the jmGeneralNewestActiveJobIndex
            is smaller than jmGeneralOldestActiveJobIndex, the job index has
            wrapped.  In this case, when the application exceeds the maximum
            job index (detected by a no such object status returned from a
            GetNext operation for the next conceptual row), the application
            SHALL start over at 1 and continue the GetNext operations to
            find the rest of the active jobs."
        ::= { jmGeneralEntry 3 }

    jmGeneralJobPersistence OBJECT-TYPE
        SYNTAX      Integer32(0..2147483647)
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The minimum time in seconds for this instance of the Job Set
            that an entry will remain in the jmJobIDTable and
            jmJobStateTable after processing has completed, i.e., the
            minimum time in seconds starting when the job enters the
            completed, canceled, or aborted state.  Depending on
            implementation, the value of this object MAY be either: (1) set
            by the system administrator by means outside this specification
            or (2) fixed by the implementation."
        ::= { jmGeneralEntry 4 }

    jmGeneralAttributePersistence OBJECT-TYPE
        SYNTAX      Integer32(0..2147483647)
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The minimum time in seconds for this instance of the Job Set
            that an entry will remain in the jmAttributeTable after
            processing has completed , i.e., the time in seconds starting
            when the job enters the completed, canceled, or aborted state.
            The value of this object MAY be either (1) set by the system
            administrator by means outside this specification or MAY be (2)
            fixed by the implementation, depending on implementation.

            This value SHALL be equal to or less than the value of
            jmGeneralJobPersistence."
        ::= { jmGeneralEntry 5 }

    jmGeneralJobSetName OBJECT-TYPE
        SYNTAX      OCTET STRING(SIZE(0..63))
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The human readable administratively assigned name of this job
            set (by means outside of this MIB).  Typically, this name will
            be the name of the job queue.  If a server or device has only a
```

```
1949          single job set, this object can be the administratively assigned
1950          name of the server or device itself.  This name does not need to
1951          be unique, though each job set in a single Job Monitoring MIB
1952          SHOULD have distinct names.
1953
1954          NOTE - The purpose of this object is to help the user of the job
1955          monitoring application distinguish between several job sets in
1956          implementations that support more than one job set."
1957      ::= { jmGeneralEntry 6 }
1958
1959
1960
1961
1962
1963  -- The Job ID Group (Mandatory)
1964
1965  -- The jmJobIDGroup consists entirely of the jmJobIDTable.
1966  --
1967  -- The two key indexes that are used in other tables to index jobs:
1968  -- jmJobSetIndex and jmJobIndex are materialized in this group.
1969  --
1970  -- Implementation of every object in this group is MANDATORY.
1971  -- See Section 4 entitled 'Conformance Considerations' on page 18.
1972
1973  jmJobID  OBJECT IDENTIFIER ::= { jobmonMIBObjects 2~~6~~ }
1974
1975  jmJobIDTable  OBJECT-TYPE
1976      SYNTAX      SEQUENCE OF JmJobIDEntry
1977      MAX-ACCESS  not-accessible
1978      STATUS      current
1979      DESCRIPTION
1980          "The jmJobIDTable provides a correspondence map (1) between the
1981          job submission ID that a client uses to refer to a job and (2)
1982          the jmJobSetIndex and jmJobIndex that the Job Monitoring MIB
1983          agent assigned to the job and that are used to access the job in
1984          all of the other tables in the MIB.  If a monitoring application
1985          already knows the jmJobIndex of the job it is querying, that
1986          application NEED NOT use the jmJobIDTable."
1987      ::= { jmJobID 1 }
1988
1989  jmJobIDEntry  OBJECT-TYPE
1990      SYNTAX      JmJobIDEntry
1991      MAX-ACCESS  not-accessible
1992      STATUS      current
1993      DESCRIPTION
1994          "The map from (1) the jmJobSubmissionID to (2) the jmJobSetIndex
1995          and jmJobIndex.
1996
```

```
1997            An entry SHALL exist in this table for each job, no matter what
1998            the state of the job and no matter what job set the job is in.
1999            Each job SHALL appear in one and only one job set.
2000
2001            NOTE - an IMPLICIT statement is NOT provided in the following
2002            INDEX clause, since it was not an SMIv1 feature.  Therefore, the
2003            extra ASN.1 tag SHALL be included in the varbind in the SNMP
2004            request and the response."
2005        INDEX  { jmJobSubmissionIDIndex }
2006        ::= { jmJobIDTable 1 }
2007
2008    JmJobIDEntry ::= SEQUENCE {
            jmJobSubmissionIDIndex              OCTET STRING(SIZE(10..32)),
            jmJobSetIndex                       Integer32(1..32767),
            jmJobIndex                          Integer32(1..2147483647)
2009    }
2010
2011    jmJobSubmissionIDIndex OBJECT-TYPE
2012        SYNTAX      OCTET STRING(SIZE(10..32))
2013        MAX-ACCESS  not-accessible
2014        STATUS      current
2015        DESCRIPTION
2016            "A quasi-unique 32-octet string ID which identifies the job
2017            uniquely within a particular client-server environment.  Either
2018            the client or the server assigns the job submission ID for each
2019            job.  The monitoring application whether in the client or
2020            running separately, uses the job submission ID to help the user
2021            identify which jmJobIndex was assigned by the agent.
2022
2023            There are multiple formats for the jmJobSubmissionIDIndex.  Each
2024            format SHALL be registered using the procedures of a type 2
2025            enum.  See section entitled: 'IANA Registration of enums' on
2026            page 21.
2027
2028            The value of jmJobSubmissionIDIndex SHOULD be one of the
2029            registered format types.  The first two octets of the string
2030            SHALL indicate which registered format is being used.  The ASCII
2031            characters '0-9', 'A-Z', and 'a-z' will be assigned in order
2032            giving 62 possible formats.  The agent SHALL assign a string of
2033            registered format (00) for any job without a Job Submission ID.
2034
2035            The format values registered so far are:
2036
2037              Format
2038              Number   Description
2039              ------   ------------
2040              00       Set by the agent when neither the client nor the
2041                       server assigned a job submission ID.
2042
```

```
            01      octets 3-10:  8-decimal-digit random number
                    octets 11-32: last 22 bytes of the jobName attribute

            02      octets 3-10:  8-decimal-digit sequential number
                    octets 11-32: Client MAC address

            03      octets 3-10:  8-decimal-digit sequential number
                    octets 11-32: last 22 bytes of the client URL

            ..      to be registered according to procedures of a type 2
                    enum.  See section 7.3 on page 22.

        NOTE - the job submission id is only intended to be unique
        between a limited set of clients for a limited duration of time,
        namely, for the life time of the job in the context of the
        server or device that is processing the job.  Some of the
        formats include something that is unique per client and a random
        number so that the same job submitted by the same client will
        have a different job submission id.  For other formats, where
        part of the id is guaranteed to be unique for each client, such
        as the MAC address or URL, a sequential number SHOULD suffice
        for each client (and may be easier for each client to manage).
        Therefore, the length of the job submission id has been selected
        to reduce the probability of collision to a very low number, but
        is not intended to be an absolute guarantee of uniqueness.
        None-the-less, collisions could occur, but without bad
        consequences, since this MIB is intended to be used only for
        monitoring jobs, not for controlling and managing them."
    ::= { jmJobIDEntry 1 }

jmJobSetIndex OBJECT-TYPE
    SYNTAX      Integer32(1..32767)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The job set index of the job set in which the job was placed
        when that server or device accepted the job.  This 16-bit value
        in combination with the jmJobIndex value permits the management
        application to access the other tables to obtain the job-
        specific objects.  This value SHALL be the same for a job in the
        jmJobIDTable as the corresponding jmJobSetIndex value in the
        jmJobStateTable and jmAttributeTable for this job.

        The value(s) of the jmJobSetIndex SHALL be persistent across
        power cycles, so that clients that have retained jmJobSetIndex
        values will access the same job sets upon subsequent power-up.

        NOTE - aAn implementation that has only one job set, such as a
        printer with a single queue, SHALL hard code this object with
```

```
        the value 1.  See Terminology and Job Model on page 11 for the
        definition of a job set."
    ::= { jmJobIDEntry 2 }

jmJobIndex OBJECT-TYPE
    SYNTAX      Integer32(1..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The sequential, monatonically increasing identifier index for
        the job generated by the server or device when that server or
        device accepted the job.  This index value permits the
        management application to access the other tables to obtain the
        job-specific row entries.  This value SHALL be the index used in
        the jmJobStateTable and jmAttributeTable for this job.

        See jmGeneralNewestActiveJobIndex on page 74 for a discussion
        about the largest value of jmJobIndex for an implementation.

        NOTE -- Agents instrumenting systems that contain jobs with a job
        identifier of 0 SHALL map the job identifier value 0 to a
        jmJobIndex value that is one higher than the highest job
        identifier value that any job can have on that system."
    ::= { jmJobIDEntry 3 }



-- The Job State Group (Mandatory)

-- The jmJobStateGroup consists entirely of the jmJobStateTable.
--
-- Implementation of every object in this group is MANDATORY.
-- See Section 4 entitled 'Conformance Considerations' on page 18.

jmJobStateG  OBJECT IDENTIFIER ::= { jobmonMIBObjects 37 }

jmJobStateTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF JmJobStateEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The jmJobStateTable consists of basic job state and status
        information for each job in a job set that (1) monitoring
        applications need to be able to access in a single SNMP Get
        operation, (2) that have a single value per job, and (3) that
        SHALL always be implemented.
```

```
            NOTE - Every accessible object in this table shall have the same
            value as one of the attributes in the jmAttributeTable.
            Implementations may either keep a separate copy or may share
            each value that is common between the jmJobStateTable and the
            jmAttributeTable.  The persistence of the two tables may be
            different depending on implementation and/or system
            administrator policy as specified by the jmGeneralJobPersistence
            and jmGeneralAttributePersistence objects defined on page .
            Thus an accounting application need only copy the entire
            jmAttributeTable or selected job rows and will obtain all of the
            information about those jobs and their states."
        ::= { jmJobStateG 1 }

jmJobStateEntry  OBJECT-TYPE
        SYNTAX      JmJobStateEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Basic per-job state and status information.

            An entry SHALL exist in this table for each job, no matter what
            the state of the job is.  Each job SHALL appear in one and only
            one job set."
        INDEX  { jmJobSetIndex, jmJobIndex }
        ::= { jmJobStateTable 1 }

JmJobStateEntry ::= SEQUENCE {
        jmJobState                          JmJobStateTC,           -- pg 31
        jmJobStateReasons1                  JmJobStateReasons1TC,   -- pg 60
        jmNumberOfInterveningJobs           Integer32(-2..2147483647),
        jmJobKOctetsRequested               Integer32(-2..2147483647),
        jmJobStateKOctetsProcessedCompleted Integer32(-2..2147483647),
        jmJobImpressionsRequested           Integer32(-2..2147483647),
        jmJobStateImpressionsCompleted      Integer32(-2..2147483647),
        jmJobStateAssociatedValue           Integer32(-2..2147483647)
}



jmJobState OBJECT-TYPE
        SYNTAX      JmJobStateTC            -- See page 31
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The current state of the job (pending, processing, completed,
            etc.).  Even though the JmJobStateTC textual-convention defines
            nine values for job states, agents SHALL only implement those
            states which are appropriate for the particular implementation.
            In other words, all possible enums for this object SHALL be
```

```
        reported if implemented by the device and available to the
        agent.  However, management applications SHALL be prepared to
        receive all the standard job states.

        The final value for this object SHALL be one of: completed,
        canceled, or aborted.  The minimum length of time that the agent
        SHALL keep a job in the completed, canceled, or aborted state
        before removing the job from the jmJobIDTable and jmJobTable is
        specified by the value of the jmGeneralJobPersistence object."
    ::= { jmJobStateEntry 1 }

jmJobStateReasons1 OBJECT-TYPE
    SYNTAX      JmJobStateReasons1TC                -- See page 60
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Additional information about the job's current state, i.e.,
        information that augments the value of the job's
        jmJobState/jobState object/attribute. -- NOTE - Companion textual
        conventions, JmJobStateReasonsnTC (n=1..4 - see page ) and
        corresponding attributes - see page  provides additional
        information about job states.

        NOTE - The jmJobStateReasonsn (n=2..4) attributes (see page 41)
        provide further additional information about the job's current
        state.

        Implementation of these values is OPTIONAL, i.e., an agent NEED
        NOT implement them, even if (1) the device supports the
        functionality represented by the reason and (2) is available to
        the agent.  These values MAY be used with any job state or
        states for which the reason makes sense.  Furthermore, when
        implemented, the agent SHALL return these values when the reason
        applies and SHALL NOT return them when the reason no longer
        applies whether the value of the job's jmJobState object changed
        or not.  When the job does not have any reasons for being in its
        current state, the agent SHALL set the value of the
        jmJobStateReasons1 object and jobStateReasonsn attributes to 0.

        NOTE - While values cannot be added to the jmJobState object the
        job states cannot be added to without impacting deployed clients
        that take actions upon receiving jmJobState values, it is the
        intent that additional JmJobStateReasonsnTC enums can be defined
        and registered without impacting such deployed clients.  In
        other words, the jmJobStateReasons1 object and jobStateReasonsn
        attributes are intended to be extensible.The jobStateReasons1
        attribute identifies the reason or reasons that the job is in
        the held, pending, processing, needsAttention, canceled, or
        completed state.  The agent shall indicate the particular
```

~~reason(s) by setting the value of the **jobStateReasons1** attribute. ~~"
::= { jmJobEntry 2 }

jmNumberOfInterveningJobs OBJECT-TYPE
SYNTAX **Integer32(-2..2147483647)**
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of jobs that are expected to be processed *before* this job is processed according to the implementation's queuing algorithm if no other jobs were to be submitted. In other words, this value is the job's queue position. The agent SHALL return a value of **0** for this attribute when this job starts processing (since there are no jobs in front of the job)."
::= { jmJobEntry 3 }

jmJobKOctetsRequested OBJECT-TYPE
SYNTAX **Integer32(-2..2147483647)**
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The total size in~~number of~~ K (1024) octets of the document(s) being requested to be processed in the job~~, including document and job copies~~. The agent SHALL round the actual number of octets up to the next highest K. Thus 0 octets SHALL be represented as **0**, 1-1024 octets SHALL be represented as **1**, 1025-2048 SHALL be represented as **2**, etc.

The server/device MAY update the value of this attribute after each document has been transferred to the server/device or the server/device MAY provide this value after all documents have been transferred to the server/device, depending on implementation. In other words, while the job is in the **pending~~H~~eld** state with the **jmJobStateReasons1** object~~attribute~~ containing a **jobIncoming~~documentsNeeded or preProcessing~~** value, the value of the **jmJobKOctetsRequested** object~~attribute~~ depends on implementation and MAY not correctly reflect the size of the job.

In computing this value, the server/device SHALL *not* include the multiplicative factors contributed by (1) the number of document copies, and (2) the number of job copies, independent of whether the device can process multiple copies of the job or document without making multiple passes over the job or document data and independent of whether the output is collated or not. Thus the server/device computation is independent of the implementation. ~~and shall be:~~

~~(1) Document contribution: Multiply the size of each document in octets by the number of document copies of that document.~~

~~(2) Add each document contribution together.~~

~~(3) Job copy contribution: Multiply the job size by the number of job copies.~~

~~(4) Round up the result to the next higher K (1024 multiple).~~"

::= { jmJobEntry 4 }

jmJob~~State~~KOctets~~Processed~~~~Completed~~ OBJECT-TYPE
SYNTAX **Integer32(-2..2147483647)**
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The current number of octets ~~completed~~ process~~ed~~ing by the server or device measured in units of K (1024) octets. The agent SHALL round the actual number of octets processed~~completed~~ up to the next higher K. Thus 0 octets SHALL be ~~is~~ represented as **0**, 1-1024~~3~~ octets~~,~~ SHALL be ~~is~~ represented as **1**, 1025~~4~~-2048~~7~~ octets SHALL be ~~is~~ **2**, etc. ~~–~~ For printing devices, this value is the number interpreted by the page description language interpreter rather than what has been marked on media.

For implementations where multiple copies are produced by the interpreter makes only a single pass over the document, the final value SHALL be equal to the value of the **jmJobKOctetsRequested** object. For implementations where multiple copies are produced by the interpreter making multiple passes over the document, the final value SHALL be a multiple of the value of the **jmJobKOctetsRequested** object.~~The value of this object shall always be the same as that of the **jobKOctetsCompleted** attribute, so that this information appears in both the **jmJobStateTable** and the **jmAttributeTable** simultaneously. See the **jobKOctetsCompleted** attribute on page in the **jmAttributeTable** for the full specification of this object/attribute.~~

NOTE - See the **impressionsCompletedCurrentCopy** and **pagesCompletedCurrentCopy** attributes for attributes that are~~is~~ reset on each document copy.

NOTE - The **jmJobKOctets~~Processed~~~~Completed~~** object can be used in the numerator with the **jmJobKOctetsRequested** object~~attribute~~ in the denominator in order to produce a "thermometer" that indicates the progress of the job, provided that the multiplicative factor is taken into account for some implementations of multiple copies."

```
    ::= { jmJobStateEntry 52 }

jmJobImpressionsRequested OBJECT-TYPE
    SYNTAX      Integer32(-2..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of impressions requested by this job to produce."
    ::= { jmJobEntry 6 }

jmJobStateImpressionsCompleted OBJECT-TYPE
    SYNTAX      Integer32(-2..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The current number of impressions completed being marked and
        stacked by the device for this job so far.  For printing
        devices, the impressions completed includes interpreting,
        marking, and stacking the output.  For other types of job
        services, the number of impressions completed includes the
        number of impressions processed.

        The value of this object shall always be the same as that of the
        impressionsCompleted attribute, so that this information appears
        in both the jmJobStateTable and the jmAttributeTable
        simultaneously.  See the impressionsCompleted attribute on page
        in the jmAttributeTable for the full specification of this
        object/attribute."
    ::= { jmJobStateEntry 73 }

jmJobStateAssociatedValue OBJECT-TYPE
    SYNTAX      Integer32(-2..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The value of the most relevant attribute associated with the
        job's current state.




-- The Attribute Group (Mandatory)

-- The jmAttributeGroup consists entirely of the jmAttributeTable.
--
-- Implementation of the twoevery objects in this group is MANDATORY.
-- See Section 4 entitled 'Conformance Considerations' on page 18.
--
```

```
-- A fewSome attributes are MANDATORY for agent conformance, and the
rest
-- aare
--- OPTIONALconditionally mandatory.  See the specification of the
--- JmAttributeTypeTC on
-- page 35 for which attributes are MANDATORY for
--- agents to implement.

jmAttribute  OBJECT IDENTIFIER ::= { jobmonMIBObjects 48 }

jmAttributeTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF JmAttributeEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The jmAttributeTable SHALL contain attributes of the job and
        document(s) for each job in a job set.  Instead of allocating
        distinct objects for each attribute, each attribute is
        represented as a separate row in the jmAttributeTable.-- Some
        attributes represent information about the job and document(s),
        such as file-names, document-names, submission-time, completion-
        time, size, etc.  Other attributes represent requested and/or
        consumed resources for each job for use by monitoring and
        accounting applications."
    ::= { jmAttribute 1 }

jmAttributeEntry  OBJECT-TYPE
    SYNTAX      JmAttributeEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Attributes representing information about the job and
        document(s) or resources required and/or consumed.

        Each entry in the jmAttributeTable is a per-job entrytable with
        an extra index for each type of attribute (jmAttributeTypeIndex)
        that a job can have and an additional index
        (jmAttributeInstanceIndex) for those attributes that can have
        multiple instances per job.  The jmAttributeTypeIndex object
        SHALL contain an enum type that indicates the type of attribute
        (see JmAttributeTypeTC on page 35).  The value of the attribute
        SHALL be represented in either the jmAttributeValueAsInteger or
        jmAttributeValueAsOctets objects, and/or both, as specified in
        the JmAttributeTypeTC textual-convention.

        The agent SHALL create rows in the jmAttributeTable as the
        server or device is able to discover the attributes either from
        the job submission protocol itself or from the document PDL.  As
        the documents are interpreted, the interpreter MAY discover
```

```
2425            additional attributes and so the agent adds additional rows to
2426            this table.  As the attributes that represent resources are
2427            actually consumed, the usage counter contained in the
2428            jmAttributeValueAsInteger object is incremented according to the
2429            units indicated in the description of the JmAttributeTypeTC
2430            enum.
2431
2432            The agent SHALL maintain each row in the jmJobTable for at least
2433            the minimum time after a job completes as specified by the
2434            jmGeneralAttributePersistence (see page 76).
2435
2436            Zero or more entries SHALL exist in this table for each job in a
2437            job set.  Each job SHALL appear in one and only one job set."
2438        INDEX  { jmJobSetIndex, jmJobIndex, jmAttributeTypeIndex,
2439        jmAttributeInstanceIndex }
2440        ::= { jmAttributeTable 1 }
2441
2442    JmAttributeEntry ::= SEQUENCE {
            jmAttributeTypeIndex            JmAttributeTypeTC,        -- pg 35
            jmAttributeInstanceIndex        Integer32(1..32767),
            jmAttributeValueAsInteger       Integer32(-2..2147483647),
            jmAttributeValueAsOctets        OCTET STRING(SIZE(0..63))
2443    }
2444
2445    jmAttributeTypeIndex OBJECT-TYPE
2446        SYNTAX      JmAttributeTypeTC        -- See page 35
2447        MAX-ACCESS  not-accessible
2448        STATUS      current
2449        DESCRIPTION
2450            "The type of attribute that this row entry represents.
2451
2452            The type MAY identify information about the job or document(s)
2453            or MAY identify a resource required to process the job before
2454            the job start processing and/or consumed by the job as the job
2455            is processed.
2456
2457            Examples of job and document attributesinformation include:
2458            jobCopiesRequested, documentCopiesRequested, jobCopiesCompleted,
2459            documentCopiesCompleted, fileName, and documentName.
2460
2461            Examples of resources required and consumed resource attributes
2462            include:  jobKOctetsRequested, jobKOctetsCompleted,
2463            pagesRequested, pagesCompleted, mediumRequested, and
2464            mediumConsumed, respectively.
2465
2466            In the definitions of the enums in the JmAttributeTypeTC textual
2467            convention, each description indicates whether the value of the
2468            attribute shall be represented using the
2469            jmAttributeValueAsInteger or the jmAttributeValueAsOctets
```

```
2470            ~~objects by the initial tag: 'INTEGER:' or 'OCTETS:',~~
2471            ~~respectively.  A very few attributes use both objects~~
2472            ~~(**mediumConsumed**) and so have both tags.~~
2473
2474            ~~If the **jmAttributeValueAsInteger** object is not used (no~~
2475            ~~'INTEGER:' tag), the agent shall return the value (**-1**)~~
2476            ~~indicating other.  If the **jmAttributeValueAsOctets** object is not~~
2477            ~~used (no 'OCTETS:' tag), the agent shall return a zero-length~~
2478            ~~octet string.~~"
2479        ::= { jmAttributeEntry 1 }
2480
2481    jmAttributeInstanceIndex OBJECT-TYPE
2482        SYNTAX      Integer32(1..32767)
2483        MAX-ACCESS  not-accessible
2484        STATUS      current
2485        DESCRIPTION
2486            "A running 16-bit index of the attributes of the same type for
2487            each job.  For those attributes with only a single instance per
2488            job, this index value SHALL be 1.  For those attributes that are
2489            a single value per document, the index value SHALL be the
2490            document number, starting with 1 for the first document in the
2491            job.  Jobs with only a single document SHALL use the index value
2492            of 1.  For those attributes that can have multiple values per
2493            job or per document, such as documentFormatIndex or
2494            documentFormat~~Type~~, the index SHALL be a running index for the
2495            job as a whole, starting at 1."
2496        ::= { jmAttributeEntry 2 }
2497
2498    jmAttributeValueAsInteger OBJECT-TYPE
2499        SYNTAX      Integer32(-2..2147483647)
2500        MAX-ACCESS  read-only
2501        STATUS      current
2502        DESCRIPTION
2503            "The integer value of the attribute.  The value of the attribute
2504            SHALL be represented as an integer if the enum description in
2505            the JmAttributeTypeTC definition (see page 35) has the tag:
2506            'INTEGER:'.
2507
2508            Depending on the enum definition, this object value MAY be an
2509            integer, a counter, an index, or an enum, depending on the
2510            jmAttributeTypeIndex value.  The units of this value are
2511            specified in the enum description.
2512
2513            For those attributes that are accumulating job consumption as
2514            the job is processed as specified in the JmAttributeTypeTC,
2515            SHALL contain the final value after the job completes
2516            processing, i.e., this value SHALL indicate the total usage of
2517            this resource made by the job.
2518
```

```
2519          A monitoring application is able to copy this value to a
2520          suitable longer term storage for later processing as part of an
2521          accounting system.
2522
2523          Since the agent MAY add attributes representing resources to
2524          this table while the job is waiting to be processed or being
2525          processed, which can be a long time before any of the resources
2526          are actually used, the agent SHALL set the value of the
2527          jmAttributeValueAsInteger object to 0 for resources that the job
2528          has not yet consumed.
2529
2530          Attributes for which the concept of an integer value is
2531          meaningless, such as fileName, interpreter, and
2532          physicalDeviceName, do not have the 'INTEGER:' tag in the
2533          JmAttributeTypeTC definition and so SHALL return a value of (-1)
2534          to indicate other for jmAttributeValueAsInteger.
2535
2536          For attributes which do have the 'INTEGER:' tag in the
2537          JmAttributeTypeTC definition, if the integer value is not (yet)
2538          known, the value SHALL be (-2) to represent unknown counting
2539          integers, (2) to represent unknown enum values, or the attribute
2540          row SHALL not be present in the table."
2541      ::= { jmAttributeEntry 3 }
2542
2543  jmAttributeValueAsOctets OBJECT-TYPE
2544      SYNTAX      OCTET STRING(SIZE(0..63))
2545      MAX-ACCESS  read-only
2546      STATUS      current
2547      DESCRIPTION
2548          "The octet string value of the attribute.  The value of the
2549          attribute SHALL be represented as an OCTET STRING if the enum
2550          description in the JmAttributeTypeTC definition (see page 35)
2551          has the tag: 'OCTETS:'.
2552
2553          Depending on the enum definition, this object value MAY be a
2554          coded character set string (text) or a binary octet string, such
2555          as DateAndTime.
2556
2557          Attributes for which the concept of an octet string value is
2558          meaningless, such as pagesCompleted, do not have the tag
2559          'OCTETS:' in the JmAttributeTypeTC definition and so the agent
2560          SHALL return a value of a zero length string for the value of
2561          the jmAttributeValueAsOctets object."
2562      ::= { jmAttributeEntry 4 }
2563
```

```
-- Notifications and Trapping
-- Reserved for the future

jobmonMIBNotifications  OBJECT IDENTIFIER  ::= { jobmonMIB 2}



-- Conformance Information

jmMIBConformance OBJECT IDENTIFIER ::= { jobmonMIB 32 }

-- compliance statements
jmMIBCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
        "The compliance statement for agents that implement the
        job monitoring MIB."
    MODULE -- this module
    MANDATORY-GROUPS {
        jmGeneralGroup, jmJobIDGroup, jmJobStateGroup, jmAttributeGroup
        }

        OBJECT  jmJobState
        SYNTAX      INTEGER {
                processing(5),
                needsAttention(7),
                canceled(8),
                completed(9)
        }
    DESCRIPTION
        "It is conformant for an agent to implement just these four
        states in this object.  Any additional states are conditionally
        mandatory, i.e., an agent shall represent any additional states
        that the server or device implements.  However, a client shall
        accept all of the states from an agent."

        -- OBJECT jmAttributeTypeIndex
        -- SYNTAX      INTEGER {
        --     jobOwner(2015)
        -- }
    -- DESCRIPTION
        --"It is conformant for an agent to implement just the one
        mandatory
        these 8
        -- attributes.  Any additional attributes are
        OPTIONAL,conditionally
        -- mandatory, i.e., an agent NEED NOTshall represent any
        additional
```

```
        -- attributesstates that the server or device implements.
        However, a
        -- client SHALL accept all of the attributes from an agent and
        -- either display them to its user or ignore them.
        --
        -- NOTE - SMI does not allow an enum to be declared as mandatory
        -- if that enum is not a member of a group, but
        -- jmAttributeTypeIndex cannot be a member of a group and still
        -- be not-accessible.  So this MIB spec comments the MANDATORY
        -- attributes as if SMI allowed such a declaration in order to
        -- declare the MANDATORY attributes."

-- There are no CONDITIONALLY MANDATORY or OPTIONAL groups.

    ::= { jmMIBConformance 1 }

jmMIBGroups      OBJECT IDENTIFIER ::= { jmMIBConformance 2 }

jmGeneralGroup OBJECT-GROUP
    OBJECTS {
        jmGeneralNumberOfActiveJobs, jmGeneralOldestActiveJobIndex,
        jmGeneralNewestActiveJobIndex, jmGeneralJobPersistence,
        jmGeneralAttributePersistence, jmGeneralJobSetName}
    STATUS  current
    DESCRIPTION
        "The general group."
    ::= { jmMIBGroups 1 }

jmJobIDGroup OBJECT-GROUP
    OBJECTS {
        jmJobSetIndex, jmJobIndex }
    STATUS  current
    DESCRIPTION
        "The job ID group."
    ::= { jmMIBGroups 2 }

jmJobStateGroup OBJECT-GROUP
    OBJECTS {
        jmJobState, jmJobStateReasons1, jmNumberOfInterveningJobs,
        jmJobKOctetsRequested, jmJobStateKOctetsProcessedCompleted,
        jmJobImpressionsRequested, jmJobStateImpressionsCompleted,
        jmJobStateAssociatedValue }
    STATUS  current
    DESCRIPTION
        "The job state group."
    ::= { jmMIBGroups 3 }

jmAttributeGroup OBJECT-GROUP
    OBJECTS {
```

```
2657            jmAttributeValueAsInteger, jmAttributeValueAsOctets }
2658        STATUS  current
2659        DESCRIPTION
2660            "The attribute group."
2661        ::= { jmMIBGroups 4 }
2662
2663
2664    END
```

12. Appendix A - Instrumenting the Job Life Cycle

The job object has well-defined states and client operations that affect the transition between the job states. Internal server and device actions also affect the transitions of the job between the job states. These states and transitions are referred to as the job's *life cycle*.

Not all implementations of job submission protocols have all of the states of the job model specified here. The job model specified here is intended to be a superset of most implementations. It is the purpose of the agent to map the particular implementation's job life cycle onto the one specified here. The agent MAY omit any states not implemented. Only the **processing**, ~~**needsAttention,** ~~**canceled**, **aborted**, and **completed** states are required to be implemented by an agent. However, a conforming management application SHALL be prepared to accept any of the states in the job life cycle specified here, so that the management application can interoperate with any conforming agent.

The job states are intended to be the user visible. The agent SHALL make these states visible in the MIB, but only for the subset of job states that the implementation has. Implementations MAY need to have sub-states of these user-visible states. Such implementation is *not* specified in this model, is not supported by this Job Monitoring MIB, and will vary from implementation to implementation. In some implementations the **jmJobStateReasons1** object and the **jobStateReasons*n*** (***n*=2..4**) attributes MAY represent some or all of the sub-states of the jobs.

One of the purposes of the job life cycle~~model~~ is to specify what is invariant from implementation to implementation as far as the MIB specification and the management application ~~user~~ is concerned. Therefore, job states are all intended to last a user-visible length of time in most implementations. However, some jobs may pass through some states in zero time in some situations and/or in some implementations.

The job model does not specify how accounting and auditing is implemented, except to assume~~require~~ that accounting and auditing logs are separate from the job life cycle and last longer than job entries in the MIB~~objects~~. Jobs in the **completed, aborted,** or **canceled** states are not logs, since jobs in these ~~**completed**~~ states are accessible via SNMP~~job submission and/or job management~~ protocol operations and SHALL be~~are~~ removed from the~~se~~ Job Monitoring MIB tables after a site-settable or implementation-defined period of time. An accounting application MAY copy ~~A~~accounting information ~~may be copied~~ incrementally to an~~the~~ accounting logs as a job processes, or MAY be copied while the job is in the **canceled, aborted,** or **completed** states, depending on implementation. The same is true for auditing logs.

The jmJobState object ~~and the~~ jobState ~~attribute both~~ specifies~~y~~ the standard job states. The normal~~legal~~ job state transitions are shown in the state transition diagram presented in Table 1. ~~An implementation need not support all legal job state transitions.~~

	~~New State~~	
		~~"active" jobs~~

Old state	unknown 2	held 3	pending 4	processing 5	printing 6	needsAttention 7	canceled 8	completed 9
unknown(2)		yes	yes	yes	yes			
held(3)			yes	yes	yes		yes	
pending(4)		yes		yes	yes		yes	
processing(5)		yes			yes	yes	yes	yes
printing(6)		yes				yes	yes	yes
needsAttention(7)		yes		yes	yes		yes	
canceled(8)	yes							
completed(9)	yes							

13. APPENDIX B - Support of the Job Submission ID in Job Submission Protocols

This appendix lists the job submission protocols that support the concept of a job submission ID and indicates the attribute in that protocol.

13.1 Hewlett-Packard's Printer Job Language (PJL)

Hewlett-Packard's Printer Job Language provides job-level printer control and printer status information to applications. The PJL JOB command is used at the beginning of a print job and can include options applying only to that job. A PJL JOB command option has been defined to facilitate passing the **JobSubmissionID** with the print job, as required by the Job Monitoring MIB. The option is of the form:

```
SUBMISSIONID = "id string"
```

Where the "id string" is a string and must be enclosed in double quotes. The format is as described for the **jmJobSubmissionID** object.

The entire PJL JOB command with the optional parameter would be of the form:

```
@PJL JOB SUBMISSIONID = "id string"
```

See "Printer Job Language Technical Reference Manual", part number 5021-0328, from Hewlett-Packard for complete information on the PJL JOB command and the Printer Job Language.

14. Bibliography

[1] The Printer MIB - RFC 1579, proposed IETF standard. Also an Internet-Draft on the standards track as a draft standard: **draft-ietf-printmib-mib-info-01.txt**

[2] ISO/IEC 10175 Document Printing Application (DPA). See **ftp://ftp.pwg.org/pub/pwg/dpa/**

[3] Internet Printing Protocol (IPP), in progress on the IETF standards track. See **draft-ietf-ipp-model-010.txt**. See also **http://www.pwg.org/ipp/index.html**

[4] IEEE 1284.1, Transport-independent Printer System Interface (TIPSI).

[5] MIB-II, RFC 1213.

[6] Host Resources MIB, RFC 1514

[7] RFC 2119

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To learn how to subscribe, send email to: ~~JMP Mailing List Subscription Information:~~
jmp-request@pwg.org

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16. INDEX

This index includes the textual conventions, the objects, and the attributes. Textual conventions all start with the prefix: "**JM**" and end with the suffix: "**TC**". Objects all starts with the prefix: "**jm**" followed by the group name. Attributes are identified with enums, and so start with any lower case letter and have no special prefix.

—M—

—N—

—O—

—P—

—Q—

—S—

—T—

—U—