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The Printer Working Group

PWG Imaging System Power MIB v1.0

Status: Approved

Abstract: This document defines the PWG Imaging System Power MIB (for Printers, Copiers, Multifunction Devices, etc.) that extends IETF MIB-II [RFC1213], IETF Host Resources MIB v2 [RFC2790], IETF Printer MIB v2 [RFC3805], IETF Finisher MIB [RFC3806], and PWG Imaging System State and Counter MIB v2 [PWG5106.3].

This document is a PWG Candidate Standard. For a definition of a "PWG Candidate Standard", see:

ftp://ftp.pwg.org/pub/pwg/general/pwg-process-30.pdf

This document is available at:

ftp://ftp.pwg.org/pub/pwg/candidates/cs-wimspowermib10-20110214-5106.5.pdf

The ASN.1 source for this MIB is available at:

ftp://ftp.pwg.org/pub/pwg/candidates/cs-wimspowermib10-20110214-5106.5.mib

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In general, a PWG standard is a specification that is stable, well understood, and is technically competent, has multiple, independent and interoperable implementations with substantial operational experience, and enjoys significant public support.

For additional information regarding the Printer Working Group visit: http://www.pwg.org

Contact information:

The Printer Working Group
c/o The IEEE Industry Standards and Technology Organization
445 Hoes Lane
Piscataway, NJ 08854
USA

WIMS Web Page:

http://www.pwg.org/wims/

WIMS Mailing List:

wims@pwg.org

Instructions for subscribing to the WIMS mailing list can be found at the following link:

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1 Introduction (Informative)

This document is the first public standard MIB that addresses power management for Printers and other Imaging Systems.

The original IETF Printer MIB v1 [RFC1759] was published in March 1995, with major dependencies on the IETF Host Resources MIB v1 [RFC 1514] (for indices, devices, interfaces, storage, and Printer state). The subsequent IETF Printer MIB v2 [RFC3805] was published in June 2004, with major dependencies on the IETF Host Resources MIB v2 [RFC2790]. The IETF Finisher MIB [RFC3806] was also published in June 2004, with major dependencies on the IETF Printer MIB v2 [RFC3805] (for common subunits, datatypes, and alerts).

1.1 Imaging System Power MIB Scope

This document defines a MIB for Imaging Systems (Printers, Copiers, Multifunction Devices, etc.) that adds power management extensions to IETF MIB-II [RFC1213], IETF Host Resources MIB v2 [RFC2790], IETF Printer MIB v2 [RFC3805], IETF Finisher MIB [RFC3806], and PWG Imaging System State and Counters MIB v2 [PWG5106.3].

1.2 Power Management Elements

The abstract power management elements defined in the PWG Power Management Model [PWG5106.4] are mapped essentially one-to-one to the corresponding SNMP objects in the PWG Imaging System Power MIB (see section 4.6 for more details).

1.3 Consistency of Power Terminology

This document uses power terminology (see section 2.4) that is imported from section 2.4 of the PWG Power Management Model [PWG5106.4] and is technically aligned and consistent with the DMTF CIM Power State Management Profile [DSP1027], IEEE Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments [IEEE1621], and Advanced Configuration and Power Interface Specification v4.0 [ACPI].

1.4 Power State Transition Notifications

This document specifies the recommended power state transition notification powPowerV2Alert defined in section 5 of this specification and also the recommended printerV2Alert defined in IETF Printer MIB v2 [RFC3805].

1.5 Vendor Extension Stable Power States

This document specification supports the definition of vendor extension stable power states for any of the base standard DMTF CIM stable power states (see section 2.4. Details are specified in sections 2.4.5 and 9.1.1 of the PWG Power Management Model [PWG5106.4], which prohibits the definition of vendor extension power states for special power states (i.e., orderly shutdowns and resets), in order to avoid ambiguity.

2 Terminology

The section defines or imports all of the terms used in the PWG Imaging System Power MIB.

2.1 Conformance Terminology

The uppercase conformance terms **MUST**, **MUST NOT**, **REQUIRED**, **SHOULD**, **SHOULD NOT**, **RECOMMENDED**, **MAY**, and **OPTIONAL** in this document shall be interpreted as defined in [RFC2119].

2.2 Printing Terminology

Normative definitions and semantics of printing terms are imported from IETF Printer MIB v2 [RFC3805], IETF Finisher MIB [RFC3806], and IETF IPP/1.1 [RFC2911].

This document imports the definitions of **Power Management Client** and **Power Management Server** from section 2.2 of the PWG Power Management Model [PWG5106.4], in order to specify unambiguous conformance requirements.

2.3 Datatype Terminology

This document imports the definitions of the following standard abstract datatypes from section 2.3 of the PWG Power Management Model [PWG5106.4], which in turn imports them from W3C XML Schema Part 2: Datatypes Second Edition [XMLTYPES]. These abstract datatypes are in turn normatively mapped by this document to their corresponding SNMP MIB object syntaxes in the table below.

Table 1 – Mapping of Abstract Datatypes to SNMP Syntaxes

XML Datatype	XML Reference	SNMP Syntax	SNMP Reference	Description
boolean	Section 3.3.2	TruthValue	[RFC2579]	binary true/false
Counter → int	Section 3.4.17	Counter32	[RFC2578]	non-negative 32-bit integer (MUST NOT decrease in value)
dateTime	Section 3.3.8	DateAndTime	[RFC2579]	date/time in ISO 8601 format
Enum → string	Section 3.3.1	INTEGER	[RFC2578]	enumerated positive 32-bit integer
Gauge → int	Section 3.4.17	Gauge32	[RFC2578]	non-negative 32-bit integer (MAY decrease in value)
int	Section 3.4.17	Integer32	[RFC2578]	signed 32-bit integer
string	Section 3.3.1	SnmpAdminString or DisplayString	[RFC3411] [RFC2579]	UTF-8 [RFC3629] - messages US-ASCII [ISO646] – keywords

2.4 Power Terminology

This document imports the definitions of the IEEE power mode terms **Off Mode, On Mode, Sleep Mode** [IEEE1621] from section 2.4.1 of the PWG Power Management Model [PWG5106.4].

This document imports the definitions of the DMTF CIM stable power state terms **Hibernate, OffHard, OffSoft, On, Standby, Suspend** [DSP1027] from section 2.4.2 of [PWG5106.4].

This document imports the definitions of the DMTF CIM special power state terms **OffHardGraceful, OffSoftGraceful, ResetHard, ResetHardGraceful, ResetINIT, ResetMBR, ResetMBRGraceful, ResetNMI, ResetSoft, ResetSoftGraceful** [DSP1027] from section 2.4.3 of [PWG5106.4].

This document imports the definitions of the DMTF CIM out-of-band power state terms **NotApplicable, NoChange, Other, Unknown** [DSP1027] from section 2.4.4 of [PWG5106.4].

This document imports the definitions of vendor extension stable power states from section 2.4.5 of [PWG5106.4].

These power terms are technically aligned and consistent with DMTF CIM Power State Management Profile [DSP1027], IEEE Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments [IEEE1621], and Advanced Configuration and Power Interface Specification v4.0 [ACPI]. These power terms are also used in properties defined in the DMTF CIM power classes.

2.5 Operational State Terminology

This document imports the definitions of System operational state terms **Down**, **Idle**, **Other**, **Processing**, **Stopped**, **Testing**, **Unknown** and their corresponding valid power states from section 2.5.1 of the PWG Power Management Model [PWG5106.4].

This document imports the definitions of Subunit operational state terms defined in section 2.2.13.2.2 and the PrtSubUnitStatusTC textual convention in the IETF Printer MIB v2 [RFC3805].

3 Requirements

Per the PWG Process, this document imports the requirements (rationale, use cases, and design requirements) for the PWG Power Management MIB from section 3 Requirements of the PWG Power Management Model [PWG5106.4].

4 Relationship to Other Public Standards

This section describes the relationship of the PWG Imaging System Power MIB to other public standards.

4.1 IETF MIB-II – System and Interfaces

IETF MIB-II [RFC1213] defines the REQUIRED basic System and Interfaces groups for all managed devices that support any version of SNMP.

If the pow[Monitor/Log]ComponentType object takes a value of ‘interface’, then the corresponding [powMonitor/Log]ComponentReferenceId object MUST take a value of ifIndex in IETF MIB-II.

4.2 IETF Host Resources MIB v2 – Devices and Storage

The IETF Host Resources MIB v2.0 [RFC2790] defines the REQUIRED extended System and Device groups for all managed devices that support any version of SNMP. The IETF Host Resources MIB also defines the OPTIONAL Storage, Software Installed, and Software Running groups.

If the pow[Monitor/Log]ComponentType object takes a value of ‘system’ (hrDevicePrinter if IETF Printer MIB v2 [RFC3805] is implemented) or ‘processor’ (hrDeviceProcessor) or ‘faxModem’ (hrDeviceModem) or ‘outputChannel’ (hrDeviceNetwork) or ‘scanner’ or ‘scanMediaPath’, then the corresponding [powMonitor/Log]ComponentReferenceId object MUST take a value of hrDeviceIndex in IETF Host Resources MIB v2.

If the pow[Monitor/Log]ComponentType object takes a value of ‘storage’, then the corresponding [powMonitor/Log]ComponentReferenceId object MUST take a value of hrStorageIndex in IETF Host Resources MIB v2.

4.3 IETF Printer MIB v2 – Alerts and Subunits

The IETF Printer MIB v2 [RFC3805] defines the REQUIRED prtAlertTable, an ordered list of the warning and critical alerts on a Printer (or an MFD), which MUST be implemented as persistent across power cycles for conforming implementations of the PWG Imaging System Power MIB. The PrtAlertCodeTC textual convention defined in the IANA Printer MIB [IANA-PRT] defines both ‘powerUp’ (On) and ‘powerDown’ (OffSoft or OffHard).

The additional values ‘standby’, ‘suspend’, and ‘hibernate’ for the IANA Printer MIB are defined in the PWG Power Management Model [PWG5106.4].

The IETF Printer MIB v2 also defines the printerV2Alert SNMP trap. Clients (SNMP Managers) may register for SNMP notifications.

Note: The PWG Imaging System Power MIB intentionally does not define separate power notifications, to avoid redundant overlap with the primary IETF Printer MIB v2.

The IETF Printer MIB v2 also defines the REQUIRED subunits General (i.e., System), Input Tray, Output Tray, Marker, Media Path, Input Channel, Interpreter, and Console.

If the pow[Monitor/Log]ComponentType object takes a value for one of the Subunits defined in IETF Printer MIB v2, then the corresponding [powMonitor/Log]ComponentReferenceId object MUST take the appropriate prtXxxIndex value in IETF Printer MIB v2.

4.4 IETF Finisher MIB - Finishers

The IETF Finisher MIB [RFC3806] defines the REQUIRED finDeviceTable, which MUST be implemented as persistent across power cycles for conforming implementations of this PWG Imaging System Power MIB. The FinDeviceTypeTC textual convention defined in the IANA Finisher MIB [IANA-FIN] defines the specific finisher types used in the finDeviceType object.

If the pow[Monitor/Log]ComponentType object takes a value of 'finisher', then the corresponding [powMonitor/Log]ComponentReferenceId object MUST take a value of finDeviceIndex in IETF Finisher MIB.

4.5 PWG Imaging System State and Counter MIB v2 -– Operational States

The PWG Imaging System State and Counter (ISC) MIB v2 [PWG5106.3] defines the REQUIRED icKeyTable and icServiceTable and OPTIONAL icSubunitTable, which MUST be implemented as persistent across power cycles for conforming implementations of this PWG Imaging System Power MIB. The PWG ISC MIB also defines the IcServiceTypeTC, IcServiceStateTC, IcSubunitTypeTC, and IcSubunitStatusTC (bit-mask identical to PrtSubUnitStatusTC defined in IETF Printer MIB v2) textual conventions.

If the pow[Monitor/Log]ComponentType object takes a value of 'system', then the corresponding icServiceState object (with icServiceType of 'sytemTotals') SHOULD be implemented to report the System operational state (e.g., 'idle' or 'processing'), which directly impacts power consumption.

If the pow[Monitor/Log]ComponentType object takes a value of any Subunit defined in the IcSubunitType textual convention in the PWG ISC MIB, then the corresponding icSubunitStatus object SHOULD be implemented to report the Subunit operational state (e.g., 'Available and Idle' or 'Available and Active'), which directly impacts power consumption.

4.6 Mapping from PWG Power Management Model

This PWG Imaging System Power MIB conforms to all best practices for MIBs written in SMIv2 [RFC2578], which required mapping from the abstract power elements defined in the PWG Power Management Model [PWG5106.4] as follows:

(1) All PWG Imaging System Power MIB object names are scoped by an unambiguous group (e.g., 'powGeneral') or table (e.g., 'powMonitor') prefix.
(2) Some PWG Imaging System Power MIB object names are abbreviated from the corresponding abstract element names in (e.g., 'PowerCalendar.CalendarRunOnce' to 'powCalendarRunOnce'), to ensure that no MIB object name is longer than 31 characters (to avoid common portability problems with MIB compilers).

Several objects are defined in the PWG Imaging System Power MIB that are NOT mapped directly from abstract elements defined in the PWG Power Management Model, as follows:

- powGeneralNaturalLanguage (e.g., 'en-US') – for localization of SnmpAdminString values.
- powGeneralPolicyMaxAccess (e.g., 'readOnly', 'readWrite', or 'readCreate') – for row status capabilities in the policy tables (powTimeoutTable, powCalendarTable, and powEventTable).
- powMonitorIndex – for unique identification of each managed component (System or Subunit) and primary index for other tables in this PWG Imaging System Power MIB.

- powMonitorComponentType (e.g., ‘system’ or ‘marker’) and powMonitorComponentReferenceId (e.g., hrDeviceIndex or prtMarkerIndex) – for instance correlation of each managed component (System or Subunit).
- powTimeoutRowStatus (e.g., ‘active’, ‘notInService’, or ‘createAndWait’), powCalendarRowStatus, and powEventRowStatus – for row status management in the policy tables.

Table 2 – Mapping of Abstract Element Groups to SNMP Tables

Abstract Element Group	SNMP Table Name	Comments
Power General	(none)	Scalar objects
Power Monitor	powMonitorTable	Components (System, Subunits)
Power Log	powLogTable	Persistent log (see Usage and Note below)
Power Counter	powCounterTable	Power state transition counters
Power Meter	powMeterTable	Power consumption meters
Power Support	powSupportTable	Power states supported
Power Transition	powTransitionTable	Power transitions supported
Power Request	powRequestTable	Power state change requests
Power Timeout	powTimeoutTable	Power policies
Power Calendar	powCalendarTable	Power policies
Power Event	powEventTable	Power policies

Usage: Power Management Servers MUST implement the powLogTable group as persistent across power cycles and hardware reconfigurations. Power Management Servers SHOULD only add entries to the powLogTable when a power state transition occurs (i.e., successive powLogTable entries for the same component SHOULD NOT have the same power state). Power Management Servers SHOULD support at least 10 entries in the powLogTable (for reliable fleet management).

Note: To reduce the hardware cost of support for the PWG Imaging System Power MIB, a resource limited Power Management Server that uses NVRAM as a datastore for its persistent powLogTable could optimize by NOT saving empty or static powLogPowerStateMessage strings to NVRAM.

4.6.1 Indexing of Imaging System Power MIB

The General group in the Imaging System Power MIB defines only scalar objects (with instance qualifiers over-the-wire of '.0') and does not define or use explicit index objects.

The powMonitorTable in the Imaging System Power MIB uses a single index of powMonitorIndex for each row, which includes powMonitorComponentType (e.g., 'system') and powMonitorComponentReferenceId (e.g., value of hrDeviceIndex for the hrDeviceTable row with hrDeviceType equal to 'hrDevicePrinter' in the IETF Host Resources MIB [RFC279]). The powMonitorIndex is the primary or only index of all other tables in the Imaging System Power MIB, with the exception of the powLogTable (see below). This simplifies and clarifies the indexing of the other tables defined in the Imaging System Power MIB.

The powLogTable in the Imaging System Power MIB uses a single index of powLogIndex for each row, which includes powLogComponentType and powLogComponentReferenceId values, in order to make the powLogTable free-standing when queried by management stations or serialized to a log file.

The powCounterTable, powMeterTable, and powRequestTable in the Imaging System Power MIB all use a single index of powMonitorIndex for each row, i.e., each component instance.

The powSupportTable uses a primary index of powMonitorIndex and defines a secondary index of powSupportPowerState for each row, i.e., each supported stable power state (standard or vendor extension) for a given component instance.

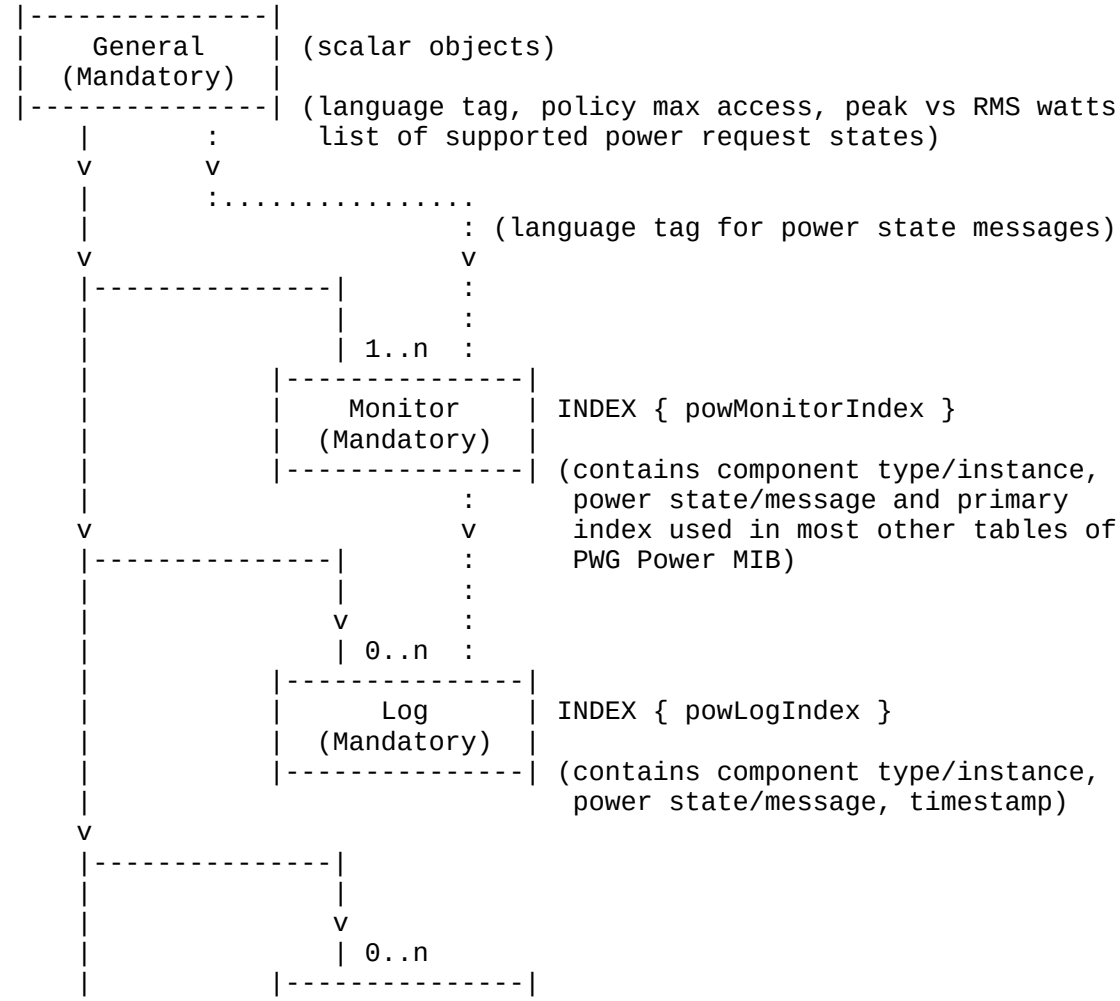
The powTransitionTable uses a primary index of powMonitorIndex and defines a secondary index of powTransitionStartPowerState and a tertiary index of powTransitionEndPowerState for each row, i.e., each supported transition between stable power states (standard or vendor extension) for a given component instance.

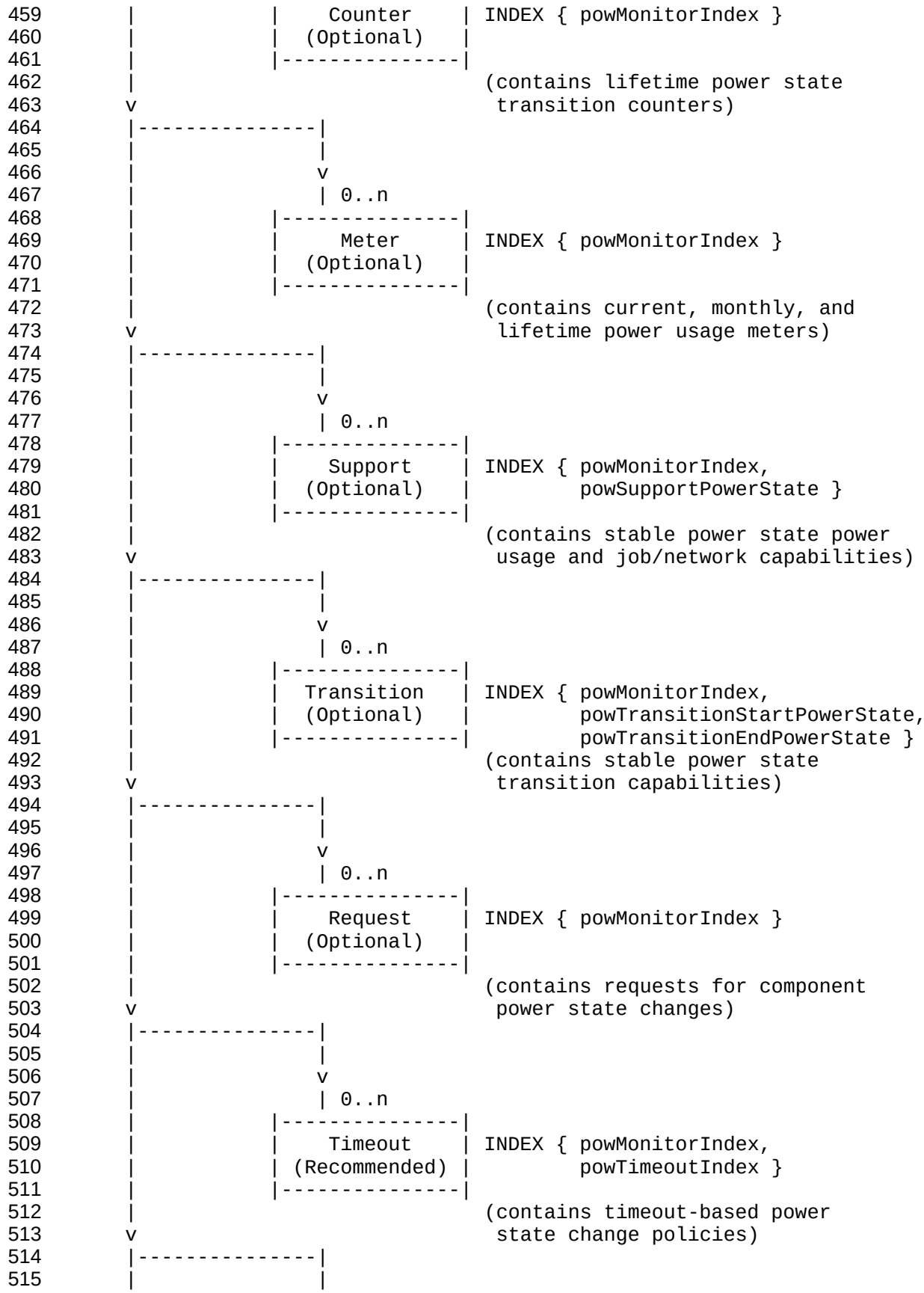
The powTimeoutTable uses a primary index of powMonitorIndex and a secondary index of powTimeoutIndex for each row, i.e., each timeout-based power state change policy for a given component instance.

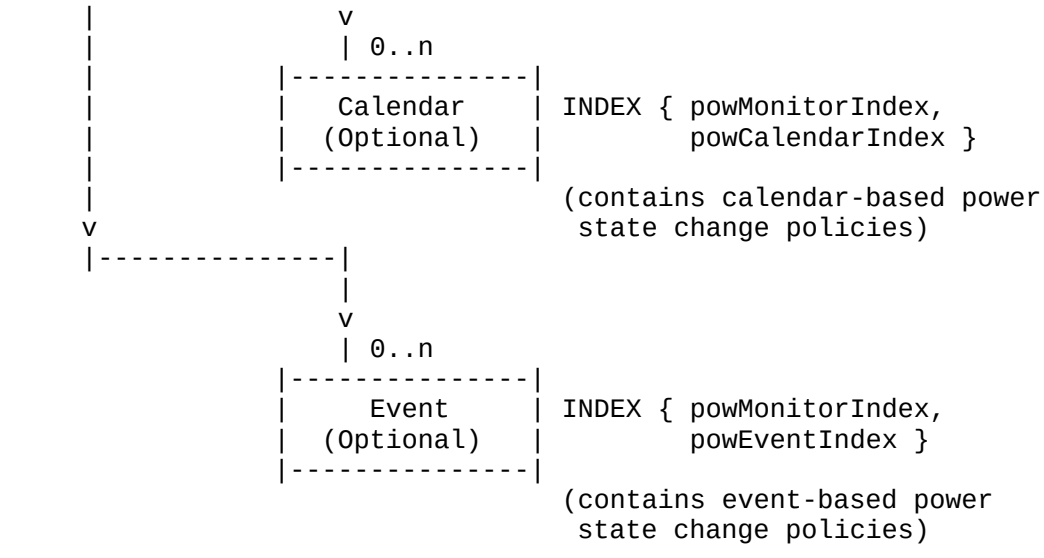
The powCalendarTable uses a primary index of powMonitorIndex and a secondary index of powCalendarIndex for each row, i.e., each calendar-based power state change policy for a given component instance.

The powEventTable uses a primary index of powMonitorIndex and a secondary index of powEventIndex for each row, i.e., event-based power state change policy for a given component instance.

4.6.2 Diagram of Imaging System Power MIB







5 Definition of Imaging System Power MIB

The ASN.1 source for the PWG Imaging System Power MIB is available at:

ftp://ftp.pwg.org/pub/pwg/candidates/cs-wimspowermib10-20110214-5106.5.mib

6 Conformance Requirements

Below are the summary conformance requirements for this specification.

6.1 Power Management Server Conformance Requirements

To claim conformance to this specification, a Power Management Server implementation for a Printer, Multifunction Device, or other Imaging System:

(a) MUST support the REQUIRED Power General, Power Monitor, and Power Log groups defined in section 5 of this specification;
(b) MUST implement all supported groups as persistent across power cycles, except for major system reconfigurations;
(c) MUST implement the Power Log group as persistent across power cycles, even in case of major system reconfigurations and SHOULD support at least 10 records in the powLogTable (for reliable fleet management);
(d) MUST implement all supported power policies (Power Timeout, Power Calendar, and/or Power Event) as persistent across power cycles and hardware reconfigurations;
(e) SHOULD support the RECOMMENDED Power Timeout group defined in section 5 of this specification;
(f) MUST conform to the Internationalization Considerations defined in section 8 of this specification;
(g) MUST conform to the Security Considerations defined in section 9 of this specification;
(h) MUST support the PWG Power Management Model [PWG5106.4] for the System object;
(i) SHOULD implement the PWG Imaging System State and Counter MIB v2 [PWG5106.3] (operational states) and the IETF Printer MIB v2 [RFC3805] (alerts) in order to report comprehensive System and Subunit states;
(j) SHOULD conform to the mapping of valid power states to each operational state defined in section 2.5.1 of the PWG Power Management Model [PWG5106.4];
(k) Only if the icKeyTable, icServiceTable, or icSubunitTable in the PWG Imaging System State and Counter MIB v2 [PWG5106.3] are implemented, MUST also implement those tables as persistent across power cycles as required in section 4.6 of this specification;
(l) Only if the Scanner and/or Marker components are supported, SHOULD support the PWG Power Management Model [PWG5106.4] for the Scanner and Marker objects; and
(m) Only if notifications are supported, SHOULD support the power state transition trap powPowerV2Trap in the PowerTrap group.

6.2 Power Management Client Conformance Requirements

To claim conformance to this specification, a Power Management Client implementation for a Printer, Multifunction Device, or other Imaging System:

(a) MUST support the REQUIRED Power General, Power Monitor, and Power Log groups defined in section 5 of this specification;
(b) SHOULD support the RECOMMENDED Power Timeout group defined in section 5 of this specification;
(c) MUST explicitly identify the implemented set of PWG Power Management Model elements defined in section 5 of this specification;
(d) MUST conform to the Internationalization Considerations defined in section 8 of this specification;

(e) MUST conform to the Security Considerations defined in section 9 of this specification;
(f) MUST support the PWG Power Management Model [PWG5106.4] for the System object;
(g) SHOULD implement the PWG Imaging System State and Counter MIB v2 [PWG5106.3] (operational states) and the IETF Printer MIB v2 [RFC3805] (alerts) in order to query comprehensive System and Subunit states;
(h) Only if the Scanner and/or Marker components are supported, SHOULD support the PWG Power Management Model [PWG5106.4] for the Scanner and Marker objects; and
(i) Only if notifications are supported, SHOULD support the power state transition trap powPowerV2Trap in the PowerTrap group.

7 IANA and PWG Considerations

There are no IANA or PWG registration considerations for this document. The textual conventions used in this PWG Imaging System Power MIB are all defined in the body of the ASN.1 MIB source itself. New registrations require a new version of the MIB.

The power state transition extensions for PrtAlertCodeTC are already defined in section 9.7 of the PWG Power Management Model [PWG5106.4].

8 Internationalization Considerations

The IETF Policy on Policy on Character Sets and Languages [RFC2277] requires conforming network protocols to support the UTF-8 [RFC3629] encoding of Unicode [UNICODE] [ISO10646].

To claim conformance to this specification, a Power Management Server or Power Management Client implementation:

(a) MUST support UTF-8 as defined in [RFC3629]; and
(b) SHOULD support Network Unicode as defined in [RFC5198], which requires transmission of well-formed UTF-8 strings and recommends transmission of normalized UTF-8 strings in Normalization Form C (NFC) [UAX15].

Unicode NFC is defined as the result of performing Canonical Decomposition (into base characters and combining marks) followed by Canonical Composition (into canonical composed characters wherever Unicode has assigned them).

WARNING – Performing normalization on UTF-8 strings received from Power Management Clients and subsequently storing the results (e.g., in System objects) could cause false negatives in Power Management Client searches and failed access.

9 Security Considerations

To claim conformance to this specification, a Power Management Server or Power Management Client that supports secure administrative operations that are privileged (i.e., Operator or Administrator ONLY) MUST implement any supported power state change and power policy create/delete/update protocol requests as secure and privileged administrative operations.

10 References

10.1 Normative References

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11 Editor's Address (Informative)

Ira McDonald
High North Inc
PO Box 221
Grand Marais, MI 49839
USA

Email: blueroofmusic@gmail.com

Phone: +1-906-494-2434

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