



The Printer Working Group

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PWG Power Management Model for Imaging Systems 1.0

Status: Approved

Abstract: This document defines an abstract PWG Power Management Model for Imaging Systems (Printers, Copiers, Multifunction Devices, etc.) that extends the abstract System and Subunit objects in the PWG Semantic Model.

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-wimspower10-20110214-5106.4.pdf>

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278 1 Introduction (Informative)

279
280 The original IETF Printer MIB v1 [RFC1759] was published in March 1995, with major dependencies on the
281 IETF Host Resources MIB v1 [RFC 1514] (for indices, devices, interfaces, storage, and Printer state). The
282 subsequent IETF Printer MIB v2 [RFC3805] was published in June 2004, with major dependencies on the
283 IETF Host Resources MIB v2 [RFC2790]. The IETF Finisher MIB [RFC3806] was also published in June
284 2004, with major dependencies on the IETF Printer MIB v2 [RFC3805] (for common subunits, datatypes,
285 and alerts).
286 The original PWG Semantic Model/1.0 [PWG5105.1] was published in January 2004, with an abstract model
287 and XML Schema for all the elements in IETF IPP/1.1 [RFC2911] and subsequent IETF and PWG IPP
288 specifications. The PWG Semantic Model/2.0 [PWGSM20] is currently under development in the PWG
289 Multifunction Device WG. However, no public standard currently addresses power management for Printers
290 and other Imaging Systems.
291

292 1.1 Power Management Model Scope

293 This document defines an abstract PWG Power Management Model for Imaging Systems (Printers, Copiers,
294 Multifunction Devices, etc.) that extends the abstract PWG Semantic Model (see section 4). This PWG
295 Power Management Model applies to System and Subunit objects. This PWG Power Management Model
296 does not apply to Service objects.
297

298 1.2 Power Management Element Classes

299
300 Sections 5, 6, and 7 of this document define all of the PWG Power Management Model elements. Below is
301 a brief informal description of these element classes:
302

303 **Power Status** – This class of read-only power management elements consists of power general, power
304 monitor, power log, power counter, and power meter elements that are only set by the Imaging System
305 itself.
306

307 **Power Capabilities** – This class of read-only power management elements consists of supported stable
308 power states and supported transitions between stable power states that are only set by the manufacturer of
309 the Imaging System (i.e., they are intrinsic to the hardware configuration of the Imaging System).
310

311 **Power Settings** – This class of read-only and read-write power management elements consists of power
312 management policies that are set by the manufacturer (factory defaults) and/or Administrator (site policies)
313 and also power state change requests (i.e., operations) that are set by the Imaging System itself and/or the
314 Administrator.
315

316 1.3 Consistency of Power Terminology

317
318 This document uses power terminology (see section 2.4 and section 9.1) that is technically aligned and
319 consistent with the DMTF CIM Power State Management Profile [DSP1027], IEEE Standard for User
320 Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments
321 [IEEE1621], and Advanced Configuration and Power Interface Specification v4.0 [ACPI].
322

323 **WARNING:** Some government and consortium documents that address power management do NOT use
324 important power state terms consistently with existing usage in the computer industry and international
325 standards. For example, for apparently historical reasons the US EPA Energy Star Program Requirements
326 for Imaging Equipment v1.1 [ESPRINTER] differs in several serious ways:

- 327
328 (a) It confuses the term “power mode” (used to mean a *set* of power states in [DSP1027] and
329 [IEEE1621]) with “power state” (used to mean a single ordinal power state in [DSP1027] and
330 [IEEE1621]).
331 (b) It ambiguously defines Active Mode, Ready Mode (replacing former Idle Mode), Sleep Mode,
332 Standby Mode, and Off Mode.
333 (c) It ambiguously defines Sleep Mode such that it is equivalent to the Standby (Light-Sleep) state in
334 [DSP1027] and [IEEE1621] and modern operating systems.
335 (d) It ambiguously defines Standby Mode such that it is equivalent to either the Suspend (Deep-Sleep)
336 state or the Hibernate (Off-Soft) state in [DSP1027] and [IEEE1621] and modern operating systems.
337
338 Imaging System manufacturers and software developers will discover that there are many such
339 inconsistencies in government and consortium documents that address power management.

340 **1.4 Power State Transition Notifications**

341
342 This document specifies the recommended power state transition notification methods in section 5.7.

343 **1.5 Vendor Extension Stable Power States**

344
345 This specification supports the definition of vendor extension stable power states for any of the base
346 standard DMTF CIM stable power states (see section 2.4.2). Details are specified in sections 2.4.5 and
347 9.1.1. This specification prohibits the definition of vendor extension power states for special power states
348 (i.e., orderly shutdowns and resets), in order to avoid ambiguity.
349

350

351 **2 Terminology**

352

353 **2.1 Conformance Terminology**

354

355 The uppercase conformance keywords "MUST", "MUST NOT", "REQUIRED", "SHOULD", "SHOULD NOT",
 356 "RECOMMENDED", "MAY", and "OPTIONAL" in this document shall be interpreted as defined in
 357 [RFC2119].
 358

359 **2.2 Printing Terminology**

360

361 Normative definitions and semantics of printing terms are imported from IETF Printer MIB v2 [RFC3805],
 362 IETF Finisher MIB [RFC3806], and IETF IPP/1.1 [RFC2911].
 363

364 This document also defines the following protocol roles in order to specify unambiguous conformance
 365 requirements:
 366

367 **Power Management Client** – Initiator of power management session requests and sender of outgoing
 368 power management operation requests (e.g., an SNMP Manager).
 369

370 **Power Management Server** - Listener for incoming power management session requests and receiver of
 371 incoming power management operation requests (e.g., an SNMP Agent).
 372

373 **2.3 Datatype Terminology**

374

375 Normative definitions and semantics of the following standard abstract datatypes are imported from W3C
 376 XML Schema Part 2: Datatypes Second Edition [XMLTYPES]. These XML datatypes in turn are normatively
 377 mapped by this specification to their corresponding SNMP MIB datatypes.
 378
 379

Table 1 – Standard Abstract Datatypes (XML, SNMP)

| XML Datatype | XML Reference | SNMP Datatype | 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 |

380

381

382 2.4 Power Terminology

383
384
385 Normative definitions and semantics of the following standard power terms are technically aligned and
386 consistent with DMTF CIM Power State Management Profile [DSP1027], IEEE Standard for User Interface
387 Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments [IEEE1621],
388 and Advanced Configuration and Power Interface Specification v4.0 [ACPI]. These power terms are also
389 used in properties defined in the DMTF CIM power classes.
390

391 2.4.1 IEEE 1621 Power Modes

392
393 [IEEE 1621] (which is primarily concerned with a simple user interface) defines 3 basic “power modes”: Off
394 Mode, Sleep Mode, and On Mode. These “power modes” in turn can be qualified with “soft / hard”, “light /
395 deep”, and “graceful” to describe specific power states (see the following sections and Table 2 in section 9.1
396 of this specification).
397

398 **Off Mode** – the set of power states where incoming jobs cannot be accepted immediately and existing jobs
399 cannot be processed immediately (i.e., without a long delay for a power state transition to On Mode).
400

401 **On Mode** – the set of power states where incoming jobs can be accepted immediately and existing jobs can
402 be processed immediately (i.e., with no delay for a power state transition).
403

404 **Sleep Mode** – the set of power states where incoming jobs MAY be accepted immediately, but existing jobs
405 cannot be processed immediately (i.e., without a short delay for a power state transition to On Mode).
406

407 2.4.2 DMTF CIM Stable Power States

408
409 This specification imports (and renames for clarity and common usage) the normative definitions and
410 semantics of the following DMTF CIM [DSP1027] stable power states. All other DMTF CIM power states
411 are special (orderly shutdowns and power resets) and will eventually result in one of the stable power states
412 defined below.
413

414 Note: This specification also supports the definition of vendor extension stable power states (see sections
415 2.4.5 and 9.1.1).
416

417 **Hibernate** – DMTF “Hibernate (Off-Soft)” (7) – ACPI S4 – the stable “Off Mode” power state where all kernel
418 and application programs and data have been saved (e.g., to a hard disk) such that a transition to On allows
419 recovery and continued processing without any loss of jobs or data – limited auxiliary power is consumed,
420 e.g., console lights – no network interfaces are operational and human intervention is required to power up
421 the system – compare with OffHard and OffSoft.
422

423 **OffHard** – DMTF “Off-Hard” (6) – ACPI G3 – the stable “Off Mode” power state where system power is
424 mechanically or electrically turned off – no power is consumed – no network interfaces are operational and
425 human intervention is required to power up the system – compare with Hibernate and OffSoft.
426

427 **OffSoft** – DMTF “Off-Soft” (8) – ACPI G2 or S5 – the stable “Off Mode” power state where only limited
428 auxiliary power is consumed, e.g., console lights – no network interfaces are operational and human
429 intervention is required to power up the system – compare with Hibernate and OffHard.
430

431 **On** – DMTF “On” (2) – ACPI G0 or S0 – the stable “On Mode” power state where the system is in Idle,
432 Processing, Stopped, or Testing operational states (see section 2.5.1 below), with no delay required for a
433 power state transition before processing incoming jobs.

434
435 **Standby** – DMTF “Sleep-Light” (3) – ACPI S1 or S2 – the stable “Sleep Mode” power state with the shortest
436 wake-up transition to On power state – typically, mechanical elements (motors, lamps, heaters, etc.) are
437 turned off or turned down, but processors and network interfaces are fully active (e.g., normal clock rate) –
438 some or all network interfaces are operational – compare with Suspend.

439
440 **Suspend** – DMTF “Sleep-Deep” (4) – ACPI S3 – the stable “Sleep Mode” power state with the lowest power
441 consumption of any “Sleep Mode” power state – typically, mechanical elements (motors, lamps, heaters,
442 etc.) are turned off, but processors and network interfaces are partially active (e.g., lower clock rate) – kernel
443 and application programs and data are preserved (i.e., periodically refreshed) in main memory – at least one
444 network interface is operational – compare with Standby.

445

446 **2.4.3 DMTF CIM Special Power States**

447

448 This specification imports (and renames for clarity and common usage) the normative definitions and
449 semantics of the following DMTF CIM [DSP1027] special power states that represent orderly shutdowns
450 (e.g., OffSoftGraceful) and power resets (e.g., ResetHard). All DMTF CIM special power states will
451 eventually result in one of the stable power states defined in section 2.4.2 above.

452

453 **OffHardGraceful** – DMTF “Off-Hard Graceful” (13) – ACPI G3 – the special power state that performs a
454 graceful hard power off – an orderly shutdown, followed by a hard power off cycle – and completes in the
455 OffHard power state.

456

457 **OffSoftGraceful** – DMTF “Off-Soft Graceful” (12) – ACPI G2 or S5 – the special power state that performs a
458 graceful soft power off – an orderly shutdown, followed by a soft power off cycle – and completes in the
459 OffSoft power state.

460

461 **ResetHard** – DMTF “Power Cycle (Off-Hard)” (9) – ACPI G0 to G3, then S0 – the special power state that
462 performs a hard power reset – hard power off cycle, followed by normal power on cycle – and completes in
463 the On power state.

464

465 **ResetHardGraceful** – DMTF “Power Cycle Off-Soft Graceful” (16) – ACPI G3, then S0 – the special power
466 state that performs a graceful hard power reset – an orderly shutdown, followed by a hard power reset – and
467 completes in the On power state.

468

469 **ResetINIT** – DMTF “Diagnostic Interrupt (INIT)” (17) – ACPI S5, then S0 – the special power state (based
470 on a diagnostic interrupt) that performs a hard power reset – hard power off cycle, followed by normal power
471 on cycle – and completes in the On power state.

472

473 **ResetMBR** – DMTF “Master Bus Reset” (10) – ACPI S5, then S0 – the special power state (based on a
474 master bus reset) that performs a hard power reset – hard power off cycle, followed by normal power on
475 cycle – and completes in the On power state.

476

477 **ResetMBRGraceful** – DMTF “Master Bus Reset Graceful” (14) – ACPI S5, then S0 – the special power
478 state that performs an orderly shutdown, followed by an MBR reset – and completes in the On power state.

479

480 **ResetNMI** – DMTF “Diagnostic Interrupt (NMI)” (11) – ACPI S5, then S0 – the special power state (based on
481 a non-maskable interrupt) that performs a hard power reset – hard power off cycle, followed by normal
482 power on cycle – and completes in the On power state.

483

484 **ResetSoft** – DMTF “Power Cycle (Off-Soft)” (5) – ACPI G2 or S5, then S0 w/ lost context – the special
485 power state that performs a soft power reset – soft power off, followed by normal power on cycle – and
486 completes in the On power state.

487
488 **ResetSoftGraceful** – DMTF “Power Cycle Off-Soft Graceful” (16) – ACPI G2 or S5, then S0 w/ lost context
489 – the special power state that performs a graceful soft power reset – an orderly shutdown, followed by a soft
490 power reset – and completes in the On power state.

491

492 **2.4.4 DMTF CIM Out-of-band Power States**

493
494 This specification imports and renames (for clarity and common usage) the normative definitions and
495 semantics of the following DMTF CIM [DSP1027] out-of-band power states. None of these out-of-band
496 power states has a mapping to ACPI [ACPI]. None of these out-of-band power states represents a
497 meaningful requested power state in power policies or operations.

498
499 **NotApplicable** – DMTF “Not Applicable” (18) – not applicable power state – do not use for transitions.

500
501 **NoChange** – DMTF “No Change” (19) – no change power state – do not use for transitions.

502
503 **Other** – DMTF “Other” (1) – undefined other power state – DO NOT USE.

504
505 **Unknown** – DMTF “Unknown” (0) – unknown power state – use only for initial default.

506

507 **2.4.5 Vendor Extension Stable Power States**

508
509 This specification supports the definition of vendor extension stable power states for any of the base
510 standard DMTF CIM stable power states (see sections 2.4.2 and 9.1). Vendor extension stable power
511 states MUST have names of the form ‘BaseVendor[1-5]’, e.g., ‘StandbyVendor1’ (see section 9.1.1).

512
513 Usage: Implementations MUST support the corresponding base stable power state, e.g., ‘Standby’,
514 whenever they support any vendor extension stable power state, e.g., ‘StandbyVendor1’.

515
516 Usage: Vendor extension stable power states MUST be strictly ordered by their nominal inactive power
517 consumption (see section 6.1.2), e.g., ‘StandbyVendor2’ MUST consume equal or higher power than
518 ‘StandbyVendor1’ and ‘StandbyVendor1’ MUST consume equal or higher power than ‘StandbyVendor’ (the
519 base state).

520
521 Usage: Vendor extensions MUST NOT be defined for DMTF CIM special power states or DMTF CIM out-of-
522 band power states, in order to avoid ambiguity.

523

524 **2.5 Operational State Terminology**

525
526 The operational state of Imaging System components SHOULD be displayed to End Users and Operators
527 whenever the power state of those components is displayed.

528
529 See: Section 4.6 of this specification.

530 **2.5.1 Operational State of System**

531

532 This specification imports the following standard System operational states defined in the `IcServiceStateTC`
533 textual convention in the PWG Imaging System State and Counter MIB v2 [PWG5106.3], where they are
534 derived from IETF Host Resources MIB v2 [RFC2790] and IETF IPP/1.1 [RFC2911].
535

536 **Conformance:** To claim conformance to this specification, a Power Management Server SHOULD conform
537 to the corresponding set of valid power states as specified below in each operational state definition.
538

539 **Down** – The System is in `OffHard`, `OffSoft`, or `Hibernate` power state and is not available for either testing or
540 normal Job processing.
541

542 **Idle** – The System is in `On`, `Standby`, or `Suspend` power state and is not currently processing any Jobs.
543

544 **Other** – For CIM compatibility – do NOT use.
545

546 **Processing** – The System is in `On` power state and is currently processing one or more normal Jobs.
547

548 **Stopped** – The System is in `On`, `Standby`, or `Suspend` power state and is currently stopped.
549

550 **Testing** – The System is in `On` power state and is currently testing and is NOT available for processing
551 normal Jobs.
552

553 **Unknown** – For CIM compatibility and default values – do NOT use otherwise.
554

555 **2.5.2 Operational State of Subunit**

556 This specification imports all of the standard Subunit operational states defined in section 2.2.13.2.2 and the
557 `PrtSubUnitStatusTC` textual convention of the IETF Printer MIB v2 [RFC3805].
558
559

560 **3 Requirements**

561
562 Per the PWG Process, this section specifies the formal rationale for developing a PWG Power Management
563 Model, based on existing printing industry standards. This section also describes simple use models for the
564 PWG Power Management Model.
565

566 **3.1 Rationale for Power Management Model**

567

568 The IETF Printer MIB v2 [RFC3805] and IETF Finisher MIB [RFC3806] define:

569

570 (a) Model of Print Devices

571 (b) Operations for Print Devices

572 • prtGeneralReset

573 • prtConsoleDisable

574 (c) Groups of simple attributes for Print Devices

575 • prtInputTable --> prtInputName

576 • finDeviceTable --> finDeviceType

577 (d) Conformance requirements for implementations of IETF Printer MIB v2 and IETF Finisher MIB

578

579 The IETF IPP/1.1 Model and Semantics [RFC2911] defines:

580

581 (a) Model of Print Services, Print Devices, and Print Jobs

582 (b) Operations for Print Services and Print Jobs

583 • Pause-Printer

584 • Print-Job

585 (c) Attributes for Print Services and Print Jobs

586 • printer-location

587 • job-id

588 (d) Conformance requirements for implementations of IETF IPP/1.1

589

590 But no public standard specification defines a power management model for Printers, Multifunction Devices,
591 and other Imaging Systems, which causes increased operating costs for customers and issues of
592 conformance to national, regional, and international standards.

593

594 Therefore a PWG Power Management Model should:

595

596 (a) Standardize a small set of power management elements for interoperability

597 (b) Encourage adoption of open standard printing and imaging infrastructures

598 (c) Discourage the further proliferation of vendor proprietary power management operations and
599 elements that damage interoperability by duplicating PWG power management operations and
600 elements
601

602 **3.2 Use Cases for Power Management Model**

603

604 See the informal description of power management element classes in section 1.2.

605

606 **3.2.1 Local Printer Use Case**

607
608 Alice, Bob, and Charlie are graphic artists who share a printer down the hall. They all work on a fairly
609 regular schedule. Alice and Bob have convinced Charlie that he should remember to manually put the
610 printer into the Hibernate power state before going home every Friday afternoon. But they all sometimes
611 stay late on Friday and they often forget to put the printer into Hibernate power state before leaving - they
612 need a PWG Power Management Model implemented in their printer.

613 **3.2.2 Remote Printer Use Case**

614
615 Joe and his colleagues send large documents to a printer in a building across the street in a 'glasshouse'
616 with some corporate network servers.

617
618 Both Joe and the operator Sue in the glasshouse manage lots of print jobs - they need to hold and release
619 jobs when printers are entering and exiting power saving states due to corporate site policies. Joe wants to
620 keep track of printer power states (i.e., relative availability) - he needs to subscribe for power management
621 events.

622
623 Sue is expected to manage several printers - she needs to be able to set and query site policies for power
624 management of those printers.

626 **3.2.3 Fleet Management Use Case**

627
628 Acme Corporation has an office building with 15 floors and different departments on different floors. Acme
629 has their main lobby on the ground floor. Acme has over 50 imaging devices (printers, copiers, MFDs, etc.)
630 from multiple vendors spread throughout their building. Acme engineering staff works 5 days a week, but
631 AP department works 6 days a week, and the main lobby is open 24/7.

632
633 The power consumption by these imaging devices is quite significant and Jim (system administrator) has
634 been tasked to look for an approach for possible reduction in this power consumption.

635
636 Jim finds this nice tool in his fleet management software that allows him to set power management
637 schedules and monitor power consumption for the imaging devices. So Jim does the following:

- 638
- 639 • Since the Acme engineering team [floors 10-15] only works 5 days a week 7am-7pm, Jim sets the
640 Monday through Friday schedule for the engineering imaging devices so that the machines enter
641 the Hibernate power state after 7pm and so that the first user can manually wake them up to the On
642 power state each morning at 7am. On weekends, the machines remain in the Hibernate power
643 state.
 - 644
 - 645 • Since there are few stand-alone printers, Jim ties computers to network printers in their vicinity such
646 that when the computers go into Suspend or Hibernate state, the printers in their vicinity go into the
647 Suspend or Hibernate power state as well.
 - 648
 - 649 • Other departments have different work schedules, so Jim schedules the imaging device sleep/wake
650 cycles accordingly.
 - 651
 - 652 • Main lobby imaging devices are left in the On power state much longer.
 - 653
 - 654 • Certain specialized imaging devices (e.g., large format plotters) are only used periodically, so Jim
655 changes the default power state on these machines to be Hibernate.
 - 656

- 657
- Jim monitors job processing loads in the various imaging devices and finds that some machines are used very rarely, so he schedules different power state transitions for them.
- 658
- 659

660 Acme Corporation also has a print server on each floor that allows for load balancing, so:

661

- Jim adds power state as one of the load balancing options, such that if imaging devices A and B meet the requirements for the next job and device A is in On state, but device B is in Standby or Suspend state, then the job will be sent to device A, instead of waking up device B.
- 662
- 663
- 664
- 665

666 Acme Corporation is expanding and they need to add new imaging devices to their fleet. Since Jim has done such a good job of saving power, Acme management asks for Jim's recommendations. Based on the power consumption data that Jim has gathered in recent months:

667

668

669

- Jim provides recommendations on which machines consume least power when in different power states.
 - Jim has noticed that some devices consume a lot less power when in idle condition since they go into the Standby or Suspend power state based on a factory device policy.
- 670
- 671
- 672
- 673
- 674

675

676 **3.2.4 Tech Support Use Case**

677

678 Big Network Corporation has over 5,000 network printers and multifunction devices installed on their enterprise network. The operating, maintenance, and support costs for these network imaging devices are a significant budget item for Big Network Corporation.

679

680

681

682 Gracie is a senior engineer in a centralized Tech Support group at Big Network Corporation, specializing in network peripherals (storage devices, imaging devices, file servers, etc). Both end users and Facilities people regularly send in trouble tickets via email or Web forms to Tech Support. Trouble tickets for network peripherals (including imaging devices) are regularly escalated to Gracie.

683

684

685

686 Gracie uses a custom-built system management tool to periodically gather both system and subunit operating and power states as well as current and monthly power consumption of these network imaging devices. This information is acquired from vendor-specific: (a) private SNMP MIBs; (b) machine-readable Web Services interfaces; and/or (c) diagnostic protocols.

687

688

689

690

691 Gracie receives a trouble ticket from Facilities about operating costs for network peripherals at one of the branch offices. She uses her custom-built system management tool to view power consumption trends and anomalies at that branch office. She discovers that one imaging device has had very high power consumption in Standby and Suspend power states when compared with other similar models of imaging devices at that branch office. She tracks the problem down to a bad firmware update that has been leaving heaters and lamps turned on when in Standby and Suspend power states.

692

693

694

695

696

697 Gracie receives a trouble ticket from an end user who has been experiencing very long delays before first-page-out on a particular network printer. She uses her custom-built system management tool to examine the power state transition counters in that network printer. She tracks the problem down to a device configuration error that is sending the network printer into Suspend after 15 seconds of device inactivity.

698

699

700

701

702 **3.2.5 Automatic Policy Use Case**

703

704 Hot Sauce Corporation has over 1,000 network printers and multifunction devices installed on their enterprise network. The optimization of power management costs for these network imaging devices is a significant technical problem for Hot Sauce Corporation.

705

706

707

708 Howard is a system administrator at Hot Sauce Corporation, specializing in power management issues. He
709 uses the built-in feature in some of their newest printers and multifunction devices to automatically create
710 appropriate power management policies based on internal operational usage histories in the managed
711 devices. After invoking this feature, Howard remembers to read and log the newly created power
712 management policies for review and approval (or modification) by affected department managers.

3.3 Design Requirements for Power Management Model

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744

The PWG Power Management Model design should:

- (1) Be based on power management use cases that include workgroup, enterprise, and fleet management environments.
- (2) Conform to existing naming conventions used in the PWG Semantic Model/2.0 [PWGSM20], including element name case (title) and keyword value case (title) requirements.
- (3) Define a set of abstract power management elements for monitoring, history, capabilities (supported power states and transitions), policies (schedules and timeouts), counters (for power state transitions), meters (for power consumption), and operations (power state change requests).
- (4) Define the correspondence between PWG standard power states and existing values of DMTF CIM_AssociatedPowerManagementService.PowerState in DMTF CIM v2.22 (or later version).
- (5) Define the correspondence between PWG standard power states and existing values of ACPI [ACPI] power states per Table 3 in DMTF Power State Management Profile [DSP1027].
- (6) Define terminology for PWG standard power states and their semantics in strict conformance with IEEE Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments [IEEE1621].
- (7) Define explicit mapping details for concrete bindings to the PWG Semantic Model (XML Schema) and a future PWG Power Management MIB (SNMP MIB).
- (8) Design for extensibility in a future version of this specification to support the automatic device-written policy use case specified in section 3.2.5 above (as this use case was deemed too complex to address in this first version).

745 **4 Relationship to Other Public Standards**

746
747 This section describes the extensions of the PWG Semantic Model/2.0 [PWGSM20], the IETF Printer MIB
748 v2 [RFC3805], and the DMTF CIM Printing classes to incorporate the PWG Power Management Model for
749 Imaging Systems (Printers, Copiers, Multifunction Devices, etc.).

750
751 The original PWG Semantic Model/1.0 [PWG5105.1] and accompanying XML Schema were based on the
752 abstract model defined in section 2 of IETF IPP/1.1 [RFC2911].

753
754 The updated PWG Semantic Model/2.0 [PWGSM20] and accompanying XML Schema currently under
755 development in the PWG Multifunction Device WG extends the IPP objects, operations, elements, and
756 semantics to Multifunction Devices.
757

758 **4.1 PWG Semantic Model – System**

759
760 The PWG Semantic Model/2.0 [PWGSM20] defines a root object called System, which is equivalent to the
761 System object in the DMTF Common Information Model (CIM) [DMTF-CIM] and is consistent with the
762 System terminology in the IETF MIB-II [RFC1213], IETF Host Resources MIB v2 [RFC2790], IETF Printer
763 MIB v2 [RFC3805], and IETF Finisher MIB [RFC3806].

764
765 The PWG Semantic Model/2.0 [PWGSM20] will include all of the abstract element classes of the PWG
766 Power Management Model in the System object:

- 767
- 768 • Power Status Class – see section 5 of this specification
 - 769 • Power Capabilities Class – see section 6 of this specification
 - 770 • Power Settings Class – see section 7 of this specification
- 771

772 **4.2 PWG Semantic Model – Subunits**

773
774 The PWG Semantic Model/2.0 [PWGSM20] (work-in-progress) defines subordinate objects called Subunits,
775 which are equivalent to the Component object in the DMTF Common Information Model (CIM) [DMTF-CIM]
776 and are consistent with the Subunit tables defined in the IETF Printer MIB v2 [RFC3805] and IETF Finisher
777 MIB [RFC3806].

778
779 The PWG Semantic Model/2.0 [PWGSM20] will include all of the abstract element classes of the PWG
780 Power Management Model in the Subunits:

- 781
- 782 • Power Status Class – see section 5 of this specification (Power Monitor group ONLY)
 - 783 • Power Capabilities Class – see section 6 of this specification
 - 784 • Power Settings Class – see section 7 of this specification
- 785

786 **WARNING:** Implementation of the PWG Power Management Model on an Interpreter (unless it is running
787 on a dedicated coprocessor) would be ambiguous (because an Interpreter is a software component of an
788 Imaging System, similar to a Service - see below).
789

790
791

792 **4.3 PWG Semantic Model – Services (out-of-scope)**

793
794 The PWG Semantic Model/2.0 [PWGSM20] (work-in-progress) defines subordinate objects called Services,
795 which are equivalent to the Service object in the DMTF Common Information Model (CIM) [DMTF-CIM] and
796 the icServiceTable defined in the PWG Imaging System State and Counter MIB [PWG5106.3].
797

798 The PWG Semantic Model/2.0 [PWGSM20] will not support the PWG Power Management Model in any
799 Service object (because each Service object represents a software component of an Imaging System).

800 **4.4 IETF Printer MIB – Alerts and Notifications**

801
802 The IETF Printer MIB v2 [RFC3805] defines the prtAlertTable, an ordered list of the warning and critical
803 alerts on a Printer (or an MFD), which MUST be implemented as persistent across power cycles for
804 conforming implementations of the PWG Power Management Model. The PrtAlertCodeTC textual
805 convention defined in the IANA Printer MIB [IANA-PRT] defines both 'powerUp' (On) and 'powerDown'
806 (OffSoft or OffHard).
807

808 The additional values 'standby', 'suspend', and 'hibernate' for PrtAlertCodeTC in the IANA Printer MIB are
809 defined in section 9.7.
810

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

813 **4.5 DMTF CIM – Alerts**

814
815 The DMTF CIM Printing Classes include CIM_PrintAlertRecord which contains the properties RecordData
816 (every integer object in a prtAlertTable entry in the IETF Printer MIB v2 [RFC3805]) and
817 LocalizedDescription (human-readable string object prtAlertDescription in a prtAlertTable entry).
818

819 **4.6 PWG Imaging System State and Counter MIB v2 – Operational States**

820
821 The PWG Imaging System State and Counter (ISC) MIB v2 [PWG5106.3] defines the icKeyTable,
822 icServiceTable, and icSubunitTable. The PWG ISC MIB also defines the IcServiceTypeTC,
823 IcServiceStateTC, IcSubunitTypeTC, and IcSubunitStatusTC (bit-mask identical to PrtSubUnitStatusTC
824 defined in IETF Printer MIB v2) textual conventions.
825
826

827 Conformance: Conforming implementations of this PWG Power Management Model that also implement
828 the PWG ISC MIB v2 [PWG5106.3] and the icKeyTable, icServiceTable, or icSubunitTable MUST
829 implement those tables as persistent across power cycles.
830

831 If the PowerLog.ComponentType element takes a value of 'System', then the corresponding icServiceState
832 object (with icServiceType of 'systemTotals') SHOULD be implemented to report the System operational
833 state (e.g., 'idle' or 'processing'), which directly impacts power consumption.
834

835 If the PowerLog.ComponentType element takes a value of any Subunit defined in the IcSubunitType textual
836 convention in the PWG ISC MIB, then the corresponding icSubunitStatus object SHOULD be implemented
837 to report the Subunit operational state (e.g., 'Available and Idle' or 'Available and Active'), which directly
838 impacts power consumption.
839

840

841 **5 Power Status Element Definitions**

842
843 The following elements are defined in the Power Status class of the PWG Power Management Model and
844 MUST only be set by the Imaging System itself.
845

846 **5.1 Power General Group (REQUIRED)**

847
848 The Power General group describes the basic power management capabilities of this Imaging System and
849 MUST only be instantiated on the System object. The following REQUIRED read-only elements are defined
850 in the Power General group.

851
852 Notes:

- 853
- 854 (1) The natural language tag for human-readable strings in the PWG Power Management Model
855 (currently only PowerStateMessage) is not included in this Power General group, because it is
856 already present in the corresponding parent objects (System, Marker, etc.) in the PWG Semantic
857 Model/2.0 [PWGSM20] XML Schema. This natural language tag MUST be defined in a MIB
858 mapping of the PWG Power Management Model.
859
 - 860 (2) The implementation supported access (i.e., read-only, read-write, or read-create) for power policies
861 in the PWG Power Management Model is NOT included in this Power General group, because it is
862 already present in the corresponding parent objects (System, Marker, etc.) in the PWG Semantic
863 Model/2.0 [PWGSM20] XML Schema. This implementation supported access MUST be defined in
864 a MIB mapping of the PWG Power Management Model.
865

868 **5.1.1 PowerUsagelsRMSWatts (boolean)**

869
870 The read-only element specifies whether or not the power consumption properties for this Imaging System
871 use units of Root Mean Square (RMS) watts (true) or unnormalized so-called peak watts (false) in a binary
872 encoding ('boolean' in an XML Schema or 'TruthValue' in an SNMP MIB).

873
874 Default Value: "false"
875

876 **5.1.2 CanRequestPowerStates (string)**

877
878 This read-only element specifies all of the stable and special power states (see sections 2.4.2 and 2.4.3)
879 that can be requested (in policies or operations) on this Imaging System listed in a string (XML
880 Schema/SNMP MIB).

881
882 Usage: This element MUST be of the format "<STATE1>,...,<STATEN>" and MUST contain a comma-
883 delimited list of power state keywords (XML Schema) or corresponding positive integer values (SNMP MIB).

884
885 Default Value: "" (empty string)
886

887 **5.2 Power Monitor Group (REQUIRED)**

888

889 The Power Monitor group lists the current power state for each System or Subunit. The following
890 REQUIRED read-only elements are defined in the Power Monitor group .
891
892

893 **5.2.1 PowerState (PowerStateWKV)**

894
895 This read-only element specifies the current enumerated power state as a keyword (XML Schema) or a
896 positive 32-bit integer (SNMP MIB) of this System or Subunit. Conforming implementations MUST support
897 standard power states (e.g., Standby) whenever they support vendor extensions (e.g., StandbyVendor1).
898

899 Implementor's Note: Implementors of this PWG Power Management Model SHOULD consider the impact
900 on system logging and network management applications before reporting intermediate power states, e.g.,
901 OffSoft or Standby before On during a ResetSoft power operation.

902
903 Default Value: "Unknown"
904

905 **5.2.2 PowerStateMessage (string)**

906
907 This read-only element specifies a human-readable string in UTF-8 [RFC3629] that describes, explains, or
908 qualifies the current power state of this System or Subunit.
909

910 Usage: This element: (a) MUST identify the power state; (b) SHOULD identify the method of entry to the
911 power state, e.g., "from timeout trigger" or "from user request"; (c) SHOULD identify the nominal power
912 consumption, e.g., "(34 watts)"; and (d) MAY include any other power-related information, e.g., "can accept
913 jobs" or "can process jobs".

914
915 Default Value: "" (empty string)
916

917 **5.3 Power Log Group (REQUIRED)**

918
919 The Power Log group lists the power log records for this Imaging System and MUST only be instantiated on
920 the System object. The following REQUIRED read-only elements are defined in the Power Log group.
921

922 Usage: All Imaging Systems MUST implement this Power Log group as persistent across power cycles and
923 hardware reconfigurations. Imaging Systems SHOULD only add records to the Power Log group when a
924 power state transition occurs (i.e., successive Power Log records for the same component SHOULD NOT
925 have the same power state). Imaging Systems SHOULD support at least 10 records in the Power Log (for
926 reliable fleet management).
927

928 **5.3.1 LogID (int (1..MAX)) – KEY**

929
930 This read-only KEY element specifies the instance in a positive 32-bit integer (XML Schema and SNMP
931 MIB) of this Power Log group of elements (e.g., for queries).

932
933 Default Value: <not specified for key>
934

935 **5.3.2 PowerState (PowerStateWKV)**

936

937 This read-only element specifies the logged enumerated power state as a keyword (XML Schema) or a
938 positive 32-bit integer (SNMP MIB) of the source System or Subunit.

939
940 Usage: Imaging Systems SHOULD only add records to the Power Log group when a power state transition
941 occurs (i.e., successive Power Log records for the same component SHOULD NOT have the same power
942 state). Recording a system heartbeat event (without a power state transition) in the Power Log MAY be
943 useful (especially if power state notifications are also sent to system management tools – see section 5.7),
944 but implementers SHOULD consider the loss of functionality caused by a Power Log flooded with heartbeat
945 events.

946
947 Implementor's Note: Implementors of this PWG Power Management Model SHOULD consider the impact
948 on system logging and network management applications before reporting intermediate power states, e.g.,
949 OffSoft or Standby before On during a ResetSoft power operation.

950
951 Default Value: "Unknown"

952

953 **5.3.3 PowerStateMessage (string)**

954
955 This read-only element specifies a human-readable string in UTF-8 [RFC3629] that describes, explains, or
956 qualifies the logged power state of the source System or Subunit.

957
958 Usage: This element: (a) MUST identify the power state; (b) SHOULD identify the method of entry to the
959 power state, e.g., "from timeout trigger" or "from user request"; (c) SHOULD identify the nominal power
960 consumption, e.g., "(34 watts)"; and (d) MAY include any other power-related information, e.g., "can accept
961 jobs" or "can process jobs".

962
963 Default Value: "" (empty string)

964

965 **5.3.4 PowerStateDateAndTime (dateTime)**

966
967 This read-only element specifies the date/time of transition into the logged power state in an ISO 8601
968 conformant encoding ('dateTime' in an XML Schema or 'DateAndTime' in an SNMP MIB) of the source
969 System or Subunit.

970
971 Default Value: "" (empty string) or <omitted> (SNMP MIB)

972 **5.3.5 PowerComponentType (PowerComponentTypeWKV)**

973
974 This read-only element specifies the enumerated type (System or specific Subunit type, e.g., InputTray) as a
975 keyword (XML Schema) or a positive 32-bit integer (SNMP MIB) of the source System or Subunit.

976
977 Default Value: "System"

978

979 **5.3.6 PowerComponentReferenceId (int (0..MAX))**

980
981 This read-only element specifies the identifier in a positive 32-bit integer or zero (if not available, because
982 there is no corresponding component in another XML schema or SNMP MIB) (XML Schema/SNMP MIB) of
983 the source component instance (System or Subunit) of the above PowerComponentType element.

984

985 Usage: For a System object, the value of this element MUST be the corresponding identifier (e.g., value of
986 hrDeviceIndex (for hrDevicePrinter) in SNMP MIB). For a Subunit object, the value of this element MUST
987 be the corresponding identifier (e.g., value of InputTrayId in XML Schema or prtInputIndex in SNMP MIB).

988
989 Default Value: "0"
990

991 **5.4 Power Counter Group (OPTIONAL)**

992
993 The Power Counter group of Power Status elements contains the lifetime power counters for each System
994 or Subunit. The following OPTIONAL read-only elements are defined in the Power Counter group.

995
996 Usage: All Imaging Systems that implement this Power Counter group MUST implement all properties as
997 persistent across power cycles and hardware reconfigurations.
998

999 **5.4.1 HibernateTransitions (Counter (0..MAX))**

1000
1001 This read-only element specifies the lifetime number of transitions into the Hibernate power state in a
1002 positive 32-bit integer or zero (XML Schema/SNMP MIB) of this System or Subunit.
1003

1004 **5.4.2 OnTransitions (Counter (0..MAX))**

1005
1006 This read-only element specifies the lifetime number of transitions into the On power state in a positive 32-
1007 bit integer or zero (XML Schema/SNMP MIB) of this System or Subunit.
1008

1009 **5.4.3 StandbyTransitions (Counter (0..MAX))**

1010
1011 This read-only element specifies the lifetime number of transitions into the Standby power state in a positive
1012 32-bit integer or zero (XML Schema/SNMP MIB) of this System or Subunit.
1013

1014 **5.4.4 SuspendTransitions (Counter (0..MAX))**

1015
1016 This read-only element specifies the lifetime number of transitions into the Suspend power state in a positive
1017 32-bit integer or zero (XML Schema/SNMP MIB) of this System or Subunit.
1018

1019 **5.5 Power Meter Group (OPTIONAL)**

1020
1021 The Power Meter group of Power Status elements contains the current, monthly, and lifetime power meters
1022 for each System or Subunit. The following OPTIONAL read-only elements are defined in the Power Meter
1023 group.

1024
1025 Usage: All Imaging Systems that implement this Power Meter group MUST implement all properties as
1026 persistent across power cycles and hardware reconfigurations.
1027

1028 **5.5.1 PowerMetersAreActual (boolean)**

1029

1030 The read-only element specifies whether or not Power Meter properties for this System or Subunit are
1031 based on actual measurement (true) or software estimation (false) in a binary encoding ('boolean' in an XML
1032 Schema or 'TruthValue' in an SNMP MIB).

1033
1034 Default Value: "false"
1035

1036 **5.5.2 PowerCurrentWatts (Gauge (0..MAX))**

1037
1038 This read-only element specifies the current power consumption in watts in a positive 32-bit integer or zero
1039 (for less than one watt, i.e., nominal none) of this Imaging System.
1040

1041 **5.5.3 PowerPeakWatts (Gauge (0..MAX))**

1042
1043 This read-only element specifies the peak power consumption in watts in a positive 32-bit integer or zero (for
1044 less than one watt, i.e., nominal none) since last reboot of this System or Subunit.
1045

1046 **5.5.4 PowerCurrentMonthKWH (Gauge (0..MAX))**

1047
1048 This read-only element specifies the current month's power consumption in kilowatt hours in a positive 32-bit
1049 integer or zero (for less than one kilowatt hour, i.e., nominal none) of this System or Subunit.
1050
1051 Usage: Because it specifies the *current* month's power consumption, the value of this property will change
1052 rapidly.
1053

1054 **5.5.5 PowerPreviousMonthKWH (Gauge (0..MAX))**

1055
1056 This read-only element specifies the previous month's power consumption in kilowatt hours in a positive 32-
1057 bit integer or zero (for less than one kilowatt hour, i.e., nominal none) of this System or Subunit.
1058
1059 Usage: Because it specifies the *previous* month's power consumption, the value of this property will be
1060 stable and may be read on any day of the current month (for reliable accounting).
1061

1062 **5.5.6 PowerLifetimeKWH (Counter (0..MAX))**

1063
1064 This read-only element specifies the lifetime power consumption in kilowatt hours in a positive 32-bit integer
1065 or zero (for less than one kilowatt hour, i.e., nominal none) of this System or Subunit.
1066

1067 **5.6 Examples of Power Status Elements (Informative)**

1068
1069 Below are concrete usage examples of Power Status elements.
1070

1071 **5.6.1 Examples of Power General Group**

1072
1073 Example of a System object with Power General Group:
1074

1075 System.SystemStatus.PowerGeneral.PowerUsagelsRMSWatts = "true"
1076 System.SystemStatus.PowerGeneral.CanRequestPowerStates =
1077 "On,Standby,Suspend,ResetSoft,OffHard,OffSoft,ResetHard"
1078
1079

1080 5.6.2 Examples of Power Monitor Group

1081
1082 Example of a System object that is powered on and ready for Jobs:
1083
1084 System.SystemStatus.PowerMonitor.PowerState = "On"
1085 System.SystemStatus.PowerMonitor.PowerStateMessage = "On from calendar trigger (34 watts)"
1086

1087
1088 Example of a Subunit object (Marker) that is in standby and must warm up before printing Jobs:
1089
1090 Marker.MarkerStatus.PowerMonitor.PowerState = "Standby"
1091 Marker.MarkerStatus.PowerMonitor.PowerStateMessage = "Standby from timeout trigger (18 watts)"
1092
1093

1094 5.6.3 Examples of Power Log Group

1095
1096 Excerpt from a System object power log:
1097
1098 System.SystemStatus.PowerLog[1].LogID = "1" (KEY)
1099 System.SystemStatus.PowerLog[1].PowerState = "On"
1100 System.SystemStatus.PowerLog[1].PowerStateMessage = "On from calendar trigger (34 watts)"
1101 System.SystemStatus.PowerLog[1].PowerStateTimestamp = "2000-01-12T12:13:14Z"
1102 System.SystemStatus.PowerLog[1].PowerComponentType = "System"
1103 System.SystemStatus.PowerLog[1].PowerComponentReferenceId = "1"
1104
1105
1106 System.SystemStatus.PowerLog[2].LogID = "2" (KEY)
1107 System.SystemStatus.PowerLog[2].PowerState = "Suspend"
1108 System.SystemStatus.PowerLog[2].PowerStateMessage = "Suspend from timeout trigger (7 watts)"
1109 System.SystemStatus.PowerLog[2].PowerStateTimestamp = "2000-01-12T19:00:13Z"
1110 System.SystemStatus.PowerLog[2].PowerComponentType = "System"
1111 System.SystemStatus.PowerLog[2].PowerComponentReferenceId = "1"
1112

1113 5.6.4 Example of Power Counter Group

1114
1115 Excerpt from a System object:
1116
1117 System.SystemStatus.PowerCounter.HibernateTransitions = "25"
1118 System.SystemStatus.PowerCounter.OnTransitions = "212"
1119 System.SystemStatus.PowerCounter.StandbyTransitions = "74"
1120 System.SystemStatus.PowerCounter.SuspendTransitions = "122"
1121

1122 5.6.5 Example of Power Meter Group

1123
1124 Excerpt from a System object:

1125
1126 System.SystemStatus.PowerGeneral.PowerUsagelsRMSWatts = "true"
1127
1128 System.SystemStatus.PowerMeter.PowerMetersAreActual = "true" (actual measurement)
1129 System.SystemStatus.PowerMeter.PowerCurrentWatts = "22"
1130 System.SystemStatus.PowerMeter.PowerPeakWatts = "54"
1131 System.SystemStatus.PowerMeter.PowerCurrentMonthKWH = "2048"
1132 System.SystemStatus.PowerMeter.PowerPreviousMonthKWH = "3244"
1133 System.SystemStatus.PowerMeter.PowerLifetimeKWH = "31344"
1134

1135

1136 **5.7 Power State Transition Notifications (RECOMMENDED)**

1137
1138 Imaging Systems and Imaging Clients that support this Power Management Model SHOULD support power
1139 state transition notifications for System and Subunit components via the printerV2Alert SNMP trap defined in
1140 IETF Printer MIB v2 [RFC3805], the PWG Imaging System Power MIB [PWG5106.5], IPP Event
1141 Notifications [RFC 3995], Web Services interfaces, and any other supported system management protocols.
1142

1143

1144

1145

1146 Note: The power state extensions for the PrtAlertCodeTC textual convention defined in the IANA Printer
1147 MIB [IANAPRT] are specified in section 9.7 of this document. The power state extensions for the printer-
1148 state-reasons attribute defined in IPP/1.1 [RFC2911] are specified in section 9.8 of this document.

1149

1149

1150 **6 Power Capabilities Element Definitions**

1151
1152 The following elements are defined in the PowerCapabilities class of the PWG Power Management Model
1153 and MUST only be set by the Imaging System itself.
1154

1155 **6.1 Power Support Group (OPTIONAL)**

1156
1157 The Power Support group lists the supported DMTF CIM stable power states (see section 2.4.2) and vendor
1158 extension stable power states (see section 2.4.5) for each System or Subunit. The following OPTIONAL
1159 read-only elements are defined in the Power Support group.
1160

1161 **6.1.1 PowerState (PowerStateWKV) – KEY**

1162
1163 This read-only KEY element specifies the instance as a keyword (XML Schema) or a positive 32-bit integer
1164 (SNMP MIB) of this Power Support group of elements – a supported stable enumerated power state of the
1165 System or Subunit.
1166
1167 Default Value: <not specified for key>
1168

1169 **6.1.2 PowerInactiveWatts (int (0..MAX))**

1170
1171 This read-only element specifies the nominal power consumption in watts in a positive 32-bit integer or zero
1172 (for less than one watt, i.e., nominal none) of this stable power state for the System or Subunit (as
1173 determined by the manufacturer, NOT by actual power usage measurement), when the System or Subunit is
1174 in a inactive operational state (e.g., Idle or Stopped).
1175
1176 Default Value: "0"
1177

1178 **6.1.3 PowerActiveWatts (int (0..MAX))**

1179
1180 This read-only element specifies the nominal power consumption in watts in a positive 32-bit integer or zero
1181 (for less than one watt, i.e., nominal none) of this stable power state for the System or Subunit (as
1182 determined by the manufacturer, NOT by actual power usage measurement), when the System or Subunit is
1183 in an active operational state (e.g., Processing or Testing).
1184
1185 Default Value: "0"
1186

1187 **6.1.4 PowerPeakWatts (int (0..MAX))**

1188
1189 This read-only element specifies the peak power consumption in watts in a positive 32-bit integer or zero (for
1190 less than one watt) of this stable power state for the System or Subunit (as determined by the manufacturer,
1191 NOT by actual power usage measurement), when the System or Subunit is in an active operational state
1192 (e.g., Processing or Testing).
1193
1194 Default Value: "0"
1195

1196

1197 6.1.5 CanAcceptJobs (boolean)

1198

1199 This read-only element specifies whether the System or Subunit will accept new incoming Jobs in this stable
1200 power state in a binary encoding ('boolean' in an XML Schema or 'TruthValue' in an SNMP MIB), unless the
1201 System or Subunit has been disabled by an Administrator. This element does NOT report the disabled
1202 condition.

1203

1204 Default Value: "false"

1205

1206 6.1.6 CanProcessJobs (boolean)

1207

1208 This read-only element specifies whether the System or Subunit will process new incoming Jobs or existing
1209 queued Jobs in this stable power state in a binary encoding ('boolean' in an XML Schema or 'TruthValue' in
1210 an SNMP MIB), unless the System or Subunit has been paused by an Administrator. This element does
1211 NOT report the paused condition.

1212

1213 Default Value: "false"

1214

1215 6.1.7 CanRequestPowerState (boolean)

1216

1217 This read-only element specifies whether this power state is valid for use in the Power Policy (Timeout,
1218 Calendar, and Event) and Power Request groups in a binary encoding ('boolean' in an XML Schema or
1219 'TruthValue' in an SNMP MIB).

1220

1221 Default Value: "false"

1222

1223 6.1.8 CanUseInterfaces (string)

1224

1225 This read-only element specifies whether the System will use the Interfaces listed in a string (XML
1226 Schema/SNMP MIB) or the empty string (none) in this stable power state, unless one or more of these
1227 Interfaces has been disabled or powered down by an Administrator. This element does NOT report the
1228 disabled or down conditions of the Interfaces.

1229

1230 Usage: This element MUST be of the format "<ID1>,...,<IDn>" (e.g., 1,3,4) and MUST contain a comma-
1231 delimited list of InterfaceID values (XML Schema) or corresponding ifIndex values (SNMP MIB). If this
1232 element is instantiated on a Subunit (e.g., in an SNMP MIB), then this element MUST have the same value
1233 as corresponding element in the parent System object.

1234

1235 Default Value: "" (empty string)

1236

1237 6.2 Power Transition Group (OPTIONAL)

1238

1239 The Power Transition group lists the supported transitions between DMTF CIM stable power states (see
1240 section 2.4.2) or vendor extension stable power states (see section 2.4.5) for each System or Subunit. The
1241 following OPTIONAL read-only elements are defined in the Power Transition group.

1242

1243 **6.2.1 StartPowerState (PowerStateWKV) – KEY**

1244 This read-only KEY element specifies the starting stable enumerated power state (see section 2.4.2) as a
1245 keyword (XML Schema) or a positive 32-bit integer (SNMP MIB) of this power state transition for the System
1246 or Subunit.
1247

1248
1249 Default Value: <not specified for key>
1250

1251 **6.2.2 EndPowerState (PowerStateWKV) – KEY**

1252 This read-only KEY element specifies the ending stable enumerated power state (see section 2.4.2) as a
1253 keyword (XML Schema) or a positive 32-bit integer (SNMP MIB) of this power state transition for the System
1254 or Subunit.
1255

1256
1257 Default Value: <not specified for key>
1258

1259 **6.2.3 StateChangeSeconds (int (0..MAX))**

1260 This read-only element specifies the nominal duration in seconds in a positive 32-bit integer or zero (for less
1261 than one second, i.e., nominal immediate) of this power state transition of the System or Subunit (as
1262 determined by the manufacturer, NOT the actual power transition duration measurement).
1263

1264
1265 Default Value: “0” (nominal immediate)
1266

1267 **6.3 Examples of Power Capabilities Elements (Informative)**

1268
1269 Below are concrete usage examples of Power Capabilities elements.
1270

1271 **6.3.1 Examples of Power Support Group**

1272
1273 Example of a System object that supports standby and administrative request for standby:
1274

```
1275 System.SystemStatus.PowerGeneral.PowerUsagelsRMSWatts = “true”  
1276 System.SystemStatus.PowerSupport[Standby].PowerState = “Standby” (KEY)  
1277 System.SystemStatus.PowerSupport[Standby].PowerInactiveWatts = “14”  
1278 System.SystemStatus.PowerSupport[Standby].PowerActiveWatts = “20”  
1279 System.SystemStatus.PowerSupport[Standby].PowerPeakWatts = “24”  
1280 System.SystemStatus.PowerSupport[Standby].CanAcceptJobs = “true”  
1281 System.SystemStatus.PowerSupport[Standby].CanProcessJobs = “false”  
1282 System.SystemStatus.PowerSupport[Standby].CanRequestPowerState = “true”  
1283 System.SystemStatus.PowerSupport[Standby].CanUseInterfaces = “1,2,3”
```

1284
1285
1286
1287 Example of a System object that supports hibernate but NOT administrative request for hibernate:
1288

```
1289 System.SystemStatus.PowerGeneral.PowerUsagelsRMSWatts = “true”  
1290  
1291 System.SystemStatus.PowerSupport[Hibernate].PowerState = “Hibernate” (KEY)
```

1292 System.SystemStatus.PowerSupport[Hibernate].PowerInactiveWatts = "2"
1293 System.SystemStatus.PowerSupport[Hibernate].PowerActiveWatts = "2"
1294 System.SystemStatus.PowerSupport[Hibernate].PowerPeakWatts = "2"
1295 System.SystemStatus.PowerSupport[Hibernate].CanAcceptJobs = "false"
1296 System.SystemStatus.PowerSupport[Hibernate].CanProcessJobs = "false"
1297 System.SystemStatus.PowerSupport[Hibernate].CanRequestPowerState = "false"
1298 System.SystemStatus.PowerSupport[Hibernate].CanUseInterfaces = "" (none)
1299
1300

1301 **6.3.2 Examples of Power Transition Group**

1302
1303 Example of a System object that supports a transition from standby to on:

1304
1305 System.SystemStatus.PowerTransition[Standby,On].StartPowerState = "Standby" (KEY)
1306 System.SystemStatus.PowerTransition[Standby,On].EndPowerState = "On" (KEY)
1307 System.SystemStatus.PowerTransition[Standby,On].StateChangeSeconds = "22"
1308

1309
1310 Example of a System object that supports a transition from standby to suspend:

1311
1312 System.SystemStatus.PowerTransition[Standby,Suspend].StartPowerState = "Standby" (KEY)
1313 System.SystemStatus.PowerTransition[Standby,Suspend].EndPowerState = "Suspend" (KEY)
1314 System.SystemStatus.PowerTransition[Standby,Suspend].StateChangeSeconds = "15"
1315

1316

1317 **7 Power Settings Element Definitions**

1318
1319 The following elements are defined in the Power Settings class of the PWG Power Management Model and
1320 MAY be set by the Imaging System itself and/or Administrator.
1321

1322 **7.1 Power Request Group (OPTIONAL)**

1323
1324 The Power Request group supports user requests for power state transitions for each System or Subunit.
1325 The following OPTIONAL read-write and read-only elements are defined in the Power Request group.
1326
1327

1328 **7.1.1 RequestPowerState (PowerStateWKV)**

1329
1330 This read-write element specifies the requested stable or special enumerated power state as a keyword
1331 (XML Schema) or a positive 32-bit integer (SNMP MIB) and MAY be set by either the Imaging System or the
1332 Administrator.
1333
1334 Default Value: "Unknown"
1335

1336 **7.1.2 RequestStatus (PowerRequestStatusWKV)**

1337
1338 This read-only element specifies the current enumerated request processing status as a keyword (XML
1339 Schema) or a positive 32-bit integer (SNMP MIB) of this power request for the System or Subunit and MUST
1340 only be set by the Imaging System itself.
1341
1342 Default Value: "None"
1343

1344 **7.2 Power Timeout Group (RECOMMENDED)**

1345
1346 The Power Timeout Group lists configured timeout-based power state change policies for each System or
1347 Subunit. The following RECOMMENDED read-write and read-only elements are defined in the Power
1348 Timeout group. These Power Timeout elements are technically aligned with the IETF Schedule MIB
1349 [RFC3231], for compatibility and extensibility.
1350
1351 Usage: All Imaging Systems that support this Power Timeout group MUST implement this Power Timeout
1352 group as persistent across power cycles and hardware reconfigurations.
1353

1354 **7.2.1 TimeoutID (int (1..MAX)) – KEY**

1355
1356 This read-only KEY element specifies the instance in a positive 32-bit integer of this timeout policy for the
1357 System or Subunit (e.g., for queries).
1358
1359 Default Value: <not specified for key>
1360

1361 **7.2.2 RequestPowerState (PowerStateWKV)**

1362
1363 This read-write element specifies the requested stable or special enumerated power state as a keyword
1364 (XML Schema) or a positive 32-bit integer (SNMP MIB) of this timeout policy for the System or Subunit.

1365
1366 Default Value: "Unknown"
1367

1368 **7.2.3 StartPowerState (PowerStateWKV)**

1369
1370 This read-write element specifies the timeout starting stable enumerated power state as a keyword (XML
1371 Schema) or a positive 32-bit integer (SNMP MIB) of this power policy for the System or Subunit.

1372
1373 Default Value: "NotApplicable"
1374

1375 **7.2.4 TimeoutPredicate (PowerTimeoutPredicateWKV)**

1376
1377 This read-write element specifies the timeout predicate condition as a keyword (XML Schema) or a positive
1378 32-bit integer (SNMP MIB) of this power policy for the System or Subunit.

1379
1380 Default Value: "None"
1381

1382 **7.2.5 TimeoutSeconds (int (0..MAX))**

1383
1384 This read-write element specifies the timeout interval in seconds as a positive 32-bit integer (XML Schema
1385 and SNMP MIB) or zero (for none) of this power policy for the System or Subunit.

1386
1387 Default Value: "0" (none)
1388

1389 **7.3 Power Calendar Group (OPTIONAL)**

1390
1391 The Power Calendar Group lists configured calendar-based power state change policies for each System or
1392 Subunit. The following OPTIONAL read-write and read-only elements are defined in the Power Calendar
1393 group. These Power Calendar elements are technically aligned with the IETF Schedule MIB [RFC3231], for
1394 compatibility and extensibility.

1395
1396 Usage: All Imaging Systems that support this Power Calendar group MUST implement this Power Calendar
1397 group as persistent across power cycles and hardware reconfigurations.
1398

1399 **7.3.1 CalendarID (int (1..MAX)) – KEY**

1400
1401 This read-only KEY element specifies the instance in a positive 32-bit integer of this calendar policy for the
1402 System or Subunit (e.g., for queries).

1403
1404 Default Value: <not specified for key>
1405

1406 **7.3.2 RequestPowerState (PowerStateWKV)**

1407
1408 This read-write element specifies the requested stable or special enumerated power state as a keyword
1409 (XML Schema) or a positive 32-bit integer (SNMP MIB) of this calendar policy for the System or Subunit.

1410
1411 Default Value: "Unknown"
1412

1413 **7.3.3 CalendarRunOnce (boolean)**

1414
1415 This read-write element specifies whether this calendar policy should be run once (single execution) or
1416 repeatedly (multiple executions) in a binary encoding ('boolean' in an XML Schema or 'TruthValue' in an
1417 SNMP MIB).

1418
1419 Default Value: "false"
1420

1421 **7.3.4 CalendarDayOfWeek (PowerCalendarDayOfWeekWKV)**

1422
1423 This read-write element specifies the trigger enumerated day of the week (Sunday through Saturday or any)
1424 as a keyword (XML Schema) or a positive 32-bit integer (SNMP MIB) of this calendar policy for the System
1425 or Subunit.

1426
1427 Default Value: "Any"
1428

1429 **7.3.5 CalendarMonth (PowerCalendarMonthWKV)**

1430
1431 This read-write element specifies the trigger enumerated month (January through December or any) as a
1432 keyword (XML Schema) or a positive 32-bit integer (SNMP MIB) of this calendar policy for the System or
1433 Subunit.

1434
1435 Default Value: "Any"
1436

1437 **7.3.6 CalendarDay (int (0..31))**

1438
1439 This read-write element specifies the trigger day of the month as a positive 32-bit integer (XML Schema and
1440 SNMP MIB) or zero (for any) of this calendar policy for the System or Subunit.

1441
1442 Usage: '1' is the first day of the month, '2' is the second day of the month, etc.

1443
1444 Default Value: "0" (any day of the month)
1445

1446 **7.3.7 CalendarHour (int (0..23))**

1447
1448 This read-write element specifies the trigger hour as a non-negative 32-bit integer (XML Schema and SNMP
1449 MIB) of this calendar policy for the System or Subunit.

1450
1451 Usage: '0' is the first hour of the day (12:00-12:59 am), '1' is the second hour of the day (1:00-1:59 am), etc.
1452 Exactly midnight (i.e., 12:00 am) is specified by a value of zero for CalendarHour and a value of zero for
1453 CalendarMinute.

1454
1455 Default Value: "0" (first hour of the day)
1456

1457 **7.3.8 CalendarMinute (int (0..59))**

1458
1459 This read-write element specifies the trigger minute as a non-negative 32-bit integer (XML Schema and
1460 SNMP MIB) of this calendar policy for the System or Subunit.

1461
1462 Usage: '0' is the first minute of the hour (e.g., 7:00pm), '1' is the second minute of the hour (e.g., 7:01pm),
1463 etc. Exactly at the hour (e.g., 7:00pm) is specified by a value of zero for CalendarMinute.

1464
1465 Default Value: "0" (first minute of the hour)
1466

1467 **7.4 Power Event Group (OPTIONAL)**

1468
1469 The Power Event Group lists configured event-based power state change policies for each System or
1470 Subunit. The following OPTIONAL read-write and read-only elements are defined in the Power Event
1471 group.

1472
1473 Usage: All Imaging Systems that support this Power Event group MUST implement this Power Event group
1474 as persistent across power cycles and hardware reconfigurations.

1475

1476 **7.4.1 EventID (int (1..MAX)) – KEY**

1477
1478 This read-only KEY element specifies the instance in a positive 32-bit integer of this event policy for the
1479 System or Subunit (e.g., for queries).

1480
1481 Default Value: <not specified for key>
1482

1483 **7.4.2 RequestPowerState (PowerStateWKV)**

1484
1485 This read-write element specifies the requested stable or special enumerated power state as a keyword
1486 (XML Schema) or a positive 32-bit integer (SNMP MIB) of this event policy for the System or Subunit.

1487
1488 Default Value: "Unknown"
1489

1490 **7.4.3 EventName (string)**

1491
1492 This read-write element specifies the trigger event name as a keyword (XML Schema or SNMP MIB) of this
1493 event policy for the System or Subunit.

1494
1495 Usage: Event names MUST be either: (a) the exact case-sensitive label (starting with a lowercase
1496 character) of an enumerated value in the PrtAlertCodeTC textual convention in the IANA Printer MIB
1497 [IANAPRT] (e.g., 'jam'); or (b) a case-sensitive keyword (starting with an
1498 Uppercase character) vendor event name (e.g., 'AcmeCrackedCrock'). Event name keywords MUST be
1499 specified in US-ASCII [ISO646] (for interoperability).

1500
1501 Default Value: "" (empty string)

1502

1503 **7.5 Examples of Power Settings Elements (Informative)**

1504 Below are concrete usage examples of Power Settings elements.

1505

1506 **7.5.1 Examples of Power Request Group**

1507

1508 Example of a System object that is processing a request for suspend:

1509

1510

1511 System.SystemDescription.PowerRequest.RequestPowerState = "Suspend"

1512 System.SystemDescription.PowerRequest.RequestStatus = "InProgress"

1513

1514

1515 Example of a System object that has completed a request for power on:

1516

1517 System.SystemDescription.PowerRequest.RequestPowerState = "On"

1518 System.SystemDescription.PowerRequest.RequestStatus = "Success"

1519

1520 **7.5.2 Examples of Power Timeout Group**

1521

1522 Example of a System object with a configured site policy for standby on inactivity:

1523

1524 System.SystemDescription.PowerTimeout[5].TimeoutID = "5"

1525 System.SystemDescription.PowerTimeout[5].RequestPowerState = "Standby"

1526 System.SystemDescription.PowerTimeout[5].StartPowerState = "On"

1527 System.SystemDescription.PowerTimeout[5].TimeoutPredicate = "Inactivity"

1528 System.SystemDescription.PowerTimeout[5].TimeoutSeconds = "120"

1529

1530

1531 Example of a System object with a configured site policy for wakeup on activity:

1532

1533 System.SystemDescription.PowerTimeout[6].TimeoutID = "6"

1534 System.SystemDescription.PowerTimeout[6].RequestPowerState = "On"

1535 System.SystemDescription.PowerTimeout[6].StartPowerState = "NotApplicable"

1536 System.SystemDescription.PowerTimeout[6].TimeoutPredicate = "Activity"

1537 System.SystemDescription.PowerTimeout[6].TimeoutSeconds = "3"

1538

1539 **7.5.3 Examples of Power Calendar Group**

1540

1541 Example of a System object that supports a site policy for hibernate every Friday at 7pm:

1542

1543 System.SystemDescription.PowerCalendar[23].CalendarID = "23" (KEY)

1544 System.SystemDescription.PowerCalendar[23].RequestPowerState = "Hibernate"

1545 System.SystemDescription.PowerCalendar[23].CalendarDayOfWeek = "Friday"

1546 System.SystemDescription.PowerCalendar[23].CalendarMonth = "Any"

1547 System.SystemDescription.PowerCalendar[23].CalendarDay = "0" (Any)

1548 System.SystemDescription.PowerCalendar[23].CalendarHour = "19"

1549 System.SystemDescription.PowerCalendar[23].CalendarMinute = "0"

1550

1551

1552 Example of a System object that supports a site policy for wakeup every Monday at 8pm:

1553
1554 System.SystemDescription.PowerCalendar[24].CalendarID = "24" (KEY)
1555 System.SystemDescription.PowerCalendar[24].RequestPowerState = "On"
1556 System.SystemDescription.PowerCalendar[24].CalendarDayOfWeek = "Monday"
1557 System.SystemDescription.PowerCalendar[24].CalendarMonth = "Any"
1558 System.SystemDescription.PowerCalendar[24].CalendarDay = "0" (Any)
1559 System.SystemDescription.PowerCalendar[24].CalendarCalendarHour = "8"
1560 System.SystemDescription.PowerCalendar[24].CalendarMinute = "0"
1561

1562 **7.5.4 Examples of Power Event Group**

1563
1564 Example of a System object that supports a site policy for standby because of paper jam:

1565
1566 System.SystemDescription.PowerEvent[10].EventID = "10" (KEY)
1567 System.SystemDescription.PowerEvent[10].RequestPowerState = "Standby"
1568 System.SystemDescription.PowerEvent[10].EventName = "jam"
1569

1570
1571 Example of a System object that supports a factory default policy for wakeup because of power on:

1572
1573 System.SystemDescription.PowerEvent[1].EventID = "1" (KEY)
1574 System.SystemDescription.PowerEvent[1].RequestPowerState = "On"
1575 System.SystemDescription.PowerEvent[1].EventName = "powerUp"
1576

1577 8 Conformance Requirements

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Below are the summary conformance requirements for this specification.

1581 8.1 Power Management Server Conformance Requirements

1582

1583 To claim conformance to this specification, a Power Management Server implementation for a Printer,
1584 Multifunction Device, or other Imaging System:

1585

- 1586 (a) MUST support the REQUIRED Power General, Power Monitor, and Power Log groups defined in
1587 section 5 of this specification;
- 1588 (b) MUST only implement the Power General and Power Log groups on the System object per section
1589 5 of this specification;
- 1590 (c) MUST implement the Power Log group as persistent across power cycles and hardware
1591 reconfigurations and SHOULD support at least 10 records in the Power Log (for reliable fleet
1592 management);
- 1593 (d) MUST implement all supported power policies (Power Timeout, Power Calendar, and/or Power
1594 Event) as persistent across power cycles and hardware reconfigurations;
- 1595 (e) SHOULD support the RECOMMENDED Power Timeout group defined in section 7 of this
1596 specification;
- 1597 (f) MUST conform to the Internationalization Considerations defined in section 10 of this specification;
- 1598 (g) MUST conform to the Security Considerations defined in section 11 of this specification;
- 1599 (h) MUST support the PWG Power Management Model for the System object;
- 1600 (i) SHOULD implement the PWG Imaging System State and Counter MIB v2 [PWG5106.3]
1601 (operational states), the IETF Printer MIB v2 [RFC3805] (alerts), and the PWG Imaging System
1602 Power MIB [PWG5106.5] (power states) in order to report comprehensive System and Subunit
1603 states;
- 1604 (j) SHOULD conform to the mapping of valid power states to each operational state defined in section
1605 2.5.1 of this specification;
- 1606 (k) Only if the icKeyTable, icServiceTable, or icSubunitTable in the PWG Imaging System State and
1607 Counter MIB v2 [PWG5106.3] are implemented, MUST also implement those tables as persistent
1608 across power cycles as required in section 4.6 of this specification;
- 1609 (l) Only if the Scanner and/or Marker components are supported, SHOULD also support the PWG
1610 Power Management Model for the Scanner and Marker objects; and
- 1611 (m) Only if notifications are supported, SHOULD also support the Power State Transition Notifications
1612 defined in sections 5.7, 9.7, and 9.8.

1613

1614 8.2 Power Management Client Conformance Requirements

1615

1616 To claim conformance to this specification, a Power Management Client implementation for a Printer,
1617 Multifunction Device, or other Imaging System:

1618

- 1619 (a) MUST support the REQUIRED Power General, Power Monitor, and Power Log groups defined in
1620 section 5 of this specification;
- 1621 (b) SHOULD support the RECOMMENDED Power Timeout group defined in section 7 of this
1622 specification;
- 1623 (c) MUST explicitly identify the implemented set of PWG Power Management Model elements defined
1624 in sections 5, 6, and 7 of this specification;

- 1625 (d) MUST conform to the Internationalization Considerations defined in section 10 of this specification;
1626 (e) MUST conform to the Security Considerations defined in section 11 of this specification;
1627 (f) MUST support the PWG Power Management Model for the System object; and
1628 (g) SHOULD implement the PWG Imaging System State and Counter MIB v2 [PWG5106.3]
1629 (operational states), the IETF Printer MIB v2 [RFC3805] (alerts), and the PWG Imaging System
1630 Power MIB [PWG5106.5] (power states) in order to query comprehensive System and Subunit
1631 states;
1632 (h) Only if the Scanner and/or Marker components are supported, SHOULD also support the PWG
1633 Power Management Model for the Scanner and Marker objects; and
1634 (i) Only if notifications are supported, SHOULD also support the Power State Transition Notifications
1635 defined in section 5.7, 9.7, and 9.8.
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9 IANA and PWG Considerations

The IANA registration considerations for this document for the PrtAlertCodeTC textual convention defined in the IANA Printer MIB [IANAPRT] are specified in section 9.7 below. The IANA registration considerations for this document for the printer-state-reason attribute defined in IPP/1.1 [RFC2911] are specified in section 9.8 below.

The XML Schema for the PWG Semantic Model/2.0 [PWGSM20] will include all of the Power Management Model element groups defined in sections 5,6, and 7 of this specification (see detailed requirements in section 4).

The XML Schema for the PWG Semantic Model/2.0 [PWGSM20] will include the standard values of the PowerStateWKV, PowerCalendarMonthWKV, PowerCalendarDayOfWeekWKV, PowerComponentTypeWKV, PowerRequestStatusWKV, and PowerTimeoutPredicateWKV enumerations defined below.

9.1 PowerStateWKV (Enum)

The table below lists all of the enumerated power state keyword values for XML Schema in the PWG Semantic Model/2.0 [PWGSM20] and their normative mapping to corresponding SNMP MIB enumerated names/values, DMTF CIM [DSP1027] power state names/values, and ACPI [ACPI] power state names.

See: Table 3 on page 12 in section 7.3 of DMTF Power State Management Profile [DSP1027].

See: PowerState, RequestedPowerState, AvailableRequestedPowerStates, and TransitioningToPowerState in CIM AssociatedPowerManagementService class.

Table 2 – Standard Power State Values (XML, SNMP, DMTF, ACPI)

| XML Power State Keyword | SNMP Power State Name/Value [4] | DMTF CIM Power State Name/Value [4] | ACPI Power State Name | Description and Required Imaging System Behavior |
|-------------------------|---------------------------------|-------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------|
| Other [1] | other(1) | Other(1) | (none) | Other – DO NOT USE |
| Unknown [2] | unknown(2) | Unknown(0) | (none) | Unknown – Initial Default ONLY |
| On | on(20) | On (2) | G0 or S0 Working | On – new jobs MUST be accepted/processed immediately |
| Standby | standby(30) | Sleep-Light (3) | S1 or S2 | Standby – highest power usage in Sleep Mode – shortest warm-up to On – new jobs MAY be accepted |
| Suspend | suspend(40) | Sleep-Deep (4) | S3 | Suspend – lowest power usage in Sleep Mode – new jobs MAY be accepted |
| ResetSoft | resetSoft(50) | Power Cycle (Off-Soft) (5) | G2 or S5, then S0 (w/ | Soft power reset – soft power off, then |

| | | | | |
|----------------------|------------------------|------------------------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| | | | lost context) | power on |
| OffHard | offHard(60) | Off-Hard (6) | G3 | Hard power off – mechanical unplug – no power consumed – Off Mode |
| Hibernate | hibernate(70) | Hibernate (Off-Soft) (7) | S4 | Hibernate – save context and OS, then soft power off – limited auxiliary power – Off Mode – NOT Sleep mode |
| OffSoft | offSoft(80) | Off-Soft (8) | G2 or S5 | Soft power off – switch w/ flea or auxiliary power – Off Mode |
| ResetHard | resetHard(90) | Power Cycle (Off-Hard) (9) | G0 to G3, then S0 | Hardware power reset – hard power off, then power on |
| ResetMBR [3] | resetMBR(100) | Master Bus Reset (10) | S5, then S0 | Hardware power reset (MBR) |
| ResetNMI [3] | resetNMI(110) | Diagnostic Interrupt (NMI) (11) | S5, then S0 | Hardware power reset (NMI) |
| OffSoftGraceful | offSoftGraceful(120) | Off-Soft Graceful (12) | G2 or S5 | Orderly shutdown, then soft power off to OffSoft |
| OffHardGraceful | offHardGraceful(130) | Off-Hard Graceful (13) | G3 | Orderly shutdown, then hard power off to OffHard |
| ResetMBRGraceful [3] | resetMBRGraceful(140) | Master Bus Reset Graceful (14) | S5, then S0 | Orderly shutdown, then MBR power reset |
| ResetSoftGraceful | resetSoftGraceful(150) | Power Cycle Off-Soft Graceful (15) | G2 or S5, then S0 (w/ lost context) | Orderly shutdown, then soft power reset |
| ResetHardGraceful | resetHardGraceful(160) | Power Cycle Off-Hard Graceful (16) | G3, then S0 | OrderlyShutdown, then hard power off, then power on |
| ResetINIT[3] | resetINIT(170) | Diagnostic Interrupt (INIT) (17) | S5, then S0 | Hardware power reset (INIT) |
| NotApplicable | notApplicable(180) | Not Applicable (18) | (none) | Not applicable (for power transitions) |
| NoChange | noChange(190) | No Change (19) | (none) | No change (for power transitions) |

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Notes:

- (1) 'Other' MUST only be used for DMTF CIM compatibility.
- (2) 'Unknown' MUST only be used for initial default values.
- (3) 'resetMBR', 'resetNMI', 'resetINIT' MUST NOT be used in the Power Request or power policy groups, because they represent hardware interrupts (see section 6.1.5 CanRequestPowerState).
- (4) SNMP MIB values are DMTF CIM values multiplied by 10 (see section 9.1.1 below).

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9.1.1 Vendor Extension Stable Power States

1675 Vendor extensions (see section 2.4.5) to base standard DMTF CIM stable power states (see section 2.4.2)
 1676 MUST be defined as follows:

- 1677 (1) In XML Schema elements, the base standard stable power state keyword (e.g., Standby) MUST be
 1678 suffixed with 'Vendor' followed by a single digit between '1' and '5' (e.g., StandbyVendor1).
- 1679 (2) In SNMP MIB objects, the base standard stable power state name (e.g., standby) MUST be suffixed
 1680 with 'Vendor' followed by a single digit between '1' and '5' (e.g., standbyVendor1) and the
 1681 corresponding base standard power state value (e.g., 30) MUST be added to a single digit between
 1682 '1' and '5' (e.g., 31).

1683
 1684 Usage: Implementations MUST support the corresponding base stable power state, e.g., 'Standby',
 1685 whenever they support any vendor extension stable power state, e.g., 'StandbyVendor1'.
 1686

1687 Usage: Vendor extension stable power states MUST be strictly ordered by their nominal inactive power
 1688 consumption (see section 6.1.2), e.g., 'StandbyVendor2' MUST consume equal or higher power than
 1689 'StandbyVendor1' and 'StandbyVendor1' MUST consume equal or higher power than 'StandbyVendor' (the
 1690 base standard stable power state).
 1691

1692 Usage: Vendor extensions MUST NOT be defined for DMTF CIM special power states or DMTF CIM out-of-
 1693 band power states, to avoid ambiguity.

1694 **9.2 PowerCalendarMonthWKV (Enum)**

1695
 1696 The table below lists all of the enumerated calendar month keyword values for XML Schema in the PWG
 1697 Semantic Model/2.0 [PWGSM20] and their normative mapping to corresponding SNMP MIB enumerated
 1698 names/values.
 1699

1700 **Table 3 – Standard Power Calendar Month Values (XML, SNMP)**

| XML Power Calendar Month Keyword | SNMP Power Calendar Month Name/Value | Description |
|----------------------------------|--------------------------------------|--------------------------|
| January | january(1) | January |
| February | february(2) | February |
| March | march(3) | March |
| April | april(4) | April |
| May | may(5) | May |
| June | june(6) | June |
| July | july(7) | July |
| August | august(8) | August |
| September | september(9) | September |
| October | october(10) | October |
| November | november(11) | November |
| December | december(12) | December |
| None | none(13) | None – no calendar month |

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1702 **9.3 PowerCalendarDayOfWeekWKV (Enum)**

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 1704 The table below lists all of the enumerated calendar day of the week keyword values for XML Schema in the
 1705 PWG Semantic Model/2.0 [PWGSM20] and their normative mapping to corresponding SNMP MIB
 1706 enumerated names/values.
 1707

1708 **Table 4 – Standard Power Calendar Day of Week Values (XML, SNMP)**

| XML Power Calendar Month Keyword | SNMP Power Calendar Month Name/Value | Description |
|----------------------------------|--------------------------------------|-------------|
| Sunday | sunday(1) | Sunday |

| | | |
|-----------|--------------|------------------------------|
| Monday | monday(2) | Monday |
| Tuesday | tuesday(3) | Tuesday |
| Wednesday | wednesday(4) | Wednesday |
| Thursday | thursday(5) | Thursday |
| Friday | friday(6) | Friday |
| Saturday | saturday(7) | Saturday |
| Any | any(8) | any calendar day of the week |

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1710 9.4 PowerComponentTypeWKV (Enum)

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The table below lists all of the enumerated power component type (System or specific Subunit, e.g., InputTray) keyword values for XML Schema in the PWG Semantic Model/2.0 [PWGSM20] and their normative mapping to corresponding SNMP MIB enumerated names/values.

Note: This enumeration is technically aligned with PrtAlertGroupTC and prtAlertGroup in the IETF Printer MIB v2 [RFC3805] and the superset IcSubunitTypeTC and icSubunitType in the PWG Imaging System State and Counter MIB [PWG5106.3].

Table 5 – Standard Power Component Type Values (XML, SNMP)

| XML Power Component Type Keyword | SNMP Power Component Type Name/Value | Description and PrtAlertGroupTC or IcSubunitTypeTC* Name/Value |
|----------------------------------|--------------------------------------|----------------------------------------------------------------|
| Other | other(1) | Other – Vendor component |
| Unknown | unknown(2) | Unknown – Initial Default ONLY |
| Console | console(4) | Console – console(4) |
| System | system(5) | System – generalPrinter(5) |
| Cover | cover(6) | Cover or Interlock – cover(6) |
| | | N/A – localization(7) – part of System or Subunit [1] |
| InputTray | inputTray(8) | Input Tray – input(8) |
| OutputTray | outputTray(9) | Output Tray – output(9) |
| Marker | marker(10) | Marker – marker(10) |
| | | N/A – markerSupplies(11) – part of Marker [1] |
| | | N/A – markerColorant(12) – part of Marker [1] |
| MediaPath | mediaPath(13) | Media Path – mediaPath(13) |
| InputChannel | inputChannel(14) | Input Channel – channel(14) |
| Interpreter | interpreter(15) | Interpreter – interpreter(15) |
| | | N/A – consoleDisplayBuffer(16) – part of Console [1] |
| | | N/A – consoleLights(17) – part of Console [1] |
| | | N/A – alert(18) – part of System or Subunit [1] |
| Finisher | finisher(30) | Finisher – finDevice(30) [3] |
| Interface | interface(40) | Interface - interface(40) [2] |
| Scanner | scanner(50) | Scanner – scanner(50) [2] |
| ScanMediaPath | scanMediaPath(51) | Scan Media Path – <none> [4] |
| FaxModem | faxModem(60) | Fax Modem – <none> [4] |
| OutputChannel | outputChannel(70) | Output Channel – <none> [4] |
| Storage | storage(80) | Storage – <none> [4] |
| Processor | processor(90) | Processor – <none> [4] |

1721

- 1722 Notes:
- 1723 (1) Component settings (e.g., localization(7) in PrtAlertGroupTC) and subcomponents (e.g.,
- 1724 consoleLights(17) in PrtAlertGroupTC) are intentionally omitted from the PWG Power Management
- 1725 Model.
- 1726 (2) Some hardware components (e.g., scanner(50) in IcSubunitTypeTC) are not in PrtAlertCodeTC.
- 1727 (3) Specific Finisher types (e.g., stapler(302) in IcSubunitTypeTC) are intentionally omitted from the
- 1728 PWG Power Management Model, as they are not first-class object types in the PWG Semantic
- 1729 Model/2.0 [PWGSM20].
- 1730 (4) Some hardware components (e.g., ScanMediaPath) are not enumerated in either PrtAlertCodeTC
- 1731 or IcSubunitTypeTC.
- 1732

1733 **9.5 PowerRequestStatusWKV (Enum)**

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1735 The table below lists all of the enumerated power request status keyword values for XML Schema in the

1736 PWG Semantic Model/2.0 [PWGSM20] and their normative mapping to corresponding SNMP MIB

1737 enumerated names/values.

1738

1739

Table 6 – Standard Power Request Status Values (XML, SNMP)

| XML Power Request Status Keyword | SNMP Power Request Status Name/Value | Description |
|----------------------------------|--------------------------------------|---------------------------------------------|
| Other | other(1) | Other – DO NOT USE – for CIM |
| Unknown | unknown(2) | Unknown – DO NOT USE – for CIM |
| None | none(3) | None – Initial default value ONLY |
| InProgress | inProgress(4) | InProgress – Currently active power request |
| Warning | warning(5) | Warning – Completed w/ warning(s) |
| Error | error(6) | Error – Completed w/ error(s) |
| Success | success(7) | Success – Completed successfully |

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1741 **9.6 PowerTimeoutPredicateWKV (Enum)**

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1743 The table below lists all of the enumerated timeout predicate keyword values for XML Schema in the PWG

1744 Semantic Model/2.0 [PWGSM20] and their normative mapping to corresponding SNMP MIB enumerated

1745 names/values.

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Table 7 – Standard Power Timeout Predicate Values (XML, SNMP)

| XML Power Timeout Predicate Keyword | SNMP Power Timeout Predicate Name/Value | Description |
|-------------------------------------|-----------------------------------------|--------------------------------------------------------------|
| Other | other(1) | Other – DO NOT USE – for CIM |
| Unknown | unknown(2) | Unknown – DO NOT USE – for CIM |
| None | none(3) | None – no timeout predicate condition |
| Activity | activity(4) | Activity – incoming job, console input, etc. |
| Inactivity | inactivity(5) | Inactivity – no incoming or queued jobs, console input, etc. |

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1749 **9.7 PrtAlertCodeTC in IANA Printer MIB**

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1751 The following values should be added to the PrtAlertCodeTC textual convention in the IANA Printer MIB

1752 [IANAPRT] according to the procedures defined in section 2.4.1 of IETF Printer MIB v2 [RFC3805]:

```
1753
1754         standby(508),           -- Not in RFC 3805
1755         suspend(509),           -- Not in RFC 3805
1756         hibernate(510),        -- Not in RFC 3805
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1758
```

9.8 printer-state-reasons in IANA IPP Registry

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This section contains the exact registration information for IANA to update the IANA IPP Registry based on the procedures defined in [RFC2911].

The registry entry will contain the following information:

Section 9 (References)

[PWG5106.4] PWG Power Management Model for Imaging Systems v1.0, PWG 5106.4, February 2011.

```
ftp://ftp.pwg.org/pub/pwg/candidates/
    cs-wimspower10-<20110214>-5106.4.pdf
```

Section 2 (Keyword Attribute Values)

The following new keyword values are defined for the printer-state-reasons attribute [RFC2911]:

Attribute (attribute syntax)

| Keyword Attribute Value | Reference |
|-------------------------|-------------|
| ----- | ----- |
| printer-state-reasons | [RFC2911] |
| standby | [PWG5106.4] |
| suspend | [PWG5106.4] |
| hibernate | [PWG5106.4] |

10 Internationalization Considerations

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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].

Conformance: 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.

11 Security Considerations

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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.

Conformance: To claim conformance to this specification, a Power Management Server or Power Management Client that supports Transport Layer Security (TLS) MUST support the mandatory cipher suite required in the claimed TLS specification (summarized in the table below).

Table 8 – TLS Support Requirements for Power Management

| TLS Version | Mandatory TLS Cipher Suite |
|---------------|-----------------------------------|
| 1.0 [RFC2246] | TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA |
| 1.1 [RFC4346] | TLS_RSA_WITH_3DES_EDE_CBC_SHA |
| 1.2 [RFC5246] | TLS_RSA_WITH_AES_128_CBC_SHA |

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1824 12 References

1825 12.1 Normative References

- 1826 [ACPI]
1827 Advanced Configuration and Power Interface Specification v4.0, June 2009.
1828 <http://www.acpi.info/DOWNLOADS/ACPIspec40.pdf>
1829
- 1830 [DSP0004]
1831 DMTF Common Information Model (CIM) Infrastructure, DSP0004, May 2009.
1832 http://www.dmtf.org/standards/published_documents/DSP0004_2.5.0.pdf
1833
- 1834 [DSP1027]
1835 DMTF Power State Management Profile, DSP1027, December 2009.
1836 http://www.dmtf.org/standards/published_documents/DSP1027_2.0.0.pdf
1837
- 1838 [IANAPRT]
1839 IANA Printer MIB, originally published in RFC3805, June 2004.
1840 <ftp://ftp.iana.org/assignments/ianaprinter-mib>
1841
- 1842 [IEEE1621]
1843 Standard for User Interface Elements in Power Control of Electronic Devices Employed in
1844 Office/Consumer Environments, IEEE 1621, December 2004.
1845
- 1846 [ISO10646]
1847 Information Technology - Universal Multiple-octet Coded Character Set (UCS), ISO/IEC Standard
1848 10646, 2006.
1849
- 1850 [PWG5105.1]
1851 PWG Semantic Model/1.0, PWG Candidate Standard 5105.1-2004, January 2004.
1852 <ftp://ftp.pwg.org/pub/pwg/candidates/cs-sm10-20040120-5105.1.pdf>
1853
- 1854 [PWG5106.5]
1855 PWG Imaging System Power MIB v1.0, PWG Candidate Standard 5106.5-2011, February 2011.
1856 <ftp://ftp.pwg.org/pub/pwg/candidates/cs-wimspowermib10-20110214-5106.5.pdf>
1857
- 1858 [RFC2119]
1859 IETF Key words for use in RFCs to Indicate Requirement Levels, RFC 2119, March 1997.
1860 <http://www.ietf.org/rfc/rfc2219.txt>
1861
- 1862 [RFC2246]
1863 IETF Transport Layer Security 1.0, RFC 2246, January 1999,
1864 <http://www.ietf.org/rfc/rfc2246.txt>
1865
- 1866 [RFC2277]
1867 IETF Policy on Character Sets and Languages, RFC 2277, January 1998.
1868 <http://www.ietf.org/rfc/rfc2277.txt>
- 1869 [RFC2790]
1870 IETF Host Resources MIB v2, RFC 2790, March 2000.
1871 <http://www.ietf.org/rfc/rfc2790.txt>
1872

- 1873 [RFC2911]
1874 IETF Internet Printing Protocol/1.1: Model and Semantics, RFC 2911, September 2000.
1875 <http://www.ietf.org/rfc/rfc2911.txt>
- 1876 [RFC3231]
1877 IETF Schedule MIB, RFC 3231, January 2002.
1878 <http://www.ietf.org/rfc/rfc3629.txt>
- 1879 [RFC3629]
1880 IETF UTF-8 Transformation of ISO 10646, RFC 3629, November 2003.
1881 <http://www.ietf.org/rfc/rfc3629.txt>
- 1882 [RFC3805]
1883 IETF Printer MIB v2, RFC 3805, June 2004.
1884 <http://www.ietf.org/rfc/rfc3805.txt>
- 1885 [RFC3806]
1886 IETF Finisher MIB, RFC 3806, June 2004.
1887 <http://www.ietf.org/rfc/rfc3806.txt>
- 1888 [RFC3995]
1889 IPP Event Notifications and Subscriptions, RFC 3995, March 2005.
1890 <http://www.ietf.org/rfc/rfc3995.txt>
- 1891 [RFC4346]
1892 IETF Transport Layer Security 1.1, RFC 4346, April 2006.
1893 <http://www.ietf.org/rfc/rfc4346.txt>
- 1894 [RFC5198]
1895 Unicode Format for Network Interchange, RFC 5198, March, 2008.
1896 <http://www.ietf.org/rfc/rfc5198.txt>
- 1902 [RFC5246]
1903 IETF Transport Layer Security 1.2, RFC 5246, August 2008.
1904 <http://www.ietf.org/rfc/rfc5246.txt>
- 1905 [UAX15]
1906 Unicode Normalization Forms, Unicode Standard Annex 15, March 2008.
1907 <http://www.unicode.org/reports/tr15/>
- 1908 [UNICODE]
1909 Unicode Standard v5.1.0, Unicode Standard, April 2008.
1910 <http://www.unicode.org/versions/Unicode5.1.0/>
- 1911 [ISO646]
1912 ISO Information technology -- 7-bit coded character set for information exchange, ISO 646,
1913 1991.[XMLTYPES]
1914 W3C XML Schema Part 2: Datatypes Second Edition, W3C Recommendation, October 2004.
1915 <http://www.w3.org/TR/2004/REC-xmlschema-2-20041028/>
- 1916

1917 12.2 Informative References

- 1918 [IEC80416-1]
1919

- 1920 Basic principles for graphical symbols for use on equipment -- Part 1: Creation of graphical symbols
1921 for registration, IEC 804161-1, November 2008.
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1959

1960 **14 Appendix A Design Alternatives (Informative)**

1961
1962 This section provides durable documentation of the 'road not taken' on various design alternatives during
1963 the development of this document.

1964 **14.1 Require Power General and Power Log only on System Object**

1965
1966 The Power General and Power Log groups in the Power Status class were allowed only on the System
1967 object, for consistency with IETF Printer MIB v2 and recent modeling experience in DMTF CIM.
1968

1969 **14.2 Delete Power State Characteristics from Power Monitor**

1970
1971 The Power State characteristics (PowerInactiveWatts and CanXxx) in Power Support group were deleted
1972 from the Power Monitor group, due to redundancy.
1973

1974 **14.3 Retain PowerStateMessage in Power Log**

1975
1976 The PowerStateMessage element was intentionally retained in the Power Log group, for diagnostic usage.
1977

1978 **14.4 Decompose Power Policy**

1979
1980 The Power Policy group was decomposed into Power Timeout, Power Calendar, and Power Event groups,
1981 for clarity and to reduce model complexity.
1982

1983 **14.5 Reduce Conformance for Power Capabilities**

1984
1985 The Power Support and Power Transition groups in the Power Capabilities class were reduced from
1986 RECOMMENDED to OPTIONAL, because they expose power usage claims, per PWG Last Call.
1987

1988 **14.6 Delete Timestamps from Power Request**

1989
1990 The StartRequestTimestamp and EndRequestTimestamp elements were deleted from the Power Request
1991 group, due to redundancy with the PowerStateTimestamp element in Power Log.
1992

1993 **14.6 Delete MonitorID and RequestID keys**

1994
1995 The MonitorID (in Power Monitor) and RequestID (in Power Request) were deleted, due to redundancy
1996 (because there can only be one instance of Power Monitor or Power Request groups in each object).
1997

1998 **14.7 Reduce Conformance for Power Meter**

1999

2000 The Power Meter group in the Power Status class was reduced from RECOMMENDED to OPTIONAL,
2001 because it exposes power usage claims, per PWG Last Call.
2002

2003 **14.8 Delete MaxXxxRecords from Power General**

2004 The MaxXxxRecords elements in the Power General group were deleted, because they are of limited utility,
2005 per PWG Last Call.
2006
2007

2008 **14.9 Change transitional to special for power states**

2009 The term “transitional power states” (obscure and inaccurate) was changed to “special power states”, for
2010 clarity, per PWG Last Call.
2011
2012