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Information technology – UPnP device architecture – Part 16-1: Low Power Device Control Protocol – Low Power Architecture

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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INFORMATION TECHNOLOGY – UPNP DEVICE ARCHITECTURE –

Part 16-1: Low Power Device Control Protocol – Low Power Architecture

FOREWORD

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The list of all currently available parts of the ISO/IEC 29341 series, under the general title *Information technology – UPnP device architecture*, can be found on the IEC web site.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

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1 UPnP Forum Steering committee, UPnP Forum, 3855 SW 153rd Drive, Beaverton, Oregon 97006 USA. See also "Introduction".

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Glossary

ACPI
Advanced Configuration and Power Interface

AP
Access Point: Any entity that has station functionality and provides access to the distribution services (Ethernet network), via the wireless medium for associated stations

AV
Audio / Video

BOOTID
BOOTID is a part of the SSDP:Alive header defined in UPnP Device Architecture 1.1 and is defined as a number that is increased each time device sends an initial announcement

BPMPX
Basic Power Management Proxy

BTH
Bluetooth

CP
Control Point

DHCP
Dynamic Host Configuration Protocol

DMA
Digital Media Adapter

DMP
Digital Media Player

IP
Internet Protocol

LPACP
Low Power Aware Control Point

NIC
Network Interface Card

OSPM
Operating System-directed Power Management

PAN
Personal Area Network

PC
Personal Computer

PM
Power Management

PM Service
UPnP Based Power Management Service

SSDP
Simple Service Discovery Protocol

Standby period
Time interval SoftAP monitors traffic for no activity before going to standby mode.

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UDN
Unique Device Number

UI
User Interface

UUID
Universally Unique Identifier

UPnP
Universal Plug and Play

WoLAN
Wake On LAN

WoWLAN
Wake on Wireless LAN

1 Introduction

The UPnP Low Power architecture allows devices implementing power saving modes to conserve energy. The purpose of this document is to define an architecture that will address the issue of reporting and tracking power states of nodes in a network. The UPnP Low Power solution is designed to enable nodes in the network to report and track the Low Power states of other nodes in the network. Additionally, for nodes that support wake up capabilities, this architecture addresses methods to wake up those nodes when required. The objective of the UPnP Low Power solution is to allow UPnP devices to conserve energy and still be discoverable by UPnP Control Points. The UPnP Control Point will be aware of the UPnP devices and services implemented on a Low Power device even when the Low Power device is in a power savings mode.

This architecture document defines two UPnP services that comprise the UPnP Low Power framework:

- Low Power device service
- Basic Power Management Proxy service

The Low Power device service allows UPnP devices to transition to low power states and still be part of the UPnP network. The Basic Power Management Proxy service can optionally represent the sleeping UPnP devices in the network and is capable of certain limited functions to support the discovery of Low Power devices that are in a power saving mode. The introduction of Low Power into the UPnP architecture will help align UPnP with emerging energy regulation requirements.

2 UPnP Low Power Feature Overview

2.1 The Need for UPnP Low Power

Platforms and devices must be able to run in an energy efficient manner. It is important that these platforms and devices intelligently transition between system power levels to reduce system power consumption, heat and noise. It is equally important that these systems be able to return to normal running power state with limited impact to the responsiveness of the overall system. For example, on PC platforms, in the state known as System Standby (G1, S3), video and hard drive subsystems, and the fan are powered down. In mobile platforms, where power consumption is a primary consideration, standby mode allows extended battery life. On desktop platforms, especially in residential environments, system noise is often a significant issue. Power Management reduces noise by transitioning desktops platforms to a power saving mode when not in use.

2.2 System Power States

A system can have many power states. The Advanced Configuration and Power Interface (ACPI) specification was developed to establish industry common interfaces; enabling robust operating system (OS) directed motherboard device configuration and Power Management of

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devices. ACPI is the key element in Operating System-directed configuration and Power Management (OSPM). For more details, please refer [ACPI].

UPnP Power states are defined in Table 2 in clause 3.2.3. A Low Power device controls its internal power state and UPnP Low Power implementation advertises the power state of the Low Power device to other UPnP devices in the network. The UPnP Low Power implementation abstracts the internal power state of Low Power device and represents the internal power state as one of the Low Power defined power states in Table 2.

2.3 UPnP Low Power Network Elements

A typical set of power managed networked devices may be a PC, laptop, printer, networked CE devices or a handheld. Each node on the network that supports UPnP Low Power runs the UPnP Control Point (CP) and/or UPnP Low Power service. Some nodes may act as a Proxy, if they wish to represent other UPnP Low Power devices in power savings mode.

- **UPnP Low Power Aware Control Point**: A device or a UPnP control point that can monitor the sleep state of other nodes in the network. It can also monitor the entry and exit of nodes from the network. It may store/cache this information. A UPnP Low Power Aware Control Point can wake up a device from a sleep state or request the device to go into a low power state.
- **UPnP Low Power Device:** A UPnP device informs the UPnP network about change in power state of the node. It also informs the UPnP networked devices about its entry into and exit from the network. A UPnP Low Power device can be classified into the following categories:
    a) Sleep-autonomous device: A device that can go to sleep autonomously using internal timers.
    b) Sleep-controlled device: A device that can go to a sleep state on receiving an external control message.
    c) Wake up-autonomous devices: A device that wakes up autonomously using internal timers.
    d) Wake up-controlled devices: A device that requires an external interaction, such as control message, to wake up.
- **UPnP Basic Power Management Proxy:** This node will act on behalf of sleeping devices and make sure that the devices are discoverable if they are in low power state. This node will also store methods for waking the UPnP Low Power devices.

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2.4 Overarching Use Cases

The following use cases illustrate the use and need for UPnP Low Power solution.

2.4.1 UPnP Low Power Solution - Without Proxy

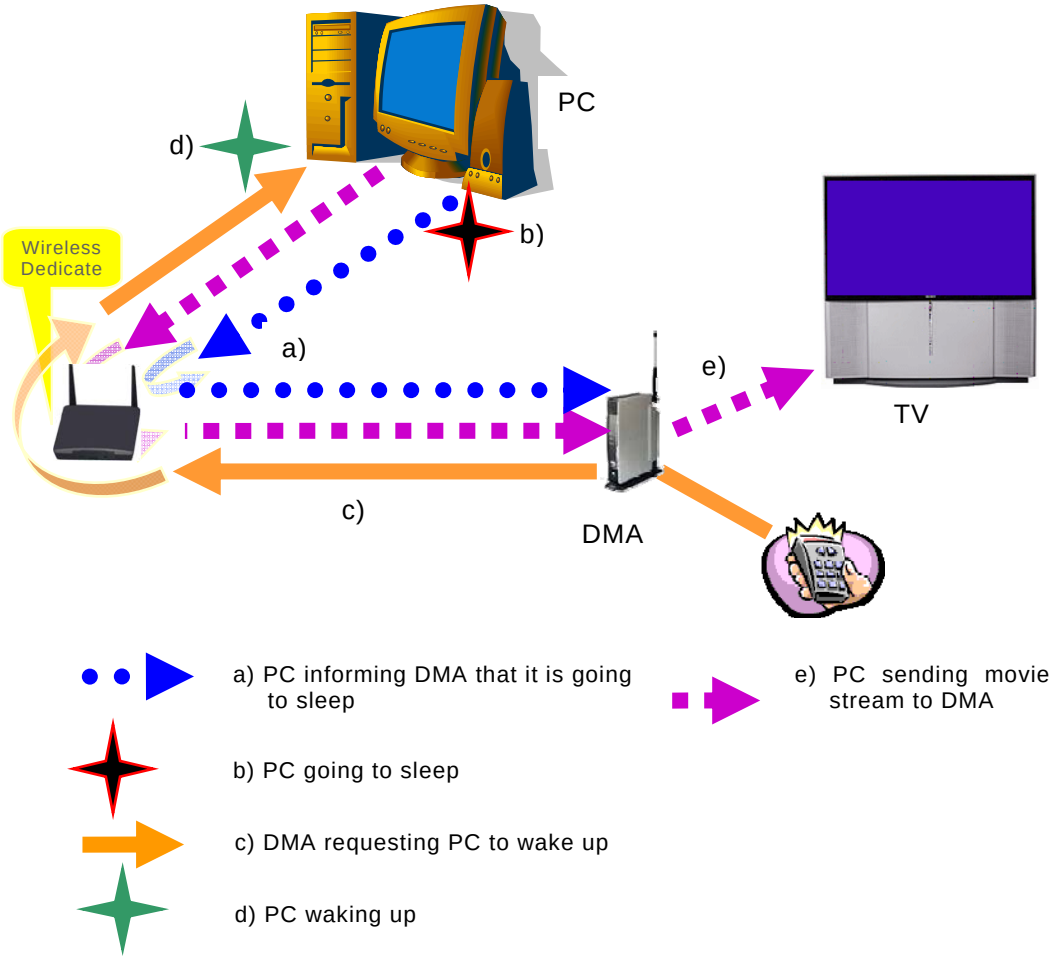

Figure 1 — UPnP Low Power solution without Proxy

a) The PC advertises that it is transitioning to a low power state. The transition information is recorded by the DMA.

b) The PC completes the transition to a low power state.

c) Richard wants to watch a movie on his TV. The movie is stored on the PC, which is in low power state (power saving mode). The DMA knows that the movie is on the PC (set up was performed earlier). The DMA wakes up the PC based on the Power management information it received from the PC. The DMA displays a user friendly message. Richard observes a “Waking up PC … please wait” message on his TV, while the DMA wakes the PC.

d) The TV displays a UI showing content selections on the PC. Using the UI, Richard browses the servers and selects the movie he wants to watch.

e) The PC streams the movie to the TV via the DMA. Richard watches his movie.

The additional information below will help define the use case better.

f) Information regarding the wake up procedure of the PC needs to be communicated to the DMA before it can wake up the PC. This information may contain wake up patterns (if present).

g) A Wake on Wireless LAN solution will be required if the PC needs to be woken up using a wireless link. A Wake on Wireless LAN solution is vendor specific mechanism and not defined by the UPnP Low Power solution.

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h) After the TV is turned off, the PC automatically enters a low power state when not in use.

2.4.2 UPnP Low Power Solution – With Basic Power Management Proxy

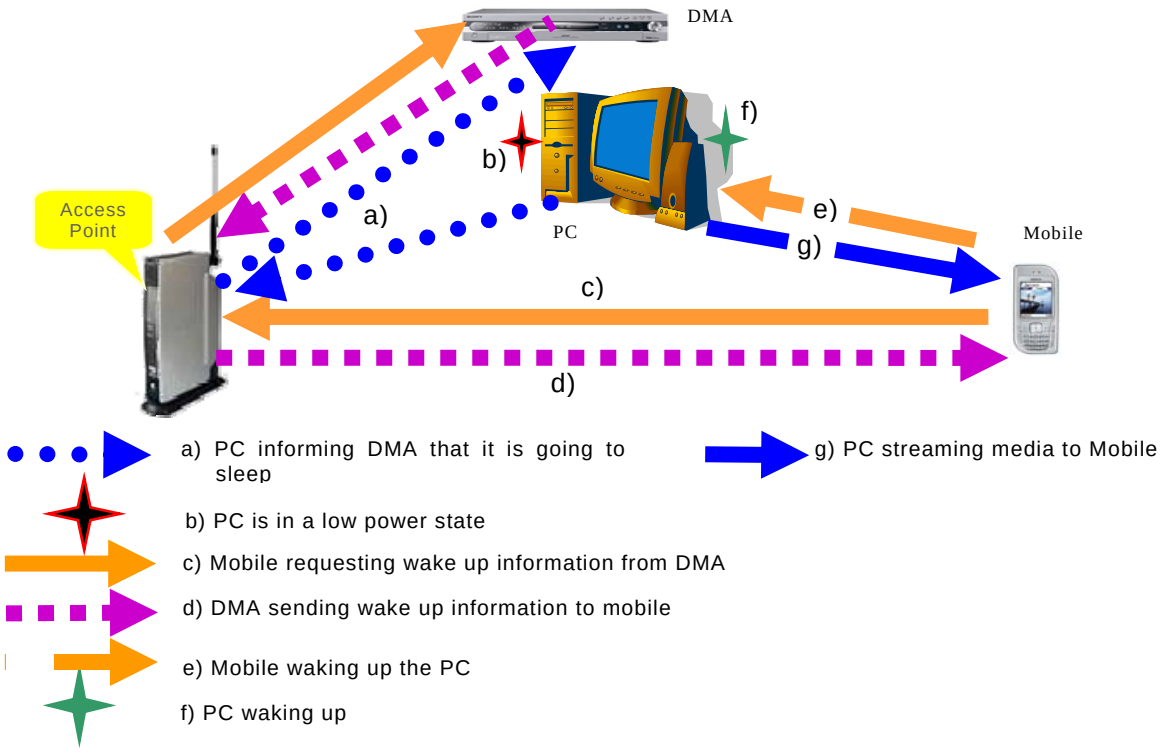

Figure 2 — UPnP Low Power Solution with Basic Proxy

a) The PC advertises that it is transitioning to a low power state. The transition information is recorded by the DMA. The Basic Power Management Proxy implemented on the DMA, knows the current power state of the PC.

b) The PC completes the transition to a low power state.

c) John wants to watch a movie on his Mobile but the PC with the movie is in a low power state. The Mobile is aware that the movie is on the PC. However, the Mobile has been out of the house and is unaware of the current wake up settings of the PC. When the Mobile comes back into the network, it requests for all sleeping devices from the Basic Power Management Proxy (DMA).

d) The Basic Power Management Proxy Service on the DMA sends the Sleep state and wake up information of the PC to the Mobile.

e) A Local UI displayed on the Mobile shows a list of media servers including the ones in low power state that are discoverable because of the presence of UPnP Basic Power Management Proxy Service. John selects media server with the movie. The Mobile wakes up the PC. John observes a “Waking up PC … please wait” message on Mobile.

f) The PC wakes up and John browses the server contents and selects the movie he wants to watch.

g) The PC streams the movie and John watches it on his Mobile/PDA.

Certain assumptions have been made in the above mentioned use case. They are:

h) The PC is configured to support UPnP Low Power functionality.

i) The Home Network is set up and functioning. The devices are connected via this Home Network.

j) These devices support UPnP Low Power states to fulfill energy saving requirements.

k) The PC supports ability to enter and exit low power states (i.e. sleep / hibernation).

l) Requirements of what needs to be in place:

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1) Devices have to be discoverable and eventually available at all times but still be able to minimize their energy consumption.
2) Media server in devices with limited resources, such as mobile phones must be available in the background and not interfere with everyday phone use. They must also be available for accepting incoming file sharing requests.

The additional information below will help define the use case better.

m) Information regarding the wake up procedure of the PC is communicated to a proxy before it can propagate the wake up information to the mobile/PDA to wake up the PC.

n) In this scenario, the PC conveyed the wake up information to the DMA prior to entering the sleep state. The DMA was able to act as a proxy and wake up the PC.

2.5 Low Level Use Cases

The following subclause describes the use cases that may arise in a network. The overarching use cases mentioned above is broken down into smaller use cases that define specific uses.

In all the diagrams below, the initial request is shown as an orange colored arrow.

The response is shown as a purple colored arrow.

Any information being sent out that does not require response are shown in blue. For example

a) A new device enters a system and announces its entry.

b) An existing device exits from the system and announces its exit.

c) An existing device changes its IP address.

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2.5.1 Use Case 1 – Device Waking PC without Use of Proxy

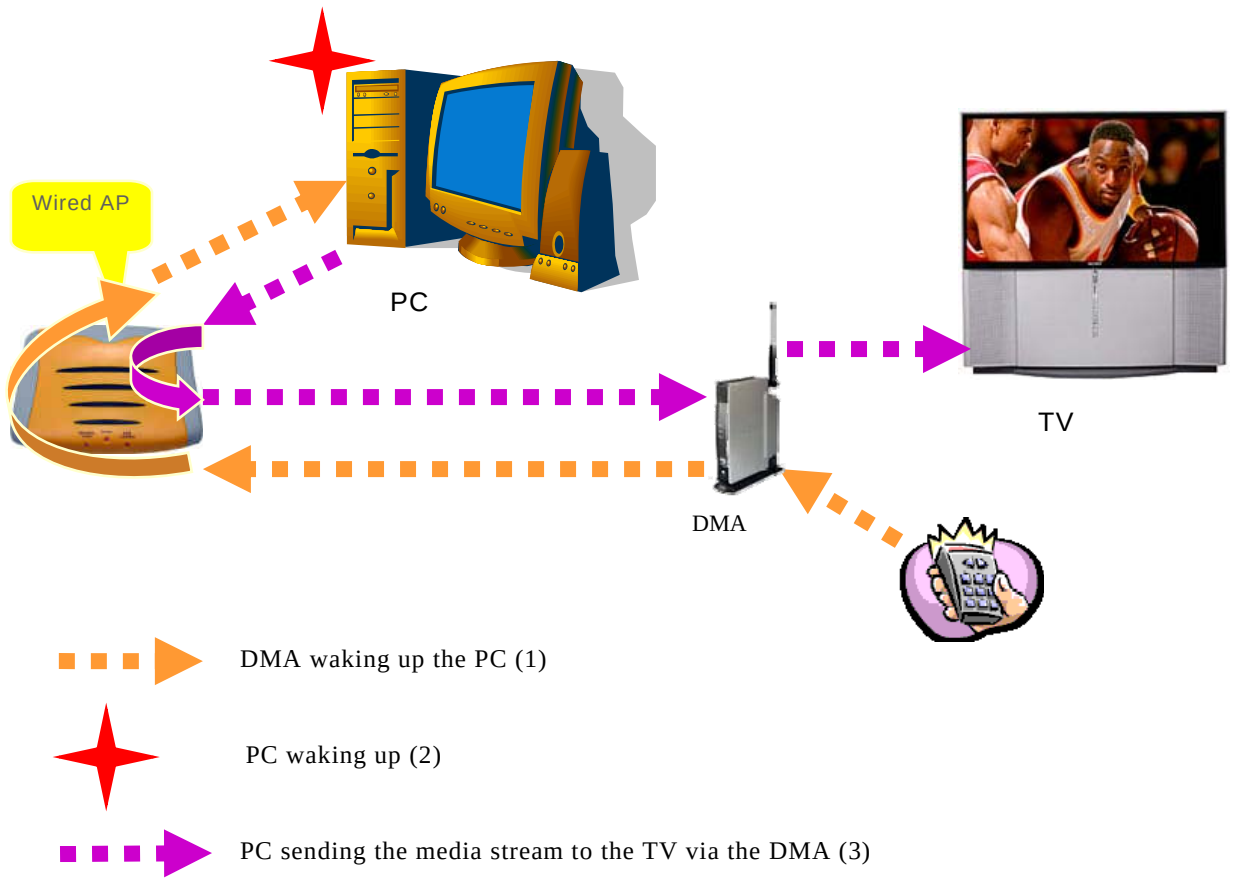

Figure 3 — Device waking PC without use of proxy

a) Jim is sitting in this living room and decides to watch a video that is stored on his PC

b) The PC is in a low power state.

c) Using his DMA remote control, Jim selects the stored video option on the DMA.

d) The DMA knows that the PC is in a low power state and it displays the following message: “Please wait while the PC wakes up” and sends a message to the PC that wakes it up.

e) The packet is sent to the wired AP which forwards it to the PC.

f) The PC wakes up on receipt of the wake up packet and then let’s the DMA know that it is awake.

g) The DMA sends the request for the list of stored videos.

h) The PC responds with the list (UI).

i) Jim selects a video to play (a basketball game).

j) The message is passed on to PC, which starts streaming the video to the DMA.

k) DMA displays the video on TV.

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