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WFDS-A new Emerging technology over Wi-Fi Direct

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Abstract –

WFDS is a standard specification defined by the Wi-Fi alliance, which is built on current standard Wi-Fi direct. WFDS specification defines an architecture, protocols and functionality for interoperability of Wi-Fi Direct Services (WFDS). The WFDS enabled system can have multiple ASP-sessions between two or more devices needing the WFDS functionalities. Service is a process that provides standardized functionality to other services or applications. Service on a device will communicate with a similar service on one or more devices using a common protocol. Among the Services, Wi-Fi alliance defined major services namely; Send, Play, Display and Print services.

Keywords—Wi-Fi Direct,802.11,Wi-Fi

I. INTRODUCTION

WFDS is a standard specification defined by the Wi-Fi alliance, which is built on current standard Wi-Fi direct. The content of this specification is designed to address the solution requirement areas identified in SRD as:

1. Send service
2. Play service
3. Print service
4. Display service
5. Enable APIs
6. Application Service Platform.

WFDS specification defines an architecture, protocols and functionality for interoperability of Wi-Fi Direct Services (WFDS). Application Service Platform (ASP) is a software service or library that implements the common functions needed by all applications and services conforming to the Wi-Fi Direct Services specification. ASP enables or creates a session which is a logical link between two ASP enabled peers to enabled streamlined and structured communication between them. The WFDS enabled system can have multiple ASP-sessions between two or more devices needing the WFDS functionalities.Wi-Fi Direct Services framework has defined components that interact to provides services capable WFD devices. ASP component is the logical entity to implement the common functions across all the services. ASP Adaptation layer is an interface layer between the Service and ASP, which services should invoke to access the ASP Functionality.Figure 1 shows the Overall Architecture.

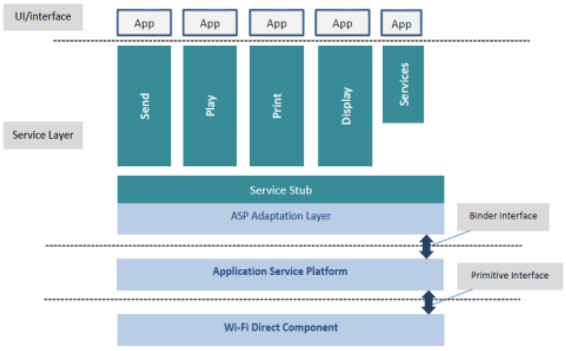

Figure 1:Overall Architecture

Although the general paradigm of Wi-Fi-Direct Service is to establish and maintain relationships as Peer Devices, there is typically a Service Advertiser and a Service Seeker role in setting up a connection. A Service Seeker is an application looking for an advertised service to connect to on a remote device. A Service Advertiser is an application that needs to make itself known to potential Service Seekers and expects incoming connection requests from interested Service Seekers.A single device may have multiple Service Advertisers and Service Seekers.Service Seeker side initiates the ASP-Session establishment.Service Advertiser side responds to an incoming request to establish ASP-Session.Service Advertiser shall advertise service(s).

II. IMPLEMENTATION

The Play service, built on the **Wi-Fi Direct Services Application Service** Platform, enables a DLNA connection that allows the user to have a control interface to play encoded media to other devices. A device with a Play Transmitter is able to discover devices with a Play Receiver. At a minimum, the Play Transmitter will be able to stream encoded video, audio and images to a Play Receiver. The Play Transmitter utilizes the DLNA Push Controller (+PU+) functionality while the Play Receiver utilizes the DLNA Media render (DMR) functionality for H.264, JPEG, LPCM, MP3 and AAC encoded files. Additionally, a Play device supports **ASP-based Device and Service Discovery response** of other **DLNA Device Classes**, **DLNA Device Capabilities and DLNA Media Format** Information. To achieve interoperability between connected digital media devices in the home, a common set of building blocks based on existing standards is needed as a basis to develop the DLNA Home Networked Device Interoperability Guidelines. UPnP technology defines an architecture for pervasive peer-to-peer network connectivity of intelligent appliances, wireless devices, and PCs of all form factors. It is designed to bringeasy-to-use, flexible, standards-based connectivity to ad-hoc or unmanaged networks whether in the home, in a small business, public spaces, or attached to the Internet. **The IPv4 protocol suite** is the **foundation for networking and connectivity** for DLNA devices in the digital home. IP also provides the underlying network communications for applications on the Internet. Based on industry-standard specifications from the IETF, IP is implemented and supported in a wide range of devices. Device categories are a grouping of Device Classes that share common environmental characteristics (requirements) with System Usages. There were no Device Categories explicitly defined in version 1.0 of the Interoperability Guidelines, as all of the Device Classes operated in the same environment.

Home Network Devices (HNDs) are a group of Device Classes that share System Usages in the home network with the same media format and network connectivity requirements.

In these Interoperability Guidelines, the following two additional Device Categories are defined:

Mobile Handheld Devices (MHDs) are a group of Device Classes that share the same System Usages as the HND Device Category, but have different requirements for media format and network connectivity.

Home Infrastructure Device (HID) supports interoperability between Device Categories.

In version 1.0 of the Interoperability Guidelines, the following two **Device Classes** were defined to support **the 2-Box Pull System Usage** for the HND Device Category.

A **Digital Media Server** (DMS) with the role of exposing and distributing content.

A **Digital Media Player** (DMP) with the role of finding content exposed by a DMS and playing the content locally on the DMP.

In these Interoperability Guidelines, the following three additional Device Classes are defined for the **HND Device Category.**

A Digital Media Renderer (DMR) with the role of playing content it receives after being setup by another network entity.

A **Digital Media Controller (DMC)** with the role of finding content exposed by a DMS and matching it to the rendering capacities of a DMR and setting up the connections between the DMS and DMR. A **Digital Media Printer (DMPr)** with the role of printing images.

The following Device Classes are defined for **MHD Device Category.**

A **Mobile Digital Media Server (M-DMS)** with the role of exposing and distributing content.

A **Mobile Digital Media Player (M-DMP)** with the role of finding content exposed by an M-DMS and playing the content locally on the M-DMP.

A **Mobile Digital Media Uploader (M-DM**U) with the role of sending content to an M-DMS with upload functionality.

A **Mobile Digital Media Downloader (M-DMD)** with the role of finding and downloading content exposed by an

M-DMS and playing the content locally on the M-DMD after downloading.

III. SYSTEM USAGES

Seven System Usages are defined that map to all of the use case scenarios being enabled by the detailed guidelines.

2-Box Pull System Usage

This usage involves a user at a DMP or an M-DMP, which enables the user to find and play content that is advertised and distributed by a DMS or M -DMS.

2-Box Push System Usage

This usage involves a user at a Push Controller, which enables the user to distribute content to a DMR for playback purposes.

3-Box System Usage

This usage involves a user at a DMC or an M -DMC, which enables the user to find content on a DMS that in turn will be played on a user selected DMR.

2-Box Printing System Usage

This usage involves a user at a Printing Controller -1, which enables the user to set up image print tasks with a DMPr.

3-Box Printing System Usage

This usage involves a user at a Printing Controller -2, which enables the user to find images on a DMS or M-DMS and then set up a print tasks with a DMPr.

Download System Usage

This usage involves a user at a Download Controller or an M -DMD, which enables the user to download content from a DMS or an M-DMS so that the Download Controller or the M-DMD has its own copy.

Upload System Usage

This usage involves a user at an Upload Controller or an M -DMU, which enables the user to send content to a DMS or an M-DMS with the Upload Device Option so that the DMS or the M-DMS can distribute the content to other endpoints.

Upload Synchronization System Usage

This usage involves a user at an Upload Synchronization Controller, which enables the user to reflect any changes to the local store of content into a DMS or an M -DMS with the Content Synchronization Device Option so that the DMS or the M -DMS can receive and distribute the new or changed content to other endpoints.

Download Synchronization System Usage

This usage involves a user at a Download Synchronization Controller, which enables the user to obtain any changes to the store of content on a DMS or an M-DMS supporting the Content Synchronization Device Option.

2 Box RUI Pull with/without A/V System Usage

This usage involves a user at a RUI Pull Controller (+RUIPL+), which enables a user to find and interact with a user interface that is offered by a RUI Source (+RUISRC+), but which is rendered by the RUI Pull Controller. A user interface might control A/V content that is rendered inside the user interface.

3 Box UI-only System Usage

This usage involves a user at a RUI Controller (+RUICTRL+), which enables a user to set up a remote UI connection between a RUI Sink (+RUISINK+) and a remote UI offered by a RUI Source (+RUISRC+). This system usage does not include control of A/V content that is rendered inside the user interface.

3 Box UI with A/V System Usage

This usage involves a user at a RUI Controller (+RUICTRL+), which enables a user to set up a remote UI connection between a RUI Sink (+RUISINK+) and a remote UI offered by a RUI Source (+RUISRC+), that includes control of A/V content that is rendered inside the user interface.

Scheduled Recording System Usage

This usage involves a user at a Scheduled Recording Controller, which enables the user to instruct a media server (DMS/M-DMS) to browse, create, modify, and cancel scheduled recordings.

EPG System Usage

This usage involves a user at an EPG Controller, which enables the user to view EPG metadata exposed by a DMS or M-DMS.

Finally comes **XBMC**-an open source media player, designed to work across a wide range of platforms,including Windows; Mac OSX and Linux. It actually began life on the Xbox gaming system.XBMC is one of the few media players which can play almost every format of audio and video fileyou can think of – and a whole lot more you've never heard of. It's designed for use on a TV screenat a distance and is therefore ideal for use on a wide variety of platforms. It can scan and index yourmusic and video files and is an ideal choice to run at the heart of a compute-based audio and videosystem. XBMC can do a lot more than simply offer a text-based searching system .

2-Box Push System Usage

The 2-Box Push System Usage pushes DLNA compliant content to a rendering device (DMR).

The user perspective is that content is being pushed to the DMR even though content might
actually be transported in a "pull" manner depending on the media transport used. The useris selecting content at the device where the content is resident. Figure 2 illustrates thisdevice interaction model. The following steps are performed in this System Usage:

1. Invoke UPnP actions to set up a playback session.
2. Request the content for playback.
3. Transport the content to the DMR.

Note that the Push Controller Device Capability functionality can only be incorporated as partof any physical device with a valid DLNA Device Class. It shall never appear as a stand-
alone device. This is how the Push Controller Device Capability inherits other DeviceFunctions (e.g. IP Connectivity) at other layers in the DLNA Device Architecture. This isapplicable to Device Classes in both the HND and MHD Device Categories.

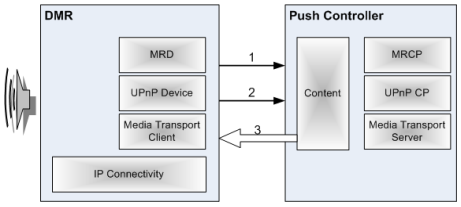

Figure 2:2- Box Push System Usage Interaction Model

3-Box System Usage

The 3-Box System Usage uses a device controller (DMC/M-DMC) to browse content on a media server (DMS/M-DMS) and to select a rendering device (DMR) to play the selected content. The DMC or the M-DMC is responsible for making sure a DMR can render theselected DLNA content. Figure 3 illustrates this device interaction model. The following steps are performed in thisSystem Usage:

1. Invoke UPnP actions to browse and select content.
2. Invoke UPnP actions to verify that the DMR has the capability to render the selected content and then set up a connection for the selected content between the DMR and the DMS or the M-DMS.
3. Request the content for playback.
4. Transport the content to the DMR

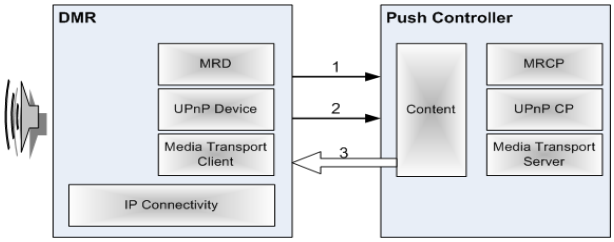

Figure 3:3-Box Usage

Download System Usage

The Download System Usage allows a Download Controller or an M-DMD to transfer and store DLNA content from a media server (DMS or M-DMS).Figure 4 illustrates this device interaction model. The following steps are performed in this System Usage:

1. Invoke UPnP actions to find content to download.
2. Request the content that needs to be downloaded.
3. Transport content to the Download Controller or the M-DMD.

Note that the Download Controller Device Capability functionality can only be incorporated aspart of any physical device with a valid DLNA Device Class. It can never appear as a stand -alone device. This is how the Download Controller Device Capability inherits other Device Functions (e.g. IP Connectivity) at other layers in the DLNA Device Architecture. In the MHD environment, this System Usage can be accomplished by a device with only this functionality,hence the need for an M-DMD Device Class to provide support for all layers in the DLNA architecture. This is not a requirement in the HND environment which shall incorporate this functionality as an addition to an existing Device Class.

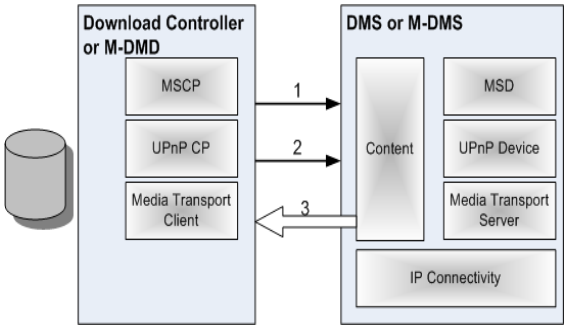

Figure 4:Download System Usage Interaction Model

Upload System Usage

The Upload System Usage has an Upload Controller Device Capability or an M -DMU to instruct a media server (DMS/M-DMS) to accept some new content to be added to its list of available content.

Figure 5 illustrates this device interaction model. The following steps are performed in this System Usage:

1. Invoke UPnP actions to create a CDS entry for the content to be uploaded.
2. Transport the content being uploaded to the DMS or the M-DMS.

Note that the Upload Controller Device Capability functionality can only be incorporated as part of any physical device with a valid DLNA Dev ice Class. It shall never appear as a stand-alone device. This is how the Upload Controller Device Capability inherits other Device Functions (e.g. IP Connectivity) at other layers in the DLNA Device Architecture. In the MHD environment, this System Usage can be accomplished by a device with only this functionality,hence the need for an M-DMU Device Class to provide support for all layers in the DLNA

architecture. This is not a requirement in the HND environment which shall incorporate thisfunctionality as an addition to an existing Device Class.

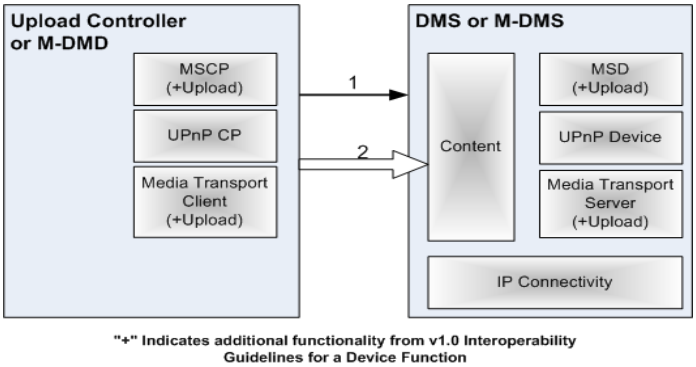

Figure 5:Upload System Usage Interaction Model

IV. CONCLUSION

WFDS is a p2p standard defined by the Wi-Fi alliance group, which is built on Wi-Fi Direct.The effort is aimed at developing a Wi-Fi Direct Services platform to foster development of applications and drive an enhanced user experience with a range of common tasks with the backward compatible with other existing Wi-fi direct services. WFDS is a certification for an exciting new technology that enables Wi Fi devices to form connections among themselves, with or without a hotspot or other WiFi network available Now, Wi Fi isn't just about accessing the Internet but about connecting all the Wi Fi devices you and your friends have anytime, anywhere.

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