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Universal Plug and Play

A report on UPnP

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1 The purpose of UPnP

The purpose of Universal Plug and Play (UPnP) is similar to that of Zero-Conf, the technology used in Apple's Bonjour service [6]. UPnP provides easy connectivity between networked Internet Protocol (IP) devices by enabling zero configuration auto discovery and connectivity between them [2].

When a UPnP device is powered on, it automatically attempts to connect to the network, obtain an IP address and then broadcast and receive information about itself and other devices on the network, including the capabilities of what it and others can do [1].

The original focus of UPnP was on devices within the home, such as media servers, Airplay devices, printers and security cameras, however the scope has since grown to include connected cars, work and industry [3].

UPnP brings the benefits that Plug 'n' Play has for directly connected devices such as USB sticks to IP networked devices; the ability to connect a new device to the network and have it just work with other connected devices such as PCs and smart phones, without requiring technical configuration and set up before use.

2 UPnP Protocols

The UPnP architecture describes six levels of protocols including addressing, discovery, description, control, eventing and presentation. While control deals with how devices can invoke other devices using SOAP, that layer will not be considered further.

2.1 Addressing

The first level of the UPnP protocol deals with establishing a presence on the network. This involves obtaining an IP address. UPnP devices implement Automatic Private IP Addressing (AutoIP) to obtain or generate an IP and address themselves. Firstly, the device will attempt to obtain an IP address via Dynamic Host Configuration Protocol (DHCP) [4]. This protocol uses UDP on ports 67 and 68 for the server and client respectively.

Initially, the device will broadcast a Discover UDP message to the whole network using the broadcast address 255.255.255.255 as the destination. The message will include the source IP address of 0.0.0.0 as it does not yet have

one, and will be sent from UDP port 68 to port 67, ensuring that a server is the only one to receive the message.

Source MAC addr	**Dest MAC addr**	**Source IP addr**	**Dest IP addr**	**Packet Description**
Client	Broadcast	0.0.0.0	255.255.255.255	DHCP Discover
DHCPsrvr	Broadcast	DHCPsrvr	255.255.255.255	DHCP Offer
Client	Broadcast	0.0.0.0	255.255.255.255	DHCP Request
DHCPsrvr	Broadcast	DHCPsrvr	255.255.255.255	DHCP ACK

Table 1: Client-server DHCP conversation summary [5]

Following receipt of the discovery message, the DHCP server will respond by broadcasting an offer which will state the offered IP address and the time duration that it will be valid for. The source and destination ports for the UDP message will be flipped, such that the source is the server port 67 and destination 68. This needs to be broadcast as the client still does not have an IP address at this time and cannot otherwise be located, but clients with an established IP address will ignore the message.

The client will then broadcast a request message which will indicate the specific IP and duration of the offer that it is accepting. The final response from the server is to acknowledge the accepted offer, and upon client receipt of the ACK, the client will start using the confirmed IP address.

Should DHCP fail to obtain an IP address, the device will fail over to generate an IP and address itself.

2.2 Discovery

2.3 Description

2.4 Eventing

2.5 Presentation

3 Security

References

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