TO: T10 Membership
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DATE: 21 April 2008
SUBJECT: T10/08-198r0, iADT Service Discovery using UPnP

1 Revisions

0 Initial revision (21 April 2008)

2 General

In the 16 April 2008 ADI working group teleconference, there was a discussion of how DTDs and ADs implementing the iADT protocol might discover each others' IP addresses. This document specifies the protocols and operations for a removable medium data transfer device (DTD) to advertise its presence to the medium changer device (automation device or library) within which the DTD is installed. The Universal Plug and Play (UPnP) protocol is used by the DTD to advertise its presence on the network internal to the automation device.

2.1 Objectives

This specification addresses one need arising from the use of an Ethernet port to provide management access to a removable medium data transfer device (DTD) in an automation device (AD). The need is that the automation device must discover the Internet Protocol (IP) address of the DTD and the network port number available on the DTD for an iADT connection. Vendor-specific port numbers may also be reported.

2.2 Automation Device Components

This document assumes that DTDs will be attached to the automation device by an Ethernet switch or hub and that this subnet is isolated from the Internet for security.

The automation device contains the following components:

- Management application accessible via front panel and/or Internet.
- Automation application client (see ADC-3)
- Remote SMC device server (see ADC-3)
- Ethernet ADI port (see ADC-3 and T10/07-469r2)

While the automation application client and remote SMC device server must use the Ethernet iADT port to access DTDs' iADT ports, the network protocol servers and the management application do not necessarily use the same Ethernet port.

2.3 DTD Components

The DTD contains the following components:

- Ethernet port for management and which is an ADI port (see ADC-3)
- DHCP client (see RFC 2131 and RFC 3315)
- ADC device server (see ADC-3)
- Optional local SMC device server and ADI bridging manager (see ADC-3)
- Optional ADT port

To support legacy operation a DTD may support an ADT port, although if the Ethernet management port is used, then the ADT port may be disabled, and vice-versa.

When a DTD is replaced, there should be no need to modify its Ethernet address to "spoof" that of the previously-installed DTD. Spoofing is only needed for identifiers presented on the DTD's primary port(s).

2.4 References

UPnP Device Architecture 1.0, UPnP Forum, 20 July 2006, available at http://www.upnp.org/.

3 Operations

3.1 DTD Identification

Throughout the life cycle of a DTD in an automation device – installation and configuration, usage, removal, and replacement – it is necessary for the management application to know where the DTD is physically located in the automation device. When the automation device and DTD communicate over a point-to-point, such as ADT, each port usually connects to a unique DTD slot and there is no ambiguity as to the location of the DTD being communicated with.

Ethernet, on the other hand, allows the automation device to communicate through a single port to all DTDs. Moreover, there is nothing in the Ethernet frame which directly identifies the physical location to or from which the frame is being sent or received. Addressing is by the six-byte source and destination addresses in the frame header, also called Ethernet hardware addresses or MAC addresses. The hardware address of an Ethernet port is nominally hard wired and unique, although it may be possible to change it.

There are more levels of addressing hierarchy built on top of the Ethernet hardware address. For our purposes, we will assume that each DTD will have a unique IPv4 and/or IPv6 address. Each IP address will correspond to exactly one Ethernet hardware address, and one Ethernet hardware address will correspond to one IPv4 and/or one IPv6 address. The Address Resolution Protocol is used to find the Ethernet hardware address corresponding to an IP address.

At an even higher level, a human-readable hostname, e.g., “drive01,” maps to an IP address. The Domain Name System (DNS) is used to translate between IP addresses and hostnames. However, a DNS implementation may not be necessary for our purposes, as the hostname – IP address mapping can be statically specified in the HOSTS file.

Given these levels of addressing, there are three ways of determining the slot number in which a given DTD is installed:

- The Ethernet hardware address can be used to uniquely identify each DTD. The hardware address may be placed on the DTD in a human- and perhaps machine-readable form. This means a label with the hardware address in both numerals and a barcode. The administrator then informs the automation device of the physical slot number of the DTD with a given Ethernet hardware address.
- The DTD’s serial number can be used to uniquely identify it. In this specification, the DTD will advertise its serial number to the automation device via UPnP. The administrator then informs the automation device of the physical slot number of the DTD with a given Ethernet hardware address.
- The automation device may implement a vendor-specific means to associate the DTD’s IP address with the physical location. This may require no special action on the part of the administrator.

3.2 DTD Booting

In this specification, the DTD uses the UPnP protocol to advertise its presence; it implements a UPnP Device. The automation device implements a UPnP Control Point and uses vendor-specific control actions to learn port numbers and/or provide the DTD with service locations. When a DTD boots, it performs the following operations:

1. DTD boots.
2. DTD acquires IP address.

3. DTD advertises device presence via UPnP.
4. DTD optionally disables ADT port.
5. DTD accepts connections on iADT and other ports

If the ADC device server processes a Device Reset task management request, it shall cause the DTD to perform a hard reset (see SAM-4) and to initiate the process above.

4 Universal Plug-N-Play Messages

This section describes the Universal Plug-N-Play (UPnP) messages used to provide the location of the DTD to the automation device. The DTD contains a device of type `X_devAdiDtd`, which supports the `X_srvAdiDtd` service. (The prefix "X_" is standard UPnP naming for a vendor-specific name, i.e., one assigned by any entity other than the UPnP Forum.)

4.1 Addressing Step

For IPv4 installations, UPnP specifies that if DCHP is not available for address configuration, then IPv4 addresses are to be configured in accordance with RFC 3927, *Dynamic Configuration of IPv4 Link-Local Addresses*. This technique uses the Address Resolution Protocol (ARP) to assign addresses in the 169.254/16 range. One requirement of RFC 3927 is "Note that addresses in the 169.254/16 prefix SHOULD NOT be configured manually or by a DHCP server."

For IPv6 installations, link-local addressing may be used.

4.2 Discovery Step

In the Discovery step, the DTD (device) advertises the `X_srvAdiDtd` service, and the automation device (control point) searches for the `X_srvAdiDtd` service.

4.2.19 Advertisement: Device available – NOTIFY with ssdp:alive

When the DTD boots, it multicasts an advertisement of the `X_srvAdiDtd` service. This consists of three discovery messages for the root device and one discovery message for the service. *Each* message is sent two or three times. Because the DTD has only a root device and no embedded devices, no discovery message is sent for an embedded device.

```
NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age = seconds until advertisement expires
LOCATION: URL for UPnP description for root device
NT: upnp:rootdevice
NTS: ssdp:alive
SERVER: OS/version UPnP/1.0 product/version
USN: uuid:device-UUID::upnp:rootdevice
```

```
NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age = seconds until advertisement expires
LOCATION: URL for UPnP description for root device
NT: uuid:device-UUID
NTS: ssdp:alive
SERVER: OS/version UPnP/1.0 product/version
USN: uuid:device-UUID (for root device UUID)
```

```
NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age = seconds until advertisement expires
LOCATION: URL for UPnP description for root device
```

```
NT: urn:schemas-upnp-org:device:X_devAdiDtd:0.0
NTS: ssdp:alive
SERVER: OS/version UPnP/1.0 product/version
USN: uuid:device-UUID::urn:schemas-upnp-org:device:X_devAdiDtd:0.0


NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age = seconds until advertisement expires
LOCATION: URL for UPnP description for root device
NT: urn:t10-org:service:X_srvAdiDtd:0.0
NTS: ssdp:alive
SERVER: OS/version UPnP/1.0 product/version
USN: uuid:device-UUID::urn:t10-org:service:X_srvAdiDtd:0.0
```

Editor's Note 1:	We should standardize the `CACHE-CONTROL: max-age` value.

4.2.20 Advertisement: Device unavailable – NOTIFY with `ssdp:byebye`

Prior to shutdown, the DTD multicasts a `ssdp:byebye` message corresponding to each of the `ssdp_alive` messages that it multicasted which have not yet expired. *Each* message is sent two or three times.

```
NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
NT: upnp:rootdevice
NTS: ssdp:byebye
USN: uuid:device-UUID::upnp:rootdevice


NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
NT: uuid:device-UUID
NTS: ssdp:byebye
USN: uuid:device-UUID (for root device UUID)


NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
NT: urn:schemas-upnp-org:device:X_devAdiDtd:0.0
NTS: ssdp:byebye
USN: uuid:device-UUID::urn:schemas-upnp-org:device:X_devAdiDtd:0.0


NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
NT: urn:t10-org:service:X_srvAdiDtd:0.0
NTS: ssdp:byebye
USN: uuid:device-UUID::urn:t10-org:service:X_srvAdiDtd:0.0
```

4.2.21 Search: Request with M-SEARCH

When an automation device boots, it sends a multicast request for devices supporting the `X_srvAdiDtd` service. The message is sent more than once and should be re-sent periodically.

```
M-SEARCH * HTTP/1.1
HOST: 239.255.255.250:1900
MAN: "ssdp:discover"
```

```
MX: seconds to delay response
ST: urn:t10-org:service:X_srvAdiDtd:0.0
```

Editor's Note 2:	We should standardize the MX value.
Editor's Note 3:	We should standardize the retransmission rate.

4.2.22 Search: Response

When a DTD processes an ssdp:discover request for the `X_srvAdiDtd` service, it unicasts the following response. The message is sent more than once.

```
HTTP/1.1 200 OK
CACHE-CONTROL: max-age = seconds until advertisement expires
DATE: when response was generated
EXT:
LOCATION: URL for UPnP description for root device
SERVER: OS/version UPnP/1.0 product/version
ST: urn:t10-org:service:X_srvAdiDtd:0.0
USN: advertisement UUID
```

Editor's Note 4:	We should standardize the `CACHE-CONTROL: max-age` value.