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Communications protocol to transport satellite delivered signals over IP networks

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A list of organizations represented on this committee can be obtained on request to its secretary.

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**Communications protocol to transport satellite delivered signals
over IP networks**

Protocole de communication pour le transport des signaux
transmis par satellite sur les réseaux IP

Kommunikationsprotokoll zum Transport von
Satellitensignalen über IP-Netze

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Foreword

This document (EN 50585:2014) has been prepared by CLC/TC 209 "Cable networks for television signals, sound signals and interactive services".

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-03-24
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2017-03-24

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Introduction

This standard describes a new communication protocol for the distribution of satellite signals onto IP networks. It effectively “translates” TV signals, received from satellites in the DVB-S and DVB-S2 formats and supplied in the first intermediate frequency range (1st IF range), into signals for use on internet-based devices in the IP world. This technology enables the reception of satellite TV on devices that do not have an integrated satellite receiver. Satellite signals can thus be transported via every IP infrastructure with or without cable.

This way, the entire satellite household can be provided with TV and sound radio programmes on tablets, PCs, laptops, smart phones, connected TVs, game consoles and media players.

This technology concept is commonly referred to as **SAT>IP**¹⁾.

1) **SAT>IP** is a short-term which covers the complete system for the transposition of SAT-IF signals to IP-based signals. This term is used in a widespread manner for marking software and hardware components used in such systems. More details are given in informative Annex E.

1 Scope

This European Standard describes the SAT>IP communication protocol. It enables a SAT>IP server to forward satellite delivered signals to SAT>IP clients over IP networks. The typical use case would be the transport of television programs that were received from the satellite by the SAT>IP server to the SAT>IP client via the IP network. SAT>IP specifies a control protocol as well as the media transport (Figure 1).

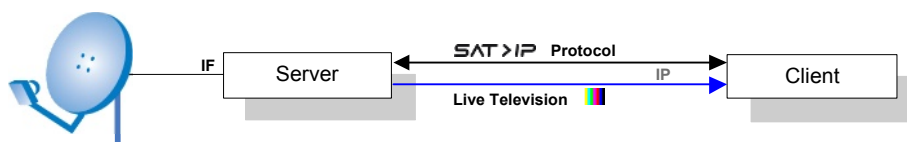


Figure 1 — Basic principle of the SAT>IP system

SAT>IP is **not** a device specification.

The SAT>IP protocol distinguishes between SAT>IP clients and SAT>IP servers.

SAT>IP Clients

SAT>IP clients may reside in set-top boxes equipped with an IP interface or may be implemented as software applications running on programmable hardware such as Tablets, PCs, Smartphones, Connected Televisions.

SAT>IP Servers

SAT>IP servers may take various forms ranging from large MDU headends servicing whole buildings or communities to in-home IP multiswitches to simple IP adapters for a set-top box to, ultimately, IP LNBs.

Actual devices may be clients or servers or both depending on their feature set.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 29341-1-1, *Information technology — UPnP Device Architecture — Part 1.1: UPnP Device Architecture Version 1.1*

ETSI TS 101 154 V1.9.1, Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream

RFC 2113 – IP Router Alert Option (Internet Engineering Task Force (IETF))

RFC 2131 – DHCP (Dynamic Host Configuration Protocol) (Internet Engineering Task Force (IETF))

RFC 2250 – RTP Payload Format for MPEG1/MPEG2 Video (Internet Engineering Task Force (IETF))

RFC 2279 – UTF-8, a transformation format of ISO 10646 (Internet Engineering Task Force (IETF))

RFC 2326 – Real Time Streaming Protocol (RTSP) (Internet Engineering Task Force (IETF))

RFC 3376 – Internet Group Management Protocol, Version 3 (Internet Engineering Task Force (IETF))

RFC 3550 – RTP: A Transport Protocol for Real-Time Applications (Internet Engineering Task Force (IETF))

RFC 4566 – SDP: Session Description Protocol (Internet Engineering Task Force (IETF))

draft-cai-ssdp-v1-03 – Simple Service Discovery Protocol/1.0 (Internet Engineering Task Force (IETF))

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1

dynamic server operation

server that is dynamically connected to a tuner when a TV program is requested in the IP format by a user

3.1.2

live television

delivered from signal source to end-user equipment without significant delay but with the possibility of (several) changes of transmission format

3.1.3

multicast data transmission

unique transmission of data signals from one server to more than one client

3.1.4

multiswitch server

server that is connected to a number of tuners in order to deliver channels requested by customers

3.1.5

SAT>IP

short-term which covers the complete system for the transposition of SAT-IF signals to IP-based signals

Note 1 to entry: This term is used in a widespread manner for marking software and hardware components used in such systems.

3.1.6

SAT>IP client

receive satellite delivered signals from SAT>IP server via IP networks; which may reside in set-top boxes equipped with an IP interface or may be implemented as software applications running on programmable hardware such as tablets, PCs, smartphones, connected televisions

3.1.7

SAT>IP server

transforms satellite signals, delivered in the SAT-IF format, to the IP format and transport it to SAT>IP clients via IP networks; which may take various forms ranging from large MDU headends servicing whole buildings or communities to in-home IP multiswitches to simple IP adapters for a set-top box to, ultimately, IP LNBS

3.1.8

static server operation

server that is always connected to a number of tuners to provide the wanted TV programs in the IP format

3.1.9

unicast data transmission

data signal transmission from one server to only one client

3.2 Abbreviations

CSV	Comma Separated Values
DHCP	Dynamic Host Configuration Protocol
DiSEqC	Digital Satellite Equipment Control
DLNA	Digital Living Network Alliance
DSL	Digital Subscriber Line
DVB	Digital Video Broadcasting
DVB-S	DVB for Satellite
DVB-S2	2 nd generation DVB for satellite
DVR	Digital Video Recorder
FEC	Forward Error Correction
GENA	General Event Notification Architecture
HTML	HyperText Markup Language
HTTP	Hyper Text Transfer Protocol
HSPA	High Speed Packet Access
IF	Intermediate Frequency
IGMP	Internet Group Management Protocol
IP	Internet Protocol
LAN	Local Area Network
LNB	Low Noise Block
MDU	Multi Dwelling Unit
MIME	Multipurpose Internet Mail Extensions
MPEG	Moving Picture Experts Group
MPTS	Multiple Program Transport Stream
MTU	Maximum Transmission Unit
MUDP	Multicast UDP
NAS	Network Attached Storage
PID	Packet Identifier
PLC	Power Line Communication
PoE	Power over Ethernet
PSK	Phase Shift Keying
PVR	Personal Video Recorder
QPSK	Quaternary Phase Shift Keying
RFC	Request For Comments
RTP	Real-time Transport Protocol
RTCP	Real-time Transport Control Protocol
RTSP	Real Time Streaming Protocol
SDES	Source Description

SDP	Session Description Protocol
SI	Service Information
SMATV	Satellite Master Antenna Television
SOAP	Simple Object Access Protocol
SPTS	Single Program Transport Stream
SR	Sender Report
SSDP	Simple Service Discovery Protocol
STB	Set-Top-Box
TCP	Transport Control Protocol
TS	Transport Stream
TTL, ttl	Time to live
UDP	User Datagram Protocol
UPnP	Universal Plug and Play
UPnP AV	UPnP Audio and Video
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
urn	universal resource name
UTF	UCS Transformation Format
WLAN	Wireless Local Area Network
XML	Extensible Markup Language

4 Basic description of SAT>IP system

4.1 SAT>IP concept

Unlike in today's satellite distribution schemes, the SAT>IP architecture allows the reception of satellite television programs also on devices which do not have a satellite tuner directly built-in. Satellite tuners and demodulators are moved or "remoted" into SAT>IP server devices. Clients control SAT>IP servers via the SAT>IP protocol. SAT>IP is a remote tuner control protocol which provides the possibility of remotely controlling tuning devices.

This means that the reception of satellite delivered programming can be dealt with by clients purely in software, provided a SAT>IP server is available on a network. Satellite programs become available on devices which would never be capable of supporting satellite TV otherwise e.g. Tablets.

From the distribution point of view, satellite distribution becomes physical layer agnostic and satellite services can be forwarded over all the latest types of wired or wireless technologies such as Powerline (PLC), Wireless LANs, Optical Fibre Distribution, etc.

4.2 Network topology

The SAT>IP protocol is designed to suit different application scenarios. The same SAT>IP client can communicate with various types of live media servers ranging from single satellite, single tuner servers to multi-satellite multi-tuner servers (Figure 2). SAT>IP clients can be designed to work in single home scenarios as well as in SMATV or large community systems.

The number of clients that can be simultaneously supported depends on the particular server implementation. Large servers can potentially serve an unlimited number of SAT>IP clients. SAT>IP servers can also be stacked and run in parallel on the same network.

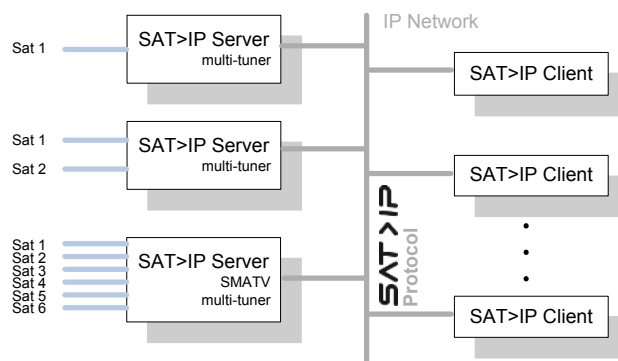


Figure 2 — Different types of live media servers

4.3 Client functionality

SAT>IP is a client driven architecture. Clients send requests to servers. Servers execute these requests and forward live television programs to clients.

SAT>IP servers ideally do not need to be configured. They are purely connected to IF satellite signals on their input and the IP network on their output.

Clients specify what they would like to receive. In this sense SAT>IP is very much comparable to today's satellite distribution architectures which are also not aware of the particular signals being received and watched by clients.

SAT>IP servers are flexible in the way in which signals are transported to clients, however the logic of what is being received resides in the clients.

SAT>IP does not specify the mechanisms through which SAT>IP clients learn about the streams which are available to them. Clients can parse DVB Service Information / Program Specific Information for learning about services available, but they can also rely on service lists containing this information.

4.4 Specification compliance

In order to be compliant with the SAT>IP specification, SAT>IP servers need to fully implement the following specification. All protocol mechanisms and tools shall be implemented.

SAT>IP clients on the other hand only need to implement the mechanisms which allow them to properly operate in a UPnP and RTSP environment.

4.5 Usage scenarios

The SAT>IP protocol has been designed with several use cases in mind which are described in informative Annex A. This listing is however not exhaustive, it is simply meant to describe the most common usage scenarios.

5 Protocol specification

5.1 General

The SAT>IP protocol allows IP based clients to interact/communicate with IP based satellite servers for live media forwarding.

SAT>IP builds on industry standards and does complement those only where necessary i.e. where there are no established satellite specific extensions.

The SAT>IP protocol makes use of:

- UPNP for Addressing, Discovery and Description,
- RTSP or HTTP for Control,
- RTP or HTTP for Media Transport.

The SAT>IP protocol stack is organised as shown in Figure 3.

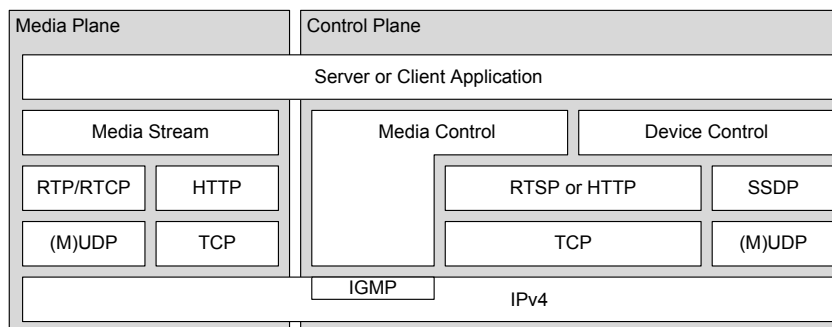


Figure 3 — SAT>IP protocol stack

SAT>IP uses a subset of the UPnP/DLNA architecture and protocols described in ISO/IEC 29341-1-1 and in RFC 2113 and SAT>IP devices can be extended to also become DLNA devices (Figure 4). As an example a SAT>IP client could access live media streams through the SAT>IP protocol and access recorded media streams through DLNA.

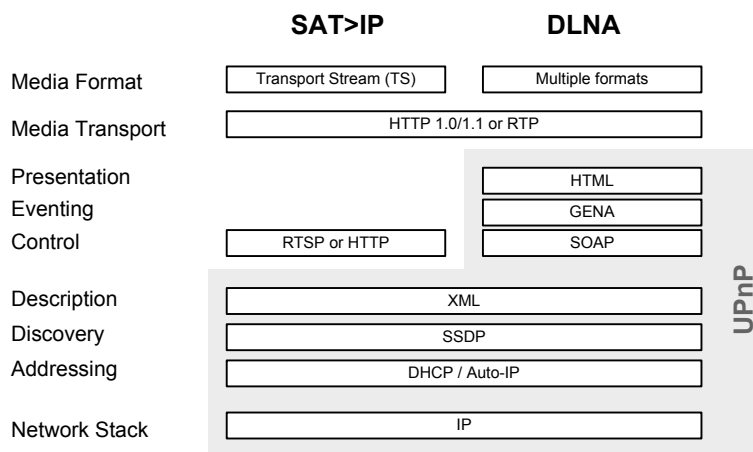


Figure 4 — Comparison between SAT>IP and DLNA

SAT>IP devices successively go through the following phases: Addressing, Discovery, Description, Control and finally Media Transport.

5.2 UPnP addressing

5.2.1 General

Addressing is the process for a SAT>IP device (client or server) to obtain a network address. This is a pre-requisite before any communication can take place. SAT>IP follows the UPnP specification (ISO/IEC 29341-1-1) by offering the following two options for address acquisition:

5.2.2 DHCP addressing

Every SAT>IP device shall have a Dynamic Host Configuration (DHCP) client and search for a DHCP server when the device is first connected to the network (RFC 2131). The device from that point onwards shall use the IP address assigned to it.

5.2.3 Auto-IP addressing

If no DHCP server can be located, the network is unmanaged and SAT>IP devices shall autoconfigure their IP address according to RFC 3376 from the Auto-IP range 169.254/16. In Auto-IP mode, SAT>IP servers shall periodically check for the existence of a DHCP server. All SAT>IP protocol mechanisms (SSDP, RTSP,...) shall work correctly whichever way the IP address is obtained.

5.3 UPnP Discovery

5.3.1 General

During the discovery phase SAT>IP servers advertise their presence to other SAT>IP servers and clients. When joining a network, SAT>IP clients search the network for available SAT>IP servers.

5.3.2 Simple service description protocol SSDP

Discovery in SAT>IP relies on draft-cai-ssdp-v1-03, Simple Service Description Protocol SSDP as specified in the UPnP Device Architecture 1.1 (ISO/IEC 29341-1-1).

As a minimum:

- a SAT>IP server is a UPnP Device and a UPnP Control Point,
- a SAT>IP client is a UPnP Control Point.

DEVICE TYPE / URN

Every UPnP device has a specific type corresponding to a certain category of device. This is expressed with a Unique Resource Name (URN) in UPnP.

The device type of a SAT>IP device shall be:

urn:**ses-com**:device:**SatIPServer**:1

where:

- "ses-com" is the domain-name,
- "SatIPServer" is the deviceType name,
- and "1" is the version of the device type.

UUID

Each instance of a SAT>IP server is uniquely identified by its Universally Unique Identifier (UUID) string. The UUID string shall have the format specified in ISO/IEC 29341-1-1: 4B-2B-2B-2B-6B where B represents a Byte written as two hexadecimal digits. The UUID of a device shall always remain fixed.

Example of a UUID string:

"2fac1234-31f8-11b4-a222-08002b34c003"

5.3.3 Server Advertisements

SAT>IP servers joining a network multicast **three** different NOTIFY ssdp:alive messages to the SSDP address 239.255.255.250 port 1900 (Table 1). This is a requirement for UPnP root devices according to the UPnP Device Architecture 1.1 (ISO/IEC 29341-1-1).

Table 1 — Multicast NOTIFY ssdp:alive message and example

Method	NOTIFY	
Request	Protocol	MUDP (Multicast UDP)
	Headers	As specified in the UPnP Device Architecture 1.1. Announcement messages from SAT>IP servers shall include the "DEVICEID.SES.COM:" header extension field with the DEVICE ID value of a particular server.
Response	No response is sent.	
Example	Request	<pre>NOTIFY * HTTP/1.1 HOST: 239.255.255.250:1900 CACHE-CONTROL: max-age=1800 LOCATION: http://<SatIPServer_IP_Address>/<description>.xml NT: <notification type> NTS: ssdp:alive SERVER: OS/version UPnP/1.1 product/version USN: <unique service name> BOOTID.UPNP.ORG: <bootID> CONFIGID.UPNP.ORG: <configID> SEARCHPORT.UPNP.ORG: <searchPort> DEVICEID.SES.COM: <DEVICEID> <CRLF></pre>

The **NTS** header value of these packets is ssdp:alive

The **NT** (Notification Type) header value is different in each of the three NOTIFY messages. It successively announces the root device, its device uuid and the urn (see example below).

The **USN** (Unique Service Name) also changes between the three announcement packets and carries a composite identifier in concordance with the NT value. Please check Table 1-1 of the UPnP Device Architecture 1.1 in ISO/IEC 29341-1-1 for more information.

The **LOCATION** header announces the URL to the UPnP device description (see 5.4). The URL should have a simple format e.g. http://<SatIPServer_IP_Address>/desc.xml.

The **CACHE-CONTROL** header announces the value during which the advertisement remains valid and before it needs to be re-sent. (1800 seconds in the example above). Multicast NOTIFY ssdp:alive messages are sent regularly by all SAT>IP servers in order to signal their continued presence. The refreshing of the NOTIFY advertisement set (consisting of the three messages) has to be done at a randomly-distributed interval of less than one half of the advertisement expiration date (e.g. 900 seconds for a max-age of 1800 seconds). This guarantees that the announcement set is repeated at least twice before it expires. Figure 5 shows the NOTIFY message timing.

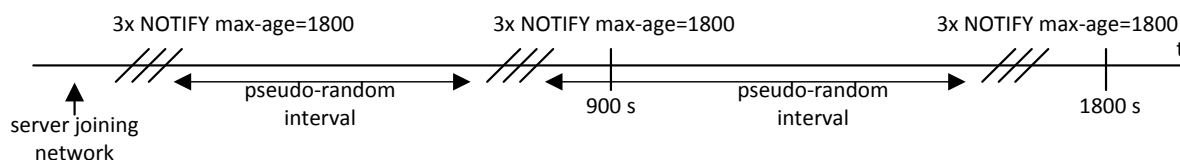


Figure 5 — NOTIFY message timing

The **BOOTID.UPNP.ORG** value shall increase each time that the device first announces on the network. It shall be stored in non-volatile memory.

The **CONFIGID.UPNP.ORG** value represents the configuration number of a root device. This value needs to be identical to the "configId=" value in the <root> section of the XML description file (see 5.4).

The **SEARCHPORT.UPNP.ORG** field is optional. Its use is **not** recommended in SAT>IP. SAT>IP devices are expected to listen to unicast M-SEARCH messages on the standard port 1900. Only if port 1900 is not available may a device select a different listening port for unicast M-SEARCH messages. If a device sends the SEARCHPORT.UPNP.ORG header field it shall respond to unicast M-SEARCH messages sent to this advertised port.

In SAT>IP networks several SAT>IP server devices may coexist on the same network. In order to distinguish themselves from each other, every device assigns itself a unique DEVICE ID on the network. This DEVICE ID is carried in the mandatory **DEVICEID.SES.COM** header field. Its use is explained in 5.3.4.

It should be noted that in UPnP

- header field names are case insensitive and header field values are case sensitive,
- the order of the header fields does not matter,
- linear white spaces following the colon after a header field and in front of a header value shall be ignored by clients.

The TTL value of each IP multicast packet should default to 2.

Example of the announcement of a SAT>IP server joining the network:

```
NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.21/desc.xml
NT: upnp:rootdevice
NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:50c958a8-e839-4b96-b7ae-8f9d989e136c::upnp:rootdevice
BOOTID.UPNP.ORG: 2318
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 1
```

```
NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.21/desc.xml
NT: uuid:50c958a8-e839-4b96-b7ae-8f9d989e136c
NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:50c958a8-e839-4b96-b7ae-8f9d989e136c
BOOTID.UPNP.ORG: 2318
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 1
```

```
NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.21/desc.xml
NT: urn:ses-com:device:SatIPServer:1
NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:50c958a8-e839-4b96-b7ae-8f9d989e136c::urn:ses-com:device:SatIPServer:1
BOOTID.UPNP.ORG: 2318
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 1
```

A SAT>IP server **present** on the network has to re-announce itself on a regular basis as described under CACHE-CONTROL above.

A SAT>IP server **leaving** the network needs to signal its departure by sending three different NOTIFY messages with the NTS value ssdp:byebye.

It should be noted that the **ssdp:byebye** messages should not include the CACHE-CONTROL, LOCATION, SERVER and DEVICEID.SES.COM headers. An example of such ssdp:byebye messages is shown in 5.3.4.1.

A SAT>IP server **changing** the network e.g. when passing from an Auto-IP network to a network with a DHCP assigned address shall signal its departure from one network by sending three NOTIFY messages with the NTS value ssdp:byebye on that network and shall announce its presence on the new network by sending three NOTIFY ssdp:alive messages.

SAT>IP **clients** (being at a minimum only UPnP Control Points) do not announce their presence. For this reason, a client leaving the network is not detectable at this level. The SAT>IP protocol however implements RTSP and IGMP which permit to detect the presence or absence of a client (RTSP session timeout, IGMP membership queries).

5.3.4 DEVICE ID negotiation

5.3.4.1 General description

Every SAT>IP server on a network carries its own non-clashing DEVICE ID value. The DEVICE ID value is negotiated between different SAT>IP servers when they join the network. The DEVICE ID value allows each SAT>IP server to uniquely associate itself with a different IP multicast address range on the network (see below).

When a server performs a cold start it reads the initial DEVICE ID value from its **non-volatile memory**. This value shall be the last value that the server had used. The server then multicasts this DEVICE ID value as part of the announcement NOTIFY messages that were described in 5.3.3.

Other SAT>IP servers already on the network (acting as control points) listen for these announcements.

As long as the DEVICE ID value received by these servers does not conflict with their own DEVICE ID value, they will not react.

In case of a **DEVICE ID conflict**, however the server that notices that another server would like to use its own DEVICE ID (DEVICE ID clash) needs to defend its own DEVICE ID, by sending (within 1 second) a **unicast** M-SEARCH message according to Table 2 containing the in-use DEVICE ID to the IP address of the joining server and **port 1900** or the port contained in the SEARCHPORT.UPNP.ORG field if present.

The joining server acknowledges receipt via a 200 OK response repeating the current DEVICE ID value.

Table 2 — Unicast M-SEARCH message and example

Method	M-SEARCH
Request	Protocol UDP unicast
	Headers As specified in the UPnP Device Architecture 1.1. A request from a server shall include a "DEVICEID.SES.COM:" field name with the DEVICE ID value of that server. The target server acknowledges receipt in repeating the DEVICE ID value in the response. A "DEVICEID.SES.COM:" field shall not be included in a client request.
Response	Line HTTP/1.1 200 OK
	Protocol UDP
	Headers As specified in the UPnP Device Architecture 1.1. The "DEVICEID.SES.COM:" field name with a DEVICE ID value shall be returned only if the request includes the "DEVICEID.SES.COM:" field name.
Example	Request
	M-SEARCH * HTTP/1.1 HOST: <Target_SatIPServer_IP_Address> MAN: "ssdp:discover" ST: urn:ses-com:device:SatIPServer:1 USER-AGENT: OS/version UPnP/1.1 product/version DEVICEID.SES.COM: 3 <CRLF>

Response HTTP/1.1 200 OK
 CACHE-CONTROL: max-age=1800
 DATE: <date>
 EXT:
 LOCATION: http://<Target_SatIPServer_IP_Address>/<description>.xml
 SERVER: OS/version UPnP/1.1 product/version
 ST: urn:ses-com:device:SatIPServer:1
 USN:uuid:01234567-0123-0123-0123-0123456789ab::urn:ses-com:device:SatIPServer:1
 BOOTID.UPNP.ORG: <bootID>
 CONFIGID.UPNP.ORG: <configID>
 SEARCHPORT.UPNP.ORG: <searchPort>
 DEVICEID.SES.COM: 3
 <CRLF>

It should be noted that the **EXT** field in 200 OK responses is required for backwards compatibility with UPnP 1.0. It consists of a header name only and has no field value.

As a consequence the joining server may leave the network by multicasting three NOTIFY ssdp:byebye messages. These messages are optional. They do not contain the DEVICEID.SES.COM field.

The joining server then has to generate a new DEVICE ID value (it should increment the former value by one) and re-announces itself on the network by sending three NOTIFY ssdp:alive messages containing the new DEVICE ID value.

If within a 5 s timeout period no unicast M-SEARCH message with a conflicting DEVICE ID field is received by the joining server, the joining server allocates itself the new DEVICE ID value and stores it in non-volatile memory. The DEVICE ID allocation timing is shown in Figure 6.

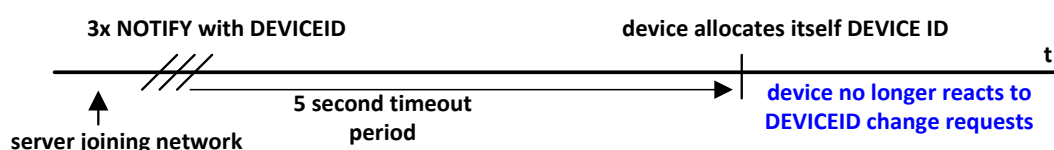


Figure 6 — DEVICE ID allocation timing

Installation Scenario

The process above is designed for the following mode of operation: on initial installation SAT>IP servers are connected to the same network and powered up one after the other. Each server will therefore sequentially acquire its own DEVICE ID value. After a power failure, server devices will simply read the last configured DEVICE ID value from non-volatile memory and re-boot more rapidly.

In order for installers to assess when to power up the next device during initial installation, it is recommended that the device provides visual feedback when the timeout period has expired (e.g. LED changing colour or pattern).

Example of SSDP message flow:

The message flow and sequence diagram below show the packet sequence when a second server arrives and claims a DEVICE ID already in use by a first server:

Server A joins an empty network and announces its DEVICE ID 1.

To: 239.255.255.250 Port 1900

```
NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.21/desc.xml
NT: upnp:rootdevice
NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:50c958a8-e839-4b96-b7ae-8f9d989e136c::upnp:rootdevice
```

BOOTID.UPNP.ORG: 2318
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 1

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.21/desc.xml
NT: uuid:50c958a8-e839-4b96-b7ae-8f9d989e136c
NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:50c958a8-e839-4b96-b7ae-8f9d989e136c
BOOTID.UPNP.ORG: 2318
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 1

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.21/desc.xml
NT: urn:ses-com:device:SatIPServer:1
NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:50c958a8-e839-4b96-b7ae-8f9d989e136c::urn:ses-com:device:SatIPServer:1
BOOTID.UPNP.ORG: 2318
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 1

As Server A is alone on the network initially it assigns itself DEVICE ID 1 (after the 5 second timeout period).

Server B joins the network and also wants to take DEVICE ID 1. It sends three NOTIFY messages.

To: 239.255.255.250 Port 1900

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.41/desc.xml
NT: upnp:rootdevice
NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63::upnp:rootdevice
BOOTID.UPNP.ORG: 2
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 1

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.41/desc.xml
NT: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63
NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63
BOOTID.UPNP.ORG: 2
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 1

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.41/desc.xml
NT: urn:ses-com:device:SatIPServer:1
NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63::urn:ses-com:device:SatIPServer:1
BOOTID.UPNP.ORG: 2
CONFIGID.UPNP.ORG: 0

DEVICEID.SES.COM: 1

Server A hears the announcements of Server B and sees that it needs to counter the request as the DEVICE IDs are clashing

Server A sends a unicast M-SEARCH message directly to the IP address of server B: Port 1900

M-SEARCH * HTTP/1.1
HOST: 192.168.178.21:1900
MAN: "ssdp:discover"
ST: urn:ses-com:device:SatIPServer:1
USER-AGENT: Linux/1.0 UPnP/1.1 IDL4K/1.0
DEVICEID.SES.COM: 1

Server B acknowledges the message with a 200 OK

HTTP/1.1 200 OK
CACHE-CONTROL: max-age=1800
DATE: Sat Jan 1 00:00:20 2000
EXT:
LOCATION: http://192.168.178.41/desc.xml
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
ST: urn:ses-com:device:SatIPServer:1
USN: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63::urn:ses-com:device:SatIPServer:1
BOOTID.UPNP.ORG: 2
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 1

Server B gives up DEVICE ID 1 and may send 3 NOTIFY ssdp:byebye messages

To: 239.255.255.250 Port 1900

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
NT: upnp:rootdevice
NTS: ssdp:byebye
USN: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63::upnp:rootdevice
BOOTID.UPNP.ORG: 2
CONFIGID.UPNP.ORG: 0

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
NT: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63
NTS: ssdp:byebye
USN: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63
BOOTID.UPNP.ORG: 2
CONFIGID.UPNP.ORG: 0

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
NT: urn:ses-com:device:SatIPServer:1
NTS: ssdp:byebye
USN: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63::urn:ses-com:device:SatIPServer:1
BOOTID.UPNP.ORG: 2
CONFIGID.UPNP.ORG: 0

Server B then has to announce that it takes DEVICE ID 2 by sending 3 NOTIFY ssdp:alive messages

To: 239.255.255.250 Port 1900

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.41/desc.xml
NT: upnp:rootdevice

NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63::upnp:rootdevice
BOOTID.UPNP.ORG: 3
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 2

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.41/desc.xml
NT: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63
NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63
BOOTID.UPNP.ORG: 3
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 2

NOTIFY * HTTP/1.1
HOST: 239.255.255.250:1900
CACHE-CONTROL: max-age=1800
LOCATION: http://192.168.178.41/desc.xml
NT: urn:ses-com:device:SatIPServer:1
NTS: ssdp:alive
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
USN: uuid:5a0c857b-add1-42d0-8673-b5ca60df4a63::urn:ses-com:device:SatIPServer:1
BOOTID.UPNP.ORG: 3
CONFIGID.UPNP.ORG: 0
DEVICEID.SES.COM: 2

After the 5 second timeout period Server B allocates itself DEVICE ID 2

The diagram in Figure 7 shows the packet sequence when a second server claims an already used DEVICE ID.

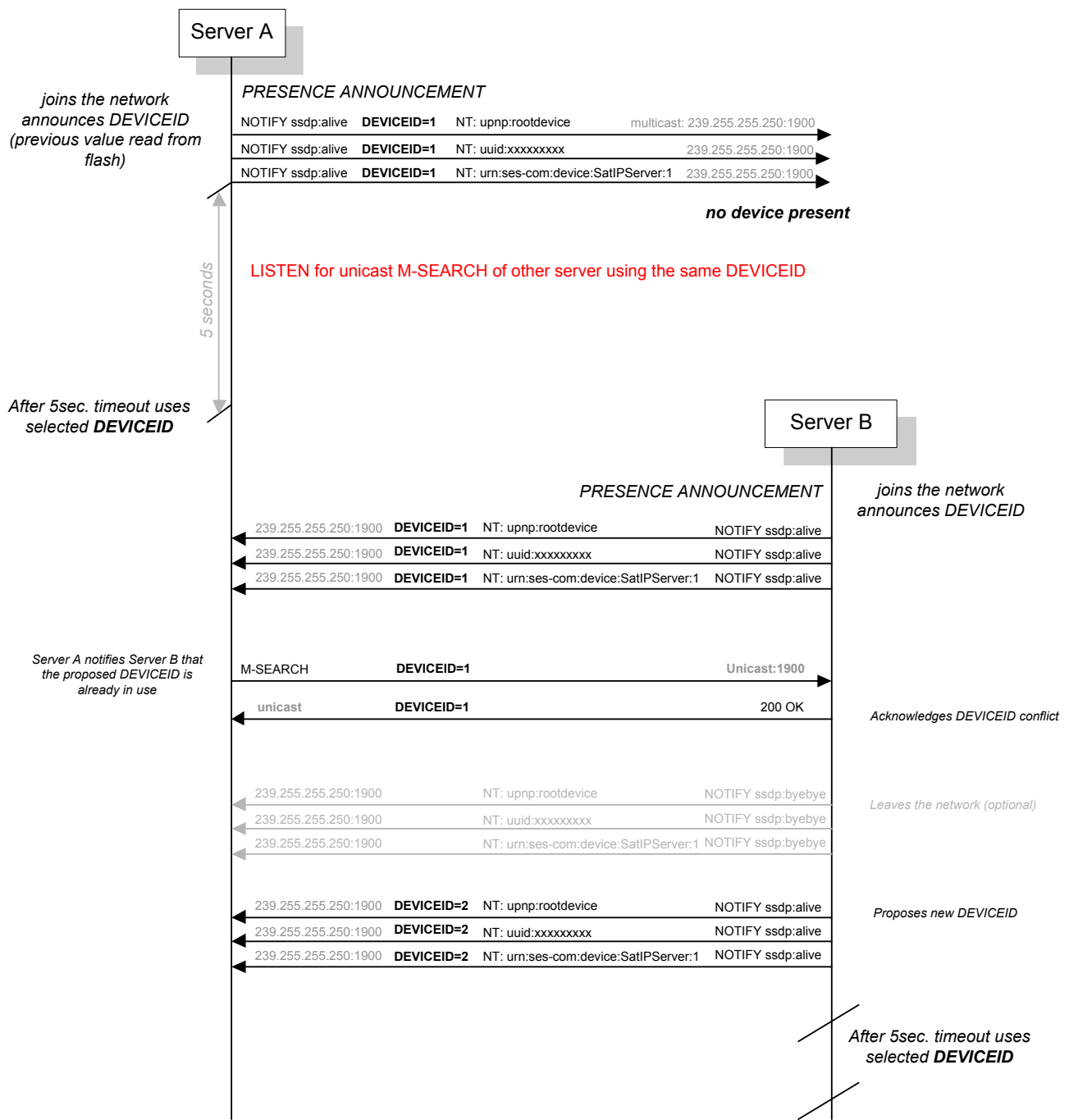


Figure 7 — Message flow when a new server claims an already allocated **DEVICE ID**

5.3.4.2 **DEVICE ID Header Field**

Table 3 summarizes when the **DEVICEID.SES.COM** field is required in SSDP messages.

Table 3 — Presence of the DEVICEID.SES.COM header field

SAT>IP	UPnP	SSDP Message	Protocol	Header Field
DEVICEID.SES.COM				
Server	Device	NOTIFY ssdp:alive	MUDP	required
		NOTIFY ssdp:byebye	MUDP	not required
	Control Point	M-SEARCH	UDP	required
	Device	200 OK	UDP	required
Client	Control Point	M-SEARCH	MUDP/UDP	not required
	Server Device	200 OK	UDP	not required

It should be noted that the response to an M-SEARCH message contains the "DEVICEID.SES.COM:" field only if the M-SEARCH request itself included the "DEVICEID.SES.COM:" field.

5.3.4.3 Multicast Address Range

In SAT>IP each server issues multicast addresses from its own multicast address range (which is not conflicting with multicast address ranges from other SAT>IP servers). This multicast address range is uniquely determined by the DEVICE ID value that each server allocates to itself during the device advertisement phase. The address range for a given SAT>IP server is given as follows:

239. <DEVICEID> . <0-254> . <0-254>

Example: the SAT>IP server with DEVICEID=3 will issue addresses from the range: 239.3.x.x

5.3.5 Client Search Requests

SAT>IP clients issue a **multicast** M-SEARCH message according to Table 4 to **discover** SAT>IP servers on the local network. Due to the unreliable nature of UDP, the recommendation is to send three identical M-SEARCH messages in 100 milliseconds.

Table 4 — Multicast M-SEARCH message and example

Method	M-SEARCH	
Request	Protocol	MUDP (Multicast UDP)
	Headers	As specified in the UPnP Device Architecture 1.1.
Response	Line	HTTP/1.1 200 OK
	Protocol	UDP
	Headers	As specified in the UPnP Device Architecture 1.1.
Example	Request	M-SEARCH * HTTP/1.1 HOST: 239.255.255.250:1900 MAN: "ssdp:discover" MX: 2 ST: urn:ses-com:device:SatIPServer:1 USER-AGENT: OS/version UPnP/1.1 product/version <CRLF>
	Response	HTTP/1.1 200 OK CACHE-CONTROL: max-age=1800 DATE: <date> EXT: LOCATION: http://<SatIPServer_IP_Address>/<description>.xml SERVER: OS/version UPnP/1.1 product/version ST: urn:ses-com:device:SatIPServer:1 USN:uuid:01234567-0123-0123-0123-0123456789ab::urn:ses-com:device:SatIPServer:1 BOOTID.UPNP.ORG: <bootID> CONFIGID.UPNP.ORG: <configID> SEARCHPORT.UPNP.ORG: <searchPort> <CRLF>

The **MAN** header value of these request packets is "ssdp:discover"

The **ST** header value contains the Search Target of the request. The value normally corresponds to the SAT>IP server URN.

The **MX** field contains the maximum wait time in seconds. The recommended value in SAT>IP is 2 seconds. Device responses should be delayed a random duration between 0 and this many seconds to balance load for the control point when it processes responses.

Example of Search Request of a SAT>IP Client and Server Response:

In order to discover servers on the network a client sends a multicast M-SEARCH ssdp:discover message to 239.255.255.250 Port 1900

```
M-SEARCH * HTTP/1.1
HOST: 239.255.255.250:1900
ST: urn:ses-com:device:SatIPServer:1
MAN: "ssdp:discover"
MX: 2
```

Servers respond in unicast UDP to IP address and port where request came from

```
HTTP/1.1 200 OK
CACHE-CONTROL: max-age=1800
DATE: Sat Jan 1 00:01:50 2000
EXT:
LOCATION: http://192.168.178.21/desc.xml
SERVER: Linux/1.0 UPnP/1.1 IDL4K/1.0
ST: urn:ses-com:device:SatIPServer:1
USN: uuid:50c958a8-e839-4b96-b7ae-8f9d989e136c::urn:ses-com:device:SatIPServer:1
BOOTID.UPNP.ORG: 2399
CONFIGID.UPNP.ORG: 0
```

SAT>IP servers shall not issue multicast M-SEARCH messages to detect other SAT>IP servers.

5.4 UPnP Description

5.4.1 General

The Description phase allows SAT>IP devices to provide more information about themselves to UPnP control points on the network. The device description is done via an XML file.

The location of this file is acquired during the discovery phase: the LOCATION field in the headers of the multicast NOTIFY ssdp:alive messages contains the URL of the description file. The XML file should have a simple name such as e.g. "desc.xml".

5.4.2 XML Device Description

The XML description provides information about the SAT>IP server device and shall be according to the following format:

```
<?xml version="1.0"?>
<root xmlns="urn:schemas-upnp-org:device-1-0" configId="configuration number">
  <specVersion>
    <major>1</major>
    <minor>1</minor>
  </specVersion>
  <device>
    <deviceType>urn:ses-com:device:SatIPServer:1</deviceType>
    <friendlyName>short user-friendly title</friendlyName>
```