

## Digital Video Broadcasting (DVB); Guidelines for DVB IP Phase 1 Handbook

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European Broadcasting Union



Union Européenne de Radio-Télévision



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Reference

DTR/JTC-DVB-199

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Keywords

broadcasting, digital, DVB, IP, TV, video

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## Foreword

This Technical Report (TR) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECTrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

Founded in September 1993, the DVB Project is a market-led consortium of public and private sector organizations in the television industry. Its aim is to establish the framework for the introduction of MPEG-2 based digital television services. Now comprising over 200 organizations from more than 25 countries around the world, DVB fosters market-led systems, which meet the real needs, and economic circumstances, of the consumer electronics and the broadcast industry.

**NOTE:** The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

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## 1 Scope

The present document is designed to help people implement the DVB-IP Phase 1 Handbook (available also as TS 102 034 [1]) and is a companion to that document. The present document is organized in separate clauses in the order of boot-up of the HNED rather than in the same order as the Handbook, each dealing with a specific aspect of the DVB-IP technology, and offering explanations and examples not found in the Handbook.

---

## 2 References

For the purposes of this Technical Report, the following references apply:

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

- [1] ETSI TS 102 034: "Digital Video Broadcasting (DVB); Transport of MPEG-2 Based DVB Services over IP Based Networks".
  - [2] ETSI TR 101 154: "Digital Video Broadcasting (DVB); Implementation guidelines for the use of MPEG-2 Systems, Video and Audio in satellite, cable and terrestrial broadcasting applications".
  - [3] IETF RFC 3927: "Dynamic Configuration of IPv4 Link-Local Addresses".
  - [4] IETF RFC 3203: "DHCP reconfigure extension".
  - [5] IEEE 1394: "IEEE Standard for a High Performance Serial Bus -Description".
  - [6] IEEE 802.1D-2004: "IEEE standard for local and metropolitan area networks--Media access control (MAC) Bridges (Incorporates IEEE 802.1t-2001 and IEEE 802.1w)".
  - [7] IEEE 802.11a-1999 (8802-11:1999/Amd 1:2000(E)): "IEEE Standard for Information technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications-Amendment 1: High-speed Physical Layer in the 5 GHz band".
  - [8] IEEE 802.11b-1999 Supplement to 802.11-1999: "Wireless LAN MAC and PHY specifications: Higher speed Physical Layer (PHY) extension in the 2.4 GHz band".
  - [9] IEEE 802.11g-2003: "IEEE Standard for Information technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications-Amendment 4: Further Higher-Speed Physical Layer Extension in the 2.4 GHz Band".
- 

## 3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

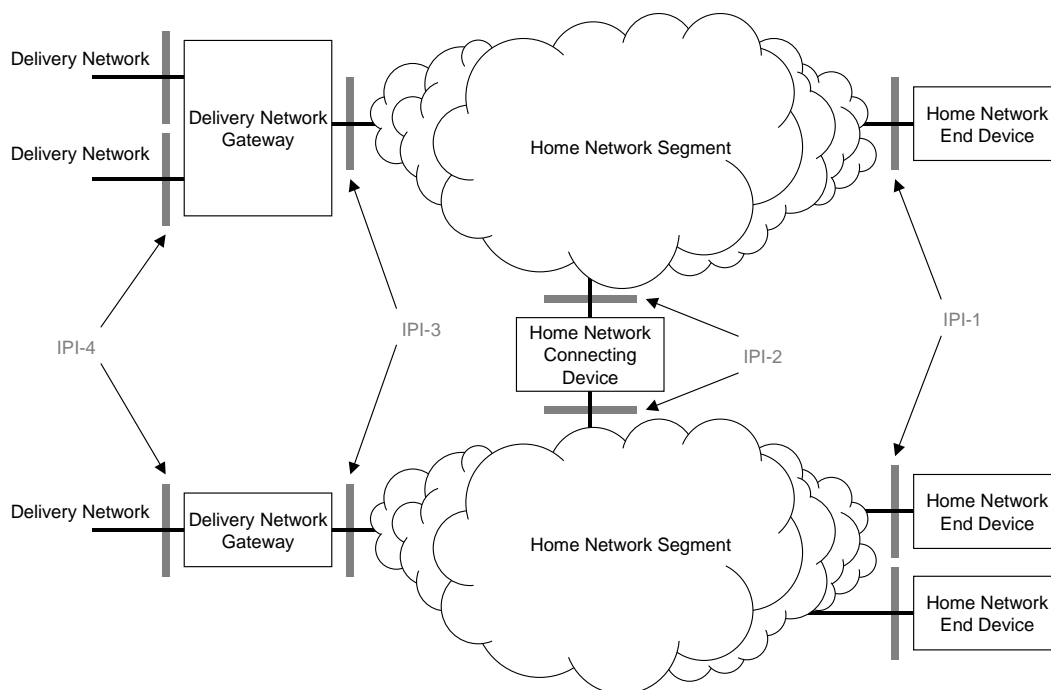
ALG	Application Level Gateway
AVC	Advanced Video Coding
CRLF	Carriage Return Line Feed
DHCP	Dynamic Host Configuration Protocol
DNG	Digital Network Gateway
DNS	Domain Name System
DSCP	Differentiated Services CodePoint
DSL	Digital Subscriber Line
DTD	Document Type Declaration
DVB	Digital Video Broadcasting

DVBSTP	DVB SD&S Transport Protocol
HNED	Home Network End Device
HNID	Home Network Interconnecting Device
HTTP	Hyper Text Transfer Protocol
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IPI	IP Infrastructure
LAN	Local Area Network
MAC	Medium Access Control
MPEG	Moving Picture Experts Group
NAK/NACK	Negative ACKnowledge
NAT	Network Address Translation
RAM	Random Access Memory
RFC	Request For Comments
RTP	Real-time Transport Protocol
RTSP	Real Time Streaming Protocol
SD&S	Service Discovery and Selection
SI	Service Information
SRV	Service, specific DNS RR
SSL	Secure Socket Layer
TS	Transport Stream
UDP	User Datagram Protocol
XML	eXtensible Markup Language

## 4 Background to the scenarios

This clause will show how it is possible to have several HNEDs in a home, and which restrictions may apply.

Figure 1 is the Home Reference Model of the DVB-IPI phase 1, copied from TS 102 034 [1] clause 4.1.2.



**Figure 1: Home Reference Model (from TS 102 034 [1])**

Figure 1 shows a complete home network system, however, the Handbook only specifies the IPI-1 interface at the HNED (Home Network End Device). While it is not obvious, specifying the IPI-1 interface also specifies the characteristics of the Home Network Segment between the HNED and the DNG, and in some cases what the DNG must deliver.

The Handbook also attempts to remain position independent of where particular servers need to reside, for example the DHCP server. This means that no protocol was defined to operate solely on the home network segment. It also means that operation of one HNED is completely independent of another.

The IPI Handbook has not defined yet the interface IPI-2 so any routing or translation scenario was deliberately ruled outside of Phase 1 of the Handbook. This does mean that you can have many HNEDs connected to a single DNG, but that multiple DNGs connected on the same network segment and variations thereof are not allowed.

---

## 5 Turning on and booting an HNED

The best way to describe how the IPI Handbook can be used is to go through what happens when you turn on an HNED. There are a number of steps in order to have:

- physical/MAC Layer Connection;
- IP Layer connectivity via obtaining an IP Address;
- network provisioning (optional);
- connection to the SD&S servers;
- content selection;
- streaming of the video content.

Network provisioning is optional and is dealt with in a separate clause.

### 5.1 Physical/MAC layer connection

The physical/MAC layers consist of either 100 Mbps Ethernet or IEEE 1394 [5], and the link layer needs to come up before anything else happens. The only variation on plain vanilla Ethernet, for example, is the mandatory use of IEEE 802.1D [6] user priority values and the corresponding IP DSCP markings. These can be used by the rest of the network to help obtain the Quality of Service required for the streamed video content.

### 5.2 IP Layer connectivity via obtaining an IP Address

Once the link layer comes up, the HNED obtains the IP address from a DHCP server with the DVB mandatory DHCP options. The Handbook specifies the minimum DHCP options required to allow the DHCP server to be simple enough to fit into a DNG or other product on the home network segment.

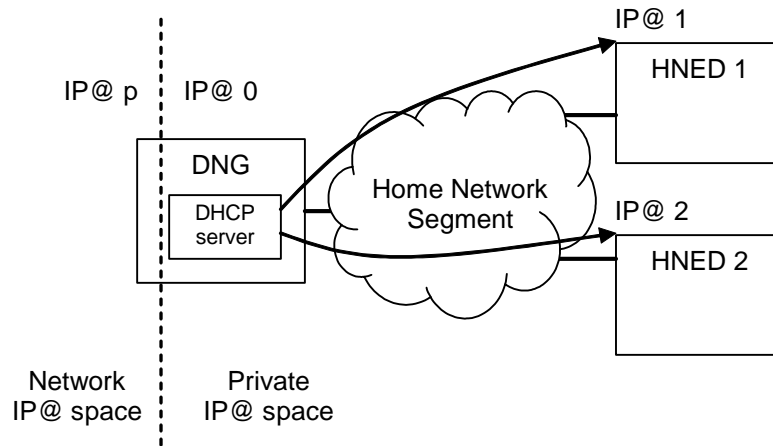
DHCP does not currently specify a way to co-ordinate the address pools of multiple DHCP servers on a network. The DHCP client simply takes the first address offered to it but, normally, the closest available server. This means that multiple DHCP servers cannot be used on the same network to serve the HNED.

The IP address assigned by the DHCP server will be different for each HNED on the same home network segment, but will be part of the same IP subnet. The use of private or public IP address space and size of the subnet mask is at the discretion of the Network Service Provider.

Whilst the IPI specification proposes two ways for HNEDs to get an IP address: DHCP server or via RFC 3927 [3] (IETF zero configuration mechanism), DHCP server is the normal way. It is expected that the RFC 3927 [3] is only to be used in emergency where the DHCP server is down for some short-term reason.

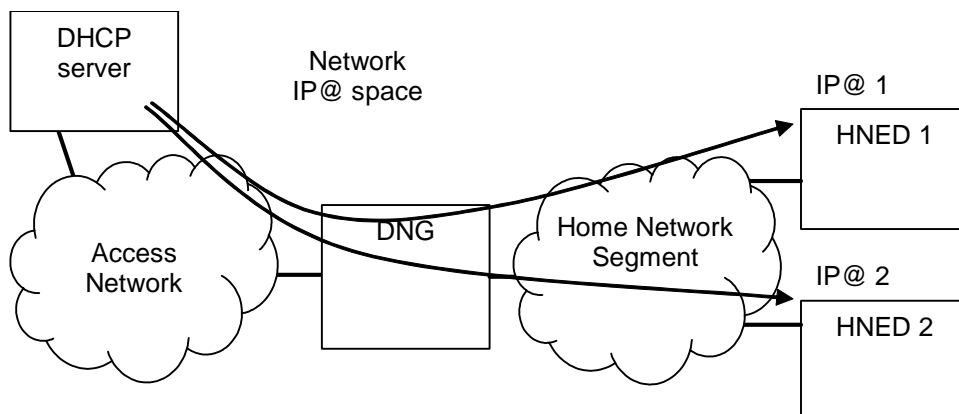
### 5.2.1 Location of the DHCP server

The DHCP server can be located in the home or in the access network. If it is in the home, it will likely be on the DNG, a scenario typical of DSL. The most popular means of address assignment is to have the home in a private IP address space whilst the public interface has an IP address given by the network operator. The DNG uses Network Address Translation to change the IP addresses of the data from public to/from private address spaces.



**Figure 2: Home Network with local DHCP server**

The DHCP server can be located on the external network, typical of a cable or Ethernet to the Home deployment. The DNG then acts as a bridge or DHCP "relay" to relay the DHCP messages to the external DHCP server. You should be aware that the DVB Class options must be preserved in this case.



**Figure 3: Home Network with remote DHCP server**

### 5.2.2 Adding a new DHCP Class option

The DHCP Class IDs defined in the Handbook are the minimum set needed to support the types of HNEDs originally supported in the commercial and technical requirements. The Handbook allows these attributes to be added to by any DVB member.

The Class ID is meant to help the DHCP server give the appropriate IP address for the type of HNED. It is an insecure method but, for example, will allow a DHCP server to give a private address to one type of HNED and a public one to another. It should not be manufacturer specific.

Following is the procedure to add a new attribute:

- 1) Contact the DVB Project Office via the web site or email with the following information:
  - name of the Class ID;
  - company name;



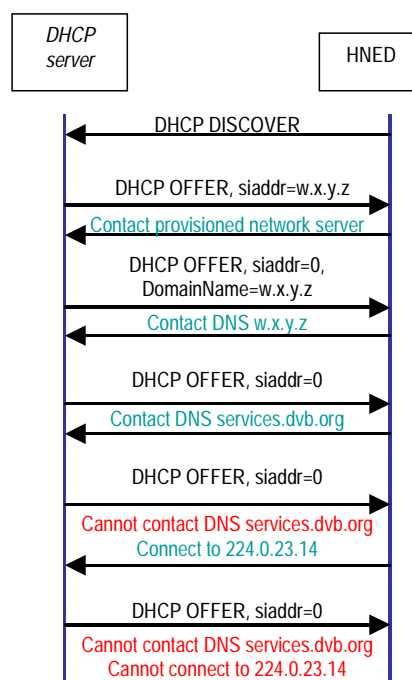
contact name, email address and phone number of the legal representative who is the signatory to the request;  
 contact name, email address and phone number of the technical representative for the request;  
 technical and commercial motivation for the request

- 2) The DVB Project Office will optionally contact the company.
- 3) The DVB Project Office will then notify the technical and legal representative of their decision.
- 4) If the decision is positive then the class ID will be published on the DVB web site and, if possible, in the next maintenance revision of the Handbook.

## 5.3 Content discovery

Now that the HNEDs have their IP address, they start looking for the SD&S servers(s) to retrieve the service lists, see figure 4.

1. DHCP server sets the *siaddr* field for network provisioning  
 => SD&S Entry Point Provisioned (see Network Provisioning)
2. DHCP server has *siaddr*=0 but sets the *Domain Name* option  
 => DNS SRV to the servers in the Domain Name Option
3. DHCP server has *siaddr*=0 and gives no *Domain Name*  
 => DNS SRV to the default server « services.dvb.org »
4. No server can be contacted  
 => HNED connects to the multicast address 224.0.23.14
5. Nothing has worked  
 => user configures manually the SD&S address



**Figure 4: SD&S server Entry Point Discovery order**

Once one of the ways of selecting the Service Discovery entry points has been chosen, the HNED knows the entry points and can access the SD&S server either in multicast or unicast way. For each entry point, the HNED collects the Service Provider Discovery information.

The Service Provider Discovery Information may be (according to the IP address class of the Service Discovery entry point):

- **Multicast (Push model):** The HNED sends an IGMP Report request to a multicast address in order to subscribe to this multicast group. The content of the "Provider" XML file is carried by the **DVBSTP** protocol with a payload id value set to 0x01 (see table 1: Payload ID values of TS 102 034 [1]).
- Retrieved on **request (Pull model)**. In this case, the HNED sends a **HTTP request**:

```
'GET /dvb/sdns/sp_discovery?id=ALL HTTP/1.1' CRLF
'Host: ' host CRLF
or
```

```
'GET /dvb/sdns/sp_discovery?id=DomainName HTTP/1.1' CRLF
'Host: ' host CRLF
```

Both models are supported.

The HNED gets thus the Service Providers' list and their Push or Pull offers. The HNED selects the **Push** (Multicast IP address (IGMP), content of XML file carried by DVBSTP) or **Pull** (in this case, it is done through a HTTP request) offers of its Service Provider.

For information, the Payload ID values of the different SD&S services are shown on table 1 of TS 102 034 [1].

### 5.3.1 Content discovery with local DHCP server

The number of mechanisms reflects the different topologies of the service provider and in-home networks, and DNGs. For example, current DSL providers use DNGs with DHCP servers that sometimes do not support network provisioning or the DHCP Domain Name option, so it is possible that the DHCP server in the DNG in the home will not support steps 1 and 2.

However, the *giaddr* field will be set (it indicates the IP address of the gateway device). This means that with basic NAT feature on the gateway device, step 3 can be performed. The HNED can connect to the default DVB server (HNED 1 in the following figure), or better directly to a specific provider (HNED 2 - this happens when the HNED is coming from the content provider, so it knows the address of its server).

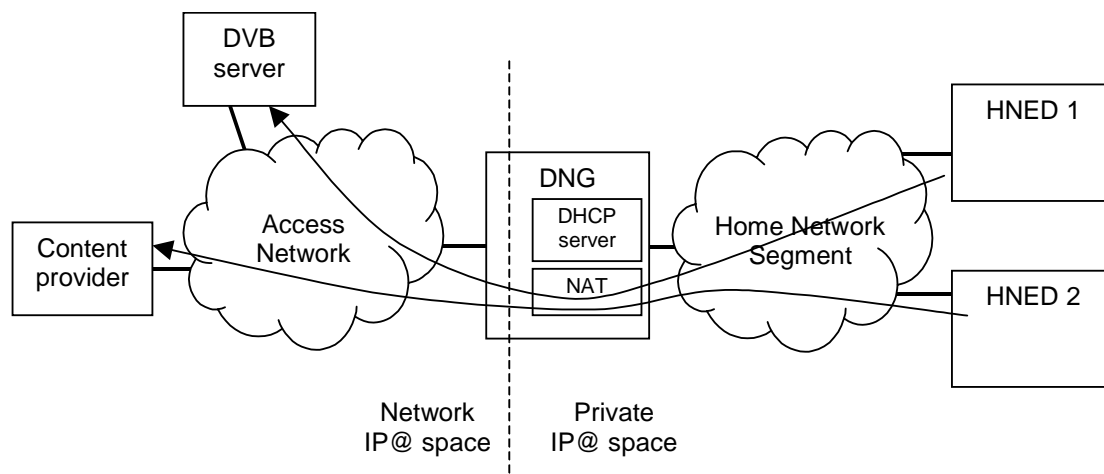
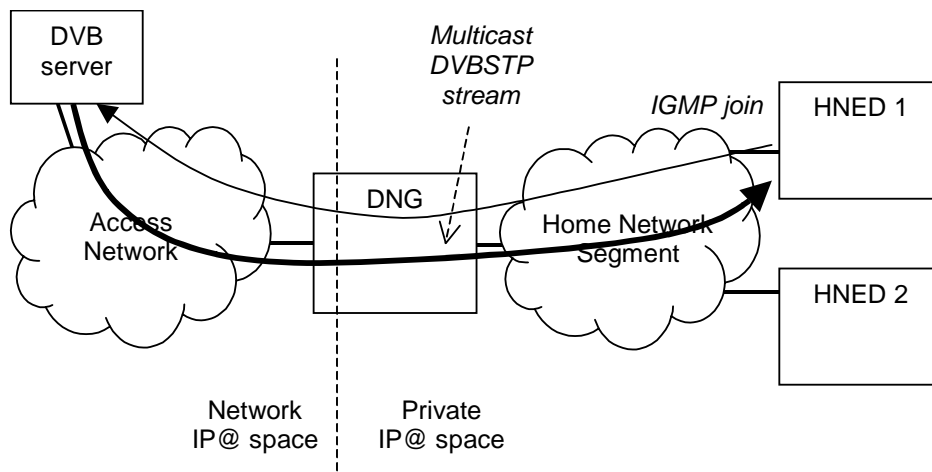


Figure 5: Content discovery with DHCP server

### 5.3.2 Content discovery without DHCP server

Whilst an HNED without a corresponding DHCP server is an abnormal situation, HNEDs can retrieve the service lists. This is by using the DVB assigned multicast address (step 4 in figure 4). If the DNG forwards the IGMP messages from the HNEDs (this is a broadcast message on the Home Network Segment, so the gateway will receive it), and provided that the DNG forwards incoming multicast packets from the access network into the home, then the DVBSTP stream can be received by the HNED. It will then build the service list based on the content of this stream.



**Figure 6: Content discovery without DHCP server**

**NOTE:** This solution may work for Live Content only. Live Content may require only an IGMP message to get the Live TV multicast stream, without RTSP protocol. Content on Demand will not be possible because it requires RTSP, and the HNED does not know where to send the RTSP message (no gateway identified).

## 5.4 Content selection

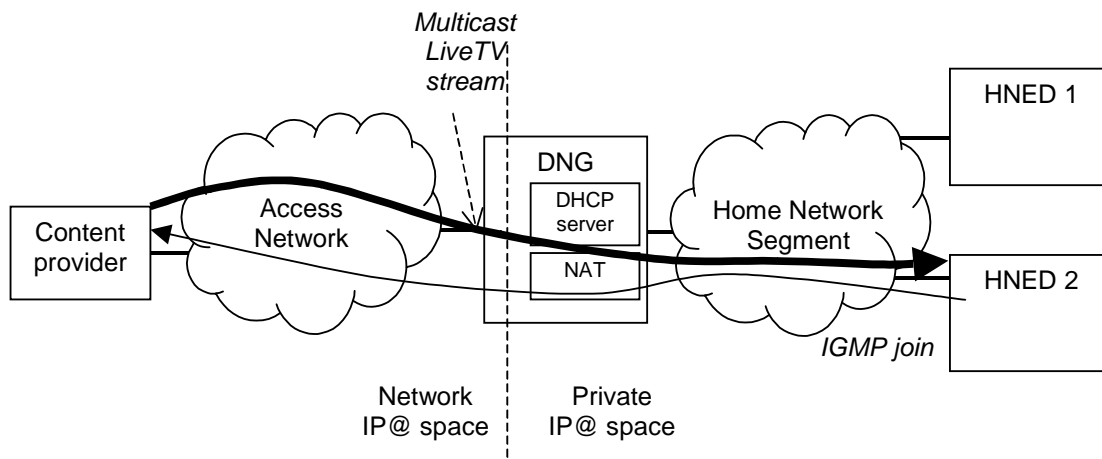
With DVB IPI phase 1, there are basically three ways to access content:

- multicast stream selection only;
- multicast stream selection plus RTSP;
- unicast stream with RTSP.

The first 2 are for live TV content while the latter is for content on demand or Media Broadcast with Trick Modes services. For Live TV, the RTSP messages are not mandatory; it is perfectly possible for the HNED to just join the corresponding multicast group.

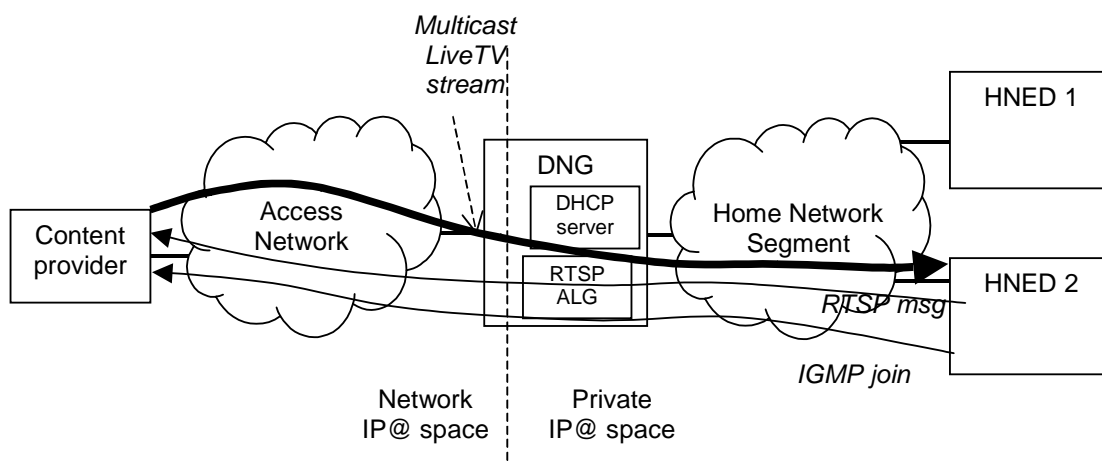
### 5.4.1 DHCP server within the home

The multicast join message is sent on the HN, and the gateway forwards it to the access network. Thus the Live TV stream can be received by the HNED.



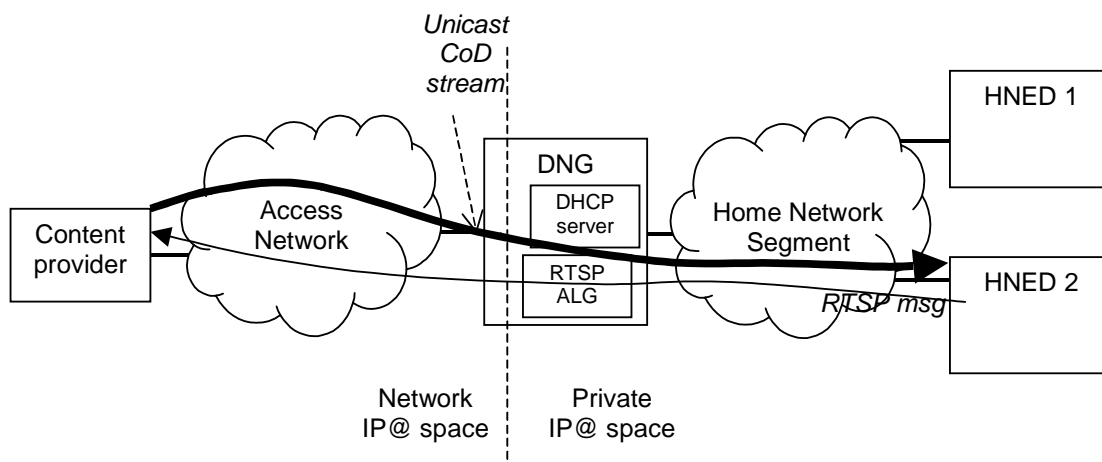
**Figure 7: IGMP live content selection with DHCP server**

If the RTSP protocol is used, the gateway needs to provide RTSP ALG (Application Level Gateway) feature: this ALG is replacing into the RTSP message payload the values of the IP address and UDP port given by the HNED by the public IP address of the gateway and an available UDP port. This RTSP message will be sent before doing the multicast join.



**Figure 8: RTSP live content selection with DHCP server**

Finally, in case of unicast streaming, no multicast join is necessary but the gateway still needs its RTSP ALG feature.



**Figure 9: Content on Demand selection**

### 5.4.2 No DHCP server

The only possibility with this configuration is to connect to a LiveTV stream without RTSP protocol. The IGMP join message has to be forwarded by the gateway to the access network, so the HNED will be able to receive this stream.

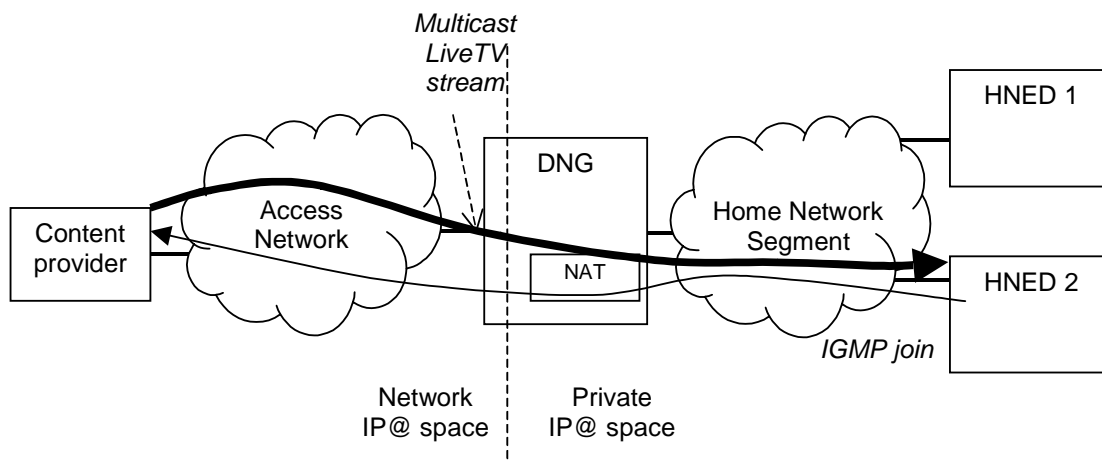


Figure 10: Live content selection without DHCP server

## 5.5 Streaming the video content

The video content uses an MPEG-2 transport stream, as defined in TR 101 154 [2], which is then encapsulated in RTP.

Multicast Content Services use IGMP version 3 with Source Specific Multicast. This allows significant scalability and implementers should note that the previous version of IGMP is not allowed.

## 5.6 Acquisition of Live Channels services

The acquisition of Live Channels services is performed through the retrieval of the content of the "Package" and "Broadcast" files.

If there is a Package service, the HNED can collect (via Push or Pull mode) the "service names" of the channels composing its bouquet.

Then, the HNED can access (via Push or Pull mode) the XML file that contains the BroadcastDiscovery structure.

For the Broadcast Discovery Information Record, there are two modes:

- "TS Full SI" (SD&S + DVB-SI).  
It provides only the necessary SD&S information to find available live media broadcast services which have embedded SI. Information on individual services is afterwards acquired from the transport stream itself through classical use of service information as defined in DVB-SI.
- "TS Optional SI" (only SD&S).  
It provides all the necessary SD&S information to create a list of available services with sufficient information for the user to make a choice and gives the necessary information on how to access the service.

In the following part, we consider the "TS Optional SI" mode.

At this step, the HNEF has collected the XML file that contains the BroadcastDiscovery structure. The HNEF can get in this file the information to access the different channels composing its bouquet.

A Live TV service may be accessed by an individual HNEF in the following ways:

- Using **IGMP** (Internet Group Management Protocol):  
In this case, the HNEF has collected a Multicast IP address for this Live TV service. To display this Live TV channel, the HNEF sends an IGMP Report request to this Multicast IP address in order to subscribe to this multicast group.
- Using **RTSP** (Real Time Streaming Protocol):  
About the use of RTSP, see clause 6 of TS 102 034 [1].

For an example of a "Package" file and a "Broadcast" file, see clause 6.

## 6 Sample complete SD&S XML file

As an example, the "Provider" file below contains 2 service providers: "Provider1" and "Provider2". Each provider proposes 2 services: a Package service (Payload ID value=5) and a Broadcast service (Payload ID value=2).

	Provider1	Provider2
Services	Package (Payload ID value=5)	Package (Payload ID value=5)
	Broadcast (Payload ID value=2)	Broadcast (Payload ID value=2)

```
<?xml version="1.0" encoding="UTF-8"?>
<ServiceDiscovery xmlns="urn:dvb:ipisdns:2003" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:dvb:ipisdns:2003 ipisdns-pl-v1-0-0.xsd">
  <ServiceProviderDiscovery>
    <ServiceProvider DomainName="provider1.com" LogoURI="0" Version="0">
      <Name Language="ENG">Provider1</Name>
      <Description Language="ENG">Provider1 ADSL TV Offer</Description>
      <Offering>
        <Push Address="224.1.1.5" Port="1234" Source="192.100.100.70">
          <PayloadId Id="5">
            <Segment ID="0" Version="0"/>
          </PayloadId>
        </Push>
        <Push Address="224.1.1.2" Port="1234" Source="192.100.100.70">
          <PayloadId Id="2">
            <Segment ID="0" Version="0"/>
          </PayloadId>
        </Push>
      </Offering>
    </ServiceProvider>
    <ServiceProvider DomainName="provider2.com" LogoURI="0" Version="0">
      <Name Language="ENG">Provider2</Name>
      <Description Language="ENG">Provider2 ADSL TV Offer</Description>
      <Offering>
        <Push Address="224.1.1.6" Port="1234" Source="192.100.100.75">
          <PayloadId Id="5">
            <Segment ID="0" Version="0"/>
          </PayloadId>
        </Push>
        <Push Address="224.1.1.3" Port="1234" Source="192.100.100.75">
          <PayloadId Id="2">
            <Segment ID="0" Version="0"/>
          </PayloadId>
        </Push>
      </Offering>
    </ServiceProvider>
  </ServiceProviderDiscovery>
</ServiceDiscovery>
```

As an example, the "Package" file below corresponds to the "Provider1". For this service provider, 2 bouquets are proposed: "Provider1 Bouquet1" and "Provider1 Bouquet2". The bouquet "Provider1 Bouquet1" contains the channels "Channel2", "Channel3" and "Channel5". The bouquet "Provider1 Bouquet2" contains the channels "Channel7", "Channel8" and "Channel9".

	Provider1 Bouquet1	Provider1 Bouquet2
Channels	Channel 2	Channel 7
	Channel 3	Channel 8
	Channel 5	Channel 9

```
<?xml version="1.0" encoding="UTF-8"?>
<ServiceDiscovery xmlns="urn:dvb:ipisdns:2003" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:dvb:ipisdns:2003 ipisdns-pl-v1-0-0.xsd">
  <PackageDiscovery DomainName="provider1.com" Version="0">
    <Package Id="1">
      <PackageName Language="ENG">Provider1 Bouquet1</PackageName>
      <Service>
        <TextualID ServiceName="Channel2"/>
      </Service>
      <Service>
        <TextualID ServiceName="Channel3"/>
      </Service>
      <Service>
        <TextualID ServiceName="Channel5"/>
      </Service>
    </Package>
    <Package Id="2">
      <PackageName Language="ENG">Provider1 Bouquet2</PackageName>
      <Service>
        <TextualID ServiceName="Channel7"/>
      </Service>
      <Service>
        <TextualID ServiceName="Channel8"/>
      </Service>
      <Service>
        <TextualID ServiceName="Channel9"/>
      </Service>
    </Package>
  </PackageDiscovery>
</ServiceDiscovery>
```

As an example, the "Broadcast" file below corresponds to the "Provider1".

	Provider1
Channels	Channel 2
	Channel 3
	Channel 5
	Channel 7
	Channel 8
	Channel 9

```
<?xml version="1.0" encoding="UTF-8"?>
<ServiceDiscovery xmlns="urn:dvb:ipisdns:2003" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:dvb:ipisdns:2003 ipisdns-pl-v1-0-0.xsd">
  <BroadcastDiscovery DomainName="provider1.com" Version="0">
    <ServiceList>
      <SingleService>
        <ServiceLocation>
          <IPMulticastAddress Address="224.111.1.12" Port="8208" Source="192.100.100.50"/>
        </ServiceLocation>
        <TextualIdentifier DomainName="provider1.com" ServiceName="Channel2"/>
        <DVBTriplet OrigNetId="0" ServiceId="5002" TSId="202"/>
        <MaxBitrate>4</MaxBitrate>
      </SingleService>
      <SingleService>
        <ServiceLocation>
          <IPMulticastAddress Address="224.111.1.13" Port="8208" Source="192.100.100.50"/>
        </ServiceLocation>
      </SingleService>
    </ServiceList>
  </BroadcastDiscovery>
</ServiceDiscovery>
```

```

    <TextualIdentifier DomainName="provider1.com" ServiceName="Channel3" />
    <DVBTriplet OrigNetId="0" ServiceId="5003" TSId="203" />
    <MaxBitrate>4</MaxBitrate>
  </SingleService>
</ServiceList>
<ServiceList>
  <ServiceLocation>
    <IPMulticastAddress Address="224.111.1.15" Port="8208" Source="192.100.100.50" />
  </ServiceLocation>
  <TextualIdentifier DomainName="provider1.com" ServiceName="Channel5" />
  <DVBTriplet OrigNetId="0" ServiceId="5005" TSId="205" />
  <MaxBitrate>4</MaxBitrate>
</SingleService>
</ServiceList>
<ServiceList>
  <ServiceLocation>
    <IPMulticastAddress Address="224.111.1.27" Port="8208" Source="192.100.100.50" />
  </ServiceLocation>
  <TextualIdentifier DomainName="provider1.com" ServiceName="Channel7" />
  <DVBTriplet OrigNetId="0" ServiceId="5007" TSId="207" />
  <MaxBitrate>4</MaxBitrate>
</SingleService>
</ServiceList>
<ServiceList>
  <ServiceLocation>
    <IPMulticastAddress Address="224.111.1.28" Port="8208" Source="192.100.100.50" />
  </ServiceLocation>
  <TextualIdentifier DomainName="provider1.com" ServiceName="Channel8" />
  <DVBTriplet OrigNetId="0" ServiceId="5008" TSId="208" />
  <MaxBitrate>4</MaxBitrate>
</SingleService>
</ServiceList>
<ServiceList>
  <ServiceLocation>
    <IPMulticastAddress Address="224.111.1.29" Port="8208" Source="192.100.100.50" />
  </ServiceLocation>
  <TextualIdentifier DomainName="provider1.com" ServiceName="Channel9" />
  <DVBTriplet OrigNetId="0" ServiceId="5009" TSId="209" />
  <MaxBitrate>4</MaxBitrate>
</SingleService>
</ServiceList>
</BroadcastDiscovery>
</ServiceDiscovery>

```

As an example, the "Package" file below corresponds to the "Provider2". For this service provider, only one bouquet is proposed: "Provider2 Bouquet". The bouquet "Provider2 Bouquet" contains the channels "Channel15", "Channel16", "Channel17" and "Channel18".

Provider2 Bouquet	
<b>Channels</b>	Channel 15
	Channel 16
	Channel 17
	Channel 18

```

<?xml version="1.0" encoding="UTF-8"?>
<ServiceDiscovery xmlns="urn:dvb:ipisdns:2003" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:dvb:ipisdns:2003 ipisdns-pl-v1-0-0.xsd">
  <PackageDiscovery DomainName="provider2.com" Version="0">
    <Package Id="3">
      <PackageName Language="ENG">Provider2 Bouquet</PackageName>
      <Service>
        <TextualID ServiceName="Channel 15" />
      </Service>
      <Service>
        <TextualID ServiceName="Channel 16" />
      </Service>
      <Service>
        <TextualID ServiceName="Channel 17" />
      </Service>
      <Service>
        <TextualID ServiceName="Channel 18" />
      </Service>
    </Package>
  </PackageDiscovery>
</ServiceDiscovery>

```



```

</Package>
</PackageDiscovery>
</ServiceDiscovery>

```

As an example, the "Broadcast" file below corresponds to the "Provider2".

	<b>Provider2</b>
	Channel 15
	Channel 16
<b>Channels</b>	Channel 17
	Channel 18

```

<?xml version="1.0" encoding="UTF-8"?>
<ServiceDiscovery xmlns="urn:dvb:ipisdns:2003" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:dvb:ipisdns:2003 ipisdns-pl-v1-0-0.xsd">
  <BroadcastDiscovery DomainName="provider2.com" Version="0">
    <ServiceList>
      <SingleService>
        <ServiceLocation>
          <IPMulticastAddress Address="224.222.2.15" Port="8208" Source="192.100.100.20"/>
        </ServiceLocation>
        <TextualIdentifier DomainName="provider2.com" ServiceName="Channel 15"/>
        <DVBTriplet OrigNetId="0" ServiceId="6001" TSId="5"/>
        <MaxBitrate>4</MaxBitrate>
      </SingleService>
      <SingleService>
        <ServiceLocation>
          <IPMulticastAddress Address="224.222.2.16" Port="8208" Source="192.100.100.20"/>
        </ServiceLocation>
        <TextualIdentifier DomainName="provider2.com" ServiceName="Channel 16"/>
        <DVBTriplet OrigNetId="0" ServiceId="6002" TSId="6"/>
        <MaxBitrate>4</MaxBitrate>
      </SingleService>
      <SingleService>
        <ServiceLocation>
          <IPMulticastAddress Address="224.222.2.17" Port="8208" Source="192.100.100.20"/>
        </ServiceLocation>
        <TextualIdentifier DomainName="provider2.com" ServiceName="Channel 17"/>
        <DVBTriplet OrigNetId="0" ServiceId="6003" TSId="7"/>
        <MaxBitrate>4</MaxBitrate>
      </SingleService>
      <SingleService>
        <ServiceLocation>
          <IPMulticastAddress Address="224.222.2.18" Port="8208" Source="192.100.100.20"/>
        </ServiceLocation>
        <TextualIdentifier DomainName="provider2.com" ServiceName="Channel 18"/>
        <DVBTriplet OrigNetId="0" ServiceId="6004" TSId="8"/>
        <MaxBitrate>4</MaxBitrate>
      </SingleService>
    </ServiceList>
  </BroadcastDiscovery>
</ServiceDiscovery>

```

## 7 Network management and provisioning

Network provisioning is optional in TS 102 034 [1], but for those implementers that wish to use it, this clause gives an overview and help in constructing both the client and server side of the system.

### 7.1 Overview

One of the commercial aims of TS 102 034 [1] is for the HNEP to be bought by a person in a retail store, bring it home, plug it in and then be able to quickly view entertainment. The technical group believed that one way to meet this commercial requirement was to automatically provision the HNEP using remote servers and back-office systems.

### 7.1.1 What is network provisioning meant to solve?

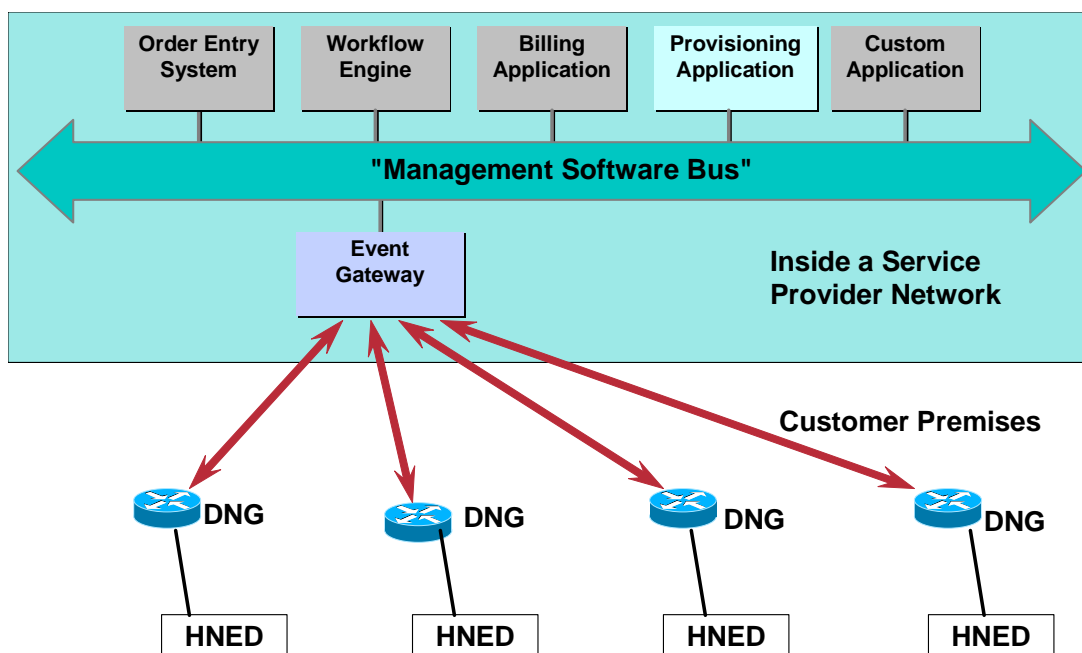
If we look at the specifics of the commercial aim and translate them into steps the user would do manually, we get a flow something like:

- 1) customer buys HNED in local electronics store;
- 2) customer connects the HNED to their home DNG and powers the HNED on;
- 3) the unit starts up with a default configuration and gets onto the Service Provider network;
- 4) customer then tells Service Provider the type of box and other information chooses services that they want, billing etc. Verified by billing server etc.;
- 5) The new services require a new configuration, perhaps even new software.

When you look at this technically this is significantly more complex because the network needs to detect a new box, (e.g. take an inventory, provision and reprovision the HNED) and then monitor the HNED for any problems. This is what Network Provisioning and Management was specifically designed to provide.

### 7.1.2 What does a service provider management system need to do?

If we look inside a typical service provider management system you get something as in figure 11.



**Figure 11: Service Provider Management System overview**

A service provider management system has many systems for order entry, billing and provisioning all linked together in some way perhaps by a "Management Software Bus" so that when a customer orders a new service it is reflected in all internal systems. In the IPI case, we assume that the HNED provisioning application is linked to these systems so that when a customer chooses a new service, it is reflected in a new configuration made by the "Provisioning Application" which then pushes it to the DNG via the "Event Gateway".

The Event Gateway is the umbilical link between the HNED and the Network Provisioning and Management. It is designed to be scalable to millions of subscribers using standard Internet XML over HTTP/HTTPS technology, where similar techniques have been used successfully. The only component that the service providers needs additionally to network provision and manage the HNEDs is that box. The specification of the Event Gateway is not included in the IPI specification, however, the protocol defines what is expected in replies to the HNED.

## 7.2 Key components

The key components of the system are the Event Gateway, the Event Agent, Configuration Agent and Inventory Agent as shown in figure 12.

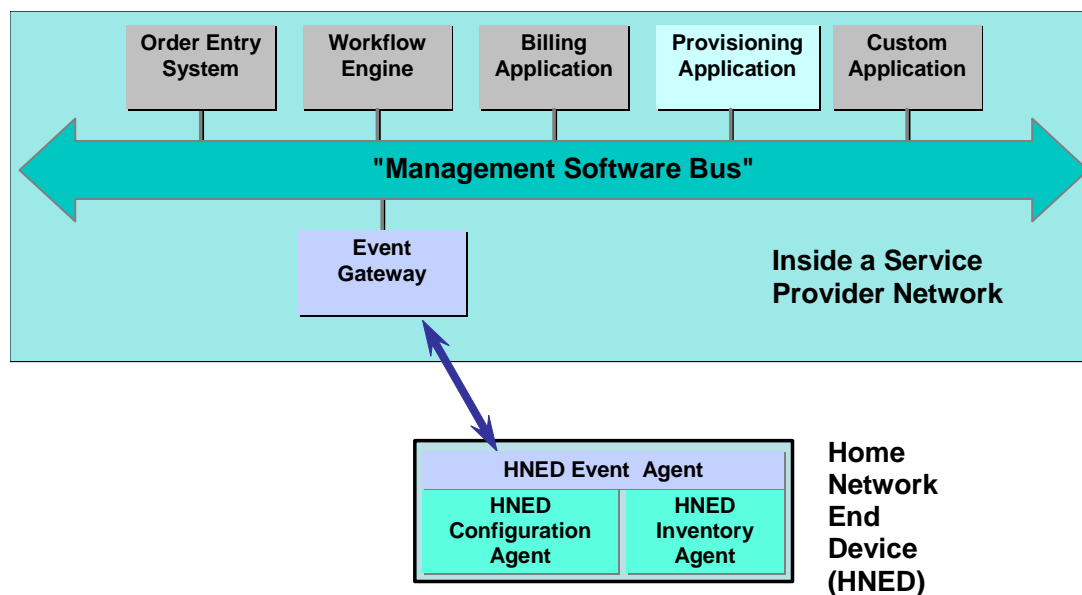


Figure 12: Management System components

### 7.2.1 Event Gateway

The Event Gateway lies in the Service Provider network and needs to:

- send configurations;
- send events;
- receive inventories;
- receive configurations;
- receive status;
- receive and react to events.

### 7.2.2 Event Agent

The Event Agent manages communications with the Event Gateway. It performs the following functions:

- ensures reliable message delivery;
- encrypts the messages (SSL);
- provides an Event API for other agents;
- delivers received events to the appropriate agent;
- forwards other agent events to the Event Gateway;
- fails over to a secondary Event Gateway if it detects the gateway or link to be down.

### 7.2.3 Configuration Agent

The Configuration Agent manages the network configuration of HNED. It performs the functions:

- receives configuration commands from the Event Agent;
- applies the configuration commands to the HNED;
- synchronizes configuration changes;
- encrypts the configuration (SSL);
- reports configuration on request;
- reports configuration changes as they occur.

### 7.2.4 Inventory Agent

The Inventory Agent manages the list of components and add-ins of the HNED, for example, software version number, plug-in cards etc. It performs the following functions:

- reports inventory on request;
- reports inventory changes when detected;
- reports status on request;
- reports status changes when detected.

## 7.3 DHCP address to configuration flow

The whole boot sequence, from start-up to service discovery, is described in clause 5, but as network provisioning is optional, we will describe what happens if network provisioning is used here:

- 1) HNED is powered on and any internal testing performed.
- 2) HNED uses DHCP to obtain an IP address and other information.
- 3) The DHCP server returns a valid IP address in the DHCP next server "*siaddr*" field which means that there is a network provisioning server available. The "*siaddr*" is the IP address of the provisioning server.
- 4) An HTTP GET "*boot*" event should then be sent with the appropriate manufacture's name, HNED flash (read-only) and RAM (read-write) storage.
- 5) The Provisioning Server return a 200 series success status to which assures that the provisioning server is operational and will provision this box. If the status is not returned then (4) is tried according to the congestion avoidance mechanism.
- 6) The Provisioning Server fills in the XML sent with the GET. The key field being the response action:
  - Response action is "none" then the HNED will send a GET "*configure*" event to the provisioning server and begin regular event polling.
  - Response action field is "inventory", "status", "configure", "update" or "boot" then the appropriate actions are performed until the response action is "none" When "none" happens then regular event polling begins.

Regular event polling consists of sending an HTTP GET "*event*" with a time as set in the "*interval*" field of the Configure XML DTD. The events will be processed until the response action field is "*none*" whereupon a new polling interval is started.

## 7.4 Worked example

We will now take the commercial example in clause 7.1.1 and turn it into a worked example of what happens from a technical viewpoint.

- 1) Customer buys HNED in local electronics store.
- 2) Customer connects the HNED to their home DNG (Delivery Network Gateway) and powers the HNED on.
- 3) HNED sends out the standard DHCP DISCOVER message with DVB mandatory DHCP options.
- 4) DHCP Server returns HNED IP Address and other options, and the Event Gateway IP address in *siaddr*.
- 5) HNED sends an HTTP GET to /dvb/boot using the Event Gateway's IP address.
- 6) The Event Gateway receives the message and either it or the Provisioning/Billing Application detects this is a new HNED and user of video. It also uses the manufacturer's name and memory size to decide whether the HNED can be provisioned. We assume that the HNED will be able to be Network Provisioned.

*In this example, the Network Service Provider has made a policy that when a new HNED and user is found then the HNED will use special "initial" configuration. This "initial" configuration typically only allows the HNED to reach very limited services until completion of a form for billing and other customer information.*

- 7) The Event Gateway needs an inventory so that it can send an appropriate initial configuration. It therefore sends the XML event return action as "inventory".
- 8) The HNED replies by sending an HTTP POST to /dvb/inventory with the inventory in XML.
- 9) After the congestion avoidance time and assuming POST success, the HNED sends an HTTP GET "event".
- 10) The Event Gateway replies with the special "initial" configuration, given to it from the provisioning application, with the XML event return event action = "update" and the configuration in the configure section of the returned XML.
- 11) The HNED reconfigures.

*In this example, while parsing the XML the HNED recognizes that a form for billing and other customer information is required, and generates the form. The form or communication protocols with the back office systems in the Network Service Provider are not specified by Network Provisioning, though it is possible to send a URL or other pointer in the initial configuration XML. Once the customer has completed the form and the information verified, the Network Service Provider sends a "final" configuration that allows access to the sets of services.*

*In this example, this final configuration also requires a change of IP address. This requires the help of the DHCP server which we assume is under the command of the Network Service Provider (see clause 5.2 on addressing).*

- 12) First the HNED needs to obtain the new IP address and only then the new reconfiguration. The DHCP Server sends a FORCERENEW message to the HNED (RFC 3203 [4]) and NAKs the DHCP REQUEST.
- 13) The HNED returns to initial DHCP state and sends a standard DHCP DISCOVER message with the mandatory DHCP options. This is the same state as (3) above.
- 14) DHCP Server returns the new HNED IP Address and other options, and, in this example, the same Event Gateway IP address in *siaddr*.
- 15) The new IP address means that the HNED sends an HTTP GET to /dvb/boot using the Event Gateway's IP address.
- 16) The Event Gateway returns an "update" event action with the final configuration.
- 17) The HNED reconfigures to the final configuration.
- 18) The HNED sends an HTTP GET "event" and the Event Gateway replies with an XML event action of "none". Final configuration is complete.
- 19) The HNED now goes back to normal polling where the HNED periodically sends an HTTP GET to /dvb/event. The XML event returns "none" unless the Event Gateway wants some action.

---

## 8 Typical applications available with limitations of the IPI phase 1 Handbook

IPI Phase 1 is a significant step in standardizing entertainment video over IP home network; however, it does not cover all possibilities or areas for standardization. This clause attempts to outline its limitations with the belief that future versions of the standard will overcome the limitations.

The limitations can be broken down into a number of areas:

- video transmission and codecs;
- topology;
- networking addressing and discovery;
- service provisioning;
- network level security;
- operation over different physical networks and Quality of Service;
- DNG/HNED only networks.

### 8.1 Video transmission and codecs

The current version of IPI only addresses an MPEG-2 transport stream with embedded MPEG-2 video codec with the original set of audio codecs. It does not address any of the new codecs such as AVC or the new audio codecs. This is a limitation of both the transport and the service discovery and selection specifications. It also does not address separation of the transport stream into elemental streams or any other carrier other than the MPEG2 transport stream.

The transport over IP is via RTP only. This means that there are some minor limitations to MPTS that means that a single PCR per MPTS should be used.

### 8.2 Topology

The current version of IPI is limited to some simple in-home network topologies given that the HNID (Home Network Interconnecting Device) has not been defined. The topologies are:

- DNG/HNED only networks;
- single segment home networks with single address space and single DHCP server.

These are quite restrictive topologies but simple enough to satisfy the majority of current uses cases. This means that a network consisting of two DNGs in the home must be on independent and unconnected network segments. This means that, for example, a DVB-S box which can deliver a DVB-IPI video stream over Ethernet must be placed on a separate segment from a DSL DNG delivering a video stream.

### 8.3 Networking addressing and discovery

The standard uses DHCP to obtain network addressing and several other pieces of information but the option table is deliberately short to make client implementation simple in the HNED. However the implementation does use the new server message outlined in RFC 3203 [4] "FORCERENEW" which is not usually implemented in most DHCP servers.

The DHCP message also requires a unique identifier so the reuse of MAC addresses by whatever method is not allowed.

The DHCP server non-availability has been designed to be an unusual occurrence so whilst the use of RFC 3927 [3] is recommended in emergency, temporary situations; a DHCP server will be required for an IPI home network to function normally.

## 8.4 Service provisioning

The service provisioning covers initial and some subsequent network level provisioning, however, it does not cover diagnostics.

## 8.5 Network level security

Network level security, for example, denial of service attacks are not covered in TS 102 034 [1].

## 8.6 Operation over different physical networks and Quality of Service

The design of IPI Phase 1 is physical layer independent and relies on the IP network to provide the required quality of service. The IPI specifications are easily met on most wired networks but less so by in-home wireless networks, particularly IEEE 802.11b [8] networks.

Quality of Service is also only signalled by the HNED. There is no enforcement mechanism so in most in-home networks this will result in best-effort service only.

## 8.7 DNG/HNED only networks

The requirement for a combination DNG/HNED e.g. a DSL modem combined with a set-top box, means that phase 1 treats this box as effectively a DNG and outside of the scope of TS 102 034 [1].

However, if this box has any Ethernet or other interface capable of providing a network for example IEEE 802.11a [7], IEEE 802.11b [8] and IEEE 802.11g [9] wireless LAN then it falls under the specification of IPI.

---

## History

<b>Document history</b>		
V1.1.1	November 2006	Publication