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Technical Specification

Digital Video Broadcasting (DVB); Guidelines for the implementation of DVB-IP Phase 1 specifications

European Broadcasting Union — Union Européenne de Radio-Télévision

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Foreword

This Technical Specification (TS) 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).

Please note that the present document is a revision to TR 102 542, and has been converted to a TS because the language used in the document is akin to that of a TS.

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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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.

1 Scope

The present document is designed as a companion document to help implement the DVB-IP Phase 1 version 3: Transport of MPEG2-TS Based DVB Services over IP Based Networks [1], which is referred to as the Handbook. The present document is organized in separate sections in the order of the boot-up sequence of the HNED rather than in the same section structure as the Handbook. Each clause deals with a specific aspect of the DVB-IP technology, and offers explanations and examples not found in the Handbook. Additionally, it provides guidelines to implement the Broadband Content Guide (BCG) specification [3].

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

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

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] ETSI TS 102 034 (V1.3.1): "Digital Video Broadcasting (DVB); Transport of MPEG-2 TS Based DVB Services over IP Based Networks".

[2] ETSI TS 101 154 (V1.8.1): "Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream".

[3] ETSI TS 102 539 (V1.2.1): "Digital Video Broadcasting (DVB); Carriage of Broadband Content Guide (BCG) information over Internet Protocol (IP)".

[4] ETSI TS 102 822-2 (V1.3.1): "Broadcast and On-line Services: Search, select, and rightful use of content on personal storage systems ("TV-Anytime"); Part 2: System description".

[5] ETSI TS 102 822-6-1 (V1.3.1): "Broadcast and On-line Services: Search, select, and rightful use of content on personal storage systems ("TV-Anytime"); Part 6: Delivery of metadata over a bi-directional network; Sub-part 1: Service and transport".

[6] ETSI TS 126 346: "Universal Mobile Telecommunications System (UMTS); Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs (3GPP TS 26.346 Release 7)".

[7] SMPTE Specification 2022-1: "Forward Error Correction for Real-time Video/Audio Transport Over IP Networks".

[8] DVB BlueBooks A109: "DVB-HN (Home Network) Reference Model Phase 1".

[9] ETSI TS 102 323: "Digital Video Broadcasting (DVB); Carriage and signalling of TV-Anytime information in DVB transport streams".

[10] ETSI TS 102 005: "Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in DVB services delivered directly over IP protocols".

2.2 Informative references

[11] IETF RFC 3927: "Dynamic Configuration of IPv4 Link-Local Addresses".

[12] IETF RFC 3203: "DHCP reconfigure extension".

[13] IEEE P802.11-REVma/D6.0, 2006: Unapproved Draft Standard for Information Technology-Telecommunications and information exchange between systems- Local and metropolitan area network- Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications.

NOTE: This document reflects the combining of the 2003 Edition of 802.11 plus the 802.11g, 802.11h, 802.11i and 802.11j Amendments) (Revision of IEEE Std 802.11-1999).

[14] IEEE 802.1d (2004) "IEEE Standard for Local and metropolitan area networks: Media Access Control (MAC) Bridges".

[15] IETF RFC 3376: "Internet Group Management Protocol, Version 3".

[16] IETF RFC 1112: "Host extensions for IP multicasting".

3 Abbreviations

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

ALG	Application Level Gateway
AVC	Advanced Video Coding
BCG	Broadband Content Guide
BiM	Binary MPEG Format for XML
CRLF	Carriage Return Line Feed
DHCP	Dynamic Host Configuration Protocol
DNG	Digital Network Gateway
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
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
LCN	Logical Channel Numbers
MPEG	Moving Picture Experts Group
MPTS	Multi Program Transport Stream
NAK/NACK	Negative ACKnowledge
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
SOAP	Simple Object Access Protocol
SPTS	Single Program Transport Stream
SSL	Secure Socket Layer
TS	Transport Stream
UDP	User Datagram Protocol
XML	eXtensible Markup Language

4 Background to the Scenarios

The following figure shows the Home Reference Model for the DVB-IP phase 1, taken from the Handbook (see [1], clause 4.1.2).

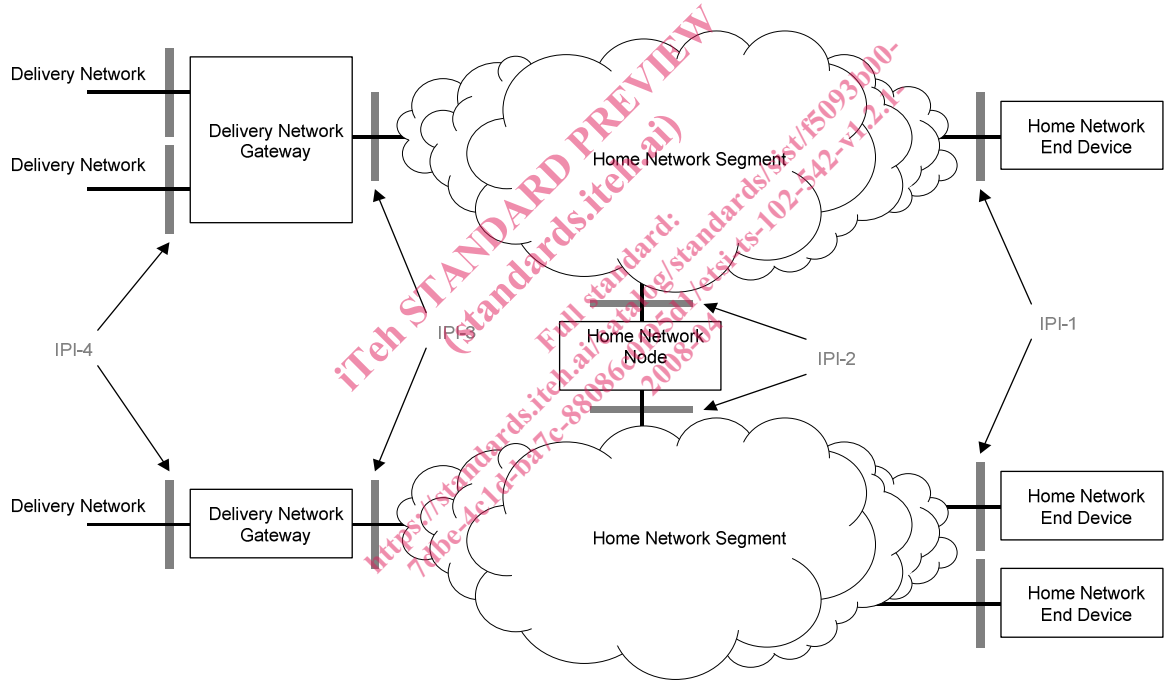

Figure 1: Home Reference Model (from TS 102 034 [1])

Figure 1 and the current version of the DVB-IP Handbook [1] focuses only on the delivery of DVB-IP services over broadband delivery networks. DVB is working on enhanced home networking functionality which will for example allow an end user to access DVB content from several devices in the home. The Home Network Reference Model for this approach is provided in [8]. The protocols and functions to support this Home Network Reference Model will be defined in upcoming specifications and therefore not covered in the current version of the present document

The Handbook only specifies the IPI-1 interface at the HNED (Home Network End Device). However, the specification of the IPI-1 interface also defines characteristics of the Home Network Segment between the HNED and the DNG, and in some cases what the DNG must deliver.

The Handbook intentionally does not attempt to specify where particular servers need to reside, for example the DHCP server. This means that no protocol is defined to operate solely on the home network segment. It also means that operation of one HNED is completely independent of the operation of another HNED in the same Home Network. Although multiple HNEDs in the same Home Network will share IP connectivity, there is no specific protocol defined in the handbook to allow them to exchange messages, or even know about the presence of each other.

The DVB-IP Handbook does not currently define the interface IPI-2 so any routing or translation scenario that may be required for interworking between Home Network Segments is outside of the scope of Phase 1 of the handbook. This means that many HNEDs can be connected to a single DNG, but multiple DNGs connected on the same network segment is not allowed.

5 Turning on and Booting an HNED

The best way to describe how the DVB-IP 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.
- Discovery of BCG information (optional).
- 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 and the link layers need to come up before anything else happens. The DVB-IP handbook requires a IEEE 802 based MAC layer with priority marking according to IEEE 802.1d [14] within the home network segment. These can be used by 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.

NOTE: **zero-configuration mechanism:**
Whilst the DVB-IP specification proposes two ways for HNEDs to get an IP address: DHCP server or via RFC 3927 [11] (IETF zero configuration mechanism), DHCP server is the normal way. It is expected that the RFC 3927 [11] is only to be used in emergency where the DHCP server is down for some short-term reason. Running in zero-conf mode provides none or very little connectivity. Basically, the HNED does not have knowledge of a gateway device to send messages to external servers, so the only possible scenario is to connect to multicast streams (provided the DNG let IGMP messages flow over to the outside): first an SD&S stream then a live TV stream.

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 as shown in figure 2. The DNG uses Network Address Translation to change the IP addresses of the data from public to/from private address spaces.

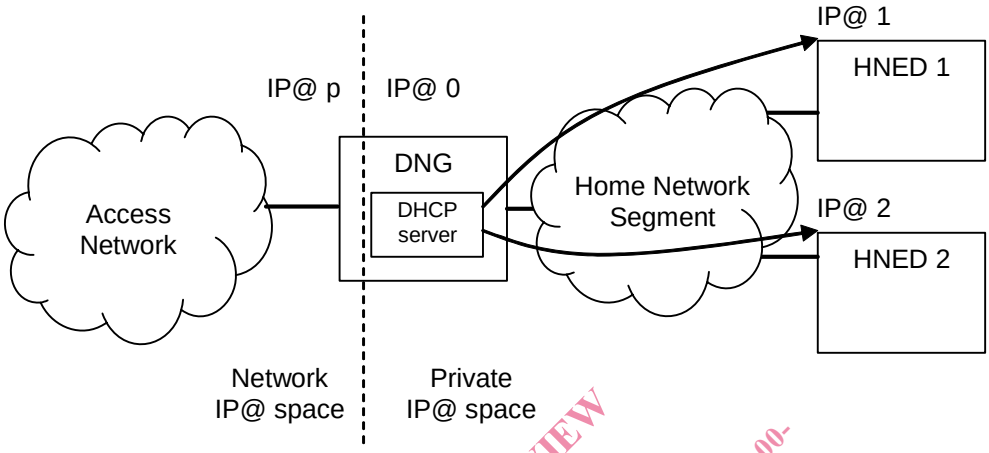

Figure 2: Home Network with local DHCP server

The DHCP server can be located on the external network, typical of some DSL, or most cable or Ethernet to the Home deployments. The DNG then acts as a bridge or DHCP "relay" to relay the DHCP messages to the external DHCP server as shown in figure 3. Please be aware that the DVB Class options must be preserved in this case.

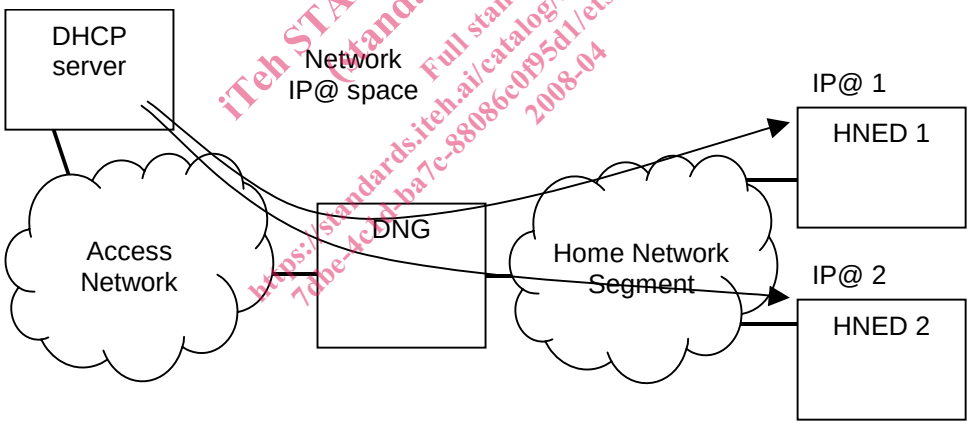

Figure 3: Home Network with remote DHCP server

In order to overcome problems with local DHCP servers and Address Translation, IPTV deployments in DSL networks often connect the HNED to a bridge port of the DNG which directly connects the HNED to the Access Network at the link layer below IP. The HNED is in this case within the IP address space of the Access Network and uses the DHCP server of the Access Network as shown in figure 4. A disadvantage is that the HNED is separate from the Home Network of the user which is connected via routed ports of the DNG.

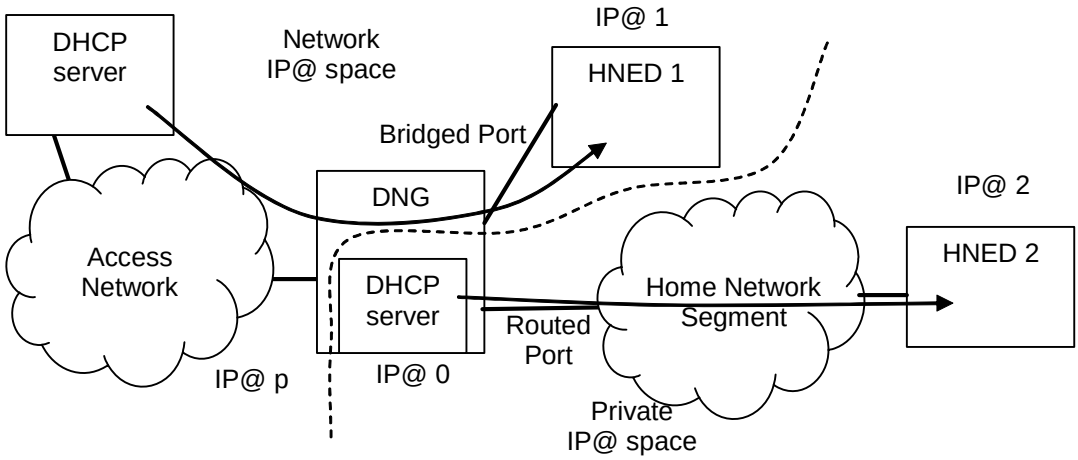

Figure 4: Home Network with remote DHCP server

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 gives 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. Figure 5 shows several ordered steps that a HNED walks through to connect to the service providers.

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

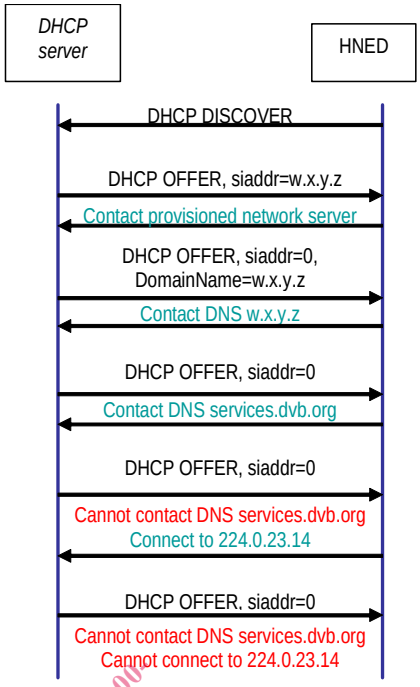

Figure 5: SD&S server Entry Point discovery order

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 figure 6), 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).

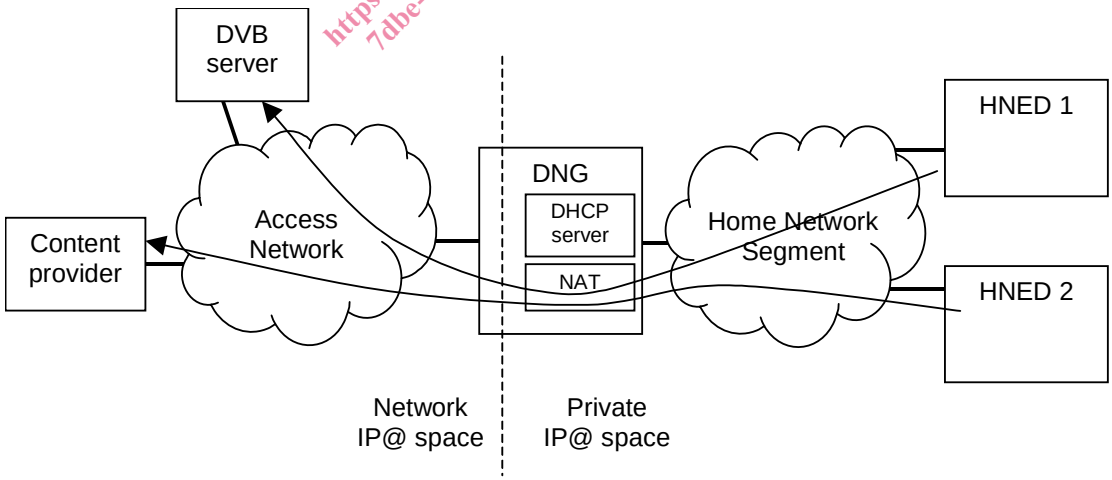

Figure 6: Content discovery with DHCP server