

NorDig-IP – Broadcast of NorDig compliant signals to NorDig compliant IRDs via IP based networks

A whitepaper by NorDig

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1 Introduction

NorDig is an association of the major Nordic broadcasters, operators, and service providers with intent to establish common minimum requirements for broadcasting and reception of digital television and related services for the various broadcast platforms used by NorDig members in the Nordic region (Denmark, Finland, Iceland, Norway and Sweden). The NorDig association was founded in 1997, and has released minimum requirements for IRDs, Test specifications for IRDs and Rules of Operation for the broadcast of NorDig compliant signals. The specifications cover digital television and related services via cable, satellite, terrestrial, and IP based networks and are available from www.nordig.org.

This white paper provides an overview of recommended network configuration for carrying digital television signals to NorDig-IP compliant IRD.

1.1 Document history

revision	date	remarks
1.0	31.10.2005	First release

1.2 Abbreviations

AIT	Application Information Table
BAT	Bouquet Association Table
BER	Bit Error Rate
CA	Conditional Access
CAT	Conditional Access Table
COD	Content On Demand
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Server
DTD	Data Type Definition
DVB	Digital Video Broadcasting
DVB-ASI	DVB Asynchronous Serial Interface
DVBSTP	DVB SD&S Transport Protocol
ECM	Entitlement Control Message
EIT	Event Information Table
EMM	Entitlement Management Message
EPG	Electronic Program Guide
ETSI	European Telecommunication Standardisation Institute
FEC	Forward Error Correction
FTTH	Fiber To The Home
HTTP	Hyper Text Transfer Protocol
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IRD	Integrated Receiver Decoder
iTV	Interactive TV
MHP	Multimedia Home Platform
MPEG	Moving Pictures Expert Group
MPTS	Multiple Program Transport Stream
NIT	Network Information Table
PAT	Program Association Table
PMT	Program Map Table
PSI	Program Specific Information
QEF	Quasi Error Free
RTCP	Real Time Control Protocol
RTP	Real Time Protocol
RTSP	Real Time Streaming Protocol
SD&S	Service Discovery & Selection
SDT	Service Description Table
SPTS	Single Program Transport Stream
STB	Set Top Box

TCP	Transmission Control Protocol
TDT	Time Date Table
TOT	Time Offset Table
TV	Television
UDP	Unified Datagram Protocol
VDSL	Very high-speed Digital Subscriber Line
VOD	Video On Demand
XML	eXtended Markup Language

1.3 References

- [1] TS 102 034, “*Digital Video Broadcasting (DVB): Transport of DVB Services over IP*”, v1.1.1, 2005-03.
- [2] NorDig-IP TV ver. 1.0, “Requirements to NorDig compliant IRDs for IP-based networks”, addendum to the NorDig Unified Requirements (ver. 1.0.2) for Integrated Receivers Decoders for use in cable, satellite, terrestrial and IP-based networks
- [3] EN 300 468, “*Digital Video Broadcasting (DVB): Specification for Service Information (SI) in DVB systems*”, v1.6.1, 2004-11.
- [4] ISO/IEC 13818-1, “*Information technology – Generic coding of moving pictures and associated audio information: Systems*”
- [5] RFC 1889, “*RTP: A Transport Protocol for Real-Time Applications*”
- [6] RFC 2250, “*RTP Payload Format for MPEG1/MPEG2 Video*”
- [7] ISO/IEC 13818-9, “*Information technology – Generic coding of moving pictures and associated audio information - Part 9: Extension for real time interface for system decoders*”
- [8] RFC 2474, “*Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers*”
- [9] RFC 2782, “*A DNS RR for specifying the location of services (DNS SRV)*”

2 Overview

2.1 General characteristics of IP-based networks

Recent developments in the broadband networks market show that there are a multitude of network types, and also a wide variety of technologies being used to implement them. An IPTV network offers broadcasters and service providers yet another network access to potential subscribers. Broadcasters and service providers shall be able to provide content independently of the specific transmission method, meaning that original information from broadcasters can be made available for subscribers in various access networks with unaltered content and user experience.

In particular three main types of IP-based access networks are used for transmission of digital television:

- Fiber-To-The-Home (FTTH)
- CAT5 twisted pair networks
- xDSL networks (in particular VDSL)

As a minimum the access line to each subscriber should be capable of offering a bitrate of 8 – 10 Mbps, allowing for one MPEG-2 (MP@ML) encoded television service along with some capacity for Internet and telephony. As the interest for higher definition television is emerging, the bit rate requirements are even stricter. This is to some extent balanced when new and more efficient encoding standards (i.e. MPEG-4) are introduced. As television is a real-time service, the access networks have to offer adequate quality of service to enable approximately error-free decoding.

In most cases, an IPTV head end receives its signals from satellite. The IPTV head-end may be quite simple, e.g. with a satellite antenna, a content processor and a network adaptation unit, but may also contain additional functions.

In addition to the pure TV related infrastructure, IPTV network operators should also provide administration and provisioning servers¹ (administration of IRDs, software provisioning, etc). Optionally other value-added services may be offered, e.g. Internet access, e-mail, news etc. The head-end may therefore also contain one or more servers and should act as the service aggregation point as well as the network administrative hub. A typical headend is shown in Figure 1.

NorDig has specified requirements for IRDs with cable, satellite, terrestrial and IP-based front-ends. NorDig has also specified common Rules of Operation for NorDig compliant broadcasts, covering the same media (still pending for IP-based networks).

The NorDig specifications are based on DVB specifications/ETSI standards and other open specifications/standards. The IRDs are specified with a common core that is independent of transmission media, allowing content to be distributed over several media while providing the same service at the end-user's receiver equipment.

The NorDig specification for broadcast over IP-based networks is based on the ETSI standard TS 102 034 ("Transport of DVB Services over IP") [1]. On these networks IP is used as the network layer protocol between the head-end and end-user. The IRD is based on a kernel that is identical with the kernel for other broadcast networks, while the physical IP interface is assumed to be Ethernet (the NorDig-IP specification [2] does not specify requirements for the physical layer and data link layer protocols).

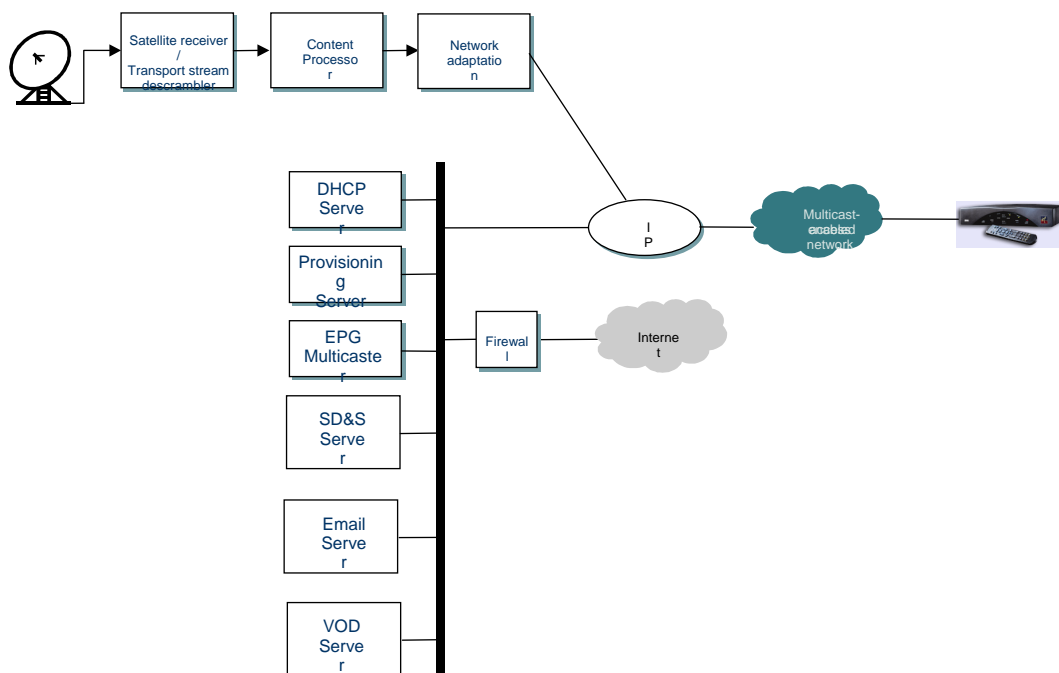


Figure 1: Illustration of typical headend

2.2 Service requirements

The following services will be required in the IPTV networks:

- Broadcast quality television and radio services
- Access to associated program information (i.e. applications and/or information transmitted along and associated with particular TV programs).

In addition the following services are regarded as valuable add-ons in IPTV networks:

- Personalised services like VOD, EPG suited for individual subscriber need, walled garden, etc.

¹ Network Provisioning [1] is optional, but there must be a mechanism for IRD administration (a.o. DHCP). However, these functions may be provided by a different operator.

In order to achieve the subscriber requirements, the MPEG encoding is not altered and MPEG-2 transport stream is used as the transport container for broadcast services. In some cases access networks with very constrained bandwidth will cause an exception to this, e.g. variable bit rate (VBR) signals must be re-encoded to CBR (when accepted by the broadcaster) to suit the characteristics of xDSL lines.

The PSI signalling tables are also transmitted as part of the MPEG-2 transport stream, hence standard chipsets and software filters can be used in IRDs. Further details are provided in following sections.

The main architecture of IP-based networks is outlined in section 2.1, assuming that the broadcast information is brought to the head-end by a NorDig compliant broadcast network (cable, satellite or terrestrial) or as baseband DVB-ASI signals directly from the operator.

The transport streams (MPTS) received from a broadcast network may contain the following types of services and applications:

- Individual television services and corresponding data streams (e.g. associated CA-streams, applications/metadata)
- Services and applications common for the entire broadcast network (e.g. EPG, software bootloader)
- Service Information tables common for all services in the transport stream (e.g. CA-related data)

When relaying the broadcast services into IP-based networks, the following assumptions are made:

- The individual service with associated program service information (PSI) is sent transparently via the IP network to the end-user's IRD, which shall support these data.
 - The PSI includes the tables PAT, PMT, and CAT. Support for these tables with associated data is mandatory for NorDig IRDs. As a consequence, the conditional access system used in the broadcast network can be used in IP-based networks as well.
 - Conditional access data, i.e. ECM and EMM, are retransmitted transparently as reflected by the PMT and CAT.
- Service Information (SI) shall be transmitted to the end-user, either as retransmission of SI-tables (see "TS Full SI" in chapter 4, below) or via alternative transmissions (see "TS Optional SI" in chapter 4, below). Support for "TS Full SI" is mandatory for NorDig IRDs, while support for "TS Optional SI" is recommended.
 - The SI includes the tables SDT, TDT and TOT, which should be transmitted, together with EIT present/following and EIT Schedule, unless available in other forms, as described below. The support of these tables is mandatory for NorDig IRDs.
 - The time and date functions may also be provided via the NTP protocol. However, if TDT/TOT is transmitted, TDT/TOT shall take precedence prior to NTP (the IRD shall support both modes).
 - EIT present/following may be retransmitted transparently whenever the DVB_triplet (original_network_id – transport_stream_id – service_id) remains unchanged. Otherwise the EIT present/following must be regenerated to reflect the new DVB_triplet values.
 - EIT schedule may also be retransmitted whenever present. However, since the EIT schedule stream may occupy several Mbps, it will be more efficient to transmit EIT schedule on a dedicated multicast address rather than to transmit EIT schedule along with a few ordinary services.
 - Both "actual" and "other" subtables (SDT and EIT) may be retransmitted whenever the DVB_triplet is unaltered for the services. Otherwise "actual" and "other" subtables must be regenerated in the head-end to reflect the new DVB_triplet values.
- Network Information tables are not used in the IP-based networks; relevant network information shall be sent via the SD&S-structure, see chapter 4 below. Support for the SD&S-structure is mandatory for NorDig IRDs for IP-networks. Any incoming NIT may thus be ignored by the IRD or removed at the head-end of the IP-network.
- The use of PSI, SI and network/operator related information is specified in [2], chapters 12 and 13.
- Some NorDig specific data, e.g. NorDig bootloader, may be retransmitted transparently. The reference for the NorDig bootloader (contained in the NIT for other broadcast networks) is signalled according to chapter 5.
- Other NorDig specific data, e.g. the NorDig logic_channel_descriptor (ver 2) may be retransmitted via the SD&S structures.

- Service related application(s) data is retransmitted transparently, including the Application Information Table² (AIT) associated with MHP applications.

3 Transmitting DVB services over IP based networks

3.1 Transport stream encapsulation

NorDig-IP compliant IRDs assume DVB services are transmitted according to the DVB-IPI specification [1]. The list below summarises the main items:

- DVB services may be transmitted as multiple program transport streams (MPTS) or decomposed into single program transport streams (SPTS). This is an operational issue, however sufficient access bandwidth must be ensured if MPTS is to be transmitted. Note that MPTS require that the optional MPTS function is provided in the IRDs.
- NorDig-IP accepts services transmitted over UDP and UDP/RTP.
- There is no requirement to contain the same number of transport stream packets in each RTP (UDP) packet. The IRD shall use the length field in the UDP header to determine the number of transport stream packets.
- The maximum size of one IP datagram (65535 octets for IPv4) shall not be exceeded. IP fragmentation should be avoided; hence care should be taken not to exceed the maximum transmission unit (MTU) of the underlying network. In case Ethernet is used (MTU of 1492 or 1500 bytes), the number of transport stream packets per IP datagram should be limited to seven (or less if IP and/or RTP header options are transmitted). It is recommended that content service providers set the DF (Don't Fragment) bit in the IP header.
- Calculation of the UDP checksum is optional. If not calculated, the checksum value shall be set to zero.
- In case RTP is used, the following rules apply:
 - The *Payload Type* parameter in the RTP header shall be set to MP2T.
 - The timestamp in the RTP header shall be derived from a 90 kHz clock source that may be locked to the clock reference of one of the programs in the transport stream. This clock shall conform to the accuracy and slew constraints for MPEG-2 system clocks as defined in ISO/IEC 13818-1 [4].
 - Other fields in the RTP header shall be completed as per RFC 1889 [5] and RFC 2250 [6].
- Header compression shall not be used.

In case RTP is used, the IRDs shall also support the RTCP protocol according to the following rules:

- Sender Reports shall be supported, but not Receiver Reports. The content service provider is recommended to send Sender Reports to enable IRDs to synchronise independent transport streams accurately (e.g. for picture-in-picture or other applications). Receiver Reports may generate a large volume of traffic at the Sender, hence shall not be supported due to scalability reasons.
- Each Sender Report shall contain two timestamps taken at the same instance; one of the RTP clock source and the other of the NPT clock. The IRD shall use these two timestamps to synchronise two streams (e.g. for picture-in-picture).

3.2 Network requirements

The DVB-IPI specification states some mandatory and some recommended network constraints.

3.2.1 Mandatory constraints

The overall requirement for TV transmission in IPTV networks is no more than one noticeable artefact per hour. The maximum RTP packet jitter shall be 40 ms peak-to-peak. This means that the IRD shall comply with the MPEG-2 Real Time Interface Specification (ISO/IEC 13818-9 [7]) with $t_{jitter} = 20\text{ ms}$.

The TM-IPI working group of DVB is currently working on a proposal for FEC for MPEG transmission in IP-based networks. NorDig will adhere to the requirements set forth by DVB as soon as they are official.

² AIT is signalled as an elementary stream in the Program Map Table (PMT).

3.2.2 Recommended constraints

Recommended constraints are informative only, but failure to meet these constraints may significantly degrade the user’s experience.

- There should be maximum one noticeable artefact per hour. The corresponding IP packet error rate depends on the transport stream bit rate.
- The recommended multicast join and leave times are as follows:
 - LEAVE time: maximum 500 ms
 - JOIN time: maximum 500 ms

It is emphasized that this is maximum levels. Ideally the join and leave time should be significantly less in order to minimise overall channel change time. Joining and leaving multicast groups shall be done according to the IGMPv3 protocol. The “source filtering” functionality shall be used.

- The network should support service transmission over both multicast and unicast. Multicast is generally used for transmitting broadcast services, while unicast is used for personalised services (e.g. VOD). Service transmission over unicast shall be initiated and controlled using the DVB profile of the Real Time Streaming Protocol (RTSP) according to the DVB-IPI specification [1].

3.3 IP address allocation

IP addresses shall be allocated using the DHCP protocol only. Static addressing shall not be used, meaning that there shall be no mechanism for the end-user to enter an IP address manually (not supported in minimum requirements for NorDig-IP IRDs [2]). The requirements for the DHCP functionality are given in the DVB-IPI specification [1].

3.4 Quality of Service

NorDig IP-based networks shall support the Differentiated Services model with regards to classification of type of data contained in each datagram. The 8-bit *Type of Service (ToS)* field in the IP packet header is used for marking according to the following rules:

- Networks compliant with RFC 2474 [8] use 6 bit of the ToS field
- Networks not compliant with RFC 2474 [8] use 3 bit of the ToS field

The markings shall be as listed in the DVB-IPI specification [1].

3.5 Forward Error Correction

FEC is an ongoing area for standardisation within IPTV in DVB. This is one area that will be considered to be included in future NorDig specifications when agreed in DVB.

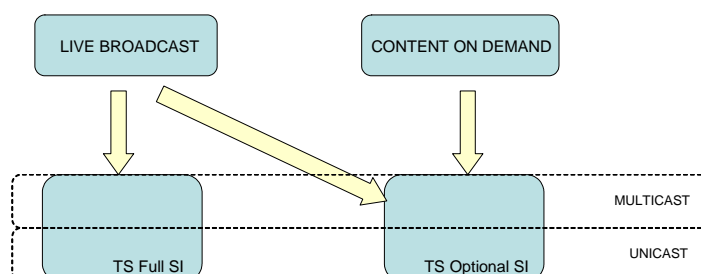
The quality requirement for delivery to the end user should be based on QEF reception (not more than one visible artefact per hour). This requirement may translate to max one MPEG packet loss per hour, and a BER better than one in 10^{11} bits (after error correction, when available). For the concentrated (backbone) traffic, even stricter requirements should apply.

4 Service Discovery

Service Discovery & Selection is the mechanism to provide information about service offering and how services can be accessed. Compared to traditional DVB networks (e.g. satellite) SD&S is very much like the SI mechanism. Relevant information in the SI tables may be transferred to appropriate SD&S structures.

SD&S information can be delivered in a push (multicast) and pull (unicast) model. Both live broadcasts (e.g. broadcast TV) and content on demand (e.g. VOD) shall be supported. Two SD&S types are defined for live broadcast:

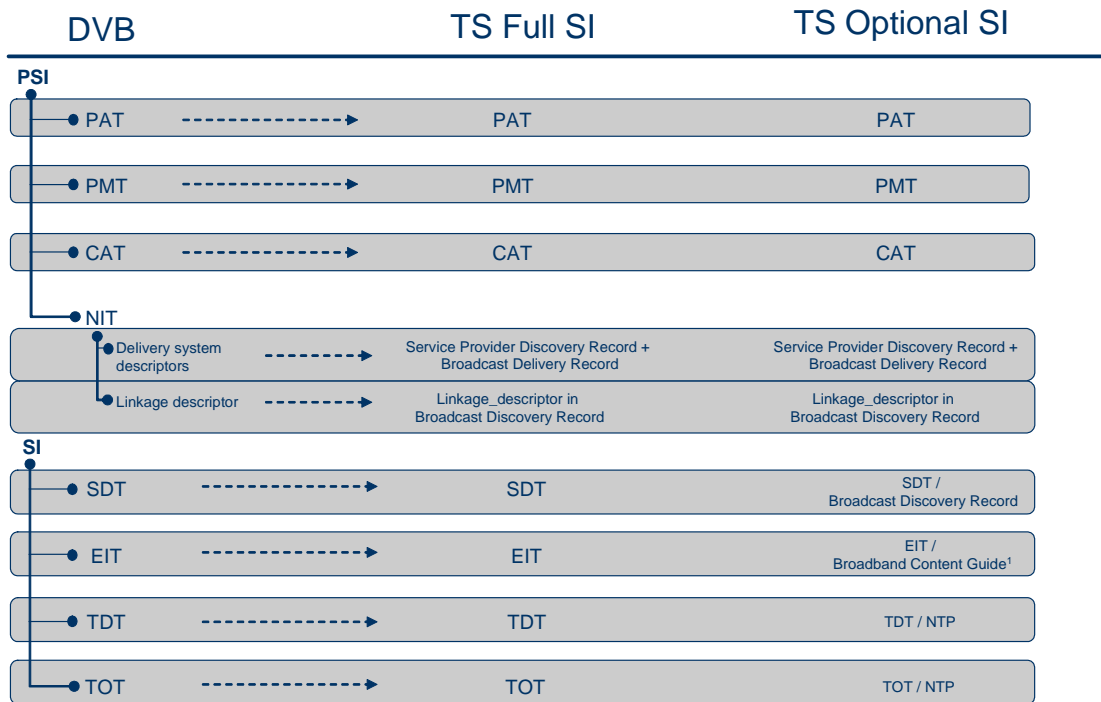
1. **TS Full SI:** This scheme allows transparent retransmission of transport streams from other delivery networks (e.g. satellite). Hence all inbound PSI and SI tables



are retransmitted without any change. Due to the fact that the NIT table is replaced by SD&S structures in DVB-IP networks, NIT shall be ignored by IRDs and the DVB-IP service provider must generate service discovery information specifically. The “TS Full SI” scheme is supported by NorDig-IP IRDs.

2. **TS Optional SI:** In this scheme retransmission of the SI tables is optional. Hence it is assumed that the DVB-IP service provider has other mechanisms for relaying appropriate service information. If SI tables are present, the SD&S information shall take precedence. It is not mandatory for NorDig-IP IRDs to support TS Optional SI.

To summarise, most PSI/SI information in DVB networks are either retransmitted transparently or transferred into SD&S structures before being transmitted into IPTV networks. Figure 2 shows how the most relevant PSI/SI tables are treated.



¹Broadband Content Guide is an XML format subject for future standardisation within DVB

Figure 2: Transfer of PSI/SI information into IPTV networks (the most relevant tables are shown only)

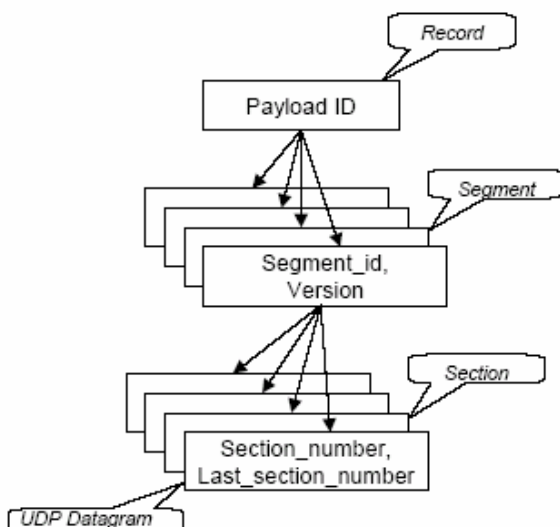


Figure 3: Fragmentation of SD&S records

SD&S information is represented with xml records, and the DTDs of the different records are specified [1]. A maximum cycle time (of the entire SD&S information) is specified to 30 seconds, meaning that IRDs will wait no longer than 30 seconds to acquire the entire SD&S information set. An SD&S record may be of substantial size; hence they may be fragmented into segments and sections as indicated in figure 3. The versioning mechanism is similar to DVB PSI/SI, meaning that a change to a SD&S segment causes the segment version_id to be incremented. Hence IRDs can monitor the segment version_id to decide whether an update has been performed. Different cycle rates can also be set to allow certain data to be transmitted more often than other data.

The different steps in Service Discovery are given in Figure 4.

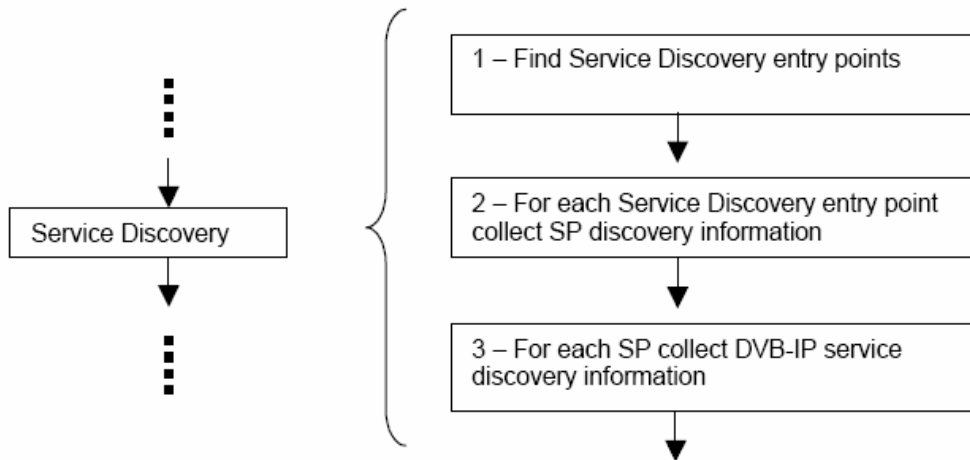


Figure 4: Steps in Service Discovery

4.1 SD&S Data Model

The SD&S data model is comprised of several records in a specific order. The overall data model is shown in Figure 5.

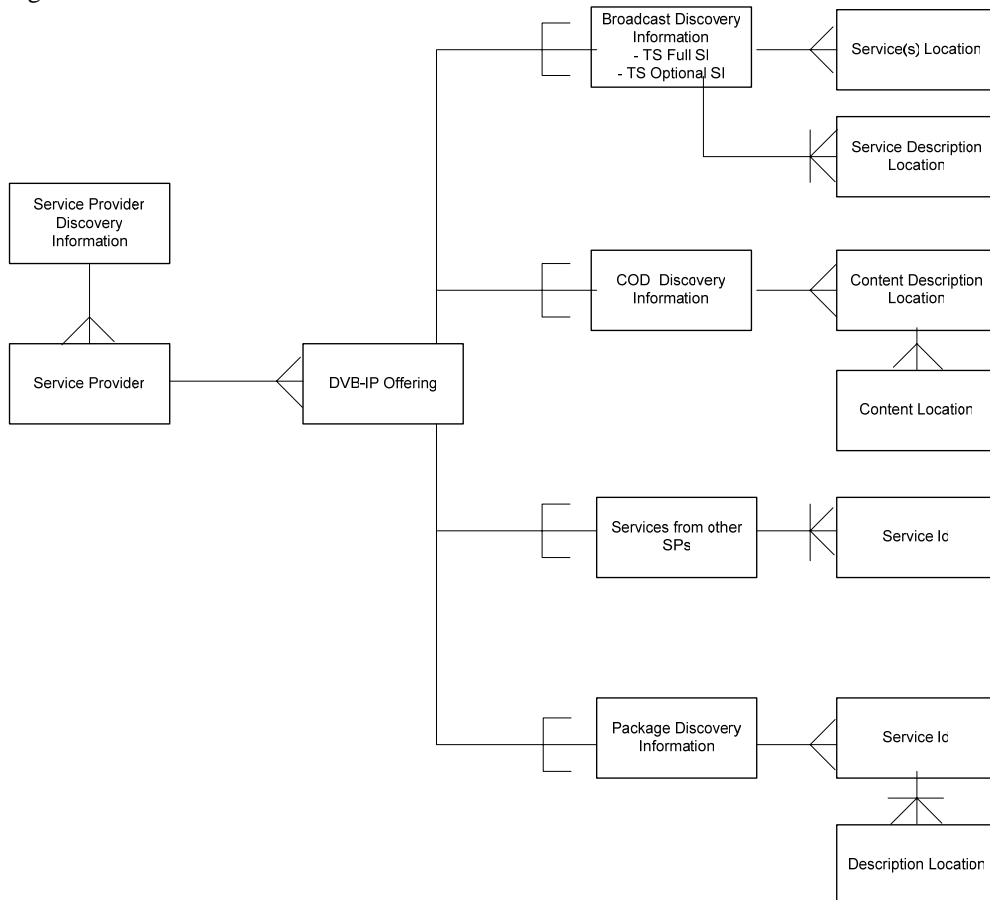


Figure 5: SD&S data model

The model is described in more detail in the following sections.

4.2 Service Discovery Entry Points

The IRD will look for SD&S entry points in the priority order defined below:

1. SD&S entry points contained in the Network Provisioning option [1]. If the Network Provisioning option is implemented, then the sdEntries element in the Configuration DTD shall list the SD&S entry points. This means that the IRD can be provided with entry points as part of the configuration data received on a provisioned network. If this option is not implemented, the IRD shall go to the next step.
2. A list of SD&S entry points may be acquired via DNS (which is acquired via DHCP option 15). A list of SD&S entry points is then acquired via DNS according to RFC 2782 [9]. The service name is `_dvbservdsc`, the protocol may be TCP or UDP, while the rest of the name is the domain name provided via DHCP Option 15. An example of a possible lookup may be:
 - `_dvbservdsc._tcp.example.com`, or
 - `_dvbservdsc._udp.example.com`
3. A list of SD&S entry points may be acquired via DNS according to the service location RFC 2782 [9]. The service name is `_dvbservdsc`, the protocol may be TCP or UDP, while the rest of the name is the domain name maintained by DVB for service discovery (`services.dvb.org`). Hence the lookup shall be one of the following:
 - `_dvbservdsc._tcp.services.dvb.org`
 - `_dvbservdsc._udp.services.dvb.org`
4. SD&S entry points are transmitted in an IANA registered multicast address (224.0.23.14, DvbServDisc). If the IRD has not received any valid SD&S packets within a period of two maximum cycle time (i.e. 60 seconds), the IRD shall go to the next step.
5. The user shall be allowed to enter an URL of an SD&S entry point manually.

4.3 Service Provider Discovery Information

The SD&S entry points discovered in section 4.2 provide information about the available service providers. This information is carried in the Service Provider Discovery Record.

The fields in the Service Provider Discovery Record are specified in TS 102 034 [1]. The record describes a.o. the following two important fields:

- **Location(s)**: Provides the location of the DVB IP Offering Record(s) which describes the offerings of the particular Service Provider.
- **Payload Id**: The `payload_id` indicates the type of service discovery information available at the location(s) provided. The valid values for `payload_id` are defined in Table 1.

Table 1: Available payload_id values

payload id	SD&S record carried
0x00	Reserved
0x01	Service Provider Discovery Information
0x02	Broadcast Discovery Information
0x03	COD Discovery Information
0x04	Services from other SP's
0x05	Package Discovery Information
0x06 – 0xEF	Reserved
0xF0 – 0xFF	User Private

Hence typical values for the `payload_id` field in the Service Provider Discovery Record is 0x02 (Broadcast Discovery Record) or 0x03 (COD Discovery Record).

4.4 DVB-IP Service Discovery Record

The DVB-IP Service Discovery Record is the “parent” for the following records:

- Broadcast Discovery Record
 - TS Full SI
 - TS Optional SI

- COD Discovery Record
- “Service from other Service Provider” Record
- Package Discovery Record

The DVB-IP Service Discovery Record contains the service provider domain name (an internet DNS domain name registered by the Service Provider) and a version_number.

4.4.1 Broadcast Discovery Record – TS Full SI

The “TS Full SI” Broadcast Discovery Record provides all necessary information to find available live media broadcast transport streams that is transmitted with embedded SI information (i.e. meaning that the SI tables are part of the overall transport stream). Information about the individual services are acquired from the transport stream itself by classical interpretation of the DVB-SI tables (EN 300 468 [3]). The NorDig-IP IRDs shall support TS Full SI.

4.4.2 Broadcast Discovery Record – TS Optional SI

The “TS Optional SI” Broadcast Discovery Record must provide all the necessary information to create a list of available services with sufficient information for the user to select a channel [1]. This record is to be transmitted in case the SI tables are not provided embedded into the transport stream carrying the actual service. However, if this record is transmitted, and the SI tables are embedded into the transport stream, the Broadcast Discovery Record will take precedence. The NorDig-IP specification [2] states that support for TS Optional SI is not mandatory for NorDig-IP IRDs.

4.4.3 COD (Content On Demand) Discovery Record

The COD Discovery Record provides all the necessary information to discover the COD servers (e.g. VOD servers) available on the network and the location of their catalogue of content. The NorDig-IP IRD specification states that this mode is not mandatory for NorDig-IP IRDs.

4.4.4 “Service from other Service Provider” Record

A service provider may reference individual services or complete offerings from other service providers. To reference an individual service, the textual service identifier is supplied. To reference a complete offering, the service provider’s DNS domain name is supplied. The NorDig-IP IRD specification states that this mode is not mandatory for NorDig-IP IRDs.

4.4.5 Package Discovery Record

A service provider may wish to group particular services into a single entity, e.g. for marketing purposes. The Package Discovery Record is used for this purpose. Note that the Package Discovery Record does not enable discovery of new services. All services included in a Package Discovery Record must be identified through Broadcast Discovery Record, COD Discovery Record, or “Service from other Service Provider” Record. The Package Discovery Record is very similar to the BAT table defined in the DVB SI specification [3]. The NorDig-IP IRD specification states that this mode is not mandatory for NorDig-IP IRDs.

4.5 Service selection

Two protocols are defined for selecting a service in a DVB-IP network:

- IGMP (version 3): used to select Live Media Broadcast services transmitted in a multicast group, usually live TV. Such services are streamed continuously and do not need to be initiated by each IRD. The “Service Locator” attribute in service discovery records provides all information needed to issue an IGMP request. An example is provided in Figure 6.

Service Locator

IGMP protocol	1	} IGMP request to 239.192.101.52:8208
Address	239.192.101.52	
Port	8208	
Source address	192.168.213.25	
RTSP protocol	0	

Figure 6: Example of service selection using IGMP

- RTSP: Optionally the Live Media Broadcast services may be offered as unicast services. In this case the IRD is engaged in explicit set up and tear down of the services, and the RTSP protocol is used. The “Service Locator” attribute in service discovery records signals the use of RTSP and provides all information needed to issue the appropriate RTSP method. An example is provided in Figure 7. It must be emphasised that RTSP is most often used for content on demand type of service, e.g. VOD.

Service Locator

IGMP protocol	0	} RTSP SETUP to 192.168.213.25
Source address	192.168.213.25	
RTSP protocol	1	

Figure 7: Example of service selection using RTSP

4.6 Transmission of SD&S information

The SD&S records can be transmitted either as multicast or unicast. In case multicast is used, the DVB SD&S Transport Protocol (DVBSTP) is used to transport the records. In case unicast is used, the HTTP protocol is used to transport the records.

4.6.1 Multicast delivery of SD&S

The DVBSTP protocol is specified in the DVB-IP specification [1] and is used when the SD&S information is transmitted using multicast UDP packets.

4.6.2 Unicast delivery of SD&S

When SD&S information is available only via unicast, the IRD must use HTTP to communicate with the SD&S server(s). In order to retrieve SD&S information, the IRD issues a HTTP GET request:

```
'GET /dvb/sdns' <request> 'HTTP/1.1' CRLF
'Host: ' host CRLF
```

Two different requests are defined:

- **sp_discovery_request**: Request for discovery information relating to service providers. The host address will in this case specify the IP address of the SD&S server obtained when searching for the SD&S entry points (refer to section 4.2)

- **service_discovery_request:** Request for discovery information relating to the service offering of a service provider. The host address in this case refers to the URI that contains a DVB-IP Offering Record (which describes the offerings from a service provider).

The return from the SD&S server on these requests is the appropriate XML records as defined in [1].

5 SW download

There are basically two different mechanisms for software download in DVB-IP networks. One mechanism is software download through the Network Provisioning option [1]. The second mechanism is through an “on-air” bootloader service, i.e. a dedicated software download service that has been retransmitted from broadcast networks into the IPTV network. The latter mechanism is specifically defined by NorDig and is used to upload software to NorDig compliant IRDs.

In broadcast networks, the bootloader service is transmitted as an individual MPEG2 service with a data stream as the only elementary stream. I.e. the bootloader service is identified through a unique DVB triplet (original_network_id – transport_stream_id – service_id). A linkage_descriptor in the NIT table identifies the bootloader service for broadcast IRDs. This is shown in Figure 8.

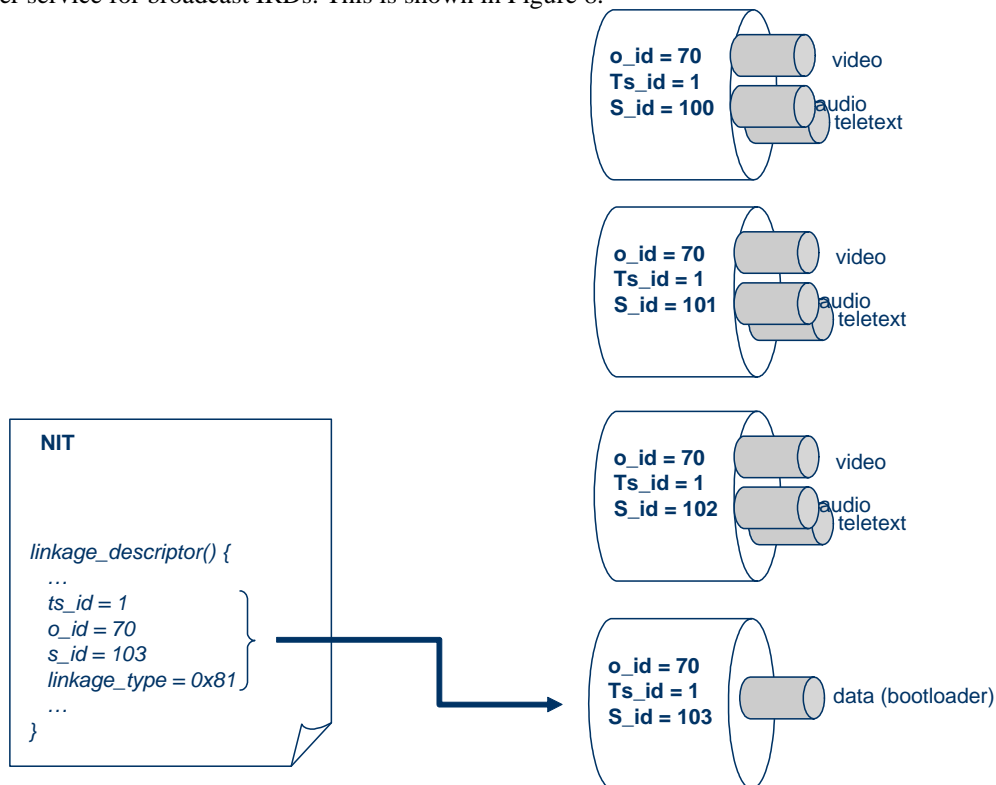


Figure 8: Signalling of NorDig bootloader in broadcast networks

In this example four services are transmitted, three TV services and one bootloader service. Each service is identified through a unique DVB_triplet. The NIT contains a linkage_descriptor referring to a NorDig bootloader service (linkage_type = 0x81). The DVB_triplet in the linkage_descriptor uniquely identifies the actual NorDig bootloader service.

Due to the fact that the NIT table is replaced by SD&S structures in DVB-IP networks, the NIT table should be omitted. Instead, a linkage_descriptor may be inserted into the Broadcast Discovery Record, referring to a NorDig bootloader service exactly as is done for broadcast networks, i.e. using the DVB triplet as identifier.

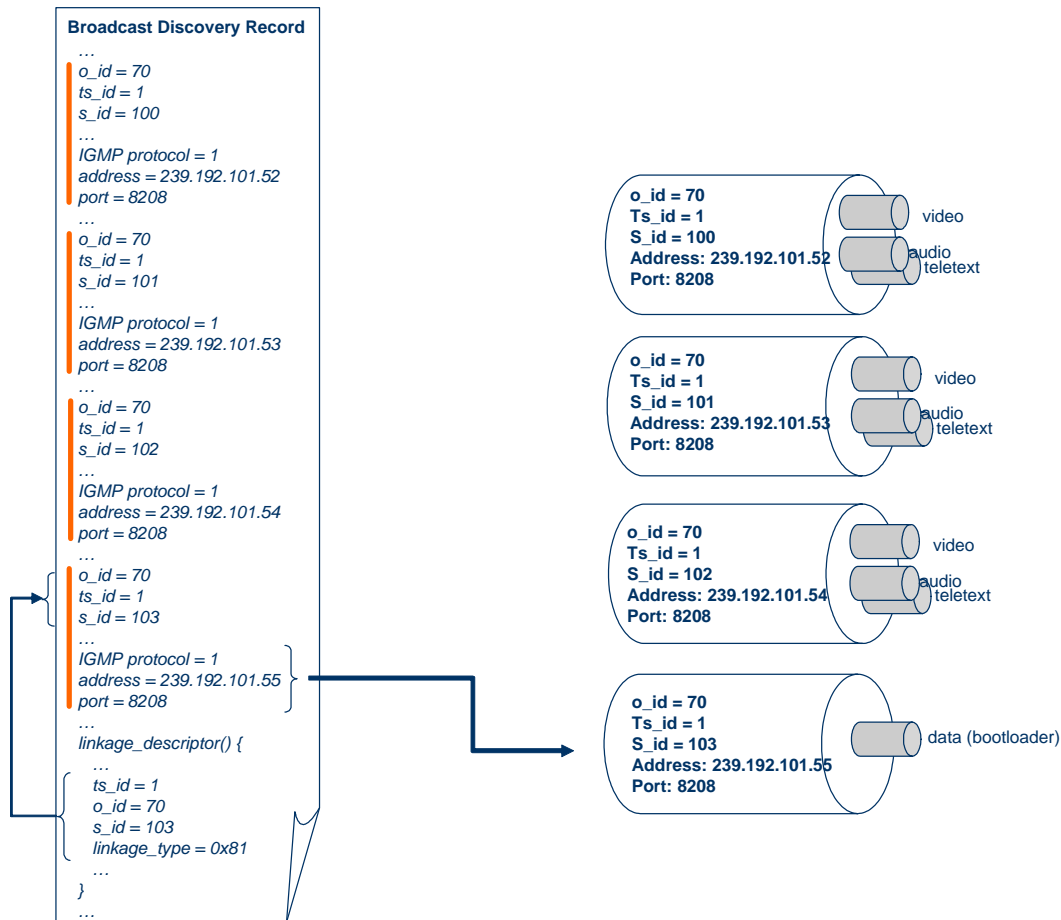


Figure 9: Using linkage_descriptor in Broadcast Discovery Record to signal NorDig bootloader

In this example four services are transmitted into the IPTV network. The DVB_triplets are preserved from the broadcast network, and each service is mapped onto a multicast group. The Broadcast Discovery Record identifies all services (using the DVB_triplet) and the associated service locator(s). A NorDig linkage_descriptor is inserted into the Broadcast Discovery Record, referring to the NorDig bootloader service using the DVB_triplet. Furthermore, the service locator(s) for the actual DVB_triplet refers to the actual NorDig bootloader service. Hence, the IRD may issue an IGMP join command to the actual multicast address (i.e. IGMP join to 239.192.101.55:8208).

6 Summary

The NorDig-IP specification is based on the ETSI Technical Specification “*Digital Video Broadcasting (DVB): Transport of DVB Services over IP*” (TS 102 034 [1]). The specification was approved in ETSI in March 2005 and will hopefully provide the fundament for all commercial IPTV deployments. The NorDig-IP specification extends the ETSI specification on a few issues, e.g. the presence of a linkage_descriptor in the Broadcast Discovery Record (SD&S) to signal a NorDig bootloader stream. The intention for NorDig is to align with DVB when solutions to these items are agreed on in DVB.