TLN WRO Specification type Document

< Specification and Certification AO STB >

Document Housekeeping

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Telenet has appealed the CRC decisions of the VRM, BIPT and CSA of 29 June 2018 concerning the market analysis of the broadband and broadcasting market in Belgium and it consequently reserves all its rights in relation to this document."

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List of Appendixes

This document may refer to further detailed documents that are added in Appendixes to this document.
A reference to an appendix is in this document highlighted with grey background.
The list with appendixes of this document:

A. Appendix A, <APP_I_S_PDAA_A> contains:
    1) Appendix A – <Surge and lightning protection>
B. Appendix B, <APP_I_S_PDAA_B> contains:
    2) Appendix B - <CPPS – Telenet CAS XML API>
    3)

The appendix (es) referred to in this section List of Appendixes, contain(s) detailed technical information which is only relevant when a Beneficiary enters in a concrete implementation project to become Beneficiary of the Telenet Reference Offer and/or Annex.

List of References

This document may refer to external documents or information sources.
A reference to an external document or information source is in this document highlighted with grey background.
The list of referred external documents or information sources in this document:
Reference 1: TLN_WRO_TA_G_C_PAAA - General Certification Procedures
Reference 2: TLN_WRO_TA_I_S_PDAB - Specification and Certification for iDTV interconnection on TLN VHE
Reference 3: TLN_WRO_TA_B_S_PAAB - Specification and Certification for BB IP Interconnect
Reference 4: TLN_WRO_TA_G_A_PAAB_- Architecture ROTV and AIDTV
Reference 5: TLN_WRO_TA_I_S_PIAA_- Specification and Certification AO VoD Back-End
Reference 6 : Guidelines for Implementation: DASH-IF Interoperability Points, DASH Industry Forum, http://dashif.org/wp-content/uploads/2016/12/DASH-IF-IOP-v4.0-clean.pdf
Reference 7 : TLN_WRO_TA_B_A_PAAA_V1.0 - Architecture ROBB
Reference 8 : TLN_WRO_TA_I_S_PDAB_V1.0 - Specification and Certification iDTV interconnection

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1 Abstract

This document describes the major building blocks an AO STB must have in order to be able to successfully interoperate with the TLN ROTV/AIDTV. Each required building block is briefly described explaining it´s expected functional behavior.

In addition the non functional requirements for the AO STB are also described in this document. For the delivery of VoD, two different options are highlighted, one with DVB-C delivery and one with IP delivery.

Generic sections specifying certification procedures applicable to all AO CPE or network equipment that will be connected to the TLN network are described in General Certification Procedures Document TLN_WRO_TA_G_C_PAAA - General Certification Procedures.

2 AO STB General Functional Description

(1) The conceptual block diagram of an AO STB is shown in the figures below. The first figure depicts the block diagram for a STB where the optional VoD traffic is delivered over DVB-C. The second figure shows the block diagram for a STB where the optional VoD traffic is delivered over IP. Both block diagrams share a lot of common components and differ for the specific components to enable the DVB-C and IP delivery of VoD assets and related functionalities.

(2) In summary the AO STB needs to capture, descramble and decode TV signals and related program information transmitted over the TLN cable network and present this on its output interfaces towards the TV set. Further it provides interaction capabilities with the customer by implementing a graphical user interface allowing interaction via an RCU.

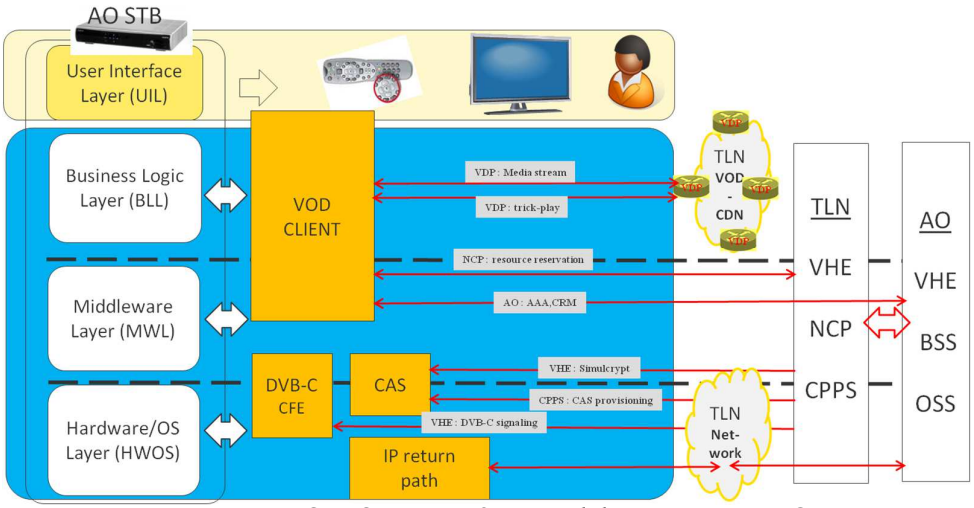


Figure 2-1: STB Overview for VoD delivery over DVB-C

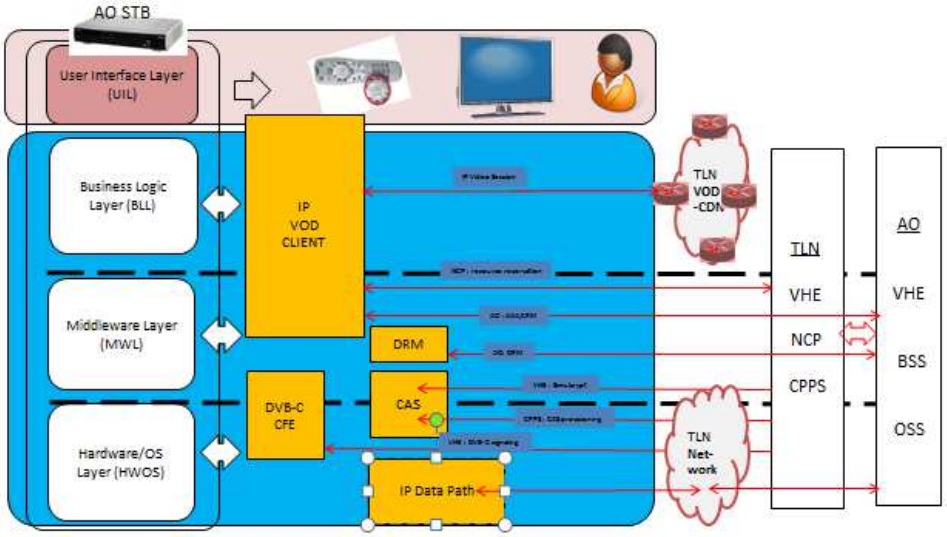


Figure 2-2: STB Overview with VoD delivery over IP

(3) A typical CA process consists of four key elements: the broadcast multiplexing equipment (in the VHE), the AO 3rd party CA system (in the 3rd party location), the STB, and the STB security

module. The broadcast multiplexing equipment (located in the TLN VHE) generates the encrypted program streams (using encryption keys provided by the 3rd party CA system (located in 3rd party site) that are transmitted to the customer STB. The STB filters out the signals requested by the customer and pass them to the STB security module. The security module then authorizes these programs for decryption if the customer has a subscription for the requested program. The programs are then decrypted in real time and sent back to the STB for display.

(4) Only one distinct 3rd party CA system can be present that operates on behalf of all different AO´s together.

(5) The function of the iDTV interactive Data Return Path is to allow IP communication between the AO STB, the AO iDTV back-end systems and the TLN IP network components involved in delivering service (e.g. TLN Video Data pumps in TLN CDN) to the AO STB.

(6) The function of the AO STB VoD subsystem is to allow AO STB, interaction with the AO iDTV technical and CRM back-end systems (located in the AO VHE), the TLN back-end systems dedicated to VoD service delivery (located in the TLN VHE) and the TLN IP network components involved in delivering the VoD service (e.g. TLN Video CDN). Two different options are offered to an AO, in a first option, the VoD assets are delivered to the STB over DVB-C and use CAS for call admission, in the second option, the IP protocol will be used for the delivery of the assets.

In case IP delivery is used for the delivery of the VoD assets, DRM technology will be used to ensure the management of the digital rights. The DRM process consists of the following elements: video packager performing encryption, AO 3rd party DRM system, the STB and the STB security module. The video packager encrypts the VoD assets using an encryption key provided by the 3rd party DRM system. When the encrypted video assets are delivered to the STB, they are handed over to the STB security module. The security module will authorize the asset for decryption based on the license that the STB will retrieve from the 3rd party DRM system and pass on to the STB security module.

(7) When the AO chooses the option with IP delivery, it will have to use the ISO BMFF On-Demand profile of the MPEG-DASH standard (Reference 6).

(8) Common Encryption (CENC) allowing PlayReady DRM and Widevine DRM is supported by the packager component.

3 AO STB General Functional Requirements

3.1 AO STB Hardware and OS

(9) TLN does not impose specific requirements on AOSTB HW and OS, the AO is free to choose any type of STB HW or OS as long as the overall solution can support the complete set of requirements for the TLN ROTV/AIDTV.

3.2 AO STB Middleware

(10) The middleware typically supports a number of common platform services that can be accessed by the Business Logic Layer (BLL).TLN does not impose specific requirements on middleware; the AO is free to choose any type of STB middleware as long as the overall solution can support the complete set of requirements for the TLN ROTV/AIDTV.

3.3 AO STB Business Logic Layer

(11) The Business Logic Layer (BLL) typically supports the applications that run on the STB, like EPG, User Preferences settings, Recording functions, Reminders, etc…TLN does not impose specific requirements on the BLL; the AO is free to choose any type of BLL as long as the overall solution can support the complete set of requirements for the TLN ROTV/AIDTV.

3.4 AO STB User Interface Layer

(12) The User Interface Layer (UIL) defines the way the customer can interact via its RCU with the applications offered by the service.TLN does not impose specific requirements on the UIL; the AO is free to choose any type of UIL as long as the overall solution can support the complete set of requirements for the TLN ROTV/AIDTV.

4 AO STB Conditional Access *(CA)* subsystem Functional Requirements

4.1 General

(11) The primary purpose of a CA system for digital broadcasting is to determine which individual receivers/set-top decoders shall be able to decode and deliver particular program services / individual programs, to the viewers. Both smartcard-less and smartcard based solutions can be used for the CA system. Typically a DVB-C based CA system enables "simul-crypt", which allows several (but limited in total number) CA systems to be present in parallel. The TLN wholesale offer will use this "simul-crypt" technique to enable the offer to AO´s.

4.2 AO STB CAS subsystem

(12) The AOSTB must be equipped with a CAS module that allows descrambling of encrypted MPTS service streams and can handle CAS entitlement messages to add/remove rights to a given STB to access certain services. It consists of following major sub-components:

- Descrambler
- CAS control message (ENM/ECM) handling module
- Smart Card (SC)

4.2.1 Descrambler

(13) A conditional access system (CAS) uses a combination of scrambling and encryption to prevent unauthorized reception. Scrambling is the process of rendering the sound, pictures and data unintelligible. Encryption is the process of protecting the secret keys that have to be transmitted together with the scrambled signal in order for the descrambler to work. The responsibility of the descrambler module is de-scrambling the signals, to which the individual STB is properly entitled so that they can be viewed.

4.2.2 CAS control message (EMM/ECM) module

(14) The EMM (Entitlement Management Message) allows a single decoder to view the programme material which is scrambled via a DVB 'common scrambling algorithm' by providing the key to the code word which is involved in the scrambling. The code word is sent via the ECM (Entitlement Control Message).

4.2.3 Smart Card

(15) Each CA system provides a security module that descrambles and decrypts data. This security module is either embedded within the STB ("software" Smart card) or is insert-able in the form of a Smart card. The Smart card contains the subscriber's authorization codes required to de-scramble the signals and the EMM/ECM messages.

4.3 3rd party CA system to TLN VHE interface

4.3.1 General

(16) TLN offers a DVB-C based interface that allows the 3rd party CA system that is operated by the 3rd party on behalf of all AO´s together to inject it´s conditional access signaling at TLN Head-end level where it will be merged with the signaling of existing TLN CA systems.

(17) Notwithstanding other references included in the Reference Offers, AO's can select a different CA system than the AO CA system already available on the Telenet network. Only in case of technical impossibilities to implement this different CA system, Telenet will need to reject this request. Also, the CA system used by the AO can be used on other networks.

4.3.2 DVB-C Normative References

(18)AO STB´s must be compatible with below specified ETSI standards.

(19)Normative reference is a term covering separate documents referenced within the standard and means that, unless otherwise stated, the most recent versions of the separate documents should be referenced.

- [1] ETSI TS 101 197 (V1.2.1): "Digital Video Broadcasting (DVB); DVB SimulCrypt; Head-end architecture and synchronization".
- [2] ETSI TS 103 197 (V1.4.1): "Digital Video Broadcasting (DVB); Head-end implementation of DVB SimulCrypt".
- [3] ETSI EN 300 468: "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems".
- [4] ISO/IEC 13818-2: "Information technology; Generic coding of moving pictures and associated audio information: Video".
- [5] ISO/IEC 13818-3: "Information technology; Generic coding of moving pictures and associated audio information - Part 3: Audio".

4.3.3 TLN DVB-C SimulCrypt specifications

(20)Telenet completely adheres to the latest DVB SimulCrypt specifications and as such no further specific requirements are applicable in this domain.

(21)Telenet currently deploys card based and card-less (software based) CA systems concurrently in SimulCrypt mode. For the card-less CA, specific signaling and data streams are broadcasted on the Telenet DVB-C network. Next to the regular CA descriptors in the CAT and PMT tables for EMM and ECM declaration, and the ECM and EMM streams itself, the card-less CA also uses private data streams to distribute the security modules and other data to the different STB models.

(22)Obviously the CA client software on the STB of the AO needs to ignore this card-less CA specific signaling and data streams. It must filter out the CA data targeted for the AO client. Verification of this functionality will be part of the certification process for the introduction of the AO CA System and STB on the Telenet network.

(23)During certification, it will also be verified that the introduction of the AO CA system and its dedicated signaling and data streams does not adversely affect the already deployed Telenet STB ´s.

4.3.4 CA system signalling connection

(24)The AO 3rd party CA System is connected from its location at the 3rd party CA operator premises with a secure encrypted IP connection that will carry the EMM/ECM messages generated by the AO 3rd party CA servers towards the TLN VHE where they will be merged and “simul-crypted” and injected in the digital transport streams by the TLN statistical multiplexers

(25)The AO SMS is the subsystem of the 3rd party CA system that manages the subscriber's information and generates the required entitlement management messages (EMM) based upon the provisioning information it receives from the TLN – CPPS.AO. An EMM provides general information about the subscriber and the status of the subscription. The EMM is sent with the ECM. The ECM is a data unit that contains the key for decrypting the transmitted programs.

(26)SimulCrypt allows multiple STB´s, each using a different CA system, to operate in parallel within the same DVB-C transmission system and to authorize and decode the programs for display. The different ECMs and EMMs required by each CA system are transmitted simultaneously. Each STB recognizes and uses the appropriate ECM and EMM needed for authorization.

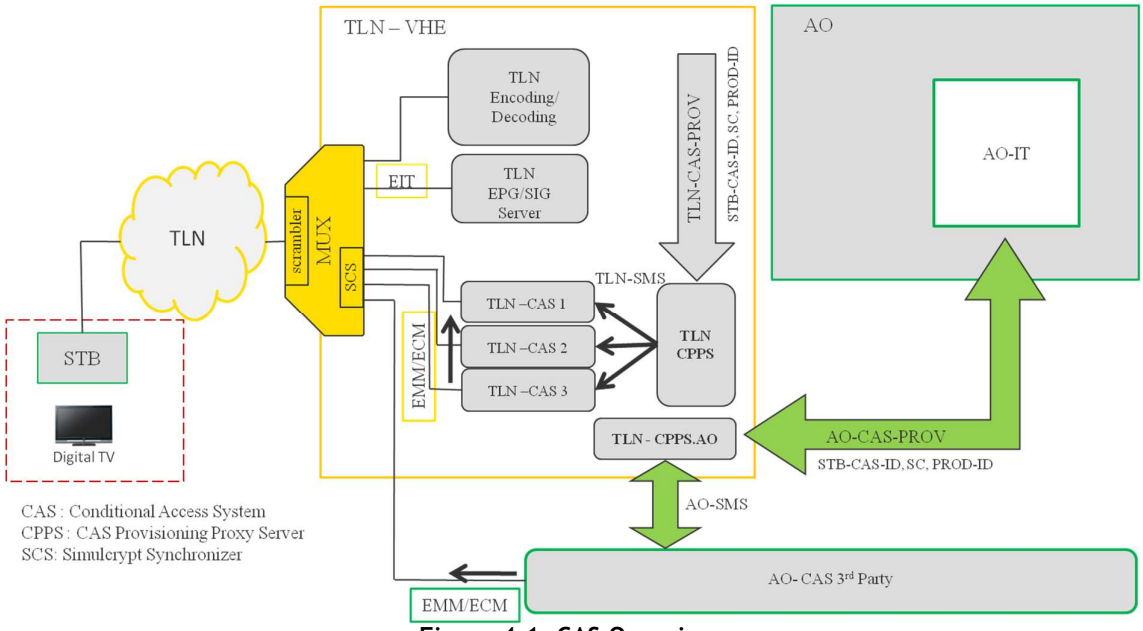


Figure 4-1: CAS Overview

4.3.5 3rd party CA system explicit operational requirements

(27) For security reasons it is important to include at least the following operational functions in the CA system:

-Disable/enable decoder
-Disable/enable card
-Disable/enable program service
-Send message to decoder
-Send message to decoder for individual program service
-Show customer's ID card

4.4 CA Provisioning

4.4.1 General

(28) The CA system Proxy Provisioning Server (CPPS) is the TLN API server that is used for all CA system provisioning currently in use in the TLN network.

(29) The current document describes the CPPS (CAS Proxy Provisioning Server) as part of the Telenet Reference Offers. CPPS can be described as a "proxy activation" providing a preliminary and fully automated verification of the eligibility of a client activation, without client details being stored. The CPPS is an important element to avoid fraud and ensure the network security. The CPPS is applied in a non-discriminatory manner towards Telenet clients as well as (clients of) the Beneficiary.

(30) It is possible, following a specific request of the Beneficiary, to foresee or implement other possibilities as an alternative for the CPPS. In order for such alternative to be accepted, the characteristics offered by the CPPS solution should also be provided by the alternative. In order for the alternative to be applicable a specific agreement should be concluded by Telenet and the Beneficiary detailing the functionalities of the alternative and guaranteeing the equivalence to the CPPS.

(31)In case an alternative is proposed and agreed between both Parties, all references to CPPS as included in the Reference Offers should be read and interpreted in accordance with the specific agreement between both Parties.

4.4.2 CA Provisioning

(32)A CA system is typically provisioned from a CRM system. The CRM system holds the customer accounts and also stores the services the customer has subscribed to (e.g. the customer subscription towards premium pay TV packages). As such the AO CRM system will have to fulfill this role towards the 3rd party CA system. The AO CRM system will typically upon creation of a new customer use the TLN-IT portal. They will call CPPS.AO to instruct the 3th party CAS to activate that user. The AO CRM system can then manipulate programs for these users and this will need to be handled as well via the CPPS.AO.

4.4.3 TLN CPPS to 3rd party CA system

(33)The AO´s IT systems will use the TLN CPPS API (exposed as XML over HTTP) to send customer subscription information on (i)DTV services towards the TLN CPPS dedicated for AO operation. The CPPS will translate this in the messages required by the 3rd party CA system (just like it does for the TLN own CA systems).

(34)The main API messages and their purpose are explained on a conceptual level here below. Full details of the API can be found in Appendix B: CPPS - Telenet CAS XML API v3.

(35)As can be deducted from the figure below the main CPPS API messages allow the AO CRM system to perform following actions:

- Activate STB : allows to provision a new STB on the CA system, link it with the SC and activate the combination so that the 3rd party AO CA system will start to generate the required ECM/EMM messages for this combination
- Add Package : allows to provision a new service package that will entitle the customer owning an earlier activated STB/SC combination to the reception of the TV channels (or other services) inside the package
- Remove Package : Remove earlier granted entitlements from an STB/SC combination
- De-activate STB : Remove an STB/SC combination from the CA system

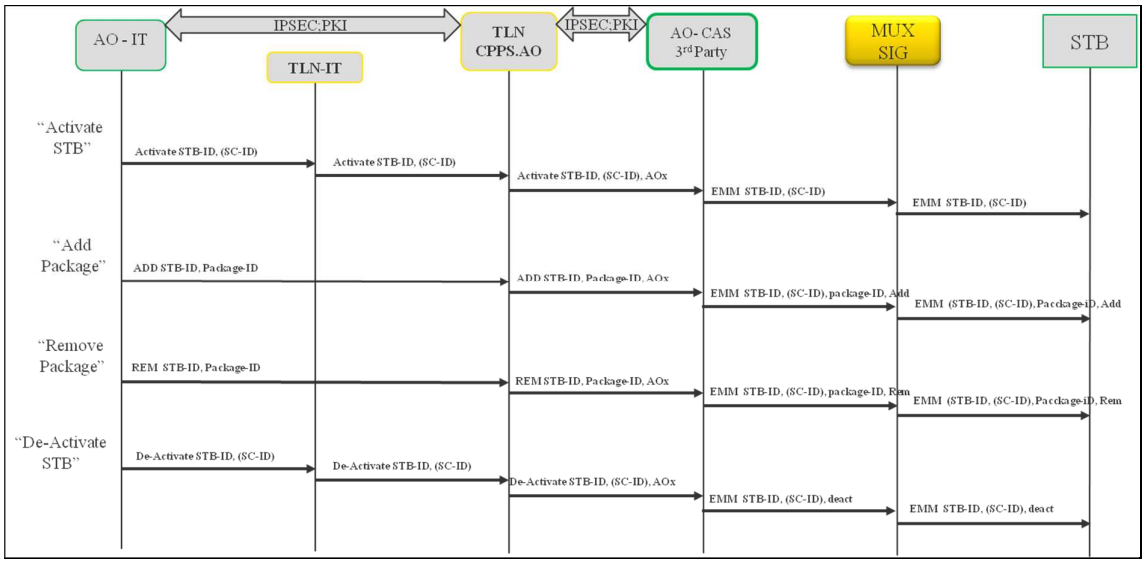


Figure 4-2: Activate STB

4.4.4 CA Provisioning connection

(36) The TLN CPPS is an API which is exposed as XML over http and located between the AOCAS 3rd Party and AO IT systems. A Secure connection (IPSEC, PKI) is used to transport the provisioning messages between the AO IT CRM systems and the CPPS.

4.5 CA Restrictions

4.5.1 One-way STB

(37) Depending on the capabilities of the 3rd party CA system, jointly chosen by the different AO´s, limitations will apply to the use of the CA system on non-interactive STB`s (not having an IP return path). As those limitations have an impact on the overall security (e.g. if a given CA supplier does not guarantee the security of its technology for one-way STB`s the whole set-up becomes insecure), TLN will strictly impose and follow-up with the AO`s and 3rd party CA provider that all relevant CA system supplier guidelines are strictly followed.

4.5.2 CA system Migration

(38) Migration from one CA system to another one is a complex, costly and time consuming process. Hence AO`s should provide all possible measures to avoid the need for migrations.

4.5.3 CA connection to IP Return path

(39) For most home STB installations, a return path is available between the set-top decoder and the network. This return path will allow the security modules in the STB to contact the back-end CA Subscriber Management System. For example, the operator may want the customer's STB to contact the SMS to perform certain security operations. This process could be initiated by commands sent over-air or (less likely) the SMS could initiate an inbound connection to the customer's STB and interrogate it directly.

(40) There are a number of reasons for using a return path:

a) *Enhanced security;*
The return path establishes a one-to-one link between the operator and each STB.
b) *Transmission of entitlement messages;*
For large shared networks, the capacity for transmission of entitlement messages may be in adequate and additional capacity may be achieved by using the return path connection.
c) *Upgrade of security protocols;*
The return path provides an extra facility which allows in case of emergency to upgrade the security algorithms.

(41) If the selected CA system is a software based CA system, the return path will have to be used to connect the STBs of the AO with the CA servers for authentication and for entitlement updates.

(42) TLN may in the future make the use of the STB return path for CA operations mandatory if network capacity constraints or security requirements would impose this.

4.6 TLN CA Operational procedures

(43) For security reasons it is important to include at least the following functions in a CA system:

-Disable/enable decoder
-Disable/enable card
-Disable/enable program service

-Send message to decoder
-Send message to decoder for individual program service
-Show customer's ID card

(44) Telenet regularly performs maintenance work on its multiplexors and CA systems. This can cause temporary loss of connectivity between multiplexors and the CA system. Completely in accordance with the SimulCrypt standard, the Multiplexors will go in crypto period extension, meaning that the scrambling is static (with the same key) and the ECMs are also static.

(45) Depending on the CA of the AO, this can have an impact on e.g. the provisioning of new customers. AO STB and systems should be able to handle those operational aspects.

5 AO STB Digital Video Broadcast – Cable *(DVB-C)* signaling subsystem Functional Requirements

5.1 General

(42) TLN provides read access to DVB-C signalling information (NIT, DVB-C Mux frequency map, DVB-C MUX service map,) in order to allow AO STB´s to "tune" into the correct MUX and select the correct MPTS services for decoding by its STB/SC in function of its end-user channel selections.

5.2 AO STB DVB-C cable front-end

(43) The AOSTB must be equipped with a DVB-C front-end module that allows "tuning" into DVB-C QAM modulated signals carrying TLN DTV signals. It consists of following major sub-components :

- QAM tuner module
- MPTS DEMUX module
- DVB-C PSI/SI signalling decoding module

(44) The above three modules make sure the STB application and middleware software can get access to the necessary signalling data that it requires to present the services to the TV viewer and act upon its input via the RCU.

(45) As seen in the following figure, the DVB-C signaling structures consist of three main blocks. These provide Digital TV services "Table of contents" services such as: list of DTV transport Multiplexers, list of channels, language selection, Teletext, CA/Entitlement and Electronic program guide information.

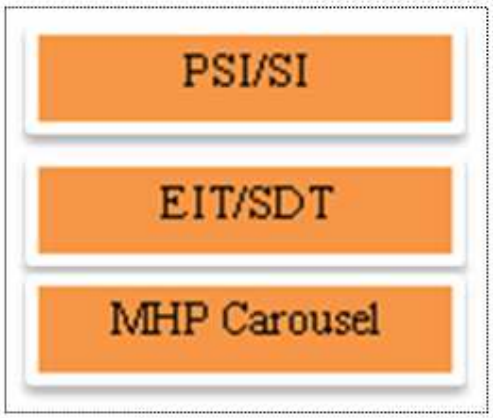


Figure 5-1: DVB-C Signal Structure

5.2.1 QAM tuner module

(46) The digital television audio and video signals are coded in MPEG transport streams. Different MPEG transport streams are multiplexed and modulated, using a QAM (Quadruple Amplitude Modulation) scheme to allow transport of the digital information over the analogue cable network. The QAM tuner module allows the STB to lock-into the different modulated transport multiplexers, de-modulate the signals and extract the digital frames for feeding into the de-multiplexer module. The common forms of QAM include 16QAM, 32QAM, 64QAM, 128QAM and 256QAM. Telenet uses 256QAM modulation for the transport of its digital TV signal MUXes.

5.2.2 MTPS DEMUX module

(47) When an AO STB tunes into a TLN DTV MUX, it will selects the correct MPTS services for decoding in function of the end-user channel selections. In order to do this, AO STB must contain a MPTS demux module. A de-multiplexer (or demux) is a device taking a single input signal and selecting one of many data-output-lines, which is connected to the single input. A multiplexer is often used with a complementary de-multiplexer on the receiving end. In digital television and digital radio systems, several variable bit-rate data streams are multiplexed together to a fixed bit-rate transport stream by means of statistical multiplexing. This makes it possible to transfer several video and audio channels simultaneously over the same frequency channel, together with various services. The device that accomplishes this is called a statistical multiplexer. In several of these systems, the multiplexing results in an MPEG transport stream (MPTS).

5.2.3 DVB-C PSI/SI signalling decoding module

(48) DVB Service Information (SI) is an enhancement of MPEG PSI (Program Specific Information).It provides extra information which the receiver can use. Where there are several TS available, in order to successfully demultiplex a program (i.e. Channel), the decoder must be notified of both transport stream id (to find the correct multiplex) and the program number of the service (to find the correct program within the multiplex).

5.3 DVB-C Normative References

5.3.1 General

(49) Extensive standardization effort has been carried out by ETSI (standards) in order to create a well defined framework to enable broad interoperability for DVB compliant equipment (transmitters and receivers). This framework defines the performance expected of DVB compliant equipment, thereby supporting the technical choices that were made when defining the architecture and normative requirements (ETSI standards) of the DVB systems.

(50) The Telenet digital TV implementation is DVB-C compliant, however TLN has made use of the possibility the DVB-C framework offers to extend it with private extra capabilities.

5.3.2 DVB-C normative references

(51) In order to achieve compliance with the TLN ROTV specification set for DTV, it is necessary to conform to the mentioned DVB-C standards and other works as indicated, in addition to the other requirements of this specification. Notwithstanding, intellectual property rights and/or royalty fees may be required to use or implement such normative references.

(52) The relevant DVB-C documents can be found at: http://docbox.etsi.org/Reference.

5.3.3 TLN DVB-C implementation specifics

(53) TLN has extended the standard DVB-C specifications with a number of private signalling descriptors to create extra functionalities. Those extensions are documented in TLN_WRO_TA_I_S_PDAB - Specification and Certification for iDTV interconnection on TLN VHE which describes the signaling as it is generated by the TLN VHE.

5.4 TLN DVB-C signalling for AO STB

5.4.1 General

(54) The TLN DVB-C signaling system is incorporated in the broadcast transmission streams of the digital television signals over the cable network. The base transmission system uses MPEG-2 or MPEG-4 family digital audio/digital video streams, amended with the accompanying

signaling information transported in DVB-C multiplexers using a 256 or 64 QAM modulation with channel coding. The main signaling elements are explained in this paragraph.

5.4.2 NIT signalling structure

(55) The NIT (Network Information Table) provides a grouping of Transport Streams and tuning information such as channel frequencies and modulation characteristics. The TLN DVB-C network transmits the NIT_other on one or more transport streams of the DVB-C network.

(56) The NIT structure consists of frequency, symbol rate, modulation and polarization etc.

5.4.3 TLN DVB-C home channel

(57) The TLN DVB-C network uses a “home MUX” that serves special status and provides services only available in this MUX like software upgrade services. Typically an STB will search for and tune into the “home MUX” as part of its boot and start-up procedure and will start the network structure discovery process from that entry point.

5.4.4 PSI/SI signalling tables

(58) DVB Service information (SI) is an enhancement of MPEG PSI (Program Specific Information). It provides extra information which the receiver can use to ease the decoding process. The primary link between DVB SI and MPEG is the PSI in MPEG and is contained primarily in the PAT (Program Association Table), PMT (Program Map Table) and CAT (Conditional Access Table) set of tables.

5.4.5 EPG/EIT signalling

(59) The EPG/EIT signalling information provides Digital TV “Table of contents” services such as CA/Entitlement, Electronic program guide information.

5.4.6 Software update and reboot

(60) TLN provides signalling /transport support for AO STB´s initial configuration, boot, initial software download and software update services.

6 AO STB interactive Data Return path Functional Requirements

6.1 VoD DVB-C

6.2 iDTV interactive Data Return Path General Characteristic

6.2.1 iDTV interactive Data Return Path via Telenet Network

(61)The Network Interface Unit (NIU) is the point of connection to Telenet HFC network. The AO STB and Modem are connected to the NIU via a coax cable and the AO STB is connected to the AO Modem typically via an Ethernet port.

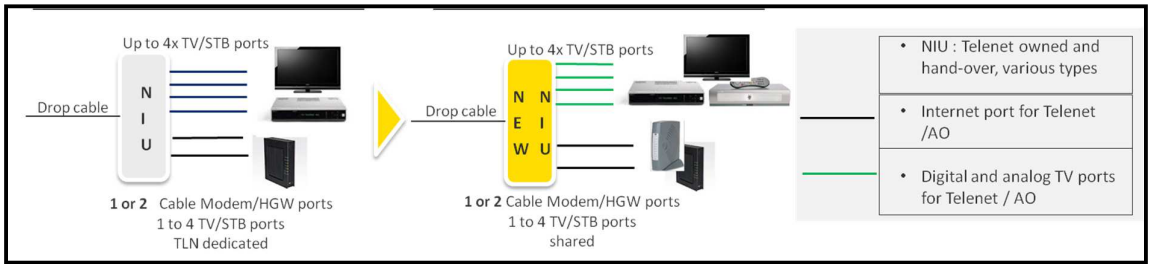


Figure 6-1: NIU

(62)STB IP traffic is forwarded to the Modem and placed by the Modem in a BSoD tunnel. All traffic from the modem will be routed over the correct AO point of interconnect.

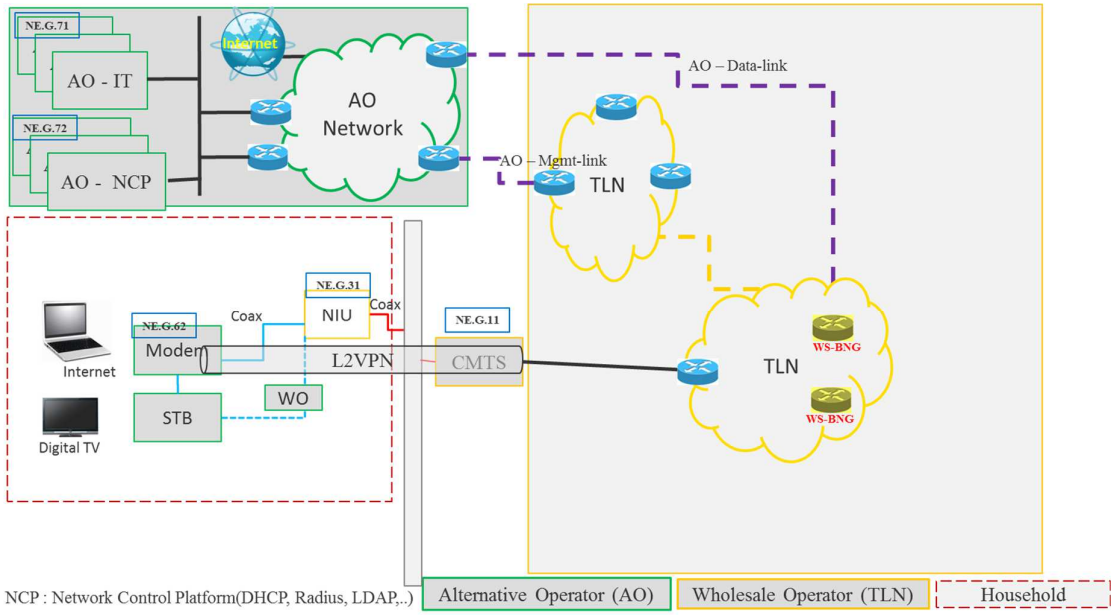


Figure 6-2: STB Traffic

6.2.2 iDTV interactive Data Return Path via other (non cable) network

The option exists for an AO to provide its own iDTV data return path over an alternative (non cable) access infrastructure. In this case TLN and the AO will set-up a managed interconnect link to allow communication at NOC-M and/or NOC-H POI where the AO aggregates all alternative return path traffic for which interaction is required with the Telenet Network (e.g. VoD stream management (trick play, ...)). The details of this aggregated alternative return data path link are further discussed in the document TLN_WRO_TA_B_S_PAAB - Specification and Certification for BB IP Interconnect.

6.2.3 iDTV interactive Data Return Path (via Cable) Control plane messages

(63) The connection path between the AO STB IP control plane and the TLN Network is handled by the Network Control Platform which on its turn acts as an intermediate towards AO systems involved in session set-up and tear-down, handling and allocation of IP – addresses, etc.

6.3 Physical Transport Connection

6.3.1 iDTV interactive Data Return Path via TLN cable network

(64) The AO Modem is interconnected via a coax jumper cable towards the NIU. The AO STB will be typically connected to the AO Modem via a UTP cable.

(65) In case AO users prefer not to place any new wires at home, the AO Modem can be connected to a power socket using a Powerline adapter so that the LAN side Ethernet signal of the Modem is carried on the electricity cables inside home and can be extracted via a second Powerline adapter at another place in the home for connection to the STB.

6.3.2 iDTV interactive Data Return Path via other (non cable) network

(66) In this case TLN does not impose any specific requirements on the connection.

6.4 Restrictions

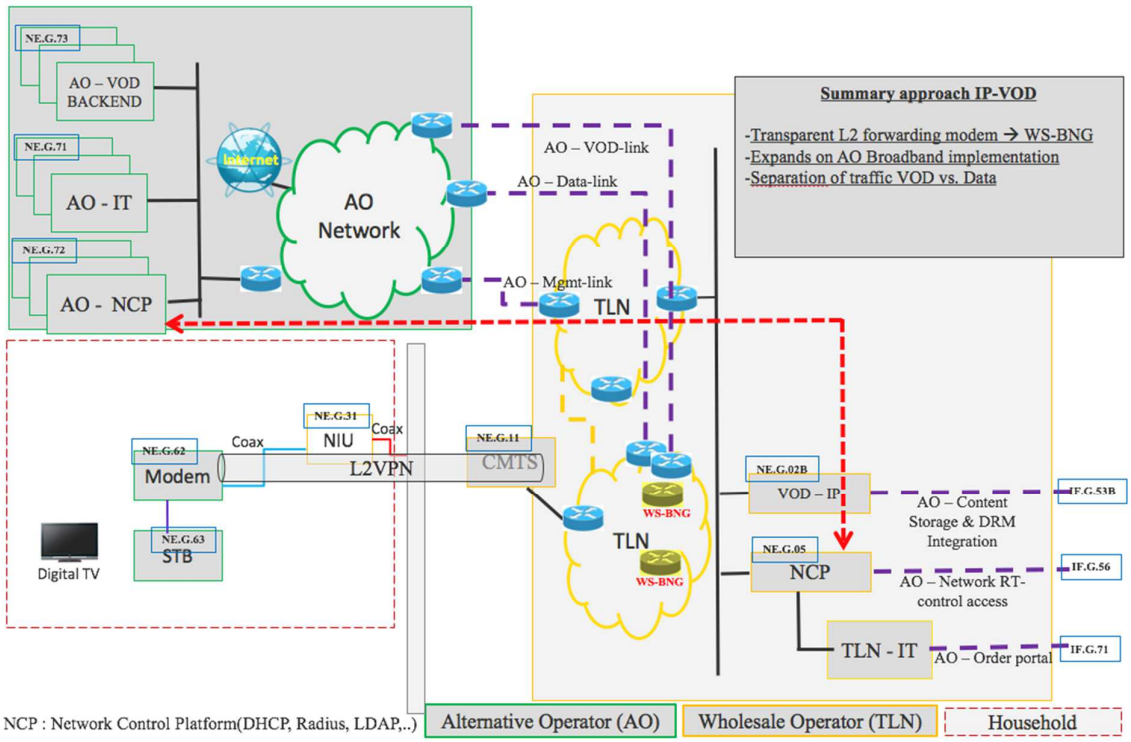
(67) Value added services on the iDTV return path, like (but not limited to) extended EPG data (2 weeks), STB management and supervision, VoD trick-play control management, etc. are not provided. As the return path offers a direct IP connection path between the AO STB and the AO back-end, the AO has the freedom to implement this by its own means.

(68) Traffic management rules and policies, as well as bandwidth restrictions will apply on the IP Data return path over the Telenet cable network and its use is strictly limited to providing TV related interactivity services in the framework of the ROTV.

(69) The IP return path has a designated bandwidth (US/DS) and does not provide guaranteed QOS.

6.5 VoD IP

(70) For VoD IP the IP data path is different than for VoD DVB-C. Refer to the ROTV and AIDTV Architecture, ROBB Architecture as well as IP Interconnect documents for more details, on top of the restrictions mentioned in this section.



6.5.1 Restrictions

(71)Because the STB will need to be a device on the LAN of the modem, it therefore requires the broadband setup of the TLN WHS offer.

(72)Traffic management rules and policies, as well as bandwidth restrictions will apply on the IP Data path over the Telenet cable network and its use is strictly limited to providing TV related interactivity services in the framework of the ROTV and AIDTV VoD IP.

(73)The IP path has a designated bandwidth (US/DS) and can provide QoS.

7 AO STB DVB-C Video on Demand (VoD) subsystem Functional Requirements

(74)This section describes the VoD system if the AO chooses to deliver the video assets over DVB-C.

7.1 VoD System Setup General Overview

(75)The VoD system set-up is described in the figure below. The purpose of each major building block is briefly described in the sub-sections below and the building blocks that require explicit interfacing towards AO equipment and systems are detailed in further sections in this document.

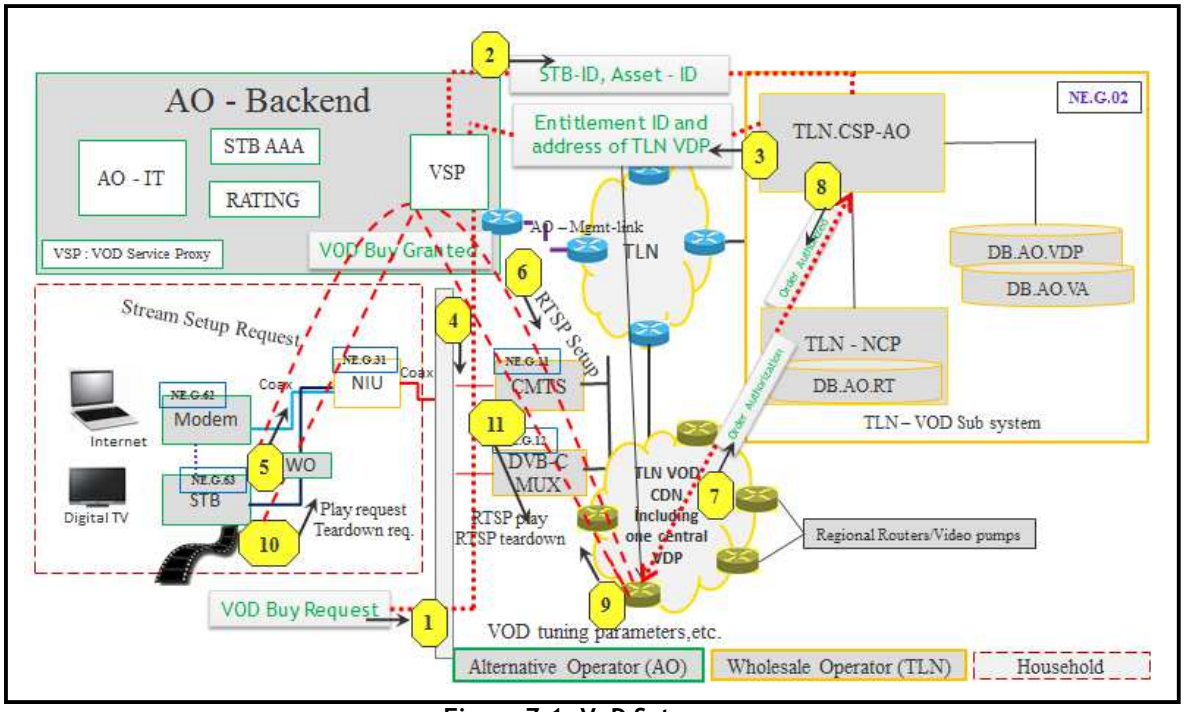


Figure 7-1: VoD Setup

Flow:

- The VoD buy request from AOSTB goes via AOVSP to TLNCSP-AO, and includes STB-ID and asset-ID
- TLNCSP-AO may grant or deny the request (valid STB-ID, asset-ID?). When granted it will return an Entitlement-ID and the address of the TLNVDP that will accept stream setup requests
- AOSTB requests stream setup from AOVSP, which sends an RTSP SETUP on behalf of the AOSTB to the appointed TLNVDP. The SETUP request includes the STB-ID, VoD Serving Area and Entitlement-ID.
- TLNVDP checks authorization (entitlement) and network resources, and instructs TLNCDN to prepare the stream, and returns to AOVSP the VoD tuning parameters and the TLNCDN server where trick play can be performed (and which session-id to use).
- AOSTB (via AOVSP) effectively starts the stream playout by sending RTSP PLAY request to the appointed TLNCDN server.
- The stream will continue playing until AOSTB (via AOVSP) sends RTSP TEARDOWN to TLNVDP (or other conditions cause TLNVDP to terminate the stream, such as pause time-out or end-of-stream reached).

7.1.1 AO VoD Service Proxy (VSP) and back-end

(76) The VoD Service Proxy (VSP) which is located in AO-Backend provides the transmission of a VoD Buy Request and stream control requests between AO STB and TLN VoD Subsystem. Response to the STB after a VoD Buy Granted/Denial is also provided by VSP. In this way it acts as main intermediate between the VoD client software on the AO STB´s and the Telenet VoD related back-end systems.

7.1.2 TLN VoD Core Services Platform for AO (TLNCSP-AO)

(77) The TLN Core Services Platform (CSP-AO) for AO is located in TLN-VoD Subsystem. After a VoD Buy Request is received, VSP transmits STB-ID and Asset-ID to the TLN CSP-AO which will do appropriate controls and send back the Entitlement-ID and addressing information of the TLNVDP to VSP for transmitting to the AO STB.

7.1.3 TLN VoD-CDN including VDP

(78) TLN VoD CDN is the content network having central resource management (VDP) and several regional routers/video pumps which will route and stream the content towards the AO STB (via DVB-C MUX for VoD) which has been requested by transmission of RTSP requests (setup, trick-play etc.) by this AO STB. In addition it will send order (entitlement) verification requests to the TLN-VoD Subsystem and check and perform allocation of streaming resources.

7.1.4 TLN - NCP

(79) NCP is the Network Control Platform which takes care of session set-up/tear-down and control in the broad sense using protocols like DHCP, Radius, LDAP, etc. TLN –NCP provides virtualization for multiple AO environments, clear separation between TLN and AO traffic/addresses, simple operations & easy scalability. It also acts as an intermediate with “similar” AO platforms.

7.1.5 TLN DVB-C MUX for VoD

(80) The TLN DVB-C MUX provides downstream transport services for the VoD media streams started on request of AO STB´s.

7.1.6 AO STB IP data return path

(81) This is an IP path that can be used by the AO STB only for interactive communication between the AO STB and the AO back-end systems for purpose of this annex. The IP return path does not have to be provided by Telenet (i.e. it is an option).

7.2 AO VoD Service Proxy (VSP)

7.2.1 General

(82) The VSP (VoD Service Proxy) is located in AO-Backend and communicates to the TLN-VoD subsystem on behalf of the AO STB´s. VSP acts as an aggregation proxy on behalf of all AO STB´s, aggregating all requests from AO STB customers engaging in the ordering of a VoD movie and keeping session state. It typically sends STB-ID, VoD serving area and VoD Asset-ID to the TLNCSP-AO and VDP in TLN-VoD subsystem and receives, upon successful authorization CDN parameters from there. Further it performs the role of main interface function to the AO CRM systems.

7.2.2 AAA and interaction with AO CRM

(83) The AO STB VOD client logic will need to support interaction with the AO CRM systems. The presence of the AO CRM (typically via an intermediate proxy platform)in the VOD order flow allows an AO to perform AAA and rating functions required for Network Authentication, Authorization, and Accounting and billing purposes.

7.2.3 Resource management

(84) The VOD resource management system is responsible for monitoring and dynamically reserving streaming capacity to deliver a VOD stream to a given customer. It will treat AO and TLN customers on a fair and equal basis. This implies that the resource management system will take into account that the bandwidth that can be allocated dynamically by a number of simultaneous streams generated on a node and VOD serving area is in proportion to the relative weight of the AO customer base on that node/area.

7.2.4 VOD asset order flow

(85) During the “Buy VOD Asset” process, Asset (STB-ID, asset-ID, VSA) request and grant are exchanged between AO CRM (AOVSP) and AOSTB, serving as identifiers of a particular asset by a particular AO STB. In case of any error, i.e.: Asset-ID does not belong to AO, VDP Resource Reservation will fail.

7.2.5 VOD media streaming

(86) TLN VDP delivers media streams to the STB`s of individual AO customers via one or more DVB_C QAM`s dedicated to VOD containing dynamically generated MPTS`s.

7.2.6 Trick-play commands

(87) The signaling for the trick play functionality (pause, play etc.) is assured by RTSP (Real Time Streaming Protocol). When RTSP request is sent for trick-play, VDP routers/video pumps will route and stream the content towards the AO STB. Pause action cannot be applied for a limitless time. The streams are released after a time-out period.

7.2.7 CDR and billing

(88)CDR (Call Detailed Record) and ADR (Audit Detailed Record) files are generated on a per period basis.

(89)CDR record files are fed on a per period basis into the TLN-IT wholesale billing/rating engines to allow the TLN wholesale department to produce an aggregate bill per AO, including consumption details for AO individual customers.

Subscription type wholesale billing will be calculated directly from the administrative order database.
The AO CRM involvement in the VOD order flow makes it possible to rate the VOD asset orders and create AO's own pricing and billing approaches for VOD.

7.2.8 AO VSP to TLN physical transport connection

(90)The Telenet Network will have "Management link" connections for each AO. These will be realized with a standard IP connection over the AO-IP-mgmt interconnect link. Since the link carries sensitive traffic, it is secured with IP-VPN (IPSEC and PKI protected).

(91) The VSP accesses the TLN-VoD systems on a secure (pre-configured) IP-VPN (IPSEC and PKI protected) over the "Management link". A Secure LOG process on all transactions is enabled using this PKI infrastructure.

7.2.9 VSP Protocol definition

(92)During the "Buy VoD Asset" process, Asset (STB-ID, asset-ID, VSA) request and grant are exchanged between AOVSP and AOSTB, serving as identifiers of a particular asset by a particular AO STB in a particular VoD serving area. The AOVSP interacts as a proxy with the TLN VoD systems (CSP-AO, VDP and CDN).

(93) In case of any error, VDP Resource Reservation will fail. Some of the possible error situations are listed below:

- STB-ID is not on white list.
- Asset-ID does not belong to AO.
- VSA is incorrect vs. AO STB network discovery path.

(94)The formal protocol definition which includes the programming API´s that will allow AO VSP to interact with the TLNCSP-AO will be made available during implementation phase to the beneficiary.

7.2.10 AO VSP AAA/Rating functions

(95)The presence of the AO VSP in the flow allows an AO to perform AAA and rating functions required for Network Authentication, Authorization, Accounting and billing purposes. By means of these functions, it is possible to know for AO which customers are on the network, keep in control of actions, create raw usage and audit information- and rate the VoD asset orders. Hence it gives the AO the necessary freedom to control its customer experience and create its own pricing and billing approaches for VoD.

7.2.11 TLN VoD orders control checks

(96)Following checks are applied by TLNCSP-AO on transactions send by AO VSP:

- Is the AO STB-ID on white list?

- Does the requested asset-ID belong to AO?

7.3 TLN VoD Resource Manager

7.3.1 General

(97) The VoD resource management system (VDP) is responsible for monitoring and dynamically reserving streaming capacity to deliver a VoD stream to a given customer. It will treat AO and TLN customers on a fair and equal basis.

7.3.2 TLN VoD Content Data Network (CDN) architecture

(98) Provisioning of AO hosted content (media, meta data) catalogue space, including management (upload, add/change/remove assets) and media distribution to regional network delivery points are performed via the TLN CDN, acting as a distributed content network.

(99) Access to TLN VoD service includes delivery under session control by AO of AO customer initiated media streams from this regional TLN CDN egress point until AO STB (via DVB-C MUX for VoD) according to same principles on QOS level (Network stream resource management provided by TLN) as applied to streams initiated by TLN retail customers.

7.3.3 TLN VoD CDN monitoring

(100) TLN monitors the used VoD capacity via a semi-manual process at TLN side based on network/server monitoring. CDR (Call Detailed Record) and ADR (Audit Detailed Record) files are generated on a per period basis (at least daily) sorted on a per AO basis.

7.3.4 VoD Capacity Management

(101) The VoD resource management system will treat AO customers on a fair and equal basis. This implies that the resource management will take into account that the bandwidth that can be allocated dynamically by a number of simultaneous streams generated on a node and VoD serving area is in proportion to the relative weight of the AO customer base on that node/area.

(102) AO VoD media assets will be encoded conform existing TLN parameter and bandwidth, currently SD or HD. No bandwidth/encoding quality variants will be allowed different from TLN standards. (Reason is to keep bandwidth resource management consistent). Catalogue publishing windows (updates becoming available to STB) will be the same as for TLN.

(103) The TLN resource manager has a real-time and accurate view at any moment in time on the available VoD streaming resources on per video pump and per HFC VoD serving area level. VoD order requests may not always be granted since a CDN server typically has a fixed boundary for the rate of request it can handle or the number of simultaneous streams that it can send out at any time. In addition boundaries at HFC node level exist with respect to the available bandwidth capacity allocated to VoD. SD and HD require different bandwidth capacity. Pause actions, introduced by the user via RCU trick play commands cannot be applied for an unlimited time as during pause the resources need to be kept reserved. Therefore paused streams are automatically released after a time-out period by the VDP.

7.4 TLN Video Pump (CDN) media stream delivery to AO STB

7.4.1 General

(104) In summary, the TLN CDN delivers media streams to the STB`s of individual AO customers via one or more DVB_C QAM`s dedicated to VoD containing dynamically generated MPTS`s.

7.4.2 Physical Transport connections

(105) When a cable subscriber purchases a VoD asset, the video stream is assigned to a QAM modulator over a specified 8 MHz RF channel on the HFC network dedicated to VoD delivery. The VoD QAMS are using MPTS over DVB-C encoding to ensure reliable transport of the VoD video frames from the VoD edge QAMS serving the VSA´s towards the STB´s.

7.4.3 Protocol messages

(106) The VoD delivery system uses the Real Time Streaming Protocol (RTSP) protocol for controlling set-up and playback control of VoD streams. The signaling for the stream setup and trick play functionality (pause, wind/rewind etc.) is assured by RTSP using the IP return path. The signaling messages used to notify the AO VSP which TLNVDP to contact and which entitlement id to use, are using a HTTP based TLN proprietary.

7.4.4 VoD Media Stream Delivery

(107) Technically, when the customer selects the movie, a point-to-point unicast connection is set up to the customer's STB from the delivering streaming server (CDN). This unicast connection is “emulated” over the DVB-C “broadcast” VoD QAM using dynamically generated Program ID´s (PID). The codec´s used for video are MPEG-2, MPEG-4 in MPTS transport containers. The signaling used to notify the AO STB in which VoD QAM and on which MPTS PID it will find the VoD movie it ordered is carried in the response to the RTSP SETUP request (TLNVDP)

(108) The role of the VoD QAM in the video-on-demand set-up is to receive an IP unicast stream containing MPEG transport stream packets over IP from the CDN after transport over the TLN IP backbone and then to re-produce that transport stream on the correct RF output for transmission over the hybrid fiber-coax cable plant. The PID remapping capability is used so that the QAM can guarantee that the IP unicast stream is converted into an MPTS with the correct PID and with the correct TSID as per instruction of the resource manager (VDP).

7.4.5 VoD regional serving areas (VRSA)

(109) The Telenet VoD CDN currently (mid 2013) contains 8 VoD regional serving areas. In each of those areas one or more CDN servers are located serving the total population of STB´s present in that area.

7.5 VDP VoD Transaction Authentication

7.5.1 General

(110) The TLN VDP will “authenticate” requests to start playing a particular VoD asset that it receives from AO STB`s by contacting the TLN VoD back-end to verify if the request parameters correspond to a prior reservation request it received from the AO VSP. TLN makes some specific controls triggered by the reception of the RTSP SETUP request on the VDP by contacting the TLN VoD back-end in order to verify if this is a valid request.

7.5.2 Transaction Authentication Results codes

(111) In normal conditions and when AO STB VoD client software behaving properly a transaction authentication should not fail, because appropriate reservation (entitlement) has been set-up prior to the request. However AO STB VoD client might generate transaction for which it did not do prior reservations, hence transactions may fail to be authenticated for reasons like :

- Unknown STB_ID
- Unknown Asset_ID
- Invalid Entitlement-ID
- Wrong VDP address (trying to use other VDP then with which reservation request was made
- General network errors

7.6 CA system for VoD transactions

7.6.1 General

(112) TLN uses an efficient network based mechanism to protect VoD content via a Conditional Access system.

7.6.2 Main principles of operation

(113) The AO will have to “enable” a given STB for participation in the TLN VoD service if it desires so by selecting this option in the TLN-IT-portal.

(114) Telenet uses group tokens (security encryption keys) that are rotated on continuous basis to protect “bundles” of VoD streams. The security keys are generated by the CA system (3rd party CA system in case of AO VoD streams) and fed to the regional VoD edge QAM´s where they are inserted in the dynamically generated transport streams containing individual VoD sessions.

(115) No further details are given in this public section of the document as this directly relates to security and content protection.

7.6.3 Detailed interface specification for TLN VoD CA usage

(116) The formal protocol definition, which include the programming API´s that will allow the AO STB and the AO 3rd party CA system to interact with the TLN VoD CA platforms will be made available during implementation phase to the beneficiary.

7.7 AO STB to TLN VDP and CDN RTSP Interface

7.7.1 General

(117) Further processing of a successful VoD buy request will result in AO STB to TLN VDP and CDN interaction (via AOVSP) which is implemented by means of RTSP at this interface. The AO STB to TLN VDP and CDN RTSP interface can be examined in figure 4-1 above.

7.7.2 Physical Transport connection

(118) Video servers are located in TLN VoD CDN areas. The TLNVDP servers are centrally located. All can be addressed by AO STB´s using RTSP protocol over a standard IP connection between the TLN and the AO network.

7.7.3 Protocol messages

(119) The TLN VoD platform uses MPTS over DVB-C for video streams and stream control is done using the Real Time Streaming Protocol over the IP data return path.

(120) The Real Time Streaming Protocol (RTSP) is a network control protocol designed for use in entertainment and communications systems to control streaming media servers. The protocol is used for establishing and controlling media sessions between end points. Clients of media servers issue VCR-like commands, such as play and pause, to facilitate real-time control of playback of media files from the server.

(121) The high level description of RTSP commands used by the TLN VoD service is as follows:

SETUP

A SETUP request is used to request a video pump controller (such as the TLN VDP) to allocate network resources and provide the client (such as the AO STB via AO VSP) with the transport parameters of the actual video stream. The TLN VDP also provides in the SETUP response the address of the CDN server and corresponding session-id for trick play.

PLAY

A PLAY request will cause the media streams to be played. A range can be specified. If no range is specified, the stream is played from the beginning and plays to the end, or, if the stream is paused, it is resumed at the point it was paused. A scale (speed) can be specified to control the playback speed (including speed 0 for pausing) and direction. PLAY requests are sent to the TLN CDN server assigned by the TLN VDP.

TEARDOWN

A TEARDOWN request is used to terminate the session. It stops all media streams and frees all session related data on the server.

GET_PARAMETER

GET_PARAMETER requests are sent periodically to the TLN VDP as long as the VoD session is active and is used as a form of keep-alive. The TLN VDP will terminate a stream if several keep-alives have been missed to free up network resources.

(122) The formal protocol definition which includes the programming API´s that will allow AO VSP to interact with the TLN VDP will be made available during implementation phase to the beneficiary.

TLN makes some specific controls during RTSP SETUP request. e.g.: Check: STB-ID on white list; VSA (is correct vs. network discovery), Entitlement-ID is valid.

7.8 VoD order and play-back message flow

(123) At the start of a VoD order (Buy VoD asset), the AOSTB sends a VoD buy request to its own VSP which includes AAA and Rating functions in AO-backend. The STB-ID and Asset-ID are added to the asset request by the VSP before it's sent to the TLN VoD System from AO VSP. This communication between TLN VoD and AO VSP occurs over a secured connection by IPSEC, KPI, to provide secure logging of the transaction.

(124) At TLN side, it is checked if the STB-ID is on white list and if the asset-ID belongs to AO or not. In case all checks are OK, then the VoD order request is approved and an entitlement is created of which the ID is returned to VSP.

(125) The VSP can then request stream preparation using RTSP SETUP, including the STB-ID, Entitlement-ID and VoD serving area of the AOSTB. The TLN VoD system then verified the validity of the entitlement and network resource reservation is started.

(126) The resource reservation module will check in its data tables if sufficient capacity is still available to play out the newly ordered stream on the designated Video server and within the VSA where the AO STB that issued the request resides. If this check is positive, the reservation is made and the stream preparation is completed and a positive reply is sent to the VSP in the AO Backend, which will on its turn, after having completed the necessary AAA and Rating logic, pass on the answer to the AO STB.

(127) Now the AO STB can start the play request. RTSP PLAY command is used for this and this command is sent via AOVSP to the TLN CDN. Video stream play clearance is now released to the AO STB and it's possible to send further trick-play commands from this AO STB. These are again RTSP PLAY commands and carry the user-interaction via its RCU to TLN via AOVSP.

7.9 Restrictions

(128) The TLN VoD offer does not include any VAS services on VoD like (but not limited to): Asset viewing window entitlement management (24H/48H); SD/HD compatibility check with STB; Bookmarking (AO must manage: restart viewing from bookmark point themselves).

(129) Value added services on the iDTV return path, like (but not limited to) extended EPG data (2 weeks), STB management and supervision, are not provided. As the return path offers a direct IP path between the AO STB and the AO back-end, the AO has the freedom to implement this by its own means.

(130) TLN will not provide iVoD (possibility to launch a VoD movie from inside an application). The AO has the capability to develop this by its own means.

7.10 Operational Procedures

(131) Telenet will execute from time to time operational changes on the VoD infrastructure. An AO making use of the TLN ROTV VoD part should be prepared at all time to adapt its infrastructure, devices and systems, as well as its operational procedures to handle those changes. In addition it is strongly recommended by TLN that AO will take this into account in the design of its solution, so that impact of future changes will be limited. Below a non exhaustive list is given, showing some examples of operational changes that TLN has executed in the past and which will be repeated likely in the future:

- Creation of new VoD regional service areas, or re-organization of existing ones
- Updates to the VoD security algorithms on the VoD CA systems
- Re-organization of the VoD catalogue data structures
- Introduction of additional VoD QAM´s
- Re-allocation of VoD QAMs in the HFC spectrum
- Changes in the configuration of mapping QAMs to HFC nodes
- Changes in VoD catalogue publishing schedules
- Changes in CDN distribution and propagation schedules and delays
- Changes in the RTSP dialect

8 AO STB IP Video on Demand (VoD) subsystem Functional Requirements

(132) This section describes the VoD system if the AO chooses to deliver the video assets over IP from a STB centric view. A perspective that focusses on the back-end side can be found in Reference 5.

8.1 IP VoD System Setup General Overview

(133) The VoD subsystem set-up is described in the figure below. The purpose of each major building block is briefly described in the sub-sections below and the building blocks that require explicit interfacing towards AO equipment and systems are detailed in further sections in this document.

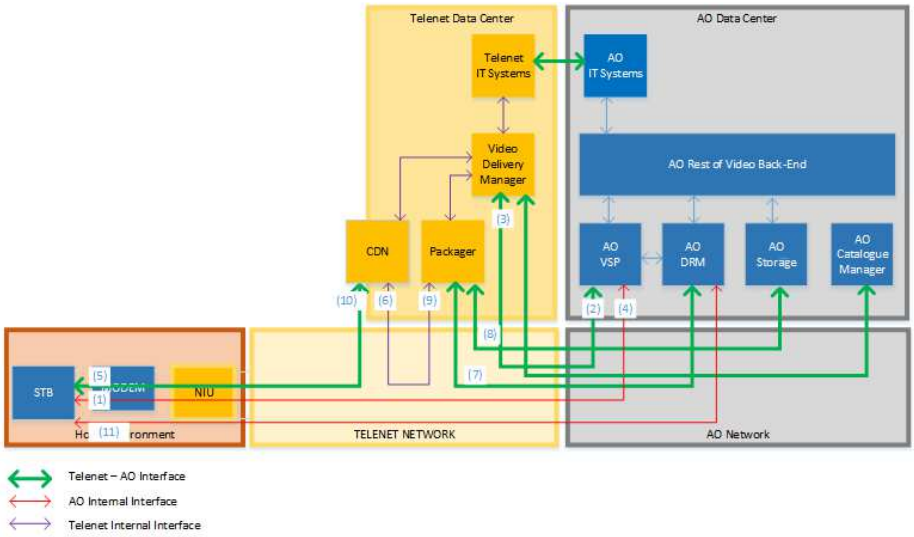


Figure 8-1: VoD Session Setup

(134) The typical (happy) flow the AO STB engages in for accessing and a video asset is described below:

- The UI interaction takes place between the AO STB and the AO Back-End. This happens over the AO VoD link.
- The VoD buy request from AO STB is sent to the AO VSP, subsequently, a request is issued from AO VSP to the TLN VDM. This request includes the STB-ID, the Asset-ID and other data.
- The TLN VDM component will grant or deny the request based on the STB-ID and Asset-ID data. If the request is granted, the TLN VDM will return a URL, of which the FQDN will point towards the TLN CDN. The URL will only be valid for a specific amount of time and for that specific STB and will contain tokens. The URL can both be HTTP or HTTPS. The AO VSP will pass on the URL to the AO STB.
- Using this URL the AO STB can fetch the content from TLN CDN. The CDN Node will check the validity of the request and if granted will return the requested data. The CDN node can also and this at any time, respond with an HTTP 302 message, effectively redirecting the request to another, more appropriate node.
- The TLN CDN will have caching capabilities, to offload components and network links behind it.
- In case the content is not yet cached, CDN will contact the packager and this one will fetch the content from AO storage, request an encryption key from AO DRM and performs on-the-fly encryption and packaging of the VoD assets.

8.2 AO STB

(135) The AO STB performs several functions to enable the delivery of VoD assets. It will communicate with the AO back-office over the AO VoD link. Once it has received a valid asset ID for a VoD asset that needs to be delivered over IP, it will interact with the AO VSP, with the AO DRM platform and with the Telenet CDN to obtain the asset.

8.2.1 AO STB – AO Back-End Integration

(136) The AO STB will interact with the AO Back-End to obtain the relevant data to present on the user interface.

8.2.2 AO STB – AO VSP Integration

(137) The AO STB will interact with the AO VSP to validate its requests and obtain the right link to the CDN. The details on how this interaction takes place is up to the AO to specify. The link to the CDN will be provided by the TLN VDM component to the AO VSP, details on this can be found further in this document.

8.2.3 AO STB – AO DRM Interaction

(138) The AO STB will interact with the AO DRM component to obtain the license for a specific video asset. The details on how this interaction takes place is up to the AO to specify.

8.2.4 VoD media streaming from CDN to AO STB

8.2.4.1 General

(139) The VoD delivery system uses an ABR protocol for delivering the video segments from the CDN to the AO STB. The requests from the STB to the CDN use the HTTP protocol, optionally over a TLS session (HTTPS). The video segments are packaged and encrypted by the Telenet Packager.

(140) The AO will need to ensure that the right mechanisms (e.g. Adaptive Bit Rate determination algorithm and buffering) are implemented in the STB to ensure the correct end-to-end working of the video delivery.

(141) TLN CDN delivers media streams to the STB`s of individual AO customers via an IP connection with the right QoS parameters. These QoS parameters will determine how the traffic is treated in the Telenet network.

(142) The TLN CDN delivers media streams to the STB`s of individual AO customers over a unicast IP path, using HTTP or HTTPS.

8.2.4.2 Video Protocol

(143) The TLN IP VoD platform uses HTTP delivery for Adaptive Bit Rate (ABR) streams for the delivery of video streams.

(144) Adaptive Bit Rate technology for video delivery has become the de facto standard for delivery of video assets over IP. Adaptive Bit Rate technology will have different video layers associated with a given video asset.

(145) The video layers are typically separated in different chunks or segments which are each retrieved via an HTTP request.

(146) In Adaptive Bit Rate technology, a manifest file contains metadata related to the video assets (e.g. addressing of a video chunk, DRM related information, different bit rates at which the video has been encoded.

(147) The Packager that is responsible for the on-the-fly packaging and encryption of the video assets supports the on-demand profile of the MPEG-DASH Standard.

(148) Common Encryption needs to be used and in terms of DRM technology, PlayReady DRM or Widevine DRM will need to be used by the AO.

(149) The codec´s used for video are MPEG-2, MPEG-4 in MPTS transport containers.

(150) More advanced features, such as trick play will make use of dedicated messages according to the ABR protocol.

(151) In the solution, dedicated controls and tokens are used and exchanged between the VDM and the AO VSP that will also be used during the exchange of messages between the AO STB and the CDN.

(152) The formal protocol definition which includes the programming API´s that will allow AO VSP to interact with the VDM will be made available during implementation phase to the beneficiary.

8.2.4.3 VoD Media Stream Delivery between AO STB and CDN

(153) Technically, when the customer selects the VoD asset, a point-to-point unicast TCP/IP connection is set up from the customer's STB to the delivering streaming server (CDN).

(154) The TLN CDN platform will be responsible for the delivery of this HTTP(S) streams towards the AO STB. This layer will act as an active Content Delivery Network, effectively being a reverse HTTP(S) proxy with caching capabilities.

(155) The TLN CDN will when necessary employ HTTP redirection mechanisms, like HTTP 302 messages, to redirect STB requests to a more appropriate TLN CDN node.

(156) The TLN CDN will also provide an extra layer of security by working with tokens, as part of the URL. This will be used to set a maximum lifetime of the URL.

(157) The formal protocol definition that will allow AO STB to interact with the CDN will be made available during implementation phase to the beneficiary.

8.2.5 TLN - NCP

(158) NCP is the Network Control Platform which takes care of session set-up/tear-down and control in the broad sense using protocols like DHCP, Radius, LDAP, etc. TLN –NCP provides virtualization for multiple AO environments, clear separation between TLN and AO traffic/addresses, simple operations & easy scalability. It also acts as an intermediate with “similar” AO platforms.

(159) The NCP, and corresponding interconnects, are required for VoD IP, since the broadband reference offer is a prerequisite, as described in the ROBB Architecture.

8.2.6 AO STB IP data path

(160) The AO VoD link will be used by the AO STB only for interactive communication between the AO STB and the AO back-end systems.

(161) The IP path requires the Telenet WHS broadband reference setup, as described in the ROBB Architecture, ROTV and AIDTV Architecture and IP Interconnect documents (References 7 and 8).

8.3 AO VoD Service Proxy

(162) The AO VSP (VoD Service Proxy) is located in AO-Backend and communicates to the TLN-VoD subsystem on behalf of the AO STB´s. VSP acts as an aggregation proxy on behalf of all AO STB´s, aggregating all requests from AO STB customers engaging in the ordering of a VoD movie. It sends STB-ID, VoD Asset-ID and other data to the TLN VDM-AO in TLN-VoD subsystem and receives, upon successful authorization, CDN parameters from there. Furthermore it performs the role of main interface function to the AO CRM systems.

8.3.1 VDM-VSP Protocol definition

(163) During the “Buy VoD Asset” process, Asset (STB-ID, asset-ID) request and grant are exchanged between AO VSP and AO STB, serving as identifiers of a particular asset by a particular AO STB. The AO VSP interacts as a proxy with the TLN VoD systems.

(164) If the request is accepted, the VDM will return a URL to the AO VSP. The AO VSP can then send this URL to the AO STB which can use this URL to request the video asset. The URL will contain the appropriate token.

(165) In case of any error, VDM Resource Reservation will fail. Some of the possible error situations are listed below:

- STB-ID is not on white list.
- Asset-ID does not belong to A0
- The Asset-ID does not belong to a VoD Service (e.g. SVoD/TVoD) mode where the STB (identified by the STB-ID) has been provisioned for

(166) The formal protocol definition that includes the programming API´s that will allow AO VSP to interact with the TLN VDM will be made available during implementation phase to the beneficiary.

8.3.2 AO VSP AAA/Rating functions

(167) The AO STB VoD client logic will need to support interaction with the AO CRM systems. The presence of the AO CRM (typically via an intermediate proxy platform) in the VoD order flow allows an AO to perform AAA and rating functions required for Authentication, Authorization, and Accounting and billing purposes.

(168) The presence of the AO VSP in the flow allows an AO to perform AAA and rating functions required for Network Authentication, Authorization, Accounting and billing purposes. By means of these functions, it is possible to know for AO which customers are on the network, keep in control of actions, create raw usage and audit information- and rate the VoD asset orders. Hence it gives the AO the necessary freedom to control its customer experience and create its own pricing and billing approaches for VoD.

8.3.3 CDR and billing

(169) CDR (Call Detailed Record) and ADR (Audit Detailed Record) files are generated on a per period basis.

(170) CDR record files are fed on a per period basis into the TLN-IT wholesale billing/rating engines to allow the TLN wholesale department to produce an aggregate bill per AO, including consumption details for AO individual customers.

Subscription type wholesale billing will be calculated directly from the administrative order database.
The AO CRM involvement in the VoD order flow makes it possible to rate the VoD asset orders and create AO's own pricing and billing approaches for VoD.

8.3.4 AO VSP to TLN physical transport connection

(171) The Telenet Network will have VoD link for each AO. This link will be used for the traffic between the Telenet network and the AO network. For more details on the AO VoD link, references 7 and 8 can be consulted.

8.4 AO DRM for VoD transations

8.4.1 General

(172) To perform Digital Rights Management, the AO will need to provide a DRM subsystem that will consist of a key server and a license server part.

8.4.2 Main principles of operation

(42) The AO STB will communicate with the AO DRM system to obtain the relevant license for a video asset. More specifically, it will integrate with the licsense server of the AO DRM subsystem. It is up to the AO to do this. This communication will happen over the AO VoD link.

(43) In the end-to-end solution, TLN provides a packager component that is reponsible for the on-the-fly encryption and packaging of the VoD assets. To realise this it is integrated with the AO DRM subsystem and more specifically the key server part. More details on the back-end integration can be found in Reference 5.

(44) The AO will share the DRM license with the AO STB over the IP data path. In the STB, the STB security module will be responsible for decrypting the encrypted VoD asset.

(45) To realise the end-to-end solution, the Common Encryption scheme (CENC) needs to be used.

(46) It will be up to the AO to integrate its component with the Telenet packager according to an interface provided by Telenet.

(47) No further details are given in this public section of the document as this directly relates to security and content protection. The formal protocol definition, which include the programming API´s that will allow the AO STB and the AO DRM subystem to interact with the TLN VoD packager platforms will be made available during implementation phase to the beneficiary.

8.4.3 AO DRM to TLN physical transport connection

(173) The Telenet Network will have VoD link for each AO that will be used for connection the AO DRM to the Telenet network. For more details on the AO VoD link, references 7 and 8 can be consulted.

8.5 Telenet Video Head End and CDN

8.5.1 Telenet VoD Delivery Manager (VDM)

(174) The TLN VoD Delivery Manager (VDM-AO) for AO is located in TLN-VoD Subsystem.

(175) At the start of a VoD order (Buy VoD asset), the AO STB sends a VoD buy request to its own VSP which includes AAA and Rating functions in AO-backend. The AO VSP forwards this VoD buy request, including a number of data elements such as the STB-ID and Asset-ID, to the TLN VDM.

(176) At TLN side, a number of checks are performed to assess the validity of the request. In case the VoD order request is approved, the VDM will send back the url and addressing information of the TLN CDN to VSP for transmitting further to the AO STB.

(48) In case of any error, VDM Resource Reservation will fail. Some of the possible error situations are listed below:

- STB-ID is not on white list.
- Asset-ID does not belong to A0
- The Asset-ID does not belong to a VoD Service (e.g. SVoD/TVoD) mode where the STB (identified by the STB-ID) has been provisioned for

(177) When the CDN node receives the request from the STB, it will check the validity of the embedded token in the URL. Subsequently it will ensure the video data is returned and that the right resources are allocated in the network to ensure the traffic is treated with the required QoS level.

(178) The communication between AO VSP and Telenet VDM happen over the AO VoD link.

8.5.2 Telenet Packager

(179) The Telenet packagers is responsible for the on-the-fly packaging and encryption of the video assets.

(180) The packager components is not directly interacting with the AO STB. The assets themselves will be delivered to the AO STB over the CDN.

(181) The packager will support Common Encryption allowing PlayReady and Widevine DRM.

(182) The packager will support the ISO BMFF on demand profile of MPEG-DASH.

(183) If the video segments are not cached in the CDN, the packager will perform the on-the-fly encryption and packaging. In assigning the resources required to do this the different AOs or parties that will make use of the packager will be assigned on a fair and equal basis.

(184) Video Packager resource monitoring is done on two levels, (1) fully automated within the video packager (2) semi-manually to continuously expand the system in order to meet the requirements, based on CDR/ADR information.

(185) More details on the back-end integration of the packager can be found in reference 5.

8.5.3 Telenet Content Delivery Network

8.5.3.1 Content Delivery

(186) The TLN CDN platform will be responsible for the playout of the HTTP(S) streams towards the AO STB. This layer will act as an active Content Delivery Network, effectively being a reverse HTTP(S) proxy with caching capabilities.

(187) TLN CDN has central resource management and several regional delivery nodes which will route and stream the content towards the AO STB, which has been requested by transmission of the request issued by this AO STB. In addition, it will send order (entitlement) verification requests to the TLN-VoD Subsystem and check and perform allocation of streaming resources.

(188) The TLN CDN can listen to the origin (TLN Packager) for HTTP header options, like Cache-Control.

(189) The TLN CDN will when necessary, employ HTTP redirection mechanisms, like HTTP 302 messages, to redirect STB requests to a more appropriate TLN CDN node.

(190) The TLN CDN will also provide an extra layer security by working with tokens. This will be used to set a maximum lifetime of the URL.

(191) The formal protocol definition that will allow AO STB to interact with the CDN will be made available during implementation phase to the beneficiary.

8.5.3.2 TLN VoD Resource Management

8.5.3.2.1 General

(192) The VoD resource management system is responsible for monitoring and dynamically reserving streaming capacity to deliver a VoD stream to a given customer. It will treat AO and TLN customers on a fair and equal basis. This implies that the resource management system will take into account that the bandwidth that can be allocated dynamically by a number of simultaneous streams generated on a node and VoD serving area is in proportion to the relative weight of the AO customer base on that node/area.

8.5.3.2.2 TLN Content Delivery Network (CDN) Resource Management

(193) TLN CDN has central resource management and several regional delivery nodes which will route and stream the content towards the AO STB, which has been requested by transmission of the request issued by this AO STB.

(194) The TLN CDN will when necessary, employ HTTP redirection mechanisms, like HTTP 302 messages, to redirect STB requests to a more appropriate TLN CDN node to meet the requested resources.

8.5.3.2.3 TLN CDN monitoring

(195) CDN monitoring is done on two levels, (1) fully automated within the CDN to spread the load over the entire system and optimally use the available capacity and (2) semi-manually to continuously expand the system in order to meet the requirements, based on CDR/ADR information.

8.5.3.2.4 VoD Capacity Management

(196) The VoD resource management system will treat AO customers on a fair and equal basis. This implies that the resource management will take into account that the bandwidth that can be allocated dynamically by a number of simultaneous streams generated on a node is in proportion to the relative weight of the AO customer base on that node.

(197) AO VoD media assets will be encoded conform existing TLN parameter and bandwidth. The details on the supported formats can be found in Reference 5. No bandwidth/encoding quality variants will be allowed different from TLN standards. (Reason is to keep bandwidth resource management consistent). Catalogue publishing windows (updates becoming available to STB) will be the same as for TLN.

(198) The TLN resource manager has a real-time and accurate view at any moment in time on the available VoD streaming resources on per CDN node and per HFC node. VoD order requests may not always be granted since a CDN server typically has a fixed boundary for the rate of request it can handle or the number of simultaneous streams that it can send out at any time. In addition, boundaries at HFC node level exist with respect to the available bandwidth capacity allocated to VoD. SD and HD require different bandwidth capacity.

8.5.3.3 VDM VoD Transaction Authentication

8.5.3.3.1 General

(199) The TLN CDN will “authenticate” requests to start playing a particular VoD asset that it receives from AO STB`s.

8.5.3.3.2 Transaction Authentication Results

(200) In normal conditions and when AO STB VoD client software behaving properly a transaction authentication should not fail, because appropriate reservation (entitlement) has been set-up prior to the request. However AO STB VoD client might generate transaction for which it did not do prior reservations, hence transactions may fail to be authenticated for reasons like :

- Unknown STB_ID
- Unknown Asset_ID
- Invalid Entitlement-ID
- Wrong CDN address
- General network errors
- Transaction no longer valid (due to timing expiration)
- Incorrect token hash

8.5.4 Physical Transport connection

(201) Video servers are located in TLN VoD CDN areas. The TLN VDM servers and packagers are centrally located.

(202) The CDN nodes can be addressed by AO STB´s over a standard IP connection between the TLN and the AO network.

(203) The Telenet CDN locations, since maintained by Telenet and on it's network, will be managed by Telenet at its own discretion.

8.6 General Considerations

8.6.1 Restrictions

(204) The TLN VoD offer does not include any VAS services on VoD like (but not limited to): SD/HD compatibility check with STB; Bookmarking (AO must manage: restart viewing from bookmark point themselves).

(205) Value added services on the iDTV IP data path, like (but not limited to) extended EPG data (2 weeks), STB management and supervision, are not provided.

(206) TLN will not provide iVoD (possibility to launch a VoD movie from inside an application). The AO has the capability to develop this by its own means. In this case, this will not make use of QoS mechanisms.

8.6.2 Operational Procedures

(207) Telenet will execute from time to time operational changes on the VoD infrastructure. An AO making use of the TLN ROTV VoD part should be prepared at all time to adapt its infrastructure, devices and systems, as well as its operational procedures to handle those changes. In addition it is strongly recommended by TLN that AO will take this into account in the design of its solution, so that impact of future changes will be limited. Below a non exhaustive list is given, showing some examples of operational changes that TLN has executed in the past and which will be repeated likely in the future:

- Creation of new VoD regional service areas, or re-organization of existing ones
- Updates to the VoD security algorithms on the VoD DRM systems
- Re-organization of the VoD catalogue data structures
- Introduction of new CDN nodes
- Changes to the IP QoS levels and signalling
- Changes in VoD catalogue publishing schedules
- Changes in CDN distribution and propagation schedules and delays
- Changes in ABR protocol
- Changes in token

8.6.3 System Scaling

(208) The IP VoD subsystem contains several components that will need to be dimensioned according to the actual load that is required to serve the AO subscribers. These include the CDN, the packager and the Video Delivery Manager.

(209) The AO will provide the relevant estimates and data to dimension the components in accordance with the required capacity.

9 AO Device Management by TLN Requirements

9.1.1 Concept and purpose

(210) TLN requires that it has remote management access with a minimum basic capability set on AO CPE devices. This access is required to allow TLN to ensure network integrity and assist the AO in efficient troubleshooting on complex E2E network problems, by being capable of integrating a basic management view of the AO devices in TLN´s troubleshooting tools.

9.1.2 Device management Functions

(211) For the non interactive DTV service without an IP network return path. As the device is not remote reachable from the network, no remote management functions are possible.

(212) TLN recommends however that the AO will build in enough diagnostic capabilities in its STB that can be activated by the end-user, under guidance of an AO telephone support advisor to assist in easy troubleshooting.

(213) For an interactive DTV service following minimum remote device management functions are required:

- STB Data-link loop back test: allows testing data path connectivity from a central network location until STB Ethernet interface
- STB DVB-C QAM tuner level test (SNR, BER, ERRPKT, lock mode): allows testing the current condition and performance of the STB tuner on the signal quality level.
- VOD null stream E2E loopback test: allows testing if a VOD stream can be received.
- STB status parameter test: allows reading the essential parameters on the STB that will reflect its operational status.

9.1.3 SNMP MIB specifications

(214) For the non interactive DTV service without an IP network return path, SNMP management is not possible.

(215) Management Information Bases (MIBs) are a collection of objects or definitions that define the properties of managed objects. TLN needs to know the names and types of a subset of objects on AO Docsis CPE (CM) to enable the TLN SNMP manager or management application to perform a minimum subset of operations on AO CPE equipment that are required for successful operation of the network.

(216) The formal definition of this subset of objects, parameters and the operations on them are provided in the format of an SNMP MIB definition in TLN_WRO_TA_G_S_PAAB _ Specification for Device Management).

9.1.4 Reset and Factory Reset specifications

(217) Different reset scenario need to be performed.

- Via UI menu
  - Reset settings
  - Reset settings with full disk (PVR only)
  - Reset setting and keep recordings (PVR only)

- Via SNMP (MIB Navigator-Telenet-Trigger)
  - Full factory reset

  - Factory reset keep recording (PVR only)
  - Soft reset and keep setting
  - Soft reset and perform FSCK

- Via SNMP (MIB Core-CoreReset)
  - Reinit
  - Reset

- Via IRD (STB)
  - Full factory reset
  - Factory reset keep recording (PVR only)
  - Soft reset and keep setting
  - Soft reset and perform FSCK
  - Reinit
  - Reset

- Via STB front panel
  - Reinit
  - Reset

10 AO STB general - Non Functional Requirements

10.1 Mechanical Requirements

10.1.1 Housing

(218) TLN does not impose any requirements as this is the responsibility domain of the AO. However it is strongly advised to AO to follow industry standard practices.

10.1.2 Diagnostic Leds

(219) Below are the minimum LED indication requirements that should be supported by AO STB in order to assist in efficient troubleshooting.

- Alert LED
  - Not active during normal mode
  - Not active when tuned on blocked channel
  - Not active when Ethernet cable is disconnected
  - Active when coax removed
  - Active when tuned on faked channel
  - Active when box not paired
- Recording LED
  - Active during recording
  - Deactivated when recording finished
- Power LED
  - Green in operational mode
  - Orange in standby mode

10.1.3 Labels

(220) TLN does not impose any requirements as this is the responsibility domain of the AO. However it is strongly advised to AO to follow industry standard practices. In addition the logo of the AO must be clearly visible on the device to facilitate customer support and repair actions, giving as such a clear visual indication if a CPE in a customer's home is owned by TLN or one of the AO´s.

10.1.4 Connectors

(221) TLN imposes requirements only for the Antenna-in connector towards the WO, the rest is AO choice and responsibility, but TLN strongly recommends following industry standards.

- All RF connectors must be F (IEC169-24), torque resistance: 4Nm

  Inner conductor:

  Minimum diameter 0,57mm, clamping force 30 grams
  Nominal diameter 0,8mm, clamping force 50 grams
  Maximum diameter 1,0mm, clamping force 80 grams

10.2 Environmental Requirements

10.2.1 Packaging

(222) TLN does not impose any requirements as this is the responsibility domain of the AO. However it is strongly advised to AO to follow industry standard practices.

10.2.2 RoHS and WEEE compliancy

(223) RoHS is the directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment on 2002/95/EC and the abbreviation for Restriction of Hazardous Substances. This directive is closely linked with Waste Electrical and Electronic Equipment Directive (WEEE) – 2002/96/EC.

(224) These directives are in the responsibility domain of AO, and TLN does not impose any requirements. AO is strongly advised to follow the standards and the requirements imposed by law about RoHS.

10.2.3 EU CoC compliancy

(225) TLN does not impose any requirements as this is the responsibility domain of the AO. However it is strongly advised to AO to follow industry standard practices and any requirements in this domain imposed by law should be met.

10.3 Safety Requirements

10.3.1 Surge and Lightning protection

(226) Telenet will execute a group of tests to be able to determine the immunity level of the various interface ports of the AO STB (sometimes in combination with the AO CM and TLN NIU) against voltages over-surges and lightning strikes. Common mode tests will be carried out up to a test level of 10 kV. Ground will be either the premises earth of the customer or in case of absence of the latter the braid of the CATV cable. Tests that will be carried out are destructive, using a different (new) STB at each stage to avoid “exhausting” phenomena. The connection between STB and modem (if applicable) will be made using a UTP RJ45. After each test the functionality of the STB will be verified. Detailed info can be obtained in the reference document.

(227) This section has a corresponding appendix document with reference: Appendix A (see List of Appendixes section).

10.3.2 Temperature and Humidity

(228) TLN does not impose any requirements as this is the responsibility domain of the AO. However it is strongly advised to AO to follow industry standard practices.

10.3.3 Fire resistance

(229) Fire resistance rating means the time that a material or assembly of materials will resist the effects of fire as determined by the appropriate standard fire test prescribed in the NBC.

(230) This rating is in the responsibility domain of AO, and TLN does not impose any requirements. AO is strongly advised to follow the standards and the requirements imposed by law about Fire resistance.

10.4 EU Consumer Goods label Requirements

10.4.1 CE - mark

(231) CE marking (originally EC mark) is a mandatory conformity mark for products placed on the market in the European Economic Area (EEA). With the CE marking on a product the manufacturer ensures that the product conforms to the essential requirements of the applicable EC directives. The letters "CE" stand for "Conformité Européenne" ("European Conformity").

(232) This conformity is in the responsibility domain of AO, and TLN does not impose any requirements. AO is strongly advised to follow the standards and the requirements imposed by law about CE labeling.

11 Certification procedure for AO STB to enable usage of TLN ROTV

11.1 Introduction

(233) The tests will cover all of the requirements specified by TLN in this specification document.

12 Test score card

CONFORMANCE TEST SCORE CARD	
Conformance Test Score Card Number	TLN-WRO-TA-TSC-C-PAAA
Test Identification	
Test Execution Date	
Test Run Type	Full / Reduced(without OOS cases)
Device / Equipment / Interface Name	
Device / Equipment / Interface Type / Class	
AO Device / Equipment / Interface Identification	
Software Version	
Tested by	
Overall Result Status	Pass / Fail
Applicability	Select 1 or more : ROTV / ROBB / AIDTV

CONFORMANCE TEST ITEM LIST					
Test Cases Summary	FORMAT	IN SCOPE	MAN	PASS/FAIL	REM
			"Y/N"	**"P/F"**	(*xy)
3. AO STB General Functional Requirements	**HO**				
3.1. AO STB Hardware and OS	NA		Y		
3.2. AO STB Middleware	NA		Y		
3.3. AO STB Business Logic Layer	NA		Y		
3.4. AO STB User Interface Layer	NA		Y		
4. AO STB CAS Subsystem Functional Requirements	**HO**				
4.1. General			Y		
4.2. AO STB CAS SUBSYSTEM			Y		
4.3. 3RD PARTY CA SYSTEM TO TLN VHE INTERFACE			Y		
4.4. CA PROVISIONING			Y		
4.5. CA RESTRICTIONS			Y		
4.6. TLN CA OPERATIONAL PROCEDURES			Y		
5. AO STB Digital Video Broadcast – Cable (DVB-C) signaling subsystem Functional Requirements	**HO**				
5.1. General			Y		

5.2. AO STB DVB-C CABLE FRONT-END	N NA		Y		
5.3. DVB-C NORMATIVE REFERENCES			Y		
5.4. TLN DVB-C SIGNALLING FOR AO STB	N NA		Y		
6. AO STB interactive Data Return path Functional Requirements	**HO**		Y		
6.1. *IDTV INTERACTIVE DATA RETURN PATH GENERAL CHARACTERISTIC*	NA		Y		
6.2. *PHYSICAL TRANSPORT CONNECTION*	NA		Y		
6.3. *RESTRICTIONS*	NA		Y		
7. AO STB DVB-C Video on Demand (VoD) subsystem Functional Requirements	**HO**				
7.1. *VoD SYSTEM SETUP GENERAL OVERVIEW*			Y		
7.2. *AO VoD SERVICE PROXY (VSP)*			Y		
7.3. *TLN VoD RESOURCE MANAGER*			Y		
7.4. *TLN VIDEO PUMP (CDN) MEDIA STREAM DELIVERY TO AO STB*			Y		
7.5. VDP VoD TRANSACTION AUTHENTICATION			Y		
7.6. CA SYSTEM FOR VoD TRANSACTIONS			Y		
7.7. AO STB TO TLN VDP AND CDN RTSP INTERFACE			Y		
7.8. VoD ORDER AND PLAY-BACK MESSAGE FLOW			Y		
7.9. RESTRICTIONS			Y		
7.10. OPERATIONAL PROCEDURES			Y		
8. AO STB IP Video on Demand (VoD) subsystem Functional Requirements	**HO**				
8.1. *IP VoD SYSTEM SETUP GENERAL OVERVIEW*			Y		
8.2. *AO STB*			Y		
8.3. *AO VoD SERVICE PROXY (VSP)*			Y		
8.4. AO DRM for VoD TRANSITIONS			Y		
8.5. TELENET VIDEO HEAD END AND CDN			Y		
8.6. GENERAL CONSIDERATIONS			Y		
9. AO Device Management by TLN Requirements	**HO**				
10. AO STB general - Non Functional Requirements	**HO**				
10.1. *MECHANICAL REQUIREMENTS*			Y		
10.2. *ENVIRONMENTAL REQUIREMENTS*			Y		
10.3. *SAFETY REQUIREMENTS*			Y		
10.4. *EU CONSUMER GOODS LABEL REQUIREMENTS*			Y		
Remarks					
(*xy) : "Remark explanation comes here"					