TLN WRO Specification type Document

< Media Access Control *(MAC)* and Upper layer interface specification for connection of AO Euro-Docsis 3.0 equipment to TLN network >

Document Housekeeping

Document Category and type

CAT	TYPE	DOC ID	Comment
Broadband	SPEC	TLN-WRO-TA-B-S-PAAC	Specification type documents (-SPEC) are documents specifying logical / physical interfaces / protocols, etc.., to which AO equipment/systems need to comply

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A reference to an appendix is in this document highlighted with grey background.

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 CAT: Broadband: TLN-WRO-TA-B-C-PAAC
Reference 2 : TLN WRO CAT: Broadband: TLN-WRO-TA-B-C-PAAB
Reference 3 : TLN WRO CAT: Broadband: TLN-WRO-TA-B-C-PAAA

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1 Abstract

This document describes which specifications AO Docsis Euro-Docsis 3.0 CPE should sustain to interoperate with TLN ROBB on MA, IP and Upper layers functionality. Each required specification is briefly described explaining it´s expected functional behavior.

This document has a corresponding certification document with reference: TLN-WRO-TA-B-C-PAAC which is used to test AO Docsis equipment compliance against this specification.

The feasibility of the technical designs and methods described in this document are subject to verification by a Proof of Concept (POC) test organized by Telenet and may be changed or updated depending on the outcome of this POC.

2 Glossary and Abbreviations

ACK: Acknowledge Packet
API: Application Programming Interface
BB: Broadband
BW: Bandwidth
CM: Cable modem
CMTS: Cable Modem Termination System
CPE: Customer Premises Equipment
DB: Database
DHCP: Dynamic Host Configuration Protocol
DOCSIS: Data over Cable Service Interface Specification
DS: Downstream
EC: European Committee
GRE: Generic Routing Encapsulation
GTC: GRE Tunnel Concentrator
HFC: Hybrid Fiber Coax
HW: Hardware
IP: Internet Protocol
MAC: Media Access Control
NCP: Network Control Platform
NE: Network Element
OAM: Operation and Maintenance
OSS: Operation Support Systems
RPOI: Regional point of interconnection
SNMP: Single Network Management Protocol
TFTP: Trivial File Transfer Protocol

3 AO Euro-Docsis 3.0 CPE MAC and Upper Layer Functional Description

(1) The AO Docsis CPE is the equipment, required to connect an AO customer to the TLN HFC network with as purpose to provide broadband internet connectivity in the customer household. There are typically two main building blocks present in a Docsis CPE device: the "physical interface layer" used to establish the RF connectivity and Docsis physical layer communication between the Docsis CPE and HFC Network, and the "data interface communication layer" used to establish the "data communication path" with the help of MAC and IP layer interfaces' addresses and control plane protocols. Since the TLN network operates in compliance to the Euro-Docsis standards variant of the Docsis standards framework, all the requirements and references should be read as being referred to the Euro-Docsis perspectives of the standards.

(2) There are a number of important specifications that AO Docsis CPE should support for MAC, IP and upper layer communication. These specifications describe how the AO Docsis CPE should react to provide connectivity with TLN HFC Network, what security conditions AO Docsis CPE should reselect, and which features should be present in the AO Docsis CPE to interoperate with TLN CMTS within the Docsis Operation Support System Interface specifications domain.

4 AO Euro-Docsis 3.0 CPE MAC and Upper Layer Functional Requirements

4.1 Euro-Docsis 3.0 MAC and upper Layer

4.1.1 Euro-Docsis 3.0 Mac and upper layer general requirements

(3) In order to ensure successful interoperability on the MAC layer, IP layer and the upper layers the AO Euro-Docsis CPE device must be in conformance with the Docsis 3.0 MAC and upper layer specifications (Euro-Docsis variant) as published in the public Docsis 3.0 specification library on www.cablelabs.com.

4.1.2 Euro-Docsis 3.0 Mac and upper layer TLN specific requirements

(4) The TLN network implementation is fully in accordance with the Euro-Docsis specifications. As such no specific TLN requirements are applicable. However the Euro-Docsis specifications allow an operator to choose a number of implementation options within the framework of the specifications. Those implementation options are mainly related to the domains of device provisioning, address management, device configuration and security. The implementation options that TLN has chosen in those domains are explained further in this document.

4.2 Euro-Docsis 3.0 Security

4.2.1 Euro-Docsis 3.0 Security layer general requirements

(5) As Docsis modems are operating on a shared access medium a strict compliance to the Docsis security specifications (Euro-Docsis variant) on the MAC layer and upper layers for the AO Euro-Docsis CPE as published in the public Docsis 3.0 specification library on www.cablelabs.com.

4.2.2 Euro-Docsis 3.0 Security layer TLN specific requirements

(6) The TLN network implementation is fully in accordance with the Euro-Docsis specifications. As such no specific TLN requirements are applicable. However the Euro-Docsis specifications allow an operator to choose a number of implementation options within the framework of the specifications. Those implementation options are mainly related to the domains of device provisioning, address management, device configuration and security. The implementation options that TLN has chosen in those domains are explained further in this document.

4.3 Euro-Docsis 3.0 OSSI

4.3.1 Euro-Docsis 3.0 OSSI general requirements

(7) In order to guarantee seamless interoperability with the TLN CMTS systems in the domains of network management and provisioning a strict compliance is required for the AO Euro-Docsis CPE to the Docsis Operations Support Systems Interface (OSSI) specifications (Euro-Docsis variant) as published in the public Docsis 3.0 specification library on www.cablelabs.com.

4.3.2 Euro-Docsis 3.0 OSSI TLN specific requirements

(8) The TLN network implementation is fully in accordance with the Euro-Docsis specifications. As such no specific TLN requirements are applicable. However the Euro-Docsis specifications allow an operator to choose a number of implementation options within the framework of the specifications. Those implementation options are mainly related to the domains of device provisioning, address management, device configuration and security. The implementation options that TLN has chosen in those domains are explained further in this document.

4.4 Older Docsis versions

(9) The TLN network is closed for deployment of Docsis 2.0, Docsis 1.0 or any other non Docsis 3.0 compliant CPE equipment. The only Docsis version on AO Docsis CPE must be Docsis 3.0.

4.5 AO CPE MAC and IP layer provisioning: “Off-line” stage

4.5.1 AO Docsis CPE asset white list upload

(10) TLN requires a list (white list) of HFC MAC addresses (and some related information) of AO customer CPEs per AO, at least two weeks prior to the potential installation and connection to the TLN HFC network of a device on this list by the AO. This implies that an upload mechanism and related process is foreseen to allow transfer of those lists on a regular basis. These HFC MAC addresses are configured in the TLN NCP inventory databases with the default profile for each AO operator. Based on these HFC MAC addresses, TLN authenticates devices before granting them access to the cable network.

(11) If the AO does not upload HFC MAC addresses upfront, the onsite technician or eventual self install procedures for the AO will fail. In that case, the AO CPE modem will be treated as a not provisioned Telenet modem and redirect to the Telenet self install portal when it tries to come online. No further interaction will be possible in this case, until the AO has uploaded the HFC MAC address for this modem as described above. The upload time slot windows and the time periods between the upload of the modem list and the first moment in time such a modem can be become active in the network is described in the technical processes documents.

4.5.2 AO Docsis CPE modem configuration template upload

(12) The AO must upload AO CPE modem configuration files for each individual cable modem that has earlier been uploaded on the white list (as described above) on a TLN NCP configuration server. A modem configuration file will be linked to an individual HFC MAC address by including this individual MAC address as part of the configuration file name. The configuration file contains the required parameters that the modem needs to get connectivity and establish data path between the TLN and AO networks. TLN requires configuration files to be uploaded upfront to avoid excessive real time interactions between AO and TLN NCP systems when the modem comes online.

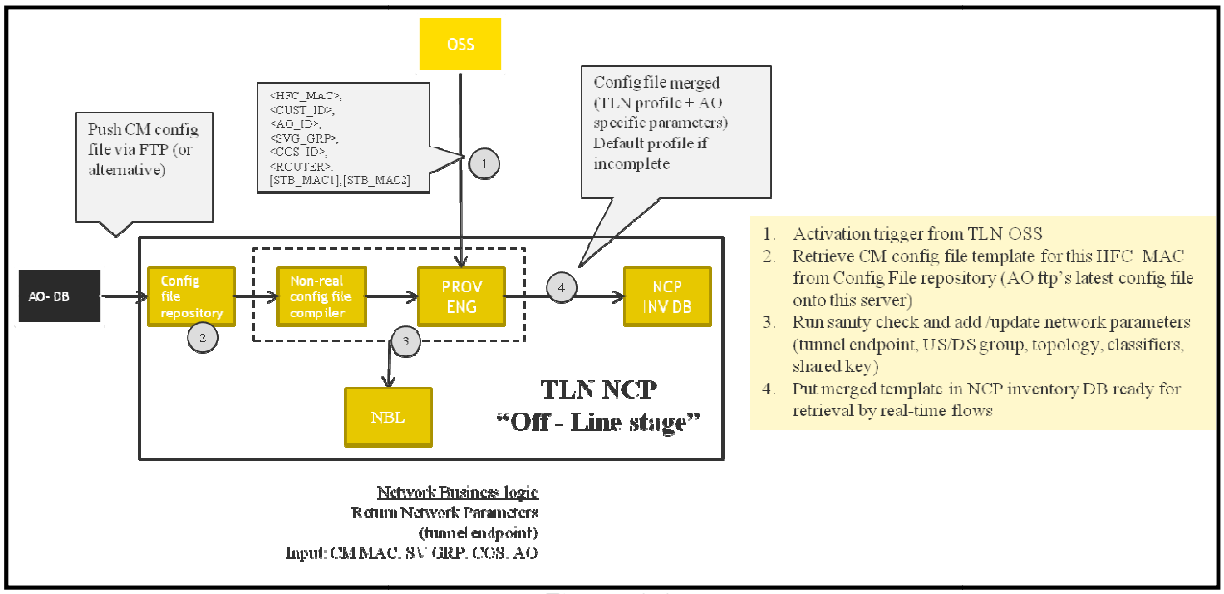

Figure 4-1

4.6 AO CPE MAC and IP Layer provisioning: “On-line” stage

4.6.1 AO Modem activation flow

(13) In the description of the “Off-line” stage process above (figure 4-1) it has been explained how an AO can upload lists of Docsis CPE devices and their related configuration files into the NCP inventory database (LDAP). Further it has been shown how TLN runs sanity checks on the AO provided configuration files and how it adds /updates network parameters (tunnel endpoint, US/DS groups, topology information, classifiers, shared key etc.) describing how the TLN network will transport the traffic of AO customers to the hand-over points and how it stores the merged final AO modem configuration files in the NCP LDAP inventory database.

(14)After this “off-line” stage the network is fully prepared for the first time activity of the AO modem to complete the process. This next step will be triggered as explained further by the AO modem trying to acquire an IP address.

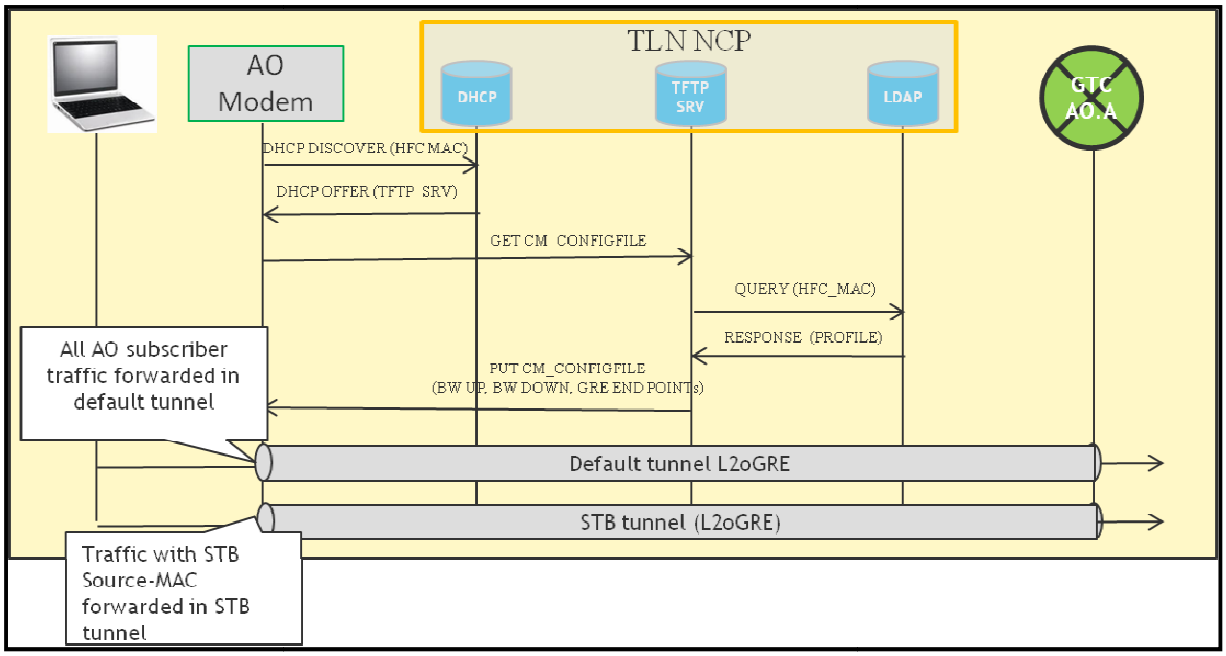

Figure 4-2

4.6.2 AO Docsis CPE "Management" IP address Assignment

(15) The "on-line" modem initialization process is triggered by the AO Docsis CPE (CM) launching a DHCP discovery which contains parameters like vendor-type, modem type, DOCSIS capabilities and HFC-MAC-ID. The TLN-NCP checks the AO-ID by using HFC-MAC-ID if it is white listed in TLN NCP inventory database and if the request originates from the correct geographical area and if all parameters are corresponding to the prior provisioned configuration info.

(16) If all above checks are positive, the TLN-NCP will send a DHCP offer message to the CM containing management IP address, IP addresses of TFTP and TOD servers and name of initial modem configuration file. If the checks are negative, an error event will be logged and the modem will not be able to get in "on-line" status.

4.6.3 AO Modem configuration

(17) After the modem has acquired its management IP address, it will ask for its configuration (identified via the HFC-MAC-ID) file to TLN-TFTP server (NCP). Then the modem gets date/time with TOD server.

(18) The modem configuration file contains, among other parameters, the end point parameters of GRE tunnel (TLN tunnel concentrator address and credentials). With the help of this info the GRE tunnel path is established and the modem is ready to start interacting with the AO network and systems.

4.7 IP Layer Connectivity for AO Docsis CPE

4.7.1 L2 GRE Tunnelling

(19) After AO CPE "management" IP address acquisition and completion of the modem configuration process all the data traffic originated from the "LAN" side of the modem will be "GRE encapsulated" by the modem and delivered at the correct tunnel endpoints at the correct GTC were it is hand-over to the AO network. (Eventual STB return path traffic follows similar flow).

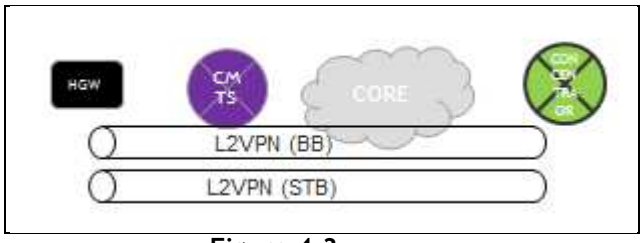

Figure 4-3

(20) The L2 GRE tunnel provides a transit path over the TLN HFC network from the AO CPE to the GTC. The use of the L2 GRE tunneling mechanism provides a clean architecture where on the IP layer and on IP address space level the AO Backbone network to AO Household connectivity and routing and address management aspects are clearly separated from the TLN network in a transparent way.

4.7.2 Access Authentication

(21)The AO CPE sends a DHCP discovery message to the AO DHCP Server in order to get its Public IP address, after finalizing the initial L2 GRE data path establishment. Then as shown in the below figure HGW or CM (whichever exists) adds multiple DHCP option fields (like HFC-MAC-ID, shared key, etc.) to the DHCP discovery message. This is used to identify the client residing behind the individual modem. After adding this option, HGW/CM forwards the request through the appropriate GRE tunnel based upon the info that resides in the CM configuration file.

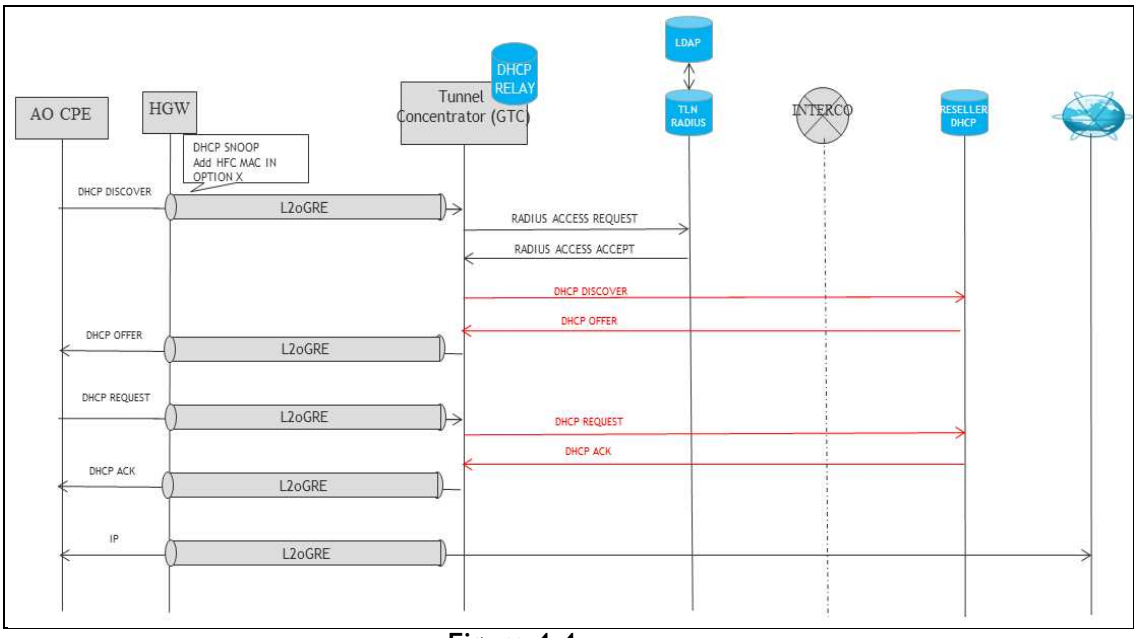

Figure 4-4

(22)When the discover message reaches the Tunnel Concentrator (GTC), it will temporary keep the message and sends a Radius access request message to the Telenet NCP Server :

- If access is granted, the GTC relays the DHCP discovery to the AO NCP Server (DHCP) and correspondingly an IP address will be assigned by the AO NCP.
- If access is denied; as a reason of e.g. TLN inspection of malicious subscriber i.e.; DHCP discovery is dropped and a logging event is generated.

(23)Then the tunnel Concentrator (GTC) snoops the AO NCP DHCP ACK message in order to follow subscriber state and forward traffic to the correct GRE tunnel.

4.7.3 IP Address assignment

(24) The DHCP Discovery Message is replied to by the AO DHCP Server, since the AO is responsible for IP address assignment to the AO CPE via DHCP. The AO will have to provide IP address ranges per RPOI of sufficient size in order to avoid excessive change requests. The AO is also responsible for its own policy management to deploy in its AO Backbone Network.

(25) An AO STB should set DHCP option 60 as a Vendor Class Identifier to identify the STB easily. If the TLN NCP detects malicious attempts from AO CPE, TLN has the right to reject the DHCP discovery messages and drop them.

(26) TLN has the right to differentiate the given IP pool as Docsis CPE Pool, STB Pool etc. and ask the AO to provide appropriate public IP address ranges for each.

4.8 AO Device Management by TLN Requirements

(27) The Applicable Requirements about AO Device Management can be found on TLN-WRO-TA-B-S-PAAA.

5 AO Euro-Docsis 3.0 CPE – Non Functional Requirements

(28) The Applicable Requirements about AO Device Management can be found on TLN-WRO-TA-B-S-PAAA.