Telecommunications Standards Advisory Committee (TSAC)

Technical Specification

Coaxial Cable Home Networking

IMDA TS CCHN
Issue 1, 1 October 2016

Info-communications Media Development Authority
Resource Management & Standards
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IDA TS CCHN Issue 1, Aug 2012 re-issued as IMDA TS CCHN, 1 October 2016	Technical Specification for Coaxial Cable Home Networking (CCHN)
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PART A INTRODUCTION

1 SCOPE

1.1 This Specification describes the use of in-premises coaxial cabling for high speed data networking within the home. The Specification defines the minimum technical requirements for the connection of Home Networking Transceivers (HNT) over the in-premises coaxial cabling.

1.2 The use of the coaxial cable home networking must not interfere with the licensed TV or broadband access services carried in the same medium. It shall comprise HNT equipment (a pair of HNT or more) and associated Isolation Filter (IF) that conform with requirements set out in Part B of this Specification.

2 REFERENCES

For the technical requirements captured in this Specification, reference has been made to the following standards. Where versions are not indicated, implementation of this Specification shall be based on current and valid versions of these standards published by the respective Standards Development Organisations.

[1] IEC CISPR 32, Electromagnetic compatibility of multimedia equipment – Emission requirements

Note: Validity of the IEC CISPR 22, EMC standard for information technology equipment, will lapse by 31 March 2017, in sync with IEC's timeline for withdrawing this CISPR standard, and replacing it with the CISPR 32 standard.

[2] IEC CISPR 24, Information technology equipment – Immunity characteristics – Limits and methods of measurement

[3] IEC 60950-1, International Electrotechnical Commission – Safety of Information Technology Equipment

[4] IEC 62368-1, Audio/video, information and communication technology equipment – Part 1: Safety requirements

[5] ITU-T Rec G.9954, Home Networking Transceivers – Enhanced Physical, Media Access, and Link Layer Specifications

[6] COPIF 2008 (09/2008), Code of Practice for Info-communications Facilities in Buildings

3 ABBREVIATIONS

AC	Alternating Current
BPF	Bandpass Filter
BSP	Band-stop Filter
CL	Convergence Layer
DC	Direct Current
DOCSIS	Data over Cable Services Interface Specifications
HNT	Home Networking Transceivers
HPNA	HomePNA (former Home Phoneline Networking Alliance)
IF	Isolation Filter
IFG	Inter-Frame Gap
IP	Internet Protocol
LLC	Link Layer Control
MAC	Media Access Control
MII	Media Independent Interface

PHY	Physical Layer
PSD	Power Spectral Density
RG	Residential Gateway
STB	Set-Top-Box

4 GENERAL REQUIREMENTS

4.1 Isolation Filter

Service providers who offer the coaxial cable home networking option, and suppliers of HNT equipment are required to ensure that the HNT equipment shall be supplied together with IF of overall length not exceeding 56 mm and diameter not exceeding 21 mm. This is intended for facilitating the deployment of IF at the distribution tap that will not cause any obstruction to future work at the distribution tap.

4.2 Power Supply

The HNT equipment may be AC or DC powered. For an AC powered equipment, the Specification shall be complied with when operating from an AC mains supply of voltage, 230V ± 10% and frequency, 50 Hz ± 2%. Where external power supply is used, e.g. AC adaptor, it shall not affect the capability of the equipment to meet the Specification.

4.3 Electromagnetic Compatibility (EMC) and Safety Requirements

4.3.1 Electromagnetic Compatibility (EMC) Assessment

4.3.1.1 Electromagnetic Interference (EMI) or Emission Measurements

The following emissions measurements shall be performed on the HNT equipment, where applicable:

(a) Radiated emissions from the HNT equipment shall be measured to Class B requirements defined in §4 and Tables A.4 and A.5 of CISPR 32 [1];

(b) Conducted emission at the DC power port of the HNT equipment shall be measured to Class B requirements defined in §4 and Table A10 of CISPR 32 [1];

(c) Conducted emission at the AC mains port shall be measured for HNT equipment with dedicated AC/DC power converter to Class B requirements defined in §4 and Table A.10 of CISPR 32 [1] (equipment with DC power port which is powered by a dedicated AC/DC power converter or adapter is defined as AC mains powered equipment [§3.1.1 of CISPR 32]); and

(d) Conducted emission at the wired network port[1] of the HNT equipment shall be measured to Class B requirements defined in Table A.12 of CISPR 32 [1].

4.3.1.2 Electromagnetic Susceptibility (EMS) or Immunity Testing

The following immunity tests may be performed on the HNT equipment to requirements defined in CISPR 24 [2], where applicable:

(a) RF electromagnetic field (80 MHz to 1 GHz) at the enclosure of equipment;

(b) Electrostatic discharge at the enclosure of equipment;

(c) Fast transients (common mode) at dc power and ac main power ports that have cables

[1] Wired network port is used for voice, data and signaling transfers intended for connection to a communication network, e.g. CATV, PSTN, ISDN, ADSL and LAN (§3.1.32 [1]).

longer than 3 m;

(d) RF common mode 0.15 MHz to 80 MHz at dc power and ac mains power ports that have cables longer than 3 m;

(e) Voltage dips and interruptions at ac mains power port of equipment with dedicated ac/dc power converter; and

(f) Surges, common and differential mode at AC mains power port of equipment with dedicated AC/DC power converter.

4.3.2 Equipment Safety Testing

4.3.2.1 Equipment safety testing or assessment shall be performed to requirements defined in IEC 60950-1 [3] or IEC 62368-1 [4], based on the following assumptions:

(a) HNT equipment is powered by a dedicated external power supply (AC/DC converter or power adapter/charger); and

(b) HNT equipment operates with SELV in environments where overvoltage from telecommunication networks is not possible. SELV refers to voltages not exceeding 42.4 V peak or 60 V DC.

4.3.2.2 For HNT equipment safety assessment performed with the hazard-based approach, the processes defined in IEC 62368-1 [4] shall be used:

(a) Identify energy sources in the HNT equipment;

(b) Classify energy sources (effect on the body or combustible material, e.g. possibility of injury or ignition);

(c) Identify safeguards for protection against energy sources; and

(d) Consider the effectiveness of safeguards with respect to compliance criteria or requirements defined in the IEC 62368-1 standard.

PART B HOME NETWORKING TRANSCEIVERS

(based on ITU-T Rec. G.9954 01/2007 [5])

1 SYSTEM REFERENCE MODEL FOR COAXIAL CABLE HOME NETWORKING TRANSCEIVERS

1.1 Figure 1-1 shows the basic reference model for in-premises coaxial cable home networking transceivers (HNT). The interface of concern in this Specification is the wire-side electrical and logical interface (W1) between a HNT station and the coaxial cable.

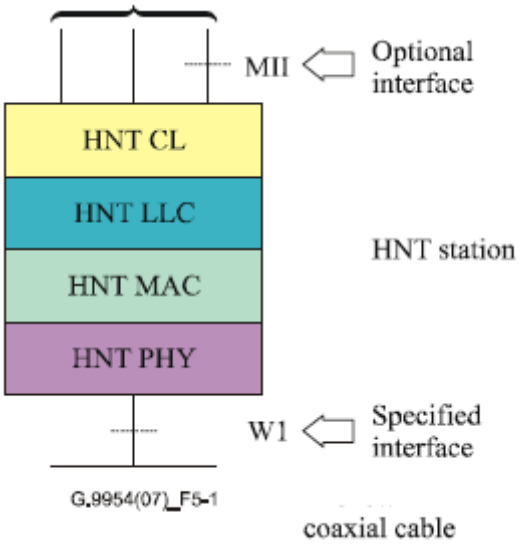

Figure 1-1 (Figure 5-1/G.9954): **Basic Reference Model**

1.2 The HNT system implements a *shared medium* single-segment network, as shown in Figure 1-2 (Figure 5-3/G.9954) below. All stations on a segment are logically connected to the same shared channel on the coaxial cable.

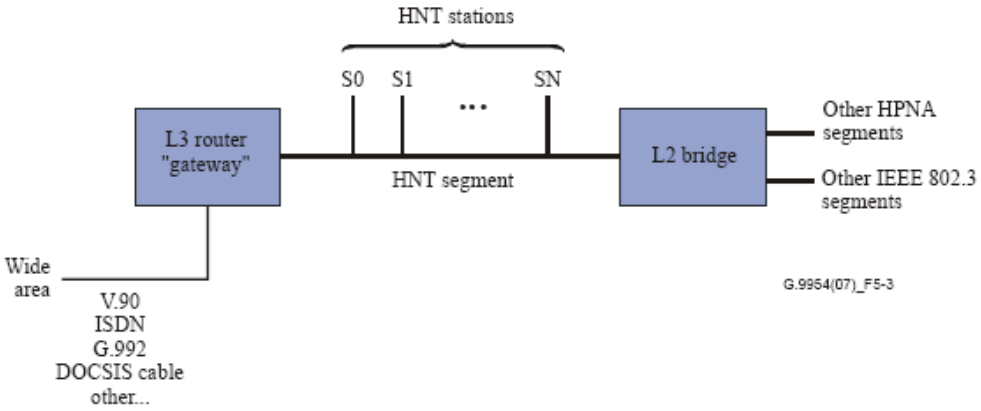

Figure 1-2 (figure 5-3/G.9954): **HNT shared medium network segment on the co-axial cable**

1.3 Figure 1-3 below shows an example of the home network using coaxial cable home networking, where a variety of types of network devices (e.g. IP Set-top Boxes) are connected via the coaxial cables in the home, to a Internet Gateway Device (RG) and possible bridges to other home network segments, possibly based on other home networking technologies (e.g. wireless, power-line).

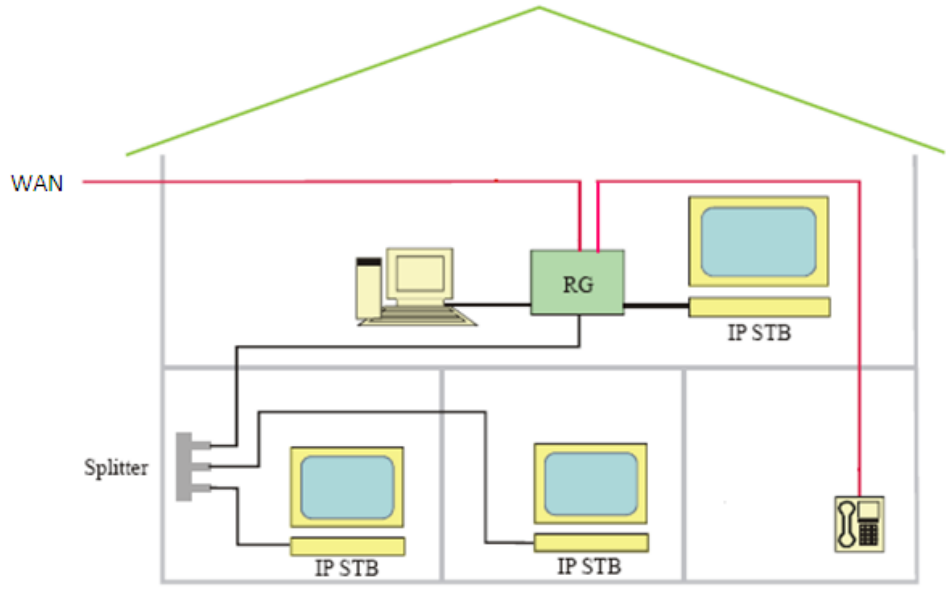

Figure 1-3 (modified from Figure 5-4/G.9954): **Home network using the coaxial cable**

1.4 An Isolation Filter (IF) shall be implemented, where the in-premise coaxial cable network is not physically disconnected from the coaxial cable access network, to prevent interference between HNT devices operating on in-premises cabling with the licensed TV or broadband access services carried in the same medium.

1.5 The IF shall be installed at the distribution point, i.e. before the coaxial cable splitter point where the main cable is split into the different room points.

1.6 The IF serves to ensure network separation between neighbours and isolate the coaxial cable home network from the coaxial cable broadband access network.

1.7 The IF shall provide a minimum of 40dB isolation and shall allow the licensed TV or broadcast access services carried in the same medium to pass through to the home network and isolate the Sub-Mode F frequency spectrum from 52 - 68 MHz.

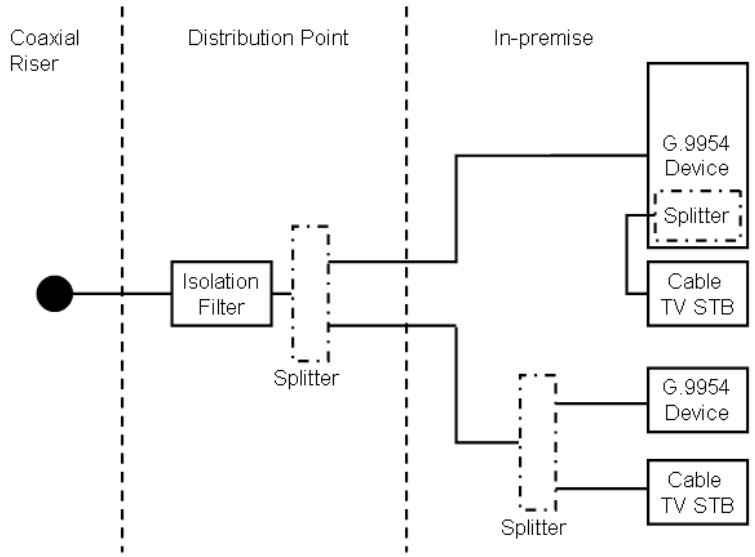

Figure 1-4a: **Isolation Filter**

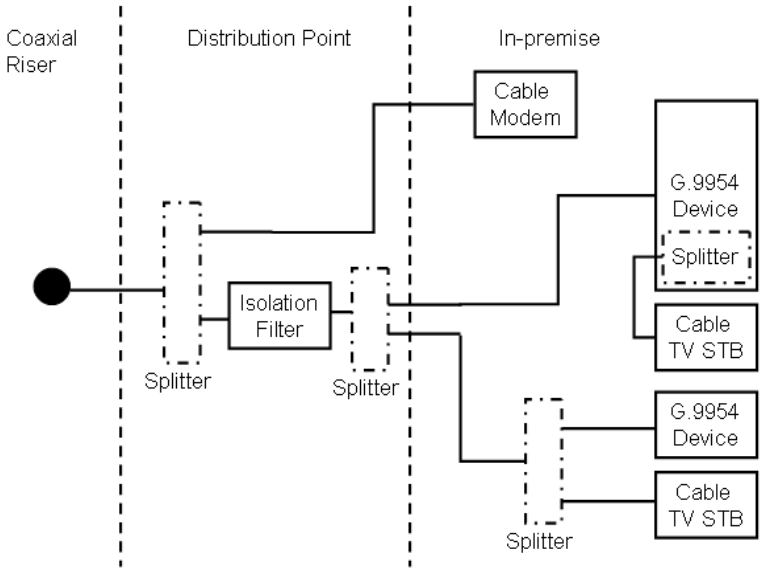

Figure 1-4b: **Isolation Filter (with Co-existence of DOCSIS)**

1.8 The technical performance requirements of the broadband coaxial cable system as defined in COPIF 2008 [4] Chapter 13 Section 2 shall be complied with after the introduction of the IF.

2 FREQUENCY AND POWER SPECTRAL DENSITY

2.1 Frequency Spectrum

The HNT shall operate in the Sub-mode F frequency spectrum from 52 to 68 MHz.

2.2 Isolation Filter Requirements

The IF shall be installed to (1) pass through broadcast FM and TV signals and cable TV signals; (2) provide isolation from DOCSIS network; and/or (3) isolate HNT from neighbours. The IF shall minimally fulfil the specifications as provided in Table 2-2 and Figure 2-2 below.

S/N	Specification (w.r.t. 75 Ohm Impedance), f (MHz)	Min Requirements
1	Attenuation	
	f <= 42MHz	<= 1dB[2]
	42MHz < f < 52MHz	>= (1 + (f-42)*40/10)dB
	52MHz <= f <= 68MHz	>= 41dB
	68MHz < f < 85MHz	<= (41 - (f-68)*40/17)dB
	f >= 85MHz	<= 1dB
2	Return Loss	
	f <= 42MHz	>= 12dB
	42MHz < f < 52MHz	<= (12 - (f-42)*11/10)dB
	52MHz <= f <= 68MHz	<= 1dB
	68MHz < f < 85MHz	>= (1 + (f-68)*11/17)dB
	f >= 85MHz	>= 12dB
3	Ripple	<= 2dB

Table 2-2: **Isolation Filter (IF) Specifications**

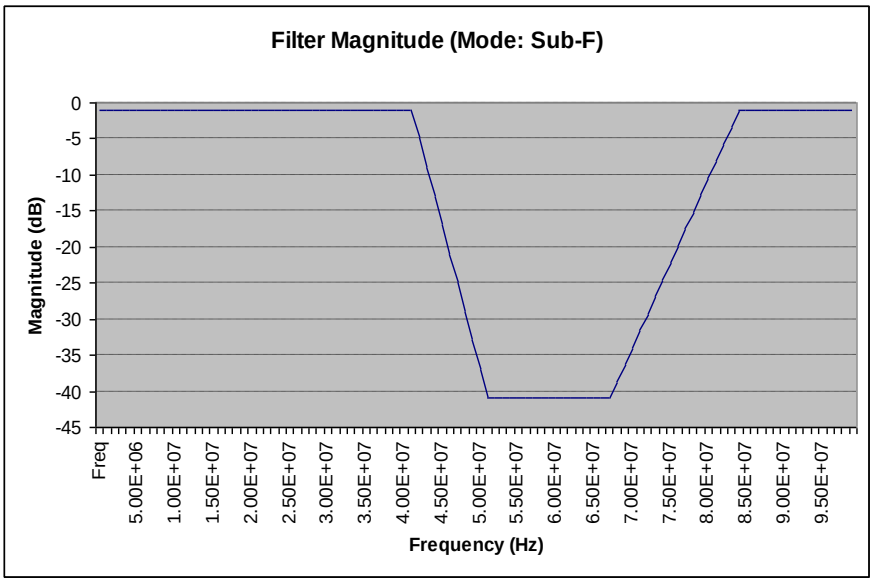

Figure 2-2: **Isolation Filter for Sub-Mode F (52~68 MHz)**

[2] The filter may exclude 0 - 5MHz for the purpose of lightning/surge protection, if desired.

2.3 Spectral Mask

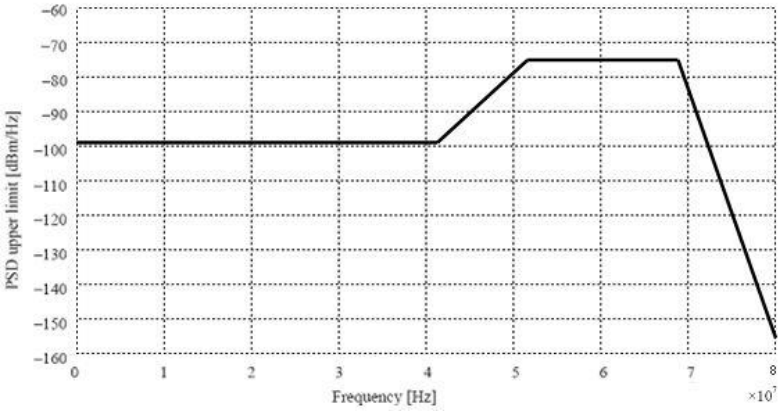

Figure 2-3: **Transmit PSD upper bound for sub-Spectral Mode F**

When transmitting in spectral sub-mode F, the resolution bandwidth used to make this measurement shall be 10 kHz for frequencies between 2.5 and 80.0 MHz, and 3 kHz for frequencies between 0.015 and 2.5 MHz. An averaging window of 213 seconds shall be used, and 1500-octet MTUs separated by an IFG duration of silence shall be assumed. A total of 50 kHz of possibly non-contiguous bands may exceed the limit line under 2.5 MHz, with no sub-band greater than 20 dB above the limit line. A total of 50 kHz of possibly non-contiguous bands may exceed the limit line between 80.0 and 100.0 MHz, with no sub-band greater than 20 dB above the limit line.

3 ELECTRICAL CHARACTERISTICS

3.1 Transmit Power

Stations shall transmit according to the transmit power limitations described in Table 3-1 (Table 7-7/G.9960), corresponding to the spectral mode they transmit. Transmit power shall be measured during the header, across a 75-ohm load between centre and ground, integrated from 0 to 100 MHz.

Spectral mode	Transmit power limit [dBm]
F	[-2 +1]

Table 3-1 (Table 7-7/G.9954): **Transmit Power Requirements**

3.2 Transmit Voltage

Stations that are not transmitting shall emit less than -85 dBVrms measured across a 75-ohm load between centre and ground.

4 RF PASS–THROUGH PORT (OPTIONAL)

Where a secondary RF Pass-through Port is provided on the HNT device, the Pass through Port shall comply with the following specifications. The provision of the RF pass-through port is optional.

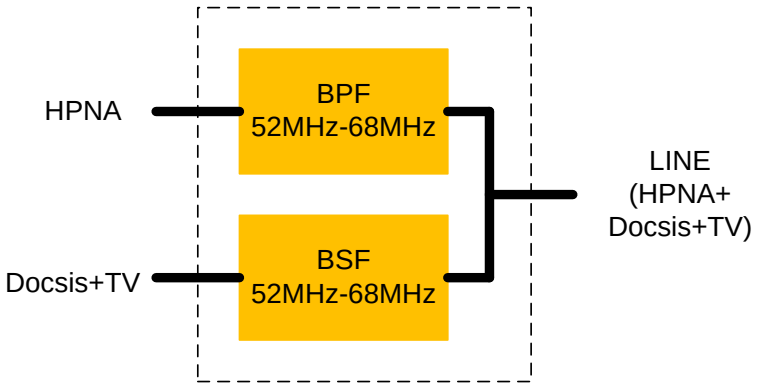

Figure 4: **Pass-through Port (Diplexer Structure)**

Port	Parameter	Frequency	Condition	Required Value
Line To HPNA	Insertion Loss	5MHz – 42MHz 52MHz – 68MHz 75MHz – 860MHz		**>35dB** **<4dB** **>45dB**
	Return Loss (Reflection)	52MHz – 68MHz	Measured from Line to HPNA Port. HPNA Port should be 75Ω Terminated.	**>15dB**
	Group Delay	52MHz – 68MHz		**<100nSec**
Line To DOCSIS + TV	Insertion Loss	5MHz – 42MHz 52MHz – 68MHz 75MHz – 860MHz		**<2dB** **>45dB** **<2dB**
	Return Loss (Reflection)	5MHz – 42MHz 75MHz – 860MHz	Measured from Line to DOCSIS/TV Port. DOCSIS/TV Port should be 75Ω Terminated.	**>15dB** **>15dB**
	Group Delay	5MHz – 42MHz 75MHz – 860MHz		**<75nSec** **<25nSec**
HPNA To DOCSIS + TV	Isolation	5MHz – 42MHz 75MHz – 860MHz		**>40dB** **>45dB**
DOCSIS + TV To HPNA	Isolation	52MHz – 68MHz		**>45dB**

Table 4: **RF Pass-through Port (Optional) Requirements**

Annex
Corrigendum / Addendum

Revised TS		Items Changed	Date of Issue
Page	Section		
Changes to IDA TS CCHN Issue 1, July 2014			
3	Part A §4.3	The IMDA TS CCHN Issue 1 (October 2016) has replaced the IDA TS CCHN Issue 1 (July 2014). Changes are largely editorial to provide updates and clarity in the application of EMC and safety requirements, in line with standards development that has taken place in the Standards Development Organisation concerned.	1 Oct 16