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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

The present document is part 2 of a multi-part deliverable covering the Ethernet and power over cables, as identified below:

Part 1: "Overview, common and generic aspects";

Part 2: "Ethernet and power over coaxial cables for IP video surveillance".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Executive summary

The present document describes standardization specification for an Ethernet & Power over Coax technology intended to promote the development of interoperable Ethernet & Power over Coax solutions for Video Surveillance.

The Ethernet & Power over Coax (E&PoC) technology standardized in the present document enables an energy efficient and sustainable transition from legacy analogue Video Surveillance systems to IP Video Surveillance systems by enabling the transmission of IP data over coaxial cable infrastructures, also called IP-over-Coax solutions, while ensuring safe and reliable power delivery, hence allowing a robust, manageable and interoperable infrastructure.

The Ethernet & Power over Coax technology (E&PoC) also addresses network extension issue by providing the ability to extend a Video Surveillance Network with additional IP cameras or devices without having to run an entirely new cable from the head end device to a new front end device. Ethernet & Power over Coax technology allows plug-and-play connectivity, allowing seamless connection and addition of a front end device to the network.

The Ethernet & Power over Coax technology (E&PoC) relies on the HomePlug AV family of standards, which is a robust, very stable and interoperable technology largely deployed over the world for very high rate applications like in-home LAN extension over power lines, but also in commercial environments such as access networks in Asia.

Introduction

The objective of the present document is to provide requirements that would ensure interoperability between a set of communication devices, also referred as edge devices (e.g. IP cameras, adapter devices, Power over Coax cameras), and connected over a coaxial cable infrastructure to a receiver device (e.g. Power over Coax switch device).

The present document provides requirements covering system-level issues - e.g. neighbour networking, receiver device port reset, hot-plug - power distribution and data transmission over an Ethernet & Power over Coax system.

1 Scope

The present document specifies Ethernet & Power over Coax system characteristics in such a way that interoperability issues arising from the connection of several Ethernet & Power over Coax devices in such system are minimized, providing a specification that can be used as the basis for testing and certification.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

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

The following referenced documents are necessary for the application of the present document.

[1] IEEE Std 1901™-2010: "IEEE Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications".

NOTE: Available at https://standards.ieee.org/findstds/standard/1901-2010.html.

[2] HomePlug AV Specification Version 1.1 May 21, 2007.

NOTE: Available at https://docbox.etsi.org/Reference/homeplug_av11/homeplug_av11_specification_final_public.pdf.

[3] HomePlug AV Specification Version 2.1 February 21, 2014.

NOTE: Available at https://docbox.etsi.org/Reference/homeplug_av21/homeplug_av21_specification_final_public.pdf.

2.2 Informative references

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

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

Not applicable.

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

Basic Service Set (BSS): set of stations that is compliant with the Basic Service Set (BSS) definition, as described in IEEE 1901 [1].

E&PoC Basic Service Set (BSS): set of E&PoC stations (E&PoC STAs) forming an E&PoC network

E&PoC Station (E&PoC STA): device or chipset that contains a Medium Access Control (MAC) and physical layer (PHY) interface to the communication and power medium that are compliant with the specification defined in the present document

NOTE: One device may embed several E&PoC STA, e.g. an IEEE 1901 power over coax switch device may embed several chipsets, each chipset being considered as an E&PoC STA (actually an rSTA).

E&PoC System: Ethernet & Power over Coax system made of one or more receiver stations (rSTA) and one or more edge stations (eSTA) - i.e. multiple E&PoC BSSs) - as defined in clause 4.3.1

edge Device (eDEV): communication device having edge connectivity - e.g. PoC IP camera, PoC adapter as defined in clause 4.3.2

NOTE: There are 2 types of eDEVs: Adapter eDEV and Terminal eDEV. Terminal eDEV devices are typically Ethernet and IP devices. Such IP devices may implement an IPv4 or an IPv6 stack, supporting either a fixed or a dynamic (e.g. DHCP) IP configuration, and providing adequate user interface to configure the IP addresses.

edge Station (eSTA): E&PoC edge station, as defined in clause 4.3.4

edge System (eSYS): both Terminal eDEV or entity composed of an Adapter eDEV and the communication device (e.g. an IP camera) connected to this Adapter eDEV

HomePlugAV Station: device that contains an HomePlugAV-conformant Medium Access Control (MAC) and PHYsical layer (PHY) interface to the communication and power medium, compliant with either [2] or [3]

IEEE 1901 Station: device that contains an IEEE 1901-conformant Medium Access Control (MAC) and physical layer (PHY) interface to the communication and power medium, compliant with [1], [2] and [3]

linear bus topology: topology wherein at least two eDEV / eSYS are connected to a same rDEV port, using T-connectors

point-to-point topology: topology wherein only one eDEV / eSYS is connected to an rDEV port

Power over Coax (PoC): ability for an rDEV to provide power to an eDEV / eSYS through a coaxial cable

receiver Device (rDEV): communication device having receiver capability - e.g. PoC switch, as defined in clause 4.3.1

receiver Station (rSTA): E&PoC receiver station, as defined in clause 4.3.3

User Interface (UI): mechanism (preferably keyboard and display) to enable user interaction with the network, as defined in [1], [2] or [3]

3.2 Symbols

Void.

3.3 Abbreviations

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

1901 STA	IEEE 1901 Station
AV	Audio Video
AVLN	Audio Video Logical Network, HomePlug AV IN-Home Logical Network
BM	BSS Manager
BSS	Basic Service Set
CI	Crosstalk Interference
DEV	Device
E&PoC BSS	E&PoC Basic Service Set
E&PoC STA	E&PoC Station
E&PoC	Ethernet and Power over Coax
eDEV	E&PoC edge Device
eSTA	E&PoC edge Station
eSYS	edge System
FFT	Fast Fourier Transform
IP	Internet Protocol
LAN	Local Area Network
MAC	Medium Access Control
NMK	Network Management Key
NN	Neighbour Network
OFDM	Orthogonal Frequency Division Multiplexing
PHY	Physical layer
PoC	Power over Coax
rDEV	E&PoC receiver Device
rSTA	E&PoC receiver Station
STA	Station
UI	User Interface
UIS	User Interface Station
VMS	Video Management System

4 The E&PoC System

4.1 Introduction

The clause 4 provides an overview of an E&PoC System for video surveillance, focusing on the several system devices and wiring infrastructure, as well as the network topologies for this system.

4.2 System overview

An E&PoC System allows transferring data between an Edge Device (eDEV), as defined in clause 4.3.2, and a Receiver Device (rDEV), as defined in clause 4.3.1, over a coaxial cable infrastructure. Typically, an Edge Device (eDEV) is sending one or more video streams to the Receiver Device (rDEV). Both eDEV and rDEV are relying on IEEE Std. 1901-2010 and HomePlugAV MAC and PHY layers to operate layer 1 and 2 communication (as defined in [1], [2] and [3]). These video streams are further conveyed to a remote Video Management System (VMS) and/or recorded on a dedicated server, through a dedicated LAN.

An E&PoC System also allows transferring power from a Receiver Device (rDEV) to an Edge Device (eDEV) - e.g. a PoC camera - or an Edge System (eSYS) - e.g. an Adapter device connected to an IP camera - over a coaxial cable infrastructure.

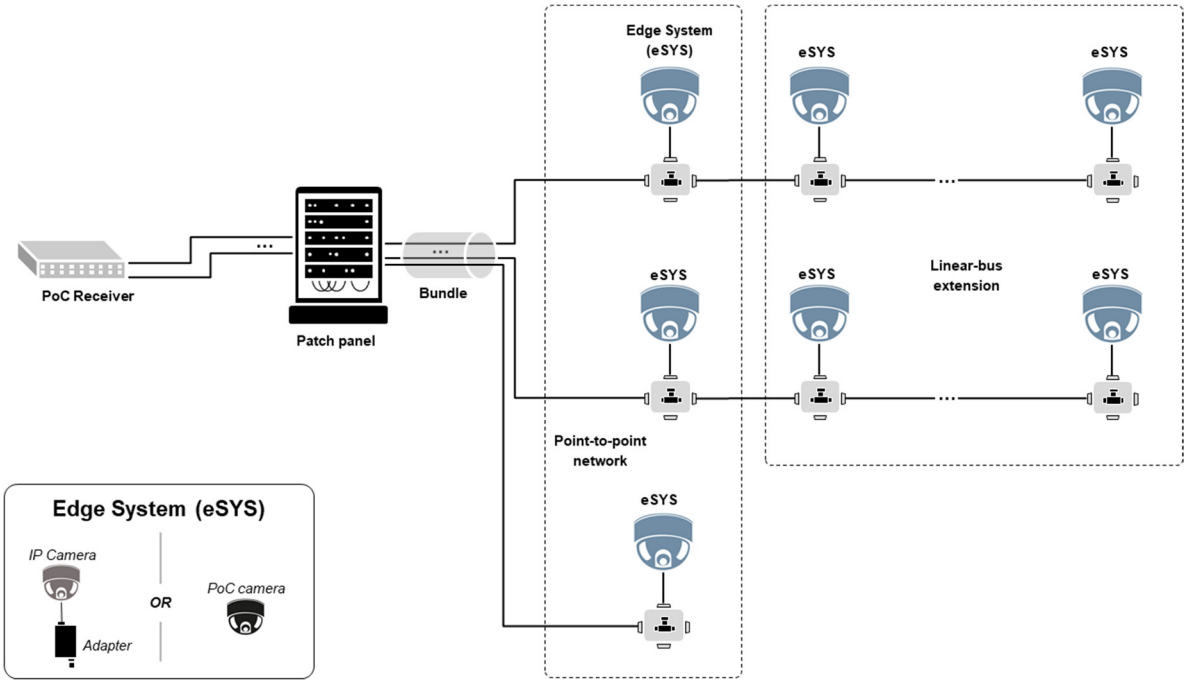

Figure 1: E&PoC system and topology example

4.3 Ethernet & Power over Coax system block diagram

4.3.1 rDEV (Receiver Device) definition

An E&PoC receiver device, or rDEV, is an E&PoC device having receiver capability.

An E&PoC receiver device (rDEV) shall provide coaxial cable connectivity.

An rDEV is in charge of receiving video streams from one or more eDEV it is connected to, while supplying power to these eDEV through a Coax cable.

An rDEV may embed one or more rSTAs (see also clause 4.3.3).

A typical Receiver Device is a PoC switch device, which is compliant with the present specification document.

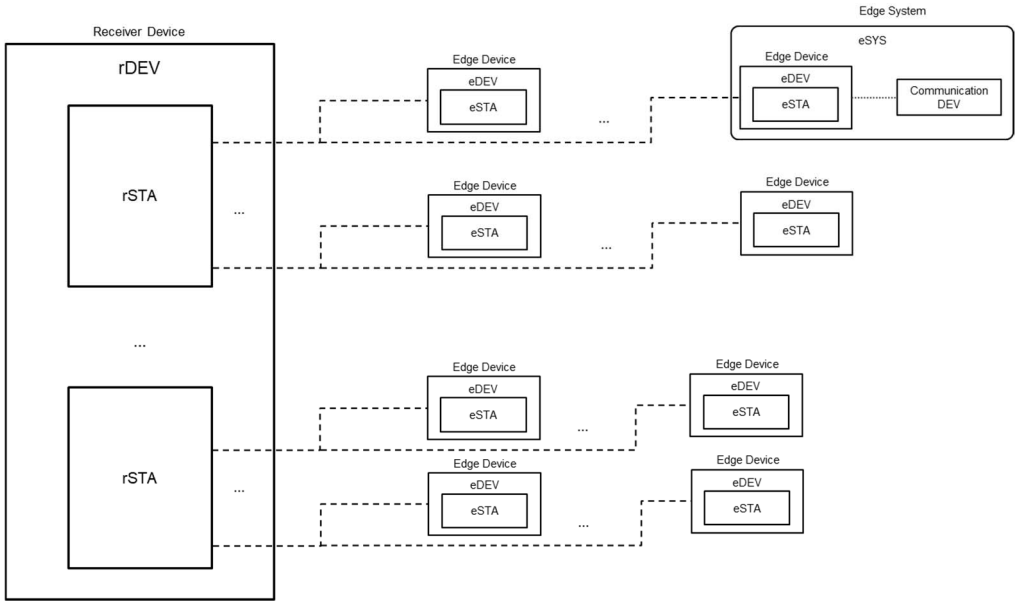

Figure 2: E&PoC system block diagram

4.3.2 eDEV (Edge Device) / eSYS definition

An E&PoC edge device, or eDEV, is an E&PoC device connected to an rDEV device through a coaxial cable, through one of the topologies defined in clause 4.4.

An E&PoC edge device (eDEV) shall provide coaxial cable connectivity.

An eDEV embeds exactly one eSTA (see also clause 4.3.4).

A Typical Edge Device may be a PoC adapter, connected to a PoE camera, or a PoC camera (as displayed in Figure 1), which are compliant with the present specification document.

An eDEV shall belong to one of the two following eDEV types:

- *Adapter eDEV.* An adapter eDEV is in charge of forwarding data content - e.g. video stream(s) - from a communication device (e.g. an IP camera) to the rDEV it is connected to, while receiving power from this rDEV through the coaxial cable. An Adapter eDEV shall be capable of forwarding power to its connected communication device.

NOTE*:* Local powering of the connected communication device, even if not prevented, is out of the scope of the present document and should be addressed in a future specification revision.

- *Terminal eDEV.* A Terminal eDEV is in charge of transmitting data content - e.g. video stream(s) for a camera - to the rDEV it is connected to, while receiving power from this rDEV through the coaxial cable. Terminal eDEV devices are IP devices implementing an IPv4 or an IPv6 stack.

The entity composed of an Adapter eDEV and the communication device (e.g. an IP camera) connected to this Adapter eDEV, is referred to as an eSYS.

A Terminal eDEV is also considered as an eSYS.

Therefore, in the following clauses of the present document, eSYS refers to either an entity composed of an Adapter eDEV and the communication device (e.g. an IP camera) connected to this Adapter eDEV or a Terminal eDEV.

4.3.3 rSTA (Receiver Station) definition

An rSTA is an E&PoC station (E&PoC STA) embedded in an rDEV. An rSTA is typically an IEEE 1901 (as defined in [1]) or a HomePlugAV (as defined in [2] or [3]) chipset embedded in an rDEV.

The communication network mode of an rSTA shall be compliant with the requirement of Table 1.

An rSTA may be physically connected to one or more Edge Stations (eSTAs), through one or more rDEV ports.

One or more rSTAs may belong to one same rDEV.

4.3.4 eSTA (Edge Station) definition

An eSTA is an E&PoC station (E&PoC STA) embedded in an eDEV. An eSTA is typically an IEEE1901 (as defined in [1]) or a HomePlugAV (as defined in [2] or [3]) chipset embedded in an eDEV.

The communication network mode of an eSTA should be compliant with the requirement of Table 1.

An eSTA shall be physically connected to one single rSTA, through one single rDEV port, which provides power supply to the connected eDEV.

4.4 Supported topologies

4.4.1 Forewords on supported topologies

The present E&PoC specification is addressing the topologies described in clauses 4.4.2 and 4.4.3.

Any other topology is out of the scope of the present document.

4.4.2 Linear Bus topology

In a linear bus topology (as depicted in Figure 1), at least two eDEV / eSYS are connected to a same rDEV port, using T-connectors.

It is recommended to limit the length of the cable connecting the T-connector to the eDEV / eSYS to no more than 3 m.

4.4.3 Point-to-point topology

In a point-to-point topology (as depicted in Figure 1), only one eDEV / eSYS is connected to an rDEV port.

5 Interoperability requirements for an E&PoC system

5.1 Communication mode background

5.1.1 Specification context

The E&PoC network consists of several E&PoC edge stations (eSTA) connected to an E&PoC receiver station (rSTA) that interact over a coaxial cable medium to provide a power distribution and video data transport network, which supports station portability transparently to upper layers as well as service across a broad area.

An E&PoC station (STA), either eSTA or rSTA, is one of the followings:

- An IEEE 1901 STA operated in In-Home / FFT mode, as defined in [1]
- A HomePlugAV 1.1 STA, as defined in [2]
- A HomePlugAV 2.1 STA, as defined in [3]

Inside an E&PoC system, the wiring topology may be constrained in terms of number of eSTA connected to an rSTA / number of eSTA connected to one port of an rSTA. Clauses 6 and 7 provide requirements on power management and data transmission in relation with such topology constraints.

An E&PoC system is made of one or more logical networks, or E&PoC Basic Service Set (BSS).

Figure 1 shows how coax cable network configuration for a given E&PoC system can vary depending on how the wiring is laid out, what is connected to the coaxial cable segment, and where it is connected. In general, each segment has either a star-topology wiring or a linear bus topology originating from the rSTA.

In order to ensure interoperability between E&PoC stations (both eSTA and rSTA) and HomePlugAV stations, an E&PoC STA shall be either a HomePlugAV 1.1 STA, a HomePlugAV 2.1 STA or an IEEE1901 FFT STA [1].

5.1.2 Requirements

Table 1: Communication network mode

E&PoC Receiver Station (rSTA) / E&PoC Edge Station (eSTA)	
Requirement 5.1.1	An E&PoC STA shall be compliant with one of the following modes: • In-Home mode, as described in [1]. In such case, the E&PoC BSS shall be operated as an In-home BSS, as described in [1]. • HomePlugAV 1.1 STA, as defined in [2]. In such case, the E&PoC BSS shall be operated as an AVLN, as described in [2]. • HomePlugAV 2.1 STA, as defined in [3]. In such case, the E&PoC BSS shall be operated as an AVLN, as described in [3].

Table 2: E&PoC Physical/MAC layer for IEEE1901-compliant devices

E&PoC Receiver Station (rSTA) / E&PoC Edge Station (eSTA)	
Requirement 5.1.2	An E&PoC STA that operates the In-Home mode, as described in [1], shall behave as an IEEE 1901 FFT STA, therefore implementing the IEEE 1901 Fast Fourier transform (FFT) (orthogonal frequency division multiplexing (OFDM) physical layer (PHY)/medium access control (MAC), as defined in [1].

5.2 E&PoC System and BSS

5.2.1 Specification context

An E&PoC network is referred as a single E&PoC basic Service Set (E&PoC BSS).

An E&PoC system is made of one or more rSTA and one or more eSTA (i.e. multiple E&PoC BSSs). An E&PoC BSS is managed by a single E&PoC STA, also referred as the "E&PoC BSS manager" (E&PoC BM). Any further reference to a "BM" in the present document implicitly refers to an E&PoC BM. The E&PoC BM of an E&PoC BSS may be either an rSTA or an eSTA.

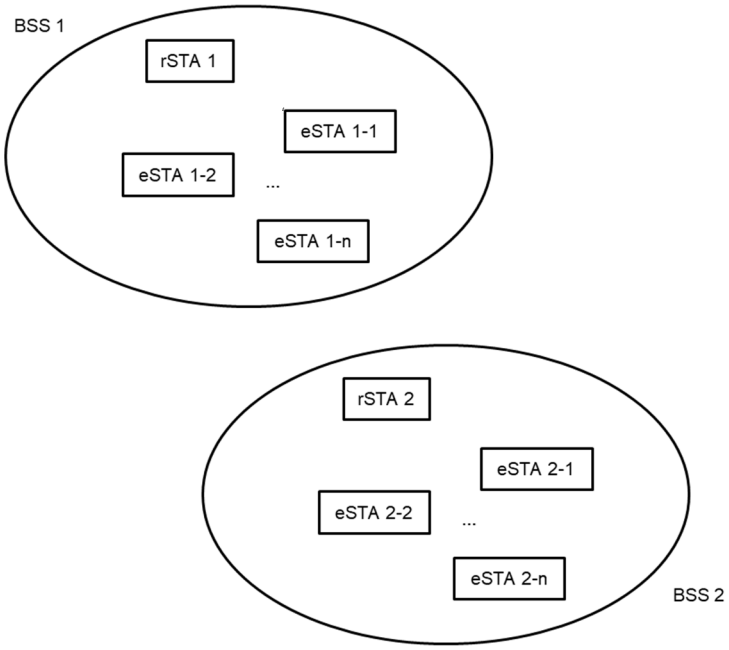

Figure 3: E&PoC BSSs

5.2.2 Requirements

Table 3: E&PoC System and BSS

E&PoC Receiver Station (rSTA) / E&PoC Edge Station (eSTA)	
Requirement 5.2.1	An E&PoC STA shall join all the other E&PoC STAs it is physically connected to, so as to form an E&PoC BSS, provided they share the same E&PoC password / NMK. Any two E&PoC STAs that are part of the same E&PoC BSS shall be capable of communicating with each other.

5.3 Neighbour networks

5.3.1 Specification context

An E&PoC BSS may need to operate in the presence of neighbour networks of other compatible E&PoC devices.

Neighbour Network (NN) is an entirely autonomous association of E&PoC devices, which are operated autonomously.

Typically, an E&PoC BSS involving several rSTA belonging to one same device - e.g. multi-chipset switch device embedding several IEEE 1901 / HomePlugAV chipset - may experience substantial inter-network signal crosstalk - i.e. signals from one E&PoC BSS may be detectable on adjacent E&PoC BSSs. In case of multi-chipset switch device, signal crosstalk may result from coupling between the device chipsets.

This Crosstalk Interference (CI) leads to substantial performance degradation resulting in:

- wrong STA association, i.e. as outside network signals may appear as valid signals to the adjacent networks, one eSTA may associate to an rSTA it is not actually connected;
- significantly reduced throughput; or
- even loss of service at specific STAs or even network wide.

In order to mitigate the effects of crosstalk interference (CI) while not affecting the overall E&PoC BSS performance, the following measures should be considered:

- Any two receiver stations (rSTAs) belonging to a same receiver device (rDEV) shall never associate with each other and, therefore, join the same E&PoC BSS.

5.3.2 Requirements

Table 4: Neighbour networks

E&PoC Receiver Device (rDEV)	
Requirement 5.3.1	Any two receiver stations (rSTAs) belonging to a same receiver device (rDEV) shall never join the same E&PoC BSS.
Requirement 5.3.2	Any two receiver stations (rSTAs) belonging to different receiver devices (rDEV) shall never join the same E&PoC BSS.

5.4 Security in E&PoC system

5.4.1 Specification context

A typical E&PoC system may be made of hundreds of camera devices.

One should keep in mind that changing the Password/NMK of some of the STAs in the system may significantly increase the overall system maintenance, as the list of the several Password/NMK used in the system should be recorded and maintained.

Therefore, an E&PoC STA, either eSTA or rSTA, shall implement the default Password/NMK value provided in Table 6 or Table 7.

5.4.2 Requirements

Table 5: Default Password/NMK

E&PoC Receiver Station (rSTA) / E&PoC Edge Station (eSTA)	
Requirement 5.4.1	An E&PoC STA (both rSTA and eSTA) shall implement the default E&PoC Password/NMK value provided in Table 6 or Table 7.

Table 6: E&PoC default Password

Item	Parameter	Symbol	Value
1	E&PoC Default Password 0	$Password_{E\&PoC0}$	HomePlugAV

Table 7: E&PoC default NMK

Item	Parameter	Symbol	Value
1	E&PoC Default NMK0	$NMK_{E\&PoC0}$	50:D3:E4:93:3F:85:5B:70:40:78:4D:F8:15:AA:8D:B7

5.5 Receiver Device (rDEV) per-port PoC reset

5.5.1 Specification context

In case an eDEV software is stalled, it may be valuable to perform a hardware reset of this device.

Such hardware reset may be performed remotely by performing rDEV port power OFF / power ON.

5.5.2 Requirements

Table 8: Receiver Device (rDEV) per-port PoC reset (Conditional)

E&PoC Receiver Device (rDEV)	
Requirement 5.5.1	When the Power over Coax (PoC) supply is turned off for one port of an rSTA connecting one or more eSTAs, in an initial E&PoC BSS, all the other E&PoC STAs (both the rSTA and eSTAs connected on the remaining ports of the rSTA) from this initial E&PoC BSS shall keep effective connectivity. This requirement assumes all the eSTAs are powered through the Coax cable (i.e. eSTA local powering is excluded from this requirement).
Requirement 5.5.2	When the Power over Coax (PoC) supply is turned on for one port of an rSTA connecting one or more eSTAs, all these eSTAs shall join the E&PoC BSS made of the E&PoC STAs they are physically connected to the other ports of the rSTA, so as to form an E&PoC BSS that provides effective connectivity between all these E&PoC STAs. This requirement assumes all the eSTAs are powered through the Coax cable (i.e. eSTA local powering is excluded from this requirement).

5.6 Support to installation (Optional)

5.6.1 Specification context

Installing one or more E&PoC Terminal eDEVs according to a daisy-chain topology requires for the installer some minimum knowledge on the eDEV's typical and maximum power consumption.

5.6.2 Requirements

Table 9: Support to installation (Optional)

E&PoC Edge Device (eDEV)	
Requirement 5.6.1	The eDEV vendor shall provide the nominal power consumption and the maximum power consumption of the eDEV, along with the associated eDEV operating mode configurations.

5.7 Hot-Plug support

5.7.1 Specification context

The data streaming - such as video streaming - sent by the eDEV to the rDEV is considered as a highly critical information. Losing some of this information, even temporarily, would have significant impact on the user experience and is therefore considered as not acceptable.

This is why the addition of a new eDEV to any existing E&PoC network should not impact the performance of any eDEV already operated in the network.

5.7.2 Requirements

Table 10: Hot-Plug support

E&PoC Edge System (eSYS)	
Requirement 5.7.1	Adding a new eSYS to an existing E&PoC BSS shall not cause any data communication error to the existing data communication currently operated over this E&PoC BSS.

6 Power distribution requirements for an E&PoC system

6.1 Edge DEV (eDEV) / Edge System (eSYS) power

6.1.1 Specification context

In order to limit current consumption over the cable medium, it is important that an eDEV, or an eSYS, operates within a bounded range of input voltage. In this respect, as described in Figure 4.

- The eDEV (resp. eSYS) shall turn on at a voltage less than or equal to V_{ONmax} and greater than V_{OFFmin}.
- The eDEV (resp. eSYS) shall turn off at a voltage less than V_{OFFmin}. The eDEV (resp. eSYS) shall never turn off at a voltage greater than V_{OFFmax}.
- When the voltage of an eDEV (resp. eSYS) is less than V_{OFFmin}, the power consumption of this eDEV (resp. eSYS) shall not exceed $P_{STANDBYmax}$ range.

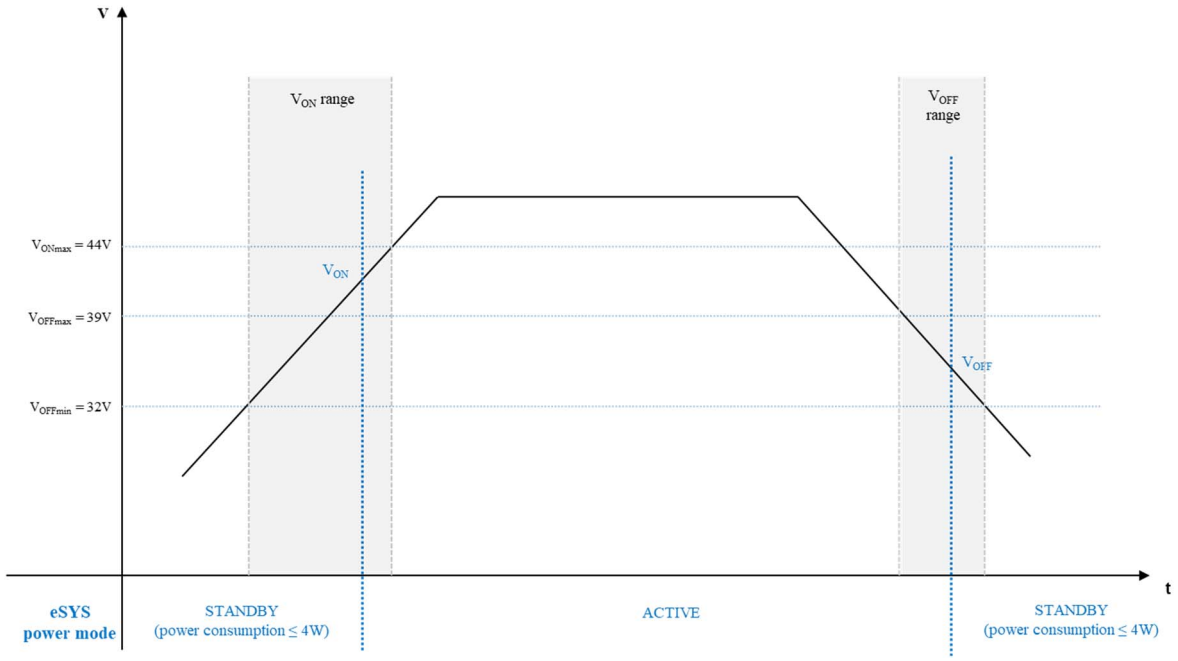

Figure 4: eDEV power limits

The following eDEV Types shall be considered:

- *Type-0 eDEV*. A Type-0 eDEV is an Adapter eDEV. A Type-0 eDEV shall ensure that it meets the above requirements. A Type-0 eDEV may not ensure that the eSYS it is part of meets the above requirements. Type-0 eDEVs introduce potential risk of power failure and line instability in daisy-chain topologies.
- *Type-I eDEV*. A Type-I eDEV may be either an Adapter eDEV or a Terminal eDEV. A Type-I eDEV shall ensure that itself, as well as the eSYS it is part of, meets the above requirements. Therefore, Type-I eDEVs are well-suited, and therefore recommended, for linear bus topologies connecting several eDEVs powered through the coax cable.
- *Type-I+ eDEV*. A Type-I+ eDEV may be either an Adapter eDEV or a Terminal eDEV. A Type-I+ eDEV shall ensure that itself, as well as the eSYS it is part of, meets the above requirements. Therefore, Type-I+ eDEVs are well-suited, and therefore recommended, for linear bus topologies connecting several eDEVs powered through the coax cable. Moreover, adding a new Type-I+ eDEV/eSYS to an existing E&PoC BSS shall not cause any eDEV/eSYS already operated on this BSS to interrupt its service due to a lack of power.

Based on the above considerations, the following recommendations should be considered:

- The use of Type-0 adapters should be limited to point-to-point topologies (see also clause 4.4.3).
- A Type-0 adapter should rely on local powering when operated in a linear bus topology (see also clause 4.4.2).

The eDEV (resp. eSYS) may be capable of drawing power from a local power source. When a local power source is provided, the eSTA may draw some, none, or all of its power from the eDEV (resp. eSYS).

6.1.2 Requirements

Table 11: eDEV Type-I / Type-I+ power

E&PoC Edge Device (eDEV) Type-I / Type-I+	
Requirement 6.1.1	The power supply of a Type-I eDEV shall operate within the characteristics in Table 13 hereafter. A Type-I eDEV shall ensure that the power supply of the eSYS it is part of operates within the characteristics in Table 13 hereafter.

6.1.3 Requirements

Table 12: eDEV Type-0 power

E&PoC Edge Device (eDEV) Type-0	
Requirement 6.1.2	The power supply of a Type-0 eDEV shall operate within the characteristics in Table 13 hereafter. A Type-0 eDEV may not ensure that the eSYS it is part of operates within the characteristics in Table 13 hereafter.
Requirement 6.1.3	A Type-0 eDEV shall provide connectivity for local powering. It is highly recommended to limit the usage of Type-0 eDEVs to point-to-point topology. It is highly recommended to rely on local powering when using a Type-0 eDEV in a linear bus topology.

Table 13: eDEV power limits

Item	Parameter	Symbol	Unit	Value
1	Max eDEV input voltage	$V_{eSTAmax}$	V	57
2	Max eDEV Power supply turn on voltage	V_{ONmax}	V	44
3	Min eDEV Power supply turn off voltage	V_{OFFmin}	V	32
4	Max eDEV Power supply turn off voltage	V_{OFFmax}	V	39
5	Max standby power consumption	$P_{STANDBYmax}$	W	4

6.1.4 Requirements

Table 14: eDEV Type-I+ Hot-Plug support (Optional)

E&PoC Edge Device (eDEV) Type-I+	
Requirement 6.1.4	Adding a new eDEV/eSYS to an existing E&PoC BSS shall not cause any eDEV/eSYS already operated on this E&PoC BSS to interrupt its service due to a lack of power.

6.2 Receiver Device (rDEV) per-port PoC

6.2.1 Specification context

In order an rDEV to accommodate several eSYSs over a linear bus for one given rDEV port, relying on a cable type having significant resistance, it is required to have the rDEV generating a minimum output Power P_{rDEV}, (i.e. a minimum output power per rDEV port) and associated voltage V_{rDEVOn} on the line, according to one of the several rDEV power classes defined in Table 16.

In this respect:

- The specification for P_{rDEV} and V_{rDEVOn} in Table 16 is for the rDEV output power and output voltage range for an active rDEV port.
- The maximum power P_{rDEV} of an rDEV, regardless of its power class, shall not exceed 99,9 W.

The E&POC system defined in the present document uses floating ground. It is therefore required that the negative potential is connected to the outer shield of the coaxial cable for each of the rDEV ports.

6.2.2 Requirements

Table 15: rDEV power

E&PoC Receiver Device (rDEV)	
Requirement 6.2.1	A Receiver Device (rDEV) shall be capable of supplying an output Power P_{rDEV} and an output voltage V_{rDEVOn} over any of its port, with P_{rDEV} and V_{rDEVOn} having the characteristics specified in Table 16.
Requirement 6.2.2	The maximum power P_{rDEV} of an rDEV, regardless of its power class, shall not exceed 99,9 W
Requirement 6.2.3	The negative potential shall be located onto the outer shield of the coaxial cable for each port of a Receiver Device (rDEV)

Table 16: rDEV power on supply limits

rDEV class	rDEV Output Power P_{rDEV} (W)	rDEV Output Voltage V_{rDEVOn} (V)	
	$P_{rDEVmin}$	$V_{rDEVOnmin}$	$V_{rDEVOnmax}$
1	4	53,5	57,0
2	7	53,5	57,0
3	15,4	53,5	57,0
4	30	53,5	57,0
5	45	53,5	57,0
6	60	53,5	57,0
7	75	53,5	57,0
8	90	53,5	57,0

6.3 Receiver Device (rDEV) per-port PoC control (Optional)

6.3.1 Specification context

One or more eSTA devices connected to one same port of an rDEV may experience some issues that require a reboot of such eSTA devices.

Such reboot can be achieved by turning the power off on the rDEV port where such faulty device(s) is connected.

In case the port of a manageable rDEV is set to off, the voltage $V_{rDEVoff}$ of this port under high impedance should follow the specification of Table 18.

6.3.2 Requirements

Table 17: Receiver Device (rDEV) per-port PoC control (Conditional)

E&PoC Receiver Device (rDEV)	
Requirement 6.3.1	A multi-port rDEV may provide either a User Interface (UI) or connectivity for a User Interface Station (UIS) that allows monitoring the value of the output voltage V_{rDEV} (OR the level of PoC) on any of its ports.
Requirement 6.3.2	A multi-port rDEV may provide either a User Interface (UI) or connectivity for a User Interface Station (UIS) that allows setting the output voltage to either V_{rDEVOn} or $V_{rDEVOff}$ on any of its ports.
Requirement 6.3.3	When a Receiver Device (rDEV) port is powered off, the voltage $V_{rDEVoff}$ of this port under high impedance shall not exceed a maximum value $V_{rDEVoffmax}$ as specified in Table 18.

Table 18: rDEV power off supply limits

Item	Parameter	Symbol	Unit	Value
1	Max output voltage per inactive rDEV port under high impedance	$V_{rDEVoffmax}$	V	0,5 V

7 Data transmission requirements for an E&PoC system

7.1 Receiver Station / Device throughput capability

7.1.1 Specification context

An rDEV may embed a plurality of rSTAs (e.g. a 16-port PoC switch may embed 4 rSTAs), each rSTA being in charge of connecting one or more eSTAs arranged in a linear bus topology over one or more ports.

Each connected eSTA should send video stream, to its connected rSTA. In this respect, some eSYS have the ability to generate several video streams simultaneously (e.g. multi-stream IP cameras).

An rDEV is also in charge of forwarding all the video streams received from each of its connected eSYS to a remote client (e.g. VMS) or recording device over a LAN.

Therefore, an rSTA shall be capable of:

- Processing all the streams it receives over any of its ports from the connected eSTAs.
- Processing all the streams it receives simultaneously over all of its ports from the connected eSTAs.

Similarly, an rDEV shall be capable of:

- Processing all the streams it receives simultaneously over all of its ports from the connected eSTAs.

7.1.2 Requirements

Table 19: rSTA throughput capability

E&PoC Receiver Station (rSTA) / Device (rDEV)	
Requirement 7.1.1	Each port of an rSTA shall be capable of handling a global stream bit rate per port that is at least equal to $B_{rSTAPortmin1}$ for throughput class 1, 2 or 3 as defined in Table 20.
Requirement 7.1.2	All ports of an rSTA shall be capable of handling simultaneously a global stream bit rate per port that is at least equal to $B_{rSTAPortmin2}$ for throughput class 1, 2 or 3 as defined in Table 20.
Requirement 7.1.3	All ports of all rSTAs of an rDEV shall be capable of handling simultaneously a global stream bit rate per port that is at least equal to $B_{rSTAPortmin3}$ for throughput class 1, 2 or 3 as defined in Table 20.

Table 20: rSTA / rDEV throughput constraints

Item	Parameter	Symbol	Unit	Class 1	Class 2	Class 3
1	Minimum rSTA Port supported throughput for Requirement 7.1.1	$B_{rSTAPortmin1}$	Mbps	80	200	240
2	Minimum rSTA Port supported throughput for Requirement 7.1.2	$Br_{STAPortmin2}$	Mbps	20	50	60
3	Minimum rSTA Port supported throughput for Requirement 7.1.3	$B_{rSTAPortmin3}$	Mbps	20	50	60

Table 21: Network extension capability

E&PoC Receiver Station (rSTA) / Device (rDEV)	
Requirement 7.1.4	Each port of an rSTA shall be capable of handling simultaneously a minimum of $N_{eSTAperPortmin}$ eSYS connected according to a linear bus topology (see Table 22) with a global stream bit rate per port that is at least equal to $B_{rSTAPortmin3}$ for throughput class 1, 2 or 3 as defined in Table 20.

Table 22: Network extension constraint

Item	Parameter	Symbol	Unit	Min
1	Minimum number of eSTA per rDEV/rSTA port	$N_{eSTAperPortmin}$	-	2

7.2 Adapter eDEV throughput & streaming capability

7.2.1 Specification context

An Adapter eDEV is in charge of forwarding the video stream it receives from a connected communication device, e.g. an IP camera, to an rSTA it is connected to through a coaxial cable. In this respect, some communication devices, e.g. multi-stream IP cameras, have the ability to generate several video streams simultaneously.

Therefore, an Adapter eDEV shall be capable of processing all the streams it receives from a connected communication device, e.g. an IP camera.

7.2.2 Requirements

Table 23: Adapter eDEV throughput capability

E&PoC Adapter Edge Device (Adapter eDEV)	
Requirement 7.2.1	The eSYS formed by the Adapter eDEV connected to a communication device (e.g. an IP camera), shall be capable of transmitting towards an rSTA a stream with a throughput up to $B_{AdaptEDEV1}$ for throughput class 1, 2 or 3 as defined in Table 24.
Requirement 7.2.2	The eSYS formed by the Adapter eDEV connected to a communication device (e.g. an IP camera), shall be capable of transmitting towards an rSTA a stream with a throughput up to $B_{AdaptEDEV2}$ for throughput class 1, 2 or 3 as defined in Table 24 when each port of the rSTA is connected to a minimum of $N_{eSTAperPortmin}$ eSYS in a linear bus topology (see Table 22).

Table 24: Adapter eDEV throughput constraints

Item	Parameter	Symbol	Unit	Class 1	Class 2	Class 3
1	Adapter eDEV supported throughput for Req. 7.2.1	$B_{AdaptEDEV1}$	Mbps	80	200	240
2	Adapter eDEV supported throughput for Req. 7.2.2	$B_{AdaptEDEV2}$	Mbps	10	25	30

Table 25: Adapter eDEV streaming capability

E&PoC Adapter Edge Device (Adapter eDEV)	
Requirement 7.2.3	An Adapter eDEV shall be capable of transmitting towards an rSTA a minimum of $N_{AdaptEDEVStreammin}$ streams, with an aggregated throughput up to $B_{AdaptEDEV1}$ for throughput class 1, 2 or 3 as defined in Table 24, received from a communication device (see Table 26).

Table 26: Adapter eDEV streaming constraint

Item	Parameter	Symbol	Unit	Min
1	Minimum number of streams supported by an Adapter eDEV	$N_{AdaptEDEVStreammin}$	-	2

7.3 Terminal eDEV throughput & streaming capability

7.3.1 Specification context

A Terminal eDEV, e.g. a PoC camera, is in charge of sending video stream to an rSTA it is connected to through a coaxial cable. In this respect, some Terminal eDEVs have the ability to generate several video streams simultaneously (e.g. multi-stream IP cameras).

7.3.2 Requirements

Table 27: Terminal eDEV throughput capability

E&PoC Terminal Edge Device (Terminal eDEV)	
Requirement 7.3.1	A Terminal eDEV shall be capable of transmitting a stream with a throughput up to $B_{TerminalEDEV1}$ for throughput class 1, 2 or 3, as defined in Table 30, towards an rSTA when each port of the rSTA is connected to a minimum of $N_{eSTAperPortmin}$ eSYS in a linear bus topology (see Table 22).

Table 28: Terminal eDEV streaming capability (conditional)

E&PoC Terminal Edge Device (Terminal eDEV)	
Requirement 7.3.2	A Terminal eDEV shall be capable of transmitting towards an rSTA a minimum of $N_{TerminalEDEVStreammin}$ streams, as defined in Table 29, with an aggregated throughput up to $B_{TerminalEDEV2}$ for throughput class 1, 2 or 3 as defined in Table 30. This requirement applies only to Terminal eDEVs having the ability to generate and transmit more than one stream simultaneously.

Table 29: Terminal eDEV streaming constraint (conditional)

Item	Parameter	Symbol	Unit	Min
1	Minimum number of streams supported by a Terminal eDEV	$N_{TerminalEDEVStreammin}$	-	2

Table 30: Terminal eDEV throughput constraints

Item	Parameter	Symbol	Unit	Class 1	Class 2	Class 3
1	Terminal eDEV supported throughput for Requirement 7.3.1	$B_{TerminalEDEV1}$	Mbps	10	25	30
2	Terminal eDEV supported throughput for Requirement 7.3.2	$B_{TerminalEDEV2}$	Mbps	80	200	240

Annex A (normative): Requirements summary

All the requirements listed in the previous clauses of the present document are gathered in Table Table hereafter.

Table A.1: Requirements summary

Requirement		E&PoC device Type			
Req. ID	Req. Status	Adapter eDEV Type-0	Adapter eDEV Type-1	Terminal eDEV	rDEV
Requirement 5.1.1 - Communication network mode	Mandatory	✓	✓	✓	✓
Requirement 5.1.2 - E&PoC Physical/MAC layer	Mandatory	✓	✓	✓	✓
Requirement 5.2.1 - E&PoC System and BSS	Mandatory	✓	✓	✓	✓
Requirement 5.3.1 - Neighbour Networks	Mandatory				✓
Requirement 5.3.2 - Neighbour Networks	Mandatory				✓
Requirement 5.4.1 - Default Password/NMK	Mandatory	✓	✓	✓	✓
Requirement 5.5.1 - Receiver Device (rDEV) per-port PoC reset	Conditional				✓
Requirement 5.5.2 - Receiver Device (rDEV) per-port PoC reset	Conditional				✓
Requirement 5.6.1 - Support to installation	Optional	✓	✓	✓	
Requirement 5.7.1 - Hot-Plug support	Mandatory	✓	✓	✓	
Requirement 6.1.1 - eDEV Type-I / Type-I+ power	Mandatory		✓		
Requirement 6.1.2 - Type-0 power	Mandatory	✓			
Requirement 6.1.3 - Type-0 power	Mandatory	✓			
Requirement 6.1.4 - eDEV Type-I+ Hot-Plug support (applicable for eDEV Type-I+ only)	Optional		✓		
Requirement 6.2.1 - rDEV power	Mandatory				✓
Requirement 6.2.2 - rDEV power	Mandatory				✓
Requirement 6.2.3 - rDEV power	Mandatory				✓
Requirement 6.3.1 - Receiver Device (rDEV) per-port PoC control	Conditional				✓
Requirement 6.3.2 - Receiver Device (rDEV) per-port PoC control	Conditional				✓
Requirement 6.3.3 - Receiver Device (rDEV) per-port PoC control	Conditional				✓
Requirement 7.1.1 - rSTA throughput capability	Mandatory				✓
Requirement 7.1.2 - rSTA throughput capability	Mandatory				✓
Requirement 7.1.3 - rSTA throughput capability	Mandatory				✓
Requirement 7.1.4 - Network extension capability	Mandatory				✓
Requirement 7.2.1 - Adapter eDEV throughput capability	Mandatory	✓	✓		
Requirement 7.2.2 - Adapter eDEV throughput capability	Mandatory	✓	✓		
Requirement 7.2.3 - Adapter eDEV streaming capability	Mandatory	✓	✓		
Requirement 7.3.1 - Terminal eDEV throughput capability	Mandatory			✓	
Requirement 7.3.2 - Terminal eDEV streaming capability	Conditional			✓	

Annex B (informative): Change History

Date	Version	Information about changes
2019-04-08	0.0.3	Annex A: changed from informative to normative
2019-04-11	0.0.4	Clause 6.2.1: Added clarification that "The E&POC system defined in the present document uses floating ground."

History

Document history		
V1.1.1	June 2019	Publication