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Energy Efficient IP Video Surveillance Systems over Coaxial Cables

Disclaimer

Reference
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Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) Operational energy Efficiency for Users (OEU).

The present document has been done with ICT users' support (eG4U), as the new proposed IP video surveillance solution allows the reuse of existing coaxial cabling for efficient remote powering over the same cable, the simple extension of the coaxial cable network to accommodate additional devices without requiring the installation of additional separate cables for each additional device, and the use of long cables (beyond 100 meters) without requiring repeaters every 100 meters.

Modal verbs terminology

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Introduction

The present document describes the motivations for the standardization of technology which enables Energy Efficient IP Video Surveillance Systems over new and legacy Coaxial Infrastructures.

1 Scope

The present document describes the motivations for the standardization of technology which enables Energy Efficient IP Video Surveillance Systems over new and legacy Coaxial cables. The technology enables the transmission of both IP data and power over a single coaxial cable, and is based as much as possible on existing standards. The standardization of this technology is needed for the deployment of sustainable Video Surveillance Systems using interoperable products from different manufacturers.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative 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.

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.

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

[i.2] HomePlugAV1: "HomePlug® AV Specification" Version 1.1 May 21, 2007.

[i.3] HomePlugAV2: "HomePlug® AV Specification" Version 2.1 February 21, 2014.

[i.4] PoE: IEEE Std 802.3af ™-2003 (clause 33): "Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)".

[i.5] PoE+: IEEE Std 802.3at ™-2009 :"Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements".

[i.6] PoE++: IEEE 802.3bt ™-2018: "IEEE Approved Draft Standard for Ethernet - Amendment 2: Power over Ethernet over 4 Pairs".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

edge device/front end device: communication device having edge connectivity like a power over coax IP camera or a power over Coax IP adapter

receiver device/head end device: communication device having IP receiving and power over coax delivering capabilities, like a power over coax switch

3.2 Symbols

Void.

3.3 Abbreviations

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

AV	Audio Video
CCTV	Closed-Circuit TeleVision (also known as Video Surveillance)
HD	High Definition
ICT	Information and Communications Technology
IP	Internet Protocol
IPoC	IP over Coax
IPPoC	IP and Power over Coax
LAN	Local Area Network
PoC	Power over Coax
RATP	Régie Autonome des Transports Parisiens (French transport operator)
SD	Standard Definition

4 Introduction

The present document describes the need for standardization of IP-and-Power-over-Coax technology intended to promote the development of interoperable IP-and-Power-over-Coax solutions for Video Surveillance.

Concerning devices, they will also address any IP device (not limited to IP cameras) such as video intercom devices, displays, IP audio devices.

In terms of architecture (see Figure 1 as an example over coaxial cables), Video Surveillance Systems generally consist of:

- head end or receiver devices (such as switches, power supplies, etc.) connected to a larger IP infrastructure;
- front end or edge devices (such as surveillance cameras);
- a cable infrastructure connecting the head end devices to the front end devices, so that:
  - any data collected from the front end devices can be transported to the head end devices, and then further managed (analysed, stored, accessed) by other devices within the larger IP infrastructure;
  - power and management data may be supplied from the head end devices to the front end devices, if the front end devices enable this feature.

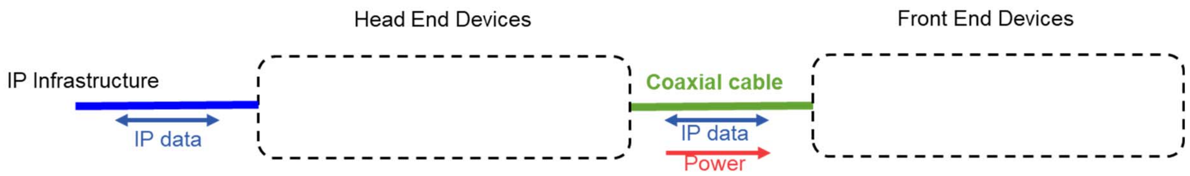

Figure 1: Video Surveillance System Architecture (example with Coaxial cables)

Analogue Video Surveillance systems are characterized by the use of analogue cameras as front end devices, coaxial cables for the infrastructure, a variety of head end devices able to handle the signals from analogue cameras, and most often a separate power supply network for front end devices.

IP Video Surveillance systems are characterized by the use of IP network cameras as front end devices (most of them enabling power supply over cables), most often Ethernet or fiber optic cables for the infrastructure (often limited in length to 100 meters, due to current IP/Ethernet data and power transmission standards), and IP headend devices.

The IP-and-Power-over-Coax technology which requires standardization enables an energy efficient and sustainable transition from legacy analogue Video Surveillance systems to IP Video Surveillance systems.

Energy efficiency is achieved through optimal use of the legacy coaxial cable infrastructure, and will be addressed in the next clause.

Standardization of IP-and-Power-over-Coax technology enables interoperability between IP-and-Power-over-Coax technology.

Furthermore, new installations can also benefit from the use of coaxial cable infrastructures over long distances (above 100 meters) between head end and front end devices, as a viable alternative to Ethernet cables.

5 Needs

5.1 Generalities

This clause addresses needs that were identified through interviews with a variety of end-users, as well as from monitoring trends, and which can be classified in this way:

- Interoperability
- Coaxial cable re-use
- IP-over-Coax
- Power-over-Coax
- New Installations
- Network Extension
- Plug and Play

5.2 Interoperability

Interoperability contributes to sustainable solutions over the long term, providing end-users with a wider range of choices for head end and front end devices, and freeing them from dependence on proprietary technologies and single manufacturers.

Interoperability is key for both data and power. It is a strong need because end-users have to maintain their network, replacing old products by new ones, or adding new products, from different manufacturers.

5.3 Coaxial Cable Re-use

In the context of legacy analogue video surveillance systems, there is today a very large installed base of surveillance cameras connected over coaxial cable (including analogue SD cameras and HD CCTV). The ability to reuse these coaxial infrastructures while replacing these cameras with IP Video Security devices will eliminate the need for:

- removing existing cables;
- disposing of the cables removed;
- purchasing new cables;
- installing the cables purchased.

In addition, re-using existing coaxial cables results in significant savings for the end user, in terms of time and resources.

Legacy analogue Video Surveillance necessarily include a power supply network designed for the front end devices. This will no longer be needed, since the power can also be supplied over the existing coaxial infrastructure.

Clearly the re-use of existing coaxial cables when transitioning legacy video surveillance systems to IP is an environmentally sound approach.

5.4 IP-over-Coax

The unavoidable transition to IP, in order to benefit from the wide choice of feature-rich IP equipment and well-established and open standards, implies a need for solutions which enable the transmission of IP data over coaxial cable infrastructures, also called IP-over-Coax solutions, referred to as IPoC solutions.

A major requirement is the transparent integration of the IPoC solution in the IP Video Surveillance ecosystem, and its compliance with relevant standards in use in the IP ecosystem.

In terms of bandwidth, the requirements are linked to the ability to support video transmissions from up to 4K network cameras. The data network should allow high bitrates data transfer for multiple HD Video streams, and give the opportunity to also extend the usages to other than video IP applications.

Figure 2 contains an example of an IP-and-Power over Coax infrastructure, with the necessary IP-and-Power-over-Coax Adapters, both in the head end and the front end. IPPoC adapters are IPoC adapters with the additional PoC technology, described in the following clause.

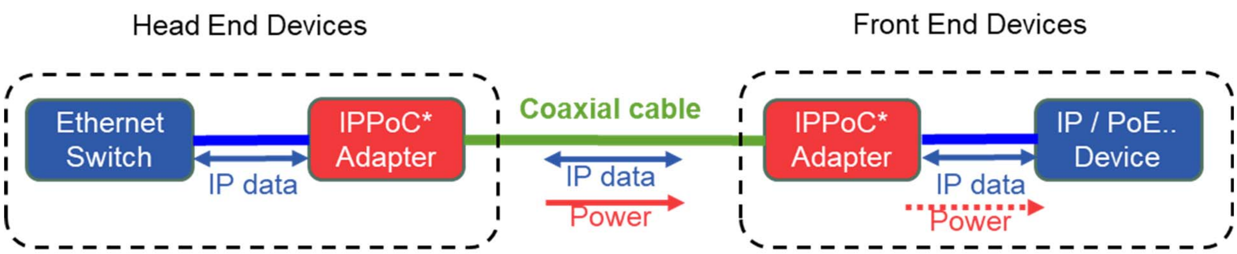

Figure 2: IP-and-Power-over-Coax System Architecture

5.5 Power-over-Coax

A major trend in Video Surveillance solutions is the use of the cable used to transmit data, to also supply power to the front end devices.

Given the need to re-use legacy coaxial cable infrastructure, this requires power supply technologies which operate over coaxial cables, referred to as PoC technologies.

Interoperability of front end and head-end adapter devices should also be achieved with most commonly used standards, such as the IEEE 802.3 family of standards ([i.4], [i.5], [i.6]), so that the complete range of IP devices which are compliant with this family of standards can be used in the IP-and-Power-over-Coax solution.

Power should be delivered in a safe and standardized way to allow a robust, manageable and interoperable infrastructure.

5.6 New Installations

Many new installations of Video Surveillance systems require the use of long distance cables (100 meters and above) to connect Video Security devices to the IP Network.

The standardization of IP-and-Power-over-Coax technology could also benefit new installations, as no standardized technology exists for long distance cables (100 meters and above).

5.7 Network Extension

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 is an important need. Front end devices all become a potential extension point for adding a new IP device to a network (this is called the multi-drop feature), minimizing the amount of cable needed for an installation. This is valid for both existing and new installations.

Figure 3 is one example of network extension, enabling an extension of the coaxial cable network to accommodate more front end devices, without requiring an additional cable between the head end and the front end.

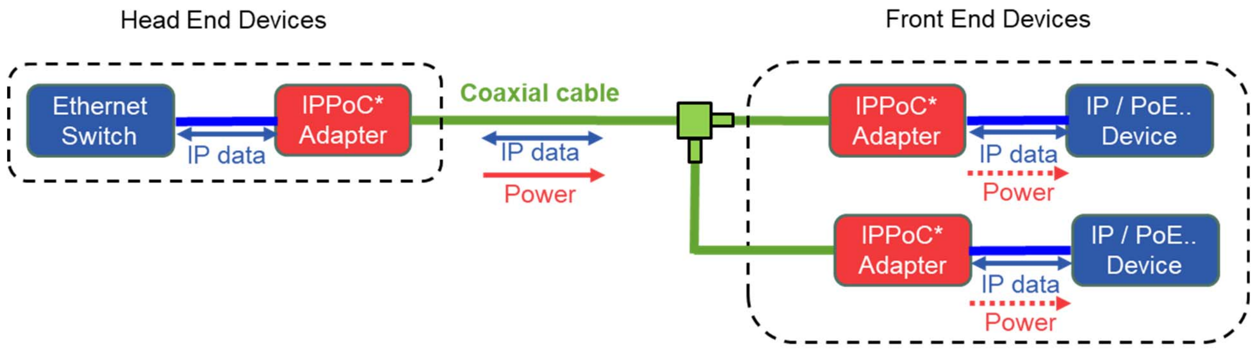

Figure 3: IP-and-Power-over-Coax System Architecture with Network Extension

The power supply to front end IP devices over the legacy coaxial cable needs to be safe and reliable. Adding a device to the network should not bring down the network, as an example.

An example of Network Extension in a subway station is provided in Figure A.1.

5.8 Plug-and-Play

It should be very easy to connect and add a front end device to the network (the Plug-and-Play) feature.

Some IP-over-Coax technologies require manual pairing between devices when one is added to a network. This creates complex installation procedures, and therefore it is necessary to be able to easily add devices to a network without any associated complex procedure.

6 Solutions

An examination of the IP-over-Coax technologies deployed with respect to the needs described in the previous clause identified the interoperable HomePlug® AV family of standards ([i.1], [i.2], [i.3]) as a good candidate, with some minor modifications. Therefore one specification is required to identify under which conditions this family of standards should be used to satisfy the identified needs.

The HomePlug® AV family of standards 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.

7 Need for standardization

Concerning the transmission of power over coax, no standardized technology exists, with existing IPoC and IPPoC products using their own proprietary technologies, creating a need for standardization.

Annex A: Subway Station Example

Figure A.1 is an example of an IP and Power over Coax infrastructure in a subway station.

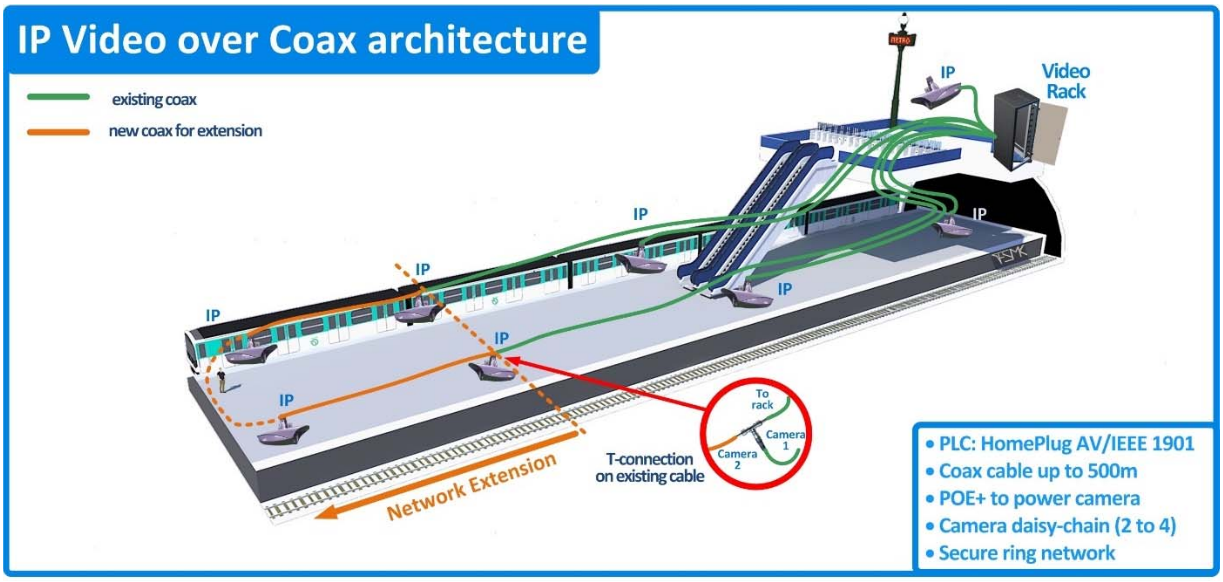

Figure A.1: IP and Power over Coax System Architecture in a subway station (courtesy of RATP)

Annex B: Authors & contributors

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Annex C:
Change History

Date	Version	Information about changes
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History

Document history		
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