



## **Access, Terminals, Transmission and Multiplexing (ATTM); Benefit Analysis of Ethernet and power over coaxial cables - IP Video Surveillance Case Studies**

*iTeh Standards PREVIEW  
(standards.iteh.ai)  
Full standards catalog: <https://standards.iteh.ai/catalog/standards/sist/eb57ac29-ca79-444a-a6f4-50017c5fda77/etsi-tr-105-177-v1.1.1-2020-04>*

---

**Reference**

---

DTR/ATTMSDMC-8

---

**Keywords**

---

environmental impact, ethernet, IP, power over coaxial cable, video surveillance**ETSI**

---

650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C  
Association à but non lucratif enregistrée à la  
Sous-Préfecture de Grasse (06) N° 7803/88

---

**Important notice**The present document can be downloaded from:  
<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at [www.etsi.org/deliver](http://www.etsi.org/deliver).

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at <https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:  
<https://portal.etsi.org/People/CommiteeSupportStaff.aspx>

---

**Copyright Notification**

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2020.  
All rights reserved.

**DECT™**, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members.  
**3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

**oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners.

**GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

# Contents

Intellectual Property Rights .....	7
Foreword.....	7
Modal verbs terminology.....	7
Introduction .....	7
1 Scope .....	9
2 References .....	9
2.1 Normative references .....	9
2.2 Informative references.....	9
3 Definition of terms, symbols and abbreviations.....	9
3.1 Terms.....	9
3.2 Symbols.....	10
3.3 Abbreviations .....	10
4 Design solutions for VSS using IP and remote powering over coaxial cables.....	10
4.1 General .....	10
4.2 Basic principles .....	10
4.2.1 Alternative design solutions.....	10
4.2.1.1 Coaxial cabling signal transmission with LV AC power to cameras.....	10
4.2.1.2 Optical fibre cabling signal transmission with LV AC power to cameras .....	11
4.2.1.3 Balanced cabling signal transmission and remote powering of cameras.....	11
4.2.1.4 Coaxial cabling signal transmission and remote powering of cameras .....	12
4.3 Models for remote powering using coaxial cabling .....	13
4.3.1 General.....	13
4.3.2 Powering Classes .....	13
4.3.3 DC loop resistance .....	14
4.3.3.1 Cable DC loop resistance .....	14
4.3.3.2 System requirements .....	14
4.3.4 Point-to-point implementations .....	15
4.3.5 Bus implementations.....	15
4.4 Upgrade of legacy coaxial solutions.....	15
4.5 "New build" coaxial solutions.....	16
5 Implementation of VSS using IP and remote powering over coaxial cables .....	16
5.1 General .....	16
5.2 Use case for Class 3 devices.....	17
5.2.1 Point-to-point implementation.....	17
5.2.2 Linear bus implementation .....	17
5.3 Use case for Class 4 devices.....	17
5.3.1 Point-to-point implementation.....	17
5.3.2 Linear bus implementation .....	17
5.4 Use case (point-to-point) for Class 6 devices .....	17
5.5 Use case (point-to-point) for Class 8 devices.....	18
6 Benefit analysis overview .....	18
6.1 General .....	18
6.2 Cost of ownership.....	18
6.2.1 Factors .....	18
6.2.2 Design.....	18
6.2.3 Installation .....	19
6.2.4 Operation .....	19
6.2.5 Maintenance.....	19
6.2.6 Results of benefit analysis .....	19
6.3 Environmental impact .....	22
6.3.1 Factors .....	22
6.3.2 Material consumption .....	22

6.3.3	Energy performance.....	23
6.3.4	End-of-life.....	24
<b>Annex A:</b>	<b>Application cases.....</b>	<b>25</b>
A.1	General.....	25
A.2	Underground station implementation.....	25
A.3	Small train station implementation.....	26
A.4	Medium-sized train station implementation.....	27
A.5	Mass transit - large train station implementation.....	28
A.6	Other surveillance applications.....	29
History	.....	32

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)  
Full standard:  
<https://standards.iteh.ai/catalog/standards/sist/eb57ac29-ca79-444a-a6f4-50017c5fda7/etsi-tr-105-177-v1.1.1-2020-04>

---

## List of figures

Figure 1: Traditional coaxial cabling solution for video surveillance .....	11
Figure 2: Traditional optical fibre cabling solutions for video surveillance.....	11
Figure 3: Signal and remote powering provision using balanced cable for video surveillance.....	12
Figure 4: Signal and remote powering provision using coaxial cable for video surveillance (point-to-point).....	13
Figure 5: Signal and remote powering provision using coaxial cable for video surveillance (linear bus) .....	13
Figure 6: Voltage drops allowance and resistance modelling .....	14
Figure 7: Cable congestion under platforms .....	16
Figure A.1: Underground station example .....	25
Figure A.2: Rural village station example.....	26
Figure A.3: Medium-sized station example .....	27
Figure A.4: Large city station.....	28

---

## List of tables

Table 1: Power Classes of ETSI TS 105 176-2.....	13
Table 2: Power delivery parameters for $V_{DEV} = 55,25$ VDC and $V_{DEV} = 44$ VDC .....	14
Table 3: Maximum lengths at DC loop resistance limits.....	15
Table 4: Cost of Ownership: design phase.....	20
Table 5: Cost of Ownership: installation phase.....	21
Table 6: Cost of Ownership: operational phase.....	22
Table 7: Cost of Ownership: maintenance phase .....	22
Table 8: Environmental impact: material consumption.....	23
Table 9: Environmental impact: energy performance .....	24
Table 10: Environmental impact: End-of-Life .....	24
Table A.1: Underground station infrastructure.....	26
Table A.2: Main characteristics affecting the network installation costs .....	26
Table A.3: Rural village station infrastructure .....	27
Table A.4: Main characteristics affecting the network installation costs .....	27
Table A.5: Medium-sized station infrastructure.....	28
Table A.6: Main characteristics affecting the network installation costs .....	28
Table A.7: Large city station infrastructure.....	29
Table A.8: Main characteristics affecting the network installation costs .....	29
Table A.9: Linear example - Tunnel .....	30

Table A.10: Dispersed example - Industrial site .....	30
Table A.11: Multi-level dispersed example - Car park .....	30
Table A.12: Multi-level dispersed example - Museum .....	31

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

Full standard:  
<https://standards.iteh.ai/catalog/standards/sist/eb57ac29-ca79-444a-a6f4-50017c5fda7/etsi-tr-105-177-v1.1.1-2020-04>

---

# Intellectual Property Rights

## Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

## Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

---

# Foreword

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

---

# Modal verbs terminology

In the present document "**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).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

---

# Introduction

Traditionally, short- and medium- range Video Surveillance Systems (VSS) have used point-to-point coaxial cables for the transmission of the video signals from the camera to, and the camera control signals from, a monitoring centre with power supplied to the cameras via a separate and local Low Voltage (LV) AC power supply.

Longer transmission lengths and/or the need to support high resolution cameras require the replacement of the coaxial cable with optical fibre cable.

VSS are now able to take advantage of balanced pair cabling and the standards developed by IEEE, ISO/IEC and CENELEC which allow the signals and DC power to be delivered over the same cable, once again on a point-to-point basis.

The provision of signal and DC power within a single cable construction has clear advantages in terms of cost and flexibility of installed configuration, avoiding the need to re-provision LV power and associated infrastructure.

The present document considers the opportunities offered by employing a combined signal and DC powering solution using coaxial cable which not only avoids the replacement of the installed cable but, dependent on the performance of the coaxial cable, can also offer extended distance of support beyond that offered by the balanced cable solution.

Equally importantly, the combined signal and DC powering solution using coaxial cable offers the opportunity to connect multiple cameras in a linear bus configuration.

The present document:

- a) presents the basic principles of, and describes in detail the coaxial cabling solution for, Video Surveillance Systems (VSS) using IP technology;
- b) describes in detail the implementation of VSS using IP signalling and remote powering using the coaxial cabling solution;
- c) provides a benefit analysis (both of cost-of-ownership and environmental impact) of coaxial cabling, balanced cabling and wireless approaches to IP-based VSS;
- d) contains a number of use cases for transportation systems and other surveillance applications.

**ITeH STANDARD PREVIEW**  
**(standards.iteh.ai)**

Full standard:  
<https://standards.iteh.ai/catalog/standards/sist/eb57ac29-ca79-444a-a6f4-50017c5ffda7/etsi-tr-105-177-v1.1.1-2020-04>



---

# 1 Scope

The present document reviews the benefit analyses and environmental impact for selected use cases (such as mass transit systems) of using coaxial cables to support both Ethernet and power over coaxial equipment for IP Video Surveillance Systems (VSS) when:

- a) upgrading existing analogue VSS using legacy coaxial cables as compared with installation of alternative transmission media; and
- b) building new VSS by installing coaxial cables as compared with other transmission media.

---

# 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] CENELEC EN 50173-1: "Information technology - Generic cabling systems - General requirements".
- [i.2] ETSI TS 105 176-2: "Access, Terminals, Transmission and Multiplexing (ATTM); Ethernet and power over cables; Part 2: Ethernet and power over coaxial cables for IP video surveillance".
- [i.3] IEEE 802.3™: "IEEE Standard for Ethernet".
- [i.4] IEEE 802.3cg™: "IEEE Standard for Ethernet - Amendment 5: Physical Layer Specifications and Management Parameters for 10 Mb/s Operation and Associated Power Delivery over a Single Balanced Pair of Conductors".
- [i.5] ISO/IEC 11801-1: "Information technology - Generic cabling for customer premises - General requirements".

---

# 3 Definition of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in ETSI TS 105 176-2 [i.2] and the following apply:

**low voltage:** voltage exceeding extra-low voltage but not exceeding 1 000 V a.c. or 1 500 V d.c. between conductors, or 600 V a.c. or 900 V d.c. between conductors and earth

## 3.2 Symbols

For the purposes of the present document, the symbols given in ETSI TS 105 176-2 [i.2] apply.

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 105 176-2 [i.2] and the following apply:

AC	Alternating Current
DC	Direct Current
E&PoC	Ethernet and Power over Coax(ial cabling)
EMI	ElectroMagnetic Interference
ISM	Industrial, Scientific and Medical
LV	Low Voltage
PSU	Power Supply Unit
QoS	Quality of Service
UPS	Uninterruptible Power System
VDC	Volts Direct Current
VSS	Video Surveillance System
WAP	Wireless Access Point

---

# 4 Design solutions for VSS using IP and remote powering over coaxial cables

## 4.1 General

This clause provides a general description of the Ethernet & Power over Coax (E&PoC) technology which is the subject of the present document.

Clause 4.2 describes the basic principles of the various design solutions for VSS.

For E&PoC solutions:

- clause 4.3 provides further details of the models for remote powering of devices within VSS;
- clause 4.4 addresses the upgrade of VSS constructed from legacy coaxial cabling;
- clause 4.5 addresses the design and installation of new build VSS installations.

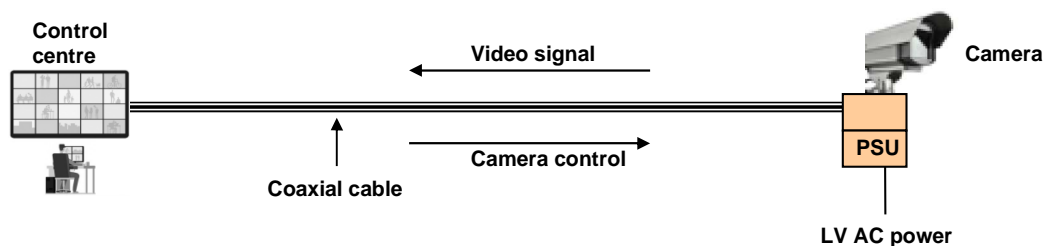
## 4.2 Basic principles

### 4.2.1 Alternative design solutions

#### 4.2.1.1 Coaxial cabling signal transmission with LV AC power to cameras

Traditionally, VSS have used point-to-point coaxial cables for the transmission of the analogue video signals from the camera to, and the camera control signals from, a monitoring centre with power supplied to the camera Power Supply Unit (PSU) via a separate and local LV AC power supply, typically directly fed by the energy grid.

Figure 1 is a schematic of the basic solution.



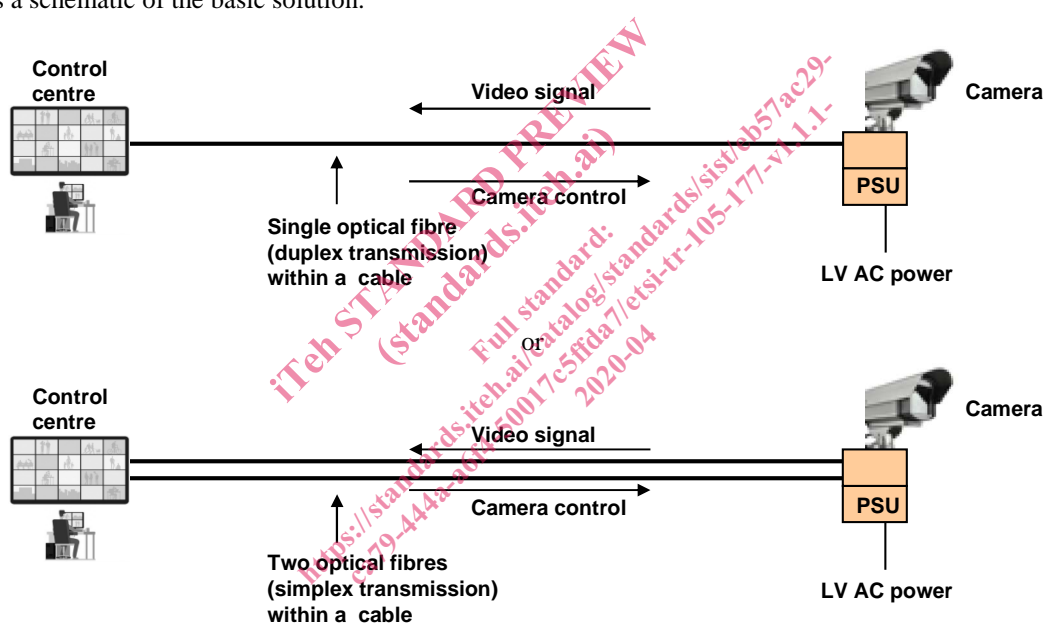
**Figure 1: Traditional coaxial cabling solution for video surveillance**

The length of coaxial cable is limited by the bandwidth and attenuation of the coaxial cable in relation to the delivery for the required video reception quality.

#### 4.2.1.2 Optical fibre cabling signal transmission with LV AC power to cameras

Where the achievable transmission length using coaxial cable is inadequate, optical fibre may be used in either simplex or duplex mode.

Figure 2 is a schematic of the basic solution.



**Figure 2: Traditional optical fibre cabling solutions for video surveillance**

Depending on the optical fibre technology used (single-mode, multi-mode or plastic) it can offer transmission distances of many kilometres with single-mode optical fibres to just tens of meters with plastic optical fibres.

There may be other technical factors for selecting optical fibre technology in specific situations such as safety and security concerns.

#### 4.2.1.3 Balanced cabling signal transmission and remote powering of cameras

4-pair balanced cabling components of Category 5 and above (as specified in ISO/IEC 11801-1 [i.5] and CENELEC EN 50173-1 [i.1]) enable both the signal transmission (using Ethernet protocols of IEEE 802.3 [i.3]) and the delivery of DC power of up to 90 W to the camera. This allows the replacement of the local LV AC power supply and the associated Power Supply Unit (PSU) with a DC/DC convertor which converts the remote powering voltages to those needed by the cameras (typically 12 V DC). Figure 3 is a schematic of the basic solution.