# ETSI TR 103 948 V1.1.2 (2025-01)


**Wireline Access Network Systems;**
**General engineering for existing network reuse;**
**Implementation of IP equipment on existing coaxial networks**

Reference
RTR/ATTM-0639

Keywords
coaxial, customer premises networks, energy efficiency, fixed networks, network, power over coaxial cable, sustainability, video surveillance

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# 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).

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# 1 Scope

The present document supports deployment of video surveillance equipment standardized in ETSI TS 105 176-2 [i.1] and ETSI TR 105 177 [i.2] on existing networks.

# 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 regards to a particular subject area.

[i.1] ETSI TS 105 176-2 (V1.1.1): "Access, Terminals, Transmission and Multiplexing (ATTM); Ethernet and power over cables; Part 2: Ethernet and power over coaxial cables for IP video surveillance".

[i.2] ETSI TR 105 177 (V1.1.1): "Access, Terminals, Transmission and Multiplexing (ATTM); Benefit Analysis of Ethernet and power over coaxial cables - IP Video Surveillance Case Studies".

[i.3] ETSI GR OEU 029 (V1.1.1): "Energy Efficient IP Video Surveillance Systems over Coaxial Cables".

[i.4] ETSI EN 305 174-8 (V1.1.1): "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment and Lifecycle Resource Management; Part 8: Management of end of life of ICT equipment (ICT waste/end of life)".

[i.5] ETSI TS 105 174-8 (V1.1.1): "Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment and Lifecycle Resource Management; Part 8: Implementation of WEEE practices for ICT equipment during maintenance and at end-of-life".

[i.6] ISO/IEC 11801-1 (2018): "Information technology -- Generic cabling for customer premises".

[i.7] EIA/TIA 568-C.2: "Balanced Twisted-Pair Telecommunications Cabling and Components Standards".

[i.8] EN 50173-1:2018: "Information technology - Generic cabling systems - Part 1: General requirements" (produced by CENELEC).

[i.9] IEEE 802.3af™: "IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications - Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI)".

[i.10] IEEE 802.3at™: "IEEE Standard for Information technology-- Local and metropolitan area networks-- Specific requirements-- Part 3: CSMA/CD Access Method and Physical Layer Specifications Amendment 3: Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements".

[i.11] IEEE 802.3bt™: "IEEE Standard for Ethernet Amendment 2: Physical Layer and Management Parameters for 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:

**User Interface (UI):** mechanism (preferably keyboard and display) to enable user interaction with the network

## 3.2 Symbols

Void.

## 3.3 Abbreviations

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

| | |
|---|---|
| BNC | Bayonet Nut Connector |
| CCTV | Close Circuit TeleVision |
| CuR | Red Copper |
| DSL | Digital Subscriber Line |
| E&PoC | Ethernet and Power over Coax |
| FeCu | Steel Copper |
| I-BNC | I Bayonet Nut Connector |
| ICT | Information & Communication Technology |
| IP | Internet Protocol |
| LAN | Local Area Network |
| LSZH | Low Smoke Zero Halogen |
| NF | French Norm |
| POC | Power over Coax |
| PoC | Power over Coaxial |
| POE | Power Over Ethernet |
| PoE | Power over Ethernet |
| PUR | Polyurethane |
| PVC | PolyVinylChloride |
| T-BNC | T Bayonet Nut Connector |
| UI | User Interface |
| VMS | Video Management System |

# 4 Implementation of a wired capillary architecture

## 4.1 Capillary Architecture Wiring Types

### 4.1.1 Generalities

The implementation of a wired capillary architecture is considered and broadly described as in Figure 1.

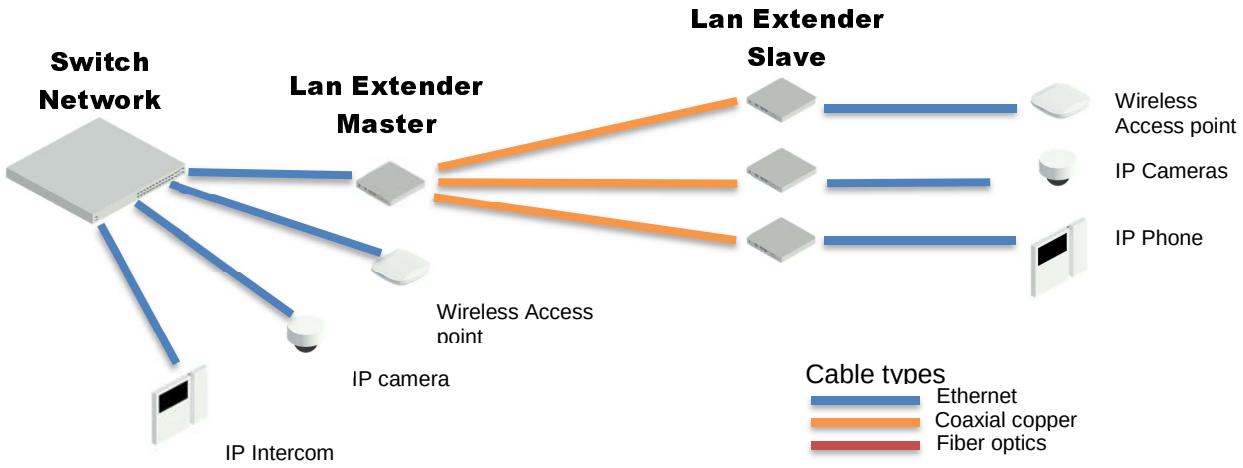



**Figure 1: Capillary Architecture**

**Table 1: Types of wiring**

| Cable use | Conductor type | Equipment use | POE | Circuit bypass |
|---|---|---|---|---|
| Analog video | Coaxial conductor | Old standard | NO | NO |
| | Optical fibre | With dedicated converter | NO | NO |
| IP video<br><br>Other IP equipment | Symmetric twisted pairs | Standard for equipment within 90 m | Low power equipment | NO |
| | Coaxial conductor | Standard for equipment over 90 m and less than 500 m<br>Very exceptionally up to 1 800 m (after report validation) | Low power equipment | YES |
| | Optical fibre | Standard for equipment over 500 m | NO | NO |

### 4.1.2 Coaxial wiring

Coaxial cables will be used to connect access points that are more than 90 m from their network connection.

For renewal, it will be common to use existing coaxial cables regardless of their length for IP transport.

Commonly used coaxial cables have a characteristic impedance of 75 Ω.

Signals transported over coaxial wiring are historically analogue video signals. Use of Ethernet 10b2 type cables for such signals been used for such signals, and new applications of DSL technology now allow Ethernet signals to be transported over bifilar or + wires.

Coaxial link chains can be used to distribute signals over long lengths of cable with suitable end equipment. Depending on the signals to be transmitted, they allow the use of T-connectors.

## 4.2 IP binding channel

### 4.2.1 IP link channel over Ethernet cable (point to point)

Each element should meet a minimum category for the IP channel to match the described class, as described in Figure 2.

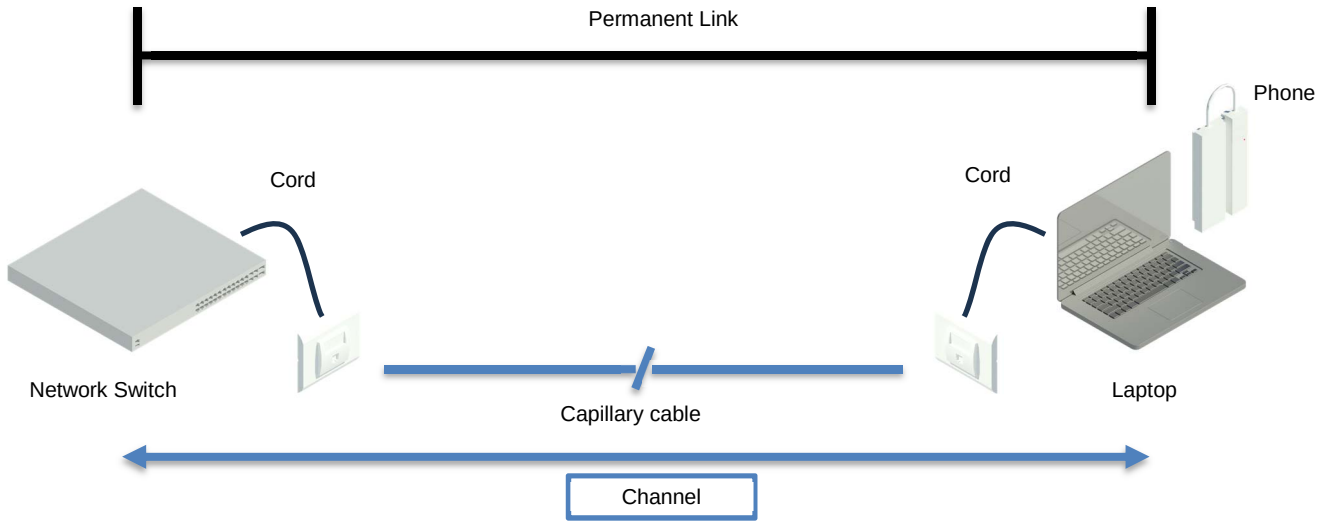



**Figure 2: IP link chain**

In operating mode, the following recommendations apply:

- Single equipment connection.
- Single cable connects installations, each equipment is connected by flexible patchcords.
- While additional breakpoints are possible but not recommended, it is important to note that they reduce bond length performance.

As a reminder, from class D, the categories have been subdivided as in Table 2.

**Table 2: Category (cable)**

| Category (cable) | CAT5 | CAT5e | CAT6 | CAT6a | CAT7 | CAT7a | CAT7+ |
|---|---|---|---|---|---|---|---|
| **Frequency of use (according to standards)** | 100 MHz | 100 MHz | 250 MHz | 500 MHz | 600 MHz | 1 000 MHz | 1 200 MHz |
| **Characterization frequency** | 200 MHz | 200 MHz | 450 MHz | 550 MHz | 900 MHz | 1 200 MHz | 1 500 MHz |
| **Class (links)** | D | D | E | Ea | F | Fa | Fa |

The use of CAT6 or CAT6A is recommended to improve the velocity of propagation of the signal to receiver at the camera.

The patch cord should have a minimum section of AWG24 stranded copper (Not copper Clad Aluminium).

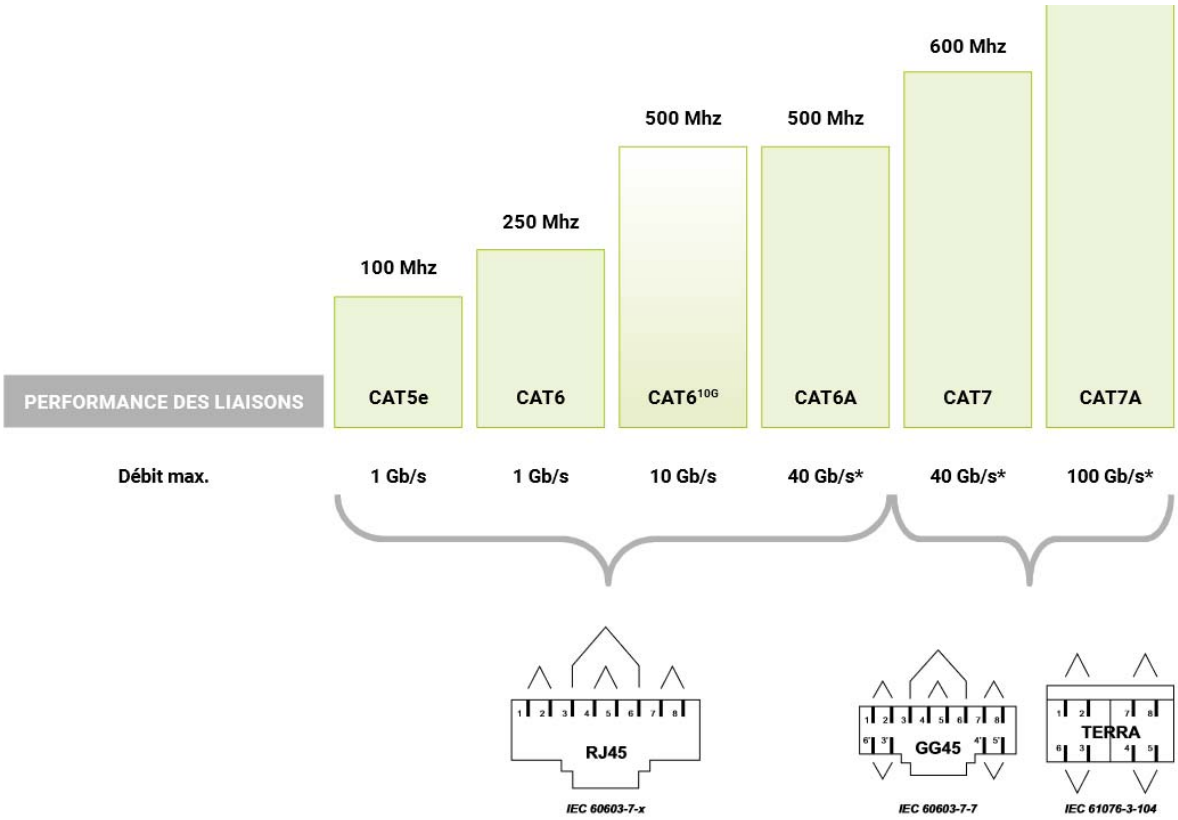



**Figure 3: Cable categories and their characteristics**

It is advisable to specialize in CCTV wiring. This is to limit malicious disconnections:

- Separation of CCTV concentration points.
- Camera access point is enclosed in the terminal installation, no accessible wall access.
- Outdoor Ethernet access points should be protected against corrosion (IP65 installation).

4-pair cables will be subject to a validation test performed according to ISO/IEC 11801 [i.6] Class Ea, EIA/TIA 568-C.2 CAT6A [i.7], EN 50173-1 [i.8] Class Ea standard, for Ethernet link channel whose ends are connected in RJ45 (see Figure 4).

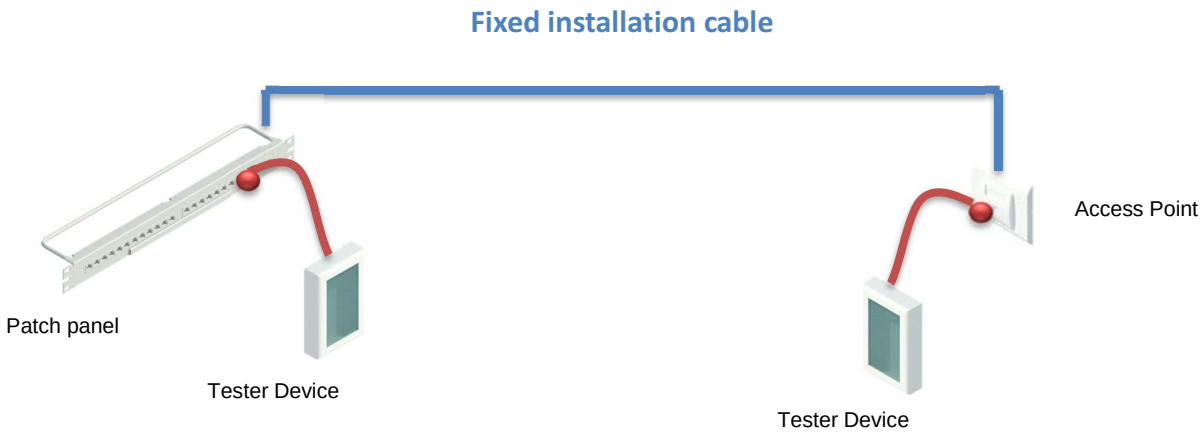



**Figure 4: Permanent link test**

For this test, two measurement patchcords supplied with a tester are used.

The link channel should have a length of less than 100 m, patchcord included, and will only be "Point to Point" (only one distant end).

End equipment can be powered either by the switch (via POE) or via a separate power supply (see Figure 5).

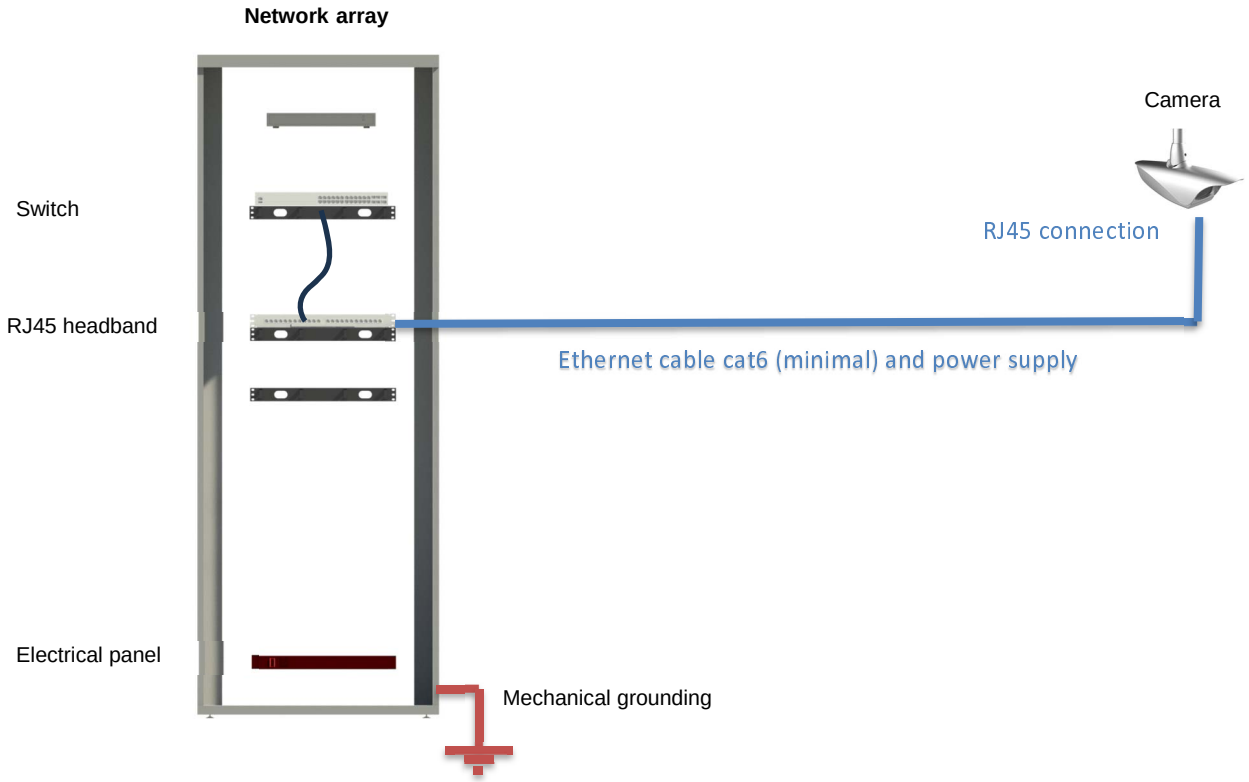



**Figure 5: POE link test**

## 4.2.2 IP link chain over coaxial cable

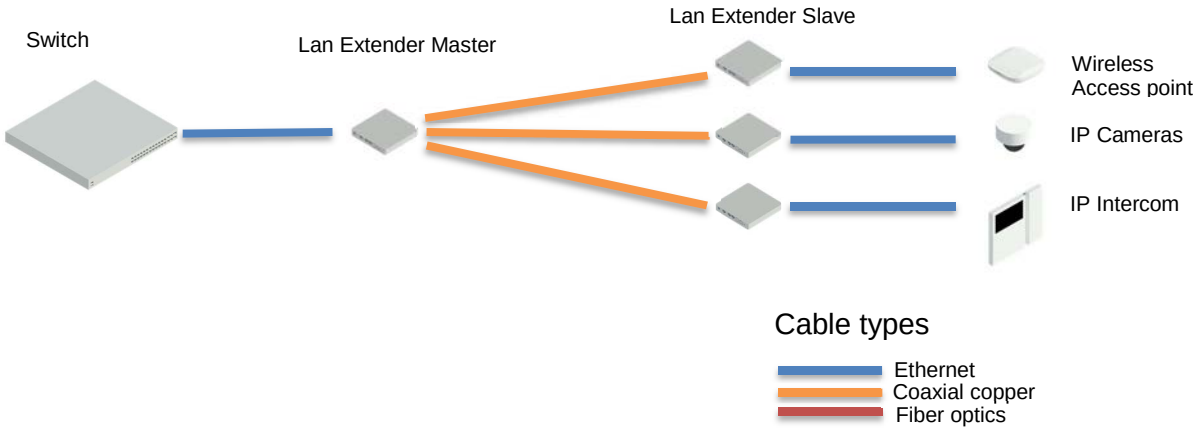



**Figure 6: IP video example**

For renewal, it will be common to use existing coaxial cables regardless of their length for IP transport over coaxial (IP video example, see Figure 6).

The completed line name is Ethernet and Power over Coax (E&PoC).

Interest of a coaxial channel is relevant in sites where it will not be possible to install network equipment in good condition within 90 m of equipment. In building, cabling is carried out in Ethernet on twisted pairs (see Figure 7).

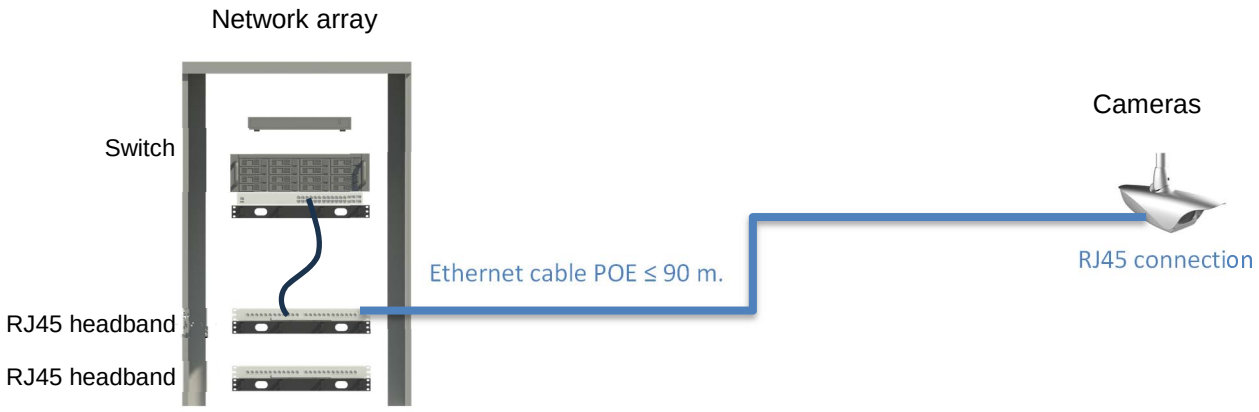



**Figure 7: Twisted pair link**

This is the standard configuration for connections of IP equipment even with remote power supply ≤ 90 m. Advantages are implementation cost, simplicity of the link channel, quality tests of the links, standardization. Coaxial cable is adapted to Ethernet channel by 2 media converter equipment (see Figure 8).

Master equipment can often connect several channels of coaxial links. (8 or 16 channels) Length of connecting channels will depend on type of chosen power supply for end equipment. End user equipment can be powered by the end "slave" converter equipment (POE). "Slave" equipment is powered by "Master" equipment (POC).

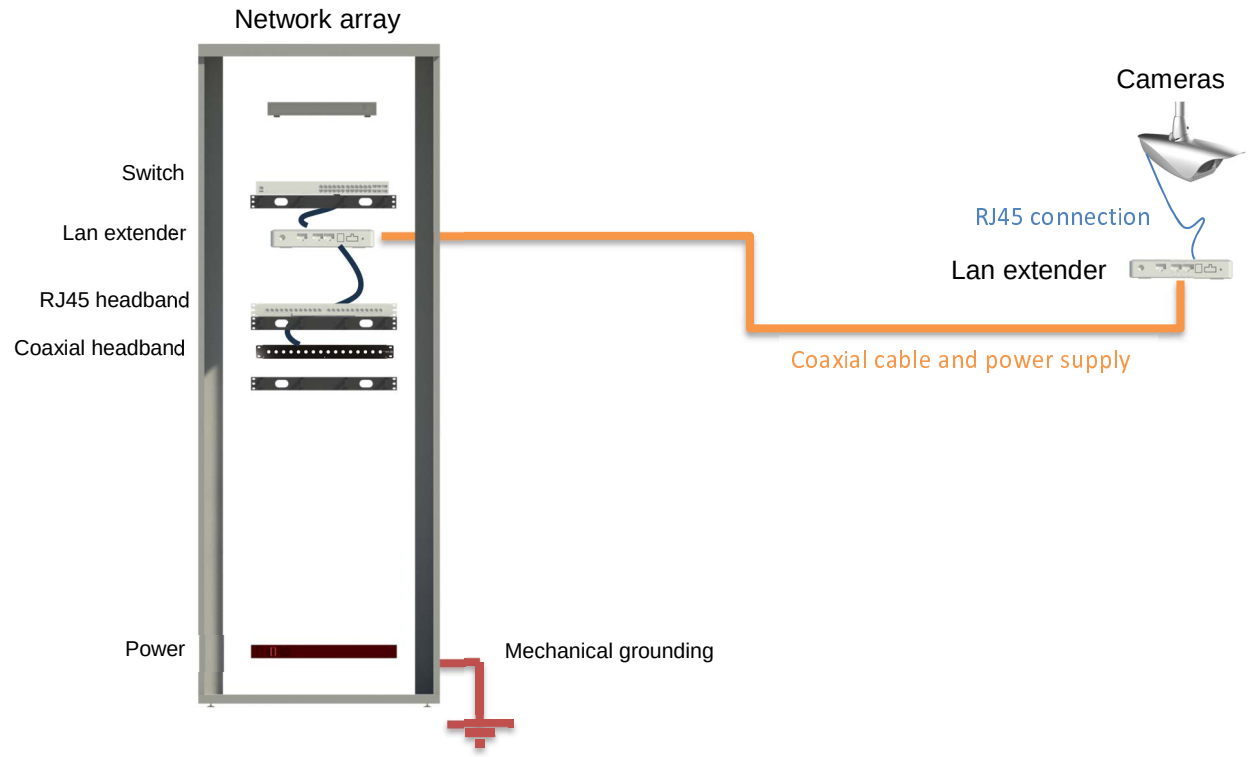



**Figure 8: POC cable**

This converter can have a dedicated low voltage power supply for end equipment when the consumption of end equipment is too high (PoE++ for example), see Figure 9.

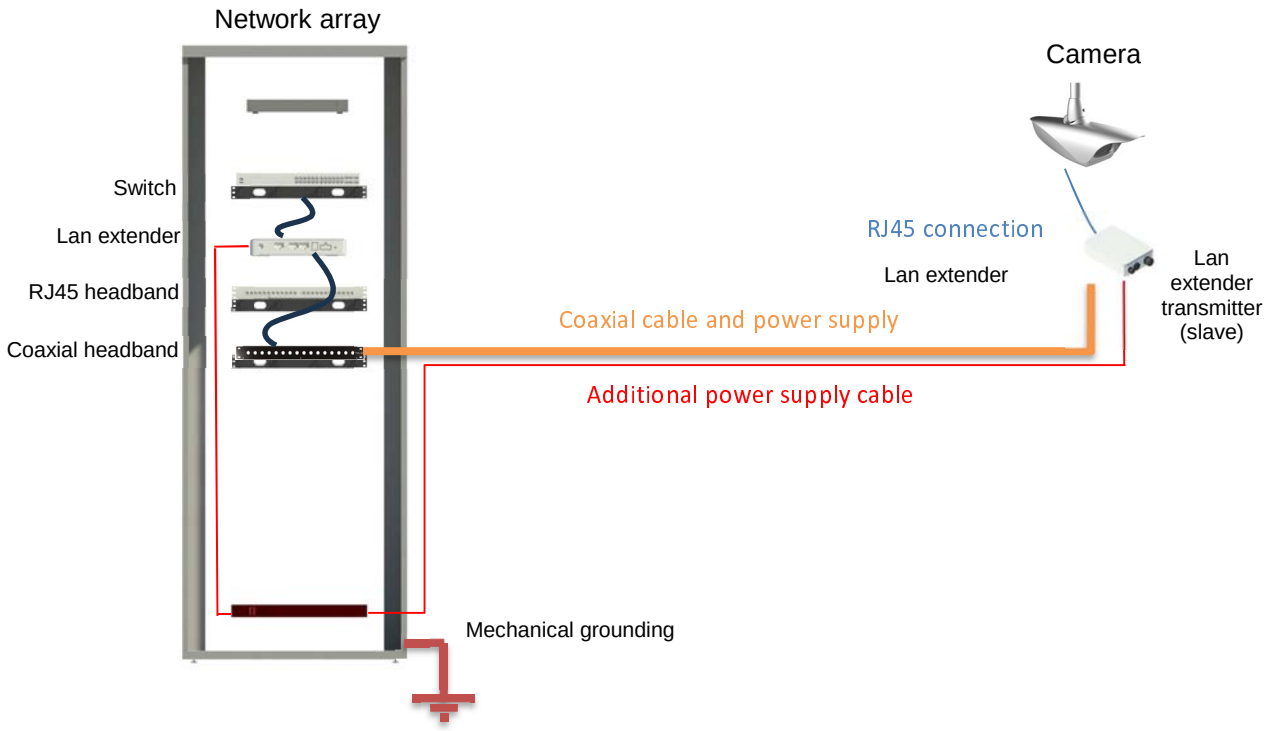



**Figure 9: POC cable with additional power supply**

### 4.2.3 Renewal installation of existing video channels

"LAN EXTENDER" technology makes it possible to modernize an analog link channel by replacing it with IP video solution (see Figure 10).

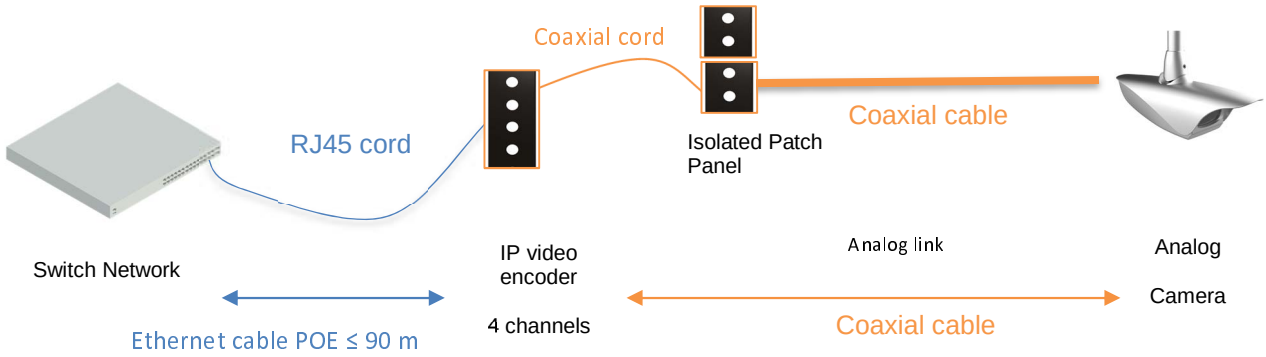



**Figure 10: Existing analog channel**

The subject is service of end equipment is currently done by analog video and a power source from local network.

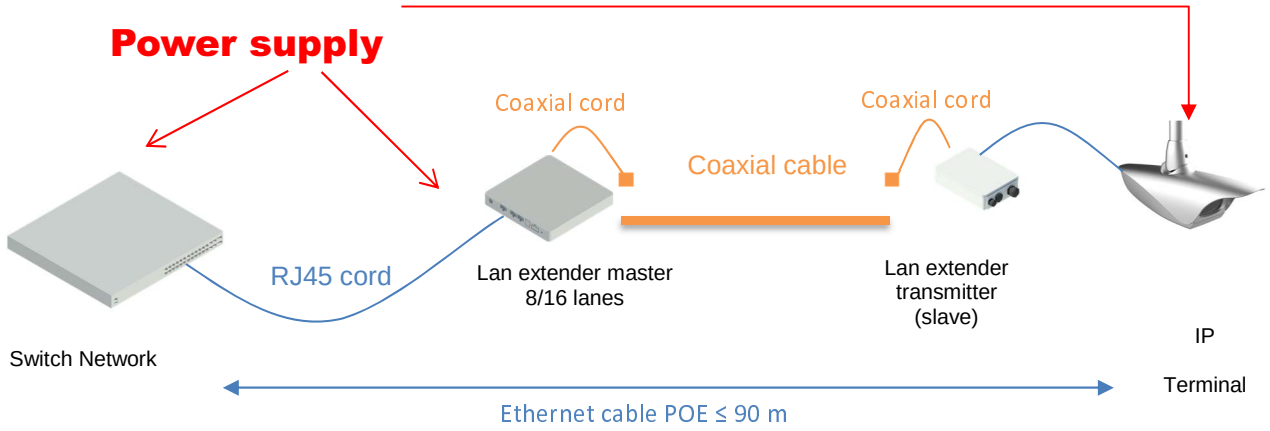



**Figure 11: Channel renewal**

By keeping the same coaxial capillary cable, the active equipment is replaced (see Figure 11).

Precautions relative to this renewal installation process are listed in Table 3.

**Table 3: Main precautions for a renewal installation**

| Entity | Type | Comments |
|---|---|---|
| End feed | It will be possible to remove end low voltage power cable | By monitoring energy balance of upstream installation, if the consumption of link channel is compatible. |
| Lan Extender Slave | Inserting the box | Adapt existing installation.<br>Replace end installation. |
| Coaxial patchcords | Adapt link channel | It is recommended to renew coaxial patchcords. |
| Link quality | Access physical characteristics | • Access compatibility of length of connecting channel.<br>• Quality of coaxial connections.<br>Type of cable loop resistance under evaluation and power measurements received at the end are indicative methods. |

## 4.3 Coaxial cables

### 4.3.1 Types of used coaxial cables

There are two types of quality of coaxial cables (see Figure 11 and some examples of cables in Figure 12a and Figure 12b) with different uses:

- Rigid cables intended for connections between fixed installations between premises, buildings or sites. They can be adapted, even as cable layers, to many types of routing such as slabs (e.g. marine, and cablofils) but also hooks and sheaths.

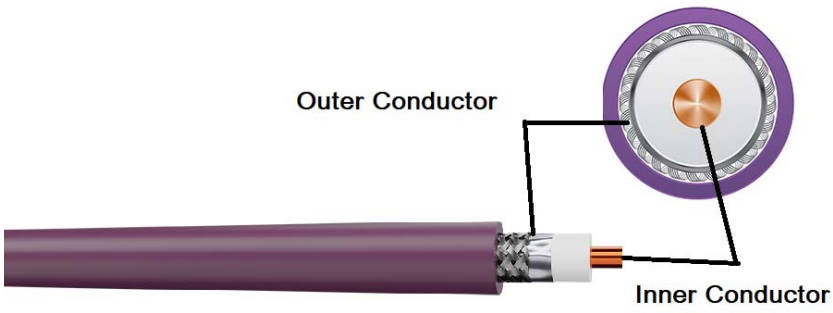



**Figure 12a: Rigid coaxial cable**

- Flexible patchcords for internal wiring of installations.

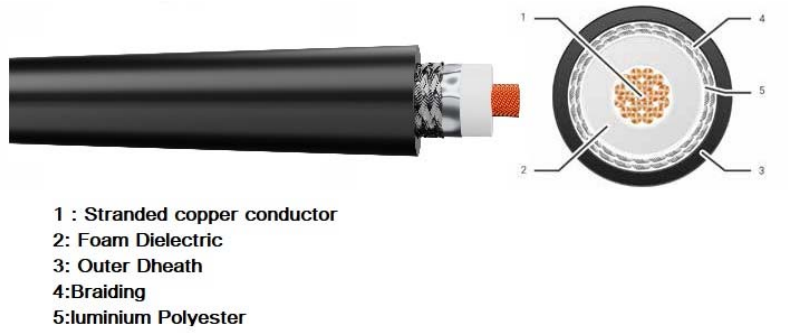



**Figure 12b: Flexible coaxial cable**

Coaxial patchcords are consumable and should support:

- Power delivered by equipment providing remote power supply to the links and power supplied end.
- Numerous manipulations of twists and disconnections. More rigid cable should remain protected from frequent manipulations.

**Table 4: Examples of coaxial cable**

| Standards | Cable reference | Composition | Section *(mm²)* | Loop Resistance ±10 % *(Ohm/km)* | Application |
|---|---|---|---|---|---|
| NF C 93 550 | KX6 | 7 × 0,2 CuR | 0,22 | 132 | FIXED/MOBILE |
| PVC | UHD06 | 1 × 0,6 CuR | 0,28 | 80 | MOBILE/FIXED |
| PVC | RG59 | 1 × 0,6 FeCu | 0,28 | 150 | MOBILE/FIXED |
| LSZH | UHD06 | 1 × 0,6 CuR | 0,28 | 80 | FIXED |
| NF C 93 550 | KX8 | 7 × 0,4 CuR | 0,88 | 50 | FIXED |
| PVC | RG11 | 1 × 1,7 CuR | 2,27 | 20 | FIXED |
| LSZH | UHD10 | 1 × 1,1 CuR | 0,95 | 31 | FIXED |
| LSZH | UHD16 | 1 × 1,6 CuR | 2,01 | 16 | FIXED |
| PUR | FLEX08 | 7 × 0,29 CuR | 0,47 | 44 | MOBILE |
| PUR | FLEX12 | 7 × 0,40 CuR | 0,88 | 50 | MOBILE |

### 4.3.2 Cable quality control

The first cable quality control measurement of the link chain is the loop measurement of the coaxial circuit.

In accordance with ETSI TR 105 177 [i.2], following Figure 13, a shunt (short-circuit) is made at the end of a circuit (or cable). The resistance is measured at the other end of the circuit between the axial conductor and the peripheral screen conductor. The values obtained should be equivalent to those announced by the cable manufacturer supplier according to the length of the circuit.

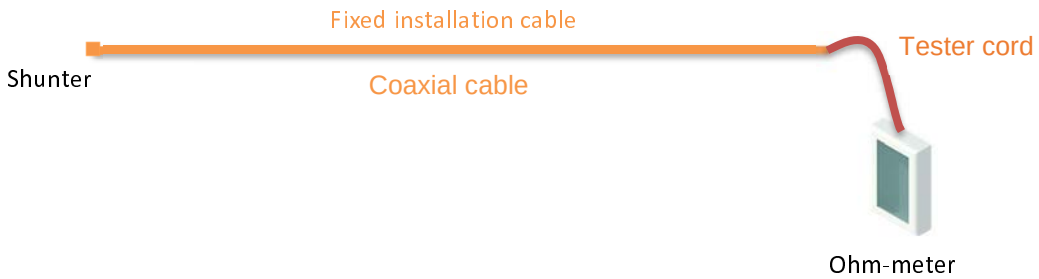



**Figure 13: Quality control measurement**

### 4.3.3 Curvature radius

For most coaxial video cables, bend radius is approximately 5 times the outside diameter of the cable.

### 4.3.4 Channel equipment insulation

It is essential to take all the necessary precautions to insulate the cable connections from the earth or metal masses over the entire length of the coaxial link chain (see Figure 14).

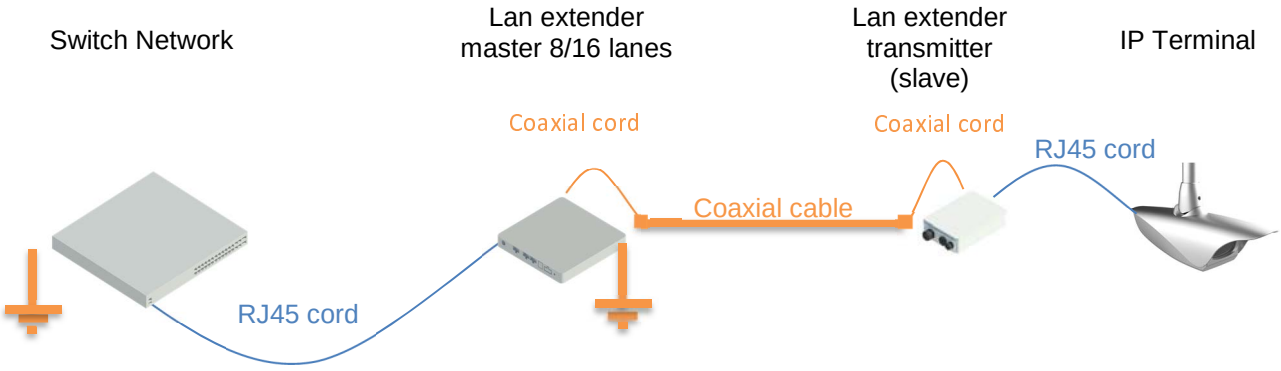



**Figure 14: IP over coaxial link chain (BNC connection to isolate from ground)**

## 4.4 Connections

### 4.4.1 Connector choice

Connectors for coaxial cable used for capillary cabling (75 Ω) should absolutely be of BNC crimping or compression connector type, see Table 5.

**Table 5: Coaxial connectors**

| | Classic BNC connector | BNC Compression connector |
|---|---|---|
| Type of coaxial capillary connectors |  |  |
| Recommendations | With boots obligatory<br>Flexible or fixed cabling o | This connector is suitable for rigid core cable connections |

### 4.4.2 Choice and installation of coaxial junctions

Coaxial jumpers or patch cords are intended to connect:

- Two active elements of the same installation.
- Active equipment to a cable on a patch panel or splitter.

Direct connections on rigid cables are not recommended.

These jumpers or patch cords should meet the same level of quality as the entire linking chain:

- Risk of seriously degrading the quality of the signal if it is not done.
- To support electrical power transported in case of PoC (Power Over Coax).

- In a technical room, it is tolerated to use preformed jumpers or preformed patch cords instead of cables, but it will be important to meet the constraints of the cables.

Coaxial jumpers or patch cords should support:

- Powers delivered by equipment that remotely supplies links and end equipment.
- Numerous manipulations of twists and disconnections should be supported by cables and connectors.

Table 6 provides a comparison of the constraints.

**Table 6: Coaxial patch cord constraints**

| Constraints | Patch cords | Cables |
|---|---|---|
| Use | Coaxial cable management (short length) | Coaxial permanent link |
| Coiling & Overlengths | Prohibited  | |
| Labelling | Imperative if:<br>• Patch cords are tied in strands<br>• Patch cord pathway is difficult to follow it | |
| Connectors | BNC Compression connector if built on site<br>Classic BNC connector in case of preformed patch cord | BNC Compression connector |
| Path plan | Not applicable | Imperative |

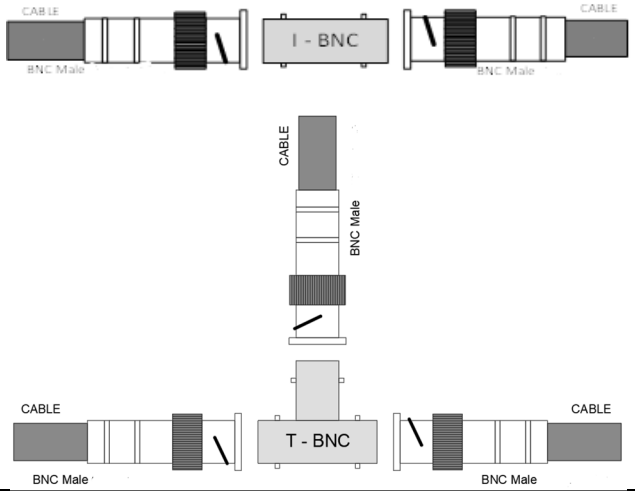
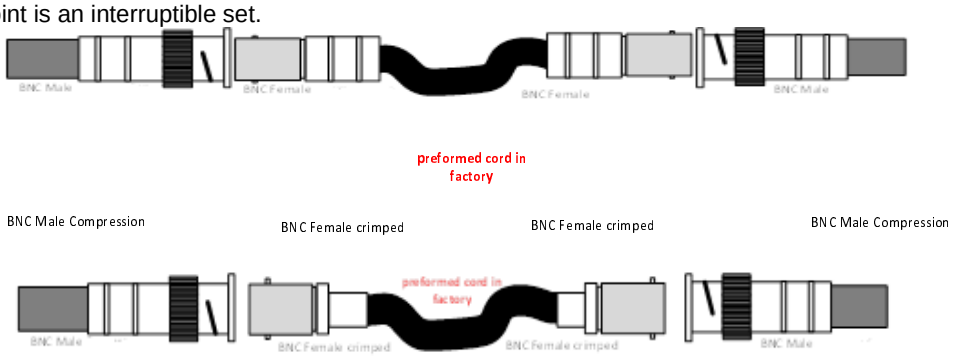
# 4.5 Connection end

## 4.5.1 Detail on coaxial connections

The use of male / female connection is recommended as soon as possible to reduce the size of the connections under the following configurations described in Table 7.

**Table 7: Coaxial connection configurations**

| | Description of configurations |
|---|---|
| 1 | The compression BNC connector is recommended for cable connection, female BNC connectors are reserved for connection patch cords.<br>In the case of connection between 2 cables, a female compression BNC connector is required for the thinnest cable.<br>This set is more robust, less resistant and recommended for connection patch cords.<br>  |

| | Description of configurations |
|---|---|
| 2 | When connecting 2 cables, I-BNC or T-BNC is used if the suitable female connector cannot be found.<br>  |
| 3 | A breakpoint is an interruptible set.<br>  |

## 4.5.2 Concentrating points

Depending on the system configuration, the video link chains can be patched on cross-connects.

Their function is the interface between rigid video cables transiting in cable trays and flexible patch cords connecting active equipment.

There are 3 types of coaxial splitters:

- Patch panels in patch bays or active equipment.
- Distribution frames or in cabinets.
- Junction boxes.

Patch panels in installations:

- Example of patch panel.

Individual connection to equipment is detailed below in Figure 15.

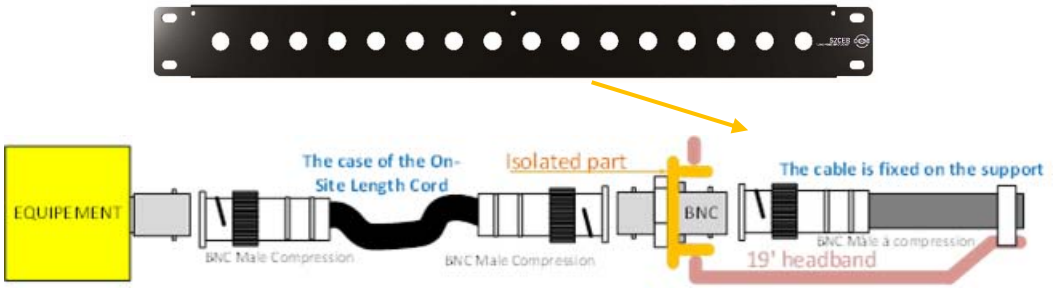



**Figure 15: Equipment/Patchcord/Cable**

- The fixing of the BNC is insulated to meet all possible uses of coaxial use, according to Figure 16.

**Figure 16: Isolated BNC headband**

Cables are connected to coaxial BNC connectors attached to patch panels.

Use of twined connections with male connector allows handling of compression connectors without stressing cable connection (avoids rotation and torsion).

### Urbanization of facilities

Urbanization of facilities is described in Figure 17.

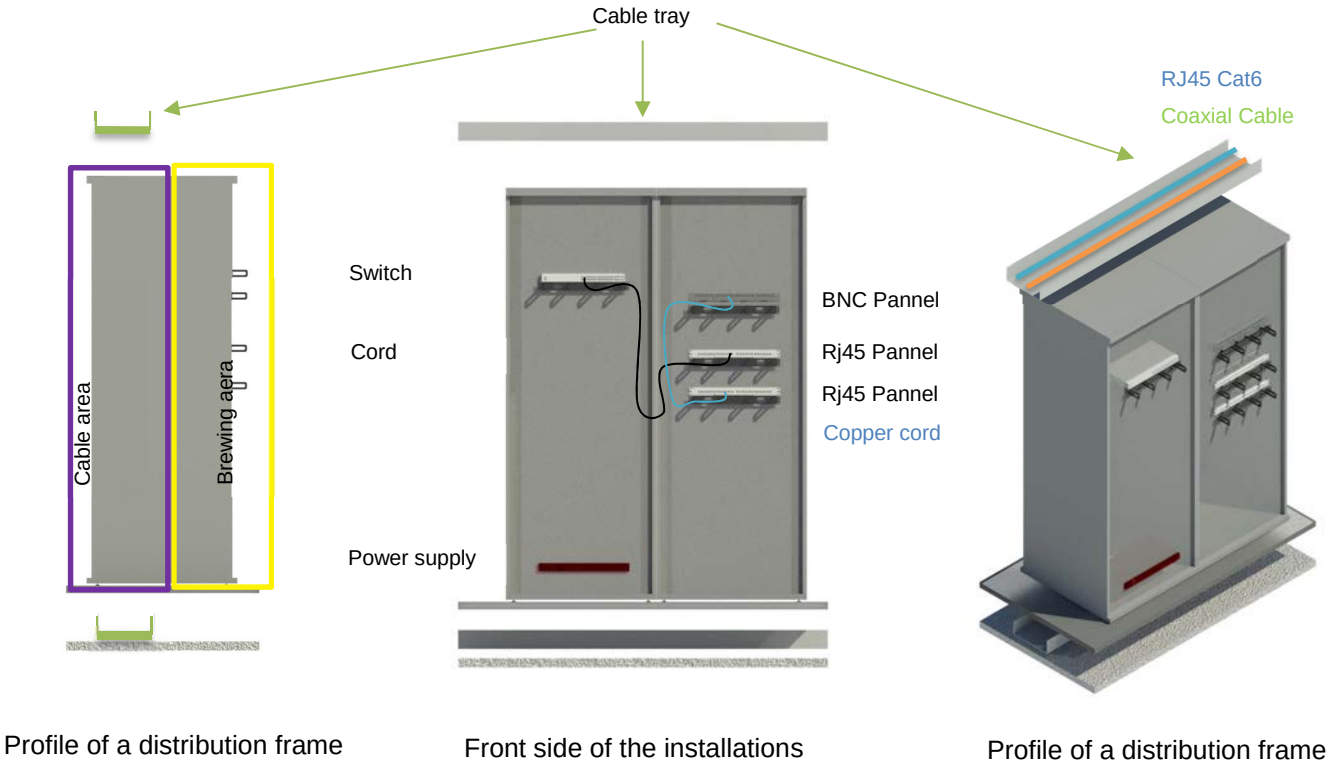



**Figure 17: Two types of urbanization of facilities**

- 19" uprights are set back from door to allow adequate patching space for connection patch cords.
- Equipment and patch panels are fitted with patch cord guides allowing patch cord support and channelling on sides of facilities.
- Patch cord tracking can be performed by a single operator; patch cords remain on front panel and are accessible from an end of its length to the other.

### 4.5.3 Intermediate connections and junction boxes

All coaxial connections (see Table 7) should be made in an installation (splitter, concentration bay, camera stand, etc.) or a waterproof connection box (see Figure 18).

**Figure 18: Coaxial connection**

All cut-off points or intermediate boxes should be located on plans, cable books.

Nevertheless, these intermediate cut-off points should be avoided.

These intermediate connections have several functions:

- Close connection of equipment.

- Continuity connection ("sleeve" function).

Some cables are too rigid to be connected directly to the equipment, a connection with a flexible cord is necessary in a box close to the equipment (Access Point).

The implementation of a Male/Female compression fitting is to be done as a priority (see Table 7, case 1). If the Female BNC is not available on the market, the use of an I-BNC connector is tolerated (see Table 7, case 2).

### 4.5.4 Transport channel quality

The first quality control measurement of the link chain is loop measurement of coaxial circuit.

A shunt (short circuit) is made at the end of a circuit (or cable). The resistance is measured at the other end of the circuit between the axial conductor and the peripheral screen conductor. The obtained values should be equivalent to those stated by the cable supplier according to the length of the circuit.

# 5 Access point and patchcord tracking

## 5.1 Identification of access points

### 5.1.0 Introduction

Identification of an access point is essential for the cabling of any telecommunications system.

It allows identification of service cable and precise location of access points in large quantities in a fixed installation.

### 5.1.1 Numbering of access points

The numbering of an access point is:

- Unique to a site.
- Short identification to be easily tagged on access point and patch panels of concentration facilities.

### 5.1.2 Cables

The cables should be identifiable by:

- Directly written reference at ends on cable labels.
- Or specific reference from a site reference document.
- Or a distribution diagram.

### 5.1.3 Patchcords

Patchcords are linked to link chain. They directly connect two proximity devices or a device to its transmission cable.

Their identification is then essential in maintenance actions.

They should be identified if:

- Monitoring of their continuity is not easily accessible.
- Patchcords directly connect end equipment in the room.
- When on-site wiring diagram does not exit.

# 6 Compliance criteria for identity reduction

## 6.1 Declaration of video equipment

Video equipment characteristics will be provided and registered.

## 6.2 Type of link channels

### 6.2.1 Equipment POE power supply

Length of coaxial cables depends on their type and range of POE.

Three standards are available in POE (Power Over Ethernet), POE+ and POE++ see technical characteristics on Figure 19).

Conform to IEEE 802.3af [i.9], IEEE 802.3at [i.10] and IEEE 802.3bt [i.11].

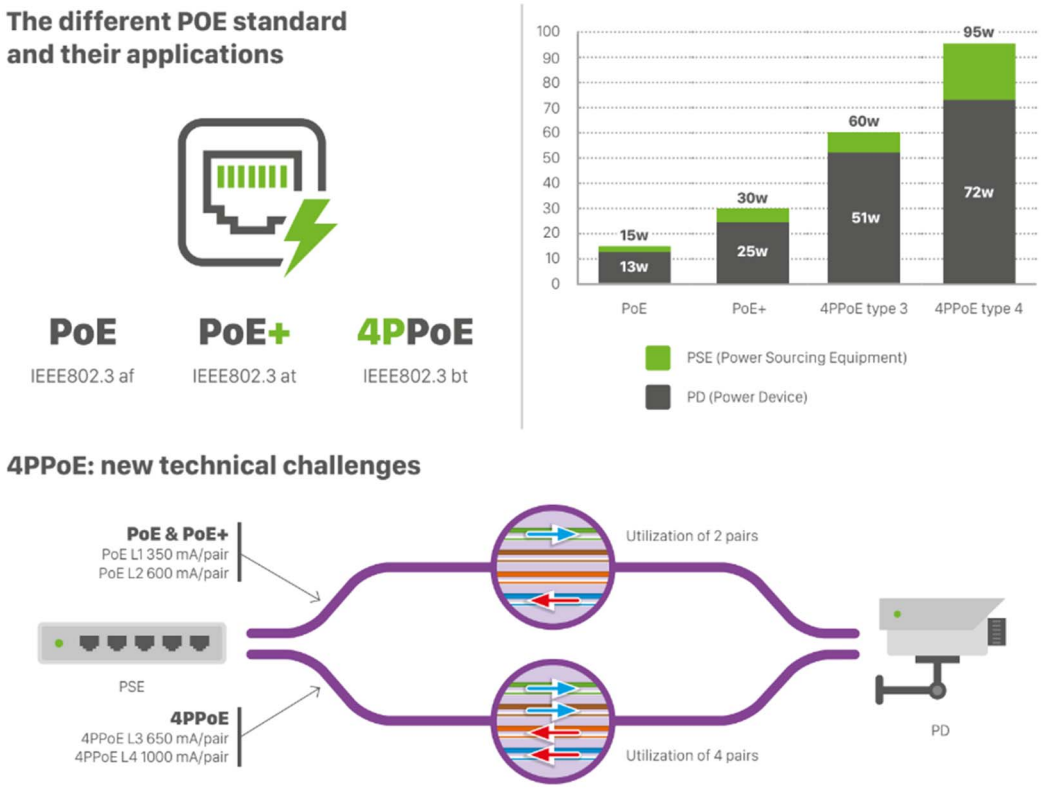



**Figure 19: POE technical characteristics**

## 6.3 Specific constraints of video surveillance channels

Video surveillance stakes involve protecting access to connections to surveillance camera link chain. This is to limit malicious disconnections:

- Camera access point is enclosed in terminal installation, no accessible wall access. Connection can be direct to camera.
- Many external Ethernet access points should be protected against corrosion (IP65 installation).
- Separation of CCTV concentration points.

# 6.4 Implementation of link channel

## 6.4.1 Link channel quality

Performance of video transmission depends on quality of each component of coaxial cable chain, see Table 8.

**Table 8: Component quality**

| | Topic | Additional details |
|---|---|---|
| 1 | Equipment performance | |
| 2 | Link chain quality | Cable connection quality<br>Qualitative choice of coaxial jumpers<br>Number of connections in the link chain<br>Wiring of facilities |
| 3 | Environment adaptation | Equipotentiality of masses - ground plane - cable connection at the ends |

## 6.4.2 Connecting of concentrating video equipment

Generally, equipment connection will support to carry out a standard exchange of a sub-assembly (board) without having to disconnect all the wiring from the equipment.

Wiring distribution of patchcords will correspond to distribution direction of equipment boards. (Horizontal card for horizontal wiring.)

Video hubs are usually very dense. It is recommended, see Figure 20:

- To install racks in order of numbering from top to bottom in facilities.
- To label racks because numbering is included in equipment identification.

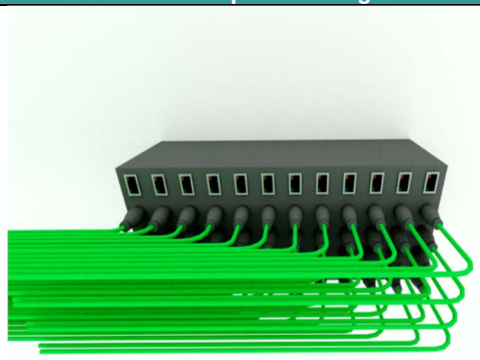
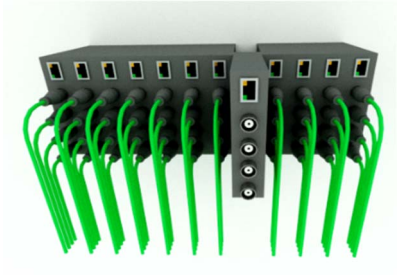
| | Non-compliant wiring | Compliant wiring |
|---|---|---|
| *Drawing* |  (For example, Ip video encoder) |  |
| *Recommendation* | Horizontal wiring of patch cords prevents standard exchange of left cards | Vertical patch cord wiring allows standard exchange of a single equipment |

**Figure 20: Installation recommendations**

## 6.4.3 Cable quality control

First quality control measurement of link chain is loop measurement of coaxial circuit.

A short circuit is made at the end of the circuit and resistance is measured at the other end between the axial conductor and the peripheral screen conductor.

Values differ according to cables and their theoretical balance calculated according to linear resistance provided by the manufacturer (examples of values in clause 4.4.1).

## 6.5 Coaxial cable distribution

### 6.5.1 Generalities

Video link chain requires nearby concentration equipment of patching distributors.

Their function is interface between rigid video cables transiting in cable trays and flexible cords connecting active equipment.

There are 3 types of coaxial splitters:

- Panels or patch panels in patch bays or active equipment.
- Distributors on frame or in cabinets.
- Junction or derivation boxes.

### 6.5.2 Patch panel front

For example, patch panel 19" with 16 BNC connectors per U can be installed in RJ45 patch cabinets with a 1U cable pass, see Figure 20.

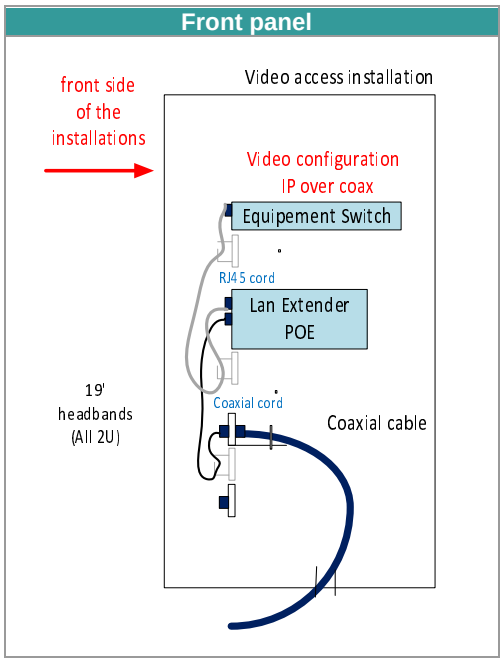
They complete service of access points over 90 m away. In the case of smaller cabinets, a suitable headband could be installed.

Urbanization of 19" strips is identical to that of the RJ45. It requires a cord guide either below or above.

Patch panels are installed in existing video concentration installations. These insulated Plexiglas panels were the result of special production; they are no longer used for new installations.

### 6.5.3 Fitting description

Patch panels are installed in existing video concentration installations, see Figure 21. These insulated Plexiglas panels were the result of a special production, they are no longer used for new installations.




NOTE: 1U headband with 16 BNCs and 1U front panel cord passes.

**Figure 21: Patch panels in existing video concentration installations**

The bay houses 2 types of installation with different constraints:

- Active equipment requiring high IP protection (IP53 or IP55).
- A coaxial cable splitter that should be accessible for access to the cable connections.

## 6.6 IP link channel over coaxial cable

IP over coax link chains use same link chains as old analog video chains.

Global connection chain which is isolated from grounding and earthing. (Cable, cords, and connectors.)

# 7 Remote power supply of telecommunication equipment

## 7.1 PoC supply (Power Over Coax)

Power over Coax (PoC) provides Ethernet over coaxial cabling with a simple and convenient way to power devices on the same principle as Power Over Ethernet (PoE), see Figure 22.

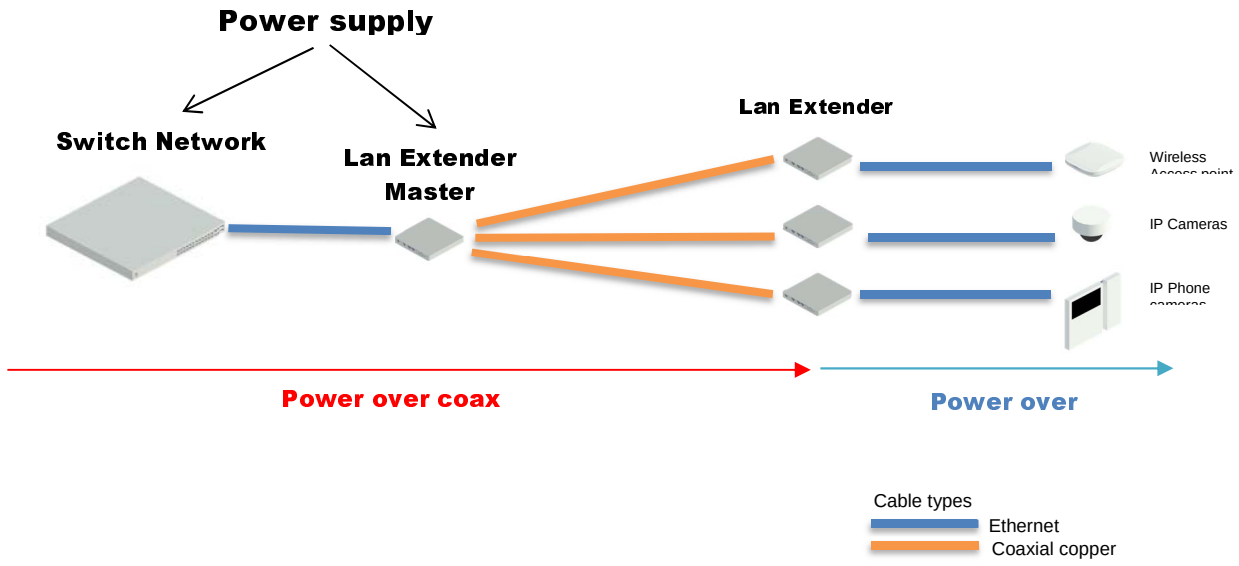



**Figure 22: Power over Coax (PoC) provides Ethernet over coaxial cabling**

Distance limitation of use of end devices is mainly a function of the power consumed by all the components.

## 7.2 Risks on contacts of PoC link channel

Link breaking currents could damage to connector contacts.

Consumed PoC powers cause significant temperature rises on bad contacts or overly resistant cords.

It is recommended as a plug on cords:

- Satisfactory quality for BNC connectors.
- Minimum quality for flexible cord cables.

# 8 Technical specifications of patchcords and jumpers

Patchords and jumpers should follow the requirements and recommendations described in clause 4 and its relative subclauses (especially clause 4.3).

# 9 Sustainability and efficiency recommendations

## 9.1 General recommendations

The present document considers the recommendations on sustainability and efficiency described in the following ETSI documents:

- ETSI TR 105 177 [i.2] describe in the paragraphs on "Environmental impact" (clause 6.3).
- ETSI GR OEU 029 [i.3].

## 9.2 Waste management

The present document takes into account the requirements for processes in relation to management of end-of-life of ICT equipment define in the following standards:

- ETSI EN 305 174-8 [i.4].
- ETSI TS 105 174-8 [i.5].

# History

| Document history | | |
|---|---|---|
| V1.1.1 | September 2024 | Publication |
| V1.1.2 | January 2025 | Publication |
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