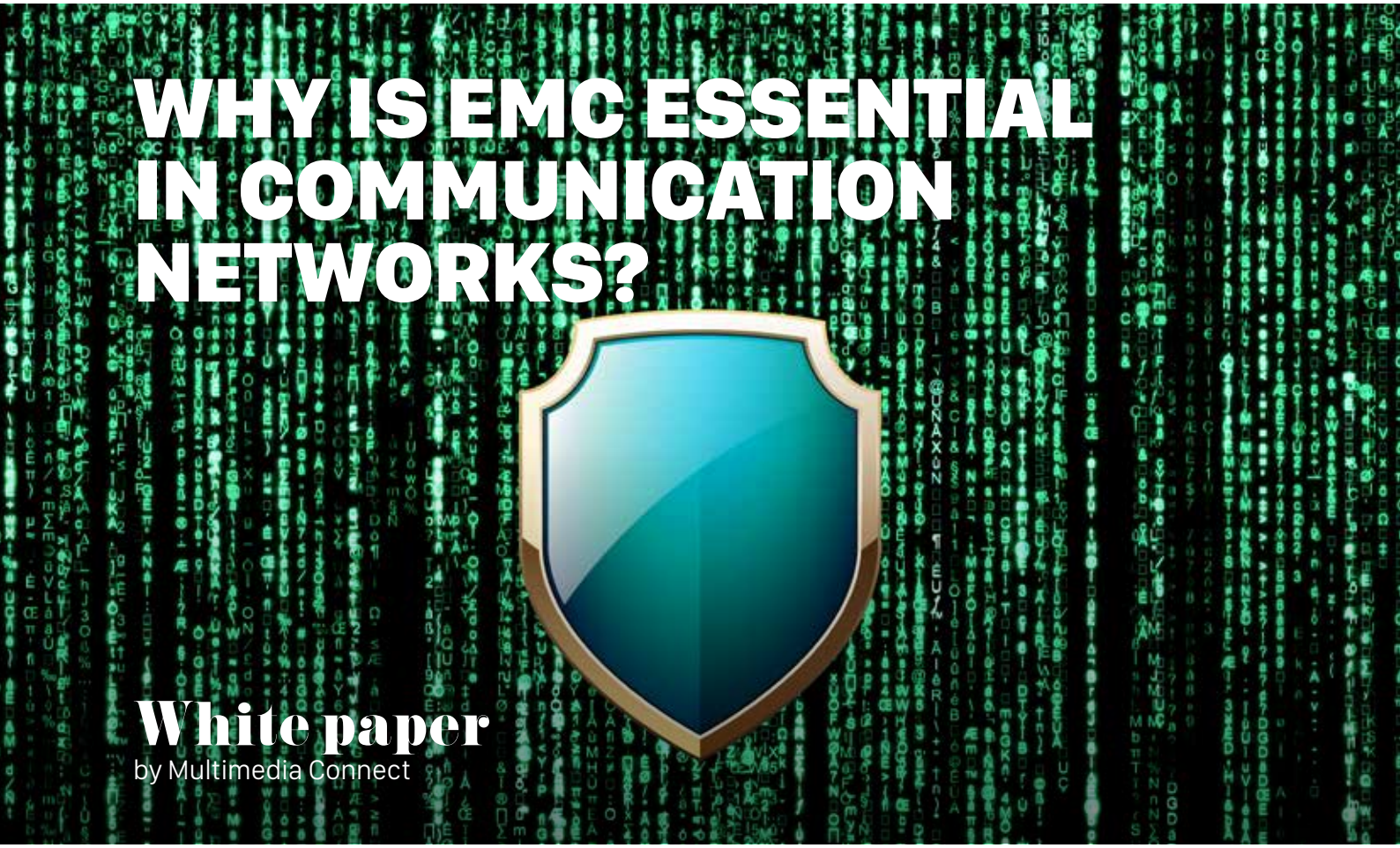
WHY IS EMC ESSENTIAL IN COMMUNICATION NETWORKS?

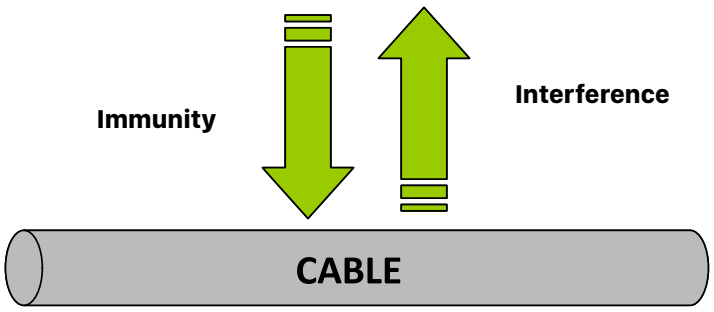


White paper
by Multimedia Connect

EMC: DEFINITION AND STANDARDS

ElectroMagnetic Compatibility describes a device's or system's ability:

- To not inflict electromagnetic interference on its immediate environment!
- To be immune to disturbances from their direct environment

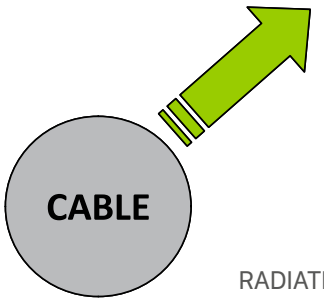


EMC IN A CABLE

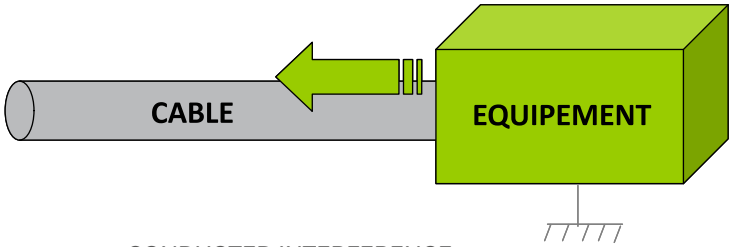
Electromagnetic waves generally propagate in two ways:

Radiated interference in AV systems
Diaphonie câble (NEXT), télédiaphonie câble (FEXT), diaphonie exogène (Alien NEXT & FEXT), borne WiFi...

Conducted interference in AV systems
Surtension câble, surtension appareils actifs, décharges électrostatiques terre de l'installation...



RADIATED INTERFERENCE



CONDUCTED INTERFERENCE

This interference is a characteristic of inductive or capacitive electrical phemomena associated with the performance of the products used and the quality of a system's installation. Regulatory documents are available on this topic which govern the entire scope of EMC.

• For device performance

Standards EN55022 (2006) & EN 55022/AD1.0 (2008)
Information-processing equipment – Radio interference characteristics – Measurement restrictions and methods.

• For installation regulations

EN 50174-2(2008)
Information technology – Installation of cabling systems – Part 2: planning and practices for indoor installation.
This includes an extensive appendix covering EMC in different installation environments (offices, hospitals, etc.). It also contains a checklist which can be used to assess the installation site.

EN 50310 (2001)
Implementation of equipotential bonding and grounding systems at sites with IT equipment.
This standard defines the regulations for grounding systems in buildings. It is currently being updated.

• Implementation decree and directive

Directive 2004/108/CE concerning the harmonization of Member state legislation concerning electromagnetic compatibility, repealing directive 89/336/EEC – Effective as of 20 July 2009.
This directive requires all equipment or systems (including cabling) to be Electromagnetically Compatible.

This Directive suggests the use of a shielded cabling system to prevent interference.
As an example, it recommends the use of a (shielded) PTT299 cable instead of a PTT298 cable for telephone transmission in residential areas.

For several years, a number of European countries (Germany, France, Switzerland, etc) have chosen to use shielded VDI systems in order to ensure electromagnetic compatibility.

EMC AND INFORMATION TRANSMISSION

A network's most defining characteristic is its throughput. To understand the relationship between EMC and binary throughput, the following data must be considered:

- First of all, operating frequency is often described as the modulation rate (R) which is equal to the inverse of the time interval required to send a Bit..
- Next, the signal's logarithmic base, in other words, the number of bits sent within a given period (T), must be considered. For example, the logarithmic base of a binary signal is 2 (0 and 1), a byte (8 bits) has a rate of 28=256
- Finally, it can be said that the binary throughput (D), which represents the quantity of binary data sent per unit of time, is equal to

D = R * LOG2 (V) (D is expressed in bits/s)

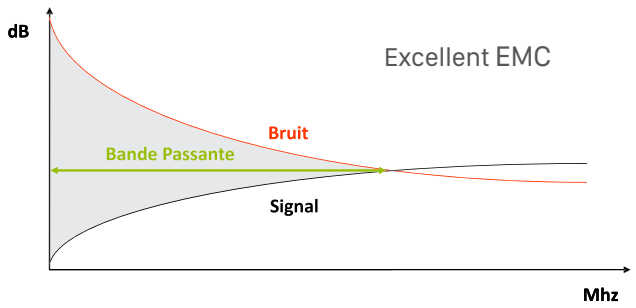
R = Modulation rate
V = Signal's logarithmic base

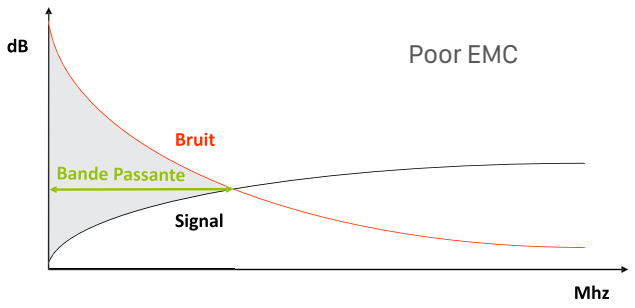
For an Ethernet LAN, modulation rate (R) is limited according to the channel's capacity (C) (theoretical maximum bandwidth). This capacity is defined by the SHANNON theorem using the following formula:

C = BW * LOG2 (1 + SNR)

BW = Channel bandwidth
SNR =Signal to noise Ration

This formula requires good electromagnetic immunity in order to maintain a low noise level and the largest possible bandwidth





To summarize, throughput is directly related to bandwidth which is defined by noise level and, therefore, EMC immunity.
The better the immunity, the closer the actual throughput will be to the theoretical throughput. As such, systems which meet EMC requirements will benefit from a lower transmission error rate and a more consistent throughput.

EMC IN PRACTICE IN NETWORKS

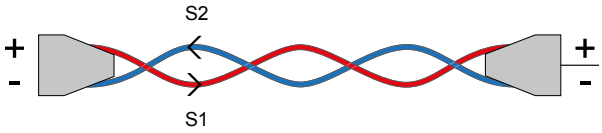
First of all, a brief history of network transmission media: while signal to noise ratio is such a crucial element, network protocols have always treated the immunity of transmission media as an obligation.
Ever since it was created, the IT network has always used “immunized” media..

10 BASE 5 - Yellow coaxial cable (Braided for EMC protection)
10 BASE 2 - Fine coaxial cable (Braided for EMC protection)
16mb TOKEN RING - IBM Type 1 (Shielded for EMC protection)
10 BASE T - Twisted pair cabling (Balanced or shielded for ECM protection)

COAXIAL CABLE

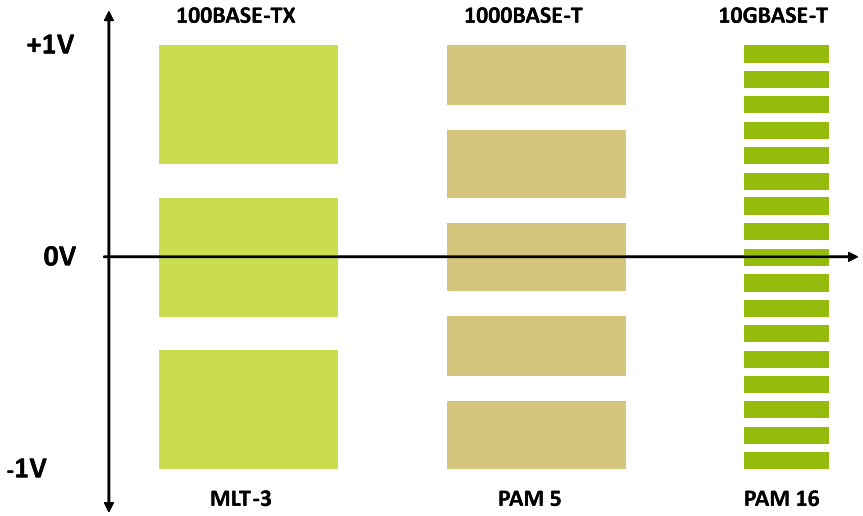
Outer shielding for EMC protection

TWISTED PAIR CABLE



Balanced for EMC protection

Given today’s throughputs, a non-shielded twisted pair cable would seem to be an effective response to bandwidth requirements. The arrival of the 1000 BASE T and, in particular, the 10G BASE T with more sensitive encoding will lead to us favouring shielded options.



Thanks to increasingly more sensitive encoding, the noise level acceptable for today’s networks is 100 times greater than before.
Electromagnetic immunity is becoming fundamental.

SHIELDED CABLING, NUMBER ONE FOR EMC

A cabling system's shielding protects against external interference and keeps to a minimum any interference created by signal transmission through twisted pair cables.

• Type of shielding

The effectiveness of shielding as an electromagnetic barrier depends on its type and its structure. Different configurations are envisaged depending on the cable type:

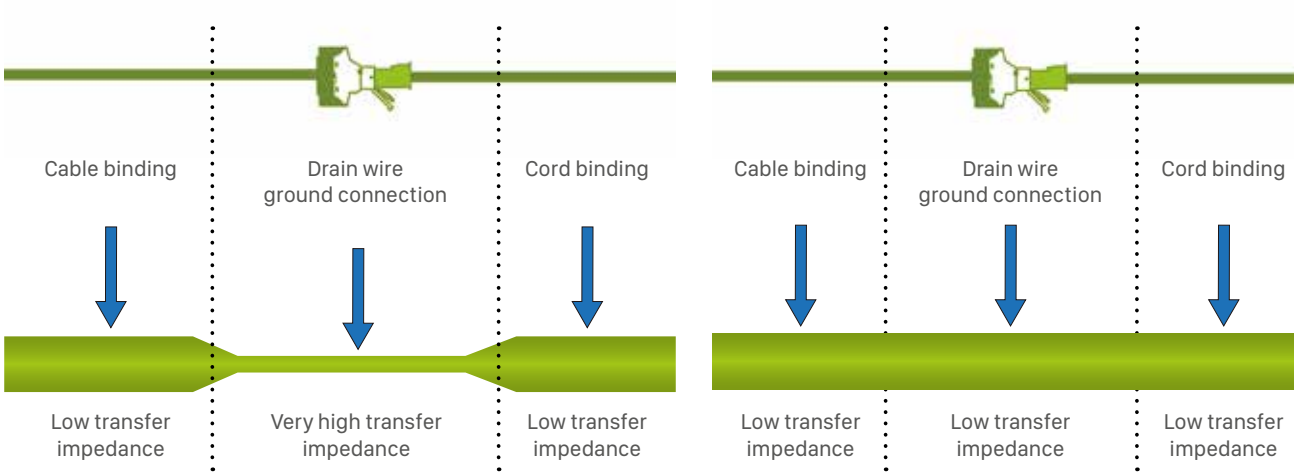
F/UTP Ribbon shielding

SF/UTP Outer braided and ribbon shielding

F/FTP Outer and individual ribbon shielding

S/FTP Individual ribbon and outer braided shielding

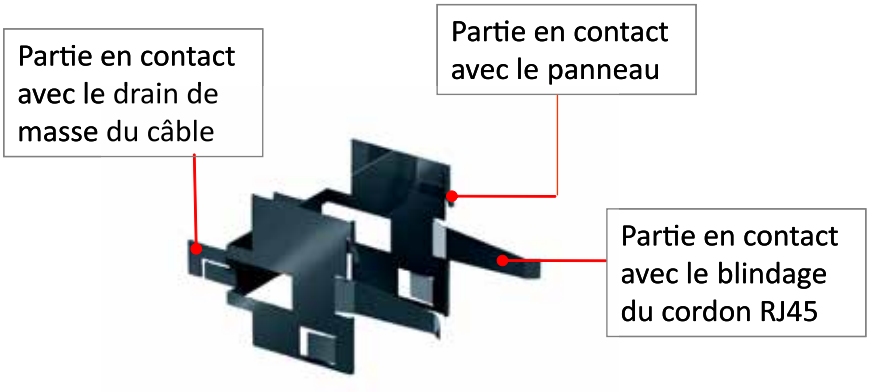
While the shield itself is considered important, its durability throughout the system's lifespan is crucial. Transfer impedance (expressed in Ohms) indicates a cable shield's electrical resistance.



FOCUS

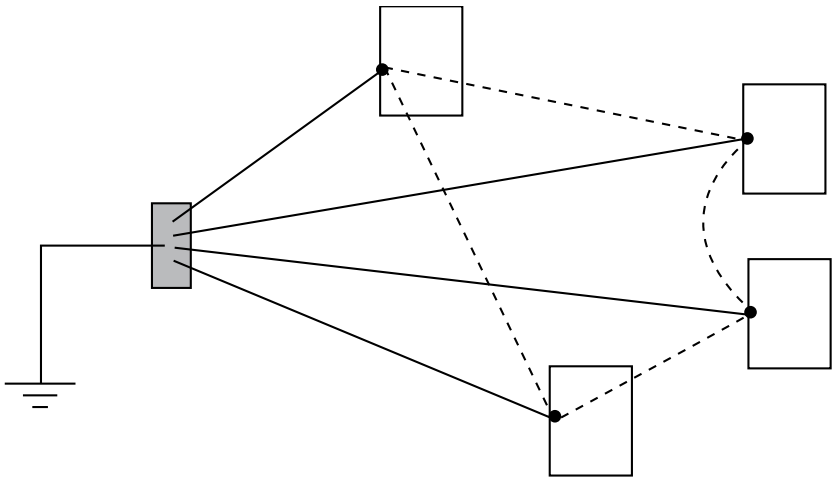
GROUNDING CONNECTION UNIT - MK6AFS

The diagram below shows the layout of a Category 6A RJ45 connector.
The main purpose of this connector is to provide exceptional continuity between the cable and the RJ45 cord through simple drain contact.



A SHIELDED SYSTEM WHICH COMPLIES WITH REGULATIONS

European standards on EMC installation and management are extremely specific. The way in which grounding connections are linked to audiovisual systems was misunderstood for many years, but in fact, it is simply a case of following a few basic rules.



Connections required for safety reasons
Connections for reducing potential difference

- All grounding bundles contained within a building must be wired and linked together
- A building has only one grounding well
- All shields must be connected to an outlet

In the cabinet, ground contact with the RJ connector is generally automatic on the patch panel.
The patch panel is connected to the cabinet mounts while the cabinet itself is connected to the ground (connected directly to the main strip).

Using a shielded cord with the terminal outlet establishes contact between the shielding and the body of the electric device. As the device is grounded, continuity is maintained.