CONVERGENCE OF BUILDING NETWORKS, A REALITY AT LAST!

White paper
by Multimedia Connect

The intelligent building, for so long a much-discussed myth, is finally becoming a reality.
As proof, the most recent ‘Intelligent Building’ show, in Paris, was a huge success, with convergence of the different building networks as its main focus.
Developments in technology and usage are now making it possible to bring concrete form to a concept first launched in the 80s. Because, whilst convergence is not exactly a new idea, implementation has had to take place in several stages as innovations have occurred.

KEY DEVELOPMENTS:

1980’s – Cabled networks and premises of ‘Dual play’ transmissions – TV and Internet
1990’s – Telephone networks integrated into computer systems (PABX)
2000’s – IP telephony, IP video surveillance
2010’s – IPTV, IP building management (KNX-IP – PROFINET, etc.)

Hardware and software modernization has made it possible to unify the networks within the building.

Highlighting of the various convergent applications in the remainder of this document…

TECHNICAL DEVELOPMENTS THAT HAVE ACCELERATED CONVERGENCE

The IP protocol

This is the main factor of convergence. The IP (Internet Protocol) transmission protocol makes it possible to assign a specific address to any item of equipment and thus to 'route' the data within the network. This protocol, in widespread use for data transmission over Ethernet networks for computer systems, was next used in telephonic transmissions with IPBXs. But the major new development concerns the transfer of 'Building automation' tools from proprietary protocols to IP protocols over twisted pairs.
This is the case, for example, with KNX-IP which unifies the GTC protocol (Centralized building management) with data networks.

Performance of structured cabling

Implemented using a single connector, the RJ45, structured cabling has undergone a 1000-fold increase in capacity over the last 25 years. The increase from a maximum throughput of 10 megabits/s to 10 gigabits/s has favored content transfer without throughput restrictions.
But cabling performance is not the only factor to encourage interconnection of items of equipment other than telephones and computers.
The way in which cabling is now implemented within buildings makes it denser, more modular and pre-configured to act as an interface with all the IP equipment.

Remote power feeding, the other role of cabling

Since 2003 and the ratification of PoE (Power over Ethernet), there has been constant development in the field of mixed applications, i.e. applications mixing data and electrical power. The clearly defined objective, in the long term, is to be able to replace electrical cables with an RJ45 connection.
Since 2009, transmission power has been fixed at 24 watts by PoEPlus, and is already envisaged to change to 70 watts and even 100 watts in the coming months. It is possible to envisage future remote power feeding for our computers, screens and televisions… without any need to connect them to the electrical network. The gain in mobility and ease of use will then be huge.

Improvement of signal conversion

Where the signal remains analog, it can also be transmitted by physical transformation with symmetry and impedance converters.
Baluns, well-known to users of cabling in the 80s, have changed enormously and now allow conversions to very high frequencies, over 2 GHz.
The balun (balanced/unbalanced) is used to adapt to a different medium. It also forms the link with heterogenous connectors: BNC/RJ45, Mini jack/RJ45, etc.
These now make it possible to transmit video and audio signals over twisted pairs. As an example, it is now possible to propagate a 2.15 GHz satellite TV signal over a twisted pair cable, using the latest generation of baluns, which was unimaginable 2 years ago.

New communication protocols

The manufacturers of active systems are adapting to the fact of having to transmit new content over RJ45/Twisted pair solutions.
As an example, the future HD BASE T transmission standard (www.HDBASET.org) allows simultaneous transmission of 5 signals over an RJ45 cable: HD video, audio, networks, controls and power.
This protocol, the designated replacement for HDMI, would be able to support Internet TV within the house or building.

HD BASE T table to be added

Criterion	HDMI 1.4	DiiVA	DisplayPort 1.2	HDBaseT 1.0
Uncompressed Video/Audio	10.2 Gbps	13,5 Gbps	Up to 21.6 Gbps (16G of actual data)	**Up to 10,2 Gbps** HDBaseT is capable of scalling up to 20 Gbps
Maximum Cable Length	Few meters	26 m	15 m for 5G (limited to 1080P, 24 bits) 3m for 5G-21.6 Gbps	**Up to 100m** Including the support of multi hoos (8x100 m)
Cabme	HDMI Cable	A DiiVA Proprietary Cable	DisplayPort Cable	**Low cost standard Cat5e/6 LAM cable**
Connector	HDMI Connector	A DiiVA Proprietary Connector	DisplayPort Connector	**Standard RJ-45 connector**
Charging Power	No	5 W	No	**Up to 100W** Can be used for powering remote TVs
Ethernet	100 Mps	Gigabit	720 Mbps	**100 Mbps** HDBaseT is capable of calling up to Gigabit
Daisy Chain	No	Yes	No	**Yes**
Installation-Friendly	No	No	No	**Yes** Use existing network wiring, field terminated connector
USB	No	Yes	Yes	**Yes**
Networking	No	Daisy Chain and Star topologies	Daisy Chain and Star topologies	**Extended-range Daisy Chain and Star topologies** Entire home and in-room coverage as well as commercial and industrial installations

ECONOMIC AND CULTURAL EVENTS THAT HAVE ACCELERATED CONVERGENCE

Centralization

All the items of equipment are now detectable on the same medium with a shared administration. Interactions between networks are anticipated and prevented.
For example, air conditioning is not increased whilst all the windows are open, lighting is not kept on when the employees have left the premises

Centralization also makes it possible to manage consumption of electrical power. This is proposed by many software manufacturers, as being both an economically profitable and an environmentally friendly measure.

Cost saving

This term actually refers to the rationalization of administration and maintenance personnel. Whereas a conventional building requires a manager for each network (Computer and telephone systems, safety, etc.), an intelligent building allows simplified administration with reduced workforces. Often, it is the computer department, already familiar with IP communication systems, that will find its role expanding to incorporate building management.

Remote administration

One of the major advantages of IP systems is their remote accessibility. These networks are 'remotable', i.e. they can be controlled even at a distance from the building.
Network management is implemented from a single control point, thus standardizing control and supervision actions.
It is possible to envisage coordinating the lighting, air conditioning or computer systems of a building, whether it is in Paris or Hong Kong.

CONVERGENCE AND ITS APPLICATIONS

Convergence concerns the communication, safety and building management networks of the building. The principle of convergence consists of grouping together networks on the same medium, according to shared rules of applications, thus instantly rationalizing network administration

Communication	Safety	Building management
• Telephony • Computer system • Video: Remote display, • videoconferencing, video projection, etc. • Audio: Public adress, background • music, etc.	• Video-surveillance • Access control • Fire safety • Alarm and intruder detection	• Lighting • HVAC (Heat/Ventilation & Air Conditioning) • Elevator • Power management

OM4 IN DETAIL

In October 2009, TIA TR42.12 (fibre optics) set the tone by publishing the specifications for a new multi-mode optical fibre, optimized for 850 nm LASER sources. This new optical fibre resembles OM4, although this name is generally used only for ISO documents.
With the coming publication of amendment 2.0, OM4 will be officially standardized.

OM4 fibre was developed for use in connections over 100 m long, for 40G/100G applications. Very long connections between distribution areas are not uncommon in large Data Centres. Its main characteristic is its bandwidth in the 850 nm range with restricted sources (e.g. VCSEL), which may reach 4700 MHz*km.

This level of performance is obtained by using very fine layers of refraction that guide rays of light to the centre of the optical fibre, for rays arriving at any angle. The limitations of Differential Mode Delay (DMD) make this fibre an investment in the future by significantly increasing the bandwidth at 850 nm.

CATEGORY	CORE DIAMETER µm	MINIMUM BANDWIDTH MHz*km		
		BANDWIDTH - source LED		LEDBANDWIDTH - source VCSEL
		850 nm	1300 nm	850 nm
OM1	50 ou 62.5	200	500	Not specified
OM2	50 ou 62.5	17.2	500	Not specified
OM3	50	1500	500	2000
OM4	50	3500	500	4700

SINGLE-MODE GLASS FIBRE OS

Single mode fibres are governed by two different regulatory documents: ITU-T standards or ISO/EN standards.
ITU-T telecommunications standards award a performance level to optical fibres according to their capacity to carry large amounts of data over long distances. There are over 15 different ITU-T fibres types, which differ in their optical optimization range or their flexibility.
The most used fibre is ITU-T G652 D due to its level of performance around 1310nm. It is the equivalent of an OS2 optical fibre.
The most recent fibre, the ITU-T G657 (Bending Insensitive Fibre) is used as a subscriber fibre in FTTH networks. Its extreme flexibility makes it perfectly suited to residential installations.

ISO/IEC standards define the backbone or campus transmissions up to a maximum of 10km. ISO/EN identifies two types of single mode fibres: OS1 fibres for transmissions up to two kilometres, and long distance OS2 fibres.

CATEGORY A	TRANSMISSION LOSS (dB*km)	
	1310 nm	1550 nm
OS1	1.0	1.0
OS2	0.4	0.4

OS2 fibre is the equivalent of the ITU-T G653 standard that acts as the benchmark for single mode fibres.

SUMMARY

Summary Table Max loss/length by optical fibre category

Max application LENGTH	CATEGORY	MAXIMUM CHANNEL TRANSMISSION LOSS				
		Multi-mode			Single	
		650 nm	850 nm	1300 nm	1300 nm	1550 nm
25 m	OP1	7.5	-	-	-	-
50 m	OP1	12.0	-	-	-	-
100 m	OP2	13.0	6.3	6.3	-	-
	OH1	3500	-	-	-	-
200 m	OP2	23.0	9.6	9.6	-	-
	OH1	-	5.0	-	-	-
300 m	OM1,OM2, OM3, OM4, OS1, OS2	-	2.55	1.95	1.8	1.8
500 m	OM1,OM2, OM3, OM4, OS1, OS2	-	3.25	2.25	2.0	2.0
2000 m	OM1,OM2, OM3, OM4, OS1, OS2	-	8.5	4.5	3.5	3.5
5000 m	OS2	-	-	-	4.0	4.0
10 000 m	OS2	-	-	-	6.0	6.0

Summary Table Optical fibre applications

Application	Wavelength (nm)	OP1	OM1	OM2	OM3	OM4	OS1	OS2
		980 µm	62.5 µm	50 µm	50 µm	50 µm	9 µm	9 µm
Improved Profibus V2.0	650	50 m	-	-	-	-	-	-
ATM 155	850 - 1310	-	1000 m	1000 m	1000 m	1000 m	2000 m	12500 m
ATM 622	850 - 1310	-	1000 m	1000 m	1000 m	1000 m	2000 m	12500 m
100 BASE SX	850	-	300 m	300 m	300 m	300 m	-	-
1000 BASE SX	850	-	220 m	550 m	550 m	550 m	-	-
1000 BASE LX	1300	-	550 m	550 m	1000 m	1000 m	2000 m	5000 m
10G BASE SX	850	-	32 m	86 m	300 m	550 m	-	-
10G BASE LW	1300	-	220 m	220 m	220 m	220 m	2000 m	10 000 m
10G BASE LX4	1310	-	300 m	300 m	300 m	300 m	2000 m	10 000 m
40G BASE SR4	850	-	-	-	-	100 m	125 m	-
100G BASE SR4	850	-	-	-	-	100 m	125 m	-
40G BASE LR4	1310	-	-	-	-	-	2000 m	10 000 m
100G BASE LR4	1310	-	-	-	-	-	2000 m	10 000 m