PACe

Optical infrastructure for buildings

ACOME

PACe

Network solutions – PACe infrastructure

Contents

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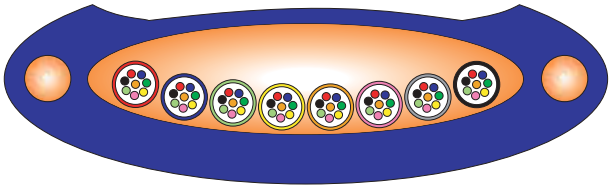
Réf. DTLC 12/2003 - 189 An

PACe

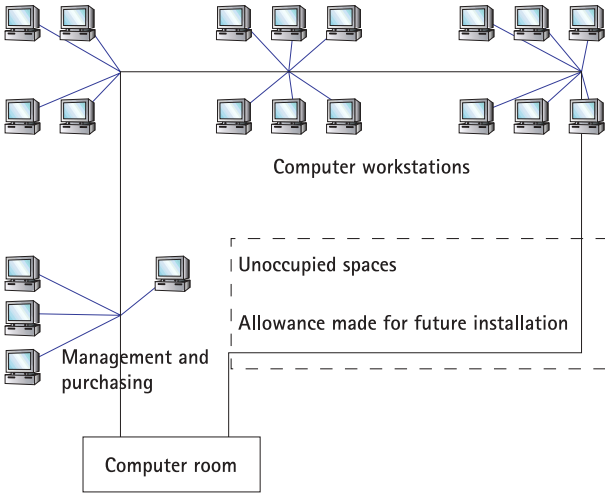
Introduction

The PACe concept



The PACe architecture concept is based on the use of permanent access cable to form a network architecture that is an integral part of the building's infrastructure.

The PACe cable is laid throughout the building to be served. Because the cable can be accessed *anywhere*, *anytime*, groups of optical fibres can be broken out at any point along the cable's length and connected to a user or group of users, an access point or a cross-connection point.



The fibres contained within the PACe are broken out in turn at each position in which an access point must be provided.

The fibres that are not broken out during installation remain available for use at a later date as future needs dictate.

The principle of permanent accessibility allows new groups of fibres to be broken out anywhere, anytime. All spare fibres are thus grouped together and there are no restrictions on the positions at which they are broken-out and where they are routed to.

Upgradeability – Durability of wiring

PACe

Introduction
Applications

PACe is perfectly suited to all network configurations: standard backbone wiring, as well as the wiring of service sector platforms, residential buildings or sites and industrial sites. Each network topology and the advantages provided by the PACe architecture are examined in greater detail in the following pages.

Backbone wiring
Setting the standard in optical wiring: the PACe concept provides cost savings throughout the entire data transmission system, from the passive system to active equipment.

Industrial wiring
With its unique design, enabling the perfect distribution of optical fibre over large open areas, the advantages of optical fibre in an industrial environment can be extended to all points on an industrial site, providing unequalled modularity and extendibility

Service sector platform wiring
Allowing access to the optical wiring at any point within the offices and readily able to accommodate changes in the workstation layout, this type of wiring fully demonstrates the economic and ergonomic advantages to be gained using the *anywhere, anytime* connectability of the PACe wiring architecture.

High rise office building wiring
Offering simpler alternative to the ring or star wiring systems, the PACe system allows optical fibre to be distributed to all floors.

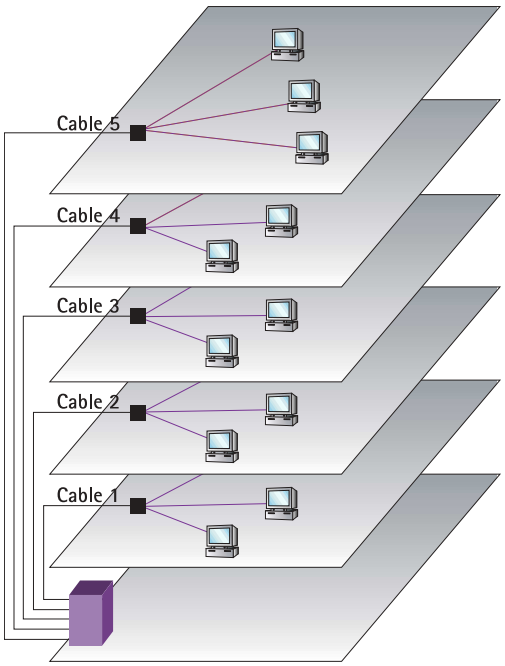
High-rise residential building wiring (broadband)
The PACe system allows the end users to be easily and quickly reached, giving a new dimension to access networks.

PACe

Applications
Backbone wiring

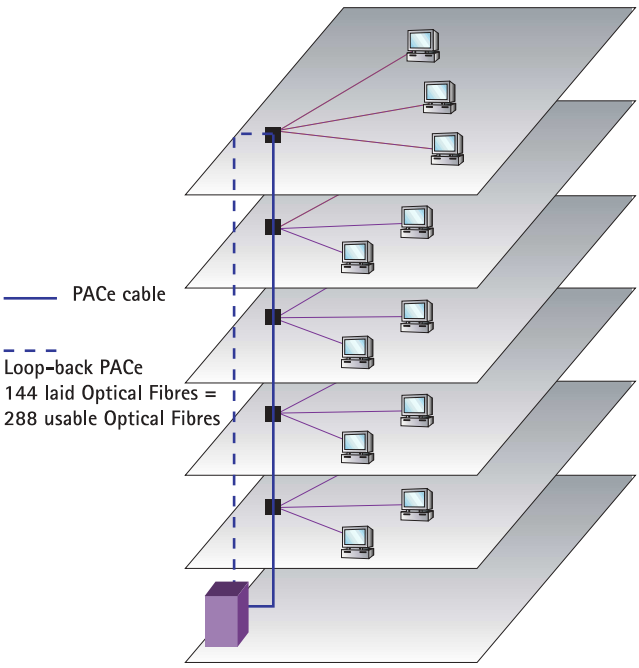
Optical backbone

- One cable per floor
- One cable head per floor, together with associated connectors and patching
- Higher costs



PACe solution

- Uses a single PACe cable for the entire building
- Doubles the number of available fibres
- No more patching at each floor level, direct connection to active equipment via PACe-cord
- FTTD and FTTO can be achieved more cheaply than copper wire solutions



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Applications
Backbone wiring

PACe backbone cables

With a traditional solution, the length of cable required is three to six times greater than that required using PACe. What is more, a PACe cable is considerably easier and quicker to place than running a cable to each floor, resulting in **significant savings on cable laying costs.**

Choosing PACe avoids the need for optical cable terminations at each floor level (optical trays, pigtails, adaptors, jumpers). A PACe-cord is taken off at each floor level, directly connecting to the active equipment used at that floor level, resulting in **significant cost savings on passive optical hardware**.

The use of PACe cable and PACe-cord spurs allows the fibre to be run as close a possible to the workstation without the need for patching. The centralised optical cabling system is thus at the heart of the network infrastructure, leading to **reductions in the amount of cable laid and savings on passive and active hardware.**

As with standard cabling systems, PACe cable can be looped-back to create a redundant cabling system. However, this solution serves above all to optimise the number of installed fibres. By cutting the fibres used to serve a given floor, the lengths of fibre between the main cross-connect and the floor concerned are used, while the reminder of the fibre appears redundant...
Connecting the looped-back cable to the main cross-connect allows the severed fibre to be used in the other direction. There are therefore twice as many usable fibres as there are laid fibres.
114 fibres laid = 288 available fibres: PACe cable allows a 50% saving to be achieved on the number of fibres laid.

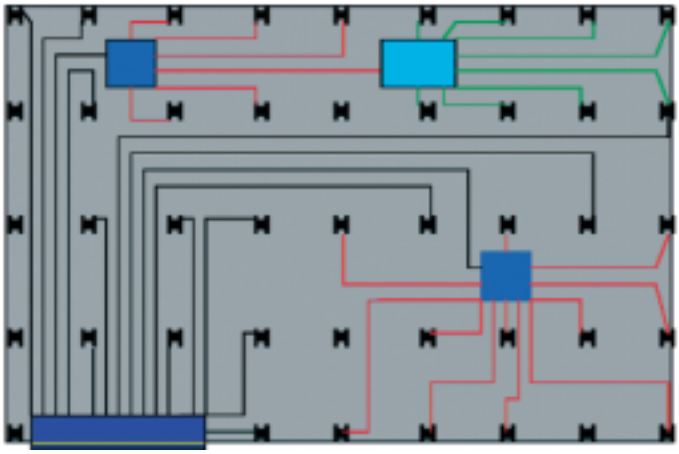
PACe

Applications
Industrial wiring

This type of wiring is required to serve a large number of widely spread points over a large surface area. The logical architecture is often broken-down into a number of levels of concentration: multi-level hierarchical star topology.

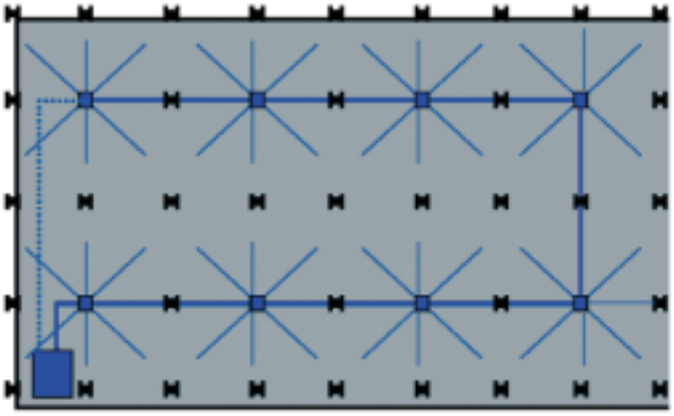
Traditional wiring

Level 1 wiring
Level 2 wiring
Level 3 wiring



PACe wiring

Access point
PACe
PACe-cord



The PACe covers the entire surface of a workshop.
Each access point covers an area able to serve 6 points.
Possibility of looping-back: doubles the number of available fibres

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PACe

Applications
Industrial wiring

PACe in an industrial environment

The star topography of existing networks requires a large number of cables to be laid in order to reach all points of the workshop to be served. Intermediate cross-connects are often required in order to reach the most remote points (in the case of copper) or to make the wiring system manageable.
A **single PACe cable** crossing the workshop allows all existing points to be connected, allowing **a five to ten-fold reduction in the length of cable and cable tray required.**

A simpler system of wiring, improve maintenance, simpler implementation and the elimination of hierarchical wiring all result in **direct savings on the costs of installing, managing and maintaining the wiring system.**

The moving of equipment sometimes requires changes or additions to be made to the wiring system.
Once laid, PACe cable covers the entire area of the workshop. Its ease of accessibility and the ready availability of spare fibres enable changes to be made to the network already in place.
Workstations can be moved and workshops relocated without requiring the wiring system to be changed, thus ensuring its upgradeability and future-proofness

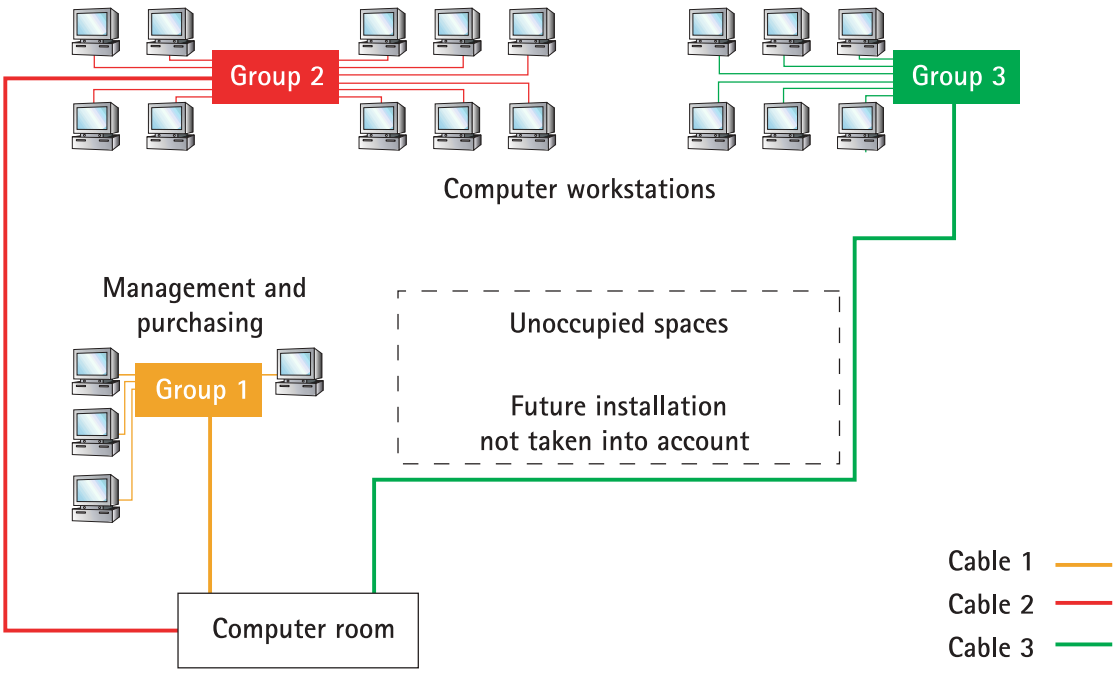
Also in this case, simply by looping the PACe the number of available fibres will be double the number of fibres in the cable.
1 fibre laid = 2 fibres available

PACe

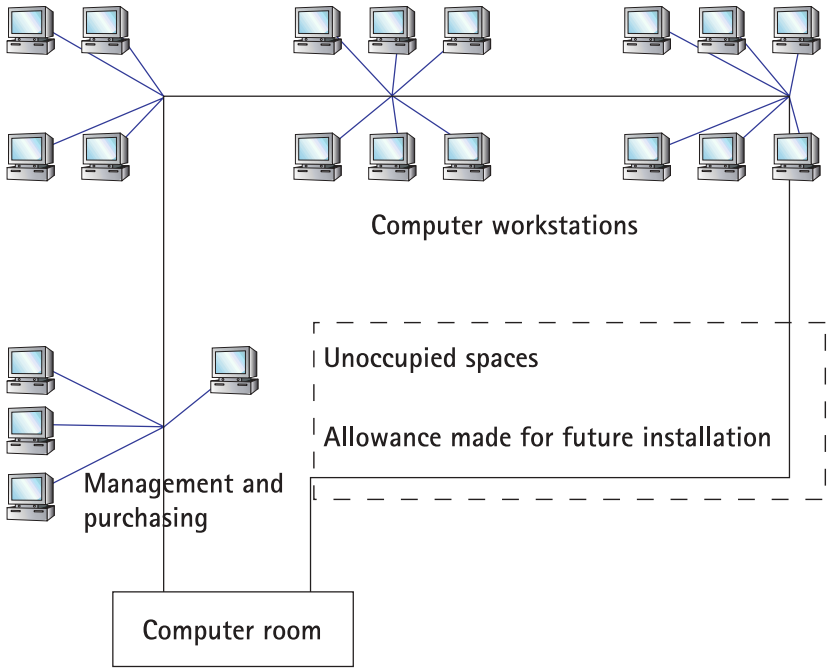
Applications

Service sector platform wiring

Traditional wiring



PACe wiring



PACe

Applications

Service sector platform wiring

PACe in a service sector platform environment

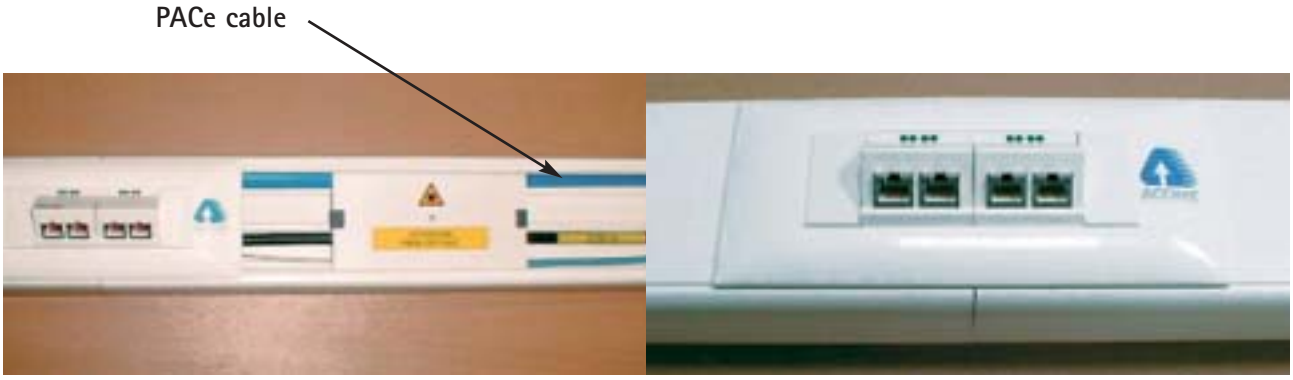
The PACe is run in the false ceiling, channels, raised floors or electrical skirting trunking and covers the entire area to be computerised. Each opening formed in the cable allows the connection of groups of 2, 4 or 6 workstations.
The cable is naturally looped in this type of infrastructure. A single looped PACe cable can ensure secure, redundant operation.

Reductions in the amount of cable to be laid and the number of cable trays required, together with simpler installation lower the costs of installation.

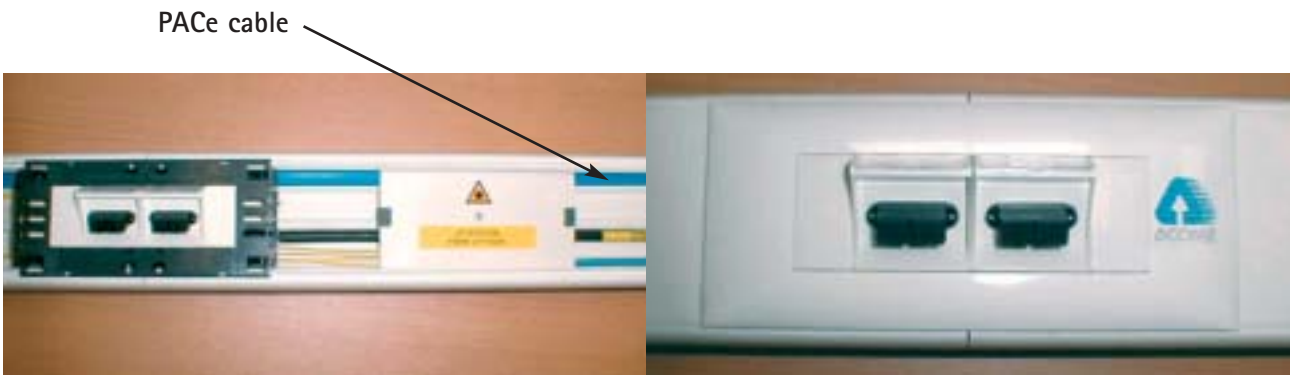
The loop architecture doubles the number of useable fibres (2 optical fibres connect 2 workstations) or ensures physical network redundancy, ensuring **continued operation in the event of PACe breakage.**

When first laid, the cable already contains the fibres required for future upgrades. The PACe covers the areas to be connected in the future at no additional cost (no cable opening or optical connections). When the computer equipment is moved or expanded, the **physical network architecture is already in place**. All that is required is to connect the new work groups to the PACe. **Wiring systems using PACe are upgradeable, simple and durable, as well as cheaper to maintain and modify.**

Fibre To The Office (FTTO): in this type of application, the PACe solution can be combined with active products located in the skirting trunking, the final connection will then be formed using standard copper RJ/RJ patch cords.



Fibre To The Desk (FTTD): the PACe is fanned-out directly in the trunking, allowing the terminal equipment to be directly connected using optical fibre patch cords.



PACe

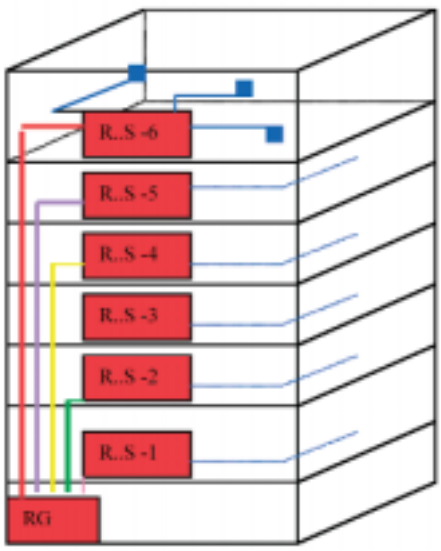
Applications

Wiring of high-rise office buildings

In this type of architecture, each floor has a large surface area and a large number of points to be connected.

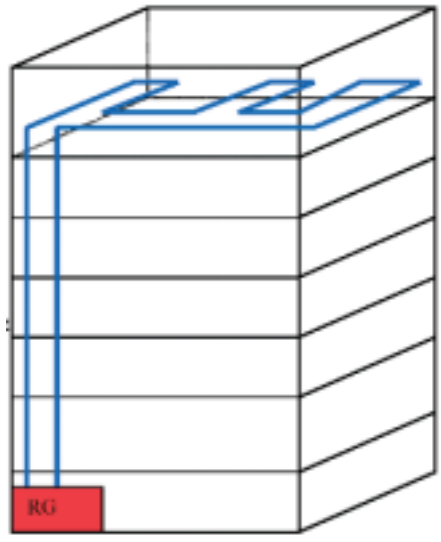
Traditional wiring

- A main cross-connect (R-G) is located on one floor of the building.
- A secondary cross-connect (R-S) is provided at each floor level.
- Each SXC is connected to the MXC by an optical cable that requires patching.
- Optical fibre distribution cable is required for runs exceeding the 90 m limit of copper wire.
- Horizontal cross-connects (HXC ■) regularly distributed over each floor allow the entire floor to be connected using copper or optical fibre terminal cables.



PACe wiring

- A looped-back PACe provides 288 usable fibres for 144 fibres laid.
- A separate PACe cable will be provided on each floor (providing an immediate or future connection capacity of 144 points per floor).
- In the event that the number of workstations per floor does not justify using all the fibres of a PACe, a single PACe cable may be used to connect several floors.



PACe

Applications

Wiring of high-rise office buildings

PACe in a high-rise office building environment

The PACe runs around each floor level along the building infrastructure (corridors, channels...), remaining as close as possible to the users. Branch connections are formed in the PACe according to the user needs.
A looped cable containing 144 fibres provides 288 usable fibres for the wiring system. These 288 fibres potentially allow 144 optical connections to be formed immediately or at a later date. **The PACe thus forms an integral part of the building's infrastructure. Installing a long term structured wiring solution increases its service life.**

The secondary cross-connects are no longer required, the passive equipment, cable laying, rack installation and connection costs are reduced to an absolute minimum, ensuring that the **wiring system is cheaper to implement.**

A PACe cable can serve one or several floors. The wiring will be installed to suit both the immediate and anticipated future needs: **PACe cable always allows optimum management of the cables laid.**

PACe

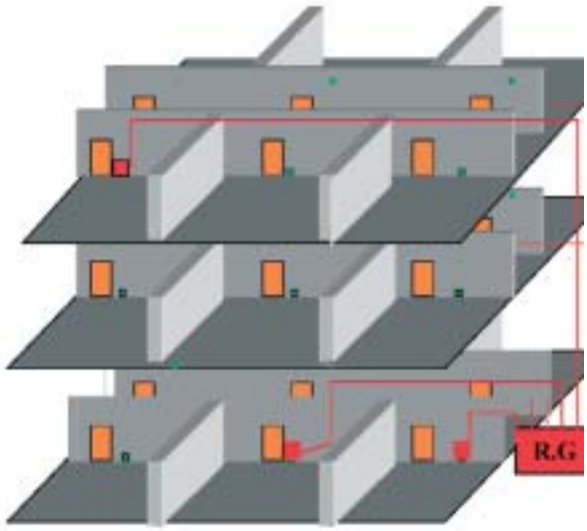
Applications

Wiring of high-rise residential buildings (broadband)

The purpose of this type of wiring is to provide a maximum number of services to mass consumers in an urban environment.

Traditional wiring

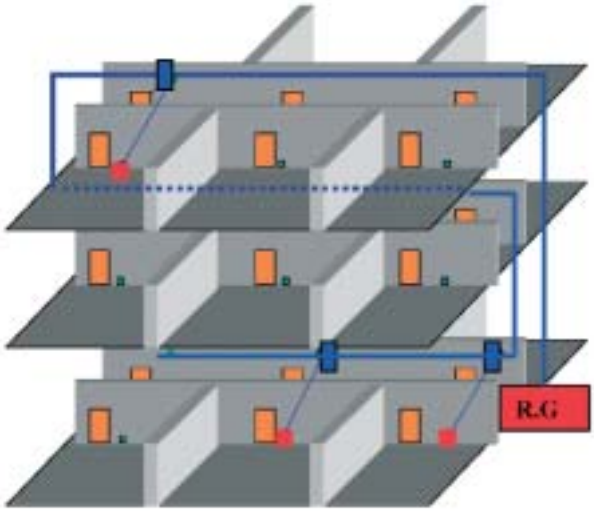
A separate optical feed must be run from the main cross connect (R-G) **to each potential** user to avoid the need to add cable trays or add further cables as new customers are added.
In this example, **18 two-fibre cables are required to be laid** for 3 actual users (■)



PACe wiring

Split-PACe ▮
PACe-cord ——
PACe ——

A single PACe cable covers the entire building.
The wiring system requires no further cables to be laid.
Split-PACe will be added as and when new users require to be added.



PACe

Applications

Wiring of high-rise residential buildings (broadband)

PACe in a high-rise residential building environment

In this type of infrastructure, the service provider offering connections to a varied customer base must run the optical cable as close as possible to each potential customer. The investment does not depend on the actual number of customers, but an estimate based on the connection of all potential customers. In the case of PACe, the investment is limited to the cost of incorporating the cable in the building infrastructure.

Savings are achieved in terms of the length of cable and amount of cable tray to be laid.

Investment proportional to the number of customers connected (each additional split-PACe allows the connection of 6 new subscribers).

Category C1+ cable guaranteeing the safety of the users.

PACe

Applications

PACe and PACe Cord cables: exemplary fire properties

The fire properties of the materials used in the construction and fitting-out of buildings is crucial for the safety of life and property.

- In the event of a fire in a building open to the public, the preservation of life is of overriding importance. This obviously means preventing the spread of fire. It also means limiting smoke emissions, not only because of their toxicity (suffocation followed by asphyxia), but also because of their opacity which slows down the evacuation of people and the response of the emergency services.

- In the case of a fire in premises not open to the public, the priority is to save property.
  Certain materials release hydrochloric acid when they burn, which has the effect of corroding the metal components of the electrical and computer equipment. Damage is not limited only to the fire zone, but also occurs in smoke-affected areas.
  It is thus essential to choose materials that release non-corrosive smoke.

Because **PACe and PACe-cord** cables are dedicated for internal wiring applications, they are designed to have exemplary fire properties.

Use of low flammability, low smoke materials (non toxic and non corrosive)

The original design of the **PACe and PACe-cord** cables has allowed this performance to be achieved through the exclusive use of LS0H* sheathing for both the secondary coating of the optic fibres (compact tubes for PACe cables, 900 µm semi-tight buffer for PACe Cords) and the cable envelope

*(*LS0H: Low Smoke, Zero Halogen materials)*

PACe

Applications

PACe and PACe Cord cables very successfully meet the requirements of the Construction Products Directive (CPD)

They pass the following tests:
(Standardised national and international tests)

Fire resistance

IEC 60332-1 and NFC 32070 test no.1 – 1 kW burner Classification C2
IEC 60332-3-24 [3C] – Test on layered wires
NFC 32070 test no. 2 – Classification C1 (80cm) and conforming with **RATP K209** (30 cm)
PrEN 50399-2-1 - Construction Products Directive: **Euroclass C**

Smoke emission

PrEN 50399-2-1 – Construction Products Directive: smoke production = s1 Acidity corrosivity = a1
IEC 61034-1 and 2 – Density of smoke emissions: light transmittance >85%

PACe

System components

Pre-sale assistance

Our technical and sales departments are at your disposal to provide advice:

- on the choice of architecture best suited to your needs,
- on the fibre specification corresponding to your expectations,
- regarding the selection of passive elements (connectors, splices, etc.) or active elements to be installed.

PACe wiring design document production

We provide support for the production of

- general wiring block diagrams,
- cable sizes,
- connection and installation drawings,
- the detailed wiring file for the existing or future infrastructure.

Qualification, inspection, acceptance

If you wish your network to be qualified for particular applications or bit rates, to perform or order an inspection or an acceptance file, **ACOME is there to assist you and ensure the success of your PACe project.**

- validation of wiring design,
- assistance at site start-up,
- validation of measuring and acceptance procedure,
- site audit,
- adaptation of equipment for specific systems.

ACOME training courses

ACOME offers dedicated training modules relating to PACe and its implementation. These courses allow the different players in the cable and wiring system market to acquire the knowledge they require in order to apply the PACe concept. These courses can complement existing optical training courses.

Two modules dealing with the PACe wiring system are proposed:

- *Module no. 7, a new wiring concept. Intended for design engineers, computer managers, wiring system integrators. This module provides the knowledge required for an optimum use of the PACe wiring system within the various existing network infrastructures.*
- *Module no. 8, PACe system implementation. This module is intended for installers, and covers the practical aspects of the installation of the different elements of the PACe system in their actual environment.*

PACe

System components

Open-PACe – cable opening tool

This ergonomic tool is specially designed to allow the safety, accurate and speedy opening of PACe cables.

- Nylon body
- Stainless steel blade
- Supplied in a blue case (200 x 70 x 30mm)
- Weight: 300 g
- Supplied with a spare blade

Clip-PACe – Closure clip

Black plastic clip serving to secure the cable in:

- Split-PACe (junction boxes)
- Node-PACe (break-out boxes) as well as to protect the cable at the point of opening to extract the compact tube

PACe

System components

Split-PACe – junction box

Box for taking compact tubes off from the main cable. It comprises two coiling zones and a splicing zone. It is attached to the cable tray by means of a clip.

- Stainless steel body and cover. Colour: RAL 9001
- PACe cable secured by means of clip-PACe
- 2 clamps on the sides for attaching PACe-cord
- Radius of curvature of fibres inside box greater than 25 mm (complying with ISO-IEC 11801 and EIA/TIA 568)
- Overall protection rating of box: IP54
- Supplied with 3 clip-PACe
- Dimensions: 186 x 152 x 30 mm
- Weight: 780 g

PACe

System components

Node-PACe – break-out box

Box for breaking-out the ends of PACe cables.

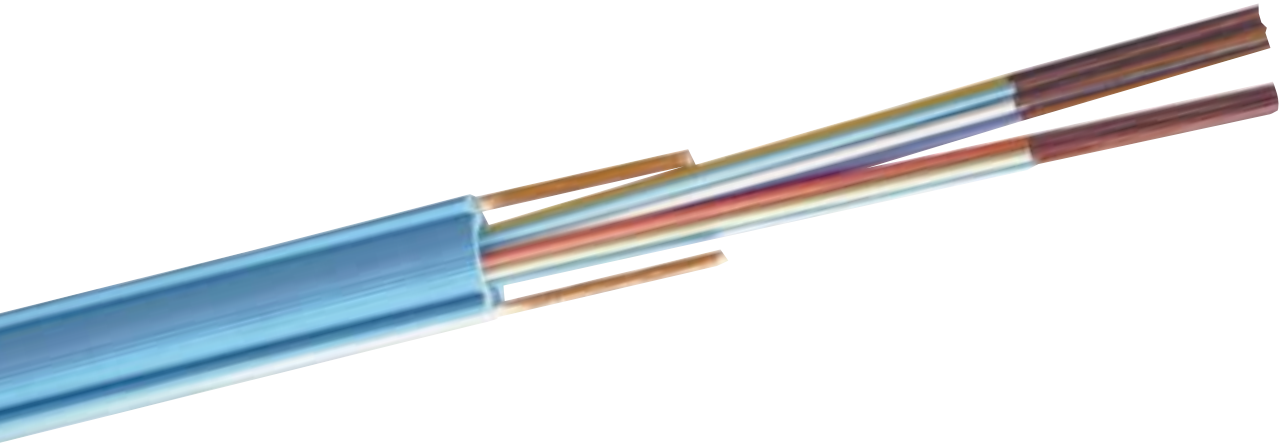
- Stainless steel body and cover. Colour: RAL 9001
- Fixed to the PACe cable by means of a clip-PACe
- Fitted with clamps on the sides for attaching 5 mm diameter RICHCO type corrugated tubing (ref OFBLT 3.1 05 PP) for routing the compact tubes to the connecting trays.
- Radius of curvature of fibres inside box greater than 25 mm (complying with ISO-IEC 11801 and EIA/TIA 568)
- Overall protection rating of box: IP54
- Supplied with 3 clip-PACe
- Dimensions: 186 x 152 x 30 mm
- Weight: 780 g

PACe

System components

PACe

- Optical fibre cable containing between 4 and 144 single mode or multi-mode fibres.
- 4, 8 or 12 fibre compact tube internal module.
- Modular range, containing 4, 8 or 12 compact tubes per PACe cable.
- LSOH outer jacket in accordance with NFC 32062.
- Exceptional fire resistance. Complies with standards like RATP standards.



PACe-cord

2 mm fitted jumper optical fibre lead

- 2 individually sheathed, aramid fibre reinforced fibres with a 900 µm semi-tight buffer structure.
- Glass yarn cable strengthening member.
- LSOH outer jacket in accordance with NFC 32062 with flame retardant properties.

PACe

System components
Sales references

Equipment reference numbers

Open PACe (opening tool)	IB 1306
Split-PACe (junction box + 3 clips)	IB 1302
Clip-PACe (closure system)	IB 1303
Node-PACe (break-out box + 3 clips)	IB 1305

PACe-cord

Multimode 50/125
Ref: N 6392A
Delivered lengths: 100 m or 500 m

Multimode 62.5/125
Ref: N 6393A
Delivered lengths: 100 m or 500 m

Single mode
Ref: N 6394A
Delivered lengths: 100 m or 500 m

PACe

System components
Sales references

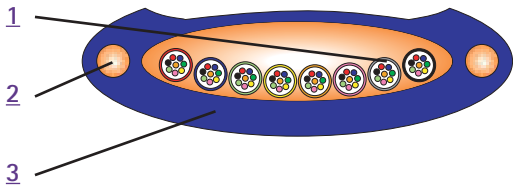
PACe
16 to 144 fibres – internal dielectric 62.5/125, 50/125, 9/125

Description

1 **Compact tube** : 4, 8 or 12 FOTAG colour-coded single- or multimode optical fibres assembled within a thermoplastic skin

2 **Strength members** : Non metallic, FRP

3 **Outer jacket** : Blue LSOH jacket complying with EN 50290-2-27: 16.6 mm wide – 9 mm high



ACOME references

PACe capacity	Compact tube modularity	Number of compact tubes	PACe with 62.5/125 multimode fibres	PACe with 50/125 multimode fibres	PACe with 9/125 singlemode fibres*
16 fibres	4 fibres per CT	4	N 6262A	N 6271A	N 6280A
32 fibres		8	N 6263A	N 6272A	N 6281A
48 fibres		12	N 6264A	N 6273A	N 6282A
32 fibres	8 fibres per CT	4	N 6265A	N 6274A	N 6283A
64 fibres		8	N 6266A	N 6275A	N 6284A
96 fibres		12	N 6267A	N 6276A	N 6285A
48 fibres	12 fibres per CT	4	N 6268A	N 6277A	N 6286A
96 fibres		8	N 6269A	N 6278A	N 6287A
144 fibres		12	N 6270A	N 6279A	N 6288A

* 9/125: G652 fibres

General cable characteristics

	PACe
Temperature range:	
transport and storage	-40°C to +70°C
installation	-5°C to +50°C
operation	-30°C to +70°C
Allowable tension (N)	1,000
Crushing resistance (N/cm)	200
Min. bending radius (mm)	90
Fire resistance	Complies with IEC 60332-1 and IEC 60322-3-24 (3C) Complies with NFC 32070-2.1 (C2) and NFC32070-2.2 (C1)
Smoke density	Satisfies the requirements of IEC standards 61034-1 and 2 with a minimum light transmittance of 85% (min. required >60%)
Packaging	500 m and 1,000 m drums
Nominal weight of cable (kg/km)	140
Jacket marking	A ← PACe - year and week of production – ACOME – no. and type of optical fibres → B + metric

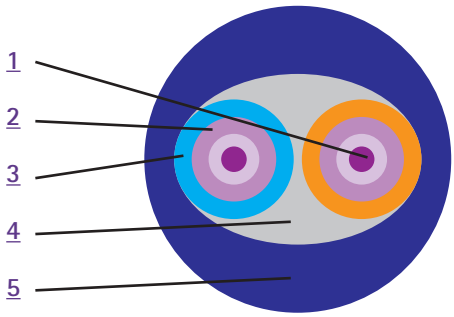
PACe

System components
Sales references

PACe-cord
Reinforced duplex – internal dielectric 62.5/125, 50/125, 9/125

Description

1 Optical fibre : 900 µm single- or multimode semi-tight buffer optical fibre
2 Single strength member : Aramid fibres
3 Inner sheath : 1.95 mm diameter LSOH sheath (jumper no.1 = blue – jumper no.2 = orange
4 Combined strength member : Glass yarn
5 Outer jacket : LSOH jacket complying with EN 50290-2-27.
Round, 5.6 mm nominal diameter
Min. thickness: 0.8 mm
Colour coded: multimode = blue
single-mode = pale green



ACOME references

PACe-cord capacity	PACe-cord with 62.5/125 multimode fibres	PACe-cord with 50/125 multimode fibres	PACe-cord with 9/125 9/125 single-mode fibres*
2 fibres	N 6393A	N 6392A	N 6394A

*9/125: G652 fibres

General cable characteristics

	PACe
Temperature range:	
transport and storage	-40°C to +70°C
installation	-5°C to +50°C
operation	-30°C to +70°C
Allowable tension (N)	1,250
Crushing resistance (N/cm)	300
Min. bending radius (mm)	50
Fire resistance	Complies with IEC 60332-1 and IEC 60322-3-24 (3C) Complies with NFC 32070-2.1 (C2) and NFC32070-2.2 (C1)
Smoke density	Satisfies the requirements of IEC standards 61034-1 and 2 with a minimum light transmittance of 85% (min. required >60%)
Packaging	500 m drum or 100 m reel
Nominal weight of cable (kg/km)	30
Jacket marking	PACe-cord – year and week of production – ACOME - no. and type of optical fibres – product ref + metric

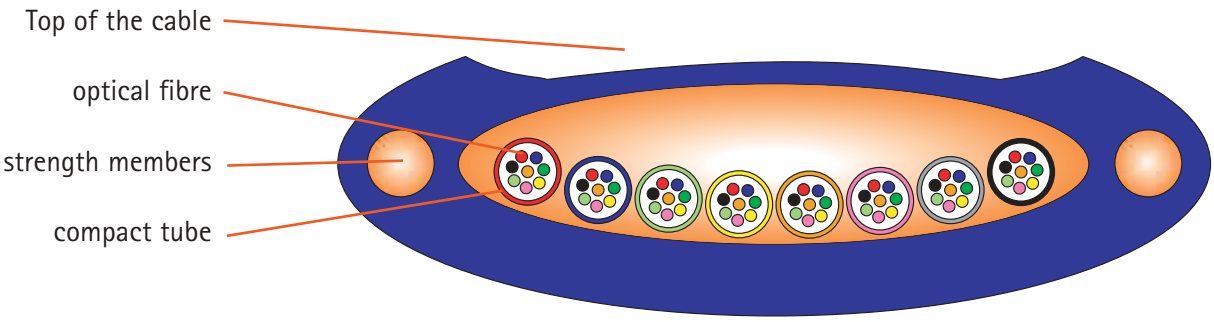
General cable characteristics

Cables and fibres	Wiring systems	Applications
IEC/EN 60793	EN 50173	IEEE 802.3 10M to 10 Gbit
IEC/EN 60794-1	ISO 11801	IEEE 802.5 Token ring
		ANSI X3T9-5 (FDDI)
		ATM (155, 622, ...)

PACe

System implementation

This chapter gives a step-by-step description of operations necessary for implementing a wiring system using PACe cable and its associated components.



Recommended tools

- Open PACe (ACOME opening tool) (1)
- Scissors (2)

Connection accessories

- Split-PACe: junction and connection box
- Clip-PACe: system for protecting openings formed in the cable
- Node-PACe: rack or cabinet-mounted break-out box

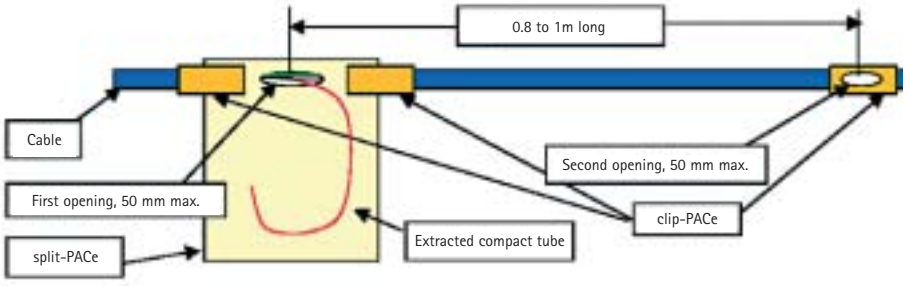
PACe

System implementation

Attaching the cable to the cable tray

For ease of laying and access, it is recommended to run the cable along the side of the cable tray (see photographs below).

Forming a branch connection



Accessing the fibres

To access the fibres, two openings (max 5 cm long) must first be formed in the cable a distance of 0.8 to 1 metre apart (length of fibre needed to form the connection).

Note: separate the cable from its support over a length of approximately 2 metres to facilitate preparation and the forming of the branch connection.

PACe

System implementation

Opening the cable

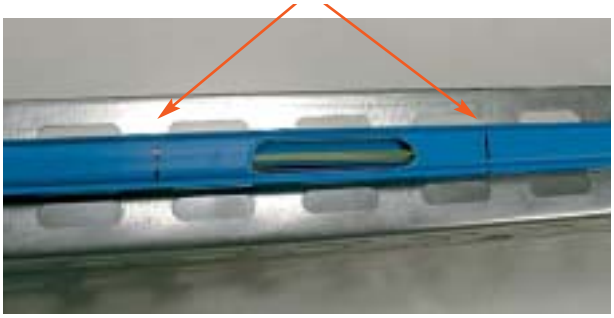
Place the opening tool on the cable with its blade in contact with the top of the jacket. Slide the tool forward, applying light pressure to make the blade penetrate into the jacket material. Create an opening of the desired length. To complete the opening and remove the cut section of jacket, lever it out by placing your thumb on the front of the tool and lifting the back.

Installing and attaching the box

Once the openings no. 1 and no. 2 are formed

- Make 2 marks 105 mm apart, centred on one of the openings
- Place the cable in the clip-PACe
- Remove the protective paper from the foam
- Close the clip-PACe

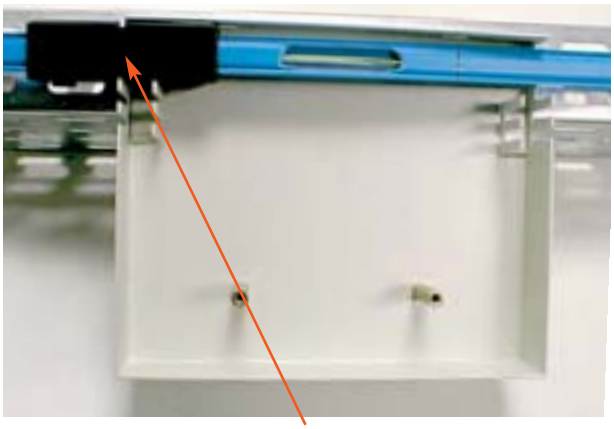
Markings 105 mm apart



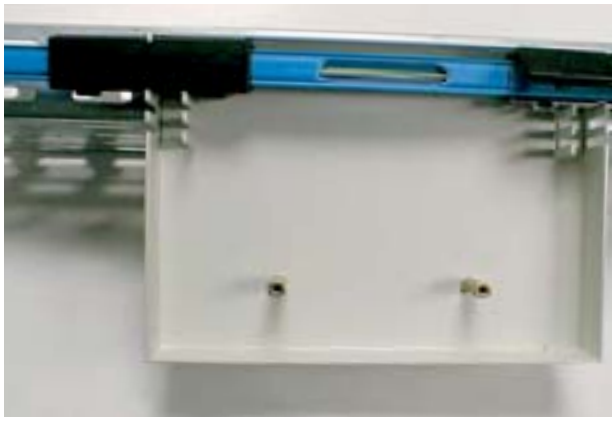
PACe

System implementation

1/ Slide the box under the cable and position the clip-PACe



2/ Place the second clip-PACe



3/ Close the second clip-PACe

4/ Re-attach the cable to the cable tray

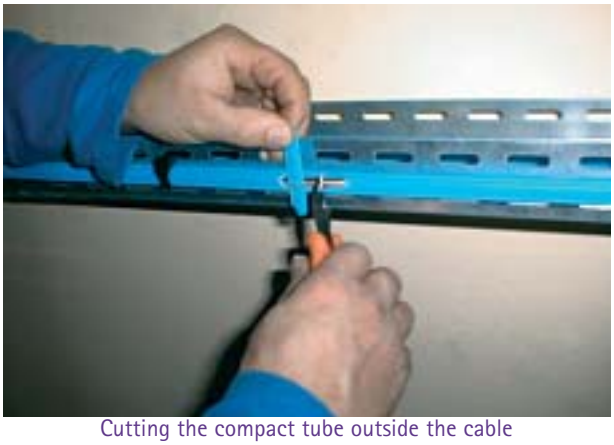
PACe

System implementation

Accessing the compact tubes

Follow the instructions below **to extract the compact tube from the cable without damaging the fibres:**

- Take one of the cable jacket cuttings removed when forming the openings
- Use this cutting to extract the compact tube to be connected though the opening no.2
- Cut the compact tube outside the opening
- Use the jacket cutting again to pull the compact out via the opening no. 1,
- Remove the compact tube's thermoplastic covering to access the fibres



Cutting the compact tube outside the cable

Closing the cable

Extracting the compact tube from the cable required 2 openings to be formed. The first of these is located within the box, the other is on the cable, and must therefore be closed using a clip-PACe.

- Place a clip-PACe centrally on the opening no. 2
- Remove the protective paper from the foam
- Close the clip-PACe

Cable opening

Placing of the clip

Clip after closure

PACe

System implementation

Installing the PACe-cord

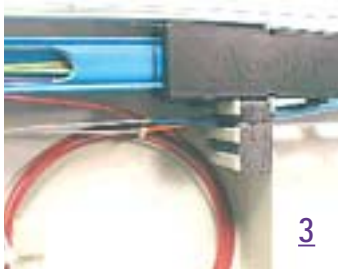
Prepare the cable as follows:

- Prepare a length of cable approximately 0.8 to 1 metre long so as to have a sufficient length of 900 µm fibre to form the connection to the compact tube,
- Form a notch in the foam of the box (photograph 1),
- Place the cable in the clamps provided in the box for this purpose. The 2 mm jumpers of the PACe-cord are superimposed (photograph 2),
- Before connecting, attach the PACe-cord with the PACe cable on the support (photograph 3).

General view of coiled elements (photograph 4).

1

2



3

4

Note 1: SAFETY PRECAUTIONS to be taken: goggles and gloves MUST be worn. It is recommended to wear an apron when using cutting tools.

Note 2: When the cable is installed for the first time, it is recommended to perform a test on a sample or one end of the cable.

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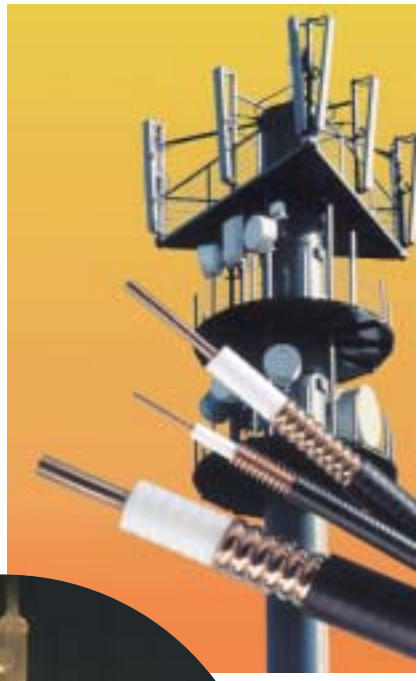
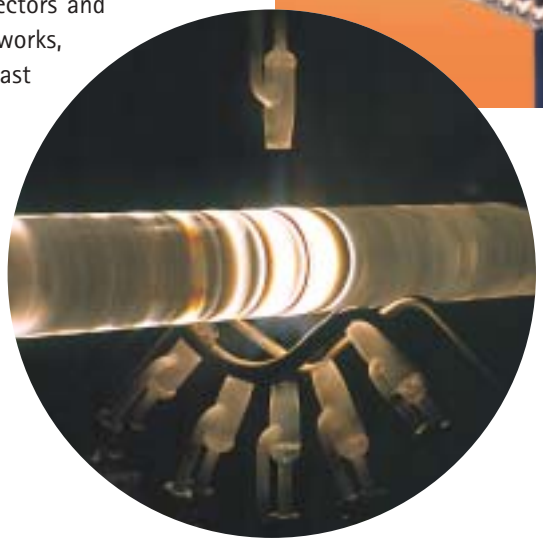
- HYPERCELL® 50 Ohm coaxial cables, connectors and accessories for radio communication networks, radio local loop, radio-relay and broadcast networks
- GIGACOME® 75 Ohm coaxial cables, connectors and accessories for video communication networks, multimedia and voice over IP.





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Notes

Notes

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