Product Guide

AL.COM
Laser Transmitter

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Summary

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Introducing Wireless Optical Transmission

Thank you for spending a few moments to learn about an alternative new technology for Metropolitan Area Networks, **the Wireless Optical Link** and specifically, our solution : the AL.COM Family 200 laser transmitter.

Enjoy !

Actipole is a leader in wireless transmission systems and today, we introduce a new, high end product based on laser transmitters, leading the way toward broadband wireless optical systems financially accessible for everyone.

Drawing from its experience of several years on many customers sites, using many combinations of parameters (bandwidth, distance, geographic location, weather conditions), Actipole can now offer today a proven solution matching specific requirements.

Actipole is intending to become now a significant partner to telecommunications operators, carriers and equipment manufacturers eager to offer new products from the field of high speed optical networks.

This is the type of challenge we offer to achieve together with you, by putting our team at your disposal in order to continuously adjust our products with the market needs. In addition, our Sales team will be here to assist you at any time, being pre-sales assistance or post-sales customer support !

This guide will provide an overview of the basic elements of wireless optical communications, for a good understanding of the field and will answer the questions frequently asked by our existing or prospective customers.

Of course, we are hoping for your feedback so we can make this document an evolving source of information , benefiting as many future Wireless Optical Transmission users as possible !

We also invite you to visit our web site at the following URL :

http: //www.ita-systems.com

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The AL.COM Family 200 Transmitter

The AL.COM Family laser link is a **wireless optical connection** that enables full duplex communication between phone networks, computer networks or video networks. It works similarly as an optical fiber, and allows digital data communications from **1 Mbps up to 200 Mbps, in full duplex mode.**

The AL.COM Family laser link uses an optically modulated laser in the visible spectrum (red) to exchange binary information. It's **a point-to-point link** (building to building), transparent to the protocol used , meaning that the equipment will automatically adapt to the transfer speeds of the connecting equipment.

Installed as a rooftop solution, The AL.COM Family 200 interconnects any building located **up to 1 mile with direct line of sight**. The remote network becomes then an extension of your local network, without any difference for the end-user.

Link : ATM 155 Mbps
End user : France Télécom R & D

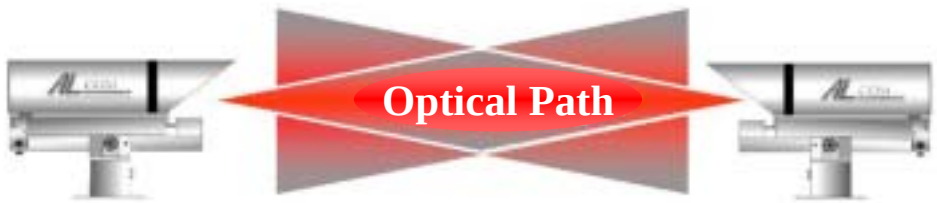

Illustration: *Overlapping Optical Paths*

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The AL.COM Family 200 Product Line

The AL.COM Family 200 is presented in 4 options, in order to fit varying requirements for site conditions and distance:

AL.COM *City* is particularly recommended for distances less or equal to 650 m : this package is equipped with a fix lens allowing for the presetting of the spotlight's dimension.

Like an optical fiber, it is transparent to the protocols used, and allows for the exchange of digital data **from 1 Mbps to 200 Mbps, in full duplex mode.**

World exclusivity : with a pointing support device and its optical head, it is a solution rapid to deploy and setup, thanks to its use of visible red light.

Its serial connection enables a transmitter-based monitoring, with the AL.COM LINK MANAGEMENT (ALM) software.

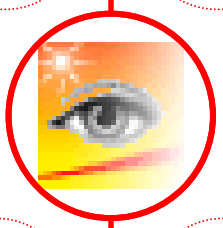
AL.COM *Expert* is particularly recommended for distances less or equal to 1 500 m.

In addition from the ***City*** option, this package adds a motorized emission lens, which manages automatically the dimensions of the two laser beams**,** depending on local weather conditions, to increase link performances by 15 dB.

World exclusivity: The optical link is coupled with a service radio link (unlicensed 433 MHz frequency)) used for real time monitoring and optimization of the link.

This package includes the Technical Kit and the ALM software, for AL.COM 200 network management.

4 OPTIONS THAT FIT YOUR NEEDS



AL.COM Family & ALM
100 % available

AL.COM *Carrier* is particularly recommended for distances less or equal to 2000 m.

In addition to the ***Expert*** package, this package is equipped with **a high-sensitivity reception module**, which allows for a significant increase in the link overall availability.

The optical link is coupled with a service radio link (unlicensed 433 MHz frequency)) used for real time monitoring and optimization of the link.

This package includes the Technical Kit and the ALM software, for AL.COM 200 network management.

AL.COM *Privilege* is adapted to any climatic conditions for distances less than or equal to 2500 m, thanks to its specific options (fans, electric resistors, dedicated support module…)

A high-end package, it is equipped - in addition to the options from the ***Carrier*** package - with a motorized control for the X and Y axis, for automatic targeting and self-aligning of the optical link (pointing/tracking).

AL.COM Privilege**,** with the best features on the market, allows for applications only limited by your imagination.

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From a AL.COM Family 200 link to a network architecture

Generally speaking, all the optical atmospheric transmissions device available on the market today claim a transparence to the protocol used. This, by essence, excludes the possibility of exchanging technical data (service link) between two transmitter through the optical link.

Each device working independently from one another, it is necessary to ensure monitoring of both units.

This handicap didn't allow a global view of the link, or any real-time intelligence in the system. Until now.

The latest innovations in the AL.COM Family 200 technology allow the transition from transmitter to link.

A service link is added so that system data from the remote site can be collected independently of the optical link (thus preserving the protocol transparency) by the local site using a secondary link, in order to be processed on site or by a remote processing facility.

The link management is performed through the AL.COM Links Management (ALM) software, which visualizes from one single PC, both transmitters and the active link they constitute.

The network administrator can modify various setup parameters at any time and without interrupting the optical link.

He can also delegate to an on-site PC the local automation of such tasks: the on-site PC will then be able to perform, depending on local conditions (weather, distance, environment…), real-time optimization of such parameters as:

- The system dynamics, through the zooming function that controls convergence and divergence of the beam, depending on levels of received power, to **improve overall performance in degraded weather conditions.**
- The alignment of the devices, through the motorized axis control that will correct any offset caused by building vibrations, building motions, support instability (with pylons), and therefore **increase link distances and reliability**.

Maintenance interventions, other than equipment failure, are therefore virtually eliminated.

The ALM software allows for the management of multiple links simultaneously. The deployment in **multi-site architecture** (loop or star topology) is now possible by **risk-free connection of many AL.COM Family 200 links**. The resulting network offers the same functionality as traditional networks.

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AL.COM Family 200 Applications

Any metropolitan, digital data link between buildings, at a distance less than or equal to 2500 m, in direct line of sight, where the alternative for laying out an optical fiber is impossible, too costly or for which the delay would be too long.

Examples of typical applications :

Telecom Operators	Wired local loop connection to main networks; GSM, UMTS or Local Wireless Loop deployment, etc...
Local government agencies, Corporations, Counties, Municipalities, Hospitals, Universities, Military bases, etc...,	Creation or transfer (of leased lines for instance) of a link to connect private data, voice or video networks of a single customer with multiples locations **on a private property or separated by public property** such as a street, a residential area, a river (or other natural obstacles), or any administrative boundary (like a country border), etc…
Private and public users of Temporary Links	- For construction sites mobile offices: highway and roads, railways (for TGV, French High-Speed Train), dams… - For emergency communications after natural disasters, - Outdoors HQ settings (Military, Police, Firefighting squads, Scientific, etc…) - Concerts, sports meetings, ...

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The AL.COM Family 200 advantages

High Bandwidth: up to 200 Mb/s de of bandwidth today; up to 1Gb/s in coming months and much more in the future with the WDM technology (Wavelength Division Multiplexing).

Cost-effective: no license or royalties to any regulatory body is needed for the installation of this equipment.
Overall return on investment (ROI) is better than with other solutions, because of lower setup costs and higher bandwidth. Typical ROI for such a fully owned point-to-point link is usually less than 12 months.

Quick and Easy Setup: An optical wireless solution in about half a day, typically.

Distance of transmission: up to 1.5 mile (2500 meters) today.

Link Quality: link reliability equal to or better than the reliability of radio (hertzian) transmission systems.

Open Architecture: (transparent to protocol used) allowing a plug and play installation with all standard protocols on the market.

Modular System: very easy to upgrade, when more bandwidth or more interconnectivity with futures high-speed networks are needed.

Flexibility : many possible use in both indoors and outdoors applications.

Reduced Operation and Maintenance Costs: Experience shows that, on average, operating and maintaining aAL.COM Family 200 link costs less than with a radio link (hertzian).

Secured Transmission: Since a laser link doesn't radiate, it is much more difficult to hack that a radio link..

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AL.COM Family 200 : high technology and pragmatism

Adding a new product like AL.COM Family 200 in today's telecommunication networks requires for this equipment to integrate transparently from both the user and network administrator's perspectives.

Indeed, it represents a critical link in the complex network chain of systems, as it generally concentrate on one gateway very many, sensitive information flows.

In addition to intrinsically good performances, it is required for the system to have **an operational availability close to 100%.**

Installed as a rooftop solution, in environments typically difficult (electromagnetic pollution, various radiations, chimney smokes, vibrations, heights, etc…), the system must in addition endure the full spectrum of the site's local weather conditions.

This set of constraints therefore required an adequate architecture and a robust design in order to deliver not just high-speed transmissions performances, but also, a system capable of withstanding adverse conditions such as building induced vibrations resulting in misalignment, rain and storms, variations of temperature inducing condensation, fog and frost on the optical elements, and many more problems…

AL.COM Family understood these constraints and delivers today one of the most robust and mature wireless optical communication technology, as the perfect balance of high-technology and pragmatism.

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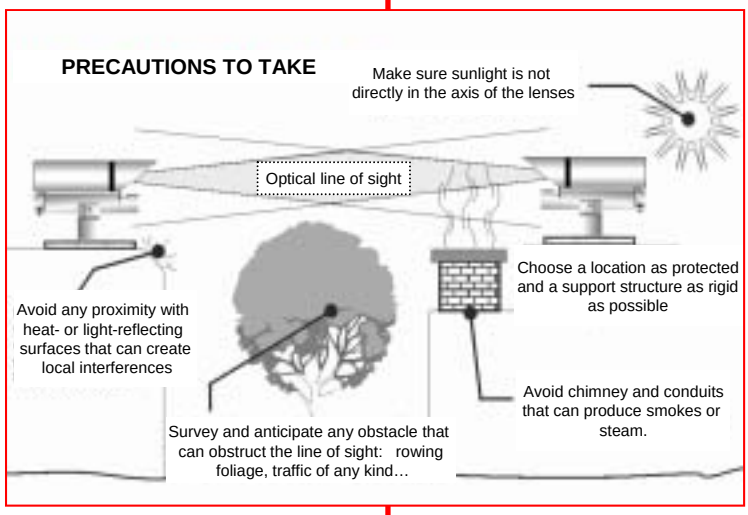
AL.COM Family 200 On-site Installation And Set-up

The transmitter is generally installed on a building rooftop, and in all cases, high enough to be above normal eye level.**The optical line of sight between transmitters must always be free of any obstacle**, current or future (such as foliage, chimney smokes…)

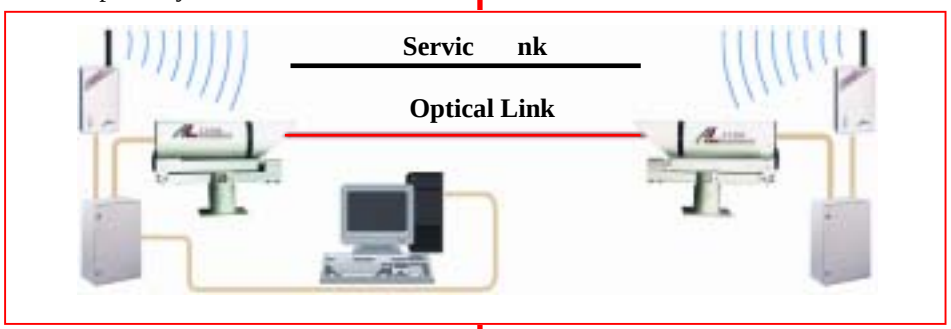
A pre-sales site survey is recommended to inventory all potential obstacles that may with time obstruct the optical line of sight and provide this very important information to the customer.



IMPORTANT : The transmitter will always be anchored to the most rigid support, in order to minimize any path drift due to vibration, shock or similar elements.

The chosen installation location will have to take in consideration all these elements, as well as provide the best possible shelter against adverse weather condition and best orientation to avoid direct sunlight into the optical systems.

Similarly, the location of the two power supplies (dimensions: 400mm x 300mm x 200mm) will be chosen to be at least 2 meters away from the transmitters; specific mounting brackets may be necessary. Electrical supply lines, serial connection (RS 232 for monitoring) and optical fibers paths from the customer site's telecom patch panel to the power supplies will be determined with the customer.



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AL.COM Family 200
and Customer Application Integration

The AL.COM Family 200 link is transparent to the communication protocol, its mission simply being to transfer frames of data bit after bit.

Each bit of data sent as input to one transmitter is identically restored at the other transmitter output.

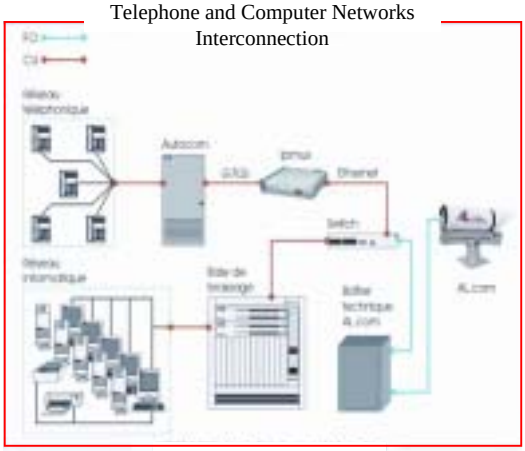
No processing is operated on the content or the nature of the transmitted data.

The signal being restored at the transmitter output, the attenuation budget for the signal between the transmitter and the customer input point must consider all jumper/fiber/jumper segments and all cable paths.

Nevertheless, it is necessary to take in consideration all transit times between the active systems connected to the two AL.COM200 transmitters.

Link : Ethernet 100 Mbp/s
End User : Promodes Paris
Localize : Paris (75)

Telephone and Computer Networks Interconnection



The path elements to consider are:

Total fiber length between the active equipment and the AL.COM 200 transmitter A

Processing time of AL.COM 200 transmitter A

Propagation time of the light between transmitter A and transmitter B

Processing time of AL.COM 200 transmitter B

Total fiber length between the AL.COM 200 transmitter B and the active equipment.

Each time must be summed and taken into consideration with regard to the network topology and the overall design of the solution.

Propagation time of light in a fiber is 3.3 nanosecond/meter.

Propagation time of light in the air is 3 nanosecond/meter.

Total electronic delay introduced by both ends of the link is about 600 nanoseconds (or 300 ns per transmitter).

Though extremely high, the speed of light must be taken into account…

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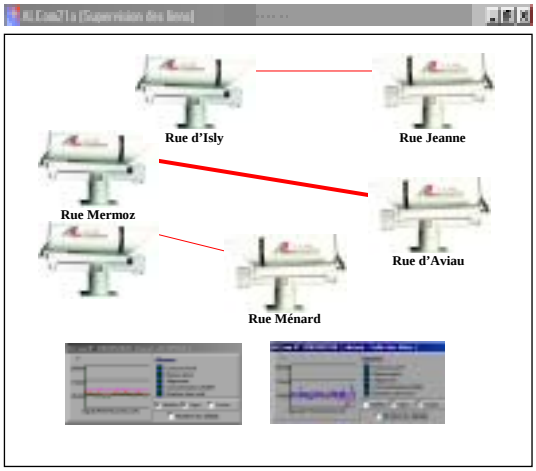
AL.COM Active Link Management Software (ALM) : Setup, monitoring and maintenance

The AL.COM Link Management (ALM) application software is a PC-based user interface, compatible with Windows 95, 98, 2000, NT or XP, that can control via its serial port, one or several AL.COM systems. This application allows the supervision of a link rather than just a single transmitter.

The technical data exchanged are such as the ambient light and optical signal levels, the power consumption level for the laser diode, the position of the motorized projection lenses, the overall system configuration. After analysis of this data, the software can send system alarms so that an operator can act, and adjust each AL.COM 200 unit.

Since ALM has constant knowledge of the system status at both ends, it can be coupled with an optional optimization module to automatically control the link quality. This module allows for a significant increase in the link reliability, especially during degraded weather conditions.

The user screen can represent graphically the **topology of the network** of AL.COM 200 devices being monitored, from a single PC.

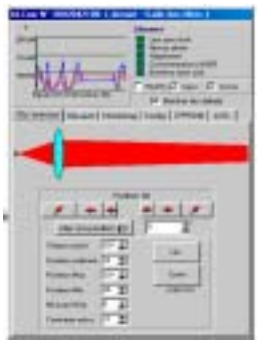


The service channel between the two transmitters can be setup using either a radio modem (4800 bauds) or a terminal server connection.

The application delivers five main functions :

- assistance with setup
- dynamic representation of AL.COM 200 units forming one of more links
- Monitoring and real-time tests of each transmitter and each link
- Global maintenance of all AL.COM 200 units, with on-site PC or by remote control of the on-site PC.
- Automatic, real-time optimization of the link, including the stability of its alignment (pointing/tracking function).

The ALM application is provided with all packages as a standard option. It interfaces with no extra charge with the optional Automatic Optimization and Axis Motorization modules.



Above (left) : ALM window , showing the graphical representation of the various links under monitoring and the active link currently being monitored, with the two transmitter information windows for the two transmitters involved.
Above (right): The 2 transmitter windows for the active link, expanded to show specific tab options.

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Safety, Environment and Health

In just a few years, lasers have taken a very important place in everyday technology, from medical to industrial applications.

Lasers are a coherent source of light, highly monochromatic and very small in dimensions. Depending on their emitting power, they could present a danger for the environment and live beings. The AL.COM Family 200 device uses **a level of power that do not present any danger**: it emits a level of energy that is 5 times lower than the norm for Maximum Authorized Emission (a value representing a maximum energy level that do not present any danger for the human eye).

AL.COM Family 200 transmitters are therefore harmless to the health and to the environment. It also offer the advantage of not adding any electromagnetic pollution in the atmosphere.

Actipole chose to offer a solution that uses a visible light instead of an invisible light, like many competitors, as it clearly adds a level of safety with regards to people's health, the red light beam being easily identifiable to the unaided eye.

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Frequently Asked Questions

Why choose a wireless optical communication instead of radio or hertzian systems ?

The qualification unit for radio and hertzian systems is the Gigahertz (GHz) , but in optical systems, the unit is in the hundred of Terahertz (THz) or at least 100 to 1000 times more.

By nature, optical systems can carry a lot more information than hertzian or radio systems.

Additionally, the higher the frequency (> 2 Gigahertz), the more directive the link becomes, and it will require a clear line of sight between emitter and receiver.

Hertzian and radio technology are as directive as light when used in very high frequencies. The base stations they require typically use very bulky antennas that are not esthetically appealing and do not integrate well with the surrounding environment.

With optics, the antenna is simply an emitting lens, with a diameter less than a few centimeters.

In time, the complete optical transmission devices will decrease even more in size.

The ideas of Point-to-Point and Point-to-Multipoint are not inherent to radio and hertzian technology, as Point-to-Multipoint systems can be developed in optical technology.

Generally speaking, the idea of Point-to-Multipoint assumes for a given emitter, a certain level of power to « light up » a given area of coverage. The wider the area, the more receivers you can install and receive signal in that zone, but with signal levels proportionally weak for each of them.

By narrowing the covered area, you will have a stronger level of signal, but less receivers that can be deployed.

The extreme case is when you use one emitter and one receiver, with a point-to-Point system where the signal received is at a maximum.

New technologies in optical receivers, with very high sensitivity, allow today to consider the deployment of Point-to-Multipoint optical networks.

Compared to a wireless radio or hertzian system, what kind of QoS should I expect with a wireless optical system ?

The laws of physics governing electromagnetic phenomenon are basically the same for hertzian systems and optical systems. The significant factor resulting in a different behavior is the wavelength,

In general, a wave traveling through a given medium will be affected when the dimensions of the obstacles it encounters are about the same order of magnitude in size as its wavelength..

Following this theory, hertzian transmissions, with millimeter wavelengths (or 10^{-3} m), will therefore be affected by rain, but optical transmissions, with micron wavelengths (or 10^{-6} m), will be this time affected by fog.

Link budget calculations for either technology is therefore completely comparable.

With the current trends in research and development in optical technology, resulting in even lower receivers sensitivity, it is agreed that the increase in budget link margins will favor the optical systems in the future.

Why isn't wireless optical communications more deployed ?

Wireless optical technology has been available for close to 30 years at both the prototype and small production stages.

Until now, major developments of telecom infrastructures has been done using fiber optics, for long distances networks and all research and development was geared toward this type of applications.

Recent deregulation in the Telecom market in many countries the ensuing creation of competing operators, specifically in the local loop services, the rapid increase in Internet usage and other services requiring broadband-like bandwidth led to a new surge in the development of high performance wireless optical systems, specifically targeted for short-distance and high throughputs.

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Frequently Asked Questions

Simply stated, how does a wireless optical link work ?

An wireless optical transmission can be compared to the transmission we could initiate by using a flashlight and a « switch on/off » Morse-like code at night.

The flashlight is replaced by a laser source (comparable to a light bulb) which intensity is made to rapidly flicker: this is called modulation. Our eye is replaced by a detector set to this laser source, which can detect the rapid variations of the laser.

Each end of the transmission system is equipped with an emitter/receiver which allows the simultaneous transmission, at the same speed in both ways. This is called full duplex.

?

One of the advantages of lasers is that it can be modulated at extremely high speeds, from 155 millions times per second and soon reaching up to 1 billion times per second.

At these speeds, the proper processing of the « 0 » and « 1 » can really be called « high technology » !

With optics, what is the difference between a LED and a laser diode, between visible and invisible light (red versus infrared) ?

The main characteristic of an LED is its spread spectrum (or spectrum width).

The spread spectrum is the number of actual wavelengths (or frequencies, or « colors ») emitted simultaneously by an emitter.

LEDs emit a spread spectrum of several tens of nanometers: typically, a LED centered on 820 nm, will emit the maximum of power at that bandwidth, and a little less between 810 and 830 nm , and so on until no power can be measured around 760 nm and 880 nm; in this case the spread spectrum is 120 nm: LED are considered polychromatic devices.

A laser emitter has a much narrower spread spectrum, around a few nanometers. A laser diode with the same bandwidth as previously will emit between 819 and 821 nm (only 3 nm of spectrum). Lasers are considered monochromatic devices.

Because of its monochromatic nature, with a laser, it is possible to:

• easily guide light with lenses, allowing an optical range (distance of transmission) much higher than with LEDs.

• use very narrow receivers that will only pickup the intended signal and not the ambient noise, unlike LEDS.

Additionally, it is possible with current technology to modulate more powerful signals with a laser diode than with a LED.

The fact that the light is visible or not (red versus infrared) is only here as a reference as compared with the human eye perception: there are really no significant difference in performance by transmitting visible or invisible light.

To conclude, the laser is technically more interesting that the LED because it can allow transmissions at further distance. Visible light is preferred as it is simpler to install, monitor and maintain a system with visible light.

Why choose today a wireless optical solution

Wireless optical transmission is today the only existing solution for implementing high and very-high throughputs networks, that are necessary now and which demand will increase even more with the development of Internet services with higher values added.

The future generalization of fiber optics cabling throughout the access path (e.g. FFTH) will progress quickly and will make wireless optical systems the natural complement to high speed access.

Choosing any other media, wireless radio or cable, only guarantees the short-term risk of becoming obsolete.

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End Users Reference

Local government agencies, Corporations

Insee, Edf, Sncf,

Net2s, Promodes,

Kompass France

Mutualité Sociale Agricole,

La Dépêche de Tahiti

IBM Polynésie,

Doris Engenering,

Bird and bird

Crédit Agricole

Nature et Découverte

Universities

Iufm de Nantes

Institut National des Télécoms

Universite de Marne la Vallée

Military bases

Gendarmerie Nationale

Marine Nationale

Armée de Terre

Ministère de la Défense

Municipalities

Ville de Saint- LÔ

Ville de Vileurbanne

Ville de Saint Etienne

CCI de Douai

Telecom Operators

France Télécom

LDCom - Kaptech

Hospitals

Hoptitaux de Colmar, Limoges

Irm de Tours

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Technical Specifications

Technical Specifications	*City*	*Expert*	*Carrier*	*Privilege*
EMITTER	**Laser Diode**			
Wavelength	690nm			
Power (emission)	10dBm			
Beam diameter (output)	45mm			
Beam Divergence	2.5mRad	Adjustable from 1 to 20 mRd through motorized lenses Automatically adjusted with monitoring PC and software.		
RECEIVER	**PIN Photodiode**		**Avalanche Photodiode with AGC**	
Active detection Area	20cm²			
Receiver angular field	8mRad		10mRad	
Sensitivity	-38dBm		-45dBm	
Electronic Dynamic Range	25dB		40dB	
Optomecanichal Dynamic range : 10 dB	-	10dB		
TYPE OF TRANSMISSION	**Digital, transparent to portocols**			
Bandwidth	from 1 to 200 Mbps			
Areas of application	Any digital signal between 1 and 155 Mbps : E1/T1 to E3/T3 ATM 25, 50 and 155, FDDI, Ethernet 10/100Mbps,Token Ring, etc...			
INTERFACE	**Optical Fiber**			
Fiber Type	Multimode			
Connectors	SC			
Wavelength	1300 nm			
Optical Sensitivity (input)	-30 dBm			
Optical Power (output)	-16 dBm			
MOTORIZATION OF AXIS				
Résolution	Optional			10µRad
Correction range				20mRad
Answer Frequency (variance)				0,1Hz
Additional Dynamic Range				6dB
POWER SUPPLY	**External power supply**		**External technical power box**	
Input	220 VAC			
Power consumption MAX	50W			
DC Supply (output)	12VDC			
Equipment	Standard Plug		Circuit-breaker, standard plug, fuses Optical Rack	
CONDITIONS OF USE				
Temperature Range	- 20° C to + 50° C			
Construction	Weatherproof for outdoors use.			
Recommended distance	650m	1500m	2000m	2500m
PHYSICAL CHARACTERISTICS				
Dimensions (L x h x l)	605 x 380 x 160 mm			
Footprint	200 x 200 mm			
Mounting	4 M8-type screws			
Matérials	Aluminium and stainless steel			
Total weight	21 Kg			25 Kg
EXTERNAL MONITORING INTERFACE	**RS232, 4800bps**			
Logiciel ALM –Active Links Managment	Each device	Each link		
Monitoring Parameters	Signal on fiber, atmospheric signal levelm laser consumption, …			
Actions	-	Manual or automatic Divergence		
	-			Alignement

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