

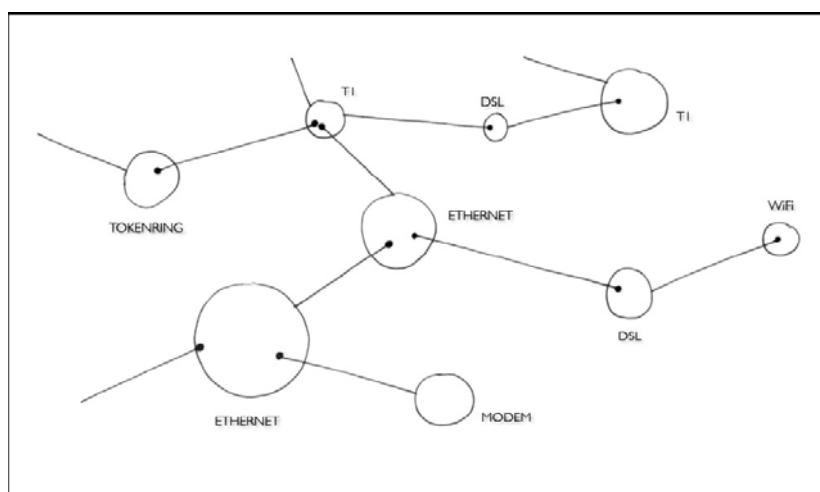
### General information

#### 1 What differences are there between ETHERNET and INTERNET?

Internet is a public term which refers to “the network of networks”: the interconnection of multiple local area networks worldwide. Those networks can vary in type (Ethernet, TokenRing, T1, DSL, Modem and so forth) and they are interconnected through gateways (routers) that allow for the “translation” of the data into different languages (protocols).

The term Ethernet has nothing to do with Internet. Whereas the latter is a general-public term, Ethernet is the name of a system (norm) that defines a software protocol for the exchange of data between machines as well as the type of hardware interface needed for this exchange (connections, line-drivers ...).

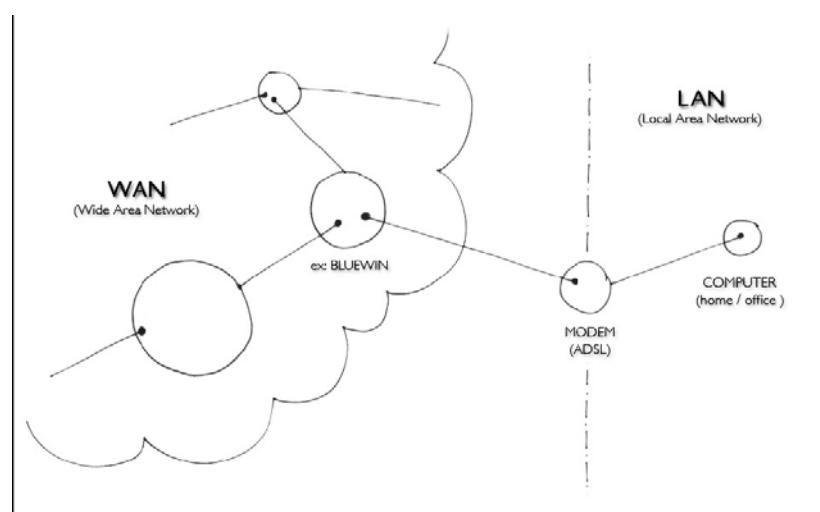
Within companies as well as in the general industry, as it does not require to be connected to other networks over the Internet, Ethernet is used to create local networks between computers (or such). Ethernet was invented by Xerox and was later normalized by the IEEE normalization institute (Institute of Electrical and Electronics Engineers). It was then fixed in the norm IEEE reference 802.3.



Ethernet is only a small part of the greater Internet network

#### 2 What is a LOCAL network?

A local area network (also known as LAN), as opposed to a wide area network (WAN), usually refers to all the networks found within the geographical limitations of a building or group of buildings. In most cases, only one type of technology will be used to build a network. A LAN usually relies on a gateway (router) to a WAN, thus allowing for the connection to other networks over the internet.



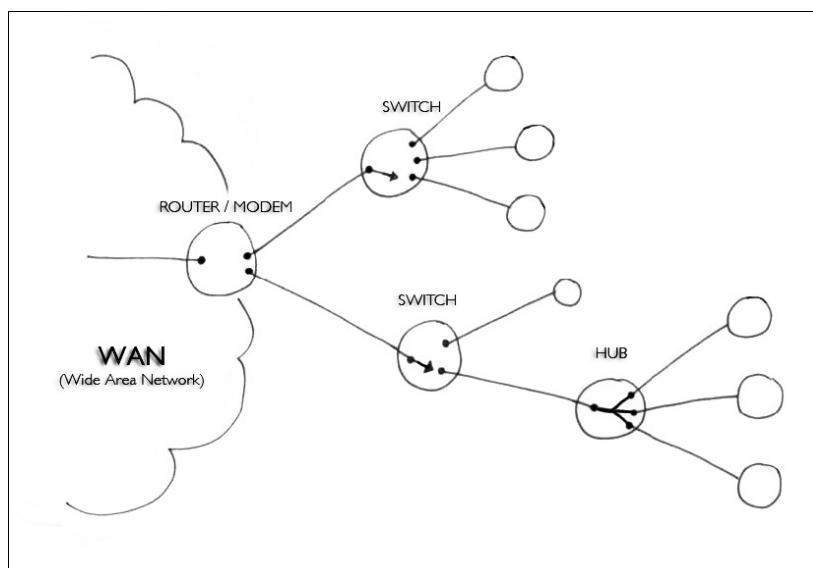
Difference between local (LAN) and wide (WAN) networks

### 3 What do you need to build an Ethernet network?

An Ethernet network can use various types of different connection cables: older networks used to rely on coaxial cables. Nowadays, some networks requiring great connection distances use optical fibers, but most current local networks use RJ45 cables made of four twisted-pair cables. Connection speeds can vary between 10, 100 and even 1'000 Mbits/seconds. As opposed to those based on coaxial cables, networks using RJ45 use star-shaped rather than daisy-chained connection patterns. At the heart of the star, one will find one or many switches acting as adaptors, where can be plugged the various elements that will need to communicate together. Switches allow for full bidirectional communication (simultaneous full-duplex sending and receiving) among the connected machines.

It should also be noted that a few years ago, hubs were used instead of switches because of their lower costs. Even though they do not allow for full-duplex nor contain intelligent-routing procedures, HUBS are compatible with SWITCHES connected to the same network.

Finally, ROUTERS are used as platforms between different types of physical networks, such as between a local Ethernet network and an ADSL Internet access line.



Parts of a network: routers, switches, hubs and PCs

### 4 What is a JAVA APPLET?

Java is a high-level, object-oriented programming language invented by Sun. It has this distinctive feature that it does not need to be compiled for specific processors (Pentium, G3 ...) as would be the case with C++ for example. Instead, a pseudo-compilation process is used and each operating system runs a 'Virtual Machine' allowing for this code's translation into the end-machine's language.

Because of this system, it is easy to create small programs (applets) that can then be inserted in web pages. The browser used to display the web page will decrypt the Java code and load it, regardless of the machine's operating system or processor. This avoids the complication of installing specific applications on each machine trying to access a component that is connected to the network.

### 5 What are TCP, IP and HTTP?

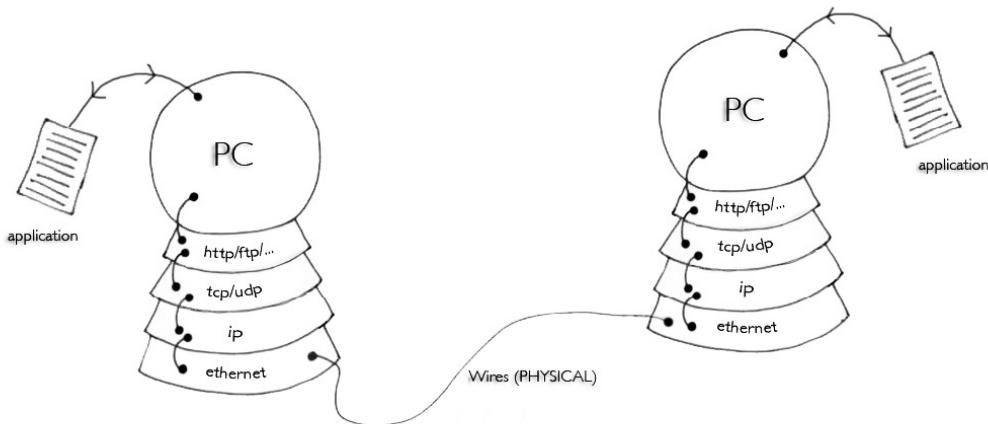
TCP/IP defines a chain of protocols which encapsulate the data received from the physical layer of the network (Ethernet or other) and forwards it to the applications requiring an access to the network. More specifically:

**>> IP** allows for addressing messages through the attribution of a unique address to each of the network's computer or system, regardless of the physical technology involved (Ethernet, TokenRing, TI, DSL ...).

**>> TCP** checks those messages and ensures that they come through to the recipient.

**>> HTTP** as well as **FTP**, **Telnet** and other protocols are examples of applications relying on the lower layers of TCP/IP to relay data to the network and each of those protocols have specific special features: HTTP (Hyper Text Transfer Protocol) will be used to transfer web pages from web servers to web browsers

(Netscape, Mozilla, Internet Explorer, ...) while FTP (File Transfer Protocol) is dedicated to the transfer of files and such.



Different layers of communication between two computers

### 6 What are the differences between TCP and UDP?

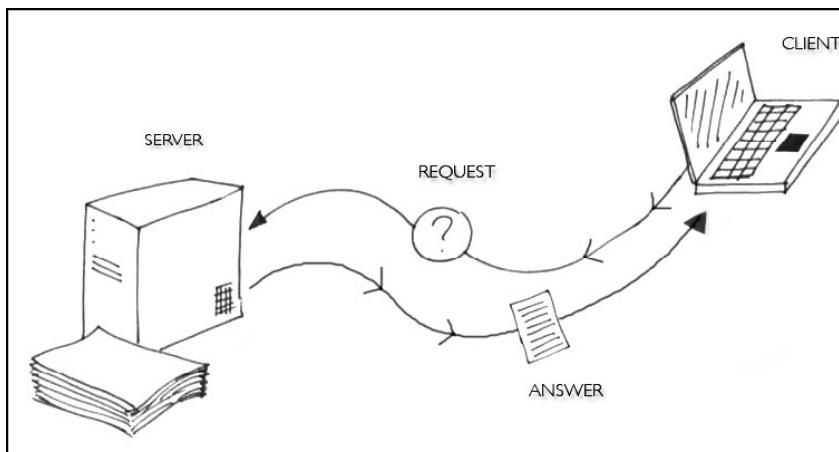
UDP is a lighter version of TCP that will only offer the possibility of directing data from the network's layer to a given application (port system). TCP provides additional safety and allows for the reorganization in the right sequence of the packets, regardless of that in which they were received. It also provides an acknowledge that will allow the sender to resend lost packets.

Features	UDP	TCP
CheckSum ( <i>data integrity</i> )	✓	✓
Multiport ( <i>multiplexing of data</i> )	✓	✓
Flux control		✓
Data Acknowledge ( <i>Ack</i> )		✓
Reconstruction of packets' order		✓

### 7 What is the meaning of the terms CLIENT and SERVER?

A network is a mean of communication between two or more elements (PC, Systems, ...). Based on the TCP/IP protocol and in most cases, there are two elements: one onto which useful information is stored (SERVER) and a second one that tries to access this information (CLIENT).

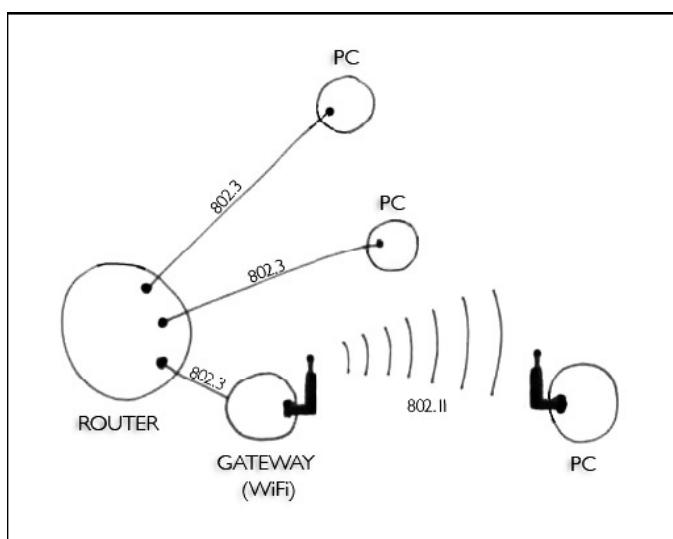
*This situation could be compared to a restaurant. The SERVER has some information available (menu, food) and waits for a CLIENT to inquire about it (ask for the menu). To make things a little more complicated, if both parts hold information, the SERVER might then play the CLIENT's role. In our comparison, the SERVER will ask for payment information from the waiting CLIENT, who will then provide the SERVER with a credit card. The SERVER waiting to provide information and the CLIENT who punctually logs onto the SERVER to request information are what characterize this structure.*



SERVER and CLIENT roles

### 8 Is WiFi wireless Ethernet?

Even though it is often argued that they are the same in order to make the equation easier, Ethernet and WiFi are not based on the same protocols. WiFi (Wireless-fidelity LAN) is not a network based on the Ethernet protocol (802.3) but one ruled by a different norm, the IEEE802.11 norm, with its a/b/g declinations. These protocols require bridges to be established in order to communicate. Those bridges are usually referred to as "Access Points" (AP).



WiFi is a specific protocol which makes it possible to use Ethernet-compatible equipment without cable-connecting them

### Industry and Applications

#### 1 As a field bus, what can we expect from Ethernet?

Even though Ethernet was not developed to be used as a field bus, its technical features allow for a growing number of applications in this field. It is important to note that in this document, we only refer to a standard use of the Ethernet norm using TCP/IP. Real-time solutions such as POWERLINK or SERCOS-III also exist but are incompatible with standard networks as they don't rely on TCP/IP.

Benefits of using Ethernet as a field bus:

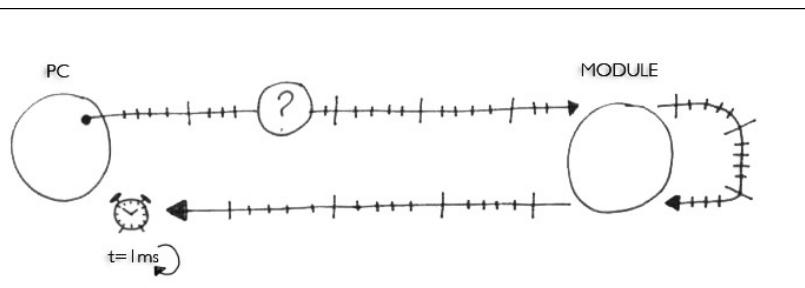
- Low material cost (based on a gigantic market).
- A reliability which has been proved over fifteen years of use.
- Transmission speeds (and therefore a bandwidth) reaching 1Gbits/s.
- Unlimited addressing system.
- Possibility to configure each system through mini web servers (http).
- No specific hardware or communication software needs to be installed on the computer (all recent computers offer Ethernet access).
- Multicast and broadcast possible.

However, Ethernet, in its standard form, shows the following drawbacks:

- It is not deterministic (transmission times are not always specifically defined).
- Resend of data in case of loss will only take place after a relatively long lapse of time (TCP/IP).

#### 2 How many times per second can we normally formulate requests from a cabled Ethernet module as opposed to WiFi?

The answer will vary greatly depending on the network's structural parameters. On an unsaturated normal (local) network, at a speed of 10Mbits/s, a packet's minimum theoretical size will be of 100 bytes. This minimum packet size is that of a single query, but greater packet sizes will correspond to a greater number of queries. From those numbers, we can estimate the theoretical limit for the module's interrogation frequency to be of 10 kHz (10'000 queries per second = 0.1 ms answer time). However, empirical measures would seem to indicate a frequency closer to 1 kHz (1'000 queries per second = 1 ms answer time). This difference can likely be attributed to the time needed by the CLIENT (PC) and SERVER (Module) to process the packet's information. With WiFi, we note a 0.1 kHz frequency (100 queries per second = 10 ms answer time).



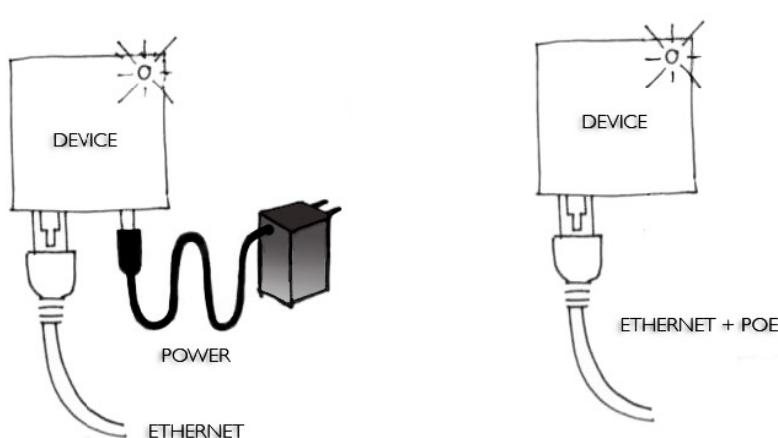
Transfer time required for a query to be sent to the module and for the PC to receive an answer

#### 3 What does the IEEE 802.3af – Power Over Ethernet norm- defines?

The IEEE 802.3af norm is a recent add-on to the IEEE802.3 norm regulating Ethernet. It defines a way to bring energy to Ethernet devices through eight twisted pairs RJ45 network cables.

As opposed to most of the existing solutions, this norm uses a compatibility detection mechanism in order to avoid the transmission of energy to incompatible devices. Standard power supplies give out 48 V, with a

maximum of 350 mA (max 16 W). This makes it possible to use a single cable to power an Ethernet module while at the same time using it for communication purposes, in a similar manner to that offered by a USB bus (5 V and 500 mA, max 2.5 W).



a) 2 cables (data and power supply)      b) one cable (data and power supply)

#### 4 What levels of security can we expect from Ethernet?

This will depend on the definition of the term security. From a technical point of view, Ethernet offers the safeguarding of the transferred data through TCP/IP. With such functions as checksum, acknowledging of packets and reorganization of data, it is easy to confirm whether a packet has been received or not.

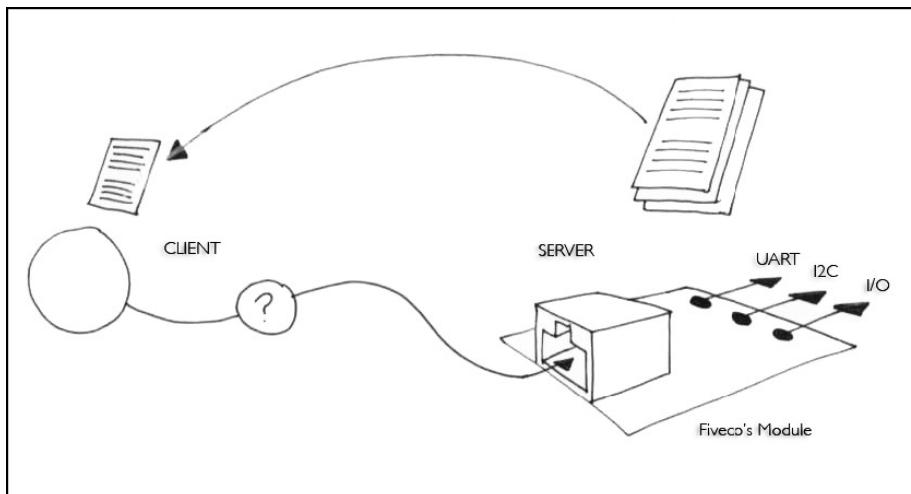
If by security we refer to the blocking of potential outside attacks, it is important to realize that Ethernet networks are not always connected to the outside world. It is possible to use this technology independently of the Internet and other networks. As a result, the securing of a local network dedicated to, for example, industrial machines will be achieved through the definition of a clear line between it and all what lies outside of that network.

If a connection is necessary (for monitoring or other such uses), a router firewall can be used to ensure the networks' safety. This firewall will be configured so that the access will be limited only from specifically authorized systems. This method is often used to connect enterprises' networks to the Internet.

### FiveCo and its products

#### 1 What is an Ethernet server (i.e. FMod-TCP)?

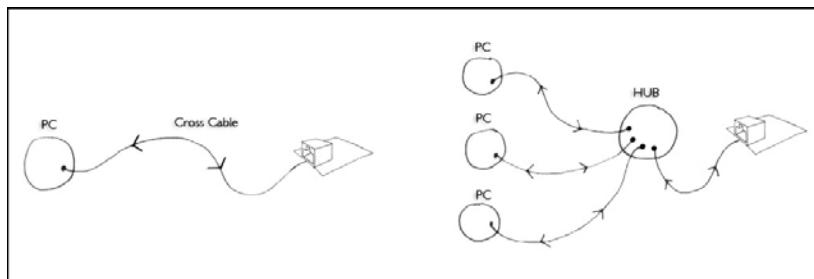
Referring to an Ethernet Server is a misuse of language. Ethernet is not based on a CLIENT-SERVER protocol but is often coupled with TCP, based on such a model. A TCP SERVER is a module that will allow CLIENTS (the controlling computer for example) to connect with it through the use of a TCP protocol. The CLIENT wishes to obtain some information that is stored on the SERVER and opens the communication. Then, both CLIENT and SERVER will be able to transmit information to their counterpart. In the case of FiveCo modules, the TCP information SERVER works along with an HTTP SERVER. This means that a webpage (html, jpg, gif, jar documents) is stored on the module and that it can be retrieved by any CLIENT through a web browser. This webpage can be used to set the module's parameters and to access module-related data.



A TCP server's role

#### 2 Can the module be directly connected to a computer?

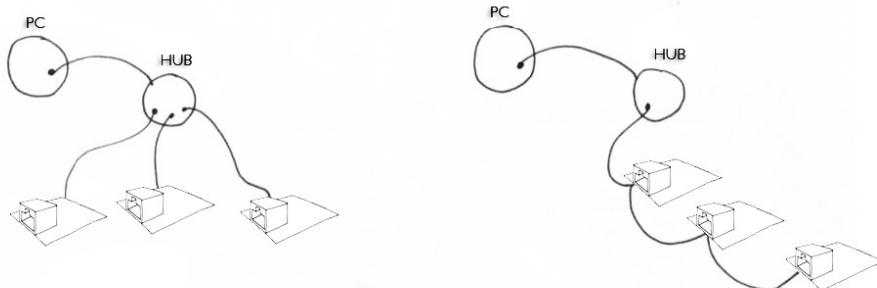
Yes. There are two types of RJ45 cables. On one hand, we find normal cables, used to connect the equipment to SWITCHES, HUBS or ROUTERS. On the other hand, there are Cross Cables, usually identified as such by a small red ribbon. Those latter allow for the direct connection of two pieces of equipment.



a) connection through Cross Cable b) connection through a hub/switch

### 3 Is it possible to cascade the modules?

No. An Ethernet-based network using RJ45 cables requires to be wired using a star connection pattern.



a) Yes, it is possible

b) No, it is not possible

### 4 Should the module be connected to a PC for the module to function?

Yes, for most of FiveCo's products, the module needs a TCP client to send commands to it.

The FMod-LEDSEQUENCER is an exception. Its sequence can be programmed once and run independently without the need of a connection to a PC.

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If you have more questions, feel free to ask them to support@fiveco.com, we will be happy to answer.

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