Networking - Part 4

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There is a lot of physical supports usable by networks :

1. Metallic wires (mostly cooper) :
   - coaxial wires (a long time ago ...) ;
   - twisted pairs ;
   - powerline (with network adapters) ;
2. Optical (light) :
   - guided (optic fibers) ;
   - free-air (laser beams) ;
3. Radio frequencies :
   - WiFi network ;
   - Bluetooth network ;
   - RF beams.

The majority of local networks (LAN) use copper twisted pairs, Nowadays with a predominance of the Ethernet standard.

Ethernet is a family of wired computer networking technologies. It was commercially introduced in 1980 and first standardized in 1983 as **IEEE 802.3**.
Ethernet first used a **bus topology**, with a coaxial cable as shared media :

- **10Base2** 10Mb/s, max range 200m ;
- **10Base5** 10Mb/s, max range 500m.

It is now obsolete, but this principle is taken up by the new **SPE**[1] standard.

1. Single Pair Ethernet : one pair as P2P or shared network

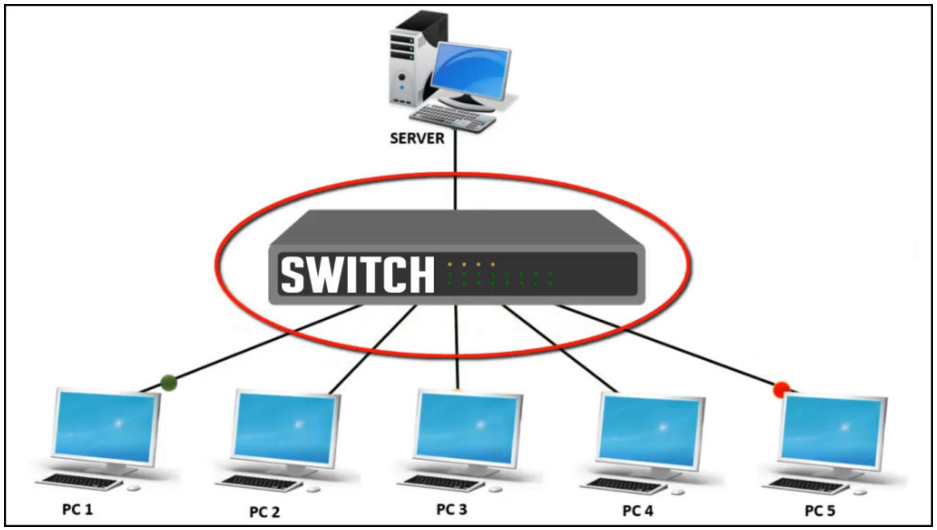
Modern Ethernet use **multi-star topology** and twited cooper pairs or optical fibers. Most known implementations (in LAN) are "cooper" ones :

- **10BaseT** 10Mb/s, 2 pairs ;
- **100BaseT** 100Mb/s, 2 pairs ;
- **1000BaseT** 1Gb/s, 4 pairs ;
- **10GBaseT** 10Gb/s, 4 pairs.

All these standards are compatible with each other, subject to using hubs [2] that are capable of it. They are called **Ethernet switches** [3]

2. Understand this term in a generic sense, not just in Ethernet terminology.
3. **The purpose of this course is not to distinguish between the old technology of shared media and the new paradigm of switched Ethernet that has existed since... 1993 !**

There are two types of equipment in a single-star network :



- **Data Terminal Equipment** (DTE), like **hosts and routers**
- **Data Communication Equipment** (DCE), like **switches and bridges**

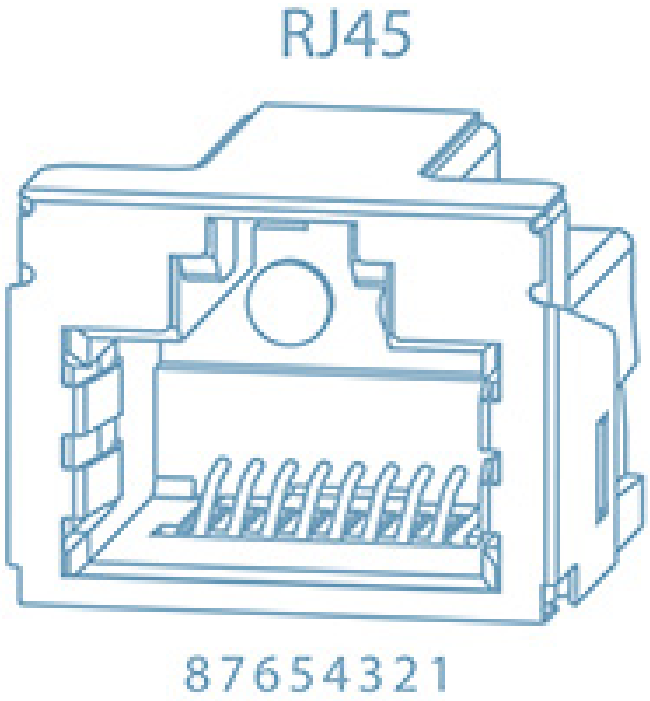
DTE always have an IP address, DCE should not, unless they are manageable.

To form a larger network, several switches can be cascaded as multiple-star topology :

- **Edge switches** normally use their last port to uplink to a **core switch** ;
- Normal hosts use the edge switches to connect ;
- Servers, default router, ... use the core switch(es) to connect.

Sometime, a switch is note an alone equipment, but a stack of multiple switches. You need special ones to do that.

Up to 10Gb/s, Ethernet uses an **RJ45** [4] type socket. It is the **EIA/TIA568B** [5] standard which is standardized today.

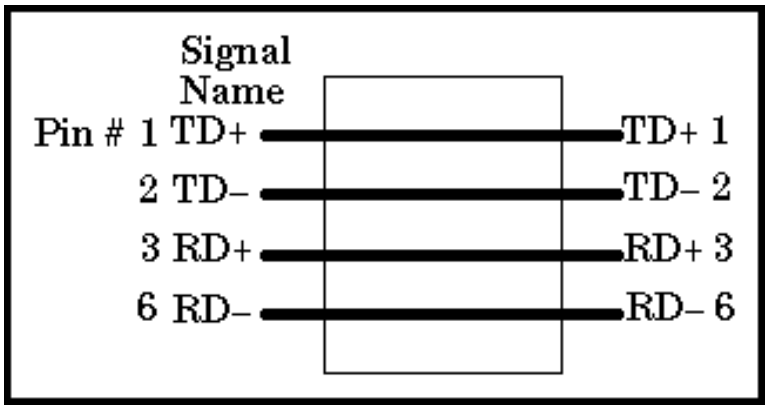


PIN RJ45	EIA/TIA 568 B		
1	white	orange	pair 2
2	orange		
3	white	green	pair 3
4	blue		
5	white	blue	pair 1
6	green		
7	white	brown	pair 4
8	brown		

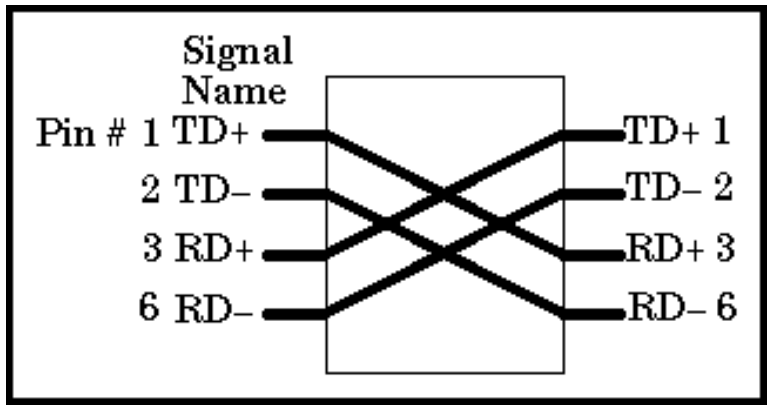
4. https://en.wikipedia.org/wiki/Registered_jack
5. https://en.wikipedia.org/wiki/ANSI/TIA-568

For **10baseT** and **100baseT**, only **two pairs** are used. In some cases, now rare, the use of a crossover cable is necessary :

DCE to DTE



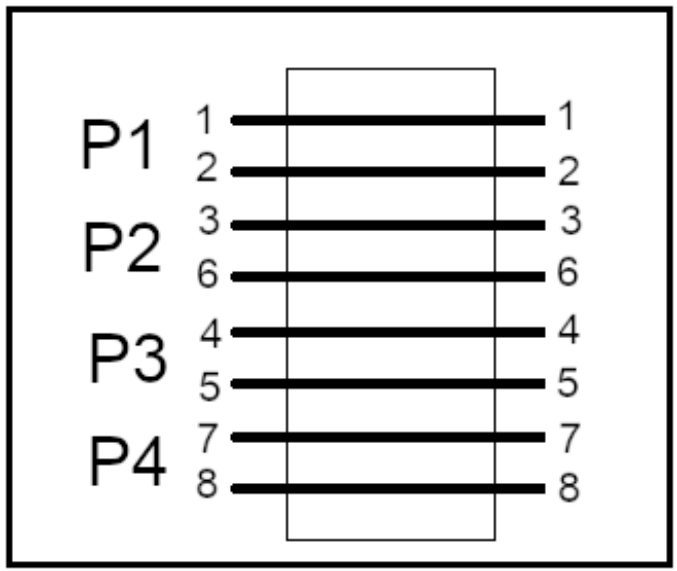
DCE to DCE or DTE to DTE



Nowadays, **only direct cables** are used, thank to **auto-crossover** included in DTE and DCE devices.

For **1000baseT** and **10GbaseT**, **four pairs** are used in all cases.
Each pair is use for TX and RX at the same time :

1GbT / 10GbT



Only direct cables are used !

Some DTE or DCE have **special ports** in addition to the RJ45 ports. They are called **GBIC**[6].

They receive modules that transform them into **additional RJ45** or **fiber optic** ports.
The main interest of fiber optics is to allow **greater range**, while maintaining **high speed**.

6. GigaBit Interface Converter