

Automotive Ethernet

General Ethernet :

Ethernet is used for **Bandwidth**

In vehicles, low power consumption is important. Also , requirement for ECU(Electronic Control Unit) is to be able to completely wake up from sleep under 100 milliseconds.

Standard 4 wires ethernet cannot handle this speed currently.

So instead of standard ethernet, we use **Automotive Ethernet** which can take care of these issues.

Comparing Ethernet to CAN(Controller Area Network) and FLEXRAY

CAN:

it is a multidrop (bus) technology where user can add / remove nodes.

Multidrop or bus technology means every node or every ecu is physically, electrically connected to the same wires as every other node.

single twisted pair copper wire. => low cost/ light weight easy for **plug and play** Message or Packet based communication.

Unique for CAN is that **Non-Destructive Arbitration** for handling message or packet **collisions**.

This is handled in the arbitration section or the arbitration ID of the can network. So when there is a possible collision risk , the arbitration ID is used to identify the message or packet. and the packet or the message with the smaller ID is sent first, whereas the packet or the message with the larger ID is sent later but **WITHOUT A NEED FOR RE-TRANSMISSION**.

so lower ID number transmits first, other one waits, not not getting killed just waits. And nodes that transmits the higher ID packet also understands the situation and also waits.

This has a drawback: nodes that lost the arbitration (the ones sending the higher ID packet) will have to wait. *this makes CAN not as time-critical and accurate in time.*

This is why FlexRay was developed

FlexRay:

it is similar to CAN in terms of wiring. it is a **MultiDrop** technology BUT **all nodes must be pre-programmed with a fixed configuration**

up to 10Mb/s. speed. also good for plug and play. message or packet based communication.

==> Collision avoidance is based on time slots for each node

Every node in FlexRay is aware of time base so this helps each node to understand when it is allowed to transmit. So basically there is a cycle time, and it is divided into slices and each node has its own time slot

where it is allowed to transmit. So collisions don't happen in FlexRay.

This helps very accurate in time and security critical.

Automotive Ethernet :

(100Base-T)/(1000Base-T)

==> base means this is the speed at the slowest rate

Modern ethernet technologies, be it automotive or not, is NOT a bus technology anymore. Instead, it is *point-to-point technology*. This means that each node is connected to only one other node. For multiple communication, we need to introduce a **SWITCH**.

Switch distributes the traffic to the nodes within a network based on their **physical address** that.

Today commercially there are 100base and 1000base ethernet, 100 meaning 100Mb/s, 1000 meaning 1Gb/s.

Note that automotive ethernet is very cost effective network but not enough for **uncompressed audio and video streaming** since they handle around 10MBits.

Automotive Ethernet

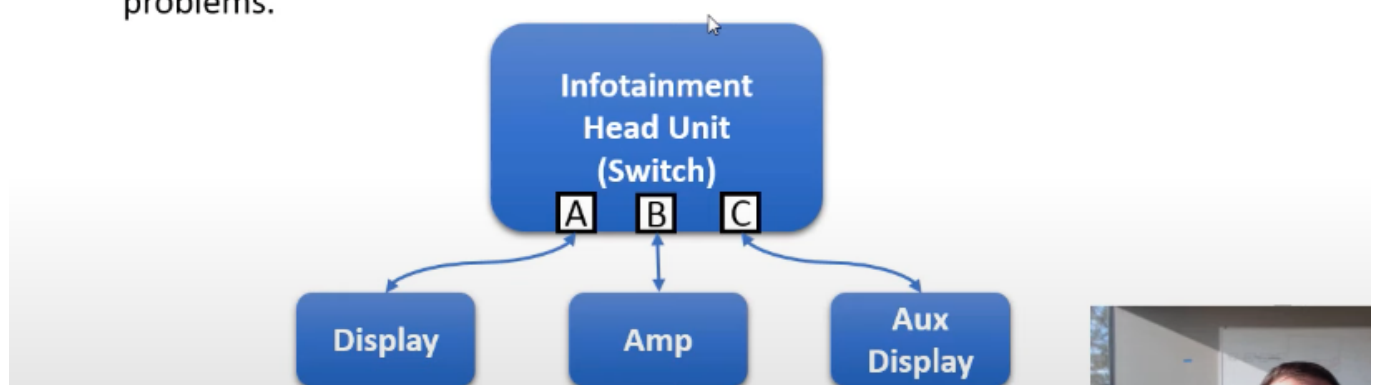
(100BASE-T1 / 1000BASE-T1)

• Pros

- Up to 1000 Mb/s
(each direction and each leg)
- Widely used technology
(much support)
- Good clock synchronization
technology available (based on IEEE 1588)
- History of adaptation to solve new problems.

• Cons

- Requires a switch
- Not possible to add or remove nodes unless the switch has spare ports
- Tools cannot just connect and sniff the bus



In bus technology, all the node load can be used and it is locked to 100 or 1000 mbits. In ethernet, however, it is not the case, aggregate bandwidth can exceed 100 or 1000.

Networking Topologies :

- Defines how devices are connected to each other.

- Defines how the device communicate with each other.
- Determines network characteristics.
- Simple Technologies:
 - ◦ Point to Point(port)
 - ◦ Ring
 - ◦ Star (ethernet) like one switch with many ports
 - ◦ Bus (chained or attached) like CAN , FLEXRAY
- Complex topologies can combine these(like mesh)