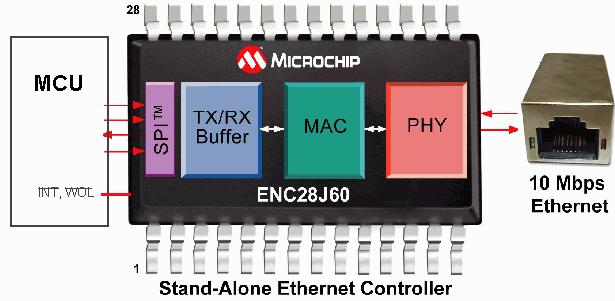
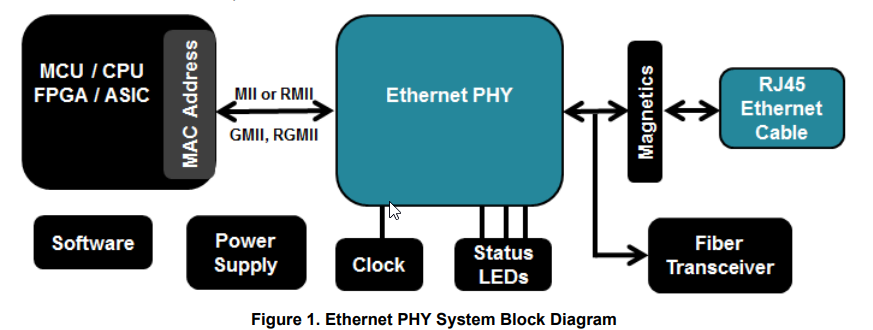
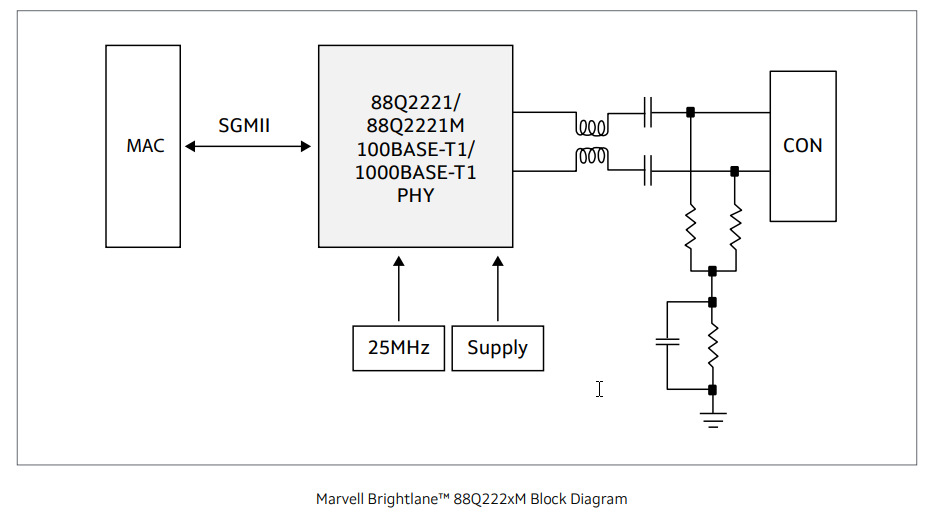
**1/ Hardware**

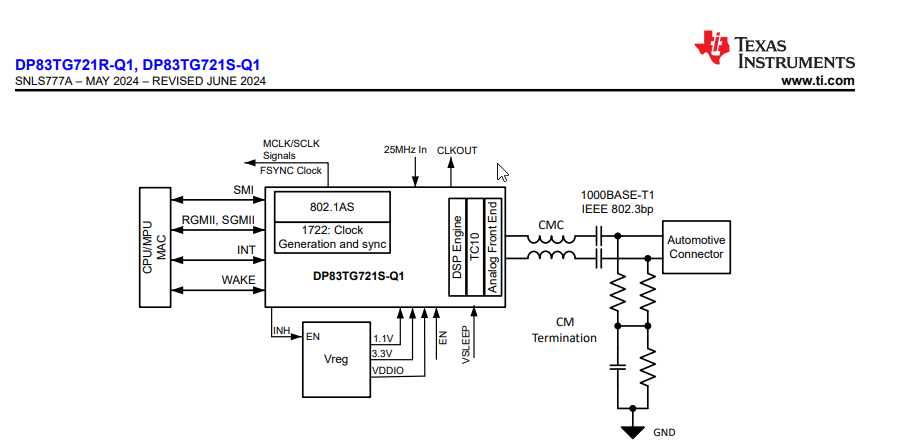


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**PHY**



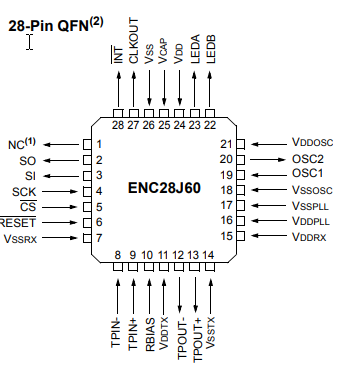
[Marvell Brightlane 88Q222xM Third Generation Automotive 1000Base-T1 PHY Product Brief](https://www.marvell.com/content/dam/marvell/en/public-collateral/automotive-solutions/marvell-automotive-ethernet-phy-88q222xm-product-brief.pdf)



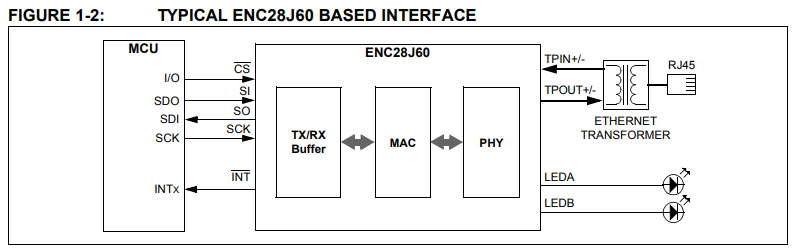
DP83TG721x-Q1 1000BASE-T1 Automotive Ethernet PHY

**MAC- VLAN- AVB**

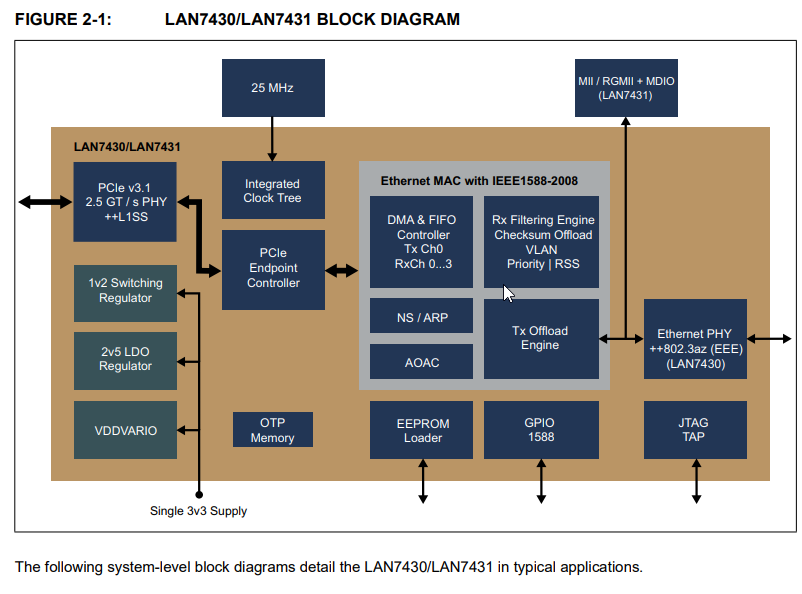
**Ethernet Controller with SPI Interface**

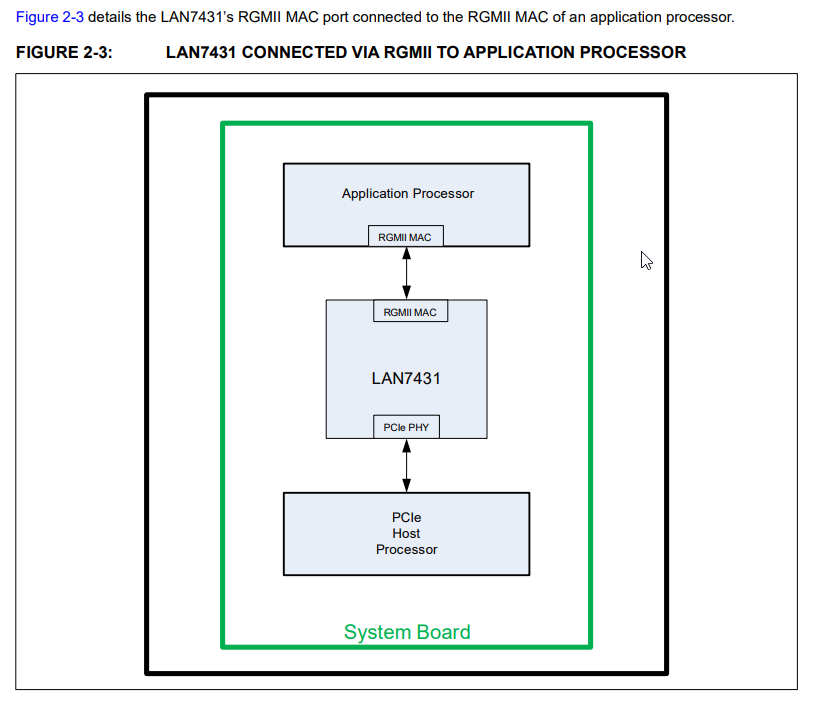


[ENC28J60 Data Sheet](https://ww1.microchip.com/downloads/aemDocuments/documents/OTH/ProductDocuments/DataSheets/39662e.pdf)

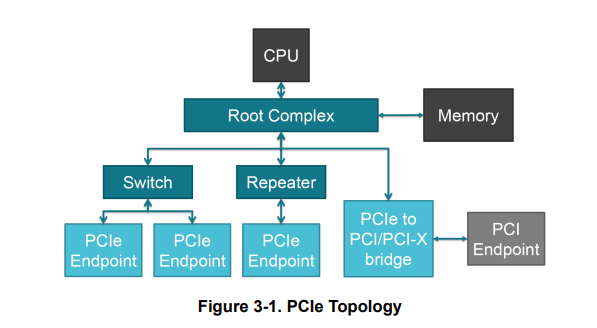


Ethernet Controller with PCIe Interface





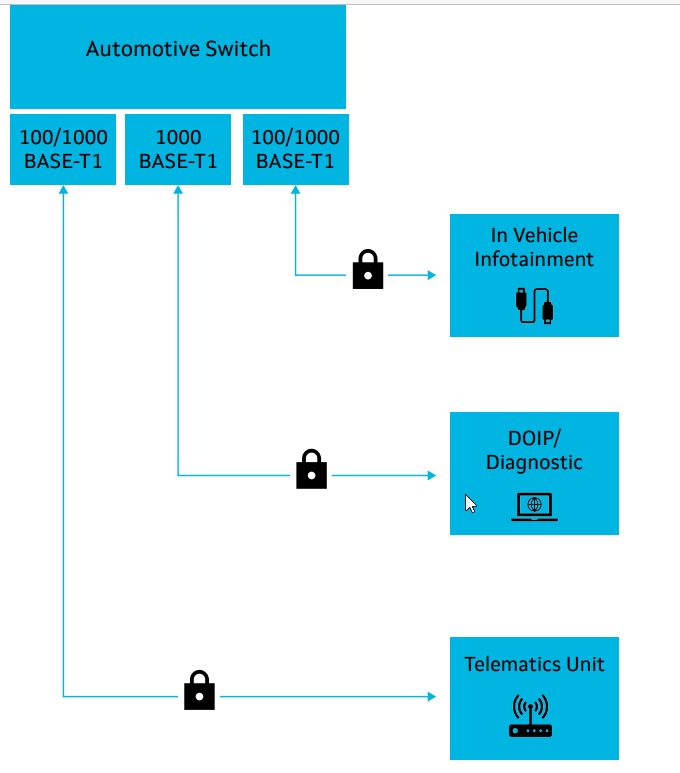
PCIe protocol

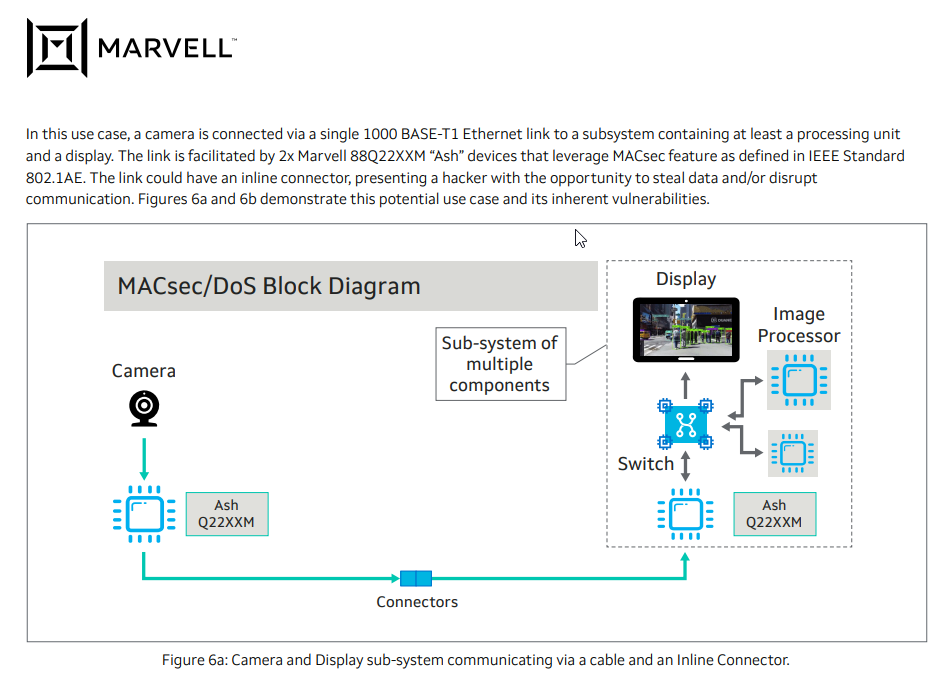


**Network Interface Cards (NICs):** typically include both a Media Access Control (MAC) layer and an Ethernet Physical (PHY) layer.

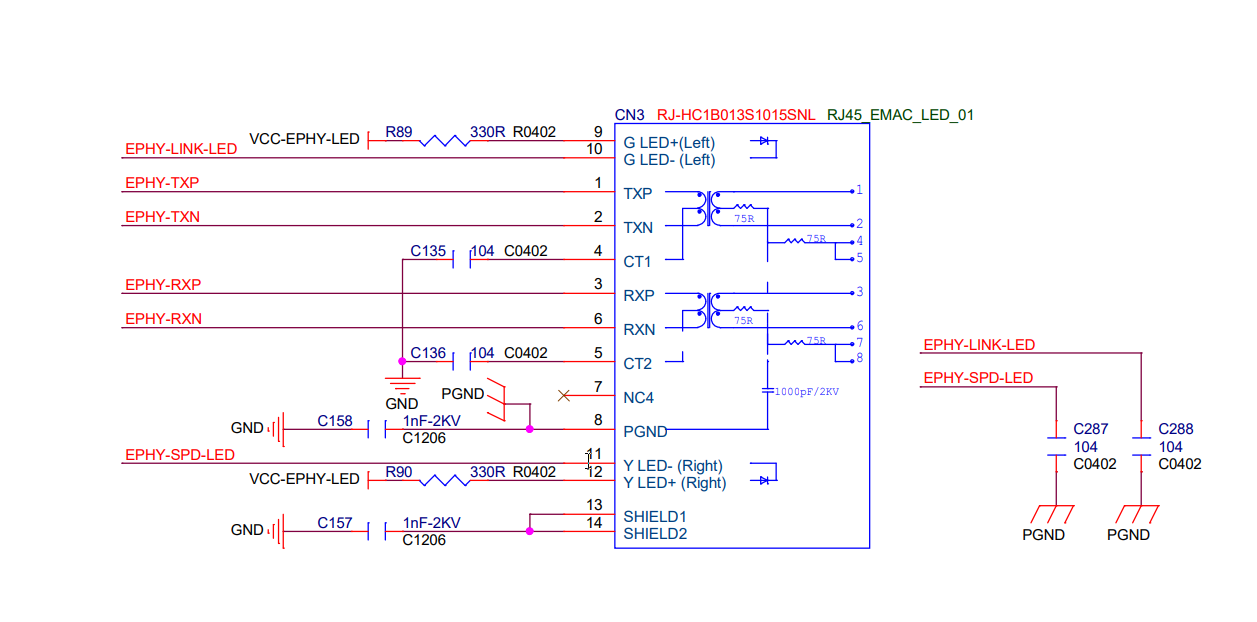
MAC (Media Access Control) Layer: This layer is responsible for controlling how data is placed on and received from the network medium. It handles addressing and channel access control mechanisms, ensuring that data packets are correctly formatted and sent to the right destination.

Ethernet PHY (Physical) Layer: This layer deals with the physical connection to the network. It converts the digital data from the MAC layer into signals that can be transmitted over the network medium (e.g., electrical signals for copper cables or light signals for fiber optics) and vice versa.

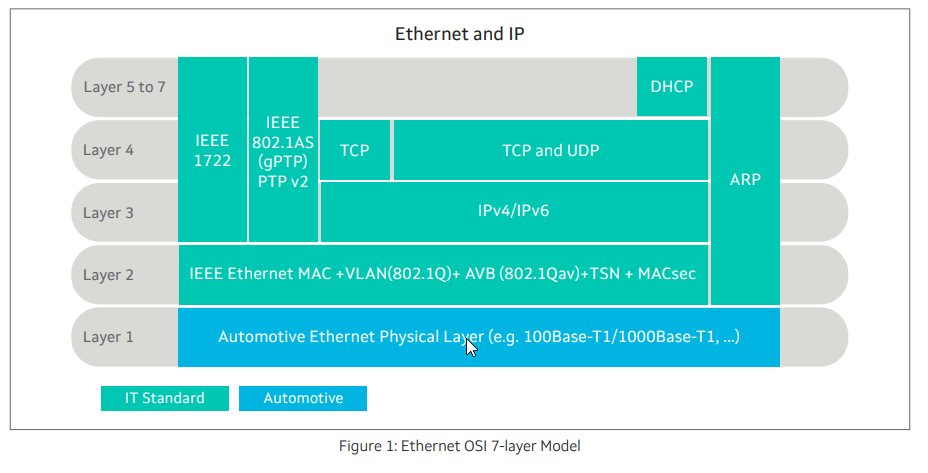




**Schematic RJ45 and SoC**

****https://linux-sunxi.org/images/7/7e/ORANGE\_PI-ONE-V1\_1.pdf

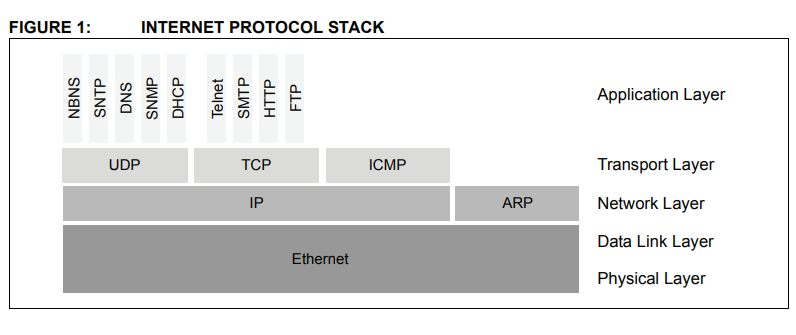
**2/ Software**

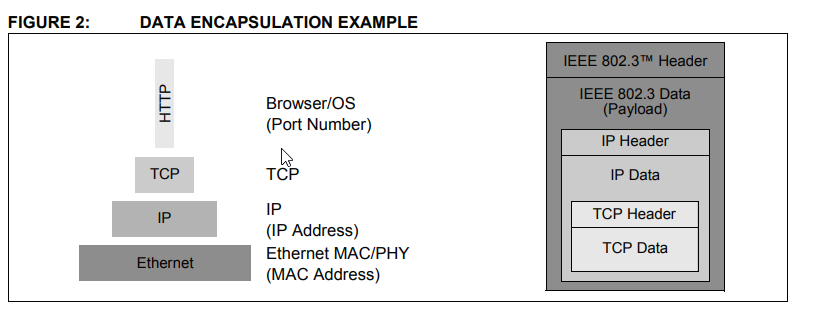


AVB: [Getting Started with AVB on Linux\* — TSN Documentation Project for Linux\* 0.1 documentation](https://tsn.readthedocs.io/avb.html)

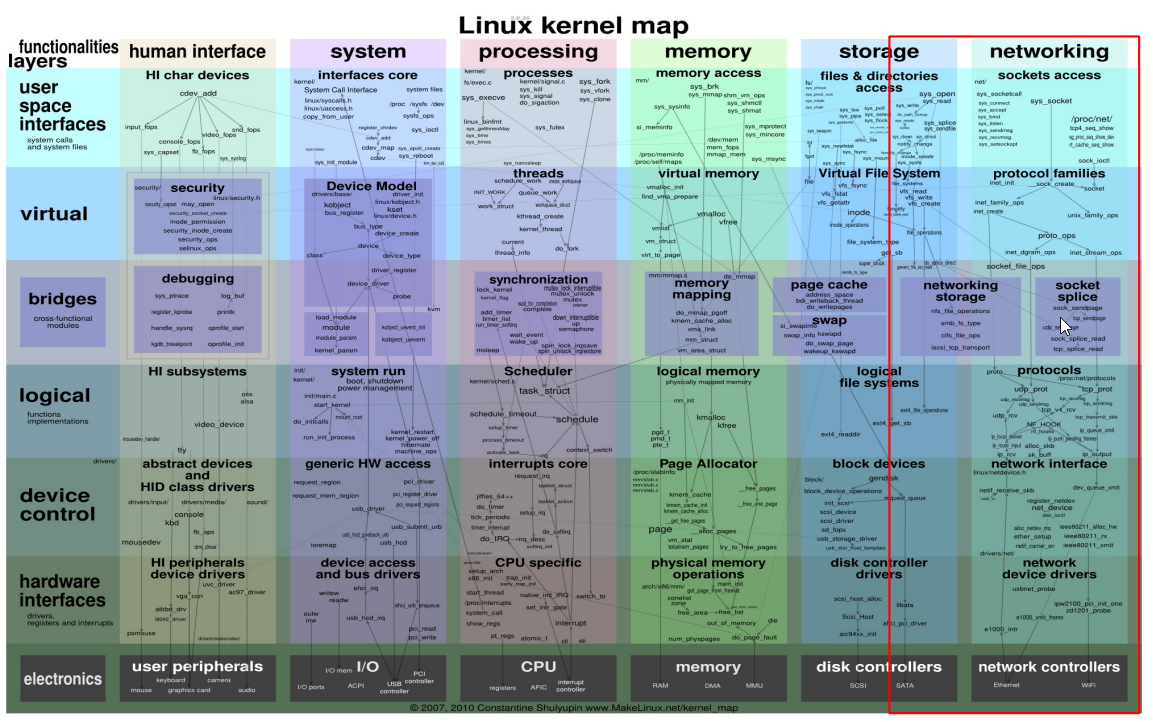
VLAN: [Configuring VLAN Interfaces — TSN Documentation Project for Linux\* 0.1 documentation](https://tsn.readthedocs.io/vlan.html)

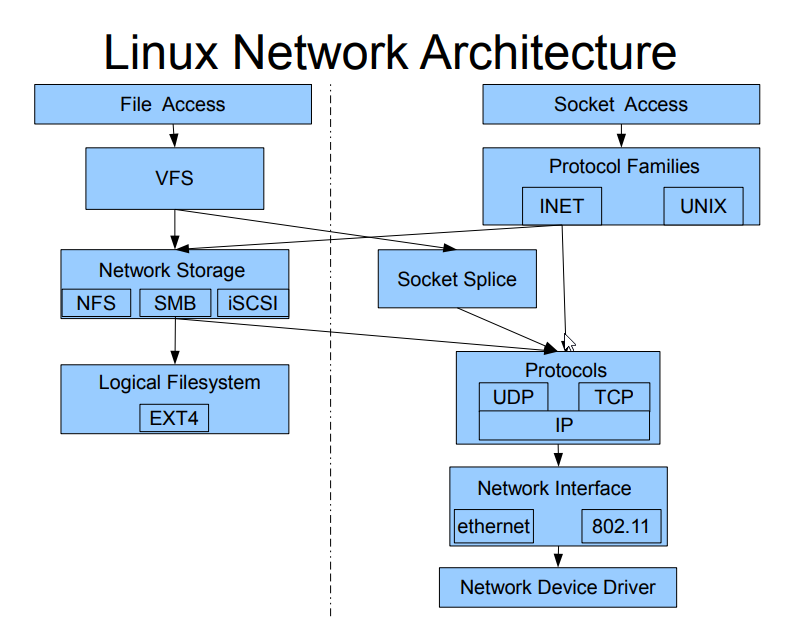
TSN: [Configuring TSN Qdiscs — TSN Documentation Project for Linux\* 0.1 documentation](https://tsn.readthedocs.io/qdiscs.html)





Linux Kernel Network





**Synchronizing Time with Linux\* PTP**

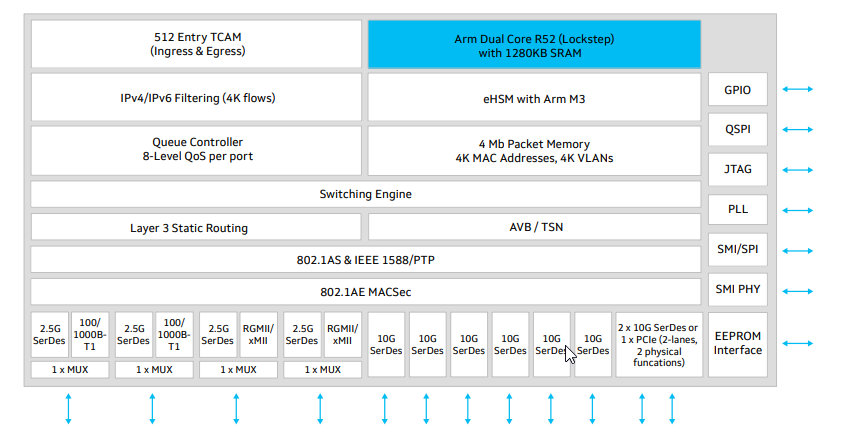
[Synchronizing Time with Linux\* PTP — TSN Documentation Project for Linux\* 0.1 documentation](https://tsn.readthedocs.io/timesync.html#:~:text=The%20file%20gPTP.cfg%20%28available%20in%20configs%20folder%20of,network%20interface%20this%20instance%20of%20ptp4l%20is%20controlling.)

[Networking — The Linux Kernel documentation](https://www.kernel.org/doc/html/latest/networking/index.html)

[Linux Kernel Network stack and architecture – The Linux Channel](https://thelinuxchannel.org/2024/07/linux-kernel-network-stack-and-architecture/)

[raoul\_kernel\_slides.pdf](https://caesar.web.engr.illinois.edu/courses/CS598.S11/slides/raoul_kernel_slides.pdf)

**3/ Ethernet Switch**

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Brightlane™ Q6223 Central Switch

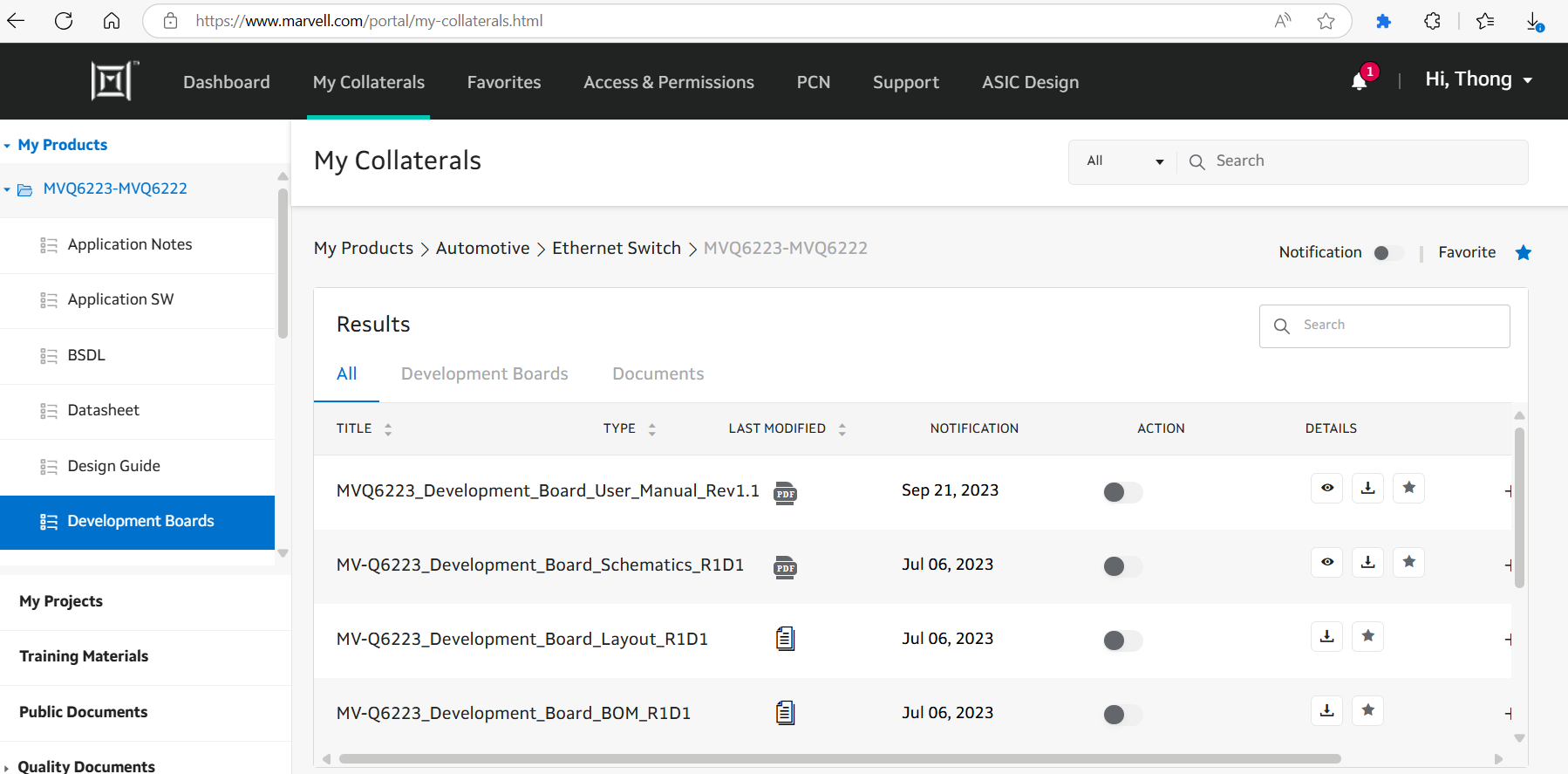
[**Marvell Brightlane Q6223 Central Switch Product Brief**](https://www.marvell.com/content/dam/marvell/en/public-collateral/automotive-solutions/marvell-automotive-brightlane-mvq6223-secure-managed-switch-product-brief.pdf)

**VLAN** [**Catalyst 4500 Series Switch Cisco IOS Software Configuration Guide, 12.2(25)EW - Understanding and Configuring VLANs [Cisco Catalyst 4500 Series Switches] - Cisco**](https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst4500/12-2/25ew/configuration/guide/conf/vlans.html)

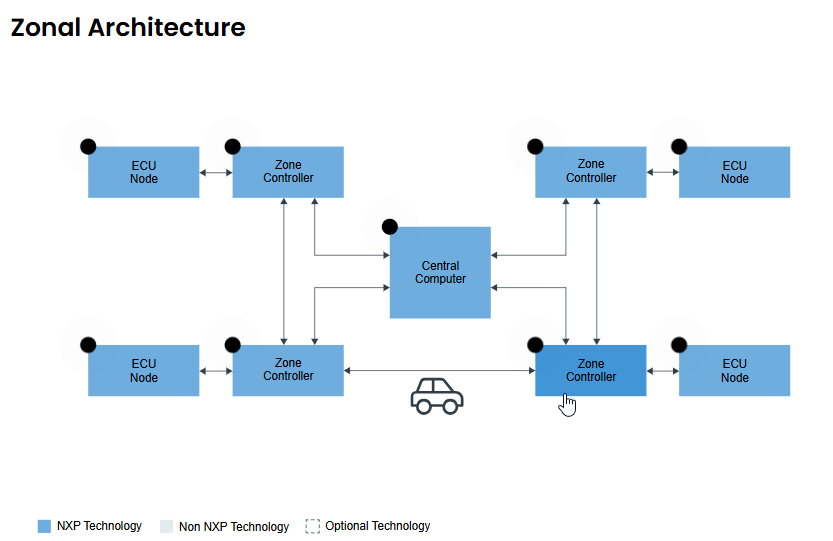
[**l3\_int.pdf**](https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst4500/12-2/25ew/configuration/guide/conf/l3_int.pdf)

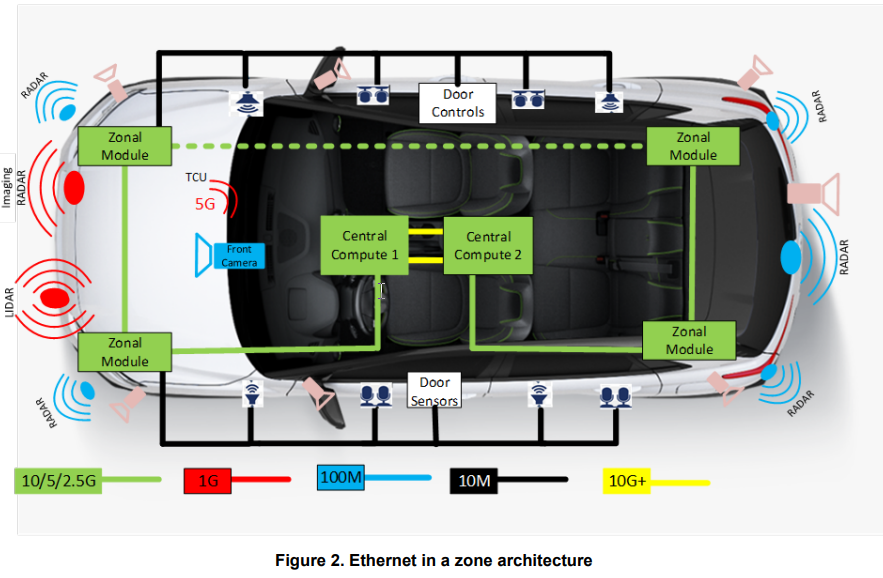
* **VLAN Table Unit (VTU)**
* **Address Translation Unit table (ATU)**
* **Ingress Rate Limiting (IRL)**
* **Forwarding Information Database number (FID)**

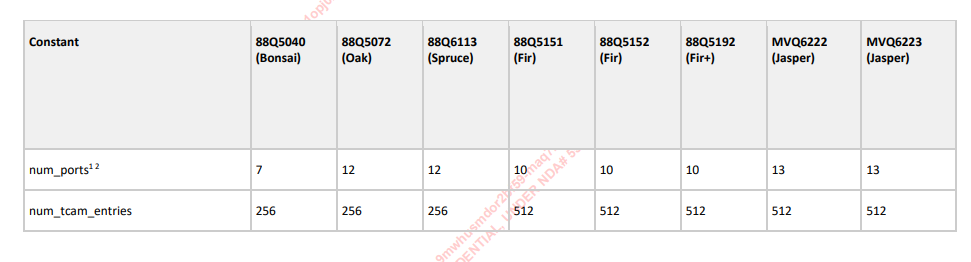
[**https://www.marvell.com/portal**](https://www.marvell.com/portal)Go to portal and register an account to login

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**4/ Zonal Control Module - Zonal Architecture**







Yes, you **can ping two laptops via an Ethernet cable**, but there are a few steps to ensure it works properly. Here's how you can do it

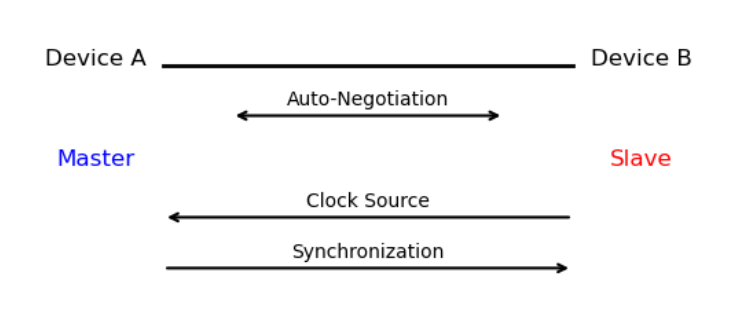
**What You Need**

* Two laptops with Ethernet ports
* One Ethernet cable (preferably a **crossover cable**, but most modern Ethernet ports support auto MDI-X, so a regular cable usually works)

**Steps to Set It Up**

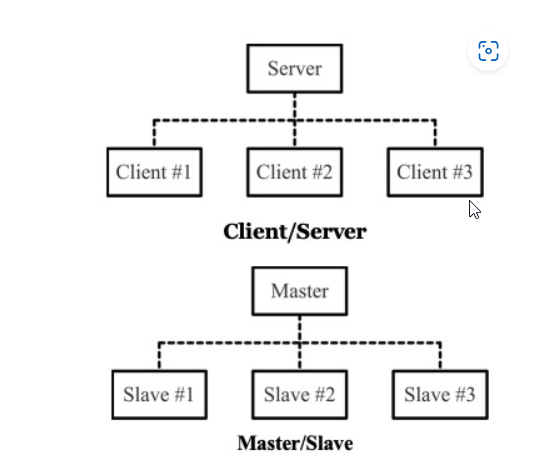
1. **Connect the Ethernet Cable** between the two laptops.
2. **Assign Static IP Addresses**:
   * On **Laptop A**:
     + IP: 192.168.1.1
     + Subnet Mask: 255.255.255.0
   * On **Laptop B**:
     + IP: 192.168.1.2
     + Subnet Mask: 255.255.255.0
3. **Disable Firewalls Temporarily** (optional but helpful for testing).
4. **Ping from One Laptop to the Other**:
   * On Laptop A, open Command Prompt or Terminal and type:
   * ping 192.168.1.2
   * On Laptop B, try: ping 192.168.1.1

Here is a simple diagram illustrating **Ethernet master-slave mode negotiation**:



**🔍 Diagram Explanation:**

* **Device A** and **Device B** are connected via an Ethernet cable.
* During **auto-negotiation**, both devices exchange capabilities to decide roles.
* One becomes the **Master** (provides the clock), and the other becomes the **Slave** (synchronizes to the clock).
* Arrows show:
  + **Auto-Negotiation** (bidirectional)
  + **Clock Source** (from Master to Slave)
  + **Synchronization** (Slave aligns with Master's clock)



[Industrial Ethernet Guide - Client/Server Vs. Master/Slave - Copperhill](https://copperhilltech.com/blog/industrial-ethernet-guide-clientserver-vs-masterslave/)

[Marvell Brightlane 88Q222xM Third Generation Automotive 1000Base-T1 PHY Product Brief](https://www.marvell.com/content/dam/marvell/en/public-collateral/automotive-solutions/marvell-automotive-ethernet-phy-88q222xm-product-brief.pdf)

[The Need for MACsec Security in Ethernet- Based Vehicle E/E Architecture](https://www.marvell.com/content/dam/marvell/en/public-collateral/automotive-solutions/marvell-macsec-security-in-ethernet-based-vehicle-white-paper.pdf)

[ENC28J60 | Microchip Technology](https://www.microchip.com/en-us/product/ENC28J60)

[Ethernet PHYs | TI.com](https://www.ti.com/interface/ethernet/phys/overview.html)

[DP83TG721x-Q1 1000BASE-T1 Automotive Ethernet PHY with Advanced TSN and AVB datasheet (Rev. A)](https://www.ti.com/lit/ds/symlink/dp83tg721r-q1.pdf?ts=1747198551678&ref_url=https%253A%252F%252Fwww.ti.com%252Finterface%252Fethernet%252Fphys%252Fproducts.html)

[Ethernet Theory of Operation](https://ww1.microchip.com/downloads/aemDocuments/documents/OTH/ApplicationNotes/ApplicationNotes/01120a.pdf)

[ORANGE\_PI-ONE-V1\_1](https://linux-sunxi.org/images/7/7e/ORANGE_PI-ONE-V1_1.pdf)

[Three things you should know about Ethernet PHY](https://www.ti.com/lit/ta/ssztch5/ssztch5.pdf?ts=1747125306397&ref_url=https%253A%252F%252Fwww.bing.com%252F)

[DP83869HM High Immunity 10/100/1000 Ethernet Physical Layer Transceiver With Copper and Fiber Interface datasheet (Rev. C)](https://www.ti.com/lit/ds/symlink/dp83869hm.pdf?ts=1747205445251&ref_url=https%253A%252F%252Fwww.ti.com%252Fproduct%252FDP83869HM)

[Implementing Native PCIe Interconnects Over Automotive Cable Channels](https://www.ti.com/lit/wp/snla380/snla380.pdf?ts=1668049195375&ref_url=https%253A%252F%252Fwww.google.co.jp%252F)