



# Sensor / ECU end-to-end Communication Required Features

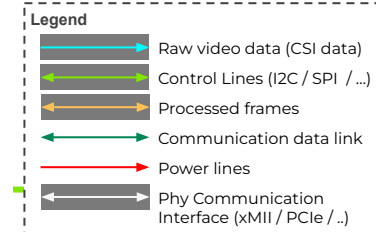
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## Introduction & Scope

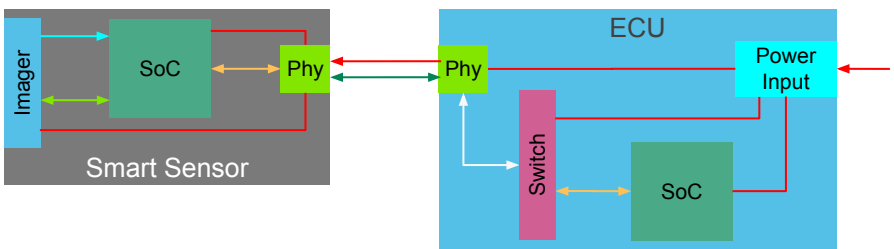
- The scope of these slides is to present to ISAAC Study Workgroup the required features for a **potential new communication protocol**
- It covers **needs for the full communication** as an end-to-end for imaging sensor (typically camera) as well as ECU provider (typically Zonal / Domain controller)
- In the scope of the **end-to-end communication**, these challenging topics are covered
  - **Communication latency** between sensor and ECU
  - Required functions and **features for physical and data link** layers
  - Required **features for switching** functions

# Sensor / ECU end-to-end Communication Required Features

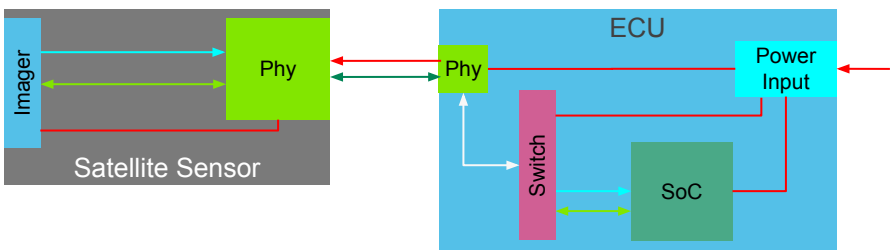
## Sensor - ECU interfacing



### Smart sensor - ECU interface



### Satellite sensor - ECU interface



#### Power over Network

- ECU shall supply camera sensor
- ECU shall monitor supply status
- Will the new standard support PoE?

#### ECU Inbound communication

- Smart sensor → Processed Camera frames (< 1 Gbps)
  - Typically around 100 Mbps
- Satellite sensor → Raw Camera Data (CSI) (> 1 Gbps)
  - Typically more than 5 Gbps

#### ECU Outbound communication

- Smart sensor → Control frames (CAN / FlexRay ..) (< 100 Mbps)
- Satellite sensor → Control frames (I2C ..) (< 100 Mbps)

#### Secure communication

- Hardware security modules support
- MACSec support

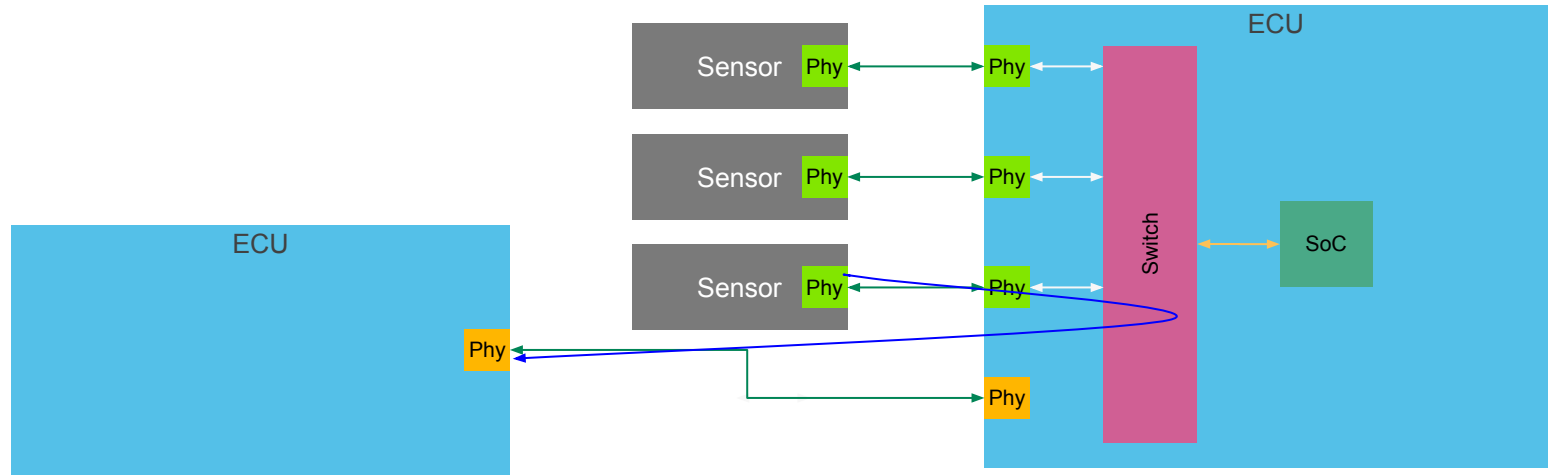
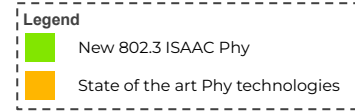
#### Precise Time Protocol support

- Required for ADAS / AD functions

## End-to-end Sensor-ECU interfacing requirements

# Sensor / ECU end-to-end Communication Required Features

## Sensor - ECU network switching



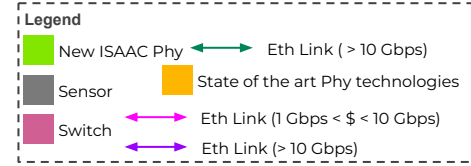
### Important questions here

- There is a challenge to optimize the switch backbone bandwidth based on the fact that there is a huge downstream from the sensors and huge upstream to SoC and the other ECUs versus a very low upstream to the sensors.
- How is it possible to minimize the number of the different types of the physical interfaces?
  - Can we replace the SOTA Phys with new phys? To optimize overall cost?
- Shall we need a different Media Independent Interface for the new PHYs? How could this impact switch portability?
- For Satellite sensors, how much switching bandwidth required?
- Which security protocols to be used, and is it implemented on the switch or on the Phy?

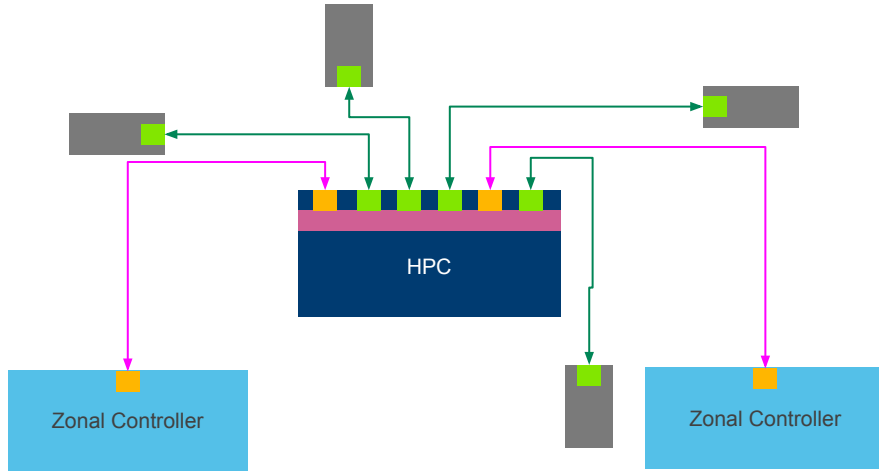
The design of the new protocol imposes new challenges on Ethernet switch as well

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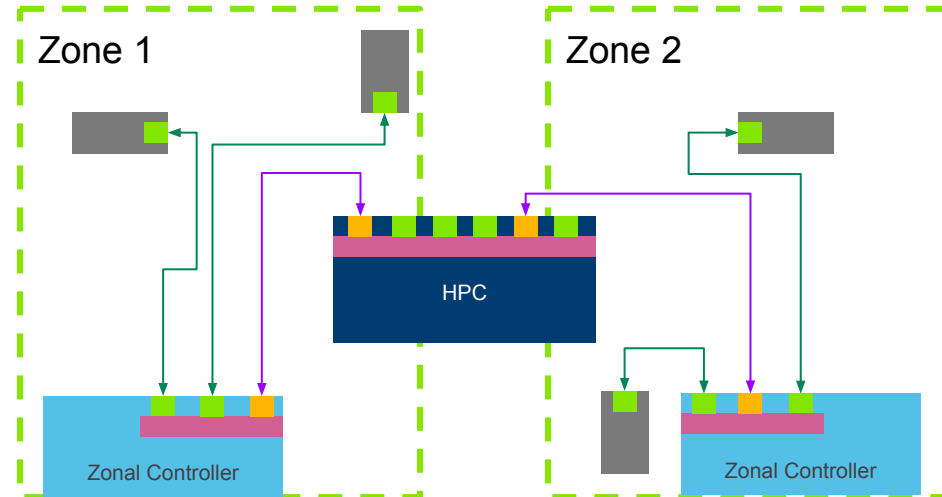
## Sensor - Zonal Architecture (e.g. Surround View cameras)



**Near future architecture**



**Far Future Architecture**



### Important points here

- Future architecture require high switching bandwidth for zonal controllers, what is the optimal switching bandwidth for zonal controllers?
- In case of satellite sensors, will the switch or the SoC on the ECU control the camera sensor?
- Controlling camera through switch logic offloads SoC from any traffic but complicates the switch firmware
- Image frame latency is a big concern in that architecture, since the Ethernet switch mounted on ZC is the main source of transmission latency

**Future zonal architecture introduces challenges on the design of the new protocol**

## Conclusion

- **Compatibility** between the **new protocol Phy** and **other** state of the art **Phys** should be considered to be able to **optimize the cost**
- The **design of the switch** function should be taken into consideration
- **Latency** plays an important role in the design of Zonal Architecture, and will affect the design of the switch and Phy
- **Security** features and **PTP** features are very important factors in the design



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