Informática y Comunicaciones

Chapter 5
Case Study: Powerlink

Chapter 5: outline

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5.3 Powerlink cycle:

- Isochronous phase
- Asynchronous phase

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Ethernet Powerlink

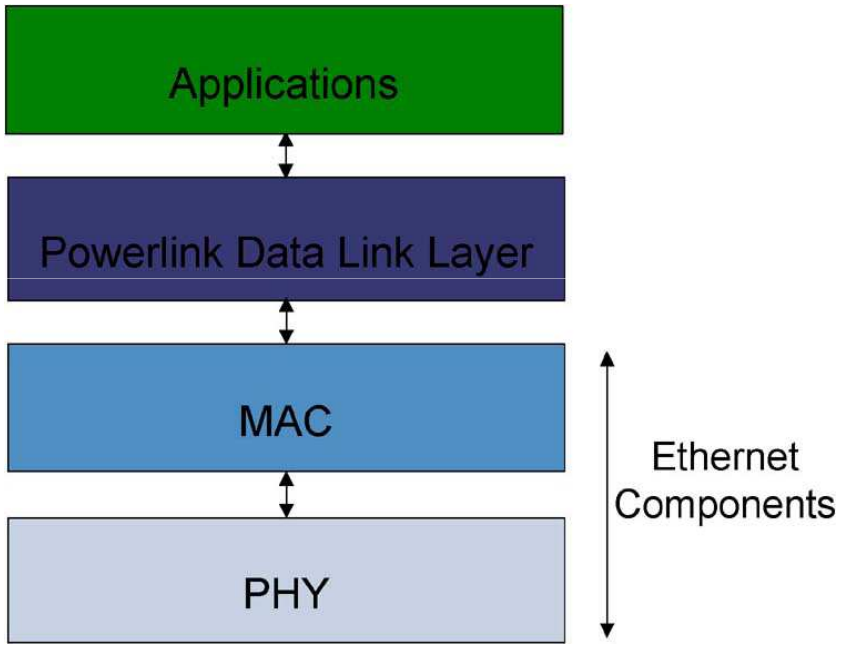
- It is one of the relevant standards in Europe for the use of Ethernet in the automation industry
- Originally developed by the Austrian specialist Bernecke&Rainer (B&R), it is advanced by leading automation companies under the management of the EPSG (the Ethernet POWERLINK Standardization Group)
- It is a communication profile for extension of the IEEE 802.3 (Fast Ethernet) for automation

Powerlink development facts

- Fast Ethernet according to IEEE802.3u 100BASE-TX as a transmission medium
- Use of standard network-hubs and standard cables
- Deterministic transmission of cyclical data with a minimal cycle time of 200 µs
- Jitter smaller than 1 µs
- Transmission of deterministic and time uncritical data
- Use of standard IP protocols (TCP, UDP, HTTP)

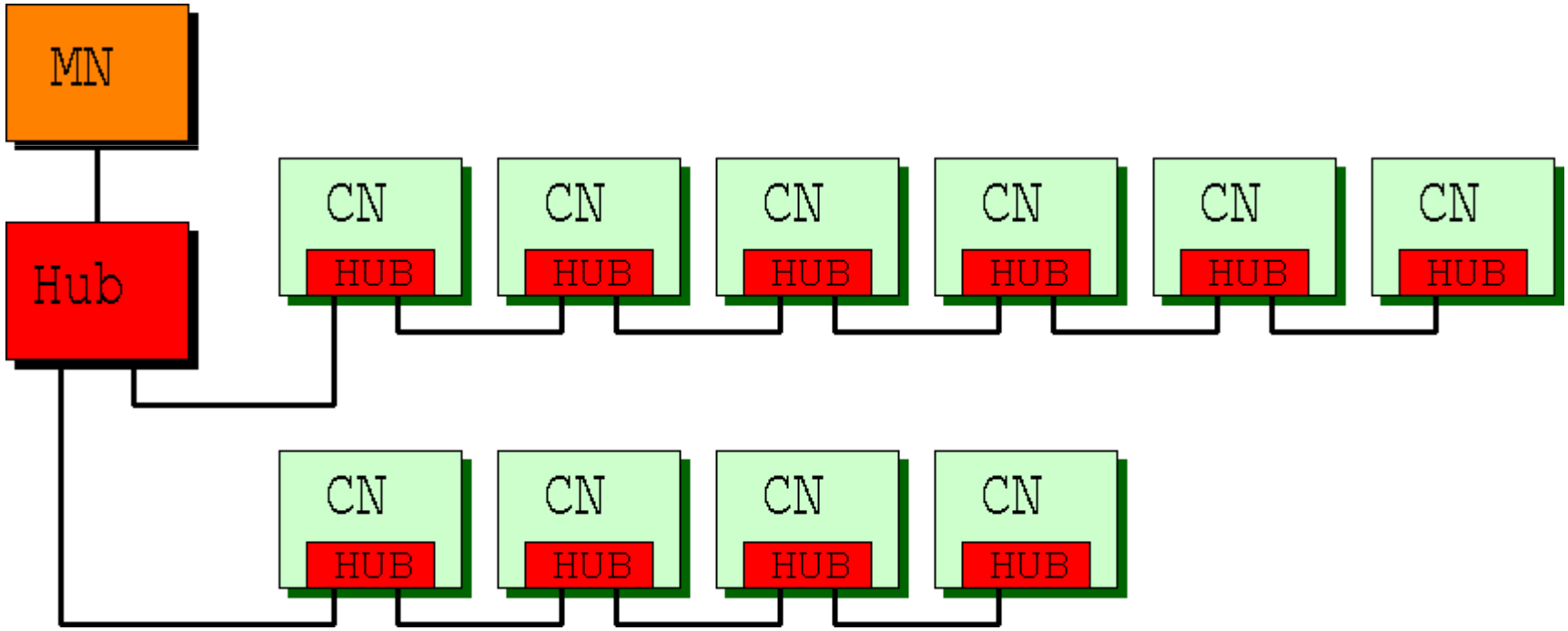
Powerlink benefits

- Powerlink uses existing Ethernet physical layer and media access control (MAC) devices.
- Benefit: Low cost and wide availability of Ethernet devices and components.
- Powerlink can be fully implemented using existing hardware and some additional software.
- The interconnection of Powerlink and computer LANs is straightforward.



Powerlink structure

- MN: Managing node
- CN: Controlled node



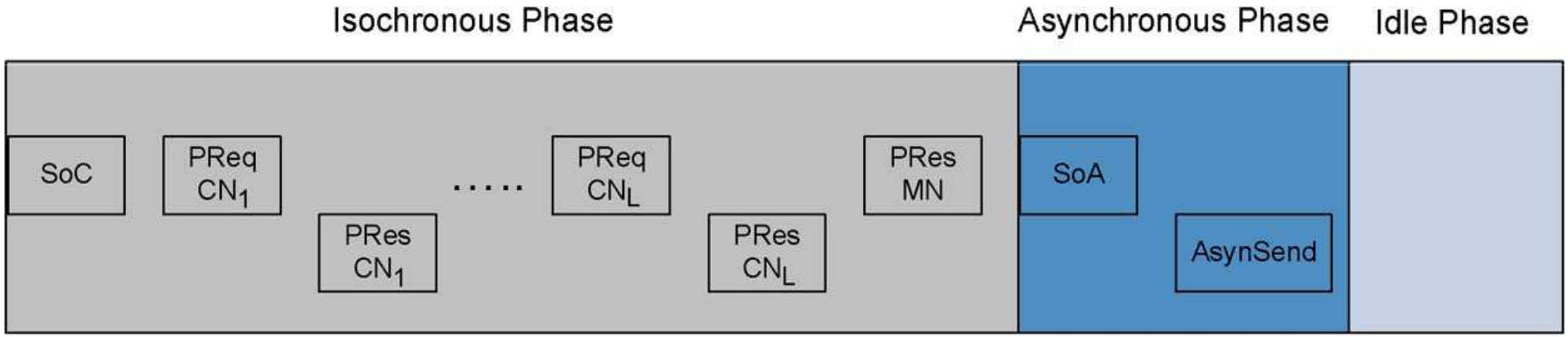
Powerlink operation modes

POWERLINK provides three services:

- Isochronous Data Transfer: One pair of messages per node shall be delivered every cycle. This is typically used for the exchange of time critical data (real-time data).
- Asynchronous Data Transfer: There may be one asynchronous message per cycle. The right to send shall be assigned to a requesting node by the MN. It is used for the exchange of non time-critical data.
- Synchronization of all nodes: At the beginning of each isochronous phase, the MN transmits a multicast message very precisely to synchronize all nodes in the network.

Powerlink cycle

- Isochronous Phase
- Asynchronous Phase
- Idle Phase



Isochronous phase

- The MN starts sending a SoC frame to all nodes via Ethernet multicast (synchronization)
- Then, the MN sends A PReq frame to every real-time node. The accessed node shall respond by a PRes frame.
- PReq is an Ethernet unicast frame. It is received by the target node only.
- PRes is sent as an Ethernet multicast frame. It is received by all the nodes.
- The PReq / PRes procedure shall be repeated for each configured and active isochronous CN.

Asynchronous phase

- Non real-time nodes may send data in the asynchronous phase.
- Nodes may request to send data while they respond during the isochronous phase, or when invited by the MN at the beginning of the asynchronous phase.
- The MN keeps track of all pending requests and assigns transmission times for the different CNs that have requested it.
- The cycle ends with an idle phase during which no data transmission takes place.

Other industrial Ethernet solutions

- EtherNet/IP
  - Protocol specified by the ODVA
  - Allows a universal connection of automation components
- EtherCAT
  - Compliant communication according to the CANopen communication profile
  - Facilitates easy and fast development of EtherCAT Slave devices
- PROFINET
  - One of the most frequently used bus system for Industrial automation
  - Uniform network from the office level down to the sensor

Chapter 5: summary

- Industrial Ethernet standards are necessary
- Powerlink allows the use of standard hardware components and IP protocols
- Powerlink manages both isochronous (real-time data) and asynchronous (non real-time data) transmissions