

# PHY requirements

## Why PHY delays matter!

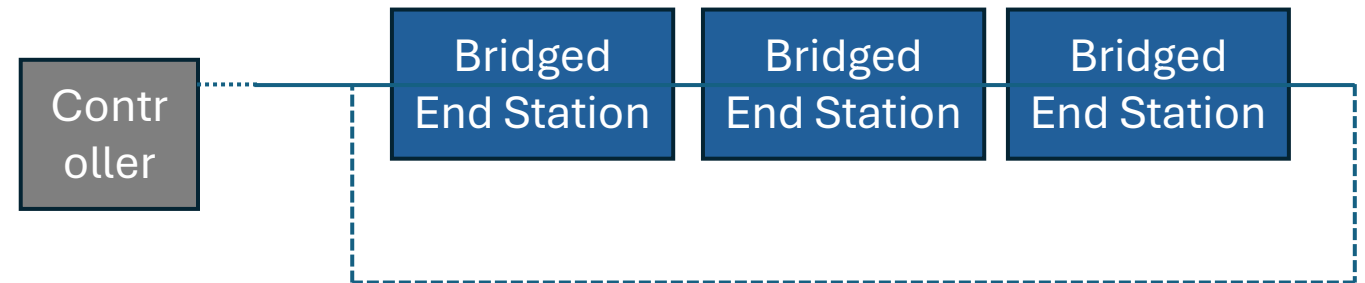
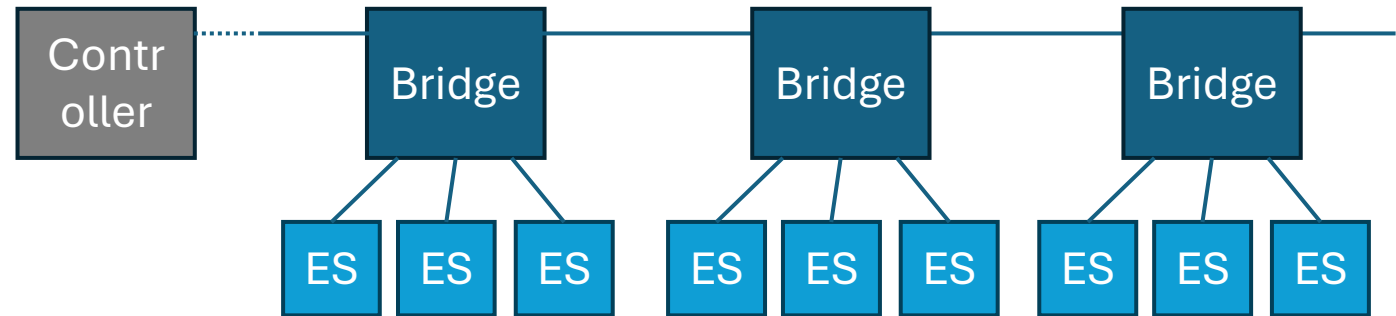
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# Markets and Topologies

- Process automation
  - Often tree topology
- Factory automation
  - Often linear or ring topology
- Machine automation
  - Often linear or ring topology



# Performance impact of PHY delays

- Tree topology
  - The PHY delay of an end station **only applies once** in the communication between end station and controller
- Linear or ring topology
  - The PHY delay of a bridged end station **applies for each hop** in the communication between end station and controller
  - Example: Linear topology with 64 bridged end stations connect to a controller
    - ⇒ The frame transmitted to the last end station is charged with a delay of
      - ⇒ 63 hops, each with two PHY delays (receive and transmit)

# Expected PHY delays

## An example

- IEC61158 / IEC61784 family of fieldbus standards
  - Example “IEC61158 Type 10 – PROFINET”
    - The expected PHY delays (Table 88) are specified in the IEC61784-2-3:2023

Link Speed	RX delay <sup>a</sup>	TX delay <sup>a</sup>	Jitter
10 Mbit/s – 1 Tbit/s	Mandatory: < 1 $\mu$ s Recommended:< 500 ns	Mandatory: < 1 $\mu$ s Recommended:< 500 ns	< 4 ns
10 Mbit/s Special case: 10BaseT1L	Mandatory: < 5 $\mu$ s <sup>b</sup> Recommended:< 500 ns	Mandatory: < 5 $\mu$ s Recommended:< 500 ns	< 4 ns

<sup>a</sup> If IEEE 802.3 defines lower values, then these definitions apply. Lower values mean lesser latencies.

<sup>b</sup> 5  $\mu$ s are equivalent to 6,25 octets at 10 Mbit/s.

**NOTE – Latency variation influences the synchronization quality!**

# Customer expectations

- Existing machine and automation cell designs are not PHY dependent
- Introducing a new PHY for copper should not require changes in the machine and automation cell
- Roundtrip delays for motion or other high-speed applications shall still be achievable without new machine designs

# Link diagnostics

## An example

- IEC61158 / IEC61784 family of fieldbus standards
    - Example “IEC61158 Type 10 – PROFINET”
  - State machines use the information provided e.g. by ifOperStatus and ifAdminStatus controlling the behavior of the stations
- ⇒ Stable link states (UP or DOWN) concurrently on both sides of the link are required – no intermediate states used

NOTE – It is expected that during UP the nominal link speed is always provided!

Thanks

Questions