Requirements of Industrial Applications

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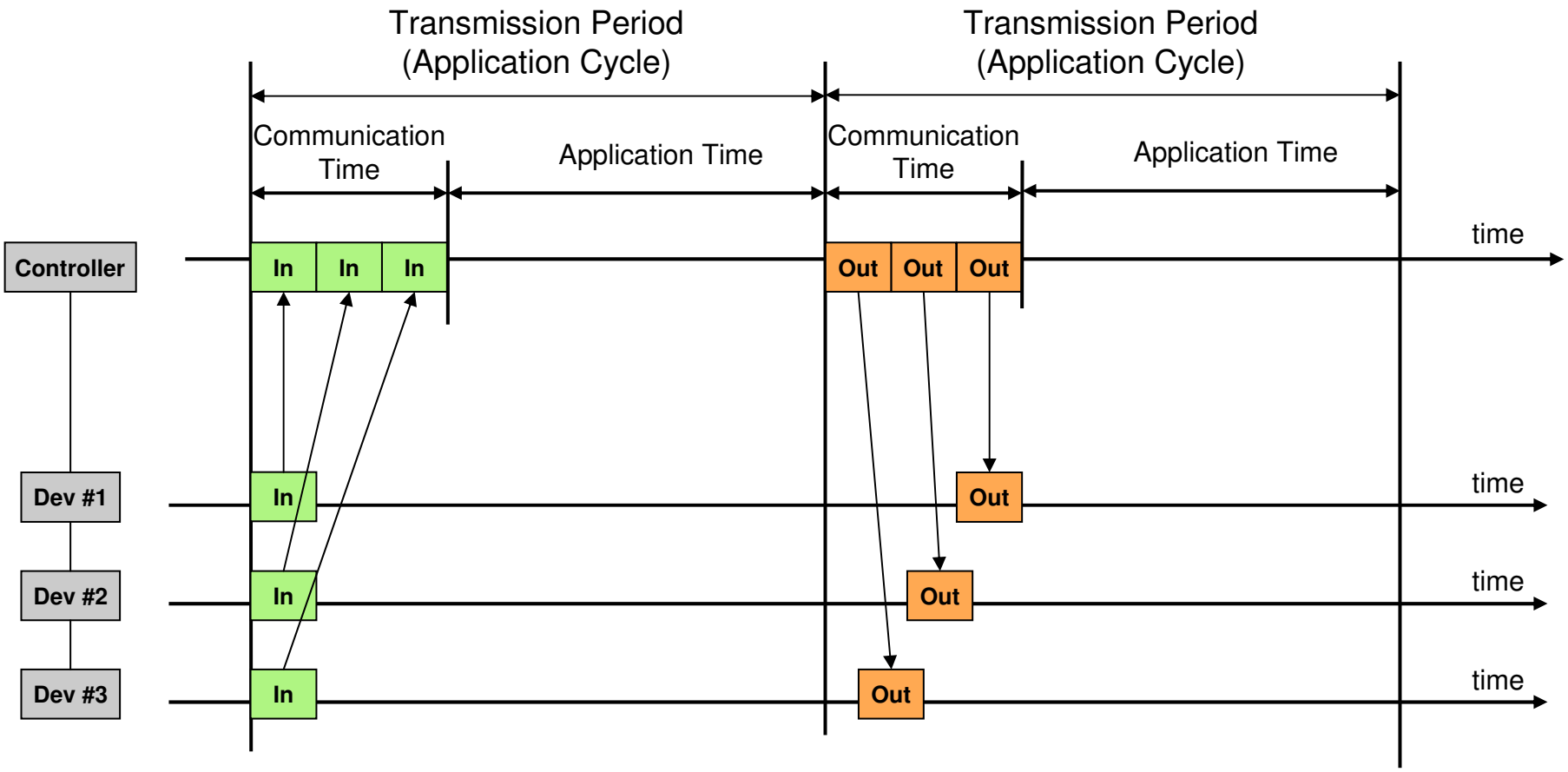
Overview

- **Introduction**
  - Application model of industrial control
  - Applications with "Low Latency"
  - Trends in the industrial area

- **Requirements of some industrial applications**
  - Pitch Control
  - Laser Cutting
  - Packaging
  - Printing

- **Summary**
  - Overview of typical topologies
  - Roundup

Application Model of Industrial Control



Minimize the communication time in order to get maximum time for the application => Reduce Latency

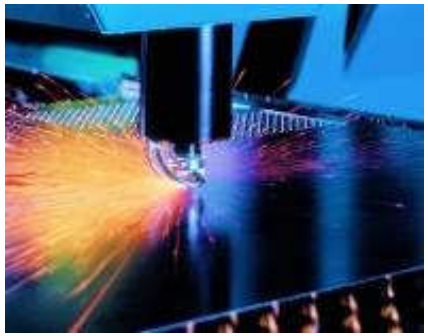
Some applications with low latency requirements

Printing

Milling

Packaging

Wind Turbines



Laser Cutting

Plastics processing

Why do we need faster Control Loop?

Milling

- Save time, because you need no reworking of the machined part

Packaging:

- Increase the packaging throughput
- Increase the possible precision and reproducibility

Printing:

- Replacement of the mechanical control through electronic control
- Higher speed, higher printing quality

General trend:

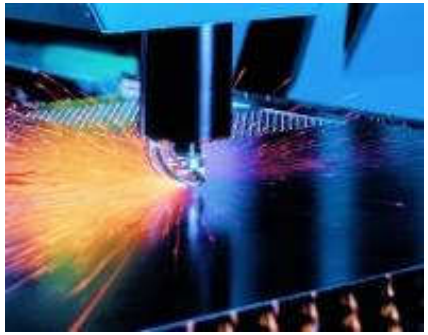
- Applications get faster, the proccessing power of uController and PC-processors increases, therefore also the communication performance has to keep up with this trend.

Application: Pitch Control for Wind Turbines

- Number of Controllers: 1
- Number of Devices: 8
- Number of Input Data and Output Data of each Device
  - Input Data: 40Bytes
  - Output Data: 40Bytes
- Transmission Period: 125us
- Communcation Time: < 50% of the Transmission Period
- Topologie: Daisy Chain
- Communications-Relationship: one-to-one
- Interfering traffic: yes

Application: Laser Cutting

- Number of Controllers: 1
- Number of Devices: 10
- Number of Input Data and Output Data of each Device
  - Input Data: 60Bytes
  - Output Data: 20Bytes
- Transmission Period: 125us
- Communcation Time: < 50% of the Transmission Period
- Topologie: Daisy Chain
- Communications-Relationship: one-to-one
- Interfering traffic: yes



Application: Packaging

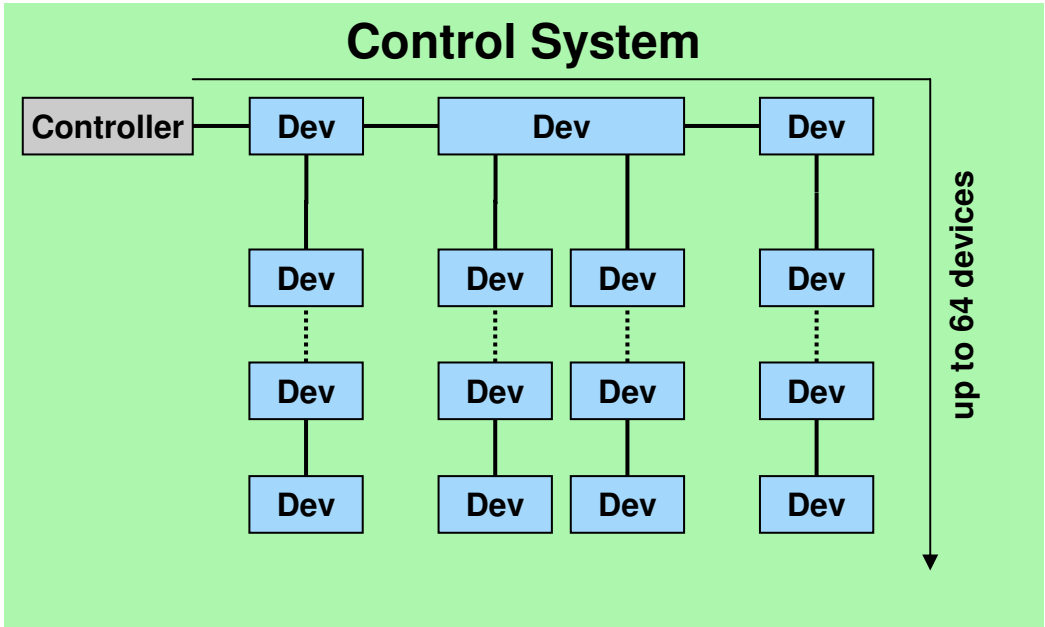
- Number of Controllers: 1
- Number of Devices: up to 48
- Number of Input Data and Output Data of each Device
  - Input Data: 3Bytes
  - Output Data: 10ytes
- Transmission Period: 500us
- Communcation Time: < 50% of the Transmission Period
- Topologie: Daisy Chain / Comb
- Communications-Relationship: one-to-one
- Interfering traffic: yes

Application: Printing

- Number of Controllers: 10
- Number of Devices: -
- Number of Input Data and Output Data of each Controller
  - Input Data: 384Bytes
  - Output Data: 384Byte
- Transmission Period: 1ms
- Communcation Time: < 50% of the Transmission Period
- Topologie: Daisy Chain / Ring
- Communications-Relationship: one-to-many (multicast)
- Interfering traffic: yes

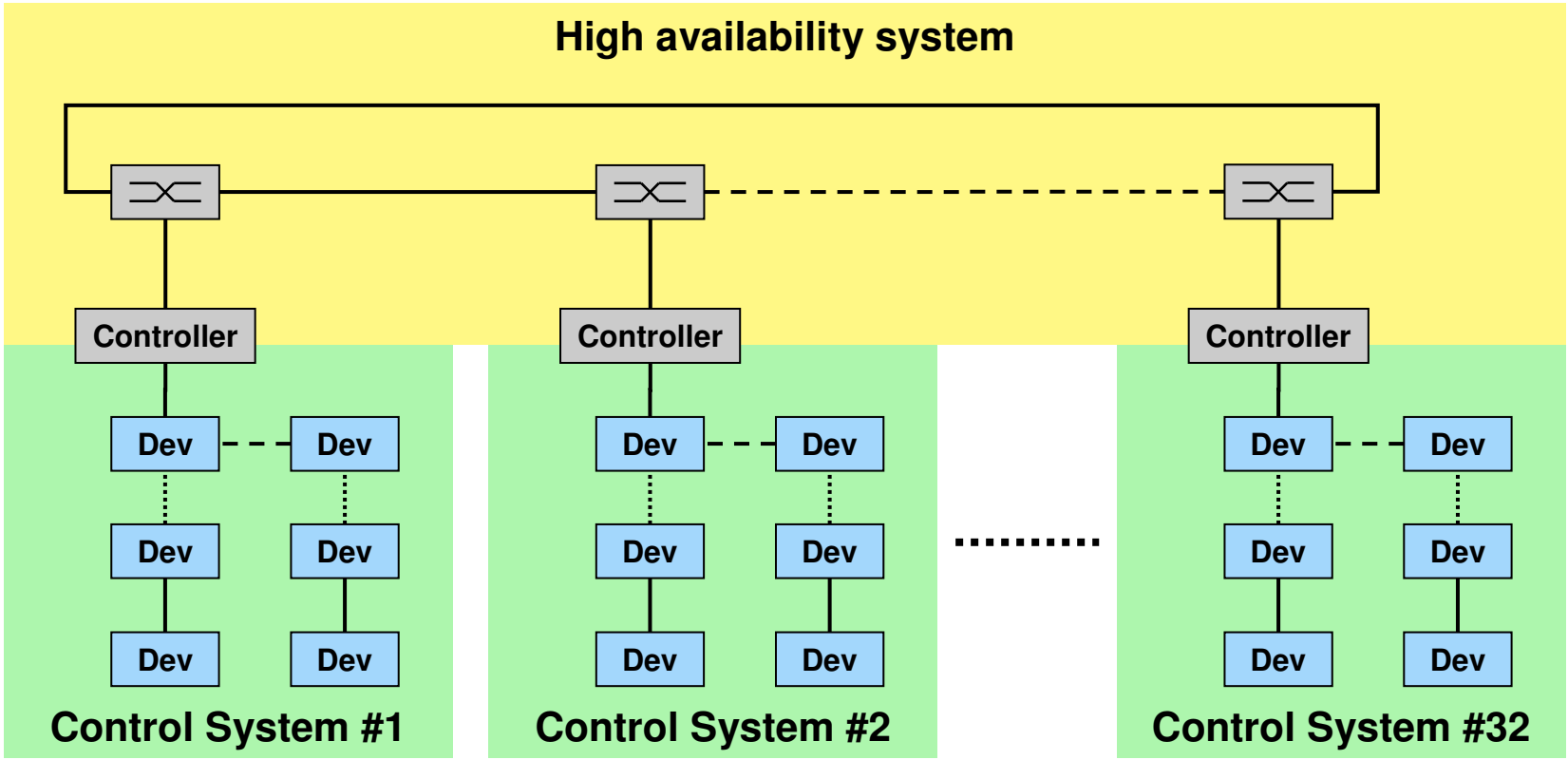
Topology: Daisy Chain / Comb

- At most 64 Devices in Daisy Chain
- At most 512 Devices @one Controller



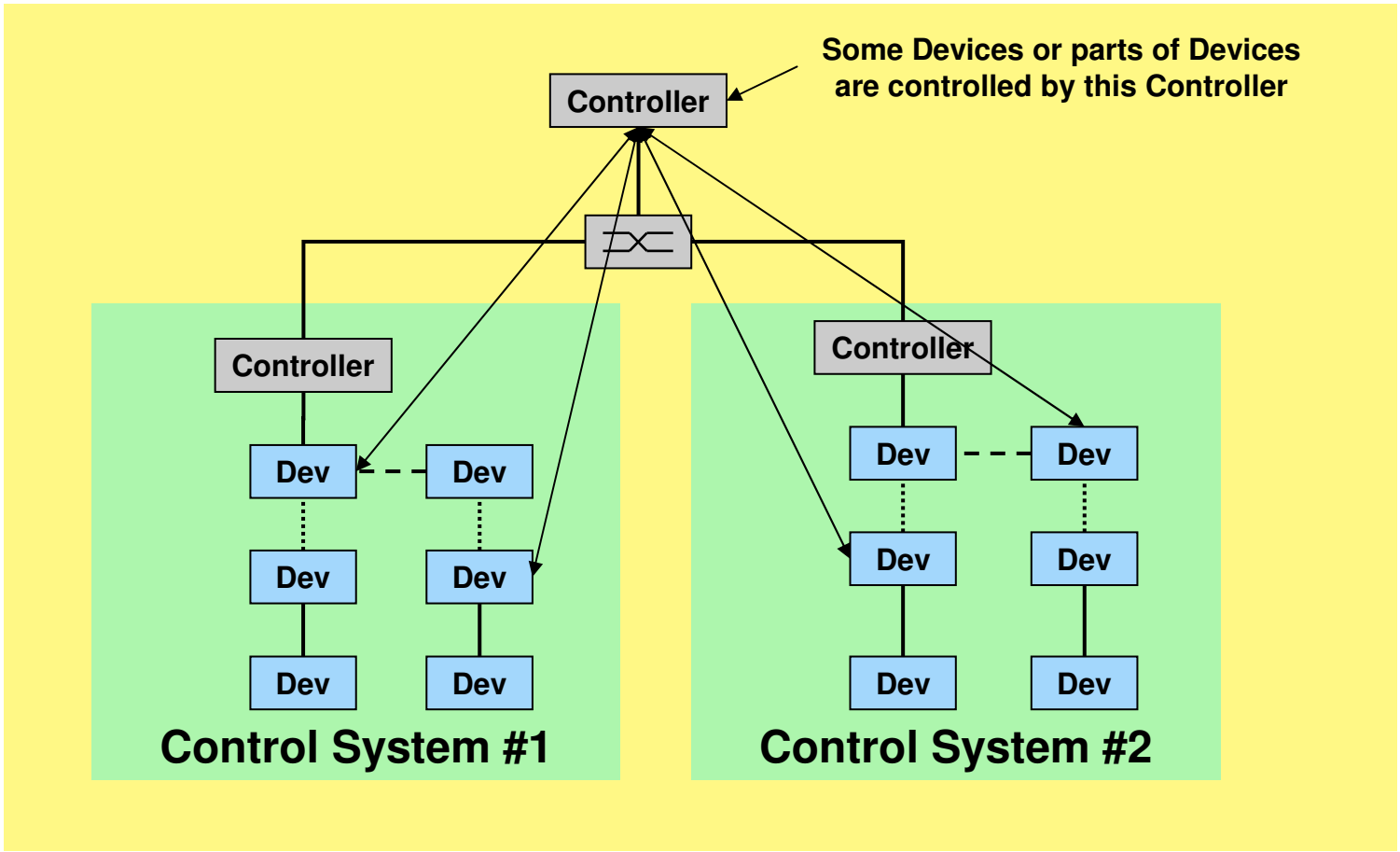
Topology: Ring topology

- Up to 50 Devices or Controller in the ring



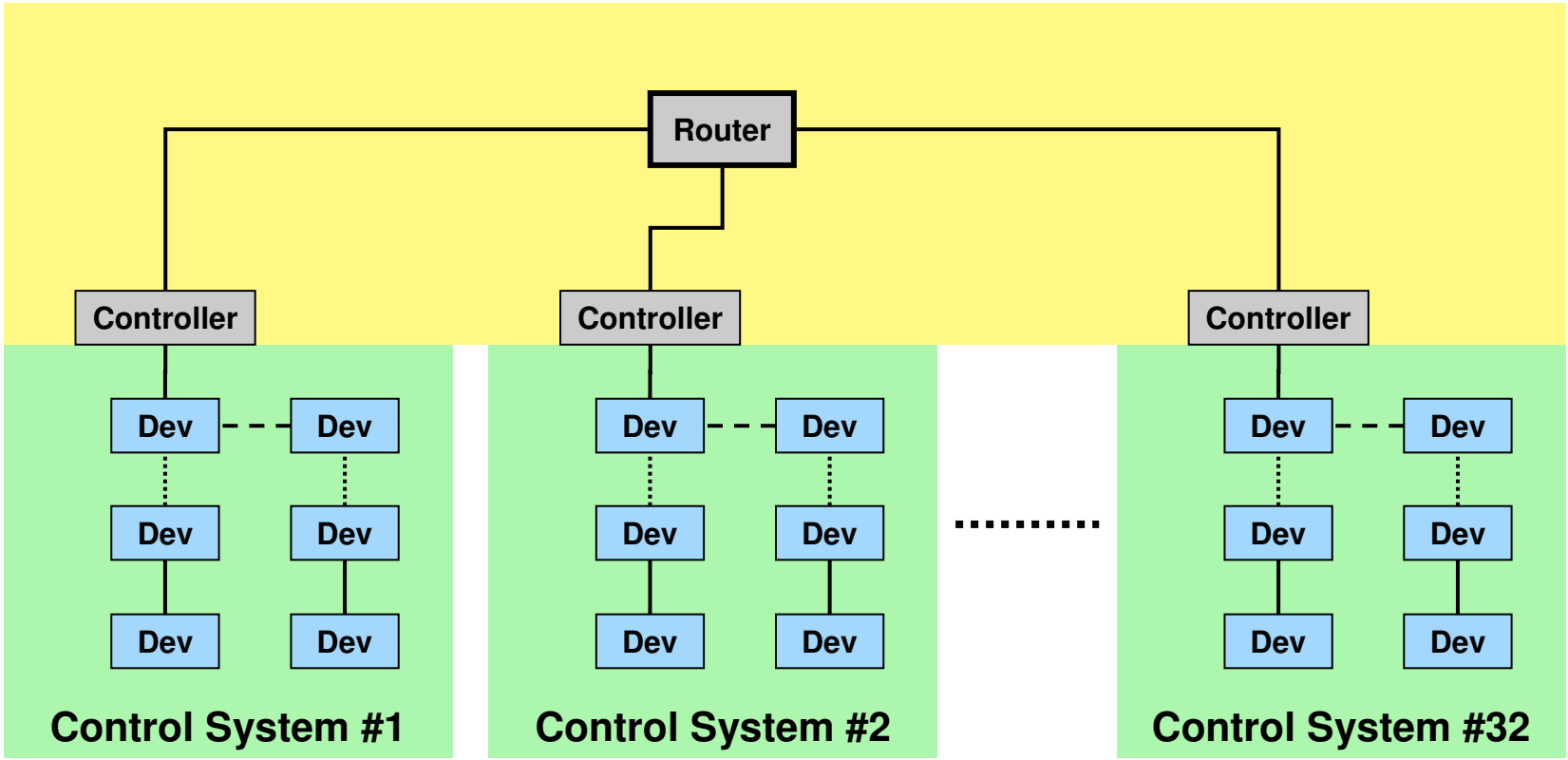
Topology: Meshed control systems

- At most 4000 control streams



Topology: Control streams via router

- Application cycles in the range of 10ms and 100ms



Roundup: Requirements for Control streams of Industrial Applications

Quantities

- At most 512 Devices @one Controller (L2 network)
- At most 4096 control streams on a L2 network
- Typical data sizes: 10 to 300 Bytes/frame for Sensor/Actors and >300 Bytes/frame between Controllers
- Max. hop count: up to 64 hops in daisy chain
- Max latency / hop: < 3us

Transmission periods of typical Control Loops

- 31,25us to 125us => Plastic processing, Pitch Control
- 125us to 500us => Packaging, Printing
- 500us to 1ms => Standard Automation business

Topology aspects

- Daisy Chain / Comb / Ring
- Hierarchical network with different link speeds (FE, GE, ...)
- High availability for Control streams
- Control streams over L3 Router

Thank you for your attention!