How may Systems work?

Karl Weber, Beckhoff Automation

Beckhoff Automation at a glance

- Founded 1980 to handle Industrial Automation issues at local side

  … after a while starting with own development…

- PC based technology is the base for Control Automation Technology

- Communication is a very substantional part
  - Supporting over 25 different communication technologies

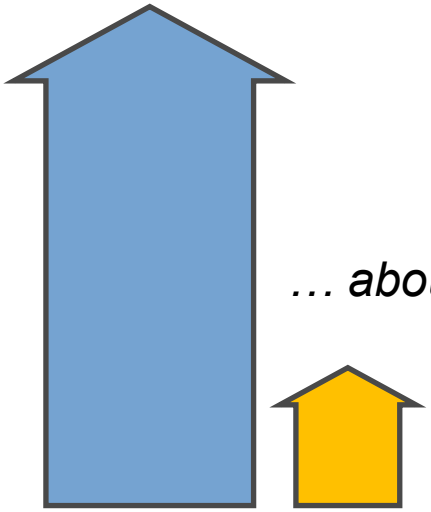
    ….
  - Ethernet for Control Automation Technology ➔ EtherCAT
    - Keep Ethernet frames but new Bridging concept

  - Base Technology for european robots (KUKA, ABB)
    ➔ precison, performance

Ethernet in the Market

IMS Research: 2012 *World Market for Industrial Ethernet* report:

31.3m industrial networked nodes in 2011 (1 node = 2.x ports)



… about 25% with some sort of Ethernet (<50% Std)

*source:*http://www.iebmedia.com/index.php?id=8595&parentid=74&themeid=255&showdetail=true&bb=true

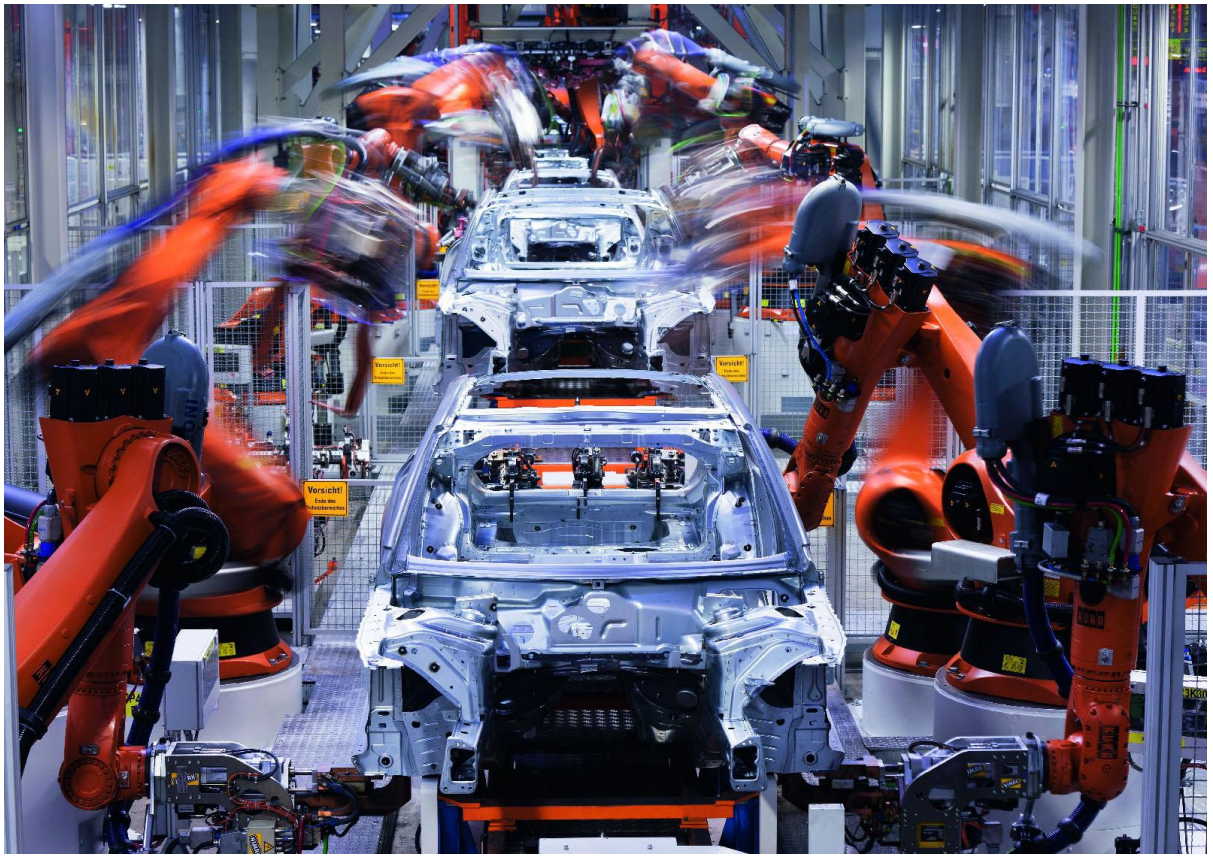
Reasons for resilience of fieldbus technologies:

- **Simplicity**
- **Reliability**
- **Numerous legacy systems in the field**

… will not give way easily to Ethernet progress.

Trends in Industry

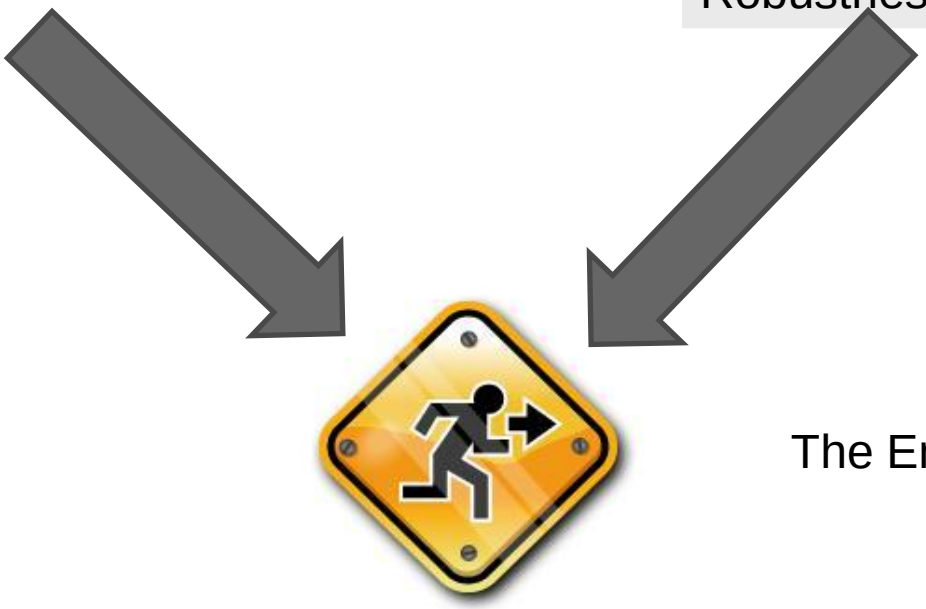
- Enhanced support required for
  - Vision systems (important but not focus today ➔ follows automotive)
  - DRIVES! (very high demands regarding Sync and Latency)
  - Safety! With some level of reliability



Basic Requirements and Issus

- CBSA (simple, performance!!)
- TAS (complex scheduling, diagnostic)
- BLS (do not work – Christian)
- PS (performance!!)

Single Standard for all	ok
Performance	?
Ease of handling	?
Better Diagnostic	?
Robustness	?



The End or Way out?

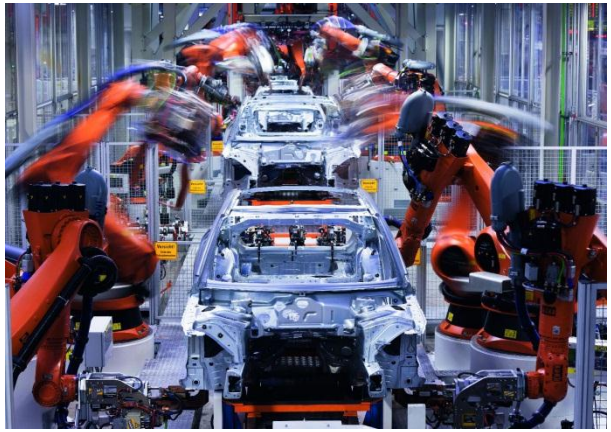
Structuring

- Arbritary Structures have negative effects…
  - Complex Schedule
  - Unpredictable Performance
  - Hard to determine Reliability
  - Error in a single component can affect <u>all components</u>

… But real structures are not so complex

Hierarchical systems

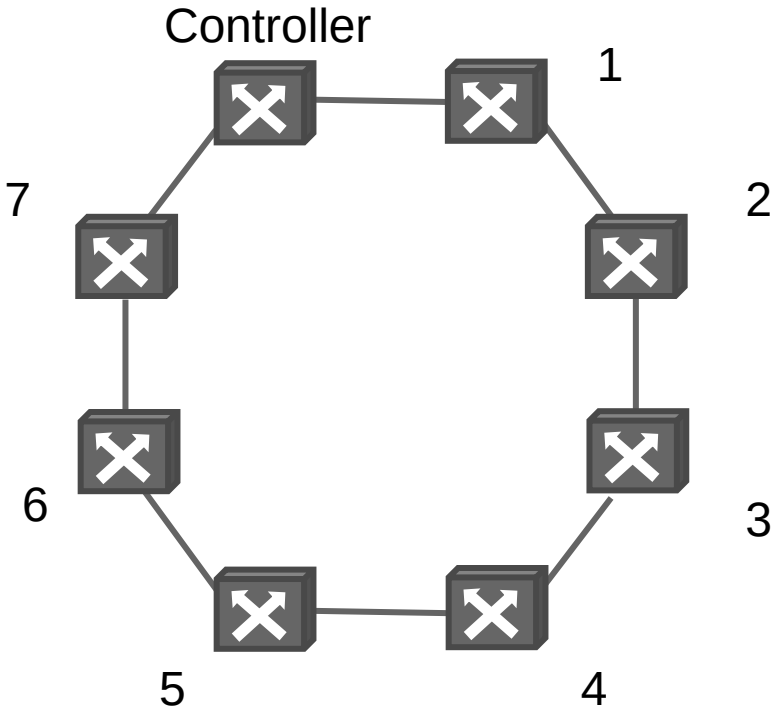
Line / Ring topologies



Rings and combinations

Line➔ Ring building blocks

- Each node belongs to a certain structural element
- Removal/Extension easy
- Path selection trivial
- Schedule rule:
  - Controller ➔ Device: Send frame to last first
  - Oposite Direction: Send at the same time (or almost at the same time)

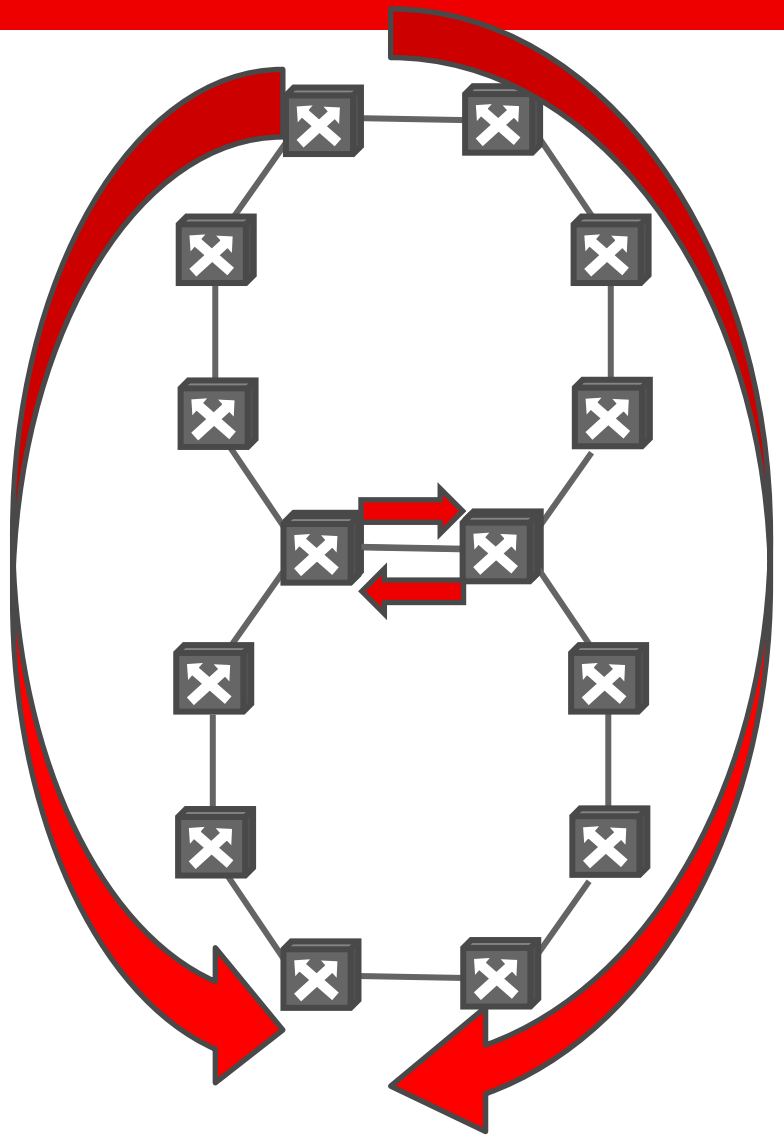


Controller right: 7,6,5,4,3,2,1
Controller left: 1,2,3,4,5,6,7

More complex structures

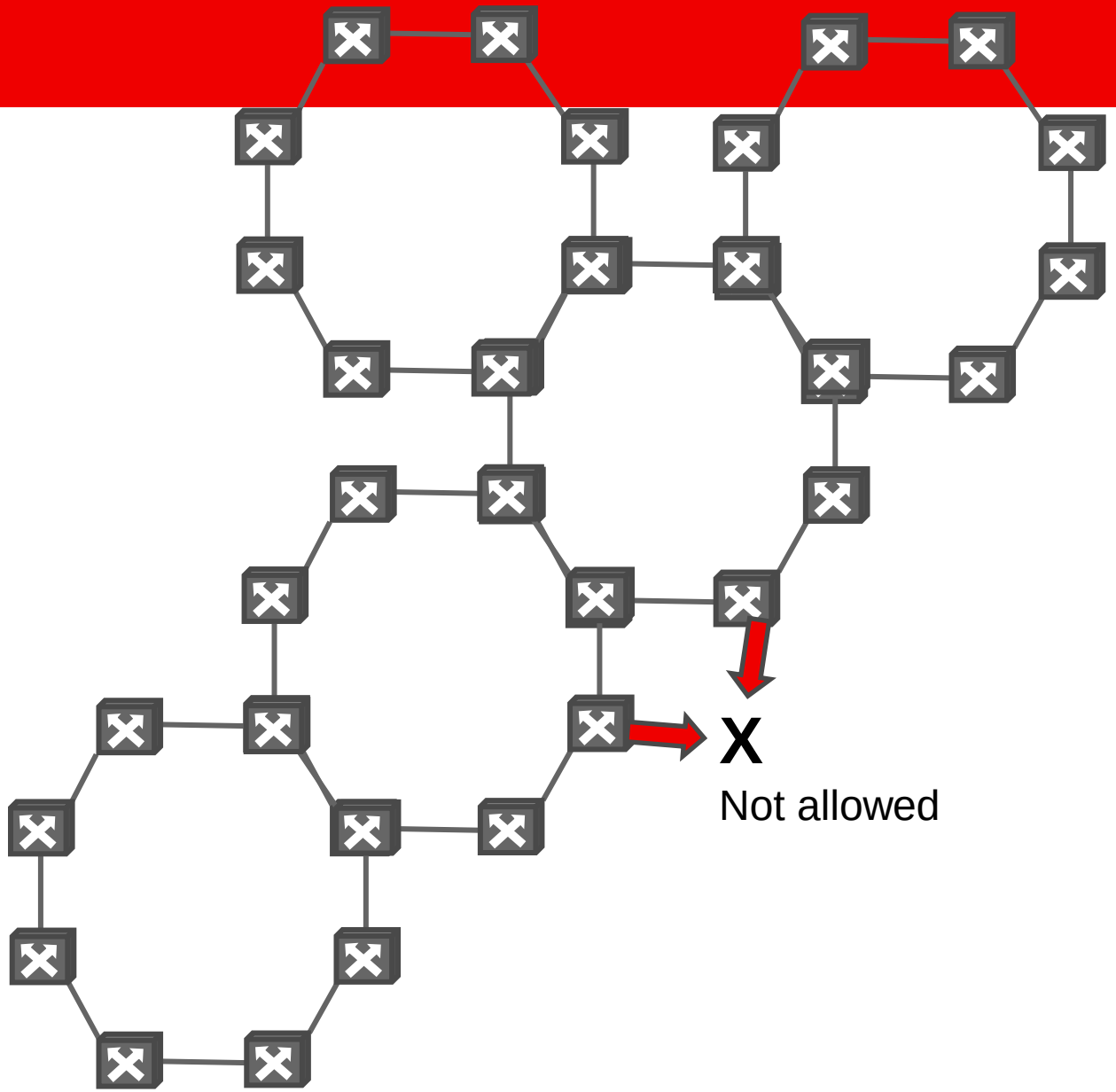
- Good for extended systems to provide good reliability
- Transit ports belong to both rings
- Not as simple to schedule
  ➔ more flexible „TAS“ required

  Maybe proxies at the second ring preferable (especially for larger systems)
- Path selection with a bypass
  (if and only if source/destination in different rings)
  ! Redundancy requirements that one error (transient/permanent) in one ring can be tolerated!
  Schedule different if error occurs!



More complex structures

- Reflect a hierarchy
- The same SIMPLE path rules apply
- More availability possible but with extended cost
- Restrictions must be enforced at startup!!
  ➔ ISIS?
- Can be displayed with a simple file browser



Conclusion

- Difficult to handle all kind of topologies
- The proposed subset makes it much easier
- Only useful if base protocols support it

➔This shall not exclude other options!

… more to discuss regarding robustness

Thank You!

We like smart high performance solutions!