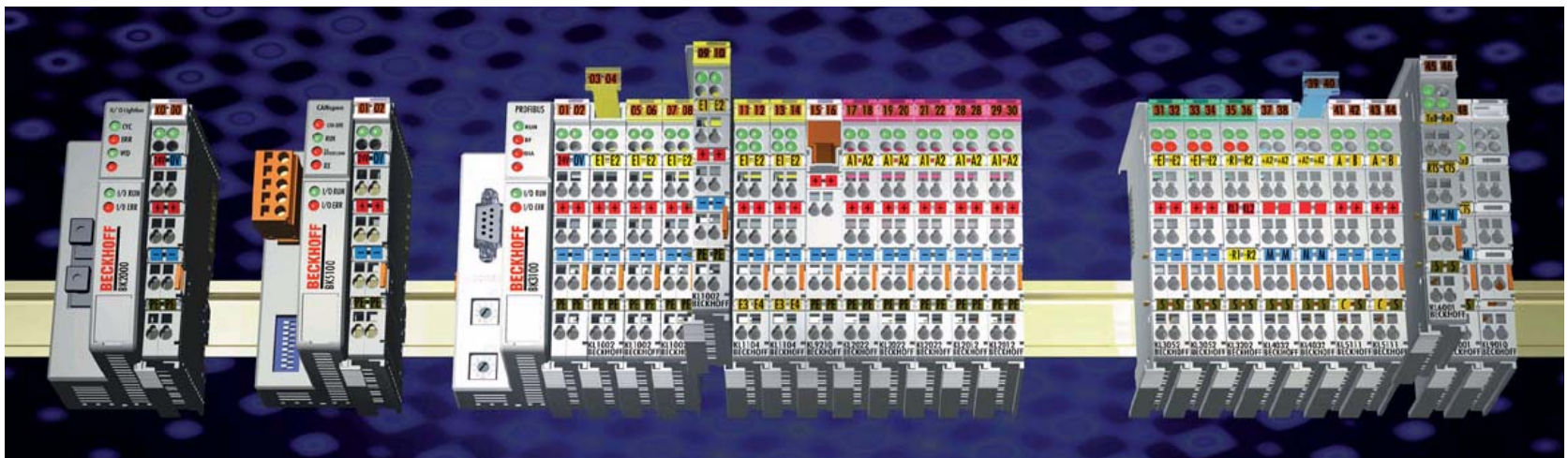


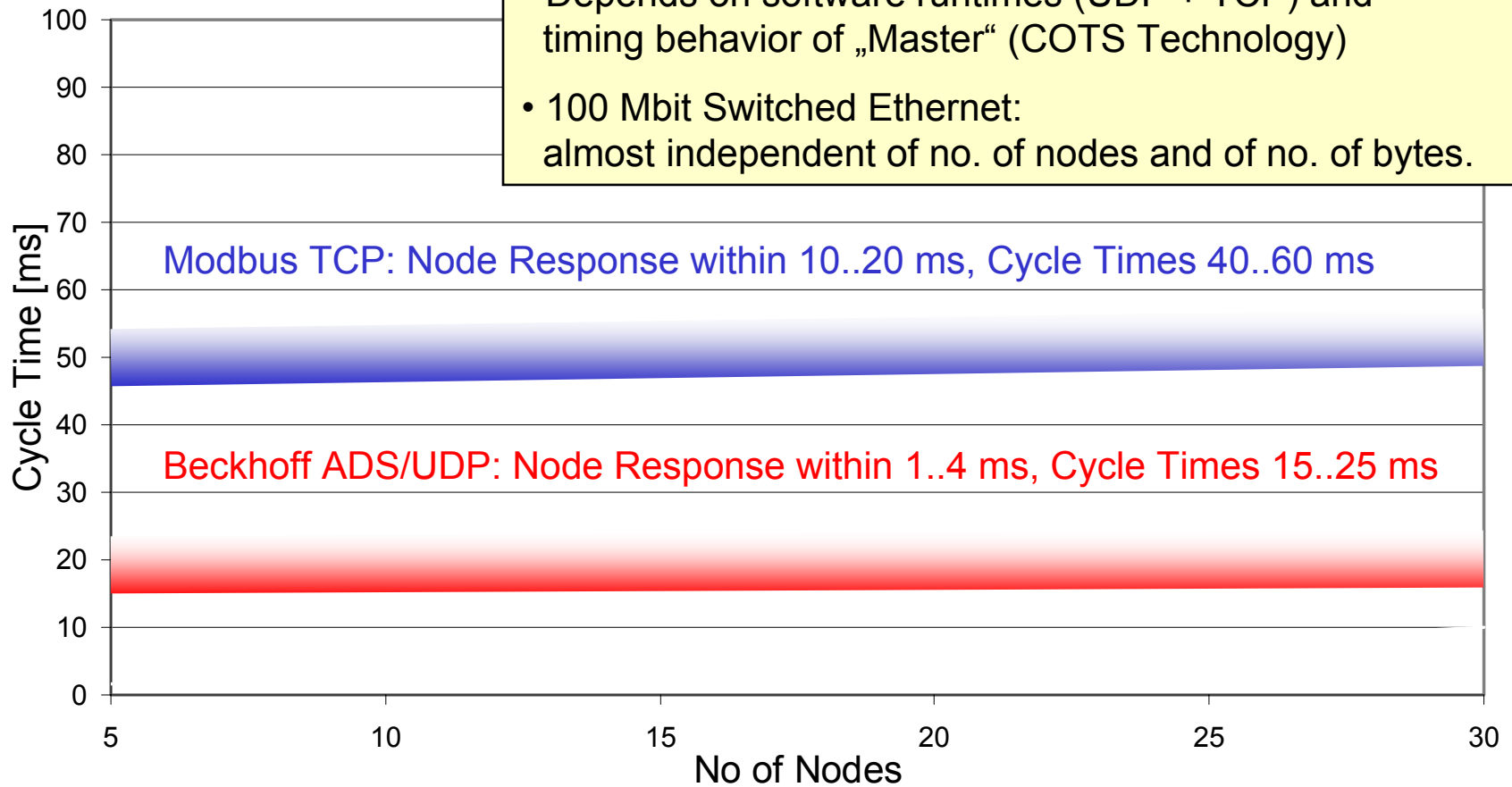
Performance Comparison

- Bus Cycle Times
- Reaction Times / Determinism
- Implementations

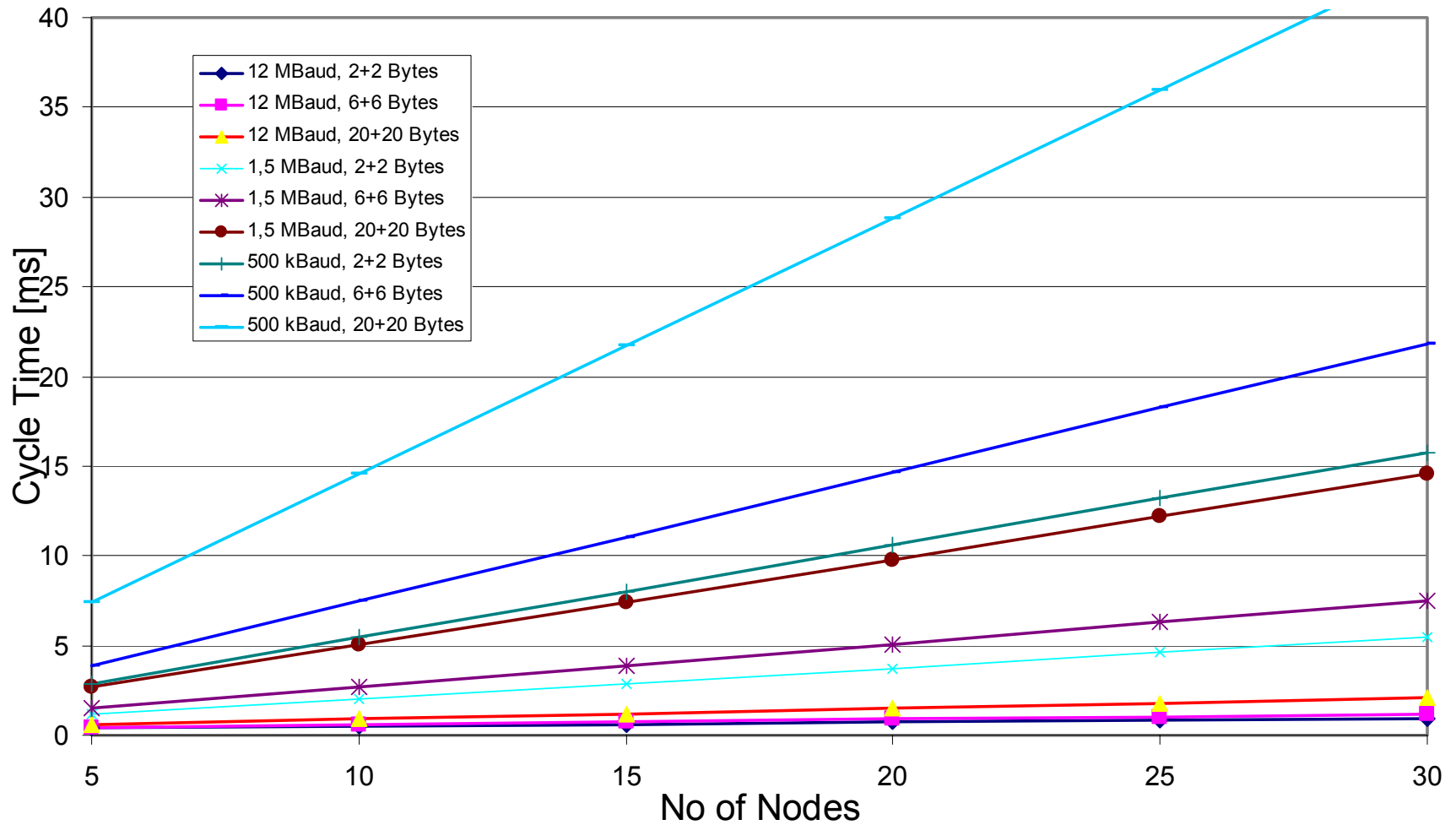


Bus Cycle Time: Ethernet

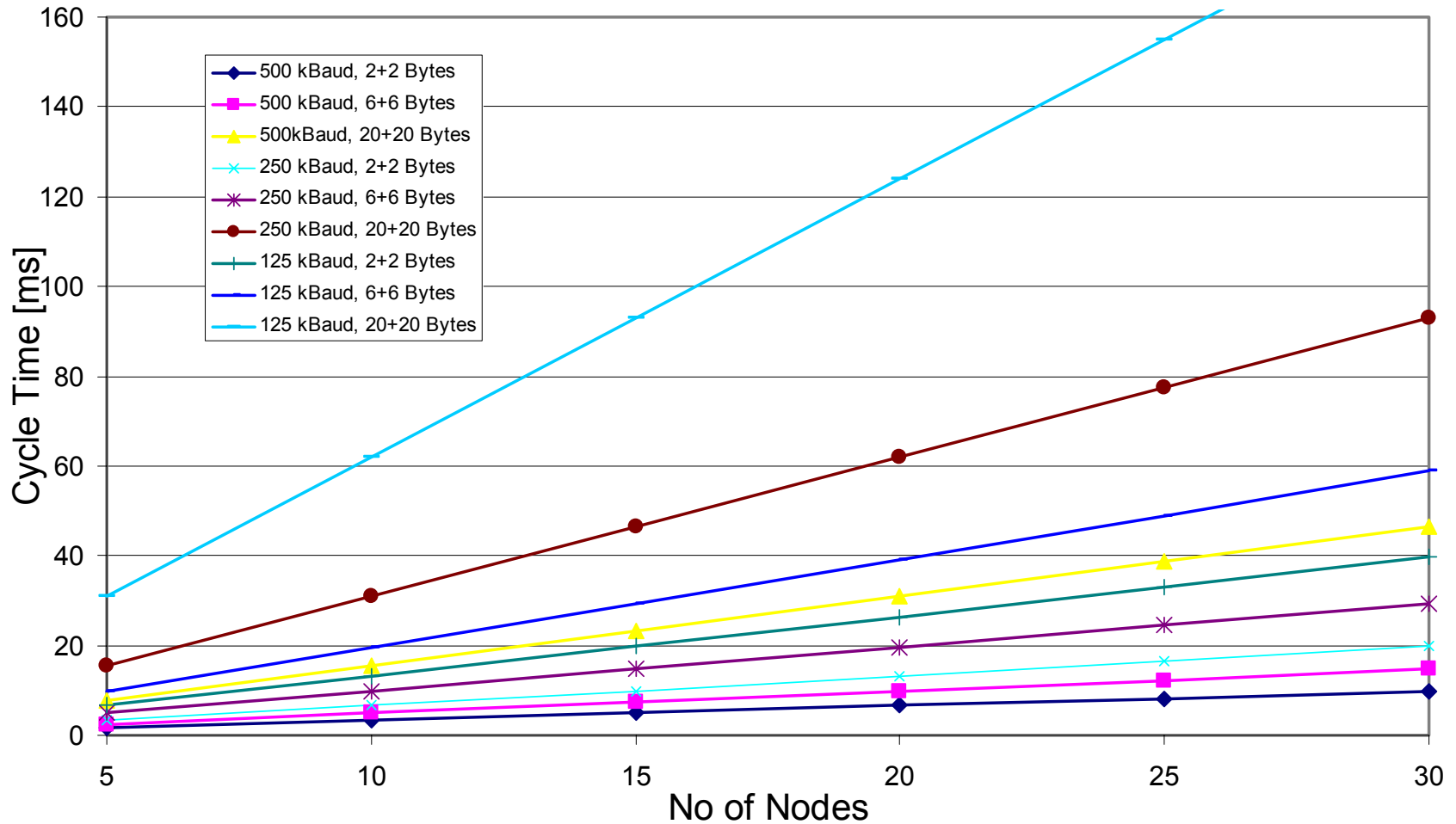
- Ethernet Cycle Time is hardly predictable.
- Depends on software runtimes (UDP + TCP) and timing behavior of „Master“ (COTS Technology)
- 100 Mbit Switched Ethernet: almost independent of no. of nodes and of no. of bytes.



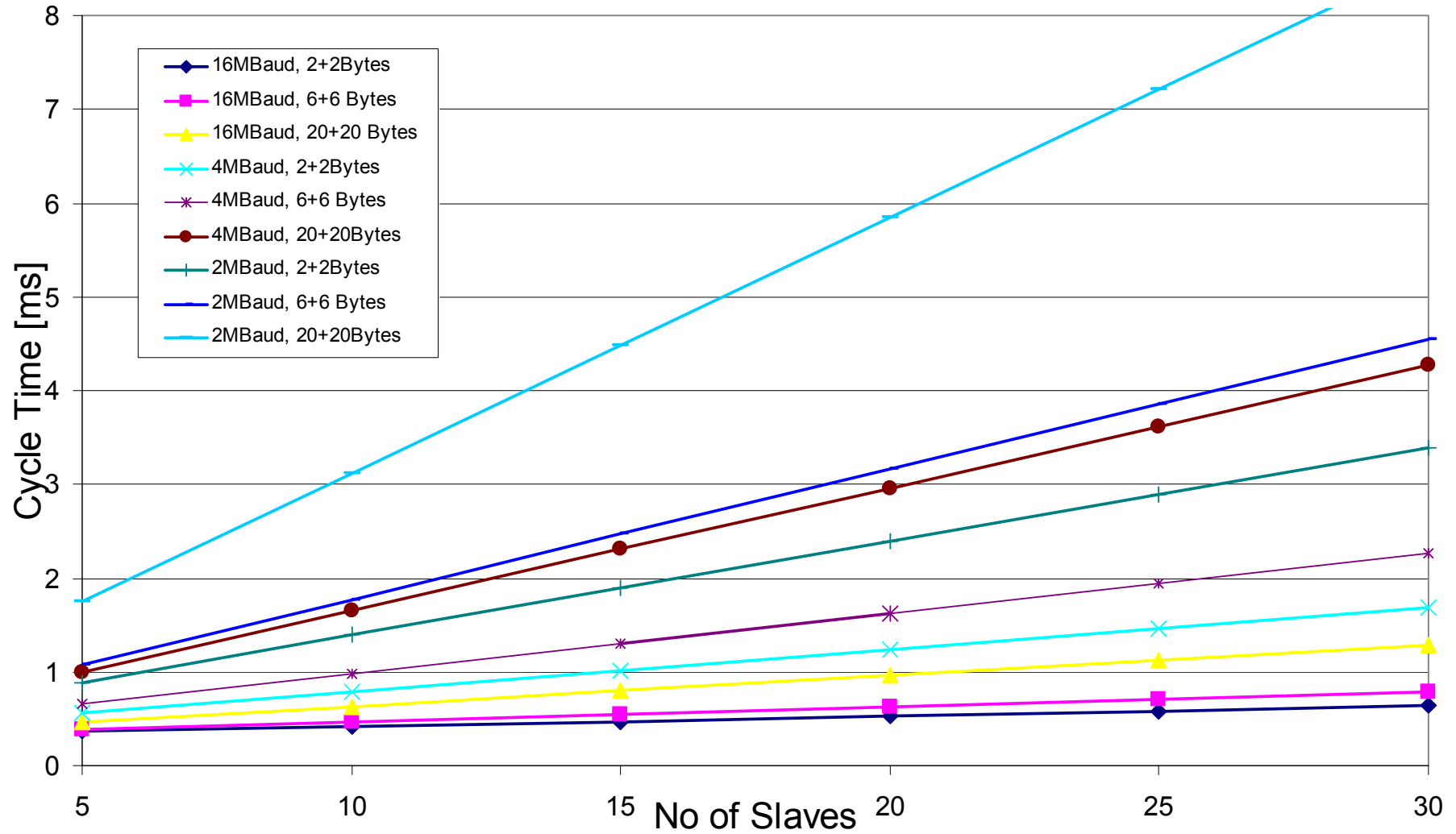
Bus Cycle Time: Profibus



Bus Cycle Time: DeviceNet



Bus Cycle Time: Sercos

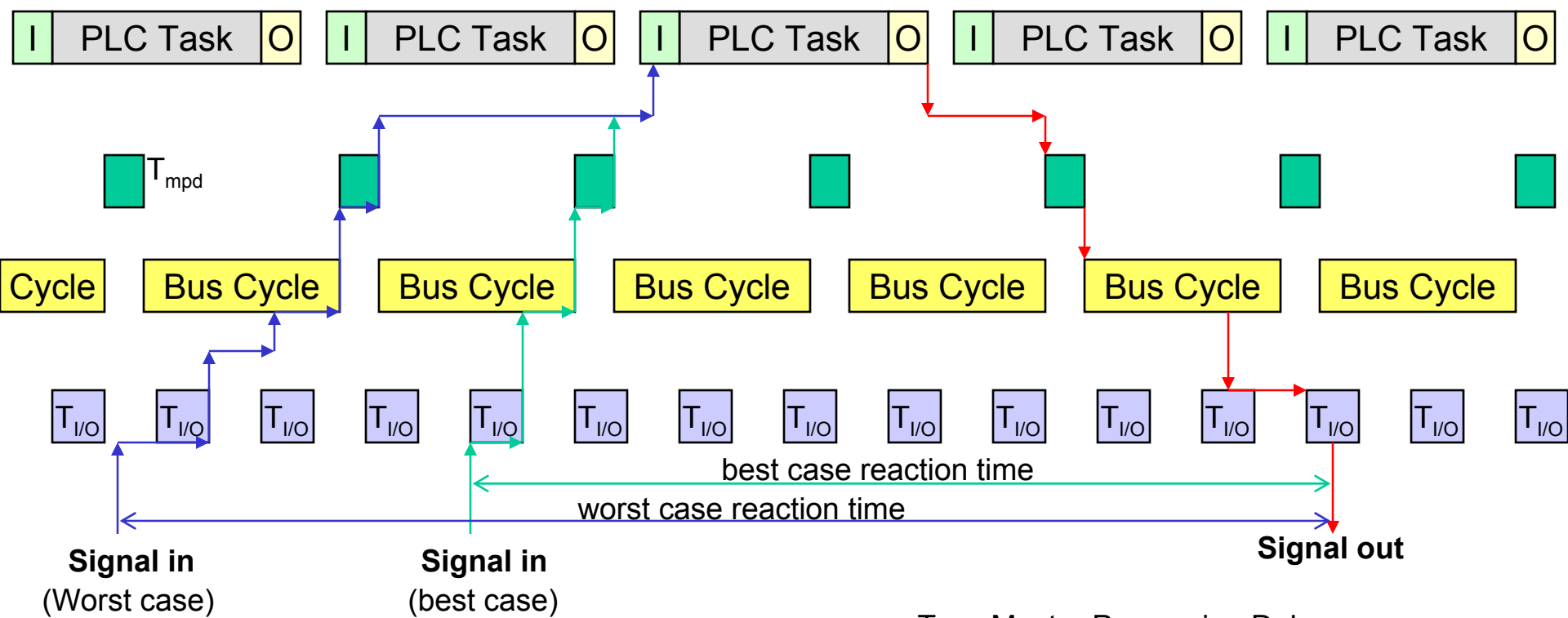


Reaction Time I

Reaction to Digital Input

Typical for:
AllenBradley PLC / DeviceNet

- Scenario I:
- Bus Cycle Time **similar** to Task Cycle Time
 - Bus Cycle **not** synchronised with PLC Task
 - Local I/O Cycle **not** synchronised with Bus Cycle



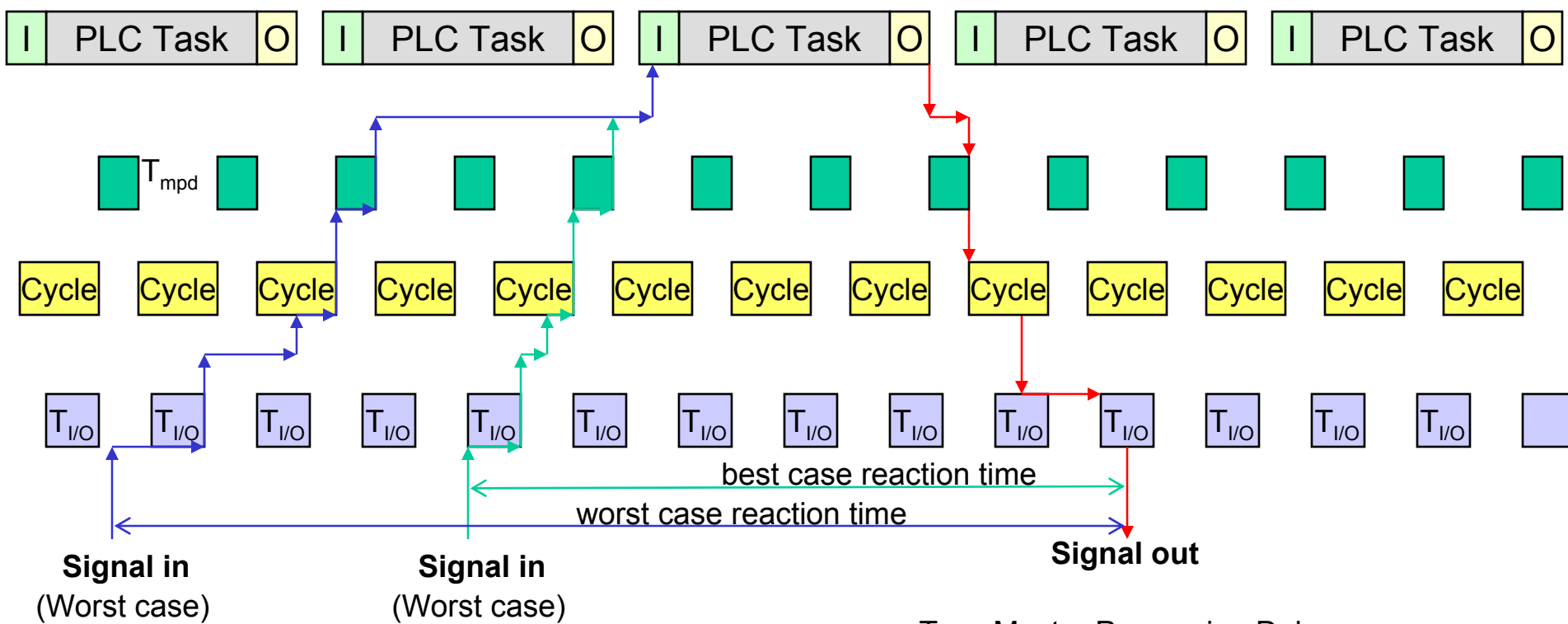
T_{mpd} : Master Processing Delay
 $T_{I/O}$: Local I/O Update Time (Extension Bus)

Reaction Time II

Reaction to Digital Input

Typical for:
Siemens PLC / Profibus, AB / ControlNet

- Scenario II:
- Bus Cycle Time **shorter** than Task Cycle Time
 - Bus Cycle **not** synchronised with PLC Task
 - Local I/O Cycle **not** synchronised with Bus Cycle



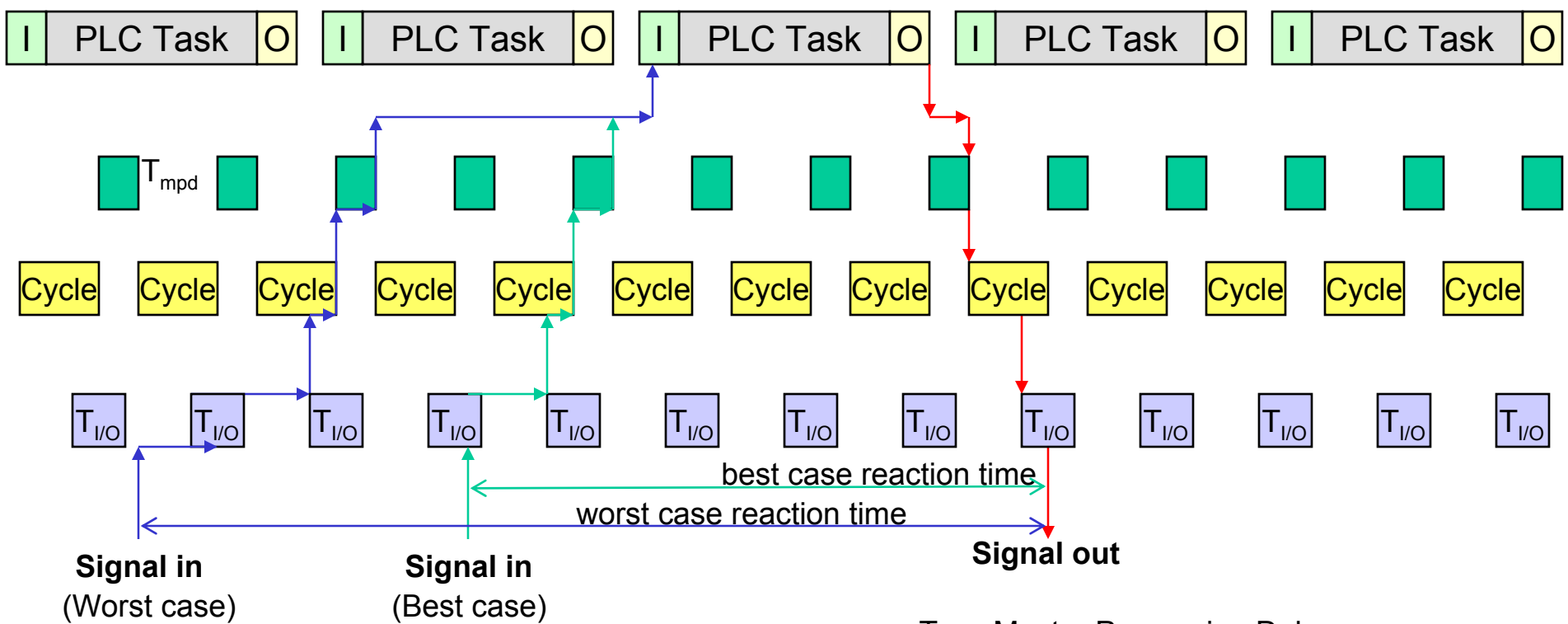
T_{mpd} : Master Processing Delay
 $T_{I/O}$: Local I/O Update Time (Extension Bus)

Reaction Time III

Reaction to Digital Input

Typical for:
Siemens PLC / Profibus I/O (Beckhoff)

- Scenario III:
- Bus Cycle Time **shorter** to Task Cycle Time
 - Bus Cycle **not** synchronised with PLC Task
 - Local I/O Cycle **synchronised** with Bus Cycle



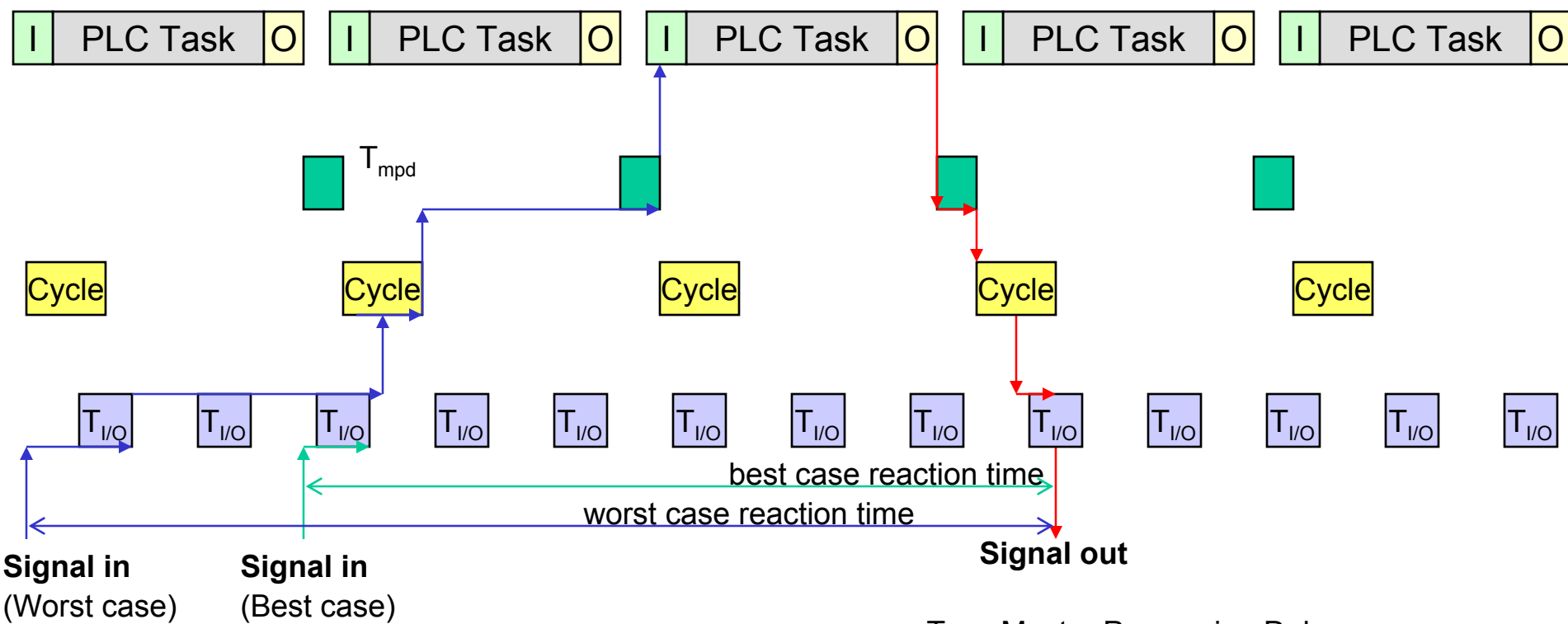
T_{mpd} : Master Processing Delay
 $T_{I/O}$: Local I/O Update Time (Extension Bus)

Reaction Time IV

Reaction to Digital Input

Scenario IV:

- Bus Cycle Time **shorter** than Task Cycle Time
- Bus Cycle **synchronised** with PLC Task
- Local I/O Cycle **not** synchronised with Bus Cycle



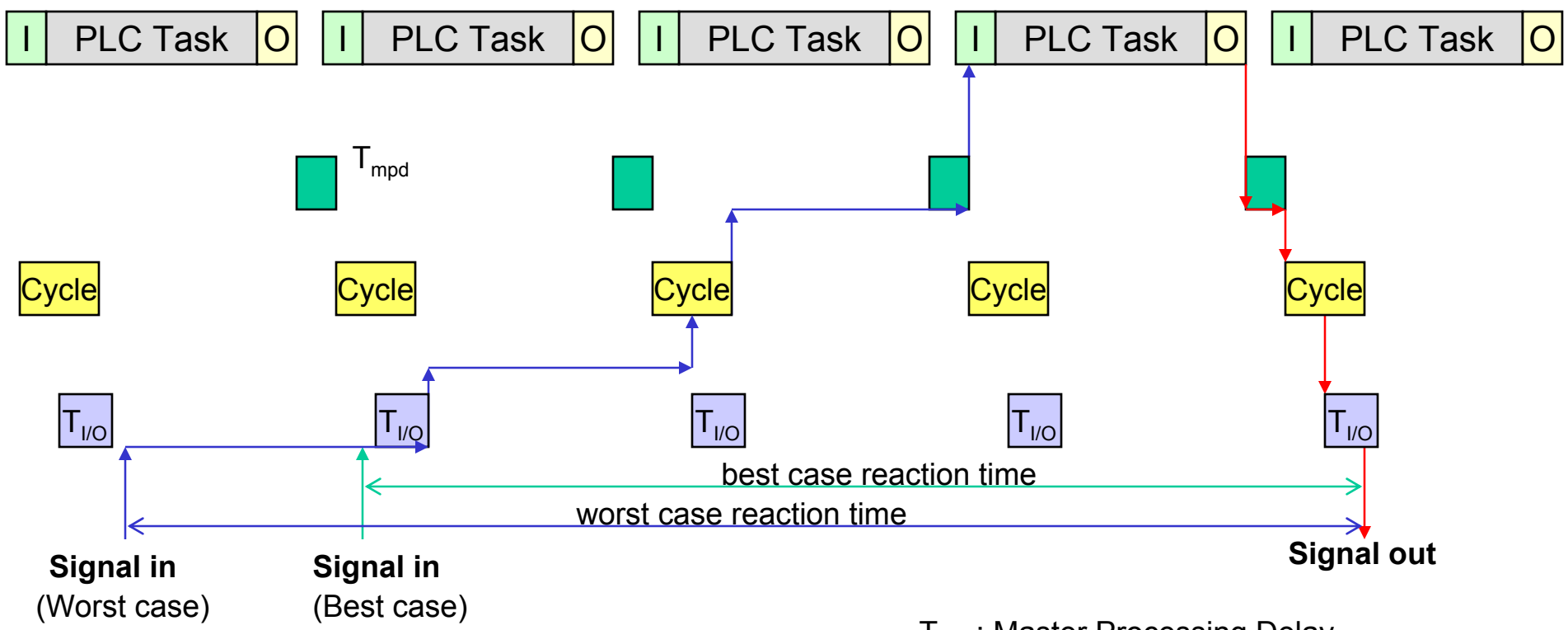
T_{mpd}: Master Processing Delay

T_{I/O}: Local I/O Update Time (Extension Bus)

Reaction Time V

Reaction to Digital Input

- Scenario V:
- Bus Cycle Time **shorter** than Task Cycle Time
 - Bus Cycle **synchronised** with PLC Task
 - Local I/O Cycle **synchronised** with Bus Cycle



T_{mpd} : Master Processing Delay
 $T_{I/O}$: Local I/O Update Time (Extension Bus)

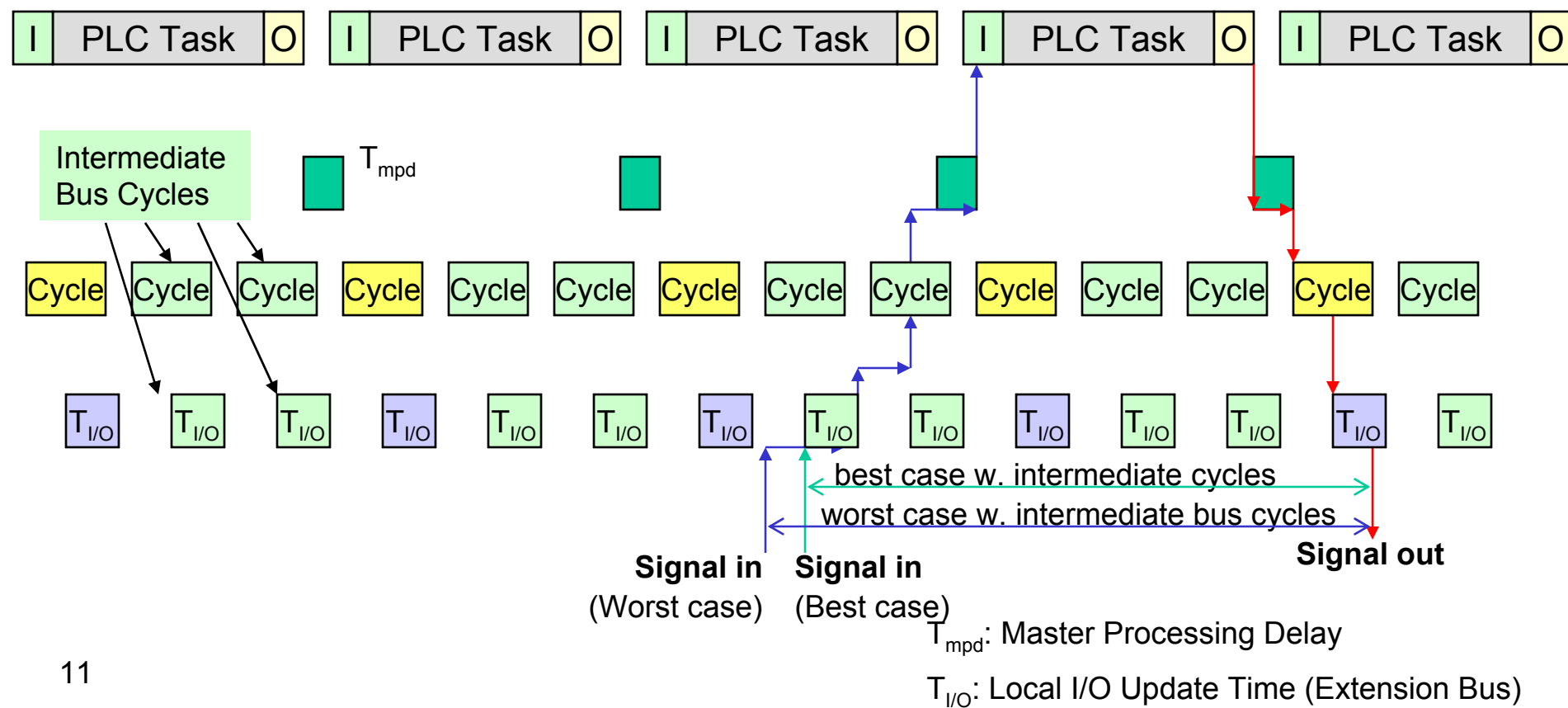
Reaction Time VI

Reaction to Digital Input

Possible with:
Beckhoff TwinCAT / Profibus / Sercos

Scenario VI:

- Bus Cycle Time **shorter** than Task Cycle Time
- Bus Cycle **synchronised** with PLC Task
- Local I/O Cycle **synchronised** with Bus Cycle
- „Tuning“: **Intermediate Bus Cycles introduced**



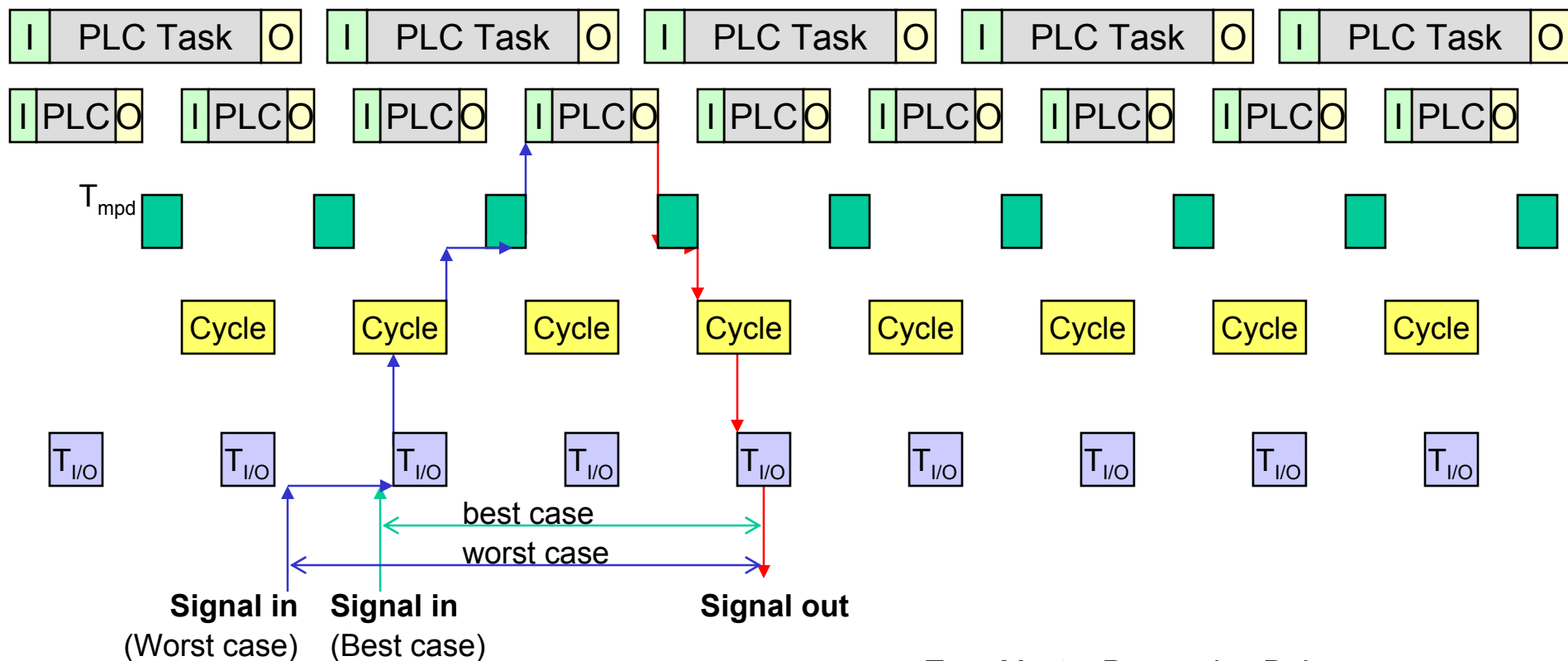
Reaction Time VII

Reaction to Digital Input

Typical for:
Beckhoff TwinCAT / Profibus / Sercos

Scenario VII:

- Bus Cycle Time **short, Several** Task Cycle Times
- Bus Cycle **synchronised** with fastest PLC Task
- Local I/O Cycle **synchronised** with Bus Cycle



T_{mpd} : Master Processing Delay

$T_{I/O}$: Local I/O Update Time (Extension Bus)

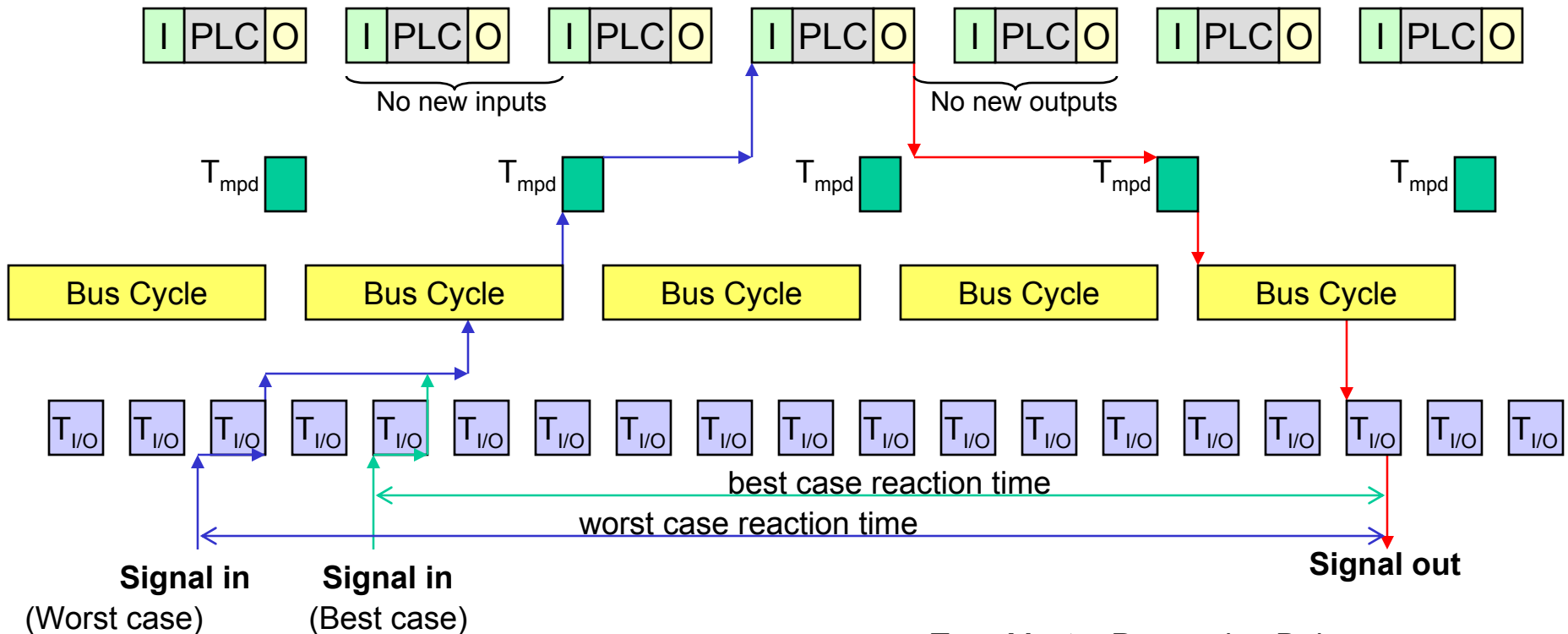
Reaction Time VIII

Reaction to Digital Input

Typical for:
poor bus choice

Scenario VIII:

- Bus Cycle Time longer than Task Cycle Time
- Bus Cycle not synchronised with PLC Task
- Local I/O Cycle not synchronised with Bus Cycle



T_{mpd}: Master Processing Delay

T_{I/O}: Local I/O Update Time (Extension Bus)

Reaction Time: Conclusions

- Bus Cycle Time alone is no good performance indicator
- „Fast enough“ generally means: faster than PLC cycle
- Short Reaction Time is only one criteria – in many applications determinism is crucial
- Synchronisation improves determinism, not necessarily reaction time
- Some applications may require „tuning“

Bus Performance Comparison: Implementations



	Typical bus cycle time	Bus Coupler: K-Bus Synchronised with fieldbus?	Fieldbus Card: internal firmware cycle time	TwinCAT: card synchronised with TCAT task?
Profibus	1-3 ms	Yes (optional)	~ 0,5 ms	yes
Devicenet	5-15 ms	no	~ 2 ms (COS: 0,2ms**)	No (COS: yes**)
Sercos	1-2 ms	yes	~ 0,2 ms	yes
CANopen	3-15 ms	No (in sync mode: yes#)	~ 0,5 ms	no
Lightbus	1-2 ms	yes	~ 0,2 ms	yes
Ethernet	15-100 ms	no	~ 5..15 ms	no