

EEE for Real-Time Industrial Ethernet (?)

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See also our comment # 246

Motivation

- Real-time Industrial Ethernet (**RE**), especially IEC 61158, plays increasing role in industrial communications
- Energy efficiency of interest for industrial communications
- Can EEE philosophy be adapted to RE in a straight-forward manner?

Purpose of this talk

- Make TG EEE aware of potential for energy efficiency in RE
- Address needed retrofit of current EEE
- Induce / gauge support from TG EEE

Outline

- RE
 - Significance
 - Differences to standard Ethernet
 - Cycle time and message structure
- Why energy saving in RE?
- Retrofitting EEE to RE
- Suggested solution: adjustable quiet time
- Where to go from here?
- Summary

Significance of Real-Time Industrial Ethernet

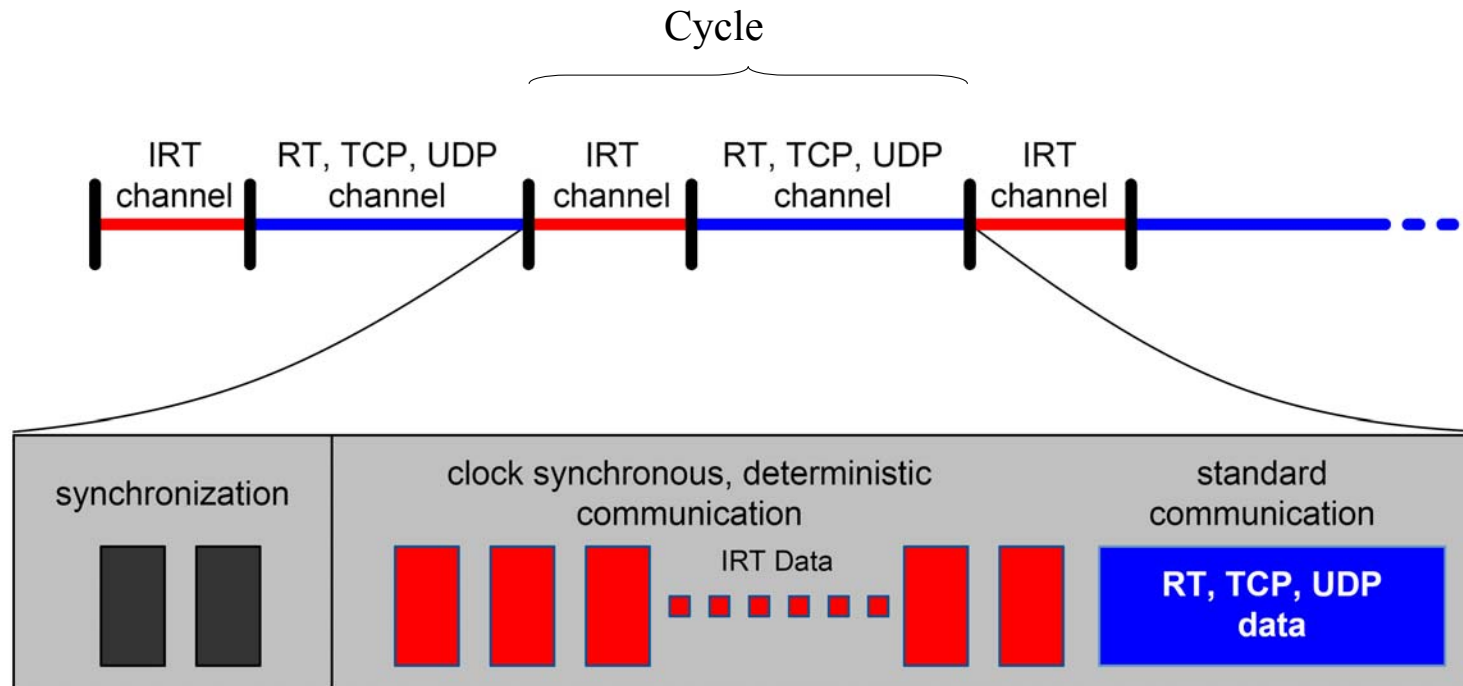
- Industrial (RE!) Ethernet < 2% of total Ethernet market
- But: # of installed units rapidly increasing
 - Ethernet: ~ 10% p.a.
 - Industrial Ethernet: > 30% p.a.!

Differences

	Office Networks	Industrial Networks
Network structure	Core, distribution, and access (typically star topology)	Core, distribution, and machine level (typically line or ring)
Real time communication	Minimum response time up to 150 ms	Response-time requirements 10's of μs – ~ 100 ms (rather on the shorter side)
Environmental conditions	"Office" conditions for network elements	Harsh industry atmosphere (moisture, dust, shock, ...)
Availability and redundancy	OSPF failover times 1-10 s; ~ 3s for RSTP	Failover times < 200 ms with MRP (IEC 62349)

How does RE work?

- Example according to IEC 61158
- Time-slotted data transfer



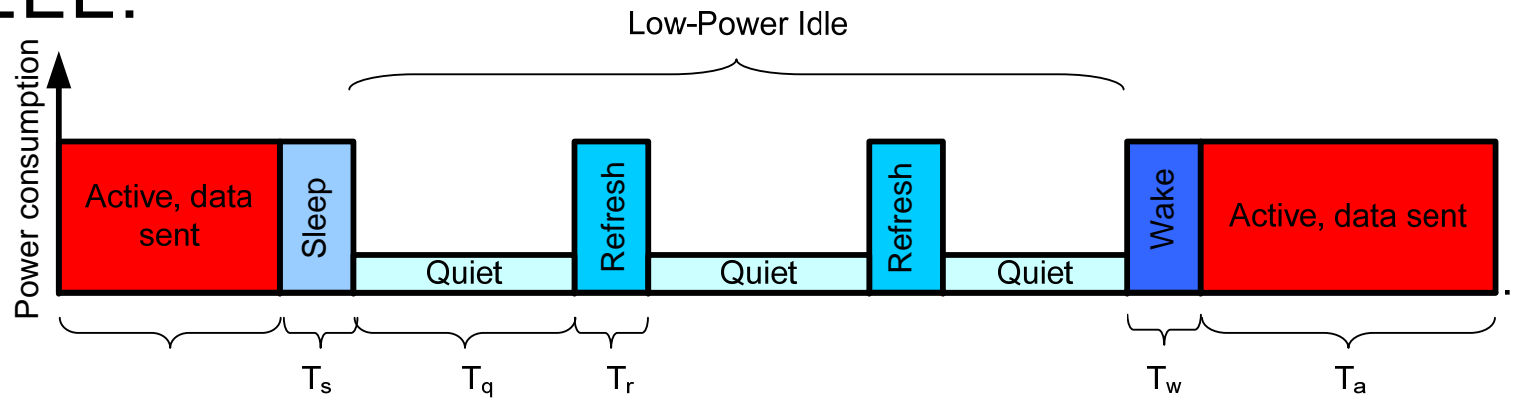
Source: PROFIBUS Nutzerorganisation (PNO), "PROFINET AND IT"

Why saving energy in industrial communications?

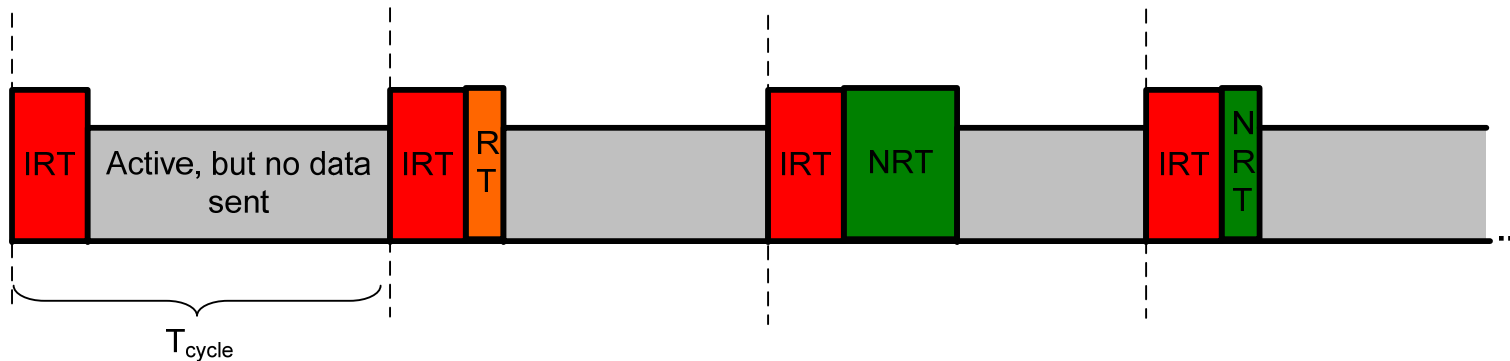
- Fixed or decreasing thermal budget and size of components
 - Passive cooling only, no air vents!
 - Denser packing made possible through lower energy consumption
 - In contrast/conflict with data-rate increase (FE -> GE)
- Cost saving (energy expenditure)
- Industrial networks always on but not always fully used (lunch break, over night, weekends, holidays, ...)
- Global energy conservation (Green ICT)

EEE for RE: bridging the gap

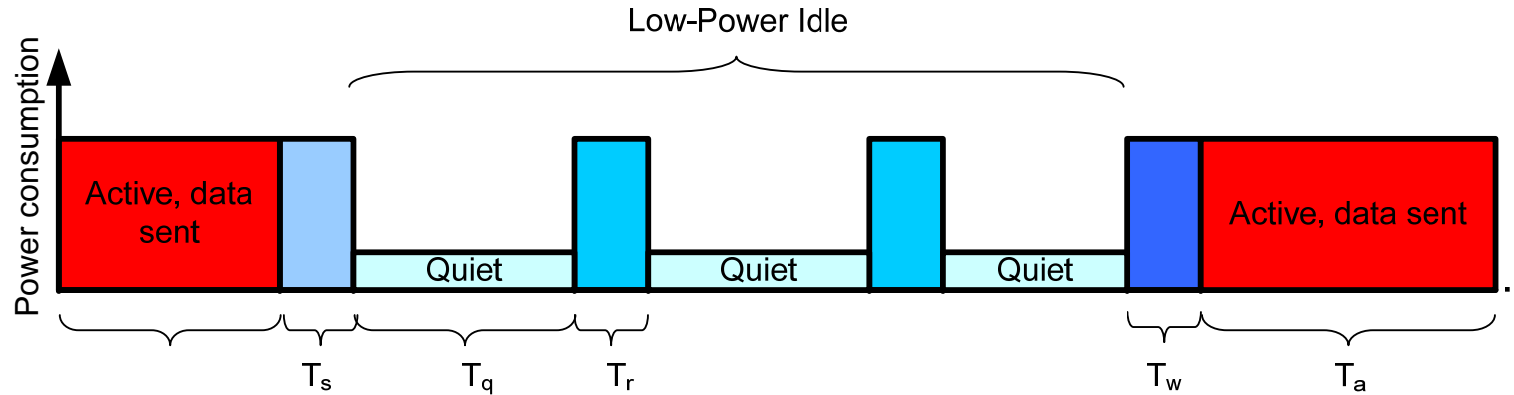
EEE:



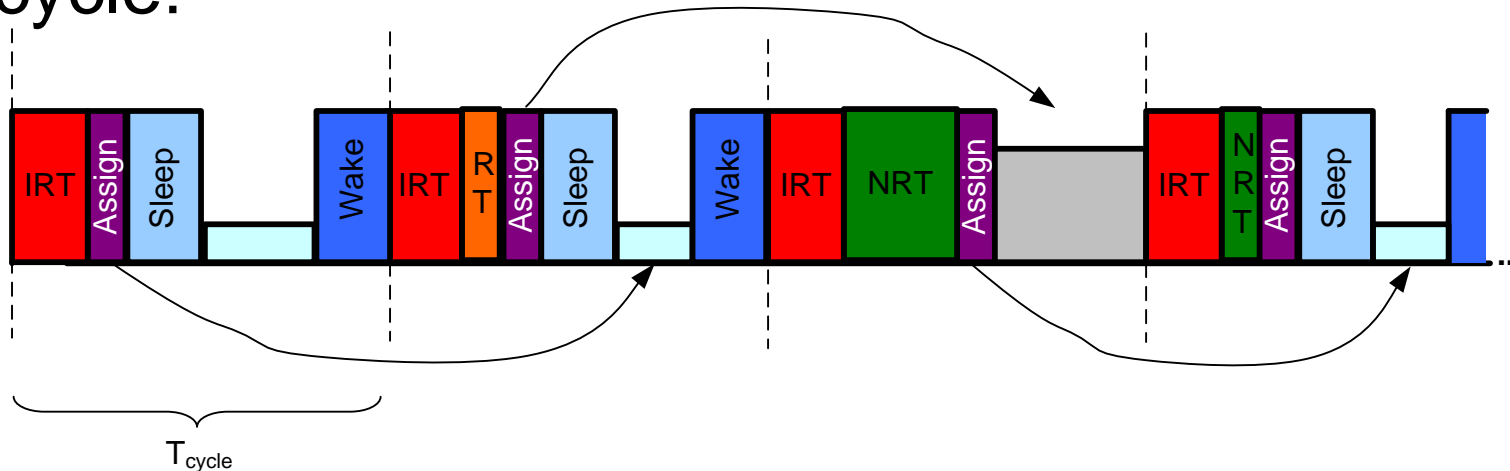
What we have:



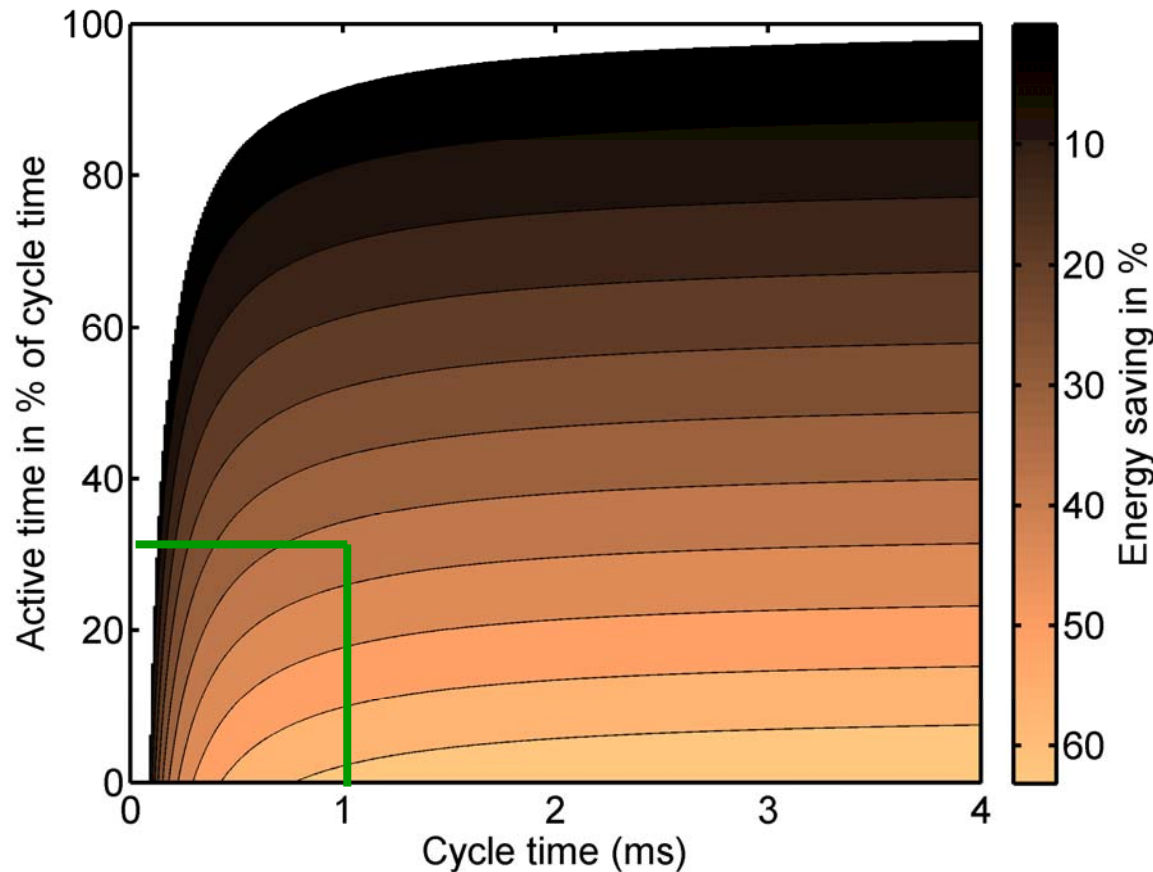
Retrofitting EEE for RE



One approach: shorter low-power idle within each cycle!



Expected energy savings from retrofitted EEE



- 100Base-TX
- Timers taken from draft 1.1
- Energy consumption taken from Chou et al., Jan 2008

Suggested changes to current EEE approach

- Target data rates: FE, GE, (10-GE)
- Make quiet time shorter
 - Currently 2.5 ms (1000BASE-X, Table 36–3a)
 - GE RE cycle times likely much shorter
- Make quiet time dynamically adjustable
- Make sleep and wake timer as short as possible
- Allocate quiet-time control to MAC or cross-layer

Where to go from here?

- Late (?!) for incorporation into current EEE draft
- But:
 - Potential topic for revision of EEE in 802.3
 - Pro-active approach
 - Solicit contributions from IEC 61158 and others (?)
 - Coordination with other IEEE TGs?
(802.1Qat, 802.1AS, ...)

Summary

- Presented industrial communications with an emphasis on real-time Ethernet to TG EEE
- Motivated energy saving in industrial communications
- Presented potential EEE hacks to accommodate RE
- Suggested next steps

CI 24	SC	P 43	L	# 246
Walewski, Joachim		Siemens AG		
<i>Comment Type</i>	T	<i>Comment Status</i>	X	LATE
<p>COMMENTER ALSO FLAGS CLAUSE 36 Our comment concerns clause 24 (100BASE-X) and clause 36 1000BASE-X. We base our comments on Draft 1.1 as provided by the EEE working group.</p> <p>We are interested in whether the emerging EEE standard could be extended in order to include real-time Ethernet, especially PROFINET. Real-time Ethernet is characterised by synchronised, cyclic data frames. In the case of PROFINET these frames are between 31.25 us and 4 ms long. In order to enable energy saving in this kind of transmission scheme one would need to switch the respective Tx and Rx of within one cycle. Since the current timers, especially the quiet timer (see tables 24-2 and 36-3 on pages 43 and 84, respectively), are currently too long, we wonder if they can be changed. In particular, in order to accommodate energy saving for varying cycle payloads, one would need to dynamically adjust these timers, e.g., the quiet timer, from one cycle to the next. Therefore, we would not only need shorter timers (particularly the quiet timer) but also dynamically adjustable timers.</p> <p>If the topic outlined and the issues raised are of interest for the IEEE 802.3az TG we are happy to provide more details at the next IEEE 802 plenary in Vancouver, BC.</p> <p><i>Suggested Remedy</i></p> <p>Making timers dynamically adjustable and shorter enabling EEE on Real-time Ethernet (Profinet).</p>				
<i>Proposed Response</i>		<i>Response Status</i>	O	