IEEE 802.3cg 10 Mb/s Single (Twisted) Pair Ethernet (10SPE)

ORLANDO: ELEVATOR/ESCALATOR USE CASE, TOPOLOGY AND FAILURE MODES (rev6)

Supporters

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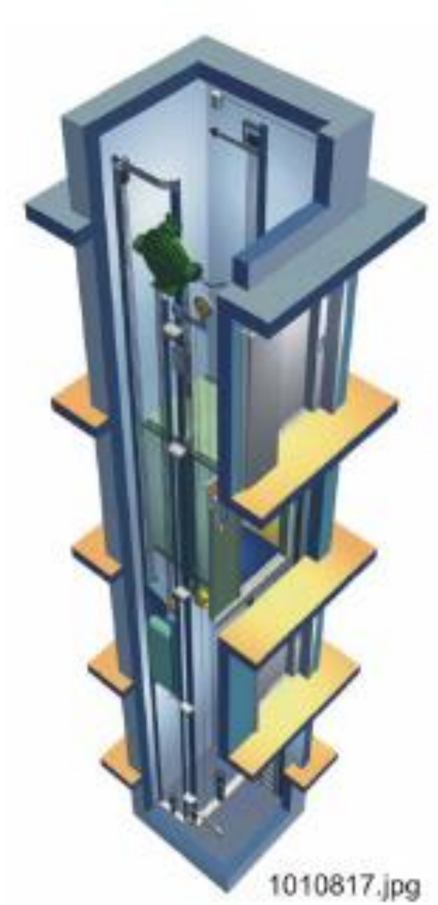
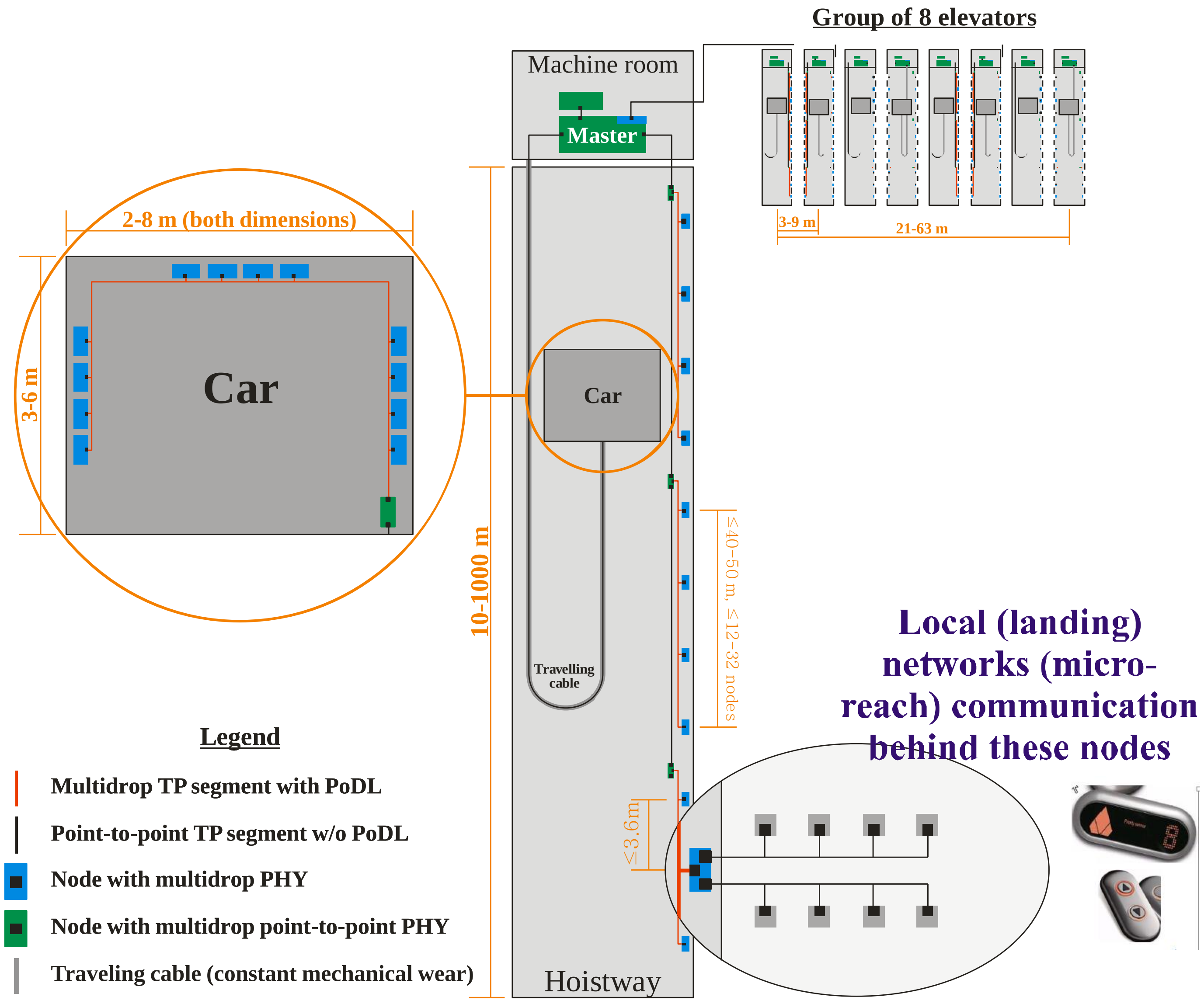
A typical elevator



Layered architecture (bottom-to-top):

- User I/O and sensors
- Lift and motion control
- Group control
  - Single units are often linked into groups of 2-16 single units via networks
- Site control and supervision
  - Groups are often linked into site control and supervision groups via networks
- Cloud
  - Sites are monitored and controlled remotely

Possible network schematics of an elevator



Introduction (elevators, global)

- Current network solutions: legacy, slow-speed networking
  - Volume: mainly RS485-, CAN- and simple proprietary solution-based products
- On the worldwide market:
  - Currently: ≈850.000 new installations / year: each having avg. 20 serial port interfaces
  - 2020: ≈1.000.000 new installations / year, meaning 20 million nodes / year
- Requirements of near-future systems (functional safety, voice and video streaming, Power over Network/PoNetwork) can not be met using these networks
- Product’s life (market-dependent):
  - Life-cycle is 15-30 years
- We can estimate that half of the 20 million nodes per year market could be Ethernet-based in ten years’ time

Future network: bird's eye view

- **External interfaces**: interfacing commercial Ethernet-based devices, building automation, e.g. security- and door-controllers, cameras, motion-detector (*any*-reach)
- **Group communication:** linking lift groups inside the building
- **Machine-room**: high communication speed with several head-units/controllers (short-reach)
- **Travelling-cable**: point-to-point (long reach)
- Local **car**: multiple devices, in confined space (short-reach)
- **Hoistway**: Short-reach multidrop branch serving 2-16 floors

  ► Multiple branches can be linked together using daisy-chained point-to-point switches (mixture of long-and short-reach)
- Local **landing communication**, such as displays, call buttons, card readers (**micro-reach**, BP-like possibly with flat ribbon cable)

Future network: “all over Ethernet” network end-to-end

Type	Reach	Nodes	Topology	PoNetwork	Notes
Micro-reach[1]	≤10m	≤8 nodes	Multidrop	Yes	New use-case, similar to BP[1]
Short-reach	**≤40m**	**≤24 nodes**	Multidrop	Yes	**Would a straw-poll be possible to probe interest and support?**
Long-reach	≤1000m	2 nodes	Point-to-point	No	

- Multidrop (half-duplex) 10SPE to **replace legacy networks** (RS485, CAN, I2C etc.), extension of reach and number of nodes shall be considered, as follows:
  – Reach: “minimum 40m” instead of “minimum 15m”
  – Nodes: “up to 24 nodes” instead of “up to 6-8 nodes”

  \+ PoNetwork as an option

- [1] Not a new PHY, just a new use-case, so in real life micro- ad short-reach would run on the same PHY

Failure modes

- Past experience with RS485: node (controller/host) or even XCVR failure caused network segment failure very seldom (due to components used and simple design principles followed)
- Assumption on 10SPE PHY: failure of controller and/or PHY would have a low chance of “jamming” the whole segment (= communication between other nodes on the same segment)
- Simple calculations (see our last presentation given Sep 2017 in Charlotte) show that point-to-point underperforms multidrop:
  - with respect to reliability/availability, when the latter is used in daisy-chain setup
  - propagation-delay-wise (our understanding is that every point-to-point hop would introduce ≈6µs switching delay)
  - with respect to scalability (even in engineered systems)
  - with regards to PoNetwork

Power-budget (short- and micro-reach)

- Some (original) expectations were beyond possibilities
- Adjusted expectations show that core features of up to 24 nodes / MD segment could be covered by 32W (at 24VDC) at the PD side → **is this reasonable or shall we go deeper in adjustment of requirements?**
- Further decrease of consumption can be achieved by:
  - Decoupling core features (communication and control) from mechanisms where consumption can not be brought beyond a certain point (involving physical motion, sound, lightning)
    - All functional and safety control elements has PoNetwork
    - Exposed and power-demanding parts (LCD displays, actuators, relays, LED arrays) have local PSU
  - Introduction of new technologies (with less power consumptions)

Understanding and doing the work needed towards the change of specs

- Looking for further support
- Running necessary measurements and simulations
  - Performance of current components/cables used
  - Noise profile of an elevator environment
  - Abstract simulation of the extend network specs
- Pinning the new figures
- Anything else / did we miss something?

Next steps

- Going more precise on figures elevator world needs → large scale, formal and repeatable calculation to understand past needs
  - ► Ongoing work that is expected to yield output by Geneva (Jan 2018), where we would like to present the results
- Designing and running necessary calculations and simulations towards the changed specs
- Doing necessary network and noise characteristics measurements in elevator environment and using appropriate components (connector and cables)
- Last but not least: looking for supporters and offering our support

Thank you for your kind attention

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