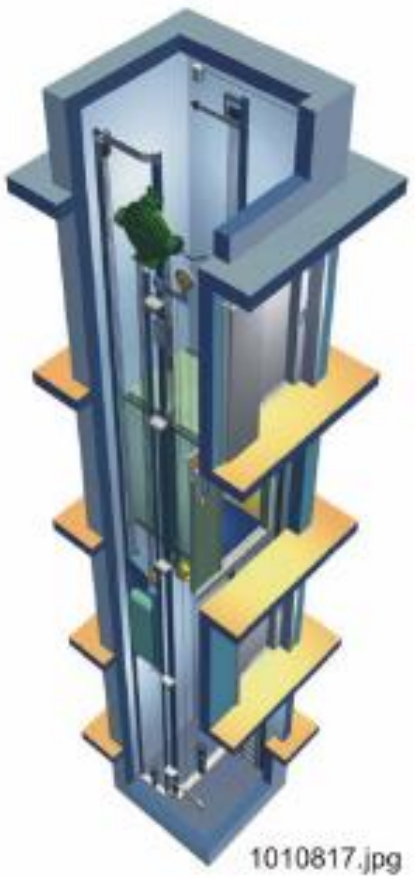
IEEE 802.3cg 10 Mb/s Single (Twisted) Pair Ethernet

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

Supporters

A typical elevator



- Single units are often linked into groups of 2-16 single units via networks
- Groups are often linked into site control and supervision groups via networks

Introduction (elevators, global)

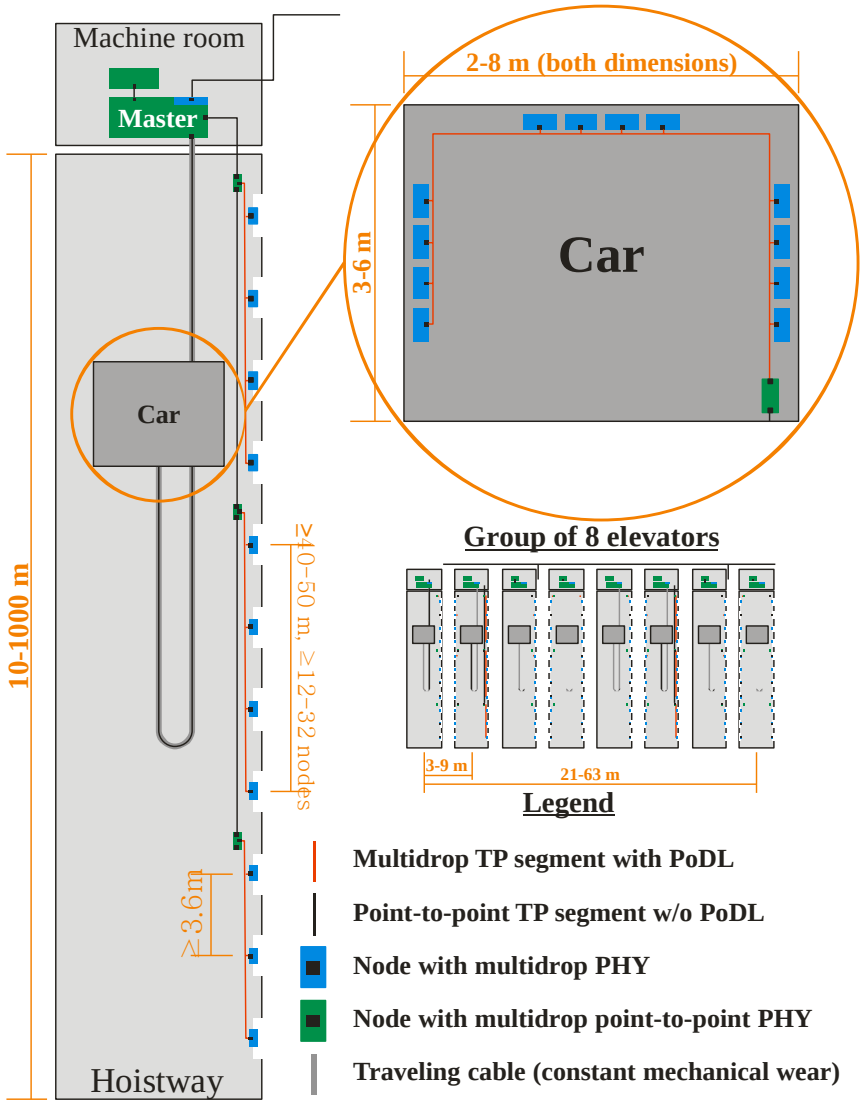
- Current network solutions: legacy, slow-speed networking
  - Volume: mainly RS485-, CAN- and simple proprietary solution-based products
- On the worldwide market:
  - Currently: ≈850.000 new installations / year: each having avg. 20 serial port interfaces
  - 2020: ≈1.000.000 new installations / year
- Requirements of near-future systems (functional safety, voice and video streaming, power over communication line) can not be met using these networks
- Product's life (market-dependent):
  - Life-span is 15-20 years (up to 30 years in some areas)
  - 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

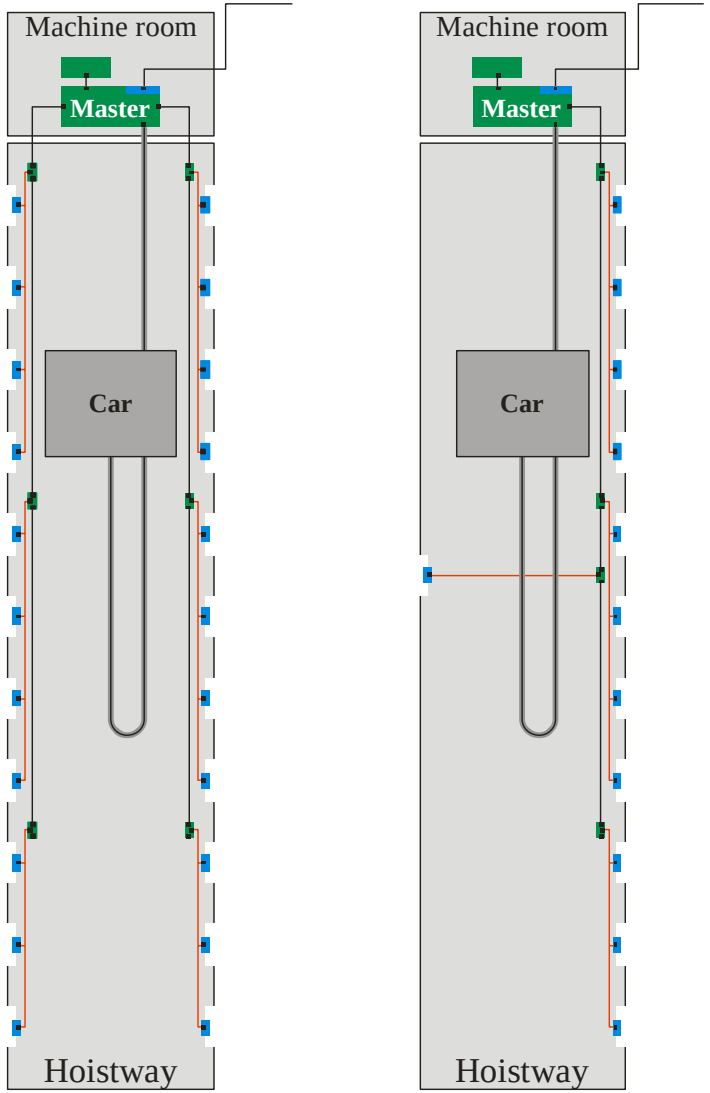
- **Machine-room**: high communication speed with several head-units/controllers (short-reach)
- **Travelling-cable**: point-to-point (long reach)
- **Car**: multiple devices, in confined space (short-reach)
- **Hoistway/landings**: daisy-chain of switches serving smaller branches (mixture of long- and short-reach)
- Landing-side **local communication**, such as displays, call buttons, card readers (**micro-reach**, BP-like possibly with non-TP cable)
- **External interfaces**: interfacing commercial Ethernet-based devices, building automation, e.g. security- and door-controllers, cameras, motion-detector (any-reach)

Possible network schematics of an elevator

Typical network topology in an elevator (1 side)



Typical network topology in an elevator (2 sides)



Future network: details

Type	Reach	Nodes	Topology	PoNetwork	Notes
Micro-reach	≤10m	≤8 nodes	Multidrop (HD)	Yes	New, similar to BP
Short-reach	**≤50m**	**≤32 nodes**	Multidrop (HD)	Yes	**Request for change of specs**
Long-reach	≤1000m	2 nodes	Point-to-point (FD)	No	

- To give much better chance for the short-reach PHY to become a viable general replacement option for legacy (RS485, I2C, CAN) networks, extension of reach and number of nodes could be considered, as follows
  - Reach: “minimum 50m” instead of “minimum 25m”
  - Nodes: “up to 32 nodes” instead of “up to 6-8 nodes”
- In real life micro- and short-reach PHY can (or even is preferred to) be the same unit

Power-budget (short- and micro-reach)

- Some (original) expectations were beyond possibilities
- Adjusted expectations show that core features of up to 32 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 increase 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)
  - Introduction of new technologies

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 cahne 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
  - with regards to PoNetwork
  - propagation-delay-wise (our understanding is that every point-to-point hop would introduce ≈6µs switching delay

Understanding and doing the work needed towards the change of specs

- Looking for further support
- Running necessary measurements and simulations
- Pinning the new figures
- Anything else?

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

Ari Kattainen
Gergely Huszak