10 Mb/s Single Twisted Pair Ethernet
Power Link Segment Disturbances

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Overview

Supporting Presentation for other possibilities raised:

Link loss recovery? A ‘fast recovery’ objective, and if so, how long?

Suggestion of new Objective:

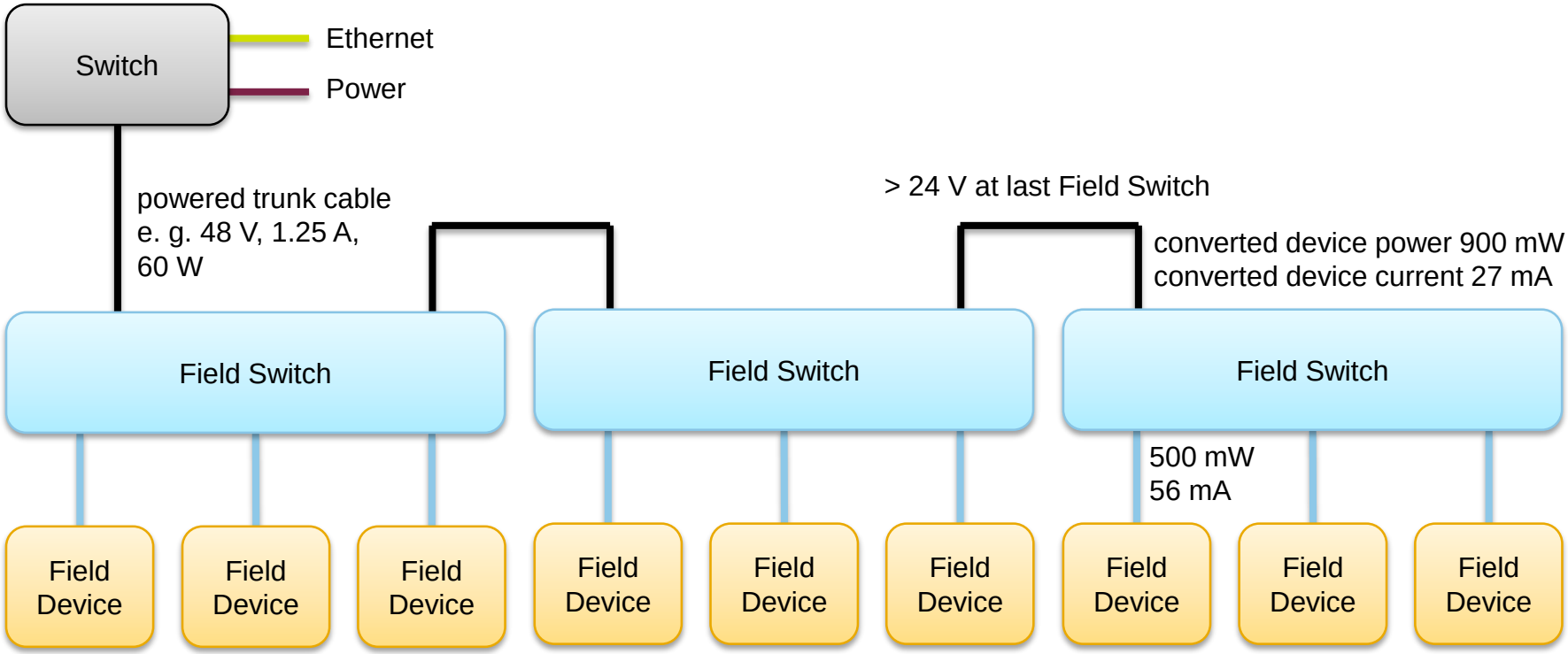
Provide a PHY impulse noise tolerance of at least 50 ms.

Content:

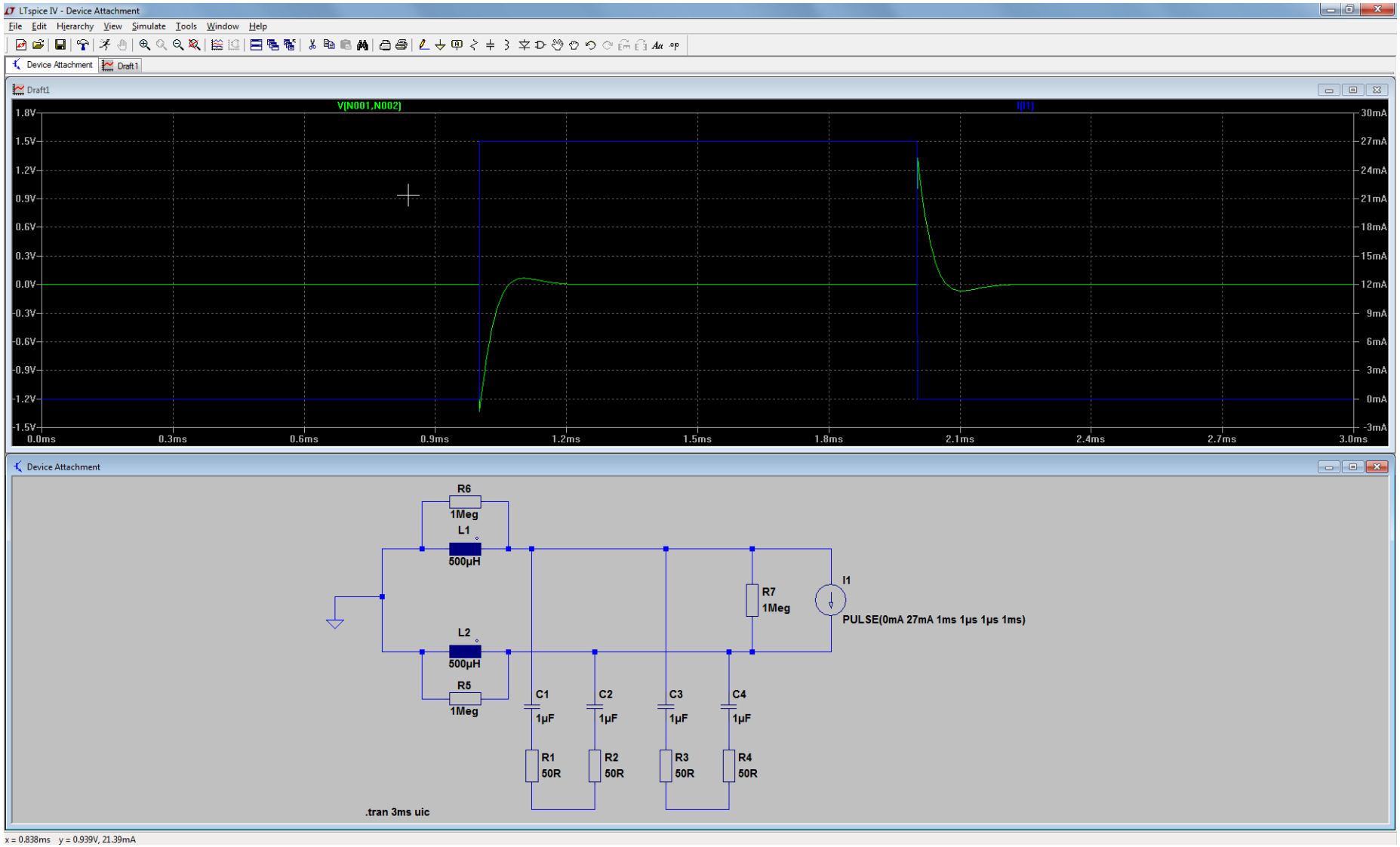
- Powered Daisy-Chain Topology
- Disturbances by Connecting Components
- Influence on Communication
- Influence on the PHY Design

Powered Daisy-Chain Topology

- Connecting or disconnecting of a field device leads, depending on the supply voltage of a field switch to a current step on the daisy-chain trunk.
- These current steps will have a similar or even higher amplitude than the communication signal itself (e. g. 27 mA will lead to a disturbance of about 1.35 V, what is, depending on the signal attenuation much more than the communication signal itself).
- Connecting or disconnecting a field switch will lead to even higher disturbances.



Disturbances by Connecting Components

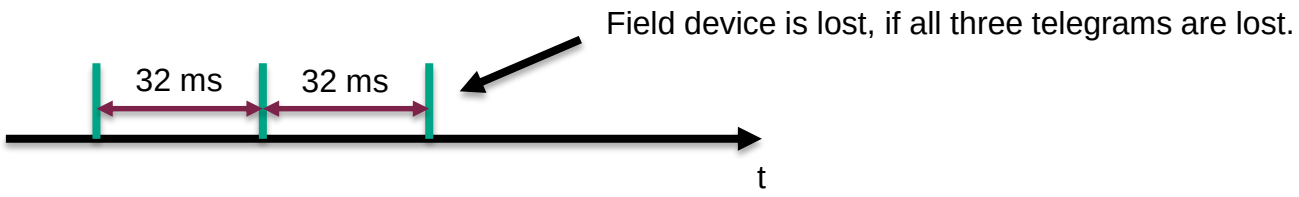


Disturbances by Connecting Components

- Connecting or disconnecting a field device, as shown on the previous slide, will lead to a short disturbance on the trunk (in the given example for about 200 µs (2000 bit times @10 Mbit/s)).
- Connecting or disconnecting a complete field switch, the disturbance amplitude will be higher, due to the higher current change seen on the trunk cable.
- Taking into account, that several inductors are connected in a daisy-chain, this will increase the overall inductance and therefore lengthen the disturbance time to more than a millisecond in a typical system (> 10000 bit times @ 10 Mbit/s).
- Assuming, that the field switches also contain larger capacitors, which need to be charged slowly and that there will be need for ramping the supply current of a field switch, this will lengthen the time while the communication may be disturbed.
- According to IEC61158-2 fieldbus standard attaching a field device may disturb the bus communication for up to 20 ms. After that time the current consumption of the device must be stable and may not change with a higher rate than 1 mA/ms.
- Taking such a time into account as a base line, the expectation is that a powered 10SPE system must be able to handle similar or when thinking about redundancy even higher signal disturbance times without dropping the link.

Influence on Communication

- Data telegrams which are transmitted during connecting or disconnecting a device to a powered 10SPE system will most likely be destroyed.
- This is not an issue when operating such a system, because the upper layer protocols (e. g. Profinet or EthernetIP) will be able to handle such situations as long as the disturbance is short enough.
- A field device normally is lost, if 3 consecutive telegrams from this device are lost.
- Assuming 32 ms cycle time, if a link fails for more than about 64 ms, all nodes connected to this link will get a communication failure.
- If a trunk link segment is disturbed for a longer time this would lead to a complete loss of all devices being connected to this link.



Influence on the PHY Design

- The 10SPE PHY needs to be able to withstand the disturbances when connecting or disconnecting a field device or a field switch within a daisy-chain powered trunk.
- These disturbances will have similar effects on the communication than transient noise pulses, but most likely in another frequency range and having a longer duration compared to the EFT burst packets.
- Therefore the link drop state machine within the PHY needs to be designed so that it has a long enough time constant to be able to handle such disturbance effects.
- As the link segment behavior after the disturbance is the same or very similar than before no retraining of the PHY is necessary in such a case.
- To have some safety margin the impulse noise tolerance of the 10SPE PHY needs to be high enough to be able to withstand about 50 ms of disturbances while changing the configuration of a running segment.

Thank You