10 Mb/s Single Twisted Pair Ethernet
Auto-Negotiation Start Delimiter
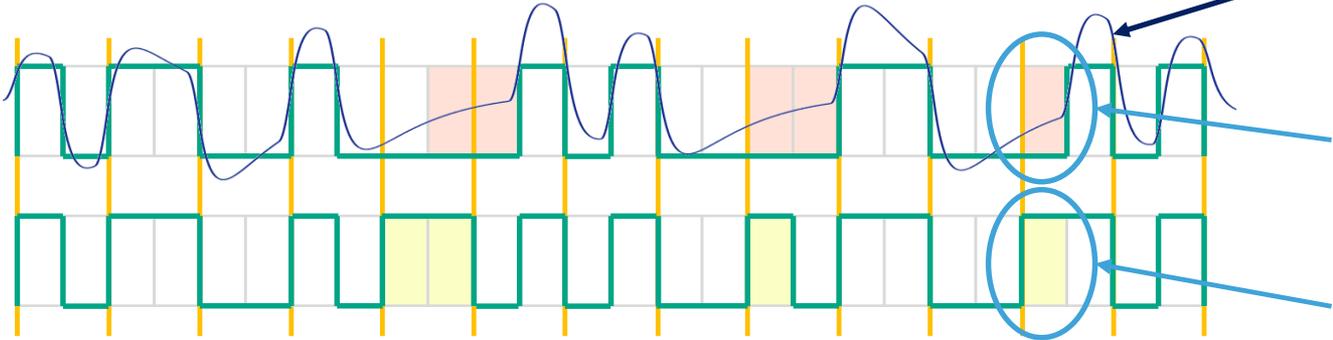
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Content

- Start Delimiter

- Correlator Output

- Conclusion

Start Delimiter

- Standard Clause 98 start delimiter:

The blue curve shows the receive signal after an approx. 1000 m link segment, a 200 kHz 2nd order high pass and 8 MHz 1st order low pass filter.

Due to BLW effect the red shaded areas do not contain much signal energy, thus not having a big effect on the correlation.

The below signal shows a valid DME data signal. The yellow shaded areas show the difference in the data signal compared to the start delimiter (code violations).
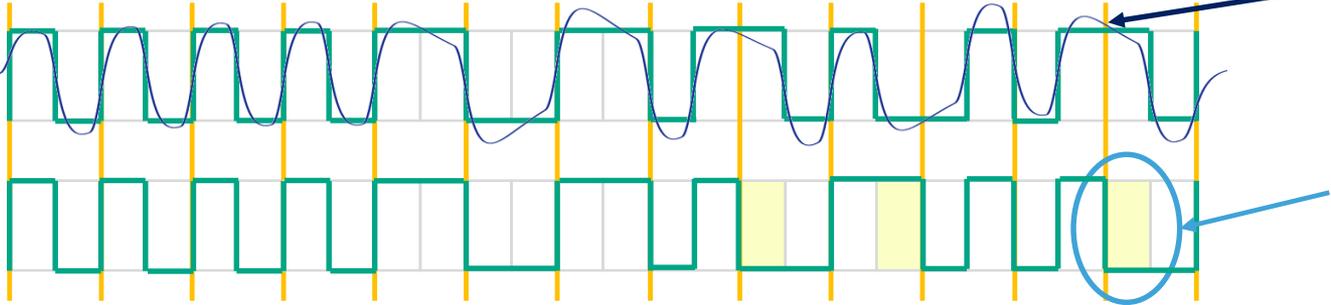
Due to the low signal frequency and a typical high pass filter frequency of 200 kHz at the receive side of the PHY (cutting off noise in the range of up to 150 kHz in industrial applications and allowing for a ramp rate of up to 100 mA/ms change in current consumption for powered applications), the long pulses of the start delimiter show a quite high BLW. Therefore a detection of the start delimiter using correlation will not be optimal. A simple detection of the start delimiter, e.g. using a simple shift register with value comparator, is also prevented by the high BLW.

- Proposed new start delimiter for low speed Auto-Negotiation version:

The blue curve shows the receive signal after an approx. 1000 m link segment, a 200 kHz 2nd order high pass and 8 MHz 1st order low pass filter.

The below signal shows a valid DME data signal. The yellow shaded areas show the difference in the data signal compared to the start delimiter (code violations).

The proposed start delimiter does not contain any longer pulses than in the normal DME signal, thus causing significantly less BLW. Additionally it provides a short preamble at the beginning of the start delimiter allowing an easy synchronization. The suggested start delimiter has only three DME code violations (compared to the four DME code violations of the original start delimiter), but due to the significantly reduced BLW being better visible for the correlation function.

Correlator Output

- Standard Clause 98 start delimiter (correlator output):

Correlation result is approx. 3.12 for original start delimiter
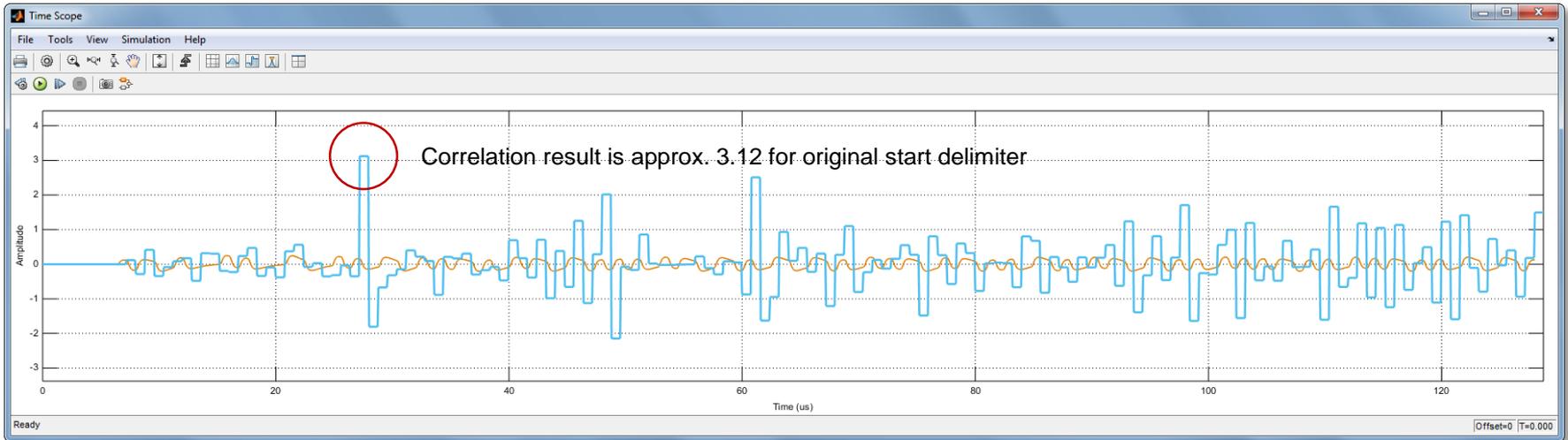
- Proposed new start delimiter for low speed Auto-Negotiation version (correlator output):

Correlation result is approx. 3.65 for proposed new start delimiter
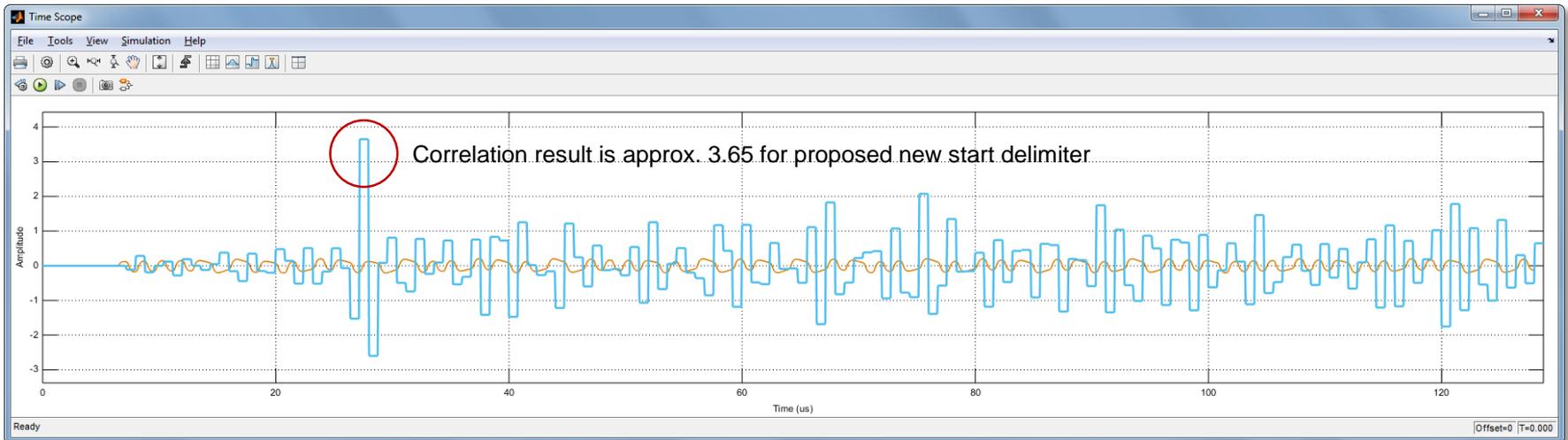
Conclusion
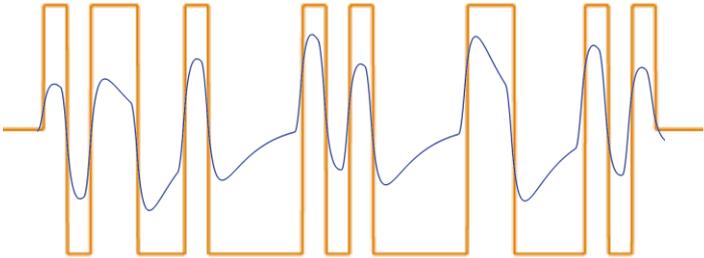
Clause 98 start delimiter	Proposed new start delimiter for low speed mode
+ Clause 98 standard start delimiter.	- Not the standard start delimiter of Clause 98.
+ Very good correlation properties, if the high pass filter corner frequency is low compared to the Auto-Negotiation signal frequency.	+ Good correlation properties, even if the high pass filter corner frequency is in a similar range than the Auto-Negotiation signal frequency.
- The standard start delimiter has a quite high difference in the number of "+1" and „-1" pulses introducing a DC offset into the signal.	+ The difference in the number of "+1" and "-1" pulses has been reduced compared to the standard start delimiter.
- The frequency range of the start delimiter is significantly lower than for the normal DME signal.	+ The frequency range is identical to the normal DME signal.
- The start delimiter causes a high amount of BLW in combination with the high pass filter in the receive path of a 10BASE-T1L PHY.	+ Significantly reduced BLW in combination with the high pass filter in the receive path of a 10BASE-T1L PHY.
- Due to BLW reduced correlation properties (because of the BLW there are areas with no signal energy left after high pass filtering).	+ Better correlation properties in combination with the high pass filter in the receive path of a 10BASE-T1L PHY.
- Due to high amount of BLW need for a more complex synchronization of the receiver.	+ First four pulses allow an easy synchronization of the edge detector in the receiver (in principle they are a short preamble).
- A correlator/matched filter is needed for reliable detection of the start delimiter.	+ Depending on the noise environment also very simple detection methods on binary level are possible (using a shift register and value comparison).

- The proposed new start delimiter for Clause 98 low speed Auto-Negotiation mode has similar properties as the normal DME signal thus, in combination with the receive path filtering of a 10BASE-T1L PHY, providing reduced BLW and therefore an easier detection of the start delimiter and edge detector synchronization.
- Therefore it is proposed to change the start delimiter of Clause 98 to the new version for the low speed Auto-Negotiation mode.

Thank You