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

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Content

- **New Start Delimiter Proposal:**

  A new Start Delimiter for the „low speed“ Auto-Negotiation Mode

- **Conclusion:**

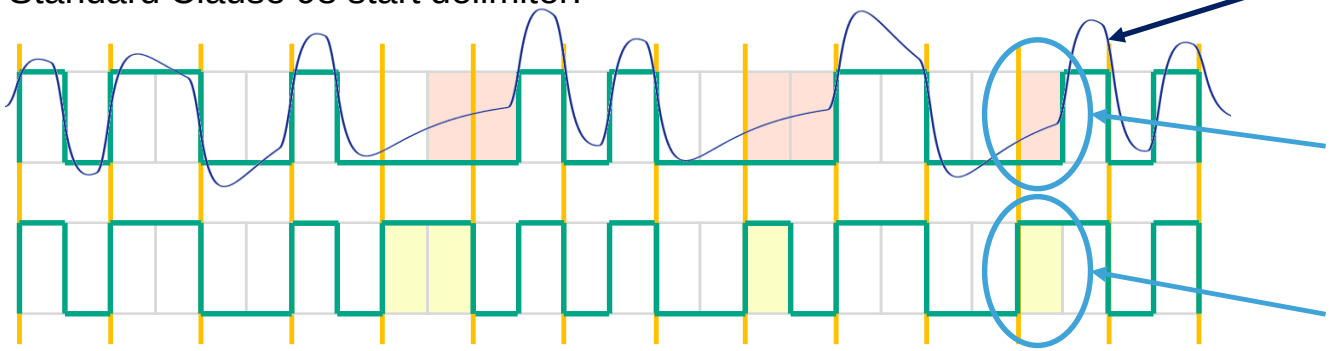
  Reliable telegram decoding

  Reduced implementation effort in „low speed“ detection circuit

  Only affecting the „low speed“ mode, keeping compatibility for the „high speed“ mode

New Start Delimiter Proposal

- Standard Clause 98 start delimiter:



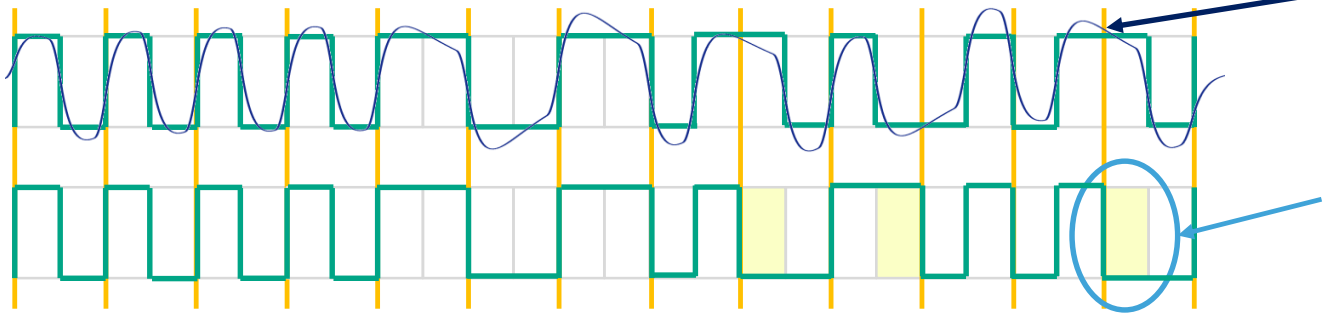
The blue curve shows the receive signal after an approx. 1000 m link segment, a 200 kHz 1st order high pass and 8 MHz 1st order low pass filter.

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).

  - The start delimiter specified in Clause 98 causes a **high BLW** at the receiver.
  - Therefore detection of the start delimiter using a **correlator is quite bad**.
  - A **simple detection** (e.g. using a shift register and comparator) **is prevented**.

- 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 1st 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).

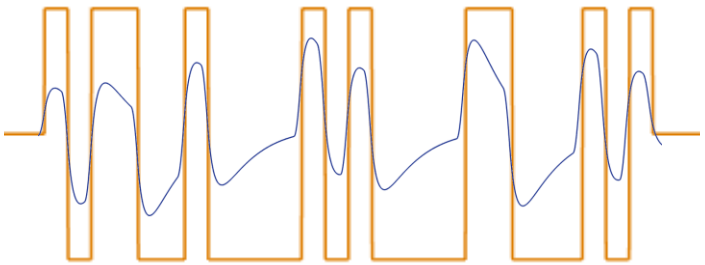
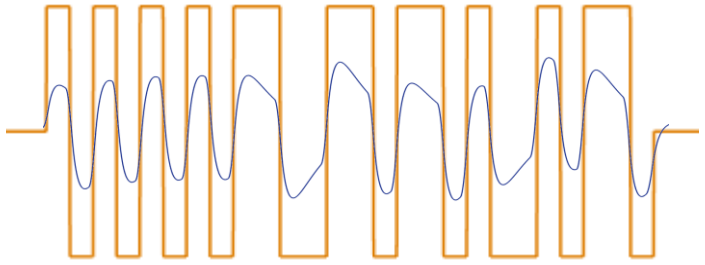
  - The proposed start delimiter causes **significant less BLW** (no longer pulses as normal DME signal).
  - Only three instead of four code violations, but they are **better visible to the correlator**.
  - A **simple detection** (e.g. using a shift register and comparator) **is possible**.

Conclusion

- The existing **Clause 98 start delimiter for the „high speed“ Auto-Negotiation will not be changed**, therefore there will be **no compatibility issues with existing implementations**.
- The proposed new start delimiter for the „low speed“ Auto-Negotiation provides **less BLW**, has an **increased visibility using a correlator** and also provides the ability to use a **simple implementation** by sampling the edges of the data signal into a shift register and just checking for the correct start delimiter value in this register (applying some noise filtering on the oversampled signal before, if necessary).
- There is **minimal to no implementation effort** for the proposed start delimiter:
  - If both „high speed“ and „low speed“ Auto-Negotiation are implemented in the same chip, then an additional 26 bit multiplexer plus a small selection logic are required to be able to switch between the two start delimiters.
  - If only „low speed“ Auto-Negotiation is being implemented, there is no effort at all compared to the existing Clause 98 Auto-Negotiation (as just the SD sequence is changed).
- Adapting the start delimiter for the „low speed“ Auto-Negotiation improves the reliability of the telegram decoding while reducing complexity in the detection circuit without adding or only adding minimal effort to the start delimiter circuitry.
- **Therefore the suggestion is to change the start delimiter for the „low speed“ Auto-Negotiation to the proposed new one.**

Backup Slides

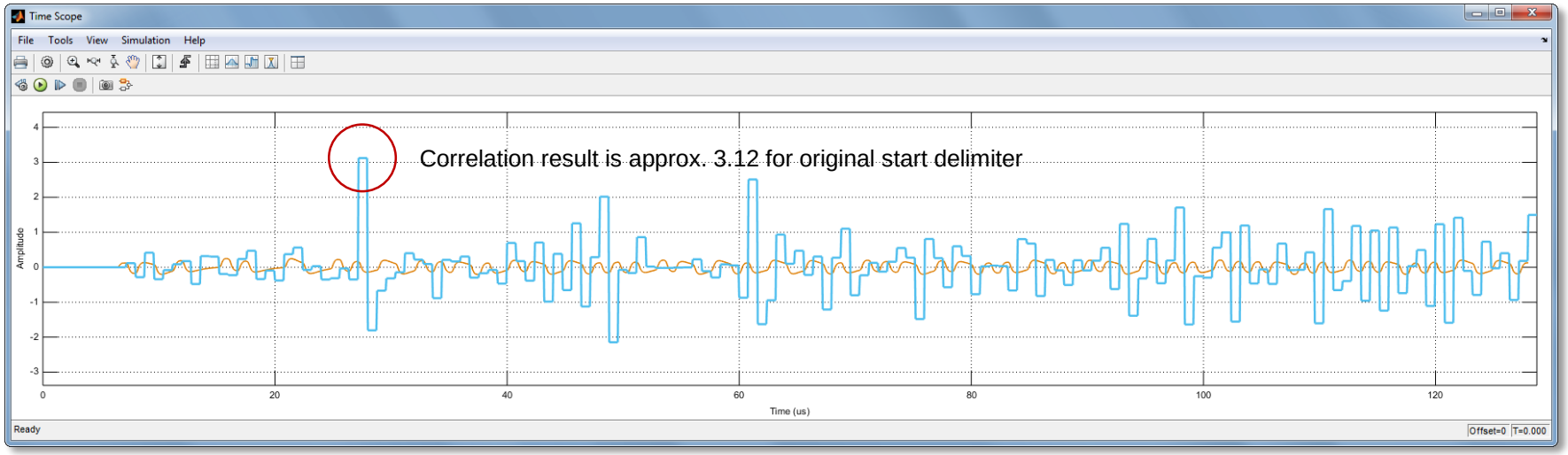
Comparison

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).

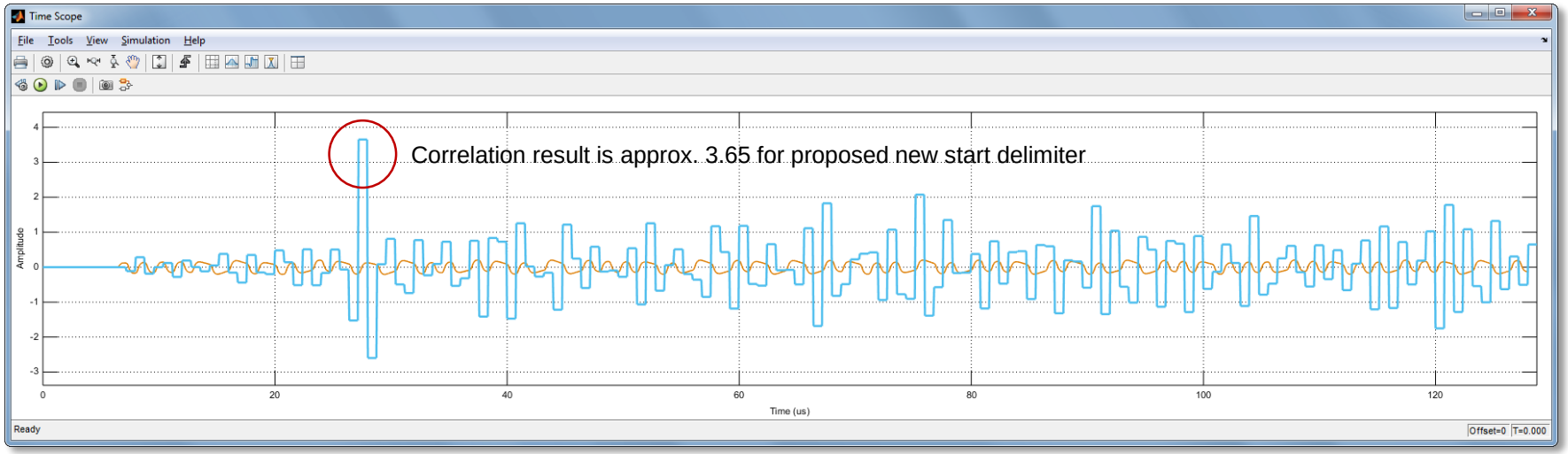
- The proposed new start delimiter for Clause 98 low speed Auto-Negotiation mode has similar properties as the normal DME signal thus, in combination with the receive path filtering of a 10BASE-T1L PHY, providing reduced BLW and therefore an easier detection of the start delimiter and edge detector synchronization.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

Correlator Output

- Standard Clause 98 start delimiter (correlator output):



- Proposed new start delimiter for low speed Auto-Negotiation version (correlator output):



Thank You