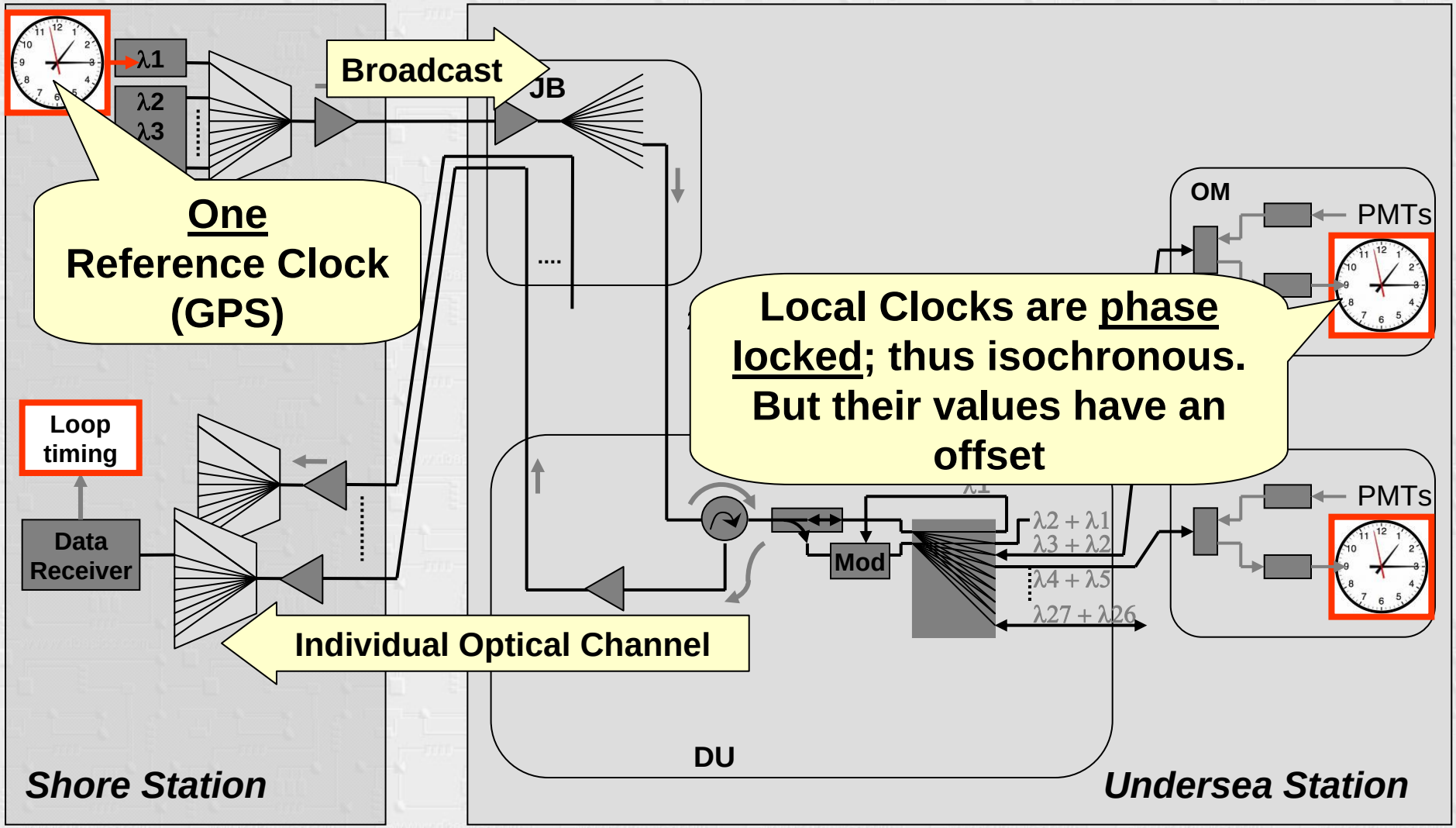
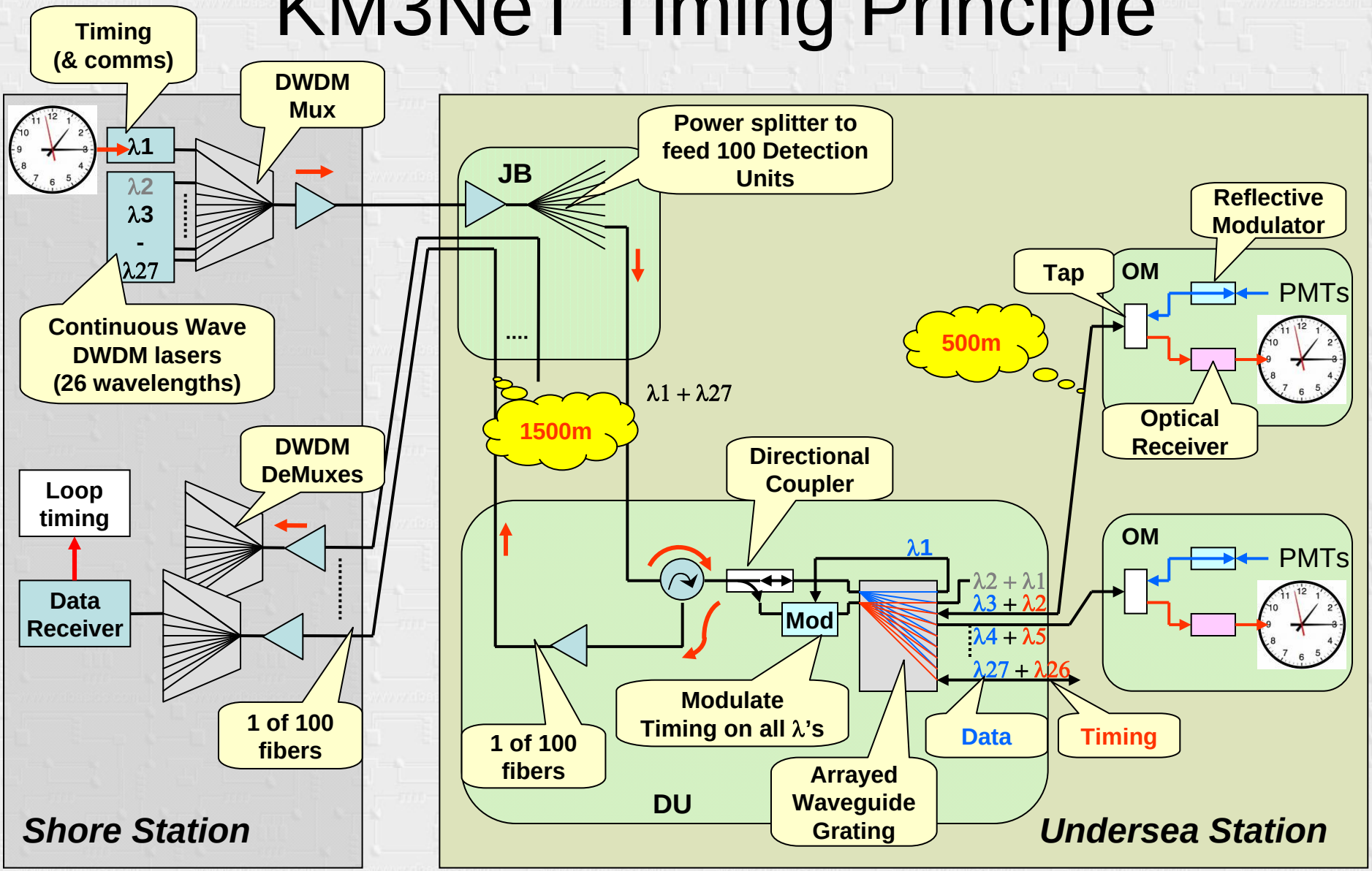
Transfer exact timing using a coded data communication channel

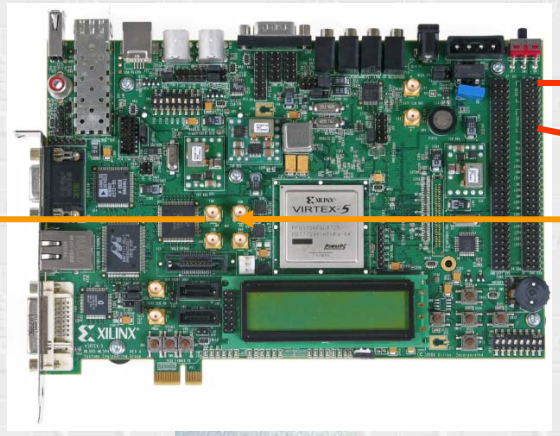
KM3NeT Timing Principle



KM3NeT Timing Principle

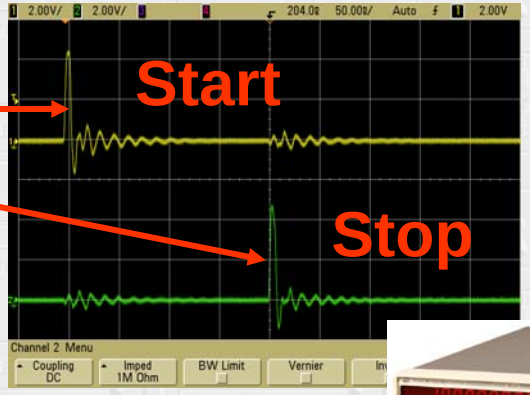


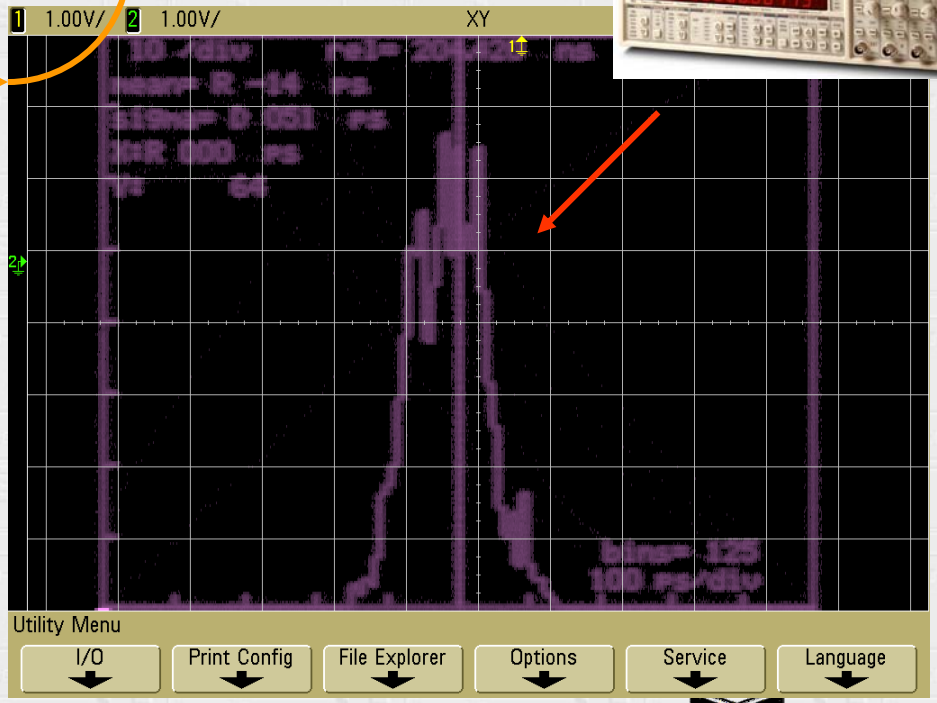
Timing over 8B10B Test Setup



Tx
8B/10B Encoded

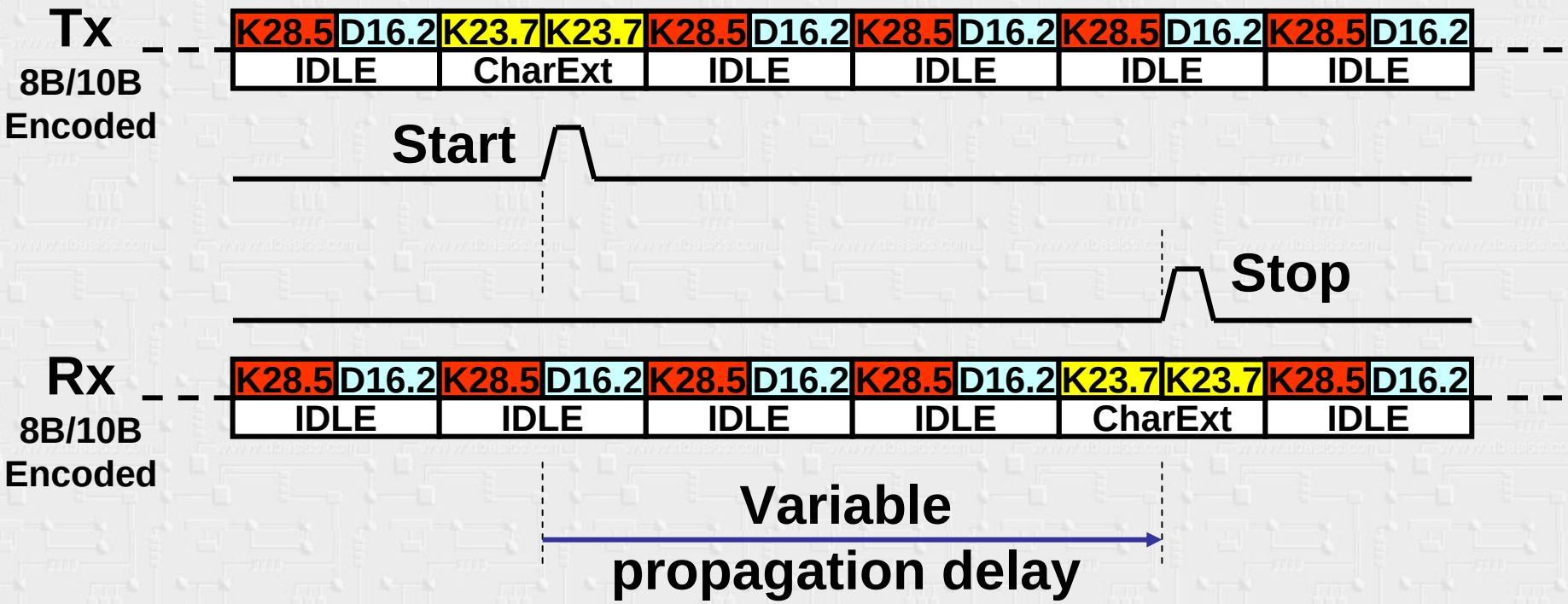
Rx
8B/10B Encoded



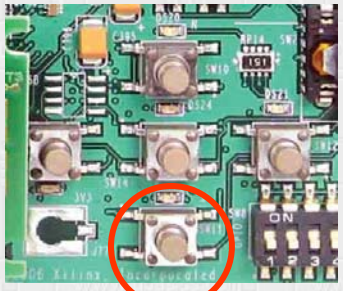


Constant Impedance Trombone Line
0 → 2x10 cm = 0 → 700 ps

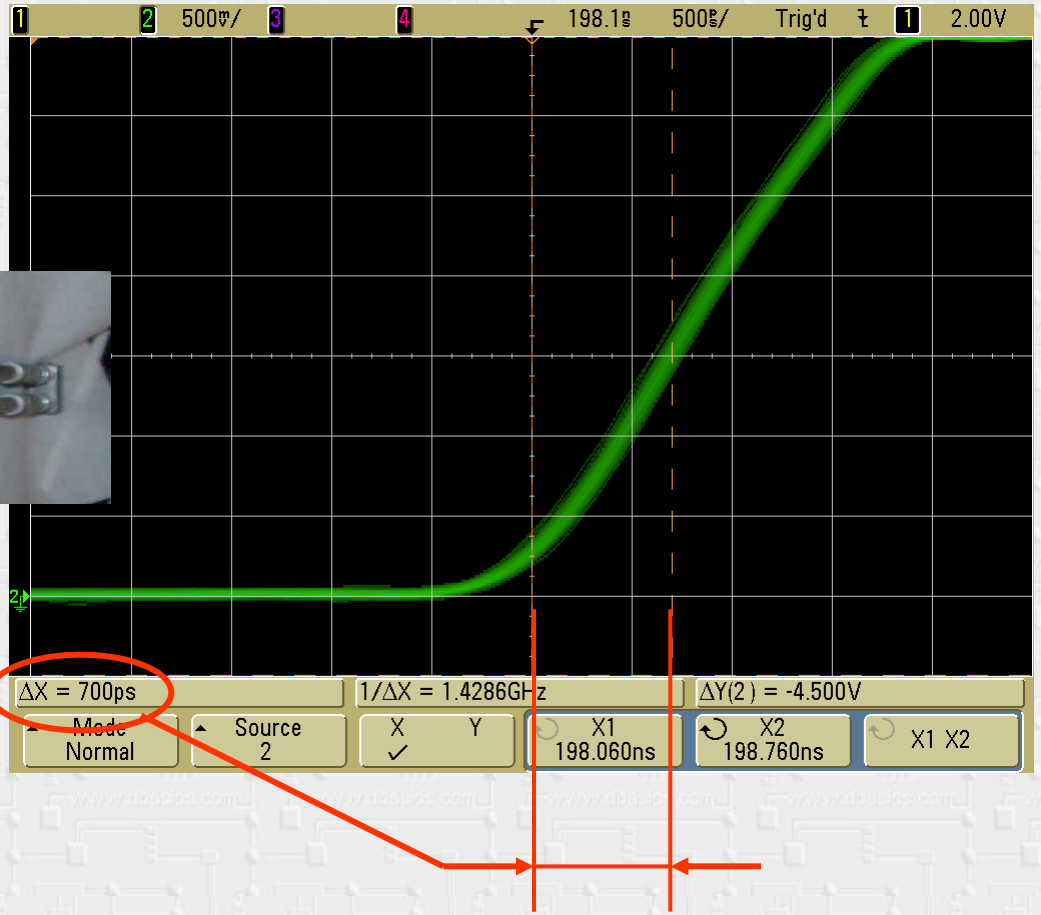
Timing over 8B10B



Variable Propagation Delay…

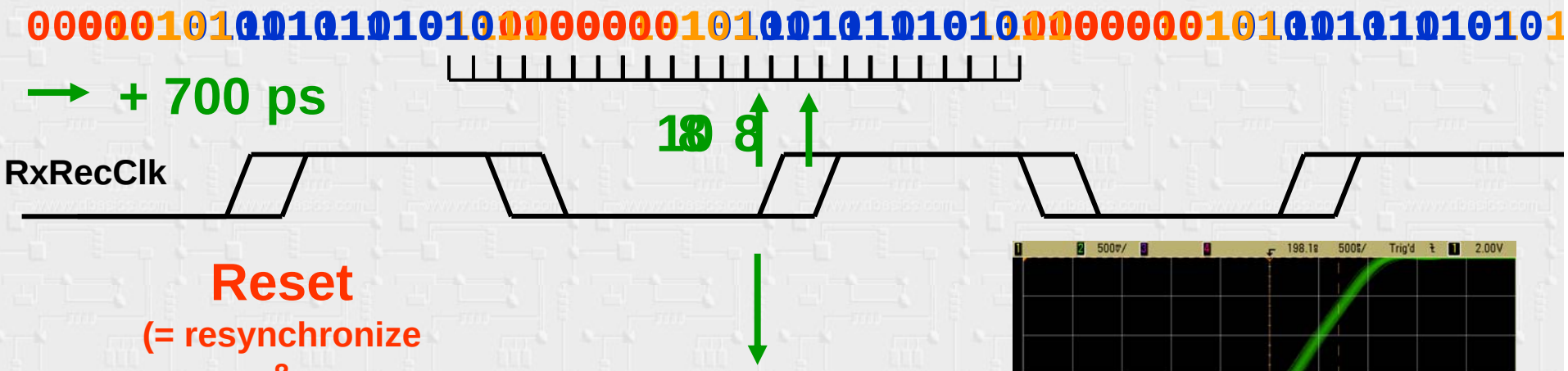


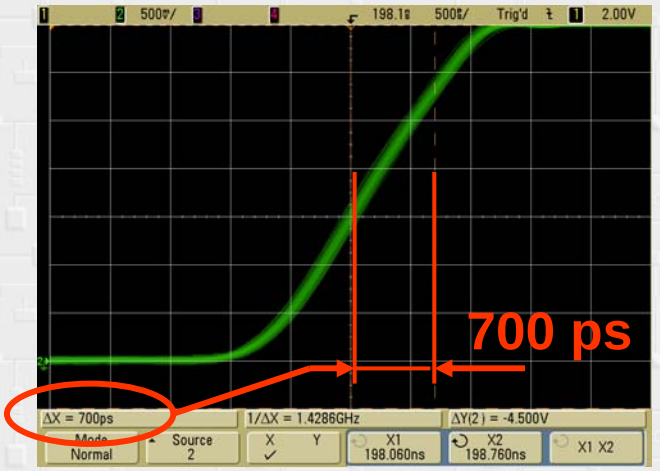
Reset
(= resynchronize)



What is happening???

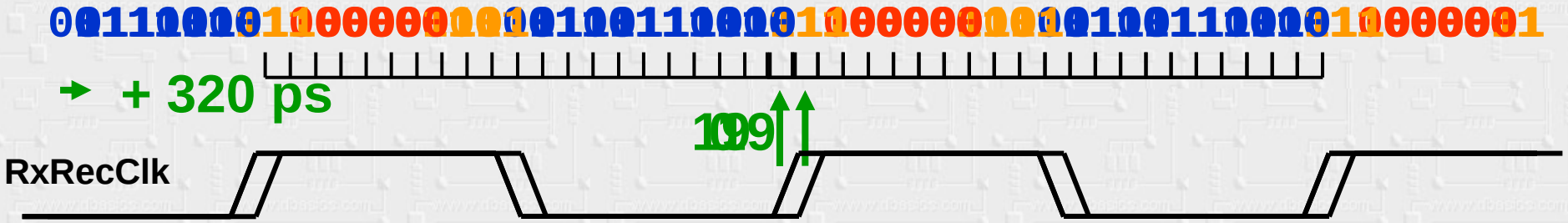
Closer Inspection…





At 3.125 Gbps:
Absolute timing is determined by "Start/Stop" delay
(in 20 bit steps of 6.4 ns) **plus**
BitSlide fine delay *(20 steps of 320 ps)*

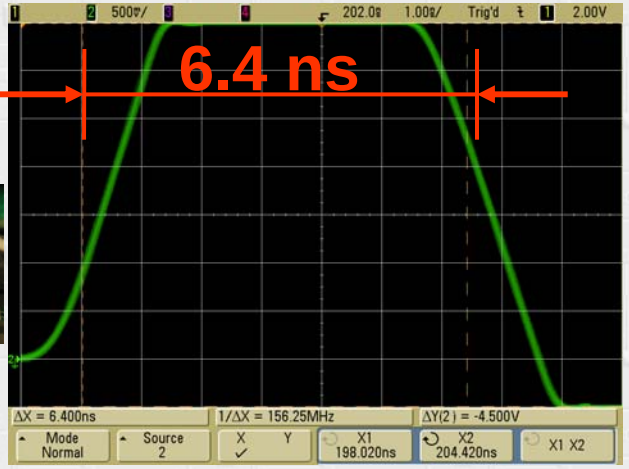
Demo: “On the edge”…



Reset
(= resynchronize
&
Byte Re-Align)

BitSlide(4:0)

0 0000 = 09



Conclusion

- Timing information is distributed inherent over a serial data channel **and can be used**
- Timing resolution is equal to a **U**nit **I**nterval (= bit time; at 3.125 Gbps = 320 ps)
- Receivers in Optical Modules are all **phase locked** (thus *isochronous*) to one master clock (GPS) on shore

For the skeptic…

Does this work from board to board?