10 Gigabit Ethernet Transmissions Technologies

sonet.com

www.sonet.com
Joe Lutz: Chief Cook and Bottle Washer

10BASE	-LX4	1310nm -LRM	1310nm -LR (-LW) LAN (WAN) Serial	-EX4 (extended reach LX4)	850nm -SR (-SW) LAN (WAN) serial	(-LW 1310nm WAN) (-EW 1550nm WAN)
Reach over legacy MMF	**300m**	**220m**	**NA**	**1km**	**30-80m**	**NA**
Reach over SMF	**10km**	**NA**	**10km**	**40km**	**NA**	**40km**
IEEE Standard	**802.3ae-2002**	**802.3aq**		**NA**		

Distances depend actual characteristics of fibers in the field.

10Gbase-LX4

The LX4 technology splits the 10G signal in 4 channels, i.e. 4 λ s. Each λ operates at 3.125Gb/s.

λ1 = 1275nm

λ2 = 1300nm

λ3 = 1325nm

λ4 = 1350nm

The 4 wavelengths are then combined and transmitted on a single fiber. The benefits of this are several, firstly the electronics and lasers operating at 3.125 Gb/s are cheaper to implement than those operation at 10.3 Gb/s line rate. But you need 4 lasers instead of 1. An additional cost is the optical mux-dmux that is necessary for combining/splitting the 4 wavelengths. At the LX4 rate manufacturers can take advantage of the technologies used in sonet OC-48 systems helping to keep the costs down. Also because of the lower channel rates of LX4 jitter is easier to accmodate. The period of 3.125 Gb/s channel rate signal is 320pS. Signal jitter over 300m of legacy 62.5um FDDI class fiber is approximately 157pS due to differential mode delay distortion.

10Gbase-LRM

The LRM standard uses a single high speed laser operating at the line rate of 10.3 Gb/s. This simplifies the optical layer by the eliminating multiple lasers and mux-dmux used the the LX4 standard. However at 10.3 Gb/s the signal period is only 97pS. Extracting the signal out of the jitter now becomes an issue, or more of an issue as compared to the LX4 standard. Because of jitter LRM only supports transmission over 220 meters of legacy 62.5um FDDI grade cable. 10Gbase-LRM also requires an off-set launch cable. LRM systems also typically have to use EDC, electronic data compensation. EDC is basically adaptive equalization as used in lower data rate systems (modems) only now stretching the technology to work at a 10.3G line rate.

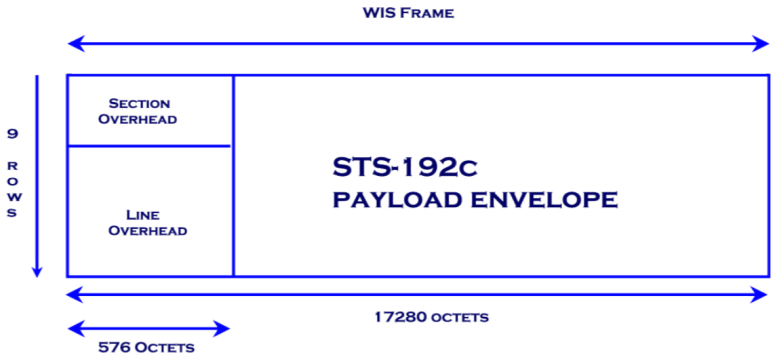
LAN PHY

Data Rate: 10Gb/s
Encoding: 64B/66B (PCS: Physical Coding Sublayer)
Line Rate (after encoding): 10.3125Gb/s

WAN PHY

Data Rate: 10Gb/s
Encoding: 64B/66B (PCS: Physical Coding Sublayer)
Line Rate (after encoding + line rate adaptation): 9.58464 Gb/s

The WAN PHY uses the same PCS operating in rate adaptation mode to ensure the output data stream will match the payload carrying capacity of a SONET OC-192 signal (or equivalently an SDH STM-64). The WAN
PHY also incorporates the WAN Interface Sublayer (WIS) to provide a simplified SONET framer function as well as the
complement of SONET/SDH compatible MIBs. The output of the WIS is an OC-192 frame compatible signal.
The only difference between the LAN PHY and the WAN PHY is the WIS sublayer. Both share the same PCS and serial
Physical Medium Attachment (PMA) and Physical Medium Dependent (PMD) sublayers. In this way, the cost benefit from
economies of scale applies to both PHY types.



For more detail: http://grouper.ieee.org/groups/802/3/ae/public/may00/bottorff_1_0500.pdf

www.sonet.com
Joe Lutz: Chief Cook and Bottle Washer