Comprehensive Transmitter and Receiver Jitter Methodology
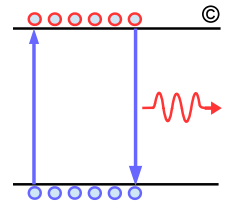
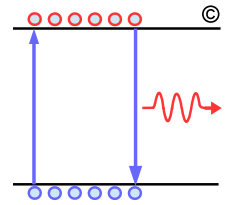**Ali Ghiasi**

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IEEE 802.3bm Task Force

January 2014 Interim

Overview

- Overview of FC-MJS jitter methodology

- Taking credit for Golden PLL on the transmitter

- Issue separating receiver stress sensitivity from receiver jitter tolerance
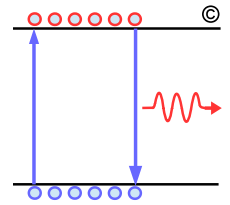
Comprehensive Jitter Methodology

❑ **Comprehensive jitter methodology was developed during 1 GFC standardization in FC-MJS project "the platinum standard for jitter methodology"**

❑ **MJS jitter methodology was based on principle to use low cost oscillator and reduce burden of the power supply filtering to enable volume applications**

– Transmitter low frequencies jitter was relax by defining a high pass single pole filter with -20 dB/dec with corner frequency at 1/1667 Baudrate for all measurements (in Ethernet since 10 GbE filter BW reduced to 1/2578*baudrate)

– All receivers during stress sensitivity test must tolerate all allowed transmitter generated low frequencies jitter which gets tracked by Golden PLL.

5 UI

- 20 dB/Dec

TX Jitter Filtering

0.05 UI

RX Jitter Tracking

100 KHz   10 MHz (1/2578 x Baudrate)
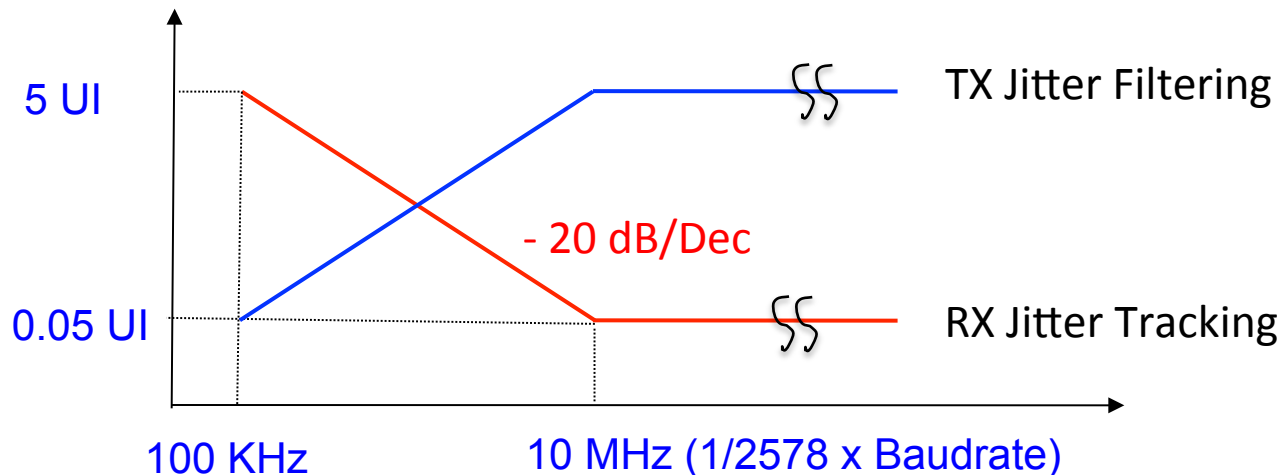
Fundamental Issue

❑ **With introduction of DFE based receiver in 802.3ap (KR) and 802.3aq (LRM) a disconnect was introduced between transmitter and receiver**

- Transmitter relaxation as defined by MJS Golden PLL was kept
- But receiver were only tested under unstress condition at two frequencies
- An stress link with addition of SJ can be much more stressful for some receiver
- Actual transmitter may have any SJ frequencies as filtered by the Golden PLL
- Testing the receiver at two specific frequencies does not necessary guarantee the receiver can actually tolerate all SJ frequencies as allowed by the Golden PLL

❑ **If we want to take credit for TX jitter relaxation then any receiver including DFE based must tolerate the TX jitter relaxation otherwise we need to tighten up the transmitter jitter generation for reliable link operation!**

Clause 95 Transmitter and Receiver Jitter Definition
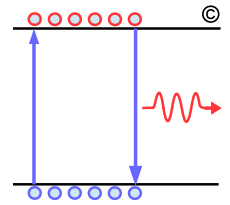
- ❑ **Clause 95.8.5 Transmitter and dispersion penalty (TDP) defines test methodology including transmitter relaxation with Golden PLL**
  - – "The clock recovery unit (CRU) used in the TDP measurement has a corner frequency of 10 MHz and a slop of 20 dB/decade"
- ❑ **Clause 95.8.9 defines stress receiver sensitivity at max VECP, J2, J4, and MAX OMA**
  - – SJ defined to be in range of 0-0.05 UI, which can be 0 UI but real link may have 0.05 UI!
- ❑ **Clause 95.8.9 defines jitter tolerance per LRM method with some modification and at max OMA**
  - – Jitter tolerance test is not defined at max VECP, J2, and J4
  - – Defining only SJ (190,5)/(940,1) kHz/UI does not gurnatee the CDR can operate over the range of the allowed transmitter Golden PPL band!
- ❑ **Jitter tolerance test needs to be added to stress receiver sensitivity test in table 95-7 over the full range of Golden PLL band 100 kHz-10x PLL corner frequency (100 MHz) instead of creating two separate tests to avoid potential interoperability issue!**
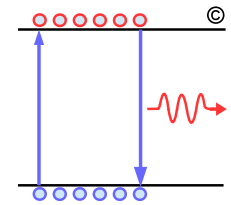
Update Table 95-7 as Shown

Table 95–7—100GBASE-SR4 receive characteristics

Description	Value	Unit
Signaling rate, each lane (range)	25.78125 ± 100 ppm	GBd
Center wavelength (range)	840 to 860	nm
Damage threshold[a] (min)	3.4	dBm
Average receive power, each lane (max)	2.4	dBm
Average receive power, each lane[b] (min)	−11	dBm
Receive power, each lane (OMA) (max)	3	dBm
Receiver reflectance (max)	−12	dB
Stressed receiver sensitivity (OMA), each lane[c] (max)	−5.6	dBm
Conditions of stressed receiver sensitivity test: and jitter tolerance *		
Vertical eye closure penalty (VECP),[d] each lane	3.6	dB
Stressed eye J2 jitter,[d] each lane	0.41	UI
Stressed eye J4 jitter,[d] each lane	0.55	UI
OMA of each aggressor lane	3	dBm
Stressed receiver eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.28, 0.5, 0.5, 0.33, 0.33, 0.4}	
~~Receiver jitter tolerance in OMA, each lane (max)[c]~~	~~5.6~~	dBm
Conditions of receiver jitter tolerance test:		
~~Jitter frequency and peak-to-peak amplitude~~	~~(190, 5)~~	kHz, UI
~~Jitter frequency and peak-to-peak amplitude~~	~~(940, 1)~~	kHz, UI
~~OMA of each aggressor lane~~	~~3~~	dBm

* Sinusoidal jitter (SJ) is applied at max allowed limit per CRU definition in Clause 95.8.5.