# Implementing improved extinction ratio limit

Piers Dawe

Mellanox

# Supporters

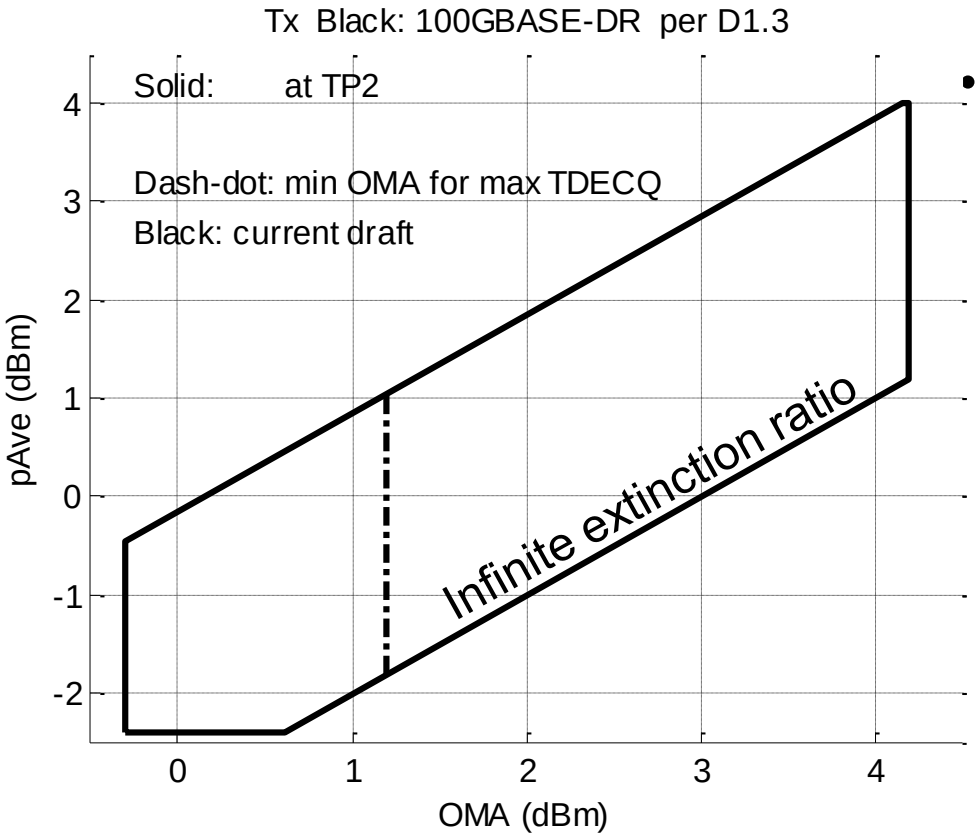
- Dazeng Feng Mellanox
- Jonathan King Finisar
- Oded Wertheim Mellanox

# Introduction

- To allow a variety of transmitter technologies for good performance, low power and cost, the extinction ratio spec should be reduced to as low as reasonable while protecting the link and the receiver
  - As shown in recent presentations in P802.3cd ad hoc and P802.3bs SMF ad hoc
- http://ieee802.org/3/bs/public/adhoc/smf/17_04_25/dawe_01_0417_smf.pdf
- http://ieee802.org/3/cd/public/adhoc/archive/dawe_042617_3cd_adhoc-v3.pdf

- This presentation shows two simple ways to do this for 100GBASE-DR

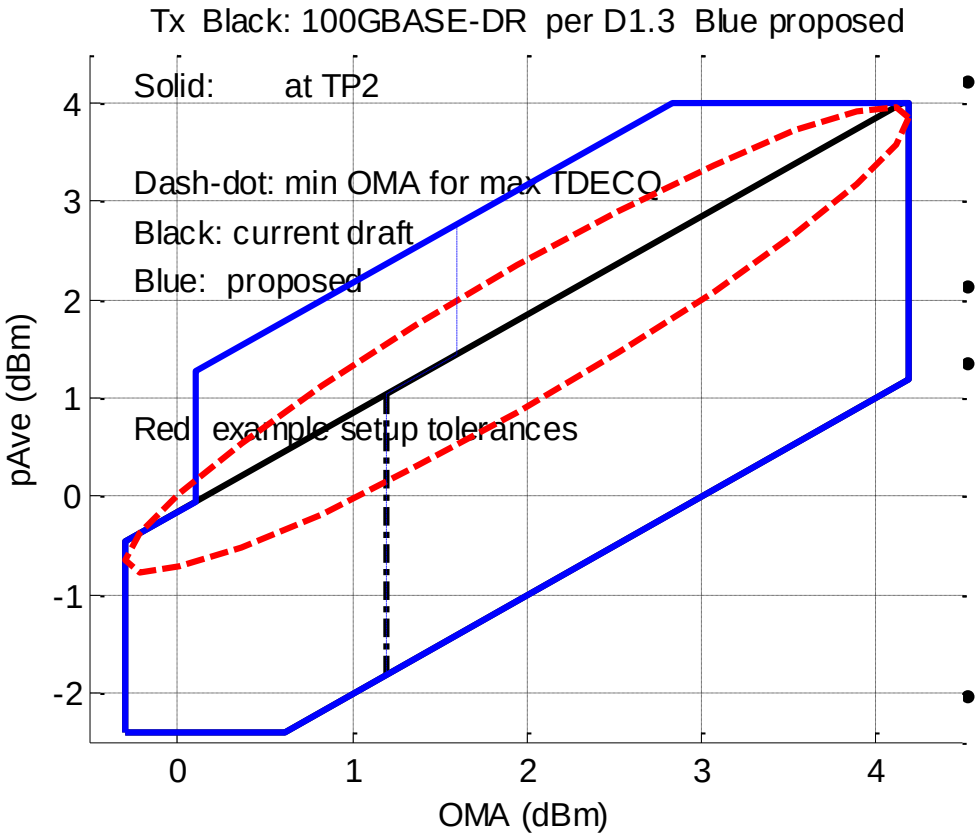
# Transmitter setup map




- Black polygon: Tx spec in D1.3, with 5 dB min. extinction ratio

- A single Tx waveform measurement is used to find TDECQ, OMA, mean power, and extinction ratio

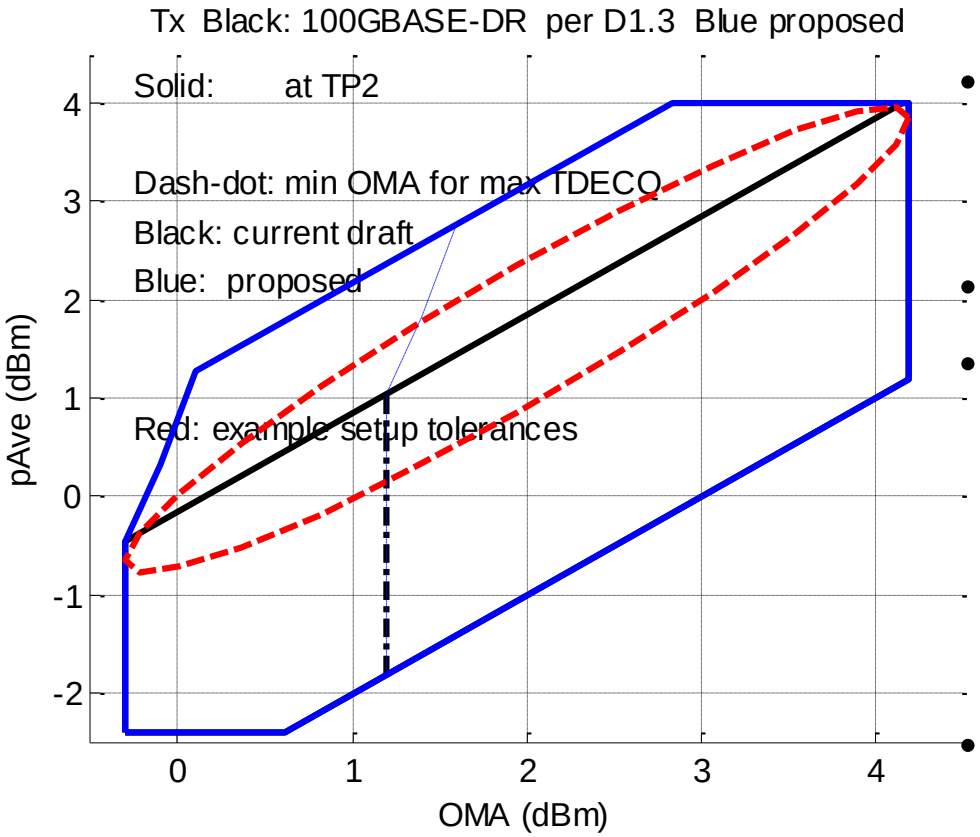
# Transmitter setup map: proposal A




- A single Tx waveform measurement is used to find TDECQ, OMA, mean power, and extinction ratio

- Black polygon (partly hidden under blue one): Tx spec in D1.3, with 5 dB min. extinction ratio
- Blue polygon: proposal A
- OMA-TDECQ is increased by 0.4 dB between 3.5 and 5 dB extinction ratio, to allow for multipath interference penalty of the reflections in the draft
- Tx spec is easier
  - Needs very good power control (output coupling, tracking, ageing)
- Channel, connectors and receivers don't change
  - Unless we change the SRS ER: see slide 9

# Transmitter setup map: proposal B




- A single Tx waveform measurement is used to find TDECQ, OMA, mean power, and extinction ratio

- Black polygon (partly hidden under blue one): Tx spec in D1.3, with 5 dB min. extinction ratio
- Blue polygon: proposal B
- OMA-TDECQ is increased by 0.4 dB at 3.5 dB extinction ratio, to allow for multipath interference penalty of the reflections in the draft
  - Gradual increase with extinction ratio avoids re-entrant corner
- Tx spec is easier
  - Power control requirements are more reasonable
- Channel, connectors and receivers don't change
  - Unless we change the SRS ER: see slide 9

# Option A

**Table 140–6—100GBASE-DR transmit characteristics**

| Description | Value | Unit |
|---|---|---|
| Signaling rate (range) | 53.125 ± 100 ppm | GBd |
| Modulation format | PAM4 | — |
| Wavelength (range) | 1304.5 to 1317.5 | nm |
| Side-mode suppression ratio (SMSR), (min) | 30 | dB |
| Average launch power (max) | 4 | dBm |
| Average launch power[a] (min) | –2.4 | dBm |
| Outer Optical Modulation Amplitude ($OMA_{outer}$) (max) | 4.2 | dBm |
| Outer Optical Modulation Amplitude ($OMA_{outer}$) (min)[b] | –0.3 | dBm |
| Launch power in $OMA_{outer}$ minus TDECQ (min) | | |
| Extinction ratio ≥ 5 dB | –1.3 | dBm |
| 3.5 dB < extinction ratio < 5 dB | –0.9 | dBm |
| Transmitter and dispersion eye closure for PAM4 (TDECQ) (max) | 2.5 | dB |
| Average launch power of OFF transmitter (max) | –15 | dBm |
| Extinction ratio (min) | ~~5~~ 3.5 | dB |
| $RIN_{15.5}OMA$ (max) | –136 | dB/Hz |
| Optical return loss tolerance (max) | 15.5 | dB |
| Transmitter reflectance[c] (max) | –26 | dB |

[a]Average launch power (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
[b]Even if the TDECQ < 1 dB, the $OMA_{outer}$ (min) must exceed these values.
[c]Transmitter reflectance is defined looking into the transmitter.

# Option B

**Table 140–6—100GBASE-DR transmit characteristics**

| Description | Value | Unit |
|---|---|---|
| Signaling rate (range) | 53.125 ± 100 ppm | GBd |
| Modulation format | PAM4 | — |
| Wavelength (range) | 1304.5 to 1317.5 | nm |
| Side-mode suppression ratio (SMSR), (min) | 30 | dB |
| Average launch power (max) | 4 | dBm |
| Average launch power[a] (min) | –2.4 | dBm |
| Outer Optical Modulation Amplitude ($OMA_{outer}$) (max) | 4.2 | dBm |
| Outer Optical Modulation Amplitude ($OMA_{outer}$) (min)[b] | –0.3 | dBm |
| Launch power in $OMA_{outer}$ minus TDECQ (min) | | |
| ER ≥ 5 dB | –1.3 | dBm |
| 3.5 dB < ER < 5 dB | 0.45 – 0.27ER [d] | dBm |
| Transmitter and dispersion eye closure for PAM4 (TDECQ) (max) | 2.5 | dB |
| Average launch power of OFF transmitter (max) | –15 | dBm |
| Extinction ratio (ER) (min) | ~~5~~ 3.5 | dB |
| $RIN_{15.5}OMA$ (max) | –136 | dB/Hz |
| Optical return loss tolerance (max) | 15.5 | dB |
| Transmitter reflectance[c] (max) | –26 | dB |

[a]Average launch power (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
[b]Even if the TDECQ < 1 dB, the $OMA_{outer}$ (min) must exceed these values.
[c]Transmitter reflectance is defined looking into the transmitter.

d Where ER is the extinction ratio in dB

*[Notes c and d would be reversed]*

tinction ratio limit

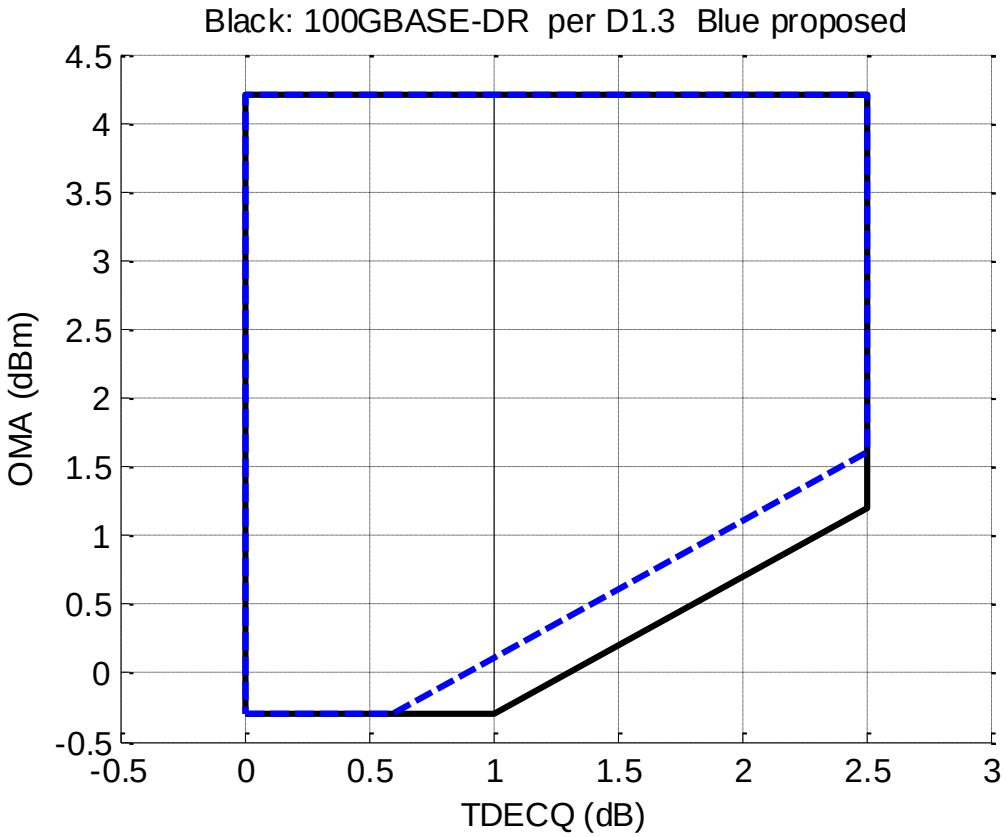
# Both options

- **140.7.9 Stressed receiver sensitivity**
- Add another exception:
- The extinction ratio is to be approximately 5 dB
- *Explanation: the drafts say:*
- Stressed receiver sensitivity shall be within the limits given in Table 140–7 if measured using the method defined in 121.8.9 with the following exceptions
  - and
- **121.8.9.2 Stressed receiver conformance test signal characteristics and calibration**
- ... set the extinction ratio of the E/O converter to approximately the minimum specified in Table 121–6.
  - *and*
- the extinction ratio is approximately the minimum specified in Table 121–6

# Backup

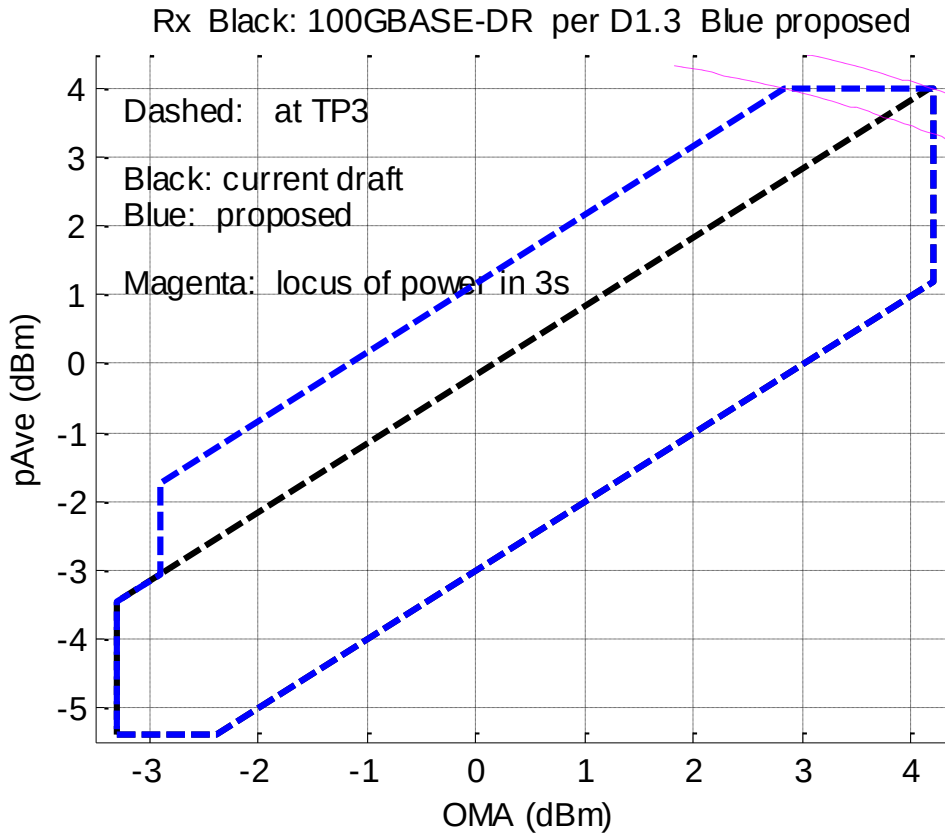
-

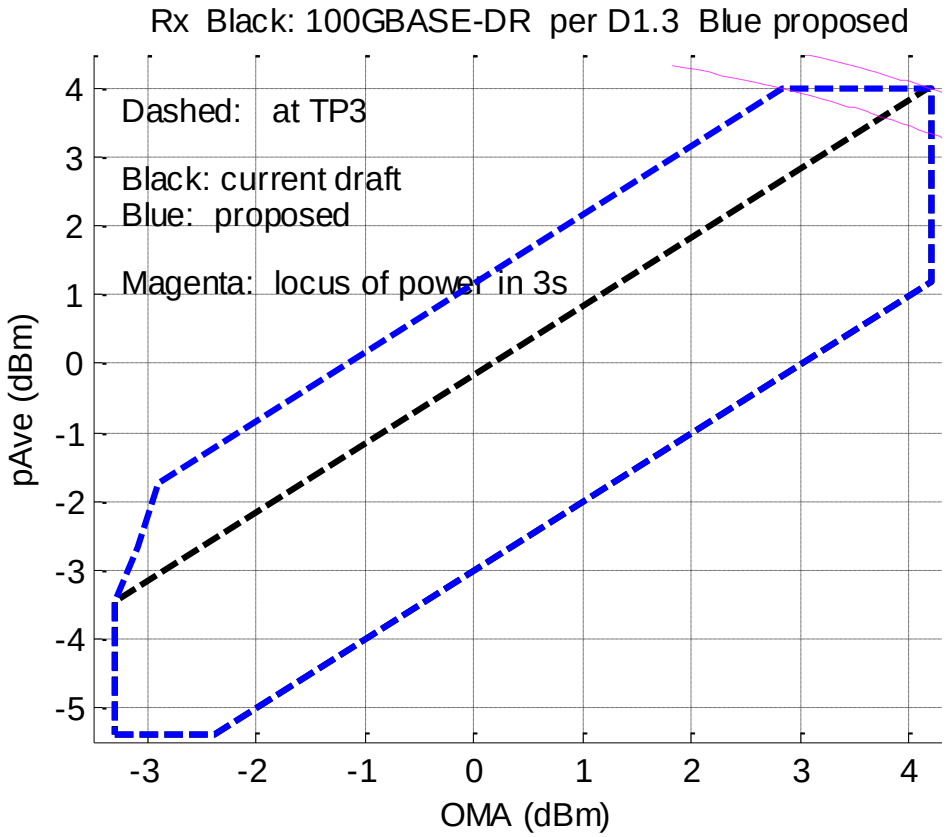
# TDECQ – OMA map




- Transmitter provides better OMA-TDECQ at lowest extinction ratio

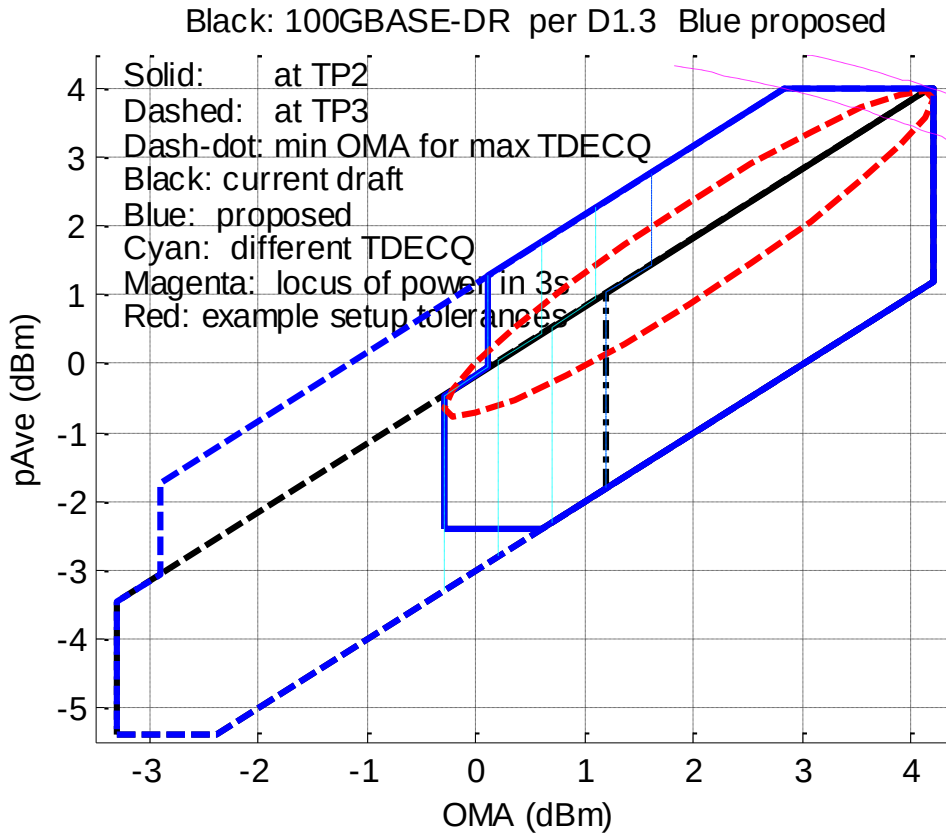
# Options A and B at Rx (TP3)

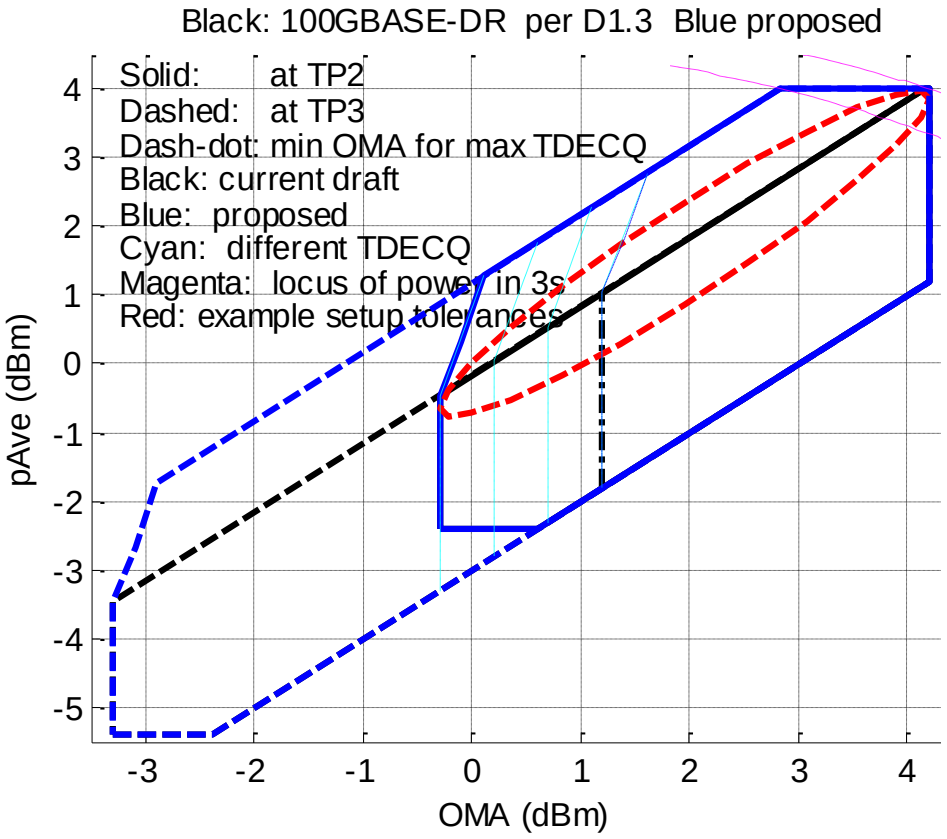



- Magenta lines show loci of equal power in runs of 3s
- Receiver overload is not affected
- Receiver sensitivity is not affected

# Options A and B, TP2 and TP3




- 