# Burst Marker Detection Rate in EPoC

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# Introduction

- Packet loss in EPoC Phy will be due to two factors:
  1. Packet loss due to burst detection error.
  2. Packet loss due to uncorrectable errors by the FEC.
- Two sources of burst detection error.
  1. Failure to detect a valid burst.
  2. False detection of an invalid burst. This causes dropping of the existing burst.
- Burst detection error rate (BDER) should include both failure to detect and false detection.

# Burst loss rate (due to burst marker detection error) is same as packet loss rate

- Assume a burst loss rate of $\frac{1}{x}$
- Assume there are $N$ packets per burst on average.
- Burst loss rate of $\frac{1}{x}$ implies 1 burst is lost in every $x$ bursts. Which further implies $N$ packets are lost in every $Nx$ packets.
- Therefore packet loss rate = $\frac{N}{Nx} = \frac{1}{x}$ = burst loss rate.

# Packet Loss rate for EPoC

- EPoC target packet loss rate is 5E-5 for US and 1E-6 for DS at the MAC/PLS service interface [1].
- What is the target packet loss rate at phy?

# Burst error rate (due to burst marker detection error) for Upstream.

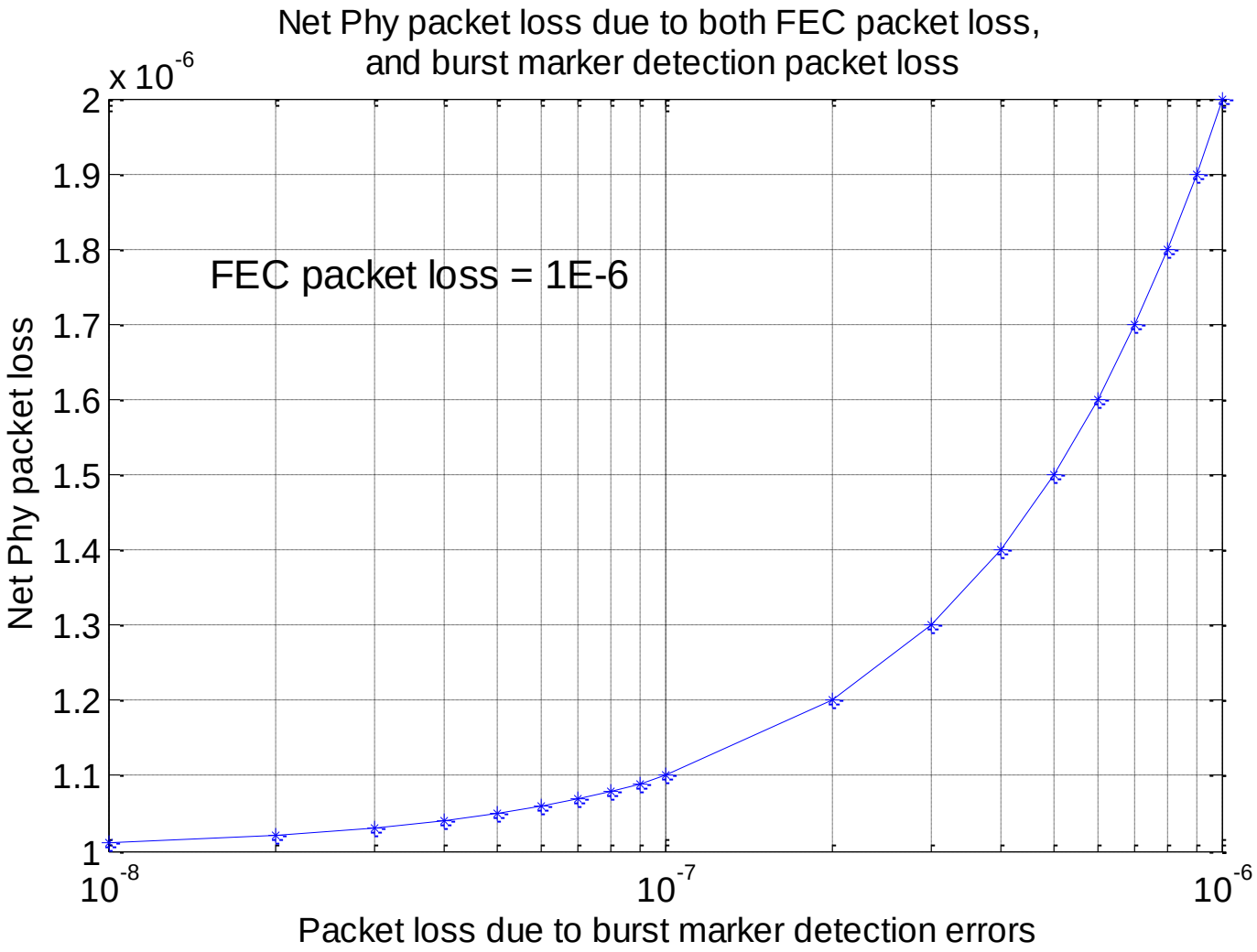
- In Upstream both the start and end of a burst have a burst marker.
- Thus the burst marker detection error rate should be 2 times lower than the targeted burst detection error rate.

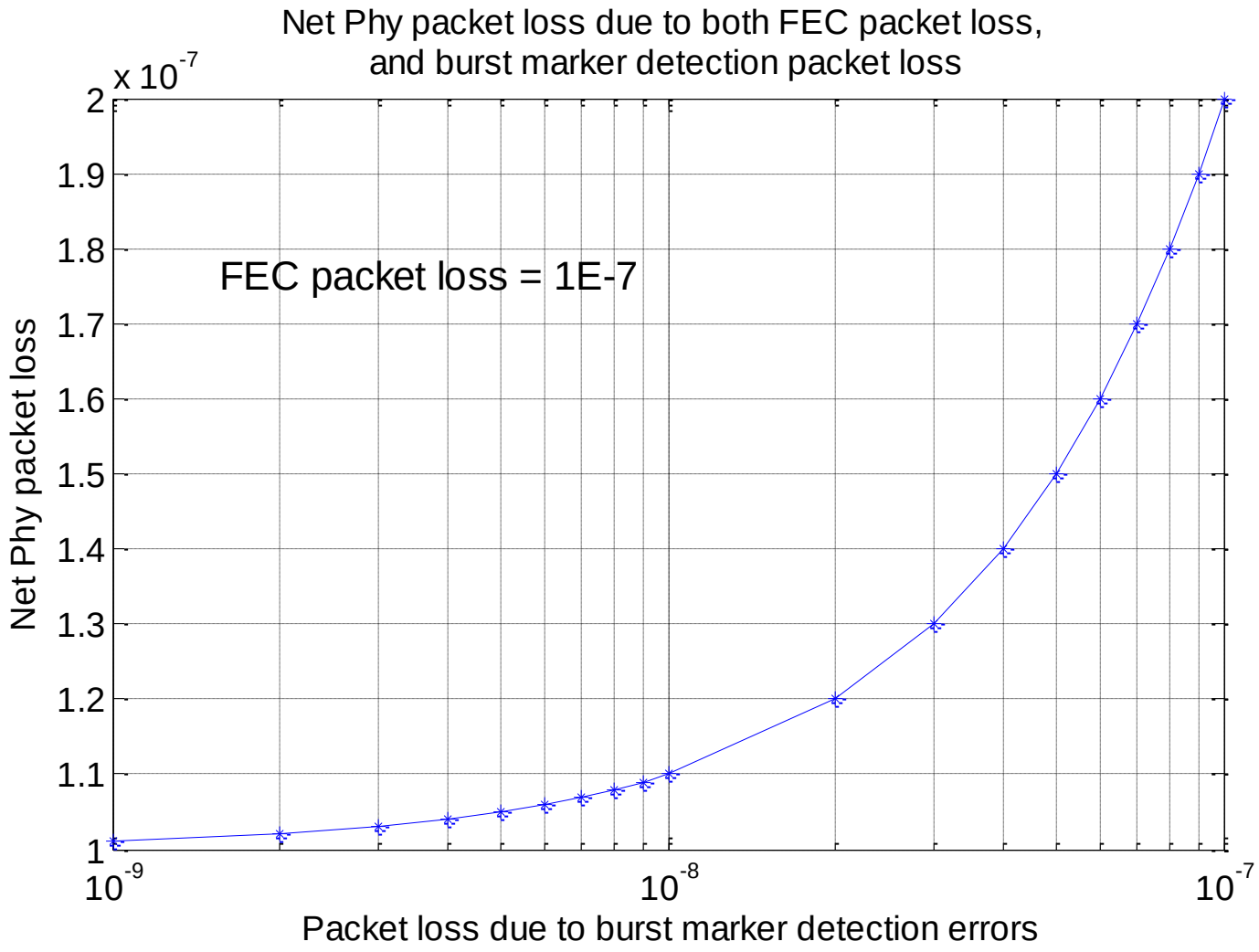
# Increase in Phy packet loss rate due to burst marker detection errors

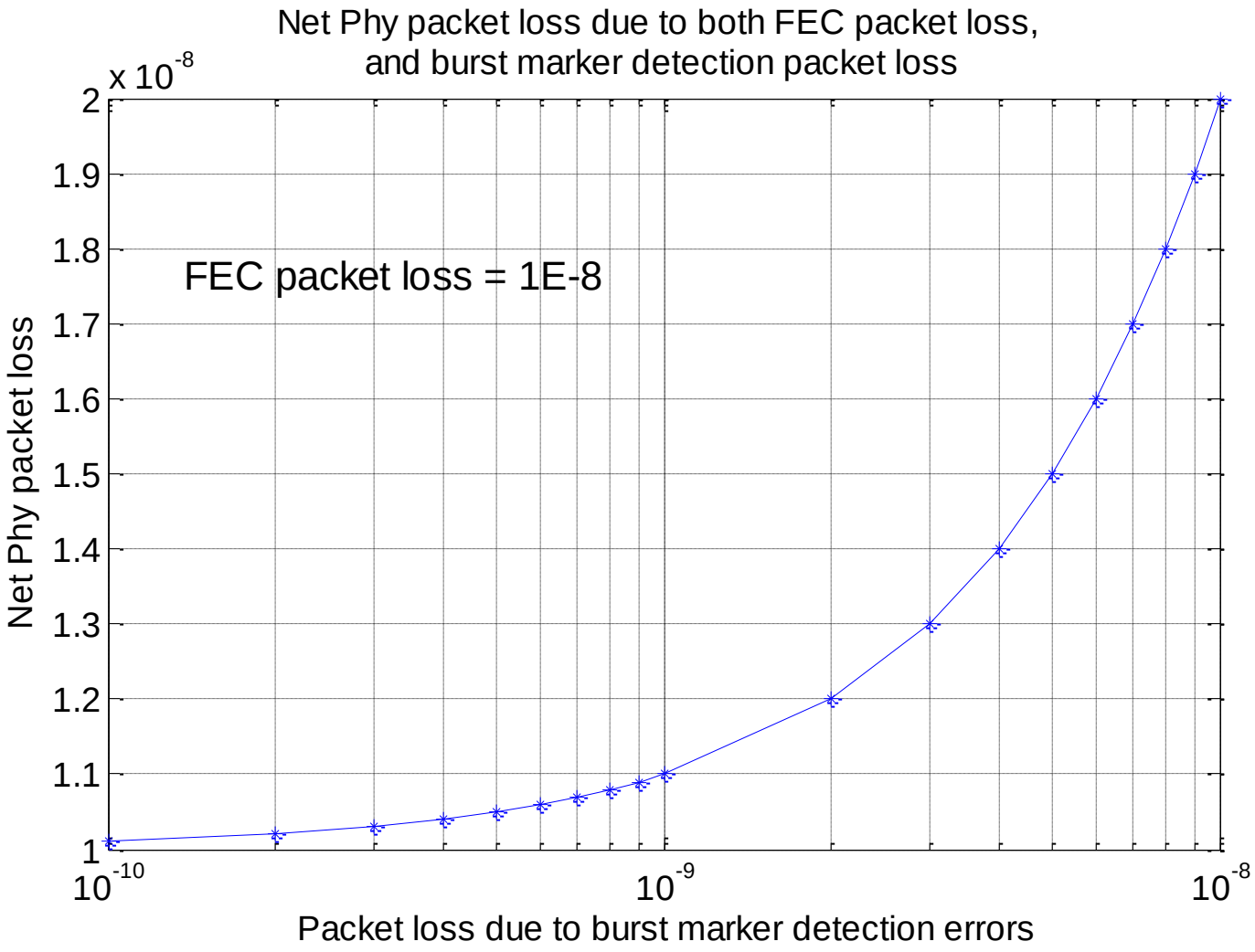
- Let the FEC Phy packet loss rate (ignoring burst marker detection errors) be equal to $\frac{1}{x}$
- Let the Phy packet loss rate due to burst marker detection errors be equal to $\frac{1}{y}$
- Let $y$ = number of packets transmitted . 1 packet will be lost due to burst marker detection errors, leaving $y-1$ packets for the Phy FEC.
- Out of this $y-1$ packets, $\frac{y-1}{x}$ will be lost in the Phy FEC .

- Total number of packets lost in the Phy = $1+\frac{y-1}{x} = \frac{x+y-1}{x}$

- Therefore Net Phy packet loss rate = $\frac{\frac{x+y-1}{x}}{y} = \frac{x+y-1}{xy}$


Net Phy packet loss due to both FEC packet loss,
and burst marker detection packet loss
x 10^-6
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
FEC packet loss = 1E-6
Net Phy packet loss
10^-8
10^-7
10^-6
Packet loss due to burst marker detection errors


Net Phy packet loss due to both FEC packet loss,
and burst marker detection packet loss
x 10^-7
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
FEC packet loss = 1E-7
Net Phy packet loss
10^-9
10^-8
10^-7
Packet loss due to burst marker detection errors

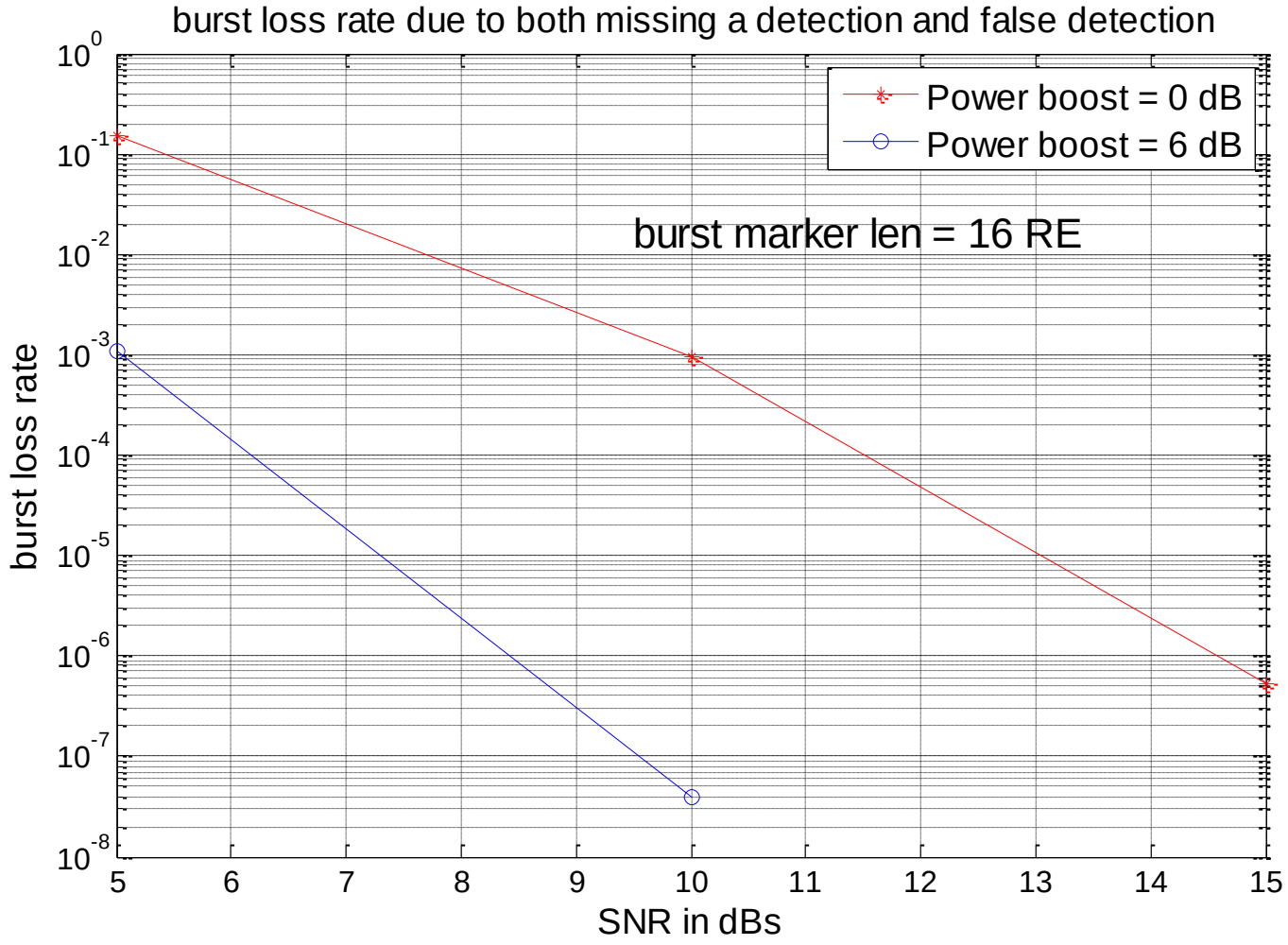

Net Phy packet loss due to both FEC packet loss,
and burst marker detection packet loss
x 10^-8
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
FEC packet loss = 1E-8
Net Phy packet loss
10^-10
10^-9
10^-8
Packet loss due to burst marker detection errors

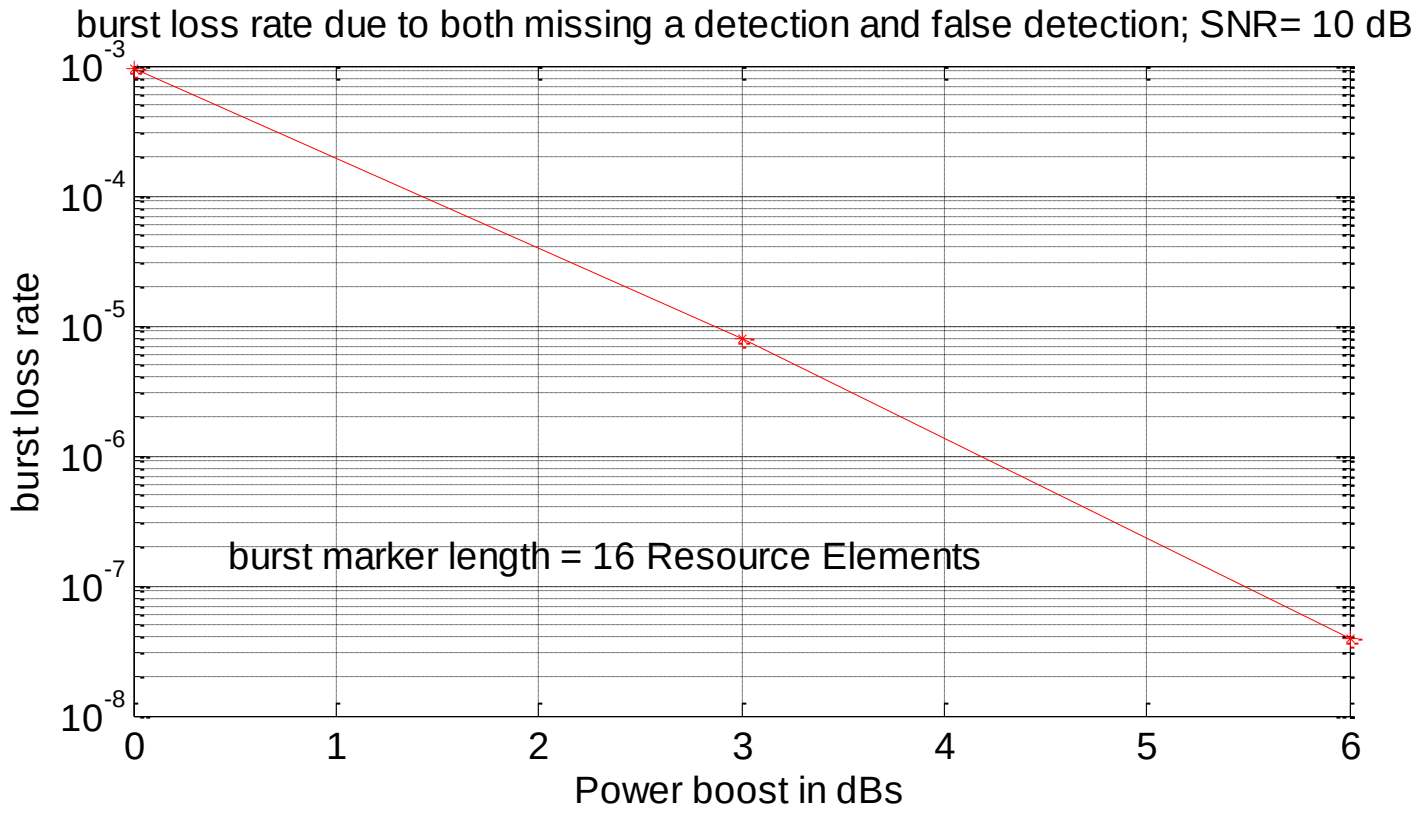
# Discussion

- Before deciding on a burst marker scheme, the following needs to be defined first:
  1) Need to define the FEC Phy Packet loss rate for EPoC, for both Upstream and Downstream.
  2) Need to define target burst loss rate (for the burst marker scheme).
  3) Need to define the minimum SNR value to evaluate the burst marker detection scheme, for both upstream and downstream

# Initial Recommendations

1. The bust marker scheme should be able to operate at a minimum SNR value of 10 dB, for both upstream and downstream.
2. The bust markers shall be boosted in power by 6 dB.
3. The burst loss rate (from the burst marker detection errors) should be an order of magnitude better than the FEC Phy packet loss rate. This target increases the FEC Phy packet loss rate by 10%
4. The FEC Phy packet loss rate should incorporate at least 10% margin to accommodate the extra packet loss due to burst marker detection errors.


burst loss rate due to both missing a detection and false detection
Power boost = 0 dB
Power boost = 6 dB
burst marker len = 16 RE
burst loss rate
SNR in dBs
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
10^-7
10^-8
5
6
7
8
9
10
11
12
13
14
15


burst loss rate due to both missing a detection and false detection; SNR= 10 dB
burst loss rate
10^-3
10^-4
10^-5
10^-6
10^-7
10^-8
burst marker length = 16 Resource Elements
0
1
2
3
4
5
6
Power boost in dBs

# References

1. **Approved Project Objectives IEEE P802.3bn EPON Protocol over Coax (EPoC) PHY Task Force** Mark Laubach Broadcom (Updated 25 November 2012)

# Thank you

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# Example of burst loss rate vs. Packet loss rate, due to burst marker detection error

- Assume burst loss rate = 10%;
- Assume 20 long bursts with ‘x’ packets each.
- Assume 10 short bursts with ‘y’ packets each.
- Out of 20 long bursts 2 bursts will be lost, resulting in loss of 2x packets.
- Out of 10 short bursts 1 burst will be lost, resulting in loss of y packets.
- Total loss of packets = 2x + y.
- Total packets = 20x+ 10y.
- Packet loss rate = $\frac{2x+y}{20x+10y} = \frac{1}{10} = 10\%$ (same as burst loss rate).