Lecture 8

Exercise 1: Assuming the units per subscriber are kbits/second and constant flow of traffic, how many bytes per month was forecast to be consumed by each subscriber at the start of 2014? How many subscribers are there in the world? *Hint: 1 Exabyte is 10^{18} bytes*

Q. $\dfrac{180 \text{ kb/s}}{8 \text{ bits/byte}} \times 3600 \times 24 = 1.9 \text{ GBytes /day}$

$\approx 60 \text{ GBytes/month.} = 6 \times 10^{10} \text{ B/month.}$

$\dfrac{36 \times 10^{18}}{6 \times 10^{10}} \approx 6 \times 10^{8} \approx 600 \text{ Million subscribers.}$

Exercise 2: Assuming a growth rate of 30%, how long will it take for traffic to increase by an order of magnitude (a factor of 10)?

30% CAGR

$\underbrace{1.3 \times 1.3 \times 1.3 \dots}_{N}$
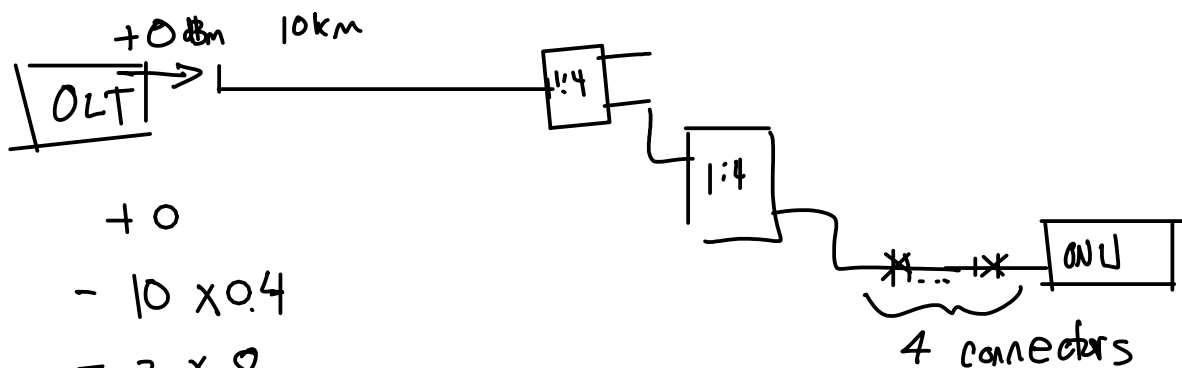
$(1.3)^{N} = 10$

$N \log 1.3 = \log 10$

$N = \dfrac{\log 10}{\log 1.3} = \dfrac{1}{\log 1.3} = 8.8$

Exercise 3: What is loss of an ideal N-way splitter?

$$2 \qquad \frac{1}{2}$$

$$4 \qquad \frac{1}{4}$$

$$N \qquad \frac{1}{N}$$

in dB $\quad 10 \log\left(\frac{1}{N}\right) = -10 \log(N)$

Exercise 4: Assuming a transmit power of 0 dBm, 10 km of 0.4dB /km cable, two 4-way splitters with a loss of 8 dB each, four connectors with a 1 dB loss each, and a receiver sensitivity of -27 dBm what is the margin? What if the cable was 20 km long?

$$+0 \, \text{dBm} \qquad 10\text{km}$$

OLT $\rightarrow$ ⸻ 1:4

1:4

4 connectors ⟶ ONU

$$+0$$
$$-10 \times 0.4$$
$$-2 \times 8$$
$$-4 \times 1$$
$$\overline{}$$
$$= 0 - 4 - 16 - 4 = -24 \, \text{dBm}$$

$$\text{margin} = -24 - (-27)$$
$$= 3 \, \text{dB}$$

if cable was 20 km we would have
addional loss of 0.4 dB/km × (20-10) = 4 dB
∴ margin would be 3-4 = $\frac{-1}{3}$