Lecture 4

Exercise 1: Assuming 10 million subscribers, what was the ARPU per year? Per month?

$$\frac{\$\,10\times10^9 \text{ revenue}}{10\times10^6 \text{ subscribers}} = \$1000 / \text{subscriber} / \text{year}$$

$$= \frac{\$1000}{12} \approx \$83 / \text{month}$$

Exercise 2: How does the deployment cost per user compare to the annual revenue per user?

max deployment cost = $\$40/m \times 50m = \$2000$ / house passed

min. " " = $\$20/m \times 10m = \$200$ /house passed

ranges from $\frac{\$2000}{\$1000} = 2X$ annual ARPU

to $\frac{\$200}{\$1000} = 0.2X$ annual ARPU.

Exercise 3: Assume city blocks are 100m long and there are 10 houses per block as shown in the following diagram. What length of distribution cable is required per house? If the distribution cable must run an average of 100 m to reach the trunk and each drop is 30m long, what is the ratio of distribution cable to drop cable length?

to reach trunk → 100m; block length → 100m

$$\frac{100m + 100m}{10 \text{ houses}} = 20m/\text{house}$$

$$\frac{\text{distr. cable}}{\text{drop cable}} = \frac{20m}{30m} \approx 66\% \text{ of cable is distribution}$$

Exercise 4: What is power in mW of 1 mV signal if the cable impedance is 75 ohms? What is the power in dBm?

$$P = \frac{V^2}{R} \qquad R = 75\,\Omega$$

$$V = 1mV_{rms}$$

↑ assumed if not specified.

$$P = \frac{(10^{-3})^2}{75} = \frac{10^{-6}}{75} = 13 \times 10^{-9} W$$

$$P_{dBm} = 10 \log (13 \times 10^{-6} mW) = -79 \text{ dBm}$$

Exercise 5: A 0 dBmV signal is applied to the input of a distribution amplifier with a gain of 20 dB and a 2 dB noise figure. What are the output signal and noise powers? What is the output C/N measured over a 6 MHz bandwidth?

Signal = 0 dBmV = −79 dBm

after amplifier: −79 dB + 20 dB = −59 dBm

Noise = KTBF

$$= \underbrace{-176}_{kT\ @290K} \text{ dBm/Hz} + 10\log_{10}(6\times10^6) + 2\text{ dB}$$

↑ 6 MHz channel bandwidth

$$= -176 + 68 + 2 = -106 \text{ dBm.}$$

$$C/N = -59 - (-106) = 47 \text{ dB}$$