Exercise 1: For each of the following digital communication services identify the source, sink and the channel(s) involved: (1) the Ethernet connection between a computer and a router; (2) a cell phone call ; (3) watching a YouTube video at home.

service	source	channel(s)	sink
(1) Ethernet	router computer	Ethernet cable	computer router
(2) cell phone call	audio from user	free space (F.O., T.P. cables)	regular phone ?
(3) YouTube video	server	fiber optic cables, ADSL, cable modems	users computer

Exercise 2: What units would be used to specify error rate, delay, and delay variability? For each of the following data sources/sinks identify (1) the relative data rate variability, (2) the tolerance to errors, (3) the tolerance to delay: (a) a phone call between two people, (b) downloading a computer program, (c) streaming a video over a computer network. What units would each be measured in? Try to estimate typical values and for each quantity.

Units: (1) bit error rate $= \dfrac{\text{bits in error}}{\text{total bits}}$
(BER) (P_e)

eg. $1\% = 0.01 = \underline{10^{-2}}$

(2) delay : seconds ms
μs

(3) jitter : standard deviation (s)
variance (s^2)

	tolerance to jitter	tolerance to errors	delay	
phone call		High 5% ?loss?	Low ≪ 1s	
download software		Low (100's of years)	High minutes, seconds←	
video streaming		High (uncompressed) 10^{-3}? low (compressed) $(10^{-9}?)$	High seconds	

$B = bytes$ $\dfrac{Bytes}{bits}$

$b = bits$

Ex. 3

$$3525_{10} \longrightarrow$$

$$2048$$
$$\overline{1477}$$
$$1024$$
$$\overline{453}$$
$$256$$
$$\overline{197}$$
$$128$$
$$\overline{69}$$
$$64$$
$$\overline{5}$$
$$4$$
$$\overline{1}$$

2^0

1	✓	1
2		0
4	✓	1
8		0
16		0
32		0
64	✓	1
128	✓	1
256	✓	1
512		0
1024	✓	1
2048	✓	1

2^{11} = 2048

```
  O     D      C      5
0000  110 1  11 00   0 101
```

bit & bytes in network or big-endian order

```
  C 5            O D
1100 0101     0000 1101
```
bytes in little-endian
bits in big-endi

```
1010 0011     1011 0000
```
bytes in little-endian bits in little-endian

Exercise 4

```
1010 0011 1011 0000
```

16 bits little endian

$$3525_{10} = 0x DC5$$

OH   #

Ex. 5

"3525" → 0x33   0x35   0x32   0x35

0011 0011   0011 0101   ← network (big-endian)
                            bit order

1100 1100   1010 1100   ← little endian
                            bit order