Our Setup, Bandwidth

Qcamp 2019, Experimental Session

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1 Introduction

In this handout, we look again at our setup and characterise its capability to transmit or receive "secure" information. We will utilise the concept of "bandwidth": the amount of data that can be transmitted in a fixed amount of time, usually expressed in bit-per-second (i.e. bps, kbps, Mbps, or Gbps) or byte-per-second (i.e. Bps, kBps, MBps, or GBps). Note the different capitalisation for bit and Byte.

1.1 Public Channel

In our infra-red communication, each packet sent consists of 32 bits of data (4 ASCII characters). It requires around 300 ms to transmit one packet. Out of this, \sim 70 ms are used for transmitting the IR pulses (may vary depending on whether the messages have more 1s or 0s), while the rest of the time is for the communication between Arduino and computer (both Alice and Bob) and some other overheads 1 .

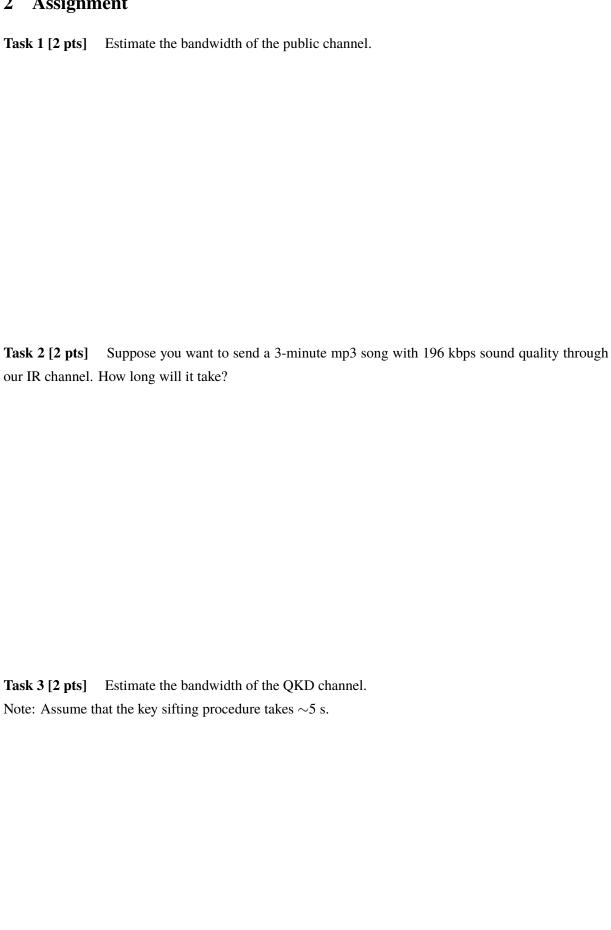
1.2 QKD Channel

In the QKD channel, each transmission cycle consists of 16 polarisation bits. Each bits requires 1.5 s to send, and the time is mostly wasted to rotate the polarisers (\sim 1.1 s to rotate 90°). After the transmission cycle, the key sifting procedure is performed. On top of that, in BB84 scheme, on average only 50 percent of the bits will be kept (it ignores the bits where the polarisation bases do not match).

Right off the bat, you may have noticed that the key rate in the QKD channel is far lower than that in the classical communication. This is also true in the real world applications of QKD, but in a different way: the key rate is very low because the signal intensity drops over a long fibre. For a \sim 50 km fibre, the signal drops \sim 10 times. Thus, if one wants to build a QKD link between, say Singapore and Kuala Lumpur (\sim 350 km), with the current technology, the key rate will drop by \sim 10⁷ times.

 $^{^{1}}$ The value of \sim 300 ms itself is determined by first, sending the packet with high repetition rate, and decreasing the rate until the packets do not drop unexpectedly. In our testing session, the rate is \sim 5 Hz (corresponding to \sim 200 ms). We add another \sim 100 ms to be more on the cautious side: sometimes the computers slow down.

Assignment





²https://en.wikipedia.org/wiki/Key_size