

CARLETON UNIVERSITY

Department of Systems and Computer Engineering

SYSC 4600 – Digital Communications – Quiz 3 – Fall 2015

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100 pts, 20 mins

Name:

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Q1 [35 pts] – Transmission Rate

It was discussed in the lectures that the peak data rate, R_{max} , can be calculated as

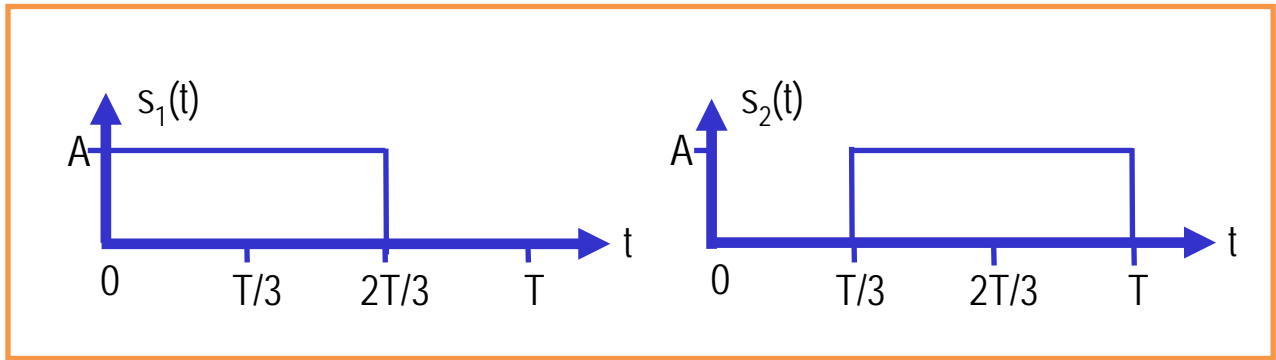
$$R_{max} = n W \log_2(1 + \text{SNR}) \text{ [b/s]}, \text{ where}$$

- $n = \text{minimum}(n_{tx}, n_{rx})$, where n_{tx} and n_{rx} denote the number of antennas at the transmitter and the receiver, respectively (n is often referred to as the MIMO gain),
- $\log_2(1 + \text{SNR})$: spectral efficiency [b/s/Hz],
- W : bandwidth [Hz].

Consider a wireless link in which $\text{SNR} = 20 \text{ dB}$ and the target peak rate is $R_{max} = 10 \text{ Mb/s}$. The access point has 2 antennas. Suggest appropriate values for

- i) the number of antennas at the mobile device,
- ii) the bandwidth, and
- iii) the spectral efficiency.

Q2 [65 pts] – Signal Space Analysis



Consider the above binary transmission system in which “1” is represented by $s_1(t)$ and “0” by $s_2(t)$.

- Find the dimension of the signal space.
- Obtain the basis functions and sketch them.
- Write $s_1(t)$ and $s_2(t)$ as a linear combination of the basis functions.

(additional space for Q2)