

CARLETON UNIVERSITY
Department of Systems and Computer Engineering

SYSC 4600

Digital Communications

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Assignment 4

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Due on : **Will not be collected (for studying purposes only)**

Review

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

$$R_{max} = n W \mu \text{ [bits/sec]}, \text{ where}$$

- $n = \text{minimum}(n_{tx}, n_{rx})$, 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),
- μ is the peak spectral efficiency [bits/sec/Hz],
- W is the total bandwidth [Hz].

Question 1) 4G Wireless Cellular Networks

The Long Term Evolution (LTE) and LTE-Advanced (LTE-A) are 4th generation (4G) wireless cellular standards. LTE networks are being deployed around the world today, and LTE-A network deployments will likely start in the next few years.

There is plenty of material in the internet on LTE and LTE-A; for instance:

- [http://en.wikipedia.org/wiki/LTE_\(telecommunication\)](http://en.wikipedia.org/wiki/LTE_(telecommunication))
- <http://en.wikipedia.org/wiki/LTE-advanced>
- <http://www.3gpp.org/technologies/keywords-acronyms/98-lte>
- <http://www.worldtimezone.com/4g.html>
- http://en.wikipedia.org/wiki/List_of_LTE_networks
- <http://www.3gpp.org>
- <http://www.gsma.com/aboutus/gsm-technology/lte>
- <http://www.fiercewireless.com/tags/lte>
- <http://www.cellular-news.com/tags/lte/>
- <http://4g-portal.com/>
- <http://lteworldseries.com/>
- <http://www.telecoms.com/?s=LTE>

By browsing a few of the above websites, find the downlink peak data rates (shared by all the wireless terminals in a cell) that LTE and LTE-A offer.

Suggest realistic values for n , W , and μ , based on the LTE and LTE-A rate targets. Substantiate your suggestions with a brief discussion.

Question 2) Contemporary and Upcoming Wireless LANs

Search the internet for the following WLAN technologies

- 802.11ad – @ 60 GHz, 6.8 Gbps
WiGig Alliance (subsumed by WiFi Alliance, Mar 2013)
- 802.11ac – @ 5 GHz, Gigabit WiFi (Feb 2014)
- 802.11af – TV whitespace (Jun 2014)
- 802.11ah – @ Sub 1 GHz, sensor networks (Jan 2016)
- 802.11ai – Fast initial link set-up (Feb 2015)
- 802.11p – DSRC (dedicated short-range communications)
- 802.11ax – 160 MHz @ 5 GHz, 10+ Gbps (2018-2019)

Suggest realistic values for n , W , and μ , based on the rate targets of three of the above 802.11 standards. Substantiate your suggestions with a brief discussion.