CARLETON UNIVERSITY

Department of Systems and Computer Engineering
SYSC4700 Telecommunications Engineering 2014

Professor Halim Yanikomeroglu

TERM PROJECT

Towards Green Cellular Networks

SUBMIT TWO HARD COPIES OF THE REPORT IN THE ASSIGNMENT BOX BY 4:00 PM, TUESDAY, APRIL 8. GROUPS WHICH NEED ADDITIONAL TIME: I WILL CONTINUE ACCEPTING REPORTS UNTIL 4:00 PM, FRIDAY, APRIL 11.

AWARD: $250 for the best project with a certificate (Acknowledgment: Department of Systems and Computer Engineering).

1. Context

The great success of wireless communications goes without saying. Wireless gadgets of all types, especially smart phones and tablets, have already become an integral part of our lives. Many experts predict that the "Internet of Things (IoT)" will be the next major advance in wireless; this will necessitate the wireless networking of an unprecedented number of sensor-type devices.

The wireless traffic is expected to increase about 1000 times in the next 10 years or so. This rapid expansion and the surge of wireless traffic also raise some concerns, especially due to the increasing energy consumption and the corresponding carbon footprint and other environmental issues. As such, there is an increasing awareness on the "greenness" aspect of cellular networks.

In order to support the exponentially increasing demand, cellular networks are expected to experience a denser deployment of base stations. These base stations will have smaller (WLAN-type) coverage areas; this is often referred to as the "small cell deployment" concept. The utilization of "picocells" and "femtocells" are expected to result in a much lower energy consumption per megabyte of traffic when compared to the conventional "macrocells".

2. Description

Assume that your group is a team of engineers working for a leading cellular operator. Your task is to assess the small cell deployment concept (picocells and femtocells instead of macrocells) for reducing the energy consumption within the context of the 5G wireless networks of the next decade.

3. Requirements

The report will address the followings, in separate sections:

3.1) Briefly describe

- 4G LTE-Advanced
- 5G (expectations)

3.2) Identify appropriate energy efficiency metric (such as, bits/joule). Assess the energy efficiency in 3G and 4G networks.

3.3**)** Several techniques are currently being articulated to reduce the carbon footprint of cellular networks. Present an overview of those.

3.4) Identify target energy efficiency values for 5G networks for various applications.

3.5**)** Give an overview of the small cell deployment concept. Discuss the associated technology, hardware, software, etc., necessary for this application.

3.6**)** Discuss whether the small cell deployment is the way to go for green cellular networks.

3.7**)** Conclude your report with some closing remarks.

3.8**)** Provide a reference list at the end of the report.

Carefully substantiate your claims. Note that this is not a science-fiction project; rather you are trying to make projections for the beyond-4G networks.

4 Report

A group is normally formed by three or four students. Two-member groups are not allowed.

There are two deadlines ahead of you:

- Deadline 1: 4:00 pm, Friday, March 14. Email the names of your group members to the course TAs Yaser Fouad (yfouad@sce.carleton.ca), Irem Bor (irembor@sce.carleton.ca), with cc to me (halim@sce.carleton.ca). **This e-mail must be copied to all group members.**

- Deadline 2: 4:00 pm, Friday, April 11. Two copies of the final report due in the course assignment box.

Missing the first deadline may result in some penalty in your overall mark for this project.

Each group will write one report, and will submit it in two hard copies. All group members will get the same mark. It is up to your group to organize the work and allocate tasks to group members. Your group output will be a report which addresses the above issues. Include references (papers, books, internet, etc.), with enough information that they can be verified by readers.

Do not copy from other sources (especially from internet) or use others' ideas, unless they are acknowledged and properly referenced. Violating this rule amounts to plagiarism, which is a serious instructional offence (see "instructional offences" in the undergraduate calendar, and www.plagiarism.org for definitions and examples of plagiarism). Reference to "other sources" also includes any overlap of your own work in other courses, such as fourth year projects, for example.

The report itself (without figures) should be no more than 10-15 pages of double-spaced text; you may put as many figures as you deem appropriate. Your marks will be based on the correct knowledge and persuasiveness revealed in your report, its organization, coherence and clarity, and use of references.

SYSC 4700 PROJECT MARKING FORM – Winter 2014

Student names:

Group number:

Marked by:

		Mark	Out of:	Comments if any
Overall organization and clarity of the report, including presentation format (proper acronyms, coherence, informative pictures, …)			Max. 10	
Overall correct knowledge and persuasiveness			Max 10	
Completeness and persuasiveness in answering requirements posed in project description:				
Q3.1	4G LTE-Advanced		Max 5	
	5G		Max 5	
Q3.2	Energy efficiency metric. Energy efficiency in 3G & 4G		Max 10	
Q3.3	Overview of the techniques being articulated to reduce the carbon footprint		Max 10	
Q3.4	Target 5G energy efficiency		Max 5	
Q3.5	Small cell concept		Max 15	
Q3.6	Small cell for green networks		Max 10	
Q3.7	Conclusions		Max 10	
Q3.8	Use of references throughout the report		Max 10	
Total			**Max. 100**	