

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Since the increasing of multimedia applications, mobile network operator observes rapid growth of data traffic load demand in their networks. Some studies show that total wireless network traffic produced from voice and data service will increase ten – times by 2015 compared to 2009 in developing region [1]. Operator have to find the way to increase system capacity with limited frequency resources , one of the solutions is finding incumbent operators called GSM refarming.

GSM refarming refers to phasing out currently used GSM services and reallocating the frequency bands to more frequency efficient and data optimized technologies such as 4G Long Term evolution (LTE). However, the strong need for GSM refarming. It is a time consuming process as it is complicated for mobile operator to shut down their GSM network immediately due to the existing voice demand and global roaming capability [2].

The coexistence of LTE systems with existing GSM cellular networks is proposed to address the challenge of growing data demand and maintain GSM service. In [7] studied that deployment cognitive devices at downlink of cellular network, it also showed that only limited opportunity of frequency sharing exist. In doing so, we are going to concern about uplink

GSM system. In the coexistence system studied in [3], LTE femtocell are deployed on GSM cell, yet, it operates on GSM band under certain frequency allocation scheme as a means of facilitating smooth transition to LTE on GSM frequency band. It has been studied that LTE femtocells are able to set off destructive interference to LTE macro network when femtocell use constant frequency channel with macro system [5, 6]. Before the deployment LTE to GSM Cell, some inquiries need to be investigated; to what extent will mutual impact between macrocell GSM and deployed LTE femtocells on each performances, then to what extent the performances system change due to deployment condition change i.e impact of frequency reuse factor, macrocell size, femtocell number and deployment femtocell position.

To resolve the inquiry, much work must be done. In [3] does not provide a clear and comprehensive solution, so more metrics need to be defined and compared in different scenarios. In view of that, we are going to investigate various deployment condition, for instance, heterogeneous frequency reuse factor, heterogeneous macrocell size, dynamic femtocell number and dynamic deployment position in this study.

It is needed to evaluate the feasibility of the coexistence network and impact of various deployment conditions. We are going to explore frequency allocation in term of evaluating accurately coexistence networks performance and LTE utilization on GSM frequency.

## **1.2 Objectives**

The objectives of the thesis work are to design frequency allocation between GSM and LTE femtocells in the coexistence network and investigate the performance of the coexistence network.

## **1.3 Problem**

### **1.3.1 Problem limitation**

Scope and limitation of this research as follows.

1. Problem is limited in the frequency allocation aspect between GSM and LTE femtocell in the coexistence network
2. Addressed to the uplink GSM system

### **1.3.2 Problem**

To achieve the objective of this study, some problems need to be studied, which are listed below.

- In design coexistence network between GSM and LTE femtocell, to what extent the mutual impact between GSM macrocell and deployed LTE femtocells on each performances.
- To what extent the performance system change due to deployment condition change i.e impact of femtocell number, deployment femtocell position, frequency reuse factor, and macrocell size.

## **1.4 Hypothesis**

Scenario where LTE femtocell are deployed on GSM macrocell do not cause harmful interference to the GSM and LTE. Various deployment condition, for example, the change of femtocell number, deployment position, reuse factor and macrocell size are desired to provide an impact on the performance of the coexistence network.

## **1.5 Research Method**

Research methods used in this research are:

1. Study literature which is related to GSM system and LTE system.
2. Analyze problems with technical approach
3. Techniques of data collecting are study literature and analysis data obtained procedurally. The steps of the study including,
  - a. Define and formulate the problem
  - b. Study literature
  - c. Formulate the hypothesis
  - d. Determine model or research design
  - e. Simulation model design
  - f. Analyze and interpret
  - g. Make conclusion and report