Resource Sharing Between M2M and H2H Traffic under Time-controlled Scheduling Scheme in LTE Networks

Kennedy Edemacu
Muni University
Department of Computer and Information Sciences
Arua, Uganda
edemacu.kennedy@gmail.com

Tonny Bulega
Makerere University
College of Computing and Information Sciences
Kampala, Uganda
tbulega@cis.mak.ac.ug

***Abstract*—Machine-to-Machine (M2M) communication is becoming a commonly used terminology due to the idea of Internet of Things (IoT). M2M communication has many areas of application, such as in; medical, transport, environmental monitoring, smart grids among others. As the field of its application expands, the number of M2M devices is expected to grow exponentially in the next few years. Long Term Evolution (LTE) has been identified as one of the suitable wireless communication technologies for M2M communication. Incorporating M2M communication on top of regular Human-to-Human (H2H) communication in LTE is a challenging task due to the expected increase in the number of M2M devices coupled with the unique characteristics of M2M traffic. Therefore, the current scheduling and resource allocation techniques among others being used in LTE need to be refined to efficiently accommodate M2M communication. A scheduling scheme called fixed Access Grant Time Interval (AGTI) time-controlled scheduling scheme was proposed for scheduling M2M traffic in LTE. Resource sharing and utilization under this scheme is inefficient due to fixed AGTI assignment which results into fixed nature of resource allocation. In this work, we propose a scheduling scheme called Dynamic AGTI Time-controlled Scheduling Scheme in which the AGTI is dynamically assigned basing on M2M and H2H traffic intensities. We model the proposed scheme using M/G/m/m queuing technique focusing on resource utilization and Quality of Service (QoS) of both M2M and H2H traffic. The analytical results show that, the Dynamic AGTI Time-controlled Scheduling Scheme achieves; better percentage resource utilization as compared to Fixed AGTI Time-controlled Scheduling Scheme while providing optimal blocking probability for both M2M and H2H traffic. However, the monitoring of resource usage and reassignments of AGTI in Dynamic AGTI Time-controlled Scheduling Scheme increases scheduler complexity.**

Keywords*—LTE, Machine-to-Machine Communication, Human-to-Human communication, Fixed AGTI Time-controlled Scheduling Scheme and Dynamic AGTI Time-controlled Scheduling Scheme.

I. Introduction

The integration between real world and cyber world of ICT (Information and Communication Technology) has not been sufficient yet. In most cases, humans still play some role in manipulating and transforming data and signals. But there is a trend of computers becoming smaller, inexpensive and more available to be embedded in everyday objects [3]. These computers are further equipped with sensors and wireless communication abilities so that every object they are embedded in, have the potential to communicate to Internet leading to Internet of Things (IoT).

Initially, only humans used to have access to Internet through use of computers and mobile phones exchanging data amongst themselves, commonly known as H2H communication. The emergency of IoT has led to extension of this to other objects, and this is termed as M2M Communication. M2M communication is an end to end communication between machines with little or no human intervention. These machines are referred to as Machine Type Communication Devices (MTCDs).

M2M communication has quite distinct characteristics as compared to H2H communication [12]. Some unique characteristics associated with M2M communication are [11];

- Very high number of MTCDs per cell.
- MTCDs produce traffic with diverse QoS requirements.
- Each MTCD produces small amounts of traffic in intervals.

M2M Communication has lots of application areas, like in; intelligent transport systems, smart metering and monitoring, environmental monitoring, and medical [1], [4], [6], [7], [8]. As a result, according Dohler *et al* [5], the number of MTCDs is expected to grow exponentially and it is anticipated to hit a figure of seven trillion by 2017.

Due to mobility of some MTCDs, wireless networks are considered to be of paramount importance in transmission of M2M traffic. Currently, Global System for Mobile Communications/General Packet Radio Services (GSM/GPRS) networks which are widely used, provide the basis on which M2M communication applications operate. But the expected exponential increase in the number of MTCDs will make the current systems run out of capacity leading to poor performance of M2M communication in near future.

As a result, LTE which is a 4G technology has been identified as a suitable candidate for M2M communication. But, LTE was primarily designed for H2H communication.

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