Machine-to-Machine Communications

N

Rashid A. Saeed
Electronics Engineering School, Sudan University of Science and Technology (SUST), Sudan

Mohammed A. Al-Magboul
Electronics Engineering School, Sudan University of Science and Technology (SUST), Sudan

Rania A. Mokhtar
Electronics Engineering School, Sudan University of Science and Technology (SUST), Sudan

INTRODUCTION

M2M communication is a general term refers to automatic data communication between machines without or with very little human intervention. The main feature of M2M communication is that it may includes a tremendous number of communicating terminal with a very little traffic per terminal. Therefore, it involves low cost and effort. This technology is expected in near future to include billions of devices connected together through broad range of wired and wireless communication technologies. However, the development of M2M communication technology in future will depend heavily on wireless communication technologies, due to the numerous useful characteristics of wireless means, and simplicity of installation and deployment.

This article aims to explains and display the developments of M2M communications technology with particular focus on wireless communications technologies. It also examines the future of M2M communications technology, and provides examples to certain of uses by which M2M communication is being developed today, and its contribution to the promotion of social and economic developments.

The article is organized as follows: Section Two discusses M2M Communications infrastructure, Section Three discusses M2M application and presents the smart grid as a candidate to killer application for M2M, and Section Four illustrates certain challenges facing M2M. While Section Five presents the future research directions. Finally Section Six summarizes and concludes the article.

BACKGROUND

Present day communication technology has witnessed a paradigm shift with the advent of machine to machine (M2M) or (machine-type) communications that have immense potential. As a vehicle for wireless communication, M2M networks have become the domain of interest for the industry and academia. Nowadays, intense efforts are being exerted for standardizing M2M smart grid networks and communication protocols by bodies like 3GPP, ETSI, IEEE, and IETF. Various services and smart grid applications which involve M2M networks and communications could be identified. These include electric vehicular (EV) and intelligent power distribution design and home automation.

These services and applications have completely transformed the way communication systems are defined and believed to operate so far.

Several types of communication between things are available currently or can be done; examples include communication between humans such as voice call, messaging, etc, communications between man and machines e.g., interaction between man and computer, and communications between machines, i.e. Machine-to-Machine (M2M). This article is mainly about machine -to- machine communication (M2M) and its applications with more emphasis about smart grid.

M2M communication is not, as it first comes to mind, directly connected device-to-device, but complete networks system operated to exchange information and commands between appliances in two directions. Such communications were originally achieved by having the remote network of machines (e.g., access sensor network technologies integrated to specific M2M area networks technologies such as Wi-Fi, Bluetooth,

DOI: 10.4018/978-1-4666-5888-2.ch611

Zigbee, etc) which in turn will connect to external network (e.g., the internet, and wide area networks).

Expectations indicates that, the year 2014 will witness 1.5 billion wirelessly connected devices that are not mobile phones and do not require any human interaction (Grubic et. al, 2008). Another project was from the European Telecommunications Standards Institute (ETSI), which suggested that there was a potential to connect up to 50 billion machines today, and even more in the near future. There are other expectations with different numbers, and the reasons for that, the difference is owing to the type of connection included in the above estimates. The difference between 50 and 1.5 billion is significant, this because (ETSI) estimation covers all devices connected, including the RFIDS/NFCS wireless communications technologies that are used globally for a significant number of applications such as access control, asset tracking and contactless payments.

MACHINE-TO-MACHINE COMMUNICATION INFRASTRUCTURE

M2M communication is broadly uses wireless communication technologies, both licensed and license exempt spectrum bands, short-range wireless communication technologies, and cellular system. M2M communications system over cellular network is already deployed and perhaps will become the longest consumer of wireless bandwidth in the future.

This dependence on cellular network need to optimize these network to support stationary or low mobility M2M devices, this because some estimates consider that 90% of M2M devices in all applications are stationary consider or require low mobility. Examples are smart meters in smart electrical grid, which do not-require mobility. We can also note that the majority of M2M devices generate low volume of data. For instance, smart meters used in smart electrical grid generate about 200-to-500 bytes of data per hour (Joo, Kim & Liu, 2007). However, the shear amount of M2M devices will have significant impact on the cellular networks and will take a lot of resources of these networks (i.e., bandwidth) as mentioned above, additionally; there are some of M2M applications such as Network Video Surveillance, in-vehicle camera systems which will need high speed data streams. Consequently, third and fourth generations (3G/4G) wireless technologies will play important role in the future of M2M communications system because of its high data rate.

Figure 1 shows the basic M2M communications structure, intelligent and communications enabled M2M devices form an M2M area networks, Including small-scale home environments or a much larger, factory environments. The following is an explanation for the various elements of structure:

- **M2M Area Network:** Provides connectivity between M2M devices and M2M gateways. Its primary components of these networks are sensors, processors, and radio transceivers. M2M area networks employ various PAN and LAN technologies such as WiFi, ZigBee, Bluetooth, etc., or wireline networks such as power line communications (PLC), meter bus (M-BUS), and G.hn.
- **M2M Gateways:** M2M gateway runs M2M applications and provides control and localization services for data collection. M2M gateway may also provide service to other devices (e.g. legacy) connected to it but hidden from the network domain (ETSI TS 102 690, 2011). The Gateways are used to transmit traffic from M2M devices towards the M2M core networks. Flexible gateway is necessary to deal with all heterogeneous M2M networks, which may include wireless sensor networks, wide area networks, or UWB. The M2M devices also can directly connect to M2M core network through the cellular networks system, without the need for gateway.
- **M2M Backhaul:** The M2M backhaul consists of core and access networks, they act as a transport networks in the M2M (Jung-Ito et. al, 2013). M2M core includes M2M service capabilities and core network; usually core network contains 3GPP core networks, ETSI TISPAN core network, and 3GPP2 core network, etc. TISPAN (Telecommunications and Internet Converged Services and Protocols for Advanced Networking) has been an essential