# Chapter 22
# 5G:
# An Expressway to IoT and Tactile Internet

**Nidhi Sharma**
*National Institute of Technology Kurukshetra, India*

**Rajeev Mohan Sharma**
*National Institute of Technology Kurukshetra, India*

## ABSTRACT

*The tactile internet works on opportunities, critical services, and skill-set transfer instead of data. The global scenario is how realistically a machine/device is going to communicate with the other machine/device. Machine/device connectivity in IoT architecture relies on scalability, signal simplification, low cost and long-term sensors for energy efficiency, and improved battery lifetime. While 5G designs are guided by increased user networking demands in the field of industrial automation, precision agriculture, and augmented reality, researchers are forced to consider the unison of new technologies instead of incremental additions to the LTE specifications.*

## INTRODUCTION

Every generation handover the new capacities to the cellular world. 1G gives us the 1st mobile phone. 2G is able to transmit the text first time. 3G provides us with the online connectivity feature. And with 4G we are enjoying the speed of 1Gbps today. But as more and more devices are coming online the 4G LTE system is not going to work properly. By 2020, 5th generation cellular networks aims to provide data rates of more than 10Gbps, opens up the paths for massive connected devices (Internet of things) communicating critical services (Tactile Internet) through haptic sensors (Annunziato A.2015).

## INTERNET OF THINGS

Internet of things (IoT), refers to the billions of physical devices around the world that are now connected to the Internet, collecting and sharing data. This vision is possible due to low cost of processors and

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wide area coverage though wireless networks. A level of digital intelligence is provided to the devices that would be dumb otherwise. This digital intelligence enable them to communicate themselves without any human intervention. So, IoT will merge the digital and physical worlds.

There have been vision of machines communicating with one another since the early 1800s. Machines have been providing direct communications since the telegraph (the first landline) was developed in the 1830s and 1840s, providing necessary component for developing the Internet of Things. The development of computers began in the 1950s.

The Internet, is a significant component of the Internet of Things. Global Positioning Satellites (GPS) is now a reality after 1993, as the Department of Defense provides a stable and highly functional system of 24 satellites. This was followed by private and commercial satellites. Satellites provides basic communications system necessary for the IoT.

One additional and important component in developing a functional IoT was IPV6's remarkably intelligent decision to increase address space. By the year 2013, the Internet of Things had evolved into to a system using multiple technologies, ranging from the Internet to wireless communication and from micro-electromechanical systems (MEMS) to embedded systems. The traditional fields of automation (including the automation of buildings and homes), wireless sensor networks, GPS, control systems, and others, all support the IoT.

Today Internet of Things consists of any device with an on/off switch connected to the Internet. This includes almost every thing, ranging from cell phones to building maintenance to the jet engine of an airplane. Medical devices, such as a heart monitor implant or a biochip transponder in a farm animal, can transfer data over a network .

The idea of adding sensors and intelligence to basic objects was discussed throughout the 1980s and 1990s, but apart from some early projects, the progress was slow because the technology wasn't ready. The processors are cheap but power hungry too. So, it is not cost effective to connect up billions of devices. So the use of RIFD tags(low power chips) that can communicate wirelessly seems to be a good alternative . But this will demands increasing availability of broadband internet and cellular and wireless networking support with low latency. Such real time support system is only possible via 5G.

## TACTILE INTERNET

Haptic communication refers to the ways in which people and animals interact via the sense of touch . A new codex is required to transmit muscle movement . Huge information (big volumes of data, haptic feedbacks) is travelled through the single packet (Aijaz A, Dohler M, Aghvami AH, Friderikos V, Frodigh M,2017). In earlier cellular networks both uplink and downlink are communicating to the same base station as it is a homogenous kind of network. But in 5g heterogeneous network, it is desirable that uplink is talking to the world i.e to femto or picocells and downlink is communicating to microcells in base station (Gupta A, Jha RK, 2016). Machine-to-machine communications (M2M) is a well-recognized trend for tactile internet .To achieve the system response time required by M2M, the demands on human-to-machine interaction also hold.

We are human beings .Being human we are monitoring and sensing all kinds of things, all the time. If we touch and move an object in front of our eye what is the reaction time of visual human system, so that it seems real. And if we do it remotely what is the lag time. The lag time depends upon human