

# Chapter 11

## Personal Environments: Towards Cooperative 4G Services

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### ABSTRACT

*The Fourth Generation of wireless networks promises to offer a vast range and diversity of converged services in order to revolutionize the way we communicate today. 4G can not only offer ultra-high data rates, but would also enable the ubiquitous computing paradigm, particularly interesting for the end-user with the help of various personalized and user-friendly services and devices. This increase in short-range communication among users and introduction of personalized services would form a “Personal Ubiquitous Environment” around the user. Since in such environments, multiple users will come closer (without any third-party barriers); their cooperation would be the key to success. Several technological and social barriers have prevented so far an effective cooperation between technologies, systems or users. This chapter focuses on the potential impacts of cooperative ubiquitous services in 4G networking systems. The authors explain the technological implications of cooperative systems considering the personal environment ubiquity. Furthermore, it attempts to characterize the socio-technical dimension of the potentials and limits of cooperation in 4G systems.*

### 1. INTRODUCTION

The goal of the original Internet was to provide a unified communication platform for different kind of devices and networks as well as future technologies, where every single host would be an equal player. However, this fundamental design radically

changed over time with the emergence of the client/server architecture, with relatively small number of privileged servers serving a huge mass of consumer hosts. This emerged architecture was totally opposite to the fundamental design of the Internet i.e. “a cooperative network of peers”. However, in late 90s, with the appearance of the music-sharing application, Napster, the Internet experienced another drastic change, where the architectural design of the

DOI: 10.4018/978-1-61520-674-2.ch011

Internet reverted and pushed back to its original “peer to peer” notion. The millions of hosts connected to the Internet, inspired by the culture of cooperation and openness, started connecting to each other directly, forming collaborative groups, sharing their resources to become user-created powerful information clusters. Currently, the peer to peer applications are using the Internet much as it was originally dreamed for; a common platform for hosts to collaborate and to share information as equal computing peers.

Wireless communication has simply revolutionized the way we communicate today and is not less than a magic for someone who does not know how it works. It enables us to communicate anytime, anywhere in any form (data, voice). However, wireless technology is not only limited to communication, it can offer much more than just a phone call. The limits of wireless communication are still unpredictable and unimaginable. The father of radio communication Heinrich Hertz once said “I do not think that the wireless waves I have discovered will have any practical applications.” The inventor of first wireless telegraph system Guglielmo Marconi said “Have I done the world good; or have I added a menace?” These early giants of wireless communications were not so sure about the usefulness of their work and were underestimating the power of wireless. They might have envisaged that without the essence of cooperation and sharing, no technology can be economically and socially viable.

The cooperation in wireless technologies is a key to discover a variety of unforeseen innovative applications (Nash, 1951; Borcea, 2002; Frattasi, 2004; Gupta & Kumar, 2002). This latter is the core reason, why the cooperation is gradually increasing with the progress in the generation of mobile systems. Cooperative and distributed wireless techniques have received significant attention in the past decade and a large body of research both highly useful and contradicting has emerged. Today we are at the doorstep of 4G systems, where collaborative services, technolo-

gies, environments and so on, are the major areas of research concern.

As it was originally expected, the future is not limited to cellular systems and 4G should not be exclusively understood as a linear extension of 3G. In concrete terms 4G is more about services than ultra-high speed broadband wireless connectivity. As predicted in Frattasi (2005), keeping the cellular core, the network architecture will be predominantly extended to short-range cooperative communication systems. Apart from the coverage extension, power and spectral efficiency, increased capacity and reliability, this enormous flexibility at the user end will help in the development of “personal ubiquitous environment” around the user. The 4G service and technology infrastructure will induce the user’s devices to form cooperative groups and share information and resources in order to attain mutual socio-technical benefits. The whole bunch of unforeseen 4G cooperative services would enable the 4G technologies to recede into the background of our lives, making us a part of an intelligent and ubiquitous personal substrate.

Until recently, the cooperative services in 4G systems have received significant attention due to their high degree of technological and social flexibility, infinite freedom of choice and cooperation for the user and more importantly, a potential mega-revenue source for the industrial players. In this chapter, we focus on the services side of the cooperation in 4G systems and discuss how these personalized services would make use of the multitude of wireless systems and networks available under the auspices of 4G in a cooperative manner.

### **Cooperative Services in 4G**

The widely agreed upon rule for success in 4G telecommunication markets is to visualize a cooperative service chain of multiple suppliers to satisfy the ever-growing requirements of end customers (Roussos, 2003). The evolution of 4G systems in

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