Chapter LX
Location-Based Network Resource Management

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ABSTRACT

The vision that wireless technology in the near future will provide mobile users with at least similar multimedia services as those available to the fixed hosts is quite established today. Towards this direction, extensive research efforts are underway to guarantee Quality-of-service (QoS) in mobile environments. An important factor that affects the provisioning of resources in such environments is the variability of the environment itself. From the user's perspective, this variability is a direct consequence of the user's movement and, at any given time, a function of his position. Exploiting the user's location to optimally manage and provision the resources of the mobile network is likely to enhance both the capacity of the network and the offered quality of service. In this chapter, we aim to provide a general introduction to the emerging research area of mobile communications, which is generally known as location-based network resource management.

INTRODUCTION

This chapter aims at presenting, in a concise form, state of the art material in the field of location-based network resource management. The current section acts as a general introduction to the evolution of mobile wireless networks, services, and the need for network resource management, so that the readers can familiarize themselves with the issues involved and acquire the global picture of the problem.

Mobile Wireless Networks' and Services' Evolution

Two broad categories can be discerned in the realm of mobile wireless networks: Wireless networks

that have a well-defined infrastructure (e.g., cellular networks) and ad hoc (infrastructureless) networks. Although there has been a growing interest in the area of ad hoc networks in recent years, in this chapter we concentrate mainly on cellular mobile wireless networks. Since the inception of cellular networks in the early 1980 (the idea of frequency reuse is much older and it can be attributed to D. H. Ring, Bell Laboratories [1947]), the mobile networks have passed several phases. The first generation included the analog systems such as the North American system AMPS (advance mobile phone service), the Nordic system NMT (Nordic mobile telephone), the British system TACS (total access communication system), the Japanese system NAMTS (Nippon advanced mobile telephone system), the German system Netz-C and D, the French system Radiocom 2000, and the Italian system RTMI/RTMS just to name a few. These systems were designed primarily for the transmission of analog voice although there were capable of transmitting digital data in low rates.

The transition from analog to digital (second generation) systems was an imperative need in order to fix problems such as regional incompatibilities, low data rates, high blocking probabilities and low security levels while increasing systems' capacity. In the sphere of second generation systems, we can distinguish the systems GSM (global system for mobile), ADC (American digital cellular or IS-54), PDC (personal digital cellular), DCS-1800 (digital communication system at 1800 MHz) and lower tier cordless systems as DECT (digital European cordless telephone), CT2 (cordless telephone 2), PACS (personal access communication systems) and PHS (personal handy phone system). Second generation systems inherited the circuit-switching feature of analog systems but the users' demand for high-data-rate wireless access applications such as mobile IP, multimedia communications and network providers' demand for high-frequency utilization, pointed to packet-switching technologies. The twiddle of the switching technology towards third generation systems was obtained using intermediate (2.5 generation) systems such as HSCSD (high speed circuit switched data), GPRS (general packet radio service), and EDGE (Enhanced Data rate for GSM Evolution).

Third generation systems "3G" such as the Japanese system ARIB, the European system UMTS and the North American cdma2000 will be based on an all-IP network architecture to deliver the promised broadband services with QoS guarantees. 3G cellular systems will be enhanced by complementary WLAN systems such as IEEE802.11b and HIPERLAN, which offer high-data rate wireless access for low mobility users. Integrated 3G/WLAN network architecture provides a vehicle for the future generation of mobile communications. The next generation of mobile communications, termed 4G, foresees a heterogeneous infrastructure comprising different wireless/wired access technologies, where users will enjoy ubiquitous access to applications in an "always best connected" mode regardless of their mobility. This system will be capable of supporting the provision of higher data rates in localized service areas and seamless inter-system mobility.

The explosion of new radio technologies and network architectures in the past few years was fueled by users' insatiable thirst for advanced data services. Voice is not anymore the key service as in the first and second generation mobile systems and the humble 9.6KBps data rate, offered by GSM, is not sufficient for services like Web browsing or video conferencing. A wider range of broadband wireless services, from mobile business applications to mobile entertainment, has emerged in the last years. For network and service providers, the successful delivery of mobile data services is critical to subscriber growth and thus the increase of average revenue per user. A term frequently used to describe the successful delivery of services is this of QoS (quality of service). QoS provisioning takes different forms depending on the service