Chapter 13
Border Adaptive Micro-Base-Station for Wireless Communications

Henry Gao
Glocom Inc., USA

Yushi Shen
Microsoft Corporation, USA

ABSTRACT

This chapter presents a novel architecture, namely the border adaptive micro-base-station network, which can sufficiently meet the bandwidth requirements for the future wireless networks. From the three screens convergence point, the goal is to make the wireless service performance match that of the wired systems, instead of downgrading the performance of wired network applications to the wireless level. Based on the analysis of Shannon theory, the only way to build future wireless networks is to adopt this micro-base-station approach instead of progressively improving the traditional large-cell-base-station systems, such as Long-Term Evolution (LTE).

INTRODUCTION

At the present, there are two major types of wireless network systems, namely the mobile telecom (MSCBC) and the wireless local area network (LAN). The second-generation mobile telecom (2G) has been a great success; however, its descendant 3G has not been as successful. The 3GPP long term evolution plan (LTE) hopes to create a new era for mobile communications. However, in the face of overwhelming bandwidth requirements, most operators have abandoned their original quality commitments, and lowered their service standards by limiting the data volume. Evidence

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indicates that the 3GPP-LTE and other two competitors are all going in the wrong direction.

Another wireless system started from the wireless local area network, led by the WiFi Alliance (Wi-Fi), and the goal is to provide small-scale mobility. In order to expand coverage, the WiMAX Forum (WiMAX Forum) has been formed in 2001, and directly competes with the mobile telecom. However, WiFi and WiMAX are facing the same "Five-No" problems: namely, insufficient bandwidth, inconvenient roaming, weak network management, unsafe system, and no killer applications.

The main service of the 2G system is voice, and the success of 2G is based on the fact that the 2G voice quality is comparable to that of the landline telephone.

Today, both types of wireless systems have been focusing on wireless multimedia. However, the question is how can they provide wireless multimedia with comparable performance as the landline Internet? The answer is not even remotely close!

We believe that the crux of the problem does not lie in fancy applications, but in the basic bandwidth resources. Currently, the industry confines the wireless telecom market to the so-called fragmented time, which basically downgrades wired network applications to the wireless level, only to cause a serious limitation on the network economy's great potential.

This chapter presents a novel architecture, namely, the border adaptive micro-base-station network (Gao & Shen, 2012). This structure is going to be able to provide sufficient bandwidth increase (theoretically unlimited bandwidth), and thus meeting all the bandwidth requirements of the future wireless networks. The goal of this wireless system is to find the right solution, which can enhance the bandwidth and quality on demand, that is to say, to make wireless system performance comparable to that of the wired systems.

Hot spots in crowded areas, such as campus, coffee and tea-rooms, shopping malls, exhibition, stadium, airports and so on, are high-density mobile terminal regions. Once the broadband services get popular, bandwidth demand is to far exceed the capacity of the traditional base-stations. Through centralized management, the high density micro-base-stations can always split the crowd in space, and relatively reduce the number of terminals within the service area of each micro-base-station. If the space between base-stations is reduced to 10 meters or below, the gain of system bandwidth can be up by thousands of times.

In high-density residential areas, wireless signals are completely overlapped. The border adaptive micro-base-station wireless network ensures the radio spectrum management from the system architectural design. The dynamic slot and frame distribution mechanism completely eliminates mutual interference, and in the meanwhile, strictly prevents the unlawful seizure of private network resources.

In rural areas, the overlapping structure of micro and large-cell base-stations can concurrently cover both centralized and decentralized areas. If a region without sufficient bandwidth is identified, it can simply install extra base-stations. The closed-loop transmission power and antenna beam control can automatically reduce the peripheral base-station coverage, and boost up the system bandwidth capacity in the designated areas.

Along the railway and tunnels, micro-base-stations are arranged in one direction, which enables the network system to achieve high-speed vehicular communications. When the mobile terminals pass through numerous micro-base-stations at speeds of hundreds of kilometres per hour, each base-station may only send a few packets, or no packet at all. The high-speed lossless handover mechanism can ensure real-time high-quality video-telecom with a packet loss rate below one ten thousandth (0.01%).