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License-exempt: Wi-Fi complement to 3G

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ABSTRACT

In this paper we compare and contrast the development of Wi-Fi as a license-exempt wireless broadband technology to access the internet with the licensed regime of broadband cellular networks such as 3G. This exploration is based on an assessment of the two different innovation journeys which resulted from two different underlying communication paradigms and two different regulatory regimes, leading to different business models and different diffusions patterns. In concluding we compare the merits of the two cases and derive recommendations for policy and strategy formation.

1. Introduction

Today, Wi-Fi has become the preferred means for connecting to the internet – without wires: at home, in the office, in hotels, at airports, at the university campus. Increasingly, Wi-Fi, synonymous with wireless local area networks (WLANs), provides access to the internet for remote communities in developing countries. Even in rural areas of developed countries community-based Wi-Fi initiatives have emerged to provide broadband wireless internet access, as incumbent operators failed to extend the wired infrastructure to less profitable areas. Moreover, local governments in major cities have recognized the added-value in providing municipal Wi-Fi.

The uptake of Wi-Fi resembles the diffusion of digital mobile cellular communication, see Fig. 1 (based on: GSM Association, 2007; Instat, 2007), denoted as 2G – the second generation; analogue cellular being the first generation. Cellular has become the preferred means for voice communication: early 2007 there were 2829 million mobile users worldwide. In roughly a decade wireless has overtaken wireline communication with a deployment history of over 100 years. Although designed and optimized to support voice, the cellular technology and associated standards have evolved to support data communications with increasing data rates; denoted by 2.5G, GPRS and EDGE. Personal multi-media communication with high data rates (originally up to 2 Mbits/s) is denoted as 3G – the third-generation; currently providing packet data rates up to 7 Mbits/s.

The success of Wi-Fi is remarkable, as hitherto the most significant developments in radio frequency technology – radio-relay systems, R-TV broadcasting, cellular – have emerged under a licensed regime, whereby a government agency provides exclusive rights to the use of a specific part of the radio frequency (RF) spectrum, thereby providing the application protection from harmful interference by other radio frequency users. The success of Wi-Fi, however, emerged under a licensed-exempt open access regime, whereby it had to contend with many other applications and users in the same RF band, including microwave ovens.

The success of digital cellular communications, in particular the domination of GSM −80% of the mobile phones are based on the GSM standard (GSM Association, 2007), has been attributed to the leading role of European governments and their

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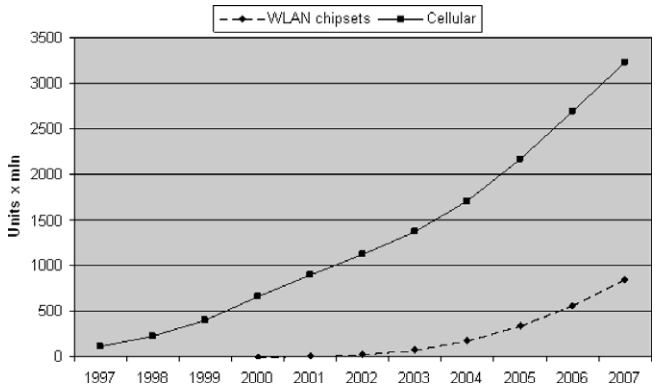

Fig. 1. Digital cellular and WLAN diffusion, 1997-2007.

institutions in creating a harmonized market for cellular communication through a standardization effort of digital mobile technology, the allocation of RF spectrum on a regional basis, combined with a coordination effort in the alignment of the underlying business model in the second half of 1980s. The importance of standardization becomes apparent if we compare the uptake of cellular communication in Europe and the USA. In contrast, the success of Wi-Fi must be attributed to the private sector, albeit, it has been triggered by the US Federal Communications Commission (FCC)[1] in setting the example allowing radio communications including Radio-LANs to operate in bands designated for industrial, scientific and medical (ISM) applications from 1985 onward.

In this paper we compare and contrast the development of Wi-Fi as a license-exempt wireless broadband technology to access the internet with the licensed regime of broadband cellular networks. Often one can observe debates about the question which one is better, in terms of data rates being supported, in quality, in utilizing the radio frequency spectrum, in the contribution to welfare, etc. The generic answer to this question is: it depends. We will argue that the systems should be compared on their merits. Based on our insights we conclude this contribution with recommendations for policy and strategy formation.

To evaluate the two systems, an appreciation of the two, distinctly different development trajectories is considered necessary. Hence, we will start with a recap of the historical developments having led to the current day success of these two forms of wireless communication: (1) the genesis and development of cellular communication, originally designed for the transmission of voice and (2) the genesis and development of wireless local area networking, originally designed for the transmission of data. While these different starting points have led to different business models and hence to different diffusion models, the transition from analogue to digital communication and applications becoming based on the TCP/IP protocol stack, allow these development trajectories to converge. Cellular networks are increasingly supporting data and Wi–Fi is increasingly supporting voice.

2. The origin and development of cellular

In 1906 Fessenden transmitted for the first time the human voice using radio technology. In the 1920s and 1930s this led to radio broadcasting and to radio receivers appearing in most homes.[2] In 1946 mobile telephony service was introduced when AT&T, with the permission of the FCC, provided the first commercial car-borne service in St. Louis, Missouri, which quickly expanded to cover the major cities in the US (Manninen, 2002; Meurling and Jeans, 1994). In 1947 Bell Labs introduced the concept of cellular communications to resolve capacity constraints of these systems through the geographical re-use of frequencies. To make the concept work the principle of 'switch-over' between cells had to be realized, a functionality for which the technology was not yet available.[3]

[1] The Federal Communications Commission is an United States government agency, directly responsible to Congress. The FCC was established by the Communications Act of 1934 and is charged with regulating interstate and international communications by radio, television, wire, satellite and cable. The FCC's jurisdiction covers the 50 states, the district of Columbia, and US possessions (FCC, 2007).

[2] Critical to the development of radio communication and broadcasting has been the invention of the vacuum tube by Fleming in 1915.

[3] This functionality would be developed in the 1960s–1970s.