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**Conference Paper**

## Fixed and mobile broadband: Demand and market structure

23rd European Regional Conference of the International Telecommunications Society (ITS), Vienna, Austria, 1st-4th July, 2012

**Provided in Cooperation with:**

International Telecommunications Society (ITS)

*Suggested Citation:* McDonough, Carol C. (2012) : Fixed and mobile broadband: Demand and market structure, 23rd European Regional Conference of the International Telecommunications Society (ITS), Vienna, Austria, 1st-4th July, 2012, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/60350>

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Research Question: The Configuration of the Broadband Industry in the United States and OECD Nations, Now and in the Future

Title: Fixed and Mobile Broadband: Demand and Market Structure

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Mobile broadband subscriptions have increased dramatically over the last five years. In some nations, mobile subscriptions now exceed fixed-line broadband subscriptions. According to the International Telecommunications Union, which collects data from over 200 economies worldwide, the number of mobile broadband subscriptions globally was estimated at 1 billion for 2010, almost double the subscriptions for 2009. According to data from the OECD, mobile broadband subscriptions in the United States now are greater than fixed-line subscriptions. More than sixty-two percent of U.S. broadband subscribers subscribe to a wireless plan, while only thirty-eight percent subscribe to a fixed-line service. In Korea and Japan, the number of wireless broadband subscribers also dominates the number of fixed-line subscribers. These data, however, do not report the overlap between wireless and fixed-wire broadband subscribers.

The term “broadband” refers to high-speed internet. Upload speed measures the speed at which a user can send data to the internet. Download speed measures the speed at which a user can obtain data from the internet. Most high-speed internet connections are asymmetric, providing better speed for downloading than uploading. In the United States, the minimum speed threshold for broadband was set in 2010 to download speeds of at least 4Mbps. and upload speeds of at least 1 Mbps. In Korea and Japan, broadband plans start from a minimum of 2 Mbps.

The rapid growth of mobile broadband leads us to inquire whether mobile broadband is, or will be, a substitute for wired broadband, or whether the two types of broadband access are complementary. The manner in which consumers demand mobile and wired broadband is influenced by several factors: 1) the comparative speed and reliability of the two modes of access, 2) comparative prices of the two modes, 3) availability of each mode, 4) the structure of the industries that provide fixed and mobile broadband, and the marketing strategies of the

providers. Moreover, consumer demand can be measured as a binary variable (subscribe to a service or not) or measured by intensity of use or speed (Mbps.).

There are four types of fixed-line broadband service: ADSL (Asymmetric Digital Subscriber Line), FTTN (fiber to the node), FTTH (fiber to the home), and Cable/HFC (hybrid fiber coax). ADSL is broadband service via copper telephone wires typically provided by legacy local telephone companies. The most advanced ADSL, known as ADSL2+, typically has a speed of about 10 Mbps. FTTH connectivity is the mode often used by legacy telephone companies in order to provide customers with triple-play service: phone, internet, and television. As of March 2011, FTTH connectivities in the United States had advertised downstream speed of 50 Mbps. and upstream speed of 20 Mbps. Cable broadband usually delivers service via a hybrid fiber-coaxial architecture. Cable download speeds, as of 2009, were at least 10 Mbps. Unlike most OECD countries, where DSL tends to dominate, the majority of subscribers in the United States fixed broadband market are cable subscribers.

In contrast, for cellular wireless broadband, the average 2011 speed in the United States was slightly more than 1 Mbps. and the peak speed was slightly less than 4 Mbps. Not only is wireless broadband substantially slower than fixed broadband. Surveys show that many wireless customers are displeased with the reliability of the service.

Thus, where fixed broadband is available, it offers consumers greater speed and reliability than wireless broadband. When fiber is used, the information path can be assigned to one single customer. Moreover, fiber and cable have the potential to increase speed. A single optical fiber can carry 10,000 times the information that can be carried on the entire radio frequency spectrum. The limited availability of radio frequency spectrum imposes severe capacity constraints on wireless networks, given current technologies. While not all subscribers require large amounts of bandwidth, the increased usage of video or video-intensive applications do require higher speeds, speeds not currently typically available from wireless broadband. The primary advantage to mobile broadband is its portability or mobility; the user is not tied to a fixed line or to the relatively short-range coverage of a Wi-Fi access point connected to a fixed line.

Wireless broadband tends to be the more expensive form of broadband, when price is measured by price per Mbps. However, wireless broadband may be less expensive than fixed broadband when costs are compared for a minimum threshold speed and capacity. For instance, in the United States in the summer of 2011, the prices per Mbps. were wireless (\$17.15), DSL (\$16.40), FTTN(\$8.55), Cable Modem (\$3.83) and FTTH (\$2.91).<sup>1</sup> In many European markets, however, as of June 2008, mobile broadband was cheaper than the incumbent DSL provider for at least 3 GB download per month.<sup>2</sup>

Discussion of the relationship between fixed and mobile broadband includes (1) the relationship in demand, (2) the relationship in production (3) interrelationships between demand and supply.

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<sup>1</sup> Ross,S. (2011) FTTH: Life After the FIOS Build, *Broadband Communities*, 32, pp.34-40.

<sup>2</sup> Wood, R and M. Hatton (2008), *Mobile and fixed broadband: co-habitation or competition?* analysys mason.

Beginning with consumer demand, consumers may view fixed and mobile broadband as substitutes, complements, or unrelated services. The two types of service are considered substitutes if their characteristics and functionalities are sufficiently similar that a reduction in the price of one service leads to an increase in the demand for the other. The two types of service are complementary if the unique characteristics of one type of service add value to the use of the other type of service. That is, the benefit of one service is enhanced by the consumer's use or availability of the other type of service. When two products or services are complementary, an increase in the price of one results in a reduction in the demand for the other.

On the demand side, there may be analogies between fixed and wireless voice telephony and fixed and wireless broadband. Data from the U.S. Department of Health and Human Services survey (2005-2011) shows that while many U.S. consumers substituted wireless for fixed telephony, more than one-half of the consumers surveyed had both landline and wireless voice telephony service. Using these data for 2001-2007, Caves found that wireline and wireless voice telephony were strong substitutes: a one percent decrease in the price of wireless service led to a 1.2-1.3 percent decline in the demand for wireline service.<sup>3</sup>

The nature of the relationship between fixed and mobile broadband is constrained by consumers' broadband options. Fixed broadband is available mostly in developed countries, in regions where DSL lines have been installed by legacy telephone services or where income and population density are sufficiently high to support private sector buildout of fiberoptic lines. Developing countries typically do not have wired telephony or broadband services and rely on wireless services for voice and data telephony. According to the International Telecommunications Union, an estimated 12 percent of households in developing nations have fixed line telephone subscriptions and an estimated 4 percent of households have fixed broadband subscriptions.<sup>4</sup>

Available evidence suggests that, at present, many consumers in *developed* nations, with access to both fixed and wireless broadband, view fixed and wireless broadband as complements rather than substitutes. A 2010 survey of 6000 consumers in OECD nations found that 84 percent of mobile broadband subscribers also have a fixed broadband connection. The key factor in motivating mobile subscribers was mobility, while more than 70 percent of respondents believed that mobile broadband was slower, less reliable and more expensive than fixed broadband.<sup>5</sup> Survey results from Singapore show similar findings: in 2010, 91 percent of households with broadband had fixed broadband and 28 percent had wireless broadband, while in 2009, 92 percent had fixed broadband and only 12 percent had wireless.<sup>6</sup> Further evidence on the complementarity between fixed and wireless broadband in OECD nations comes from

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<sup>3</sup> Caves, K (2001, December) Quantifying price-driven wireless substitution in telephony, *Telecommunications Policy*, pp.984-998.

<sup>4</sup> MobiThinking (2011) Global mobile statistics 2011. MobiThinking

<sup>5</sup> Scott, M (2001, February) Operators should position mobile broadband as a complement to fixed broadband, not a substitute. *Analysismason*.

<sup>6</sup> Infocomm Development Authority of Singapore (2011) 2010 Annual Survey on Infocomm Usage in Households.

the empirical work of Lee, Marcu and Lee: they report a significantly negative coefficient on fixed broadband price in the mobile broadband penetration equation.<sup>7</sup>

From the supply side, fixed and mobile broadband have many of the characteristics of complements in production. According to the economic theory of complementarities in production, two elements have complementarity if an increase in the level of one element raises marginal return to an increase in the other element.<sup>8</sup> Fixed and wireless broadband seem to have the requisite characteristics for complementarity in production. A provider offering both fixed and wireless broadband would enjoy economies of scope regarding marketing and billing. Moreover, a provider's fixed broadband lines would provide backhaul support for the wireless system. In addition, the concept of acquisition complementarity extends beyond the value creation arising from economies-of-scope cost savings.<sup>9</sup> Value can also be created due to revenue growth or increases in market share. These sources of value creation are likely for a provider offering dual broadband access.

However, in the United States and in many other OECD nations, fixed broadband and wireless broadband are provided by competing services. In the United States, legacy telephone operators often offer fixed broadband service, using DSL technology or upgrading to fiberoptic cable to provide triple-play services to consumers: voice telephony, television, and broadband. Competing in the broadband market are cable television providers, who have upgraded their lines to offer triple-play services. Although the cable providers have participated in the FCC spectrum auctions and have obtained spectrum licenses,<sup>10</sup> they have not built out wireless networks such that they might offer consumers a quadruple-play package, including wireless broadband.

Wireless broadband requires licensing of radio spectrum and the build out of a network of towers and antennae. As increased demand for video and video-related applications increase bandwidth and speed demands, a major issue for the wireless segment is the development of technologies to address bandwidth and reliability challenges.

In the past, fixed broadband providers seem to have been reluctant to offer wireless broadband services. Perhaps because of the large investment that the cable companies and the legacy telephony providers have made in their fixed line networks, these fixed broadband providers

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<sup>7</sup> Lee, S., M. Marcu, and S. Lee (2011) An empirical analysis of fixed and mobile broadband diffusion, *Information Economics and Policy*, 227-233.

<sup>8</sup> Milgrom, P. and J. Roberts (1990) The economics of modern manufacturing: technology, strategy and organization, *American Economic Review*, 80, 511-528, and Tanriverdi, H. and C.H. Lee (2008) Within-industry diversification and firm performance in the presence of network externalities: evidence from the software industry, *Academy of Management Journal*, 51, pp.381-397.

<sup>9</sup> Helfat, C.E. (1997) Know-how and asset complementarity and dynamic capability accumulation: the case of R&D. *Strategic Management Journal* 18, 339-360, and Kim, J. and S. Finkelstein (2009) The Effects of Strategic and Market Complementarity on Acquisition Performance: Evidence from the U.S. Commercial Banking Industry, 1989-2001, *Strategic Management Journal* 30, pp.617-646..

<sup>10</sup> Deposit by Sprint Group Leads Wireless Bidders (1994) *The New York Times*, November 28 (PCS Auctions) and Cable Group Spending Big on Spectrum (2006) *Reed Business Information*, September 25 (AWS Auctions).

are cautious about any market move that could reduce the demand for fixed broadband. What we seem to be observing is that, while fixed and wireless broadband providers have been in competition to provide consumers with substitutable services, many consumers have evaluated the functionalities of each type of broadband and have found them to be complementary.

A recent development in the U.S. market suggests that the attitudes of consumers and suppliers about the relationship between fixed and mobile broadband may be converging. In December 2011, Spectrum Co LLC, a joint venture of the major cable providers, announced it had entered into an agreement whereby Verizon Wireless would acquire Spectrum's wireless licenses. At the same time, the companies entered into agreements whereby the cable companies and Verizon Wireless would (1) become agents to sell one another's products and (2) form an innovation technology joint venture for the development of technology to better integrate wireline and wireless products and services.<sup>11</sup> Another development that packages wireless with wireline service is that five of the U.S.'s largest cable networks (Bright House, Cablevision, Comcast, Cox and Time Warner) have joined forces to combine their WiFi networks into a single network with over 50,000 hotspots in their markets.<sup>12</sup>

*Developing* nations often do not have a fixed broadband infrastructure, because the cost of building a FTTH or FTTN infrastructure is not sufficiently profitable for the private sector to undertake and the public sector lacks the resources for such buildout. For such developing nations, mobile broadband can be a cost-effective substitute for fixed-line broadband, although mobile offers less speed and reliability than fixed broadband. The mobile phone and mobile broadband have been called the "single most transformative technology for development."<sup>13</sup> Mobile applications have revolutionized the way information is spread in developing countries, with a great variety of applications in fields such as personal banking, medical information, diagnosis and records, and agriculture, as well as for communication via email and social networking sites.

To conclude, in developed nations, where both fixed and mobile broadband are typically available, there is evidence that consumers consider the two forms of broadband to be complements. The industry seems to be moving in the direction of offering packages that include both modes of internet access. If providers offer bundles of services that include both fixed and wireless broadband, this may have the effect of increasing the degree to which consumers view the two as complements, because the marginal transaction costs of dealing with multiple providers is eliminated. Such bundles would also tend to increase the market power of the providers that offer such bundled services. However, depending upon the configuration of the bundles, bundled fixed and mobile broadband may result in increased substitution between the two, if the bundles increase the ease with which the consumer can substitute one type of broadband for the other.

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<sup>11</sup> Verizon Wireless News Center (2011) Comcast, Time Warner Cable, And Bright House Networks Sell Advanced Wireless Spectrum to Verizon Wireless for 43.6 Billion.

<sup>12</sup> Major U.S. Cable Companies Join Forces for Single Wi-Fi Service, Cellular News, May 21, 2012.

<sup>13</sup> Sachs, J (2011) Mobile Phones to Speed Healthcare Delivery in East Africa, *The East African*.

