5 Mobile broadband

A central part of next generation transition planning has been the integration of mobile broadband with fixed broadband networks. Where ubiquitous access is the emphasis, wireless broadband communications provide the critical component of mobile and nomadic access. The ability to be connected seamlessly everywhere is the driving force behind an emphasis on fixed-mobile convergence. Where basic fixed access competition is the concern, wireless is seen as a potential additional, lower-cost provider that can increase competition in broadband access to the home. And where concerns over equity and access in remote locations are the major focus, wireless technologies are seen as a major potential solution because of their lower costs.

The United States is in the fourth quintile of OECD countries in terms of 3G penetration. While the growth rate in U.S. subscriptions is high, and is 10th in the OECD, several countries with higher growth rates currently have lower levels of penetration than does the U.S. Because of this, it is unclear whether our current performance in 3G penetration will improve or decline in the near future.

It is difficult to pin down a particular policy or practice responsible for better performance in mobile broadband penetration. The primary regulatory differences between the United States and countries that are high-performing in the area of mobile data appear to be the later introduction of 3G-specific allocations in the United States, and the relative regional fragmentation of the licenses. In Europe, Japan, South Korea, and Australia, national regulators auctioned or awarded in beauty contests between three and five nationwide licenses intended specifically for 3G services. In the United States, the AWS auction (the first 3G-specific auction) was concluded five or six years later, in the latter half of 2006.

Because of the flexibility of licenses granted earlier, however, it is not correct to treat the 2006 AWS auction as the critical point of 3G licensing in the U.S. Most prominently, Verizon Wireless was the first U.S. mobile carrier to introduce 3G services; it did so in 2003 and continues to make flexible use of its allocations in the 800 and 1900 MHz bands for delivering 3G services. Similarly, Sprint Nextel, Leap Wireless, and Alltel use one or both of those bands for 3G services. On the other hand, AT&T Wireless and T-Mobile use only the later-allocated 1.7MHz or 2.1MHz bands for 3G services. It is certainly possible that the need to upgrade earlier equipment on the same channels, the uncertainty of when new spectrum would be available (the spectrum ultimately awarded in 2006 was first identified five years earlier), and the regional fragmentation contributed to relatively slow and uneven rollout. A clear benefit of the flexible allocations aspect of American policy, however, emerges when one considers that the most salient concern currently reported by European regulators is transitioning GSM spectrum, the 900 and 1800 MHz bands, over to 3G. The U.S. policy of flexible allocation *ex ante* allowed licensees to make that transition for themselves early on.

Nomadic access seems to have developed not from spectrum policies but from business models and public interventions. We noted in the prior chapter how competitive entrants, like Free in France or Telenor in Sweden, or incumbents like Swisscom and BT through Openzone, are innovating with new service models to extend their network using nomadic access. Similarly, we see public, municipal efforts contributing to the availability of nomadic access. This does not appear to be the result of any country-specific spectrum policy differences that we have observed. We therefore do not further elaborate here on our earlier emphasis on nomadic access in the context of benchmarking and access.

The tentative nature of our descriptions of wireless broadband policy is perhaps best captured by the European Regulator's Group June 2009 report on next generation transition. Regarding wireless policy, the ERG stated: "It would appear, however, that at this point is too soon to give a definite solution to or

present best practices to problems identified by NRAs and Member States on how to handle future transitional problems. The main reason for this is that while regulators are considering different ways to handle transitional issues, there is still little actual practice as such."[322] In this report, the ERG reported the primary current challenges faced by the European regulators as:

1. Refarming the 900 and 1800 MHz band originally allocated to 2G, GSM services. The problems here are:

    - The original grants do not permit the grantees to offer 3G services

    - Adding flexibility would give the original grantees an unfair advantage over competitors who have higher-frequency allocations, and would therefore face higher infrastructure costs with more base stations to deliver equivalent services

2. 790-862 MHz: the digital dividend spectrum, released by the transition to digital TV

3. 2.6 GHz band and 3.4-3.8GHz bands, both relatively less contentious but require increased regulatory flexibility to achieve their use, and in some cases to free them from incumbent occupants, including government users

These kinds of challenges are familiar to Americans, even if the specific frequencies are slightly different. The primary insight to be gained is from the difficulties raised by refarming the GSM bands. In theory, because of the flexible definitions of personal communications services allocations, the United States does not have a similar problem. We note, however, that the difficulty presented is as much about assuring that after the transition the countries continue to have a competitive market. The early advantage of Verizon in deploying 3G services may or may not be due to its ability to reuse its 800 and 1900 MHz bands. If it is, and if the advantage persists, then competitive imbalance may turn out to be a price the United States is paying for its early flexibility. This is a question that should require future observation.

We approach the 3G question using the same approach we used for our analysis of competition and access. We consider country-level case studies of firm behavior to identify the likely effects of policies that recur as important to shaping the market. Our review leads us to identify no definitive driver of high 3G penetration. We see countries with very different strategies and market structures doing well, and other countries without obviously different policies doing worse. Countries with auctions, for example, have done both well, and poorly. Countries with beauty contests have similarly performed on both sides of this divide. Countries with four or five simultaneous allocations have done well, and poorly. South Korea did very well even with what was initially a two-player allocation, for all practical purposes. Our primary conclusion is therefore that there is substantial need for additional study of mobile wireless policies and business models, to be extended to both mobile cellular architectures and nomadic access.

Of the top ten countries in terms of 3G penetration, four substantially outperform their fixed broadband penetration: Italy, 5th in 3G but 22nd in fixed; Spain, 7th in 3G by 20th in fixed; Australia, 3rd in 3G but 16th in fixed; and New Zealand, equal with the UK at 10th in 3G, but 18th in fixed. The top two countries, Japan and South Korea, are the overall high performers, as are Sweden (6th) and Finland (8th). Of these, only Sweden and the UK are truly high performers on nomadic access as well, with South

322 ERG (08) 60 rev 1; RSPG09-277, European Regulators Group and Radio Spectrum Policy Group Joint Publication, ERG-RSPG Report on transitional radio spectrum issues, June 2009, pp 23-24.

Korea making a respectable showing in that dimension as well. Here, we cover the consistently high performers first, then move to cover the low-fixed, high-mobile performers, and the low-mobile, high fixed performers (the Netherlands and Canada). We then look at the differences among the Nordic countries, where Sweden and Finland have substantially higher mobile broadband penetration than Norway and Denmark.

5.1 The consistently high performers: Japan and South Korea

Just as they do in fiber infrastructure, Japan and South Korea lead the world in 3G penetration as well. Japan has over close to 72 3G subscriptions per 100 inhabitants, and South Korea has 63. By comparison, the United States has 20.6 3G subscriptions per 100 inhabitants.

Japan awarded three identical, 2x20MHz paired spectrum blocks in a beauty contest to NTT DoCoMo, KDDI's au Corp, and Vodafone in June of 2000. NTT DoCoMo launched the world's first 3G network in 2001. DoCoMo still holds over 70% of 3G subscriptions. Vodafone was purchased by Softbank in 2006. Since then, Softbank Mobile has emphasized lower prices and cross-selling with its broadband service, and has invested in cellular infrastructure, more than doubling the number of base stations between 2006 and 2008 relative to the number it originally purchased from Vodafone. Softbank Mobile added more subscribers to its network in 2008 than either NTT DoCoMo or KDDI au Corp. The three-way competition, with smaller entrant eMobile (a division of eAccess, the owner of AOL Japan) well behind, has emphasized very high speed data and mobile video and music distribution, as well as lower prices. All the carriers no longer sell 2G services, and all are pushing to develop and launch 4G technologies.

On the regulatory front, the MIC has responded to the competitive structure of the 3G market by allocating more spectrum to 4G services in the 1.7 GHz range, as well as the bands originally intended to be allocated in the 1.5 GHz range, so as to expand the number of 4G licenses it intends to issue from three to four. This is intended to allow all four mobile carriers, including eMobile, to compete in the 4G market.

The South Korean experience must be treated with caution, as it appears to be a particularly salient example of the managed economy model of regulation. The South Korean MIC auctioned two identical 20 MHz blocks for 3G licenses in December 2000, to SKT and KTF (majority owned by KT). It then granted a third license to LGT in mid 2001, and actually awarded the three licenses simultaneously in November of 2001. LGT did not deploy at all, and was fined for the interim reservation period. In 2006, when the providers were not rolling out networks beyond Seoul, the MIC threatened them with fines. Investment followed throughout the country. Throughout 2006 the MIC fined SKT, KTF, and LGT for price fixing and illegal handset subsidies.

The most interesting move in South Korea is the shift, since 2007, toward encouraging fixed-mobile convergence. All carriers were permitted to integrate with fixed line providers, in moves described earlier in the Competition and Access part. This vertical integration was, as in Japan, accompanied by a requirement that the mobile carriers open their data networks to competitors. These requirements do not yet appear to have been implemented, and it is therefore too soon to tell what their effect on competition, availability, price, and service innovation in mobile data will be.

5.2 High mobile, low fixed performers

Italy, Spain, Australia, and New Zealand all substantially outperform their fixed-line penetration when it comes to mobile broadband networks.

Italy auctioned five identical licenses in October of 2000, each providing 2x10MHz paired and 1x5 unpaired blocks to each licensee. There were only five contenders, after one potential bidder, Blu, withdrew. Of the five licensees, Ipse 2000, a subsidiary of Spain's Telefonica Moviles, failed to deploy, and had its license revoked in 2006. The remaining four licensees: Telecom Italia Mobile, Vodafone Italy, Wind, and 3 Italia (owned by Hong Kong-based Hutchison-Whampoa) remain in intense competition today. 3 Italia launched 3G services first, in March 2003; while it remains the smallest of the four providers in terms of total mobile subscribers, it continues to be the largest 3G provider, with 34% of the 3G market, followed by Vodafone and Telecom Italia (29% each), and Wind making up the small remainder.

The major regulatory tension of the past few years has involved the initial prohibition, in 2006, on Telecom Italia and Vodafone from offering integrated fixed-mobile packages, which was later reversed in 2007. Now, TI, Vodafone, and Wind all offer bundled packages for their fixed and mobile offerings. Moreover, since June of 2008 Vodafone also bundles access to its Wi-Fi hotspots throughout Italy. Trying to match these owners of fixed and mobile platforms, fixed broadband providers FastWeb and Tiscali are both offering 3G services, which they buy wholesale from primary mobile network operators.

The current primary challenges that the Italian regulator reported to the ERG were the “refarming” of the 900 and 1800 MHz GSM bands, and the reassignment from defense use to civilian use of allocations at 3.5GHz. The former is widely reported throughout Europe, and primarily raises the concern that reassignment to some providers, but not others, would enable those who have the new, lower-frequency spectrum to offer lower-cost services, with fewer cell sites and better coverage, thereby upsetting the competitive structure of the market. The 3.5GHz band appears to primarily involve internal politics of budget compensation to the Defense department for the lost frequencies. Neither issue is resolved as yet. As noted in the Access and Competition part, the Italian providers Telecom Italia and Vodafone have entered voluntary agreements to share cell infrastructure so as to reduce the costs of their 3G networks.

In 2000, Spain awarded four identical, 2x15MHz paired, plus 1x5MHz unpaired blocks in a beauty contest to Telefonica (the Spanish incumbent), Vodafone, Orange (a subsidiary of France Telecom) and Xfera, a consortium whose members included Vivendi and TeliaSonera. Launch was slow initially, and in 2004 the Spanish authorities permitted the competitors to share infrastructure in order to reduce costs of deployment. Vodafone, Telefonica, and Orange all launched 3G services that year, and HSDPA 3.5G in 2006, while Xfera struggled internally and ultimately launched only in 2006. The Spanish regulator reported to the ERG that its major transition issue concerned how to transition 900MHz and 1800MHz to 3G without distorting competition. Telefonica and Vodafone do have 900MHz allocations, while Orange and Xfera do not.

Australia conducted a more fragmented auction than any of the prior countries we have reviewed, resulting in the emergence of four 3G licensees: Telstra, Vodafone, Optus (a subsidiary of Singaporean Sing-Tel) and Hutchison 3G Australia (H3G), each holding somewhat different amounts and configurations of spectrum dedicated to 3G services. Two additional smaller winners of the 2001 licenses, Personal Broadband Australia and 3G Investments, did not develop into substantial players in the Australian market.

The difference in Australia's initial approach does not seem to have dampened competition. All four national licensees from 2001 were active participants in the 3G market until H3G and Vodafone merged in June 2009. H3G was the first to launch 3G services in 2003. In response, Optus and Vodafone signed a collaboration agreement, in which they agreed to share their infrastructure, like cell towers, so as to lower the cost of deployment and speed up construction of their competing networks. Incumbent Telstra signed a similar, 50/50 deal with H3G. The deals raised concerns in the regulator that the alliances were pulling the country's 3G market into an effective duopoly, but the regulator then took no apparent public action against these alliances. All four (now three) players in the 3G market claim to have near 100% coverage for the Australian population, although the Australian's government's contentious relationship with Telstra, which took its most recent major step with the announced national broadband network plan and the requirement that Telstra undertake structural separation, also spilled over to lawsuits over coverage, over dropping of CDMA service before 3G service was in fact universally available, and over advertising practices.

New Zealand's relatively high 3G penetration followed a substantially different path. As with the other countries surveyed, New Zealand allocated blocks of spectrum for five 3G licenses in January of 2001. One of the blocks was awarded to the Maori Spectrum Trust's Huataki. The other four were auctioned. No bidder in the auction was permitted to own more than 15MHz of spectrum. Of these four, only two emerged as real competitors: Vodafone and Telecom New Zealand's mobile arm. The other two, Telstra and Clear, merged in late 2001, but still failed to launch 3G services after two false starts. The New Zealand 3G market is now relatively evenly split between the leader, Vodafone, and New Zealand Telecom. In the meantime, several efforts to build a third provider in the spectrum block awarded Huataki have not materialized. Despite the spectrum caps, and new efforts that resulted in redistribution of 900/1800 MHz spectrum from Vodafone and Telecom Mobile to Huataki as part of plans to reuse the 2G spectrum, no third provider has emerged in New Zealand.

New Zealand's market therefore has two 3G players, unlike the other countries we have observed, which have mostly four, or in the case of South Korea and in large measure Japan, three providers. Whether New Zealand's high mobile penetration rate results from the fact that its fixed broadband market has long been uncompetitive; whether it is the small size of the market (although New Zealand is no smaller than Norway or Finland); or whether competition between two providers is not much less effective than three or four providers to achieve high penetration remains unresolved by the New Zealand example.

5.3 Low mobile, high fixed countries

Two countries stand out as top ten performers in fixed broadband penetration who find themselves in the bottom quintile in the OECD in terms of 3G penetration. These countries are the Netherlands and Canada. Both currently have lower penetration, but higher growth rates, than the United States.

The market structure and trajectory in the Netherlands appear no different than those of the higher-penetration countries. The Dutch regulator allocated five standard UMTS licenses to the existing mobile phone providers: KPN Mobile, Vodafone, Orange, T-Mobile, and O2. KPN bought O2 in 2005. T-Mobile bought Orange in 2007. The remaining three competitors are all active in the 3G market. They appear to be offering and competing on a wide range of services, including mobile video and integration with hotspots. Nonetheless, the number of 3G subscribers reported in the Netherlands is lower than in the majority of OECD countries. The Netherlands has a reasonably high degree of 2G penetration, and two of its major players, KPN Mobile and Vodafone, paid the Dutch government to extend their GSM licenses for an additional three years to last until 2013, the same year that their other competitors' 2G licenses expire. These all suggest that the Dutch competitors are continuing to focus on

their 2G and 2.5G offerings, and that this may be slowing transition to 3G. The major 3G players began rolling out mobile TV offerings over the 3G and 3.5G networks since 2007. It may be that the Netherlands' anemic performance in mobile broadband is transitory. It did see a 125% growth between the first quarter of 2008 and the first quarter of 2009. While the gap may be closing, the experience of the Netherlands certainly diminishes any claims that there might be a simple recipe for success in the mobile sector.

Canada's wireless mobile broadband market and regulatory environment are the most similar to those of the United States, but with poorer results. Like the United States, Canada had flexible allocations in the mid-1990s that formed the basis of its 3G transition, well before Industry Canada got around to auctioning 3G-specific licenses (called, like in the U.S., Advanced Wireless Services) in the past year. Like the United States, Canada had many regional licenses. Its wireless market is nonetheless dominated by three national players, which together account for 95% of wireless customers, rendering much of the activity surrounding these three practically moot. As in the United States, the three players are extensions of fixed-broadband incumbents, except that in Canada one of these is a cable operator—Rogers. The other two are Bell Canada and Telus. As in the United States, Canada too has had two distinct technologies, but there the rollout has been inverted. In the U.S., Verizon was first with its 1xEV-DO Rev A version of mobile broadband, and continues to lead the market with it. In Canada this was the choice of Bell Canada and Telus. Rogers, however, using the European-compatible W-CDMA/HSDPA standard, now leads the market. Because the latter allowed Rogers to be the only provider to offer mobile video calling, Bell Canada and Telus are both moving in a joint effort to roll out their own W-CDMA/HSDPA network, apparently in a bid to compete more effectively with Rogers. In the meantime, all these players purchased additional spectrum in the recent AWS auctions, preparing for rolling out 4G services when these become feasible. Several potential entrants purchased spectrum in those auctions as well; most prominently from the perspective of fixed-mobile convergence, these included the other two regional cable operators, Shaw and Videotron. They also included a new entrant, Globalive, an extension of a long-distance reseller. In all, these new entrants may revitalize the Canadian market, but this is, of course, speculative.

Were Canada the only example of a negative mismatch, we might have suggested that regional fragmentation and the absence of a single, globally-compatible standard were determinative. However, given the similarly weak performance in the Netherlands, with its almost identical structure to that of other, higher-performing European mobile data markets, this is a difficult conclusion to sustain. Instead, we simply note here the necessity of further and deeper study into mobile broadband. In theory, a beauty contest that results in three players, such as in the case of Japan, should do poorly by comparison to an auction of flexible licenses that results in many players of diverse sizes. The result, when looking at Japan and Canada, was the opposite. Why, and what exactly we in the United States can learn from these disparate performances, should be the subject of further study.

5.4 The Nordic countries

The Nordic countries present an interesting case because all four are high performers on fixed broadband, but Sweden and Finland have much higher 3G penetration than Norway and Denmark. Norway and Denmark each have slightly higher penetration rates, at 21% and 25%, than does the United States (20%). Both countries, however, have had slower growth rates in the past year. Sweden (42%) and Finland (38.8%) both have much higher current rates, and while Sweden's growth rate is slightly lower than in the United States, Finland's 3G penetration growth rate has been almost twice as high as that of the U.S.

Sweden awarded four licenses to provide 3G service in December of 2000, each for a nominal license fee of $11,000. The licenses were awarded in a beauty contest, and in a unique move, Sweden awarded none of these licenses to its incumbent, Telia. Instead, they went to Swedish entrant Tele2, Vodafone Sweden, Hi3G (the Hutchison-Whamopoa entrant), and Orange Svierge. Telia re-entered the market soon thereafter by entering a joint venture with Tele2, named Svenska UMTS-Nat.

The licenses were conditioned on by far the most aggressive roll out requirements, requiring the licensees to roll out 3G service to 99.98% of the population within two years of the original grant. While none of the licensees indeed met this ambitious target, the following few years saw several efforts by the licensees to extend the period, and by the regulator to threaten fines and injunctions. Through this dynamic, and with explicit permission to share facilities (TeliaSonera with Tele2, Vodafone with Hi3G) so as to reduce costs, 98% of the population was covered by 3G network coverage by the middle of 2006. The cost was that Orange dropped out of the grueling race in 2002, and had its license revoked in 2004.

Since 2003, Hi3G has played the role of catalyst in the Swedish market. It was the first to roll out 3G service in May 2003; it was later the first to roll out higher speed HSDPA services in November of 2006, just as the 3G network coverage reached the high levels required by the regulator. In each case, it was followed within six months to a year by TeliaSonera and Tele2's joint venture, and then by Vodafone. In each case, lower prices, bundling of handsets, and new applications played a role in attracting subscribers. In 2007 Hi3G launched higher upload speeds with HSUPA, and in 2008 higher download and upload speeds yet by deploying HSPA+.

In May 2008 the Swedish regulator attempted to push forward the next generation transition by awarding four 4G licenses in the 2.6GHz range, which are technology neutral, and whose licensees, TeliaSonera, Telenor, Tele2, Hi3G and Intel, claim they will use both for Long Term Evolution (LTE) mobile and WiMax services. It is also working to reallocate the 900 MHz GSM spectrum, and channels cleared by the digital TV transition in 790-862MHz, to mobile broadband.

In all, the Swedish story is one of: four concessions through a beauty contest; aggressively defined and enforced rollout requirements, and fierce innovative competition from those players who survived the grueling process.

Finland held the first 3G auction in 1999, distributing six UMTS licenses. Of these, however, only three became nationwide providers—the licenses originally assigned to Telia and Sonera, one of which was sold to DNA of Finnet Group when TeliaSonera was formed, and to Elisa. Of the remaining three, two never took off, and one is a regional licensee in the Aland islands. Unlike the Swedish authority, the Finnish FICORA did not impose any deployment requirements, except that all networks be operational by January 2001. This requirement was met only experimentally, and it was not until October of 2004 when TeliaSonera launched the first commercial 3G network in 20 cities. Elisa launched in only eight cities a month later, and DNA launched a year later, in three cities. By April of 2006 take-up was still slow, and the regulator allowed bundling of 3G phones with subscriptions, increasing take-up. In late 2006 to mid-2007 the Finnish regulator engaged in a series of calls to the providers to lower and coordinate their rates, which was apparently followed not by price competition but by a coordinated lowering of prices. In 2007 the Finnish regulator was the first in Europe to permit providers to offer 3G services in the 900 MHz band. It is difficult to disentangle which of these acts had an effect of increasing growth and moving Finland from a weaker performer, more in line with Norway and Denmark, to a strong performer like Sweden. Finland saw 3G penetration growth rates of over 80% between 2007 and 2008, and 144% between 2008 and 2009, leading it now to occupy a position in the

top 10 countries in terms of 3G penetration. In April of 2009, the Finnish regulator granted TeliaSonera, Elisa, and DNA additional 1800MHz bands in which to launch 4G, LTE services.

Norway awarded four identical 2X15 plus 5 licenses in December of 2000, apparently in a beauty contest. Two of its licensees failed however, leaving only Telenor and Norway's first mobile telephony entrant, NetCom (now owned by TeliaSonera), in play. It imposed much weaker roll out requirements than did Sweden, and quickly relaxed even those in 2003. Hi3G bought one of the two unused licenses and was given several years to begin to roll out its network; it has not done so yet, and has now received extensions until 2012. The fourth license was sold in a sealed bid with only one bidder, to the third facilities-based GSM provider, Mobile Norway, which teamed up with mobile reseller Tele2. It has not yet rolled out its 3G services. In all, the Norwegian market seems to have begun anemically with two failed launches and delayed launches by the remaining providers; part of what is puzzling about this picture is that several of the same players, most prominently TeliaSonera and Hutchison-Whamopoa, have been extremely active and aggressive in the Swedish and Finnish markets, but much less so in the Norwegian market.

Finally, Denmark awarded four identical nationwide UMTS licenses in September of 2001. They were nominally "auctioned," although all four were awarded for an identical price to Hi3G, incumbent TDC's Mobile Nordic, Telia Denmark, and Orange, which was later bought out by Telenor. The build-out requirements were less stringent than Sweden's, but more so than Finland or Norway. Denmark also prohibited its providers from sharing infrastructure. Hi3G was the only 3G provider until the end of 2005, when Mobile Nordic rolled out 3G services. It took another year for Telenor to roll out 3G service. Hi3G was also the first to launch HSDPA, and remains the leader in speeds and subscriptions, with 36% of the 3G market. As in Norway, much of the market jockeying in Denmark has taken the form of acquisition of resellers, or mobile virtual network operators (MVNOs).

Observing the Nordic countries leaves one with more questions than answers. The most successful of the bunch, Sweden, used a beauty contest and aggressive regulatory deadlines to push investment. The second most successful, Finland, used auctions and a very light regulatory touch of a while, followed by more of an emphasis on price regulation and freeing up more spectrum. Norway and Denmark mostly followed intermediate strategies, with only middling success by global standards.

5.5 Mobile broadband: conclusions

Our conclusions with regard to mobile broadband strategies is that more study is needed. We observe successes and failures with beauty contests and auctions. We observe successes and failures with loose and tight rollout requirements. We observe successes and failures with flexible allocations and inflexible allocations. We cannot say that allocating 20 or 40 more MHZ to 3G resulted in better or worse results, whether these were translated into a fifth national licensee or in larger allocations per licensee. The subject is intensely important, will play a central role in the transition to ubiquitous connectivity, and is poorly understood.

We do see, however, increasing trends to fixed mobile convergence, with the owners of mobile licenses buying fixed broadband providers, or vice versa; and shared physical facilities to reduce deployment costs. In several cases, both in this section and in the section on competition and access in the fixed lined, we see that mobile cellular, nomadic, and fixed services are being integrated to form the experience of seamless, ubiquitous access for subscribers. In each case, these are trends that might raise concerns of competition policy, where potential competitors combine, but where there appear to be good reasons having to do with shifting to seamless connectivity. A major consideration in future planning

will be how to allow these kinds of integrations that promote seamless, ubiquitous access, without undermining competition.

5.6 Nomadic access

By “nomadic access” we mean wireless access to the Internet using non-cellular technologies, mainly Wi-Fi, where the user logs in to some form of wireless extension of an existing fixed network connection. Nomadic access is provided mostly as what we know as Wi-Fi hotspots. As a matter of spectrum policy, it depends on permission to operate unlicensed devices, rather than on a license to operate a network or particular service in a defined slice of spectrum over which the licensee exerts exclusive control. American consumers are familiar with nomadic access in airports, coffee shops or other public spaces, and in city spaces where municipalities themselves, or non-profits, have set up public Wi-Fi access areas. Internationally, we observe several models for making wireless nomadic connectivity that go beyond this kind of free-standing Wi-Fi hotspot to provide an element in a user's mobile connectivity options. Most of the innovation here is not technical or institutional, but in services. All the top countries in this domain, and in terms of hotspots per 100,000, are European countries. The practices are largely described in the competition and access chapter. Here we merely recapitulate to locate the European experience with fixed-nomadic developments.

What appears to be the most important trajectory that is different from what we see in the United States are the uses that French broadband provider Free and fixed-mobile broadband provider SFR are doing with their systems. Unlike hotspot providers, whether in a given locale or of a national footprint, Free and SFR do not deploy special hotspots with their own dedicated connections. Instead, they configure their fixed broadband end user equipment in the user's home, as a dual system: one capable of providing a secure home network to the subscriber, and the other, at the same time, providing a hotspot for permitted users. In the case of these two companies, these permitted users are other subscribers of the same carrier. In Free's case, at least, the fixed home network traffic has priority in situations where it competes for congested capacity with the nomadic users. In the case of Free, this offering also allows mobile phone users whose phones have Wi-Fi capabilities to make mobile voice calls. The combination of nomadic mobile broadband and phone allows Free to function in competition to the increasing fixed-mobile converged platform of France Telecom/Orange, and SFR, itself a mobile provider that more recently through its neuf Cegetel purchase also offers fixed broadband connectivity. SFR seems to use this nomadic capability to complement and balance the load on its 3G network, by routing calls and data uses from handheld devices over either the firm's 3G network, or over its fixed-plus-nomadic network, at least whenever a subscriber is within reach of another subscriber. The interesting feature of this approach is that it offers a very direct and simple path to blanket all areas with substantial residential penetration with nomadic access, without developing an additional standalone mesh networking or other extension technique.

An alternative approach that continues to build nomadic access through extension of home broadband networks is the model adopted by FoN. Here, end users become members of a club with hundreds of thousands of members. Each member can use the Wi-Fi box of any other member. Others can buy access instead of using in exchange for their own capacity. Again, the advantages are similar to those of the Free or SFR model, but the implementation does not depend on any given carrier adopting the program. Instead, users can opt in themselves by installing the necessary equipment in their home, connected to their broadband network.

Beyond the user-side versions like FoN, we also see carrier-side bundling of more traditional hotspots model with their broadband offering. Telenor Sweden combines the Wi-Fi network created by one of

the broadband entrants it purchased, Glocalzone, its own hotspots, and a newer set of hotspots it contracted with pan-European Wi-Fi hotspot provider The Cloud, which include 800 spots in Sweden, and another 8,000 throughout Europe. Together, these provide coverage in 24 of Sweden's cities, and Telenor bundles free access to all these nomadic access points with its mobile broadband subscriptions. In response, TeliaSonera Sweden also bundles its nomadic access network, which covers over 2,200 hotspots throughout Sweden, with its mobile broadband offerings. Beyond these bundled offers, Swisscom, which has a large network of Wi-Fi hotspots, offers lower rates for Wi-Fi hotspot use for both fixed-broadband and mobile subscribers. British Telecom provides a separate offering, Openzone, sold on a separate monthly subscription or bundled with mobile roaming minutes.

Nomadic access is at present very much a poor relation to mobile broadband over cellular networks. The hotspots model has developed as a relatively expensive, occasional access mode, or as a way for municipalities, in particular, to make specific city spaces, like parks or squares, Internet friendly. We are beginning, however, to see models that leverage existing fixed-broadband connections to provide more comprehensive coverage, at lower-cost. These new approaches, most clearly those offered by FoN, on the one hand, and Free and SFR, on the other, suggest a development trajectory that could make nomadic broadband components an important element of ubiquitous, seamless connectivity.