

Wireless Access Technologies
Joseph H. Weber
Strategic Policy Research

1. My name is Joseph H. Weber. I am a principal consultant and partner in Strategic Policy Research (SPR), a consulting firm that specializes in issues of telecommunications policy, economics, law and technology. I am a telecommunications engineer with over 30 years of experience at Bell Labs and AT&T. Most of my career was focused on network planning and engineering, a specialty that requires an understanding of the costs and capabilities of telecommunications technologies of all kinds. I have spent the last ten years consulting on telecommunications policy matters for clients in the US, Europe, the Caribbean, Latin America and Australia.
2. I am here today to discuss the likely role of wireless technologies as an alternative to the wireline network for the delivery of a wide variety of telecommunications services.
3. Wireless technologies have been developing rapidly for the past two decades. Mobile telephony has exhibited explosive growth, and is increasingly being substituted for wireline services. A variety of fixed wireless services have been proposed and developed, but have had only modest success in most places to date. I believe there are four principal reasons why fixed wireless services have failed to live up to their promise in the past.
 - (a) Fixed wireless systems are most viable when they can gather revenues from several services. They started a number of years ago by focusing on voice services and more recently have emphasized broadband data services. Neither has been sufficient to support the infrastructure investment and marketing expenditures required except in certain niche markets.
 - (b) Spectrum availability and cost is often an issue, particularly in the US where there are very many competing uses for spectrum, including some from Government and military applications. Scarcity in turn has led to high prices when spectrum is offered, and regulatory restrictions on the amount of spectrum available to an operator and the uses to which it may be put.
 - (c) In some countries, and particularly in the US, the market for both voice and data fixed wireless-based services has been largely preempted by:
 - (d) (1) widespread availability of cable TV facilities that are rapidly being upgraded to support broadband and even voice services; and (2) an aggressive network unbundling regime that allows competitors to utilize telephone company facilities at low costs and to provide service with very little investment.
 - (e) Equipment costs have been too high to enable entrants to compete effectively, particularly when they are entering markets already served by wireline carriers.
4. As an American being asked to provide expert testimony on New Zealand, I am intrigued by what appears to be an ideal environment for the successful utilization of wireless technology to provide a wide variety of services. Each of the above problems is being ameliorated here, either by the specific characteristics of the country, or by the evolution of technology.
 - (a) The maturing of Voice over IP (VoIP) technology opens up credible opportunities for wireless to deliver both voice and data - that is, to capture several revenue streams and be a complete substitute for the copper wire.

VoIP has evolved during the past five years ago from a specialty product for computer aficionados to a service suitable for wide application. This transformation has occurred for several reasons. First of all, of course, the technology has progressed and costs have dropped. It is no longer necessary to use a computer to utilize VoIP – it can be done with specially designed standalone units. Secondly, the wide availability of broadband access using DSL and other technologies has largely eliminated the performance problems associated with low speed access lines, and the use of sophisticated routing and prioritization algorithms within the IP network has helped to minimize performance problems there. Vonnage, in the US, offers a full range of voice services for those that have high speed Internet access lines at prices that are very competitive with conventional telephone services. I have similar personal experience. Cablevision, the cable TV company that provides my cable TV and Internet access services in New Jersey, has recently offered voice services using VoIP at a price of \$35 per month with unlimited local and domestic long distance calling – far less than the cost of conventional telephony for most people.

- (b) As a smaller country with low population and population densities, and of course with the same amount of spectrum as larger countries, it is likely that there is less demand for spectrum, so carriers can more readily obtain enough spectrum to provide robust services at reasonable cost.
 - (c) Cable TV deployment is limited and there are currently no unbundling requirements, allowing ample opportunity for wireless to enter the market.
 - (d) Equipment costs, of course, are declining because of Moore's Law. This is likely not only to reduce the costs of wireless service, but also reduce or eliminate, or even reverse any difference between the costs of wireless and wireline services. This effect is due to the fact that a larger fraction of the cost of wireless technology is in electronic equipment, subject to Moore's Law, than is the case for wireline. The cost of the cables, supporting structures and right of way at the center of wireline services are not declining, and they comprise a larger fraction of the cost of these services than the non-electronic portions of wireless services, principally antennas and supporting structures.
5. Another element in the mix is Project PROBE, which seems to me to be a very exciting and innovative move by the New Zealand Government. I understand that tens of millions of dollars have been allocated to this project, and networks are to cover much of the country. This in turn has allowed local as well as national players to participate. This process has apparently led to widespread credible plans for rolling out wireless networks in New Zealand.
 6. Finally, recent deployments by the likes of BCL and Woosh Wireless confirm the opinions expressed above – that the time is ripe for fixed wireless deployment in New Zealand. It is clear that these players have the ability to offer a complete range of voice and data services in competition with the copper network, and that such offerings are at the center of their technology and business plans.
 7. I will now briefly discuss the principal characteristics of each of the major categories of wireless service, as well as their current status and likely evolution.

Wireless Mobile

8. Wireless mobile is, of course, the dominant wireless technology in use today, and there will be significant improvements over the next few years.

9. Mobile telephone systems currently compete with wireline voice systems, increasingly becoming a substitute for wireline. The magnitude of this substitution in the US can be estimated using data published by the FCC. In December 1999, there were just short of 190 million wireline access lines in the US, including both incumbent (“**ILEC**”) and competitive (“**CLEC**”) carriers, and it grew slowly to only 192.5 million in 2002. ILEC lines counts actually declined during this period. Looking back, between 1985 and 1990, ILEC lines alone grew at a rate of 4.2% per year. If CLEC lines are assumed to have grown from zero in 1985 to the 8 million achieved in 1999, the growth rate of the entire wireline market was in excess of 5%. If we assume that this total demand continued to grow at a rate of, say, 4.5% from 1999 to 2003, the total number of lines in 2002 would have been almost 220 million, 28 million more than the actual number of 192.5 million. The difference is probably due to two causes—displacement of voice grade internet access lines by broadband services, and substitution of wireless. Broadband access lines grew from 2.7 million in 1999 to almost 20 million in 2002. If we assume that half of this growth was pure growth, and half was displacement of dial-up lines, that leads to a dial-up displacement of 8.6 million lines. Subtracting these two numbers leads to an estimate that there was a likely substitution of wireless for over 18 million terrestrial access lines between 1999 and 2002, or about 8 percent of the projected wireline market. If all high speed access lines resulted from dial-up conversions, that would still imply a migration of over 10 million lines, or about 5% of the projected wireline market. This trend is likely to accelerate as wireless mobile prices drop, service quality improves, and local number portability is extended to wireless services.
10. Third generation (3G) protocols using this spectrum, currently being implemented, support high speed data services, either circuit switched or packet, with data rates up to 2Mbps, which will offer competition for DSL. Fourth generation (4G) systems, currently being trialed in Europe, will be available in about three years, and will support packet switched data rates of up to 100 Mbps, suitable for multichannel TV distribution, if adequate spectrum can be made available.
11. The service quality problems that have often been associated with mobile telephony should lessen as the carriers flesh out their networks, and, in the US, consolidate as the FCC removes its restrictions on spectrum ownership. These problems are less severe in any event if the customer is at a fixed location.

Fixed Wireless Technologies

12. I have identified fixed wireless as a separate category from mobile to conform to current commonly understood distinctions. It should be recognized, however, that spectrum and protocols used for mobile wireless can be used for fixed applications as well, as demonstrated by Woosh Wireless.
13. One fixed wireless service that has had spectrum specifically allocated for it is called Local Multipoint Distribution System (“**LMDS**”). This service operates at very high frequencies (28 GHz) which allows it to provide large amounts of bandwidth. Unfortunately, the transmission paths are limited to line-of-sight, and subject to atmospheric interference. Wireless services using these frequency bands are most suitable for use in high density situations, such as central business districts and office parks, where buildings are close together and demands for bandwidth are high.
14. Another set of fixed wireless services that has spectrum allocated to it is called Multichannel Multipoint Distribution System (“**MMDS**”). These services operate at frequencies below 5 GHz, and do not experience the same propagation problems as LMDS, but offer less bandwidth. As mentioned above, frequencies in this spectrum area can be used interchangeably for fixed and mobile service. Typically the only difference is that the fixed services do not accommodate movement between base stations in the middle of a call. IP Wireless has developed a set of products to support broadband data

services in the 2-2.5 Gbps band using mobile telephony (3GPP UMTS) packet protocols that allow for the provision of broadband services. Woosh in New Zealand and Clearwire in the US are offering broadband services using this technology. Airspan has a set of products in similar frequency bands being used by BCL as part of its EXTEND product. Other companies such as YDI Wireless and Trango Broadband are also developing products for this market. It can be expected that wider availability and lower cost of VoIP technology will substantially improve the viability of such technologies because of the ability to support more services using the same infrastructure.

15. Fixed wireless technology has not been widely deployed in the US to date. Providers like Winstar attempted to offer only voice service during the bubble that followed the passage of the Telecommunications Act of 1996, and suffered financial problems. More recently, Clearwire, Airwire (7000 end users in central Florida) and other small companies such as WI-LAN, US Wireless Online and TowerStream are offering broadband services, particularly in areas where broadband access is not otherwise available. BellSouth purchased a number of MMDS licenses in the southeastern US, but it is not clear what it has done with them. As noted above, it is likely that market for the deployment of these technologies has been foreclosed in many areas by the widespread availability of unbundled network elements (UNEs) at low prices, and the extensive deployment of cable TV networks, which are rapidly being upgraded to provide broadband services.

Unlicensed (Wi-Fi) Services

16. Unlicensed 802.11 (Wi-Fi) services are growing rapidly, but are generally limited to local areas and distances of a few hundred feet. Vivato, however, offers a phased array antenna system that has a range of up to 4 km. Such a system, in conjunction with point-to-point wireless or other transmission systems and VoIP, could provide a viable alternative to wireline voice and DSL service.
17. Newer standards (802.16a, approved in January 2003; and 802.20, under development) offer the promise of unlicensed spectrum that can operate over longer distances. (Preliminary estimates are of up to 4 km, but may be longer once the developers get to work.) In conjunction with VoIP they could form the basis for another access alternative to wireline for both voice and data service, with the advantage of mobility if desired.
18. There appear to be substantial investments in these systems. Companies such as Nokia, Proxim and Ensemble are developing products to utilize 802.16 protocols. Deployment of "hotspots" is very rapid, and many companies, including Intel and IBM, are providing technology and deploying services.

Satellite Systems

19. Broadband services using geosynchronous satellites are available from the DBS providers Echostar and DirecTV in the US. The services generally operate using a high speed downlink, and a terrestrial telephone upstream connection. They are not priced competitively with DSL or cable service, and are focused on customers for whom other alternatives are not available. VSAT solutions are also available, but these are only suitable for higher value services. There are capacity limitations if the services are widely utilized. SKY in New Zealand apparently does not offer broadband data services at this time. This technology is not suitable for voice because of delays.
20. Satellite systems using higher frequencies (Ka band) and spot beams offer promise of becoming a viable alternative for broadband access in certain locations. Again, these systems are not suitable for voice services.
21. Low Earth Orbit (LEO) systems have been planned and even introduced. Iridium, unfortunately, failed, and plans for other services have been scaled back. These

systems do not suffer from the delays associated with geosynchronous systems, and can provide a high quality of service, but they are complex and expensive, requiring many satellites and sophisticated antenna arrangements. There is little promise of extensive deployment in the next few years.

Comments on the Schema report

22. TelstraClear has submitted a report by Schema that drew a bleak picture of the viability of fixed wireless as an access technology. The Schema submission is a detailed discussion of the radio propagation issues associated with certain wireless systems that it refers to as Fixed Wireless Access (FWA). It does not discuss the possibility of using current or future wireless mobile protocols and spectrum or satellite technology for the provision of fixed services. It also focuses very closely on existing technologies, and does not attempt to forecast the future evolution of these rapidly changing technologies. In its comparisons with DSL –based services, it takes a highly optimistic view of what can be accomplished with DSL, and appears not to consider the extensive investments required to support true broadband services using that medium. It fails, finally, to consider the unique situation in New Zealand, where spectrum may be more readily available and hence less expensive than in more heavily populated areas.
23. A few of the key assumptions and statements in the report that are untrue or misleading are listed below.
- (a) It is assumed that wired network operators' costs are likely to drop more rapidly than wireless in the future. As noted above this is almost certainly untrue.
 - (b) The report states that "There is little or no appetite amongst investors to invest in FWA..", a statement that is clearly contradicted by the activities of Woosh Wireless, BCL and other wireless service providers in New Zealand.
 - (c) The report states that 2.4 GHz systems have been deployed using interference reducing techniques such as spread spectrum that are not frequency efficient. This is theoretically true but not particularly relevant. CDMA is a spread spectrum technology widely used in both New Zealand and the US. Spectral efficiency does not appear to be a problem in either place.
 - (d) The report expresses the opinion that proprietary standards will limit the deployment of some wireless technologies, but does not entertain the likelihood that open standards will evolve over the next five years, which almost certainly will happen. Standards such as IEEE 802.16, IEEE 802.20 and 3GPPT00, which are open standards, are in place or under development.
 - (e) The report states that lack of spectrum and security problems will limit the effectiveness of "Wi-Fi" systems. Again, it does not allow for the evolution of standards (e.g. IEEE 802.11i) and possibly the augmentation of available spectrum (e.g. 5GHz).
 - (f) In its comparisons with DSL capability, the report overstates the capability of DSL without substantial investment. DSL often requires substantial investment in fiber transmission facilities if high transmission speeds are to be realized as Telecom has outlined in its plans for its mass market multi-service NGN rollout.
 - (g) Environmental (health and safety) issues are raised as an impediment to fixed wireless. These problems have been largely resolved in the US, where the FCC forbids local jurisdictions from considering such issues when presented with an application, so long as objective standards are met. Radiation Standard NZS 6609 is being applied in the same manner in New Zealand.

- (h) The analysis estimates that DSL costs about as much as wireless, but does not specify what DSL costs are included. (It also doesn't identify the basis for the wireless costs.) This type of comparison requires careful definition of the basis for the comparison to be useful, a definition that is not included in the report.
- (i) The report also states that cost equality is not good enough – entrants will need greater margins. Woosh Wireless and BCL apparently disagree.
- (j) The case studies are all about failed ventures in Europe based on investments made several years ago. It makes no mention of the fact that technology is changing, or that spectrum (one of the bottlenecks in Europe) may be easier to obtain in New Zealand. It also does not indicate what markets were being pursued by these operators or what the competitive landscape looked like. A forward looking view with constraints clearly identified might offer an alternative perspective.

Summary

- 24. The above discussion has focused on the trends in wireless technology and services, and the opportunities available for use of such technologies as competitive alternatives in New Zealand in the near future. It also has identified the reasons why such technologies have not been successful in the past, and shows why the current environment in New Zealand, absent regulatory action of the type envisioned by the Commission, should prove fertile ground for deployment of advanced wireless systems. It also points out some of the shortcomings of the report prepared by Schema and submitted by TelstraClear, which attempts to show that fixed wireless is not a viable access technology.