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WIRELESS COMES TO YOUR RIGHT-OF-WAY¹

The story may be apocryphal but it has the “ring-tone” of truth. In AT&T’s early implementation of cellular telephony, a consultant for the telephone giant (then an undivided “Ma Bell”) is said to have predicted that subscribers to the new service might number as many as 900,000 by the year 2000. The offering was imagined then to be chiefly vehicular and largely for businesses. The forecast was 120 times too conservative.

According to the principal industry trade group, the Cellular Telecommunications & Internet Association (“CTIA”), cellular and PCS customers reached about 108 million by the end of 2000.² Three years later, another 50 million subs were estimated to have signed up for commercial wireless service. Even more dramatic has been the increase in minutes of use (“MOU”), or air time. These had grown to 800 billion by December 2003, up 30% from 2002 and 200% since 2000.

Wireless telephony has become so popular so quickly that its providers have begun to act on their hopes of displacing or seriously eroding their wire telephone competition. Increasingly

¹ Presented to the Information & Telecommunications Committee of the National League of Cities, September 18, 2004, San Francisco. Based on an article submitted for publication in the Fall 2004 issue of the *NATOJ Journal of Telecommunications Policy*.

² http://www.ctia.org/public_policy/statistics/index.cfm/AID/10030

we read of customers who have discontinued physical connections at their residences or businesses in favor of radio service. Even those who keep wire telephones are using them less, especially for long-distance or other toll calling. In fact, wireless carriers have detected a new “busy hour” to go along with the classic morning and afternoon commuting times of heavy usage. Motivated by cellular marketing plans that offer large numbers of total or evening/weekend minutes for one flat monthly rate, wireless customers are dialing for distance at night from home via their mobile phones.³

Because there are six wireless carriers serving communities across the country,⁴ and others who focus on particular regions or localities, competition to gain or retain customers is fierce. The “number portability” ordered by the FCC is now the general rule, increasing pressure on customer retention.⁵ With customers increasingly expecting reliable wireless service in their homes as well as in their cars or on the street, cellular providers are seeking residential cell sites that will meet these expectations.

The issue is not simply one of coverage – that is, will the signals in homes be strong enough not only to reach the front door but to penetrate indoors. Carriers must also provide for capacity – that is, sufficient channels or bandwidth to accommodate lengthy conversations conducted simultaneously by multiple customers, as well as massive data transfers that could

³ More information about these wireless trends can be found in the accompanying White Paper from Comp Comm, Inc. dated May 25, 2004.

⁴ Two of the six, AT&T Wireless and Cingular Wireless have announced merger plans, which are pending at the FCC and other agencies as of this writing.

⁵ Number portability refers to the ability to keep a telephone number when changing carriers, within certain geographic limitations on point of service. It applies to both wireless-to-wireless and wire-to-wireless (or vice versa) changes of carrier. *See, e.g.* <http://www.fcc.gov/cgb>.

include still photos or motion video. As usage, services and bandwidth requirements go up, more sites are needed to provide the needed network capacity while maintaining service quality.

Cell division allows more intensive and efficient use of the limited spectrum licensed to each wireless carrier. Frequencies used in a given cell can be reused if sufficiently separated from that cell. These new offspring sites can be smaller, and their antennas mounted lower, since they don't need to cover the large areas typically associated with lattice towers or the taller "monopoles."

All of the social developments and technical imperatives described above point to more placements of wireless communication facilities ("WCFs") at the curbsides of your streets and roads, that is, in the public right-of-way ("PROW"). These sites are better able to serve residents in their homes and individual employees in their offices or stores. Subdivision into smaller cells at reduced antenna heights better suits PROW installation, where existing power, telephone or light poles are on the order of 30 to 40 feet tall rather than 100 feet or more.

Of course, the use of these "vertical elements" to mount antennas is not completely novel. Curbside deployment of radio systems for reading meters and other forms of monitoring and signaling, in fact, is commonplace. But the scale of the coming encroachment of commercial WCFs is significantly greater, and local governments had better prepare for the invasion.

One form of preparation, working with your municipal attorneys, is to make the mental shift from Section 332(c)(7) of the Communications Act to Section 253 of the same federal statute. When relatively tall towers were being placed mostly on private property, or on public property outside the PROW, it was comparatively easy to work with the first of these sections. Your zoning codes enjoy a presumption of regularity. You could write the codes to minimize

numbers of towers (*e.g.* by encouraging co-location on existing towers, siting on existing non-tower buildings or other structures, etc.) You could provide for preferred siting in commercial and industrial zones. Even in residential zones, you could employ stricter height limits, property-line setbacks, and the like. On your own public property, you might be exempt from certain zoning restrictions, and you had the opportunity – state or local law permitting -- to charge market rents as a landlord.

Your discretion in these zoning or leasing actions has been restrained only by the federal “due process” protections of Section 332(c)(7)(B): That there be “substantial evidence” for the way you apply local regulations, that you act within a reasonable time, and that your actions not “prohibit” wireless service or discriminate unreasonably between or among wireless providers. Prohibition, explained the courts, could be avoided if the refusal to approve a given site were accompanied by feasible suggestions for alternate sites – even if the substitute locations were technically or economically less desirable.

With the move of WCFs to the PROW, Section 253 comes to the foreground in wireless service installation and improvement. Like Section 332(c)(7), this section forbids local and state governments from prohibiting telecommunications service. However, the prohibition is not confined to wireless service. In fact, until now most cases reaching the courts have involved wire services such as conventional telephony that have used the PROW for decades. In these cases, courts have been quick to criticize and often overturn local laws that seem to give state or local authorities “unfettered discretion” to deny PROW placements or that charge newcomers

more than incumbents.⁶ However, restrictions on PROW occupancy that are fairly related to state or local responsibilities for health, safety, universal service and PROW management under Section 253(b) or (c) usually have passed muster with judges.⁷

The technical advantages for wireless carriers of WCF placement in the PROW are reinforced by economic and legal considerations. Charges for installations on private utility poles or public light standards likely will be lower than rental payments to private or public property owners outside the PROW.⁸ Separately, many states, by legislative or judicial actions, have limited fees for PROW occupancy permits to recovery of the justifiable municipal costs associated with permit review.

In many respects, the legal protections for wireless carriers under Section 253 are broader than under Section 332(c)(7). While the latter forbids unreasonable discrimination between or among personal wireless service providers, Section 253 protects all telecommunications service providers in the PROW, wire and wireless. Thus, any free or reduced-rate occupancy granted a telephone company years ago could become the basis for a wireless carrier's insistence on equivalent treatment.

Moreover, if ministerial "encroachment" permits or other relatively cut-and-dried administrative processes are used to approve wire carriers in the PROW, their wireless

⁶ A common problem is state laws a century or more old that allow telephone companies essentially free occupancy of the PROW in exchange for their presumed obligations of universal service as carriers of last resort.

⁷ See, e.g., Frederick Ellrod & Nicholas Miller, *Property Rights, Federalism, and the Public Rights-of-Way*, 26 Seattle U. L. Rev. 475 (2003).

⁸ On the other hand, the revenue opportunity for installation of WCFs on otherwise unproductive municipally owned vertical elements is not to be sneered at.

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competitors are likely to complain about complicated, time-consuming “conditional use permits” that have been characteristic of WCF zoning outside the PROW. Additionally, it becomes more difficult for municipalities to refuse a PROW placement without the “alternative-site” jurisprudence that has built up around Section 332(c)(7).⁹

Given the popularity and relative success of “co-location” of WCFs in the early history of personal wireless service implementation, it bears noting that PROW placements probably will not tolerate such sharing of single sites. The vertical elements in use today, at 30 or 40 feet, are simply too short or too weak or unstable, to meet the spacing and load-bearing requirements entailed by co-location.

The ways in which communities adjust to the movement of WCFs into the PROW will be as different as their various zoning codes and permitting regulations. The constant in the equation is the need to prepare early, so that an influx of applications does not threaten the measured and deliberate consideration of public safety and aesthetics that are legitimate objects of PROW management.

*James R. Hobson
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September, 2004*

⁹ This is not to say that such defenses would be improper under Section 253. However, wireless carriers may be able to demonstrate that without curbside placements, they are unable to serve customers in homes, offices and stores in a way that allows them to compete. And again, the competitors are wire as well as other wireless companies.



Trends in Mobile Wireless (AKA “Cellular”) Usage And Implications for Wireless Facilities Siting

May 25, 2004

ABSTRACT

Usage of mobile communications has evolved well beyond “Yuppies” on the phone in their cars. As a result, *where, how many* and *what kind* of wireless facilities (“cell towers” and other sites) are needed has changed as well. This paper summarizes these trends and some implications for local governments responsible for planning for and reviewing these facilities.

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I. Introduction & Overview

The world of wireless communications continues its rapid evolution. The *users* of mobile communications have changed dramatically over the past 20 years. And *how, how much* and *for what* mobile services are used has changed radically: mobile devices are not just cell phones and pagers anymore, but encompass all sorts of personal communications devices, including phones with text messaging and cameras, Blackberries™ which allow users to send and receive e-mail, and devices such as the Palm Treo™ which incorporate phone, web browser, e-mail device and organizer all in one. And the future promises even greater change as new services and devices are developed.

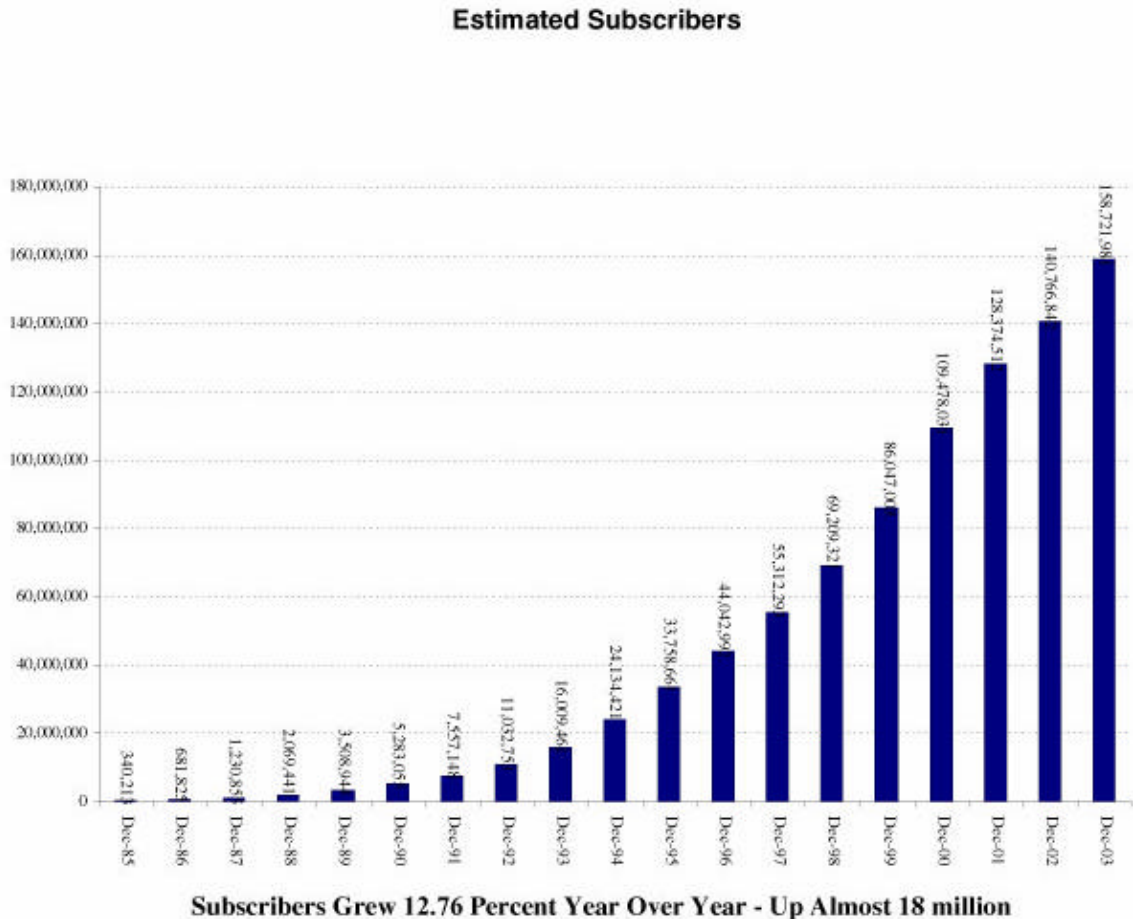
Because the users and usage of wireless services have grown and changed, the networks that provide these services have grown and changed as well. Base station equipment (computers, transmitters, antennas, etc.) is regularly upgraded to accommodate new services and provide new functionality. And this new demand has not only increased the *number* of cell sites needed, but *where* these sites are typically needed has changed as well. Where once companies were concerned about providing service along the major roads and thoroughfares, now customers are requiring service where they live and work.

One key result of all this is that local governments will continue to see requests for new sites for wireless facilities. And this trend shows no sign of slowing anytime in the near future. By better understanding the drivers behind this expansion, local governments can better plan and respond to requests for new sites.

II. Subscriber Evolution

The biggest changes in subscribers are **how many** and **what type**.

The number of subscribers has increased dramatically over the last 10 years. There are now more than 160 million US wireless subscribers¹, more than twice the number of subscribers just 5 years ago.



Source: CTIA

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Figure 1 – CTIA: Estimated Wireless Subscribers 1985-2003

The type of user has changed as well. “Early adopters” were generally upper-income, professionals or those who spent a great deal of their workday away from a desk but still needed to be in contact: people such as doctors, sales people, and real estate agents. As phones and service became more affordable, whole new groups began to subscribe: small business people and other mobile workers who don’t spend their workday at an office, such as those in construction. More recently, new users are driven to “go

¹ Cellular Telephone and Internet Association: www.ctia.org.

wireless” more for personal rather than work-related reasons, and so some of the newest and fastest-growing groups of users are families, young adults (many of whom do not even own a traditional landline phone), and teens and children.

III. Usage Evolution

The biggest changes in usage are **how much, what for, when** and **where**.

Because the cost per minute of wireless service (especially voice) has generally decreased, and with the introduction of plans offering incentives such as “free long distance,” “free nights and weekends,” and “free mobile to mobile,” people are using their mobile phones more often, and staying on calls longer when they do.

The average number of minutes used per user (“Minutes of Use” or “MOU” in industry parlance) has increased every year.

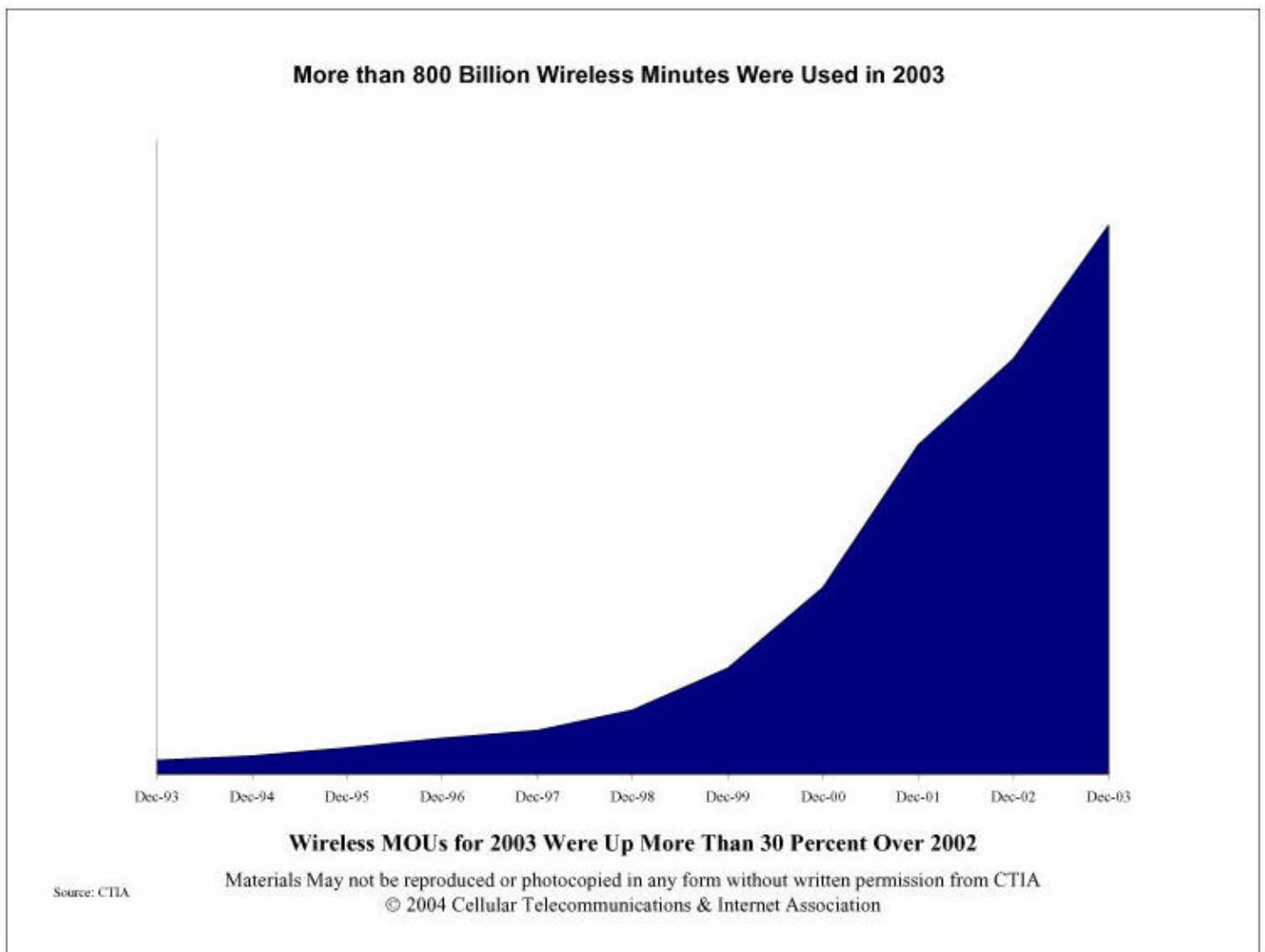
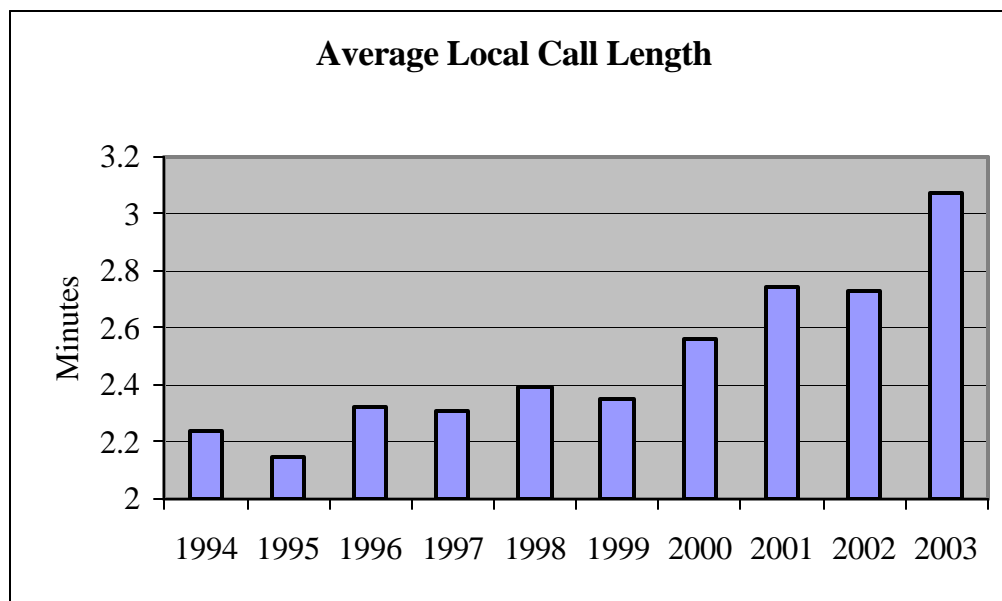


Figure 2 – CTIA: Wireless Minutes of Use (MOU) 1993-2003



*Figure 3 – CTIA: Average Local Call Length 1994-2003²
(Please note Fig. 3 is local calls only and does not reflect
the increase in long distance usage reflected in Fig. 2.)*

New devices and new applications mean *why* people use mobile communications is changing. Wireless is not just voice phone calls anymore, but text messaging, e-mails, photos, music and even short video clips. Soon it will be web browsing and large documents and files (already in limited use through wireless modems). These ever-expanding uses will continue to drive up both minutes of use and bandwidth requirements³.

And because of the shift from work-related to personal use, where and when people use their wireless devices has changed dramatically. People once used their mobile phones mostly in their cars. Now phones are carried on the person and are used in the workplace and even more at home. Now usage is not just at the traditional peak drive times (morning and evening rush hours), but all through the day and evening. Currently more than 14% of mobile users use a wireless phone as their primary phone.⁴ And the “free calling after (X) PM” plans have created new “busy hours” for the carriers, generally at 7 or 9 PM, depending on the carrier and plan. So the demand by users for service is now in the evening and at the home.

² Data taken from CTIA Table. See Appendix III. Used with permission.

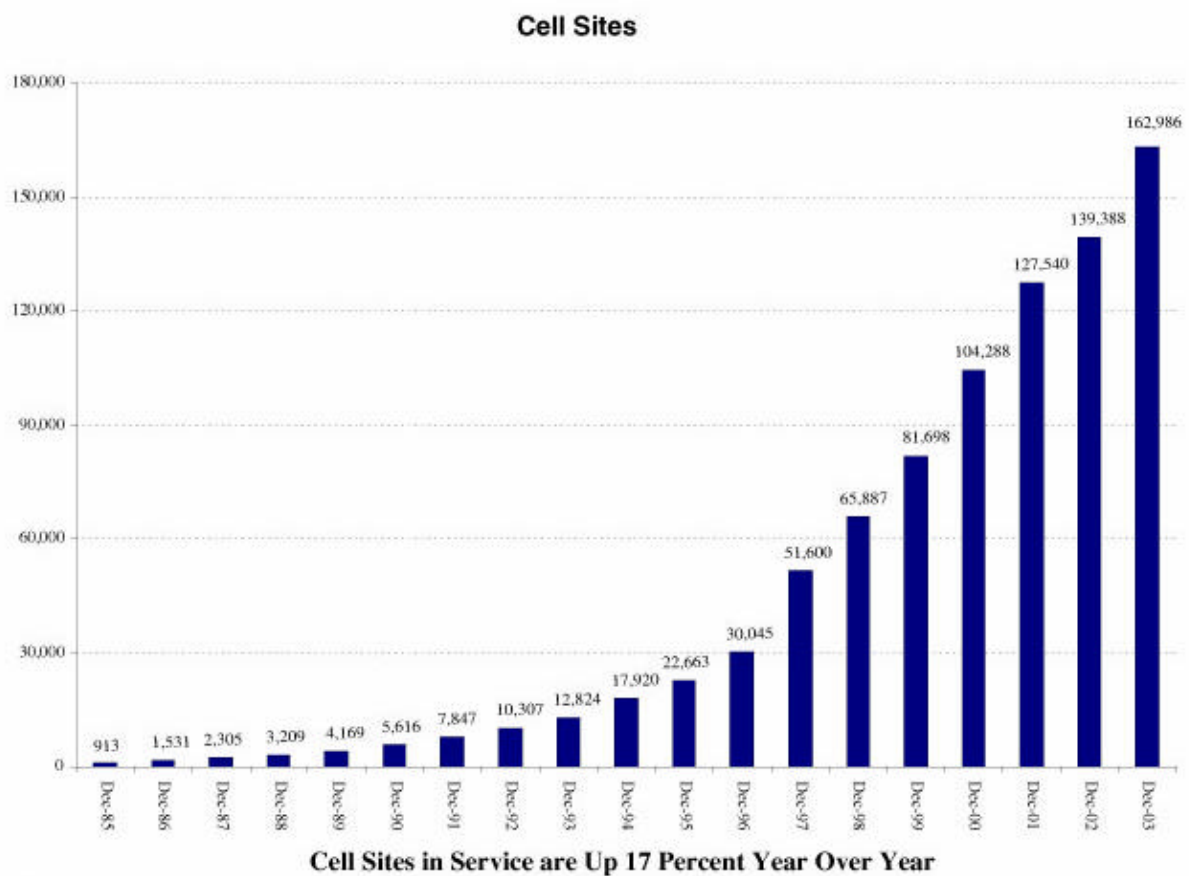
³ Put simply, bandwidth is a measure of how much of an allotted frequency band (the size of the “slice”) is needed for a particular application or service. Voice and messaging are relatively low-bandwidth services. Photos, video, and web browsing typically require higher data volumes and therefore are considered higher bandwidth applications. When multiple applications (services) are carried in the same frequency band, the bandwidth requirements are effectively cumulative. So, more services, even if they are low bandwidth services, require more bandwidth.

⁴ In-Stat/MDR, February 2004. See www.cellular-news.com/story/10738.shtml.

IV. Network Evolution

All these changes in technology, in subscribership, and in usage patterns has dramatically **changed the requirements of the wireless networks** that provide these services.

Each carrier is provided a limited frequency range for providing their services⁵. Each site can only serve a finite number of users at any one time within its allocated frequencies. Increasing numbers of customers, higher-bandwidth services, and the addition of new services, combine to consume a bigger portion of this frequency range. Thus, as customers, usage, services and bandwidth requirements increase, more sites are needed to provide the necessary network capacity and maintain service quality⁶.



Source: CTIA

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⁵ As determined by their license(s) from the FCC.

⁶ This is of course a simplification of the capacity, service quality and frequency re-use issues, but greater detail was not considered relevant for this paper.

Figure 4 – CTIA: Cell Sites in Service 1985-2003

Because usage is dramatically increasing in residential areas (as customers use their phones and other devices at home), more and more new sites will be needed in or near residential areas.

These sites can often be smaller (shorter) since they don't need to cover as large a geographic area. So new types of structures can be used for supporting cell sites. These “vertical elements” can include new structures beyond the traditional tall buildings and towers, such as residential buildings and streetlights.

Since most of these new sites still need to carry large volumes of traffic, they will likely be “full” sites, with all the equipment, utility and interconnect requirements that that entails, and not “microcells” (with smaller equipment requirements).

Furthermore, as new services are added, new (more) equipment may be needed at each site. However, there is also a general technology evolution towards smaller equipment (more miniaturization), that over time may reduce the space needed. This varies greatly by carrier, technology, and frequency.

V. Summary

The need for new locations is not going to stop any time soon. This is due primarily to the following factors:

- “Market Penetration” (number of subscribers) continues to increase.
- Minutes of Use (how long each person spends on their cell phone) continues to increase.
- New services (applications, such as e-mail, photos, etc.) will continue to be developed.

All these require increasingly intense use (and re-use) of the frequencies allotted to each carrier. Thus **more and more sites will be needed to meet the growing demand.**

- Hilly or varied terrain can make this all the more the case.
- However, as the number of sites increase, the *average* coverage radius (area each site serves) will continue to decrease. *Generally* this will mean that **the heights needed will decrease** as well.
- New sites that don’t require the height of “traditional” towers or rooftops may **utilize other structures** not considered “suitable” in the past, such as existing streetlights or low-rise buildings.

Many of the new sites will be needed to **serve residential areas**. Usage has shifted/expanded from primarily people in cars to people where they live (and work), meaning coverage is important not just along main roads, but also in residential areas. The new “busy hours” are no longer just the major drive-time hours but also the first “free” evening hour (generally 7 PM or 9 PM, depending on the carrier).

In some regards, **each carrier has its own requirements and objectives**, due to the frequencies at which they operate, the type of technology and equipment they use, the customers they serve, and the choices they make in the services to offer their customers.

Carriers are unable to forecast in detail where and how many sites they will need because:

- Need is largely driven by customer demand, and they can’t predict where the demand will be (either number of new customers or where those customers are, e.g. new developments).
- They can’t predict the technology changes (antennas, equipment requirements) that might happen in the future.
- They can’t predict what new services might be developed and what that would require from a network (site and equipment) perspective.

APPENDIX I: CTIA Wireless Industry Survey Results 1985-2003

THE CELLULAR TELECOMMUNICATIONS & INTERNET ASSOCIATION'S ANNUALIZED WIRELESS INDUSTRY SURVEY RESULTS DECEMBER 1985 – DECEMBER 2003

Reflecting Domestic U.S. Commercially-Operational Cellular, ESMR and PCS Providers

Date	Estimated Subscribers	Annualized Total Service Revenues (\$000)	Annualized Roamer Service Revenues (\$000)	Cell Sites	Employees	Cum Capital Investment (\$000)	Average Local Monthly Bill	Avg. Local Call Length (Min)
1985	340,213	\$482,428	N/A	913	2,727	\$911,167	N/A	N/A
1986	681,825	\$823,052	N/A	1,531	4,334	\$1,436,753	N/A	N/A
1987	1,230,855	\$1,151,519	N/A	2,305	7,147	\$2,234,635	\$96.83	2.33
1988	2,069,441	\$1,959,548	N/A	3,209	11,400	\$3,274,105	\$98.02	2.26
1989	3,508,944	\$3,340,595	\$294,567	4,169	15,927	\$4,480,142	\$89.30	2.48
1990	5,283,055	\$4,548,820	\$456,010	5,616	21,382	\$6,281,596	\$80.90	2.20
1991	7,557,148	\$5,708,522	\$703,651	7,847	26,327	\$8,671,544	\$72.74	2.38
1992	11,032,753	\$7,822,726	\$ 973,871	10,307	34,348	\$11,262,070	\$68.68	2.58
1993	16,009,461	\$10,892,175	\$1,361,613	12,824	39,810	\$13,956,366	\$61.49	2.41
1994	24,134,421	\$14,229,922	\$1,830,782	17,920	53,902	\$18,938,678	\$56.21	2.24
1995	33,785,661	\$19,081,239	\$2,542,570	22,663	68,165	\$24,080,467	\$51.00	2.15
1996	44,042,992	\$23,634,971	\$2,780,935	30,045	84,161	\$32,573,522	\$47.70	2.32
1997	55,312,293	\$27,485,633	\$2,974,205	51,600	109,387	\$46,057,910	\$42.78	2.31
1998	69,209,321	\$33,133,175	\$3,500,469	65,887	134,754	\$60,542,774	\$39.43	2.39
1999	86,047,003	\$40,018,489	\$4,085,417	81,698	155,817	\$71,264,865	\$41.24	2.38
2000	109,478,031	\$52,466,020	\$3,882,981	104,288	184,449	\$89,624,387	\$45.27	2.56
2001	128,374,512	\$65,316,235	\$3,752,826	127,540	203,580	\$105,030,101	\$47.37	2.74
2002	140,766,842	\$76,508,187	\$3,895,512	139,338	192,410	\$126,922,347	\$48.40	2.73
2003	158,721,981	\$87,624,093	\$3,766,267	162,986	205,629	\$145,866,914	\$49.91	3.07

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APPENDIX II: About COMP COMM

COMP COMM, INC. helps local governments successfully manage the growth of wireless communications facilities. COMP COMM is *an independent wireless communications engineering consulting firm that helps municipalities manage their emerging wireless issues.*

We have designed, installed, managed and inspected hundreds of wireless sites and networks since our founding in 1975. As a result, we understand the issues involved in resolving the conflicts arising from antenna siting, and provide the expertise, the unbiased information, and the cost-effective solutions to address the breadth of technical, regulatory and community issues affecting wireless facilities siting.

COMP COMM has developed a suite of services designed specifically to help municipalities. These services include:

- zoning application reviews,
- expert witness testimony,
- RF emissions modeling and certification,
- tower siting evaluations and comparative site analysis, and
- comprehensive plans and ordinances for wireless communications facilities.

We can work directly with municipalities or in concert with their legal, planning or engineering firms.

COMP COMM's philosophy is based on the *balanced* expansion of wireless communications. Given both the ever-increasing demand for wireless services and the requirements of the federal Telecommunications Act of 1996, few municipalities can totally prevent the expansion of wireless communications facilities in their area. COMP COMM believes that, by proactively planning how wireless communications facilities *can* come into their area, local governments can manage their growth, reduce or even eliminate the contentiousness surrounding this issue, lessen the chance of future litigation, and successfully balance the needs of all their constituents.

Our position as independent experts, our focus on municipal clients, our years of experience in the wireless industry, our commitment to engineering excellence, and our knowledge of the regulations and industry players *uniquely qualify us* to help municipalities solve the new problems they are facing due to the explosive growth in wireless communications. COMP COMM can be *your* expert in mastering these complex issues.

COMP COMM has been certified as a WBE since 2001.

Detailed information on our services is available by contacting us and on our website at www.compcomminc.com.