Adventures in the Public Hotspot Wi-Fi World

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Part I - Adventures in a Wi-Fi World: Europe

Author's Note
The following document will be the longest commentary you have received on Wi-Fi that is not an academic or vendor white paper. It's something altogether different. Part I is a description of my personal experiences using Wi-Fi "hotspot" services the week of May 12th in Europe. And it's a compilation of many of my challenges to the tech industries "conventional wisdoms" surrounding the Public Hotspot Service model. If folks out there have seen some of my emails, you will recognize my style. To others, every word is written by me, not my staff, not a PR agency. So it's not their fault.

I welcome any comment you may have and I am available via phone and email for further discussion.[1]

To summarize what you will read below:

1) What you probably think you know about "public Wi-Fi hotspot services" and service providers is most likely wrong.

2) What you probably don't know about wide-area based wireless services is much better than you would have conceived.

A word on my qualifications to write on this subject. I joined QUALCOMM in early 1994 after 10-plus years in the personal computer industry. My "bridge" between the computer world and the wireless world was a stint as head of sales and marketing at a pre-Wi-Fi wireless LAN startup in 1993. When the commercial products were being produced by companies like NCR, Proxima, and Xircom. When the 802.11b was a long way from standardization. We never got the product to market and ran out of money – it worked out OK for me, since I ended up at QUALCOMM – but the bottom line is I have been tracking wireless LAN technology for over a decade.

This commentary is lengthy, but I hope it will be entertaining as well as enlightening. Because, like many things in life, the truth is often more complicated than just writing "you can access the Internet at 11mbps from your

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[1] If you need to speak with me in person, you can contact me through my assistant, Jo Rufing, at 1-858-658-4279 (jrufing@qualcomm.com)

local Starbucks" a hundred times. Consider everything below "on the record," and I would welcome any comments or spirited debate around the issues below. If you spend 30 minutes, if you visit the relevant websites shown below, if you put on your critical thinking hat, I believe my views will drive some interesting thoughts.

Introduction

Although we have stated it hundreds of times publicly, I'll say it again. QUALCOMM likes Wi-Fi. We have deployed almost 200 hotspots on our corporate campuses, at a fully burdened deployment and installation cost of around $300,000. And we like Wi-Fi in our homes, as hundreds of QUALCOMM employees have installed Wi-Fi in their houses, connected to residential cable modems or DSL connections.

We also believe in wide area network (WAN) wireless data. We have purchased hundreds of WAN data PC cards, which allow us to surf the Internet, access our corporate VPN and compute remotely over 3G CDMA2000 1X. The median data usage levels for these PC cards, which can be used in major geographic swaths of the United States, including most major metropolitan areas, is well over 100MB (megabytes) per month, with some folks using a lot more data and others using less. This costs QUALCOMM a fixed rate of $79.95 per month on Verizon Wireless, and $80 per month on Sprint PCS. For nationwide, all you can eat data, anywhere you can eat it. Pretty much anywhere you would want to make a CDMA2000 1X call on either operators' network. The key point being where YOU want to make a call, not where you have to walk or drive five minutes to make a call – a key point of differentiation which will become clearer below. Check out wireless WAN coverage areas for a New York City or a Chicago on both networks below.

Relevant Web sites:
www.verizonwireless.com
http://www.verizonwireless.com/express_network/index.html (pricing)
www.sprintpcs.com
http://www1.sprintpcs.com/explore/coverage/NewZipCode.jsp (pricing)

Prior to my experience in Europe, I have traveled the last seven months with my trusty IBM ThinkPad with my CDMA2000 1X PCMCIA card for the last seven months on business and pleasure across the U.S. These travels have included Hawaii (personal, but had to stay in touch with the office, even from the Big Island), Phoenix, Las Vegas, Los Angeles, San Jose, Oakland, San Francisco, Seattle, New York, Chicago, Denver…you get the idea. For seven months, I have not had to crawl under a desk, struggle with an RJ11 jack, fight with an out-of-data dial-up phone listing, pay an exorbitant hotel local-access charge. For seven months, wherever I have traveled, I have been able to do my email, access my corporate data, surf the Internet…all at speeds typically twice what I would have gotten off my internal 56.6 kbps modem. Because we all know that, although we have 56kpbs modems, we don't get 56kbps, we get 30-45kbps.

So, if I were to travel on a one week trip in the U.S., say going from San Diego to San Francisco, then from San Francisco to Chicago to New York and home, I could use my wireless wide area PC card and be productive – anywhere I have wireless coverage, anywhere I can make a phone call, as much as I need to…at a fixed rate of $80 per month.

My European Wi-Fi Hotspot Service Adventures

In mid-May, I traveled to Europe for press and analyst activities. I went from San Diego on the wonderful British Airways non-stop to London. Two days in London, one day in Stockholm, one day in Helsinki. But with a twist. I picked the hotels and meeting areas to be places where there were Wi-Fi hotspot services available, because I wanted to see what the experience was like. Unlike the majority of folks out there propagating the public hotspot myth, at QUALCOMM we're actually using the stuff – both Wi-Fi and wireless WAN, in our homes, in our business and in our travels. But I digress. (Afterall, why should we expect anyone to actually try a service before hyping it and calling it the "death of 3G?")

So, I checked into the One Aldwych hotel in London. Great hotel, great location, well suited to the business traveler. Great restaurant. They asked me if I wanted my Wi-Fi card (you need to purchase a "scratch-off card" with the passwords to access most Wi-Fi networks on a "per-use" basis). I said yes. So they sent me up a card to my 4th floor room. It had to be the 4th floor room, since only one wing of one floor, in addition to the lobby area, had coverage. Since the service was new to the hotel, they only had "2-hour Pass" cards, at 8 pounds ($13.60). It was explained to me that when the trial was over, full 24-hour cards would be available for 16 pounds ($27.20). Now, I checked in Sunday PM, so no use using my card then. Monday, following my full day of meetings, I was ready to give the service, "Liberty-I," a try.

So, I got my scratch-off card which had a 17-digit alphanumeric number on it (try entering 17 digits twice accurately). So I scratch the card, go to the WEP page on my ThinkPad (where you set up your Wi-Fi access), enter the 17-digit key. Twice. Nothing happens – no connection. Follow the instructions on the scratch-off card again. Try every which way to configure my wireless network card. Try everything. After 20 minutes of playing around, I call down to the front desk. "Sir, did you install the CD-ROM for the Liberty I-zone software." "Huh?" I say. Guess what, my PC (brand new IBM X30 ThinkPad with embedded 802.11b) does not have a CD-ROM unless you travel with the dock. I don't. So the hotel delivers me their Dell 7500 laptop to my room, and I'm doing browser-based email over Wi-Fi access on the hotel's computer, getting pinged by Mark I. Greene's daughter over AOL IM on the hotel's machine. Whoever Mark I. Green was.

Now, this does not even take into account that the Liberty-I service has statements on their support Web site (support URL below) that note:

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PLEASE NOTE!
Windows 98 users must de-install the Liberty-i software after use, as all redundant ports e.g. Ethernet ports are disabled during a wireless Internet session. De-installing the software after you have used the WLAN card to access the Internet will automatically re-enable all ports disabled during the session, leaving your PC as it was before.

Now, I don't know about you, but in my case I was using someone else's laptop, but even then, statements like the above do not make me comfortable. Let alone what an IT department would think of lots of users putting unvetted CD-ROM's in their laptops and installing/uninstalling unknown software. Bet they would not be happy.

Relevant Web sites:
http://www.onealdwych.com/index2.html
http://www.liberty-izone.com/liberty-i/default.asp
http://www.snlglobal.com/liberty-i/support/support.asp?do=p1 (for the install info. above)

Next stop was Stockholm. Due to the joys of business travel, I arrived at my hotel at 1:30 AM, and was picked up for my meetings at 7:30 AM. For obvious reasons, no computing that night, and lots of good strong Swedish coffee was needed in the morning. We selected a specific business center because it was part of the Telia HomeRun service. This was the IVA Conference Center in Stockholm. The Telia HomeRun service was a lot more reasonable on several levels. First the cost was 120 SEK ($15.26) for 24 hours. Second, the registration was all browser based, so no CD's required. One small user issue was that the gray scratch-off stuff was really tough, and I almost scratched off the card's username and password trying to get it off. Again, not a bad service. The user interface was well implemented, except for the location directory (go ahead, try the URL below and go to the location directory).

Relevant Web site:
http://www.homerun.telia.com/eng/start/

From there we went to Helsinki, where we had a day of meetings at the stately Hotel Kamp. Always interesting being a QUALCOMM guy doing work in Helsinki, but that's another story. At the Hotel Kamp, we had picked the second floor business center for its wireless access. I went to the front desk to get my scratch-off card. The concierge said one will be right up to our conference room. It's a great hotel, so the Sonera wGate card came right up. It was encased in plastic, and I got ready to tear it open when I asked, "How much is this card." The answer: 50 Euros for 24 hours ($58). Yes, 50, five-zero, Euros. I asked, "why so much?" She answered politely that this was a very good value compared to the cost of using an analog line. Good point. But, given a 50 Euro cost (yes, 50

Euros), I can't report on the service, because I sent the card right back downstairs with the concierge.

That evening, I was able to use the Finnish version of Homerun at one of the Scandic hotels in Helsinki. Again, good user experience. Cost, 15 Euros ($17.40).

Relevant Web sites:
http://www.hotelkamp.fi/
www.sonera.fi (go to English, pick business solutions, then pick Sonera wGate)
www.homerun.teliamobile.fi

At the end of the week, I flew from Helsinki to LAX (via London). Why LAX vs. San Diego, when I live in San Diego? Well, I like wine, and there was a Wine Spectator Magazine event at the Westin Century Plaza. On the desk, a sign for "High Speed Internet Access." Now, this was wired Ethernet. Cost, $9.95 for a 24-hour period. I did not use this – I was back in California so I could fire up the trusty ThinkPad with my CDMA2000 1X card and get my mail while my wife fought both San Diego and L.A. Friday rush hour traffic to meet me – but a good bookend to the story.

So, let's add it up…

London: $27
Stockholm: $15
Helsinki: $58 (if I hadn't sent the card back)
Helsinki: $17 (hotel that PM)
Los Angeles $10 for wired Internet (if I had used it)

THE HOTSPOT WAY: Grand total cost, $127 USD to access the Internet in five "hotspots," four via 802.11b, one via wired Ethernet. Four different service providers, with five different user interfaces, five different pricing schemes, five different instruction sets. In an environment where I planned ahead and specifically selected locations with hotspots.

THE WIDE AREA WAY: For a similar trip in the U.S., grand total cost: $13.30, which reflects 5 days usage out of the 30 days usage that I get for $80 flat rate from Verizon or Sprint. And in the WIDE AREA WAY, I could use the service ANYWHERE in the metro areas that I would be visiting, for AS LONG AS I WANT. Examples of this from other trips, the lunchroom of *Wired Magazine* where I did a presentation for an editor, or in the cab from Manhattan to JFK (connected to my VPN the whole way, the only gating issue was getting a bit nauseous from an ancient cab with no shocks in rush hour traffic). Or every airport with a log-on/authentication time of a couple of seconds, for a quick 15

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minutes checking mail. Everywhere in the airport. Or from the balcony of my hotel on the Big Island watching whales spout. You get the idea.

So, what would the "Wi-Fi" rebuttal be to this?

1) *Wi-Fi is faster*

Well, on this trip, I did email, tracked the days bad news from around the world, accessed my corporate network via VPN. I did not download massive attachments; I did not download MP3 files. So, like every trip on which I used my CDMA2000 1X card, the speeds of 50-80kbps are fine – even for reasonably large attachments. When I would track my usage, I'd typically be in the range of 6-9 MB per hour of connection time. And remember, on a hotspot service, ALL Wi-Fi connections speeds are limited by the backhaul (i.e. the way the access point is connected to the Internet). In all my European Wi-Fi hotspot connections (like those in the U.S.), I typically got in the high hundreds of kilobits per second, not the mythical 11mbps. Go ahead folks, test it for yourself. While this is faster than the wireless WAN connection – for what I was using it for, and for most of what the readers of this tome would be using a wireless connection for – the wireless WAN connection is perfectly adequate. If you have noticed, I've been avoiding the "2G-3G" debate. I've been avoiding the "my PowerPoint theoretical peak rates are faster than your PowerPoint theoretical peak rates" sparing. In the context of "user experience," that's not relevant. What's relevant is what I, as a consumer and businessperson, experience when using a given technology, and what it cost my company or my wallet. Go and try the stuff. Form your own opinions.

BACKHAUL 101: Just want to offer a bit more detail about this, as I've done in several in-person interviews and meetings where I've had to explain backhaul on a whiteboard. If you have an access point in a hotspot environment, the physical "access point" is mounted on wall somewhere, connected via data cabling to a PC. Now, you go in with your laptop, sign on, pay your money, etc. Your laptop will communicate over the air via 802.11 a, b, or g to the Wi-Fi access point at peak rates of 54, 11, or 54 mbps, respectively. But that access point/PC in the hotspot NEEDS A CONNECTION TO THE INTERNET. And this is almost always a WIRED connection. Typically, the hotspot is connected to the Internet via a T1 connection. A T1, by definition, is 1.528 mbps, and costs in the U.S. anywhere from $600-$1,000 per month for the hotspot operator. Another way to "backhaul" is via a DSL connection, which will provide 300-500kbps (at a much lower cost than a T1, but potentially with some commensurate "grade of service" issues. The hotspot service operator has to pay these costs, pay any maintenance, etc., whether anyone is using their site or not. Think of it as your laptop being a fire-hose, connected to the Internet via "backhaul" which is more like a garden hose. Your device can access the Internet off ANY method only as fast as your backhaul will allow. So why are there faster technologies being

implemented like 802.11a or 802.11g? Because they were designed for PRIVATE, LOCAL NETWORKS. If your enterprise has 100 megabit or gigabit Ethernet, it can make use of the higher speeds. A lot of companies are looking at 802.11g for within-the-home network distribution of movies, music, etc., where the speed is useful (very interesting space).

2) There are lots of hotspots
There aren't. The number of hotspot locations and services are growing, but they will be located largely in places where you WON'T be. I've given examples for my European trips. For folks in the U.S., go to www.boingo.com, www.wayport.com, and www.t-mobile.com/hotspot/default.asp?nav=hm. Go to their location directories and see where the hotspots are. Some of it is rather humorous. If you like, you can go to and work from Boingo's locations in New York City – where there are exactly 15 hotspots after 18 months of publicity…"Overlooking the Sunken courtyard in front of the building," or "Rear portion of deli." Couldn't make this stuff up if I had to.

I'd put the Wi-Fi-enabled pubs, McDonalds, and Borders books into this category as well. (And my wife and I get Starbucks delivered to our house. http://www.starbucks.com/shop/category.asp?category%5Fname=Coffee.)

A rule of thumb is that a hotspot will (in reality, not press releases) cover about 25,000 square feet (approx. 2,500 square meters). This is basic high school geometry: Pi times the radius squared, on an access point radius of about 90 feet (28m). And radio planning when it comes to buildings and RF propagation is more akin to voodoo than high school geometry. Now, I know the folks making noise say "300 feet," but those of us who have Wi-Fi in our houses, or those companies whose IT departments have installed hundreds of access points know that the 300-foot number is wishful thinking.

So, if you take the 25,000 square foot number, this works out to about 1,000 hotspots per square mile of Wi-Fi coverage (400 per square kilometer). So, the 20,000, or 50,000, or even the 100,000 hotspots we hear about to be deployed nationally in the next two to three years in the U.S. will ultimately cover an area IN AGGREGATE the size of one or two suburban wide area cell sites. And there are tens of thousands of cell sites in the U.S. Gartner projects around 100,000 public access points at the end of 2006. This reflects an aggregate coverage area of about 100 square miles, out of the more than 3 million square miles of the U.S. Keep in mind that Rhode Island, the smallest of the 50 states, is 1,500 square miles.

PUBS, STARBUCKS, AND BORDERS BOOKS 101: So, why are we seeing all these press releases about pubs, coffee shops and book stores? With few

exceptions, there are some common characteristics, especially when you go past the very noisy articles to the actual company press releases, and actual company exec comments. First, these businesses need access to the Internet for their own internal IT requirements (i.e., reporting back and forth to their corporate entities). Or, in the case of a recent pub announcement, networking up the gaming machines in the pubs was going to create new revenue opportunities for the game machine folks and the pub owners. So, if companies need to have Internet backhaul for their business requirements, the marginal cost of adding a Wi-Fi access point is relatively low. However, folks go to a pub to socialize and drink pints, they go to a bookstore to browse and buy books, and they go to McDonalds to eat. I'm not sure that doing email at the end of the day in a pub, with or without a few pints, would be career enhancing over the long term. Nor, good as the occasional burger may be, I'm not sure laptops are made for long-term dousing with ketchup and salt.

3) All business hotels will have Wi-Fi installed
Not likely. Remember, it's cheap to install a few Wi-Fi access points. Cometa, a venture of several U.S. tech companies, stated at a recent Lehman Brothers conference that an access point costs about $1,500 in a hotspot environment with all costs included (which you will notice meshed IDENTICALLY with the $1,500 per access point cost of our enterprise deployment, a number we have been showing publicly for months). Not a high hurdle for a coffee shop. Or a deli. However, once you want to move the Wi-Fi coverage beyond the lobby, business center, or certain rooms, the costs escalate.

HOTEL UBIQUITOUS COVERAGE 101: With the costs of covering a hotel – the site surveys, RF planning, access points, power cable runs, data cable runs, and other assorted software, hardware and support – the hotel would be installing hundreds, if not thousands of access points at a cost in the hundreds of thousands or millions of dollars for the equipment. Look in the location directories again of the Boingo's, Wayports, and T-Mobiles. You will see lobby access only. Now, contrast this reality against the wireless WAN access in the U.S. Anyplace in a hotel where you can make a CDMA2000 1X voice phone call on Sprint PCS or Verizon, you will get predictable access – FASTER than the dial-up connection.

This does not take into account that the hotspot environment, in the U.S. and Europe will be fragmented, with lots of different providers. This means lots of different log-on methods, lots of different usage experience, lots and lots of different pricing policies, and lots and lots of Big Bills!

A Note on Technology

My examples of wide area wireless have been focused on CDMA2000 1X, which has been broadly deployed by Sprint PCS and Verizon Wireless in the U.S. (among others) and by dozens of carriers in dozens of countries worldwide. Visit www.3gtoday.com which details all of the 3G operators and services around the globe (commercial plug, since it's a QUALCOMM-managed site).

As much as you are seeing announcements in Europe for the marriage of GPRS and Wi-Fi, we also believe that is a non-starter. For two reasons. First, a lot of the European wireless networks are already congested for voice traffic. GPRS is NOT made for high data traffic, and ANY data traffic on the network will take away from available voice capacity, which is already being stretched in many European metropolitan areas. Second, EDGE, which has had as many sightings and has the same commercial reality as the Loch Ness Monster, should pop above the surface at some point later this year or in 2004, and may help the networks be a bit faster, but will require new devices, and still uses the same scarce radio spectrum as the GSM voice network. So my guess is that you won't see too many European GSM providers offering packages that allow users "all you can eat" data for 80 Euros, or even 100 Euros on their existing networks. From a user's perspective, GPRS fails the "better than wireline access" test. Don't take my word for it, speak to folks who have actually tried to do what I have described above on a commercial GPRS network. You can't, because it's a lousy experience for the user of the service, and you would be paying hundreds of Euros a month.

You WILL however see the emerging UMTS operators trying on lots of innovative services. Why? Because they are on CLEAR spectrum. Because they are using an RF Air Interface that is many times more efficient than both GSM and EDGE. Because the wireless standard is designed to be more friendly to higher bandwidth data services than GSM. The UMTS carriers in Europe will have the capacity, will have the economics, and will be able to deliver the USER experience to allow the types of services we are seeing on the CDMA2000 1X networks today. Over great swaths of land. In a fully mobile environment (I'm jealous that mass transit actually exists in Europe). Did I mention that QUALCOMM has broad chipset product lines for both CDMA2000 1X and UMTS phones and networks?

An Unexpected Moral to the Story:

We have now established that the "hotspot reality" is not what is expected. But there is a twist to the wireless WAN equation. While I was in Europe for the week, was my U.S. CDMA2000 1X provider happy or sad? Think about it for a bit.

If you answered "happy" you are correct, because every day that I am out of the country I am NOT putting any load on their network, even though I am still paying a flat monthly rate.

On the other hand, if someone is has a wireless WAN PCMCIA card in their portable, at a flat rate, and then uses their laptop on their home Wi-Fi network, they are actually making themselves MORE profitable to the operator. The operator gets my money every month, and I have actually reduced the load on their network every time I use my home Wi-Fi network.

This speaks to a long term environment where Wi-Fi continues to grow in the enterprise, continues to grow in the home, and where operators continually look to WHERE THE TRAFFIC IS GENERATED, and continually evaluate ways to keep service levels high to consumers/businesses while looking for ways of reducing costs of delivering the bits of data wirelessly. And WHERE THE TRAFFIC IS GENERATED will not be people traveling to a pub, McDonalds or Starbucks to connect.

As checkpoint to this logic, some basic questions for the readers:

When traveling, how many folks out there use the hotel phone to make a long distance call? How many folks use their cell phones? Why?

If hotels are making a ton of money on dial-up connections (gotta love the new access charges even for toll-free numbers), what's going to be their hurry to do a massive capital investment to install Wi-Fi throughout the hotel? Especially in today's business travel environment?

How many folks pay exorbitant access charges for 56k dial-up in a hotel because we have to?

When's the last time you used a pay phone? Although some have gone away, they are still just about everywhere, so why have you abandoned them?

For the Europeans reading this, did you enjoy having a different phone card for every country you visited?   Would you enjoy having to get different "cards" every time you would want to use a Wi-Fi network, or have massive numbers of active subscriptions?

How many times have you used an "email payphone" in an airport or convention center? There are more than you think today in public spaces. Look around.

Are you happy when you get the bill for the $50 data call from your hotel room (I've known lots of folks who have been stuck with bills significantly higher than that)?

Do you really want to go down to the lobby of a hotel at 10 PM after a day of work and a business dinner, just so you can access your email? Let alone fight with a difficult scratch-off card and a 17-digit alphanumeric password at the end of a long day?

A Few Ghosts of Wireless Past

A Bit of History: Does anyone out there remember CT-2 Wireless Services? This was a low-power voice only service – Voice "hotspots" launched in the middle 1990 s in the U.K. (Rabbit), France (Bebop), Netherlands (Greenpoint), Hong Kong (several services, including Pacific Link). The concept was that you would use a low-cost, low-power handset within 30 meters of an "access point." These access points were in hotel lobbies, bus stops, airports, convention centers…you get the idea. These were not trials, these were broad deployments in the tens of thousands of base stations, with hundreds of thousands of users at one point. We know from historical precedent, those who do not learn from history are bound to repeat it. Spend some time on Google searching some of the companies above. It will be informative and entertaining. Because their services only exist in Google Memory, since they were consigned to technological oblivion by the 2G wide-area voice networks such as GSM and cdmaOne.

And does anyone remember MobileStar? MobileStar was the Wi-Fi hotspot service provider that went BANKRUPT and was purchased by T-Mobile as the basis for their Starbuck's Wi-Fi network. Take a look at this article from two years ago http://news.com.com/2110-1033-255733.html. What's changed? Do a Google search on MobileStar. For that matter, do a Google search on "Boingo 5000," since, up until last July, Boingo was publicly stating that they would have 5,000 hotspots by the end of 2002. Well, it's almost June 2003, and they have 1,300, and that includes free sites. And Boingo's directory has a HUGE overlap with Wayport's directory listing. What does this mean to their businesses?

A View of Wireless Future

Given all this, how do I see the world? Wi-Fi continues to grow in the enterprise and in the home. Why? Because it makes sense, both economically, as well as from a user experience, control and cost perspective. Wide area wireless data services, already prevalent on PDA devices (see Sprint PCS' and Verizon Wireless' device lineup) will begin to expand rapidly in PCMCIA format for laptops, and will begin to be embedded in more and more devices. Especially as folks actually USE the services and see the utility they can provide.

Lots of creative pricing strategies will evolve, but ultimately consumers and business folks will want to pay a fixed rate for a bucket of services – no per-MB pricing – probably with fine print in the contracts to keep folks from using more than their fair share of system capacity (i.e., no downloading of pirated MP3's hours a day).

The user experience will continue to improve. In the U.S., the country's first CDMA2000 1xEV-DO network has commercially launched (www.monetmobile.com). 1xEV-DO provides wide area wireless access at hundreds of kilobits per second – to all users on a loaded network. And does this in a manner much more efficiently that today's CDMA2000 1X systems (and much more efficiently than any other commercial wireless standard on this planet). Verizon has announced plans to deploy CDMA2000 1xEV-DO commercially in the Washington, D.C. area, as well as San Diego, later this year. Watch this space, as we believe that CDMA2000 1xEV-DO has the potential to alter this discussion considerably.

Wide area wireless data will be the dominant way that people on the move connect, just as wide area wireless voice is the predominant method that people on the move make a phone call. At places where people naturally would want to get wireless data, like an airport, a train station, a convention center, a predictable process will evolve. If there is a lot of wide area wireless data traffic, an operator will evaluate whether it will save them money to find a way for that data to be offloaded to Wi-Fi. A consumer or businessperson will evaluate whether it saves them money, provides a fundamentally different experience in use, or some combination of both. It will be the same process that we all gradually went through with cell phones for voice, where we are all perfectly comfortable sitting at the hotel room desk staring at the hotel phone on the desk while on our cell phones for our long distance calls. When folks end up back within the walls of their businesses, or return to their homes at the end of the

day, they will be back on their wired or Wi-Fi networks. And we probably won't have "desktop" computers anywhere.

Keep in mind that everything I have been describing above is applicable for laptops and PDAs connected to wide area wireless networks and Wi-Fi networks. Yet, by any metric, the global volume of these devices is very small when compared to the volumes of wireless handsets sold globally. And very few folks have looked at what is REALLY happening in the handset world. They are getting smarter, getting better screens, getting massive amounts of memory, and are capable of amazing applications. You don't need a big box on your desk or a laptop to lug around to have Moore's Law in effect. But I think that's the topic of my sequel.

After all these words, if you want to experience everything I discuss above in a personal way, take the following test, what I would call the Two-Week Challenge:

1) DATA WHEREVER YOU CAN CALL: For two weeks, whenever and WHEREVER you take out your cell phone to make a voice call, understand that more often than not you can get full wireless data access anywhere from wherever you have CDMA2000 1X voice coverage. Existing today, where you can make a phone call, you have – at speeds much faster than dial-up, with available, affordable flat-rate pricing per month – all service you need. This is true today nationally in the U.S. on both Sprint PCS Vision service and Verizon's Express Network, is true in dozens of countries around the world that have launched 3G CDMA2000 1X services, and will soon be true in Europe with the increasing number of UMTS (WCDMA) commercial network launches.

2) VOICE ONLY WHERE YOU CAN GET WI-FI: For a different two-week experience, try this experiment. I apologize in advance, as it will be painful. For two weeks, anywhere you travel, anywhere you work, imagine that you are ONLY allowed to make a voice phone call where you can (legally) access and log onto an 802.11 Wi-Fi hotspot service network. See how many services you have to sign up for (remember, you have to get on 802.11 using your laptop or PDA before you can use your cell phone). See how much it ends up costing you. And under this scenario, imaging that you are NOT ALLOWED to travel to a hotspot. You have make your connections where YOU would want to make your phone calls. It won't be a very convenient two weeks, and will be VERY expensive. Unless you happen to live work and play in a building with a Starbucks or a Borders books.

Finally, I invite folks out there to massively fact check my views above. It's been shocking to me the degree that many folks have just repeated the story lines of

the latest press releases, which reflect the press releases prior. I think that although you may disagree with many of my assessments, they will be hard to refute. And if one spends the time, you may find yourself questioning the flood of "public Wi-Fi" hotspot announcements, and looking past the announcements to the real technical, business and social hurdles. Or even better, don't believe any of this and go out and actually try the various technologies and services, and gain your own experiences.

Part II - Adventures in the Hotspot World: U.S.

Author's Note
Part II is the continuation of my Adventures in Wi-Fi piece on Europe, which I wrote at the end of May 2003. That piece got much more attention than I had originally expected, from Australia to Austria, and several detailed responses, one of which was by Glenn Fleishman, detailed on his website www.wifinetnews.com . For complete context of this discussion, including lots of "point/counterpoint", you may want to visit Alan Reiter's Weblog at http://reiter.weblogger.com/ and scroll down to the June 9, 2003 entry.

This document is divided into three parts. First, an "access travelogue" of my recent trip to Dallas and Atlanta. The second part contains viewpoints on how this discussion shapes up in terms of Wireless Coverage, Performance, and Cost. In the final section of this document, I'll "back up" and detail my response to Glenn's well-written rebuttal to my "straw men" from my first document and to an executive from a company that provides Wi-Fi to the hospitality industry. The complete online exchange between myself and this executive is captured on Alan Reiter's weblog.

Access Travelogue – Dallas & Atlanta

I left San Diego on June 1, 2003 for the Sprint PCS Business User's Conference in Dallas, and then flew to Atlanta to be on a plenary panel at SUPERCOMM on June 4th. What follows is a U.S. equivalent of my European adventures described in "Part I". Since a few folks out there had issues with some of my European foibles, I'm going to make the caveat that if someone is a Wi-Fi connection deity they might get on-line easier than I, and may have been able to steal someone's Wi-Fi bandwidth while sitting outside of an urban building, but I've gotten dozens of commiserating responses to my mails, and only one accused me of being technically inept ("It also appears Mr. Belk clearly does not understand the current available forms of authentication for HSIA hotspots". Uh huh. And the point?). This prompts my additional caveat that connecting to various Wi-Fi schemes will no doubt get much easier as time goes on. With these caveats, hopefully I will receive less mail to answer this time, because I also have a day job at QUALCOMM.

But I'll counter with the additional fact that the Sierra Wireless PCMCIA CDMA2000 1x card installed in my IBM ThinkPad has a connection "watcher", which fires up on your desktop when you start your laptop. To connect to the Wireless WAN, you click on "connect", and the card will authenticate and put you on line in less than 10 seconds. And you stay connected until you choose to disconnect. That's it. Every time. Everyplace you can make a phone call with Sprint PCS, and most places across great swaths of the U.S. where you can make a phone call on Verizon Wireless (I'm not saying whose card I have in my laptop) For $80/month for unlimited Wireless WAN data access, wherever, whenever, and for as long as you need to connect.

 My access alternatives for my travels the week of June 1st, 2003 are summarized in the following table. Maybe you'll see a pattern below:

5/2003

Location	CDMA2000 1x WWAN Coverage Available	Dial-up Available	Pay-for-Use Wired Ethernet Available	Pay-for-Use Wi-Fi Service Available	Wi-Fi Available (Free) (Note 8)*
Home to Airport San Diego	Sprint PCS Verizon Wireless	No	No	No	No
Airport San Diego	Sprint PCS Verizon Wireless	Yes, airport lounge	No	T-Mobile, Admiral's Club	No
DFW to Wyndham Anatole Hotel	Sprint PCS Verizon Wireless	No	No	No	No
Wyndham Anatole Hotel	Sprint PCS Verizon Wireless	Yes	No in-room access biz center only $0.40/ min for DSL (Note 1)*	No	No
Anatole to DFW	Sprint PCS Verizon Wireless	No	No	No	No
DFW Delta Crown Room	Sprint PCS Verizon Wireless	Yes	No	Wayport (Note 6)*	No
ATL to Hotel in Atlanta	Sprint PCS Verizon Wireless	No	No	No	No
Hotel in Atlanta	Sprint PCS Verizon Wireless	Yes, 60 minutes free, then $0.25/min	Yes. $9.95 per day, noon to noon	No	No
Convention Center	Sprint PCS Verizon Wireless	??? Almost all the payphones are gone (Note 2)*	Yes, in Jail (Note 3)*	Yes, CCLD fairly broad access $9.95/ day (Note 7)* IBM Hotspots Free	Yes. IBM (may have been others as well)
Dinner out	Sprint PCS Verizon (Note 4)*	No	No	No	No
Hotel to Airport	Sprint PCS Verizon Sprint PCS Verizon (Note 4)*	No	No	No	No
Atlanta Airport	Sprint PCS Verizon (Note 5)*	Yes, airport lounge	No	?	No
San Diego Airport to Home Taxi	Sprint PCS Verizon Wireless	No	No	No	No

Note 1*: Literature in the Wyndham hotel rooms state that the Wyndham Anatole is undergoing significant renovation and that high-speed Internet access will be installed in rooms. No details on whether Wi-Fi or wired, no details on cost. Looking at Wyndham literature, they tend to have better connectivity options than most hotel chains. Plus, I've always like their hotels.

Note 2*: Wish I had a digital camera along to show folks what I mean on both this note and the next note. Almost ALL of the payphones are gone from the Atlanta Congress Center, leaving blank walls of payphone bank divider slots with only an occasional payphone left on the wall. Please ask yourself why they are gone if traveling to a location to access (voice) data is such a good thing. Maybe analogous to why hitching posts and water troughs are gone from urban streets today.

Note 3*: In several of the common areas, there were PC's with Free Internet Access. There were about 10-15 PCs in each location, with smoked glass around the PCs. Folks came from all over

the Atlanta Congress Center and waited outside in line to get access, to get the opportunity to stand in a small area and use a PC. Watching folks in these smoked glass rooms, someone commented that it looked like a visiting room in a Jail.

Note 4*: Although most of our conversation has been about laptops, I've alluded to the fact that PDAs play into the equation. In Dallas, I never left the hotel. Sprint PCS and my folks kept me busy. However, in Atlanta, my meetings and speech kept me going until 7 p.m. I had to check email (4 p.m. San Diego time), but also had to get to my 8 p.m. dinner reservation (this ever happen to anyone out there?). So, I did browser-based email on my Handspring Treo for about 20 minutes in the cab to the restaurant. Also (unfortunately) had to check mail briefly during dinner. Check your carrier's website, many have aggressive and cost effective plans for Phones/PDA's for email and Internet access.

Note 5*: Same thing. Check email on Treo on way to airport. And made use of the 20 min. on the plane before they closed the door and asked everyone to turn their devices off.

Note 6*: Picked up Wayport signal. I asked two folks at the Crown Room about Wayport. They stated that although there is a signal, they do not offer the service yet. For fun, did multiple runs on a speed test site for my CDMA2000 1x Wireless WAN Card. 75, 77, and 102 kbps respectively. When I then checked Wayport's website for more details (via CDMA2000 1x connection), they show good coverage of DFW for $6.95 per use, not related to the club specifically, which is why the Club staff probably had no clue. T-Mobile's plans range from $0.10/minute (60 minute minimum), to $29.95/month for a 12-month contract, to $39.95/month by month.

Note 7*: The Hotspot provider in Convention Center was CCLD, Convention Center Long Distance. Charge of $9.95/day. However, their coverage map is just for the common areas of the convention center, not the convention hall itself. If you read http://www.shorecliffcommunications.com/magazine/volume.asp?Vol=31&story=297, you will understand some of the issues.

> One quote is "CCLD is really interested in installing wireless to the convention floor. However, there are some issues to address"

> "We have some concerns with frequency interference issues on the show floor, particularly when exhibitors bring their own wireless systems," Harris said. "We've not quite worked out what to do when an exhibitor complains the next booth's wireless microphone is interfering with them. We can solve one problem easily, but our shows are huge."

So again, they have built a for profit system that folks can either opt to use, or can use free hotspots if paid for available (i.e. paid for by an exhibitor), or can install (Per FCC Part 15 rules allowing unlicensed spectrum users to interfere with one another) their own Wi-Fi system on the show floor. Or they can use the Wireless WAN provider of their choosing.

Note 8*: Publicized free Hotspots. I'm sure folks out there have 'warchalked' some of these cities/ locations along the way, but in my opinion 'warchalking' and/or stealing of bandwidth is not a sustainable platform for the broad and commonplace adoption of any technology.

Learning: Coverage

In Dallas I participated with Sprint PCS folks in several panel discussions to groups of IT executives that attended the Sprint PCS "Business User Conference". Sharing the panel was Oliver Valente, CTO of Sprint PCS. I'll get to some of Sprint's comments in a second.

In my talk, discussion inevitably got to Wi-Fi. I asked two questions of 200+ IT Executives who attended the sessions over the course of two days. Question One: "Have you installed any form of 802.11 in your company"? My guess is that 80-85% of the hands in each session went up. Question Two: "Do any of your corporate campus Access Points have a coverage range or coverage radius of 300 feet?" Not one hand went up. In two days. When I would state that we used 28M (90 feet) as an average for our corporate deployments (almost 200 access points on our corporate campuses for meeting rooms and common areas), there was a lot of nodding of heads up and down (not side to side), but to be fair, one person actually spoke up and said they use 100 feet. No doubt Glenn Fleishman will receive mails from the "we make 802.11b go for miles" folks, but those are mails that I'd like our RF folks to look at, cause if there is something I've learned in 10 years in wireless---it's that RF is difficult, interference is interference, and free lunches are rare.

Oliver Valente and his staff spoke about Sprint PCS's national network. One of the comments was that Sprint had installed 19,830 cell sites across their markets as of April 30, 2003. All are CDMA2000 1x. I asked Oliver about my stated assumption (which I had previously validated with our network folks) that an average suburban cell site has a coverage radius of about 3 miles. He said that was a reasonable assumption (with usual caveats). Remember, I've stated repeatedly that RF is akin to voodoo. It is. I use suburban sites for my "model", since Rural Sites will typically have much larger cell radii, and urban sites typically have much smaller cell radii.

So, let's go back to my metrics from Wi-Fi Adventures Part I to look at coverage:

- 90 ft. x (pi times radius squared) = approximately 25,000 square feet of coverage area for an Access Point

- 3 miles x (pi times radius squared) = approximately 750,000,000 square feet of coverage area for a suburban Cell Site

This is a ratio of about 25,000 to one (actually 30K to one but I won't quibble), and reflects the "approximately 1,000 Wi-Fi access points per square mile of coverage" metric.

So, let's do the following exercise:

- 20,000 cell sites x 25,000 (equivalent access points worth of coverage per cell site) says that Sprint PCS today has equivalent wireless data coverage of about 500,000,000 access points. 500,000,000!

Verizon Wireless would also be in the hundreds of millions of Wi-Fi Access Point equivalents worth of current coverage area, but I'd need to find their public numbers on Cell Sites deployed, and the percentage (ever increasing) that have been upgraded to CDMA2000 1X.

Wayport, Boingo and T-Mobile combined have less than 5,000 Access Points deployed nationwide. Cometa will be adding 20,000 over time. Gartner says there will be an aggregate 103,000 Public Wi-Fi Hotspots by the end of 2006. And each of these access points needs its own individual expensive backhaul.

Both Sprint PCS and Verizon Wireless are continuing to add coverage. Sprint described how their plans call for an additional 1700 cell sites in 2003.

So, optimistic projections show 100,000 hotspots for the Public Hotspot Services by the end of 2006, and the case can be made that the two national CDMA2000 operators could have equivalent wireless data coverage are of about 1 billion Wi-Fi Hotspots this year.

1,000,000,000 WWAN Hotspot "equivalent coverage area" vs. 100,000 Wi-Fi Hotspots.

And think about it, even with hundreds of thousands of square miles of Wireless WAN coverage for voice today, there are still places where you get irritated if your voice call does not go through, or a wireless voice call drops. But folks are predicting that everyone will be happy with a hundred or even a few hundred square miles of Wi-Fi Hotspot service access in the 3.4 million square miles of the U.S.?

Learning: Performance

Where there is Wi-Fi, and the choice is made to access the network, and the network is there to access, Wi-Fi is faster than CDMA2000 1X Wireless WAN. I have never disputed that. For the umpteenth time, folks at QUALCOMM all happily use Wi-Fi on our almost 200 access points on our corporate campuses hooked to our internal IT infrastructure, and we use Wi-Fi on our many personal systems at home (over DSL or cable modems). Wi-Fi in the office and home is growing, and Wi-Fi in the office and home will continue to grow at healthy rates. When I've been testing around the world in the past weeks, Wi-Fi access has typically been in the 400kbps to 1.2 mpbs range, with a midrange of 600-700kbps. Just my personal experience as one end user, not formal testing. Your experiences may vary.

By the same token, when I've tested CDMA2000 recently, my results have been in the 40-105kbps range (without any compression), with typical performance being in the 70-80kbps range (including the downloading of a 10MB PowerPoint file).

In the ancient, pre-CDMA2000 1X days (last year), when I would still use dialup, crawling under dusty hotel desks, I NEVER got 56kbps off my 56kbps dialup modem. My midrange experience would be about 35-42kbps. In some places in the world, I'd be happy getting 9.6 kbps, but in the U.S., typically 35-42kbps. So…

- CDMA2000 1X = 1.5-2x dialup speeds almost everywhere
- Wi-Fi Hotspot = 20-30x dialup speeds in limited locations
- Wi-Fi Hotspot = 7-15x CDMA2000 speeds in limited Hotspot locations

But there is a twist to this story as well. And I'm looking into the future, which is something I haven't done very much of in these dialogs. Wi-Fi centric service folks talk a lot about their worldview circa year end-2006. That's where the 103,000 2006 Gartner Hotspot projection comes from.

CDMA2000 1xEV (there are varying flavors, I won't get into details here, but feel free to visit www.cdg.org , or www.3gpp2.org for info on the standards), are delivering 300-500kpbs in early commercial implementations around the world. Verizon Wireless will be launching CDMA2000 1xEV in Washington DC and San Diego in 2003.

Not to speak for any carrier, but several carriers are examining 1xEV technologies. And it is our hope that one or more of the Wireless WAN carriers deploys 1xEV nationally before the end of 2006 (hopefully a lot before!). So, assume there are one or more national 1xEV carriers (again, purely a hypothetical at this point!):

- CDMA2000 = 1.5-2.5x dialup speeds (almost everywhere)
- Wi-Fi Hotspot = 20-30x dialup speeds (in limited locations)
- Wi-Fi Hotspot = 7-10x CDMA2000 1X speeds (in limited locations)

- CDMA2000 1xEV = 8-15x Dialup speeds (almost everywhere)
- Wi-Fi Hotspot = 1.5-2x CDMA2000 1xEV speeds (in relatively few locations)

1xEV changes the performance differential between Wi-Fi and Wireless WAN in ways that will begin to become apparent before the end of this year. However, this is not a "futures" issue. CDMA2000 1X TODAY provides a user experience that is faster than what folks get via dialup, and consistent over huge coverage areas. Where there is free access to Wi-Fi (like IBM's free hotspot at SUPERCOMM) folks probably would use the Wi-Fi if they have Wi-Fi embedded in their device, and if they can configure to the network. But if you wanted broader access in the convention halls of SUPERCOMM Atlanta, it would have cost you the $9.95 per day from CCLD (see Note 7 on the access chart above). And that leads to the "Cost" question.

Learning: Cost

Contrary to one of Glenn Fleishman's comment to my original document, the $80 I describe for the "all you can eat" CDMA2000 1X Wireless WAN data plans for Sprint PCS and Verizon Wireless are not "QUALCOMM's company rate". These rates are available to anyone. Almost anywhere. Check their web sites.

For CDMA2000 1X enabled PDA's such as the Handspring (nee Palm?) Treo, or the new Samsung devices, or the Kyocera 7135 Smartphone, there are various plans and services that allow high levels of voice calling plus data access for your PDA at rates not that different from the voice only plans.

For WWAN PCMCIA Cards to install in laptops, the prices are coming down from multiple vendors, and both operators have more aggressive pricing to get more cards out. Go take a look. www.sprintpcs.com www.verizonwireless.com

Would we all like pricing to be lower at some point? Sure. But it seems very inconsistent to give the carriers a hard time for $80 all you can eat national data access over the equivalent of hundreds of millions of access points of coverage area, and billions of dollars of investment in wireless infrastructure, when the Wi-Fi access points can cost a user $10/day for one place at one time. Hotel $10. Coffee shop $6-10. Convention Center $10. Next day at the Hotel $10. Etcetera. WISP $39.99/month for coffee shops and book stores.

Other rebuttals have spoken to the relative cost of installing Wi-Fi vs. the cost of installing cell sites. In the case of the CDMA2000 1X operators, this rebuttal does not fly. Why? The cell sites of the Wireless WAN networks are ALREADY THERE. There are tens of thousands of cell sites in the United States, deployed, in commercial operation. And the Carriers already own their spectrum, and folks are not allowed to interfere with that spectrum---a clear differentiation from Wi-Fi's FCC Part 15 spectrum that I'll touch upon a bit further along.

5/2003

Lifestyle, Economics, Performance---my Responses to Glenn Fleishman

A lot of the rebuttals to my original mail included statements along the lines of Wi-Fi networks will have aggressive monthly subscription prices, and that folks are willing to move/travel to specific Hotspot locations for access. Although folks are using, and will be using Hotspot services in increasing numbers (it's gotta go up from the tens of thousands subscribed nationally today), I have a hard time seeing high levels of Hotspot service subscriber adoption, for business and technical reasons, predicated on individual's lifestyles, economic tolerances, and performance needs. Even with Wi-Fi embedded in an increasing number of devices, the service adoption rates and subscription levels being described in various announcements and white papers often test credibility.

Glenn Fleishman has several quotes along these lines:

"Most U.S. hotels use a simple gateway page, or use a room based authentication. Most are also not expensive, and most are part of networks."

"However, Belk isn't at the point where the Wi-Fi networks are broad enough that he would have had a flat monthly subscription (at probably $50 per month) that would have allowed him a "free" connection to the hotel at probably T-1 (1.5mbps) speeds."

I have problems with this approach on a few levels. First, $9.95 a day in one locations being specified as "not expensive" is just as subjective as classifying $80/month as expensive. It comes down to an individual's usage patterns, their pricing elasticity for services, the applications they are using, and their personal convenience metrics.

And it's not just $9.95 a day. If I'm at a convention in Atlanta that is not a SUPERCOMM convention with IBM giving away service (with a live tech support person at the Hotspot location to help everyone out, not a costless exercise for IBM), then I'm paying $9.95 a day for wired Ethernet in the hotel, and $9.95 a day for Wireless Ethernet in the convention center common areas (from CCLD). And if there is service in the Airport lounge, it will be a third provider, meaning a third subscription or a third daily charge. I could easily pay $50 or more for three days, and have three providers, one wired Ethernet, and one Wireless Ethernet to deal with. If I'm shipping big files around, or have the need for true broadband or multi-media, I will need the faster access, but I would posit for millions of mobile professionals, CDMA2000 1X in flat monthly rate plan would fill most needs. Don't believe me, go try it!

Glenn states that I confuse Ubiquity with utility. He states:

"Ubiquities advantage fades in direct proportion to its speed relative to nearby faster service at a comparable price." If I can get 80kbps for $80 per month everywhere, but find myself within short walks (or on top of) 1mbps for $50 per month in certain places, the right answer might be a subscription to both services."

This also has a few assumptions, many of which I think we may agree upon. Ultimately it will be in the operators' and users' interest to find ways of optimizing both Utility and Ubiquity. But the "short walk" is a personal preference, one that neither Glenn nor I can answer for the folks reading this or the world at large. I want ubiquity, Glenn will walk for Utility. Personal Choice. But there is a third dimension that I believe impacts this choice---what are you doing with the bandwidth???

Caveat---A model follows. This is a test. Just a test. PhD's relax. Assume 640kbps from a Wi-Fi Hotspot. That's 80 KB per second. In 60 Seconds you can theoretically ship 4.8 MB. In an hour, you can ship about 280 MB (2.2 gigabits).

On CDMA2000 1X assume 80kbps (you can assume higher or lower, I'm using 80 'cause I'm not a PhD, and it makes the math easy). That's 10KB a second. 600KB per minute. 36MB per hour (and the Sprint PCS guys would yell at me that these are raw rates before compression, and that with their network based compression schemes, the user experience could be significantly higher).

T-Mobile has stated often that their average Hotspot subscriber session is 45-50 minutes. I informally track my sessions, and for my own personal experience that's a pretty good number for "sit down" email / web sessions, plus or minus one hour of access per session. For me, VPN email, web browsing etc., for that hour I will typically use about 6 to10 MB of data traffic, of which 80-85% or so of the traffic will be on the downlink, and 15-20% of the traffic will be on the uplink. So I'm not stressing the network, my user experience meets my expectations. I had to download a 10MB PowerPoint™ on this trip. It took about 18 minutes. That's probably the boundary of my personal usability threshold. But it works, and works well. Everywhere. If I could have gotten Wi-Fi easily, I might have paid the 10 bucks for that session, and if I had been on Wi-Fi, my email and browsing would have been faster. But that's my own personal price elasticity, and the knowledge that our accountants would probably not have squawked at the extra 10 bucks on my expense report.

The extreme examples here would be if you are Instant Messaging, no way do you need a Wi-Fi connection, and if you are streaming in high-resolution video, or downloading MP3's, CDMA2000 1X will not provide the same experience. If you are a student with Wi-Fi on campus for free, your favorite coffee shop with free/cheap access, and your off-campus house with Wi-Fi backhauled to your $40/month cable modem, you probably don't need a separate CDMA2000 1X Wireless WAN subscription (although you have or will probably soon have a color multimedia handset which does lots of cool wireless data services). If you are business person dealing with the access experience chart at the top of this document, wanting constant access to email and the internet, Wi-Fi, or Wi-Fi + Wired Ethernet is not as convenient or usable as CDMA2000 1X.

In this view, I agree with Glenn, as my views reflected my personal experiences. Folks go to McDonalds, Starbucks, etc by the millions. Some will use Wi-Fi there. Some will travel to use Wi-Fi there. But if our payphone to cell phone behavior migration is any indication, over time I believe more folks will just want to do their basic connectivity from "anywhere".

Glenn states "Keep speed low, cost medium, and ubiquity at 11…, and you have 3G service today. Turn ubiquity down and speed moderate to high, and you have Wi-Fi; the cost number might be at all kinds of settings today, but moderate to low tomorrow"

My view, as stated above is that the speed required, and the experience delivered is a function of what the broader universe of users will be doing. But what happens in San Diego and Washington D.C. later this year when CDMA2000 1xEV-DO is deployed and speed is now 50%+ that of Wi-Fi, cost is medium, and "ubiquity at 11"? Worth some thinking…

I stated, "However, folks go to a pub to socialize and drink pints, they go to a bookstore to browse and buy books, and they go to McDonald's to eat". To which Glenn responds, "Belk is conflating current behavior with future behavior".

Again there is no distinct answer to this one. I believe that once wireless data in general moves past the "early adopter" phase, the "travel to connect" model will be problematic for a great number of people. Think Payphones. Wireless Payphones. Read the CT-2 section in Part I of this document. Do a Google search on CT-2 Cordless. There were hundreds of thousands of CT-2 "voice" Hotspots deployed by many of the leading wireless operators of the world. Now a memory on Google.

On Hotel Ubiquity, Glenn states that "Roaming convergence with single cell/Wi-Fi bill (T-Mobile) or single login/aggregated service (Boingo, ipass, GRIC) is becoming a matter of course, not the exception."

I think we are a very LONG way from useful service aggregation. Useful meaning beyond coffee shops and bookstores. We clearly agree on the aggregation of elements of Wireless WAN / Wi-Fi services over time. But in the meantime there are also lots of Wired Ethernet service providers that are in the mix as well, so this is not just a Wi-Fi/WAN question. To simplify this process too much negates the horrible memories many of us have about cell roaming in the early days. And this is worse. Much worse. Why? Well, another "model".

Assume you have six hotel rooms in a row on the second floor of a hotel. All the traveling biz folks have cell phones (a reasonable assumption at this point). One is talking on Verizon Wireless's system. In the next down the hall is someone on his/her T-Mobile phone, the next on AT&T Wireless, the next on Sprint PCS, the next on Cingular, and the guy/gal at the end of the hall is doing all his/her long-distance calls on the Hotel phone system (either he/she failed economics, or his/her battery is dead). Think of how long it took for all these carriers to cobble together their roaming agreements and billing technology to the point where all the back end gobbledygook is relatively transparent to the user. A long time. Currently, Wi-Fi Hotspot service providers in hotels, airports, convention centers, train stations etc., consist of a broad range of players. These players include independents, "one-offs", lots of smaller regional and target market players, some of which are aligned and/or 'roam out' to various WAN carriers, national independent players, consolidators, and folks who are owned and/or aligned with the national Wireless WAN players. And this does not take into account the various providers of Wired Ethernet pay-for-use services in public environments. None of this seems like it will be inexpensive or user friendly very quickly.

Glenn states under 3G and unlimited bills that "the finances just don't make sense. If it costs a small fraction of your cost of licensed spectrum and cell towers to build or buy into a national network that offers substantially higher speeds at partner locations, why not preserve that spectrum for higher-cost services."

I'm not sure if his response was in relation to the U.S. or Europe, so I'll answer to both. In the U.S., as I described above, the cell sites are already there, the spectrum long-since purchased, the CDMA2000 1X systems are already deployed, and the roadmap is there for a (relatively) low cost migration to all those sites providing hundreds of kbps over equivalent area of hundreds of millions of access points via 1xEV. In Western and Eastern Europe, their

spectrum for UMTS at 2.1 GHz is clear and ready for innovative services, either stand-alone or in conjunction with public Wi-Fi service providers.

Free Wi-Fi. Glenn describes that "Schlotzky's Deli put in free Wi-Fi in a small number of Texas stores. They said they now have six percent of their customers to those stores coming because of the free Wi-Fi."

In my view, there will be a lot of experiments like this and it is a healthy part of the process. Many universities already offer campus Wi-Fi for students. Libraries and other public spaces are putting out Hotspots. In my opinion, however, "free" goods, especially in unlicensed spectrum are ripe for "tragedy of the commons" issues (for non-econ sorts, Google the term). Most will be fine. But what happens when the Real Estate office next to the Schlotzky's uses Schlotsky's free Wi-Fi for their office network? Or when the six person accounting office next door to a Wi-Fi enabled coffee shop hijacks the coffee shop's T1 for $39.95 per month (a T1 that the coffee shop is paying $600-$1000 per month for)?

Glenn's comment of "likewise I don't know any early adopter who doesn't check out the locations of local Wi-Fi from Starbucks to community networks to sticking their laptop out of the window before traveling." "High-speed connectivity at broadband speeds not fast modem speeds are now a necessity, not an option, for many travelers. Current 3G can't fulfill that; Wi-Fi is the only option that does."

I agree that is true for very early adopters of Wi-Fi (far left of the bell curve). My brother-in-law who works for a Wi-Fi wireless network management company is one (www.wildpackets.com). But this goes to personal preference. I want my connectivity wherever I am (as I am an very early adopter of Wireless WAN data services). Maybe it's because of using the CDMA2000 1X card first, I'm "trained" to be able to connect where "I" want to. Traveling to a "destination" to access data, like I did to use the IBM hotspot at SUPERCOMM, is not my first choice, and I would not have done it if I were not doing my homework for this piece. As to broadband speeds being a necessity, again, it depends on your usage patterns, and the performance needed to meet your personal requirements. 60-80kbps does not limit my utility on the road, nor does it limit the utility of dozens of IT folks I spoke with at the Sprint PCS Business User's conference that are increasing their adoption of Wireless WAN based solutions for their mobile workforce (at the same time as many are building out Wi-Fi on their corporate campuses).

Finally, Airports. Glenn states that, "The real closer in this gap is Airports. When we hit the top 35 airports in the country having significant Wi-Fi presence,

which I still predict as 25 of them out of 25 by the end of this year, then you'll see business travelers make a massive uptake."

I'd be surprised if there was not ubiquitous coverage today of most of the top 35 airports Glenn mentions, by Verizon Wireless and Sprint PCS. As for this trip, I looked at Wayport, Boingo and T-Mobile's sites. T-Mobile had Admirals Club coverage in San Diego, DFW, and Atlanta, along with broader coverage at DFW. Wayport had DFW fairly well covered ($6.95 per airport use), and Boingo had DFW fairly well covered. Atlanta and San Diego need work. Will airports get covered with Hotspots? Over time, probably. Ubiquitous coverage in all the airports? Possible, but less probable.

However, there will still be the multiple provider issues, and if there are too many folks with Hotspots, potential interference issues that will impact performance. For example, a Hotspot provider can spend a ton of time, effort, and money getting permission to deploy Wi-Fi in an airport, but then there is nothing to keep the "coffee shop" from having their own access point, and there is nothing to keep the Cinnamon Roll place from popping an access point across the hallway. Or anybody else for that matter. All interfering with one another, and making the experience in use a bit trickier for the masses. Let alone what happens when a commercial microwave oven leaks a bit. Spend some time looking at the FCC web site on rules for Part 15 devices. Remember: RF tricky, Interference, nasty. Take a look at http://www.wi-fizone.org/zoneSiteSurvey.asp?TID=7 for a few hints (this is the Wi-Fi Alliance web site).

So, I hope I've made the case for a few things. One, coverage matters. Two, the type of applications used matters. And three, a Hotspot service in a location often does not provide a simple user experience, a simple roaming model, or a simple and sustainable business model.

Both Glenn and I agree on a lot of areas. Wi-Fi will grow in Enterprises/Campuses and homes. The Wireless WAN operators will ultimately be more involved in the Wi-Fi Hotspot service model over time, for reasons discussed more in the previous mails. There will be lots of service experimentation from both Wireless WAN and Wi-Fi providers. However, where we disagree will ultimately be determined by individual users, and groups of users with similar and dissimilar lifestyle, economic, and performance demands. That being said, I think this dialog and process is healthy, and I know it's got me thinking in much broader ways. Finally, for many of the readers of this --- go out and trial a Wireless WAN card from Sprint PCS or Verizon Wireless.

Hotel Wi-Fi Dynamics

The "Adventures in Wi-Fi" commentary has been posted in a number of online websites, including one popular site --Alan Reiter's Weblog: http://reiter.weblogger.com. Alan, one of the founders of the PCIA, and the president of Wireless Internet and Mobile Computing, posted my document in it's entirety and he subsequently received several comments on my commentary. One of the responses was from "Mr. Smith," vice president of sales for "Company A" -- a company that provides WiFi service to the hospitality industry. I will not use "Mr. Smith's" real name for my commentary, but you can read the complete online exchange on Alan's Weblog. Below you will find my reply addressing each of Mr. Smith's comments on my views about Wi-Fi hotspot service models in hotels.

First of all, I'd like to compliment Mr. Smith's company. Reviewing the website, it is evident that the company has built a robust and professional platform for the hospitality business. It is also evident from the client list, including many A-tier hotel chains, that they are building a solid business base.

Caveats: I'm a WWAN guy, and I'm not an engineer or a hotel guy, but I'd like to comment on a few of the points raised by Mr. Smith.

Mr. Smith takes issue with my comment that certain installations would require hundreds or thousands of access points at a cost in the hundreds of thousands to even millions of dollars. He states that "the cost for Wi-Fi in the hotel setting should be in the $200/room range…We have installed 300 room hotels for approximately 60K for 100% coverage in rooms, conference space, and lobby."

I don't see how this is inconsistent with my statements about ubiquitous coverage in a hotel environment. We've been sharing our internal Wi-Fi costs for quite some time. At QUALCOMM, we have installed almost 200 access points, at a fully burdened deployment/installation cost of about $300,000. This number was validated last week by statements made by Cometa at a Lehman Brothers conference, where they stated that access points should run about $1500 each.

This is not for ubiquitous coverage of our dozens of buildings in San Diego, but just for common area[s] and key meeting rooms. We are not a little company, but we're not huge as well, with about 6500 employees.

When I looked at Company A's Website, I saw that the majority of their many installations are in the limited service/all-suite hotel chains (to use terms from their white paper).

So, given that a 300-room hotel can cost $60K, how much would a Sheraton Sixth Avenue New York cost? How much would a Venetian Las Vegas cost? A Hyatt San Francisco? Or any key convention hotels in the 1000 - 2000 room range? Not made of 'tilt-up' construction -- but massive concrete and rebar?

In the company's "online cost calculator" it gives a lot of top line parameters for hotel installation/deployment costs. This includes, but is not inclusive of, layout, number of buildings, number of rooms, floors per building, type of structure (wood/cinderblock/steel…), wall materials (concrete/drywall…), ceiling, flooring, wiring info, number of meeting rooms, etc.

And a zinger in many cities: If wiring or electrical needs installing, will it require Union installers?

Again, it is evident that Company A has established a business model that works, and for the most part, the types of structures that they are installing Wi-Fi in are easier RF environments than some of the sample hotels I've mentioned. As I stated before, RF is difficult, difficult stuff to get to work in a ubiquitous environment.

The company also provides a ton of services to the hotel in support of Internet access and other hotel back-office services. In the interest of disclosure, the recurring costs for those services should have been mentioned, unless the $60K covers everything forever, and the company is done once the access points are in. Could be, again, it's not my business, but I doubt it.

So why are hotels installing Wi-Fi? The company's website has some good white papers, available through a quick registration. Very well written, pragmatic, thoughtful, and for the genre, very under hyped. Some reasons include: keep existing business, appeal to new customers, support existing meeting facilities, support a new 'flag', to reduce non-revenue Internet 'dial-up' access.

Another reason, from page three of Company A's white paper: 'While hotels have benefited from a 13.6% increase in fax and Internet connection revenues in the last year, telephone revenues has been virtually flat. Telephone revenue at limited service and all-suite hotels has actually declined.'

Are folks actually talking less on the phone? My guess is a more likely reason is the substitution effect of folks sitting at their hotel desks or on the beds…talking on their cell phones. Which means they have coverage that they can use for data access (and now this goes back to my last paper).

So, if the Hawthorn Suites website is any indication of Company A's service platform, the cost for Wi-Fi service is $9.95 per day, billed to your room. There is a 'frequent surfer' program that reduces the cost by an undisclosed amount.

Company A's white paper has several ways that a hotel can justify the expenditure, and I'll quote liberally here:

- "With capital funds" [fairly self explanatory, please see white paper]

- "With user fees: A basic wireless solution in a 125-room hotel would need approximately 5 room uses a night of guest access to break-even (at a $9.95 per use price point), excluding the T-1 (the high speed connection to the Internet itself)?"

- "The cost of a T-1, if there is not appropriate excess bandwidth available on property installed telecommunications lines, will run anywhere from $700 - $1200 per month."

My comments here are twofold: One, that pesky backhaul cost again. And second, one of overall beef with almost ALL conversations in this space -- is the "11 mpbs" thing again in relation to Hotspots with DSL or T-1 backhaul. It's fiction.

Mr. Smith comments, "This results in 11 mbps throughput in ANY place in the hotel. True, this is limited by backhaul of 1.5mbps, but that is the actual number you get, not 50-80K if you are lucky."

This is a false statement, and one parroted across the Wi-Fi hotspot service provider world, and in my opinion needs to stop. It's not 11mbps…it's [a] maximum of 1.5mbps. Maximum.

And this is where you have a T-1 line and not a DSL connection, which would be less expensive, but slower. And if you look at Laptop Magazine (July or June 2003), they now test devices with embedded Wi-Fi at 5 feet and 30 feet from the access point (how's that for realism?). Five feet is silly. Results are low- to mid-hundreds of kbps at 30 feet.

Everybody, the WWAN guys, and the WLAN guys should all talk actual user experience. Save the peak rates for marketing purposes and your PowerPoints, that's fine, but then talk about REAL rates, and how the REAL rates apply to user experience.

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Other financing methods detailed in the white paper include Lease/Purchase option, and the hotelier increasing room/facility rates. This is worth reading, as Company A states "currently, industry average rates for the fixed cost per room per day model range anywhere from $0.25 to $2.50, depending on the size of the property, the number of floors, number of buildings, building configuration, etc."

So, in this model, a thousand room hotel could be spending $1,750 to $17,500 per week to provide Wi-Fi access, depending on what the RF guys would call "morphology" of the structure and its environment. So, using their own numbers showing breakeven of 5 users per day at $9.95 for a 125-room hotel, if linearly scalable, this would mean 40 users a day at $9.95 would break even for the 1,000 room hotel (excluding those pesky backhaul costs again).

But I can't see how $400 per day, $2,800 per week, covers costs of up to $17,500. And I would have to assume that Company A's numbers, while definitely not hype driven (again, I think they have a good business), definitely err on the side of their worldview.

Towards the end of Mr. Smith's comments, there is definitely common ground. When he states that certain carriers will have a hard time -- we agree. Putting the QUALCOMM commercial hat on, Sprint PCS and Verizon Wireless already have 3G CDMA spread across the U.S.-- with coverage over many of Company A's hotels.

One thing folks forget, in the case of Sprint PCS and Verizon -- they own their spectrum -- and their cell sites are already there (albeit always filling coverage holes). And Mr. Smith's statement that "the smart ones [operators] are already deploying serious plans for Wi-Fi that will support existing strategy…" is a statement that I would agree with.

So, where does this net out? This is not a zero sum game for quite some time. I expect Company A's business model to prosper. People will use their networks and be very satisfied.

But other folks will be sitting on their beds, having phone calls home on their cell phones -- bypassing the hotel's phone system -- and then getting on their CDMA2000 enabled laptop and doing their mail and surfing, happily at speeds about twice the speed of their dialup today, on flat-rate, "all you can eat" data plans.

And for folks in Washington, DC and San Diego, moving to speeds in the hundreds of kilobits per second this fall. Different users will apply their own

worldviews -- their own lifestyles, their own pricing elasticities for services, their own perceptions about performance requirements. And those are three parameters that a thread like this can't answer.