



WIRELESS COMMUNICATIONS ALLIANCE

Wireless Broadband?

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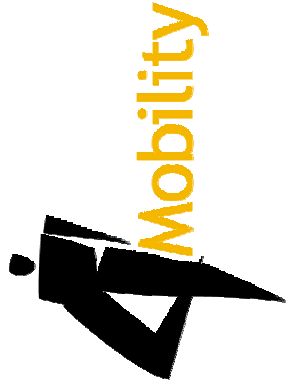
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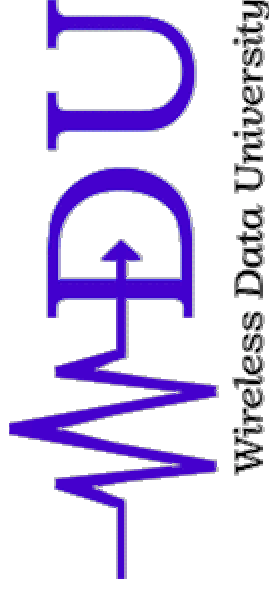
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Comprehensive Wireless Data Sales Training**

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Issues We Will Address Today

- Will There be a Clear Winner in Broadband Wireless Data Technology?
- How will 3G, Wi-Fi, and WiMax fare in the next 2 to 3 years?
- Will Wireless become a Serious Factor for "Last Mile" Connectivity?
- Will Wireless VoIP take Business from Cellular Operators?
- Is More Spectrum needed for Unlicensed Wireless Services? (vs. Better Management, SDR, UWB, etc.?)

My Job: To get you thinking, To Get you Agitated, and To Sometimes take a Contrarian View!



The New Wireless Hype!

- Wi-Fi with VoIP will take customers from 3G networks
- Wide-area and Wi-Fi phones and infrastructure are coming to a network near you soon
- WiMAX will be all things to all people
 - Regardless of the frequency band, it will work out to 30 miles per site!
- The unlicensed spectrum for Wi-Fi is suffering from interference so we need more spectrum
- Software-defined radios, cognitive radios will mean the end to the spectrum shortage
- New fortunes will be made in the wireless frontier
- The wireless Internet will be just like the wired Internet, only unplugged and ubiquitous



Wireless Data Truisms

- Not a single terrestrial provider of wireless data-only services has EVER made a profit!
 - In the wide-area network space, data services provide incremental revenue to the operators—voice pays the bills
- The playing field is more crowded than ever
 - New players enter the fray every day
- The more bandwidth and data speed you provide, the more that will be required
- The spectrum is a finite resource
 - This point is hotly debated between the spectrum savvy and the Internet interlopers
- RF propagation is part science and part black magic
- Interference will not be eliminated by software!



Wireless Truisms

- In the Americas, there will NOT be a single wireless voice and data standard
 - We will have to live with multiple standards
 - Expect to see wireless handsets and devices that will be capable of operating across various technologies
 - In other words: The chip and handset vendors will “fix” the multiple standards issue
- The first round of technology “religious wars” are over
 - Each network has chosen its preferred path and is now implementing it
- There is no one single network that is “all things to all people”
 - Each has advantages and disadvantages
 - Choices will continue to provide customers with value
 - Choices will continue to provide market differentiation
- Most customers don’t know which technology they are using!



Wireless Truisms

- There are new contenders coming
 - Ultra Wide Band
 - WiMAX
 - TD-SCDMA
 - A player or two to be named later!
- Don't Forget Wi-Fi, Bluetooth, Zig-Bee, and others
- The next round of technology wars will not come from within the traditional communications sector but rather from the “Internet Invaders”
 - The trick will be how to “balance” existing technologies and services with the need to test and deploy new technologies
- **Wireless is part science and part black magic**
 - Real-world experience and knowledge are more important than politics and the promise of spectrum nirvana



Will There Be A Clear Winner?

- The short answer is NO!
- Wi-Fi is already experiencing interference issues
- WiMax is the new kid on the block
 - WiMax may have a problem with uptake because it is perceived as being from “outside” the wireless industry
- IP Wireless, Flarion, ClearWire, Canopy, and more are being deployed
- Wide-area voice networks are upgrading data speeds
 - EV-DO to 4 Mbps
 - WCDMA to 8-10 Mbps (HSDPA)
- No one can make money serving only notebook users!
 - The total available market **MUST** include more!
 - Home and small business
 - Mobility workers and consumers
 - Bet they won’t carry multiple devices for voice and data services



3G, Wi-Fi, And WiMAX

The Next 2-3 Years



3G Networks

- 3G Wide-Area Networks
 - Status Report
 - 102 operators worldwide
 - 45 countries
 - 52 companies with 501 devices
 - 117 million 3G subscribers worldwide
 - United States
 - 3G Data services by
 - Verizon Wireless (3 cities, majors by end 2005)
 - Sprint PCS (0 Cities, majors by end 2005)
 - AT&T Wireless (4 cities, 2 more this year)
 - Cingular (just received bids)
 - Caveat: NOT all suburbs and NO rural areas covered
 - Real data rates
 - CDMA2000 1xEV-DO Rev 0: 300-800 Kbps
 - WCDMA (today) 220-330 Kbps with peaks to 384
 - Future: 2-10 Mbps (EV-DO Rev. A and WCDMA HSDPA)



3G Over The Next 2-3 Years

- Worldwide deployment continues
- Most systems metro-only
 - Fall back to slower technologies
- Devices become more combined consumer devices
 - Higher resolution camera/phone, MP3 player/phone, medical monitor/phone, video camera/phone, and more
- 3G and Wi-Fi makes its debut
 - VoIP, least-cost routing, voice and data simultaneously
 - Will these become mainstream devices?
 - Competitors include in-building WAN, WAN to DSL/cable extensions, fiber to home with WAN backhaul
- Voice continues to pay the freight—Data services “fall” to the bottom line: Operators continue to make money!



Wi-Fi

The Next 2-3 Years



Cometa Shuts Down

- Cometa is a joint venture formed by Intel Ventures, IBM, AT&T Longlines, Apax Partners, and 3i to provide 20,000 Wi-Fi hotspots a year. (December 2002)
- What I said at the time: Since no terrestrial network has ever made money offering data-only services, what do these folks know that the rest of the industry does not?
- What happened: Business model changed twice, back pedaling, rolled out Seattle as a test market, failed to obtain additional funding
- If Cometa, backed by these companies, could not make a go of the “hotspot” business, how are the others going to fair?



Wi-Fi Next 2-3 Years

- Wi-Fi folks continue to make it into a wide-area play
 - Interference issues get worse
- Industry consolidation
 - WISPs go out of business in droves
 - Helped along by WiMAX threat and 3G roll-out
- VoIP comes of age not as easily or quickly as is being projected
- Wi-Fi gets built into everything
 - Interference even on local level becomes a problem
- FCC and Feds still believe Wi-Fi is the “killer” use for wireless and give Wi-Fi community some TV spectrum
- Wi-Fi industry tries to “regulate” unlicensed spectrum
- Wi-Fi ends up as the last 100 feet, just as it started
- VoIP continues to grow but not as fast as predicted!



Wi-Fi Next 2-3 Years

- Wi-Fi “Hotspots” increasingly offering “free” Internet access
 - I have not paid for Wi-Fi or wired high-speed Internet service in the past eight months
 - Wi-Fi and wired Internet are becoming “perks”
 - More coffee shops are offering Wi-Fi for free
- Good News: Wide-area networks are working to integrate Wi-Fi and wide-area services into a common data offering
- Security and ease of use (too many companies for sign-up) hinder adoption
- Interference is raising its ugly head
- Metro “mesh” networks are the current rage
 - Will they be replaced by high-speed wide-area networks?
- Wi-Fi continues to be an area where chip and device folks make money, not Wi-Fi operators



WLAN's Impact On 3G Wireless

- Some—mobile professionals
 - Most only need access at office, home, airport, and hotel
 - WLAN public networks provide convenience
 - Few will pay—enterprise unlikely to pay
 - Few will pay for 3G wide-area wireless
- Minor—sales professionals
 - If client location access is needed, then WAN needed
 - Client enterprises not likely to support visitors
- None—consumers
 - WLAN hotspot coverage is primarily at business locations
 - Unlikely to pay
- None—service, delivery, fleet management
 - Large geographical coverage is required
- WLAN can be an added value for WAN operators
 - T-Mobile has integrated billing plans



WiMAX Next 2-3 Years

- WiMAX continues to make big noise
 - Is it being over hyped? (What's new?)
- When will it really be ready for prime time?
 - All technologies take longer to come to market than proponents believe they will
- Is there really an economic model ?
- WiMAX as broadband to static locations
 - Will WiMAX be the backhaul for Wi-Fi?
 - Will WiMAX be able to compete with DSL and cable where installed?
 - Will WiMAX be able to compete in rural America?
- When WiMAX goes mobile
 - Who will use it?
 - Will it include VoIP services?
 - Can it compete for voice and data services with 5 existing wireless operators?



WiMAX: Changing The Laws Of Physics?

- The 802.16 standard for **2-11 GHz** is a wireless metropolitan-area network (wireless MAN) technology that provides broadband wireless connectivity to fixed, portable and nomadic users. The ultimate complement to Wi-Fi, the WiMAX wireless MAN standard can be used to backhaul 802.11 hotspots and WLANs to the Internet, provide campus connectivity, and enable a wireless alternative to cable and DSL for last-mile broadband access. **It provides up to 50 kilometers of service area range**, allows users to obtain broadband connectivity without needing direct line of sight with the base station, and provides total data rates of up to 280 Mbps per base station - a sufficient amount of bandwidth to simultaneously support hundreds of businesses with T1/E1-type connectivity and thousands of homes with DSL-type connectivity with a single base station.



RF Propagation Is Only Part Science!

RF Propagation Calculator

File Recalculate! Params Options Help

Nominal range [m] 100 Building loss [dB] 0
 Tx to obstruction distance [m] 50 Obstruction to Rx distance [m] 50
 Tx antenna gain [dBi] 0 Rx antenna gain [dBi] 6
 Propagation Law 2 Obstruction radius [m] 0.05
 Tx antenna height [m] 2 Obstruction height [m] 0
 Rx antenna height [m] 2
 Heights baseline

Tx power [dBW] -10 Rx noise figure [dB] 6
 Carrier frequency [Hz] 2.45e+009 Signal bandwidth [Hz] 1e+006
 Fading margin [dB] 20 Rx detector S/N [dB] 16
 Temperature [K] 290 Input Intercept [dBm] 5

Max. range [exc. diffr. loss] = 771.467 m No diffraction
 Margin at nom. range [exc. diffr. loss] = 17.7463 dB Hill Type Diff. Tog



WiMAX: Regulatory Working Group!

- Goal is to “harmonize” WiMAX spectrum worldwide
 - Both licensed and license-exempt
 - Spectrum allocations sought
 - License-Exempt: 5 GHz
 - Licensed: 3.5 GHz
 - Licensed 2.5 GHz
 - However, there is now an “assault” on the 700-MHz TV spectrum
- Good luck, folks!



WiMAX's Future COULD Be Bright!

- First prove the business model for wireless broadband
 - There is no market research that supports a solid business model for broadband wireless today
 - Spreadsheet projections and “gut feel” economics don’t guarantee that WiMAX will be a financially viable technology
- Deploy with QOS, seamless security, and ease of set-up and use
- Do not over promise and under deliver
- DO NOT ship products until they have been extensively field tested
- Work with wireless providers and Wi-Fi community, not in competition with them



Wireless

Will It Become a Serious Factor for the Last Mile?



Last Mile Today

- Copper to the home/office
- Cable to the home (and now office)
- Fiber to the curb (in some areas)
- Broadband over Power Lines (BPL)
 - Up and running in some areas
 - The FCC's latest "good-guy technology"
- Wireless
 - Wi-Fi
 - MMDS with various technologies
 - Canopy
- Will WiMAX succeed in this space?



WiMAX: The Next Last Mile?

- What is the business model where there is DSL/cable?
 - What can you charge for high-speed data services?
 - DSL pricing is coming down rapidly
 - Recent Verizon pricing of \$26.95 per month
 - Cable pricing coming down as well
- Monet is suspending its EV-DO service in small communities
 - Could not compete with DSL and cable services
- Sprint discontinued point-to-multipoint services
- However, Nextel seems to be doing well with its Flarion offering in North Carolina but...
 - Its offering is NOT a standalone business



WiMAX For The Last Mile?

- Coverage is a BIG issue, especially in 2 to 11-GHz band
- Requires no truck rolls but customer support will be high for a while
- Can WiMAX provide better Quality of Service than cable and DSL services?
- System is still shared bandwidth
 - How many users per site can WiMAX truly support?
 - Enough to make a profit?
- Cities and counties don't want more towers
 - Cell sites take up to 3 years to plan and install in many areas
 - Co-location can be expensive
- Is there enough money in non-DSL/cable areas?

The Wireless Last Mile

- So far, no business case has been proven
 - Existing players are still “investing” in the wireless last mile
- Many players are “betting the farm” on last mile wireless
- If the FCC and others allocate spectrum in the 700-MHz TV band, it could change everything
 - 700-MHz coverage is MUCH better than coverage at 2 GHz and above
 - Number of sites is reduced dramatically
 - Total system cost also reduced
- A lot of “ifs” for all of the money that is being thrown at wireless last mile



More Cell Sites Required At Higher Frequencies

| Frequency (MHz) | Cell Radius (km) | Cell Area (km ²) | Relative Cell Count |
|-----------------|------------------|------------------------------|---------------------|
| 450 | 48.9 | 7521 | 1 |
| 850 | 29.4 | 2712 | 2.8 |
| 950 | 26.9 | 2269 | 3.3 |
| 1800 | 14.0 | 618 | 12.2 |
| 1900 | 13.3 | 553 | 13.6 |

Up to 5 Times as many sites

Source: Qualcomm ITU 8/F Submission, June 11, 2001, "COVERAGE COMPARISON OF IMT-2000 SYSTEMS AT VARIOUS FREQUENCY RANGES, INCLUDING 450 MHZ"



Wireless Voice Over IP (VoIP)

Will It Take Business from Wide-Area Wireless Network Operators?



Wireless VoIP: Serious Competitor?

- VoIP-only phones are already on the market
 - Cisco, Symbol, no major vendors
 - Slow sales, slow adoption
 - For in-company communications, do we really want a phone in meetings, walking the halls?
- The “Internet is free” folks seem to believe that a large number of us will carry and use Wi-Fi VoIP phones
- Does VoIP have a strong future?



VoIP Phones And Alternatives

- Motorola and others are building wide-area/Wi-Fi VoIP phones
- Big push is for in-home extended coverage of wide-area networks
- Are these VoIP phones or are they tunneling GSM and CDMA over Wi-Fi connections?
 - That is what the Unlicensed Mobile Access (UMA) organization is promoting
 - Claims to have 5 major wireless carriers, 5 handset, and 5 Infrastructure companies as members
- Future for VoIP wireless phones is murky
 - However, wireless operators with data services are very interested in VoIP phones for the mainstream
- Again: Will you trust your most valuable communications to the Internet as a transport?



More Spectrum?

Is More Spectrum Needed for Unlicensed Wireless Services?



Spectrum: Plentiful Or Scarce?

- The wireless community says spectrum is scarce
 - It is a finite resource
 - We need to use what we have more efficiently
 - And we need to protect incumbents
- The Internet community says it is plentiful
 - Software-defined radios and other technologies will support multiple systems in the same portion of the spectrum and prevent interference
 - Claims that the “wireless community” has mismanaged the spectrum over the years and is too protective
 - Some want all spectrum deregulated
- The FCC appears to be listening to the clout behind the Internet community, not the wireless community
- How do you spell disaster?



Spectrum: Who Is Right?

- No one knows the answer yet!
- BUT...
 - We must be careful as we explore the options
 - Nextel/Public Safety interference issue has been going on for years and will take about 4 more years to be resolved
 - The FCC is finding that BPL is interfering with existing radio systems as was predicted by the wireless industry
- We need a spectrum policy and overall plan
 - We need to share public and government spectrum allocations
 - We need to set aside spectrum for new technologies
 - And we need to protect existing users
- There are ways to make this work for everyone!



Unlicensed Spectrum?

- Do we need more?
- Do we need better “management”?
 - How do you manage unlicensed spectrum?
 - San Francisco Wi-Fi WISPs are trying
 - But what about the next guy?
 - Without registration of systems, how do you find those that are interfering and notify them? Why bother?
 - Will more unlicensed spectrum solve the interference issues?
 - My answer is a resounding NO
- Example: the Citizen Band is an FCC disaster
 - Because people are selfish and greedy
 - How can you “regulate” the unregulated?
- Compromise is possible
 - Consider a “supervised” amount of spectrum with frequency coordination and a “permit”

The Answer is NOT more of the same! We need new ideas.



My Predictions

For The Wireless Industry



The FCC Is Mesmerized!

- Playing politics, NOT engineering supervision
- “Pro” broadband over power lines (BPL)
 - A potentially disruptive technology
- On an unlicensed spectrum kick, even to the point of giving away spectrum already in use (TV channels) for unlicensed use BEFORE it addresses or fixes existing interference issues
- At the FCC it is politics as never before. Damn the technology assessments. What is good for the party is good for the FCC!
- Watch this space closely for more examples of this!



New Spectrum Auctions

- In the U.S. there will be “new” wireless spectrum auctioned in the near future
 - This spectrum will not be available for use for a number of years
 - However, the incumbent wireless companies will not be alone at the bidders’ table
 - AOL, Microsoft, Intel, and others may make a play for this spectrum



Wireless Devices

- As chipsets make wireless devices easier to build, there will be a shift from traditional device vendors (Nokia, Motorola, Sony-Ericsson)
- The new players will be Disney, MTV, AOL, even Yahoo
 - Affinity branding of services and devices will become popular over the next few years
- Wireless phones will become increasingly integrated with consumer products such as cameras, media players, game machines
- Multi-network chips will “fix” the technology problems
 - Multi-mode (GSM/CDMA/WCDMA) devices will become the norm
- Software-defined radios and other new devices will take longer to come to market than predicted by those who are developing them
- Near term: The price of wireless devices will move slowly downward. The same money will buy more features and functions.



Smartphones, PDAs, Notebooks

- Smartphones and wireless PDAs will account for no more than 20% of the world market
- Standard phones will become “smarter”
- There will be no winner in the operating system wars
- Notebook computers will come equipped with more “flavors” of RF built in

And...

- Most of the market in “poorer” countries will continue to be low-end phones



Industry Consolidation

- There will continue to be industry consolidation
- The Cingular/AT&T merger is only the first
 - Look for operators who need more spectrum and those who have it to merge—spectrum is the currency of wireless success
 - Those who believe that spectrum issues will go away because of new technologies that are on the horizon are just plain wrong!
- Companies to watch: Verizon/Sprint PCS
 - Verizon could buy all of Sprint, acquire LD and wireless spectrum at the same time
- Nextel could be in spectrum trouble if it doesn't settle the interference issue



New Technologies

- Repeating myself
 - New technologies take longer to be commercialized than anyone working on them believes
 - There can be a huge difference between what works in the lab and what works in the real world
 - Most technology advances are incremental in nature
 - Look for Intel to “take the lead” for WiMax
 - It wants and needs a wireless technology that it can “drive” into the market
 - Unfortunately, some bad decisions will be made by politicians who do not understand wireless technologies and believe what they are being told by others (non-technology folks)
 - There are ways to protect the “rights” of existing wireless operators and still provide plenty of opportunity for new technologies to be developed, tested, and proven!



Final Comments

- Is the Internet REALLY a mission-critical network?
 - Would you, will you, trust your most important voice and data communications to this network?
- Is VoIP REALLY ready for prime time?
- The spectrum rush is on
 - The President's Spectrum Management taskforce dropped the ball
 - The FCC and both candidates are mesmerized by Wi-Fi and will probably allocate too much new "unlicensed" spectrum
- SDR and other software "answers" to spectrum problems will NOT solve all of the problems
 - Those who think they will have not worked in the "real RF" world
- Rushing forward can and will get us in trouble
 - Better to proceed with caution



Thank you!

Questions?

And one more thing!

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