

THE WIRELESS LANDSCAPE
&
Trends for 2002

Joanie M. Wexler
Independent Technology Journalist
joanie@jwexler.com
408-871-8202

Author, "Wireless in the Enterprise" Newsletter, *Network World Fusion*
Newsletter Archives: www.nwfusion.com/newsletters/wireless

Wireless Communications Alliance
January 14, 2002

THE THREE PRIMARY WIRELESS “BUCKETS”

1) Wireless LANs (WLANs)

- Local mobility, simpler alternative to cabling at LAN-like speeds

2) Mobile WANs (2G, 2.5G, 3G)

- Wide-area mobility. Voice and data connectivity for roaming users worldwide (albeit with less bandwidth than WLANs)

3) Broadband wireless access (BWA), a.k.a. “wireless “last mile” (MMDS, LMDS, e.g.)

- “Fixed” (not mobile) wireless alternative to DSL, cable modem, T1 and other wired Internet access services. Also used to bridge sites that are fairly close to one another as an alternative to installing fiber cabling. Current services support data only.

WIRELESS LANs (WLANs)

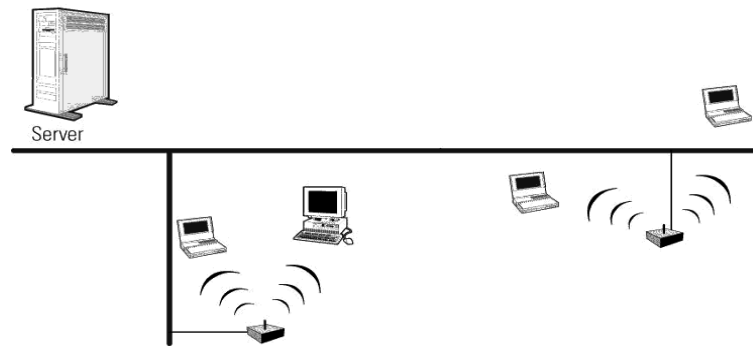
APPLICATIONS

- Simpler/less expensive alternative to cabling in certain work environments with a respectable amount of bandwidth
- At work: Mobile access to the wired office/campus LAN (delivers user productivity boost)
- In homes: Mobility, sharing of a single Internet access connection among multiple computing, entertainment, and voice devices
- Public access LANs (public “hot spots”): Internet (or intranet) access in public places extends WLAN investment, utility to places like:
 - Hotels
 - Airports
 - Conference centers
 - Starbucks

WLANs (continued)

BASIC WLAN ARCHITECTURE

A basic system comprises a wireless access point/base station and a client network interface card for the user's laptop computer, PDA, etc. Both components are radios.



- Client WLAN interfaces are usually in a small PC Card form factor with antenna.

Price: <\$100 for enterprise devices (<\$50 for home market)

- Access points (APs) are mounted strategically throughout a WLAN-enabled location, usually following a site survey. They serve a function analogous to a shared hub in a wired LAN environment. They connect on the back end to a wired Ethernet LAN.

Price: \$150 - \$200 for businesses, depending on architecture used by systems vendors. (<\$100 for home market)

WLANs, BASIC WLAN ARCHITECTURE (*continued*)

- Access point controller (in some configurations): Strategy by some systems vendors, such as Proxim. The APC runs in wiring closet and supports security and management functions. Need to buy an additional component, but you preserve part of your system investment as technology changes.

Price: About \$1,500 (Proxim), but has multiyear shelf life

WLAN coverage distance, from AP to client

- Up to 90 feet (5GHz systems) or up to 300 feet (2.4GHz systems)

WLANs (continued)

PRIMARY WLAN TECHNOLOGIES

IEEE 802.11 series

- 802.11b** Most mature and most widely deployed WLAN today worldwide.
2.4GHz unlicensed band. 11 Mbps maximum, shared speeds
Uses direct sequence spread spectrum (DSSS) radio transmission
- 802.11a** Early products just began shipping (Agere Systems/ORiNOCO and Proxim).
About a 3-fold price premium over 802.11b, depending on vendor and vendor architecture
5GHz unlicensed band, 54 Mbps maximum shared speeds
Uses DSSS radio transmission
Favored 5GHz alternative in North America
- 802.11e** An 802.11 working group effort to build quality of service into 802.11x LANs so that they can support voice and video. Today, many 802.11b vendors support SpectraLink Voice Protocol, a proprietary method of adding QoS and voice capabilities to their systems.
- 802.11g** Moving forward, but shaky
Currently allows use of 3 incompatible modulation techniques
2.4GHz, 22 Mbps maximum shared speeds
Backward-compatible with 802.11b (like 10/100/1000 wired Ethernet cards)
- 802.11h** Under construction: A modified version of 802.11a that controls power such that it will not interfere with European military applications. 802.11h, then, gives .11a technology a chance to be blessed for use in Europe
- 802.11i** An IEEE effort to add more robust encryption and key handling capabilities to 802.11b and 802.11a (and/or .11h)

WLANS, PRIMARY WLAN TECHNOLOGIES (*continued*)

HomeRF

2.4GHz unlicensed spectrum.

10 Mbps speeds shared among PCs, cordless phones, and entertainment devices in the home. Currently comprises 45% of home LAN installations, according to research firm Cahners In-Stat/MDR

Uses frequency-hopping spread spectrum (FHSS) radio transmission

HiperLAN2 5GHz, 54 Mbps maximum shared speeds

Favored 5GHz alternative in Europe

Designed for multimedia ("ATM-like," with inherent classes of service)

Uses OFDM radio transmission

Initial products to start shipping this quarter

MMAC 5GHz, 24 Mbps maximum shared speeds

Favored 5GHz alternative in Japan

ATM-like

"Mobile Multimedia Access Communications"

Bluetooth 2.4GHz, 1 Mbps maximum shared speeds

Technically, a "personal area network" (PAN) set up in a peer-to-peer arrangement. Some like to say a WLAN connects a device to a network, while a PAN (Bluetooth) wirelessly connects a device to another device (a headset to a phone, e.g.)

Vendors are saying 2002 will be "the year of Bluetooth." (This time they really mean it.)

WLANS (continued)

WLAN IMPLEMENTATION CHALLENGES

Security and mobile asset management

- With mobility comes potential lack of management control, security vulnerabilities. Businesses are very concerned over the buzz surrounding security issues, and this could stall implementations.
- HiperLAN2 (Europe) has built 3DES support into standard
- 802.11a (North America) hasn't announced how it will improve security yet. Different implementations by different vendors OK, but thwarts interoperability among multivendor systems
- As mobile devices get "thicker" and host applications and content, they become more valuable. IT departments must find centralized management solutions and synchronization capabilities. Client/server mobile management systems are emerging (e.g., mFormation)

Interference in the cluttered 2.4GHz range

- Occupied by IEEE 802.11b, HomeRF, Bluetooth, cordless phones, microwave oven emissions, baby monitors
- Particularly an issue for multitenant office buildings, where the company's LAN next door might interfere with your LAN setup

WLANs, WLAN IMPLEMENTATION CHALLENGES, Interference (*continued*)

- An industry move to uncluttered 5GHz band enables higher speeds, but:
 - Customer likely needs more APs for equivalent coverage
 - Not backward-compatible with .11b; investment protection issues
 - Lack of worldwide standard, both for technology and consistent spectrum
 - Possible Solution(s):
 - Dual-mode access points (e.g., Enterasys: slots for PC Cards; can mix and match whichever WLAN types you want)
 - Dual mode chips/radios (Atheros, Magis, Spirea, and Systemonic)
 - Antennae that run full 5GHz spectrum (Skycross)

Standards wars

See slides 5,6 for the bevy of standards: 'Nuff said.

A huge topic but suffice to say some fragmentation will occur and will stall implementation

WLAN WHO'S WHO*

Key WLAN Systems Players

802.11b/a: 3Com, Agere Systems/ORiNOCO, Apple, Cisco, Enterasys, Ericsson, Intel, Intermec, Nokia, Proxim, Symbol

HomeRF: AT&T, 3Com, Motorola, Nokia, Proxim, Siemens

HiperLAN2 (Europe): About 30 backers, including Alcatel, Dell, Ericsson, Matsushita, Motorola, Nokia, Philips, Samsung

Key WLAN Hot Spot Integrators

Wayport, Guest-tek, iPass, Colubris/GRIC partnership, VoiceStream (MobileStar's rescuer), ISPs in general

* List not exhaustive

2002 WLAN OUTLOOK

- 2002 will be a planning year for many vendors and users of wireless LANs, as market “noise” surrounding different technologies and standards quiets down.
- WLAN system vendors have dropped 802.11b prices, presumably to seed the market. Shipments are up but revenues and revenue growth are down:

Aggregate Shipments and Revenues, 802.11b and 802.11g WLAN NICs

	2001	2002	2003	2004
Shipments (000)	6162	7588	8277	6339
Revenues (\$M)	789	681	524	275
% Revenue Change from Previous Year	95%	- 14%	- 23%	-48%

Source: Cahners In-Stat/MDR

- Expect further proliferation of 802.11b LANs in enterprises and possibly homes
- Expect further proliferation of 802.11b-based public hot spots.
- Expect to see Bluetooth devices creep into everyday life.
- Expect the emergence of residential wireless LAN “packages,” offered by broadband last-mile carriers (LEC, cable company).

These packages will likely bundle wireless LAN PC cards and an access point (likely HomeRF), cordless phone(s), Internet access service and local and long-distance phone service for what will hopefully be a compelling monthly fee.

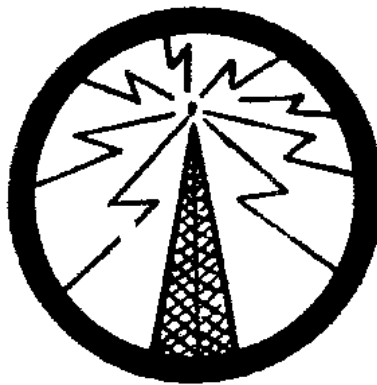
MOBILE WANs, a.k.a, the “3G buzz”

APPLICATIONS

- Local/long-distance voice and/or Internet/intranet access via a mobile phone/PDA/laptop
- More ubiquitous connectivity, albeit at slower speeds

2G, 2.5G, 3G: What are all these “G’s?”

- “G” indicates “generation,” which describes network systems in terms of analog v. digital, circuit switched v. packet switched, and speed. Exact definition of each generation, particularly 3G, is fuzzy, but relates to the airlink protocol, spectral efficiency and speed potential.
- Different technology used for each new generation of service is theoretically more spectrally efficient so network operators can support more customers – and/or mobile data and multimedia applications become more viable.



MOBILE WANS (continued)

THE “Gs” AT A GLANCE

1G Analog cellular phone systems (AMPS)

2G The current prevailing infrastructure

Digital phone systems, circuit-switched, “PCS” services. 19.2K maximum speeds (most <14.4K)

Implementation of three different airlink standards in use in the U.S. has fragmented coverage and contributed to non-stellar service quality.

2.5G Digital, packet-switched (“always on”) — like LAN, cable modem, DSL

Carriers don’t need to acquire new spectrum to deploy

Speeds: Starting at about 30 Kbps+

Airlink technologies: Generalized Packet Radio Service (GPRS), Enhanced Data for GSM Evolution (EDGE), CDMA2000/1XRTT

2.5G services are just emerging in the U.S.

- AT&T Wireless in selected markets, based on GPRS
- Verizon and Sprint services imminent (this quarter?), predicted to be “nationwide” out of the chute, based on CDMA2000/1XRTT

MOBILE WANS, THE Gs AT A GLANCE (continued)

3G Digital, packet-switched

Speeds: 384 Kbps – 2 Mbps

Usually requires carriers to acquire—to the tune of billions of dollars—new spectrum. Initial spectrum acquisitions are largely complete worldwide.

3G services were launched in Tokyo, Japan (NTT DoCoMo) in October 2001

Primary technologies: Wideband CDMA (W-CDMA), CDMA2000

Much U.S. activity afoot to reallocate spectrum

- The FCC recently opened government airwaves (27 MHz in seven bands) for Time Division Duplexing, optimized for high-speed data bursts
- The FCC recently declared that the 2.5GHz licensed band pegged for MMDS BWA service could also be used for some 3G/mobile services.
- Some old UHF TV channels going to 3G
- NextWave licenses likely to be divvied up among top U.S. carriers

MOBILE WANS (continued)

MOBILE WAN IMPLEMENTATION CHALLENGES

- Spectrum, deployment costs to carriers have been so high, how affordable can subscribers expect 3G services to be?
- Standards wars could fragment market as they did in the 2G/PCS space
- Facing competition by wireless LANs in public hot spots
 - Sprint PCS joins WECA
- Availability of new technology comes in stages
 - Note AT&T's progression from TDMA to GSM to GPRS to EDGE to UMTS
- Availability of spectrum
 - NextWave saga still not resolved
- Infrastructure/spectrum costs in "down" economy
- Billing models/compelling service packages to be ironed out
 - Consumers aren't accustomed to "paying by the megabyte"
- For enterprises
 - Mobile application development/integration is confusing
 - Choose mix of off-shelf, homegrown, wireless gateways, WASP services
 - Choose device(s) as standard mobile platform for employees; need ability to transcode to all major devices for m-commerce initiatives
 - Synchronization of data
 - Development platforms: WAP, Java, BREW?
- Security and Management

MOBILE WAN WHO'S WHO*

Key Network Operators/Carriers:

US: AllNet, AT&T Wireless, Cingular, Sprint PCS, Verizon, VoiceStream

Europe: BT Cellnet (UK), Orange (UK), Sonera (Finland)

Japan: NTT/DoCoMo

Key Technology/Infrastructure Vendors:

CommWorks (3Com), Ericsson, Lucent, Nortel, Qualcomm, Nokia

Key Handset/PDA Makers:

AT&T, Ericsson, Handspring, Matsushita, Motorola, NEC, Nokia, Palm, RIM, Sanyo

* List not exhaustive

2002 MOBILE WAN OUTLOOK

- Expect additional 2.5G/GPRS service rollouts from AT&T Wireless
- Expect near-term 2.5G service rollouts from Verizon and Sprint
- These rollouts will serve primarily to enable carriers to support additional wireless voice customers, rather than enabling very many new data applications. To the degree that the newer, more spectrally efficient technologies enable more users to be supported in the same cell site, it's possible that voice subscribers will find themselves kicked off their networks less often.
- Expect no 3G service rollouts in the U.S. or Europe
- Business customers will spend the year largely educating themselves and developing mobile strategies for their internal users and m-commerce (B2C).

2002 MOBILE WAN OUTLOOK (continued)

Activity in the handset market gives an idea of the ubiquity of the digital mobile WAN technologies:

**Mobile Handsets Produced Worldwide
(in 000s)**

	2001	2002	2003	2004	2005
2G (CDMA, TDMA, GSM)	316,413	417,612	366,521	174,779*	30,040*
2.5G (GPRS, EDGE, CDMA 1XRTT)	8,313	67,715	256,354	570,947	844,434
3G (WCDMA, CDMA2000)	40,656	49,349	54,381	62,032	72,672
WORLDWIDE TOTAL	365,442	534,676	677,256	807,758	947,146

* Projected number of CDMA-based 2G phones to be produced in this year is 0.

Source: Cahners In-Stat/MDR

2002 is clearly **not** the year of 3G or even 2.5G. While 2.5G uptake will begin doubling as early as next year, mainstream 3G remains a “future” even in 2005.

MOBILE WAN GLOSSARY

Wireless Glossary

1XRTT: Next-generation Code Division Multiple Access (CDMA) mobile networks that will support 144K bit/sec packet-based traffic. Is considered a 2.5G technology.

2G: The currently deployed generation of digital mobile networks, also called personal communications services (PCS) networks. By contrast, first-generation networks, known as Advanced Mobile Phone Service (AMPS), were analog in nature. 2G in the CDMA market is synonymous with CDMAOne.

2.5G: Packet-based networks that enable subscriber data rates of 30K bit/sec to 384K bit/sec and support Mobile IP for always-on connections and transparent roaming. 2.5G technologies include 1XRTT and 3XRTT, as well as Enhanced Data for GSM Evolution (EDGE) and General Packet Radio Service (GPRS).

3G: Generation of mobile wireless networks on the drawing board that will support multimedia and enable packet speeds above 384K bit/sec, possibly to 2M bit/sec. These speeds will be supported from a fixed point of access (vehicular speeds will reportedly reach 384K bit/sec), and usually at short distances, such as within a building or campus. Includes the following technologies:

- Wideband CDMA (W-CDMA)
- CDMA2000
- IMT-2000 by the International Telecommunications Union standards body and Universal Mobile Telephone System, or UMTS, in Europe. Some skeptics question whether 3G will be needed if 2.5G networks should persevere.

3XRTT: A 2.5G wireless network that will deliver 144K to 384K bit/sec packet-switched speeds. Deployment time frame predictions range from 2001 to 2004.

IS-95: A transmission protocol running in today's wireless networks that employs CDMA bit-transport technology.

IS-136: A transmission protocol running in today's wireless networks that employs Time Division Multiple Access (TDMA) bit-transport technology.

CDMA: Code Division Multiple Access. A spread-spectrum method of allowing multiple users to share the radio frequency spectrum by assigning each active user an individual code. Current CDMA transmission protocols are specified as IS-95.

CDMA2000: A North American 2.5G technology, synonymous with 1XRTT, that enables packet-switched mobile networks.

CDMAOne: Currently deployed generation of spread spectrum-based CDMA mobile technology, also called IS-95. CDMAOne is a circuit-switched scheme with a subscriber data rate of 14.4K bit/sec.

EDGE: Enhanced Data for GSM Evolution. Third-generation (3G) technology for GSM networks said to deliver data rates up to 500K bit/sec. EDGE data services could begin in 2002 for the GSM network and the IS-136 TDMA network.

GPRS: General Packet Radio Service. A version of GSM airlink technology that can combine up to eight (out of eight) time slots in each time interval for IP-based packet data speeds up to a maximum rate of 160K bit/sec. GPRS supports IP and X.25 networking.

GSM: Global System for Mobile communications. The most mature digital cellular standard that dominates the wireless world with over 200 million users. GSM networks offer circuit-switched data services at 9.6K to 14.4K bit/sec speeds.

HSCSD: High-Speed Circuit-Switched Data. A version of GSM airlink technology that combines two to four of GSM's time slots (out of eight) to provide service at 28.8K bit/sec to 56K bit/sec speeds.

IMT-2000: The name given by the International Telecommunication Union (ITU) for 3G networks.

TDMA: Time Division Multiple Access. A wireless access protocol that allows multiple users to share a channel by chopping up the channel into sequentially accessed time slices. GSM is one flavor of a TDMA network. In addition, there is a set of TDMA technology specifications known as IS-136.

UMTS: Universal Mobile Telephone System. Europe's name for 3G wireless networks.

WCDMA: Wideband CDMA. Leading contender as a 3G-standard airlink protocol that provides 20-MHz bandwidth.

BROADBAND WIRELESS ACCESS (BWA)

APPLICATIONS

- Alternative to DSL, cable modem services where not available for SOHOs and consumers
- Inexpensive, comparatively quick-to-install alternative to T1 for businesses
- Provides CLEC competition to incumbent local exchange carriers ☺

PRIMARY SERVICES

- Multichannel Multipoint Distribution System (MMDS): two-way, 2.5GHz licensed band
- Local Multipoint Distribution System (LMDS): two-way, 28GHz licensed band (microwave)

BWA (continued)

Multichannel Multipoint Distribution System (MMDS)

- Specifies a service in the 2.5GHz range
- Primary U.S. license holders:
Sprint Broadband Direct (nationwide), WorldCom (nationwide), Nucentrix (Texas, Oklahoma and Midwest)
- Current services operate on “first generation” technology, which requires line of sight between the user’s transceiver and the radio tower. When line of sight is available, communications can take place over distances of up to 35 miles
- 2G technology/infrastructure equipment will not require line of sight, so services can be made available to many more customers
- 2G networks will also be more cellular in nature, so distances are shorter. But this setup is more scalable (and thus more affordable) to BWA network operators.
- 2G networks will be made possible in part by the use of Orthogonal Frequency Division Multiplexing (OFDM), which largely solves the multipath/interference problem caused by signals being deflected off objects in transmission path

BWA (continued)

Sprint Broadband Direct activity

- Has deployed consumer services in 14 markets (50,000 customers); Detroit also has “business” MMDS services
- Announced in September it would quit signing on new customers until 2G technology becomes available.
- Too expensive to install outside transceivers and cable from roof to inside modem. Takes about 24 months to recoup installation costs from monthly subscriber fees of \$40 to \$50
- Looking for QoS capabilities so can offer classes of service
- No timeline in place for 2G, but is testing equipment

WorldCom activity

- Has deployed business services in 13 markets
- Says it's easier to get LOS to business than to a consumer (higher rooftops)
- Charges \$200 to \$600 per month (not including discounts) so ROI is quicker; about 10 months
- Offers businesses speed choices, SLAs
- No testing or timeline for 2G

BWA (continued)

Local Multipoint Distribution System (LMDS)

- 28 GHz band (microwave)
- Suited for densely populated urban areas where it is difficult and expensive to deploy additional or new wired infrastructures.
- Typical speeds are 45M bit/sec downstream in a point-to-multipoint configuration. However, LMDS has the potential to exceed OC-3 (155M bit/sec) speeds. Distances between sites are limited to 4 kilometers
- Gathering steam outside U.S. where last-mile alternatives are fewer; scarce in U.S. as yet.

BWA WHO'S WHO*

Key MMDS Infrastructure Equipment Makers:

Hybrid, IP Wireless, Navini, Iospan, SOMA, Vyyo

Key LMDS Infrastructure Equipment Makers:

Alcatel/Newbridge, Ericsson, Harris, Lucent, Netro, Nortel, Siemens, Vyyo

Key MMDS Network Operators:

Nucentrix, Sprint, WorldCom

LMDS Network Operators:

LMDS Wireless

BWA pioneer WinStar acquired in December by IDT in New Jersey for \$5 billion

Teligent in Chapter 11

Note: Cisco recently exited the BWA market, despite its founding member status of the Broadband Wireless Internet Forum (BWIF) and advocacy of its VOFDM technology for 2G BWA systems.

* List not exhaustive

2002 BWA OUTLOOK

- Static
- Expect consolidation and reorganization
- Sprint Broadband Direct will continue to serve existing MMDS customers and test 2G technology
- WorldCom will spend its time signing on new MMDS business customers in the cities where it has deployed towers this year (8 of 13 markets were deployed in 2001).
- Carriers are seeking 2G equipment that will enable service deployment to locations without line of site to the cell tower. 2G gear will also enable subscriber self-installation (similar to what has happened in the DSL market). Such systems necessitate an indoor transceiver mount

2002 WIRELESS LANDSCAPE OUTLOOK SUMMARY

- 802.11b WLANs are where the customer purchasing/installation action is.
- The IEEE working groups will spend a good chunk of the year working out standards compatibility issues, migration strategies, and modifying 802.11 technologies for additional security and QoS, The .11h group will also work on adding the appropriate power control to 802.11a to hasten its acceptance in the European market.
- Mobile WAN players will continue to develop next-generation handsets and networks, though the majority of users won't see much difference in services.
- Some 2.5G rollouts will enable carriers to support more voice customers and make more money. Businesses and consumers might find additional wireless data services (including some m-commerce) available to them with the additional bandwidth.
- 3G networking (384 Kbps to 2 Mbps wireless WAN speeds) remains several years away.
- The BWA industry will strive for 2-generation technology needed to serve masses of users; otherwise, it is difficult for carriers to justify remaining in the market.

WIRELESS RESOURCES

WLANs

Key WLAN Industry Groups

Wireless Ethernet Compatibility Alliance (WECA) – Certifies interoperability testing and standards compliance with 802.11x standards. Also disseminates 802.11-oriented information to the public.

www.wi-fi.org

Wireless LAN Association (WLANA) -- Educational and resource organization for 802.11, HomeRF and Bluetooth

www.wlana.org

HiperLAN2 Global Forum – Educational and resource organization for HiperLAN2 standards

www.hiperlan2.com

Multimedia Mobile Access Communication/MMAC (Japan) Resource Page

www.arib.or.jp/mmac/e/what.htm

Bluetooth Special Interest Group – Resource organization primarily for industry.

www.bluetooth.org

802.11 v. HomeRF v. Bluetooth Comparison/Face-off

www.homerf.org/data/face_off/FaceOff_Positioning.pdf

IEEE 802.11 Working Group Home Page

grouper.ieee.org/groups/802/11/

“Your 802.11 Wireless Network Has No Clothes”

A discussion of security deficits in 802.11 networks/University of Maryland

www.cs.umd.edu/~waa/wireless.pdf

WIRELESS RESOURCES (continued)

MOBILE WANs

Mobile 3G Resource Site
www.mobile3g.com/

U.S. Federal Communications Commission 3G Service Descriptions, Definitions
<http://www.fcc.gov/3G/>

CDMA Developers Group Home Page
www.cdg.org

GSM Home Page (with 2.5G deployment info)
www.gsmworld.com/index1.html

? ? ? ? ? ?

BWA

Broadband Wireless Internet Forum Home Page
www.bwif.org

LMDS Backgrounder
www.lmdswireless.com/whatislmds.html

? ? ? ? ? ?

WLANs, Mobile WANs, BWA:

“Wireless in the Enterprise” Newsletter Archives, Network World Fusion
www.nwfusion.com/newsletter/wireless

