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Wireless local loop

Wireless local loop (**WLL**), is the use of a wireless communications link as the "last mile / first mile" connection for delivering plain old telephone service (POTS) or Internet access (marketed under the term "broadband") to telecommunications customers. Various types of WLL systems and technologies exist.

Other terms for this type of access include **broadband wireless access** (**BWA**), **radio in the loop** (**RITL**), **fixed-radio access** (**FRA**), **fixed wireless access** (**FWA**) and **metro wireless** (**MW**).

Contents

Definition of fixed wireless service

Fixed Wireless Terminal (FWT) units differ from conventional mobile terminal units operating within cellular networks – such as GSM – in that a fixed wireless terminal or desk phone will be limited to an almost permanent location with almost no roaming abilities.

WLL and FWT are generic terms for radio based telecommunications technologies and the respective devices which can be implemented using a number of different wireless and radio technologies.

Wireless local loop services are segmented into a number of broad market and deployment groups. Services are split between licensed – commonly used by carriers and Telcos – and unlicensed services more commonly deployed by home users and Wireless ISPs (WISPs).

Licensed points-to-point microwave services

Licensed microwave services have been used since the 1960s to transmit very large amounts of data. The AT&T Long Lines coast to coast backbone in the USA was largely carried over a chain of microwave towers. These systems have been largely using 3700–4200 MHz and 5000–6200 MHz. The 5 GHz band was even known as the "common carrier" band. This service typically was prohibitively expensive to be used for local loops, and was used for backbone networks. In the 1980s and 1990s it flourished under the growth of cell towers. This growth spurred research in this area, and as the cost continues to decline, it is being used as an alternative to T-1, T-3, and fiber connectivity.

Licensed point-to-multipoint microwave services

Multipoint microwave licenses are generally more expensive than point to point licenses. A single point to point system could be installed and licensed for 50,000 to US$200,000. A multipoint license would start in the millions of dollars. Multichannel Multipoint Distribution Service (MMDS) and Local Multipoint Distribution Service (LMDS) were the first true multi point services for wireless local loop. While Europe and the rest of the world developed the 3500 MHz band for affordable broadband fixed wireless, the U.S. provided LMDS and MMDS, and most implementations in the United States were conducted at 2500 MHz. The largest was Sprint Broadband's deployment of Hybrid Networks equipment. Sprint was plagued with difficulties operating the network profitably, and service was often spotty, due to inadequate radio link quality.

Unlicensed multi point wireless service

Most of the growth in long range radio communications since 2002 has been in the license free bands (mostly 900 MHz, 2.4 GHz and 5.8 GHz). Global Pacific Internet and Innetix started wireless service in California in 1995 using Breezecom (Alvarion) frequency hopping radio which later became the standard 802.11.

A few years later NextWeb Networks of Fremont began deploying reliable license free service. For Nextweb they originally deployed 802.11b equipment and later switched to Axxcelera which uses propriety protocol.

1995–2004: License-free equipment

Most of the early vendors of license-free fixed wireless equipment such as Adaptive Broadband (Axxcelera), Trango Broadband, Motorola (Orthogon), Proxim Networks, Redline Communications and BreezeCom (Alvarion) used proprietary protocols and hardware, creating pressure on the industry to adopt a standard for unlicensed fixed wireless. These Mac Layers typically used a 15–20 MHz channel using Direct Sequence Spread Spectrum and BPSK, CCK and QPSK for modulation.

These devices all describe the customer premises wireless system as the Subscriber Unit (SU), and the operator transmitter delivering the last mile local loop services as the Access Point (AP). 802.11 uses the terms AP and STA (Station).

2002–2005: Wi-Fi local loop

Originally designed for short range mobile internet and local area network access, IEEE 802.11 has emerged as the de facto standard for unlicensed Wireless Local Loop. More 802.11 equipment is deployed for long range data service than any other technology. These systems have provided varying results, as the operators were often small and poorly trained in radio communications, additionally 802.11 was not intended to be used at long ranges and suffered from a number of problems, such as the hidden node problem. Many companies such as KarlNet began modifying the 802.11 MAC to attempt to deliver higher performance at long ranges. *(see Long-range Wi-Fi)*

2005–present: Maturation of the wireless ISP market

In nearly every metropolitan area worldwide, operators and hobbyists deployed more and more unlicensed broadband point to multipoint systems. Providers that had rave reviews when they started faced the prospect of seeing their networks degrade in performance, as more and more devices were deployed using the license free U-NII (5.3/5.4 GHz) and ISM (2.4 and 5.8 GHz) bands and competitors sprung up around them.

The growing interference problem

Interference caused the majority of unlicensed wireless services to have much higher error rates and interruptions than equivalent wired or licensed wireless networks, such as the copper telephone network, and the coaxial cable network. This caused growth to slow, customers to cancel, and many operators to rethink their business model.

There were several responses to these problems.

2003: Voluntary frequency coordination (USA)

Next-Web, Etheric Networks, Gate Speed and a handful of other companies founded the first voluntary spectrum coordination body – working entirely independently of government regulators. This organization was founded in March 2003 as BANC,[1] "Bay Area Network Coordination". By maintaining frequencies used in an inter-operator database, disruptions between coordinating parties were minimized, as well as the cost of identifying new or changing transmission sources, by using the frequency database to determine what bands were in use. Because the parties in BANC comprised the majority of operators in the Bay Area, they used peer pressure to imply that operators who did not play nice would be collectively punished by the group, through interfering with the non cooperative, while striving not to interfere with the cooperative. BANC was then deployed in Los Angeles. Companies such as Deutsche Telekom joined. It looked like the idea had promise.

2005: Operators flee unlicensed for licensed

The better capitalized operators began reducing their focus on unlicensed and instead focused on licensed systems, as the constant fluctuations in signal quality caused them to have very high maintenance costs. NextWeb, acquired by Covad for a very small premium over the capital invested in it, is one operator who focused on licensed service, as did WiLine Networks. This led to fewer of the more responsible and significant operators actually using the BANC system. Without its founders active involvement, the system languished.

2005 to present: Adaptive network technology

Operators began to apply the principles of self-healing networks. Etheric Networks followed this path. Etheric Networks focused on improving performance by developing dynamic interference and fault detection and reconfiguration, as well as optimizing quality based routing software, such as MANET and using multiple paths to deliver service to customers. This approach is generally called "mesh networking" which relies on ad hoc networking protocols, however mesh and ad hoc networking protocols have yet to deliver high speed low latency business class end to end reliable local loop service, as the paths can sometimes traverse exponentially more radio links than a traditional star (AP->SU) topology.

Adaptive network management actively monitors the local loop quality and behaviour, using automation to reconfigure the network and its traffic flows, to avoid interference and other failures.

Mobile technologies

These are available in Code Division Multiple Access(CDMA), Digital Enhanced Cordless Telecommunications – DECT (TDMA/DCA) (See ETSI 6 EN 300 765-1 V1.3.1 (2001–04) -"Digital Enhanced Cordless Telecommunications (DECT); Radio in the Local Loop (RLL) Access Profile (RAP); Part 1: Basic telephony services"), Global System for Mobile Communications(GSM), IS136 Time Division Multiple Access (TDMA) as well as analog access technologies such as Advanced Mobile Phone System(AMPS), for which there will be independent standards defining every aspect of modulation, protocols, error handling, etc.

Deployment

The Wireless Local Loop market is currently an extremely high growth market, offering internet service providers immediate access to customer markets without having to either lay cable through a metropolitan area MTA, or work through the ILECs, reselling the telephone, cable or satellite networks, owned by companies that prefer to largely sell direct.

This trend revived the prospects for local and regional ISPs, as those willing to deploy fixed wireless networks were not at the mercy of the large telecommunication monopolies. They were at the mercy of unregulated re-use of unlicensed frequencies upon which they communicate.

Due to the enormous quantity of 802.11 "Wi-Fi" equipment and software, coupled with the fact that spectrum licenses are not required in the ISM and U-NII bands, the industry has moved well ahead of the regulators and the standards bodies.

In 2008, Sprint and ClearWire were preparing to roll out massive WiMAX networks in the United States, but those talks may be stalled pending new investment.[2]

WLL methods

- Mobile:
  - CDMA (USA).
  - TDMA (USA).
  - GSM (ITU – Worldwide).
  - UMTS 3rd Generation (World).

    - Personal Handy-phone System (PHS in Japan, PAS/Xiaolingtong in China)
- Fixed or local area network:
    - DECT, for local loop
    - LMDS
    - IEEE 802.11, originally designed for short range mobile internet and network access service, it has emerged as the facto standard for Wireless Local Loop.
    - WiMAX or IEEE 802.16 may become the dominant medium for wireless local loop. Currently more operators are running on the 802.11 MAC at 2 and 5 GHz. 802.16 was unlikely to outperform 802.11 until at least late 2008. Intel is promoting this standard, while Atheros and Broadcom are still focused largely on 802.11.
    - Satellite Internet access for autonomous building.

Manufacturers

- Huawei
- Airspan
- Alvarion
- Axxcelera
- Cambridge Broadband
- Intracom Telecom
- P-Com
- Redline Communications
- Sony Ericsson
- SR Telecom

See also

- 8P8C (RJ-45)
- Antenna
- Basic Exchange Telephone Radio Service
- Electrical cable
- RF connector
- Wi-Fi
- Wireless Internet service provider (WISP)

References

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2. "Sprint, Clearwire Near WiMax Deal" (http://www.thestreet.com/s/sprint-clearwire-near-new-wimax-deal/newsanalysis/technology-stories/10403584.html?dlbk). thestreet.com.

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