Finding the Best Fit - Wi-Fi versus WiMAX

Wavion White Paper
February 2008

WAVION
WIRELESS NETWORKS

Overview

Wi-Fi and WiMAX are two different technologies that often compete in fixed and nomadic deployments. This paper discusses which technology provides the best fit for different applications.

The discussion reviews aspects such as the affect of frequency licensing on the technology in terms of interference, bandwidth and power. The cost of the technology is also reviewed on the operator side and the cost of clients. The discussion highlights the strengths and weaknesses of each technology.

Wavion spatially adaptive, beamforming Wi-Fi technology is specifically designed for metro deployments. This enables Wavion's WBS-2400 base station to successfully deal with most of the traditional disadvantages Wi-Fi technologies. With Wavion's Wi-Fi solution, operators are able to deploy high quality, cost effective wireless infrastructures.

Licensing Regulations

A major consideration when comparing the Wi-Fi and WiMAX technologies is regulation. Wi-Fi technology is License Exempt (Unlicensed), though regulated in the maximum allowable power. The WiMAX technology requires a license, which defines the frequency band, channel bandwidth, power limit, and geographic area.

The licensed vs. unlicensed consideration involves several parameters:

- **Interference**

  Licensed frequency band lowers the probability of interferences since transmission in the licensed frequency band is allowed only to the licensees. License exempt frequency band is open to anyone and thus may suffer from uncontrolled interferences that may affect network performance.
- **Spectrum Cost**

  Licensed bands (like 2.3GHz, 2.5GHz and 3.5GHz) are usually very costly, and require large upfront investment. Many medium-small operators don't have the initial capital needed to buy the required frequency license. In addition, such licenses are normally sold for nation-wide coverage, making it even more difficult for medium-small operators to consider this possibility.
- **Power Limit**

  The allowed maximum transmission power in licensed bands is normally higher than in unlicensed bands. This implies that wider range and higher spectral efficiency can be achieved in principle. Yet, in practice the limiting factor in most cases is the client device, where the maximum power is limited by battery drain consideration. As a result, the client device transmit power is just as limited in the licensed band as in the unlicensed band.
- **Channel Bandwidth**

  Bandwidth allocation is often smaller in licensed band (3.5MHz to 7MHz) compared to unlicensed band (normally 20MHz). This implies that the maximum achievable throughput rates of licensed band are usually significantly lower than those in unlicensed bands.

Client device cost

Wi-Fi is a mature technology that is already embedded in many devices. Today, you can hardly find a new laptop that does not have a Wi-Fi client embedded in it. In cases one prefers to use stronger Wi-Fi clients, to increase range or indoors penetration, low cost Wi-Fi CPEs are available for several 10's of dollars.

Mobile WiMAX is an emerging technology. Its client devices are planed to be produced in masses (for the 802.16e standard), but will never reach the numbers of Wi-Fi. The fixed WiMAX CPEs (for the 802.16d standard) will never reach a mass production since the Fixed WiMAX standard has been replaced by the Mobile one. As a result, the WiMax CPE price is high and ranges from $200 to $400 in most cases and will stay in this range in the near future.

Base station and network cost

The proliferation of Wi-Fi devices makes the cost of a Wi-Fi base station much lower than that of the WiMax base station. In addition, since Mobile WiMAX is designed to compete against 3G, it has mobility support in its core network, and includes some very costly components such as ASN gateway (starts at a $100K from leading vendors), Home agent, and an IP CS core network. All of these additional and costly components increase significantly the cost of a WiMax based network.

Wi-Fi base stations, on the other hand, do not require additional costly components, making the cost of Wi-Fi based network much more attractive compared to a WiMAX based network.

Applications

As in many fields, there is no one technology that universally provides the best fit. It all depends on the specific application.

If the application is providing broadband access for mobile users, then WiMAX is the more suitable technology since it was specifically designed for this type of application.

However, if the application is providing broadband access for fixed and nomadic users in limited zones, then Wi-Fi has similar performances as WiMAX, provided that the interference level is low or can be dealt with. If the application is providing backhaul for security and surveillance cameras, then Wi-Fi is definitely the more suitable technology since in most cases only the unlicensed spectrum is available for this task.

In some applications WiMAX and Wi-Fi together can be successfully combined, to benefit from the advantages each technology has to offer. For example, Wi-Fi is used to provide the last "half a mile" access to the end user, and WiMAX is used to provide long range backhauling to the ISP's POP. The benefits of this combination include:

- Cost effective backhaul, with long range, interference free, licensed WiMAX.
- Cost effective access, exploiting zero cost Wi-Fi clients, which already exist in laptops and many PDAs and other end user devices.

Wavion's Wi-Fi vs. WiMAX

Wavion developed its spatially adaptive, beamforming Wi-Fi technology specifically for outdoor and metro deployments. This enables Wavion's WBS-2400 base station to successfully deal with most of the traditional disadvantages of Wi-Fi versus the WiMAX technologies.

With Wavion's Wi-Fi solution, operators are able to deploy high quality, cost effective wireless infrastructures. This is the ideal solution smaller and alternative to operators, who do not have the capital to invest in a licensing for fixed and nomadic, indoor and outdoor applications.

Wavion technology advantages

Coverage
The coverage area provided Wavion's technology is two to three times that of conventional Wi-Fi Access Points. Superior range and uniform coverage means that the network can be scaled to reach a larger group of users, which can yield higher subscriber revenues at lower costs.
Wavion's technology provides users with a powerful, high quality signal that is not dependent on line-of-sight positioning, and is highly resistant to interference. This results in a much improved uniform coverage with far fewer dead spots and allows mobile users to get stronger connections with fewer re-associations between access points while the client is in motion.

Capacity
The spatially adaptive technology improves the link budget, which significantly increases the throughput to Wi-Fi clients. The technology also minimizes the "fading phenomena" where Wi-Fi clients experience rate drops from time to time. This provides further improvement on the effective capacity of the infrastructure.
This capacity increase, allows the operator to offer higher grade of service to clients, as well as increasing the number of clients that can be served per base station.

Indoor Penetration
Indoor penetration is very susceptible to multipath and signal reflection. Since the spatially adaptive technology exploits multipath to increase bi-directional link budget, it is has a superior ability to penetrate buildings and walls compared to any conventional access points. This enables network operators to offer access in residences, places business and schools. In addition, deeper indoor penetration makes self-install service a reality by reducing the need for separate outdoor CPEs.

Interference immunity
Wavion's technology has incorporated advanced mechanisms for interference handling. It's Dynamic Interference Handling (DIH) as well as its beamforming technology which concentrates the antenna beam only on the client, allows operation in severe interference conditions. This minimizes the effect that interference may have on the performance in terms of capacity and coverage.

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