WiFi vs. iBurst:
A "Smarter" Wireless Provider

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Technology Report

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In the United States today, wireless networks engulf us. Wireless networking exists for the high classes in Manhattan as well as the conservative hard working families in rural Indiana. Large corporations utilize the wireless technology, as do self-employed professionals in small towns also use the wireless technology due to its ease of operation and it convenience. Campuses throughout the country have their own wireless local area networks allowing students to access the internet whether they are located in the library or their assigned dormitory room. Today, the most widely used wireless networking solution is the WiFi system. However, the wireless technology is quickly progressing and other wireless networking alternatives, such as iBurst, are just waiting to be the next widely accepted standard. It is evident such wireless solutions are a commodity in flourishing countries and communities in the world. However, in rural communities, where wireless funds are sparse, the opportunity of deploying a wireless solution can significantly impact the healthcare, economy and educational system in a proactive way. So what wireless technology do we select? WiFi or iBurst? This report provides analysis of each technology in terms of product definition/features, product technology and product cost. The final section will provide some conclusion as to which is better for which applications as well as a head-to-head comparison of the technologies key points.

What is WiFi?

The most basic definition of WiFi is the wireless network technology that utilizes radio waves to connect a user to the internet as well as to other user's terminal on the same network.[i] More specifically, WiFi, or *Wireless Fidelity*, systems are those wireless area networks that follow the 802.11 standard.

Originally, the WiFi standard was developed to connect laptop to local area networks, but now the technology is used to connect laptops and PCs to the internet as well as for voice over internet protocol phone access, online gaming with consoles such as Microsoft's Xbox 360 and Sony's Playstation 3, and for aiding the connectivity of consumer electronics. Now, the technology has a WiFi Alliance, whose sole responsibility is to tests and certify equipment that meets the 802.11x standards. [ii]

As stated earlier, WiFi is used in both the home, university and business settings. Typically, home uses consist of terminating a broadband connection provided by an internet service provider, such as Comcast, with a wireless router that provides access to the internet. Another common use for WiFi at home is the implementation of an ad-hoc mode for client-to-client connectivity. These WiFi systems at home can also be uses to connect WiFi-compatible devices to each other or to the internet.[ii]

WiFi systems in business are typically more complex. The goal of WiFi systems in business and university systems is to provide connectivity of all the end-users and devices. Due to the size of corporate business parks, their WiFi systems are considerably larger than those in the home environment. However, due to the confidentiality of material that is shared on a business or university network, security is an issue. Therefore, a key feature of a business self-managed WiFi system is the integration of a security gateway and firewall as well as DHCP servers and intrusion detection systems.[ii]

What are the advantages and disadvantages of WiFi?

WiFi systems are very convenient in many respects. For example, the WiFi system is very easy and cheap to deploy in comparison to wired system. Running cable to "wire" end users in a network can not only be costly, but very time consuming. In addition, WiFi systems can provide network access in locations that might have normally been difficult or impossible to run cables for a wired network.[ii]

Additionally, the 802.11 standard has been adopted globally. Thus, the same WiFi clients can be utilized in different countries throughout the world. New protocols, such as Quality of Service and some power saving mechanisms, have been developed to make WiFi more suitable for latency-sensitive applications (i.e. phone and video).[ii]

However, with any action there is a reaction. Thus, WiFi does introduce some disadvantages. As far as the systems themselves, their coverage area is limited. The WiFi network will only provide connectivity in a finite range. Certain adjustments to the system, which will be covered in the technology section, can be made to increase coverage.[2] Typical WiFi systems today only cover approximately a 125 meter radius.[iii]

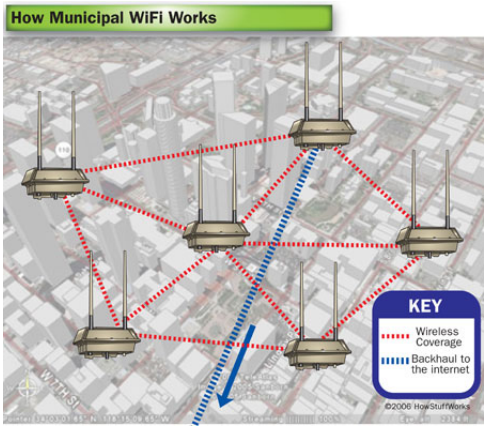
Other issues with WiFi include its high power consumption and security. Now, WiFi systems support certain security features, such as wired equivalent privacy (WEP) or WiFi proctected access (WPA). However, most systems are defaulted to be an open (public or "accessible to anyone") network. The security features must be implemented after deployment.[2]

What is the WiFi Technology?

WiFi systems utilize radio waves to transmit data from one point to another point or series of points. The central point of the system is known as an "access point." The access point must have a backhaul connection to the internet. This might means that the access point might be directly wired to an internet source or it is the range of another access point it has access to that has a backhaul connection.

From the end users view, the access point broadcasts beacon packets with the enclose Service Set Identifier (SSID), or basically its "network name," enclosed. These packets are transmitted from an access point in a radial fashion every 100 milliseconds (see technology picture in *What is the iBurst technology*? Section). The packets are broadcast at a rate of 1Mb/s, which is the lowest rate of transfer in the WiFi standard. Thus, this means the end user's device must be able to communicate at a rate of 1Mb/s or better. Any end user within the range of the access point can utilized the WiFi system (unless the network is secured then the user must be in range and supply a key or password).

Today, many cities and towns are implementing public wireless networks know as "municipal WiFi." A typical characteristic of these types of systems the "mesh" network. This network (see the next page)[iv] uses the end users as access points. Thus, everyone is in the system is used to provide a more reliable and self-sustaining network. In the mesh network, the internet is provided through a series of nodes. At least one of these nodes must have a backhaul line connecting to the internet. Thus, when transmitting data on a mesh system, the data jumps from node to node until a node is



found that is connected to the internet (i.e. finishing the transmission). The image on the prior page describes the mesh network approach.

What do WiFi customers need?

The WiFi user needs to have a receiver in order to utilize the WiFi technology. Due to the WiFi's appeal of portability, these receivers are usually a PCMCIA card. If you are using a home network setup by yourself, you can simply purchase one of these from an electronics store for approximately $30 to $50 dollars.[v] However, if your are utilizing a WiFi service from a provider, such as Verizon Wireless or Cingular Wireless, you will need to purchase their laptop card which is configured to their network. In the case of Cingular, the laptop card is $379.99.[vi]

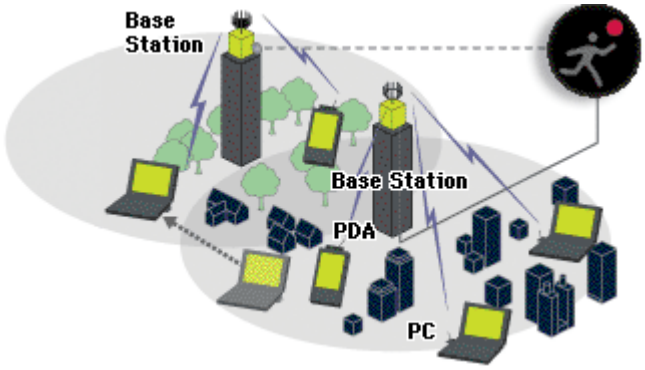
Not only do WiFi users need to purchase the hardware, but they also need to pay service charges. If you are setting up a home wireless network, you service charge is going to be a monthly fee for unlimited wired broadband internet access. You simply can connect this broadband connection to a router or access point to obtain a home wireless network. However, if you are purchasing a WiFi service (i.e. wireless broadband internet access), you pay a monthly service fee for home much data you send and receive on that network. See the cost table for details.

Setup costs for a WiFi system are rather low. The base station can be purchased at any electronics store. Routers and wireless access points cost approximately $50 to $200 depending on the type of WiFi you are trying to implement. For example, the Netgear 802.11g Wireless router is for sale at $49.99 at Best Buy. New versions of the 802.11 standard have been developed and their products are now on the market. These products are usually more expensive (in the $100 to $200 dollar price range).

What is iBurst?

iBurst is another technology solution to the wireless broadband problem. The system provides users, whether recreational or corporate, with a wireless, yet continuous, high speed connection through broadband internet and email means. The new technology allows the user to operate their connection in an "always-on" mode as long as the user is within a specific distance of the ground station. Again, the advantage this wireless solution has on "wired" systems is the ease of deployment and the lower costs.

iBurst, which has been adopted as its own standard of IEEE 802.20, optimizes its bandwidth by incorporating "smart antennas" into their networks. Again, the application of the standard allows client devices to be anywhere in the world that offers iBurst.



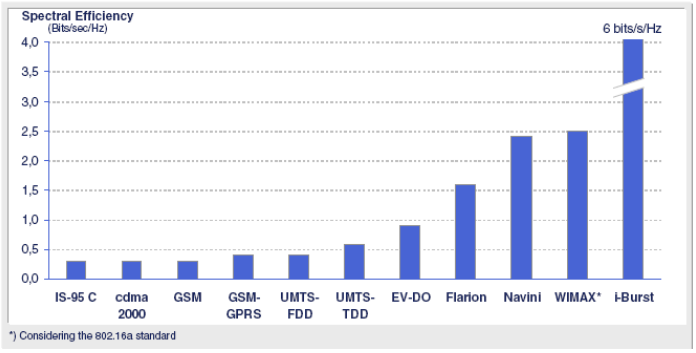
Similar to WiFi, he appeal of iBurst is the capability to use the service exactly when you need it. iBurst achieved its goal of developing a service that is always accessible as long as you are within a specific range of the base station.[vii] What does this extra degree of freedom mean to internet users? Internet uses can increase effectiveness, thus, increasing productivity. iBurst clients do not have to hassle with the downloading content that might need to be used later. Rather clients can simply access the internet whenever necessary. Another advantage is iBurst allows used to upload data to the web whenever necessary. Thus, if a client is on vacation and wants to upload their pictures from their daytrip, they can do this via the iBurst service and now relatives across the world can see photos of their relatives' latest excursions.

What are the advantages of iBurst?

The iBurst technology, originally developed by ArrayComm, provides broadband connectivity to people on the move. iBurst is capable of providing a user with service even while traveling 60km/hour.[viii] Additionally, the coverage of iBurst is much larger than the coverage of WiFi (coverage of 1km to 12km depending on interference of structures and trees). Thus, iBurst requires less hardware to cover the same amount of area compared to that of a WiFi system.

Aside from the larger coverage area, the iBurst system provides a more efficient use of the spectrum by implementing the smart antennas. Spectral efficiency is a measure of how well a technology transmits data. The higher the value of the efficiency, which is measured in bis/sec/Hz, the compact the technology is during the transmission procedure. Additionally, higher efficiency values means that less spectrum need to be purchase to implement the system. Thus, higher spectral efficiency results in cheaper deployment costs. From the graph to the right[ix], you can see that iBurst currently leads the industry in spectral efficiency. The must acclaimed WIMAX technology only provides approximately 2.5 bits/sec/Hz compared to iBurst's 6 bits/sec/Hz. Thus, iBurst can process more data transmission per base station compare to the WIMAX technology.

Figure 8 System Spectral Efficiency



Source: Company data, Arthur D. Little analysis

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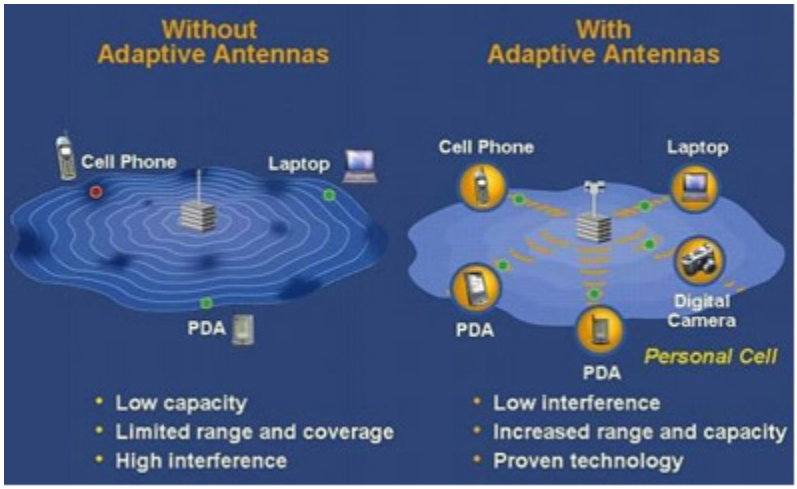
What is the iBurst technology?

As stated earlier, the iBurst technology is based on smart antennas, specifically the IntelliCell technology from ArrayCom. The IntelliCell technology uses advanced algorithms to adjust the signal patterns and radio frequencies of the voice and data transfers over the network. The result is a personal channel for each user for efficient reception of voice or data information. These channels are capable of following the user as they move resulting in a truly "mobile" wireless broadband connection.

Each iBurst base station (i.e. IntelliCell station) can support up to 12 off the shelf antennas. These antennas work in conjunction with the signal processing algorithms to control the radio signals.



User's intended signals are amplified while all other signals are rejected. The processing frees up the spectrum allowing more users to utilize the spectrum. Cheaper costs for infrastructure, spectrum, maintenance and network operations are a result of the spectrum optimization.

The technology also utilizes its processing and antennas to point a signal in the direction of a detected user terminal. This reduces the power consumption and increase the signal quality compared to WiFi systems that emit the signal in all directions. Additionally, this also decreases the chances of lost signals which the first technologies encountered when trying to point a signal in a specific direction (a result of point to an end-user and having something, such as a tree or building, in the line-of-sight).[x]
The technical term for iBurst is High Capacity Spatial Division Multiple Access (HC-SDMA), describing the technology's signal optimization algorithms. The iBurst technology operates at the 1.7GHz, 1.8GHz, 1.9GHz and 2.3GHz bands. The most typical is the 1900 MHz band. The technology also provides a 1Mbps uplink capacity and a 345kbps downlink capacity. Because of the spectrum optimization, the iBurst system only needs at little as 5MHz of bandwidth.

iBurst Transmission Systems

As we already know, iBurst utilizes the IntelliCell technology provided now by Kyocera (it was purchased from ArrayComm). Each iBurst system contains the 12 antennas (see bottom right[xi]), the base station and a power amplifier. The power amplifier, seen at the top right[xi], provides power to the antennas. Additionally, the base station does all the processing, sending and receiving of the data (see base station on the next page[xi]). Wire needs to be routed from the power amplifier to the

antennas in order to provide energy. Similarly, cabling need to be routed from the base station to the antennas. Typically, FSJ40 cabling is used. According to Yamatech, the routing of both the wire and the cable usually costs approximately $25,000 per base station.

Some specifications of the base station are below[xi]:

- TDD Duplex method
- 5 MHz bandwidth
- 8 Carriers
- 3 Spatial Channels
- 33.8dBm/user maximum transmit power
- 2.4kW maximum power consumption

What do iBurst customers need?

Since iBurst is a pure IP, end-to-end system based on base stations and wireless modems or cards, the users need hardware to receive the service. In order for a customer to select the proper hardware, the user must acknowledge what capabilities he/she wishes to acquire from the iBurst service.

The iBurst system supports both fixed portable interfaces and mobile interfaces. The fixed portable interface requires the customer to have an iBurst access bridge or modem (see to the left[xii]). This bridge plugs into the user's desktop, laptop or PDA. When plugged into a fixed or mobile device, the bridge provides a high speed broadband connection as long as the service is active and the bridge is located in the iBurst network coverage area. This device can be easily reconfigured to work for another device by simply powering down the bridge, plugging the bridge into the new target and then powering the bridge system back up again. This allows an easy and quick interface for using one bridge for several devices at different times. These modems cost around $360.

Similarly to WiFi, user's can purchase a laptop card (seen to the right[iii]). The PMCIA card does not need any external power sources. The card can simply be inserted into the users PMCIA card slot and internet access is immediate. The cost for the laptop card usually runs about $320.

Like the WiFi service provider, iBurst customers purchase a plan in terms of how much you data you send and receive on the network. It is a pay-as-you go plan. The table below compares Cable Wired Broadband vs. Cingular's WiFi System vs. Yamatech (Red Ball Internet's) iBurst system.

Monthly Broadband Internet Costs - Wired Comcast vs. Cingular's WiFi vs. Yamatech's Iburst			
Comcast Broadband Cable			
Expenditure	*Details*	*Cost*	*Recharge*
Unlimited	Unlimited page views/mo.	approx. $50/mo.	N/A
Cingular's WiFi Network			
Expenditure	*Details*	*Cost*	Recharge
10Mb limit (2 year contract)/mo. 50Mb limit (2 year contract)/mo. Unlimited	160 page views/mo. 800 page views/mo. Unlimited page views/mo.	$69.98/mo $79.98/mo. $99.98/mo.	$0.005/kb for every kb you exceed your plan a month
Red Ball Internet - Yamatech's WiFi Network			
Expenditure	*Details*	*Cost*	*Recharge*
100Mb limit/mo.	1,600 page views/mo.	$12.95/mo	$12.95 for an additional 100Mb
500Mb limit/mo.	8,000 page views/mo.	$24.95/mo.	$19.96 for an additional 500Mb
1Gb limit/mo.	16,000 page views/mo.	$39.95/mo.	$23.97 for an additional 1Gb
2Gb limit/mo.	32,000 page views/mo.	$54.95/mo.	$21.98 for an additional 2Gb
*Costs were obtained off the companies website or from speaking to a representative, http://redballinternet.ca/step_2_choose_a_service_package.html or http://www.cingular.com/home/			

Now that we have covered user costs, we can delve into the cost for deployment of an iBurst system. I consulted with Mr. Karl Holmqvist, CEO of Yamatech Group, Inc, and Mr. Tsuyoshi Tsuchiya, Manager of International Sales of Kyocera Corp, in order to acquire pricing quotes on deployment costs. An iBurst transmission systems (seen on the left[xiii]) cost approximately $100,000/piece for the base station and amplifiers. The twelve antennas that can be configured with the base station can simply be off the shelf antennas. Thus, these would cost approximately $100/antenna. According to Kyocera, a microwave backbone links costs approximately $50,000/unit. However, Yamatech informed me that this function can be acquired by using the Motorola Canopy radio, which costs significantly less (approximately $15,000/radio). Each network needs an EMS server ($100,000/network), seen at the right[xiv].

Summary

While iBurst out performs WiFi in terms of coverage and mobility, it still may not be feasible to deploy an iBurst system. If one just need a small wireless network without the ability to be truly mobile (or moving and utilizing the service), it would be most economical to deploy a WiFi system. However, if you wanted to cover a large area, IBurst is the solution for you. It covers up to 12 kilometers and is easy to deploy. While it does use very dynamic processing techniques, it is more economical than WIMAX in the case that it has a much better spectral frequency (about twice as much). Thus, more of the spectrum is utilized for data transmission. This means less systems need to be deployed for a given population in comparison to WiMAX systems. Thus, iBurst is an optimal candidate for use in rural communities. To close this report I have provided a

chart reviewing and comparing some of the characteristics of iBurst to those in a WiFi system.[xv]

Review: WiFi vs. iBurst		
Characteristic:	Wi Fi	iBurst
Standard	802.11	802.20
Coverage	25-125 meters	1km-12km
Data Transfer:	Up to 54 Mbps	1Mbps
Frequency:	2.4 GHz, 5GHz	1.7GHz, 1.8GHz, 1.9GHz, 2.3GHz
Transmission:	Radial	Adaptive Array Antenna Technology
Modulation:	OFDM, PSK, CCK	HC-SDMA
Bandwidth:	50MHz	5MHz
Mobility:	Limited to "hot spot" range - connection cannot move with user	Completely mobile - can even provide service to user moving 60km/hr.
Power:	Distributes signal in radial fashion which results in wasted power and money	Distributes signal directly to users by means of "smart antennas" - Reduces power consumption and more cost efficient
Deployment Costs:	Low	High
User Hardware Costs:	Medium	Medium
Service Costs:	Medium	Medium

[i] http://en.wikipedia.org/wiki/Wireless_network
[ii] http://en.wikipedia.org/wiki/Wi-Fi
[iii] http://en.wikipedia.org/wiki/IEEE_802.11
[iv] http://electronics.howstuffworks.com/municipal-wifi1.htm
[v] http://www.bestbuy.com/
[vi] http://www.cingular.com/home/
[vii] http://www.iburst.co.za/default.aspx?link=iburst_overview
[viii] http://www.iburst.com.my/about_iburst_vs.html
[ix] Mobile Broadband Wirless Report, 2004. Arthur D. Little
[x] http://www.iburstdirect.co.za/default.aspx?link=iburst_technology
[xi] http://global.kyocera.com/prdct/telecom/office/iburst/basestation.html
[xii] http://redballinternet.ca/monthly_packages.html
[xiii] http://www.iburst.com.my/about_iburst_tech.html
[xiv] http://global.kyocera.com/prdct/telecom/office/iburst/ems.html
[xv] http://www.tech-faq.com/wi-fi-802.11.shtml