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Comparative Analysis of Wifi and Bluetooth Technologies in Wireless Networking

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Abstract: Bluetooth and Wi-Fi (the brand name for products using IEEE 802.11 standards) have some similar applications: setting up networks, printing, or transferring files. Wi-Fi is intended as a replacement for cabling for general local area network access in work areas. This category of applications is sometimes called wireless local area networks (WLAN). Bluetooth was intended for portable equipment and its applications. The category of applications is outlined as the wireless personal area network (WPAN). Bluetooth is a replacement for cabling in a variety of personally carried applications in any setting and can also support fixed location applications such as smart energy functionality in the home.

I. Introduction

Wireless network refers to any type of computer network that is not connected by cables of any kind. It is a common method by which telecommunications networks and enterprise (business), installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations. Wireless telecommunications networks are generally implemented and administered using a transmission system called radio waves. This implementation takes place at the physical level (layer) of the network structure.

II. Types of wireless connections

Wireless PAN

Wireless Personal Area Networks (WPANs) interconnect devices within a relatively small area that is generally within a person's reach. For example, both Bluetooth radio and invisible Infrared light provides a Wireless PAN for interconnecting a headset to a laptop. ZigBee also supports WPAN applications. Wi-Fi PANs are becoming commonplace (2010) as equipment designers start to integrate Wi-Fi into a variety of consumer electronic devices. Intel "My WiFi" and Windows 7 "virtual Wi-Fi" capabilities have made Wi-Fi PANs simpler and easier to set up and configure.

Wireless LAN

A wireless local area network (WLAN) links two or more devices using a wireless distribution method, providing a connection through an access point to the wider internet. The use of spread-spectrum or OFDM technologies also gives users the mobility to move around within a local coverage area, and still remain connected to the network.

- Wi-Fi: "Wi-Fi" is a term used to describe 802.11 WLANs, although it is technically a declared standard of interoperability between 802.11 devices.
- Fixed Wireless Data: This implements point to point links between computers or networks at two distant locations, often using dedicated microwave or modulated laser light beams over line of sight paths. It is often used in cities to connect networks in two or more buildings without installing a wired link.

Wireless mesh network

A wireless mesh network is a wireless network made up of radio nodes organized in a mesh topology. Each node forwards messages on behalf of the other nodes. Mesh networks can "self heal", automatically re-routing around a node that has lost power.

Wireless MAN

Wireless Metropolitan Area Networks are a type of wireless network that connects several Wireless LANs.

- WiMAX is a type of Wireless MAN and is described by the IEEE 802.16 standard.

Wireless WAN

Wireless wide area networks are wireless networks that typically cover large areas, such as between neighboring towns and cities, or city and suburb. These networks can be used to connect branch offices of business or as a public internet access system. The wireless connections

between access points are usually point to point microwave links using parabolic dishes on the 2.4 GHz band, rather than Omni directional antennas used with smaller networks. A typical system contains base station gateways, access points and wireless bridging relays. Other configurations are mesh systems where each access point acts as a relay also. When combined with renewable energy systems such as photo-voltaic solar panels or wind systems they can be stand alone systems.

Mobile devices networks

With the development of smart phones, cellular telephone networks routinely carry data in addition to telephone conversations:

- Global System for Mobile Communications (GSM): The GSM network is divided into three major systems: the switching system, the base station system, and the operation and support system. The cell phone connects to the base system station which then connects to the operation and support station; it then connects to the switching station where the call is transferred to where it needs to go. GSM is the most common standard and is used for a majority of cell phones.[6]
- Personal Communications Service (PCS): PCS is a radio band that can be used by mobile phones in North America and South Asia. Sprint happened to be the first service to set up a PCS.
- D-AMPS: Digital Advanced Mobile Phone Service, an upgraded version of AMPS, is being phased out due to advancement in technology. The newer GSM networks are replacing the older system.

Uses

Wireless networks continue to develop, usage has grown in 2010. Some examples of usage include Cellular phones which are part of everyday wireless networks, allowing easy personal communications. Another example, Inter-continental network systems, use radio satellites to communicate across the world. Emergency services such as the police utilize wireless networks to communicate effectively as well. Individuals and businesses use wireless networks to send and share data rapidly, whether it be in a small office building or across the world.

III. WI-FI TECHNOLOGY

The Wi-Fi Technology stands for

"Wireless Fidelity"

It is a network without wires. This time it is not wires but the air between them that is being transformed. Over the past seven years, a wireless technology has arrived with the power to totally change the game. It's a way to give the Internet wing without licenses, permission, or even fees. In a world where we've been conditioned to wait for cell phone carriers to bring us the future, this anarchy of the airwaves is as liberating as the first PCs - a street-level uprising with the power to change everything.

It works on the basis of broad band network. A box the size of a paperback, and costing no more than dinner for two, magically distributes broadband Internet to an area the size of a football field. A card no larger than a matchbook receives it. The new technology being used is

"OPEN SPECTRUM".

Open spectrum is a Federal Communications le more unlicensed, radio frequency spectrum that is available for use by all. Proponents of the "commons model" of open spectrum advocate a future where all the spectrum is shared, and in which people use Internet protocols to communicate with each other, and smart devices, which would find the most effective energy level, frequency, and mechanism. Previous government-imposed limits on who can have stations and who can't would be removed, and everyone would be given equal opportunity to use the airwaves for their own radio station, television station, or even broadcast their own website. A notable advocate for Open Spectrum is Lawrence Lessig.

General Features of Wi-Fi

Wi-Fi is cheap, powerful, and, most important, speed it works. A box the size of a paperback magically distributes broadband Internet to an area the size of a football field. A card no larger han a matchbook receives it. The next laptop you buy will probably have Wi-Fi built in. Wires may soon be for power alone.

IV.WI-FI MODELS

- Wi-Fi is known formally as 802.11. There are actually three standards, denoted by letters appended to the numbers:
- 802.11a
- 802.11b
- 802.11g.

The three differ in speed.

- Wi-Fi runs at 11 megabits per second (Mbps). That's the advertised rate, anyway. It can be affected by interior walls, distance from the signal, phases of the moon and so on.

The 802.11b Model

Seeking to invent a speedy way to send data via unlicensed airwaves, engineers working on a standard for wireless local-area networks borrowed from existing technologies - Ethernet's data packets, the Internet's routing protocols, and spread spectrum's use of many channels within a frequency band. The result is information delivered at speeds up to 11 Mbps in the 2.4-GHz band, and at a range of about 300 feet. In 1999, an industry group wisely decided to give it a friendlier name and settled on the retro-chic Wi-Fi, for wireless fidelity

The 802.11a Model

Finalized four years ago, 802.11a works in the 5- to 6-GHz band at speeds of up to 54 Mbps. Products based on the standard were first introduced in late 2001. Its strengths: high speed and lower risk of radio frequency interference than either 802.11b or 802.11g. Its weakness: *a* is incompatible with the more popular *b* and the emerging *g*, because it strayed from the 2.4-GHz band. As a result, some manufacturers have quit building products for it. But as WLANs proliferate, it could prove essential to serving large populations in concentrated area, such as downtowns, universities, and business centers.

The 802.11g Model

The much-anticipated 802.11g has already been revised six times; approval is expected in mid-2003. It promises complete inter-operability with b and transmission rates up to five times faster in the same 2.4-GHz band. Early products are already on the market from Wi-Fi heavyweights such as Apple, Linksys, Netgear, and D-Link. Among the challenges for *g*: higher vulnerability to radio frequency interference from other 2.4-GHz devices, such as late-generation cordless phones.

V. BLUETOOTH

Bluetooth is a proprietary open wireless technology standard for exchanging data over short distances (using short wavelength radio transmissions in the ISM band from 2400-2480 MHz) from fixed and mobile devices, creating personal area networks (PANs) with high levels of security. Created by telecoms vendor Ericsson in 1994, it was originally conceived as a wireless alternative to RS-232 data cables. It can connect several devices, overcoming problems of synchronization.

Bluetooth is managed by the Bluetooth Special Interest Group, which has more than 15,000 member companies in the areas of telecommunication, computing, networking, and consumer electronics. The SIG oversees the development of the specification, manages the qualification program, and protects the trademarks. To be marketed as a Bluetooth device, it must be qualified to standards defined by the SIG. A network of patents is required to implement the technology and is only licensed to those qualifying devices; thus the protocol, whilst open, may be regarded as proprietary.

Implementation

Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centered from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz (allowing for guard bands). This range is in the globally unlicensed Industrial, Scientific and Medical (ISM) 2.4 GHz short-range radio frequency band.

Originally Gaussian frequency-shift keying (GFSK) modulation was the only modulation scheme available; subsequently, since the introduction of Bluetooth 2.0+EDR, π/4-DQPSK and 8DPSK modulation may also be used between compatible devices. Devices functioning with GFSK are said to be operating in basic rate (BR) mode where an instantaneous data rate of 1 Mbit/s is possible. The term Enhanced Data Rate (EDR) is used to describe π/4-DPSK and 8DPSK schemes, each giving 2 and 3 Mbit/s respectively. The combination of

these (BR and EDR) modes in Bluetooth radio technology is classified as a "BR/EDR radio".

Bluetooth is a packet-based protocol with a master-slave structure. One master may communicate with up to 7 slaves in a Piconet; all devices share the master's clock. Packet exchange is based on the basic clock, defined by the master, which ticks at 312.5 µs intervals. Two clock ticks make up a slot of 625 µs; two slots make up a slot pair of 1250 µs. In the simple case of single-slot packets the master transmits in even slots and receives in odd slots; the slave, conversely, receives in even slots and transmits in odd slots. Packets may be 1, 3 or 5 slots long but in all cases the master transmits will begin in even slots and the slave transmits in odd slots.

Bluetooth provides a secure way to connect and exchange information between devices such as faxes, mobile phones, telephones, laptops, personal computers, printers, Global Positioning System (GPS) receivers, digital cameras, and video game consoles.

BLUETOOTH APPLICATIONS

- Wireless control of and communication between a mobile phone and a hand free headset. This was one of the earliest applications to become popular.
- Wireless Bluetooth headset and Intercom.
- Wireless networking between PCs in a confined space and where little bandwidth is required.
- Wireless communication with PC input and output devices, the most common being the mouse, keyboard and printer.
- Transfer of files, contact details, calendar appointments, and reminders between devices with OBEX.
- Replacement of previous wired RS-232 serial communications in test equipment, GPS receivers, medical equipment, bar code scanners, and traffic control devices.

VI. CONCLUSION

Bluetooth and Wi-Fi (the brand name for products using IEEE 802.11 standards) have some similar applications: setting up networks, printing, or transferring files. Wi-Fi is intended as a replacement for cabling for general local area network access in work areas. This category of applications is sometimes called wireless local area networks (WLAN). Bluetooth was intended for portable equipment and its applications. The category of applications is outlined as the wireless personal area network (WPAN). Bluetooth is a replacement for cabling in a variety of personally carried applications in any setting and can also support fixed location applications such as smart energy functionality in the home (thermostats, etc.).

Wi-Fi is a wireless version of a common wired Ethernet network, and requires configuration to set up shared resources, transmit files, and to set up audio links (for example, headsets and hands-free devices). Wi-Fi uses the same radio frequencies as Bluetooth, but with higher power, resulting in higher bit rates and better range from the base station. The nearest equivalents in Bluetooth are the DUN profile, which allows devices to act as modem interfaces, and the PAN profile, which allows for ad-hoc networking.

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