

Survey of Wireless Technologies

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Introduction

This survey provides an overview of the most important wireless technologies available today. It describes what services they provide and what categories they belong to. A common way to categorize network technologies is by Wide Area Networks (WAN), Metropolitan Area Networks (MAN), Local Area Networks (LAN), Personal Area Networks (PAN) and Body Area Networks (BAN). WANs are typically very large networks spanning multiple countries, continents and sometimes the entire globe while BANs are small and operates within the range of the human body.

1 Wide Area Network

Nordic Mobile Telephone (NMT) is a first generation, terrestrial, cellular, mobile communication technology used primarily in Norway, Sweden, Denmark and Finland. NMT operates at the 450 MHz (NMT-450) and 900 MHz (NMT-900) frequency bands. NMT-900 was introduced at a later stage in order to support a larger amount of communication channels. The advantage of NMT over GSM is that it can cover a larger area which makes it suitable for less densely populated countries.

Global System for Mobile communications (GSM) is a second generation, terrestrial, cellular, mobile communication standard. In most of the world it operates in the 900 MHz and 1800 MHz frequency bands, except in the United States, Canada and some other countries in America where it operates at 850 MHz and 1900 MHz. Even with the introduction of third generation mobile standards GSM is still one of the most widely used services around the world. GSM offers a Short Message Service (SMS) and data transfer by the General Packet Radio Service (GPRS) in addition to conventional voice communication.

Universal Mobile Telecommunications System (UMTS) is a third generation, terrestrial, cellular, mobile communication standard. It offers better quality communication and faster data transfer rates than the third generation GSM technology.

Iridium is a Low Earth Orbit (LEO), satellite based, mobile technology for voice communication. The 66 Iridium satellites employs inter-satellite linking in order to maximize coverage even in areas where no terrestrial gateway stations

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can be located. The Iridium satellite constellation enables communication by Iridium satellite phones across the entire world, including the north and the south pole.

Globalstar is a LEO, satellite based, mobile technology similar to that of Iridium. The main difference is that it does not use inter-satellite linking like Iridium. This makes the coverage area of Globalstar more limited because it requires that a terrestrial gateway station is in view for a satellite to operate. Remote locations, like the north and south pole, has no terrestrial gateway stations which means that Globalstar's services are not available in those areas.

Global Positioning System (GPS) is a Medium Earth Orbit (MEO), satellite based, navigation technology. It is used by both civilians and in military operation. GPS relies on a constellation of at least 24 satellites to provide location, speed and direction information to its users. It works by using something similar to triangulation combined with atomic clocks in the satellites in order to accurately determine the correct location.

There are also special wireless technologies designed for weather balloons and military Unmanned Aerial Vehicles (UAV). They concentrate mostly on information gathering and navigation control in the case of UAVs. The Tactical Control System (TCS) has been designed in an effort to standardize the protocols, interfaces and formats for communication with UAVs.

2 Metropolitan Area Network

A Metropolitan Area Network (MAN) is a network which covers the approximate area of a city. Worldwide Interoperability for Microwave Access (WiMAX) is an ad hoc, mesh network based on the IEEE 802.16 standard [1]. It is intended to be used as wireless MAN to provide broadband access for up to 50 kilometers from the base station. There is also a standard for mobile base stations which aims to serve users 5 to 15 kilometers away. This provides a much better range than the more commonly used WLAN/WiFi technology which is mostly limited to less than 100 meters. However WiMAX base stations are currently much larger and more expensive than its WiFi counterpart.

3 Local Area Network

Wireless LAN (WLAN, but also known as WiFi) is a low tier, ad hoc, terrestrial, network technology for data communication. The WLAN standards operate on the 2.4 GHz and 5.8 GHz ISM frequency bands. It is specified by the IEEE 802.11 standard [2] and it comes in many different variations like IEEE 802.11a/b/g/n. The application of WLAN has been most visible in the consumer market where most portable computers support at least one of the variations.

4 Personal Area Network

Digital Enhanced Cordless Telecommunications (DECT) is a low tier, terrestrial standard for portable digital phones. It operates at around 1.9 GHz which is

outside the ISM frequency band. It is widely used in Europe and certain other countries.

Bluetooth is a low tier, ad hoc, terrestrial, wireless standard for short range communication. The IEEE 802.15.1 standard [3] contains the Bluetooth specification. It is designed for small and low cost devices with low power consumption. The technology operates with three different classes of devices: Class 1, class 2 and class 3 where the range is about 100 meters, 10 meters and 1 meter respectively. Wireless LAN operates in the same 2.4 GHz frequency band as Bluetooth, but the two technologies use two different signaling methods which should prevent interference.

ZigBee is a low tier, ad hoc, terrestrial, wireless standard in some ways similar to Bluetooth. The IEEE has specified ZigBee in the IEEE 802.15.4 standard [4]. It operates in the 68 MHz, 915 MHz and 2.4 GHz Industrial, Science and Medical (ISM) bands. Wibree is a competitor to ZigBee which aims for devices to become smaller and even more energy efficient.

5 Body Area Network

Wireless Body Area Networks (BAN) is a relatively new concept that is based on sensor networks. The German Fraunhofer-Institut[5] has studied how BAN can be applied to medical care for several years.

The main idea is that each person carries a network of sensors integrated in their clothing or attached to their body. Each Body Sensor Unit (BSU) communicates with a Body Central Unit (BCU) which in turn can communicate the information to medical personnel by for instance GSM, DECT, Bluetooth or UMTS. This will make it possible to monitor the physical state of a person in real-time without having to connect a series of wires which prevents mobility. The goal is to make the BSUs and BCUs as small as possible so that they can be integrated into a user's clothing or attached directly to the body by plaster.

References

- [1] IEEE Standard 802.16-2004, Air Interface for Fixed Broadband Wireless Access Systems, 2004.
- [2] IEEE Standard 802.11-1999, Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications, 1999.
- [3] IEEE Standard 802.15.1-2005, Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Wireless Personal Area Networks (WPANs), 2005.
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