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Interference Avoiding for Mobile Ad Hoc Networks

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Abstract:

The Recent research trends in MANETS is due to its characteristics like independent of infrastructure, dynamic topology behavior, limited energy source, multihop routing, mobility of nodes. All the above characteristics require challenges regarding Performance, Reliability, and Securities. In this paper we propose a Performance Analysis and compare various WLAN standards used for MANETSs and we check their co-existence nature with zero interference occurrence.

Keywords: *Mobile Ad Hoc Network (MANTEs), Complimentary Code Keying (CCK), Binary Phase Shift Keying (BPSK), Multiple- Input/Multiple-Output (MIMO), Offset Quadrature phase-shift keying (O-QPSK).*

1. Introduction

Bluetooth is wireless LAN technology design to connect devices of different functions such as telephones, notebooks, computers (desktop and laptop), cameras, printers, coffee makers, and so on. Bluetooth was originally started as a project by the Ericsson Company and later formalized by the Bluetooth Special Interest Group (SIG), includes Sony Ericssion, IBM, Intel, Toshiba and Nokia. In an ad hoc environment (infrastructure less) all Bluetooth (IEEE 802.15 PAN) devices (also called gadgets), find the existence of each other and finally make a network called piconet. We could also connect Bluetooth LAN to the internet by the means of gadgets capability. A Bluetooth network can‘t be large; if it is then there is chaos. Bluetooth use to communicate devices like PDA and peripherals. Bluetooth technology has several applications. With Bluetooth we could use wireless mouse and keyboard, monitoring devices with sensor devices, home security devices.

1.1 Characteristics& Architecture

A Bluetooth device has a built-in short range radio transmitter. The data rate of Bluetooth device is 1 Mbps with a 2.4-GHZ bandwidth. By this figure it might be possible it could interfere with IEEE.11b wireless LAN. Bluetooth follows two types of networks: piconet and scatternet. Where Piconet: A small network and can have up to eight nodes, among them one of which is called master; the rest are called slaves. In order to communicate between master and slave, they can be one-to-one or one-to-many. The maximum numbers of slaves in a piconet can have seven. Scatternet: Two or more piconet combined together to form a scatternet. A slave node in one piconet can be the master in another piconet. This node can receive messages from both the piconets and act as master/slave at the same time and they can communicate by mans of multi hopping

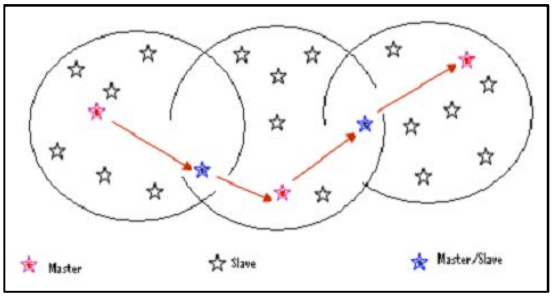

Figure 1: Master/slave Configuration for Piconet/Scatternet Bluetooth Characteristics.

The radio layer is somewhat similar to the physical layer of the Internet model. Bluetooth devices are low power and have range of 10 m. It uses a 2.4 GHz ISM band which are further divided into 79 channels of 1 MHz each. In order to avoid the interference from other devices and other network it uses frequency hopping spread spectrum method and it hops 1600 tps. The baseband layer works as the MAC layer in LANs. In order to access the given layer it uses the TDMA. All the master and slave communicate using time slot (625 μs).

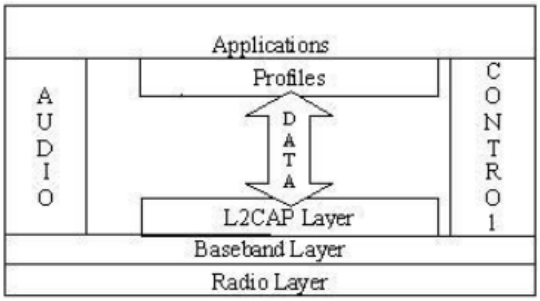

Figure 2: Architecture

In the case of master and slave configuration Bluetooth can create two types of physical links: SCO (synchronous connection-oriented) is used when first preference goes to avoid latency rather than error free delivery (integrity). ACL (asynchronous connectionless link) in the reverse case of SCO means when first preference goes to error free delivery (integrity).The logical Link Control and Adaptation Protocol (L2CAP) is similar to LLC sub-layer in LANs. ACL physical link follows the said protocol; SCO doesn‘t follow it. L2CAP has data packet and format as:

2bytes	2bytes	0 to 65,535bytes
Length	Channel id	Data and Control

Figure 3: Data packet

Finally we could see that how Bluetooth technology works and can be best suited for ad hoc network.[2,3]

2.Wireless Fedility Ieee 802.11 (Wi-Fi)

Wireless Fidelity (Wi-Fi) standard given by the Wi-Fi Alliance to the IEEE 802.11 can also use by its extensions like 80.11a, 802.11b and 802.11b. There are several more extensions are going to be introduced by Wi-Fi (802.11) i.e. 802.11e, 802.11i, 802.11p and 802.11n. Wi-Fi is the transmission of radio signals. In order to define data transmission and manages location independent network access using radio signals

on the bases of that we can call it as a packet protocol. The structure of physical/link layer interface of Wi-Fi is similar to Ethernet.

The layers above the physical and data link layers include TCP/IP. By the above introduction we can clearly see all programs and applications for TCP/IP that can run on an Ethernet can also be run on Wi-Fi interface.[2,3,8,7].

2.1 Architecture

All extensions of 802.11 like (a, b, g, etc) follows five layers TCP model and data link layer is divided into two sub-layers: Media Access Control (MAC): Logical Link Control (LLC).Five layer TCP Model.

TCP/IP	IEEE
Application Layer	Application Layer
Transport Layer	Transport Layer
Network Layer	Network Layer
Data link Layer	LLC
	MAC
Physical Layer	Physical Layer

Figure4: Architecture

The two lower layers are specified by IEEE 802 networks:802.2 LLC, 802.3 PHY and MAC, Ethernet, 802.11 PHY and MAC, Wi-Fi. The primary task of physical layer is to perform encoding scheme, modulation and deals with the transmission of radio signals in actual through space. As we know that physical layer implementation work in particular specific bands means some specific frequency allocated for some specific applications.

Medium Access Control (MAC) layer is sub-layer of Data link Layer (DDL). The primary task of said layer is to control the transmission and sometimes it can be used to provide services like mobility management. The format of MAC address of Wi-Fi is similar to the MAC address of Ethernet (802.3) i.e. 6 octets. It uses the CSMA/CA (means to prevent collision before they happen) is similar to the mechanism used in Ethernet (802.3) i.e. CSMA/CD. Both act as a peer-to-peer protocol.

IEEE 802.11 defines lots of services but in this paper we only discuss the two main services i.e. Station services (SS): The services defined by: Authentication, De-authentication and privacy etc. and Distributed System Services (DSS): The services

defined by: Association, Re-association, Disassociation, Distribution and Integration.[3,8].

Fig 4 Shows IEEE 802.11 standard can be best suited for ad hoc network. In order to explore Wi-Fi we have some more extensions that are going to be implemented in the field of communication like: 802.11e – It follows quality of services, such as Streaming multimedia or VOIP. 802.11i – It is used for high security implementations. 802.11p – It is used to support exchange of data between high speed vehicles.

3. Zigbee Ieee 802.15.4

Wi-Fi Characteristics	**IEEE 802.11 Protocols**			
	802.11a	802.11b	802.11g	802.11n*
Operating frequency	5.3 GHz and 5.8 GHz	2.4GHz	2.4GHz	2.4 GHz or 5GHz
Average signal Range	-30 to 35 m	-30 to 35 m	-30 to 35 m	-60 to 70m
Available bandwidth per channel	-20 to 22 MHz	-20 to 22 MHz	-20 to 22 MHz	20 or 40 MHz
Data Rate(Min-Max)	6,9,12,18, 24,36,48.54 Mbps 6,12 and 24Mbps are mandatory	1,2,5,5,11 Mbps	1,2,5,5,116,9,12,18,24 ,33,36,48.54 Mbps1,2,5,5,11 6,12 and 24Mbps are mandatory	1,2,5,5,6.9,11 ,12,18,24,36,48,54,121, 5,30,144,44,270,300M bps
Typical Throughput for Max Data Rate	18 to22 Mbps	6 Mbps	18 to22 Mbps	74 Mbps
Modulation	OFDM	CCK or DSSS	OFDM	OFDM using MOMO and CB
Channels	36,40,44,4 8,52,56,60 ,64,149,15 3,157,161	1-11	1-11	3 non overlapping 2.4 GHz 12 non overlapping UNII channels in 5GHz
Special Considerations	HF signals have more trouble with physical obstructio n	2.4 GHz subject to interference: Bluetooth products, cordless phones	2.4 GHz subject to interference: Bluetooth products, cordless phones	

ZigBee technology (similar to Bluetooth) provides low data rate and low power connectivity for gadgetsthat follows low battery life as long as several months to several years. ZigBee has low cost and built to perform wireless networking protocol targeted towards automation and remote control application. In the started couple of work has been done for low data rate standards but later on the ZigBee Alliance and the IEEE decided to join forces and ZigBee is the final name for the given technology.[3,4,5] The main features of ZigBee are developed for application with relaxed throughput

requirements which cannot handle the power consumption of heavy protocol stack, very low power consumption, low data rate in an ad hoc self-organizing network among inexpensive fixed, low cost network flexibility moving and portable devices.

3.1 Characteristics

ZigBee also be implemented in highly meshed network but the same we can‘t pursue with Bluetooth. For a given application depending on the given radio frequency environment and power output consumption, so ZigBeecould able to access wireless devices expected to transmit at 10-75 meters. It can operate in unlicensed radio frequency worldwide like 2.4 GHz global, 915 MHz Americas or 868 MHz Europe along with data rate 250 kbps at 2.4GHz, 40 kbps at 915 MHz and 20 kbps at 868 MHz.

3.2 Architectural Specification

On the specification of PHY and MAC, we can able to access it on different types of networks like as star, meshand cluster tree. Communication redundancy elimination is a unique feature of Zigbee network layer. PHY layer works on order to include energy and link quality detection, add clear channel assessment for improved coexistence with other wireless networks.

PHY MHz	**Frequency MHz**	**spreading**		**Data parameter**		
		Clip rate kbps	modulation	Bit rare kbps	Symbol ratekbps	symbol
868/915	868-868.6	300	BPSK	20	20	Binary
	902-928	600	BPSK	40	40	Binary
2450	2400-2483.5	200	O-QPSK	250	62.5	Orthogonal

Figure 6:Information regarding frequency bands and data rates.

Power required in	**Bluetooth**	**Wi-Fi**
Transmit(ma)	50-100	340-450
Receive(ma)	50-80	250-310
Idle(ma)	1.5-2	10-32

Figure 7: Typical Bluetooth and Wi-Fi power requirement

After all to ensure power conservation, and low latency through guaranteed time slots routing schemes are designed.[4,5]

4.IEEE 802.16 WI-MAX

Wi-Max acronym stands for worldwide interoperability for microwave access. As we know in the modern era of broadband wireless access, Wi-Max (IEEE 802.16) is an outstanding, well suitable, useful connection oriented protocol to which access fixed and mobile with low cost, high reliability, very high data rate and better efficiency. Wi-Max standard defines the formal speciation for deployment of broadband wireless metropolitan area networks (wireless MANs) and with the help of Wi-MAX (802.16) we can access broadband anytime, on virtually any device and anywhere.

Wireless parameter	**Bluetooth**	**Wi-Fi**	**Zig Bee**
Frequency	2.4 GHz	2.4 GHz	2.4 GHz
MAC Layer	IEEE 802.15	IEEE 802.11	IEEE 802.15.4
Stack size	250 KB	1 MB 32 KB	32 KB,4KB
Minimum Quiet	15 MHz	22 MHz	3MHz
Bandwidth required	Dynamic	Static	static
No. of channels	19	13	16

Wireless parameter	**Bluetooth**	**Wi-Fi**	**Zig Bee**
Raw Data rate	1 Mbps	11 Mbps	250 Kbps
Range	9m	75 to 90m	Indoors: up to 30m Outdoors: up to100m
Current consumption	60mA	400 mA	25-35mA
N/W join time	>3sec	1 sec	30 ms
Interference avoidance method	FHSS	DSSS	DSSS

Figure 8: Comparison Table [3, 4, 6, 8, 9]

4.1 Features of IEEE 802.16

In particular communication when there are several obstacles like trees and building Then that type of communication is calledline-of-sight (LOS) communication. Straight line communication is called non line-of-sight (NLOS) like communication in the house etc.

4.2 Wi-MAX (802.16) Architecture

Wi-Max (802.16) follows the unidirectional flow of packet known as service flow and have some set of QoS.

These kind of service flow is identified as a 32-bit service flow identifier. Wi-Max (802.16) is a connection oriented protocol and its connection identified by a 16-bit connection identifier (CID). Wi-Max (802.16) Physical Layer: IEEE 802.16 in 2001, microwave frequencies (10-66 Ghz), high data rate, LOS and PTP mode and fixed subscriber stations only. IEEE 802.16-2004- in 2004, frequencies (2-11 GHz) and (10-66 GHz bands), medium data rates, PTP, LOS, NLOS and PMP modes, fixed subscriber stations only. IEEE 802.16-2005- in 2005, low to medium data rates, PTP and PMP modes, both fixed and mobile subscriber stations [8].

Characteristics	WiMax	Wi-Fi
AIRWAVE	Licensed and license-exempt 128-bit Triple-DES and 1024-bit RSA security	License-exempt only WPA+WEP security, inadequate though 802.11i will improve
COVERAGE	Optimised for outdoor non-line of sight mesh networks, advanced smart antenna	Optimised for indoor, No mesh, Smart antenna
RANGE	50km Point to multipoint, ,Tolerant of greater multipath delay spread up to 10ms, PHY and MAC designed for multimile range Standard MAC	100 meters Point to point, PHY and MAC optimised for 100m range, Range can be extended but then MAC non standard
QoS	Grant request MAC Designed to support voice and video from the start Supports differentiated service levels e.g, TDD/FDD/HFDD -symmetric or asymmetric, Centrally enforced QoS	Contention-based MAC, no guaranteed QoS Standard cannot guarantee latency for voice or video, TDD only-asymmetric Proposed 802.11e QoS standard is prioritisation only
SPECTRAL EFFICIENCY	Bandwidth 10, 20MHz; 1.75, 3.5, 7, 14Hz; 3, 6MHz, Maximum data rate 70Mbps Maximum 5.0 bps/Hz	Bandwidth 20MHz, Maximum data rate 54Mbps, Maximum 2.7 bps/Hz
SCALABILITY	Sectorization, Scalable independent of bandwidth with 1.5MHz to 20MHz width channels MAC supports thousands of users	MAC supports tens of users

Figure: 9Physical and MAC layer

Service Specific convergence sub-layer (CS): converts higher layer packets into MAC level Service data Units (SDUs), interfaces with higher layers and finally maps higher-level transmission parameters to MAC level service flow and connection parameters. MAC Common Part sub-layer (MAC CPS): follows retransmissions, QoS, link initialization, transmission scheduling, error control, fragmentation, control channel access and link initialization. Security Sub-layer: it uses X.509 standard for certificate-based dentification of nodes, encryption, key management, key distribution and authentication. [7]

Next on the agenda are:

• 802.16c/d, published in Jan 2003, c‘ protocol relates to protocols, test suite structures and test purposes while d‘ fixes errata and protocols not covered in c‘, and creates the system profiles.

• 802.16e, which adds mobility to the standard and really throws down the gauntlet to cellular

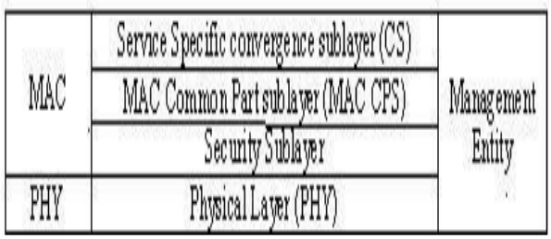

Figure 10: Wi-Max and Wi-Fi comparison table

5. IEEE 802.20 (MOBILE-FI)

Mobile-Fi (IEEE 802.20) is the youngest IEEE standard. In order to access fully mobile broadband, it is the first standard designed to carry native IP traffic with licensed airwave below 3.5 GHz and provides symmetrical wireless rates over long distance (~15km). Mobile-Fi, enables world wide deployment of affordable, ubiquitous, always-on and interoperable mobile broadband wireless access networks that meet the needs of business and residential market‖ this the first theme behind IEEE 802.20 uses packet based air interference optimized for transport of IP services.

6. Conclusion

Computer networks specially Mobile Ad hoc Network is the emerging field and most popular for Research, Applications and Services. Different WLANs standards exhibit various characteristic. In this paper we have analyzed different WLANs IEEE standards like Bluetooth, Wi-Fi, Wi-Max, ZigBee and Mobile-Fi and check their usability in ad hoc network with their characteristics, merits and demerits of each. On the bases of said characteristics of each, we could choose particular technology depends upon our network. We conclude all of the above said technologies are complimentary to each other rather than competing. We can also say that with some prerequisite arrangements the above said technologies can perform well in interference free co-existence environment.

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