Survey: Wireless and Mobile Ad Hoc Network Routing and Satellite Communication Challenges

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ABSTRACT

Wireless and mobile communication increase from time to time due to the advancement of technology and the invention of the mobile device as well as the interest of the people shift from fixed communication to mobile because they need to access data service using their mobile device at anywhere and anytime for audiovisual and multimedia service. As technology becomes advanced the interest of the human being increase and they want to make easy their life by using of their devices like location-based service, personal environment service and mobile cloud computing. In wireless and mobile communication, there are challenges and open research areas like routing in mobile ad hoc network, satellite communication, and cellular network.

Key words: Coded Division Multiple Access (CDMA), Frequency Division Multiple Access (FDMA).

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1. INTRODUCTION

Wireless and mobile communications become more acceptable and usable than fixed personal computer networks, which is rapidly growing in the world. The invention of movable device (like smart phone, laptop and PAD) makes the life of person easy. Because they can moves from one place to another place with their hand held device and they can access connection at anywhere.

The first generation of wireless and mobile communication was based on analog (frequency) which use Frequency Division Multiple Access (FDMA) for only voice transmission. The first generation was relatively large in size when compared with second generation (2G) device. Due to the size of integrated circuit (IC) reduce the size of the device also reduce. 2G support voice and Short Message Service (SMS) up to 160 characters. It introduces three Popular Time Division Multiple Access (TDMA) and one Coded Division Multiple Access (CDMA). 1) Global System for Mobile Communication (GSM) previous known as Group Special Mobile uses African and European countries. 2) Interim Standard 136 (IS-136) uses in North America. 3) Pacific Digital Cellular (PDC) use in Asia countries. And Interim Standard 95 (IS-95) it is based on coded division multiple accesses (CDMA) uses in USA. The researcher search about the audiovisual and multimedia service on the wireless and mobile communication which leads to 3G (third generation) to access the internet using browser for video calling and film or music downloading target by using mobile device that is based on Wideband CDMA (W-CDMA) technology for UMTS (Universal Mobile Telecommunication System), The speed of data transmission on a 3G network ranges between 384Kbps to 2Mbps. This means a 3G network actually allows for more data transmission and therefore the network enables voice and video calling, file transmission, internet surfing, online TV, view high definition videos, play games and much more. 3G is the best option for users who need to always stay connected to Internet than 2G. To improve the data service speed and bandwidth transmission capacity peak of data rate in the mobile device access of the internet up to 10-20Mbps to addressing the audiovisual and multimedia over the wireless and mobile communication 4G (Fourth Generation) was introduced based on OFDM (Orthogonal Frequency Division Multiplexing) both LTE (Long Term Evaluation) and WiMax (Worldwide Interoperability for Microwave Access) use OFDMA With the addition of multiple antennas, MIMO (Multiple Input Multiple Output) and it becomes possible to increase peak bit rates to the range of 100 Mb/s in order to deliver very high data rates and spectral efficiency, as well as enhanced link reliability, coverage, and energy efficiency.

Based on the distance coverage of radio frequency which can be categorized in to two namely radio technology for local area net-work and wide area network (e.g. 2G, 3G, 4G, 802.11a/g/n/b/ac/ad) and radio technology for short range communication (e.g. . Blue-tooth, UWB (ultra wide band) and Zigbee (TV connected with home device)). Using of the IEEE 802.15.3 wireless personal area network (WPAN), IEEE 802.11n wireless local area net-work (WLAN), and the IEEE 802.15.6 wireless body area network (WBAN) standards to make ambient awareness to the personal environment service [13] to optimize life space of user by ambient intelligence.

Now a day a lot of research deals and future of next generation wireless and mobile communication about 5G (Fifth Generation) which is under development give their idea and architecture about it. It could be focused on higher system spectral efficiency, data rates, network capacity, scalability and reliability of communications, as well as lower battery consumption and cost. Radio frequency spectrum unallocated is limited in bandwidth which is not meet the requirement bandwidth of 5G [1], other wireless communication alternative to radio frequency introduced VLC (Visible Light Communication) based on light source which use OFDM is the most popular multicarrier technology that can be applied to indoor VLC for high data rate with LED (Light Emitted Diode) for VLC-based fixed communication but it is difficult to apply this in wireless communication because light source of VLC is highly directional and has narrow beam width, it is extremely difficult to maintain these VLC requirements in mobile scenarios and give pro-posed solution to this idea. The 5G will have to support: less latency and reliable, data rate will support up to multiple gigabyte per second, and Network scalability and flexibility [2] the vision of Mobile and Wireless Communications Enablers for the Twenty-Twenty Information Society (METIS) which is consortium comprises 29 partners spanning telecommunication manufacturers, network operators, the automotive industry, and academia. Among these are five major global telecommunications manufacturers, five global operators, and 13 academic partners, they deals about the 5G scenarios and requirements as well as the methodology used for investigating them. Ubiquitous network in the next generation [11] will integrated with current network user based selection use the third parties as service level agreement pro-vide to different service provider with heterogeneous wireless network to fulfill roaming between them. As advance of wireless and mobile communication technology and device more the user can carry his/her data on pocket which means user can easy access the data on cloud using mobile device [12] in the next generation cellular network. The next generation communication system will be high data rate and communicate all electronic device even the from the plan flay see figure 1.This document consist fires introduction, the second section Types of attack in wireless and mobile communication (WMC), the third section Security issue in WMC, the fourth section challenges in WMC, the sixth section compare wireless and wired network and conclusion.

1.1 Satellite Communication

Basically Satellite categorized in to two based on its creativity, namely artificial (manmade) and natural satellite. Natural satellite such as moon, artificial (manmade) satellite is a ma-chine that launched on the space in order to communicate, weather forecasting, for radio and television transmission, for identification of location (navigation), map, mobile communication, space research etc. In 1945 Clarke introduced [3] the use of manmade satellite about the space of orbit to the television program, this idea now a day globally used for many satellite applications. Satellite can be classified in to three based on orbit, thus are GEO (Geosynchronous Earth orbit), MEO (Medium Earth Orbit) and LEO (Low Earth Orbit). The usage of satellite is basically ubiquitous coverage and instant infrastructure. Different Satellite Communications Systems are used for different purposed such as Experimental, International, Regional, Domestic, Military, Navigational and Radio Determination, Personal Communications System and Broadband Satellite System. GEO satellites are synchronous with respect to earth. Looking from a fixed point from Earth, these satellites appear to be stationary. These satellites are placed in the space in such a way that only three satellites are sufficient to provide connection throughout the surface of the Earth (that is; their footprint is covering almost 1/3rd of the Earth). The orbit of these satellites is circular.

There are three conditions which lead to geostationary satellites. Lifetime expectancy of these satellites is 15 years.

1) The satellite should be placed 35,786 Kms (approximated to 36,000 Kms) above the surface of the earth.
2) These satellites must travel in the rotational speed of earth, and in the direction of motion of earth, that is eastward.
3) The inclination of satellite with respect to earth must be 00.

These satellites are used for TV and radio broadcast, weather forecast and also, these satellites are operating as backbones for the telephone networks.

LEOs satellites are placed 500-1500 Kms above the surface of the earth. As LEOs circulate on a lower orbit, hence the exhibit a much shorter period that is 90 to 120 minutes. LEO systems try to ensure a high elevation for every spot on earth to provide a high

quality communication link. Each LEO satellite will only be visible from the earth for around ten minutes. These satellites are mainly used in remote sensing and providing mobile communication services (due to lower latency).

MEOs can be positioned somewhere between LEOs and GEOs, both in terms of their or-bit and due to their advantages and disadvantages. Using orbits around 10,000 km, the system only requires a dozen satellites which is more than a GEO system, but much less than a LEO system. These satellites move more slowly relative to the earth's rotation allowing a simpler system design (satellite periods are about six hours). Depending on the inclination, a MEO can cover larger populations, so requiring fewer handovers, most of the time which is used for weather forecasting and global position system (GPS).

In this orbit the upper Van Allen belts (15,000- 20,000 Km) and lower Van Allen belts (2000- 5000 Km) are available, this layers of highly charged particles trapped by the earth's magnetic field. Any satellite flying within them would be destroyed fairly quickly by the highly-energetic charged particles trapped there by the earth's magnetic field. In this layer we cannot place any satellite. Satellite communication is used to help the wireless and mobile communication which is difficult to install optical and base station like in sea, desert etc. for addressing ubiquitous communication in the world using of wireless and mobile communication.

1.2   Mobile Ad hoc Network

Wireless network can be divided in to two, namely lack of infrastructure wireless network (self-organized like ad hoc network) and infrastructure wireless network (like access point, 3G and 4G).Mobile Ad hoc Networks (MANET) are a kind of wireless network where all de-vices have equal status on a network and free to associate with any other in ad hoc network device in the link range. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently this action leads problem with MANET like security and mobility of the node from one place to other place maintain of the routing table. In order to reduce the gap of infrastructure less network with infrastructure network like security and routing mechanism in wireless network, many routing protocol have been developed under proactive, reactive and hybrid protocols. Proactive proto-col store all information on the routing table for communication with other node as well as it need additional hardware and software, its routing table periodically updated. The disadvantage of this routing table is not suitable for large network topology because if the network is large every node have to periodically update the routing table and store all information of all node available in the network so it consumed and need more bandwidth as well as memory space. Reactive protocol is on demand routing protocol that mean the routing table only has the information of a node which is request to communicate but no need of maintained all information about the whole node in the topology in routing table. Disadvantage of this protocol is need more time to finding the route which is leads to obstacle of the network. Hybrid protocol is the combination of proactive and reactive protocol. The routing protocol is used to find the best path in the given network based on their metric used. Most of the time to find the optimal path is count of next hop. In [4] developing of secure mechanism of dynamic MANET on demand (DYMO) which is reactive routing protocol the successor of ad hoc on-demand distance vector (AODV) routing with ECC (Elliptic Curve Cryptography) which is used to authenticate and share and generate secrete key based on public key algorithm.

2.TYPES OF ATTACK IN WIRELESS AND MOBILE COMMUNICATION (WMC)

Based on the location of the attacker that can be classified in to two namely internal attacks and external attack and also based on the action of the attacker it can be classified in to two namely active attack and passive attack. In [5] known attacks in wireless and mobile communication is data integrity and confidentiality related at-tack which is attempts to compromise the integrity and confidentiality of data contained in the transmitted packets (E.g. denial of service on sensing (DoSS) attack, node capture attack, and eavesdropping attack.), power consumption related attack which attempts to exhaust the devices power supply, which is one of the most valuable assets in wireless networks (E.g. denial of sleep attack.), service available and bandwidth consumption related attacks it is like power consumption related attack but its main aim is to the node forward available bandwidth consumption (E.g. flooding attack, jamming attack, replay attack, selective for-warding attack.), routing related attack which is attempt to change routing information, and to manipulate and benefit from such a change in various ways like unauthorized routing up-date attack and wormhole attack, identity related attack which is cooperate with eavesdrop-ping attacks or other network-sniffing software to obtain vulnerable MAC and network ad-dresses. They target the authentication entity such as impersonal attack and Sybil attack, and privacy related attacks which is uncovers the anonymity and privacy of communications and, in the worst case, can cause false accusations of an innocent victim like traffic analysis attack. MANET is Vulnerable to the attack due to the nature of the node mobility in self-organized network with lack of centralized infrastructure also each node considers themselves as router for forwarding of packet of data to the other node. There are numbers of attack affected the MANET [6] these attack can be categorized in to two Types namely internal attack and external attack based on the location of the attacker. Others MANET attack can be categorized in to passive and active attacking based on the way of behaviors attacking in MANET [7].

2.1 Security Issue In Wmc

Several security-related protocols for wireless mobile communication systems have been pro-posed based on the symmetric key cryptosystem or the public key cryptosystem In order to encrypt and decrypt the message between the desired parties which is the sender and the receiver. Symmetric algorithm which is used the same secret key between the parties, faster than asymmetric algorithm; the key length is short when compared with asymmetric algorithm but asymmetric algorithm has two key one for encrypt which are public key and the second used to decrypt the message which is privet key.

Mobile networks have two major classes namely the mobile stations (MSs) and the net-work. The network itself consists of three major components base stations (BSs), base station controllers (BSCs), and mobile switching centers (MSCs). The MS can access the mobile network via a base station, one or more of which are monitored and controlled by a BSC. An interface of a mobile network with other mobile or fixed networks is managed by a mobile switching center. Privacy of conversation between two MSs is not guaranteed since the encrypted message is always decrypted by the network before forwarding it to another mobile user. Dou to the use of radio frequency and the mobility nature of the node which is leads to security related problem. To address this kind of problems researcher uses different encryption mechanism, in [8] deals secure mechanism to the node before sender and receiver start to conversation.

3. CHALLENGES IN WMC

3.1 Satellite Communication

1) Orbits and Solar Power the Satellite Position: The satellite is eclipsed by the Earth once per day in the period around the vernal and autumnal equinoxes when the Sun is above the equator. The Incident Solar Energy: The rest the year the Sun is above or below the Earth's orbital plane and the satellite receives uninterrupted sunlight.

2) Satellite size and weight the available on board power is limited, as is the power output of the transmitter. The sizes of the antennas are limited so that signal strengths transmitted and received by the satellite are both very low.

3) Keeping it on station orbiting the Earth are subject to forces such as solar radiation pressure, (often called solar wind), the varying strength of the Earth's magnetic field and the varying gravitational forces due to the satellite's changing position with respect to the Sun and the Moon and the fact that the Earth is not a perfect sphere.

4) Attitude Control Controlling a space-craft's attitude requires sensors to mea-sure its current orientation or attitude, a control system which calculates the deviation from its desired orientation and determines the forces needed to reduce the deviation to zero and actuators to apply the necessary forces to re-orient the vehicle to the desired attitude.

5) Transponders this is the payload which communications satellites are designed to carry. Multiple Access Modern transponders can carry many different types of communications traffic. They can also receive signals from multiple ground stations, combining (multiplexing) or split-ting (de-multiplexing) them for onwards transmission to other multiple ground stations. This method, by which many users share a common satellite resource, is called Multiple Access. There are several schemes for accomplishing this:

TDMA - Time Division Multiple Access allocates a time slot to the user in a repetitive time frame. The signal is digitized and the data bits are stored in a buffer in a compressed time frame until their allocated time slot comes around when they are trans-mitted during their allocated time.

FDMA - Frequency Division Multiple Access shares the bandwidth between the users, with each user allocated a unique, narrower section of the avail-able bandwidth.

CDMA - Code Division Multiple Access, also known a Spread Spectrum, modulates the user's signal with a pseudorandom code so that it occupies the full available spectrum, appearing as noise.

6) Telemetry and Command

Telemetry systems monitor the status of the satellite's systems including the functioning of electronic and propulsion sub-systems and its energy management as well as its attitude and position in space and provide the capability to transmit this information to a control center on the ground.

Command systems use the telemetry inputs in control systems to compare the satellite's actual status with its desired status and to transmit control signals back to the satellite to operate on board actuators such as switches, solenoids, motors or propulsion jets to keep the satellite operating within its design parameters. The control functions include maneuvering, antenna deployment, station keeping, attitude control, energy management and communications channel switching.

7) Latency or Propagation Delay Latency usually refers to the time it takes a bit or packet of information to dribble through a local network or signal processing equipment from its input point to its output point. It is often of the order of microseconds or somewhat longer for long distance cable connections. For a satellite network however, the signal paths, or hops, include both the long uplinks and downlinks between the ground and the satellite.

8) Antennas are normally passive devices. Though they have gain, they do not add any energy to the signal. Instead they concentrate the available transmitted or received signal energy into a preferred direction.

9) Signals and noise A key limiting factor in determining the performance of a communications link is the amount of noise in the receiving system, sometimes called the noise floor which sets the fundamental lower limit to the signal level necessary for extracting the transmitted message from the noise. In general terms, the greater the noise, the greater the signal level has to be to avoid being lost in the noise, however modern signal processing techniques enable signals to be extracted from well below the noise level.

10) The Van Allen Radiation Belt This is a region of high energy charged particles moving at speeds close to the speed of light encircling the Earth which can dam-age solar cells, integrated circuits, and sensors and shorten the life of a satellite or spacecraft.

11) Space Whether Threat In [9] Geomagnetic storms can disturbance the ionosphere density (called scintillation), leading to increased noise in the electromagnetic signals traveling to and from the satellites.

12) Security Satellite communication is vulnerable to attack because it use radio frequency spectrum for the communication purpose.

3.2 Radio Frequency Spectrum

There are forty different types of radio communication services, defined in the ITUs Radio Regulations. Some of the radio services, among others, are as given below:

- Fixed Service
- Mobile Service
- Fixed Satellite Service
- Mobile Satellite Service Maritime Mobile Service
- Maritime Mobile Satellite Service
- Aeronautical Mobile Service Ship Movement Service
- Aeronautical Mobile (R) Service Aero Mobile Satellite Service
- Broadcasting Service
- Broadcasting Satellite Service Radiolocation Service
- Radiolocation Satellite Service Radio navigation Service
- Radio navigation Satellite Service
- Meteorological Aids Service Earth Exploration Satellite Amateur Service
- Radio Astronomy Service Safety Service
- Standard Frequency And Time Signal Service

The following is the basic challenges in radio frequency spectrum:

1) Trend of modern telecommunication is to-wards Mobility necessitating greater demands on radio frequency spectrum.
2) Making available adequate spectrum for proper growth of telecom services, especially for implementation of future wire-less technologies.
3) With increased spectrum usage Increased interference cases requiring more efforts for resolution of the same, Greater enforcement, Need for more spectrum efficient radio systems, Increased sharing among various radio systems, Increased complexities in spectrum management process.

3.3 In MANET

Routing: Since the topology of the network is constantly changing, the issue of routing packets between any pair of nodes becomes a challenging task. Most protocols should be based on reactive routing instead of proactive. Multi cast routing is another challenge because the multi cast tree is no longer static due to the random movement of nodes within the net-work. Routes between nodes may potentially contain multiple hops, which is more complex than the single hop communication.

Security and Reliability: In addition to the common vulnerabilities of wireless connection, an ad hoc network has its particular security problems due to e.g. nasty neighbor relaying packets. The feature of distributed operation requires different schemes of authentication and key management. Further, wireless link characteristics introduce also reliability problems, because of the limited wireless transmission range, the broadcast nature of the wire-less medium (e.g. hidden terminal problem), mobility-induced packet losses, and data trans-mission errors.

Quality of Service (QoS): Providing different quality of service levels in a constantly changing environment will be a challenge. The inherent stochastic feature of communications quality in a MANET makes it difficult to offer fixed guarantees on the services offered to a device. An adaptive QoS must be implemented over the traditional resource reservation to sup-port the multimedia services.

Inter-networking: In addition to the communication within an ad hoc network, inter-networking between MANET and fixed net-works (mainly IP based) is often expected in many cases. The coexistence of routing proto-cols in such a mobile device is a challenge for the harmonious mobility management. Power Consumption: For most of the light-weight mobile terminals, the

communication-related functions should be optimized for lean power consumption. Conservation of power and power-aware routing must be taken into consideration.

Multicast: Multicast is desirable to support multiparty wireless communications. Since the multicast tree is no longer static, the multicast routing protocol must be able to cope with mobility including multicast membership dynamics (leave and join).

Location-aided Routing: Location-aided routing uses positioning information to define associated regions so that the routing is spatially oriented and limited.

4 COMPARISON OF WMC WITH WIRED INTERNET COMMUNICATION

In [10] deals the current technology about wire-less and mobile communication progress look like. The basic aim of wireless and mobile communication is to achieve ubiquitous network, secure data transmission, high data rate transmit for audiovisual and multimedia to know the difference between wired and wireless net-work see Table 1.

Table 1 Difference between wireless and wired networks

Characteristic	Wired Network	Wireless Network
Installation	Difficult to moderate	Easy installation
Visibility Node to Node on same network	All of the nodes on a wired network can hear all other nodes	Cannot hear all of the other wireless nodes on the same network
Visibility Network to Network	Networks are invisible to other wired networks.	Wireless networks are often visible to other wireless networks. One wireless network can affect the performance of other wireless networks.
Time to installation	It take more time	It take less time
Cost	Less (such Ethernet, cables, switches are not expensive)	More (wireless adapters and access points are quite expensive)
User connectivity	Connectivity is possible only cabling extended.	Connectivity is possible without extended cable.
Mobility	Impossible	Possible for wireless user to connect to network and communicate with other users anytime, anywhere.
Reliability	High	Relatively low.
Speed	High	Low (duo to physical and weather threat).
Cables	Ethernet, copper and optical fibers	Works on radio waves and microwaves.
Security	Good because it use software and firewall.	Weak (because wireless communication signals travel through the air and can easily be intercepted but it can improve by encryption technique)
Types	Local Area Network(LAN), Metropolitan Area network(MAN),Wide Area Network	Satellite, Infrastructure,Infrastructure less wireless network
Standards	802.3	802.11a/, g/, n/b/ac/ad,802.15.3 WPAN, 802.15.6 WBAN etc.
Signal Loss	Less	More (due to more interference, absorption,refraction and reflection etc.)
Interference	Less	Higher (the potential for radio interference due to weather, other wireless devices, or obstructions like walls)
Connection Set up time	Less	More
Quality of Service	Better	Poor (due to higher jitter, Delays and longer connection set up times)

6 CONCLUSION

In this paper, try to see the technology advancement of wireless and mobile communication from 1G up to next generation which is call 5G including vast proposed idea to achieve ubiquitous network and what kind of future add in each advanced network generation for accessing of data starting from vehicle to vehicle to people-to-people in addition to that the data rate and speed

transmits was increased. To achieve the next generation which is 5G a lot of researcher search anew propagation in addition to the radio frequency spectrum because the bandwidth 5G required not supported by ITU (International Telecommunication Union) which is an organization give service related to telecommunication and have authority to allocate radio frequency spectrum for all wireless and mobile communication but the unallocated of radio frequency spectrum is bandwidth limited, so alternative solution proposed by re-searchers just like visible light communication for wireless and mobile communication.

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