MANET and WSN: WHAT MAKES THEM DIFFERENT?

Teeb H. Hadi
Technical Computer Department
Middle Technical University- Baqubah Technical Institute
Baghdad, Iraq

***Abstract*- A wireless channel laid theMobile Ad-Hoc Network (MANET) and Wireless Sensor Network (WSN)in an unlicensed spectrum that is susceptible to obtrusion by other radio waves technologies working in the same frequency.The objective of this study is to showthat the WSN is a special type of ad hoc wireless network that are used to provide a wireless communication infrastructure that allows us to observe, instrument and respond to natural phenomena in any environment. Even that, the results showthe essential differences between WSN and MANET such as: WSN focus on environment interaction whereas MANET interaction closed to human, data rate in WSN is very low with large number of centralized node but so rich multimedia data can be carried in MANETwith less number of decentralized node,…etc.From all previous papers, this review comparison shows that the importance of both networks depends on the used application with special aspect in WSN.**

Keywords- Wireless,Communication, Technologies, WSN, MANET

I. INTRODUCTION

The process of information transmission between two points or more that are not connected by an electrical conductor is called a wireless communication [1]. The most common wireless technologies use radio because radio waves distances can be short, such as a few meters for television or as far as thousands or even millions of kilometers for deep-space radio communications. It includes various types of fixed, mobile, and portable applications, including "two-way radios", "cellular telephones", "personal digital assistants" (PDAs) and "wireless networking" [2].A *wireless networks*can be defined as computer networks that are not usedthe cables of any kind. This attributes freedom of movement and the ability to extend applications to different parts of a building, city, or nearly anywhere in the world [3]. The enterprises use a wireless network as a connection between different equipment locations or to avoid the costly process of introducing cables into buildings. It allows users to achieve total PC portability and location independence[4]. Wireless networks allow it's users to interact with e-mail or browse the Internet from any location that users prefer. The wireless systems basically operate with radio waves soits implementation takes place at the physical level of network structure [5].Computer devices have processors, memory and a means of interfacing with a particular type of network so that the cells of traditional phones don't fall within the definition of a computer device. Newer phones and even audio headsets are beginning to combine network adapters and computing power. Finally, most electronics will display wireless network connections [6].The main objective of this literature paper is to review the differences between WSN and MANET such as: routing protocol, number of nodes, node movement, interaction, features, applications, network size,..…etc.

II. MOBILE AD-HOC NETWORKS (MANET)

On wireless networks, an ad-hoc network is instant network in which wireless devices are communicated directly with each other with self-configuration and short range. The mode of ad-hoc allows all wireless devices within the communication range to operate together [7]. Basically, MANET is designed for the establishment of a network anytime and anywhere, without specifications to infrastructure to support the mobility of the users in the network.In such an environment, networks are subject to severe blocking. Therefore, the performance of an ad hoc system relies on the stability of the network architecture [8,9]. Figure1 gives overview of an ad-hoc network, where wireless mobile nodes have created a network, with one of mobile node so far to reach [10]. Wireless ad hoc networks only contain of nodes supported with transceiver. The nodes of MANET should be able to manage and arrange their own network due to the network is formed to be independent network from an infrastructure.Furthermore, the establishment of the networks should be in a decentralized and distributed manner [11]. MANET has a complexity aspect with its node themselves where the nodes must be able to solve network's problem like the security and routing problems. Also the node should be adaptable to changes of network topology because ad-hoc network can change their topology in unpredictably and quickly [12, 13].

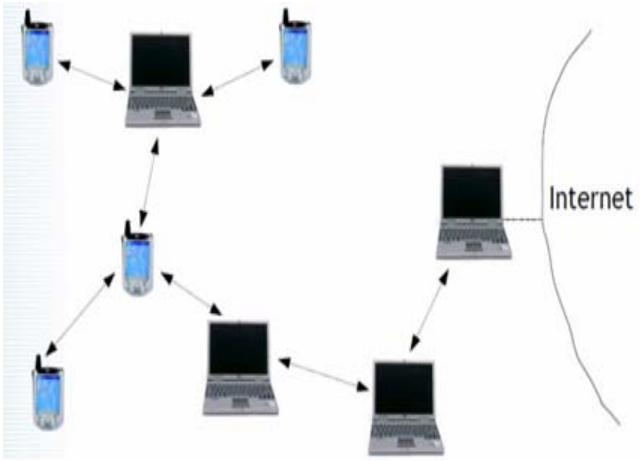

Figure1. Ad-Hoc Network

The devices of MANET combine the communication that based on Wi-Fi toallow them to interact with each other using wireless (one hop) and mobile (multi-hop) networks so that any physical scenario supporting the communication services on the move to its users as potential collaboration arena [14].Unfortunately no work that has been done to support QoS for Internet and other network architecture is suitable directly in MANET environment. To support QoS, the link state information such as bandwidth, delay, error rate and loss rate in the network must be available and manageable. However the mobility, resource limitations, random joining and leaving of network nodes make the managing and getting this link state information is so difficult [15].

A. Mobile Ad-Hoc Networks Features

- Wireless links.
- Rapidly and ease deployable, self-configuring.
- Autonomous, no need for existing infrastructure.
- Nodes are mobile, topology can be very dynamic.
- Nodes act both as host and router.
- Limited energy, security and computing resources.
- Can be connected to external networks or it can be standalone network.

B. Applications of MANET

- Battlefield communication
- Search-and-rescue
- Mini site operations
- Robot data acquisition
- Sensor networks
- Vehicular networks
- Student on campus
- Cellular network and wireless Hot Spot extension
- Personal area networking using PDAs, laptops and hand phones, etc.

C. Routing Protocols in MANET

Routing is the process of moving of the information from a source (host) to a destination (another host) in the network. Where, at least one intermediate node within the network is forwarded. Routing can be find the end-to-end paths, minimize overhead, find loop free and do the route maintenance [16]. Routing protocol for ad-hoc network can be categorized in two strategies*Flat* and *Hierarchical architec*ture as shown in table I.

TABLE I. ROUTING PROTOCOLS in MANET

Hierarchical	Flat		
	Reactive	**Proactive**	**Hybrid**
Zone-based Hierarchical Link State (ZHLS)	- Ad hoc On-demand Distance Vector Routing (AODV). -Dynamic Source Routing (DSR). - Location Aided Routing (LAR). - Temporally Ordered Routing Algorithm (TORA)	-Global State Routing (GSR). -Hierarchical State Routing (HSR). - Destination Sequenced Distance Vector Routing (DSDV).	Zone Based Routing Protocol (ZRP)

III. WIRELESS SENSOR NETWORK (WSN)

A wireless sensor network (WSN) is a network of several smallest nodes called sensors that based on centralized communication with wireless signals. WSN is special network that spreadto sense the area of interest [17].The nodes in sensor network are limited with respect to energy supply, communication bandwidth and restricted computational capacity.It's expected that sensor nodes adjust and operate in changing environments and should be useable in large areas [18].The scale of traditional wireless networks is often orders of magnitude less than that of sensor networks,often thickly and deployed redundantly, additionally the nodes can be added to and deleted from the network dynamically without manual intervention by human and fundamentally use broadcast

communication paradigms [19,20]. Failures are oversensitive in wireless sensor networks due to inhospitable, unstable environment and unattended deployment [21].In WSN, passing link failure are more repeated then perpetual failures particularly in presence of high dynamic of low-power wireless link. The effect of link faults channelizes to route vibration, emergent link employment of links on replacement paths, conflicting data flow over intercede router buffers [22].

Figure2 shows that sensor nodes are responsible for gathering the information of environment and sending it to a sink node, thatable to manage and achieve all the communications between other nodes [23].

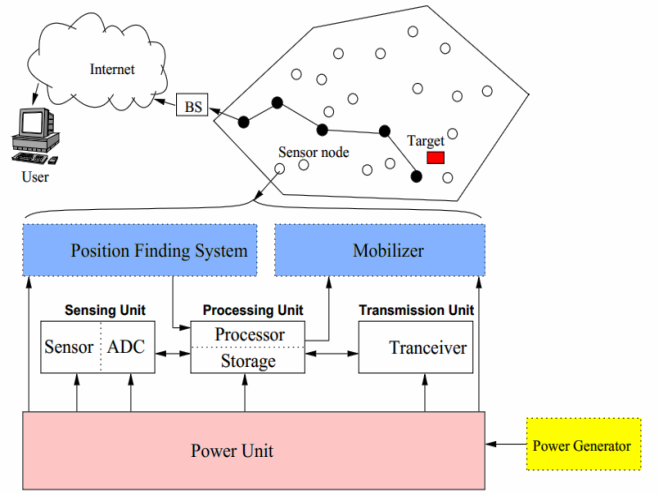

Figure2. Wireless Sensor Network

Sink node (Base station)receives the collected information by the network from several sensor nodes and delivers it to the end user so the placement of a sink node has a big impact on lifetime and on energy consumption in WSNs.[24].WSN supplies the following essential functionalities [25, 26]:

- ✓ Dataacquisition and signal conditioning for different sensors.
- ✓ Provisionalstorage of the obtained data.
- ✓ Data processing.
- ✓ Analysis of the processed data for diagnosis and,potentially alert generation.
- ✓ Self-monitoring.
- ✓ Scheduling and implementation of themeasurement tasks.
- ✓ Managementthe configuration of sensor node.
- ✓ Reception, transfer andforwarding of packets of data.
- ✓ Management and coordinationthe communications and networking.

A. Wireless Sensor Network Features

- Ability to cope with node failures (communication failure)
- Mobility of nodes
- Dynamic network topology
- Scalability to large scale of deployment
- Heterogeneity of nodes
- Ability to withstand harsh environmental conditions
- Unattended operation
- Ease of use and large scale deployment
- Power consumption

B. Applications of WSN

- Physical security for military operations
- Habitat monitoring
- Environmental monitoring
- Seismic and structural monitoring
- Object tracking
- Industrial automation
- Field experiments
- Nuclear reactor control
- Bio-medical applications
- Traffic monitoring
- Fire detection

C. Routing protocols in WSN

In a WSN environment, it's impractical to assign and maintain the hierarchicalstructures of the network because it's nodes can be spread in large quantities with randomly move also the topology of the network may vary according to energyefficiency decisionsorsensor failures. The message overhead for maintaining the routing tables and the memory space desired tosave and store them is not availablefor resourceconstrained and the energy in WSNs. In a WSNs, routing protocols must be lightweight both memory footprint and processing power and should berequire the minimal message overhead [25].The routing protocols in WSNs can be classified as *flat, hierarchical and Location based*protocols as shown in tableII.

In hierarchical protocols, the network organizesit's nodes into many logical levels. This is typically done by a process called *cluster formation*. A cluster containsa set of geographically proximal sensor nodes; one of these nodes serves as a *cluster head* [21]. The cluster heads can be organized into moreover hierarchical levels. In flat routing protocols, the attempting to find good-quality routes from source to sink nodes can be implemented by some form of *flooding*. Since flooding operation is a so costly in resource famished networks and smart routing algorithms straiten the flooding to localized regions. So to establish routing paths, some algorithms use probabilistic techniques depended on certain heuristics [27].

TABLE II. ROUTING PROTOCOLS in WSN

Hierarchical	Flat	Location based
- Low Energy Adaptive Clustering Hierarchy (LEACH) - Power-Efficient Gathering in Sensor Information Systems (PEGASIS) - Threshold Sensitive Energy Efficient Network (TEEN) - Adaptive Periodic Threshold Sensitive Energy Efficient Sensor Network (APTEEN) - Minimum Energy Communication Network (MECN)	-Sensor Protocols for Information via Negotiation (SPIN) -Direct Diffusion (DD) -Rumor Routing - Energy Aware Routing (EAR). - Sequential Assignment Routing (SAR). - Minimum Cost Forwarding Algorithm (MCFA). - Active Query forwarding In sensor network (ACQUIRE).	- Geographic and Energy Aware Routing (GEAR) - Sequential assignment routing (SAR). -Ad-hoc positioning system (APS). - Geographic adaptive fidelity (GAP). - Greedy other adaptive face routing (GOAFR). - Geographic distance routing (GEDIR).

IV. CRITICAL DIFFERENCES BETWEEN WSNS and MANETS

BothWSN & MANET networks use a wireless channel laid in an unlicensed spectrum that is susceptible to obtrusion by other radio waves technologies working in the same frequency.Although there are many significant similarities between WSNs and MANETs, there are also essential differences between them such as: energy critical, scalability, addressing, active networking and etc...TableIII summarizes the essential differences between WSN and MANET networks.

TABLE III. FUNDAMENTAL DIFFERENCES BETWEEN WSN and MANET

Issues	MANET	WSN
Standards	IEEE 802.11	IEEE 802.15.4
Number of nodes	Less than WSN	Very large
Node movement	Decentralized	Centralized
Node works	Nodes act both as host & router	Nodes separately
Interaction	“Closed” to humans	With environment
Main purpose	Distributed computing	Information gathering
Application-equipment	More expensive	Less than MANET
Application-specific	Comparably uniform	Much stronger on application specifics
Scale	Larger	Much larger
Bandwidth	Deficient more than WSN	Sometimes deficiency
Failure in nodes	Less than WSN	prone to failure
Data rate	Designed to carry rich multimedia data	Very low
Data redundancy	No	Yes
Power	-	Limited
Population of nodes	Sparsely	Densely
Deployed by	Several unrelated entities	Single owner
Application node	-	stationary nodes
Communication mode	Point-to-Point	Broadcast
Routing Protocols	Pro-active, Reactive, Hybrid	Flooding, Gossiping, Flat Routing, Hierarchical, Location based
Memory constrained	Less than WSN	Very high
Network size	Depends on active users	Depends on extension of the observed area
Identification	Unique ID by its MAC address	Not unique

V. CONCLUSION

The principle work, the main features, applications and the fundamental differences between WSN and MANET have been presented.The following conclusions can be summarized:

1) WSN is a special type of ad hoc networks; both are using a wireless channel laid in an unlicensed spectrum that is susceptible to obtrusion by other radio waves technologies working in the same frequency.

2) WSN focus on environment interaction whereas MANET interaction closed to human.

3) WSNis data centralized, but the control of the network is published among the nodes in MANET so it has no background network for the central control of the network operations.

4) In WSN, data rate is very low but so rich multimedia data can be carried in MANET.

5) Sensor network has very huge number of nodes that usually spread once in their life time, while MANET has less number of nodes that usually move in an ad hoc manner.

ACKNOWLEDGMENT

The authors are grateful to the staff of Baqubah Technical Institute / Middle Technical University-Iraq for their help.

REFERENCES

[1] Monika P., Anshul A., "An Introduction to Wireless Communication", International Journal of Engineering Trends and Technology (IJETT), Volume 12, Number 1, Jun 2014.

[2] Vimalanathan P, R SriVidya, "A Survey: On Generation of Wireless Telephony Technology", International Journal of Computer Technology & Applications, Vol 3 (4), 1467-1470, July-August 2012.

[3] Ankur B., Dr. B.B. Meshram, "Survey of Attacks on Wireless Network", International Journal of Innovative Research in Computer and Communication Engineering, Vol. 1, Issue 1, March 2013.

[4] Kirti, "Basic Concepts of Wireless Network", International Journal of Science and Research (IJSR), Volume 3 Issue 7, July 2014.

[5] Rakesh K., Neeraj T., "An Investigation on Wireless Mobile Network and Wireless LAN (Wi-Fi) for Performance Evaluation", International Journal of Computer Applications, Volume 126 – No.6, September 2015.

[6] Alejandro R., Georgios B., "Separation Principles in Wireless Networking", IEEE Transactions On Information Theory, Vol. 56, No. 9, September 2010.

[7] P.Visalakshiand et al., "Ad hoc network- An Overview",International Journal of Modern Engineering Research (IJMER), Pp-27-29 ,National Conference on Architecture, Software systems and Green computing (NCASG).

[8] Aarti, Dr. S. S. Tyagi, "Study of MANET: Characteristics, Challenges, Application and Security Attacks", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 5, May 2013.

[9] Saleh A., Putra S., "An overview of Mobile Ad-hoc Networks for the Existing Protocols and Applications", International Journal on applications of graph theory in wireless ad hoc networks and sensor networks, Vol. 2, No. 1, March 2010.

[10] Andreas Tønnesen, "Mobile Ad-Hoc Networks", Penguin pixmap (c) everaldo.com – 802.11 illustrations by Lars Strand.

[11] S. Mueller, R. P. Tsang, and D. Ghosal, "Multipath routing in mobile ad hoc networks: Issues and challenges," Performance Tools and Applications to Networked Systems, pp. 209–234, 2004.

[12] Ankur O., Prabhakar L., "MANET: History,Challenges and Applications", International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 2, Issue 9, September 2013.

[13] Gang W.,Guodong W., "An Energy Aware Geographic Routing Protocol for Mobile Ad Hoc Networks", International Journal of Software informatics, Vol. 4, No. 2, pp. 183-196, June 2010.

[14] Ashwini P. and et al., "A Survey of Network Security in Mobile Ad-Hoc Network", IOSR Journal of Computer Engineering, Volume 18, Issue 5, Ver. III (Sep. 2016), PP 29-36.

[15] Samba S. and et al., ""A Survey on Mobile Ad-Hoc Wireless Network", Information Technology Journal, ISSN: 1682-6027, Volume 3, Issue 2, 2004.

[16] Amit Sh., Nitin Ch., "Overview of Routing Protocols in MANET's and Enhancements in Reactive Protocols', Beaumont TX 77710 project, 2008.

[17] Ajay J. and et al., "Wireless Sensor Network: Architectural Design issues and Challenges",International Journal on Computer Science and Engineering, Vol. 02, No. 09, 2010.

[18] Gowrishankar.S. and et al., "Issues in Wireless Sensor Networks", Proceedings of the World Congress on Engineering, London, U.K Vol. I, July 2 - 4, 2008.

[19] Madhav B. and Anagha R., "Wireless Sensor Network", International Journal of Computer Engineering Science (IJCES), Vol. 2, Issue 3, March 2012.

[20] A. Perrigand et al., "SPINS: Security Protocols for Sensor Networks", Wireless Networks Journal, Vol. 8, No. 5, pp. 521–34 Sept. 2002.

[21] N. NARASIMHA D. and K. GOPINATH, "A survey of routing algorithms for wireless sensor networks", Indian Institute of Science, pp. 569–598, Nov.–Dec. 2006.

[22] Karthick K.M and Rengarajan N, "Investigation of Faults, Errors and Failures in Wireless Sensor Network: A Systematically Survey", International Journal of Advanced

Computer Research, Volume-3 Number-3 Issue-12 September-2013.
[23] Jayashree V., "A Comparative Study on Cellular, Sensor and Ad hoc Networks", International Journal of Advanced Smart Sensor Network Systems, Vol. 2, No.3, 2012.
[24] Jennifer Y. and et al., "Wireless sensor network survey", Elsevier Journal (Computer Networks), 2008.
[25] Dhaval C. Bhatt and Tarulata Ch., "A Survey on Wireless Sensor Network: An Application Perspective", International Journal of Engineering Research & Technology (IJERT), Vol. 2, Issue 11, November – 2013.
[26] Paolo Baronti and et al., "Wireless sensor networks: A survey on the state of the art and the 802.15.4 and ZigBee standards", Elsevier Journal (ScienceDirect-Computer communications), ISSN: 1655–1695, 2007.
[27] Hussein Mohammed Salman," Survey of routing protocols in wireless sensor networks", International Journal of Sensors and Sensor Networks, Vol. 2, No. 1, pp. 1-6, 2014.