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Simulation of 3D Network for under Water Wireless Sensor Network

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Abstract:- **The Underwater Wireless Sensor Network (UWSN) has wide range of application in various fields. The energy consumption by the wireless sensor nodes are to be reduced to prolong the network life time. Hence various network topologies with various algorithms are developed to meet the challenges faced by UWSN. The 3D topology provides better communication establishment which is evident from simulation results.**

I.INTRODUCTION:

In recent years the underwater communication is at the peak necessitate under various categories. Scientific applications to observe temperature, salinity, oxygen levels, bacterial and other pollutant content, dissolved matter, etc.Industrial applications involves control and actuation components. Military applications involve securingor monitoring port facilities or ships in foreign harbours, de-mining and communication with submarines and divers. This paper shows a challenges in Underwater Wireless Sensor network, network performance metrics, and a novel 3D network topology for establishing the network.

II. MARINE BASED WSN ARCHITECTURAL STRUCTURE AND CHALLENGES

A.MARINE BASED WSN GENERAL ARCHITECTURE

The general architecture of wireless sensor networks in marine environmental monitoring is illustrated in Figure 1 illustrated.

1) Wireless Underwater Acoustic Networking: The underwater sensor nodes and autonomous underwater vehicles, which are deployed to carry out cooperative surveillance in a given area. The architectures of underwater acoustic sensor networks can be classified depending on the network topology used.

a) Static Underwater Sensor Networks:

A group of sensor nodes are deployed to the bottom of the water area with a deep water anchor. The surface sinks receive data from wireless acoustic link interconnections are used between underwater sensor nodes and underwater sinks via direct links or through multi-hop pathways.

b) Moving Underwater Sensor Networks: Underwater sensor nodes are attached to a surface anchor to the bottom of the water area, with flexibility of movement in a certain area.

c) Underwater Sensor Networks with autonomous underwater vehicles: Autonomous Underwater Vehicles (AUVs) are used to enhance the capabilities of underwater sensor networks in terms of self-configuration of sensor nodes, Global position satellite (GPS) technology are used to track the location of the vehicles on or near the sea surface.

B. DIFFICULTIES AND CHALLENGES

In the marine environment, the following are the issues to be considered.

1) Movement:

The sea water breaks the buoy nodes and sometimes the WSN may need reconfiguring.

2) Management of energy consumption:

Batteries are used in marine WSNs. Wireless communication mechanisms have been applied to save energy aimed to minimize radio activity.

3) Software Design of the Network:

The program code enables the connectivity and data delivery between the nodes, base station and the end-users.

4) Data Transmission and Security:

Environmental conditions and network design affects the sensor nodes. The radio signal strength of the data transmission is affected by the water environment can result in an unstable line-of-signal between wireless nodes[2].

III. PERFORMANCE METRICS

The overall performance of a data network can be measured by evaluating different communication parameters. The most important are: received signal strength indication (RSSI), throughput (TP), round trip time (RTT) and efficiency (Ef). RSSI estimates the link quality between two adjacent nodes. Generally, the scale is expressed in negative values and measured in decibels (-dBm); the more negative the value, more loss of signal strength. This value is obtained directly from the XBee radio communication module through an explicit programed device. Each time a packet is generated, the device activates the program to extract the RSSI included in the packet; however, if the package is not sent because of a media access failure, the program assigns a RSSI value equal to 0 dBm. This should be taking into consideration when calculating the average of RSSI values obtained on each experiment. The IEEE standard specifies that a radio receiver may only accept signals that at least have a signal strength of -89 dBm or better as described in the standard[3]

Throughput is defined as the amount of data received during a given period of time (also known as measurement window), refer to equation (1). The TP of a system is given in bits per second and depends on attributes such as the transfer rate used and the packet size among others. Thus, having registered the beginning and end of each test and the number of bytes received at the receiving node, the throughput can be calculated [4], [5].

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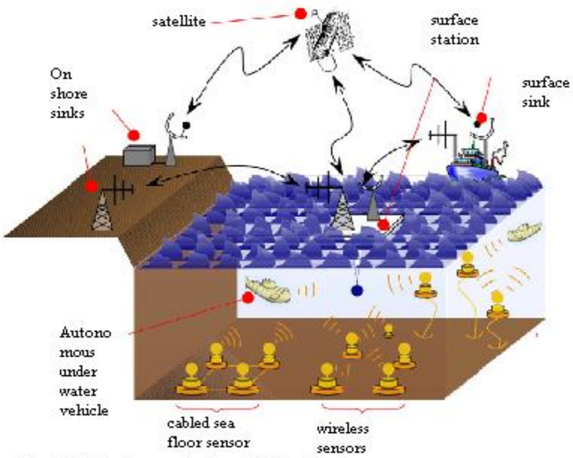

Fig.1.Wireless Communication in Marine Environment

$$TP = \frac{number\ of\ bits\ received}{Measurement\ Window}............(1)$$

Round Trip time is defined as the time it takes for a packet to travel from the source to the destination node and return to the source node. The main types of delays include: sending node processing delay, signal propagation delay and receiving node processing delay. Equation (2) is used to determine the RT of a package, simply calculate the difference in time between the arrival and departure times of a packet [4], [5].

RTT = Arrival Time - Departure time……(2)

Efficiency (Ef) of each test is defined as the number of packets received at the receiver station, represented in proportion to the total of packets sent. To calculate E, the number of packets received is divided by the number of packets sent during each test, as shown in equation (3).

$$Rf = \frac{number\ of\ packets\ received}{number\ of\ packets\ send} * 100....(3)$$

IV. ENERGY HARVESTING SYSTEM DESIGN

The energy supply of a wireless sensor network is generally provided by batteries which have limited energy [6]. Wireless sensor nodes are often deployed in sea surface areas, and they are planned for long-time operation, therefore, it is not convenient to replace the sensor batteries. Marine sensor nodes (sink nodes) consumes high energy due to the use of long-range wireless communication protocol (GPRS). In order to reduce the energy consumption it is needed to design an energy harvesting system which uses renewable energies source such as solar [4], tidal power [7], or wind energy [9,10]

The following three aspects are considered for designing marine environment monitoring: energy harvesting devices, power management system, and energy storage devices.

- *Energy harvesting devices:*
  An energy harvesting devices are responsible for harvesting energy from the environment. According to the characteristics of available ambient energies, we should choose appropriate energy harvesting devices and should consider how to install the energy harvesting devices..
- *Energy storage devices:* Energy storage devices normally adopt the rechargeable batteries. [11].

V. 3D NETWORK TOPOLOGIES

V.1. IMPLEMENTATION

To add 3D network topologies to the simulation environment, we needed to modify how it generates the topologies and the connectivity matrices. The initial simulator placed nodes in a linear fashion along the xz-plane based on a pre-existing topology or in a pseudo-random fashion according to user specified parameters. minimum and maximum Euclidean y distance for a node. The simulator then randomly generates nodes with y coordinates within those ranges (along with x and z as originally generated).

V.2. ANALYSIS

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The simulator correctly generates 3D topologies, we examine the node positions generated. Figure 2(a) shows a typical 2D topology and Figure 2(b) shows a typical 3D topology. In the 2D topology, the node positions are all in a plane where the y position is 0. In the3D topology, the node positions vary between 30 and 60 meters along the y-axis, correctly generating a 3D topology Figure 3 shows the total average energy consumption for all decentralized communication algorithms in 3D topologies.

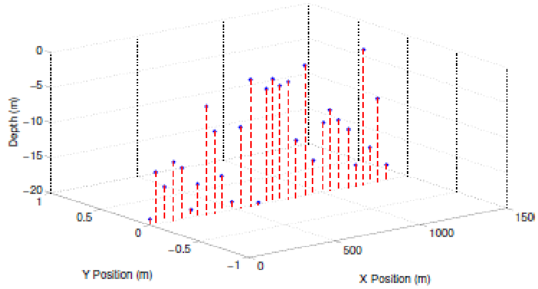

Fig.2.a 2 D Network Topology

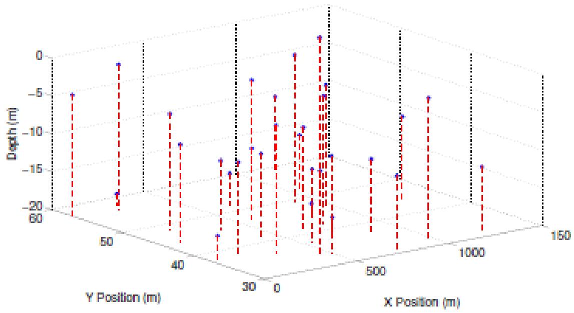

Fig.2.b 3 D NetworkTopology

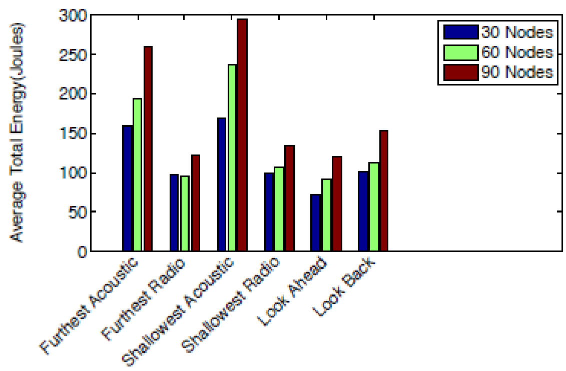

Fig.3.Total Average Energy for Decentralized Communication Algorithms in 3D Topologies

VI. CONCLUSION

UWSN technology has reached a stage where it is being used in many underwater projects such as sea Sampling Networks, environmental monitoring, undersea exploration, disaster prevention, assisted navigation, surveillance and tidal waves energy harvesting. The 3Dnetwork topology gives best result with reduced energy consumption.

REFERENCES

[1] J. Partan, J. Kurose, and B. N. Levine, “A survey of practical issues in underwater networks,” in *Proceedings of the 1st ACM International Workshop on Underwater Networks (WUWNet’06)*, pp. 17–24, Los Angeles, Calif, USA, September 2006.

[2] B. Arazi, I. Elhanamy, O. Arazi, and H. Qi.‖ Revisiting public – key cryptography for wireless sensor neworks, Computer,‖ ISSN 0018-9162 pp. 103-105, 2005.

[3] L. M. S. Committee y I. Computer, IEEE Standard for Information technology Telecommunications and information exchange between systems- Local and metropolitan area networks Specific requirements–Part 15.4: Wireless MAC and PHY Specifications for Low-Rate WPANs Control, New York, USA, 2006.

[4] J. Birla and B. Sah, “Performance Metrics in Ad-hoc Network,” in International Journal of Latest Trends in Engineering and Technology (IJLTET), vol. 1, no 1, pp. 46-49, May 2012.

[5] R. Piyare and S. ro Lee, “Performance Analysis of XBee ZB Module Based Wireless Sensor Networks,” in International Journal of Scientific & Engineering Research, vol. 4, no 4, pp. 1615-1621, April 2013.

[6] Alippi C., Camplani R., Galperti C., Roveri M. Effective design of WSNs: from the lab to the real world. Proceedings of the 3rd International Conference on Sensing Technology; Tainan, Taiwan. 30 November–3 December 2008; pp. 1–9.

[7] Perez C.A., Jimenez M., Soto F., Torres R., López J.A., Iborra A. A system for monitoring marine environments based on Wireless Sensor Networks. Proceedings of the IEEE Conference on OCEANS; Santander, Spain. 6–9 June 2011; pp. 1–6.

[8] Pirisi A., Grimaccia F., Mussetta M., Zich R.E., Johnstone R., Palaniswami M. Optimization of an Energy Harvesting Buoy for Coral Reef Monitoring. Proceedings of the 2013 IEEE Congress on Evolutionary Computation; Cancún, Mexico. 20–23 June 2013; pp. 629–634.

[9] Hsu C.L. Constructing transmitting interface of running parameters of small-scaled wind-power electricity generator with WSN modules. Expert Syst. Appl. 2010;37:3893–3909.

[10] Seah W.K.G., Zhi A.E., Tan H. Wireless sensor networks powered by ambient energy harvesting (WSN-HEAP)—Survey and challenges. Proceedings of the 1st International Conference on Wireless Communication, Vehicular Technology, Information Theory and Aerospace & Electronic Systems Technology; Aalborg, Denmark. 17–20 May 2009; pp. 1–5.

[11] Cesare A., Romolo C., Cristian G., Manuel R. A Robust, Adaptive, Solar-Powered WSN Framework for Aquatic Environmental Monitoring. IEEE Sens. J. 2011;11:45–55.