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Performance Analysis of Underwater Channel for Belhop and MMPE Propagation Models of EEVBF Routing Protocol

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ABSTRACT: In the communication and wireless domains, there is a huge need and developments required day-by-day. Each and every communication are required to be perfect and more accurate. Compare to the normal scenarios, Underwater Wireless Communications are most prominent in this case, which requires high-accuracy and noise free communications over the environment. For these needs, Underwater Wireless Sensor Networks (UWSNs) is introduced and which it has Medium Access Control (MAC) protocol to made sufficient level of communications. Simulating UWSN communications requires modeling the acoustic wave's propagation while a node tries to transmit data to another one. There are several models proposed in the literature from the simplest ones based in the sound propagation theory to more elaborate and complex models based on the physics of acoustic sound propagation. In this work describe several acoustic propagation models that represent different approaches to the same problem, but with different degrees of complexity/accuracy. in order of increasing complexity, so for the performance of Bellhop, Monterrey Miami Parabolic Equation (MMPE) propagation model acoustics are predicted and the parameters are BER, Energy, PDR, throughput. It is a performance analysis of underwater channel for various propagation models of routing protocol. Routing protocol used here is Energy efficient vector based forwarding protocol (EEVBF).

KEYWORDS: Underwater Wireless Sensor Networks, UWSN, Medium Access Control, MAC, Routing protocol, EEVBF, Acoustic Propagation

I. INTRODUCTION

There has been an expanding enthusiasm for the advancement of Underwater Wireless Sensor Networks (UWSNs) in the most recent years. The principal endeavors to investigate UWSN conduct depended on the develop innovation created amid the most recent decade in Terrestrial Wireless Sensor Networks (TWSNs). In spite of having a fundamentally the same as usefulness, UWSNs display a few structural contrasts as for the terrestrial ones, which are essentially because of the transmission medium attributes (ocean water) and the flag utilized to transmit information (acoustic ultrasound signals) [1]. At that point, the outline of proper arrange engineering for UWSNs is genuinely muddled by the states of the correspondence framework and, as an outcome, what is legitimate for earthly WSNs is maybe not substantial for UWSNs, so a general survey of the general system engineering is required keeping in mind the end goal to supply a suitable system benefit for the requesting applications in such a threatening submarine correspondence condition. Fundamentally, a UWSN is shaped by the collaboration among a few system hubs (frequently called sensor hubs) that set up and keep up the system using bidirectional acoustic connections.

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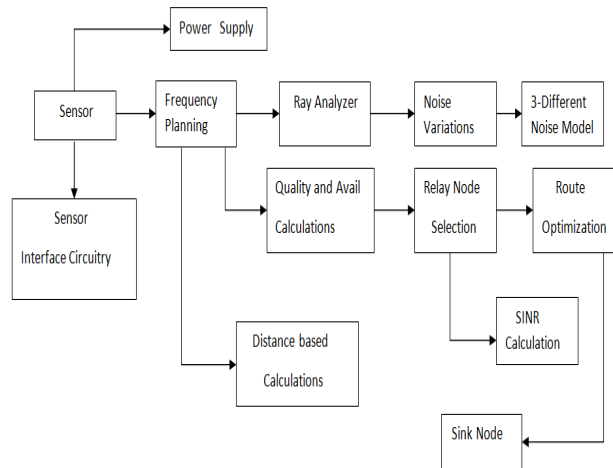


Fig.1 System Block Diagram

Each hub can send/get messages from/to different hubs in the system and furthermore to forward messages to remote goals if there should arise an occurrence of multi-jump systems. Each hub may have one or a few sensors that are currently recording ecological information which ought to be sent to exceptional sink hubs, ordinarily stages or floats at the surface. Sink hubs have correspondence channels to forward (and additionally nearby store) the gathered information to the remote control station in the drift, normally through a Radio Frequency (RF) interface. Since acoustic signs are essentially utilized as a part of UWSNs, it is important to consider the primary angles associated with the engendering of acoustic flags in submerged conditions, including: (i) the engendering velocity of sound submerged is around 1,500 m/s (five requests of greatness slower than the speed of light), thus the correspondence connections will experience the ill effects of expansive and variable engendering delays also, moderately substantial movement actuated Doppler impacts; (ii) stage and size changes prompt higher piece mistake rates contrasted and radio channels' conduct, being obligatory the utilization of Forward Error Correction Codes (FEC); (iii) as recurrence builds, the lessening saw in the acoustic channel likewise increments, being this a genuine transfer speed imperative; (iv) multipath impedence in submerged acoustic interchanges is serious due basically to the surface waves or vessel movement, being a major issue to accomplish great data transfer capacity proficiency.

Along these lines, outlining an effective and dependable correspondence channel isn't a simple assignment, being generally unique in relation to TWSN approaches. This reality might be the purpose behind the presence of a ton of reproduction instruments that characterize diverse models of submerged acoustic flag spread. Truth be told, there is no assertion about when to utilize a specific reenactment instrument or potentially standard model to speak to the submerged acoustic spread conduct; to be sure there are nearly the same number of reenactment instruments for this reason as MAC and directing convention proposition. When all is said in done, these investigations have for the most part been engaged in creating higher layer conventions without giving careful consideration to the physical layer and its segments. AUV-Net-Sim [2] is a case where the physical layer is excessively straightforward, in light of Thorp approximations, so unique condition conditions can't be considered in the spread model, prompting recreation comes about that might be a long way from the ones acquired in genuine system arrangements. Different methodologies characterize complex submerged acoustic spread models that are nearer to the genuine conduct of submerged acoustics. This is the situation of the acoustic spread model proposed by Xie and Gibson [3] which it depends on the Monterey Miami Parabolic Equation (MMPE).

The MMPE condition computes the advancement of sound weights delivered by an acoustic source in a particular submerged situation. It partitions the situation in a matrix of 3-D cells, playing out the requiring calculations to get a delegate sound weight for every cell. In the event that we diminish the cell measure, we can get more exact

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Vol. 7, Issue 5, May 2018

expectation comes about, yet the computational interest for the relating figurings is overpowering at medium to expansive size system situations. The MMPE show is executed with OPNET Modeler [4], so little scale arrange recreations might be performed, yet there is a natural adaptability issue when performing system recreations. Another submerged system reproduction structure is the World Ocean Simulator System (WOSS) [5]. It is made by a few apparatuses like (i) ns2 test system [6], (ii) Bellhop instrument that precisely models the submerged sound proliferation by a particular beam following calculation and (iii) organize situations characterized with genuine information (temperature, saltiness, wave action and so forth.) from surely understood world sea databases. The WOSS structure and the MMPE show are two methodologies that play out an precise acoustic engendering displaying, however they experience the ill effects of high many-sided quality constraining the recreation to little system situations and low quantities of system hubs. With a specific end goal to lighten the multifaceted nature imperative, in [7] we proposed a measurable forecast display in light of the Bellhop beam following apparatus that decreases its intricacy and accomplishes comparable levels of forecast exactness, so we will have the capacity to perform arrange displaying with sensible high precision level and low computational overhead.

These demonstrating instruments and a considerable measure of varieties around them prompt the hard undertaking of contrasting two distinctive propositions unless they are actualized on a similar stage and even for this situation, the test system ought to be as practical as conceivable towards the genuine condition conditions. Generally the results will absence of exactness and observational testing, at any rate in downsize tests, ought to be finished before discharging the last execution of the submerged hubs, diminishing the energy of reenactment apparatuses for anticipating genuine system conduct. At recreation time, when we characterize the parameters of a system situation and the area where arrange hubs would be sent, we may utilize a basic presumption through general situation parameters or characterize those situation parameters that will have an immediate impact in the acoustic engendering conduct. For instance, we may choose to utilize a basic situation where the sound speed engendering is considered as a settled estimation of 1,500 m/s, with a two dimensional organization region (profundity isn't considered) and a straightforward acoustic engendering approach like the one proposed by Thorp [8], to assess the execution of a point-to-point connect between two hubs. Despite what might be expected, we could characterize a more itemized organize situation by including, among others, the situation area with bathymetry and floor dregs creation that will affect in transit sound engendering is reflected/retained at the sea floor.

Likewise, the temperature of the water will rely upon both the scope and longitude of system situation and the period of the year. This reality together with the water saltiness and the profundity may change the sound speed in the vicinity of 1,450 and 1,540 m/s. There are other vital elements that may change sound proliferation conduct, for example, the notable sea wave's impact which is distinctive for shallow and profound waters, or the clamor delivered by ships, organic movement or shores. These situation parameters ought to be considered keeping in mind the end goal to create nitty gritty acoustic engendering models for UWSN, so displaying larger amount arrange conventions will know about system situation conditions and the got reenactment results would be nearer to the ones gotten in test tests [9]. In this work, we will survey a few acoustic proliferation models from straightforward ways to deal with the more exact ones and watch their conduct when distinctive system situation parameters are changed (i.e., wave movement), so we can decide their sensibility to natural system situation parameters. At that point, we will pick the most suitable acoustic engendering model as far as precision what's more, low-multifaceted nature, keeping in mind the end goal to dissect the execution conduct of various MAC conventions and furthermore check how the situation ecological changes affect on their system execution as far as throughput, deferral and crashes.

From the outcome acquired in this investigation, we will welcome: (i) the significance of characterizing an exact and low many-sided quality proliferation model and (ii) the sensibility of higher layer conventions to the time-fluctuating situation natural conditions.

Acoustic Propagation Replication

Recreating UWSN correspondences requires displaying the acoustic wave's spread while a hub tries to transmit information to another. There are a few models proposed in the writing from the easiest ones situated in the sound engendering hypothesis to more intricate and complex models in light of the material science of acoustic sound proliferation. In this segment, we will portray a few acoustic proliferation models that speak to various ways to deal

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Vol. 7, Issue 5, May 2018

with a similar issue, yet with various degrees of multifaceted nature/precision. We will introduce them arranged by expanding multifaceted nature, so for each approach we will know how engendering acoustics are anticipated and what parameters are considered for that reason.

A. Monterrey Miami Parabolic Equation (MMPE)

The Monterey-Miami Parabolic Equation show [11] is utilized to anticipate submerged acoustic engendering utilizing an explanatory condition which is nearer to the Helmholtz condition (wave condition) [12]; this condition depends on Fourier investigation. The sound weight is figured in little incremental changes in range and profundity, shaping a lattice. It fuses irregularity and wave movement to the estimation, utilizing a dynamic engendering misfortune figuring. The creators demonstrate that little changes inside and out and hub separations can drive to huge contrasts in the way misfortune because of the sea wave's movement affect on acoustic proliferation (more subtle elements in [3]). The spread misfortune recipe in light of the MMPE demonstrates is the accompanying one:

$$PL(t) = m(f,s,dA,dB) + w(t) + e() \quad (2)$$

where:

PL(t): spread misfortune while transmitting from hub A to hub B.

m(): spread misfortune without irregular and occasional parts; acquired from relapse of MMPE information.

f: recurrence of transmitted acoustic signs (in kHz).

dA: sender's profundity (in meters).

dB: beneficiary's profundity (in meters).

s: Euclidean separation between hubs An and B (in meters).

w(t): intermittent capacity to rough flag misfortune because of wave development.

e(): flag misfortune because of arbitrary clamor or mistake.

The m() work speaks to the proliferation misfortune gave by the MMPE display. As per the logarithmic idea of the information, a nonlinear relapse is the best choice to give a way to deal with the model in light of the coefficients, A, provided by the preparatory model. The proposed articulation to figure this capacity is the accompanying one:

$$m(f,s,dA,dB) = \log(|s|) + \log(A) + \log(dA) + \log(s) + \log((dA-dB)^2) + \log(s \cdot dB) + \log(A^5) + \log(f^2 + 40100 + f^2 + 0.00275) + \log(0.003) + \log(s^9) + \log(A^6 \cdot dB) + \log(A^8 \cdot s) \quad (3)$$

The w() work approximates the flag misfortune because of the wave development. It considers the development of a molecule that will sway around its area sinusoidal [13]. That development is spoken to as roundabout motions that lessen their sweep as the profundity of the molecule increments. The length of that sweep is reliant of the vitality of the wave and is identified with its stature esteem. The basic waves have several meters of wavelength and have an impact up to 50 m of profundity. For the estimation of the impacts of the wave we will consider:

$$w(t) = h(lw,dB,t,hw,Tw) \cdot E(t,Tw) \quad (4)$$

where:

h(): scale factor work.

lw: sea wave length (meters).

dB: profundity of the beneficiary hub (meters).

hw: wave tallness (meters).

Tw: wave period (seconds).

E(): capacity of wave impacts in hubs.

B. Bellhop (BH)

Bellhop Ray Tracing requires the solution of the ray equations to determine the ray coordinates of the acoustic signal propagation. Amplitude and acoustic pressure requires the solution of the dynamic ray equations which are described in detail in [14]. This tool is integrated with empirical data updated from world databases that measure the Sound Speed Profile (SSP), bathymetry and floor sediment such as the General Bathymetric Chart of the Oceans (GEBCO) and National Oceanic and Atmospheric Administration (NOAA) [15, 16]. The ocean wave's motion is also

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 7, Issue 5, May 2018

included to calculate the rays' trajectories; so taking into account the type of sediments and the sound speed profile (SSP) this propagation model shows a behaviour that it is very close to experimental studies for acoustic propagation in underwater environments (more details can be found in [14,17]). For a system with cylindrical symmetry, the ray equations can be written as:

$$Drds = c\xi(s), d\xi ds = -1c^2 \partial c \partial r \quad (5)$$

$$dz ds = c\zeta(s), d\zeta ds = -1c^2 \partial c \partial z \quad (6)$$

where $r(s)$ and $z(s)$ represent the ray cylindrical coordinates and s is the arclength along the ray; the pair $c(s)$ [$\xi(s)$, $\zeta(s)$] represents the tangent versor along the ray. Initial conditions for $r(s)$, $z(s)$, $\xi(s)$ and $\zeta(s)$ are $r(0)=r_s$, $z(0)=z_s$, $\xi(0)=\cos \theta_{scs}$, $\zeta(0)=\sin \theta_{scs}$ (8)

where θ_s represents the launching angle, (r_s, z_s) is the source position, and c_s is the sound speed at the source position. The coordinates are sufficient to obtain the ray travel time:

$$\tau = \int \Gamma ds c(s) \quad (7)$$

which is calculated along the curve $[r(s), z(s)]$.

Figure 1 shows how the Bellhop tool draws the ray trajectories to calculate the travel of the acoustic signals and thus obtain the attenuation at different points of the scenario.

C. MAC and Routing

In the wake of investigating and examining a few acoustic spread models, in this segment we will present a few higher system layer conventions that we will utilize later in our examinations. The vast majority of the higher conventions exhibited underneath were proposed for earthly system advances, and their system execution is outstanding. Notwithstanding, as expressed in the presentation, UWSNs display a few compositional contrasts regarding the earthly ones. Specifically, the acoustic flag proliferation delay is a few requests of greatness higher than RF signals, bringing about substantial flag spread versus parcel transmission time proportions, something which it isn't alluring for acquiring high usage levels of system assets, and as a result restricting the general system execution. Along these lines, the conduct of larger amount conventions may genuinely change when they are utilized in UWSN situations.

Similarly as with acoustic spread models, they chose conventions for the assessment include: (a) few MAC layer conventions: from basic recommendations, similar to ALOHA that exclusive considerations of sending the parcel message, until the point that more unpredictable conventions like DACAP that incorporate bearer sense and impact shirking by methods for no less than three-way handshake trades; and (b) a few directing conventions: a basic static steering and a cross-layer steering proposition FBR. We will test every one of them to decide how the situation natural changes affect on their execution as far as throughput and deferral.

In energy efficient vector based forwarding, the is used more efficiently by allotting number of slots to transmit the data in order to reduces the noise. First it choose two nearby nodes in that it chooses a node which has nigh energy level.

II. LITERATURE SURVEY

In the year of 2011 the authors "Llor, J.; Stojanovic, M.; Malumbres, M.P." proposed a paper titled "A simulation analysis of large scale path loss in an underwater acoustic network [7]" in that they described such as: Proliferation conditions in a submerged acoustic channel are known to shift in time, making the got flag quality veer off from the ostensible esteem anticipated by a deterministic engendering model. To encourage vast scale framework outline in such conditions (e.g. control assignment), we build up a factual proliferation display in which the transmission misfortune is dealt with as an arbitrary variable. By redundant calculation of acoustic field utilizing beam following for an arrangement of shifting natural conditions (surface tallness, wave movement, little removals of transmitter and recipient around ostensible areas), an outfit of transmission misfortunes is aggregated which is then used to induce the measurable model parameters.

A sensible understanding is found with log-typical appropriation, whose mean complies with a log-separate increments, and whose fluctuation gives off an impression of being steady for a specific scope of between hub removes in a given organization area. The measurable model is esteemed helpful for more elevated amount framework

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Vol. 7, Issue 5, May 2018

arranging, where reenactment is expected to survey the execution of applicant organize conventions under different asset allotment arrangements, i.e. to decide the transmit power and data transmission designation important to accomplish a coveted level of execution (network, throughput, dependability, and so forth.).

III. EXPERIMENTAL RESULTS

The following table illustrates the input parameters of the proposed work.

TABLE.1 INPUT PARAMETERS

S.NO	CHARACTERISTICS	RANGES
1	NUMBER OF NODES USED	12
2	TRANSMISSION RANGE	100m
3	WIDTH	100
4	PACKET SIZE	50bytes
5	UW-MAC	BROADCAST MAC
6	SIMULATION TIME	100sec
7	INITIAL ENERGY	5 kilojoules

Performance of Energy Consumption

The following figure illustrates the energy consumption ratio of the proposed work. Obtain the performance of Bellhop, Monterrey Miami Parabolic Equation (MMPE), propagation model in the terms of energy with respect to time. Comparison of energy consumed between BH, MMPE, performance is analysed. X-axis represents simulation time in secs and Y-axis represents energy in joules. Energy consumption is less in MMPE propagation model when compare to other propagation models.



Fig.2 Energy Consumption Ratio

Performance of Throughput

The following figure illustrates the Throughput analysis of the proposed work. Obtain the performance of Bellhop, Monterrey Miami Parabolic Equation (MMPE) propagation model in the terms of Throughput with respect to time. Comparison of Throughput between BH, MMPE performance is analyzed. X-axis represents simulation time in secs

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 7, Issue 5, May 2018

and Y-axis represents Throughput. Throughput is high in MMPE propagation model when compare to other propagation models.

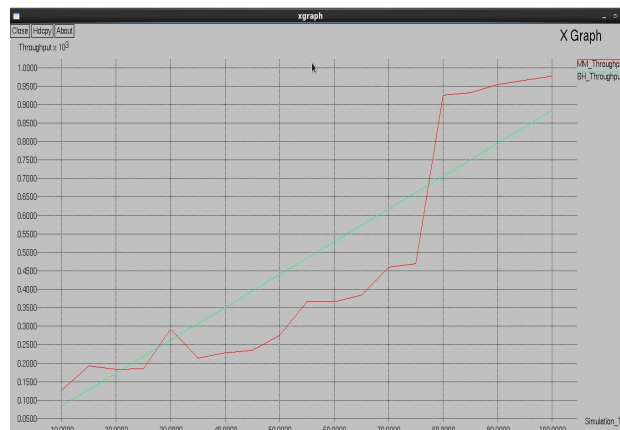


Fig.3 Throughput Analysis

Performance of BER

The following figure illustrates the BER of the proposed work. Obtain the performance of Bellhop, Monterrey Miami Parabolic Equation (MMPE) propagation model in the terms of energy with respect to time. Comparison of energy consumed between BH, MMPE performance is analysed. X-axis represents simulation time in secs and Y-axis represents energy in joules. Energy consumption is less in MMPE propagation model when compare to other propagation models.



Fig.4 Bit Error Rate

Performance of PDR

The following figure illustrates the Packet Delivery Ratio of the proposed work. Obtain the performance of Bellhop, Monterrey Miami Parabolic Equation (MMPE) propagation model in the terms of energy with respect to time. Comparison of energy consumed between BH, MMPE performance is analysed. X-axis represents simulation time in secs and Y-axis represents energy in joules. PDR is high in MMPE propagation model when compare to other propagation models.

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Vol. 7, Issue 5, May 2018



Fig.5 Packet Delivery Ratio Analysis

IV. CONCLUSION

In this paper we analyzed underwater acoustic propagation models from a simple approach to more detailed and accurate models, in order to perform whether differences between them may seriously impact in the performance evaluation of protocols. As a first conclusion we found that accurate and low-complexity propagation models are required for network simulation in order to obtain reliable results attained to the specific scenario and environmental parameters. From the performance of Bellhop, Monterrey Miami Parabolic Equation (MMPE), MMPE propagation model gives the better performance when compared with other propagation models.

Also we perform several simulation experiments to determine the sensibility of protocols (MAC and routing protocols) to propagation models and scenario environmental parameters. From the obtained results, we conclude that: MMPE high packet delivery, they show better behaviour in terms of good throughput and energy consumption and BER.

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