Performance Escalation and Optimization of Overheads in the Advanced Underwater Sensor Networks with Internet of Things

S Pradeep, Yogesh Kumar Sharma

Abstract: ***In today's world, a huge range of devices are interconnected with the wireless technologies which gave the dawn to the state-of-the-art technology of Internet of Things (IoT). A number of smart gadgets and machines are now monitored and controlled using IoT protocols. The technologies of IoT are now spread to the entire world by which there is all time connectivity in the devices connected using IoT. From the research reports of Statista.com, The sale of smart home devices elevated from 1.3 billion dollars to 4.5 billion dollars from year 2016 to year 2019 in the United States. As per the news from Economics Times, there will be around 2 billion units of eSIM based devices by year 2025. With the use of eSIM, the subscribers can use the digital SIM card for the smart devices and the services can be activated without need of the physical SIM card. It is one of the recent and secured applications of Internet of Things (IoT). Beyond the traditional applications, IoT is under research for the environment monitoring and prior notifications to the regulating agencies so that the appropriate actions can be taken. The reports from LiveMint.com underline that Indian Institute of Technology (IIT) and Ericsson getting associated for handling the air pollution in Delhi. As per the news report by Grand View Research Inc., the global NB-IoT market size is presented to touch more than 6,000 million dollars by year 2025. NB-IoT refers to the radio technology standard with low-power wide-area network (LPWAN) so that the huge coverage of smart devices can be done with higher degree of performance in the connectivity. The research manuscript is presenting the use case analysis of underwater network with the integration of IoT so that the all time connectivity and performance can be analyzed on the assorted dimensions.***

Keywords : Advanced Wireless Networks, IoT Enabled Underwater Networks, Underwater Sensor Networks

I. INTRODUCTION

The today's scenario is surrounded with the assorted gadgets and smart devices in which the all time connectivity is there for assorted parameters and dimensions. Underwater Networks are deployed in the ocean or deep river area for cavernous analysis of specific key points [1, 2].

Underwater Networks with IoT integrates the advanced wireless protocols so that the remote monitoring under the ocean can be done [3, 4].

Figure 1: Internet of Underwater Things (IUT)

Following are the applications domains and perspectives of IoT implementations [5, 6, 7]

Defense Applications

- IoT enabled Underwater Network
- IoT based Underwater Acoustic Network
- IoT enabled submarines

Smart City

- Smart Parking
- Smart Roads
- Smart Toll Plaza
- Smart Traffic Lights
- Traffic Congestion

Environment Protection and Sustainable Resources

- Forest Fire Detection
- Air Pollution
- Earthquake Detection
- Sea Based Disaster Prediction
- Snow Level Monitoring
- Avalanche and Landslide Prevention

Smart Home

- Wearable
- Smart Home Appliances
- Old Age Persons' Monitoring Devices

Smart Water

- Potable water monitoring
- Chemical leakage detection
- Remote Swimming Pool Analysis
- Pollution Levels Analysis
- Water Leakages
- River Floods

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Retail
- Supply Chain Control
- Smart Product Management
- Intelligent Shopping Applications
- Industrial Control

Industrial Applications
- Smart Grids
- Machine to Machine Communication
- Machine Auto-Diagnosis
- Indoor Air Quality
- Industrial Disaster Prediction
- Temperature Monitoring
- Ozone Presence
- Indoor Location

Smart Agriculture
- Smart Farming
- Agriculture Robots (Agribots)
- Soil Quality Measurement
- Green Houses

Digital Health and Telemedicine
- Patients Surveillance
- Medical Fridges
- Ultraviolet Radiation
- Telemedicine
- Digitally Connected Health

II. UNDERWATER SENSOR WITH INTERNET OF THINGS

A wide range of simulators and frameworks are available to simulate the scenarios of Internet of Things (IoT) in Free and Open Source distribution. These libraries and simulators can be used for research and development so that the performance of different algorithms of smart environment and IoT can be analyzed [8, 9]. To work with any research project for advanced wireless environment, it is required to simulate it so that the prior behavior can be evaluated on multiple parameters before launching the actual project of IoT enabled underwater scenario[10].

III. SIMULATION SCENARIO

CupCarbon is the prominent and multi featured simulator that is used for the simulation of smart cities and IoT based advanced wireless networks scenarios. The scenarios of advanced IoT are getting huge fame as per the reports from the research analytics [11, 12].

CupCarbon provides the effective Graphical User Interface (GUI) for the integration of objects in the advanced protocols enabled devices and wireless sensors. In addition, the CupCarbon simulator is having the Senscript Editor in which the programming of sensor nodes and algorithms can be done. SenScript is the script that is used for the programming and control of sensors used in the simulation environment. In SenScript, a number of programming constructs and modules can be used so that the IoT environment can be simulated. CupCarbon is having a SenScript Editor in which the SenScript code is placed and executed by the developer.

Creating Dynamic Scenarios for IoT and Smart Cities using CupCarbon Simulator

The working environment of CupCarbon is having enormous options to create and program the sensors of different types. At the middle, there is a *Map View*, in which the smart underwater scenario under simulation can be viewed dynamically.

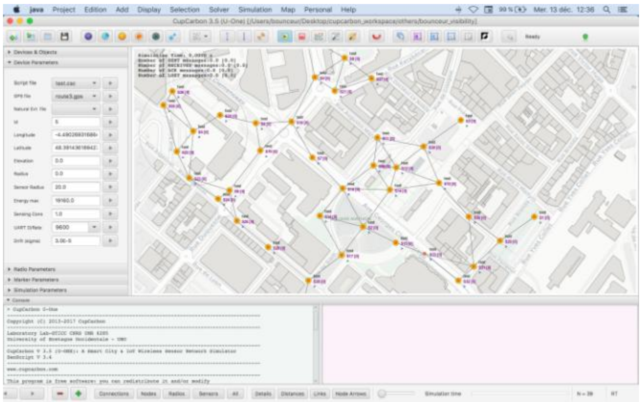

Figure 2: Assorted Objects and Connections in CupCarbon Simulator

The sensors and smarts objects are displayed in the map view. To program these smart devices and traffic objects, the Toolbar of CupCarbon provides the programming modules so that the behavior of each and every object can be controlled and programmed.

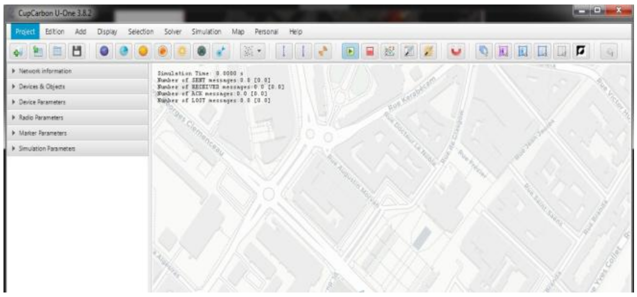

Figure 3: Working Panel of CupCarbon Simulator

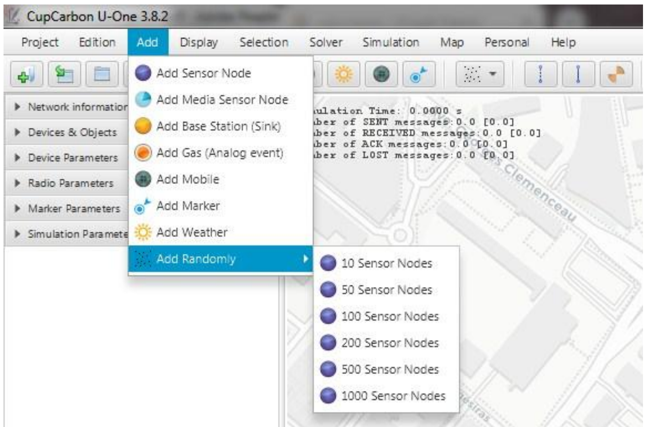

Figure 4: Adding different types of Sensor Nodes in CupCarbon

Any number of nodes or motes can be imported in CupCarbon for the programming with the random positions. In addition, the weather conditions and environmental factors can be added so that the IoT project can be simulated under specific environmental temperature. Using this option, the performance of IoT based underwater scenario implementation can be done under different situations with varying sea temperatures.

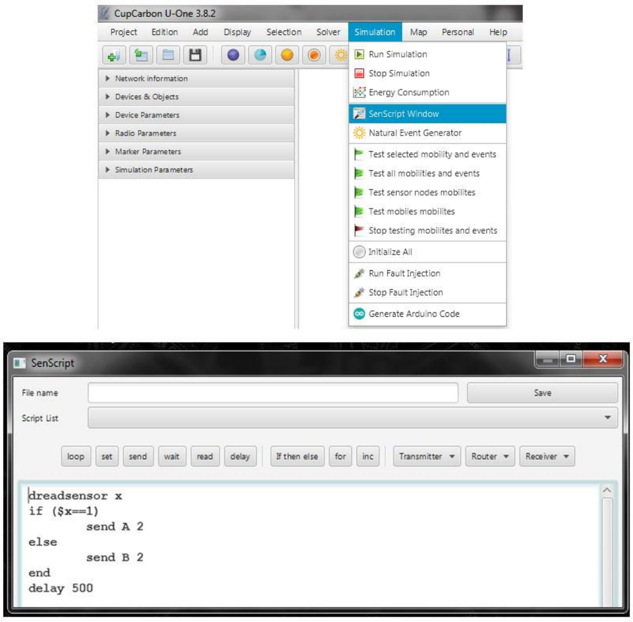

Figure 5: SenScript Editor in CupCarbon for Programming of Sensors

The SenScript Editor provides the programming editor so that the functions and methods with each sensor or smart device can be executed. SenScript Editor is having a wide range of inbuilt functions which can be called. These functions can be attached with the sensors and smart objects in the CupCarbon simulator.

Figure 6: Integration of Markers and Routes in the CupCarbon

The markers and routes provide the traffic path for the objects in the smart wireless integrated environment. By this approach, the vehicles can follow the shortest path from source to destination with the consideration of congestion or jams.

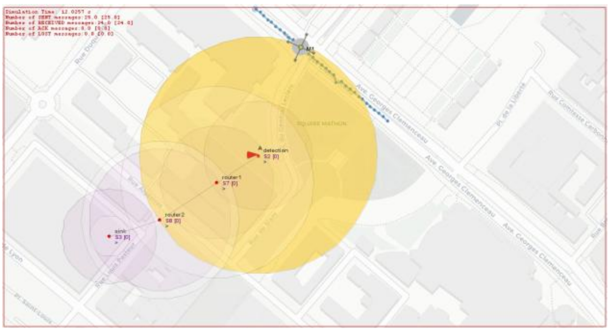

Figure 7: Execution of SenScript in CupCarbon

On execution of the code written in SenScript, the animated view of underwater scenario is visualized with the mobility of underwater vehicles and objects. This view enables the development team to check whether there is any probability of congestion or loss of performance. By this visualization, the improvements in the algorithm and associated code of SenScript can be done so that the proposed implementation can provide higher degree of performance and minimum resources.

Figure 8: Google Map View of Simulation in CupCarbon

In CupCarbon, the simulation scenario can be viewed like Google Map including Satellite View. It can be changed to Satellite View in a single click. Using these options, the traffic, roads, towers, underwater vehicles and other objects can be visualized along with the congestion in the simulation and real time environment can be felt.

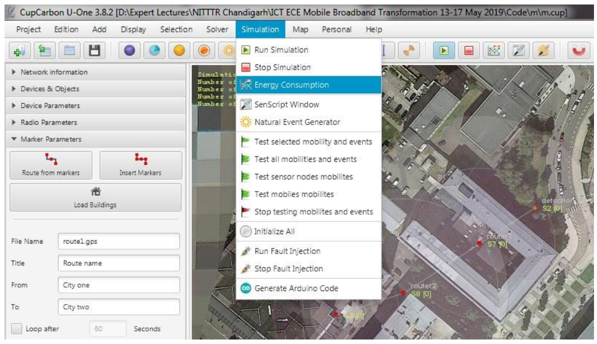

Figure 9: Analyzing the Energy Consumption and Research Parameters in CupCarbon

On running and visualization of the Smart Underwater scenario using CupCarbon is always required to analyze the performance of the network to be deployed. For such evaluations of a new project, the parameters like energy, power, security, integrity are others are required to be investigated. CupCarbon integrates the options for energy consumption and other parameters so that the researchers and engineers can view the expected effectiveness of the project.

IV. CONCLUSION

The government agencies as well as the corporate giants are getting associated for the big wireless integrated projects so that the better control on the huge infrastructure and resources can be done. The research scholars and practitioners can propose novel and effective algorithms for advanced implementations for the Internet of Underwater Networks. The proposed algorithms can be simulated using advanced simulators and the performance parameters can be analyzed on different dimensions.

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