Throughput Analysis of Wireless Geophone Networks for Seismic Surveys

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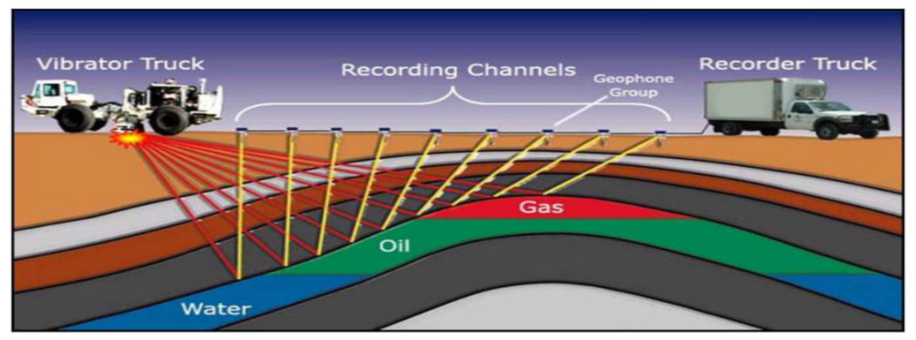
BACKGROUND

Traditional seismic data acquisition systems rely on cables to deliver data in conducting oil and gas exploration. Although cabled systems provide reliable seismic data transfer, their deployment and maintenance costs are increasing substantially as surveys become larger in scale [1].



Transmission	Cost	Weight	Speed	Security
Wired	High	Heavy	Almost instantaneous	Excellent
Wireless	Lower by 50%	Lower by 75%	Depends on the system time delay	Poor and could be improved using different protocols

Table 1. Comparison between wired and wireless data transmission in seismic data acquisition.

INTRODUCTION

- In this work, we evaluate the throughput of a wireless geophone network (WGN) architecture that uses IEEE802.11 standard to send data from wireless geophones (WG) to the storage and processing unit. More specifically, we investigate the transmission from WGs to access points called wireless geophone gateways (WGG).
- Standards/protocols explain how data are transferred and received in communication networks.
- IEEE 802.11 standard is suitable for WGN because it uses white space spectrum and eliminate any possible interferences with licensed users [2].
- As the number of WGs increases, the medium will be more busy and hard to control. Hence, data transfer is done using Carrier Sense Multiple Access/Collision Avoidance CSMA/CA protocol [3].
- The WGN should support a sum-throughput between 1-5 Gb/s depending on the sampling time [1].

KEY WORDS

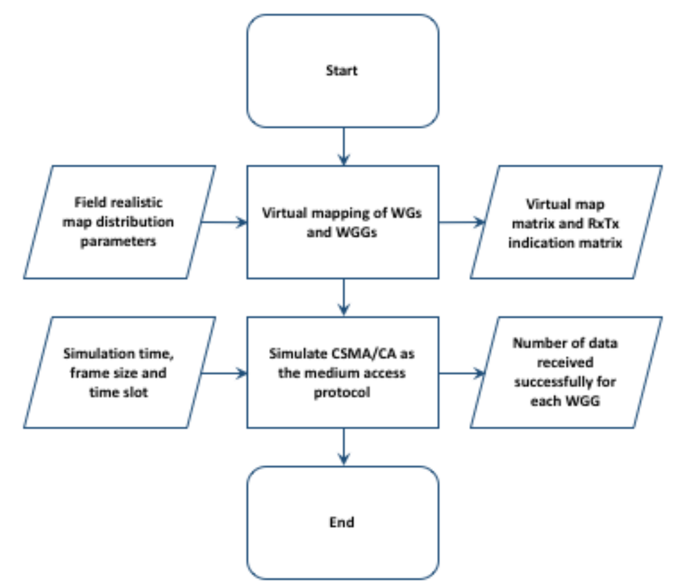
- WG: Wireless Geophone.
- WGG: Wireless Geophone Gateway.
- WSN: Wireless Geophones Network.
- Throughput: A measure of how much data received successfully versus total data transmitted.

OBJECTIVE

Simulating WGN to analyze the network throughput for the transmission between WGs and WGGs.

METHODOLOGY

MATLAB was used to do the simulation of CSMA/CA protocol as shown in the following flowchart diagram. The table on the right side shows some of the network parameters used. Below is the map distribution of the simulated WGN.



Total number of WGs	14400
Range of WG	150 meters
Total number of WGGs	128
Range of WGG	1000 meters
Data rate “Wi-Fi (11g)”	6 Mb/s
Simulation time	1 s
Time slot	0.002 s
Frame size	$\frac{0.9}{Number\ of\ WGs\ per\ WGG}$ s

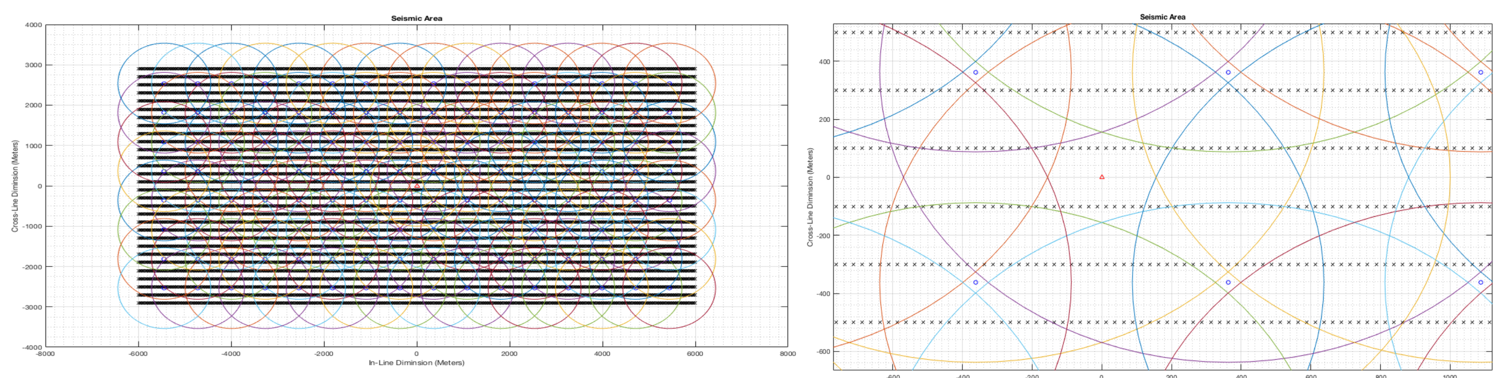
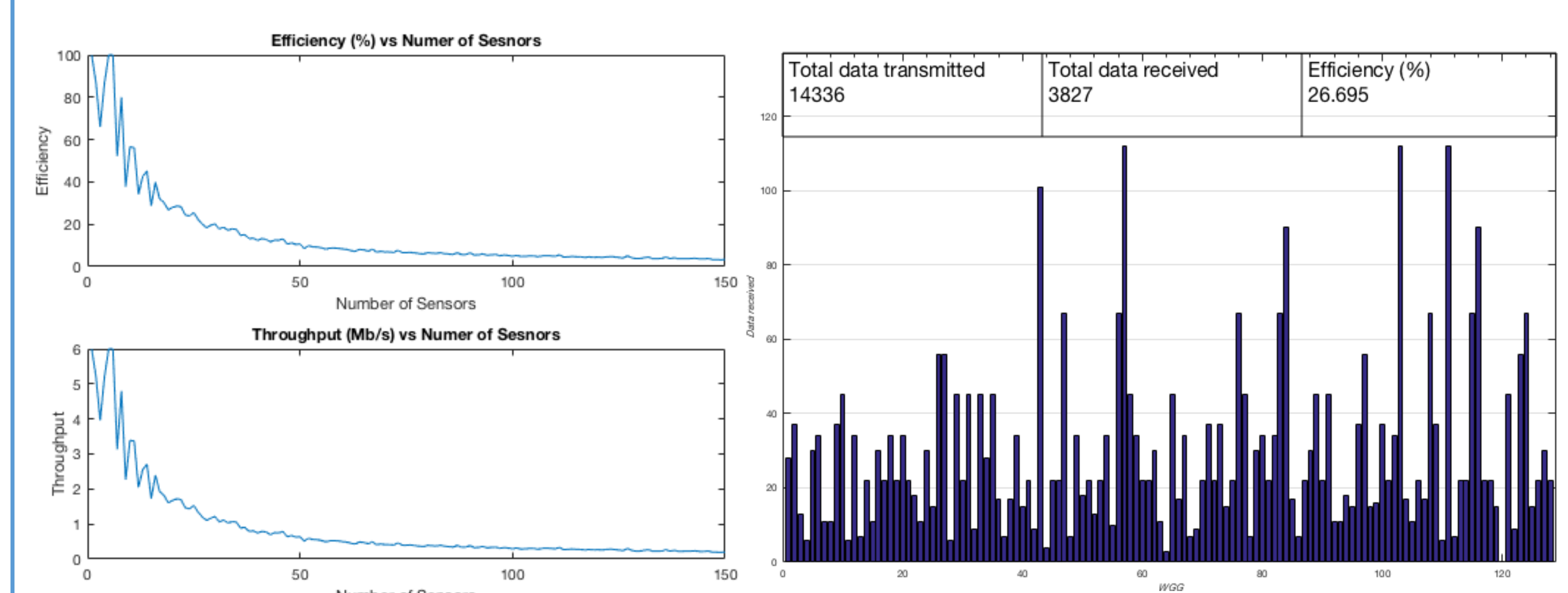


Figure.2 Flowchart, different simulation parameters and resultant map distribution.

RESULTS

Throughput and accompanied efficiency of WGN are both plotted as the number of WGs per one WGG increases. After simulating the whole network, a graph of all data received successfully for all WGGs was obtained as can be seen below.



(a) (b)

Figue.1 a) WGN throughput and accompanied efficiency. b) Data received successfully for all access pints in the network.

CONCLUSION

- Total of 14,400 WGs were simulated to transmit data to WGGs using CSMA/CA protocol.
- In the simulation, optimum value of WGs per WGG was found to be around 112. dividing the total number of WGs by 112 result in 128 WGGs.
- Only 26.7% of the original data were collected.
- Increasing the number of WGs connected to each WGG requires high degree of interpolation techniques to compensate the lost data.

References

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[2] B. F. Adriana, E. G. Ryan, Knightly, W. K. Edward, P. Ecclesine, P. Santosh, "IEEE 802.11af: A Standard for TV White Space Spectrum Sharing" *IEEE Commun. Mag.* pp. 92-100, October 2013.

[3] S. Nimarta, S. Paramjeet, R. Shaveta, "Improved Optimal Slotted CSMA/CA Protocol Cites" *International Journal of Computer Applications* (90975 – 8887), vol.79, no.6, pp.43-47, October 2013.

ACKNOWLEDGEMENT

I would like to thank “Allah” and then all people who contributed to make this research experience possible especially Dr. Al-Ghadhban, Dr. Al-Dharrab and Dr. Iqbal since I was guided directly by them step by step. They certainly made the path to the research world much easier.

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