Accepted Manuscript

Wireless Sensor Networks in oil and gas industry: Recent advances, taxonomy, requirements, and open challenges

Mohammed Y. Aalsalem, Wazir Zada Khan, Wajeb Gharibi, Muhammad Khurram Khan, Quratulain Arshad

PII: S1084-8045(18)30130-9

DOI: 10.1016/j.jnca.2018.04.004

Reference: YJNCA 2118

To appear in: *Journal of Network and Computer Applications*

Received Date: 16 October 2017

Revised Date: 10 February 2018

Accepted Date: 11 April 2018

Please cite this article as: Aalsalem, M.Y., Khan, W.Z., Gharibi, W., Khan, M.K., Arshad, Q., Wireless Sensor Networks in oil and gas industry: Recent advances, taxonomy, requirements, and open challenges, *Journal of Network and Computer Applications* (2018), doi: 10.1016/j.jnca.2018.04.004.

Wireless Sensor Networks in Oil and Gas Industry: Recent Advances, Taxonomy, Requirements, and Open Challenges

Mohammed Y Aalsalem[1], Wazir Zada Khan[1], Wajeb Gharibi[1], Muhammad Khurram Khan[2], Quratulain Arshad[1]
[1]Farasan Networking Research Laboratory, Faculty of CS & IS, Jazan University, Kingdom of Saudi Arabia
[2]Center of Excellence in Information Assurance, King Saud University, Kingdom of Saudi Arabia
{ aalsalem.m, wazirzadakhan, gharibi }@jazanu.edu.sa, mkhurram@ksu.edu.sa, brightsuccess_12@yahoo.com

***Abstract*—**The industrial world of oil and gas involves critical processes and machinery for the exploration, extraction, refining, transporting and marketing petroleum products. Oil and gas companies need to control, monitor, maintain and secure the processes and industrial assets in an efficient manner. To resolve the critical challenges of pipeline condition, corrosion and integrity monitoring, gas leak detection, and other related problems, Wireless Sensor Networks (WSN) provide promising solutions. WSN is the most prevalent technology used in oil and gas industry that has provided remote facilities to detect and report the anomalous events like the positions of leakage, corrosion or any other damage. A few existing studies in the literature do not cover the recent WSN based systems and techniques and only review the pipeline monitoring systems. These surveys lack the recent WSN based systems developed for monitoring and detecting damages to pipelines as well as other assets of oil and gas industry. In this paper we present a comprehensive review and detailed comparison of the most recent systems or techniques developed for monitoring various anomalous events that are involved in the three sectors (upstream, midstream, downstream) of oil and gas industry. We also describe the important requirements of WSNs to be deployed in the oil and gas industry. Finally, we highlight critical challenges of oil and gas industry.

Keywords—Leak and Corrosion Detection, Flow, Pressure and Temperature Monitoring, Wireless Sensor Networks, Oil and Gas Pipeline Monitoring.

I. INTRODUCTION

Oil and Gas industry involves indusial operations and these operations are performed in three levels (sector) from upstream, midstream and downstream. Upstream sector is comprised of searching and extracting the raw materials. The companies actively search for underground and under water sources of crude oil and natural gas and by using sophisticated intrusive (drilling) and non-intrusive (surveying) equipment and techniques; they draw oil and natural gas to the surface. The Midstream sector encompasses the production and storage of oil and gas and finally transporting it to the downstream sector. The crude or refined petroleum products are stored in the storage tanks and then transported usually via pipelines, barge, oil tanker, truck or rail to the final destination of refineries for commencing the downstream processes. The downstream sector involves refining processes, purifying of crude oil and natural gas, distribution and retail of petroleum products. The final products that are made to market and distribute include petrol, gasoline, diesel oil, jet fuel, lubricants, heating oil, asphalt, waxes and a plethora of different petrochemicals. Figure 1 shows the three sectors of oil and gas industry and their responsibilities.

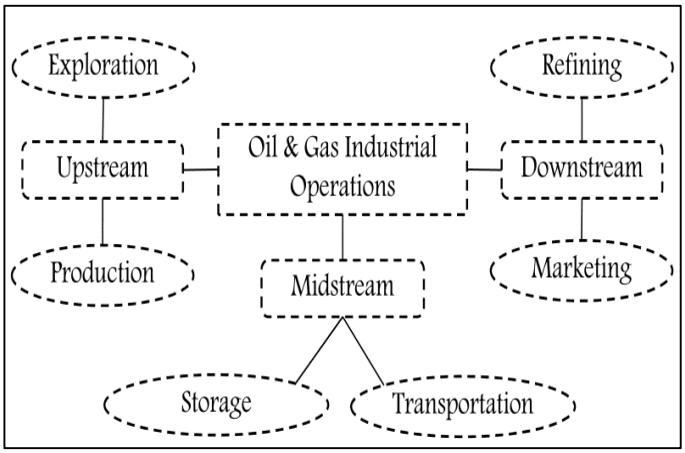

Figure 1. Subdivisions of Oil & Gas industrial operations.