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Wireless Technologies for Condition-Based Maintenance (CBM) in Petroleum Plants

Kannan Srinivasan[1], Moïse Ndoh[1], Hong Nie[2], Congying (Helen) Xia[2], Kadambari Kaluri[2], Diane Ingraham[2]

[1] National Research Council of Canada
Institute for Information Technology
Wireless Systems
Sydney, Nova Scotia, Canada.
Kannan.Srinivasan@nrc-cnrc.gc.ca, Moise.Ndoh@nrc-cnrc.gc.ca
http://iit-iti.nrc-cnrc.gc.ca
[2] Cape Breton University
Sydney, Nova Scotia, Canada.
Hong_Nie@capebretonu.ca, Helen_Xia@capebretonu.ca,
Kadambari_Kaluri@capebretonu.ca, Diane_Ingraham@capebretonu.ca
http://www.capebretonu.ca

Abstract. Wireless devices and systems have been deployed in many communication sectors but have not yet been adequately adapted to harsh industrial environments. Cost effective, reliable and scalable wireless technologies have yet to be introduced in industrial plants, including petroleum plants. At this time, there are very few, if any, cost-effective Commercial-Off-The-Shelf (COTS) radios available that can be used to provide reliable data links under the very harsh conditions encountered in petroleum environments. This paper presents a strategic approach to research wireless system technologies and their application to the oil and gas industry, specifically for asset integrity and automated diagnostic CBM applications.

Introduction and Strategy

The failure of critical operational equipment in the petroleum industry is a major expense because downtimes mean a loss of revenue to the companies. Recent study [5] has shown that inaccurate predictions of lifetime of equipment costs about $1 trillion per year in replacing good equipment. To mediate this, companies may choose to employ Condition-Based Maintenance (CBM) strategies that maximize operational uptimes and minimize equipment repair and replacement. CBM requires timely, reliable, up to date, and cost effective data collection for reliable equipment failure prediction [8].

Currently the petroleum industry pays high labor charges for skilled technicians to run routes with data collectors on a regular basis as part of (CBM) procedures [5]. This labor intensive solution is not always timely and cost effective. An alternative solution involves hard wired data collectors. The costs of installing such

dedicated solution is very expensive due to the cost of conventional (copper, fiber optic) wires. Some estimates are as high as $2000 per linear foot! Plants operating in rigorous environments with extremes of high and low temperatures, rain, snow, ice, and harsh or corrosive chemicals mean even hardened cables must be replaced every 6 months and cost estimates in the order of $6 - $8 million are certainly possible depending on the project.

A reliable, robust and rugged wireless mesh networking architecture, apart from solving the cable issue, could provide near real time monitoring capability. This, integrated with existing CBM trend analysis software, can help predict equipment failure in a timely fashion. However, the electromagnetic environment in a petroleum plant is a challenge for implementing any wireless communication technology. We propose to design a power-efficient, robust wireless mesh network that involves careful modeling [7] of the wireless channel followed by suitable transceiver architecture implementation [6] [2], signal processing [1] [3] and cross layer protocol stack [4] designs.

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