# Poster Abstract: Integrating Wireless Sensor Networks with Networked Control Systems

Khaled Daabaj
School of Information Technology
Murdoch University
Perth, WA 6150, Australia
Email: k.daabaj@murdoch.edu.au

*Summary*—**The integration of Wireless Sensor Networks (WSNs) into industrial networked monitoring and control systems has become an essential factor to effectively regulate and manage industrial automation operations. The automation of monitoring and control systems is an important function for many utility companies such as oil/gas and electricity companies in order to reduce operating cost and to increase efficiency. There are many issues that have to be dealt with concerning the integration of WSNs into such systems and these issues have to be addressed in an application-specific manner. One of the most widely used control systems in industrial control automation is the Supervisory Control And Data Acquisition (SCADA) systems, and with the aim of improving productivity of monitored sites (e.g., oil/gas well and pipelines) at minimal costs, it is very significant to enable the interoperability of SCADA systems with new technologies such as WSNs and extensibility of future SCADA systems for new applications. Furthermore, a new approach of in-network processing system is essential to successfully monitor, detect, identify, and localize anomalies such as blockage and leakage. This new approach should consider the benefits of low cost, flexible deployment, continuous monitoring, and accurate problem detection, identification, and localization quickly, reliably, and accurately, thereby improving the current SCADA system.**

## I. INTRODUCTION

Wireless Sensor Networks (WSNs) can be invaluable in civil, environmental, industrial, and military applications for collecting, processing, and disseminating wide ranges of complex data. They have therefore, attracted considerable research attention in the last few years. For example, the early SmartDust project [1] aims to integrate sensing, computation, and wireless communication capabilities into a small form factor to enable low-cost production of these tiny sensor nodes in large numbers. On the other side, Supervisory Control And Data Acquisition (SCADA) systems [2] have been widely used in industrial asset monitoring, HVAC control, automatic meter reading, oils and gas industry, and more. Due to their application-specific nature, most SCADA systems are heavily customized to achieve a specific purpose. For example, a Remote Terminal Unit (RTU) that monitors and controls a production well in an oilfield is only connected with a few sensors at the production well. The RTU usually collects sensor data at pre-defined intervals, and only sends data back when being polled by a central data server. A user can only access the data either by connecting to the RTU in the site or reading from the data server in the control room.

### *A. SCADA systems Challenges:*

A major drawback of typical SCADA systems is their inflexible, static, and centralized architecture, which largely limits their interoperability with other systems. WSNs are a promising technology that can significantly improve the sensing capability of the SCADA system. Sensor networks employ large number of low-cost sensors with easy and flexible deployment, which can largely extend the sensing coverage. For example, in a SCADA system developed for oil/gas fields, the RTUs are usually places at production wells and injection wells. However, there are many other places, such as pipeline, tanks, etc., that have valuable data but are too expensive (e.g., wired network) to deploy more RTUs. In such cases, WSNs are a perfect solution to extend the sensing capability of the SCADA system. However, it is difficult to integrate sensor networks with current SCADA systems due to their limited interoperability. Another drawback of the current SCADA systems is their limited extensibility to new applications. In the oilfield monitoring, a user in the field can only access a sensor's data by physically going to that well and connecting to its RTU and the rigid design of current RTUs makes it hard to extend the SCADA from one application to another. Table I compares the major differences between SCADA systems and WSNs [3].

| System | Architecture | Storage & Control | Flexibility | Cost | Node Density | Data Rate | Network Protocol |
|---|---|---|---|---|---|---|---|
| SCADA | Centralized | Central site | Inflexible | Expensive | Low | Low | Proprietary |
| WSN | Decentralized | Local sensor node | Versatile | Inexpensive | High | High | Non-proprietary |

TABLE I
COMPARISON BETWEEN SCADA AND WSN SYSTEMS FOR OILFIELD MONITORING [3]

### *B. Interconnectivity Architecture:*

Designing flexible communication architecture is one of the key factors to enable interconnectivity and extensibility where SCADA systems should adopt the use of networking technology rather than proprietary or link-level approaches. Such a scheme would make it easy to shift to a multitier architecture. At the top tier is SCADA backbone network that connects all RTUs while at the lowest tier some RTUs are connected with WSNs to support multihop data communication between different RTUs within adjacent monitored sites. Therefore, data sharing between RTUs becomes possible as data from a remote sensor can be forwarded to the backbone network by multiple relaying wireless sensor nodes that flexibly extend the sensor coverage of the SCADA system.

## II. CONCLUSION

Most sensors used in SCADA systems are wired, which limits their use. Integrating WSNs with SCADA systems would make monitoring more flexible. An integration platform solution is essential to identify this need which serves as a gateway between WSN and SCADA. This solution should allow facilitating flexible, maintenance-free systems suitable for most industrial and field operations using low power, battery-operated solutions that offer a low cost, wireless alternative to traditional cabled systems.

## REFERENCES

[1] J. M. Kahn, R. H. Katz, and K. S. J. Pister, "*Next century challenges: mobile networking for smart dust*", in Proc. Mobicom, pp. 483-492, 1999.
[2] Stuart Boyer, "*SCADA: Supervisory Control and Data Acquisition*", Instrument Society of America, 2004.
[3] S. Yoon, W. Ye, J. Heidemann, B. Littlefield, and C, Shahabi, "*SWATS: Wireless Sensor Networks for Steamflood and Waterflood Pipeline Monitoring*", CiSoft, 2008.