Demo Abstract: HONS (Hybrid Open Networking Stack) for Diverse Wireless Sensor Networks

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Abstract

HONS (Hybrid Open Networking Stack) is a system which can service diverse types of sensor nodes as a single network. By defining open packet format of IEEE 802.15.4 standard, it can form low-power multi-hop network of diverse sensors. HONS system is composed of routers and wireless sensor nodes. Routers are motes with wired power and form the basic backbone of the multi-hop network. Wireless sensor nodes are motes powered by battery, and operate in a lower-power mode, and are attached to the multi-hop network formed by routers.

Categories and Subject Descriptors

C.2.2 [**Computer-Communication Networks**]: Network Protocols

General Terms

Performance, Design, Reliability, Experimentation

Keywords

Hybrid Network Protocol, Open Network, Diverse Wireless Sensor

1 Introduction

In the multi-hop network service of wireless sensor networks, low-power network stack is a necessity. Especially in the outdoor environment without wired power, the performance of a low-power operation characterizes the usefulness of the entire system. However when we analyze where WSN is applied, there also exist many areas where power is supplied; for example, factory automation, home network, port, and power utilities. To optimize for these environments, HONS is designed to be structured as a two-level network. HONS is made of routers and low-power wireless sensor nodes. Routers have wired power supply and provide multi-hop mesh routing. Low-power wireless sensor nodes operate in low-power mode and are attached to the multi-hop networks formed by routers, as a leaf node. Routers enable stable multi-hop network, and wireless sensor nodes enable connecting diverse sensors in low power using a very short code. In HONS, both routers and wireless sensor nodes are implemented using TinyOS. It supports thermometer, humidity sensor, light sensor, power meter for appliances, human presence detector, and door sensor, and it is very easy to support any other sensor.

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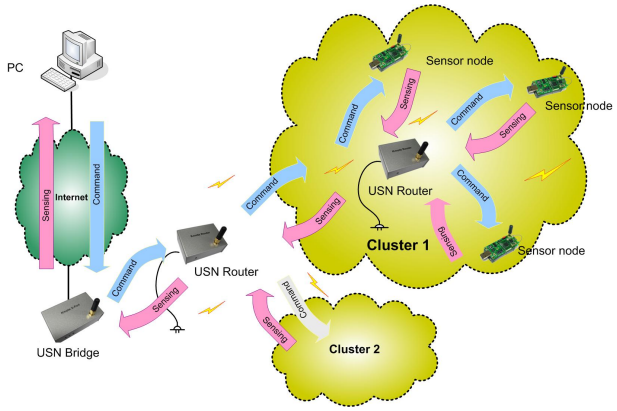

Figure 1. HONS System Diagram

2 HONS Design

2.1 Overview of HONS

HONS system is composed of following components: application server, USN-bridge which connects the server and the multi-hop sensor network through the Internet, USN router, and wireless sensor node. The system diagram of HONS is depicted in Figure 1. An application server is the storage of sensor data. A USN-bridge acts as a sink node, which is also the starting point in forming the network. It collects data and forwards data to the server through the Internet. A router forms a multi-hop network, and whenever it receives a packet sent from a wireless sensor node, it forwards the packet to the USN-bridge. A wireless sensor node periodically samples data and sends it. For a low-power operation, except when it turns on the radio for packet transmissions, it stays in a sleep state.

2.2 Open Networking Packet Interface

For wireless sensor nodes and routers to be connected into a single network, both use IEEE 802.15.4 standard. Figure 2 shows the common packet format. A wireless sensor node picks one of nearby USN router as its parent and is attached to the network. It does not support multi-hop network, but connects to the network through only a single-hop communication with a router. Because of this characteristic, it can control duty-cycle by turning on RF only when transmitting

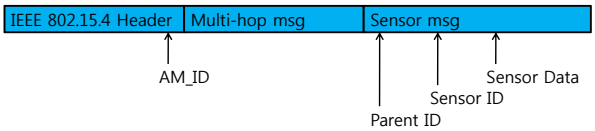

Figure 2. Open Networking Packet Interface

its own sensor data. Under the condition of one transmission per minute, it can last for three years with two regular AA alkaline batteries. For the coexistence of USN routers and wireless sensor nodes, they use the same predefined active message ID [1] and data fields.

For a wireless sensor node to be connected to the network, it uses the same RF channel and group ID as those of a router. Before a wireless sensor node joins the network, it broadcasts sensor data periodically. To be connected to the network, a wireless sensor node listens to multi-hop routing message which a USN router sends periodically, and it picks the parent. When the parent is determined, it starts duty-cycling and operates in a low-power mode.

3 Diverse Wireless Sensor Network

Monitoring system using wireless sensor nodes with diverse sensors will be demoed, to operate through the Internet. The demo system is composed of diverse kinds of wireless sensor nodes, routers, USN-Internet bridge, and IDC server. Wireless sensor nodes are based on Kmote and use thermometer, humidity sensor, light sensor, electric power meter, 3-axis acceleration sensor, human presence Examples of sensors can be seen in Figure 3. detector. Some Kmote is compatible with Telosb motes, also supports TinyOS.

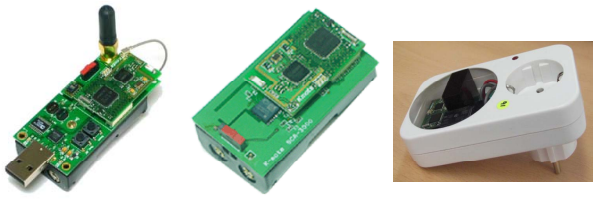

Figure 3. Diverse Wireless Sensors (temperature, humidity, acceleration, electric power meter)

Figure 4. Internet Bride, Multi-hop Router

TinyOS based wireless sensor nodes are connected to the IDC server via USN routers and USN-Internet bridges, which are shown in Figure 4. Bridge support hardwired TCP/IP connection to wireless sensors, instead of local bridge or gateway, the IDC server will configure wireless sensor network. This reduces network setup cost and increases Internet-centric scalability. In a demo, we will access the IDC server through monitoring GUI running on a laptop, and verify the data of wireless sensor nodes. Figure 5 is the snapshot of monitoring GUI. The IDC server also provides monitoring and controlling of wireless sensor nodes.

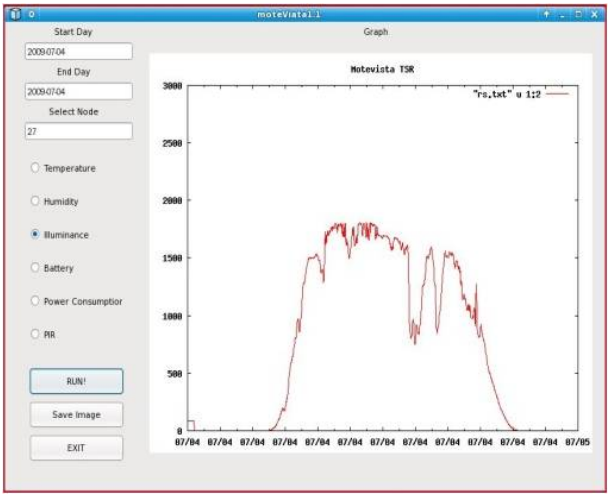

Figure 5. Sensor Monitoring GUI

4 References

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