

A Sensor Network Architecture for the IP Enterprise

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1. INTRODUCTION

Due to the well-known constraints on wireless sensor network applications, an application-level proxy server is often used to separate the sensor network from the rest of the enterprise network. The application-level proxy offers rich translations, caching, and support for reliable networking, and as such is a key component in many classes of wireless sensor network applications.

We propose to demonstrate a complementary network architecture in which the sensor network and the enterprise network can interoperate through a “lightweight” gateway that runs at the network layer. In short, the sensor network and the enterprise network will be linked through an internetworking device that functions like an IP router.

2. DETAILED DESCRIPTION

The demo will consist of several wireless sensor network nodes, a gateway router, and one or more client PCs. Each wireless sensor network node is equipped with an 802.15.4 radio, and runs a low-power 15.4 radio stack. The router has a 15.4 link, as well as Ethernet and 802.11 links for connection to the client PCs.

The core of the demonstration will consist of a complete and functional IP network which includes the wireless sensor network nodes, the router, and the client PCs. The nodes run a TinyOS 2.0-based operating system [1] which includes embedded IP services [2].

In this demo, each node has an IP address, and can act as an IP router by sending and forwarding packets along a default route to the gateway at the edge of the network, and by receiving packets along the same path. Routes within the embedded mesh network are discovered using a beacon-based adaptive tree construction protocol, as is common practice within wireless sensor networks.

The gateway router forwards packets between the embedded and enterprise IP subnets. Thus, each node has native IP connectivity with hosts on the other side of the gateway router, and can both initiate and accept IP traffic. We will demonstrate this IP interconnection using “ping” and “traceroute” from the client PCs.

Above the common IP network layer, the sensor nodes provide standard UDP and TCP-based services. System and network information in ASCII becomes accessible over TCP sockets, alongside graphical interfaces presented over HTTP to a web browser. Services like remote reboot can be executed with a simple binary UDP packet, or through an embedded web services protocol running over UDP. Sensor data can be reliably delivered over TCP.

Within this architecture, these services become natively accessible to standard IP clients – without any application-layer translation. Separating the network-layer translation from the application-layer translation enables a greater diversity of applications executing within the network, and we will show several different sensor network applications running over a common IP framework.

3. CONCLUSION

An IP-based network architecture can allow for integration between the sensor network and the enterprise network at multiple levels, and application-level proxies can become an important optimization instead of an absolute requirement. We hope that by enabling interconnection at the network layer as well as the application layer, the distant worlds of enterprise and embedded networking can be drawn closer together, and new development can flourish.

4. REFERENCES

- [1] TinyOS 2.0 Core Working Group.
http://www.tinyos.net/scoop/special/working_group.tinyos_2-0.
- [2] J. Postel. Internet Protocol, STD 5 (RFC 0791).