Demo Abstract: An Eventual Consistent Wireless Light Control System

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Abstract

We demonstrate a working system that utilizes an eventual consistent reliability model for wireless light control application. Initial results using only resource limited nodes, such as the popular mote platform, are promising; we achieve great end-to-end reliability for light control, with latency well within human-time scale.

Categories and Subject Descriptors

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

General Terms

Reliability, Human Factors, Performance

Keywords

Eventual consistency, wireless building light control

1 Introduction

Many discrete control applications when performed over wireless require sequence of control states and timing information to be well maintained between the controller and the device being controlled. This is often challenging from the networking perspective since issues such as media access contentions, queuing delays and packet losses can introduce additional delay to control message propagation, causing the control to miss precise timing information required by the application.

However, there is a family of control applications where precise timing on control state transitions can be relaxed or missed as long as the device being controlled matches the eventual state of the controller. Many home and office building automation applications fall into this category. In this demonstration, we present the effectiveness of a working system that takes an eventual consistent approach to a wireless light control application, where different groups of lights will eventually reach the state of their controlling switches. This eventual consistent property implies an unpredictable time bound for control due to the inherent nature of wireless networking, such as intermittent connectivity in particular. For the case where network partition does not exist, this demonstration shows that lights can reach the eventual state of the controlling wireless switch well within human-time scale for satisfactory user experience. By human-time scale, we mean on the order of one second.

2 Demo Description

The demonstration will consist of a set of individually AC-powered lights, where the power of each light is controlled by an embedded node equipped with a 802.15.4 wireless radio. The application pre-configures the lights into different logical groups and associates them into a smaller set of battery powered mote switches. Each switch can control a distinct group of lights wirelessly. The lights will be those typically found in home and office settings and will be scattered around the booth. The logical grouping of the lights will be reflected either spatially or by their colors. The switches will be self-contained mechanical switches with motes embedded inside. Users can carry the switches, but the physical deployment of the lights and switches is expected to be relatively static. The system is also capable of supporting light control over multihop topologies.

Users can stress the demo to experience the eventual consistent transport. By switching at a fast pace, users can overrun the system with lights failing to catch up with the switching pace. However, once the switch position has settled, all lights in the group will settle consistently to the final setting, with a latency well within one second. Indeed, a learning from this demo is to have typical users be aware that wireless control latency is a statistical distribution, as opposed to the usual control experience from wired connections. While most of the time latency appears to be instantaneous, in some unlikely occasions time to reach consistency may take closer to the limit of human-time scale due to the wireless networking issues mentioned before. These instances are considered outliers in the distribution. Users can further stress the system by controlling multiple groups of lights at the same time, which generates bursty and congested traffic load that the protocols need to react upon. By testing with this demo, users can experience the inherit latency and reliability performance of a real wireless light control system taking this eventual consistency approach.

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