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Application Note

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Network Case Study: Twisthink Wireless Lighting Control

twisthink
DESIGN TECHNOLOGY STRATEGY

For the EM250 and EM260 Platforms

EM250

EM260

Ember's customers have implemented a variety of different networks for field deployment. These networks utilize different topologies, different numbers and density of devices and different traffic patterns. However, each can be analyzed and provide some valuable data on network reliability and robustness. Ember will continue to publish these notes documenting such customer networks as an information base for other customers.

This application note is intended for Ember customers who are designing a ZigBee system and are interested in field experiences and reliability. The specific target audience is system architects and software engineers developing new applications for their Ember-enabled products.

This application note applies to EM250 and EM260 devices and EmberZNet stack releases. Where possible we will note the types of devices and software version being used in a particular network.

If you are interested in contributing your field experiences either anonymously or publicly, please contact Ember at portal.ember.com. We believe it is in the interest of all companies deploying wireless technology to publish such results to provide real field data of expected performance.

Contents

Introduction

For each of the networks being reviewed, we will try to cover the following items:

1. Overview of the system and system goals
2. Network Description - Size of network, device types, data rates and patterns
3. Network Environment
4. Network reliability and failures
5. Conclusions and Summary

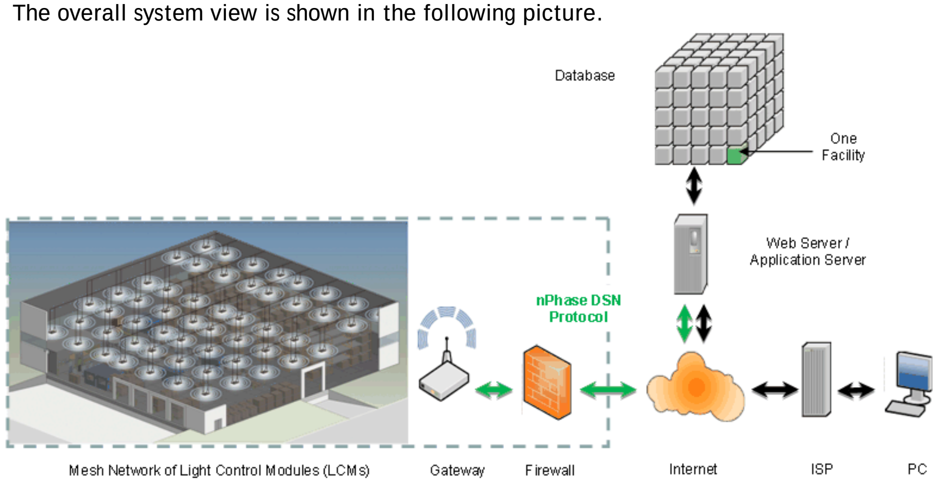
For some network deployments all of this data may not be available or it may be confidential and cannot be released. If data is not available that will be noted.

System Overview

The Kanepi system was developed by Twisthink for industrial lighting control in large warehouse or manufacturing type configurations. Typically these types of facilities have large rows of overhead lighting with fixtures every 25-40 feet that were traditionally controlled in banks by switches, contactors or circuit breakers. Wireless control with step dimming at the light fixture enables optimization of energy use and decouples the lights from the occupancy sensors and the daylight harvesting sensors.

Each light fixture includes a ZigBee device. All data reports are sent to a central concentrator. Control of the system is done using a central controller implemented on an EPIC single board computer running embedded Linux. Additional light in the facility can also be manually requested using touch screens or wireless light switches. The traffic from these switches is also routed through the gateway for processing.

The overall system view is shown in the following picture.



System Overview

Network Description

A typical network is from 300 to 1200 lighting fixtures. All lighting fixtures are EM260 devices acting as routers. The gateway is an EM250 device coordinator connected to an EPIC single board computer running embedded Linux. The EPIC computer can also leverage additional EM250 based coordinators using the XTEND product from Digi Corporation.

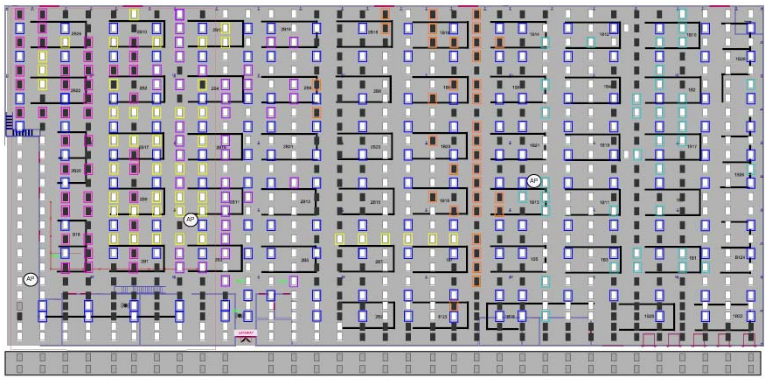
Typical data flow from the gateway out to devices in the network is intermittent based on schedule, sensors, and operator action. All routing is done using “many to one” routes into the gateway, and broadcasts from the gateway to devices in the network. The gateway updates the “many to one” routes throughout the day.

Typical latency on the system when lights are triggered from an occupancy sensor is less than 1 second.

Standard security is in use with a trust center link key.

The system operates on EmberZNet 3.2 software. In field upgrades of host software have been conducted during the life of these systems using over the air bootloaders.

The picture below shows a typical system as seen from the control screen view.



Network Environment

The systems operate in industrial and commercial facilities that also include typical WiFi networks. The building structures are usually metal frame and metal roofing but there are few interior walls. The ZigBee radios are installed as part of the light fixture. The design life of a light fixture is 15-20 years.

Network Reliability

In the test network of 800+ lighting control modules, lighting commands are sent approximately 30 times per day. Within the network, 35 unique groups are defined, and each group contains from 5-20 lights. This network is controlled using a combination of scheduled (time of day triggered), reactive (sensor triggered), and manual (operator triggered) events. Each event typically is controlling several groups. After each lighting command the gateway verifies each light has properly changed state. Any failure in the process generates alerts that are logged and investigated.

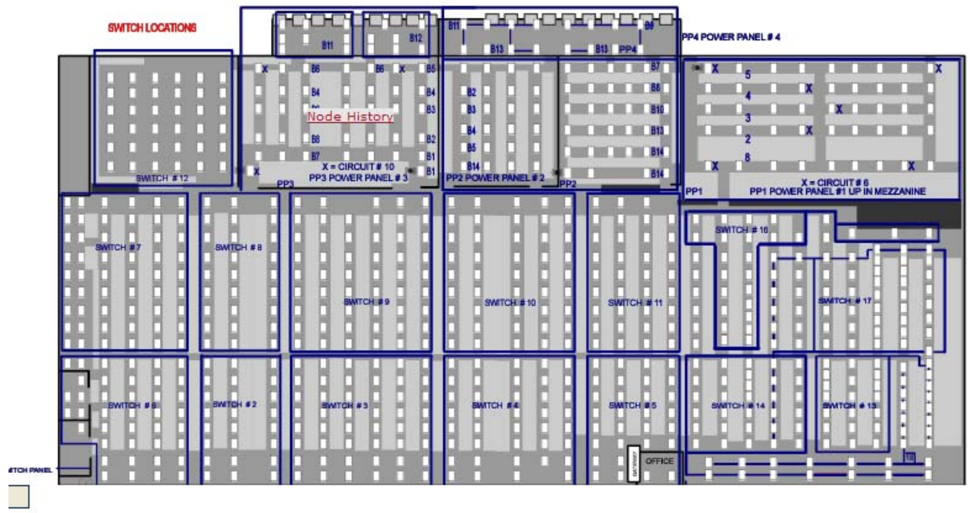
On average the network processes approximately 3000 lighting commands per day. The network has been running since December of 2007. At the time of this writing, we are not aware of a single communications failure attributed to the PHY/ZigBee layer of the system, with well over 1,000,000 messages logged.

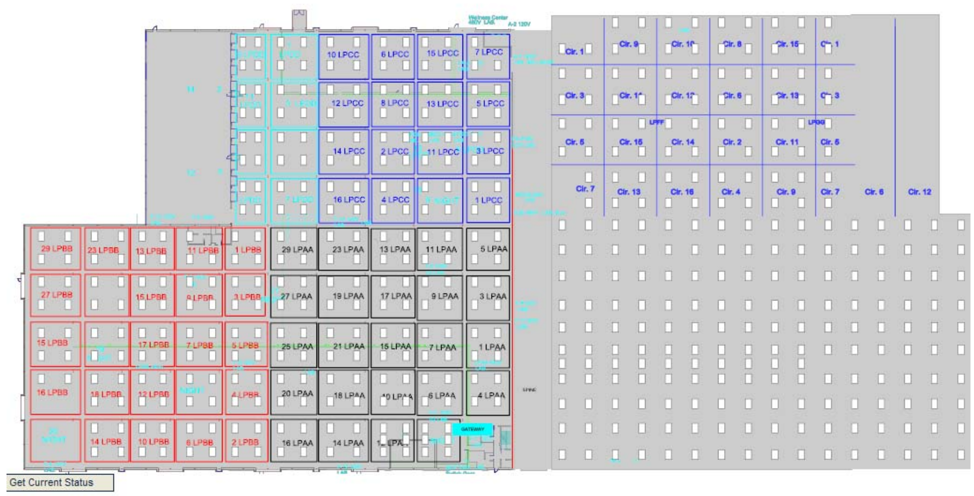
Conclusions and Summary

This data shows expected reliability for a distributed ZigBee network in a commercial environment. The particular environment is typical for many ZigBee commercial uses and provides a good indicator of expected operation. These networks experience little to no message loss over time indicating a robust and reliable system.

Appendix A – Additional Site Installations

These photos are of additional sites using this wireless system.





Appendix B – Company Info

A brief intro to Twisthink (www.twisthink.com):

Since 2001, Twisthink has sought to partner with clients to design, develop and deliver innovative products/business solutions. Twisthink is built on the premise that combining Design, Technology and Strategy consistently results in successful commercialization of products. As a Team, we have combined the skills of "scientific" industrial design with "artful" electronic engineering – the outcome; excellence and innovation at high speed! Our unique capabilities bring tremendous expertise in brand development, user interface/industrial design and electronic design (hardware, software, pcb layout with a strong emphasis on wireless radio and antenna integration). We serve a variety of markets and our clients range in size from venture capital-backed firms to Fortune 500 companies throughout the United States and Europe.

Simply put, our passion is "problem solving" and our mission is "**the science of design _ the art of technology"**!

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Kanepi Innovations: Wireless Infrastructure Solutions

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After Reading This Document

If you have questions or comments from this document, please contact an Ember support representative at portal.ember.com.

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