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Effective Application of LoRaWAN Technology in the Built Environment

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Introduction

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Presenter Introduction

Presentation Topics

- An Introduction to LoRaWAN
  - The Components of a LoRaWAN System
  - A typical IoT Architecture
  - BeMS Hardware Requirements
- Setting-up The Solution
  - Considerations When Using RF Technology With BeMS
  - LoRaWAN Authentication and Registering Sensors to the Network
  - Accessing LoRaWAN Data
- How to Integrate LoRaWAN Data into BeMS?
  - BeMS Protocols vs LoRa
  - Physical Media and Protocol Considerations
  - Maximising Battery Life
  - Fixed and Mobile Applications Within a Building
  - Sharing Data With Other Systems
- LoRaWAN Sensors for Building Services
  - Open System Interoperability
  - Sensors for BeMS Applications
  - Accuracy
  - Reactivity
  - Reliability
- Case Study
  - Example Application for a LoRaWAN BeMS Solution in a School

Questions

Presenter

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Introduction to LoRaWAN

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The Components of a LoRaWAN System

- Sensors
- Gateways
- Network Server
- Application Server
- Join Server

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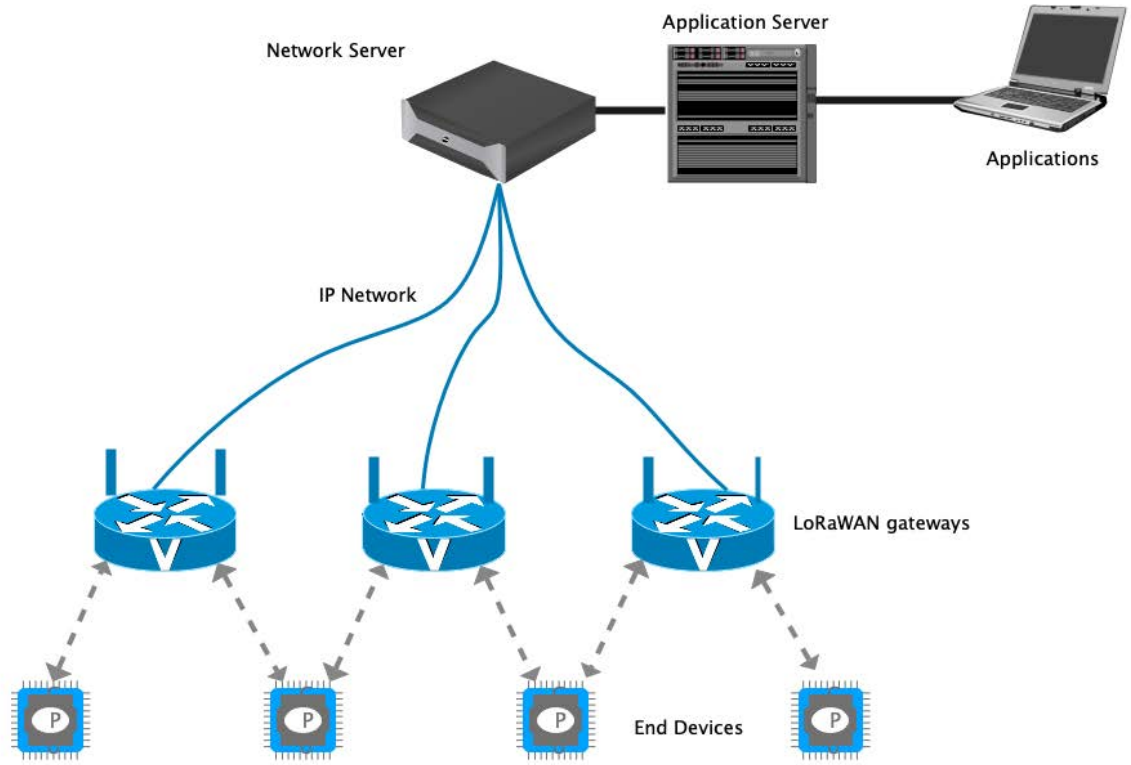
A typical IoT Architecture

- Sensors and Gateways as On-Premises Devices
- Network Server and Application Server as Cloud Services
- Join Server as an Online Resource



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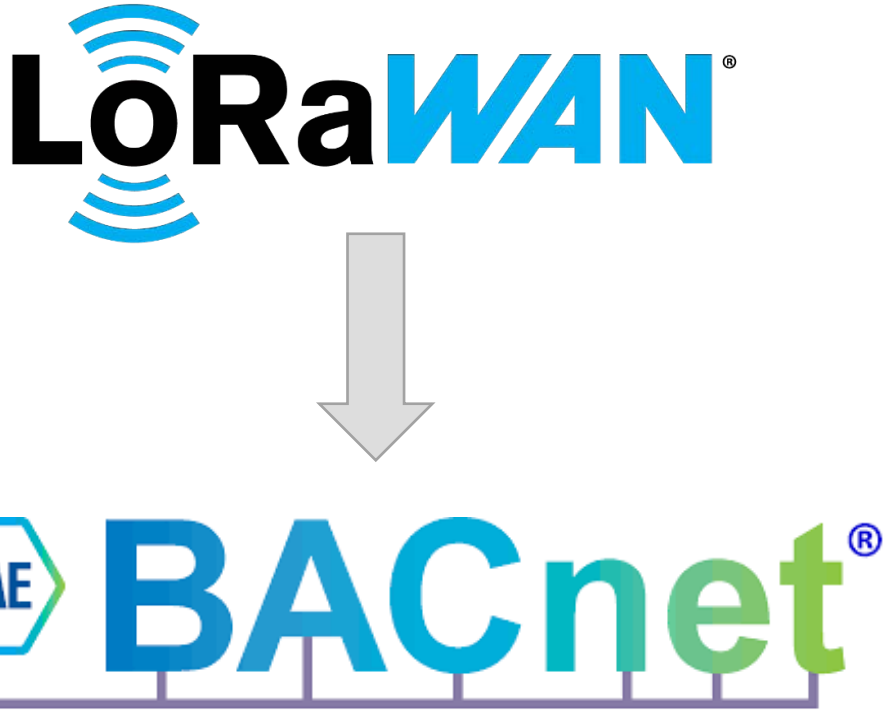
BeMS Hardware Requirements

- Combined Gateway, Network and Application Server on a Single Hardware Platform
- Connection to Physical Media Used in Building Automation
- Protocol Gateway to Allow Interoperability With BeMS
- Means of Managing Network Security



Setting-Up The Solution

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Considerations When Using RF Technology With BeMS

- Building Fabric can Attenuate Signals
- Receivers May Be Inside Metal Enclosures Causing Signal Reflections and Adding to Electromagnetic Shielding
- Sensors May be Some Distance From the Receiver
- Communications Should be Encrypted

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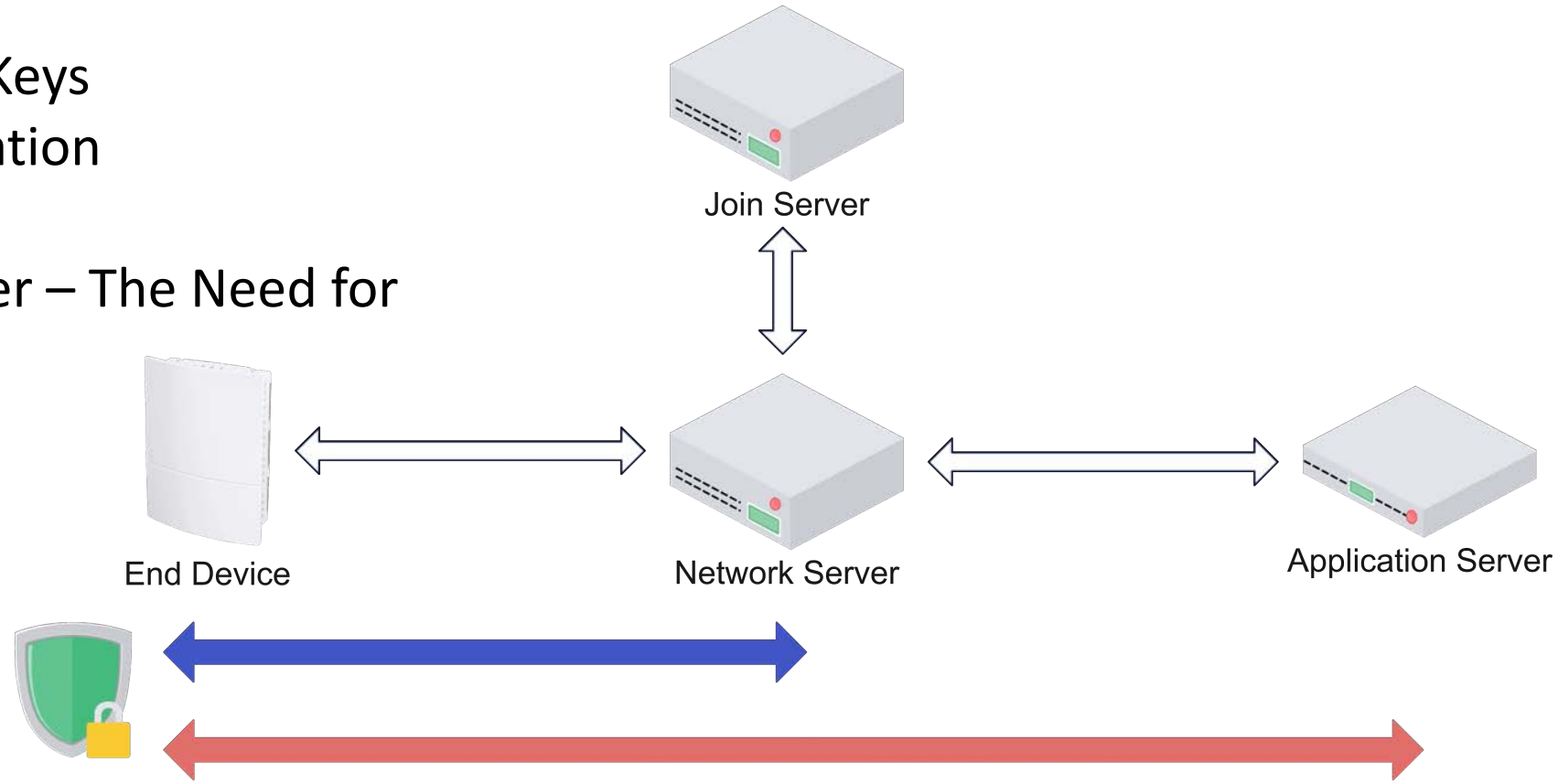
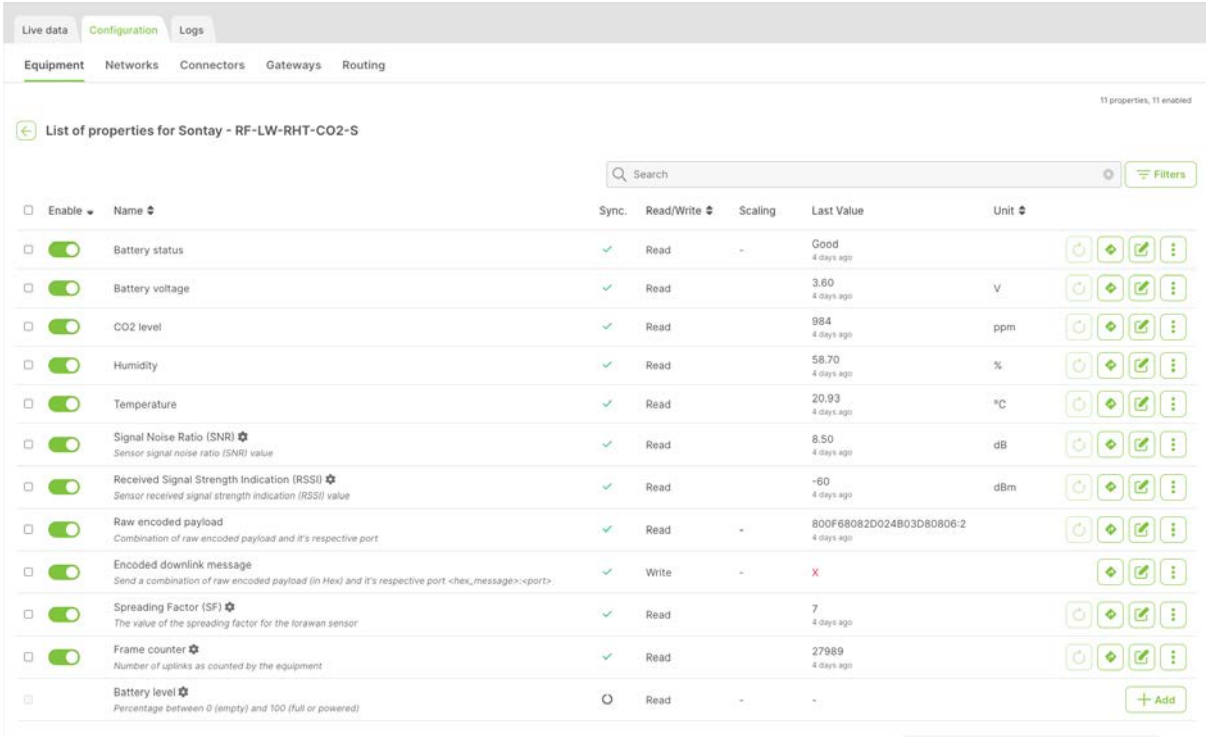
LoRaWAN Authentication and Registering Sensors to the Network

- End to End Encryption
- Pre-Shared Encryption Keys
- Over The Air Authentication
- Issuing Session Keys
- Accessing the Join Server – The Need for Internet Connectivity



Accessing LoRaWAN Data

- Data Arrives Encrypted at The Application Server
- Once Decrypted, Individual Data Need to Be Extracted
- In a Hardware Gateway the Data is Often Presented via a Web Page
- There May Still be Reliance on Internet Connectivity for This Stage



How to Integrate LoRaWAN Data Into BeMS

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BeMS Protocols vs LoRa

- LoRa Data is a String of Text Typically as JSON
- Data Types Are Not Explicitly Expressed in LoRa
- BeMS Protocols Will Often Require the Data Type to be Known
- BeMS Protocols Are Usually Transmitted as a Series of Individual Variables

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Physical Media and Protocol Considerations

- Gateways May Interface With Multiple Physical Media Types
- Multiple Physical Layers May Support the Same Protocol
- Protocols May Require the Gateway to be Engineered to Add or Remove Labels or Units
- Low Level Protocols Such as Modbus may Require Multiple Variables to send Floating Point Numbers

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Maximising Battery Life

- Minimise Periodic Transmissions
- Set COV Transmissions at the Highest Acceptable Level
- Different Sensor Types Consume Different Amounts of Power
- Avoid Generating Unnecessary Signals

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Fixed and Mobile Applications Within a Building

- End Devices Will Automatically Negotiate The Ideal Transmission Frequency Based on the installation Environment
- Fixed Sensors Will Benefit From Improved Battery Life
- Sensors Which are Regularly Relocated May Have to Negotiate a New Frequency
- Initial Frequency Negotiations can Take Some Time

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Sharing Data With Other Systems

- As an IoT Technology, LoRaWAN is Designed to Share Data Directly to Cloud Services
- When Used Within a Building, it is Usually Advantageous to Consume the Data at the BeMS and Provide a High-Level Interface For Onward Information Exchange
- This Could Be Engineered Directly at the Automation Level or via a PC-Based Head-End

LoRaWAN Sensors for Building Services

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Open System Interoperability

- LoRaWAN is Intended as a Vendor-Independent Technology
- Philosophy That Best-in-Class Solutions Can be Engineered at Every Level
- Allows for a Broader Range of Sensing Technologies to be Incorporated Into a BeMS

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Sensors For Building Services Applications

- Best in Class means choosing sensors designed specifically for building services applications
- Many sensors were originally designed for monitoring storage spaces
- When selecting a sensor for a building services application, there are a number of factors to consider

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Sensors For BeMS Applications

- Considerations for selecting sensing technology should include:
  - Sensors designed for specific media types
  - Form factor
  - Environmental suitability
  - Consistency with hard-wired and network bus variants
  - Accuracy, Reactivity and Reliability

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Accuracy

- Sensor Accuracy is a Function of the End Devices
- Sensor Accuracy is Aligned With Fixed Wire Counterparts
- Frequency of Readings May Impact the Overall Control Scheme
- Most Temperature Control Applications or General Logging Schemes Will be Indistinguishable From Fixed Wire Variants

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Reactivity

- Response Time is Unaffected When Deployed as a LoRaWAN Sensor
- Relaying Values via LoRa Adds Additional Lag Time
- This Can be Mitigated by Setting Smaller COV Figures
- Increased Transmissions Reduce The Battery Life

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Reliability

- LoRaWan Sensors are as Reliable as Any Other Fixed Wire Sensor
- Reliability of Data can be Affected By a Number of Factors:
  - Environment Changes
  - Interference
  - Battery Failure
- LoRaWAN Will Make Adjustments to Compensate for RF Issues
- A Good LoRaWAN Sensor Will Provide Battery Status as Part of its Data Payload

Case Study

Example Application for a LoRaWAN BeMS Solution
in a School

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Problem

For compliance reasons, the local authority requires temperature and CO_2 levels to be monitored in 9 classrooms at a schools within the local area.

This must feed into the BeMS to either control ventilation rates or provide alarms in the event of a high concentration threshold being exceeded.

All values must be logged at 15 minute intervals for analysis.

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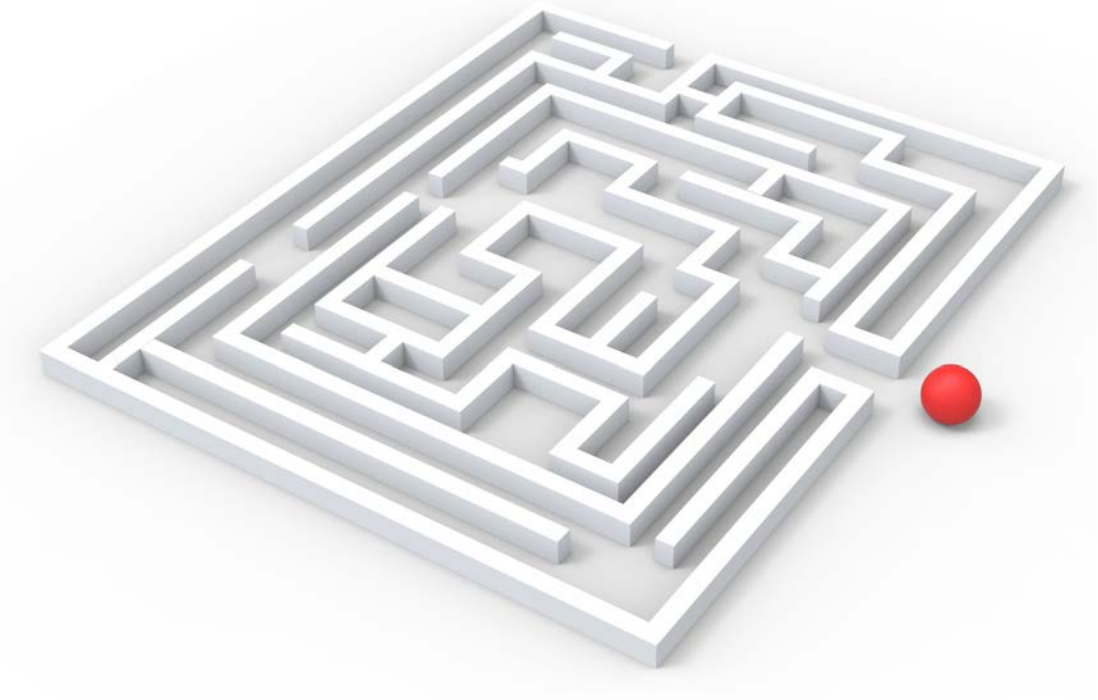
Specific Challenges

- The school is in use.
- The BeMS has insufficient spare hardware I/O to accommodate the additional points.
- The plant room and classrooms are separated by some distance and numerous physical barriers (including fire breaks).



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The LoRaWAN Solution

- Classroom installation completed in less than 1 hour
- Control panel modifications in a similar time frame
- All other elements require only software modifications
- Entire solution deployed and logging values in a single day
- Estimated battery life of four years

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Questions

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