LoRa Network Implementation

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### Introduction

- Project Concept and Objectives
- System Overview
- Project Design
- Technology and Components
- Discussion of Project



### What is LoRa?

- Wireless modulation technology
- It provides significantly longer range than competing technologies
- Low bandwidth, Low power
- Excellent range and penetration
- Operates in the unlicensed ISM bands
  - 433MHz, 868MHz, 915Mhz
  - Within regulation (power, duty-cycle, bandwidth)



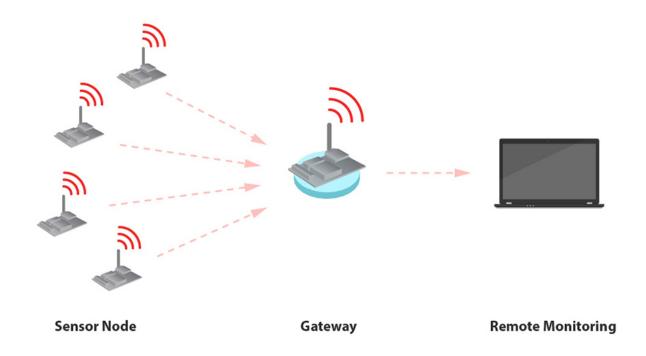
## **Project Objectives**

- Design and implement a proof of concept LoRa Network
- Integrate network server/cloud connectivity
- Develop an Android application to query the backend
- Make system fully bi-directional



### A LoRa Network consists of:

- Gateways
- Remote Devices
- Network Servers

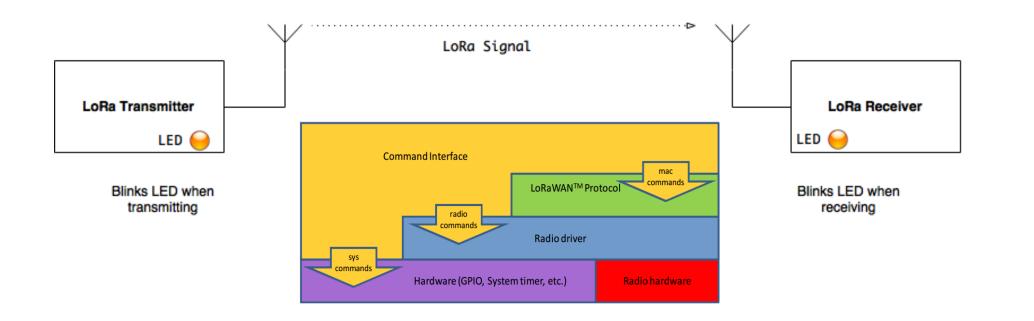




# **Basic Design Concept**

LoRa Range Potential

15-20Km Line of Sight

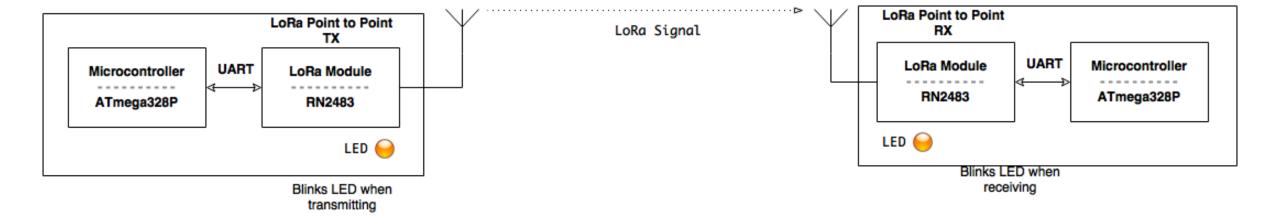




# Point to Point System

LoRa Range Potential

15-20Km Line of Sight

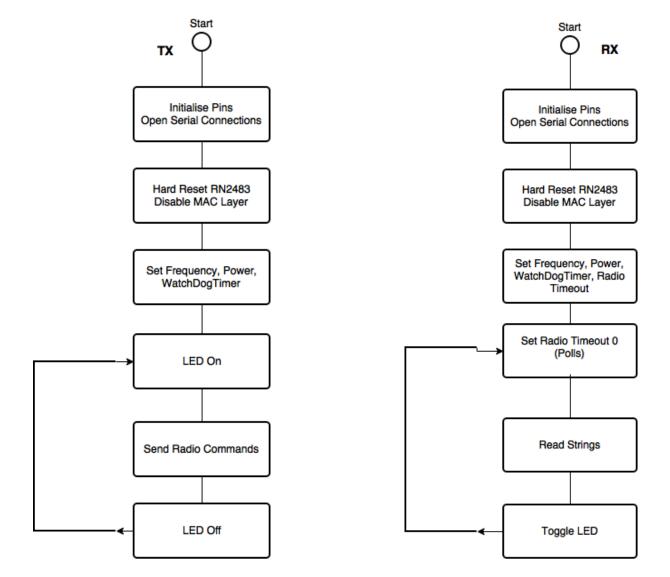




RX LED HIGH LOW

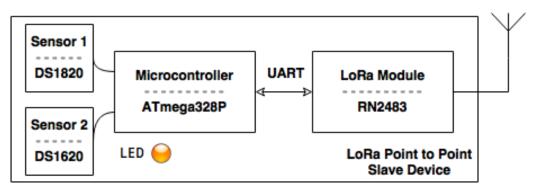


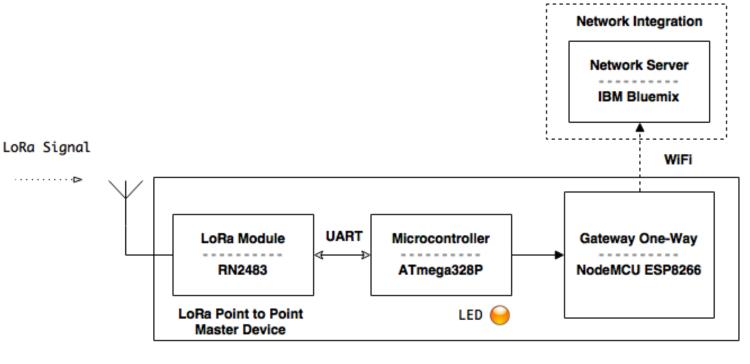
# Point to Point System





# Point to Point Master and Slave

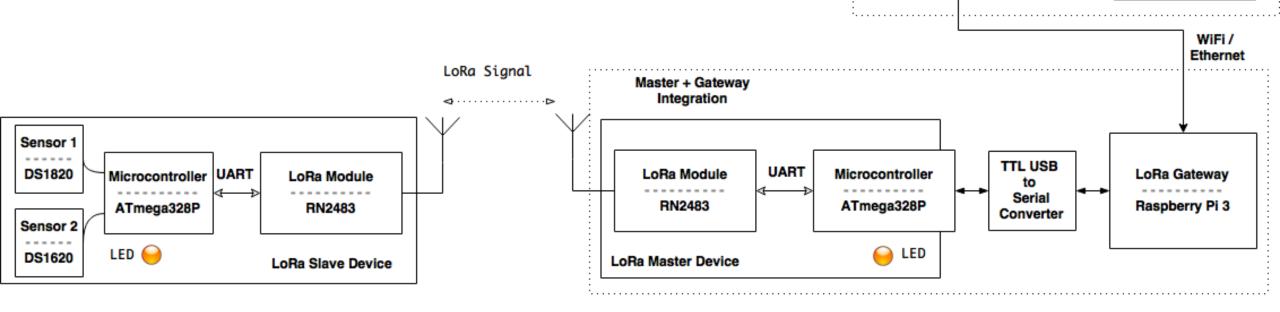








# Bi-Directional Single Master, Single Slave



Database

Cloudant NoSQL

Application

Android

WiFi / GSM

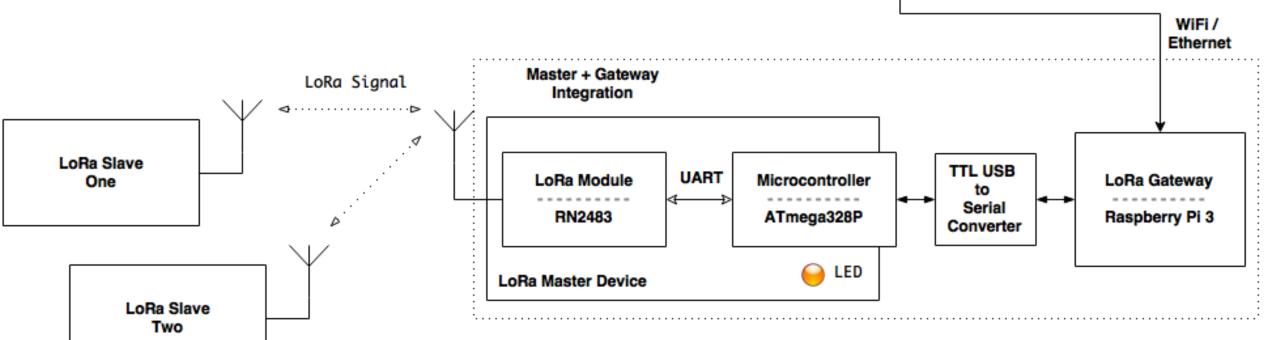
Network Integration

**Network Server** 

**IBM Bluemix** 



# Bi-Directional Single Master, Multiple Slave



**Network Integration** 

**Network Server** 

**IBM Bluemix** 

Database

Cloudant NoSQL

Application

Android

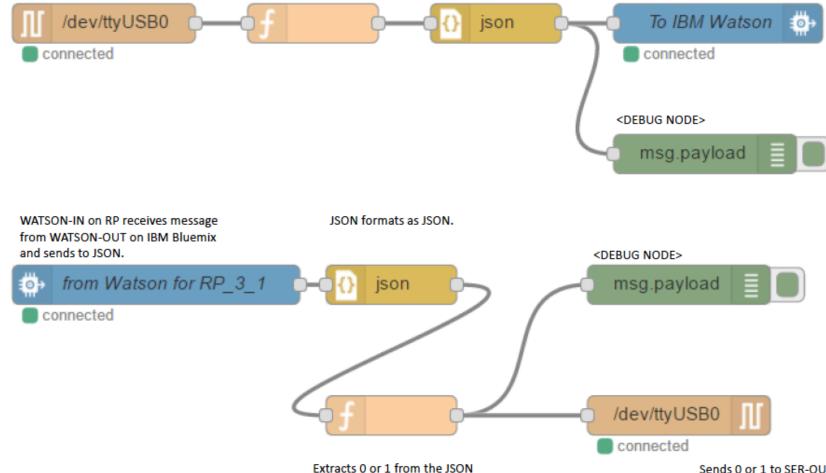
WiFi / GSM



## **Gateway Setup**

SER-IN sends A/M/Z001:1:33:22:11 to FXN FXN sends {d: {sensor0Val:33, sensor0Val:22, sensor0Val:11}} to JSON JSON formats and sends to IBM Bluemix TO-WATSON on RP IBM Bluemix TO-WATSON
Sends to WATSON-IN on IBM Bluemix

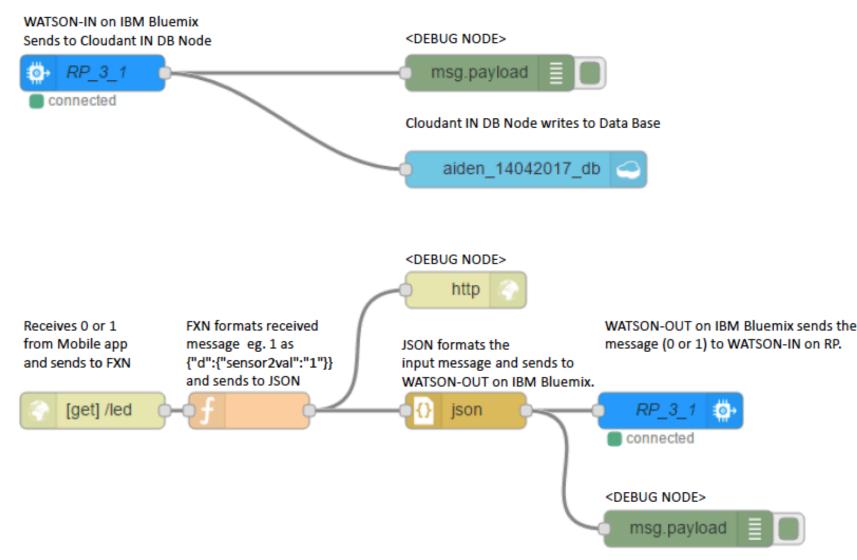
 $\mathcal{C}$ RASPBERRY





### Network Server Setup

# ON IBM BLUEMIX





# **Project Discussion**

- Ground up development hinders end goal delivery
- Power consumption reduction
- Prototype master and slave setup is backwards for testing reasons
- Scalability is becomes complex when dealing with several nodes
- App integrates geo-location share features



Thank You. Questions?



### LoRaWAN

- LoRaWAN is the Network MAC Layer of the LoRa stack.
- Communication protocol and architecture that utilizes the LoRa physical layer to enable wide area network capability.
- Supports
  - secure bi-directional communication,
  - mobility
  - Localization
  - Security AES 128bit

LoRa communication stack

LoRaWAN MAC options (adaptive data rate, encryption, etc)

LoRaWAN device profile Class A-C (directionality, energy, etc)

LoRaWAN modulation (spectrum modulation, chirping)

local radio standard (EU: 868 MHz, US: 915 MHz)



## Range Improvements

- Increase the height of gateway and antenna
- Outdoor signal is better than indoor
- Keep short distance between gateway and antenna to reduce attenuation
- Use a good connector (N-type)
- Use omni-directional antenna
- Prevent multipath propagation by having obstacles close to antenna
- Avoid strong interference from GSM/WiFi, etc.