

# LoRa and OPC-UA based secure Industry 4.0 Application Scenario

Aniket Yeole

June 16, 2018



# Contents

<b>1</b>	<b>Introduction</b>	<b>5</b>
1.1	Scope for LPWAN in Industry 4.0 Application . . . . .	5
1.2	Purpose . . . . .	5
1.3	Delimitation . . . . .	5
<b>2</b>	<b>State of Art</b>	<b>7</b>
2.1	. . . . .	7
<b>3</b>	<b>Technical Background</b>	<b>9</b>
3.1	Fundamentals of IoT protocol . . . . .	9
3.1.1	LoRa . . . . .	9
3.1.2	SigFox . . . . .	9
3.1.3	NarrowBand IoT . . . . .	9
3.2	LoRa vs LoRaWAN . . . . .	9
3.2.1	Architecture . . . . .	9
3.2.2	LoRaWAN operation modes . . . . .	9
3.2.3	The Things Network . . . . .	9
3.3	MQTT Protocol . . . . .	9
3.4	OPC-UA . . . . .	9
3.4.1	OPC-UA Architecture . . . . .	9
3.4.2	OPC-UA Server . . . . .	9
3.4.3	OPC-UA Client . . . . .	9
3.5	ProfiBus . . . . .	9
3.5.1	background . . . . .	9
<b>4</b>	<b>Security Aspect for LoRaWAN network</b>	<b>11</b>
4.1	Current Security Features and Vulnerabilities . . . . .	11
4.1.1	AES Encryption . . . . .	11
4.1.2	Data Encryption . . . . .	11
4.1.3	Identifiers . . . . .	11
4.1.4	Multicast vs Unicast . . . . .	11
4.2	Security at Architectural Level . . . . .	11
4.2.1	End Devices . . . . .	11
4.2.2	Gateway . . . . .	11
4.2.3	Network Server . . . . .	11
4.2.4	Application Server . . . . .	11
<b>5</b>	<b>System Design</b>	<b>13</b>
5.1	LoRa as LPWAN choice . . . . .	13
5.2	OPC-UA as a choice . . . . .	13
5.3	MQTT for bridging . . . . .	13
5.4	ProfiNet . . . . .	13

---

<b>6</b>	<b>Implementation and Results</b>	<b>15</b>
6.1	Inter operable LoRa and OPC-UA . . . . .	15
6.1.1	Bridging LoRaWAN and OPC-UA . . . . .	15
6.2	LoRa and Profinet . . . . .	15
6.3	Results . . . . .	15
6.3.1	* . . . . .	15
<b>7</b>	<b>Conclusion</b>	<b>17</b>
7.1	Future Work . . . . .	17
<b>8</b>	<b>Appendix</b>	<b>19</b>

# Chapter 1

## Introduction

1.1 Scope for LPWAN in Industry 4.0 Application

1.2 Purpose

1.3 Delimitation



## Chapter 2

# State of Art

### 2.1





## Chapter 3

# Technical Background

### 3.1 Fundamentals of IoT protocol

#### 3.1.1 LoRa

#### 3.1.2 SigFox

#### 3.1.3 NarrowBand IoT

### 3.2 LoRa vs LoRaWAN

#### 3.2.1 Architecture

#### 3.2.2 LoRaWAN operation modes

#### 3.2.3 The Things Network

### 3.3 MQTT Protocol

### 3.4 OPC-UA

#### 3.4.1 OPC-UA Architecture

#### 3.4.2 OPC-UA Server

#### 3.4.3 OPC-UA Client

### 3.5 ProfiBus

#### 3.5.1 background



## Chapter 4

# Security Aspect for LoRaWAN network

### 4.1 Current Security Features and Vulnerabilities

#### 4.1.1 AES Encryption

#### 4.1.2 Data Encryption

#### 4.1.3 Identifiers

#### 4.1.4 Multicast vs Unicast

### 4.2 Security at Architectural Level

#### 4.2.1 End Devices

#### 4.2.2 Gateway

#### 4.2.3 Network Server

#### 4.2.4 Application Server



## Chapter 5

# System Design

5.1 LoRa as LPWAN choice

5.2 OPC-UA as a choice

5.3 MQTT for bridging

5.4 ProfiNet



## Chapter 6

# Implementation and Results

### 6.1 Inter operable LoRa and OPC-UA

#### 6.1.1 Bridging LoRaWAN and OPC-UA

### 6.2 LoRa and Profinet

### 6.3 Results

#### 6.3.1 \*





## Chapter 7

# Conclusion

### 7.1 Future Work



Chapter 8

Appendix