Do IoT LoRa Networks Support Emergency Evacuation Systems ?

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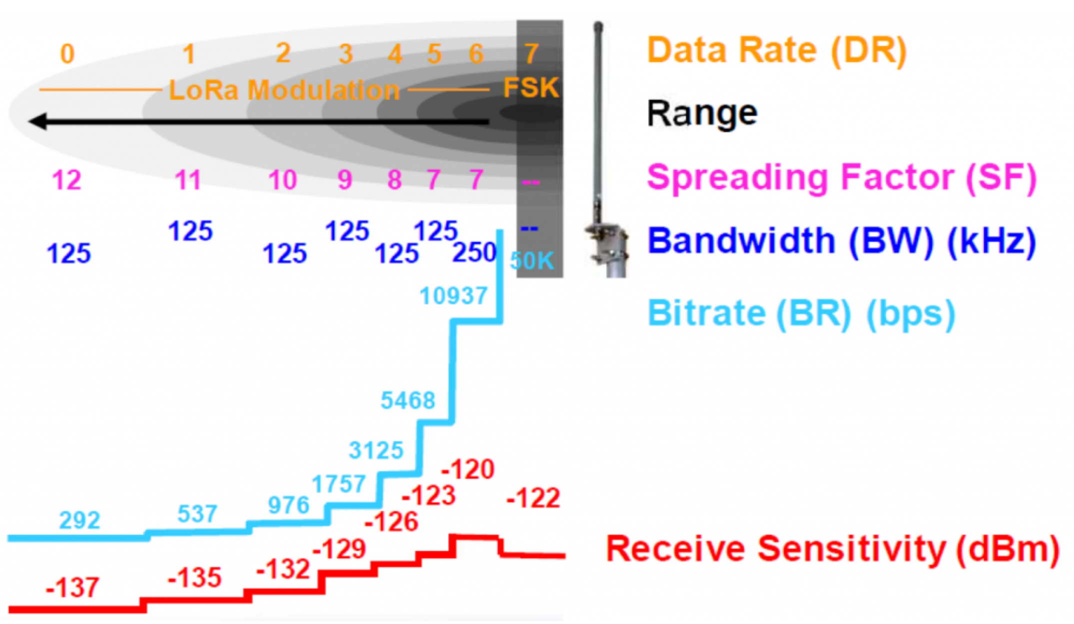
1. Introduction

The need of a new kind of wireless networks that could send data far away with limited resource constraints emerged recently to support IoT applications like smart building and smart environment monitoring. **LoRaWan** is one of this emerging wireless networks [1], it allows end-devices to reach the gateway in a range up to 5Km, Unlike other technologies LoRaWan is the best versatile solution to deploy IoT application in both urban and rural area where there is no communication infrastructure.

2. Parameter selection problem

The physical layer of LoRa technology (Semtech SX1276) has 4 parameters which make 6720 possible settings [2]:

- **Carrier Frequency** (CF):
  - [868, 914, 433MHz]
- **Spreading Factor** (SF):
  - [SF7 - SF12]
- **Coding Rate** (CR):
  - [4/5 - 4/8]
- **Bandwidth** (BW):
  - [7.8Khz - 500Khz]
- **Transmission Power** (P^{tx}):
  - [-4dBm +20dBm]
- **Data Rate** (DR)



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3. Emergency Evacuation Systems

Examples of Emergency Evacuation Systems (EES) range from the small-scale evacuation of a building due to a storm or fire to the large-scale evacuation of a city because of a flood, bombardment or approaching weather system [3], especially a Tropical Cyclone. In situations involving hazardous materials or possible contamination. Evacuees may be decontaminated prior to being transported out of the contaminated area.

4. LoRaWAN network

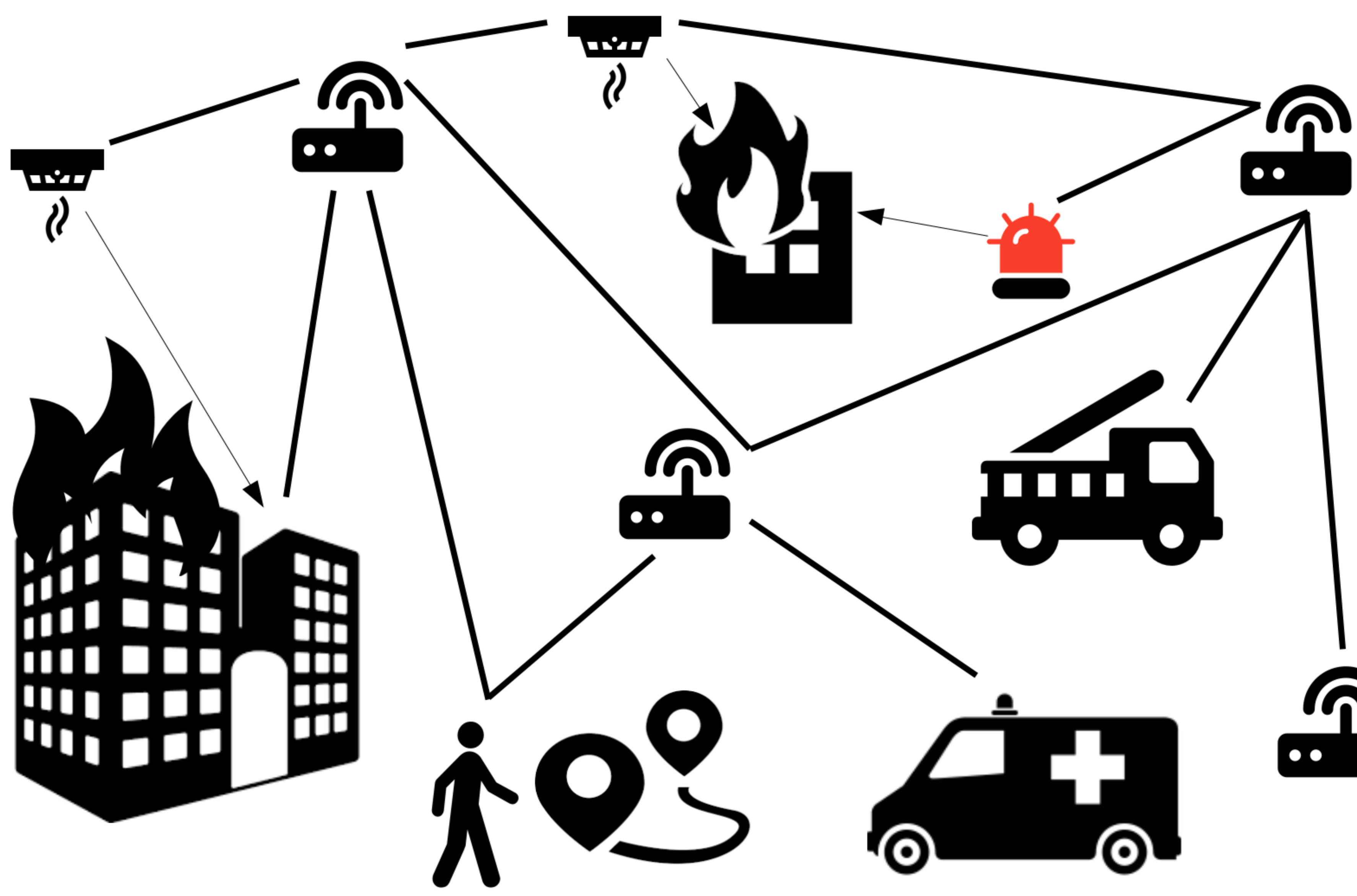

Figure 1. EES architecture

5. Architecture and Specification

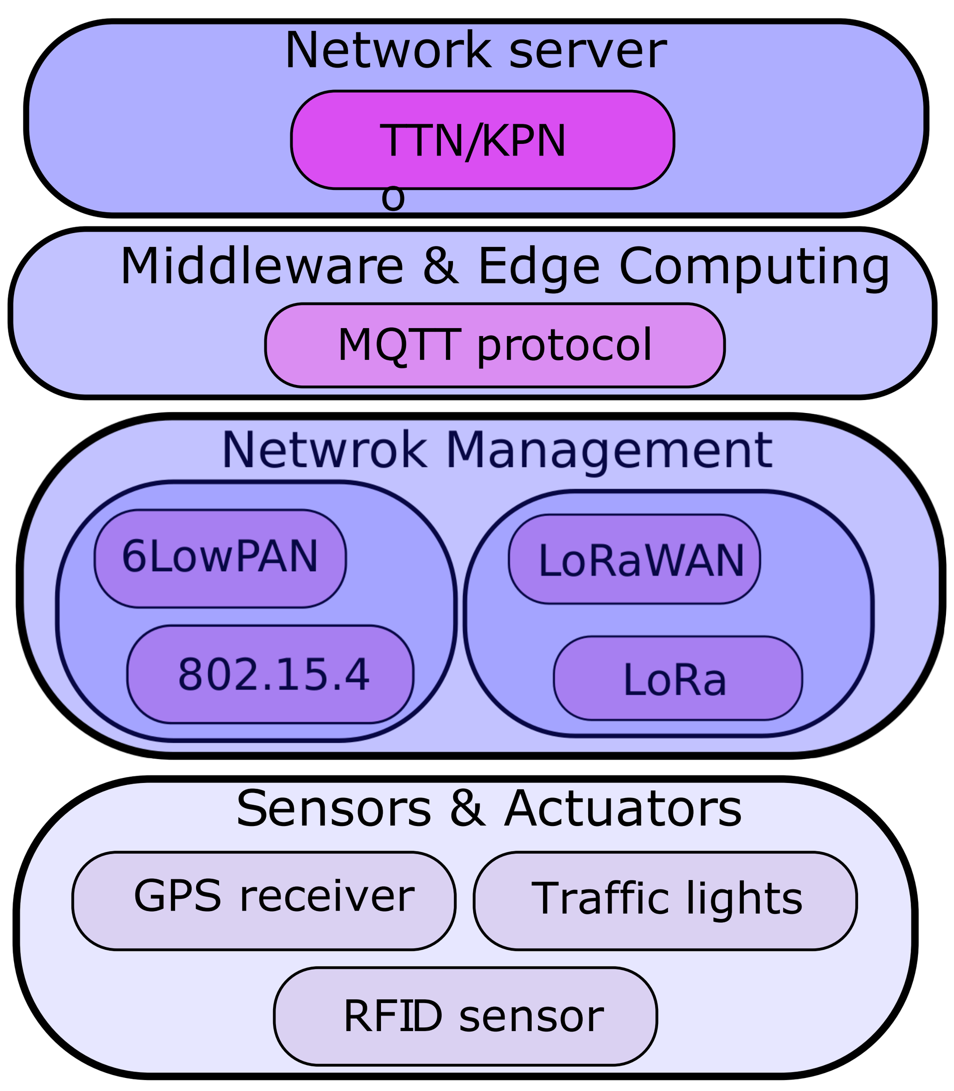

Figure 2. EES network layers

	$CF_{[Hz]}$	6LoWPAN	LoRaWAN
Modulation	2.4G	O-QPSK	-
	915M	BPSK	LoRa
	868M	BPSK	LoRa/GFSK
Channels	2.4G	16	-
	915M	10	64+8 (↑), 8(↓)
	868M	1	10
$CF_{[MHz]}$	2.4G		-
	915M	902-929	902-928
	868M	868-868.6	863-870 and 780
$BW_{[Hz]}$	2.4G	5M	-
	915M	2M	125K-500K
	868M	600M	125K-250K
$DR_{[bps]}$	2.4G	250M	-
	915M	40M	980-21.9K
			FSK: 50K
$CR_{[dBm]}$	2.4G	-85	-
	915M	-92	
	868M	-92	-137

Table 1. LoRa and 6LowPAN characteristics [4]

7. Discussion

➠ **Advantages:** To select the wireless network that best fit smart building application requirements, four main parameters are generally used: (i) cost; (ii) data rate; (iii) autonomy and (iv) communication range. Each technology has its CF, CR and BW which are compiled in the table above.

➠ **Conclusion:** Low Power Wide Area Networks ($LPWAN$), Wireless Sensor Network (WSN) and Internet of things (IoT) architecture are the first candidates to ensure disaster monitoring and management systems. Particularly, IEEE802.15.4 and LoRa networks give new insight for effective EES. This work gives an overview of deployment of IoT architecture for EES. Such services and demand for edge computing in real-time poses new architectural and service orchestration challenges. As a future work, we plan to study the efficiency of using a reinforcement learning to adapt these two networks to the emergency situation of the building.

7. References

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