



Analysis on the Application of LoRa Technology in University Smart Library

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ABSTRACT

LoRa (Long of Range) wireless communication technology stands out among many Low Power Wide Area Networks (LPWAN) technologies due to its long distance, large capacity, and low power consumption. The article analyzes the feasibility of applying LORA technology to university smart libraries, and discuss about its limitations when applying LoRa to university library.

KEYWORDS

LoRa, Smart Library, Digital Library, Network System Design, University Library, IoT

1 Opinion

LoRa is a representative network architecture to build the system structure of university smart libraries, be disseminated to other universities, and facilitate the National University Digital Library Alliance.

2 Arguments

The reasons for using LoRa as the network architecture of digital libraries in universities will be explained from the following aspects:

2.1 Development Trends

2.1.1 Inevitable Trend for Intelligent Library

In the 2016 trend report of library published by IFLA, it is one of the major trend for libraries to enhance libraries by information science skills around big data. In the other word, smart and digital library has become inevitable.

2.1.2 High applicability of IoT architecture to libraries

Various physical objects and facilities in a library, including but not limited to books, rooms and air conditioners, can be embedded in electronic chips, connected through software, sensors and networks, allowing these objects to collect and exchange data with each other. Hence the higher efficiency and broader applications for libraries.

2.1.3 Obvious advantages of LoRa among all IoT network systems

Firstly, LoRa is a more flexible autonomous network that can be deployed wherever needed. Therefore, diverse demands from universities of library networking customization can be fulfilled by LoRa.

Secondly, LoRa is a private network, libraries do not have to worry about data leakage to service providers.

Finally, the low power consumption and low-cost sensor used by LoRa is very suitable for sensor data in libraries that needs to be uploaded regularly, such as humidity, light intensity and temperature.

The comparison of wireless network standards is shown in Figure 1 below.

The system structure and function of university intelligent library based on LoRa is shown in Figure 2 below.

2.2 Value Creation

2.2.1 Convenience for Library Environment Monitoring

On both control terminal and mobile terminal, LoRa maintains real-time sensor data display of the entire library environment.

2.2.2 Optimization of Reader Environment

After all objects connected through LoRa, thresholds of different kinds environment data can be adjusted with flexibility based on reader's feedback. For example, turning up the temperature of LoRa air-conditioner according to the data of temperature sensor when a student says it is too hot.

2.2.3 Data Value

{Reading room design type, air conditioner setting coordinates, air conditioner wind power output, air conditioner humidity output, air conditioner temperature output}

Such data sets will provide designers with reference data to help designers find the optimal design plan for library details. Furthermore, data sets from LoRa sensors can circulate among libraries that have similar design demands.

3 Limitations

3.1 Free Band

LoRaWAN works in the ISM free frequency band, and its protocol specifications are open to public, which brings a problem --- a good target to attacks. This makes the security of library vulnerable.

3.2 Not a Complete Protocol

LoRa only defines the physical layer and the link layer, without the network layer and the transport layer definition, hence major protocol functions missing such as network management. Therefore, time cost of coding the smart library system might be higher for further developing upon the LoRaWAN layer.

3.2 LoRa's Nature --- Openness

LoRa's openness allows libraries to customize the its detail. However, there also follows cons. LoRa needs to integrate additional security solutions to achieve the security of the Internet of Things. At this point, the NB-IoT technology based on the operator network has a natural advantage, that is, it does not require additional integration as solutions are provided by operators.

Method	transmission speed (M/S)	Number of connected devices	Working frequency band	Transmission distance	Power consumption	Application scope
Zigbee	0.02 ~ 0.24	2 ¹⁶ - 2 ⁶⁴	0.85/0.89/2.4	10 ~ 100m	1 ~ 3	Home network, control network, sensor network
Bluetooth	1 ~ 3	7	2.4	2 ~ 10m	1 ~ 100	Personal network
Wi-Fi	1 ~ 11	255	2.4	30 ~ 100m	100	Wireless local network
LoRa	0.03 ~ 0.6	Millions	0.433/0.868/0.915	15km	3	Sensor and control network

Figure 1: Comparison of wireless communication technology

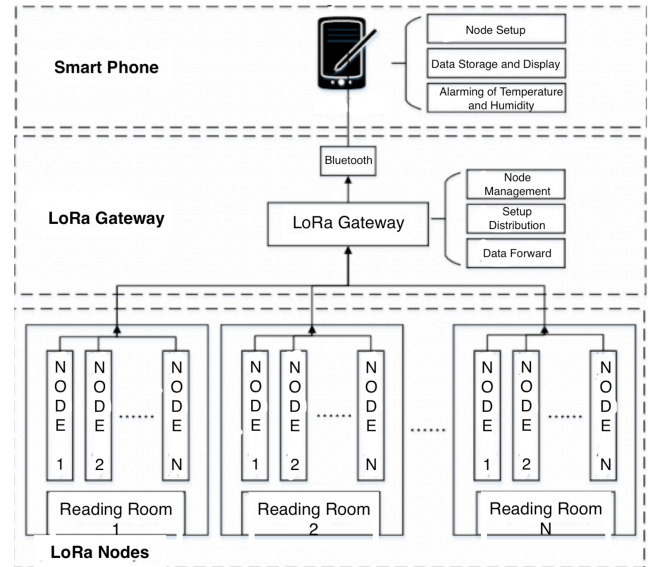


Figure 2: System structure and function of university intelligent library based on LoRa

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