LoRaWAN

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Abstract: LoRa is low power wide area wireless netwo rk (LPWAN) protocol for Internet of Things (IoTs) ap plications. These technologies offer novel communication paradigm to address discrete IoT's applications. LoRa i s a recently proposed LPWAN technology based on sp read spectrum technique with a wider band.

I. INTRODUCTION

Lora (**Lo**ng **Ra**nge) is a proprietary low-power wide-area network modulation technique. It is based on sp read spectrum modulation techniques derived from ch irp spread spectrum (CSS) technology It was develop ed by Cycleo of Grenoble, France, and acquired by Semtech, the founding member of the LoRa Alliance and it is patented.

II. OBJECTIVE

Lora uses license-free sub-gigahertz radio frequency bands like 433 MHz, 868 MHz (Europe), 915 MHz (Australia and North Amer ica), 865 MHz to 867 MHz (India), and 923 MHz (Asia). LoRa enables long-range transmissions with low power consumption. Th e technology covers the physical layer, while other t echnologies and protocols such as LoRaWAN (Long Range Wide Area Network) cover the upper layers. It can achieve data rates between 0.3 kbit/s and 27 kbit/s depending upon the spreading factor.
LoRa devices have geolocation capabilities used for t rilateration positions of devices via timestamps from gateways.

III. RELATED WORK

Since LoRa defines the lower physical layer, the up per networking layers were lacking. LoRaWAN is on e of several protocols that were developed to define the upper layers of the network. LoRaWAN is a c loud-based medium access control (MAC) layer protocol but acts mainly as a network layer protocol for man aging communication between LPWAN gateways and end-node devices as a routing protocol, maintained by th e LoRa Alliance.
LoRaWAN defines the communication protocol and s ystem architecture for the network, while the LoRa physical layer enables the long-range communication link. LoRaWAN is also respons ible for managing the communication frequencies, dat a rate, and power for all devices. Devices in the ne twork are asynchronous and transmit when they have data available to send. Data transmitted by an end-node device is received by multiple gateways, whichf orward the data packets to a centralized network ser ver. Data is then forwarded to application servers. T he technology shows high reliability for the moderate load, however, it has some performance issues relate d to sending acknowledgments.

IV· METHODOLOGY

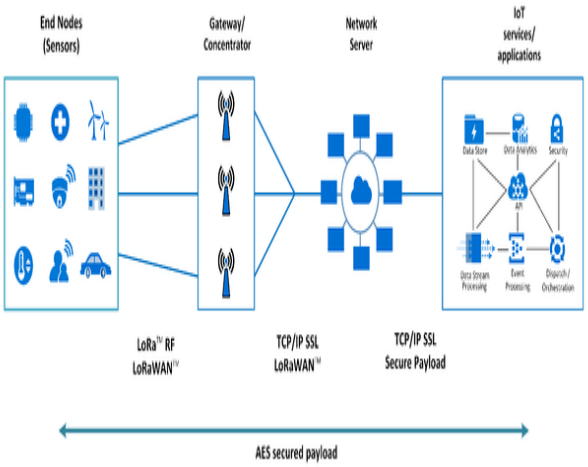
- CHALLENGE ONE first satellite to use LoRa
- Amazon Sidewalk, IoT network for Ring home c ameras, Amazon Alexa assistant, and other consu mer devices
- Reindeer tracking in Finland
- Glasgow IoT network
- IoT networks in Argentina, Brazil, and Estonia
- Smart fire alarms and fire detection
- Smart Parking
- Black rhino poaching protection in Tanzania and endangered sea turtle monitoring in Peru
- Natural disaster prediction
- Cotton farming in Australia
- Utility metering in India
- Autonomous irrigation and soil health monitoring
- Smart water monitoring and water monitoring for commercial farms
- City-wide network in Calgary, Alberta, Canada
- IoT Network in Alba Iulia, Romania

- IoT Network in Gold Coast, Australia as part of required upgrades for the 2018 Commonwealth Games
- Country-wide LoRa network in Switzerland, operated by Swisscom.
- IoT4Africa is a consortium of African passionate, investors and experts, aware of the opportunitieso ffered by the Internet of Things that creates plat forms and infrastructures to facilitate the develop ment and integration of IoT technologies in Afri ca for developers, companies, and private users.

The 2021 Roadmap: Ivory Coast, Cameroon, Senegal, Nigeria, Ghana...

V. SYSTEM COMPOSITION

- The Lora Alliance is a non-profit and open association of members with a vision to standardize LoRaWan for LPWAN (Low Power Wide Area Network) to enable IoT
- LoRaWAN is part of the LPWAN network
- LoRaWAN utilize the IoT such as seamless interoperability among IoT, secure bi-directional communication, mobility and localization services
- The alliance consists of several companies who together build carrier communication networks and sensing solutions, to improve the connected world
- LoRaWAN network architecture uses a star topology network similar to WIFI
- The data rates range of LoRaWAN are from 0.3 kbps to 50 k



LoRaWAN has three classes – known as A, B, and C – that operate simultaneously:

- Class A is asynchronous: this means a specific operation begins upon receipt of a signal that the preceding operation has been completed. These end nodes only transmit when they need, and the rest of the time they are on 'standby'
- Class B allows messages to be sent down to battery-powered nodes. All LoRaWAN stations are a slave to 1PPS (one-pulse-per-second), and they transmit beacon messages at the same time. All nodes in class B are assigned a time slot within a 128-second cycle. This means you can tell a node to listen to every fifth slot and allow for a downlink message to be transmitted when the slot comes up.
- Class C nodes can listen constantly and can send a downlink message at any time. This is primarily used for AC-powered applications, as it takes a lot of energy to keep a node actively awake.

VI. FUTURE SCOPE

Smart City: LoRa WAN will be inevitable technology in future smart city applications together with the Internet of Things like:

- Smart lighting
- Air quality and pollution monitoring
- Smart parking and vehicle management
- Facilities and infrastructure management
- Fire detection and management
- Waste management

Industrial Applications: LoRa WAN is suitable for a wide range of industrial applications.

- Radiation and leak detection
- Smart sensor technology
- Item location and tracking
- Shipping and transportation

Smart home applications: In the future, billions of smart devices and home appliances will be connected to the internet.

- Enhanced home security
- Home automation for IoT enables smart appliances

Healthcare: LoRa is one of the best solutions for connecting healthcare devices efficiently

- Health monitoring devices and management
- Wearable technology

Agriculture: LoRa technology can be used in smart agriculture and farming applications.

- Smart farming and livestock management
- Temperature and moisture monitoring
- Water level sensors and irrigation control

VII. CONCLUSIONS

In the future, our global, national and regional netw orks have to support billions or even trillions of de vices. Lora can play a significant role in providing a smart, low cost and highly efficient network for f uture applications. It has an association of more than 400 companies globally to contribute, improve and implement a smart network for future needs.

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