

Lory and HimalayaTalk White Paper

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The logo for SystemBase, featuring a stylized red 'S' icon followed by the text 'SystemBase' in a bold, red, sans-serif font.

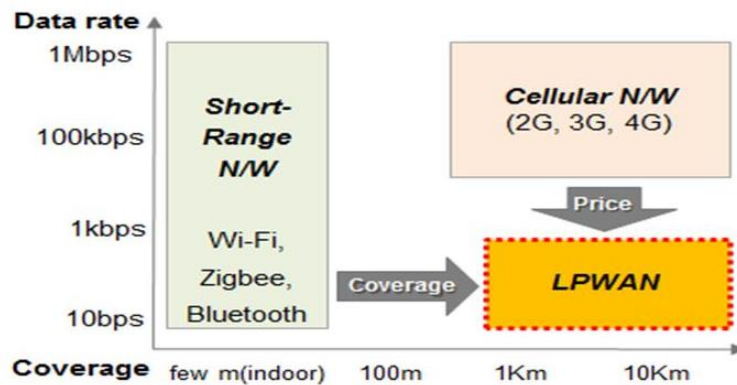
LPWA (Low Power Wide Area) Technology

AI, Big Data, and IoT are the three keywords for IT in 2016. There will be an era of automatic pattern reorganization for services without human concern. Collect data from IoT, accumulate and analyze data collected from the “Big Data”. An artificial intelligence learns from these analyzed data to create optimal service.

There are many issues on the Internet of Things, but how to connect a large number of sensor nodes efficiently and cheaply is becoming a most important issue. So what emerged is LPWA. LPWA stands for Low Power Wide Area. In Korean, it is called low power long distance communication. Since the sensor nodes at the bottom of the IoT are transmitting small sensing data occasionally, a wireless communication connection method for the sensor node is needed.

The following provides the requirements for the sensor node.

- Low Power Consumption
- Low Price (less than \$ 5 per device)
- Long Range (formerly Wi-Fi, ZigBee, Bluetooth, etc.)
- Capable of Handling a Large Number of Accessing Sensor Nodes
- Easy Deployment (wireless)



<LPWA Characteristics >

Since sensor nodes are usually located at the end and are scattered locally, in order to connect each sensor node by wire, a very long and large number of cables are required. This increases the cost of the project and comes with difficult cable installation. Therefore, a radio communication capable of covering a wide area is required. Sensor nodes are not the devices that produce massive amounts of data, but occasionally requires small amount of real-time data communication. That is why wireless communication meets these requirements. Additionally,

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instead of changing the wireless modulation part to lower the transmission speed, increasing the communication distance was developed, and the term LPWA became popular and great number of competitors started to appear.

The following chart is a comparison regarding major LPWA technologies and their properties.

| Technology | SIGFOX | LoRa | LTE-M | NB-IoT |
|------------------------------|-------------------------------------|---------------------------------------|-------------------------------------|-------------------------------------|
| Company | SIGFOX (F) | SEMTECH (A) | Ericsson | HWAWEI (Ch) |
| Standardization Organization | LoRa Alliance | ETSI | 3GPP | 3GPP |
| Coverage | Up to 13 km | Up to 11 km | Up to 11 km | Up to 15 km |
| Frequency Band | ISM Band 800~900MHz, 0~100MHz | ISM Band 800~900MHz, 400~500MHz | Licensed Band LTE Band 1.4MHz | Licensed Band LTE Band 200kHz |
| Communication Speed | Up to 1 kbps | Up to 5.4 kbps | Up to 1 Mbps | Up to 150 kbps |
| Roaming | No | Yes | Yes | Yes |
| Battery Life | Up to 10 years | Up to 10 years | Up to 10 years | Up to 10 years |
| Availability (Korea) | Undecided | SKT Nation Wide Service | Q1 2016 | Q4 2016 |

Among telecommunication companies in Korea, SK Telecom Co., (or SKT) actively started the LPWA business with the establishing nationwide LoRa network. Then, KT Corporation and LG Uplus moved toward LTE-M business. SKT has taken a strategy to bring both LoRa and LTE-M at the same time after that. It is worth to pay attention to the mid-technology LTE-M version when the NB-IoT technology is introduced and the “Power of LPWA” map is redrawn. SIGFOX was considered by KT, but withdrawn. SIGFOX is strong in Europe, but the technology itself is closed technology. Therefore, LoRa technology became popular in Korea and emerged as a trend of LPWA.

LoRa Technology

There is the term IoST which stands for Internet of Small Things. It is a concept that extends the scope of IoT by connecting the small objects that deals with information about temperature, humidity, weight, and location through a wireless network. For these purposes, LTE-class wireless communication technology is not only costly but also wasteful of bandwidth itself. The LPWA technology has emerged for this reason and LoRa technology will be dealt below,

which is one of the most popular LPWA.

Antecedent technology of LoRa was used for US defense, but it was release to the public after SEMTECH acquired the technology and named it. SEMTECH provides only the first layer; simple connection, but the standard of the upper layer was left to LoRa Alliance™ (<http://loralliance.org>). LoRa Alliance™ offers LoRaWAN protocol as an open specification. The LoRa Alliance is a member of various major European mobile service providers such as KPN, the Netherlands's largest mobile company, and Swisscom, the Switzerland's number one mobile company, as well as IBM, CISCO, SEMTECH and MicroChip. The No.1 mobile carrier in Korea, SKT, has established a nationwide network, making LoRa Alliance to watch the applications and market trends in Korea.

The wireless characteristics of the LoRa are as follows:

- Tx Output Power: +10 dBm @ 433 MHz
- High Density Sensitivity - Up to 148 dBm Reception
- 168 dB Maximum Link Budget
- Tx Current: typ. 40 mA @ 14 dBm
- Rx Current: typ 14.2 mA
- Sleep Mode/Low Power Down Mode: typ. 1uA
- LoRa Modulation/Demodulation (Patent)
- Programmable Bit Rate: 300 bps ~ 5.5 kbps

Using the LoRa technology makes it easier for customers to understand the benefits they will gained.

- It is a long-distance communication. (up to 10km in open space)
- Strong Against Noise and Surrounding Interference
- Less Power Consumption During Communicating Over Air
- Long Battery Life
- Easy to Develop since Open Protocol
- Low Cost

Here is some more detailed information of the LoRa

- Long Range, Low Power Solutions: Up to 10 km, up to 10 Years of Battery Life
- The device can connect to multiple base station to find the best route to connect to the target device.

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- Simple Access Procedure Allows Massive Device Connection without Any Hassle.
- Simplified Connection between the Devices and the Base stations Allow Less Cost
- Applied ADR (Adaptive Data Rate) to Optimize Signal Interference and Optimum Frequency Utilization
- Location Measurement Feature
- Open Ecosystem provided from the LoRa Alliance
- Frequency Band: ISM Band
- Provides a device with Class A/B/C to select a configuration suitable for the service
- Payload: 50 bytes
- Encryption : AES-128
- ADR (SF7~SF12)
- Channel Hopping
- Duty Cycle Limited

Lory and HimalayaTalk

Lory is the world's first pocket-sized mobile base station developed by SystemBase. When you link with the "HimalayaTalk" app provided by our company, you can communicate on the move in the communication shaded area. Once you have Lory in your pocket, you can send and receive text messages and location information without extra fees from your mobile phone. It also works when you do not have any mobile base station nearby.

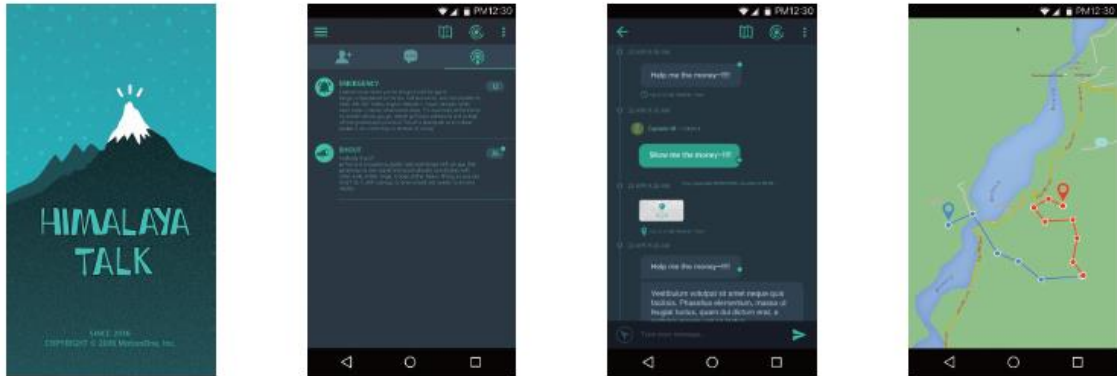
Lory is based on a wireless communication technology, LoRa, that was used in U.S. military decades ago. This model was developed in compliance with the radio wave regulation in South Korea. The test result shows stable communication at a speed of 3,100 bps at a distance of 10 km from the open field.

There are a lot of places where Lory can be used; in the event of a disaster, when the communication is overrun or the base station down, and in desert construction sites.

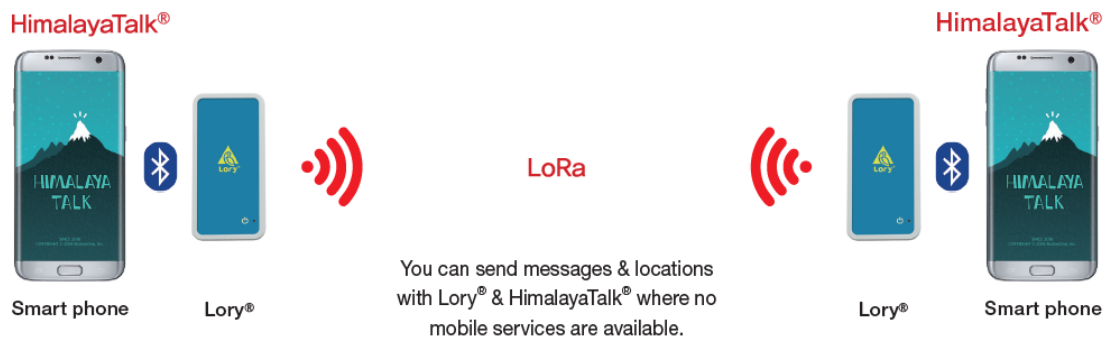
HimalayaTalk is a mobile app that enables text communication even in a communication shaded area. It has a peer-to-peer chat or group chat, as well as a broadcast feature that sends messages to all Lory users in range. There is an emergency signal broadcast feature. This feature is useful when you need help in the immediate vicinity, such as distress situation in a mountain. Emergency messages can be delivered to all Lory users within the communication range, and especially show the accumulated traveling path of the victims on the map when signals are received.

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Below is a screenshot showing the main features of the HimalayaTalk app.



The following figure shows text messaging using Lory with the HimalayaTalk app.



In the above diagram, the smartphones and Lories are connected by using Bluetooth (BLE). By installing the HimalayaTalk app on the smartphone, users can transmit text and location information to the Lory user in a distance.

Application of Lory and HimalayaTalk

With Lory and HimalayaTalk, they can apply to numerous applications.



It can be used when there is a disaster such as an earthquake, when the existing communication network is disabled, when communication is needed in a harsh environment such as mine or construction site, when there is no base station. It can also be used in daily life.