■Universiti Sains Malaysia (USM)へのNerveNet技術の紹介

2019年3月25,26日の二日間、USMのEngineering Campus（マレー半島側）とPenang Campus（ペナン島）にて、NerveNet+LoRa技術の紹 介とデモを行いました。デモは、タイ国のNational Electronics and Computer Technology Center(NECTEC)が同行し実施しました。

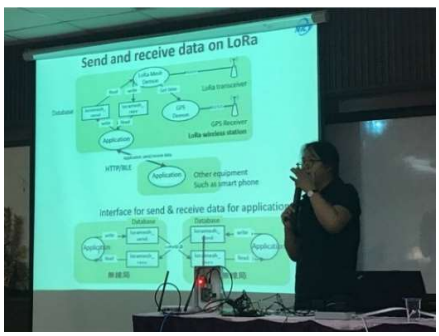
3月25日、USM Engineering Campusにて、2018年開始のASEAN IVOプロジェクト「Smart Aquaculture Quality Monitoring System with Internet of Things」のリーダであるProf. Widad Ismail (USM)とそのメンバー。3月26日、USM Penang CampusのComputer Science学科にてComputer Science学科、Electrical Engineering学科、mathematical engineering学科より合計１２名程度の参加で、専門分野はsmartcity, transportation, cyber security, information retrieval, tourism, database, wireless, optimization, natural language等多様なメンバーが参加。

NICTアジア連携センター浅井副所長がNerveNet+LoRa技術の概要を説明し、当該技術を習得したNECTEC技術者2名が同技術のデモを行なった。

通称 NerveNet+LoRaと称している技術は、従来のNerveNetの機能のひとつである情報同期機能を利用し、装置間で情報を伝送する部分には世界的に利用されつつあるLoRaを適用したうえで、宛先を指定しないで情報を無線拡散させる方式を採用し、情報を他の装置の次々に 伝搬させる技術である。NECTEC技術者は装置3組それぞれにモニタを接続し、1組には NECTEC開発のセンサボード（温度、湿度等）を接続したデモシステムを構成した上で、 システム構成、情報の送受信処理の流れ、LoRaによる情報送受信間隔、制御パソコン上で のデータ操作の様子、などを説明した。デモは2装置間の情報伝搬と、センサへ のセンサ情報要求に対する応答データの表示を見せた。

NerveNet+LoRaの概要説明を行う浅井

デモ機器



デモを行うNECTECのTanikaさん

以上

Introduction of NerveNet+LoRa

Presented by NICT Asia Center

Nobuyuki Asai (Non Asia Asai)

< NICT Researcher >

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NerveNet concept

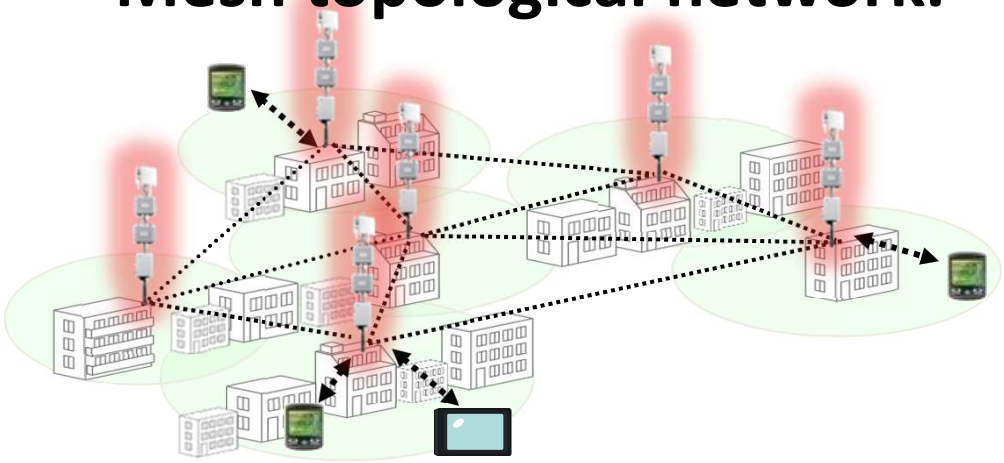
Japan has lots experience to suffer the natural disaster and sometime network infrastructure is damaged such as no telephone, no mobile and no internet.

Robust Network	Configure mesh topological network.
Quick recovery adhoc Network	Potable and connect live network.

NerveNet is designed as Layer 2 switch to enable to configure mesh topological network using VLAN mechanism and attach many type of transmission.
And NerveNet is designed as running on the Linux operating system to enable to configure and set up quickly as adhoc network.

NerveNet concept

Mesh topological network.



Potable and quick recovery.

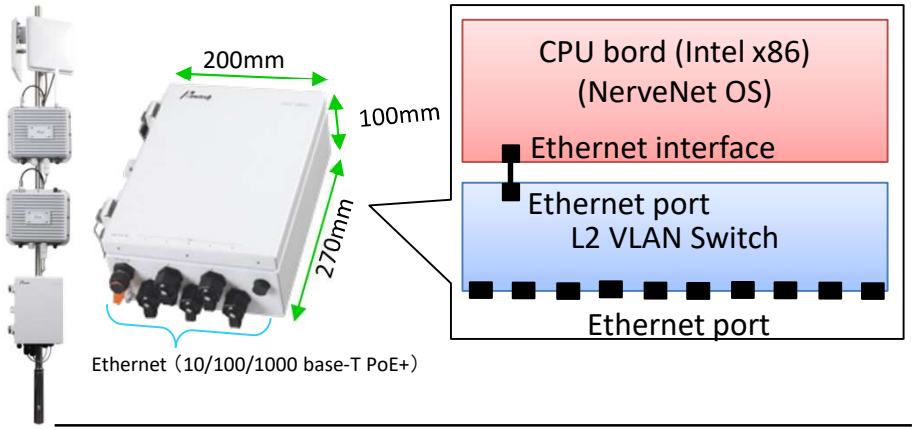
< Proven fact of Kumamoto earthquake in 2016 >

14/Apr 21:26 Kumamoto earthquakes occurred.
16/Apr 1:25Nand biggest occurred.
16/Apr 15:00 NICT decision to dispatch researchers and the network equipment
18/Apr 20:05 Arrive at Takamori town in Kumamoto.
19/Apr 13:30 1 access point was established for the public administration
at the disaster countermeasures headquarters (General Administration Division).
19/Apr 14:30 another AP for the residents near the entrance of the town office.
20/Apr 20:30 an internet satellite circuit via Kashima Space Technology Center was provided.
As a result, both networks recorded a maximum of 18 Mbps.

NerveNet Spec

High-Performance L2 Switch Type

NerveNet NPS-108AC (Hirakawa Hewtech)



Type	NPS-108AC
Network Interface	IEEE 802.3at(PoE+) Ethernet (10/100/1000 base-T) 5 ports
Operation Temp./Humidity	-10 ~ 50℃ / 20 ~ 85%
Power input/consumption	DC12V / 25W average (100W max)
Protection class	IP65
Weight	5.5kg
Other interfaces	Serial ATA, PCI-E, USB, SD, Serial
Storage	2.5 inch SSD 8GB (default)
OS	Debian Linux 8 (NerveNet OS)
RAM	4GB
CPU	Intel Atom

All-Software Type

Raspberry Pi 3 (RS Components)

CPU bord (ARM)
(NerveNet OS & Soft Switch)
Ethernet interface
Wi-Fi interfaces (USB)

※No L2 VLAN Switch hardware

Type	Raspberry Pi 3 model B
Network Interface	Ethernet (10/100/1000 base-T) 1 port, Embedded Wi-Fi (11gn)
Operation Temp.	0 ~ 70℃
Power input/consumption	DC5V / 6.5W average (12.5W max)
Weight	120g
Other interfaces	USB2.0 x4 , micro SD, GPIO
Storage	2.5 inch SSD 8GB (default)
OS	Debian Linux 8 (NerveNet OS)
RAM	1GB
CPU Broadcom BCM2837	Quad Core 1.2GHz

Case study

Measures against natural disasters

Japan has high risk of natural disaster

Earthquake, tunami	The Great Hanshin-Awaji Earthquake of 1995
	the 2011 Tōhoku earthquake and tsunami
	The 2016 Kumamoto Earthquake
Heavy rain, typhoon flood & destruction	2017 : Northern Kyushu heavy rain
	2015 : Kanto · Tohoku heavy rain
	2012 : Kyushu northern heavy rain
	2011 : Heavy rain caused by Typhoon 12
	:

Medical relief activities at the time of large scale disaster

Wide area disaster Emergency Medical Information System (EMIS)
Information sharing cloud of medical institution, government / administration and related institutions

1. Facility information such as hospitals at the time of disaster
2. DMAT (Disaster Medical Assistance Team) information
3. Emergency notification to the Ministry of Health, Labor and Welfare, etc.
4. Basic information such as the number of beds, doctors, and nurses

Case study

Demand for network in disasters

Intra-area/Wide area transport & ambulance management

It is important to grasp resources such as transport vehicles (ambulances) and doctor helicopters managed by each medical institution.

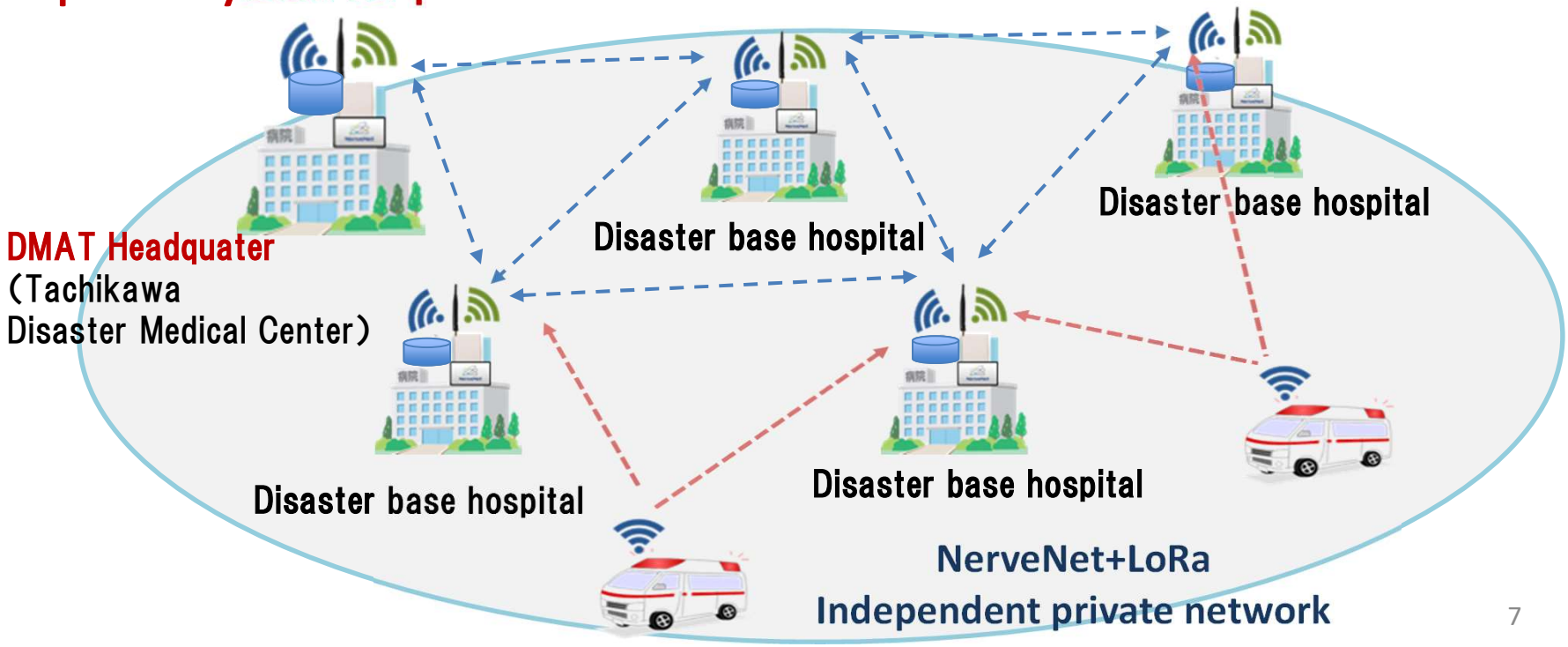
Currently, emergency vehicle management is performed using a mobile phone network, but there is a risk that management of the emergency vehicle can not be performed if the mobile phone network can not be used.

Demand for Emergency Vehicle Management with Private Network Independent of Mobile Phone Network.

Case study

Apply NerveNet+LoRa to Vehicle Management

Establish connection between disaster base hospitals by an independent private network, and share information grasp of vehicle information by NerveNet + LoRa private network with distributed sharing Database.
Vehicle information such as ambulance location received at any hospital is shared among hospitals.
→ **Share information such as patient transport instructions and the hospital's acceptance system for patients.**



In-vehicle node

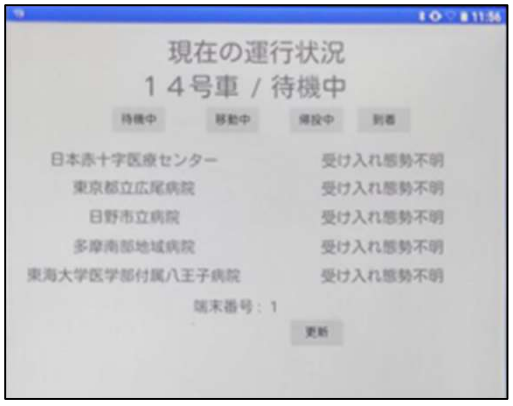
Raspberry Pi3 Model B
LoRa module
Bluetooth LE
Wi-Fi
GPS receiver, Battery

Hospital Rooftop nodes

Intel NUC、GPS receiver
LoRa module ×2
（one for In-vehicle node,
another is for hospital）
Wi-Fi

BLE

Ethernet/Wi-Fi



Display notification of hospital status to tablet
Send vehicle status (in transit, standby etc) from tablet

Display vehicle position, route on map

Case study

LoRa module

Supplier is RF Link
LoRa module : RM-92A

Item	Spec
Conformed technical standard	ARIB STD-T108, 920 MHz band specified low power radio station, IEEE802.15.4g adaption
Transmission output	+13dbm
Modulation method	LoRa/FSK/GFSK
Maximum transfer rate	292.97bps～37500bps (Lora mode) 50kbps～100kbps(FSK/GFSK mode)
Maximum reception sensitivity	-137dBm
Antenna gain	3dBi
Interface	Serial : 115200bps Connector : USB

For Application development

No need to study complicated LoRa setting

NerveNet provide LoRa Mesh demon and when user configure the LoRa wireless node, user set the parameter onto LoRa Mesh demon.
It is not necessary to study in detail interface of LoRa.
Node & network topology and configuration will be automitaclly done by NerveNet.

No need to study complicated communication method

NerveNet provide the API for application program.
When application program receive/send data from/to another node, application program access to database only. All receive/send data is controlled by Nervenet and put receive/send data into database.

Distributed synchronized database for application

NerveNet provide the database on each node with synchronization of data with other nodes. Application program can be develop on each node as stand alone and it is possible to reduce the communication with other node.

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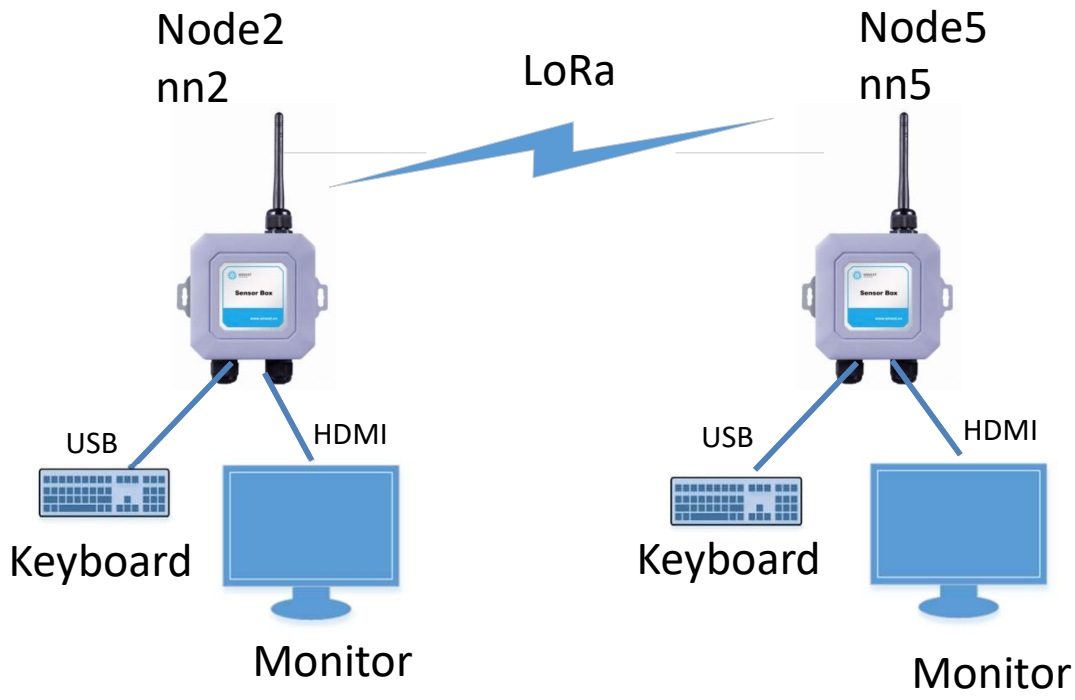
Demo of NerveNet+LoRa

Thanika Duangtanoo
NECTEC

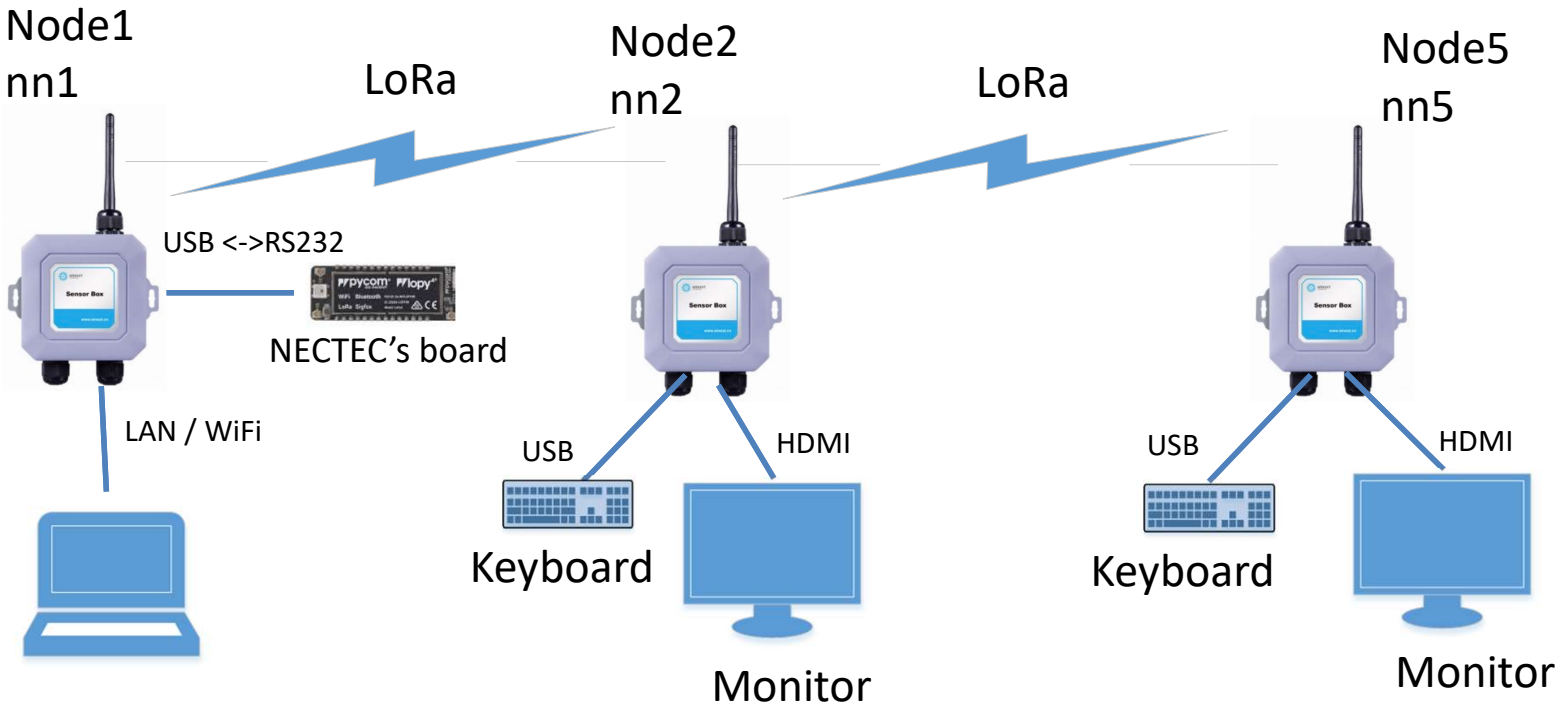
Demo 1



key text in format “destination message” + ENTER
i.e. nn5 hello world [ENTER]

Display message in text data to other monitor

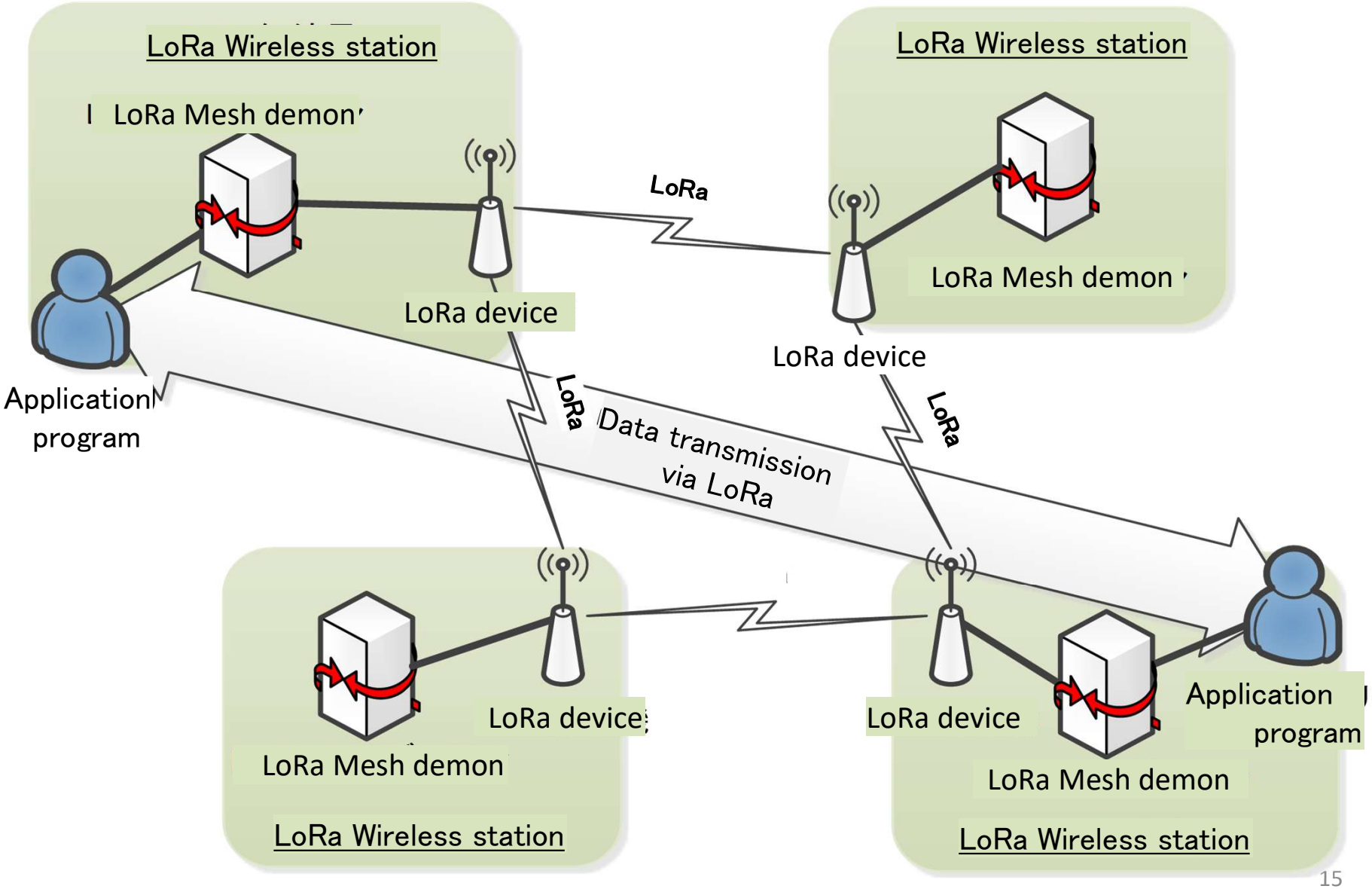
Demo 2



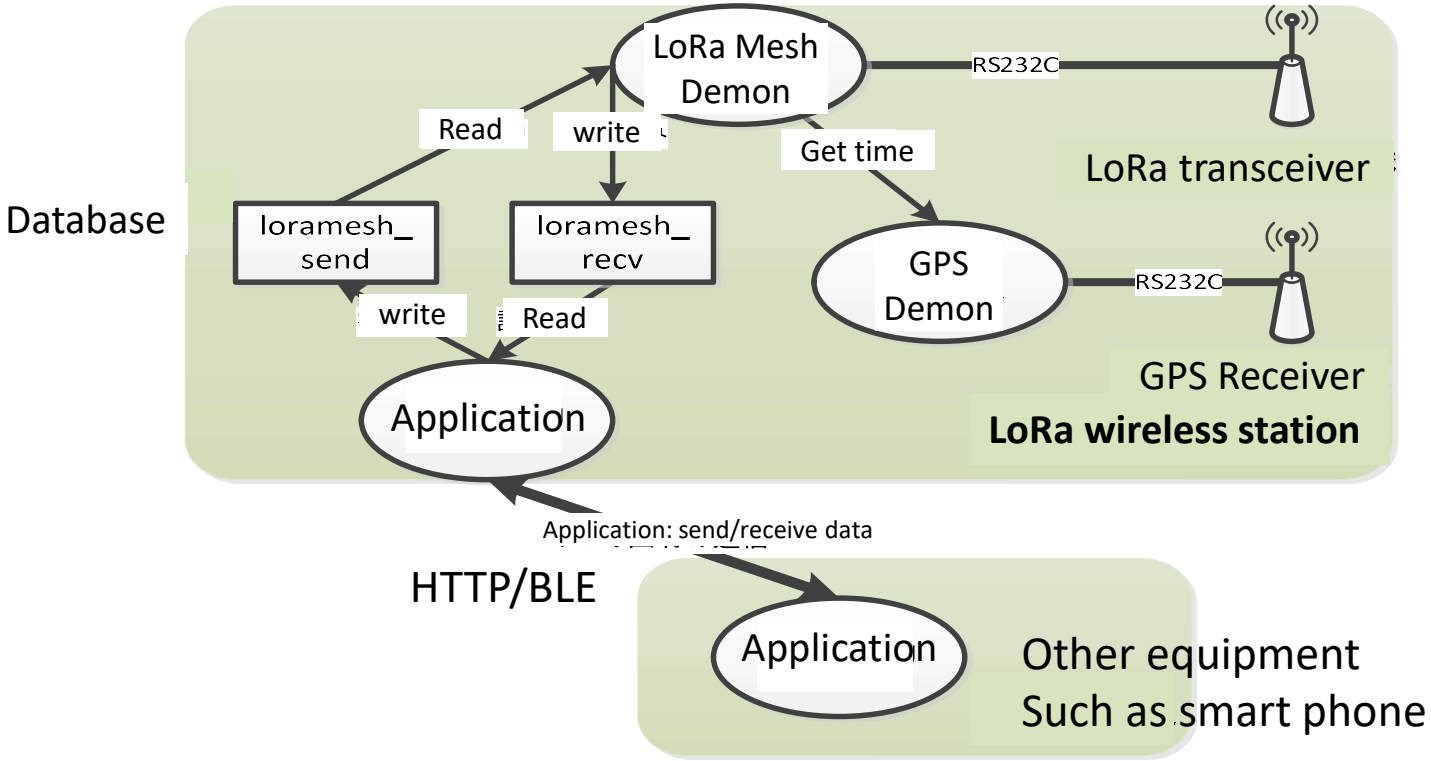
key text in format "destination message" + ENTER
i.e. nn1 $ spi get 0 [ENTER]

Node1 will send "$ spi get 0" to NECTEC's board.
The board will reply sensor values

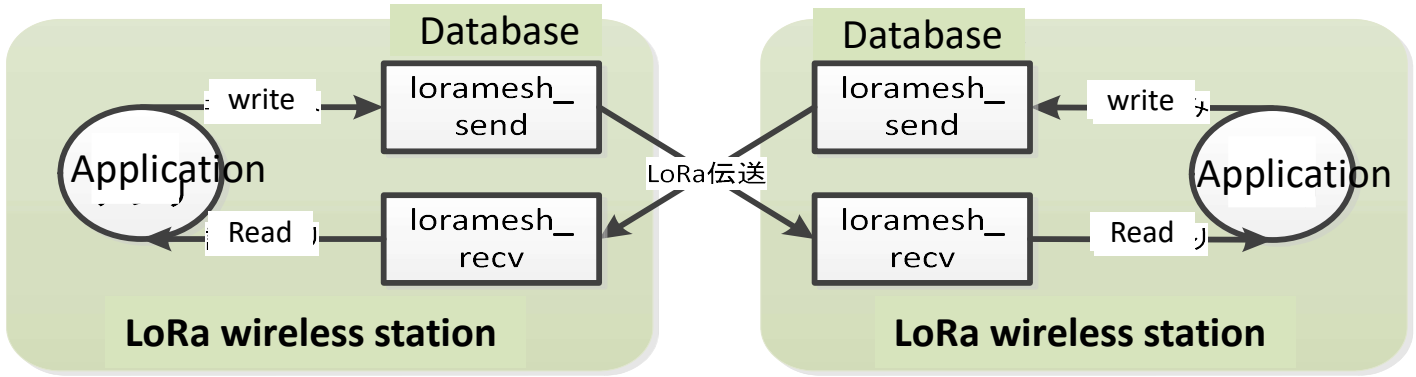
Information sharing on LoRa (Flooding)



Send and receive data on LoRa

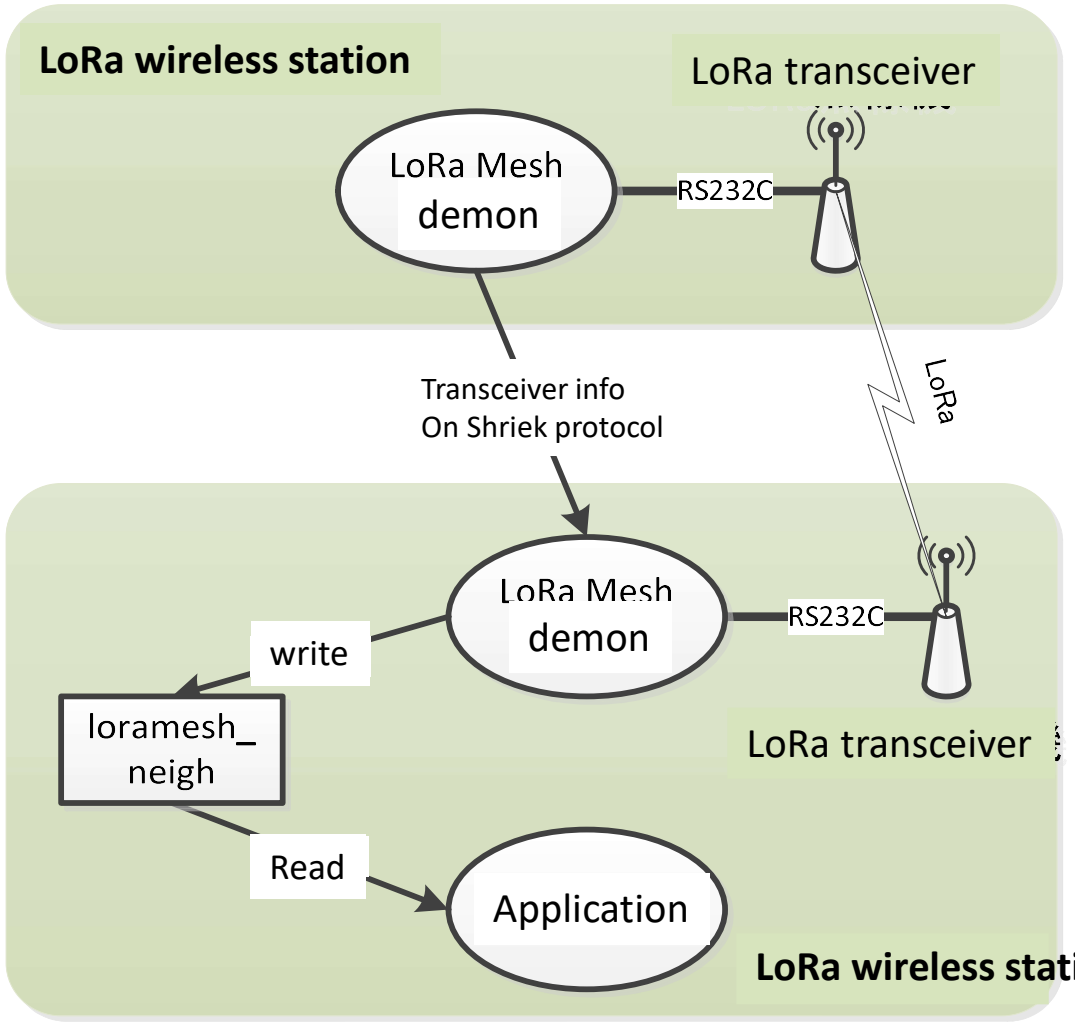


Interface for send & receive data for application



Mechanism of adjacent node discovery

(communication between rooftop nodes)

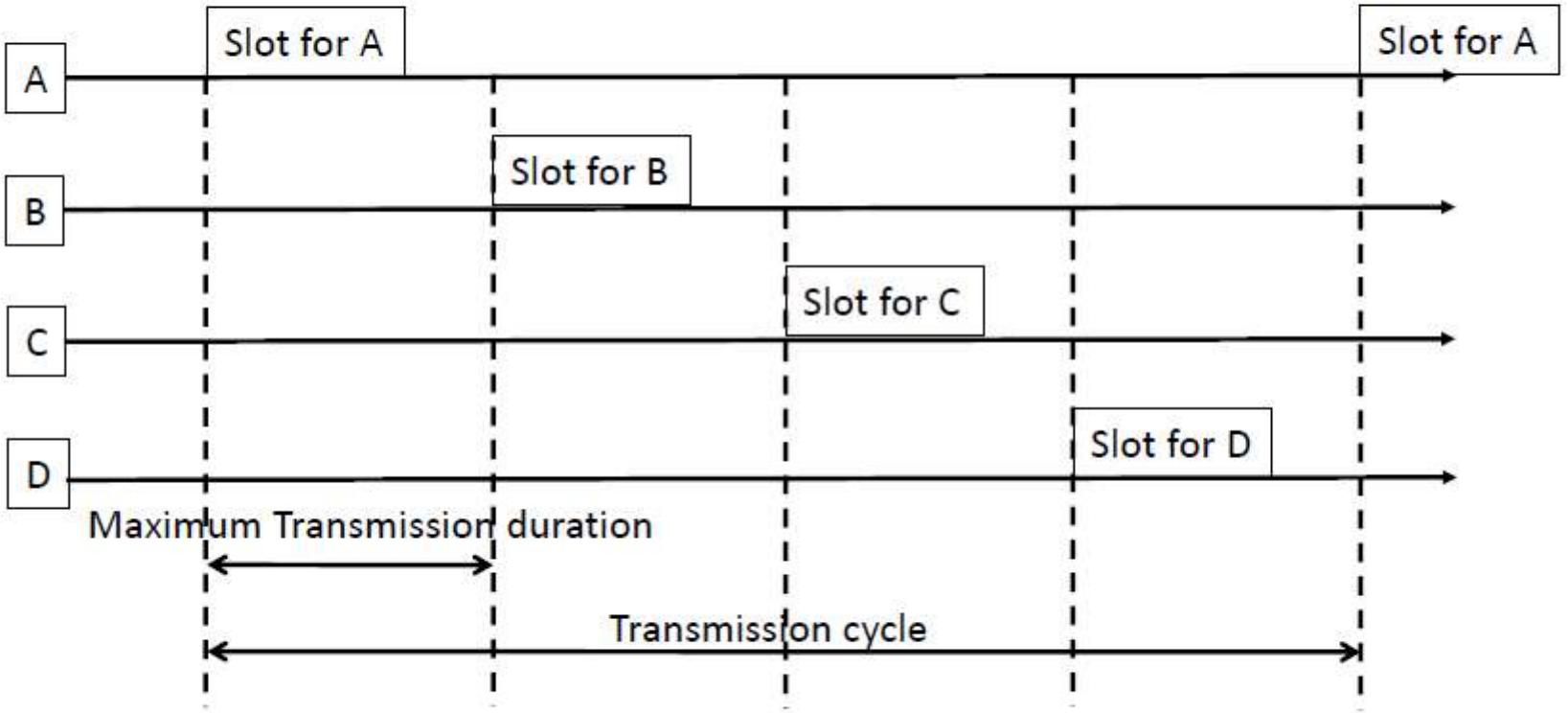


Understand the topology of the network by grasping adjacent nodes and sharing it among node

→ No need to define network topology

Use for efficiency at the time of flooding

Transmission Slot allocation



Time synchronization is done by GPS

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