# NerveNet

# Never Die Network In Thailand

### Presented By
Kulit Na Nakorn, Ph.D. (kulit.n@chula.ac.th)
Faculty of Engineering, Chulalongkorn University

### Authors
Assoc. Prof. Kultida Rojviboonchai, Ph.D. (kultida.r@chula.ac.th)
Faculty of Engineering, Chulalongkorn University
Masugi Inoue
National Institute for Information and Communications Technology (NICT), Japan

CHULA ƩNGINEERING   COMPUTER
Foundation toward Innovation
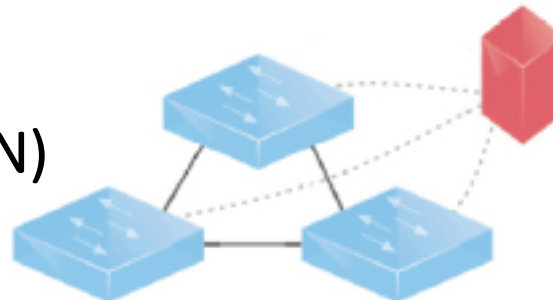
## Vehicular Networks

- Intelligent Transportation System
- Reliable Broadcasting Protocol
- Heterogeneous Network

## Localization

- Floor and Indoor Localization
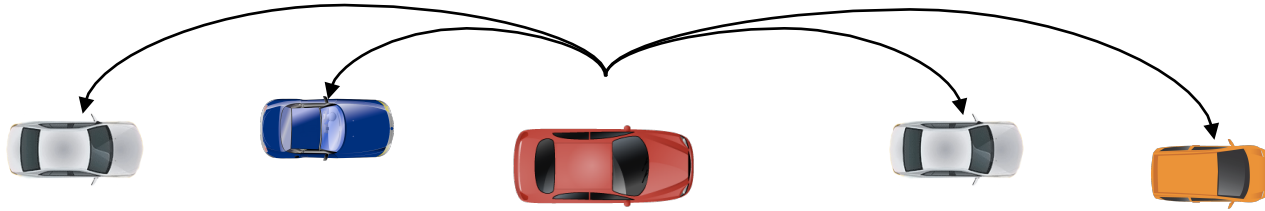- Indoor Navigation System

## Software Defined Network (SDN)

DECA : Density-Aware Reliable Broadcasting Protocol
DECA is designed to be simple and flexible but reliable in vehicular networks.
 A forwarder is selected by using only density information. (no. 1-hop neighbors)

NoG : Non-geographical Knowledge Reliable Broadcasting Protocol
NoG is also designed for vehicular network. It is an improvement of DECA.
NoG selects a preferred forwarder using  density information and node relationship.
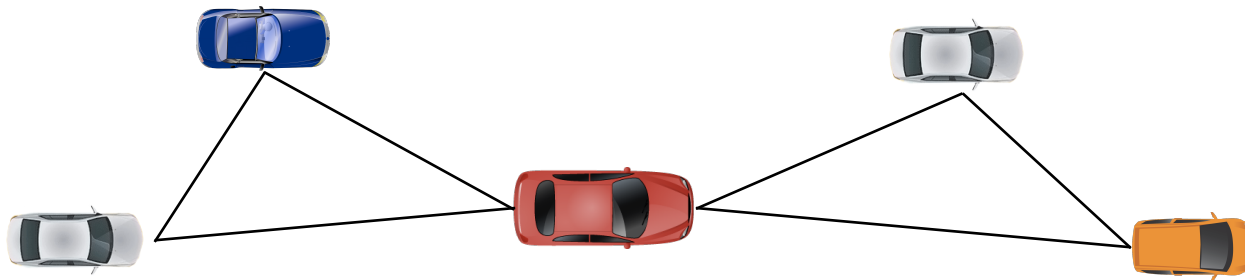
## Testing Platform on Shuttle Buses in Chulalongkorn University Campus

- Chulalongkorn University campus area ~1.5 km$^2$
- 21 DENSO WSU-5001T Devices (IEEE802.11p)
    - 19 Units are deployed on Chula Shuttle Buses
    - 2 Units are deployed as infrastructures
- Each unit equips with Raspberry Pi and Wi-Fi access point
    - 6 sensors are connected with Rpi :
    GPS/Accelerometer/Gyroscope/Light Sensor/Temperature Sensor/Humidity Sensor
- Use **DECA** as a protocol
- More than 2 years of
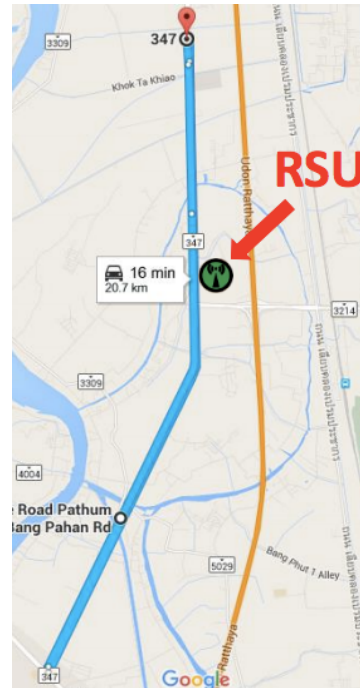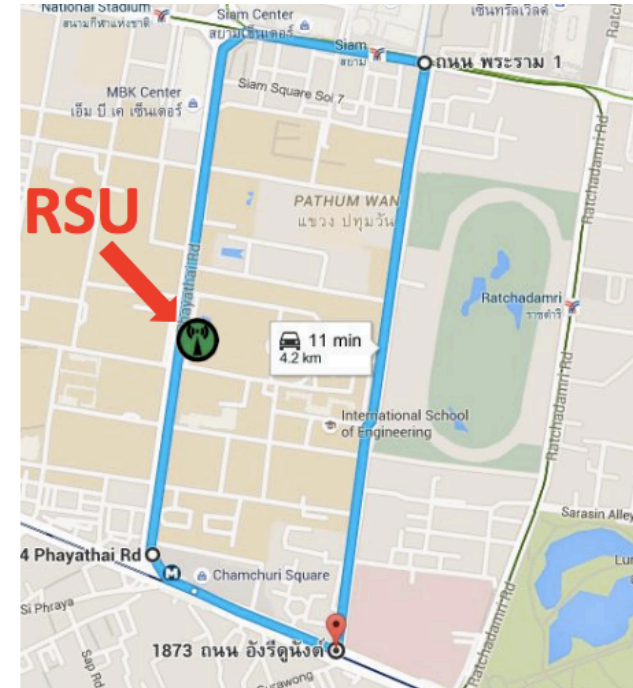  testing and still goes on

Supported by
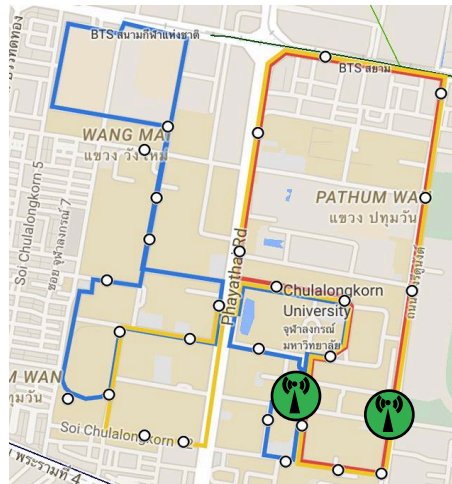
## IEEE802.11p performance testing

- **Highway Area**
  - Testing Distance 20.7km
  - Speed 60-100 km/h
- **Urban Area**
  - Testing Distance 4.2km
  - Speed 25-30 km/h
- 4 DENSO WSU-5001T Devices are deploy on 4 cars
- Use **DECA** as a protocol
- Total testing distance is almost 1000 km.

Supported by



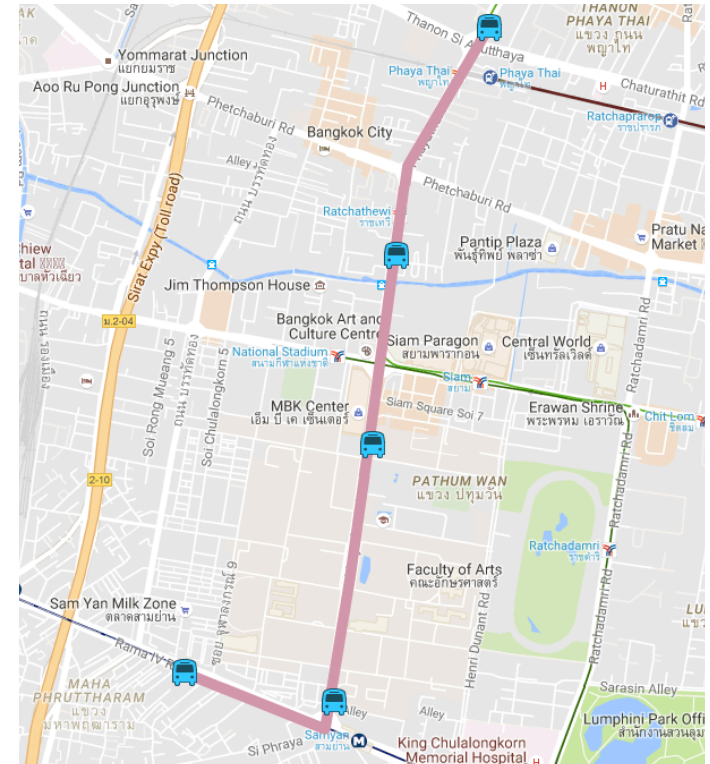Highway Area (20.7km)

Urban Area (4.2km)

**IEEE802.11p performance testing on public transportation in downtown of Bangkok**

- 7 DENSO WSU-5001T Devices
  - 5 bus stops on Phaya Thai road that cannot connect to each other.
  - 2 buses in opposite direction (must carry data and deliver to bus stops)
- Distance from the first bus stop to the last bus stop is 3.65km.
- Use **DECA** as a protocol
- New data will be generated every 1 minute and data lifetime is 30 minutes.
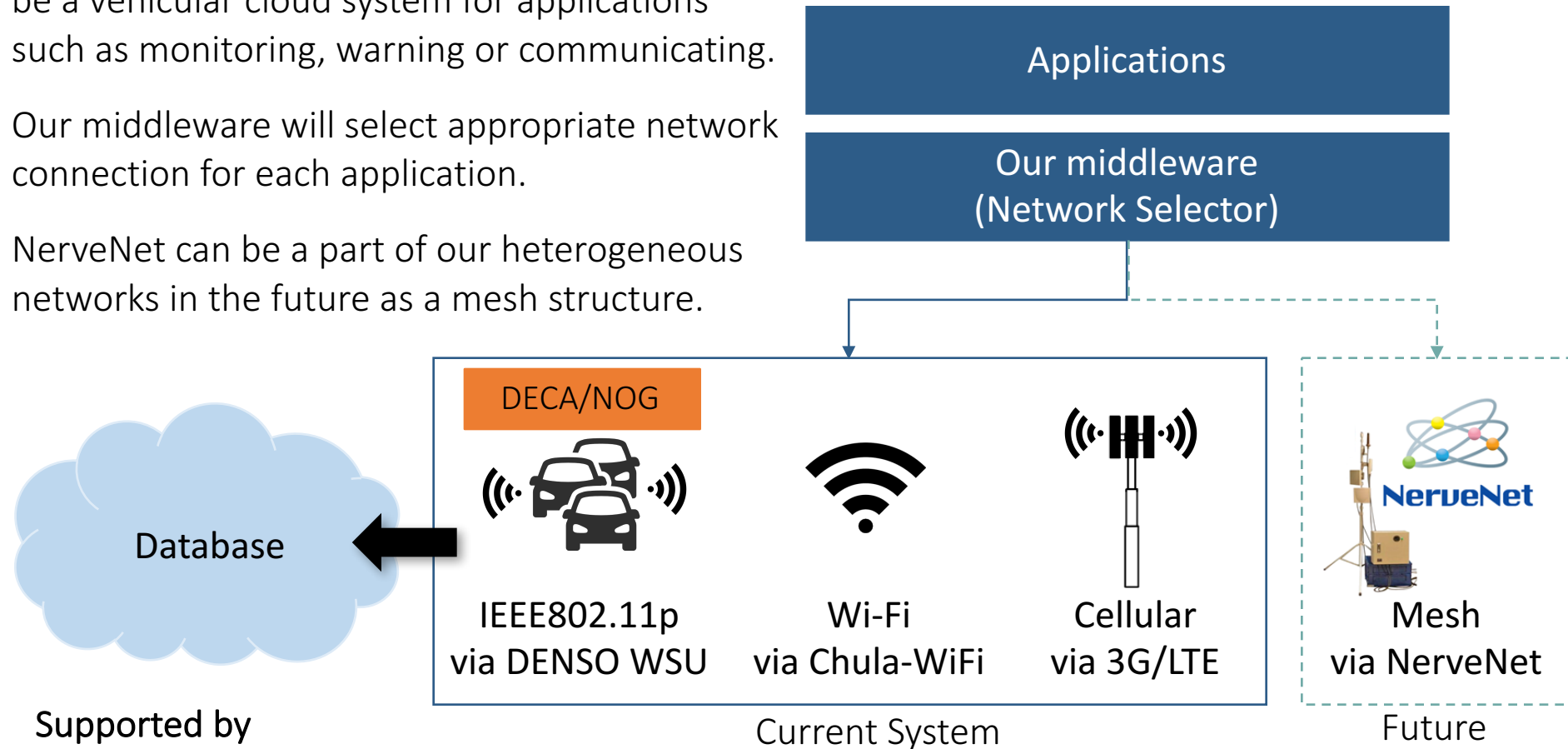- The delivery ratio results are more than 83%

Supported by

Currently, we develop our testing platform to be a vehicular cloud system for applications such as monitoring, warning or communicating.

Our middleware will select appropriate network connection for each application.

NerveNet can be a part of our heterogeneous networks in the future as a mesh structure.

**Applications**

**Our middleware (Network Selector)**

DECA/NOG

Database

IEEE802.11p via DENSO WSU

Wi-Fi via Chula-WiFi

Cellular via 3G/LTE

**Current System**

NerveNet

Mesh via NerveNet

Future

**Supported by**

NBTC

ITS Thailand สมาคมระบบขนส่งและจราจรอัจฉริยะไทย
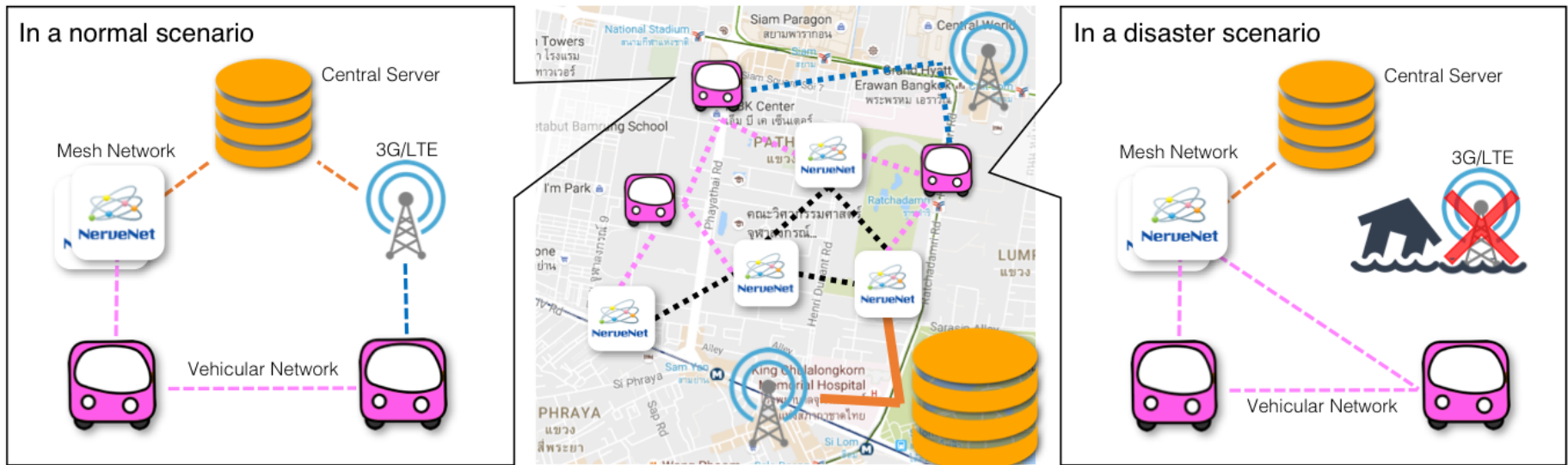
*DENSO*

CHULA ΣNGINEERING  COMPUTER
Foundation toward Innovation

**In a normal scenario**

NerveNet mesh network can be a part of network infrastructures to provide more network capacities and availabilities for IoT devices such as Chula shuttle buses.

**In a disaster scenario**

Other infrastructures were destroyed, the NerveNet mesh network can serve as the main infrastructure for the IoT devices to communicate to the central server. Therefore, search-and-recue applications or disaster-recovery applications can take benefit from the network.

Q & A

THANK YOU