Our Research and Collaboration in IoT & V2X & Connected Vehicles

Apinun Tunpan, Ph.D.
Chief Technology Officer

apinun@smartsensedesign.com

SMART SENSE
INDUSTRIAL DESIGN CO., LTD.

Company Profile

SMART SENSE
INDUSTRIAL DESIGN CO., LTD.

- **We are Specialized in Getting "Things" Connected Online and Analyze their Data.**
  - Tech Startup focusing on Industrial Internet of Things (IIoT) solutions & services. founded in Dec 2015.
  - We are a Registered Research & Development Company (with the Revenue Department).
  - We are Endorsed by the Board of Investment (BOI) in the "high-value-added software" category (We aim for Machine Learning & Artificial Intelligence in IIoT)

Connected Commercial Trucks

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OUR IOT SOLUTION FOR AQUACULTURE

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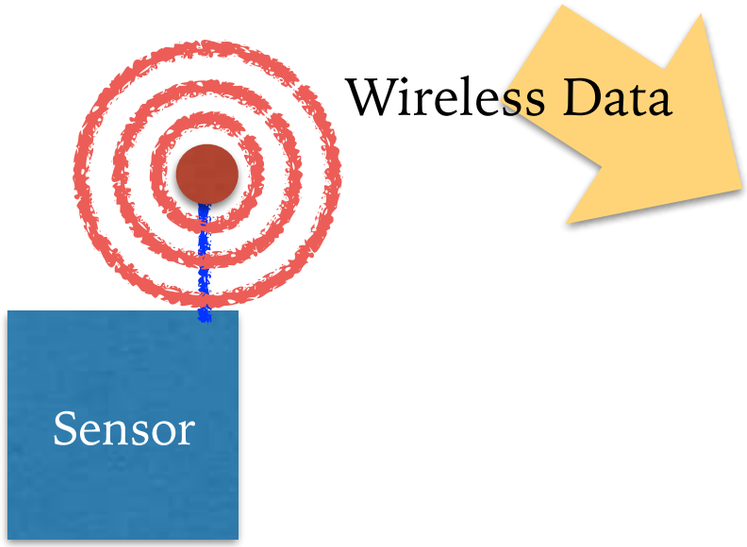
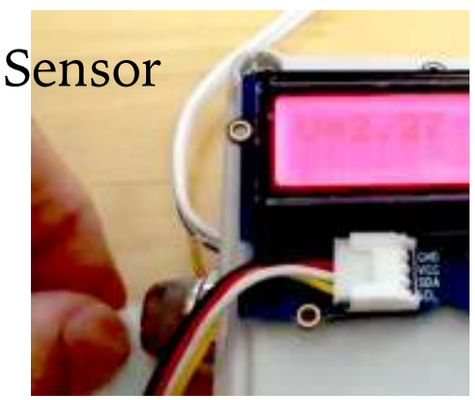
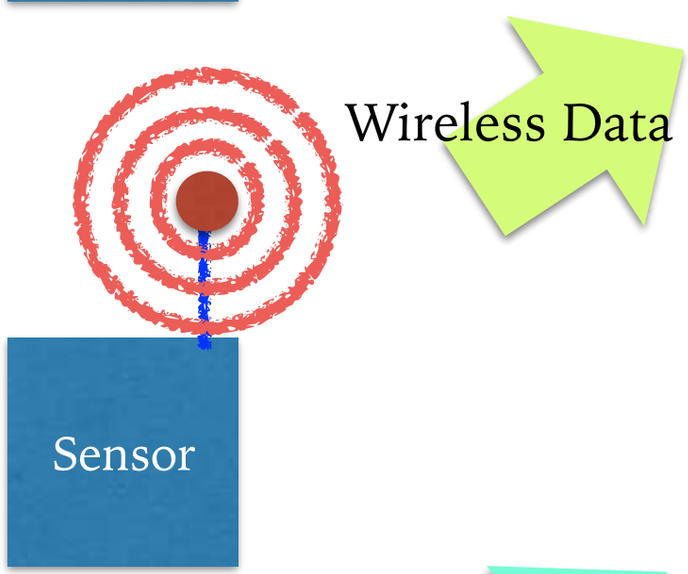
INFRASTRUCTURE MONITORING

Temperature, Humidity, Luminance

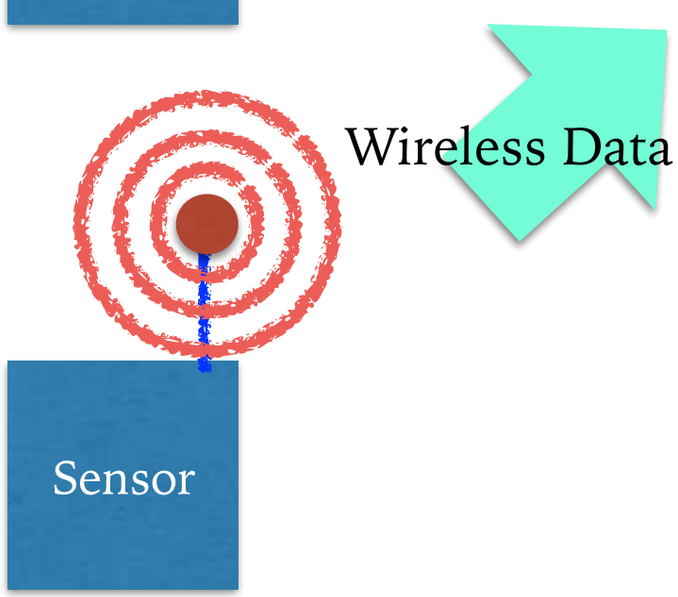


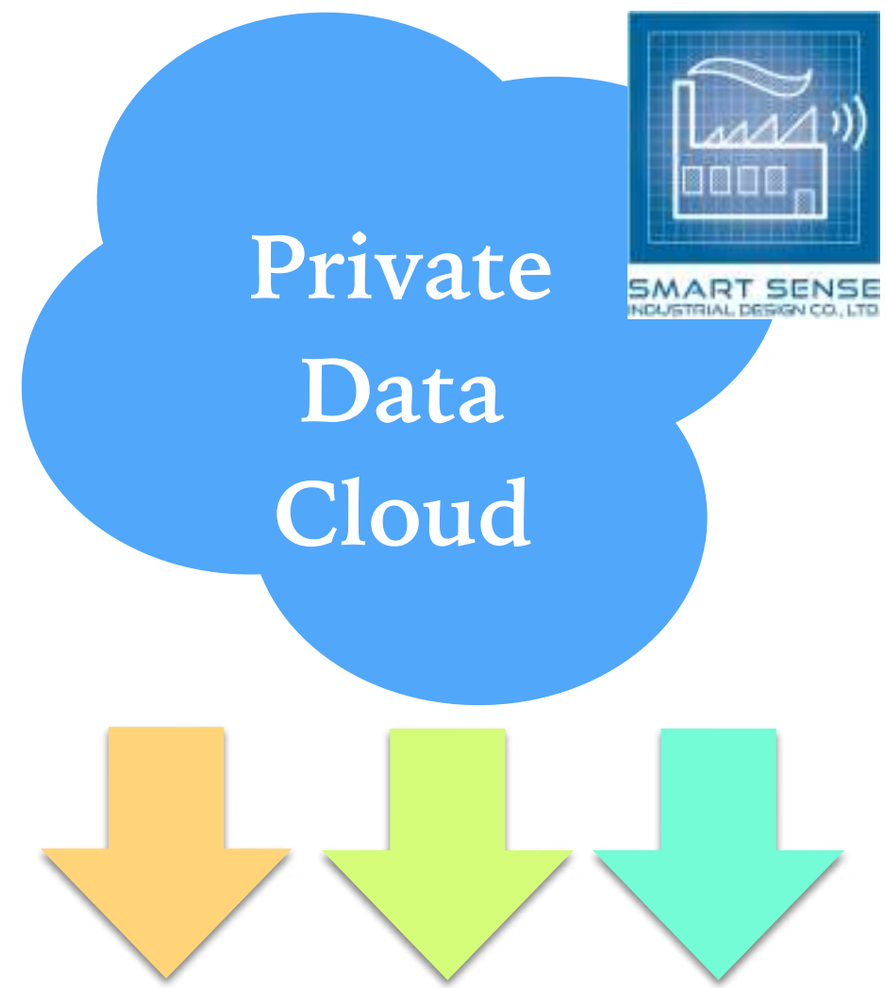
Gas Sensor

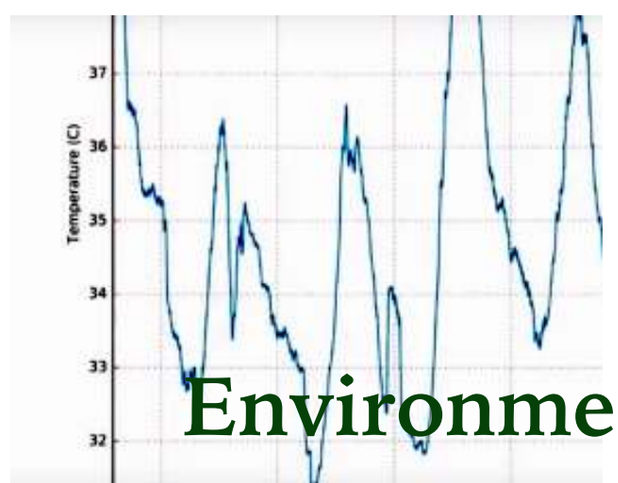




Connected Actuators

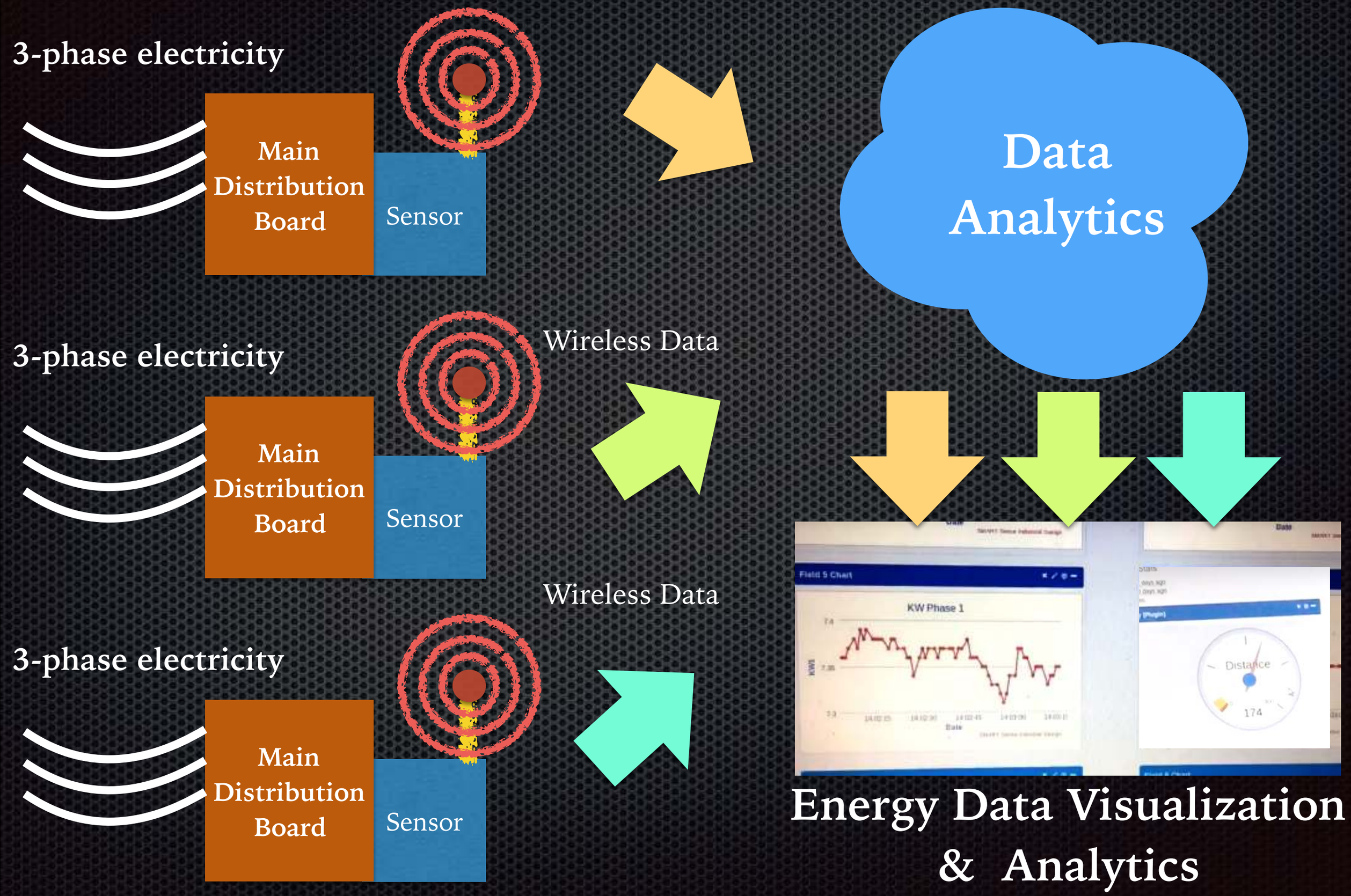






Environmental Data
Visualization & Analytics

Electricity Energy Monitoring & Analytics



Why Energy Analytics ?

- Identify “Hidden” Electricity Consumption Inefficiency !
- Energy Trending & Planning
- Going “Greener”

Our Partners

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NSRC
Network Startup Resource Center

advanticsys

The Abdus Salam International Centre for Theoretical Physics
ICTP
T/ICT4D

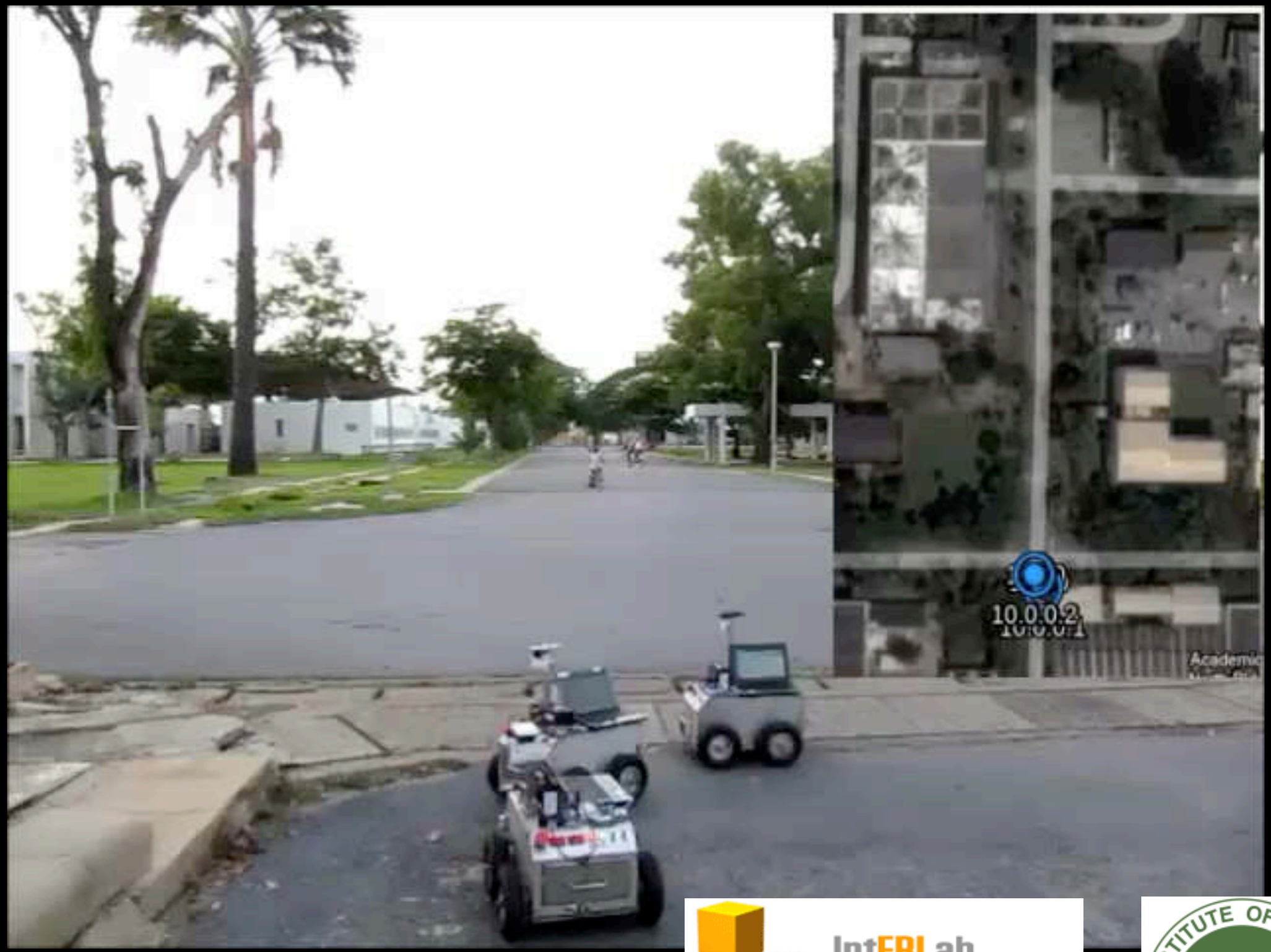
isif asia

ITS Thailand
สมาคมระบบขนส่งและจราจรอัจฉริยะไทย

RATCHAPRASONG
Discover the Heart of Bangkok

สวทช
NSTDA

Robotic Mobile Ad hoc Network
2011 - 2013



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Tak-Net : an experiment on Rural Community Wireless Mesh Network for Rural Community Development

Easy Installation

VoIP ready for everyday use and emergency preparedness

Range Extension

Raspberry Pi as a Community Content Delivery Server

Smart Rural Schools

Building SMART Rural Digital Economies with Rural Student Makers

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โครงการพัฒนาระบบ Internet of Things และบริการแอพลิเคชั่น เพื่อช่วยการจราจรรอบศูนย์การค้าขนาดใหญ่

IoT & Application Services for Alleviating Traffic Congestion near Large Commercial Buildings

เสนอต่อ

การประกวด Thailand City Innovation Challenge

สำนักงานนวัตกรรมแห่งชาติ (NIA)

โดย by

บริษัท สมาร์ท เซนส์ อินดัสเตรียล ดีไซน์ จำกัด (SMART Sense)

โดยความร่วมมือกับ in Collaboration with

สมาคมผู้ประกอบวิสาหกิจในย่านราชประสงค์

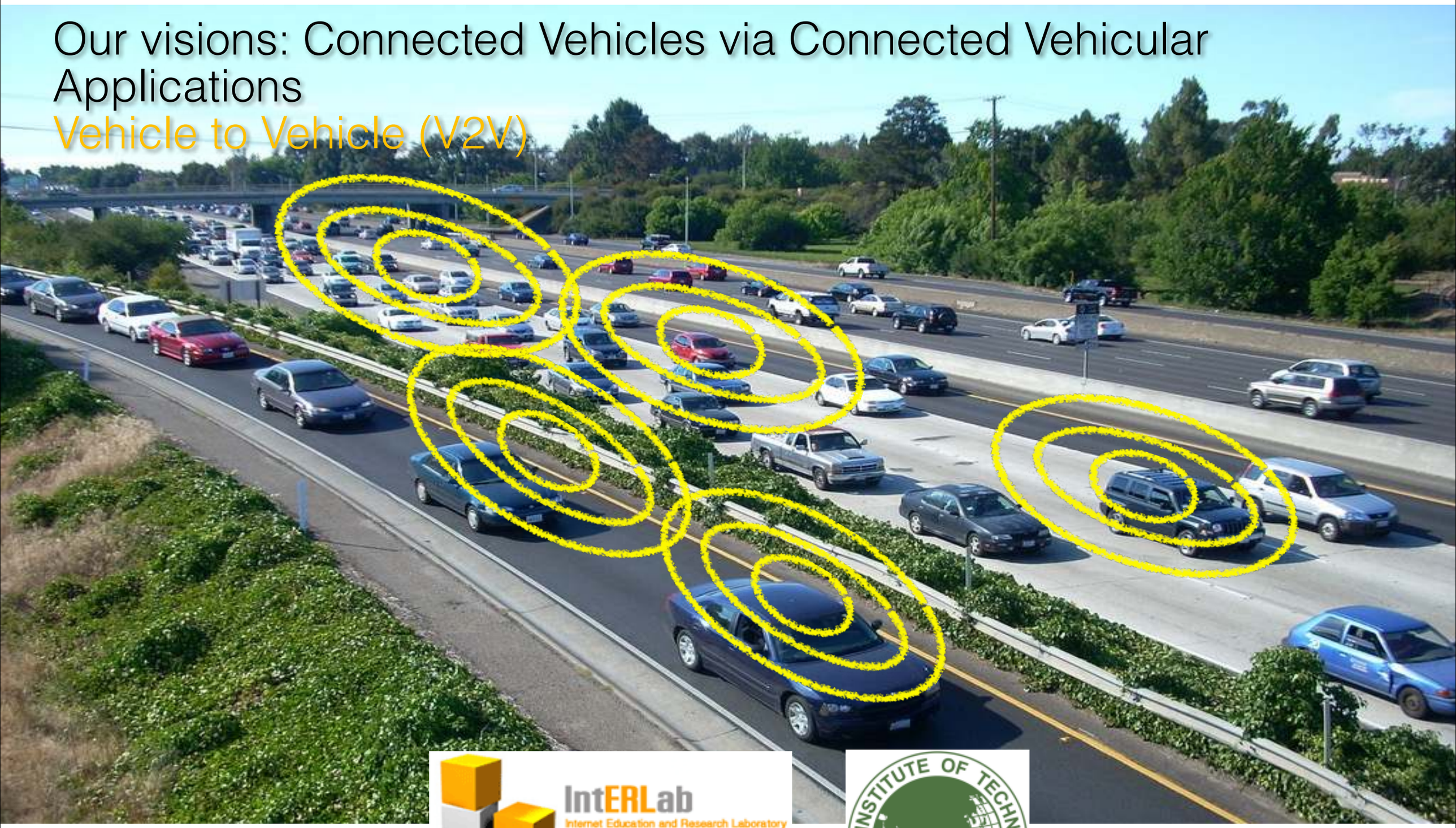
The Ratchaprasong Square Trade Association (RSTA)

Web Application as a Service Platform for V2X Communication from the CarTalk-as-a-Service Project

Nunthapath Weshsuwannarugs, Dr. Apinun Tunpan,
and Prof. Kanchana Kanchanasut

Our visions: Connected Vehicles via Connected Vehicular Applications

Vehicle to Vehicle (V2V)



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NSTDA

Our visions: Connected Vehicles via Connected Vehicular Applications

Vehicle to Infrastructure (V2I)

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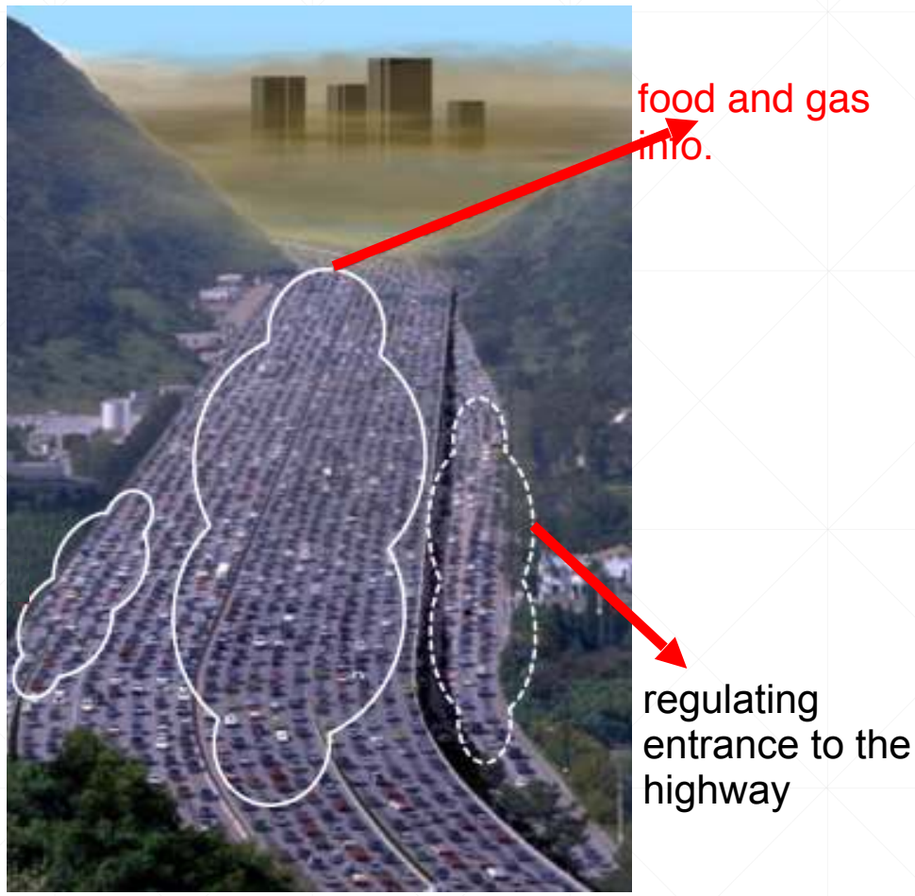
Vehicular Cloud (slide borrowed from Dr Gerla UCLA)

Vehicles in the same geographic domain form a P2P cloud to collaborate in some activity



Related work:

MobiCloud – *Dijian Huang*
Maui – *MSR*
Auton Vehi Clouds – *S. Olariu*
IC Net On Wheels – *Fan Bai GM*

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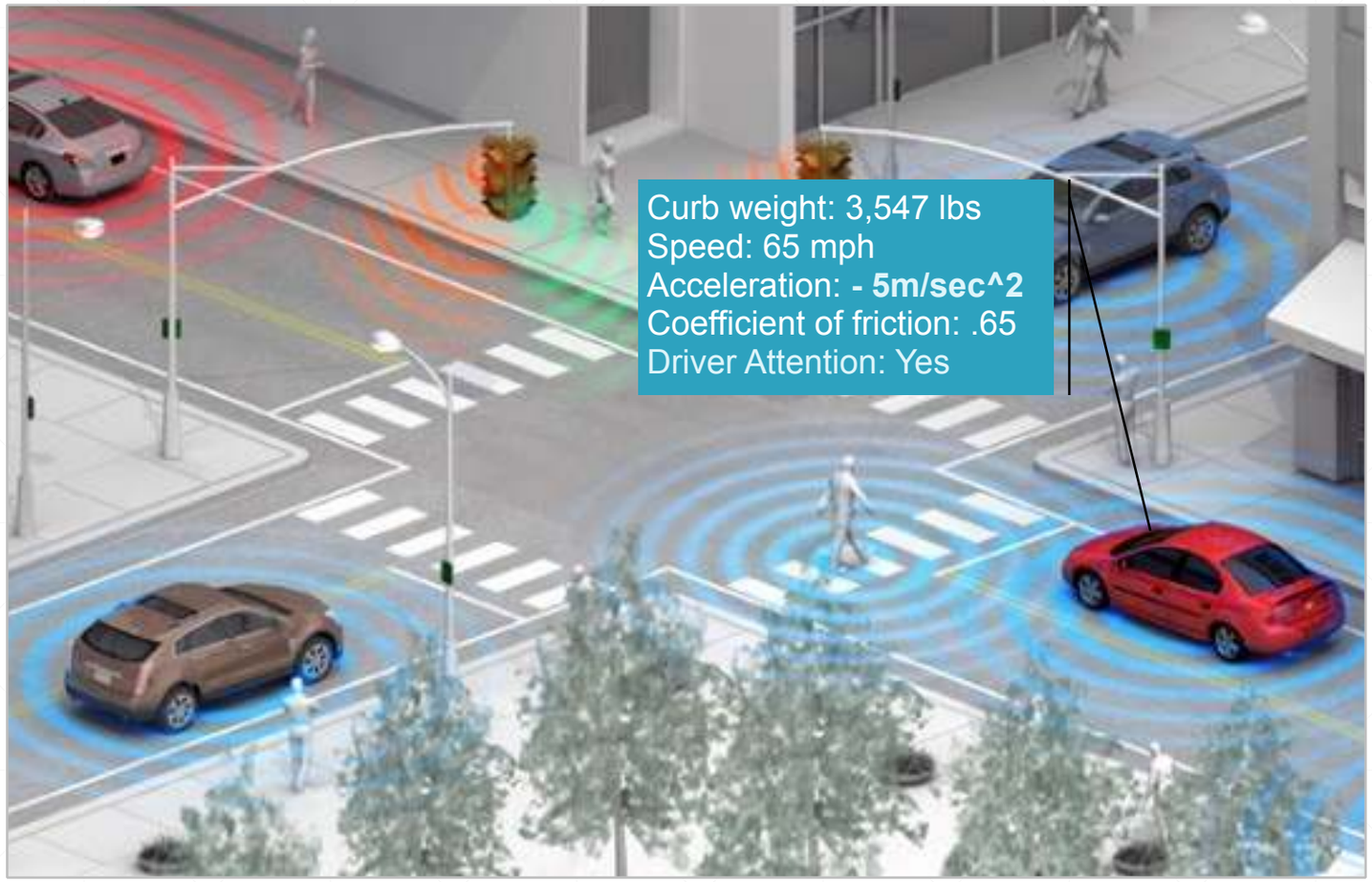
V2V Communications for Safe Driving



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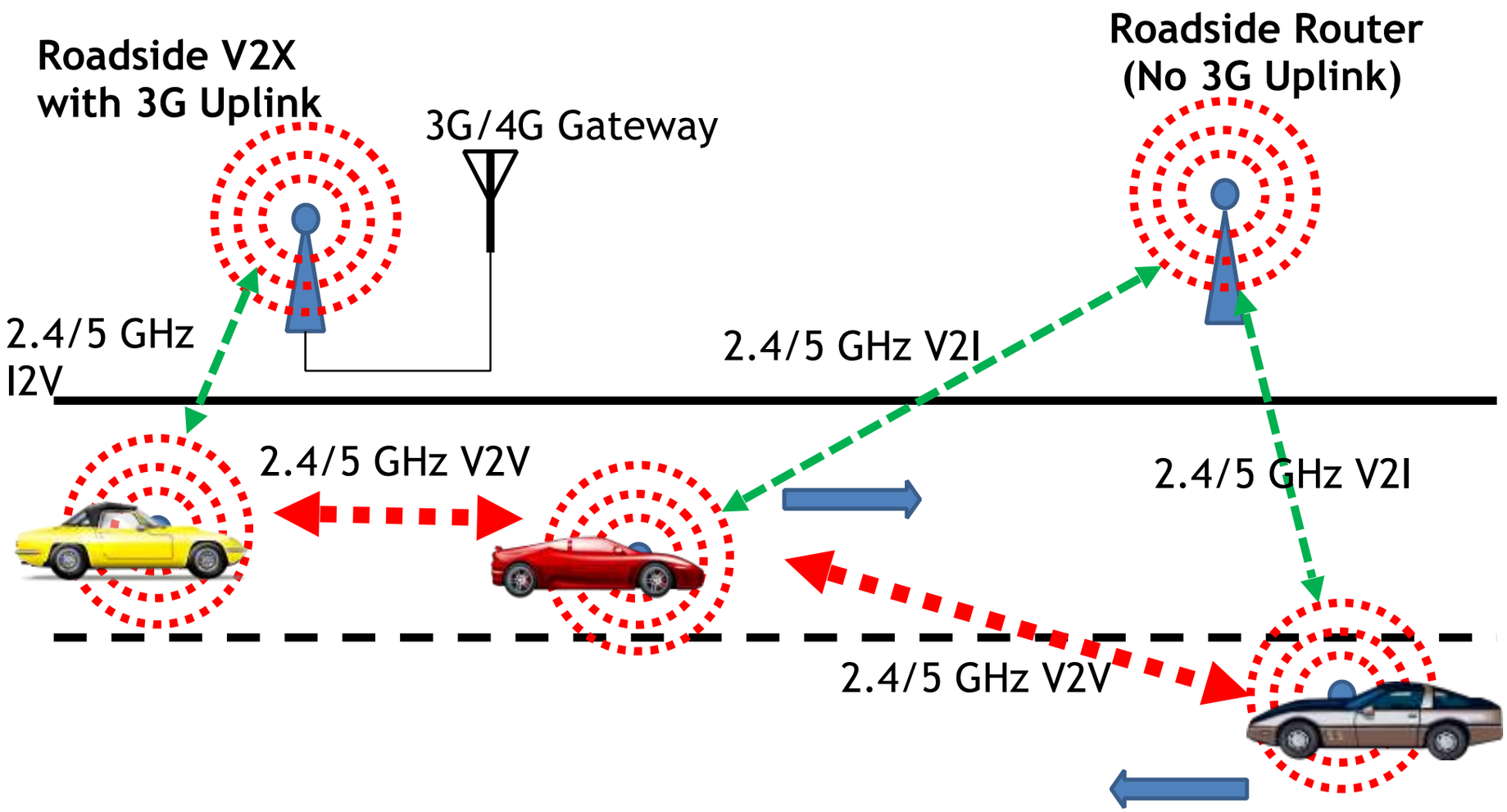
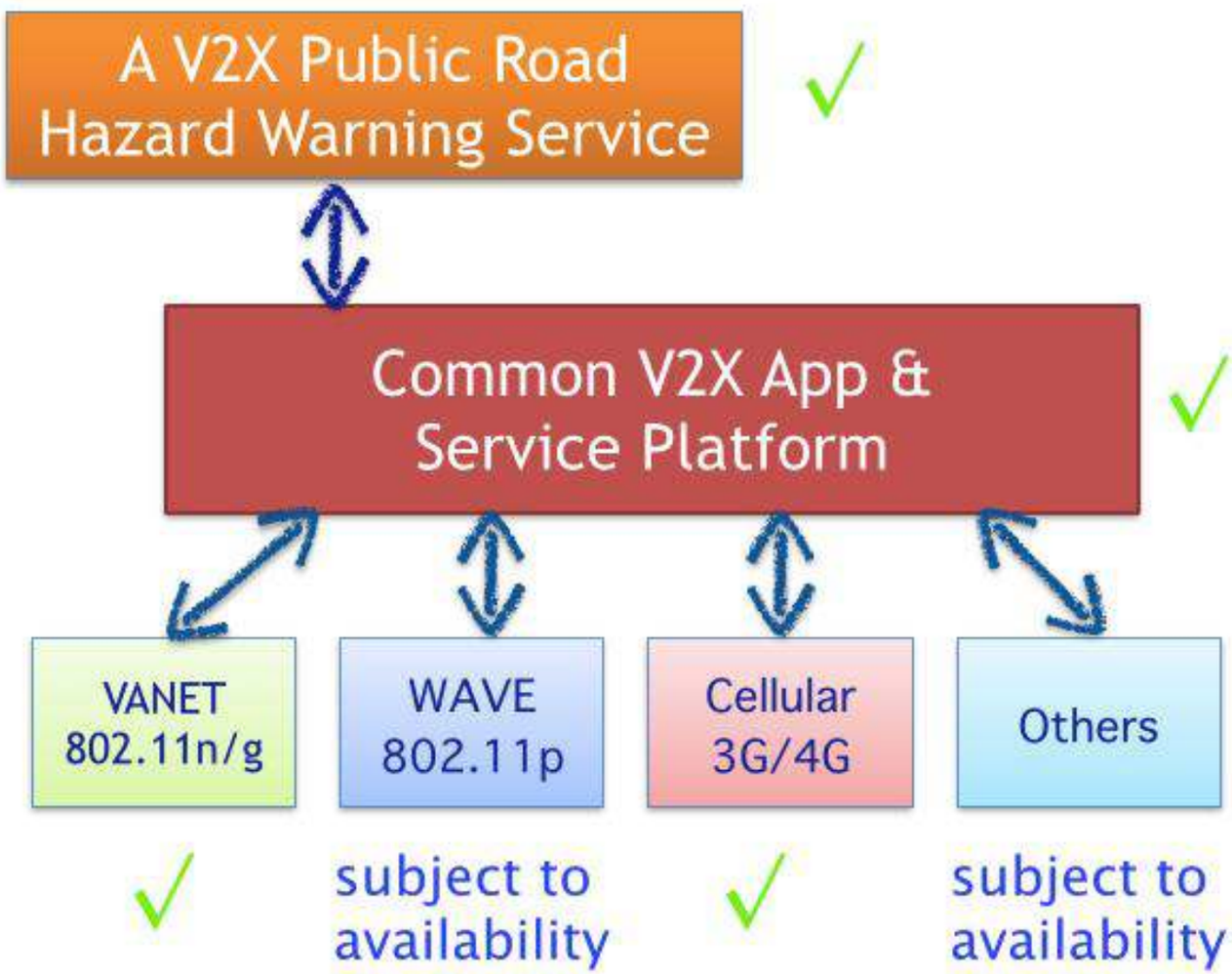
V2X Service Architecture

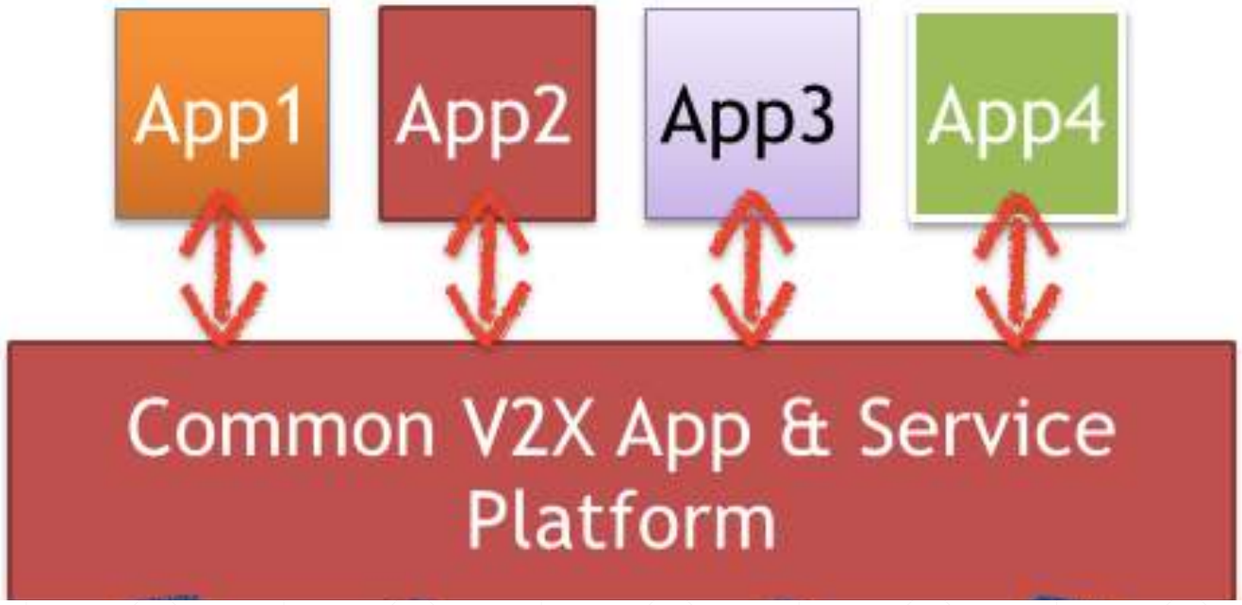


Scope of work

- วิจัยและพัฒนาต้นแบบ Common V2X Web Application & Service Platform



Objective



- พัฒนาระบบต้นแบบ Common V2X Web Application & Service Platform

ซึ่งสามารถทำงานกับเครือข่าย

- V2V ในลักษณะ VANET (Vehicular Ad hoc Network)
- V2I และ I2V ผ่าน Cellular Network (3G/4G)

รูปภาพจาก *US Department of Transport* แสดงแนวคิดของ *V2I* และ*I2V*

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สวทช NSTDA

Common V2X Web Application & Service Platform

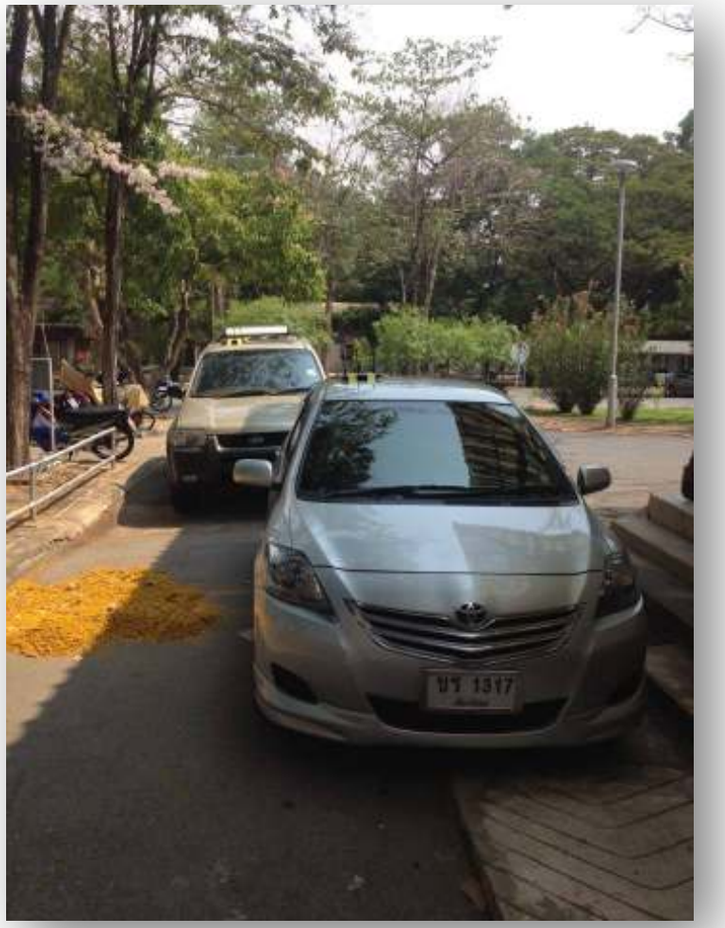
Common V2X App & Service Platform

Hybrid Routing Decision :
VANET, VDTN 3G/4G, or WAVE (if available)

Web App & Service APIs for :
web services, messaging, bulk data transfer, etc.

Simple Vehicular Cloud -features :
Data store, Data retrieval, Data exchange

Vehicular Router Prototype



- IEEE 802.11ac dual-band
  - 2.4Ghz
  - 5Ghz

OpenWrt
Wireless Freedom

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API สำหรับการพัฒนาระบบ Car Talk

- มี Application Programming Interface (API) เพื่อช่วยอำนวยความสะดวกให้สามารถพัฒนา V2X Web Application

Neighbor-related API	Description	Target	Method	RETURNS	Requires
broadcast	Broadcast data, e.g user Lat/Lon	/api/broadcast	Post	JSON	JSON
listNeighbor	List all neighbor (Only IP Address)	/api/listNeighbor	Get	JSON	N/A
listNeighborDataAll	List all neighbor (IP Address and Data, eg. Lat/Lon)	/api/ listNeighborDataAll	Get	JSON	N/A

Vehicular Cloud API	Description	Target	Method	Returns
store	Store data	/api/store	Post	JSON
retrieve	Retrieve data	/api/retrieve	Get	JSON

GPS Positioning API	Description	Returns
getCurrentPosition	Get Position	position.coords.latitude position.coords.longitude

Web Socket API	Description	Returns	Requires
onopen	Calls when a connection is opened	Boolean	
onmessage	Message is received	JSON	
onclose	Server connection has been closed		
onerror	Error occured		
send	Send message		JSON

3G Cellular Status Check	Description	Returns	Requires
isConnected	Check if cellular data is connected	Boolean	

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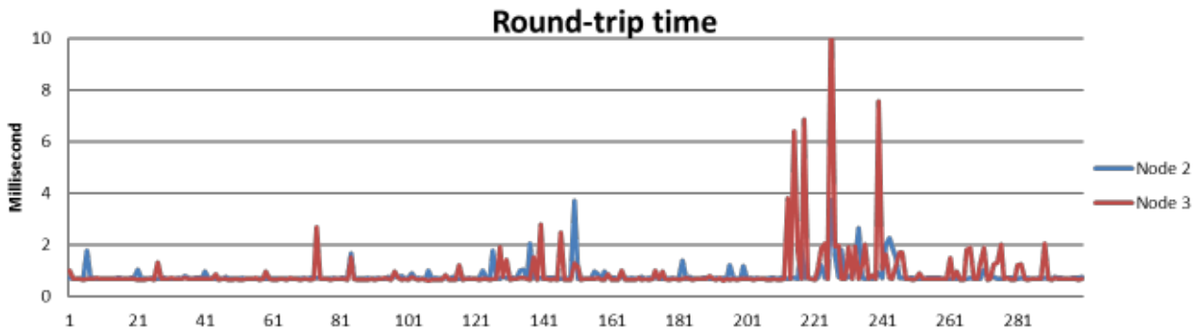
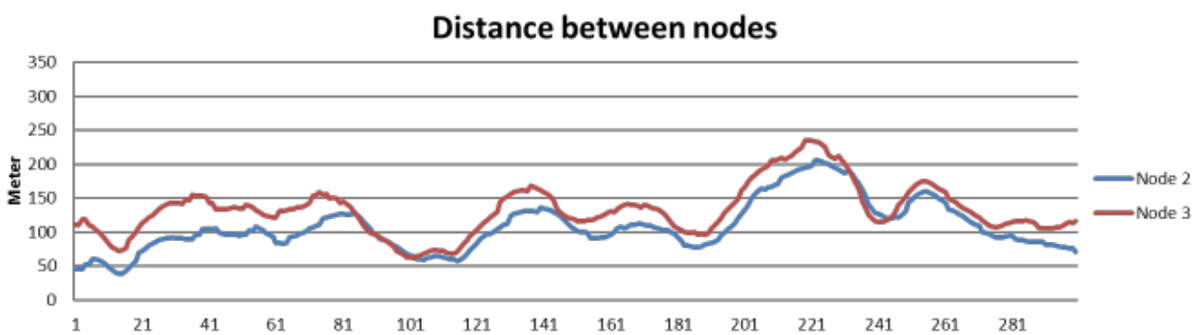
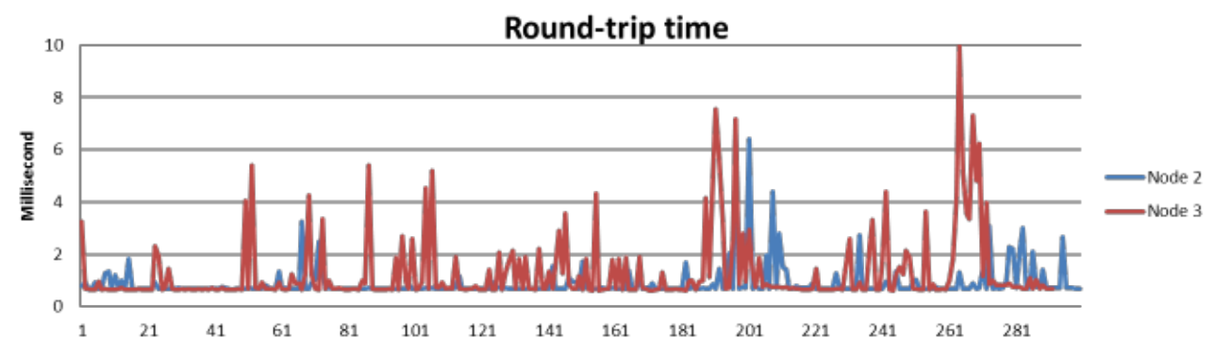
การทดสอบอุปกรณ์ในเขตเมือง

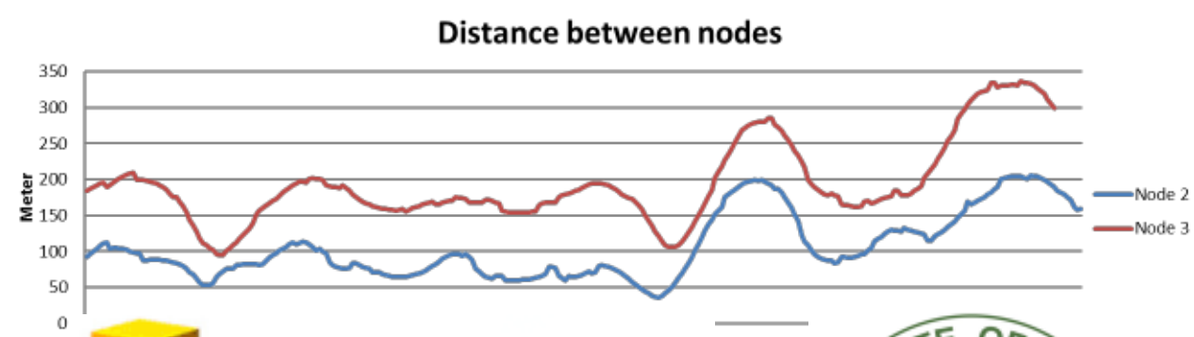
- วิธีการทดสอบ
  - รถยนต์สามคันวิ่งตามกัน
  - มีระยะห่างระหว่างคันแตกต่างกันในแต่ละการทดสอบ
  - ทดสอบ Delay และ throughput

ผลการทดสอบ ในเขตเมือง









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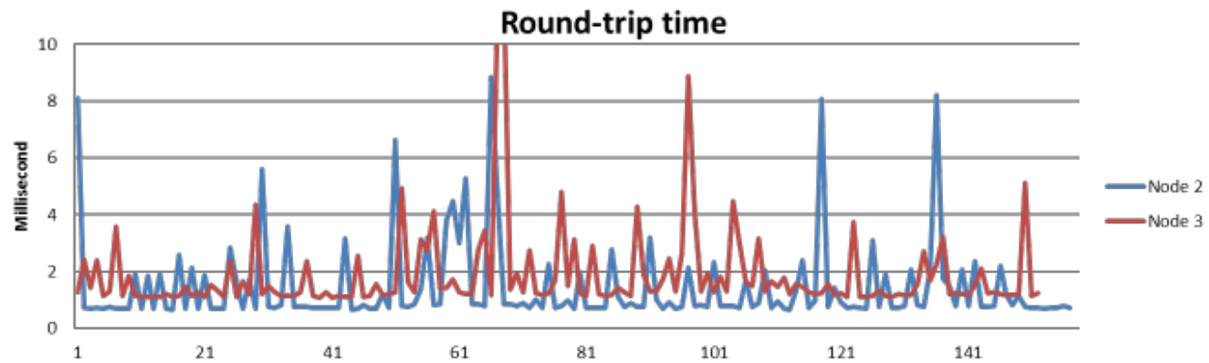
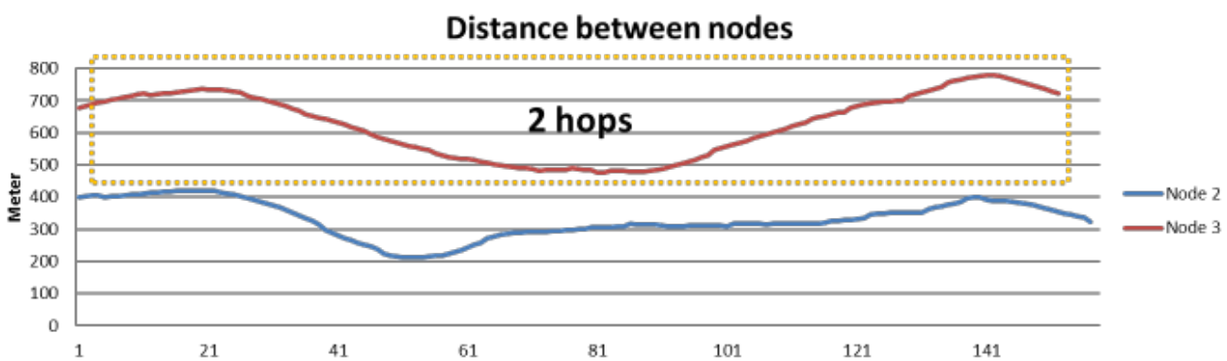
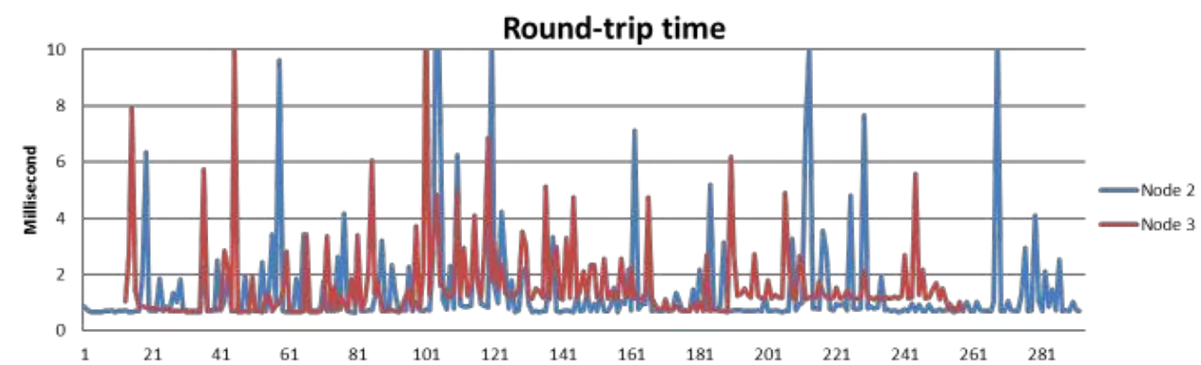
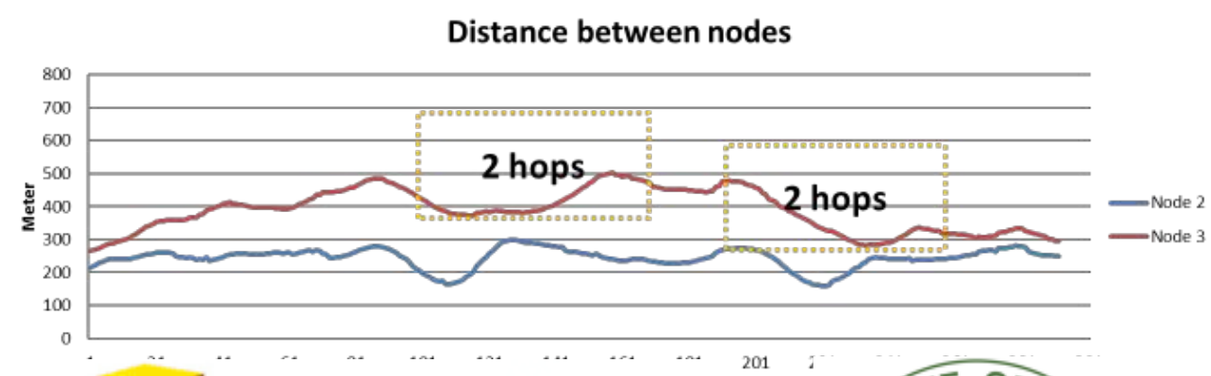
ผลการทดสอบ ในเขตเมือง









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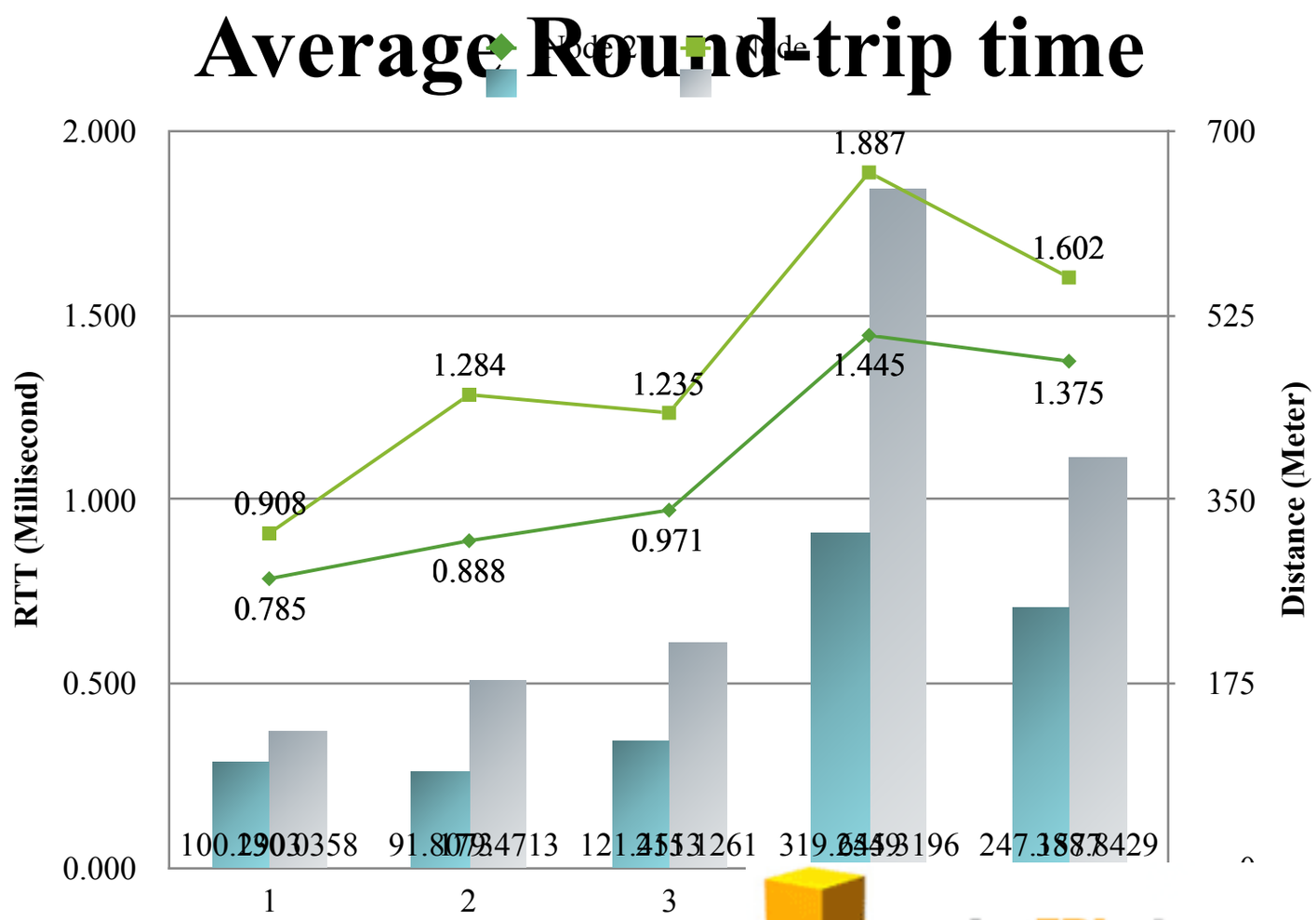

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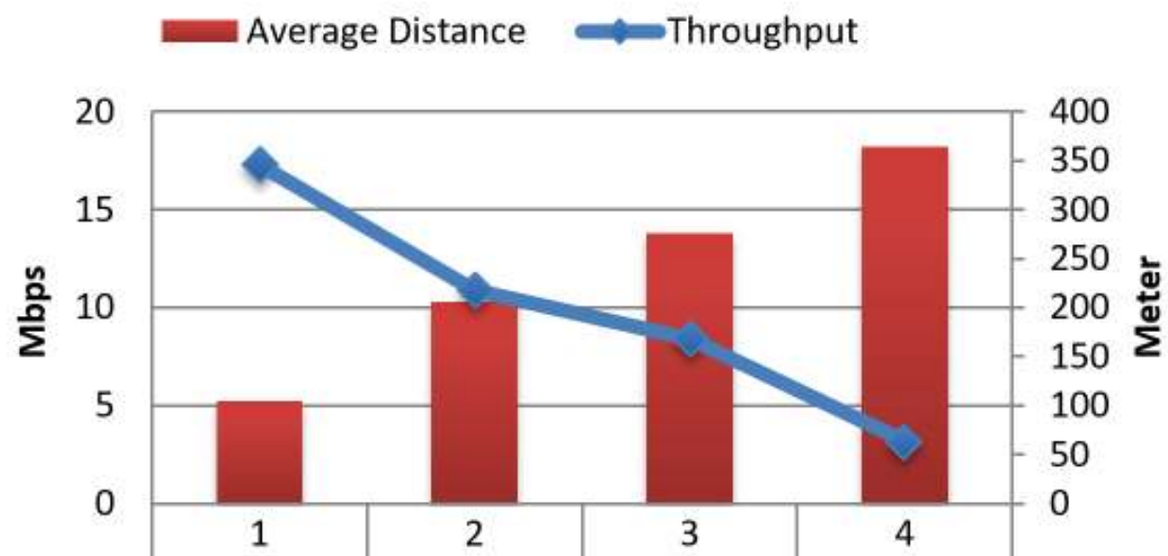

	1	2	3	4
Average Distance	105	206	276	364
Throughput	17.3	10.9	8.44	3.17

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Our Interests

SMART SENSE
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- SMART EV & E-Mobility through IoT, Sensors, Actuators, Applications, and Data Analytics.
- Infotainment Apps for Autonomous Vehicles.
- We do have our own expertise as well as partners and resources to pursue R&D + Biz development.
- We already have experience in ICT & IoT for mobility & transportation.

Thank you !

Apinun Tunpan, Ph.D.
Chief Technology Officer

apinun@smartsensedesign.com