

GNSS Applications

UTOKYO/ICG Workshop on GNSS for Policy and Decision Makers
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GNSS Applications - 1

- Surveying, Mapping and Geodesy
- Transportation
 - Car Navigation, ITS, ADAS, V2X
 - Road Pricing, Toll Collection
 - Congestion Management
 - Railway Network
 - Marine : AIS, VMS
 - Aviation : SBAS / GBAS
 - UAV / DRONE
- Vehicle Accidents / Emergency Services
 - eCall/ ERA-GLONASS / E-911
- Tax / Insurance
 - Tax based on location or distance traveled

ITS: Intelligent Transport System
ADAS: Advance Driving Assistance System
V2X: Vehicle to Anything
V2V: Vehicle to Vehicle
AIS: Auto Identification System
VMS: Vessel Monitoring System
GCP: Ground Control Point

GNSS Applications - 2

- Legal and Law Enforcement
 - Fishing Zone Management, Illegal Fishing Control
 - Crime Prevention
- Agriculture
 - Precise farming, Auto or Semi-Auto Driving of Tractors
 - Product Supply-Chain Management
- Location Based Applications
 - Services, Entertainment, Advertisement, Gaming, Marketing
- Warning during Disasters
 - EWS of QZSS, SAR of GALILEO
- Geo-Fencing / Geo-Securities
- Robotics
 - Navigation, Actions based on Location
- Scientific Applications
 - Space Weather : Scintillation, Radio Occultation, Plasma Bubble

EWS: Early Warning System

GNSS Applications - 3

- Telecommunication
 - Synchronize cell towers
 - microsecond order for CDMA
 - Few hundred nanoseconds for 5G
 - Network Time Protocol
 - millisecond order
- Power Grid
 - Phase Synchronization between grids is required for higher efficiency and avoid power failures
- Time Stamping of
 - Financial and Banking Transactions
 - Legal, Clerical, Shipping Documents
- Scientific Timing Applications
 - Time stamping of events
 - e. g. Global VLBI Observation, earthquake occurrences, arrival of neutrino in particle physics



Queensland (Australia) Monitoring Fishing Boats

Queensland to introduce mandatory GPS trackers for commercial fishermen to track sustainable catch

<https://www.youtube.com/watch?v=2qWTAZ8hmOY&t=77s>

4 Vessel Tracking Obligations

4.1 Vessel tracking requirements for all commercial fishing boats

Unless otherwise specified under this policy or the *Vessel Tracking Guidelines*, all commercial fishing boats (including primary and tender boats fishing under Commercial Fishing Boat Licences, Commercial Harvest Fishing Licences and Charter Fishing Licences) are required to have a vessel tracking unit installed and operational while undertaking commercial and non-commercial activities.

This obligation will commence from 1 January 2019 for all crab, net and line boats, and from 1 January 2020 for all other commercial fishing boats.

The vessel tracking unit must be an approved unit and installed and maintained in accordance with the Fisheries Queensland's *Vessel Tracking Installation and Maintenance Standards*.

Penalties apply for using a commercial fishing boat without an approved and operational vessel tracking unit.



<https://www.abc.net.au/news/rural/2017-10-20/queensland-introduce-mandatory-gps-trackers-commercial-fishing/9066936>

The screenshot shows the website [daf.qld.gov.au/business-priorities/fisheries/monitoring-compliance](https://www.daf.qld.gov.au/business-priorities/fisheries/monitoring-compliance). The page title is "Fisheries monitoring and compliance". It features a navigation menu on the left with categories like Aquaculture, Fisheries habitats, and Fisheries monitoring and compliance. The main content area includes a video player titled "Fisheries monitoring film" and several links for "Fisheries compliance", "Monitoring interactive map", "Fisheries monitoring and reporting", and "Queensland Boating and Fisheries Patrol".

Link to Video:
<https://www.daf.qld.gov.au/business-priorities/fisheries/monitoring-compliance>

GNSS Field Demo for Fishery Management



May 2018

Presenting how GPS can help fishermen



About 50 local fishermen attended the program

May 2018

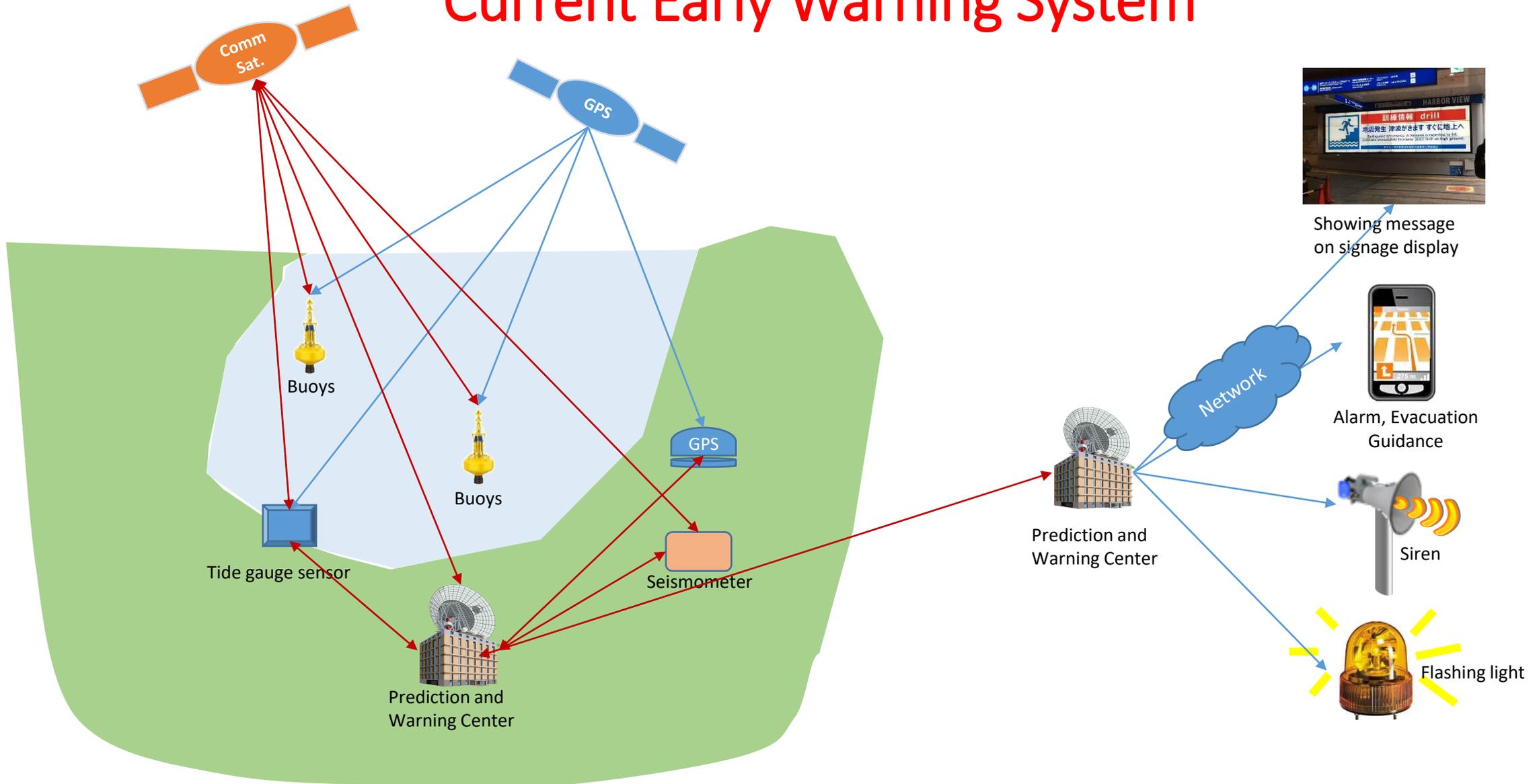
New Possibilities beyond Position and Time Data

- GNSS is not only for Position and Time
- Also capable of
 - Broadcasting Warning Messages during disasters
 - QZSS (Japan) EWS (Early Warning System)
 - GALILEO (Europe), in future
 - Search And Rescue Services (SAR)
 - GALILEO (Europe)

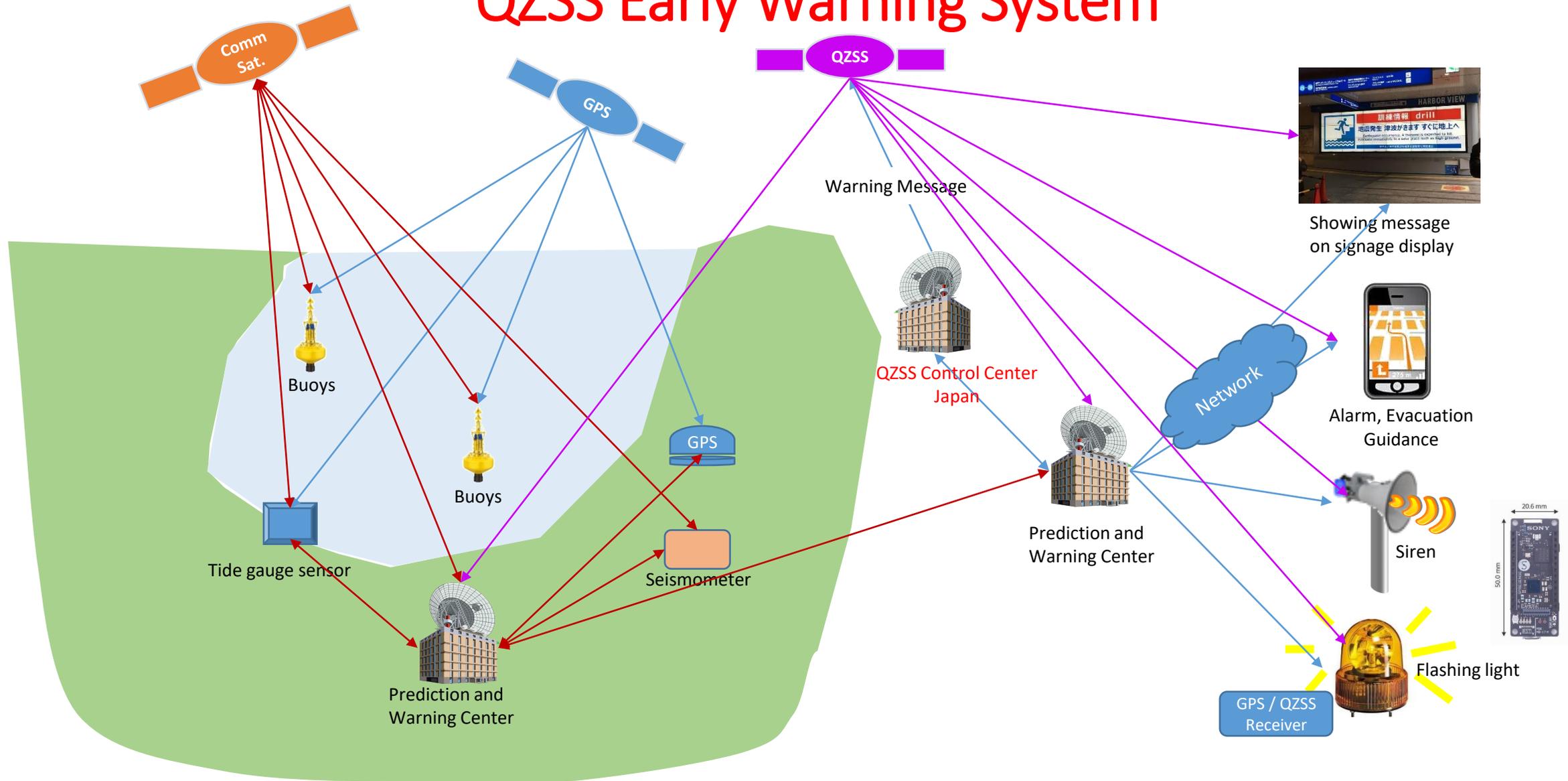
Problems of Early Warning System

- Difficulty in reaching the people at risk or reaching to the “the Last Mile”
 - How to send alerts to people in the risk zones?
- Shutdown of power and communication systems due to Earthquake, Tsunami etc.
 - Alerts can't be send effectively
 - Mobile-phones, SMS, Internet, Social Media may not work
 - Even if mobile phone is working, due to bandwidth congestion, communications may not be established on time
 - Delayed arrival of alert message

Current Early Warning System



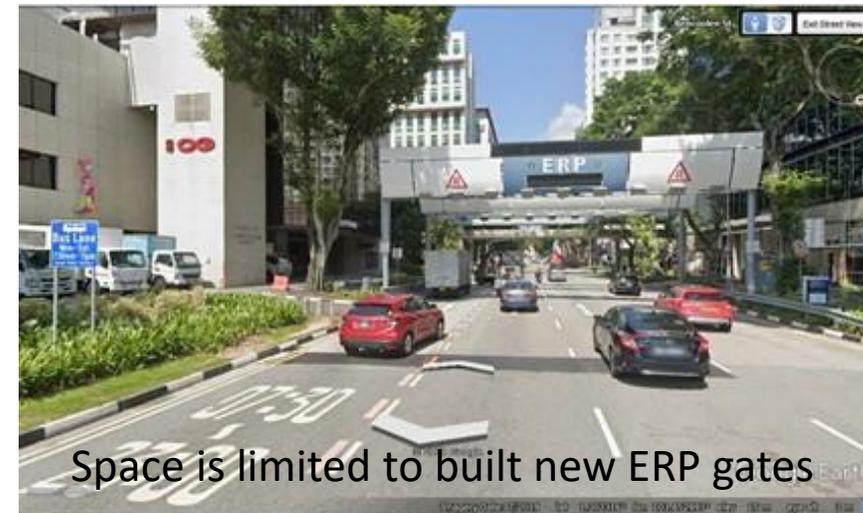
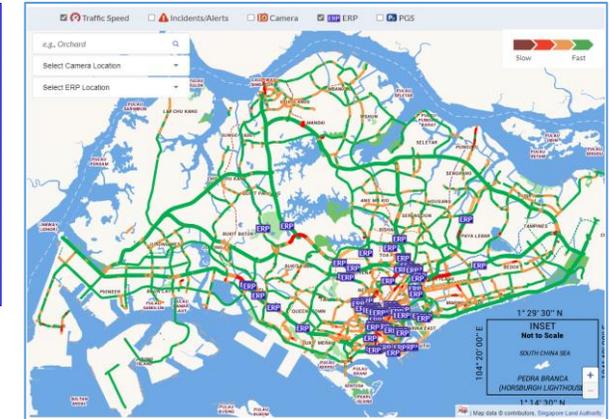
QZSS Early Warning System



Road Pricing System

Singapore Case

- Singapore has already dedicated
 - 12% land for roads and 14% land for housing
- 45% households own a car
- Traffic Congestion Control is necessary for smooth traffic
 - Use ERP to charge the road users on some of the road sections.
 - ERP encourages the drivers to consider alternative routes
 - It also encourages to use public transports
- Singapore was the first country in the world to manage road congestion by implementing an **Electronic Road Pricing system (ERP)**.
 - ERP has since been used as a reference by other cities like London.
- ERP-2 is now being developed based on
 - Global Navigation Satellite System (GNSS) Technology



Space is limited to built new ERP gates

Dynamic Road Pricing

DRP For:

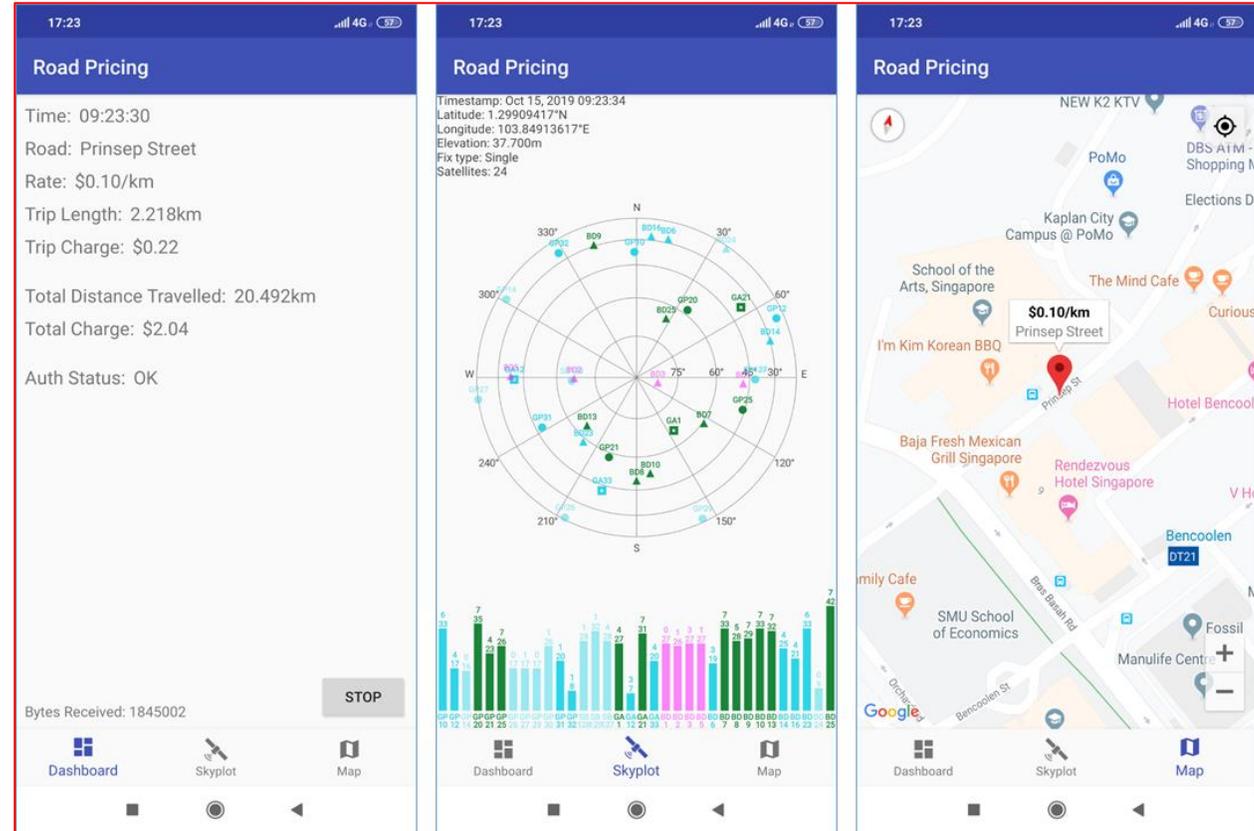
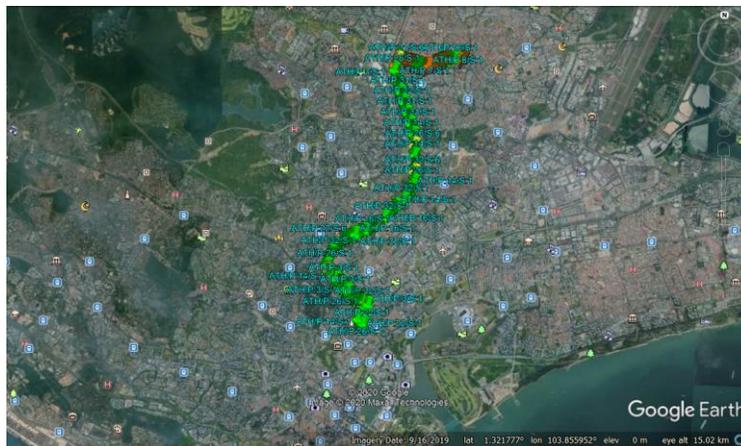
- Gate-less Toll Charging
- Traffic Congestion Monitoring and Reduction
- Parking Service and Management
- Emergency Route Planning
- Vehicle Monitoring for Safer and Secure Services
- MaaS (Mobility As A Service)
- Micro-Mobility Services and Management
- Driver's Behavior Monitoring
- Traffic Data Analysis

Key Features of DRP:

- High-Accuracy Position Data
 - Lane-level positioning capabilities
- Secured and Certified Position Data
 - Using signal authentication and Position certification system to protect from spoofing, data tampering etc
- Proprietary AI based Technology
 - Prediction of traffic congestion in advance for better route management
- Cross-border Implementation System
 - The same system can work seamlessly regardless of national boundary
- Easy and Simple implementation in vehicles

Dynamic Road Pricing

Toll Charging, Traffic Congestion Management, Traffic Monitoring



City Environment Monitoring

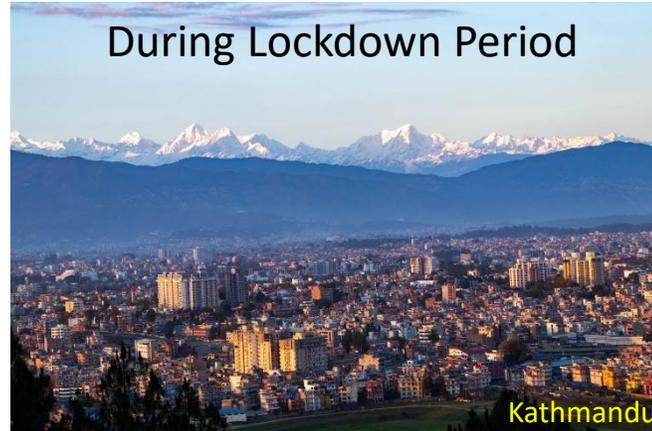
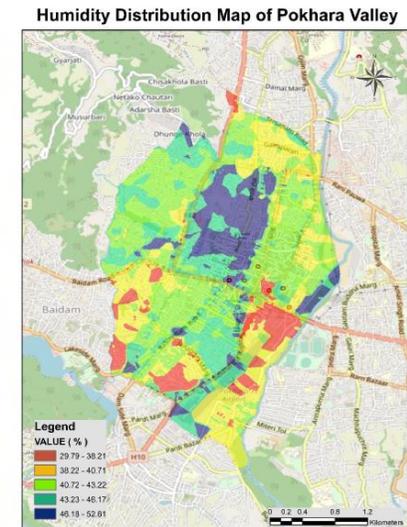
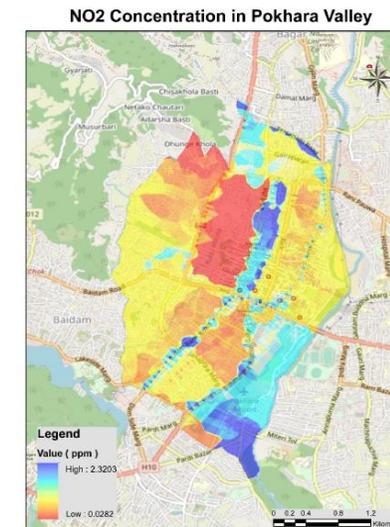
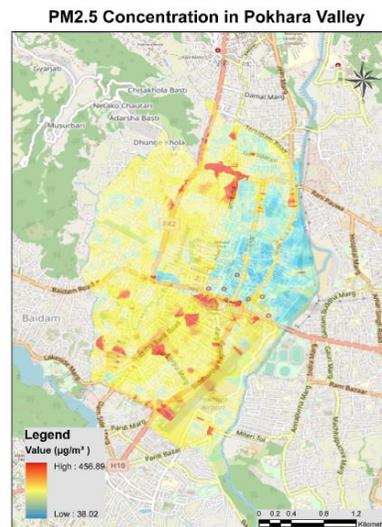
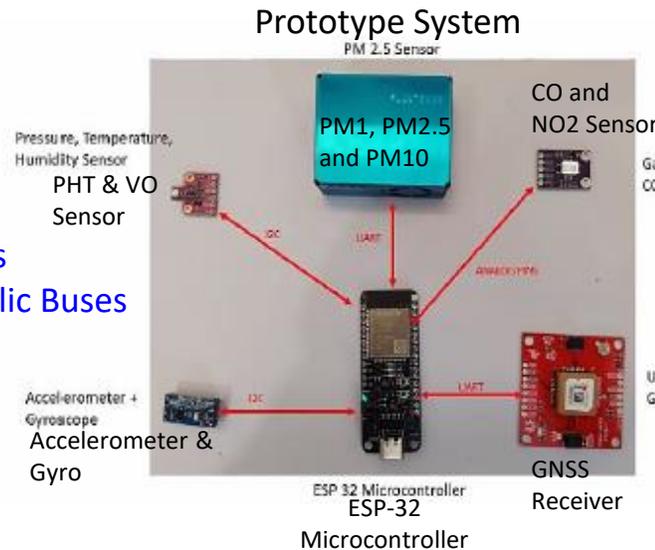


Photo Sources: https://www.nepalitimes.com/here-now/nepals-smoky-mountains/?fbclid=IwAR31xbeCKSSj9_gNOAU7BKMquQAzTg0Z6J-LUTmtsZu9o7o9ozsddu8Z5Vo

- Monitor City Air Quality
- Dynamic and Real-Time
- Use Low-Cost Sensor Systems
- Implement the Sensor in Public Buses

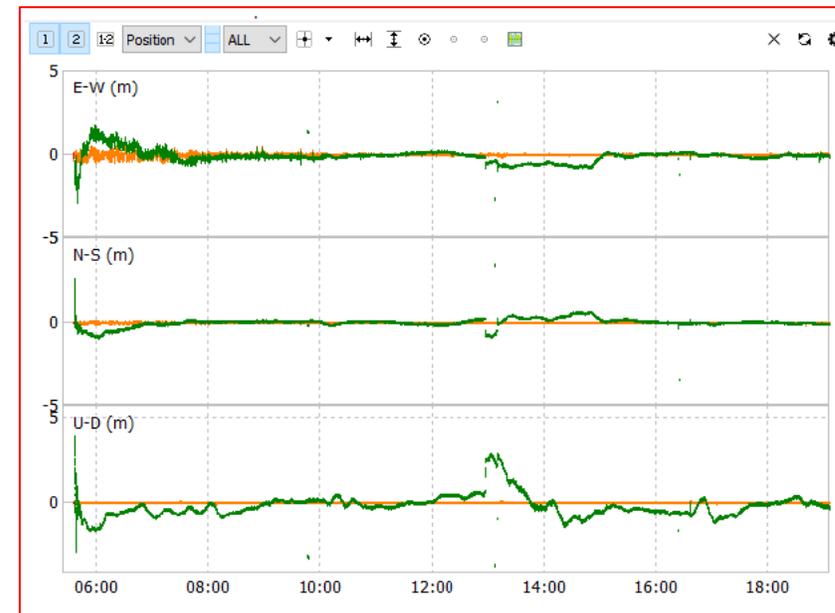


Sea Level Rise Measurement

University of Philippines, Philippines

MADOCA for Sea Level Rise Measurement

Explore MADOCA accuracy assessment for Sea Level Rise Measurement

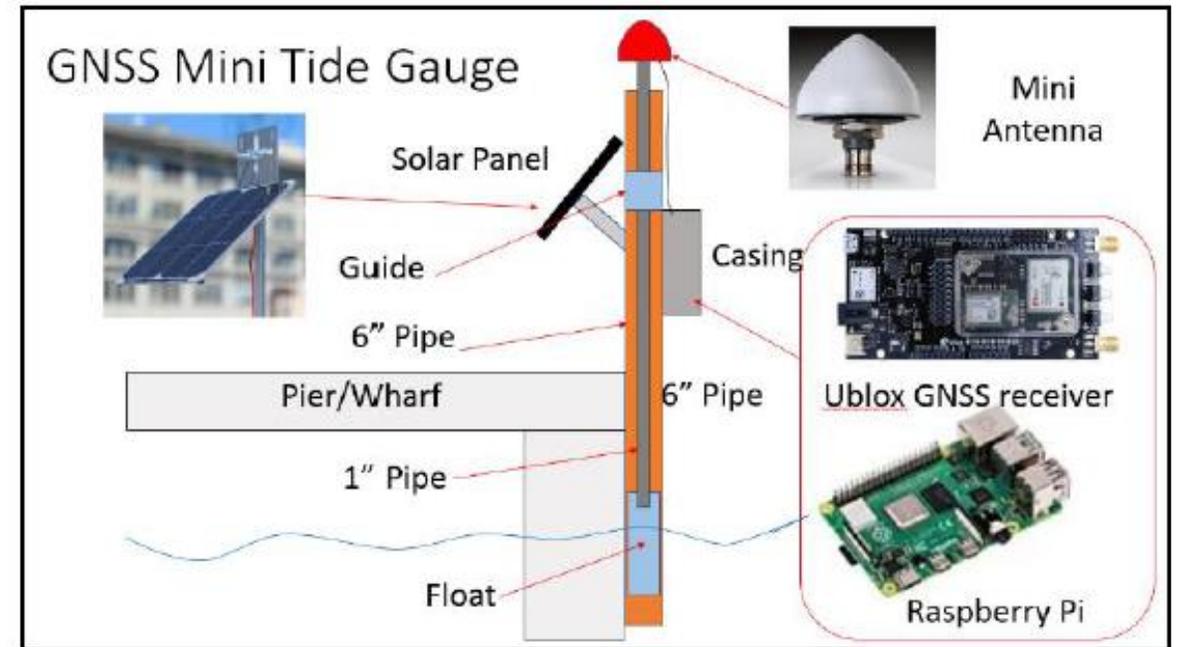
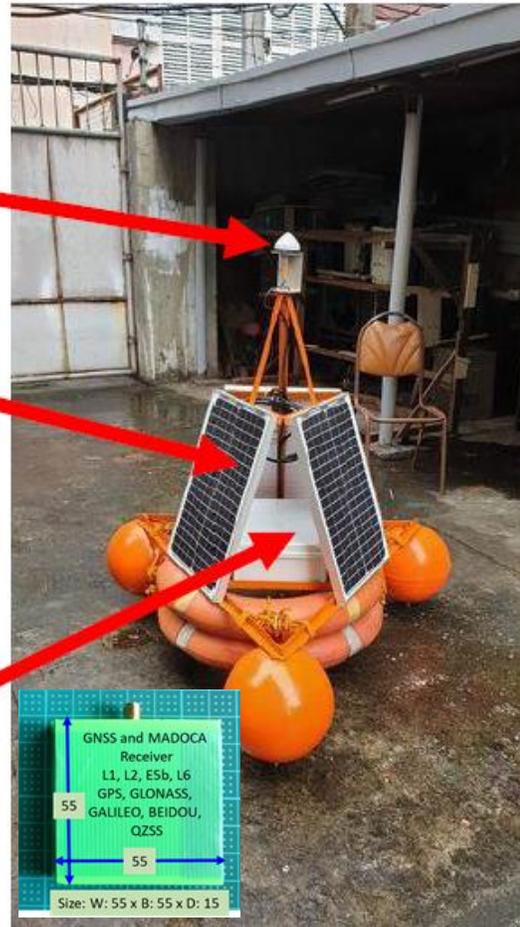


Low-Cost MADOCA Receiver for Sea-Level Rise Measurement

GNSS antenna

Solar power

TiBox enclosure containing the battery, raspberry pi and Ublox and MADOCA decoder



Source: Technical Report, GNSS/QZSS MADOCA PPP Data Acquisition for Sea Level Rise Measurement, DR. ROSALIE B. REYES, UP DGE and Project Leader, CLSR-Phil Project