IoT Deployment and Challenges in Rural Areas

Seminar on Future Network for Smart Digital Malaysia
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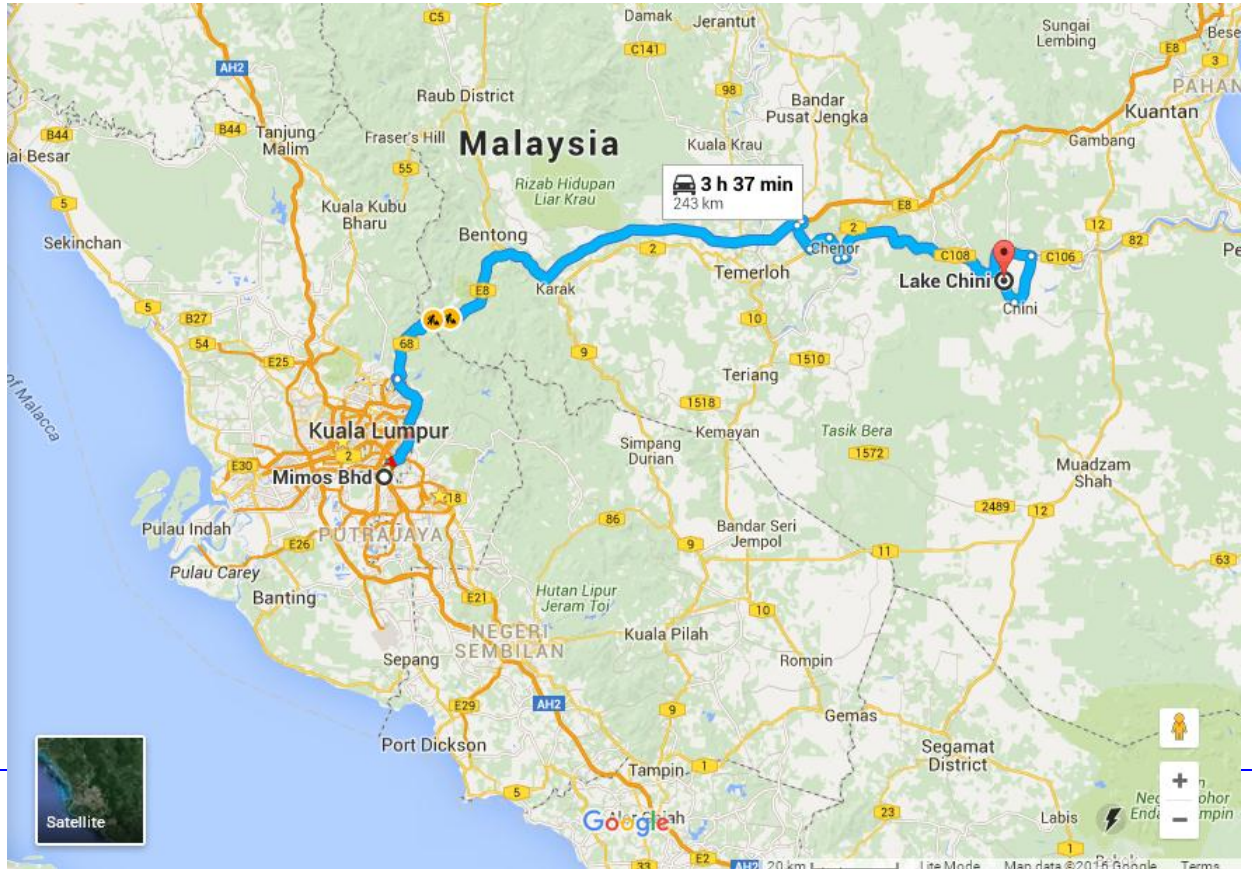
Outline

- Introduction
  - Tasik Chini
- Deployment
  - Pusat Penyelidikan Tasik Chini (PPTC)
  - Water Quality Monitoring Stations
- Challenges

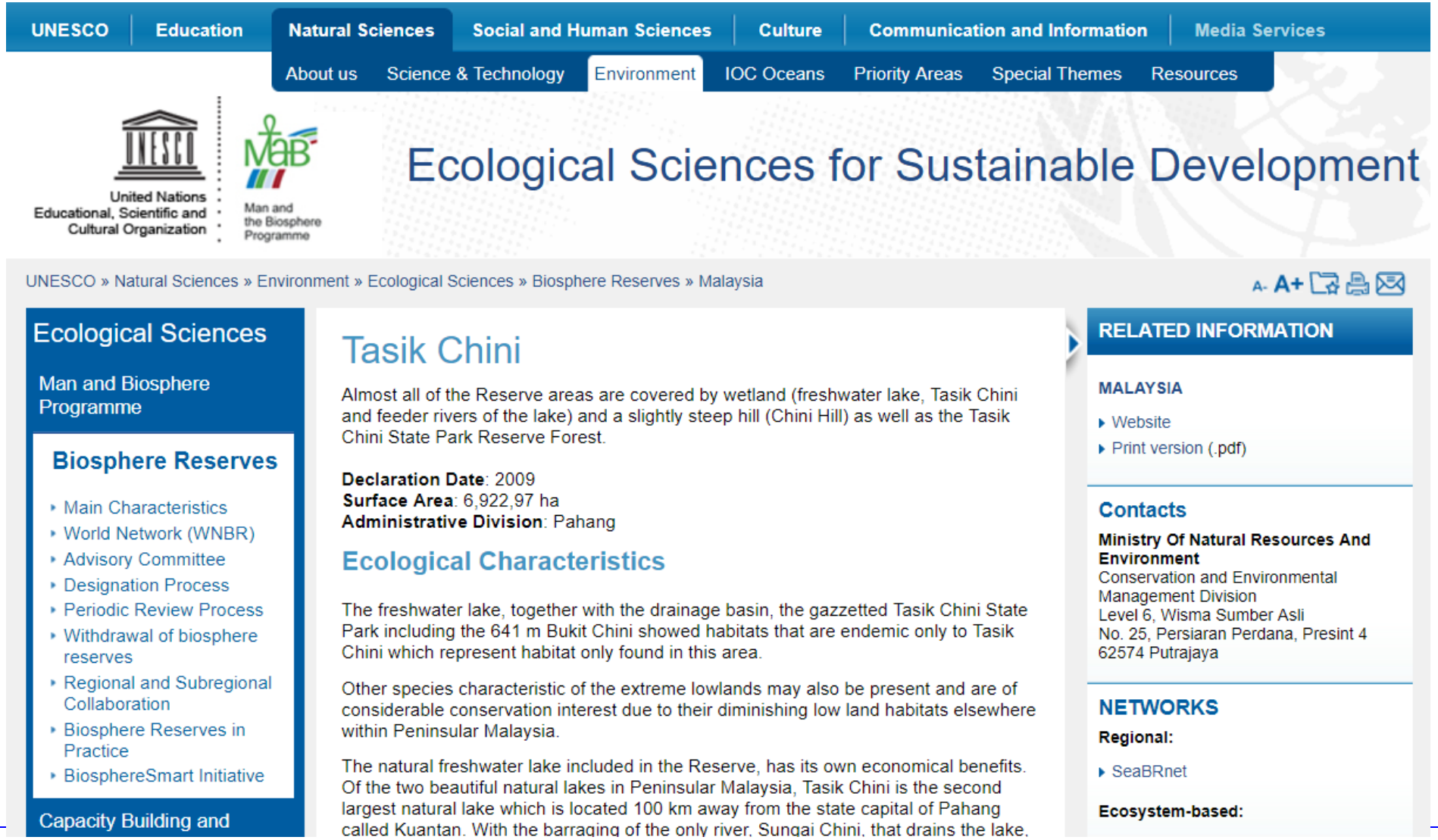
Introduction

Tasik Chini

- Tasik Chini is the second largest fresh water lake in Malaysia. The lakeshores are inhabited by the Jakun branch of the Orang Asli (indigenous people).
- The 12,565 acres (5,026 hectares) lake is made up of a series of 12 lakes. Sungai Chini, which drains from the lake, flows into Sungai Pahang.
- Tasik Chini is one of the UNESCO Biosphere Reserve status sites in Malaysia.



UNESCO Biosphere Reserve



http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/asia-and-the-pacific/malaysia/tasik-chini

Tasik Chini

Tasik Chini ecosystem under threat?

Tasik Chini's ecosystem is claimed to be in critical condition due to unregulated agriculture, logging and mining. Pix by MUHD ASYRAF SAWAL/ NSTP

By T N ALAGESH - March 13, 2017 @ 3:39pm

PEKAN: Months after clusters of lotus flowers started blooming at Tasik Chini, floodwaters spilled into the lake, submerging the iconic plants.

Water from Sungai Pahang, which burst its banks in late January, spilled into Sungai Chini, causing the water level in the lake to rise and become murky.

Lake Chini Resort manager Mohd Azizan Ibrahim said the water level during the floods was about

RECOMMENDED

Toys 'R' Us employees in the dark about their future

M'sian badminton stunned by Morten Frost resignation

Can a dying lake in Pahang be revived?

NOVEMBER 18, 2016 ENVIRONMENT, LIVING, TSOL - ENVIRONMENT

BY MARIA J. DASS

RELATED ARTICLES

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The blues, greens, gr
waters of Tasik Chini
pink from the few blo
across the water, sur

I had heard years ago
"development" and th
tarik.

But the Federal and S
of the past.

Prior to this, lotus pla
dying, slowly succum
logging and mining in

Preserving a natural asset

METRO NEWS

Wednesday, 19 Apr 2017

By Ong Han Sean

Dr Wan Junaidi taking a look at the plants in Tasik Chini.

KUANTAN: Tasik Chini became a topic of discussion at the state assembly, when several assemblymen agreed that efforts must be taken to preserve it as an important natural asset.

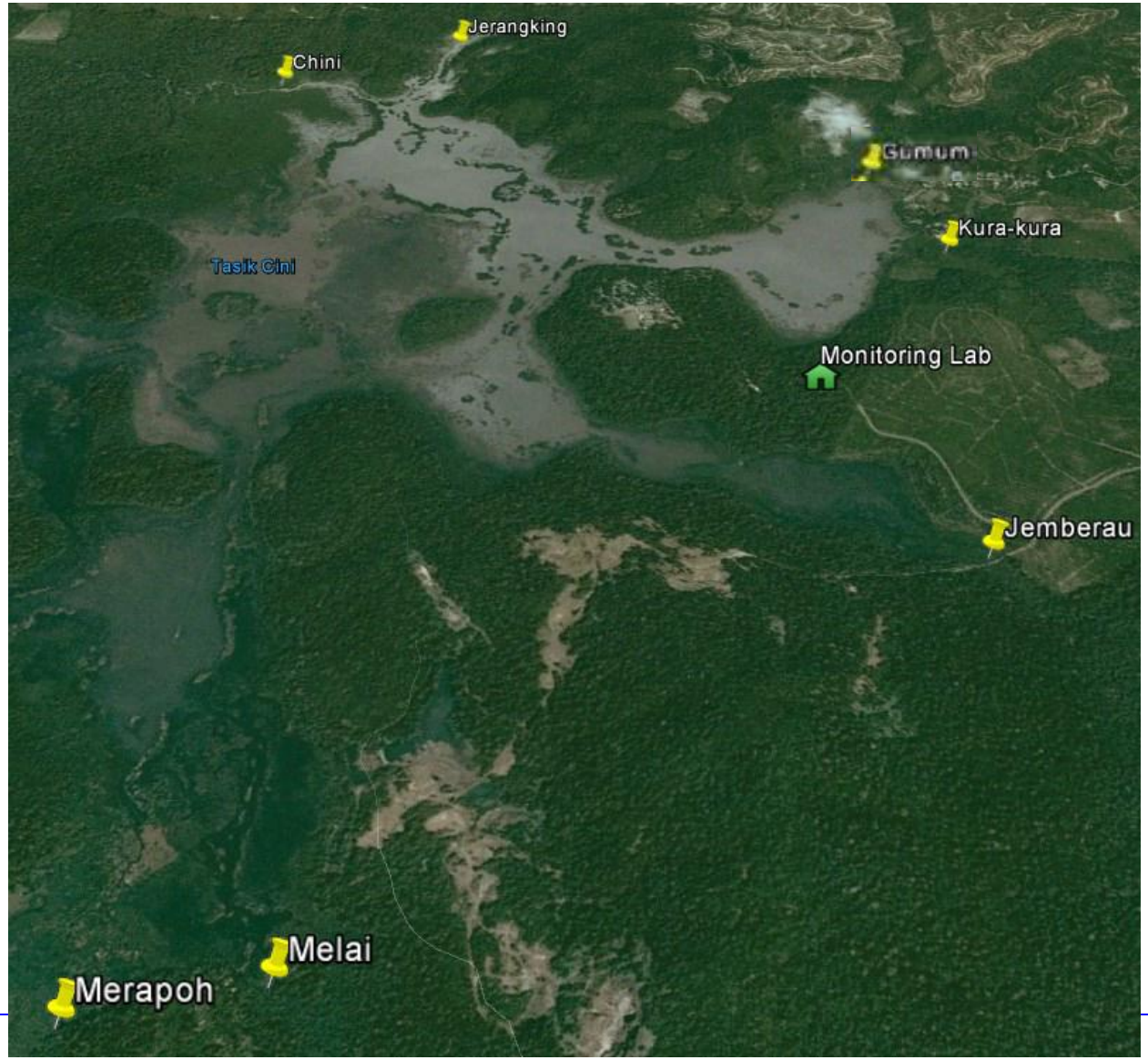
State Tourism and Culture Committee chairman Datuk Seri Mohd Sharkar Shamsudin

Deployment

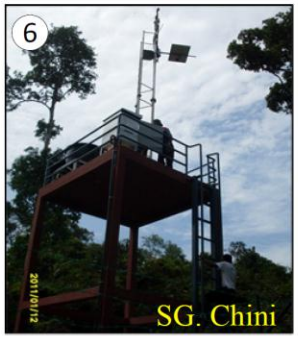
Pusat Penyelidikan Tasik Chini (PPTC)

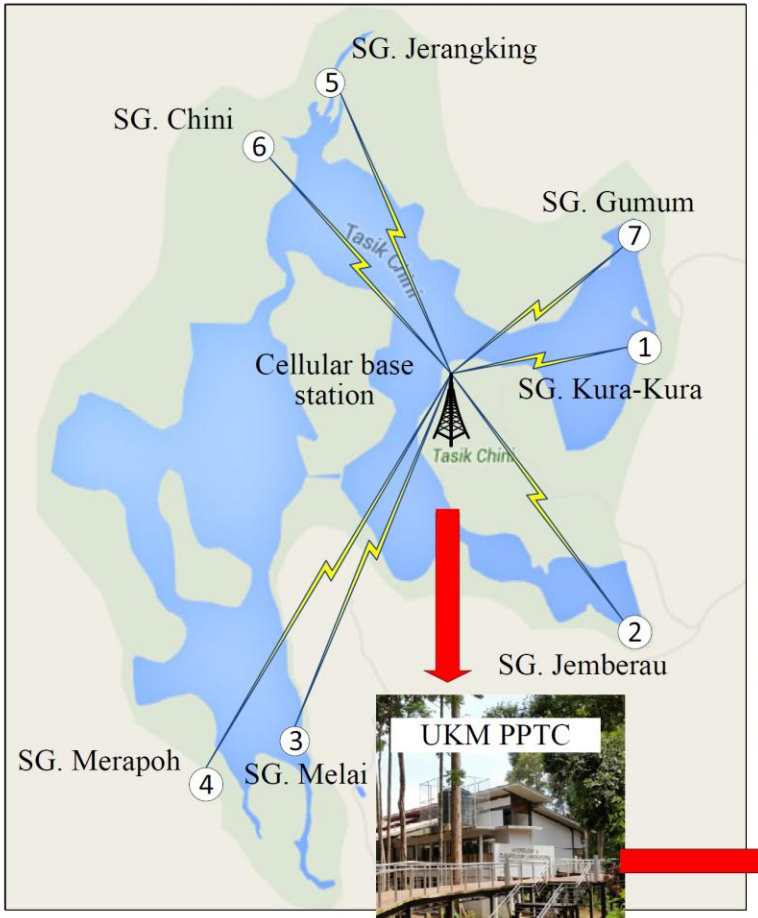
- Research center facilities (belongs to UKM)
- Command Control Centre and Monitoring Stations for data collection (water quality)

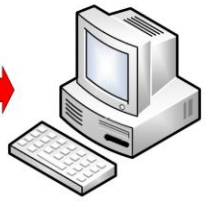
Monitoring Lab (PPTC) *(green)* **and Monitoring Stations** *(yellow)*



Overview of Hydrological Monitoring Stations at Lake Chini







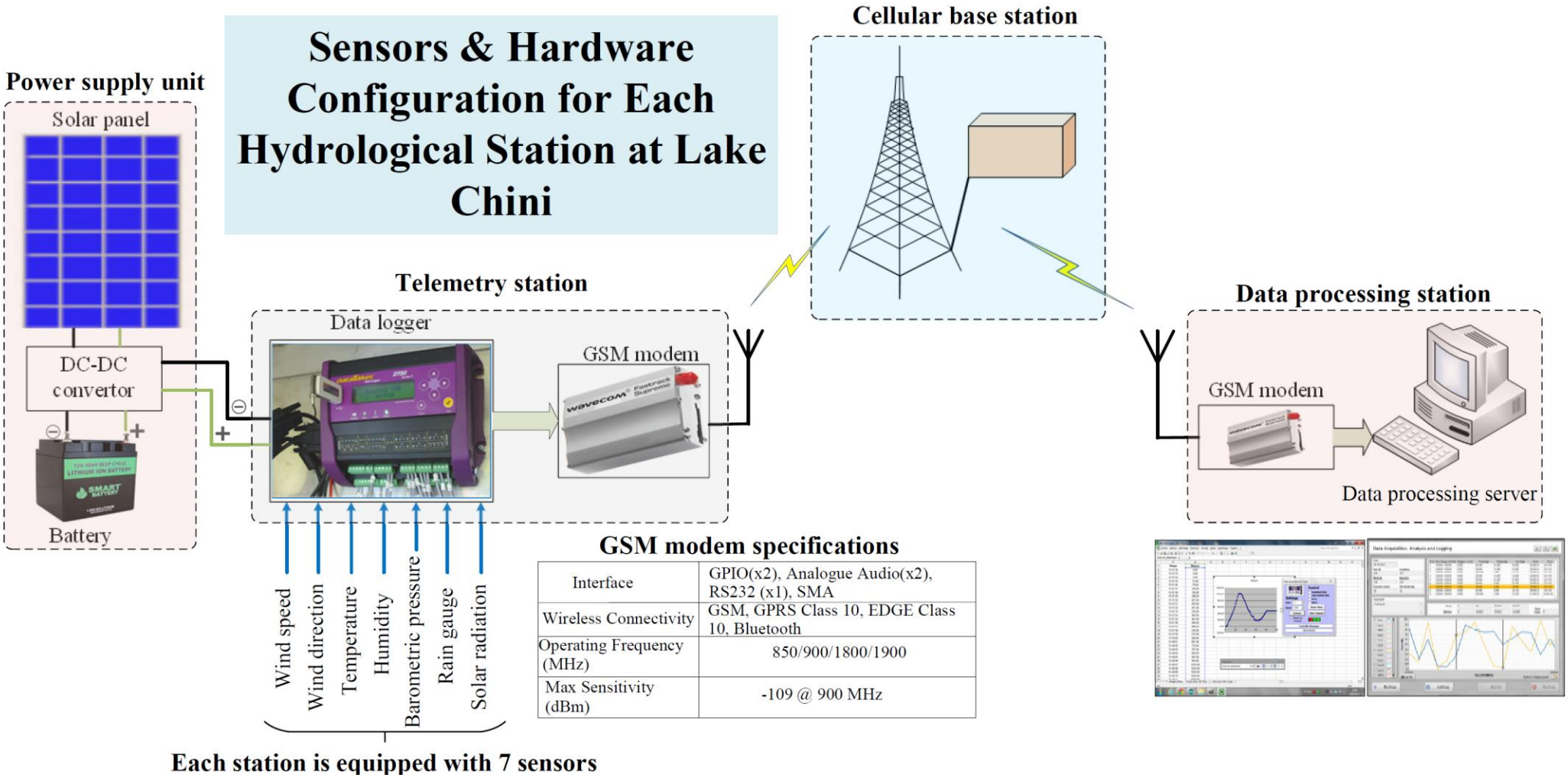
Data processing server

Control Centre at PPTC

Monitoring Station

Current Setup

Sensors & Hardware Configuration for Each Hydrological Station at Lake Chini

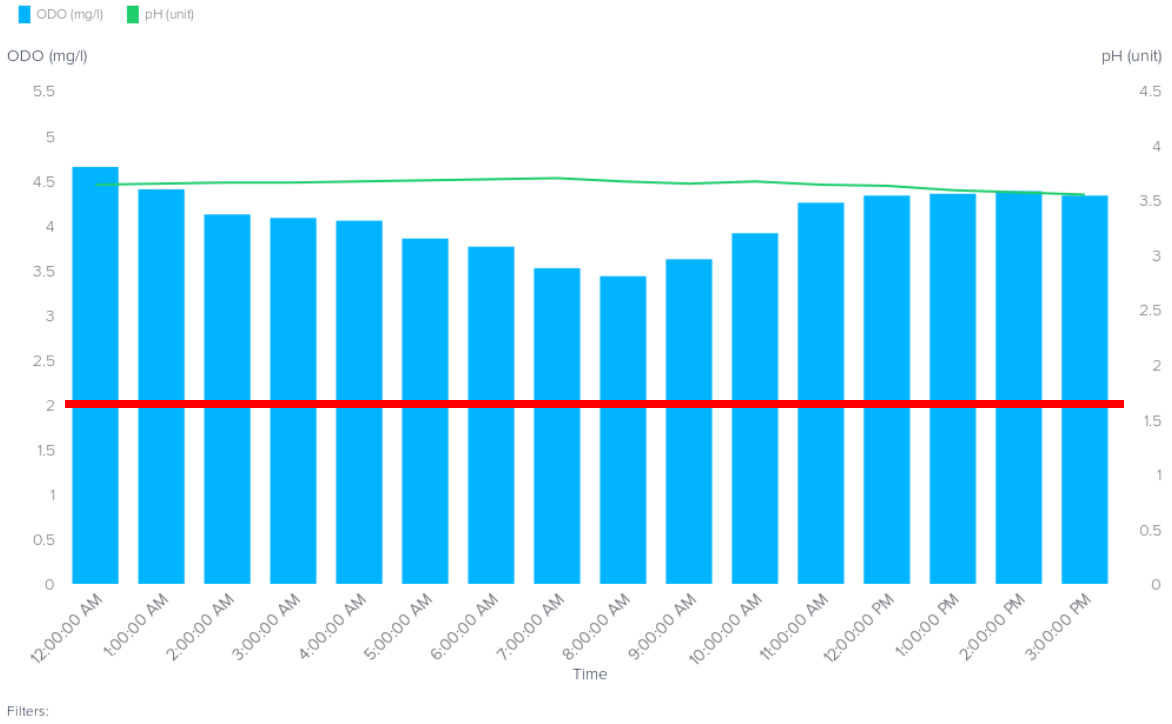


GSM modem specifications

Interface	GPIO(x2), Analogue Audio(x2), RS232 (x1), SMA
Wireless Connectivity	GSM, GPRS Class 10, EDGE Class 10, Bluetooth
Operating Frequency (MHz)	850/900/1800/1900
Max Sensitivity (dBm)	-109 @ 900 MHz

Sample Measurements at Jemberau Station

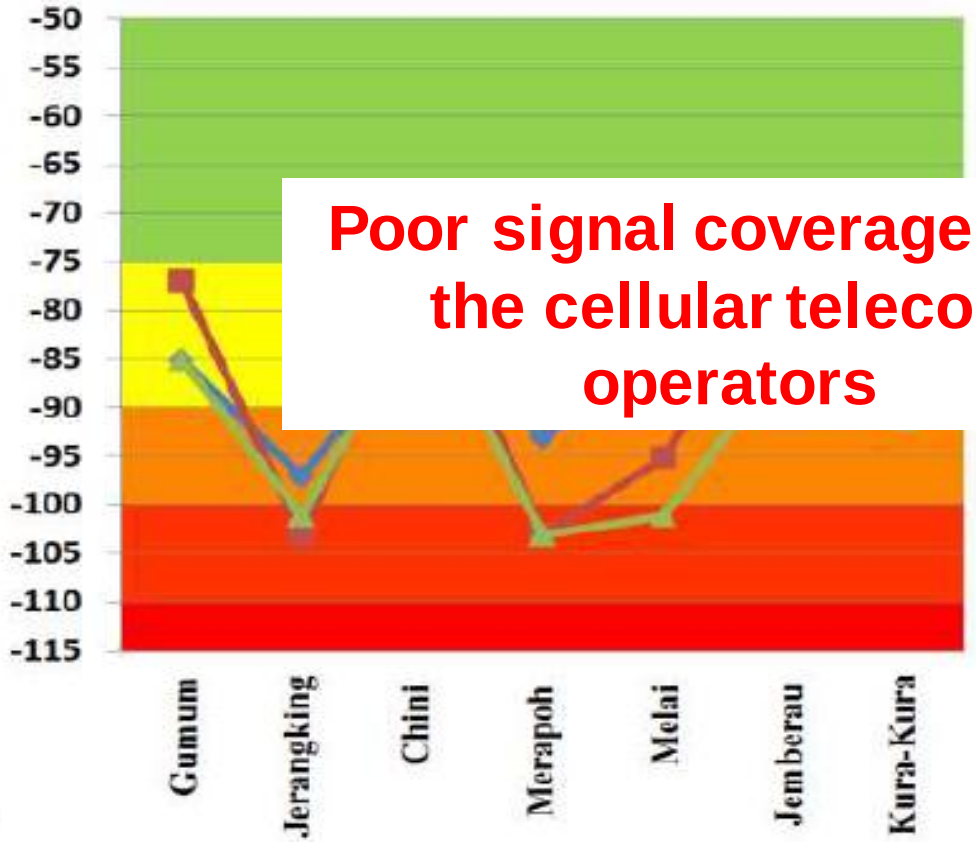
Dissolved Oxygen (ODO) and Acidity (pH), Saturday, 15/10/2016 12:00 am to 3:00 pm



GUIDELINE:

- **0-2 mg/L: not enough oxygen to support life**
- **2-4 mg/L: only a few fish and aquatic insects can survive**
- **4-7 mg/L: good for many aquatic animals, low for cold water fish**
- **7-11 mg/L: very good for most stream fish**

Challenges

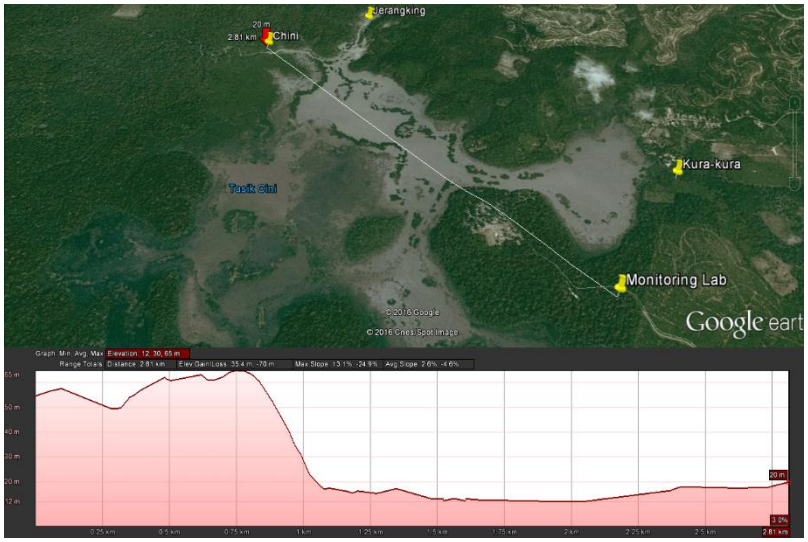


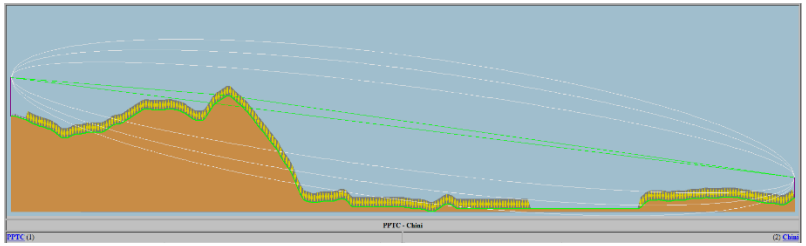
Poor signal coverage from the cellular telecom operators

Classification	RSS range	Indicator
Excellent	> -70 dBm	Green
Good	-70 to -85 dBm	Yellow
Fair	-86 to -95 dBm	Mustard
Poor	-96 to – 109 dBm	Orange
No Signal	< -110 dBm	Red

Propagation Environment

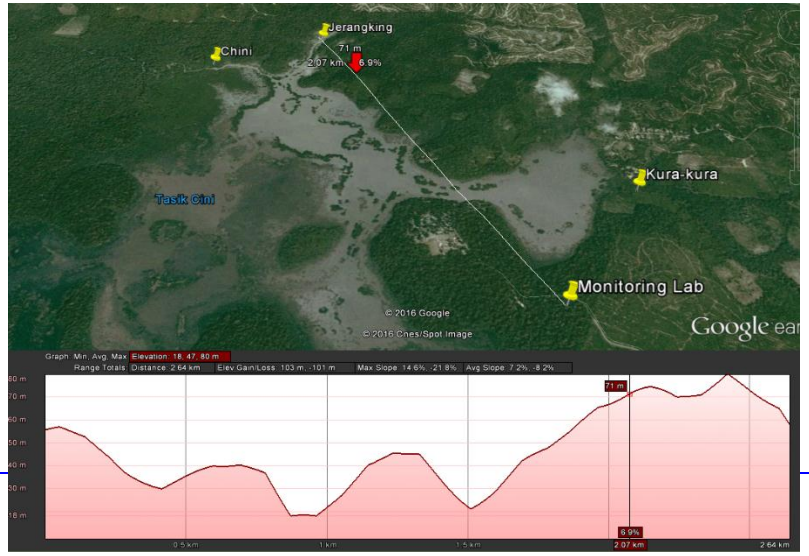
Sg. Chini St.

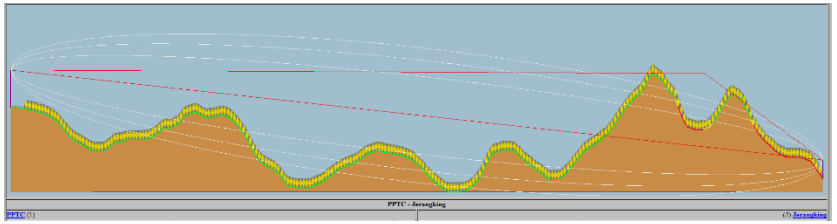




Performance	
Distance	**2.783 km**
Precision	10.0 m
Frequency	450.000 MHz
Equivalent Isotropically Radiated Power	6.310 W
System gain	142.68 dB
Required reliability	90.000 %
Received Signal	-77.11 dBm
Received Signal	31.23 µV
Fade Margin	**18.07 dB**

Jerangking St.





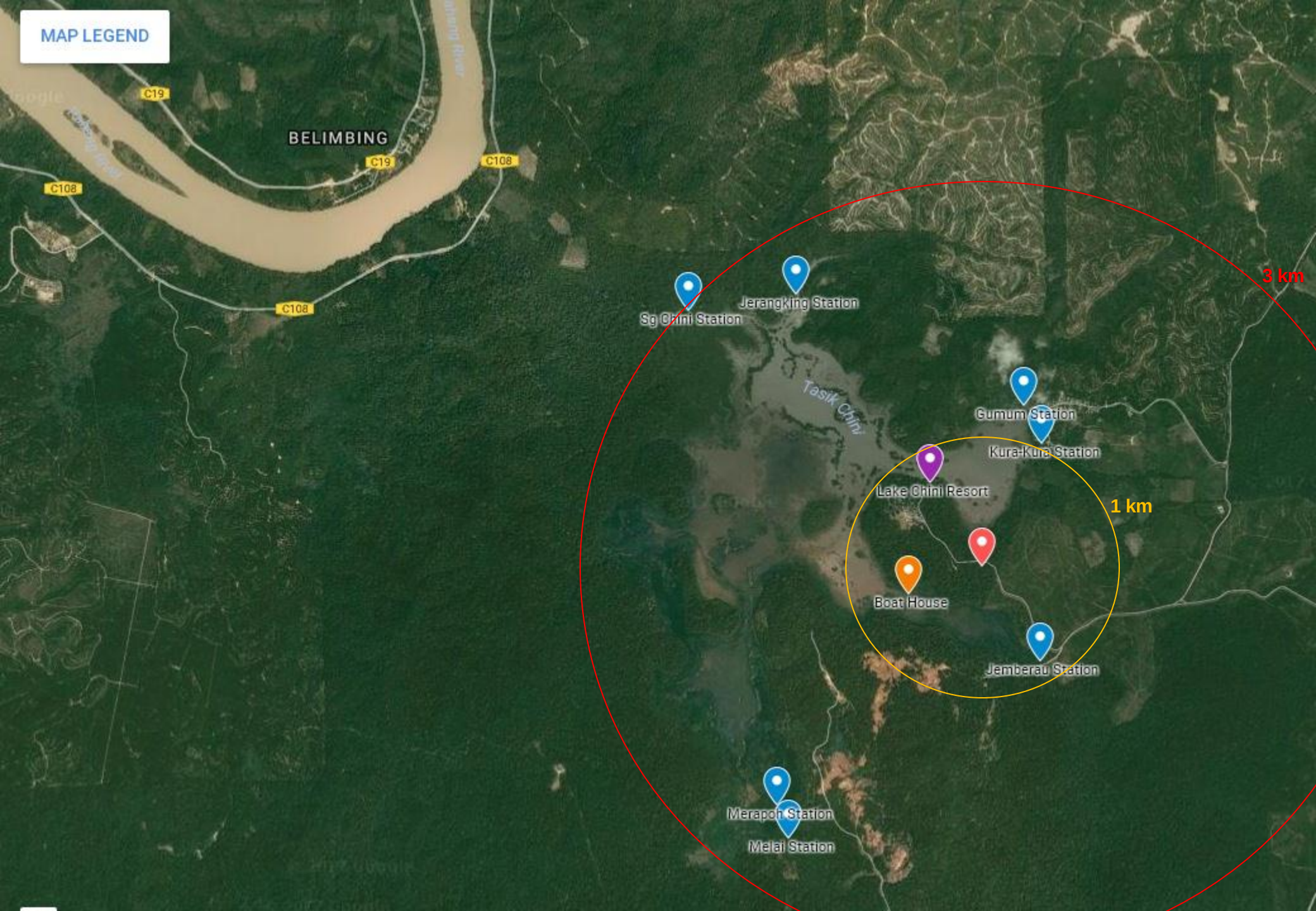
Performance	
Distance	**2.571 km**
Precision	10.0 m
Frequency	450.000 MHz
Equivalent Isotropically Radiated Power	6.310 W
System gain	142.68 dB
Required reliability	90.000 %
Received Signal	-103.19 dBm
Received Signal	1.55 µV
Fade Margin	**-8.01 dB**

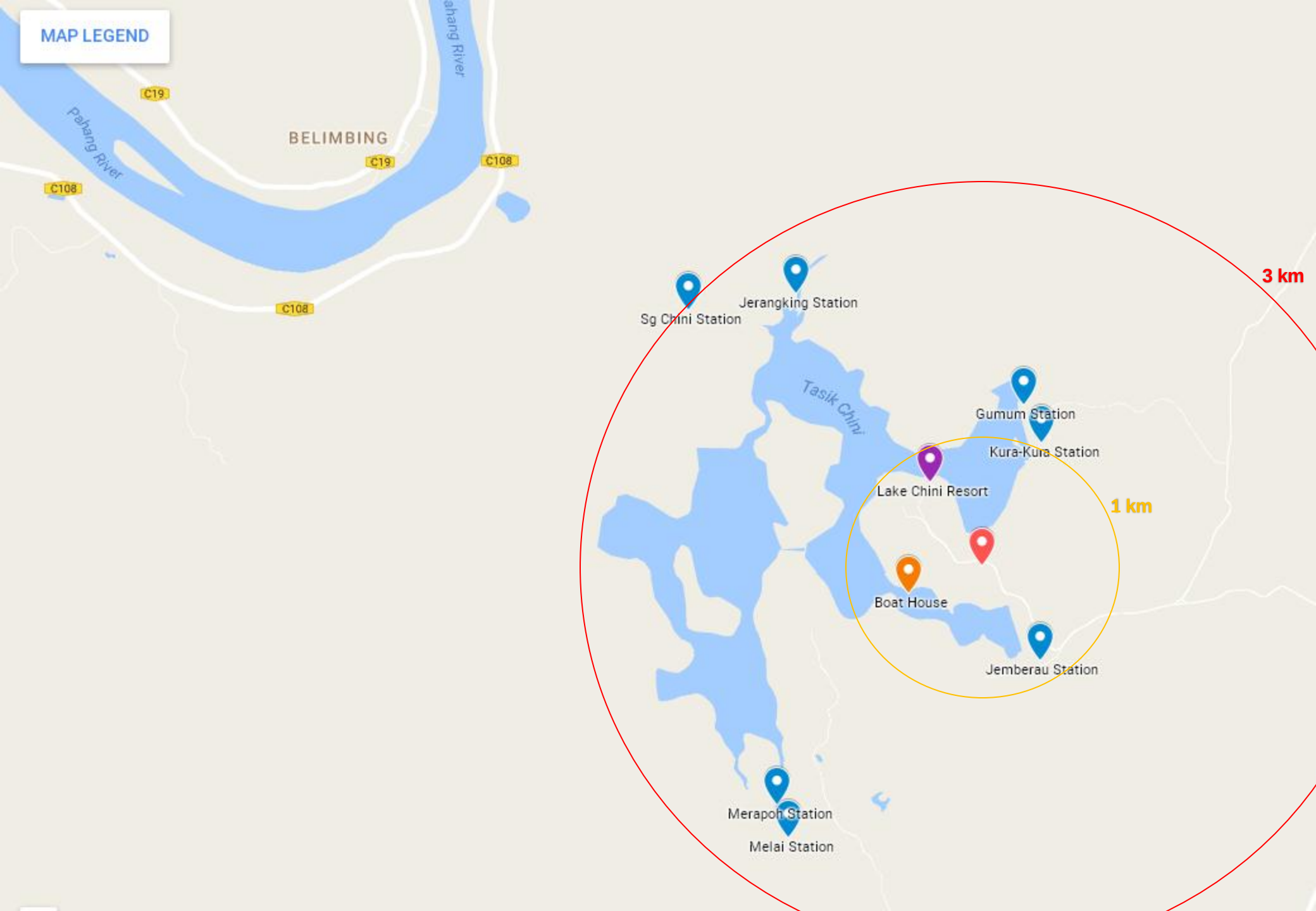
Network Infrastructure & Connectivity

- LoRa
- WiSUN
- Others – NB-IoT, Weightless, TVWS …

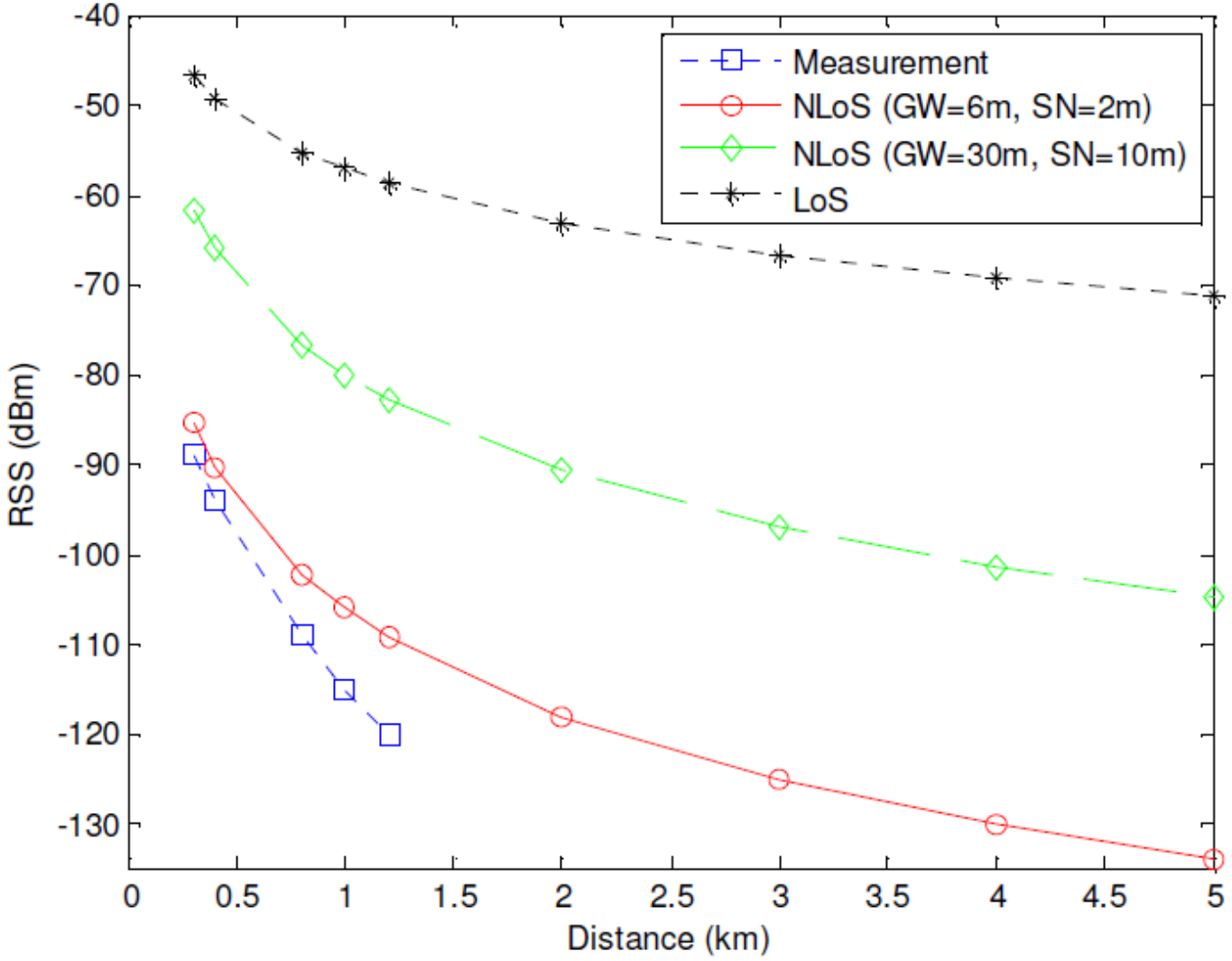
Location of LoRa Gateway at PPTC

LoRa
Gateway


MAP LEGEND
BELIMBING
C19
C108
Sg Chini Station
Jerangking Station
Tasik Chini
Gumum Station
Kura-Kura Station
Lake Chini Resort
Boat House
Jemberau Station
Merapoh Station
Melai Station
3 km
1 km


MAP LEGEND
C19
BELIMBING
C19
C108
C108
C108
Pahang River
Pahang River
3 km
Sg Chini Station
Jerangking Station
Tasik Chini
Gumum Station
Kura-Kura Station
Lake Chini Resort
1 km
Boat House
Jemberau Station
Merapoh Station
Melai Station

RSS vs. Distance



Comparison of LOS/NLOS models and measurement at Chini Lake (Freq = 922MHz)

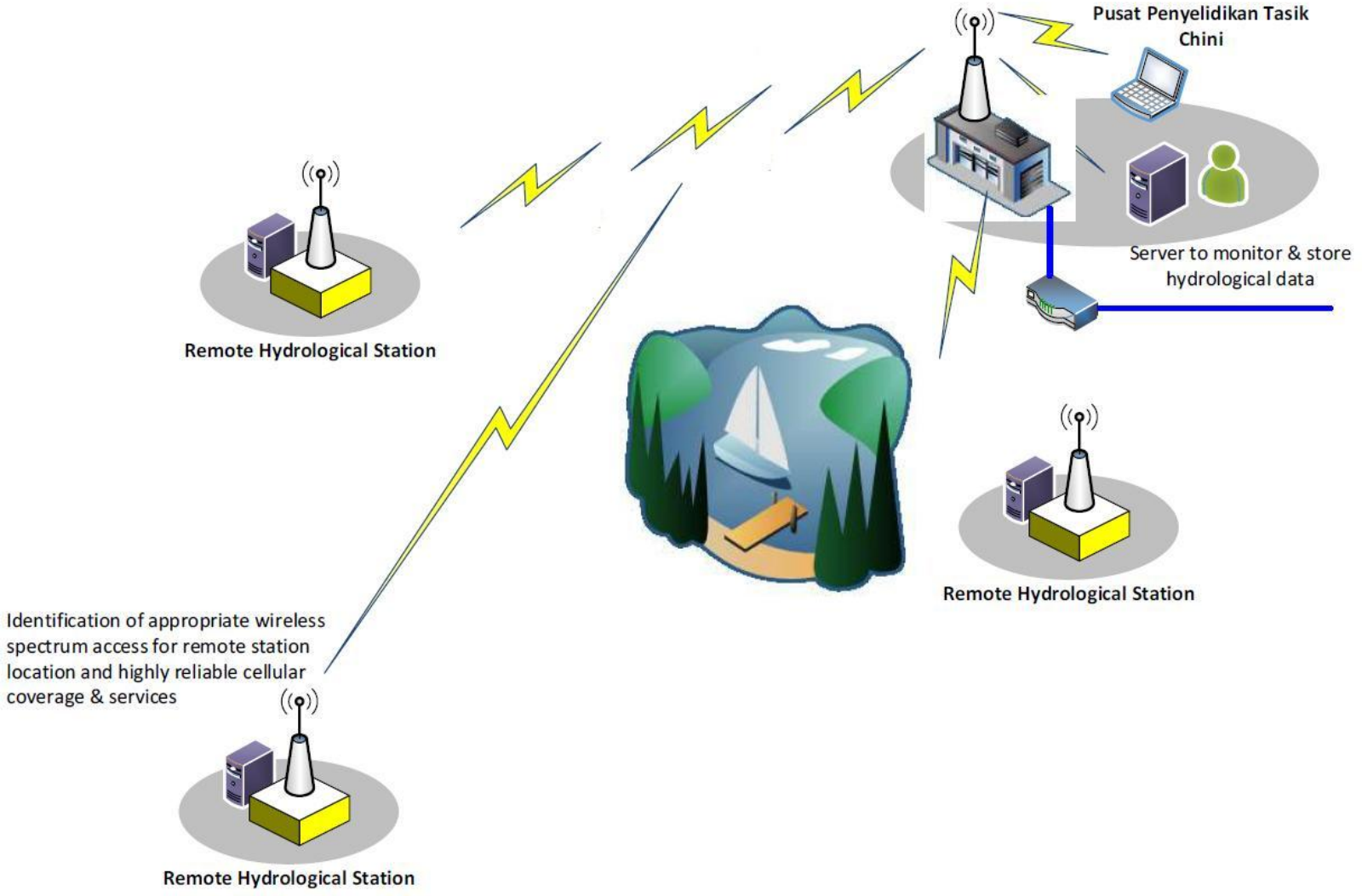
- RSS for actual measurement at Tasik Chini and theoretical propagation models is given in this slide.
- NLoS propagation model is based on Hata Model for different gateway (GW) and sensor node (SN) height.
- Green diamond markers and red square markers represent the simulated configuration for GW = 30m & SN = 10m, and GW = 6m & SN = 2m, respectively.

Summary

- Ultimate aim
  - Provide IoT solution for environmental preservation (sensors, connectivity, middleware, analytics etc)
- Challenges
  - Network Infrastructure & Connectivity
    - Propagation environment, vegetation effect, terrain, etc
  - Business Model
    - Community and environmental driven

Thank You!

Network Architecture (LTE and TVWS Network)



Spectrum Measurement Results