

# A PROTOTYPE IMPLEMENTATION OF EMERGENCY COMMUNICATION SYSTEM FOR SMALL-SCALE FISHING BOATS

*Miriam A. Mejias and Cenie V. Malabanan*



# Background of the Study

Fishing at sea is one of the most dangerous occupation in the world.

## PHIIPPINES

1.6 million involved in fisheries

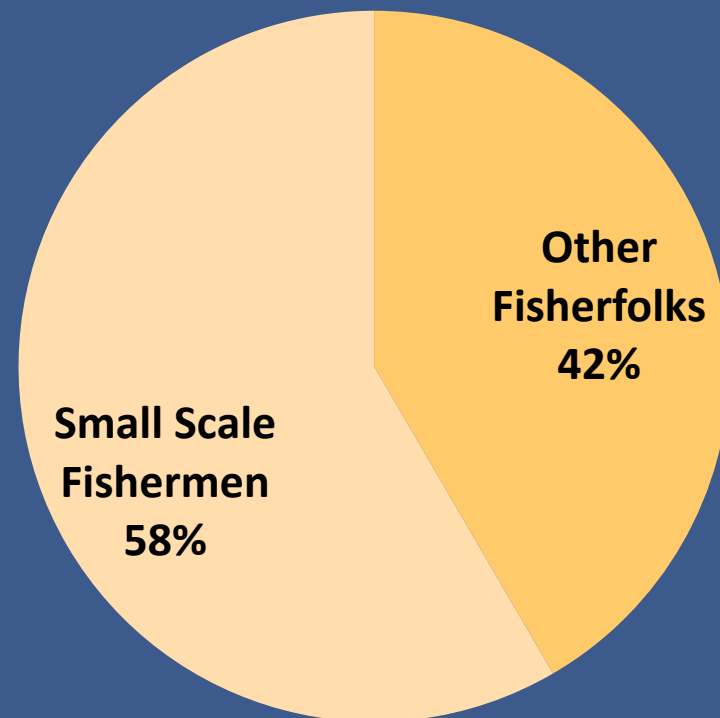
1.37 million belongs to municipal fisheries

Fishing boats

1. Municipal Fishing
2. Commercial Fishing

Safety at sea is often substandard in the small-scale sector.

Small Scale Fishermen in the Philippines





# Communication at Sea



- December 2012, 300 fishermen went missing when Typhoon 'Pablo' hit the main southern island of Mindanao.
- 2017, 40 fishermen went missing in Palawan where 26 motorbancas were battered by stormy seas at the height of tropical storm "Vinta's" onslaught.
- In the Philippine Coast Guard official website, there are reports of missing fishermen each month.



REPUBLIC OF THE PHILIPPINES  
**PHILIPPINE COAST GUARD**  
 139 25th Street, South Harbor, Port Area, 1018 Manila

#### 4. Coast Guard searches for the missing fisherman in Sarangani Province ...

(News)

... advised all local fishermen and nearby coastal barangays to be on the lookout and report to the nearest PCG units for possible sightings of the said missing fisherman. ...

Created on 09 February 2018

#### 6. PCG continues search of three (3) missing fishermen between Negros Oriental and Siquijor waters ...

(News)

PCG: Personnel of Coast Guard Station (CGS) Dapitan continue its search for three (3) fishermen who remain missing after a fishing venture between the vicinity waters off Barangay Canday-Ong, Dumaguete ...

Created on 18 January 2018

#### 7. PCG recovers the cadaver of missing fisherman from Carles in Capiz ...

(News)

PCG: The cadaver of missing fishermen of capsized motor banca "ChakChak" which was hit by big waves and strong winds 2 nautical miles off Sitio Naburot, Carles last December 19 was recovered by the personnel ...

Created on 22 December 2017

#### 8. Coast Guard still searches for two missing fisherman in Iloilo ...

(News)

PCG: Personnel of Coast Guard Station (CGS) Iloilo continues its search for two fishermen who remain missing after a fishing venture at vicinity waters off Sition Luzaran, Barangay Lapaz, Nueva Valencia ...

Created on 21 November 2017

#### 9. Coast Guard retrieves 2 cadaver, 1 still missing in Camarines Norte ...

(News)

Coast Guard Station (CGS) Camarines Norte retrieved two (2) cadavers and still searching for one (1) missing child who drowned and went missing at the vicinity waters off Pandawan Fishport, Mercedes Camarines ...

Created on 17 November 2017

# Statement of the Problem

Mobile signal at sea is unstable/loss.

1

Expensive distress communication devices

2

Unknown last location of fishermen.

3

Unreliable/lack of information sources

4

Delayed search and rescue.

5

Rescue operations are costly and time consuming.  
Stop operation

6

No closure with the family left behind of missing fishermen

7



# A PROTOTYPE IMPLEMENTATION OF EMERGENCY COMMUNICATION SYSTEM FOR SMALL-SCALE FISHING BOATS

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# Objectives

01

To design and develop an on-board device that can send an emergency signal to the base station and receive warning signal from the base station.

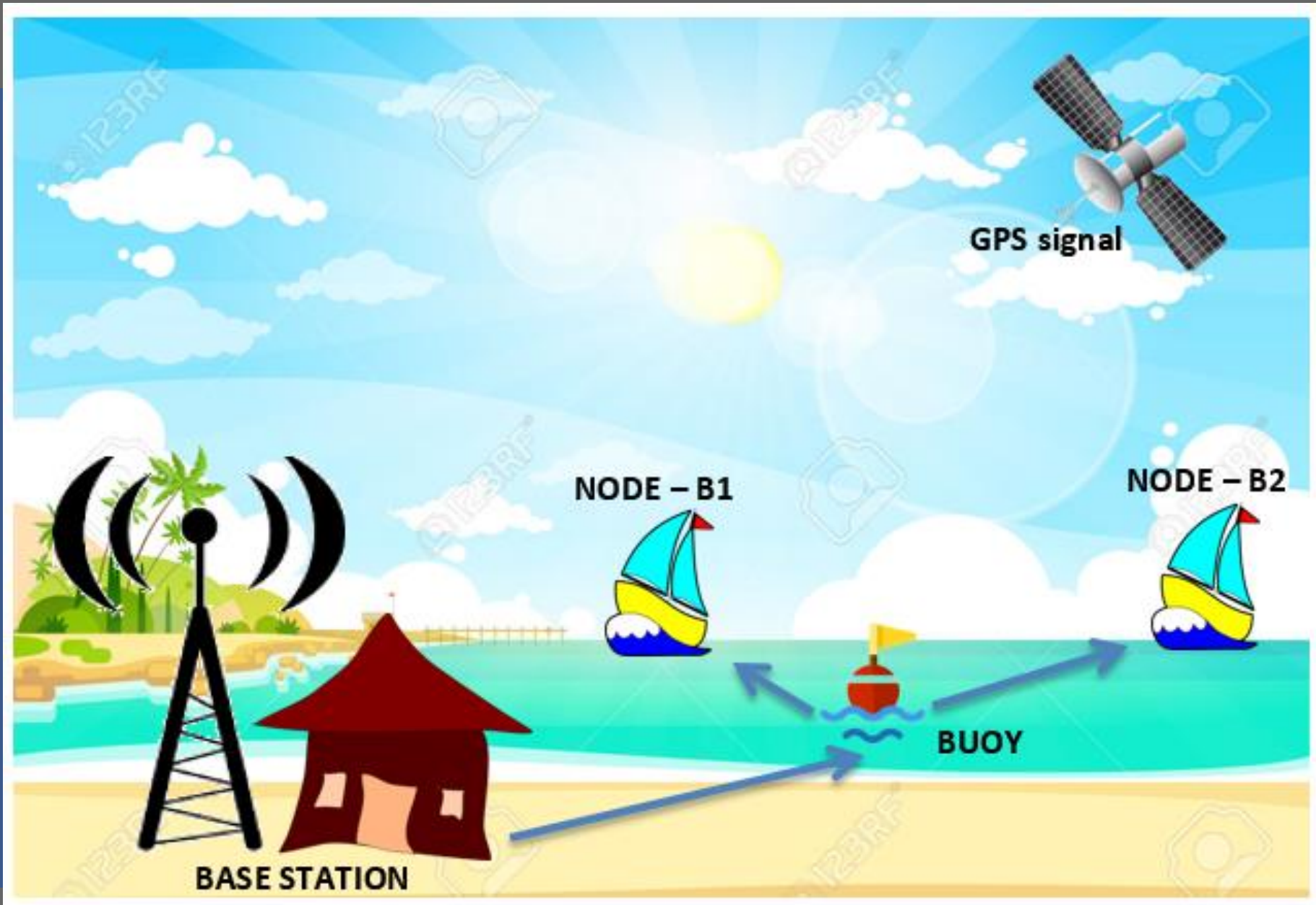
02

To design and develop a geolocation software using GPS that can track the vessel's path traversed and locate the real time position of the boats using the wireless mesh network.





# System Architecture





## Significance of the Study

- **Continuous stream of signals to the Bantay Dagat, providing immediate assistance in rescue operations.**
- **Faster tracking of the missing fishermen by providing the exact nearest locations during search operations.**
- **Provide closure to the family if the bodies are recovered.**
- **Vessel monitoring becomes far more feasible as the location, the time during which the vessel was at that particular location and other important data is collected will enable the rightful authorities to take prompt action in case any emergency situations arise.**

**Location  
Determination**

**A**

**Distress  
message  
communication**

**B**

**Sudden  
weather  
change  
alerting**

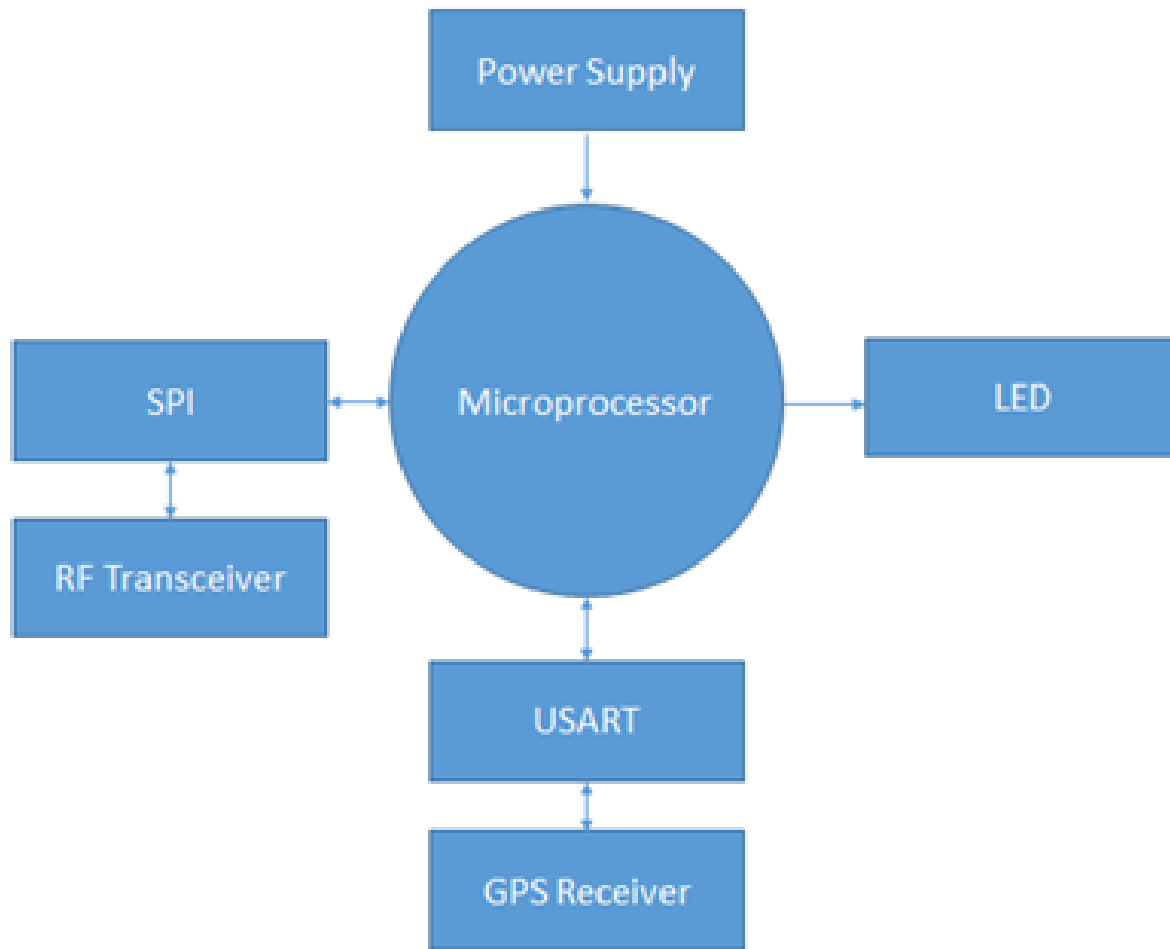
**C**

# Coordinate Mapper

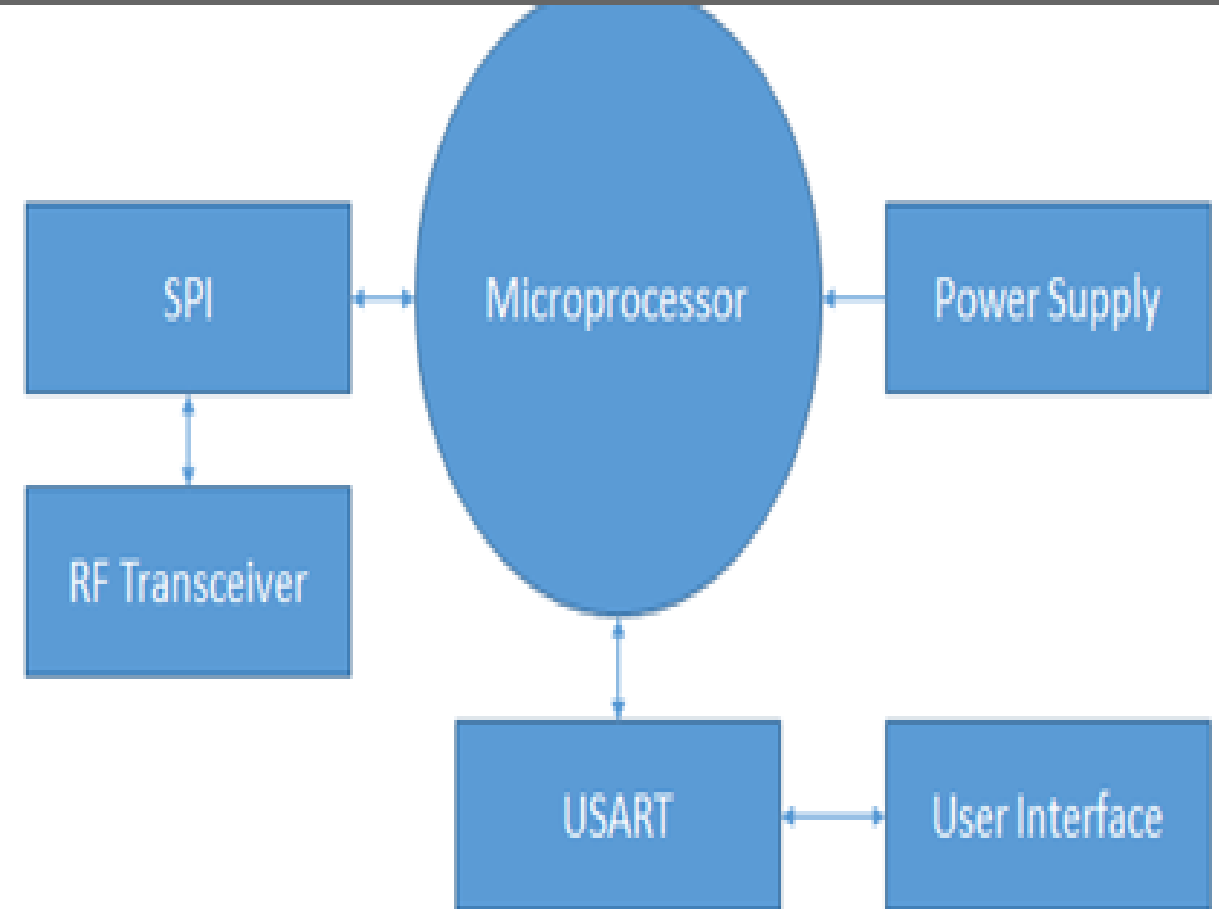
- Shows the aerial map of the coverage area used in testing (Macajalar Bay area nearing Agusan, CDO)
- Letter-Number coordinate system is used (e.g. A0).
- Each boat with GPS modules is registered with an ID number.
- Saves data logs of the GPS coordinates and the distress signal sent from each boat, and the broadcasted warning signal sent to each boat.
- Show the track path of each boat and the maximum distances travelled where RF signal was still attainable.



# Hardware Integration



Off shore set-up



Base Station set-up



- Locate base station

- Wait for transmission

- Plot coordinates

- Forward SOS

- Receive SOS

- For remote unit devices, a GPS coordinate is broadcasted every 30 seconds. The interval is adjustable programmatically.
- When a remote device received an SOS message from base station, the external LED will blink for about 2 minutes. If the external button is pressed, an SOS is broadcasted.
- For middle unit (floating buoy), whatever message received is rebroadcasted.
- For base station, whatever message received is delivered to the coordinate mapper application (once located by the application).



# Coordinate Mapper Software

Coordinate Mapper 1.0

**a**

Status: Looking for Base Station...

ID	Grid	Coordinate	Last Transmission
0	S-18	8.491708, 124.738935	08:11AM 04/21/18
1	S-18	8.491742, 124.739032	08:18AM 04/21/18
2			
3			

**b**

**c**

**d**

**e**

**f**

☐ Show maximum displacement 50%  200%

☐ Show trails

**g** SEND EMERGENCY MESSAGE

# Server



01

Send emergency warning for fishermen to go back to shore.

02

Receive distress signal from fishermen

03

Real-time monitor of connected boats (trail and coordinates)

04

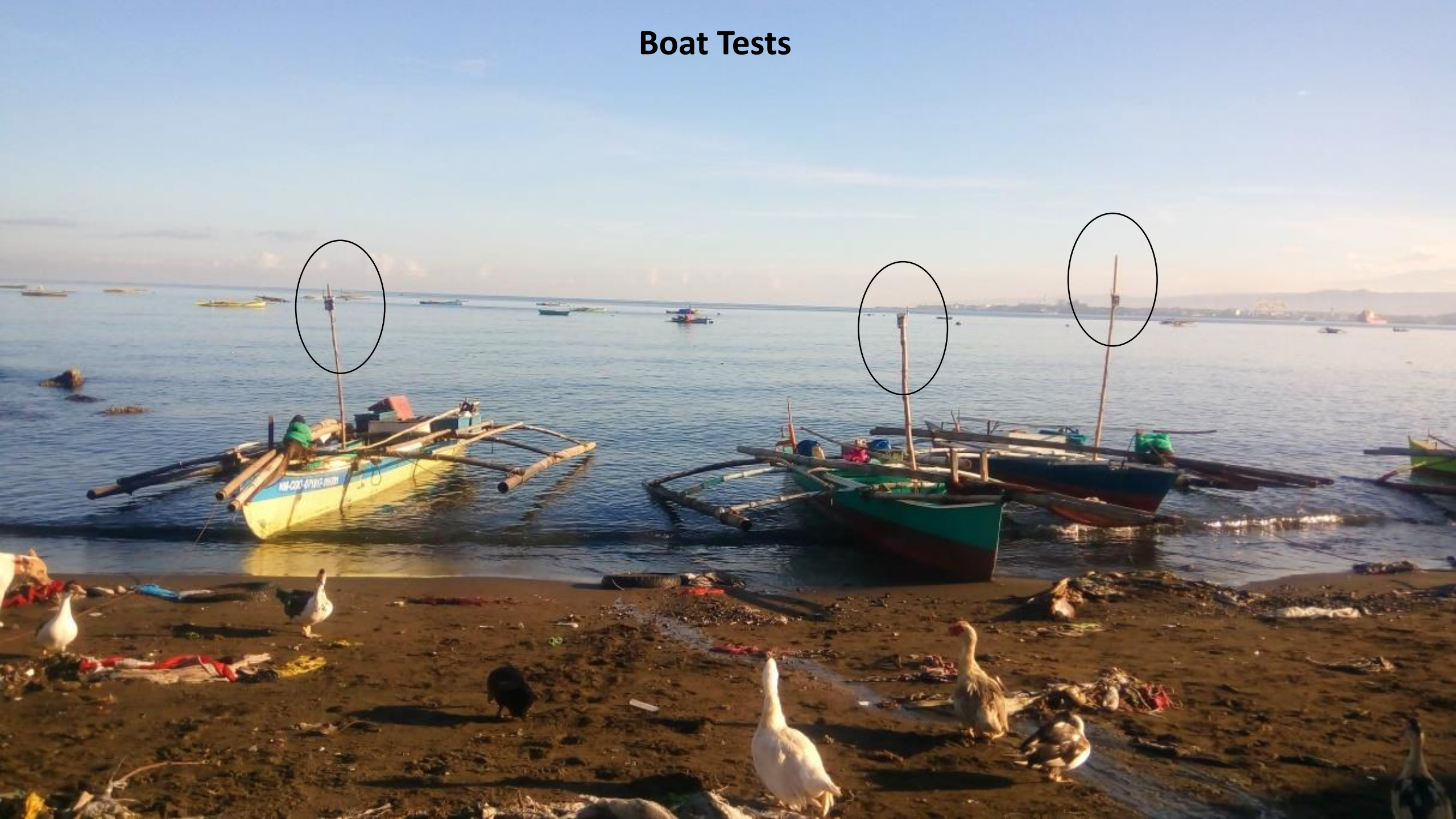
Storage and retrieval of last known location of disconnected nodes

# HARDWARE PROTOTYPE





# Boat Tests





## Base Station Set Up





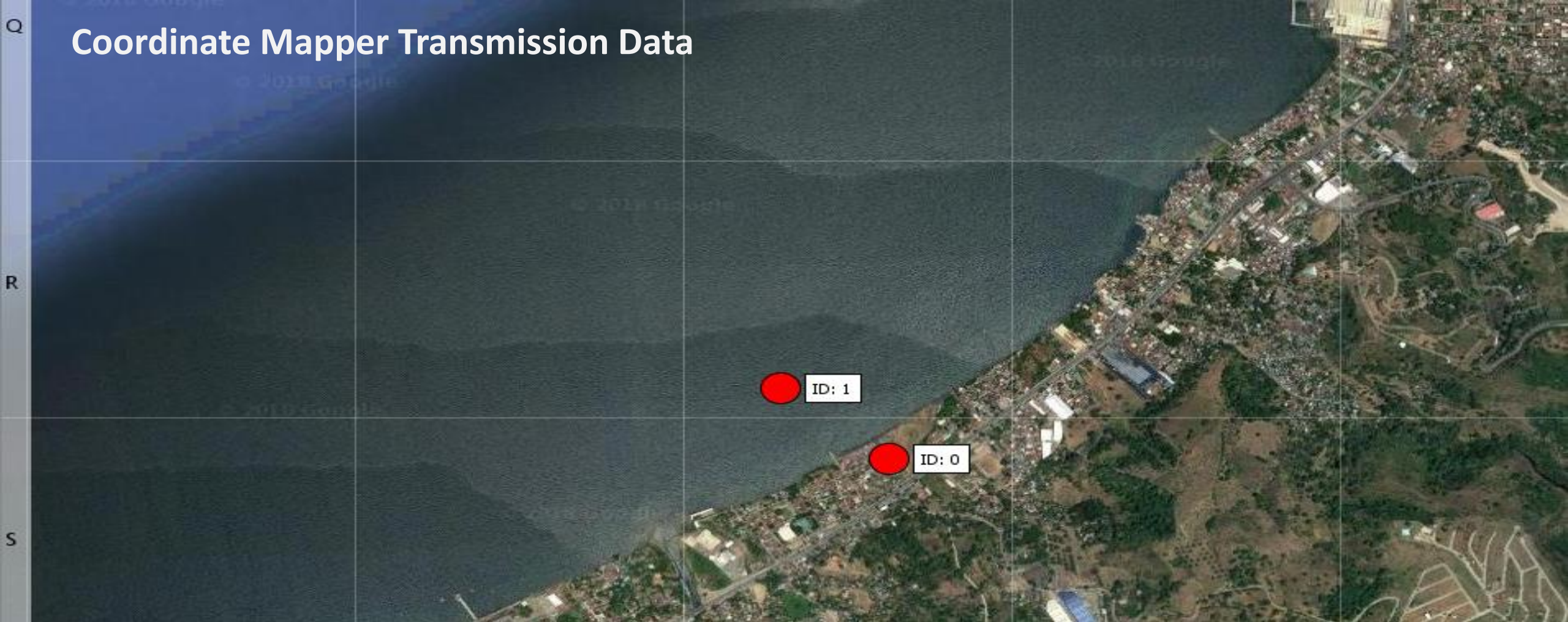
# RESULTS

Real time monitoring of the boat's traversed path, location, and distance.





# Coordinate Mapper Transmission Data



Status: **Looking for Base Station...**

ID	Grid	Last Transmission
0	S-18	09:11AM 04/20/18
1	R-18	09:02AM 04/20/18

```
C:\Users\Christian\Desktop\MEJIAS\Mapper\dist>java -jar Mapper.jar
```

```
Stable Library
```

```
=====
```

```
Native lib Version = RXTX-2.1-7
```

```
Java lib Version   = RXTX-2.1-7
```

```
///  
COM10 opened
```

```
///  
COM10 writing
```

```
Detected base-station on ///  
COM10
```

```
Warning: Boat ID 0 has no GPS signal
```

```
Data cache: -ru;241;-coor;0;0829.49982;12444
```

```
logging: -ru;241;-coor;0;0829.49982;12444.33893;0#
```

```
Data cache: -ru;167;-coor;1;0000.00000;00000
```

```
Warning: Boat ID 1 has no GPS signal
```

```
Data cache: -ru;241;-coor;1;0829.50299;12444
```

```
logging: -ru;241;-coor;1;0829.50299;12444.33936;0#
```

```
Data cache: -ru;167;-coor;0;0829.50120;12444
```

```
logging: -ru;167;-coor;0;0829.50120;12444.33770;0#
```

```
Data cache: -ru;241;-coor;0;0829.50069;12444
```

```
logging: -ru;241;-coor;0;0829.50069;12444.33798;0#
```

```
Data cache: -ru;217;-coor;0;0829.49992;12444
```

```
logging: -ru;217;-coor;0;0829.49992;12444.33812;0#
```

```
Data cache: -ru;42;-coor;0;0829.49989;12444.
```

```
logging: -ru;42;-coor;0;0829.49989;12444.33827;0#
```

```
Data cache: -ru;130;-coor;0;0829.49962;12444
```

```
logging: -ru;130;-coor;0;0829.49962;12444.33815;0#
```

```
Data cache: -ru;200;-coor;0;0829.49973;12444
```

```
logging: -ru;200;-coor;0;0829.49973;12444.33820;0#
```

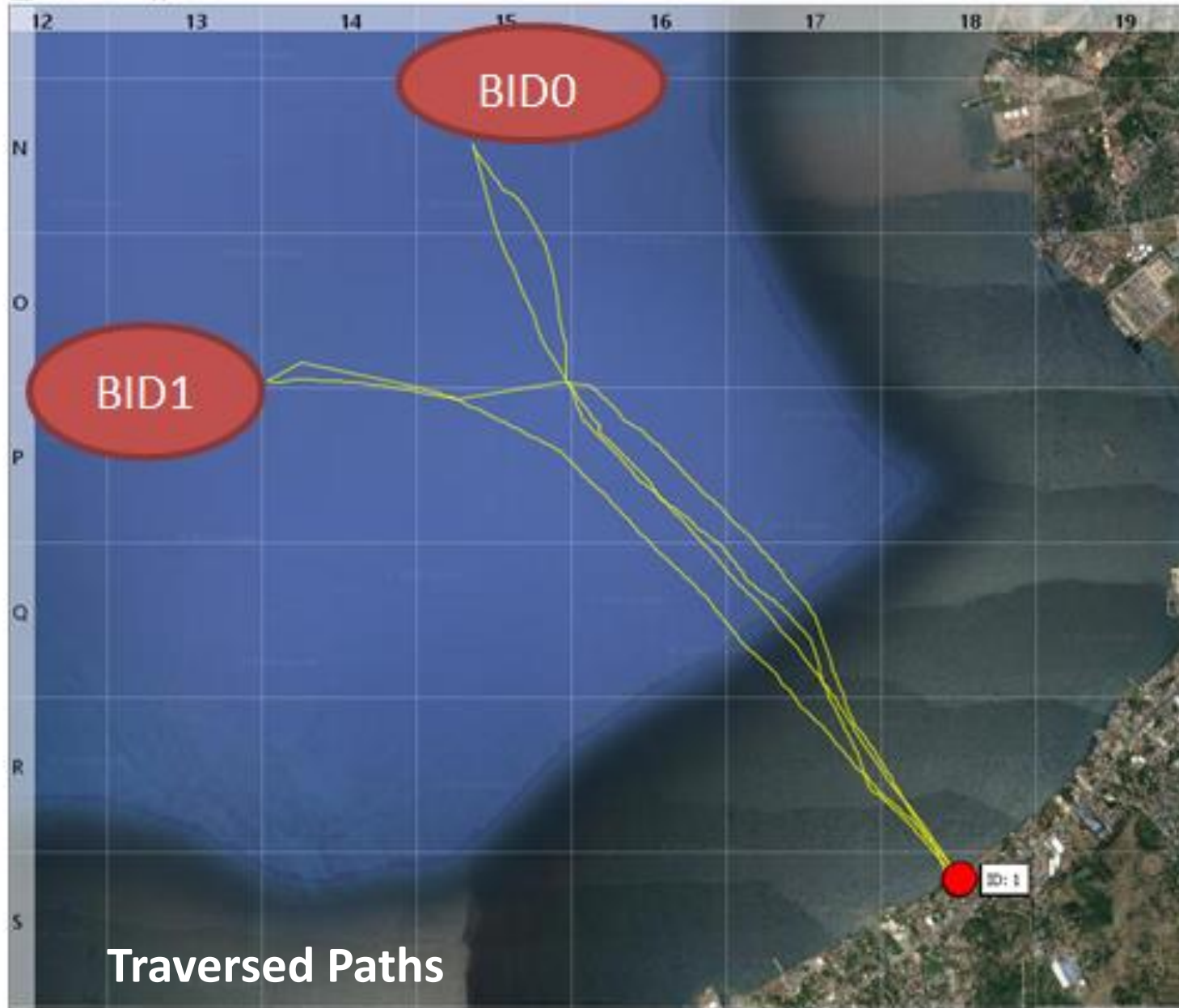
```
Data cache: -ru;241;-coor;0;0829.49982;12444
```

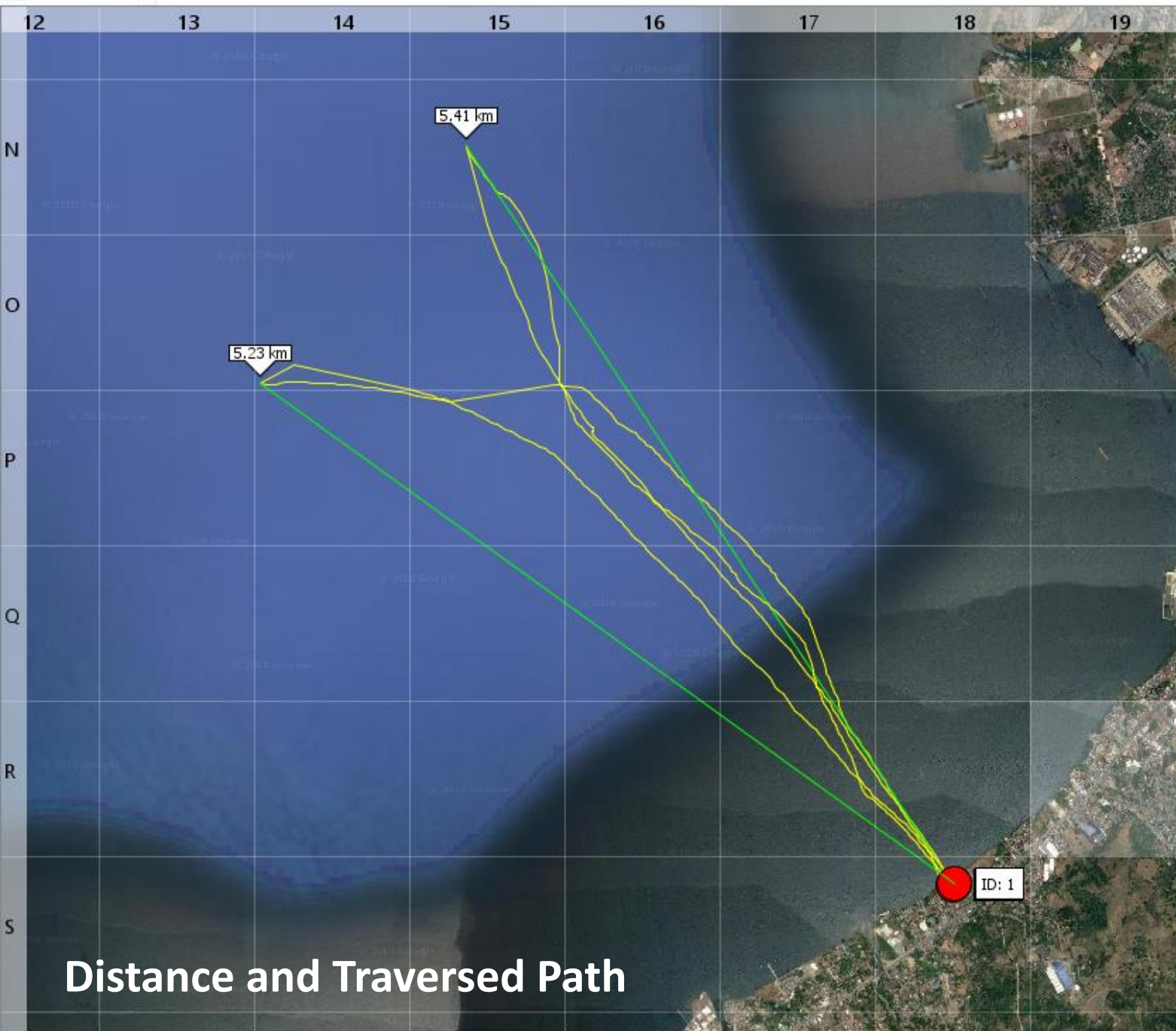
Real time  
monitoring of data  
logs



Optimum Distance Tested





Status: **Looking for Base Station...**

ID	Grid	Coordinate	Last Transmission
0	S-18	8.491708, 124.738935	08:11AM 04/21/18
1	S-18	8.491742, 124.739032	08:18AM 04/21/18
2			
3			

☒ Show maximum displacement

50%

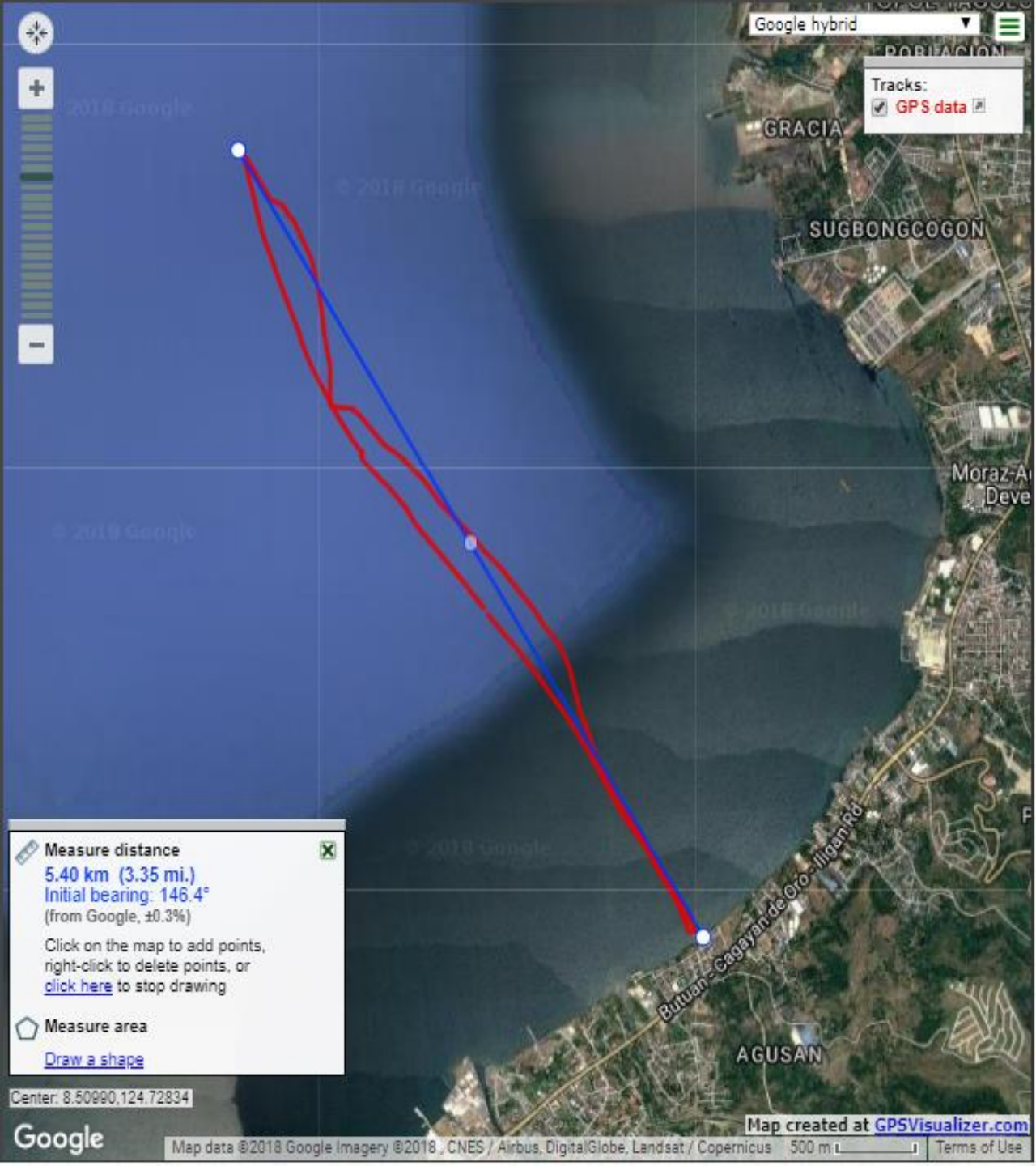
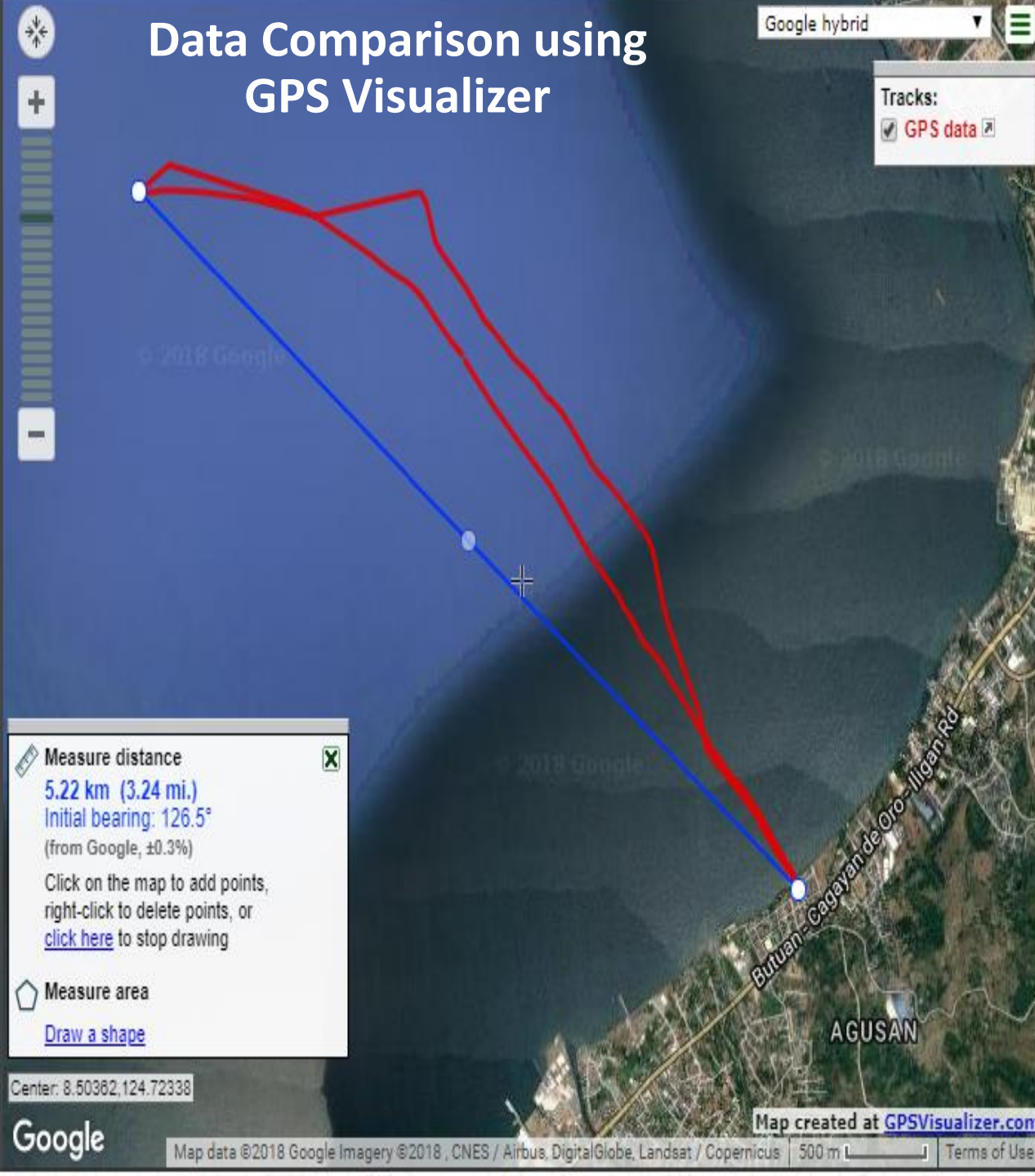
200%

☒ Show trails

SEND EMERGENCY MESSAGE



# Data Comparison using GPS Visualizer



					Distance in Kilometers	
	BASE		SHORE		Two point formula	Haversine Equation
213	8.491742	124.739	8.519025	124.7017	5.132	5.104
214	8.491742	124.739	8.519043	124.7014	5.157	5.129
215	8.491742	124.739	8.519083	124.7012	5.186	5.157
216	8.491742	124.739	8.520135	124.7029	5.097	5.071
217	8.491742	124.739	8.51873	124.7096	4.436	4.417

Figure 48: Comparison of Distance Computation of BID1 using Two Point Formula Versus Haversine Equation.

					Distance in Kilometers	
	BASE		SHORE		Two point formula	Haversine Equation
	Latitude	Longitude	Latitude	Longitude		
225	8.491708	124.7389	8.532041	124.7124	5.361	5.353
226	8.491708	124.7389	8.527719	124.7135	4.894	4.884

Figure 49: Comparison of Distance Computation of BID0 using Two Point Formula Versus Haversine Equation.



# Sending Broadcast Message from Base Station



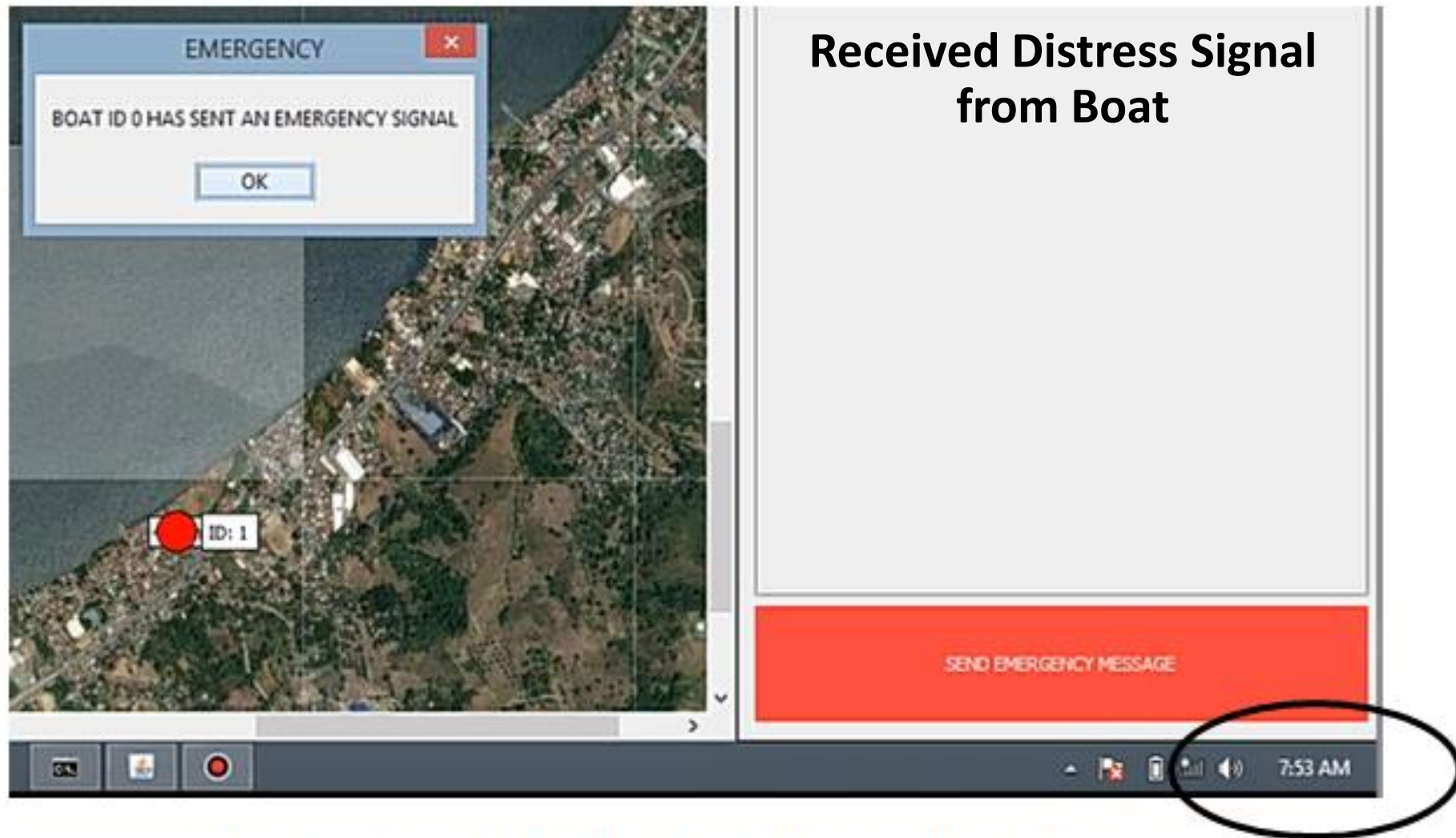


Figure 51: SOS signal from the boat sent to the base station

serial\_20180420\_082016.txt - Notepad

File Edit Format View Help

07:53:31.692 Sending em07:53:31.696 ergency sign07:53:31.700 al  
07:53:45.709 Polling...



Terminal

Terminal

08:11:11.812

00,001512.008:15:11.821 0,0829.96949,N,  
12443.78318,E,72.310,D3,2.6,2.9,1208:15:11.825  
0,008:11:11.827 829.80708;108:11:11.829 2443.91762,0  
08:11:11.839 #

Trans08:11:11.819 ing: -ru;25408:11:11.824 ;-coor;  
0,008:11:11.827 829.80708;108:11:11.829 2443.91762,0  
08:11:50.477 Received emergency signal from base stati  
08:11:50.480 n  
08:11:52.476 Received e08:11:52.480 mergency signal fr  
om base station  
08:12:09.966 Polling...  
08:12:10.708 Rece08:12:10.711 iving...08:12:10.715  
08:12:11.822 Received: \$PUBX,  
00,001212.00,0808:12:11.826 29.80213,N,  
12443.91357,E,72.943,D3,1.6,2.3,0.35508:12:11.830 ,  
214.49,-0.001,0.75,1.06,0.66,11,0,0\*408:12:11.834 C  
Trans08:12:11.838 mitting: -ru08:12:11.842 ;67;-coor;  
0,08:12:11.847 0829.80213;108:12:11.853 2443.91357,0  
8:12:11.854 0#  
08:13:09.910 Polling...  
08:13:10.688 Re08:13:10.693 ceiving 08:13:10.696 ...  
08:13:11.802 Received: \$PUBX,  
00,001312.00,0829 08:13:11.807 79658,N,  
12443.90010,E,70.818,G3,3.5,4.3,6.938,2808:13:11.810  
8.05,0.025,0.68,0.96,0.57,12,0,0\*6C08:13:11.814  
Transmitt08:13:11.818 ting: -ru;08:13:11.823 77;-coor;  
0,08:13:11.827 0829.79658;108:13:11.834 2443.90010,0  
08:13:11.838 #  
08:13:25.049

M1M2M3M4M5M6M1M2M3M4M5M6

00,001512.008:15:11.821 0,0829.96949,N,  
12443.78318,E,72.310,D3,2.6,2.9,1208:15:11.825  
024,333.99,0.023,0.68,0.96,0.57,12,0,008:15:11.829 \*56  
Trans08:15:11.833 mitting: -ru08:15:11.837 ;85;-coor;  
0,08:15:11.842 0829.96949;08:15:11.847 12443.78318;  
15:11.855 8;0#  
08:16:09.745 Polling 08:16:09.750 ...  
08:16:10.699 Receivin08:16:10.703 g...  
08:16:11.809 Recei08:16:11.814 ved: \$PUBX,  
00,001612.00,0830.07017,N,  
12443.7242708:16:11.818 ,E,72.032,D3,3.2,3.12.608,33  
7.06,0.016,0.68,0.96,0.57,12,0,0\*57  
08:16:11.825 Transmitting08:16:11.829 :-ru;  
140;-c08:16:11.834 oor;  
0,0830.008:16:11.838 7017;1244308:16:11.842 .  
72427;0#  
08:17:09.693 Polling...  
08:17:10.700 Receivin08:17:10.706 g...  
08:17:11.815 Received: \$PUBX,  
00,001712.00,0830.17285,N,  
1208:17:11.819 443.66956,E,71.150,D3,3.3,3.2,12.450  
328.95,-0.008:17:11.822 98,0.70,0.98,0.57,11,0,0\*72  
08:17:11.827  
Transmitt08:17:11.831 ing: -ru;22608:17:11.835 ;-coor;  
0,08308:17:11.839 0.17285;124408:17:11.843 3.66956;0  
#08:17:11.847

C:\WINDOWS\system32\cmd.exe - java -jar Mapper.jar

Received data from base-station: -ru;136;-coor;1;0829.66142;12444.15795;  
clearing saved data  
Received data from base-station: -ru;146;-sos;1;  
clearing saved data  
Received data from base-station: -ru;72;-sos;1;  
clearing saved data  
Received data from base-station: -ru;65;-sos;1;  
clearing saved data  
Received data from base-station: -ru;243;-coor;1;0829.81620;12443.96095;  
clearing saved data  
Received data from base-station: -ru;13;-sos;1;  
Received data from base-station: -ru;35;-co  
Received data from base-station: -ru;35;-coor;1;0829.83350;12443.94024;  
Received data from base-station: -ru;95;-coor;1;0829.95409;12443.78329;  
Received data from base-station: -ru;48;-sos;0;

EMERGENCY  
BOAT ID 0 HAS SENT AN EMERGENCY SIGNAL  
OK

ID: 1  
369.55m  
50.49m  
467.43m  
198.88m

C:\WINDOWS\system32\cmd.exe - java -jar Mapper.jar

loading stored data  
Received data from base-station: -ru;245;-coor;1;0829.51457;12444.33140;  
clearing saved data  
Received data from base-station: -ru;107;  
saving lacking data  
loading stored data  
Received data from base-station: -ru;107;-coor;1;0829.52914;12444.31347;  
clearing saved data  
Received data from base-station: -ru;21  
saving lacking data  
Received data from base-station: -ru;214;-coor;1;0829.59417;12444.24006;  
Received data from base-station: -ru;136;-coor  
Received data from base-station: -ru;136;-coor  
Received data from base-station: -ru;136;-coor;1;0829.66142;12444.15795;  
Received data from base-station: -ru;146;-sos;1;

EMERGENCY  
BOAT ID 1 HAS SENT AN EMERGENCY SIGNAL  
OK

ID: 1  
181.87m  
16.72m

# Conclusions

- **The devices both in the base and nodes were able to successfully transmit and receive emergency communication.**
- **The coordinate mapper software was able to pinpoint the exact nearest location of the fishermen's boats.**
- **Using the devices, these will add another layer of communication and improvements in disaster relief operation in our local fishermen.**
- **The efficiency of the developed prototype wireless communication system is effective enough to be used given that the point of connection must be within line of sight to ensure that the nodes meet and that they can communicate.**

# Recommendations

- **Test a much longer range of RF transceivers.**
- **Design a prototype that can withstand extreme conditions.**
- **With further development;**
  - **Can be branch out in many other possible risk and disaster management.**
  - **Can also help map if a certain location at sea is congested or not with fishermen.**
  - **Can also aid in monitoring boundaries between municipal and commercial fishing boundaries.**



**THANK YOU!**