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— AgroSitter —  
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## Team Members



SUMIN LEE



YUNCHANG CHAE



CHANGHO SEO



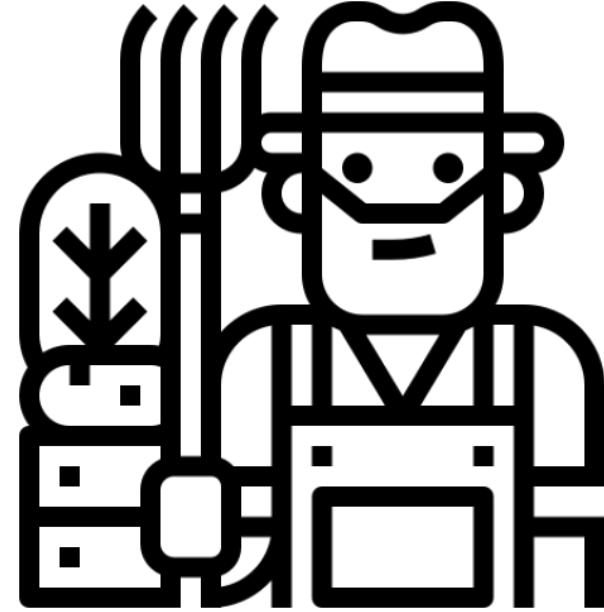
CHANHYEOK JUN



SUKRYUL LIM



## Introduction

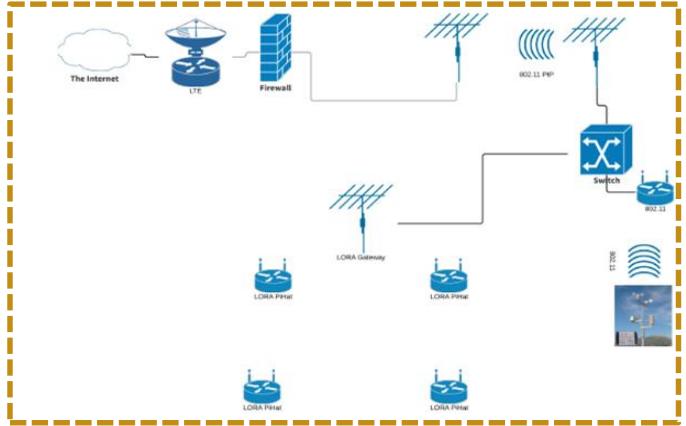


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**“Farmers in Indiana must deal with a huge amount of workload”**

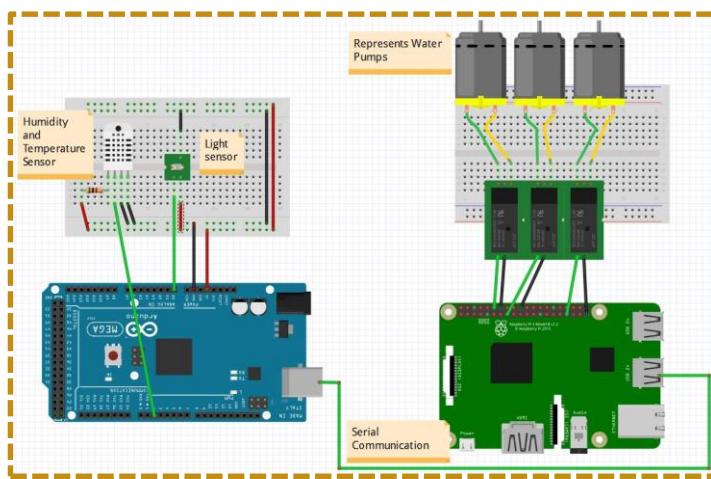
**“the climate of Indiana is very changeable across the field in scales of just a couple acres”**

## Previous Project



# “LoRa Network Does **not** work”

A24	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Id	Humi	Temp	24	24	24	24	01/01/12-4	Packet #	1	0	1	-70	8.bn.111.100m			
2	111	69	24	24	24	24	24	01/01/12-4	1	0	2	-69	8.bn.111.100m	8.bn.111.100m-01/01/12-0042-15			
3	111	68	24	24	24	24	24	01/01/12-4	2	0	2	-69	8.bn.111.100m	8.bn.111.100m-01/01/12-0042-18			
4	111	69	24	15	24	24	24	01/01/12-4	3	0	3	-65	8.bn.111.100m	8.bn.111.100m-01/01/12-0042-22			
5	111	69	24	15	24	24	24	01/01/12-4	4	0	4	-70	8.bn.111.100m	8.bn.111.100m-01/01/12-0042-26			
6	111	67	25	25	25	25	25	01/01/12-4	5	0	5	-71	8.bn.111.100m	8.bn.111.100m-01/01/12-0042-30			
7	111	67	25	25	25	25	25	01/01/12-4	6	0	6	-65	8.bn.111.100m	8.bn.111.100m-01/01/12-0042-33			
8	111	67	25	14	25	25	25	01/01/12-4	7	0	7	-71	8.bn.111.100m	8.bn.111.100m-01/01/12-0042-37			
9	111	67	25	16	25	25	25	01/01/12-4	8	0	8	-68	8.bn.111.100m	8.bn.111.100m-01/01/12-0042-41			
10	111	67	25	17	25	25	25	01/01/12-4	9	0	9	-72	8.bn.111.100m	8.bn.111.100m-01/01/12-0042-45			
11	111	67	25	10	25	25	25	01/01/12-4	10	0	10	-67	8.bn.111.100m	8.bn.111.100m-01/01/12-0042-48			
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16	111	67	25	9	25	25	25	01/01/12-4	15	0	15	-65	8.bn.111.100m	8.bn.111.100m-01/01/12-0043-07			
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19	111	67	25	8	25	25	25	01/01/12-4	18	0	18	-76	8.bn.111.100m	8.bn.111.100m-01/01/12-0043-18			
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21	111	67	25	8	25	25	25	01/01/12-4	20	0	20	-68	8.bn.111.100m	8.bn.111.100m-01/01/12-0043-26			
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23	111	67	25	13	25	25	25	01/01/12-4	22	0	22	-66	8.bn.111.100m	8.bn.111.100m-01/01/12-0043-33			



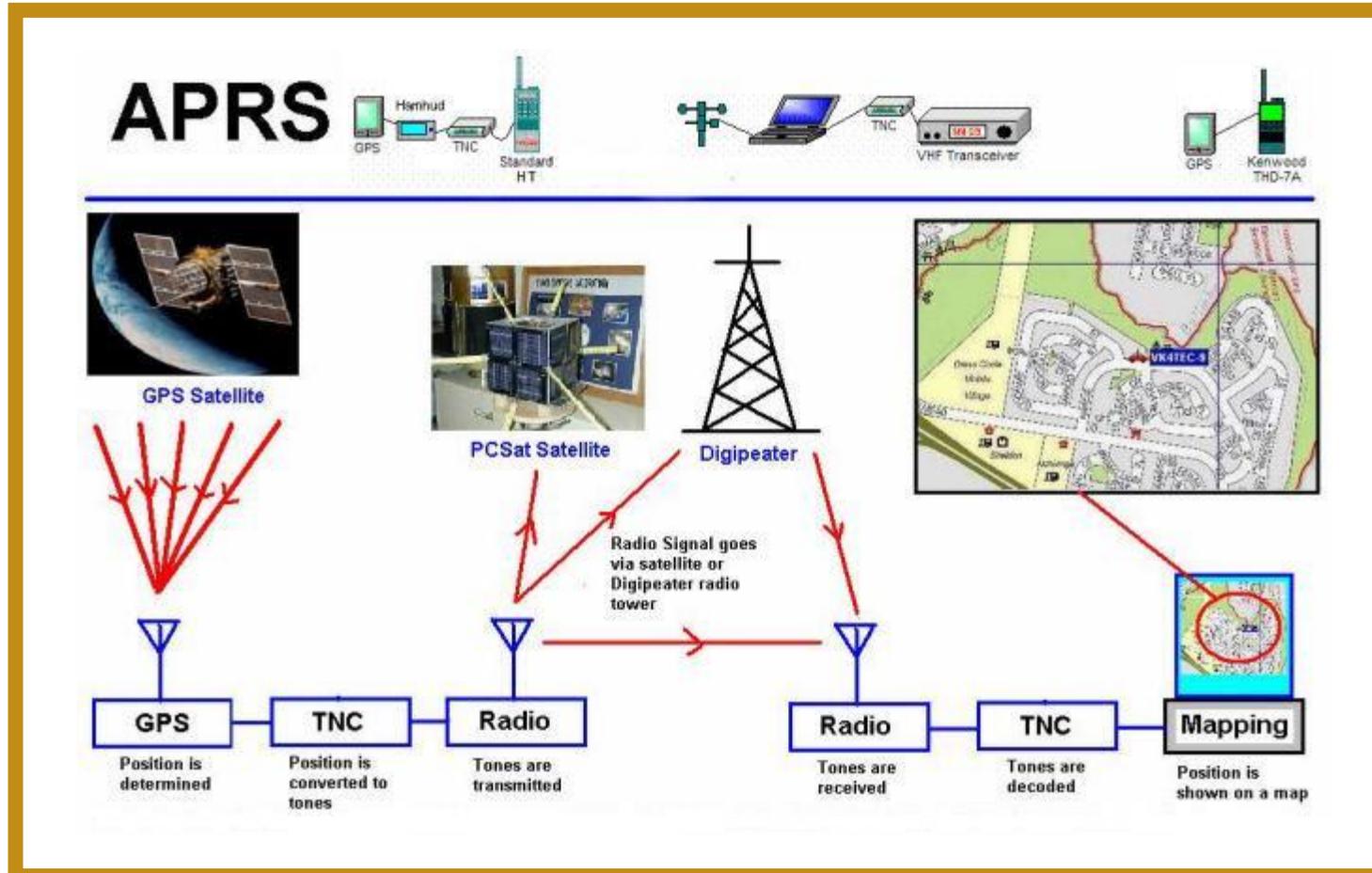
## *Project Goal*



# **APRS**

*(Automatic Packet Reporting System)*

**"Adequate Network for Agricultural IoT"**



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**Research**

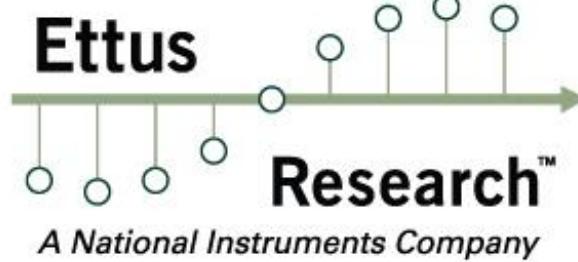
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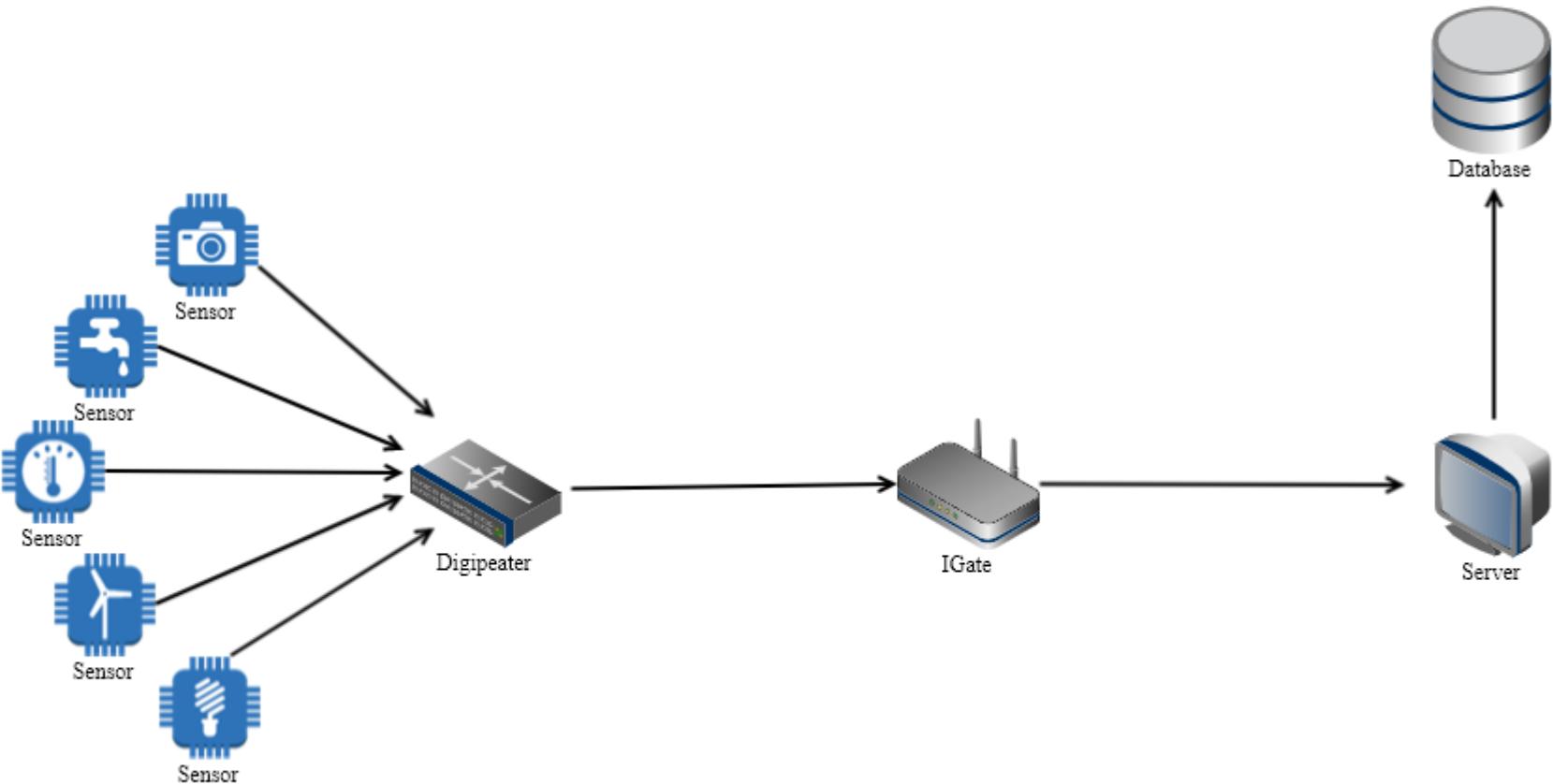
**Future Work**

**Reference**



## Network Diagram

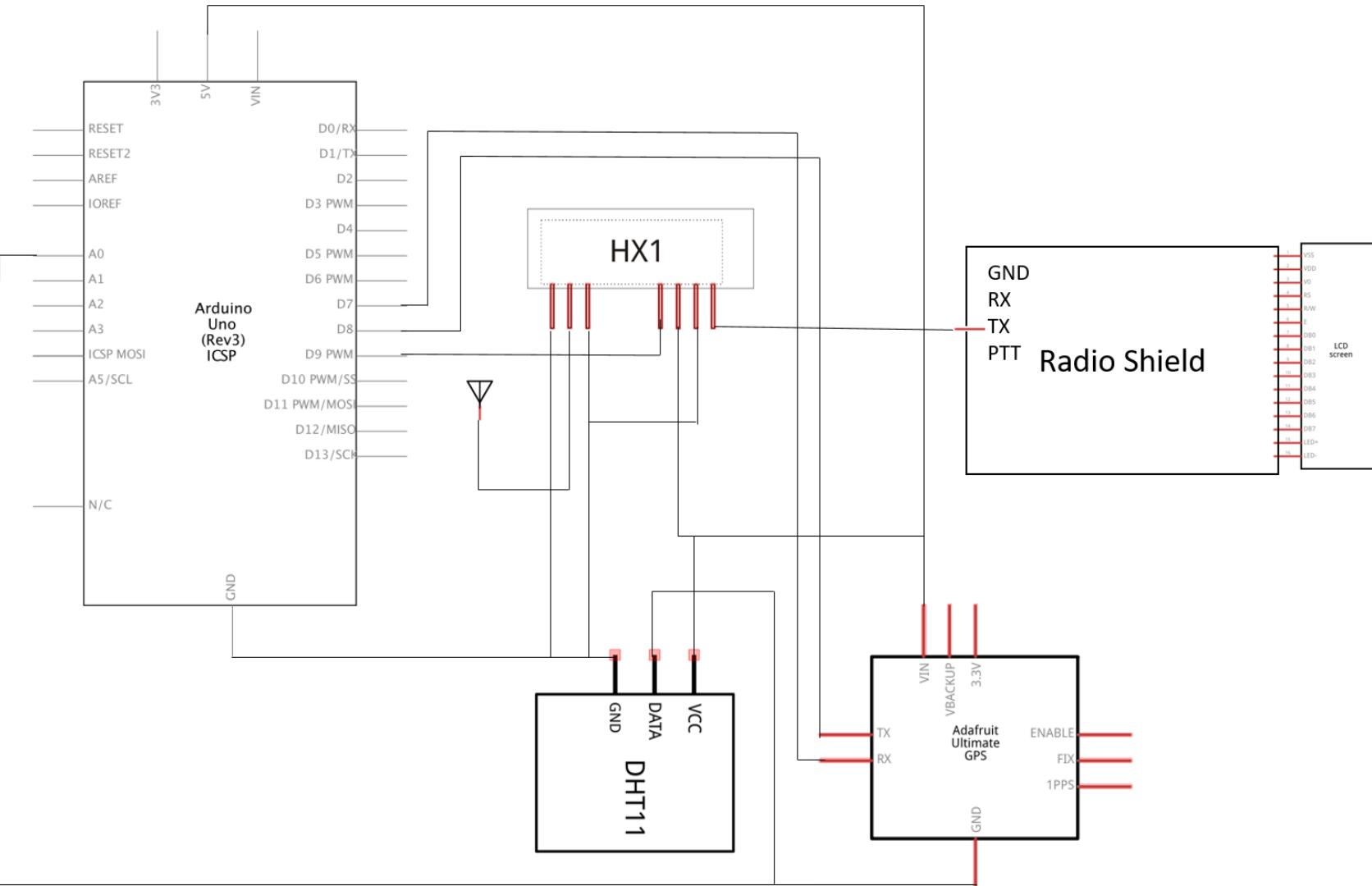
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## Circuit Board





## Arduino Code

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```
void setup()
{
    // OPEN Serial port for GPS
    Serial.begin(115200);
    delay(5000); GPS.begin(9600);
    GPS.sendCommand(PMTK_SET_NMEA_OUTPUT_RMCGGA);
    GPS.sendCommand(PMTK_SET_NMEA_UPDATE_1HZ); // SET Update rate to 1 Hz

    // Request updates on antenna status, comment out to keep quiet
    GPS.sendCommand(PGCMD_ANTENNA);
    delay(1000);
    mySerial.println(PMTK_Q_RELEASE); // Ask for firmware version
    Serial.begin(4800); Serial.println("C"); delay(3);
    Serial.print("MKD9NDI-1\r\n"); //SET CALLSIGN
    delay(10);
    Serial.print("PWIDE1-1,WIDE2-1\r\n"); //SET DIGIPATH
    delay(10); pinMode(highval, OUTPUT); delay(10);
}
```



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## Arduino Code

```
String date_time;
// Make date_time string
if (millis() - timer > 2000) {
    timer = millis();

    date_time.concat("20");
    date_time.concat(GPS.year); date_time.concat('-');
    date_time.concat(GPS.month); date_time.concat('-');
    date_time.concat(GPS.day);
    date_time.concat(" ");

    if (GPS.hour < 10) { date_time.concat("0"); }
    date_time.concat(GPS.hour); date_time.concat(":");
    if (GPS.minute < 10) { date_time.concat("0"); }
    date_time.concat(GPS.minute); date_time.concat(":");
    if (GPS.seconds < 10) { date_time.concat("0"); }
    date_time.concat(GPS.seconds);
}

String data = "";
count++;
// Make contents to put into sending packet
data = data + "test"+(String)count + ", ";
data = data + (String)DHT.temperature + ", ";
data = data + (String)DHT.humidity + ", ";
data = data + date_time + ", ";
data = data + (String)GPS.longitude + ", ";
data = data + (String)GPS.latitude + ", ";
int sate = (int)GPS.satellites;
data = data + (String)sate + ", ";
data = data + (String)GPS.speed;
```



## Arduino Code

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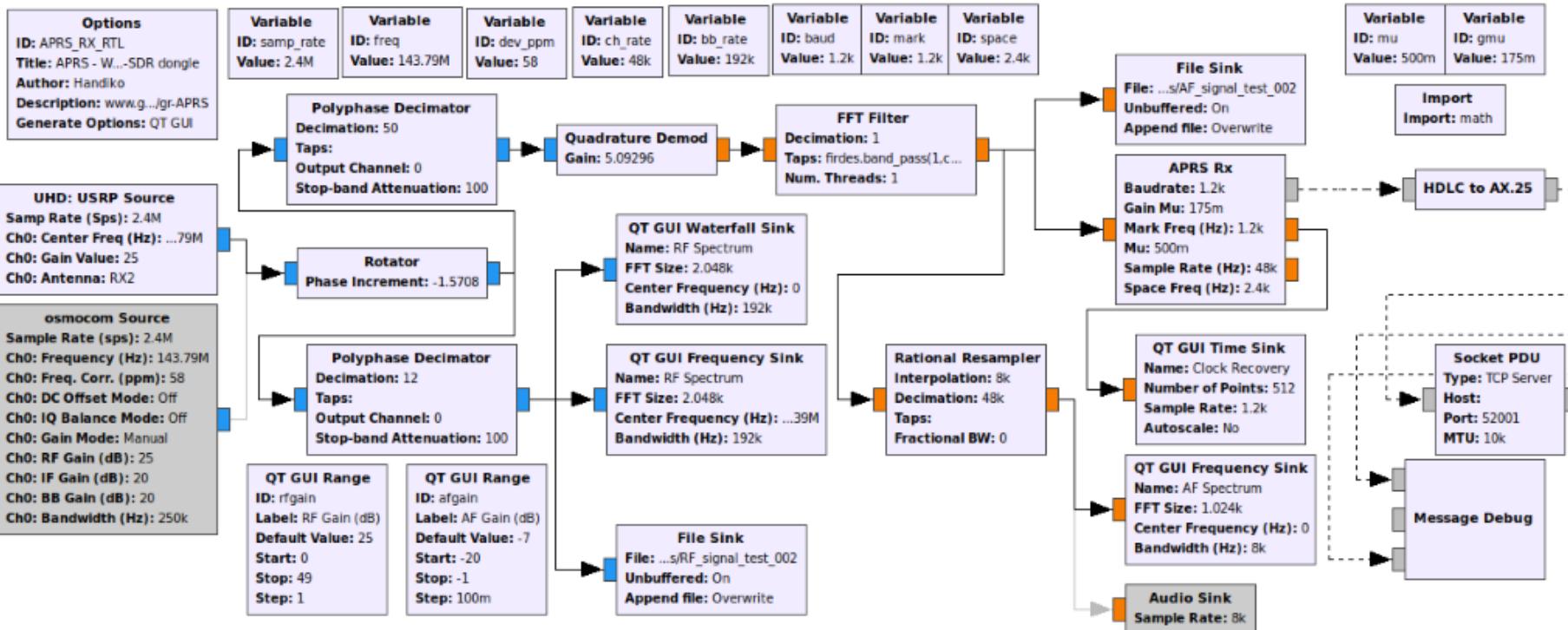
**Future Work**

**Reference**

```
/* Trasmitting */
digitalWrite(highval, HIGH); // Pull up
// Send string
Serial.print("!"); Serial.print(data); Serial.print("\r\n");
delay(3000); //Wait 3s until send whole packet
digitalWrite(highval, LOW); // Pull down
// Print LCD count
Serial.println("C"); delay(10);
Serial.print("W"); Serial.println(count); delay(10000);
```

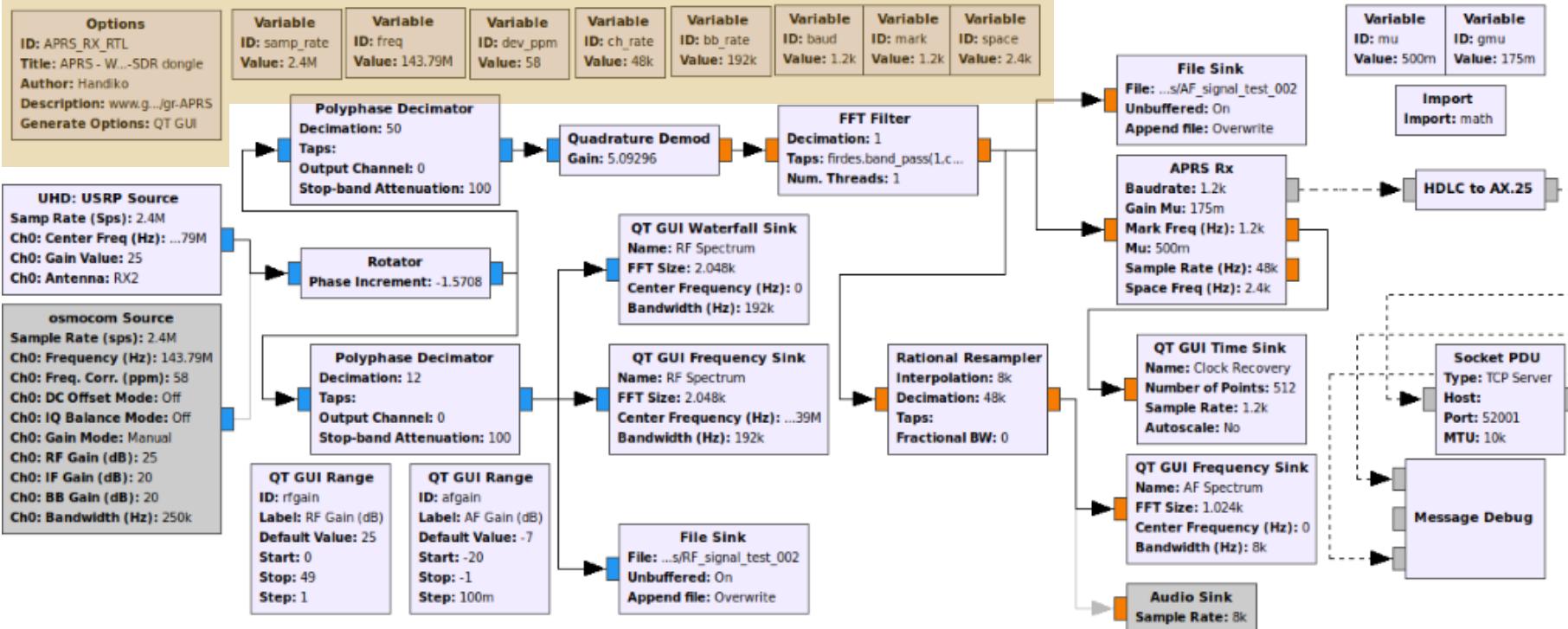
## SDR Flow Chart

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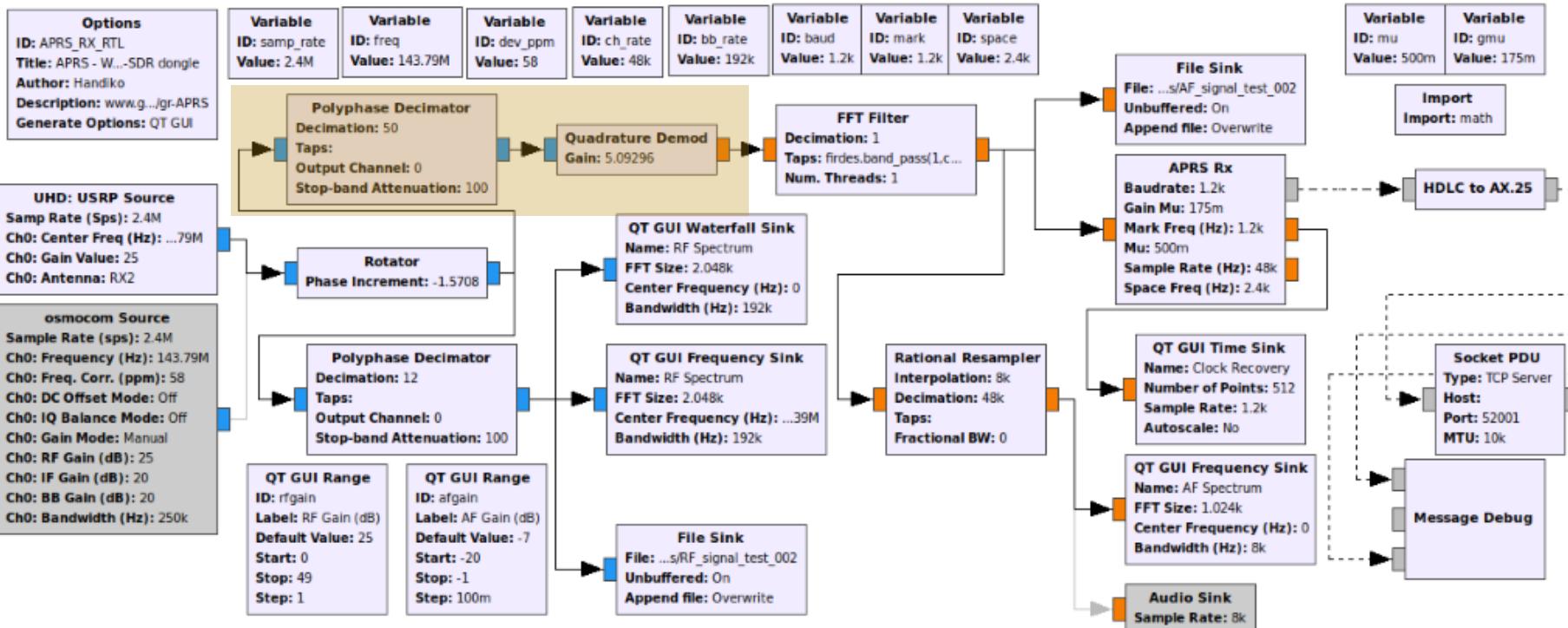
## SDR Flow Chart

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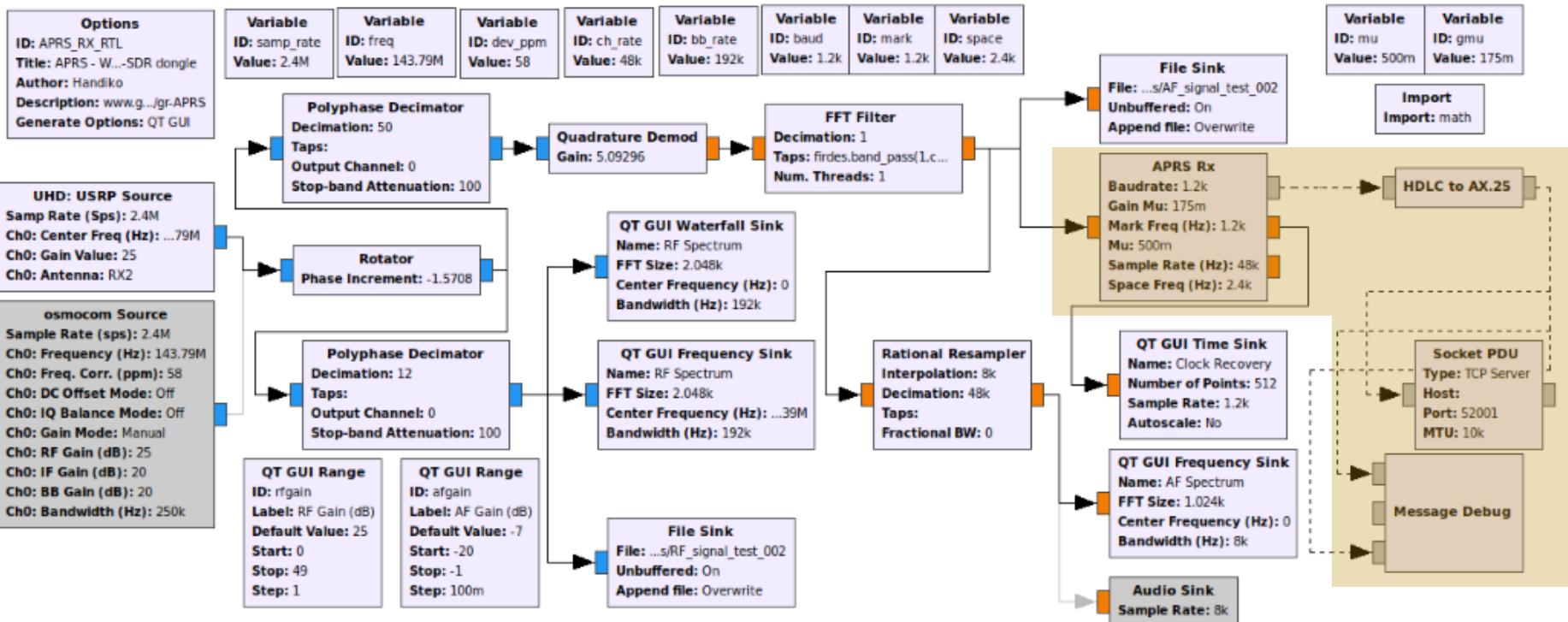
## SDR Flow Chart

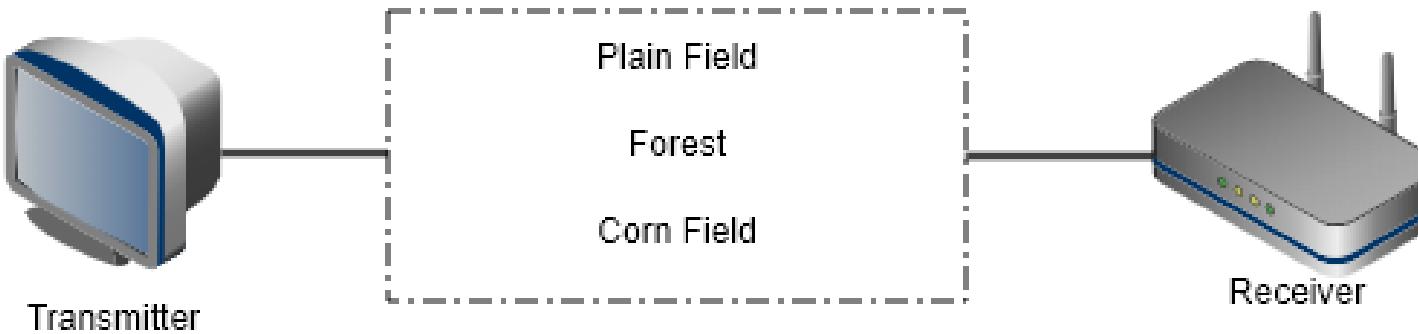
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## SDR Flow Chart

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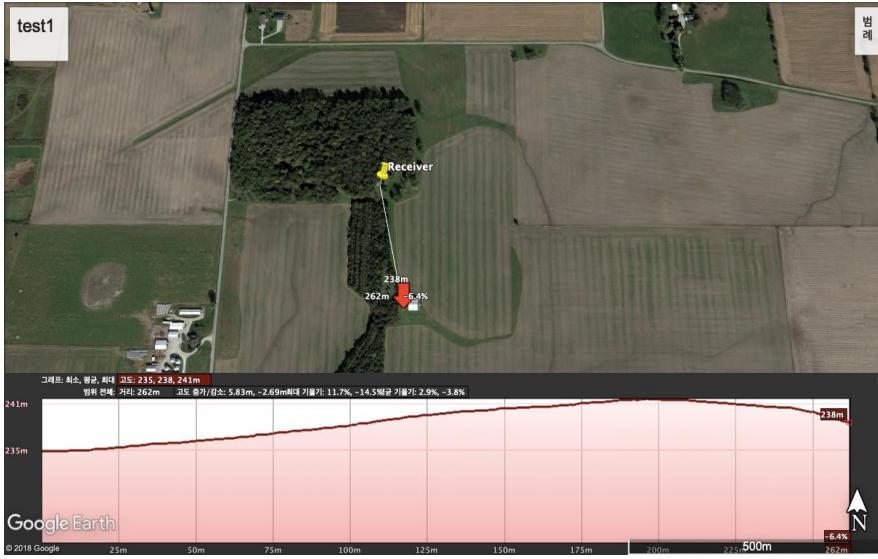




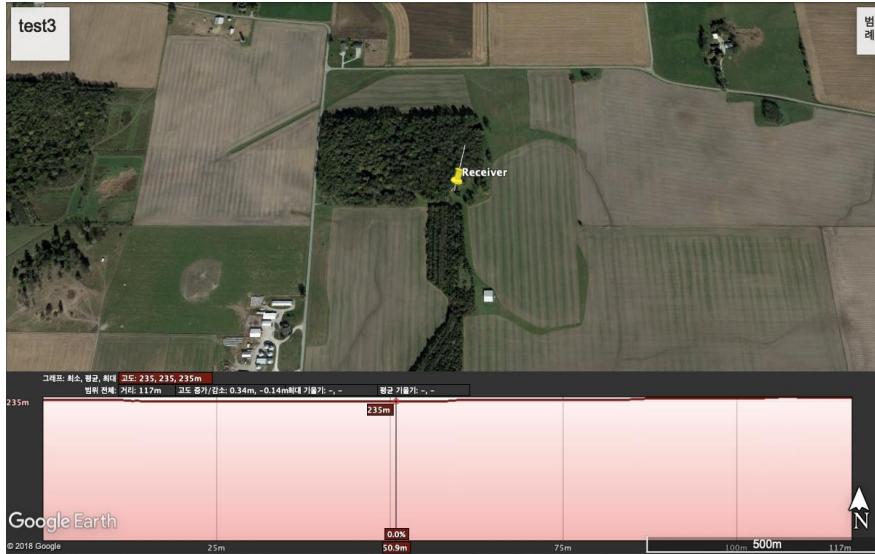
## Test-Availability



## Test-Availability



## Test-Availability



**Land type: Forest**  
**Distance: 117m**  
**Elevation Difference: 0.34m**  
**Tone availability: Available**



**Land type: Forest & Corns**  
**Distance: 587m**  
**Elevation Difference: 1m**  
**Tone availability: Available**

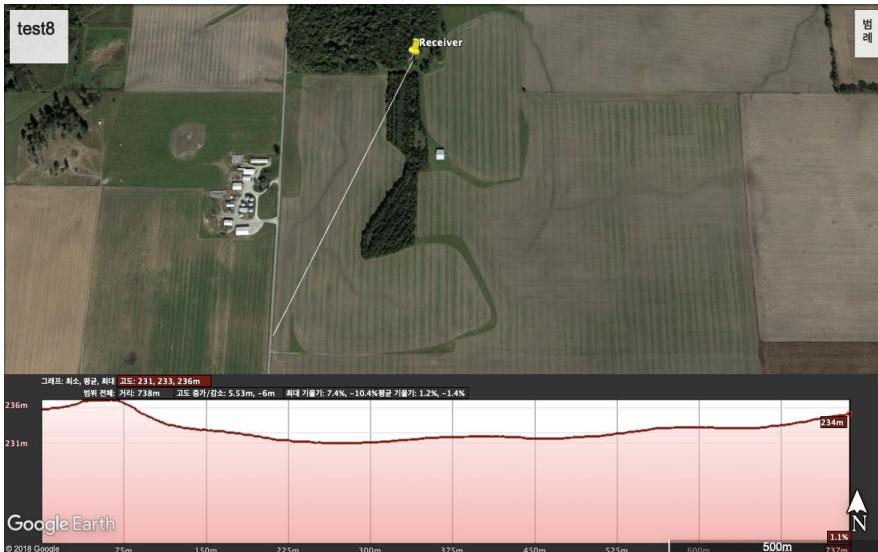
## Test-Availability



## Test-Availability



**Land type: Forest & Corns**  
**Distance: 586m**  
**Elevation Difference: 2m**  
**Tone availability: Available**



**Land type: Forest & Corns**  
**Distance: 738m**  
**Elevation Difference: 1m**  
**Tone availability: Available**

## Test-Availability



**Land type: Corns**  
**Distance: 1730m**  
**Elevation Difference: 3m**  
**Tone availability: Not Available**



**Land type: Corns & plane field**  
**Distance: 1880m**  
**Elevation Difference: 4m**  
**Tone availability: Not Available**

- 1. APRS (Radio signal) propagates well in agricultural environments  
Longest distance 779m**



- 2. Need to check on data packet, signal strength**

**Introduction**

**Research**

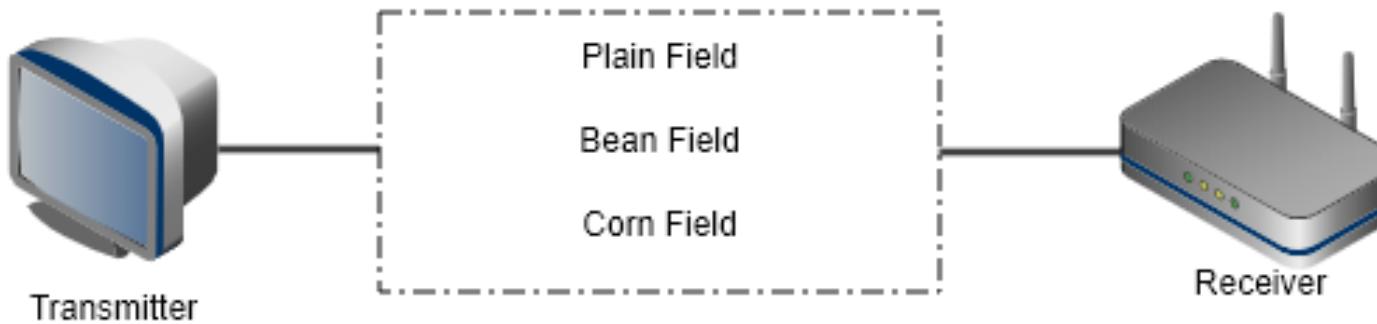
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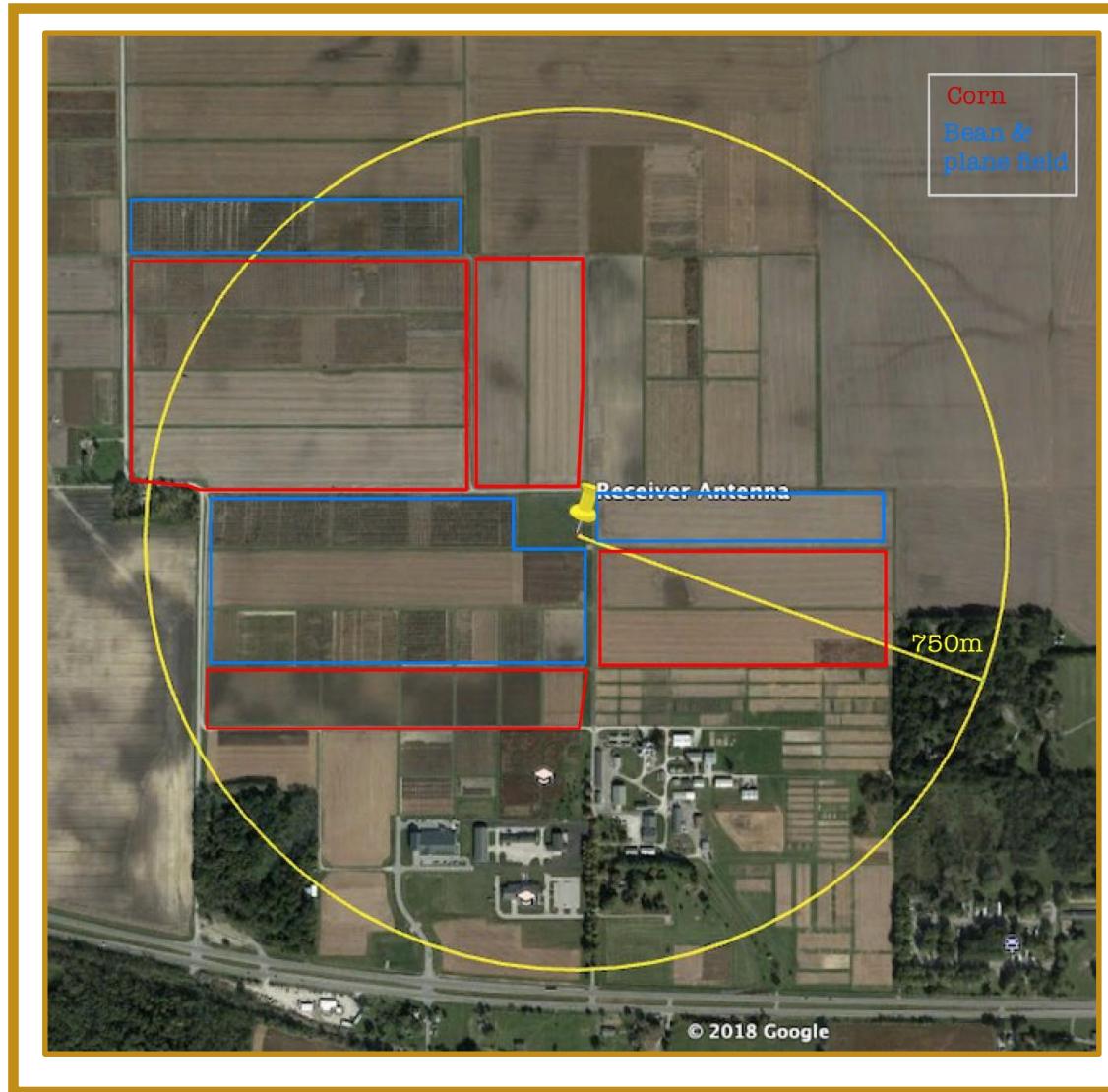
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## Test-Stability



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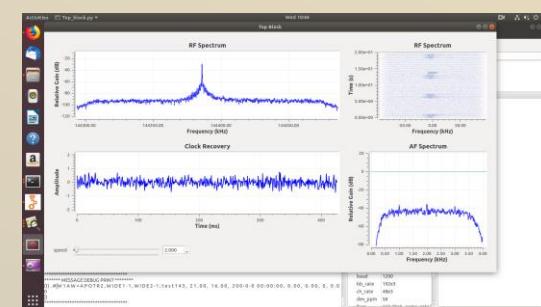
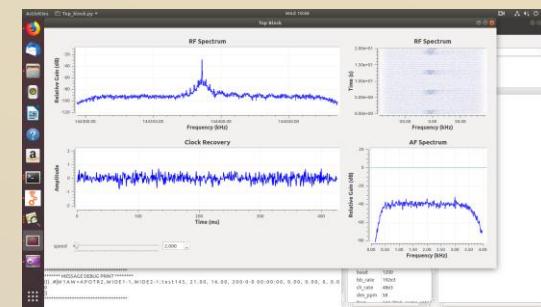
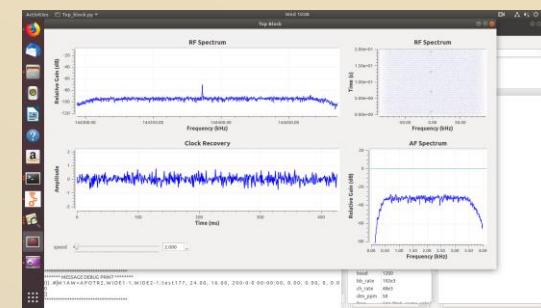
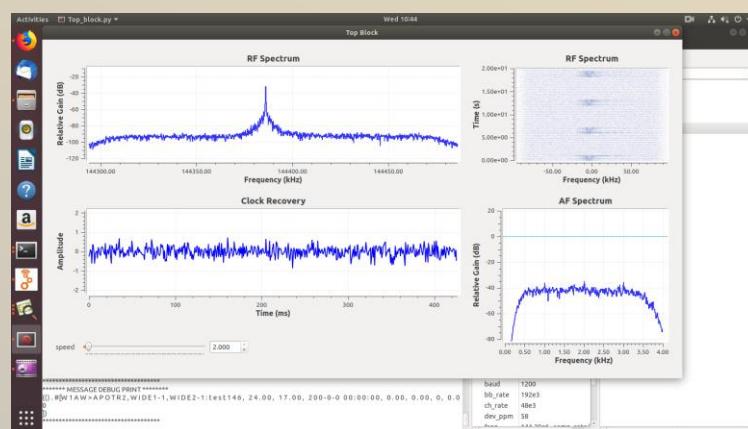
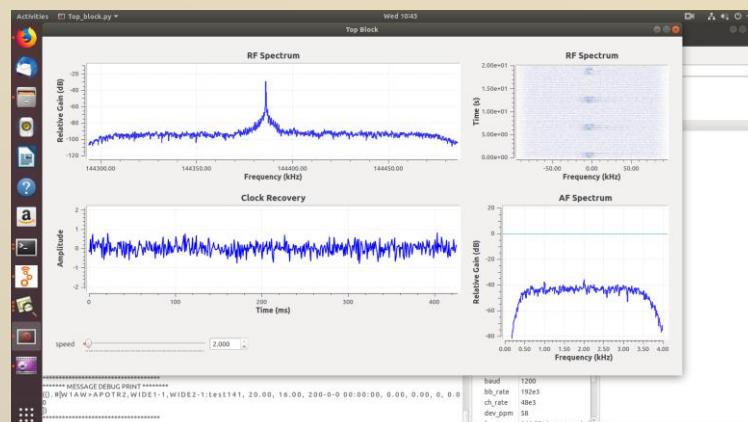
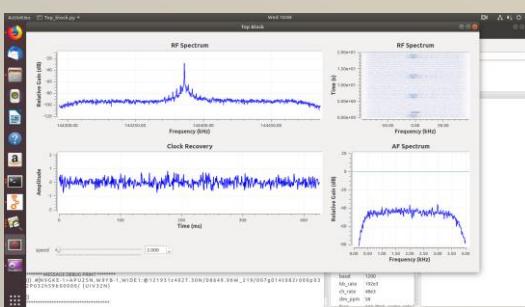
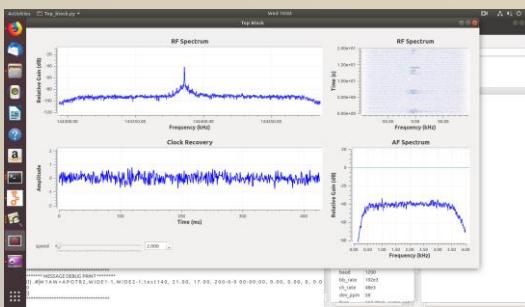
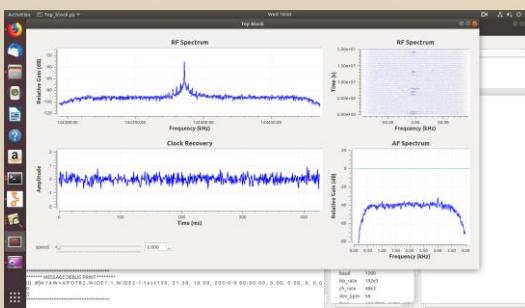
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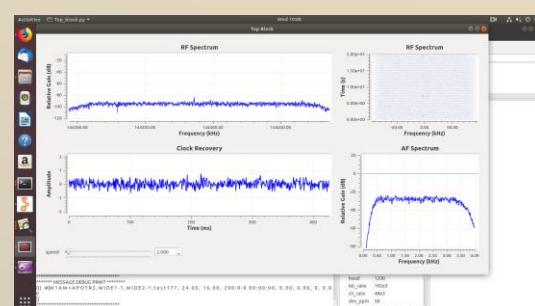
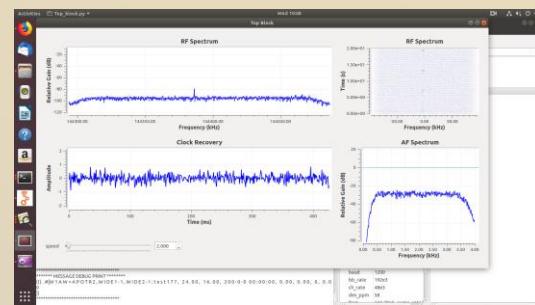
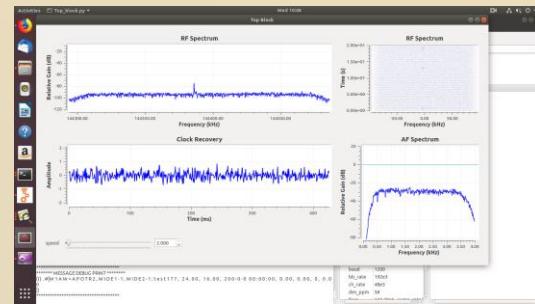
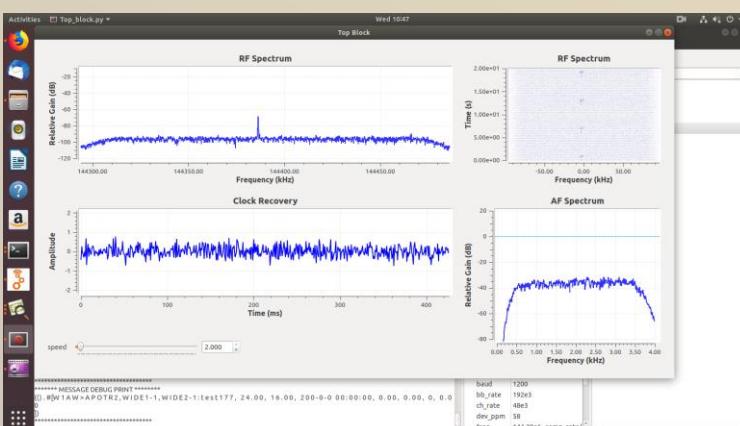
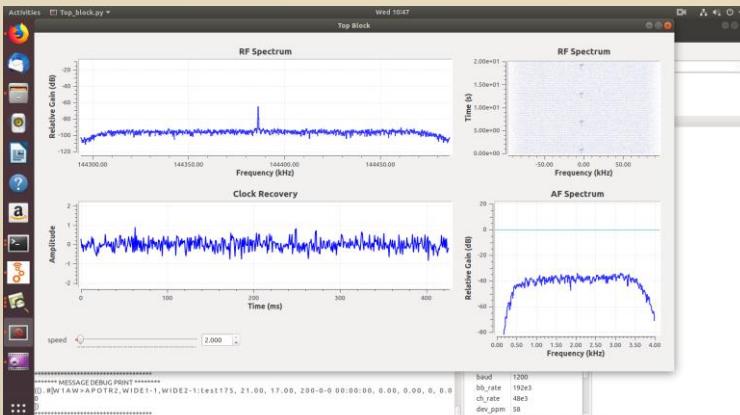
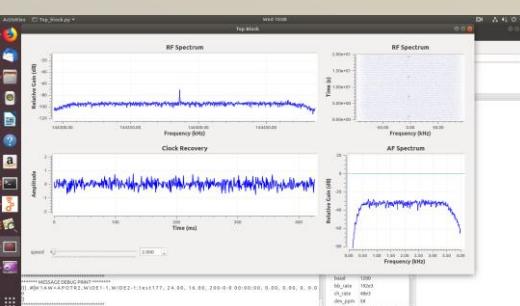
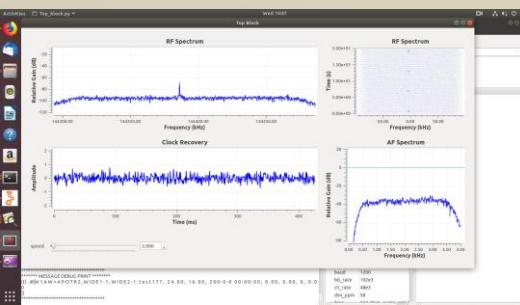
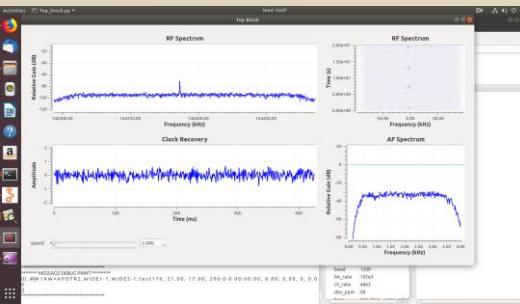
Reference

[https://www.youtube.com/watch?  
v=r7tQECytsyU&feature=youtu.be](https://www.youtube.com/watch?v=r7tQECytsyU&feature=youtu.be)

## **Test-Stability(Strong)**



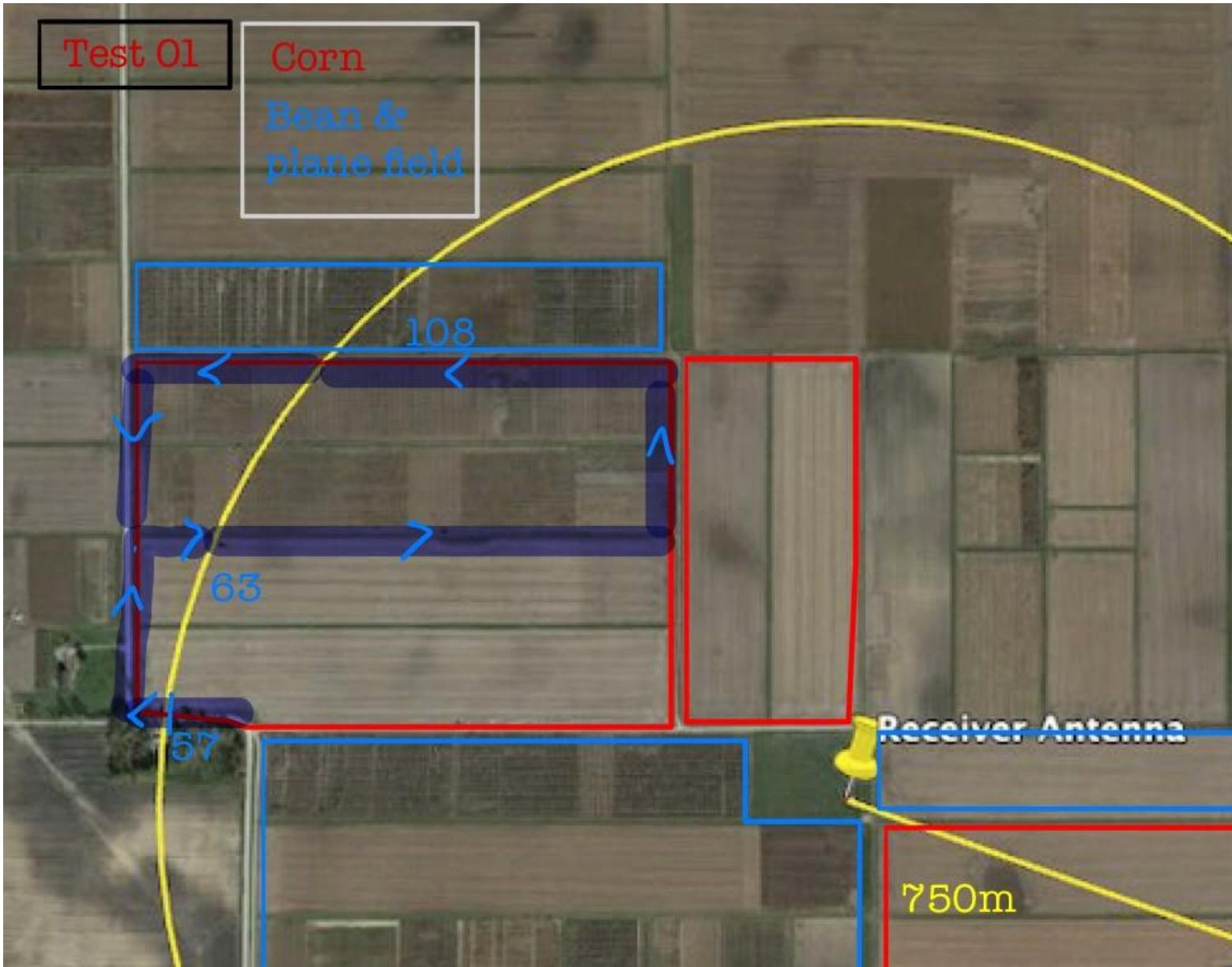
## **Test-Stability(Weak)**





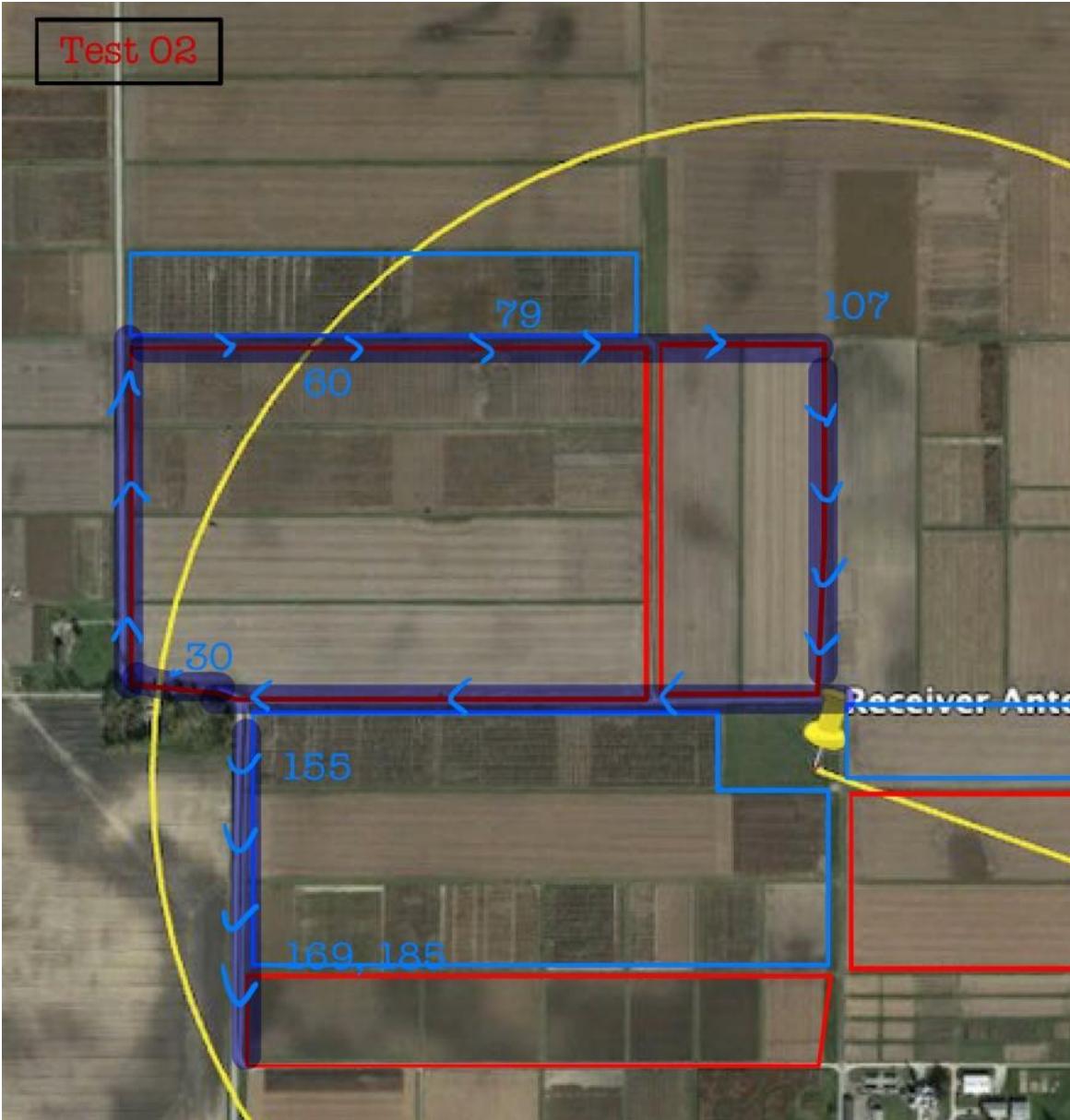
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## Test-Stability



## Test-Stability

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- 1. Propagation problem has been solved**
- 2. Potential of APRS as the adequate network for agricultural IoT has been proved.**
- 3. IoT using APRS could be used for other purpose in wilderness.**

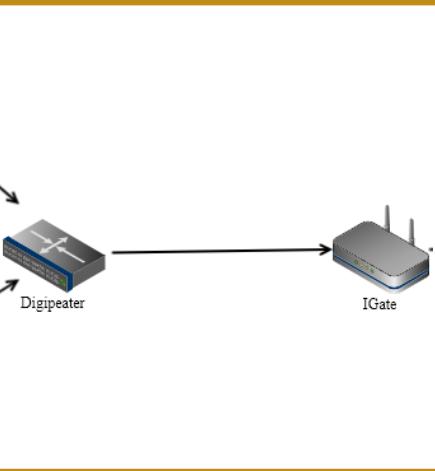
## Future Work



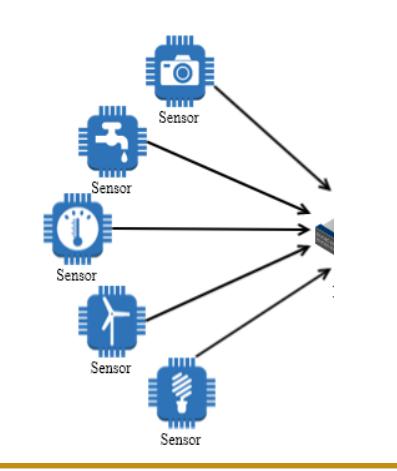
### APRS

(Automatic Packet Reporting System)

**Stronger signal power  
to transmitter within  
the low power  
environment.**



**extend distance  
availability by  
setting up Digipeaters**



**Adapt more sensors  
that are needed  
for AgIoT**

## Reference

- [https://www.tapr.org/aprs\\_information.html \(APRS description\)](https://www.tapr.org/aprs_information.html)
- To make a circuit diagram, we used a fritzing program.
- [1] [http://wiki.sunfounder.cc/index.php?title=Humiture\\_Sensor\\_Module](http://wiki.sunfounder.cc/index.php?title=Humiture_Sensor_Module)
- [2] <https://learn.adafruit.com/adafruit-ultimate-gps/downloads>
- Vuran, M. C., Salam, A., Wong, R., & Irmak, S. (2018). *Internet of underground things in precision agriculture: Architecture and technology aspects*. *Ad Hoc Networks*, 81, 160-173.
- Hartono, R., Hasbi, W., Choiriyah, I., & Yatim, R. (2019). Design of APRS Modem Using IC TCM3105 and ATMega2560 Microcontroller. *arXiv preprint arXiv:1901.05292*.
- Hongyim, N., & Mithata, S. (2017, November). Designing and Implementation Exploration Vehicle Remote Controller Using APRS Protocol. In 2017 21st International Computer Science and Engineering Conference (ICSEC) (pp. 1-5). IEEE.



# Q&A



# THANK YOU

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SUMIN LEE Sejong Univ.

CHANHYEOK JUN Jeju Univ.

AIDAN MAIS , AUSTIN RIEGSECKER, MILOS, TOMO, KAR EE HO Purdue Univ.

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