Test Sheet – Ad Hoc Network Communication for Disaster Relief IR Communication Sub-System Test

Location	EE Building D-125
Date	20 December 2023
Time	18:00
Description	This test document is specifically crafted for evaluating ad hoc network communication within TechBatch's IR communication system. The primary objective is to conduct comprehensive tests, systematically collect the results, and subsequently publish a detailed report.
Aim	This test guide is formulated to validate the sub-system's ability to accurately transmit and receive data signals from the IR transmitter and receiver under diverse conditions.
Expected Outcome	Reliable communication is expected for different angles and ranges between Base Unit (BU) and Mobile Unit (MU). Communication will be corrupted when the MU is out of range.
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Test Devices & Tools

1. Ruler
Ruler will be used to measure the distance between the base unit and the mobile unit.

Calibration: The precision and the accuracy of the ruler can be tested with another ruler. Intervals of the ruler are accepted as a true reference for dimension measurements.

2.Computer with Serial Window of the Arduino IDE:
As long as the base and mobile unit communicate 'Message is Received' message will appear in the serial window of the Arduino IDE.

Calibration: Serial window is reset for each test. Reset process can be done by the button which is on the top right corner of the serial window of Arduino IDE.

2. Protractor

Calibration: To check the protractor one can use a known reference angle to compare the reading on the protractor with the actual angle. For example, one can use a 90-degree wall or a 180-degree angle ground.

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Test Environment

The testing environment for this subsystem is a part from the main map of the system. First five rows and columns of the map (tiles marked from A to E and 1 to 5) will be used to show that the mobile unit and base unit communicate until the 3 tile distance. A unit that contains an ESP32 microcontroller, a transmitter and a receiver which represents the **base unit** will be placed at the beginning of the map (tile A1), and another unit with an ESP32, a transmitter and a receiver that represents the **mobile unit** will move between A1 and A4. A computer screen will be used to track the communication.

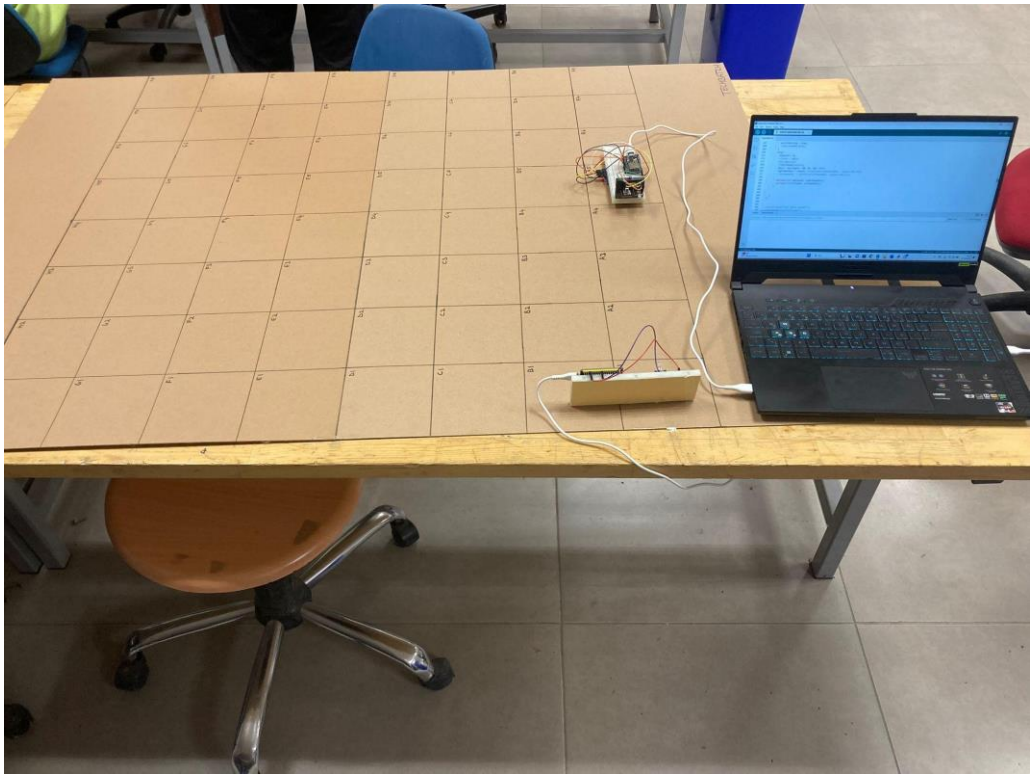

Figure 1: Test environment for IR communication.

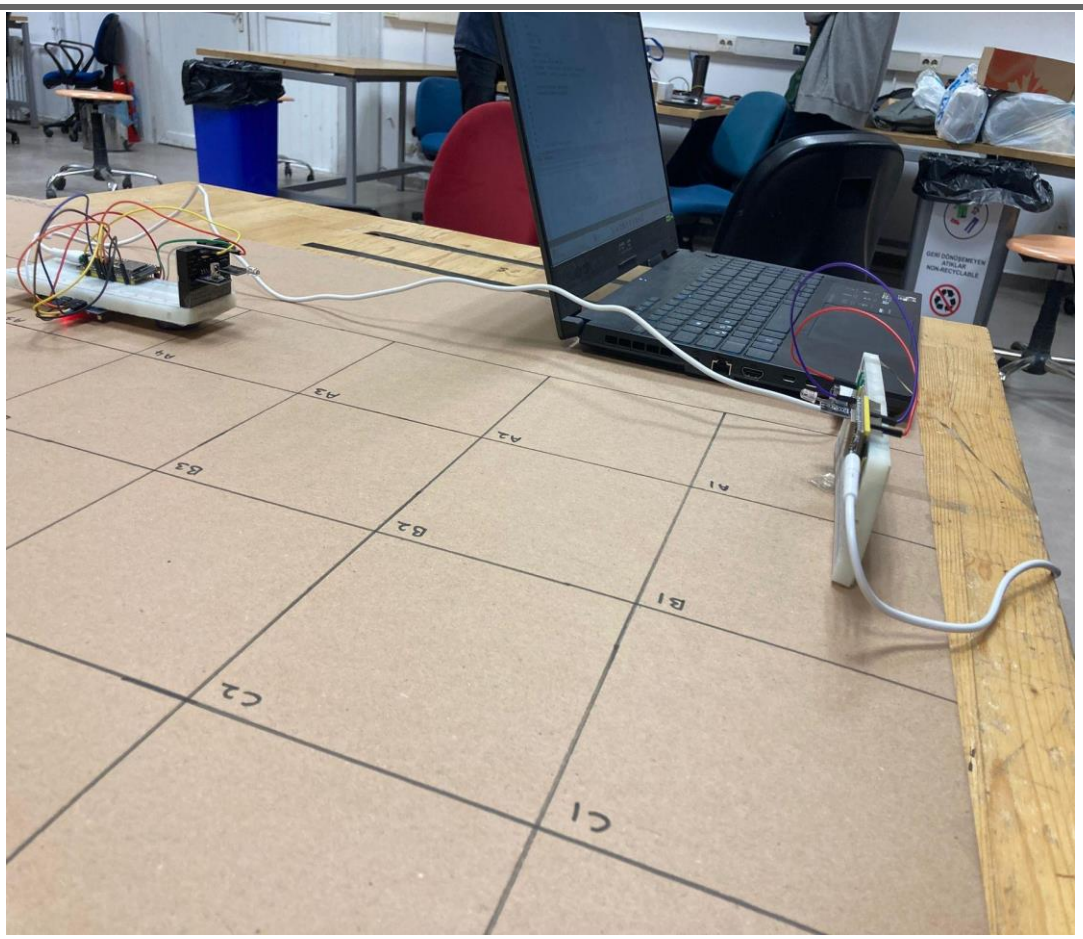

Figure 2: Test environment for IR communication.

Test Parameters

Parameter	Range	Step Size	Number of Measurements
Distance between emitter and transmitter	2-5 tiles	1 tile	4
Angle of the transmitter	0-180°	30°	7

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1. Test Procedure

1. **IR communication test for different distances between the mobile unit and base unit is planned. The procedure is as follows:**

    1. Units that represent base and mobile units are connected to two different computers through their ESP32 microcontrollers.
    2. The files named **"BU.ino" and "MU1.ino"** are opened and the programs in the files are loaded to the ESP32 microcontroller of the base and mobile units.
    3. The base unit is placed on the center of the A1 tile as seen in figure above.
    4. The mobile unit is placed on the tile A2.
    5. To check for communication, we will verify there is reliable communication between the base and mobile unit by printed messages on the serial monitor of Arduino IDE.
    6. **"Message is received from BU/MU: " ,"MU/BU sent the message: "** messages will be seen on the screen if the two side communication occurs, and if the communication cannot sustain received messages won't be seen.
    7. The mobile unit will stay in each tile for a while and the serial monitor will be tracked to record how many of the first 20 messages that are sent and received were delivered successfully or not.
    8. The same measurement will be performed on each tile.

2. **IR communication test for different angles between the emitter and transmitter is planned. The procedure is as follows:**

    1. Units that represent base and mobile units will be connected to two different computers through their ESP32 microcontrollers.
    2. The files named **"BU.ino" and "MU1.ino"** are opened and the programs in the files are loaded to the ESP32 microcontroller of the base and mobile units.
    3. The base unit is placed on the center of the A1 tile as seen in figure above.
    4. The mobile unit is placed on the tile A2.
    5. Mobile unit is rotated from 0 degree to 180 degree with a 30 degree step size .
    6. To check for communication, we will verify there is reliable communication between the base and mobile unit by printed messages on the serial monitor of Arduino IDE.
    7. **"Message is received from BU/MU: " ,"MU/BU sent the message: "** messages will be seen on the screen if the two side communication occurs, and if the communication cannot sustain received messages won't be seen.
    8. The mobile unit will stay in each step for a while and the serial monitor will be tracked to record how many of the first 10 messages that are sent and received were delivered successfully or not.
    9. If 8 of 10 messages are unsuccessful, communication is considered as failed.
    10. After the measurement, the process is repeated in the following tile until tile A4 for the angle ranges specified on the tables below.

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Test Data

Table 1: Distance (@ 0 degree)

Parameter Value	Actual Performance	Expected Performance	Error
1 tile	100%	>95% reliable communication	0%
2 tiles	100%	>90% reliable communication	0%
3 tiles	100%	>85% reliable communication	0%
4 tiles	100%	>80% reliable communication	0%
5 tiles	0%	<10% reliable communication	0%

Table 2: Angle (@ A2)

Parameter Value	Actual Performance	Expected Performance	Error
0	100%	>90% reliable communication	0%
30	100%	>90% reliable communication	0%
60	100%	>90% reliable communication	0%
90	100%	>90% reliable communication	0%
120	100%	>80% reliable communication	0%
150	100%	>80% reliable communication	0%
180	100%	>70% reliable communication	0%

Table 3: Angle (@ A3)

Parameter Value	Actual Performance	Expected Performance	Error
0	100%	>90% reliable communication	0%
30	100%	>90% reliable communication	0%
60	100%	>80% reliable communication	0%
90	100%	>70% reliable communication	0%
120	100%	<20% reliable communication	80%
150	100%	<20% reliable communication	80%
180	99%	<10% reliable communication	89%

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Table 4: Angle (@ A4)

Parameter Value	Actual Performance	Expected Performance	Error
0	100%	>90% reliable communication	0%
30	100%	>80% reliable communication	0%
60	100%	>70% reliable communication	0%
90	100%	<50% reliable communication	50%
120	100%	<30% reliable communication	70%
150	100%	<20% reliable communication	80%
180	10%	<10% reliable communication	0%

Data Analysis

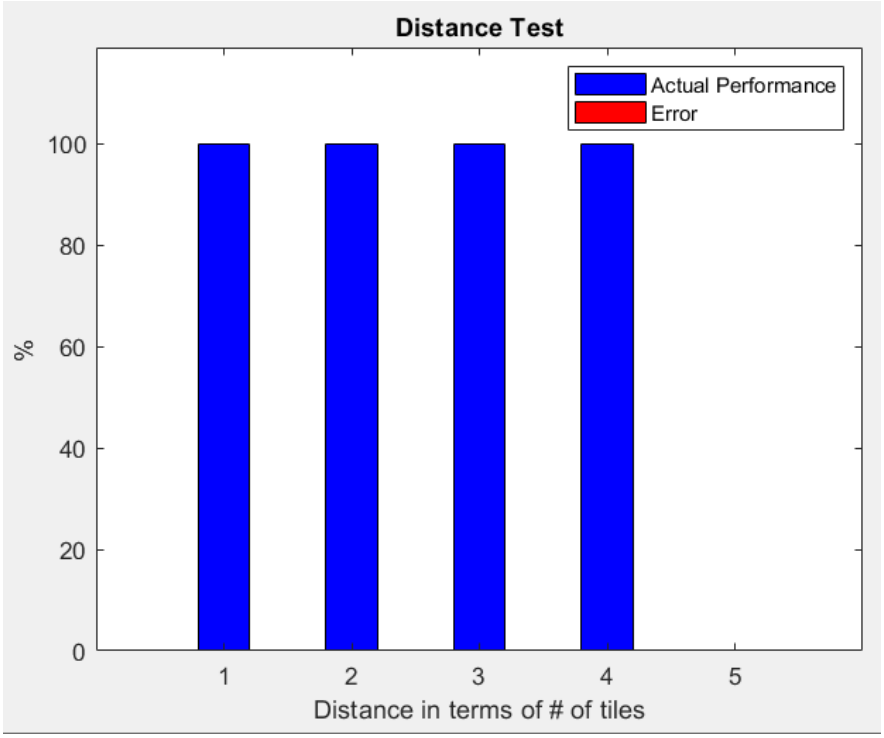

Figure 3: Distance Test Results

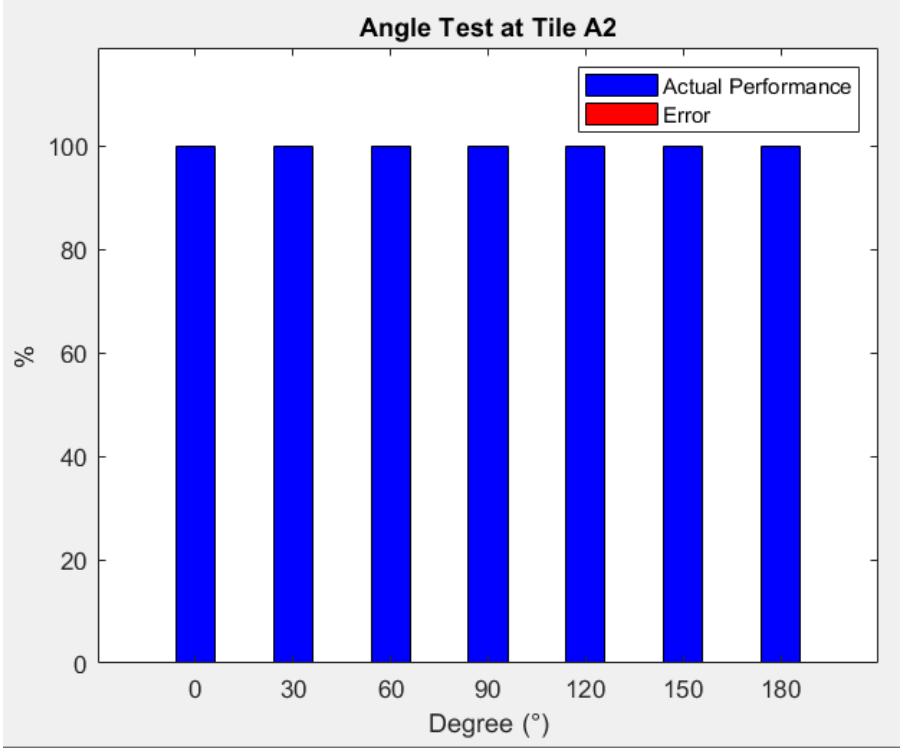

Figure 4: Angle Test Results at Tile A2

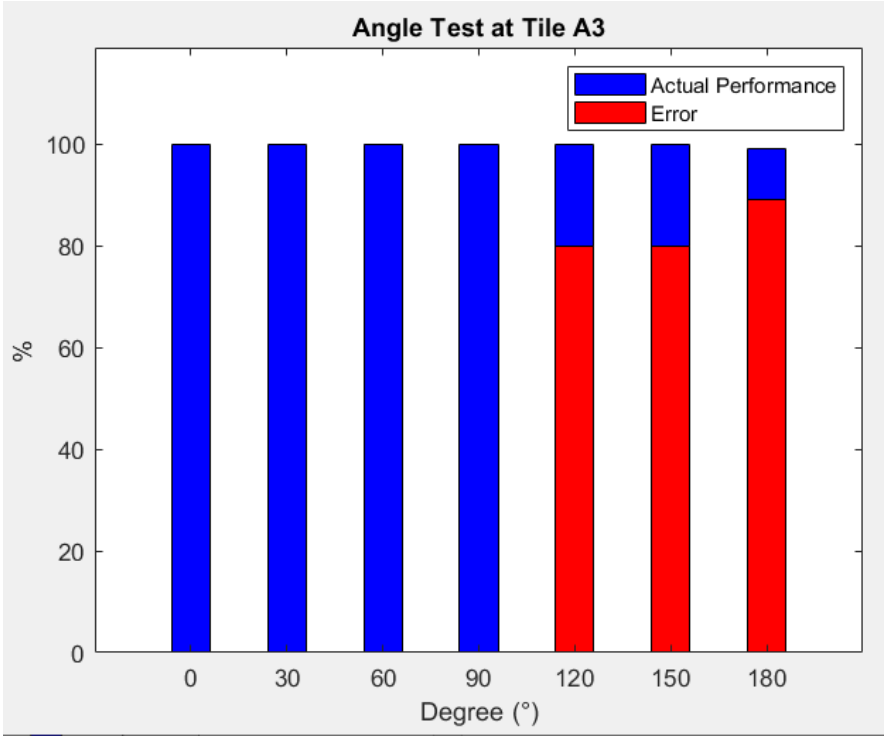

Figure 5: Angle Test Results at Tile A3

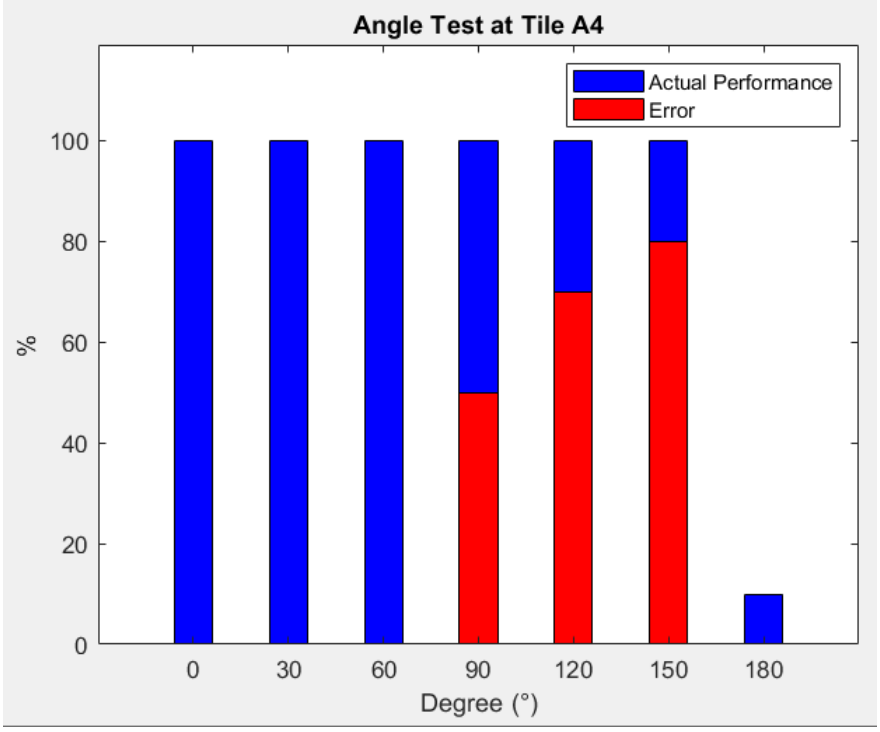

Figure 6: Angle Test Results at Tile A4

Results and Discussion

(To be filled after the test)

Distance Test

In the distance test, we successfully achieved the expected performance at each distance, as illustrated in the accompanying graph. This outcome affirms our accomplishment in establishing reliable communication between the base unit and mobile unit within the specified distances. Consequently, it ensures dependable communication at the prescribed range limit of the base unit.

Angle Test

During the angle test, discrepancies were observed in some angles, particularly at tiles A3 and A4. These errors can be attributed to an unexpectedly high communication performance at certain angles, surpassing our initial expectations. However, this anomaly does not pose a significant challenge. On the contrary, it presents an advantage by facilitating communication over a wide range of angles, notably up to 180 degrees in most cases. This promising result opens the possibility of employing a stationary base unit instead of one that requires rotation, simplifying the communication setup between the base unit and mobile units.