RAGNAROK RED

Aaron Helmore, Thulith Wilfred Mallawa, Samih El Shoghri, James Debeyser

ULTRA WIDE-BAND (UWB) AND BLUETOOTH AUGMENTED INDOOR LOCALIZATION NETWORK

Overview

This project involves developing a network of UWB/Bluetooth (DWM1001C) transceivers to track multiple people, across a few rooms in GP South. The aim is to minimize the number of nodes required to provide sufficient tracking of a moving target (tag).

This will be achieved by using a BLE mesh network containing advertising nodes, relays and a base station. The base station will receive the “flood” of information from the mesh network, process it and display it to an online dashboard (2D - map).

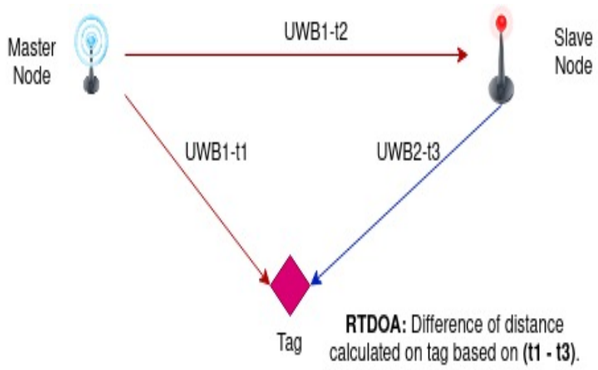
Key Performance Indicators

- Localisation accuracy: Use UWB to localise tags to a fine grain ranging accuracy of at least 0.8m.
- Minimizing static nodes: Use 6 nodes to accurately localize a tag.
- Persistent BLE Mesh provisioning: Once provisioned, the nodes remembers their association to the BLE mesh network.
- Scalability: The node network should be able to track multiple tags throughout the test area.
- Web-Dashboard: Location of tags able to be seen on web dashboard in close to real time.

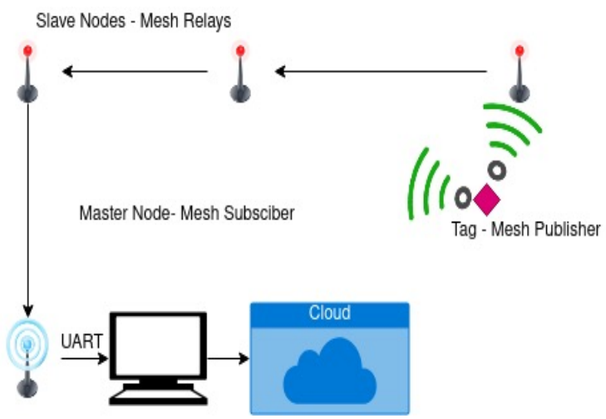
System Overview (Core Technologies)

- Localization using reverse time difference of arrival (RTDOA).
- Node synchronization using time division multiple access (TDMA) and clock calibration packet service (CCP).
- Ranging calculation used to locate tags
- Data relay using BLE mesh network.

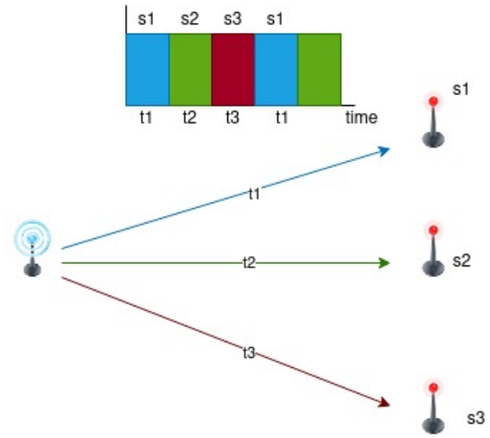
RTDOA Implementation



BLE Mesh Implementation

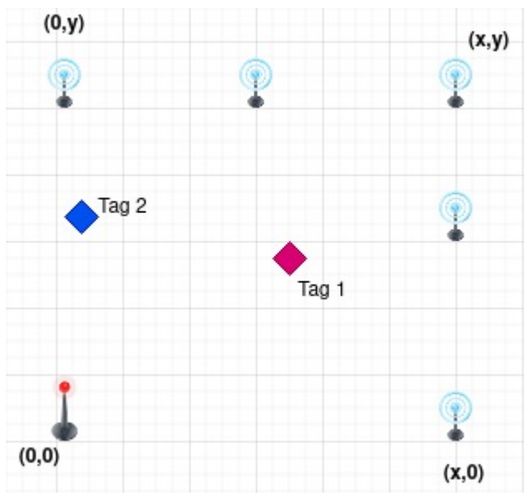


Node Synchronization Implementation



Master controls the radio activity on the slaves by using TDMA for slave radio to be active only in the time allocated (Avoids UWB broadcast overlap).

Operations Overview



Conclusion

Results Achieved

Localisation accuracy:

- **0.8-1m** of ranging accuracy

Static nodes required:

- Ranging can be done with a minimum of **3 nodes**.

Persistent BLE Mesh:

- Mesh only requires to be provisioned **once**.

PC Interface:

- Dynamically adaptable to custom grid sizes.

Tags Tracked:

- No theoretical max for the number of tags that can be tracked **(RTDOA)**.

Web Dashboard:

- Tag location updated on dashboard approximately every 600ms.

Limitations

BLE Mesh Bottleneck:

- The mesh has a cap on the amount of data that can be transferred without implementing segmented data messages. This limits the numbers of tags that can be active at once.

Scalability:

- The maximum grid size is limited by the masters UWB range (Required for TDMA).

Improvements

- **Time synchronisation** with BLE Mesh
- **Segmented data messages** BLE Mesh (Increase packet transfer)
- **Implement PC interface** to display tag location (in real time)