Documentation Part 2

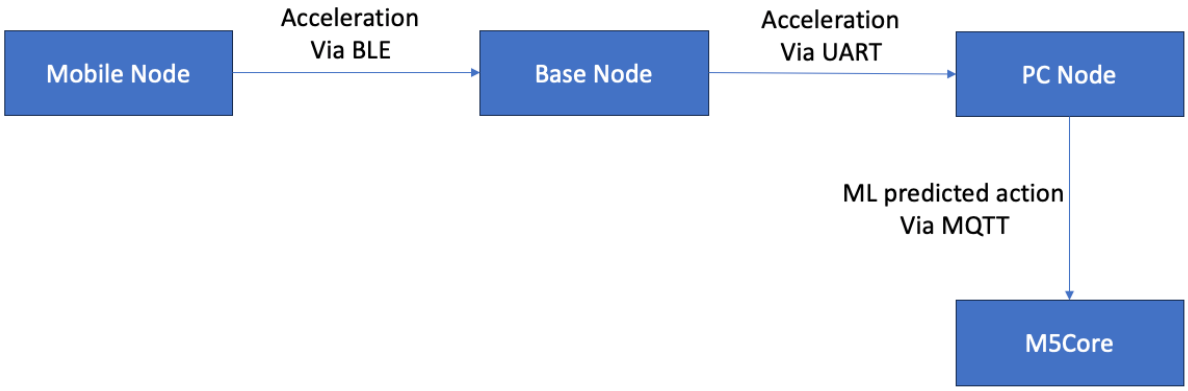
System Integration

This project uses the LIS2DH accelerometer on the Thingy:52. The accelerometer outputs three floats, one for each of the x, y and z axis. The mobile node (Thingy:52) can transmit the sensor data over BLE at 40Hz, providing a good data resolution. The base node (NRF52840) receives the BLE information, converts it to JSON format and sends to the PC via UART.

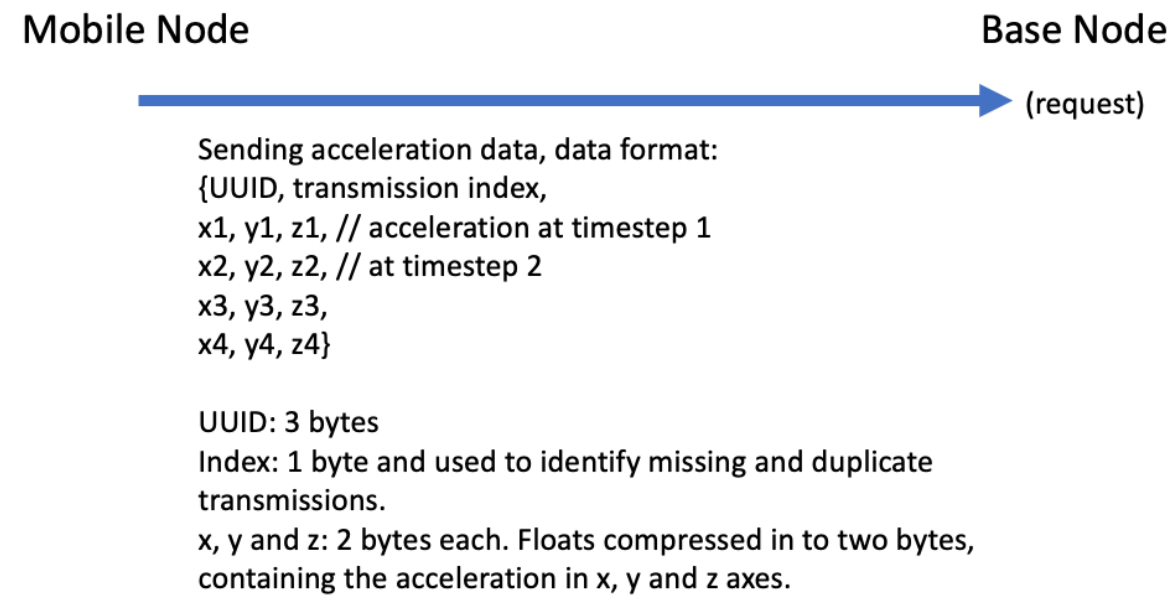
After arriving at the PC, the acceleration data is passed into a machine learning model to predict/classify the user's activity/action. This machine learning model is a significant data processing procedure that processes acceleration data and turn it into desired information, thus integrating the sensor data into a usable product.

Wireless Network Communications

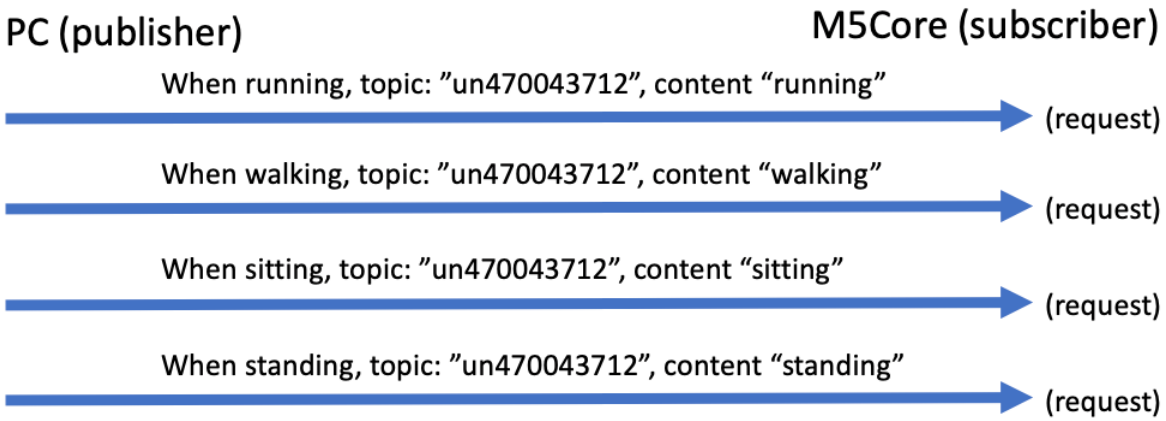
The diagram below shows how the information is transferred through the network.



The diagram below shows the message protocol between the mobile and base node. The information is passed via BLE advertisements.



The diagram below shows the message protocol between the PC and M5Core:



Key Performance Indicator

Test accuracy measures the performance of the machine learning model on unseen data. The fact of being unseen ensures that the accuracy values is reflective of real-life applications and performance. The accuracy is measured in percentages:

KPI ranking	Test accuracy
Excellent	>90%
Good	80-90%
Satisfactory	70-80%
Poor	60-70%
Terrible	<60%

Latency measures the delay between the user performing the action and the system displaying the action. This can be affected by the data transmission time, delays in the machine learning inference and GUI refresh rate. Latency can be measured in seconds.

KPI ranking	Delay (sec)
Excellent	<1
Good	1-3
Satisfactory	3-5
Poor	5-10
Terrible	>10

Number of parameters in the ML model measures the complexity and how resource-intensity the model is. Having many parameters requires more training data and resource, and thus harder to train.

KPI ranking	Number of parameters
Excellent	<5,000
Good	5,000-10,000
Satisfactory	10,000-50,000
Poor	50,000-100,000
Terrible	>100,000

Software functionality measures how complete the web dashboard/GUI's functionality and how easy it is to use.

KPI ranking	Extent of software functionality
Excellent	All functionalities are implemented. The GUI is intuitive and easy to use. The GUI provides additional relevant features/displayed information for use and debugging.
Good	All functionalities implemented. The GUI is intuitive and easy to use.
Satisfactory	All basic functionalities are implemented.
Poor	Some of functionalities are missing, impeding use.
Terrible	The GUI/software is missing.

Software reliability measures how long the software can operate on average before crashing or freezing.

KPI ranking	Software reliability
Excellent	It always works without crashes/freezes.
Good	It never crashes, but it may freeze briefly after 30 minutes of use and recovers by itself.

Satisfactory	Crashes or requires user intervention after 30 minutes of use.
Poor	Crashes/freezes between 10 to 30 minutes of use.
Terrible	Crashes/freezes within 10 minutes of use.