**Testing PV-Alert in Real Environment**

Summary of tasks that has to be done as part of real environment testing are *application development*, *conducting testing and data collection* and *discussion of results*

**Application Development**

* Two sets of application are supposed to be developed; client-Server collision prediction application that runs on smartphones and on fog server and application for GPS accuracy improvement application that runs on mobile devices.
* The architecture of each application needs to be documented diagrammatically and verbally.
* Brief description of tools ( programming language, programming environment, operating system)used needs to be included

**Conducting Testing and data collection**

* In order to conduct testing we have to choose a road scenario for communication testing and an open area for GPS accuracy data. The latter is already done.
* Data collection for GPS is also already done
* For testing communication delay and PDR, I suggest ISAT parking area in front of our offices, since we have wireless coverage.
* The scenarios detected needs to be documented including justifications

**Results of testing**

The outputs of the tests can be categorized into 3

1. GPS accuracy
2. Communication efficiency
3. Accuracy of the algorithm
4. **GPS accuracy**

* GPS data can be collected using the following format

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Point 1** | | **Point 2** | | **….** | | **Point n** | |
| **Lat** | **Long** | **Lat** | **Long** | **….** | **…** | **Lat** | **Long** |
| **GTK GPS** |  |  |  |  |  |  |  |  |
| **Smartphone GPS** |  |  |  |  |  |  |  |  |
| **Corrected GPS** |  |  |  |  |  |  |  |  |

* From this data we can produce the following graphs
* Longitudinal measurement vs. points for the **three GPS measures** in the graph
  + i.e. A graph with x-axis p1, p2, …, pn and y-axis longitudinal measurement
* Latitudinal measurement vs. points for the **three GPS measures** in the graph
  + i.e. A graph with x-axis p1, p2, …, pn and y-axis latitudinal measurement
* Histogram of GPS error in **longitudinal** and **lateral** position, and in **distance [Refer PD1]**
* Justification for all graphs with supporting literatures is required

1. **Communication efficiency**

* **Warning Reception Delay** – delay from the time data is sent to warning is received
  + - The following type of table may help to collect data for the graph

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Distance** | **Delay** | | | |
| **Pedestrian** | | **Vehicle** | |
| **Wi-Fi** | **LTE[[1]](#footnote-2)** | **Wi-Fi** | **LTE** |
| 5 |  |  |  |  |
| 20 |  |  |  |  |
| 40 |  |  |  |  |
| 60 |  |  |  |  |
| 80 |  |  |  |  |
| 100 |  |  |  |  |
| 120 |  |  |  |  |
| 140 |  |  |  |  |
| 160 |  |  |  |  |
| 180 |  |  |  |  |
| 200 |  |  |  |  |
| 1000km |  |  |  |  |

* + - Delay should include time taken to run GPS accuracy algorithm, collision prediction algorithm, propagation delay, etc
    - **Graph** - Average Delay vs. Distance [for a Pedestrian and a Vehicle – our **notion** is delay is affected by speed and distance] - To be done for WiFi and Cellular (LTE) connections i.e.
  + Wi-Fi 🡺 Delay vs distance i.e. x-access distances and y-axis is delay for both pedestrian and vehicle in one graph
  + LTE 🡺 Delay vs distance i.e. x-access distances and y-axis is delay for both pedestrian and vehicle in one graph
* **Packet Delivery Ratio** (PDR)– how much of the packets sent to fog nodes have arrived to their destination
  + - The following type of table may be used to collect data for the graph

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Distance** | **Delay** | | | |
| **Pedestrian** | | **Vehicle** | |
| **Wi-Fi** | **LTE** | **Wi-Fi** | **LTE** |
| 5 |  |  |  |  |
| 20 |  |  |  |  |
| 40 |  |  |  |  |
| 60 |  |  |  |  |
| 80 |  |  |  |  |
| 100 |  |  |  |  |
| 120 |  |  |  |  |
| 140 |  |  |  |  |
| 160 |  |  |  |  |
| 180 |  |  |  |  |
| 200 |  |  |  |  |
| 1000km |  |  |  |  |

* + - **Graph** – PDR (Percentage) vs Distance [in case of Pedestrian and Vehicle - our **notion** is PDR is affected by speed and distance] - To be done for WiFi and Cellular connection i.e.
      * Wi-Fi 🡺 PDR (%) vs Distance i.e. x-access distances and y-axis is PDR (%) (0 to 100) for both pedestrian and vehicle in one graph
      * LTE 🡺 PDR (%) vs Distance i.e. x-access distances and y-axis is PDR (%) (0 to 100) for both pedestrian and vehicle in one graph

1. **Accuracy of the algorithm**

Accuracy of the collision prediction algorithm is measured based on how many collision risk warnings are correctly given to a driver and a pedestrian. For this purpose it will be formulated in terms of precision and recall. True positive (TP), false positive (FP), true negative (TN) and false negative (FN) will enable us to calculate precision and recall.

* **Precision = TP/ (TP +FP)**
* **Recall = TP/ (TP +FN**

Therefore, percentage of precision and recall will be used to tell how much accurate the algorithm is

1. For LTE the effect of delay may not be noticeable at short distance, but for completeness purpose we will include it [↑](#footnote-ref-2)