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# Project Planning and Organisation

This project took place over several months which meant that if time was not managed carefully important tasks may have been left incomplete. From this need a project plan was developed.

# Research

Before any development work could begin several key questions had to be answered about how the project should proceed: Would the application provide static or dynamic routing to the user? How would the Application be developed? How would the shortest path be found?

## Static or Dynamic Routing

To determine whether the application should provide static or dynamic routing it is first important to understand what both involve.

### Static Routing

For the purposes of this report Static Routing will be defined as routing between two fixed points with the whole route available for the user to view. A popular example of this is google maps which can be seen in Figure 1 Static Routing Example.

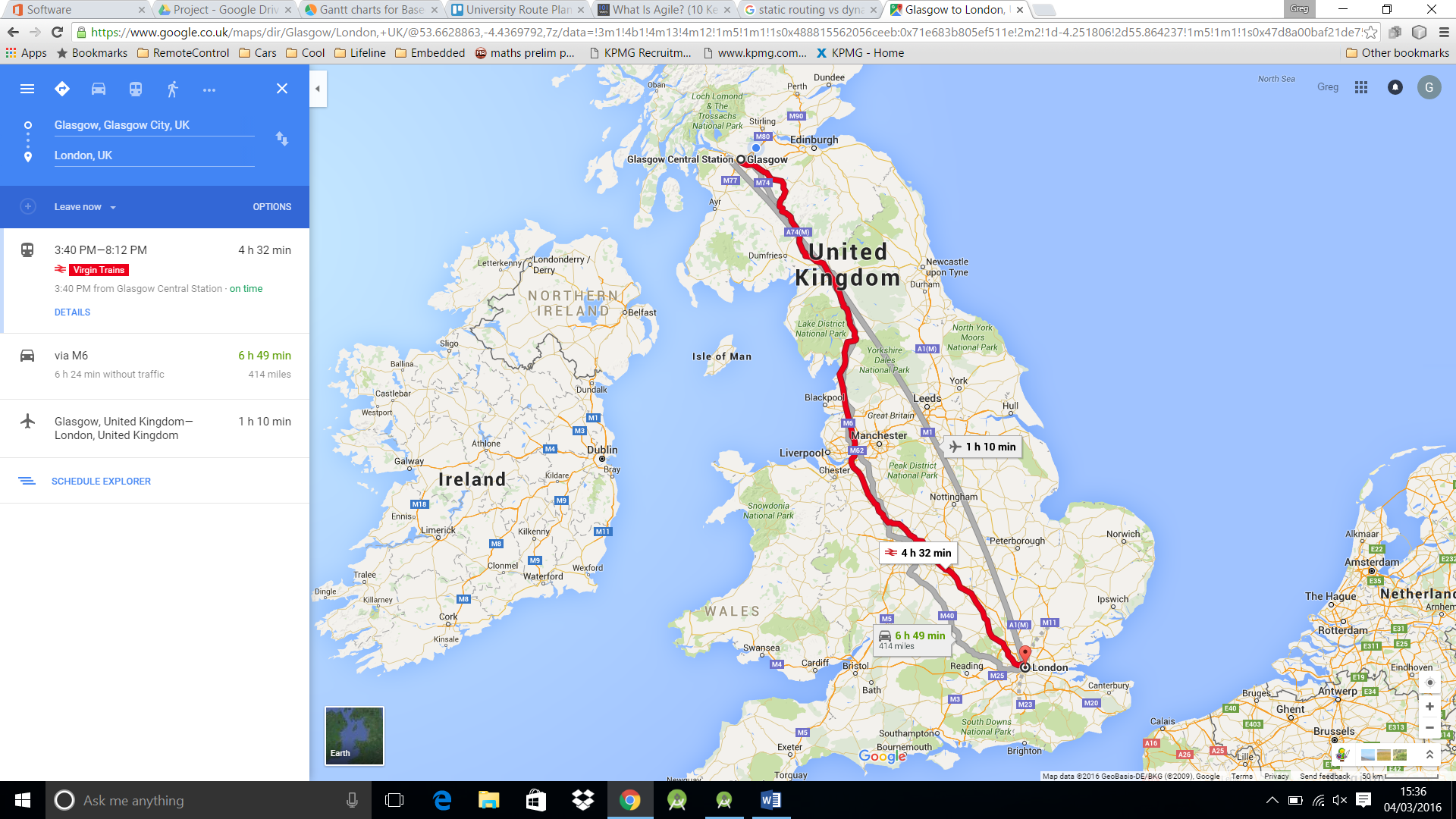


Figure 1 Static Routing Example [1]

### Dynamic Routing

By comparison Dynamic Routing will be defined as routing from the user’s changing location to a fixed endpoint. This means as the user moves the route will automatically adjust to their new location. This is the type of routing used in Satellite Navigation systems or Google Navigation which can be viewed below in

TODO

It is also common for the display to be more restricted showing only a short section of the route at a time i.e. where the user is to go next.

## Location Services

The main difference between the two types of routing is whether or not they the user’s location is utilised to improve the user interface or not. In order to decide between them then it is important to determine whether this is possible.

There are three main technologies which could be used to determine the user location: Global Positioning Service, Cellular Positioning and Wi-Fi.

### Global Navigation Satellite System (GNSS)

There are several of these systems currently in operation. The most famous of these being the U.S. funded Global Positioning Service (GPS) however there are others such as the Russian Federation’s GLONASS and soon the European Galileo [2]. These were devised as systems to enable users worldwide to calculate their current location. The GPS system for example comprises of twenty-four satellites continuously producing signals that tell a user where a satellite is and highly accurate timing information about when this signal was produced. All twenty-four satellites communicate on the same two frequencies using Code Division Multiple Access in order to avoid collisions. By listening to the signals generated by at least four of the satellites to discover their locations and calculating the time it has taken to reach the user and hence how far away they are from each the users own location can be calculated. [3]

The accuracy of GPS is roughly 3.5m on the horizontal plane without using additional information. There are other systems which can be used in conjunction with GPS to provide up to millimetre accuracy however 3.5m should be accurate enough for this project [4]. The accuracy of Galileo is expected to improve to the centimetre range [5] once it is completed in 2020 [6].

There are two main limiting factors however: the accuracy of the GPS receiver in the user’s phone and that much of the time the user will be indoors. The accuracy of the receiver in a typical mobile phone is roughly 2-3m under good multipath conditions or up to 10m under bad multipath conditions [7]. Multipath is when the signal may reach the receiver via many paths for example direct from the satellite compared to being reflected by a building in between the satellite and receiver. This means that the signal will degrade when near buildings due to the weak multipath suppression available on mobile phone antennae. The app will always be expected to be running in an urban landscape therefore meaning the GNSS location may have quite a low accuracy. Receiving GNSS signals indoors can become a challenge as the signal when received outdoors is already very weak when compared with the background noise and the signal can be 10-100000 times weaker when indoors [8]. This can make it difficult to receive the necessary signals from four satellites at once making it near impossible to reliably and quickly determine location indoors via this method.

### Cell Tower Based Location

### Wifi Based Location

### Current Android Solution

### Dynamic Routing Field Test

### Improved Suggestion

## Application type

## Routing

### Routing Information

### Path Finding

# Design

## Initial Design

## Final Design

## Reason for changes

## Software patterns

# References

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