

# Dynamic Routing of Vehicles Using Existing Networks of Consumer Devices

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## Overview

It is proposed to create a system to collect positional data from consumer communication devices as they move along roadways. This positional data will be collected and analyzed to provide information about the traffic patterns on segments of roadways. This traffic information will then be provided to navigation devices, allowing them to dynamically calculate routes based on the quality of roadways.

## Project Description

This dynamic vehicle routing system will use various consumer-grade networked devices to provide data about roadways. This data will be analyzed to determine the traffic amount and velocity along segments of roads. The traffic data is used to generate a cost factor for each road segment. For example, instead of calculating the cost of a road segment statically, based only on distance and the maximum or average speed along that segment, the number and current speed of vehicles can be considered as well. This cost factor would change with the road traffic, so that road segments with higher traffic and lower speeds would have a higher cost. The cost of road segments would then be distributed to any interested navigation devices. These devices would be updates to the current GPS based location devices, allowing the street information to be constantly updated to reflect current conditions. These devices would then direct drivers to use the best route at the current time, which would help to reduce congestion on busy roads.

## Research Plan

This system would require research in the following areas, dealing with the positional data generated by user devices:

**Collection:** How will the system know the location of vehicles? Particularly in the initial stages of an actual deployment of the system, it is important that this information be obtained from common, consumer-grade devices. For example, GPS equipped cell phones would simply report their current position periodically, using existing data communication methods. For devices that do not provide GPS support, the location of the device may be calculated by analyzing its transmissions at various cell towers. However, these mechanisms may not scale well if every phone near a roadway is providing its information. New, specialized devices may be required. For example, it may be better to incorporate the location reporting mechanism to the vehicle itself.

**Processing:** Once this raw position data is received by the system, it must be processed. A major issue is determining which signals represent vehicles. How can the system

distinguish between 30 single passenger cars in one road segment, and a passenger bus with 30 riders with cell phones? If vehicles begin to incorporate GPS and cell equipment, this problem will become somewhat less of an issue. Also, how will the system accurately associate devices with roadways, when pairs of roads are located nearby. Privacy concerns must also be addressed. Position information should remain anonymous, and some of the data may not be acceptable to be sent without any form of encryption.

**Interpretation:** Once information about usage of roadway segments is available, how can this information be interpreted? When is a road “full”? When is a road considered “too slow”? How can the system determine when a roadway with less traffic will be better than a road with higher traffic?

**Distribution:** Once an analysis has been made, how can this information be shared with interested devices? Is this a choice between broadcasting road data, and providing road data based only on client requests? What is the best combination? For example, broadcasting to every device the message that a small residential street has minimal traffic would be wasteful of bandwidth. However, problems are likely to occur if the system must answer hundreds of thousands of requests about the state of the major routes in a larger city.

## Benefits

This dynamic traffic routing system will benefit the general public in many areas. Firstly, the system will improve transportation efficiency, by keeping more vehicles advancing towards their destination at higher rates. This would intern have an effect on energy consumption, as vehicles would not waste energy while waiting in traffic. Finally, the system would improve public safety, primarily by allowing emergency vehicles to more quickly reach their destination. In addition, as users begin to avoid highly congested roads, the safety of those roads would improve.

## Equipment

Research on this problem will require the use of computer systems capable of performing simulation and analysis of the behavior of this system.

To investigate an implementation of such a system, cell phone network hardware would be needed to collect the phone’s position information, and then relay this information to the computer system used to process the data. The computing facilities required are unknown at this time, but would be determined based on the simulation results.