

FreeSim_Mobile: A Novel Approach to Real-Time Traffic Gathering using the Apple iPhone™

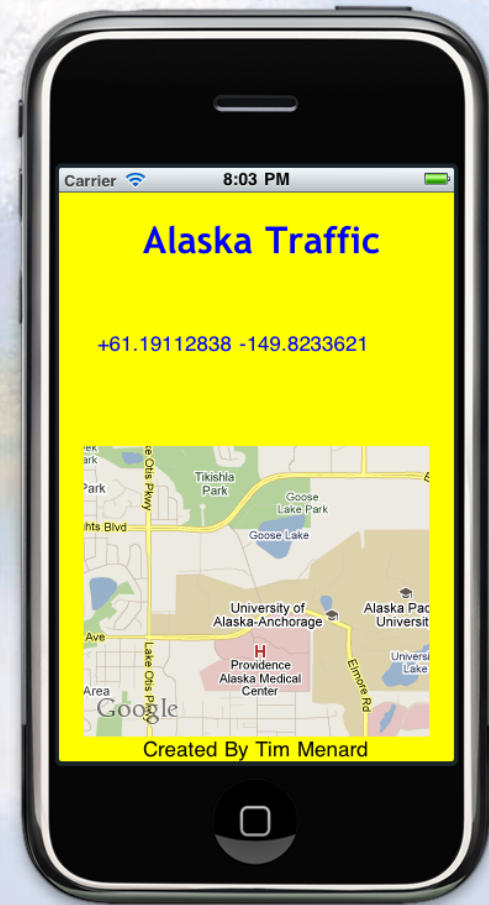


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What is FreeSim_Mobile?

- A real-time tracking application for the iPhone™
- It sends the user's current location to a central server where **FreeSim** determines the user's vehicle speed
- **FreeSim** is a traffic simulator that allows real-time data from a distributed set of vehicles as input.
- **FreeSim Mobile** was developed and tested on a iPhone 3G™



Outline

- I. Statement of Problem
- II. Overview of the iPhone™ Capabilities
- III. Overview of the Proportional Model Algorithm
- IV. A Case Study
- V. Conclusions

Problem

- Current research at UAA is studying real-time traffic dynamics, such as real-time traffic mapping
- Limitations of this system are
 - High cost of tracking devices
 - Monthly service fees
- Fiscally infeasible on limited funding

Loading the Alaska Traffic Service...



The Smart Phone Solution

- There is a rise in GPS and web capable smart phones in the marketplace that make the application a reasonable alternative
- Most of the costs are absorbed on the user's end.
- Most smart phone allow access to the phones GPS through writing a simple application

Related Work

- Smart Phone research is a rapidly growing field
- Universities studying the potential of cellular phones
 - UC Berkeley's Mobile Millennium project, in collaboration with Nokia
 - Florida International University
- Commercial real-time traffic gathering
 - TomTom
- Other cellular phone applications
 - Waze
 - BuddyWay

Why the iPhone?

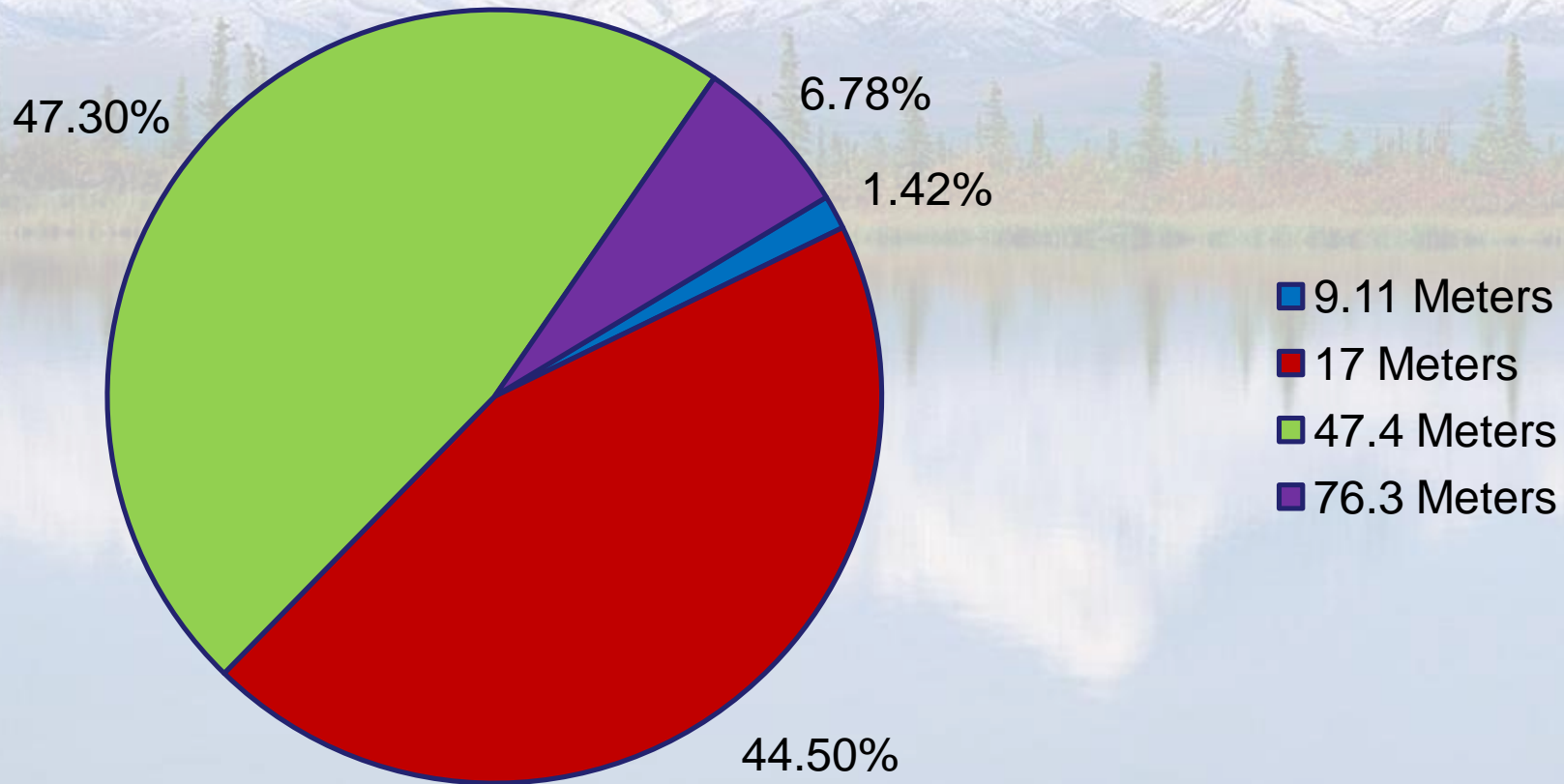
- The iPhone™ makes up 25% of the smart phone market place in the United States
- AT&T is the largest cellular provider in Alaska.
- They are easy to work with and user friendly.

How location is determined

- The iPhone™ location identification uses three different means for determining location.
 - First, GPS is used to triangulate the position with a high level of accuracy.
 - Second, through WiFi positioning, which is rarely used while driving.
 - Finally, cell tower positioning, which is the least accurate of the three approaches.
- While driving GPS is the primary means of determination

Location Accuracy

CONFIDENCE RADII OF THE IPHONE™ POSITIONING



The Proportional Model Algorithm

- Determines a section of roadway's speed by a proportional calculation based off
 - Location
 - Time reported
 - Distance

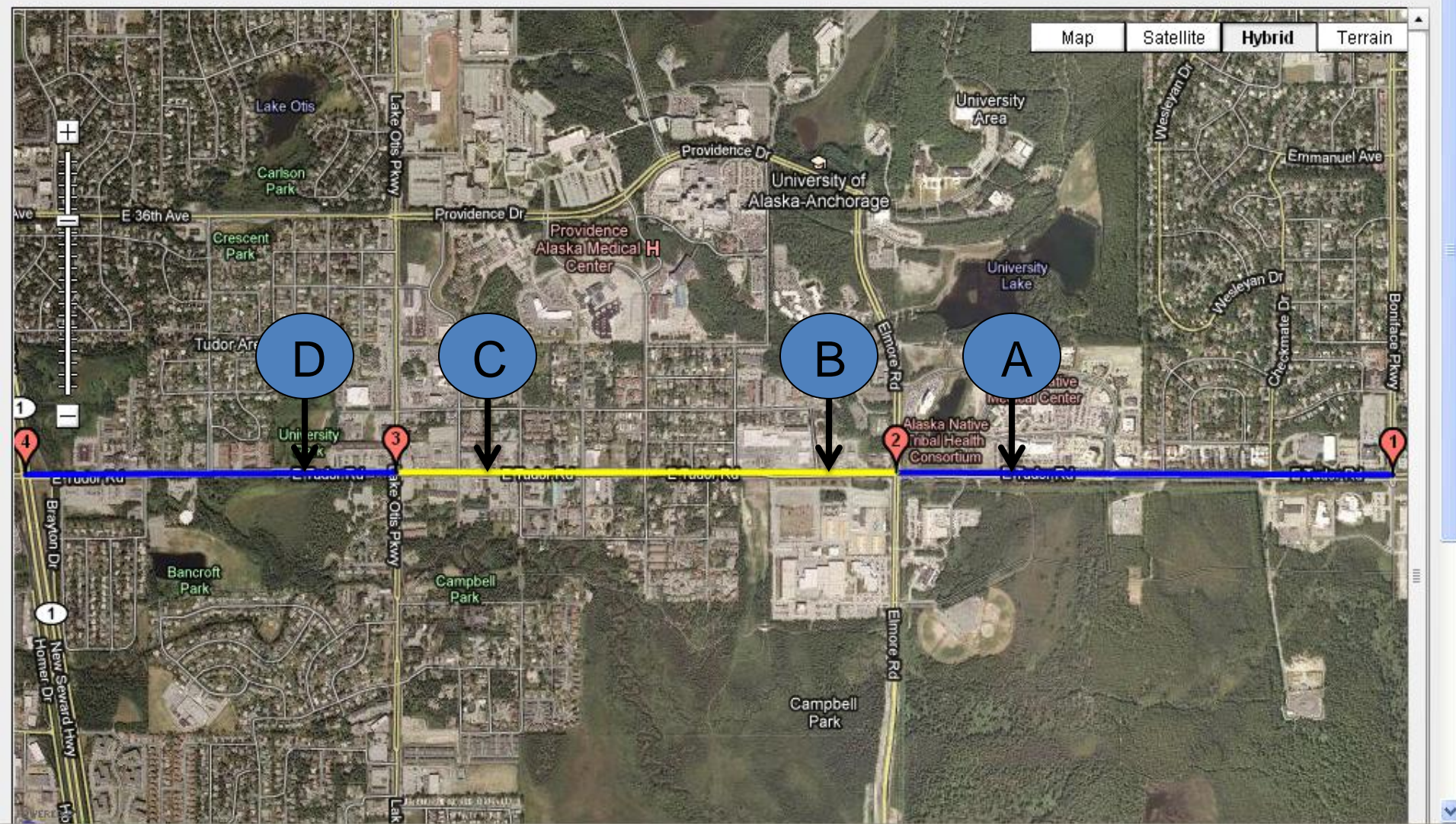
The Proportional Model Algorithm

- The probability of the data being transmitted at the start and end of a section of roadway is highly unlikely
- The proportional model determines the amount of time to traverse a section of roadway based on the inside point locations as well as the entering and exiting point.

Algorithm Walk-Through

1. $TTT(M, N)$ is the time to traverse the edge between node M to node N
2. The distance between any two locations X and Y can be found by $D(X, Y)$
3. The time at which a vehicle transmits the data at location X is t_x

FreeSim - VNC2010 Study Results

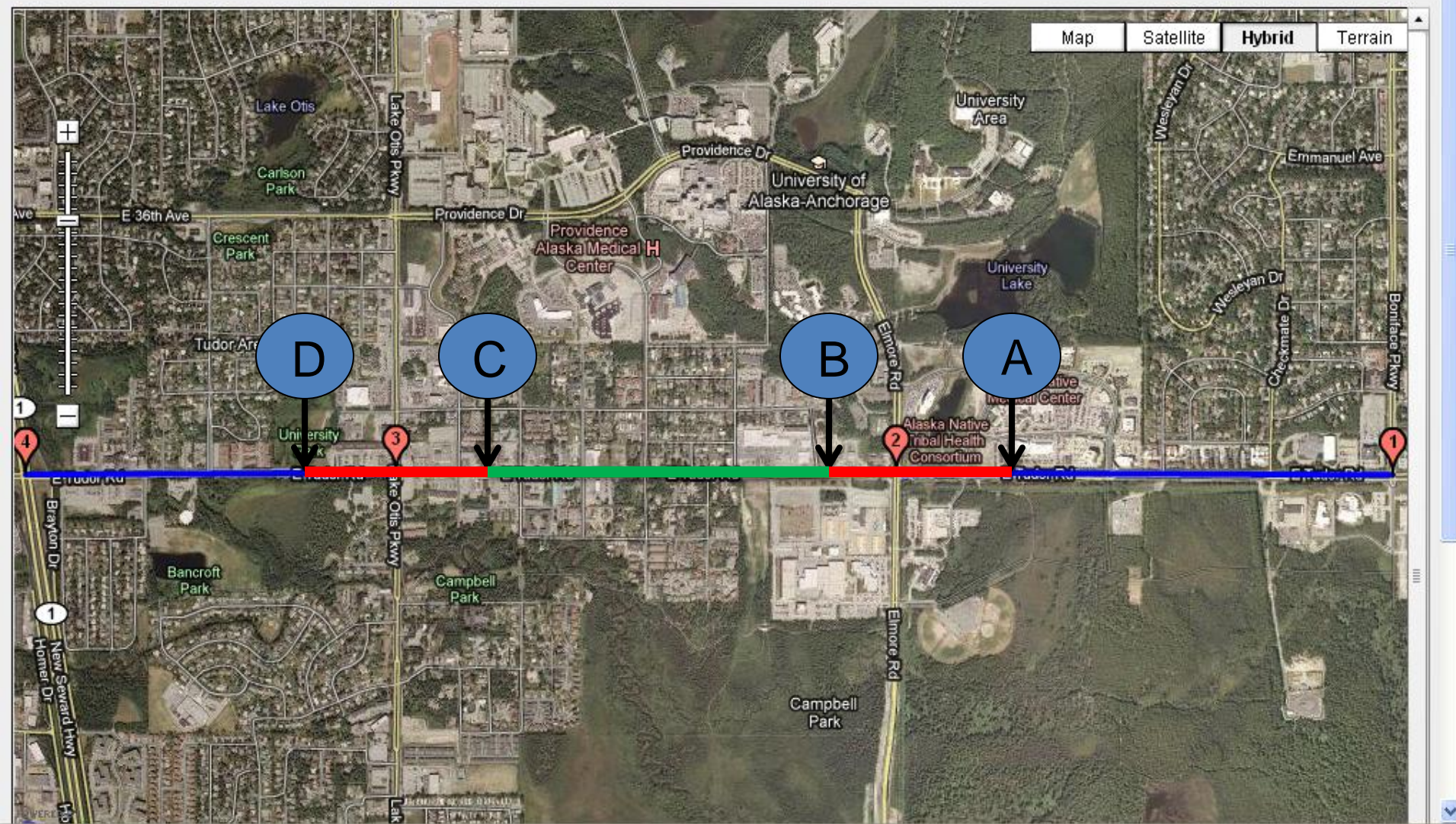


Proportional Model Formula

- The proportional model uses the following formula to calculate the weight of the edge

$$\begin{aligned} \text{TTT}(2,3) &= \text{TTT}(2,B) + \text{TTT}(B,C) + \text{TTT}(C,3) \\ &= (t_B - t_A) \frac{D(2, B)}{D(A, B)} + (t_C - t_B) + (t_D - t_C) \frac{D(C,3)}{D(C, D)} \end{aligned}$$

FreeSim - VNC2010 Study Results



Case Study

- A study was conducted on a 0.99 mile/1.59 kilometer section of roadway in Anchorage, Alaska
- The road is usually congested throughout the day
- Test vehicles equipped with a stopwatch, a vehicle tracking device, and an iPhone™ had drove the roadway at different times of day.

Variables

- The vehicle tracking devices report their position every 10 seconds.
- The iPhone™ reports its position every 8 seconds.
- Ten drivers drove the section of roadway during different times of the day.

Analysis

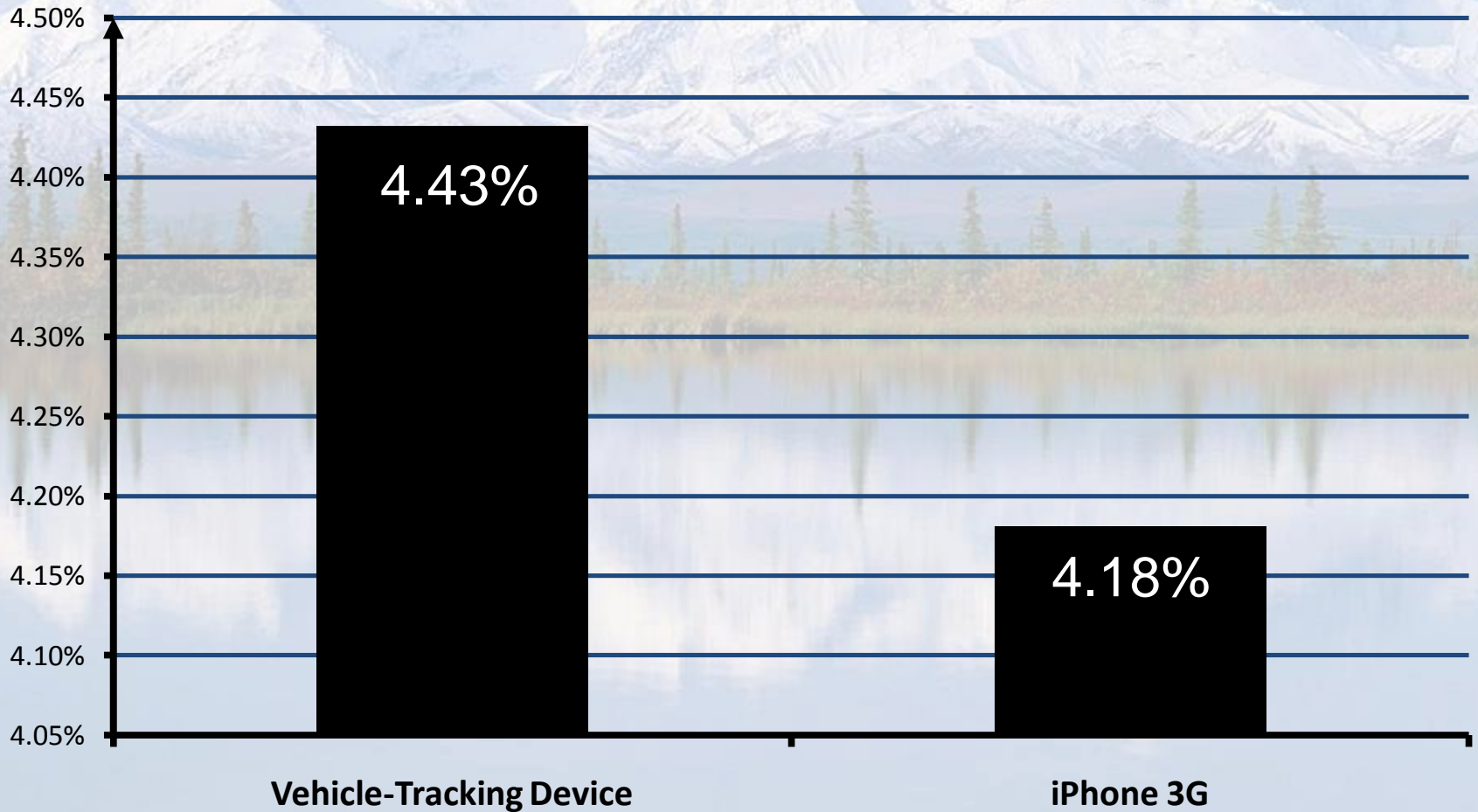
- The middle edge was determined by manual timing as well as calculating the vehicle tracking device and iPhone™ data.
- Utilizing the proportional model algorithm, we were able to compute the average percentage difference between the ten test runs by comparing the actual time to traverse versus the calculated times.

Results of Case Study

- The percentage difference from the calculated vehicle tracking device was 4.43% from the actual TTT
- The iPhone™ was 4.18% from the actual TTT
- All ten executions can be seen online at <http://www.alaskatraffic.net/freesim-vnc2010.html>

Comparison Results

% Difference From Actual TTT To Calculated TTT



Conclusions

- From the case study we have shown that the iPhone™ is as accurate as a tracking device installed in vehicles
- Since iPhone™ penetration in Alaska is so high, we have the potential to hit a much bigger market.
- The iPhone™ is only able to obtain location as opposed to tracking devices that are able to obtain additional data.



Questions

