Traffic Wizard

Team Blue

CS410 - December 16, 2011

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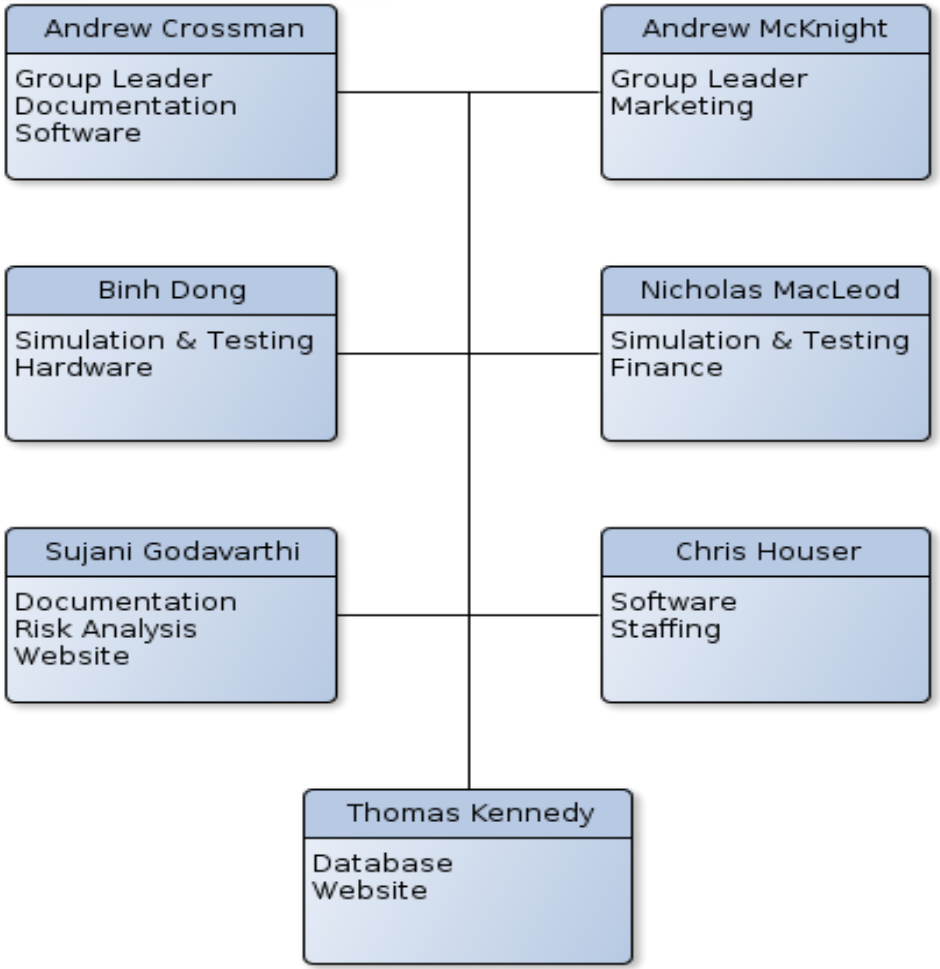
Team Blue Staff



Domain Experts

Michele Weigle, Ph.D.

Research:

- Vehicular Networks
- Network Simulation
- Internet Congestion Control

Tamer Nadeem, Ph.D.

Research:

- Vehicular Networks
- Mobile Computing
- Location Determination Systems

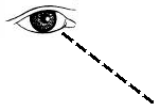
Societal Problem

A driver's limited awareness of adverse traffic conditions increases his/her potential to get caught in heavy traffic congestion.

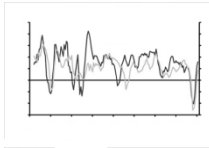
Heavy Congestion Factors

Heavy Traffic Avoidance

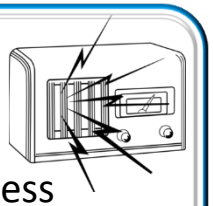
Visual Cues
- Time of day
- Weather
- Geography/Obstacles
- Reaction time



Experience/Patterning
- Available time



Media
- Coverage
- Latency
- Availability/Access
- Reliability



GPS
- Connectivity
- Error prone
- Access

Word of Mouth
- Availability
- Reliability

Traffic Cameras
- Coverage
- Outage
- Timely access

Mobile Apps
- Distraction
- Reliability of sources
- Availability/access

Traffic Wizard Solution

Goal

Go beyond current techniques and information media to give the driver knowledge of the current conditions so he can choose the best route.

Objectives

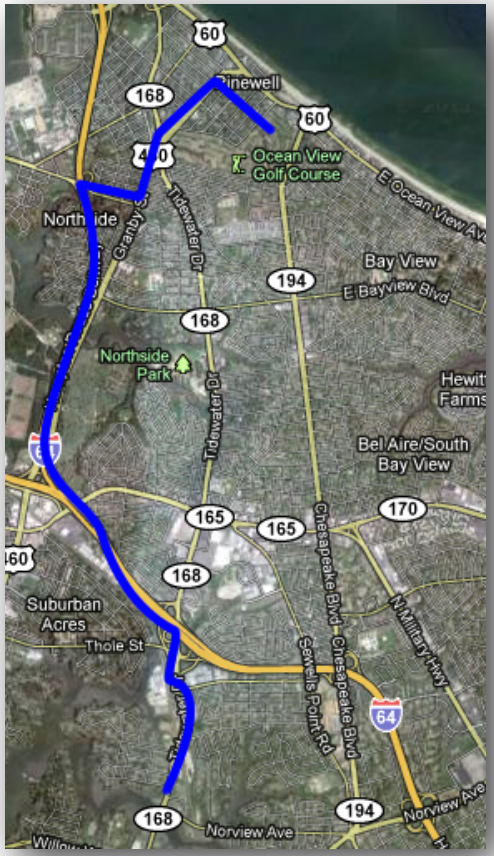
- Personalized smartphone application for traffic updates
- User profile system for storing frequent routes
- Analysis of stored routes before or during travel time
- Accurate traffic information based on custom routes
- Virtual checkpoint system for efficient data exchange

Virtual Checkpoints

What are virtual checkpoints?

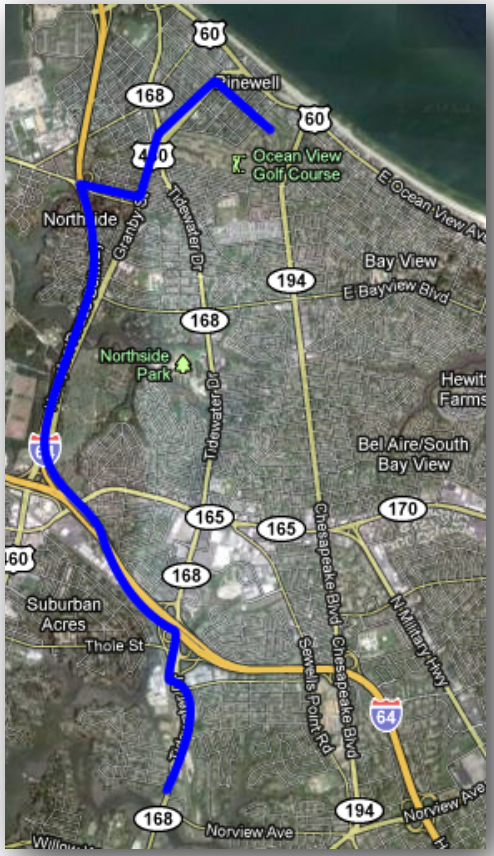
- GPS locations of specific points along roadways
- Identifies road segments by amount of traffic congestion
- Can be dynamically re-allocated as roads and traffic patterns change

Without Traffic Wizard

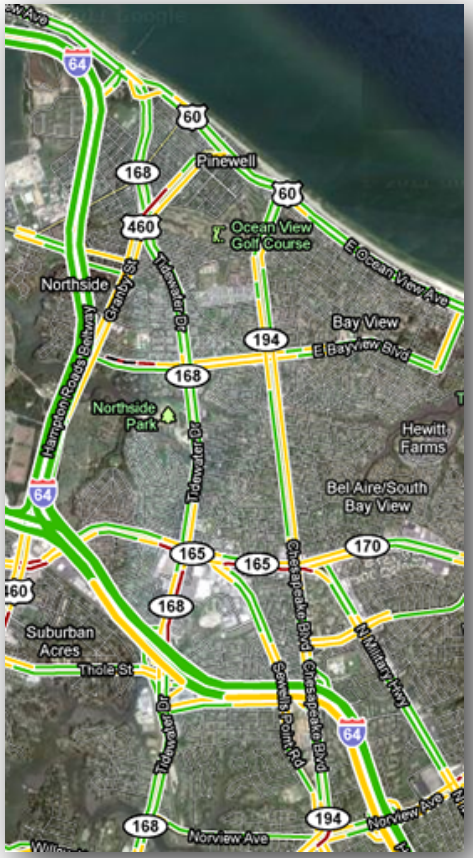


- Typical route taken
- Driver knows highways have highest speed limits and no stoplights

Without Traffic Wizard



Typical Route



"Current Traffic Conditions"

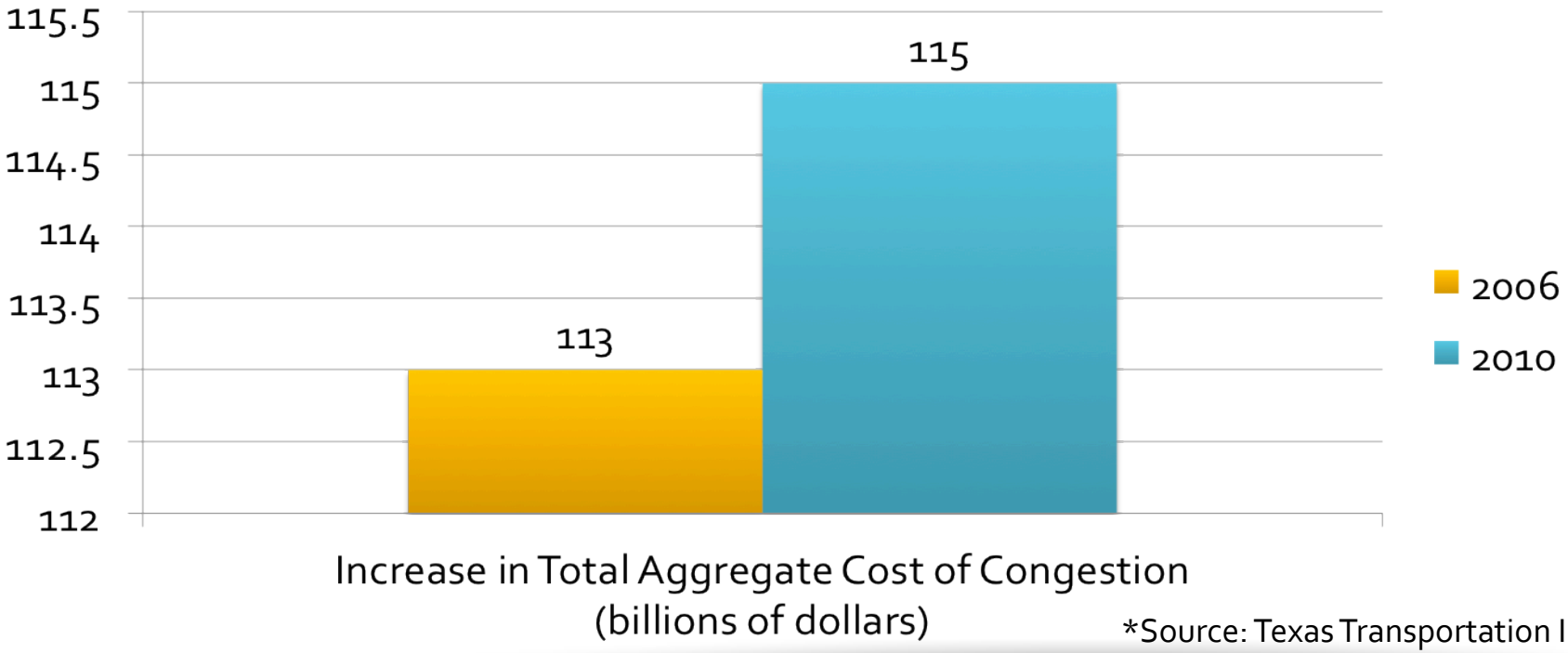
With Traffic Wizard Profile

Real-time Conditions
(Virtual checkpoint representation)

Current Optimal Route

U.S. Traffic Data

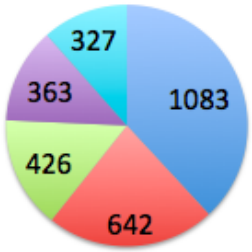
- 4.8 billion hours of excess commute time
- 1.9 billion gallons of excess fuel consumed



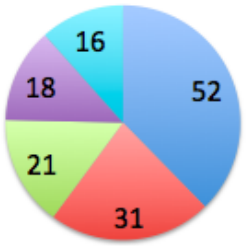
*Source: Texas Transportation Institute

U.S. Traffic Data

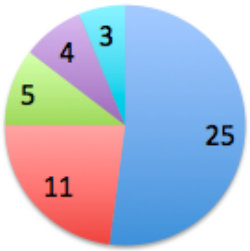
Average Annual Traffic Costs **Per Commuter Per Year**, by Area Population



Aggregate Cost, as calculated from fuel and delay excesses
(dollars)



Average Hours Delayed



Average Fuel Excess, due to longer commute times

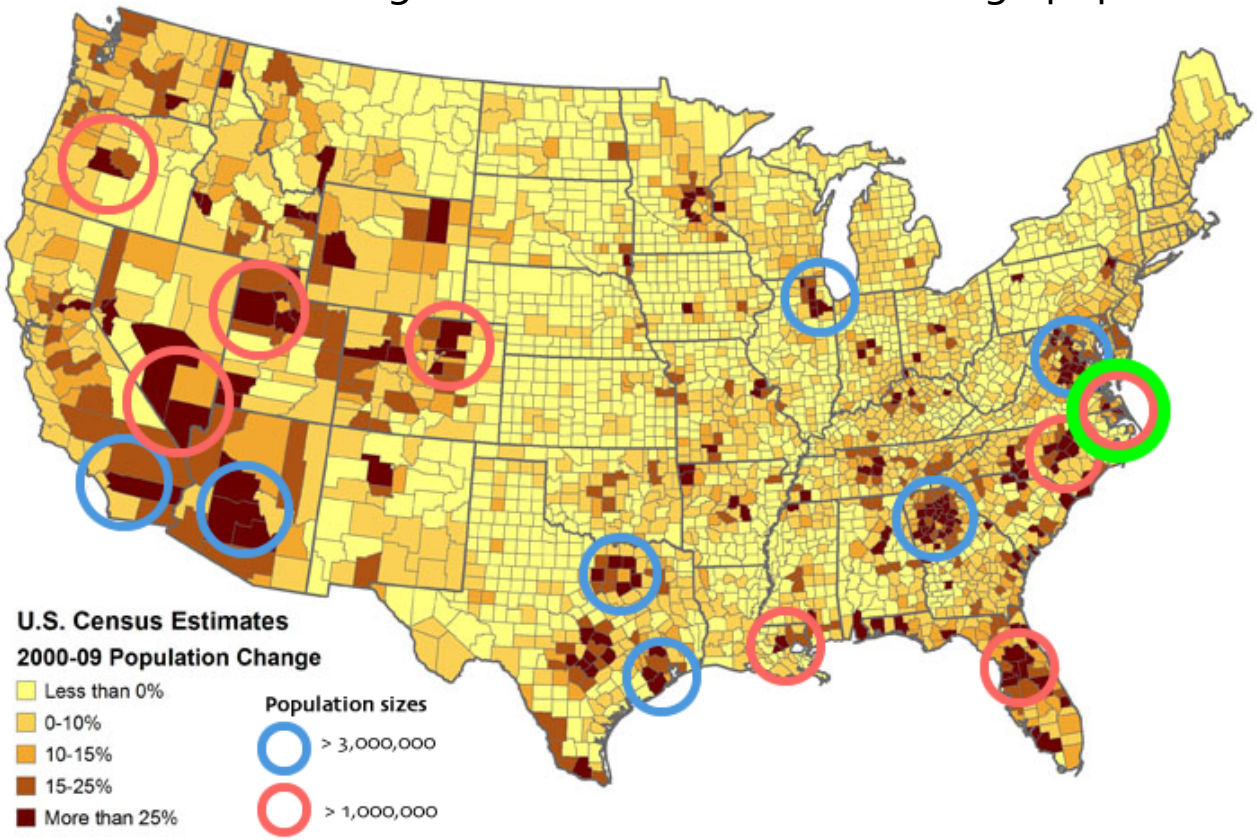
*Source: Texas Transportation Institute

Legend of population sizes

Very Large Areas	Large Areas	Medium Areas	Small Areas	Other Urban Areas
> 3,000,000	> 1,000,000	> 500,000	< 500,000	

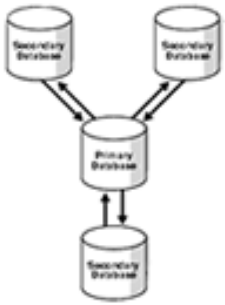
Population Trends

- The highest congestion cost is incurred in areas with larger populations
- Populations are increasing at the fastest rate in these high population areas



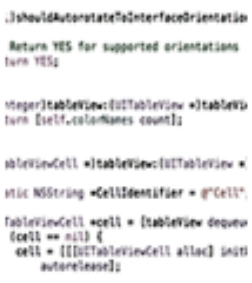
*Source: Texas Transportation Institute

Phase One Milestones

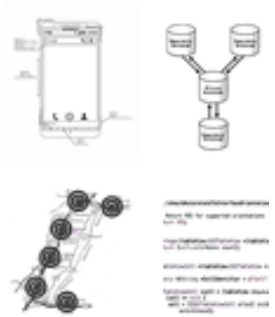


Databases

Data Simulation

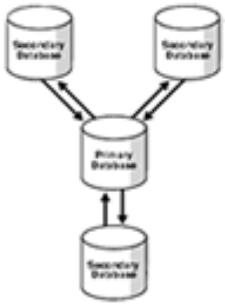


Algorithms



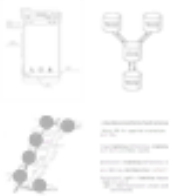
Testing

Phase One Databases



Data Simulation

Algorithms



Testing

Databases

- Simulated checkpoints
- Subsets of roads/speed limits

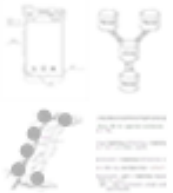
Phase One Simulation

Databases

Data Simulation

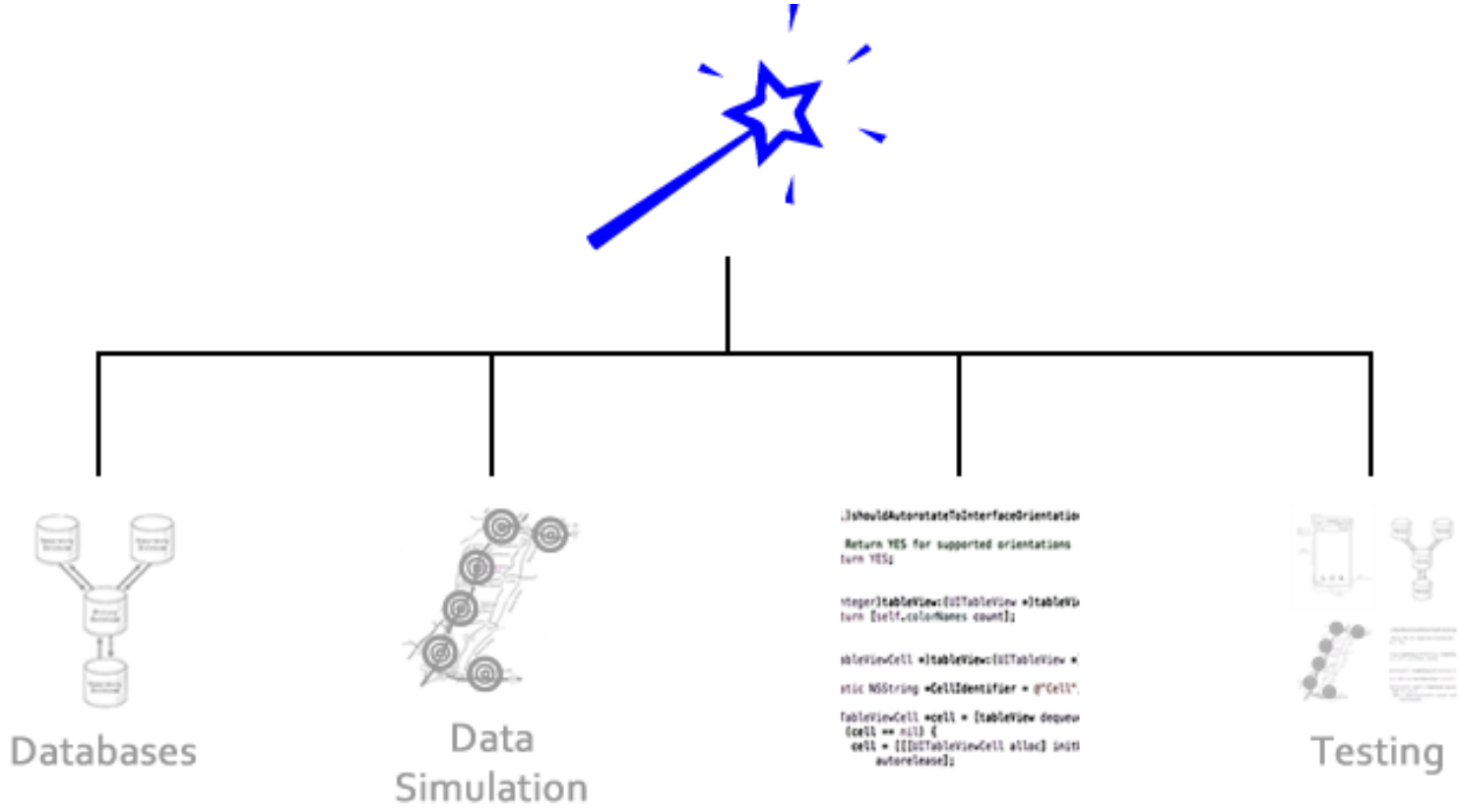
- Artificial driver input

Algorithms



Testing

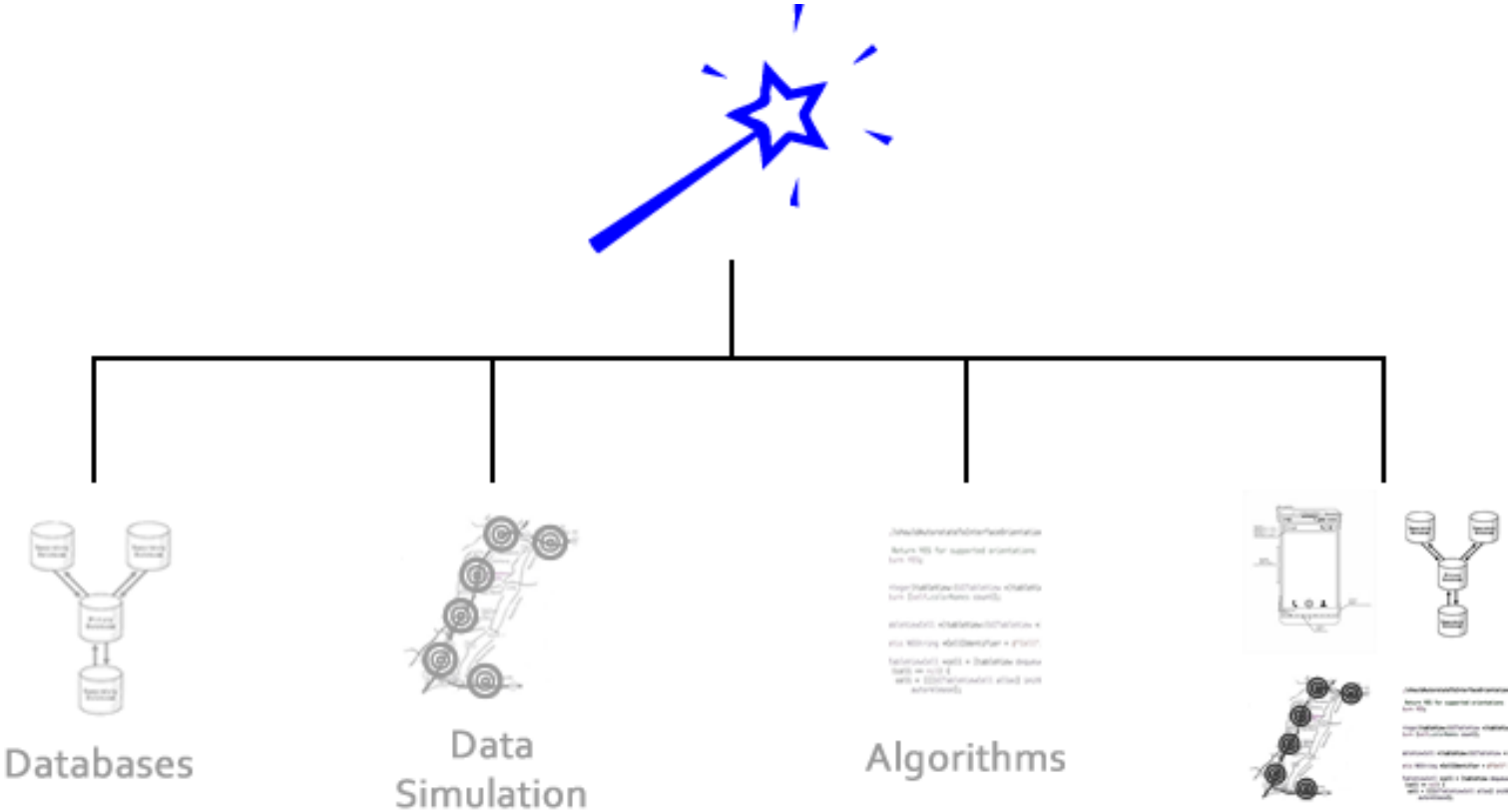
Phase One Algorithms



- Scaled down versions
  - Use simulated data

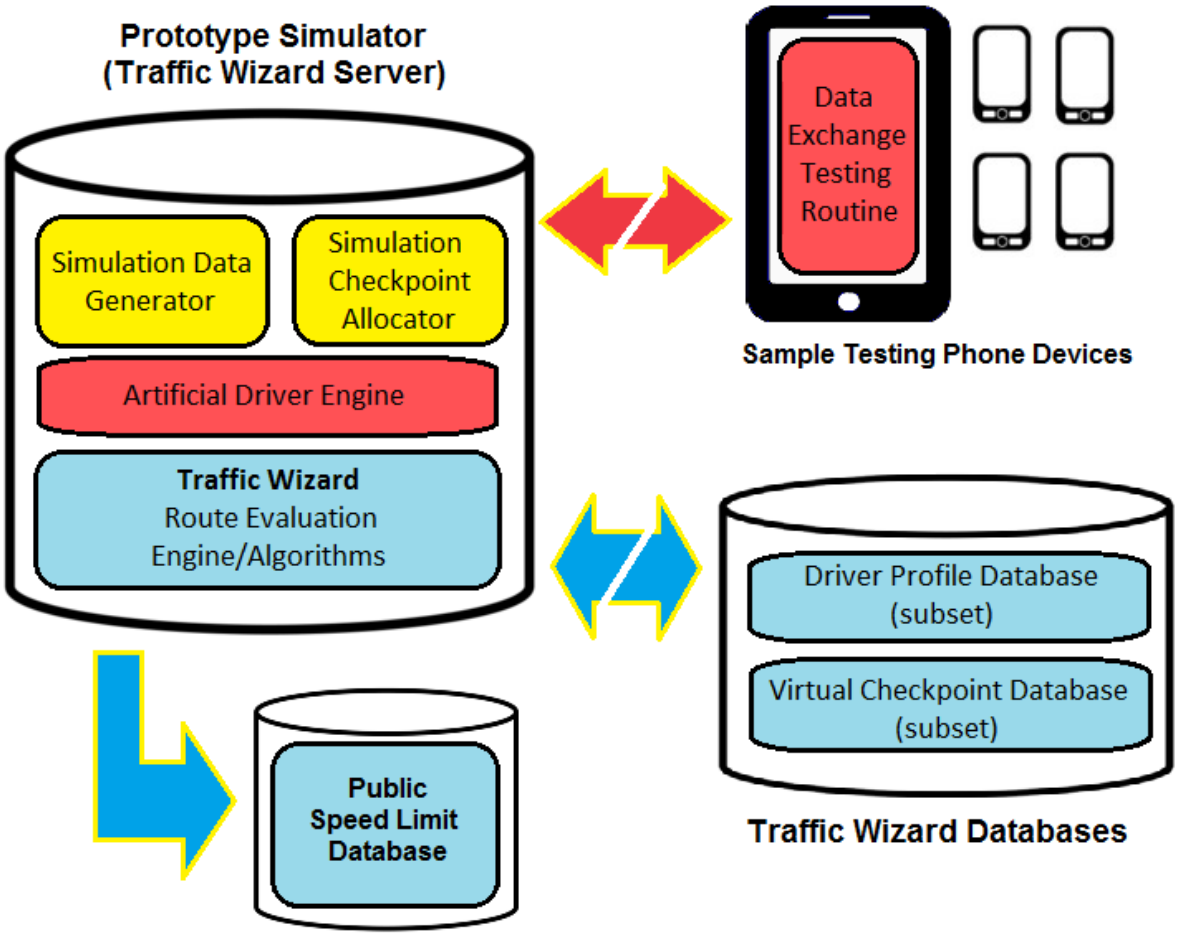
Algorithms

Phase One Testing



- Algorithm validity/accuracy
- Data exchange with phones

Major Functional Components



Phase One Staffing

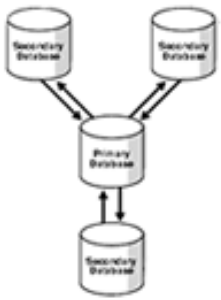
Position	Number of Employees	Salary	Cost
Software Engineer (Intern)	2	$45,000	$45,000.0
Salary Cost			$45,000.00
40% Overhead			$18,000.00
Total Cost (Phase 1 Staffing)			**$63,000.00**

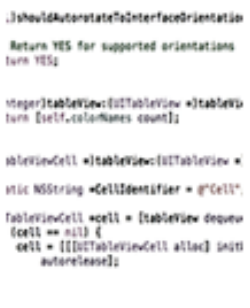
*Phase 1 duration: 6 months

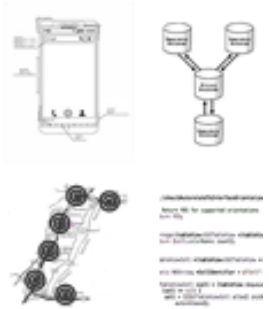
Phase One Resources

Resources	Quantity	Cost Per Unit	Total Cost
Workstations	2	$1,000	$2,000.00
Servers	2	$2,000	$4,000.00
Android Phones	6	$600	$3,600.00
SQL		$0	$0
XML		$0	$0
PHP		$0	$0
Apache		$0	$0
Total Cost (Phase 1 Resources)			$9,600.00

Phase Two Milestones

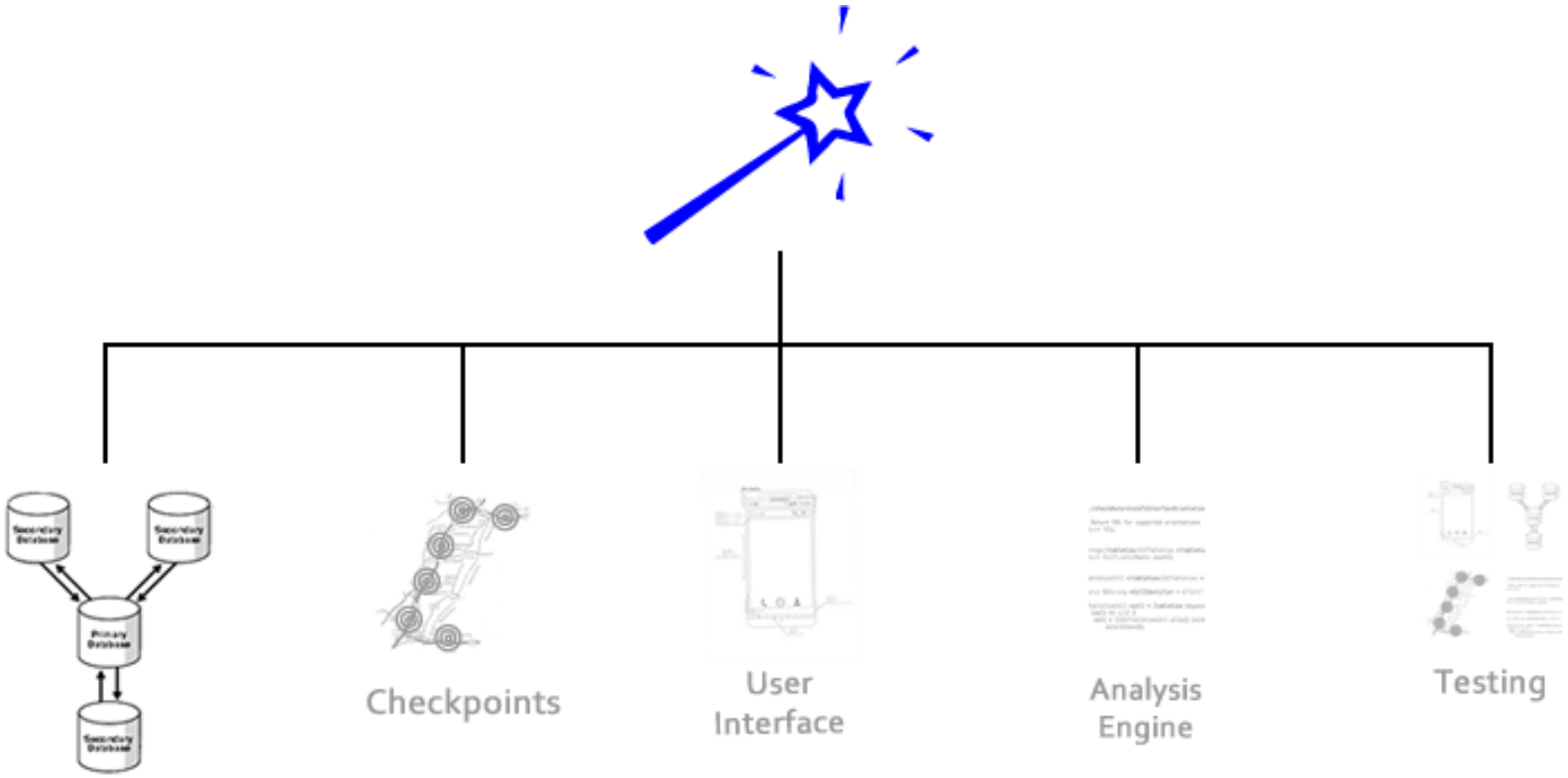






Databases | Checkpoints | User Interface | Analysis Engine | Testing

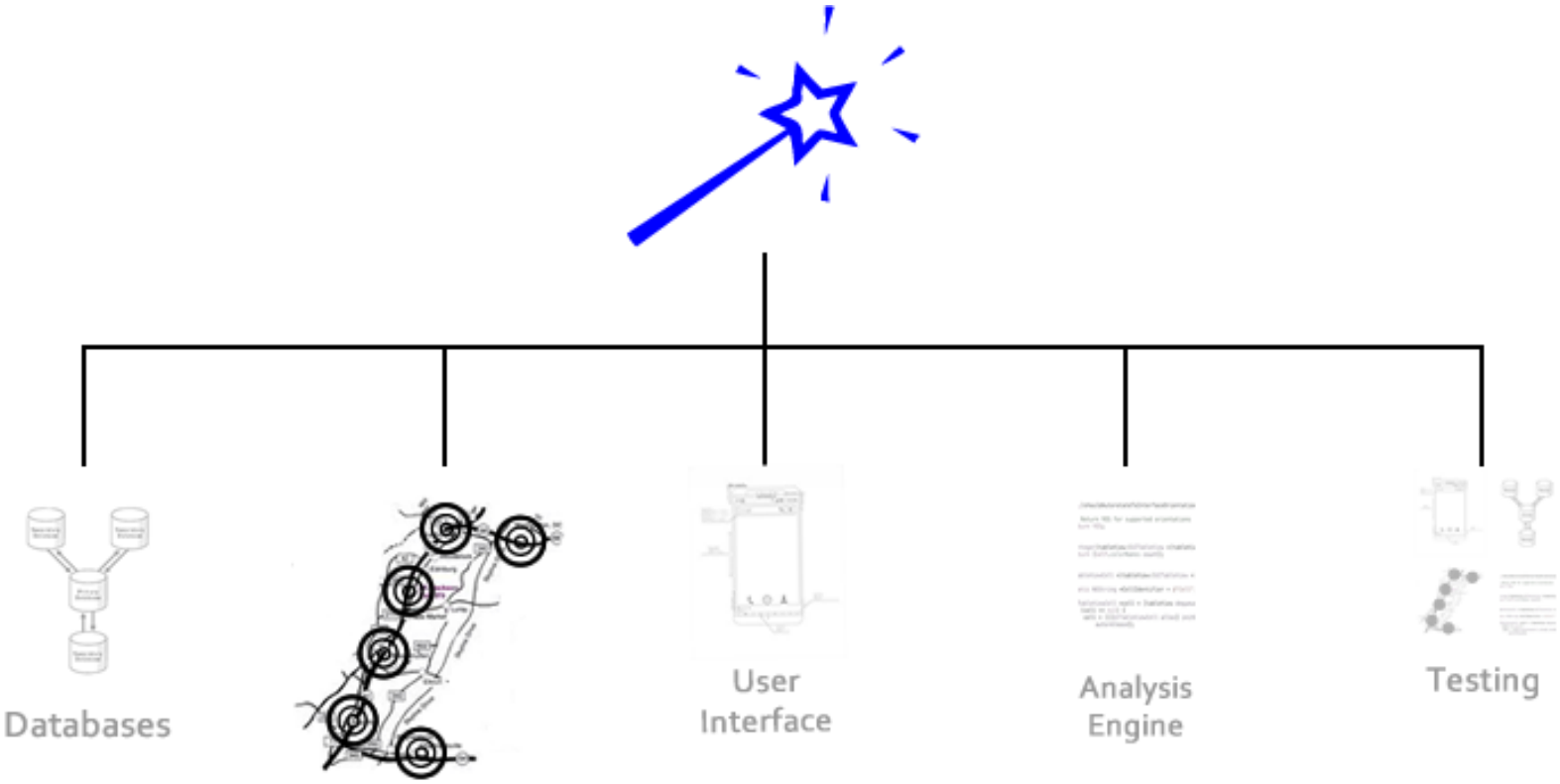
Phase Two Databases



Databases

- Public Speed Limit Database
- Checkpoint Database
- User Database

Phase Two Checkpoints



Checkpoints

- Placement and Analysis

Phase Two User Interface

Databases

Checkpoints

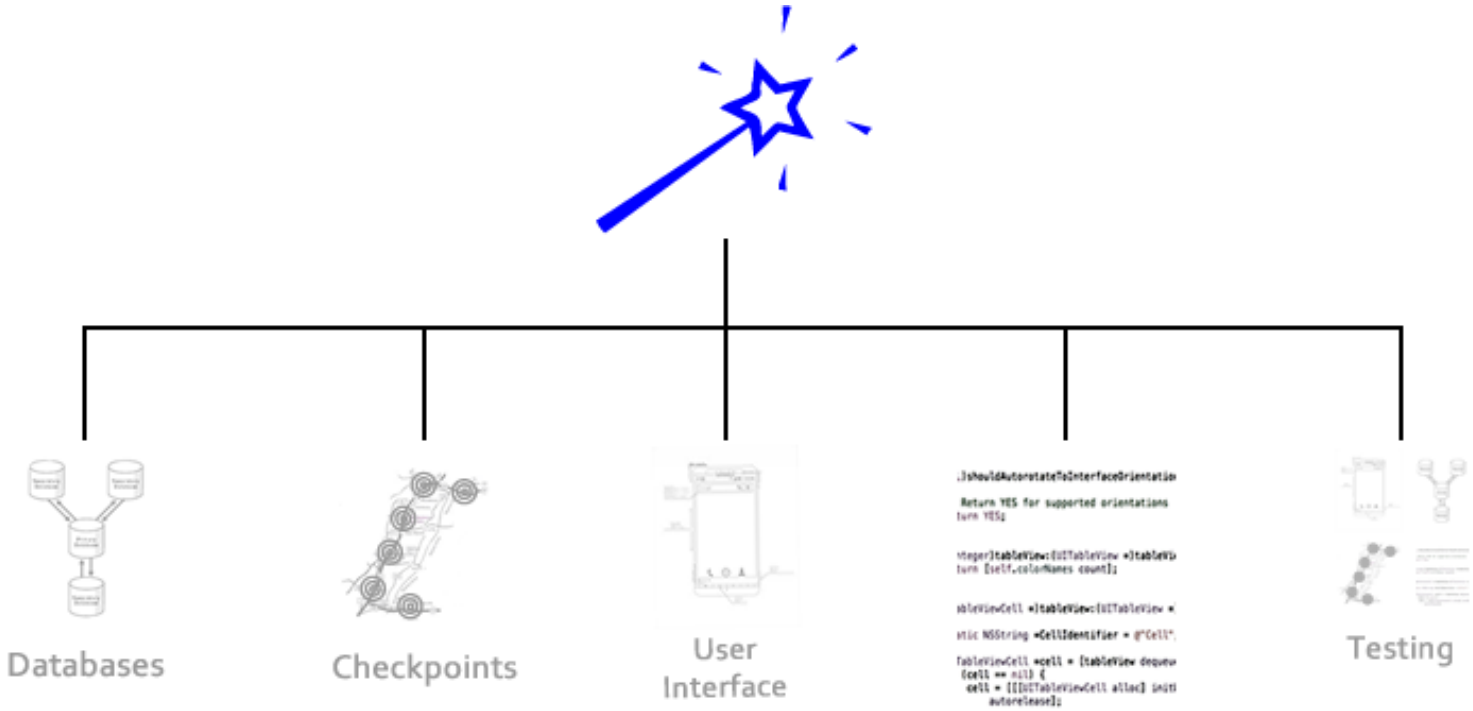
User Interface

Analysis Engine

Testing

- Smartphone App Interface
- Across several different OS's

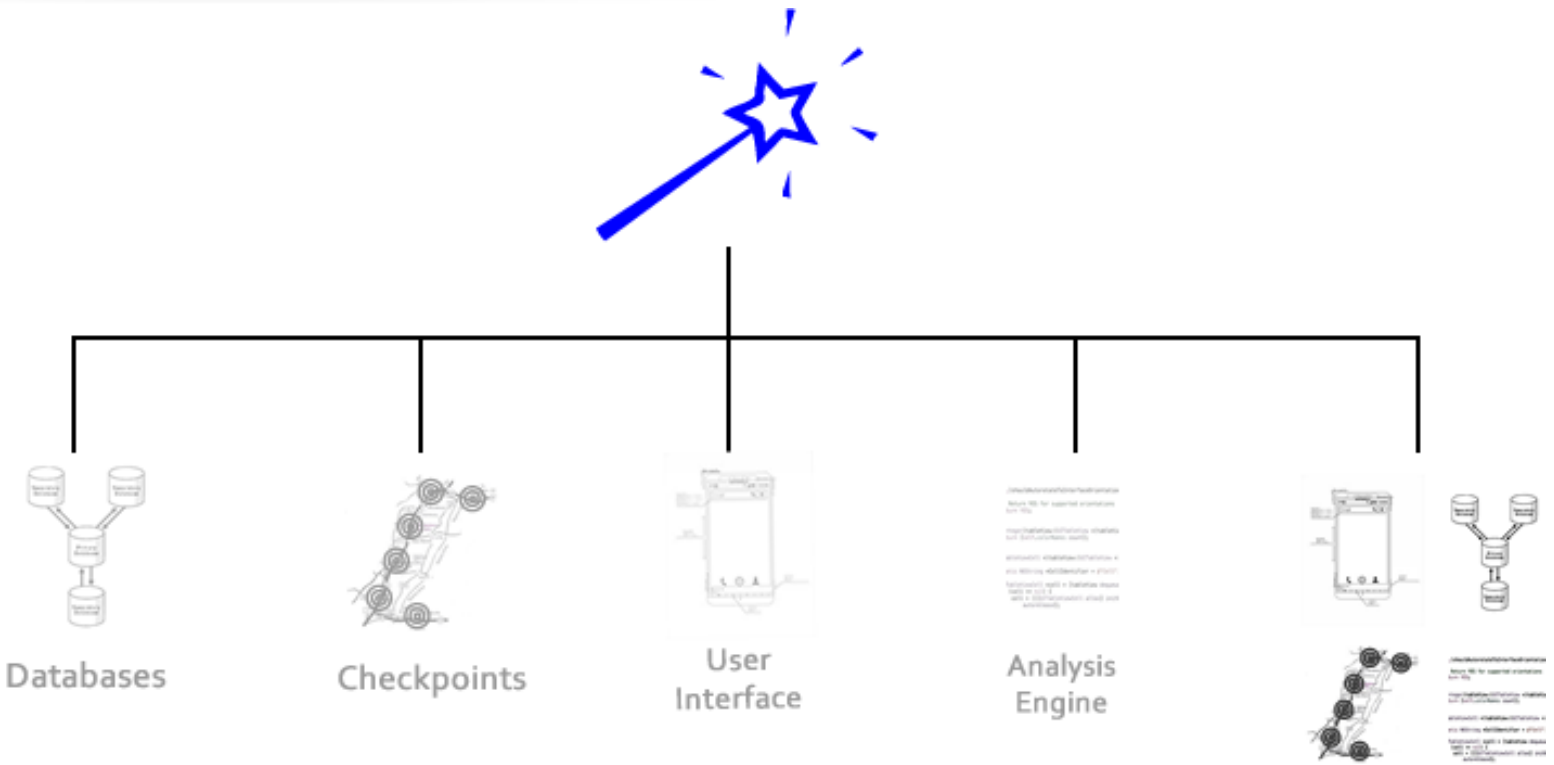
Phase Two Analysis Engines



Analysis Engine

- Based on profile
- Uses checkpoint information
- Route analysis algorithms

Phase Two Testing



- Alpha and Beta phases
- Checkpoint revalidation
- Server load testing
- GUI functionality

Testing Phases

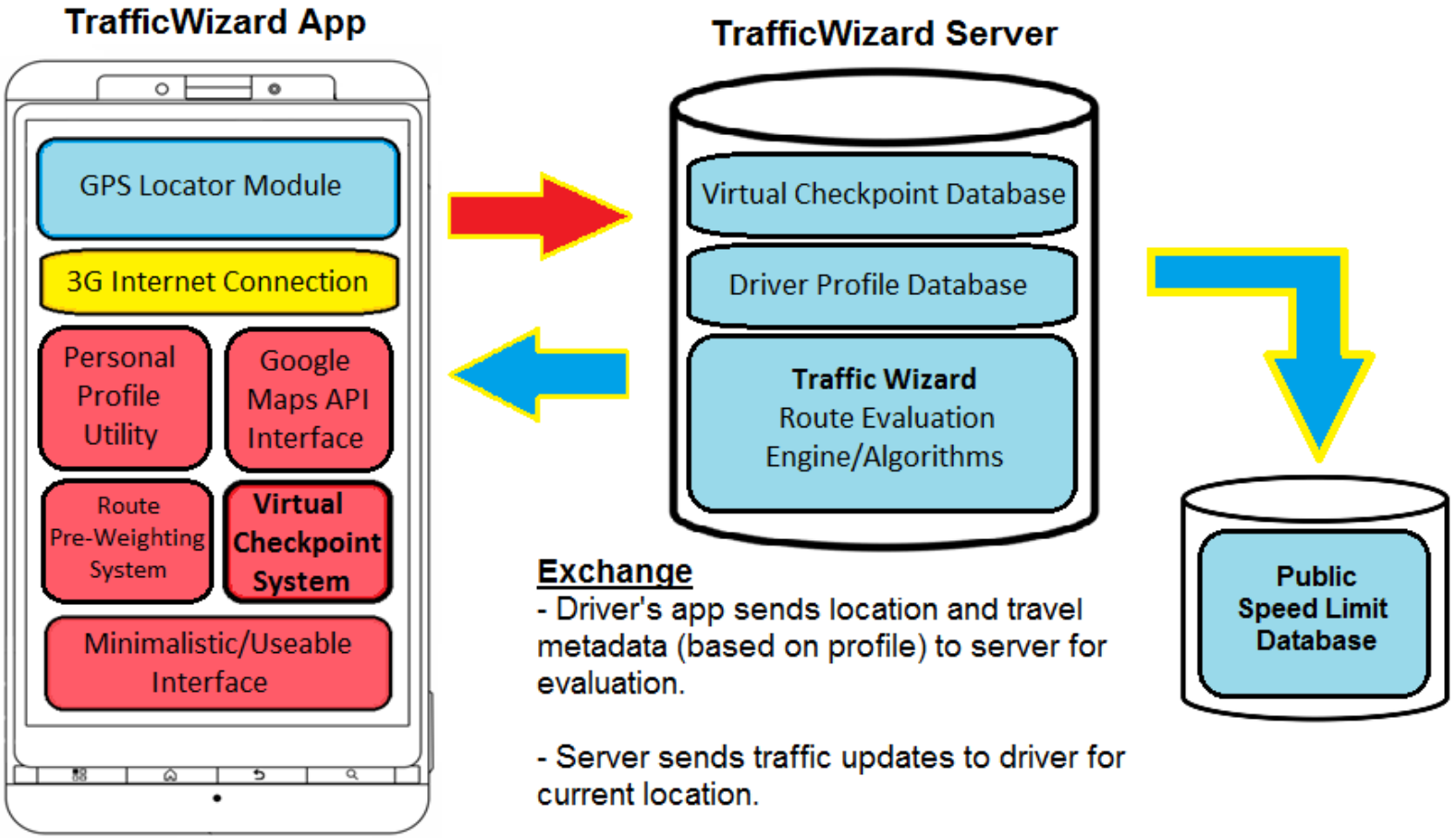
Alpha Testing Phase (Closed)

- Virtual Checkpoint placement verification
- Efficient driver data collection
- Functionality testing (GUI / Analysis)
- Server Load testing

Beta Testing Phase (Public)

- Virtual Checkpoint re-allocation
- Verify driver data transmission throughput
- Trip/Route integration (Profile-based)
- Increased Server Load Testing

Major Functional Components



Exchange

- Driver's app sends location and travel metadata (based on profile) to server for evaluation.

- Server sends traffic updates to driver for current location.

Phase Two Staffing

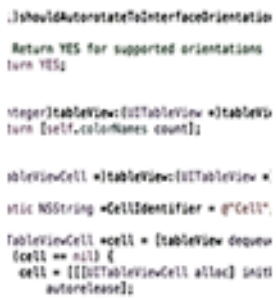
Position	Number of Employees	Salary	Cost
Project Manager	1	$84,000	$74,760.0
Software Engineer	4	$68,000	$242,080.0
Database Administrator	1	$80,000	$72,000.0
Software/Hardware Tester	2	$62,000	$111,600.0
Salary Cost			$500,440.00
40% Overhead			$200,176.00
Total Cost (Phase 2 Staffing)			**$700,616.00**

Phase Two Resources

Resources	Quantity	Cost Per Unit	Total Cost
Workstations	10	$1,000	$10,000.00
Oracle Servers	5	$3,500	$17,500.00
Android Phones	10	$600	$6,000.00
Google Maps API	1	$10,000	$10,000.00
SQL		$0	$0
XML		$0	$0
PHP		$0	$0
Apache		$0	$0
Total Cost (Phase 2 Resources)			$43,500.00

Phase Three Milestones

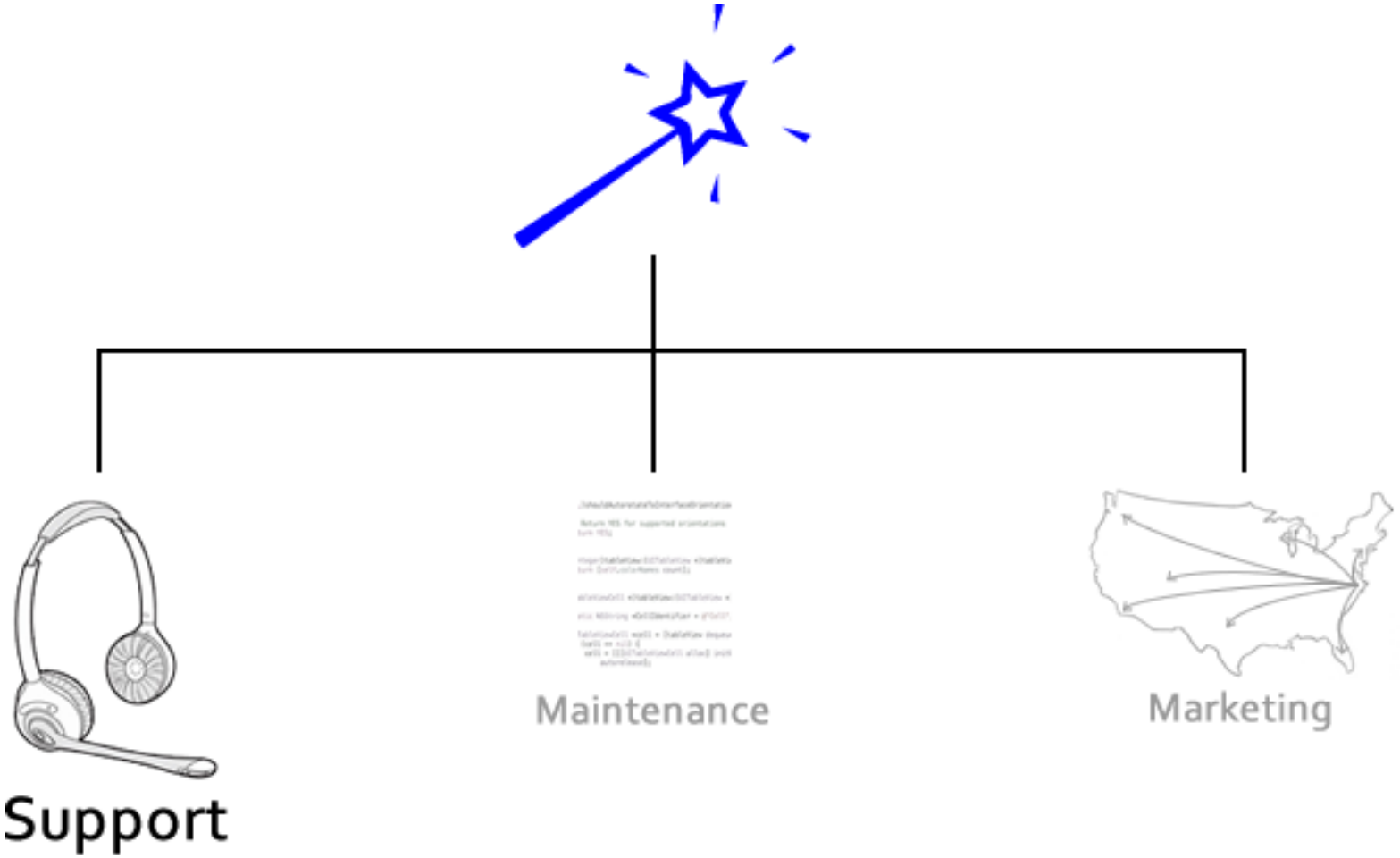
Support



Maintenance

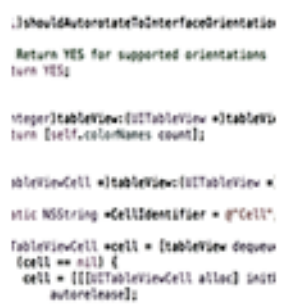
Marketing

Phase Three Support



Phase Three Code Maintenance

Support



Maintenance

Marketing

- Fix bugs
- Add functionality
- Security assurance

Phase Three Marketing

Support

Maintenance

- Maintain interest in current areas
  - Expansion campaigns

Marketing

Phase Three Staffing

Position	Number of Employees	Salary	Cost
Project Manager*	1	$84,000	$74,760.0
Software Engineer*	2	$68,000	$121,040.0
Database Administrator*	1	$80,000	$72,000.0
Marketing Director	1	$75,000	$67,500.0
HR Manager	1	$46,000	$46,000.0
Documentation Specialist	1	$40,000	$40,000.0
Salary Cost			$421,300.00
40% Overhead			$168,520.00
Total Cost (Phase 3 Staffing)			**$589,820.00**

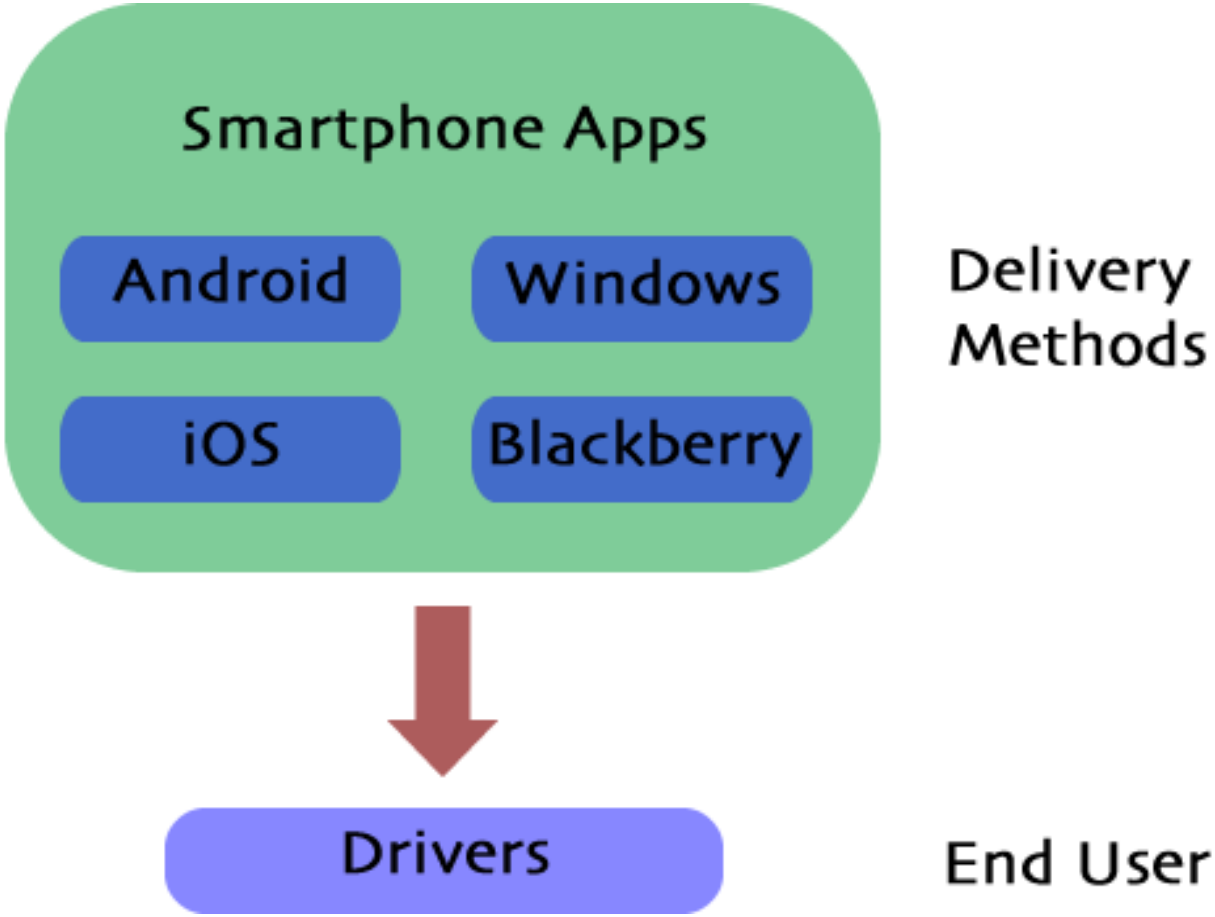
*Staffing requirements per region

Phase Three Resources

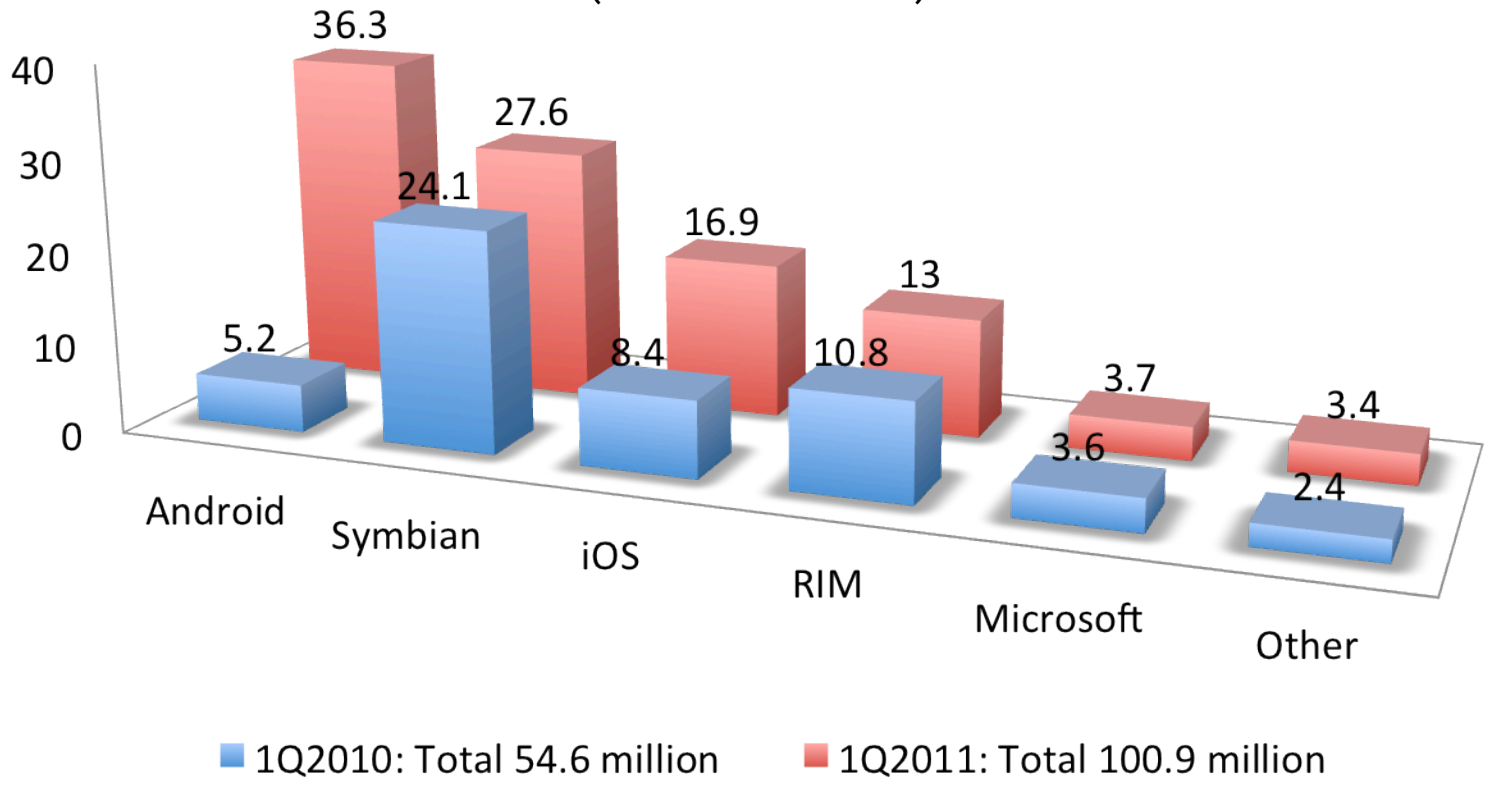
Resources	Quantity	Cost Per Unit	Total Cost
Workstations*	10	$1,000	$10,000.00
Oracle Servers*	5	$3,500	$17,500.00
SQL		$0	$0
XML		$0	$0
PHP		$0	$0
Apache		$0	$0
Total Cost (Phase 3 Resources)			$33,500.00

*Hardware requirement per region.

Customer Identification



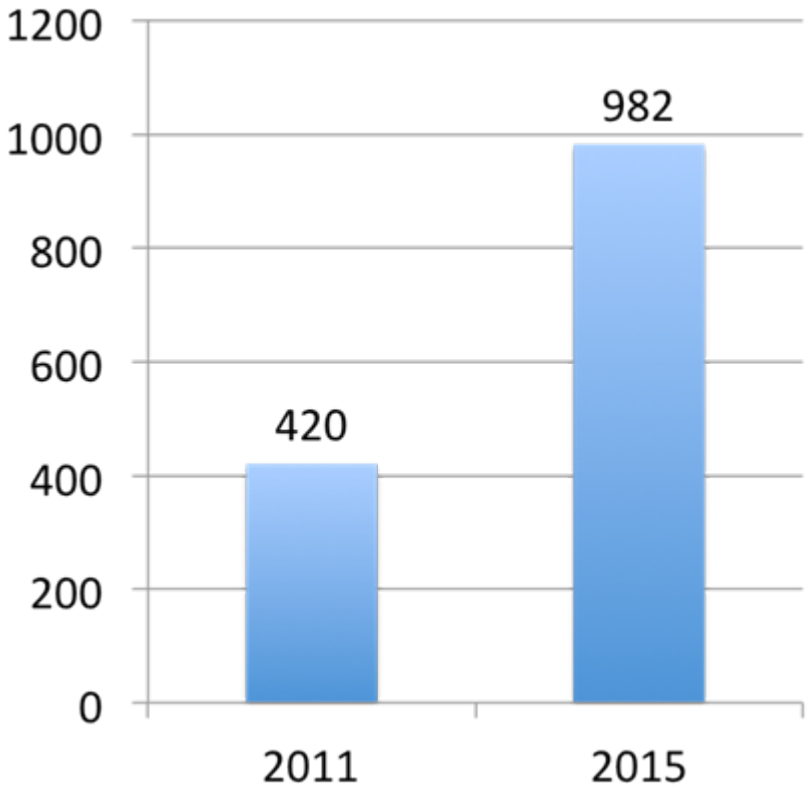
Worldwide Smartphone Sales Increases by OS



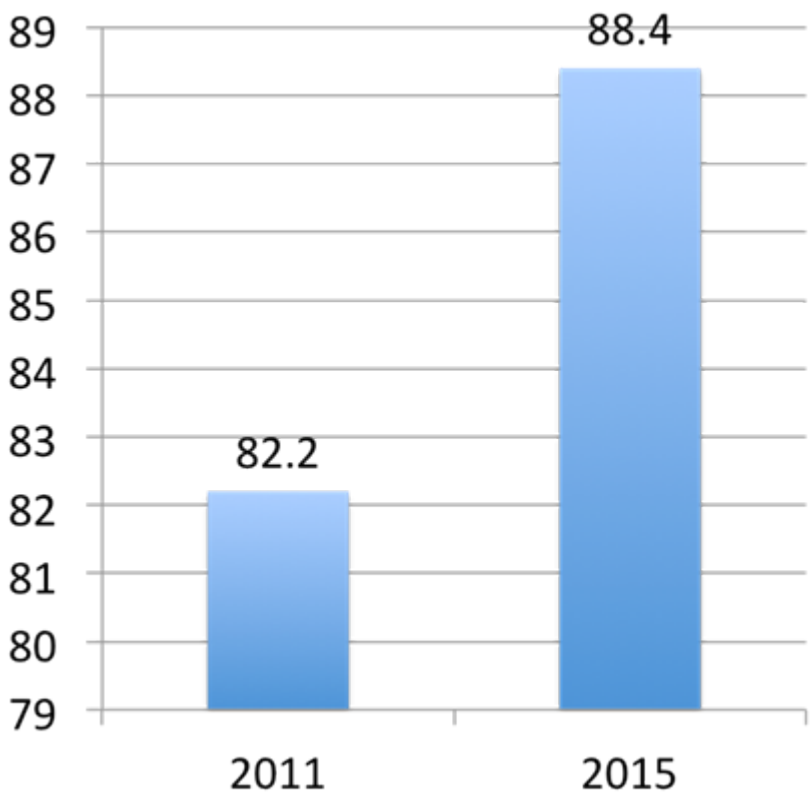
*Source: Mashable Tech

Market Projections

Projected Worldwide Smartphone Sales
(Millions of units)



Projected US Smartphone Sales
(Millions of units)



*Source: Email Marketing Reports

Competition

	Traffic Wizard	INRIX	TomTom	Sygic	RAC Traffic (UK)	Beat The Traffic
Android Support	x	x		x	x	x
iPhone Support	x	x	x	x	x	x
Real-time Traffic Updates	x	x	x	x	x	x
Accident Notification	x	x			x	x
Time Predictions	x	x	x	x		x
Turn-by-turn GPS Directions			x	x		
Traffic Camera Viewer						x
Virtual Checkpoint System	x					
Personalized Travel Profile	x					
Price	**Free** **$4.99/yr** **$14.99**	Free $24.99	*$49.99 - $119.99 $9.99 w/WEBFLEET	*$14.99 - $69.99 *€9.99 - €19.99/yr	Free £0.69	Free $3.99

*Price dependent on country

Customer Return on Investment

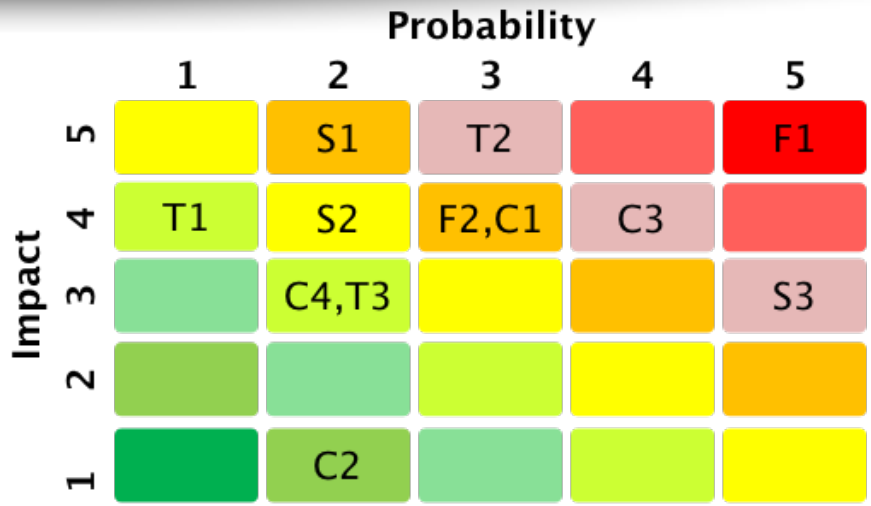
For the “average” user (two trips per day, 5 days a week, 50 weeks per year):

- Customer uses free version
  - Minimal data usage – Investment returns after first traffic incident avoidance
- Customer purchases yearly subscription
  - Avoiding 15 minutes of traffic per year pays back subscription cost
- Customer purchases lifetime subscription
  - Avoiding 45 minutes of traffic for the rest of user’s life pays back cost

Company Return on Investment

- Subscription revenue:
  - Estimated Phase 3 yearly operating cost: $972,000, with active expansion to two new metropolitan areas per year
  - To offset with only yearly subscriptions at $4.99 each, less than 200,000 subscriptions need to be sold
  - With a potential market of over 40 million people, there is plenty of room for profit
- Data brokerage
  - Potentially lucrative contracting to state and federal departments of transportation
- Commercial licensing
  - Special subscriptions sold to commercial shipping, state vehicles

Risk Assessment



Financial Risks

F1. Customer Investment – Vital to growth and sales

F2. Hardware/Software Network Maintenance – Fixing broken equipment, maintaining network

Customer Risks

C1. Product Interest – Market competition

C2. Ease-of-use to Customer – Simple and easy to use interface / installation

C3. Driver Distraction – Interaction becomes a potential distraction to driver

C4. Product Accessibility – Requires smartphone / data plan to provide traffic updates

Technical Risks

T1. Communication Protocols – Latency of technology

T2. Server Infrastructure – Configuration for distribution (scalability of regional systems)

T3. Hardware Failure – Potential for server failure

Schedule Risks

S1. Database Design – Virtualizing checkpoints (critical placement, initial allocation)

S2. Application Development – Oversights while improving app functionality and features

S3. Prototype / Test Phase – Dependent on quality, used for resolving issues

Financial Risk Mitigation

Financial Risks

F1. Customer Investment

Probability 5 *Impact 5*

Traffic Wizard cannot succeed if customers do not buy into it. This is highly dependent on marketing and will be mitigated with effective advertising.

F2. Hardware/Software Network Maintenance

Probability 3 *Impact 4*

Server infrastructure is subject to needing repairs and the network connecting drivers must be maintained. Since the foundation of the app lies in drivers' smartphones (as opposed to additional hardware), the probability of this is decreased.

Customer Risk Mitigation

Customer Risks

C1. Product Interest

Probability 3 *Impact 4*

With so many products and competition in the market, customers will need to prefer this solution over others. This can be overcome with effective marketing.

C2. Ease-of-use to Customer

Probability 2 *Impact 1*

Low cost, efficient, and easy installation of the product onto drivers' smartphones.

C3. Driver Distraction

Probability 4 *Impact 4*

Interaction with an app while driving is a high distraction risk. This will be mitigated with a minimalistic interface that assists the driver with little to no physical interaction with the device.

C4. Product Accessibility

Probability 2 *Impact 3*

Not every driver has a smartphone to access and download the app. The smartphone market has been well analyzed and is expected to grow immensely.

Technical Risk Mitigation

Technical Risks

T1. Communication Protocols

Probability 1 *Impact 4*

Communications between a device and the cloud are designed to occur within small time frames. Latency will negate the usefulness of traffic data. Traffic Wizard's virtual checkpoint system will assist with efficient information exchange.

T2. Server Infrastructure

Probability 3 *Impact 5*

The configuration and design of the server infrastructure must be able to compile and distribute data to connected drivers. The server will have to be efficiently scalable in design. Traffic Wizard is expected to hold the potential to connect with manufacturer telematics to assist with future scalability.

T3. Hardware Failure

Probability 2 *Impact 3*

The inevitable risk of technical issues due to hardware failure will be present in Traffic Wizard's operations. Sensible upkeep and maintenance should prove to mitigate this factor.

Schedule Risk Mitigation

Schedule Risks

S1. Database Design

Probability 2 *Impact 5*

Traffic Wizard's virtual checkpoint system will require initial (and recursively re-assessed) latitude and longitude assignments as virtual checkpoints in critical areas. This is necessary to act as the foundation for traffic analysis. Checkpoints will be able to be dynamically re-allocated as necessary.

S2. Application Development

Probability 2 *Impact 4*

Oversights in implementation and development can significantly delay progress of the app. Best practices in the software development process should help mitigate any issues in functionality.

S3. Prototype / Testing Phase

Probability 5 *Impact 3*

This phase is heavily dependent on the quality of execution of the product. Design issues must be resolved in this stage and the program must be proven to work. With an Alpha and Beta testing phase, an initial user base can be built along with initial patterning statistics from the checkpoints.

Conclusion

Traffic Wizard will deliver timely, accurate traffic information to drivers, enabling them to make the best possible travel decisions.

With our Virtual Checkpoint System and pre-trip analysis engine, avoiding traffic will be easy on driver's minds, their data plans, and ultimately their wallets.

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References

Competition App Reference Links:

Beat The Traffic:
http://itunes.apple.com/us/app/beat-the-traffic/id339660839?mt=8

Sygic:
http://www.sygic.com/en

INRIX:
http://www.inrix.com/mobile.asp

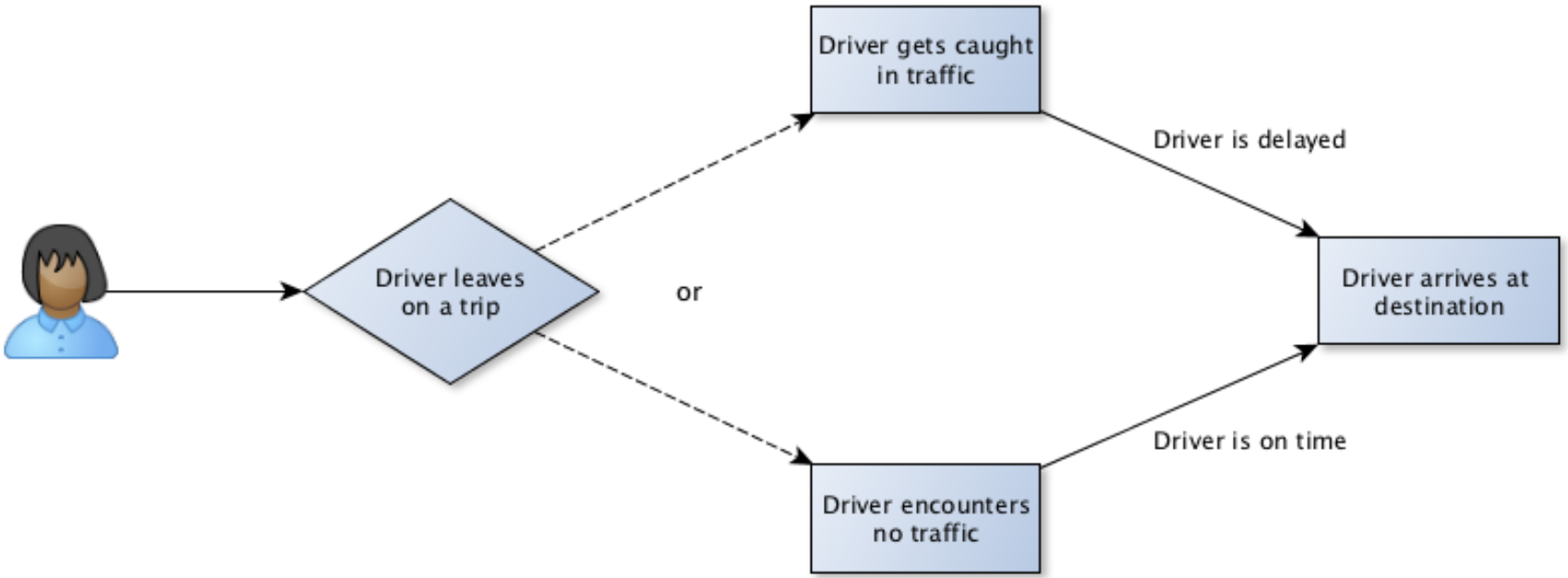
TomTom:
http://www.tomtom.com/en_gb/products/mobile-navigation/tomtom-app-for-iphone/

RAC:
http://itunes.apple.com/gb/app/rac-traffic-plus/id38933907 6?mt=8

Traffic.com:
http://itunes.apple.com/us/app/traffic.com/id327245871?mt=8

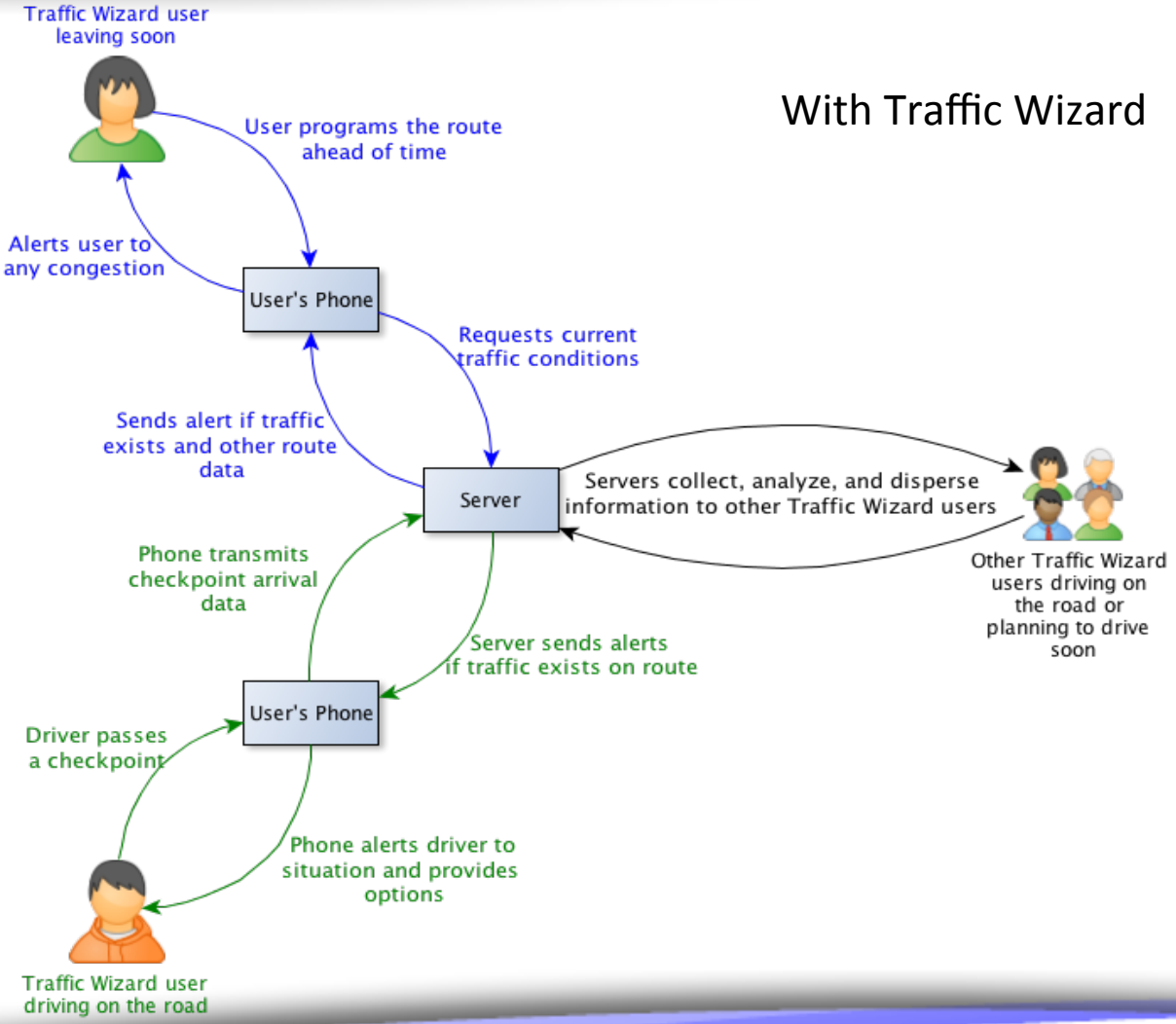
Appendix A: Process Flows

Without Traffic Wizard



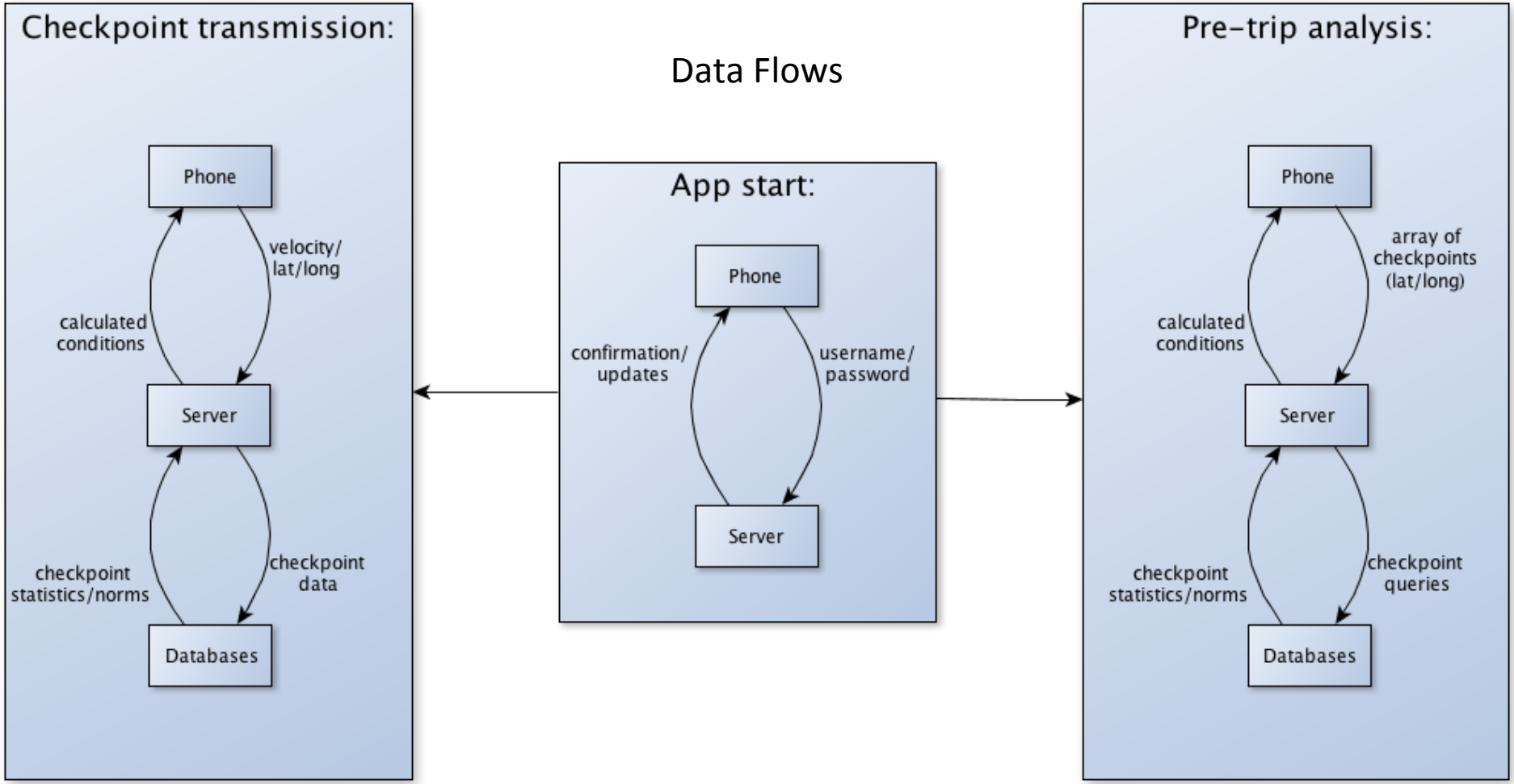
Appendix A: Process Flows

With Traffic Wizard

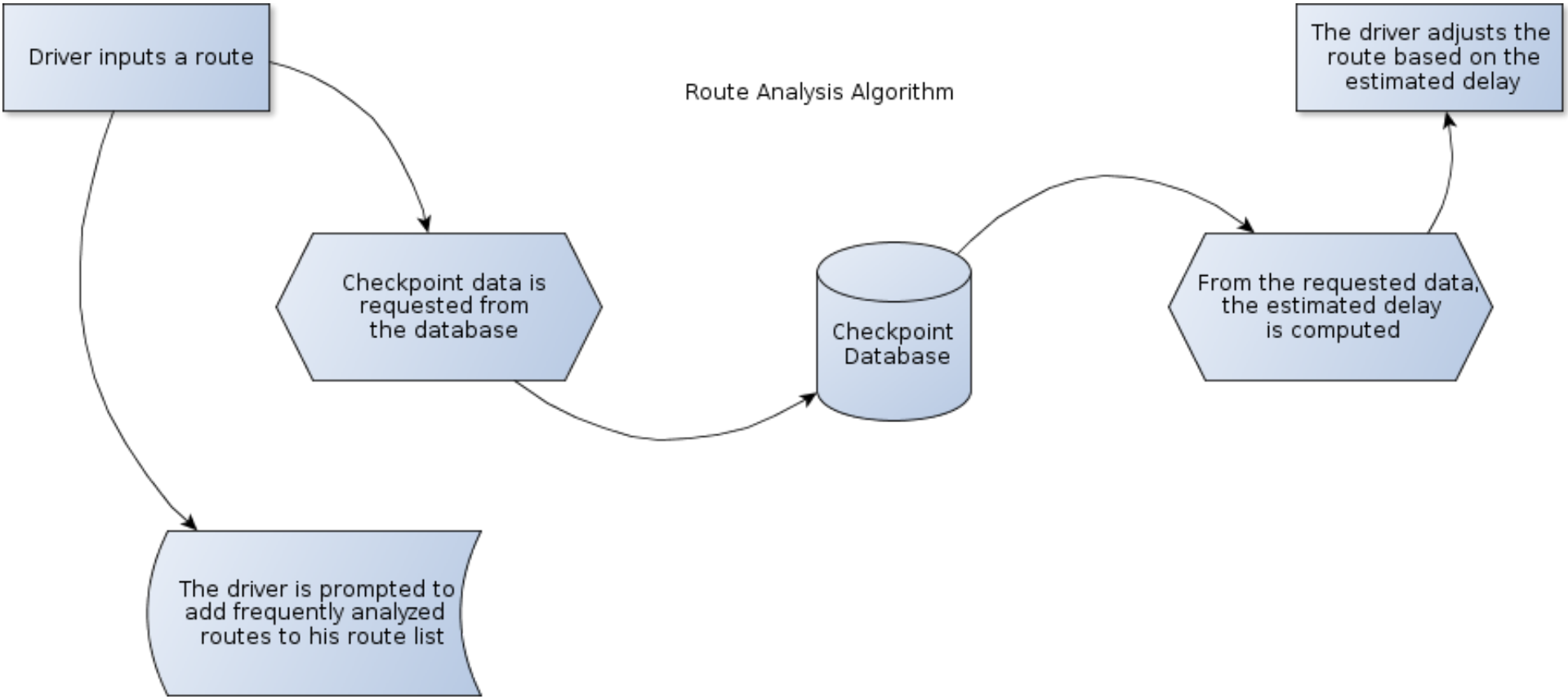


Appendix A: Process Flows

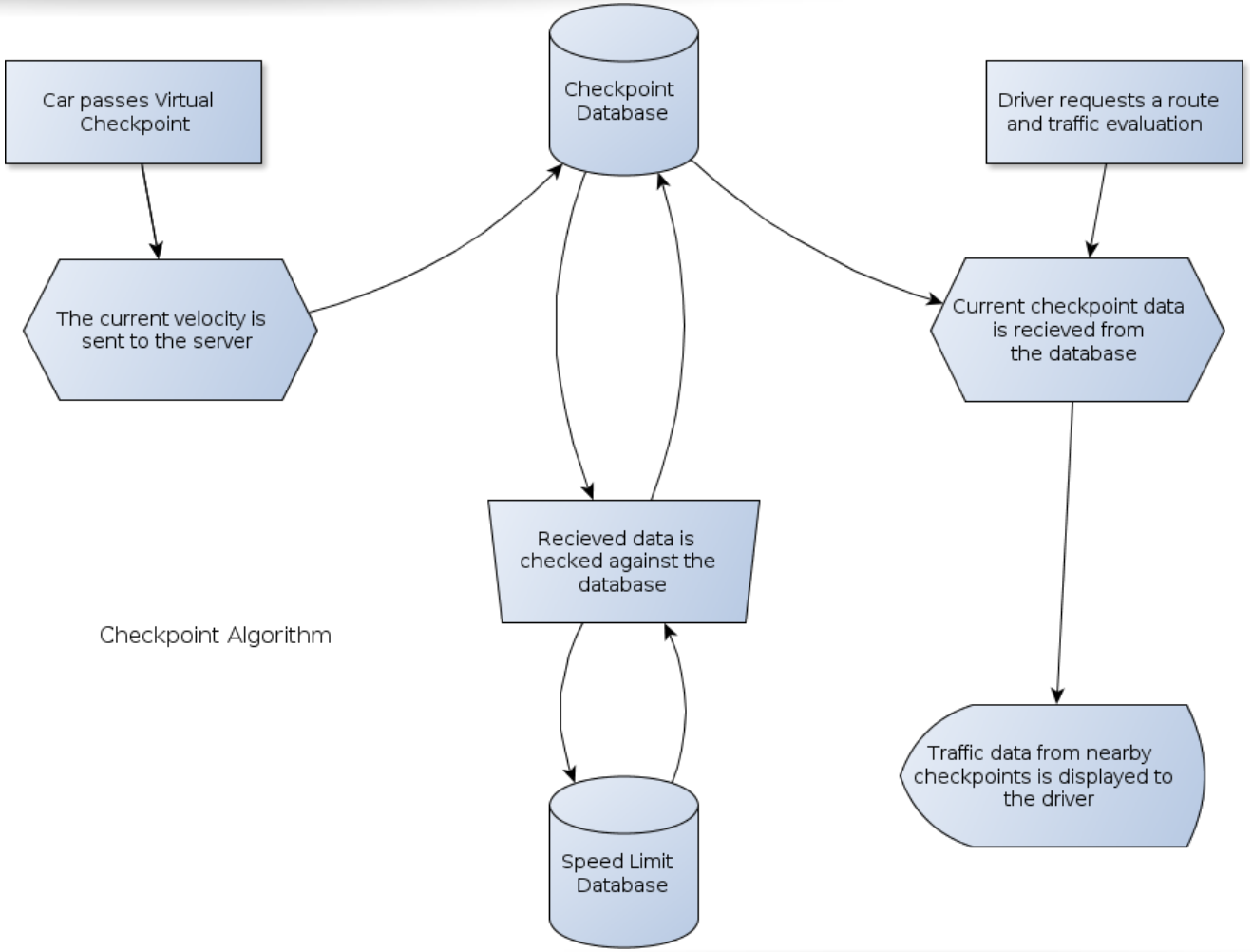
Data Flows



Appendix B: Software Modules

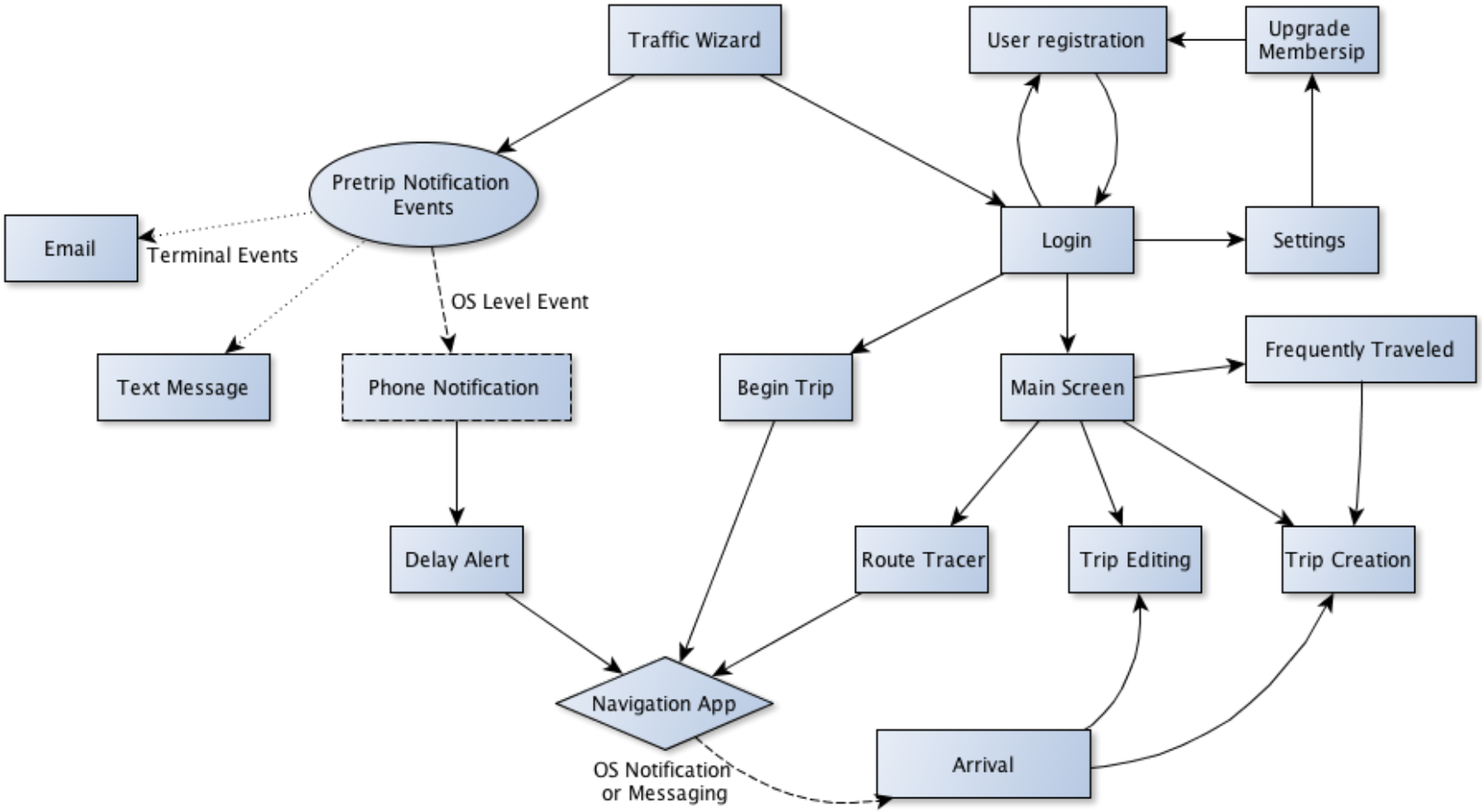


Appendix B: Software Modules

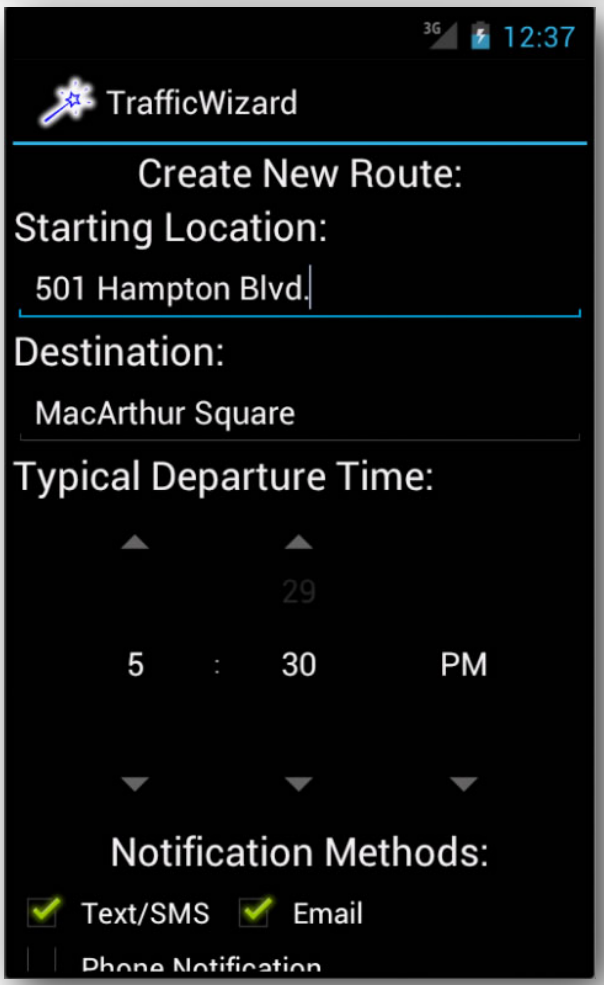


Checkpoint Algorithm

Appendix C: User Interface

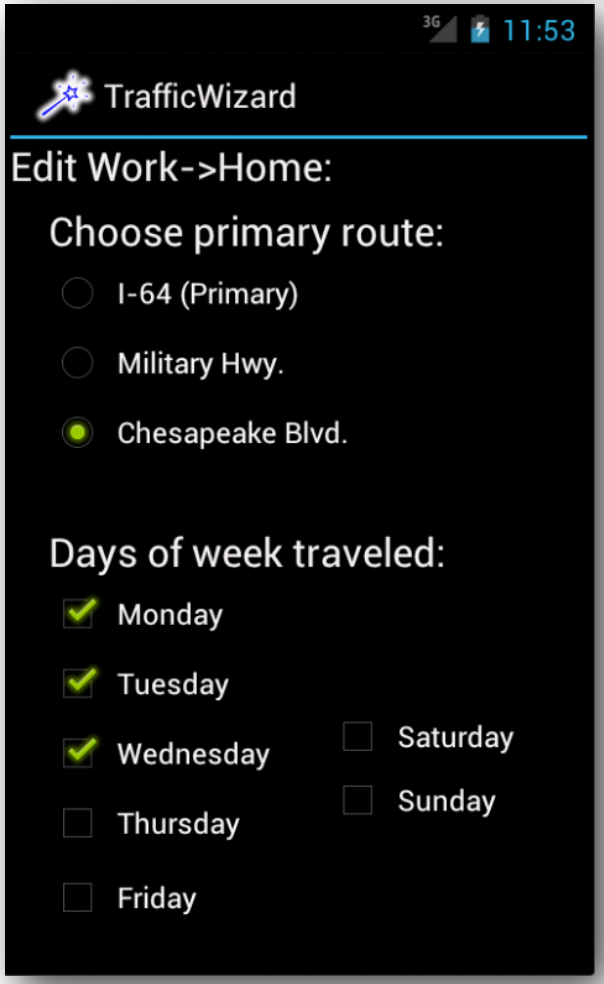


Appendix C: GUI Screenshots



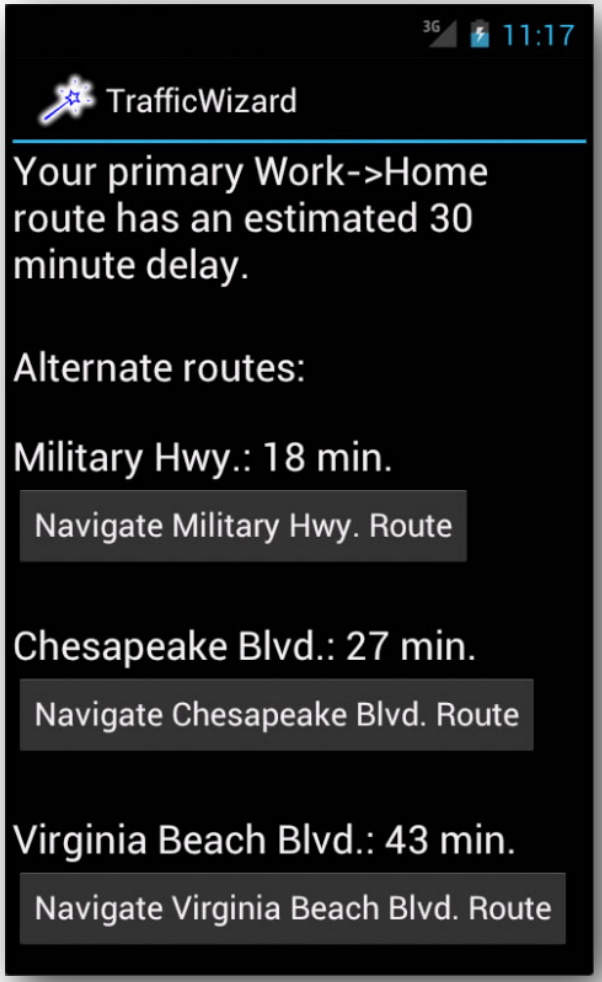
- Location and time specific trips
- Multiple notification methods

Appendix C: GUI Screenshots



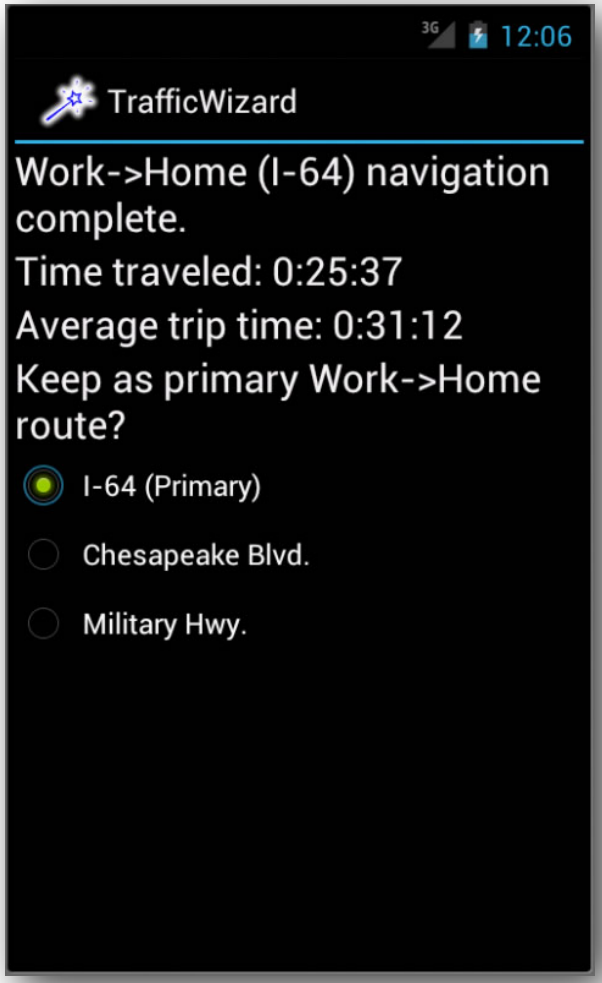
- Set times of travel
- Change primary route for trips
- Trip/route specific settings

Appendix C: GUI Screenshots



- Informs of delays on route to be traveled soon
- Presents options for alternatives
- Can lead to third party navigation app for unfamiliar routes

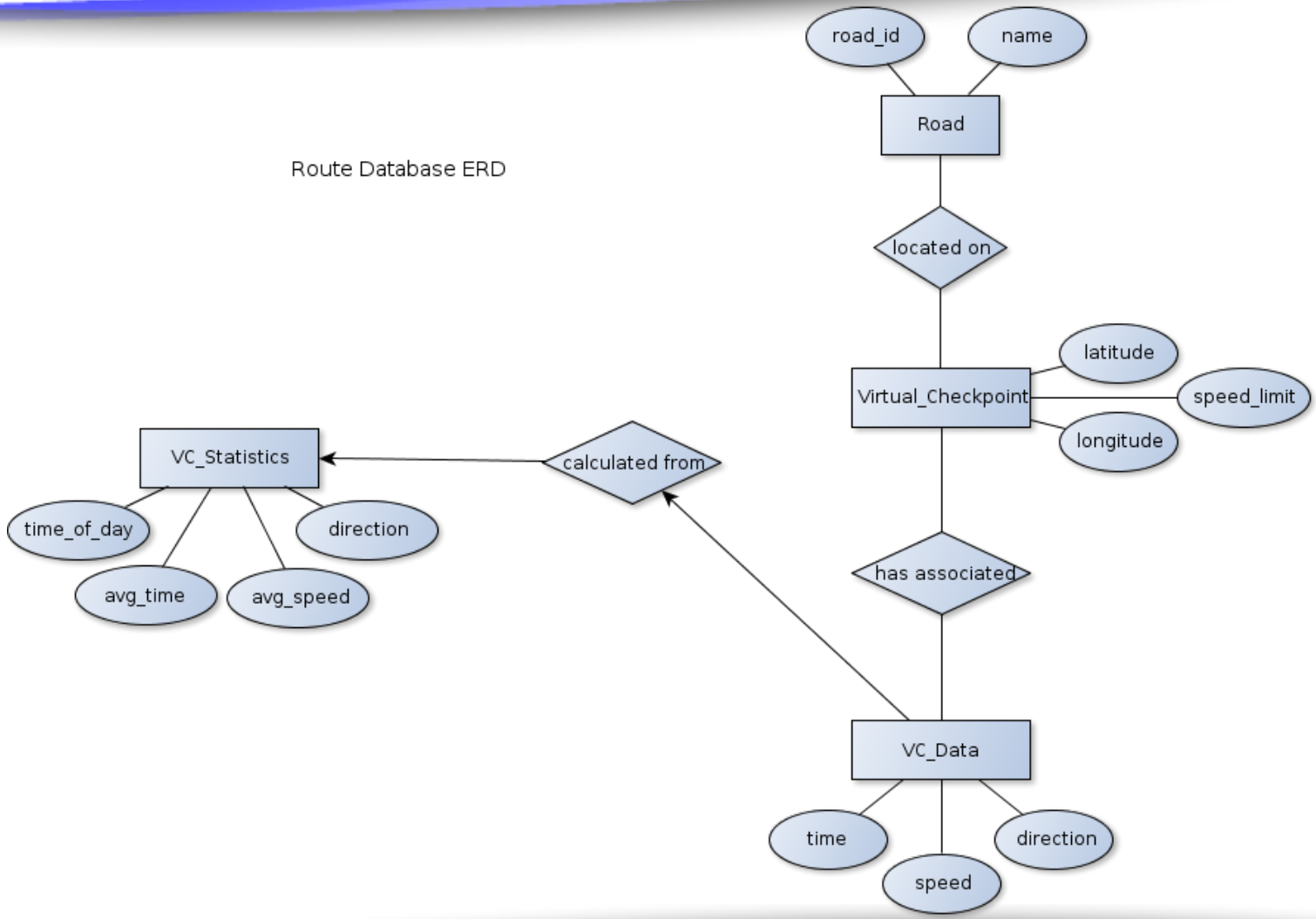
Appendix C: GUI Screenshots



- Trip summary
- Ability to adjust route settings, or set new primary route

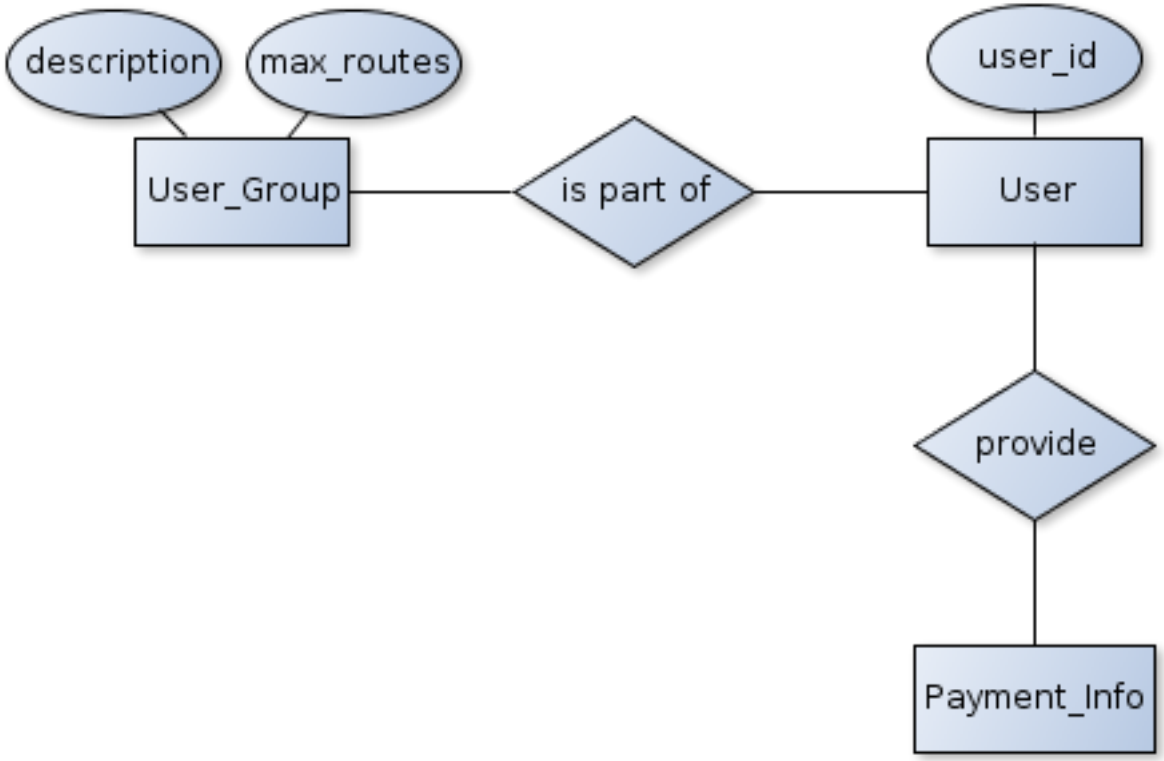
Appendix D: Database Design

Route Database ERD



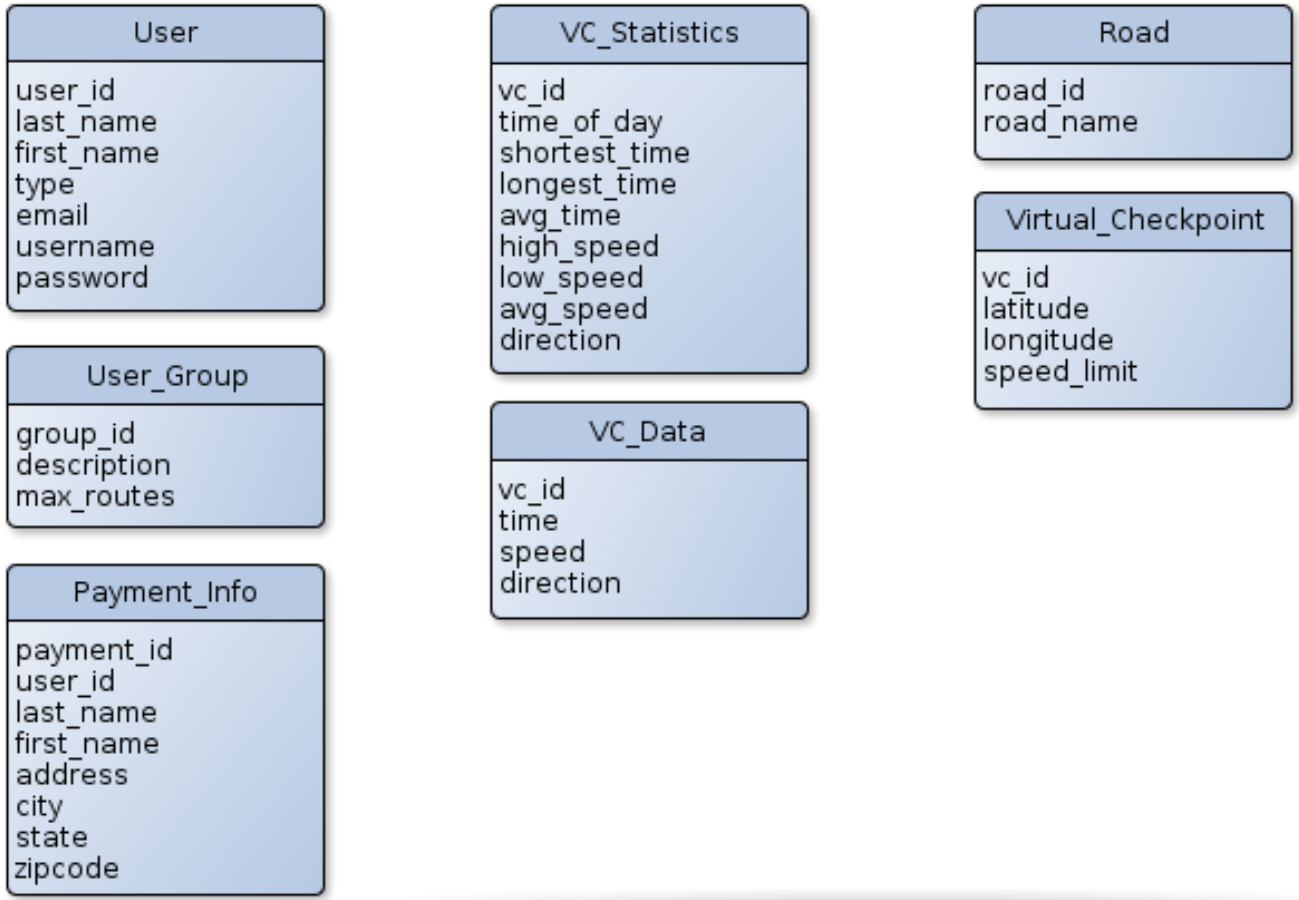
Appendix D: Database Design

Customer Database ERD



Appendix D: Database Design

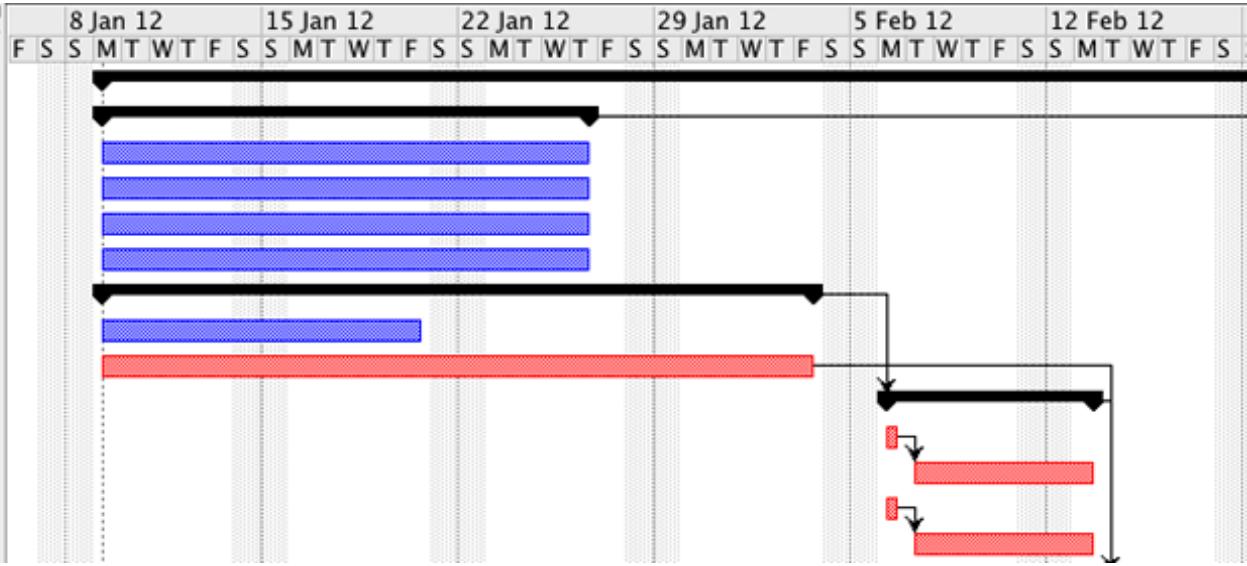
Database Schema



Appendix E: Work Breakdown

Phase 1 Planning and Acquisition

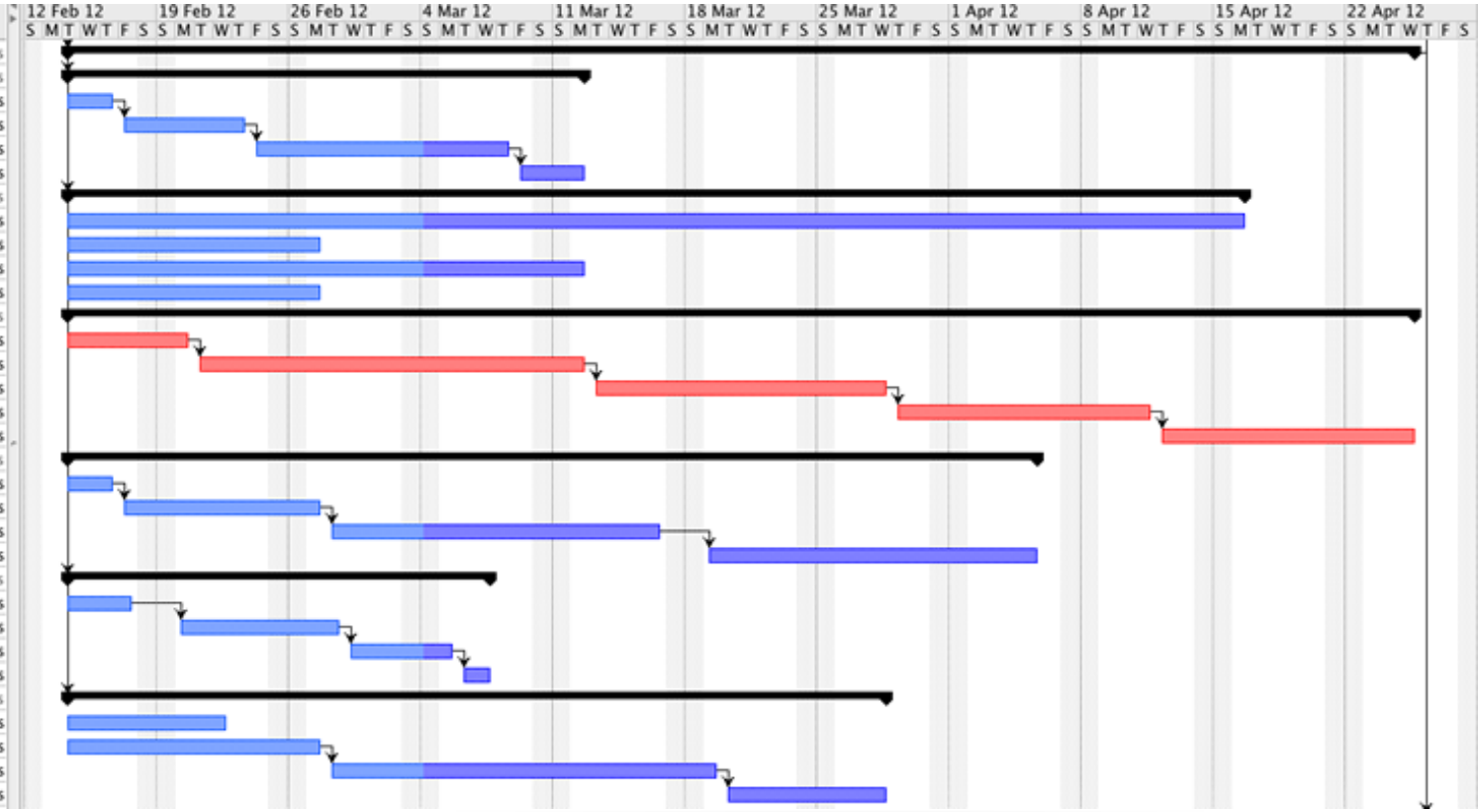
Name	Duration
⊟Phase 1	108 days
⊟Develop Project Team	14 days
Interview/Hire Database Developer	14 days
Interview/Hire Software Developer	14 days
Interview/Hire GUI Developer	14 days
Interview/Hire Documentation Specialist	14 days
⊟Planning	20 days
Hardware Plan	10 days
Software Plan	20 days
⊟Hardware	6 days
Research workstation brand/model	1 day
Purchase workstations	5 days
Research server brand/model	1 day
Purchase server	5 days



Appendix E: Work Breakdown

Phase 1 – Prototype Development

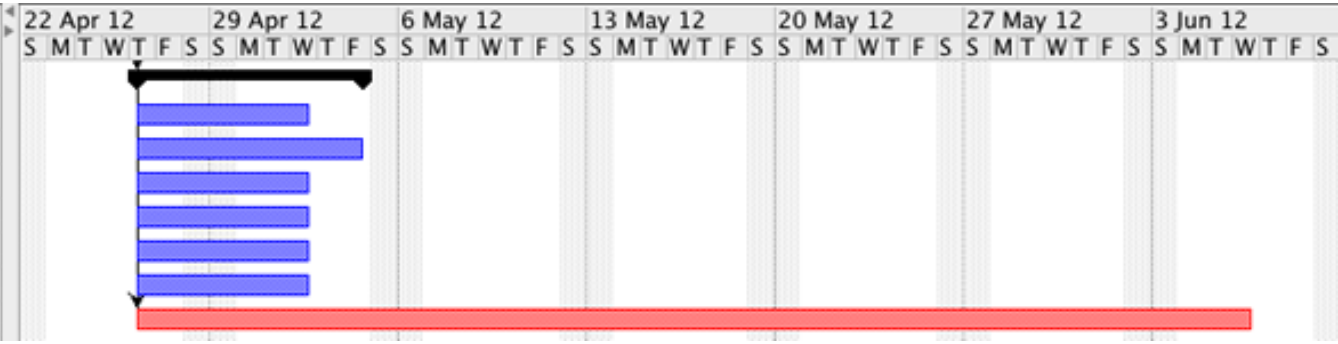
Name	Duration
Prototype/Simulation Development	52 days
GUI	20 days
Analysis	3 days
Design	5 days
Implementation	10 days
Testing	2 days
Algorithms	45 days
Virtual Checkpoint Allocation Algorithm	45 days
GPS Data Collection Algorithm	10 days
Route Analysis Algorithm	20 days
Congestion Notification Algorithm	10 days
Databases	52 days
Analysis	5 days
Design	15 days
Implementation	12 days
Integration	10 days
Testing	10 days
Hardware Interface	38 days
Analysis	3 days
Design	7 days
Implementation	14 days
Testing	14 days
Data Simulation	17 days
Analysis	4 days
Design	7 days
Implementation	4 days
Validation	2 days
Traffic Analysis Engine Simulation	32 days
Analysis	7 days
Design	10 days
Implementation	15 days
Testing	7 days



Appendix E: Work Breakdown

Phase 1 Documentation and Testing

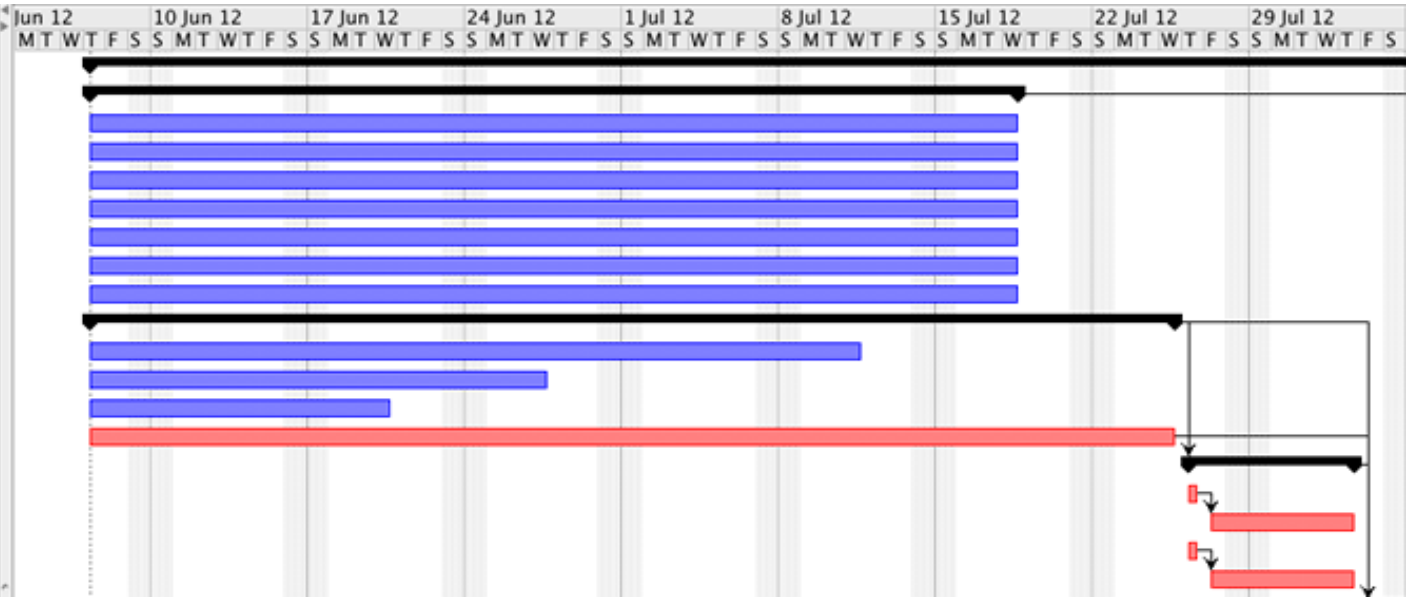
Name	Duration
⊟Documentation	7 days
Database Documents	5 days
Algorithm Documents	7 days
Hardware Interface Documents	5 days
Data Mining Documents	5 days
Traffic Analysis Engine Documents	5 days
GUI Documents	5 days
Prototype Testing	30 days



Appendix E: Work Breakdown

Phase 2 Planning and Acquisition

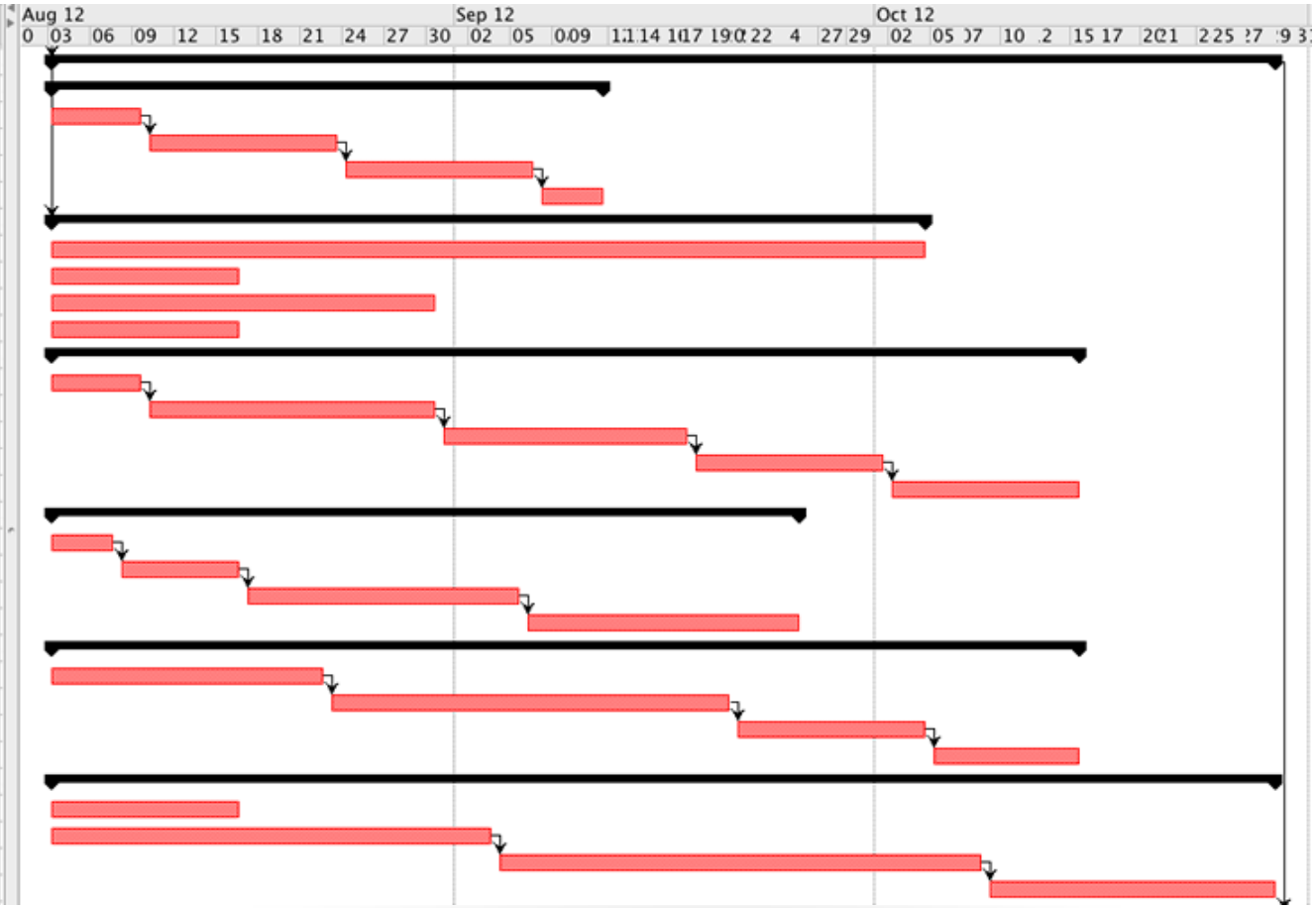
Name	Duration
⊟Phase 2	297 days
⊟Develop Project Team	30 days
Interview/Hire Webmaster	30 days
Interview/Hire Database Developer	30 days
Interview/Hire Software Developer	30 days
Interview/Hire GUI Developer	30 days
Interview/Hire Reports Expert	30 days
Interview/Hire Marketing Specialist	30 days
Interview/Hire Documentation Specialist	30 days
⊟Planning	35 days
Risk Management	25 days
Support Plan	15 days
Hardware Plan	10 days
Software Plan	35 days
⊟Hardware	6 days
Research workstation brand/model	1 day
Purchase workstations	5 days
Research server brand/model	1 day
Purchase server	5 days



Appendix E: Work Breakdown

Phase 2 Software Development

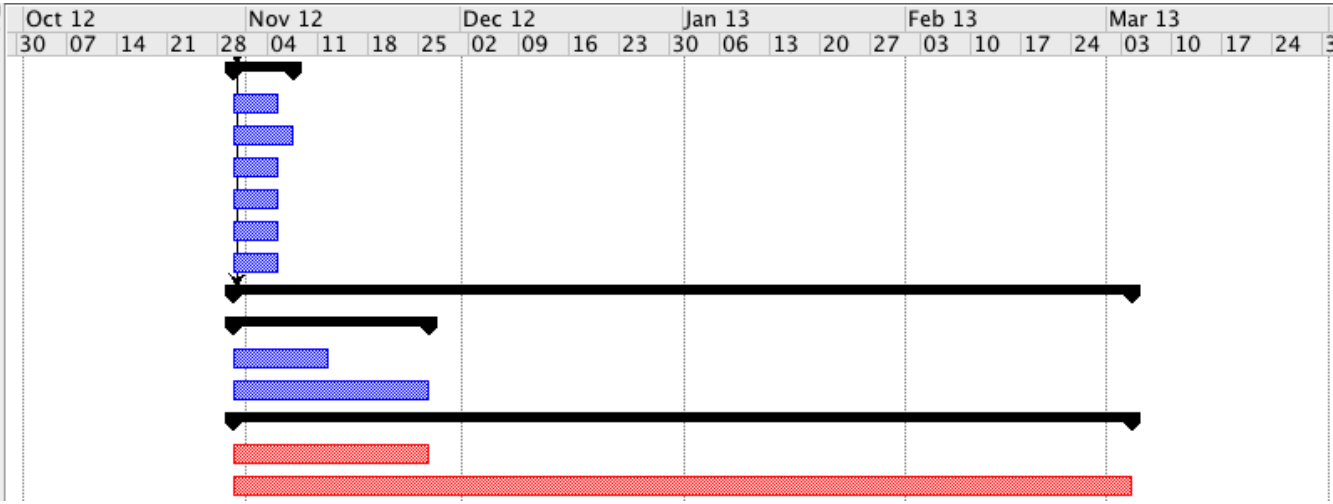
Name	Duration
⊟Software Development	62 days
⊟GUI Development	28 days
Analysis	5 days
Design	10 days
Implementation	10 days
Testing	3 days
⊟Algorithm Development	45 days
Virtual Checkpoint Allocation Algorithm	45 days
GPS Data Collection Algorithm	10 days
Route Analysis Algorithm	20 days
Congestion Notification Algorithm	10 days
⊟Database Development	52 days
Analysis	5 days
Design	15 days
Implementation	12 days
Integration	10 days
Testing	10 days
⊟Hardware Interface Development	38 days
Analysis	3 days
Design	7 days
Implementation	14 days
Testing	14 days
⊟Data Mining	52 days
Analysis	14 days
Design	21 days
Implementation	10 days
Testing	7 days
⊟Traffic Analysis Engine	62 days
Analysis	10 days
Design	22 days
Implementation	25 days
Testing	15 days



Appendix E: Work Breakdown

Phase 2 Documentation and Testing

Name	Duration
Documentation	7 days
Database Documents	5 days
Algorithm Documents	7 days
Hardware Interface Documents	5 days
Data Mining Documents	5 days
Traffic Analysis Engine Documents	5 days
GUI Documents	5 days
Testing	90 days
Alpha	20 days
Server Load Testing	10 days
System Functionality Testing	20 days
Beta	90 days
Server Load Testing	20 days
System Functionality Testing	90 days



Appendix E: Work Breakdown

Phase 3 – Yearly Recurring Cycles

Name	Duration
Phase 3	365 days
Develop Project Team	30 days
Interview/Hire marketing specialist	30 days
Interview/Hire tech support specialists	30 days
Hardware	15 days
Regional requirement assessments	10 days
Purchase additional workstations/equipment	5 days
Purchase additional servers	5 days
Technical Support	365 days
Define procedures	7 days
Specialist training	7 days
Ongoing operations	365 days
Marketing	60 days
Expansion research	25 days
Regional campaigning	60 days
Data Mining	365 days
Out-years Improvement	365 days
Software Maintenance	365 days
GUI	365 days
Algorithms	365 days
Databases	365 days
Hardware Interface	365 days
Traffic Analysis Engine	365 days
Documentation	365 days
User manual refinement	365 days