ZeroTraffic

Welcome to the future of congestion management

Version 1.0
July 2017

WEBSITE | CROWDSALE | CONTACT

1 EXECUTIVE SUMMARY

Our governments have failed to control traffic congestion repeatedly. That's because building roads is extremely expensive and tolls are unpopular. But we the people can take back control by limiting demand for using the congested/standstill roads during peak hours. The ideal target ages for our users are single and couples before having children (<33) and after children leave the home (>45). We will use non-monetary incentives using smart phones which are better than money, such as points, badges, levels, and status and seek sponsors and media who may award fuel, product discounts, recognition, etc. as well thru weekly, monthly, and yearly contests in various sizes such as cities, provinces or states and countries. This will be addictive like computer games because we will seek to put users on a dopamine treadmill.

We sell tokens which can be traded or sold by our investors. These tokens are used only for registering an authorized Deputy Mayor (DM) for a district near the preferred location of the investor and sized by payment type and competitive investor landscape in the investor's area. No equity or debt shares are provided.

ZeroTraffic believes it has a unique solution by combining pervasive user owned GPS smart phones, new gamification techniques that allow motivation and engagement to be increased with non-monetary rewards, and ZeroTraffic's unique experience in Intelligent Transportation Systems. We see the potential to reduce rush hour traffic by 10% and increase remaining travel speed by a significant factor on highways and arterial roadways.

Use of congestion fees to modify driver behaviour has been considered, but extremely high set-up and operational costs along with poor political reception has severely limited its use. Recently incentive based solutions have been studied in a number of jurisdictions (Bangalore, Netherlands, Stanford and Singapore) and results show that they can be effective.

Our solution exploits the pervasiveness of smartphone combined with local DM who are local users who (hold tokens) and have the right to update and correct for errors in the system. The smart phone becomes a virtual transponder application to eliminate the need for expensive infrastructure required in other congestion fee and incentive systems to provide a solution with very low cost of deployment. The smart phone based transponder application is used to implement exclusion zones allowing self-verification that the driver did not travel during rush hour on specified roads or regions. By removing a small amount (5-10%) of drivers from standstill congested roads and have them travel outside of rush hour, we can dramatically increase travel speed and reduce time for all.

ZeroTraffic will offer coins where investors can buy and sell coins at will and the holder of the coin is a registered DM of a district near his preferred location. Such DM will uniquely advise the company per standstill traffic areas in the district and related congestion times for end

users. Size and location of territory will be computed at close and price paid will be proportional to size of territory with respect to quantity and size of nearby coin investors. A map user interface for a district will be provided to gather DM input. Close of transaction and issuance of coins in 4 weeks after start. District areas will be distributed on software test and validation

We use gamification technology to appeal to the intrinsic motivators of the drivers to change their driving patterns. Our incentive system reduces focus on monetary awards by using well established techniques from the gaming industry to influence driver behavior. We provide an effective solution to driver behaviour modification with very low operational costs.

For the general public, our technology solution is an opt-in incentive program - a user opts-in by downloading and installing our virtual transponder application on their GPS enabled smart phone. The application is a trusted and encrypted monitoring program that verifies compliance. It only reports compliance, not any confidential position or travel information attributable to the owner. By using blue tooth proximity detection, we can verify car-pooling, and allow car pools to be an exception to rush hour exclusion.

Desired driver behaviour results in points being rewarded. For example, every day a verified compliance of travelling only outside of rush hour gets points in each direction. Points can also be earned other activities, e.g., referring a friend, getting a customized travel plan, car-pooling etc. Points, badges, and levels will be given for participation, completion and achievement used to achieve our goals for users. There are many proven techniques from the computer games industry that we will use, such as on-boarding, engagement loops, etc. The focus will be on fostering intrinsic motivation and minimizing reliance on extrinsic motivators. The system will use rewards of various general forms SAPS (Status, Access, Power, and Stuff) to best fit different motivators. Reputation enhancement will be made through social networking, and appeal to social goals will be used to foster intrinsic motivation. By making non-monetary rewards through gamification we keep the cost of operations down and provide lasting methods to motivate people.

Earlier trials show incentives can be given to reduce congestion. We innovate by having the first GPS smartphone application vs. installed transponder readers and license plate readers, by using non-monetary gamified rewards, allow verification of car-pooling through Bluetooth, and bring the experience of building the largest Intelligent Highway System in Canada to get the real problem solved uniquely well.

2 PROBLEM BACKGROUND

The cost of congestion worldwide Is in the hundreds of billions. According to INRIX congestion cost U.S. drivers nearly $300 Billion in 2016, an average of $1,400 per driver. A report on Canadian cities, "The High Cost of Congestion in Canadian Cities" concludes:

> *"This paper has reviewed the state of congestion in Canadian cities and found that in many of the country's large urban areas, it has reached acute levels that are imposing significant costs on drivers, the economy, the environment, and the quality of life of Canadians. A conservative estimate of costs is $4.6 billion annually, of which almost $3.7 billion is in the Toronto, Montréal and Vancouver regions."*

The navigation device manufacturer TomTom published the latest release of a study examining the difference in journey times between peak and off-peak hours for every major city in the World (for 2016). The three most congested cities were Mexico City with an increased travel time of 66%, Bangkok at 61%, and Jakarta at 58%.

It has been recognized in recent years that increasing capacity on a congested facility induces an increase in demand which in turn results in the facility becoming congested again. This has motivated looking into ways to modify traveler's behaviour to spread the peak demand over a larger time interval. Peak spreading results in a more efficient use of the transportation system since it reduces the concentration of travel during peak hours and increases travel during periods where there is reserve capacity

The sources of highway congestion can be grouped into:

Bottlenecks (40%)
Traffic Incidents (25%)
Work Zones (10%)
Bad Weather (15%)
Poor Signal Timing (5%)
Special Events and Others (5%)

Sources related to bottlenecks, work zones and special events can be addressed by methods that target to change driver behavior either by time shifting or route shifting.

In many jurisdictions, congestion charging or road tolls have been proposed or implemented to effect behaviour modification on road-users. These programmes attempt to manage traffic volume by imposing charges which disincentivize drivers from using heavily trafficked zones at peak hours. Congestion charging or Electronic Road Pricing (ERP) schemes have been implemented in a number of urban centres worldwide, most notably London, Stockholm and Singapore. Similar methods have also been employed for freeway traffic management, by arrangements such as High-Occupancy and Toll (HOT) lanes or Express Toll Lanes (ETL) which may levy a charge which varies by time-of-day.

In recent years, as congestion issues mount, there has been increased interest in these types of scheme. However, any behaviour modification program which relies on mandatory fees faces a number of drawbacks. Because it relies on a penalty rather than an incentive, enforcement is essential. This means that expensive infrastructure must be installed to monitor traffic by means of license plate recognition or an in-vehicle transponder. Additionally, congestion charging is frequently politically unpopular. Congestion charging is often perceived as an environmental tax, or as discriminatory towards low-income road users.

The various problems associated with congestion charging have opened the door to some alternative ways of thinking. One such approach is to use small incentives to reward desirable behavioural changes, rather than attempting to disincentivize undesirable actions. Such approaches are attractive as all that is required to modify behaviour of a small percentage of the drivers.

It is well known that congestion is a 10% phenomenon; a 10% percent of the load from peak to off-peak, congestion will come down significantly for everyone.

The reason is that as load approaches capacity, the rise in congestion is very severe at the high end.

We present in the rest of the document our solution for reducing congestion based on modifying drivers through an incentive scheme.

3 FEASIBILITY OF PROPOSED SOLUTION

We propose an innovative and unique incentive based system, ZeroTraffic, to reduce traffic congestion by influencing commuter behaviour to shift travel away from peak-hours.

ZeroTraffic has the following key elements:

Deputy Mayors who provide local/regional traffic information
Privacy enabled virtual transponder application
Gamification framework to influence commuter behaviour
Reliance on motivating commuter through intrinsic motivators such as recognition for good social and environmental behaviour
Non-reliance on monetary awards

We discuss each of the key elements below starting first with Deputy Mayors.

Deputy Mayors will receive a district near their preferred location which will allow them to mark a map per congestion and times of congestion on a scheduled basis. The Deputy Mayor doesn't need to update the map because the ZeroTraffic system will use traffic data to estimate congested areas without input. Obviously local knowledge is key especially before critical volumes of users are signed up.

A number of studies: INSINC in Singapore, CAPRI at Stanford, Spitsmidjen in Netherlands and INSTANT in Bangalore, India (see Appendix B for brief descriptions) have been conducted to evaluate the impact of reward based systems to reduce congestion by modifying commuter behaviour. The studies have demonstrated that such reward based systems are successful in their objective of modifying behaviour of a certain percentage of the commuters with overall benefits for all commuters. For example, Figure 1 taken from the Spitsmidjen programme shows the effect on the probability density function of departure time of different levels of incentive. The solid (0 Euro) line shows the pre-existing situation with no incentive in place. It may be seen that an incentive of the order of 3 Euros has a significant effect on the shape of the distribution, and that the additional change in behaviour due to a larger incentive is not significant. It may be seen that a small incentive offers better value for money in terms of departure times modified per dollar spent.

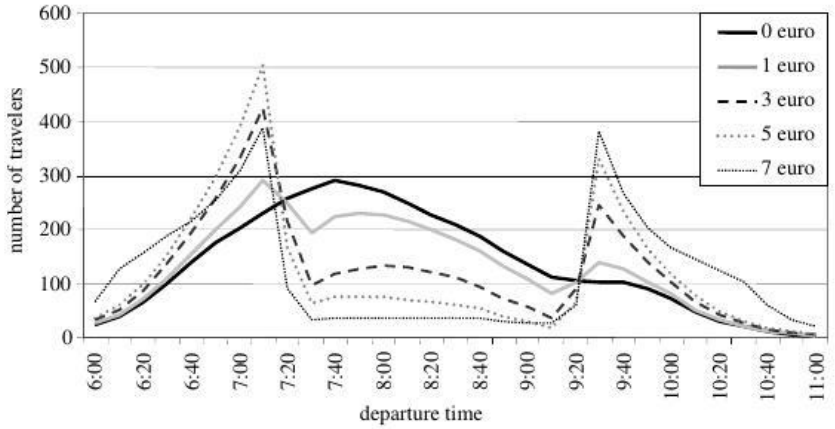

Figure 1: Effect of Different Incentive Levels on Departure Time

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We improve upon these previous studies by the introduction of a virtual transponder application, a Deputy Mayor responsible for traffic and reliance on non-monetary rewards.

What kinds of behavioural change have an impact on highway occupancy levels? The best-case scenario here is the elimination of an entire journey by means of commuter car-pooling or telecommuting. If, however, a journey simply must be made, evidence suggests that time-shifting travel away from peak-hours is a much more effective strategy than encouraging road users to re-route onto alternative roads. Re-routing is only effective where there is spare capacity elsewhere in the system, which is rarely the case in dense urban areas. Existing tools such as in-car GPS navigation units with integrated traffic information from Traffic Message Channel (TMC) make it easy for drivers to discover alternate less-trafficked routes, so any spare capacity is rapidly eliminated. Accordingly, it is much more effective to focus on encouraging commuters to time-shift their journeys away from peak hours.

We have designed ZeroTraffic to influence commuter behaviour to shift journey away from peak hours.

Congestion is a highly non-linear problem, whereby a small increase in traffic volume beyond the optimal carrying capacity of the highway results in a dramatic reduction in speed and hence in the volume of traffic carried. Figure 2 illustrates this behaviour of exponential increase in travel time close to fully congested traffic, and conversely the significant gain to be made in travel time by a reduction of as small as 10% close to full congestion. Accordingly,

an incentive scheme does not need to achieve anything near to 100% participation. If just 10% of drivers adjust their behaviour then travel times may be dramatically reduced.

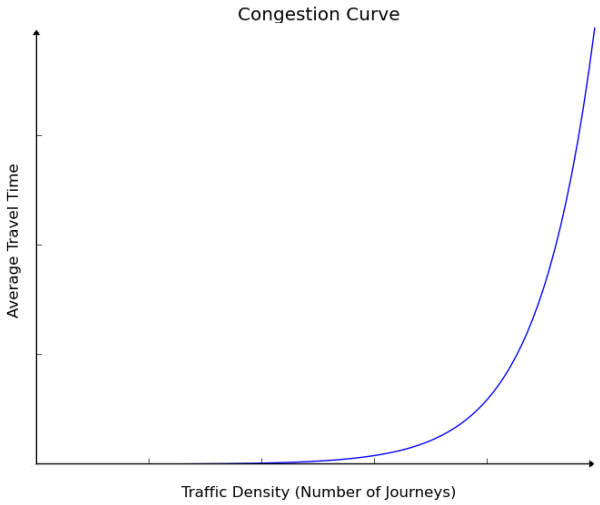

Figure 2: Effect of small reduction in congestion on travel time

This is an important observation because when modifying behaviour, the individual's constraints have to be considered. A range of factors including work, study and family commitments affect the timing and frequency of commuter travel. It is not possible for everyone to leave earlier or later for work, or from work. The fact that modifying behaviour of only 10% of the drivers can result in significant improvements in congestion bolsters the case that reward based systems can be a powerful tool in addressing traffic congestion issue.

Based on the previous studies on reward based systems we are confident that ZeroTraffic will be able to influence at least 10% of the commuters to shift their travel away from peak-hours.

A drawback of existing congestion fee based systems and reward based systems is their use of infrastructure such as transponders, transponder readers, license plate readers and associated infrastructure such as overhead gantries. This results in prohibitive deployment costs as well as limiting the use of such systems to preselected areas. We introduce the concept of a virtual transponder application which results in fractional deployment costs and provides flexibility in targeting the areas to reduce traffic. The virtual transponder application is a GPS-enabled smartphone application that detects travel within defined congestion zones and provides the key metric for the ZeroTraffic incentive system. It is also able to measure carpooling activity of registered users by making use of Bluetooth detection technology.

A large segment of the population has smartphones. This implies that the driving patterns of a large segment of the drivers can be measured (and in turn incentivized) through an application on their smartphone eliminating the need for expensive infrastructure associated with transponder readers and license plate readers. Not only does this provide significant cost savings for a specific installation, it scales easily with negligible implementation costs in new jurisdictions.

ZeroTraffic exploits the pervasiveness of smartphone use through its virtual transponder application to eliminate the need for expensive infrastructure required in other congestion fee and incentive systems to provide a solution with very low cost of deployment.

Gamification is the use of game mechanics and game design techniques in non-game contexts. Gamification works by making a technology, product or service more engaging by taking advantage of humans' psychological predisposition to engage in gaming. It can be seen as design of an incentive system which takes users through a series of actions resulting in desired behavior.

Gamification techniques have their basis in the hugely successful 71 billion dollars video-gaming industry. These techniques are now being increasingly adopted by businesses for consumer and non-consumer facing applications. Foursquare a location-based social networking website for mobile devices was an early adopter of gamification. It has been highly successful growing from its start in 2009 to over 20 million registered users today. Fitocracy uses gamification to help users improve their fitness. It was launched in February 2011 and has over 600,000 users today. Samsung consumer facing website SamsungNation has received 66% more visitors and 309% more comments since it has integrated gamification elements. Gamification is also being used successfully by businesses promoting social good and environmental responsibility, e.g., Practically Green, Recyclebank. We provide a list of references in Appendix D for the reader interested in learning about gamification.

A gamification website will be developed for ZeroTraffic to capitalize on the proven success of gamified systems to engage members online while influencing behaviours offline.

Key to success of gamification is that it provides meaning; gamified applications should connect to what is already meaningful to the user. Also, research into human behaviour demonstrates that people are motivated by challenges that feel inherently worthwhile. ZeroTraffic with its aim to reducing traffic congestion and improving travel times for drivers is an ideal candidate for gamification.

The prevalence of smartphones with sensors (GPS, accelerometers, cameras, microphones) and the popularity of native applications have resulted in users increasingly willing to track, reflect and modify their behaviour. ZeroTraffic gamification strategy will be well accepted by smartphone users.

ZeroTraffic will appeal to multiple intrinsic motivations of users: reduce traffic congestion, social good, environmentally responsible, to motivate drivers to shift their travel times.

ZeroTraffic uses gamification technology to appeal to the intrinsic motivators of the drivers to change their driving patterns. The incentive system of ZeroTraffic reduces focus on monetary awards by using well established techniques from the gaming industry to influence driver behavior. ZeroTraffic provides an effective solution to driver behaviour modification with very low operational costs.

We discuss next some important aspects that we have considered in the process of the design of gamified system for ZeroTraffic. We followed the process outlined in the seminal book "For the Win" (by Werbach, K. and Hunter, D., Wharton Digital Press) to analyse the requirements of the gamified system for ZeroTraffic and an initial identification of design elements.

A major criticism of gamification is that it can become a means of exploitation or manipulation. This is not an issue for ZeroTraffic as the objective of the system is driven by typical commuter interests – saving time, doing social good, being environmentally responsible. Additionally, it is also in the Deputy Mayor's interest to provide local accurate feedback since failing to do so could potentially increase traffic in that DM's congestion zone.

It is essential to carefully consider all the different motivations that users may have for engaging with the system. Commuters are a diverse group of individuals, encompassing many different income levels and belief systems. A successful programme will reach out to several different groups of users, each of whom may have different motivations for wishing to participate. A rich, interactive website is vitally important for connecting with the public and with the particular motivations of different groups.

When designing any incentive-based system, it is important to be aware of some basic human psychology. Motivations may be one of two types – 'intrinsic' or 'extrinsic.' An intrinsic motivation is one for which the reward is a direct result of the action in question – for example the desire to minimize one's environmental impact is an intrinsic motivation. An extrinsic motivation, on the other hand, is externally supplied – for example many people return their empty beer bottles in order to collect the deposit money. Care must be taken when designing any system of incentives, since it is well known that intrinsic motivation is generally stronger

than extrinsic motivation, but a poorly-thought-out reward may crush an individual's intrinsic motivation.

There is also evidence to suggest that building social networking features into such a website will improve user engagement and retention. The more socially-engaged an individual user is with others on a website, the more engaged he or she is likely to be with the wider aims of the programme. In particular, the Stanford CAPRI platform included provision for social networking features. When the social graph data was analyzed there was a strong correlation between users who had many online 'friends' on the system and those who effected the greatest modification in their own behaviour. Social features include the means to create use profiles and other content such as bulletin boards, forums or 'walls' containing messages and pictures, mechanisms for discovering and interacting with other users and the ability to form and join teams. Many of the features found on popular social networking sites such as Facebook and LinkedIn are valuable for deepening user engagement with one another and with the programme. In the context of commuters, social networking methodology may be used to provide channels for users to explore 'Green' fuel-saving tips, organize car pools to reduce the number of single car trips taken, or simply socialize and chat. Teaming functions may be incorporated allowing users to join a team of other users from their workplace or neighbourhood and compete with other teams in order to achieve recognition for the group.

Finally, by incorporating interactive elements such as quizzes and mini games, together with social features such as the ability to 'friend' other users, the website provides a novel channel for messaging to the most engaged group of regular road users. It may be used as a low-cost way to educate road users on issues related to safety, economy and environmental responsibility. At the same time, the site may serve as a rich source of data on the preferences and opinions of road-users, which may serve to inform future government policy directions.

A brief discussion of the implementation of ZeroTraffic is presented in Section 4. An outline of the steps in the setup of ZeroTraffic is presented below:

Identification of congestion zones: Congestion zones are the highway extents where peak traffic flow is encountered at rush hour. A congestion zone is defined in terms of a highway, direction, and bounded by an upstream and a downstream crossing. Each identified congestion zone has a number of time-ranges associated with it corresponding to peak hours. In Toronto, for example, there may be a congestion zone on Hwy 401 Eastbound from Yonge to Bayview in both express and collector from 8am to 10am and from 4pm to 6pm.

User Registration: General users are registered in the system with the following information: home address, work address and normal working hours. A user account is created with their selected login, password and user name.

Trip planning and advice: When first registered (and thence on a regular basis), the system will perform a shortest-path routing to determine the most direct route from home to work and back for each user. The number of congestion zones on the route is enumerated. The system works out an alternate route or route avoiding as many of the congestion zones as possible. This is offered to the user as an alternate routing suggestion. Points available by avoiding different congestion zones are shown to the user. The system also shows the user the points available for travel at different times. These alternatives are presented to the user allowing them to choose to alter their route or their time of arrival to avoid the congestion zones and collect the points.

Information Presentation: The ZeroTraffic website will present information such as the projected time and dollar savings due to time-shifting the route. This may be shown not only for a single journey segment but also for a work week, a calendar month and for an entire year. Users may be surprised to see how much the savings add up to if they are able to shift their work day to off-peak hours year-round.

Discussion and Chat Forums: The ZeroTraffic website will provide discussion and chat forums to discuss issues related to traffic, trip planning, fuel efficiency, environmental impacts etc.

Point Awards: Points will be awarded for many activities to support both primary and secondary objectives of the system. These activities will include:

- Congestion zone avoidance
- Carpooling
- Use of monthly transit pass
- Referral to new users
- Regular login into ZeroTraffic website
- Contribution to discussions on ZeroTraffic website
- Sharing of success stories resulting from use of ZeroTraffic

Points will be used for awards of badges, levels, leader boards places to motivate the users to accumulate points. Provision will be made to use points for:

- Games with real rewards - perhaps a lottery or a simple interactive game, where users may wager points for the possibility of monetary awards. Such rewards will consist of cash, coupons, branded royalty points made possible by corporate sponsorship.
- Competition between individual users and between teams of users.

4 PROPOSED SOLUTION

The main components of ZeroTraffic are the virtual transponder application and the gamification website. Together they provide the means to collect metrics on user compliance with avoiding congestion zones and the incentive scheme to engage and modify driver traffic patterns to achieve the goal of reduced traffic congestion. Each of these components is elaborated below.

1. Virtual Transponder Application

The virtual transponder application refers to a GPS-enabled smartphone application. A smartphone application will be developed for all major platforms (Android, iPhone and Blackberry) and will be made available to free of charge to all programme participants via the Apple App Store, Google Play market or Blackberry App World as applicable.

The primary purpose of this application will be to calculate the metrics used for the incentive program to award points. The parameters required for the calculation of the metrics: exclusions zone, home and work addresses will be stored on the smartphone. The congestion zones can be defined by the transportation authorities to best address the key congestion points. The congestion zones are defined by the location and time. Each congestion zone is monitored by a Deputy Mayor.

The GPS location and time will be used to determine whether the user is within or outside of an exclusion zone.

As an illustration consider Toronto. Figure 3 shows congestion zones, one defined over a section of Highway 401in, and the other covering the downtown core.

Figure 3: Congestion Zones

On a regular basis as determined by the user through the application settings, the application will prepare a summary report with the metrics as an email and upon confirmation by the user send it to the gamification server where it will be attached to the user account. In addition, the smartphone application will record time and location on regular intervals, anonymize it, encrypt it using HTTPS and transmit it to the central web server where it will be stored without any attachment to the user account. The purpose of this data is to collect data flow for traffic status and planning purposes. Congested zones will be streets which typically have standstill traffic and are to be drawn on a map by DMs and accepted and edited by ZeroTraffic coordinators.

The application will also include a Bluetooth detector which will allow ZeroTraffic to assign rewards to registered users who may be in exclusion zone but are carpooling.

2. Gamification Framework

The gamification framework is central to ZeroTraffic. It employs game elements in non-game environments as a way to encourage drivers to adopt desired behaviours. It will engage users online with the aim to influence and modify their behaviour offline. It is

based on lessons learnt from the 70-billion-dollar video-gaming industry on user engagement, granting rewards targeted to specific motivators. The idea is to target intrinsic motivators of the users such as social good, environmental impact to keep them engaged and motivate them to modify their driving behaviour. The complete design of the gamification framework will consist of the following main components:

2.1. Rich, gamified, socially-enabled website

A key user-visible part of the system is the ZeroTraffic website. The website is the primary portal through which users experience the system, review their past performance, set goals and receive rewards or incentives.

2.2. Reward Calculation Algorithms

ZeroTraffic will use the collected metrics from the Deputy Mayors and virtual transponder application as the primary input to calculating credits to be awarded to the uses. Credits/Tokens? will also be awarded for other activities beneficial to the overall goal of congestion reduction. This can include referral to potential new users, switch to fuel efficient or hybrid cars, sharing of benefits resulting from use of system, allow use of anonymized travel patterns from the virtual transponder application, etc. Behavioural psychology research has indicated that individuals are more motivated by the chance to receive a larger prize, as opposed to the certainty of a small award, even when the overall expected pay-out is the same. This insight will be used, in future if the source of funding (e.g. corporate sponsors) exists, to create games which will allow the user to exchange the credits they earn for small monetary rewards.

2.3. Social elements

In conjunction with the rewards, it has been seen that social factors are of key importance in reshaping user behaviour. The INSINC and Stanford Capri pilot programmes indicate that the more 'friends' a user has within the system, the greater the behaviour modification. The implication is that users will be motivated by competition with their friends. An alternative paradigm which may also be effective is to allow users to form and join teams (for example for a certain workplace or neighbourhood). The addition of teams allows for competition with a more cooperative and social flavour. It is important to realize that different groups of target users have different weightings for the various motivations: accumulation of rewards, competition with other individuals, cooperation with team members and so forth.

The ZeroTraffic website will support common social networking facilities, such as forums, user profiles and discussion groups, with the aim of building a robust and cohesive user community. The connections between users may be examined as a social graph. This social graph, in conjunction with other data generated by the system (such as the trace

of individual journeys taken) permits analysis to be performed which may yield novel insights into the nature of traffic flows and journey intents. This information may be used as feedback to 'tune' the rules of the game in order to achieve maximum effectiveness.

2.4. 'Gamified' challenges

The gamification website will provide a number of activities and challenges to create an environment that leaves the user in control and provides an enjoyable experience while guiding the user through a series of actions that lead to intended goals of social good – reduced traffic congestion. Gamified features which may be included in the ZeroTraffic website include the award of points for completing certain actions and the presentation of badges to reflect user achievements. For example, a user may be awarded a 'Green Commuter' badge, which is then displayed in her user profile for her friends and other team members to see. Leader boards may be used to track overall and team standings. Interactive mini-games may be incorporated, perhaps as a mechanism for implementing a reward lottery in a more interactive and compelling manner.

4.1 ISSUES

Our proposed solution addresses issues key to wide acceptance by users, namely respecting user data privacy concerns and maintaining the fairness and integrity of reward policies. The virtual transponder solution that we have put forward preserves the user anonymity in the data available to the central server. The reward system based on the best techniques and processes from the gamification field has been designed with full awareness of the pitfalls of a system not being perceived as fair. Our solution is also designed to eliminate the driver distraction making it safe for adoption by the public.

4.1.1 User Privacy

Users today are acutely aware of their privacy rights and are wary of joining programs where sensitive information such as their travel may be collected. A system that provides the user assurance that location and travel data that can be attributed to them is not collected would alleviate their concerns and greatly increase participation. ZeroTraffic provides this assurance.

ZeroTraffic application will clearly state what information is collected, what of this is personally identifiable, why this information is collected and how this information is used. Measures in place for data security will also be well publicized at the gamification website.

When the user registers with ZeroTraffic the only information kept with the user account is the login and password, user selected name (for use on the gamification website), user email, and home and work address.

Data collected by the smartphone application will be anonymized, the travel history will not be stored directly with a user account. The purpose of collecting this data is to provide current traffic flow data for better planning by the transpiration agencies. For this purpose, only aggregate data is sufficient, there is no need to associate it with a user. The smartphone application will record time and location, encrypt it using HTTPS and transmit it to the central web server. The encryption prevents man-in-the-middle eavesdropping. Sending of such information will be optional (via application setting) and the user may turn it off. However, to encourage the user to participate in this anonymized data collection, ZeroTraffic will offer a nominal number of credits on a regular basis to users who do opt to send this information.

The metrics used for the incentive program to award credits are calculated by the smartphone application itself and the confidential data does not go further than the smartphone. The parameters required for the calculation of the metrics, exclusions zone, home and work addresses will be stored on the smartphone. On a regular basis as determined by the user through the application settings, the application will prepare a summary report with the metrics as an email and upon confirmation by the user send it to the gamification server where it will be attached to the user account. The metrics information will be the primary method to collect credits awarded by the ZeroTraffic program.

A benefit of the reward based system is that an extremely skeptical user who on occasion may not want his travel tagged in any way can turn off the application for that particular travel. He can then continue to use the application the rest 99.9% of the time. Such extreme users can still participate in the ZeroTraffic system.

4.1.2 Driver Distraction

A number of measures will be taken to avoid driver distraction and to encourage compliance with the ban on the use of hand held devices in Ontario.

The ZeroTraffic smartphone application is designed to collect aggregate information on the driver compliance with travel outside of congestion zone. It can collect this information while running in the background and does not need any user interaction for this purpose.

The application settings will by default impose strict compliance with the ban on the use of handheld devices. When the device detects it is in motion, the smartphone application will display a safety warning reminding the user that it is against the law in Ontario to interact with a hand-held device while driving. It will solicit user interaction by providing access to interactive function only when the device senses it has been stationary for a number of seconds.

To allow the possibility for access to interactive functions when the user is not the driver, e.g., when the user is a passenger in a moving vehicle or walking, the application settings will allow the user to override this restriction. In such cases a warning message will be displayed to the user and the user will be prompted to acknowledge that he is aware of the ban and his use of the device is in compliance with the ban. Further, each time the device is turned on or the application started it will revert to the default setting.

4.1.3 Integrity of the Incentive Regimen

It is important to establish and maintain the fairness and integrity of the incentive regimen, i.e., rewards are provided only to individuals who benefit the ZeroTraffic program objectives and that it is seen to be fair in that it does provide rewards to all individuals whose travel patterns do benefit the program objectives.

In general, where the rewards are small, we needn't be too concerned that users will expend much effort on cheating, but care must be taken to ensure that individuals are not able manipulate the system for gain.

The system will be agnostic to the behaviour of people prior to the implementation of the system, e.g., if a driver was travelling off-peak prior to the implementation of the system, the driver would still be eligible to participate in the program and benefit from the rewards if offers if the driver continues to avoid the exclusion zones. This has the advantage of keeping the system fair to people who have already adopted good behaviour and also reduces the costs associated with tracking existing behaviour.

Since the credits are attached to users through their smartphone and not to the vehicle (which may be the case for a system based on license plate readers) it eliminates the possibility of user with multiple vehicles registering one vehicle and driving a different vehicle in the congestion zone and still collecting credits.

An important objective is to confine rewards to the target group - commuters who drive or carpool to and from work on a regular basis.

The act of registering with the system will require the user to provide his home and work address. This provides an initial filter to ensure that the registered user belongs to the target group. The system will check that the addresses provided are real, they are apart at least a pre-specified distance, and there exists a reasonable route between the addresses that passes through the congestion zones.

The program can target large employers in addition to individual commuters. If employer decides to sign up with ZeroTraffic, that employer will coordinate the induction of employees

into the programme, which ensures that all target users are indeed employees and that their home and work addresses are recorded accurately. Employers who sign up will receive recognition on the ZeroTraffic gamification site, possibly at different levels reflecting the participation level of their employees.

In case of rewards larger than nominal (e.g. acquired by accumulating a large number of points and then building upon it using the games provided on the ZeroTraffic website) a verification can be done that the individual commutes on a regular basis and the work and home addresses provided to the system are valid.

5 BENEFITS

ZeroTraffic program is an innovative program that exploits the ubiquitous presence of smartphones and the latest developments in gamification to provide an efficient and cost-effective solution to the problem of traffic congestion. The efficacy of the reward based approach and gamification techniques is supported by a number of studies in USA, Singapore, Netherlands and India.

ZeroTraffic builds upon the approach used in these studies to improve the deployment and delivery of the solution through its use of the virtual transponder concept and use of richer gamification. The virtual transponder application eliminates the need for expensive infrastructure while the gamification strategy targets intrinsic motivators reducing the reliance on monetary awards resulting in extremely low operational costs for the program. The benefits provided by ZeroTraffic include:

Cost Savings from Reduction in Traffic Congestion

According to INRIX 730,000 hours of driving time are lost every year to congestion. Reducing congestion simply saves money. Based on studies on reward based incentive system carried out elsewhere and the use of advanced gamification techniques in Zerotraffic a 10% or higher reduction in congestion can be conservatively expected. Given the minimal deployment and operational costs as discussed below, the economic benefits of Zerotraffic is significant providing a ROI of 100 times or higher.

Low Deployment Costs

The deployment costs of competitive congestion fee based systems are very high. In addition to equipment such as license plate readers, transponder readers, special infrastructure has to be put in place, e.g., overhead gantries to mount license plate readers or transponder readers, medians and barriers have to be put in place to separate regular lanes from express lanes, etc. For example, the E-ZPass on the Ohio turnpike cost in excess of $50 million in 2009; it cost $134 million to build the express lanes along a 10-mile section of the median of California State Route 91 freeway; and implementation costs for the first two years of the London plan were approximately $348 million.

By comparison, the cost for deploying Zerotraffic program will be negligible. It only requires development of application for a variety of smartphone platforms, design and implementation of the gamification website, integration and test runs, initial publicity and advertising. A key component of the ZEROTRAFFIC solution is the user smartphone itself reducing the high equipment and infrastructure costs.

Low Operational Costs

Not only the deployment but the operation costs of congestion fee based systems can be high. It has been estimated that operating and maintenance costs of toll collection are on the average about 20% of revenues. A study of New Jersey' Garden State parkway showed that the figure was as high as 37%. The operating expenses for the tolling system on the California State Route 91 freeway were almost $24 million in 2006.

Zerotraffic relies on engaging users and motivating them to modify their driving patterns through techniques and lessons learnt from the video gaming industry and employed with great success in non-gaming applications, e.g., Foursquare, SamsungNet, RecycleBank. The focus of Zerotraffic is to provide non-monetary awards which can address better the intrinsic motivators essential to long term involvement of the users. The key motivator used by Zerotraffic is the recognition of the user being a responsible citizen contributing to the reduction in traffic congestion and the resulting economic savings to the society (in the order of hundreds of millions of dollars) as well as environmental benefits. Visible social recognition is a strong motivator and has proven successful in programs such as PracticallyGreen, RecycleBank, Fitocracy in other domains.

For the small segment of population that may not be motivated by altruism, the program can also actively solicit corporate sponsors to provide material rewards including cash prizes, corporate branded rewards (Aerpolan, Petro-Points, Shoppers Optimum Points etc.) or coupons.

The cost for operating Zerotraffic is expected to be minimal: servers to collect and analyze the data, servers to run the Zerotraffic gamification website, help desk staff to assist the users, on-going publicity and advertising costs, with negligible costs for the monetary awards. The low operational costs make it easy to support Zerotraffic on a continual basis.

No Cost to Users

Not only does Zerotraffic provide the user the opportunity to earn rewards while contributing to helping ease the traffic gridlock, unlike most congestion fee programs it requires no user investment in new equipment such as transponders. The smartphone application will make negligible demand of the cellular data bandwidth.

Improved Traffic Flow Information

The smartphone application will provide anonymized location data to the central servers. This data is of great value in updating traffic flow information and can be used to improve traffic light signaling, planning and for traffic dissemination services.

Engagement of Corporations

The Zerotraffic program provides a ready opportunity to corporations to be highly visible in being a socially responsible corporate citizen by supporting the solution of traffic congestion problems and green initiatives. They can do this by sponsoring rewards and by supporting employees in participation in the program.

Long Term Engagement of Users

The Zerotraffic program supplements the basic reward based behaviour modification of the driver with the latest insight and techniques from the new field of gamification. This allows it to not only attract new users, but to keep the current users engaged and participating in the program. Gamification techniques also allow the system to attract and keep different type of users, i.e., users with different motivations: extrinsic rewards, intrinsic rewards, social networking, and recognition as game leaders etc. The gaming aspects of the program are flexible and can be easily augmented and adapted to target new motivators.

Public Acceptance

Congestion fee programs face considerable resistance from the public as they are seen to be punitive and favouring the segment of population that can afford the fees. In fact, though such programs have been put forward in many jurisdictions they get rejected for political reasons, e.g., Mayor Michael Bloomberg's failed attempt to implement congestion pricing in New York City. The proposal did not meet legislative approval and was dropped without going forward to a vote in 2008. Congestion charging is often perceived as an environmental tax, or as discriminatory towards low-income road users. HOT and ETL lanes have been referred to derisively as "Lexus Lanes."

The Zerotraffic program, a positive incentive program with no new user costs will not suffer from such negative perceptions. Indeed, a scheme such as ZeroTraffic which offers positive reinforcements for behaviour that benefits the public with reduced travel time, reduced fuel costs, environmental benefits such as reduced emissions, noise etc., will be welcomed by the public making.

6 CONCLUSIONS AND RECOMMENDATIONS

In summary, our governments have failed to control traffic congestion repeatedly. That's because building roads is extremely expensive and tolls are unpopular. But we the people can take back control by limiting demand for using only the congested/standstill roads during peak hours. The ideal target ages for our users are single and couples before having children (<33) and after children leave the home (>45). We will use non-monetary incentives using smart phones which are better than money, such as points, badges, levels and status and seek sponsors and media who may award fuel, product discounts, recognition, etc. as well thru weekly monthly and yearly contests in various sizes such as cities, provinces or states and countries. This will be addictive like computer games because we will seek to put users on a dopamine treadmill.

We sell tokens which can be traded or sold by our investors. These tokens are used only for registering an authorized Deputy Mayor for a district near the preferred location of the investor and sized by payment type and competitive investor landscape in the investor's area. No equity or debt shares are provided.

The solution to congestion will require a combination of different strategies and techniques. At present, transportation authorities continue to address it with plans to increase road capacity, improvements in public transit, traffic flow (e.g. traffic signalling), traffic information dissemination to the travellers and encouragement for carpooling (e.g. HOV lanes). Use of congestion fees to modify driver behaviour has been considered, but extremely high set-up and operational costs along with poor political reception has severely limited its use.

We propose Zerotraffic as an innovative and unique tool to the transportation authorities in their fight against traffic congestion. The Zerotraffic uses a privacy enabled virtual transponder application to collect metrics on driver compliance with avoiding congestion zones (as defined by the authorities), it employs a gamification framework for incentive design that targets drivers' intrinsic motivators to obtain the intended result of modifying the driver behaviour to shift travel times from the peak hours to off-peak hours. Zerotraffic builds upon lessons learnt from previous attempts at reward based approaches to traffic behaviour modification. The use of virtual transponder application minimizes set-up costs and the use of a richer gamification framework allows the use of non-monetary awards as incentives. These innovations result in significantly low set-up and operational costs. Combining this with the expected behaviour modification of 10% or higher of the drivers will result in significant saving to the economy, e.g., savings of 400 million dollars or higher to the Toronto economy.

We will monitor the performance of the deployed system. We will adjust and improve Zerotraffic based on feedback and lessons learnt will be used to continually fine tune the

virtual transponder application and the gamification framework to improve system performance.

6.1 Crowdsale

Crowdsale information can be found on the ZeroTraffic website.

6.2 Contact Information

Please contact any of the following staff for further information on ZeroTraffic.:

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7 SCHEDULE

The overall schedule for project is planned to be 12 months to full on-going operation divided into the following phases:

Implementation Phase

The Implementation phase will last 8 months. During this phase, the virtual transponder application and the gamified ZeroTraffic website will be implemented.

Evaluation Phase

The Evaluation phase is planned to be of 2 months duration. The readiness of the system for release to the public will be evaluated during the evaluation phase. Updates to the virtual transponder app and the gamified ZeroTraffic website will be made as needed.

Production Roll-Out Phase

The Production Roll-Out phase is planned to be of 2 months duration. ZeroTraffic will be rolled out over all territories over this period. Updates to the virtual transponder app and the gamified ZeroTraffic website will be made as needed.

Operation Phase

ZeroTraffic will be fully operational and supported across all territories. Data and results will be collected and analyzed. Improvements will be made to the virtual app and the website as necessary.

The major phases and associated deliverables are shown in the Table 1 below.

Table 1 Schedule

Timeline (Months)	Phase
0 – 8	Implementation ✓ Implement Virtual Transponder Application ✓ Implement Gamified ZeroTraffic Website ✓ Publicity of the ZeroTraffic program
8 – 10	Evaluation ✓ Evaluation of ZeroTraffic Website ✓ Evaluation of Virtual Transponder App ✓ Tuning of System Parameters ✓ Tuning of Incentive Scheme ✓ Updates to ZeroTraffic Website ✓ Updates to Virtual Transponder App ✓ Publicity of the ZeroTraffic program
10 – 12	Production Roll-Out ✓ Roll-out of ZeroTraffic across all territories ✓ ZeroTraffic Operation Support ✓ User Support ✓ Maintenance and Update of Virtual Transponder App ✓ Maintenance and Updates of ZeroTraffic Website
12 – Ongoing	Operation Phase ✓ ZeroTraffic operation support ✓ Review and incorporation of feedback from Deputy Mayors and Users ✓ Data Analysis and Tuning of System Algorithms and parameters ✓ Maintenance of Virtual Transponder App ✓ Maintenance of ZeroTraffic website ✓ Publicity of the ZeroTraffic program

Appendix A – Biographies

Stuart Berkowitz, CEO and President

Prior to Zerotraffic, Stuart founded Array Systems Computing Inc. while he was a Ph.D. student at the University of Toronto, in 1981. He received a BSc in Computer Science from Cornell University in 1975, and achieved a MS in Mathematics from the University of Illinois in 1976. He has written several papers and articles in mathematics and new technologies. He devised the fastest parallel method for inverting a matrix or computing the determinant. He has two patents.

He founded, operated and sold Array Telecom Inc, specializing in Voice Over Internet Protocol, to Comdial in 1998 and VoiceGenie Technologies Inc, a Voice XML company, to Alcatel in 2006. VoiceGenie had number one North American market share in 2004 according to the Gartner Group. These spin out efforts capitalized on promising technologies pioneered by Array Systems Computing Inc. He is planning on other spinouts.

Stuart was an active member of the Young Presidents Organization and was on the board of the World Presidents Organization in Toronto. In 1994 and again in 1995, he was honoured as one of the Top 100 Ontario Entrepreneurs.

Kristopher Huber, Chief Technology Officer (CTO)

As the Chief Technology Officer (CTO) of ZeroTraffic, Kris surveys and assesses the impact of new and emerging technologies on the company. He guides the company on its technical direction, and through consultation with clients and stakeholders develops new technologies and strategies for improving the company's competitive performance within a given industry.

Kris has 10 years of R&D expertise emphasizing the development of relevant and innovative research initiatives. Before becoming the CTO of Array, Kris was the Manager of R&D at Array Systems. Kris received his PhD in Electrical Engineering in 2005 from McMaster University.

Rajesh Jha, VP of Engineering

As VP of Engineering, Rajesh manages the engineering department and oversees all projects within ZeroTraffic He has over fifteen years of experience managing projects in application areas such as sonar, radar, remote sensing, modelling and simulation, and intelligent transportation systems.

Rajesh has an M.A.Sc. degree in Engineering from the University of Toronto and B.Tech. degree in Engineering from the Indian Institute of Technology (IIT), Delhi. He also has his Project Management Professional (PMP) Certification.

Roberta Webber-Manners, Project Engineer

Roberta has over 19 years of experience as a Software Engineer, Software Lead and Project Engineer on a wide range of sonar, radar and intelligent transportation systems at Array.

Roberta received her D.Phil in Engineering Science and M.Eng. degree in Engineering and Computing Science, both at the University of Oxford.

Roberta has significant experience in ITS systems, she has implemented, delivered and provided support in roll-out and post production for a number of systems for the Next Generation COMPASS System (NGCS) for Ministry of Transportation, Ontario (MTO). Roberta designed and implemented the Database Manager (DBM) Distributed Function which integrates with the NGCS Traffic Manager (TM), DMS Message Writer (DMSMW) and Browser-Based User Interface (BBUI) functions to complete the Next Generation COMPASS System (NGCS) intelligent transportation system traffic control centre software. She also led the design, implementation and delivery of the NGCS-Lite

Appendix B – ZeroTraffic Background

ZeroTraffic's involvement in the field of Intelligent Transportation Systems began with the founding of a predecessor company in 1981, which employed the initial ZeroTraffic employees. Our very first project was the implementation of intelligent traffic signal control software for the former Metro Toronto Traffic Control Centre (MTTCC). We continued to be involved in the implementation and post-delivery support for this system throughout the 1980s and into the 1990s.

In the early 1990s, MTTCC awarded the staff at ZeroTraffic the Central MUX Integration (CMI) project. This program had the objective of integrating a legacy multiplexer and the traffic cell software previously developed by ZeroTraffic onto a new QNX-based platform. The software consisted of three main components - the Systems Software, CMUX Emulator and Traffic Task. This software was delivered to MTTCC in 1993.

Further work for MTTCC followed, including a rework of the Metro Transportation's plan change system, a communication reconfiguration project, and a requirements analysis and feasibility study for the proposed Traffic Signal Control System. In the mid 1990s, ZeroTraffic's core team performed an upgrade of the Metro Transportation Traffic Signal Control System (TSCS) for Metro Toronto Transportation.

From 2005 to 2011, ZeroTraffic's experience include actively involved in the development of the Ontario Ministry of Transportation's Next Generation COMPASS System (NGCS). The NGCS replace the existing infrastructure in the COMPASS Traffic Operations Centres (TOCs) which has been in operation since 1991. The COMPASS system is the freeway traffic management system for all the 400-series freeways in the Province of Ontario, including Highway 401, which includes the busiest stretch of highway in North America.

Our chief engineers delivered to MTO in 2015 a light version of NGCS which can be deployed within smaller jurisdictions and have been supporting MTO in the maintenance, upgrades and roll-out of the ITS software.