

SYSTEM AND METHOD FOR FLEXIBLE AND EFFICIENT PUBLIC TRANSPORTATION

BACKGROUND OF THE INVENTION

[001] The present invention relates to a flexible and efficient system
5 and a method for providing public transportation by taxi cab.

[002] The common modes of public transportation currently deployed in
cities around the world are trains, buses and taxi cabs. Trains run on fixed
routes and often fixed schedules. This mode of transportation requires
10 passengers to travel to, and board at, designated train stations. These stations
are often far apart and thus passengers have to walk a fair distance or take
another mode of transportation such as buses to and from the stations.

[003] Some governments have encouraged customers to cycle to the
15 train stations before taking the trains. However, this creates additional
problems of having to install and maintain bicycle racks at the train stations as
well as add preventive measures to deter theft of bicycles. However, since
bicycles are generally not allowed on trains, customers will still have to rely on
walking or taking public buses to their destinations after alighting from trains.
20 Even if they are allowed on trains, the bicycles take up space leading to the
inconvenience and discomfort of other passengers as well as reducing the
throughput for the trains.

[004] Like trains, buses run on fixed routes but on varying schedules due to traffic conditions. This mode of transportation also requires customers to travel to and board at designated bus stops. These stations are not as far apart
5 but the customers still have to walk a fair distance to and from the bus stops.

[005] The above two modes of public transportation can be inconvenient to people who are mobility-impaired, late for appointments, do not want to make multiple transfers or are just too lazy to walk to and from the train
10 station or bus stop.

[006] The third form of public transportation, taxi cabs, offers more flexibility but at a higher cost to their customers. They do not follow fixed routes, schedules or designated stops but are available on-demand to the customers
15 who flag them down on the street or make requests with the taxi cab companies.

[007] However when demand for taxi cabs is high, potential customers often cannot obtain service. As taxi cabs do not follow fixed routes and cab
20 drivers get to keep their own earnings, these drivers make their own judgments and proceed to where they believe the demands are high. This often leads to a concentration of taxi cabs in popular areas and leaves other areas without enough cabs to file the demand.

[008] Taxi cabs travel the roads when empty to look for passengers, leading to unnecessary wastage of fuel as well as adding to the limited capacity of the road network.

5 [009] Taxi companies do not have complete control over the movement of their cab drivers since they utilize a bidding system for on-demand requests. Therefore, even when prospective customers in remote areas send requests for cabs, cab drivers may not want to travel to these areas and these requests are left unfulfilled or have very long response time.

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[0010] Furthermore, as taxi cab drivers earn money per trip, it is in their best interest to maximize the number of trips. Finally, customers also do not like to share taxi cabs as it may be difficult to divide the cab fares. As a consequence, taxi cabs are usually not being utilized to their maximum
15 capacity.

[0011] Quite a number of systems exist which are designed to improve the service provided by taxi cabs. For example, the U.S. Patent No. 5,168,451 discloses a "User Responsive Transit System" which includes a central
20 dispatch computer for managing customer requests for cabs and selecting cabs to fill these requests. The computer determines the most efficient vehicles to dispatch by calculating the total added travel distance to service each request in relation to the dispatches previously assigned. This system contemplates

that each cab carries only one customer at a time, and that each cab driver determines his/her own route to the pick-up and destination locations.

[0012] The US Patent Publication 2004/0158483 A1 discloses a method
5 for “flexible automobile sharing” based on demand which utilizes a fleet of
vehicles equipped with GPS tracking, on-board navigational guidance and
wireless communication between the vehicle drivers and a “central ride
matching center.” Drivers, who are normally customers themselves, are guided
to pick up passengers along the way that want to travel to the same
10 destination, thus forming car-pools that utilize the excess capacity of the
vehicles. The drivers are compensated for transporting these passengers.

[0013] The U.S. Patent No. 7,840,427 discloses another, similar system
for utilizing the excess capacity of motor vehicles, particularly vehicles used in
15 commuting to and from work. The system matches the supply and demand of
transportation services, enabling vehicle owners to sell, and customers to hire,
the excess capacity in real time, with the advantage of “trusted security” by
prescreening “approved” drivers with “clean” records. Customers are presented
with the probability of a vehicle in their vicinity prior to their departure and they
20 may be directed to move to a more convenient pick-up point. Billing information
is calculated and sent to the customer at the end of the trip.

[0014] The U.S. Patent Publication No. 2011/0099040 A1 discloses a
“Mobile Taxi Dispatch System” that selects taxi cabs to fulfill customer requests

based on a number of criteria, such as time of availability, distance from the customer and customer preferences. The system makes an initial selection and sends the request to the selected cab drivers for bidding. The system then makes a final selection from among the cab drivers that accepted and bid on
5 the request.

[0015] In another form of public transportation, private vehicle owners are allowed to offer the spare capacity of their vehicles to customers that go on the same routes or to the same destinations in exchange for some
10 compensation. Although this car-pooling system may have been successful on a smaller, personal scale, i.e., colleagues sharing a car to work, this system has not been implemented widely or at all.

[0016] One reason why car-pooling has not found wide use could be
15 because government regulations prohibit private vehicle owners from offering such a service to make money. Other reasons may be that private vehicle owners may not like to share their vehicles with strangers and customers may not want to hop into unknown vehicles. Furthermore, as private vehicle owners are usually only driving their vehicles to work or to some routine destinations at
20 routine schedules, customers may not be able to always find transit vehicles when they need them.

SUMMARY OF THE INVENTION

[0017] It is a principle object of the present invention to provide a public
5 transportation system and method that offer the convenience and flexibility of
taxi cabs with nearly the efficiency of buses.

[0018] It is a further object to provide a new transportation system and
method that yield a higher utilization rate than can private vehicles and taxi
10 cabs, thus allowing a higher commuting throughput for the congested roads in
cities.

[0019] It is a still further object of the present invention to provide a new
transportation system and method that saves fuel and maintenance costs,
15 since cabs do not travel on the road to look for passengers, leading to a smaller
carbon footprint per cab as well as per customer.

[0020] In accordance with the present invention, customers are offered a
system that is as easy and familiar to use but yet cheaper than the current taxi
20 cab system due to the higher utilization of cabs and cost savings.

[0021] Since cabs in the new system arrive at a requesting customers'
locations, just as they do with the current taxi cab system, there is no need for
customers to invest in new apparatus such as bicycles and for the governments

to build and maintain bicycle parks at train stations. The new system can be deployed on existing road infrastructures.

[0022] Existing cab-sharing schemes rely on customers/cab drivers to
5 split the fares which can lead to disagreements. This new system according to the invention bills customers directly and individually.

[0023] The new system offers compensation to customers whose times
on the cab are lengthened due to the detours the cab drivers have to make to
10 pick up additional customers. This leads to better acceptance by the customers to share their cabs in this new form of public transportation.

[0024] The cab drivers are hired and compensated by transportation
companies that are regulated by the government. This allows the customers to
15 have the same sense of security when using this new system just as when they were using the existing public bus and taxi cab systems. Furthermore, training provided by the companies would promote a good service to the customers.

[0025] These objects and advantages, as well as other objects and
20 advantages which will become apparent from the discussion that follows, are achieved, in accordance with the present invention, by providing a new demand-responsive transit system of public transportation having a fleet of transit vehicles serving urban and suburban regions in which the vehicles are dispatched in real time in response to individual customer service requests for

the system to provide transportation service from any origin location within a local service area to any destination location within the local service area at a desired time. The system includes:

5 [0026] (a) a central dispatch controller having (1) a first transmitting and receiving (T/R) device for receiving transportation service requests from prospective customers, including an agreed-upon Latest Time of Arrival (LTA), and for communicating dispatches to, and receiving vehicle location and passenger information from, the transit vehicles, and (2) a first programmed
10 computer including a first processor and a first memory, coupled to the first T/R device and responsive to the received information, for determining which of the vehicles can service the received transportation requests and for issuing transportation commands to the vehicles for executing said service requests; and

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[0027] (b) the plurality of transit vehicles each having (1) a second transmitting and receiving (T/R) device for communicating with the central dispatch controller, (2) a GPS locator for determining the current location of the vehicle, and (3) a second programmed computer including a second processor
20 and second memory with a transportation fare basis stored therein, coupled to the second T/R device and to the GPS locator, for receiving transportation commands from, and transmitting vehicle location and current passenger information to, the central controller and for calculating transportation fares.

[0028] Upon receipt of a service request the first processor selects a most suitable vehicle to fulfill the service request in dependence upon proximity of the vehicle to a requested customer origin location, current passenger capacity of the vehicle and whether the LTA for all the current vehicle
5 passengers can be fulfilled, determine an Expected Time of Arrival (ETA) and thus a LTA for the customer and transmits a transportation command to the selected vehicle to transport the customer in accordance with the service request.

10 [0029] Upon completion of a service request, the second processor determines the service fare, in dependence upon the stored fare basis, the distance travelled, and the actual Time of Arrival (TA) as compared to the ETA and/or the LTA.

15 [0030] According to the invention, this system operates to implement a method which comprises the steps of:

[0031] (1) receiving a service request from a prospective customer (PC) for transportation from the PC's origin location to the PC's destination location;

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[0032] (2) automatically selecting a most suitable vehicle to fulfill said service request in dependence upon proximity of the vehicle to the origin location, current passenger capacity of the vehicle and whether the LTA for all the current passengers in the vehicle can be fulfilled;

[0033] (3) determining an ETA and thus a LTA for the PC;

[0034] (4) informing the PC of the ETA and receiving an acceptance by
5 the PC, such that the PC becomes a customer;

[0035] (5) issuing a transportation command to the selected vehicle to
transport the customer in accordance with the service request;

10 [0036] (6) executing the service request of the customer by means of
the selected vehicle;

[0037] (7) upon reaching the destination location, determining the
service fare, in dependence upon the stored fare basis, the distance travelled,
15 and the actual Time of Arrival (TA) as compared to the ETA and/or the LTA;
and

[0038] (8) receiving payment from the customer.

20 [0039] The LTA of the PC in step (3) can be determined as a function of
the determined ETA.

[0040] The new system according to the invention can be run by the
government directly, by a single business company or by a consortium of

business companies. It can also be run by the government or a business company or an entity created to manage it with other transportation companies participating in the system by contributing their vehicles. Regardless of its configuration, the organization will be referred to herein as the "Company".

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[0041] A fleet of taxi cabs, which could be in the form of minibuses, passenger cars or any type of vehicles with more capacity than just the driver, operates from small depots scattered across the region of operation. The fleet can consist of different type of vehicles with different capacities.

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[0042] Depots are holding areas where the cabs can stay while waiting to be dispatched. Depots can be physical buildings where maintenance and refueling services are offered; as well as virtual depots such as a car park or an empty plot of land.

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[0043] The optimization system (System) deploys and redeploys cabs based at different depots at different times depending on current and past data such as traffic conditions and demands.

20 [0044] The cab drivers are hired, trained and compensated by the Company.

[0045] The cabs are designed to be shared by different customers who may board and alight at different times and locations.

[0046] The cab drivers can be asked to change their planned routes based on real-time requests to detour to pick up additional customers or to drop off customers.

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[0047] In case of break-downs or situations resulting in the cab drivers' not being able to fulfill the requests, they can inform the System which will then dispatch another cab to that location to pick up all the customers and continue with the journey.

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[0048] The System also allocates timings and locations to the cab drivers for break times, refueling as well as servicing.

[0049] The System continuously tracks the locations and the operational status of the fleet of cabs using positioning and wireless technologies such as GPS and 3G mobile data networks.

[0050] Customers use communication technologies, such as phone calls to operators, Short Messaging System (SMS), mobile applications (for example, iOS or Android apps), Internet websites or otherwise, to register their requests for transportation. In doing so, the customers provide at least the following information:

[0051] Current location,

- [0052] Destination,
 - [0053] Capacity needed (number of customers), and
 - [0054] Mobile number (or other identifiable data such as user name).
- 5 [0055] The System may also support additional preferences such as:
- [0056] Baggage space needed,
 - [0057] Whether handicapped facility is required, and
 - [0058] Driver gender preferences.
- 10 [0059] Upon receiving the requests, the System processes the information and selects the most suitable cabs to fulfill the requests, based on:
- [0060] Current route/destination of the cabs if they are travelling,
 - [0061] Proximity of the cabs with regard to the request location,
 - 15 [0062] Capacity of the cabs to handle the additional number of customers,
 - [0063] Whether the detour to pick up the customers will extend the estimated time to arrive of existing customers in the cabs by more than the Latest Time To Arrive at Destination (LTA),
 - 20 [0064] Other preferences from the customers, and
 - [0065] Business rules of the Company.
- [0066] The System will then send back at least some of the following information to the customers:

- [0067] Cab identification (for example car license plate number),
 - [0068] Pick-up location,
 - [0069] Drop-off location,
 - 5 [0070] Expected Time To Depart (ETD) - i.e. when the cab will arrive,
 - [0071] Expected Time To Arrive at Destination (ETA),
 - [0072] Latest Time To Arrive at Destination (LTA) - i.e. a type of service-level agreement,
 - [0073] Maximum Fare (MF) to pay, and
 - 10 [0074] Nominal Fare (NF) - i.e. the minimum fare to pay.
- [0075] The System may also direct the customers to more suitable locations to take the cabs if necessary. This may happen if:
- 15 [0076] The requested locations are not along a road or are inaccessible, Government regulations limit the stopping points (i.e. cabs are only allowed to pick up/alight customers at designated locations), and/or
 - [0077] It is more efficient for the customers to be picked up at those
 - 20 locations than the requested locations. (For example, cabs do not have to make a large detour in order to pick up the customers, whereas customers can walk a reasonably short distance to be more accessible.)

[0078] Similarly, the System may also request customers to alight at more suitable locations if necessary. This may happen if:

[0079] The destinations are not along a road or are inaccessible,

5 [0080] Government regulations limit the stopping points, and/or

[0081] It is more efficient for the customers to alight at those locations than the requested destinations. (For example, cabs do not have to make a large detour in order for the customers to alight whereas customers can walk a
10 reasonably short distance to their requested destinations.)

[0082] The System may dispatch the selected cabs immediately upon request or wait until the customers reply with their confirmation, depending on business rules.

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[0083] The System may dispatch more than one cab to handle the capacity demand if necessary. The customer who made the request will be billed the fare. Should the different cabs arrive at the destination at different times, the arrival time at the destination is calculated as the time it took the last
20 cab to arrive.

[0084] Cab drivers can receive notifications to move away from the depot or to make a detour to pick up customers at the stated pick-up locations.

[0085] Cab drivers may also receive other information, such as the name or other identifiable data (such as a user name) of the customers so that the drivers can greet and verify the customers upon arrival.

5 [0086] Cab drivers may also receive contact information of the customers such as their mobile numbers, or they can contact the customers via the System if they cannot find the customers at the stated pick-up location.

[0087] Timely notifications (for example, three minutes before) may be
10 sent to the customers before the cabs arrive at their locations.

[0088] These notifications can be in the form of Short Messaging System (SMS) messages to the customers' mobile phones, alerts by mobile applications such as alarms or other suitable methods, to inform customers that
15 their cabs are arriving soon.

[0089] The notifications may be opt-in by the customers or compulsory, as set by the System depending on the business rules.

20 [0090] A published time limit (for example, thirty seconds) may be set for cabs to wait for customers. After this time, the cab can take off without the customers.

[0091] If customers miss their cabs, the System may check with them to see if they need another cab. A penalty may be issued, depending on the business rules.

- 5 [0092] Customers may also cancel their cabs before boarding. A penalty may be given for cancellation, depending on the business rules.

[0093] Upon reaching their drop off locations, customers may be rewarded for sharing their cabs by paying a different fare depending upon the
10 time it took to arrive at their destinations (TA):

[0094] If the TA is on or before the ETA, the customers may be required to pay the MF.

- 15 [0095] If the TA is after the ETA but before the LTA, they may be allowed to pay a fare lesser than MF, which decreases at a stated rate.

[0096] If the TA is on or after the LTA, they may be allowed to pay a nominal fare (NF) or be compensated if the NF is negative.

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[0097] The amount to be paid by the respective customers will be displayed together with other information on screens in the cab for both the drivers and customers.

[0098] Customers may be encouraged to pay using credit/fare cards, to allow automatic deductions from their accounts or to use other cashless options. However, they may also pay cash to the drivers who thus collect on behalf of the Company.

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[0099] Cab drivers can then either pass the cash to their employers or opt to have the cash amounts deducted directly from their bank accounts at a regular basis depending on the business rules.

10 [00100] For a full understanding of the present invention, reference should now be made to the following detailed description of the preferred embodiments of the invention as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

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[00101] In order that the invention may be better understood and put into practical effect, reference will now be made to the accompanying drawings, in which:

20 [00102] Figure 1 is a map-like diagram illustrating the operation of the system and method according to the present invention.

[00103] Figure 2 is a flowchart showing an overview of the system and method.

[00104] Figure 3 is a flowchart of the process of operation with respect to a customer.

5 [00105] Figure 4 is a flowchart of process of the operation with respect to a taxi cab driver.

[00106] Figure 5 is a flowchart of a taxi cab selection algorithm.

10 [00107] Figure 6 is a chart illustrating a fare calculation.

[00108] Figure 7 is a map-like diagram illustrating coverage boundaries of the system and method.

15 [00109] Figure 8 is a map-like diagram illustrating coverage zones of the system and method.

[00110] Figure 9 is a map-like diagram illustrating courier operation in the system and method.

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[00111] Figure 10 is a flowchart of the courier service with respect to the consumer.

[00112] Figure 11 is a block diagram of the system according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

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[00113] The preferred embodiments of the present invention will now be described with reference to Figures 1-11 of the drawings.

[00114] Figure 1 is a map-like diagram illustrating the operation of the system and method according to the present invention.

[00115] The map shows a section of a big city.

[00116] Depots are scattered around the city. There are 2 in this section of the city.

[00117] Cabs are deployed at these depots depending on perceived demands based on past data.

[00118] 1 - Customer A sends a request to the System for a cab to Destination A.

[00119] 2 - The System processes the request and dispatches Cab to pick up Customer A as it is the closest. The System then informs Customer A on the Cab license plate number, ETD_A , ETA_A , LTA_A and MF_A .

[00120] 3 - Cab reaches Customer A and she boards the cab. The System calculates and directs Cab on the most optimum route.

[00121] 4 - While Cab is moving towards Destination A, Customer B sends a request for cab to Destination B. The System processes the request

and dispatches Cab to pick up Customer B as it is the closest and Customer A will still be able to reach Destination A before LTA_A . The System then informs Customer B on the Cab license plate number, ETD_B , ETA_B , LTA_B and MF_B .

[00122] 5 - The System recalculates and directs Cab on the most optimum route. Cab makes a detour to the new route instead of continuing on the previously planned route P.

[00123] 6 - Cab reaches Customer B and he boards the cab. The System calculates and directs Cab on the most optimum route.

[00124] 7 - Cab reaches Destination A. Because of the detour, time taken for Customer A to reach Destination A is more than ETA_A , Customer A is asked to pay a fare that is lower than MF_A .

[00125] 8 - Customer A pays the fare and alights.

[00126] 9 - Cab continues on the route to Destination B. As time taken for Customer B to reach Destination B is equal to or less than ETA_B , Customer B is asked to pay a fare that is equal to MF_B .

[00127] 10 - Customer B pays the fare and alights.

[00128] 11 - As there are no more requests for cabs at this time, the System directs Cab to a depot to wait for future dispatches.

20 [00129] Variation 1: System with coverage boundaries.

[00130] The System can be set up with coverage boundaries so that cabs do not have to travel to less popular areas and thus can potentially increase their utilization rate.

[00131] Customers making the request at locations or going to destinations that are outside the coverage boundaries may be notified and advised or guided to proceed to the nearest areas of coverage.

5 [00132] An illustration of coverage boundaries is shown in Figure 7.

[00133] Variation 2: System with coverage zones.

[00134] The System can be set up with multiple coverage zones so that cabs belong and operate in different coverage zones so as to further increase
10 the utilization rate for cabs as well as provide coverage to less popular areas.

[00135] Coverage zones may be operated by a single company or different companies.

15 [00136] One or more depots in each coverage zone should be shared with each of its adjacent coverage zone.

[00137] Customers may be asked to transfer at such depots to another cab operating in that coverage zone.

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[00138] Customers may be compensated for such transfers depending on business rules.

[00139] An illustration of coverage zones is shown in Figure 8.

[00140] Variation 3: Customers presented with choice of cabs.

[00141] Instead of selecting the most suitable cab for a request, the
System can present a list of possible choices of cabs to the customers for them
5 to choose from.

[00142] The information of each option presented to the customers may
include and not limited to:

[00143] Cab identification (For example, car plate number),
10 [00144] Pick-up location,
[00145] Drop-off location,
[00146] ETD,
[00147] ETA,
[00148] LTA,
15 [00149] MF,
[00150] Gender of driver and
[00151] Current number of passengers on board.

[00152] The System will then dispatch the selected cab to the pick-up
20 location.

[00153] Variation 4: Delayed compensation for customers for sharing their
cabs.

[00154] Instead of allowing customers to pay a fare that is lower than MF if the ride took longer than ETA, they would still be asked to pay the maximum fare (MF) for the current trip.

5 [00155] However, the differences between the MF and the fare that the customers are supposed to pay are recorded and deducted as savings for the customers' next trips.

[00156] This could be done to encourage customers to continue using the
10 system of public transportation.

[00157] Variation 5: Membership/Royalty Scheme for customers.

[00158] A membership/loyalty scheme can be implemented so that customers can be rewarded as they use the system to encourage more usage.
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[00159] The membership /loyalty scheme could also not be owned or run by the Company but instead partnered with another company or organization such as credit card companies.

20 [00160] The scheme may reward customers with points, cash or kinds.

[00161] The scheme may reward customers based on or combination of the number of trips taken, the distance, the time spent in cabs, the number of customers shared, the fare paid or other suitable quantifiable methods.

[00162] Variation 6: API for third-party application development for customers/consumers.

[00163] Application Programming Interface (API) can be developed for
 5 own and third-party developers to develop applications that can be used by customers/consumers.

[00164] The API may be provided free or with charges.

10 [00165] The API allows functionality extensions to be build on top of the current system for the benefits of customers/consumers. An example of such an application is a Personal Assistant software that resides on a mobile device that can automatically request a cab for the user before a meeting.

15 [00166] Examples of functionalities that may be accessed are as follows and not limited to:

[00167] Request a cab,

[00168] Cancel the cab,

[00169] Notifications/alerts before the cab arrive,

20 [00170] Get pick-up location,

[00171] Get drop-off location,

[00172] Get expected time to arrive at pick up location (ETD),

[00173] Get expected time to reach drop off location (ETA),

[00174] Get latest time to reach drop off location (LTA),

[00175] Get maximum fares (MF) to pay for the trips,

[00176] Get expected fares to pay based on the current time taken and expected time to reach destination,

[00177] Get membership/ loyalty points and statuses should the system supports and

[00178] Request for membership/ loyalty point deductions should the system supports.

[00179] Variation 7: API for third-party application development for businesses.

[00180] API can be developed for own and third-party developers to develop applications that can be used by businesses.

[00181] The API may be provided free or with charges.

[00182] The API allows functionality extensions to be built on top of the current system for the benefits of businesses. An example of such an application is Hotel Reception software where the business user can be notified when customers are arriving. If the customers permit, their names and profiles can be available to the business user who can then greet and customize their services individually.

[00183] Examples of functionalities that may be accessed are as follows and not limited to:

- [00184] Notification (with name and profile if customers permit) of customers arriving at a specified location,
- [00185] Notification (with name and profile if customers permit) of customers' arrival at a specified location,
- 5 [00186] History of the customers (if permitted) arriving at a specific location,
- [00187] Statistics of customers arriving at a specific location,
- [00188] Request for membership/loyalty points and statuses for a particular customer should the system supports and
- 10 [00189] Request for membership/ loyalty point deductions for a particular customer should the system supports.

[00190] Variation 8: Courier Service.

- [00191] Instead of or in addition to transporting customers from a request
- 15 location to destination, the system is used as a just-in-time courier service.
- [00192] An example scenario is as follows:

- [00193] A person with an item to deliver (sender) makes a request with following information:
- 20 [00194] Current Location,
- [00195] Destination,
- [00196] Capacity (Size),
- [00197] Mobile number of sender
- [00198] Mobile number of receiving person (receiver),

[00199] The system notifies and confirms with the receiver to ensure he/she will be available to receive the item.

5 [00200] The system dispatches the most suitable transport vehicle (TV) which could be from the depot or en route to deliver other items.

[00201] Timely notifications (for example, 3 minutes before) may be given to the sender to inform him/her about the estimated time to arrive at the request
10 location.

[00202] The receiver signs off the item to the driver.

[00203] Timely notifications (for example, 3 minutes before) may be given to the receiver to inform him/her about the estimated time to arrive at the
15 destination.

[00204] The transport vehicle arrives and the receiver signs off the item.

[00205] A notification may be sent to the sender to inform about the
20 successful delivery.

[00206] An illustration for the courier operation is shown in Figure 9.

[00207] The flowchart of the process for the courier operation with respect to the consumers is shown in Figure 10.

[00208] Figure 5 is a flowchart of a taxi cab selection algorithm.

5 [00209] R is the radius which the System uses to calculate the area around the request location X. The System then checks if there are any cabs in this area. Initial value of R is chosen based on business rules.

[00210] $R_{\max}$ is the maximum radius to check. It can be set due to coverage boundaries or based on business rules.

10 [00211] T is the approximate time it takes for the customers to respond their confirmation. It can be set based on business rules and/or past experiences.

[00212] P is the pick-up point closest to or at X that is most efficient for the cab to pick up the customers.

15 [00213] Q is the drop-off point closest to or at Y that is most efficient for the cab to drop off the customers.

[00214] Figure 6 is a chart illustrating a fare calculation.

[00215] 1 - Customers pay a fare equal to the MF if the time taken to reach their drop off points is equal or less than ETA.

[00216] 2 - If the time taken is more than ETA and less than LTA, the fare that the customers pay drops off at a decreasing rate towards NF. In this example, the fare decreases at a constant rate towards NF.

[00217] 2A - The actual rate of decrease is adjustable and depends on business rules. In this alternative example, the fare decreases slower initially after time taken pass ETA and gradually decreases more as time moves towards LTA.

5 [00218] 3- When time taken is or pass LTA, the customer will be asked to pay a fare equal to NF. The NF can be positive, zero or negative. If NF is negative, the customer may be compensated instead.

[00219] Figure 7 is a map-like diagram illustrating coverage boundaries of
10 the system and method.

[00220] Coverage boundaries are set up in order to improve utilization of cabs.

[00221] The map shows the coverage area of the public transportation.

[00222] The areas that are darkened are outside the coverage
15 boundaries.

[00223] 1 - Within the coverage boundaries, the public transportation operates as per normal as described in Figure 7. Cab is dispatched to pick up Customer A and travels towards Destination A.

[00224] 2 - When Customer B requests for a cab, the System informs him
20 that he is outside the coverage boundaries and guide him to the nearest location where he can get coverage.

[00225] 3 - When Customer B enters the coverage area, he remakes the request for cab.

[00226] 4 - Cab has just dropped off Customer A. The System processes the request and dispatches Cab to pick up Customer B as it is the closest. The System then informs Customer B on the Cab license plate number, ETD_B , ETA_B , LTA_B and MF_B .

5 [00227] 5 - Cab reaches Customer B and he boards the cab. The System calculates and directs Cab on the most optimum route to Destination B and continues the process as described in Figure 1.

[00228] Figure 8 is a map-like diagram illustrating coverage zones of the
10 system and method.

[00229] The map shows a section of a big city.

[00230] The area in this section is broken up into 2 coverage zones in order to improve utilization of cabs.

[00231] The coverage zones are overlapped with a depot or stand in the
15 overlapped area.

[00232] 1 - Customer sends a request for cab to Destination.

[00233] 2 - The System processes the request and dispatches Cab Z2 to pick up Customer as it is the closest. The System then informs Customer on the Cab Z2 license plate number, ETD , ETA , LTA and MF .

20 [00234] 3 - Cab Z2 reaches Customer A and she boards the cab. The System calculates and directs Cab Z2 on the most optimum route to the depot for switching over to Zone 1.

[00235] 4 - When Cab Z2 is about to reach the depot, the System dispatches Cab Z1 to the same depot as it is the most suitable cab in Zone 1.

[00236] 5 - Cab Z2 arrives at the depot and Customer alights and waits for the connecting cab.

[00237] 6 - Cab Z1 reaches the depot and Customer boards the cab. The System calculates and directs Cab Z1 on the most optimum route to
5 Destination.

[00238] 7 - Cab Z1 reaches Destination. As time taken for Customer to reach Destination is equal or less than ETA, Customer is asked to pay a fare that is equal than MF.

[00239] 8 - Customer pays the fare and alights.
10

[00240] Figure 9 is a map-like diagram illustrating courier operation in the system and method.

[00241] The map shows a section of a big city.

[00242] Depots are scattered around the city. There are 2 in this section
15 of the city.

[00243] Transport Vehicles (TV) are deployed at these depots depending on perceived demands based on past data.

[00244] Figure 10 is a flowchart of the courier service with respect to the
20 consumer.

[00245] 1 - Sender A sends a request for courier service to Receiver A.

[00246] 2 - The System processes the request and dispatches TV to pick up the package from Sender A as it is the closest. The System then informs Sender A on the TV license plate number, ETD_A , ETA_A , LTA_A and MF_A .

[00247] 3 - TV reaches Sender A and she signs over the package to the driver. The System calculates and directs TV on the most optimum route.

[00248] 4 - While TV is moving towards Receiver A, Sender B sends a request for courier service to Receiver B. The System processes the request
5 and dispatches TV to pick up the package from Sender B as it is the closest and the package from Sender A will still be able to reach Receiver A before LTA_A . The System then informs Customer B on the TV license plate number, ETD_B , ETA_B , LTA_B and MF_B .

[00249] 5 - The System recalculates and directs TV on the most optimum
10 route. TV makes a detour to the new route instead of continuing on the previously planned route P.

[00250] 6 - TV reaches Sender B and he signs over the package to the TV driver. The System calculates and directs TV on the most optimum route. A timely notification/alert may be sent to Receiver A before the TV arrives.

15 [00251] 7 - TV reaches Receiver A. Because of the detour, time taken for the package from Sender A to reach Receiver A is more than ETA_A , thus Receiver A is asked to pay a fee that is lower than MF_A . Alternatively, the fee can be billed to Sender A depending on business rules.

[00252] 8 - Receiver A signs off the package from the TV driver. A timely
20 notification/alert may be sent to Receiver B before the TV arrives.

[00253] 9 - TV continues on the route to Receiver B. As time taken for the package from Sender B to reach Receiver B is equal or less than ETA_B , Receiver B is asked to pay a fee that is equal than MF_B . Alternatively, the fee can be billed to Sender B depending on business rules.

[00254] 10 - Receiver B signs off package from the TV driver.

[00255] 11 - As there are no more requests for courier service at this time, the System directs TV to a depot to wait for future dispatches.

5 [00256] Figures 11a and 11b illustrate the central dispatch controller and the corresponding taxi cab communication apparatus, respectively, of the electronic system according to the present invention.

[00257] At the central dispatch office 100, a dispatcher takes telephone
10 calls from prospective customers via a telephone land line 101 or the wireless cell phone system. For this purpose the dispatcher uses a speakerphone device 102 having a microphone 104 and speaker 106. The dispatcher operates a computer 108 having a processor and memory (not shown) as well as the usual computer keyboard 110, mouse 112 and display 114. The
15 computer communicates electronically with the corresponding communication devices in the taxi cabs via a transmitter/receiver 116.

[00258] Taxi cabs 117 which cooperate with the dispatcher each have a computer 118 that receives current location information in real time from a GPS
20 unit 120 and communicates with the central controller via a transmitter/receiver 122.

[00259] There has thus been shown and described a novel system and method for flexible and efficient public transportation which fulfills all the objects

and advantages sought therefor. Many changes, modifications, variations and other uses and applications of the subject invention will, however, become apparent to those skilled in the art after considering this specification and the accompanying drawings which disclose the preferred embodiments thereof. All
5 such changes, modifications, variations and other uses and applications which do not depart from the spirit and scope of the invention are deemed to be covered by the invention, which is to be limited only by the claims which follow.

CLAIMS

What is claimed is:

1. A demand-responsive transit system for a plurality of transit vehicles serving
5 urban and suburban regions in which local transit vehicles are dispatched in
real time in response to individual customer service requests for the system to
provide transportation service from any pick-up location within a local service
area to any destination location within the local service area at a desired time,
said system comprising, in combination:
 - 10 (a) a central dispatch controller having (1) a first transmitting and receiving
(T/R) device for receiving transportation service requests from prospective
customers, including an agreed-upon Latest Time of Arrival (LTA), and for
communicating dispatches to, and receiving vehicle location and passenger
information from, said vehicles, and (2) a first programmed computer including
15 a first processor and a first memory, coupled to said first T/R device and
responsive to the received information, for determining which of said vehicles
can service the received transportation requests and for issuing transportation
commands to said vehicles for executing said service requests; and
 - (b) said plurality of transit vehicles each having (1) a second transmitting and
20 receiving (T/R) device for communicating with said central dispatch controller,
(2) a GPS locator for determining the current location of the respective vehicle,
and (3) a second programmed computer including a second processor and

second memory, coupled to said second T/R device and to said GPS locator, for receiving transportation commands from, and transmitting vehicle location and current passenger information to, said central controller and for calculating transportation fares;

- 5 wherein transportation commands are issued to transit vehicles to transport multiple customers in a vehicle at the same a time; and

wherein upon receipt of a service request, said first processor selects a suitable vehicle to fulfill the service request in dependence upon proximity to a requested customer pick-up location, vehicle passenger capacity and whether
10 the LTA for the customer and the current vehicle passengers can be fulfilled, and transmits a transportation command to the selected vehicle to transport the customer in accordance with the service request.

2. The system defined in claim 1, wherein at least one of said first and second memory has a transportation fare basis stored therein, and wherein, upon
15 completion of a service request, at least one of the first and the second processor determines the service fare for the customer, in dependence upon the stored fare basis, the distance travelled, and the actual Time of Arrival (TA) as compared to at least one of the Expected Time of Arrival (ETA) and the LTA.

3. The system defined in claim 1, wherein a plurality of vehicle depots are
20 established in the local service area, and wherein vehicles return to one of said

depots, when not transporting customers, to wait for the next transportation command.

4. The system defined in claim 1, wherein vehicles transporting customers are commanded to pick up and drop off other customers along the way.

5 5. The system defined in claim 1, wherein the first processor also receives information on traffic conditions within the local service area, and wherein said first processor issues routing commands to said transit vehicles to inform their drivers of optimized routes between customer pick-up and drop-off locations in dependence upon traffic conditions.

10 6. The system defined in claim 1, wherein the second processor also receives information on traffic conditions within the local service area, and wherein said second processor determines for the vehicle driver an optimized route between the customer pick-up and drop-off locations in dependence upon traffic conditions.

15 7. The system defined in claim 3, wherein historical vehicle demand data is stored in said first memory, and wherein said first processor issues deployment commands to said vehicles to wait at designated depots in dependence upon said demand data.

8. The system defined in claim 3, wherein preference is given to vehicles
20 underway in transporting customers over vehicles waiting at depots in issuing transportation commands to service customer requests.

9. The system defined in claim 1, wherein said first processor transmits data to customers relating their service requests, said data including at least two items of information selected from the group consisting of:

- (1) Vehicle identification,
- 5 (2) Pick-up location,
- (3) Drop-off location,
- (4) Expected Time To Depart (ETD), when the vehicle will arrive at pick-up location,
- (5) Expected Time To Arrive at Destination location (ETA),
- 10 (6) Latest Time To Arrive at Destination (LTA) as agreed with the customer,
- (7) Maximum Fare (MF) to pay, and
- (8) Nominal Fare (NF) which is the minimum fare to pay.

10. The system defined in claim 1, wherein said second processor provides data to the driver and customers in the vehicle, said data including at least one
15 item of information selected from the group consisting of:

- (1) Vehicle identification,
- (2) Expected Time To Depart (ETD), when the vehicle will arrive at pick-up location,
- (3) Expected Time To Arrive at drop-off location (ETA), and
- 20 (4) Latest Time To Arrive at drop-off (LTA) as agreed with the customer.

11. The system defined in claim 9, wherein said first processor transmits at least four of said items of information to said customers.
12. The system defined in claim 9, wherein said first processor transmits at least eight of said items of information to said customers.
- 5 13. The system defined in claim 2, wherein, upon completion of a service request, at least one of the first and the second processor determines the service fare for the customer with a reduction to compensate the customer for sharing the vehicle with other customers.
14. The system defined in claim 2, wherein, in accordance with the stored fare
10 basis, the service fare for a customer is calculated in dependence upon the time it took to arrive at the customer's drop-off location (TA).
15. The system defined in claim 14, wherein, in accordance with the stored fare basis, the service fare is calculated to be equal to a Maximum Fare (MF) if the Time of Arrival (TA) is at or before an Expected Time of Arrival (ETA).
- 15 16. The system defined in claim 14, wherein, in accordance with the stored fare basis, the service fare is calculated to be less than a Maximum Fare (MF) if the Time of Arrival (TA) is after an Expected Time of Arrival (ETA) but before the LTA.

17, The system defined in claim 16, wherein, in accordance with the stored fare basis, the service fare is decreased at a prescribed rate in dependence upon the duration of time that the TA is after the ETA.

18. The system defined in claim 14, wherein, in accordance with the stored
5 fare basis, the service fare is calculated to be equal to a Nominal Minimum Fare (NF) if the Time of Arrival (TA) is at or after the LTA.

19. The system defined in claim 1, wherein a prospective customer is asked to meet the selected transport vehicle at a more suitable location than the pick-up location requested by such customer.

10 20. The system defined in claim 1, wherein said first processor issues transportation commands to said vehicles with at least two items of information selected from the group consisting of:

(1) Current route/and destination of the vehicles if they are travelling,

(2) Proximity of the vehicles with regard to the requested pick-up location,

15 (3) Capacity of the vehicles to handle an additional number of customers, as required to fulfill the service request,

(4) Whether the detour to pick up the requesting customer will extend the time to arrive of existing customers in the vehicles by more than their ETA,

(5) Preferences of the customers, and

(6) Business rules of the transit system.

21. The system defined in claim 1, wherein said first processor issues transportation commands to substitute a different vehicle for a disabled vehicle.

5 22. The system defined in claim 1, wherein said first processor issues scheduling commands to said vehicles for at least one of refueling, maintenance servicing and break times.

23. The system defined in claim 1, wherein said first T/R device is operative to communicate and exchange data with prospective customers and customers.

10 24. The system defined in claim 23, wherein said first T/R device communicates with a standard protocol selected from the group consisting of Short Messaging System (SMS), Internet websites and mobile apps.

25. The system defined in claim 23, wherein said data include at least two items of information selected from the group consisting of:

- 15 (1) Customer's current location,
- (2) Customer's destination location,
- (3) Number of passengers in customer's party to be transported,
- (4) Customer's contact information, and
- (5) Other customer preferences that the system supports.

26. The system defined in claim 3, wherein said depots provide at least one of a parking space, fuel and maintenance service for said vehicles.

27. The system defined in claim 1, wherein the LTA is calculated as a fixed duration following the Expected Time of Arrival (ETA).

5 28. The system defined in claim 1, wherein the LTA is calculated as a function of the duration of time between the expected time of customer pick-up and the Expected Time of Arrival (ETA) after the ETA.

29. The system defined in claim 28, wherein the function is a percentage of said duration.

10 30. A method of operating a demand-responsive transit system for a plurality of transit vehicles serving urban and suburban regions in which local transit vehicles are dispatched in real time in response to individual customer service requests for the system to provide transportation service from any origin location within a local service area to any destination location within the local
15 service area at a desired time, said system comprising, in combination:

(a) a central dispatch controller having (1) a first transmitting and receiving (T/R) device for receiving transportation service requests from prospective customers (PC's), including origin and destination locations and an agreed-upon Latest Time of Arrival (LTA), and for communicating dispatches to, and
20 receiving vehicle location and passenger information from, said transit vehicles, and (2) a first programmed computer including a first processor and a first

memory, coupled to said first T/R device and responsive to the received information, for determining which of said vehicles can service the received transportation requests and for issuing transportation commands to said vehicles for executing the service requests; and

- 5 (b) said plurality of transit vehicles each having (1) a second transmitting and receiving (T/R) device for communicating with said central dispatch controller, (2) a GPS locator for determining the current location of the respective vehicle, and (3) a second programmed computer including a second processor and second memory with a transportation fare basis stored therein, coupled to said
10 second T/R device and to said GPS locator, for receiving transportation commands from, and transmitting vehicle location and current passenger information to, said central controller, and for calculating transportation fares for customers;

said method comprising the steps of:

- 15 (1) receiving a service request from a prospective customer (PC) for transportation from the PC's origin location to the PC's desired destination location;
- (2) automatically selecting a most suitable vehicle to fulfill said service request in dependence upon proximity of the vehicle to the origin location, current
20 passenger capacity of the vehicle and whether the LTA for all the current passengers in the vehicle can be fulfilled;

- (3) determining an ETA and thus a LTA of the PC;
 - (4) informing the PC of the ETA and receiving an acceptance by the PC, such that the PC becomes a customer;
 - (5) issuing a transportation command to the selected vehicle to transport the customer in accordance with the service request;
 - (6) executing the service request of the customer by means of the selected vehicle;
 - (7) upon reaching the destination location, determining the service fare, in dependence upon the stored fare basis, the distance travelled, and the actual Time of Arrival (TA) as compared to the ETA and/or LTA; and
 - (8) receiving payment from the customer.
31. The method defined in claim 30, wherein step (3) includes the steps of determining the ETA and determining the LTA as a function of the ETA.