SYSTEM AND METHOD TO IMPROVE THE EFFICIENCY IN ARRANGING ON-DEMAND AND SCHEDULED TRANSPORT SERVICE

TECHNICAL FIELD OF THE INVENTION

The invention described herein pertains generally to a system and method for arranging transport service amongst parties through use of devices such as mobile terminals that are carried by the respective parties.

BACKGROUND OF THE INVENTION

The following discussion of the background to the invention is intended to facilitate understanding of the present invention. However, it should be appreciated that the discussion is not an acknowledgment or admission that any of the material referred to was published, known or a part of the common general knowledge in any jurisdiction as at the priority date of the application.

Current vehicle dispatch systems employed by ride-hailing mobile applications (“apps”) typically adopt a 1-to-1 matching method, wherein the matching between a specific vehicle and a specific requester is determined upon the vehicle accepts the requester’s ride request and before the vehicle travels to a pickup location specified in the requester’s ride request. There are at least four types of system-level inefficiencies arising from this 1-to-1 matching method.

The first inefficiency is the likely occurrence of unnecessarily long waiting time by either the requester or the vehicle when arranging on-demand transport service. For example, at a particular pickup location, a requester, who has arrived at the pickup location, may be waiting for its matched vehicle that has yet to arrive, while at the same moment a vehicle that has arrived at the same pickup location is waiting for its matched requester who has yet to arrive. Notably, vehicles, waiting for prolonged durations at pickup locations, may negatively affect other vehicles coming into and/or departing from the pickup location, slowing down or even blocking the traffic at the pickup location.

Another inefficiency is that the current 1-to-1 matching method is vulnerable to cancellation by either a matched requester or a matched vehicle. A cancellation initiated by one party will break the matching status of the matched party, or force the matched party to restart another 1-to-1 matching.

The third inefficiency is that there is often an unavoidable waiting time for requesters when arranging on-demand transport service, as the 1-to-1 matching method dispatches a matched vehicle only after that a requester requests an on-demand ride. For example, if a requester makes a request for a ride from the pickup location using the 1-to-1 matching method, it is very likely that the requester will have to spend a significant amount of time to wait for the vehicle to come unless the matched vehicle is coincidentally present at the pickup location when the requester makes its request.

The fourth efficiency is that, during a scheduled transport service, a matched vehicle is often unproductive when the scheduled departure time is approaching. For example, if a vehicle has accepted a scheduled ride request to board a requester at a particular pickup location at a particular departure time, the vehicle has to limit its activities close to the pickup location when the scheduled departure time is approaching, such that the vehicle can arrive at the pickup location before or at the scheduled departure time.

Thus, there exists a need to more efficiently match requesters and vehicles to at least alleviate one or more of the above-mentioned technical inefficiencies.

SUMMARY OF THE INVENTION

In accordance with an aspect of the invention there is a computer-implemented method for arranging on-demand transport service between a plurality of requesters and a plurality of vehicles, comprising the steps of: (a) receiving from the plurality of requesters a plurality of requests for ride from a pickup location; (b) grouping the plurality of requests from the pickup location;

(c) storing the plurality of requests into a requester pool for the pickup location; (d) receiving from the plurality of vehicles a plurality of acceptances to pick up the plurality of requesters from the pickup location; (e) storing the plurality of acceptances into a vehicle pool of the pickup location; (f) detecting an user device of at least one vehicle that has arrived at (or is close to) a pickup location, wherein an acceptance made by the at least one vehicle is found in the vehicle pool of the pickup location; and (g) matching the at least one vehicle with a requester, wherein a request made by the requester is found in the requester pool of the pickup location.

Preferably, the pickup location is a pickup point, or a plurality of pickup points of a defined transportation station, or a plurality of pickup points in a defined neighbourhood or a plurality of pickup points on a defined route.

Preferably, a cancellation of an unmatched acceptance in the vehicle pool requires no action from any requester in the requester pool, and a cancellation of an unmatched request in the requester pool of a pickup location requires no action from any vehicle in the vehicle pool.

Preferably, a plurality of notifications to invite a first plurality of vehicles to go to the pickup location is sent to the first plurality of vehicles in order to balance the vehicle pool and the requester pool of the pickup location, if the plurality of acceptances in the vehicle pool of the pickup location is fewer than the plurality of requests in the requester pool of the pickup location.

Preferably, the first plurality of vehicles receive the plurality of notifications to go to the pickup location; a second plurality of vehicles bids for the plurality of notifications by submitting their acceptances, wherein the second plurality of vehicles is a subset of the first plurality of vehicles; one or more acceptances from the second plurality of vehicles are determined to be successful; and the one or more successful acceptances are added into the vehicle pool of the pickup location.

Preferably, the plurality of requests in the requester pool of the pickup location is queued according to a request order at which the plurality of requests are made by the plurality of requesters, and the plurality of acceptances in the vehicle pool of the pickup location is queued according to a vehicle order at which the plurality of vehicles arrive at (are close to) the pickup location.

Preferably, an user device of at least one requester that has arrived at (or is close to) the pickup location is detected, wherein the request made by the at least one requester is found in the requester pool of the pickup location;

Preferably, the step of detecting the user device of at least one requester or the user device of at least one vehicle or both is facilitated by at least one satellite positioning system.

Preferably, the step of detecting the user device of at least one requester or the user device of at least one vehicle or both is facilitated by at least one network device at the pickup location.

Preferably, the at least one network device is a wireless network device.

Preferably, the at least one network device is configured to receive at least one identification information of the user device of at least one requester or the user device of at least one vehicle or both via a wireless technology.

Preferably, the user device of at least one requester or the user device of at least one vehicle or both are configured to receive at least one identification information of the at least one network device via a wireless technology.

Preferably, the at least one network device is: a Wi-Fi router installed at the pickup location; a kiosk installed at the pickup location; the user device of at least one vehicle, wherein the at least one vehicle has arrived (or is close to)

the pickup location; or the user device of at least one requester, wherein the at least one requester has arrived (or is close to) the pickup location.

Preferably, a predetermined number of acceptances from the first plurality of vehicles are received and stored in a supply surplus vehicle pool of the pickup location.

Preferably, the predetermined number of acceptances in the supply surplus vehicle of the pickup location is predetermined based on a number of forecasted requests for ride from the pickup location for a pre-programmed time interval.

Preferably, a scheduled ride request from the pickup location becomes part of the forecasted requests for ride from the pickup location, if a scheduled departure time of the scheduled request for ride falls within the pre-programmed time interval.

Preferably, the acceptance made by the at least one vehicle is queued as a first unmatched acceptance in the vehicle pool of the pickup location, and the request made by the requester is queued as a first unmatched request in the requester pool of the pickup location.

Preferably, there is a cancellation of acceptance made by a previously matched vehicle in the vehicle pool of the pickup location, the previously matched vehicle remains in the vehicle pool of the pickup location.

Preferably, the previously matched vehicle’s presence at the pickup location is operable to be detected again and queued according to a new arrival time.

Other aspects of the invention will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 illustrates an example process flow that matches a requester and a vehicle for an on-demand (or scheduled) transport service.

FIG. 2 illustrates an example of the conventional 1-to-1 matching method that matches a specific requester and a specific vehicle based on the orders of the request.

FIG. 3 illustrates an embodiment of the invention comprising a system for detecting the arrival of a user.

FIG. 4 illustrates an embodiment of the invention comprising a method for determining the arrival of a user.

FIG. 5A illustrates an embodiment of the invention that is configured to perform the pool-queue matching method based on the vehicle's arrival order when arranging on-demand transport service.

FIG. 5B illustrates an embodiment of the invention that is configured to perform the pool-queue matching method based on the vehicle's arrival order when arranging on-demand and scheduled transport service.

FIG. 6 illustrates an embodiment of invention that is being utilized to arrange on-demand (or scheduled) transport service.

FIG. 7 illustrates an embodiment of a user interface of the invention that is configured for the requester to indicate whether it has arrived at the pickup location.

FIG. 8A illustrates an embodiment of a user interface of the invention that is configured to display the vehicle's presence in relation to the pickup location (e.g., the pickup location is a taxi stand in the embodiment).

FIG. 8B illustrates an embodiment of a user interface of the invention that is configured for the vehicle to indicate whether it has arrived at the pickup location.

Other arrangements of the invention are possible and, consequently, the accompanying drawings are not to be understood as superseding the generality of the preceding description of the invention.

DETAILED DESCRIPTION

Particular embodiments of the present invention will now be described with reference to the accompanying drawings. The terminology used herein is for the purpose of describing particular embodiments only and is not intended to limit the scope of the present invention. Additionally, unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one or ordinary skill in the art to which the present invention belongs. Where possible, the same reference numerals are used throughout the figures for clarity and consistency.

Throughout this document, unless otherwise indicated to the contrary, the terms “comprising”, “consisting of”, and the like, are to be construed as non-exhaustive, or in other words, as meaning “including, but not limited to”.

Throughout the specification, unless the context requires otherwise, the word “comprise” or variations such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

Throughout the specification, unless the context requires otherwise, the word “include” or variations such as “includes” or “including”, will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

<u>Definitions</u>

Requester: an entity formed by one or more individuals who is/are departing from one place and using a single user device (e.g., a mobile terminal) to send a request for ride.

Vehicle: an automotive vehicle, either driverless or operated by driver(s), which is providing on-demand and/or scheduled transport service. Some examples of vehicles are taxi and private-hire vehicle.

User: throughout the specification, the term “user” refers to a user of the invention, who could be either a requester or a vehicle as defined above. The user uses a user device (e.g., a mobile terminal in possession of a requester; or a mobile terminal installed in a vehicle) to interact with the invention (i.e., the vehicle dispatch system) to arrange on-demand and/or scheduled transport service.

User Device: either a mobile device or a stationary device that is connected to a network and is operable by a user. Throughout the specification, the term “mobile device” refers to any portable device that is connected to a network (e.g., internet) and carried by a user. Examples of “mobile device” include: a mobile phone (e.g., featured phone or smartphone), tablet, computer (e.g., laptop, netbook), PDA (Personal Digital Assistant), wearable device (e.g., iWatch), or a computing device installed on the vehicle. The stationary device refers to any computing device installed at the pickup location (e.g., a kiosk).

Wireless network device: a wireless network device that can exchange data and signals with the user devices through wireless technologies such as Wi-Fi, BLUETOOTH, Infrared, or Super Wi-Fi. The wireless network device may also be equipped with computing power to store and process data. Furthermore, in some embodiments of the invention, the wireless network device is configured to be in data communication with the vehicle dispatch server via a network (e.g., internet). In some embodiments, the wireless network device may be integrated with the stationary user device at the pickup location. In some embodiments, the wireless network device is arranged to be in data communication with the vehicle dispatch server via a cable.

Device-specific ID: a device-specific ID refers to a unique identifier that can be used to identify a device, in particularly, a mobile device. Examples of device-specific IDs include: mobile phone number by the cellular network, MAC (Media Access Control) address, IMEI (International Mobile Equipment Identity) number, Apple's UDID (Unique Device Identifier), or a unique ID generated by the vehicle dispatch server for each user.

Server: "server" refers to an apparatus connected to the data communication network, receiving and sending data to other apparatuses connected to the data communication network, as well as processing and storing data.

Vehicle dispatch system: throughout the specification, unless the context requires otherwise, the term "vehicle dispatch system" refers to the overall system of the present invention that functions to arrange on-demand and scheduled transport service. The "vehicle dispatch system" comprises a "vehicle dispatch server" that is configured to receive and send data from other apparatuses, devices, equipment, modules and components of the vehicle dispatch system, as well as to process and store the data.

Pickup location: the term "pickup location" refers to a pickup point (such as building lobby, taxi stand, bus stop and any other designated point for the vehicles to pick up the requesters), or a plurality of pickup points in a defined neighbourhood or on a defined route.

Arriving: throughout the specification, unless the context requires otherwise, the term "arriving" refers to a status of a user (e.g., either a requester or a vehicle) that been accepted into the vehicle dispatch system (e.g., a requester whose request for ride has been received and accepted by the vehicle dispatch system; a vehicle that has accepted a notification of request for ride from a particular pickup location) but has not yet arrived at the designated pickup location.

Ready for boarding: throughout the specification, unless the context requires otherwise, the phrase “ready for boarding” refers to the status of a user (e.g., a requester or a vehicle) that has arrived at (or close to) the pickup location, but (the matched requester) has not yet boarded the matched vehicle or (the matched vehicle) has not yet picked up the matched requester.

Boarded: throughout the specification, unless the context requires otherwise, the term “boarded” refers to the status of a user (e.g., a requester or a vehicle) that (the matched requester) has successfully boarded the matched vehicle or (the matched vehicle) has successfully picked up the matched requester.

Prompt: throughout the specification, unless the context requires otherwise, a “prompt” refers to a message or window (e.g., electronic message) that appears, alerting a user (e.g., a requester or a vehicle) or asking for a confirmation.

Ride-hailing (or E-hailing) app: a ride-hailing app refers to an electronic application software installed in an electronic device (e.g., computer or mobile device), one of whose functions enables a requester to use the electronic device to book a trip or hail a ride electronically, or enables a vehicle to use the electronic device to accept a notification of request for ride.

On-demand: throughout the specification, unless the context requires otherwise, the term “on-demand” refers to a type of transport service arrangement where the requester intends to board a vehicle and start the trip (as soon as possible) upon sending a ride request.

Scheduled: throughout the specification, unless the context requires otherwise, the term “scheduled” refers to a type of transport service arrangement where the requester intends to board a vehicle and start the trip at or around a specified time.

Process Flow

FIG. 1 illustrates an example process flow of the main steps for arranging an on-demand (or scheduled) transport service, and highlights the main difference between the conventional 1-to-1 matching method and the present invention “pool-queue matching”: the 1-to-1 matching method matches a specific requester and a specific vehicle upon said vehicle accepts said requester’s request, whereas the “pool-queue matching” matches a requester who is present at (or close to) the pickup location to a vehicle that is present at (or close to) the same pickup location.

From the perspective of a requester, a general process of providing on-demand (or scheduled) transport service starts with the requester requesting for a ride (110), specifying a pickup location where the requester wishes to depart from. The requester, upon arriving at the pickup location (120), will board a vehicle matched or dispatched to it (130). The vehicle may or may not have arrived at (or be close to) the pickup location when the requester arrives at the pickup location. If the vehicle has not yet arrived at the pickup location, the requester then needs to wait for the vehicle to arrive.

From the perspective of a vehicle, a general process of providing on-demand (or scheduled) transport service starts with the vehicle receiving one or more notifications about requests for ride. The vehicle accepts a suitable notification to accept, depending on, for example, the geographical proximity and convenience of the requests as well as the detailed requirements of the requests (e.g., the pickup location, the destination and the number of passengers). Having accepted a suitable notification (140), the vehicle will then proceed to the pickup location specified by the notification. The vehicle, upon arriving at the pickup location (150), will board a requester matched to it (160). The requester may or may not have arrived at (or be close to) the pickup location when the vehicle arrives at the pickup location. If the requester has not yet arrived at the pickup location, the vehicle then needs to wait for the requester to arrive.

The conventional 1-to-1 matching method, adopted by the current ride-hailing apps, immediately matches a specific requester to a specific vehicle upon said vehicle accepts a notification of a request made by said requester (141). For example, when a requester uses a conventional ride-hailing app such as UBER, GRAB, DIDI CHUXING to make a request for ride (110), the app will broadcast the request to a group of vehicles. As soon as the request is accepted by a specific vehicle (140), the information about the vehicle (e.g., the plate number and model of the vehicle, the name and contact of the driver of the vehicle) will be immediately notified to the requester (141). In another word, the requester–vehicle match is completed and fixed (141) without considering whether the requester or the vehicle is present at (or close to) the pickup location. In fact, at the moment when the requester–vehicle match is completed and fixed, the vehicle is usually not present at (or close to) the pickup location, unless the vehicle is coincidentally present at (or close to) the pickup location when the request is made, which is a rather rare scenario.

After the requester–vehicle match is completed and fixed, the requester and the vehicle will then proceed to the pickup location for boarding. Accordingly, the party that has arrived at the pickup location first will then have to wait for the other party to arrive. Once both the matched requester (120) and the matched vehicle (150) have arrived the pickup location, the matched requester will then board the matched vehicle (130) / (160). In systems that utilize the 1-to-1 matching method, the step 130 and the step 160 of Figure 1 refer to the same step.

The “pool-queue matching method”, described by the present invention, matches a specific requester that is present at the pickup location to a specific vehicle that is also present at the pickup location (151). In some embodiments of the invention, a requester, after making the request for a ride, will not be matched to any specific vehicle until the requester has arrived at (or be close to) the pickup location. Once the details of the matched vehicle (e.g., the plate

number and model of the vehicle; the name and the contact number of the driver of the vehicle) are sent to the requester, the requester can immediately board the matched vehicle since the vehicle is already present at (or close to) the pickup location (130). Similarly, in some embodiments of the invention, a vehicle, after accepting a notification about going to a pickup location, will not be matched to any specific requester until the vehicle has arrived at (or be close to) the pickup location. Once the details of the matched requester (e.g., the name and the contact number) are sent to the vehicle, the vehicle can immediately board the requester since the requester is already present at (or close to) the pickup location (160).

FIG. 2 further illustrates an exemplary system that utilizes the 1-to-1 matching method. For illustration, the arrow 280 indicates the order at which the requesters request for a ride, and the arrow 270 indicates the order at which the vehicles accept the requests. For example, the requester R1 and the matched vehicle V1 are ranked by the system to be the 1st pair in the queue, because the matching between R1 and V1 is completed earlier than the match between R2 and V2.

When a requester requests for a ride, its status is set as “Arriving” (illustrated as dotted line such as R3, R5). Once the requester has arrived at the pickup location, its status is updated to “Ready for Boarding” (illustrated as solid line such as R1, R2, R4). Similarly, when a vehicle accepts a notification of a request for a ride, its status is set as “Arriving” (illustrated as dotted line such as V1, V5). Once the vehicle has arrived at the pickup location, its status is updated to “Ready for Boarding” (illustrated as solid line such as V2, V3, V4). The arrow 290 indicates the order at which the vehicles will arrive at the pickup location: V3, V2, V4, V1 and V5. It is apparent from FIG.4 that the vehicles’ arrival order might be different from the acceptance order. For example, although V1 is ranked the first in the acceptance order, it has not yet arrived at the pickup location while V3, V2 and V4 are already present at (or close to) the pickup location.

Current ride-hailing apps adopt such a 1-to-1 matching method to match between a specific requester and a specific vehicle at the time when the vehicle accepts a notification of the requester's request. The vehicle then travels to the pickup location as specified by the matched requester. The matching is fixed such that the requester R1 boards the vehicle V1, the requester R2 boards the vehicle V2, and so on. In this section, the waiting time for a requester is defined as the duration between the requester completes requesting for a ride and the matched vehicle successfully boards the requester. Similarly, the waiting time for a vehicle is defined as the duration between the vehicle arrives at the pickup location and the vehicle successfully boards the matched requester.

Four types of system-level inefficiencies from this 1-to-1 matching method are observed, when multiple requesters request for ride from a same pickup location. The "pool-queue" matching method of this invention address these inefficiencies, mainly through grouping requesters' ride requests according to pickup locations and matching a pool of requesters of a pickup location with a pool of vehicles of the said pickup location. The efficiency gain from the "pool-queue" matching method increases with the number of requests from a pickup location. Examples of a pickup location of large number of requests include airport, train stations or building lobbies in the busy business districts during peak hours.

The first inefficiency is the likely occurrence of unnecessarily long waiting time by either a requester or a vehicle when arranging on-demand transport service. As highlighted in instance 201, a requester R1, which has arrived at the pickup location and is "Ready for Boarding", is still waiting for the matched vehicle V1 to come to the pickup location; at the same moment, a vehicle V3, which has arrived at the pickup location and is "Ready for Boarding", is still waiting for its matched requester R3, which has not yet arrived, as highlighted in the instance 202. Moreover, vehicles' waiting for a prolonged duration at the

pickup location (e.g., V3) may negatively affect other vehicles, such as slowing down or even blocking the traffic.

Another inefficiency of the 1-to-1 matching method is that it cannot effectively manage sudden cancellation(s) by either the matched requester(s) or the matched vehicle(s). For example, as highlighted in instance 203, when a requester R5 cancels its original request after a match has been formed between R5 and V5, V5 will have to incur additional time to restart another 1-to-1 matching for arranging transport service, which might not be immediately successful. Even if another 1-to-1 matching is successfully established, the pickup location for V5 may be different and incurs additional travel time and cost. This could be particular problematic for V5 during the peak hours: V5 might have made significant efforts to drive towards the pickup location, but now be forced to change its route to another pickup location. Similarly, if the cancellation is initiated by V5, R5 will have to spend additional time to restart another 1-to-1 matching for arranging transport service, which can be challenging for R5 during the peak hours.

The third inefficiency is that there is often unavoidable waiting time for requesters when arranging on-demand transport service, as the 1-to-1 matching method dispatches a matched vehicle only after that a requester requests an on-demand ride. For example, if a requester makes a request for a ride from the pickup location using the 1-to-1 matching method, it is very likely that the requester will have to spend a significant amount of time to wait for the vehicle to come unless the matched vehicle is coincidentally present at the pickup location when the requester makes its request.

The fourth efficiency is that the vehicle is unproductive during the time period approaching a scheduled departure time when arranging scheduled transport service. For example, if a vehicle has accepted a scheduled ride request to board a requester at a particular pickup location at a particular departure time, the vehicle has to limit its activities not far from the said pickup location when

the time is approaching the scheduled departure time, such that the vehicle can arrive at the said pickup location before or at the said scheduled departure time.

The Arrival Detection System and The Method thereof

FIG. 3 illustrates an example system for detecting the arrival of a user (e.g., a vehicle or a requester). In an embodiment of the invention, the system comprises at least one user device 310 that is operable by at least one user for arranging an on-demand or scheduled transport service, at least one wireless network device 320 installed at a pickup location, and a vehicle dispatch server 330 that is operable to determine the arrival of the at least one user. The user device 310, the wireless network device 320 and the vehicle dispatch server 330 are configured to be able to communicate data with each other.

In some embodiments of the invention, once a requester makes a request for a ride or a vehicle accepts a notification, the device-specific ID of the user device 310 (e.g., the requester's user device; the vehicle's user device) is then transmitted to and stored at the vehicle dispatch server 330. In some embodiments of the invention, other identification information of the user device 310, such as the particulars of the user of the user device, is transmitted to and stored at the vehicle dispatch server 330. In some embodiments of the invention, the device-specific IDs of the requesters' devices 310 are stored in a specialized database (e.g., database for requester pool and priority requester pool) of the vehicle dispatch server 330. In some embodiments of the invention, the device-specific IDs of the vehicles' devices are stored in a specialized database (e.g., database for vehicle pool and supply surplus vehicle pool) of the vehicle dispatch server 330.

In some embodiments of the invention, the presence of a user of a user device 310 is determined through a wireless network device at the pickup location detecting wireless signals from the user device. The wireless network

device 320 installed at the pickup location is configured to obtain device-specific IDs of user devices 310 through wireless exchange of data and signals (via a process 321). As the wireless network device 320 is configured to be in data communication with the vehicle dispatch server 330, it is operable to transfer and store the device-specific IDs of the detected nearby user device 310 into the vehicle dispatch server 330 (via a data transmission process 322); if the detected user device 310 becomes no longer detectable by the wireless network device 320, the device-specific ID of the user device 310 will be removed from the vehicle dispatch server 330 (via a data transmission process 322). The vehicle dispatch server 330, upon receiving a device-specific ID from the data packet communicated in the process 322, checks whether the received device-specific IDs includes any device-specific ID of targeted users stored in the database of the vehicle dispatch server 330. If a match is found, the vehicle dispatch server 330 then determines that the user of the user device 310 has arrived at (or is close to) the pickup location. In some further embodiments, the data packets communicated in the process 322 also comprise the signal strength of the user device 310 as detected in the process 321, and the vehicle dispatch server 330 is configured to assess whether the signal strength of the user device 310 is above a predetermined (or dynamically determined) threshold value, further improving the flexibility in coverage distance for detecting the presence of the user device 310 (and accordingly its user) at the pickup location.

In some other embodiments of the invention, the wireless network device 320 may be equipped with data processing capability. The vehicle dispatch server 330 transmits the device-specific IDs of the targeted user devices 310 from its database to the wireless network device 320 installed at the specific pickup location (via a process 322). The wireless network device 320 is configured to obtain device-specific IDs of user devices 310 through wireless exchange of data and signals (via a process 321) with the user devices 310. The wireless network device 320 then compares and matches the device-specific IDs obtained from the process 321 and the process 322. In some embodiments, if

a match is found, the wireless network device 320 confirms the presence of the specific user device 310 at the pickup location. In some further embodiments, the wireless network device 320 communicates the confirmation of the presence of the specific user device 310 back to the vehicle dispatch server 330, which updates its database that the specific user device (and accordingly its user) has arrived at (or is close to) the pickup location. In some embodiments, the wireless network device 320 is also configured to capture the signal strengths of the user devices 310 via a process 321, and compare the signal strength with a predetermined (or dynamically determined) threshold value when determining the presence of the user device 310 (and accordingly its user) at the pickup location.

In some embodiments of the invention, the presence of a user of a user device 310 at a pickup location is determined through the user device detecting wireless signals from a wireless network device at the pickup location. A vehicle dispatch server 330 is configured to be in data communication with the user device 310 directly, and therefore transmit the device-specific ID of the wireless network device 320 installed at the corresponding pickup location to the user device 310 via a process 331. The user device 310, once detecting signals from the wireless network device 320 with the particular device-specific ID, is able to determine that the user has arrived at (or is close to) the designated pickup location. The user device 310 then communicates back to the vehicle dispatch server 330 that the user has arrived at (or is close to) the designated pickup location via a process 331. In some embodiments of the invention, the user device 310 also compares the signal strength of the wireless network device 320 with a predetermined (or dynamically determined) threshold value when determining whether it has arrived at (or is close to) the designated pickup location. In some embodiments of the invention, the user device 310 transmits the device-specific ID of the detected wireless network device 320 and the corresponding signal strength together to the vehicle dispatch server 330. The vehicle dispatch server 330 then determines the presence of the user device 310 at

the pickup location by considering both the presence of the device-specific ID of the corresponding wireless network device 320 and the corresponding signal strength.

In some embodiments of the invention, the wireless network device 320 and the requester's user device 310 are integrated into a single apparatus (e.g. a kiosk which also offers Wi-Fi connection) at a pickup location. When a requester requests an on-demand ride using the installed apparatus at the pickup location, the vehicle dispatch server will determine the requester as having arrived at the pickup location.

In some embodiments of the invention, once a user device 310 (and accordingly its user) is confirmed to be present at the pickup location, the user device 310 can function as a wireless network device 320 to exchange signals and data with other user devices 310 in its proximity.

The threshold signal in each of the above embodiments of the invention may be adjusted to improve the coverage range and accuracy in detecting the presence of user devices and accordingly improve the efficiency for a "Ready to Board" requester to successfully board a "Ready to Board" vehicle.

In some embodiments of the invention, the presence of a user of a user device 310 at a pickup location is determined through detecting its proximity to the pickup location by a satellite-based positioning system (e.g., the U.S. Global Positioning System, the Russian GLONASS), via the satellite-based positioning component of the user device. The user device 310, obtaining its position through satellite-based positioning system, updates its position to the vehicle dispatch server 330 at a pre-determined frequency via a process 331. The vehicle dispatch server compares the position of the user device with the position of the pickup location, to determine that the user of the user device has arrived at (or is close to) the designated pickup location. In some embodiments of the invention, the user device 310 compares its position with

the position of the particular pickup location, and updates a vehicle dispatch system 330 about whether the user has arrived at (or is close to) the designated pickup location via a process 331.

FIG. 4 illustrates an example method for the vehicle dispatch server to determine the arrival of a user, assisted with the arrival detection system as described in FIG. 3. The arrival detection system is utilized to automatically update users' statuses (i.e., whether the users have arrived at the pickup location).

For scheduled ride requests, an "Arriving" requester in the priority requester pool 511 is among the next to be matched with a vehicle, if its scheduled departure time is within a pre-programmed time interval from the current moment (e.g., the scheduled departure time is less than 30 minutes later). A dynamically determined number of on-demand requesters (that are the first few "Arriving" requesters in the requester pool 510 according to the request order 580) will also be among the next to be matched with vehicles. The number of these "Arriving" requesters may be dynamically adjusted to achieve that sufficient number of requesters' statuses are updated, so that the number of unmatched "Ready for Boarding" requesters are no less than the forecasted number of new "Ready for Boarding" vehicles (i.e., the vehicles update their status from "Arriving" to "Ready for Boarding") for a pre-programmed interval from the current moment.

When a requester is among the next few in a queue at a pickup location to be matched with a vehicle (410), the vehicle dispatch server 330 keeps detecting the arrival of the requester at the pickup location utilizing the arrival detection system (420) for a pre-programmed time interval. If the arrival of the requester is detected, the requester's status is automatically updated to "Ready for Boarding" (430); otherwise, a prompt appears on the requester's user device 310, asking the requester whether it has arrived at the pickup location (440). If the requester positively responds to this prompt, the requester's status is then

updated to “Ready for Boarding” (430). If the requester negatively responds to the prompt, the process repeats from step 410 after a pre-programmed time interval.

When a vehicle informs a vehicle dispatch server 330 that the vehicle is “Ready for Boarding” (450), the vehicle dispatch server keeps detecting the arrival of the vehicle at the pickup location utilizing the arrival detection system (460) for a pre-programmed time interval. If the arrival of the vehicle is detected, the vehicle’s status is automatically updated to “Ready for Boarding” (470); otherwise, a prompt appears on the vehicle’s user device 310, asking the vehicle (or the driver of the vehicle) whether the vehicle has arrived at the pickup location (480). If the vehicle (or the driver of the vehicle) positively responds to this prompt, the vehicle’s status is then updated to “Ready for Boarding” (470); If the vehicle (or the driver of the vehicle) negatively responds to the prompt, the process returns to await the vehicle to inform the vehicle dispatch server that it is “Ready for Boarding” (450).

In situations where the arrival detection system is absent or malfunctioning, process 420 and process 460 take the default value of “No” in determining the arrival of a user using the method in FIG. 4.

In some embodiments of the invention, the requester’s status is treated as “Ready for Boarding” with process 420 taking the default value of “Yes” in determining the arrival of a user using the method in FIG. 4.

Pool-Queue Matching Method

FIG. 5A illustrates an example method for the pool-queue matching based on the vehicles’ arrival orders when arranging on-demand transport service. When multiple requesters request for rides to depart on-demand from the same pickup location, they are grouped into the requester pool 510. Vehicles that accept notifications to go to the pickup location are grouped into the vehicle pool 520 of the pickup location.

A pickup location may be a pickup point, such as a building lobby, a taxi stand, a bus stop, and so on. A pickup location may also be a collection of a few pickup points, along a pre-defined route or in a pre-defined neighbourhood.

After pooling requesters and vehicles according to their designated pickup locations, the pool-queue matching method of the invention virtually queues the requesters according to the order at which they request for a ride (as indicated by the arrow 580). The method also queues the vehicles according to the order at which they arrive at the pickup location (as indicated by the arrow 590), whereby the “Arriving” vehicles, which have not arrived at the pickup location, are tentatively assumed to arrive at the order at which they have accepted the notifications (i.e., V1 arrives before V5).

In some embodiments of the invention, only the “Ready for Boarding” requesters and vehicles are matched, and the matching is conducted based on the respective queue orders of the “Ready for Boarding” requesters and vehicles. For examples in FIG 5A, V3 boards R1 (581), V2 boards R2 (582), and V4 boards R4 (583). When V1 arrives (after V4), the V1 will board the next “Ready for Boarding” requester (among R3 and R5). Similarly, when R3 arrives, the R3 will board the next “Ready for Boarding” vehicle (among V1, V5 and V6).

The pool-queue matching method reduces the unnecessary waiting time as highlighted in instances 201 and 202: rather than that R1 waits for V1 while V3 waits for R3, the improved method allows the “Ready for Boarding” requester R1, which is the first in the requester pool, to board the “Ready for Boarding” vehicle V3 (581), which is the first in the vehicle pool. In an extreme scenario where the vehicle V1 never arrives at the pickup location, the 1-to-1 matching method will force the “Ready for Boarding” requester R1 to wait indefinitely or to cancel its request. In a similar scenario where the requester

R3 never arrives at the pickup location, the 1-to-1 matching method will force the “Ready for Boarding” vehicle V3 to wait indefinitely or to cancel its acceptance.

The pool-queue matching method is resilient to cancellation by either the requesters or the vehicles, because a requester is not matched to any specific vehicle until the vehicle has arrived at (or is close to) the pickup location, and only a vehicle that has arrived at (or is close to) the pickup location is matched to the requester. For example, when the “Arriving” requester R3 cancels its request for ride, there will be no immediate impact on any vehicle in the vehicle pool as R3 is not yet matched to any specific vehicle in the vehicle pool. However, the vehicle dispatch server 330 may stop sending ride requests from this pickup location to vehicles until the pickup location’s demand (defined as the number of requesters in the requester pool 510) exceeds the supply (defined as the number of vehicles in the vehicle pool 520).

In some embodiments of the invention, even if a match has been established between a “Ready for Boarding” requester and a “Ready for Boarding” vehicle (e.g., R1 and V3), V3 can be released from the match if R1 somehow fails to board V3 after a pre-determined time interval (e.g., three minutes) – for example,

(1) R1 decides to cancel the request;

(2) R1 does not like the model of the matched vehicle;

(3) R1 fails to find V3; or

(4) R1 in fact has not yet arrived at the pickup location, because of malfunctioning of the arrival detection system at the pickup location or a mistaken response to the prompt about R1’s presence at the pickup location.

R1 will then be deemed as “absent”, and removed from the requester pool 510. The status of V3 is then changed from “Ready for Boarding” to “Arriving” first. If V3 later informs the vehicle dispatch server 330 that V3 has arrived at the pickup location (450) and the vehicle dispatch server 330 verifies that V3

is indeed present at the pickup location (460 or 480), V3 will then be matched with the next “Ready for Boarding” requester (among R3 and R5).

In some embodiments of the invention, when the “Arriving” vehicle V5 cancels its acceptance and is removed from the vehicle pool 520, there is no immediate impact on any particular requester as V5 is not yet matched to any requester in the requester pool 510. However, in order to make up for the loss of a vehicle in the vehicle pool, the vehicle dispatch server 330 may start sending notifications from this pickup location to other vehicles to increase the vehicle supply to this pickup location, until supply equals demand.

In some embodiments of the invention, in order to shorten the waiting time of requesters at a pickup location (e.g., during the peak hours), a supply surplus vehicle pool 521 comprising a predetermined number (X) of vehicles is appended to the vehicle pool 520 for the pickup location, where the vehicle queue spans across the vehicle pool and the supply surplus vehicle pool according to the arrival order (590). For example, in anticipation of future requests, in excess of the five requesters’ requests (R1 – R5), one additional vehicle V6 may be added into the supply surplus vehicle pool 521 of the pickup location. The vehicle dispatch server 330 may start sending notifications from this pickup location to other vehicles to increase the number of vehicles in the supply surplus pool until it equals the predetermined number X.

In some embodiments of the invention, the number of vehicles in the supply surplus pool 521, denoted as X, is determined by the total number of forecasted requesters’ requests D(t) at the pickup location over a determined period of time T from a certain moment t_0 (e.g., the current moment) as in the following equation, where X is an integer:

$$X \leq \int_{t_0}^{t_0+T} D(t)dt$$

In some embodiments of the invention, the forecasted requesters' requests D(t) as a function of time t may be modelled from the historical data of the requests at the pickup location. In some embodiments of the invention, the forecasted requesters' requests D(t) as a function of time t may be amended with the scheduled passenger arrival data when the pickup location is at a transport station (e.g., an airport or a train station). In some embodiments of the invention, the length of the time period T may be estimated based on the forecasted time it takes from a requester making a request (or a vehicle accepting the notification of the request) to the vehicle arriving at the pickup location.

In some embodiments of the invention, the forecasted requesters' requests D(t) may be turned off during pre-programmed period of the day (e.g., during off-peak hours).

FIG. 5B illustrates an example method for pool-queue matching, where scheduled ride requests are also present. When requesters (R6 – R8) request scheduled rides to depart from a pickup location at its particular scheduled departure time t_s^i respectively, they are grouped into a priority requester pool 511 of the pickup location, and queued according to the order of the scheduled departure time t_s (as indicated by the arrow 560).

The matching between a requester and a vehicle is first determined for the "Ready for Boarding" requesters in the priority requester pool 511, and then for the "Ready for Boarding" requesters in the requester pool 510. For examples in FIG. 5B, V3 boards R6 (561), V2 boards R8 (562), and then V4 boards R1 (584). When V1 arrives (after V4), it will board R2; however, if R7 in the priority requester pool arrives before V1 arrives, the "Ready for Boarding" requester in the priority requester pool R7 will take priority over the unmatched "Ready for Boarding" requester in the requester pool R2 to board the next "Ready for Boarding" vehicle V1.

The number of vehicles in the supply surplus vehicle pool X is increased by the total number of each scheduled requesters' request $\delta(t - t_s^i)$ at the pickup location over a determined period of time T from a certain moment t_0 (e.g. the current moment) as in the following equation, where X is an integer:

$$X \leq \int_{t_0}^{t_0+T} [D(t) + \sum_i \delta(t - t_s^i)]dt$$

If the scheduled departure time of a requester R_i in the priority requester pool 511, t_s^i, has passed ($t_s^i < t_0$), the scheduled departure time will take the value of the reference moment ($t_s^i = t_0$) in the above equation. A requester will be removed from the priority requester pool 511 when the requester either boards a vehicle or cancels its request for a ride.

In some embodiments of the invention, the forecasted requesters' requests D(t) may be turned off during pre-programmed period of the day (e.g., during off-peak hours).

FIG. 6 illustrates the operation of a vehicle dispatch system according to one embodiment of the invention. The process from a requester making a ride request to the requester boarding the matched vehicle is illustrated.

When an on-demand ride request (to depart from a pickup location) from a requester's device 610 is sent to a pool balancer module 620 of the said pickup location in a vehicle dispatch server 330 (via the process 611), the requester pool 510 will be updated accordingly and the demand for vehicle (number of vehicles in the requester pool 510) will increase by 1. When a scheduled ride request (to depart from a pickup location) from a requester's device 610 is sent to a pool balancer module 620 of the said pickup location in a vehicle dispatch server 330 (via the process 611), the priority requester pool 511 will be updated accordingly and the number of vehicles (X) needed in the supply surplus vehicle pool 521 will also be updated according to the described equation for X. After the pool balancer module 620 checks with a

queuing module 680 and a supply surplus module 681 to utilize the pool-queue matching method (via the process 621), the pool balancer pass the number of needed vehicles to a notification module 630 and a bidding module 640 (via the process 631). The notification module then notifies vehicles 650 about requests for vehicles to go to the pickup location (via the process 632). The notified vehicles may then bid for the notifications (via the process 641) and the bidding module will determine which of the vehicles are successful in securing the bids. The successful vehicles 650 will receive a confirmation (via the process 642) and the successful vehicles' data (e.g., the plate number and model of the vehicle, the name and contact of the vehicle driver) will be returned to the pool balancer module 620 (via the process 643). The requester will also receive a confirmation of request acceptance from the vehicle dispatch server 330 (via the process 612). For an on-demand ride request, if no vehicles have accepted the notification after a predetermined period of time (e.g., 5 minutes), the requester will also receive a notice of failed request from the vehicle dispatch server 330 (via the process 612). For a scheduled ride request, if no vehicles are in the vehicle pool at the pickup location at a predetermined time (e.g., 15 minutes before the scheduled departure time), the requester will also receive a notice of failed request from the vehicle dispatch server 330 (via the process 612). This paragraph provides a complete description of an embodiment of the invention starting from a requester making a ride request to the said requester receiving a confirmation that its request has been accepted by the vehicle dispatch server. However, the requester has not yet been matched with any particular vehicle at this stage.

While the vehicle 650 is "Arriving" (i.e., on the way to the pickup location), the vehicle's information such as its location data will be sent to a pickup location status module 660 at a pre-programmed frequency (via the process 661). The pickup location status module in a vehicle dispatch server, with the assistance from the arrival detection system and method described in FIG. 3 and FIG. 4, keeps track of all the "Arriving" and "Ready for Boarding" vehicles, as well as

keeping track of all the “Arriving” and “Ready for Boarding” vehicles. The pickup location status module update the requesters 610 about the vehicles’ statuses and locations at a pre-programmed frequency (via the process 662).

Once the vehicle 650 has arrived at (or is close at) the pickup location (according to the arrival detection system and method described in FIG. 3 and FIG. 4), the vehicle will send a confirmation to the pickup location status module 660 (via the process 663) to update the vehicle dispatch server 330 of its arrival. The vehicle’s status in the pool balancer module 620 will then be updated to “Ready for Boarding” (via the process 622). A requester 610, who has arrived at (or is close to) the pickup location (according to the arrival detection system and method described in FIG. 3 and FIG. 4), will then be matched to the vehicle 650. The pickup location status 660 will then send the matched requester’s data to the vehicle 650 (via the process 664), as well as send the vehicle’s data to the matched requester 610 (via the process 665).

Upon matching the vehicle 650 and the requester 610, a vehicle status module 670 then keeps track of the status of both the matched vehicle 650 and the matched requester 610. Upon the matched requester 610 boards the matched vehicle 650, the vehicle 650 will then send a confirmation of boarding to the vehicle status module 670 (via the process 671). In some embodiments of the invention, once receiving the confirmation of boarding, the vehicle status module 670 will send a further confirmation of “successful boarding” to both the vehicle 650 (via the process 672) and the requester 610 (via the process 673). Both the pickup location status module 660 and the pool balancer module 620 will update the statuses of the requester 610 and the vehicle 650 to “Boarded”, both the “Boarded” requester and the “Boarded” vehicle will then be correspondingly removed from the requester pool 510, the priority requester pool 511, the vehicle pool 520, or the supply surplus pool 521 in the pool-queue matching method. The embodiments described above provides a complete description of how the requester 610 successfully boards

a matched a vehicle utilizing the vehicle dispatch system and the method thereof.

In some embodiments of the invention, at a pre-programmed frequency the pool balancer module 620 will write (and read) the historical data about the above-described process(es) into (and from) a data storage module 690 (via the process 623).

In the conventional bidding process, only one vehicle will be selected for each round of notification (and bidding), likely to result in a lower success rate for vehicles to secure a bid. In some embodiments of the invention, by pooling requesters according to the pickup location, more than one vehicle may be needed in one round of bidding. With this improved method, the pool balancer 620 passes the number of needed vehicles to a notification module 630 and a bidding module 640 (via the process 631). The bidding module 640 first receives the bids from vehicles during a pre-programmed period of time (via the process 641), and then computes the score for each vehicle as a function of the vehicle's travel distance (or time) to the pickup location and its service ratings. The bidding module subsequently ranks the vehicles according to the computed score and selects the first few vehicles as "successful bidders" according to the number of needed vehicles sent to the notification module and the bidding module (via the process 631).

Embodiments of the User Interfaces

Fig 7 illustrates a user interface of a prompt to a requester about its arrival at a pickup location. To enable the requester to respond to displayed prompt text, the prompt to the requester 730 has a selectable feature 731 for negative response and a selectable feature 732 for positive response. The background of the prompt is the user interface displayed to the requester when the requester is waiting to be matched with a vehicle. In some embodiments of the invention, the address(es) of the requester's destination(s) 710 and the

pickup location 720 are also displayed. In some embodiments, the requester can cancel its request via a selectable feature 791 (e.g., “Cancel”).

Fig 8A illustrates a user interface of a vehicle after it has accepted a notification of request to go to a pickup location. The vehicle can inform a vehicle dispatch server 330 that it is “Ready for Boarding” via a selectable feature 801 (e.g., “Arrive”). In some embodiments, the user interface displays a map 810 with graphics showing the pickup location 811 and the vehicle’s current location 812. In some embodiments, the vehicle can filter the notifications by the vehicle’s preferred destination areas via a selectable feature 813. In some embodiments, the address of the pickup location 820 is displayed. In some embodiments, the vehicle can cancel its acceptance of the notification via a selectable feature 891 (e.g., “Cancel”).

Fig 8B illustrates a user interface of a prompt to a vehicle about its arrival at the pickup location. To enable the vehicle to respond to displayed prompt text, the prompt to the vehicle 830 has a selectable feature 831 for negative response and a selectable feature 832 for positive response.

The above is a description of embodiment(s) of a system and method for improving the efficiency in arranging on-demand and scheduled transport service. It is to be further appreciated that features from one or more embodiments as described may be permutated and/or combined to form further embodiments without departing from the scope of the present invention.

Claims:

1. A computer-implemented method for arranging on-demand transport service between a plurality of requesters and a plurality of vehicles, comprising:

(a) receiving from the plurality of requesters a plurality of requests for ride from a pickup location;

(b) grouping the plurality of requests from the pickup location;

(c) storing the plurality of requests into a requester pool of the pickup location;

(d) receiving from the plurality of vehicles a plurality of acceptances to pick up the plurality of requesters from the pickup location;

(e) storing the plurality of acceptances into a vehicle pool of the pickup location;

(f) detecting an user device of at least one vehicle that has arrived at (or is close to) a pickup location, wherein an acceptance made by the at least one vehicle is found in the vehicle pool of the pickup location; and

(g) matching the at least one vehicle with a requester, wherein a request made by the requester is found in the requester pool of the pickup location.

2. A method according to claim 1, wherein the pickup location is a pickup point, or a plurality of pickup points of a defined transportation station, or a plurality of pickup points in a defined neighbourhood or a plurality of pickup points on a defined route.

3. A method according to claim 1, wherein the plurality of requests in the requester pool of the pickup location is queued according to a request order at which the plurality of requests are made by the plurality of requesters, and the plurality of acceptances in the vehicle pool of the pickup location is queued according to a vehicle order at which the plurality of vehicles arrive at (are close to) the pickup location.

4. A method according to claim 1, wherein a user device of at least one requester that has arrived at (or is close to) the pickup location is detected, wherein the request made by the at least one requester is found in the requester pool of the pickup location.

5. A method according to claim 1 and claim 4, wherein the step of detecting the user device of at least one requester or the user device of at least one vehicle or both is facilitated by at least one satellite positioning system.

6. A method according to claim 1 and claim 4, wherein the step of detecting the user device of at least one requester or the user device of at least one vehicle or both is facilitated by at least one wireless network device at the pickup location.

7. A method according to claim 6, wherein the at least one wireless network device is configured to receive at least one identification information of the user device of at least one requester or the user device of at least one vehicle or both via a wireless technology.

8. A method according to claim 6, wherein the user device of at least one requester or the user device of at least one vehicle or both are configured to receive at least one identification information of the at least one wireless network device via a wireless technology.

9. A method according to claim 6, wherein the at least one wireless network device is:

a Wi-Fi router installed at the pickup location;

a kiosk installed at the pickup location;

the user device of at least one vehicle, wherein the at least one vehicle has arrived (or is close to) the pickup location; or

the user device of at least one requester, wherein the at least one requester has arrived (or is close to) the pickup location.

10. A method according to claim 1, wherein a predetermined number of acceptances from the first plurality of vehicles are received and stored in a supply surplus vehicle pool of the pickup location.

11. A method according to claim 10, wherein the predetermined number of acceptances in the supply surplus vehicle of the pickup location is predetermined based on a number of forecasted requests for ride from the pickup location for a pre-programmed time interval.

12. A method according to claim 11, wherein a scheduled ride request from the pickup location becomes part of the forecasted requests for ride from the pickup location, if a scheduled departure time of the scheduled ride request falls within the pre-programmed time interval.

13. A method according to claim 1, wherein a plurality of notifications to invite a first plurality of vehicles to go to the pickup location is sent to the first plurality of vehicles in order to balance the vehicle pool and the requester pool of the pickup location, if the plurality of acceptances in the vehicle pool of the pickup location is fewer than the plurality of requests in the requester pool of the pickup location.

14. A method according to claim 13, wherein the first plurality of vehicles receive the plurality of notifications to go to the pickup location;
a second plurality of vehicles bids for the plurality of notifications by submitting their acceptances, wherein the second plurality of vehicles is a subset of the first plurality of vehicles;
one or more acceptances from the second plurality of vehicles are determined to be successful; and

the one or more successful acceptances are added into the vehicle pool or the supply surplus vehicle pool of the pickup location.

15. A method according to claim 1, wherein a vehicle, which has arrived at (or is close to) a pickup location and whose acceptance is the first unmatched acceptance according to the arrival order in the vehicle pool of the pickup location, is matched with a requester, whose ride request is the first unmatched request according to the request order among the present requesters in the requester pool of the pickup location

16. A method according to claim 15, wherein there is a cancellation of acceptance made by a previously matched vehicle in the vehicle pool of the pickup location, the previously matched vehicle remains in the vehicle pool of the pickup location.

17. A method according to claim 16, wherein the previously matched vehicle's presence at the pickup location is operable to be detected again and queued according to a new arrival time.

18. A method according to any of the preceding claims, wherein a cancellation of an unmatched acceptance in the vehicle pool requires no action from any requester in the requester pool, and a cancellation of an unmatched request in the requester pool of a pickup location requires no action from any vehicle in the vehicle pool.