COMMUNICATIONS SERVER APPARATUS, METHOD AND COMMUNICATIONS SYSTEM FOR FULFILMENT OF AN ORDER FROM A USER

Technical Field

The invention relates generally to the field of communications. One aspect of the invention relates to a communications server apparatus for fulfilment of an order from a user. Other aspects of the invention relate to a method for fulfilment of an order from a user, and a communications system for fulfilment of an order from a user.

One aspect of the invention has particular, but not exclusive, application for fulfilling or completing an order made by a user. The overall action of fulfilling the order may be decoupled into separate processes, where one process may be concerned with picking up the item(s) contained in the order by a first agent and delivery of the item(s) to a virtual hub, and another process may be concerned with delivery of the item(s) contained in the order from the virtual hub to the user or a destination location associated with the user.

Background

With Covid-19, e-commerce demand has drastically changed from not-so-urgent goods to urgent essentials. More and more consumers have changed their purchasing habits, relying on e-commerce to buy goods and daily essentials. The traditional e-commerce supply chain usually takes a few days to finish the cycle, which is insufficient to fulfil the new demand. Consumers' expectations have changed to get delivery in a short timeframe, where the known traditional e-commerce supply chain may not cope with. Consumers' expectations have changed

to get delivery in one or two hours, where this type of delivery may be classified as "Instant Delivery".

The challenge for "Instant Delivery" is amplified if an order from a customer requires pickup from multiple locations. This is common since each instant delivery order usually has dozens of items, covering multiple categories of goods (e.g., household, raw food, cooked food, medicine, etc), whose suppliers range from supermarkets, restaurants, wholesalers, drugstores, etc. If the traditional delivery order batching method is adopted, for example, as shown in FIG. 6, by assigning one or multiple orders to one driver, the driver has to go to multiple pickup locations to collect all the items, and then deliver to multiple consumers. Referring to FIG. 6, a first driver has to travel to multiple pickup locations (e.g., stores) 690a, 690b, 690c, 690d to pick up items to fulfil one or more orders, and then deliver the items to different consumers/customers 692a, 692b. Similarly, a second driver has to travel to various pickup locations 690a, 690b, 690c to pick up items and then deliver the items from these locations 690a, 690b, 690c to the corresponding consumers 692c, 692d. As can be appreciated, a typical driver flow can easily fail the Instant Delivery SLA (Service Level Assurance), which may be one or two hours. If the number of orders per batch is reduced, the profitability and efficiency will be affected.

For known order batching (or pooling) methods, the majority group it into a CVRP (Capacitated Vehicle Routing Problem), with different variants, like CVRPPD (with pickup delivery precedence constraint), CVRPTW (with time window constraint), etc. However, none of the known methods can effectively solve the SLA issue "Instant Delivery" is facing. Multiple pickups and deliveries can improve the batching efficiency, but with the cost of sacrificing consumers' experience, who would have to wait longer.

There are also known multi-echelon designs, which is a typical offline solution focusing on inventory management, but without considering the fact that each delivery requires pickup from multiple locations with tight delivery time windows.

Summary

Aspects of the invention are as set out in the independent claims. Some optional features are defined in the dependent claims.

Implementation of the techniques disclosed herein may provide significant technical advantages. Techniques disclosed herein provide a decoupling approach involving the use of a virtual hub for fulfilment of orders, where tasks of the same type can be assigned to the same group of agents. For example, pickup tasks can be assigned to first agents or pickup agents for delivery of items for the orders from pickup locations to the virtual hub, while delivery tasks can be assigned to second agents or delivery agents for delivery of the items from the virtual hub to destination locations. As such, orders made by users can be decoupled into separate processes, one for the pickup tasks and another for the delivery tasks. By breaking the orders into separate and smaller processes, directed to respective groups of agents, this may allow a more efficient use of resources and processing load in processing the orders. Further, transmitting smaller amounts of respective data (i.e., related to pickup tasks or the delivery tasks) to the respective groups of agents, and just data that are relevant to the respective groups of agents (e.g., just data relating to the pickup tasks being transmitted to the pickup agents) may allow a more efficient use of resources and data network traffic.

The decoupling approach according to the techniques disclosed herein may offer time efficiency and allow efficiency in resource utilisation, for example, in terms of transportation resources. The virtual hub provides a location where items corresponding to one or more orders can be delivered to and delivered from, and

allows one first agent to deliver items from one or more pickup locations to the virtual hub (as part of pickup tasks) for onward delivery by one or more second agents, and for one second agent to deliver items (that have been delivered by one or more first agents to the virtual hub) from the virtual hub to one or more destination locations (as part of delivery tasks). This helps to save time and resources as compared to known techniques which require the same agent to perform both the pickup tasks and the delivery tasks that involve travelling to multiple pickup locations to pick up items and travelling to multiple pickup locations to deliver the items, often time without proper planning as to the sequence of order fulfilment,and the travelling routes and times.

In the techniques disclosed herein, the first agents can concentrate on utilising their time on the pickup tasks and delivering the items to the assigned virtual hub, without having to perform the subsequent delivery tasks, while the second agents can concentrate on utilising their time on the delivery tasks and delivering the items from the assigned virtual hub to the destination locations, without having to perform the prior pickup tasks. In contrast, in know techniques where the same agent is responsible for the pickup tasks and the delivery tasks, the agent would need to juggle between the pickup tasks and the delivery tasks, and may, for example, have to perform a delivery task in between two pickup tasks, which all adds up in terms of time. Such a situation is likely to lead to increased time usage as the same agent is bound to complete the pickup tasks and the delivery task for one order first before moving to the tasks for another order, when the pickup tasks for separate orders could have been completed together within the same timeframe (thus saving time), for example, when the pickup locations for the pickup tasks may be in close proximity to each other or the pickup tasks for separate orders could even be related to the same pickup location as could be achieved by the techniques disclosed herein.

It is also clear from the above that the same agent in known techniques would need to travel to and from multiple locations for multiple orders, including potentially

having to travel to the same pickup location multiple times for different orders or having to travel to the same area or region multiple times for different orders. This leads to both increased time usage and resource usage, which could be alleviated by the techniques disclosed herein as, for example, one first agent would be able to perform pickup tasks for different orders in one trip, in particular where the same pickup locations are involved, or the pickup locations may be in close proximity to each other, or the pickup locations may be along the way during delivery by the first agent to the virtual hub.

In at least some implementations, the techniques disclosed herein may provide for batching of pickup tasks into a pickup job and/or batching of delivery tasks into a delivery job. Batching of the pickup tasks and/or the delivery tasks may be carried out taking into consideration timing issues for completion of the pickup tasks. The pickup job may be assigned to a first agent or pickup agent. The delivery job may be assigned to a second agent or delivery agent. Such batching of pickup tasks and/or delivery tasks may allow for efficient use of bandwidth, data network traffic and processing load. By suitably batching, for example, a group of pickup tasks together, such batched pickup tasks (or pickup job) can be processed as a whole and data related thereto can be transmitted one time to a communications device of the first agent. Without batching, the pickup tasks would be processed separately, perhaps, even independently from each other without considering that there may be common elements among the pickup tasks that may suitably allow them to be processed together, and respective data related to the pickup tasks would need to be transmitted separately to the communications device of the first agent.

In an exemplary implementation, the functionality of the techniques disclosed herein may be implemented in software running on a handheld communications device, such as a mobile phone. The software which implements the functionality of the techniques disclosed herein may be contained in an “app” – a computer program, or computer program product – which the user has downloaded from an online store.

When running on the, for example, user's mobile telephone, the hardware features of the mobile telephone may be used to implement the functionality described below, such as using the mobile telephone's transceiver components to establish the secure communications channel for fulfilment of an order from a user.

Brief Description of the Drawings

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

FIG. 1 is a schematic block diagram illustrating an exemplary communications system involving a communications server apparatus.

FIG. 2A shows a schematic block diagram illustrating a communications server apparatus for fulfilment of an order from a user.

FIG. 2B shows a schematic block diagram illustrating a data record.

FIG. 2C shows a schematic block diagram illustrating architecture components of the communications server apparatus of FIG. 2A.

FIG. 2D shows a flow chart illustrating a method for fulfilment of an order from a user.

FIG. 3 shows a schematic diagram illustrating a method for batched pickup and batched delivery of various embodiments.

FIG. 4 shows a schematic diagram illustrating an order batching approach of various embodiments.

FIG. 5 shows a schematic block diagram illustrating a system for implementing decoupled order batching, according to various embodiments.

FIG. 6 shows a schematic diagram illustrating an order batching approach of the prior art.

Detailed Description

Various embodiments may relate to decoupled order batching for delivery, e.g., instant delivery. An "instant delivery" may refer to a delivery in a short delivery timeframe after a consumer has made an order or a purchase, for example, via an e-commerce platform. In recent times, consumers' expectations have changed to get delivery of items for their corresponding orders in one or two hours, as non-limiting examples of a delivery that may be classified as an "instant delivery".

The present techniques may enable fixing the assignment of hubs to the pickup and delivery locations and addressing operational routing challenges. Further, the present techniques may assign virtual hubs to the orders in real-time as part of the online decision, which may allow the techniques to decouple pickup from delivery to be efficiently batched separately.

The present techniques may make use of a system including user communication devices and a computing device to enable a decoupled order batching method, through real-time virtual hub assignment, for example, to achieve high profitability and efficiency while not sacrificing consumers' satisfaction.

The present techniques may provide for assigning each order made by a user or customer in real time to a particular virtual hub. One or more first agents (e.g., shoppers) may then fulfil one or more orders by picking up items or products corresponding to the one or more orders from one or more pickup locations (e.g., stores/merchants) and deliver the products to the corresponding virtual hub(s). One or more second agents (e.g., drivers), different from the first agents, may then collect the products from the virtual hub(s) and deliver the products to one or more consumers/customers who made the corresponding order(s).

Referring first to FIG. 1, a communications system 100 is illustrated, which may be applicable in various embodiments. The communications system 100 may be for fulfilment of an order from a user.

The communications system 100 includes a communications server apparatus 102, a first (user or client) communications device 104 and a second (user or client) communications device 106. These devices 102, 104, 106 are connected in or to the communications network 108 (for example, the Internet) through respective communications links 110, 112, 114 implementing, for example, internet communications protocols. The communications devices 104, 106 may be able to communicate through other communications networks, such as public switched telephone networks (PSTN networks), including mobile cellular communications networks, but these are omitted from FIG. 1 for the sake of clarity. It should be appreciated that there may be one or more other communications devices similar to the devices 104, 106.

The communications server apparatus 102 may be a single server as illustrated schematically in FIG. 1, or have the functionality performed by the communications server apparatus 102 distributed across multiple server components. In the example of FIG. 1, the communications server apparatus 102 may include a number of individual components including, but not limited to, one or more microprocessors (µP) 116, a memory 118 (e.g., a volatile memory such as a RAM (random access memory)) for the loading of executable instructions 120, the executable instructions 120 defining the functionality the server apparatus 102 carries out under control of the processor 116. The communications server apparatus 102 may also include an input/output (I/O) module (which may be or include a transmitter module and/or a receiver module) 122 allowing the server apparatus 102 to communicate over the communications network 108. User interface (UI) 124 is provided for user control and may include, for example, one or more computing peripheral devices such as display monitors, computer keyboards and the like. The

communications server apparatus 102 may also include a database (DB) 126, the purpose of which will become readily apparent from the following discussion.

The communications server apparatus 102 may be for fulfilment of an order from a user.

The communications device 104 may include a number of individual components including, but not limited to, one or more microprocessors (µP) 128, a memory 130 (e.g., a volatile memory such as a RAM) for the loading of executable instructions 132, the executable instructions 132 defining the functionality the communications device 104 carries out under control of the processor 128. Communications device 104 also includes an input/output (I/O) module (which may be or include a transmitter module and/or a receiver module) 134 allowing the communications device 104 to communicate over the communications network 108. A user interface (UI) 136 is provided for user control. If the communications device 104 is, say, a smart phone or tablet device, the user interface 136 may have a touch panel display as is prevalent in many smart phone and other handheld devices. Alternatively, if the communications device 104 is, say, a desktop or laptop computer, the user interface may have, for example, one or more computing peripheral devices such as display monitors, computer keyboards and the like. Communications device 104 may also include satnav components 137, which allow communications device 104 to conduct a measurement or at least approximate the geolocation of user communications device 104 by receiving, for example, timing signals from global navigation satellite system (GNSS) satellites through GNSS network using communications channels, as is known.

The communications device 106 may be, for example, a smart phone or tablet device with the same or a similar hardware architecture to that of the communications device 104. Communications device 106, has, amongst other things, user interface 136a in the form of a touchscreen display and satnav components 138.

Communications device 106 may be able to communicate with cellular network base stations through cellular telecommunications network using communications channels. Communications device 106 may be able to approximate its geolocation by receiving timing signals from the cellular network base stations through cellular telecommunications network as is known. Of course, communications device 104 may also be able to approximate its geolocation by receiving timing signals from the cellular network base stations and communications device 106 may be able to approximate its geolocation by receiving timing signals from the GNSS satellites, but these arrangements are omitted from Figure 1 for the sake of simplicity.

The communications device 104, for example, may be associated with a user or consumer, and may be used to transmit order data including at least one data field indicative of an order made by a user for delivery to a destination location associated with the user. The order may include at least one item offered at one or more pickup locations.

The communications device 106, for example, may be associated with a pickup agent assigned to an order from a user, and may be used to receive data indicative of pickup data indicative of at least one pickup task for the order and hub data indicative of a virtual hub associated with the order, or may be associated with a delivery agent, and may be used to receive data indicative of delivery data indicative of a delivery task for the order and hub data indicative of a virtual hub associated with the order.

It should be appreciated that one or more additional communications devices may be included in the communications system 100, for example, associated with another user, or another pickup agent, or another delivery agent.

FIG. 2A shows a schematic block diagram illustrating a communications server apparatus 202 for fulfilment of an order from a user, while FIG. 2B shows a

schematic block diagram illustrating a data record 240 that may be generated by the communications server apparatus 202.

The communications server apparatus 202 includes a processor 216 and a memory 218, where the communications server apparatus 202 is configured, under control of the processor 216 to execute instructions in the memory 218 to, in response to receiving order data having at least one data field indicative of an order made by a user for delivery to a destination location associated with the user, the order including at least one item offered at at least one pickup location, assign a virtual hub to the order by associating hub data indicative of the virtual hub with the order, the virtual hub being assigned based on the at least one pickup location and the destination location, generate, in one or more data records 240, pickup data 242 indicative of at least one pickup task for the order, wherein a respective pickup task of the at least one pickup task is associated with the at least one item, a respective pickup location of the at least one pickup location where the at least one item is available, and the virtual hub, and delivery data 244 indicative of a delivery task for the order, wherein the delivery task is associated with the at least one item, the virtual hub and the destination location, transmit, for receipt by at least one communications device of at least one first agent assigned to the order, the pickup data 242 and the hub data for delivery of the at least one item by the at least one first agent from the respective pickup location to the virtual hub, and transmit, for receipt by at least one communications device of a second agent assigned to the order, the delivery data 244 and the hub data for delivery of the at least one item by the second agent from the virtual hub to the destination location. The processor 216 and the memory 218 may be coupled to each other (as represented by the line 217), e.g., physically coupled and/or electrically coupled.

In other words, there may be provided a communications server apparatus 202 for fulfilment of an order from a user (or fulfilment of at least one order from at least one user). A user (or consumer or customer) may make an order (e.g., on or via an

online platform, e-commerce platform, website, etc.) with at least one item (or product) offered at at least one pickup location (e.g., a pickup store, a retail location, a business location, etc.). In response to receiving (user) order data having at least one data field indicative of the order made by the user for delivery to a destination location (or final location) associated with (or corresponding to) the user (e.g., residence or work location of the user, current location of the user, etc.), the communications server apparatus 202 may assign a virtual hub (e.g., in real time and/or dynamically) to the order by associating the order with hub data indicative of the virtual hub, where the virtual hub may be assigned to the order based on the at least one pickup location and the destination location (e.g., taking into consideration the location of the virtual hub relative to the at least one pickup location and the destination location).

In various embodiments, the hub data may include data indicative of a location of the virtual hub. The location may, for example, be defined in terms of data derived from a global navigation satellite system (GNSS), e.g., global positioning system (GPS). The location may be defined in terms of latitude and longitude values.

As a non-limiting example, the order may include a plurality of items that may be available at one or more pickup locations. This may mean, for example, that all of the items may be available at one pickup location, or one or more of the items may be available at a first pickup location and one or more of the remaining items may be available at a second pickup location. It should be appreciated that there may be more pickup locations involved, e.g., a third pickup location, a fourth pickup location and so on, if required, for the plurality of items ordered by the user to be delivered to the virtual hub.

The communications server apparatus 202 may generate, in one or more data records 240, pickup data 242 indicative of one or more pickup tasks for the order, where a respective pickup task may be associated with the at least one item (or a

respective item of the at least one item), a respective pickup location of the at least one pickup location where the at least one item may be available or offered, and the virtual hub (for delivery of the at least one item from the respective pickup location to the virtual hub). The pickup data 242 may, for example, include data indicative of one or more of the at least one item, the respective or corresponding pickup location from where the at least one item is available or can be obtained, or the estimated time for completion of the at least one pickup task. A pickup task involves a first agent obtaining or picking up the item(s) from or at a pickup location, and delivering the item(s) from the pickup location to the assigned virtual hub.

The communications server apparatus 202 may further generate, in the one or more data records 240, delivery data 244 indicative of a delivery task for the order, where the delivery task may be associated with the at least one item, the virtual hub and the destination location (for delivery of the at least one item from the virtual hub to the destination location). The delivery data 244 may, for example, include data indicative of one or more of the at least one item, the destination location, or the estimated time for completion of the delivery task. A delivery task involves a second agent delivering the item(s) from the assigned virtual hub to the destination location associated with the user who made the order.

The communications server apparatus 202 may transmit the pickup data 242 and the hub data to at least one communications device of at least one first agent (or pickup agent or shopper) assigned to the order for delivery of the at least one item by the at least one first agent from the respective pickup location to the virtual hub. In response to receiving the pickup data 242 and the hub data, the at least one first agent assigned to the order may travel to the respective pickup location and pick up or purchase the at least one item from the respective pickup location and then deliver or transport the at least one item to the virtual hub. The at least one first agent may be assigned to the order based on at least one condition, e.g., familiarity of the at least one first agent with the at least one pickup location or area of the at

the at least one pickup location, availability of the at least one first agent, current location of the at least one first agent, etc. This may help to minimise item pickup or collection time at the at least one pickup location, or minimise the overall time required for the pickup task.

The communications server apparatus 202 may transmit the delivery data 244 and the hub data to at least one communications device of a second agent (or delivery agent or driver) assigned to the order for delivery of the at least one item by the second agent from the virtual hub to the destination location. In response to receiving the delivery data 244 and the hub data, the at least one second agent may travel to the virtual hub and collect the at least one item, delivered by the at least one first agent to the virtual hub, at or from the virtual hub and then deliver or transport the at least one item to the destination location. The second agent may be assigned to the order based on at least one condition, which may include, for example, familiarity of the second agent with the destination location(s) or area of the destination location(s), availability of the second agent, current location of the second agent, etc. This may help to minimise the delivery time to the destination location, or minimise the overall time required for the delivery task.

In the context of various embodiments, there may be a plurality of defined or pre-determined virtual hubs, and a particular virtual hub may be selected from the plurality of defined virtual hubs to be assigned to the order, e.g., based, at least in part, on the at least one pickup location and the destination location.

In the context of various embodiments, a virtual hub may be a zero-inventory site or location, meaning that there may be no inventory at the virtual hub compared to a physical warehouse or depot with stored inventory or items. Nevertheless, in some embodiments, one or more virtual hubs may have potential storage capacity, for example, virtual hubs in the form of a van or a shopping mall, where one or more items may be placed or stored temporarily at the virtual hub after having been

delivered by the first agent(s) (or pickup agent(s)) to the virtual hub prior to arrival of the second agent(s) (or delivery agent(s)) at the virtual hub for onward delivery to user(s). It should be appreciated that such virtual hubs may offer temporary storage facility to only items corresponding to one or more orders that have been made, in contrast to physical warehouses or depots carrying a huge inventory or items that are stored long term at the warehouses or depots, where the items are awaiting orders. In other words, items that are at a virtual hub are items that have been ordered (i.e., part of orders) that have been picked up and delivered by first agent(s) to the virtual hub and are at the virtual hub temporarily before being promptly delivered by second agent(s) to user(s), while items that are at a warehouse or depot are stored long term, and awaiting orders that are still to be made by users for those stored items.

In the context of various embodiments, a virtual hub may allow for cross transfer or handing over of one or more items from one or more first agents to one or more second agents for subsequent delivery to one or more users. The item(s) may be transferred or handed over by the first agent(s) directly to the second agent(s) at the virtual hub.

A virtual hub is transient or temporaneous in the sense that, while it is available for use, for example, as a place or location for temporary holding of item(s) or cross transfer of item(s) for first and second agents, and can be assigned to one or more order(s) at one or more particular time(s), there may be times that the virtual hub may not be in use or assigned to an order, and the virtual hub itself may be perceived not to physically exist at its defined location when not assigned to an order.

A defined or pre-determined virtual hub that may be assigned to an order may be sited or located anywhere and in any form, subject to local rules and regulations, and may include, for example, a vehicle (e.g., a van, car, etc.), a structure or building

(e.g., a bus stop, a train station, a cafe, a shopping mall, etc.), a point-of-interest (POI), or any suitable location, including an open space location (e.g., a road junction, a pavement on a certain road, location in front of a certain building or store, etc.)

A virtual hub is movable in the sense that, for orders made by the same user, different virtual hubs may be assigned for the different orders, depending on the pickup location(s) and destination location(s) corresponding to the orders. Further, where virtual hubs are in the form of movable objects, for example, vehicles, the movable objects can be moved to defined locations to serve as virtual hubs at those locations.

In the context of various embodiments, the one or more data records 240 may include one or more pickup data fields, and one or more delivery data fields. The communications server apparatus 202 may generate, for or in the one or more pickup data fields, the pickup data 242. The communications server apparatus 202 may generate, for or in the one or more delivery data fields, the delivery data 244.

In the context of various embodiments, the one or more data records 240 may be associated with or accessible by the communications server apparatus 202. The one or more data records 240 may be modified or updated by the communications server apparatus 202. The one or more data records 240 may be stored at the communications server apparatus 202, e.g., in the memory 218.

The communications server apparatus 202 may further generate, in the one or more data records 240 (e.g., for or in one or more time data fields of the one or more data records 240), timing data indicative of a time window for coordination between delivery of the at least one item by the (assigned) at least one first agent to the virtual hub and (subsequent) delivery of the at least one item by the (assigned) second agent from the virtual hub. Such time window may allow, for example, for

efficient cross transfer of item(s) from the first agent(s) to the second agent(s), for example, allowing for just-in-time cross transfer. Such time window may help to minimise the waiting times for both the first agent(s) and the second agent(s). In this way, the waiting time (if any) for the first agent(s), who may have arrived at the virtual hub earlier, for arrival of the second agent(s) at the virtual hub for cross transfer of the item(s) can be minimised, and the waiting time (if any) for the second agent(s), who may have arrived at the virtual hub earlier, for arrival of the first agent(s) at the virtual hub for cross transfer of the item(s) can be minimised. The timing data may be transmitted to the respective communications devices of the at least one first agent and the second agent.

For generating the timing data, the communications server apparatus 202 may generate, in the one or more data records 240, first time data indicative of the time by when the at least one item is to be delivered by the (assigned) at least one first agent to the virtual hub. The first time data may be comprised in or may be part of the timing data. The time by when the at least one item is to be delivered by the at least one first agent to the virtual hub may be determined based on the longest predicted pickup finishing time, which may be determined for a particular pickup task from among the at least one pickup task for the order and which requires the longest or maximum time estimated or predicted for completion (i.e., longest estimated completion time) of the particular pickup task. In other words, the first time data may be indicative of the time by when all pickup tasks for the order are completed and the item(s) for the order has been delivered to the virtual hub. The time by when the at least one item is to be delivered by the at least one first agent to the virtual hub may be defined in terms of an absolute time, e..g., the at least one item should reach the virtual hub by 3:00 pm, or a relative time or period, e.g., the at least one item should reach the virtual hub in or within an hour's time. The first time data may be transmitted to the at least one communications device of the at least one first agent.

For generating the first time data, the communications server apparatus 202 may generate, for each of the at least one pickup task, estimate data indicative of an estimated completion time for the pickup task, determine, based on the estimate data of the at least one pickup task (i.e., based on the estimated completion times), a longest estimated completion time, and generate the first time data based on the longest estimated completion time. in other words, the pickup task with the longest estimated completion time may be determined from the pickup tasks for the order, and the longest estimated completion time may be used as basis for determining or defining the time by when the at least one item is to be delivered by the at least one first agent to the virtual hub.

For generating the timing data, the communications server apparatus 202 may generate, in the one or more data records 240, second time data indicative of the time by when the at least one item is to be delivered from the virtual hub by the (assigned) second agent. The second time data may be comprised in or may be part of the timing data. The time by when the at least one item is to be delivered by the second agent from the virtual hub and the time by when the at least one item is to be delivered by the at least one first agent to the virtual hub may overlap each other. The time by when the at least one item is to be delivered by the second agent from the virtual hub may be the same as or later than the time by when the at least one item is to be delivered by the at least one first agent to the virtual hub. The time by when the at least one item is to be delivered from the virtual hub by the second agent may be determined based on the longest estimated completion time (or longest predicted pickup finishing time) as described above. In other words, the second time data may be indicative of the time by when all pickup tasks for the order are completed and the item(s) for the order has been delivered to the virtual hub and delivery of the item(s) from the virtual hub by the second agent can start. The time by when the at least one item is to be delivered from the virtual hub by the second agent may be in terms of an absolute time, e..g., the at least one item should be delivered starting from 3:00 pm, or a relative time or period, e.g., the delivery

should start in or within 5 minutes' time. The second time data may be transmitted to the at least one communications device of the second agent.

In various embodiments, the order may include a plurality of items offered at a plurality of pickup locations, and the virtual hub may be assigned based on the plurality of pickup locations and the destination location. The communications server apparatus 202 may, for generating the pickup data 242 and the delivery data 244, generate, in the one or more data records 240, a plurality of pickup data indicative of a plurality of pickup tasks for the order, wherein respective pickup data of the plurality of pickup data corresponds to a respective pickup task of the plurality of pickup tasks, wherein, for each pickup task of the plurality of pickup tasks, the pickup task may be associated with one or more items of the plurality of items, a respective pickup location of the plurality of pickup locations where the one or more items are available, and the virtual hub, and delivery data indicative of a delivery task for the order, wherein the delivery task is associated with the plurality of items, the virtual hub and the destination location. The communications server apparatus 202 may further generate, in the one or more data records 240, batched pickup data based on the plurality of pickup data, the batched pickup data being indicative of the plurality of pickup tasks. The communications server apparatus 202 may further transmit, for receipt by the at least one communications device of the at least one first agent, the batched pickup data and the hub data for delivery of the plurality of items by the at least one first agent from the plurality of pickup locations to the virtual hub. The communications server apparatus 202 may further transmit, for receipt by the at least one communications device of the second agent, the delivery data and the hub data for delivery of the plurality of items by the second agent from the virtual hub to the destination location. Such embodiments may involve a user making an order for a plurality of items that may be picked up by (at least) one first agent from a plurality of pickup locations to be delivered to a virtual hub, and delivery of the plurality of items by a second agent from the virtual hub to a destination location associated with the user.

The plurality of pickup tasks, or collectively known as batched pickup tasks or simply as a pickup job, may involve a group of pickup tasks that is batched together for delivery of items by one first agent in one trip or journey from at least one pickup location to the assigned virtual hub (which may be associated with one or more orders). The plurality of pickup tasks may be batched together taking into account the longest estimated completion time. The at least one first agent may be assigned based on at least one condition, which may include, for example, familiarity of the first agent with the pickup location(s) or area of the pickup location(s), availability of the first agent, current location of the first agent, etc.

In various embodiments, there may be a plurality of first agents assigned to the order. The communications server apparatus 202 may, for generating the batched pickup data, generate a plurality of batched pickup data based on the plurality of pickup data, wherein each respective batched pickup data of the plurality of batched pickup data are indicative of one or more respective pickup tasks of the plurality of pickup tasks. The communications server apparatus 202 may, for transmitting the batched pickup data and the hub data, transmit, for receipt by the at least one communications device of a respective first agent of the plurality of first agents, the each respective batched pickup data and the hub data for delivery of one or more items of the plurality of items by the respective first agent from one or more pickup locations of the plurality of pickup locations to the virtual hub. Such embodiments may involve a user making an order for a plurality of items that may be picked up by a plurality of first agents from a plurality of pickup locations to be delivered to a virtual hub, and delivery of the plurality of items by a second agent from the virtual hub to a destination location associated with the user.

In various embodiments, in response to receiving a plurality of order data associated with a plurality of orders made by a plurality of users, wherein each order data of the plurality of order data is associated with a respective order of the plurality of orders

made by a respective user of the plurality of users and includes at least one data field indicative of the respective order made by the respective user for delivery to a respective destination location associated with the respective user, the respective order including at least one item offered at at least one pickup location, the communications server apparatus 202 may, for assigning the virtual hub, assign the virtual hub to the plurality of orders by associating the hub data with the plurality of orders, the virtual hub being assigned based on the at least one pickup location and the respective destination locations, for generating the pickup data and the delivery data, generate, in the one or more data records 240, for each order of the plurality of orders, pickup data indicative of at least one pickup task for the order, wherein a respective pickup task of the at least one pickup task is associated with the at least one item, a respective pickup location of the at least one pickup location where the at least one item is available, and the virtual hub, and delivery data indicative of a delivery task for the order, wherein the delivery task is associated with the at least one item, the virtual hub and the respective destination location, generate, in the one or more data records 240, batched delivery data based on the plurality of delivery data of the plurality of orders, the batched delivery data being indicative of the plurality of delivery tasks of the plurality of orders, and, for transmitting the delivery data and the hub data, transmit, for receipt by at least one communications device of at least one second agent (or the second agent) assigned to the plurality of orders, the batched delivery data and the hub data for delivery (of the plurality of items) by the at least one second agent from the virtual hub to the respective destination locations. Such embodiments may involve a plurality of users making a plurality of orders for a plurality of items that may be picked up by (at least) on first agent from at least one pickup location to be delivered to a virtual hub, and delivery of the plurality of items by (at least) one second agent from the virtual hub to a plurality of destination locations respectively associated with the plurality of users.

The plurality of delivery tasks, or collectively known as batched delivery tasks or simply as a delivery job, may involve a group of delivery tasks that is batched

together for delivery of items by one second agent in one trip or journey. The plurality of delivery tasks may be batched together taking into account the longest estimated completion time. The at least one second agent may be assigned based on at least one condition, which may include, for example, familiarity of the second agent with the destination location(s) or area of the destination location(s), availability of the second agent, current location of the second agent, etc.

In various embodiments, there may be a plurality of second agents. The communications server apparatus 202 may, for generating the batched delivery data, generate a plurality of batched delivery data based on the plurality of delivery data, wherein each respective batched delivery data of the plurality of batched delivery data are indicative of one or more delivery tasks of the plurality of delivery tasks, and, for transmitting the batched delivery data and the hub data, transmit, for receipt by the at least one communications device of a respective second agent of the plurality of second agents, the each respective batched delivery data and the hub data for delivery by the respective second agent to one or more of the plurality of destination locations. Such embodiments may involve a plurality of users making a plurality of orders for a plurality of items that may be picked up by (at least) one first agent from at least one pickup location to be delivered to a virtual hub, and delivery of the plurality of items by a plurality of second agents from the virtual hub to a plurality of destination locations respectively associated with the plurality of users.

In the context of various embodiments, a communications device may include, but not limited to, a smart phone, tablet, handheld/portable communications device, desktop or laptop computer, terminal computer, etc.

FIG. 2C shows a schematic block diagram illustrating architecture component of the communications server apparatus 202. That is, the communications server apparatus 202 may further include an assignment module 250 to assign a virtual hub to an order from a user, a data generating module 252 to generate the pickup

data 242 and the delivery data 244 (see FIG. 2B), and a transmitting module 254 to transmit the pickup data 242, the delivery data 244 and the hub data.

In the context of various embodiments, the communications server apparatus 202a may be a single server, or have the functionality performed by the communications server apparatus 202a distributed across multiple server components.

FIG. 2D shows a flow chart 260 illustrating a method for fulfilment of an order from a user. In response to receiving order data having at least one data field indicative of an order made by a user for delivery to a destination location associated with the user, the order including at least one item offered at at least one pickup location, at 261, a virtual hub is assigned to the order by associating hub data indicative of the virtual hub with the order, the virtual hub being assigned based on the at least one pickup location and the destination location, at 262, pickup data indicative of at least one pickup task for the order are generated in one or more data records, wherein a respective pickup task of the at least one pickup task is associated with the at least one item, a respective pickup location of the at least one pickup location where the at least one item is available, and the virtual hub, at 263, delivery data indicative of a delivery task for the order are generated in the one or more data records, wherein the delivery task is associated with the at least one item, the virtual hub and the destination location, at 264, the pickup data and the hub data are transmitted, for receipt by at least one communications device of at least one first agent assigned to the order, for delivery of the at least one item by the at least one first agent from the respective pickup location to the virtual hub, and, at 265, the delivery data and the hub data are transmitted, for receipt by at least one communications device of a second agent assigned to the order, for delivery of the at least one item by the second agent from the virtual hub to the destination location.

The method may further include generating, in the one or more data records, timing data indicative of a time window for coordination between delivery of the at least

one item by the at least one first agent to the virtual hub and delivery of the at least one item by the second agent from the virtual hub.

Generating the timing data may include generating, in the one or more data records, first time data indicative of the time by when the at least one item is to be delivered by the at least one first agent to the virtual hub. Generating the first time data may include generating, for each of the at least one pickup task, estimate data indicative of an estimated completion time for the pickup task, determining, based on the estimate data of the at least one pickup task, a longest estimated completion time, and generating the first time data based on the longest estimated completion time.

Generating the timing data may include generating, in the one or more data records, second time data indicative of the time by when the at least one item is to be delivered from the virtual hub by the second agent.

In various embodiments, the order may include a plurality of items offered at a plurality of pickup locations, and the virtual hub may be assigned based on the plurality of pickup locations and the destination location. A plurality of pickup data indicative of a plurality of pickup tasks for the order may be generated in the one or more data records, wherein respective pickup data of the plurality of pickup data corresponds to a respective pickup task of the plurality of pickup tasks, wherein, for each pickup task of the plurality of pickup tasks, the pickup task is associated with one or more items of the plurality of items, a respective pickup location of the plurality of pickup locations where the one or more items are available, and the virtual hub. Delivery data indicative of a delivery task for the order may be generated in the one or more data records, wherein the delivery task is associated with the plurality of items, the virtual hub and the destination location. The method may further include generating, in the one or more data records, batched pickup data based on the plurality of pickup data, the batched pickup data being indicative of the plurality of pickup tasks. The batched pickup data and the hub data may be

transmitted, for receipt by the at least one communications device of the at least one first agent, for delivery of the plurality of items by the at least one first agent from the plurality of pickup locations to the virtual hub. The delivery data and the hub data may be transmitted, for receipt by the at least one communications device of the second agent, for delivery of the plurality of items by the second agent from the virtual hub to the destination location.

In various embodiments, there may be a plurality of first agents. A plurality of batched pickup data may be generated based on the plurality of pickup data, wherein each respective batched pickup data of the plurality of batched pickup data are indicative of one or more respective pickup tasks of the plurality of pickup tasks, and the each respective batched pickup data and the hub data may be transmitted, for receipt by the at least one communications device of a respective first agent of the plurality of first agents, for delivery of one or more items of the plurality of items by the respective first agent from one or more pickup locations of the plurality of pickup locations to the virtual hub.

In various embodiments, in response to receiving a plurality of order data associated with a plurality of orders made by a plurality of users, wherein each order data of the plurality of order data is associated with a respective order of the plurality of orders made by a respective user of the plurality of users and includes at least one data field indicative of the respective order made by the respective user for delivery to a respective destination location associated with the respective user, the respective order including at least one item offered at at least one pickup location, the virtual hub may be assigned to the plurality of orders by associating the hub data with the plurality of orders, the virtual hub being assigned based on the at least one pickup location and the respective destination locations, for each order of the plurality of orders, pickup data indicative of at least one pickup task for the order may be generated in the one or more data records, wherein a respective pickup task of the at least one pickup task is associated with the at least one item, a respective pickup

location of the at least one pickup location where the at least one item is available, and the virtual hub, and delivery data indicative of a delivery task for the order may be generated in the one or more data records, wherein the delivery task is associated with the at least one item, the virtual hub and the respective destination location. The method may further include generating, in the one or more data records, batched delivery data based on the plurality of delivery data of the plurality of orders, the batched delivery data being indicative of the plurality of delivery tasks of the plurality of orders. The batched delivery data and the hub data may be transmitted, for receipt by at least one communications device of at least one second agent assigned to the plurality of orders, for delivery by the at least one second agent from the virtual hub to the respective destination locations.

In various embodiments, there may be a plurality of second agents. A plurality of batched delivery data may be generated based on the plurality of delivery data, wherein each respective batched delivery data of the plurality of batched delivery data are indicative of one or more delivery tasks of the plurality of delivery tasks, and the each respective batched delivery data and the hub data may be transmitted, for receipt by the at least one communications device of a respective second agent of the plurality of second agents, for delivery by the respective second agent to one or more of the plurality of destination locations

It should be appreciated that descriptions in the context of the communications server apparatus 202a may correspondingly be applicable in relation to the method as described in the context of the flow chart 260, and vice versa.

The method as described in the context of the flow chart 260 may be performed in a communications server apparatus (e.g., 202; FIGS. 2A and 2C) for fulfilment of an order from a user, under control of a processor of the communications server apparatus.

In the context of various embodiments, an “App” or an “application” may be installed or resident on a communications device and may include processor-executable instructions for execution on the device for implementing or performing the techniques disclosed herein for fulfilment of an order from a user.

There may also be provided a computer program product having instructions for implementing the method for fulfilment of an order from a user as described herein.

There may also be provided a computer program having instructions for implementing the method for fulfilment of an order from a user as described herein.

There may further be provided a non-transitory storage medium storing instructions, which, when executed by a processor, cause the processor to perform the method for fulfilment of an order from a user as described herein.

Various embodiments may further provide a communications system for fulfilment of an order from a user, having a communications server apparatus, at least one first communications device, at least one second communications device, at least one third communications device, and communications network equipment operable for the communications server apparatus and the at least one first, second, and third communications devices to establish communication with each other therethrough. The at least one first communications device includes a first processor and a first memory, the at least one second communications device includes a second processor and a second memory, and the at least one third communications device includes a third processor and a third memory. The at least one first communications device is configured, under control of the first processor, to execute first instructions stored in the first memory to transmit, for receipt by the communications server apparatus for processing, order data having at least one data field indicative of an order made by a user for delivery to a destination location associated with the user, the order including at least one item offered at at least one pickup location. The

communications server apparatus includes a fourth processor and a fourth memory, and is configured, under control of the fourth processor, to execute fourth instructions stored in the fourth memory to, in response to receiving data indicative of the order data, assign a virtual hub to the order by associating hub data indicative of the virtual hub with the order, the virtual hub being assigned based on the at least one pickup location and the destination location, generate, in one or more data records, pickup data indicative of at least one pickup task for the order, wherein a respective pickup task of the at least one pickup task is associated with the at least one item, a respective pickup location of the at least one pickup location where the at least one item is available, and the virtual hub, and delivery data indicative of a delivery task for the order, wherein the delivery task is associated with the at least one item, the virtual hub and the destination location, transmit, for receipt by the at least one second communications device of at least one first agent assigned to the order, the pickup data and the hub data for delivery of the at least one item by the at least one first agent from the respective pickup location to the virtual hub, and transmit, for receipt by the at least one third communications device of a second agent assigned to the order, the delivery data and the hub data for delivery of the at least one item by the second agent from the virtual hub to the destination location. The at least one second communications device is configured, under control of the second processor, to execute second instructions stored in the second memory to receive data indicative of the pickup data and the hub data. The at least one third communications device is configured, under control of the third processor, to execute third instructions stored in the third memory to receive data indicative of the delivery data and the hub data.

Various embodiments or techniques will now be further described in detail.

Various embodiments may allow for a system or environment involving multiple shoppers 370a, 370b, 370c, 370d and multiple drivers 374a, 374b, 374c, 374d, as shown in FIG. 3, where each shopper 370a, 370b, 370c, 370d may transfer items to

multiple drivers 374a, 374b, 374c, 374d, and each driver 374a, 374b, 374c, 374d may collect items from multiple shoppers 370a, 370b, 370c, 370d. As non-limiting examples, “Shopper 1” 370a may pick up items to fulfil one or more order(s) and the order(s) may then be delivered by “Driver 1” 374a, “Driver 2” 374b, and “Driver 3” 374c to end user(s). “Driver 2” 374b may deliver orders fulfilled by “Shopper 1” 370a and “Shopper 3” 370c, while “Driver 4” 374d may deliver orders fulfilled by “Shopper 2” 370b, “Shopper 3” 370c and “Shopper 4” 370d.

The techniques disclosed herein may decouple the fulfilment process (involving pickup and delivery) into two individual processes: pickup only (by “Shoppers”, “Pickup agents”, “Fulfilment agents”, or the like) and delivery only (by “Drivers”, “Delivery agents”, or the like).

The techniques disclosed herein may provide a method of dynamically assigning one or more virtual hubs for shoppers and drivers to cross-transfer delivery items. Effectively, with a virtual hub, each shopper may transfer items to multiple drivers and each driver may collect items from multiple shoppers, similar to the environment described in the context of FIG. 3. Virtual hubs may be decided in real time by the system of various embodiments based on the pickup store(s) and the delivery location(s).

In various embodiments, virtual hubs may be a concept of zero inventory (or zero stock) based on just-in-time cross transfer between a shopper and a driver. For example, a car / van or any location can be a virtual hub in this case. With virtual hubs, there may be no holding of inventory (or in other words, holding zero inventory). Nevertheless, it should be appreciated that in some embodiments, item(s) corresponding to order(s) may be placed temporarily at the assigned or associated virtual hub. A virtual hub can be assigned dynamically in real time based on the pickup store(s) and the delivery location. As such, depending on the pickup location(s) and the destination location, a particular virtual hub may be suitably

selected out of a number of available virtual hubs for the corresponding order, for example, based on the relative distance to the pickup location(s) and the destination location, or minimisation of overall time for the order to be fulfilled and the product(s) delivered to the user.

In contrast, a physical hub implemented in known approaches would require long term storage facility in order to hold inventory, and, in particular, a large quantity of stock in order to fulfil future orders, e.g., in the form of a warehouse. Further, given space and cost constraints, there is usually one physical hub that is available for inventory holding and, therefore, there is no option for assigning another physical hub. Further, as there is only a single physical hub, there is no consideration other than the location of the physical hub itself, and, therefore, the single physical hub is used in known approaches for all situations irrespective of where the pickup locations and destination locations are.

In various embodiments, the virtual hub itself may be mobile, and may not require a fixed location. In the techniques disclosed herein, there may be pre-determined locations of these virtual hubs prior to assigning the orders to the virtual hubs. Hence, the cross transfer of products may happen at any points-of-interest (POIs) across an area or city (subject to rules and regulations).

As the techniques disclosed herein may provide for instant delivery with a generally short time window, virtual hub assignment may be based on minimisation of the total routing time of the overall delivery system.

FIG. 4 shows a schematic diagram illustrating an order batching approach of various embodiments, involving a virtual hub 484. On the batched pickup side, a first shopper ("Shopper 1") may travel to multiple pickup locations (e.g., stores) 480a, 480b, to pick up items to fulfil one or more orders and deliver these items or order(s) to the virtual hub 484, while a second shopper ("Shopper 2") may travel to multiple

pickup locations (e.g., stores) 480c, 480d, to pick up items to fulfil one or more orders and deliver these items or order(s) to the virtual hub 484. On the batched delivery side, a first driver ("Driver 1") may collect, from the virtual hub, items that have been transferred to the virtual hub 484 and deliver the items to one or more consumers 482a, 482b, while, similarly, a second driver ("Driver 2") may collect items that have been transferred to the virtual hub 484 and deliver the items to one or more consumers 482c, 482d.

Pickup tasks (for shoppers) and delivery tasks (for drivers) may be batched separately. Such a decoupled order batching may have one or more of the following features:

(i) Allows shoppers to parallely execute time-consuming pickup tasks, especially for orders containing items from multiple stores or merchants or retail locations. This may help to reduce the overall service time, improve SLA and consumer satisfaction.

(ii) Improve batching efficiency. The traditional batching has to tradeoff between pickup locations and delivery locations. Most batchings can only guarantee either pickup locations close to each other or delivery locations close to each other, or in-between, but it is challenging to guarantee both. By batching pickup and delivery tasks separately, both may be achieved easily.

(iii) Reduce pickup action time by assigning shoppers to the stores they may be (most) familiar with.

The features of the decoupled order batching method mentioned above may be as demonstrated in FIG. 4 where there is a hub 484 and the following non-limiting example of FIG. 5, with separate batched pickup and batched delivery.

Referring to FIG. 5, the techniques described herein may, for implementing decoupled order batching, provide for applications ("Apps") installed or resident on corresponding client or user devices (for example, mobile devices, communication devices, etc., e.g., a smartphone) to be run (or operated or executed) on the devices. These may include a "Consumer" App 350 for consumers or users, e.g., installed on and to be run on a corresponding consumer communications device, and a "Driver" App 352 for drivers, e.g., installed on and to be run on a corresponding driver communications device. There may also be provided a "Shopper" App 354 for shoppers, e.g., installed on and to be run on a corresponding shopper communications device.

The techniques for implementing decoupled order batching described herein may further include a "Decoupled Order Batching Service" 360, a "Pickup Batching Engine" 362, and a "Delivery Batching Engine" 364.

The "Shopper" App 354 may be implemented to perform one or more of the following:

- Accept a Batched Pickup job from the "Decoupled Order Batching Service" 360;
- Update item status from "To pickup" to "Picked up" after the item is collected from a corresponding store;
- Update item status from "Picked up" to "Available for delivery" after the item is sent to the corresponding virtual hub;
- Update item status from "Available for delivery" to "Sent to driver" after driver collects the item from the virtual hub;
- Once all the non-cancelled items are in the status "Sent to driver", the "Shopper" App 354 may automatically turn to "Available for the next job" status for the Shopper.

Additionally or alternatively, an order status update may be implemented instead of item status, such that the status of an order, as a whole containing one or more items, may be updated instead of updating the status of individual items.

The "Consumer" App 350 may be implemented to perform one or more of the following:

- Generate an order;
- Display order status update from "To pickup" to "Picked up" after all the items are collected from the stores;
- Display order status update from "Picked up" to "Delivered to consumer" after the order is delivered to the consumer.

The "Driver" App 352 may be implemented to perform one or more of the following:

- Accept a Batched Delivery job from the "Decoupled Order Batching Service" 360;
- Display order status from "To pickup" to "Picked up" after the order is collected from the virtual hub;
- Update order status from "Picked up" to "Delivered to consumer" after the order is delivered to the consumer.

The item status and the order status in relation to the shopper may be updated based on one or more of manual pressing of a defined button in the Shopper App 354 and the shopper's GPS ping. The order status in relation to the driver may be updated based on one or more of manual pressing of a defined button in the Driver App 352 and the driver's GPS ping. The order status update in the Consumer App 350 may be based on or tied to the updates in the Shopper App 354 and the Driver App 352.

The "Decoupled Order Batching Service" 360 may be implemented to perform one or more of the following:

1. For each new order (e.g., made by a consumer via the “Consumer” App 350),
    - Assign the order to a virtual hub based on or according to its pickup stores and delivery location;
    - Break down each order into multiple pickup tasks (e.g., each pickup task may be from or correspond to one pickup store to the virtual hub assigned) and one delivery task (e.g., from the assigned virtual hub to a delivery location);
    - Predict the finishing time of all pickup tasks. Calculate or determine the longest predicted pickup finishing time among all the pickup tasks of the same order, which will be the predicted or estimated finishing time of all pickup tasks. For each respective pickup task, the estimated finishing time may include the estimated time to allocate the task to the shopper, the estimated travelling time from the shopper's location to the store(s), the estimated collection time at the store(s), and the estimated travelling time from the store(s) to the assigned virtual hub. Any differences in the shoppers' starting times are taken into account in the estimated time to allocate a task to the shopper, which may be predicted based on shopper’s supply demand balance. Any differences in transportation mode speed for the shoppers may be taken into account in the estimated travelling times, although such differences may be minimal in cases where shoppers travel using 4-wheel vehicles (e.g., the shoppers drive 4-wheel vehicles for travelling);
    - Add all pickup tasks into “Pickup task pool”, with the longest predicted pickup finishing time as soft time window constraints (upper bound to reach the virtual hub). This may be used as criteria in making batching decision in the “Pickup Batching Engine” 362, where the shopper for the respective pickup task should not reach the assigned virtual hub later than the upper bound value;
    - Provide the “Pickup task pool” or the tasks contained therein to the “Pickup Batching Engine” 362;

- Add delivery tasks into “Delivery task pool”, with the longest predicted pickup finishing time as hard time window constraints (lower bound to leave the virtual hub). The lower bound to leave virtual hub may be used as data input in the “Delivery Batching Engine” 364 of when the items or products in the task are ready to be delivered from the assigned or respective virtual hub;
- Provide the “Delivery task pool” or the tasks contained therein to the “Delivery Batching Engine” 364.

2. For each Batched Pickup job received from the “Pickup Batching Engine” 362,
   - Assign to a shopper based on at least one of shopper availability, current location, familiarity with stores, etc.
3. For each Batched Delivery job received from the “Delivery Batching Engine” 364,
   - Assign to a driver based on at least one of driver availability, current location, familiarity with delivery locations, etc.

The “Pickup Batching Engine” 362 may be implemented to perform one or more of the following:

- Cluster all pickup tasks received from the “Decoupled Order Batching Service” 360 based on or according to the respective virtual hub;
- For each virtual hub, batch pickup tasks into batched pickup jobs, with the virtual hub being the single depot for the batched pickup jobs;
- Provide the batched pickup jobs to the “Decoupled Order Batching Service” 360.

It should be appreciated that a “pickup task” is from one pickup store to the assigned virtual hub, while a “pickup job” is a group of “pickup tasks” that are batched together to be picked up by one shopper in one trip (not necessarily for a single order, and may be for two or more orders). The upper bound to reach the virtual hub may be used as criteria/constraint in making batching decisions. The route

sequence may be optimised by a vehicle routing optimisation algorithm to minimise routing time.

The “Delivery Batching Engine” 364 may be implemented to perform one or more of the following:

- Cluster all delivery tasks received from the “Decoupled Order Batching Service” 360 based on or according to the respective virtual hub;
- For each virtual hub, batch delivery tasks into batched delivery jobs, with the virtual hub being the single start point for the batched delivery jobs;
- Provide the batched delivery jobs to the “Decoupled Order Batching Service” 360.

It should be appreciated that a “delivery task” is from one virtual hub to the consumer, while a “delivery job” is a group of “delivery tasks” that are batched together to be delivered by one driver in one trip. Instant delivery SLA (promised delivery time to customers) may be used as criteria/constraint in making batching decisions. The route sequence may be optimised by vehicle routing optimisation algorithm to minimise routing time.

It will be appreciated that the invention has been described by way of example only. Various modifications may be made to the techniques described herein without departing from the spirit and scope of the appended claims. The disclosed techniques comprise techniques which may be provided in a stand-alone manner, or in combination with one another. Therefore, features described with respect to one technique may also be presented in combination with another technique.

Claims

1. A communications server apparatus for fulfilment of an order from a user, comprising a processor and a memory, the communications server apparatus being configured, under control of the processor to execute instructions in the memory to:

in response to receiving order data comprising at least one data field indicative of an order made by a user for delivery to a destination location associated with the user, the order comprising at least one item offered at at least one pickup location,

assign a virtual hub to the order by associating hub data indicative of the virtual hub with the order, the virtual hub being assigned based on the at least one pickup location and the destination location;

generate, in one or more data records,

pickup data indicative of at least one pickup task for the order, wherein a respective pickup task of the at least one pickup task is associated with the at least one item, a respective pickup location of the at least one pickup location where the at least one item is available, and the virtual hub; and

delivery data indicative of a delivery task for the order, wherein the delivery task is associated with the at least one item, the virtual hub and the destination location;

transmit, for receipt by at least one communications device of at least one first agent assigned to the order, the pickup data and the hub data for delivery of the at least one item by the at least one first agent from the respective pickup location to the virtual hub; and

transmit, for receipt by at least one communications device of a second agent assigned to the order, the delivery data and the hub data for delivery of the at least one item by the second agent from the virtual hub to the destination location.

2. The communications server apparatus as claimed in claim 1, further configured to generate, in the one or more data records, timing data indicative of a time window for coordination between delivery of the at least one item by the at least one first agent to the virtual hub and delivery of the at least one item by the second agent from the virtual hub.

3. The communications server apparatus as claimed in claim 2, wherein, for generating the timing data, the communications server apparatus is configured to generate, in the one or more data records, first time data indicative of the time by when the at least one item is to be delivered by the at least one first agent to the virtual hub.

4. The communications server apparatus as claimed in claim 3, wherein, for generating the first time data, the communications server apparatus is configured to:

generate, for each of the at least one pickup task, estimate data indicative of an estimated completion time for the pickup task;

determine, based on the estimate data of the at least one pickup task, a longest estimated completion time; and

generate the first time data based on the longest estimated completion time.

5. The communications server apparatus as claimed in any one of claims 2 to 4, wherein, for generating the timing data, the communications server apparatus is configured to generate, in the one or more data records, second time data indicative of the time by when the at least one item is to be delivered from the virtual hub by the second agent.

6. The communications server apparatus as claimed in any one of claims 1 to 5, wherein the order comprises a plurality of items offered at a plurality of pickup locations, and wherein the virtual hub is assigned based on the plurality of pickup

locations and the destination location, and wherein the communications server apparatus is configured to:

for generating the pickup data and the delivery data, generate, in the one or more data records,

a plurality of pickup data indicative of a plurality of pickup tasks for the order, wherein respective pickup data of the plurality of pickup data corresponds to a respective pickup task of the plurality of pickup tasks, wherein, for each pickup task of the plurality of pickup tasks, the pickup task is associated with one or more items of the plurality of items, a respective pickup location of the plurality of pickup locations where the one or more items are available, and the virtual hub; and

delivery data indicative of a delivery task for the order, wherein the delivery task is associated with the plurality of items, the virtual hub and the destination location;

generate, in the one or more data records, batched pickup data based on the plurality of pickup data, the batched pickup data being indicative of the plurality of pickup tasks;

for transmitting the pickup data and the hub data, transmit, for receipt by the at least one communications device of the at least one first agent, the batched pickup data and the hub data for delivery of the plurality of items by the at least one first agent from the plurality of pickup locations to the virtual hub; and

for transmitting the delivery data and the hub data, transmit, for receipt by the at least one communications device of the second agent, the delivery data and the hub data for delivery of the plurality of items by the second agent from the virtual hub to the destination location.

7. The communications server apparatus as claimed in claim 6, wherein the at least one first agent comprises a plurality of first agents, and wherein the communications server apparatus is configured to:

for generating the batched pickup data, generate a plurality of batched pickup data based on the plurality of pickup data, wherein each respective batched pickup data of the plurality of batched pickup data are indicative of one or more respective pickup tasks of the plurality of pickup tasks; and

for transmitting the batched pickup data and the hub data, transmit, for receipt by the at least one communications device of a respective first agent of the plurality of first agents, the each respective batched pickup data and the hub data for delivery of one or more items of the plurality of items by the respective first agent from one or more pickup locations of the plurality of pickup locations to the virtual hub.

8. The communications server apparatus as claimed in any one of claims 1 to 7, wherein, in response to receiving a plurality of order data associated with a plurality of orders made by a plurality of users, wherein each order data of the plurality of order data is associated with a respective order of the plurality of orders made by a respective user of the plurality of users and comprises at least one data field indicative of the respective order made by the respective user for delivery to a respective destination location associated with the respective user, the respective order comprising at least one item offered at at least one pickup location, the communications server apparatus is configured to:

for assigning the virtual hub, assign the virtual hub to the plurality of orders by associating the hub data with the plurality of orders, the virtual hub being assigned based on the at least one pickup location and the respective destination locations,

for generating the pickup data and the delivery data, generate, in the one or more data records, for each order of the plurality of orders,

pickup data indicative of at least one pickup task for the order, wherein a respective pickup task of the at least one pickup task is associated with the at least one item, a respective pickup location of the at least one

pickup location where the at least one item is available, and the virtual hub; and

delivery data indicative of a delivery task for the order, wherein the delivery task is associated with the at least one item, the virtual hub and the respective destination location;

generate, in the one or more data records, batched delivery data based on the plurality of delivery data of the plurality of orders, the batched delivery data being indicative of the plurality of delivery tasks of the plurality of orders; and

for transmitting the delivery data and the hub data, transmit, for receipt by at least one communications device of at least one second agent assigned to the plurality of orders, the batched delivery data and the hub data for delivery by the at least one second agent from the virtual hub to the respective destination locations.

9. The communications server apparatus as claimed in claim 8, wherein the at least one second agent comprises a plurality of second agents, and wherein the communications server apparatus is configured to:

for generating the batched delivery data, generate a plurality of batched delivery data based on the plurality of delivery data, wherein each respective batched delivery data of the plurality of batched delivery data are indicative of one or more delivery tasks of the plurality of delivery tasks; and

for transmitting the batched delivery data and the hub data, transmit, for receipt by the at least one communications device of a respective second agent of the plurality of second agents, the each respective batched delivery data and the hub data for delivery by the respective second agent to one or more of the plurality of destination locations.

10. A method for fulfilment of an order from a user, the method comprising:

in response to receiving order data comprising at least one data field indicative of an order made by a user for delivery to a destination location associated

with the user, the order comprising at least one item offered at at least one pickup location,

assigning a virtual hub to the order by associating hub data indicative of the virtual hub with the order, the virtual hub being assigned based on the at least one pickup location and the destination location;

generating, in one or more data records,

pickup data indicative of at least one pickup task for the order, wherein a respective pickup task of the at least one pickup task is associated with the at least one item, a respective pickup location of the at least one pickup location where the at least one item is available, and the virtual hub; and

delivery data indicative of a delivery task for the order, wherein the delivery task is associated with the at least one item, the virtual hub and the destination location;

transmitting, for receipt by at least one communications device of at least one first agent assigned to the order, the pickup data and the hub data for delivery of the at least one item by the at least one first agent from the respective pickup location to the virtual hub; and

transmitting, for receipt by at least one communications device of a second agent assigned to the order, the delivery data and the hub data for delivery of the at least one item by the second agent from the virtual hub to the destination location.

11. The method as claimed in claim 10, further comprising generating, in the one or more data records, timing data indicative of a time window for coordination between delivery of the at least one item by the at least one first agent to the virtual hub and delivery of the at least one item by the second agent from the virtual hub.

12. The method as claimed in claim 11, wherein generating the timing data comprises generating, in the one or more data records, first time data indicative of

the time by when the at least one item is to be delivered by the at least one first agent to the virtual hub.

13. The method as claimed in claim 12, wherein generating the first time data comprises:

generating, for each of the at least one pickup task, estimate data indicative of an estimated completion time for the pickup task;

determining, based on the estimate data of the at least one pickup task, a longest estimated completion time; and

generating the first time data based on the longest estimated completion time.

14. The method as claimed in any one of claims 11 to 13, wherein generating the timing data comprises generating, in the one or more data records, second time data indicative of the time by when the at least one item is to be delivered from the virtual hub by the second agent.

15. The method as claimed in any one of claims 10 to 14, wherein the order comprises a plurality of items offered at a plurality of pickup locations, and wherein the virtual hub is assigned based on the plurality of pickup locations and the destination location,

wherein generating the pickup data comprises generating, in the one or more data records, a plurality of pickup data indicative of a plurality of pickup tasks for the order, wherein respective pickup data of the plurality of pickup data corresponds to a respective pickup task of the plurality of pickup tasks, wherein, for each pickup task of the plurality of pickup tasks, the pickup task is associated with one or more items of the plurality of items, a respective pickup location of the plurality of pickup locations where the one or more items are available, and the virtual hub,

wherein generating the delivery data comprises generating, in the one or more data records, delivery data indicative of a delivery task for the order, wherein

the delivery task is associated with the plurality of items, the virtual hub and the destination location,

the method further comprising generating, in the one or more data records, batched pickup data based on the plurality of pickup data, the batched pickup data being indicative of the plurality of pickup tasks,

wherein transmitting the pickup data and the hub data comprises transmitting, for receipt by the at least one communications device of the at least one first agent, the batched pickup data and the hub data for delivery of the plurality of items by the at least one first agent from the plurality of pickup locations to the virtual hub, and

wherein transmitting the delivery data and the hub data comprises transmitting, for receipt by the at least one communications device of the second agent, the delivery data and the hub data for delivery of the plurality of items by the second agent from the virtual hub to the destination location.

16. The method as claimed in claim 15,

wherein the at least one first agent comprises a plurality of first agents,

wherein generating the batched pickup data comprises generating a plurality of batched pickup data based on the plurality of pickup data, wherein each respective batched pickup data of the plurality of batched pickup data are indicative of one or more respective pickup tasks of the plurality of pickup tasks, and

wherein transmitting the batched pickup data and the hub data comprises transmitting, for receipt by the at least one communications device of a respective first agent of the plurality of first agents, the each respective batched pickup data and the hub data for delivery of one or more items of the plurality of items by the respective first agent from one or more pickup locations of the plurality of pickup locations to the virtual hub.

17. The method as claimed in any one of claims 10 to 16, wherein, in response to receiving a plurality of order data associated with a plurality of orders made by a

plurality of users, wherein each order data of the plurality of order data is associated with a respective order of the plurality of orders made by a respective user of the plurality of users and comprises at least one data field indicative of the respective order made by the respective user for delivery to a respective destination location associated with the respective user, the respective order comprising at least one item offered at at least one pickup location,

assigning the virtual hub comprises assigning the virtual hub to the plurality of orders by associating the hub data with the plurality of orders, the virtual hub being assigned based on the at least one pickup location and the respective destination locations,

generating the pickup data comprises generating, in the one or more data records, for each order of the plurality of orders, pickup data indicative of at least one pickup task for the order, wherein a respective pickup task of the at least one pickup task is associated with the at least one item, a respective pickup location of the at least one pickup location where the at least one item is available, and the virtual hub,

generating the delivery data comprises generating, in the one or more data records, for each order of the plurality of orders, delivery data indicative of a delivery task for the order, wherein the delivery task is associated with the at least one item, the virtual hub and the respective destination location,

wherein the method further comprises generating, in the one or more data records, batched delivery data based on the plurality of delivery data of the plurality of orders, the batched delivery data being indicative of the plurality of delivery tasks of the plurality of orders, and

wherein transmitting the delivery data and the hub data comprises transmitting, for receipt by at least one communications device of at least one second agent assigned to the plurality of orders, the batched delivery data and the hub data for delivery by the at least one second agent from the virtual hub to the respective destination locations.

18. The method as claimed in claim 17,

wherein the at least one second agent comprises a plurality of second agents,

wherein generating the batched delivery data comprises generating a plurality of batched delivery data based on the plurality of delivery data, wherein each respective batched delivery data of the plurality of batched delivery data are indicative of one or more delivery tasks of the plurality of delivery tasks, and

transmitting the batched delivery data and the hub data comprises transmitting, for receipt by the at least one communications device of a respective second agent of the plurality of second agents, the each respective batched delivery data and the hub data for delivery by the respective second agent to one or more of the plurality of destination locations.

19. A computer program or a computer program product comprising instructions for implementing the method as claimed in any one of claims 10 to 18.

20. A non-transitory storage medium storing instructions, which when executed by a processor cause the processor to perform the method as claimed in any one of claims 10 to 18.

21. A communications system for fulfilment of an order from a user, comprising a communications server apparatus, at least one first communications device, at least one second communications device, at least one third communications device, and communications network equipment operable for the communications server apparatus and the at least one first, second, and third communications devices to establish communication with each other therethrough,

wherein the at least one first communications device comprises a first processor and a first memory, wherein the at least one second communications device comprises a second processor and a second memory, and wherein the at least one third communications device comprises a third processor and a third memory,

wherein the at least one first communications device is configured, under control of the first processor, to execute first instructions stored in the first memory to transmit, for receipt by the communications server apparatus for processing, order data comprising at least one data field indicative of an order made by a user for delivery to a destination location associated with the user, the order comprising at least one item offered at at least one pickup location;

wherein the communications server apparatus comprises a fourth processor and a fourth memory, the communications server apparatus being configured, under control of the fourth processor, to execute fourth instructions stored in the fourth memory to, in response to receiving data indicative of the order data:

assign a virtual hub to the order by associating hub data indicative of the virtual hub with the order, the virtual hub being assigned based on the at least one pickup location and the destination location;

generate, in one or more data records,

pickup data indicative of at least one pickup task for the order, wherein a respective pickup task of the at least one pickup task is associated with the at least one item, a respective pickup location of the at least one pickup location where the at least one item is available, and the virtual hub; and

delivery data indicative of a delivery task for the order, wherein the delivery task is associated with the at least one item, the virtual hub and the destination location;

transmit, for receipt by the at least one second communications device of at least one first agent assigned to the order, the pickup data and the hub data for delivery of the at least one item by the at least one first agent from the respective pickup location to the virtual hub; and

transmit, for receipt by the at least one third communications device of a second agent assigned to the order, the delivery data and the hub data for delivery of the at least one item by the second agent from the virtual hub to the destination location;

wherein the at least one second communications device is configured, under control of the second processor, to execute second instructions stored in the second memory to receive data indicative of the pickup data and the hub data; and

wherein the at least one third communications device is configured, under control of the third processor, to execute third instructions stored in the third memory to receive data indicative of the delivery data and the hub data.