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(54) **CALENDARING LOCATION-BASED EVENTS AND ASSOCIATED TRAVEL**

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(60) Provisional application No. 61/142,875, filed on Jan. 6, 2009.

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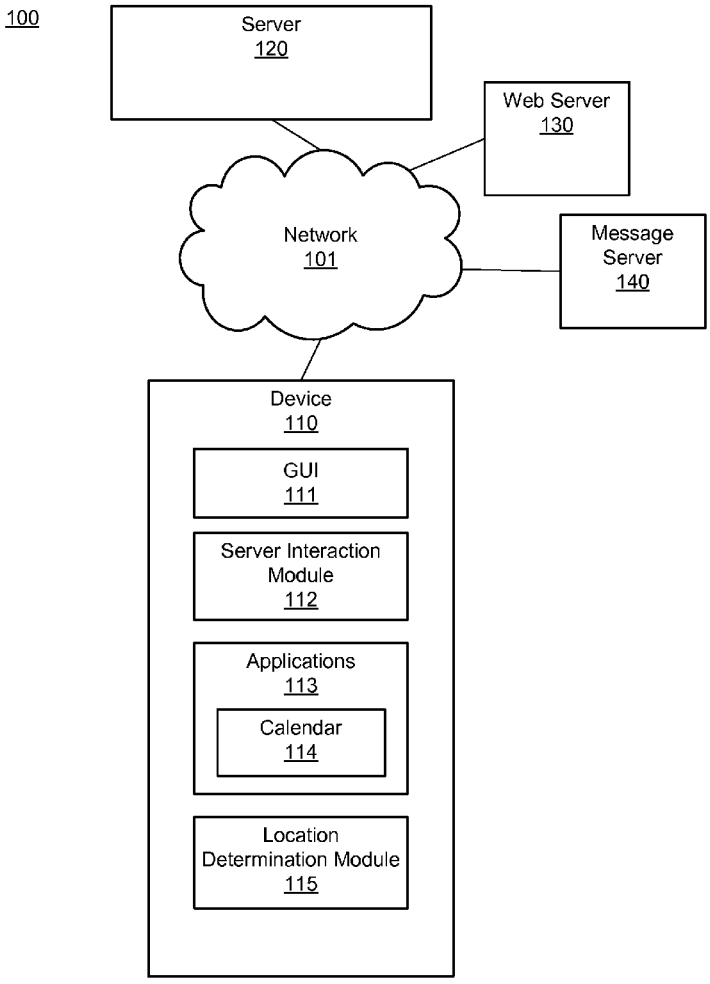
(57) **ABSTRACT**

A user interface for an electronic calendar represents different locations or different users or different user calendars in different portions of the display. Calendar entries can be associated with one or more locations, one or more users, and with one or more user calendars. The different locations may reside in different time zones and a timeline for each time zone is displayed. The position of the calendar entry provides a visual identifier of the timeline with which the event is associated. Travel time to and from events in the calendar are calculated for calendared events and shown adjacent to the beginning and end of the event. A user's future location at a point in time is inferred from patterns in the user's locations and by analyzing the user's calendared events and correspondence in order to calculate travel time to calendared events.



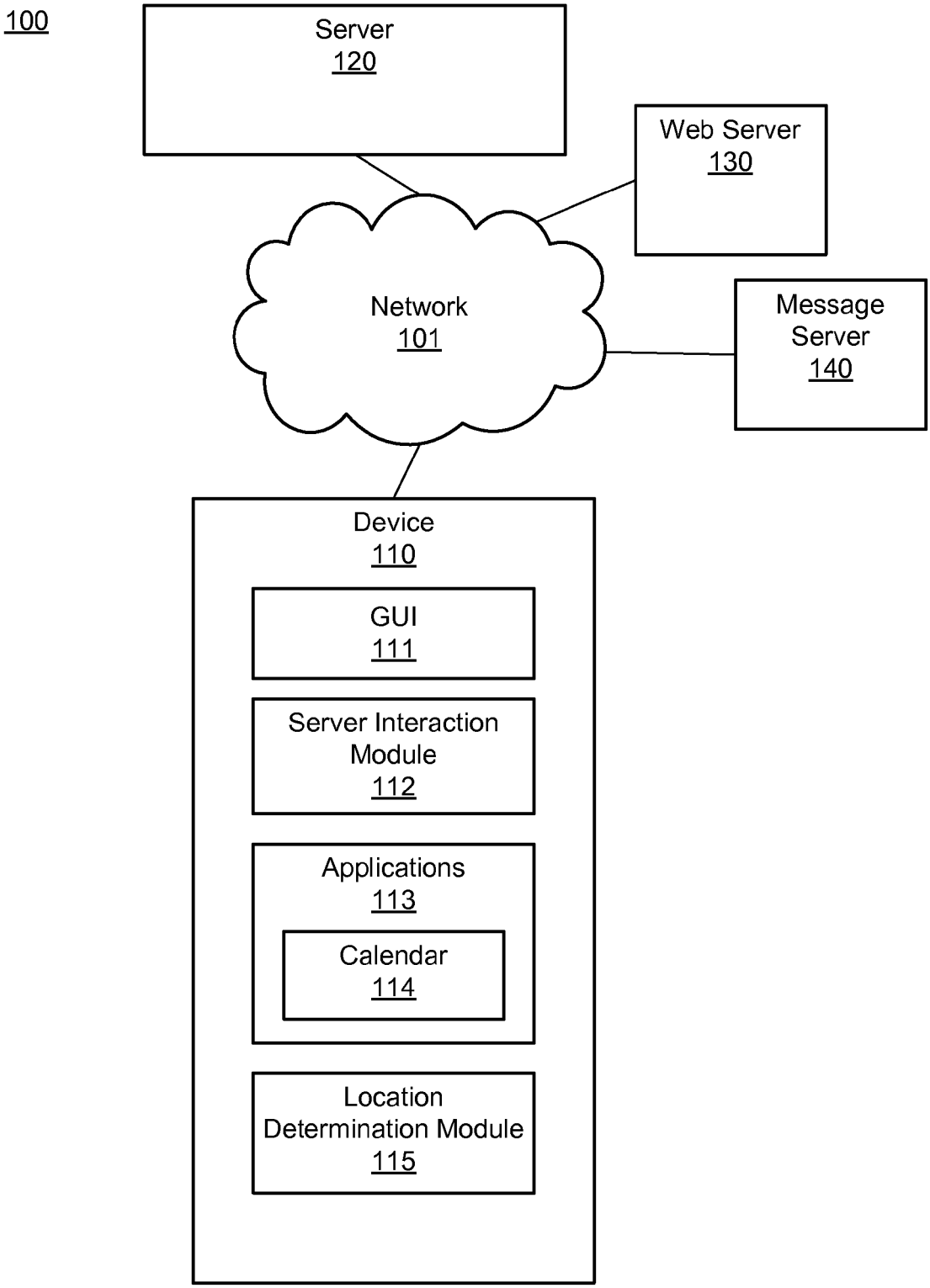

100
Server
120
Web Server
130
Network
101
Message
Server
140
Device
110
GUI
111
Server Interaction
Module
112
Applications
113
Calendar
114
Location
Determination Module
115

FIG. 1

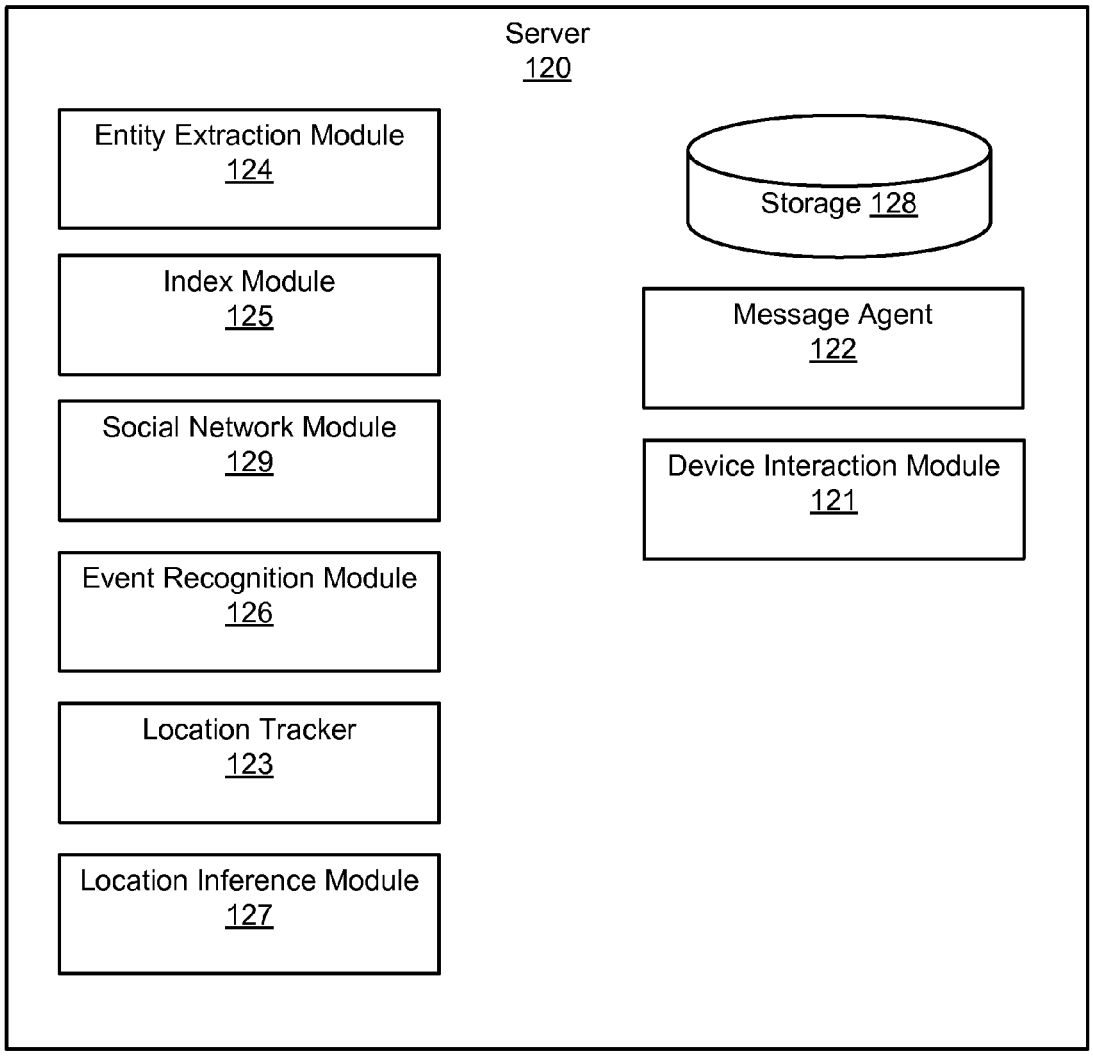

Server
120
Entity Extraction Module
124
Index Module
125
Social Network Module
129
Event Recognition Module
126
Location Tracker
123
Location Inference Module
127
Storage 128
Message Agent
122
Device Interaction Module
121

FIG. 2A

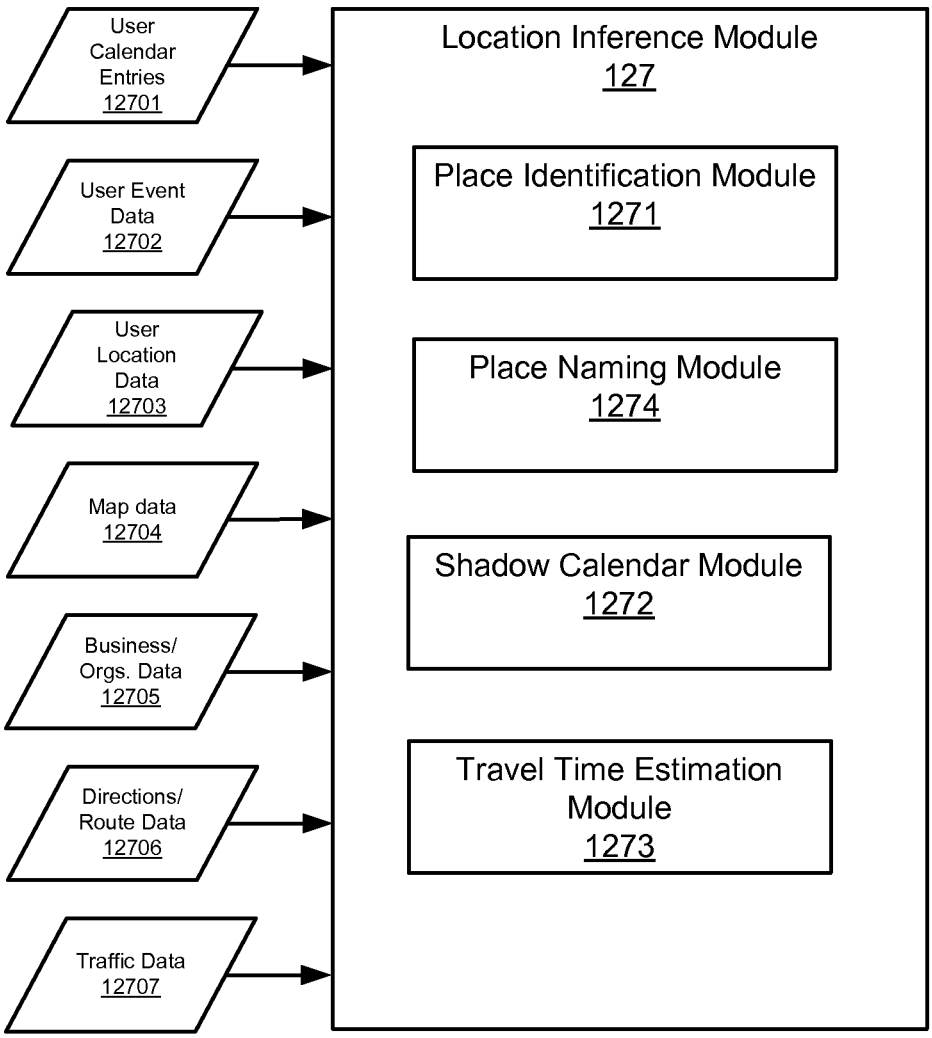

User Calendar Entries 12701
User Event Data 12702
User Location Data 12703
Map data 12704
Business/ Orgs. Data 12705
Directions/ Route Data 12706
Traffic Data 12707
Location Inference Module 127
Place Identification Module 1271
Place Naming Module 1274
Shadow Calendar Module 1272
Travel Time Estimation Module 1273

FIG. 2B

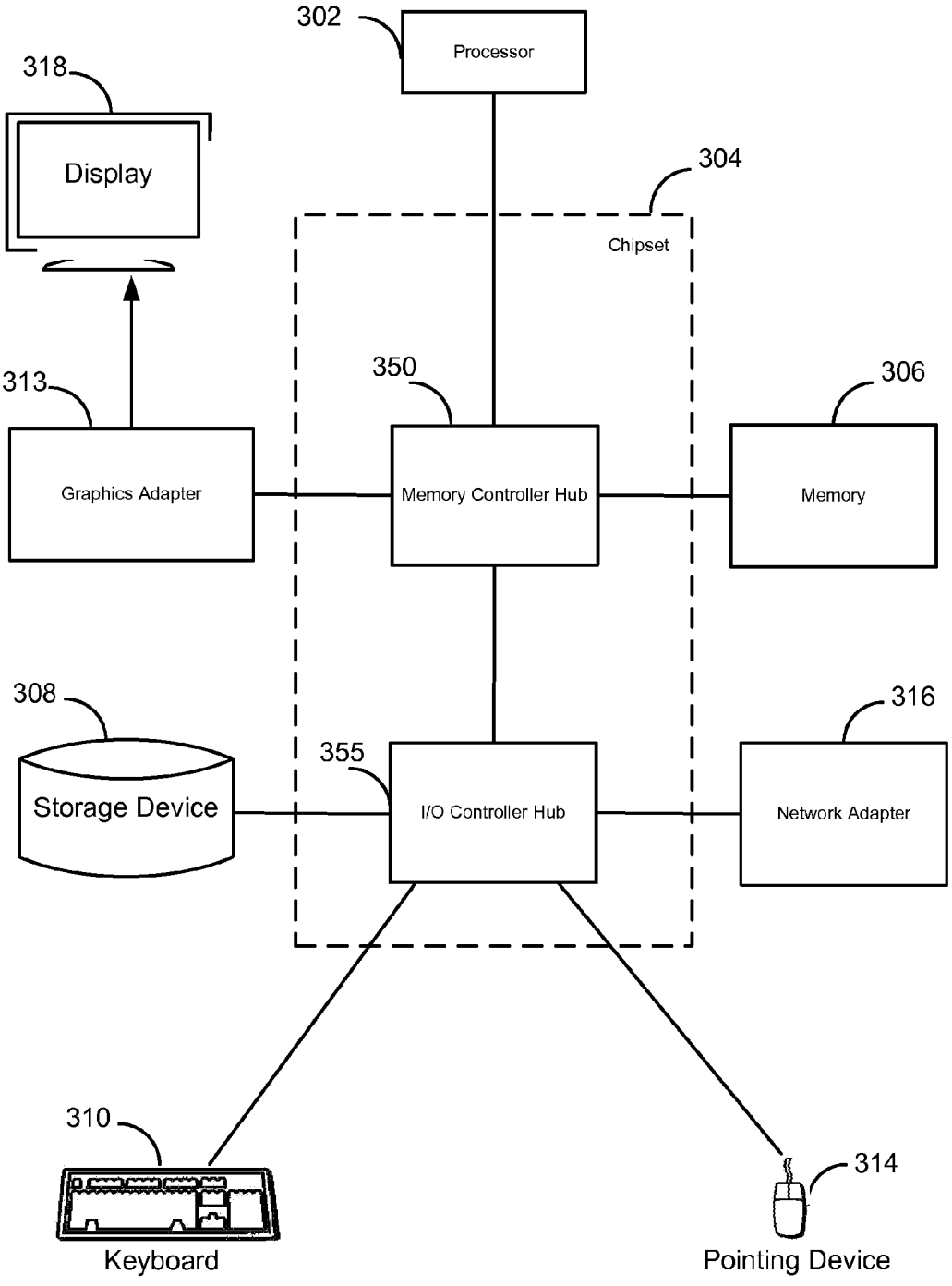

302
Processor
318
Display
304
Chipset
313
Graphics Adapter
350
Memory Controller Hub
306
Memory
308
Storage Device
355
I/O Controller Hub
316
Network Adapter
310
Keyboard
314
Pointing Device
300

FIG. 3

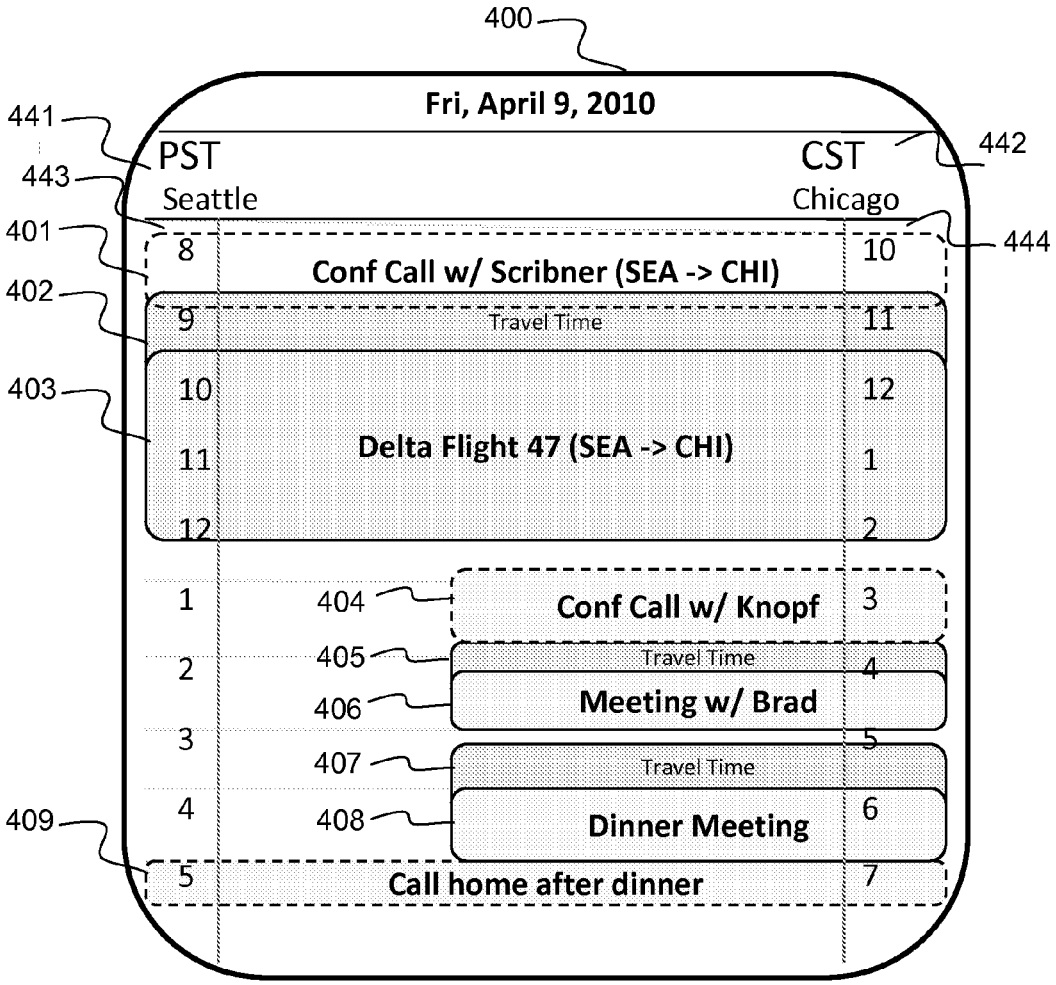

400
Fri, April 9, 2010
441
PST
Seattle
443
CST
Chicago
442
444
401
8
Conf Call w/ Scribner (SEA -> CHI)
10
402
9
Travel Time
11
403
10
11
12
Delta Flight 47 (SEA -> CHI)
12
1
2
1
404
Conf Call w/ Knopf
3
2
405
Travel Time
4
406
Meeting w/ Brad
3
407
Travel Time
5
4
408
Dinner Meeting
6
409
5
Call home after dinner
7

FIG. 4

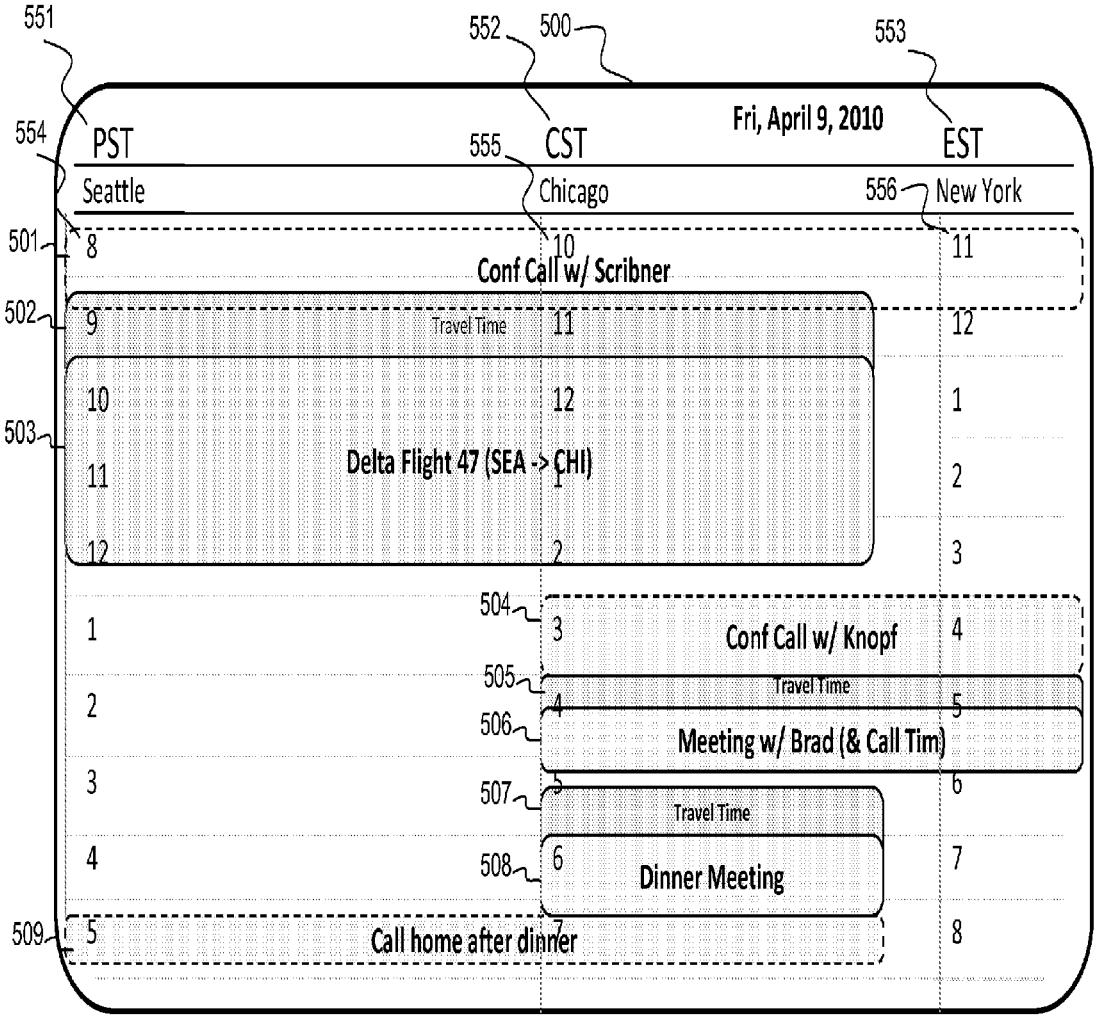

551
552
500
553
554
555
556
PST
CST
EST
Fri, April 9, 2010
Seattle
Chicago
New York
501
502
503
504
505
506
507
508
509
Conf Call w/ Scribner
Travel Time
Delta Flight 47 (SEA -> CHI)
Conf Call w/ Knopf
Travel Time
Meeting w/ Brad (& Call Tim)
Travel Time
Dinner Meeting
Call home after dinner

FIG. 5

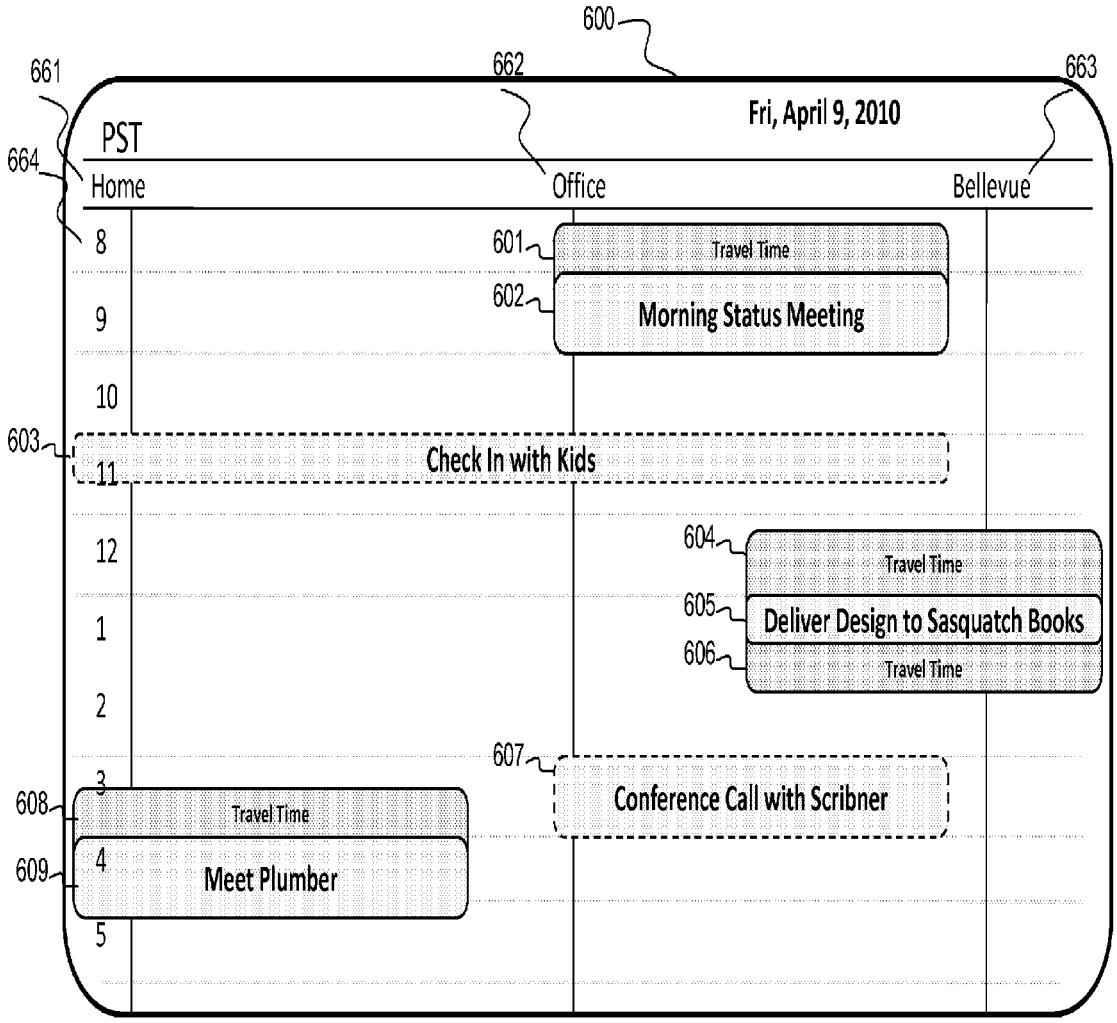

600
661
662
663
Fri, April 9, 2010
PST
664
Home
Office
Bellevue
8
9
10
11
12
1
2
3
4
5
601
Travel Time
602
Morning Status Meeting
603
Check In with Kids
604
Travel Time
605
Deliver Design to Sasquatch Books
606
Travel Time
607
Conference Call with Scribner
608
Travel Time
609
Meet Plumber

FIG. 6

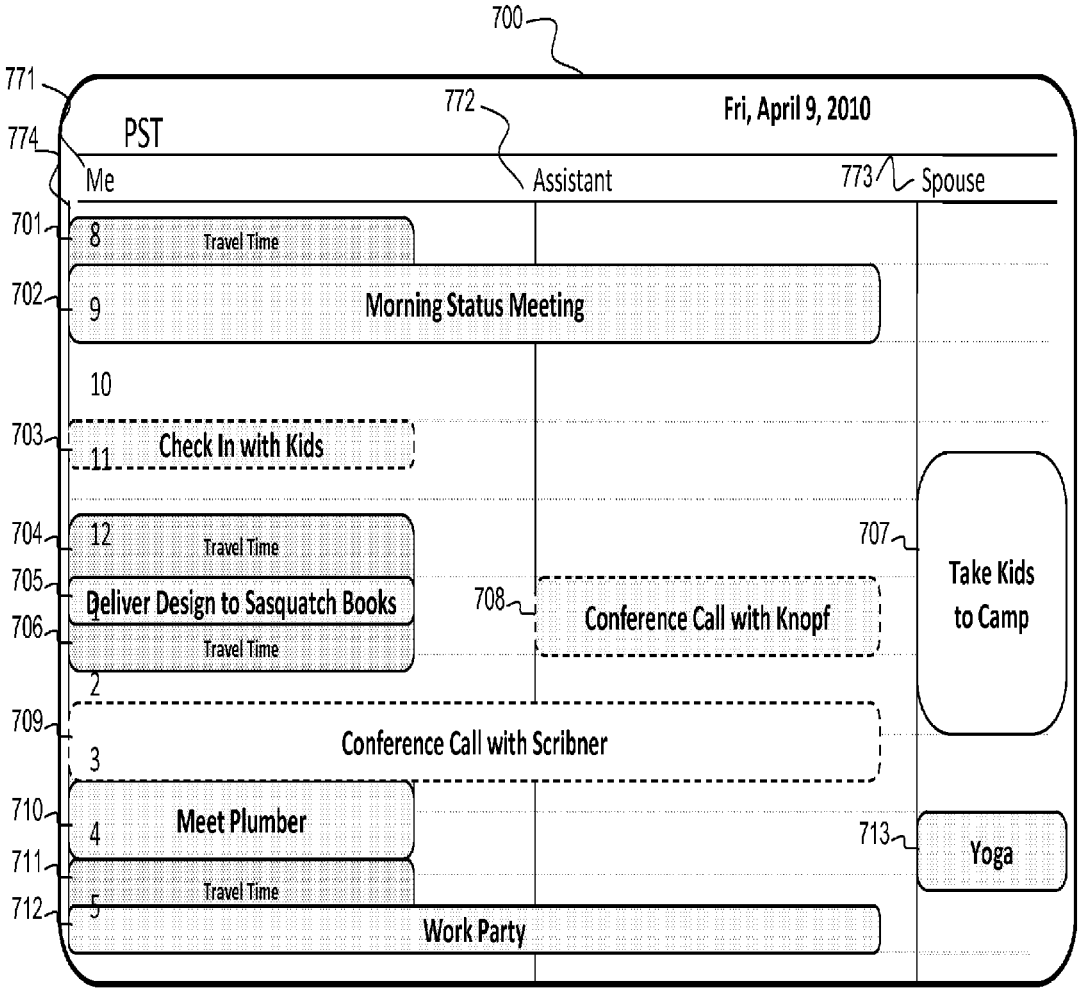

700
771
772
Fri, April 9, 2010
774
PST
Me
Assistant
773
Spouse
701
8
Travel Time
702
9
Morning Status Meeting
10
703
11
Check In with Kids
704
12
Travel Time
707
Take Kids to Camp
705
Deliver Design to Sasquatch Books
708
Conference Call with Knopf
706
1
Travel Time
2
709
Conference Call with Scribner
3
710
Meet Plumber
4
713
Yoga
711
Travel Time
712
5
Work Party

FIG. 7

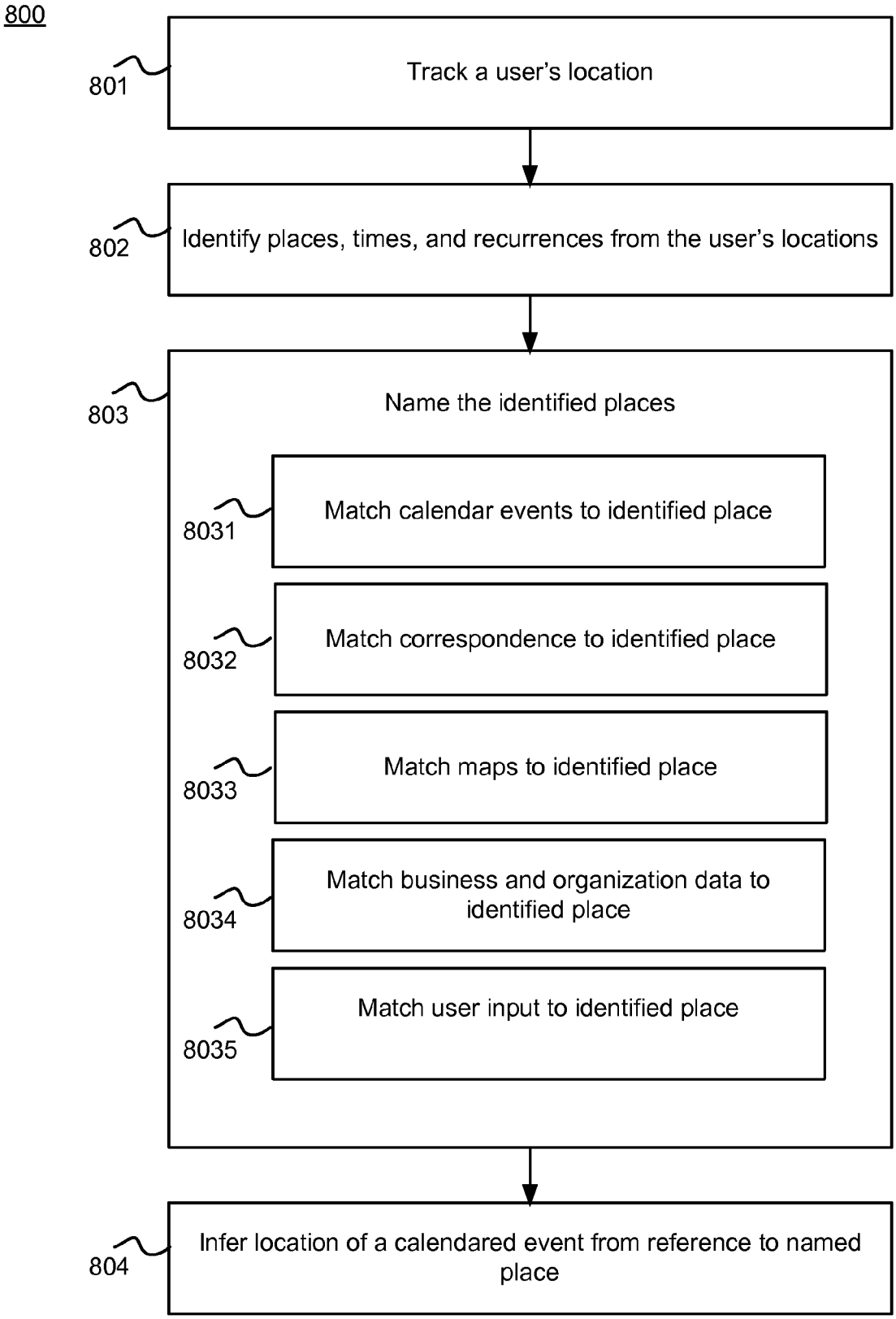

800
801
Track a user's location
802
Identify places, times, and recurrences from the user's locations
803
Name the identified places
8031
Match calendar events to identified place
8032
Match correspondence to identified place
8033
Match maps to identified place
8034
Match business and organization data to identified place
8035
Match user input to identified place
804
Infer location of a calendared event from reference to named place

FIG. 8

CALENDARING LOCATION-BASED EVENTS AND ASSOCIATED TRAVEL

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of U.S. application Ser. No. 12/624,682, filed on Nov. 24, 2009, which is a continuation of U.S. application Ser. No. 12/568,354 filed on Sep. 28, 2009, which claims the benefit of U.S. Provisional Patent Application No. 61/142,875, filed Jan. 6, 2009, which is hereby incorporated by reference in its entirety. This application is related to U.S. patent application Ser. No. 12/512,854, filed Jul. 30, 2009, entitled "Data-Oriented User Interface for Mobile Device," and U.S. patent application Ser. No. 12/512,752, filed Jul. 30, 2009, entitled "Social Network Model for Semantic Processing" which are incorporated by reference in their entirety.

BACKGROUND

1. Field of the Invention

[0002] The present invention relates to electronic calendars.

2. Description of the Related Art

[0003] Users commonly maintain electronic calendars in order to track scheduled appointments, organize meetings, provide reminders to attend planned events, and for the convenience of sharing their availability with others through allowing others to view the electronic calendar. Although electronic calendars are convenient for helping users avoid being double-booked for activities occurring at the same time, conventional electronic calendars do not adequately account for implicit conflicts created by the locations of various meetings. For example, scheduling two adjacent meetings or events that occur in different places may not allow enough time to travel between the events.

[0004] To address the travel time issue, users have developed a variety of approaches, each with respective drawbacks. First, users may choose not to show travel times between events on their calendar. Drawbacks of this approach include the risk of forgetting about or wrongly estimating the travel time required to arrive at an event and leaving too late. Also, other users viewing the calendar may attempt to schedule a meeting with the user for the slot that was intended by the user for travel to another meeting because the slot appeared to be free.

[0005] Second, users may extend the existing meeting to account for the travel time needed to and from the meeting. Drawbacks of this approach include the risk that the user may incorrectly estimate the travel time, and/or forget the actual start time of the meeting. Also, should the meeting be rescheduled, the user must perform the same estimations and extension again. This approach also hinders the user's ability to invite others to the meeting, since the meeting period reflects the user's own travel times and the travel times may vary for others travelling from different locations.

[0006] Another approach involves the user manually entering an appointment immediately before and an appointment immediately after any meeting that requires travel in order to block off an estimated travel period on the electronic calendar. This approach is cumbersome for those who travel frequently as any meeting that requires travel becomes a requirement to create three calendar entries that each must be moved if the meeting is rescheduled. This approach also still suffers from the drawback mentioned above regarding the risk that the user may incorrectly estimate the travel time.

SUMMARY

[0007] Embodiments of the invention provide methods, systems, and computer program products for an electronic calendar that recognizes events on the calendar occur at locations and accounts for travel between the locations for the calendared events. In one embodiment, a user interface for the electronic calendar represents different locations in different portions of the display. Calendar entries, such as a conference call or a plane flight, can be associated with one or more location, such as the locations of all conference call participants or the departure and arrival cities for the flight. In one particular embodiment, the different locations reside in different time zones and a timeline for each time zone is displayed. The position of the calendar entries provides a visual identifier to the user of the timeline with which the event is associated.

[0008] In another embodiment, travel time to and/or from events in the calendar are calculated for calendared events. The time estimated for travel to an event can be shown adjacent to the beginning of the event and the time estimated for travel from the event can be shown adjacent to the end of the event.

[0009] In another embodiment, a user's future location at a point in time is inferred from observing patterns in the user's activities and locations as well as by analyzing the user's calendared events and correspondence. By inferring where a user is likely to be traveling from in order to arrive at an event, an estimate can be made as to the appropriate amount of time to allot in the calendar for travel to the event. By inferring where a user is likely to be traveling after an event, an estimate can be made as to the appropriate amount of time to allot for travel after a calendared event.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a high-level block diagram of the computing environment, in accordance with an embodiment of the invention.

[0011] FIG. **2**A is a block diagram of a server, in accordance with an embodiment of the invention.

[0012] FIG. **2**B is a block diagram of a location inference module, in accordance with one embodiment of the invention.

[0013] FIG. **3** is a high-level block diagram illustrating an example of a computer for use as a user device or server, in accordance with an embodiment of the invention.

[0014] FIG. **4** is an illustration of a user interface displaying a calendar showing events in two locations in different time zones, in accordance with an embodiment of the invention.

[0015] FIG. **5** is an illustration of a user interface displaying a calendar showing events in three locations in three different time zones, in accordance with an embodiment of the invention.

[0016] FIG. **6** is an illustration of a user interface displaying a calendar showing events in three locations within the same time zone, in accordance with an embodiment of the invention.

[0017] FIG. **7** is an illustration of a user interface displaying a calendar showing events for three users, wherein some events are shared events between multiple users, in accordance with an embodiment of the invention.

[0018] FIG. **8** is a flow chart illustrating a method of inferring a location of a calendar event, in accordance with an embodiment of the invention.

[0019] One skilled in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated herein may be employed without departing from the principles of the invention described herein.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0020] Embodiments of the invention provide methods, systems, and computer program products for an electronic calendar that recognizes events on the calendar occur at locations and accounts for time needed to travel between the locations for the calendared events. The electronic calendar may be accessed through an application on a mobile device such as a "smart phone" or a laptop that is equipped with GPS or other location determination technology. Thus, as the user carries the device from place to place throughout the day, the user can access the user's calendar and the device can track the user's location. Through recognizing patterns in the user's locations and from analyzing the user's calendared events and the user's correspondence, the user's future location can be inferred, thus enabling estimates of travel times to events on the calendar from the user's likely starting location and estimates of travel times from events on the calendar to the user's likely next destination.

[0021] FIG. **1** is a high-level block diagram of the computing environment **100** in accordance with an embodiment of the invention. The computing environment **100** includes a server **120** that is connected via a network **101** to a user device **110**. The network **101** is a communications network such as a local area network, a wide area network, a wireless network, an intranet, or the Internet. In one embodiment, the computing environment **100** also includes a web server **130** that serves web pages to the user device **110** and a message server **140** that serves messages such as email or SMS messages to the user device **110**. Although only one user device **110** and a limited number of servers are shown in FIG. **1** for clarity, any number and type of user devices and server configurations may be connected to the network **101**.

[0022] In one embodiment, data flowing to and from the user device **110** passes through the server **120**. For ease of reference, the term "document" will be used herein to refer to a discrete collection of data, such as an appointment request, an email, a web page, a message, a file, or any other type of electronic document. The term "correspondence" will be used herein to refer to any document that contains a message sent by the user or received by the user, such as an email, a text-message, an appointment request, or the like. The server **120** analyzes the documents flowing to and from the user device **110** in order to extract entities from the data and to recognize events. Entities are data objects that represent people, organizations, locations, or other real world items. Entities have properties associated with them, such as aliases, addresses, latitude/longitude coordinates, points of contact for the entity, and the like. The server **120** extracts the entities from the documents and passes the entity information to the user device **110** so that the user device **110** can offer to the user contextually-relevant actions with respect to the entities, as described by U.S. patent application Ser. No. 12/512,854, filed Jul. 30, 2009, entitled "Data-Oriented User Interface for Mobile Device," which has been incorporated herein. The server **120** also extracts event information from an analysis of the user's correspondence for use in adding to calendar entries. The server **120** also tracks the user's location from location information received from the user device and can infer the user's future location at various times based on patterns in the tracked locations, the user's calendared events, and the user's analyzed correspondence.

[0023] In various embodiments, the user device **110** may be any device capable of communicating over the network **101**. Examples of a user device **110** include a personal digital assistant (PDA), a mobile device with limited functionality or a "smart phone" mobile device that offers broad functionality such as large memory storage and an advanced user interface, and any portable computer. In one embodiment, the user device **110** is a "smart phone" device that offers broad functionality. For example, the device may track calendar appointments, provide GPS or other location determination functionality, send and receive SMS messages and email, offer web access, manage contact information, and manage and communicate other types of documents.

[0024] The user device **110** has a graphical user interface **111** that allows a user to access and interact with data stored on the user device to make use of the device's functionality. The graphical user interface **111** allows users to view information and select information, for example, by clicking on it, touching it, highlighting it with a cursor, or any other method of selecting a portion of the displayed information. The graphical user interface **111** can be used to display and edit the user's calendar and details about the calendar entries. Examples of the user interface **111** are described below with reference to FIGS. **4-7**. In one embodiment, the graphical user interface **111** also includes node menus that contain actions relevant to a selected entity and/or spinners which allow a user to simultaneously view information from a variety of applications that is relevant to an entity, both of which have been described in U.S. patent application Ser. No. 12/512,854, filed Jul. 30, 2009, entitled "Data-Oriented User Interface for Mobile Device," which has been incorporated by reference in its entirety.

[0025] In this example, in addition to the graphical user interface **111**, the user device **110** includes various applications **113** that support the functionality of the user device **110**. For example, the user device **110** may include a calendar application **114** and telephone, email, contact manager, browser, word processing, map browser, spreadsheet, and/or other business or personal applications. A user of the user device **110** may create, receive, send, access, store, or otherwise interact with data through the applications **113**. Specifically, the user can use the calendar application **114** to schedule, view and update calendar entries, and send meeting requests to others. As will be described in more detail below, the calendar application **114** recognizes that some events are tied to specific locations and the electronic calendar represents different locations in different portions of the display. Calendar entries, such as a conference call or a plane flight, can be associated with one or more locations, such as the locations of all conference call participants or the departure and arrival cities for the flight. In one particular embodiment, the different locations may reside in different

time zones, and the calendar application **114** displays the relative local time for calendar entries in association with the calendar entries.

[0026] The user device **110** also includes a location determination module **115**. The location determination module **115** determines the current location of the user device **110**, for example from received GPS and/or cellular signals and/or any other location determination method known to those of skill in the art. In one embodiment, the location determination module **115** determines the location of the user device in terms of latitude and longitude.

[0027] The user device **110** also includes a server interaction module **112** to manage the communications between the server **120** and the user device **110**. Specifically, the server interaction module **112** receives data sent to the user device **110** from the server **120**, including, in one embodiment, metadata identifying extracted entities within the data and recognized events. The server interaction module **112** also receives data to be sent to the server **120** from the user device **110**, for example outbound email and text messages and the determined location of the user device **110** from the location determination module **115**.

[0028] FIG. **2**A is a block diagram of a server **120**, in accordance with an embodiment of the invention. The server **120** analyzes data flowing to and from the user device **110** in order to extract entities and recognize events. In this example, the server **120** includes an entity extraction module **124**, an index module **125**, a social network module **129**, an event recognition module **126**, a location tracker **123**, a location inference module **127**, a storage module **128**, a message agent **122**, and a device interaction module **121**.

[0029] The entity extraction module **124** identifies entities from data flowing to and from the user device **110**. The entity extraction module **124** parses text in a document in order to identify entities. For example, location names, names of people, and names of organizations are extracted based on full natural language processing, whereas phone numbers, email addresses, and URLs are extracted based on regular expressions, and dates and times are extracted based on a set of rules. In one embodiment, the entity name may be an alias of the word or words that appear in the text that undergoes analysis by the entity extraction module **124**. In one embodiment, the entity type is one of person, organization, location, or other. The entity name and type may be output from the entity extraction module to storage **128** and/or communicated to the user device **110** through the device interaction module **121** of the server **120**.

[0030] The index module **125** indexes the data according to the entities extracted by the entity extraction module **124**, in one embodiment. In cases where a document contains more than one extracted entity, the document may be indexed under each extracted entity. The index module **125** may store the results of the indexing in a local storage **128** or remote storage (not shown).

[0031] The social network module **129** builds the social network model implicit in the user's data, such as from contacts, email, web pages, as well as other types of documents. The social network model is a description of the relationships between the entities that are found in the user's data. The social network model adjusts the strength of relationships determined to exist between entities, particularly people entities. The server **120** uses the user's social network model, for example, to aid in entity extraction and to aid in identifying entities from an ambiguous reference in the user's data, as described in U.S. patent application Ser. No. 12/512,752, filed Jul. 30, 2009, entitled "Social network Model for Semantic Processing" which has been incorporated by reference. The social network module **129** stores the social network model in storage **128**.

[0032] The message agent **122** receives inbound messages from message server **140** and outbound messages from the user device **110**. The message agent **122** may also act as a mail transfer agent in routing messages between servers and mail clients. The message agent **122** provides the server **120** with the ability to intercept and process messages passing between devices on the network **101**.

[0033] The event recognition module **126** recognizes events from data flowing to and from the user device **110**, including the user's correspondence. The event recognition module **126** parses text in a document in order to identify appointments, meeting requests, flight reservations, and itineraries. A variety of techniques can be used to recognize events and extract event information from the parsed text. In one embodiment, a machine learning algorithm uses features such as the presence of date, time, location, people and other entities, and the presence of phrases such as "meet", "get together", and the like to learn a model for recognizing when a document refers to an event. The event information may comprise a time period, one or more locations, and one or more participants. The event information may be output from the event recognition module **126** to storage **128** and/or communicated to the user device **110** through the device interaction module **121** of the server as metadata associated with the document. In one embodiment, when the user views a document with associated event metadata, the user interface provides a mechanism to create a new event in the calendar using the associated metadata. metadata. In one embodiment, entities related to the event are highlighted; when the user selects a highlighted entity, a node menu appears including an option to create a new event incorporating the metadata. Node menus are discussed in more detail in U.S. patent application Ser. No. 12/512,854, filed Jul. 30, 2009, entitled "Data-Oriented User Interface for Mobile Device," which has been incorporated herein by reference.

[0034] The location tracker **123** receives information regarding the location of the user device **110** from the location determination module **115** of the user device **110**. For example, the location tracker **123** may receive a stream of coordinates derived from GPS signals or from cellular or other location determination technologies. In one embodiment, the location of the user's device **110** is tracked every **10** minutes. In other embodiments, the location may be tracked more or less frequently. Generally, a higher frequency of location determinations results in more accurate location data but a shorter battery life for the device **110**. The location tracker **123** may store the user's location data in storage **128**.

[0035] The location inference module **127** infers the future location of the user based on prior patterns, the user's calendared events, and the user's correspondence. The location inference module **127** is described in greater detail with reference to FIG. **2**B.

[0036] The device interaction module **121** manages the communications between the server **120** and the user device **110**. Specifically, the device interaction module **121** receives documents from, for example, web server **130** or message server **140** through message agent **122**, or from other loca-

tions on the network **101**, to be sent to a user device **110**. In one embodiment, the device interaction module **121** also receives metadata identifying entities within documents from the entity extraction module **124** and event information from event recognition module **126**. The device interaction module **121** also receives data from the user device **110** for subsequent processing by the server **120**, including the location information from the location determination module **115** of the user device **110**.

[0037] FIG. **2**B is a block diagram of a location inference module **127**, in accordance with one embodiment of the invention. The location inference module **127** infers the user's future location based on prior patterns, the user's calendared events, and the user's correspondence. The location inference module **127** includes a place identification module **1271**, a place naming module **1274**, a shadow calendar module **1272** and a travel time estimation module **1273**.

[0038] The place identification module **1271** identifies places of importance in the user's saved location data. A place of importance is anywhere the user stops for a while or spends a significant amount of time. In one embodiment, a place is defined as a map point (for example, expressed in latitude/longitude coordinates), a distribution around that point (for example, a circle of fixed radius or a normal distribution with a certain standard deviation), and, optionally, one or more names. In one embodiment, a place is created for anywhere the user stops for at least **30** minutes, and places are discovered by clustering recorded location points to find these places. Places may be initially unnamed, until processed by the place naming module **1274**. Places may have an associated history which tracks the when, how often, and for how long the user has visited the place; places with longer histories may be made more prominent in the user interface. Addresses discovered in the user's data may also be considered to be places; the address can generally be converted to map coordinates.

[0039] The place naming module **1274** correlates places identified by the place identification module **1271** with place names from the user, place names from the user's data, publicly-available business and place names, and other sources in user calendar entries **12701** and user event data **12702** extracted by the event recognition module **126** of the server **120**, and by coordinates or other user location data **12703** received by the location tracker **123** of the server **120**. The place naming module **1274** tracks possible names for identified places. A single place may have multiple valid names (such as "The White House" and "The President's house"); in addition multiple places with different names may appear as the same location due to the limitations of the device's location technology.

[0040] The place naming module **1274** can associate names with places in various ways. The user may choose to associate a name with an address or map location; in one embodiment, the user may be prompted to name places with extensive history. The user may also choose to add both a place name and an address or map location (as indicated via a map browsing application) to a calendar event; this creates an implicit association. An association may also be created when the user has a calendar event that lists a location name and his location log shows him to be at certain map coordinates during that time. Similarly, the user's correspondence may refer to an event that corresponds to a particular place and time found in the user's location log. Finally, associations may also be generated by using publicly-available location data to find possible names. All of these examples provide evidence of a location-name association; the place naming module maintains a "confidence" in every association by combining and weighing the available evidence. Places and names may be shown to the user only when the confidence reaches a threshold.

[0041] The shadow calendar module **1272** uses patterns in the user location data **12703** to create a typical routine generally followed by the user. In some cases, places with special meaning to a user, such as "work" and "home" can be inferred from patterns in the user's locations. For example, John lives in West Seattle and works downtown. The shadow calendar module **1272** has observed that he is typically in one location at night and the other during weekdays. Thus, the shadow calendar module **1272** may associate the names "home" and "work" with these places, and create a typical schedule for the user being at "home" and at "work." The typical schedule of where the user is throughout the day, week, month, or other time period is referred to herein as the user's "shadow calendar." By observing the user's typical locations, the shadow calendar module **1272** can infer where the user is likely to be in the future according to the same pattern, unless another event from the user calendar entries **12701** or user event data **12702** is scheduled to alter the pattern. Thus, events scheduled by the user can supersede events in the shadow calendar.

[0042] In one embodiment, the shadow calendar module **1272** creates "patterns" that consist of a place, a time span, a recurrence, and a probability. A place refers to any place identified and named by modules **1271** and **1274**. A time span might be a range of times, with a distribution representing variance around the endpoints. Typical recurrences include daily, weekly, every weekday, and the like. Finally, the probability represents the percentage of the time the user has been observed to be in that place during those time spans (and thus a projected future probability of finding him there). For example, John's "work" pattern would consists of the place that has been identified as "work", the time span 9:00 am -5:00 pm with a normal distribution to represent that he sometimes arrives or leaves earlier or later, the recurrence "every weekday", and the probability 0.67 because John is often out of the office for meetings—about one third of the time.

[0043] The travel time estimation module **1273** estimates the travel time needed to travel to and from a calendared event. The travel time to the event can be estimated from where the user currently is, for example as reported through the user location data **12703**, from a departure point that the user explicitly adds to the event data, or from where the user is predicted to be in advance of the calendared event based on the user calendar entries **12701**, user event data **12702** or the shadow calendar created by the shadow calendar module **1272**. Similarly, the travel time needed after the event can be estimated based on the location of the next calendared event based on the user calendar entries **12701** and the user event data **12702**, or to where the user is predicted to be heading based on the shadow calendar created by the shadow calendar module **1272**.

[0044] The travel time estimation module **1273** may receive map data **12704**, business and organization data **12705**, directions and route data **12706**, traffic data **12707**, and user location data **12703** as inputs to preparing travel

time estimations. The map data **12704** and business and organization data **12705** can help identify the coordinates of the location for the event. For example, if the event is at Stella's Café in Seattle, the business and organization data **12705** can identify the street address for the restaurant. The map data **12704** can correlate the street address for the restaurant to a geospatial location, for example in coordinates. The directions and route data **12706** can plan the route between the user's starting location and the geospatial location of Stella's Café. The directions and route data **12706** may include directions and routes for multiple modes of transportation, such as walking, cycling, taking mass transit (e.g., bus, trolley, train, ferry), or driving. Traffic data can be used to estimate which route among several possibilities (e.g., surface streets versus a freeway, or a train versus driving) is the fastest to Stella's Café, and ultimately how long the travel time is expected to be. Lastly, observed travel time from any of the user's previous visits to this location, particularly at the same departure time, can influence the travel time estimate. In one embodiment, the system uses the user location data **12703** to compute and record the travel time for every route the user travels. When a future meeting calls for a route the user has traveled before, the travel time may be estimated as the average travel time of all previous trips along that route. The average may be computed as a weighted average, where the closer the trip was in time of day to the planned trip, the greater weight that trip has in determining the projected time. For example, suppose the user is planning a meeting at Stella's Café for noon on the next day. He may have traveled to there from work five times previously, three times at around noon and twice at 6:00 pm. When predicting the travel time, the system may weight the travel time of the three noon trips more than that of the two evening trips. The travel time estimates can be presented to the user as blocks of time immediately adjacent to the calendared appointments, as will be shown and described with reference to FIGS. **4-7** below. These estimates can be dynamically updated, for example, in response to changing traffic conditions, and the corresponding length of the blocks of time adjacent to the calendared appointments are updated accordingly.

[0045] FIG. **3** is high-level block diagram illustrating an example of a computer **300** for use as a server **120** or user device **110**, in accordance with an embodiment of the invention. Illustrated are at least one processor **302** coupled to a chipset **304**. The chipset **304** includes a memory controller hub **350** and an input/output (I/O) controller hub **355**. A memory **306** and a graphics adapter **313** are coupled to the memory controller hub **350**, and a display device **318** is coupled to the graphics adapter **313**. A storage device **308**, keyboard **310**, pointing device **314**, and network adapter **316** are coupled to the I/O controller hub **355**. Other embodiments of the computer **300** have different architectures. For example, the memory **306** is directly coupled to the processor **302** in some embodiments.

[0046] The storage device **308** is a computer-readable storage medium such as a hard drive, compact disk read-only memory (CD-ROM), DVD, or a solid-state memory device. The memory **306** holds instructions and data used by the processor **302**. The pointing device **314** is a mouse, track ball, or other type of pointing device, and is used in combination with the keyboard **310** to input data into the computer system **300**. The graphics adapter **313** displays images and other information on the display device **318**. In some embodiments, the display device **318** includes a touch screen capability for receiving user input and selections. The network adapter **316** couples the computer system **300** to the communications network **101**. Some embodiments of the computer **300** have different and/or other components than those shown in FIG. **3**.

[0047] The computer **300** is adapted to execute computer program modules for providing functionality described herein. As used herein, the term "module" refers to computer program instructions and other logic used to provide the specified functionality. Thus, a module can be implemented in hardware, firmware, and/or software. In one embodiment, program modules formed of executable computer program instructions are stored on the storage device **308**, loaded into the memory **306**, and executed by the processor **302**.

[0048] The types of computers **300** used by the entities of FIG. **1** can vary depending upon the embodiment and the processing power used by the entity. For example, a mobile device **110** that is PDA typically has limited processing power, a small display **318**, and might lack a pointing device **314**. The server **120**, in contrast, may comprise multiple blade servers working together to provide the functionality described herein.

[0049] FIG. **4** is an illustration of a user interface **400** displaying a calendar showing events in two locations in different time zones. The user interface **400** allows the user to view a visual representation of calendar entries according to the location in which the events represented by the calendar entries occur and the local time at which they occur. The user interface **400** is divided into two portions: the portion on the left **441** corresponding to Pacific Standard Time, and the portion on the right **442** corresponding to Central Standard Time. In the example, these time zones have been chosen because the user is currently in Seattle, in the Pacific time zone, and will be traveling to Chicago, in the Central time zone. The user may manually select these time zones, or allow the device to select them automatically, based on the locations of calendar events during the day being viewed.

[0050] A timeline **443** corresponding to Pacific Standard Time is placed vertically within the portion on the left **441**, and a timeline **444** corresponding to Central Standard Time is placed vertically within the portion on the right **442**. Each timeline **443**, **444** displays numbers corresponding to times in the respective time zone. Calendared events are shown as enclosed shapes that overlap one or more of the timelines **443**, **444** associated with the different locations. In this embodiment, the position of events on the left or the right portion of the screen provides a visual identifier to the user regarding which timeline the event is associated with, and thus, which timeline the event originated from or is connected to. In this example, the shape of events is rectangular with rounded corners, but any other shape may be used additionally or alternatively. The start and end times for an event are represented respectively by where the top edge and bottom edge of the shape crosses the timeline **443**, **444**. Thus, the vertical extent of the shape is correlated to the length of the event. The horizontal placement and extent of the shape represents the location or locations which is relevant to the event, as will be described in more detail below. In addition, each shape may contain a text description of the event to identify the event to the user. Each event may be associated with additional information that may or may not be displayed to the user, including other participants in

the event, the location of the event, the exact start time and end time of the event, the organizer of the event, and/or any other information that is generally tracked with respect to calendar entries, as known to those of ordinary skill in the art.

[0051] The first calendared appointment for the user on Friday, Apr. 9, 2010 is a conference call **401** between Seattle and Chicago. The user interface **400** allows the user to quickly grasp what time it is in Seattle and Chicago for any calendar entry by viewing the timelines **443**, **444** down the left **441** and right **442** sides of the display. In one embodiment, events that do not have to take place in any specific location are identified in a different color or otherwise distinguished from events that are tied to specific locations. In the example shown in FIG. **4**, events that do not have to take place in any specific location, for example calls **401**, **404**, and **409**, are surrounded by a "time box" having dotted lines. The dotted lines overlap the timelines relevant for the people participating in the event (i.e., the call participants) but do not require the participants to be at any particular location. Thus, when the user has the conference call **401**, the user is calling from Seattle to Chicago, so the event **401** overlaps both timelines **443** and **444**, despite the fact that the user could be anywhere in Seattle or even en route to another city while making the call. Again, the position of the event "time box" relays important information regarding timelines to the user: especially which timelines are relevant to that event. Because the user may participate in these events while en route, they may be scheduled to overlap with travel time without a conflict; in one embodiment, the user is warned of the overlap and may choose whether to schedule the event. For example, the user may choose to make the conference call **401** while en route to the airport for his flight.

[0052] After the call **401**, the user has a flight **403** scheduled from Seattle to Chicago. The flight event **403** is represented as an enclosed shape outlining an area that spans the timelines **443**, **444** associated with both Seattle and Chicago because the flight takes off in one location and lands in the other, and is thus relevant to both timelines. The travel time to get to the airport for the flight event **403** is shown by calendar entry **402** adjacent to the upper edge of the flight event **403**. In this embodiment, the user can quickly view the duration of the flight by the vertical extent of the shape **403** and quickly grasp the total time the user will be in transit from the combination of the travel time **402** and flight event **403**. Optionally, the travel time **402** may be displayed as spanning the entire width of the associated calendar entry **403** to emphasize that the travel time **402** is closely tied to the event represented by the calendar entry **403**. Alternatively, the travel time **402** may be displayed as overlapping just one timeline **443** and positioned on one side of the display **441**, for example as spanning the left half of the flight event **403** in order to emphasize that the travel represented by the travel time **402** is associated with one location, namely Seattle. The user can also quickly ascertain what the local time will be in Chicago when the flight will arrive by referencing where the bottom edge of shape **402** crosses the Chicago timeline **444**.

[0053] In contrast to travel events such as flight **403**, events that occur in just one location are shown as enclosed shapes having horizontal extents and placements to overlap just the timeline for that one location. For example, the user can quickly grasp that the meeting with Brad **406** occurs in Chicago rather than Seattle, as evidenced by the fact that the calendar entry **406** is an enclosed shape placed on the right side **442** of the display and overlaps the timeline **444** for Chicago.

[0054] Also shown in FIG. **4** are two meetings **406** and **408** that include travel time estimates **405** and **407** that allocate time in the calendar to travel to the meetings. In this example, the travel times appear as shapes that connect to a top or bottom edge of another calendared event. The travel times **402**, **405** and **407** can be estimated by the travel time estimation module **1273** of the server **120** with reference to map data **12704**, business and organization data **12705**, directions and route data **12706**, traffic data **12707**, and user location data **12703** as inputs to preparing travel time estimations. In one embodiment, the travel time estimation module **1273** automatically places these travel times **402**, **405** and **407** into the calendar so that they appear as scheduled events to prevent the user from double-booking the time before the meeting/event. The travel times **402**, **405** and **407** also assist the user in planning when the user needs to leave a previous engagement in order to arrive at the next scheduled meeting/event on time.

[0055] FIG. **5** is an illustration of an alternate user interface **500** displaying a calendar showing events in three locations in three different time zones. In other embodiments, more or fewer time zones and locations can be displayed which allows the user great flexibility in how the user views calendar entries arranged by location and time. In this embodiment, the user interface **500** is divided into three portions: the portion on the left **551** corresponding to Pacific Standard Time, the portion in the middle **552** corresponding to Central Standard Time, and the portion on the right **553** corresponding to Eastern Standard Time. The on-screen location of the "time box" that represents the event provides a visual cue to the user of what timeline or timelines are relevant to the event in question. In this embodiment, these time zones have been chosen because the user is currently in Seattle, in the Pacific time zone, will be traveling to Chicago, in the Central time zone, and also has two meetings that include calls to people in New York, the Eastern time zone. A specific city or other location within each of the time zones may or may not be labeled in the portions **551**, **552**, **553** of the user interface **500**. Each of the three portions includes a respective timeline **554**, **555**, **556** that shows the local time for the location corresponding to the respective portion **551**, **552**, **553**. In some implementations, the locations and time zones are represented in the order in which they appear on a map as a default organization, but in other implementations they are presented in an order determined by user preference.

[0056] Included in this example are a calendar entry **501** for a conference call with participants from all three time zones; calls **504** and **509** with participants from two time zones each; a flight event **503** that begins in one location (Seattle) and ends in another (Chicago) and requires travel time **502**, and two meeting events **506**, **508** that each require travel time **505**, **507** to attend. Note that in this example, meeting **506** with Brad in Chicago includes a call to Tim in New York, hence the calendar entry **506** overlaps the timelines for Chicago **555** and New York **556**.

[0057] FIG. **6** is an illustration of a user interface **600** displaying a calendar showing events in three locations within the same time zone. The user interface **600** allows the user to view a visual representation of calendar entries according to the location in which the events represented by

those calendar entries occur. The timeline **664** for the Pacific Standard Time that applies to all the locations in this example is shown along the left of the interface **600**, but user interface **600** is still divided into three parts: the left side **661** represents the location of the user's home, the middle **662** represents the location of the user's office, and the right side **663** represents Bellevue, a location to which the user must travel.

[0058] The user begins the day at home. In order to attend the morning status meeting **602** at the office, an estimated travel time **601** has been inserted into the calendar to account for the travel time from the user's home to the office.

[0059] According to the calendar shown in FIG. **6**, the user plans to call **603** to "Check In with Kids" at 11. Again in this example, dotted lines surround appointments that do not need to occur at any particular location. In one embodiment, the calendar events that do not need to occur at any particular location are placed so as to overlap the location that the location inference module **127** predicts that the user will be based on the user's patterns. In this example, the conference call **607** overlaps the office location **662** because the user is generally in the office on Friday afternoons according to the shadow calendar developed by the shadow calendar module **1272** of the location inference module **127**.

[0060] Travel time **604** is an estimate of the time needed for the user to travel to the delivery location of Sasquatch Books corresponding to event **605** in Bellevue from the user's office. Travel time **606** is an estimate of the time needed for the user to travel from the delivery location of Sasquatch Books corresponding to event **605** in Bellevue back to the user's office. Although the user may not have explicitly indicated that the user would be traveling back to the office, the location inference module **127** predicts that the user will return to the office based on the user's past patterns according to the shadow calendar developed by the shadow calendar module **1272** of the location inference module **127**. The location inference module **127** also predicts that the user will be traveling home to meet the plumber **609** from the office based on the shadow calendar. Thus, travel time **608** is an estimate of the time needed for the user to travel home from the office. Travel time **608** is shown overlapping with conference call **607**; however, because the conference call could be made during travel (as indicated by the dotted border around the conference call **607**), the user need not consider this a conflict. On the other hand, if the user is planning on driving home and prefers to not drive while on the phone, the overlap suggests that he should reschedule either the conference call **607** or the plumber visit **609**.

[0061] FIG. **7** is an illustration of a user interface **700** displaying a calendar showing events for three users, wherein some events are shared events between multiple users, in accordance with an embodiment of the invention. Whereas the examples shown in FIG. **4-6** illustrate user interface divided into portions representing locations, the portions of the user interface **700** of FIG. **7** represent different people. Collectively, locations and people will be referred to herein as "calendar entities." The user interface **700** allows the user to view a visual representation of calendar entries according to who is involved in the event represented by those calendar entries. The timeline **774** for the Pacific Standard Time that applies to the user and the user's assistant and spouse is displayed along the left of the interface **700**, but the user interface **700** is divided into three parts: the left side **771** represents the user's own calendar, the middle **772** represents the user's assistant's calendar, and the right side **773** represents the user's spouse's calendar. Note that in this example, travel times **701**, **704**, **706**, and **711** are presented only on the user's calendar for the user's calendared events. Note also that only events that involve the user overlap the timeline **771**. The events on the calendars of the assistant **772** and the spouse **773** are placed at the vertical position on the screen that corresponds to the scheduled time for the event and the horizontal position on the screen corresponding to the entity/person involved in the event.

[0062] The user interface **700** includes examples of events **702**, **709** and **712** that involve the user and the user's assistant. In a single glance, the user can grasp where the user and the user's assistant's schedules overlap and when the user's assistant is committed to other responsibilities, like conference call **708**. Likewise, the multiple user view of user interface **700** allows the user to see how the user's schedule lines up the schedules of others in his life. For example, the user has calendared a call **703** to check in with the kids before the user's spouse takes the kids to camp **707**, and the user must be home to meet the plumber **710** because the user's spouse will be at yoga **713**.

[0063] FIG. **8** is a flow chart illustrating a method of inferring a geographic location of a calendar event, in accordance with an embodiment of the invention. In step **801**, the user's location is tracked. For example, the location determination module **115** of the user device **110** determines the location of the user device and communicates the location information to the location tracker **123** of the server **120**.

[0064] In step **802**, places, times, and recurrences are identified from the user's tracked locations, for example by the place identification module **1271** of the location inference module **127**. Generally, as a user spends time in an area, several location readings are communicated from the location determination module **115** of the user device **110** to the location tracker **123** of the server. These location readings are grouped, for example, by identifying a central location of a plurality of similar locations readings and a reasonable variance threshold for readings to be considered to be from the same location. Over time, patterns of recurrences develop in the times that a user is reported as being at various locations. These observed patterns become the basis for the shadow calendar module **1272** of the location inference module **127** to develop the shadow calendar. For example, the user may generally be tracked around one set of coordinates overnight, and another set of coordinates during weekdays from 9-5, and yet at another set of coordinates on Saturday nights. Locations where the user repeatedly goes are inferred to have significance to the user, and it is these locations that it is desirable to name as places, so that when future plans call for visiting these places, they can be referred to by the place name and the travel times to and from the places can be calculated.

[0065] In step **803**, the identified places are named, for example by the place naming module **1274** of the location inference module **127**. Several techniques are used to match what has been observed from the user's patterns with name of locations that have meaning to the user. These techniques will now be described:

[0066] Calendar events are matched **8031** to the identified places based on the time at which the calendared event was

scheduled to occur and the observed location of the user at that time. For example, the user enters a meeting on Tuesday with a client into his calendar with the location of "Bob's Office." Upon attending the Tuesday meeting, the location inference module **127** observes that the user spends about an hour at a new location, and tentatively associates the name "Bob's Office" with the new location. Thus, the following week, when the user creates another weekday meeting having the location of "Bob's Office," the user interface may display a pin on a map corresponding to the inferred location, and based on the observation that the user is generally at work during weekdays, the travel time estimation module **1273** can estimate a travel time from the user's work to Bob's Office. Thus, when the user saves the calendar entry for the new meeting at Bob's Office, the travel time is also automatically scheduled.

[0067] Correspondence is matched **8032** to an identified place based on recognized event data from the analysis that the event recognition module **126** performs on the user's correspondence. For example, if a user has received an email that states "Meet me at Sarah's house tonight at 7" the event recognition module **126** would recognize that this email refers to an event and that the event takes place at a location called "Sarah's House" (as indicated by "at"), starts at 7:00 pm on the current day ("tonight" indicates both the current day and in the evening), and includes the sender ("me"). Based on this information, the location inference module **127** infers that wherever the user happens to be at 7:00 pm might be the place known as "Sarah's House" (of course, it might not, if the user ignores the email). Accordingly, when the location inference module **127** observes that the user spends around half an hour at a new location at 7:00 that evening, will tentatively associate the name "Sarah's house" with the new location.

[0068] Another technique for matching a location visited by the user with a name that has meaning to the user that can be used alternatively or additionally to the techniques described above is matching **8033** labeled map data to the identified place. For example, if the user location data **12703** indicates to the location inference module **127** that the user has spent time at a set of coordinates, map data **12704** that corresponds to those coordinates can be consulted to determine a name associated with those coordinates, such as the labeled name of the neighborhood, the park, the lake, the trail, etc. Because location information can have a certain amount of error, because there may be multiple names at or near a set of coordinates, and because we cannot assume that a set of map data is complete, associations created this way cannot be certain but are assigned a confidence value depending on the closeness of the match and degree of certainty. For example, a location in the center of a large neighborhood results in higher confidence than a location near a small park, due to the greater likelihood that the user was not at the park at all.

[0069] Data about local businesses **8034** can also be matched to the identified place. Data about local businesses from business and organizational data **12705** can be used in combination with other types of data in determining which place from a few possible places that the user spent time. For example, the location determination module **115** of John's user device **110** reports locations to the location tracker **123** that John is out of the office from 12:00-1:00 at a map location that has not been reported before. Data about local businesses shows three businesses within the error radius of the location readings: a bookstore called "Book Barn," a restaurant called "Taco Palace," and a restaurant called "Burger Heaven." Based on the fact that John was gone during lunchtime, the location inference module **127** has been programmed to infer that it is more likely that he is visiting a restaurant than a bookstore. John had also received an email from Mary that morning that said "lunch today at Burger Heaven?" Therefore, the location inference module **127** concludes that John went to Burger Heaven with Mary between 12:00-1:00. "Burger Heaven" becomes a known named place, and the next time John's user device **110** reports the locations that could correspond to any of the three businesses, the location inference module **127** will be more likely to infer that John visited Burger Heaven than Taco Palace. As with map data, matches based on business data can rarely be certain and will result in associated confidence values depending on the closeness of the match and corroborating evidence as in the example.

[0070] Referring back to FIG. **8**, alternatively or additionally, user input is matched **8035** to the identified place in order to name the place. In one implementation, a user's explicit entry of a name for location will override any names assigned through inference techniques. In some implementations, the location inference module **127** will prompt the user to confirm the identified place name is correct, but in others, a high-confidence identified place name is assumed to be correct unless and until the user edits it.

[0071] In step **804**, the location of a calendared event can be inferred from a reference to a named place. Once places the user goes have been appropriately associated with names that are used to refer to those places, the location inference module **127** can infer the location of an event from the name, and the travel time estimation module **1273** can calculate the time needed to travel to the location. To continue the previous example, if John sends his buddy Ted a lunch invite and he enters "Burger Heaven" for the meeting location, the GUI **111** can display an indication to John that the location can be mapped and show the now-known location of Burger Heaven on a map. Furthermore, the location inference module **127** will infer that John will be going to Burger Heaven from work (since he is usually at work during the day according to the shadow calendar), and provides an estimated 10-minute travel time based on map data **1204**, traffic data **12707**, and John's past trips to Burger Heaven. Thus, as the number of named places that the user has been is built up over time, the location inference module's **127** ability to determine the location of a place referred to in a future calendar entry is improved, and the travel time estimation module **1273** can estimate travel times to and/or from the place referred to in that calendar entry without additional input from the user.

[0072] The present invention has been described in particular detail with respect to several possible embodiments. Those of skill in the art will appreciate that the invention may be practiced in other embodiments. The particular naming of the components, capitalization of terms, the attributes, data structures, or any other programming or structural aspect is not mandatory or significant, and the mechanisms that implement the invention or its features may have different names, formats, or protocols. Also, the particular division of functionality between the various system components described herein is merely exemplary, and not mandatory; functions performed by a single system component may instead be performed by multiple components, and

functions performed by multiple components may instead performed by a single component.

[0073] Some portions of above description present the features of the present invention in terms of algorithms and symbolic representations of operations on information. These algorithmic descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. These operations, while described functionally or logically, are understood to be implemented by computer programs. Furthermore, it has also proven convenient at times, to refer to these arrangements of operations as modules or by functional names, without loss of generality.

[0074] Unless specifically stated otherwise as apparent from the above discussion, it is appreciated that throughout the description, discussions utilizing terms such as "determining" or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system memories or registers or other such information storage, transmission or display devices.

[0075] Certain aspects of the present invention include process steps and instructions described herein in the form of an algorithm. It should be noted that the process steps and instructions of the present invention could be embodied in software, firmware or hardware, and when embodied in software, could be downloaded to reside on and be operated from different platforms used by real time network operating systems.

[0076] The present invention also relates to an apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, or it may comprise a general-purpose computer selectively activated or reconfigured by a computer program stored on a computer readable medium that can be accessed by the computer and run by a computer processor. Such a computer program may be stored in a computer readable storage medium, such as, but is not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, magnetic-optical disks, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, application specific integrated circuits (ASICs), or any type of media suitable for storing electronic instructions, and each coupled to a computer system bus. Furthermore, the computers referred to in the specification may include a single processor or may be architectures employing multiple processor designs for increased computing capability.

[0077] In addition, the present invention is not described with reference to any particular programming language. It is appreciated that a variety of programming languages may be used to implement the teachings of the present invention as described herein, and any references to specific languages are provided for enablement and best mode of the present invention.

[0078] The present invention is well suited to a wide variety of computer network systems over numerous topologies. Within this field, the configuration and management of large networks comprise storage devices and computers that are communicatively coupled to dissimilar computers and storage devices over a network, such as the Internet.

[0079] Finally, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and may not have been selected to delineate or circumscribe the inventive subject matter. Accordingly, the disclosure of the present invention is intended to be illustrative, but not limiting, of the scope of the invention.

What is claimed is:

1. A computer-implemented method, comprising:

obtaining data from a message electronically exchanged between a user and at least one other user;

identifying, in the data, an identifier and a time; and

as a result of location data of a device associated with the user satisfying a set of conditions based at least in part on the time, assigning the identifier to the location in data for an electronic map.

2. The computer-implemented method of claim **1**, wherein the identifier is a name of a place.

3. The computer-implemented method of claim **1**, wherein assigning the identifier to the location comprises associating the identifier with global positioning system coordinates in a data store.

4. The computer-implemented method of claim **1**, wherein the message is formatted according to a calendar application.

5. The computer-implemented method of claim **1**, wherein the set of conditions are further based at least in part on data associated with the location from a source different from the message.

6. The computer-implemented method of claim **1**, wherein the set of conditions are based at least in part on the location data of the device indicating the device being located at the location.

7. The computer-implemented method of claim **1**, wherein the location is a geographical area.

8. A system, comprising:

one or more processors; and

memory storing instructions executable by the one or more processors to cause the system to:

obtain data from a message electronically exchanged between a first user and a second user, the data indicating an identifier and a time;

determine satisfaction of a set of conditions based at least in part on the time and location data of a device; and

associate the identifier to the location to be used with an electronic map.

9. The system of claim **8**, wherein the instructions are further executable to cause the system to receive the location data from the device.

10. The system of claim **8**, wherein the identifier comprises a name associated with a geographic area.

11. The system of claim **8**, wherein the device is associated with the first user.

12. The system of claim **8**, wherein the set of conditions are further based at least in part on another message electronically exchanged between a third user and second user.

13. The system of claim **8**, wherein the message is an electronic mail message or text message.

14. The system of claim **8**, wherein the instructions are further executable to cause an event to be associated with the location.

15. A non-transitory computer-readable storage medium having stored thereon instructions that, if executed by one or more processors, cause a system to:

obtaining an identifier and a time based at least in part on a message electronically exchanged between a first user and a second user; and

as a result of location data of a device associated with the user satisfying a set of conditions based at least in part on the time, assigning the identifier to the location in data for an electronic map.

16. The non-transitory computer-readable storage medium of claim **15**, wherein the instructions, if executed, further cause the system to solicit confirmation of assignment of the identifier to the location from the first user.

17. The non-transitory computer-readable storage medium of claim **15**, wherein assigning the identifier to the location.

18. The non-transitory computer-readable storage medium of claim **15**, wherein the data for the electronic map is specific to the first user.

19. The non-transitory computer-readable storage medium of claim **15**, wherein the instructions, if executed, further cause the system to assign another identifier to the location such that the identifier and the other identifier are both associated with the location.

20. The non-transitory computer-readable storage medium of claim **15**, wherein the location lacks an assignment of an identifier prior to assignment of the identifier by the system.

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