US 20090271370A1

(54) **DISCOVERY OF FRIENDS USING SOCIAL NETWORK GRAPH PROPERTIES**

(75) Inventors: **Sunil Jagadish**, Bangalore (IN); **Jignashu Parikh**, Bangalore (IN)

Correspondence Address:
Yahoo! Inc.
c/o DARBY & DARBY P.C.
P.O. BOX 770, Church Street Station
NEW YORK, NY 10008-0770 (US)

(73) Assignee: **YAHOO! INC.**, Sunnyvale, CA (US)

(21) Appl. No.: **12/111,050**

(22) Filed: **Apr. 28, 2008**

(57) **ABSTRACT**

Embodiments are directed towards providing a list of potential friends to a user based on an analysis of friends' contact lists. The user may provide a subset of friends within a contact list for analysis, along with a degree of separation over which to perform the analysis, and/or a minimum threshold number of occurrences for identifying a candidate friend. The subset of friends' contact lists may then be recursively traversed and merged, where common friends may be identified as members of a candidate set for suggesting friends to the user. In one embodiment, the candidate members may be retained within the candidate set if there is a commonality between the friends and the candidate that exceeds the minimum threshold. The candidate list may also be rank order using various approaches, including a weighted energy diffusion model based in part on a number of communications between the candidates.

100

Client Device   *102*

103   Client Device   • • •

104   Client Device

Wireless Network

110

105

101   Client Device

Wide Area Network/Local Area Network - (Network)

106

108

Social Services (SS)

Friend Finder Service (FFS)

FIG. 1

FIG. 2

FIG. 3

— 400

START

402 — User Selects Subset Of Contacts In Contact List

404 — User Specifies DoS? →NO— Employ Default DoS — 405

YES

406 — Employ User Specified DoS

408 — User Threshold? →NO— Employ Default Threshold — 409

YES

410 — Employ User Threshold

412 — Get Contact Lists

418 — Move To Next DoS of Friends

414 — Perform Recursive Search of Contact Lists

—NO— 416 — DoS Exceeded?

YES

420 — Select Ordering Mechanism

422 — Rank Candidates Using Selected Ordering Mechanism (See Fig. 5)

424 — Display Candidate Of Friends

RETURN

FIG. 4

FIG. 5

600

A

B, C, D, E, ... O, P,...

First Degree of Separation

B

A, B, W, X, Y, Z,...

D

A, W, X1, X2, X3...

O

A, W, Q, R, S, T,...

C

A, W, X, Z,...

E

A, Y, Y1, Y2,...

P

A, X, Y1, Z, Z1,...

Second Degree of Separation

W

C, X1, X2, Z, W1,...

Z

C, W, X3, X5,...

Z1

Y1, X2, X3, W, X5, P...

X

C, X1, X4, X5,...

Y1

X2, X3, X4, X5, P, Z, ...

Third Degree of Separation

X1

X, X2, Z, ...
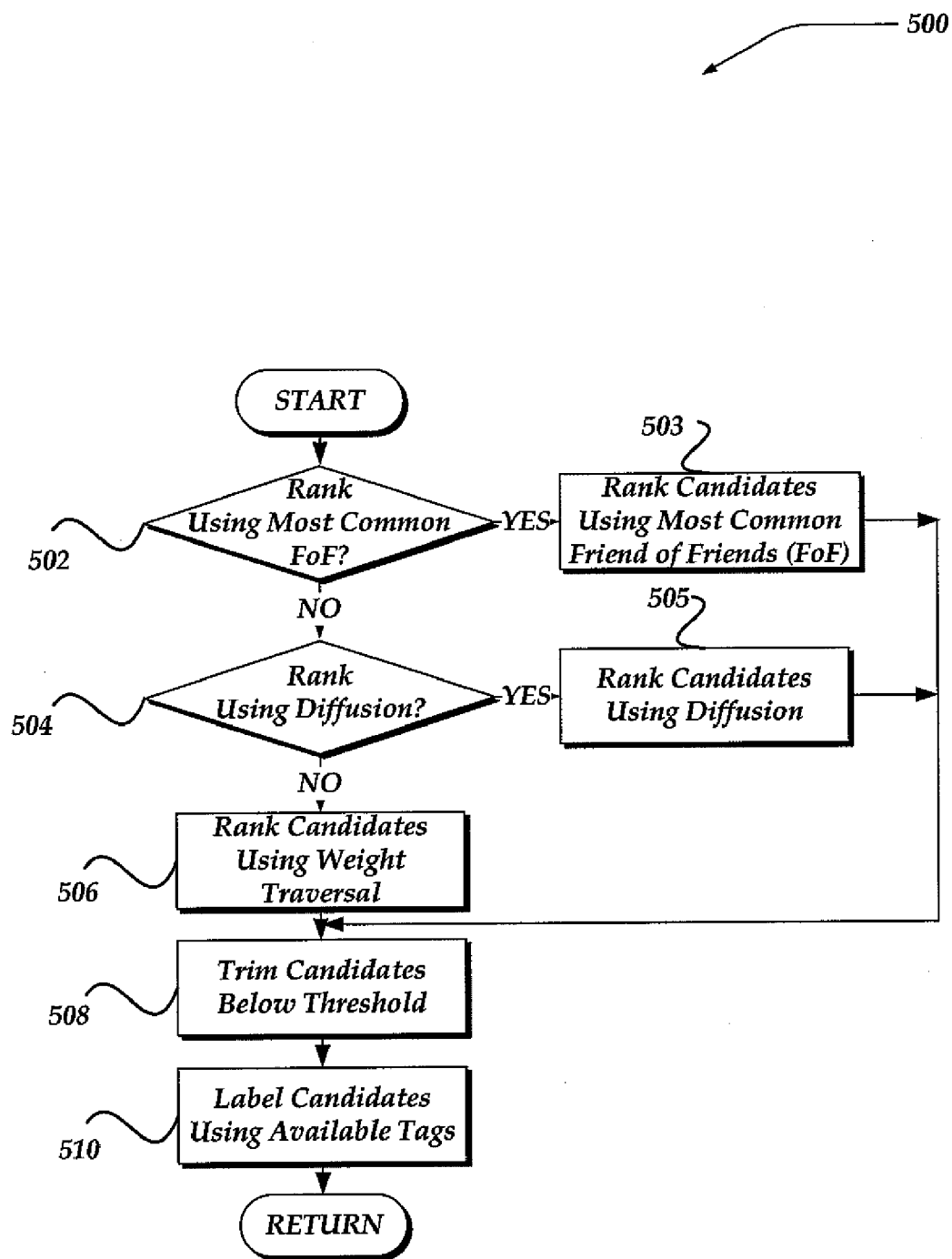
X4
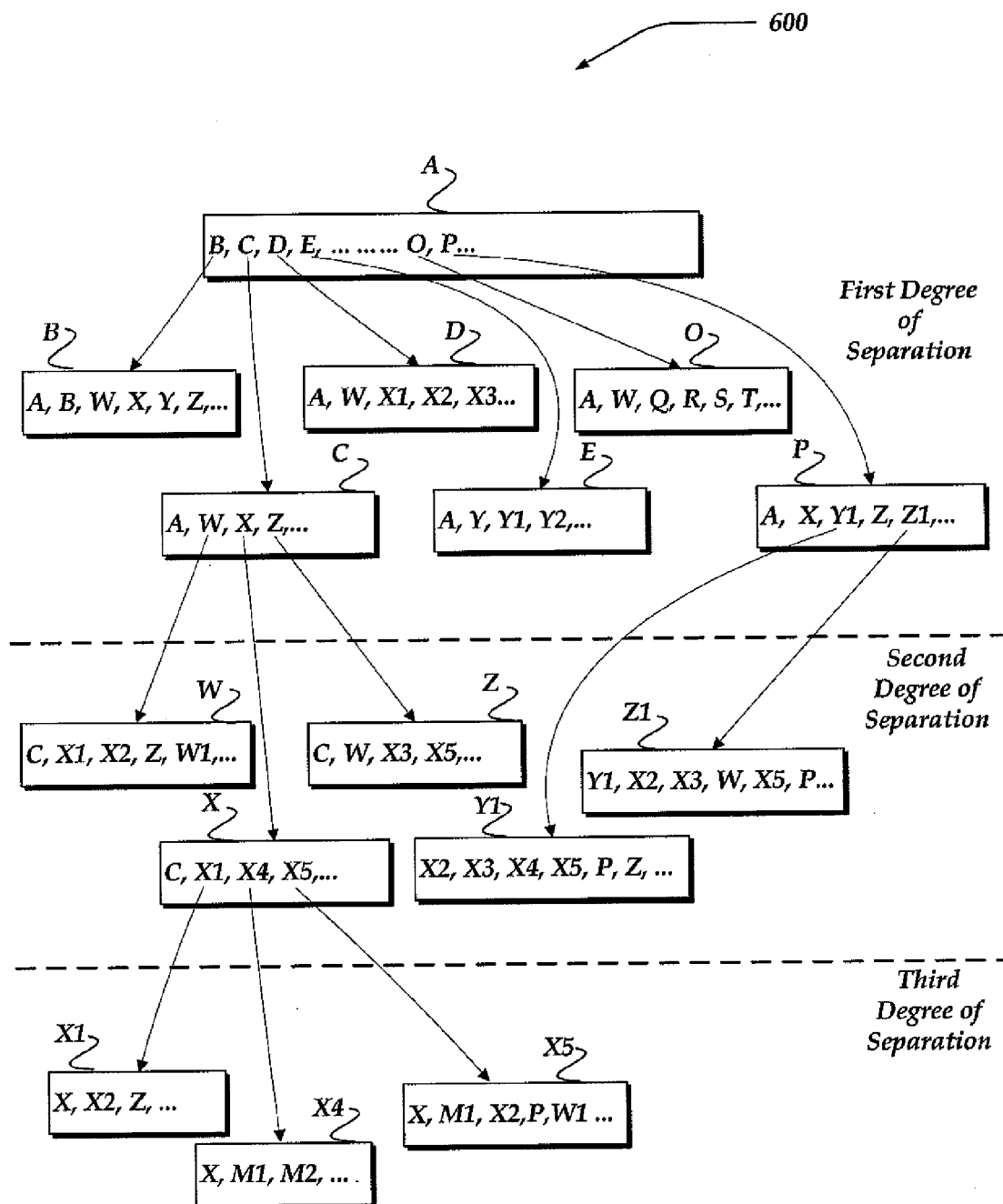
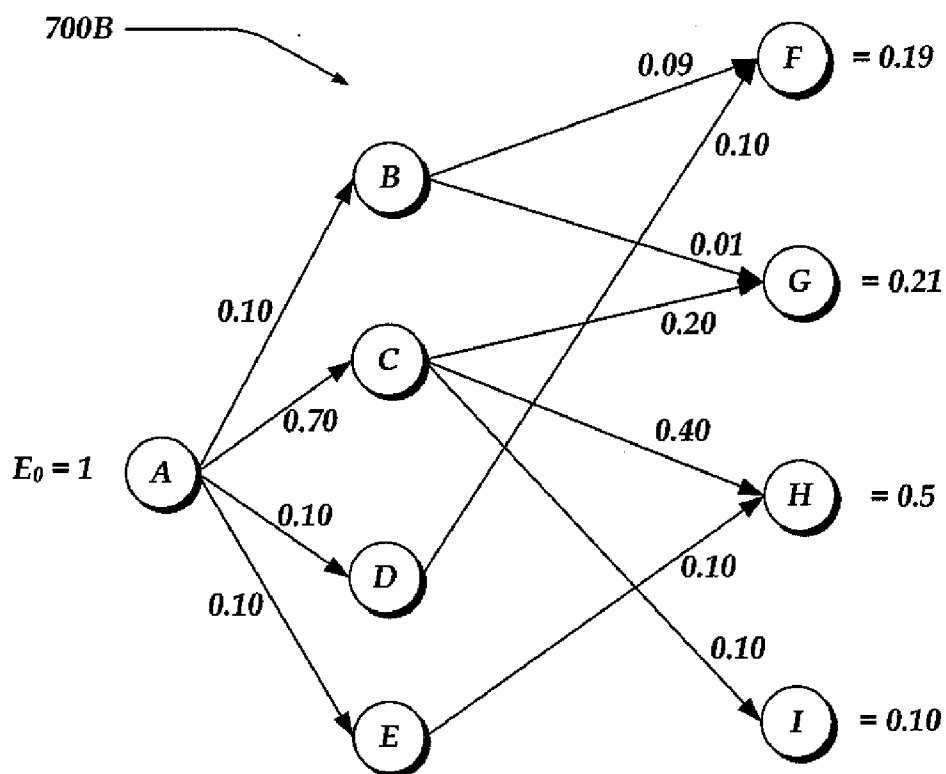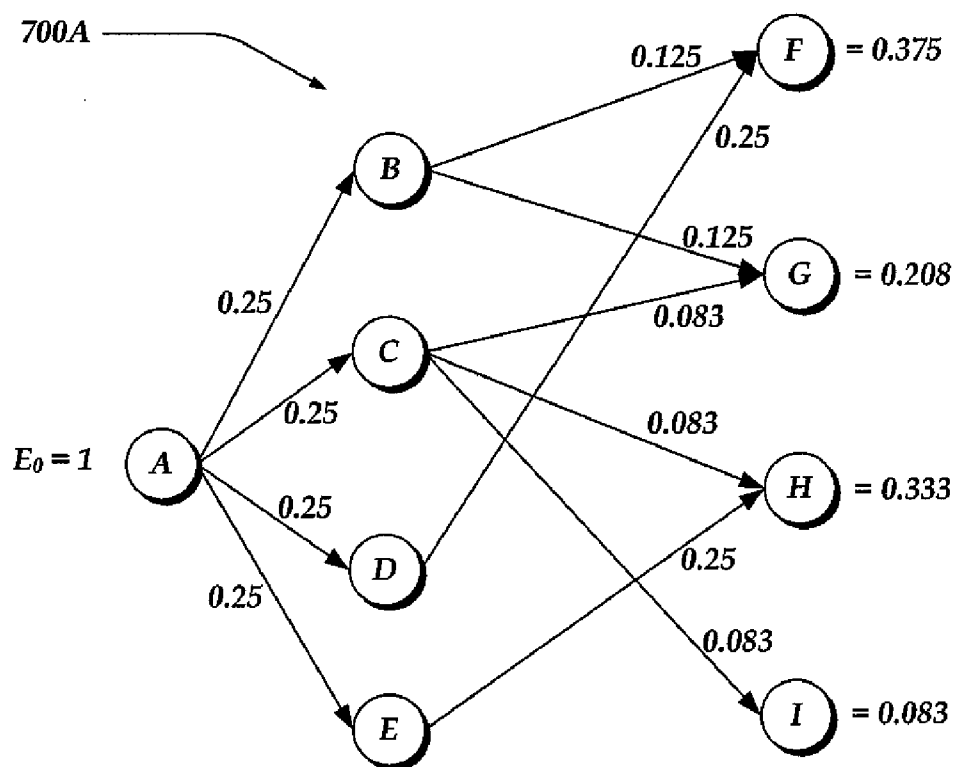X, M1, M2, ...

X5

X, M1, X2, P, W1 ...

FIG. 6

FIG. 7

DISCOVERY OF FRIENDS USING SOCIAL NETWORK GRAPH PROPERTIES

TECHNICAL FIELD

[0001] The present invention relates generally to communications and, more particularly, but not exclusively to performing a providing a list of potential friends based on a friends' relationship graph identifiable through their respective contact lists.

BACKGROUND

[0002] Social networking is a concept that an individual's personal network of friends, family colleagues, coworkers, and the subsequent connections within those networks, can be utilized to find more relevant connections for dating, job networking, service referrals, activity partners, and the like.

[0003] A social network typically comprises a person's set of direct and indirect personal relationships. Direct personal relationships usually include relationships with family members, friends, colleagues, coworkers, and other people with which the person has had some form of direct contact, such as contact in person, by telephone, by email, by instant message, by letter, and the like. These direct personal relationships are sometimes referred to as first-degree relationships. First-degree relationships can have varying degrees of closeness, trust, and other characteristics. These relationships can also be unidirectional or bidirectional. A unidirectional relationship typically means that a first person is willing and able to interact with a second person, but the second person may not be willing or able to interact with the first person. Conversely, a bidirectional relationship typically means that both people are willing and able to interact with each other.

[0004] Indirect personal relationships typically include relationships through first-degree relationships to people with whom a person has not had some form of direct contact. For example, a friend of a friend represents an indirect personal relationship. A more extended, indirect relationship might be a friend of a friend of a friend. These indirect relationships are sometimes characterized by a degree of separation between the people. For instance, a friend of a friend can be characterized as a second-degree relationship.

[0005] However, in today's busy world, people often lose contact with their friends, classmates, co-workers, and the like. Finding these people again can sometimes be difficult, if not impossible. For example, a person might go to a website, type in a particular name of a lost friend, and information about the lost friend. Such 'profile' information might include where the lost friend went to school, when they went to school, where they worked, and/or the like. Providing profile information often requires, however, that the lost friend, 'subscribed' to the particular website that is to be searched and/or that the lost friend further entered such profile information about themselves. If such profile information is incomplete or absent, then searches based on profile information will likely also be incomplete or otherwise lacking.

[0006] Moreover, it may be that the person performing the search may be looking for persons based on a common activity, such as dating, a business, a club, or the like. This may be especially valid, where a person is attempting to determine whether or not to participate in a particular social network activity. As more of one's friends are associated with the particular social network activity, the more likely that the person will also participate. Thus, there is a desire to improve how persons may locate and/or identify friends and/or potential friends. Therefore, it is with respect to these considerations and others that the present invention has been made.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Non-limiting and non-exhaustive embodiments of the present invention are described with reference to the following drawings. In the drawings, like reference numerals refer to like parts throughout the various figures unless otherwise specified.

[0008] For a better understanding of the present invention, reference will be made to the following Detailed Description, which is to be read in association with the accompanying drawings, wherein:

[0009] FIG. 1 is a system diagram of one embodiment of an environment in which the invention may be practiced;

[0010] FIG. 2 shows one embodiment of a client device that may be included in a system implementing the invention;

[0011] FIG. 3 shows one embodiment of a network device that may be included in a system implementing the invention;

[0012] FIG. 4 illustrates a logical flow diagram generally showing one embodiment of a process for identifying candidate friends within friends' contact lists;

[0013] FIG. 5 illustrates a logical flow diagram generally showing one embodiment of a process for ranking for display candidate friends;

[0014] FIG. 6 illustrates a non-exhaustive example of a contact graph based on contact lists useable as one embodiment for identifying candidate friends; and

[0015] FIG. 7 illustrates non-exhaustive examples of contact graphs useable in embodiment for employing ranking mechanisms of candidate friends.

DETAILED DESCRIPTION

[0016] The present invention now will be described more fully hereinafter with reference to the accompanying drawings, which form a part hereof, and which show, by way of illustration, specific embodiments by which the invention may be practiced. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Among other things, the present invention may be embodied as methods or devices. Accordingly, the present invention may take the form of an entirely hardware embodiment, an entirely software embodiment or an embodiment combining software and hardware aspects. The following detailed description is, therefore, not to be taken in a limiting sense.

[0017] Throughout the specification and claims, the following terms take the meanings explicitly associated herein, unless the context clearly dictates otherwise. The phrase "in one embodiment" as used herein does not necessarily refer to the same embodiment, though it may. As used herein, the term "or" is an inclusive "or" operator, and is equivalent to the term "and/or," unless the context clearly dictates otherwise. The term "based on" is not exclusive and allows for being based on additional factors not described, unless the context clearly dictates otherwise. In addition, throughout the specification, the meaning of "a," "an," and "the" include plural references. The meaning of "in" includes "in" and "on."

2

[0018] As used herein, the terms "social network" and "social community" refer to a concept that an individual's personal network of friends, family colleagues, coworkers, and the subsequent connections within those networks. A social network, for example, can be utilized to find more relevant connections for a variety of activities, including, but not limited to dating, job networking, service referrals, content sharing, like-minded individuals, activity partners, or the like.

[0019] An online social network refers to a person's set of direct and/or indirect personal relationships, including real and virtual privileges and permissions that users may associate with these people. Direct personal relationships refers to relationships with people the user communicates with directly, including family members, friends, colleagues, coworkers, and other people with which the person has had some form of direct contact, such as contact in person, by telephone, by email, by instant message, by letter, or the like. These direct personal relationships are sometimes referred to as first-degree relationships. First-degree relationships can have varying degrees of closeness, trust, and other characteristics.

[0020] Indirect personal relationships refer to relationships through first-degree relationships to people with whom a person has not had some form of direct or limited direct contact, such as in being cc'd on an e-mail message, or the like. For example, a friend of a friend represents an indirect personal relationship. A more extended, indirect relationship might be a friend of a friend of a friend. These indirect relationships are sometimes characterized by a degree of separation between the people. For instance, a friend of a friend can be characterized as two degrees of separation or a second-degree relationship. Similarly, a friend of a friend of a friend can be characterized as three degrees of separation or a third-degree relationship, and so forth.

[0021] As used herein, the term "contact list" refers to any source of information about members in a person's list of contacts. As such a contact list includes email address books, buddy lists, text messaging address lists, and the like. A contact list typically includes a name of a contact (as used herein "a contact"), and a phone number, or other unique identifier. A contact list may also include an address, a tag indicating a relationship, a membership, or other selected information about the contact. It is important to note that while a name of a contact may reside within a contact list, it should not be inferred expressly or inherently that the name of the contact has communicated in any manner with the person with which the contact list is associated. For example, the contact list owner might have entered a name into their contact list, based on a friend's suggestion, an advertisement, or the like, but might not have communicated with that contact. However, the contact list owner might also enter a name within the contact list, and have communicated with that contact. Thus, while it is typical that a contact list includes a person's first degree of separation relationships, the contact list may also include contacts that are not currently defined within such a relationship.

[0022] As used herein, the term "profile information" refers to explicitly provided labels, tags, and other added information about a contact that indicates a characteristic about the contact beyond a name, address, or phone number, email address, or other messaging address related information. Such profile information typically provides such information as a whether the contact is a friend, family member, a class-

mate, batchmate, a co-worker, sports buddy, or the like. Profile information may also indicate a school association, an employer association, a religious affiliation, or the like. Profile information as stated above may also include such information as when a person went to a school, where they worked, how long they were employed at a particular location, or similar additional information about the contact's social activities. Profile information about a contact may also include information about what the contact likes and/or dislikes, hobbies, or the like, as well as physical characteristics about the contact such as height, weight, eye color, hair color, age, gender, or the like.

[0023] The following briefly describes the embodiments of the invention in order to provide a basic understanding of some aspects of the invention. This brief description is not intended as an extensive overview. It is not intended to identify key or critical elements, or to delineate or otherwise narrow the scope. Its purpose is merely to present some concepts in a simplified form as a prelude to the more detailed description that is presented later.

[0024] Briefly stated, embodiments are directed towards providing a list of candidate friends to a user based on an analysis of friends' contact lists. In one embodiment, the user may provide a subset of friends or contacts within a contact list for analysis. In one embodiment, the user might specify a degree of separation over which to perform the analysis, and/or a minimum threshold number of occurrences for identifying a candidate friend. The subset of friends' contact lists may then be recursively traversed and merged, where common friends may be identified as members of a candidate set for suggesting friends to the user. Thus, a list of candidate friends may be generated independent from use of profile information about a contact, or even a number of communications between contacts. That is, various embodiments of the invention may be used to overcome a dependency upon profile information to enable a user to find their friends, classmates, co-workers, or the like. In one embodiment, candidate friends may be retained within the candidate set or enabled for display if there is a commonality between the friends and the candidate that exceeds the minimum threshold.

[0025] In one embodiment, the list of candidate friends may be ranked or ordered for presentation to the user based on a variety of ranking/ordering mechanisms. Thus, in one embodiment, the candidate list may be ordered based on a measure of how many of the user's friends (or friends of friends, or so on) have the candidate in their contact list. Another embodiment of a ranking/ordering mechanism includes a diffusion based approach, in which energy may be determined and diffused based on a number of contacts and contact relationships. Candidates may be determined from the diffusion based approach, in one embodiment, as those contacts having an energy above some value after N iterations (or at equilibrium) over a contact graph.

[0026] Yet another embodiment of a ranking/ordering mechanism may include traversal in a weighted graph, wherein edges of a graph of friends may be weighted based on an amount of interactions or communications identified between friends within a modified diffusion based graph. In one embodiment, energy may be distributed over the graph of friends proportional to a strength of a relationship based on a number of interactions. The weighting may also include a memory that modifies the weighting determined from an amount of interactions, based on when the interactions occurred. For example, in one embodiment, where the inter-

actions were identified as occurring a long time ago (e.g., months, years, or the like), these interactions might have a lower weighting than those that occurred more recently (e.g., hours, days, weeks, or the like). The invention is not limited, however, to these weighting schemes, and others may also be employed, without departing from the scope of the invention.

[0027] Moreover, post ranking or grouping of candidates may also be achieved, in still another embodiment using tags or other labeling mechanisms. Thus, where a friend has labeled a contact, commonality of labels may be used to group or otherwise organize the candidate list. For example, where a label such as "UC Berkeley" is used by four of the user's friends to label a common friend identified within the candidate list, then that label may be used to identify and/or otherwise group or organize a display of the candidates within the list. Thus, while identifying the candidates is independent of profile information, subsequent ranking, or grouping of the results may employ at least some profile information, if it is available. While at least one embodiment of ranking the candidates might employ communication information, the invention is not constrained to such information. Nor is the invention constrained to employing labels, profile information, or the like, about a contact within contact lists for ordering the resulting candidate friends list.

[0028] However, in one embodiment, a user may select an initial set of friends from within their own contact list based on a variety of criteria that would then influence a result. For example, the user might select persons within their own contact list based on being the user's batchmate (e.g., those graduating with the user). Then, embodiments of the invention, independent of profile information, may return candidate friends that are likely to be the user's batchmates.

[0029] In one embodiment, an application might reside on a remote server that the user may access to perform the search for friends. However, in another embodiment, the application might reside within at least one user's client computer. In one embodiment, the contact lists might further reside within one or more remote servers, and/or within each user's client computer. In either situation, however, it is expected that each contact, and/or potential contact within a person's contact list has enabled access for at least some searching to locate candidate friends.

Illustrative Operating Environment

[0030] FIG. 1 shows components of one embodiment of an environment in which the invention may be practiced. Not all the components may be required to practice the invention, and variations in the arrangement and type of the components may be made without departing from the spirit or scope of the invention. As shown, system 100 of FIG. 1 includes local area networks ("LANs")/wide area networks ("WANs")-(network) 105, wireless network 110, client devices 101-106, Friend Finder Service (FFS) 106, and social services (SS) 108.

[0031] Generally, client devices 102-104 may include virtually any mobile computing device capable of receiving and sending a message over a network, such as wireless network 110, or the like. Such devices include portable devices such as, cellular telephones, smart phones, display pagers, radio frequency (RF) devices, infrared (IR) devices, Personal Digital Assistants (PDAs), handheld computers, laptop computers, wearable computers, tablet computers, integrated devices combining one or more of the preceding devices, or the like.

One embodiment of a mobile device usable as one of client devices 102-104 is described in more detail below in conjunction with FIG. 2.

[0032] Client device 101 may include virtually any computing device that typically connects using a wired communications medium such as personal computers, multiprocessor systems, microprocessor-based or programmable consumer electronics, network PCs, or the like. In one embodiment, one or more of client devices 101-104 may also be configured to operate over a wired and/or a wireless network.

[0033] Client devices 101-104 typically range widely in terms of capabilities and features. For example, a cell phone may have a numeric keypad and a few lines of monochrome LCD display on which only text may be displayed. In another example, a web-enabled client device may have a touch sensitive screen, a stylus, and several lines of color LCD display in which both text and graphics may be displayed.

[0034] A web-enabled client device may include a browser application that is configured to receive and to send web pages, web-based messages, or the like. The browser application may be configured to receive and display graphics, text, multimedia, or the like, employing virtually any web based language, including a wireless application protocol messages (WAP), or the like. In one embodiment, the browser application is enabled to employ Handheld Device Markup Language (HDML), Wireless Markup Language (WML), WMLScript, JavaScript, Standard Generalized Markup Language (SMGL), HyperText Markup Language (HTML), eXtensible Markup Language (XML), or the like, to display and send information.

[0035] Client devices 101-104 also may include at least one other client application that is configured to receive content from another computing device. The client application may include a capability to provide and receive textual content, multimedia information, or the like. The client application may further provide information that identifies itself, including a type, capability, name, or the like. In one embodiment, client devices 101-104 may uniquely identify themselves through any of a variety of mechanisms, including a phone number, Mobile Identification Number (MIN), an electronic serial number (ESN), mobile device identifier, network address, or other identifier. The identifier may be provided in a message, or the like, sent to another computing device.

[0036] Client devices 101-104 may also be configured to communicate a message, such as through email, Short Message Service (SMS), Multimedia Message Service (MMS), instant messaging (IM), internet relay chat (IRC), Mardam-Bey's IRC (mIRC), Jabber, or the like, between another computing device. However, the present invention is not limited to these message protocols, and virtually any other message protocol may be employed.

[0037] Client devices 101-104 may further be configured to include a client application that enables the user to log into a user account that may be managed by another computing device, such as SS 108, FFS 106, or the like. Such user account, for example, may be configured to enable the user to receive emails, send/receive IM messages, SMS messages, access selected web pages, or participate in a social networking activity. However, managing of messages or otherwise participating in other social activities may also be performed without logging into the user account.

[0038] Thus, a user of client devices 101-104 may employ any of a variety of client applications to access content, read

web pages, receive/send messages, or the like. In one embodiment, for example, the user may employ a browser or other client application to access a web page hosted by SS **108**, FFS **106**, or the like.

[0039] Moreover, client devices **101-104** may employ one or more client applications, such as those described above, to access a contact list. The contact list may include various contacts for which a user of the client device has entered. In at least one embodiment, the contacts may be first degree of separation contact. However, in another embodiment, a user may have entered a contact and/or contact information having not yet communicated with the entered contact. This event might arise based on any of a variety of scenarios. For example, a friend might suggest to the user to communicate with the contact, and provide information about the contact to the user. This could arise, for example, during a potential dating situation, a job opportunity, a referral to a business, a medical professional, or any of the like.

[0040] In any event, storage of a contact list associated with a user of a client device may be achieved locally, at the user's client device, and/or remotely at another device, such as SS **108**, FFS **106**, or the like. In any event, the user may configure their contact list to be searchable by FFS **106** for use in identifying candidate friends.

[0041] In one embodiment, client devices **10-104** may employ a remote mechanism, such as might be hosted by SS **108**, FFS **106**, or the like, for use in obtaining a list of candidate friends, such as is described further below. In another embodiment, the client device may include a client application that is configured and arranged to determine the list of candidate friends. For example, in one embodiment, the client application might be configured to operate similar to a peer-to-peer configuration to query other client devices, and/or other network devices, to access contact lists to generate the candidate friends list. Thus, it should be noted, that embodiments of the invention may be configured to operate on a network device, such as FFS **106**, SS **108**, or the like, within client devices, and/or a combination of client devices and network devices.

[0042] Wireless network **110** is configured to couple client devices **102-104** with network **105**. Wireless network **110** may include any of a variety of wireless sub-networks that may further overlay stand-alone ad-hoc networks, or the like, to provide an infrastructure-oriented connection for client devices **102-104**. Such sub-networks may include mesh networks, Wireless LAN (WLAN) networks, cellular networks, or the like.

[0043] Wireless network **110** may further include an autonomous system of terminals, gateways, routers, or the like connected by wireless radio links, or the like. These connectors may be configured to move freely and randomly and organize themselves arbitrarily, such that the topology of wireless network **110** may change rapidly.

[0044] Wireless network **110** may further employ a plurality of access technologies including 2nd (2G), 3rd (3G), 4th (4G) generation radio access for cellular systems, WLAN, Wireless Router (WR) mesh, or the like. Access technologies such as 2G, 2.5G, 3G, 4G, and future access networks may enable wide area coverage for client devices, such as client devices **102-104** with various degrees of mobility. For example, wireless network **110** may enable a radio connection through a radio network access such as Global System for Mobile communication (GSM), General Packet Radio Services (GPRS), Enhanced Data GSM Environment (EDGE),

Wideband Code Division Multiple Access (WCDMA), Bluetooth, or the like. In essence, wireless network **110** may include virtually any wireless communication mechanism by which information may travel between client devices **102-104** and another computing device, network, or the like.

[0045] Network **105** is configured to couple FFS **106**, SS **108**, and client device **101** with other computing devices, including through wireless network **110** to client devices **102-104**. Network **105** is enabled to employ any form of computer readable media for communicating information from one electronic device to another. Also, network **105** can include the Internet in addition to local area networks (LANs), wide area networks (WANs), direct connections, such as through a universal serial bus (USB) port, other forms of computer-readable media, or any combination thereof. On an interconnected set of LANs, including those based on differing architectures and protocols, a router acts as a link between LANs, enabling messages to be sent from one to another. Also, communication links within LANs typically include twisted wire pair or coaxial cable, while communication links between networks may utilize analog telephone lines, full or fractional dedicated digital lines including T1, T2, T3, and T4, Integrated Services Digital Networks (IS-DNs), Digital Subscriber Lines (DSLs), wireless links including satellite links, or other communications links known to those skilled in the art. Furthermore, remote computers and other related electronic devices could be remotely connected to either LANs or WANs via a modem and temporary telephone link. In essence, network **105** includes any communication method by which information may travel between computing devices.

[0046] Additionally, communication media typically embodies computer-readable instructions, data structures, program modules, or other data in a modulated data signal such as a carrier wave, data signal, or other transport mechanism and includes any information delivery media. The terms "modulated data signal," and "carrier-wave signal" includes a signal that has one or more of its characteristics set or changed in such a manner as to encode information, instructions, data, or the like, in the signal. By way of example, communication media includes wired media such as twisted pair, coaxial cable, fiber optics, wave guides, and other wired media and wireless media such as acoustic, RF, infrared, and other wireless media.

[0047] SS **108** includes virtually any network computing device that is configured to provide various resources, including content and/or social networking services over network **105**. SS **108** may also provide access to any of a variety of content, including, but not limited to messages, such as emails, SMS messages, IM messages, as well as content that may include audio files, video files, text files, streaming files, graphical files, or the like. Thus, virtually any content may be available through SS **108** for access by client devices **101-104**. SS **108** might also provide FTP services, APIs, web services, database services, or the like, to enable users to access content. However, SS **108** are not limited to these mechanisms, and/or content, and others are envisaged as well.

[0048] In one embodiment, SS **108** might be configured and arranged to provide a website for users to participate in a social networking activity. In one embodiment, participation might include becoming a member to the social networking activity. However, in another embodiment, participation might not require becoming a member.

5

[0049] In one embodiment, SS **108** may be configured and arranged to manage contact lists for one or more of client devices **101-104**. In one embodiment, SS **108** may further be configured to enable a user or owner associated with a given contact list to modify content of the contact list, as well as other properties of the contact list. For example, in one embodiment SS **108** may enable a user to enable access to at least a subset of contacts identified within the contact list by another application, user, or the like. Thus, in one embodiment, a user might identify at least a subset of the contacts within their contact list as searchable by an application such as might reside on FFS **106**, SS **108**, and/or another client device to generate a candidate list of friends. In one embodiment, the user might identify the subset of contacts based on some criteria known to the user about the subset of contacts independent of stored profile information. For example, the user might select the subset based on them being batchmates of the user, or the like.

[0050] Devices that may operate as SS **108** include, but are not limited to personal computers, desktop computers, multiprocessor systems, microprocessor-based or programmable consumer electronics, network PCs, servers, network appliances, and the like.

[0051] One embodiment of FFS **106** is described in more detail below in conjunction with FIG. **3**. Briefly, however, FFS **106** may include any computing device capable of connecting to network **105** to enable a searching of contact lists to generate a list of candidate friends for a user. In one embodiment, a user might employ a user interface provided by FFS **106** to identify a subset of contacts within their contact list as starting friends from which to conduct a friends' search. In one embodiment, the interface may be integrated with an interface associated with a messenger application, browser application, or the like.

[0052] FFS **106** may then search contact lists associated with the subset of contacts to identify candidate friends to the requesting user. In one embodiment, the requesting user may specify a level in which the search for candidate friends is to be conducted. For example, the requesting user might specify a degree of separation over which to be searched. In another embodiment, the requesting user might also provide additional constraints on the search, and/or an ordering of a result of the search. For example, in one embodiment, the requesting user might specify a minimum threshold indicating a minimum number of relationships to be identified before including a contact in the list of candidate friends. In another embodiment, the requesting user might further specify other information, such as weighting criteria, or the like, useable to order the results. In any event, FFS **106** may employ a process such as described below in conjunction with FIGS. **4-5** to perform at least some of its actions.

[0053] Devices that may operate as FFS **106** include personal computers, desktop computers, multiprocessor systems, microprocessor-based or programmable consumer electronics, network PCs, servers, or the like.

[0054] As noted above, the search for a list of candidate friends may also be performed by an application hosted within one or more client devices, similar to a peer-to-peer mechanism. Moreover, where the friend finder application may be hosted within FFS **106**, it should be recognized that the application may also reside within SS **108**. Moreover, the friend finder application may be distributed across a plurality

of network devices, and/or client devices, without departing from the scope of the invention.

Illustrative Client Environment

[0055] FIG. **2** shows one embodiment of client device **200** that may be included in a system implementing the invention. Client device **200** may include many more or less components than those shown in FIG. **2**. However, the components shown are sufficient to disclose an illustrative embodiment for practicing the present invention. Client device **200** may represent, for example, one of client devices **101-104** of FIG. **1**.

[0056] As shown in the figure, client device **200** includes a processing unit (CPU) **222** in communication with a mass memory **230** via a bus **224**. Client device **200** also includes a power supply **226**, one or more network interfaces **250**, an audio interface **252**, video interface **259**, a display **254**, a keypad **256**, an illuminator **258**, an input/output interface **260**, a haptic interface **262**, and an optional global positioning systems (GPS) receiver **264**. Power supply **226** provides power to client device **200**. A rechargeable or non-rechargeable battery may be used to provide power. The power may also be provided by an external power source, such as an AC adapter or a powered docking cradle that supplements and/or recharges a battery.

[0057] Client device **200** may optionally communicate with a base station (not shown), or directly with another computing device. Network interface **250** includes circuitry for coupling client device **200** to one or more networks, and is constructed for use with one or more communication protocols and technologies including, but not limited to, global system for mobile communication (GSM), code division multiple access (CDMA), time division multiple access (TDMA), user datagram protocol (UDP), transmission control protocol/Internet protocol (TCP/IP), SMS, general packet radio service (GPRS), WAP, ultra wide band (UWB), IEEE 802.16 Worldwide Interoperability for Microwave Access (WiMax), SIP/RTP, Bluetooth™, infrared, Wi-Fi, Zigbee, or any of a variety of other wireless communication protocols. Network interface **250** is sometimes known as a transceiver, transceiving device, or network interface card (NIC).

[0058] Audio interface **252** is arranged to produce and receive audio signals such as the sound of a human voice. For example, audio interface **252** may be coupled to a speaker and microphone (not shown) to enable telecommunication with others and/or generate an audio acknowledgement for some action. Display **254** may be a liquid crystal display (LCD), gas plasma, light emitting diode (LED), or any other type of display used with a computing device. Display **254** may also include a touch sensitive screen arranged to receive input from an object such as a stylus or a digit from a human hand.

[0059] Video interface **259** is arranged to capture video images, such as a still photo, a video segment, an infrared video, or the like. For example, video interface **259** may be coupled to a digital video camera, a web-camera, or the like. Video interface **259** may comprise a lens, an image sensor, and other electronics. Image sensors may include a complementary metal-oxide-semiconductor (CMOS) integrated circuit, charge-coupled device (CCD), or any other integrated circuit for sensing light.

[0060] Keypad **256** may comprise any input device arranged to receive input from a user. For example, keypad **256** may include a push button numeric dial, or a keyboard. Keypad **256** may also include command buttons that are

associated with selecting and sending images. Illuminator **258** may provide a status indication and/or provide light. Illuminator **258** may remain active for specific periods of time or in response to events. For example, when illuminator **258** is active, it may backlight the buttons on keypad **256** and stay on while the client device is powered. Also, illuminator **258** may backlight these buttons in various patterns when particular actions are performed, such as dialing another client device. Illuminator **258** may also cause light sources positioned within a transparent or translucent case of the client device to illuminate in response to actions.

[0061] Client device **200** also comprises input/output interface **260** for communicating with external devices, such as a headset, or other input or output devices not shown in FIG. **2**. Input/output interface **260** can utilize one or more communication technologies, such as USB, infrared, Bluetooth™, Wi-Fi, Zigbee, or the like. Haptic interface **262** is arranged to provide tactile feedback to a user of the client device. For example, the haptic interface may be employed to vibrate client device **200** in a particular way when another user of a computing device is calling.

[0062] Optional GPS transceiver **264** can determine the physical coordinates of client device **200** on the surface of the Earth, which typically outputs a location as latitude and longitude values. GPS transceiver **264** can also employ other geo-positioning mechanisms, including, but not limited to, triangulation, assisted GPS (AGPS), E-OTD, CI, SAI, ETA, BSS or the like, to further determine the physical location of client device **200** on the surface of the Earth. It is understood that under different conditions, GPS transceiver **264** can determine a physical location within millimeters for client device **200**; and in other cases, the determined physical location may be less precise, such as within a meter or significantly greater distances. In one embodiment, however, a client device may through other components, provide other information that may be employed to determine a physical location of the device, including for example, a MAC address, IP address, or the like.

[0063] Mass memory **230** includes a RAM **232**, a ROM **234**, and other storage means. Mass memory **230** illustrates another example of computer storage media for storage of information such as computer readable instructions, data structures, program modules or other data. Mass memory **230** stores a basic input/output system ("BIOS") **240** for controlling low-level operation of client device **200**. The mass memory also stores an operating system **241** for controlling the operation of client device **200**. It will be appreciated that this component may include a general purpose operating system such as a version of UNIX, or LINUX™, or a specialized client communication operating system such as Windows Mobile™, or the Symbian® operating system. The operating system may include, or interface with a Java virtual machine module that enables control of hardware components and/or operating system operations via Java application programs.

[0064] Memory **230** further includes one or more data storage **244**, which can be utilized by client device **200** to store, among other things, applications **242** and/or other data. For example, data storage **244** may also be employed to store information that describes various capabilities of client device **200**, as well as store an identifier. The information, including the identifier, may then be provided to another device based on any of a variety of events, including being sent as part of a header during a communication, sent upon request, or the like. In one embodiment, the identifier and/or other information about client device **200** might be provided automatically to another networked device, independent of a directed action to do so by a user of client device **200**. Thus, in one embodiment, the identifier might be provided over the network transparent to the user.

[0065] Moreover, data storage **244** may also be employed to store personal information including but not limited to contact lists, personal preferences, data files, graphs, videos, or the like. At least a portion of the information may also be stored on a disk drive or other storage medium (not shown) within client device **200**.

[0066] Applications **242** may include computer executable instructions which, when executed by client device **200**, transmit, receive, and/or otherwise process messages (e.g., SMS, MMS, IM, email, and/or other messages), multimedia information, and enable telecommunication with another user of another client device. Other examples of application programs include calendars, browsers, email clients, IM applications, SMS applications, VOIP applications, contact managers, task managers, transcoders, database programs, word processing programs, security applications, spreadsheet programs, games, search programs, and so forth. Applications **242** may include, for example, messenger **243**, browser **245**, and optional client friend finder (CFF) **246**.

[0067] Browser **245** may include virtually any client application configured to receive and display graphics, text, multimedia, and the like, employing virtually any web based language. In one embodiment, the browser application is enabled to employ Handheld Device Markup Language (HDML), Wireless Markup Language (WML), WMLScript, JavaScript, Standard Generalized Markup Language (SMGL), HyperText Markup Language (HTML), eXtensible Markup Language (XML), and the like, to display and send a message. However, any of a variety of other web based languages may also be employed.

[0068] Messenger **243** may be configured to initiate and manage a messaging session using any of a variety of messaging communications including, but not limited to email, Short Message Service (SMS), Instant Message (IM), Multimedia Message Service (MMS), internet relay chat (IRC), mIRC, and the like. For example, in one embodiment, messenger **243** may be configured as an IM application, such as AOL Instant Messenger, Yahoo! Messenger, .NET Messenger Server, ICQ, or the like. In one embodiment messenger **243** may be configured to include a mail user agent (MUA) such as Elm, Pine, MH, Outlook, Eudora, Mac Mail, Mozilla Thunderbird, or the like. In another embodiment, messenger **243** may be a client application that is configured to integrate and employ a variety of messaging protocols. In one embodiment, messenger **243** may employ various message boxes to manage and/or store messages.

[0069] In either event, a user of client device **200** may employ messenger **243** and/or browser **245** to access a contact list residing, such as might reside in data storage **244**, or the like. In one embodiment, messenger **243** and/or browser **245** might also be configured to enable the user to access a contact list that may be associated with the user residing on a remote network device, such as FFS **106** and/or SS **108** of FIG. **1**.

[0070] CFF **246** represents one embodiment of a client application that may be configured and arranged to enable a user to generate a list of candidate friends based on an analysis of friends' contact lists over a defined degrees of separation. In one embodiment, CFF **246** may provide an interface

to the user to enable finding candidate friends that may be integrated with and/or accessed from messenger **243** and/or browser **245**. In one embodiment, for example, CFF **246** may operate as a configurable plug-in to messenger **243** and/or browser **245**.

[0071] In any event, CFF **246** may be configured to enable a user to identify at least a subset of contacts within their contact list from which to commence the search for candidate friends. In one embodiment, CFF **246** may enable the user to identify a plurality of contact lists from which to start the search. For example, the user may be enabled to identify an email contact list, an IM contact list, as well as other contact lists. Thus, the contacts from which a search may be initiated need not be identified within a single contact list associated with the user.

[0072] In one embodiment, CFF **246** may also enable the user to provide various constraints, or selections, upon the search and/or a display of a result of the search. Thus, the user might be enabled to identify a number of degrees of separation within which the search is to be performed; a threshold on a minimum number of occurrences of each of the common friends identified within a search, an ordering criteria, a desired tag, and/or label useable for grouping results, or the like. The invention, however, is not limited to these examples, and other selections may also be available to the user, without departing from the scope of the invention.

[0073] CFF **246** may then iteratively search each available contact list, starting with those of at least the subset of friends, and continuing over the identified degrees of separation. In one embodiment, the identified degrees of separation may be defaulted to some degree, such as one, two, or the like. However, in another embodiment, the user may provide a degree over which to conduct the search.

[0074] CFF **246** may then generate a list of candidate friends (friends of friends) based on the iterative search. CFF **246** may further order and/or group the resulting candidate friends using any of a variety of ranking or ordering mechanisms, including, but not limited to a most common friends of friends, a diffusion based approach (also called an energy propagation approach), and/or a traversal in a weighted graph approach (also called a weighted energy propagation approach). The list of candidate friends may also be organized or grouped based on available tags, labels, or other available profile information. In this embodiment, the profile information is employed on the determined list of candidate friends to organize or otherwise group them, rather than to search for members of the list. Thus, a presence or lack thereof of profile information is not an impediment to at least one embodiment of the invention. CFF **246** may then provide the ordered and/or grouped list of candidate friends for display to a user. The user may then select to automatically include some or all of the candidate friends into the contact list. Moreover, CFF **246** may enable the user to further contact one or more of the friends in the candidate list. In one embodiment, CFF **246** might be configured to hide at least some information about a candidate friend, to enable privacy protections or the like to be implemented. Thus, in one embodiment, an attempt to communicate with a candidate friend might be performed through CFF **246**, where, for example, a message might be sent to the candidate friend indicating that a user would like to communicate with the candidate and requesting permission, or performing some other authorization mechanism. CFF **246** may

employ processes substantially similar to those described below in conjunction with FIGS. **4-5** to perform at least some of its actions.

[0075] As noted, CFF **246** may employ a variety of ordering mechanisms in preparation for providing the candidate list of friends to the requesting user's display. One embodiment of the most common friends of friends ordering mechanism mentioned above operates, in part, for a candidate U in a candidate set measures how many of friends (or friends of friends, and so on) selected by user Y have user U in their friends' list. This mechanism may then provide a most common friend set of candidate friend ordering.

[0076] Another ordering mechanism mentioned above is the diffusion based approach (or energy propagation approach) FIG. **7** illustrates non-exhaustive examples of contact graphs useable in embodiment for employing ranking mechanisms of candidate friends. In particular, one embodiment of the diffusion based approach, sometimes called an energy propagation model is illustrated in model **700A** of FIG. **7**. In one embodiment of the diffusion based approach, friends are organized by user Y can be activated by an initial energy level E, which is then distributed (in one embodiment, equally) to their friends, and so on. The users in the candidate set having a maximum energy after N iterations (or at equilibrium) are suggested to the user Y in an energy order (e.g., descending or ascending energy order).

[0077] As an illustrative example, as shown in model **700A** of FIG. **7** are contacts A-I. Also shown is a contact list relationship. For example, contact A includes within a contact list, contacts B-E, while contact B includes at least contacts F-G; contact C includes at least H-I; contact D includes at least contact F; and contact E includes at least H. It is clear from above, that contacts B-E may represent all or a subset of contacts from within contact A's contact list, similarly for the other contacts. In one embodiment, the contacts within model **700A** may be identified as having an upstream or downstream relationship with respect to another contact. Thus, for example, contact A has a downstream relationship (one degree of separation) with contacts B, C, D, and E. Similarly, B, C, D, and E each have an upstream relationship with contact A. Likewise, contact F has an upstream relationship with contacts B and D; contact F has an upstream relationship with contacts B and C; contact H has an upstream relationship with contacts C and E; and so forth. Thus, to extend this illustration, contact C has a downstream relationship with contacts G, H, and I.

[0078] In any event, contact A, which may, in one embodiment, represent the requesting user, may be assigned with an initial energy value. In this example, contact A is assigned a constant value or $E_o=1$. However, other values may also be selected. The energy is then equally distributed to contact A's friends (e.g., contacts B-E). As shown, then contacts B-E each are assigned an energy level of 0.25, for this example. The energy of each contact within model **700A** may then be further distributed or propagated. For example, as shown, contact B may then propagate its energy of 0.25 to candidates in the model using an equal distribution. As shown, contact B distributes 0.125 energy to contacts F-G.

[0079] The input energy for a contact is then a sum of energy received. For example, as shown in model **700A**, the energy of contact E, E(G), would be 0.125+0.083=0.208. Energy propagation stops when the energy received by a user is less than some threshold, in one embodiment. However, in another embodiment, energy propagation may stop based on

8

a degree of separation. For example, energy propagation might be stopped at distance D (to a second degree of separation).

[0080] Friends are recommended to the requesting user in an order based on a highest energy contacts have after the propagation is stopped. Thus, in the illustrated example of model 700A, the candidate friends might be ordered as: F(0. 375), H(0.333), G(0.208), I(0.083). In one embodiment, as noted elsewhere, a threshold might be used to display the candidates. Thus, in one embodiment, for example, candidates below some threshold, for example 0.1 might not be displayed in the list of candidate friends. In the example model 700A, contact I would then not be displayed to the requesting user. Other modifications may also be used within the diffusion based approach.

[0081] Another embodiment of an ordering mechanism is the traversal weighted graph. One embodiment of a model is illustrated as model 700B in FIG. 7. In this mechanism, edges of the friends graph can be weighted by a normalized score of an amount of interactions between users and its friends, or by virtually any other criteria. Then, in one embodiment, the diffusion model can be applied to this graph where the energy is disseminated relative to the strength (edge weights) between users.

[0082] Thus, similar to the diffusion based approach, an energy is initially assigned to the initial contact (as shown, contact A). The energy may then be distributed proportional to a weight or strength of relationship of contacts. Thus, for example, in one embodiment, the strength of relationship may be measured by a relative frequency of communications sent by one contact to another contact. For example, in one embodiment, all communications may be used, independent of whether it is an IM communications, email communications, or the like. However, in another embodiment, a subset of communications might be selected, such as IM communications, only, or the like. In this manner, the requesting user might be provided additional capability of selecting friends based on a mode of communications, as well.

[0083] In one embodiment, a weight of contact B for contact might be determined as: weight AB=(number of messages from contact A to contact B)/(Total number of messages sent by contact A to all other contacts in model 700B. Thus, weights of an edge of model 700B may be between, 0 to 1, in one embodiment (other values ranges may also be selected). Also, a sum of weights of all edges from a contact A adds up to 1 (or some other value). The energy propagated from contact A to contact B then equals weight AB*E(A), where E(A) represents an energy for contact A.

[0084] It should be noted, that other specifications, and variations may also be used. For example, in one embodiment, weighting may be implemented that accounts for when communications last occurred. Thus, older communications might receive lower weights than more recent communications, or the like.

[0085] As shown in model 700B, the numbers on the edges (lines) represent the energy transferred through a particular edge. Let's assume then for this example, that contact A sent 2, 14, 2, and 2 communications to contacts B, C, D, and E, respectively. Then the weights of edges AB, AC, AD, and AE would be 0.1, 0.1, 0.7, and 0.1 respectively. If contact A has an initial energy of 1, for example, this would be propagated to contact B based on weight of edge AB, or 1*0.10=0.10. Other edge energy values are shown for illustration. In any event, then based on the example, contact A would receive a list of

candidate friends ordered as: H(0.5), G(0.21), F(0.019), followed by I(0.10). Again, a threshold might be applied that truncates the ordered list.

[0086] As noted, CFF 246 of FIG. 2 may also organize the candidate friends based on a label, tag, or the like. Thus, for example, if a contact's profile information within another's contact list provides a tag, label, or the like. These may be weighted, and/or otherwise used to order or group the candidate list. It should be remembered, however that the candidate list is generated independent of profile information and communication frequency information. Such examples of additional information may be used subsequently, as described above, to order the results.

[0087] Also, while CFF 246 may reside within a client device and access contact lists from any of a variety of sources, the invention is not so constrained. Thus, in another embodiment, such as described below in conjunction with FIG. 3, an application substantially similar to CFF 246 may operate to perform substantially similar actions to CFF 246 from within a remote network device.

Illustrative Network Device Environment

[0088] FIG. 3 shows one embodiment of a network device, according to one embodiment of the invention. Network device 300 may include many more components than those shown. The components shown, however, are sufficient to disclose an illustrative embodiment for practicing the invention. Network device 300 may represent, for example, FFS 106 and/or SS 108 of FIG. 1.

[0089] Network device 300 includes processing unit 312, video display adapter 314, and a mass memory, all in communication with each other via bus 322. The mass memory generally includes RAM 316, ROM 332, and one or more permanent mass storage devices, such as hard disk drive 328, tape drive, optical drive, and/or floppy disk drive. The mass memory stores operating system 320 for controlling the operation of network device 300. Any general-purpose operating system may be employed. Basic input/output system ("BIOS") 318 is also provided for controlling the low-level operation of network device 300. As illustrated in FIG. 3, network device 300 also can communicate with the Internet, or some other communications network, via network interface unit 310, which is constructed for use with various communication protocols including the TCP/IP protocol. Network interface unit 310 is sometimes known as a transceiver, transceiving device, or network interface card (NIC).

[0090] The mass memory as described above illustrates another type of computer-readable media, namely computer storage media. Computer storage media may include volatile, nonvolatile, removable, and non-removable media implemented in any method or technology for storage of information, such as computer readable instructions, data structures, program modules, or other data. Examples of computer storage media include RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by a computing device.

[0091] The mass memory also stores program code and data. For example, mass memory might include data store 354. Data store 354 may be include virtually any mechanism usable for store and managing data, including but not limited

9

to a file, a folder, a document, or an application, such as a database, spreadsheet, or the like. Data store **354** may manage information that might include, but is not limited to web pages, information about members to a social networking activity, contact lists, identifiers, profile information, tags, labels, or the like, associated with a user, as well as scripts, applications, applets, and the like.

[0092]   One or more applications **350** may be loaded into mass memory and run on operating system **320**. Examples of application programs may include transcoders, schedulers, calendars, database programs, word processing programs, HTTP programs, customizable user interface programs, IPSec applications, encryption programs, security programs, VPN programs, web servers, account management, and so forth. Applications **350** may include remote friend finder (RFF) **355**, web services **356**, and Message Server (MS) **358**.

[0093]   Web services **356** represent any of a variety of services that are configured to provide content over a network to another computing device. Thus, web services **356** include for example, a web server, messaging server, a File Transfer Protocol (FTP) server, a database server, a content server, or the like. Web services **356** may provide the content over the network using any of a variety of formats, including, but not limited to WAP, HDML, WML, SMGL, HTML, XML, cHTML, xHTML, or the like. In one embodiment, web services **356** may interact with RSM **355** when a client device requests content.

[0094]   In one embodiment, web services **356** may be configured to provide social networking site content upon request from a client device. However, the information is not so limited and web services **356** may also be configured to provide a variety of other information, without departing from the scope of the invention. In one embodiment, web services **356** may be configured and arranged to enable a user of a client device to access and otherwise manage communications with another user, manage a contact list, and/or request a search for candidate friends be performed. Thus, in one embodiment, web services **356** may be configured with a plug-in, script, webpage, or the like, that enables a user to also access at least some of the functionality of RFF **355**.

[0095]   Message server **354** may include virtually any computing component or components configured and arranged to forward messages from message user agents, and/or other message servers, or to deliver messages to a local message store, such as data store **354**, or the like. Thus, message server **354** may include a message transfer manager to communicate a message employing any of a variety of email protocols, including, but not limited, to Simple Mail Transfer Protocol (SMTP), Post Office Protocol (POP), Internet Message Access Protocol (IMAP), NNTP, or the like.

[0096]   However, message server **354** is not constrained to email messages, and other messaging protocols may also be managed by one or more components of message server **354**. Thus, message server **354** may also be configured to manage SMS messages, IM, MMS, IRC, mIRC, or any of a variety of other message types.

[0097]   In one embodiment, message server **354** and/or web services **356** may enable a user to remotely access and manage contact lists stored in data store **354**. In one embodiment, message server **354** and/or web services **35** may also enable a user to identify portions or all of the contact lists which may be accessible to others and/or to RFF **355** for use in generating a list of candidate friends for another.

[0098]   RFF **355** may operate substantially similar to, albeit different from, CFF **246** of FIG. **2**. Thus, RFF **355** may enable a plurality of users to generate lists of candidate friends, displayable at the requesting user's display device. RFF **355** may also provide one or more interfaces for use within or in conjunction with message server **354** and/or web services **356** to enable a user to request a search, view a result of the search, and/or request communications with at least one candidate friend within the list of candidate friends. Moreover, RFF **355** may provide one or more interfaces to enable the requesting user modify their contact lists with at least some of the candidate friends within the list of candidate friends. RFF **355** may employ processes substantially similar to those described below in conjunction with FIGS. **4-5** to perform at least some of its actions.

Generalized Operation

[0099]   The operation of certain aspects of the invention will now be described with respect to FIGS. **4-5**. FIG. **4** illustrates a logical flow diagram generally showing one embodiment of a process for identifying candidate friends within friends' contact lists. Process **400** of FIG. **4** may be performed within a client device, such as client devices **101-104**, within FFS **106**, and/or within SS **108** of FIG. **1**.

[0100]   As shown, process **400** begins, after a start block, at block **402**, where a user may request a search be performed to provide a list of candidate friends. The invention is not so limited, however, and the search may be initiated based on any of a variety of conditions, events, or the like. Thus, in one embodiment, where a user of a client device indicates an interest in a social networking group, activity, or the like, such event/condition might automatically trigger the search. Similarly, the search could be triggered on a variety of other conditions, including, but not limited, to an upcoming holiday, a promotion by a social networking group, business or the like. The invention is not limited to these mechanisms for triggering the search, and others are also envisaged.

[0101]   In any event, in one embodiment, the requesting user might select at least a subset of contacts or friends from within one or more contact lists with which to initiate the search. In one embodiment, all contacts within the user's contact list(s) might be used. In one embodiment, such as where a social networking group initiates the search, an evaluation of the user's contacts might identify a subset contacts. For example, in one embodiment, at least some of the user's contacts might be identified as members of the social network. Thus, these members could also be used as the initial subset of contacts. In one embodiment, the user might select at least the subset of contacts based on one or more criteria. For example, the user might select the subset because the user knows them to be batchmates, poker players, fly fishers, or virtually any other criteria. Such a selection that would be independent of any stored profile information may then influence a result of the search. For example, it may be anticipated that selection of the initial subset based on some criteria will result in finding candidates that also satisfy the 'implied' criteria. The identified subset of contacts may then be provided to the friend finder service.

[0102]   Processing flows next to decision block **404** where a determination is made whether the user has specified a degree of separation (DoS) over which to conduct the search. In one embodiment, the user might be provided with an interface to enter a value at this juncture. In another embodiment, the user might have configured the search with user preferences prior

to, or at virtually any other time. In any event, if the user has specified a DoS, processing flows to block **406**, where the user's value is used to establish a range for searching. Otherwise, processing flows to block **405**, where a default DoS is employed. In one embodiment, the default value might be 1 or 2, or the like. However, other values may also be established as a default value. In one embodiment, the default value might also be configured as a condition, such that differing DoS are searched until at least a pre-determined number of candidate friends are identified.

[0103] In either instance (block **405** or **406**) process **400** then moves to decision block **408**, where a determination is made whether the user has specified a minimum threshold for inclusion of a candidate friend. If the user has specified a value, processing flows to block **410**, where that value is employed; otherwise, processing flows to block **409**, where a default threshold value is employed. In one embodiment, the default threshold might also be configured as a condition, so as to enable at least some pre-determined number of candidate friends to be identified, or the like.

[0104] After either block **409** or **410**, processing continues to block **412**, where a first set of contact lists are accessed based on the identified subset of friends (or based on subsequent iterations of process **400**). In one embodiment, the contact lists may be specific to contact lists associated with particular communication protocol(s) (IM, SMS, email, or the like). However, in another embodiment, the contact lists might be independent of a communication protocol, such that any available contact lists might be accessed. It is noted, that it is expected that privacy issues, preferences, or the like, might prevent access for searches of a contact's contact list. In one embodiment, a contact might specify that particular contacts within their contact lists are not to be included within a search (or only specified contacts are to be included). Thus, process **400** may be configured to recognize such concerns, and appropriately exclude/include within a search the identified contacts.

[0105] Processing flows next to block **414**, where a recursive search occurs to identify those friends that are also friends of other friends. One embodiment, of a recursive search is illustrated within FIG. **6**.

[0106] Turning briefly to FIG. **6**, a graph **600** structure of contact lists is illustrated. Graph **600** may include many more or less components than those shown in FIG. **6**. However, the components shown are sufficient to disclose an illustrative embodiment for practicing the present invention. As shown, graph **600** includes a partial contact list for contacts A, B, C, D, E, O, P, W, X, X1, X4, X5, Y1, Z, and Z1. Contact lists for contacts B, D, O, C, E, and P may be considered to be at a first degree of separation from contact A. Thus, as shown, contacts B, D, O, C, E, and P are identified within contact A's contact list. Similarly, contacts W, Z, Z1, X, and Y1 may be considered to be at a second degree of separation from contact A, as they do not appear within contact A's contact list, but do appear within those contacts within contact A's contact list. Similarly, contacts X1, X4, and X5 represent third degree of separation contacts to contact A. Again, graph **600** merely represents a non-exhaustive example of possible contact relationships based on membership within at least one contact list. Graph **600** therefore, should not be construed as limiting the scope of the invention in any manner, and other structures may also be employed, without departing from the scope of the invention.

[0107] As shown, assume contact A represents the requesting user, and has further selected a subset of contact: B, C, D, E, O, and P. At block **414** of FIG. **4**, a search is performed upon the contact lists of the subset of contacts to identify common friends. Using the graph **600** of FIG. **6**, those contacts having more than one friend in common would then be: W (4), X(3), Y(2), Z(3), and Y1(2, where the number in parenthesis indicates a number of other contacts that contact is found to be in common. Thus, if the process was to conclude at a first DoS, in one embodiment, this might be the list of candidate friends.

[0108] Processing continues, however, to decision block **416**, where a determination is made whether the identified DoS from block **405** or **406** is exceeded. If not, then processing moves to block **418**, wherein the next level of DoS is to be searched is identified. Processing then loops back to blocks **412** and **414** to search the next level. In the example of FIG. **6**, then contact lists W, X, Y, Z, Y, and Y1 might be searched. A result of which is incompletely illustrated within FIG. **6**. However, for purposes of explanation, it may be seen that contacts X1, X2, X4, and X5 are found to be in common between 2, 2, 3, 2, and 4 other contacts, respectively. If this were where the process **400** was to terminate, then the list of candidate friends might further include at least some of these contacts (based on a threshold setting). Similarly, the process might again loop back and continue until the DoS identified is reached.

[0109] If it is determined at decision block **416**, that the identified DoS are exceeded, processing flows to block **420**, where an ordering mechanism is selected. In one embodiment, the mechanism might include at least any of those described above. In one embodiment, a default ordering mechanism might be identified. Because ordering may, in one embodiment, be an option, in another embodiment, blocks **420** and **422** may be optional.

[0110] However, where blocks **420** and **422** are performed, processing flows to block **422** to perform the selected ordering of the list of candidates. One embodiment of block **422** is described in more detail in conjunction with FIG. **5**.

[0111] Processing then flows to block **424** where the candidate friends may then be displayed to the requesting user. In one embodiment, the requesting user may then add one or more candidate friends to a contact list, and/or attempt to contact one or more of the candidate friends. As noted above, due to privacy reasons, in at least one embodiment, the request to communicate might be sent through an agent, through a friend of the candidate friend, or the like, where at any point, a recipient might select not to respond, respond by refusing to communicate, or perform any of a variety of other actions. Process **400** may then return to a calling process to perform other actions.

[0112] Thus, as may be seen from above, the process of identifying candidate friends is performed independent of profile information, a number of communications, or the like, between contacts, thereby providing a higher likelihood that at least one friend of a friend may be identified. Such approach may also be performed more quickly than traditional mechanisms that may require determining profile information, a number of communications, or the like.

[0113] FIG. **5** illustrates a logical flow diagram generally showing one embodiment of a process for ranking for display candidate friends. However, the invention is not limited to these mechanisms.

[0114] Process **500** of FIG. **5** begins, after a start block, at decision block **502**, where a determination is made whether to rank/organize the list of candidate friends obtained through process **400** using a most common friend of friend mechanism. If so, processing flows to block **503**; otherwise, processing flows to decision block **504**.

[0115] At block **503**, the list of candidate friends may be ordered based on a most common friend of friends. Thus, using FIG. **6** as an example, candidate friends might be ordered, based on a first DoS search as: W, X, Z, then Y and Y1. Where the numbers are the same (e.g., such as for contacts X and Z), the order may be selected based on other criteria, such as alphabetical, geographic proximity from the requesting user, or the like. Processing then branches to block **508**.

[0116] At decision block **504**, a determination is made whether to rank/organize the list of candidate friends using a diffusion based approach, such as described above. If a diffusion based approach is to be used, processing flows to block **505** to rank using the diffusion approach. Using FIG. **7**, graph **700A**, a candidate list for that example would be ordered as: F(0.375), H(0.333), G(0.208), and then I(0.083). Processing then branches to block **508**.

[0117] If at decision block **504**, the diffusion based approach is not to be used, then in one embodiment, processing may flow to block **506**, where a weighted energy propagation approach is used. Using FIG. **7**, graph **700B**, a candidate list for that example would be ordered as: H(0.5), G(0.21), F(0.19), then I(0.1). Processing then flows to block **508**.

[0118] At block **508**, the list of ordered candidates may be further trimmed by inhibiting a display of those candidates that fall below the minimum threshold. For example, using FIG. **7**, graph **700A**, where, for example, the threshold is set to 0.1, then I(0.083) would not be displayed to the requesting user. Similarly, for graph **700B**, with the threshold at 0.1, all of contacts H, G, F, and contact I would be displayed to the requesting user.

[0119] Processing then may flow to block **510**, where if available, tags, labels, or other profile information about a contact within the list of candidate friends, might be useable to further group or organize the candidate friend list. For example, if several of the candidate friends have a tag, or other identifier indicating a same school, employer, or the like, such information might also be useable to group candidate friends. In any event, block **510** may be an optional block that may be used in addition to and/or as a replacement to one of the other sorting approaches described above. Processing then returns to a calling process to perform other actions.

[0120] It will be understood that each block of the flowchart illustration, and combinations of blocks in the flowchart illustration, can be implemented by computer program instructions. These program instructions may be provided to a processor to produce a machine, such that the instructions, which execute on the processor, create means for implementing the actions specified in the flowchart block or blocks. The computer program instructions may be executed by a processor to cause a series of operational steps to be performed by the processor to produce a computer implemented process such that the instructions, which execute on the processor to provide steps for implementing the actions specified in the flowchart block or blocks. The computer program instructions may also cause at least some of the operational steps shown in the blocks of the flowchart to be performed in parallel. Moreover, some of the steps may also be performed across more

than one processor, such as might arise in a multi-processor computer system. In addition, one or more blocks or combinations of blocks in the flowchart illustration may also be performed concurrently with other blocks or combinations of blocks, or even in a different sequence than illustrated without departing from the scope or spirit of the invention.

[0121] Accordingly, blocks of the flowchart illustration support combinations of means for performing the specified actions, combinations of steps for performing the specified actions and program instruction means for performing the specified actions. It will also be understood that each block of the flowchart illustration, and combinations of blocks in the flowchart illustration, can be implemented by special purpose hardware-based systems which perform the specified actions or steps, or combinations of special purpose hardware and computer instructions.

[0122] The above specification, examples, and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

What is claimed as new and desired to be protected by Letters Patent of the United States is:

1. A processor readable storage medium that includes data and instructions, wherein the execution of the instructions on a computing device provides for managing social networking relationships over a network by enabling actions, comprising:

receiving a list of contacts within at least one contact list associated with a requesting user;

receiving access to a plurality of contact lists, each contact list within the plurality of contacts lists being associated with a different contact within the received list of contacts;

searching within the plurality of contact lists to identify a list of candidate friends wherein each candidate friend is identified as a contact within in at least two contact lists within the plurality of contact lists, independent of use of profile information;

ordering the list of candidate friends; and

providing the ordered list of candidate friends to the requesting user.

2. The processor readable storage medium of claim **1**, wherein ordering the list of contacts further comprises:

determining an initial energy for the requesting user;

propagating the initial energy through a graph generated from the list of candidate friends, wherein the graph is based on a relationship of friends within contact lists, and wherein the propagation of the energy results in an equal distribution between friends of a friend within the graph;

determining a total energy for a friend based on a sum of energy received from upstream friends within the graph; and

sorting the list of candidate friends based on the total energy for each friend within the list of friends.

3. The processor readable storage medium of claim **2**, wherein the energy that is propagated is weighted based on at least one of a number of communications from an upstream friend to a downstream friend in the graph.

4. The processor readable storage medium of claim **1**, wherein the execution of the instructions enable actions, further comprising:

receiving a request from the requesting user to communicate with at least one contact within the ordered list of contacts;

sending an invite to the at least one contact indicating that the requesting user would like to initiate a communications; and

if the at least one contact indicates a consent, enabling a communications between the requesting user and the at least one contact to proceed.

5. The processor readable storage medium of claim **1**, wherein the execution of the instructions enable actions, further comprising:

employing the list of candidate friends to identify another plurality of contact lists, wherein each contact list in the other plurality is associated with different friends within the list of candidate friends; and

searching within the other plurality of contact lists to identify additions to the list of candidate friends wherein each additional candidate friend is identified as a contact within in at least two contact lists within the other plurality of contact lists.

6. The processor readable storage medium of claim **1**, wherein searching the plurality of contact lists is performed recursively by replacing contact lists within the plurality of contact lists with contact lists associated with friends within the list of candidate friends, and wherein the recursive search is performed until a determined degree of separation is exceeded.

7. A method for managing a social networking relationships over a network, comprising:

receiving a list of contacts from within an initial contact list;

determining a degree of separation over which to perform a search for a list of candidate friends;

recursively performing the following until the determined degree of separation is exceeded:

searching contact lists, where each contact list is associated with one of the contacts within the list of contacts, to identify the list of candidate friends by adding to the list of candidate friends any contact that is in at least two contact lists, wherein the two contact lists are associated with different contacts within the list of contacts;

accessing contact lists associated with each added contact within the list of candidate friends; and

updating the list of contacts based on the added contacts to the list of candidate friends;

ordering the list of candidate friends; and

displaying the list of candidate friends to a user, such that the user is enabled to seek communications with at least one candidate friend within the list of candidate friends.

8. The method of claim **7**, wherein ordering the list of candidate friends is achieved using a weighted energy propagation mechanism, wherein the weighting is based on at least one of a number of communications by a first contact to a second contact, or a time in which a communications occurred between contacts.

9. The method of claim **7**, wherein the recursive search is independent of profile information associated with a contact within a contact list.

10. The method of claim **7**, wherein ordering the list of candidate friends further comprises truncating display of the list by inhibiting display of a candidate friend having a value

less than a threshold value, wherein the value represents at least a number of friends having the candidate friend in their respective contact lists.

11. The method of claim **7**, wherein ordering the list of candidate friends further comprises organizing the list based on available tags associated with each candidate friend within the list of candidate friends.

12. A network device to manage a social networking interaction over a network, comprising:

a transceiver to send and receive data over a network; and

a processor that is operative to perform actions, comprising:

receiving a list of contacts from within an initial contact list from a requesting user;

determining a degree of separation over which to perform a search for a list of candidate friends;

recursively performing the following until the determined degree of separation is exceeded:

searching contact lists, where each contact list is associated with one of the contacts within the list of contacts, to identify the list of candidate friends by adding to the list of candidate friends any contact that is in at least two contact lists, wherein the two contact lists are associated with different contacts within the list of contacts;

accessing contact lists associated with each added contact within the list of candidate friends; and

updating the list of contacts based on the added contacts to the list of candidate friends;

ordering the list of candidate friends; and

displaying the list of candidate friends to the requesting user, such that the requesting user is enabled to seek communications with at least one candidate friend within the list of candidate friends.

13. The network device of claim **13**, wherein ordering the list of candidate friends is performed based on a most common friend of friend ordering.

14. The network device of claim **13**, wherein displaying the list of candidate friends further comprises inhibiting display of candidate friends within the list having an associated value less than a threshold.

15. The network device of claim **13**, wherein at least one contact list includes at least one contact that is identified as being excluded from the searching.

16. The network device of claim **13**, wherein the requesting user is enabled to seek communications further comprises proxying a communication to the at least one candidate friend from the requesting user, such that the requesting user is unable to communicate with the at least one candidate friend directly, until the at least one candidate friend provides authorization.

17. A mobile device for enabling a communications within a social network over a network, comprising:

a memory arranged to store data and instructions;

an input interface for receiving requests and sending responses; and

a processor arranged to enable actions embodied by at least a portion of the stored instructions, the actions comprising:

receiving a list of contacts from within an initial contact list;

determining a degree of separation over which to perform a search for a list of candidate friends;

recursively performing the following until the determined degree of separation is exceeded:

searching contact lists, where each contact list is associated with one of the contacts within the list of contacts, to identify the list of candidate friends by adding to the list of candidate friends any contact that is in at least two contact lists, wherein the two contact lists are associated with different contacts within the list of contacts;

accessing contact lists associated with each added contact within the list of candidate friends; and

updating the list of contacts based on the added contacts to the list of candidate friends;

ordering the list of candidate friends; and

displaying the list of candidate friends to a user, such that the user is enabled to seek communications with at least one candidate friend within the list of candidate friends.

18. The mobile device of claim 17, wherein the searching of contact lists further comprises performing the searching of at least one contact list residing on another mobile device.

19. The mobile device of claim 17, wherein ordering the list of candidate friends further comprises employing at least one of a most common friend of friends ordering, a diffusion based ordering, a weighted energy propagation ordering, or an ordering based on available profile information.

20. The mobile device of claim 17, wherein at least two contact lists are associated with a same contact, and wherein the two contact lists is associated with different communication mechanisms.

* * * * *