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(54) **CLOUD-BASED PRINT SERVICE**

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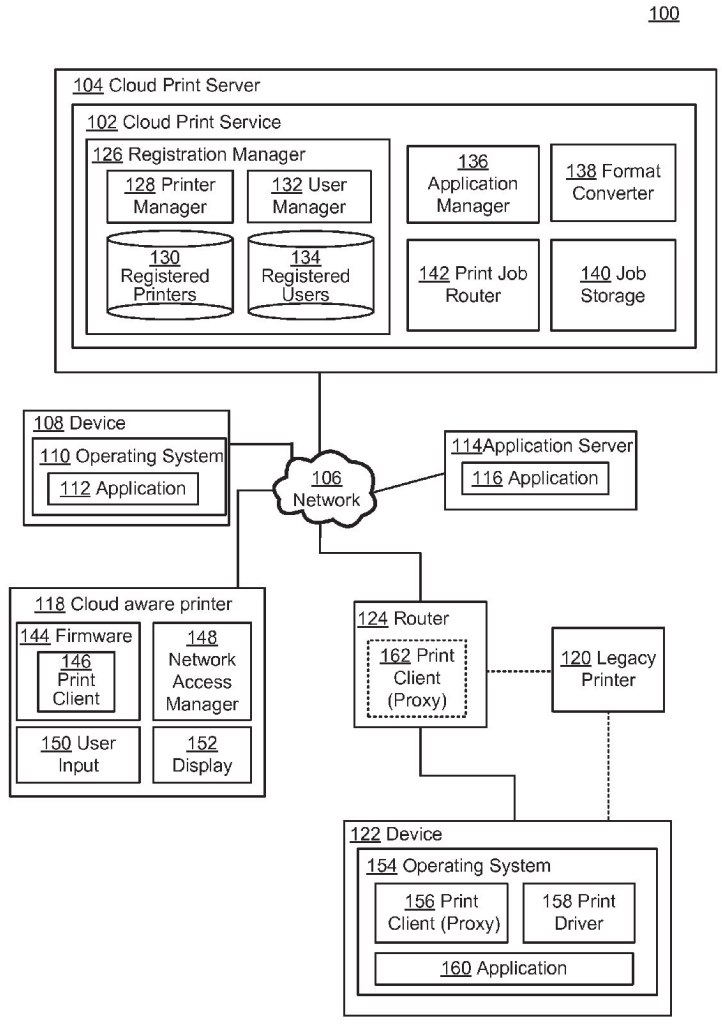
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(57) **ABSTRACT**

A print server may include an application manager configured to receive a print request over a network from an application executing on a device, and configured to provide, over the network, a print dialog to a user of the application, the print dialog configured to provide for a selection of at least one printer associated with a user account of the user and thereafter receive a selected printer from the selection. A format converter may be configured to receive a print job designating the selected printer, the print job including print data and print characteristics expressed in a first format, and configured to convert the print job from the first format into a printer-specific format associated with the selected printer. A print job router may be configured to route the print job over the network from the print server to a print client associated with the selected printer, for printing by the selected printer, using the printer-specific format.



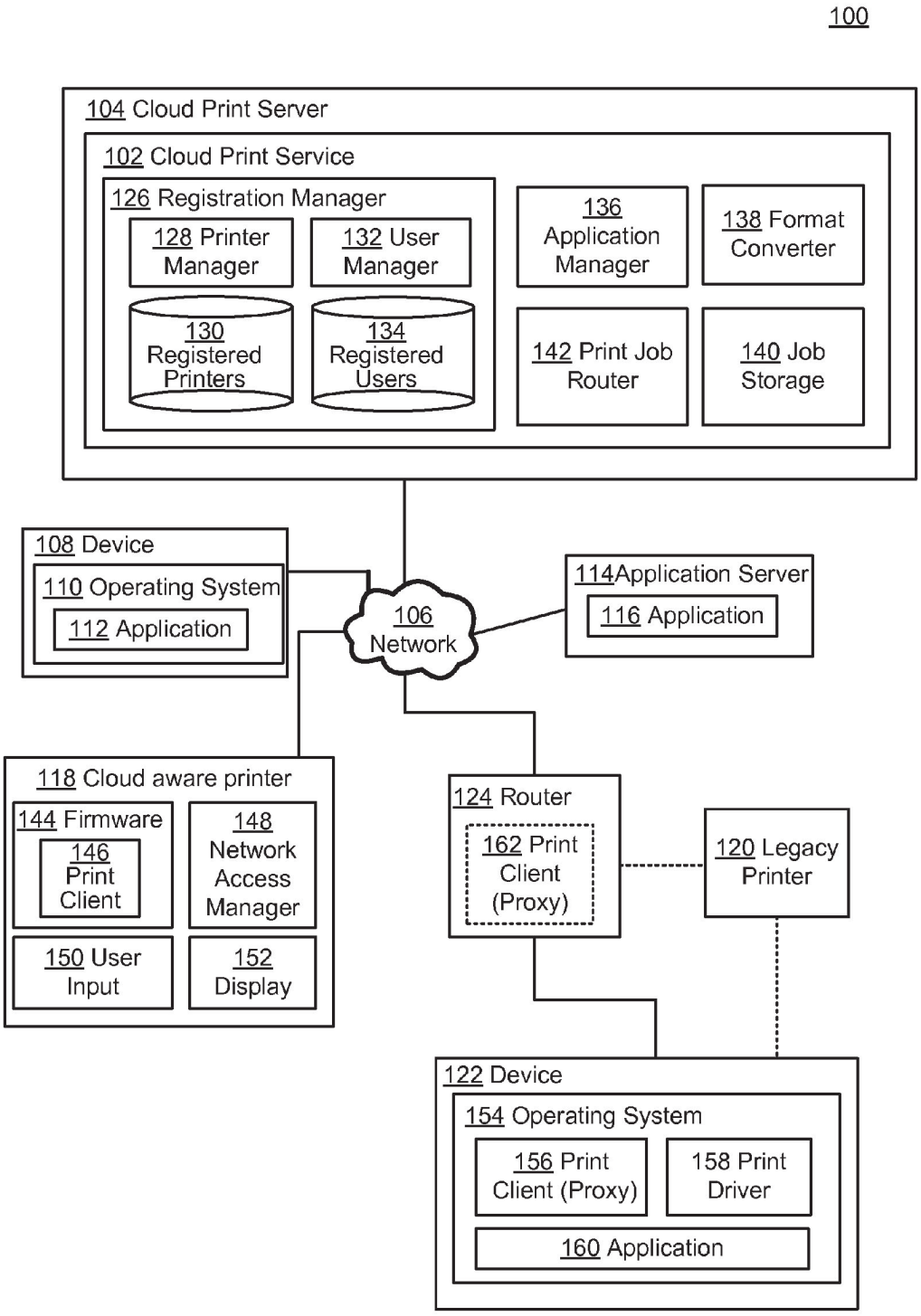

100
104 Cloud Print Server
102 Cloud Print Service
126 Registration Manager
128 Printer Manager
132 User Manager
130 Registered Printers
134 Registered Users
136 Application Manager
138 Format Converter
142 Print Job Router
140 Job Storage
108 Device
110 Operating System
112 Application
106 Network
114Application Server
116 Application
118 Cloud aware printer
144 Firmware
146 Print Client
148 Network Access Manager
150 User Input
152 Display
124 Router
162 Print Client (Proxy)
120 Legacy Printer
122 Device
154 Operating System
156 Print Client (Proxy)
158 Print Driver
160 Application

FIG.1

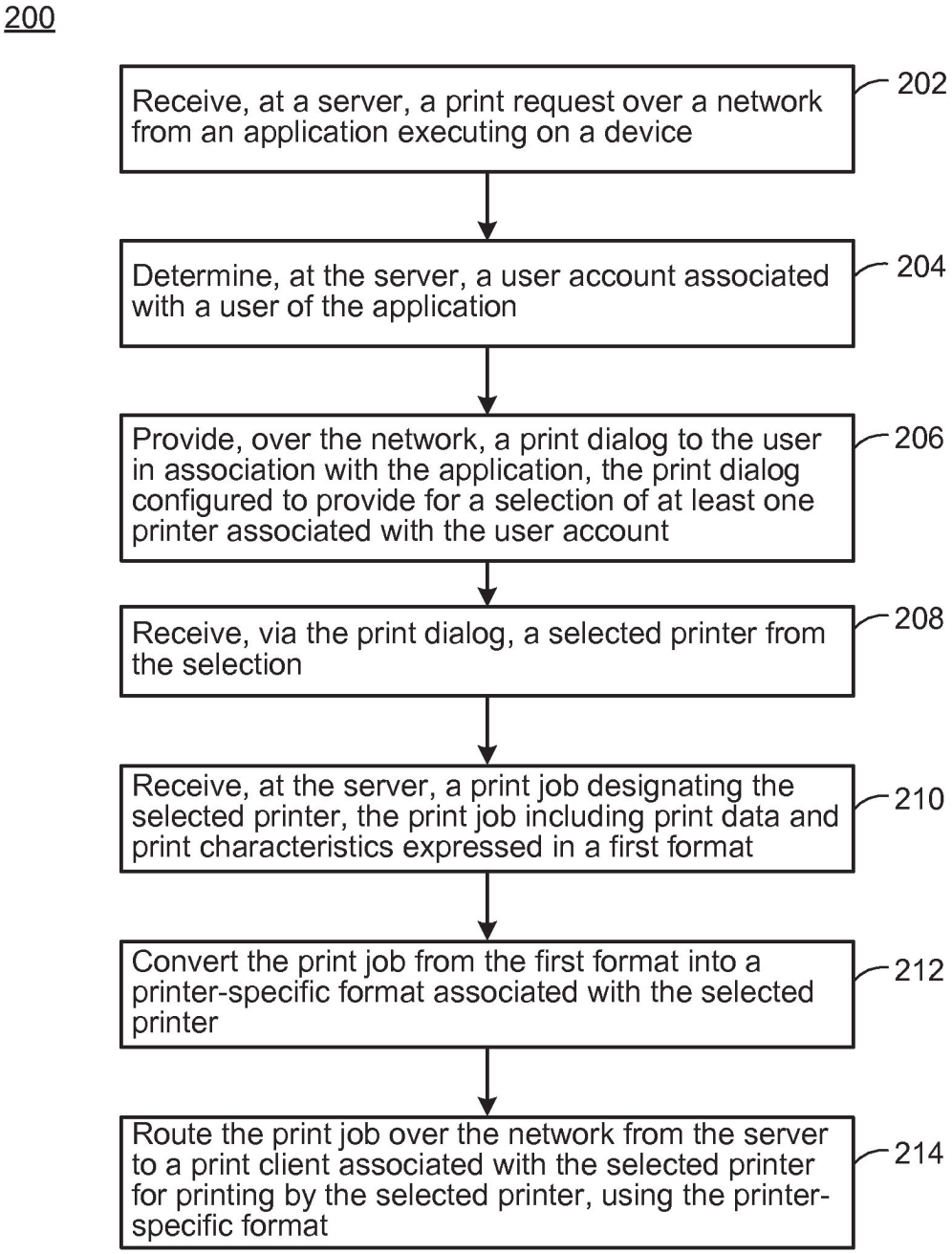

200
Receive, at a server, a print request over a network from an application executing on a device
202
Determine, at the server, a user account associated with a user of the application
204
Provide, over the network, a print dialog to the user in association with the application, the print dialog configured to provide for a selection of at least one printer associated with the user account
206
Receive, via the print dialog, a selected printer from the selection
208
Receive, at the server, a print job designating the selected printer, the print job including print data and print characteristics expressed in a first format
210
Convert the print job from the first format into a printer-specific format associated with the selected printer
212
Route the print job over the network from the server to a print client associated with the selected printer for printing by the selected printer, using the printer-specific format
214

FIG.2

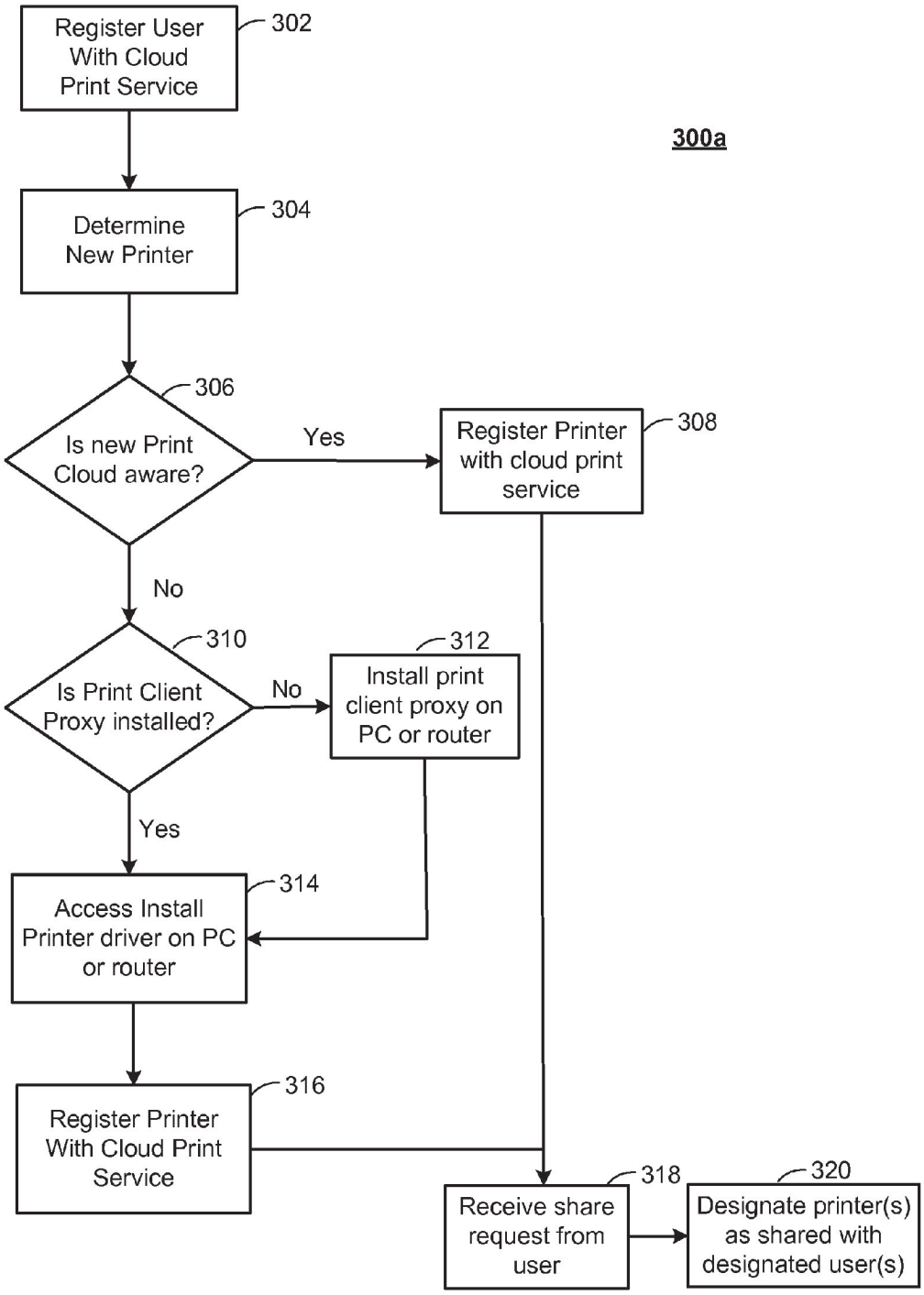

Register User With Cloud Print Service
302
300a
Determine New Printer
304
306
Is new Print Cloud aware?
Yes
Register Printer with cloud print service
308
No
310
Is Print Client Proxy installed?
No
312
Install print client proxy on PC or router
Yes
314
Access Install Printer driver on PC or router
316
Register Printer With Cloud Print Service
318
Receive share request from user
320
Designate printer(s) as shared with designated user(s)

Fig.3A

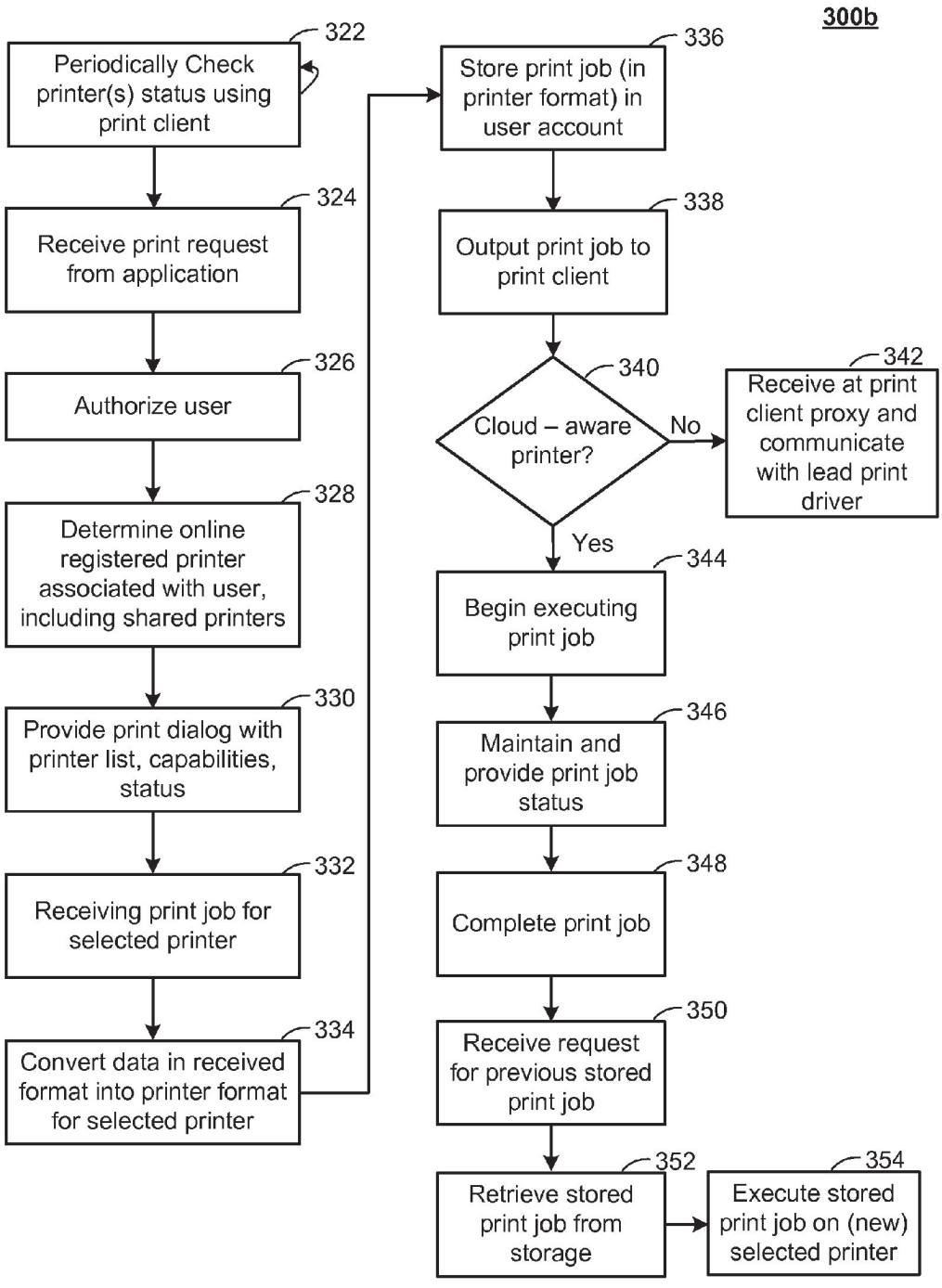

300b
322
Periodically Check printer(s) status using print client
324
Receive print request from application
326
Authorize user
328
Determine online registered printer associated with user, including shared printers
330
Provide print dialog with printer list, capabilities, status
332
Receiving print job for selected printer
334
Convert data in received format into printer format for selected printer
336
Store print job (in printer format) in user account
338
Output print job to print client
340
Cloud – aware printer?
No
342
Receive at print client proxy and communicate with lead print driver
Yes
344
Begin executing print job
346
Maintain and provide print job status
348
Complete print job
350
Receive request for previous stored print job
352
Retrieve stored print job from storage
354
Execute stored print job on (new) selected printer

Fig.3B

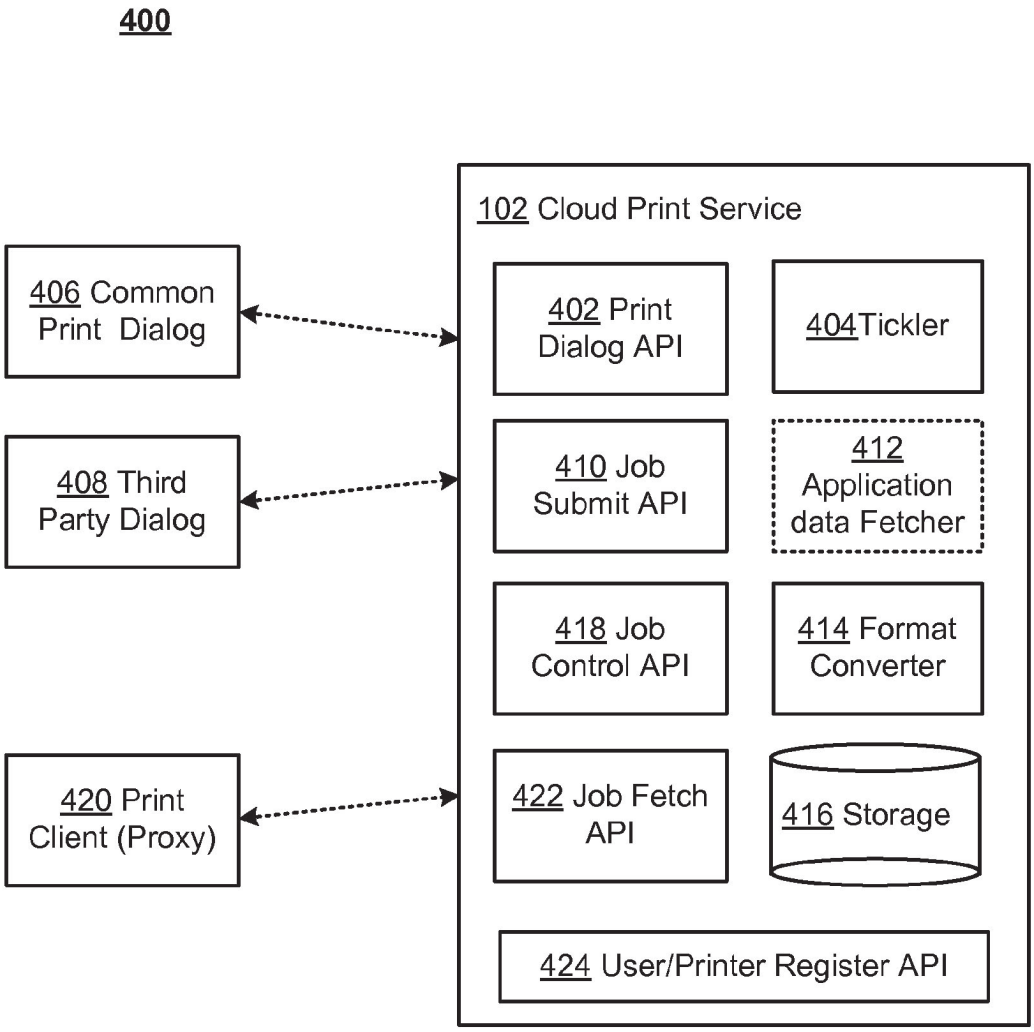

400
102 Cloud Print Service
406 Common Print Dialog
408 Third Party Dialog
420 Print Client (Proxy)
402 Print Dialog API
404Tickler
410 Job Submit API
412 Application data Fetcher
418 Job Control API
414 Format Converter
422 Job Fetch API
416 Storage
424 User/Printer Register API

FIG.4

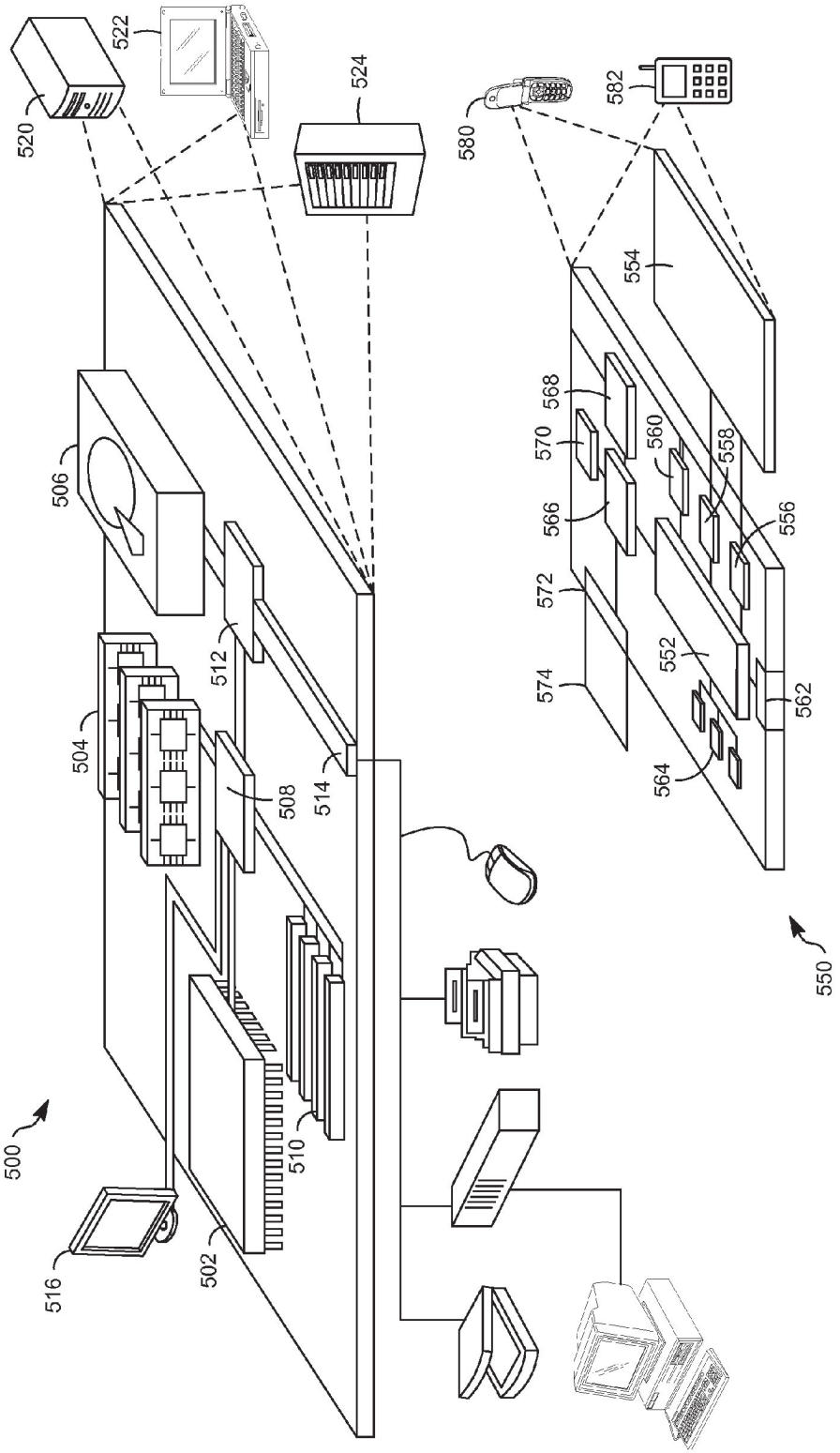

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FIG. 5

CLOUD-BASED PRINT SERVICE

TECHNICAL FIELD

[0001] This description relates to printing.

BACKGROUND

[0002] An ability to print within a computing environment generally ranges from desirable to indispensable. Conventional printers, and associated printing techniques, typically involve installation of a print driver within the context of an operating system or platform of an associated computer. The print driver is generally specific to the associated (type of) printer, and to the operating system, and enables applications running in the context of the operating system to communicate with (e.g., send print jobs to) the printer.

[0003] Thus, in an example user experience, an owner of a computer running a particular operating system purchases a printer, and then installs a version of the printer driver associated with the user's operating system onto the computer. In other example scenarios, a printer (i.e., associated printer driver) may be installed in the context of a network. In the latter scenario(s), it is possible to share the installed printer among multiple network users. For example, a local computer executing an application, operating system, and printer driver, may print from the application to a remote printer, using an intermediary print server. Somewhat similarly, an application may execute on a remote device, and the operating system and printer driver may be installed on the remote device, as well. Then, a user may experience or use the remotely-executing application at a local computer (e.g., in a remote desktop or other virtual computing environment), and may print to a local or remote printer which receives commands from the remotely-installed printer driver.

[0004] The above-referenced paradigm for printing generally uses, for each (type of) printer, a print driver for each operating system/platform from which printing may occur. Consequently, it may be difficult for printer manufacturers to generate and maintain such print drivers for all available operating systems/platforms, and, even to the extent to which printer manufacturers are successful in doing so, it may be difficult for individual and/or network users to be aware of, identify, obtain, or otherwise implement an appropriate driver (s) (or associated updates).

[0005] Further, it may occur that a particular operating system/platform does not support a particular print driver, or any print driver at all. For example, operating systems designed to run in resource-limited environments, such as mobile devices (e.g., netbooks or smartphones), may have limited or no resources to execute a print driver. As a result, it may be difficult or impossible for applications running on such devices, or running remotely for use on such devices, to print in a satisfactory manner.

[0006] Similarly, network applications (e.g., "web applications") exist in which an application executes on a remote server while being used by a user on a local machine, e.g., using a browser or other client-side user interface. Such applications allow users to benefit from the use thereof, without requiring local installation (and associated depletion of local hardware resources). Printing documents associated with such applications is typically problematic, and often requires an initial conversion of such documents into a standardized format (e.g., the portable document format, or ".pdf") before printing can proceed in a reliable or predictable fashion.

[0007] In short, conventional printers and printing paradigms often provide a fragmented, expensive, resource-intensive, potentially unpredictable user experience which is suboptimal at best and unworkable at worst for many users.

SUMMARY

[0008] According to one general aspect, a print server may include instructions stored on a computer-readable medium, and the print server may include an application manager configured to receive a print request over a network from an application executing on a device, and configured to provide, over the network, a print dialog to a user of the application, the print dialog configured to provide for a selection of at least one printer associated with a user account of the user and thereafter receive a selected printer from the selection. The print server may include a format converter configured to receive a print job designating the selected printer, the print job including print data and print characteristics expressed in a first format, and configured to convert the print job from the first format into a printer-specific format associated with the selected printer, and a print job router configured to route the print job over the network from the print server to a print client associated with the selected printer, for printing by the selected printer, using the printer-specific format.

[0009] According to another general aspect, a computer-implemented method may include receiving, at a server, a print request over a network from an application executing on a device, determining, at the server, a user account associated with a user of the application, providing, over the network, a print dialog to the user in association with the application, the print dialog configured to provide for a selection of at least one printer associated with the user account, receiving, via the print dialog, a selected printer from the selection, receiving, at the server, a print job designating the selected printer, the print job including print data and print characteristics expressed in a first format, converting the print job from the first format into a printer-specific format associated with the selected printer, and routing the print job over the network from the server to a print client associated with the selected printer for printing by the selected printer, using the printer-specific format.

[0010] According to another general aspect, a computer program product may include a cloud print service that is tangibly embodied on a computer-readable medium and may include executable code that, when executed, is configured to cause a data processing apparatus to receive, at the cloud print service, a print request over a network from an application executing on a device, provide, over the network, a print dialog association with the application, the print dialog configured to provide for a selection of at least one printer, receive, via the print dialog, a selected printer from the selection, receive, at the cloud print service, a print job designating the selected printer, the print job including print data and print characteristics expressed in a first format, convert, using the cloud print service, the print job from the first format into a printer-specific format associated with the selected printer, and route the print job over the network from the cloud print service to a print client associated with the selected printer for printing by the selected printer, using the printer-specific format.

[0011] According to another general aspect, a cloud-aware printer may include a network access manager configured to execute communications over a network between the cloud-aware printer and a cloud print service being executed on a

cloud print server, and a print client configured to execute a print job originating from an application executing on a device that is on the network, the print job being received from the cloud print service via the network access manager.

[0012] The details of one or more implementations are set forth in the accompanying drawings and the description below. Other features will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. **1** is a block diagram of a system for implementing a cloud print service.

[0014] FIG. **2** is a flowchart illustrating example operations of the system of FIG. **1**.

[0015] FIGS. **3**A and **3**B are flowcharts illustrating more detailed and/or specific more specific examples of the operation of system of FIG. **1**.

[0016] FIG. **4** is a block diagram of a more detailed example of an implementation of a cloud print service of FIG. **1**.

[0017] FIG. **5** is a block diagram showing example or representative computing devices and associated elements that may be used to implement the systems and methods of FIGS. **1-4**.

DETAILED DESCRIPTION

[0018] FIG. **1** is a block diagram of a system **100** for implementing a cloud print service **102**. As shown in the example of FIG. **1**, the cloud print service **102** may be executed on a cloud print server **104** which provides printing capabilities over a network **106**. As described in detail below, the cloud print service **102** therefore provides a user with a uniform printing experience which is platform-independent and which unburdens the user of the need to configure, update, or otherwise maintain or oversee printer operations. Various other features and advantages of the cloud print service **102** are described in detail below, and/or would be apparent.

[0019] In FIG. **1**, a device **108** is illustrated as an example of virtually any computing device from which a user may wish to execute a print job. By way of non-limiting example, then, the device **108** may include a laptop or desktop computer, a netbook, a tablet computer, a smartphone, a camera, or any device which may store or have access to data which the user may desire to print.

[0020] In the example of FIG. **1**, an operating system **110** is illustrated as executing an application **112**. Again, these elements are included by way of illustration and example, and may include virtually any operating system or other platform on which virtually any application may run. For example, the operating system **110** may include operating systems such as the Windows operating system, Mac OS, or Linux, and may include mobile platforms such as Android, Symbian, or iPhone OS, to name a few examples. In other examples, the operating system **110** may include a browser-based operating system, such as the Chrome OS.

[0021] Consequently, the application **112** may include virtually any application which may run on any underlying operating system or platform. Examples of such applications are well-known and too numerous to mention in any detail, but generally include document processing applications, email applications, image editing or presentation software, a web browser, or virtually any application which provides the user with a rendering of data which the user may wish to print.

[0022] In particular, as referenced above, the application **112** may represent a web application which executes on a remote application server **114** as application **116**. That is, the application **116** may include any application functionality which is accessed by the user over the network **106** and experienced locally as the application **112**, e.g., using a browser running at the device **108**. As is known, such web applications allow an owner of the application server **114** to assume responsibility for installing, configuring, executing, and maintaining the application **116** at the application server **114**, so that the user of the device **108** may obtain the benefit of the application **116** without many or any of the associated costs and responsibilities. Techniques for executing such a web application, and related technology, are well known in the art and are therefore not described further in detail herein, except as may be helpful or necessary to understand operations of the system **100** of FIG. **1**.

[0023] The network **106** may thus represent, for example, the public Internet or other wide area public or private network. The network **106** may represent, in further examples, a corporate or other intranet, and/or a smaller-scale, local or personal network, any of which may be implemented using standard network technology.

[0024] Further in FIG. **1**, a cloud-aware printer **118** is illustrated which is configured to communicate with the cloud print service **102** over the network **106**. In this regard, the term "cloud" or "cloud-aware" references the use of "cloud computing," which, generally speaking, includes a style of computing in which computing resources such as application programs and file storage are remotely provided over a network such as the Internet, typically through a web browser. For example, many web browsers are capable of running applications, which can themselves be application programming interfaces ("API's") to more sophisticated applications running on remote servers. In the cloud computing paradigm, a web browser interfaces with and controls an application program that is running on a remote server. Through the browser, the user can create, edit, save and delete files on the remote server via the remote application program. Thus, it may be observed that the application server **114** and associated application **116** may also represent examples of cloud computing.

[0025] In the context of the cloud-aware printer **118**, the cloud print service **102** enables the application **112** to print directly to the cloud-aware printer **118**, without a requirement or need for (e.g., independently of), involvement of the operating system **110**. In other words, the application **112** may communicate directly with the cloud print service **102** to thereby print to the cloud-aware printer **118**, without e.g., requiring a local driver within the operating system **110**. As a result, virtually any application **112** that may be configured to communicate with the cloud print service **118** may make use of the cloud-aware printer **118**, as described in detail, below.

[0026] For example, the cloud print service **102** may be configured to register the user and/or the device **108**, as well as the cloud-aware printer **118**. In a specific example, the device may be a smartphone, and the user may use the application **112** to purchase a ticket (e.g., a movie ticket, or an airline ticket). Then, the user may print the purchased ticket directly to the cloud-aware printer **118**, even though the device **108** and/or the operating system **110** may not have the resources, or otherwise be configured, to support native printing in a conventional sense (e.g., may not currently be executing a print driver of any sort associated with the cloud-aware

printer **118**). In this way, the user of the application **112** may be provided with a print option and associated abilities that are not currently provided in conventional printing paradigms and techniques. Many other such examples are described herein, or would be apparent.

[0027] The cloud-aware printer **118** may be contrasted with a legacy printer **120**, which does not natively support communication with the cloud print service **102**. Therefore, to illustrate additional or alternative examples of implementations of the system **100** of FIG. **1**, a separate device **122** is illustrated, which, as described below, may be modified to impart the advantages of the cloud print service **102** to the legacy printer **120**. Similarly, a router **124** may additionally or alternatively be modified to thereby enable the legacy printer **120** to participate in the cloud printing paradigm defined by the operations of the cloud print service **102**, as described in detail below.

[0028] In short, the system **100** provides an ability for virtually any application running on any device within the network **106** (e.g., the applications **112**, **116** and devices **108**, **120**) to communicate with the cloud print service **102** to thereby print to any printer which is also in (direct or indirect) communication with the cloud print service **102**. Consequently, users may benefit from increased printing options and abilities, and experience an overall decrease in the costs and efforts associated with doing so. Meanwhile, printer manufacturers may experience a decreased or eliminated need to provide users with the (updated) driver(s) and other prerequisites for users to fully experience the benefits of their products. This may result in, for example, higher customer satisfaction, and a decreased cost of producing and maintaining printers.

[0029] In more detail, the cloud print service **102** includes a registration manager **126**, which may be configured to register printers and users. As shown, then, a printer manager **128** may be configured to receive a registration of the cloud-aware printer **118** and/or the legacy printer **120**, including storing identification information therefore within a data store **130** of registered printers. Similarly, a user manager **132** may be configured to register a user(s) who may currently or potentially wish to execute print jobs using the cloud print service **102**, and to store identification information for such users within a data store **134** of registered users.

[0030] There are many example scenarios and techniques by which users and/or printers may come to be registered with the cloud print service **102** through the registration manager **126**, many of which are described below in detail, e.g., with respect to FIG. **3**A. In general, for example, a user of the device **108** may use a browser to visit a website associated with the cloud print service **102**, and may enter a username/password combination to establish a user account with the print service.

[0031] In other examples, such users already may have a user account with a separate and possibly related service or service provider. For example, various online services (e.g., other cloud-based computing resources) may provide functionality such as email, data storage, and document processing, and, in such cases, a user already may have a secure user account established in connection therewith. In such cases, the cloud print service **102** may leverage or access such existing user accounts, e.g., to avoid a need to create a new user account, and to facilitate access of existing users of other services with the cloud print service.

[0032] Consequently, it may be appreciated that although the user manager **132** and registered users data store **134** are illustrated as being within the cloud print service **102**, it also may occur that related functionality exists externally to the cloud print service, and is accessed thereby. For example, the application server **114** may provide an email application as the application **116**, and a user of the device **108** may be registered with this email application (service). In such a case, the application server **114** may have the responsibility of maintaining the user's account, and the cloud print service **102** may simply interface with the application server **114** and provide access to the user once the user is logged into the application **116**.

[0033] Techniques for registering users, maintaining user accounts, and maintaining security of users' accounts, are well-known in the art, and are not necessarily described here in detail, except as may be necessary or helpful to understand operations of the system **100**, or related systems.

[0034] Meanwhile, the printer manager **128**, as referenced above, is responsible for registering the cloud-aware printer **118**, the legacy printer **120**, and/or any printer which may interface with the cloud print service **102** and which may currently or potentially be accessed by a user of the cloud print service. As also referenced above, specific techniques for, and example of, printer registration are provided below with respect to FIG. **3**A.

[0035] An application manager **136** may be configured to communicate with any application which may be desired to be used for printing within the system **100**, including, e.g., the application **112**, and the application **116**. Thus, for example, the application manager **136** may implement various application programming interfaces (APIs) which enable such communication with external applications.

[0036] Specific examples of operations of the application manager **136** are provided below, e.g., with respect to FIGS. **3**B and **4**. In general, though, the application manager **136** may include the functions of receiving a print request, and then receiving an actual print job, from, e.g., the application **112**. In general, the first function of receiving a print request may include providing the user of the application **112** (directly or indirectly) with a print dialog or other user interface with which the user may select an available/associated registered printer. Receiving the print job may include receiving print data to be printed, along with print characteristics characterizing preferences and other aspects of how the print data is desired to be printed (e.g., color vs. black-and-white, paper size, orientation, number of copies, or any other relevant or desired print characteristic). The application manager **136** may conduct other communications with the application **112**, as well, such as, e.g., providing a status of a printer or print job.

[0037] The application manager **136** may communicate with the application **112** (or other application) in a format that is independent of a specific printer, e.g., that is generic with respect to all available or relevant printers within the system **100**. In this way, the application **112** is relieved of some or all of the burdens associated with needing knowledge of a destination printer when formulating and/or sending the print job.

[0038] For example, with reference to the print job just described, the application **112** may formulate both the print data and print characteristics in the same manner, regardless of whether the print job is destined for, e.g., the cloud-aware printer **118** or the legacy printer **120**. In fact, even if the user

of the application **112** does not currently have any registered printer associated with his or her user account, the print job still may be forwarded to the cloud print service **102** for storage, and later printed to whatever printer is ultimately registered with the cloud print service **102** and the user's account.

[0039] Consequently, the application **112** may include or use, or be associated with, APIs to communicate with the application manager **136**, where such APIs may be light-weight, consistent, customizable, and easy to implement within or among various applications. Moreover, such APIs may rarely, if ever, need to be updated or maintained by the user in order for the user print from the application using the cloud print service **102**. Instead, such updates may be managed by an administrator or other provider of the cloud print service **102** and/or by a provider of the application **112**, so that the user of the application **112** is unburdened of associated efforts and responsibilities. Even as new printers are introduced into the marketplace over time, the user may have the experience that the application **112** is able to utilize the new printer(s) simply by way of registration of the new printers with the cloud print service **102**, as described in detail, below.

[0040] Print jobs received at the application manager **136** in the printer-independent or generic format may be passed to a format converter **138**, which may be configured to receive a print job from the application manager **136** and facilitate or execute conversion of the print job into a format associated with the designated (type of) printer for the print job in question. Such conversion may thus generally include, as needed, conversion of the print data itself, as well as conversion of the print characteristics specified within a given print job.

[0041] For example, printers generally require low-level, device or type-specific instructions which provide a basis by which printers actually apply ink to paper to achieve a desired appearance. Such instructions therefore may include very specific portrayal of the desired print outcome, using, e.g., a Page Description Language (PDL). For example, the language PostScript may be used to describe a desired print outcome, and then rendered (e.g., rasterized) by a specific printer to generate printed text or images. Additionally, fixed-layout document formats exist which are designed to facilitate device-independent printing while maintaining document fidelity. For example, the portable document format (.pdf) is an example of such a format, where .pdf documents may be generated using PostScript. Somewhat similarly, the XML Paper Specification (XPS) provides such a fixed-layout document format, which is based on the eXtensible Markup Language (XML).

[0042] Print data may be received from the application **112** in virtually any format, including, e.g., Hypertext Markup Language (HTML), or in a format associated with document processing and/or images (e.g., .jpeg), or in the PDF or XPS formats referenced above. The format converter **138** may thus be configured to receive print data in these and other various formats and convert the print data into a format that is recognizable by a designated printer.

[0043] Similarly, the format converter **138** may be configured to convert the print characteristics associated with the print job into a format that is recognizable by the designated printer. That is, as referenced above, the print characteristics may include aspects of how the print data should or can be printed; i.e., based on preferences of the user and/or on capabilities (or lack thereof) of the designated printer(s). For example, the legacy printer **120** may be a black-and-white printer with no two-sided printing abilities, while the cloud-aware printer **118** may be a color printer with two-sided printing. The format converter **138** may then provide conversion, accordingly, depending on a selected printer.

[0044] The format converter **138** may provide and execute the resulting, converted print job using, e.g., a protocol referred to herein as a cloud print protocol (CPP). Thus, the cloud print protocol allows the cloud print service to communicate with the cloud-aware printer **118** or the legacy printer **120**. Further detail and other aspects of the cloud print protocol are described in more detail, below.

[0045] The converted print job may be stored in a data store **140**, illustrated as job store **140** in FIG. **1**. Although illustrated separately in FIG. **1** for the sake of clarity and description, it may be appreciated that the job store **140** may overlap or coincide with the data stores **130**, **134** of the registration manager **126**. That is, for example, print jobs of a given user may be stored in conjunction with the user account of the user, and in conjunction with one or more printers registered to that user. As a result, print jobs may be committed to long-term storage, so that, for example, users may locate, identify, and re-print desired print jobs, even if the user later accesses the cloud print service **102** from a different device than was used to originally send a given print job.

[0046] Thus, it may be observed that conversion of the print job at leas partially occurs at a separate device(s) (e.g., the cloud print server **104**, the cloud-aware printer **118**, the device **122**, or the router **124**) from the device(s) on which the originating application is executing (e.g., the device **108**, the application server **114**, or the device **122**). In this way, for example, it is possible to formulate and submit a print job at least partially separately from a conversion of the print job into a printer-specific format, and to thereby divorce such conversion from an underlying operating system of the executing application.

[0047] A print job router **142** may be configured to route the converted print job to a designated printer, and otherwise monitor and mediate execution and success/failure of the print job. The print job router **142** may thus be responsible for managing and monitoring on-going print jobs from a plurality of users which are designated for a corresponding plurality of printers, as described in detail, below.

[0048] In so doing, the print job router **142** may be configured to execute, e.g., with a print client **146** executing on firmware **144** of the cloud-aware printer **118**. The print client **146** may communicate with the cloud print service **102**, e.g., with the print job router **142** and/or the registration manager **126**, using the cloud print protocol referenced above.

[0049] More specifically, the print client **146** may be configured to register the cloud-aware printer **118** with the cloud print service **102**, and to thereby associate the thus-registered printer **118** with a user of the device **108**. Moreover, the print client **146** may be configured to actually drive the cloud-aware printer **118** and thereby execute the desired printing.

[0050] In the example of FIG. **1**, the cloud-aware printer **118** is illustrated as including the print client **146** within the firmware **144**. The firmware **144**, as would be appreciated by one of skill in the art, may represent factory-installed hardware and/or software which provides designated functions without generally requiring or allowing user modification or configuration (e.g., may utilize read-only memory). Thus, the cloud-aware printer **118** may be pre-configured from before a

time of purchase to communicate and coordinate with the cloud print service **102**, to thereby provide a convenient and enjoyable user experience.

[0051] For example, the cloud aware printer **118** may include a network access manager **148**, user input **150**, and a display (or other user output) **152**, which may generally represent conventional components that are not described here in detail except as needed to assist in understanding the operation of the system **100**. Of course, the cloud-aware printer **118** also may include other conventional components, which are not discussed here for the sake or clarity and conciseness.

[0052] The network access manager **148** may represent associated hardware and/or software which enables the cloud-aware printer **118** to communicate over the network **106** with the cloud print service **102**. For example, such communication may be conducted wirelessly if the cloud-aware printer **118** is within range of an appropriate wireless network. In other examples, the network access manager **148** may enable a wired connection of the cloud-aware printer **118** to the network **106**, e.g., by way of connection to a router such as the router **124**.

[0053] The user input **150** may represent virtually any sort of keypad, stylus, or other techniques for entering data to the cloud-aware printer **118**. Similarly, the display **152** may represent virtually any sort of audio and/or video display to output information to a user of the cloud-aware printer **118**.

[0054] In example scenarios, then, a user may purchase the cloud-aware printer **118**. Upon powering, the cloud-aware printer **118** may automatically output or identify the cloud print service **102**, e.g., by printing a URL or other identifier on paper loaded in a paper tray of the cloud-aware printer **118**, or by displaying such information using the display **152**. Similarly, the cloud-aware printer **118** may output registration information for itself, e.g., a serial number or other unique identifier.

[0055] Then, in one example scenario, the purchaser may use the device **108** or other network device to communicate with the cloud print service **102**, e.g., by using a browser to visit a website of the cloud print service **102** provided by the cloud print server **104**. The user/purchaser may then log into his or her user account associated with the cloud print service **102** and be prompted to enter the registration information for the cloud-aware printer **118**.

[0056] In other example implementations, the user input **150** and display **152** may similarly be used to communicate directly with the cloud print service **102** using the network access manager **148**. For example, upon powering, the cloud-aware printer **118** may automatically connect to the cloud print service **102** using the print client **146** and the network access manager **148**, and then use the display **152** to prompt the user/purchaser to login to the cloud print service **102**, to thereby automatically associate the cloud-aware printer **118** as being registered to the user/purchaser.

[0057] In contrast, the legacy printer **120** may not be manufactured to include the print client **146** and/or other components of the cloud-aware printer **118**. For example, the legacy printer **120** may have been manufactured prior to an availability of the cloud print service **102**, or simply may have been made without the necessary components to communicate with the cloud print service **102**.

[0058] In such a case, the legacy printer **120** may be connected in a conventional way to the device **122** (e.g., by USB or other suitable wired or wireless connection). For example, the device **122** may include an operating system **154**, which may be used to host a print client **156** which is conceptually similar to the print client **146**, and which serves as a proxy for the legacy printer **120** to thereby allow the legacy printer **120** to participate in the system **100**.

[0059] In some implementations, the print client/proxy **156** may communicate directly with the legacy printer **120** to execute a print job from the cloud print service **102**. In other implementations, the operating system **154** may have a conventional printer driver **158** installed for the legacy printer **120**, in which case the system **100** may leverage some or all of the functionality of the print driver **158** to drive the legacy printer **120**.

[0060] Thus, in operation, the print client/proxy **156** may be configured to register the legacy printer **120** with the registration manager **126** (printer manager **128**) of the cloud print service **102**, in a similar manner(s) as described above and depending on a presence or absence of capabilities of the legacy printer **120** (e.g., whether the legacy printer **120** includes network access, user input and/or display components).

[0061] Once registered, an application **160** which may desire to print to the legacy printer **120** may communicate a print job to the cloud print service **102**, e.g., in the manner described above with respect to the application **112**. As the legacy printer **120** is thus incorporated and integrated into the system **100**, it may be appreciated that the application **112** and/or the application **116** may thus print to the legacy printer **120**, as easily as to the cloud-aware printer **118**. For example, a user of the device **108** may use the application **112** to execute a print job to the legacy printer **120**, even if the legacy printer **120** is remote from the device **108** over the network at the time of the printing.

[0062] Similarly, a print client **162** may be installed as a proxy component on the router **124**, as an addition or alternative to the print client **156**, to integrate the legacy printer **120** into the system **100**. The print client (proxy) **162** may thus similarly allow for registration of the legacy printer **120** with the cloud print service **102** and with one or more users (e.g., of the device **108** and/or the device **122**), and may accept print jobs from the cloud print service **102** which are designated for the legacy printer **120**.

[0063] Many features and advantages are provided by the system **100** and variations thereof, as referenced herein and/or as would be apparent to one of skill in the art. For example, as described, the system **100** facilitates remote printing in a straight-forward and easily implementable fashion, because a user need only log in to the cloud print service **102** and register a printer using any device (e.g., personal computer, smartphone or other mobile device, or a printer itself). Then, the user can thereafter login to the cloud print service **102** from any device, anywhere on the network **106**, and send a print job to the thus-registered printer from any compatible application, even if the device and printer are remote from one another.

[0064] In other example implementations, it is possible to share printers between different users. For example, techniques currently exist for sharing documents in existing cloud-based document processing/management systems, such as when a first user sends an email to a second user with a link to a document to be shared. With the system **100**, such techniques and concepts can be extended to the realm of printing. For example, the first user may send a link referencing a printer to be shared (e.g., referencing or including registration information for the printer), so that the second,

receiving user may simply follow the link to associate the identified printer with the second user's cloud print service user account. In these and other scenarios, users may, e.g., print documents directly to a receiving user, or print work documents to a home printer (or vice versa), and otherwise experience the benefits of remote printing.

[0065] FIG. **2** is a flowchart **200** illustrating example operations **202-214** of the system of FIG. **1**. Although the flowchart **200** of FIG. **2** illustrates the operations **202-214** in sequential order, it will be appreciated that this is merely an example, and that additional or alternative operations may be included. Further, operations of FIG. **2** and related operations may be executed in a different order than that shown, or in a parallel or overlapping fashion.

[0066] In the example of FIG. **2**, a print request may be received at a server, over a network and from an application executing on a device (**202**). For example, as described above, the application manager **136** may receive a print request from a user of the application **112** executing on the device **108**, or of the application **116** executing on the application server **114**, or of the application **160** of the device **122**. The print request may be received over the network **106** using an API that is common to the application **112/116/160** and the application manager **136**.

[0067] A user account associated with a user of the application may be determined at the server (**204**). For example, the application manager **136** may conduct authentication of the user of the application in question, e.g., in conjunction with the registration manager **126**. The authentication may occur prior to the print request, or in response thereto.

[0068] A print dialog may be provided over the network to the user in association with the application, the print dialog configured to provide for a selection of at least one printer associated with the user account (**206**). For example, the application manager **136** may determine that both of the printers **118**, **120** are registered and associated with the user account of the user in question. Then, the application manager **136** may render the print dialog in conjunction with the application, and including a selection between the two printers **118**, **120**.

[0069] A selected printer from the selection may be received, via the print dialog (**208**). For example, the application manager **136** may receive a selection of either the cloud-aware printer **118** or the legacy printer **120**.

[0070] A print job designating the selected printer may be received at the server, the print job including print data and print characteristics expressed in a first format (**210**). For example, the application manager **136** may receive the print job designating either of the printers **118**, **120**. The print job, as described, may include both the actual print data to be printed, as well as print characteristics specifying a manner in which the print data is to be printed, relative to printer capabilities of the selected printer(s). For example, such print characteristics may include a designation of one-sided versus two-sided printing, paper size, paper tray, color versus black-and-white, and various other such well-known print characteristics.

[0071] The print job, including the print data and such print characteristics, may be expressed in the first format as a printer-independent format. That is, the print job may be communicated to the application manager **136** by way of an appropriate API and in a manner which is generic or agnostic with respect to the selected printer, or to any printer. Consequently, the application in question need not have any knowledge of the printer to be used, even after the printer has been selected, in order to transmit the print job.

[0072] The print job may be converted from the first format into a printer-specific format associated with the selected printer (**212**). For example, the format converter **138** may be configured to convert the first (e.g., printer-independent) format into a printer-specific format for a selected one of the printers **118**, **120**. As may be appreciated, and as described herein, the term printer-specific in this context may include, e.g., reference to a specific type, category, or brand of printer, or to a uniquely-identified printer. The print job in the printer-specific format may include a full rasterization of the print job for use in printing by the selected printer (e.g., when the selected printer includes the cloud-aware printer), or may include a partial conversion so that final rasterization may occur later (e.g., at the print client (proxy) **156** and/or the print driver **158** of the device **122**, as described herein).

[0073] The print job may be routed over the network from the server to a print client associated with the selected printer for printing by the selected printer, using the printer-specific format (**214**). For example, the print job router **142** may be configured to route the print job to the print client **146** of the cloud-aware printer **118**, or to the print client(s) **156/162** of the legacy printer **120**.

[0074] FIGS. **3**A and **3**B are flowcharts illustrating more detailed and/or specific more specific examples of the operation of system of FIG. **1**. More specifically, FIG. **3**A illustrates a first flowchart related to example scenarios for registering users and/or printers with the cloud print service **102**, while FIG. **3**B illustrates example operations for receiving and executing a print job from a registered user.

[0075] In FIG. **3**A, a user may be registered with the cloud print service **102** (**302**). For example, as referenced above, a user wishing to use the cloud print service **102** may visit a web site thereof and establish a user account, e.g., by providing a username/password combination. In other scenarios, the user may visit the cloud print service website or a related website (e.g., an online email provider), and associate an existing user account of the related website with the cloud print service **102**. The user account information may then be established and stored by (or accessed by) the user manager **132** and/or the registered users data store **134**.

[0076] In FIG. **1**, a single cloud print service **102** is illustrated. However, it may be appreciated that the network **106** may be used by multiple providers to provide multiple cloud print services. For example, a printer manufacturer may provide a cloud print service for its printers, while a 3^{rd} party provider for more general cloud computing may provide the cloud print service **102** as an auxiliary feature for its existing cloud-based computing platform, and therefore as a general service which is not specific to any particular type of printer.

[0077] Once a user account is established or available, a new printer may be determined (**304**), such as when a new printer is purchased and powered on, or when a given user gains access to a previously-inaccessible printer. For example, if the new printer is cloud-aware (**306**), the registration of the cloud-aware printer with the cloud print service **102** may proceed directly, such as described above (**308**). For example, as described, the user may login to the cloud print service **102** through an associated website or using the cloud-aware printer **118** itself, and registration information identifying the cloud-aware printer **118** may be entered by the user or received automatically by the cloud print service **102** over the network **106**.

[0078] If the new printer is not cloud-aware, e.g., is a legacy printer such as the legacy printer **120**, then it may be determined whether a print client is available on a device associated with the legacy printer **120** (**310**). If not, then it may be necessary to install such a print client proxy on an associated device (**312**), such as on the device **122** and/or associated router **124**, as shown in FIG. **1**. For example, the user may execute such an installation by visiting the website of the cloud print service **102**, and following a link to download an appropriate print client **156**/**162**.

[0079] If the legacy printer **120** requires an associated conventional print driver in addition to the print client **156**/**162**, e.g., from a manufacturer of the legacy printer **120**, then such software also may be downloaded or otherwise installed an the appropriate device (**314**), e.g., on the device **122** or the router **124**.

[0080] Then, e.g., using the print client, the legacy printer **120** may be registered with the cloud print service **102**. As with the cloud-aware printer, such registration may include providing of a unique identifier for the legacy printer **120**, as well as other information which may be required by, or useful to, the cloud print service **102**. For example, such registration information may include printer capabilities of the legacy printer **120**, such as whether and how the legacy printer **120** provides color printing, two-sided printing, or other print features, and, further, details of the legacy printer **120** such as a number and location of paper trays, detailed information on how to report paper jams or other exceptions or malfunctions, and other information characterizing the legacy printer **120**.

[0081] Again, such registration information may also be required by, or useful for, the cloud print service **102** with respect to the cloud-aware printer **118**. However, in the case of the cloud-aware printer **118**, it may occur that such registration information is provided automatically by the cloud-aware printer **118**, or at least partially provided at an earlier stage, such as at a time of manufacture of the cloud-aware printer **118**. In the latter case, for example, it may occur that a printer manufacturer provides the cloud print service **102** for all of its printers. In such a case, the printer manufacturer may know or may determine any needed registration information (e.g., printer capabilities) when initially manufacturing each printer for sale. Then, during an actual registration of a specific cloud-aware printer, it may only be necessary to transmit a minimal amount of information to identify the specific printer uniquely for association with one or more users.

[0082] In the above examples, it is assumed that the printer (s) to be registered are being registered with the account(s) of logged-in users who wish to access a new printer. As a further technique for registering printers, and as referenced above, it may occur that already-registered printers of a first user may be associated (shared) with an already-registered second user.

[0083] For example, a share request may be received from a user (**318**), identifying a registered printer to be shared and identifying one or more users to receive the share request. The share request may be provided, e.g., by email, to the identified user(s). Then, the registered printer(s) may be designated as shared with the designated users (**320**). That is, a receiving/second user may thereafter have some or all printing rights with respect to the shared printer.

[0084] In the example flowchart **300***b* of FIG. **3***b*, it is assumed that all relevant users and printers are registered with the cloud print service **102**, and that a user, e.g., a user of the device **108** and/or **122**, may wish to print to either the cloud-aware printer **118** or the legacy printer **120**.

[0085] Initially, then, the cloud print service **102**, e.g., the print job router **142**, may be configured to periodically check a status of a printer(s), using a corresponding print client (**322**). For example, the print job router **142** may be aware that the cloud-aware printer **118** is available, as long as the cloud-aware printer **118** is powered on at a given time. On the other hand, checking a status of the legacy printer **120** may require that the router **124** and/or the device **122** is/are both powered (e.g., so that corresponding print client(s) **156**/**162** is/are available). In the present context, printer status may include a determination as to whether a given printer is available, or is currently experiencing an exception (e.g., paper jam), and/or a determination as to a current number of print jobs queued for the printer in question.

[0086] At some point in time, a print request may be received from an application (**324**). For example, a user of the device **108** may be using the application **112**, e.g., by reading an email or other document, or by viewing an image within an image viewing application. Within the application, the user may select a print option, e.g., by using a generally conventional technique(s), such as selecting from within a drop-down menu, or selecting a printer icon displayed within the application. Such action may initiate or execute a communication between the application **112** and the application manager **136**, so as to notify the application manager **136** that a print job may be forthcoming.

[0087] It may be necessary to authorize the user (**326**) as being allowed to proceed with printing. For example, the need may exist to ensure that the user in question has a user account established with the cloud print service **102**.

[0088] User authorization techniques are generally well-known, and not discussed here in detail. In general, though, the application manager **136** may communicate with the user manager **132** to verify that the user has provided a valid username/password, or otherwise been authenticated. If the user does not have a valid user account, then a user account may be established. Of course, it may occur that user authorization occurs prior to receipt of a print request, as well.

[0089] For the authorized user, the application manager **136** may then communicate with the printer manager **128** to determine which registered printers from the registered printers **130** are associated with the user's account, including any printers shared with the user by another user (**328**). For example, the application manager **136** may determine that the user is associated with both the cloud-aware printer **118** and with the legacy printer **120**. Based on the status checks referenced above by the print job router, it may be assumed that both printers **118**, **120** have been determined to be available for printing.

[0090] As referenced herein, the user may be remote from the printers **118**, **120**, e.g., may be using a mobile device as the device **108**, and may be walking, riding within a car, or otherwise in an environment not currently considered optimal or feasible for printing. Further, the user may be using the application **112**, which may similarly represent an application not currently associated with optimal or feasible printing options (e.g., web applications, as referenced above).

[0091] Nonetheless, simply by selecting "print" and signing into the cloud print service **102**, such a user may be presented with full printing options for all registered and available printers. For example, the cloud-aware printer **118** may represent a work printer, while the legacy printer **120** is

a home printer of the user. In another example, and continuing the example above in which the device **108** represents a mobile device, e.g., a smartphone, it may occur that the user is talking to another user who owns the cloud-aware printer **118**. The device user may use online capabilities of the device **108** to select and purchase tickets, e.g., tickets to a show, or airline tickets. Then, the device user may select the cloud-aware printer **118** of the other user to print the tickets, so that the two users may both meet later at a rendezvous point and may both have hard copies of the needed tickets.

[0092] Continuing the example operations of FIG. **3**B in more detail, once the printers **118**, **120** are determined as being associated with the user of the device **108**, the application manager **136** may present the user with a print dialog including a list of the available printers **118**, **120**, and/or current information about capabilities or a status of each printer (**330**).

[0093] As referenced above, and as described in more detail below with respect to FIG. **4**, the application manager **136** may provide such a print dialog either directly or indirectly. That is, in either case the application manager **136** may access a suitable API to interact with the application **112**. In a first example, a suitable API may be used to actually render a print dialog within the application **112**, where a presentation and other aspects of an appearance of such a print dialog may be determined exclusively by the application manager **136**. In such cases, such print dialogs are thus provided by the cloud print service **102** and may therefore be consistent in appearance and content within and among various applications. For example, the cloud print service **102** may be included within, or operate in conjunction with, a suite of applications (e.g., email applications, image viewing applications, and any other cloud-based/web applications). Consequently, there may be value to a provider of such a suite of application to have the cloud print service **102** provide a uniform print dialog across multiple applications. Further, it may be easiest and most straight-forward for a developer of the application **112** to integrate and utilize the API(s) of the application manager by using a provided print dialog.

[0094] In other example implementations, however, an application developer may specifically wish to develop a specific print dialog to be associated with the application **112**, which may be different from a default print dialog provided by the application manager **136**. For example, such a choice may be a matter of preference as to an appearance or functionality of the print dialog. In other examples, and conversely to the examples above, it may occur that the application **112** is itself part of a suite of applications, and, further, that each application within such a suite may be compatible with multiple cloud print services. In such a case, the application developer may wish to provide a uniform print dialog across all of the application suite and cloud print services. Consequently, the application manager **136** may use a suitable API (or aspects thereof) to provide the application **112** with information necessary to render a print dialog, and the application itself may be responsible for an actual desired rendering.

[0095] However the print dialog is provided, it may subsequently occur that the user selects from the provided printer list, e.g., from the printers **118**, **120**, and then is provided with printer options associated with a selected printer. Upon selecting from these options, the user may then submit, and the application manager **136** may then receive, the print job from the selected printer (**332**), including the actual print data and the selected print characteristics. As referenced and described herein, the print job may be communicated to the application manager using a corresponding API, and in a format that is independent of the selected printer (e.g., in a format that would be the same for the same print job for either printer **118**, **120**, regardless of which printer **118**, **120** was actually selected). In this way, the application **112** need not have any awareness or knowledge of the selected printer, other than allowing for the actual selection thereof by the user from within the print dialog.

[0096] At the cloud print service **102**, the received print job may then be converted into a printer format for the selected printer (**334**). For example, the format converter **138** may be configured to convert the printer-independent format into a format associated with the cloud-aware printer **118** or the legacy printer **120**, depending on a selection of the user.

[0097] The print job may then be stored in association with the user account of the user (**336**), e.g., within the job storage **140**. The print job may be stored in either the printer-independent format as received from the application **112**, or in the printer format associated with the selected printer. In either case, as referenced above, such persistent storage of the print job in association with the user account allows for later location and printing of the same print job at a later date, without having to re-generate the document to be printed (e.g., without having to visit a website at which a document was originally generated).

[0098] The print job may then be output to a corresponding print client (**338**). For example, the print job router **142** may output the converted print job to either of the printers **118**, **120**, or both, depending on which was selected earlier. If the selected printer does not include a cloud-aware printer (**340**), e.g., includes a legacy printer, then the print job may be received at the local print client and communicated to the local print driver (e.g., may be received at the print client(s) **156**/**162** and communicated to the print driver **158**).

[0099] It may be appreciated that the burden of converting the print job from the printer-independent format received from the application **112** for actual printing at one of the printers **118**, **120**, may be shared to varying extents between the format converter **138** and the various print clients **146**, **156**, **162**. For example, in one example using the cloud aware printer **118**, the format converter **138** may provide essentially the entire process of determining printer commands for the cloud-aware printer **118**. In this case, the print client **146** may be used to receive the print job for forwarding to appropriate printer hardware (e.g., processor(s) driving the associated ink dispensers). In such a case, the cloud-aware printer **118** may be very inexpensive to manufacture, with minimal hardware/software requirements.

[0100] In other scenarios, the format converter **138** may execute a partial format conversion, and the print clients **146**, **156**, **162** may be more involved in calculating or otherwise determining actual, low-level printer commands. Such a practice may be suitable, for example, where a manufacturer of the printer in question has certain specific needs or requirements which are not readily compatible with the cloud print service **102**, or, in other cases, where the printer in question already has the processing capabilities to be responsible for a certain amount of the conversion process. In the latter case, although such printers may be relatively more expensive due to supporting the associated hardware and software requirements associated with the conversion(s), it may make sense simply to leverage such existing resources if they do already exist, rather than support them independently at the cloud

print service **102**. In particular, the legacy printer **120** may already have a relatively large amount of hardware/software resources, including the print driver **158**, so that it may make sense to perform a relatively small proportion of the format conversion process at the format converter **138**, while allowing the print client **156**/**162** and the print driver **158** to finalize and execute a final print job.

[0101] In either case, the print job may proceed with execution (**344**), during which the print job router **142**, having provided the print job, may continue to maintain the print job status for provision to the application **112**, as needed (**346**). For example, after execution of the print job begins, a paper jam may occur at the legacy printer **120**. Then, the print job router **142** may become aware of the paper jam through the print client **152**, and may thereafter output a notification to the application **112**, perhaps using the print dialog of the application manager **136**.

[0102] Assuming any such exceptions may be resolved, the print job may be completed (**348**). At a later time, as referenced above, a request may be received for a previous, stored print job (**350**). For example, a user of the application **112** may select "print," and the resulting print dialog may include an option to select previous print jobs, whereupon such previous print jobs may be retrieved from the job storage **140** (**352**). For example, the user may be provided the options of identifying previous print jobs by search terms, dates of printing, or other selection criteria. Then, the user may execute a selected, previous print job, and, moreover, may execute such a print job using any registered printer associated with the user (**354**).

[0103] FIG. **4** is a block diagram of a more detailed example of an implementation of the cloud print service **102** of FIG. **1**. More specifically, FIG. **4** illustrates specific APIs that may be used by the various components of the cloud print service **102**. As such, it may be appreciated that such APIs may individually be included in one or more of the various components of the cloud print service **102** illustrated in FIG. **1**, as would be apparent.

[0104] In the example of FIG. **4**, the cloud print service **102** is illustrated as including a print dialog API **402**, which is in communication with a tickler **404**. The tickler **404** may be operable to send notification(s) of new print jobs available for a given printer(s).

[0105] Then, upon authorization of a user by the print dialog API **402**, a list of printers, associated printer capabilities, and current jobs per printer and other status information may be provided to the application user, e.g., by way of a common print dialog **406**, which may be rendered, e.g., using Javascript. As already explained, such a print dialog **406** may, in appearance, resemble conventional print dialogs, except as otherwise set forth herein (e.g., may allow for selection of an available printer and associated print features). In an example of a non-conventional aspect of the common print dialog **406**, the common print dialog **406** may include a field(s) to allow a user to search and identify a previous/stored print job that is persistently stored by the cloud print service **102**.

[0106] The print dialog API **402** may thus provide (e.g., render) the common print dialog **406** essentially in its entirety for the application user, and thereby provide a common print dialog experience across applications interfacing with the cloud print service **102**. As also described, the print dialog API also may simply provide sufficient information for an application developer to construct a third party dialog **408**, which may be different in appearance than the common print dialog **406**, e.g., may have a proprietary appearance associated with a suite of applications provided by the developer/provider thereof.

[0107] Assuming authorization of the user proceeds, the user may then provide printer selection(s) and associated desired print characteristics, as well as the actual print data. The print data may be expressed in any conventional format, e.g., HTML, PDF, XPS, or an image format such as JPG, to name a few.

[0108] The print job may then be received at a job submit API **410**, e.g., from either dialog **406**, **408**. In some implementations, the print data may be included by reference to remote print data, e.g., by identification of an appropriate URL. Then, an application data fetcher **412** may be used to retrieve data to be printed.

[0109] The job submit API **410** may receive the print job in, to give a specific and non-limiting example(s), a hyper-text transfer protocol (HTTP) multi-part request which may include the printer capabilities expressed, e.g., in XPS, as well as a MIME type identifying the content type. The job submit API may then provide the print job, including the print data and print characteristics, to a format converter **414**. The format converter **414** operates essentially as described herein with respect to the format converter **138** of FIG. **1**, and stores the print job within storage **416**.

[0110] A print client **420**, which may represent any of the print clients **146**, **156**, **162** of FIG. **1**, communicates with a job control API **418** and a job fetch API **422**, to execute the print job. Specifically, the job fetch API **422** may provide the print job to the print client **420**, e.g., may be used by the print client **420** to fetch the next available job for the specified printer.

[0111] The job control API **418** may be responsible for authorizing the print client **420** as needed, and for receiving updated status information from the printer in question, such as whether the print job has completed or failed. Such status information may also be stored within the storage **416** in associated with a corresponding print job. The job control API may include status information including, e.g., whether a print job is currently queued and not yet downloaded to a corresponding print client **420**, or spooled/downloaded and added to the client side native printer queue (if applicable).

[0112] In further examples of the print client as the print client proxy **156**, it may occur that the proxy fetches print jobs in PDF format, along with the user-selected print characteristics represented as XML. Then, the proxy may use a PDF interpreted library to rasterize and print the PDF.

[0113] Finally in FIG. **4**, a user/printer register API **424** is illustrated which is responsible for communicating with the print client **420** to register the user(s) and all associated printers. Such registration information may be communicated using a HTTP multi-part request, and may include identification of the printer along with the printer capabilities (e.g., expressed in XPS), and may be stored in the storage **416** with the various print jobs. Further, as referenced above with respect to FIG. **3**A, such registration processes and information may occur previously to actual print job executions, or interspersed therewith. In the latter case, for example, the user may seek to execute a print job only to find that all available printers are currently occupied, jammed, or offline. Nonetheless, it would be a simple matter for the user then to register a new printer with the cloud print service **102** and proceed accordingly with the newly-registered printer to execute the desired print job.

[0114] Many other examples and variations of the systems and operations of FIGS. **1** to **4** would be apparent to one skilled in the art. For example, instead of printing to a hardware printer, the system(s) **100**/**400** or similar systems may be used to print to PDF or other software format.

[0115] FIG. **5** is a block diagram showing example or representative computing devices and associated elements that may be used to implement the systems of FIGS. **1** and **3**. FIG. **5** shows an example of a generic computer device **500** and a generic mobile computer device **550**, which may be used with the techniques described here. Computing device **500** is intended to represent various forms of digital computers, such as laptops, desktops, workstations, personal digital assistants, servers, blade servers, mainframes, and other appropriate computers. Computing device **550** is intended to represent various forms of mobile devices, such as personal digital assistants, cellular telephones, smart phones, and other similar computing devices. The components shown here, their connections and relationships, and their functions, are meant to be exemplary only, and are not meant to limit implementations of the inventions described and/or claimed in this document.

[0116] Computing device **500** includes a processor **502**, memory **504**, a storage device **506**, a high-speed interface **508** connecting to memory **504** and high-speed expansion ports **510**, and a low speed interface **512** connecting to low speed bus **514** and storage device **506**. Each of the components **502**, **504**, **506**, **508**, **510**, and **512**, are interconnected using various busses, and may be mounted on a common motherboard or in other manners as appropriate. The processor **502** can process instructions for execution within the computing device **500**, including instructions stored in the memory **504** or on the storage device **506** to display graphical information for a GUI on an external input/output device, such as display **516** coupled to high speed interface **508**. In other implementations, multiple processors and/or multiple buses may be used, as appropriate, along with multiple memories and types of memory. Also, multiple computing devices **500** may be connected, with each device providing portions of the necessary operations (e.g., as a server bank, a group of blade servers, or a multi-processor system).

[0117] The memory **504** stores information within the computing device **500**. In one implementation, the memory **504** is a volatile memory unit or units. In another implementation, the memory **504** is a non-volatile memory unit or units. The memory **504** may also be another form of computer-readable medium, such as a magnetic or optical disk.

[0118] The storage device **506** is capable of providing mass storage for the computing device **500**. In one implementation, the storage device **506** may be or contain a computer-readable medium, such as a floppy disk device, a hard disk device, an optical disk device, or a tape device, a flash memory or other similar solid state memory device, or an array of devices, including devices in a storage area network or other configurations. A computer program product can be tangibly embodied in an information carrier. The computer program product may also contain instructions that, when executed, perform one or more methods, such as those described above. The information carrier is a computer- or machine-readable medium, such as the memory **504**, the storage device **506**, or memory on processor **502**.

[0119] The high speed controller **508** manages bandwidth-intensive operations for the computing device **500**, while the low speed controller **512** manages lower bandwidth-intensive operations. Such allocation of functions is exemplary only. In one implementation, the high-speed controller **508** is coupled to memory **504**, display **516** (e.g., through a graphics processor or accelerator), and to high-speed expansion ports **510**, which may accept various expansion cards (not shown). In the implementation, low-speed controller **512** is coupled to storage device **506** and low-speed expansion port **514**. The low-speed expansion port, which may include various communication ports (e.g., USB, Bluetooth, Ethernet, wireless Ethernet) may be coupled to one or more input/output devices, such as a keyboard, a pointing device, a scanner, or a networking device such as a switch or router, e.g., through a network adapter.

[0120] The computing device **500** may be implemented in a number of different forms, as shown in the figure. For example, it may be implemented as a standard server **520**, or multiple times in a group of such servers. It may also be implemented as part of a rack server system **524**. In addition, it may be implemented in a personal computer such as a laptop computer **522**. Alternatively, components from computing device **500** may be combined with other components in a mobile device (not shown), such as device **550**. Each of such devices may contain one or more of computing device **500**, **550**, and an entire system may be made up of multiple computing devices **500**, **550** communicating with each other.

[0121] Computing device **550** includes a processor **552**, memory **564**, an input/output device such as a display **554**, a communication interface **566**, and a transceiver **568**, among other components. The device **550** may also be provided with a storage device, such as a microdrive or other device, to provide additional storage. Each of the components **550**, **552**, **564**, **554**, **566**, and **568**, are interconnected using various buses, and several of the components may be mounted on a common motherboard or in other manners as appropriate.

[0122] The processor **552** can execute instructions within the computing device **550**, including instructions stored in the memory **564**. The processor may be implemented as a chipset of chips that include separate and multiple analog and digital processors. The processor may provide, for example, for coordination of the other components of the device **550**, such as control of user interfaces, applications run by device **550**, and wireless communication by device **550**.

[0123] Processor **552** may communicate with a user through control interface **558** and display interface **556** coupled to a display **554**. The display **554** may be, for example, a TFT LCD (Thin-Film-Transistor Liquid Crystal Display) or an OLED (Organic Light Emitting Diode) display, or other appropriate display technology. The display interface **556** may comprise appropriate circuitry for driving the display **554** to present graphical and other information to a user. The control interface **558** may receive commands from a user and convert them for submission to the processor **552**. In addition, an external interface **562** may be provide in communication with processor **552**, so as to enable near area communication of device **550** with other devices. External interface **562** may provide, for example, for wired communication in some implementations, or for wireless communication in other implementations, and multiple interfaces may also be used.

[0124] The memory **564** stores information within the computing device **550**. The memory **564** can be implemented as one or more of a computer-readable medium or media, a volatile memory unit or units, or a non-volatile memory unit or units. Expansion memory **574** may also be provided and

connected to device **550** through expansion interface **572**, which may include, for example, a SIMM (Single In Line Memory Module) card interface. Such expansion memory **574** may provide extra storage space for device **550**, or may also store applications or other information for device **550**. Specifically, expansion memory **574** may include instructions to carry out or supplement the processes described above, and may include secure information also. Thus, for example, expansion memory **574** may be provide as a security module for device **550**, and may be programmed with instructions that permit secure use of device **550**. In addition, secure applications may be provided via the SIMM cards, along with additional information, such as placing identifying information on the SIMM card in a non-hackable manner.

[0125] The memory may include, for example, flash memory and/or NVRAM memory, as discussed below. In one implementation, a computer program product is tangibly embodied in an information carrier. The computer program product contains instructions that, when executed, perform one or more methods, such as those described above. The information carrier is a computer- or machine-readable medium, such as the memory **564**, expansion memory **574**, or memory on processor **552**, that may be received, for example, over transceiver **568** or external interface **562**.

[0126] Device **550** may communicate wirelessly through communication interface **566**, which may include digital signal processing circuitry where necessary. Communication interface **566** may provide for communications under various modes or protocols, such as GSM voice calls, SMS, EMS, or MMS messaging, CDMA, TDMA, PDC, WCDMA, CDMA2000, or GPRS, among others. Such communication may occur, for example, through radio-frequency transceiver **568**. In addition, short-range communication may occur, such as using a Bluetooth, WiFi, or other such transceiver (not shown). In addition, GPS (Global Positioning system) receiver module **570** may provide additional navigation- and location-related wireless data to device **550**, which may be used as appropriate by applications running on device **550**.

[0127] Device **550** may also communicate audibly using audio codec **560**, which may receive spoken information from a user and convert it to usable digital information. Audio codec **560** may likewise generate audible sound for a user, such as through a speaker, e.g., in a handset of device **550**. Such sound may include sound from voice telephone calls, may include recorded sound (e.g., voice messages, music files, etc.) and may also include sound generated by applications operating on device **550**.

[0128] The computing device **550** may be implemented in a number of different forms, as shown in the figure. For example, it may be implemented as a cellular telephone **580**. It may also be implemented as part of a smart phone **582**, personal digital assistant, or other similar mobile device.

[0129] Thus, various implementations of the systems and techniques described here can be realized in digital electronic circuitry, integrated circuitry, specially designed ASICs (application specific integrated circuits), computer hardware, firmware, software, and/or combinations thereof. These various implementations can include implementation in one or more computer programs that are executable and/or interpretable on a programmable system including at least one programmable processor, which may be special or general purpose, coupled to receive data and instructions from, and to transmit data and instructions to, a storage system, at least one input device, and at least one output device.

[0130] These computer programs (also known as programs, software, software applications or code) include machine instructions for a programmable processor, and can be implemented in a high-level procedural and/or object-oriented programming language, and/or in assembly/machine language. As used herein, the terms "machine-readable medium" "computer-readable medium" refers to any computer program product, apparatus and/or device (e.g., magnetic discs, optical disks, memory, Programmable Logic Devices (PLDs)) used to provide machine instructions and/or data to a programmable processor, including a machine-readable medium that receives machine instructions as a machine-readable signal. The term "machine-readable signal" refers to any signal used to provide machine instructions and/or data to a programmable processor.

[0131] To provide for interaction with a user, the systems and techniques described here can be implemented on a computer having a display device (e.g., a CRT (cathode ray tube) or LCD (liquid crystal display) monitor) for displaying information to the user and a keyboard and a pointing device (e.g., a mouse or a trackball) by which the user can provide input to the computer. Other kinds of devices can be used to provide for interaction with a user as well; for example, feedback provided to the user can be any form of sensory feedback (e.g., visual feedback, auditory feedback, or tactile feedback); and input from the user can be received in any form, including acoustic, speech, or tactile input.

[0132] The systems and techniques described here can be implemented in a computing system that includes a back end component (e.g., as a data server), or that includes a middleware component (e.g., an application server), or that includes a front end component (e.g., a client computer having a graphical user interface or a Web browser through which a user can interact with an implementation of the systems and techniques described here), or any combination of such back end, middleware, or front end components. The components of the system can be interconnected by any form or medium of digital data communication (e.g., a communication network). Examples of communication networks include a local area network ("LAN"), a wide area network ("WAN"), and the Internet.

[0133] The computing system can include clients and servers. A client and server are generally remote from each other and typically interact through a communication network. The relationship of client and server arises by virtue of computer programs running on the respective computers and having a client-server relationship to each other.

[0134] In addition, the logic flows depicted in the figures do not require the particular order shown, or sequential order, to achieve desirable results. In addition, other steps may be provided, or steps may be eliminated, from the described flows, and other components may be added to, or removed from, the described systems. Accordingly, other embodiments are within the scope of the following claims.

[0135] It will be appreciated that the above embodiments that have been described in particular detail are merely example or possible embodiments, and that there are many other combinations, additions, or alternatives that may be included.

[0136] Also, 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 proto-

cols. Further, the system may be implemented via a combination of hardware and software, as described, or entirely in hardware elements. 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.

[0137] Some portions of above description present features in terms of algorithms and symbolic representations of operations on information. These algorithmic descriptions and representations may be 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.

[0138] Unless specifically stated otherwise as apparent from the above discussion, it is appreciated that throughout the description, discussions utilizing terms such as "processing" or "computing" or "calculating" or "determining" or "displaying" or "providing" 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.

What is claimed is:

1. A print server including instructions stored on a computer-readable medium, the print server comprising:

an application manager configured to receive a print request over a network from an application executing on a device, and configured to provide, over the network, a print dialog to a user of the application, the print dialog configured to provide for a selection of at least one printer associated with a user account of the user and thereafter receive a selected printer from the selection;

a format converter configured to receive a print job designating the selected printer, the print job including print data and print characteristics expressed in a first format, and configured to convert the print job from the first format into a printer-specific format associated with the selected printer; and

a print job router configured to route the print job over the network from the print server to a print client associated with the selected printer, for printing by the selected printer, using the printer-specific format.

2. The print server of claim **1**, wherein the first format includes a printer-independent format.

3. The print server of claim **1**, comprising a registration manager configured to determine the user account and associated selection of at least one printer from among a plurality of user accounts and printers registered with the print server.

4. The print server of claim **1**, wherein the application manager is configured to authenticate the user relative to the user account, in response to receiving the print request.

5. The print server of claim **1**, wherein the application manager is configured to provide the print dialog including providing, via an application program interface (API), information to the application with which to render the print dialog in association with the application.

6. The print server of claim **1**, wherein the application manager is configured to communicate with the print client to determine a current status of the selected printer.

7. The print server of claim **1**, wherein a registration manager of the print server is configured to communicate with the print client to execute a printer registration of the selected printer, including determining printer capabilities of the selected printer for executing the print job, relative to the print characteristics.

8. The print server of claim **1**, wherein the print client is installed on the selected printer, and the selected printer is a network-aware printer.

9. The print server of claim **1**, wherein the print client is configured to execute within a browser application.

10. The print server of claim **1**, wherein the print client is installed on a printer device that is locally connected to the selected printer.

11. The print server of claim **1**, wherein the print client is installed on a router that is locally connected to the selected printer.

12. The print server of claim **1**, wherein the format converter is configured to convert the print job from the first format into the printer-specific format including executing a rasterization of the print job for use by the selected printer in executing the print job.

13. The print server of claim **1**, wherein the format converter is configured to convert the print job from the first format into the printer-specific format including providing the print job in the printer-specific format to the print client, for subsequent execution of a rasterization of the print job for use by the selected printer in executing the print job.

14. The print server of claim **1**, wherein the print server is configured to store the print job in association with the user account.

15. A computer-implemented method, comprising:

receiving, at a server, a print request over a network from an application executing on a device;

determining, at the server, a user account associated with a user of the application;

providing, over the network, a print dialog to the user in association with the application, the print dialog configured to provide for a selection of at least one printer associated with the user account;

receiving, via the print dialog, a selected printer from the selection;

receiving, at the server, a print job designating the selected printer, the print job including print data and print characteristics expressed in a first format;

converting the print job from the first format into a printer-specific format associated with the selected printer; and

routing the print job over the network from the server to a print client associated with the selected printer for printing by the selected printer, using the printer-specific format.

16. The method of claim **15**, wherein the first format includes a printer-independent format.

17. The method of claim **15**, wherein the print client is installed on the selected printer, and the selected printer is a network-aware printer.

18. The method of claim **15**, wherein the print client is installed on a printer device that is locally connected to the selected printer.

19. A computer program product, the computer program product including a cloud print service that is tangibly

embodied on a computer-readable medium and includes executable code that, when executed, is configured to cause a data processing apparatus to:

receive, at the cloud print service, a print request over a network from an application executing on a device;

provide, over the network, a print dialog association with the application, the print dialog configured to provide for a selection of at least one printer;

receive, via the print dialog, a selected printer from the selection;

receive, at the cloud print service, a print job designating the selected printer, the print job including print data and print characteristics expressed in a first format;

convert, using the cloud print service, the print job from the first format into a printer-specific format associated with the selected printer; and

route the print job over the network from the cloud print service to a print client associated with the selected printer for printing by the selected printer, using the printer-specific format.

20. The computer program product of claim **19**, wherein the first format includes a printer-independent format.

21. The computer program product of claim **19**, wherein the cloud print service is configured to:

register a plurality of users in association with a plurality of user accounts

register a plurality of printers to receive print jobs, and

associate user accounts with at least one registered printer of the registered printers.

22. The computer program product of claim **21**, wherein the cloud print service is configured to:

receive a request from a first registered user to share a registered printer of the first registered user's user account with a second registered user; and

associate the registered printer with a user account of the second registered user.

23. The computer program product of claim **19**, wherein the print client is installed on the selected printer, and the selected printer is a network-aware printer.

24. The computer program product of claim **19**, wherein the print client is installed on a printer device that is locally connected to the selected printer.

25. A cloud-aware printer, comprising:

a network access manager configured to execute communications over a network between the cloud-aware printer and a cloud print service being executed on a cloud print server; and

a print client configured to execute a print job originating from an application executing on a device that is on the network, the print job being received from the cloud print service via the network access manager.

26. The cloud-aware printer of claim **25**, wherein the print client is configured to provide registration information for the cloud-aware printer for registration thereof with the cloud print service.

27. The cloud-aware printer of claim **26**, wherein the cloud-aware printer provides the registration information including printing at least a portion of the registration information, including a website associated with the cloud print service.

28. The cloud-aware printer of claim **26**, wherein the cloud-aware printer provides the registration information including displaying at least a portion of the registration information on a display of the cloud-aware printer.

29. The cloud-aware printer of claim **26**, wherein the cloud-aware printer provides the registration information including transmitting at least a portion of the registration information using the network access manager.

30. The cloud-aware printer of claim **26**, wherein the cloud-aware printer is configured to receive user registration information for association thereof with the registration information within the cloud print service.

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