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**Method, apparatus and system for device-to-device synchronization and
pervasive digital output**

Inventor: William Ho Chang and Ying Liu

5 **Field of invention**

Present invention relates to device synchronization and digital output. More particularly, it relates to an apparatus, process and method where an information apparatus can pervasively output to any output device at any time, anywhere conveniently.

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Background

An Information apparatus refers to both stationary computers and mobile computing devices (pervasive devices). Examples of information apparatus without limitation include desktops, laptop, palmtop (hand-held computer), personal digital assistant (PDA); Internet enabled cellular phones, smart phones, pagers, digital capturing device (e.g. digital camera and video cameras), Internet appliances, e-books and digital pads. An output device may include fax machines, printers, copiers, image and/or video display devices, and audio output devices. For simplicity, hereafter we may refer to an output device as a printer or output as printing. However, it should be understood that the term printer and printing used in the discussion of present invention refers to an extent to the large scope of output devices.

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Fueled by the ever increasing bandwidth, processing power, wireless internet and available software applications for pervasive devices, millions if not billions of users are creating, downloading, and transmitting content and information with their pervasive computing devices or information apparatus. As a result, there is a need to allow users to easily output content and information from their pervasive computing devices (information apparatus) to any output device. People need to output directly and conveniently from pervasive information apparatus, without depending for example on synchronization between pervasive computing devices with a stationary PC for printing.

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As an example, an information worker at an airport, receiving Email in his hand-held computer (information apparatus) may want to walk up to a nearby printer or fax

machine to have his e-mail printed. In addition, the mobile worker may also want to print a copy of his to do list, appointment book, business card, and his flight schedule from his mobile devices. As another example, a traveler stopping at a convenience store, gas station, or kiosks may want to print out a copy of the map he just downloaded from the Internet using his Internet enable wireless phone (information apparatus). Yet another example, an individual who just finished a stock trade or performed an e-commerce transaction using his PDA (information apparatus) may want to print out a copy of his transaction confirmation, invoice or receipt.

Conventionally, output device (e.g. printer) is connected to information apparatus via wired connection such as through a cable line. A wireless connection is also possible by using, for example, radio communication or infrared communication. Regardless of wired or wireless connection, a user must first install in his/her information apparatus a printer driver corresponding to that particular printer model and make. Using a device dependent driver, the user's information apparatus may process digital content (digital document or image) into the printer's input space. Printer's input space corresponds to the type of input that a printer understands. For example, printer's input space may include printer specific input format and encoding, page description language, markup language, instructions, protocols or data that can be understood or used by a particular printer make and model. Printer's input space is therefore, in general, device dependent. Different printer model may specify its own input, designed or adopted for optimal operation by the printer manufacturer. Consequently, different printer usually requires using its own specific printer driver for accurate printing on a particular printer. A device driver (printer driver in this example) is used to control, manage, communicate, and output to a printer. Sometimes the device driving feature is included as part of an application software.

Installing a printer driver or an application can be accomplished by, for example, installing manually using CD or floppy disk supplied by the printer manufacturer. Or alternatively, a user may be able to download that particular driver from a network. For a home or office user, this installation process may take anywhere from several minutes to several hours depending on the type of driver and user sophistication level with computer devices and networks. Even with plug and play driver installation, it still

required the user to execute multiple step process for each printer. Nevertheless, this installation and configuration process is adding undoubtedly a degree of complexity and work to the end-user that may otherwise be spending this time doing other productive or enjoyable work. Moreover, many unsophisticated users may be discouraged from

5 adding new peripherals (e.g. printers, scanners) to his home computer or network to avoid the hassle of installation and configuration. Therefore, there is a need to provide a more user-friendly method where installation of printer drivers is more transparent to the end-user.

10 Moreover, Conventional printing method may pose significant higher challenge and difficulty for mobile device users than for home and office users. The requirement for pre-installation of device-dependent driver is in conflict with the concept of pervasive computing and printing. For example, a mobile user may want to print his e-mail, PowerPoint, web page, or other document at airport, in airplane, gas station, convenient

15 store, kiosk, hotel, conference room, office, and home. It is likely that the user finds at each of these locations printer of different make and model. It is usually not a viable option to pre-install all possible (hundreds if not thousands of) printer drivers in the user's information apparatus. Therefore, the user may have to install and configure a printer driver each time at each of these locations before printing. This is certainly an

20 undesirable and discouraging process to promote pervasive computing. Therefore, there's a need for a method that allows user to simply walk up to any printer, press a few buttons and receive his/her printouts.

The following example illustrates some of the problems that mobile users may

25 encounter under conventional printing paradigm. With hundreds of, if not thousands of, different printer models/make available in market, the chance is quite high that a mobile user finds different printers at different locations. A mobile user wanting to print only one page of his e-mail, walking up to a printer in an airport is unlikely to have the driver for that particular printer model preinstalled. Moreover, the user does not want to be

30 bothered with looking for a driver or downloading it and installing it just to print out one page of email at the airport. Therefore, a more convenient printing solution is needed so that a user can simply walk up to a printer and easily print his/her digital document without having to worry about installing or pre-installing particular printer drivers.

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