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(54) Title: SECURE PRINT POLICY ENFORCEMENT

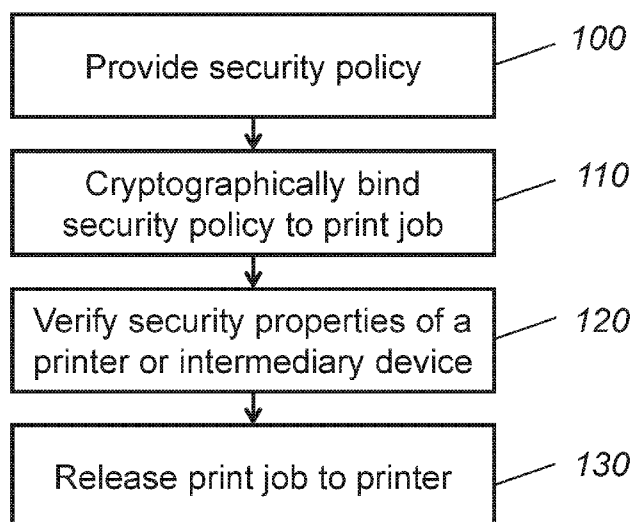


Figure 1

(57) Abstract: A method is described for enforcing a secure print policy, the method comprising providing a security policy, cryptographically binding the security policy to a print job to generate a secure print job, verify security properties of at least one of: a printer and an intermediary device using the security policy and a remote attestation protocol, and provided the security properties are verified, releasing the print job to the printer.

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,  
KM, ML, MR, NE, SN, TD, TG).

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- *as to the identity of the inventor (Rule 4.17(i))*
- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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## SECURE PRINT POLICY ENFORCEMENT

### BACKGROUND

[0001] Sensitive data can be protected from being printed in an unauthorised manner based on enforcement of a secure print policy that enables a security protocol to be followed. Some services, such as pull-print for example, may be configured by an administrator to use transport layer security (TLS) with known and verified printer certificates to provide some assurance that a user is printing to a printer identified by a company's IT policies. Tools can be provided that allow IT security management to monitor endpoints for non-compliant incidents and anomalies to allow security breaches to be identified quickly. It is also possible to perform print job routing in a distributed printing environment, where print job destination rules associate print job destinations with a security level to allow print jobs to be associated with a print job destination if security requirements are met.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0002] Various features of certain examples will be apparent from the detailed description which follows, taken in conjunction with the accompanying drawings, which together illustrate, by way of example only, a number of features, and wherein:

[0003] Figure 1 is a flow chart of a method for enforcing a secure print policy according to an example;

[0004] Figure 2 is a schematic of an instance of a secure print policy according to an example;

[0005] Figure 3 is a schematic of an associated policy for a print job according to an example; and

[0006] Figure 4 is a schematic of a production device according to an example.

## DETAILED DESCRIPTION

[0007] In the following description, for purposes of explanation, numerous specific details of certain examples are set forth. Reference in the specification to "an example" or similar language means that a particular feature, structure, or characteristic described in connection with the example is included in at least that one example, but not necessarily in other examples.

[0008] There is disclosed a method for enforcing a secure print policy by cryptographically binding the security policy to a rendering or print job. The job can be released to a rendering apparatus, such as a 2D or 3D printer for example, once a remote attestation protocol has been used to verify the security properties of the printer (or an intermediary device).

[0009] According to an example, a security policy is associated with a print job and the release of the print job occurs when the policy has been satisfied by verifying security properties of the printer or an intermediary device. The security policy can be cryptographically bound to the print job to ensure that it cannot be modified without detection. The security policy can be used in conjunction with a remote attestation protocol to verify security properties of the printer or the intermediary device before passing sensitive information to the printer or the intermediary device.

[0010] According to an example, a security policy can be instantiated and associated with a print job instance. Devices participating in a printing workflow can verify that a targeted printer satisfies the policy before allowing the document to be sent to the printer. This includes verification of the printer's integrity (attestation) and that the printer possesses a known public key or group public key based on the policy. Other aspects can also be checked, such as printer functionality, location, or other context.

[0011] Figure 1 shows a flow chart of a method for enforcing a secure print policy according to an example. When a user initiates a print job, an instance of a security policy is created at block 100.

[0012] Figure 2 shows a schematic of an instance of a secure print policy according to an example. When a print job is created the security policy is

instantiated and, if the route, destination server or printer is known, cryptographically bound to the print job. This bundle can be sent over an infrastructure or peer-to-peer link to the printer or intermediary device. When the policy specifies remote attestation to be run against the printer or intermediary device, the policy instance is sent to the device that performs the attestation.

[0013] A security policy can comprise of one or more of the following non-exhaustive list of properties: whether a printer is to have full-disk encryption turned on; a specific set of printers that the document is to be printed at (e.g. any printer, Printer A and Printer B, or any office Y printer); whether the print job can be retained after use; whether a printer is to have a specific operating system version installed; an expiry date on the print job after which it is to be destroyed if it is not released; and whether a print job can be transported on a bring-your-own-device (BYOD) or mobile device. These properties can be pred-defined and/or user configurable.

[0014] In an example, a policy can be used to enforce a number of properties about a printer including administrator defined values (name, location and so on), properties of the identity (e.g. expiration), and configuration of the printer (software, settings, hardware components).

[0015] Referring back to figure 1, the security policy is associated with a print job or print document at block 110 by cryptographically binding the security policy to the print job or print document.

[0016] In this connection, figure 3 shows an example of an associated security policy for a print job according to an example. In an example, if a workstation shares a symmetric key with a printer or print server, or if a workstation has the public key of any intermediary hops, the policy can be integrity protected and encrypted along with the print job before transportation to the printer or intermediary device. This binds the policy instance with the job instance, ensuring that the policy cannot be modified without detection by an honest participant. Similarly, a workstation that knows specific printer public keys or group keys for classes of printers (e.g. Office printers, printers on the third floor) can encrypt jobs for just those groups of printers.

[0017] In an example, the key can be shared using an authenticated encryption scheme. For example, a symmetric key can be encrypted with the public key of the intended printer to ensure only it can receive the symmetric key.

[0018] In an example, before the print job is provided to the printer or intermediary device, a device such as a mobile phone can verify that the targeted printer satisfies the security policy at block 120. In an example, if the print job goes directly to the printer, the user's workstation can verify that the printer satisfies the policy. In an example, if the print job is encrypted under a user key or sent using a mobile device, the user's mobile device can verify the policy once the printer is selected. In an example, if the print job is sent to a pull-print server, the server can check the policy. To verify the policy, the verifying device can ask the printer to perform a remote attestation to verify the printer's configuration as recorded in the measurement log. The policy can also be sent to the verified printer to ensure it handles the print job according to its criteria (e.g. does not retain the document after printing).

[0019] In an example, a print job is encrypted such that it is released when a user enters or otherwise provides a decryption PIN at or to a printer. Therefore, the job is released to the specific printer, but it does not tell the user anything about the integrity of the printer. Provided that the security properties and/or security policy have been verified, the print job or print document can be released to the printer or intermediary device at block 130. The policy is then selectable by the user at print time (from a print driver for example). This enables use cases to provide customers high assurance that print jobs are delivered to printers meeting specific requirements. For example, a job can be created that can be printed by printers in a secure location as defined by a privileged group key provided to such printers. For example, this covers scenarios where a user is in a public location like a hotel and wants to ensure print jobs are only released to printers with known configurations and security protection.

[0020] The methods described improve the security of a printing workflow and are of value to organizations such as law firms and financial institutions that manage highly confidential documents. Electronic documents vary in the degrees of protection that need to be afforded to them. This extends into the

printing domain. The methods described make it possible to define a security policy for a print job and be given assurance that the policy can and has been adhered to during the printing process. In an example, print jobs can be sent from a PC or mobile device over an unencrypted channel to the printer, or transport security like transport layer security (TLS) can be used.

[0021] In an example, since the identity of the endpoint is known, the integrity of the printer endpoint can be expressed in the security policy connection. This provides support for embedding integrity statements in TLS certificates and enhances its value and effectiveness. As such, the methods described add assurance that a pre-defined security policy has been adhered to and that the policy itself has not been modified. This makes enforcing security policies for print jobs much easier because a workstation issuing a print job has knowledge of how a target printer is secured or configured. For example, when printers have a certificate installed to enable TLS protocols for transport security, the user can tell how the target printer has been configured and if it is a valid printer, given a security policy that specifies which printers to use.

[0022] The methods described also remove the need for all printers to be maintained by a central authority and gives the user the control or assurance that the authority has performed checks. For example, services like pull-print may be configured by an administrator to use TLS with known and verified printer certificates and using the pull print service provides some guarantees that the user is printing to a printer identified by the enterprise IT policies.

[0023] Examples in the present disclosure can be provided as methods, systems or machine-readable instructions. Such machine-readable instructions may be included on a computer readable storage medium (including but not limited to disc storage, CD-ROM, optical storage, etc.) having computer readable program codes therein or thereon.

[0024] The present disclosure is described with reference to flow charts and/or block diagrams of the method, devices and systems according to examples of the present disclosure. Although the flow diagrams described above show a specific order of execution, the order of execution may differ from that which is depicted. Blocks described in relation to one flow chart may be combined with

those of another flow chart. In some examples, some blocks of the flow diagrams may not be necessary and/or additional blocks may be added. It shall be understood that each flow and/or block in the flow charts and/or block diagrams, as well as combinations of the flows and/or diagrams in the flow charts and/or block diagrams can be realized by machine readable instructions.

[0025] The machine-readable instructions may, for example, be executed by a general-purpose computer, a special purpose computer, an embedded processor or processors of other programmable data processing devices to realize the functions described in the description and diagrams. In particular, a processor or processing apparatus may execute the machine-readable instructions. Thus, modules of apparatus may be implemented by a processor executing machine readable instructions stored in a memory, or a processor operating in accordance with instructions embedded in logic circuitry. The term 'processor' is to be interpreted broadly to include a CPU, processing unit, ASIC, logic unit, or programmable gate set etc. The methods and modules may all be performed by a single processor or divided amongst several processors.

[0026] Such machine-readable instructions may also be stored in a computer readable storage that can guide the computer or other programmable data processing devices to operate in a specific mode.

[0027] For example, the instructions may be provided on a non-transitory computer readable storage medium encoded with instructions, executable by a processor. Figure 4 shows an example of a rendering apparatus in the form of a printing device 400 comprising a processor 410 associated with a memory 420. The memory 420 comprises computer readable instructions 100-130 which are executable by the processor 410. For example, the method shown in Figure 1 may be incorporated as computer readable instructions 100-130 that are executable by the processor 410. The instructions 100-130 comprise: Instruction 100 to provide a security policy, instruction 110 to cryptographically bind the security policy to a print job, instruction 120 to verify security properties of a printer or intermediary device, and instruction 130 to release the print job to the printer or intermediary device.

[0028] Such machine-readable instructions may also be loaded onto a computer or other programmable data processing devices, so that the computer or other programmable data processing devices perform a series of operations to produce computer-implemented processing, thus the instructions executed on the computer or other programmable devices provide a operation for realizing functions specified by flow(s) in the flow charts and/or block(s) in the block diagrams.

[0029] Further, the teachings herein may be implemented in the form of a computer software product, the computer software product being stored in a storage medium and comprising a plurality of instructions for making a computer device implement the methods recited in the examples of the present disclosure.

[0030] While the method, apparatus and related aspects have been described with reference to certain examples, various modifications, changes, omissions, and substitutions can be made without departing from the spirit of the present disclosure. In particular, a feature or block from one example may be combined with or substituted by a feature/block of another example.

[0031] The word "comprising" does not exclude the presence of elements other than those listed in a claim, "a" or "an" does not exclude a plurality, and a single processor or other unit may fulfil the functions of several units recited in the claims.

[0032] The features of any dependent claim may be combined with the features of any of the independent claims or other dependent claims.

## CLAIMS

1. A method for enforcing a secure print policy, the method comprising:  
  
providing a security policy;  
  
cryptographically binding the security policy to a print job to generate a secure print job;  
  
verifying security properties of at least one of: a printer and an intermediary device using the security policy and a remote attestation protocol;  
and  
  
provided the security properties are verified, releasing the print job to the printer.
2. A method as claimed in claim 1, wherein providing the security policy is performed when a user initiates the print job.
3. A method as claimed in claim 1, wherein the security policy comprises one or more properties that must be satisfied in order to verify the security policy.
4. A method as claimed in claim 3, wherein the properties are comprised of one or more of: whether the printer or intermediary device has full-disk encryption turned on; a specific set of printers or intermediary devices that the print job are to be printed at; whether the print job can be retained after use; whether the printer or intermediary device have specific operating system versions installed; an expiry date on the print job after which it is to be destroyed if it is not released; and whether the print job can be transported on a bring-your-own-device or mobile device.

5. A method as claimed in claim 1, wherein a workstation shares a symmetric key with the printer or intermediary device or a server thereof to protect the integrity of the security policy.
6. A method as claimed in claim 1, wherein the secure print job is encrypted before transportation to the printer or intermediary device.
7. A method as claimed in claim 1, wherein a bring-your-own-device or mobile device verifies the security properties.
8. A method as claimed in claim 1, wherein the security policy is sent to a device performing the remote attestation protocol.
9. A system for enforcing a secure print policy, the system comprising:
  - a server configured to,
    - provide a security policy;
    - cryptographically bind the security policy to a print job to generate a secure print job;
    - verify security properties of at least one of: a printer and an intermediary device using the security policy and a remote attestation protocol; and
    - provided the security properties are verified, release the print job to the printer.
10. A production device for enforcing a secure print policy, the production device comprising:

a processor configured to,

receive a security policy;

receive a secure print job having a security policy that is cryptographically bound to the print job;

receive a remote attestation protocol;

verify security properties of at least one of: a printer and an intermediary device using the security policy and a remote attestation protocol; and

provided the security properties are verified, produce the print job at the production device.

11. A production device as claimed in claim 10, wherein the production device is a three-dimensional printer.

12. A non-transitory machine-readable storage medium encoded with instructions executable by a processor, the machine-readable storage medium comprising:

instructions to:

(i) provide a security policy;

(ii) cryptographically bind the security policy to a print job to generate a secure print job;

(iii) verify security properties of at least one of: a printer and an intermediary device using the security policy and a remote attestation protocol; and

(iv) provided the security properties are verified, release the print job to the printer.

13. A non-transitory machine-readable storage medium encoded with instructions executable by a processor as claimed in claim 12, further comprising instructions to:

provide the security policy when a user initiates the print job.

14. A non-transitory machine-readable storage medium encoded with instructions executable by a processor as claimed in claim 12, further comprising instructions to:

encrypt the secure print job prior to transportation to the printer or intermediary device.

15. A non-transitory machine-readable storage medium encoded with instructions executable by a processor as claimed in claim 12, further comprising instructions to:

transmit the security policy to a device performing the remote attestation protocol.

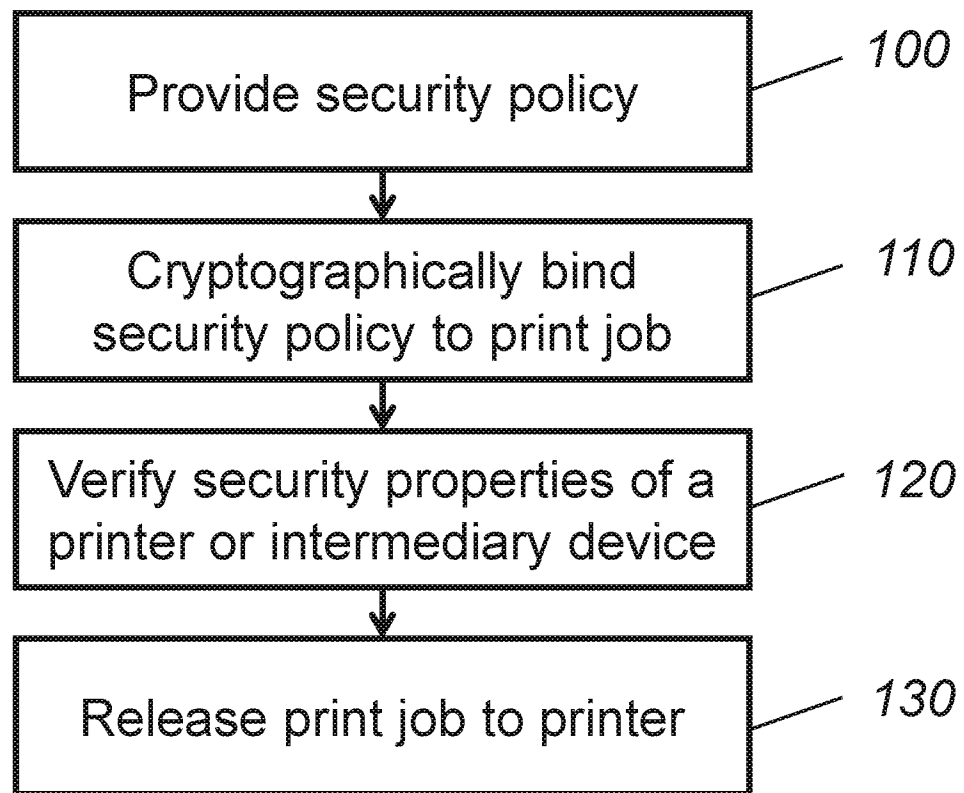


Figure 1

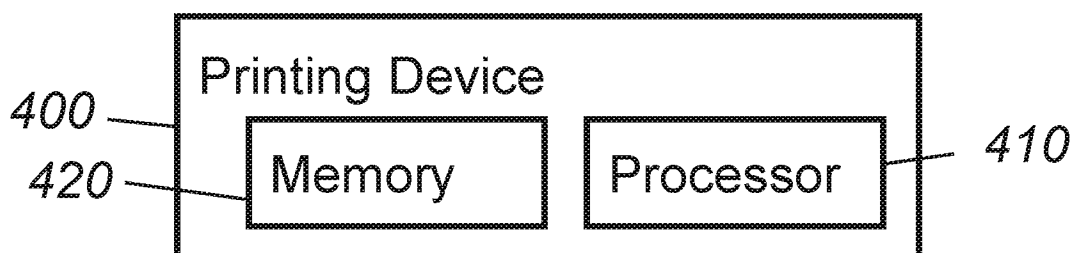
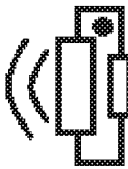


Figure 4

HP ePrint Secure Mobile Print

X



Connected



Recent

Print document  
838.Pdf

Document Policy

Destination

☐ Any printer (insecure)

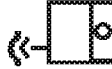
☐ Any office printer

☐ HP PageWide M586 MFP

Mobile

Transport using one of these devices:

☒ Nexus 5

☐ Nexus 6P

Cancel

Print

Figure 2

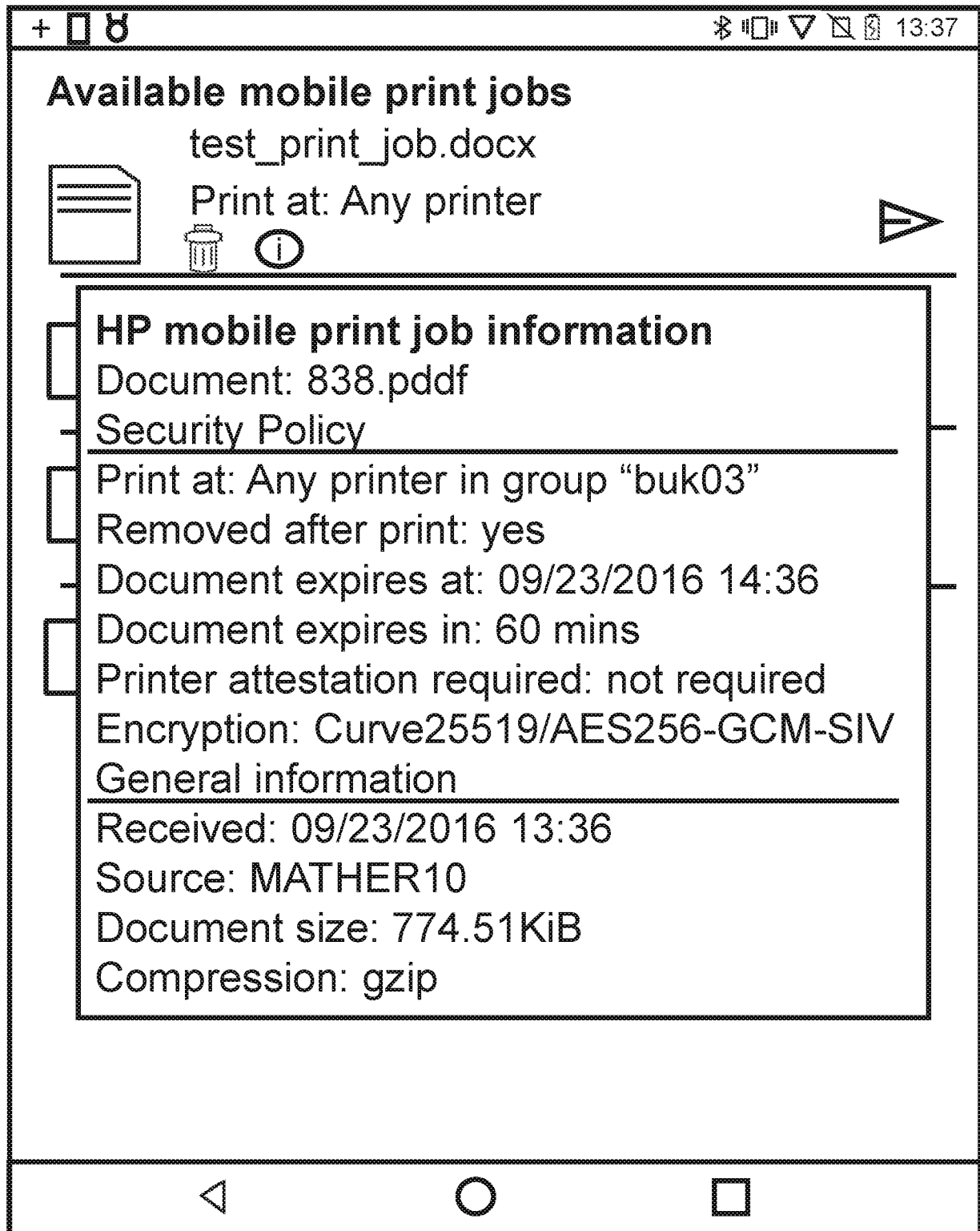


Figure 3

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2018/041937

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| A. CLASSIFICATION OF SUBJECT MATTER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                     |                                                                            |
| <p style="text-align: center;"><b>G06F 3/12 (2006.01)</b><br/> <b>G06F 21/84 (2013.01)</b></p> <p>According to International Patent Classification (IPC) or to both national classification and IPC</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                     |                                                                            |
| B. FIELDS SEARCHED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                     |                                                                            |
| Minimum documentation searched (classification system followed by classification symbols)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                     |                                                                            |
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| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                     |                                                                            |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                     |                                                                            |
| PatSearch (RUPTO internal), Esp@cenet, PAJ, USPTO, Information Retrieval System of FIPS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                     |                                                                            |
| C. DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                     |                                                                            |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                  | Relevant to claim No.                                                      |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | US 2009/0185223 A1 (KANAI YOICHI et al.) 23.07.2009, paragraphs [0037], [0386], [0388], [0391], [0392], [0412], [0413], [0435], [0437], [0402], [0403], [0442], [0443], [0478], [0481], [0608], [0676], [0678], [0702], fig. 41, 44 | 1-3, 6-7, 9-10, 12-14                                                      |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                     | 5, 8, 11, 15                                                               |
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| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | US 2016/0026418 A1 (VERIZON PATENT AND LICENSING INC.) 28.01.2016, paragraphs [0029], [0031]                                                                                                                                        | 5, 11                                                                      |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | US 2008/0034403 A1 (CANON KABUSHIKI KAISHA) 07.02.2008, paragraphs [0040], [0042]                                                                                                                                                   | 8, 15                                                                      |
| <input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                     |                                                                            |
| <p>* Special categories of cited documents:</p> <p>“A” document defining the general state of the art which is not considered to be of particular relevance</p> <p>“E” earlier document but published on or after the international filing date</p> <p>“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>“O” document referring to an oral disclosure, use, exhibition or other means</p> <p>“P” document published prior to the international filing date but later than the priority date claimed</p> <p>“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>“&amp;” document member of the same patent family</p> |                                                                                                                                                                                                                                     |                                                                            |
| Date of the actual completion of the international search                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                     | Date of mailing of the international search report                         |
| 15 October 2018 (15.10.2018)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                     | 01 November 2018 (01.11.2018)                                              |
| Name and mailing address of the ISA/RU:<br>Federal Institute of Industrial Property,<br>Berezhkovskaya nab., 30-1, Moscow, G-59,<br>GSP-3, Russia, 125993<br>Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                     | Authorized officer<br><br>A. Grigoriev<br><br>Telephone No. (495)531-64-81 |