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- (54) **METHOD AND APPARATUS FOR CONTROLLING ACCESS TO ENCRYPTED DATA** 7,346,170 B2 * 3/2008 Asano H04L 9/0822
380/278
7,814,554 B1 * 10/2010 Ragner G06F 21/52
726/27
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G11B 20/00166
713/193
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380/277
8,542,833 B2 * 9/2013 Devol G06F 21/552
380/259
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(Continued)

OTHER PUBLICATIONS

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(57) **ABSTRACT**

A method and apparatus for controlling access to encrypted data is provided. The device comprises: a processor and a memory, the processor configured to: control access to encrypted data, stored at the memory, the encrypted data categorized according to a plurality of categories, using a respective encryption key for each category in the plurality of categories; and, control access to a given encryption key according to given criteria associated with a given category, respective criteria different for each respective category, access to the given encryption key including one or more of, when the respective criteria are met, generating the given encryption key and decrypting the given encryption key.

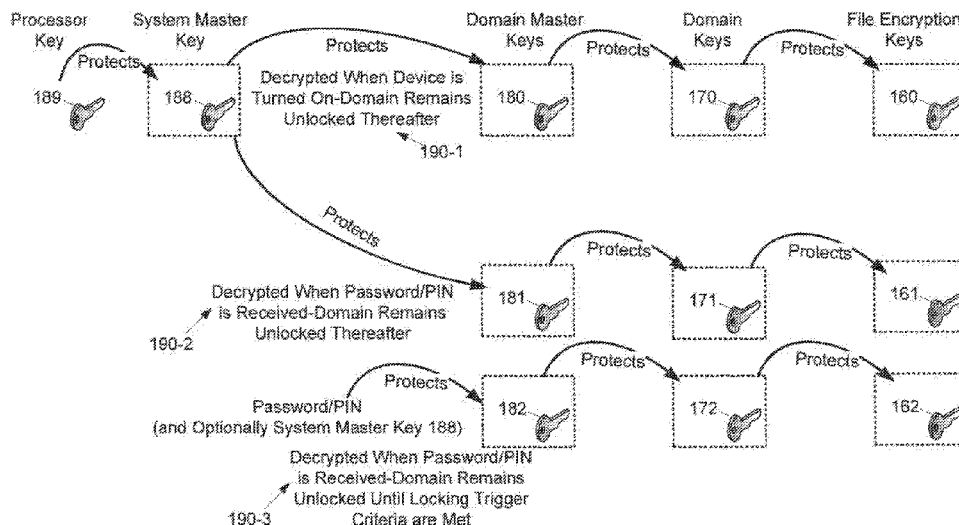
- (51) **Int. Cl.**
G06F 12/14 (2006.01)
G06F 21/60 (2013.01)
G11B 20/00 (2006.01)
- (52) **U.S. Cl.**
CPC **G11B 20/0021** (2013.01); **G06F 21/602** (2013.01)
- (58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

- 6,367,019 B1 4/2002 Ansell et al.
- 6,405,309 B1 * 6/2002 Cheng G06F 9/4401
713/1

23 Claims, 9 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

2005/0232415 A1 10/2005 Little et al.
2006/0190724 A1 8/2006 Adams et al.
2010/0150342 A1* 6/2010 Richards H04L 9/0833
380/30
2011/0035600 A1* 2/2011 Busser G06F 21/6227
713/189
2011/0238985 A1 9/2011 Sovio et al.
2011/0252234 A1* 10/2011 De Atley H04L 9/0894
713/165

OTHER PUBLICATIONS

CIPO, Office Action, dated Dec. 21, 2020 re Canadian Patent Application No. 2869791.
Search Report dated Apr. 22, 2015, issued on Corresponding European Patent Application No. 14191915.9. 7 pages.
SMS & Apps Lock <https://play.google.com/store/apps/details?id=mig.app.sms>; accessed Oct. 3, 2013.

* cited by examiner

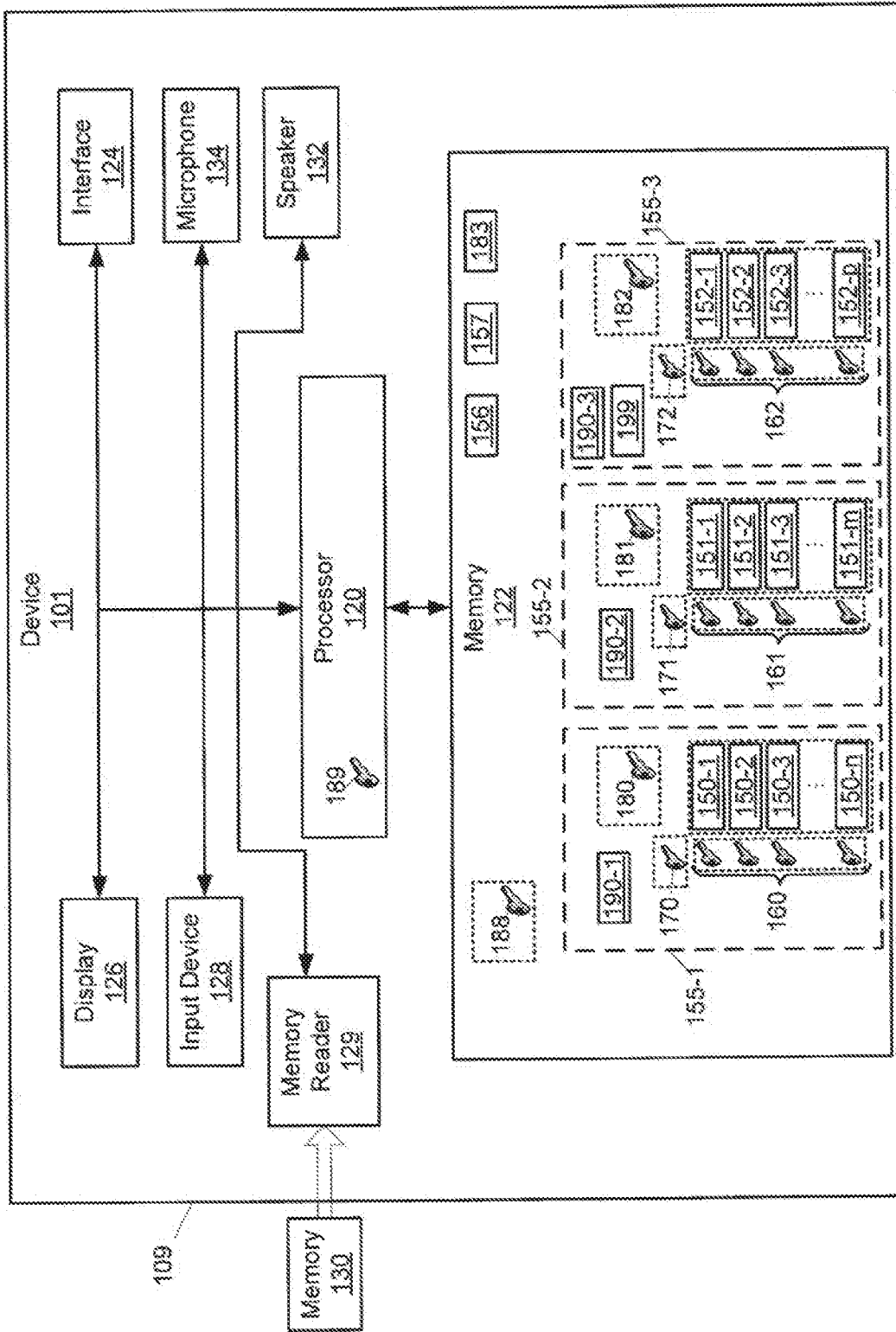


Fig. 1

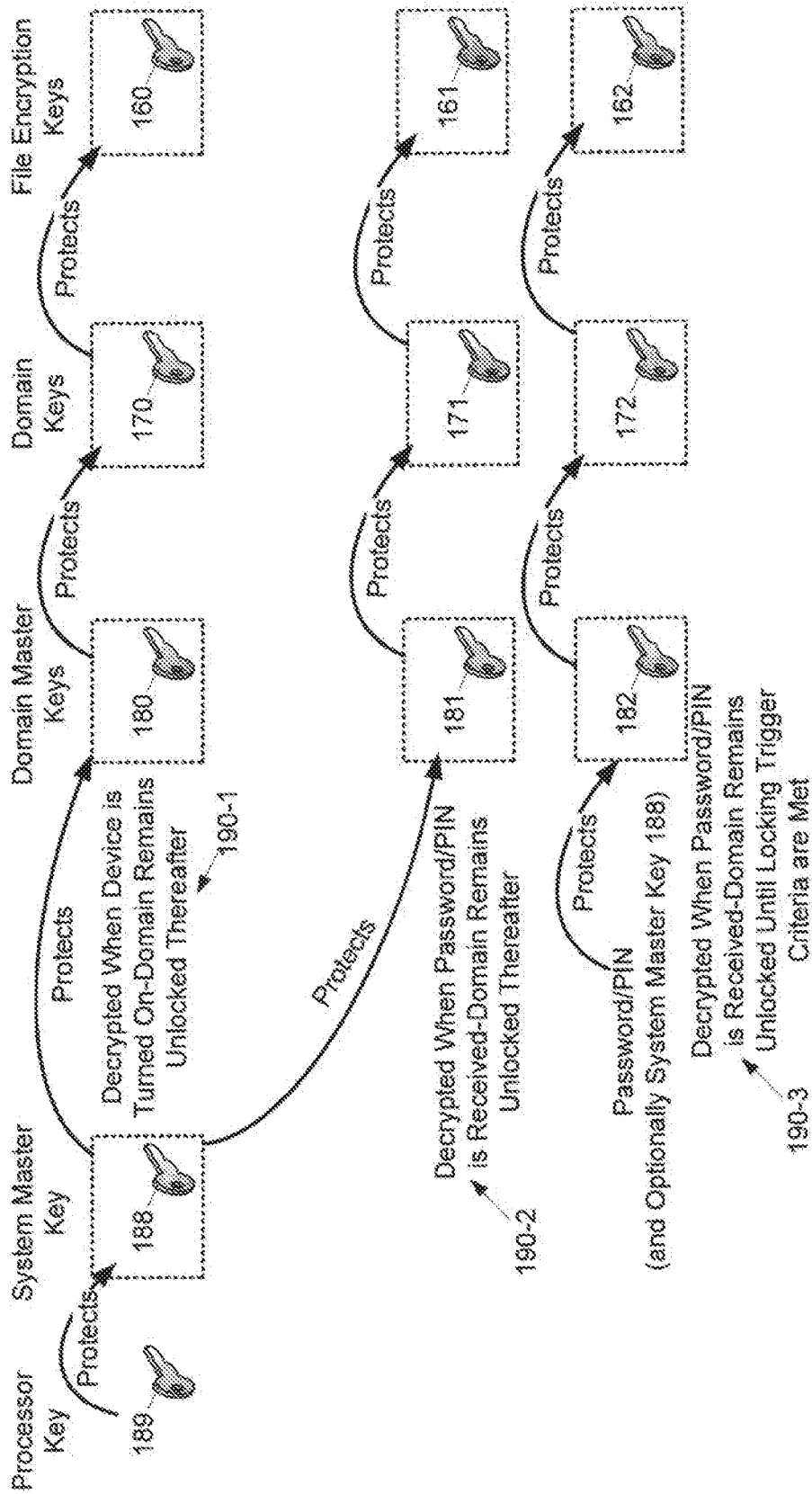


Fig. 2

300 ↘

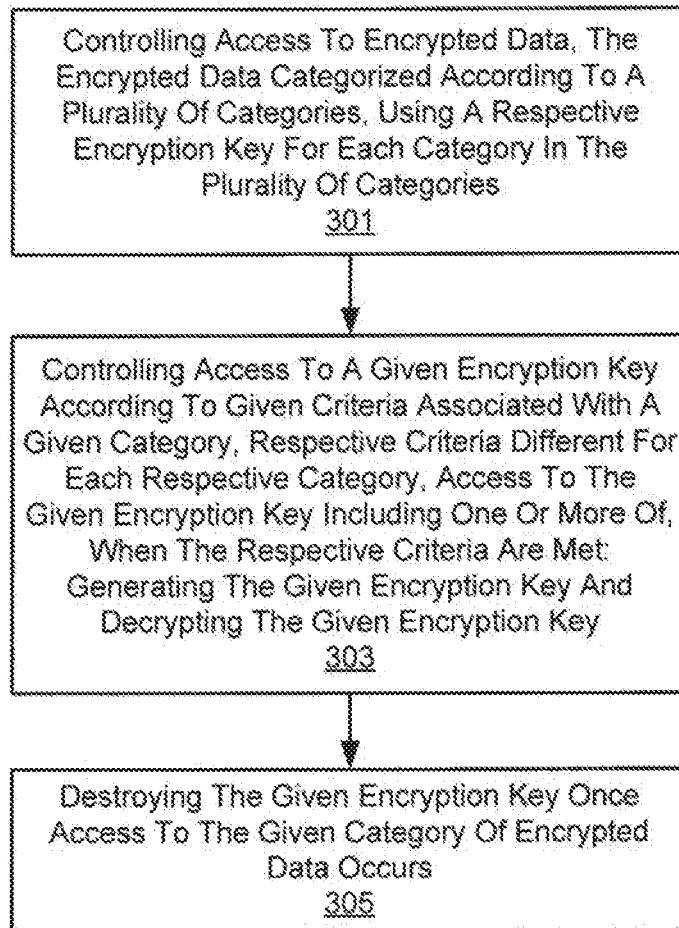


Fig. 3

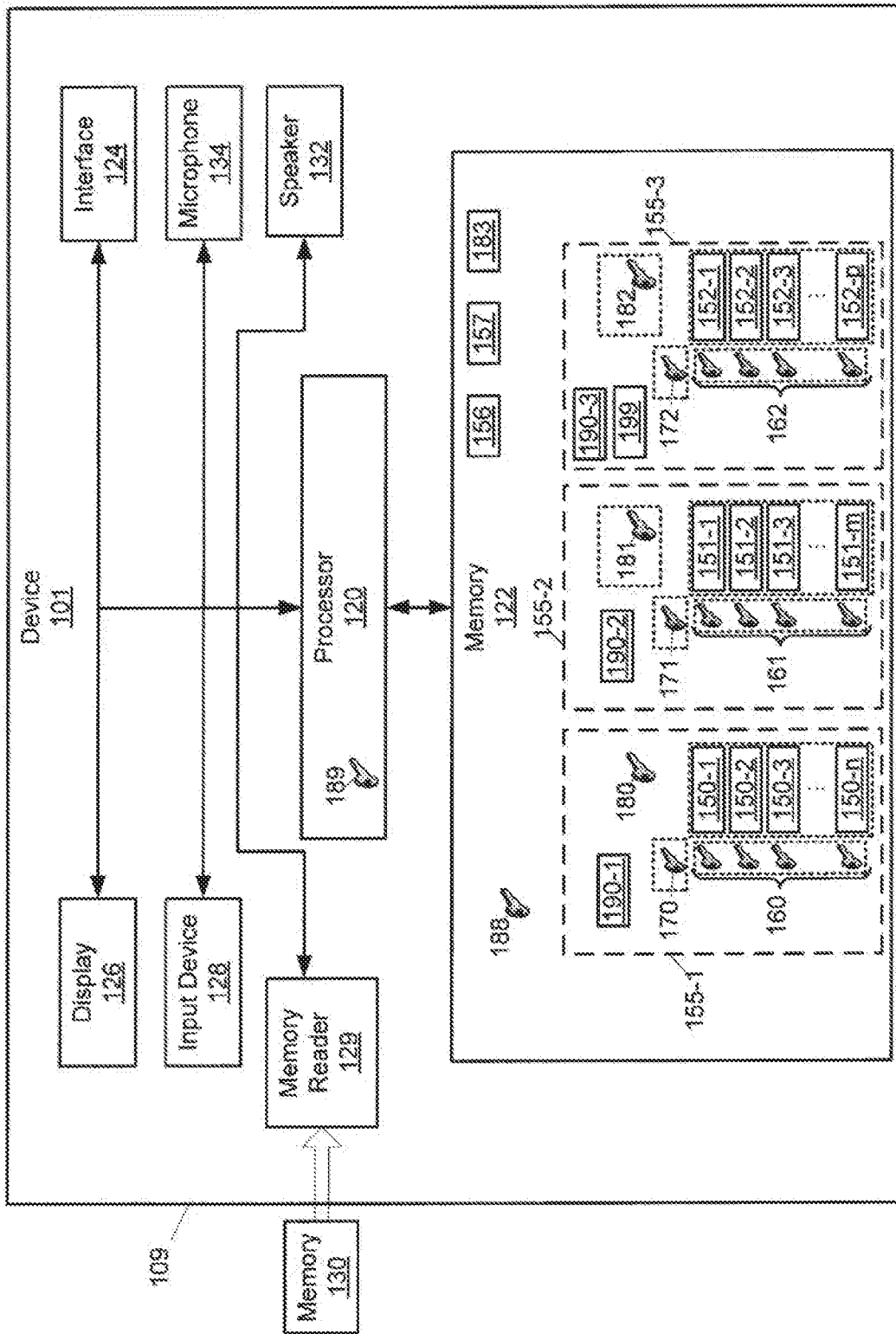


Fig. 4

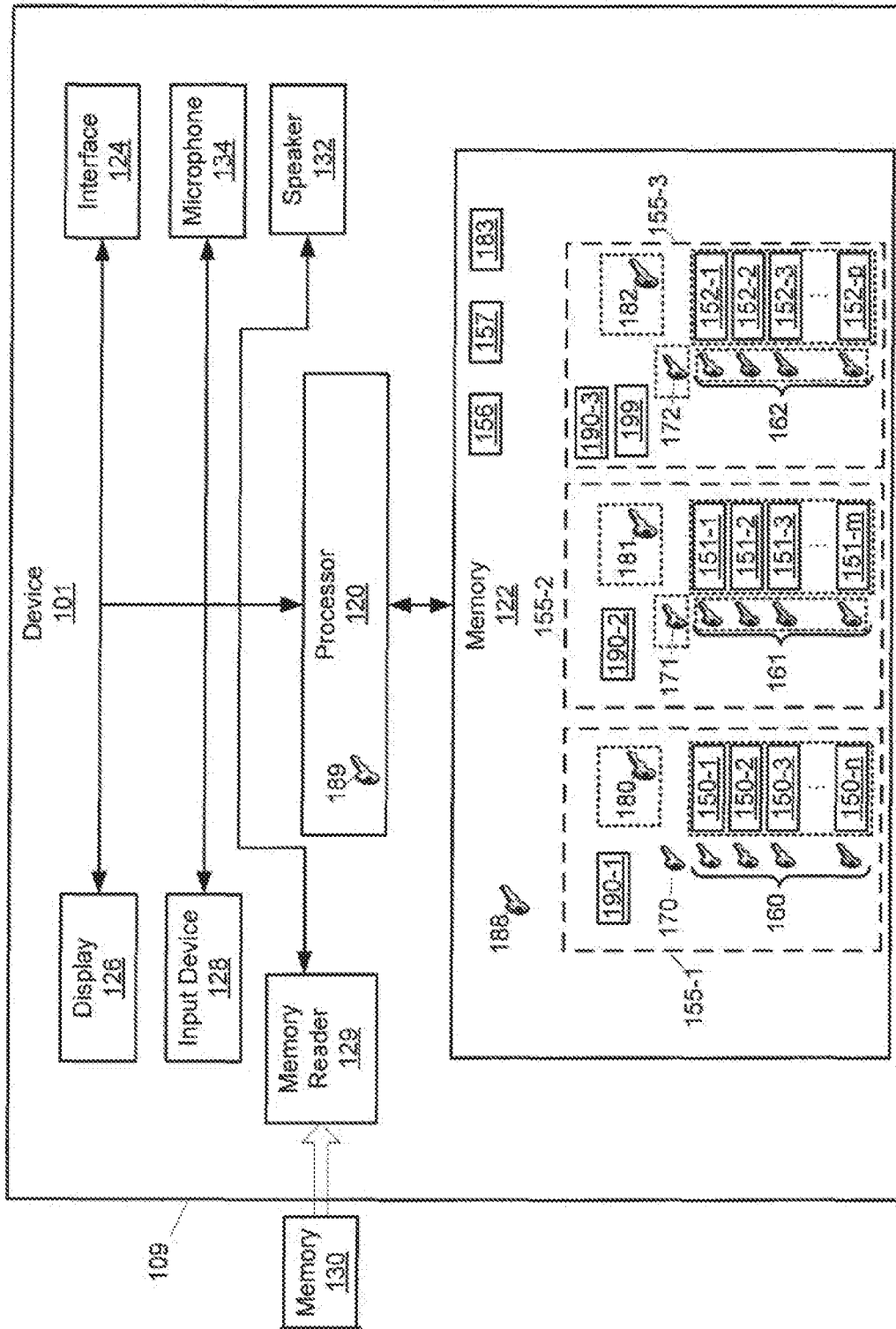


Fig. 5

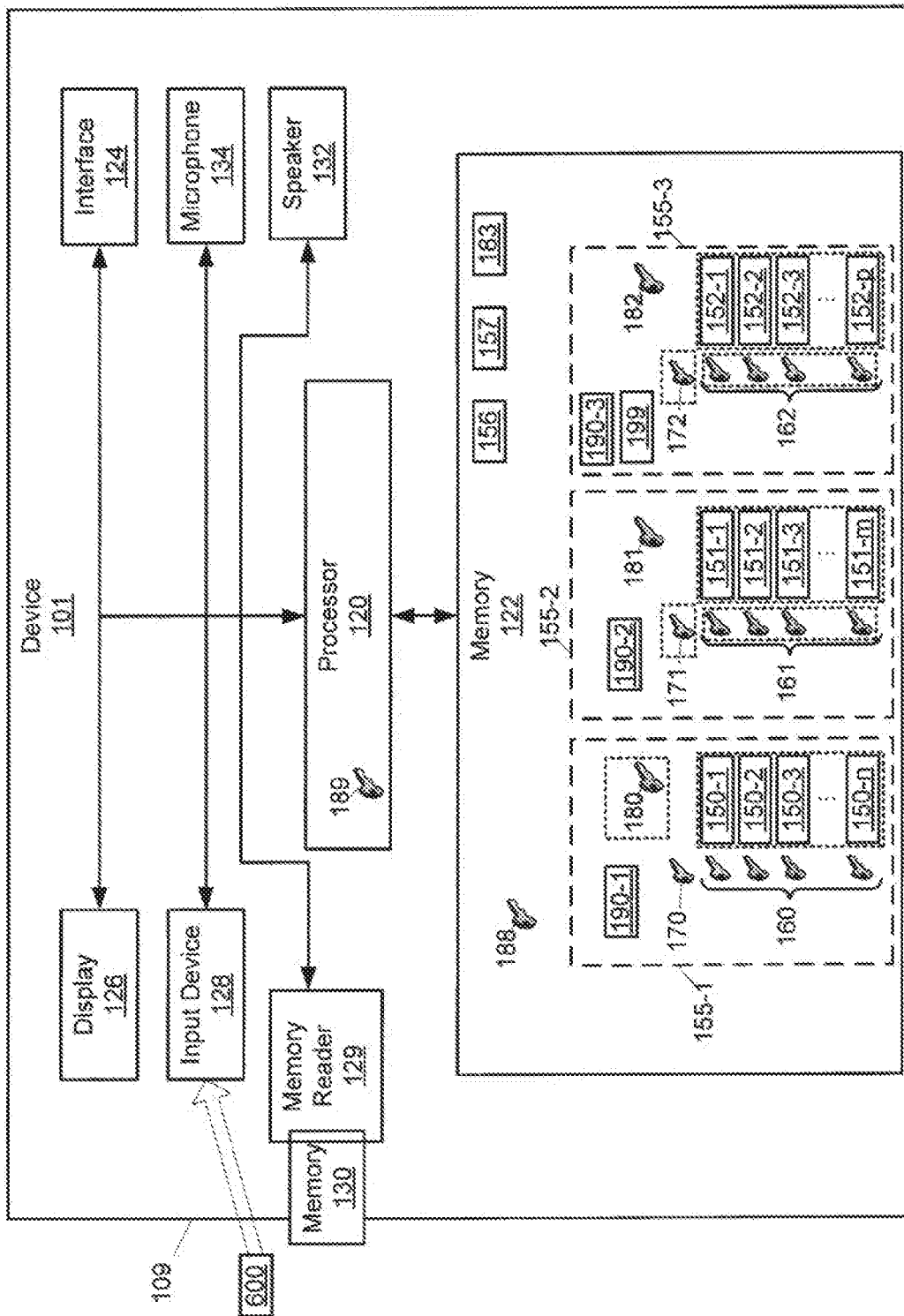


Fig. 6

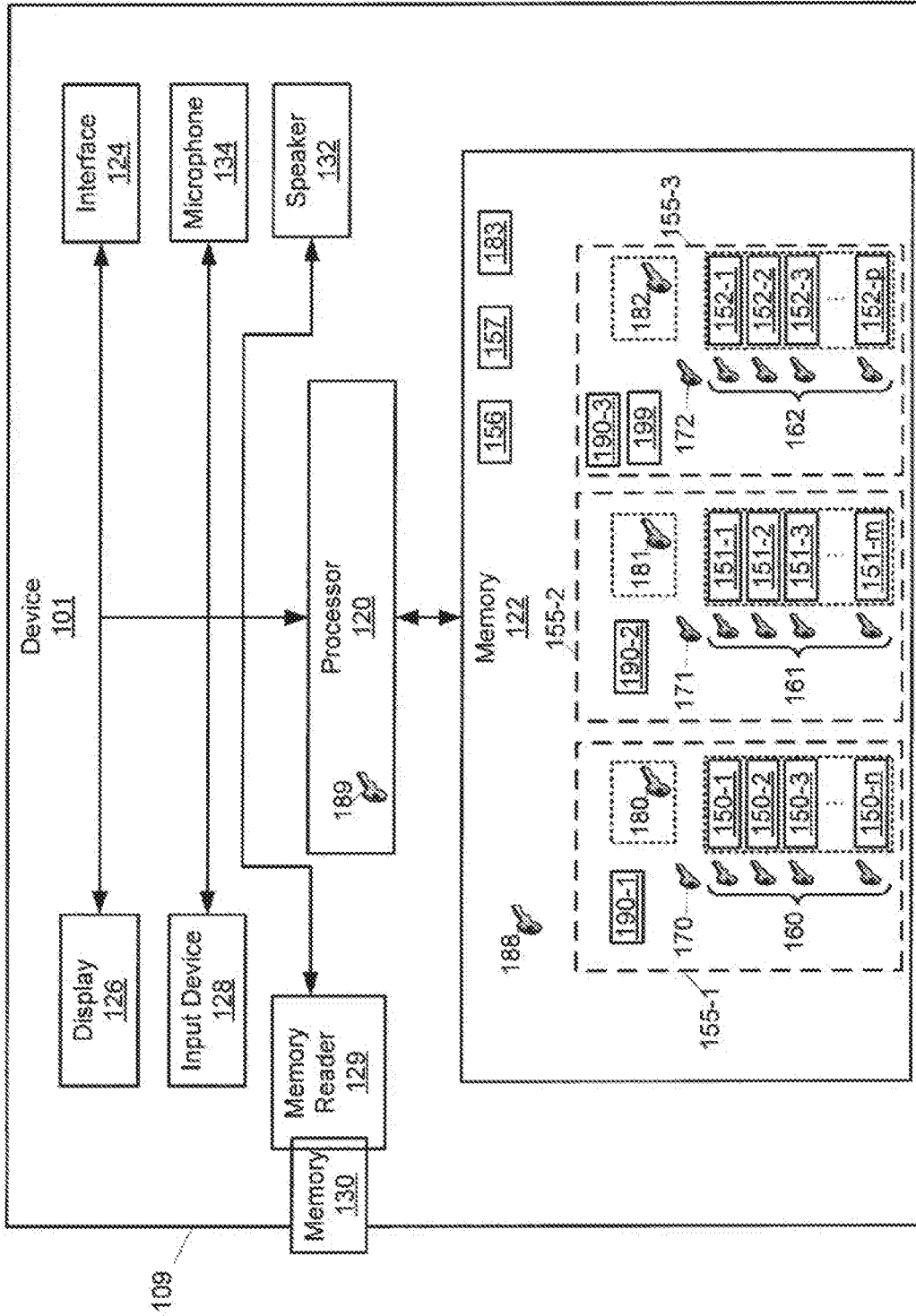


Fig. 7

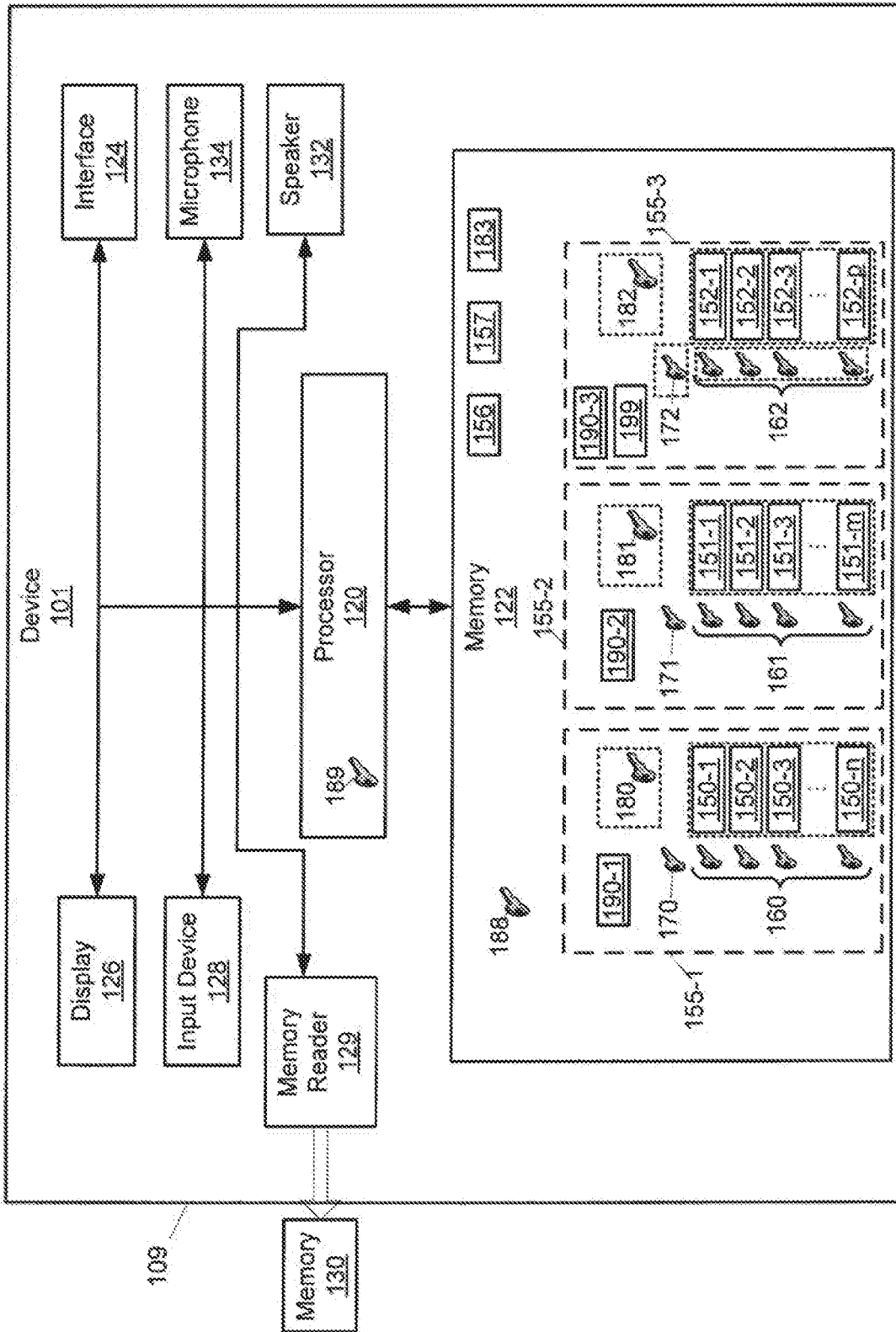


Fig. 8

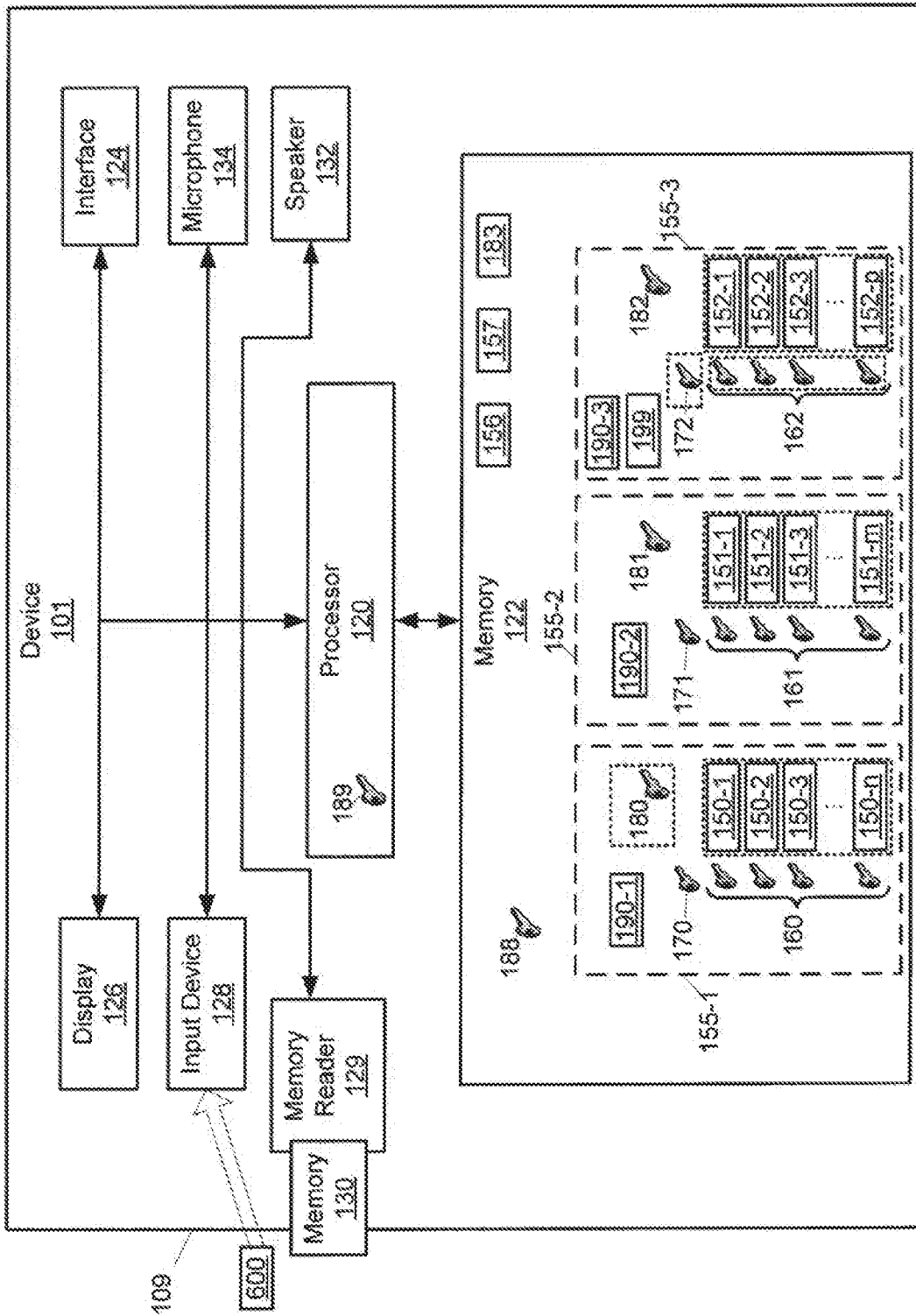


Fig. 9

METHOD AND APPARATUS FOR CONTROLLING ACCESS TO ENCRYPTED DATA

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

FIELD

The specification relates generally to devices, and specifically to a method and apparatus for controlling access to encrypted data.

BACKGROUND

The evolution of computers is currently quite active in the mobile device environment. It is now well-known to including calendaring, contacts, and messaging functions in mobile devices. More recently, there has been a veritable explosion of the number and type of applications that are configured to the unique form factors and computing environments of mobile devices.

BRIEF DESCRIPTIONS OF THE DRAWINGS

For a better understanding of the various implementations described herein and to show more clearly how they may be carried into effect, reference will now be made, by way of example only, to the accompanying drawings in which:

FIG. 1 depicts a device for controlling access to encrypted data, according to non-limiting implementations.

FIG. 2 depicts relationships between encryption keys and criteria for gaining access thereto, according to non-limiting implementations.

FIG. 3 depicts a method for controlling access to encrypted data, according to non-limiting implementations.

FIG. 4 depicts the device of FIG. 1 after start-up, according to non-limiting implementations.

FIG. 5 depicts the device of FIG. 1 after a start-up category has been unlocked, according to non-limiting implementations.

FIG. 6 depicts the device of FIG. 1 after an initial authentication, according to non-limiting implementations.

FIG. 7 depicts the device of FIG. 1 after an operational category and locked category have been unlocked, according to non-limiting implementations.

FIG. 8 depicts the device of FIG. 1 after locking trigger criteria are met and locked category is again locked, according to non-limiting implementations.

FIG. 9 depicts the device of FIG. 1 after authentication reoccurs and the locked category is again unlocked, according to non-limiting implementations.

DETAILED DESCRIPTION

In general, this disclosure is directed to a device, and in particular a mobile electronic device, for controlling access to encrypted data stored thereupon. In general, mobile electronic devices represent electronic devices that are readily movable from place to place. In particular, data at such devices is encrypted to prevent the data from being accessed in the even the device is lost, stolen or the like. Further, the

data can be organized into different categories that can include, for example, a “work” category of data pertaining to a business and/or a government entity that issued the device. In some devices, all “work” data is encrypted while at rest and is fully inaccessible when the device is powered off. After device reboot, however, all “work” data can be accessible due to an encryption key for the “work” data being automatically restored to memory after the device reboot, which can hence be usable by services that have sufficient permissions. Although accessing the data is controlled by data access policies, security conscious organizations are mindful of such key availability being a substantial attack vector. Hence, present implementations provided advanced protection control of access to data at the devices, including, but not limited to data categorized as sensitive, such sensitive data stored in a manner similar to the device being powered off, while still enabling the device and, “non-sensitive” data in the “work” space, to remain sufficiently accessible.

In this specification, elements may be described as “configured to” perform one or more functions or “configured for” such functions. In general, an element that is configured to perform or configured for performing a function is configured to perform the function, or is suitable for performing the function, or is adapted to perform the function, or is operable to perform the function, or is otherwise capable of performing the function.

In this specification, data may be described as being “accessible”. In general, an element that is accessible is unencrypted, decrypted and/or an encryption key for decrypting the data is itself accessible and/or unencrypted and/or decrypted.

An aspect of the present specification provides a method comprising: controlling access to encrypted data, stored at a memory of a device, the encrypted data categorized according to a plurality of categories, using a respective encryption key for each category in the plurality of categories; and, controlling access to a given encryption key according to given criteria associated with a given category, respective criteria different for each respective category, access to the given encryption key including one or more of, when the respective criteria are met: generating the given encryption key and decrypting the given encryption key.

Access to the given encryption key may not be available until the given criteria is met.

The method can further comprise destroying the given encryption key once access to the given category of encrypted data occurs.

Each of the plurality of categories can be based on one or more of a ranking system, data sensitivity, operational needs of the device, and usability of the device.

The encrypted data can be partitioned at the memory based on the plurality of categories, each of the partitions can comprise one or more of a physical partition of the memory and a virtual partition.

Access to the given encryption key can comprise one or more of: decrypting the given encryption key using one or more of a system master key, a processor key, and data read from an external memory received in an external memory reader of the device; and generating the given encryption key from the data read from the external memory received in the memory reader.

The method can further comprise: decrypting, using the given encryption key, a given category encryption key previously generated when the given category was first

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generated; and, decrypting using the given category key, one or more file encryption keys used to decrypt the encrypted data for the given category.

One of the plurality of categories of the encrypted data can comprise a start-up category, start-up encrypted data associated therewith used to start the device when the device is turned on and prior to receiving user input at an input device, start-up criteria associated with the start-up category can comprise determining that the device has been turned on, the start-up encrypted data can remain accessible once a master start-up encryption key is accessed after the start-up criteria is met, and the method can further comprise: decrypting, using the master start-up encryption key, at least one encryption key for decrypting the start-up encrypted data.

One of the plurality of categories of the encrypted data can comprise an operational category, operational encrypted data associated therewith used to one or more of: operate the device after the device is turned on; perform operations at the device; and provide a user an operational experience at the device, operational criteria associated with the operational category comprising: receiving input using an input device, that matches one or more of password data stored at the memory and PIN (personal identification number) data read from an external memory received in an external memory reader of the device, the operational encrypted data can remain accessible once a master operational encryption key is accessed after the operational criteria is met, and the method can further comprise: decrypting, using the master operational encryption key, at least one encryption key for decrypting the operational encrypted data.

One of the plurality of categories of the encrypted data can comprise a locked category of locked encrypted data, locked criteria associated with the locked category can comprise: receiving input using an input device, that matches one or more of password data stored at the memory and PIN (personal identification number) data read from an external memory received in an external memory reader of the device, once a master locked encryption key accessed after the locked criteria is met, and the method can further comprise: decrypting, using the master locked encryption key, at least one encryption key for decrypting the locked encrypted data; and, destroying the at least one encryption key when one or more locking trigger criteria are met such that the locked encrypted data is no longer accessible until the locked criteria is again met.

The locking trigger criteria can comprise one or more of: determining that a time-out period has occurred; receiving, at the device, a locking command from a server; receiving a locking command from applications running at the device; determining that an external memory has been removed from an external memory reader; and, determining that device is being one or more of turned on and powered down. The method can further comprise one or more of: controlling applications running at the device to transition to a reduced functionality state once the one or more locking trigger criteria are met; and, stopping the applications running at the device once the one or more locking trigger criteria are met.

Another aspect of the specification provides a device comprising: a processor and a memory, the processor configured to: control access to encrypted data, stored at the memory, the encrypted data categorized according to a plurality of categories, using a respective encryption key for each category in the plurality of categories; and, control access to a given encryption key according to given criteria associated with a given category, respective criteria different

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for each respective category, access to the given encryption key including one or more of, when the respective criteria are met; generating the given encryption key and decrypting the given encryption key.

Access to the given encryption key may not be available until the given criteria are met.

The processor can be further configured to destroy the given encryption key once access to the given category of encrypted data occurs.

Each of the plurality of categories can be based on one or more of a ranking system, data sensitivity, operational needs of the device, and usability of the device.

The encrypted data can be partitioned at the memory based on the plurality of categories, each of the partitions can comprise one or more of a physical partition of the memory and a virtual partition.

The processor can be further configured to provide access to the given encryption key by one or more of: decrypting the given encryption key using one or more of a system master key, a processor key, and data read from an external memory received in an external memory reader of the device; and generating the given encryption key from the data read from the external memory received in the memory reader.

The processor can be further configured to: decrypt, using the given encryption key, a given category encryption key previously generated when the given category was first generated; and, decrypt, using the given category key, one or more file encryption keys used to decrypt the encrypted data for the given category.

One of the plurality of categories of the encrypted data can comprise a start-up category, start-up encrypted data associated therewith used to start the device when the device is turned on and prior to receiving user input at an input device, start-up criteria associated with the start-up category can comprise determining that the device has been turned on, the start-up encrypted data can remain accessible once a master start-up encryption key is accessed after the start-up criteria is met, and the method can further comprise: decrypting, using the master start-up encryption key, at least one encryption key for decrypting the start-up encrypted data.

One of the plurality of categories of the encrypted data can comprise an operational category, operational encrypted data associated therewith used to one or more of: operate the device after the device is turned on; perform operations at the device; and provide a user an operational experience at the device, operational criteria associated with the operational category comprising: receiving input using an input device, that matches one or more of password data stored at the memory and PIN (personal identification number) data read from an external memory received in an external memory reader of the device, the operational encrypted data can remain accessible once a master operational encryption key is accessed after the operational criteria is met, and the method can further comprise: decrypting, using the master operational encryption key, at least one encryption key for decrypting the operational encrypted data.

One of the plurality of categories of the encrypted data can comprise a locked category of locked encrypted data, locked criteria associated with the locked category can comprise: receiving input using an input device, that matches one or more of password data stored at the memory and PIN (personal identification number) data read from an external memory received in an external memory reader of the device, once a master locked encryption key accessed after the locked criteria is met, and the method can further

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comprise: decrypting, using the master locked encryption key, at least one encryption key for decrypting the locked encryption data; and, destroying the at least one encryption key when one or more locking trigger criteria are met such that the locked encrypted data is no longer accessible until the locked criteria is again met.

The locking trigger criteria can comprise one or more of: determining that a time-out period has occurred; receiving, at the device, a locking command from a server; receiving a locking command from applications running at the device; determining that an external memory has been removed from an external memory reader; and, determining that the device is being one or more of turned off and powered down. The processor can be further configured to one or more of: control applications running at the device to transition to a reduced functionality state once the one or more locking trigger criteria are met; and, stop the applications running at the device once the one or more locking trigger criteria are met.

A further aspect of the specification provides a computer program product, comprising a computer readable program code adapted to be executed to implement a method comprising: controlling access to encrypted data, stored at a memory of a device, the encrypted data categorized according to a plurality of categories, using a respective encryption key for each category in the plurality of categories; and, controlling access to a given encryption key according to given criteria associated with a given category, respective criteria different for each respective category, access to the given encryption key including one or more of, when the respective criteria are met: generating the given encryption key and decrypting the given encryption key. The computer usable medium can comprise a non-transitory computer usable medium.

FIG. 1 depicts a device 101 for controlling access to encrypted data. Device 101 comprises a housing 109, which houses a processor 120 interconnected with a memory 122, a communications interface 124, a display 126, and an input device 128, and optionally an external memory reader 129 (configured to receive an external memory 130), a speaker 132, and a microphone 134. Communications interface 124 will be interchangeably referred to as interface 124. Device 101 further stores encrypted data 150-1, 150-2, 150-3 . . . 150-n, 151-1, 151-2, 151-3 . . . 151-m, 152-1, 152-2, 152-3 . . . 152-p at memory 122. Data 150-1, 150-2, 150-3 . . . 150-n will also be referred to hereafter collectively and generically as data 150, data 151-1, 151-2, 151-3 . . . 151-m will also be referred to hereafter collectively and generically as data 151, and data 152-1, 152-2, 152-3 . . . 152-p will also be referred to hereafter collectively and generically as data 152. Each of data 150, 151, 152 can comprise data files, messages, email, calendar data, PIM (personal information manager) data, applications and the like. Memory 122 further stores an application 156 for controlling access to encrypted data 150, 151, 152. In some implementations, as depicted memory 122 further stores one or more applications 157 that use encrypted data 150, and/or encrypted data 151 and/or encrypted data 152 to operate and/or access and/or function, once encrypted data 150, and/or encrypted data 151 and/or encrypted data 152 is unencrypted, as described below.

A number of “n” sets of data 150, a number “m” sets of data 151, and a number “p” sets of data 152, “n”, “m”, and “p” can each be the same or different; indeed there is generally no correlation between the numbers “n”, “m” and “p”.

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Further, data 150, 151, 152 is categorized according to a plurality of categories 155-1, 155-2, 155-3, which are delineated in FIG. 1 by broken lines. Plurality of categories 155-1, 155-2, 155-3 will be collectively referred to hereafter as categories 155, and generically as a category 155. Further, while three categories 155 are depicted, any number of categories is within the scope of present implementations.

Further, data associated with each of categories 155 is not limited to respective encrypted data 150, 151, 152; rather other types of data can be associated with each category 155, including, but not limited to, respective encryption keys, respective criteria and the like, as described hereafter. Each category 155 can also be referred to as a “domain” and can be distinguished from each other at memory 122 via one or more of physical partitioning of memory 122 and/or virtual partitions at memory 122. In other words, encrypted data 150, 151, 152 can be partitioned at memory 122 based on the plurality of categories 155, each of the partitions comprising one or more of a physical partition of memory 122 and a virtual partition. Alternatively, encrypted data 150, 151, 152 can be categorized using one or more of labels, metadata and the like. Each category 155 and/or partition and/or virtual partition can further comprise associated keys and criteria, as described hereafter.

In a non-limiting example, one of the plurality of categories 155 of encrypted data, for example category 155-1 and/or data 150, can comprise a start-up category, start-up encrypted data 150 associated therewith used to start device 101 when device 101 is turned on and/or powered up. Another one of the plurality of categories 155 of encrypted data, for example category 155-2 and/or data 151, can comprise an operational category, operational encrypted data 151 associated therewith used to one or more of: operate device 101 after device 101 is turned on; perform operations at device 101; and provide a user of device 101 an operational experience at device 101. Another one of the plurality of categories 155 of encrypted data, for example category 155-3 and/or data 152, can comprise a locked category of locked encrypted data 152. Each of these categories will be described in more detail below, however, locked data 152 can comprise one or more of sensitive data and/or data associated with an enterprise operating and/or issuing and/or controlling device 101, such as a government or business; hence, locked data 152 can comprise data that is considered particularly sensitive to the enterprise. In some implementations locked category 155-3 can be referred to as a work domain as category 155-3 can comprise data, associated with an entity that employs a user of device 101, that can be characterized as “sensitive” data by the entity.

In some implementations, the plurality of categories 155 can be ranked, for example according to sensitivity of data 150, 151, 152 associated with each category 155. Hence, each of the plurality of categories 155 can be based on one or more of a ranking system, data sensitivity, operational needs of device 101, and usability of device 101.

In any event, each of data 150, 151, 152 can be unencrypted with a respective key 160, 161, 162 respective to each set of data 150, 151, 152. Each of keys 160, 161, 162 can comprise a symmetric encryption key including, but not limited to a 256 bit symmetric encryption key, which can be randomly generated when a respective set of data 150, 151, 152 is generated. Each of keys 160, 161, 162 can hence also be referred to as a file encryption key (“FEK”), and stored, encrypted (as described below) as a metadata attribute of associated encrypted data 150, 151, 152.

Keys 160, 161, 162, can be in a one-to-one relationship with data 150, 151, 152. In other words, there can be a

respective key **160** for each of data **150-1**, **150-2**, **150-3** . . . **150-n** (i.e. a number “n” sets of data **150**, and a number “n” keys **160**), a respective key **161** for each of data **151-1**, **151-2**, **151-3** . . . **151-n** (i.e. a number “m” sets of data **151**, and a number “m” keys **161**), and a respective key **162** for each of data **152-1**, **152-2**, **152-3** . . . **152-n** (i.e. a number “p” sets of data **152**, and a number “p” keys **162**). Hence the term key **160** refers to a set of “n” keys **160**, the term keys **161** refers to a set of “m” keys **161**, and the term keys **162** refers to a set of “p” keys **162**.

In FIG. 1, data **150**, **151**, **152** being encrypted are designated by dashed lines surrounding each of the encrypted data **150**, **151**, **152**, which is distinct from the broken lines delineating each category **155**.

Further, each of keys **160**, **161**, **162** is encrypted using a respective encryption key **170**, **171**, **172** associated with each category **155**; keys **160**, **161**, **162** being encrypted is designated by dashed lines surrounding each of keys **160**, **161**, **162**, which is distinct from the broken lines delineating each category **155**.

Each of keys **170**, **171**, **172** can comprise a symmetric encryption key including, but not limited to a 256 bit symmetric encryption key, which can be randomly generated when a respective category **155** is first generated. Each of keys **170**, **171**, **172** can hence also be referred to as a “domain” key. Each of domain keys **170**, **171**, **172** can include, but is not limited to an AES (Advanced Encryption Standard) key, implemented using CBC (cipher-block chaining), XTS (ciphertext stealing) and the like, but other types of encryption keys are within the scope of present implementations.

Further, each of domain keys **170**, **171**, **172** is encrypted using a respective encrypted master key **180**, **181**, **182** associated with each category **155**; keys **170**, **171**, **172** being encrypted is designated by dashed lines surrounding each of keys **170**, **171**, **172**, which is distinct from the broken lines delineating each category **155**.

The process of unencrypting domain keys **170**, **171**, **172** can colloquially be referred to as “unlocking a domain”, and the process of deleting unencrypted domain keys **170**, **171**, **172** can colloquially be referred to as “locking a domain”.

Hence, memory **122** can further store an encrypted master key **180**, **181**, **182** associated with each category **155**. For example encrypted master key **180** is associated with category **155-1**, encrypted master key **181** is associated with category **155-2**, and encrypted master key **182** is associated with category **155-3**. Hence, encrypted master keys **180**, **181**, **182** can also be referred to as encrypted domain master keys **180**, **181**, **182**.

Each of encrypted domain master keys **180**, **181**, **182** can comprise a symmetric encryption key including, but not limited to a 512 bit symmetric encryption key. Each of encrypted domain master keys **180**, **181**, **182** can include, but is not limited to an AES (Advanced Encryption Standard) key, implemented using CBC (cipher-block chaining), XTS (ciphertext stealing) and the like, but other types of encryption keys are within the scope of present implementations.

However, one or more of encrypted domain master keys **180**, **181**, **182** can be generated, as needed, using input received an input device **128**, for example one or more of password data and/or personal identification number (PIN) data that matches one or more of password data stored at device **101** and PIN data stored at external memory **130**, presuming that external memory **130** has been received in external memory reader **129**. While the password data

and/or PIN data stored at device **101** and/or external memory **130** is not depicted, it is appreciated to be nonetheless present.

In these implementations, device **101** further stores an algorithm **183** for generating domain master keys **180**, **181**, **182** from input received at input device **128**. In other words, input received at input device **128** and/or external memory reader **129** (such as a password and/or PIN) is input to algorithm **183** and algorithm **183** outputs an unencrypted version of a domain master key **180**, **181**, **182**. In other words, without the appropriate input (i.e. a password and/or PIN) a respective domain master keys **180**, **181**, **182** cannot be generated. Algorithm **183** can further receive, as input for generating one or more domain master keys **180**, **181**, **182**, system master key **188**, which can be concatenated with the password and/or PIN. For example, algorithm **183** can comprise an algorithm for generating hashes and the like. Algorithm **183** can further comprise further operations on output of algorithm **183**, and/or intermediate output of algorithm **183**, in order to generate one or more of domain master keys **180**, **181**, **182**.

In implementations where the password and/or PIN is used to generate one or more domain master keys **180**, **181**, **182**, a respective domain master key **180**, **181**, **182** can be changed when the password and/or PIN is changed.

Encrypted domain master keys **180**, **181**, **182** being encrypted, and/or not yet generated, is designated by dashed lines surrounding each of encrypted domain master keys **180**, **181**, **182**, which is distinct from the broken lines delineating each category **155**.

When encrypted domain master keys **180**, **181**, **182** are not generated, as needed, encrypted domain master keys **180**, **181**, **182** can be accessed (i.e. decrypted) using a system master key **188** stored at memory **122**, which is in turn encrypted using a processor key **189** stored at processor **120**.

Processor key **189** can be embedded at processor **120** during manufacture and is protected from external access via security features at processor **120**. Processor key **189** can comprise a symmetric key including, but not limited to, a 128 bit key, a 256 bit key, an AES key, an AES CBC key, an AES XTS key and the like.

System master key **188** can comprise a symmetric key including, but not limited to, a 256 bit key, an AES key, an AES CBC key, an AES XTS key and the like. System master key **188** is generally decrypted upon one or more of an initial boot of device **101** and when device **101** is turned on, and persists (i.e. remains unencrypted) thereafter, until device **101** is turned off, and/or a battery pull occurs. In other words, system master key **188** is encrypted while device **101** is in an off state, and/or prior to an initial boot of device **101**.

Access to domain master keys **180**, **181**, **182** comprises one or more of: decrypting one or more domain master keys **180**, **181**, **182** using one or more of system master key **188** and processor key **189** (i.e. processor key **189** decrypts system master key **188** which in turn can be used to decrypt one or more of domain master keys **180**, **181**, **182**); and generating domain master keys **180**, **181**, **182** from input data received at input device **128** of device **101**, for example using algorithm **183**, as described above.

Further, domain master keys **180**, **181**, **182** are destroyed once access to an associated category **155** of encrypted data **150**, **151**, **152** occurs; in other words, decrypted and/or generated domain master keys **180**, **181**, **182** are deleted from memory **122** once associated domain keys **170**, **171**, **172** are decrypted. Hence, domain master keys **180**, **181**, **182** are generally only stored in an unencrypted state at

device **101** for short periods of time, for example a time from decrypting a domain master key **180, 181, 182** to a time that a respective domain key **170, 171, 172** is decrypted.

Indeed, encrypted keys **160, 161, 162, 170, 171, 172,** and **189** generally persist at memory **122**, and, when unencrypted, a copy of the unencrypted keys **160, 161, 162, 170, 171, 172,** and **189** persist at memory **122** only under certain conditions and/or criteria.

For example, as described above, the unencrypted version of system master key **188** is destroyed and/or deleted in memory **122** when device **101** is turned off and the like. Domain keys **170, 171, 172** generally persist in memory **122** only when an associated category **155** is unlocked; locking the associated category **155** and/or domain results in the unencrypted versions of the domain keys **170, 171, 172** being deleted from memory **122**. Similarly, unencrypted versions of keys **160, 161, 162** can persist only when associated data **150, 151, 152** is being accessed, and can be deleted thereafter.

In general, access to each domain master keys **180, 181, 182** is controlled according to criteria **190-1, 190-2, 190-3** associated with a respective category **155**. Criteria **190-1, 190-2, 190-3** will be described in further detail below, and will be hereafter referred to, collectively and generically, as criteria **190**. When given criteria **190** is met, an associated domain master key **180, 181, 182** is decrypted and/or generated, and then the unencrypted and/or generated version is destroyed once an associated category **155** and/or domain is unlocked.

Furthermore, one or more categories **155** and/or domains can be locked when associated locking trigger criteria **199** are met; in depicted implementations, only category **155-3** is associated with locking trigger criteria **199**, though it is implicit that categories **155-1, 155-2** are to be locked when device **101** is turned off, powered down, and the like. Otherwise categories **155-1, 155-2** remain unlocked once respective domain keys **170-1, 170-2** are unencrypted.

Locking trigger criteria **199** for category **155-3** can include, but is not limited to: determining that a time-out period has occurred; receiving, at the device, a locking command from a server (not depicted, but device **101** can be in communication with a server via interface **124**); receiving a locking command from applications running at device **101**; determining that external memory **130** has been removed from external memory reader **129**; determining that device **101** is being one or more of turned off and powered down, and the like.

In any event, in order to control access to domains/categories **155**, processor **120** is generally configured to: control access to encrypted data **150, 151, 152**, stored at memory **122** of device **101**, encrypted data **150, 151, 152** categorized according to a plurality of categories **155**, using a respective encryption key **180, 181, 182** for each category **155** in the plurality of categories **155**; and, control access to a given encryption key **180, 181, 182** according to given criteria **190** associated with a given category **155**, respective criteria **190** different for each respective category **155**, access to the given encryption key **180, 181, 182** including one or more of, when the respective criteria **190** are met: generating the given encryption key **180, 181, 182** and decrypting the given encryption key **180, 181, 182**.

Further, as depicted in FIG. 1, device **101** is in an off-state as all data **150, 151, 152** is encrypted and all keys **160, 161, 162, 170, 171, 172, 180, 181, 182, 188** are encrypted; hence device **101** is in a secure state.

A non-limiting example of the relationship between the various keys **160, 161, 172, 170, 171, 172, 180, 181, 182,**

188, 189 described above, as well as example criteria **190** is depicted in FIG. 2. Processor key **189**, which is protected in processor **120**, protects system master key **188** (i.e. processor key **189** decrypts system master key **188**). System master key **188** protects domain master keys **180, 181,** and a password and/or PIN (and optionally system master key **188**, as described above) protects domain master key **182**; in other words, system master key **188** decrypts system domain master keys **180, 181,** while a password and/or PIN is used to generate domain master key **182**.

Domain master key **180** protects domain key **170**, which in turn protects file encryption keys **160**; domain master key **181** protects domain key **171**, which in turn protects file encryption keys **161**; and, domain master key **182** protects domain key **172**, which in turn protects file encryption keys **162**.

As described above, once a respective domain key **170, 171, 172** is decrypted by a respective unencrypted domain master key **180**, the respective unencrypted domain master key **180** is destroyed and/or deleted from memory **122**.

Further, criteria **190** for each category **155** and/or domain are different.

For example, one of the plurality of categories **155** of encrypted data **150** can comprise a start-up category **155-1**, start-up encrypted data **151** associated therewith used to start device **101** when device **101** is turned on, and hence start-up criteria **190-1** associated with the start-up category **155-1** comprises determining that device **101** has been turned on. Further, start-up encrypted data **150** remains accessible once a master start-up encryption key **180** is accessed after the start-up criteria is met (i.e. start-up category **155-1** and/or the start-up domain remains unlocked while device **101** remains turned-on). These implementations include decrypting, using master start-up encryption key **180**, at least one encryption key **170, 160** for decrypting the start-up encrypted data **150**, which can include decrypting domain key **170**, which is in turn used to decrypt file encryption keys **160**, which in turn are used to decrypt start-up data **151**.

Another one of the plurality of categories **155** of encrypted data **151** can comprise an operational category **155-2**, operational encrypted data **151** associated therewith used to one or more of: operate device **101** after device **101** is turned on; perform operations at device **101**; and provide a user an operational experience at device **101**. Operational criteria **190-2** associated with operational category **155-2** can comprise: receiving input using input device **128** which matches one or more of password data stored at device **101** and PIN data read from external memory **130** received in external memory reader **129** of device **101**. The operational encrypted data **150-2** remain accessible once master operational encryption key **181** is accessed after operational criteria **190-2** is met (i.e. operational category **155-2** and/or the operational domain remains unlocked while device **101** remains turned on and after password data and/or PIN data is received and a match is found). These implementations include: decrypting, using master operational encryption key **181**, at least one encryption key **161, 171** for decrypting operational encrypted data **152**, which can include decrypting domain key **171**, which is in turn used to decrypt file encryption keys **161**, which in turn are used to decrypt operational data **151**. Further, in implementations where the input received at input device **128** matches the PIN data read from external memory **130**, the matching results in unlocking of external memory **130**, which can also store data and/or an algorithm for decrypting and/or generating and/or accessing a master operational key **181**.

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Another one of the plurality of categories **155** of encrypted data **152** can comprise a locked category **155-3** of locked encrypted data **152**, locked criteria **190-3** associated with locked category **155-3** comprising: receiving input using input device **128** that matches one or more of password data stored at device **101** and PIN (personal identification number) data read from external memory **130** received in external memory reader **129** of device **101**. Once a master locked encryption key **182** is accessed after locked criteria **190-3** is met, these implementations further comprise: decrypting, using the master device locked encryption key **182**, at least one encryption key **162**, **172** for decrypting locked encrypted data **151**; and, destroying the at least one encryption key **182** (i.e. an unencrypted version thereof) when one or more locking trigger criteria **199** are met such that locked encrypted data **151** is no longer accessible until locked criteria **190-3** is again met. Further, in implementations where the input received at input device **128** matches the PIN data read from external memory **130**, the matching results in unlocking of external memory **130**, which can also store data and/or an algorithm for decrypting and/or generating and/or accessing a master operational key **182**.

Further, when any of one or more applications **157** rely on encrypted data **152** being accessible to operate, processor **120** can control the one or more applications **157** running at device **101**, transition to a reduced functionality state (e.g. a locked state) once the one or more locking trigger criteria **199** are met; and/or stop the one or more applications **157** running at device **101** once the one or more locking trigger criteria **199** are met. In transitioning the one or more applications **157** to either transition to a locked state and/or stop, the applications **157** enter a mode where encrypted data **152** is not accessed, thereby preventing the applications **157** from crashing and the like. For example, a locked state of an application **157** can comprise a reduced functionality state, operating with a subset of functionality (i.e. due to data **152** being inaccessible), where application **157** does not shut down and/or stop, but waits until locked criteria **190-3** is again met and encrypted data **152-3** is again accessible. Applications **157** that transition to a locked state can colloquially be referred to as being “aware” applications that are configured to run in a reduced functionality state when data **152** is not accessible. Applications **157** that are stopped can colloquially be referred to as being “unaware” applications that are not configured to run in a reduced functionality state when data **152** is not accessible.

Differences between start-up data **150**, operational data **151** and locked data **152** can be understood with regard to a non-limiting example of a calendar program which starts automatically when device **101** is turned on. In these implementations, start-up data **150** can include data for starting the calendar programs, such as an executable file, data for formatting a calendar at display **126**, form data and the like. Operational data **151** can comprise data indicating whether given time periods in the calendar is free or busy and/or other non-sensitive data. Locked data **152** can comprise details of meetings, events, and the like, that occur in each of the busy time periods that can include sensitive data that could be of use to a hacker and/or a competitor of an entity associated with device **101**. An administrator, a programmer, and the like, can determine whether data is to be classified as start-up data, operational data or locked data.

Further, while three categories **155** have been described, other categories **155** are within the scope of present implementations. For example, some implementations can include one or more applications categories and/or domains that include data, and associated keys and criteria, and optionally

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locking trigger criteria, for one or more of applications **157**, in which respective categories are locked under different conditions, such as receiving a locking command from a respective application. Other implementations can include one or more remote entity categories and/or domains that include data, and associated keys and criteria, and optionally locking trigger criteria, for one or more of applications running at a remote server (for example in tandem with a client application at device **101**), in which respective categories are locked under different conditions, such as receiving a locking command from the remote server. Yet further implementations can include a “personal” category that comprises data associated with a user of device **101** but not a business entity associated therewith; the sensitivity of data in the “personal” category can be ranked between operational data **151** and locked data **152**. However, such rankings can be optional. Further, data within each category of data can be, itself, ranked and domains associated with each ranking within each category, which can include respective criteria for unlocking/decrypting data in each sub-category.

It is appreciated that FIG. **1** further depicts a schematic diagram of device **101**, which will hereafter be described in further detail. It should be emphasized that the structure of device **101** in FIG. **1** is purely an example. For example, as depicted in FIG. **1**, it is contemplated that device **101** comprises a device that can be used for implementing both wireless voice (e.g., telephony) and wireless data communications (e.g. email, web browsing, text, and the like), as well as any other specialized functions, including, but not limited to one or more of, computing, and/or entertainment related functions.

Housing **109** can comprise any housing, casing, and the like. It is appreciated that device **101** can be portable (readily movable from place to place) and, in some implementations, device **101** can be handheld (sized and shaped to be held or carried in a human hand, and typically used while so held or carried); hence, housing **109** can be configured for a type of device **101**. In general, housing **109** encloses or houses the components of device **101**; however some components can be visible via apertures, windows and the like in housing **109**. For example, display **126** is generally visible.

At least one input device **128** is generally configured in receive input data, and can comprise any suitable combination of input devices, including but not limited to a keyboard, a keypad, a pointing device, a mouse, a track wheel, a trackball, a touchpad, a touch screen and the like. Other input devices are within the scope of the present implementations, including, but not limited to, external memory reader **129**, and near field communication (NFC) reader, and the like. In some implementations, password data and/or PIN data can be received from an NFC device using the NFC reader.

Input from input device **128** is received at processor **120** (which can be implemented as a plurality of processors, including but not limited to one or more central processing units (CPUs)). Processor **120** is configured to communicate with a memory **122** comprising a non-volatile storage unit (e.g. Erasable Electronic Programmable Read Only Memory (“EEPROM”), Flash Memory, and the like) and a volatile storage unit (e.g. random access memory (“RAM”), and the like). Programming instructions that implement the functional teachings of device **101** as described herein are typically maintained, persistently, in memory **122** and used by processor **120** which makes appropriate utilization of volatile storage during the execution of such programming instructions. In some implementations, processor **120** comprises at least a portion of memory **122**, for example as

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on-board random access memory (RAM). It is further appreciated that memory 122 is an example of computer readable media that can store programming instructions executable on processor 120. Furthermore, memory 122 is also an example of a memory unit and/or memory module.

In particular, it is appreciated that memory 122 stores an application 156, that, when processed by processor 120, enables processor 120 to: control access to encrypted data 150, 151, 152, stored at memory 122 of device 101, encrypted data 150, 151, 152 categorized according to a plurality of categories 155, using a respective encryption key 180, 181, 182 for each category 155 in the plurality of categories 155; and, control access to a given encryption key 180, 181, 182 according to given criteria 190 associated with a given category 155, respective criteria 190 different for each respective category 155, access to the given encryption key 180, 181, 182 including one or more of, when the respective criteria 190 are met: generating the given encryption key 180, 181, 182 and decrypting the given encryption key 180, 181, 182.

Processor 120 can be further configured to communicate with display 126, and optional microphone 134 and optional speaker 132. Display 126 comprises one or more of a flat panel display, an LCD (liquid crystal display), a plasma display, an OLED (organic light emitting diode) display, a capacitive touchscreen, a resistive touch screen, a CRT (cathode ray tube) display, and the like. Optional microphone 134 comprises a microphone for receiving sound data at device 101. Optional speaker 132 comprises a speaker for providing sound data, audible alerts, audible communications from remote communication devices, and the like, at device 101. Processor 120 can also control one or more of display 126 and optional speaker 132 to provide notifications. In some implementations, device 101 can further comprise an indicator and/or notification device (not depicted), for example an LED (light emitting diode), a light and the like that can also be configured to provide notifications.

Interface 124 (and/or another communications interface, not depicted) can be implemented as one or more radios and/or connectors and/or network adaptors, configured to wirelessly communicate with one or more communication networks (not depicted) and/or wireless communication networks and/or wired communication networks and/or wireless transceivers. It will be appreciated that, in these implementations, interface 124 can be configured to correspond with network architecture that is used to implement one or more communication links to the one or more communication networks, including but not limited to any suitable combination of USB (universal serial bus) cables, serial cables, wireless links, cell-phone links, cellular network links (including, but not limited to 2G, 2.5G, 3G, 4G+, UMTS (Universal Mobile Telecommunications System), CDMA (Code division multiple access), WCDMA (Wideband CDMA), FDD (frequency division duplexing), TDD (time division duplexing), TDD-LTD (TDD-Long Term Evolution), TD-SCDMA (Time Division Synchronous Code Division Multiple Access) and the like), wireless data, Bluetooth™ links, NFC (near field communication) links, WiFi links, WiMax links, packet based links, the Internet, analog networks, the PSTN (public switched telephone network), access points, and the like, and/or a combination. When interface 124 is configured to communicate with one or more communication networks, interface 124 can comprise further protocol specific antennas there for (not depicted). In some implementations, however, interface 124 can be optional.

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Optional external memory reader 129 and external memory 130 can respectively include, but are not limited to, combinations of a card reader and a card, a smart card reader and a smart card, and the like. Further, as described above, external memory 130 can store a PIN and/or algorithms for decrypting and/or generating domain master keys 180, 181, 182, and external memory reader 129 can read the PIN and/or algorithms, which are then available to processor 120 for decrypting and/or generating domain master keys 180, 181, 182. External memory reader 129 is hence configured to receive external memory 130, and further external memory 130 is configured to be removably insertable in external memory reader 129. In some implementations, data stored at external memory 130 is locked and/or encrypted and is not unlocked and/or decrypted until input data that matched the PIN is received at input device 128.

While not depicted, device 101 further comprises power source which can include, but is not limited to, a battery, a power pack, and the like.

It should be understood that a wide variety of configurations for device 101 are contemplated.

Attention is now directed to FIG. 3 which depicts a flowchart illustrating a method 300 for controlling access to encrypted data, according to non-limiting implementations. In order to assist in the explanation of method 300, it will be assumed that method 300 is performed using device 101. Furthermore, the following discussion of method 300 will lead to a further understanding of device 101 and its various components. However, it is to be understood that device 101, and/or method 300 can be varied, and need not work exactly as discussed herein in conjunction with each other, and that such variations are within the scope of present implementations. It is appreciated that, in some implementations, method 300 is implemented in device 101 by processor 120, for example by implementing application 156.

It is to be emphasized, however, that method 300 need not be performed in the exact sequence as shown, unless otherwise indicated; and likewise various blocks may be performed in parallel rather than in sequence; hence the elements of method 300 are referred to herein as “blocks” rather than “steps”. It is also to be understood that method 300 can be implemented on variations of device 101 as well.

At block 301, processor 120 controls access to encrypted data 150, 151, 152, stored at memory 122 of device 101, encrypted data 150, 151, 152 categorized according to a plurality of categories 155, using a respective encryption key 180, 181, 182 for each category 155 in the plurality of categories 155. Such control to encrypted data 150, 151, 152 can include, but is not limited to, encrypting and decrypting data 150, 151, 152 using keys 160, 161, 162 etc. when data 150, 151, 152 is to be accessed by an application 157 and the like.

At block 303, processor 120 controls access to a given encryption key 180, 181, 182 according to given criteria 190 associated with a given category 155, respective criteria 190 different for each respective category 155, access to the given encryption key 180, 181, 182 including one or more of, when the respective criteria 190 are met: generating the given encryption key 180, 181, 182 and decrypting the given encryption key 180, 181, 182. For example, as described above, access to a given encryption key 180, 181, 182 is not available until given criteria 190 is not met. Further, as also described above, access to the given encryption key comprises one or more of: decrypting the given category encryption key 180, 181, 182 using one or more of a system master key 188 and a processor key 189, and generating the given

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encryption key **180, 181, 182** from input data received at input device **128** of device **101**.

Block **303** can further comprise: decrypting, using the given encryption key **180, 181, 182**, a given category encryption key **170, 171, 172** previously generated when the given category **155** was first generated; and, decrypting, using the given category encryption key **170, 171, 172**, one or more file encryption keys **160, 161, 162** used to decrypt the encrypted data **150, 151, 152** for the given category **155**.

At block **305**, processor **120** destroys the given encryption key **180, 181, 182** one access to the given category **155** of encrypted data **150, 151, 152** occurs. For example an unencrypted version of the given encryption key **180, 181, 182** is deleted, though an encrypted version of given encryption key **180, 181, 182** persists at memory **122** and/or can again be generated using the key generation algorithm **183**.

Various aspects of method **300** will be described with respect to FIGS. **4** to **9**, each of which is substantially similar to FIG. **1**, with like elements having like numbers. In each of FIGS. **4** to **9**, a given key being decrypted and/or generated at memory **122** will be indicated by a removal of the dotted lines that surround the given key, though it is appreciated that an encrypted version of the given key persists at memory **122** and/or the given key can again be generated using algorithm **183**. Removal of dotted lines that surround the given key can also indicate that the unencrypted version of the given key is located in a volatile portion of memory **122**, while an encrypted version of the given key can persist in a non-volatile portion of memory **122**.

Attention is next directed to FIG. **4**, which depicts device **101** upon start-up, and hence processor key **189** has been used to decrypt system master key **188**. The decrypted version of system master key **188** can be destroyed when device **101** powers down. Further, start-up domain master key **180** has been decrypted using system master key **188**, and the decrypted version of start-up domain master key **180** can be destroyed when associated domain key **170** is decrypted using start-up domain master key **180**.

For example, attention is next directed to FIG. **5** which depicts device **101** after start-up domain master key **180** is used to decrypt domain key **170**; the unencrypted version of start-up domain key **180** is destroyed, while the encrypted version of start-up domain key **180** persists at memory **122**. Further, domain key **170** has been used to decrypt file encryption keys **160**. Domain key **170** and file encryption keys **160** remain accessible while device **101** remains on.

In some implementations, file encryption keys **160** are not decrypted when domain key **170** is decrypted; rather a given file encryption key **160** can be decrypted using domain key **170** when an associated set of data **150** is to be accessed, for example by an application **157**.

Attention is next directed to FIG. **6** which depicts input data **600** being received at input device **128**, input data **600** including, but not limited to password data and/or PIN data, that matches password data and/or PIN data stored at memory **122** and/or external memory **130** (i.e. external memory **130** has been received in external memory reader **129**). In any event, receipt of input data **600** results in domain master keys **181, 182** being made accessible either by decrypting one or more of domain master keys **181, 182** using system master key **180** and/or by generating one or more of domain master keys **181, 182** using algorithm **183**. As described above, category **155-2** can comprise an operational category and category **155-3** can comprise a locked category, hence, domain master keys **181, 182** can respectively comprise an operational domain master key and a

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locked domain master key. The domain master keys **181, 182** are then used to respectively decrypt domain keys **171, 172**.

For example, attention is next directed to FIG. **7** which depicts device **101** after domain master keys **181, 182** are used to respectively decrypt domain keys **171, 172**; the unencrypted versions of domain keys **181, 182** are destroyed, while the encrypted versions of domain keys **181, 182** persist at memory **122**, and/or domain keys **181, 182** can again be generated once input data **600** is again received at input device **128**. Further, domain keys **171, 172** have been used to respectively decrypt file encryption keys **161, 162**.

In some implementations, file encryption keys **161, 162** are not decrypted when domain keys **171, 172** are decrypted; rather a given file encryption key **161, 162** can be decrypted using the associated domain key **171, 172** when an associated set of data **151, 152** is to be accessed, for example by an application **157**.

Attention is next directed to FIG. **8**, which depicts device **101** after a locking trigger criteria **199** is met for category **155-3**. For example, a data lock timeout can occur, external memory **130** can be removed from external memory reader **129**, a lock request can be received from an application **157**, a remote server and/or a third party application (e.g. located at the remote server). Once the locking trigger criteria **199** is met associated category **155-3** is locked, and hence unencrypted versions of keys **162, 172** are destroyed, though encrypted keys **162, 172** persist at memory **122**. Hence, comparing FIG. **8** to FIG. **1**, it is clear that in FIG. **8**, category **155-3** is in the same state as in FIG. **1**, hence in FIG. **8**, category **155-3** is in the same state as when device **101** is off.

Attention is next directed to FIG. **9**, which depicts device **101** again receiving input data **600** (and again, in some implementations, external memory **130** has again been received in external memory reader **129**). For example, a graphic user interface (GUI) can be provided at display **126** indicating that category **155-3** is locked (e.g. the associated domain is locked) and input data **600** can be requested in the GUI. Once input data **600** is again received, domain master key **182** is again decrypted and/or generated, as further depicted in FIG. **9**, which can then again be used to decrypt domain key **172**, which can in turn be used to decrypt keys **162** and/or when access to associated data **152** is requested.

It is further appreciated that while category **155-3** is locked, data associated with category **155-3** can be received at device **101**; for example, a message can be received that is categorized as being sensitive. However, as domain key **172** is not accessible while category **155-3** is locked, the message cannot yet be encrypted using an associated file key **152**, which has to be generated and in turn encrypted using domain key **172**. In these implementations, device **101** can further store a public asymmetric encryption key, which can be used to temporarily encrypt the message until category **155-3** is unlocked; device **101** further stores an associated private asymmetric encryption key which can be used to decrypt the message once category **155-3** is unlocked. The private asymmetric encryption key can itself be encrypted using one or more of domain key **172** and a file key **152**; the private asymmetric encryption key then becomes available to decrypt the message once category **155-3** is again unlocked. A file encryption key **162** can then be generated and the message can be encrypted therewith.

In some implementations, one or more categories **155** and/or device **101** can be in different locked states, depending on one or more of locking trigger criteria **199** and further data lock trigger criteria stored at device **101**, which can

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cause various features of device 101 to be locked when respective data lock trigger criteria are met. In particular, device 101 can be in one of the following lock states:

LOCKED: Categories 155-2, 155-3 are fully locked (i.e. no associated data keys are decrypted), as first authentication has not yet occurred; category 155-1 is locked only while device 101 is off, otherwise access to start-up data 150 is available.

UNLOCKED: In an unlocked category 155, full access to associated data 150, 151, 152 is available.

UX_LOCKED: A category 155 can be in a user interface (UI) lock, in which access to associated data 150, 151, 152 is allowed by applications 157, but an associated graphic user interface prevent users from accessing category-related data 150, 151, 152; such as UX_LOCKED state can occur when an associated category timeout occurs.

PENDING_DATA_LOCK: A category 155 is in transition to the LOCKED state, applications 157 are to prepare for data lock to be enforced, as described above.

DATA_LOCKED: Category 155-3 is in a full lock state (after initial user authentication); only access to start-up data 150 and operational data 151 is possible.

Persons skilled in the art will appreciate that there are yet more alternative implementations and modifications possible. For example, techniques described herein can be applied to any number of categories 155 and any number of locking trigger criteria 199. Furthermore, present implementations include dynamically creating categories 155 and/or criteria 190 and/or locking trigger criteria 199 and/or dynamically changing categories 155 and/or criteria 190 and/or locking trigger criteria 199. For example criteria 190 and/or locking trigger criteria 199 can be dynamically created and/or changed for an existing category 155 based on commands received from a server (not depicted) associated with an entity operating and/or issuing device 101. Similarly, one or more categories 155 can be created based on commands from the server, for example an administrative category could be created, accessible only upon receipt of an administrative password and/or PIN.

Described herein is a method, and apparatus for controlling access to encrypted data, and specifically controlling access to different categories of encrypted data based on criteria associated with each category; at least one category can be controlled using knowledge that is not stored at the apparatus, for example a password and/or a PIN and/or data stored at an external memory insertable at an external memory reader at the apparatus. However, data that should be available for starting the device can be made available upon start-up, while data that should be available for operating the device can be made available upon a first authentication at the device. Sensitive data that is generally locked (i.e. encrypted) is fully inaccessible when the apparatus is in a data lock state; indeed, in the data lock state, the sensitive data is stored in the same manner as when the apparatus is off and/or powered down.

Those skilled in the art will appreciate that in some implementations, the functionality of device 101 can be implemented using pre-programmed hardware or firmware elements (e.g., application specific integrated circuits (ASICs), electrically erasable programmable read-only memories (EEPROMs), etc.), or other related components. In other implementations, the functionality of device 101 can be achieved using a computing apparatus that has access to a code memory (not shown) which stored computer-readable program code for operation of the computing apparatus. The computer-readable program code could be stored on a computer readable storage medium which is

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fixed, tangible and readable directly by these components (e.g., removable diskette, CD-ROM, ROM, fixed disk, USB drive). Furthermore, it is appreciated that the computer-readable program can be stored as a computer program product comprising a computer usable medium. Further, a persistent storage device can comprise the computer readable program code. It is yet further appreciated that the computer-readable program code and/or computer usable medium can comprise a non-transitory computer-readable program code and/or non-transitory computer usable medium. Alternatively, the computer-readable program code could be stored remotely but transmittable to these components via a modem or other interface device connected to a network (including, without limitation, the Internet) over a transmission medium. The transmission medium can be either a non-mobile medium (e.g., optical and/or digital and/or analog communications lines) or a mobile medium (e.g., microwave, infrared, free-space optical or other transmission schemes) or a combination thereof.

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Persons skilled in the art will appreciate that there are yet more alternative implementations and modifications possible, and that the above examples are only illustrations of one or more implementations. The scope, therefore, is only to be limited by the claims appended hereto.

What is claimed is:

1. A method comprising:

[controlling access to encrypted data files, stored] *storing*, at a memory of a device[, the]:

- (i) encrypted data files categorized according to a plurality of categories, each encrypted data file encrypted using [one or more] *a* respective file encryption [keys] *key*, each respective file encryption key in a category encrypted using a respective category key respective to the category, the respective category key encrypted using a respective domain master key respective to the category, the respective domain master key available using a system master key, which is *in* turn encrypted using a processor key stored at a processor of the device, the system master key configured to protect each of *the* respective domain master keys of each of the plurality of categories; and,

- (ii) *respective access control criteria corresponding to each of the categories, each access control criteria comprising one or more of: the device being turned on; receiving a password at an input device of the device that matches password data stored at the memory; or receiving a personal identification number at the input device that matches data read from an external memory reader of the device;*

controlling access to the encrypted data files by:

- (i) upon startup of the device, decrypting the system master key using the processor key; [and, when]
- (ii) *determining, for each category, whether the corresponding criteria are met;*
- (iii) *in response to determining that the corresponding criteria associated with one of the [category] categories is met[.], one or more of decrypting or generating the respective domain master key;*

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(iv) decrypting the respective category key using the respective domain master key;

(v) *in response to decrypting the respective category key, destroying an unencrypted respective domain master key while retaining the decrypted respective category key; and*

(vi) decrypting *each of* the one or more respective file encryption keys *corresponding to the one of the categories*, using the respective [domain master] category key[.] *without the unencrypted domain master key*[destroying an unencrypted respective domain master key after the one or more respective file encryption keys are decrypted,

the criteria comprising one or more of: the device being turned on; receiving a password at an input device of the device that matches a password data stored at the memory; or receiving a personal identification number at the input device that matches data read from an external memory reader of the device].

2. The method of claim 1, wherein each of the plurality of categories is based on one or more of a ranking system, data sensitivity, operational needs of the device, or usability of the device.

3. The method of claim 1, wherein the encrypted data files are stored in partitions of the memory based on the plurality of categories, each of the partitions comprising one or more of a physical partition of the memory or a virtual partition.

4. The method of claim 1, wherein:

one of the [category comprises] plurality of categories is a start-up category, start-up encrypted data files associated therewith used to start the device when the device is turned on and prior to receiving user input at the input device,

[start-up] *wherein the criteria associated with the start-up category [comprising determining] comprise a determination that the device has been turned on,*

wherein the respective domain master [domain] key [comprising] is a master start-up domain encryption key,

wherein the respective category key [comprising] is a start-up domain encryption key, and

wherein the start-up encrypted data files [remaining] remain accessible once the master start-up domain encryption key is accessed after one or more of the [start-up] criteria associated with the start-up category is met, and after the start-up encrypted data files are decrypted using the respective file encryption keys, the respective file encryption keys being decrypted using the start-up domain encryption key.

5. The method of claim 1, wherein:

one of the [category comprises] plurality of categories is an operational category, operational encrypted data files associated therewith used to one or more of: operate the device after the device is turned on; or perform operations at the device; or provide a user with an operational experience at the device;

[operational] *wherein the criteria associated with the operational category [comprising] comprise:*

[receiving] *receipt of input using [an] the input device, that matches one or more of the password data stored at the memory, or the [personal identification number] data read from [an external memory received in] the external memory reader of the device,*

wherein the respective domain master [domain] key [comprising] is a master operational domain encryption key,

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wherein the respective category key [comprising] is an operational domain encryption key, and

wherein the operational encrypted data files [remaining] remain accessible once the master operational domain encryption key is accessed after one or more of the [operational] criteria associated with the operational category is met, and after the operational encrypted data files are decrypted using the respective file encryption keys, the respective file encryption keys being decrypted using the operational domain encryption key.

6. The method of claim 1, wherein:

one of the [category comprises] plurality of categories is a locked category of locked encrypted data files,

[locked] *wherein the criteria associated with the locked category [comprising: receiving] comprise: receipt of input using the input device, that matches one or more of the password data stored at the memory, or the [personal identification number] data read from [an external memory received in] the external memory reader of the device,*

wherein the respective domain master [domain] key [comprising] is a master locked domain encryption key, wherein the respective category key [comprising] is a locked domain encryption key, and

wherein the method further [comprising] comprises: once the master locked domain encryption key is accessed after one or more of the criteria associated with the locked category is met:

decrypting, using the master locked domain encryption key, at least one of the respective file encryption keys for decrypting the locked encrypted data files; and, destroying at least one decrypted respective file [en] encryption key when one or more locking trigger criteria are met such that the locked encrypted data file is no longer accessible until one or more of the criteria associated with the locked [criteria] category is again met.

7. The method of claim 6, wherein the locking trigger criteria comprise one or more of:

determining that a time-out period has occurred;

receiving, at the device, a locking command from a server;

receiving a locking command from *one of a plurality of* applications running at the device;

determining that an external memory has been removed from the external memory reader; or,

determining that *the* device is being one or more of turned off or powered down.

8. The method of claim 6, further comprising[one or more of]:

controlling one or more applications running at the device to transition to a reduced functionality state once the one or more locking trigger criteria are met; or, stopping the applications running at the device once the one or more locking trigger criteria are met].

9. A device comprising:

[a processor and] a memory[, the processor configured to] storing:

[control access to encrypted data, stored at the memory, the] (i) encrypted data files categorized according to a plurality of categories, each encrypted data file encrypted using [one or more] a respective file encryption [keys] key, each respective file encryption key in a category encrypted using a respective category key respective to the category, the respective category key encrypted [usina] using a respective domain master key respective to the category, the

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respective domain master key available using a system master key, which is *in* turn encrypted using a processor key stored at the processor, the system master key configured to protect each of the respective domain master keys of each of the plurality of categories; and,

(ii) *respective access control criteria corresponding to each of the categories, each access control criteria comprising one or more of: the device being turned on; receiving a password at an input device of the device that matches password data stored at the memory; or receiving a personal identification number at the input device that matches data read from an external memory reader of the device;*

[control access to the encrypted data files by] a processor configured to:

(i) upon startup of the device, [decrypting] *decrypt* the system master key using the processor key; [and, when]

(ii) *determine, for each category, whether the corresponding criteria are met;*

(iii) *in response to determining that the corresponding criteria associated with one of the [category] categories is met[:], one or more of [decrypting or generating] decrypt or generate the respective domain master key;*

[decrypting] (iv) *decrypt* the respective category key using the respective domain master key;

(v) *in response to decrypting the respective category key, destroy an unencrypted respective domain master key and retain the decrypted respective category key; and*

[decrypting] (vi) *decrypt each of the one or more respective file encryption keys corresponding to the one of the categories, using the respective [domain master] category key[:] without the unencrypted domain master key [destroying an unencrypted respective domain master key after the one or more respective file encryption keys are*

decrypted; the criteria comprising one or more of: the device being turned on; receiving a password at an input device of the device that matches password data stored at the memory; or receiving a personal identification number at the input device that matches data read from an external memory reader of the device].

10. The device of claim 9, [further comprising an input device,] wherein:

one of the [category comprises] plurality of categories is a start-up category, start-up encrypted data files associated therewith used to start the device when the device is turned on and prior to receiving user input at the input device,

[start-up] *wherein the criteria associated with the start-up category [comprising determining] comprise a determination that the device has been turned on, wherein the respective domain master [domain] key [comprising] is a master start-up domain encryption key, wherein the respective category key [comprising] is a start-up domain encryption key, and*

wherein the start-up encrypted data files [remaining] remain accessible once the master start-up domain encryption key is accessed after one or more of the [start-up] criteria associated with the start-up category is met, and after the start-up encrypted data files are decrypted using the respective file encryption keys, the

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respective file encryption keys being decrypted using the start-up domain encryption key.

11. The device of claim 9, wherein:

one of the [category comprises] plurality of categories is an operational category, operational encrypted data files associated therewith used to one or more of: operate the device after the device is turned on; or perform operations at the device[:]; or provide a user with an operational experience at the device],

[operational] *wherein the criteria associated with the operational category [comprising] comprise: [receiving] receipt of input using [an] the input device, that matches one or more of the password data stored at the memory, or the [personal identification number] data read from [an] the external memory received in the external memory reader of the device, wherein the respective domain master [domain] key [comprising] is a master operational domain encryption key, wherein the respective category key [comprising] is an operational domain encrypted key, and*

wherein the operational encrypted data files [remaining] remain accessible once the master operational domain encryption key is accessed after one or more of the [operational] criteria associated with the operational criteria is met, and after the operational encrypted data files are decrypted using the respective file encryption keys, the respective file encryption keys being decrypted using the operational domain encryption key.

12. The device of claim 9, wherein:

one of the [category comprises] plurality of categories is a locked category of locked encrypted data files,

[locked] *wherein the criteria associated with the locked category [comprising: receiving] comprise: receipt of input using the input device, that matches one or more of the password data stored at the memory, or the [personal identification number] data read from [an external memory received in] the external memory reader[of the device], wherein the respective master domain key [comprising] is a master locked domain encryption key, wherein the respective category key [comprising] is a locked domain encryption key, and wherein the [method] processor is further [comprising] configured to: once the master locked domain encryption key is accessed after one or more of the criteria associated with the locked category is met,*

[decrypting] *decrypt, using the master locked domain encryption key, at least one of the respective file encryption keys for decrypting the locked encrypted data files; and,*

[destroying] *destroy at least one decrypted respective file [en] encryption key when one or more locking trigger criteria are met such that the locked encrypted data file is no longer accessible until one or more of the [locked] criteria associated with the locked category is again met.*

13. A non-transitory computer medium storing a computer program code wherein execution of the computer program is for:

[controlling access to encrypted data files, stored] *storing, at a memory of a device[, the]:*

(i) encrypted data files categorized according to a plurality of categories, each encrypted data file encrypted using [one or more] a respective file encryption [keys] key, each respective file encryption key in a category encrypted using a respective category key respective to the category, the respective category key encrypted using a respective domain master key respective to the

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category, the respective domain master key available using a system master key, which is in turn encrypted using a processor key stored at a processor of the device, the system master key configured to protect each of the respective domain master keys of each of the plurality of categories; and,

(ii) *respective access control criteria corresponding to each of the categories, each access control criteria comprising one or more of: the device being turned on; receiving a password at an input device of the device that matches password data stored at the memory; or receiving a personal identification number at the input device that matches data read from an external memory reader of the device;*

controlling access to the encrypted data files by:

(i) upon startup of the device, decrypting the system master key using the processor key; [and, when]

(ii) *determining, for each category, whether the corresponding criteria are met;*

(iii) *in response to determining that the corresponding criteria associated with one of the [category] categories is met[:], one or more of decrypting or generating the respective domain master key;*

(iv) decrypting the respective category key using the respective domain master key;

(v) *in response to decrypting the respective category key, destroying an unencrypted respective domain master key while retaining the decrypted respective category key; and*

(vi) *decrypting each of the one or more respective file encryption keys corresponding to the one of the categories, using the respective [domain master] category key[:] without the unencrypted respective domain master key[destroying an unencrypted respective domain master key after the ones or more respective file encryption keys are decrypted,*

the criteria comprising one or more of: the device being turned on; receiving a password at an input device of the device that matches password data stored at the memory; or receiving a personal identification number at the input device that matches data read from an external memory reader of the device].

14. *The method of claim 1, wherein the system master key one or more of: remains decrypted until the device is turned off; or persists until the device is turned off; and the system master key being otherwise encrypted one or more of: when the device is in an off-state; or prior to an initial boot of the device.*

15. *The device of claim 9, wherein the system master key one or more of: remains decrypted until the device is turned off; or persists until the device is turned off; and the system master key being otherwise encrypted one or more of: when the device is in an off-state; or prior to an initial boot of the device.*

16. *The non-transitory computer medium of claim 13, wherein each of the plurality of categories is based on one or more of a ranking system, data sensitivity, operational needs of the device, or usability of the device.*

17. *The non-transitory computer medium of claim 13, wherein the encrypted data files are stored in partitions of the memory based on the plurality of categories, each of the partitions comprising one or more of a physical partition of the memory or a virtual partition.*

18. *The non-transitory computer medium of claim 13, wherein: one of the plurality of categories is a start-up category, start-up encrypted data files associated therewith*

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used to start the device when the device is turned on and prior to receiving user input at the input device,

wherein the criteria associated with the start-up category comprise a determination that the device has been turned on,

wherein the respective domain master key is a master start-up domain encryption key,

wherein the respective category key is a start-up domain encryption key, and

wherein the start-up encrypted data files remain accessible once the master start-up domain encryption key is accessed after one or more of the criteria associated with the start-up category is met, and after the start-up encrypted data files are decrypted using the respective file encryption keys, the respective file encryption keys being decrypted using the start-up domain encryption key.

19. *The non-transitory computer medium of claim 13, wherein: one of the plurality of categories is an operational category, operational encrypted data files associated therewith used to one or more of: operate the device after the device is turned on; or perform operations at the device,*

wherein the criteria associated with the operational category comprise:

receipt of input using an input device, that matches one or more of the password data stored at the memory, or the data read from the external memory reader of the device,

wherein the respective domain master key is a master operational domain encryption key,

wherein the respective category key is an operational domain encryption key, and

wherein the operational encrypted data files remain accessible once the master operational domain encryption key is accessed after one or more of the criteria associated with the operational category is met, and after the operational encrypted data files are decrypted using the respective file encryption keys, the respective file encryption keys being decrypted using the operational domain encryption key.

20. *The non-transitory computer medium of claim 13, wherein: one of the plurality of categories is a locked category of locked encrypted data files,*

wherein the criteria associated with the locked category comprise: receipt of input using the input device, that matches one or more of the password data stored at the memory, or the data read from the external memory reader of the device,

wherein the respective domain master key is a master locked domain encryption key,

wherein the respective category key is a locked domain encryption key, and

wherein execution of the computer program is for: once the master locked domain encryption key is accessed after one or more of the criteria associated with the locked category is met:

decrypting, using the master locked domain encryption key, at least one of the respective file encryption keys for decrypting the locked encrypted data files; and, destroying at least one decrypted respective file encryption key when one or more locking trigger criteria are met such that the locked encrypted data file is no longer accessible until one or more of the criteria associated with the locked category is again met.

21. *The non-transitory computer medium of claim 20, wherein the locking trigger criteria comprise one or more of:*

*determining that a time-out period has occurred;
receiving, at the device, a locking command from a
server;*

*receiving a locking command from one of a plurality of
applications running at the device;* 5

*determining that an external memory has been removed
from the external memory reader; or,*

*determining that the device is being one or more of turned
off or powered down.*

22. *The non-transitory computer medium of claim 20, 10
wherein execution of the computer program is for:*

*controlling one or more applications running at the
device to transition to a reduced functionality state
once the one or more locking trigger criteria are met.*

23. *The non-transitory computer medium of claim 13, 15
wherein the system master key one or more of: remains
decrypted until the device is turned off; or persists until the
device is turned off; and the system master key being
otherwise encrypted one or more of: when the device is in an
off-state; or prior to an initial boot of the device.* 20

* * * * *