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Schroeder et al.

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(54) **SYSTEMS AND METHODS FOR CONTROLLING DATA EXPOSURE USING ARTIFICIAL-INTELLIGENCE-BASED PERIODIC MODELING**

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(63) Continuation of application No. 17/349,791, filed on Jun. 16, 2021, now Pat. No. 11,711,438, which is a (Continued)

(51) **Int. Cl.**
H04L 67/303 (2022.01)
G06F 18/21 (2023.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04L 67/303*** (2013.01); ***G06F 18/217*** (2023.01); ***G06F 21/60*** (2013.01);
(Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

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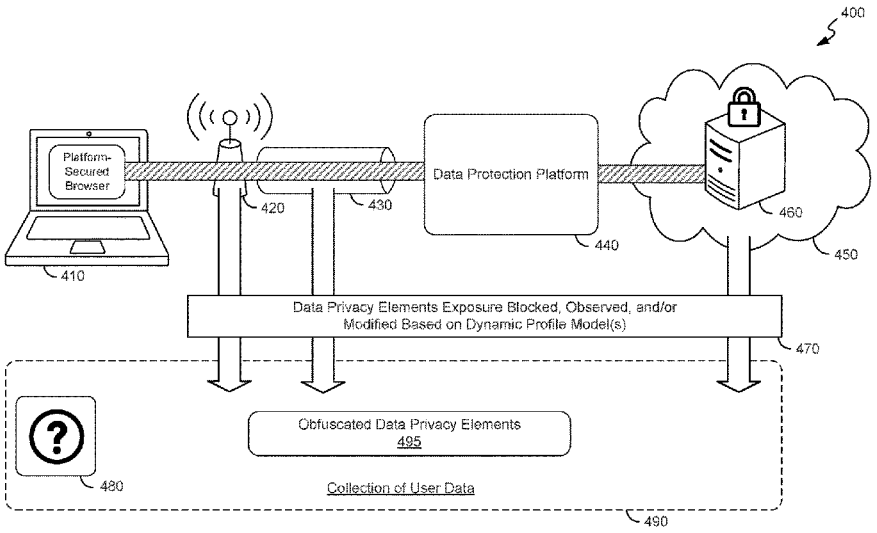
(74) *Attorney, Agent, or Firm* — Polsinelli LLP

(57) **ABSTRACT**

Systems and methods for periodically modifying data privacy elements are provided. The systems and methods may identify a set of data privacy elements. A data privacy element can characterizes a feature of a computing device and can be detectable by a network host. A first artificial profile can be generated by modifying a first data privacy element based on an artificial profile model that defines a relationship associated with one or more constraints between the set of data privacy elements. Subsequent to generating the first artificial profile, a second artificial profile can be generated by periodically modifying a second data privacy element in accordance with the relationship defined by the artificial profile model. The computer device can be masked from being identified by the network host by sending the second artificial profile including the second data privacy element to a requested network location.

21 Claims, 13 Drawing Sheets



Related U.S. Application Data

continuation of application No. 16/657,598, filed on Oct. 18, 2019, now Pat. No. 11,068,605, which is a continuation-in-part of application No. 16/280,755, filed on Feb. 20, 2019, now Pat. No. 10,706,158, which is a continuation of application No. 16/005,268, filed on Jun. 11, 2018, now Pat. No. 10,282,553.

(51) **Int. Cl.**

G06F 21/60	(2013.01)
G06F 21/62	(2013.01)
G06N 20/00	(2019.01)
H04L 9/40	(2022.01)

(52) **U.S. Cl.**

CPC ***G06F 21/6263*** (2013.01); ***G06N 20/00*** (2019.01); ***H04L 63/102*** (2013.01); ***H04L 63/107*** (2013.01)

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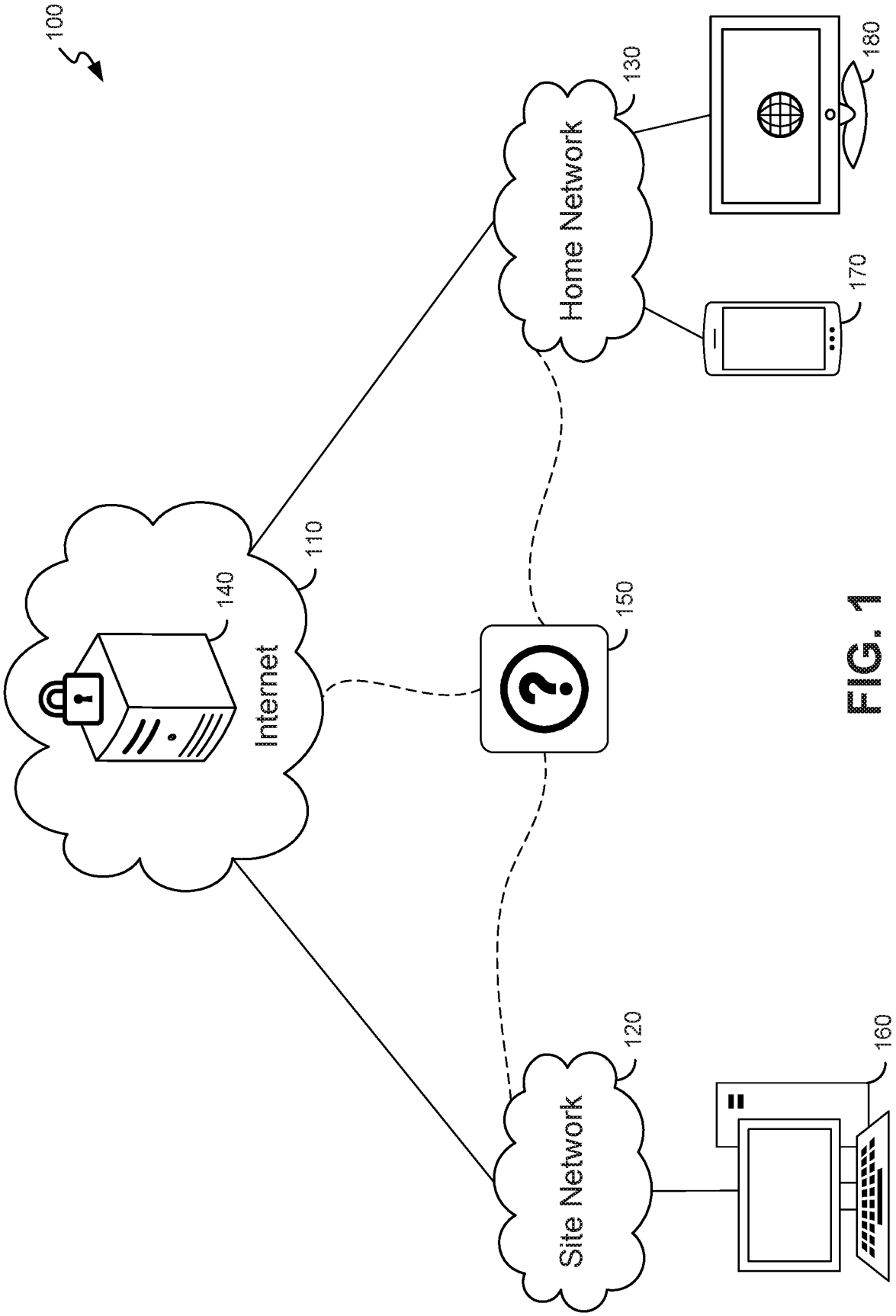
100
Internet
110
140
Home Network
130
180
170
150
Site Network
120
160

FIG. 1

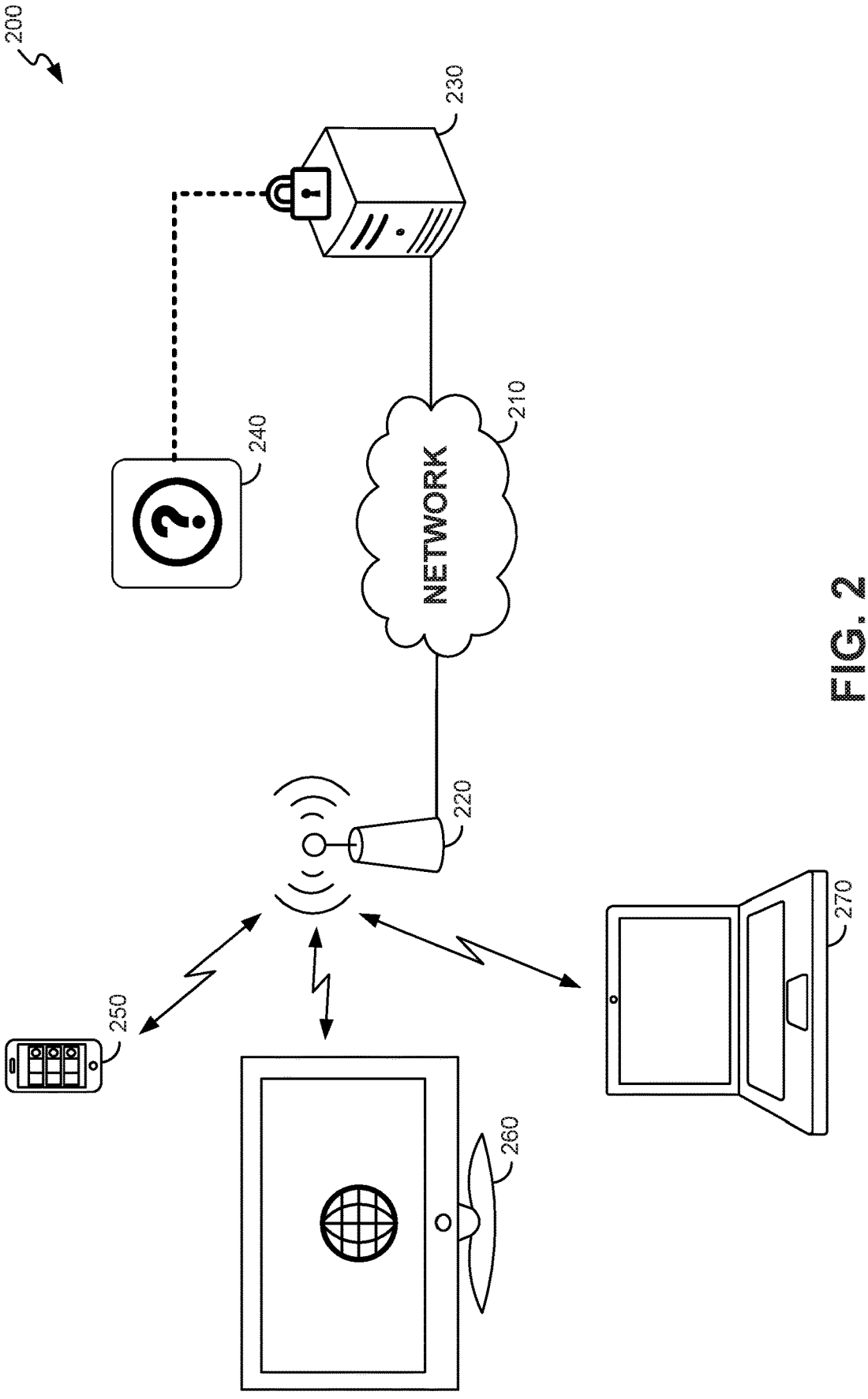

FIG. 2

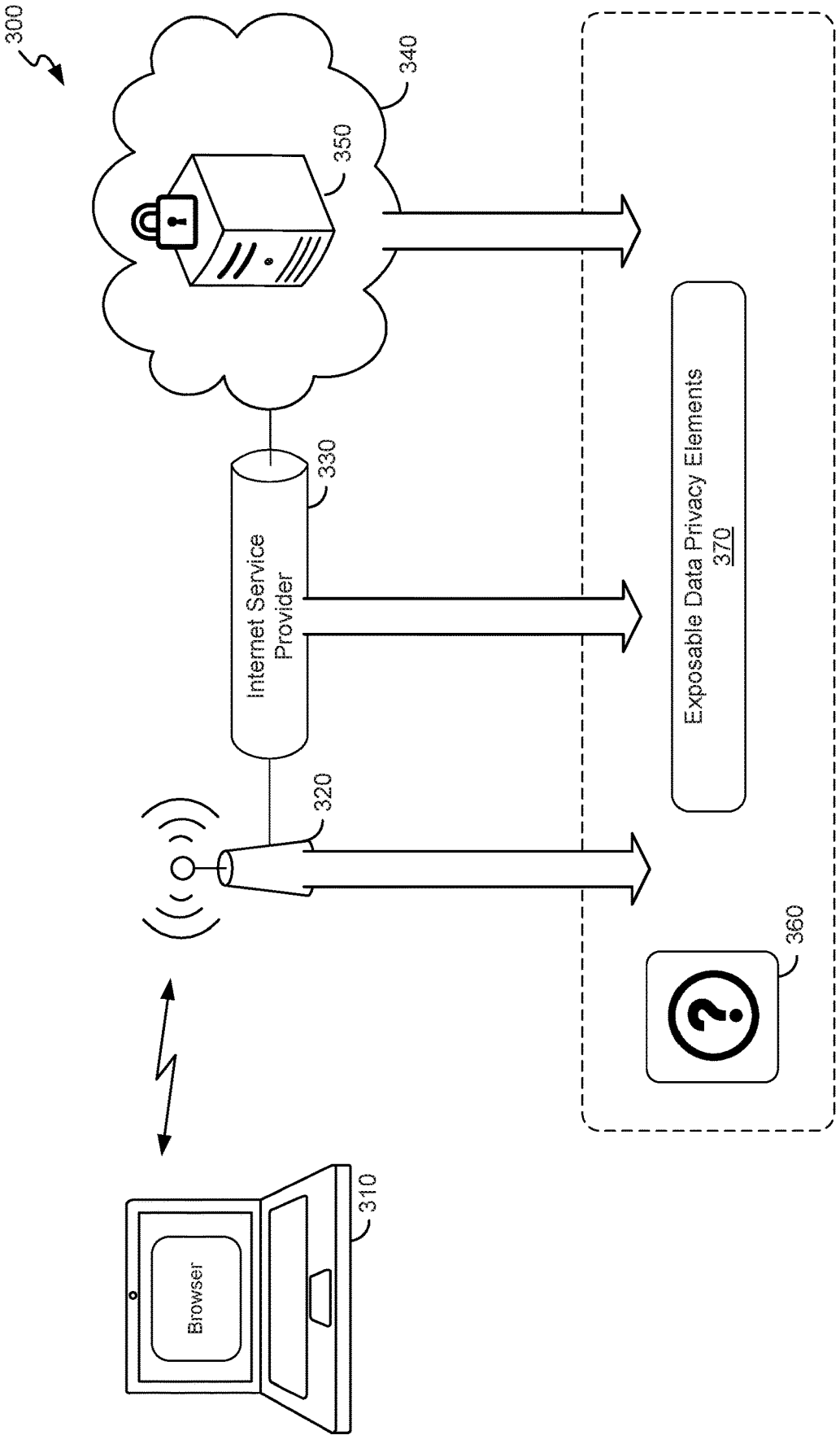
300
340
350
330
Internet Service Provider
320
Exposable Data Privacy Elements
370
360
310
Browser

FIG. 3

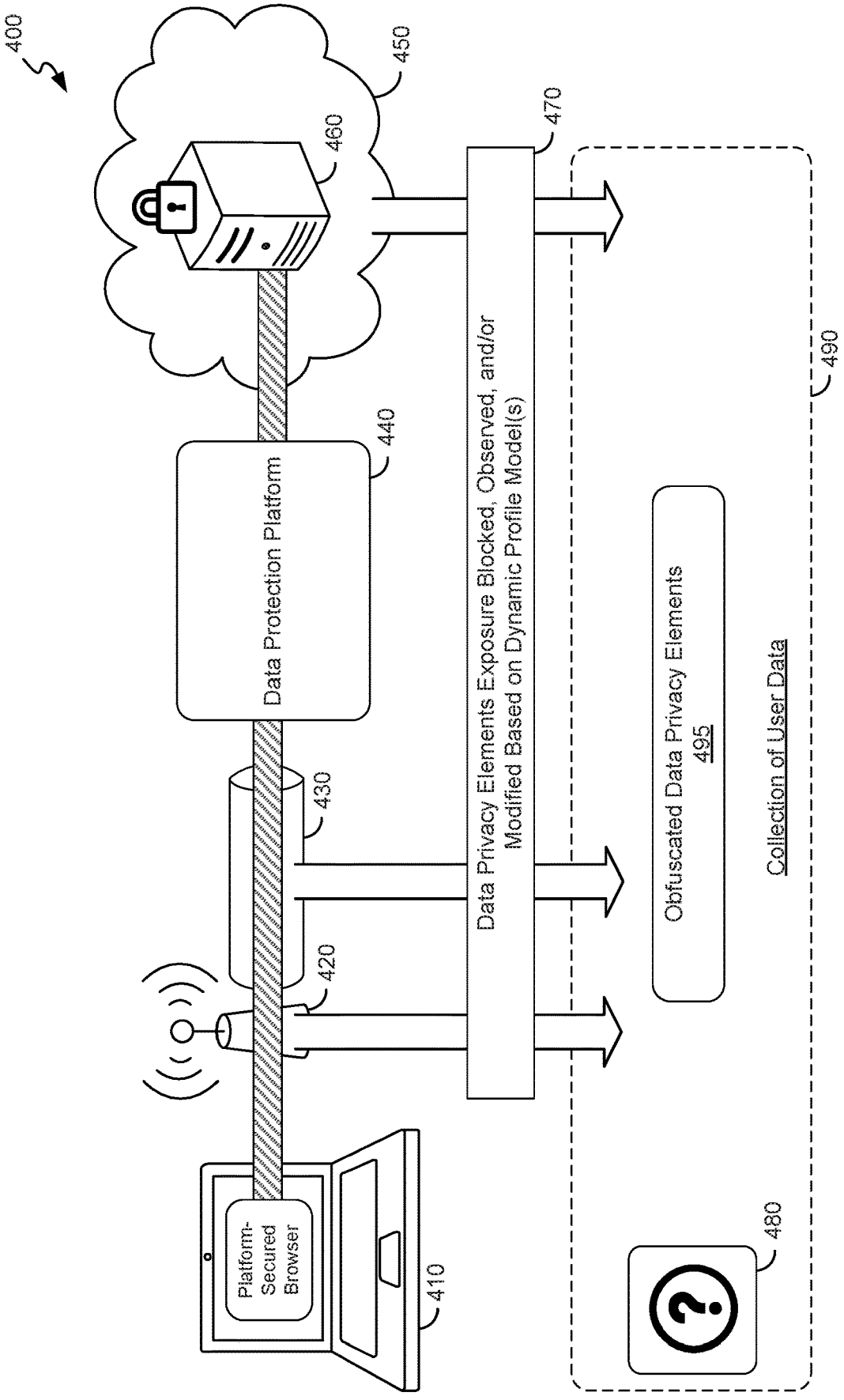
400
450
460
470
490
440
Data Protection Platform
Data Privacy Elements Exposure Blocked, Observed, and/or Modified Based on Dynamic Profile Model(s)
Obfuscated Data Privacy Elements 495
Collection of User Data
430
420
Platform-Secured Browser
410
480

FIG. 4

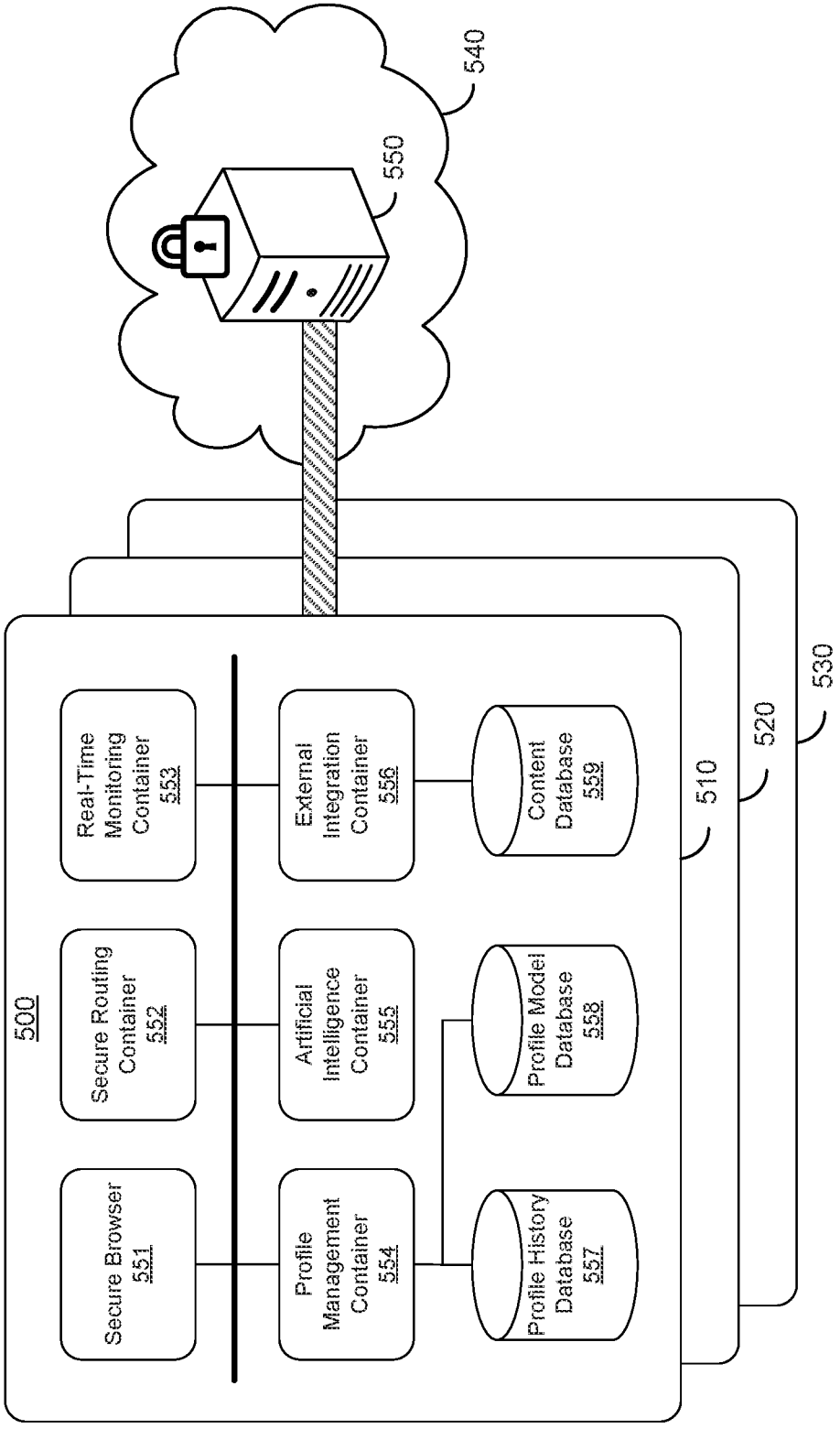
540
550
500
Secure Browser 551
Secure Routing Container 552
Real-Time Monitoring Container 553
Profile Management Container 554
Artificial Intelligence Container 555
External Integration Container 556
Profile History Database 557
Profile Model Database 558
Content Database 559
510
520
530

FIG. 5

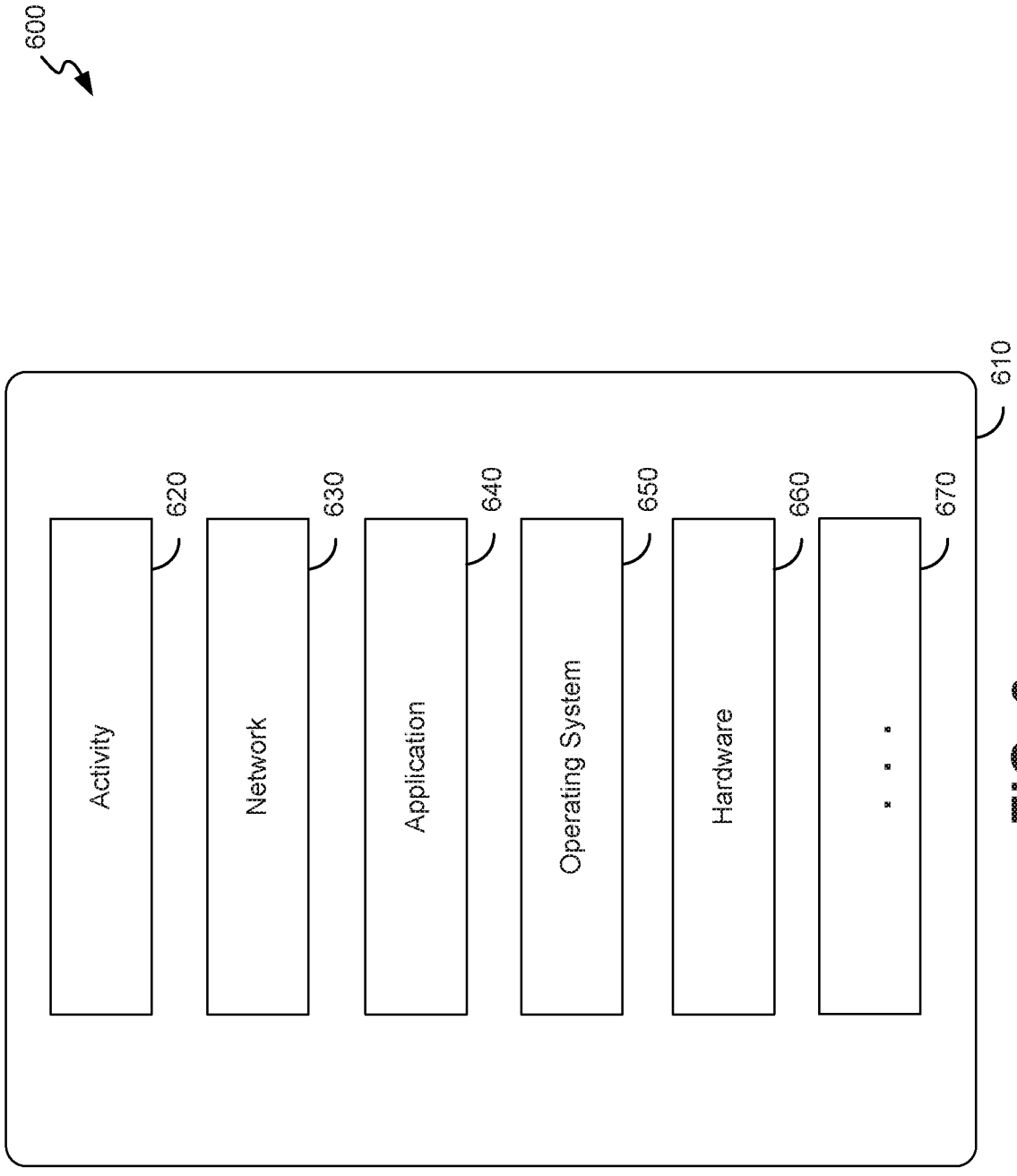
600
610
620
630
640
650
660
670
Activity
Network
Application
Operating System
Hardware
. . .

FIG. 6

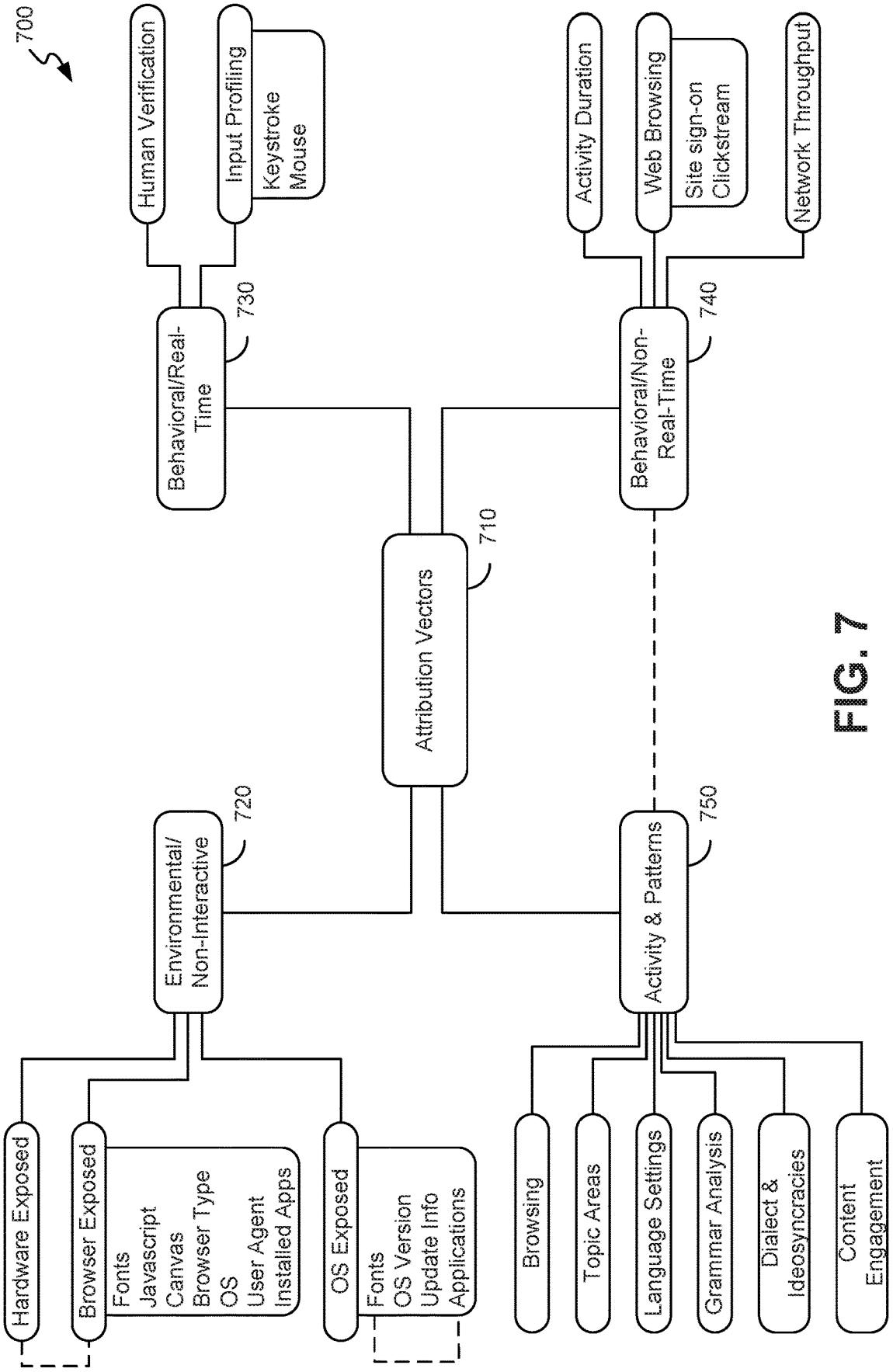
700
Human Verification
Input Profiling
Keystroke
Mouse
730
Behavioral/Real-Time
Activity Duration
Web Browsing
Site sign-on
Clickstream
Network Throughput
740
Behavioral/Non-Real-Time
Attribution Vectors
710
Environmental/ Non-Interactive
720
Activity & Patterns
750
Hardware Exposed
Browser Exposed
Fonts
Javascript
Canvas
Browser Type
OS
User Agent
Installed Apps
OS Exposed
Fonts
OS Version
Update Info
Applications
Browsing
Topic Areas
Language Settings
Grammar Analysis
Dialect & Ideosyncracies
Content Engagement

FIG. 7

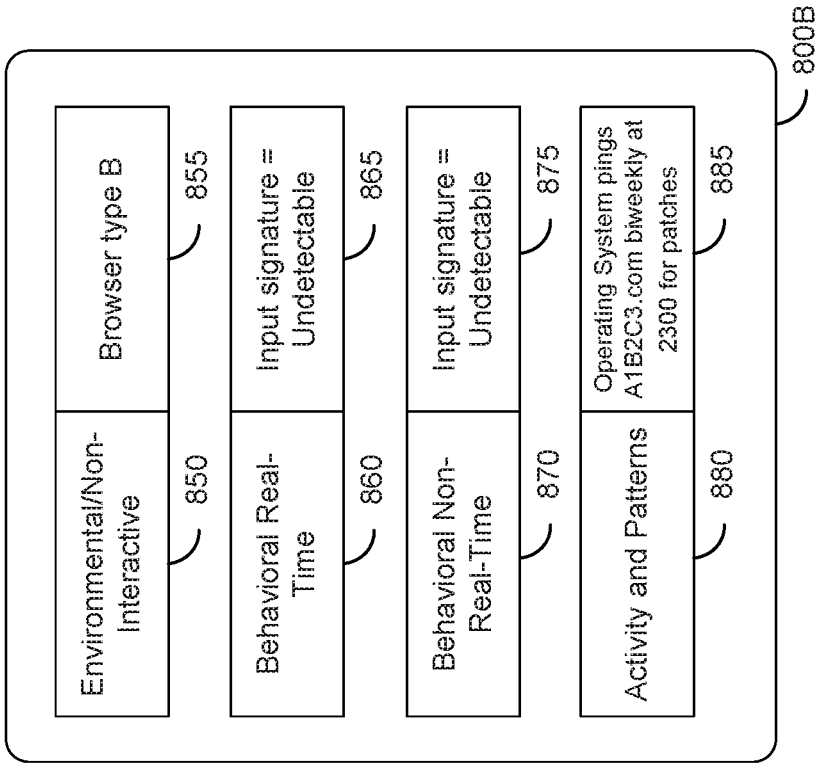
800B
Environmental/Non-Interactive
850
Browser type B
855
Behavioral Real-Time
860
Input signature = Undetectable
865
Behavioral Non-Real-Time
870
Input signature = Undetectable
875
Activity and Patterns
880
Operating System pings A1B2C3.com biweekly at 2300 for patches
885

FIG. 8B

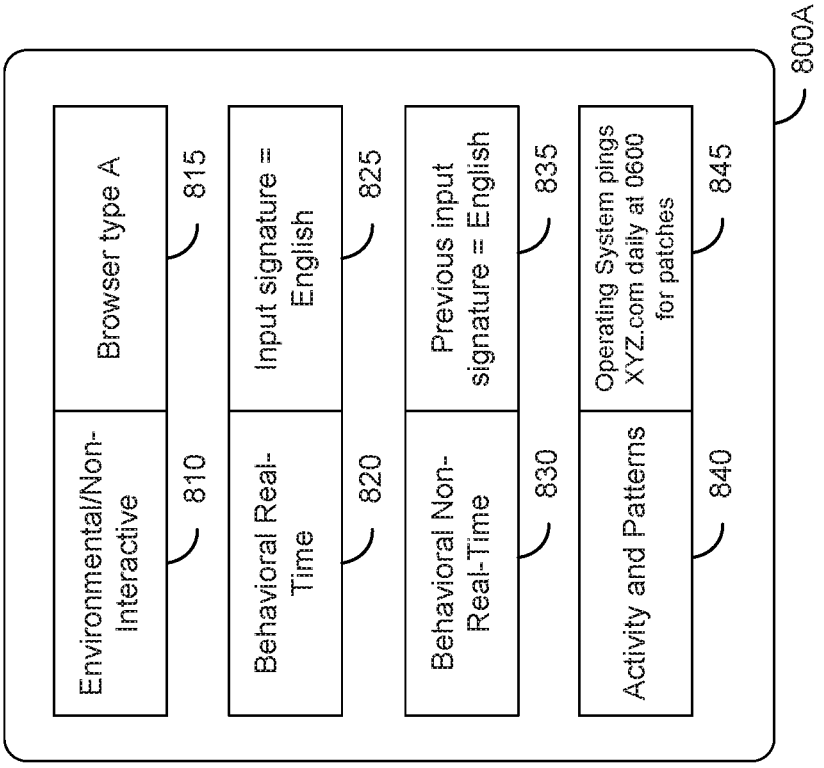
800A
Environmental/Non-Interactive
810
Browser type A
815
Behavioral Real-Time
820
Input signature = English
825
Behavioral Non-Real-Time
830
Previous input signature = English
835
Activity and Patterns
840
Operating System pings XYZ.com daily at 0600 for patches
845

FIG. 8A

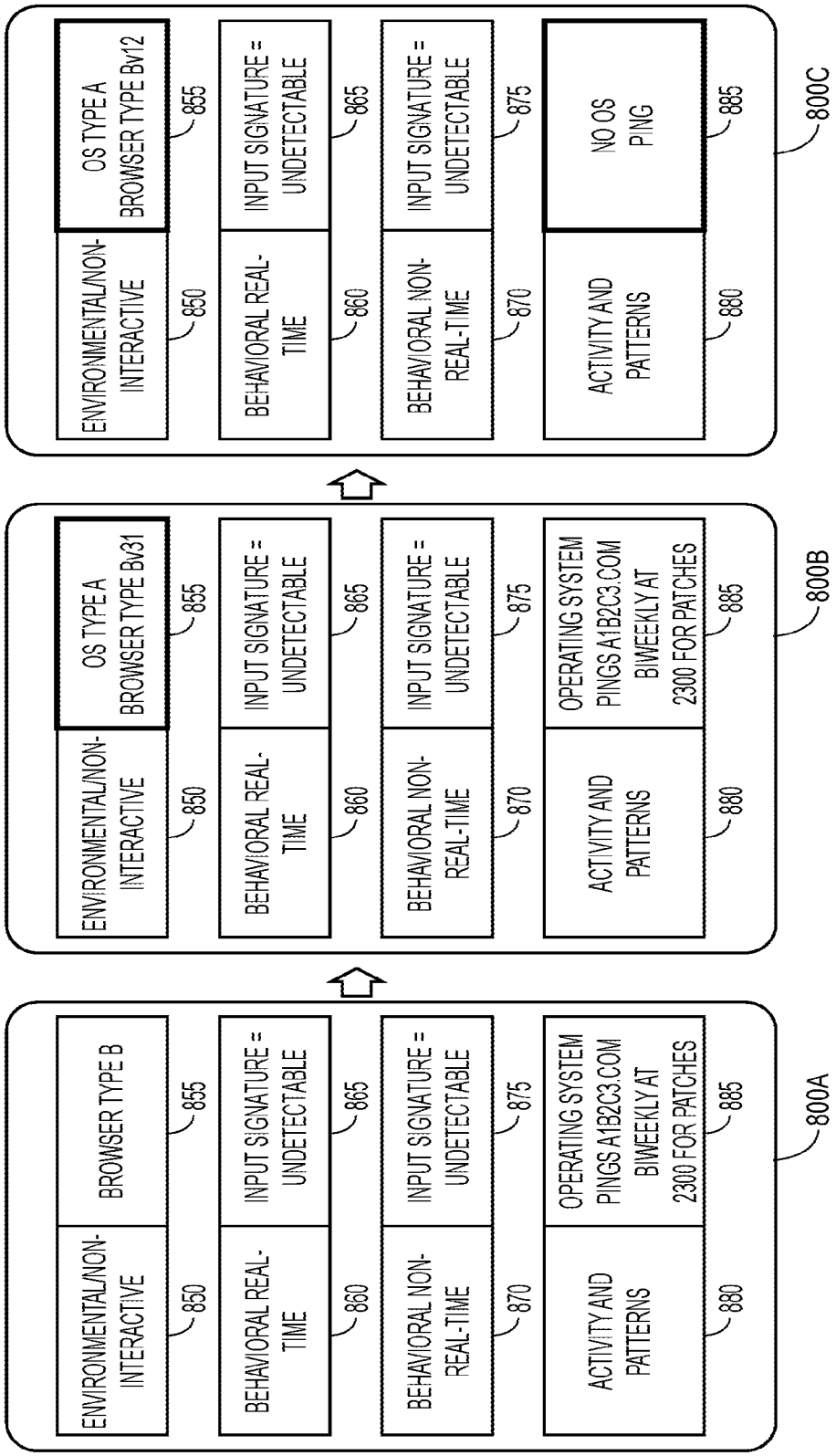
ENVIRONMENTAL/NON-INTERACTIVE
850
BROWSER TYPE B
855
BEHAVIORAL REAL-TIME
860
INPUT SIGNATURE = UNDETECTABLE
865
BEHAVIORAL NON-REAL-TIME
870
INPUT SIGNATURE = UNDETECTABLE
875
ACTIVITY AND PATTERNS
880
OPERATING SYSTEM PINGS A1B2C3.COM BIWEEKLY AT 2300 FOR PATCHES
885
800A
ENVIRONMENTAL/NON-INTERACTIVE
850
OS TYPE A BROWSER TYPE Bv31
855
BEHAVIORAL REAL-TIME
860
INPUT SIGNATURE = UNDETECTABLE
865
BEHAVIORAL NON-REAL-TIME
870
INPUT SIGNATURE = UNDETECTABLE
875
ACTIVITY AND PATTERNS
880
OPERATING SYSTEM PINGS A1B2C3.COM BIWEEKLY AT 2300 FOR PATCHES
885
800B
ENVIRONMENTAL/NON-INTERACTIVE
850
OS TYPE A BROWSER TYPE Bv12
855
BEHAVIORAL REAL-TIME
860
INPUT SIGNATURE = UNDETECTABLE
865
BEHAVIORAL NON-REAL-TIME
870
INPUT SIGNATURE = UNDETECTABLE
875
ACTIVITY AND PATTERNS
880
NO OS PING
885
800C

FIG. 8C

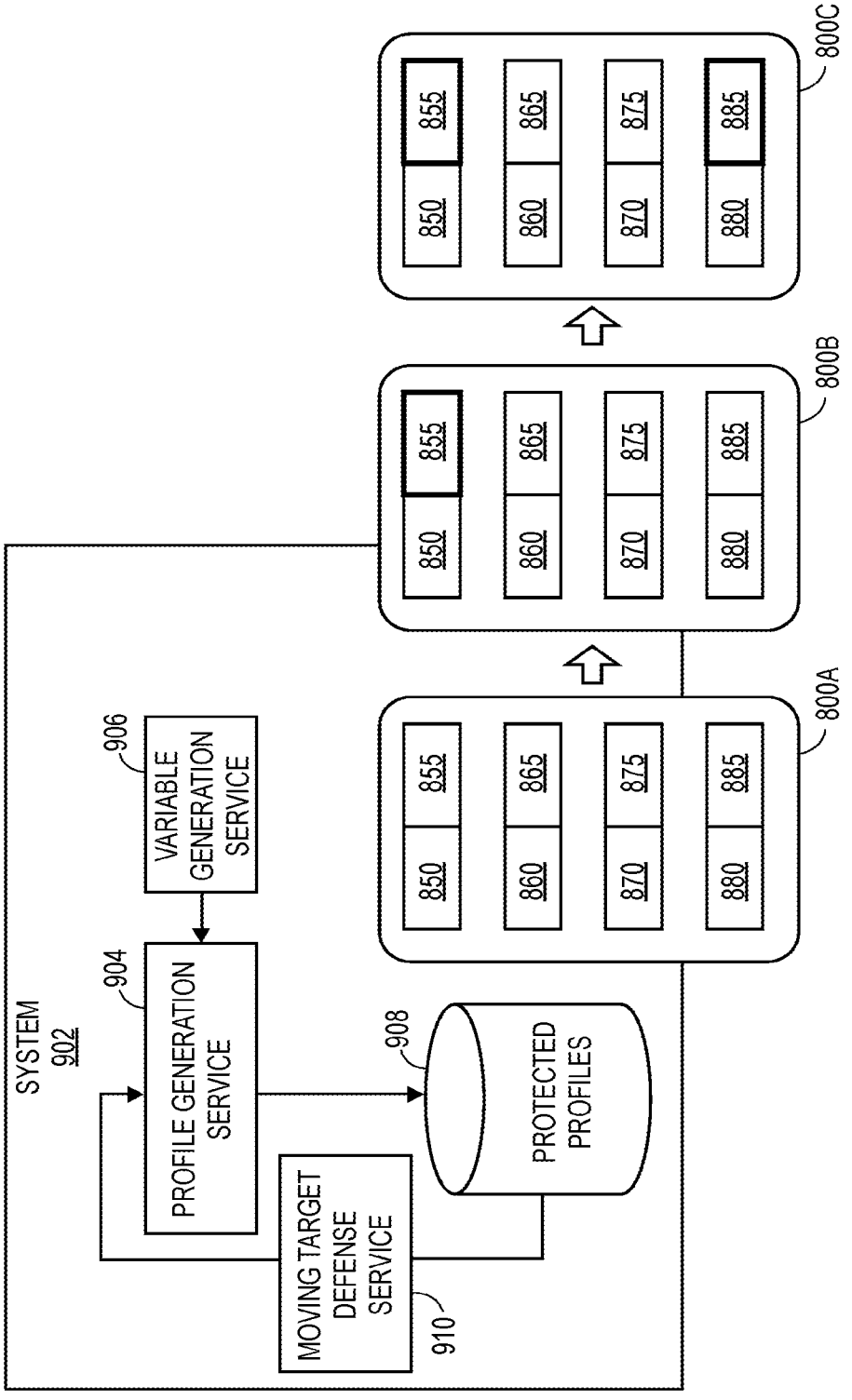
SYSTEM
902
VARIABLE GENERATION SERVICE
906
PROFILE GENERATION SERVICE
904
MOVING TARGET DEFENSE SERVICE
910
PROTECTED PROFILES
908
800A
800B
800C
850
855
860
865
870
875
880
885

FIG. 9A

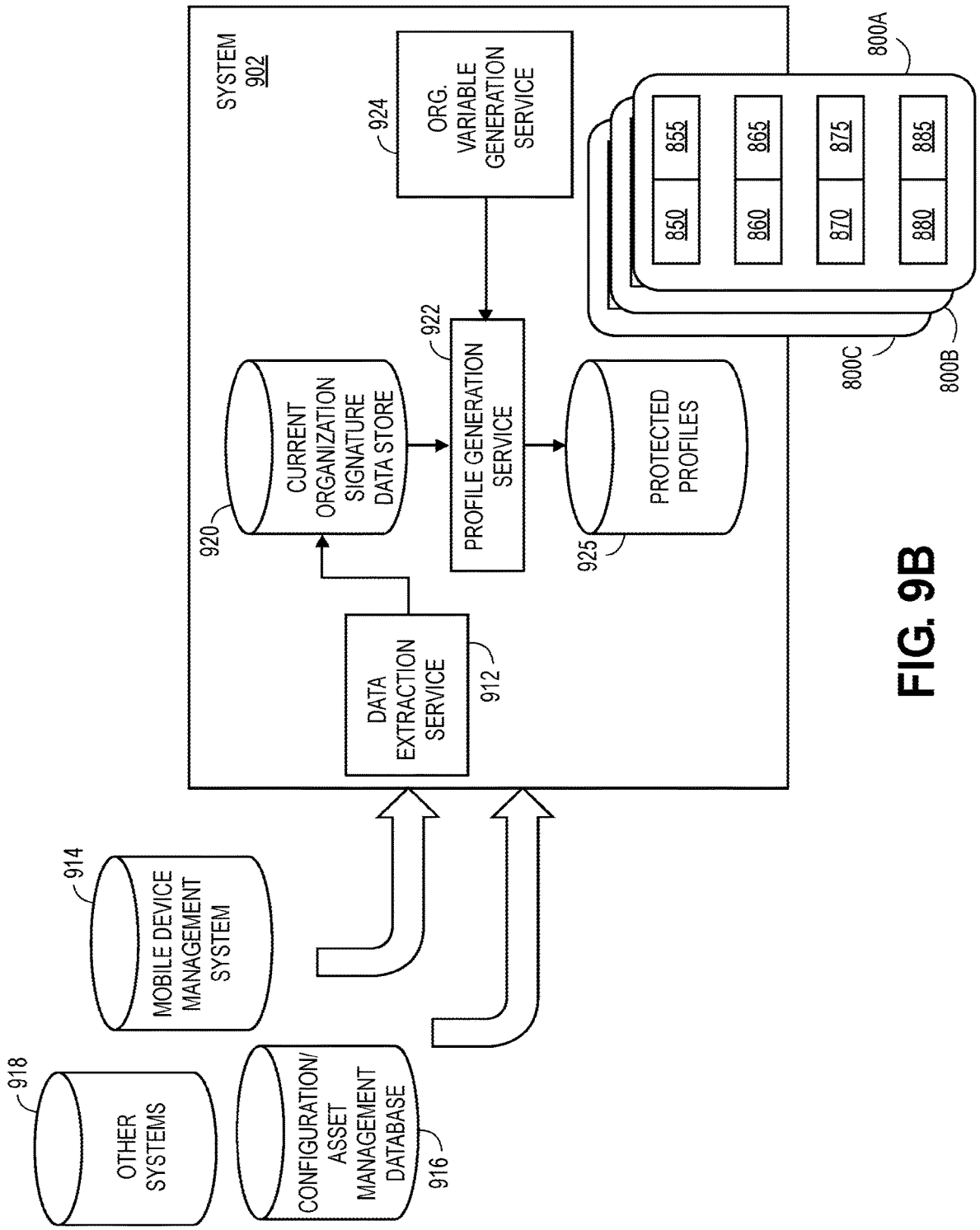
SYSTEM
902
ORG. VARIABLE GENERATION SERVICE
924
800A
850
855
860
865
870
875
880
885
800C
800B
922
PROFILE GENERATION SERVICE
CURRENT ORGANIZATION SIGNATURE DATA STORE
920
PROTECTED PROFILES
925
DATA EXTRACTION SERVICE
912
MOBILE DEVICE MANAGEMENT SYSTEM
914
OTHER SYSTEMS
918
CONFIGURATION/ ASSET MANAGEMENT DATABASE
916

FIG. 9B

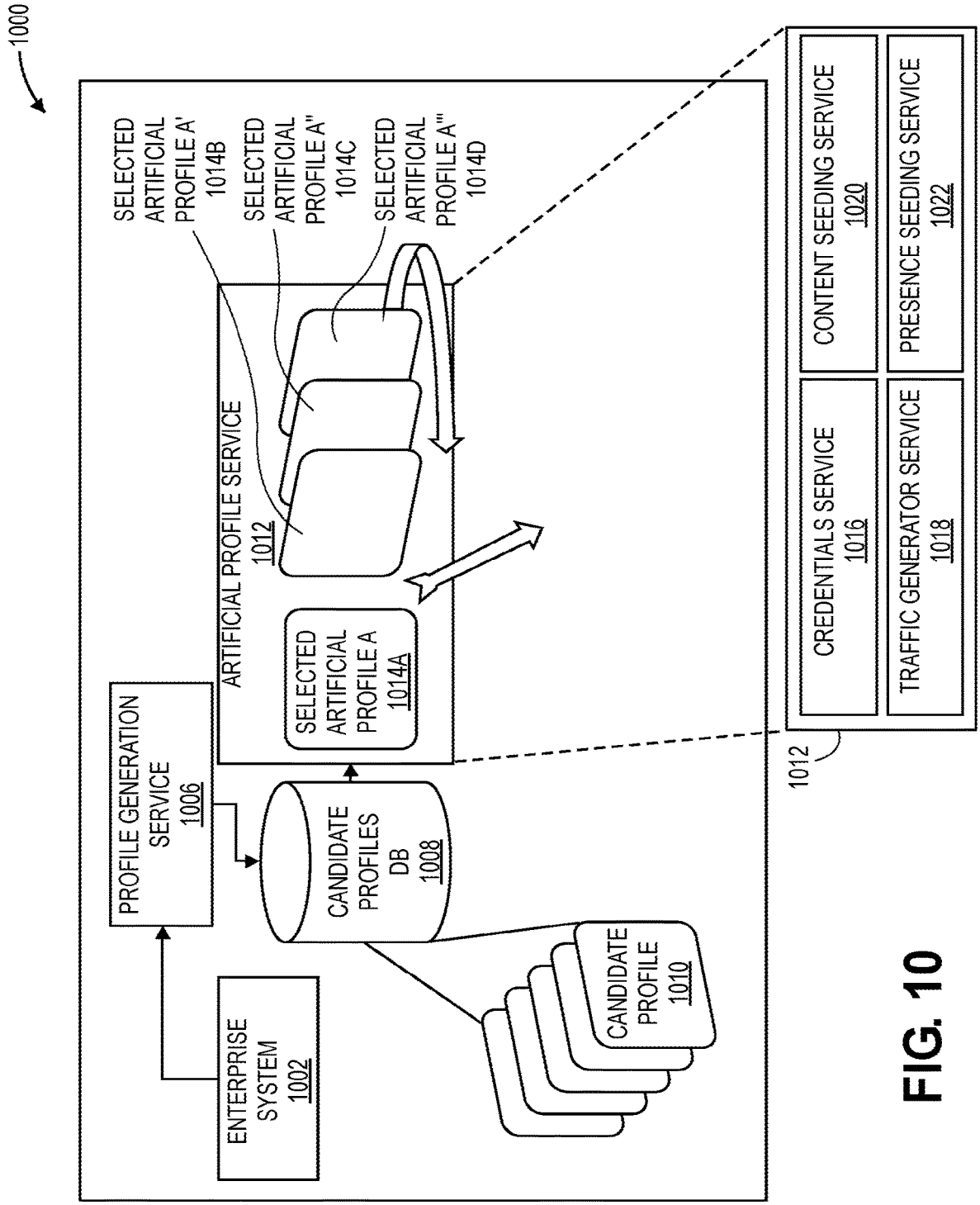
1000
ENTERPRISE SYSTEM 1002
PROFILE GENERATION SERVICE 1006
CANDIDATE PROFILES DB 1008
CANDIDATE PROFILE 1010
ARTIFICIAL PROFILE SERVICE 1012
SELECTED ARTIFICIAL PROFILE A 1014A
SELECTED ARTIFICIAL PROFILE A' 1014B
SELECTED ARTIFICIAL PROFILE A'' 1014C
SELECTED ARTIFICIAL PROFILE A''' 1014D
1012
CREDENTIALS SERVICE 1016
TRAFFIC GENERATOR SERVICE 1018
CONTENT SEEDING SERVICE 1020
PRESENCE SEEDING SERVICE 1022

FIG. 10

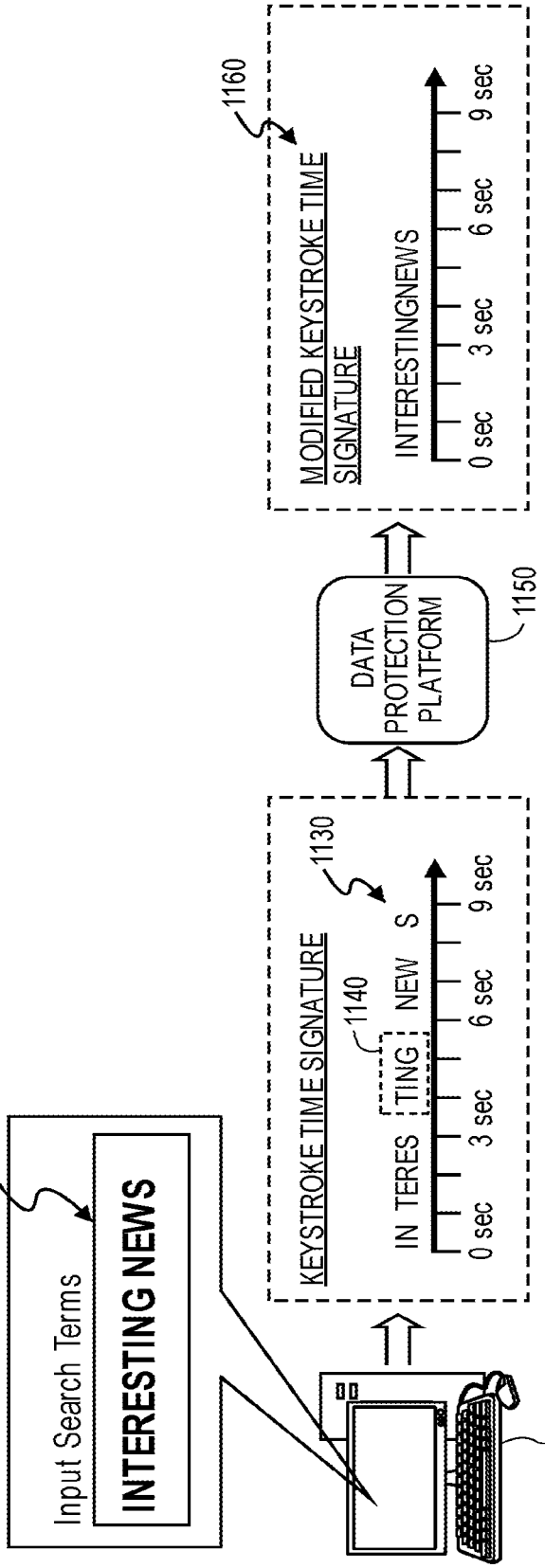
1100
1160
MODIFIED KEYSTROKE TIME SIGNATURE
INTERESTINGNEWS
0 sec
3 sec
6 sec
9 sec
DATA PROTECTION PLATFORM
1150
1130
KEYSTROKE TIME SIGNATURE
1140
IN TERES
TING
NEW
S
1120
Input Search Terms
INTERESTING NEWS
1110

FIG. 11

SYSTEMS AND METHODS FOR CONTROLLING DATA EXPOSURE USING ARTIFICIAL-INTELLIGENCE-BASED PERIODIC MODELING

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation of U.S. patent application Ser. No. 17/349,791 filed Jun. 16, 2021, now U.S. Pat. No. 11,711,438, which is a continuation of U.S. patent application Ser. No. 16/657,598 filed Oct. 18, 2019, now U.S. Pat. No. 11,068,605, which is a continuation in part U.S. patent application Ser. No. 16/280,755 filed Feb. 20, 2019, now U.S. Pat. No. 10,706,158, which is a continuation of U.S. patent application Ser. No. 16/005,268 filed Jun. 11, 2018, now U.S. Pat. No. 10,282,553, the disclosures of which are incorporated herein by reference in their entireties. The present application also claims priority to International Application PCT/US2019/14143 filed Jan. 18, 2019 and International Application PCT/US2020/18981 filed Feb. 20, 2020.

TECHNICAL FIELD

The present disclosure relates to systems and methods for controlling data exposed to external networks using artificial-intelligence-based modeling. More particularly, the present disclosure relates to systems and methods for dynamically creating, modifying, and validating artificial profiles using a data protection platform to control data exposure.

BACKGROUND

Every computing device connected to the Internet produces exposable data. The exposable data may be accessed by authorized network hosts (e.g., web servers providing access to a webpage) or unauthorized network hosts (e.g., hackers) through a network. In some scenarios, the exposed data can be used to reveal sensitive information relating to devices or the users operating the devices. For instance, when a laptop connects to a web server to gain access to a webpage, the web server can query the browser for certain information. However, an unauthorized network host could exploit a vulnerability in a network using that information. For example, the unauthorized network host can execute a data breach of a network using the obtained information. The near-constant usage of computing devices and the Internet increases the complexity of and privacy risks associated with exposable data.

SUMMARY

The term embodiment and like terms are intended to refer broadly to all of the subject matter of this disclosure and the claims below. Statements containing these terms should be understood not to limit the subject matter described herein or to limit the meaning or scope of the claims below. Embodiments of the present disclosure covered herein are defined by the claims below, not this summary. This summary is a high-level overview of various aspects of the disclosure and introduces some of the concepts that are further described in the Detailed Description section below. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used in isolation to determine the scope of the claimed subject matter. The subject matter should be understood by reference to appropriate portions of the entire specification of this disclosure, any or all drawings and each claim.

Embodiments of the present disclosure include a computer-implemented method. In some embodiments, the method may include identifying a set of data privacy elements and generating an artificial profile model. For example, a data privacy element may characterize a feature of a computing device. A data privacy element may be detectable by an unauthorized network host (e.g., a hacker or a virus) or an authorized network host (e.g., an authorized website or web server). Further, the artificial profile model may include the set of data privacy elements. The artificial profile model may include a constraint for generating new artificial profiles. The method may also include receiving a signal indicating that a computing device is requesting access to a network location; and detecting one or more data privacy elements associated with the computing device request to access the network location. The method may include determining an artificial profile for the computing device. The artificial profile may include the one or more data privacy elements. The artificial profile may be usable to identify the computing device. The method may include automatically modifying the one or more data privacy elements. For example, modifying the one or more data privacy elements may use the constraint included in the artificial profile model. The method may include generating a new artificial profile for the computing device. The new artificial profile may include the modified one or more data privacy elements. The new artificial profile may mask the computing device from being identified.

Embodiments of the present disclosure include a system. The system may comprise: one or more data processors; and a non-transitory computer-readable storage medium containing instructions which, when executed on the one or more data processors, cause the one or more data processors to perform operations including the methods described above and herein.

Embodiments of the present disclosure include a computer-program product tangibly embodied in a non-transitory machine-readable storage medium, including instructions configured to cause a data processing apparatus to perform operations including the methods described above and herein.

BRIEF DESCRIPTION OF THE DRAWINGS

The specification makes reference to the following appended figures, in which use of like reference numerals in different figures is intended to illustrate like or analogous components.

FIG. **1** is a schematic diagram illustrating a network environment in which exposable data can be accessed by authorized or unauthorized network hosts, according to certain aspects of the present disclosure.

FIG. **2** is a schematic diagram illustrating a network environment in which exposable data associated with computing devices can be accessed by authorized or unauthorized network hosts, according to certain aspects of the present disclosure.

FIG. **3** is a schematic diagram illustrating a network environment in which exposable data can be accessed by authorized or unauthorized network hosts at various stages of an interaction session, according to certain aspects of the present disclosure.

FIG. **4** is a schematic diagram illustrating the network environment of FIG. **3** with the addition of a data protection

platform that blocks, modifies, or observes exposable data, according to certain aspects of the present disclosure.

FIG. **5** is a schematic diagram illustrating a data protection platform, according to certain aspects of the present disclosure.

FIG. **6** is a block diagram illustrating a non-exhaustive set of data privacy elements that can be exposed to network hosts.

FIG. **7** is a block diagram illustrating an artificial profile model, according to certain aspects of the present disclosure.

FIGS. **8**A-**8**C are block diagrams illustrating artificial profiles generated using the artificial profile model illustrated in FIG. **7**, according to certain aspects of the present disclosure.

FIG. **9**A is a schematic diagram illustrating artificial profiles that change over time using the artificial profile models illustrated in FIG. **8**C, according to certain aspects of the present disclosure;

FIG. **9**B is a schematic diagram illustrating artificial profiles generated using data profile seeding techniques, according to certain aspects of the present disclosure;

FIG. **10** is a schematic diagram illustrating artificial profiles generated using deception techniques, according to certain aspects of the present disclosure;

FIG. **11** is a diagram illustrating a process flow for controlling input signatures during an interaction session, according to certain aspects of the present disclosure.

In the appended figures, similar components and/or features can have the same reference label. Further, various components of the same type can be distinguished by following the reference label by a dash and a second label that distinguishes among the similar components. If only the first reference label is used in the specification, the description is applicable to any one of the similar components having the same first reference label irrespective of the second reference label.

DETAILED DESCRIPTION

Certain aspects and features of the present disclosure relate to systems and methods for controlling data exposure using artificial-intelligence-based (hereinafter referred to as "AI-based") profile models. Specifically, certain aspects and features of the present disclosure relate to systems and methods for providing a data protection platform that is configured to automatically manage the exposure of data privacy elements. For example, a data privacy element may be any item of data that can be exposed (e.g., accessible) to a third-party, such as a hacker. Data privacy elements can be evaluated (e.g., alone or in combination with other data, such as social media profiles) to expose information about users and/or or network systems (e.g., organizations). Non-limiting examples of data privacy elements include activity data (e.g., web browsing history), network data (e.g., network topology), application data (e.g., applications downloaded on the computing device), operating system data (e.g., the operating system (OS) and the corresponding version of the OS running on the computing device), hardware data (e.g., the specific hardware components that comprise the computing device), and other suitable data that exposes information about a user and/or a network.

When a computing device accesses the Internet, various data privacy elements may be exposed as the computing device navigates across web servers. For example, when the computing device accesses an Internet Service Provider (ISP), certain data privacy elements may be stored at the ISP's servers as the ISP facilitates an Internet connection. However, the data privacy elements that are stored at the ISP's servers may be accessible to other network hosts, such as authorized users (e.g., network security engineers) or unauthorized users (e.g., hackers). The accessibility of the stored data privacy elements by other users exposes the data privacy elements. This data exposure creates a security risk because the data privacy elements can be used by unauthorized users, for example, to identify vulnerabilities of the computing device or of the network systems to which the computing device is connected. Identifying vulnerabilities leaves the computing device or the network to which the computing device is connected open to data breaches or other nefarious conduct.

According to certain embodiments, the data protection platform can enhance data protection by controlling and/or managing the exposure of the data privacy elements. In some implementations, the data protection platform (described in greater detail at FIG. **5**) may include an application that is deployed in a cloud network environment. For example, the data protection platform may include an application server on which an application is stored, which, when executed, performs various operations defined by the data protection platform. The data protection platform may also include one or more database servers on which the storage functionalities associated with the application can be performed in the cloud network environment. In some implementations, the computing device (e.g., operating by a user) can connect to the data protection platform using a platform-secured browser. For example, the platform-secured browser can be hosted by the data protection platform to avoid the Internet activity performed on the computing device being stored locally at the computing device. According to certain embodiments, while the computing device navigates the Internet using the platform-secured browser, the data protection platform can automatically, dynamically, in real-time, and/or intelligently control the exposure of data privacy elements associated with the computing device or the network to which the computing device is connected. Non-limiting examples of controlling the exposure of data privacy elements can include blocking data privacy elements from being accessible by web servers or application servers, blocking data privacy elements from being stored at web servers or application servers, modifying one or more data privacy elements according to an artificial profile model, providing the data privacy elements to web servers or applications servers, detecting which data privacy elements are exposed, determining which data privacy elements are required to enable Internet activity (e.g., certain web sites do not function if cookies are disabled), determining which data privacy elements are not required to enable Internet activity, modifying a feature (e.g., a time signature of keystrokes, taps, or mouse clicks) of input received from the computing device, or other suitable techniques for controlling exposure of data privacy elements. In some implementations, artificial profiles can be specific to certain organizations, industries, subject matter, or user-defined applications. For example, the artificial profiles specific to an organization would include data privacy elements that are relevant or consistent with data privacy elements that would be expected for the organization.

Advantageously, the data protection platform can control the exposure of data privacy elements to protect the privacy of the user, computing device, and/or network systems (e.g., operated by organizations, companies, governments, or other suitable entities) as the computing device navigates the Internet. For instance, if a network host can collect data privacy elements of users, computing devices, and/or net-

works (e.g., such that the collection is authorized or unauthorized), the collected data can expose information (e.g., potentially private or sensitive information) about the organization to which the users, computing devices, and/or networks belong. Thus, by using embodiments described herein for managing or controlling the exposure of data privacy elements for users, computing devices, and/or network systems of an organization, the data protection platform thereby manages or controls the exposure of potentially sensitive information about the organization itself. Managing or controlling the exposure of data privacy elements can prevent data breaches of the users, computing devices, and/or network systems because network hosts, such as hackers, can be prevented from collecting certain data privacy elements, or can at least be prevented from collecting accurate data privacy elements, which obfuscate or mask identifies or attributes of the users, computing devices, and/or network systems.

Further, the data protection platform can control the exposure of data privacy elements using artificial profiles, which are generated using an artificial profile model, to obfuscate the user and/or network in a realistic manner. In some implementations, the artificial profile model (described in greater detail with respect to FIG. **7**) can include a model that is generated using machine-learning techniques and/or AI techniques. For example, the artificial profile model may include data representing a relationship between two or more data privacy elements. The relationship between the two or more data privacy elements can be automatically learned using machine-learning techniques, for example, or can be user defined based one or more user-defined rules. In some implementations, when the data protection platform modifies a data privacy element to obfuscate a computing device, the modification of the data privacy element can be performed within the constraints of the relationship learned or defined by the artificial profile model.

As a non-limiting example, a specific application may be downloaded on a computing device. Downloading the specific application on the computing device may also cause a specific set of fonts to be installed on the computing device. When the computing device accesses a website, the web server that provides access to the website may execute a tracking asset (e.g., a cookie) that is stored in the computing device's browser. The tracking asset can request certain data privacy elements from the computing device. For example, the tracking asset may request (from the computing device's browser) data privacy elements identifying which fonts are installed on the computing device. From the perspective of the network host (e.g., the web server providing access to the website), if the data privacy elements collected from the computing device indicate that a font is installed on the computing device, or the lack of a font installed on the computing device, that indication may be evaluated to determine (with some likelihood) whether or not an application has been downloaded onto the computing device. Again, from the perspective of the network host, if the exposure of data privacy elements from the computing device indicate with a certain likelihood that an application has been downloaded on the computing device, this information introduces an attack vector (e.g., known or unknown vulnerabilities or exploits associated with that application), exposes user information (e.g., the application is specific to an industry, which exposes the industry associated with the organization), or may not provide any information at all.

According to certain embodiments, the data protection platform can obfuscate the identifiable attributes of the computing device by modifying the data privacy elements (i.e., the identity of the fonts that are installed on the computing device) so that the web server collects inaccurate data about the computing device when the computing device accesses the website. However, the modification of the data privacy elements would not appear to be realistic (e.g., to a hacker) if the identity of the fonts were modified to include a font that was inconsistent with the specific set of fonts associated with the specific application. Accordingly, in order to control the data privacy elements of the computing device in a realistic manner, the artificial profile model can include data representing the relationship between the specific application and the set of specific fonts. Thus, generating an artificial profile for the computing device may involve changing the specific application to a new application, which is exposed to the website, and to also modify the set of specific fonts to a set of new fonts associated with the new application. In this non-limiting example, the modified data privacy elements collected by the website (i.e., the identity of the new application and the set of new fonts) will seem realistic to a hacker because both data privacy elements (e.g., the application and the associated set of fonts) are consistent with each other. As an advantage of the disclosed embodiments, generating artificial profiles to be consistent with dependencies defined in the artificial profile model increases the realistic nature of the modified artificial profiles so as to enhance the data protection of computing devices and/or networks.

These non-limiting and illustrative examples are given to introduce the reader to the general subject matter discussed here and are not intended to limit the scope of the disclosed concepts. For example, it will be appreciated that data privacy elements other than fonts can be collected, including, but not limited to, which plugins are installed in the browser of the computing device, or any other information collectable from a browser, computing device, or Operating System running on the computing device. The following sections describe various additional features and examples with reference to the drawings in which like numerals indicate like elements, and directional descriptions are used to describe the illustrative embodiments but, like the illustrative embodiments, should not be used to limit the present disclosure. The elements included in the illustrations herein may not be drawn to scale.

FIG. **1** is a schematic diagram illustrating network environment **100**, in which exposable data can be accessed by authorized or unauthorized network hosts, according to certain aspects of the present disclosure. Network environment **100** can include Internet **110**, site network **120** and home network **130**. Each of Internet **110**, site network **120**, and home network **130** can include any open network, such as the Internet, personal area network, local area network (LAN), campus area network (CAN), metropolitan area network (MAN), wide area network (WAN), wireless local area network (WLAN); and/or a private network, such as an intranet, extranet, or other backbone. In some instances, Internet **110**, site network **120**, and/or home network **130** can include a short-range communication channel, such as Bluetooth or Bluetooth Low Energy channel. Communicating using a short-range communication such as BLE channel can provide advantages such as consuming less power, being able to communicate across moderate distances, being able to detect levels of proximity, achieving high-level security based on encryption and short ranges, and not requiring pairing for inter-device communications.

In some implementations, communications between two or more systems and/or devices can be achieved by a secure

communications protocol, such as secure sockets layer (SSL), transport layer security (TLS). In addition, data and/or transactional details may be encrypted based on any convenient, known, or to be developed manner, such as, but not limited to, DES, Triple DES, RSA, Blowfish, Advanced Encryption Standard (AES), CAST-128, CAST-256, Decorrelated Fast Cipher (DFC), Tiny Encryption Algorithm (TEA), eXtended TEA (XTEA), Corrected Block TEA (XXTEA), and/or RC5, etc.

As illustrated in the example of FIG. **1**, site network **120** may be connected to computer **160**, home network **130** may be connected to mobile device **170** (e.g., a smartphone) and smart TV **180** (e.g., a television with Internet capabilities), and Internet **110** may be connected to secure server **140**. Site network **120** may be a network that is operated by or for an organization, such as a business. Computer **160** may connect to secure server **140** using site network **120**. Home network **130** may be a network that is operated by or for a residential area, such as a single family dwelling or an apartment complex. Mobile device **170** and smart TV **180** may connect to secure server **140** using home network **130**. Secure server **140** may be any server connected to the Internet or a cloud network environment. For example, secure server **140** may be a web server that is hosting a website. It will be appreciated that, while network environment **100** shows a single site network and a single home network, any number of network in any configuration can be included in network environment **100**.

In some implementations, network host **150** may a computing device (e.g., a computer) connected to a computer network, such as any of Internet **110**, site network **120**, and/or home network **130**. In some implementations, network host **150** may be any network entity, such as a user, a device, a component of a device, or any other suitable network device. In some instances, network host **150** may be an authorized device, such as a web server that allows users to access a website, an application server that allows users to access an application, a network security engineer, or other suitable authorized devices. In some instances, network host **150** may be an unauthorized network host, such as a hacker, a computer virus, or other malicious code. For example, network host **150** may be able to access secure server **140**, site network **120**, and/or home network **130** to collect exposable data privacy elements that expose information about secure server **140**, site network **120**, computer **160**, home network **130**, mobile device **170**, and/or smart TV **180**. As computer **160**, mobile device **170**, and/or smart TV **180** communicate over Internet **110**, for example, with secure server **140**, various exposable data privacy elements can be collected and stored at servers or databases of any of site network **120**, home network **130**, or Internet **110**. Either substantially in real-time (with Internet activity of computer **160**, mobile device **170**, or smart TV **180**) or non-real-time, network host **150** can access the data privacy elements that may be stored at secure server **140**, site network **120**, and/or home network **130**. Network host **150** can access the stored data privacy elements in an authorized manner (e.g., a website that allowed access after a cookie has been installed in a browser) or an unauthorized manner (e.g., secure server **140** may be hacked by network host **150**). Either way, network host **150** can evaluate the collected data privacy elements to determine whether there are any vulnerabilities in any aspects of secure server **140**, site network **120**, and/or home network **130**. Network host **150** can then use the vulnerabilities to execute a data breach. The ability of network host **150** to collect exposable data privacy elements is described in greater detail with respect to FIG. **2**. Further, according to certain embodiments described herein, the data protection platform can be used to prevent network host **150** from accessing or collecting the data privacy elements or to obfuscate the real data privacy elements so as to provide inaccurate or useless information to network host **150**.

FIG. **2** is a schematic diagram illustrating network environment **200**, in which exposable data associated with computing devices can be accessed by authorized or unauthorized network hosts, according to certain aspects of the present disclosure. In some implementations, network environment **200** can include secure server **1230**, network **210**, gateway **220**, mobile device **250**, smart TV **260**, and laptop **270**. For example, network environment **200** may be similar to or a more detailed example of home network **130** of FIG. **1**. Mobile device **250**, smart TV **260**, and laptop **270** may be located within a defined proximity, such as within a home or residence. Secure server **230** may be the same as or similar to secure server **140**, and thus, further description is omitted here for the sake of brevity. Network **210** may be the same as site network **120** or home network **130** of FIG. **1**, and thus, further description is omitted here for the sake of brevity. Network host **240** may be the same or similar to network host **150**, and thus, further description is omitted here for the sake of brevity. Gateway **220** may be an access point (e.g., a router) that enables devices, such as mobile device **250**, smart TV **260**, and laptop **270** to connect to the Internet. FIG. **2** is provided to illustrate how network host **240** can collect exposable data privacy elements from secure server **230** based on routine and seemingly innocuous data communications between devices.

As a non-limiting example, smart TV **260** may be configured to automatically and periodically transmit a signal to secure server **230**. The signal may correspond to a request for updates to the software stored on smart TV **260**. In this non-limiting example, secure server **230** may be a server that stores software updates or that controls the distribution of software updates to smart TVs like smart TV **260**. However, the signal transmitted from smart TV **260** may include data privacy elements that expose information about smart TV **260**, gateway **220**, and/or network **210**. For example, the signal may include a variety of data privacy elements, including, but not limited to, the version of the software currently stored on smart TV **260**, the viewing data collected by smart TV **260** (if authorized by the user), the service set identifier (SSID) of gateway **220**, a password to connect to gateway **220**, login credentials associated with a user profile recently logged into on smart TV **260**, information about the hardware or firmware installed in smart TV **260**, information about the hardware, firmware, or software recognized to be installed at gateway **220**, the physical location of smart TV **260** (e.g., determined using an Internet Protocol (IP) address), applications downloaded by a user on smart TV **260**, and/or application usage data. The data privacy elements included in the signal may be stored at secure server **230**.

In some cases, if relatively sensitive information is included in the signal, such as viewing data (e.g., accessed video content) recently collected by smart TV **260**, secure server **230** may store that sensitive information securely behind protection mechanisms, such as firewalls. However, secure server **230** may be hacked by network host **240**. In this scenario, the sensitive information (i.e., the data privacy elements included in the signal and subsequently stored at secure server **230**) may be exposed to network host **240**.

In some cases, if relatively innocuous information is included in the signal, such as the version of software stored on smart TV **260** or the SSID of gateway **220**, the informa-

tion may be stored at secure server **230** without many protection mechanisms, such as firewalls. For instance, secure server **230** may not need to securely store the version of the software currently stored on smart TV **260** because this information may be relatively innocuous. However, network host **240** can access secure server **230**, either in an authorized or unauthorized manner, to obtain the exposed data privacy element of the software version. The software version can nonetheless be used maliciously by bad actors because the software version can be exploited to identify vulnerabilities in the software. The identified vulnerabilities can be used to execute a data breach or hacking of smart TV **260**, which places at risk the privacy information associated with a user of smart TV **260**.

FIG. **2** illustrates the problem of data privacy elements being exposable to other hosts, such as servers, hackers, websites, or authorized users, during an interaction between devices, such as smart TV **260** and secure server **230**. Exposable data privacy elements can be exploited by unauthorized hosts, such as hackers, to determine vulnerabilities that can be exploited to attack a network or an individual device. Further, exposable data privacy elements can also be exploited by authorized hosts, such as a website, to profile users based on online activity; however, this profiling can create risks of private information being exposed.

FIG. **3** is a schematic diagram illustrating network environment **300**, in which exposable data can be accessed by authorized network hosts (e.g., a web server hosting a webpage, an application server hosting an application, and so on) or unauthorized network hosts (e.g., a hacker) at various stages of a browsing session. Further, FIG. **4** is a schematic diagram illustrating network environment **400**, which is similar to network environment **300**, but with the addition of an exemplary data protection platform **440** that controls the exposure of data privacy elements to block or obfuscate private information from being exposed, according to certain embodiments.

Referring again to FIG. **3**, network environment **300** can include laptop **310**, gateway **320**, ISP **330**, network **340**, and secure server **350**. A browser can be running on laptop **310**. The browser can enable a user operating laptop **310** to communicate with secure server **350** through network **340**. However, as the browser running on laptop **310** interacts with secure server **350**, exposable data privacy elements **370** can be collected at various devices connected to the Internet. For example, gateway **320**, ISP **330** can store one or more data privacy elements that can expose information about laptop **310** because laptop **310** communicates with gateway **320** and ISP **330** to connect with secure server **350**. While the exposable data privacy elements **370** can be collected at gateway **320**, ISP **330**, or secure server **350** (e.g., by network host **360**), gateway **320**, ISP **330**, and secure server **350** may or may not be the source of the exposable data privacy elements. For example, the browser running on laptop **310** can expose certain information about the Operating System (OS) installed on laptop **310**, but that OS information may be collected by a web server when the web server queries the browser, or when network host **360** accesses the OS information in an unauthorized manner (e.g., by hacking the web server to gain access to the stored OS information).

Referring again to FIG. **4**, in some implementations, the addition of data protection platform **440** into network environment **300** (as represented by network environment **400**), can control the exposure of data privacy elements as laptop **410** navigates the Internet. In FIG. **4**, gateway **420** may be the same as or similar to gateway **320**, ISP **430** may be the same as or similar to ISP **330**, network **450** may be the same as or similar to network **340**, and secure server **460** may be the same as or similar to secure server **350**, and thus, a description of these devices is omitted for the sake of brevity. In some implementations, data protection platform **440** can provide a platform-secured browser for laptop **410**. As the user navigates the Internet using the platform-secured browser, data protection platform **440** can block, modify, and/or observe the data privacy elements (e.g., at block **470**) that are exposed to devices across the Internet.

Continuing with the example described in FIG. **4**, when a web server queries the platform-secured browser, the data protection platform **440** can block the OS information from being provided to the web server. As another example, the data protection platform **440** can modify the OS information (e.g., using an artificial dynamic model profile), and provide the modified OS information to the web server. According to certain embodiments, network host **480** may collect artificial exposable data privacy elements **495** at block **490**, however, the collected data privacy elements obfuscate the actual information about the user operating system, the platform-secured browser, or laptop **410** itself. Advantageously, the collected exposable data privacy elements **495** would not expose any real vulnerabilities of laptop **410**.

As noted above in FIG. **4**, the browser running on laptop **410** can interact with secure server **460**, and exposable data privacy elements **470** can be collected at various devices connected to the Internet. As noted above, gateway **420** and ISP **430** can store one or more data privacy elements that can expose information about laptop **410** because laptop **410** communicates with gateway **420** and ISP **430** to connect with secure server **460**. For example, platform-secured network element **380** can be added into network environment **400** at a point between laptop **410** and gateway **420**.

FIG. **5** is a schematic diagram illustrating data protection platform **500**, according to certain aspects of the present disclosure. In some implementations, data protection platform **500** may be implemented using cloud-based network **510**. For example, data protection platform **500** may be an application that is deployed in cloud-based network **510**. Data protection platform **500** in cloud-based network **510** may include an application server (not shown) that is constructed using virtual CPUs that are assigned to or reserved for use by data protection platform **500**. Further, data protection platform **500** may be implemented using one or more containers. Each container can control the exposure of data privacy elements. A container may include stand-alone, executable code that can be executed at runtime with all necessary components, such as binary code, system tools, libraries, settings, and so on. However, because containers are a package with all necessary components to run the executable code, the container can be executed in any network environment in a way that is isolated from its environment. It will be appreciated that any number of cloud-based networks can be used to implement data protection platform **500**. For example, assuming data protection platform **500** is implemented using a set of containers, a subset of the set of containers can be deployed on cloud-based network **510**, another subset of the set of containers can be deployed on cloud-based network **520**, another subset of the set of containers can be deployed on cloud-based network **530**, and so on. It will also be appreciated that data protection platform **500** may or may not be implemented using a cloud-based network.

Referring to the non-limiting example illustration of FIG. **5**, data protection platform **500** can include a number of containers that are deployed using cloud-based network **510**. For instance, data protection platform **500** can include

secure browser **551**, secure routing container **552**, real-time monitoring container **553**, profile management container **554**, AI container **555**, external integration container **556**, profile history database **557**, profile model database **558**, and content database **559**. Further, data protection platform **500** may control the exposure of data privacy elements that are exposable during a browsing session between a computing device (e.g., laptop **410** of FIG. **4**) and secure server **550** on network **540**.

In some implementations, secure browser **551** may be a container that includes executable code that, when executed, provides a virtual, cloud-based browser to the computer device. For example, the platform-secured browser running on laptop **410** shown in FIG. **4** may be provided by the data protection platform **500** using secure browser **551**. In some implementations, secure routing container **552** may be a container that includes executable code that, when executed, provides the computing device with a virtual private network (VPN) to exchange communications between the computing device and the data protection platform **500**. Secure routing container **552** can also facilitate the routing of communications from the computing device or from any container within data protection platform **500** to other devices or containers internal or external to data protection platform **500**. For example, if data protection platform **500** is implemented across several cloud-based networks, then secure routing container **552** can securely route communications between containers across the several cloud-based networks. Real-time monitoring container **553** can be a container including executable code that, when executed, monitors the exposable data privacy elements associated with a browsing session in real-time. For example, if a computing device connects with a web server to access a search engine website, real-time monitoring container **553** can monitor the user input received at the search engine web site as the user types in the input. In some implementations, real-time monitoring container **553** can control the exposure of behavioral/real-time attribution vectors (e.g., attribution vectors **730**, which are described in greater detail with respect to FIG. **7**). For example, real-time monitoring container **553** may modify the input dynamics of keystroke events, as described in greater detail with respect to FIG. **11**.

Profile management container **554** can include executable code that, when executed, controls or manages the artificial profiles that have been created and stored. For example, profile management container **554** can use artificial intelligence (e.g., Type II Limited Memory) provided by AI container **555** to generate a new artificial profile based on the artificial profile model (e.g., artificial profile model **700** described in greater detail with respect to FIG. **7**) and/or administrator entered constraints (e.g., region, demographic, protection level requirements) to ensure that newly created or modified artificial profiles are compliant with previously generated profiles stored in the profile history database **557**. AI container **555** can include executable code that, when executed, performs the one or more machine-learning algorithms on a data set of all available data privacy elements to generate the artificial profile model. The generated artificial profile model can be stored at profile model database **558**. Further, external integration container **556** can include executable code that, when executed, enables third-party systems to integrate into data protection platform **500**. For example, if an organization seeks to use data protection platform **500** to control the exposure of data privacy elements for all employees of the organization, external integration container **556** can facilitate the integration of the third-party systems operated by the organizations. Content database **559** may store content data associated with browsing sessions in a content file system. For example, if during a browsing session between a computing device and a web server, the user operating the browser determines that content data should be stored from the web server, that content data can be stored in content database **559** and the content file system can be updated.

It will be appreciated that data protection platform **500** may include any number of containers to control the exposure of data privacy elements during webpage or application navigation. It will also be appreciated that data protection platform **500** is not limited to the use of containers to implement controlling data privacy elements. Any other system or engine may be used in data protection platform **500** to implement controlling data privacy elements, in addition to or in lieu of the use of containers.

FIG. **6** is a block diagram illustrating non-limiting example **600**, which includes a non-exhaustive set **610** of data privacy elements that can be exposed to network hosts or any other device within a network. FIG. **6** is provided to describe in greater detail the various data privacy elements associated with a particular browser, computing device, or network. For example, non-exhaustive set **610** includes the various data privacy elements that can be exposed to network hosts during online activity performed by a computing device, such as computing device **310** of FIG. **3**. Further, the data privacy elements included in non-exhaustive set **610** may also be collected while the computing device is not browsing the Internet or interacting with an application. For example, even though the computing device may not currently be accessing the Internet, one or more data privacy elements may nonetheless be stored at a gateway, an ISP server, or a secure server on the Internet. The stored one or more data privacy elements may have been collected during a previous interaction with the computing device. In this example, the stored one or more data privacy elements are still exposed because a network host can access the stored one or more data privacy elements even while the computing device is not currently accessing the Internet.

In some implementations, non-exhaustive set **610** may include data privacy elements **620**, which are related to the online activity of a user. Non-limiting examples of the activity of a user may include any interaction between user input devices and a browser (e.g., the user entering text into a web site using a keyboard), the browser and a web server (e.g., the browser requesting access to a webpage by transmitting the request to a web server, the search history of a browser, the browsing history of a browser), the browser and an application server (e.g., the browser requesting access to an application by transmitting the request to the application server), the browser and a database server (e.g., the browser requesting access to one or more files stored at a remote database), the browser and the computing device on which the browser is running (e.g., the browser storing data from a cookie on the hard drive of the computing device), the computing device and any device on a network (e.g., the computing device automatically pinging a server to request a software update), and any other suitable data representing an activity or interaction. In some implementations, data privacy elements **620** may also include a detection of no activity or no interactions during a time period, for example, a period of time of no user interaction or user activity.

In some implementations, data privacy elements **620** may include information about input received at a browser, but that was not ultimately transmitted to the web server due to subsequent activity by the user. For example, if a user types in certain text into an input field displayed on a webpage, but

then deletes that text without pressing any buttons (e.g., a "send" button), that entered text may nonetheless be an exposable data privacy element that can reveal information about the user, even though that entered text was never transmitted to a web server. It will be appreciated that the present disclosure is not limited to the examples of data privacy elements **620** described herein. Other data privacy elements related to a user's activity or non-activity that is not mentioned here, may still be within the scope of the present disclosure.

In some implementations, non-exhaustive set **610** may include data privacy elements **630**, which are related to information about networks and/or network configurations. Non-limiting examples of information about a network may include a network topology (e.g., how many web servers, application servers, or database servers are included in the network, and how are they connected); network security information (e.g., which Certificate Authorities (CAs) are trusted, which security protocols are used for communicating between devices, the existence of any detected honeypots in the network, and so on); the versions of security software used in the network; the physical locations of any computing devices, servers, or databases; the number of devices connected to a network; the identify of other networks connected to a network; the IP addresses of devices within the network; particular device identifiers of devices, such as a media access control (MAC) address; the SSID of any gateways or access points; the number of gateways or access points; and any other suitable data privacy element related to network information. Network hosts can evaluate data privacy elements **630** to identify and exploit vulnerabilities in the network. It will be appreciated that the present disclosure is not limited to the examples of data privacy elements **630** described herein. Other data privacy elements related to a network that are not mentioned here, may still be within the scope of the present disclosure.

In some implementations, non-exhaustive set **610** may include data privacy elements **640**, which are related to information about applications stored on the computing device or accessed by the computing device. Non-limiting examples of application information may include an identity of one or more applications installed on the computing device; an identify of one or more applications accessed by the computing device (e.g., which web applications were accessed by the computing device); a software version of one or more applications installed on the computing device; an identity of one or more applications that were recently or not recently uninstalled from the computing device; the usage of one or more applications installed on the computing device (e.g., how many times did the user click or tap on the execution file of the application); whether an application is a native application stored on a mobile device or a web application stored on a web server or application server; an identity of one or more applications that are active in the background (e.g., applications that are open and running on the computing device, but that the user is not currently using); an identify of one or more applications that are currently experiencing user interaction; the history of software updates of an application; and any other suitable data privacy element relating to applications. It will be appreciated that the present disclosure is not limited to the examples of data privacy elements **640** described herein. Other data privacy elements related to an application that are not mentioned here, may still be within the scope of the present disclosure.

In some implementations, non-exhaustive set **610** may include data privacy elements **650**, which expose information about the OS installed on the computing device. Non-limiting examples of OS information may include an identity of the OS installed on the computing device; a version of the OS installed on the computing device; a history of the updates of the OS; an identity of a destination server with which the computing device communicated during any of the updates; an identification of patches that were downloaded; an identification of patches that were not downloaded; and identification of updates that were downloaded, but not properly installed; system configurations of the OS; the settings or the hardware-software arrangement; system setting files; activity logged by the OS; an identity of another OS installed on the computing device, if more than one; and any other suitable data privacy element relating to the OS currently installed or previously installed on the computing device. It will be appreciated that the present disclosure is not limited to the examples of data privacy elements **650** described herein. Other data privacy elements related to the OS that are not mentioned here, may still be within the scope of the present disclosure.

In some implementations, non-exhaustive set **610** may include data privacy elements **660**, which expose information about the hardware components of the computing device. Non-limiting examples of hardware information may include an identity of the various hardware components installed on the computing device; an identify of any firmware installed on the computing device; an identity of any drivers downloaded on the computing device to operate a hardware component; configuration settings of any hardware component, firmware, or driver installed on the computing device; a log of which external hardware devices have been connected to the computing device and which ports were used (e.g., Universal Serial Bus (USB) port); the usage of a hardware component (e.g., the CPU usage at a given time); an identify of any hardware components that are paired with the computing device over a short-range communication channel, such as Bluetooth (e.g., has the computing device connected to a smart watch, a virtual-reality headset, a Bluetooth headset, and so on); and any other data privacy elements that relate to hardware information. It will be appreciated that the present disclosure is not limited to the examples of data privacy elements **660** described herein. Other data privacy elements related to the hardware components of the computing device or other associated devices (e.g., a virtual-reality headset) that are not mentioned here, may still be within the scope of the present disclosure. It will also be appreciated that non-exhaustive set **610** may also include data privacy elements **670** that are not described above, but that are within the scope of the present disclosure. Further, there may or may not be overlap between data privacy elements **620**, **630**, **640**, **650**, **660**, and **670**.

While FIG. **6** illustrates a non-exhaustive set of data privacy elements that may be exposed by the user, the browser running on the computing device, the computing device itself, or any device that the computing device interacted with, certain embodiments of the present disclosure include generating a model for creating artificial profiles based on the non-exhaustive set **610** of data privacy elements. The model may be generated using one or more machine-learning techniques and/or one or more AI techniques, as described in further detail with respect to FIG. **7**.

FIG. **7** is a block diagram illustrating a non-limiting example of an artificial profile model **700**, according to certain aspects of the present disclosure. As described above, certain embodiments provide for generating an artificial profile model, which can be used as the basis for creating

artificial profiles for users navigating the Internet. The advantage of using an artificial profile model as the basis for creating or modifying artificial profiles is that the artificial profile model ensures that the newly created or modified artificial profiles are consistent with constraints, relationships and/or dependencies between data privacy elements. Maintaining consistency with the constraints, relationships and/or dependencies that are defined in the artificial profile model makes for more realistic artificial profiles. Further, realistic artificial profiles advantageously decrease the likelihood that a network host will flag an artificial profile as fake, while at the same time obfuscates or blocks information about the user, browser, or computing device.

In some implementations, artificial profile model **700** may be trained by executing one or more machine-learning algorithms on a data set including non-exhaustive set **610** of FIG. **6**. For example, one or more clustering algorithms may be executed on the data set including non-exhaustive set **610** to identify clusters of data privacy elements that relate to each other or patterns of dependencies within the data set. The data protection platform can execute the clustering algorithms to identify patterns within the data set, which can then be used to generate artificial profile model **700**. Non-limiting examples of machine-learning algorithms or techniques can include artificial neural networks (including backpropagation, Boltzmann machines, etc.), bayesian statistics (e.g., bayesian networks or knowledge bases), logistical model trees, support vector machines, information fuzzy networks, Hidden Markov models, hierarchical clustering (unsupervised), self-organizing maps, clustering techniques, and other suitable machine-learning techniques (supervised or unsupervised). For example, the data protection platform can retrieve one or more machine-learning algorithms stored in a database (not shown) to generate an artificial neural network in order to identify patterns or correlations within the data set of data privacy elements (i.e., within non-exhaustive set **610**). As a further example, the artificial neural network can learn that when data privacy element #1 (in the data set) includes value A and value B, then data privacy element #2 is predicted as relevant data for data privacy element #1. Thus, a constrain, relationship and/or dependency can be defined between data privacy element #1 and data privacy element #2, such that any newly created or modified artificial profiles should be consistent with the relationship between data privacy elements #1 and #2. In yet another example, a support vector machine can be used either to generate output data that is used as a prediction, or to identify learned patterns within the data set. The one or more machine-learning algorithms may relate to unsupervised learning techniques, however, the present disclosure is not limited thereto. Supervised learning techniques may also be implemented. In some implementations, executing the one or more machine-learning algorithms may generate a plurality of nodes and one or more correlations between at least two nodes of the plurality of nodes. For example, the one or more machine-learning algorithms in these implementations can include unsupervised learning techniques, such as clustering techniques, artificial neural networks, association rule learning, and so on.

In some implementations, the data protection platform can map data privacy elements to a machine-learning model (e.g., artificial profile model **700**), which includes a plurality of nodes and one or more correlations between at least two nodes. Based on the mapping and the one or more correlations, the data protection platform can intelligently predict or recommend other data privacy elements that are related to, dependent upon, and/or correlated with data privacy elements included in an existing artificial profile (e.g., in the case of modifying an artificial profile). The execution of the one or more machine-learning algorithms can generate a plurality of nodes and one or more correlations between at least two nodes of the plurality of nodes. Each node can represent a value associated with a data privacy element and correspond to a weight determined by the machine-learning algorithms. In the case of creating new artificial profiles, the data privacy elements included in the newly-created profiles can include a set of data privacy elements that are consistent with any relationships or dependencies identified in artificial profile model **700**, and thus, realistic artificial profiles can be created. In the case of modifying existing artificial profiles, the data privacy elements included in the existing artificial profile can be modified in a manner that is consistent with the relationship and dependencies that are identified in artificial profile model **700**, and thus, existing artificial profiles can be obfuscated, such that the obfuscated profile would appear to be realistic.

To illustrate and only as a non-limiting example, artificial profile model **700** may be the result of executing one or more clustering algorithms on non-exhaustive set **610**. The clustering algorithm may have identified that non-exhaustive set **610** included several distinct groupings or clusters of data privacy elements. For example, the clusters may be identified based on one or more similarities between values of the data privacy elements. In some implementations, the clusters of data privacy elements may be referred to as attribution vectors **710**. Further, the clusters of data privacy elements may include environment/non-interactive attribution vector **720**, behavior/real-time attribution vector **730**, behavioral/non-real-time attribution vector **740**, and activity and patterns attribution vector **750**. It will be appreciated that any number of attribution vectors or clusters may be determined in artificial profile model **700**, and that environment/non-interactive attribution vector **720**, behavior/real-time attribution vector **730**, behavioral/non-real-time attribution vector **740**, and activity and patterns attribution vector **750** are merely non-limiting examples of identifiable clusters of data privacy elements. The present disclosure is not limited to the attribution vectors illustrated in FIG. **7**.

Continuing with the non-limiting example, environmental/non-interactive attribution vector **720** may correspond to data privacy elements that are clustered together based on environmental or non-interactive attributes of a computing device or browser. Environmental or non-interactive attributes, in this example, may refer to attributes that are not related or dependent upon a user interaction with a webpage, or that are related to environment attributes of a computer. For example, attribution vectors **720** may include data privacy elements relating to hardware components of a computing device; browser attributes, such as fonts used, browser type, or installed web apps; and OS attributes, such as fonts used by the OS, OS version, information about software updates (e.g., update schedule and IP addresses of update distribution servers), and applications installed in the OS. Additionally, the machine-learning algorithms may have identified patterns in the data privacy elements clustered as environment/non-interactive attribution vectors **720**. For example, the dashed line between "hardware" and "browser" in FIG. **7** indicates that the hardware information is relevant data for the browser information (e.g., the types of browsers that can be downloaded on the computing device are constrained by the hardware information). As another example, the dashed line between "fonts" and "applications" in FIG. **7** indicates that the data privacy

elements relating to the fonts available in the OS are correlated or dependent on the applications installed in the OS.

In some implementations, behavioral/real-time attribution vector **730** may correspond to data privacy elements that are clustered together based on real-time attributes of a user input (e.g., input or keystroke dynamics of user input received at a browser). Behavioral real-time attributes, in this example, may refer to attributes that are related to or dependent upon real-time user interaction with a webpage, such as mouse movements, mouse clicks, or text inputs. For example, attribution vectors **730** may include data privacy elements relating to input profiling based on keystroke events and/or mouse movements. Input profiling will be described in greater detail below with respect to FIG. **11**. Data privacy elements relating to real-time input can be exposed to network hosts and exploited to reveal information about the user.

In some implementations, behavior/non-real-time attribution vector **740** may correspond to data privacy elements that are clustered together based on non-real-time attributes of a user input. Behavioral non-real-time attributes, in this example, may refer to attributes that are determined based on aggregated information from previous online activity performed by the user. For example, attribution vectors **740** may include data privacy elements relating to the average duration of activity on webpages, a bounce rate indicating an average time spend on a webpage before navigating away from the webpage, statistics about clickstream data, and other suitable non-real-time attributes of user input. Attribution vectors **730** and **740** differ in that the data privacy elements relating to attribution vector **730** are based on in-the-moment text input or mouse movements, whereas, data privacy elements relating to attribution vector **740** are based on an evaluation of aggregated data associated with user input.

In some implementations, activity and patterns attribution vector **750** may correspond to data privacy elements that are clustered together based on the content of user input. Activity and patterns attributes, in this example, may refer to attributes that are determined based on the content of the input entered into a browser by a user. For example, attribution vectors **750** may include a data privacy element that exposes the browsing history of the user, the dialect or idiosyncrasies used by the user, the user's engagement with content (e.g., tapping or clicking on advertisement content), and/or any other suitable activity- or pattern-based data privacy elements.

It will be appreciated that artificial profile models may be used by data broker companies (e.g., in an advertising context), while still protecting user privacy. As a non-limiting example and for illustrative purposes only, a user of the data protection platform may utilize a profile to interact with another user or party. Through a trust relationship with that other user or party, the user may select which data privacy elements to expose to the other user or party. As non-limiting examples, the selected data privacy elements can be exposed to the other user or party by passing information along via HTTP headers, HTTP verbs (e.g. POST), or other techniques, such as a YAML (YAML Ain't Markup Language) or XML (Extensible Markup Language). In some implementations, the selected data privacy elements can last for the duration of an online session, can be manually or automatically modified during the online session, or can be automatically modified after each session. For example, an online session may begin when a user logs into the data protection platform. When the user logs into the data protection platform, an artificial profile may be generated for the user, and that artificial profile may include data privacy elements that are the same or different (entirely or partially) as the data privacy elements of the last artificial profile generated for the user. Further, since many existing exploit and exploit techniques are detectable by modern firewalls, the data protection platform can generate artificial profiles to overtly pretend to have vulnerabilities that an organization is capable of defending against. Accordingly, network attacks by network hosts, such as hackers, are inhibited because the network hosts may attempt network attacks based on inaccurate information, the network's firewalls are stopping the attack attempts (and the network attacks that may succeed in accessing the network will likely fail because the data protection platform may be a hybrid mix of containers and inaccurate information).

FIGS. **8**A-**8**B are block diagrams illustrating artificial profiles generated using the artificial profile model illustrated in FIG. **7**, according to certain aspects of the present disclosure. FIG. **8**A illustrates artificial profile **800**A, which represents the data privacy elements that are exposed to a web server when a computing device loads a website, for example. For the purpose of illustration and only as a non-limiting example, artificial profile **800**A may include four attribution vectors. The four attribution vectors may include environmental/non-interactive attribution vector **810**, behavioral real-time attribution vector **820**, behavioral non-real-time attribution vector **830**, and activity and patterns attribution vector **840**. In some implementations, an attribution vector may be a category, grouping, or classification of data privacy elements.

Environmental/non-interactive attribution vector **810** may be detected when the computing device loads the webpage. Environment/non-interactive attribution vector **810** may include data privacy element **815**, which indicates a type of browser running on the computing device. For example, browser type A (e.g., the GOOGLE CHROME browser may be a browser type, and the MOZILLA FIREFOX browser may be another browser type) may be a value of data privacy element **815**, which may be detected when computing device loads the webpage. Behavioral real-time attribution vector **820** may include data privacy element **825**, which indicates a real-time input signature associated with the input received at the computing device by the user. The input signature of input received at the computing device is described in greater detail with respect to FIG. **11**. For example, an input signature of "English" (e.g., detected based on the key dynamics of the input indicating that the letters "TING" are typed sequentially without a pause by the user) may be a value of data privacy element **825**, which may be detected when computing device interacts with the webpage. Behavioral non-real-time attribution vector **830** may include data privacy element **835**, which indicates a non-real-time input signature associated with previous inputs received at the computing device while accessing the website or other websites. For example, an input signature of "English" may be a value of data privacy element **835**, which may be detected when computing device interacts with the webpage or any other webpage at a previous time. Behavioral real-time attribution vector **820** detects, analyzes, and profiles input in real-time as the inputs are being entered by the user operating the computing device, whereas, behavioral non-real-time attribute vector **830** represents a behavioral pattern associated with the user operating the computing device, but which occurred in the past. Lastly, activity and patterns attribution vector **840** may include data privacy element **845**, which indicates an activ-

ity or pattern of the Operating System (OS) installed on the computing device. For example, an activity or pattern of the detected OS may be that the OS transmits a signal to XYZ.com daily at 6:00 a.m. For example, XYZ.com may be a web site that stores or distributes patches for the OS. The signal that is transmitted daily from the OS of the computing device may correspond to a request to download new patches, if any.

While artificial profile **800**A represents the real data privacy elements that were exposed to the web server hosting the website accessed by the computing device, new artificial profile **800**B represents the modified artificial profile. For example, data protection platform can generate new artificial profile **800**B by modifying data privacy elements of artificial profile **800**A. Further, data protection platform may modify artificial profile **800**A based on an artificial profile model. The artificial profile model may be a model that is generated using machine-learning techniques, and that includes one or more dependences or relationships between two or more data privacy elements. Accordingly, when new artificial profile **800**B is generated, the data privacy elements of artificial profile **800**A that are modified are done so within the constraints of the artificial profile model, so as to obfuscate the user with a realistic artificial profile. Advantageously, obfuscating information about a user in a realistic manner is more likely to cause a potential hacker to accept the obfuscated information as the real information of the user. Conversely, by modifying artificial profiles without being consistent with underlying dependencies and relationships between data privacy elements, a the potential hacker may recognize the inconsistent as a flag indicating that the artificial profile is includes inaccurate or obfuscated information. If a potential hacker recognizes that the collected data privacy elements are obfuscated, the potential hacker may be more likely to continue a data breach using alternative approaches, potentially elevating the severity of an attack on the network.

Continuing with the non-limiting example illustrated in FIG. **8**B, the data protection platform can generate new artificial profile **800**B (e.g., a modified version of artificial profile **800**A) for the user to obfuscate or mask the user's real data privacy elements (e.g., the data privacy elements included in profile **800**A). In some implementations, new artificial profile **800**B may include the same attribution vectors as artificial profile **800**A, however, the present disclosure is not limited thereto. In some implementations, new artificial profile **800**B may include more or less attribution vectors than the underlying artificial profile that is being modified. Environmental/non-interactive attribution vector **850**, behavioral real-time attribution vector **860**, behavioral non-real-time attribution vector **870**, and activity and patterns attribution vector **880** may each correspond to its respective attribution vector in artificial profile **800**A, however, the value (e.g., the data underlying the data privacy element) may have been changed. For example, the data protection platform may modify data privacy element **815** from "Browser type A" to "Browser type B" (e.g., from a GOOGLE CHROME browser to a FIREFOX browser). In some implementations, data privacy element **815** is modified before a network host, such as a web server providing access to a webpage, can collect any data from the browser of the computing device or from the computing device itself. When the network host collects data privacy elements from the computing device (e.g., a web server collected data privacy elements from the browser operating on the computing device), the network host will collect the obfuscated data privacy element **855**, which indicates that Browser type B is being used, instead of data privacy element **815**, which indicates the actual browser being used by the user.

The data protection platform may modify data privacy element **825** from "input signature=English" to "input signature=Undetectable." In some implementations, data privacy element **825** is modified before a network host, such as a web server providing access to a webpage, can collect any data from the browser of the computing device or from the computing device itself. When the network host collects data privacy elements from the computing device (e.g., a web server receiving input entered by the user at the computing device), the network host will collect the obfuscated data privacy element **865**, which indicates that the input signature is undetectable, instead of data privacy element **825**, which indicates the input signature indicates a likelihood that the user is an English speaker. The data protection platform can change the input signature (e.g., input dynamics) of user input received at the computing device using techniques described in greater detail with respect to FIG. **11**. However, as a brief summary, the data protection platform can change the time signature associated with the inputted keystroke events so as to obfuscate any detectable key event features, such as the letters "TING" being typed together without a pause (indicating that the user is likely a native English speaker). Similarly, the data protection platform can modify data privacy element **835** from "previous input signature=English" to "previous input signature=undetectable." Just as with the modification of data privacy element **825** to data privacy element **865**, the data protection platform can modify data privacy element **835** to data privacy element **875** using the same or similar technique (e.g., the techniques described in FIG. **11**).

The data protection platform may modify data privacy element **845** from "Operating System pings XYZ.com daily at **0600** for patches" to "Operating System pings A1B2C3.com biweekly at **2300** for patches" (e.g., one Operating System's automatic update procedure to another Operating System's automatic update procedure). In some implementations, data privacy element **845** is modified before a network host, such as a web server providing access to a webpage, can collect any data from the browser of the computing device or from the computing device itself. When the network host collects data privacy elements from the computing device (e.g., a web server collected data privacy elements from the browser operating on the computing device), the network host will collect the obfuscated data privacy element **885**, which indicates that a the OS pings an external server on a regular schedule, instead of data privacy element **845**, which indicates the actual automatic update schedule of the OS installed on the computing device. Had the network host collected data privacy element **845** from the browser of the computing device, the network host could have identified and exploited a vulnerability in the OS installed on the computing device, or a vulnerability in the servers of XYZ.com. However, advantageously, since the network host instead collected modified data privacy element **885** (as part of collecting modified artificial profile **800**B from the browser or computing device), the network host collected realistic, yet obfuscated, information about the browser and computing device. Thus, the network host cannot effectively mount an attack on the network or the computing device because modified artificial profile **800**B does not expose any real vulnerabilities existing in the browser or the computing.

In some implementations, the data protection platform does not need to generate artificial profile **800**A, which includes data privacy elements that were actually detected

from the browser or computing device. Instead, the data protection platform can automatically and dynamically generate modified artificial profile **800**B, while or in conjunction with, the user browsing webpages on the Internet. In these implementations, the data protection platform does not need to detect the actual data privacy elements exposed by the computing device, but rather, the data protection platform can generate an artificial profile for the user, browser, or computing device, so as to obfuscate any potentially exposable data privacy elements.

In some embodiments, the data privacy elements can be modified periodically or continuously over time such that sequential artificial profiles cannot be tracked from one artificial profile to another, as is shown in the non-limiting example illustrated in FIG. **8**C. In an example embodiment, the data protection platform can generate new artificial profile **800**C (e.g., a modified version of artificial profile **800**B) that obfuscates or masks the data privacy elements included in artificial profile **800**B. In some implementations, new artificial profile **800**C may include the same attribution vectors as artificial profile **800**B, although the present disclosure is not limited thereto (e.g., in some implementations, artificial profile **800**C may include more or less attribution vectors than artificial profile **800**B, the previous artificial profile that has been modified to produce the new artificial profile). Modifying one or more data privacy elements over time prevents an artificial profile from being trackable and compromised because each iteration of the artificial profile prevents the profile from being related to its previous version. For example, a minimal amount of data privacy elements can be modified from artificial profile **800**B at a specific time (time=t1) to create the non-trackable and protected artificial profile **800**C. In this example embodiment, the data protection platform can modify data privacy element **855** from "Browser Type B" to "OS Type A/Browser Type Bv31" to create artificial profile **800**B. At a subsequent time (e.g., time=t2), the data protection platform can create artificial profile **800**C by modifying data elements **855** and **885** of artificial profile **800**B from "OS Type A/Browser Type Bv31" to "OS Type A/Browser Type Bv12" and "Operating system pings A1B2C3.com biweekly at **2300** for patches" to "No OS ping", respectively, to create artificial profile **800**D. In some implementations, the data privacy elements are modified before a network host, such as a web server providing access to a webpage, can collect any data from the browser of the computing device or the computing device itself. When the network host collects the data privacy elements from artificial profile **800**C, the network host will collect the modified data privacy element **855** and data privacy element **885**, which indicates that Browser Type Bv12 is being used and detects the OS version based on the modification of the OS versions and maintenance communications (e.g. ping), instead of the actual browser type used and/or user activity.

Had the network host collected the browser type and/or the OS activity from artificial profile **800**C without being modified over time, the network host could have identified and exploited a vulnerability in the artificial profile model that generates the artificial profile(s). However, since the network host collected realistic, yet obfuscated, information about the browser and the computing device that changes over time, the network host cannot effectively mount an attack against a browser and computing device that is seemingly inconsistent from one artificial profile to the next artificial profile. Moreover, the network host would not realize that the artificial profiles are masking the same computing device. To the network host, the computing device for artificial profile **800**A would be distinct from the computing device for artificial profile **800**B, which would be distinct from the computing device for artificial profile **800**C, etc. FIG. **9**A illustrates an example system for generating artificial profiles that change over time using the artificial profile models illustrated in FIG. **8**C, according to certain aspects of the present disclosure. System **902** can include profile generation service **904** that aggregates data privacy elements for inclusion in a user profile. The data privacy elements can be modified to create artificial profiles by variable generation service **906**, which can use an artificial profile model (such as described in FIG. **7**) as the basis for modifying data privacy elements such that newly created or modified artificial profiles are consistent with constraints, relationships, and/or dependencies between data privacy elements. This ensures that the artificial profiles, which are stored within protected profiles database **908**, appear realistic over each iteration such that a network host would not flag the artificial profile as fake, while at the same time obfuscating or blocking information about the true underlying user, browser, and/or computing device.

In some embodiments, moving target defense service **910** can select one or more artificial profiles from protected profiles database **908** to continuously modify one or more data privacy elements within each artificial profile. The moving target defense service **910** can select any number of candidate artificial profiles to continually modify in order to frustrate any malware mechanism looking for patterns or actual relationships between the data privacy elements. In some embodiments, the moving target defense service **910** can perform an effectively endless number of artificial profile iterations.

In the example shown, the moving target defense service **910** has selected artificial profile **800**A and modified data privacy element **855** to generate artificial profile **800**B (as discussed in FIG. **8**C). The modified data privacy element **855** can be changed by variable generation service **906** in such a way that it's consistent with the constraints, relationships, and/or dependencies between other data privacy elements in artificial profile **800**B. At a subsequent time, moving target defense service **910** triggers another modification to artificial profile **800**B to create artificial profile **800**C. In the example shown, for example, data privacy element **885** was modified.

The moving target defense service **910** can be triggered to modify one or more data elements in each artificial profile in a number of ways. In some embodiments, a user can initiate the change to the artificial profile. In some embodiments, the change to the artificial profile can be automatically initiated by the data protection platform. For example, the artificial profile can be refreshed/modified on a periodic basis, such as every session, every hour, every day, every week, etc. Alternatively, the artificial profile can be dynamically modified in response to a triggering event, such as an event that indicates a security issue. For example, the triggering event can be related to possible intrusion features detected by an intrusion detection service, such as malware signatures or program execution events with parameters including, but not limited to: suspicious APIs called, instructions executed, IP addresses accessed, etc.

FIG. **9**B illustrates an example embodiment of artificial profiles that are generated using data profile seeding techniques, according to certain aspects of the present disclosure. In some instances, system **902** of an organization or enterprise can generate artificial profiles with attributes that lead back to the organization, but not to any individual employee of the organization. In this way, a network host

trying to find/exploit vulnerabilities within the organization would find the artificial profiles more realistic, and as a result would base their attacks off the artificial profiles rather than trying to uncover real profiles.

The above can be accomplished through data profile seeding, which seeds the data privacy elements with constraints, relationships, and/or dependencies that are indicative of the organization. To create realistic organization specific profiles, seeding data can be gathered from the current computing environment for the organization (manually or automatically). For example, system **902** can include a data extraction service **912** that can request data about user attributes associated with the organization. In some embodiments, the data can be requested from, but not limited to, a mobile device management system **914**, a configuration/asset management database **916**, or other similar system **918** that contain user attribute data. The user attribute data may in some embodiments be based on organizational policies, regularly compliance or mission objectives. These can include user information, online behavior and patterns, device information associated with individual users, specific IP ranges, preferred geographic locations, language settings, OS emulation, etc. The data extraction service **912** can store any organization specific features, attributes, or signatures within current organization signature data store **920**.

In some embodiments, profile generation service **922** can generate artificial profiles seeded with organization specific signatures. Organization specific signatures can be those signatures that have characteristics that allow an attacker/observer/etc. to differentiate data generated by that organization—i.e. track their activities. For example, organization specific signatures can be related to corporate-created standard laptop configurations for all employees meant to standardize security, applications and operating system configurations. A classic example is the fact that Booz computers had the Harvey Balls font installed by default on their systems—a font Booz developed many years ago. The presence of that font would be a strong indicator that the machine in question is a Booz machine, and that the user in question is likely a Booz employee. These types of standard profiles mean if there is a tracking element or security vulnerability, it is pervasive across thousands of devices, and can expose most of the corporate activity to tracking and monitoring by third parties. While it is easier for the organization's administrators to scan network traffic to identify networking stacks (TCP/IP fingerprinting), perform browser fingerprints, etc. in order to build a profile of a user made up of organization specific signatures, an attacker can do so without their cooperation (such as by scanning traffic themselves). To combat this, profile generation service **922** can generate artificial profiles seeded with modified organization specific signatures

For example, organization variable generation service **924** can determine and develop relationships between the features, attributes, or signatures within current organization signature data store **920** in order to build one or more models based on the organization. For example, by extracting the OS, application, and/or other system configuration elements from configuration/asset management database **916**, system **902** can build one of more models by copying those elements and then modifying them to prevent surveillance and tracking.

In some embodiments, current organization signature data store **920** can train one or more artificial intelligence (AI) or machine learned (ML) models that can dynamically determine organization specific relationships. Profile generation service **922** can use the models to modify data privacy elements in such a way that the data privacy elements within each artificial profile are consistent with constraints, relationships, and/or dependencies that would be seen in a real profile. These artificial profiles can be stored as protected profiles **925**.

For example, in the example embodiment shown, the models created by organization variable generation service **924** can modify data privacy element **855** to generate artificial profile **800**B, and can then modify data privacy element **885** to generate artificial profile **800**C. Data privacy elements **855** and **885** have been modified in accordance with organization specific relationships such that artificial profiles **800**B and **800**C appear to be from the organization, while at the same time obfuscating or blocking information about the true underlying individual employee.

FIG. **10** illustrates an example embodiment of artificial profiles generated using deception techniques, according to certain aspects of the present disclosure. Most systems have known or unknown vulnerabilities and may be penetrated through a variety of means. In order to make it harder for an attacker to identify and/or exploit users and user data within the system, system **1000** may generate artificial profiles that are intended to mislead/misdirect an adversary, helping to make the system asymmetrically more difficult to defeat.

In some embodiments, artificial profiles may be placed into the environment to be used for deception purposes instead of obfuscating a specific end user. For example, some detection purposes can include, but is not limited to, honeypotting (data that appears to be legitimate, but is actually isolated and monitored to lure and detect attackers), moving target defense (modifying artificial profiles on a periodic, continuous, and/or dynamic basis to make it harder to identify actual patterns and vulnerabilities), white noise (adding more environments into the mix to make it harder to identify actual user activity), and other similar deception techniques.

In some embodiments, System **1000** can include profile generation service **1006** that can collect actual user and/or system data from the enterprise system **1002**. Candidate profiles **1010** can be generated by profile generation service **1006** via AI and/or ML models, which generates artificial data privacy elements and can aggregate them into a realistic profile similar to the methodologies discussed in FIGS. **7**-**8**C. The candidate profiles can be stored within candidate profiles database **1008**.

In some embodiments, one or more candidate profiles **1010** can be selected as selected artificial profile A **1014**A. Any number of candidate profile **101** may be selected—for example, 50 candidate profiles **1010** may be selected to represent 50 fake users, and in some embodiments additional candidate profiles **1010**/fake users may be selected when system **1000** desires more fake users as white noise (either manually or dynamically). Artificial profile service **1012** may then insert selected artificial profile A **1014**A into a virtual environment isolated from the real network.

For example, in some embodiments credentials service **1016** may seed selected artificial profile A **1014**A with seemingly real credentials to get into the isolated virtual environment. The credentials from credentials service **1016** can be used for a number of different purposes including, but not limited to: providing an attacker something to "discover" (e.g., tricking an attacker into spending their time on artificial profile A **1014**A instead of a real user); the 'system', such as isolated containers or other systems that look like enterprise system **1002**, that the credentials provide access to can be monitored for use of these credentials (which is an indication that a system was compromised/hacked and

administrators can take action (or system **1000** may take an automated action, such as moving target defense, etc.)); the credentials can expose a broader fake network to the adversary, which is an artificially designed place that wastes their time, etc.

In some embodiments, the credentials can, for example, admit access to other systems or containers that look like enterprise system **1002**. In some embodiments, one or more selected artificial profile A's **1014**A can be associated with one another through the use of shared secrets (such as passwords, usernames, access keys, access tokens, etc.), shared networking features (subnets, gateways, etc.), or other means. This provides options for an attacker to attempt to exploit once they're able to penetrate or otherwise access the system. This information will appear to relate to other user profiles or systems, increasing the realism of selected artificial profile A **1014**A. This incentivizes attackers to focus on selected artificial profile A **1014**A instead of another artificial profile masking a user online.

In some embodiments, selected artificial profile A **1014**A and other artificial profiles may be injected into the containers in a realistic way. For example, artificial profile service **1012** can include traffic generator service (for example, Selenium) that generates artificial traffic within the isolated virtual environment (e.g., container). To an attacker, the artificial traffic would look real since traffic generator service could in some embodiments use features of traffic from enterprise system **1002**. Artificial profile service **1012** may also include content seeding service **1020**, which can generate word files, text files, images, etc. that appear as if from a user associated with selected artificial profile A **1014**A. And in some embodiments, artificial profile service **1012** may include presence seeding service **1022**, which may lure attackers by creating social media accounts for each selected artificial profile. These social media accounts would make the selected artificial profiles appear to be from real people within the enterprise/organization. For example, presence seeding service **1022** may post information that deceptively links the artificial user associated with the artificial profile to the enterprise (e.g., by posting they are employees of enterprise, posting recent news about enterprise, etc.). In some embodiments, additional logging and/or network monitoring can be targeted towards selected artificial profile A **1014**A within the isolated virtual environment to detect an exploit. If an attacker is identified, since the attacker is within an isolated virtual environment and cannot access real data privacy elements, system **1000** can monitor the attacker's activities to determine how the attacker is attempting to exploit vulnerabilities in the system and the methods of malware/attack they are employing. This information can in some embodiments be fed back into system **1000** to refine and update existing security protocols.

In some embodiments, the fake users may be associated with artificial profiles that also undergo moving target defense techniques. For example, a new artificial profile—for example, selected artificial profile A' **1014**B—may be created from selected artificial profile A **1014**A by modifying one or more data privacy elements on a periodic or continuous basis similar to that disclosed for FIGS. **8**C-**9**A. Similarly, selected artificial profile A" **1014**C may be created from selected artificial profile A' **1014**B by modifying one or more data privacy elements, and selected artificial profile A'" **1014**D may be created from selected artificial profile A" **1014**C by modifying one or more data privacy elements. Selected artificial profile A **1014**A, selected artificial profile A' **1014**B, selected artificial profile A" **1014**C, and/or selected artificial profile A'" **1014**D can modify data privacy elements via profile generation service **1006** via AI and/or ML models, which can generate artificial data privacy elements and can aggregate them into a realistic profile similar to the methodologies discussed in FIGS. **7**-**8**C. Therefore, new artificial profiles may be created from an artificial profile in the same or a similar way that an artificial profile can be created from a real profile.

In some embodiments, selected artificial profile A **1014**A, selected artificial profile A' **1014**B, selected artificial profile A" **1014**C, and selected artificial profile A'" **1014**D can be rotated in use for moving target defense (e.g., user activity appears to move through the additional selected artificial profiles instead of only selected artificial profile A **1014**A). In other embodiments, selected artificial profile A' **1014**B, selected artificial profile A" **1014**C, and/or selected artificial profile A'" **1014**D can be deployed in addition to selected artificial profile A **1014**A for deception purposes, including simulated white noise purposes.

FIG. **11** is a diagram illustrating process flow **1100** for controlling input signatures during an interaction session, according to certain aspects of the present disclosure. Process flow **1100** may be performed at least in part at data protection platform **1150**. Data protection platform **1150** may be the same as or similar to data protection platform **510** of FIG. **5**, and thus, a description of data protection platform **1150** is omitted here. Process flow **1100** may be performed to modify input signatures associated with input received at a platform-secured browser, such as the platform-secured browser of FIG. **4**. In some implementations, an input signature may include a feature that characterizes an input received at the platform-secured browser. For example, a feature may be the time signature of keystrokes inputted at the platform-secure browser, however, the present disclosure is not limited thereto. Another example of a feature that characterizes an input may be movement associated with a cursor or mouse clicks.

The feature of an input can be exposed as a data privacy element when a computing device accesses a website. To illustrate process **1100** and only as a non-limiting example, computer **1110** may be operated by a use. For instance, the user may be navigating a website or application using a platform-secured browser. The website displayed on the browser of computer **1110** may include input element **1120**. Input element **1120** may be a text box displayed on a webpage for a search engine. Further, input element **1120** may be configured to receive input from the user operating computer **1110**. Continuing with the non-limiting example, the user may type the phrase "interesting news" into input element **1120**. The natural keystroke event timing associated with inputting the letters "interesting news" into input element **1120** is shown in keystroke time signature **1130**. For example, the user may naturally input the letters of "interesting news" in the following pattern: "IN," then a pause, "TERES," then a pause, "TING," then a pause, "NEW," then a pause, and finally the letter "S." The pauses of the pattern may occur naturally as the user types the phrase. The user may move or adjust his or her fingers to continue typing. Naturally, certain letters are more likely to be typed together quickly, such as "TING," and for other letters, there may be a need for a brief pause while the user's fingers adjust or find the next letter on a keyboard.

However, keystroke dynamics, such as a keystroke time signature can be a data privacy element that exposes information about the user operating computer **1110**. For example, an input profiling technique can be used to determine that keystroke time signature **1130** indicates that the user is an English speaker. Letter grouping **1140** (i.e., the

letters "TING") are often used in the English language, but are not often used together in other languages. Accordingly, the keystroke time signature **1130** can be evaluated to detect certain letter groupings, such as letter grouping **1140** of "TING" typed sequentially without pauses. The detected letter groups can reveal information about the user to a web server, such as the language of the user.

According to certain embodiments, data protection platform **1150** can modify keystroke time signature **1130** to obfuscate or block any information that could be extracted from keystroke time signature **1130**. For example, data protection platform **1150** can receive the input of "interesting news" from the platform-secured browser, however, data protection platform **1150** can detect keystroke time signature **1130** from the received input before transmitting the input to the web server hosting the website that includes input element **1120**. Instead of transmitting the received input in the pattern of keystroke time signature **1130**, data protection platform **1150** can transmit the letters "interesting news" to the web server with the characteristic of modified keystroke time signature **1160**. Modified keystroke time signature **1160** can indicate that all letters of "interesting news" are typed one-after-another without any pauses. Thus, while the network host, for example, the web server hosting the web site that includes input element **1120**, can gain access to the time signature or detect the time signature of the received input of "interesting news," but the detected time signature at the web server would be modified keystroke time signature **1160**, instead of the real keystroke time signature of **1130**. Advantageously, keystroke time signature **1130**, which represents the natural keystroke dynamics of the user operating computer **1110**, can be obfuscated so as to prevent an accurate input profiling of the received text.

In some implementations, data protection platform **1150** can automatically (or potentially not automatically) modify features of the received input. For example, to modify the keystroke time signature of input text received at an input element, data protection platform **1150** can provide an intermediary, such as an invisible overlay over the websites accessed by the platform-secured browser. In some implementations, the intermediary may intercept the input text received at the input element (e.g., before the text is transmitted to the web server), modify the time signature of the input text, and then transmit the input text with the modified time signature to the web server. Other techniques for performing the modification may include modifying input streams, providing on-screen input methods, and other suitable techniques. In some implementations, data protection platform **1150** may provide additional information to the user, instead of modifying an input stream. For example, data protection platform **1150** can notify the user that the input text is defined by a keystroke time signature that may reveal the language of the input text. In some implementations, the time signature of the input text can be modified immediately (e.g., in real-time) upon being received at the input element, whereas, in other implementations, the time signature of the input text can be modified over a period of time or at a later time. In some implementations, data protection platform **1150** can impose an effect on inputted text or inputted mouse interactions, such that the effect automatically changes the browser to modify a time signature of the inputted text or mouse interactions. For example, data protection platform **1150** can include a shim that serves as a wedge between the OS and the browser (or application, if being used). The shim can influence or modify how the OS reports inputs received at a keyboard or a mouse. The shim may be used to modify how the OS reports the time signature of inputted text, for example. In some implementations, an intermediary may not be used, but rather the native environment of the application or browser may be structured so that inputs received at the browser are outputted with a defined time signature. In these implementations, the input text or mouse interaction is not intercepted at the browser, but rather, the input text or mouse interaction is defined so as to have a particular time signature. The present disclosure is not limited to detecting the keystroke time signature of inputted text. In some implementations, mouse movement can also be detected as a data privacy element, and subsequently modified by data protection platform **1150** to remove any extractable characteristics.

It will be appreciated that the input may also include video signals, audio signals, motion signals, and/or haptic signals (e.g., received from a haptic glove). For example, in the context of a virtual-reality headset, the inputs received at a web server may comprise much more data than text or mouse interactions. Using the techniques described above, data protection platform **1150** can modify the inputted video signals, audio signals, motion signals, and/or haptic signals, so as to obfuscate information about the user operating the virtual-reality headset.

The foregoing description of the embodiments, including illustrated embodiments, has been presented only for the purpose of illustration and description and is not intended to be exhaustive or limiting to the precise forms disclosed. Numerous modifications, adaptations, and uses thereof will be apparent to those skilled in the art.

What is claimed is:

1. A computer-implemented method, comprising:

gathering seeding data, wherein the seeding data is gathered from a computing environment associated with an organization, and wherein the seeding data includes data privacy elements corresponding to different users associated with the organization;

identifying an organization specific signature associated with the organization, wherein the organization specific signature is based on the seeding data;

training an artificial profile model using a data set of data privacy elements and organization specific signatures, wherein the artificial profile model is trained to define relationships that are associated with different constraints amongst different data privacy elements and the organization specific signature;

generating an artificial profile for a computing device within the computing environment, wherein the artificial profile is generated by modifying a data privacy element associated with the computing device and the organization specific signature, and wherein the artificial profile is generated according to one or more constraints associated with the relationships defined by the artificial profile model;

receiving a signal indicating that the computing device is requesting access to a network location; and

masking the computing device from being identified by a network host by sending the artificial profile including the modified data privacy element and the modified organization specific signature to the network location.

2. The computer-implemented method of claim **1**, wherein the modified data privacy element and the modified organization specific signature allow for identification of the organization while masking the computing device from being identified.

3. The computer-implemented method of claim **1**, wherein the artificial profile is inserted into an isolated virtual environment that monitors for suspicious activity.

4. The computer-implemented method of claim 1, further comprising:

periodically modifying a second data privacy element to generate a second artificial profile, wherein the second data privacy element is modified in accordance with the one or more constraints.

5. The computer-implemented method of claim 1, wherein the artificial profile model is trained based on one or more attribution vectors, and wherein an attribution vector represents a detectable characteristic associated with a set of data privacy elements that have been clustered based on a similarity in values.

6. The computer-implemented method of claim 1, wherein the seeding data corresponds to organizational policies and objectives associated with the organization.

7. The computer-implemented method of claim 1, wherein the organization specific signature corresponds to computing device configurations for computing devices associated with the different users.

8. A system, comprising:

one or more data processors; and

a non-transitory computer-readable storage medium containing instructions which, when executed on the one or more data processors, cause the one or more data processors to perform operations including:

gathering seeding data, wherein the seeding data is gathered from a computing environment associated with an organization, and wherein the seeding data includes data privacy elements corresponding to different users associated with the organization;

identifying an organization specific signature associated with the organization, wherein the organization specific signature is based on the seeding data;

training an artificial profile model using a data set of data privacy elements and organization specific signatures, wherein the artificial profile model is trained to define relationships that are associated with different constraints amongst different data privacy elements and the organization specific signature;

generating an artificial profile for a computing device within the computing environment, wherein the artificial profile is generated by modifying a data privacy element associated with the computing device and the organization specific signature, and wherein the artificial profile is generated according to one or more constraints associated with the relationships defined by the artificial profile model;

receiving a signal indicating that the computing device is requesting access to a network location; and

masking the computing device from being identified by a network host by sending the artificial profile including the modified data privacy element and the modified organization specific signature to the network location.

9. The system of claim 8, wherein the modified data privacy element and the modified organization specific signature allow for identification of the organization while masking the computing device from being identified.

10. The system of claim 8, wherein the artificial profile is inserted into an isolated virtual environment that monitors for suspicious activity.

11. The system of claim 8, wherein the instructions further cause the one or more data processors to perform additional operations including:

periodically modifying a second data privacy element to generate a second artificial profile, wherein the second data privacy element is modified in accordance with the one or more constraints.

12. The system of claim 8, wherein the artificial profile model is trained based on one or more attribution vectors, and wherein an attribution vector represents a detectable characteristic associated with a set of data privacy elements that have been clustered based on a similarity in values.

13. The system of claim 8, wherein the seeding data corresponds to organizational policies and objectives associated with the organization.

14. The system of claim 8, wherein the organization specific signature corresponds to computing device configurations for computing devices associated with the different users.

15. A computer-program product tangibly embodied in a non-transitory machine-readable storage medium, including instructions configured to cause a data processing apparatus to perform operations including:

gathering seeding data, wherein the seeding data is gathered from a computing environment associated with an organization, and wherein the seeding data includes data privacy elements corresponding to different users associated with the organization;

identifying an organization specific signature associated with the organization, wherein the organization specific signature is based on the seeding data;

training an artificial profile model using a data set of data privacy elements and organization specific signatures, wherein the artificial profile model is trained to define relationships that are associated with different constraints amongst different data privacy elements and the organization specific signature;

generating an artificial profile for a computing device within the computing environment, wherein the artificial profile is generated by modifying a data privacy element associated with the computing device and the organization specific signature, and wherein the artificial profile is generated according to one or more constraints associated with the relationships defined by the artificial profile model;

receiving a signal indicating that the computing device is requesting access to a network location; and

masking the computing device from being identified by a network host by sending the artificial profile including the modified data privacy element and the modified organization specific signature to the network location.

16. The computer-program product of claim 15, wherein the modified data privacy element and the modified organization specific signature allow for identification of the organization while masking the computing device from being identified.

17. The computer-program product of claim 15, wherein the artificial profile is inserted into an isolated virtual environment that monitors for suspicious activity.

18. The computer-program product of claim 15, wherein the instructions further cause the data processing apparatus to perform additional operations including:

periodically modifying a second data privacy element to generate a second artificial profile, wherein the second data privacy element is modified in accordance with the one or more constraints.

19. The computer-program product of claim 15, wherein the artificial profile model is trained based on one or more attribution vectors, and wherein an attribution vector represents a detectable characteristic associated with a set of data privacy elements that have been clustered based on a similarity in values.

20. The computer-program product of claim **15**, wherein the seeding data corresponds to organizational policies and objectives associated with the organization.

21. The computer-program product of claim **15**, wherein the organization specific signature corresponds to computing device configurations for computing devices associated with the different users.

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