US 20170026404A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2017/0026404 A1

Peeler (43) Pub. Date: Jan. 26, 2017

(54) **DENIAL OF SERVICE PROTECTION FOR IP TELEPHONY SYSTEMS**

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(21) Appl. No.: **14/804,555**

(22) Filed: **Jul. 21, 2015**

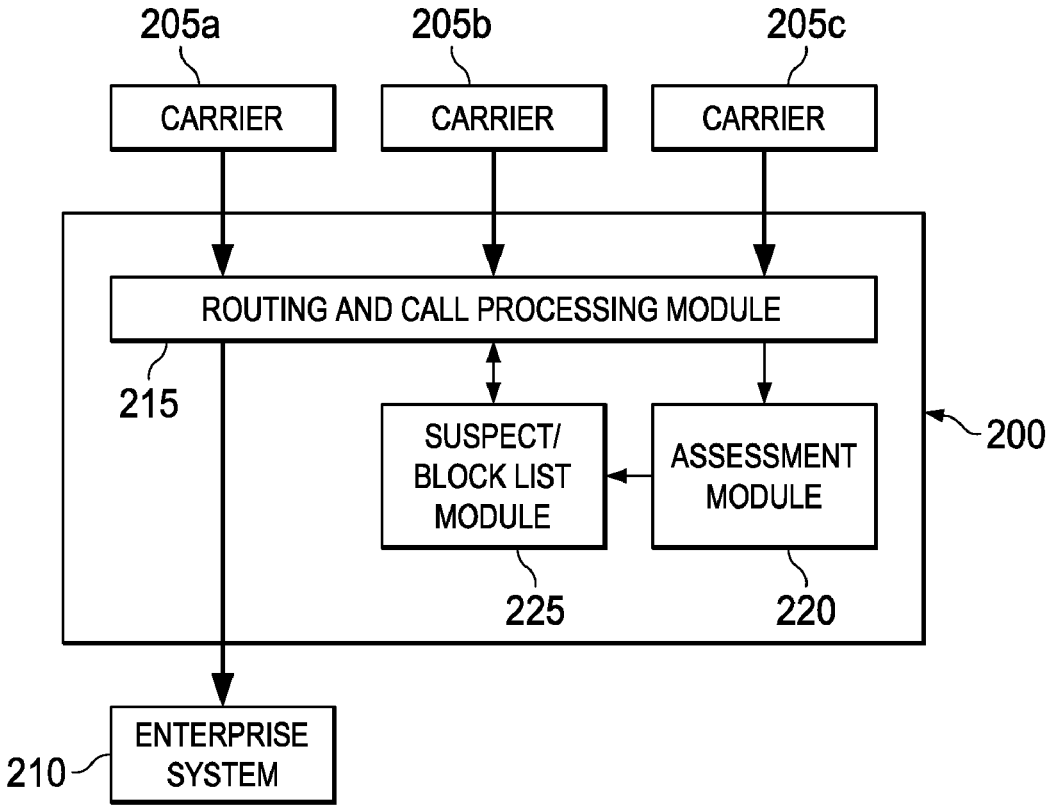
Publication Classification

(51) **Int. Cl.**
H04L 29/06 (2006.01)

(52) **U.S. Cl.**
CPC ***H04L 63/1458*** (2013.01); ***H04L 63/1416*** (2013.01)

(57) **ABSTRACT**

A system and method for protecting components of an IP telephony network whereby a protection scheme is enabled upon detection of resource exhaustion within the network that prevents delivery of incoming messages. Resource exhaustion may result from denial of service attacks and/or malfunctions in automated dialing systems. Once a protection scheme is enabled, the system activates mechanisms for identifying calling parties that are suspected of contributing to the resource exhaustion condition. These suspected calling parties may be placed in a blocked sender list, either manually or automatically. Calling parties may be presented with a challenge function in order to determine whether the call is being made by an automated dialing system. The system blocks incoming calls from calling parties identified in the blocked sender list either permanently or for a specified time duration. The protection scheme remains enabled for a specified duration or until the resource exhaustion condition has subsided.



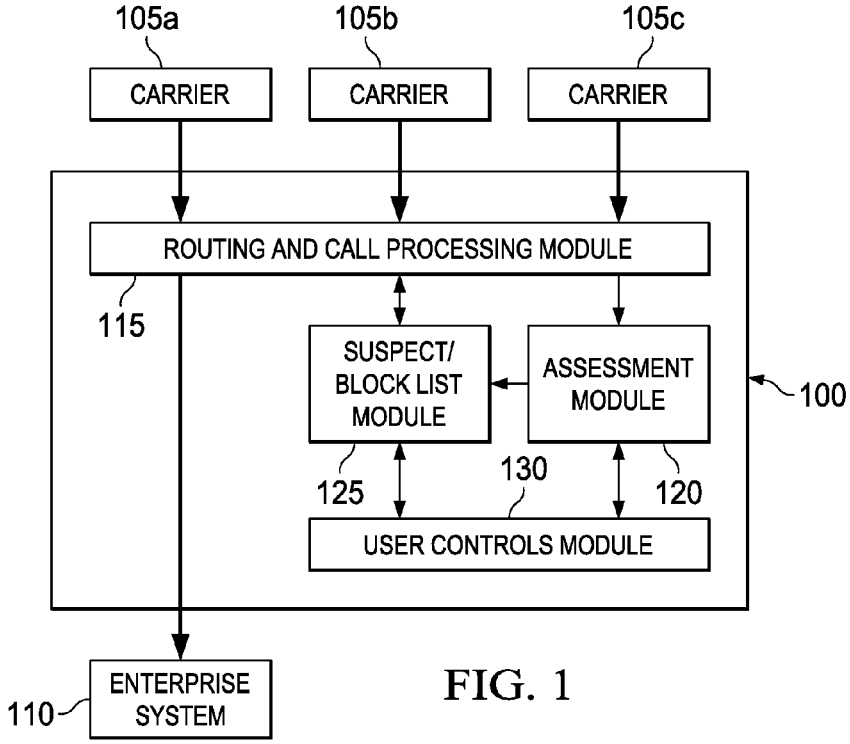

105a
105b
105c
CARRIER
CARRIER
CARRIER
ROUTING AND CALL PROCESSING MODULE
115
SUSPECT/ BLOCK LIST MODULE
ASSESSMENT MODULE
100
125
130
120
USER CONTROLS MODULE
ENTERPRISE SYSTEM
110

FIG. 1

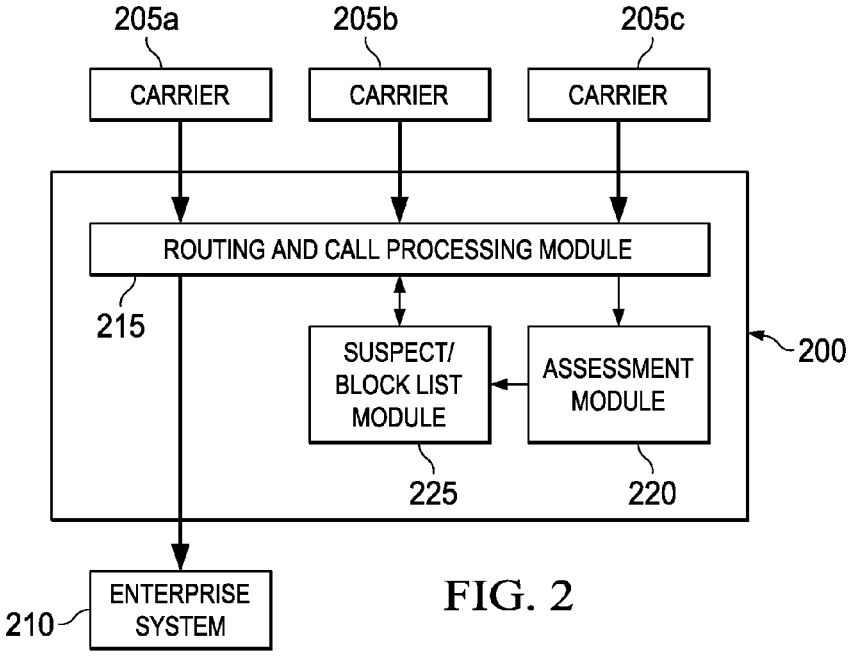

205a
205b
205c
CARRIER
CARRIER
CARRIER
ROUTING AND CALL PROCESSING MODULE
215
SUSPECT/ BLOCK LIST MODULE
ASSESSMENT MODULE
200
225
220
ENTERPRISE SYSTEM
210

FIG. 2

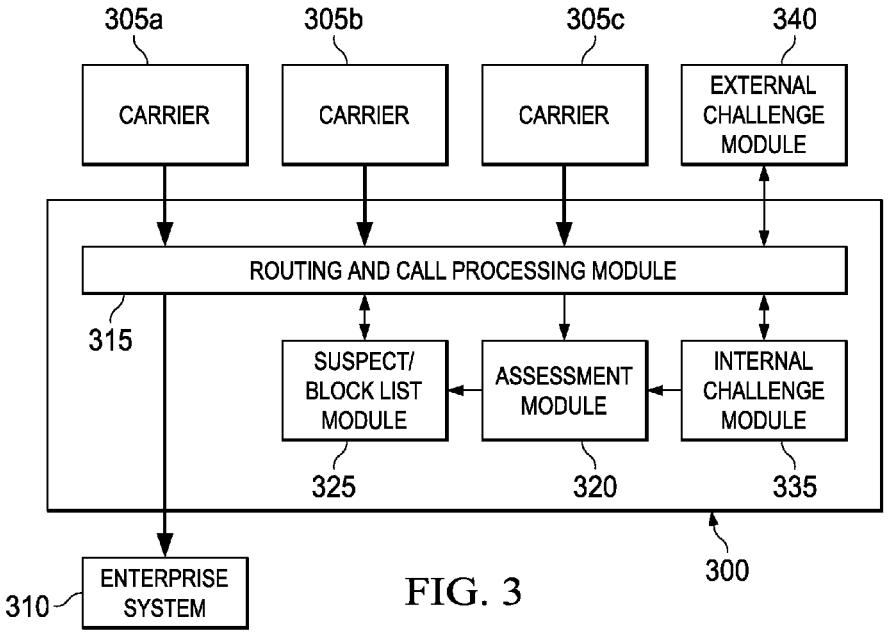

305a
305b
305c
340
CARRIER
CARRIER
CARRIER
EXTERNAL CHALLENGE MODULE
ROUTING AND CALL PROCESSING MODULE
315
SUSPECT/ BLOCK LIST MODULE
ASSESSMENT MODULE
INTERNAL CHALLENGE MODULE
325
320
335
300
310
ENTERPRISE SYSTEM

FIG. 3

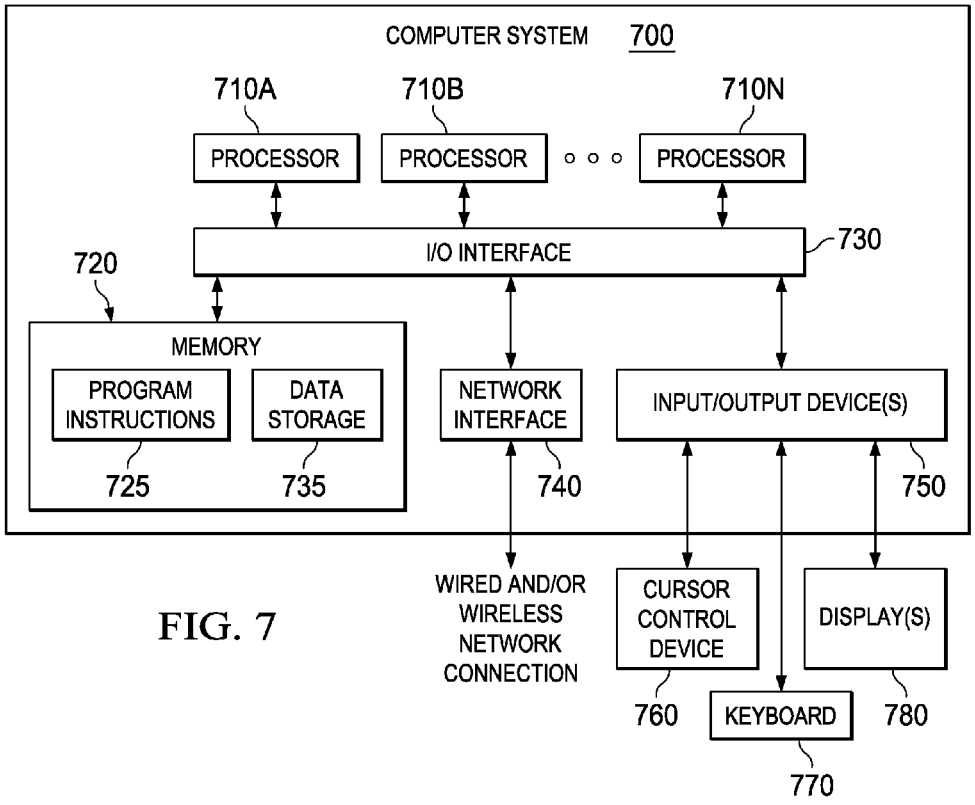

COMPUTER SYSTEM 700
710A
710B
710N
PROCESSOR
PROCESSOR
PROCESSOR
I/O INTERFACE
730
720
MEMORY
PROGRAM INSTRUCTIONS
DATA STORAGE
725
735
NETWORK INTERFACE
740
INPUT/OUTPUT DEVICE(S)
750
WIRED AND/OR WIRELESS NETWORK CONNECTION
CURSOR CONTROL DEVICE
DISPLAY(S)
760
KEYBOARD
780
770

FIG. 7

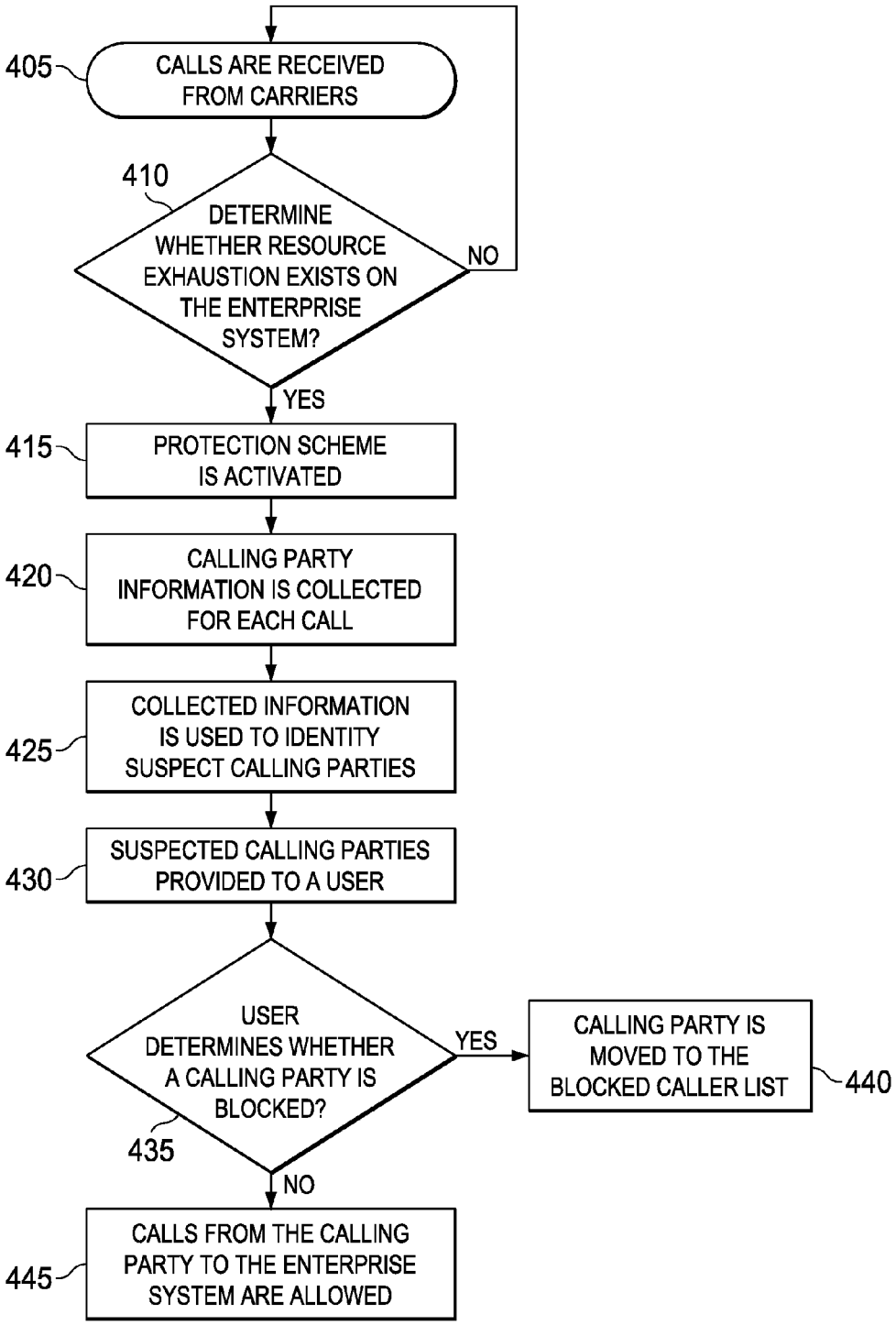

405
CALLS ARE RECEIVED FROM CARRIERS
410
DETERMINE WHETHER RESOURCE EXHAUSTION EXISTS ON THE ENTERPRISE SYSTEM?
NO
YES
415
PROTECTION SCHEME IS ACTIVATED
420
CALLING PARTY INFORMATION IS COLLECTED FOR EACH CALL
425
COLLECTED INFORMATION IS USED TO IDENTITY SUSPECT CALLING PARTIES
430
SUSPECTED CALLING PARTIES PROVIDED TO A USER
USER DETERMINES WHETHER A CALLING PARTY IS BLOCKED?
435
YES
CALLING PARTY IS MOVED TO THE BLOCKED CALLER LIST
440
NO
445
CALLS FROM THE CALLING PARTY TO THE ENTERPRISE SYSTEM ARE ALLOWED

FIG. 4

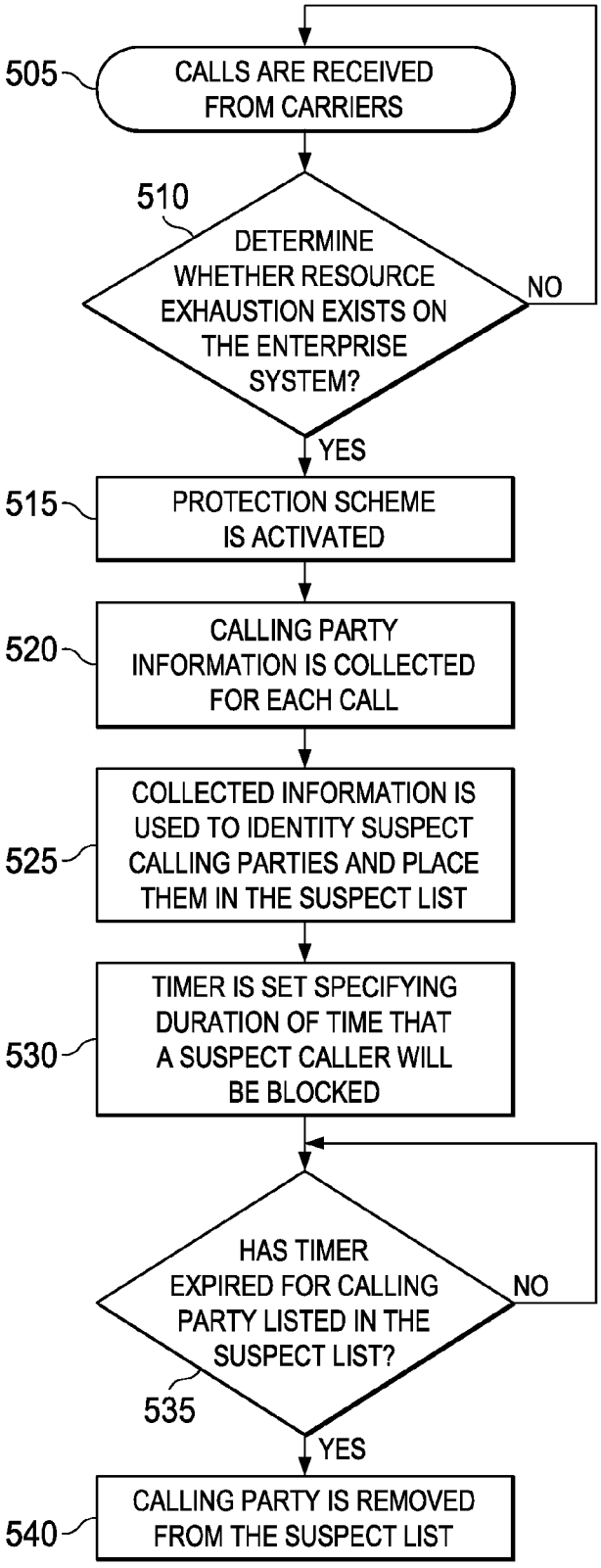

505
CALLS ARE RECEIVED FROM CARRIERS
510
DETERMINE WHETHER RESOURCE EXHAUSTION EXISTS ON THE ENTERPRISE SYSTEM?
NO
YES
515
PROTECTION SCHEME IS ACTIVATED
520
CALLING PARTY INFORMATION IS COLLECTED FOR EACH CALL
525
COLLECTED INFORMATION IS USED TO IDENTITY SUSPECT CALLING PARTIES AND PLACE THEM IN THE SUSPECT LIST
530
TIMER IS SET SPECIFYING DURATION OF TIME THAT A SUSPECT CALLER WILL BE BLOCKED
HAS TIMER EXPIRED FOR CALLING PARTY LISTED IN THE SUSPECT LIST?
NO
535
YES
540
CALLING PARTY IS REMOVED FROM THE SUSPECT LIST

FIG. 5

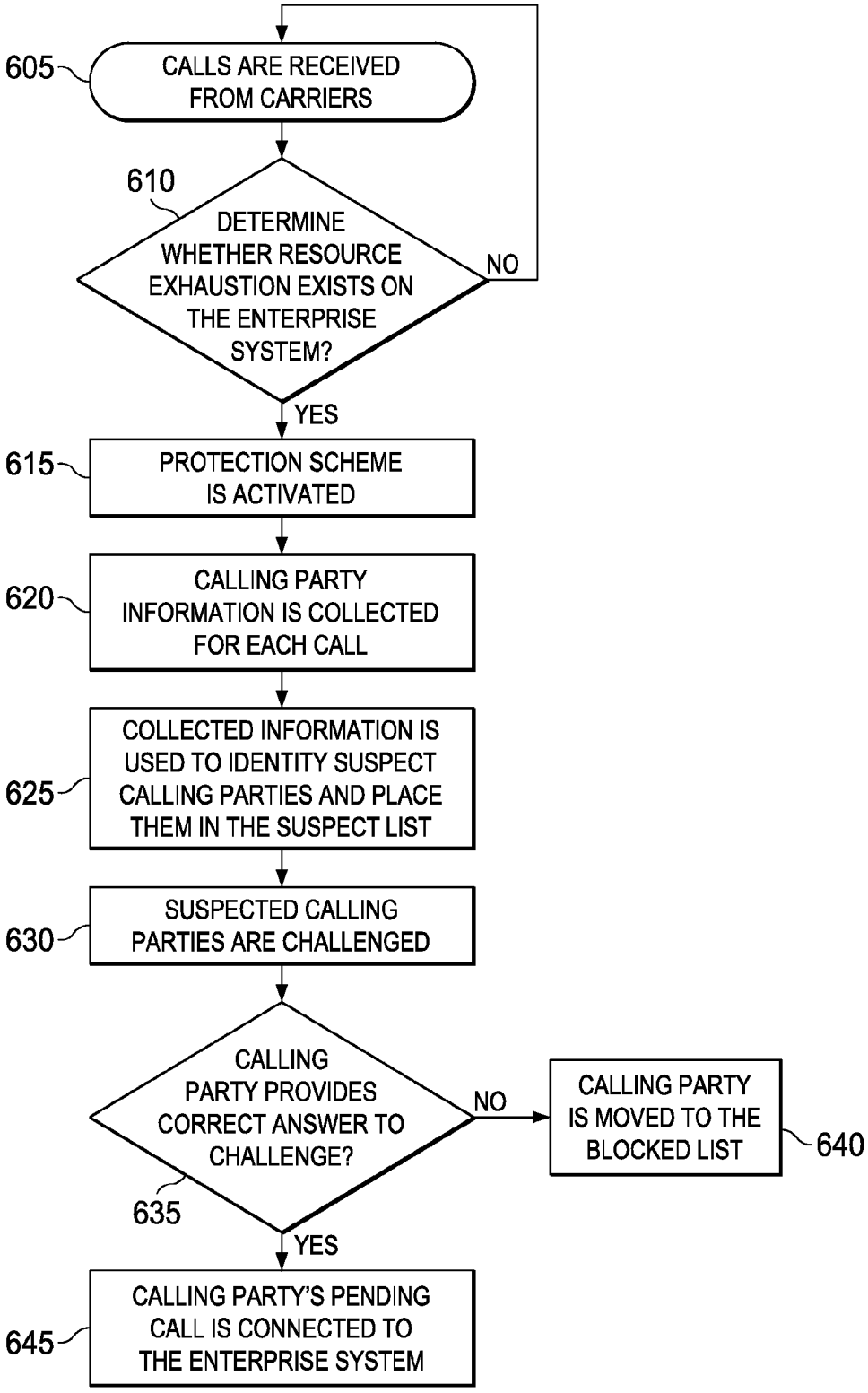

605
CALLS ARE RECEIVED FROM CARRIERS
610
DETERMINE WHETHER RESOURCE EXHAUSTION EXISTS ON THE ENTERPRISE SYSTEM?
NO
YES
615
PROTECTION SCHEME IS ACTIVATED
620
CALLING PARTY INFORMATION IS COLLECTED FOR EACH CALL
625
COLLECTED INFORMATION IS USED TO IDENTITY SUSPECT CALLING PARTIES AND PLACE THEM IN THE SUSPECT LIST
630
SUSPECTED CALLING PARTIES ARE CHALLENGED
CALLING PARTY PROVIDES CORRECT ANSWER TO CHALLENGE?
635
NO
CALLING PARTY IS MOVED TO THE BLOCKED LIST
640
YES
645
CALLING PARTY'S PENDING CALL IS CONNECTED TO THE ENTERPRISE SYSTEM

FIG. 6

DENIAL OF SERVICE PROTECTION FOR IP TELEPHONY SYSTEMS

TECHNICAL FIELD

[0001] This disclosure relates generally to protecting telecommunication systems, and more specifically, to protecting IP telephony systems from events such as denial of service attacks.

BACKGROUND

[0002] The following discussion sets forth the inventors' own knowledge of certain technologies and/or problems associated therewith. Accordingly, this discussion is not an admission of prior art, and it is not an admission of the knowledge available to a person of ordinary skill in the art.

[0003] With the transition from public switched telephone networks (PSTNs) to internet telephony, new challenges have arisen in protecting telephone networks. One consequence of transmitting telephone calls via the internet is that these calls are now subject to the vulnerabilities of the internet. One type of internet attack that is of particular concern to IP telephony systems is a denial of service attack. Due to the resource limits faced by IP telephony systems and the real-time requirements of IP telephony systems, denial of service attacks are particularly effective at disrupting the normal operations of an IP telephony system.

[0004] Denial of service attacks are used by malicious actors to effectively disable a network device. In a denial of service attack, an overwhelming number of messages are directed to a targeted networked device. The deluge of messages causes resource exhaustion on the targeted network device. Due to the resulting resource exhaustion, the targeted device is unable to process the incoming stream of messages and is thus unable to process legitimate messages in a timely manner.

[0005] Denial of service attacks can cause crippling problems in a network when directed at conventional targets, such as web server and email servers. The problems caused by denial of service attacks is even more harmful in real-time systems such as IP telephony networks. In conventional denial of service attacks, web servers and email servers are prevented from providing timely responses to external requests. In some situations, a delayed response by the targeted server may still be acceptable. For example, a delay in email delivery by a targeted email server may not even be perceived by users. In another example, a web server targeted by a denial of service attack may still be able to provide degraded, but still acceptable, performance by delivering low-bandwidth web content. In a real-time system, however, denial of service attacks completely disable the system's ability to provide any acceptable response. Significant financial harm can result from such disruptions in an IP telephony system. The effects of a denial of service attack can go beyond financial harm when directed at telephone networks such as 911 systems.

[0006] In addition to denial of service attacks, similar effects can result from non-malicious or marginally-malicious actors. Automated dialing systems are used by entities such as telemarketer and survey solicitors to automatically initiate calls. Malfunctions in these automated dialing systems or aggressive use of these system can result in excessive call volumes that can resemble a denial of service attack.

[0007] An IP telephony system must be able to operate in real-time. Due to the effects of a denial of service attack, an IP telephony system may be prevented from accepting any legitimate incoming calls. A denial of service attack may also result in unacceptably degraded quality of legitimate calls. Accordingly, there is a need for an IP telephony protection system that can prevent denial of service attacks from disrupting the operations of the IP telephony system. To address these, and other concerns, the inventors hereof have developed an IP telephony protection system, as described in detail below.

SUMMARY

[0008] In order to provide a system for protecting IP telephony systems from certain vulnerabilities of the internet, especially denial of service attacks, an IP telephony protection system, method and software program are claimed. The claimed invention provides the ability to protect an IP telephony system from denial of service attacks with minimal processing burden and using various protection schemes.

[0009] Embodiments can be used for protecting one or more components of an IP telephony network, the protection being provided by: monitoring incoming messages directed towards an intended recipient located on the IP telephony network wherein each incoming message originates from a sender; monitoring one or more levels of resource exhaustion by the intended recipient; monitoring messages that cannot be delivered to the intended recipient due to resource exhaustion; and enabling a protection scheme if the number of undeliverable messages exceeds a first threshold; wherein the enabled protection scheme further comprises: identifying one or more senders that are suspected of directing multiple incoming messages towards the intended recipient; placing the identified suspect senders on a suspected sender list; and blocking incoming messages from senders identified in a blocked sender list.

[0010] In certain embodiments, a protection scheme will further include: presenting a challenge action to a sender identified in the suspected sender list; evaluating a response provided to the challenge action by the identified suspect sender; and placing the identified suspect sender on the blocked sender list, if the evaluation determines that the identified suspect sender has not provided a correct response to the challenge action. In certain embodiments, a protection scheme will further include moving one or more senders from the suspected sender list to the blocked sender list for a predefined duration of time. In certain embodiments, a protection scheme will further include: providing information regarding senders placed on the suspected sender list to a user; and receiving input from the user, wherein the input directs movement of a sender from the suspected sender to the blocked sender list. In certain embodiments, the protection scheme is enabled for a first time duration and is disabled when the first time duration expires. In certain embodiments, the protection scheme remains enabled until it is determined that resource exhaustion no longer prevents message delivery to the intended recipient. In certain embodiments, the challenge action requires a verbal response from the sender.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention may be better understood, and its numerous objects, features, and advantages made

apparent to those skilled in the art by referencing the accompanying drawings. The use of the same reference symbols in different drawings indicates similar or identical items. Reference will now be made to the accompanying drawings, wherein:

[0012] FIG. **1** is a block diagram of an IP telephony protection system according to a first embodiment.

[0013] FIG. **2** is a block diagram of an IP telephony protection system according to a second embodiment.

[0014] FIG. **3** is a block diagram of an IP telephony protection system according to a third embodiment.

[0015] FIG. **4** is a flowchart of a method for IP telephony protection according to the embodiment illustrated in FIG. **1**.

[0016] FIG. **5** is a flowchart of a method for IP telephony protection according to the embodiment illustrated in FIG. **2**.

[0017] FIG. **6** is a flowchart of a method for IP telephony protection according to the embodiment illustrated in FIG. **3**.

[0018] FIG. **7** is block diagram of an illustrative telecommunications system that could be used to implement the IP telephony protection system according to some embodiments.

DETAILED DESCRIPTION

[0019] Embodiments disclosed herein are directed generally to an IP telephony protection system.

[0020] The term "telecommunications," as used herein, is intended to encompass voice communications or telephony, as well as other forms of communications (e.g., video communications, videoconferencing, instant messaging or IM, Short Messaging Service or SMS, emails, etc.) that may take place electronically, for example, over wireless networks, circuit-switched networks, packet-switched networks, or any combination thereof. As such, a reference to a "call" in the description of embodiment of the claimed invention may encompass a voice call, a video call or a data message.

[0021] An embodiment of the claimed invention is illustrated in FIG. **1**. In the embodiment of FIG. **1**, calls originate from calling parties using carriers **105***a-c* and are directed to an enterprise communication system **110**. The incoming calls originating from carriers **105***a-c* are received by a media gateway control function **100**. According to various embodiments, the media gateway control function **100** may be comprised within a standalone device or it may be a component of a larger IP telephony device. One of the functions of the media gateway control function **100** is to process the calls received via carriers **105***a-c* and to route these calls to enterprise system **110**. Another function of the media gateway control function **100** illustrated in FIG. **1** is to protect the enterprise system **110** from excessive call volume, especially excessive call volume resulting from denial of service attacks.

[0022] In the embodiment of FIG. **1**, incoming calls are received by a routing and call processing module **115** of the media gateway control function **100**. This module is responsible for processing calls incoming via carriers **105***a-c*. One call processing function provided by the routing and call processing module **115** is to enable protection schemes that block calling parties that have been previously identified as participating in attacks or otherwise generating undesirable call volume. If a protection scheme has been enabled, the routing and call processing module **115** checks the identity of each calling party against the entries of the block caller list to determine whether the incoming call should be immediately rejected. In some embodiments, the list of blocked calling parties is received from external systems by the media gateway control function **100**. In such embodiments, the list of blocked calling parties will contain data aggregated by internet security organizations based on attacks observed throughout the internet. In some embodiments and as described below, the list of blocked calling partied utilized by the media gateway control function **100** may also contain calling parties previously identified as malicious by the media gateway control function **100**. In the embodiment of FIG. **1**, the list of blocked calling parties is maintained by suspect/block list module **125**.

[0023] In order to protect the enterprise system **110** from denial of service attacks, the media gateway control function **100** evaluates the incoming calls received from carriers **105***a-c* and determines whether any calling parties appears to be contributing to an attack or is otherwise causing undesirable call volume. A responsibility of the routing and call processing module **115** is to monitor the available call capacity of the enterprise system **110**. Based on its monitoring of the available call capacity, the routing and call processing module **115** determines when incoming calls received from carriers **105***a-c* have saturated the channels available to enterprise system **110**. In some embodiments, saturation will be determined by the routing and call processing module **115** based on the number PRI channels and/or SIP sessions that remain available to the enterprise system **110**. Once this point of saturation is reached, the routing and call processing module **115** must resort to blocking any additional incoming calls intended for enterprise system **110**. In the embodiment of FIG. **1**, the routing and call processing module **115** triggers the activation of a protection scheme once call blocking begins due to resource exhaustion. The protection scheme activated by the routing and call processing module **115** will identify calling parties suspected of participating in an attack and provide the ability to block further calls by any calling parties suspected of participating in the attack.

[0024] In some embodiments, the threshold for triggering the activation of a protection scheme by the media gateway control function **100** may be configurable. For instance, a protection scheme may be enabled based on available call capacity of the enterprise system **110** dropping below a configurable threshold. In some embodiments, saturation may be determined based on metrics other than call capacity available to enterprise system **110**. For instance, a protection scheme may be triggered by the routing and call processing module **115** based on other indicators of resource exhaustion by one or more components of the enterprise system **110**, such as available memory and/or processor loads.

[0025] By waiting to enable a protection scheme and begin blocking calls until a problematic level of resource exhaustion has been identified in the enterprise system **110**, the media gateway control function **100** minimizes the processing burden of providing protection services. Enforcing a protection scheme requires the media gateway control function **100** to expend resources that could otherwise be used in providing core call processing and routing services. To minimize this drain on resources, the media gateway control function **100** does not enable a protection scheme until a need for it has been identified.

[0026] The media gateway control function **100** may provide a suite of protection schemes that identify suspect calling parties and take various different actions to block

suspected calling parties from further calls to the enterprise system **110**. An appropriate protection scheme may be selected by the routing and call processing module **115** based on various parameters of the system, the current threat environment and/or inputs from external systems. In some embodiments, the selection of a protection scheme by the routing and call processing module **115** may be based at least in part on user input.

[0027] The media gateway control function, according to some embodiments, will also be capable of concurrently enforcing different protection schemes for different enterprise systems. The illustrated embodiments only refer to a single enterprise system that is being protected by the media gateway control function. However, multiple enterprise systems may be protected concurrently, with the determination of whether to activate a protection scheme and the selection of protection scheme particularized to each enterprise system.

[0028] Protection schemes may vary in duration and the manner in which they are disabled. In some embodiments, a protection scheme is enabled for a specified length of time. In such embodiments, a protection scheme is enforced by the media gateway control function **100** for the specified length of time and then disables the protection scheme. Other embodiments will keep a protection scheme active until the enterprise system **110** is determined to no longer be in a state of resource exhaustion.

[0029] In the embodiment of FIG. **1**, the media gateway control function **100** maintains a list of suspect calling parties that contains information identifying calling parties that are suspected of participating in attacks or otherwise responsible for undesirable call volume. In this embodiment, the media gateway control function **100** begins each protection scheme session with an empty list of suspected calling parties and builds the suspect caller list by adding parties to the list based on their observed calling behavior. In some embodiments, this list may include information received by the media gateway control function **100** from external systems. In some embodiments, the list may contain calling parties previously identified as suspect by the media gateway control function **100**. In the embodiment of FIG. **1**, the list of suspected calling parties is maintained by suspect/block list module **125**.

[0030] In the protection scheme selected in the embodiment illustrated in FIG. **1**, the routing and call processing module **115** records information identifying the calling party of each call received from carriers **105***a-c*. This incoming call information is provided by the routing and call processing module **115** to an assessment module **120**. The assessment module **120** uses this information to identify repeated calls from individual calling parties. The assessment module **120** places these repeat calling parties in the list of suspected calling parties that is maintained by the suspect/block list module **125**. In some embodiments, the assessment module **120** may base the decision to place a calling party in the list of suspected callers based on additional criteria, such as the duration of prior calls by a calling party and/or any geographic location information that is available for a calling party.

[0031] In the protection scheme of the embodiment of FIG. **1**, the assessment module **120** provides an alert indicating that calling parties have been added to the list of suspected callers. This alert notifies a user that action is required in order to move calling parties from the list of suspected callers to the list of blocked callers. The media gateway control function **100** includes a user controls module **130** by which a user can evaluate the calling parties that have been added to the suspected caller list by the assessment module **120**. Via controls provided by the user controls module **130**, a user may select any or all entries in the suspected caller list that should be moved to the blocked caller list. This input received from the user is provided from the user controls module **130** to the suspect/block list module **125** where this change is made. The routing and call processing module **115** begins using this updated blocked caller list to prevent further calls from the calling parties identified from the user from reaching the enterprise system **110**. In this manner, the routing and call processing module **115** monitors calls intended for the enterprise system **110** and activates a protection scheme that prevents malicious callers from burdening the enterprise system **110**.

[0032] Reliance on user controls introduces a delay in the ability of the media gateway control function **100** to responds to potential threats. However, some scenarios encountered by the media gateway control function **100** will benefit from a human in the loop. For instance, certain legitimate events may produce call patterns that resemble denial of service attacks. One example are mass calling events in response to radio station promotions. The promise of free tickets by a radio station can encourage repeated attempts by a calling party to reach the radio station. Certain enterprise systems that are known to be used for such mass calling events may prefer to utilize human decision making in determining whether a calling party should be blocked. For enterprise systems such as a **911** system, blocking any calling party would be done cautiously and would commonly be done using human input.

[0033] Certain of the steps undertaken by the media gateway control function **100** with respect to the embodiment of FIG. **1** are further described in the flowchart of FIG. **4**.

[0034] FIG. **2** illustrates another embodiment. The embodiment of FIG. **2** utilizes the same components as those in the embodiment of FIG. **1**, except for the lack of a user controls module **130** in the embodiment of FIG. **2**. No user controls module is present in FIG. **2** since this embodiment uses a different protection scheme that does not require user input. In the embodiment of FIG. **2**, the routing and call processing module **215** selects a protection scheme where suspect calling parties are automatically blocked for a specified duration of time.

[0035] As with the embodiment of FIG. **1**, once the protection scheme has been activated, the routing and call processing module **215** in the embodiment of FIG. **2** provides the assessment module **220** information identifying the calling party of each call received via carriers **205***a-c*. As before, the assessment module **220** tracks the number of calls received from each calling party and uses this information to identify suspect callers. As before, other embodiments may use additional information to identify suspect callers. As suspected callers are identified by the assessment module **220**, the caller identification information is added to the suspect caller list maintained by the suspect/block list module **225**.

[0036] In the embodiment of FIG. **2**, the routing and call processing module **215** has selected a protection scheme where calling parties identified in the blocked caller list are blocked by the routing and call processing module **215**. However, due to management of the blocked caller list by

the suspect/block list module **225**, suspected calling parties only remain in the blocked caller list for a specified time duration. As suspect callers are identified by the assessment module **220**, these calling parties are added to the blocked caller list maintained by the suspect/block list module **225**. A timer is set for certain entries in the blocked caller list. The suspect/block list module **225** removes a calling party from the blocked caller list after the timer associated with that entry has expired. In some embodiments, a calling party that is removed from the blocked caller list due to expiration of a blocking duration will be placed in the suspect caller list such that the calling party may be placed back in the blocked caller list based on continued monitoring of the calling party. In some embodiments, suspected parties to be blocked for a finite time duration may not be placed in the blocked caller list and instead may be subjected to blocking for specified duration from the suspected caller list using a timer.

[0037] In this manner, the protection scheme utilized by the embodiment of FIG. **2** automatically limits the frequency of calls from all calling parties to the enterprise system **210**. In some embodiments, the timer set by the suspect/block list module **225** may be configured by the assessment module **220** based on indicators that a calling party is likely a malicious actor participating in an attack. This allows calling parties repeatedly identified as suspected calling parties by the assessment module **220** to face increasingly longer delays in the frequency of calls that can be completed to enterprise system **210**.

[0038] Certain of the steps undertaken by the media gateway control function **200** with respect to the embodiment of FIG. **2** are further described in the flowchart of FIG. **5**.

[0039] FIG. **3** illustrates another embodiment of the claimed invention. The embodiment of FIG. **3** utilizes the same components as those in the embodiment of FIG. **2**, except for the addition of an internal challenge module **335** and an external challenge module **340**. In the embodiment of FIG. **3**, the media gateway control function **300** has selected a protection scheme where certain of the calling parties listed in the suspect callers list are required to provide a correct response to a challenge in order to be removed from the suspect caller list.

[0040] As with the embodiments of FIGS. **1** and **2**, once the protection scheme has been activated, the routing and call processing module **315** in the embodiment of FIG. **3** provides the assessment module **320** information identifying the calling party of each call received via carriers **305***a-c*. As before, the assessment module **320** tracks the number of calls received from each calling party and uses this information to identify suspect callers. As before, other embodiments may use additional information to identify suspect callers. As suspected callers are identified by the assessment module **320**, the caller identification information is added to the suspect caller list maintained by the suspect/block list module **325**.

[0041] In the embodiment of FIG. **3**, certain of the calling parties listed in the suspect caller list are subjected to a challenge. As before, the routing and call processing module **315** processing incoming calls received via carriers **305***a-c* and determines if a calling party is listed on the suspect caller list or the block caller list. As before, once the protection scheme has been enabled, the routing and call processing module **315** of FIG. **3** blocks all calls determined to originate from a calling party listed in the blocked caller list. In the embodiment of FIG. **3**, the routing and call processing module **315** includes the additional responsibility of issuing a challenge to calling parties identified in the suspect caller list.

[0042] The routing and call processing module **315** relies on an internal challenge module **335** and external challenge module **340**. The internal challenge module **335** is a component of the media gateway control function **300**. The external challenge module **340** is a component of an external device or system. Both the internal challenge module **335** and the external challenge module **340** issue challenges to calling parties identified by the routing and call processing module **315** as being listed in the suspect calling list. Both the internal challenge module **335** and the external challenge module **340** are also tasked with evaluating responses to issued challenges. Certain embodiments may rely on only one of the internal challenge module **335** and the external challenge module **340**.

[0043] In some embodiments, the external challenge module **335** may be configured to utilize more sophisticated technology than is available to the internal challenge module **335**. For instance, an external challenge module **340** may be configured to utilize interactive voice response systems for evaluating verbal responses from calling parties in response to a challenge. In such embodiments, the external challenge module **340** would issue a challenge to a calling party that could be answered verbally. For instance, the external challenge module **340** may use computer generated speech to demand that a calling party provide the current month as a digit number. In response, the calling party would speak an answer such as "zero-two," to assert that the current month is February. The external challenge module **340** utilizes an interactive voice response system to process the verbal response and to determine whether the processed response provides the correct answer to the challenge issued to the calling party. Other technologies that may be used by an external challenge module **340** include CAPTCHA distorted text recognition challenges that allow the media gateway control function **300** to verify that the calling party is an actual person and not a computer. An internal challenge module **335** may provide less resource intensive challenge functions, such as challenges based on responses provided by keypad inputs provided by a calling party.

[0044] If a challenged calling party is determined to have provided a correct response, the assessment module **320** is notified and provided with the identity of the calling party that has provided the correct response. The assessment module signals the suspect/block list module **325** to remove this calling party from the suspect caller list. The assessment module **320** may further utilize this information in further configuring the process by which it identifies calling parties as suspect. With this calling party removed from the suspect caller list, the routing and call processing module **315** connects the calling party to the enterprise system **310**. Future calls by the calling party to the enterprise system **310** are allowed by the routing and call processing module **315** until the calling party is again placed on the suspect list or the block list.

[0045] If a challenged calling party provides an incorrect response to a challenge, the internal challenge module **335** and the external challenge module **340** notify the routing and call processing module **315**. The routing and call processing module **315** then blocks the pending call from the calling party that has provided the incorrect response. The assessment module **315** is also notified of the incorrect response to

the challenge by the calling party. The assessment module **315** determines whether the calling party is moved from the suspect list the blocked caller list. If the assessment module determines a change is warranted, it signals the suspect/block list module **325** to make updates to both lists. In some embodiments, the assessment module **315** determines whether to switch a calling party from the suspect list to the block list based on the number of previous incorrect challenge responses provided by the calling party. In some embodiments, calling parties providing an incorrect challenge response may be directed to an alternate phone number or system that will provide escalated treatment of the situation.

[0046] Certain of the steps undertaken by the media gateway control function **300** with respect to the embodiment of FIG. **3** are further described in the flowchart of FIG. **6**.

[0047] As noted above, embodiments of the IP telephony protection system may be implemented or executed, at least in part, by one or more computer systems, including a computer system providing the services of a media gateway control function. One such computer system is illustrated in FIG. **7**. In various embodiments, computer system **700** may be a server, a workstation, a desktop computer, a laptop, a tablet computer, a mobile device, a smart phone, or the like. In some cases, system **700** may be used to implement media gateway control function of FIGS. **1-3**. As illustrated, computer system **700** includes one or more processor(s) **710**A-N coupled to a system memory **720** via an input/output (I/O) interface **730**. Computer system **700** further includes a network interface **740** coupled to I/O interface **730**, and one or more input/output devices **750**, such as cursor control devices **760**, keyboard **770**, and display(s) **780**.

[0048] In various embodiments, computer system **700** may be a single-processor system including one processor **710**A, or a multi-processor system including two or more processors **710**A-N (e.g., two, four, eight, or another suitable number). Processor(s) **710**A-N may include any processor capable of executing program instructions. For example, in various embodiments, processor(s) **710**A-N may be general-purpose or embedded processors implementing any of a variety of instruction set architectures (ISAs), such as the x86, PowerPC®, ARM®, SPARC®, or MIPS® ISAs, or any other suitable ISA. In multi-processor systems, each of processor(s) **710**A-N may commonly, but not necessarily, implement the same ISA. Also, in some embodiments, at least one processor **710**A may be a graphics processing unit (GPU) or other dedicated graphics-rendering device.

[0049] System memory **720** may be configured to store program instructions (e.g., the media gateway control function) and/or data accessible by processor(s) **710**A-N. In various embodiments, system memory **720** may be implemented using any suitable memory technology, such as static random access memory (SRAM), synchronous dynamic RAM (SDRAM), nonvolatile/Flash-type memory, or any other type of memory. As illustrated, program instructions and data implementing certain operations such as, for example, those described in connection with FIGS. **1-6**, may be stored within system memory **720** as program instructions **725** and data storage **735**, respectively. Additionally or alternatively, the media gateway control function may be a software program that is stored within system memory **720** and is executable by processor(s) **710**A-N. In other embodiments, program instructions and/or data may be received, sent or stored upon different types of computer-accessible media or on similar media separate from system memory **720** or computer system **700**. Generally speaking, a computer-accessible medium may include any tangible or non-transitory storage media or memory media such as electronic, magnetic, or optical media—e.g., disk or CD/DVD-ROM coupled to computer system **700** via I/O interface **730**. The terms "tangible" and "non-transitory," as used herein, are intended to describe a computer-readable storage medium (or "memory") excluding propagating electromagnetic signals, but are not intended to otherwise limit the type of physical computer-readable storage device that is encompassed by the phrase computer-readable medium or memory. For instance, the terms "non-transitory computer-readable medium" or "tangible memory" are intended to encompass types of storage devices that do not necessarily store information permanently, including for example, random access memory (RAM). Program instructions and data stored on a tangible computer-accessible storage medium in non-transitory form may further be transmitted by transmission media or signals such as electrical, electromagnetic, or digital signals, which may be conveyed via a communication medium such as a network and/or a wireless link.

[0050] In an embodiment, I/O interface **730** may be configured to coordinate I/O traffic between processor(s) **710**A-N, system memory **720**, and any peripheral devices in the device, including network interface **740** or other peripheral interfaces, such as input/output devices **750**. In some embodiments, I/O interface **730** may perform any necessary protocol, timing or other data transformations to convert data signals from one component (e.g., system memory **720**) into a format suitable for use by another component (e.g., processor(s) **710**A-N). In some embodiments, I/O interface **730** may include support for devices attached through various types of peripheral buses, such as a variant of the Peripheral Component Interconnect (PCI) bus standard or the Universal Serial Bus (USB) standard, for example. In some embodiments, the function of I/O interface **730** may be split into two or more separate components, such as a north bridge and a south bridge, for example. In addition, in some embodiments some or all of the functionality of I/O interface **730**, such as an interface to system memory **720**, may be incorporated directly into processor(s) **710**A-N.

[0051] Network interface **740** may be configured to allow data to be exchanged between computer system **700** and other devices attached to a network, such as other computer systems. In various embodiments, network interface **740** may support communication via wired or wireless general data networks, such as any suitable type of Ethernet network, for example; via telecommunications/telephony networks such as analog voice networks or digital fiber communications networks; via storage area networks such as FibreChannel SANs, or via any other suitable type of network and/or protocol.

[0052] Input/output devices **750** may, in some embodiments, include one or more display terminals, keyboards, keypads, touchpads, scanning devices, RFID readers, NFC readers, voice or optical recognition devices, or any other devices suitable for entering or retrieving data by one or more computer system **700**. Multiple input/output devices **750** may be present in computer system **700** or may be distributed on various nodes of computer system **700**. In some embodiments, similar input/output devices may be separate from computer system **700** and may interact with

one or more nodes of computer system **700** through a wired or wireless connection, such as over network interface **740**.

[0053] As shown in FIG. **7**, memory **720** may include program instructions **725**, configured to implement certain embodiments described herein, and data storage **735**, comprising various data may be accessible by program instructions **725**. In an embodiment, program instructions **725** may include software elements of embodiments illustrated in the above figures. For example, program instructions **725** may be implemented in various embodiments using any desired programming language, scripting language, or combination of programming languages and/or scripting languages (e.g., C, C++, C#, Java™, JavaScript™, Perl, etc.). Data storage **735** may include data that may be used in these embodiments (e.g., recorded communications, profiles for different modes of operations, etc.). In other embodiments, other or different software elements and data may be included.

[0054] A person of ordinary skill in the art will appreciate that computer system **700** is merely illustrative and is not intended to limit the scope of the disclosure described herein. In particular, the computer system and devices may include any combination of hardware or software that can perform the indicated operations. In addition, the operations performed by the illustrated components may, in some embodiments, be performed by fewer components or distributed across additional components. Similarly, in other embodiments, the operations of some of the illustrated components may not be provided and/or other additional operations may be available. Accordingly, systems and methods described herein may be implemented or executed with other computer system or processor-based configurations.

[0055] Although certain embodiments are described herein with reference to specific examples, numerous modifications and changes may be made in light of the foregoing description. Accordingly, the specification and figures are to be regarded in an illustrative rather than a restrictive sense, and all such modifications are intended to be included within their scope. Any benefits, advantages, or solutions to problems that are described herein with regard to specific embodiments are not to be construed as a critical, required, or essential feature or element of any or all the claims. Furthermore, it should be understood that the various operations described herein may be implemented in software, hardware, or a combination thereof. The order in which each operation of a given technique is performed may be changed, and the elements of the systems illustrated herein may be added, reordered, combined, omitted, modified, etc. It is intended that the embodiments described herein embrace all such modifications and changes and, accordingly, the above description should be regarded in an illustrative rather than a restrictive sense.

[0056] Unless stated otherwise, terms such as "first" and "second" are used to arbitrarily distinguish between the elements such terms describe. Thus, these terms are not necessarily intended to indicate temporal or other prioritization of such elements. The term "coupled" is defined as "connected" and/or "in communication with," although not necessarily directly, and not necessarily mechanically. The terms "a" and "an" are defined as one or more unless stated otherwise. The terms "comprise" (and any form of comprise, such as "comprises" and "comprising"), "have" (and any form of have, such as "has" and "having"), "include" (and any form of include, such as "includes" and "including") and "contain" (and any form of contain, such as "contains" and "containing") are open-ended linking verbs. As a result, a system, device, or apparatus that "comprises," "has," "includes" or "contains" one or more elements possesses those one or more elements but is not limited to possessing only those one or more elements. Similarly, a method or process that "comprises," "has," "includes" or "contains" one or more operations possesses those one or more operations but is not limited to possessing only those one or more operations.

1. A method for protecting one or more components of an IP telephony network, comprising:
- monitoring incoming messages directed towards an intended recipient located on the IP telephony network wherein each incoming message originates from a sender;
- monitoring one or more levels of resource exhaustion by the intended recipient;
- monitoring messages that cannot be delivered to the intended recipient due to resource exhaustion; and
- enabling a protection scheme if the number of undeliverable messages exceeds a first threshold; wherein the enabled protection scheme further comprises:
- identifying one or more senders that are suspected of directing multiple incoming messages towards the intended recipient;
- placing the identified suspect senders on a suspected sender list; and
- blocking incoming messages from senders identified in a blocked sender list.

2. The method of claim **1**, wherein the enabled protection scheme further comprises:
- presenting a challenge action to a sender identified in the suspected sender list;
- evaluating a response provided to the challenge action by the identified suspect sender; and
- placing the identified suspect sender on the blocked sender list, if the evaluation determines that the identified suspect sender has not provided a correct response to the challenge action.

3. The method of claim **1**, wherein the enabled protection scheme further comprises:
- moving one or more senders from the suspected sender list to the blocked sender list for a predefined duration of time.

4. The method of claim **1**, wherein the enabled protection scheme further comprises:
- providing information regarding senders placed on the suspected sender list to a user; and
- receiving input from the user, wherein the input directs movement of a sender from the suspected sender to the blocked sender list.

5. The method of claim **1**, wherein the protection scheme is enabled for a first time duration and is disabled when the first time duration expires.

6. The method of claim **1**, wherein the protection scheme remains enabled until it is determined that resource exhaustion no longer prevents message delivery to the intended recipient.

7. The method of claim **2**, wherein the challenge action requires a verbal response from the sender.

8. A tangible computer-readable storage medium having program instructions stored thereon that, upon execution by a computer system, cause the computer system to:

monitor incoming messages directed towards an intended recipient located on the IP telephony network wherein each incoming message originates from a sender;

monitor one or more levels of resource exhaustion by the intended recipient;

monitor messages that cannot be delivered to the intended recipient due to resource exhaustion; and

enable a protection scheme if the number of undeliverable messages exceeds a first threshold, wherein the executed program instruction of the enabled protection scheme further cause the computer system to:

identify one or more senders that are suspected of directing multiple incoming messages towards the intended recipient;

place the identified suspect senders on a suspected sender list; and

block incoming messages from senders identified in a blocked sender list.

9. The computer program product of claim **8**, wherein the program instructions, upon execution by the computer system, further cause the computer system to:

present a challenge action to a sender identified in the suspected sender list;

evaluate a response provided to the challenge action by the identified suspect sender; and

place the identified suspect sender on the blocked sender list, if the evaluation determines that the identified suspect sender has not provided a correct response to the challenge action.

10. The computer program product of claim **8**, wherein the program instructions, upon execution by the computer system, further cause the computer system to:

move one or more senders from the suspected sender list to the blocked sender list for a predefined duration of time.

11. The computer program product of claim **8**, wherein the program instructions, upon execution by the computer system, further cause the computer system to:

provide information regarding senders placed on the suspected sender list to a user; and

receive input from the user, wherein the input directs movement of a sender from the suspected sender list to the blocked sender list.

12. The computer program product of claim **8**, wherein the protection scheme is enabled for a first time duration and is disabled when the first time duration expires.

13. The computer program product of claim **8**, wherein the protection scheme remains enabled until it is determined that resource exhaustion no longer prevents message delivery to the intended recipient.

14. The computer program product of claim **9**, wherein the challenge action requires a verbal response from the sender.

15. A system comprising a network device configured to:

monitor incoming messages directed towards an intended recipient located on the IP telephony network wherein each incoming message originates from a sender;

monitor one or more levels of resource exhaustion by the intended recipient;

monitor messages that cannot be delivered to the intended recipient due to resource exhaustion; and

enable a protection scheme if the number of undeliverable messages exceeds a first threshold, wherein the executed program instruction of the enabled protection scheme further cause the computer system to:

identify one or more senders that are suspected of directing multiple incoming messages towards the intended recipient;

place the identified suspect senders on a suspected sender list;

block incoming messages from senders identified in a blocked sender list.

16. The system of claim **15**, wherein the network device is further configured to:

present a challenge action to a sender identified in the suspected sender list;

evaluate a response provided to the challenge action by the identified suspect sender; and

place the identified suspect sender on a the blocked sender list, if the evaluation determines that the identified suspect sender has not provided a correct response to the challenge action.

17. The system of claim **15**, wherein the network device is further configured to:

move one or more senders from the suspected sender list to the blocked sender list for a predefined duration of time.

18. The system of claim **15**, wherein the network device is further configured to:

provide information regarding senders placed on the suspected sender list to a user; and

receive input from the user, wherein the input directs movement of a sender from the suspected sender list to the blocked sender list.

19. The system of claim **15**, wherein the protection scheme is enabled for a first time duration and is disabled when the first time duration expires.

20. The system of claim **15**, wherein the protection scheme remains enabled until it is determined that resource exhaustion no longer prevents message delivery to the intended recipient.

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