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(54) **LOAD CONTROLLER FRAMEWORK**

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G06F 17/30	(2006.01)
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H04L 12/803	(2013.01)

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CPC ***H04L 47/821*** (2013.01); ***H04L 47/11*** (2013.01); ***H04L 47/627*** (2013.01); ***H04L 67/1002*** (2013.01); *G06F 9/5083* (2013.01); *G06F 17/30516* (2013.01); *H04L 47/125* (2013.01); *H04L 67/1008* (2013.01)

(58) **Field of Classification Search**

CPC H04L 47/125; H04L 67/71008; G06F 17/30516; G06F 9/5083

USPC 709/226

See application file for complete search history.

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(57) **ABSTRACT**

The present disclosure involves systems, software, and computer-implemented methods for controlling service load in a cloud-based system. An example method includes receiving a first request for the network service from a client, evaluating a load condition associated with the network service, the load condition indicating an availability of the network service to receive requests, returning a unique token associated with the first request to the client in response to the load condition indicating that the network service is not available to receive the requests, receiving a second request for the network service from the client, the second request including at least a portion of the first request and the unique token, evaluating the load condition associated with the network service, and prioritizing the second request based on the unique token in response to the load condition indicating that the network service is available to receive the requests.

19 Claims, 4 Drawing Sheets

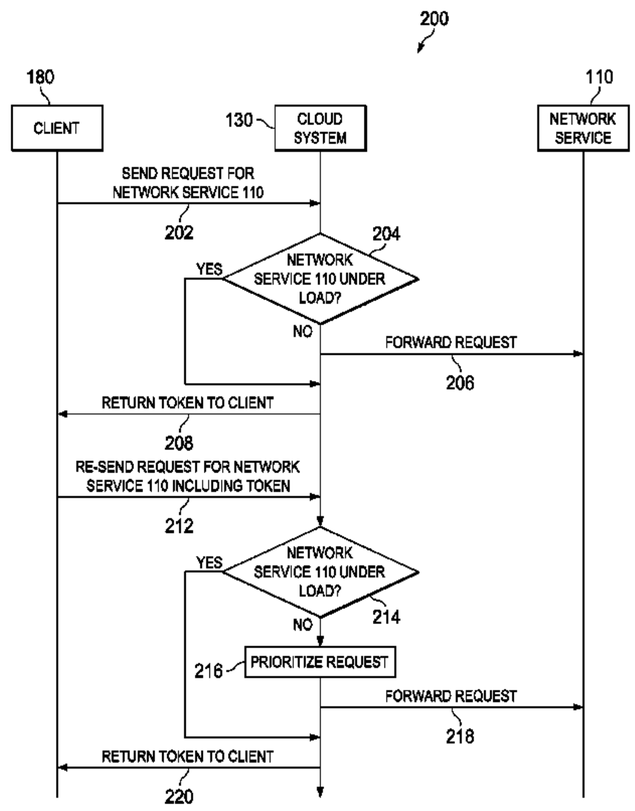

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FIG. 1

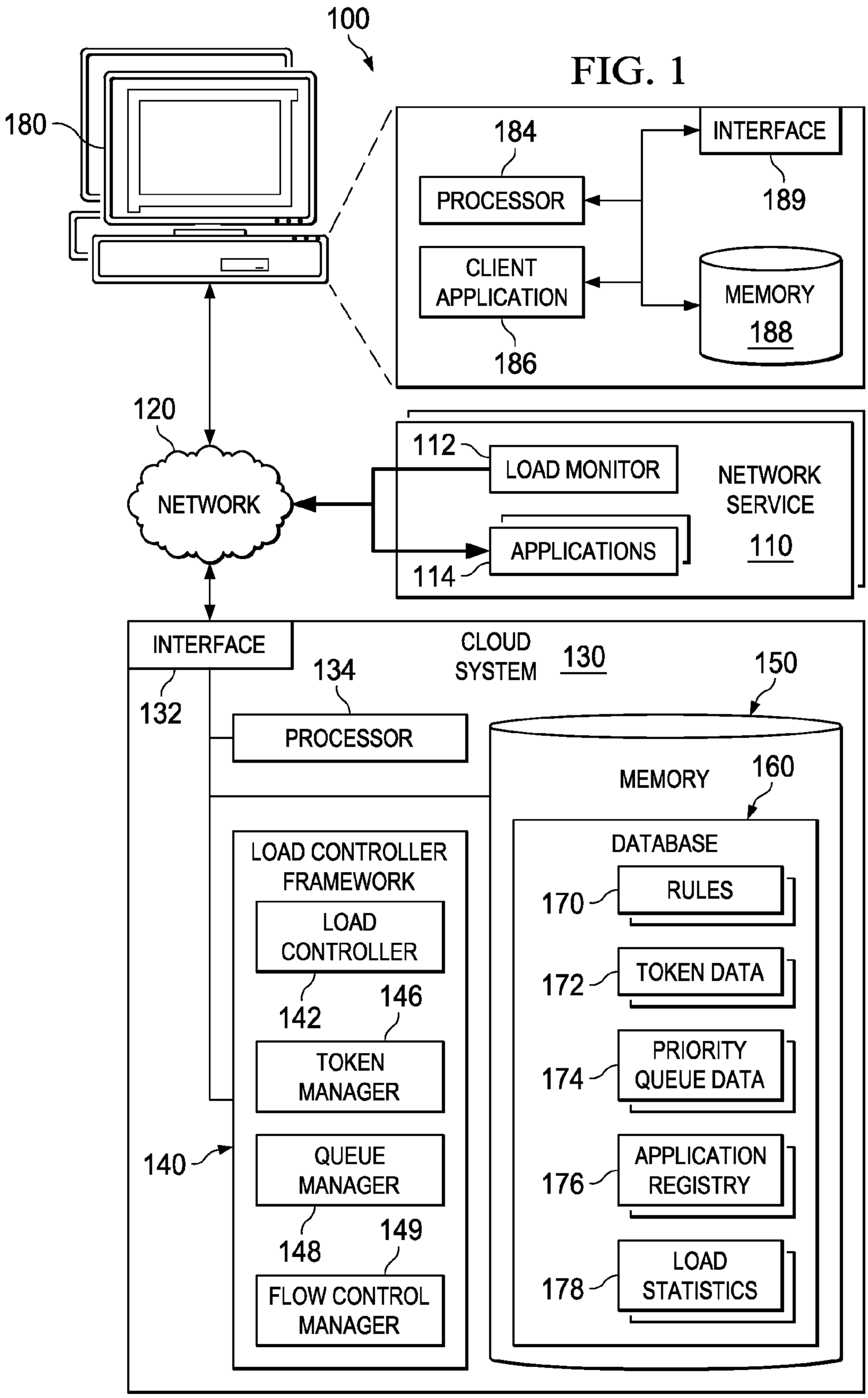
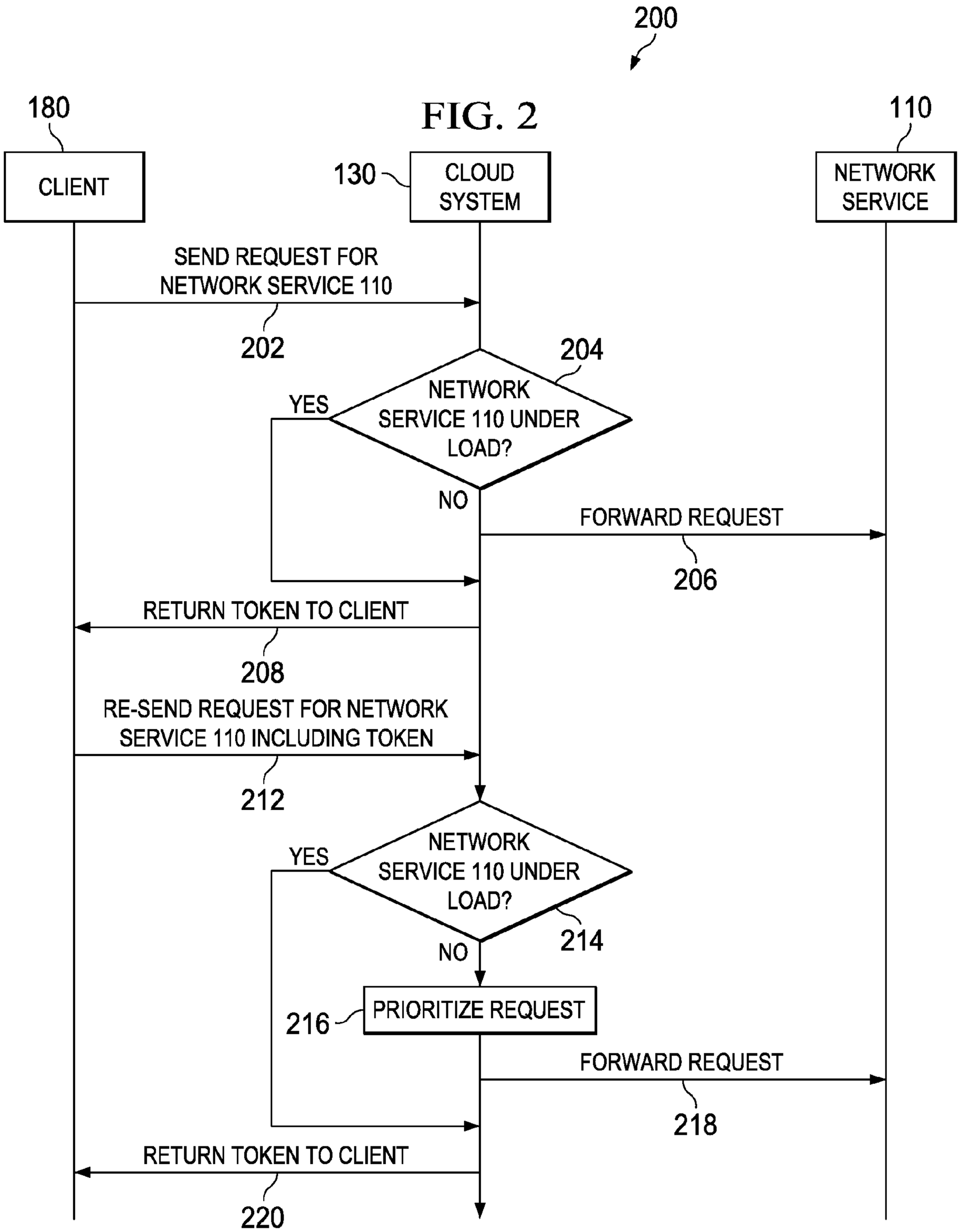

100
180
184
INTERFACE
PROCESSOR
189
CLIENT APPLICATION
MEMORY
188
186
120
NETWORK
112
LOAD MONITOR
NETWORK SERVICE
APPLICATIONS
110
114
INTERFACE
CLOUD SYSTEM 130
150
134
132
PROCESSOR
MEMORY
160
LOAD CONTROLLER FRAMEWORK
DATABASE
LOAD CONTROLLER
170
RULES
172
TOKEN DATA
142
146
TOKEN MANAGER
174
PRIORITY QUEUE DATA
140
QUEUE MANAGER
176
APPLICATION REGISTRY
148
149
178
LOAD STATISTICS
FLOW CONTROL MANAGER

FIG. 2


200
180
CLIENT
130
CLOUD SYSTEM
110
NETWORK SERVICE
SEND REQUEST FOR NETWORK SERVICE 110
202
204
NETWORK SERVICE 110 UNDER LOAD?
YES
NO
FORWARD REQUEST
206
RETURN TOKEN TO CLIENT
208
RE-SEND REQUEST FOR NETWORK SERVICE 110 INCLUDING TOKEN
212
NETWORK SERVICE 110 UNDER LOAD?
YES
NO
214
216
PRIORITIZE REQUEST
FORWARD REQUEST
218
RETURN TOKEN TO CLIENT
220

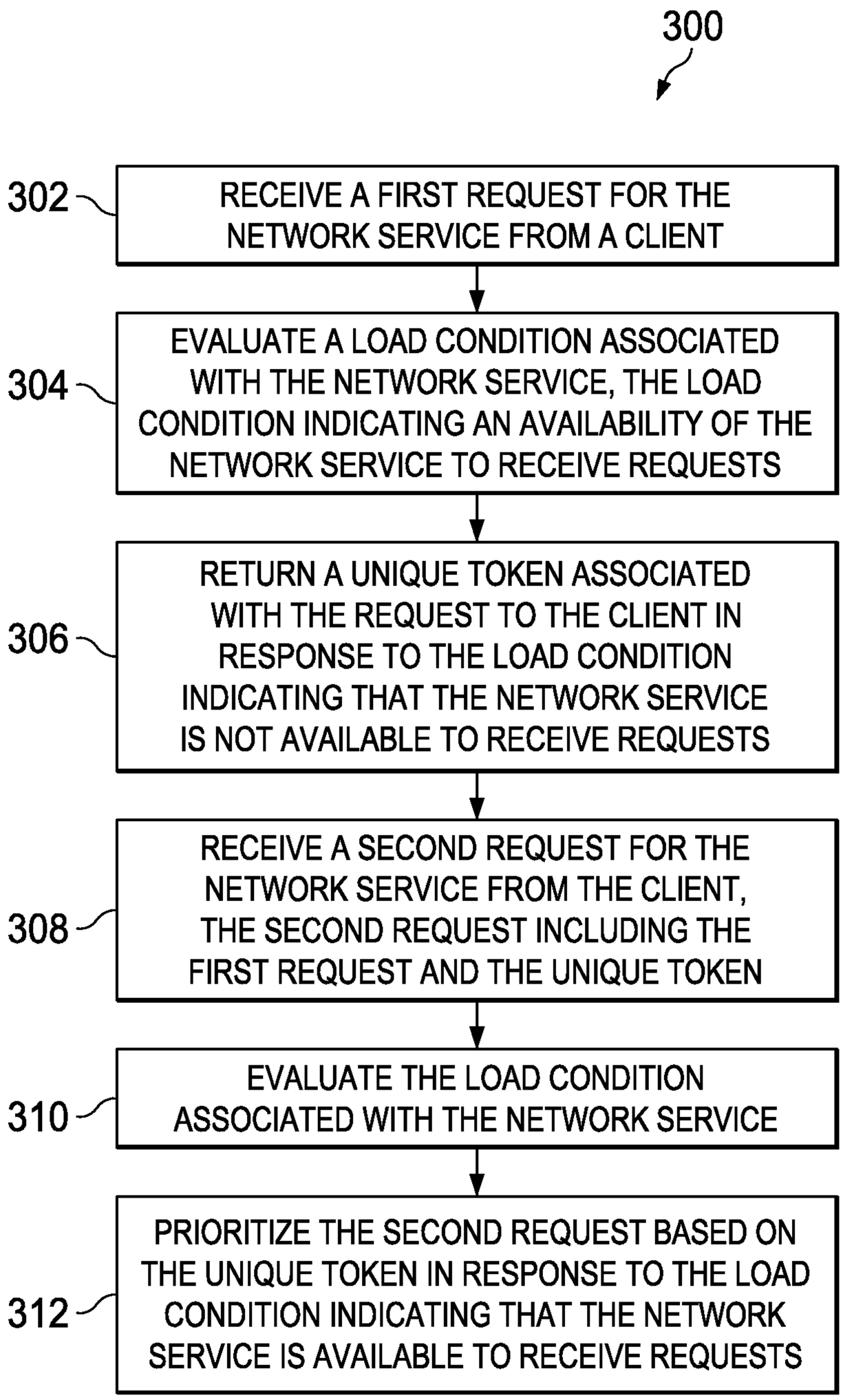

300
302
RECEIVE A FIRST REQUEST FOR THE NETWORK SERVICE FROM A CLIENT
304
EVALUATE A LOAD CONDITION ASSOCIATED WITH THE NETWORK SERVICE, THE LOAD CONDITION INDICATING AN AVAILABILITY OF THE NETWORK SERVICE TO RECEIVE REQUESTS
306
RETURN A UNIQUE TOKEN ASSOCIATED WITH THE REQUEST TO THE CLIENT IN RESPONSE TO THE LOAD CONDITION INDICATING THAT THE NETWORK SERVICE IS NOT AVAILABLE TO RECEIVE REQUESTS
308
RECEIVE A SECOND REQUEST FOR THE NETWORK SERVICE FROM THE CLIENT, THE SECOND REQUEST INCLUDING THE FIRST REQUEST AND THE UNIQUE TOKEN
310
EVALUATE THE LOAD CONDITION ASSOCIATED WITH THE NETWORK SERVICE
312
PRIORITIZE THE SECOND REQUEST BASED ON THE UNIQUE TOKEN IN RESPONSE TO THE LOAD CONDITION INDICATING THAT THE NETWORK SERVICE IS AVAILABLE TO RECEIVE REQUESTS

FIG. 3

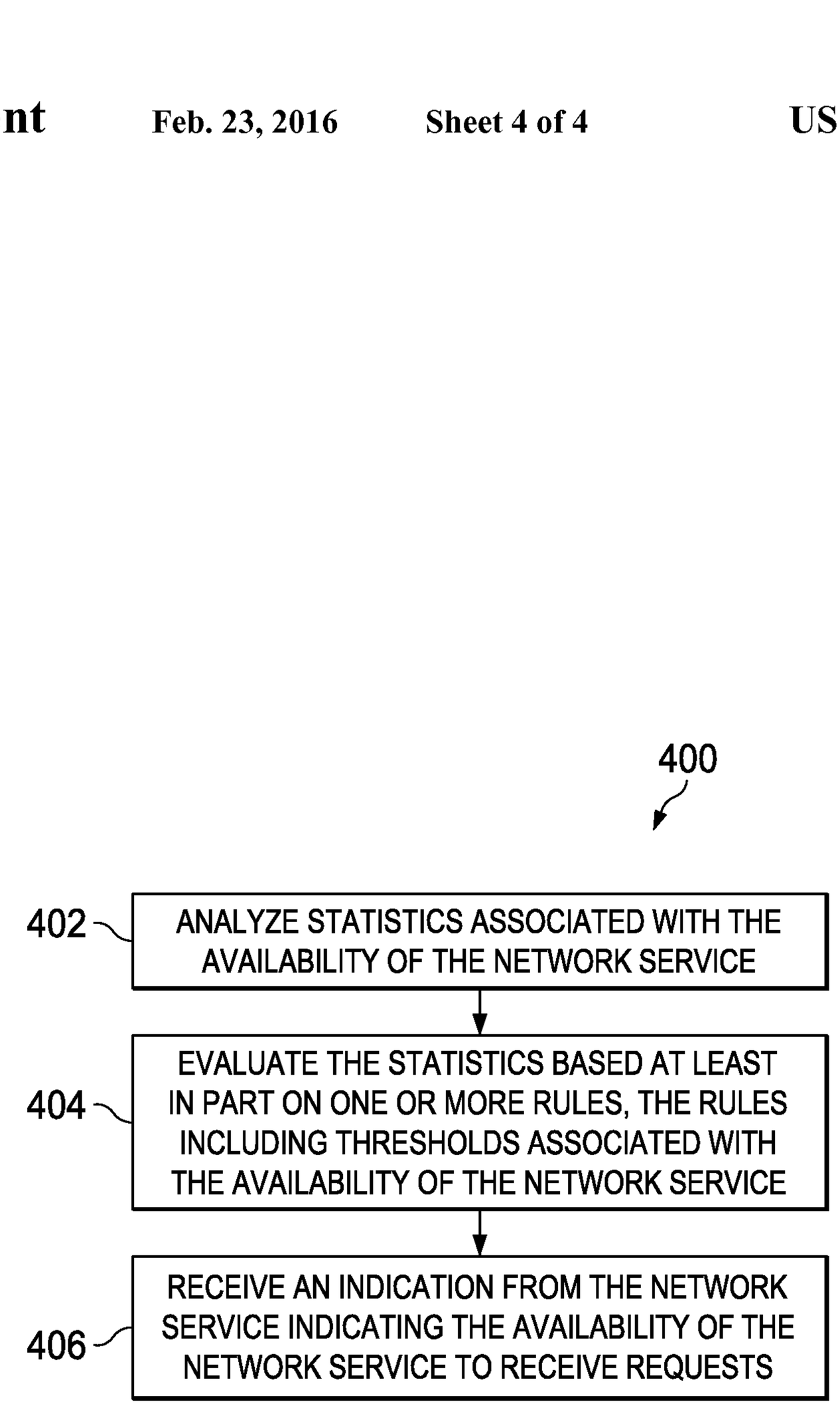

400
402
ANALYZE STATISTICS ASSOCIATED WITH THE AVAILABILITY OF THE NETWORK SERVICE
404
EVALUATE THE STATISTICS BASED AT LEAST IN PART ON ONE OR MORE RULES, THE RULES INCLUDING THRESHOLDS ASSOCIATED WITH THE AVAILABILITY OF THE NETWORK SERVICE
406
RECEIVE AN INDICATION FROM THE NETWORK SERVICE INDICATING THE AVAILABILITY OF THE NETWORK SERVICE TO RECEIVE REQUESTS

FIG. 4

LOAD CONTROLLER FRAMEWORK

TECHNICAL FIELD

The present disclosure involves systems, software, and computer-implemented methods for controlling service load in a cloud-based system.

BACKGROUND

Cloud-based systems are generally distributed systems including multiple components connected by a network. Cloud-based systems may be used to implement network services that receive requests from clients and provide responses over a network. Load conditions associated with the network services may cause the services to be unavailable to process requests from clients.

SUMMARY

The present disclosure involves systems, software, and computer-implemented methods for controlling application load in a cloud-based system. In one general aspect, an example method includes receiving a first request for the network service from a client, evaluating a load condition associated with the network service, the load condition indicating an availability of the network service to receive requests, returning a unique token associated with the first request to the client in response to the load condition indicating that the network service is not available to receive the requests, receiving a second request for the network service from the client, the second request including at least a portion of the first request and the unique token, evaluating the load condition associated with the network service, and prioritizing the second request based on the unique token in response to the load condition indicating that the network service is available to receive the requests.

While generally described as computer-implemented software embodied on non-transitory, tangible media that processes and transforms the respective data, some or all of the aspects may be computer-implemented methods or further included in respective systems or other devices for performing this described functionality. The details of these and other aspects and implementations of the present disclosure are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the disclosure will be apparent from the description and drawings, and from the claims.

DESCRIPTION OF DRAWINGS

FIG. **1** is a block diagram illustrating an example system for controlling service load in a cloud-based system.

FIG. **2** is a message flow diagram showing example interactions between a client, a cloud system, and a network service for controlling service load.

FIG. **3** is a flowchart of an example method for controlling service load in a cloud-based system.

FIG. **4** is a flowchart of an example method for evaluating a load condition associated with a network service.

DETAILED DESCRIPTION

The present disclosure involves systems, software, and computer-implemented methods for controlling service load in a cloud-based system.

Many applications utilize cloud-based systems to retrieve business data from network services. The network services may be integrated into the cloud system or implemented on computing devices external to the cloud system. For example, an enterprise resource planning (ERP) service associated with a customer may be hosted on the customer premise (e.g., an "on-premise system"), where access to the service may be brokered by the cloud system. By allowing network access to services hosted on such on-premise systems, a high risk that too many requests may overload the on-premise system exists. For example, an on-premise system may not be able to process as many requests as a cloud system due to lack of processing power or network bandwidth. Such overloading may lead to the network service responding slowly to requests for data or may slow down company critical processes on the on-premise systems. In addition to on-premise systems, components and services within the cloud system may also be subject to the same type of overloading.

The present solution provides a cloud-based solution that protects network services from being overloaded by requests. Client requests for network services are brokered by the cloud system, which in turn controls the volume of requests being sent to each network service. When a request for a certain network service is received, a load condition associated with the network service is evaluated to determine if the network service can process the request. If it is determined that the network service is not available to process requests at this time due to load, a unique token is returned to the client. The client may resubmit the request with this unique token to have the resubmitted request prioritized over other requests (submitted without their own respective unique token) if the network service is subsequently available. For example, if a client submits a request for an ERP service, the cloud system may evaluate a load condition associated with an ERP service. If it is determined that the ERP service is currently handling a number of requests greater than a pre-defined or dynamically determined load threshold, the cloud system may return the unique token to the client. The client may then resubmit the request with the unique token. If the ERP service is handling a number of requests less than the threshold when the resubmitted request is received, the resubmitted request may be prioritized above other requests that are currently pending for the ERP service. This prioritization may be implemented by inserting the resubmitted request into a priority queue containing the request for the ERP service in an advanced position such that it will be processed sooner by the ERP service than other non-prioritized requests.

In some cases, the load condition may be evaluated by analyzing statistics associated with the network service to determine whether the network service is available. The load condition may also be evaluated by checking a status indication sent by the network service itself. For example, the network service may send a message to the cloud system to indicate that it is under load and cannot process anymore requests currently.

The present solution may provide several potential advantages. By providing a common framework through which network service load can be managed, developers of network services may be relieved of having to handle such load conditions thus simplifying the process of developing network services. Further, the token mechanism described above may provide greater performance to clients requesting network services that are under load than a standard retry algorithm, as subsequent retransmissions will be given greater priority.

FIG. **1** is a block diagram illustrating an example system for controlling service load in a cloud-based system. As shown, the example environment **100** includes a cloud system

130, one or more clients 180 connected to the cloud system 130 by a network 120, and a network service 110 connected to the cloud system 130 by the network 120. In operation, the cloud system 130 may receive a request from the client 180 for the network service 110. The cloud system 130 may evaluate a load condition associated with the network service 110 and, based on this evaluation, may return a token to the client 180 if the network service is currently under load. When the client 180 resubmits the request with this token, the cloud system 130 may analyze the token to determine how to prioritize the resubmitted request.

In the illustrated implementation, the example environment 100 includes a cloud system 130. At a high level, the cloud system 130 comprises an electronic computing device operable to broker requests between the client 180 and the network services 110 based on load conditions associated with the network services 110. The cloud system 130 may be a distributed system including different servers and components. In some implementations, the cloud system 130 may be a combination of hardware components and software components executing the order to broker the request from the client 180 for the network services 110. The cloud system 130 may also be the single computing device performing this brokering.

In some implementations, the cloud system 130 may be a web service that is accessible via standard web protocols, such as, for example, Hypertext Transfer Protocol (HTTP), Simple Object Access Protocol (SOAP), or any other suitable protocol or combination of protocols. In some cases, the cloud system 130 may provide an Application Programming Interface (API) through which one or more clients 180 may submit requests to the network services 110. In some implementations, this protocol may be specific to the individual network service, or maybe generalized for use with many network services.

As used in the present disclosure, the term "computer" is intended to encompass any suitable processing device. For example, although FIG. 1 illustrates a cloud system 130, environment 100 can be implemented using two or more servers, as well as computers other than servers, including a server pool. Indeed, cloud system 130 may be any computer or processing device such as, for example, a blade server, general-purpose personal computer (PC), Mac®, workstation, UNIX-based workstation, or any other suitable device. In other words, the present disclosure contemplates computers other than general purpose computers, as well as computers without conventional operating systems. Further, illustrated cloud system 130 may be adapted to execute any operating system, including Linux, UNIX, Windows, Mac OS®, Java™, Android™, iOS or any other suitable operating system. According to one implementation, cloud system 130 may also include or be communicably coupled with an e-mail server, a Web server, a caching server, a streaming data server, and/or other suitable server.

The cloud system 130 also includes an interface 132, a processor 134, and a memory 150. The interface 132 is used by the cloud system 130 for communicating with other systems in a distributed environment—including within the environment 100—connected to the network 120; for example, the clients 180, as well as other systems communicably coupled to the network 120 (not illustrated). Generally, the interface 132 comprises logic encoded in software and/or hardware in a suitable combination and operable to communicate with the network 120. More specifically, the interface 132 may comprise software supporting one or more communication protocols associated with communications such that the network 120 or interface's hardware is operable to communicate physical signals within and outside of the illustrated environment 100.

As illustrated in FIG. 1, the cloud system 130 includes a processor 134. Although illustrated as a single processor 134 in FIG. 1, two or more processors may be used according to particular needs, desires, or particular implementations of environment 100. Each processor 134 may be a central processing unit (CPU), a blade, an application specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or another suitable component. Generally, the processor 134 executes instructions and manipulates data to perform the operations of the cloud system 130. Specifically, the processor 134 may execute the functionality required to receive and respond to requests from the clients 180.

In the illustrated implementation, the cloud system 130 includes a load controller framework 140. In some implementations, the load controller framework 140 may be a software program or set of software programs operable to evaluate and control load conditions associated with the network services 110. The load controller framework 140 may also be any combination of hardware and software components operable to perform the described load control. The various components included in the load controller framework 140 and described below may also be software, hardware, or any combination of software and hardware components.

The load controller framework 140 may include a load controller 142. In operation, the load controller 142 may receive a request from the client 180 via the network 120. The load controller 142 may determine the network service 110 associated with the request and evaluate the current load condition of the network service 110. For example, the load controller 142 may analyze statistics associated with the network service 110 indicating a number of requests sent to the network service in a recent time period, a total amount of data sent to the network service 110 in the time period, a total number of outstanding requests that the network service 110 is currently processing, or any other suitable statistic. The load controller 142 may further analyze rules 170 to determine whether any of the statistics associated with the network service 110 are above thresholds specified by the rules 170 and thus indicate that the network service 110 is unavailable to process requests. For example, a rule 170 may indicate that the network service 110 may have a maximum of ten requests pending at any time. If the load controller 142 receives a request for the network service 110 while the network service 110 has ten requests pending, the load controller 142 may reject the request and issue a token to the requesting client.

In some cases, the load controller 142 may be operable to issue tokens for requests that cannot be processed at the current time by the network service 110. In some implementations, these tokens include a globally unique identifier (GUID) that uniquely identifies the token on the cloud system 130. When a client resubmits a request with a token, load controller 142 may consult the token manager 146 to determine how to handle the request. The token manager 146 may consult the token data 172 in the database 160 to determine statistics associated with the submitted token and may cause the request to be treated differently based on the statistics. For example, if the token data 172 indicates that a token has been resubmitted fifteen times and the network service 110 has been unavailable each time, such a request may be prioritized by the token manager 146 above a request associated with the token that has only been resubmitted once. By performing this prioritization, older requests are processed first when the network service 110 becomes available to process requests.

In some implementations, the load controller **142** may refuse requests for the network service **110** for an amount of time configured in the rules **170** if a load condition is observed. For example, a rule **170** may state that the network service **110** should not have any requests sent to it for one second after load condition is observed in order to give the condition time to clear.

In some implementations, the load controller **142** may examine a current load state of the network service **110** as indicated by the network service **110** itself, such as, for example, by sending flow control indications to the cloud system **130**. Such a flow control indication may be processed by the flow control manager **149** and stored in the database **160** for use by the load controller **142**.

In the illustrated implementation, the load controller framework **140** also includes a queue manager **148**. In some implementations, requests sent by the client **180** for the network service **110** may be entered into the priority queue and processed in order according to the queue. The queue manager **148** may be operable to push and pop requests onto and off of the priority queue based on the prioritization data generated by the load controller **142** and the token manager **146**. For example, the load controller **142** may instruct the queue manager **148** that a certain request be prioritized. The queue manager **148** may then insert the prioritized request at the front of the priority queue, such that it will be processed before all other pending requests.

The queue manager **148** may also be operable to clear all requests from the priority queue when a load condition associated with the network service **110** is detected. For example, if a flow control indication is received from the network service **110**, the queue manager **148** may remove all requests that are currently pending in the priority queue for the network service **110** and cause the load controller **142** to issue tokens for each request.

The load controller framework **140** may also include a flow control manager **149**. In some implementations, the flow control manager **149** is operable to receive a flow control indication from the network service **110** indicating that the network service **110** is currently unavailable due to load. For example, the network service **110** may detect that its processor is running at one hundred percent utilization and may generate a flow control indication in order to prevent additional requests from being sent to the network service **110**. The flow control manager **149** may receive this indication and may store an indication that the network service **110** is currently unavailable in the database **160**, such as in the load statistics **178**.

Regardless of the particular implementation, "software" may include computer-readable instructions, firmware, wired and/or programmed hardware, or any combination thereof on a tangible medium (transitory or non-transitory, as appropriate) operable when executed to perform at least the processes and operations described herein. Indeed, each software component may be fully or partially written or described in any appropriate computer language including C, C++, Java™, Visual Basic, assembler, Perl®, any suitable version of 4GL, as well as others. While portions of the software illustrated in FIG. **1** are shown as individual modules that implement the various features and functionality through various objects, methods, or other processes, the software may instead include a number of sub-modules, third-party services, components, libraries, and such, as appropriate. Conversely, the features and functionality of various components can be combined into single components as appropriate.

The cloud system **130** also includes a memory **150** or multiple memories **150**. The memory **150** may include any type of memory or database module and may take the form of volatile and/or non-volatile memory including, without limitation, magnetic media, optical media, random access memory (RAM), read-only memory (ROM), removable media, or any other suitable local or remote memory component. The memory **150** may store various objects or data, including caches, classes, frameworks, applications, backup data, business objects, jobs, web pages, web page templates, database tables, repositories storing business and/or dynamic information, and any other appropriate information including any parameters, variables, algorithms, instructions, rules, constraints, or references thereto associated with the purposes of the cloud system **130**. Additionally, the memory **150** may include any other appropriate data, such as VPN applications, firmware logs and policies, firewall policies, a security or access log, print or other reporting files, as well as others.

As illustrated in FIG. **1**, memory **150** includes or references data and information associated with and/or related to providing the network service load control. As illustrated, memory **150** includes a database **160**. The database **160** may be one of or a combination of several commercially available database and non-database products. Acceptable products include, but are not limited to, SAP® HANA DB, SAP® MaxDB, Sybase® ASE, Oracle® databases, IBM® Informix® databases, DB2, MySQL, Microsoft SQL Server®, Ingres®, PostgreSQL, Teradata, Amazon SimpleDB, and Microsoft® Excel, as well as other suitable database and non-database products. Further, database **160** may be operable to process queries specified in any structured or other query language such as, for example, Structured Query Language (SQL).

As shown, the database **160** includes one or more rules **170**. In some implementations, the rules **170** may specify thresholds for various statistics associated with the network service **110**. For example, a rule **170** may specify that more than ten pending requests for a certain network service indicates that the network service is unavailable. The rules **170** may also specify actions to take when a network service **110** is observed to be under load. These actions may include, but are not limited to, issuing tokens for all requests until the load condition passes, issuing tokens for all requests for a certain amount of time, resetting the network service **110**, or any other suitable action. As discussed previously, the rules **170** may be interpreted by the load controller **142** in order to determine how to broker requests. In some implementations, each rule **170** may be associated with one of the network services **110**. Each rule **170** may also be associated with two or more network services **110**.

In some implementations, the one or more rules **170** may be statically defined such that the rules **170** specify numeric values for various statistical thresholds associated with the network service **110**. The one or more rules **170** may also be determined dynamically based on runtime conditions associated with the network service **110**. For example, the one or more rules **170** may state that the network service **110** can have ten pending requests if a server associated with the network service **110** has a central processing unit (CPU) utilization less than ninety percent.

The database **160** also includes token data **172**. The token data **172** may include a record for each token that has been issued for a request. In some implementations, the token data **172** may include a record for both pending tokens and tokens that have already been used to resubmit a request. Each record included in the token data **172** may include the GUID associated with the token, as well as an indication of the client to whom the token has been issued. The token data **172** may

include statistics associated with tokens issued by the load controller **142** for requests that cannot be processed due to load. For example, the token data **172** may indicate the number of times the token has been resubmitted which indicates the number of times the associated request has failed.

In the illustrated implementation, the database **160** includes priority queue data **174**. In some cases, the priority queue data **174** includes an ordered list of pending requests for each network service **110**. The priority queue data **174** may be updated by the queue manager **148** in order to affect prioritization of requests.

The illustrated database **160** includes an application registry **176**. In some implementations, the application registry **176** includes information about the network services **110** that registered with the cloud system **130** to have requests brokered by the load controller framework **140**. In some cases, the application registry **176** may be populated according to a request received from the network services **110**, such as through an API. Where a request is received by the cloud system **130**, the load controller framework **140** may check the application registry **176** to determine whether it should broker the request for the particular network service **110**.

As shown, the database **160** includes load statistics **178**. In some implementations, the load statistics **178** may include current load statistics associated with each of the network services **110**. The load controller **142** may consult the load statistics **178** to determine whether the each of the network services **110** is currently under load. In some cases, the load statistics **178** may include historical load statistics for each of the network services **110**, such that previous load behavior may be analyzed.

The environment **100** may also include one or more network services **110**. In some implementations, the network services **110** may be services connected to the cloud system **130** by the network **120**. In operation, the network services **110** may receive requests from the clients **180** via the cloud system **130** and may provide responses to these requests to the clients **180** via the cloud system **130**. In some cases, the network services **110** may provide responses directly to the clients **180**, such that the cloud system **130** does not broker the responses.

In some implementations, the one or more network services **110** may be on-premise services implemented at a customer premise site separate from the cloud system **130**. The one or more network services **110** may also be an integrated component within the cloud system **130**.

As shown, the one or more network services **110** include one or more applications **114**. In some cases, the applications **114** may be software programs executed by the network service **110** and operable to perform analysis associated with the network service **110**. The one or more network services **110** may also include a load monitor **112** operable to analyze the current state of the network service **110** and send a flow control indication to the cloud system **130** if the network service **110** is under load. For example, the load monitor **112** may track the current bandwidth used by the network service **110** and send a flow control indication to the cloud system **130** if the current bandwidth used exceeds a configured threshold. In some implementations, at least a portion of the load monitor **112** may be located remotely from the network service **110**. In such a case, an agent or client of the load monitor **112** may monitor locally and share gathered information related to the network service **110** with a corresponding component located remotely from the network service **110**, such as, for example, in the cloud system **130**.

Illustrated client **180** is intended to encompass any computing device, such as a desktop computer, laptop/notebook computer, wireless data port, smart phone, personal data assistant (PDA), tablet computing device, one or more processors within these devices, or any other suitable processing device. For example, client **180** may comprise a computer that includes an input device, such as a keypad, touch screen, or other device that can accept user information and an output device that conveys information associated with the operation of the cloud system **130** or client **180** itself, including digital data, visual information, or a graphical user interface (GUI). Client **180** may include an interface **189**, a processor **184**, a memory **188** and a client application **186**. Client **180** may be used by a user to access the cloud system **130** to view or change items in the database **160**, such as rules **170**.

FIG. **2** is a message flow diagram showing an example interaction **200** between a client and a cloud system for controlling service load. For clarity of presentation, the description that follows generally describes interaction **200** in the context of FIG. **1**, and specifically, client **180**, cloud system **130**, and network service **110**. However, interaction **200** may be performed, for example, by any other suitable system, environment, software, and hardware, or a combination of systems, environments, software, and hardware, as appropriate. For example, one or more of the cloud system, the client, or other computing device (not illustrated) can be used to execute interaction **200** and obtain any data from the memory of the client, the cloud system, or the other computing device (not illustrated).

At **202**, the client **180** sends a request for the network service **110** to the cloud system **130**. In some implementations, the client **180** may send the request to the cloud system **130** over the network **120**. In some cases, the client **180** may send the request according to an API specific to the cloud system **130**.

At **204**, cloud system **130** determines if the network service **110** is under load. In some cases, the cloud system **130** make this determination by examining load statistics associated with the network service **110** as discussed relative to FIG. **1**. If the cloud system **130** determines the network service **110** is not under load, the flow continues to **206**, where the cloud system **130** forwards the request to the network service **110**. If the cloud system **130** determines at **204** that the network service **110** is under load, the flow continues to **208**, where the cloud system **130** returns the token to the client **180**.

At **212**, the client **180** resends the request for the network service **110** including the token returned by the cloud system **130** at **208**. In some implementations, the client **180** may wait for a certain amount of time before resending the request. The client **180** may also resend the request immediately upon receiving the token from the cloud system **130**.

At **214**, the cloud system **130** determines whether the network service **110** is under load. For example, the cloud system **130** may determine that the network service **110** is under load by examining the current statistics associated with the network service **110**, such as a number of pending requests, an average response time for recent requests, or any other suitable statistic. The cloud system **130** may also determine that the network service **110** is under load based on a flow control indication previously received from the network service **110**, as discussed relative to FIG. **1**.

If the network service **110** is not under load, the flow continues to **216**, where the resubmitted request is prioritized. In some implementations, prioritizing the request includes analyzing token data associated with the token to determine how to prioritize the request. For example, the cloud system **130** may examine the token data **172** to determine a number of times the token has been resubmitted and prioritize the request accordingly. At **218**, the request is forwarded to the

network service **110**. Forwarding the request may occur immediately or may occur after a certain amount of time if other higher priority requests are already pending.

If the network service **110** is determined to be under load at **214**, the flow continues to **220** where the token is again returned to the client. In some implementations, the token returned to the client at **220** is identical to the token returned at **208**. The token may also be updated to be different with each subsequent retransmission. The cloud system **130** may also update the token data associated with the token in the database **160** to reflect that the token has been resubmitted.

FIG. **3** is a flowchart of an example method **300** for controlling service load in a cloud-based system. For clarity of presentation, the description that follows generally describes method **300** in the context of FIG. **1**. However, method **300** may be performed, for example, by any other suitable system, environment, software, and hardware, or a combination of systems, environments, software, and hardware, as appropriate. For example, one or more of the cloud system, the client, or other computing device (not illustrated) can be used to execute method **300** and obtain any data from the memory of the client, the cloud system, or the other computing device (not illustrated).

At **302**, a first request for the network service is received from a client. In some implementations, the first request may be a request that has not been previously submitted by the client. In some cases, the first request may be received over a network from the client. The first request may be received according to an API associated with the method **300** or the associated network service.

At **304**, a load condition associated with the network service is evaluated, the load condition indicating an availability of the network service to receive requests. In some implementations, the load condition is evaluated according to the techniques previously described relative to FIG. **1**. At **306**, a unique token associated with the request is returned to the client in response to the load condition indicating that the network service is not available to receive requests. The unique token may include a GUID to distinguish it from other tokens and may have a record associated with it stored in a database (e.g., **160**).

At **308**, a second request for the network service is received from the client, where the second request includes at least a portion of the first request and the unique token. In some implementations, the second request includes the first request in its entirety with the unique token inserted into the body of the request. The second request may also include a container message including a field for the first request and the unique token. In some implementations, the second request may include any suitable portion of the first request or a reference to the first request.

At **310**, the load condition associated with the network service is evaluated. At **312**, the second request is prioritized based on the unique token in response to the load condition indicating that the network service is available to receive requests. In some implementations, the prioritization is performed as described relative to FIG. **1**

FIG. **4** is a flowchart of an example method **400** for evaluating a load condition associated with a network service. For clarity of presentation, the description that follows generally describes method **400** in the context of FIG. **1**. However, method **400** may be performed, for example, by any other suitable system, environment, software, and hardware, or a combination of systems, environments, software, and hardware, as appropriate. For example, one or more of the cloud system, the client, or other computing device (not illustrated) can be used to execute method **400** and obtain any data from the memory of the client, the cloud system, or the other computing device (not illustrated).

At **402**, statistics associated with the availability of the network service are analyzed. At **404**, the statistics are evaluated based at least in part on one or more rules, the rules including thresholds associated with the availability of the network service. In some implementations, the one or more rules are statically defined. The one or more rules may also be dynamically specified based on runtime conditions associated with the network service, as discussed relative to FIG. **1**. At **406**, an indication is received from the network service indicating the availability of the network service to receive requests.

The preceding figures and accompanying description illustrate example processes and computer implementable techniques. Environment **100** (or its software or other components) contemplates using, implementing, or executing any suitable technique for performing these and other tasks. These processes are for illustration purposes only and that the described or similar techniques may be performed at any appropriate time, including concurrently, individually, or in combination. In addition, many of the steps in these processes may take place simultaneously, concurrently, and/or in different order than as shown. Moreover, environment **100** may use processes with additional steps, fewer steps, and/or different steps, so long as the methods remain appropriate.

In other words, although this disclosure has been described in terms of certain implementations and generally associated methods, alterations and permutations of these implementations and methods will be apparent to those skilled in the art. Accordingly, the above description of example implementations does not define or constrain this disclosure. Other changes, substitutions, and alterations are also possible without departing from the spirit and scope of this disclosure.

What is claimed is:

1. A computer-implemented method executed by one or more processors, the method performed at a load controller of a cloud-based network system, the method comprising:

receiving a first request for a network service from a client, wherein the load controller is separate from the network service;

evaluating a load condition associated with the network service, the load condition indicating an availability of the network service to receive requests, based at least in part on a determination of whether a flow control indication is received by the load controller from the network service indicating that the network service is currently unavailable to receive the requests due to load;

returning a unique token associated with the first request to the client in response to the load condition indicating that the network service is not available to receive the requests, wherein the unique token is associated with a unique identifier and wherein an entry to a token database at the load controller associated with the unique token is entered, the entry at the token database including a set of statistics associated with the token including a number of times the unique token has been submitted to the load controller;

after returning the unique token to the client, receiving a second request for the network service from the client, the second request including at least a portion of the first request and the unique token;

re-evaluating the load condition associated with the network service in response to receiving the second request;

prioritizing the second request based on the unique token in response to the load condition indicating that the network service is available to receive the requests, wherein

prioritizing the second request includes placing the second request into a queue with a plurality of other requests; and

in response to receiving a flow control indication after prioritizing the second request and prior to fulfilling the second request, removing at least the second request from the queue and returning the unique token to the client.

2. The method of claim **1**, where prioritizing the second request based on the unique token includes sending the second request to the network service before a third request that was received prior to the second request.

3. The method of claim **1**, wherein evaluating the load condition associated with the network service further comprises:

analyzing current statistics associated with the availability of the network service; and

evaluating the statistics based at least in part on one or more rules, the one or more rules including thresholds associated with the availability of the network service.

4. The method of claim **3**, wherein the one or more rules each include one or more actions to be taken when the statistics associated with the availability of the network service indicate that the network service is not available.

5. The method of claim **4**, wherein the one or more actions include at least one of: reducing a rate that requests are sent to the network service for a period of time or blocking access to the network service for a period of time.

6. The method of claim **3**, wherein the thresholds each include a time value indicating a period of time that the threshold is to be used in evaluating the statistics.

7. The method of claim **3**, wherein the current statistics associated with the availability of the network service include at least one of a number of requests sent to the network service in a recent time period, a total amount of data sent to the network service in the recent time period, and a total number of outstanding requests that the network service is currently processing.

8. The method of claim **1**, wherein evaluating the load condition associated with the network service further comprises receiving an indication from the network service indicating the availability of the network service to receive requests.

9. The method of claim **1**, wherein the network service is a network service in the cloud-based network system.

10. The method of claim **1**, wherein the network service is a customer-premise network service separate from the cloud-based network system.

11. A computer program product encoded on a tangible, non-transitory storage medium, the product comprising computer readable instructions for causing one or more processors to perform operations comprising:

receiving, at a load controller of a cloud-based network system, a first request for a network service from a client, wherein the load controller is separate from the network service;

evaluating a load condition associated with the network service, the load condition indicating an availability of the network service to receive requests, based at least in part on a determination of whether a flow control indication is received by the load controller from the network service indicating that the network service is currently unavailable to receive the requests due to load;

returning a unique token associated with the first request to the client in response to the load condition indicating that the network service is currently unavailable to receive the requests, wherein the unique token is associated with a unique identifier and wherein an entry to a token database at the load controller associated with the unique token is entered, the entry at the token database including a set of statistics associated with the token including a number of times the unique token has been submitted to the load controller;

after returning the unique token to the client, receiving a second request for the network service from the client, the second request including at least a portion of the first request and the unique token;

re-evaluating the load condition associated with the network service in response to receiving the second request; and

prioritizing the second request based on the unique token in response to the load condition indicating that the network service is available to receive the requests, wherein prioritizing the second request includes placing the second request into a priority queue, the priority queue separate from a standard queue used for requests received without an included unique token, and wherein the priority queue is prioritized over the standard queue; and

in response to receiving a flow control indication after prioritizing the second request and prior to fulfilling the second request, removing at least the second request from the priority queue and returning the unique token to the client.

12. The computer program product of claim **11**, where prioritizing the second request based on the unique token includes sending the second request to the network service before a third request that was received prior to the second request.

13. The computer program product of claim **11**, wherein in response to determining that the network service is currently unavailable to receive the requests due to load, one or more rules are evaluated to determine one or more actions to be taken when the network service is currently unavailable, wherein the one or more actions include at least one of: reducing a rate that requests are sent to the network service for a period of time or blocking access to the network service for a period of time.

14. The computer program product of claim **11**, wherein the network service is a network service in the cloud-based network system.

15. The computer program product of claim **11**, wherein the network service is a customer-premise network service separate from the cloud-based network system.

16. A system, comprising:

memory for storing data; and

one or more processors operable to perform operations comprising:

receiving, at a load controller of a cloud-based network system, a first request for a network service from a client, wherein the load controller is separate from the network service;

evaluating a load condition associated with the network service, the load condition indicating an availability of the network service to receive requests, based at least in part on a determination of whether a flow control indication is received by the load controller from the network service indicating that the network service is currently unavailable to receive the requests due to load;

returning a unique token associated with the first request to the client in response to the load condition indicating that the network service is not available to receive the requests, wherein the unique token is associated

with a unique identifier and wherein an entry to a token database at the load controller associated with the unique token is entered, the entry at the token database including a set of statistics associated with the token including a number of times the unique token has been submitted to the load controller;

after returning the unique token to the client, receiving a second request for the network service from the client, the second request including at least a portion of the first request and the unique token;

re-evaluating the load condition associated with the network service in response to receiving the second request;

prioritizing the second request based on the unique token in response to the load condition indicating that the network service is available to receive the requests, wherein prioritizing the second request includes placing the second request into a priority queue, the priority queue separate from a standard queue used for requests received without an included unique token, and wherein the priority queue is prioritized over the standard queue; and

in response to receiving a flow control indication after prioritizing the second request and prior to fulfilling the second request, removing at least the second request from the priority queue and returning the unique token to the client.

17. The system of claim **16**, where prioritizing the second request based on the unique token includes sending the second request to the network service before a third request that was received prior to the second request.

18. The system of claim **16**, further comprising prioritizing the second request among at least one other request received with an included unique token in the priority queue.

19. The system of claim **16**, wherein prioritizing the second request based on the unique token includes accessing the set of statistics associated with the unique token included with the second request and comparing those statistics to statistics associated with at least one other request received with an included unique token, wherein the second request is prioritized over the at least one other request based on a higher number of times the unique token included with the second request has been submitted to the load controller as compared to the number of times the unique token including with the at least one other request has been submitted to the load controller.

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