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(54) METHOD FOR DISTRIBUTING AND EXECUTING SERVICE LOGIC

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Publication Classification

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H04M 7/00 (2006.01)

(52) **U.S. Cl.** **379/221.08**

(57) **ABSTRACT**

A method of distributing and executing service logic across private and public networks for the generation and provision of telecommunication services is disclosed. The functionality and capabilities associated with both Intelligent Network (IN) and non-IN compliant elements of a public telecommunications system are abstracted using a set of control and informational parameters and variables which are associated with a given network element or network element category. A service creation and execution application programming interface provides access to a service creation and execution environment which is distributed in public network gateways, private network gateways, and in compatible software platforms. The distributed service creation and execution environment enable the generation, provisioning, and execution of applications across private and public telecommunication networks in order to provide novel telecommunication services via the serial or concurrent invocation of one or more distributed applications.

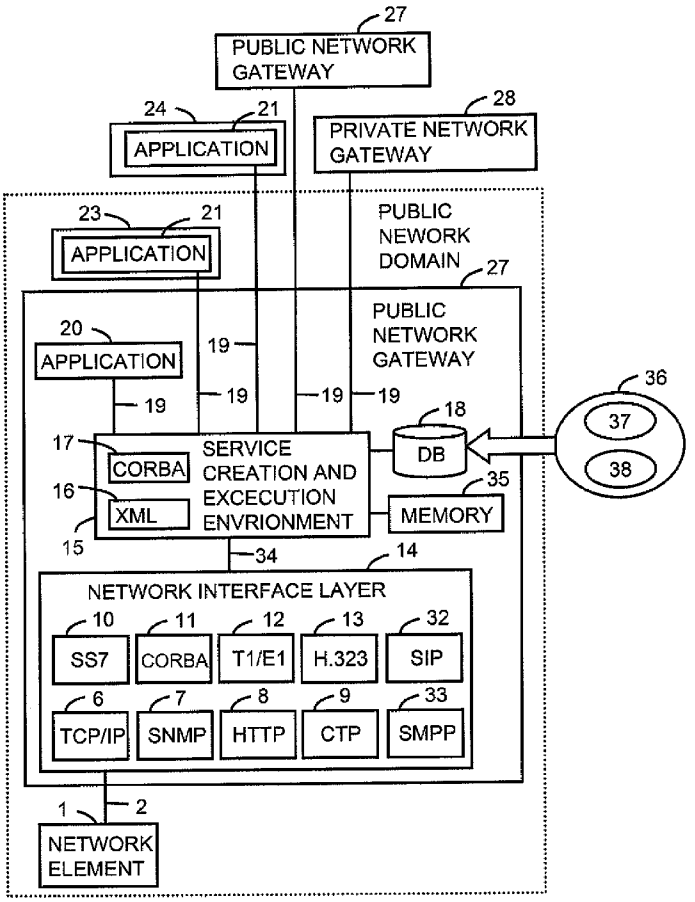
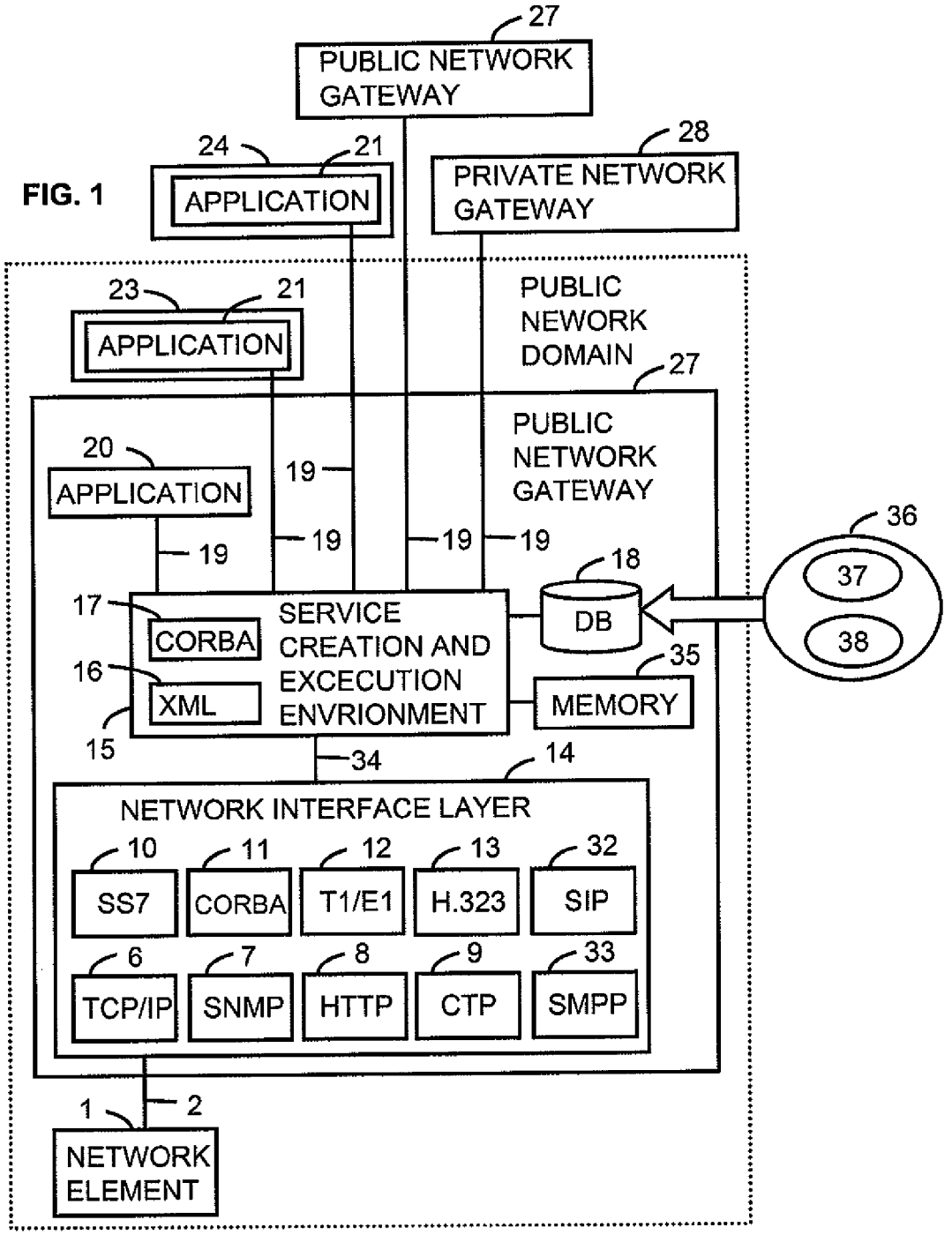


FIG. 1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PUBLIC NETWORK GATEWAY
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APPLICATION
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APPLICATION
PUBLIC NEWORK DOMAIN
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PUBLIC NETWORK GATEWAY
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APPLICATION
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CORBA
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XML
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SERVICE CREATION AND EXCECUTION ENVRIONMENT
35
MEMORY
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NETWORK INTERFACE LAYER
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SS7
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CORBA
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T1/E1
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H.323
32
SIP
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TCP/IP
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SNMP
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HTTP
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CTP
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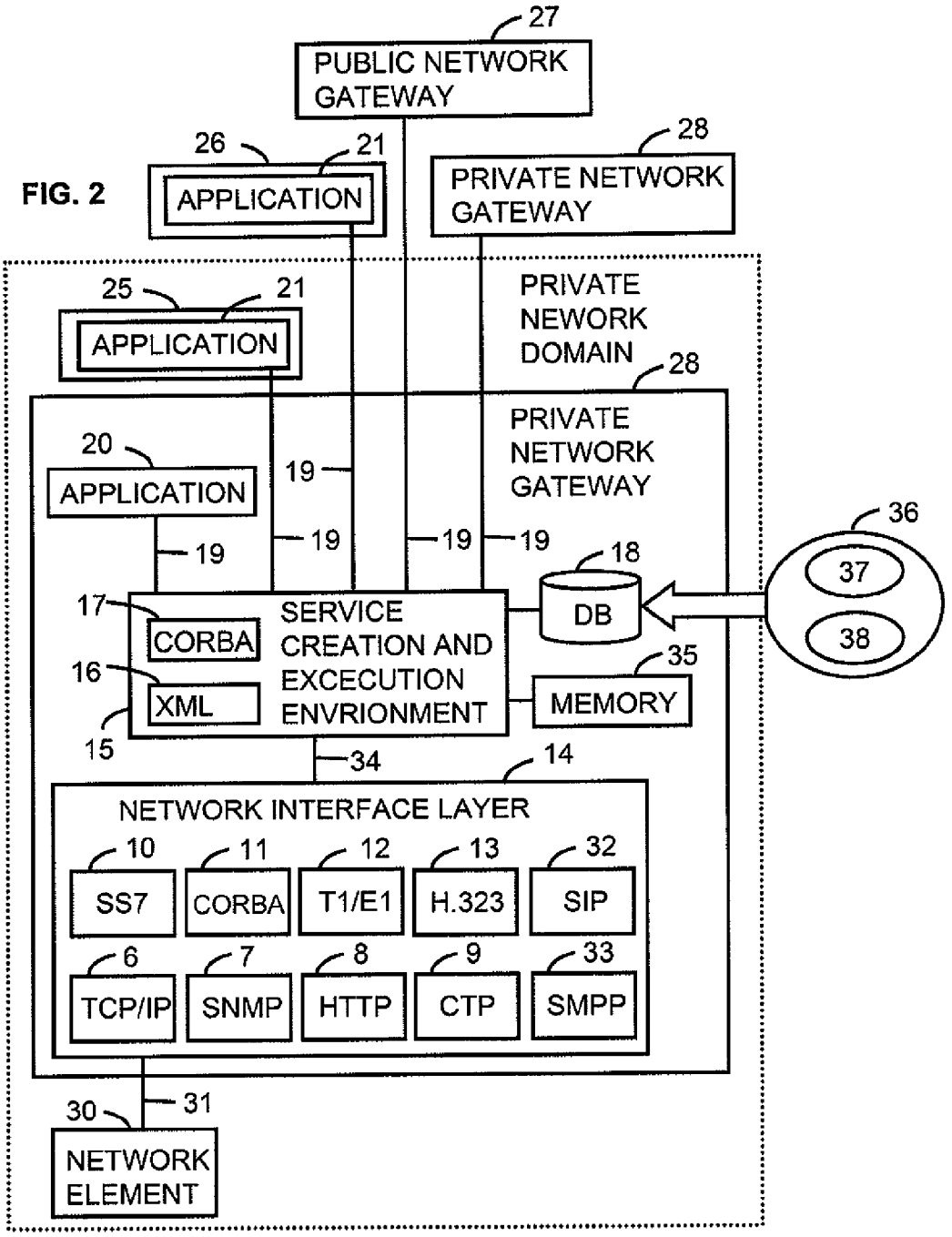
SMPP
1
2
NETWORK ELEMENT

FIG. 2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SERVICE CREATION AND EXCECUTION ENVRIONMENT
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NETWORK INTERFACE LAYER
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HTTP
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CTP
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SMPP
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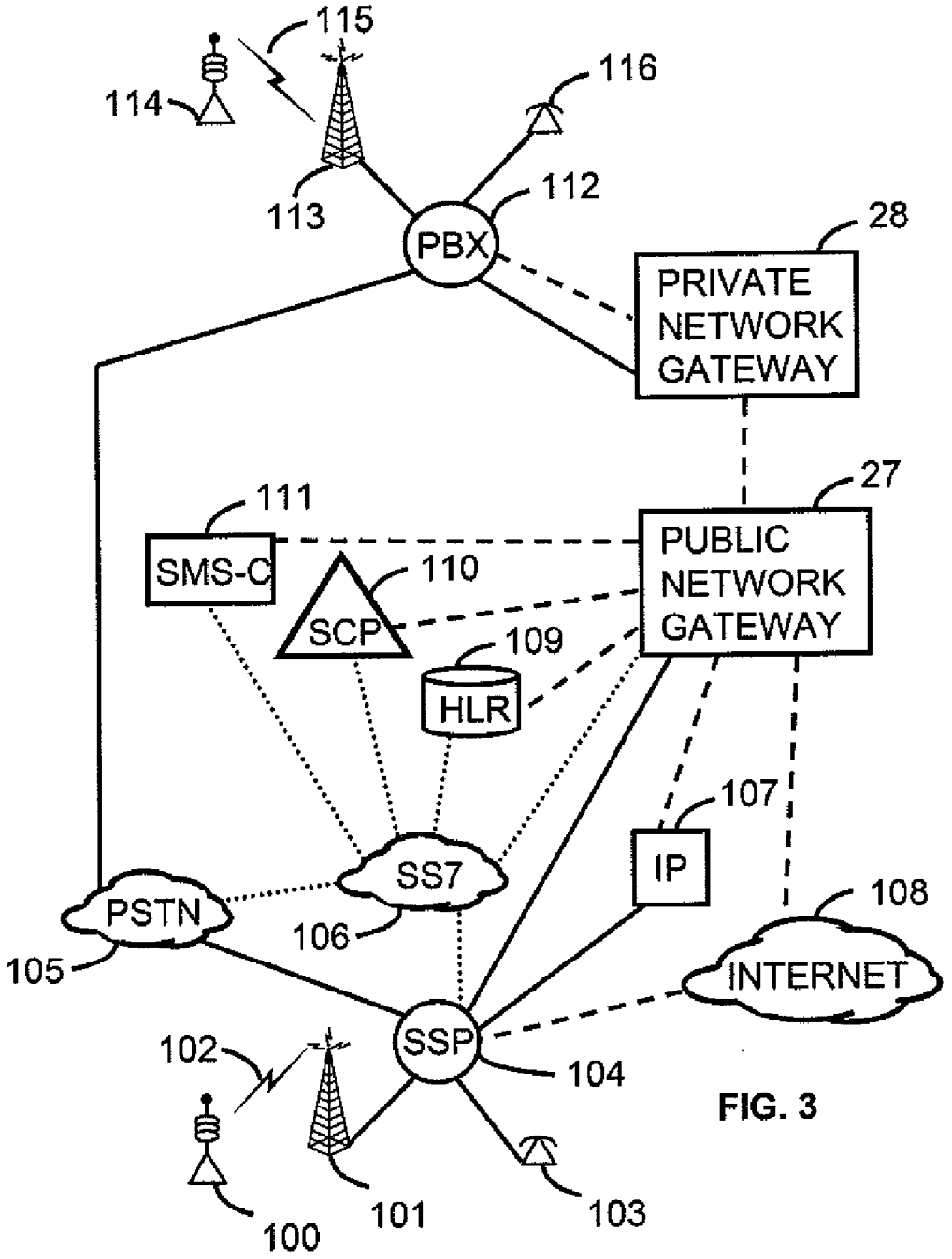
NETWORK ELEMENT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114
116
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112
PBX
28
PRIVATE NETWORK GATEWAY
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111
SMS-C
110
SCP
PUBLIC NETWORK GATEWAY
109
HLR
107
IP
SS7
108
PSTN
106
INTERNET
105
SSP
102
104
101
103
100
TRANSPORT FACILITY (E.G. ISDN, E1/T1)
SIGNALLING FACILITY (E.G. SS7, SCTP)
TCP/IP OR X.25

FIG. 3

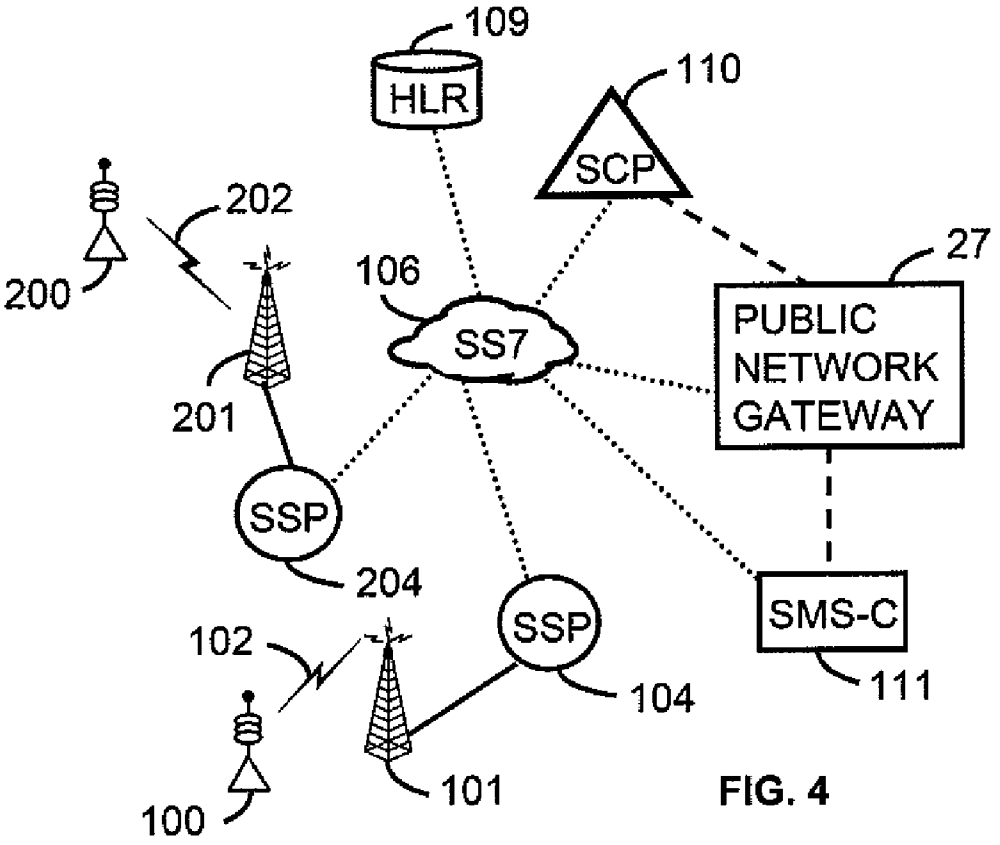
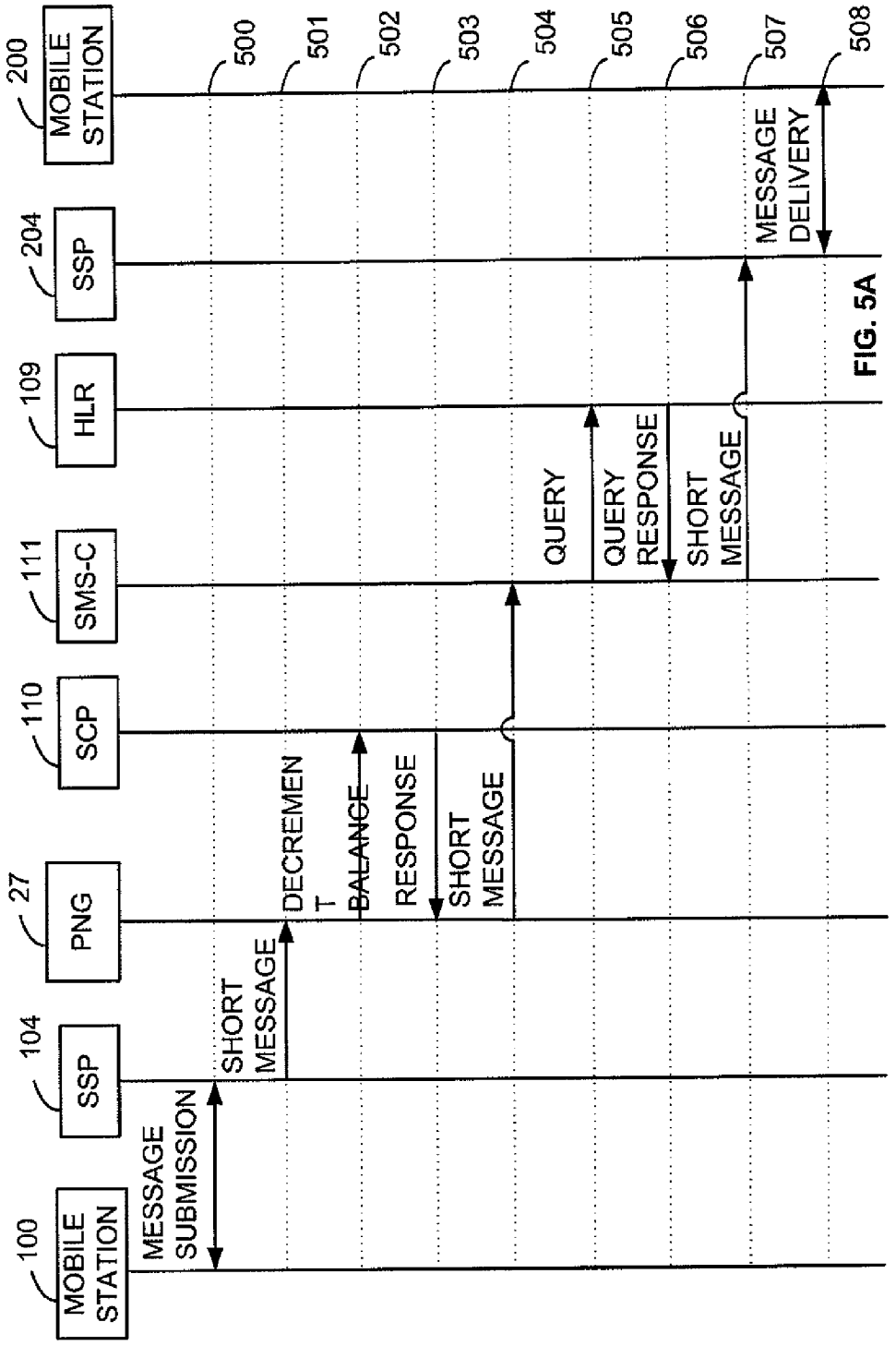


FIG. 4

——— TRANSPORT FACILITY (E.G. ISDN, E1/T1)

..... SIGNALLING FACILITY (E.G. SS7, SCTP)

- - - - TCP/IP OR X.25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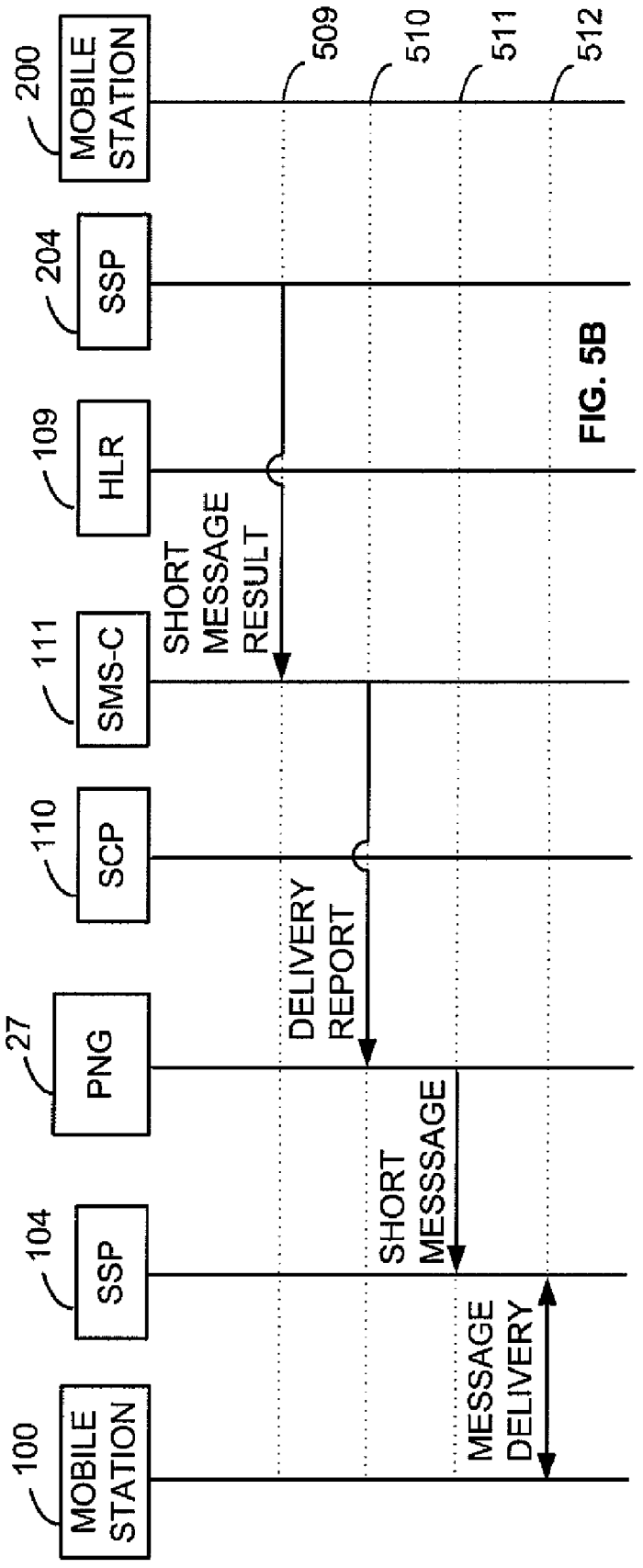
MOBILE STATION
104
SSP
27
PNG
110
SCP
111
SMS-C
109
HLR
204
SSP
200
MOBILE STATION
500
501
502
503
504
505
506
507
508
MESSAGE SUBMISSION
SHORT MESSAGE
DECREMENT BALANCE
RESPONSE
SHORT MESSAGE
QUERY
QUERY RESPONSE
SHORT MESSAGE
MESSAGE DELIVERY

FIG. 5A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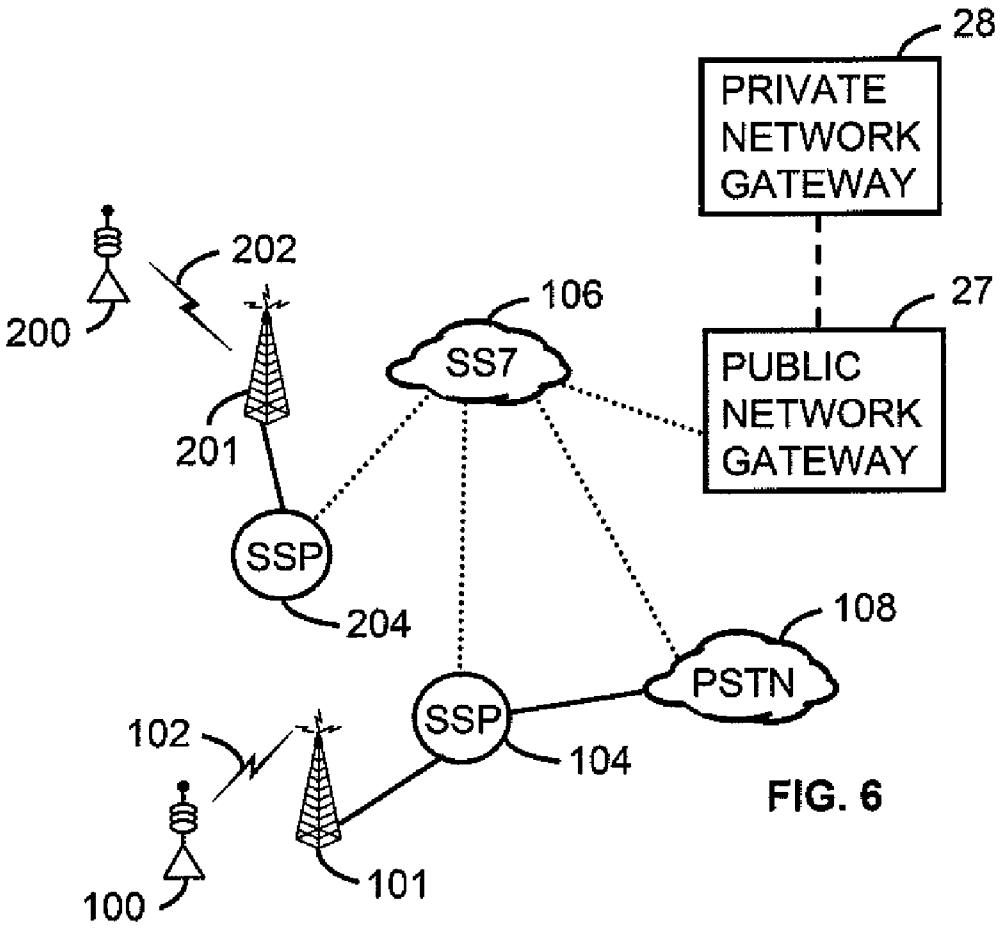
SSP
109
HLR
111
SMS-C
110
SCP
27
PNG
104
SSP
100
MOBILE STATION
509
510
511
512
SHORT MESSAGE RESULT
DELIVERY REPORT
SHORT MESSSAGE
MESSAGE DELIVERY

FIG. 5B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PRIVATE NETWORK GATEWAY
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PUBLIC NETWORK GATEWAY
106
SS7
202
200
201
SSP
204
108
PSTN
SSP
104
102
100
101
TRANSPORT FACILITY (E.G. ISDN, E1/T1)
SIGNALLING FACILITY (E.G. SS7, SCTP)
TCP/IP OR X.25

FIG. 6

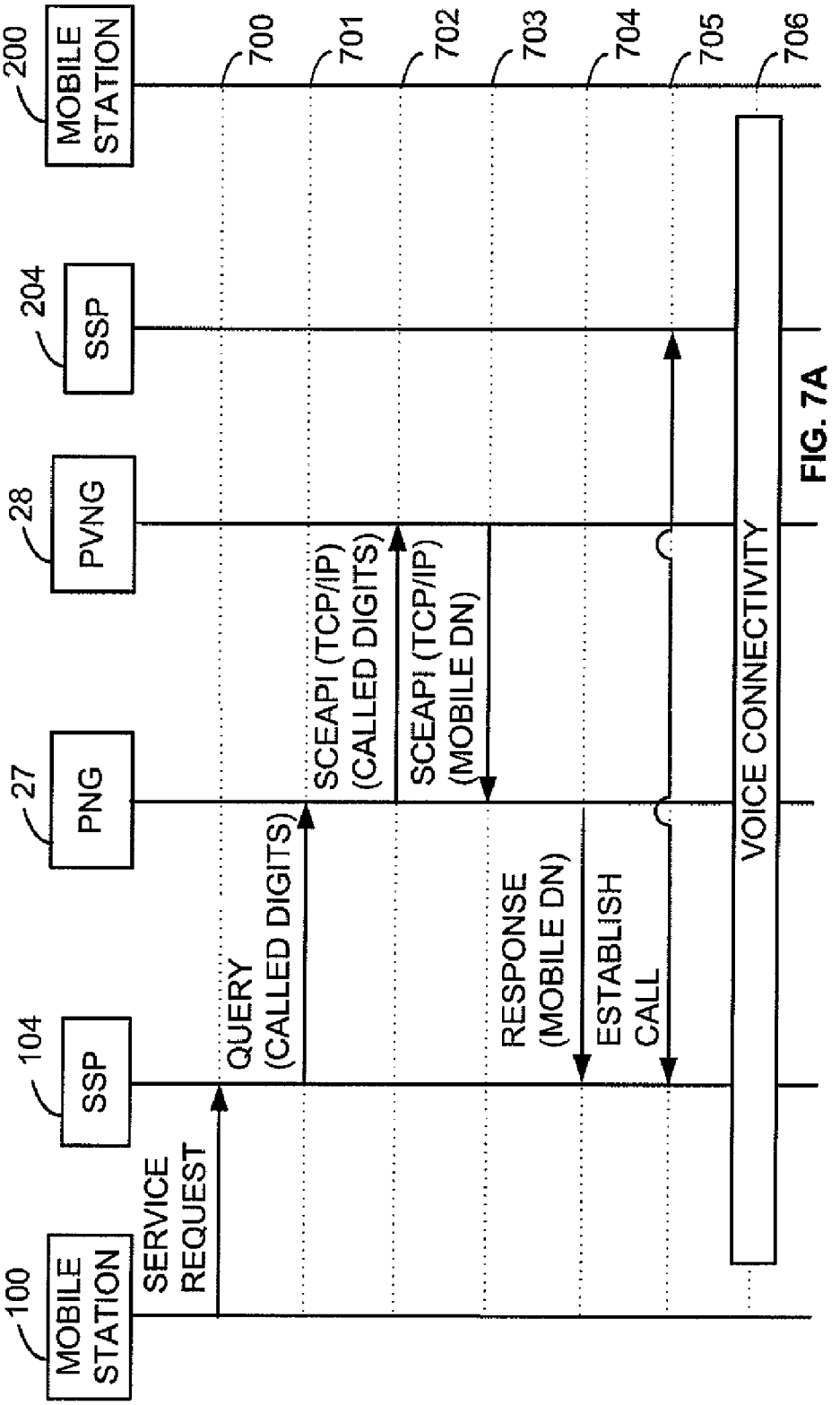
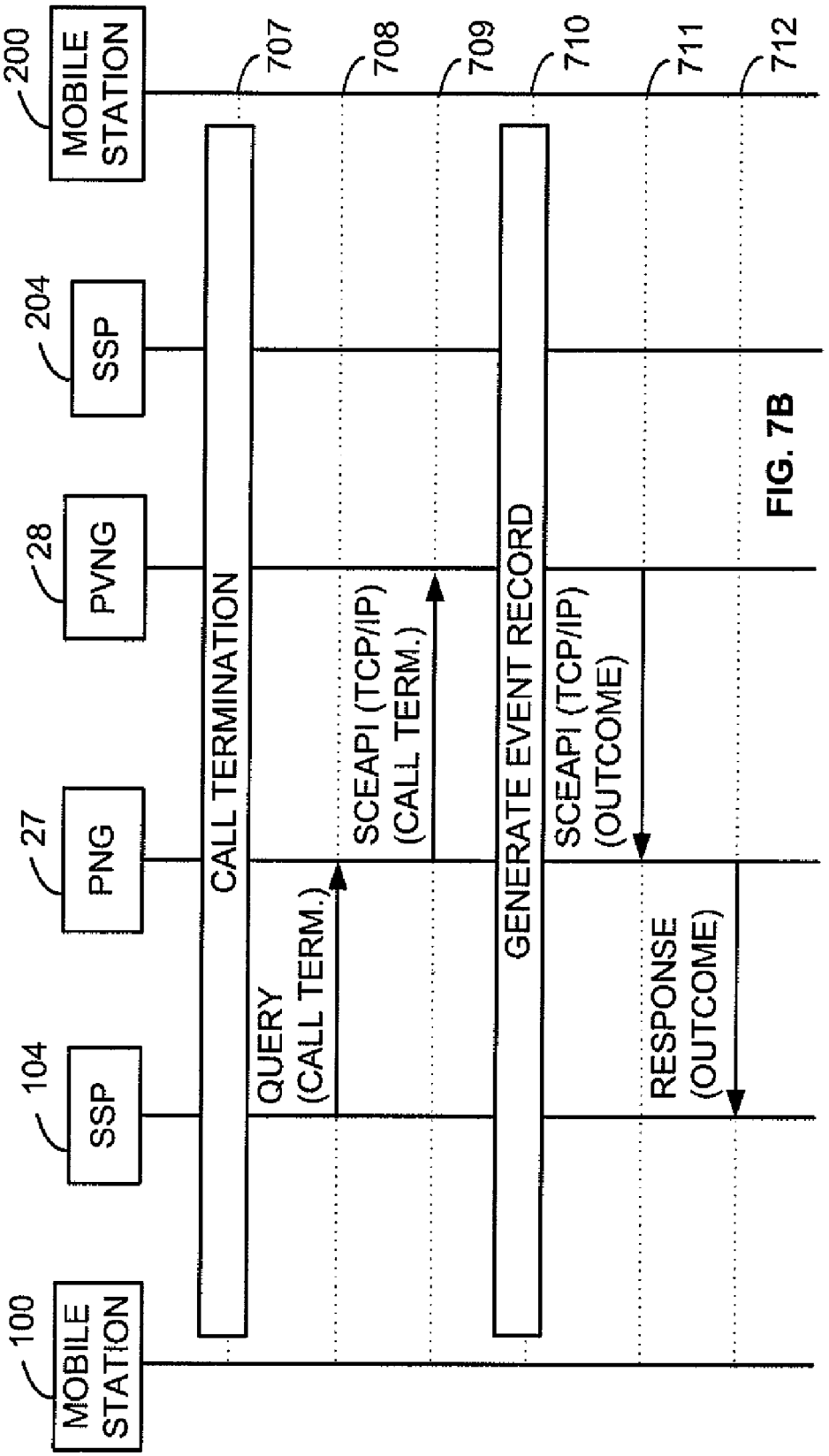

100
MOBILE STATION
104
SSP
27
PNG
28
PVNG
204
SSP
200
MOBILE STATION
700
701
702
703
704
705
706
SERVICE REQUEST
QUERY (CALLED DIGITS)
SCEAPI (TCP/IP) (CALLED DIGITS)
SCEAPI (TCP/IP) (MOBILE DN)
RESPONSE (MOBILE DN)
ESTABLISH CALL
VOICE CONNECTIVITY

FIG. 7A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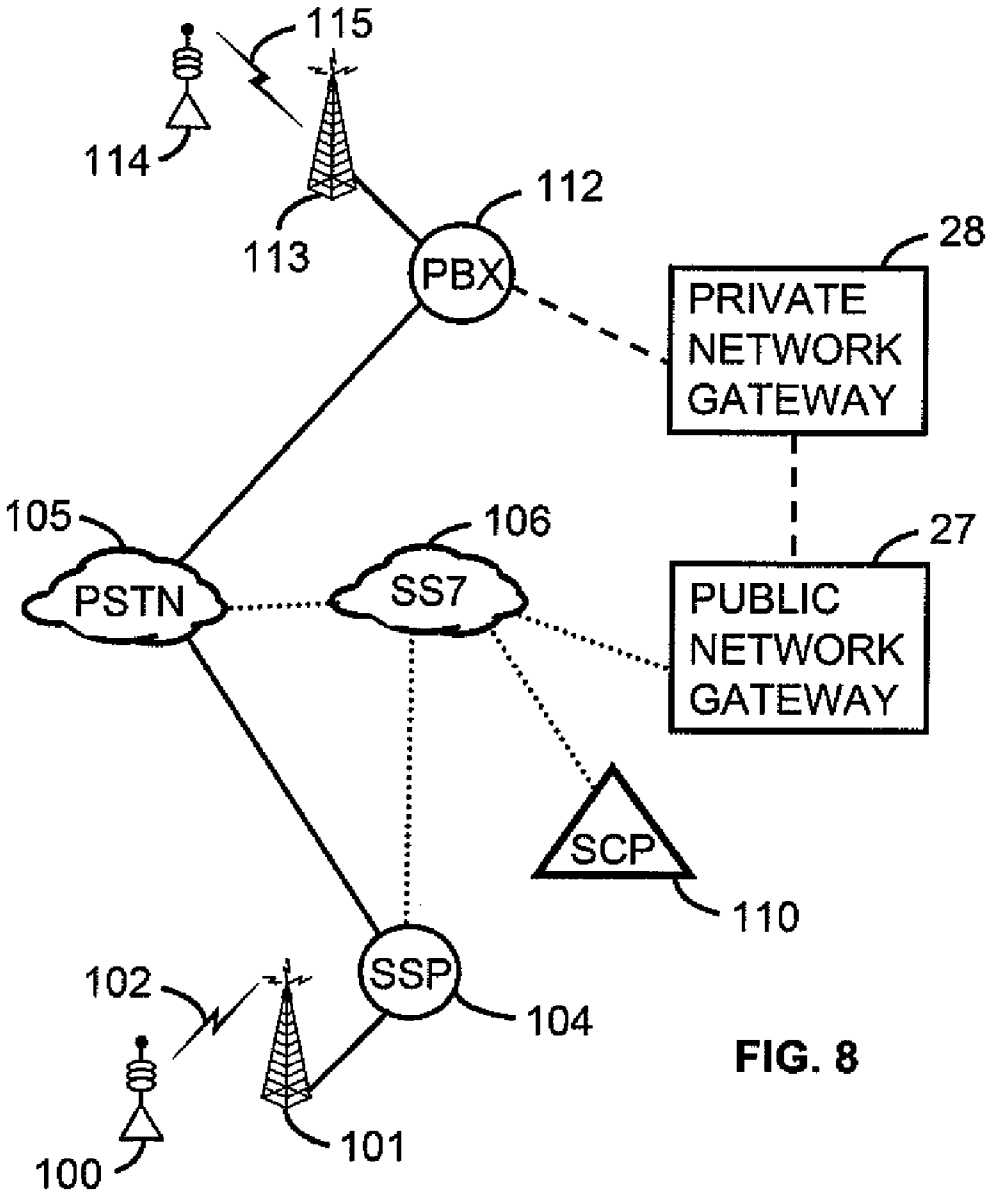
MOBILE STATION
104
SSP
27
PNG
28
PVNG
204
SSP
200
MOBILE STATION
707
708
709
710
711
712
CALL TERMINATION
QUERY (CALL TERM.)
SCEAPI (TCP/IP) (CALL TERM.)
GENERATE EVENT RECORD
SCEAPI (TCP/IP) (OUTCOME)
RESPONSE (OUTCOME)

FIG. 7B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PSTN
SS7
PUBLIC NETWORK GATEWAY
SCP
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SSP
102
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101
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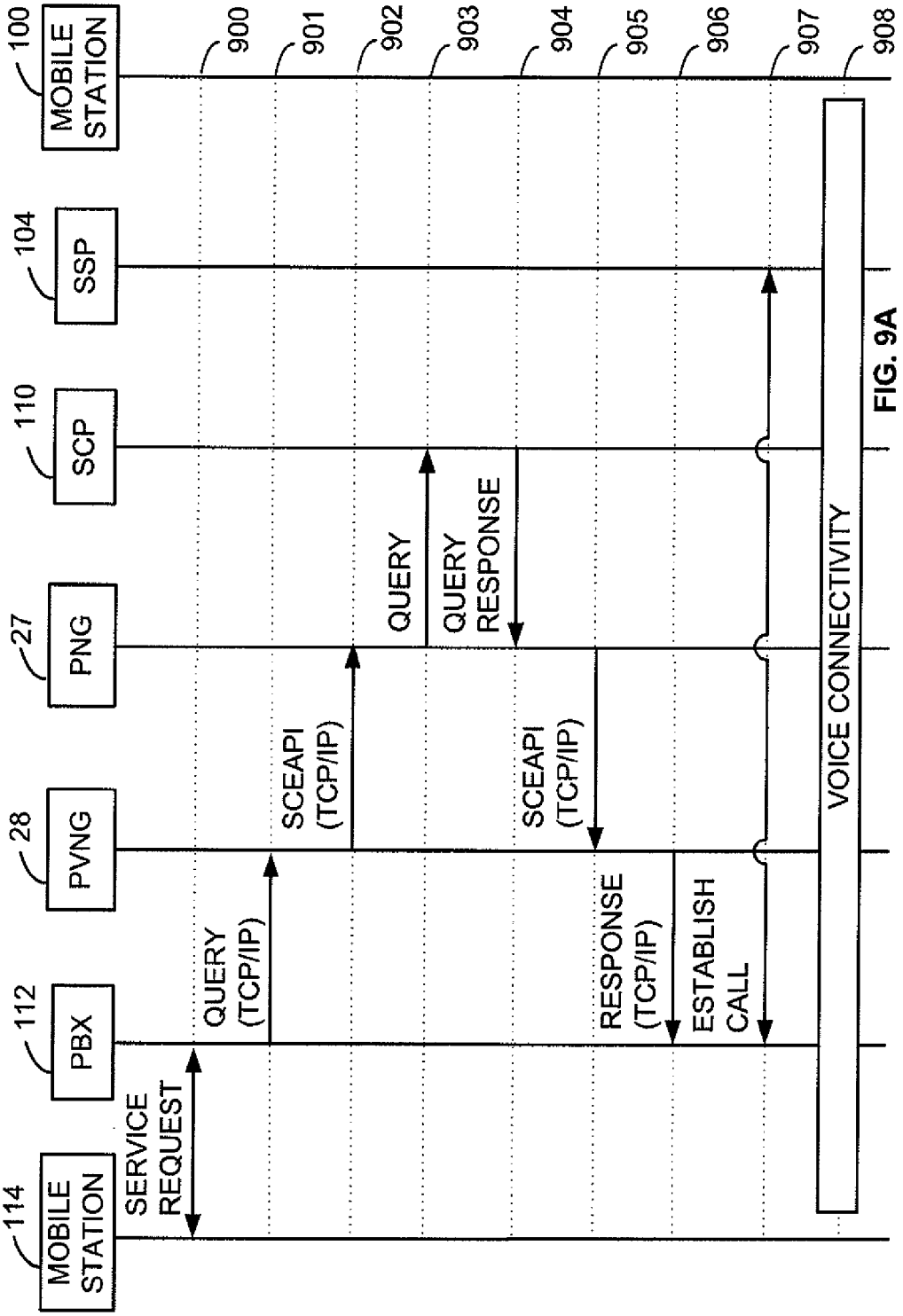
TRANSPORT FACILITY (E.G. ISDN, E1/T1)
SIGNALLING FACILITY (E.G. SS7, SCTP)
TCP/IP OR X.25

FIG. 8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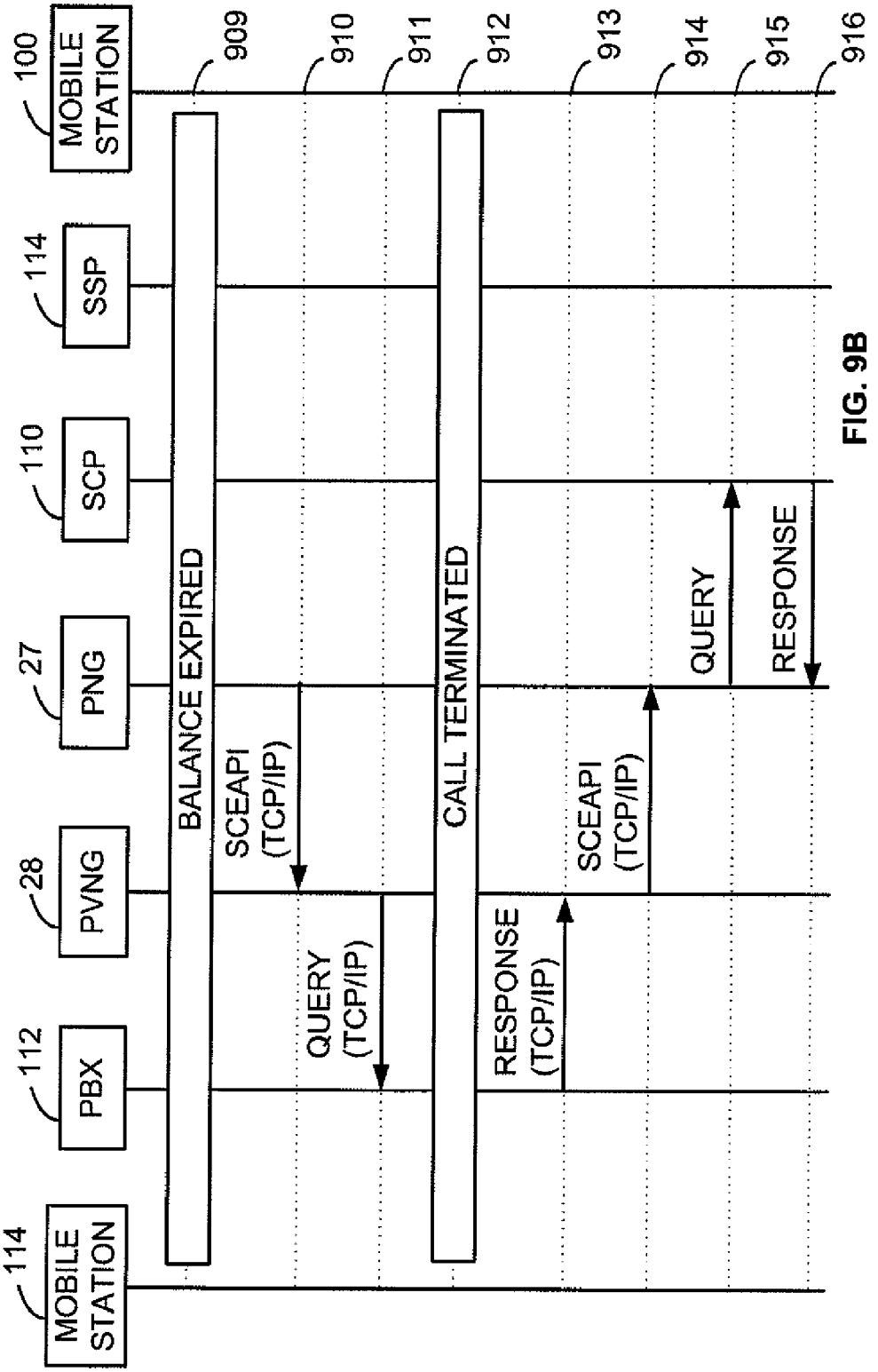
MOBILE STATION
104
SSP
110
SCP
27
PNG
28
PVNG
112
PBX
114
MOBILE STATION
900
901
902
903
904
905
906
907
908
SERVICE REQUEST
QUERY (TCP/IP)
SCEAPI (TCP/IP)
QUERY
QUERY RESPONSE
SCEAPI (TCP/IP)
RESPONSE (TCP/IP)
ESTABLISH CALL
VOICE CONNECTIVITY

FIG. 9A


100
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SSP
110
SCP
27
PNG
28
PVNG
112
PBX
114
MOBILE STATION
909
910
911
912
913
914
915
916
BALANCE EXPIRED
SCEAPI (TCP/IP)
QUERY (TCP/IP)
CALL TERMINATED
SCEAPI (TCP/IP)
RESPONSE (TCP/IP)
QUERY
RESPONSE

FIG. 9B

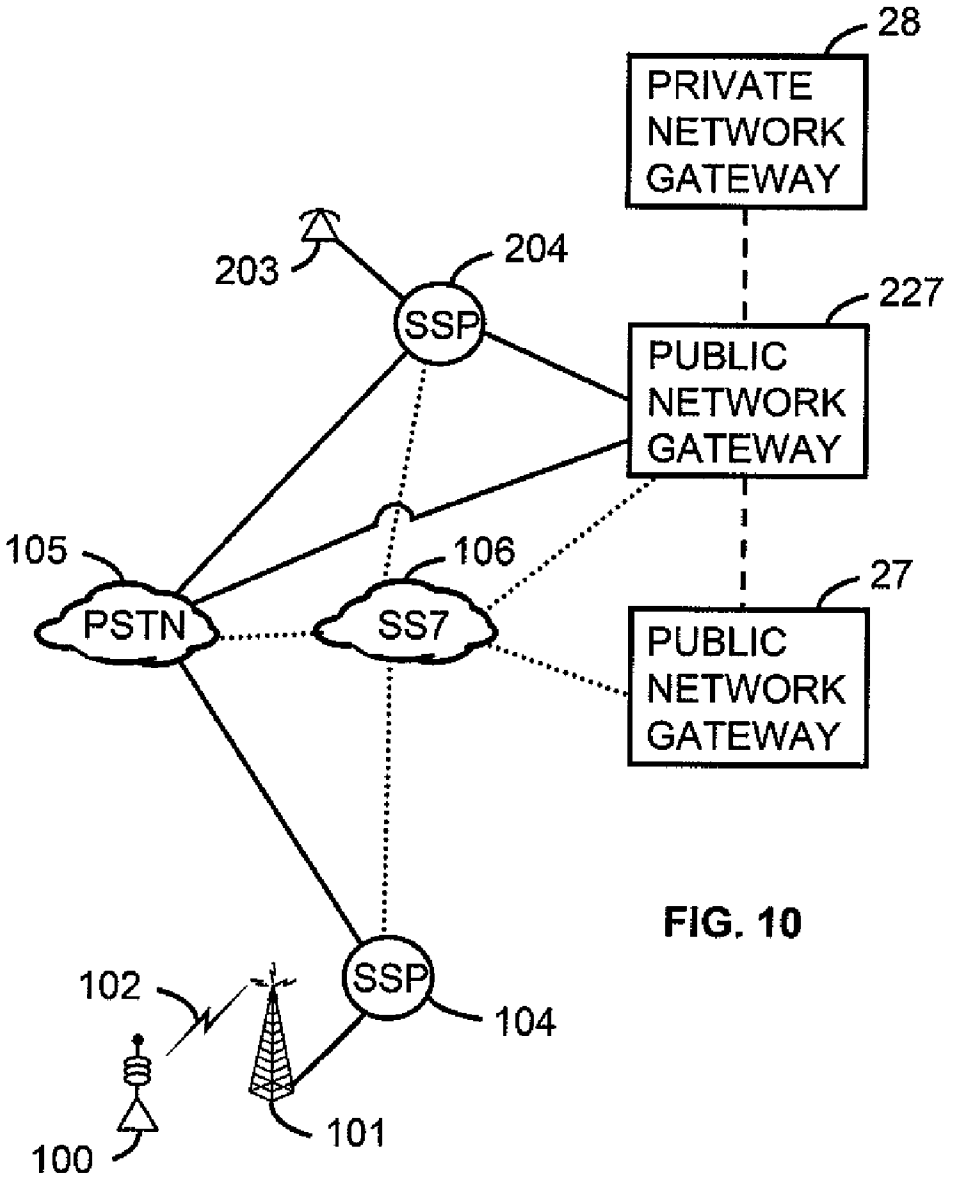
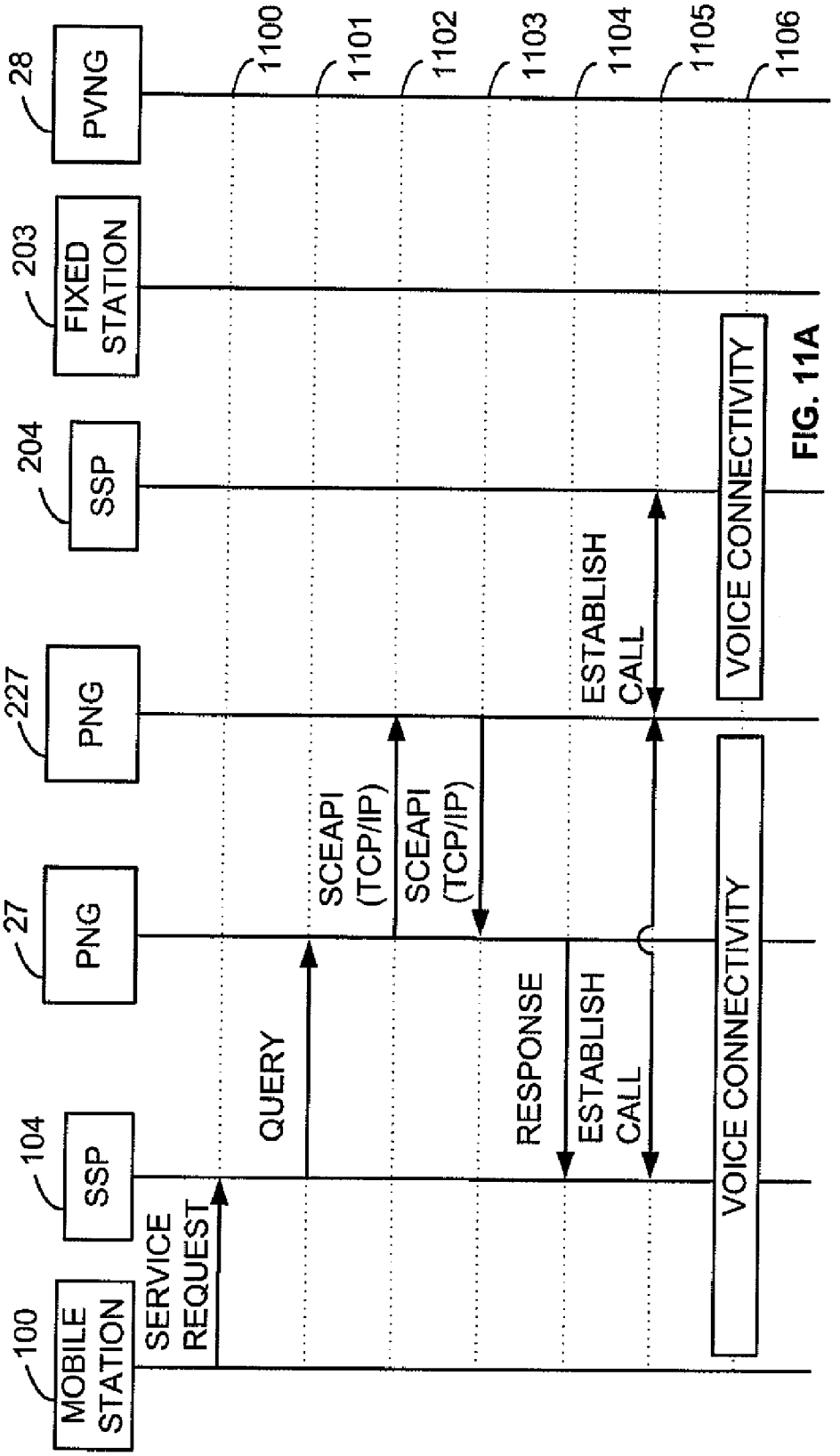

28
PRIVATE NETWORK GATEWAY
203
204
SSP
227
PUBLIC NETWORK GATEWAY
105
106
27
PSTN
SS7
PUBLIC NETWORK GATEWAY
SSP
102
104
101
100
TRANSPORT FACILITY (E.G. ISDN, E1/T1)
SIGNALLING FACILITY (E.G. SS7, SCTP)
TCP/IP OR X.25

FIG. 10


100
MOBILE STATION
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SSP
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PNG
227
PNG
204
SSP
203
FIXED STATION
28
PVNG
1100
1101
1102
1103
1104
1105
1106
SERVICE REQUEST
QUERY
SCEAPI (TCP/IP)
SCEAPI (TCP/IP)
RESPONSE
ESTABLISH CALL
ESTABLISH CALL
VOICE CONNECTIVITY
VOICE CONNECTIVITY

FIG. 11A

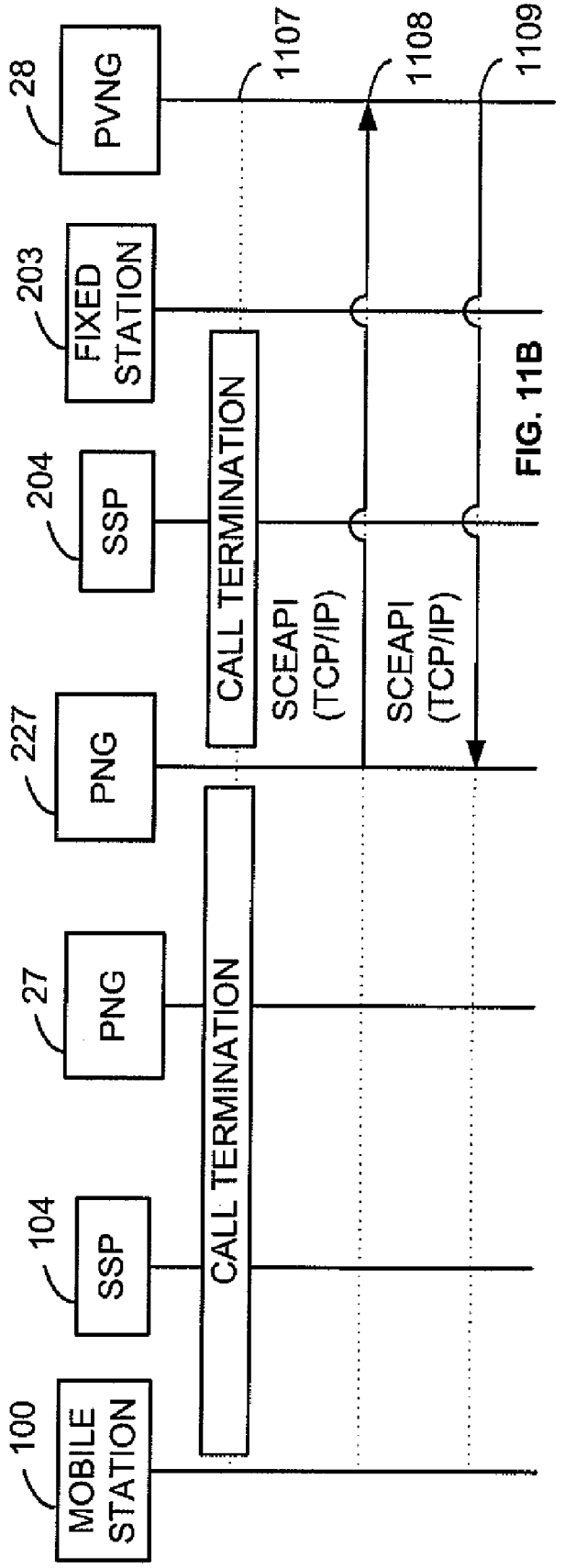
28
PVNG
203
FIXED STATION
204
SSP
227
PNG
27
PNG
104
SSP
100
MOBILE STATION
CALL TERMINATION
CALL TERMINATION
SCEAPI (TCP/IP)
SCEAPI (TCP/IP)
1107
1108
1109

FIG. 11B

METHOD FOR DISTRIBUTING AND EXECUTING SERVICE LOGIC

PRIORITY CLAIM

[0001] The present application is a divisional application claiming priority from U.S. Ser. No. 10/066,745, filed Feb. 6, 2002, the contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] Mobile network operators are faced with the challenge of introducing new applications and services. The ability to introduce new functionality that delivers competitive differentiation quickly, cost effectively and that can evolve with ease to next generation network environments are considered essential attributes by network operators.

[0003] SS7 networks have dramatically improved efficiencies of circuit-switched networks and have provided for the ability to decouple control logic and network intelligence from switching centers through the introduction of Intelligent Network (IN) core elements including Service Control Points (SCPs) and Intelligent Peripherals (IPs). The ability to send information 'out-of-band' from the underlying circuit-switched bearer channels and the decoupling of service logic has enabled a host of value added services including Calling Party Identification, Toll-free, Prepaid, and Short-Message services.

[0004] In particular, Service Creation Environments (SCEs) associated with Intelligent Network (IN) infrastructure have provided operators with the ability to deal with the complexities of designing and introducing new applications which utilize the existing terminal mobility infrastructure based on a 'Basic State Call Model' (BSCM) which in turn is comprised of several interlinked 'Trigger Detection Points' (TDPs). If certain conditions are met when call processing arrives at a TDP, normal call processing is interrupted in order to retrieve supplemental instructions from service logic which resides outside of the end-office on a Service Control Point (SCP). Call processing resumes once a response is received from the SCP—accommodating for any supplemental instructions provided by the SCP.

[0005] The SCE environment associated with IN infrastructure has typically required a high degree of specialization in order to understand the nuances of the underlying signalling protocols of the telecommunications environment as well as the vendor-specific proprietary implementation of the SCE environment. The existing SCE environment associated with IN infrastructure therefore lacks a set of open programming language-independent application programming interfaces which abstract and distil the functionality and capabilities of the underlying network elements and which leverage available development tools which are commonly available in the Information Technology (IT) environment.

[0006] The existing SCE environment has also been focused with respect to the provision of services which involve the functionality and capabilities of network elements within the public telecommunications network. The existing SCE environment does not allow for the management, provisioning, generation, and execution of telecommunication services beyond the domain of the telecommunications network. Specifically, existing SCE environments do not allow for the management, provisioning, generation, and execution of telecommunication services on a computer platform located in the private network via an application programming interface. Similarly, existing SCE environments do not allow for the management, provisioning, generation, and execution of telecommunication services which involve the functionality and capabilities of network elements located within the domain of the private network.

[0007] Many of these limitations have been based on the reliance of defined IN protocols such as ANSI-41 Wireless Intelligent Network (WIN), Global System for Mobile Communications (GSM) Intelligent Network Application Part (INAP), and GSM Customized Applications for Mobile network-Enhanced Logic (CAMEL) which accommodate for the transfer of service requests and responses among the network elements associated with the IN network. From the perspective of providing an accelerated method and system of generating compelling new services, these protocols are deficient in that they only address a subset of the functionality associated with a given network element. In particular, existing SCE environments do not attempt to access the entire spectrum of functionality or abstract the capabilities of a given network element by interfacing with the network element using the native protocols supported by the network elements. This deficiency is particularly evident in the case of network elements associated with private networks in that IN protocols do not address the functionality and capabilities provided by private network elements.

[0008] There are no known prior art teachings of a solution to the aforementioned deficiencies and shortcomings such as that disclosed herein. The prior art describes various mechanisms of generating specific services utilizing the existing capabilities of the existing SCE and IN environment, methods and systems of improving selected facets of the existing SCE and IN environment in order to provide complimentary capabilities via additional adjuncts located in the public or private domain, or methods and systems of providing a limited degree of interaction with private networks.

[0009] In particular, U.S. Pat. No. 6,044,274 by Vo, et al. provides for a mechanism whereby a given call from an non-IN capable end-office is redirected to an IN capable end-office for the purpose of applying the IN call model for the call. However, Vo et al. does not teach or suggest a method of providing telecommunication services utilizing the existing interfaces provided by the end-office.

[0010] U.S. Pat. No. 6,094,479 by Lindeberg et al. provides a bridging functionality for the purpose allowing a Computer Telephony Integration (CTI) server to emulate a public IN network element and to request a service from an existing IN service control point. However, Lindeberg et al. does not does not teach or suggest a method of provisioning, managing, generating, and executing services in a distributed fashion between the private and public domain.

[0011] U.S. Pat. No. 6,098,094 by Barnhouse et al. provides for a system which would directly replace the service switching component of existing IN networks with a distributed network architecture of computer servers. However, Barnhouse et al. does not does not teach or suggest a method of utilizing the existing base of network elements in the public and private domain.

[0012] U.S. Pat. No. 6,104,797 by Nabkel, et. al. provides for a method of generating new telecommunication services by distributing the intelligence presently resident in the public telecommunications network via the use of specialized Customer Premises Equipment (CPE) referred to as a Intelligent Communications Device (ICD). However, Nabkel et. al does not does not teach or suggest a method of utilizing the existing base of customer premises equipment and mobile stations in the public and private domain.

[0013] U.S. Pat. No. 6,115,746 by Waters et al. provides a mechanism of generating new telecommunications services by inserting new service logic into an existing IN service control point via a set of Intelligent Peripheral Controllers (IPCs) and Intelligent Peripheral Adapters (IPAs) which abstract the service logic associated with the SCP. However, Waters et. al does not does not teach or suggest a method of abstracting the capabilities of other network elements in the private and public domain.

[0014] U.S. Pat. No. 6,178,438 by Tschirhart et al. provides a distributed service management system for an IN environment. However, Tschirhart et al. does not does not teach or suggest a method of extending the distributed service management system to include the network elements in the private domain nor does Tschirhart et al. teach or suggest a method of providing telecommunication services utilizing the existing non-IN interfaces provided by the underlying Network Elements. REFERENCES CITED

REFERENCES CITED

[0015] U.S. Pat. No. 5,345,502 September 1994 Rothenhofer 379/221 U.S. Pat. No. 5,764,977 June 1998 Oulid-Aissa, et al. 707/10 U.S. Pat. No. 5,708,702 January 1998 De Paul, et al. 379/221 U.S. Pat. No. 5,862,334 January 1999 Schwartz, et al. 709/223 U.S. Pat. No. 6,014,377 January 2000 Gillespie 370/351 U.S. Pat. No. 6,016,318 January 2000 Tomoike 370/401 U.S. Pat. No. 6,029,067 February 2000 Pfundstein 455/426 U.S. Pat. No. 6,038,456 March 2000 Colby, et al. 455/456 U.S. Pat. No. 6,044,274 March 2000 Vo, et al. 455/461 U.S. Pat. No. 6,094,479 July 2000 Lindeberg, et al. 379/220 U.S. Pat. No. 6,097,937 August 2000 Sawyer 455/406 U.S. Pat. No. 6,098,094 August 2000 Barnhouse, et al. 709/203 U.S. Pat. No. 6,104,797 August 2000 Nabkel, et al. 379/201 U.S. Pat. No. 6,115,746 September 2000 Waters, et al. 709/229 U.S. Pat. No. 6,161,012 December 2000 Fenton, et al. 455/432 U.S. Pat. No. 6,178,438 January 2001 Tschirhart, et al. 709/200.

OTHER REFERENCES

[0016] GSM 02.78, "Digital cellular telecommunications systems (Phase 2+); Customized Applications for Mobile network Enhanced Logic (CAMEL) Stage 1".

[0017] GSM 03.78, "Digital cellular telecommunications systems (Phase 2+); Customized Applications for Mobile network Enhanced Logic (CAMEL) Stage 2".

[0018] GSM 03.40"Digital cellular telecommunications system (Phase 2+); Technical realization of the Short Message Service (SMS)".

[0019] GSM 09.02 (ETS 300 974), "Digital cellular telecommunications system (Phase 2+); Mobile Application Part (MAP) specification".

[0020] Heine, Gunnar. GSM Networks: Protocols, Terminology, and Implementation (Artech House Inc., Norwood, Mass., 1999).

[0021] Christensen, G., Florack, P. G., Duncan, R. Wireless Intelligent Networking (Artech House Inc., Norwood, Mass., 2001). TECHNICAL FIELD

[0022] The present invention relates to telecommunication network implementations, and, in particular, to a method and system for distributing and executing service logic for the provision of telecommunication services in both private and public networks.

SUMMARY OF THE INVENTION

[0023] A method of distributing and executing service logic across private and public networks for the generation and provision of telecommunication services is disclosed.

[0024] The functionality and capabilities associated with both Intelligent Network (IN) and non-IN compliant elements of a public telecommunications system are abstracted into one or more network element objects (NEOs) using a set of control and informational parameters and variables which are associated with a given network element or network element category. A service creation and execution environment (SCEE) provides an open service creation environment which provides a developer the ability to generate and provision applications using NEOs in conjunction with a service creation and execution application programming interface (SCEAPI).

[0025] SCEAPI provides access to SCEE which resides in a public network gateway (PNG) by means of referencing NEOs or invoking SCEE compliant applications using directives along with any associated parameters.

[0026] A PNG interfaces with plurality of network elements which may reside in a plurality of networks either directly or indirectly via a plurality of telecommunication protocols via a Network Interface Layer (NIL). SCEAPI in conjunction with the PNS provides for a distributed service creation and execution environment in order to enable the generation, provisioning, and execution of services in a manner which is independent of the complexities and nuances of the underlying network infrastructure. A given service may be generated and provisioned, for example, by invoking the call processing or billing processes resident in the underlying network elements using SCEAPI.

[0027] A private network gateway (PVNG) is a variant of the PNG which is located outside the public network domain. The PVNG is functionally similar to the PNG in that it supports SCEAPI and contains SCEE in order to order to enable the generation and provisioning of services by abstracting the informational and control parameters and variables associated with network elements or network element categories associated with the private network domain.

[0028] SCEE compliant applications may be developed and executed on the PNG or PVNG or may be developed and executed on alternative SCEE compliant software platforms. The PNG, PVNG, and other SCEE compliant servers communicate with each other via SCEAPI. SCEAPI is used in order to relay SCEE compliant service logic including service requests and responses, to access a network element

in the underlying public or private network, or to invoke SCEE compliant applications resident on the SCEE compliant software platform. SCEE compliant applications may in turn issue other SCEAPI directives in order to invoke capabilities supported by the software platform. Alternatively, SCEE compliant applications may in turn invoke other SCEE compliant applications resident on the software platform or other SCEE compliant software platforms.

[0029] The PNG and PVNG in conjunction with SCEAPI and SCEE enable the generation and provisioning of services in both the public and private domain. In particular, the applications supported directly or indirectly by the PNG and PVNG via SCEAPI permit the capabilities provided by the public and private network elements to be utilized and controlled in a manner which is defined by the service creation and execution environment resident on the PNG and PVNG and only limited by the underlying capabilities of the network elements and any restrictions imposed by the operators of networks associated with the public and private domain.

[0030] The PNG and PVNG in conjunction with SCEAPI and SCEE enable the generation, provisioning, and execution of applications which may be invoked in a serial or concurrent fashion to provide telecommunication services in a distributed fashion across a plurality of PNGs and PVNGs. As an example of the use of the SCEE and SCEAPI, the PVNG may be used to develop applications for the public network by utilizing SCEAPI and SCEE in order to provide access to the network elements under the control of the PNG. For example, a service for a public telecommunications network may be formulated on a PVNG using SCEE and relayed via a communication channel to the PNG which will validate the service logic and invoke the requisite capabilities in the underlying public network(s) upon receiving a service invocation request from the PVNG. Alternatively, applications may be developed independently on the PVNG and PNG and invoked via SCEAPI compliant directives from a co-resident application or by an application resident on an alternative PVNG or PNG.

[0031] As an example of the use of the SCEE and SCEAPI to provide telecommunication services via the serial or concurrent execution of applications resident on PNGs or PVNGs, upon meeting an initial set of conditional requirements associated with a subscriber's profile such as the time of day, an application resident on a PNG or PVNG may invoke one or more applications resident on an alternative PNG or PVNG via a SCEAPI directive. The alternative PNG or PVNG will validate the request and invoke the requisite capabilities in the underlying public or private networks or other applications or resources resident on the PNG or PVNG in a serial or concurrent fashion pursuant to the SCEAPI compliant commands and parameters provided by the invoking application and pursuant to any incremental conditional requirements defined by service logic and other conditional requirements associated with the invoked applications. This method of providing telecommunication services can be extended in that the alternative PNG or PVNG may elect, pursuant to the execution of service logic, invoke applications resident in a plurality of other alternative PNGs or PVNGs in a concurrent or serial fashion.

[0032] The PNG and PVNG in conjunction with SCEE and SCEAPI therefore provides a method of distributing and executing service logic across private and public networks for the generation and provision of telecommunication services via a distributed service creation and execution environment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] FIG. **1** illustrates a functional block diagram of the public network gateway in accordance with a simplified, non-limiting embodiment of the present invention;

[0034] FIG. **2** illustrates a functional block diagram of the private network gateway in accordance with a simplified, non-limiting embodiment of the present invention;

[0035] FIG. **3** illustrates the configuration of the public network gateway and private network gateway in an example telecommunications system in accordance with a non-limiting embodiment of the present invention;

[0036] FIG. **4** is a block diagram illustrating an embodiment of a telecommunications system for a pre-paid short message service application of the present invention;

[0037] FIG. **5**A and FIG. **5**B show message flow diagrams of a representative interaction illustrating the inventive concepts for a pre-paid short message service application of the present invention;

[0038] FIG. **6** is a block diagram illustrating an embodiment of a telecommunications system for a virtual private network application of the present invention;

[0039] FIG. **7**A and FIG. **7**B show message flow diagrams of a representative interaction illustrating the inventive concepts for a virtual private network application of the present invention;

[0040] FIG. **8** is a block diagram illustrating an embodiment of a telecommunications system for a pre-paid private network billing application of the present invention;

[0041] FIG. **9**A and FIG. **9**B show message flow diagrams of a representative interaction illustrating the inventive concepts for a pre-paid private network billing application of the present invention;

[0042] FIG. **10** is a block diagram illustrating an embodiment of a telecommunications system for a transcription application of the present invention; and

[0043] FIG. **11**A and FIG. **11**B show message flow diagrams of a representative interaction illustrating the inventive concepts for a transcription application of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0044] In the following description, for purposes of explanation and not limitation, specific details are set forth, such as particular embodiments, elements, interfaces, hardware configurations, data structures, software flows, techniques, etc. in order to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that the present invention may be practiced in other embodiments that depart from these specific details. In other instances, detailed descriptions of well known methods, devices, and elements are omitted so as not to obscure the description of the present invention with unnecessary detail.

[0045] Referring to FIG. **1**, a functional block diagram of the public network gateway (PNG) **27** is shown. PNG **27** will reside on a software platform (not shown) designed to support the development and execution of applications. The software platform may include an object request broker (ORB) agent (not shown), a distributed object management environment for interprocess communications (not shown), an event manager that coordinates and distributes events according to the priority indicated by processes (not shown), and a service manager that provides process level control for application processes (not shown). Not shown is the user interface for the PNG which provides the operational support that is required throughout the process of service creation, such as service documentation, managed object definition, interface definition, protocol definition and data input definition. The collection of operations are encapsulated in managed objects which may be manipulated via a Graphical User Interface (GUI) or invoked via command line instructions.

[0046] The functionality and capabilities associated with both Intelligent Network (IN) and non-IN compliant elements of a public telecommunications system are abstracted into one or more network element objects (NEOs) **34** using a set of control and informational parameters and variables which are associated with a given network element or network element category.

[0047] Referring to FIG. **1**, a service creation and execution environment (SCEE) **15** provides an open service creation environment which provides a developer the ability to generate and provision applications using NEOs in conjunction with the service creation and execution application programming interface (SCEAPI) **19**. SCEAPI provides access to SCEE which resides in a public network gateway (PNG) by means of referencing NEOs or invoking SCEE compliant applications using directives along with any associated parameters. SCEAPI **19** and SCEE **15** enable the generation and provisioning of services in a manner which is independent of the complexities and nuances of the underlying network infrastructure. In particular, a given NEO may be reused in order to communicate and control a variety of network elements produced by different vendors as variations in the parametric and logical attributes of the network elements are accommodated by mapping a functional or informational element into the control and informational parameters required by the network element. SCEE **15** includes a number of subcomponents in order to provide for a variety of object-oriented application programming interfaces. A common object request broker architecture (CORBA) **17** and extensible markup language (XML) **16** compliant subcomponents have been depicted. Those skilled in the art will recognize that other object oriented application programming interfaces may serve the same purpose without diluting the intent and scope of the present invention. A database **18** is used to store and retrieve information including, but not limited to, applications, network elements, users, interconnected networks, and sessions. A memory **35** is used for storage of service execution logic. SCEE **15** interacts with the network interface layer (NIL) **14** in order to access, communicate, and control the network elements **1** in the public telecommunications network via a suitable communications link and interface protocol **2**. Database **18** contains data **36** pertaining to a) the state **37** of circuit-switched calls, data-packet sessions, and applications and b) state and profile information **38** pertaining to subscribers. In a present embodiment, the state and profile information **38** in data **36** of a group of subscribers is associated with a single record.

[0048] Referring to FIG. **1**, NIL **14** interacts with network elements in the public telecommunications network including, but not limited to, operation support systems, customer care systems, service switching points (SSPs), service control points (SCPs), short message service centers (SMS-Cs), intelligent peripherals (IPs) and home location registers (HLRs). NIL utilizes a number of subcomponents which transcodes and formats messages and commands in a manner which complies with the interconnection protocols supported by a plurality of network elements. Protocol transcoding subcomponents depicted in FIG. **1** include those which support Common Object Request Broker Architecture (CORBA) 11, T1/E112, H.323 13, session initiation protocol (SIP) **32**, short message peer to peer (SMPP) **33**, transmission control protocol/internet protocol (TCP/IP) **6**, simple network management protocol (SNMP) **7**, hypertext transfer protocol (HTTP) **8**, computer telephony integration (CTI) **9**, and signaling system #7 (SS7) **10**. Those skilled in the art will recognize that other interconnection protocols may serve a similar purpose without diluting the intent and scope of the present invention. Not shown are the terminal adaptors which would provide the physical connectivity associated with a communications link for the purpose of establishing connectivity to a network element.

[0049] Referring to FIG. **1**, applications **2021** which utilize SCEAPI **19** to access SCEE **15** may reside on the PNG **27** or may reside on alternative software platforms **2324**. The alternative software platforms **2324** may reside within the domain of the public network **23** or in a domain external to the public network **24** The applications resident on the external software platforms may communicate with the PNG **27** using the objects defined by SCEAPI **19** and SCEE **15** via a communications link. The communications link may utilize a variety of signalling protocols including transmission control protocol/internet protocol (TCP/IP). Not shown is the mediation function which screens incoming objects for SCEAPI and SCEE compliance. By extending the use of SCEAPI **19** and SCEE **15** to alternative software platforms, the service creation environment may be extended outside the PNG **27** and outside the public network domain. In particular, a service for a public telecommunications network may be formulated on an alternative software platform and relayed via a communication channel to the PNG which will validate the request and invoke the requisite capabilities in the underlying public network(s).

[0050] Referring to FIG. **1**, a private network gateway (PVNG) **28** is a variant of the PNG **27** which is located outside the public network domain.

[0051] Referring to FIG. **2**, the PVNG **28** is functionally similar to the PNG **27** in that it contains SCEE **15** in order to provide for a service creation environment and NIL to access and control network elements. The PVNG **28** is tailored to the environment defined by the private domain and will contain subcomponents and NEOs which are tailored to the private domain. For example, the PVNG **28** may support NEOs and the associated NIL subcomponents in order to access and control a network element **30** such as a private branch exchange (PBX) via suitable communications link and interface protocol **31** such as TCP/IP. As in the

case of the PNG **27**, SCEAPI **19** compliant applications **2021** may be developed and executed on the PVNG **28** or may be developed and executed on alternative software platforms **2526**. The alternative software platforms may reside within the domain of the private network **25** or in a domain external to the private network **26**. The PVNG **28** may be used to develop applications for the public network by utilizing SCEAPI **19** in order to provide access to the network elements under the control of the PNG **27**.

[**0052**] Referring to FIG. **1** and FIG. **2**., SCEE **19** compliant applications may be developed and executed on the PNG **27** or PVNG **28** or may be developed and executed on alternative SCEE compliant software platforms.

[**0053**] The PNG **27**, PVNG **28**, and other SCEE compliant servers **23242526** communicate with each other via SCEAPI **19**. SCEAPI **19** may be used in order to relay SCEE compliant service logic including service requests and responses, to access a network element in the underlying public or private network, or to invoke SCEE compliant applications resident on the SCEE compliant software platform. SCEE compliant applications **2021** may in turn issue other SCEAPI directives in order to invoke capabilities supported by the software platform. Alternatively, SCEE compliant applications **2021** may in turn invoke other SCEE compliant applications resident on the software platform or other SCEE compliant software platforms.

[**0054**] Referring to FIG. **3**, the configuration of the PNG **27** and PVNG **28** in an example telecommunications system is illustrated in a block diagram. Those skilled in the art will appreciate that the illustrated network elements do not represent all of the physical nodes used to realize a public or private telecommunications network.

[**0055**] Referring to FIG. **3**, the SS**7106** network provides signalling connectivity among a number of network elements in the public network including SSPs **104**, SMS-Cs **111**, SCPs **110**, and HLRs **109**. Signalling connectivity can also be provided by other protocols including the Stream Control Transmission Protocol (STCP) specified by the Internet Engineering Task Force (IETF). The SSP **104** provides for a source and sink of communications traffic as the SSP serves fixed stations **103** or mobile stations **100**. SSPs **104** generally serve either fixed **103** or mobile stations **100** although in some configurations they may serve both fixed and mobile stations. SSPs **104** serve mobile stations **100** via base stations **101** and radio link **102**. The present invention may provide applications which are applicable to both mobile **100** and fixed **103** stations. The scope of connectivity from the SSP **104** may be extended by providing SS7 connectivity and transport connectivity to the Public Switched Telephone Network (PSTN) **105**.

[**0056**] The intelligent peripheral (IP) **107** interfaces to the SSP **104** via a transport facility such as a T1/E1 or Primary Integrated Services Digital Network (ISDN) link. The IP **107** provides a voice-based interface to callers and service subscribers for the purpose of playing pre-recorded or voice synthesized announcements and prompts. The IP **107** may be controlled via a logical communications link (not shown) established to the SCP **110**. The PNG **27** has connectivity to the network elements of the public network via signalling links using industry standard protocols such as SS7, X.25, or TCP/IP The PNG **27** may also interface with certain network elements of the public network such as the SSP **104** via a transport link such as T1/E1 or Primary ISDN link in order to provide for voice-based interactions in a similar fashion as the IP **107** or to provide switching functions in a similar fashion as the SSP. The PNG **27** may also have connectivity to the public internet **108** for the purpose of acquiring information and content for applications which reside on the PNG.

[**0057**] Referring to FIG. **3**, the private branch exchange (PBX) **112** provides a similar role to the SSP **104** in that it provides for a source and sink of communications traffic in the private domain as the PBX serves fixed stations or mobile stations. PBXs **112** generally serve either fixed **116** or mobile stations **114** although in some configurations they may serve both fixed and mobile stations. PBXs **112** serve mobile stations **114** via a base station **113** and radio link **115**. The present invention may provide applications which are applicable to both mobile **114** and fixed stations **116**. The scope of connectivity from the PBX **112** is extended by providing transport connectivity to the PSTN **105**. The PVNG **28** has connectivity to the network elements of the private network industry standard protocols such as SS7, X.25, or TCP/IP. The PVNG **28** may also interface with the network elements of the private domain via a transport link such as T1/E1 or Primary ISDN link in order to provide for voice-based interactions in a similar fashion as the IP **107** or to provide switching functions in a similar fashion as the SSP.

[**0058**] Referring to FIG. **3**, the network elements of the private and public domain may support ITU-T Intelligent Network capabilities as defined by the International Telecommunications Union (ITU) and the European Telecommunication Standards Institute (ETSI) orAdvance Intelligent Network (AIN) capabilities as defined by Telcordia. The present invention may provide applications which are applicable to network elements which support or do not support IN or AIN capabilities. In particular, the service creation and execution environment resident on the PNG **27** and PVNG **28** will optionally support the incremental call control capabilities provided by IN and AIN.

[**0059**] Referring to FIG. **3**, the PNG **27** may connect to the PVNG **28** for the purpose of distributing the service creation environment between the private and public domains via SCEAPI **19**. Those skilled in the art will appreciate that the PNG **27** and PVNG **28** in conjunction with SCEAPI **19** and SCEE **15** enable the generation and provisioning of new services in both the public and private domain. In particular, the applications supported directly or indirectly by the PNG **27** and PVNG **28** via SCEAPI **19** permit the capabilities provided by the public and private network elements to be utilized and controlled in a manner which is defined by the service creation environment resident on the PNG **27** and PVNG **28** and only limited by the underlying capabilities of the network elements and any restrictions imposed by the operators of networks associated with the public and private domain.

[**0060**] Referring to FIG. **3**, the PNG **27** and PVNG **28** in conjunction with SCEAPI and SCEE enable the generation, provisioning, and execution of applications which may be invoked in a serial or concurrent fashion to provide telecommunication services in a distributed fashion across a plurality of PNGs and PVNGs. As an example of the use of the SCEE and SCEAPI, the PVNG **28** may be used to

develop applications for the public network by utilizing SCEAPI and SCEE in order to provide access to the network elements under the control of the PNG **27**. For example, a service for a public telecommunications network may be formulated on a PVNG **28** and relayed via a SCEAPI compliant communication channel to the PNG **27** which will validate the service logic and invoke the requisite capabilities in the underlying public network(s) upon receiving a service invocation request from the PVNG **28**. Alternatively, applications may be developed independently on the PVNG **28** and PNG **27** and invoked via SCEAPI and SCEE compliant directives from a co-resident application or by an application resident on an alternative PVNG or PNG (not shown).

[**0061**] Referring to FIG. **3**, as an example of the use of the SCEE and SCEAPI to provide telecommunication services via the serial or concurrent execution of applications resident on a plurality of PNGs or PVNGs, upon meeting an initial set of conditional requirements associated with a subscribers profile such as the time of day, an application resident on a PNG **27** may invoke one or more applications resident on an PVNG **28**. The PVNG **28** will validate the request and invoke the requisite capabilities in the underlying private networks or other applications or resources resident on the PVNG **28** in a serial or concurrent fashion pursuant to the SCEAPI compliant commands and parameters provided by the invoking application and pursuant to any incremental conditional requirements defined by service logic in the invoked applications. This method of providing telecommunication services can be extended in that the PVNG may elect, pursuant to the execution of service logic and other conditional requirements, invoke applications resident in a plurality of other alternative PNGs or PVNGs (not shown) in a concurrent or serial fashion.

[**0062**] Any sequence and number of PNGs or PVNGs may be invoked in order to provide a given telecommunication service. For example, a PVNG may invoke two PNGs and one of the PNGs may invoke an alternative PVNG in order to provide a given telecommunication service.

[**0063**] Referring to FIG. **4**, the configuration of the PNG **27** in an example telecommunications system is illustrated in a block diagram for a pre-paid short message service application of the present invention. The example telecommunications system is derived from the telecommunications system illustrated in FIG. **3**. An additional SSP **204**, mobile station **200**, and base-station **201** have been depicted in the example telecommunications network in order to provide a better understating of the present invention with reference to message flow diagrams illustrated in FIG. **5**A and FIG. **5**B.

[**0064**] FIG. **5**A and FIG. **5**B depict message flow diagrams of a representative interaction which illustrate the inventive concepts for a pre-paid short message service application of the present invention for the example telecommunications network illustrated in FIG. **4**. Those skilled in the art will recognize that the short message may be submitted and routed via the network elements depicted in the telecommunications network via a variety of methods including the procedures described in TIA TR 45.2 IS-841 and GSM 03.40. Detailed descriptions of well known short message delivery methods and procedures are omitted so as not to obscure the description of the present invention with unnecessary detail.

[**0065**] At **500**, a mobile station **100** submits a short message for the destination mobile station **200** to its serving SSP **104** via radio link **102** and base station **101**. The SSP **104** receives the short message and forwards the short message to the PNG **27** based on one or more translations. The translations required to direct the short message to the PNG **27** may be accommodated within the SSP **104** or within the SS7 network **106**.

[**0066**] At **501**, the PNG **27** receives the short message and invokes a prepaid short message application resident (not shown) on the PNG **27**. The pre-paid short message application on PNG **27** determines the rate to be applied. Not shown are the message flows for an optional manifestation of the pre-paid short message service where the PNG **27** would accesses the HLR **109** in order to determine the rate based on the terminating mobile station's **200** current location. The pre-paid short message application on PNG **27** checks to see if the originating mobile station **100** has an account balance sufficiently above a minimum threshold. In this example, this validation is achieved by sending a decrement balance query to a database resident on the SCP **110**. In an alternative manifestation of the service, the database could be resident in the PNG **27**.

[**0067**] At **502**, the SCP **110** decrements the originating mobile station's balance and sends back a response which indicates the result of the SCP's **110** action. The response would contain sufficient information to indicate whether the originating mobile station **100** has a sufficient balance for the short message to proceed to the terminating mobile station **200**.

[**0068**] At **503**, the PNG **27** receives the response from the SCP **110** and determines whether the message should proceed to the terminating mobile station based on the content of the response. For the purpose of this message flow sequence, it will be assumed that the originating mobile station **100** has a sufficient balance. The PNG **27** forwards the short message to the SMS-C **111**.

[**0069**] At **504**, the SMS-C **111** receives the short message and queries the HLR **109** in order to determine the current serving SSP **104** for the terminating mobile station.

[**0070**] At **505**, the HLR **109** retrieves the current serving SSP **204** via an internal translation or database lookup and sends a response message which includes the identifier associated with the serving SSP **204**.

[**0071**] At **506**, the SMS-C **111** receives the response and forwards the short message to the serving SSP **204** indicated in the response message received from the HLR **109**.

[**0072**] At **507**, the serving SSP **204** receives the short message.

[**0073**] At **508**, the serving SSP **204** delivers the short message to the terminating mobile station **200** via a base station and a radio link. The serving SSP **204** formulates and submits a short message result message to the SMS-C **111**.

[**0074**] At **509**, the SMS-C **111** receives the short message result message and formulates and submits delivery report to the PNG **27**.

[**0075**] At **510**, the PNG **27** receives the delivery report and forwards the content of the delivery report to the pre-paid short message application resident (not shown) on

the PNG **27**. The pre-paid short message application formulates and submits a short message to the MSC **104**. The content and format of the short message may vary pursuant to the telecommunication network providers requirements. The received delivery report may also be used to provide a conciliation function in that the balance associated with the calling mobile station **100** may be adjusted depending on the outcome of the short message submission function carried out by the serving SSP **204** at **508**.

[**0076**] At **511**, the SSP **104** receives the short message.

[**0077**] At **512**, the SSP **104** delivers the short message to the originating mobile station **100** via a base station and a radio link.

[**0078**] Referring to FIG. **4**, FIG. **5**A, and FIG. **5**B, those skilled in the art will appreciate that the service creation environment provided by the PNG **27** in conjunction with SCEAPI and SCEE has provided for an innovative prepaid short message service offering which may not have otherwise been supported using the underlying network infrastructure.

[**0079**] Referring to FIG. **6**, the configuration of the PNG **27** and PVNG **28** in an example telecommunications system is illustrated in a block diagram for a virtual private network service application of the present invention. The example telecommunications system is derived from the telecommunications systems illustrated in FIG. **3** and FIG. **4** and will be used to illustrated a virtual private network service application of the present invention with reference to the message flow diagrams illustrated in FIG. **7**A and FIG. **7**B.

[**0080**] FIG. **7**A and FIG. **7**B depict message flow diagrams of a representative interaction which illustrates the inventive concepts for a virtual private network service application of the present invention for the example telecommunications network illustrated in FIG. **6**. Those skilled in the art will recognize that queries and responses may be formulated and routed via a variety of methods including the procedures described by GSM 02.78, GSM 03.78, GSM 09.02, and GSM 09.78. Those skilled in the art will also recognize that circuit-switched calls may be established via a number of methods including via the procedures described in T1.113 and ITU-T Q series recommendations. Detailed descriptions of well known query and call establishment procedures are omitted so as not to obscure the description of the present invention with unnecessary detail.

[**0081**] At **700**, a mobile station **100** submits a service request for the destination mobile station **200** to its serving SSP **104** via a radio link **102** and base station **101**. The service request contains the private virtual network address for the destination mobile station **200**. The private virtual network address will generally not be consistent with the addressing scheme used by the public telecommunications network. For example, the private virtual network address may contain fewer digits than the addressing scheme used by the public telecommunications network. The SSP **104** receives the service request and formulates a query which is forwarded to the PNG **27**. The translations required to direct the query to the PNG **27** may be accommodated within the SSP **104** or within the SS7 network. The SSP **104** may use an IN or AIN trigger in order to detect the use of the private virtual network addressing scheme.

[**0082**] At **701**, the PNG **27** receives the query and invokes a subscriber profile application resident (not shown) on the PNG **27** in order to ascertain state and profile information **37** pertaining to subscribers. Based on an internal translation or database **18** lookup, the subscriber profile application determines that the service logic for this particular application resides on the PVNG **28**. For a group of subscribers, such a database **18** lookup would be associated with a single record. The PNG **27** forwards the query to the PVNG **28** via SCEAPI **19**.

[**0083**] At **702**, the PVNG **28** receives the query and invokes a private virtual network application (not shown) resident on the PVNG **28**. The private virtual network application maps the private virtual network address to the destination address associated with the terminating mobile station **200** which is supported by the public telecommunications network. The PVNG **28** formulates and sends a response which contains the public destination address associated with the terminating mobile station **200** to the PNG **27** via SCEAPI **19**.

[**0084**] At **703**, the PNG **27** receives the response from the PVNG **28** and invokes a subscriber profile application resident (not shown) on the PNG **27** in order to ascertain state and profile information **37** pertaining to subscribers. For a group of subscribers, such a database **18** lookup would be associated with a single record. Based on an internal translation or database lookup, the subscriber profile application determines that the response was associated with a previous query and formulates a response which will forward the instructions received from the PVNG **27** to the SSP **104**. The content and format of the response may vary pursuant to the telecommunication network providers requirements including the capabilities supported by the SSP **104**. For example, the response message would vary as a function of whether the SSP **104** supports IN or AIN compliant triggers.

[**0085**] At **704**, the SSP **104** receives the response from the PNG **27**.

[**0086**] At **705**, the SSP **104** invokes the procedures to establish a call to the terminating SSP **200**. Not shown are the message flows which are used to establish connectivity via the circuit-switched or packet based network. Not shown are the message flows which may be required in order to determine the serving SSP **200** via an HLR **109** in a mobile environment.

[**0087**] At **706**, a voice connection between the originating mobile station **100** and the destination mobile station **200** is established and voice communication takes place. During this call, the virtual private networking application resident on the PVNG **27** maintains call timers for the call in order to generate an event record upon call termination.

[**0088**] At **707**, the call is terminated by either the calling or terminating mobile stations.

[**0089**] At **708**, upon recognizing that the call has terminated, the originating SSP **104** formulates a query indicating that the call has been terminated and forwards the query to the PNG **27**. The query is received by the PNG **27** and the subscriber profile application resident (not shown) on the PNG **27** is invoked. Based on an internal translation or database lookup, the subscriber profile application formulates a response which will forward the query received from the PNG **27** to the PVNG **28** via SCEAPI.

[0090] At **709**, the query is received by the PVNG **28** and the private virtual network application resident (not shown) on the PVNG **28** is invoked. Based on an internal translation or database lookup, the prepaid application determines that the query was associated with an existing session.

[0091] At **710**, the private virtual network application generates an event record which contains the details of the call (for example, originating identifiers, terminating identifiers, call duration) which may be used by either the private or public telecommunications network operator in order to apply a specific rate for the call. In an alternative manifestation of the service, the PNG **27** may generate the event record. In an alternative manifestation of the service, the PNG **27** or the PVNG **28** could determine and record the rate for the call via a rating engine resident on either the PNG **27** or PVNG **28**. The PVNG **28** formulates a response indicating the outcome of the query request and submits the response to the PNG **27** via SCEAPI **19**.

[0092] At **711**, the response is received by the PNG **27** and the subscriber profile application resident (not shown) on the PNG **27** is invoked. Based on an internal translation or database lookup, the subscriber profile application recognizes that the response is associated with an existing session and forwards the query received to the originating SSP **104**.

[0093] At **712**, the response is received by the originating SSP **104**. The originating SSP **104** recognizes that the response is associated with an earlier query and closes the session associated with the query.

[0094] Referring to FIG. **6**, FIG. **7**A, and FIG. **7**B, those skilled in the art will appreciate that the service creation environment provided by the PNG **27** and PVNG **28** in conjunction with SCEAPI **19** and SCEE **15** have provided for an innovative virtual private network offering which may not have otherwise been supported using the underlying network infrastructure.

[0095] Those skilled in the art will appreciate that the service creation environment provided by the PNG **27** and PVNG **28** in conjunction with SCEAPI **19** and SCEE **15** can be utilized for the purpose of applying capabilities and services for a group of subscribers. As an example of a service for a group of subscribers, a call-attendant function whereby calls are diverted to a live call attendant once a set of prescribed conditions have been met (e.g. terminating number busy) can be applied across a group of subscribers whose state and profile information **37** is associated with a single record as stored within database **18**.

[0096] Referring to FIG. **8**, the configuration of the PNG **27** and PVNG **28** in an example telecommunications system is illustrated in a block diagram for a private network pre-paid service application of the present invention. The example telecommunications system is derived from the telecommunications systems illustrated in FIG. **3** and FIG. **4** and will be used to illustrate a private network service pre-paid application of the present invention with reference to the message flow diagrams illustrated in FIG. **9**A and FIG. **9**B.

[0097] FIG. **9**A and FIG. **9**B depict a message flow diagrams of a representative interaction which illustrates the inventive concepts for a private network pre-paid service application of the present invention for the example telecommunications network illustrated in FIG. **8**. Those skilled in the art will recognize that queries and responses may be formulated and routed via a variety of methods including via the procedures described by GSM 02.78, GSM 03.78, GSM 09.02, and GSM 09.78. Those skilled in the art will also recognize that circuit-switched calls may be established via a number of methods including via the procedures described in T1.113 and ITU-T Q series recommendations. Detailed descriptions of well known query and call establishment procedures are omitted so as not to obscure the description of the present invention with unnecessary detail.

[0098] At **900**, mobile station **114** submits a service request for the destination mobile station **200** to its serving PBX **112** via a radio link **115** and base station **113**. The service request contains the network address of the originating mobile station **114**. The PBX **112** receives the service request and recognizes, based on an internal translation, mapping, or database lookup, that additional call treatments may need to be applied for calls originated from the mobile station **114** and formulates a query which is forwarded to the PVNG **28**.

[0099] At **901**, the PVNG **28** receives the query and invokes a subscriber profile application resident (not shown) on the PVNG **28**. Based on an internal translation or database lookup, the subscriber profile application determines that the originating mobile station **114** is associated with a pre-paid application which is resident on the PNG **27**. The PVNG **28** forwards the query to the PNG **27** via SCEAPI **19**.

[0100] At **902**, the PNG **27** receives the query and invokes a pre-paid application resident (not shown) on the PNG **27**. The pre-paid short message application on PNG **27** determines the rate to be applied. Not shown are the message flows for an optional manifestation of the pre-paid service where the PNG **27** would accesses the HLR **109** in order to determine the rate based on the terminating mobile station's **200** current location. The pre-paid application on the PNG **27** checks to see if the originating mobile station **100** has an account balance sufficiently above a minimum threshold. In this example, this check is achieved by sending a decrement balance query to a prepaid subscriber account database resident (not shown) on the SCP **110**. In an alternative manifestation of the service, the prepaid subscriber account database could be resident in the PNG **27**.

[0101] At **903**, the SCP **110** checks the originating mobile station's **114** balance and sends back a response which indicates the result of the SCP's **110** action. For the purpose of this example, the response will contain the originating mobile station's balance.

[0102] At **904**, the PNG **27** receives the response from the SCP **110** and determines whether the message should proceed to the terminating mobile station **100** based on the content of the response. For the purpose of this message flow sequence, it will be assumed that the originating mobile station **114** has a sufficient balance. The PNG **27** formulates a response indicating that the call may proceed and submits the response to the PVNG **28** via SCEAPI.

[0103] At **905**, the PVNG **28** receives the response from the PNG **27** and invokes a subscriber profile application resident (not shown) on the PVNG. Based on an internal translation or database lookup, the subscriber profile application determines that the response was associated with a

previous query and formulates a response which will forward the instructions received from the PNG **27** to the PBX **112**. The content and format of the response may vary pursuant to the private network providers requirements including the capabilities supported by the PBX **112**.

[**0104**] At **906**, the PBX **106** receives the response from the PVNG **28**.

[**0105**] At **907**, the PBX invokes the procedures to establish a call to the terminating SSP **104**. Not shown are the message flows which are used to establish connectivity via the circuit-switched or packet based network. Not shown are the message flows which may be required in order to determine the serving SSP **104** via an HLR **109** in a mobile environment.

[**0106**] At **908**, a voice connection between the originating mobile station **114** and the destination mobile station **100** is established and voice communication takes place. During this call, the prepaid application resident on the PNG **27** maintains call timers to decrement the calling subscribers account in accordance with the billing rate of the call.

[**0107**] At **909**, the prepaid application resident on the PNG **27** determines that the client's balance has expired. The prepaid application resident on the PNG **27** formulates a query indicating that the call should be terminated. The query is forwarded to the PVNG via SCEAPI.

[**0108**] At **910**, the query is received by the PVNG **28** and the subscriber profile application resident (not shown) on the PVNG **28** is invoked and executed using SCEE.

[**0109**] Based on an internal translation or database lookup, the subscriber profile application formulates a query which will forward the instructions received from the PNG **27** to the PBX **112**. The content and format of the query may vary pursuant to the private network providers requirements including the capabilities supported by the PBX **112**.

[**0110**] At **911**, the PBX **112** receives the query from the PVNG **28**.

[**0111**] At **912**, the PBX **112** invokes the procedures to terminate the existing call to the terminating SSP **100**. Not shown are the message flows which are used to terminate connectivity via the circuit-switched or packet based network. The PBX formulates a query response which indicates that the call has been terminated and forwards the query response to the PVNG **28**.

[**0112**] At **913**, the PVNG receives the query response and invokes a subscriber profile application resident (not shown) on the PVNG **28**. Based on an internal translation or database lookup, the subscriber profile application determines that the response was associated with a previous query and formulates a response which will forward the contents of the query response to the PNG **27** via SCEAPI **19**.

[**0113**] At **914**, the PNG receives the query response and invokes a pre-paid application resident (not shown) on the PNG **27**. Based on an internal translation or database lookup, the prepaid application determines that the response was associated with a previous query. The prepaid application formulates a query to the SCP **110** which will be used to decrement the balance by a suitable amount.

[**0114**] At **915**, the SCP **110** receives the query and decrements the originating mobile station's **114** balance and sends back a response which indicates the result of the SCP's **110** action.

[**0115**] At **916**, the PNG **27** receives the response and invokes a prepaid application resident on the PNG **27**. Based on an internal translation or database lookup, the prepaid application determines that the response was associated with a previous query and closes the session associated with the originating mobile station **114**.

[**0116**] Referring to FIG. **8**, FIG. **9**A, and FIG. **9**B, those skilled in the art will appreciate that the service creation environment provided by the PNG **27** and PVNG **28** in conjunction with SCEAPI **19** and SCEE **15** have provided for an innovative pre-paid service for mobile stations served by the private domain which may not have otherwise been supported using the underlying network infrastructure.

[**0117**] Referring to FIG. **10**, the configuration of the PNG **27**, PVNG **28**, and an additional PNG **227** in an example telecommunications system is illustrated in a block diagram for a transcription service application of the present invention. The example telecommunications system is derived from the telecommunications systems illustrated in FIG. **3** and FIG. **4** and will be used to illustrate a virtual private network service application of the present invention with reference to the message flow diagrams illustrated in FIG. **11**A and FIG. **11**B.

[**0118**] FIG. **11**A and FIG. **11**B depict a message flow diagrams of a representative interaction which illustrates the inventive concepts for a transcription service application of the present invention for the example telecommunications network illustrated in FIG. **10**. Those skilled in the art will recognize that queries and responses may be formulated and routed via a variety of methods including via the procedures described by GSM 02.78, GSM 03.78, GSM 09.02, and GSM 09.78. Those skilled in the art will also recognize that circuit-switched calls may be established via a number of methods including via the procedures described in T1.113 and ITU-T Q series recommendations. Detailed descriptions of well known query and call establishment procedures are omitted so as not to obscure the description of the present invention with unnecessary detail.

[**0119**] At **1100**, a mobile station **100** submits a service request for the destination fixed station **203** to its serving SSP **104** via a radio link **102** and base station **101**. The SSP **104** receives the service request and recognizes, based on an internal translation, mapping, or database lookup, that additional call treatments may need to be applied for calls originated from the mobile station **100** or for calls destined to the fixed station **203** and formulates a query which is forwarded to the PNG **27**.

[**0120**] At **1101**, the PNG **27** receives the query and invokes a subscriber profile application resident (not shown) on the PNG **27**. Based on an internal translation or database lookup, the subscriber profile application determines that the originating mobile station **100** is associated with an application which is resident on an second PNG **227**. The PNG **28** forwards the query to the second PNG **227** via SCEAPI **19**.

[**0121**] At **1102**, the second PNG **227** receives the query and invokes a subscriber profile application resident (not

shown) on the second PNG **227**. Based on an internal translation or database lookup, the subscriber profile application determines that the originating mobile station **100** or the terminating fixed station is associated with a transcription service. Pursuant to the service logic associated with the transcription service, the second PNG **227** sends a response back to the PNG which contains a SCEAPI directive to route the call to the second PNG.

[**0122**] At **1103**, the PNG **27** receives the response from the second PNG **227** and invokes a subscriber profile application resident (not shown) on the PNG **27**. Based on an internal translation or database lookup, the subscriber profile application determines that the response was associated with a previous query and formulates a response which will forward the instructions received from the second PNG **227** to the SSP **104**. The content and format of the response may vary pursuant to the telecommunication network provider's requirements including the capabilities supported by the SSP **104**. For example, the response message would vary as a function of whether the SSP **104** supports IN or AIN compliant triggers.

[**0123**] At **1104**, the SSP **104** receives the response from the PNG **27**.

[**0124**] At **1105**, the SSP invokes the procedures to establish a call to the second PNG **227** based on the destination address received in the response from the PNG **27**. Not shown are the message flows which are used to establish connectivity via the circuit-switched or packet based network. Upon receiving the call, the second PNG **227** invokes a subscriber profile application resident (not shown) on the PNG **227**. Based on an internal translation or database lookup, the subscriber profile application determines that the response was associated with a previous query and establishes a call to the fixed station **203**. Not shown are the message flows which are used to establish connectivity via the circuit-switched or packet based network. The message flows associated with establishing connectivity between the mobile station **100** and fixed station **203** may be used by the second PNG **227** in order to invoke a speech to text transcription application (not shown).

[**0125**] At **1106**, a voice connection between the originating mobile station **100** and the destination fixed station **203** is established via the second PNG **227** and voice communication takes place. During this call, the transcription application resident on the second PNG **227** transcribes the conversation via a speech to text application (not shown) which is invoked by the subscriber profile application upon receipt of an answer signal or message. The transcribed conversation is stored in file on a database which resides on the second PNG **227**.

[**0126**] At **1107**, the call is terminated by either the calling mobile station **100** or the terminating fixed station **203**. Not shown are the message flows which are used to terminate connectivity via the circuit-switched or packet based network between the mobile station **100** and the fixed station **204** via the second PNG **227**. The speech to text transcription application resident on the second PPG terminates the transcription process and informs the subscriber profile application resident (not shown) on the second PNG **227** that the transcription process has been completed and the location and name of the transcription file. Based on an internal translation or database lookup, the subscriber profile application formulates a message which will forward the transcription file to a PVNG **28** via SCEAPI.

[**0127**] At **1108**, the PVNG **28** receives the SCEAPI directive and stores the file pursuant to the commands in the SCEAPI directive. The PVNG **28** formulates and transmits an acknowledgement message to the second PNG **227** via SCEAPI.

[**0128**] At **1109**, the second PNG **227** receives the acknowledgement message and terminates the session associated with the transcription service application. Not shown are any incremental messages which may be required to terminate any active sessions in either the second PNG **227** or PNG **27**.

[**0129**] Referring to FIG. **10**, FIG. **11**A, and FIG. **11**B, those skilled in the art will appreciate that the service creation environment provided by the PNG **27**, second PNG **227**, and PVNG **28** in conjunction with SCEAPI **19** have provided for an innovative transcription service for both fixed and mobile stations in the public domain which may not have otherwise been supported using the underlying network infrastructure.

[**0130**] While the foregoing describes what are considered to be preferred example embodiments of the invention, it is understood that various modifications may be made therein and that the invention may be implemented in various forms and embodiments, and that it may be applied in numerous applications, only some of which have been described. The claims are intended to cover all such modifications and variations which fall within the true scope of the invention.

What is claimed is:

1. The method of communicating with a private or public telecommunications system; the method comprising: interfacing with the network elements which comprise a public communication network, wherein the network includes network elements consisting of at least one switching center, and an intelligent network that includes a number of network elements having a service switching function or service control function; interfacing with the network elements which comprise a private communication network, wherein the network includes a private branch exchange in which access is provided between the public communications network and the private network over at least one interface; utilizing the native communication protocols supported by the network elements located in the domain of both the public communications network and private network.

2. The method according to claim 1, wherein the informational and control parameters and variables associated with a public telecommunications network element are distilled into a vector of alphanumeric values or objects.

3. The method according to claim 1, wherein the informational and control parameters and variables associated with a private network element are distilled into a vector of alphanumeric values or objects.

4. The method according to claim 2, wherein a vector of alphanumeric values or objects define the state of a particular subscriber.

5. The method according to claim 2, wherein a vector of alphanumeric values or objects define the state of a particular circuit-switched or packet-switched session.

6. The method according to claim 3, wherein a vector of alphanumeric values or objects define the state of a particular subscriber.

7. The method according to claim 3, wherein a vector of alphanumeric values or objects define the state of a particular circuit-switched or packet-switched session.

8. The method according to claim 2, wherein the vector of alphanumeric values or objects define the controllable attributes of a public telecommunications network element.

9. The method according to claim 3, wherein the vector of alphanumeric values or objects define the controllable attributes of a private network element.

10. The method according to claim 2 wherein the set alphanumeric values or objects are utilized to provide an application programming interface which execute on a computer platform.

11. The method according to claim 3 wherein the set alphanumeric values or objects are utilized to provide an application programming interface which execute on a computer platform.

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