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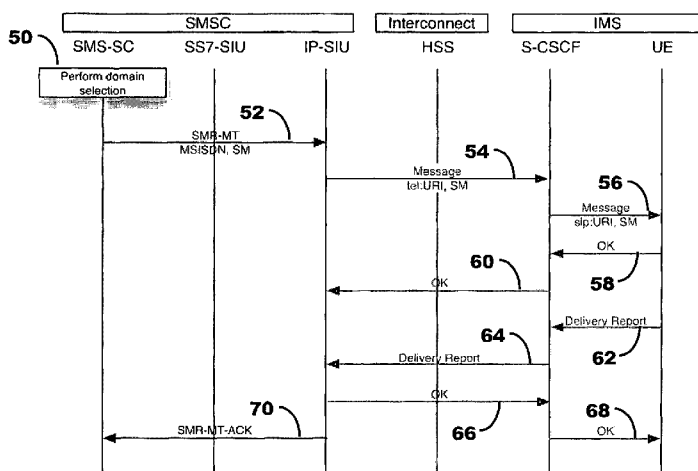
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(54) Title: SHORT MESSAGE SERVICE INTEGRATION WITH IP NETWORKS

**Fig. 5**

(57) Abstract: A short message service center (SMSC) of a circuit switched network is provided with a database of attached subscribers on an IP network such as an IMS network. The SMSC is programmed to determine, on receipt of a short message service (SMS) text message, whether the intended recipient is attached to the IP network, and if so, to forward the message directly to an IP network server specified for that subscriber. This permits communication of SMS messages from the circuit-switched network to the IMS network (and vice versa) without requiring the Home Location Register (HLR) of the circuit-switched network to be modified or upgraded for IMS compatibility.



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Short Message Service Integration With IP Networks

Technical Field

This invention relates to the provision of short message service (SMS) messages to and from internet protocol (IP) based networks.

Background Art

The 3rd Generation Partnership Project (3GPP) specifies a globally applicable third-generation (3G) mobile phone system specification based on evolved Global System for Mobile Communications (GSM) specifications. The scope of 3GPP has been enlarged to include the integration of the circuit switched (CS) mobile network with the IP Multimedia Subsystem (IMS) which is an architectural framework for delivering Internet Protocol (IP) multimedia services.

The short message system (SMS) has been a long-standing feature of the GSM and 3G architectures. It is widely used by customers and provides an important source of revenue for mobile operators. Hence there is a need to accommodate SMS messaging within an integrated network including both 3GPP and IMS networks.

The 3GPP standards mandate the introduction of a new core network node called the IP short messaging gateway (IP-SM-GW) to interconnect SS7 & MAP based CS cores and IP-based IMS cores.

Fig. 1 is a simplified system architecture of a network which implements the standards-based solution described above. One can see that in the SS7 core of the circuit switched (CS) network, there is a short messaging service center (SMSC) 14 which is in communication with a number of mobile switching centers (MSCs) 16 and with the home location register (HLR) 18. The IP-SM-GW 20 sits at the interface with the IMS core 22. In the IMS core a number of call session control function (CSCF) servers 24 are available to control the routing of session initiation protocol (SIP) based messages to other entities (not shown) of the IMS architecture. A home subscriber server (HSS) 26, similar to the HLR 18 of the SS7 core 12, maintains subscriber profile and location data for the CSCFs 24.

The fundamental concept underlying the IP-SM-GW entity 20 is that it should appear to the SMSC 14 of the CS network core as just another MSC to which SMS messages may be routed if the HLR

18 indicates the recipient subscriber of the SMS message to be attached to that (virtual) MSC. In reality the IP-SM-GW is not an MSC with mobile users attached to it, but when it receives an SMS message addressed to a subscriber who is supposed to be attached, it forwards this to a messaging server (typically a serving CSCF 24) of the IMS network.

- 5 There is a registration phase for the subscriber registering on the IMS network which enables messages on the SS7 network destined for the subscriber to be transferred via the IP-SM-GW. When the IMS user endpoint (or user equipment) (UE) boots, it registers with the CSCF 24 which then registers with the HSS 26. Specific triggers in the HSS 26 issue a registration request to the IP-SM-GW 20. The IP-SM-GW then has an MSISDN <-> SIP Identity and location entry. It sets a flag
10 in the HLR 18 using MAP AnyTimeModification to enable routing to IP-SM-GW.

As seen in Fig. 2, this solution results in large inefficiencies. When a message is received at the service center component (SMS-SC) of the SMSC for delivery to a subscriber who happens to be currently attached to the IMS network rather than the SS7 CS network, a complex message flow results. As seen in message 2, the SMS-SC notifies the gateway MSC (SMS-GMSC) using a short
15 message relay - mobile terminated (SMR-MT) message, thereby handing the message including the recipient's MSISDN number and the short message body itself to the GMSC. Both the SMS-SC and SMS-GMSC are integrated within the SMSC in this embodiment as is conventional.

In message 3a, the GMSC queries the HLR 18 (Fig. 1) using the SendRoutingInfoForSM method for that MSISDN. The HLR then relays this message to the IP-SM-GW based on the MAP
20 AnyTimeModification flag set earlier as described above. The purpose of this message is to get the subscriber's location (serving MSC) and IMSI.

In message 3b, the IP-SM-GW puts the initial SRI-SM on hold and generates a new request with the same parameters to the HLR. The HLR sees that the request comes from the IP-SM-GW and responds with the correct information (IMSI and MSC).

- 25 The IP-SM-GW then caches the information received along with the MSISDN. It generates a CorrelationID which is in fact a key to the entry in the cache.

In message 3c, the IP-SM-GW replies to the original SRI-SM back to the HLR which relays it back to the SMS-GMSC. This reply contains the CorrelationID instead of the IMSI and the IP-SM-GW address instead of the serving MSC address.

- 30 In message 4, the SMS-GMSC sends the ForwardSM with the short message to the IP-SM-GW.

In step 5, the IP-SM-GW performs a domain selection in which it looks up the MSISDN of the intended recipient and determines the appropriate S-CSCF to send the message to. Again this information has been stored earlier from the HSS 26 registration request to the IP-SM-GW 20 causing the IP-SM-GW to store an MSISDN <-> SIP Identity and location entry.

- 5 In message 6, the SMS message is reformulated as a SIP message with the SM body incorporated into the body of the SIP message and the recipient's MSISDN converted in the TEL: URI field of the SIP message. Messages 7-9 show the usual SIP exchanges between the user endpoint (UE) and the originating endpoint (in this case the IP-SM-GW). When delivery is confirmed, the IP-SM-GW acknowledges this back to the GMSC in a ForwardSM-ACK message and this is in turn
10 acknowledged back to the SMS-SC using the SMR-MT-ACK message. In addition a set of four delivery acknowledgement messages are indicated using dotted lines. The messages are denoted using dotted lines because their sending is conditional on flags set in the HLR. Such messages are referred to below as conditional messages.

- Leaving aside the 8 SIP messages between IP-SM-GW, S-CSCF and UE, and the initial and terminal
15 SMR-MT and SMR-MT-ACK messages between the SMS-SC and the SMS-GMSC, it can be seen that the IP-SM-GW solution results in an additional 8 SS7 messages (or 12 including the conditional delivery acknowledgement messages) between SMS-GMSC, HSS and IP-SM-GW. These messages are required in order to account for the fundamental design principle that the IP-SM-GW should appear to the SMSC as a regular MSC, while in fact being unable to hand on a
20 message to an attached subscriber as a normal MSC would be able to do.

A further drawback is that implementation of this system requires not only the new IP-SM-GW component, but also modification of the existing HLR entity in the SS7 core. The HLR must be modified to relay the SRI-SM to the IP-SM-GW only if it does not originate from it. It must also store the IMS registration flag and provide the MAP AnyTimeModification to manipulate it.

25 Disclosure of the Invention

The invention provides a short message service center as claimed in claim 1.

- The SMSC of the invention differs in fundamental design from the standards-based design in that it no longer requires the SMSC to interact with the virtual MSC entity of the IP-SM-GW and thus the HLR of the CS core network does not need modification to account for the lack of full MSC
30 functionality inherent in the IP-SM-GW. Instead, the SMSC maintains its own database of IMS

registered subscribers and is therefore able to make a domain selection using that database at an early stage of the routing decision making process. When the domain selection results in the IMS network being identified for routing, the SMS can be simply passed to the IP signalling interface of the SMSC which translates and forwards the message to a S-CSCF or other messaging server on the IP network.

As will be seen further below, this design change eliminates the set of 8-12 additional SS7 messages required between the HLR and the IP-SM-GW in the standards-based solution and, by removing the requirement for the HLR to participate in handling a message ultimately destined for the IMS network, obviates the need for the HLR to be upgraded with the additional functionality needed to interface with the IP-SM-GW.

The invention also provides a method of distributing SMS messages as claimed in claim 10.

Detailed Description of Preferred Embodiments

In Fig. 3 a network architecture is shown according to the invention. In Fig. 3 the same reference numerals are employed as in Fig. 1 for corresponding entities. It can be seen that, relative to Fig. 1, the IP-SM-GW is no longer present and that the modified SMSC 14 now provides the interface directly to the IMS network.

Fig. 4 shows the architecture of the SMSC 14. The SMSC has a dual stack, one stack 30 for communicating with the SS7 core and another stack 32 to communicate with the IMS core. The dual stack shown includes redundancy and a single stack could be employed with respective signalling interfaces (SIUs) to communicate with the SS7 and IMS cores respectively.

The SS7-SIU 34 and IMS-SIU 36 perform the functions of the SMS-GMSC and SMS-IWMSC (inter-working mobile switching centre) in a conventional SS7 GMSC, relaying messages to and from MSCs on the SS7 network and CSCFs on the IMS network. The message processing unit (MPU) 38 acts as an SMS-SC component in a conventional SS7 GMSC.

The rules engine unit (REU) 40 and message routing unit (MRU) 42 provide extra functionality and are not involved in the message flows described further below. The stack or stacks each also include a subscriber database 46 recording details of subscribers which are attached to the IMS network, based on registration information received from the IMS network as described below, and which provides a correspondence between the SS7 addressing (e.g. MSISDN) and the IMS

addressing (e.g. URI or SIP identity and location such as S-CSCF with which the SIP UE is registered).

As shown in Fig. 5, a message delivery to a subscriber located at a user endpoint (UE) on the IMS network is very different from the message flow of Fig. 2.

- 5 As with the arrangement of Figs. 1 and 2, there is an initial registration phase (not shown). When the IMS user endpoint (or user equipment) (UE) boots, it registers with the CSCF 24 which then registers with the HSS 26. Specific triggers in the HSS 26 issue a registration request to the modified SMSC 14. The SMSC 14 creates or modifies an entry in its database of IMS-registered subscribers, and typically this database will include a mapping MSISDN < > SIP Identity and
- 10 location entry. Crucially, no modification of the HLR is required, in comparison to Figs. 1 and 2, and the HLR need not be informed of the presence of the subscriber on the IMS network - as far as the HLR is concerned, the subscriber is simply not attached to the SS7 network, just like any other absent subscriber. The foregoing assumption that the subscriber is attached either to the CS network or to the IMS network is generally true for LTE handsets with a single radio. For UMTS
- 15 or dual-radio handsets, the subscriber may be attached to both IMS and CS cores at the same time in some cases.

- Upon receipt of a message at the SMS-SC, the first step is a domain selection step. The SMS-SC queries its own internal database of IMS registered subscribers to determine if the intended recipient is attached to the IMS network, step 50. If the subscriber has registered with the HSS of
- 20 the IMS network and has not deregistered, then the internal database will record the subscriber's presence on the IMS network and will also record the appropriate location (CSCF) and SIP address to be used in addressing a message to that subscriber. Immediately, the requirements of Fig. 2 to have a series of SRI-SM message flows to determine a pseudo-location and a virtual MSC to which the subscriber is "attached" become redundant.

- 25 In message 52, the SMS-SC component (implemented in the MPU 38 of Fig. 4) sends a short message relay - mobile terminated (SMR-MT) message to the IMS signalling interface unit 36. This includes the subscriber's MSISDN and the short message itself. The IMS-SIU 36 can perform a simple look-up in the database to obtain the subscriber's SIP identity (or more exactly, the telephony URI of the subscriber) and the address of the relevant CSCF 24, and a message is sent,
- 30 message 54, to that CSCF with the subscribers tel:URI and the short message text. In message 56,

the message is relayed to the UE by the CSCF, and an acknowledgement is sent back to the CSCF, message 58, which is in turn relayed to the IMS-SIU, message 60.

When delivery is confirmed, a series of delivery report and acknowledgement messages 62, 64, 66, 68 are exchanged between the US, CSCF and IMS-SIU, and the IMS-SIU also completes the transaction with and SMR-MT-ACK message back to the SMS-SC component to confirm completion of delivery, message 70.

Comparing the message flow of Fig. 2 showing the delivery of a mobile terminated message to an IMS registered subscriber using the standards based approach, and Fig. 5 showing the delivery of such a message to an IMS registered subscriber using the modified SMSC of the invention, it can be seen that there is a significant benefit. Firstly, the HLR does not need to be modified to take account of the IP-SM-GW acting as a virtual MSC, as in Figs. 1 and 2. This results in a significant saving in infrastructure expenses. Secondly, the IP-SM-GW component itself is no longer necessary. Thirdly, on a per-message basis it can be seen that the number of individual exchanges are reduced from 8 SIP and 8 SS7 message exchanges (or 12 SS7 with conditional delivery acknowledgements) for Fig. 2 to 8 SIP and zero SS7 messages for Fig. 5. There is no additional overhead in the initial registration process, which is actually simplified.

Fig. 6 shows a message flow which is generally similar to that of Fig. 2 and which occurs using the conventional equipment of Fig. 1 but where the delivery to the user equipment on the IMS network using SIP ultimately fails and there is a fallback to CS delivery using a serving GPRS support node (SGSN). For ease of explanation, the message flows encompassed by the bracket A and bracket B are exactly identical to the corresponding messages of Fig. 2, i.e. for bracket A up to the point where the messages 8-OK and 9-OK are passed from the UE to the S-CSCF and back to the IP-SM-GW; and for bracket B, from the point where delivery has been confirmed with the conditional message ReportSM DeliveryStatus to the end of the message flow. The fallback thus involves the messages intermediate between brackets A and B, involving 4 SIP messages relating to the delivery report failure identified with bracket C, and 3 SS7/GPRS messages between the IP-SM-GW, SGSN and UE identified with bracket D.

In comparison, Fig. 7 shows the equivalent message flows to Fig. 5 where fallback to CS delivery using SGSN is involved, and Bracket E is used to identify the same initial message flows as in Fig. 5 up to the point just before delivery fails. Following the 4 SIP delivery failure messages which are identical to those of Fig. 6 and are thus identified using the same bracket C, the IP-SIU informs the

SMS-SC that the message has failed and the SMS-SC initiates a new delivery attempt to the SS7-SIU, bracket F.

The SS7-SIU then carries out a set of six SS7 message exchanges with the HSS and the SGSN to firstly identify the SGSN and then pass the message on for delivery over GPRS, bracket G, before a
5 final acknowledgement of success back to the SMS-SC.

Comparing Figs. 6 and 7, therefore, it can be seen that the fallback to CS using the conventional architecture requires 8 SIP and 14 SS7 (or 10 without conditional delivery acknowledgement).

Using the modified SMSC, the number of messages is 8 SIP and 6 SS7 messages. This is particularly noteworthy given that the modified SMSC is particularly efficient due to its pre-
10 identification of the appropriate delivery domain. Fig. 7 demonstrates that even when delivery fails over the pre-identified domain, it is still more efficient than the standards-based method of delivery.

Finally, Figs. 8 and 9 show that even for incoming messages from a subscriber attached to the IMS network (i.e. mobile originated (MO) SMS messages from IMS), the modified SMSC is more
15 efficient than the standards-based solution.

Referring to both Figs. 8 and 9, it can be seen that in each case there are a set of four initial SIP messages, labeled with bracket H where the UE sends the message via the S-CSCF to the IP-SM-GW (Fig. 8) or to the IMS-SIU (Fig. 9) and the message is acknowledged. Also in each case the message flow terminates with a set of four corresponding report messages between the same
20 entities, labeled in each case with bracket I.

Also in each of Figs. 8 and 9 there are two internal messages within the SMSC, labeled J, where the message is passed from the external interface of the SMSC to the SMS-SC for onward delivery within the SS7 network and this is acknowledged. In Fig. 8 the external interface of the SMSC is the conventional SMS-IWMSC component, while in Fig. 9 the external interface is the IMS-SIU.

Thus, it can be seen that Fig. 8 requires two additional SS7 messages which are not needed in Fig. 8, namely passing the message from the IP-SM-GW interconnect element to the SMS-IWMSC and acknowledging (these two messages are labeled ForwardSM and ForwardSM-ACK, respectively).

Thus, in each scenario described above, the modified SMSC provides more efficient message flows with a corresponding reduction in processing, buffering, memory and bandwidth
30 requirements, as well as the previously described advantages of not having to modify the HLR of

the SS7 network or to incorporate the IP-SM-GW interconnect.

Claims

1. A short message service center (SMSC), comprising:

a) a service center entity arranged to receive and temporarily store a short message service (SMS) message and to forward said stored SMS message to a routing entity once routing is established;

b) an internet protocol (IP) signalling interface configured to provide signalling to and from a messaging server on an IP network to which the SMSC is connected, and to translate messages between an IP-compatible messaging format and an SMS format, thereby providing messaging communication between said service center entity and a messaging server on the IP network;

c) a database containing details of a plurality of subscribers attached to the IP network, said details including at least an address of a messaging server on the IP network via which a message may be routed to a recipient subscriber; and

d) a processor programmed to:

(i) upon receipt of a message at the service center entity, perform a domain selection for routing the message, resulting in the selection of either the IP network or a circuit switched (CS) network in which said SMSC is located, wherein the selection of the IP network is based at least in part on identifying or not identifying in said database said recipient subscriber indicated to be attached to the IP network;

(ii) if the domain selection results in selection of the CS network, causing the service center entity to route the message to a mobile switching center (MSC) of the CS network; and

(iii) if the domain selection results in selection of the IP network, causing the service center entity circuit to forward the message to the IP signalling interface for routing to the messaging server identified in said database for that subscriber;

whereby the domain selection is performed by the SMSC alone based on the existence or otherwise in said database of said SMSC, at the time of receipt of the SMS message at said service center entity, of details for said recipient subscriber and whereby said domain selection is

performed to select said IP network without requiring the consultation of a Home Location Register of the CS network.

2. A short message service center as claimed in claim 1, further comprising a first communications stack adapted to communicate with said circuit-switched network and a second
5 communications stack adapted to communicate with said IP network.

3. A short message service center as claimed in claim 1 or 2, further comprising an interface with a Home Subscriber Service (HSS) of the IP network whereby the database may be updated with said details of subscribers attached to the IP network from the interface with the HSS.

4. A short message service center as claimed in any preceding claim, wherein said database
10 further comprises a correspondence between a subscriber's addressing on the circuit-switched network and on the IP network.

5. A short message service center as claimed in any preceding claim, wherein the database comprises, in addition to said address of a messaging server on the IP network, an address specific to at least one subscriber attached to said network.

15 6. A short messaging service center as claimed in any preceding claim, wherein said IP network is an IP Multimedia Subsystem (IMS) network.

7. A short messaging service center as claimed in any preceding claim, wherein said circuit-switched network is a Signaling System No. 7 (SS7) network.

8. A messaging system comprising:

20 (i) a short messaging service center (SMSC) as claimed in any preceding claim;

(ii) a Home Subscriber Service of an IP network which is programmed to communicate to the SMSC details of attached subscribers;

whereby when a subscriber is attached to the IP network, details of that subscriber are recorded in said database of said SMSC.

25 9. A messaging system as claimed in claim 8, further comprising a call session control function of the IP network which is in communication with the SMSC such that, when a message is sent from a user endpoint on the IP network which is attached to the call session control function, the call session control function communicates the message directly to the SMSC.

10. A method of distributing short message service (SMS) messages, comprising the steps of:

a) maintaining, in a short message service center (SMSC) located within a circuit switched (CS) network, a database containing details of subscribers attached to an internet protocol (IP) network, wherein the IP network is connected to an IP signalling interface of the SMSC, and
5 wherein said details including at least an address of a messaging server on the IP network via which a message may be routed to a subscriber;

b) receiving and temporarily storing at a service center entity of the SMSC an SMS message directed to a recipient subscriber;

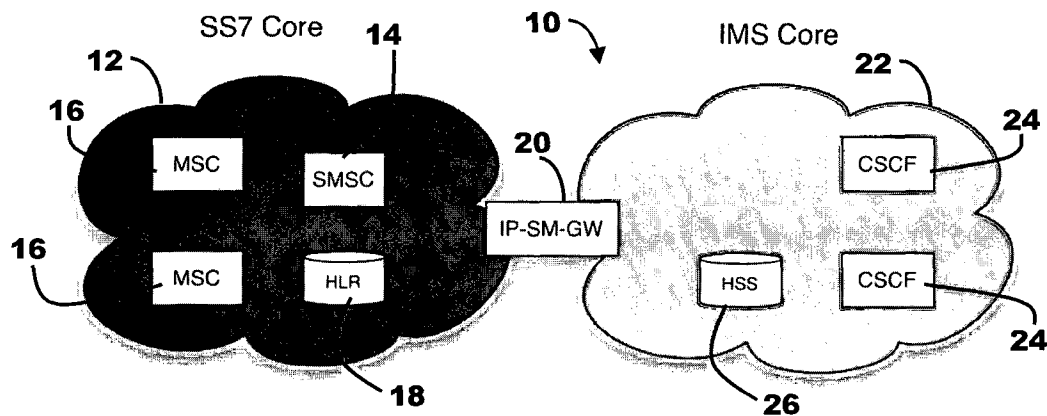
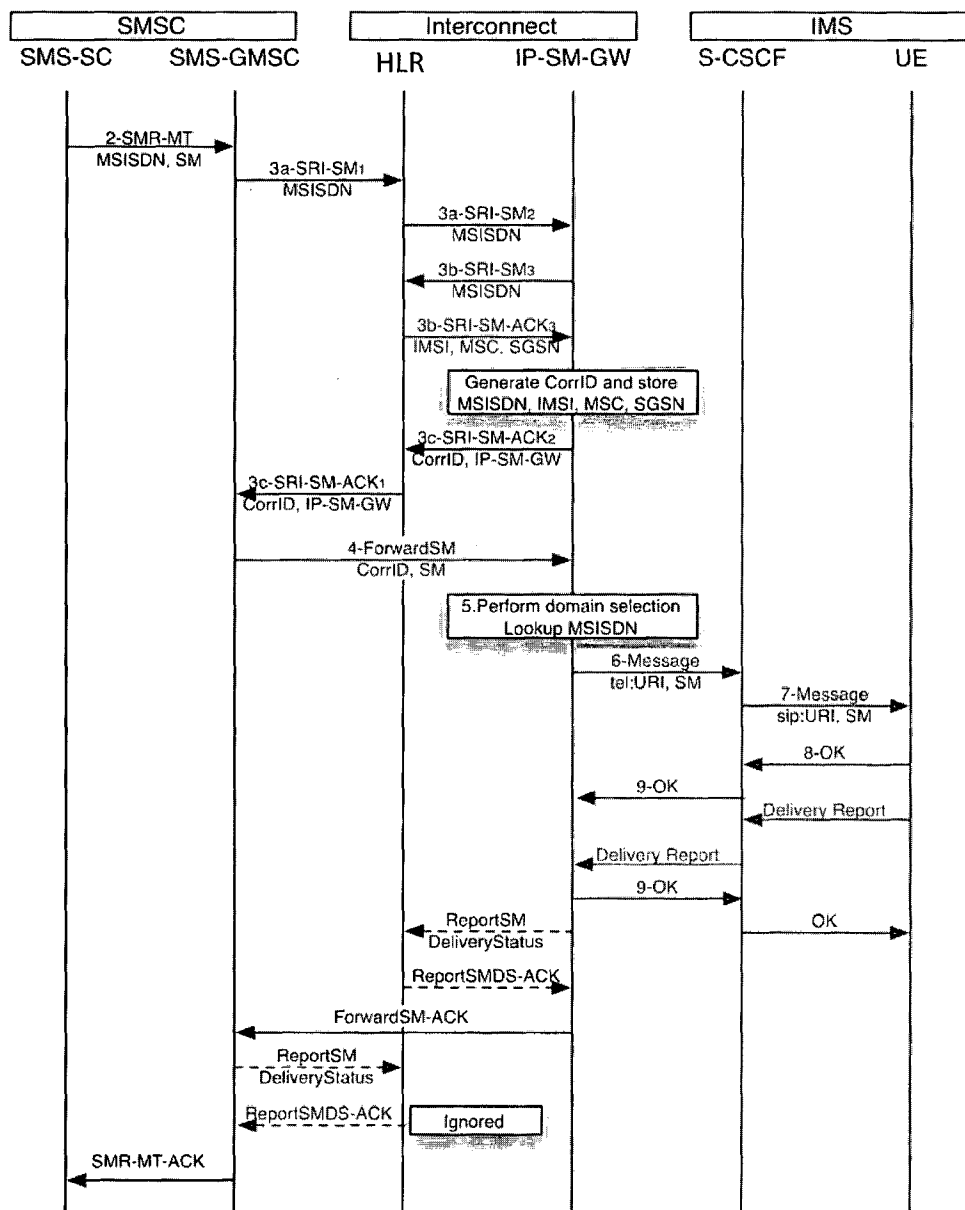
c) performing a domain selection for routing the message, resulting in the selection of
10 either the IP network or the CS network in which said SMSC is located, wherein the selection of the IP network is based at least in part on identifying or not identifying in said database said recipient subscriber indicated to be attached to the IP network

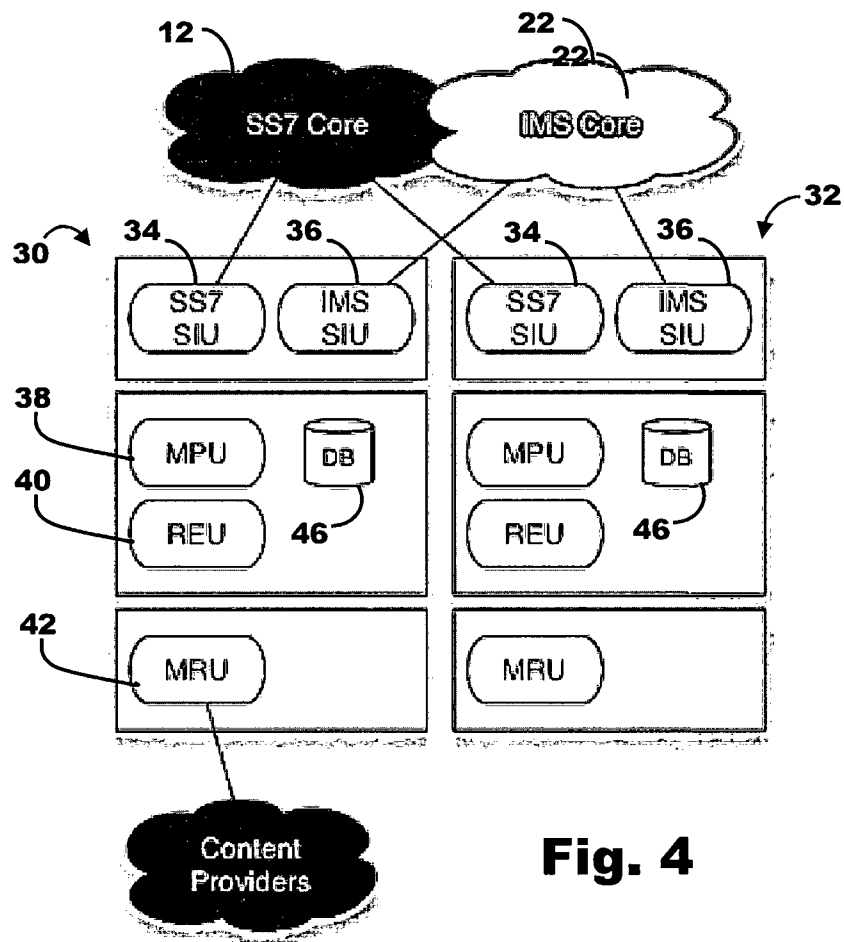
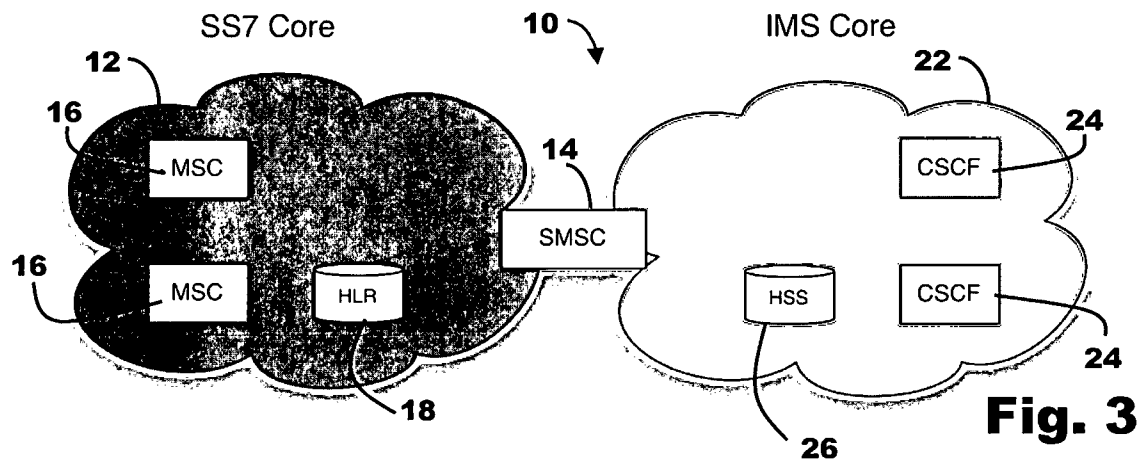
d) in the event that the domain selection results in selection of the CS network, causing the service center entity to route the message to a mobile switching center (MSC) of the CS network;
15 and

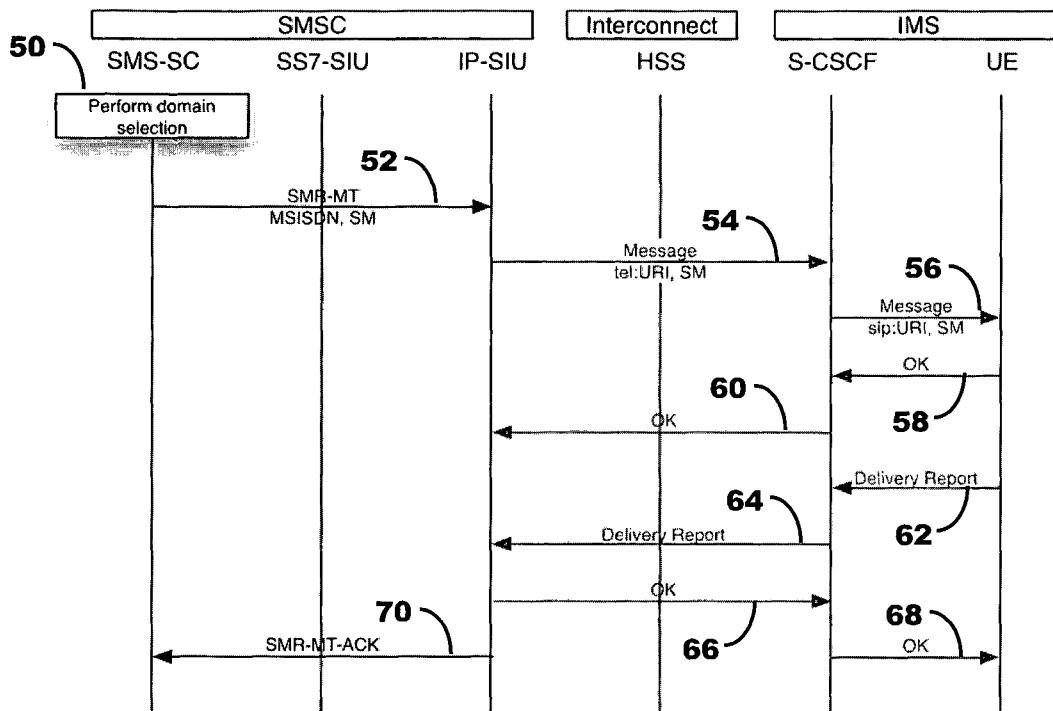
e) in the event that the domain selection results in selection of the IP network, causing the service center entity circuit to forward the message to the IP signalling interface for routing to the messaging server identified in said database for that subscriber;

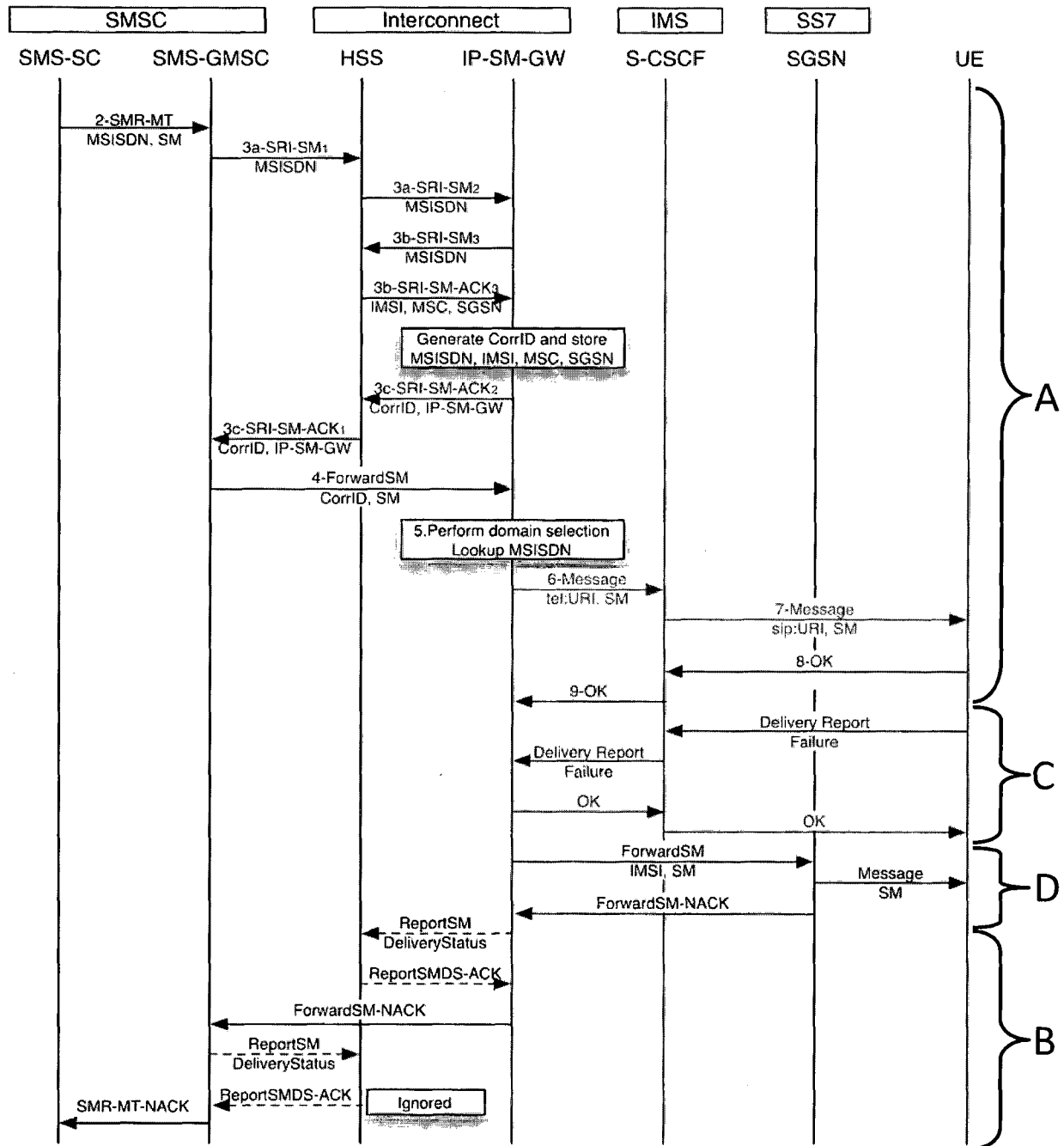
whereby the domain selection is performed by the SMSC alone based on the existence or
20 otherwise in said database of said SMSC, at the time of receipt of the SMS message at said service center entity, of details for said recipient subscriber and whereby said domain selection is performed to select said IP network without requiring the consultation of a Home Location Register of the CS network.

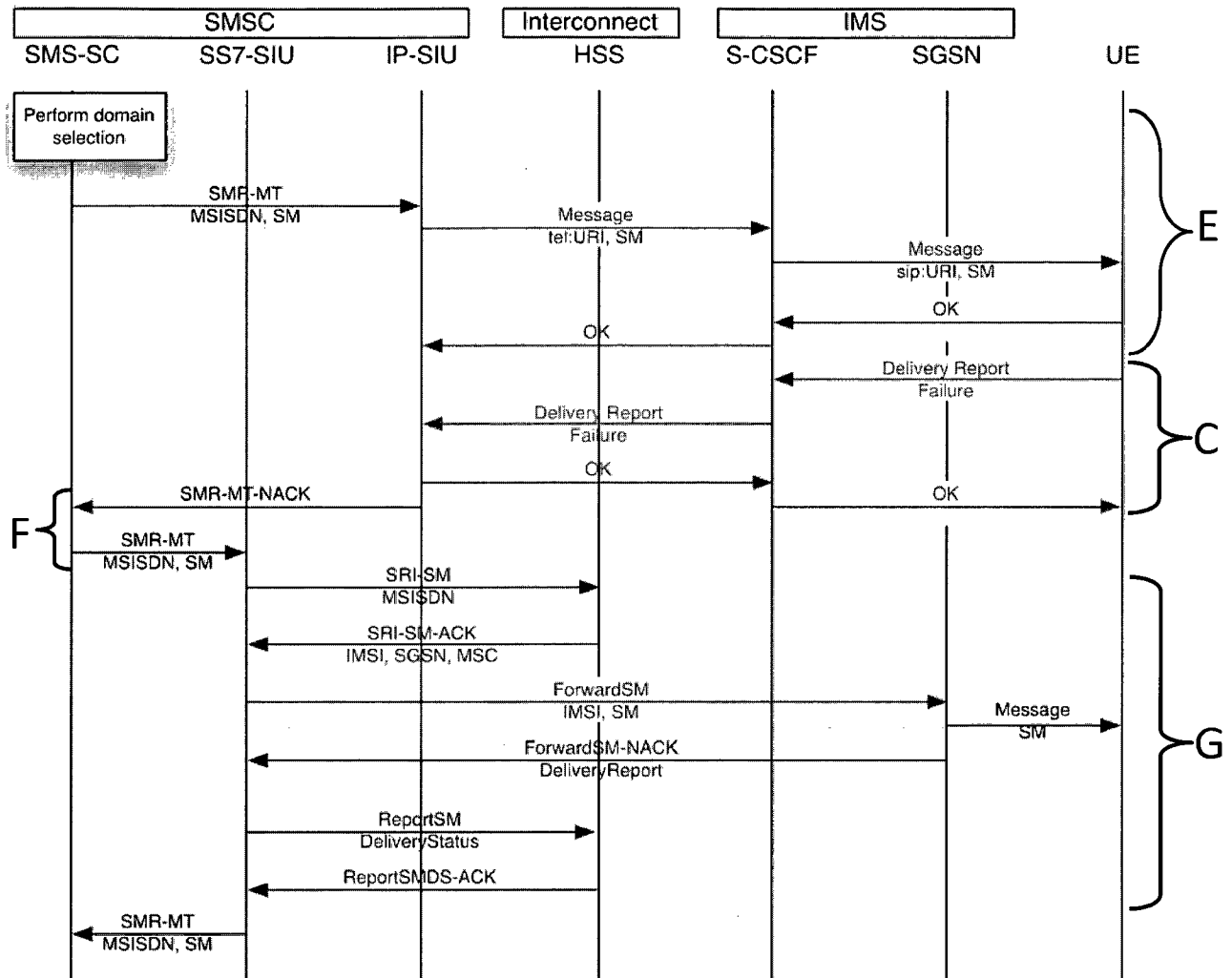
11. A computer program product comprising machine-readable instructions in tangible form
25 which when executed in a short-messaging service center (SMSC) of a circuit-switched network are effective to cause said SMSC to carry out the method of claim 10.

**Fig. 1****Fig. 2**



**Fig. 5**

**Fig. 6**

**Fig. 7**

