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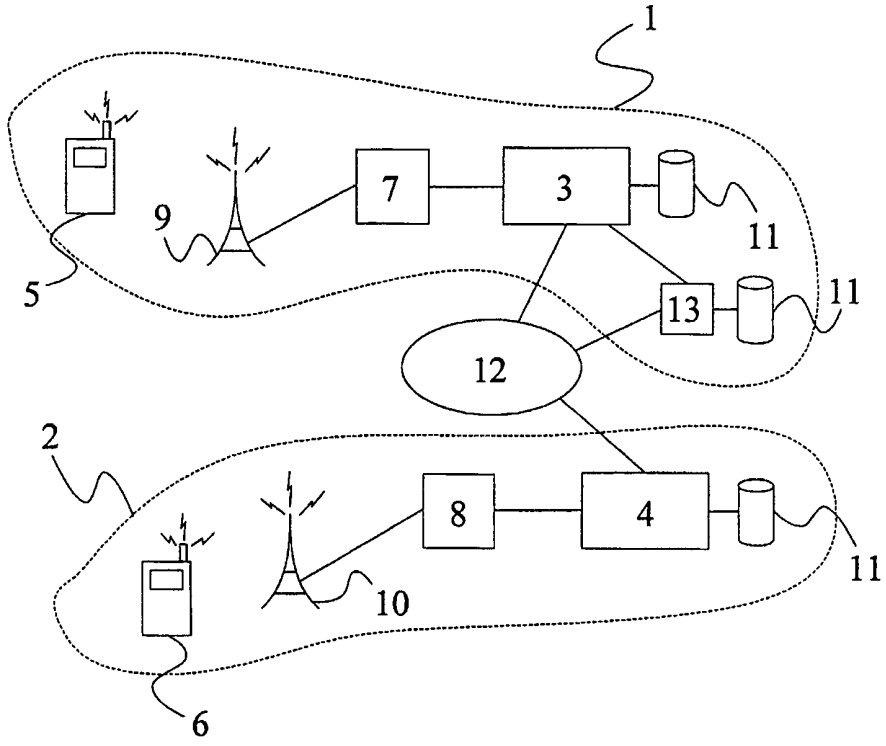
(54) Title: CALL SET–UP IN A TELECOMMUNICATIONS SYSTEM

(57) Abstract

A method of negotiating a coding type during the setting up of a voice call between two MSCs (3, 4) where the call set–up procedure is directed via an SSP (13). An Initial Address Message (IAM) is transmitted from the originating MSC (3) to the SSP (13) and includes the called number and an identification of the primary and secondary coding type preferences of the originating MSC (3). The SSP (13) determines the identity of the terminating MSC (4) based upon the called number, and further determines the coding type preferences of the terminating MSC (4). The SSP (13) then determines a call coding type preference on the basis of the coding type preferences of the terminating MSC (4) and of the coding type preference(s) of the originating exchange (3). If the call coding preference so determined differs from the primary coding type preference identified in the IAM, the primary coding type is replaced with the secondary coding type and the IAM is transmitted to the terminating MSC (4).



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Call Set-Up in a Telecommunications System

Field of the Invention

The present invention relates to call set-up in a telecommunications system and more particularly to the setting-up of voice calls via a called number translation point which performs a called party number translation.

Background to the Invention

The setting up of a telephone connection in a telecommunications system involves the negotiation and exchange of information between two or more nodes of the network. In particular, for a voice call made across a network boundary, call set-up generally involves a negotiation between the originating and terminating exchanges to determine the type of speech coding which is to be used for the call. Speech coding of voice signals is primarily used to reduce the transmission bit rate over the connection.

Considering the situation in Japanese telecommunications networks, the basic speech coding type is known as μ-law coding. μ-law coding is supported by all networks. In modern mobile digital networks (known as PDC networks), a network may support one or both of two additional coding types, namely PSI-CELP and VSELP. VSELP is referred to as a "full-rate" codec (coder/decoder) and involves a data rate of 11.2kbits/sec, whilst PSI-CELP is a "half-rate" codec involving a data rate of 5.6kbits/sec. Typically, a mobile network will support both PSI-CELP, VSELP, and μ-law, or only VSELP and μ-law. Unlike conventional networks, in mobile networks

coding and decoding may be carried out at the level of the mobile station rather than at the level of the exchange.

In the case where a call is initiated from a mobile station which supports PSI-CELP to a mobile station which also supports PSI-CELP, the voice signals may be transmitted in both directions without any need for intermediate transcoding, i.e. translation from one coding type to another. However, if a call is initiated from the same PSI-CELP supporting mobile station to a mobile station (or network) which supports VSELP (but not PSI-CELP), then the voice data must be transcoded, or the originating mobile station must change to VSELP coding if possible. Of these two options, the latter is preferred as transcoding introduces distortion into signals and occupies additional processing capacity at the terminating exchange (normally referred to as a Mobile Switching Centre (MSC)).

It will be apparent that the negotiation of coding type to be used for a voice call, is necessary because of the possible mismatch of coding types available at the originating network and at the terminating network. In addition, such a negotiation is necessary in order to take into account the coding preferences of network operators. It may be the case, for example, that the operator of a mobile network supporting both PSI-CELP and VSELP prefers to offer high speech quality to subscribers. This operator's coding preference will therefore be for the full-rate VSELP coding. Another operator of a similar mobile network may prefer to maximise his call handling capacity, and therefore prefers to use the half-rate PSI-CELP coding.

In a mobile network, each MSC knows the coding capabilities and preferences of its own network. In

addition, each MSC maintains a database containing the coding capabilities and preferences of other networks (sometimes referred to as "foreign" networks). When a call is initiated from a mobile station, the originating MSC identifies the terminating exchange on the basis of the called number prefix. The originating MSC then determines a preferred coding type on the basis of its own network's capabilities and preferences, and of the capabilities and preferences of the terminating exchange. On the basis of the preferred coding type, the originating MSC then allocates an appropriate speech channel, over the air interface, to the calling mobile station.

Call set-up is initiated by the originating MSC sending to the terminating MSC a so-called Initial Address Message (IAM). The IAM contains a number of fields which contain various data relating to the call. One of these fields is referred to as "User Service Information" (USI) field and contains the coding preference as determined by the originating MSC. Upon receipt of the IAM at the terminating MSC, that MSC examines the transmitted coding preference and compares it to its own current coding preferences. It is noted that the current preferences of an MSC may differ from those notified to and stored by the originating MSC, e.g. due to changes in traffic levels at the terminating MSC.

The terminating MSC may either accept the transmitted preference, or indicate an alternative preference, by returning to the originating MSC a Mobile Application Part (MAP) message. It is noted that if the terminating MSC decides on an alternative preference, the choice is restricted. Specifically, if the preference indicated in the IAM is for PSI-CELP, then the terminating MSC may

select VSELP or μ-law as alternatives, whilst if the preference indicated in the IAM is for VSELP, the terminating MSC may select only μ-law as an alternative, i.e. the terminating MSC may only move down the list: PSI-CELP → VSELP → μ-law. Upon receipt of the MAP message, the originating MSC may either adopt the coding type indicated therein, or may adopt the default μ-law coding.

In some cases the terminating MSC may return no MAP message to the originating MSC. If no MAP message is received at the originating MSC ahead of a so-called Answer Message (ANM, which is transmitted from the terminating MSC to indicate call answer), then the originating MSC assumes the default coding, i.e. μ-law, upon receipt of the ANM.

Many modern telecommunications networks incorporate so-called Intelligent Network (IN) services. Examples of such services are 800 number services and the like where a dialled number identifies a Service Switching Point (SSP) to which a call set-up is initially directed. The SSP performs a number translation, in association with a Service Control Point (SCP), to determine the true destination of the call. Once the true destination is determined, the SSP relays the IAM, received from the originating exchange, to the destination exchange.

The use of SSPs in telecommunications networks presents a problem *vis-à-vis* coding type negotiation. As already mentioned, before the originating MSC transmits the IAM message, it must have determined a coding type preference in order to allocate an appropriate channel to the calling mobile station. However, the originating MSC cannot determine from the dialled number the

identity of the terminating network. Therefore the preference must be determined solely on the capabilities and preferences of the originating MSC.

Furthermore, when the IAM is received by the SSP, although the SSP can determine the identity of the terminating MSC and hence its coding type capabilities and preferences, it is not aware of the complete set of current preferences of the originating MSC (which may differ from time to time in comparison with those preferences previously notified to the SSP and other network nodes). The SSP is therefore unable to perform any meaningful adjustment to the preference indicated in the IAM. The result is that in many cases μ-law coding will be selected even when a higher quality coding is available at both the originating and terminating networks. For example, consider the case where the preference of the originating MSC is for VSELP coding, but it is also capable of using PSI-CELP. Thus, in the IAM sent to the SSP, VSELP will be identified as the preferred coding type. The IAM is then relayed to the terminating MSC from the SSP. In the event that the terminating MSC is not capable of using VSELP, it does not have the possibility of reverting to PSI-CELP (as it can only use the return MAP message to move down the coding type order noted above) and therefore the call must use the default μ-law coding type.

The problem noted in the preceding paragraph is not limited to calls routed via SSPs. Rather, it appears wherever a call is routed through a network node at which a called number translation is carried out, for example at Gateway Mobile Switching Centres (GMSCs) of mobile networks.

Summary of the Present Invention

It is an object of the present invention to overcome or at least mitigate the above noted disadvantage. It is a further object to enable a coding type negotiation to take place between two nodes of a telecommunications network even when a call is initially directed to a number translation node.

According to a first aspect of the present invention there is provided a method of negotiating a coding type during the setting up of a voice call between an originating exchange and a terminating exchange of a telecommunications system, where the call set-up procedure is directed via a called number translation node, the method comprising the steps of:

(1) transmitting from the originating exchange to the number translation node a call set-up message, the call set-up message including the called number and an identification of at least a primary coding type preference of the originating exchange and of a secondary coding type preference if the originating exchange has such a secondary preference;

(2) receiving said call set-up message at the number translation node and determining thereat the identity of the terminating exchange based upon the called number;

(3) determining the coding type preferences of the terminating exchange at the number translation node;

(4) determining a call coding type preference at the number translation node on the basis of the coding type preferences determined for the terminating exchange and of the coding type preference of the originating exchange as identified in the call set-up message;

(5) if the call coding preference determined at step (4) corresponds with the primary coding type preference identified in the call set-up message, identifying in the call set-up message, the primary

coding type preference as the preferred coding type, otherwise identifying in the call set-up message, the secondary coding type preference as the preferred coding type; and

(6) transmitting the call set-up message from the number translation node to the terminating exchange.

Embodiments of the present invention enable an intermediate called number translation node to be provided with the coding type preferences of the originating exchange and the coding type preferences of the terminating exchange such that the number translation node may select a preference in substantially the same manner as may be done in the absence of a called number translation node.

Preferably, the called number translation node is a Service Switching Point (SSP) of an Intelligent Network. More preferably, at step (2), the identity of the terminating exchange is determined using a signalling connection between the SSP and a Service Control Point (SCP).

Preferably, the originating exchange is a Mobile Switching Centre of a mobile digital network. More preferably, the terminating exchange is also a Mobile Switching Centre of a digital mobile network. One or both of the MSCs may belong to PDC networks. The invention however is applicable to fixed line networks and to other mobile digital networks.

In the case that the MSCs belong to PDC networks, said preferences may be for either PSI-CELP or VSELP. In addition, the networks and MSCs may have the capability to use a default coding type, namely μ-law coding.

Preferably, the primary coding type preference is indicated in the call set-up message, sent from the originating exchange to the called number translation node, by appropriately setting a User Service Information prime (USI') parameter. The secondary coding type preference may be similarly indicated by setting the User Service Information (USI) parameter.

In the event that, at step (5), the call coding preference is found to differ from the primary coding type preference identified in the call set-up message, the USI parameter is transmitted unchanged to the terminating exchange. On the other hand, if the call coding preference corresponds with the primary coding type preference identified in the call set-up message, the USI parameter is replaced in the call set-up message with the USI' parameter.

Preferably, said call set-up message is an Initial Address Message (IAM).

According to a second aspect of the present invention there is provided apparatus for negotiating a coding type during the setting up of a voice call between an originating exchange and a terminating exchange of a telecommunications system, where the call set-up procedure is directed via a called number translation node, the apparatus comprising:

means for transmitting from the originating exchange to the called number translation node a call set-up message, the call set-up message including the called number and an identification of at least a primary coding type preference of the originating exchange and of a secondary coding type preference if the originating exchange has such a secondary preference;

means for receiving said call set-up message at the called number translation node and determining thereat the identity of the terminating exchange based upon the called number;

means for determining the coding type preferences of the terminating exchange at the called number translation node;

means for determining a call coding type preference at the called number translation node on the basis of the coding type preferences determined for the terminating exchange and of the coding type preference(s) of the originating exchange identified in the call set-up message;

means for identifying in the call set-up message, the primary coding type preference as the preferred coding type if the call coding preference determined at the called number translation node corresponds with the primary coding type preference identified in the call set-up message, or otherwise, for identifying in the call set-up message, the secondary coding type preference as the preferred coding type; and

means for transmitting the call set-up message from the called number translation node to the terminating exchange.

According to a third aspect of the present invention there is provided a method of determining a coding type preference at a called number translation node during the setting up of a voice call between an originating exchange and a terminating exchange of a telecommunications system, the method comprising the steps of:

(1) receiving at the called number translation node a call set-up message, the call set-up message being transmitted from the originating exchange and including the called number and an identification of at least a primary coding type preference of the originating

exchange and of a secondary coding type preference if the originating exchange has such a secondary preference;

(2) determining at the called number translation node the identity of the terminating exchange based upon the called number, and the coding type preferences of the terminating exchange;

(3) determining a call coding type preference at the SSP on the basis of the coding type preferences determined for the terminating exchange and of the coding type preference(s) of the originating exchange identified in the call set-up message;

(4) if the call coding preference determined at step (3) corresponds with the primary coding type preference identified in the call set-up message, identifying in the call set-up message, the primary coding type preference as the preferred coding type, otherwise identifying in the call set-up message, the secondary coding type preference as the preferred coding type; and

(5) transmitting the call set-up message from the called number translation node to the terminating exchange.

Brief Description of the Drawings

For a better understanding of the present invention and in order to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 illustrates schematically a telecommunications system wherein a call set-up procedure may be routed through a Service Switching Point; and

Figure 2 is a flow diagram illustrating a call set-up procedure in the system of Figure 1.

Detailed Description of Certain Embodiments

There is illustrated in Figure 1 a telecommunications system comprising first and second mobile telephone networks 1,2. For the purposes of the following description, these networks 1,2 are assumed to be PDC networks according to the Japanese standard. Each of the networks 1,2 comprises one or more exchanges, termed "Mobile Switching Centres" (MSCs) 3,4, which connect calls to and from mobile stations 5,6. A given mobile station 5,6 is connected to the MSC 3,4 of its network via a Base Station Controller (BSC) 7,8 and a Base Transceiver Station (BTS) 9,10. The BTS 9,10 is arranged in the "cell" in which the mobile station 5,6 is located, whilst the BSC 7,8 is associated with a small group of cells (and hence BTSs) including that in which the mobile station 5,6 is located.

A mobile station 5 requests a telephone connection by transmitting a SETUP message to the associated MSC 3 via the BTS 9 and BSC 7. This message includes the number of the called party. Assuming that the called party number is a conventional B-number, i.e. corresponding to a specific subscriber, and that the called party is a subscriber of some foreign network, i.e. network 2, then the MSC 3 prepares a call set-up message (specifically an IAM) for transmission to the MSC 4 defined by the prefix of the B-number.

As already described, preparation of the IAM involves determining a preferred coding type (i.e. PSI-CELP, VSELP or μ-law) based upon the capabilities and preference of the originating MSC 3, and the capabilities of the terminating MSC 4. The later are maintained in a capabilities database 11 associated with

the MSC 3. Assuming for example that the originating MSC 3 is capable of using both PSI-CELP and VSELP but prefers PSI-SELP, and that the terminating MSC 4 is also capable of using both PSI-CELP and VSELP, then the originating MSC 3 indicates its preference for PSI-SELP in the User Service Information parameter (USI) of the IAM. The IAM is then sent to the terminating MSC 4, via an interconnecting network 12. It is noted that after determining the coding type preference, and prior to transmitting the IAM, the originating MSC 3 allocates the necessary half rate channel to the calling mobile station 5.

In the event that the terminating exchange 4 has a coding preference which coincides with that defined in the USI parameter, i.e. in this example PSI-CELP, it returns a MAP message to the originating MSC 3. The MAP message has two fields, Codec status and Codec throughrate information. The former field is set to indicate Codec through (i.e. mobile to mobile transmission without transcoding), whilst the latter field is set to indicate half rate coding (i.e. PSI-CELP). It will be clear to the person of skill in the art how the MAP message fields will be set in the cases of other preferences and capabilities.

So far, the described call set-up procedure is according to the conventional PDC set-up procedure. However, the set-up procedure which will now be described represents a modification to that conventional procedure. Consider the case where the number dialled at the mobile station 5 is an 800 number or the like, e.g. associated with some special service such as free phone, or shortened number dialling. In such a case, the dialled number does not directly represent a network subscriber, but rather is a number which requires translation to determine such a subscriber number.

Upon receipt of a SETUP message containing an 800 number, the originating MSC 3 prepares the IAM message for relaying to the terminating exchange. However, in determining the coding type preferences, the MSC 4 is unable to identify the terminating exchange as this cannot be determined directly from the 800 number. The originating MSC 3 therefore inserts into the User Service Information prime parameter (USI') its own speech coding type preference (and allocates a channel to the calling mobile station 5). The preference will be either PSI-CELP or VSELP. In the USI parameter, the originating MSC also inserts an alternative speech coding type preference. If the MSC 3 has only one preference, then this is inserted in the USI parameter.

From the dialled 800 number, the originating MSC 3 recognises that the initial destination for the IAM is a Service Switching Point (SSP) 13. The IAM is therefore transmitted to the SSP 13 where a number translation is performed on the dialled 800 number to determine the subscriber B-number to which the call is to be directed. Using the prefix of the translated B-number, the SSP 13 is able to identify the terminating exchange 4 for the call.

The SSP 13 has a capabilities database 11 corresponding to that of the originating MSC 3 (and of the terminating MSC 4). Upon receipt of the IAM from the originating MSC 3, the SSP 13 interrogates the database 11 to identify the capabilities of the terminating MSC 4. In the event that the terminating MSC 4 is not capable of supporting the coding type preference of the originating MSC 3 (as defined in the USI' parameter of the IAM), the USI parameter is left unchanged by the SSP. The USI' parameter may be dropped (although this is not essential as it will in any case be ignored by the terminating MSC

4). The IAM is then relayed by the SSP 13 to the terminating exchange 4.

In the event that interrogation of the capabilities database 11 by the SSP determines that the terminating MSC 4 is capable of supporting the coding type preference of the originating MSC 3 (as defined in the USI' parameter of the IAM), then the definition of the coding type preference in the USI parameter is replaced, at the SSP 13, by the preference identified in the USI' parameter. Again, the coding type preference defined in the USI' parameter may be dropped before the IAM is relayed to the terminating MSC 4.

The above process may be illustrated by example. Firstly, consider the case where the originating MSC 3 is capable of using both PSI-CELP and VSELP, and prefers to use PSI-CELP. In the IAM sent from the MSC 3 to the SSP 13, the USI' parameter is set to indicate PSI-CELP, whilst the USI parameter is set to indicate VSELP. If the SSP 13 determines that the terminating exchange is only capable of using VSELP, then the USI' parameter may be dropped, and the IAM is forwarded to the terminating exchange 4 via the interconnecting network 12.

Consider now a similar case, except that the SSP 13 determines that the terminating exchange 4 is capable of using both PSI-CELP and VSELP. In this case, the USI parameter is replaced with the USI' parameter before forwarding the IAM to the terminating exchange 4.

Upon receipt of the IAM at the terminating MSC 4, the set-up procedure proceeds in the conventional manner. That is to say that the terminating MSC 4 determines whether the preference identified in the USI parameter coincides with its own current preference. If so, this is indicated in the returned MAP message. If the

signalled preference does not coincide with that of the terminating MSC 4, then an alternative coding type may be identified in the MAP.

Figure 2 is a flow diagram illustrating the procedure described above, where a mobile to mobile call is routed through a Service Switching Point.

It will be understood by the person of skill in the art that various modifications may be made to the above described embodiment without departing from the scope of the present invention. For example, whilst the above embodiment is concerned with number translation at an SSP, the invention may be applied to number translation occurring at a Gateway MSC (GMSC) of a mobile network. When a call is made to a mobile subscriber, the call is routed to the home network of the subscriber. The GMSC interrogates the Home Location Register (HLR) to determine the subscriber's location. Assuming that the subscriber is currently registered to a foreign network, the GMSC replaces the directory number with a roaming number received from the HLR. Again, it will be appreciated that the originating MSC does not necessarily know the identity of the foreign network, a deficiency which is avoided by the present invention.

Claims

1. A method of negotiating a coding type during the setting up of a voice call between an originating exchange and a terminating exchange of a telecommunications system, where the call set-up procedure is directed via a called number translation node, the method comprising the steps of:

(1) transmitting from the originating exchange to the number translation node a call set-up message, the call set-up message including the called number and an identification of at least a primary coding type preference of the originating exchange and of a secondary coding type preference if the originating exchange has such a secondary preference;

(2) receiving said call set-up message at the number translation node and determining thereat the identity of the terminating exchange based upon the called number;

(3) determining the coding type preferences of the terminating exchange at the number translation node;

(4) determining a call coding type preference at the number translation node on the basis of the coding type preferences determined for the terminating exchange and of the coding type preference of the originating exchange as identified in the call set-up message;

(5) if the call coding preference determined at step (4) corresponds with the primary coding type preference identified in the call set-up message, identifying in the call set-up message, the primary coding type preference as the preferred coding type, otherwise identifying in the call set-up message, the secondary coding type preference as the preferred coding type; and

(6) transmitting the call set-up message from the number translation node to the terminating exchange.

2. A method according to claim 1, wherein the originating exchange is a Mobile Switching Centre of a mobile digital network.

3. A method according to claim 1, wherein the terminating exchange is a Mobile Switching Centre of a mobile digital network.

4. A method according to claim 2 or 3, wherein one or both of the MSCs belong to PDC networks.

5. A method according to claim 4, wherein said coding type preferences are either PSI-CELP or VSELP.

6. A method according to any one of the preceding claims and comprising indicating the primary coding type preference in the call set-up message, sent from the originating exchange to the number translation node, by appropriately setting a User Service Information prime (USI') parameter.

7. A method according to claim 6, wherein said number translation node is a Service Switching Point (SSP).

8. A method according to claim 6 or 7 and comprising indicating the secondary coding type preference by setting the User Service Information (USI) parameter.

9. A method according to claim 8, wherein, in the event that at step (5) the call coding preference is found to differ from the primary coding type preference identified in the call set-up message, transmitting the USI parameter to the terminating exchange unchanged, whilst, if the call coding preference corresponds with the primary coding type preference identified in the

call set-up message, the USI parameter is replaced in the call set-up message with the USI' parameter.

10. Apparatus for negotiating a coding type during the setting up of a voice call between an originating exchange and a terminating exchange of a telecommunications system, where the call set-up procedure is directed via a called number translation node, the apparatus comprising:

means for transmitting from the originating exchange to the called number translation node a call set-up message, the call set-up message including the called number and an identification of at least a primary coding type preference of the originating exchange and of a secondary coding type preference if the originating exchange has such a secondary preference;

means for receiving said call set-up message at the called number translation node and determining thereat the identity of the terminating exchange based upon the called number;

means for determining the coding type preferences of the terminating exchange at the called number translation node;

means for determining a call coding type preference at the called number translation node on the basis of the coding type preferences determined for the terminating exchange and of the coding type preference(s) of the originating exchange identified in the call set-up message;

means for identifying in the call set-up message, the primary coding type preference as the preferred coding type if the call coding preference determined at the called number translation node corresponds with the primary coding type preference identified in the call set-up message, or otherwise, for identifying in the

call set-up message, the secondary coding type preference as the preferred coding type; and

means for transmitting the call set-up message from the called number translation node to the terminating exchange.

11. A method of determining a coding type preference at a called number translation node during the setting up of a voice call between an originating exchange and a terminating exchange of a telecommunications system, the method comprising the steps of:

(1) receiving at the called number translation node a call set-up message, the call set-up message being transmitted from the originating exchange and including the called number and an identification of at least a primary coding type preference of the originating exchange and of a secondary coding type preference if the originating exchange has such a secondary preference;

(2) determining at the called number translation node the identity of the terminating exchange based upon the called number, and the coding type preferences of the terminating exchange;

(3) determining a call coding type preference at the SSP on the basis of the coding type preferences determined for the terminating exchange and of the coding type preference(s) of the originating exchange identified in the call set-up message;

(4) if the call coding preference determined at step (3) corresponds with the primary coding type preference identified in the call set-up message, identifying in the call set-up message, the primary coding type preference as the preferred coding type, otherwise identifying in the call set-up message, the secondary coding type preference as the preferred coding type; and

(5) transmitting the call set-up message from the called number translation node to the terminating exchange.

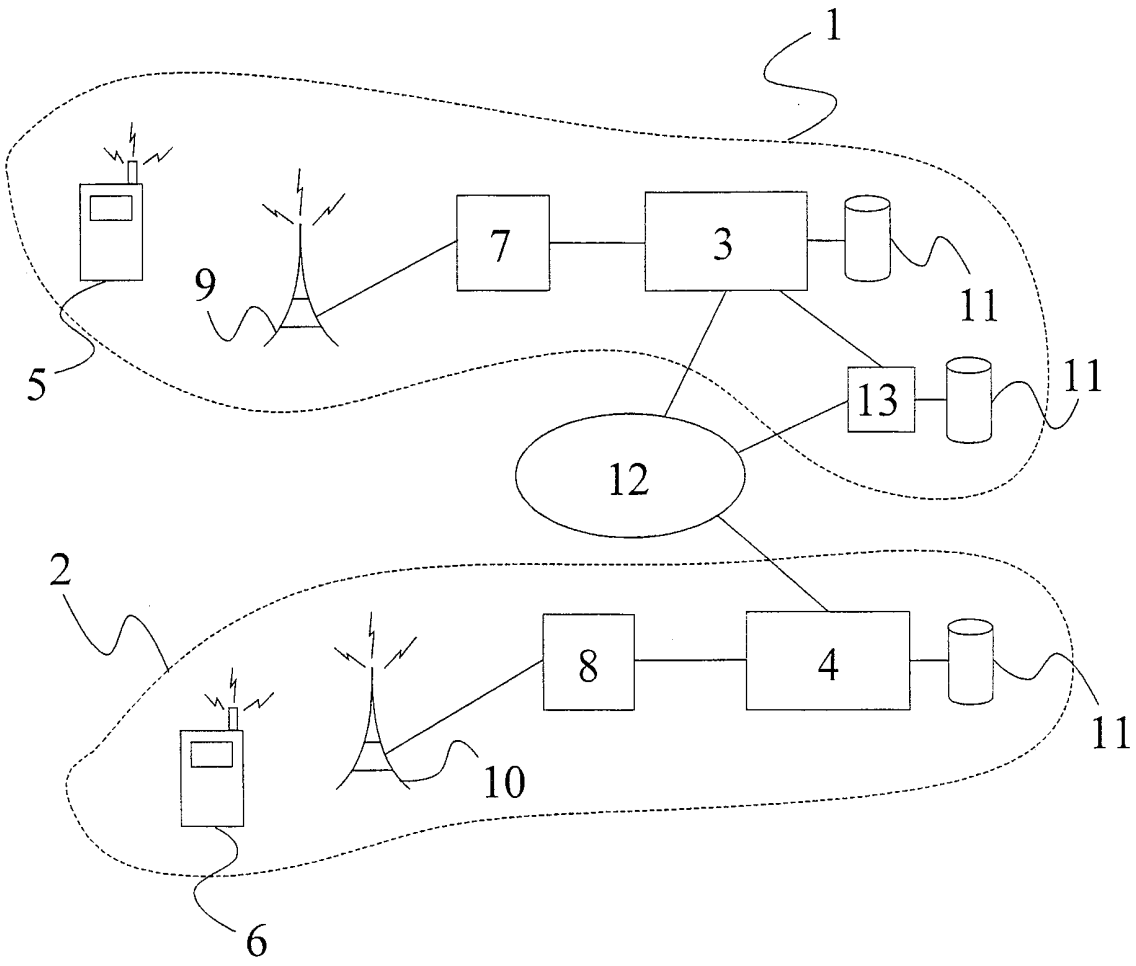

Figure 1

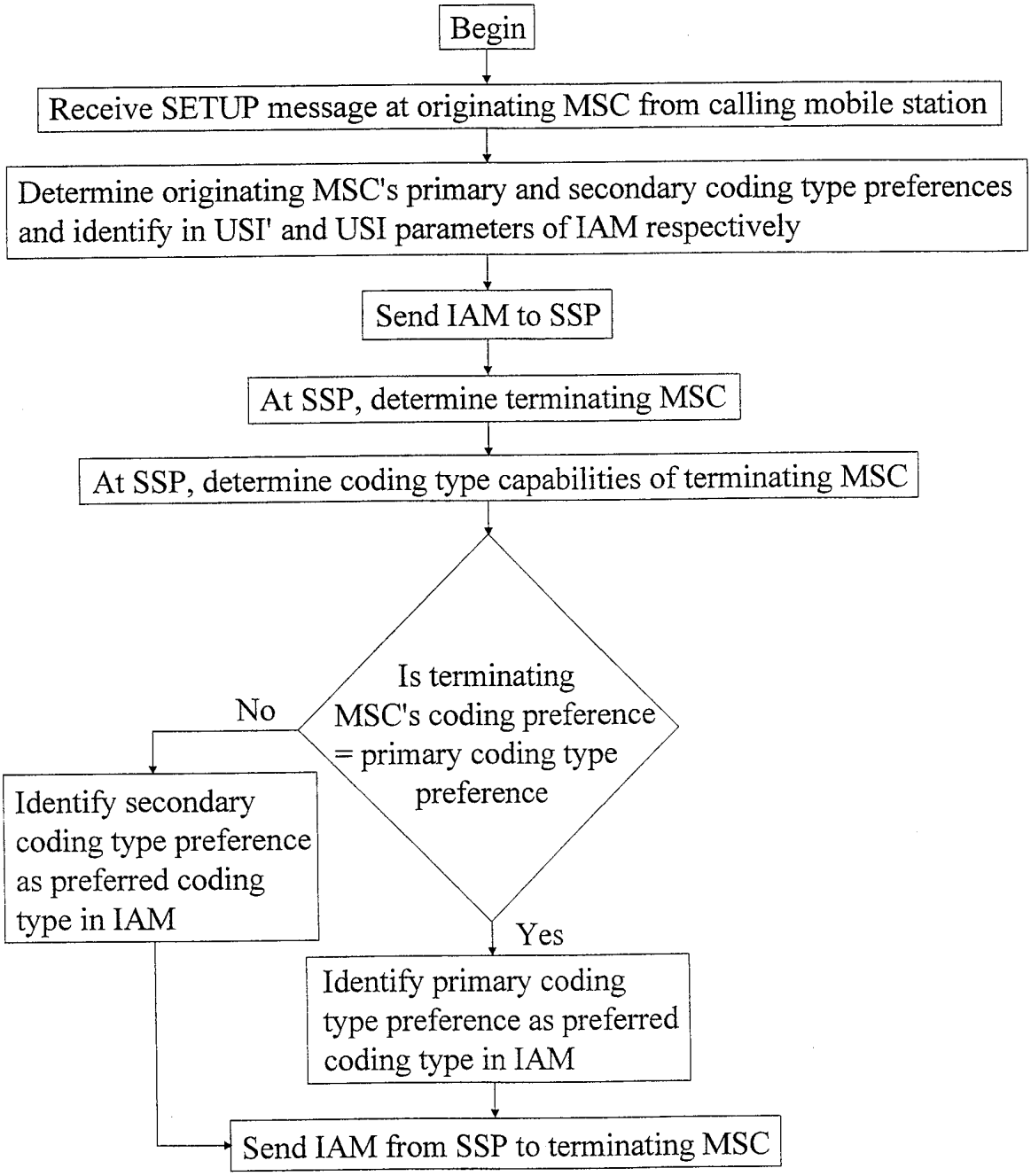
Begin
Receive SETUP message at originating MSC from calling mobile station
Determine originating MSC's primary and secondary coding type preferences and identify in USI' and USI parameters of IAM respectively
Send IAM to SSP
At SSP, determine terminating MSC
At SSP, determine coding type capabilities of terminating MSC
Is terminating MSC's coding preference = primary coding type preference
No
Yes
Identify secondary coding type preference as preferred coding type in IAM
Identify primary coding type preference as preferred coding type in IAM
Send IAM from SSP to terminating MSC

Figure 2