

	MME	Mobility Management Entity
	NAS	Non Access Stratum
	NID	Network IDentity
	PLMN	Public Land Mobile Network
5	PRL	Preferred Roaming List
	RAN	Radio Access Network
	RAT	Radio Access Technology
	RRC	Radio Resource Control
	S1AP	S1 Application Part
10	SIB1	System Information Block type1
	SIB8	System Information Block type8
	SID	System IDentity (or System IDentifier)
	SRVCC	Single Radio Voice Call Continuity
	TS	Technical Standard
15	UE	User Equipment
	UTRAN	Universal Terrestrial Radio Access Network
	VoIP	Voice Over Internet Protocol

[0004] Current LTE specifications only support interworking (e.g., Handover, CSFB, SRVCC procedures) between a single LTE system and a single CDMA2000 system of each type (1xRTT and eHRPD). There is a need to support interworking between a single LTE system and multiple CDMA2000 systems of the same type, to accommodate cases where one LTE system has overlapping radio coverage with multiple CDMA2000 systems of the same type.

25 BRIEF SUMMARY

[0005] This section is intended to provide an overview of the exemplary embodiments, and is not intended to be limiting.

[0005a] In an aspect, an apparatus is provided, comprising one or more processors; and one or more memories including computer program code, the one or more memories and the computer program code configured, with the one or more processors, to cause the apparatus to perform at least the following: receiving, at a user equipment in a long term evolution system, a message from a network element in the long term evolution system, the message at least identifying a mapping between a plurality of public land mobile network (PLMN) identities (IDs) and associated code division multiple access systems for which the

long term evolution system supports interworking; selecting, by the user equipment, one of the plurality of PLMN IDs and a corresponding code division multiple access system based on the mapping between the plurality of PLMN IDs and associated code division multiple access systems in order to handover a call from the long term evolution system; and transmitting by the user equipment one or more indications of the selected PLMN ID and the corresponding code division multiple access system to the network element in order to handover the call from the long term evolution system.

[0005b] In another aspect, an apparatus is provided, comprising one or more processors; and one or more memories including computer program code, the one or more memories and the computer program code configured, with the one or more processors, to cause the apparatus to perform at least the following: transmitting a message from a network element in the long term evolution system to a user equipment, the message at least identifying a mapping between a plurality of public land mobile network (PLMN) identities (IDs) and associated code division multiple access systems for which the long term evolution system supports interworking; receiving at the network element and from the user equipment one or more indications of one or more selected ones of the plurality of PLMN IDs, and corresponding one or more selected code division multiple access systems to which the network element has access based on the mapping between the plurality of PLMN IDs and associated code division multiple access systems, the one or more selected code division multiple access systems corresponding to one or more requested actions by the user equipment and selection by the user equipment of the one or more selected code division multiple access systems in order to handover a call from the long term evolution system; and routing information corresponding to the one or more requested actions to the one or more selected code division multiple access systems in order to handover the call from the long term evolution system.

[0005c] In an aspect, an apparatus is provided, comprising one or more processors; and one or more memories including computer program code, the one or more memories and the computer program code configured, with the one or more processors, to cause the apparatus to perform at least the following: transmitting, by a network element in a long term evolution system, to a user equipment indications of a mapping between a plurality of public land mobile network (PLMN) identities (IDs) and associated code division multiple access systems to ones of one or more long term evolution systems with which the network element is associated, and at least one of the associated one or more long term evolution systems supports interworking with the plurality of code division multiple access systems in

order to handover a call from the long term evolution system; and receiving from the user equipment comprising one or more indications of one or more selected public land mobile network (PLMN) identities (IDs) and corresponding one or more code division multiple access systems selected by the user equipment based on the mapping between the plurality of PLMN IDs and associated code division multiple access systems in order to handover the call from the long term evolution system.

[0006] In an exemplary embodiment, a method is disclosed that includes selecting, at a user equipment in a long term evolution system, one of a plurality of code division multiple access systems. The method also includes signaling one or more indications of the selected code division multiple access system to a network element.

[0007] An additional exemplary embodiment includes a computer program, comprising: code for selecting, at a user equipment in a long term evolution system, one of a plurality of code division multiple access systems; and code for signaling one or more indications of the selected code division multiple access system to a network element, when the computer program is run on a processor. A further exemplary embodiment is a

CLAIMS

What is claimed is:

- 5 1. A method, comprising:
receiving, at a user equipment in a long term evolution system, a message from a
network element in the long term evolution system, the message at least
identifying a plurality of public land mobile network (PLMN) identities (IDs)
and indicating each of the plurality of PLMN IDs associated with a code
10 division multiple access system for which the long term evolution system
supports interworking;
selecting, by the user equipment, one of the plurality of PLMN IDs received from
the network element in the long term evolution system; and
signaling by the user equipment, one or more indications of the selected PLMN ID
15 to the network element.
2. The method of claim 1, further comprising receiving a mapping of the plurality of
code division multiple access systems to associated ones of one or more long term
evolution systems, and wherein selecting further comprises selecting one of a
20 plurality of code division multiple access systems for the selected PLMN ID using
the mapping.
3. The method of claim 2, wherein:
the mapping comprises a mapping of a plurality of high rate packet data systems
25 and 1x radio transmission technology systems to the one or more long term
evolution systems;
selecting comprises selecting a high rate packet data system and a 1x radio
transmission technology system; and
signaling comprises signaling an indication of the selected a high rate packet data
30 system and an indication of the selected 1x radio transmission technology
system to the network element.
4. The method of claim 3, wherein selecting further comprises selecting the selected
1x radio transmission technology system as a circuit switched fallback system, and
35 wherein signaling further comprises signaling an indication of the selected 1x radio
transmission system to a base station for purposes of requesting parameters for
the selected 1x radio transmission system from the long term evolution system.

5. The method of claim 3, further comprising performing an uplink information transfer using one of the 1x radio transmission technology system or the high rate packet data system, the uplink transfer at least comprising a message indicating which of the 1x radio transmission technology system or the high rate packet data system is used.
6. The method of claim 1, wherein:
the plurality of PLMN IDs indicates a plurality of high rate packet data systems;
selecting comprises selecting one of the plurality of high rate packet data systems;
and
signaling comprises signaling the selected high rate packet data system to a base station in a measurement report further comprising one or more indications of one or more measurements of the selected high rate packet data system.
7. The method of claim 6, performed as part of a handover to the selected evolved high rate packet data system.
8. The method of claim 6, wherein:
the plurality of PLMN IDs indicates a plurality of 1x radio transmission technology systems;
selecting comprises selecting one of the plurality of 1x radio transmission technology systems; and
signaling comprises signaling the selected 1x radio transmission technology system to a base station in a measurement report.
9. The method of claim 8, performed as part of a handover from one radio access technology to the selected 1x radio transmission technology system and as part of a concurrent handover to the selected high rate packet data system, and wherein the method further comprises signaling by the user equipment to the base station an extended service request comprising an indication of the selected 1x radio transmission technology system.

10. The method of claim 1, wherein:
the plurality of PLMN IDs indicates a plurality of 1x radio transmission technology
systems;
selecting comprises selecting one of the plurality of 1x radio transmission
5 technology systems; and
signaling comprises signaling the selected 1x radio transmission technology
system to a base station in a measurement report.
11. The method of claim 10, performed as part of a single radio voice call continuity of
10 a voice over Internet protocol call to the selected 1x radio transmission technology
system.
12. An apparatus comprising:
one or more processors; and
15 one or more memories including computer program code,
the one or more memories and the computer program code configured, with the
one or more processors, to cause the apparatus to perform any one of the
previous method claims.
- 20 13. A method, comprising:
signaling a message from a network element in the long term evolution system to a
user equipment, the message at least identifying a plurality of public land
mobile network (PLMN) identities (IDs), each of the plurality of PLMN IDs
associated with a code division multiple access systems system for which
25 the long term evolution system supports interworking;
receiving at the network element and from the user equipment one or more
indications of one or more selected ones of the plurality of PLMN IDs, and
corresponding one or more selected code division multiple access systems
to which the network element has access, the one or more selected code
30 division multiple access systems corresponding to one or more requested
actions by the user equipment and selection by the user equipment of the
one or more selected code division multiple access systems; and
routing information corresponding to the one or more requested actions to the one
or more selected code division multiple access systems.
- 35 14. The method of claim 13, wherein the one or more requested actions comprise a
pre-registration procedure with a selected code division multiple access system, and

wherein routing further comprises routing information corresponding to the pre-registration procedure to the selected code division multiple access system.

15. The method of claim 13, wherein the plurality of PLMN IDs indicates a plurality of 1x radio transmission technology systems and a plurality of high rate packet data systems, and wherein the one or more selected plurality of code division multiple access systems comprises one of a selected 1x radio transmission technology system or a selected high rate packet data system.

16. An apparatus comprising:
one or more processors; and
one or more memories including computer program code,
the one or more memories and the computer program code configured, with the one or more processors, to cause the apparatus to perform any one of the previous method claims.

17. A method, comprising:
signaling, at a network element in a long term evolution system, to a user equipment indications of a mapping of a plurality of code division multiple access systems to ones of one or more long term evolution systems with which the network element is associated, and at least one of the associated one or more long term evolution systems supports interworking with the plurality of code division multiple access systems; and
receiving signaling from the user equipment comprising one or more indications of one or more selected public land mobile network (PLMN) identities (IDs) and corresponding one or more code division multiple access systems selected by the user equipment.

18. The method of claim 17, further comprising, responsive to the receiving, signaling the one or more indications of the one or more selected PLMN IDs and the corresponding one or more selected code division multiple access systems to a second network element in the long term evolution system.

19. The method of claim 18, further comprising receiving signaling corresponding to one or more requested actions by the user equipment and corresponding to the one or more

selected code division multiple access systems, and signaling the one or more requested actions to the second network element.

5 20. The method of claim 17, further comprising requesting via signaling the user equipment perform measurements of the one or more selected code division multiple access systems.

10 21. The method of claim 20, wherein the requesting is performed in response to signaling received from a second network element in the long term evolution system comprising an indication of at least a 1x radio transmission technology system, and wherein the requesting via signaling the user equipment perform measurements of the one or more selected code division multiple access systems further comprises requesting via signaling the user equipment perform measurements of the 1x radio transmission technology system.

15 22. The method of claim 17, wherein the one or more signaled indications comprises one or both of an indication of a selected 1x radio transmission technology system and a selected high rate packet data system, and wherein the method further comprises using the indications to select a set of CDMA2000 parameters associated with one or both of the selected 1x radio transmission technology system or the selected high rate packet data system to send to the user equipment, and sending the set of CDMA2000 parameters to the user equipment.

20 23. An apparatus comprising:
25 one or more processors; and
one or more memories including computer program code,
the one or more memories and the computer program code configured, with the one or more processors, to cause the apparatus to perform any one of the previous method claims.

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CLAIMS

What is claimed is:

- 5 1. An apparatus, comprising:
 one or more processors; and
 one or more memories including computer program code,
 the one or more memories and the computer program code configured, with the one or
 more processors, to cause the apparatus to perform at least the following:
10 receiving, at a user equipment in a long term evolution system, a message from a
 network element in the long term evolution system, the message at least identifying a
 mapping between a plurality of public land mobile network (PLMN) identities (IDs)
 and associated code division multiple access systems for which the long term
 evolution system supports interworking;
15 selecting, by the user equipment, one of the plurality of PLMN IDs and a corresponding
 code division multiple access system based on the mapping between the plurality of
 PLMN IDs and associated code division multiple access systems in order to
 handover a call from the long term evolution system; and
 transmitting by the user equipment one or more indications of the selected PLMN ID and
20 the corresponding code division multiple access system to the network element in
 order to handover the call from the long term evolution system.
2. The apparatus of claim 1, wherein:
 the mapping comprises a mapping of a plurality of high rate packet data systems and 1x
25 radio transmission technology systems to the one or more long term evolution
 systems;
 the selecting comprises selecting a high rate packet data system and a 1x radio
 transmission technology system; and
 the transmitting comprises signaling an indication of the selected high rate packet data
30 system and an indication of the selected 1x radio transmission technology system to
 the network element.
3. The apparatus of claim 2, wherein the selecting further comprises selecting the selected 1x
radio transmission technology system as a circuit switched fallback system, and wherein the
35 transmitting further comprises signaling an indication of the selected 1x radio transmission

system to a base station for purposes of requesting parameters for the selected 1x radio transmission system from the long term evolution system.

4. The apparatus of claim 2, wherein the one or more memories and the computer program code are further configured, with the one or more processors, to cause the apparatus to perform the following: performing, using the long term evolution system, an uplink information transfer of information pertaining to one of the 1x radio transmission technology system or the high rate packet data system, the uplink transfer at least comprising a message indicating which of the 1x radio transmission technology system or the high rate packet data system the information pertains to.

5. The apparatus of claim 1, wherein:

the plurality of PLMN IDs indicates a plurality of high rate packet data systems;

selecting comprises selecting one of the plurality of high rate packet data systems; and

the transmitting comprises signaling the selected high rate packet data system to a base station in a measurement report.

6. The apparatus of claim 5, wherein the handover is to the selected evolved high rate packet data system.

7. The apparatus of claim 1, wherein:

the plurality of PLMN IDs indicates a plurality of 1x radio transmission technology systems;

the selecting further comprises selecting one of the plurality of 1x radio transmission technology systems; and

transmitting further comprises signaling the selected 1x radio transmission technology system to a base station in a measurement report.

8. The apparatus of claim 7, wherein the handover is to the selected 1x radio transmission technology system and as part of a concurrent handover to the selected high rate packet data system, and wherein the one or more memories and the computer program code are further configured, with the one or more processors, to cause the apparatus to perform: signaling by the user equipment to the base station an extended service request comprising an indication of the selected 1x radio transmission technology system.

9. The apparatus of claim 1, wherein:

the plurality of PLMN IDs indicates a plurality of 1x radio transmission technology systems;

the selecting comprises selecting one of the plurality of 1x radio transmission technology systems; and

the transmitting comprises signaling the selected 1x radio transmission technology system to a base station in a measurement report.

10. The apparatus of claim 9, wherein the selecting and transmitting is of a single radio voice call continuity of a voice over Internet protocol call to the selected 1x radio transmission technology system.

11. An apparatus, comprising:

one or more processors; and

one or more memories including computer program code,

the one or more memories and the computer program code configured, with the one or more processors, to cause the apparatus to perform at least the following:

transmitting a message from a network element in the long term evolution system to a user equipment, the message at least identifying a mapping between a plurality of public land mobile network (PLMN) identities (IDs) and associated code division multiple access systems for which the long term evolution system supports interworking;

receiving at the network element and from the user equipment one or more indications of one or more selected ones of the plurality of PLMN IDs, and corresponding one or more selected code division multiple access systems to which the network element has access based on the mapping between the plurality of PLMN IDs and associated code division multiple access systems, the one or more selected code division multiple access systems corresponding to one or more requested actions by the user equipment and selection by the user equipment of the one or more selected code division multiple access systems in order to handover a call from the long term evolution system; and

routing information corresponding to the one or more requested actions to the one or more selected code division multiple access systems in order to handover the call from the long term evolution system.

12. The apparatus of claim 11, wherein the one or more requested actions comprise a pre-registration procedure with a selected code division multiple access system, and wherein the routing further comprises routing information corresponding to the pre-registration procedure to the selected code division multiple access system.

13. The apparatus of claim 11, wherein the plurality of PLMN IDs indicates a plurality of 1x radio transmission technology systems and a plurality of high rate packet data systems, and wherein the one or more selected plurality of code division multiple access systems comprises one of a selected 1x radio transmission technology system or a selected high rate packet data system.

14. An apparatus, comprising:

one or more processors; and

one or more memories including computer program code,

the one or more memories and the computer program code configured, with the one or more processors, to cause the apparatus to perform at least the following:

transmitting, by a network element in a long term evolution system, to a user equipment indications of a mapping between a plurality of public land mobile network (PLMN) identities (IDs) and associated code division multiple access systems to ones of one or more long term evolution systems with which the network element is associated, and at least one of the associated one or more long term evolution systems supports interworking with the plurality of code division multiple access systems in order to handover a call from the long term evolution system; and

receiving from the user equipment comprising one or more indications of one or more selected public land mobile network (PLMN) identities (IDs) and corresponding one or more code division multiple access systems selected by the user equipment based on the mapping between the plurality of PLMN IDs and associated code division multiple access systems in order to handover the call from the long term evolution system.

15. The apparatus of claim 14, wherein the one or more memories and the computer program code are further configured, with the one or more processors, to cause the apparatus to perform:

receiving signaling corresponding to one or more requested actions by the user equipment and corresponding to the one or more selected code division multiple

access systems; and
signaling the one or more requested actions to the second network element.

5 16. The apparatus of claim 14, wherein the one or more memories and the computer program code are further configured, with the one or more processors, to cause the apparatus to perform: requesting via transmitting the user equipment to perform measurements of the one or more selected code division multiple access systems.

10 17. The apparatus of claim 16, wherein the requesting is performed in response to signaling received from a second network element in the long term evolution system comprising an indication of at least a 1x radio transmission technology system, and wherein the requesting via transmitting the user equipment to perform measurements of the one or more selected code division multiple access systems further comprises requesting via signaling the user equipment to perform measurements of the 1x radio transmission technology system.

15 18. The apparatus of claim 14, wherein the one or more signaled indications comprises one or both of an indication of a selected 1x radio transmission technology system and a selected high rate packet data system, and wherein the one or more memories and the computer program code are further configured, with the one or more processors, to cause the
20 apparatus to perform: using the indications to select a set of CDMA2000 parameters associated with one or both of the selected 1x radio transmission technology system or the selected high rate packet data system to send to the user equipment, and sending the set of CDMA2000 parameters to the user equipment.