Source: **TSG SA WG2**
Title: **CRs on 23.251 (Network Sharing)**
Agenda Item: **7.2.3**

The following Change Requests (CRs) have been approved by TSG SA WG2 and are requested to be approved by TSG SA plenary #25.

S2 doc #	Title	Spec	CR #	cat	Version in	Rel	WI	S2 meeting	Clauses affected
S2-042577	Introduction of network sharing (non-)supporting UEs	23.251	002r1	F	6.0.0	6	NTShar	S2 #41	3.1
S2-042576	Handling of system information in connected mode	23.251	003r1	B	6.0.0	6	NTShar	S2 #41	5.2
S2-042574	Core network operator identity as part of LAI/RAI for supporting UEs	23.251	004r1	B	6.0.0	6	NTShar	S2 #41	2, 4.2.4, 4.2.6
S2-042575	Indication of selected core network operator to the CN for supporting UEs	23.251	005r1	B	6.0.0	6	NTShar	S2 #41	5.2, 5.3, 5.4

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CHANGE REQUEST

| ⌘ | **23.251** | CR | **002** | ⌘ rev | **1** | ⌘ | Current version: | **6.0.0** | ⌘ |

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

**Proposed change affects:** │ UICC apps⌘ ☐   ME ☐ Radio Access Network ☐ Core Network ☐

Title:	⌘	Introduction of network sharing (non-)supporting UEs
Source:	⌘	SA2 (TeliaSonera)
Work item code:⌘	NTShar	***Date:*** ⌘ 19/07/04
Category: ⌘	**F**	***Release:*** ⌘ Rel-6

Use *one* of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can
be found in 3GPP TR 21.900.

Use *one* of the following releases:
Ph2   *(GSM Phase 2)*
R96   *(Release 1996)*
R97   *(Release 1997)*
R98   *(Release 1998)*
R99   *(Release 1999)*
Rel-4   *(Release 4)*
Rel-5   *(Release 5)*
Rel-6   *(Release 6)*
Rel-7   *(Release 7)*

Reason for change:	⌘	To avoid confusion when referring to (non-)supporting UE as regards network sharing, especially in stage 3 specifications.
Summary of change:⌘		It is indicated in the definitions of ìsupporting UEsî and ìnon-supporting UEsî that the alternative terms ìnetwork sharing supporting UEsî and ìnetwork sharing non-supporting UEsî may be used in other specifications.
Consequences if not approved:	⌘	A common nomenclature for network sharing support can not be introduced across 3GPP specifications.

Clauses affected:	⌘	3.1			

			Y	N	
Other specs affected:	⌘		X		Other core specifications ⌘ 21.905
				X	Test specifications
				X	O&M Specifications

Other comments:	⌘	

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

3   Definitions, symbols and abbreviations

3.1   Definitions

For the purposes of the present document, the following terms and definition below apply. Terms and definitions not defined below can be found in [2].

Conventional network: A PLMN consisting of radio access network and core network, by which only one serving operator provides services to its subscriber. Subscribers of other operators may receive services by national or international roaming.

Common PLMN: The PLMN-id indicated in the system broadcast information as defined for conventional networks, which non-supporting UEs understand as the serving operator.

Core network operator: An operator that provides services to subscribers as one of multiple serving operators that share at least a radio access network. Each core network operator may provide services to subscriber of other operators by national or international roaming.

Gateway Core Network: A network sharing configuration in which parts of the core network (MSC/SGSNs) are also shared.

Multi-Operator Core Network: A network-sharing configuration in which only the RAN is shared.

Non-supporting UE: A UE that does not support network sharing in the sense that it ignores the additional broadcast system information that is specific for network sharing. In other specifications, the term ì network sharing non-supporting UEî may be used.

Supporting UE: A UE that supports network sharing in the sense that it is able to select a core network operator as the serving operator within a shared network. In other specifications, the term ì network sharing supporting UEî may be used.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

3.3   Abbreviations

For the purposes of the present document, the following abbreviations apply:

CN	Core Network
GWCN	Gateway Core Network
HLR	Home Location Register
MCC	Mobile Country Code
MNC	Mobile Network Code
MOCN	Multi-Operator Core Network
MSC	Mobile Switching Centre
PLMN	Public Land Mobile Network
RNC	Radio Network Controller
SGSN	Serving GPRS Support Node
TMSI	Temporary Mobile Subscriber Identity
UE	User Equipment
VLR	Visitor Location Register

4   General Description

4.1   Overview

A network sharing architecture shall allow different core network operators to connect to a shared radio access network. The operators do not only share the radio network elements, but may also share the radio resources themselves. In addition to this shared radio access network the operators may or may not have additional dedicated radio access networks, like for example, 2G radio access networks. There are two identified architectures to be supported by network sharing. They are shown in the figures below.

In both architectures, the radio access network is shared. Figure 1 below shows reference architecture for network sharing in which also MSCs and SGSNs are shared. This configuration will be referred to as a Gateway Core Network (GWCN) configuration.

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CHANGE REQUEST

| ⌘ | **23.251** | CR | **003** | ⌘**rev** | **1** | ⌘ | Current version: | **6.0.0** | ⌘ |

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Proposed change affects: │ UICC apps⌘ ☐   ME ☐   Radio Access Network **X**   Core Network **X**

Title: ⌘	Handling of system information in connected mode	
Source: ⌘	SA2 (TeliaSonera)	
Work item code:⌘	NTShar	***Date:*** ⌘ 10/08/04

Category: ⌘ **B**	***Release:*** ⌘ Rel-6

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R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
Rel-4 (Release 4)
Rel-5 (Release 5)
Rel-6 (Release 6)
Rel-7 (Release 7)

Reason for change: ⌘	To ensure correct behaviour of supporting UEs in connected mode (when relevant system information is sent to UEs in dedicated signalling), text is added to Section 5.2.
Summary of change:⌘	If system information is transmitted to a supporting UE in dedicated signalling, the RNC shall indicate the PLMN-id of the core network operator towards which the UE already has a signalling connection (if a PLMN-id is included in the signalling). If the UE is non-supporting, the RNC shall indicate the common PLMN (if a PLMN-id identity is included in the signalling).
Consequences if not approved: ⌘	Ambiguous behavior for network sharing supporting UEs.

Clauses affected: ⌘	5.2	

		Y	N	
Other specs ⌘			X	Other core specifications ⌘
affected:			X	Test specifications
			X	O&M Specifications

Other comments: ⌘	

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

4.2.4   Assignment of core network operator and core network node

When a UE performs an initial access to a shared network, one of available CN operators shall be selected to serve the UE. For non-supporting UEs, the shared network selects an operator from the available CN operators. For supporting UEs, the selection of core network operator by the UE shall be respected by the network. Supporting UEs inform the RNC of the network of the identity of the chosen core network operator. In a GWCN configuration, the RNC relays this information to the shared core network node.

In a MOCN configuration, the RAN routes the UE's initial access to the shared network to one of the available CN nodes. Supporting UEs shall inform the RAN of the chosen core network operator so that the RAN can route correctly. For non-supporting UEs the shared network selects an operator from the available CN operators. A redirection to another CN operator may be required for non-supporting UEs until an operator is found that can serve the UE. Redirection is described in subclause 7.1.4.

After initial access to the shared network the UE does not change to another available CN operator as long as the selected CN operator is available to serve the UE's location. Only the network selection procedures specified in TS 23.122 [4] may cause a reselection of another available CN operator. Furthermore the UE does not change to another CN node as long as the selected CN node is available to serve the UE's location.

4.2.5   PS and CS domain registration coordination

In conventional networks, the same CN operator always serves the UE in CS and PS domains. In a shared network, supporting UEs shall behave as UEs in conventional networks with respect to registration with CS and PS domains. For non-supporting UEs, the Gs interface may be configured to guarantee that the same CN operator serves the subscriber in CS and PS domains.

4.2.6   Attach/detach handling

[Editor's note: The text from TR23.851 is not clear enough to be transferred as is. It is still an open issue as far as this document is concerned.]

4.3   Network Name Display for Supporting UEs

A supporting UE shows the name of the PLMN-id it has registered with. In case of a shared network, it is the PLMN-id of the chosen core network operator. The name stored in the UE for the PLMN-id is displayed except when the network indicates to the UE a name to be displayed, as already specified for non-supporting UEs.

4.4   HPLMN Support

The use of a shared VLR/SGSN shall not result in service restrictions, e.g. roaming restrictions. Since a HLR derives whether the subscriber roams in H- or V-PLMN from the VLR/SGSN number, a shared VLR/SGSN in a GWCN shall be allocated one specific number from each supported HPLMN, i.e. a shared VLR/SGSN has multiple numbers. The VLR/SGSN number of a user's serving CN operator is used in signalling with the HLR.

5   Functional description

The new behaviours of network nodes needed in order to describe network sharing are described.

5.1   UE functions

A supporting UE selects the core network operator and provides the PLMN-id of this operator to the network for routing purposes.

5.2   RNC functions

Network sharing information, i.e. available core network operators in the shared network, shall be transmitted in broadcast system information. If system information is transmitted to a supporting UE in dedicated signalling, the RNC shall indicate the PLMN-id of the core network operator towards which the UE already has a signalling connection (if a PLMN-id is included in the signalling). If the UE is non-supporting, the RNC shall indicate the common PLMN (if a PLMN-id identity is included in the signalling).

In a GWCN, the RNC shall forward the identity of the selected core network operator as provided by a supporting UE to the shared core network node. In a MOCN, the RNC routes the initial NAS signalling messages from a supporting UE according to the selected core network.

5.3   MSC functions

When a UE accesses an MSC the first time, i.e. when there is no VLR entry for this UE, the MSC verifies whether the UE belongs to one of the operators sharing the MSC or their roaming partners. For that purposes the MSC derives the IMSI from another MSC/VLR or from the UE. The MSC determines a serving CN operator unless the old MSC/VLR or the UE have indicated a core network operator. The MSC/VLR shall also store the identity of the serving core network operator.

In case of a MOCN configuration, an MSC may not able to provide service to the UE. The UE may then have to be redirected to a MSC of another core network operator. The MSC/VLR that finally serves the UE assigns a NRI to the UE. This will allow the RAN to route any subsequent UE accesses the to the serving MSC/VLR.

5.4   SGSN functions

When a UE accesses an SGSN the first time, i.e. when the UE is not yet known by the SGSN, the SGSN verifies whether the UE belongs to one of the operators sharing the SGSN or their roaming partners. For that purposes the SGSN derives the IMSI from another SGSN or from the UE. The SGSN determines a serving core network operator unless the old SGSN or the UE have indicated a core network operator. The SGSN shall also store the identity of the serving core network operator.

In case of a MOCN configuration, a SGSN may not able to provide service to the UE. The UE may then have to be redirected to a SGSN of another core network operator. The SGSN that finally serves the UE assigns a NRI to the UE. This will allow the RAN to route any subsequent UE accesses the to the serving SGSN.

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CHANGE REQUEST

| ⌘ | **23.251** | CR | **004** | ⌘**rev** | **1** | ⌘ | Current version: | **6.0.0** | ⌘ |

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Proposed change affects: | UICC apps⌘ | | ME **X** Radio Access Network **X** Core Network **X**

Title: ⌘	Core network operator identity as part of LAI/RAI for supporting UEs	
Source: ⌘	SA2 (TeliaSonera)	
Work item code:⌘	NTShar	***Date:*** ⌘ 10/08/04
Category: ⌘	**B**	***Release:*** ⌘ Rel-6

Use one of the following categories:	*Use one of the following releases:*
F (correction)	*Ph2 (GSM Phase 2)*
A (corresponds to a correction in an earlier release)	*R96 (Release 1996)*
B (addition of feature),	*R97 (Release 1997)*
C (functional modification of feature)	*R98 (Release 1998)*
D (editorial modification)	*R99 (Release 1999)*
Detailed explanations of the above categories can	*Rel-4 (Release 4)*
be found in 3GPP TR 21.900.	*Rel-5 (Release 5)*
	Rel-6 (Release 6)
	Rel-7 (Release 7)

Reason for change: ⌘	It needs to be specified what a network sharing supporting UE considers to be the registered PLMN in relation to what is received in network signalling (and subsequently stored on the SIM/USIM).
	This resolves the major open issue for network sharing in TSG SA2.
Summary of change:⌘	Text is added in Section 4.2.4 to specify that LAI/RAIs received from the network in dedicated signalling to the UE shall contain the core network operator identity and not the common PLMN for network sharing supporting UEs.
	Text is added to the empty section 4.2.6 how attach/detach is handled. Since the LAI stored on the SIM/USIM now contains the selected core network operator the supporting UE has sufficient information to re-attach again to the same core network operator.
Consequences if not approved: ⌘	Ambiguous behavior for network sharing supporting UEs.

Clauses affected: ⌘	2, 4.2.4, 4.2.6

	Y	N	
Other specs ⌘		X	Other core specifications ⌘
affected:		X	Test specifications
		X	O&M Specifications

Other comments:	⌘	

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1 Scope

The present document covers the details of Network Sharing. It shows how several core network operators can share one radio access network and details the impacts on the network architecture. All UEs shall comply with existing requirements, among them PLMN selection and system information reception. The present document defines additional requirements for network-sharing supporting UEs.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 22.951: "Service Aspects and Requirements for Network Sharing".

[2] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[3] 3GPP TS 25.331: "RRC Protocol Specification".

[4] 3GPP TS 23.122: "NAS Functions related to Mobile Station (MS) in idle mode".

[5] 3GPP TS 32.250: "Telecommunication management; Charging management; Circuit Switched (CS) domain charging".

[6] 3GPP TS 32.251: "Telecommunication management; Charging management; Packet Switched (PS) domain charging".

[7] 3GPP TS 24.008: "Mobile radio interface Layer 3 specification; Core network protocols; Stage 3"

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definition below apply. Terms and definitions not defined below can be found in [2].

Conventional network: A PLMN consisting of radio access network and core network, by which only one serving operator provides services to its subscriber. Subscribers of other operators may receive services by national or international roaming.

4.2.4   Assignment of core network operator and core network node

When a UE performs an initial access to a shared network, one of available CN operators shall be selected to serve the UE. For non-supporting UEs, the shared network selects an operator from the available CN operators. For supporting UEs, the selection of core network operator by the UE shall be respected by the network. Supporting UEs inform the RNC of the network of the identity of the chosen core network operator. In a GWCN configuration, the RNC relays this information to the shared core network node.

In a MOCN configuration, the RAN routes the UE's initial access to the shared network to one of the available CN nodes. Supporting UEs shall inform the RAN of the chosen core network operator so that the RAN can route correctly. For non-supporting UEs the shared network selects an operator from the available CN operators. A redirection to another CN operator may be required for non-supporting UEs until an operator is found that can serve the UE. Redirection is described in subclause 7.1.4.

After initial access to the shared network the UE does not change to another available CN operator as long as the selected CN operator is available to serve the UE's location. Only the network selection procedures specified in TS 23.122 [4] may cause a reselection of another available CN operator. Furthermore the UE does not change to another CN node as long as the selected CN node is available to serve the UE's location.

When the network signals location (routing) area identities to supporting UEs, e.g. in location updating accept messages, these identities shall contain the chosen core network operator identity. For non-supporting UEs, they shall contain the common PLMN. The UE stores the received LAI/RAI on the SIM/USIM, as already specified in TS 24.008 [7].

4.2.5   PS and CS domain registration coordination

In conventional networks, the same CN operator always serves the UE in CS and PS domains. In a shared network, supporting UEs shall behave as UEs in conventional networks with respect to registration with CS and PS domains. For non-supporting UEs, the Gs interface may be configured to guarantee that the same CN operator serves the subscriber in CS and PS domains.

4.2.6   Attach/detach handling

[Editor's note: The text from TR23.851 is not clear enough to be transferred as is. It is still an open issue as far as this document is concerned.]

To attach to the same core network operator from which it detached, a UE uses information stored on the SIM/USIM. For a supporting UE in a shared network, the stored information indicates the core network operator it detached from (as specified in Section 4.2.4). This information enables a supporting UE to attach to the same core network operator from which it detached. For non-supporting UEs in a shared network, the stored information indicates the common PLMN.

4.3   Network Name Display for Supporting UEs

A supporting UE shows the name of the PLMN-id it has registered with. In case of a shared network, it is the PLMN-id of the chosen core network operator. The name stored in the UE for the PLMN-id is displayed except when the network indicates to the UE a name to be displayed, as already specified for non-supporting UEs.

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CHANGE REQUEST

| ⌘ | **23.251** | CR | **005** | ⌘rev | **1** | ⌘ | Current version: | **6.0.0** | ⌘ |

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Proposed change affects: | UICC apps⌘ ☐   ME ☐   Radio Access Network **X**   Core Network **X**

Title:	⌘	Indication of selected core network operator to the CN for supporting UEs
Source:	⌘	SA2 (TeliaSonera)
Work item code:⌘	NTShar	***Date:*** ⌘ 10/08/04

Category:	⌘	**B**	***Release:*** ⌘ Rel-6

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be found in 3GPP TR 21.900.

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  R98   *(Release 1998)*
  R99   *(Release 1999)*
  Rel-4 *(Release 4)*
  Rel-5 *(Release 5)*
  Rel-6 *(Release 6)*
  Rel-7 *(Release 7)*

Reason for change:	⌘	To ensure that the right information can be signalled to the UE as regards PLMN-ids in LAI/RAIs, the CN needs to be informed by the RNC about the selected CN operator for supporting UEs. This is necessary in order for the UE to correctly determine its registered PLMN from the received LAI (which shall indicate the chosen core network operator id for supporting UEs).
Summary of change:⌘		Text is changed to indicate that the RNC shall indicate the selected core network operator to the core network (not just in the GWCN configuration). Text is added to define the necessary functionaliy in MSCs/SGSNs to ensure that the appropriate PLMN-id is used for LAI/RAI when signalling to the UE.
Consequences if not approved:	⌘	Ambiguous behavior for network sharing supporting UEs.

Clauses affected:	⌘	5.2, 5.3, 5.4

		Y	**N**
Other specs affected:	⌘	**X**	Other core specifications ⌘ 25.413, 25.331
		X	Test specifications
		X	O&M Specifications

Other comments:	⌘	

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

4.2.4 Assignment of core network operator and core network node

When a UE performs an initial access to a shared network, one of available CN operators shall be selected to serve the UE. For non-supporting UEs, the shared network selects an operator from the available CN operators. For supporting UEs, the selection of core network operator by the UE shall be respected by the network. Supporting UEs inform the RNC of the network of the identity of the chosen core network operator. In a GWCN configuration, the RNC relays this information to the shared core network node.

In a MOCN configuration, the RAN routes the UE's initial access to the shared network to one of the available CN nodes. Supporting UEs shall inform the RAN of the chosen core network operator so that the RAN can route correctly. For non-supporting UEs the shared network selects an operator from the available CN operators. A redirection to another CN operator may be required for non-supporting UEs until an operator is found that can serve the UE. Redirection is described in subclause 7.1.4.

After initial access to the shared network the UE does not change to another available CN operator as long as the selected CN operator is available to serve the UE's location. Only the network selection procedures specified in TS 23.122 [4] may cause a reselection of another available CN operator. Furthermore the UE does not change to another CN node as long as the selected CN node is available to serve the UE's location.

4.2.5 PS and CS domain registration coordination

In conventional networks, the same CN operator always serves the UE in CS and PS domains. In a shared network, supporting UEs shall behave as UEs in conventional networks with respect to registration with CS and PS domains. For non-supporting UEs, the Gs interface may be configured to guarantee that the same CN operator serves the subscriber in CS and PS domains.

4.2.6 Attach/detach handling

[Editor's note: The text from TR23.851 is not clear enough to be transferred as is. It is still an open issue as far as this document is concerned.]

4.3 Network Name Display for Supporting UEs

A supporting UE shows the name of the PLMN-id it has registered with. In case of a shared network, it is the PLMN-id of the chosen core network operator. The name stored in the UE for the PLMN-id is displayed except when the network indicates to the UE a name to be displayed, as already specified for non-supporting UEs.

4.4 HPLMN Support

The use of a shared VLR/SGSN shall not result in service restrictions, e.g. roaming restrictions. Since a HLR derives whether the subscriber roams in H- or V-PLMN from the VLR/SGSN number, a shared VLR/SGSN in a GWCN shall be allocated one specific number from each supported HPLMN, i.e. a shared VLR/SGSN has multiple numbers. The VLR/SGSN number of a user's serving CN operator is used in signalling with the HLR.

5 Functional description

The new behaviours of network nodes needed in order to describe network sharing are described.

5.1 UE functions

A supporting UE selects the core network operator and provides the PLMN-id of this operator to the network for routing purposes.

5.2   RNC functions

Network sharing information, i.e. available core network operators in the shared network, shall be transmitted in broadcast system information.

The RNC shall indicate the selected core network operator to the CN for supporting UEs when transferring initial layer 3 signalling. The selected CN operator is (i) indicated by the UE in RRC signalling or (ii) known implicitly from an already existing signalling connection. For non-supporting UEs, the RNC shall not indicate any selected core network operator to the CN.

In a GWCN, the RNC shall forward the identity of the selected core network operator as provided by a supporting UE to the shared core network node. In a MOCN, the RNC routes the initial NAS signalling messages from a supporting UE according to the selected core network.

5.3   MSC functions

When a UE accesses an MSC the first time, i.e. when there is no VLR entry for this UE, the MSC verifies whether the UE belongs to one of the operators sharing the MSC or their roaming partners. For that purposes the MSC derives the IMSI from another MSC/VLR or from the UE. The MSC determines a serving CN operator unless the old MSC/VLR or the UE have indicated a core network operator. The MSC/VLR shall also store the identity of the serving core network operator.

In case of a MOCN configuration, an MSC may not able to provide service to the UE. The UE may then have to be redirected to a MSC of another core network operator. The MSC/VLR that finally serves the UE assigns a NRI to the UE. This will allow the RAN to route any subsequent UE accesses the to the serving MSC/VLR.

For supporting UEs, i.e. when a selected core network operator has been indicated to the MSC by the RNC, the MSC indicates the selected core network operator PLMN-id in the LAI signalled to the UE in dedicated signalling.

5.4   SGSN functions

When a UE accesses an SGSN the first time, i.e. when the UE is not yet known by the SGSN, the SGSN verifies whether the UE belongs to one of the operators sharing the SGSN or their roaming partners. For that purposes the SGSN derives the IMSI from another SGSN or from the UE. The SGSN determines a serving core network operator unless the old SGSN or the UE have indicated a core network operator. The SGSN shall also store the identity of the serving core network operator.

In case of a MOCN configuration, a SGSN may not able to provide service to the UE. The UE may then have to be redirected to a SGSN of another core network operator. The SGSN that finally serves the UE assigns a NRI to the UE. This will allow the RAN to route any subsequent UE accesses the to the serving SGSN.

For supporting UEs, i.e. when a selected core network operator has been indicated to the SGSN by the RNC, the SGSN indicates the selected core network operator PLMN-id in the LAI/RAI signalled to the UE in dedicated signalling.