QUALCOMM
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GROUP

Multimode System Selection (MMSS) – Basic Provisioning

80-W3637-1 Rev B

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References

Number	Organization	Title
IS-683	TIA	Over-the-Air Service Provisioning of Mobile Stations in Spread Spectrum Systems
C.S0016	3GPP2	[Equivalent to TIA IS-683]
31.102	3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Characteristics of the Universal Subscriber Identity Module (USIM) application
24.008	3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Mobile radio interface Layer 3 specification; Core network protocols; Stage 3
Ref Doc 86	CDG	PRL Enhancements for International Roaming

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1 Introduction

CDMA 1x / EVDO operators planning to offer LTE service have a need to provision their devices with the necessary Multimode System Selection (MMSS) data to enable correct selection of the preferred network and air interface technology.

This document describes a structure for the MMSS data (including IS-683-E PRL) to address a common early deployment scenario. This simplified structure may serve as a basis for more complex arrangements in the future as deployments and operator agreements become more mature.

MMSS Data is typically assumed to reside on the UICC (card), although details of the exact storage location, and the manner in which the information is delivered to the UE are outside the scope of this document.

1.1 Intended Audience

This document is intended for operator staff charged with preparing and maintaining the MMSS files to support an LTE deployment. Familiarity with Preferred Roaming List (PRL) concepts and terminology is assumed.

1.2 Disclaimer

Nothing in this document is to be interpreted as a claim or statement of support for a particular configuration – operators should confirm and test their proposed file contents with their OEMs prior to deployment.

2 Deployment Scenario and Assumptions

For an initial LTE deployment, a 3GPP2 operator may provide a partial overlay of LTE service on their home coverage area. The following assumptions apply for the solutions presented in this document:

- Devices are 1X, EVDO/eHRPD and LTE capable (no GSM/UMTS)
- LTE coverage is available in a subset of the operator's home coverage area
- No LTE roaming is available

This deployment scenario is illustrated by Figure 2-1 below:

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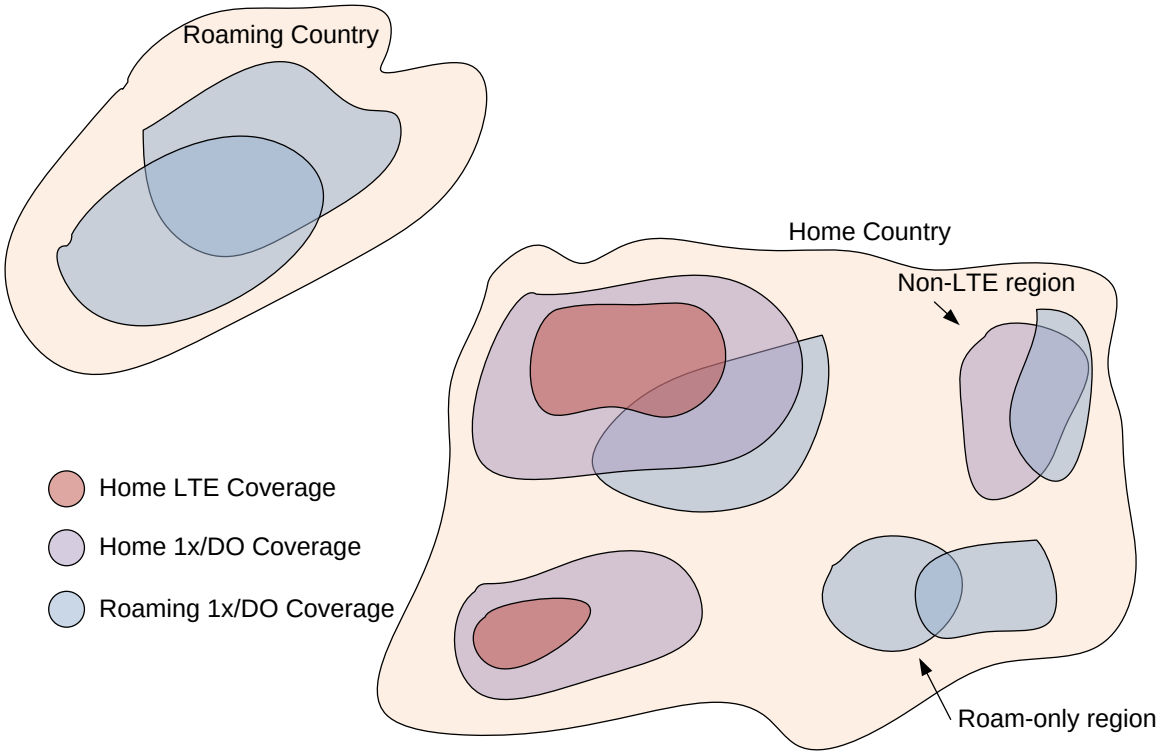

Figure 2-1. LTE Home-only, partial overlay

3 MMSS Data

The following subsections detail the content of each of the key standards-defined MMSS-related files:

- PLMN Selector – Umbrella term for several EFs containing PLMN IDs (3GPP-defined)
- PRL – Standard IS-683 PRL has new record type to link PRL to MMSS
- MLPL – MMSS Location Associated Priority List. Groupings of network IDs, with pointer to MSPL (defined in IS-683-E)
- MSPL – MMSS System Priority List. Inter-technology priorities to apply (defined in IS-683-E).

3.1 PLMN Selector

The PLMN Selector consists of several Elementary Files (EFs), as defined by 3GPP. They contain reference to network identifying information in the form of PLMN-IDs, consisting of a

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Mobile Country Code (MCC) and Mobile Network Code (MNC). In the basic deployment scenario considered here, the only 3GPP network the device will access will be the Home LTE network, so only this PLMN-ID must be present.

Although the PLMN-ID derived from the UE IMSI is interpreted as the Home PLMN-ID, it is recommended to also explicitly include this ID in the USIM Equivalent Home PLMN file (EF_{EHPLMN})[1]. Figure 3-1 shows an screenshot of the EHPLMN creation in the QPST Roaming List Editor (RLE), for the dummy MCC-MNC values 123-45. (This and all other screenshots in this document are from QPST 2.7 Build 367.)

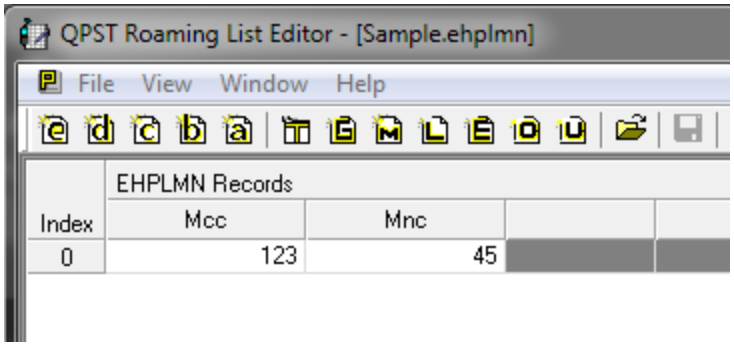

Figure 3-1. EHPLMN Provisioning

Details of the file format are shown in Appendix A.1.

3.2 MMSS Location Associated Priority List (MLPL)

The MLPL file format is defined by 3GPP2 standard C.S0016-D (commonly referred to by its TIA name IS-683-E) – the same standard that defines the PRL.

MLPL Records define groups of network identifiers (“Location Groups”) that may be present in the same geographical region. When a network is detected that belongs to a Location Group in the MLPL, the appropriate technology priorities to use are obtained by following a link from the MLPL to a specific portion of the MSPL.

For initial deployments, a simple MLPL format is recommended in which networks (both 3GPP and 3GPP2) are grouped according to their MCC only. MMSS is used to prioritize between 3GPP and 3GPP2 technologies. In the initial deployment, this only happens in the home country, so only the home MCC is required. Figure 3-2 below shows the resulting table in QPST RLE when the home country has only a single MCC assigned (see ITU[2] for MCC assignments).

[1] The PLMN-ID from the IMSI is ignored if EF_{EHPLMN} is present. Adding the home PLMN-ID explicitly to the EHPLMN list ensures it won’t be missed if this list is later expanded to include other PLMN-IDs.

[2] http://www.itu.int/pub/T-SP-E.212A-2010

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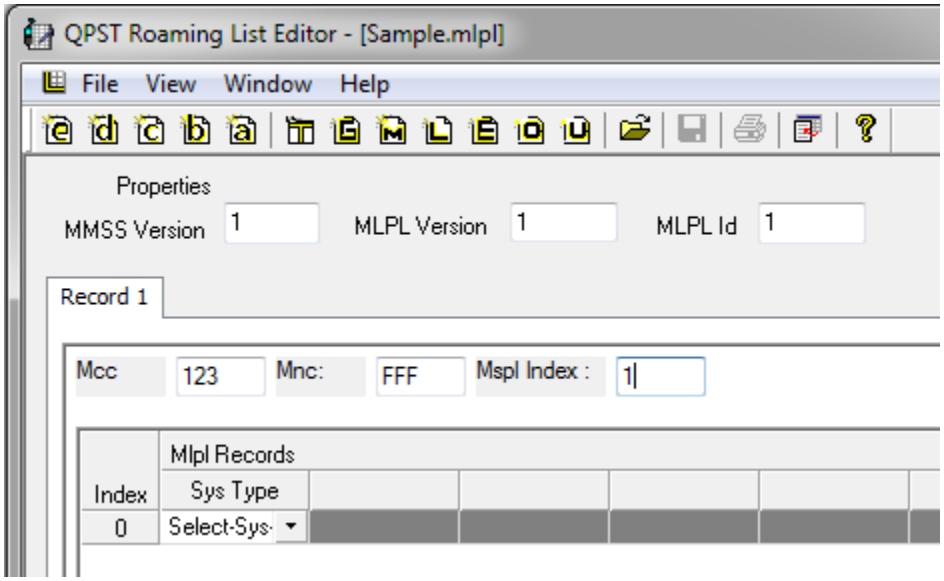

Figure 3-2. MLPL for Single-MCC Country

When the home country has multiple MCCs assigned, it is advantageous to group all MCCs into the same MLPL Record / Location Group, to indicate that all MCCs may be present in the same location. This is done by making use of the sub-record structure in the MLPL (known as SYS_LOC_TAG in the standard). The resulting MLPL is shown in Figure 3-3:

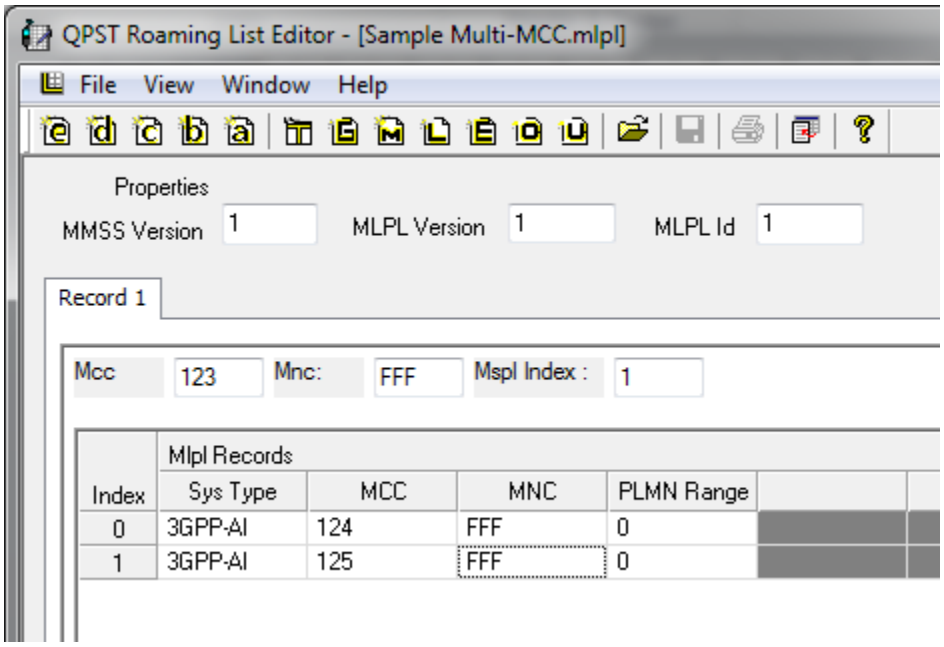

Figure 3-3. MLPL for Multi-MCC Country

Details of the file format are shown in Appendix A.2.

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3.3 MMSS System Priority List (MSPL)

The MSPL file format is defined by 3GPP2 standard C.S0016-D (commonly referred to by its TIA name IS-683-E) – the same standard that defines the PRL.

The MSPL defines a set of technology priorities/rankings for a particular Location Group (more than one Location Group can use the same set of priorities). Its structure is that of a “list of lists” – the specific priority list to use within the entire MSPL is identified by the MSPLID.

In addition to listing technology types (e.g. LTE, 1X etc.), the MSPL can further differentiate networks by their preference – Home, Home+Preferred, or Any.

In the initial deployment, only one Location Group uses MMSS, so only one MSPLID is required within the MSPL. This will prioritize home LTE (referred to as E-UTRAN in the standard) service over 1X / EVDO service from any/all allowed networks.

The resulting MSPL is shown in Figure 3-4:

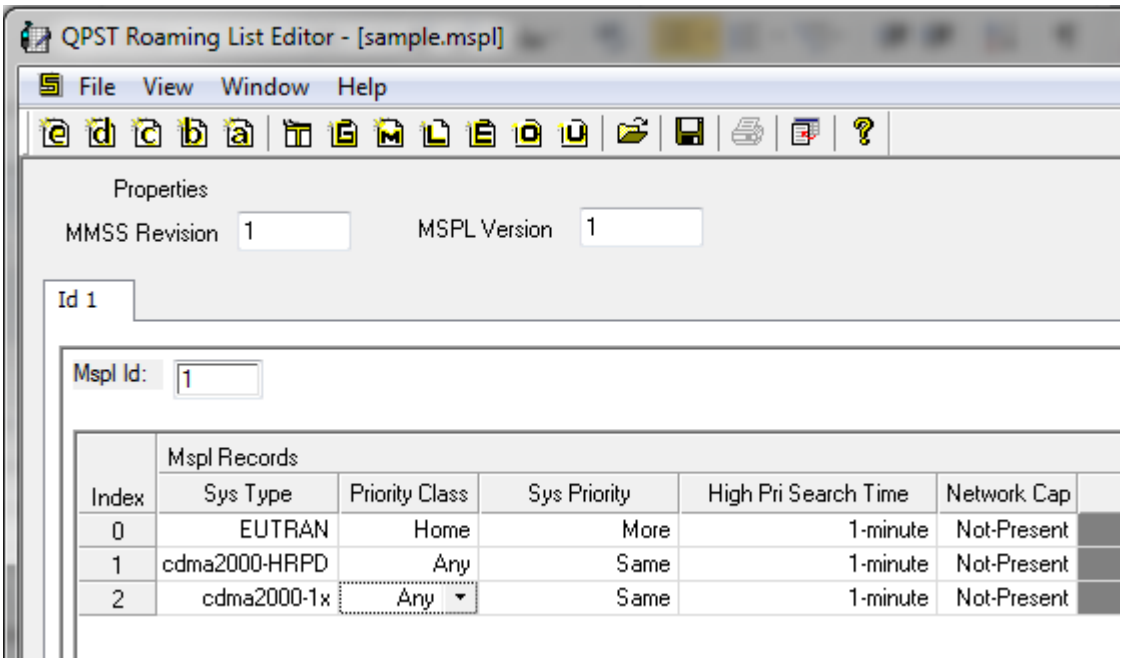

Figure 3-4. MSPL Provisioning

Note that where air interface redirection/advertisement is used to move devices between LTE and 3GPP2 technologies, it may be preferable to list EUTRAN at the same priority as the cdma2000 Air Interfaces to avoid creating a conflict between the MMSS provisioning and the network instructions.

Details of the file format are shown in Appendix A.3. The “Higher Priority Search Time” and “Network Capability” fields may not be interpreted by current implementations.

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3.4 Preferred Roaming List (PRL)

The MLPL defines systems in terms of MCC only. Although existing PRLs can encode MCC information (see CDG Reference Document #86), in many cases the MCC broadcast by 1X / DO networks is not reliable. Instead, MMSS makes use of a new PRL record structure added to revision E of IS-683 to “tag” a 1X or DO system with an MCC (and possibly MNC).

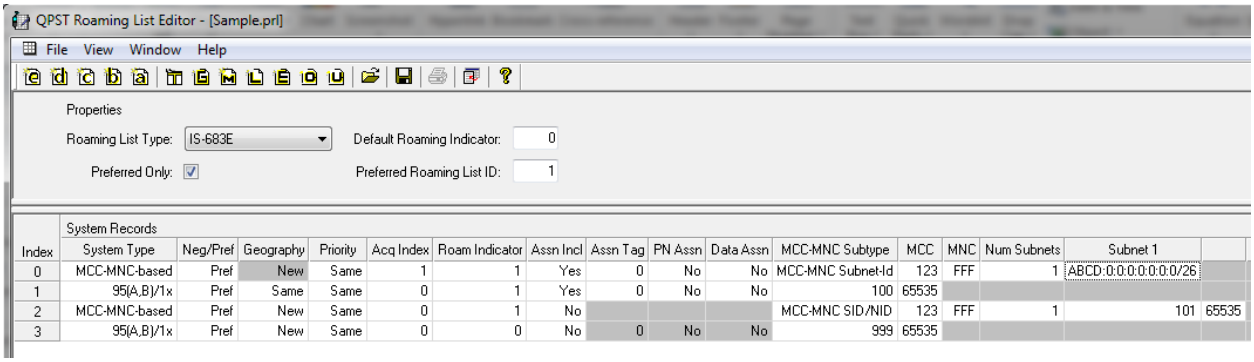
This IS-683-E PRL creates an alias MCC for a 1X / DO system that is internally defined in the MS/UE, and is not dependent on the broadcast MCC value from the system. This MCC value is then used to find a match in the MLPL, so the correct technology priorities can be applied.

The new system record may be provisioned as follows:

- Only a single “tagged” record is required in each GEO. All untagged systems will be assumed to have the same MCC value. It is recommended to apply the tag to the first record in the GEO for clarity.
- Use of a wildcard MNC is recommended, to match the MCC-level granularity in the MLPL.
- The tagged record can be either a 1X or DO system record (both use the same new System Record Type value).
- Rather than adding a tag to an existing record, it is recommended to duplicate the record and then tag it. This can assist non-IS-683-E capable devices to skip the new record and access the remaining PRL records without missing a high-priority system.

In initial LTE deployments, there may be regions (represented by GEOs in the PRL) where no LTE service is available. There may or may not be home 1X / DO coverage in these regions (refer Figure 2-1 above). To avoid unnecessarily scanning for Home LTE service in these regions, implementations may support an optimization such that a device that acquires a 3GPP2 system in a PRL GEO where no system is tagged with an MCC will not attempt to start MMSS. Operators can leave their non-LTE GEOs unmodified from the standard IS-683-C format to prevent scanning for LTE in these regions.

An example PRL System Table is shown in Figure 3-5. Note that IS-683-E does not introduce any changes to the Acquisition Table or header information (although editors may show a new “Roaming List Type” or equivalent).



Index	System Type	Neg/Pref	Geography	Priority	Acq Index	Roam Indicator	Assn Incl	Assn Tag	PN Assn	Data Assn	MCC-MNC Subtype	MCC	MNC	Num Subnets	Subnet 1	
0	MCC-MNC-based	Pref	New	Same	1	1	Yes	0	No	No	MCC-MNC Subnet-Id	123	FFF	1	ABCD:0:0:0:0:0:0:0/26	
1	95(A,B)/1x	Pref	Same	Same	0	1	Yes	0	No	No	100	65535				
2	MCC-MNC-based	Pref	New	Same	0	1	No				MCC-MNC SID/NID	123	FFF	1	101	65535
3	95(A,B)/1x	Pref	New	Same	0	0	No	0	No	No	999	65535				

Figure 3-5. IS-683-E PRL Provisioning

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In the PRL shown, the first GEO has only the EVDO record tagged. Acquisition of SID 100 will also result in MCC 123 being applied as it is in the same GEO as a tagged record. In the last GEO, acquisition of SID 999 will not result in a search for other technologies, as no record in the GEO is tagged with an MCC.

Details of the file format are shown in Appendix A.4.

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Appendix A File Format Details

The following sections describe in detail the field layout of the files, and give more information on selected field values.

A.1 EHPLMN Format

The EHPLMN shown above for MCC-MNC 123-45 gives the resulting Hex file:

21F354

This can be understood with reference to the EF_{EHPLMN} detail in 3GPP TS 31.102, which points to TS 24.008. The three-octet EHPLMN entry uses the format from the “PLMN List” element, as shown in Figure A-1:

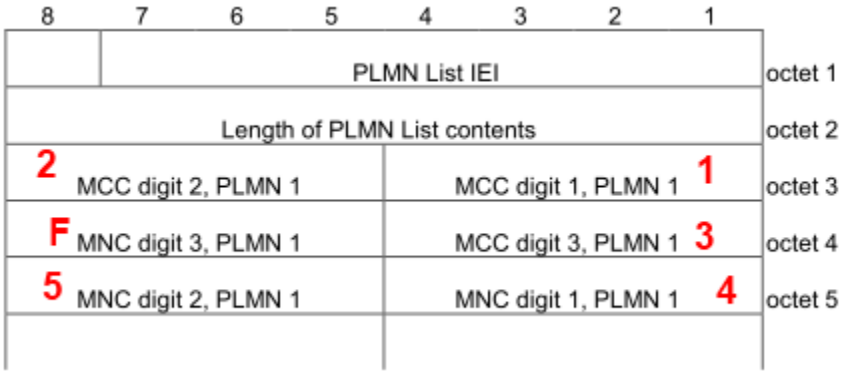

Figure A-1. EHPLMN Format

A.2 MLPL Format

The binary layout of the Multi-MCC MLPL is shown in Table A-1:

Table A-1. MLPL Binary Format

Bit Posn	Field Length	Field	Value	Field Name	Interpretation
1	16	0000000000011001	25	MLPL_SIZE	
17	8	00000001	1	CUR_MMSS_P_REV	
25	16	0000000000000001	1	MLPL_VER_ID	
41	8	00000001	1	MLPL_ID	
49	8	00000001	1	NUM_MLPL_RECS	
57	5	00000	0	LOC_PARAM_TYPE bits 7-3	
62	1	1	1	LOC_PARAM_TYPE bit 2	NUM_SYS_LOC_TAG specified

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63	1	1	1	LOC_PARAM_TYPE bit 1	MNC specified
64	1	1	1	LOC_PARAM_TYPE bit 0	MCC specified
65	12	000100100011	291	MCC	
77	12	111111111111	4095	MNC	FFF
89	8	00000010	2	NUM_SYS_LOC_TAG	
97	8	00000001	1	SYS_TYPE	3GPP_AI
105	8	00100000	32	SYS_LOC_TAG_SIZE	
113	24	001000011111010011111111		PLMN_START	124-FFF
137	8	00000000	0	PLMN_RANGE	
145	8	00000001	1	SYS_TYPE	3GPP_AI
153	8	00100000	32	SYS_LOC_TAG_SIZE	
161	24	001000011111010111111111		PLMN_START	125-FFF
185	8	00000000	0	PLMN_RANGE	
193	8	00000001	1	MSPL_INDEX	

Comments:

- The MLPL format has two identifier fields, MLPL_VER_ID and MLPL_ID. Both are available for the operator to set however they like.
- Although the wildcard MNC at bit position 77 is not strictly required (the corresponding LOC_PARAM_TYPE flag could be set to 0 and the field omitted), including it means the file retains octet-alignment, and no padding bits are needed. This may avoid conflict with some parsers that use an older version of the standard.
- The SYS_TYPE of 3GPP_AI will successfully match 3GPP2 systems who use an MCC assigned via the IS-683-E PRL.
- The PLMN values in PLMN_START use the same interleaved format as the EHPLMN. These values need not be listed explicitly in the 3GPP PLMN Selector files.

A.3 MSPL Format

The binary format of the MSPL is shown in Table A-2:

Table A-2. MSPL Binary Format

Bit Posn	Field Length	Field	Value	Field Name	Interpretation
1	16	0000000000001111	15	MSPL_SIZE	
17	8	00000001	1	CUR_MMSS_P_REV	
25	16	0000000000000001	1	MSPL_VER_ID	
41	8	00000001	1	NUM_MSPL_ID	
49	8	00000001	1	MSPL_ID	
57	8	00000011	3	NUM_MSPL_RECS	
65	8	00000111	7	SYS_TYPE	EUTRAN (LTE)
73	4	0000	0	PRI_CLASS	Home only
77	1	1	1	SYS_PRI	More
78	3	000	0	HIGHER_PRI_SRCH_TIME	1 minute

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81	1	0	0	NETWORK_CAP_IND	
82	8	00000100	4	SYS_TYPE	cdma2000 HRPD
90	4	1111	15	PRI_CLASS	Any
94	1	0	0	SYS_PRI	Same
95	3	000	0	HIGHER_PRI_SRCH_TIME	1 minute
98	1	0	0	NETWORK_CAP_IND	
99	8	00000011	3	SYS_TYPE	cdma2000 1x
107	4	1111	15	PRI_CLASS	Any
111	1	0	0	SYS_PRI	Same
112	3	000	0	HIGHER_PRI_SRCH_TIME	1 minute
115	1	0	0	NETWORK_CAP_IND	
116	4	0000	0	RESERVED	

Comments:

- MSPL_VER_ID is freely available to set as the operator chooses
- Note that the MSPL_ID field is explicitly encoded, rather than implicitly derived by position (e.g. as with the PRL Acquisition Table).
- HIGHER_PRI_SRCH_TIME and NETWORK_CAP_IND may not be interpreted by current implementations.
- The 1X and DO system type entries could in theory be combined into a single entry with system type “cdma2000_AI”, however this can lead to confusion when using the “Home” priority class, as a priority step between DO and 1X systems will exclude the most preferred 1X entries from the Home class. See IS-683-E section E.1.2.

A.4 IS-683-E PRL Format

The binary format of a single system record from the IS-683-E PRL is shown in Table A-3:

Table A-3. IS-683-E PRL System Record Binary Format

Bit Posn	Field Length	Field	Value	Field Name	Interpretation
329	5	01101	13	SYS_RECORD_LENGTH	104
334	4	0011	3	SYS_RECORD_TYPE	683E MCC-MNC
338	1	1	1	PREF_NEG	Pref
339	1	0	0	GEO	New
340	1	0	0	PRI	Same
341	9	000000000	0	ACQ_INDEX	
350	3	010	2	SYS_RECORD_SUBTYPE	MCC, MNC and multiple SIDs, NIDs included
353	12	000100100011	291	MCC	123
365	12	111111111111	4095	MNC	FFF
377	4	0000	0	RESERVED	
381	4	0001	1	NUM_SID_NID	

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385	16	0000000001100101	101	SID	
401	16	1111111111111111	65535	NID	
417	8	00000001	1	ROAM_IND	Off
425	1	0	0	ASSOCIATION_INC	No
426	7	0000000	0	RESERVED	

Comments:

- The CUR_SSPR_P_REV in the PRL header (not shown in the table) remains unchanged from IS-683-C (value 3).
- The new SYS_RECORD_TYPE of 3 is used for MCC-MNC tagging of both 1X and EVDO records.
- Although the standard allows for more than one SID/NID to be included in a single record (NUM_SID_NID field), it is recommended to only use a single SID-NID pair. Similarly for an EVDO record, use only a single SubnetID.
- For tagging a 1X record, subtype 2 as shown above is recommended, rather than subtype 1 (“MCC, MNC and multiple SIDs”), even when the NID is wildcarded.

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Appendix B Glossary

3GPP	Third Generation Partnership Project
3GPP2	Third Generation Partnership Project 2
CDG	CDMA Development Group
CDMA	Code Division Multiple Access
EF	Elementary File
EHPLMN	Equivalent Home Public Land Mobile Network
eHRPD	evolved High Rate Packet Data
E-UTRAN	Evolved UMTS Terrestrial Radio Access Network
EVDO	Evolution – Data Optimized
GEO	Geographic Region
GSM	Global System for Mobile Communications
IMSI	International Mobile Subscriber Identity
ITU	International Telecommunication Union
LTE	Long Term Evolution
MCC	Mobile Country Code
MLPL	MMSS Location Associated Priority List
MMSS	Multimode System Selection
MNC	Mobile Network Code
MSPL	MMSS System Priority List
NID	Network ID
OEM	Original Equipment Manufacturer
PLMN	Public Land Mobile Network
PRL	Preferred Roaming List
QPST	Qualcomm Product Support Tool
RLE	Roaming List Editor

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SID	System ID
TIA	Telecommunications Industry Association
UE	User Equipment
UICC	Universal Integrated Circuit Card
UMTS	Universal Mobile Telecommunications System
USIM	Universal Subscriber Identity Module

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