3GPP2 CORRESPONDENCE

Dr. Byung K Yi
Chair, 3GPP2 TSG-C
LGE
10225 Willow Creek Rd
San Diego, CA 92131
bkyi@lge.com

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Mr. Michel Zarri
Chair, 3GPP SA WG1 (SA1)
michele.zarri@t-mobile.co.uk

Subject: Preferred Roaming List for Multi-mode Terminal

Dear Mr.Zarri,

3GPP2 TSG-C would like to inform 3GPP SA1 that TSG-C is working on extending CDMA Preferred Roaming List to support multi-mode terminals supporting cdma2000, GSM and UMTS operations. Attached is a proposal currently under TSG-C review; however, we'd like to solicit your input on GSM/UMTS roaming related issues. Specifically, we have the following questions.

1. If there is any similar activity going on in 3GPP regarding the system selection for multi-mode terminals (cdma2000, GSM and UMTS) as defined in our proposal, and if so, please provide the status and timeline.
2. If the proposal has covered all possible GSM/UMTS bands defined in 3GPP specification.
3. If the proposal causes any potential problem or any adverse impact to the current GSM/UMTS system selections.

We would appreciate it if you would provide your response as soon as possible. Thank you for your assistance in helping us to move our work forward.

Best regards,

Byung K Yi
Chair, 3GPP2 TSG-C

cc:	Hideo Okinaka	3GPP2 SC Chair	okinaka@ma.kcom.ne.jp
	Henry Cuschieri	3GPP2 Secretariat	hcuschie@tia.eia.org
	Nigel Barnes	3GPP2 T3 Chair	nigel.barnes@motorola.com

GSM/UMTS PRL Overview

Nobuyuki Uchida
QUALCOMM Incorporated

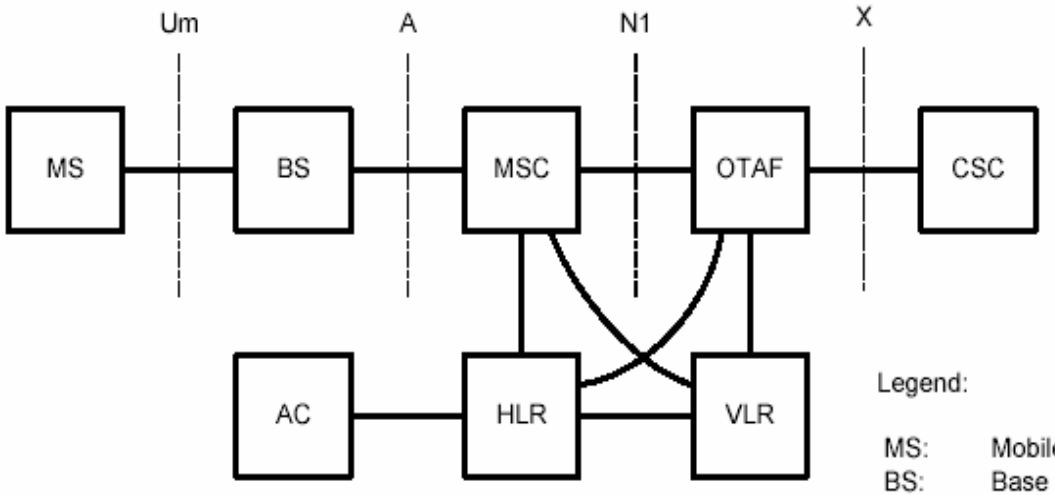
OTASP/OTAPA

- Over-the-Air Service Provisioning (OTASP)
  - Mechanism to program phones over the air using data burst messages (in another words, download NAM parameters, preferred roaming list, service programming lock and so on) OTASP is user-initiated programming procedure.

- Over-the-Air Parameter Administration (OTAPA)
  - Same as OTASP, but network-initiated.

- Standards for OTASP/OTAPA
  - 3GPP2 C.S0016-B (a.k.a. TIA-683-C)
  - 3GPP2 N.S0011 (a.k.a. TIA/EIA/IS-725-A)

Network Reference Model



Legend:

MS:	Mobile Station
BS:	Base Station
MSC:	Mobile Switching Center
OTAF:	Over-the-Air Service Provisioning Function
CSC:	Customer Service Center
HLR:	Home Location Register
VLR:	Visitor Location Register
AC:	Authentication Center

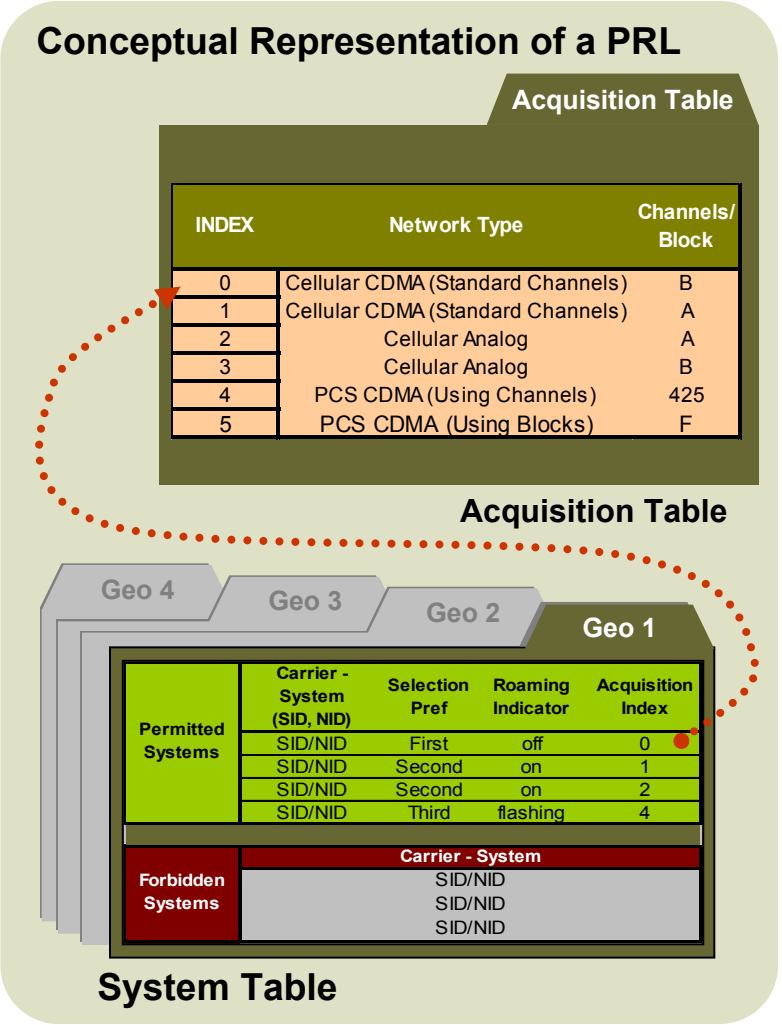
OTASP/OTAPA Features

- Parameters Download:
  - NAM parameter download (IMSI, MDN, etc)
  - Preferred Roaming List (PRL) download
  - Service Programming Lock download
  - Preferred User Zone List (PUZL) download
  - 3G Packet Data (3GPD) download (NAI, SS, etc)

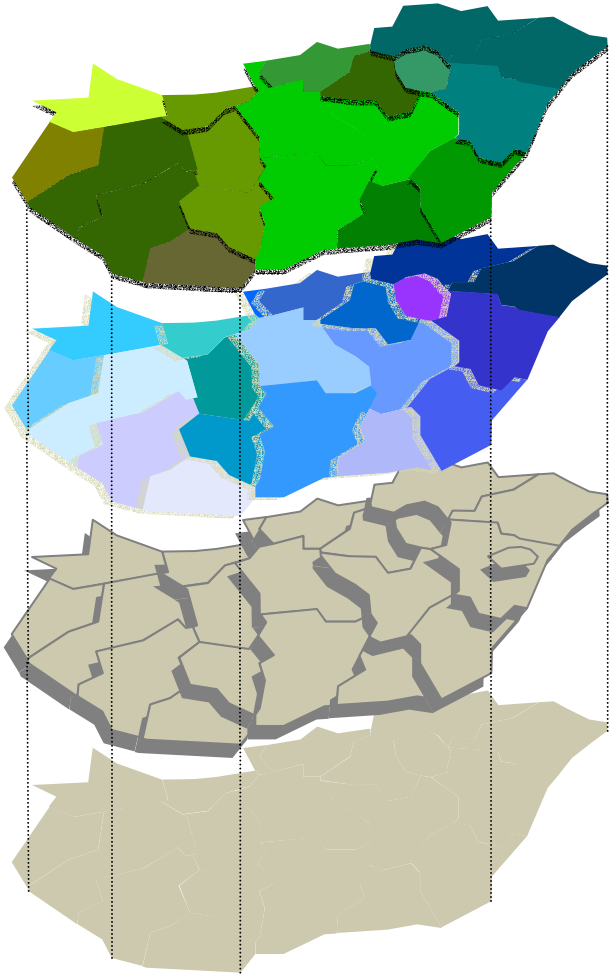
- Security
  - A-key generation
  - Root key generation
  - Secure Mode
  - Service Programming Lock
  - Subscriber Parameter Administration Security Mechanism (SPASM)

What is a Preferred Roaming List?

- The PRL is :
  - an indexed list of systems in the handset
  - built by an operator
  - a definition of systems a mobile can access
  - is not accessible to the user
- The PRL comprises two Tables:
  - The Acquisition Table
  - The System Table
- The Acquisition Table contains:
  - An Indexed list of RF channels to search.
  - Each entry describes the RF environment of a particular area.
- The System Table contains:
  - An Indexed list of Systems, keyed by (SID, NID) pairs.
  - Each entry refers to a specific RF environment
  - Each system belongs to a geographical area
  - Relative Priority can be specified
  - Roaming display behavior can be specified
  - Negative (prohibited) systems can also be specified
- Preferring one system over another
  - Preferences can exist within Geographic areas
  - An operator can specify preferences on which networks to access



Identification of a CDMA Network



- Every CDMA system is uniquely identified by the combination of
  - System Identification Code (SID)
  - Network Identification Code (NID)
- Every CDMA base station broadcasts its SID and NID in system overhead messages

What is the PRL for?

- The PRL assists the Mobile in the acquisition and system selection process
- Tells the mobile which systems are permitted and prohibited
- It speeds up acquisition
- Provides the flexibility to specify a “Roam” or “Not Roam” condition/indicator on mobile’s display
- Provides the operator flexibility in specifying mobile search behavior in:
  - home market
  - roaming markets
- 3GPP2 C.S0016-B supports PRL for;
  - CDMA2000 , IS-95 systems
  - HRPD systems

PRL Format

Preferred Roaming List Field	Length (bits)
PR_LIST_SIZE	16
PR_LIST_ID	16
PREF_ONLY	1
DEF_ROAM_IND	8
NUM_ACQ_RECS	9
NUM_SYS_RECS	14
ACQ_TABLE	variable
SYS_TABLE	variable
RESERVED	0 to 7
PR_LIST_CRC	16

Extended PRL Format

Extended Preferred Roaming List Field	Length (bits)
PR_LIST_SIZE	16
PR_LIST_ID	16
CUR_SSPR_P_REV	8
PREF_ONLY	1
DEF_ROAM_IND	8
NUM_ACQ_RECS	9
NUM_COMMON_SUBNET_RECS	9
NUM_SYS_RECS	14
RESERVED	7
EXT_ACQ_TABLE	variable
COMMON_SUBNET_TABLE	variable
EXT_SYS_TABLE	variable
RESERVED	0 to 7 (as needed)
PR_LIST_CRC	16

Acquisition Table Example

ACQ_INDEX	ACQ_TYPE	Description	Acquisition Parameters
0	‘0110’	PCS CDMA - Using Channels	PCS Channels 100, 125, 150, 175, 200
1	‘0101’	PCS CDMA - Using Blocks	PCS Block C
2	‘0011’	Cellular CDMA - Custom Channels	Channel Number 1
3	‘0010’	Cellular CDMA - Standard Channels	System A, Primary and Secondary CDMA Channel
4	‘0001’	Cellular Analog	System B

System Table Example

SID	NID_INCL	PREF_NEG	GEO	PRI	ACQ_INDEX (ACQ_TYPE)	ROAM_IND
111	0	1	0	1	2 [Cellular CDMA - Standard Channels]	Off
77	0	1	1	0	0 [PCS CDMA -Using Channels]	Off
34	0	1	1	0	2 [Cellular CDMA - Standard Channels]	Flashing
34	0	0	1	N/A	4 [Cellular Analog]	N/A
400	0	1	0	1	2 [Cellular CDMA - Standard Channels]	Off
4	0	1	1	1	0 [PCS CDMA -Using Channels]	On
12	0	1	1	1	3 [Cellular CDMA -Custom Channels]	On
0	0	1	1	0	4 (Cellular Analog)	On
776	0	0	1	N/A	4 [Cellular Analog]	N/A
61	0	1	0	1	2 [Cellular CDMA - Standard Channels]	Off
56	0	1	1	0	1 [PCS CDMA -Using Blocks]	Flashing
16	0	0	1	N/A	4 [Cellular Analog]	N/A

System Selection Process Example

- Here is an example of system selection process based on the acquisition table and system table given previous pages. (For actual system selection process, there are other things to be considered, but the followings are simplified example to understand the PRL concept.)

  a. At power up the mobile scans CDMA system using Acquisition Table in order of priority. In this case, ACQ_TYPE '0110' is the highest priority in the acquisition table.
  b. If the mobile acquires any systems using ACQ_TYPE '0110', check the SID/NID of the system.
  c. If the mobile acquires the PCS system with SID equal to 77, identifies the Geographic Region of the System Table using the SID. The mobile station determines if there is more preferred system in that Geo. In this case, Cellular system with SID equal to 111 is more preferred system.
  d. Since ACQ_INDEX of the Cellular system with SID equal to 111 is set to 2, go back to the acquisition table and scan systems using the acquisition parameters for ACQ_INDEX equal to 2. If the mobile station fails to acquire that system, then it remains the PCS system with SID equal to 77 to provide service on the most preferred system found in the Geo. In this case, the mobile starts to perform periodic reselection for the system with SID equal to 111 as the system with SID equal 111 is more preferred in this GEO.
  e. If the SID is changed to other value due to handoff, the mobile looks up the System Table, identifies the Geographic Region using the new SID and acquires the most preferred system in the GEO.

What we need for GSM/UMTS?

- For multi-mode terminal, the PRL needs to be extended to support GSM/UMTS.

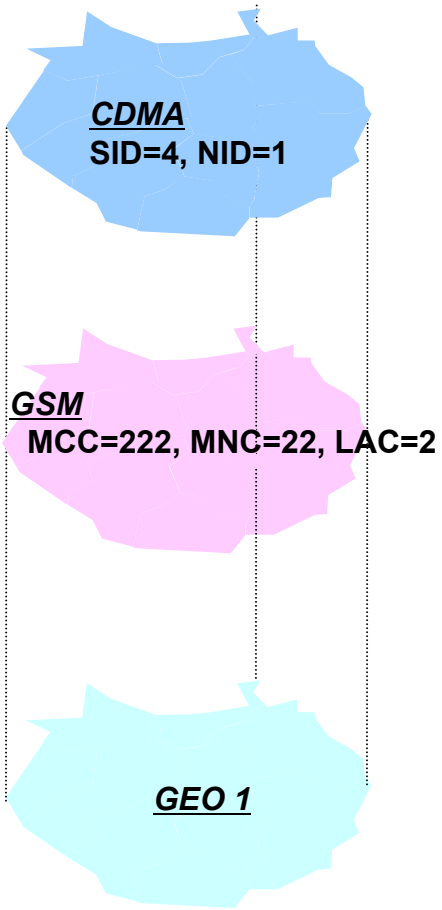
- Extended Acquisition Record
  - GSM: Frequency Band
  - UMTS: Frequency Band, UARFCN (optional)
- Three Extended Acquisition Records are proposed;
  - Generic Acquisition Record for GSM
  - Generic Acquisition Record for UMTS
  - Generic GSM/UMTS Preferred

- Extended System Record
  - GSM/UMTS: PLMN (MCC + MNC), LAC
- One Extended System Record is proposed;
  - PLMN-based system record
    - » PLMN only, PLMN and LAC, PLMN and multiple LACs
    - » Implicit-mode (refer to the contents in the SIM/USIM)

GSM/UMTS Band

- GSM Band
  - GSM 450
  - GSM 480
  - GSM 750
  - GSM 850
  - P-GSM 900
  - E-GSM 900
  - R-GSM 900
  - DCS 1800
  - PCS 1900
- UMTS Band
  - 2.1 GHz Band (IMT-2000)
  - 1.9 GHz Band (PCS 1900)
  - 1.7 GHz Band

Scenario 1



- One GEO, CDMA and GSM are deployed in this GEO.

Scenario 1 – Cont'd

Extended Acquisition Records

Index	ACQ_TYPE	Acquisition Paramameters	
0	Cellular CDMA Standard	System A or B	Pri or Sec
1	Generic Acquisition for GSM	E-GSM-900	

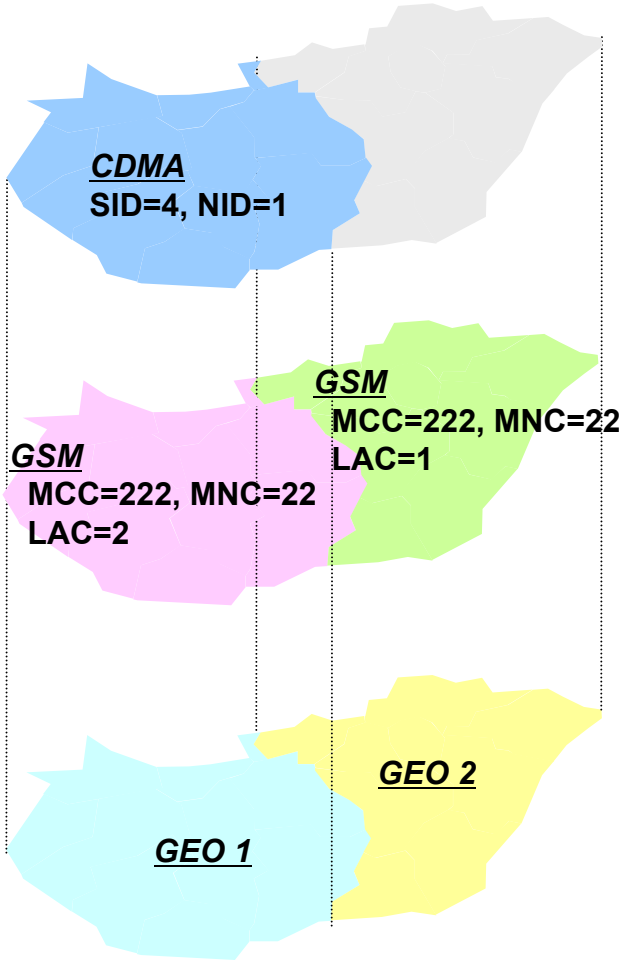
Extended System Records

Index	System Type	Pref/Neg	GEO	Priority	ACQ_INDEX	Type Specific Field				ROAM_IND
0	IS-2000/IS-95	Pref	New	More	0	SID=0	NID=65535			0
1	PLMN-based	Pref	Same	Same	1	SELECT_MODE	Allowed PLMN			0

Scenario 1 – Cont'd

1. At power up the mobile tries to acquire CDMA (index 0 in acquisition table) . If the mobile successfully acquires any CDMA system (SID 0 is wildcard SID), it stays on CDMA and provides service.
2. Else, the mobile tries to acquire GSM over E-GSM band (index 1 in acquisition table). Let's assume that mobile successfully acquires GSM (as GSM service is in this GEO). Because the GSM service matches with system table entry 1, it starts to perform periodic reselection for CDMA service over the cellular band as CDMA is more preferred in this GEO.
3. If the mobile is able to acquire any CDMA system, it stays on the CDMA system. Else it continue to perform periodic reselection for CDMA.

Scenario 2



- Two GEOs, CDMA is deployed only in GEO 1.

Scenario 2 – Cont'd

Extended Acquisition Records

Index	ACQ_TYPE	Acquisition Paramameters	
0	Cellular CDMA Standard	System A or B	Pri or Sec
1	Generic Acquisition for GSM	E-GSM-900	

Extended System Records

Index	System Type	Pref/Neg	GEO	Priority	ACQ_INDEX	Type Specific Field				ROAM_IND
0	IS-2000/IS-95	Pref	New	More	0	SID=4	NID=65535			0
1	PLMN-based	Pref	Same	Same	1	PLMN+LAC	MCC=222	MNC=22	LAC=2	0
2	PLMN-based	Pref	New	Same	1	SELECT_MODE	Allowed PLMN			0

Scenario 2 – Cont'd

1. At power up the mobile tries to acquire CDMA (index 0 in acquisition table) . If the mobile successfully acquires CDMA SID=4, it stays on CDMA and provides service.
2. Else, the mobile tries to acquire GSM over E-GSM band (index 1 in acquisition table). Let's assume that mobile successfully acquires GSM (as GSM service is in both GEOs) and that MCC/MNC/LAC = 222/22/1 (i.e. the mobile is in GEO 2 where CDMA SID=4 is not available). Because the GSM service matches with system table entry 2, the mobile stays on the GSM system. No periodic reselection for CDMA service is performed, as the GSM system table entry 2 is the most preferred in GEO 2.
3. Now let's assume that the mobile moves into a new area where MCC/MNC/LAC = 222/22/2. Because the GSM service matches with system table entry 1 (explicit match takes priority to a general match), it starts to perform periodic reselection for CDMA service over the cellular band.
4. If the mobile is able to acquire CDMA SID=4 it stays on the CDMA system. Else it continue to perform periodic reselection for CDMA.