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# Next Generation Mobile Networks Initial Terminal Device Definition

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## Abstract

This deliverable is produced by the Next Generation Mobile Network Project ITDD – Initial Terminal Device Definition.

This document provides the generic definition of an initial release NGMN terminal/device, considering a macro view of the marketplace needs on a global and/or regional basis balanced against the practical reality of terminal/device implementation. This deliverable will focus on the initial market timeframe.

This document includes Radio Interface Technology Combinations, Band Combinations, Capabilities and Feature Sets and Services, Use Cases, Target Market, Form Factor, Roaming and Fallback, Regional perspectives, and future roadmap.

The intent is to provide a specific, yet generic, description of an initial release device.

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## 1 INTRODUCTION AND SCOPE

This Initial Terminal Device Definition (ITDD), from NGMN, provides the generic definition of an initial release NGMN terminal/device, considering a macro view of the marketplace needs on a global and/or regional basis balanced against the practical reality of terminal/device implementation. This deliverable from the project will focus on the initial market timeframe of 2010.

With respect to HSPA references in this document, it is understood that some aspects of HSPA Evolution will begin to be deployed during the timeframe (2010) of the deliverable. HSPA evolution (as different aspects become available) should additionally be considered for ITDD.

### 1.1 EXECUTIVE SUMMARY

The NGMN ITDD project has examined the results from Project 8 (Terminal Access Requirements) and Project 10 (Initial Deployment Targets), taking in to account the overall scope and goals of NGMN, and has produced this project deliverable which reflects the desires of NGMN members to have user equipment which is enabled to serve common requirements while providing enough customization to be regionally useful.

The deliverable, as stated above in the Scope, defines a Data-Only device for delivery in 2010. Frequency bands and usage context were of primary concern during the course of this project; it was realized that too many requirements could possibly delay production of devices, while a broad definition would not be sufficient to provide information to the industry for the actual production of such devices.

During the course of this project, it was decided that two basic types of initial Data-Only devices should be defined. A **Global Roaming Target Device**, and a **Regionally Focused Device**. Furthermore, the Regionally Focused Device is according to particular regions. In the case of this project, the regions are Asia (China), Asia (Japan), Asia (Korea), Europe, and North America. NGMN believes this gives clear direction to the industry, allowing suppliers to focus on the Global Roaming Target Device, but recognizing that this Global device may have some delivery impacts, therefore, the option is given for regional devices to be initially deployed.



## 2 TYPES OF DEVICES AND FORM FACTOR

During the initial deliverable this project will focus on Data only devices. The expected readiness of these kinds of devices is 2010.

The type of devices that shall be considered in the ITDD project are:

### Internal Data cards

- mini-PCIe

### External Data cards

- PCI Express cards

### Embedded modules

- May be a proprietary interface

- May be part of devices such as game consoles, navigation devices, media players, etc.

### External Data Devices

- USB dongle

- USB module

There is expectation that these USB devices would have similar form factors to today's devices.

The form factor for NGMN (e.g. LTE) type devices shall be similar in their physical features (size, weight, design,...) to those already in the market.

(References: P8 Section 3.5.11)

## 3 BANDWIDTH SUPPORT

While all bandwidths are mandatory in the 3GPP specifications, the testing priorities for D1 (2010), are the 1.4, 3, 5, 10, 15 and 20 MHz bandwidths. Additionally, not all bands and bandwidth combinations will be testing priorities for the initial devices. For the bands less than 1 GHz, the 1.4, 3, and 5 MHz options will be more likely to be used. For the 700 MHz bands (US) the 5 and 10 MHz bandwidths will be used. For bands greater than 1 GHz, the 5, 10, 15 and 20 MHz bandwidths are more likely to be used.

## **4 RADIO CHARACTERISTICS**

### **4.1 SINGLE MODE (LTE ONLY) TERMINALS**

During the initial deployment phase in general the support of further RATs is considered mandatory to achieve sufficient overall coverage. Specific requirements differ by region as indicated in Table 5.1-3 – (E-UTRA Multi-Technology Frequency Band Requirements per region). In the future a single mode LTE device could very well be needed in a wider scope.

### **4.2 MULTI-MODE TERMINALS**

#### **4.2.1 FDD/TDD ASPECTS**

The desired device for the initial deployment is a multi-mode/multi band device as described in section 5. In case such a device cannot be realised in the initial timeframe the priority is on realising specific regional requirements as indicated in Table 5.1-3

Based on the P8 requirement R52d and R53d, LTE FDD/TDD dual mode device should support global E-UTRA TDD bands and FDD bands considering roaming requirements.

#### **4.2.2 MULTI-TECHNOLOGY ASPECTS (GSM, UMTS, CDMA-2000)**

The following technology combinations should be considered for the initial devices. Each technology combination may specify a region, however, it is recognized that these technology combinations may be applicable for other regions as well.

- LTE and HSPA\* (Japan/Korea)
- LTE and CDMA2000 (US/Japan/Korea)
- LTE and HSPA\* and EDGE (Europe, US, Japan)
- LTE TDD, LTE FDD and EDGE (China)
- LTE TDD and TD-HSPA and EDGE (China)

\*footnote: this applies to HSPA and/or to HSPA evolution from release 7.

#### **4.2.3 COST AND COMPLEXITY CONTROL FOR MULTI MODE TERMINALS**

The initial device shall support Class 2 and 3 devices as defined in P8 Table 3.1 “Sample UE Radio Classes”. These devices should insure that they do not exceed 2x2 MIMO capabilities for each respective class (P8 R141).

As result, complexity increase and cost shall not exceed 10-15 % e.g., over today’s (2008/2009) multi-mode WCDMA systems at the time of NGMN introduction (P8 R142).

## 5 BAND SUPPORT

3GPP 36.101 supports the following band plan:

E-UTRA Band	Uplink (UL) eNode B receive UE transmit		Downlink (DL) eNode B transmit UE receive		UL-DL Band separation	Duplex Mode
	$F_{UL\_low}$	$F_{UL\_high}$	$F_{UL\_low}$	$F_{UL\_high}$		
1	1920 MHz	1980 MHz	2110 MHz	2170 MHz	130 MHz	FDD
2	1850 MHz	1910 MHz	1930 MHz	1990 MHz	20 MHz	FDD
3	1710 MHz	1785 MHz	1805 MHz	1880 MHz	20 MHz	FDD
4	1710 MHz	1755 MHz	2110 MHz	2155 MHz	355 MHz	FDD
5	824 MHz	849 MHz	869 MHz	894 MHz	20 MHz	FDD
6	830 MHz	840 MHz	875 MHz	885 MHz	35 MHz	FDD
7	2500 MHz	2570 MHz	2620 MHz	2690 MHz	50 MHz	FDD
8	880 MHz	915 MHz	925 MHz	960 MHz	10 MHz	FDD
9	1749.9 MHz	1784.9 MHz	1844.9 MHz	1879.9 MHz	60 MHz	FDD
10	1710 MHz	1770 MHz	2110 MHz	2170 MHz	340 MHz	FDD
11	1427.9 MHz	1452.9 MHz	1475.9 MHz	1500.9 MHz	23 MHz	FDD
12	698 MHz	716 MHz	728 MHz	746 MHz	20 MHz	FDD
13	777 MHz	787 MHz	746 MHz	756 MHz	21 MHz	FDD
14	788 MHz	798 MHz	758 MHz	768 MHz	20 MHz	FDD
17	704 MHz	716 MHz	734 MHz	746 MHz	20 MHz	FDD
...						
33	1900 MHz	1920 MHz	1900 MHz	1920 MHz	N/A	TDD
34	2010 MHz	2025 MHz	2010 MHz	2025 MHz	N/A	TDD
35	1850 MHz	1910 MHz	1850 MHz	1910 MHz	N/A	TDD
36	1930 MHz	1990 MHz	1930 MHz	1990 MHz	N/A	TDD
37	1910 MHz	1930 MHz	1910 MHz	1930 MHz	N/A	TDD
38	2570 MHz	2620 MHz	2570 MHz	2620 MHz	N/A	TDD
39	1880 MHz	1920 MHz	1880 MHz	1920 MHz	N/A	TDD
40	2300 MHz	2400 MHz	2300 MHz	2400 MHz	N/A	TDD

Table 5.1-1 – E-UTRA Frequency Bands (36.101)

### 5.1 BAND PRIORITIES

Project ITDD has determined that for this deliverable, e.g., data only devices, it would not be practical in the given timeframe to mandate that a single global device for roaming be the only requirement. Therefore, table 5.1-3 forms the basis for two basic types of devices: a “Global Roaming Target” device, and “Regionally Focused” device. Additionally, it is recognised that a place exists for a more simple “country focused” device. All these devices correspond to different customer needs and could live together under the same operator.

The table below describes the band requirements for different regions. “R” indicates out of region roaming. Priorities within a region are indicated by:

“1” – highest priority

“2” – second priority

(References: P8 Section 3.4.1: R52, R52b, R53, R53b).

Comments and clarifications regarding the P8 requirements:

- P8 requirement R52b implies the same requirements for Canada as for USA except for the 700 MHz band. For USA R52b is expected to apply for 2010.
- P8 requirement R52c implies the same requirements for Australia as for Europe.
- P8 requirements R53, R53b and R53c regarding roaming are not clear in terms which bands are required for LTE and HSPA respectively.
- P8 requirement R54 implies a tri band UMTS (2 high and 1 low), a tri band LTE (2 high and 1 low).

In order to cover the essential inbound roaming requirements for all above regions the following bands are needed:

Band	Region for which this is mandatory
1	Europe, Japan (LTE, HSPA), Korea
2	US, Canada (EDGE, UMTS, HRPD)
3	Europe (EDGE, HSPA, LTE), China (EDGE)
4	US, Canada (UMTS, LTE)
5	US, Korea (EDGE, HRPD); Canada requires UMTS support as well
6	Priority 2 for LTE and priority 1 for UMTS in Japan
7	Europe (LTE)
8	Europe (EDGE, HSPA, LTE), China (EDGE)
9	
12	
13	US (LTE) (Assumes band 13 roaming is OK to US)
17	US (LTE) (Assumes band 17 roaming is OK to US)
40	China (LTE)

Table 5.1-2 Regional Band and Technology Requirements for Inbound Roaming

Note: HSPA in Band 8 for inbound roaming in the European region may need to be supported based on current views of the availability of Band 8 in the deliverable timeframe as a result of anticipated spectrum refarming actions in the European region.

Legend	LTE - FDD	UMTS	LTE-TDD	
	GPRS	HRPD/eHRPD /1xRTT		
	Operator Dependent			⊙
	Highest priority for initial phase			⊙

	GSM All*	Europe	Japan	USA	China	Comments
[Band-1] 2100		① ①	① ①	R R	⊙ R	
[Band-2] 1900	⊙		R	R	⊙ ⊙	band class 1 for cdma 2000
[Band-3] 1800	⊙	①				
[Band-4] 1700		R	R	⊙ ⊙	R	
[Band-5] 850	⊙		R	⊙ ⊙	⊙	band class 0 for cdma 2000
[Band-6] 800			2 ①			Band 6 is overlapped with Band 5
[Band-7] 2600		①	⊙		⊙	
[Band-8] 900	⊙	① ①	R	R	R	
[Band-9] 1800			2 ①			
[Band-12] 700		R	R	⊙	R	
[Band-13] 700		R	R	①	⊙	
[Band-17] 700		R	R	①	⊙	
[Band-33] 1900						
[Band-34] 2000					2 1	
[Band-38] 2600		2			⊙	
[Band-39] 1900 w					2 2	
[Band-40] 2300		R	R	R	①	

\* Applies to devices where GPRS/EDGE is mandatory

Table 5.1-3 – E-UTRA Multi-Technology Frequency Band Requirements per region

Note 1: “1” = Highest Priority, “R” = Roaming

Note 2: Band 34 is currently the choice for the TD-SCDMA pre-commercial trial, so it is marked as a priority 1 for UTRA TDD. However, it is not assumed to be a likely candidate for ITDD, since TD-SCDMA/TD-HSPA is not mandatory or highest priority for an LTE multi-mode device in the time frame for this deliverable.

### 5.1.1 GLOBAL ROAMING TARGET DEVICE

To satisfy the end user expectation of a global LTE experience, the FDD/TDD dual mode device is highly preferred in the initial timeframe. Furthermore, a single baseband chipset that supports both FDD and TDD should be mandated, and a universal RF chipset that supports all global LTE bands should be required. Due to the regional variation in LTE bands the specific band combination depends on the market requirements.



The preferred Global roaming device should be a dual mode (FDD/TDD) device and support the following technologies on the prioritized bands:

- LTE FDD mode support for Europe, Japan, Korea, US, Canada
- LTE TDD mode support for China

The preferred Global roaming device should also support all or a subset of the following technologies on the prioritized bands:

- EDGE mode for international roaming for countries without nationwide 3G/LTE coverage
- UMTS/HSPA mode for roaming to Europe, Japan, US, Canada and Korea with high data rates in countries where nationwide LTE coverage is not available in the timeframe of this deliverable
- HRPD/1xRTT mode for roaming to US, Korea with high data rates in countries where nationwide LTE coverage is not available in the timeframe of this deliverable

### 5.1.2 REGIONALLY FOCUSED DEVICE

Based on the P8 requirements R52, R52c and R54 an LTE/HSPA device should support E-UTRA Band 8 and 2 bands out of E-UTRA Bands 1/3/7 for Europe, Japan and Australia in 2010. No roaming support to North America is required in 2010 according to R53.

The recommended ITDD LTE device configuration for Europe and Japan supports the bands 1/3/7/8. The support of Band 7 with 20 MHz bandwidth is important to show LTE peak data rates.

Note: This recommendation conflicts with the P8 requirement R54 which implies a triple band solution.

Based on the P8 requirements R52b and R55 an LTE/HSPA device should support 2 out of E-UTRA Bands 5/13/17 and E-UTRA Bands 2/4 for USA in 2011. However, support of E-UTRA bands 2/5 has not been prioritized for LTE in the USA. In addition a tri-band solution in 2010 similar to R54 is seen as important for the US market. No roaming support to North America is required in 2011 according to R53b.

The recommended ITDD LTE device configuration for USA is the support of Bands 4/13/17.

Note: Support of E-UTRAN Band 2 is not prioritized in Table 5.1-3 and would conflict with the tri-band solution indicated above.

For EDGE support the requirement is to support a quad-band solution with 850/900/1800/1900 MHz bands (References: P8 Section 3.4.1: R50).

Based on the P8 requirement R52d and R53d, the recommended ITDD LTE device configuration for China supports the bands 1/7/(13 or 17)(FDD) and 38/40(TDD).

For TD-SCDMA and TD-HSPA, the recommended device supports bands 34/39 (References: P8 Section 3.4.1:R52d)

## 6 ANTENNA CONFIGURATIONS

### 6.1 BANDS ABOVE 1 GHZ

In order to fulfil the minimum transmission rate requirements, 2x2 MIMO is required. (P8 R113)

### 6.2 BANDS BELOW 1 GHZ

MIMO shall be mandatory in bands below 1 GHz, however, it is understood that the performance may be compromised by the form factor. Best effort to achieve performance within the desired time frame is expected for MIMO implementations in these bands.

## 7 INTERWORKING SCENARIOS

### 7.1 HANDOVER REQUIREMENTS

From	To	LTE	HSPA
LTE		HO mandatory	HO mandatory
HSPA		HO mandatory	HO mandatory

Table 7.1.1 – LTE to/from HSPA Handover Scenarios

From	To	LTE	HSPA	GPRS/EDGE
LTE		HO mandatory	HO mandatory	HO recommended
HSPA		HO mandatory	HO mandatory	HO mandatory
EDGE		HO recommended	HO mandatory	HO mandatory

Table 7.1.2 – LTE to/from HSPA/GPRS/EDGE Handover Scenarios

From	To	LTE	CDMA2000
LTE		HO mandatory	HO mandatory
CDMA2000		Not required <sup>1</sup>	HO mandatory

Table 7.1.3 – LTE to/from CDMA2000 Handover Scenarios

## 7.2 IDLE MODE AND CONNECTED MODE RESELECTION REQUIREMENTS

From	To	LTE	HSPA
LTE		mandatory	mandatory
HSPA		mandatory	mandatory

Table 7.2.1 – LTE to/from HSPA Reselection Scenarios

From	To	LTE	HSPA	GPRS/EDGE
LTE		mandatory	mandatory	mandatory
HSPA		mandatory	mandatory	mandatory
EDGE		mandatory	mandatory	mandatory

Table 7.2.2 – LTE to/from HSPA/GPRS/EDGE Reselection Scenarios

<sup>1</sup> This scenario is not yet defined in the appropriate specifications and therefore will not be part of the 2010 initial device.

From	To	LTE	CDMA2000
LTE		mandatory	mandatory
CDMA2000		mandatory	mandatory

Table 7.2.3 – LTE to/from CDMA2000 Reselection Scenarios

## 8 UE CAPABILITIES AND FEATURE SUPPORT

For a dual mode device, the CS domain is not required for the initial deliverable. 3GPP TS 36.306 V8.2 defines the UE radio access capabilities. The following options shall be considered:

- UE Categories: at least Category 3 (100/50Mbps)
- PDCP Parameters / RoHC: not required
- Physical layer parameters / Support of uplink transmit diversity: not required
- Physical layer parameters / Support of UE specific reference signals for FDD: not required
- General parameters / Access stratum indicator: Rel.8

## 9 POWER MANAGEMENT AND THERMAL ASPECTS

All the data modules working with laptop or Tablet PC: USB dongles, data cards... which are dependent on the PC power shall not significantly degrade the PC's battery life and thermal aspects. This will be achieved as follows:

1. When active, an NGMN modem (e.g. LTE) should consume less energy per bit transmitted or received than modems using earlier technology (e.g. HSPA) when measured under comparable conditions.
2. In order to comply with USB power requirements (500mA, 5V), the modem should consume less than 2.5W when applied to an external USB device.

## REFERENCES

"NGMN Terminal Requirements", NGMN Alliance, January, 2008

"NGMN Initial Deployment Targets, NGMN Alliance, May, 2008

3GPP Specification 36.101, "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception", V 8.3.0, September 2008

3GPP Specification 36.306, "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities", V 8.2.0, June 2008

3GPP2 Specification C.S0057-0 "Band Class Specification for cdma2000 Spread Spectrum Systems", V1.0