MegaX AMR Technical Specification

Version 00.02

SW-GSM-TS-09090415

Oct. 24, 2006

REVISION HISTORY

Version	Date	Name	Reason
00.01	Feb. 14, 2006	John Kim	1st Draft version
00.02	Oct. 24, 2006	Sylvester	Correct Typo(ZR34527)

CONTENTS

1 Introduction

1.1 Purpose and Scope

This document is to describe the functional specification for MegaX AMR. It is specified that SW and HW functional specification shall meet GSM/GPRS specification in order for customer enough to deeply understand the function of the product.

1.2 References

None

1.3 Definitions, Acronyms, and Abbreviations

APN: Access Point Name
CHAP: Challenge Handshake Authentication Protocol
CS: Coding Scheme
CSS: Cascading Style Sheet
DL: Downlink
GPRS: General Packet Radio Services
GTP: GPRS Tunneling Protocol
MS: Mobile Station
TBA: To Be Addressed
PAP: Password Authentication Protocol
PACCH: Packet Associated Control Channel
PPCH: Packet Paging Channel
PCCCH: Packet Common Control Channel
PBCCH: Packet Broadcast Control Channel
UL: Uplink

2 Product specification

2.1.1 Frequency Band

Band	Uplink frequency band	Downlink frequency band
GSM 850	824-849 MHz	869-894 MHZ
DCS 1800	1710-1785 MHz	1805-1880 MHz
PCS 1900	1850-1910 MHz	1930-1990 MHz

- Frequency hopping (GSM and GPRS)
- Discontinuous transmission with voice activity detection
- Discontinuous Reception
- Radio interface ciphering (A5-1, A5-2, and no ciphering)

2.1.2 Display

Main LCD has high resolution of 65K TFT and displays rich information and 4K CSTN LCD is employed to external LCD.

Parameter	Design	Note
Main Display	Type: 65K TFT LCD	
	Pixels/Size: 176x220 / 1.8”	
	English Character: 8x16 / 6x12 font set	
	1 line of soft icon area,1line of status icon area	
	- Operating Temperature: -10°C ~ + 60°C	
External Display	4K CSTN	
	Pixel: 96x48	
	English character: 8x16 / 6x12 font set	
	1 line of soft icon area,1line of status icon area	

2.1.3 Camera

- Embedded CMOS sensor
- Preview speed: 15 frame per second
- Zoom: digital zoom 4X
- Data Compression with JPEG and MPEG 4.
- Thumbnail function for personal information in phonebook
- Sensor array with 1.3M pixel supportable
- MPEG4 recording

2.1.4 Antenna

Intenna Type

2.1.5 Keypad

- SND: Green
- PWR/END: Red
- Five ways navigation keys
- CLR key
- Volume up/down key
- One side key for Camera shooting
- Volume up/down key
- 3x4 key

2.1.6 Speaker

- 13x18 oval type speaker for 64 chord melody play

2.1.7 Memory

It has 128MB NAND flash for store multimedia contents such as MP3 file and camera picture, etc. It has 128 Mbit flash and 64Mbit SRAM which can support "ADN" up to 500 entries plus with one stored in SIM card as well.

2.1.8 Voice CODEC

Currently, the mobile supports the two voice codec:

- FR (Full Rate Operation)
- EFR (Enhanced Full Rate Operation)
- AMR(Adpative Multi Rate) for South and North America market(Tri-band:TBD)

* AMR audio shall be supported, which will be used for moving camera.

2.1.9 SIM Card

It is locating in back side under battery pack and operating voltage is 3V.

2.1.10 Talk time and Standby time

Batteries capacity	Talk time	Standby time
730 mAh	**120 ~150 min**	**100 ~ 150 Hr.**

* 0% derating used for all talk times; 5% derating used for all standby times.

- Battery operating time (standby and talk time) is estimated value from normal field condition (DRX=5). Therefore the battery performance depends on many factors including network configuration like neighboring cell list, signal strength, battery age and its condition, the temperature, backlight status. In GSM spec, Number (2 through 9) of multiframe (parameter named on BS-PA-MFRM in the spec) between two transmissions of the same paging message to MSs of the same paging group. We assume that when we are talking about paging, the channel at issue here is the paging channel, which is a CCH (Control CHannel)- here the length of a multiframe is 234 ms. If the value for a specific network is 5 which corresponds to 234 ms x 5 = 1170 ms between paging messages. The BS-PA-MFRM shows the Discontinuous Receive (DRX) parameter of the network. DRX allows the mobile to synchronize its listening period to a known paging cycle of the network. This can typically reduce the standby power requirements by 90%. The paging procedure has been designed to facilitate

significant battery-saving potential in the handset - the larger the period between listening periods the lower battery consumption. Unless a handset is used excessively the biggest drain on its battery comes not from the time spent using it, but from the standby cycle as it monitors the paging channel, in case it is being called. In the GSM system the DRX allows the mobile, once it has located the paging signal, to synchronize a clock knowing that it will not get another signal until a specified time has elapsed. It can thus power down its circuits for most of the time during standby. When DRX is employed, the MS using information broadcast on the BCCH determines its "paging group". The paging group may appear once during a control channel multiframe, or may only be scheduled to appear once over several multiframes - the rate of repetition is determined by the network provider and it is this information which is broadcast over the BCCH, which allows the MS to determine its paging group.

- In case of high frequency of entering 'no service area', the standby time will become shorter.
- Receiving call requires the same amount of electric currents as much as that of making a call.

3 Technical Specification

3.1 Hardware specification

3.1.1 Minimum radio performance

Parameters	Standard Requirement			Remarks
	GSM 850	DCS 1800	PCS 1900	
Static Sensitivity @ RBER < 2.4 %	< - 108 dBm	< - 107 dBm	< - 107 dBm	Typical
Tx Output Power	+ 33 dBm ± 3 dB	+ 30 dBm ± 3 dB	+ 30 dBm ± 3 dB	
Tx Frequency Range	824 ~ 849 MHz	1710 ~ 1785 MHz	1850 ~ 1910 MHz	
Rx Frequency Range	869 ~ 894 MHz	1805 ~ 1880 MHz	1930 ~ 1990 MHz	
Power Class	4	1	1	
No. of RF Channels	124	374	299	
Duplex Frequency Offset	45 MHz	95 MHz	80 MHz	
Duplex Time Offset	3 Time Slot	3 Time Slot	3 Time Slot	
Channel Spacing	200 KHz	200 KHz	200 KHz	
Modulation Type	0.3 GMSK	0.3 GMSK	0.3 GMSK	
Frequency Error	< ± 0.1 PPM	< ± 0.1 PPM	< ± 0.1 PPM	
Phase Error	Peak < 20 degrees RMS < 5 degrees	Peak < 20 degrees RMS < 5 degrees	Peak < 20 degrees RMS < 5 degrees	

3.1.2 General description of each functional block

In this chapter, we will talk about brief description of functions in each blocks such as RF, Baseband chip and Multi-media chip. When faced problems, understanding hardware will be helpful for troubleshooting effectively.

3.1.2.1 Antenna

ANT is a device that receives and transmits radio signals to communicate with base station nearby. Its type is classified by its structure and implementation methods. This product is employing internal type PIFA ANT and fixed to the phone body internally. A phone user can't change the ANT. Its electrical performance is determined by careful adjustment and optimization with ANT matching circuit on PCB board, thus just changing to other type ANT can make the phone function improperly.

3.1.2.2 Antenna Switch Module

Since it supports Tri band operation (GSM 850, DCS 1800 and PCS 1900) and each system is operating at different frequency band, this device acts like a switch that controls the RF signal flow, that of in-band signal received by ANT into two different LNAs and transmitting signals from dual band PA, so that it prevents any out-of-band interference signals from interrupting proper operation at the selected band. Its switching action is controlled by 3 control signals from "Tranceiver IC", and

named as " CTRL1, CTRL2, and CTRL3"

3.1.2.3 SAW Band pass filter

In order to select desired signals (in-band signals) and reject undesired signals received by ANT, it is employing three SAW BPFs, with which each operating frequency band is covered, between ASM and Transceiver IC. ASM has some amount of rejection for undesired signals but not sufficient for the phone to meet the requirement specified in the standard, thus they were employed for better selection and rejection performance.

3.1.2.4 Transceiver IC

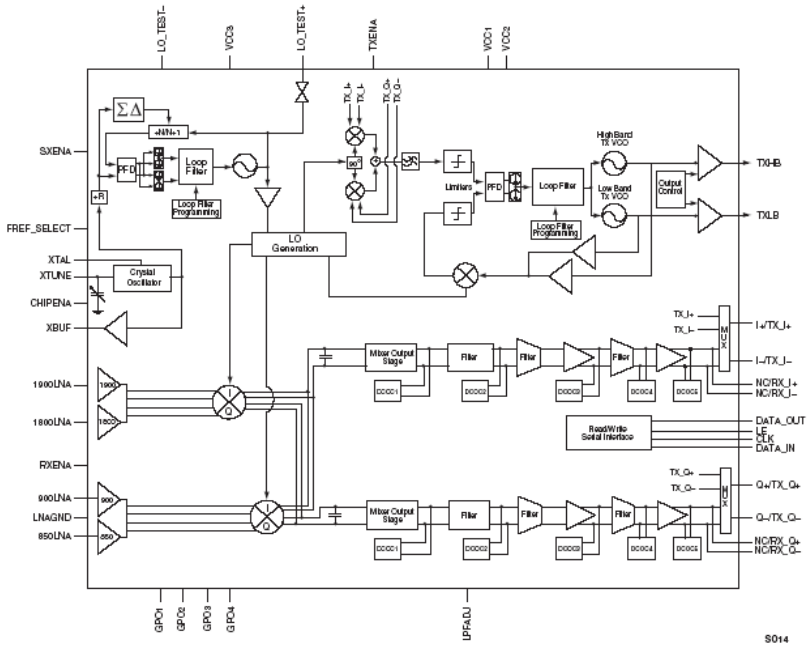


Fig.1. Tranceiver Internal block diagram

This IC provides a lot of functions required for the signal processing in RF band and base band related to both modulation of received signal and demodulation for transmitting signal, such as "low noise amplification by LNA block", " up/down conversion", " base band processing", and " frequency synthesis for LO and Tx frequency generation" etc… All functional blocks are controlled by software with sophisticated algorithms via multiple control signals grouped by and called "interfaces" (you can see many interface group in the schematic). As both receiver and transmitter architecture, SKY74117 is employing "Direct Conversion" scheme, where IF stages are not required. The internal block diagram is shown in Fig.1; SKY74117 IC has 6 basic functional blocks required for transceiver operation, which are as the following,

1. Four seperate Low Noise Amplifiers (LNA) for quad band operation
2. Integrated low drop-out voltage regulators for direct connection to the battery
3. Integrated IP2 calibration
4. Integrated loop filters
5. Integrated quad-band transmit VCO's
6. Four fully programmable GPOs control any antenna switch module

3.1.2.5 LNA Block

LNA block amplifies incoming signal from ANT so that the signal level should be sufficiently high for demodulation process. Though SKY74117 is supporting "Quad-band" and having 4 LNAs for supporting GSM 850, EGSM900, DCS 1800, and PCS 1900 respectively.

3.1.2.6 Quadrature Demodulator

Since GSM is adapting “digital modulation” scheme called “GMSK”, quadrature modulator is required for demodulation of received signal, where both “In-phase signal” and “Quadrature phase signal” (or, shortly called I/Q signals) is split for digital signal processing at base band processor (CX80504-56) to extract information. Local signal from synthesizer block is fed into the “quad-modulator” for down conversion of received RF signal to analog I/Q signals. (Later, this analog I/Q signals is converted into digital signals at Analog BB IC, CX20524-13)

3.1.2.7 Base band signal processing block

The down converted I/Q signals are filtered and amplified according to the signal strength at the ANT for optimum signal level to be fed into successive functional blocks, and the amplifier gain is adjusted to optimize the receiver performance so that the receiver has sufficient immunity in terms of interference rejection performance

3.1.2.8 Control circuit

GSM system is using Time Division Duplex (or simply TDD) schemes to separate receiver and transmitter operation, thus it requires that whole circuitry should operate precisely in terms of timing, and control block is taking charge of this function by providing complex control signals both internally and externally.
This block is also involved in proper parameter setting of internal block such as receiver I/Q filters, gain stages, and synthesizer programming according to input signal level and operating channel for optimum performance in various environment, and plays a linkage role between Analog BB IC through control lines called “interface”.

3.1.2.9 Synthesizer block

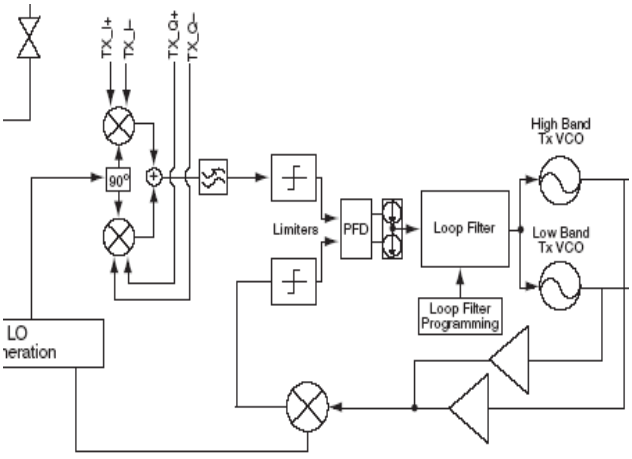


Fig .2. Transmitter Frequency Generator

To generate the required local signal(LO) to receiver block and to make Tx signal GMSK modulated, a little complicated process is undertaken as shown below
Fig 2 shows how transmitter frequency is generated, where 2 synthesizer loops are involved in, one is
“fractional-N PLL” for receiver LO signal generation from UHF VCO and the other is “Translation Loop” for direct modulation of Tx VCOs. Depending on operation band, appropriate divider (or multiplier) is selected to make accurate frequency generation. Fractional-N PLL with UHF VCO provides low phase noise and fast lock time, which is required for multi-slot operation in GSM/GPRS System. The Tx VCOs are directly modulated by translation loop in which both UHF VCO and I/Q signals from base-band are involved to generate GMSK modulated RF signal. The demodulated base-band signal is fed into Analog Base-band IC for further signal processing.
In Fig.2, the “translation loop” is composed of a couple of sub blocks as the following;
Tx VCO -> Harmonic Mixer -> LPF -> Quadrature
Modulator -> BPF -> Divider (D1 or D2) -> Phase
Detector -> Loop Filter -> Tx VCO,
And the signal directly from UHF VCO acts like a reference signal in a normal PLL loop.

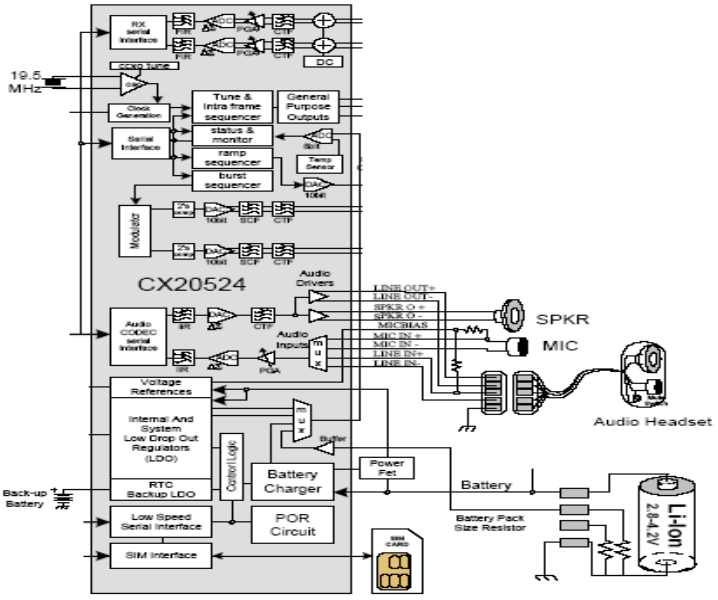
Tx I/Q signals from base-band is quadrature modulated with mixing product between UHF VCO and Tx VCO, which is 100.267 MHz in GSM band and 102.812 MHz in DCS1800 band, and compared with reference signal to generate modulating signal for Tx VCOs. For receiver LO signal generation,

only UHF VCO is used as shown in Fig.4., where UHF VCO is divided by 3 in GSM900 band operation, and multiplied by 2 after division by 3 for DCS 1800 band operation. The quadrature demodulator is realized by sub-harmonic mixer that requires 1/2 the received RF frequency from ANT, this helps preventing LO leakage to ANT port that is well known problem in a receiver employing direct conversion architecture.

3.1.2.10 Power Amplifier

There are 2 power amplifiers were employed in LM-T615S3 design to support both GSM and DCS/PCS band operation. GMSK modulated TX VCOs are input to each PA according to the operating band of interest, and Analog Power Control(APC) circuit inside Transceiver and Analog Baseband IC controls PA operation in terms of band selection and ramp control in burst mode. The VBAT pin of PA connects to an internal current-sense resistor and interfaces to an integrated power amplifier control function, which is insensitive to variations in temperature, power supply, process, and input power. And properly controlled transmitting signals (both power level and burst timing) are fed into ANT via ASM module.

3.1.2.11 Analog Baseband + PMIC



Analog Base band IC includes required signal processing blocks for both receiver and transmitter in base band domain, such as digitizing received analog I/Q signal from receiver block in transceiver IC and making analog I/Q signal from digital I/Q data from base band processor for transmitter, and except basic signal processing blocks, power management function is integrated onto the same IC, which provides DC voltage supplies for various functional blocks.
In addition, there's a couple of interface circuitries for peripheral devices such as earpiece (or receiver speaker), melody speaker, headset, MIC, SIM card interface, internal charging circuit, and coin battery for "real time clock (simply, RTC) as shown in Fig.3.

Fig.3. Analog baseband + PMIC

3.1.2.12 Earpiece/Melody Speaker/ Headset Interface

Earpiece, or receiver speaker, is providing voice signal that a phone user wants to hear during a call, while melody speaker is used only for melody sound playing (64 poly phonic sound). The reason why employed separate speaker is that a phone user usually listens voice signal in normal phone operating position, making the phone close to the listener's ear after flip open, while melody playing is performed under flip closed condition to show off to a friend or other people. Headset is recently used as a means of hands free device, or for privacy during a call, and it is providing required interface for dedicated headset device that has 4-pole plug design (for detailed operation, refer to HW troubleshooting guide, where you also can see a photo of headset)

3.1.2.13 Power Management IC

Though this block is not clearly seen in the Fig.3, PMIC takes charge of very important role, which is generating various DC voltages for each functional block. Some of them may need to be turned ON/OFF according to the predetermined timing sequence (please note that GSM is TDD system in its operation).
it is utilizing 6 different DC supplies from PMIC block, and refer to "power distribution chart" for detailed information. You will probably understand later that the knowledge on these supply lines will be very helpful for troubleshooting purposes because many cases of problems are closely related to DC supply failure.

3.1.2.14 Internal Charger

Analog BB IC has a circuitry for charging a battery, which is called "internal charger", with the help of travel charger (or, simply TC). Actually, TC is not a charger but a constant DC voltage supplier and internal charger circuitry is playing a role of charging a battery. This circuit is composed of "pass Transistor" (p-channel MOSFET), and current sensing resistor, and control block that is integrated onto the IC internally.
It controls the gate bias voltage of the pass TR with the help of SW, and adjusts charging voltage and current according to different battery type. Detailed structure of the charging circuitry will be covered in "HW troubleshooting guide" later.

3.1.2.15 Real Time Clock

RTC is a functional block that manages time and date information as is with a time watch or time clock to a phone user, and it operates independently from other blocks with independent DC supply called "coin battery", and can operate even without battery for a given time. The 32.769 KHz crystal(X301) at base band processor IC (U301) is mainly employed as reference signal source to count time. For detailed information, refer to "HW troubleshooting guide".

3.1.2.16 Baseband Processor IC

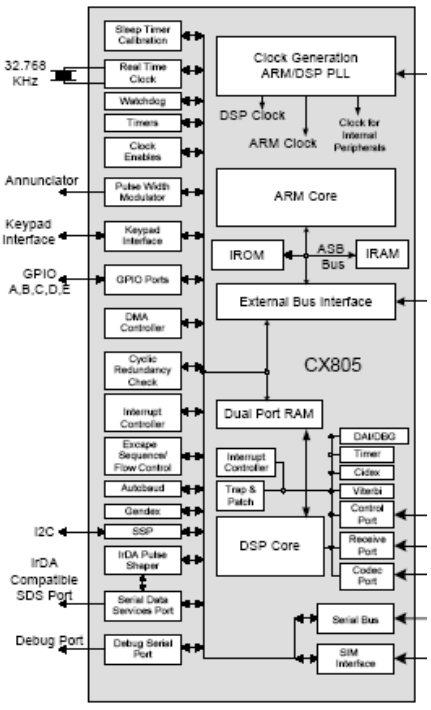


Fig.4. Baseband Processor

Base band processor IC acts as brain for a human, it commands, controls, monitors, and performs signal processing whole radio and it's beyond the scope of this manual to cover detailed operation of the processor but brief structure is as shown in Fig. 4, where the main body is divided by two cores called "ARM core" and "DSP core". ARM core takes charge of controls and commands while DSP core does mainly signal processing required for sophisticated phone operation specified in GSM standards. In addition, there's a couple of interfaces such as "keypad interface", where
Key pressing or operation is scanned and monitored, "back light interface", which is related to keypad back lighting, "ringer and alert interface", which is for providing audio signals to a phone user during a call,
" memory interface", which is for communication with flash memory where SW and other useful data are stored, and "system connector interface", which is for communication with external devices such as data cable to a computer, and other functions.
32.769 KHz crystal is connected to this IC to provide reference signal source for RTC block.

3.1.2.17 Multi-Media Processor

ZR34527 is an application and multimedia processor. ZR34527 is designed to provide a low-power, small-size and high performance solution for hand-held devices and mobile applications regardless of the cellular technology in use. ZR34527 is based on the ARM platform as a high performance, fully programmable core processor, with the addition of video- and graphics processing accelerators and a large variety of peripherals.

ZR34527 includes the following hardware units:
1. ARM926EJ (including Java acceleration) with a 32KB instruction cache and a 32KB data cache running up to 220 MHz
2. LCD controller – Supports up to 18-bit RGB in various bus formats
The image processor IC (U601) has 2 major functions as a LCD controller depending on camera turn-on state or not. The first function is that when normal operation mode, which means camera is turned off, this chip is not fully working, but acting as LCD data buffer. Other function is when camera is turned on, this chip is working for main processor to support unique functionality of camera as mentioned above.
3. External Bus Interface – SDRAM, flash, SRAM and NandFlash
4. Video (MP4-SP, H.263 profile 3) decoding of up to 30 FPS CIF resolution, together with up to 48kHz audio (AAC, MP3, and so on)
5. Video encoding of up to 15 FPS CIF or 30 FPD QCIF, together with 8kHz audio (GSM-AMR, EVRC, and so on)
6. Two-way video phone of up to 30 FPS QCIF, together with 8kHz audio
7. Music playing of up to 48kHz audio (MP3, AAC, MIDI)
8. Still picture capturing of up to 16M pixels
9. Java applets (for example, games and animations) using ZR34527 on-chip Java hardware accelerator (in ARM926EJ)

3.1.2.18 Memory

i) LRS1876
Used for code/data storage of BB processor including flash ROM and SRAM into one package
The LRS1876 is a combination memory organized as 128Mbit flash memory and 64Mbit SmartCombo RAM in one package.

ii) MD4331-d1G-V3Q18-X-P
M-DOC(DiskOnChip) is one of the industry's most efficient storage solutions, using Toshiba's 0.13 micron Multi-Level Cell (MLC) NAND flash technology and x2 technology from M-Systems. MLC NAND flash technology provides the
smallest die size by storing 2 bits of information in a single memory cell. x2 technology enables MLC NAND to achieve highly reliable, high performance data and code storage with a specially designed error detection and correction mechanism, optimized file management, and proprietary algorithms for enhanced performance.

iii) K4M64163PH-BG1L
1M x 16Bit x 4 Banks Mobile SDRAM
The K4M64163PH-BG1L is 67,108,864 bits synchronous high data rate Dynamic RAM organized as 4 x 1,048,576 words by 16 bits, fabricated with SAMSUNG′s high performance CMOS technology.
Synchronous design allows precise cycle control with the use of system clock, and I/O transactions are possible on every clock cycle. Range of operating frequencies, programmable

burst lengths and programmable latencies allow the same device to be useful for a variety of high bandwidth and high performance memory system applications.

3.1.2.19 LDO

MIC2205YML buck regulator is for power supplying to Multimedia chipset with 1.25V. Intended for low power applications, it operates from 2.7V to 5.5V input voltage range. Output voltage is adjustable. A user selectable mode input is provided to allow the user to trade-off noise ripple for low power efficiency. MIC5247-1.8YM5 is for supplying of 1.8V to 1.3M CMOS camera module.

MIC5219-2.8YM5 and MIC5205-3.3YM5 are for supplying of 2.8V to multi-media chipset and also 3.3V for USB interface. These LDOs are highly accurate, low noise, CMOS LDO voltage regulators. Performance features of the series include low output noise, high ripple rejection ratio, low dropout and very fast turn-on times.

3.1.2.20 Flash LED Driver

It operates with an input voltage range of 2.7 to 5.0 volts. The device can makes it ideal for white LED flash applications. Highly integrated and minimum external parts count make AAT3112 ideally suited for small battery-powered applications.

3.1.2.21 CODEC

This chipset which is a Low Power Asynchronous Stereo Audio DAC device with Headphones Amplifiers for high quality MP3 listening, is for converting digital audio data and voice from video data to analog signal.
The STw5094ADT-LF includes also an high performance low power combined PCM CODEC／FILTER tailored to implement the audio front-end functions required by low voltage low power consumption digital cellular terminals with added MP3.
The STw5094ADT-LF Voice Codec section can be configured either as a 14-bit linear or as an 8-bit companded PCM coder. The Frame Voice Codec sample rate can be either the standard 8kHz value or the extended 16kHz one.
In addition to the Stereo Audio DAC and CODEC／FILTER functions, STw5094ADT-LF includes a Tone／Ring／DTMF generator that can be used both in Audio Listening mode and in Voice Codec mode, a sidetone generation, a buzzer driver output and a remote control function tailored to handle an external on-hook off-hook button.
Main applications include digital mobile phones with added low-power high-quality MP3, or any battery powered equipment that requires Stereo Audio DAC with Headphones drivers.

3.1.2.22 Audio AMP

This Amplifier which has been designed for demanding high power of audio applications, is for boosting up the bell and MP3 music sound. An externally-controlled standby mode reduces the supply current to less than 10nA. It also includes internal thermal shutdown protection.

3.2 Software specification

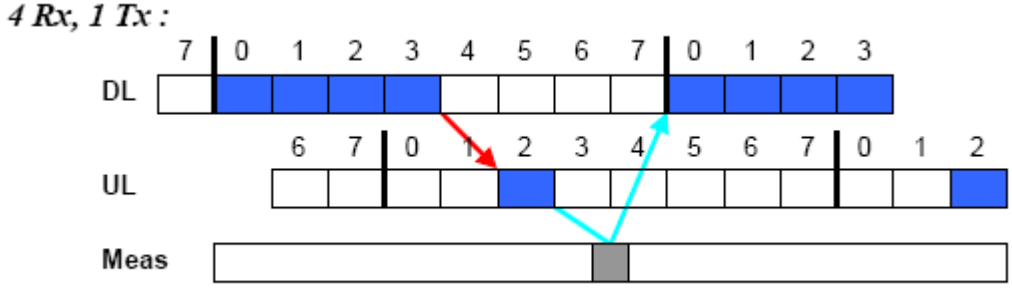
3.2.1 GPRS bearer

3.2.1.1 Multislot class

Multislot classes 1 to 12 are related to type 1 mobile which is not able to receive and transmit at the same time. The MS is required to perform one neighbor cell measurement per TDMA frame, refer to GSM 05.08. That limits the multislot configurations to the ones leaving some time to the MS for one neighbor cell measurement per TDMA frame. These neighbor cell measurement are performed during transition from Rx to Tx timeslots or vice versa, but never between Rx timeslots or between Tx timeslots. As Tra – minimum amount of timeslots to perform neighbor cell measurement an get ready to receive – shall always be respected, the MS is always able to perform neighbor cell measurement between Tx and Rx. Device with FCC ID R5WNGTC110 supports GPRS Class 8 and Mode Class B.

Multislot Class	Maximum # of slots			Minimum # of slots			
	Rx	Tx	Sum	T_{ta}	T_{tb}	T_{ra}	T_{rb}
1	1	1	2	3	2	4	2
2	2	1	3	3	2	3	1
3	2	2	3	3	2	3	1
4	3	1	4	3	1	3	1
5	2	2	4	3	1	3	1
6	3	2	4	3	1	3	1
7	3	3	4	3	1	3	1
8	4	1	5	3	1	2	1
9	3	2	5	3	1	2	1
10	4	2	5	3	1	2	1
11	4	3	5	3	1	2	1
12	4	4	5	2	1	2	1

Where, T_{ta} is minimum amount of timeslots to perform neighbour cell measurements and get ready to transmit. T_{ra} is minimum amount of timeslots to perform neighbour cell measurements and get ready to receive. T_{rb} is minimum amount of timeslots to get ready to receive. For some multislot classes, the amount of Tx timeslots may be greater than the amount of Rx timeslot. With dynamic allocation, these configuration shall ensure that thee multislot capability of the MS is not violdated, taking into account the fact that the MS has to decode all the downlink block related to its uplink allocation to know if the uplink blocks are granted for him as USF decoding.



Regarding on GPRS data rate per time slot, Typically, CS4 is running with maximum rate at 21.4 Kbps in physical layer but it is depending on coding scheme supported by the network. In order to reach maximum rate, TCP/IP header compression shall be disabled and V.42bis data compression shall be disabled as well. In case of LLC unacknowledged mode, we can go further to the maximum data rate.

3.2.1.2 Mobile class

Three classes of GPRS terminals are provided with Class A, B or Class C. Class B we shall have can monitor GSM and GPRS channels simultaneously but can support only one of these services at a time. Therefore, a class B terminal can support simultaneously attach, activation, and monitor, but not simultaneous traffic. As with class A, the GPRS virtual circuits are not disconnected when circuit-switched traffic is present, Instead of it, they are switched to busy mode. Users can make or receive calls on either a packet or a switched call type sequentially, but not simultaneously.

3.2.1.3 Access Modes

The GPRS access modes specify whether or not the GGSN request user authentication at the access point to a PDN. The available options are:

Transparent
No security authorization/authentication is requested by the GGSN. This mode access pertains to a GPRS PLMN that is not involved in the subscriber access authorization and authentication. The MS is given an address belonging to the operator or any other domain's addressing space. The address is given either at subscription as a static address or at PDP context activation as a dynamic address which is allocated from DHCP server in GPRS network. For authentication, no RADIUS authentication is performed but only IMSI-based authentication is done from SIM card.

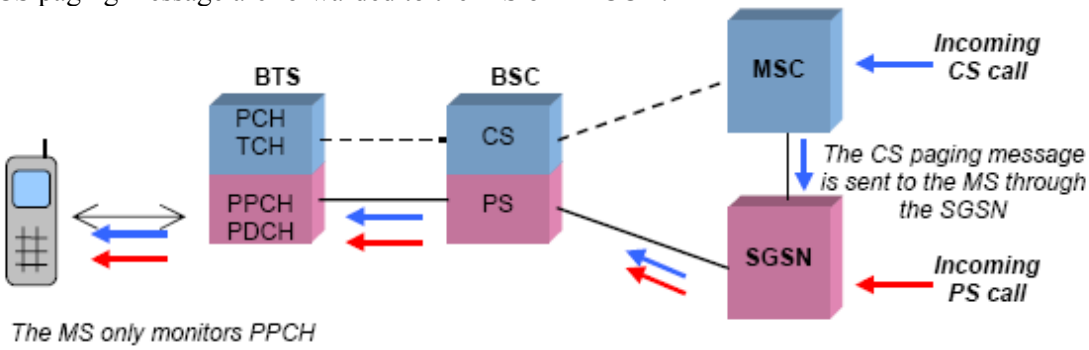
Non- transparent
GGSN acts as a proxy for authentication which means the PLMN plays a role in the ISP authentication of the MS. This access uses PAP or CHAP message issued by the mobile terminal and through over PDP context activation message built in GTP. This message is used to build a RADIUS request toward the RADIUS server associating with APN.

It shall specify PDP type IPv4 to support two modes.

3.2.1.4 Network mode

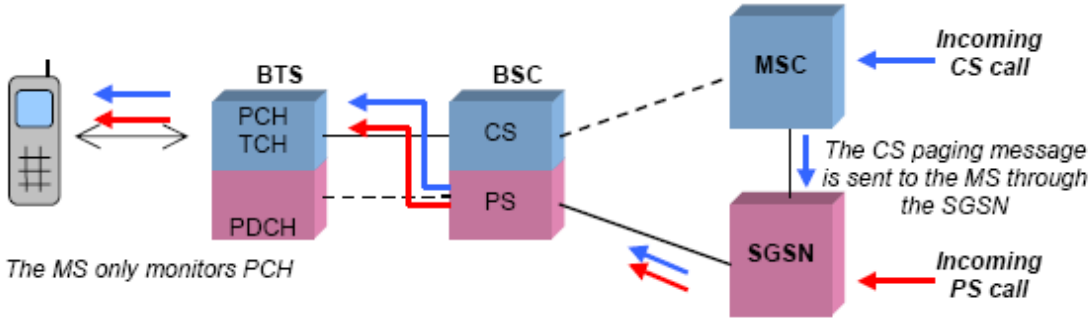
Network mode – mode I, mode II, and mode III have been defined in the beginning of GPRS specification.

Network mode I:
Paging is coordinated, i.e., the MS needs to listen only to one paging channel in idle mode, and in TBF mode CS paging message are forwarded to the MS on PACCH.



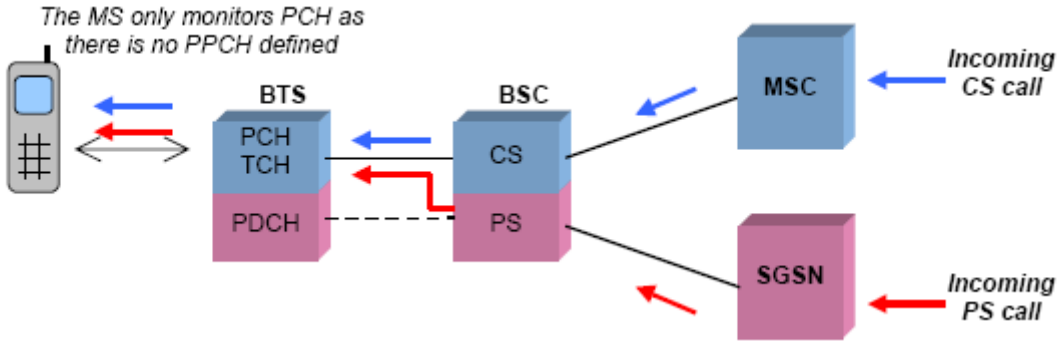
Network mode I (PPCH defined in the cell)

The paging channel to listen is PPCH(if define in the cell) or PCH(if no PBCCH is defined in the cell).



Network mode I (No PPCH defined in the cell)

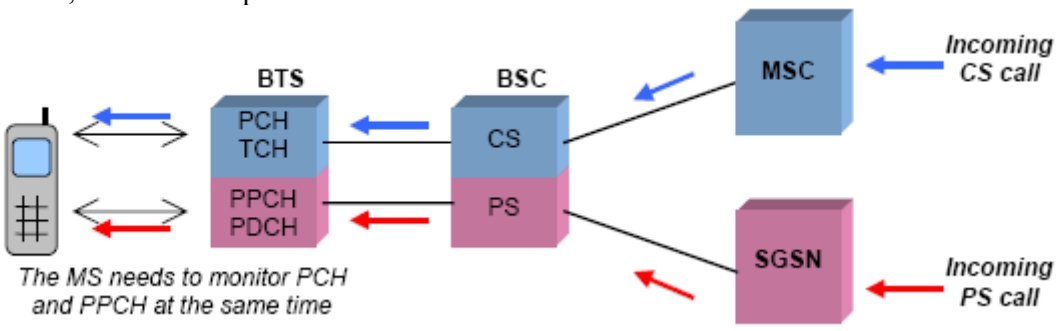
Network mode II:
Paging is not coordinated but no PCCCH is defined(no PBCCH present). That means that MS needs only to listen CCCH to get CS paging or PS paging.



Network mode II

If a TBF is on-going, then all CS paging are lost as the MS does not listen anymore the PCH(no redirection of the CS paging is performed).

Network mode III:
Paging is not coordinated, so CS paging are sent on CCCH and PS paging are sent on PPCH if defined in the cell or PCH if no PBCCH is defined in the cell. In the case where no PBCCH is defined in the cell, NMO III is equivalent to NMO II.



Network mode III(PPCH is defined)

3.2.1.5 GPRS attach

There are two modes – automatic and manual attach whenever GPRS bear is required. For MMS application, “power-on attach” is desirable for MMS client to quick connect to WAP Gateway after getting WAP push message as notification message.

3.2.2 Circuit Switch bearer

HSCSD is not implemented and GSM circuit switched data is supportable.

3.2.2.1 Asynchronous Mode

Non-Transparent Asynchronous
Non Transparent communication utilizes a special GSM network-based error correction facility called "Radio Link Protocol" (RLP) that ensures more robust transmission. What this essentially means is that the GSM network element IWU will add special error correction codes to control the flow of data. This ensures that the data transmitted first obtains a special acknowledgement signal from the receiver that informs the transmitter that the data has been received as transmitted and that the receiver is ready to receive the next set of data from the transmitter. If there is no such acknowledgement signal from the receiver, the networks will utilizes their "data buffering" feature by using a special "forward correction" technique to ensure uninterrupted data transmission throughout. Non-Transparent data only applies to data transfers and not faxing since the Group 3 standard for fax transmission is a transparent protocol.

Transparent Asynchronous
Transparent data transmission means that there is no GSM error correction supplied over the air interface.

It shall support both Asynchronous transmissions mode for data communication up to 9600 bps.

3.2.2.2 Data compression

The V.42bis Compression Standard was proposed by the International Consultative Committee on Telephony and Telegraphy (CCITT, now ITU-T) as an addition to the v.42 error-correction protocol for modems. Its purpose is to increase data throughput, and uses a variant of the Lempel-Ziv-Welch (LZW) compression method. It is meant to be implemented in the modem hardware, but can also be built into the software that interfaces to an ordinary non-compressing modem. V.42bis can send data compressed or not, depending on the data. There are some types of data that cannot be compressed. For example, if a file was compressed first, and then sent through a V.42bis modem, the modem would not likely reduce the number of bits sent. Indeed it is likely that the amount of data would increase somewhat. To avoid this problem, the algorithm constantly monitors the compressibility of the data, and if it finds fewer bits would be necessary to send it uncompressed, it switches to transparent mode. The sender informs the receiver of this transition through a reserved code word. Henceforth the data is passed as plain bytes. While transmitting in transparent mode, the sender maintains the LZW trees of strings, and expects the receiver to do likewise. If it finds an advantage in returning to compressed mode, it will do so, first informing the receiver by a special escape code. Thus the method allows the hardware to adapt to the compressibility of the data.

3.2.2.3 Error correction

V.42 error correction protocol incorporates a standard called LAP-M (Link Access Procedure for Modems), which offers better performance than MNP (Microcom Networking Protocol) ranged with1 through 4.

3.2.3 WAP browser

3.2.3.1 General

In order to access the WAP content, the terminal browser shall comply with at least the WAP 1.2 specifications. In order to allow an easy use of the browser by the customer, the mobile offers the

following possibilities.

1. At least 3 profiles containing the various WAP parameters are available:
   i. Host network access point: Access point from which the gateway is accessible (APN for GPRS and ISP number for CSD)
   ii. Gateway IP address: To specify which gateway the WAP request shall be routed to.
   iii. Login/Password: to allow the access the Network Access Server
   iv. URL History: The last requested URL's may be stored in a history file, the user may choose the size of history file. (optional)
   v. If the ME supports WTLS, a parameter to activate or deactivate this function shall be available. (optional)
2. Local bookmark
3. Cache "reset" menu: the ME allows the user to erase it
4. Provisioning OTA (defined in the WAP 2.0 specifications)
5. Provisioning Smart Card (defined in the WAP 2.0 specifications) (optional)
6. No specific "download of objects mechanism" which needs gateway adaptation or modification
7. Text input is treated as SMS MO.

3.2.3.2 WAP Push

This feature is the most important in the evolution of WAP 1.1. It makes it possible to carry out many services. For that reason, the mobile shall be full compliant with the latest PUSH WAP 1.2 specifications in its last version. It supports:

1. Service Indicator PUSH - The mobile stores at least the last PUSH notification received and handle correctly the SIs that have expired. The WAP site is loaded only if the user validates the PUSH proposition.
2. Service loaded PUSH
3. Cache Operation PUSH

3.2.3.3 Provisioning

N/A

3.2.3.4 Download and SaveAs

In addition to the mandatory WSP and WTP features, the browser of the mobile supports the following functions in order to optimize WAP session (back up context) and to allow the downloading of objects without limitation of size:

1. Suspend / Resume mechanism
2. Segmentation and Re-assembly (SAR) on WTP

The mobile offers the possibility to store downloaded objects in the phone ("save as" function after a GET request).

The maximum downloadable size is 50Kbyte including download contents and text data. Animation, Still image, and Ring tone are downloadable objects.

3.2.3.5 Local Execution

In order to allow local application execution, the mobile is full compliant with the WML Script specification (interpreter and library mandatory features). Furthermore, WML Crypto Library and more particularly the "Sign Text" function are strongly wished to allow digital signature (if the WIM is available on the SIM card).

In addition, the mobile also supports the WTAI features (Script or URI mode) to make a call or send DTMF.

3.2.3.6 Security

Security on WAP is ensured by the WTLS that have support following cryptography features – RC5, Triple DES, RC4, SHA-1, MD5, MD2, RSA, and DHE-DSA. When encryption is used between mobile and WAP gateway, non-ambiguous notification should be provided to the user. When a server certificate is received, certificate verification and validation should be done by the ME.

3.2.3.7 Connection

In order to allow the gateway and the application servers to adapt the contents to the mobile, it correctly informs its user agent characteristics sent during the establishment of the WAP session. At least, the mobile provides:

1. User agent string: this string, part of the "connect PDU" sent by the mobile, must reflect the mobile type and, preferably, the software version. Refer to appendix for more about it.
2. Client SDU size: This parameter indicates the maximum size of the WSP packets that the mobile can manage. 195K SDU size is allowed with SAR support.
3. Accept type: the mobile includes all the suitable "accept" headers. "Accept" headers are intended to inform the gateway (and the application server) about the supported media types (WML, HTML, GIF, BMP, JPEG, and so on). The mobile must not include irrelevant headers.
4. Concatenated PDU: In order to reduce the access time of the homepage, the mobile should use the "concatenated PDU" (the "connect" and "get" PDU is concatenated in the first SDU). The concatenation process must comply with WTP specification.

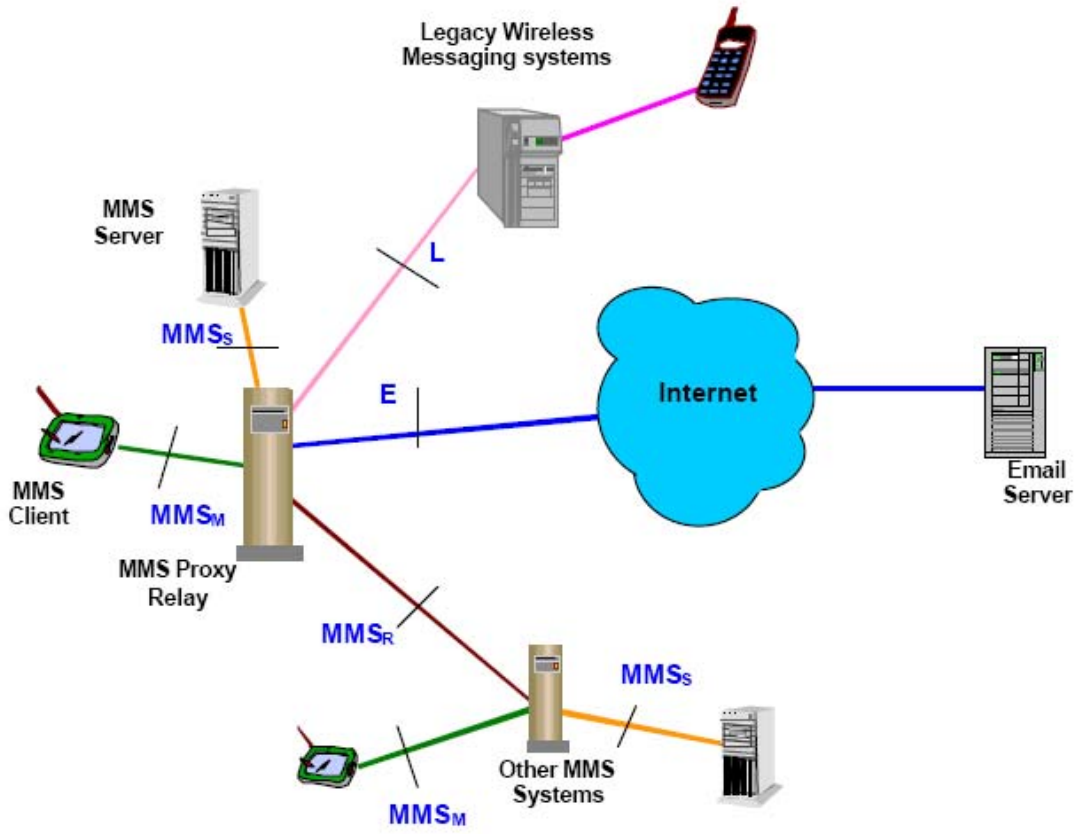
3.2.3.8 WAP contents type

Contents	MIME type
JPEG	image/jpeg
BMP	image/bmp
GIF	image/gif
WBMP	image/vnd.wap.wbmp
SMAF	application/x-smaf, audio/smaf
MIDI	audio/midi

3.2.4 Messaging

3.2.4.1 MMS

The Multimedia Messaging Service (MMS) is a messaging service that allows sending and receiving messages comprising a combination of text, sounds, images and video to MMS capable handsets with SMIL presentation. The WAP Forum and 3GPP 3G-industry groups standardize MMS. It shall use WAP transfer protocol and therefore be bearer independent like CSD and GPRS in conformance with the specification 3GPP spec.



Introduction

MMS used WAP WSP/HTTP as underlying protocols to transfer MMS PDUs between MMS client which resides on the terminal and the MMS Proxy-Relay. Due to limited bandwidth of the air interface of mobile networks MMS PDUs are transferred between an MMS client and MMS Proxy-Relay in binary encoded message format. This process is called encapsulation. WSP PDUs of HTTP messages which contain MMS PDUs as their body are used for this transport.

There are basically twelve types of PDUs in MMS level:

Primitives	Description
M-Send.req, M-Send.conf	Send message to MMS Proxy-Relay
WSP/HTTP GET.req, M-Retrieve.conf	Fetch message from MMS Proxy-Relay
M-Notification.ind, M-NotifyResp.ind	MMS notification about new message
M-Delivery.ind	Delivery Report about sent message
M-Acknowledge.ind	Acknowledgement of message delivery
M-Read-Rec.ind, M-Read-Orig.ind	Read report about sent message
M-Forward.req, M-Forward.conf	Forward transaction by means of requesting Relay from client.

Requirement

- The mobile shall send and/or receive MMS included objects.
- The mobile shall allow the user to manage a MMS inbox/outbox with the features: send, reply, transfer, delete.

- When the mobile receives a MMS, it shall manage the inbox capacity and validate or not (in the acknowledgement of the notification) the possibility of storing it (management of the MIME content type of the MMS).
- The mobile shall be able to send a MMS on both GSM and Internet addressing (MSISDN and E-mail).
- The mobile shall support to download MMS on user request or automatically.
- SMIL features (management of the objects in the MMS)
- Multi recipient (send a MMS to several persons)
- Priority of the MMS (normal, urgent)
- Delivery report request (MMS MO) & Authorization of report (MMS MT)
- Addressing hiding (the sender address is hidden)

Interoperability specification

1. The MMS shall be implemented on top of WAP1.2 and minimum supported message size shall be 30Kbytes and 50Kbytes in the size of maximum.
2. For WAP flow control, WTP SAR, using relevant TPI(Transport Information Item)s shall be supported.
3. Encoding and values in MMS headers: The contents-type in M-Send.req and M-Retrieve.conf shall be “application/vnd.wap.multipart.mixed” be used when there is no presentation and “application/vnd.wap.multipart.related” when there is SMIL presentation available.
4. MM content encoding: WSP multipart encoding shall be used. Content types in WSP multipart headers shall be encoded using WSP binary values whenever available. If not available, text encoding shall be used. Content type for SMIL shall be “application/smil”.
5. MMS client has interface with WAP gateway through WSP based protocol as default rather than HTTP based protocol as MM transport protocol.

Forward Lock

Due to mechanism to forward message with contents provided from content provider, actually downloaded through WAP, it shall protect this kind of contents from forwarding to other handsets if this content has indication of forward lock like MIME type like “application/vnd.sem.mms.protected”.

Inter-working with WAP browser

Multiple PDP context activation is required in case GPRS WAP session still be opened when WAP Push notification message got arrived. Because MMS client will be trying to connect WAP gateway to retrieve a message from MMSC with PDP context activation. If same APN is specified by operator, this kind of PDP context activation is not required. Thus, the context activation shall be managed to properly active or de-active its context required.

Content format supported

Refer to section 3.2.5

3.2.4.2 EMS

Enhanced Messaging Service (EMS) adds new functionality to the well-known SMS standard. With it, mobile phone users can add life to SMS text messaging in the form of pictures, animations, sound and formatted text. This gives the users new ways to express feelings, moods and personality in SMS messages. As well as messaging, users will enjoy collecting and swapping pictures and ring signals and other melodies, downloading them from the Internet or editing them directly on the phone.

EMS gives the user the ability to send and receive melodies and to insert pre-defined sounds in the messages.

It shall meet 3GPP TS 23.040 which is mentioning up to release 5. In case nokia smart message comes down, nokia smart message shall be converted into EMS message internally.

800 octets shall be supported for long SMS message that shall show page number for end user friendly.

Extended object type	Description
Sound	Predefined objects specified in the spec.
Animation	
Melody	User defined melody with iMelody format
Picture	User defined - Small(16x16) and large(32x32) with BMP format

The text formatting shall not be supported but it shall be ignored with identification by IE(Information Element) in the TP-UD Header, which in turn is part of the TP-UD field. In case of incoming long SMS, alerting shall heard once all parts of the messages have been received or when a specific timer expired that is depending on traffic load of SMSC.

In case of EMS receiving, objects in EMS shall be stored into file system but when ODI(Object Distribution Indicator) flag is set, this downloading feature shall not be active. But we will not specify ODI.

In case content provider will distribute EMS objects larger than one SMS, it shall check UPI(User Prompt Indicator) in order to automatically unified into one object.

3.2.5 Multimedia Object

The mobile supports and manages at least the types of objects described below. Those objects should be downloaded using the different messaging media like MMS but also thanks to browsing or internal device as camera, or others.

<table>
<tr><th>Object</th><th>Format</th><th>Application</th><th>Description</th></tr>
<tr><td rowspan="5">Picture
(Wall paper)</td><td>JPEG (24 bit)</td><td rowspan="7">WAP/MMS</td><td rowspan="7">GIF89a is used for Animation, all objects have file name with 22 bytes length at maximum.</td></tr>
<tr><td>GIF 89a (8 bit)</td></tr>
<tr><td>GIF 87a (8bit)</td></tr>
<tr><td>WBMP (1 bit)</td></tr>
<tr><td>BMP (24 bit)</td></tr>
<tr><td rowspan="2">Sound
(Ringtone)</td><td>SMAF</td></tr>
<tr><td>MIDI</td></tr>
<tr><td></td><td>AMR</td><td colspan="2">Not available</td></tr>
</table>

3.2.6 SIM Tool Kit

The mobile supports SIM Toolkit features according to the phase 2+ specifications – GSM 11.11 and GSM 11.14.

- The Proactive menu created by a “SETUP MENU” feature during the initialization of the card session is easily accessible to the user. It could be either at the first position in the menu system or directly available by a specific key. It is also available during a call as an in call menu.
- The mobile manages SIM Toolkit application some is its state (in idle mode or in call).
- The mobile indicates easily the user how to go backwards in the proactive SIM session and

to end the proactive SIM application session by a short or a long press on the “Clear” for example.

- The mobile supports a time-out in a STK session and sends a “no response from the user” response.
- For all the SIM Toolkit features, the mobile ignores the value of RFU bits (normally set to 0).
- The mobile supports the “Help information” option and offer to the user an easy way to request it. For this feature, the mobile sends a “help information required by the user” response.

3.2.7 Certificate

Current GSM protocol stack is supporting Rel97 and GCF3.17.0 as GCF CC version.

3.2.8 Factory mode

3.2.8.1 SW version

It is available for user to identify SW version with key sequence like “****36446337##**” and then following screen shot will come out.

S/W	**PX.X_RXX.XX ; Main version**
RES	XX.XX.XX ; Resource version specified that has resource like image, font, melody
CFG	XX.XX.XX ; Config version
ENG	NGTC_MPX.X.Xc_X ; Engine version that have GSM/GPRS protocol stack.

3.2.9 Firmware upgrade

3.2.9.1 SW download

When new firmware is released, firmware upgrade shall be performed. The upgrading is performed as like below procedures depending on Init API.

When Init Flash API is necessary: NV Backup -> Download -> Init Flash API -> NV Restore
When Init Flash API is not necessary: NV Backup -> Download -> NV Restore (optional)

It highly depends on the changes of firmware whether Init Flash API shall be done or not. Guideline for firmware upgrade shall be provided with Release Note and download tool when firmware upgrade is required. Detail description of each process will be mentioned in other manual.

Appendix - UA Profile

<RDF xmlns="**http://www.w3.org/1999/02/22-rdf-syntax-ns#**"
xmlns:rdf="**http://www.w3.org/1999/02/22-rdf-syntax-ns#**"
xmlns:prf="**http://www.wapforum.org/profiles/UAPROF/ccppschema-20000405#**"
xmlns:mms="**http://www.wapforum.org/profiles/MMS/ccppschema-20010111#**">
<rdf:Description rdf:ID="**Profile**">
<prf:component>
<rdf:Description rdf:ID="**HardwarePlatform**">
<rdf:type rdf:resource="**http://www.wapforum.org/profiles/UAPROF/ccppschema-20000405#HardwarePlatform**" />
<prf:ScreenSize>**160x128**</prf:ScreenSize>
<prf:Model>**C650**</prf:Model>
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<rdf:li>**UTF-8**</rdf:li>
<rdf:li>**ISO-8859-1**</rdf:li>
<rdf:li>**ISO-10646-UCS-2**</rdf:li>
</rdf:Bag>
</prf:InputCharSet>
<prf:ScreenSizeChar>**16x8**</prf:ScreenSizeChar>
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<rdf:li>**application/vnd.wap.wmlscriptc**</rdf:li>
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- <prf:SupportedBearers>
- <rdf:Bag>
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- <prf:component>
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</prf:component>
- <prf:component>
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- <prf:WmlVersion>
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20010111#MmsCharacteristics" />
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