[2009]

GPRS/EDGE Network KPIs

[Recommendations]

The document attempts to recommend the Key Performance indicators (KPIs) which may be tested to benchmark data services e.g. EDGE/GPRS of GSM Cellular Operators.

Practical measurement methods are presented towards the end of the report.

PTA would appreciate your comments on the issues highlighted at the end of this document.

Pakistan Telecommunication Authority
S&D Division

Contents

Abbreviations

2G	Second Generation
ANSI	American National Standards Institute
BTS	Base Transmitting Station
CDMA	Code Division Multiple Access
DL	Down-Link
EDGE	Enhanced Data rate for GSM Evolution
EGPRS	Enhanced General Packet Radio Service
GSM	Global System for Mobile communication
GMSK	Gaussian Minimum Shift Keying
GPRS	General packet Radio Service
HSCSD	High Speed Circuit Switched Data
IP	Internet Protocol
kbits/s/slot	Kilo Bits per second per slot
Kb	Kilo bits
KB	Kilo Bytes
MCS	Modulation & Coding Scheme
PDP	Packet Data Protocol
PSK	Phase Shift Keying
QoS	Quality of Service
TDMA	Time division Multiple Access
UE – UT	User Equipment – User Terminal
UL	Up-Link
UMTS	Universal Mobile Telecommunication Service
USB	Universal Serial Bus

Definitions

Active UE	Any user equipment which is in process of downloading or uploading any content
PDP context	PDP (e.g., IP, X.25, Frame Relay) context is a data structure present on both the *Serving GPRS Support Node* (SGSN) and the *Gateway GPRS Support Node* (GGSN) which contains the subscriber's session information when the subscriber has an active session. When a mobile wants to use GPRS, it must first attach and then *activate a PDP context*.

1. Introduction

GPRS and EDGE are GSM wireless packet data transfer standards classified as 2.5G and 2.75G respectively. Fig 1 below elaborates the positioning of EDGE and GPRS within the technology evolution growth path from 2G (GSM) to 3G (UMTS).

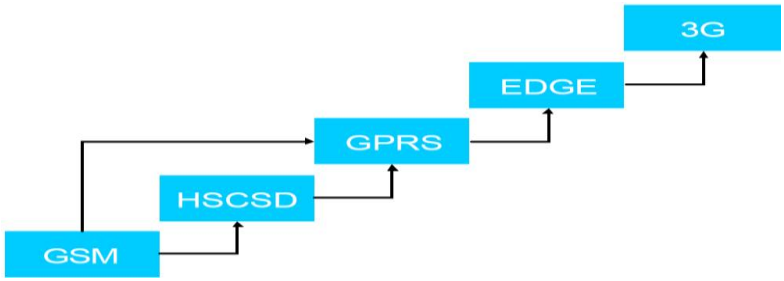

Fig: 1 Evolution from GSM to 3G

With the advent of data communication, packet switching technology was introduced to GSM, CDMA and TDMA (ANSI I36) mobile networks making it easier for non-voice applications.

EDGE is the next step up from GSM/GPRS communication leading towards 3G. It has higher data rates due to several technological improvements for example GPRS uses GMSK modulation for air interface whereas EDGE, in addition to GMSK, uses higher bit rate modulation 8-PSK. Moreover GPRS is a best-effort packet switched service where limited QoS is guaranteed during communication. In contrast EDGE introduces data transfer during mobility with a higher level of confidence.

2. Technology

In order to devise KPIs, it is prudent to have a background of the physical level frame structure of GSM. Fig 2 highlights how data is arranged into 8 time slots of one GSM frame, which are shared among multiple users to provide various voice and data services.

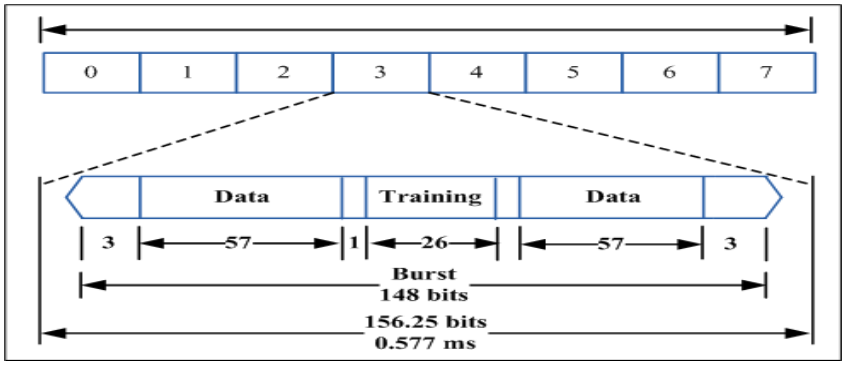

Fig: 2 GSM Frame of 8 Time slots

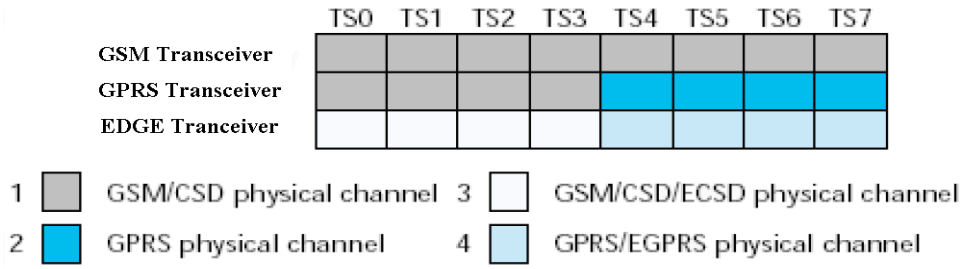

Fig: 3 Example of transceiver and channel plan in one cell

The difference between GPRS and EDGE arises on the basic usage of these slots. Fig: 3 shows that while standard GPRS transceivers support only the first two channel types, EDGE transceivers support all four. Physical channels are dynamically defined according to the need in the cell. For example, if a large number of speech users are currently active, the number of channels of the first and third types is increased, at the expense of fewer GPRS and EGPRS channels. Moreover EDGE can use all the 8 slots for data transfer whereas GPRS transceiver can operate with only 3 slots.

There exists a difference within the standards for the data rate per slot for GPRS and EDGE which is due to improved modulation and coding schemes for EDGE. This difference is shown in table: A below.

EDGE			**GPRS**	
Coding and modulation scheme (MCS)	***Speed (kbit/s/slot)***	**Modulation**	***Coding scheme***	***Speed (kbit/s)***
MCS-1	8.80	GMSK	CS-1	8.0
MCS-2	11.2	GMSK	CS-2	12.0
MCS-3	14.8	GMSK	CS-3	14.4
MCS-4	17.6	GMSK	CS-4	20.22
MCS-5	22.4	8-PSK	-	-
MCS-6	29.6	8-PSK	-	-
MCS-7	44.8	8-PSK	-	-
MCS-8	54.4	8-PSK	-	-
MCS-9	59.2	8-PSK		

Table: A Speeds due to various coding schemes in GPRS/EDGE

3. Methodology for Development of KPIs

The KPIs have been developed keeping in view the following goals:

a. Applicability
b. End to End testing (non-intrusive for network under test)
c. Ease of measurement
d. Ease of understanding for a field testing person
e. Similar treatment of rural and urban regions in terms of service offerings
f. Push for future improvement in broadband networking

4. Recommended KPIs

GPRS/EDGE based networks can be monitored for QoS using the following parameters:

4.1 Availability

This KPI can be further classified into two parameters:

4.1.1 Network Availability

Provides verification on whether the operator provides GPRS/EDGE coverage in the testing area. Coverage maps may be obtained from the GPRS/ EDGE service providers before the actual on ground testing is done.

4.1.2 Service Availability

GPRS/EDGE services are activated after proper GPRS/EDGE ATTACH and PDP activation sequences before a user can actually connect to the destination on the internet. In our first phase of defining of KPIs, it is recommended that we do not categorize networks over the time duration taken in performing these protocols. However if a failure on attach or PDP activation occurs, then a user is unable to access the internet cloud. Therefore for the first phase it is recommended that only GPRS/EDGE attach and PDP activation success be measured. Moreover the general user may not be more interested in how he connects to the internet as long as the connection time is within reasonable limits.

Categorization on the basis of this KPI is at Annex-A (*Table-1*).

4.2 Latency

Latency in a packet-switched network is measured either *one-way* (the time from the source sending a packet to the destination receiving it), or *round-trip* (the one-way latency from source to destination plus the one-way latency from the destination back to the source). For end to end testing, round trip is better suited.

Categorization on the basis of this KPI is at Annex-A (*Table-2*).

4.3 Link Speed

It is the speed at which UE is connected to its serving BTS. A good connection speed however does not guarantee a good connection to any web server. Infact it provides information about the capability of the host cellular GPRS/EDGE network at that time. For example a good Link speed may mean a good service provider network but on the other hand it may also mean that your network is relatively less loaded with real-time traffic (voice and data) and therefore it can allocate the available resources to the data request.

As shown in Fig: 3, GSM has eight time slots per frame. The time slot speed is dependent on channel conditions. The speeds, mentioned in Table-A, are dynamically chosen and eventually result in determining the overall download speed when a user may get. Based on these two parameters we can have an 8x9 matrix for EDGE and a 3x4 matrix for GPRS providing various speeds per time slot.

Ratings for GPRS/EDGE link speeds (see Annex-A (*Table-3*)) are based on the above mentioned criteria. For example a good edge network would allocate between *'4 time slots at MCS-7 per second'* upto *'5 time slots at MCS-8'* or any other combination ensuring the speeds per second remain within the anticipated limits.

4.4 Throughput

One of the most important and user specific KPI is the overall throughput you can get from your GPRS/EDGE service. These have been further subdivided into 'download' and 'upload' speeds as seen below. While recommending Throughput speeds differentiation has also been made on between urban and rural area requirements. 5 time slots at MCS-8 rate is considered excellent for DL.

The average data speeds (both upload & download) of the test samples (minimum 5 proposed) should be at least 60 % of the of the peak link speeds for at-least 70% of the time during which measurements were made.

4.4.1 Download Speeds

Most of the time user uses the GPRS/EDGE service for surfing, downloading an email attachment etc. Consequently every service provider desires to stress on download speeds. For most users it has become a key parameter of interest for both the users and the service providers. Following assumptions were made while devising the KPIs:

4.4.1.1 Urban Environment

Ratings for GPRS/EDGE DL speeds (see Annex-A (*Table-4*)) for urban environments are based on the above laid criteria.

Note: It is assumed that *3 active* EDGE/GPRS users are present in the same cell during the tests.

4.4.1.2 *Rural Environment*

Ratings for GPRS/EDGE DL speeds (see Annex-A (*Table-5*)) for urban environments are based criteria detailed above.

Note: It is assumed that 1 *active* EDGE/GPRS user is present in the same cell during the tests.

4.4.1.3 EDGE with Mobility

For EDGE download service during mobility (of over 70Km/h **or** as per the allowable/possible speed limits on the test field) rating should be done using (see Annex-A (*Table-6*)). These are half of the average of the corresponding fixed rural and urban download speeds.

4.4.2 Upload Speeds

Uploads using EDGE/GPRS are rather rare as compared to downloads, however there are instances of small documents and excel sheets uploaded by people for business applications or peer-to-peer uploads. Following assumptions were made while devising the KPIs:

4.4.2.1 Urban Environment

Ratings for GPRS/EDGE UL speeds (see Annex-A (*Table-7*)) for urban environments are based on criteria detailed above.

Note: It is assumed that *1 active* EDGE/GPRS user is present in the same cell during the tests.

4.4.2.2 *Rural Environment*

Ratings for GPRS/EDGE UL speeds (see Annex-A (*Table-8*)) for urban environments are based on criteria detailed above.

Note: It is assumed here that NO *active* EDGE/GPRS user is present in the same cell during the tests.

4.4.2.3 EDGE with Mobility

For EDGE upload service during mobility (of over 70Km/h **or** as per the allowable/possible speed limits on the test field) rating should be done using (see Annex-A (*Table-9*)). These are half of the average of the corresponding fixed rural and urban uploaded speeds.

4.5 Retainability

Once a connection is established, user should be assured that it his request is served during the whole session. Link may get disconnected on the access channel side due to propagation conditions or a case may be that link between UT & Node B exists but user is no longer able to access the desired IP address.

Performance of network can be verified according to the criteria laid down in Annex-A (*Table-10).*

5. Measurement Techniques

5.1 Measurement Options

In order to measure the above mentioned KPIs according to the Annex–A measurement schemes differ depending upon the measurement equipment/tool and the measurement requirements. The measurement methods proposed have been classified below based on the cost effectiveness versus the measurement detail criteria:

a. Option: 1 *(Simple testing)*
Crude method but requires least resources

b. Option: 2 *(Moderate Testing)*
Detailed measurement method using NEMO tool available with PTA

c. Option: 3 *(Advanced testing)*
Deep testing method with testing possible on rental basis

Detailed measurement approach of each category is given below.

5.1.1 Option: 1

1. Network Availability for GPRS/EDGE can simply be seen on the handset display. On the other hand Service availability part of KPI-1 cannot me measured accurately using this method, however using a timing device to calculate the time difference between the attempt to reach for an IP address (website) till the time destination is connected (page starts to load) will give a rough value to match against the categories.
2. Ping service can be used to measure round-trip latency because it does not perform any packet processing. Receiving end only responds (without any packet processing) back when it receives a packet, thus it is a relatively accurate way of measuring latency.
3. For KPI-3, setup a GPRS/EDGE connection using laptop; note the link speeds using the connection details which can be accessed from the task bar at the bottom right of the screen.
4. For KPI-4, setup a GPRS/EDGE connection using laptop, any capable handheld (e.g. IPhone) according to the parameters of the service provider under test. Perform one of the following:

    a. Surf to websites like (http://i.dslr.net/tinyspeedtest.html, http://testmyiphone.com/) and perform the tests. Note the parameters and rate them accordingly
    b. Alternatively you can DL a file of 500kB (4Mb) from a known ftp server or IP address (e.g. PTA's website) and note the speeds. Similarly upload speeds can be obtained by uploading a file of at-least 100kB (800kb).

5. Once a connection is established, test for link sustainability by keeping session up for ten minutes (10mins) and note down if it disconnects.

5.1.2 Option: 2

The GPRS/EDGE network can be thoroughly monitored using the NEMO outdoor tool. NEMO has a long list of measurable parameters available as can be seen in the Annex-B. Moreover the parameters to be measured for rating the network according to Annex - A are also highlighted.

5.1.3 Option: 3

Keynote Sigos has a product named Global Roamer which can be leased by PTA to test the GPRS/EDGE network in detail. The measureable parameters for GPRS by this method are attached as Annex-C.

Note 1: UL& DL file sizes and other testing conditions would be same as envisaged for the Option: 1

Note 2: For **Option 2 and 3,** other products can also be explored when it comes to purchase of equipment through proper channel in line with PPRA rule set.

5.2 Measurement Conditions

It is recommended that test be performed by keeping following into consideration:

1. During one complete test cycle (i.e. testing through **4.1** to **4.5**), destination IP MUST remain the same for all networks under test. Alternately the test destination can be fixed if it is within PTA.

2. KPI should ideally be tested for different traffic types e.g. *BURST*: for surfing; *CONTINUOUS:* for video streaming. Especially EDGE should support video streaming or IPTV (if announced).

3. In all cases, at-least 10 tests of each KPI must be performed with multiple configurations. An average of the test results to be obtained before categorizing them according to the rating tables at Annex-A.

4. For every test especially before the tests for DL & UL speeds, the cache should be cleared.

5. For DL a file of at-least 500kB (4Mb) from a known ftp server or IP address (e.g. PTA's website) may be downloaded. Similarly upload speeds may be obtained by uploading a file of at-least 100kB (800kb).

6. For each test complete details of the testing equipment may be noted with its make, model, software/hardware versions and class compatibilities. Moreover it is strongly recommended that same handset be used for all tests on all networks.

7. Before evaluation it must be verified that the service/application parameter for precedence/preference are set to their normal value on the network. It will ensure that no network resources are especially reserved for the SIM under test.

8. Multiple configurations may be used for testing, including but not limited to:
   a. Same cell testing
   b. Neighbouring cell of same BSC testing
   c. Combination of above

6. Conclusion & Recommendations

1. These KPIs are intended to apply until 30 June 2011, subject to any review or amendment that may occur prior to that time provided they adhere to the guidelines at section 3.

Rest of this section is reserved only for PTA's in-house consultation

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Annex-A

Rating Tables

Tech.	Type	Pass	Fail
GPRS & Edge	Network	Network available	Network not available
	Service	Time < 7 sec	Time > 7sec

Table-1 KPI: Availability

Tech.	Good	Average	Poor	Unsatisfactory
GPRS	Delay <500ms	500ms - 800ms	800ms -1000m	Above 1sec
EDGE	Delay <100ms	100ms - 200ms	200ms – 500ms	Above 500 ms

Table-2 KPI: Latency

Tech.	Excellent	Good	Average	Poor	Unsatisfactory
GPRS	Over 43.2kbps	Between 43.2kbps - 36kbps	Between 36kbps - 24kbps	Between 24kbps - 12kbps	Below 12kbps
EDGE	Over 272kbps	Between 272kbps - 179.2kbps	Between 179.2kbps - 88.8kbps	Between 88.8kbps - 44.8kbps	Below 44.8kbps

Table-3 KPI: Link Speed

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
GPRS	***Throughput***	Over 6.48kbps	Between 6.48 kbps – 5.4kbps	Between 5.4kbps – 3.6kbps	Between 3.6kbps – 1.8kbps	Below1.8kbps

	Time taken (approx)	Less than 77.2sec	Between 77.2sec – 92.6sec	Between 92.6sec – 139sec	Between 139sec – 278sec	Above 278sec
EDGE	***Throughput***	Over 40.8kbps	Between 40.8kbps - 26.88kbps	Between 26.88kbps – 13.32kbps	Between 13.32sec – 6.72sec	Below 6.72kbps
	Time taken (approx)	Less than 12.2sec	Between 12.2sec – 18.6sec	Between 18.6sec – 37.53sec	Between 37.53sec – 74.4sec	Above 74.4sec

Table-4 KPI: Throughput - *DL Urban*

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
GPRS	***Throughput***	Over 13kbps	Between 13kbps – 10.8kbps	Between 10.8kbps – 7.2kbps	Between 7.2kbps – 3.6kbps	Below 3.6kbps
	Time taken (approx)	Less than 38.5sec	Between 38.5 sec – 46.3sec	Between 46.3sec – 70sec	Between 70sec – 139sec	Above 139 sec
EDGE	***Throughput***	Over 81.6kbps	Between 81.6.kbps - 53.8kbps	Between 53.8kbps – 26.64kbps	Between 26.64kbps – 13.44kbps	Below 13.44kbps
	Time taken (approx)	Less than 6.13sec	Between 6.13sec – 9.3sec	Between 9.3sec – 18.8sec	Between 18.8sec – 37.2sec	Above 37.2sec

Table-5 KPI: Throughput – *DL Rural*

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
EDGE	***Throughput***	Over 30.6kbps	Between 30.6kbps - 20.17kbps	Between 20.17kbps – 10kbps	Between 10kbps – 5kbps	Below 5kbps

	Time taken (approx)	Less than 16.33sec	Between 16.33sec – 24.8sec	Between 24.8sec – 50sec	Between 50sec – 100sec	Above 100sec

Table-6 KPI: Throughput – *DL EDGE Mobility*

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
GPRS	***Throughput***	Over 4.8kbps	Between 4.8kbps – 4.32kbps	Between 4.32kbps – 3.6kbps	Between 3.6kbps – 2.4kbps	Below2.4kbps
	Time taken (approx)	Less than 20.8.8sec	Between 20.8sec - 23.1 sec	Between 23.1sec – 27.7sec	Between 27.7sec – 41.7sec	Above 41.7sec
EDGE	***Throughput***	Over 18kbps	Between 18kbps - 9kbps	Between 9kbps – 6kbps	Between 6kbps – 3.5kbps	Below 3.5kbps
	Time taken (approx)	Less than 5.5sec	Between 5.5sec – 11.11sec	Between 11.11sec – 16.7sec	Between 16.7sec – 28.6sec	Above 28.6sec

Table-7 KPI: Throughput - *UL Urban*

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
GPRS	***Throughput***	Over 9.6 kbps	Between 9.6kbps – 8.64kbps	Between 8.64kbps – 7.2kbps	Between 7.2kbps – 4.8kbps	Below 4.8kbps
	Time taken (approx)	Less than 10.41sec	Between 10.41sec - 11.6 sec	Between 11.6sec – 14 sec	Between 14sec – 21sec	Above 21sec
EDGE	***Throughput***	Over 26.9kbps	Between 26.9kbps - 13.4kbps	Between 13.44kbps – 10.56kbps	Between 10.56kbps – 5.3kbps	Below 5.3kbps

	Time taken (approx)	Less than 3.7sec	Between 3.7sec – 7.5sec	Between 7.5sec – 9.47sec	Between 9.47sec – 19sec	Above 19sec

Table-8 KPI: Throughput - *UL Rural*

Tech.	Unit	Excellent	Good	Average	Poor	Unsatisfactory
EDGE	***Throughput***	Over 11.22kbps	Between 11.22kbps – 5.6kbps	Between 5.6kbps – 4.14kbps	Between 4.14kbps – 2.2kbps	Below 2.2kbps
	Time taken (approx)	Less than 8.91sec	Between 8.91sec – 18sec	Between 18sec – 24.15sec	Between 24.15sec – 45.5sec	Above 45.5sec

Table-9 KPI: Throughput – *UL EDGE Mobility*

Tech.	Good	Average	Unsatisfactory
GPRS & Edge	No disconnection	1 - 2 disconnections	More than 2 Disconnections

Table-10 KPI: Retainability

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NEMO OUTDOOR

For GSM/GPRS/EDGE/WCDMA Wireless Networks

Nokia 6680 Mobile Phone

Technical Specifications

Mobile Features
-WCDMA 2100 / GSM/GPRS 900/1800
-GSM/GPRS/EDGE:
-Timeslots 4+1, 3+2
-WCDMA
-PS NRT 384/128
-CS NT 57.6
-CS T 64 (video calls)
-Multi RAB
-Functionality support based on:
-Core Network: 3GPP R99 June-2004 Baseline
-GERAN: 3GPP R99 July-2004 Baseline
-WCDMA RAN: 3GPP R99 March-2004 Baseline

Forcing Features
-Cell barring
-Band lock
-System lock
-Channel lock
-Scrambling code lock

Application Protocols
-ICMP ping
-FTP protocol
-HTTP protocol
-Nemo protocol (for TCP and UDP testing)
-SMTP and POP3 protocols (for email testing)
-MMS testing
-WAP testing
-RTSP streaming

Serving Cell Information
-Cellular system
-Channel number
-Roaming information
-Service information
-Cell ID -RAC -MCC
-MNC -LAC

WCDMA Signaling Messages
-Layer 3
-RRC
-RLC
-Logical subchannels for all messages

RACH Parameters
-Random access initial TX power
-Random access maximum preamble count
-Random access preamble count
-Random access preamble step
-Random access message TX power
-UL interference level

Physical Layer Parameters
-BLER -BER -RSSI
-RSCP
-Physical channel UL throughput
-TX power
-Ec/No for active/neighbor/ detected set

Power Control Parameters
-BLER
-SIR target
-TX power control algorithm
-TX power control step size
-Number of increase/decrease UL / DL power commands

Soft Handover Parameters
-Ec/No for active/neighbor set
-Soft handover status
-Soft handover event
-Addition window
-Drop window
-Replacement window
-Time to trigger 1A
-Time to trigger 1B
-Time to trigger 1C
-Added scrambling code nr.
-Removed scrambling code nr.
-Cell count active
-Cell count monitored

Additional 3G Information
-Compressed mode indication
-BS diversity state
-RRC state
-WCDMA neighbor list with GSM neighbors
-Inter-system GSM neighbor measurement results
-Results of inter-frequency neighbor measurements
-Measurement events
-Used AMR codec

GSM Signaling Messages
-Layer 3
-Layer 2
-RLC/MAC control messages
-Logical subchannels for all messages

GSM Serving Cell RF Parameters
-DTX -RLT -FER
-C1 & C2
-Mean BEP (8-PSK & GMSK)
-Mean BEP coefficient variance (8-PSK & GMSK)
-RXLEV (full & sub)
-RXQUAL (full & sub)
-Packet RXQUAL
-TXPOWER
-Timing advance
-C value

Last Edited: 13-Mar-2006

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-Signal variance
-I levels (per TN)

GSM Serving Channel Information
-BCCH -HSN
-BSIC -MAIO
-ARFCN
-TCH (FR, EFR)
-Timeslot number
-Hopping flag

GSM Neighbor Information
-N1 - N8 BCCH
-N1 - N8 BSIC
-N1 - N8 RXLEV
-N1 - N6 C1 & C2
-GSM neighbor list with WCDMA neighbors
-Inter-system WCDMA neighbor measurement results

SNDCP Information
-Header compression status
-Data compression status

LLC Tracing
-Retransmitted LLC block rate
-LLC data throughput UL/DL

RLC/MAC Information
-Retransmitted RLC block rate
-RLC/MAC data throughput UL/DL
-Number of timeslots in GPRS UL/DL
-GPRS coding scheme UL/DL
-EGPRS modulation and coding scheme UL/DL
-RLC BLER
-GPRS/EGPRS indication
-TLLI
-TFI UL/DL
-RLC window size UL/DL

Call Information
-Call type
-Number of calls
-Call connecting status
-Call attempt time
-Call failure time
-Call failure cause
-Call duration
-Call disconnect cause

Packet Data Information
-PDP activation attempt time
-PDP active duration
-PDP activation failure time
-PDP activation failure cause
-PDP context deactivation time
-PDP context deactivation cause
-Packet state
-Packet protocol address
-Attach failure time
-Attach failure cause
-Attach attempt time
-Attach attempt time
-Attach duration
-Detach time
-GMM/SM state
-QoS settings

User Level Data Information
-Data transfer protocol
-Data transfer direction
-Data transfer attempt number
-Data transfer host address
-Data transfer host port
-Application data throughput UL/DL
-Application packet error rate
-Transferred bytes UL/DL
-PPP layer data throughput
-Data connection establishment time
-Data connection rate UL/DL
-Data connection duration
-Data connection failure time
-Data connection failure cause
-Data transfer failure cause
-Data size UL/DL
-Data disconnect cause
-Ping rate
-Ping timeout
-Ping time (application data round trip travel time)

Statistics
-Call statistics
-Handover/handoff statistics
-Soft handover statistics
-Intersystem handover statistics
-Intersystem cell reselection statistics
-Location area statistics
-Attach statistics
-PDP context statistics
-MMS statistics
-Routing area statistics
-User level data statistics

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NEMO technologies

Test Case Name	Description	Test Units	KPIs	KPIS Description
GPRS / IP (CS/PS)				
Activate_PDP_Context	Checks whether the PDP context for an ip connection can be established. Optionally a PPP connection can be started after PDP context activation.	1	a GPRS APN	Used GPRS access point [gprsApn]
			a PDPContextActivationDuration	Time needed to activate a PDP Context [pdpcaend - pdpcabegin]
			a_PDPIpUpDuration	Time needed for PDP Context Activation and starting IP [ipup -pdpcabegin]
			a_PDPSetupConnectDuration	Time needed to dial the Packed Data Service Request (ATD*99...) [pdpcaend - pdpcabegin]
			ServiceType	Service Type of the tested Service [IP]
Deactivate_PDP_Context	Checks whether an activated PDP context for an ip connection can be deactivated. Optionally an established PPP connection can be stopped before PDP context deactivation.	1	a GPRS APN	Used GPRS access point [gprsApn]
			a PDPContextDeactivationDuration	Time needed to deactivate a PDP Context [pdpcdend -pdpcdbegin]
			a_PDPIpDownDuration	Time needed from stopping IP to PDP Context Deactivation end [pdpcdend - pppstop]
			ServiceType	Service Type of the tested Service [IP]
DNS_cs	Send a DNS request to each DNS server in the DNS_Servers parameter using the dig program and record the data returned and the time required to obtain the DNS response via CSD	1	a_accessType	Used access type [accessType]
			a_CSDcon_assignIP_Duration	Time to get an IP Address after CSD Call is established [ipup -connect]
			a CSDDialInDuration	Time needed to establish a CSD Data Call [connect - setup]
			a DialinNumber	Dial In Number for Circuit Switched Data Call [dialinNumber]
			DnsDuration	Duration of DNS request [DnsDuration]
			DnsResponse	Response upon DNS request [DnsResponse]
			DnsStart	Start of DNS request [DnsStart]
			ServiceType	Service Type of the tested Service [IP]
DNS_ps	Send a DNS request to each DNS server in the DNS_Servers parameter using the dig program and record the data returned and the time required to obtain the DNS response via GPRS	1	a_accessType	Used access type [accessType]
			a GPRSAttachDuration	Time needed to perform GPRS Attach
			a GPRS APN	Used GPRS access point [gprsApn]
			a PDPContextActivationDuration	Time needed to activate a PDP Context
			a_PDPIpUpDuration	Time needed for PDP Context Activation and starting IP
			a_PDPSetupConnectDuration	Time needed to dial the Packed Data Service Request (ATD*99...)
			DnsDuration	Duration of DNS request [DnsDuration]
			DnsResponse	Response upon DNS request [DnsResponse]
			DnsStart	Start of DNS request [DnsStart]
			ServiceType	Service Type of the tested Service [IP]
Email_ps	Send an e-mail via SMTP to an E-mail address. The e-mail message is fetched via POP3/IMAP. IP access to the SMTP server and POP3/IMAP server is performed via GSM/GPRS. Note: The C-side serves for definition of the EmailAccount belonging to A-Side for sending E-mail via SMTP. The D-side serves for definition of the E-mail account belonging to B-Side for fetching E-mail via POP3 or IMAP.	1	A EmailAddress	E-mail address of A side
			a GPRSAttachDuration	Time needed to perform GPRS Attach
			a GPRS APN	Used GPRS access point [gprsApn]
			a PDPContextActivationDuration	Time needed to activate a PDP Context
			a_PDPIpIpDuration	Time needed for PDP Context Activation and starting IP
			a_PDPSetupConnectDuration	Time needed to dial the Packed Data Service Request (ATD*99...)
			b_accessType	Used access type [accessType]
			B EmailAddress	E-mail address of B side
		1	b GPRSAttachDuration	Time needed to perform GPRS Attach
			b GPRS APN	Used GPRS access point [gprsApn]
			b PDPContextActivationDuration	Time needed to activate a PDP Context
			b_PDPIpIpDuration	Time needed for PDP Context Activation and starting
			b_PDPSetupConnectDuration	Time needed to dial the Packed Data Service Request (ATD*99...)
			EmailSize	Size of the E-mail size in bytes
			FetchMailDuration	Duration of fetching the E-mail(s) (maybe more than the expected one)
			SendMailDuration	Duration of sending the E-mail
FTP_dl_cs	FTP Download via CSD; Checks that a file can be downloaded from the FTP server if the connection is established via CSD	1	a_accessType	Used access type [accessType]
			a_CSDcon_assignIP_Duratio n	Time to get an IP Address after CSD Call is established [ipup - connect]
			a CSDDialInDuration	Time needed to establish a CSD Data Call [connect - setup]
			a DialinNumber	Dial In Number for Circuit Switched Data Call [dialinNumber]
			DownloadingDuration	Time to download [DownloadDurationSecs * 1000]
			FileSize	Size of file [fileSize]
			FTPHostName	Name of FTP host [ftpServer]
			MeanDownloadRate	Mean download rate [KBPerSecDownload]
			ServiceType	Service Type of the tested Service [IP]
			a_accessType	Used access type [accessType]
			a GPRSAttachDuration	Time needed to perform GPRS Attach [attachend - attachbegin]
			a GPRS APN	Used GPRS access point [gprsApn]

Test Case Name	Description	Test Units	KPIs	KPIS Description
FTP_dl_ps	FTP Download via GPRS; Checks that a file can be downloaded from the FTP server if the connection is established via GPRS	1	a_PDPContextActivationDur ation	Time needed to activate a PDP Context [pdpcaend - pdpcabegin]
			a_PDPIpUpDuration	Time needed for PDP Context Activation and starting IP [ipup -pdpcabegin]
			a_PDPSetupConnectDuratio n	Time needed to dial the Packed Data Service Request (ATD*99...) [pdpcaend - pdpcabegin]
			DownloadingDuration	Time to download [DownloadDurationSecs * 1000]
			FileSize	Size of file [fileSize]
			FTPHostName	Name of FTP host [ftpServer]
			MeanDownloadRate	Mean download rate [KBPerSecDownload]
			ServiceType	Service Type of the tested Service [IP]
			uuPppHsdpaUsed	Availability Flag: check if HSDPA is used (1) or not (0). NULL if an error occours before.
FTP_ul_cs	FTP Upload via CSD; Checks that a file can be uploaded to the FTP server if the connection is established via CSD	1	a_accessType	Used access type [accessType]
			a_CSDcon_assignIP_Dura tion	Time to get an IP Address after CSD Call is established [ipup - connect]
			a CSDDiallnDuration	Time needed to establish a CSD Data Call [connect - setup]
			a DialinNumber	Dial In Number for Circuit Switched Data Call [dialinNumber]
			FileSize	Size of file [fileSize]
			FTPHostName	Name of FTP host [ftpServer]
			MeanUploadRate	Mean upload rate [KBPerSecUpload]
			ServiceType	Service Type of the tested Service [IP]
			UploadingDuration	Time to upload [UploadDurationSecs * 1000]
FTP_ul_ps	FTP Upload via GPRS; Checks that a file can be uploaded to the FTP server if the connection is established via GPRS	1	a_accessType	Used access type [accessType]
			a GPRSAttachDuration	Time needed to perform GPRS Attach [attachend - attachbegin]
		1	a GPRS APN	Used GPRS access point [gprsApn]
			a_PDPContextActivationDuration	Time needed to activate a PDP Context [pdpcaend - pdpcabegin]
			a_PDPIpUpDuration	Time needed for PDP Context Activation and starting IP [ipup - pdpcabegin]
			a_PDPSetupConnectDuration	Time needed to dial the Packed Data Service Request (ATD*99...) [pdpcaend - pdpcabegin]
			FileSize	Size of file [fileSize]
			FTPHostName	Name of FTP host [ftpServer]
			MeanUploadRate	Mean upload rate [KBPerSecUpload]
			ServiceType	Service Type of the tested Service [IP]
			UploadingDuration	Time to upload [UploadDurationSecs * 1000]
			uuPppHsdpaUsed	Availability Flag: check if HSDPA is used (1) or not (0). NULL if an error occours before.
GPRS_Attach	Check whether a GPRS attach can be performed	1	a_GPRSAttachD uration	Time needed to perform GPRS Attach [attachend - attachbegin]
			ServiceType	Service Type of the tested Service [IP]
GPRS_Detach	Check whether a GPRS detach can be performed	1	a_GPRSDetachDuration	Time needed to perform GPRS Detach [detachend - detachbegin]
			ServiceType	Service Type of the tested Service [IP]
HTTP_Browser	Download a page via HTTP and store the headers and the decoded content. The referenced images and external style sheets of the received page can optionally be loaded with parallel HTTP requests. The received text content of the page can be checked against keywords	1	a_accessType	Used access type [accessType]
			a_GPRSAttachD uration	Time needed to perform GPRS Attach [attachend - attachbegin]
			a GPRS APN	Used GPRS access point [gprsApn]
			a_PDPContextAc tivationDuration	Time needed to activate a PDP Context [pdpcaend - pdpcabegin]
			a_PDPIpUpDurat ion	Time needed for PDP Context Activation and starting IP [UMTS and GPRS with PPP_AuthInfo: ipup - pdpcabegin GPRS without PPP_AuthInfo: ipup - pdsetup]
			DownloadDuratio n	Duration for downloading complete page (incl. external CSS and images) [LastHttpDataPacket - FirstHttpDataPacket]
			PageContent	Content of requested page [httpPage]
			ServiceType	Service Type of the tested Service [WAP]
			SumOfBytes	Sum of bytes received [totalDownloadSize]
			URL	Requested URL [url]
			uuPppHsdpaUsed	Availability Flag: check if HSDPA is used (1) or not (0). NULL if an error occours before.
HTTP_cs	Access one or more URLs on a HTTP server and optionally check the downloaded content for specified keywords. Download is done with the program wget. Uses a circuit switched connection.	1	a_accessType	Used access type [accessType]
			a_CSDcon_assignIP_Du ration	Time to get an IP Address after CSD Call is established [ipup - connect]
			a CSDDiallnDuration	Time needed to establish a CSD Data Call [connect - setup]
			a DialinNumber	Dial In Number for Circuit Switched Data Call [dialinNumber]
			DownloadContentSize	Size of content [size]
			DownloadingDuration	Download duration [downloadend - downloadbegin]
			DownloadRate	Mean download rate [KBPerSecDownload]
			DownloadURL	URL to download [Download_URLs]
			ServiceType	Service Type of the tested Service [IP]

Test Case Name	Description	Test Units	KPIs	KPIS Description
HTTP_multithread	Download a page via HTTP and store the headers and the decoded content. The referenced images and external style sheets of the received page can optionally be loaded with parallel HTTP requests after the complete download of the primary HTML page. The number of parallel requests is configurable over HTTP-Params. Caching and compression is not supported by the test case. The received text content of the page can be checked against keywords. This test case does not support any java script functionality. Each HTTP request opens its own socket connection between client and server.	1	a_accessType	Used access type [accessType]
			a GPRSAttachDuration	Time needed to perform GPRS Attach [attachend - attachbegin]
			a GPRS APN	Used GPRS access point [gprsApn]
			a_PDPContextActivation Duration	Time needed to activate a PDP Context [pdpcaend - pdpcabegin]
			a_PDPIpUpDuration	Time needed for PDP Context Activation and starting IP [UMTS and GPRS with PPP_AuthInfo: ipup - pdpcabegin GPRS without PPP_AuthInfo: ipup -pdsetup]
			DownloadDuration	Duration for downloading complete page (incl. external CSS and images) [downloadStop - downloadStart]
			PageContent	Content of requested page [httpPage]
			ServiceType	Service Type of the tested Service [WAP]
			SumOfBytes	Sum of bytes received [recBytes]
			URL	Requested URL [url]
			uuPppHsdpaUsed	Availability Flag: check if HSDPA is used (1) or not (0). NULL if an error occours before.
HTTP_ps	Access one or more URLs on a HTTP server and optionally check the downloaded content for specified keywords. Download is done with the program wget. Uses a packet switched connection.	1	a_accessType	Used access type [accessType]
			a GPRSAttachDuration	Time needed to perform GPRS Attach [attachend - attachbegin]
			a GPRS APN	Used GPRS access point [gprsApn]
			a PDPContextActivationDuration	Time needed to activate a PDP Context [pdpcaend - pdpcabegin]
			a_PDPIpIpDuration	Time needed for PDP Context Activation and starting IP [ipup -pdpcabegin]
			a_PDPSetupConnectDuration	Time needed to dial the Packed Data Service Request (ATD*99...) [pdpcaend - pdpcabegin]
			DownloadContentSize	Size of content [size]
			DownloadingDuration	Download duration [downloadend - downloadbegin]
			Down load Rate	Mean download rate [KBPerSecDownload]
			DownloadURL	URL to download [Download_URLs]
			ServiceType	Service Type of the tested Service [IP]
Ping_cs	Ping a host and record round-trip-delay and packet loss	1	a_accessType	Used access type [accessType]
			a_CSDcon_assignIP_Duration	Time to get an IP Address after CSD Call is established [ipup -connect]
			a CSDDialInDuration	Time needed to establish a CSD Data Call [connect - setup]
			a DialinNumber	Dial In Number for Circuit Switched Data Call [dialinNumber]
			NumberOfPacketsReceived	Number of received packets [PacketsReceived]
			NumberOfPacketsSent	Number of sent packets [PingCount]
			PingHost	Host to be pinged [PingHost]
			RoundTripDelay	Round Trip Delay in msec [RoundTripDelay]
			ServiceType	Service Type of the tested Service [IP]
			SizeOfPingPacket_withoutHeader	Size of ping packet without header [PingPacketSize]
Ping_ps	Ping a host and record round-trip-delay and packet loss	1	a_accessType	Used access type [accessType]
			a GPRSAttachDuration	Time needed to perform GPRS Attach [attachend - attachbegin]
			a GPRS APN	Used GPRS access point [gprsApn]
			a PDPContextActivationDuration	Time needed to activate a PDP Context [pdpcaend - pdpcabegin]
			a_PDPIpUpDuration	Time needed for PDP Context Activation and starting IP [ipup -pdpcabegin]
			a_PDPSetupConnectDuration	Time needed to dial the Packed Data Service Request (ATD*99...) [pdpcaend - pdpcabegin]
			NumberOfPacketsReceived	Number of received packets [PacketsReceived]
			NumberOfPacketsSent	Number of sent packets [PingCount]
			PingHost	Host to be pinged [PingHost]
			RoundTripDelay	Round Trip Delay in msec [RoundTripDelay]
			ServiceType	Service Type of the tested Service [IP]
			SizeOfPingPacket_withoutHeade r	Size of ping packet without header [PingPacketSize]
TCPIP_Cmp_cs	Execute TCPIP_Command within the CSD TCP/IP context. Please refer to the description of the T_TCPIP_Command parameter on restrictions regarding commands to be used by this testcase	1	a_accessType	Used access type [accessType]
			a_CSDcon_assignIP_Duration	Time to get an IP Address after CSD Call is established [ipup -connect]
			a CSDDialInDuration	Time needed to establish a CSD Data Call [connect - setup]
			a DialinNumber	Dial In Number for Circuit Switched Data Call [dialinNumber]
			ExecuteCommandDuration	Duration of TCPIP command [tcpipcmdend - tcpipcmdbegin]
			ServiceType	Service Type of the tested Service [IP]
			TCPIPCommand	TCPIP command [tcpipCmd]
	Execute TCPIP_Command within the GPRS TCP/IP		a_accessType	Used access type [accessType]
			a GPRSAttachDuration	Time needed to perform GPRS Attach [attachend -attachbegin]
			a GPRS APN	Used GPRS access point [gprsApn]

Test Case Name	Description	Test Units	KPIs	KPIS Description
TCPIP_Cmp_ps	Execute TCPIP_Command within the GPRS TCP/IP context. Please refer to the description of the T_TCPIP_Command parameter on restrictions regarding commands to be used by this testcase	1	a PDPContextActivationDuration	Time needed to activate a PDP Context [pdpcaend -pdpcabegin]
			a_PDPIpUpDuration	Time needed for PDP Context Activation and starting IP [ipup - pdpcabegin]
			a_PDPSetupConnectDuration	Time needed to dial the Packed Data Service Request (ATD*99...) [pdpcaend - pdpcabegin]
			ExecuteCommandDuration	Duration of TCPIP command [tcpipcmdend - tcpipcmdbegin]
			ServiceType	Service Type of the tested Service [IP]
			TCPIPCommand	TCPIP command [tcpipCmd]

Industry Consultation Questions

Q.1: *In section 3 methodology of preparation of KPIs is summarized: would you like to add or subtract any criteria?*

Q.2: *Should a categorization of GPRS/EDGE network be made on the basis of the PDP activation and Attach or only success of these two procedures within a certain time limit is sufficient for a judging a network.*

Q.3: *Do you agree to the assumptions made for declaring KPIs for throughput? If No then kindly provide alternative recommendation with logical reasoning.*

Q.4: *Rural & Urban areas have been considered the same in terms of Service provisioning. This means that the rules for allocation of radio communication sources remain the same for urban or rural regions. The throughput rates would only change due to the presence of active UE. Do you agree with this approach? If No then kindly provide alternative.*

Q.5: *GPRS networks do not guarantee QoS during mobility. Do we need to categorize GPRS networks during based on their throughput performance during mobility?*

Q.6: *Based on your experience, is the grading of networks from Excellent to unsatisfactory in terms of throughput according to your expectations from a service provider network?*

Q.7: *There may be many other parameters on which to distinguish GPRS networks ranging from higher layer performances to physical layer protocols. Is there any other KPI which should be tested for categorizing performance of individual network? (Your suggestion must be inline with the methodology detailed at section 3 of the document)*

Q.8: *3 separate ways of testing the KPIs have been recommended. Which one do you prefer, why and kindly suggest any other testing method, tool etc for this purpose.*

Apart from above, you are encouraged to provide any other valid comment, suggestion or argument on the document at

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