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Technical Report

3rd Generation Partnership Project;
Technical Specification Group GSM/EDGE;
Radio Access Network;
GERAN Study on Mobile Data Applications;
(Release 1~~1~~2)

GLOBAL SYSTEM FOR
MOBILE COMMUNICATIONS

A GLOBAL INITIATIVE

Keywords

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Contents

Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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x the first digit:

1 presented to TSG for information;

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

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Introduction

The present document captures the results of the feasibility study on Mobile data applications for GERAN.

1 Scope

The present document contains the results from the feasibility study on efficient support of mobile data applications for human communications in GERAN.

The following aspects shall be covered in the study:

- Analysis on relevant traffic profiles from GERAN perspective for the mobile data applications of human communications

- Analysis on the impacts on GERAN network based on the identified traffic profiles

- GERAN enhancements to alleviate these impacts with regards to: Radio resource utilization; signalling procedures; RR states and transition between them and Battery lifetime

- Common assumptions on simulations and evaluations for candidate solutions

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TR 41.001: "GSM Release specifications".

[3] 3GPP TR 22.801: "Study on non-MTC Mobile Data Applications impacts".

[4] 3GPP TR 43.868: “GERAN Improvements for Machine-type Communications”.

[5] 3GPP TR30.03U: “Selection procedures for the choice of radio transmission technologies of the UMTS”.

[6] Anderlind Erik and Jens Zander " A Traffic Model for Non-Real-Time Data Users in a Wireless Radio Network" IEEE Communications letters. Vol 1 No. 2 March 1997.

[7] Miltiades E et al. “A multiuser descriptive traffic source model” IEEE Transactions on communications, vol 44 no 10, October 1996.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

example: text used to clarify abstract rules by applying them literally.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

<symbol> <Explanation>

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

GERANEMDA	GERAN Enhancements for Mobile Data Applications
HTTP	Hypertext Transfer Protocol
IM	Instant Message
MDA	Mobile Data Applications
MS	Mobile Station
WAP	Wireless Application Protocol
UDD	Unconstrained Delay Data bearer service

4 Objectives

4.1 General

The general objectives of this study is to make the GERAN network better suited for mobile data applications used on multi-tasking capable mobile stations, e.g. IM chatting, HTTP/WAP browsing services (including streaming), social network services, etc , this study aims to consider the following objectives:

- Study and identify the relevant traffic profiles from GERAN perspective for the mobile data application of human communication, e.g. IM chatting, HTTP/WAP browsing (including streaming), social network service, etc.
- Study the impact on GERAN network based on the identified traffic profiles.
- Study enhancements to alleviate the impacts from these traffic patterns on the current GERAN networks (if any)

4.2 Performance Objectives

The candidate enhancements aiming at alleviating the identified impacts should consider the following performance objectives. When evaluating the candidate enhancements, the relative performance gains should be evaluated by comparing to the reference scenario for which the common assumptions are described in section 6.

- Improve radio resource utilization
- Reduce signalling procedures
- Minimize the impact on RR states and reduce the transition between them
- Reduce the impact on battery lifetime

[Editor's note: the measurement metric on mobile battery life should be simple and easy for solution evaluation and detailed metric for MS battery life is FFS.]

4.3 Compatibility Objectives

The candidate enhancements aiming at solving the identified problems should consider the following compatibility objectives:

- Avoid impacts on existing BTS and BSC hardware:
  - This will enable use of already existing hardware and only require a software upgrade.
- Be based on the existing network architecture and minimal impact on core network:
  - This will enable an operator to re-use existing network nodes.
- Minimize the impacts on mobile station.

5 Analysis on mobile data applications and their impacts on GERAN system

5.1 General

In recent years, mobile networks have experienced a significant increase of mobile data. Diverse mobile applications are introduced by machine type communication and human type communication. The increase of mobile data has introduced new challenges to mobile networks.

As the usage and range of applications used today for human communication, the total amount of related traffic and signalling is increasing significantly, the transitions of RR states may happen frequently, and the mobile battery life may also be impacted.

Sub-section 5 captures the study on the traffic characters for the relevant mobile data applications with considering the use cases in TR22.801 [3] under SA1 study item- MODAI, and analyzes the impacts on GERAN system.

5.2 Use case

5.2.1 Frequent Small Packet Transmission

5.2.1.1 Description and Analysis

As described in sec 5.1 in TR22.801 [3], a typical character of a lot of popular mobile applications is production of frequent small packets which is different comparing legacy Web browsing service. And the trend of small packets is expected to be exacerbated as status messages, location messages, instant messages, and keep alives etc.

One typical small packet application is IM because IM produces a lot of small packets and the interval between two packet bursts is short. A traffic model in section 6.3.2 describes the traffic characteristics analyzed for IM application.

OSAP [1] [2], Hybrid Packet Channel [3], ePRACH [4] [5] and related contributions [6] [7] are provided based on the IM + Web traffic models in sec 6.3.2 and 6.3.3, there is no consensus made on if any solutions are needed.

~~*[Editor's note: This section provides the description and the analysis on the traffic profile and impacts on GERAN system of relevant mobile data application.*~~

5.2.1.2 Aspects of required improvements

Based on the IM + Web traffic models in sec 6.3.2 and 6.3.3 and based on the simulation assumptions in sec 6.1 as studied in [1][2][3][4][5][6][7], it is concluded that no further enhancements are needed on CCCH.

[Editor's note: This section provides the analysis on the impacts on GERAN system and aspects required improvements.]

5.2.1.3 References

[1] GP-120623, Optimized System Access Procedure, Ericsson, ST-Ericsson, GERAN#54

[2] GP-120624, Detailed OSAP Signalling Procedures, Ericsson, ST-Ericsson, GERAN#54

[3] GP-130190, Performance Comparison between HPCH, IPA and Extended CCCH, Nokia Siemens Networks, GERAN#57.

[4] GP-121331, Fast TBF Re-establishment Simulations, Renesas Mobile Europe Ltd, GERANP#56

[5] GP-130143, pCR to 43.802 – Radio Resource Management and Fast TBF Re-establishment, Renesas Mobile Europe Ltd, GERANP#57

[6] GP-130153, Discussion on the impacts of OSAP, Huawei Technologies Co., Ltd. GERANP#57

[7] GP-130154, The Comparison between EPRACH and IPA, Huawei Technologies Co., Ltd. GERAN#57

5.2.2 <Use case 2>

5.3 Conclusion for analysis

Based on the IM + Web traffic models in sec 6.3.2 and 6.3.3 and based on the simulation assumptions in sec 6.1 as studied in [1][2][3][4][5][6][7], it is concluded that no further enhancements are needed on CCCH.

6 Common assumptions

6.1 Simulation assumptions

6.1.1 General

This section defines the reference scenario and parameters required for the simulations. The simulation assumptions in this study exclude the function, which means the BSC is not aware of the service or application type. And evaluation of CS service on the TCH and SDCCH is not required under this study. The simulator methodology and the simulation parameters shall be aligned with those defined in section 6.2.1 and 6.2.2 in TR 43.868 [4] for SIMTC study, except those explicitly listed in the following sections.

6.1.2 Simulator methodology

In order to evaluate the impacts introduced by the mobile data applications, a reference network scenario should be defined for GERANEMDA study. Moreover, the reference network scenario allows for the comparison of relative performance gains in regard to this scenario and it is needed for the evaluation of any enhancements studied as part of GERANEMDA and possibly also for the objective setting of GERANEMDA.

It should be noted that the reference network scenario does not include any Rel-7 (e.g. EGPRS-2, LATRED and etc.) or later (e.g. DTR) features. But it is not intended to exclude these features from GERANEMDA studies. On the contrary, the relevant Rel-7 and later features should be studied if similar enhancements are proposed. It is useful for GERANEMDA study to compare the performance of the network against the proposed reference network scenario.

Simulation parameters for the reference network scenario are defined in section 6.1.3.

6.1.3 Simulation Parameters

This section defines the parameters required for the simulations which may be required to conduct the study. The parameters are referenced where appropriate.

Table 1. Network level simulator parameters

Parameter		Value	Unit	Comment
Sectors per site		3		
Sector antenna pattern		65° deg H-plane, max TX gain 15	dBi	18 dBi antennas in 900-band are large and not considered to be common in urban areas.
Path loss model		Per 30.03, Hb = 5 m,	dB	In urban areas, 5 m over average roof height is considered more typical than the default value of 15 m in 30.03.
Minimum coupling loss		64	dB	1800: TR 25.942 2 GHz. 900: assumed 6 dB lower
Interference model		Neighbouring cells BCCH		The neighbouring cells according to the BCCH frequency reuse pattern are modelled as if they have full traffic.
Log-normal fading	Standard deviation	8	dB	
	Correlation distance	110	M	
Channel propagation		See table 4		
Output power - MS - BTS		 33 43	dBm	Excluding backoff
Backoff - MS		 6	 dB	
- BTS		4	dB	8PSK modulation assumed.
Noise figure - MS		 10	 dB	
- BTS		8	dB	
Inter-site log-normal correlation coefficient		0		Low correlation in urban scenarios.

Table 2. Network scenario

Parameter	Value	Unit	Comment
Frequency band	900	MHz	
Cell radius	500	m	
Bandwidth	4.2	MHz	
Number of frequency channels	21		
BCCH frequency reuse	4/12		
TCH frequency reuse	3/9		
BCCH or TCH under interest	BCCH and TCH		No power control and no frequency hopping on both BCCH carrier and TCH carrier

Table 3. Protocol level parameters

Parameter	Value	Comment
CCCH assumptions • Tx-integer • S • Max. retrans (M) • T3142 • T3146	 20 109 4 5 sec. (Tx+2S)/217=1.1 sec.	These default values shall be included among those evalutated. See 3GPP TS 44.018 for implementation details
BCCH configuration	Non-combined	
# PDCHs	8	Number of PDCHS availabale data traffic. 4 PDCHs are allocated on BCCH carrier, and 4 PDCHs are allocated on the TCH carrier.
# AGCHs per 51-multiframe	6	
PDCH Resource Assignment	MS multislot class 12 (BTTI)	
Link adaptation	Enabled	
Service type	1. EGPRS	
RLC mode of operation	Acknowledged Mode (AM)	

Table 4. Link specific settings.

Parameter	Value	Comment
Channel profile	TU3	
Receiver type UL	MRC	
Incremental redundancy	Enabled	

LLC PDU life time is a simulation parameter which defines the maximum time a downlink LLC PDU can be buffered. This simulation parameter should be reported with any other parameters not listed in this section and used in simulations.

6.2 Evaluation requirements

6.2.1 General

In order to evaluate the impacts on GERAN network and compare the GERAN network performance of different enhancements for different traffic profiles, network metrics and service metrics should be used to measure GERAN network performance. The network performance metrics are required and common for all traffic models, while service performance metrics are defined for each relevant traffic model separately.

6.2.2 Network Metrics

Following network metrics are used to measure the network performance.

- **Data load** – defines how much PDCH resources have been utilized for data transmissions during a simulation in average in each direction. The transmissions include blocks on PDTCH and PACCH. The formula bellow defines the data load per the direction.

$$Data\ load\ [\%] = \frac{DataBLK_{Tx}}{DataBLK_{Total}}$$

Where $DataBLK_{Tx}$ is the number of BTTI blocks transmitted during the simulation and $DataBLK_{Total}$ is the number of all available BTTI blocks. $DataBLK_{Tx}$ counts all transmitted BTTI blocks on PDCH, i.e. all blocks transmitted on PDTCH and PACCH including dummy blocks. $DataBLK_{Total}$ can be computed from the simulation time T measured in seconds and N_{PDCH}, which is the number of PDCHs available for data traffic (i.e. dedicated to PS traffic).

$$DataBLK_{Total} = \frac{N_{PDCH} * T}{0.02\ s}$$

It should be noted that the equations above express the data load in the downlink direction only. The same equations can be used to calculate the data load in the uplink in which case the number of blocks received by the network is used.

- **Control load** – defines how much of system resources have been utilized for signalling on AGCH and PCH during a simulation.

$$Control\ load\ [\%] = \frac{ControlBLK_{Tx}}{ControlBLK_{Total}}$$

Where $ControlBLK_{Tx}$ is the number of control blocks transmitted during the simulation, excluding L2 fill frames and paging blocks with no MS identity, and $ControlBLK_{Total}$ is the number of all available AGCH and PCH blocks. If (preventive) repetitions of immediate assignment messages and repeated paging requests are simulated then those messages should be counted in the control load. $ControlBLK_{Total}$ can be computed for the proposed network configuration in section 6.1.3 as follows

$$ControlBLK_{Total} = \frac{9 * 26}{6.12\ s} * T$$

Because of the multislot structure on CCCH, it is better to define the total number of AGCH/PCH blocks per the superframe lasting 6.12 s.

- **Offered load –** is the data arrival rate to LLC buffers, i.e. the amount of data generated by traffic models. This metric represents a load on the network and can be reported in kbps per cell. The offered load can be reported for uplink and downlink separately. (Please note that the data load is defined per direction). The offered load is frequently used in plots of other metrics as an independent variable on the x-axis.

$$Offered\ load_{Cell}\ [kbps] = \frac{LLC\ Data_{Generated}}{T}$$

- **LLC throughput per cell** – is a measure of the amount of LLC data in octets transmitted in a cell over a simulation in the uplink respectively downlink direction. It does not take into the account retransmissions or signalling at RLC.

$$LLC\ throughput_{Cell}\ [\text{kbps}] = \frac{LLC\ data_{Tx}}{T}$$

6.2.3 Service metrics

Following service metrics are used in estimations of user experience and satisfaction with the service according to relevant traffic model.

IM model

- **Message transmission delay** – in MO case it is the time measured from the message generated at the mobile to the reception of this message at the BSC, and in MT case it is the time measured from the message arrival at the BSC to the reception of this message at the mobile.

- **Loss of login message –** is the ratio between number of lost/blocked login messages and total arrived login messages at the mobile station.

- **Loss of ordinary message –**in MO case it is the ratio between number of lost/blocked messages and total arrived messages at the mobile, and in MT case, it is the ratio between number of lost/blocked messages and total arrived messages at the BSC.

Web browsing model

- **Packet call throughput** – is a measurement of throughput experienced by the user during a packet call in uplink and downlink direction respectively. The packet call size is the amount of the LLC data transmitted during a packet call. The packet call duration is the sum of the time used for transmitting each message measured from the arrival of this message at the mobile/BSC until the reception of this message at the BSC/mobile in the MO/MT case respectively.

$$PC\ throughput\ [kbps] = \frac{packet\ call\ size}{packet\ call\ duration}$$

[Editor's note: Other metrics for Web browsing is FFS.]

6.2.4 Evaluation methodology

The Instant Messaging traffic model in section 6.3.2 gives that a session consists of an average of 15 messages and the average message inter arrival time is 20 s. Hence the average length of a session in time would ideally be 15*20 = 300 seconds. Hence it will take that long time approximately from the time instance the simulation starts until the total number of users in the system has saturated, see Figure 1. It is proposed that for all evaluations, no metrics should be started until this time has elapsed from the simulation start, depicted as t1 in Figure 1.

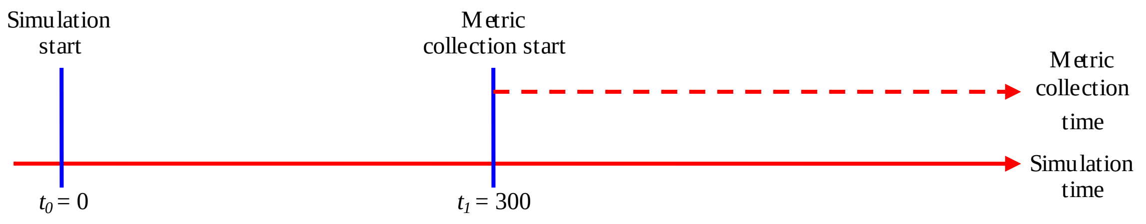


Figure 1 Metric collection methodology

6.3 Traffic model

6.3.1 General

Both single traffic scenario and mixed traffic scenario should be studied. The following traffic scenarios provide the primary focus for the evaluations. Performance evaluation of any enhancements under mixed traffic scenario is required.

Table 5: Single traffic scenarios

Label	Traffic Scenario	Description
A)	Instant Messaging	Analysis and traffic model parameters see section 6.3.2.
B)	Web Browsing	Analysis and traffic model parameters see section 6.3.3. No need to evaluate this single traffic scenario in this

		study.

Table 6: Mixed traffic scenarios

Label	Traffic Scenario	Description
S1	A + B	Instant Messaging + Web Browsing

[Editor's note: more traffic scenarios may be included if required in this study.]

6.3.2 A) Instant Messaging

Instant messaging traffic comprises a mix of user plane packets conveying the text data, along with application layer and/or transport layer protocol signalling to verify message delivery status. Some instant messaging applications may also display keep-alive behaviours.

This section describes an analytical IM traffic model loosely based on the network statistic data in Annex A.1. It describes a simple IM session, considering only login/logout, normal messages and keep-alive traffic.

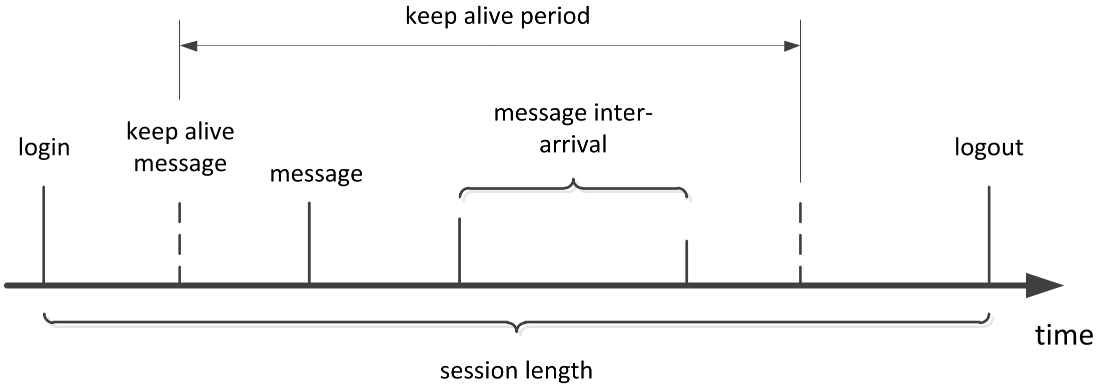


Figure 2 IM session structure

Error! Reference source not found.~~Figure~~ 2 shows an overall structure of one IM session. In the beginning, the IM application logs in to a server. Then the user types messages or receives messages from the server (other user) with randomly distributed length and message inter arrival time. At the same time, the application sends keep alive messages to the server at regular intervals no matter the user sends other messages or not. The server replies with ack and status of user's buddies. At session end, the application sends log out request to the server, which is acknowledged.

Retransmission of the lost or blocked application message is not considered. If the login message is lost or blocked, the whole session is considered to be failed/dropped, and if the logout message is lost or blocked, the session is considered to be ended. If one keep alive message irrespective the UL part or the DL part is lost or blocked, the whole session is considered to be failed/dropped.

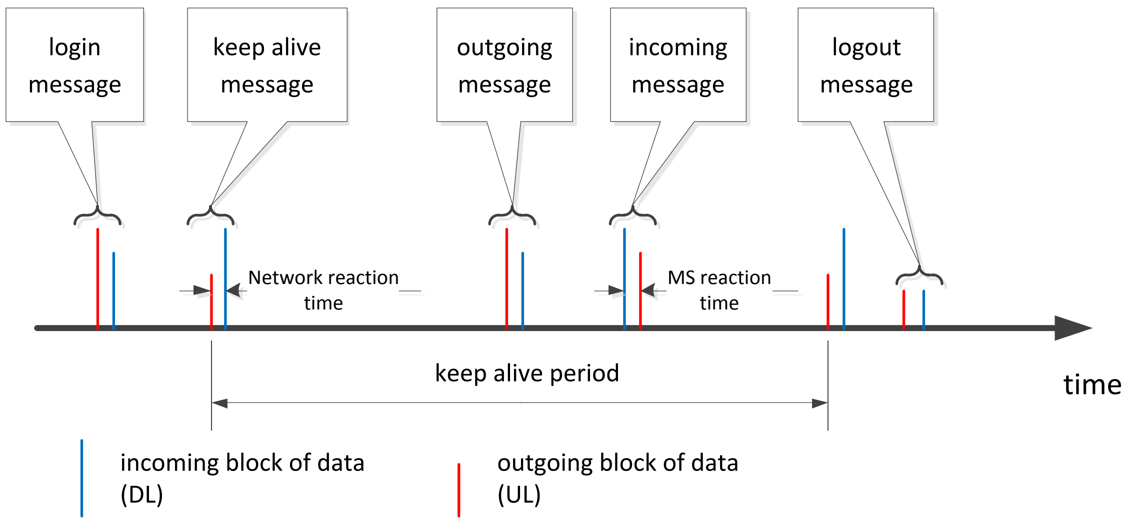


Figure 3 Packet structure in an IM session

Error! Reference source not found. Figure 3 shows that messages, keep alive messages and login/logout messages consist of blocks of data in DL and UL. Both keep alive messages and login/logout messages are mobile originated type. Blocks are then split on RLC layer into packets, creating short bursts of data. Individual packets on TCP or any higher layer are not modelled explicitly. The size of data blocks, message interarrival time and the split between outgoing (MO) and incoming (MT) messages is randomly generated according to parameters in Table 7Table 7.

Table 7. IM traffic generator parameters

Parameter	Distribution type	Mean value	Comment
Session arrival	Poisson	5/s, 10/s, 20/s	
Session length	geom	15 messages	cut off: 40 messages
Keep alive period	const	180 s	
Message interarrival time	negExp	20 s	cut off: 50s Note 1
MO message size – DL part	const	139 Byte	
MO message size – UL part	Pareto	75.3 Byte	α=1.476, k=24.3 cut off: 200Byte Note 2
MT message size – DL part	Pareto	-	α=0.529, k=20.4 cut off: 900Byte Note 2
MT message size – UL part	const	62 Byte	
Keep alive message size DL part	const	318 Byte	Note 3
– UL part	const	282 Byte	Note 3
Outgoing/incoming message split	uniform	50/50	
Login message DL part	const	1873 Byte	
– UL part	const	2056 Byte	Note 4
Logout message DL part	const	201 Byte	
– UL part	const	201 Byte	
MS reaction time	const	20 ms	
Network reaction time	const	100 ms	

Note 1: Mean value selected for this simulation meets the curve of Packet Inter arrival of time CDF (DL&UL) Figure A.1 in Annex A.1. Truncated exponential distribution is used, i.e. if the generated value for the interarrival time is greater than the cut off, subtract cut off from it and repeat until the value is less or equal to the cut off.

Note 2: Mean value, α value and k value for UL and DL selected for this simulation meet the curve of Packet size CDF in UL and DL respectively in Figure A.3 in Annex A.4.

Note 3: The size of keep alive messages has been derived from the 5 min idle traffic in the table A.1 in Annex A.1, row 22. It assumed, that only two keep alive messages were exchanged (with period 3 min, there could be 2 keep alive transmissions and corresponding responses from the server).

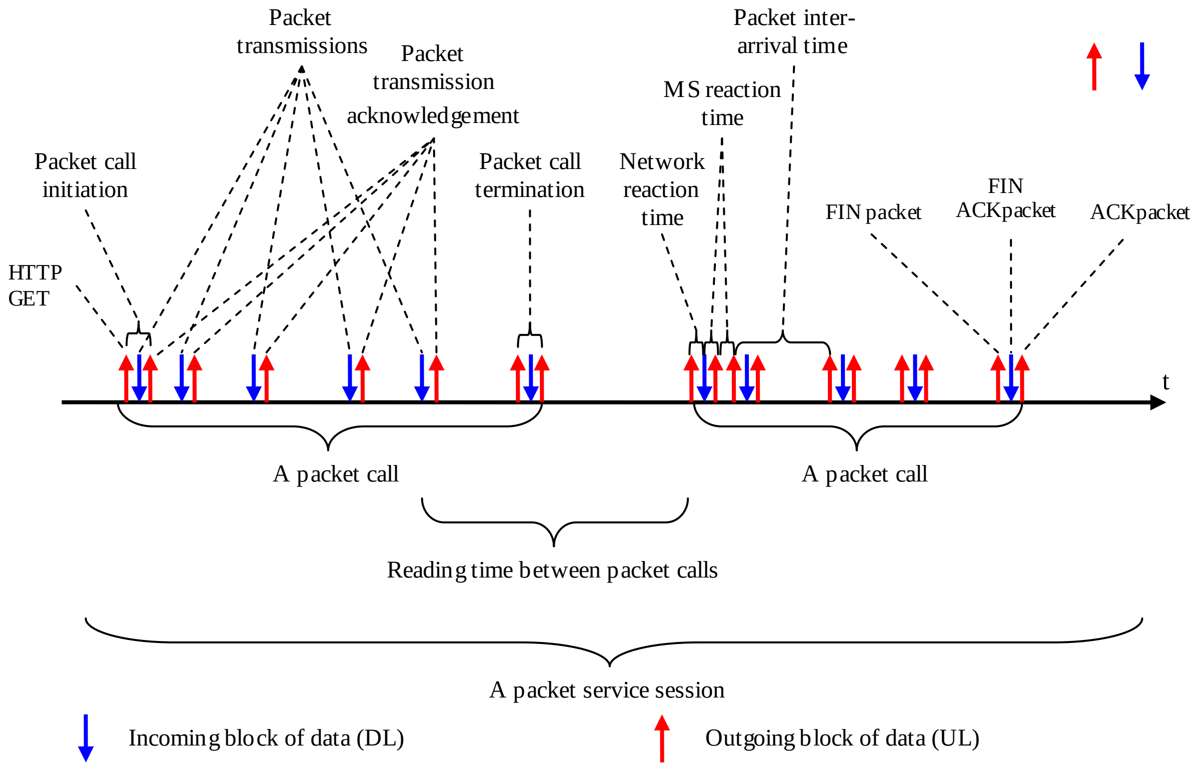
Note 4: The maximum number of information octets in LLC frame equal to 1520 is used. The generated messages should be segmented using this limitation, if the message size exceeds this value. The segments should be transmitted continuously with no interval between any two continuous segments.

The distribution types have been partially taken from WWW traffic model [5], section. B.1.2.2 (negative exponential distribution instead of geometric) and the distribution means and fixed message sizes are from IM traffic analysis in Annex A.1. The message sizes listed in Table 7~~Table 7~~ represent the amount of data at the LLC layer.

[Editor's note: parameters in Table 7 may be optimised to fit the mobile IM application.]

6.3.3 B) Web Browsing

A WWW browsing traffic model in [5] is used and described as follows in this study. Figure 4 depicts a typical WWW browsing **session**, which consists of a sequence of **packet calls**. We only consider the packets from a source which may be at either end of the link but not simultaneously. The user initiates a packet call when requesting an information entity. During a packet call several **packets** may be generated, which means that the packet call constitutes of a bursty sequence of packets, see [6] and [7]. After receiving its last packet in a packet call the MS should wait for T_fin period before terminating the packet call. It is very important to take this phenomenon into account in the traffic model. The burstyness during the packet call is a characteristic feature of packet transmission in the fixed network.



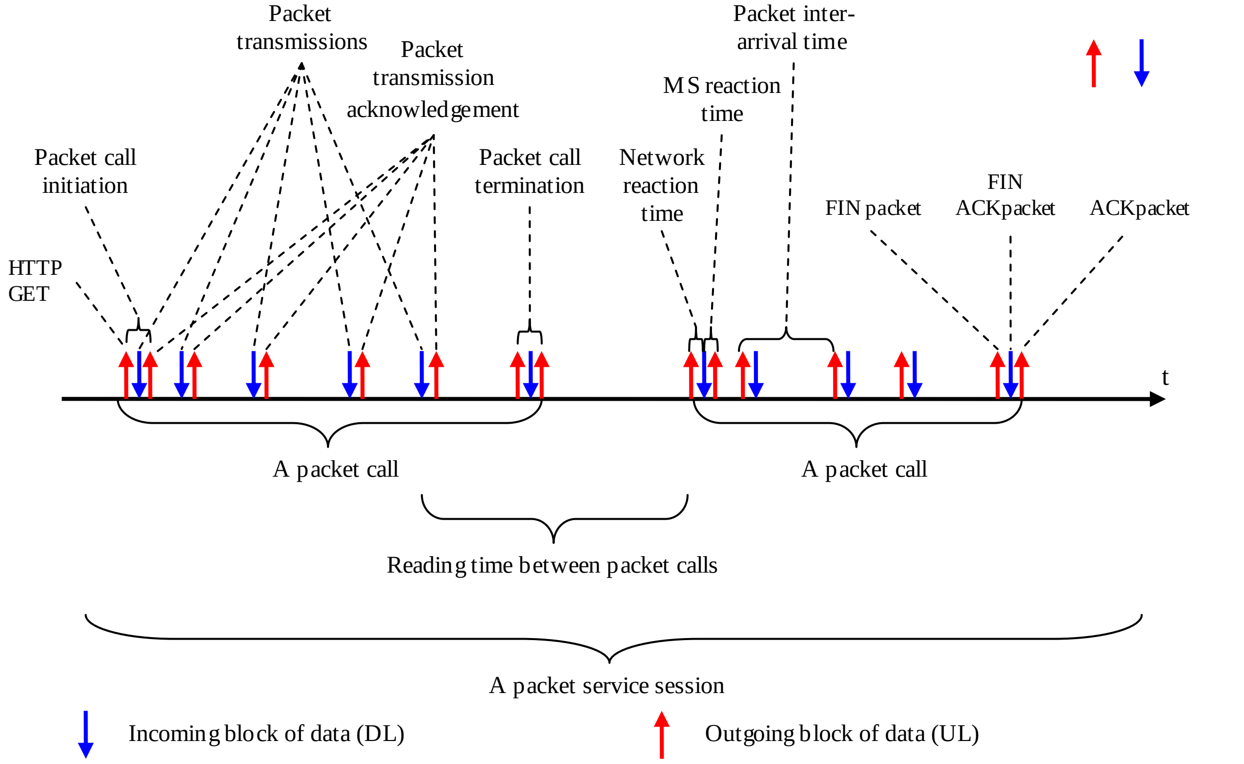


Figure 4 Typical characteristic of a packet service session.

A packet service session contains one or several packet calls depending on the application. For example in a WWW browsing session a packet call corresponds the downloading of a WWW document. After the document is entirely arrived to the terminal, the user is consuming certain amount of time for studying the information. This time interval is called **reading time**. It is also possible that the session contains only one packet call. In fact this is the case for a file transfer (FTP). Hence, the following must be modelled in order to catch the typical behaviour described in Figure 4.

- Session arrival process
- Number of packet calls per session
- Reading time between packet calls
- Number of packets within a packet call
- Inter arrival time between packets (within a packet call)
- Size of a packet
- Size of Http GET packet, Ack packet, Ack packet, and FIN-ACK packet respectively
- Timer T_fin indicating the waiting period before MS terminating the packet call

Note that the session length is modelled implicitly by the number of events during the session. And Table 8 shows the parameters for the traffic model of WWW browsing UDD 32 kbit/s.

Table 8 WWW browsing traffic model

Parameter	Distribution type	Parameter value	Comment
Session arrivals	Poisson	Mean: 5/hr	
Number of packet calls in session	Geometric	Mean 5	Max: 15
Reading time between packet calls	Geometric	Mean: 425s	Cut off: 600s
Number of packet in a packet call	Geometric	Mean: 25	Cut off: 40
Packet size:	Pareto	Mean: 480Byte	alpha = 1.1, k = 81.5 Cut off: 66666 Byte
Packet inter-arrival time	Geometric	Mean: 0.125s	Cut off: 0.5s
Http GET	Constant	350Byte	
Ack packet	Constant	66 Byte	
FIN packet	constant	66Byte	
FIN-ACK packet	constant	66Byte	
T_fin	constant	6s	
MS reaction time	const	20 ms	
Network reaction time	const	100 ms	

[Editor's note: parameters in Table 8 may be optimised to fit the mobile web browsing application.]

7 Recommended enhancements for GERAN system

7.1 Enhancement 1

7.1.1 Concept description

[Editor's note: This section clarifies problems solved by this enhancement and describes the detailed concept and mechanism of the candidate enhancement to efficiently support the mobile data application in GERAN.]

7.1.2 Performance gains

[Editor's note: This section describes performance gains of the candidate enhancement for GERAN.]

7.1.3 Impacts to GERAN system

7.1.3.1 Impacts to the Mobile Station

[Editor's note: This section identifies the impacts on Mobile Station resulting from the functional enhancements.]

7.1.3.2 Impacts to the BSS

[Editor's note: This section identifies the impacts on BSS resulting from the functional enhancements.]

7.1.3.3 Impacts to the specification

[Editor's note: This section identifies the impacts on GERAN specifications resulting from functional enhancements.]

7.2 <Enhancement 2>

8 Summary and conclusions

Annex A: Network trace and statistic information

Network trace and statistic information are shown as following.

A.1 Network Data for IM application

Statistics of Mobile QQ chatting application from real network:

Table A.1: network data statictic for Mobile QQ

No	Actions	LLC traffic UL（byte）	RLC traffic UL（byte）	LLC traffic DL（byte）	RLC traffic DL（byte）
1	Log on	2056	2478	1873	2549
2	Add friends	310	449	342	651
3	Accept invitation	714	1093	774	1516
4	Delete friends	155	205	139	305
5	Be added as friends	155	244	139	305
6	Sending message(10 bytes)	280	263	294	527
7	Sending message(10 bytes)	195	285	139	301
8	Sending message(50 bytes)	275	367	139	267
9	Sending message(50 bytes)	275	367	139	301
10	Sending message(100 bytes)	371	491	139	305
11	Sending message(100 bytes)	371	491	139	305
12	receiving message(10 bytes)	62	82	117	581
13	receiving message(10 bytes)	62	82	125	522
14	receiving message(50 bytes)	62	82	205	663
15	receiving message(50 bytes)	68	123	205	331

16	receiving message(100 bytes)	62	82	309	786
17	receiving message(100 bytes)	62	82	309	616
18	Sending picture of 16Kbytes	20360	22605	2369	3059
21	Sending picture of 18Kbytes	967	1394	1205	1671
19	Sending picture of 20Kbytes	24943	27645	2877	3871
20	Sending picture of 24Kbytes	29174	32189	2555	3498
22	Idle test for 5 minutes	564	856	636	1411
23	Log out	201	287	201	425
24	Re Log on	913	1299	990	1438
27	Check friends' profile	5726	6591	10422	11932
28	Check friends' profile	5194	6223	9778	11147

Following are the traces statistics of corresponding instant message applications (Mobile QQ), which is a typical and popular application in China.

- The trace data are observed and captured on Gb interface in EDGE/GPRS network
- Mobile QQ application is based on TCP protocol, and the packet size do not include the TCP header
- The captured packets include the background packet (e.g. heart beat packet) and active (chatty) packet. So our trace statistics can reflect the characteristics of the whole traffic.
- The trace data are collected from more than two hundred cells and thousands of MSs using mobile QQ application. Hence, the OS of the MSs are possibly different, including e.g Android, iOS and Symbian.

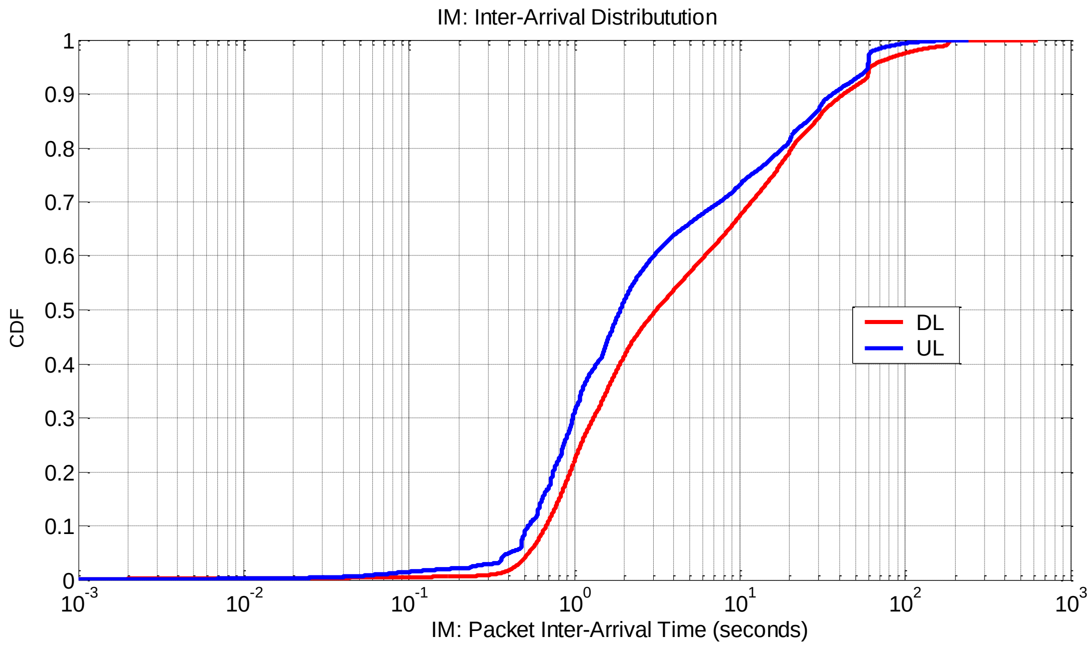


Figure A.1. IM Traffic (Mobile QQ) - Packet Inter arrival of time CDF (DL&UL)

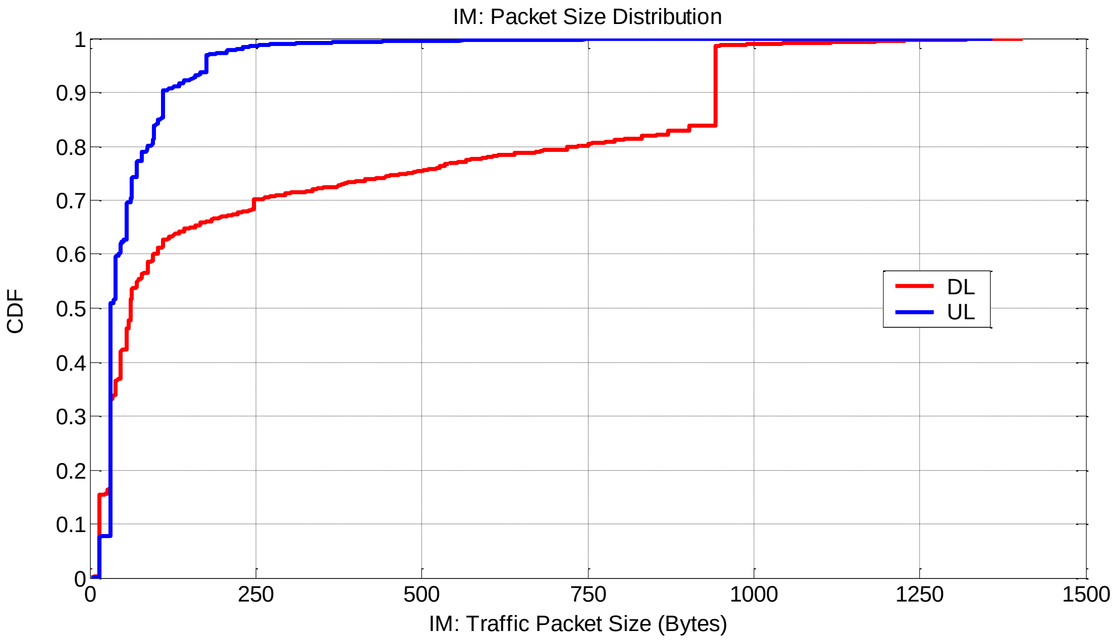


Figure A.2. IM Traffic (Mobile QQ) - Packet size CDF (UL&UL)

Figure A.3 and Figure A.4 show the uplink and downlink original data (Shantou region in China), fitted total cumulative distribution function for the packet size, respectively.

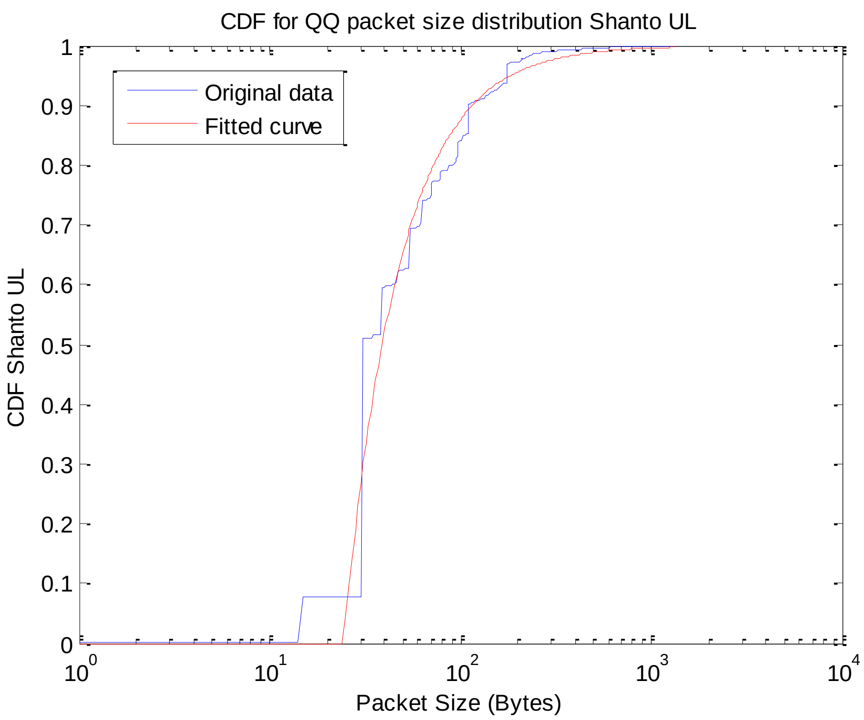


Figure A.3 Original and fitted CDF for uplink QQ packet size, Shantou.

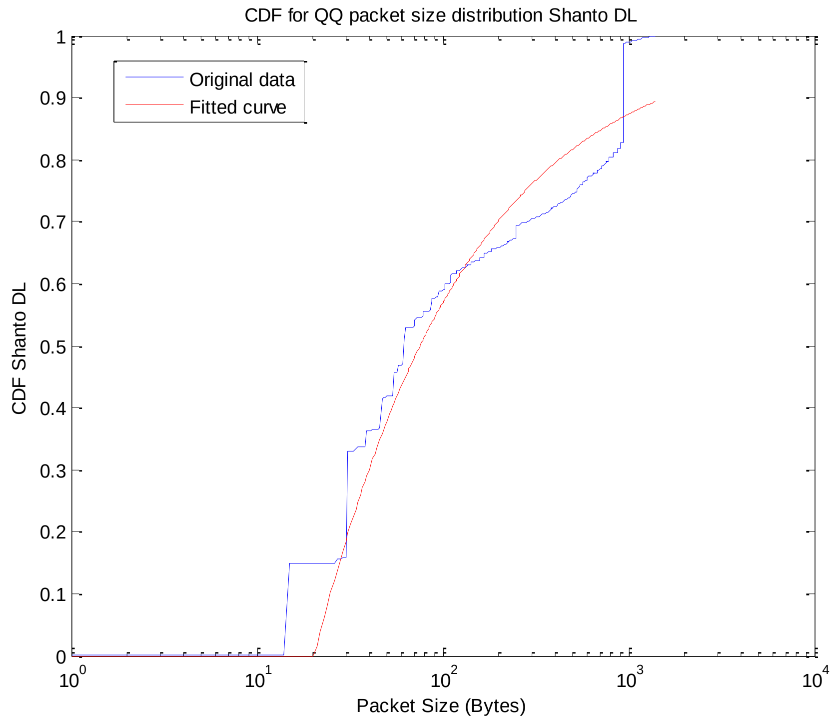


Figure A.4 Original and fitted CDF for downlink QQ packet size, Shantou.

Annex B: Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2011-09	GP#51	GP-111140			Draft Skeleton TR for review		0.0.1
2011-09	GP#51	GP-111346			Updated with comments received at GP#51 meeting		0.1.0
2011-10	Telco#1				Editorial corrections before telco#1	0.1.0	0.1.1
2011-10	Telco#2				Updated by adding clarification on relation to SIRIG and on reference scenario	0.1.1	0.1.2
2011-11	GP#52	GP-111666			Updated to modify the structure for traffic model and simulation assumption	0.1.2	0.2.0
2012-02	GP#53	GP-120121			Updated to include the agreed traffic models and simulation assumptions	0.2.0	0.3.0
2012-02	GP#53	GP-120330			Updated to include the agreed parameters for traffic model	0.3.0	0.3.1
2012-02	GP#53	GP-120446			Clarifications are added for evaluation metrics.	0.3.1	0.3.2
2012-05	GP#54	GP-120559			Updated with the agreed parameters and metrics for IM and web browsing model	0.3.2	0.3.3
2012-05	GP#54	GP-120746			Updated with the agreed parameters for IM and web browsing model.	0.3.3	0.3.4
2012-05	GP#54	GP-120800			Editorial changes.	0.3.4	0.3.5
2012-05	GP#54	GP-120807			Editorial changes.	0.3.5	0.3.6
2012-08	GP#55	GP-120970			Updated with the agreed metric for web browsing model in Telco#4	0.3.6	0.3.7
2012-08	GP#55	GP-121100			Updated with the agreed parameters for web browsing model in GERAN#55	0.3.7	0.3.8
2013-03	GP#57	GP-130257			Updated with the conclusion on CCCH for IM + web model in GERAN#57	0.3.8	0.4.0