EUROPEAN COOPERATION
IN THE FIELD OF SCIENTIFIC
AND TECHNICAL RESEARCH

EURO-COST

COST 273 TD(03) .022...
Barcelona, Spain
2003/Jan/15-17

SOURCE: Department of Electromechanical Engineering,
University of Beira Interior,
Covilhã, Portugal

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Marco A. Clemente [1], Fernando J. Velez [1,2]

[1] Department of Electromechanical Engineering
University of Beira Interior
Calçada Fonte do Lameiro, 6201-001 Covilhã, Portugal

[2] Instituto de Telecomunicações (Lisboa), Instituto Superior Técnico
Av. Rovisco Pais, 1049-001 Lisboa, Portugal

Phone: + 351-275 329 919/58
Fax: + 351-275 329 972
Emails: marco_clemente@hotmail.com, fjv@ubi.pt

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Marco A. Clemente [1], Fernando J. Velez [1,2]
[1] Department of Electromechanical Engineering
University of Beira Interior
Calçada Fonte do Lameiro, 6201-001 Covilhã, Portugal
[2] Instituto de Telecomunicações (Lisboa), Instituto Superior Técnico
Av. Rovisco Pais, 1049-001 Lisboa, Portugal
marco_clemente@hotmail.com, fjv@ubi.pt

Abstract

A description of Enhanced UMTS (E-UMTS) characterisation parameters is presented, and a first assignment of parameter values for these services is proposed. Different points of view are compared for the classification of the mixture of applications, namely ITU-T I.211, UMTS Forum and 3GPP ones. Characterisation parameters includes among others data rate, tolerance to delay and error, busy hour call attempt and session duration.

I. INTRODUCTION

Enhanced-UMTS research within IST-SEACORN (Simulation of Enhanced UMTS access and Core Networks) will explore some ideas of HSDPA (high-speed downlink packet access) as a starting point to improve UMTS. The goal of E-UMTS is to get 8-10 Mb/s in both links, Fig.1, suppor-ting new applications with higher data rate, and giving the users more capacity. It will be introduced before fourth generation systems, hence E-UMTS is a 3.5G system.

In this paper, the available data about mobile applications characterisation parameters is put together, enabling some insight into new approaches of performance analysis in E-UMTS. In this context, parameters are divided into six different types: service, traffic, communications, session and activity, service components, and operation environments.

Different types of classification are presented in Section II. Section III describes characterisation parameters, while Section IV covers the range of variation of the parameters. Conclusions are drawn in Section V.

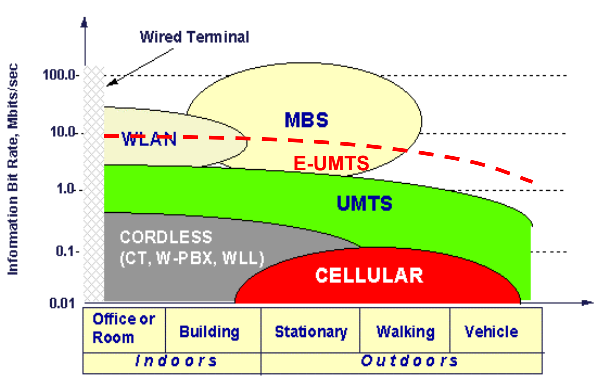

Fig. 1 – E-UMTS concept.

II. CLASSIFICATIONS

A. *ITU-T I.211 Classification*

An application is defined as a task that requires communication of one or more information streams, between two or more parties that are geographically separated, being characterized by the service attributes, and also by traffic and communications characteristics. A set of applications with similar characteristics, or a single application, can be classified as a service if they have a common set of characteristics. Applications and services can be divided into the following different groups: interactive (conversational, messaging, and retrieval) and distribution (broadcast, and cyclical) [1].

Interactive services are those in which there is a two-way exchange of information between two subscribers or a subscriber and a service provider. Includes three different categories: conversational, messaging and retrieval services.

- **Conversational services** provide bi-directional dialogue communication with bi-directional, real-time, end-to-end information transfer between two users or between a user and a service provider host. The flow of information may be bi-directional symmetric, bi-directional asymmetric and, in specific cases, unidirectional. Applications: Video-telephony, videoconference.
- **Messaging services** offer user-to-user communication between individual users with store and forward. They are not in real time. Applications: Video and voice mail.
- **Retrieval services** provide the user with the capability to retrieve information stored in information centres that, in general, is for public use. Applications: broadband retrieval services for film, audio information and archival information.

Distribution services are those whose information transfer is primarily one-way, from service provider to B-IDSN subscriber, including broadcast services, where the user has no control over the presentation of the information, and cyclical services, which allow the user some measure of presentation control.

- **Broadcast services** provide a continuous flow of information, distributed from a central source to an unlimited number of authorized receivers connected to the network. Each user can access this flow of information but has no control over it. Applications: broadcast of an electronic newspaper broadcast service.

- **Cyclical services** allow distributing information from a central source to a large number of users. The information is provided as a sequence of information entities with cyclical repetition. The user can control start and order of presentation. Applications: teletext, electronic newspaper using public networks.

B. 3GPP QoS classes

UMTS attempts to fulfil the Quality of Service, QoS, request from the application or the user, in order to reach this UMTS uses the following traffic classes [2]:

- Conversational (CONV)
- Streaming (STR)
- Interactive (INTR)
- Background (BACK)

The distinguishing factor of these classes is how delay-sensitive traffic is: the conversational class is the most delay-sensitive whereas background class is the less delay-sensitive.

Conversational class will be transmitted as a real- time connection. It is always performed between live end-users. This is the only type where the required characteristics are strictly imposed by human perception. The end-to-end delay is low (less than 400 ms) and the traffic is nearly symmetric. Some of its applications are speech service, video telephony and voice over IP.

Multimedia streaming is a technique for transferring data such that it can be processed as a steady continuous stream. In this way, the client browser can start displaying the data before the entire file has been transmitted. In this class, applications are very asymmetric, like web broadcast or video streaming on demand.

Interactive class is applied when the end-user (human or machine) is on line requesting data from remote equipment. It is characterized by the request response pattern of the end-user and the content of the packets must be transparently transferred (low bit error rate)

Examples of human interaction are: Web browsing, database retrieval, and server access. And examples of machine interaction with remote equipment: polling for measurement records and automatic data base enquiries.

Some of the interactive class applications are: location-based services, computer games.

Background class is more or less insensitive to delivery time. That is because the destination is not expecting the data within a certain time, so the delay can be from seconds to minutes. And applications, such as e-mail, SMS or downloading databases, can be delivered background since they do not require immediate action.

C. Relation between 3GPP and ITU-T I.211

Conversational class is the same in both classifications. There is a bi-directional dialogue between live end-users Multimedia streaming has to be with retrieval and broadcast classes. Information is given in a continuous flow or streaming.

Interactive class can be connected with almost every ITU-T class, except broadcast. User requests data from remote equipment.

Background class treats communications like mail interchange, while MM Streaming can be related with both retrieval and broadcast ITU-T classes Fig. 2.

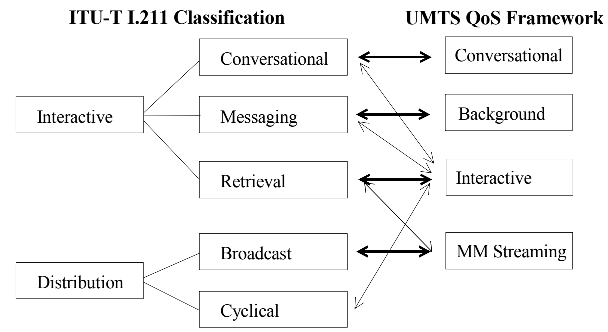

Fig. 2 - Correspondence between classes.

D. Market perspective

According to [3], services are the portfolio of choices offered by services providers to a user. Services are entities that services providers may choose to charge for separately. They will be a prime differentiate between services providers in the 3G environment. Users are likely to select their preferred 3G services providers based on the options available in that product portfolio. Different users will choose different service options. They may elect to subscribe to a personalized mobile portal offering banking facilities. They may later decide to add unified messaging. Such service options will affect the user's bill. The study presented in [3] identifies six-service categories represent the majority of the demand for 3G services over the next five years. The six service categories are defined determinedly from a user perspective and are intended to reflect the perception of the market. There is a compelling logic behind the six service categories that are illustrated in Fig. 3. A classification from the Market and QoS point of view is shown in Table 1.

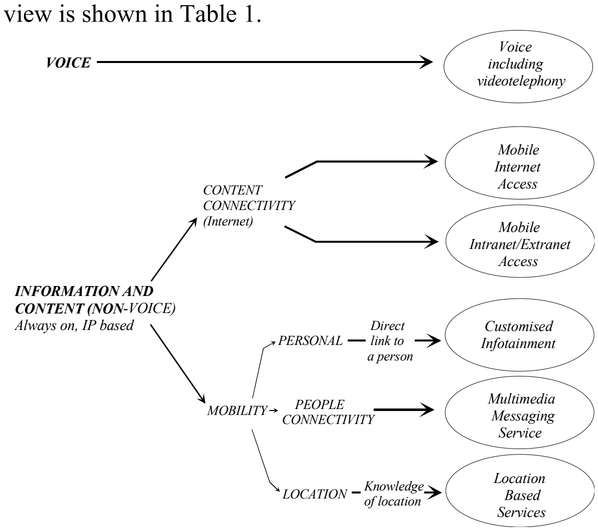

Fig. 3 - 3G services framework (market point of view).

Table 1: Correspondence between services and applications.

Service Hierarchies	Type of Information	Examples of Broadband Services	Examples of Applications	3G framework	
				Market	QoS
Interactive, Conversational	Sound	Sound	Voice	RV	CONV
			Voice over IP	RV	CONV
	Moving Pictures And Sound	Video-telephony	Various purposes	RV	CONV
		HD Video-telephony	Tele-education	RV	CONV
		HIMM Videoconference	Various purposes	RV	CONV
		Video-conference	Tele-advertising	CI	CONV
		Video Surveillance	Mobile Video Surveillance	MMS	CONV
	Data	High Volume File Transfer Service	Data File Transfer (FTP)	MIA	INTR
	Document (multimedia)	Mixed Document Communications Service	Desktop Multimedia	MIA	INTR
			Collaborative working	MIEA	CONV
			Mobile Tele-working	MIEA	CONV/INTR
		High-resolution Image Service	Interactive Remote Games	CI	CONV
			Still Images Communication	CI/MMS	INTR
Interactive, Messaging	Mixed Document	Multimedia Mail	Electronic Mailbox Service for Multimedia	MMS	BACK/ INTR
Interactive Services, Retrieval	Text, Data, Graphics, Sound, Still Images, Moving Pictures	Broadband Videotext	Audio Streaming	RV	STR
			E-commerce	MIA	STR
			Tourist Information	LBS	INTR
		Data Retrieval Service	Remote Procedure Call	MIEA	INTR
		Multimedia Retrieval Service	Urban Guidance	CI	INTR
			Mobile Portal (Content / commerce)	CI	INTR
			Assistance in Travel	LBS	INTR
Distribution, Broadcast	Moving Pictures and Sound	Video Distribution Service	Micro movies (including video clips)	CI	STR
Distribution, Cyclical	Text, Graphics, Sound & Still Images	Full Channel Broadcast Videography	E-newspaper	CI	INTR

MIA - Mobile Internet Access; MIEA - Mobile Intranet/Extranet Access; CI - Customised Infotainment; MMS - Multimedia Messaging Service; LBS - Location-Based Services; RV - Rich Voice.

III. CHARACTERIZATION PARAMETERS

Service parameters are necessary to characterize end-to-end services and their requirements from the underlying transport, as provided by UMTS Bearer Service and TE/MT Local Bearer service. They may easily become quite numerous, perhaps too numerous for many simulations. Therefore it could be useful to distinguish parameters into service, traffic, communication, service components (and activity model) and operation environments, Table 2. Details on service parameters are given in [4].

Services can be distinguished by the type of information that supports them, so that each of these types maps into a set of service components. Besides the service characteristics, the traffic and communications requirements, one also identifies the session and activity model and the service components (and their statistical behaviour). Another important aspect in the characterization of applications is the operation environment, from which, in the mobile domain, terminal mobility (characterized by the distribution of velocity and its average value) is of key relevance.

A. *Application description*

The description of services and applications is organized according to ITU-T I.211 Recommendation. A given application can be supported by different services, having as a consequence, different characteristics in terms of type of information (and service components that support them) and service characteristics [1].

ITU-T I.211 identifies the following types of information: sound, moving pictures or video, document (multimedia), data, text, graphics and still images. The classification of services in terms of I.211 Recommendation categories and types of information was done in [4], for a set of 16 applications operating in an 'E-UMTS alone' environment. Besi-des these applications, E-UMTS can support some UMTS specific ones, like voice, audio streaming, voice over IP, video clip transfer, or even others, with high foreseen demand, e.g., still image transfer, mobile portals or inter-active games. Their description follows, while ‘E-UMTS alone’ applications have already been described in [4], [5]:

Voice - usual mobile telephony.

Voice over IP - mobile telephony over IP.

Interactive remote games - multi-player interactive network games that include animation and live audio or video delivery. UMTS mobile phones have the advantage of allowing for updates, remote multi-player gaming [6].

Still images communication - exchange of still images.

Mobile Portal (for content / commerce) - it allows for having access to content and for shopping via the mobile terminal. In the case of shopping applications it will be like a Mega-market on the move [6].

Audio streaming - Access to music libraries where, as an alternative to CDs, music can be chosen and listen to on demand. While the user is listening to the music it is simple and easy to purchase the current song and download it to the mobile phone, generating impulse purchases.

Table 2: Characteristics of Enhanced UMTS applications.

Characteristics	Parameters
Service	• Intrinsic time dependency: time-based (TB) or non-time-based (NTB) • Delivery requirements: Real-time (RT) or Non Real-time (NRT) • Directionality: Unidirectional (Und) or Bi-directional (Bid) • Symmetry of the connection: Symmetric (Sym) or Asymmetric (Asy), and the respective ratio between the uplink (UL) and the downlink (DL) • Interactivity: existence or not • Number of parties: one-to-one (1-1), one-to-many (1-m) or multi-party (multi)
Traffic	• Generation process (Poisson or Bernoulli) and average generation rate • Distribution of the duration (i.i.d. – independent and identically distributed) • Average duration of connections • Transmission data rate • Latency/delay
Communications	• Burstiness • Class of service (constant, variable, available, unspecified bit rate, etc.) • Bit Error Rate, BER (FER, frame erasure ratio, is also used) • Communication protocol
Session and activity	• BHCA and inter-arrival time • Arrival distribution • Duration and its distribution • Average active/inactive time • Active/inactive time distributions
Service components	• Distribution of the generation process and generation rate (Poisson or Bernoulli) • Distribution of duration (e.g., i.i.d.) • Average duration • Number of times each component is accessed
Operation environments	• Framework: • Public – Business city centre, urban, road, public transports and commercial zones • Private – *Emergency dedicated*, *TV Broadcast dedicated, office dedicated* and *industry dedicated* • Nature of applications: Business or Familiar • Environment: Indoors (Ind), Outdoors (Outd) or Trains (TRA) • Mobility scenario: Static (ST), Pedestrian (PD), Urban (UB), Main Roads (MR) or Highways (HW) • Service provision: Public (PUB)/ Private (PRIV) • Deployment scenario – the set of applications operating simultaneously in the system, and their usage.

Micro movies (including video clips) - Micro cinema consists of a complete story told in a film of 5 min, produced for the small screen format [6].

In general, the requirements for supporting an application depend on both the intrinsic time dependency (time or non-time based) and delivery requirements (real or non-real time) of the application [7], Table 3.

Table 3: Time dependency versus delivery requirements.

Examples of applications	Real-time delivery	Non-real-time delivery
Time based information	Video conferencing telephony	Video clip transfer
Non-time-based	Image browsing	Electronic mail

B. Traffic Characteristics

On the one hand, it is important to characterize the generation process for applications:

Generation process - It describes the statistical distribution of session inter-arrivals. The most commonly used distribution is the exponential one.

Distribution of the duration - Duration refers to the average duration of a call, also named call holding time. If a negative exponential distribution is used to model call duration the parameter corresponds to the mean value $1/\mu$. Other distributions such as the lognormal are also used for this purpose [8].

Average duration of connections - It refers to the average duration of a connection, also named connection holding time.

On the other hand, it is important to describe accurately assumptions on latency/delay and channel hierarchy/ bandwidth, i.e., data rates.

Latency/end-to-end delay - Absolute delay is one of the key QoS performance parameters that must be satisfied by the broadband network [9]. In the context of service characterization, it is the maximum transfer time (in one way) that is tolerated by the service. To provide interactive response to viewers the response time between a user action and its effect should be less than 100 ms. By definition, latency requirements only apply to real-time applications [9], thus there is no latency requirement for non-real time ones, although one identifies the associated delay to a good QoS. At the application layer, the latency requirement arises from the human response time for different real-time applications. It translates into end-to-end packet latency (absolute delay) at the network layer. Such packet latency is the sum of processing delay, packetisation delay, transmission delay, queuing delay and propagation delay. For example, for image browsing applications, a full-screen photo image of 3 MB has 300 kB after JPEG (Joint Photograph Experts Group) compression [9]. This requires about 24 Mb/s link (peak) transmission rate to satisfy the response time requirements (about 100 ms end-to-end from the application level) [7]. However, this can be decreased with reduced image size, or high compression ratio, or relaxed response time to less than 10 Mb/s.

Data rate - It is important to define the average data rate associated with services. Only user plane data is considered for the average measured in [kb/s]. Specifying the average bandwidth requirement for a 'bursty' application is a challenge, because it varies according to the duration for which the average is taken. Furthermore, the values obtained vary widely across different users (such as the ones from image browsing), even for the same applications, because everyone has a unique usage pattern. The bandwidth requirement of an application (in each way) is typically specified in terms of peak and average bandwidth; for CBR applications, the peak and average bandwidth are the same. To support broadcast quality movies, a CBR MPEG-2 compressed stream requires 3 to 4 Mb/s; the bandwidth requirements can increase to 6 or even 9 Mb/s for real-time compression of live sports events, due to fast motion content. Since the amount of compressed information varies according to the content and instantaneous scene changes, compressed video is VBR in nature. The CBR MPEG-2 stream is created by traffic shaping, using a rate buffer and real-time adjustment of compression ratio (quantisation level) to maintain the buffer fullness without overflow or underflow.

C. Communications Characteristics

The communications characteristics consist of the burstiness, service classes, BER, and protocol.

Burstiness – it is defined as the ratio between the peak bit rate and the average bit rate [10], several types of communication being highly 'bursty' in nature. If this feature was adequately reflected in network design, namely in the stochastic characterization of service components, considerable economizing in network design should be achieved because of the associated statistical multiplexing gain. In the case of TV and HDTV distribution, the statistical multiplexing gain is hard to realize, because of the nature of the source signals, so burstiness is set to 1, corresponding to assuming codec smoothing.

Service Classes - To support broadband applications, and based on QoS parameters, three classes of services must be supported [7]:

Best-effort delivery – It is being addressed by the ATM Forum with the ABR class of service.

Real-time (RT) delivery of time-based information – It is the CBR or VBR with time requirements (bounds on delay variation). This can be supported by reserving peak bandwidth for each application over a QoS-based network.

Real-time delivery of non-time based information – It is probably the most challenging class of service to support, because it is 'bursty' and has an absolute delay requirement. Such unpredictability makes it very difficult to efficiently allocate bandwidth to support this class of services.

For non real-time (NRT) information, only best effort delivery is necessary, and information should be stored at the receiver. Low data rates are used, except in the cases when further resources are available. ISO and NISO stand for isochronous & non-isochronous traffic, respectively [1].

Bit error rate (BER) - It is a non-dimensional variable that expresses service tolerance to uncorrected errors in the bearer service, including non-delivered information. It is calculated as the ratio between bits received with error or omitted and the overall received bits. One can also define the frame erasure ratio, i.e., the fraction of lost or erroneous frames.

Communication Protocol - The most common communication protocols [11] are User Datagrama Protocol (UDP) and Transmission Control Protocol (TCP). The TCP protocol is a high-level protocol (session layer) that coordinates the transmission, reception and re-transmission of packets in a data network, to ensure reliable communication sessions. The TCP protocol coordinates the division of data information into packets, adds sequence and flow control information of packets. Besides, it coordinates the confirmation and retransmission of packets that are lost during a communication session. UDP is a high-level communication protocol that coordinates the one-way transmission of data in a packet data network. It coor-dinates the division of files or blocks of data information into packets and adds sequence information to the packets that are transmitted during a communication session using the Internet Protocol (IP) addressing. This allows for the receiving end to receive and re-sequence the packets in order to recreate the original data file or block of data (that was transmitted). UDP adds a small amount of overhead (control data) to each packet, relatively to other high-level protocols such as TCP. However, UDP does not provide any guarantees to data delivery through the network.

D. Session and Activity Model

Detailed parameters describe service behaviour in terms of traffic generation. Two levels of behaviour may be distinguished: call/session representing traffic generation process and activity models that describe how a session behaves in terms of idle and active periods.

Call and session related parameters are used to model the birth and death of calls and sessions. The term call usually refers to conversational services while session refers to data connections. Because model parameters for each type may be different it is useful to have different designations even though the concept is basically the same, since in E-UMTS both entities are similarly supported on PDP context establishment.

BHCA and Inter-arrival Time - BHCA (or busy hour call attempts) provides a measure of how many session initiation requests are produced during the busiest hour.

Arrival distribution, the **average duration** and **its distribution** were already defined as traffic parameters.

Activity models describe the relationship between periods of conversation or data exchange and silent periods in either direction, and are different depending on service types, and purpose of the model. A frequently used activity model for conversational services considers exponentially distributed activity and inactivity times. It must be noted that in general uplink and downlink parameter have different values.

Average Active Time - For each service there will be an average activity time in each direction, uplink and downlink. In conversational services this corresponds to "talk" periods. In interactive data services it corresponds to packet burst activity in one direction. Activity time is often modelled as exponential (continuous time) or geometric distribution (discrete time). Measured in [s].

Active Time Distribution - This parameter describes the statistical distribution of the activity time variable. The most commonly used distribution is the exponential one.

Average Inactive Time - In conversational services, inactivity time corresponds to "listen" or "silence" situation. In interactive data typically corresponds to "reading time". Uplink and downlink are highly correlated in both cases.It is usually modelled by the exponential distribution.

Inactive Time Distribution - This parameter describes the statistical distribution of the inactivity time variable. The most commonly used distribution is the exponential.

E. Service Components

If applications have access to more than one service component (sound, data and video) simultaneously, a simple activity/inactivity model is not enough, and a model for service components has to be defined for multi-service traffic engineering purposes.

However, there is lack of information about the stochastic characterization of applications in terms of the service components that will support them. In the RACE-MBS project there was a first attempt to characterize some applications [12]. Although the future broadband communications market will possibly support hundreds of applications simultaneously [7], the work performed started in the RACE-MBS [12] project, and presented in [13], has already identified some applications for the mobile domain, which are being considered as a starting point.

The final objective of this part of the study is to obtain a complete characterization of the service components for each application (e.g., average duration, and distribution of connections, or number of times service components are accessed).

The fundamental service components are audio, video and data, which in turn can be sub-divided, Fig. 4.

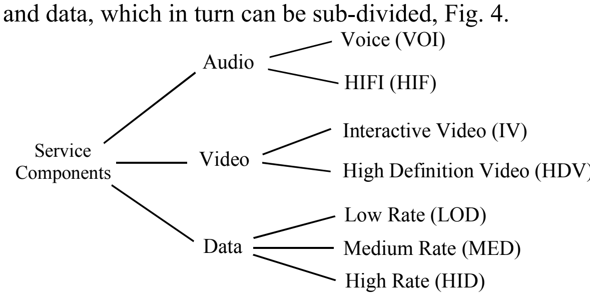

Fig. 4 - Basic service components.

Details related to the characteristics of service components were left for further work (on multi-service tele-traffic), while on operation and mobility environments are given in [14].

IV. RANGE OF VARIATION FOR THE PARAMETERS

It is fundamental to identify the range of variation of the characterisation parameters, Table 4, while Table 5 covers communications and traffic parameters. All applications are interactive.

V. CONCLUSIONS

Future systems have to be able to support actual applications and new ones, with different capacity and requirements. Thus new classifications and characterization of services and applications are needed. This work presents a description of characterisation and classification parameters, and a first assignment of parameter values for these services.

Table 4: Enhanced UMTS service characteristics.

Applications	Intrinsic time dependency	Delivery requirements	Directionality	Symmetry / Assymmetry	Asymmetry factor	Nb. of parties
Voice	TB	RT	Bid	Sym	S	1-1, 1-m
Voice over IP					S	1-m
Video-telephony (Various purposes)				Sym/Asy	S	1-1
HD Video-telephony (Tele-education)					S / low	1-1
HIMM Videoconference, various purposes					S	multi
Videoconference, tele-advertising					low	multi
Mobile Video Surveillance				Asy	5UL-0.001DL	1-1
Data File Transfer (FTP)	NTB				4UL-1DL	1-1
Desktop Multimedia	TB				1UL-5DL	1-1
Collaborative working				Sym	S	1-1, 1-m
Mobile Tele-working					S	1-1
Interactive Remote Games	TB/NTB			Asy	26UL-1000DL	1-1, 1-m
Still Images Communication	NTB				26UL-1000DL	1-1
Electronic Mailbox Service for Multimedia	TB	NRT			4UL-100DL	1-1
Audio Streaming		RT			4UL-100DL	1-1, 1-m
E-commerce					4UL-100DL	1-m
Tourist Information	NTB				4UL-100DL	1-m
Remote Procedure Call		NRT/RT			4UL-100DL	1-m
Urban Guidance	TB				5UL-1e3DL	1-m
Mobile Portal (Content/commerce)	TB/NTB	RT			1UL-5DL	1-m
Assistance in Travel	TB	NRT/RT			5UL-1e3DL	1-1
Micro movies (including video clips)	TB/NTB	RT	Und (with commands in the reverse link)		26UL-1000DL	1-m
E-newspaper	NTB	NRT	Bid		1UL-5DL	1-m

Table 5: Communication and traffic parameters.

Applications	Traffic characteristics			Communication characteristics			
	Rb [kb/s]	Avg. duration	Latency/ delay [ms]	Burstiness	Serv.Class	BER	Protocol
Voice	4-25	3	150	1	ISO&CBR/ RT-VBR	10^{-4}	UDP
Voice over IP	4-25	3	150	1	ISO&CBR/ RT-VBR	10^{-4}	UDP
Video-telephony (Various purposes)	32-384	5	200	1-5	ISO&CBR/ RT-VBR	10^{-4}	UDP
HD Video-telephony (Tele-education)	2000	30	200	1-5	ISO&CBR/ RT-VBR	10^{-4}	UDP
HIMM Videoconference (Various purposes)	32-384	30	200	1-5	ISO&CBR/ RT-VBR	10^{-4}	UDP
Videoconference, tele-advertising	384-2000	30	200	1-5	ISO&CBR/ RT-VBR	10^{-4}	UDP
Mobile Video Surveillance	32-384	10-120	200	1-5	NISO&CBR	10^{-4}	UDP, TCP
Data File Transfer (FTP)	64-2000	1-5 s	10 s	1-50	NISO&CBR	10^{-6}	TCP
Desktop Multimedia	384-2000	1-15	few sec.	1-20	ISO&RT-VBR	10^{-6}	TCP
Collaborative working	64-2000	15-50	500	1-20	ISO&CBR(VBR)	10^{-6}	TCP
Mobile Tele-working	384-2000	15-50	200	1-20	ISO&CBR(VBR)	10^{-6}	TCP
Interactive Remote Games	64-1000	10-30	50	1-30	ISO&CBR(VBR)	10^{-7}-10^{-6}	UDP, TCP
Still Images Communication	64-1000	1-10	1000	1-20	ISO&CBR(VBR)	10^{-7}-10^{-6}	TCO
Electronic Mailbox Service for Multimedia	1000-4000	0.1-3	15 s	1-20	NISO&UBR	10^{-6}	TCP
Audio Streaming	12-128	3-60	10 s	1-5	ISO&CBR/ RT-VBR	10^{-6}	UDP, TCP
E-commerce	64-1000	5	500	1-20	ISO&RT-VBR	10^{-6}	TCP
Tourist Information	64-1000	10-15	500	1-20	ISO&RT-VBR	10^{-6}	UDP
Remote Procedure Call	64-1000	5	250	1-50	NISO&ABR	10^{-6}-10^{-4}	TCP
Urban Guidance	128-4000	5-10	1-5 s	1-5	NISO&CBR	10^{-6}	TCP
Mobile Portal (Content/commerce)	64-2000	5-15	1-5 s	1-50	ISO&RT-VBR	10^{-6}	TCP
Assistance in Travel	128-4000	20-360	500	1-5	ISO&CBT & RT-VBR	10^{-6}	TCP
Micro movies (including video clips)	64-384	3-5	10 s	1	NISO&CBR	10^{-6}	UDP
E-newspaper	1000-2000	20	500	1	ISO&RT-VBR	10^{-6}	TCP

Parameters include among others data rate, tolerance to delay and error, busy hour call attempt, session duration as well as activity models describing activity and inactivity times. The range of parameter variation has been presented (service characteristics, communications and traffic ones). In conclusion, an extended set of characterisation parameters for Enhanced UMTS services and applications was presented. This is an important step in order to define realistic simulation traffic scenarios and models.

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