Agenda Item: 6.3.9
Source: BT
Title: Quality of Service
Document for: Decision

1   Introduction

As an operator BT feels that it is important to enhance 22.05 with more detail on the user requirements of services based on applications.   This would not only enhance the service developments but add the work in S2.

This contribution should be used to prepare enhancement to section 5 and to highlight some Quality of Service (QoS) requirements which:
* are from a user viewpoint
* illustrate potential UMTS applications and services
* propose typical application use
* identify specific application requirements

This work draws on requirements from BT's point of view and a review of a contribution to the QoS meeting in April from Nortel Networks. The Nortel Network's contribution has been referenced where additional ideas have been drawn from it and there would be value in incorporating ideas from this and the Nortel contribution into 22.05.

2   Voice services

Example applications in these areas could be:
➢ Conversation (one to one),
➢ audio conferencing (multiparty),
➢ voice messaging,
➢ dictation

Agenda Item: **6.3.9**
Source: **BT**
Title: **Quality of Service**
Document for: **Decision**

Typical voice call is 2 minutes duration with symmetry between the up and downlinks.

Voice services require very low delay, and low delay variance. User requirements on perceived delay give:
- <30 ms, user does not notice any delay at all
- <100 ms, user does not notice delay if echo cancellation is provided and there are not distortions on the link
- 200 - 300 ms delay is also acceptable given suitable echo cancellation, e.g. for international links.
-

Voice services will be required in all environments, at all speeds of mobility. **UMTS 22.05** currently proposes a maximum mobility speed of 500kmph, but indicates that this is focused on requirements for high-speed trains, for example. A more typical speed of 250 kmph is quoted.

A user should not perceive degradation as a result of handover. **GSM 02.08** cites a handover success rate of > 99% and max interruption due to handover of 150ms.

The Nortel contribution discuss in more detail on voice

3   Fax services

Typical Fax applications are of course Fax, but access methods should be considered - Low speed internet/remote LAN access "dial-up" style. A typical fax call is 3 minutes duration. It is likely that there will be more mobile originated access than mobile terminated. However from the point of view of symmetry it should be treated as for voice, i.e. 50% : 50%.

Throughput requirements should be sufficient to support Group 3 fax, and at least dial up modem throughputs. User perceived delay is less stringent than for voice. 200-400ms. Fax services will be required in all environments, at all speeds of mobility up to 250 kmph

Agenda Item: **6.3.9**
Source: **BT**
Title: **Quality of Service**
Document for: **Decision**

User should not perceive degradation as a result of handover. **GSM 02.08** cites a handover success rate of > 99% and max interruption due to handover of 150ms

4   *Interactive services*

Example applications of interactive services include:
- Video conference,
- multimedia call centre,
- collaborative working

Some applications with a lower volume throughput may also fall into this category as a result of delay requirements, e.g. games, e-commerce (when time critical), booking services (again could be time critical).

Synchronisation may be required between streams, but often this is done by application layer protocols, e.g. H.263 suite. Communications may be one to one or multiparty. The ability to add/remove multimedia components or participants during a session is required. Typical usage is difficult to evaluate but Video conferences are usually fairly long (e.g. 20 minutes). Symmetry considerations again should be considered the same as voice.

In relation to thoughput requirements, related standards include:
- H.261 (Full CIF and QCIF) and H.263 video compression support
- G.723, G.711 and G.728 Audio support
- T.120 data conferencing
- H.261 group can offer video at a variety of data rates and picture size/quality.
- Typically at least ISDN throughput needed for reasonable quality sound/pictures. H.261 etc generally aimed at n*64k levels of quality (e.g.64k, 128k …)

Agenda Item: 6.3.9
Source: BT
Title: Quality of Service
Document for: Decision

Ideally perceived delay should be below 200ms. **ITU-T G.114** suggests that at 200ms, 28% of users experience difficulty, 35% at 450ms and 46% at 700ms delay.

Interactive services will be required in all environments, at all speeds of mobility up to 250 kmph   however very high quality services may necessitate lower mobility (e.g. picocell). User should not perceive degradation as a result of handover. **GSM 02.08** cites a handover success rate of $> 99\%$. More detailed requirements for multimedia handover are required.

The Nortel contribution discusses Video applications.

5   *Messaging*

Example applications are:
- SMS style messaging,
- alerting,
- email without attachments,
- diary & schedule updates
- Dispatch, tracking,
- information search,
- telemetry

Symmetry (uplink/downlink) can be considered to be 15% : 85%. Throughput requirements should be sufficient to deliver 95% of traffic within delay target.

Messaging is typically as store and forward service. Best effort delivery is sufficient and provided by most Internet services today. Users can tolerate higher error rates as long as these can be corrected by higher layer protocols. To aid user perceived delay application layer requirements may be identified such as max length of storage, delivery receipts etc.

Agenda Item: **6.3.9**
Source: **BT**
Title: **Quality of Service**
Document for: **Decision**

Messaging services will be required in all environments, at all speeds of mobility up to 250 kmph.
From the handover point of view Cell reselection is required if messaging in progress. Performance should be in accordance with service delay and throughput constraints. Reselection success rate should be > 99%.

6   *Medium Multimedia*

Example application include:
➢ Internet / Intranet/ remote LAN access,
➢ email with attachments,
➢ groupware,
➢ mobile office environments
➢ applet download

It is difficult to estimate future traffic patterns and mixes with confidence. There is some indication that whilst traffic volumes have grown dramatically in the last three years, observed file sizes have remained reasonably stable.

Studies of WWW caches suggests that typical file sizes are:
HTML 4-13 kbytes
Images 5-15 kbytes
Sound 84 – 258 kbytes

Human perception studies (e.g. **Response time to user activities in Interactive Man/Machine computer systems, Glen R Gallaway** (Proceedings of the Human Factors society 25th Annual meeting 1981)) indicate that "acceptable" delays for typical activities are:

Agenda Item: **6.3.9**
Source: **BT**
Title: **Quality of Service**
Document for: **Decision**

Simple service (e.g. menu, download WWW page): max 2 sec, recommend 0.5
Complex query (e.g. database search): max 5 sec, recommend <5
Loading data (e.g. file download, applet): max 60 sec, recommend <15 sec.
So a typical HTML page should be downloaded in 0.5 sec (max 2 sec), a sound file would be acceptable if completely downloaded within 15 sec.

Fax services will be required in all environments, at all speeds of mobility up to 250 kmph. From the handover point of view Cell reselection is required if communication in progress. Performance should be in accordance with service delay and throughput constraints. Reselection success rate should be > 99%. Need to identify QoS requirements in the event of reselection

7   *High multimedia*

Example application include:
- High speed internet/intranet/LAN access,
- streamed audio,
- video,
- software download.
- Much more use of multimedia. with data volumes expected to be much greater.

Symmetry (uplink/downlink) **-** 10% : 90% Throughput requirements should be **s**ufficient to deliver 95% of traffic within delay target..
Delay requirements are as for medium multimedia, described above. Multimedia applications based on streamed video/audio can use buffered playout to remove the need for the whole file to be delivered before the user can start watching. Buffering on terminal also enables differences in delay variance (jitter) to be smoothed. Buffer size can be configured
However other large downloads may need to be completed before use (e.g. complex applets, software download).

Mobility requirements for these types of application are up to 120 kmph but lower mobility in picocell – 10 kmph

Agenda Item: **6.3.9**
Source: **BT**
Title: **Quality of Service**
Document for: **Decision**

Cell reselection required if communication in progress. Performance should be in accordance with service delay and throughput constraints. Reselection success rate should be > 99%. Need to identify QoS requirements in the event of reselection.

The Nortel contribution discusses in more detail on streaming audio.

8   Conclusion and Requirements tables

The two tables attached in annexes have been taken from the Nortel contribution and enhanced. These along with appropriate text and enhancements should be included in 22-05.

Agenda Item: 6.3.9
Source: BT
Title: Quality of Service
Document for: Decision

Table 1: End-user Performance Expectations - Real-time Streaming Services

Medium	Application	Degree of symmetry	Customer demand	Amount of traffic	Data rate	Key performance parameters and target values			
						One-way Delay	Delay variation	Information loss	Other
Audio	Conversational voice	Two-way	High	High	4-13 kb/s	<150 msec preferred <400 msec limit	< 1 msec	< 3% FER	
Audio	Voice messaging	Primarily one-way	High	Medium	4-13 kb/s	< 1 sec for playback < 2 sec for record	< 1 msec	< 3% FER	
Audio	High quality streaming audio	Primarily one-way	Low	Low	32-128 kb/s	< 10 sec	< 1 msec	< 1% FER	

Agenda Item: **6.3.9**
Source: **BT**
Title: **Quality of Service**
Document for: **Decision**

Video	Videophone	Two-way	Low	Low	32-384 kb/s	< 150 msec preferred <400 msec limit			< 1% FER	Lip-synch : < 100 msec
Video	One-way	One-way	Low	Low	32-384 kb/s	< 10 sec			< 1% FER	
Data	Telemetry - two-way control	Two-way	Low	Low	<28.8 kb/s	< 250 msec	N.A	Zero		

Agenda Item: **6.3.9**
Source: **BT**
Title: **Quality of Service**
Document for: **Decision**

Table 2: End-user Performance Expectations - Real-time Block Transfer Services

Medium	Application	Degree of symmetry	Customer Demand	Amount of traffic	Data rate	Amount of data	Key performance parameters and target values		
							One-way delay	Delay variation	Information loss
Data	Web-browsing - HTML	Primarily one-way	High	High		10 KB	< 4 sec /page	N.A	Zero
Data	Bulk data transfer/retrieval	Primarily one-way	High	Medium		10 KB-10 MB	< 10 sec	N.A	Zero
Data	Transaction services – high priority e.g. e-commerce, ATM	Two-way	High	Low		< 10 KB	< 4 sec	N.A	Zero
Data	Still image	One-way	Medium	Medium		< 1 MB	< 10 sec	N.A	Zero
Data	Interactive games	Two-way	Medium	Low		< 1 KB	< 250 msec	N.A	Zero
Data	Telemetry - monitoring	One-way	Low	Low	<28.8 kb/s		< 10 sec	N.A	Zero

Agenda Item: 　6.3.9
Source: 　　　BT
Title: 　　　　**Quality of Service**
Document for: 　Decision

Data	Telnet	Two-way (asymmetric)	Low	Low		< 1 KB	< 250 msec	N.A	Zero
Data	E-mail (server access)	Primarily One-way	High	High		< 10KB	< 4 sec	N.A	Zero

Agenda Item: **6.3.9**
Source: **BT**
Title: **Quality of Service**
Document for: **Decision**