
QVoice

UMTS /WCDMA measurement results

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1 Introduction

This is an Ascom document, to describe the QVoice drive test measurement results in a live WCDMA network. The first tests were done in the 1st quarter of 2002 ---- world's first WCDMA quality of service drive test.

1.1 Continuous expansion

Ascom's policy is one of continuous expansion, and reserves the right to change the measurement functions without advanced notice.

2 Laboratory measurements

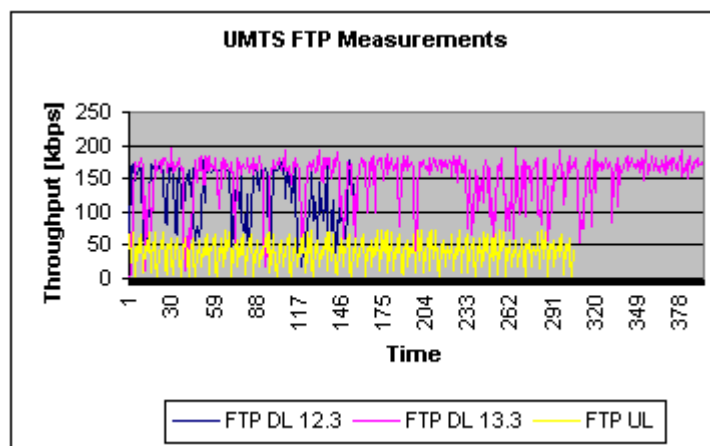
Before the drive tests were carried out, some measurements were done in a laboratory, as follows :

- QVoice with software release 3.3.3
- With three 3G terminals (3GPP Release 99), WCDMA only
- USB interfaces on the terminals
- Two APNs pre-programmed
- RF power out : 3GPP class 3 max 24 dBm
- QVS server at Gi interface

2.1 Mobile data FTP measurements

Several data transfer tests were carried out, including FTP, UDP, round trip delay. Packet oriented mode was used.

An example of the FTP result is as shown :



In this measurement, the configuration was 384Kbps uplink and 64 K bps downlink, file size was 10MB.

The average value for this FTP downlink throughput was around **152Kbps**. The efficiency (actual FTP throughput as percentage of radio link capacity) was **39.5%**

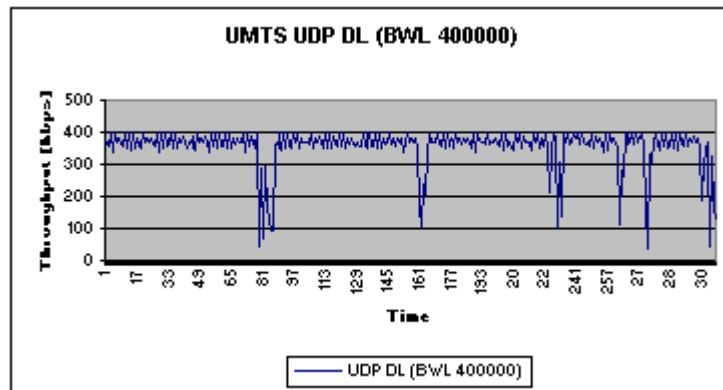
i.e. the different protocols and acknowledgements etc. had a rather high impact on the application layer throughput.

The corresponding values for uplink were **40.5 Kbps** and **63.3%**.

2.2 UDP tests

In view of the impact of FTP protocol on the link efficiency, UDP tests were carried out to see the radio link performance without these processes.

The following UDP test was done with 1000 datagrams of 1000 byte each.



One can see that the throughput held up at nearly 400 Kbps very well, with only occasional dips.

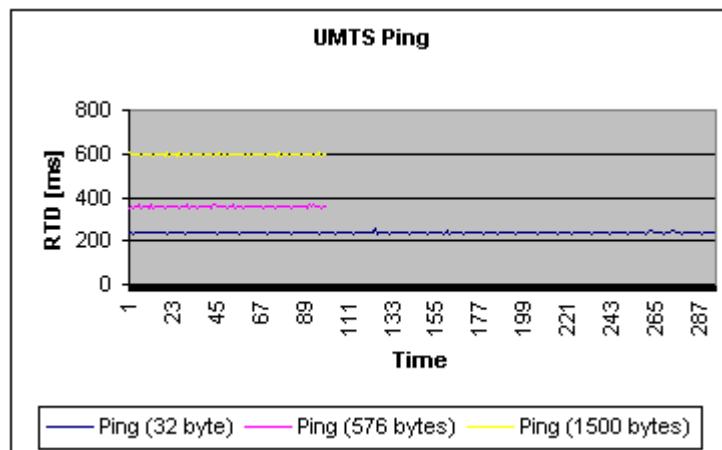
The average throughput for this test was **355 Kbps**.

2.3 Round trip delay measurements

Round trip delays (RTD) have a big impact on acknowledgement based protocols like FTP or some HTTP. A long RTD would imply a low throughput in the application layer.

The RTD tests were done between the QVoice mobile (QVM) at the air interface Uu, and the QVS at the Gi interface (i.e. the effect of public IP network is excluded.)

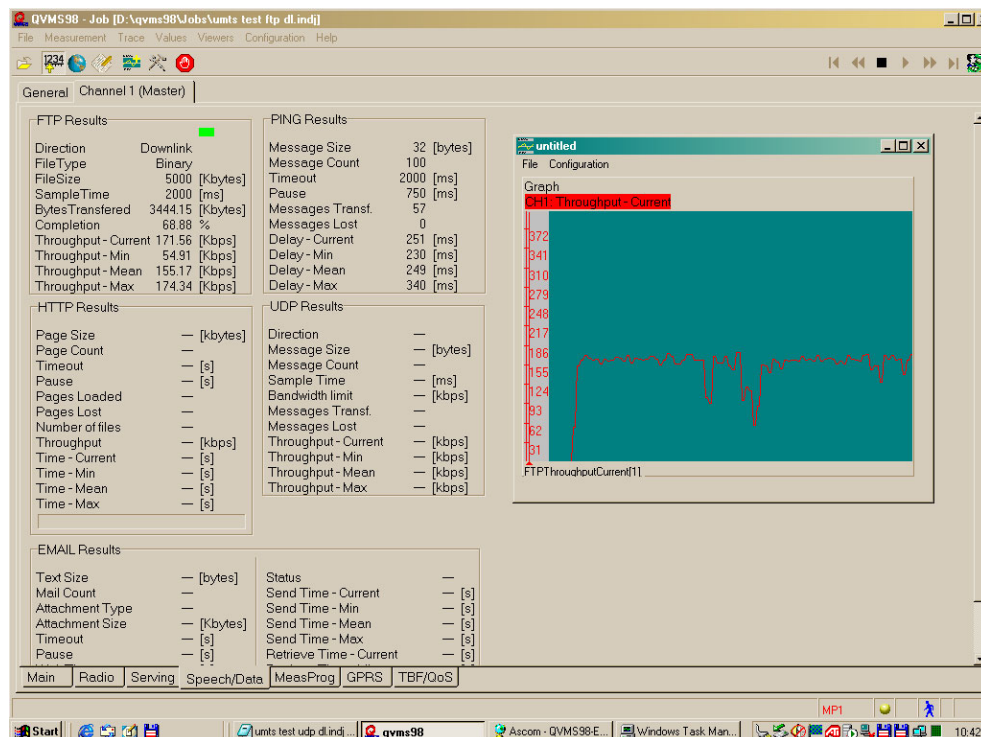
100 ICMP pings were used, at three different sizes 32, 576 and 1500 bytes:



The average RTDs were : **239, 359 and 599 ms**

2.4 Real time MMI in QVoice

Below is a real time MMI screen shot during these tests, showing a mean FTP throughput of ca. 150 Kbps (also plotted against time in the right hand window).



The results of a previous RTD tests were also shown, with mean RTD of around 240 ms.

2.5 Radio conditions

Some parameters relating to the radio condition for these tests were as follows :

PrimaryScramblingCode:64
 Condition:Active Set
 CpichEcNO:-3
 CpichRscp:-90
 Pathloss:123
 Rcm RssiInfo Ind
 UTRA-CarrierRssi:-88

2.6 Some observations

These tests results were obtained under “ideal” conditions, i.e.

- almost no load on node B, so the performance under load/cell shrinkage etc. are not detected
- no known source of interference, which is a critical factor in the performance of CDMA based systems. There are no other subscribers / node Bs present. There may, of course, be other man made interference which falls into the frequency band, but they have not been measured
- tests were done in stationary positions

Under these conditions, the performance of the WCDMA was :

- high throughput rates, for both FTP and UDP
- fairly low round trip delays
- very stable performance --- the throughput /RTD etc. remain at their levels for most of the time, rather than fluctuating wildly.

The questions remain then, what would be the performance outside the laboratory, and what is the quality of the speech calls.

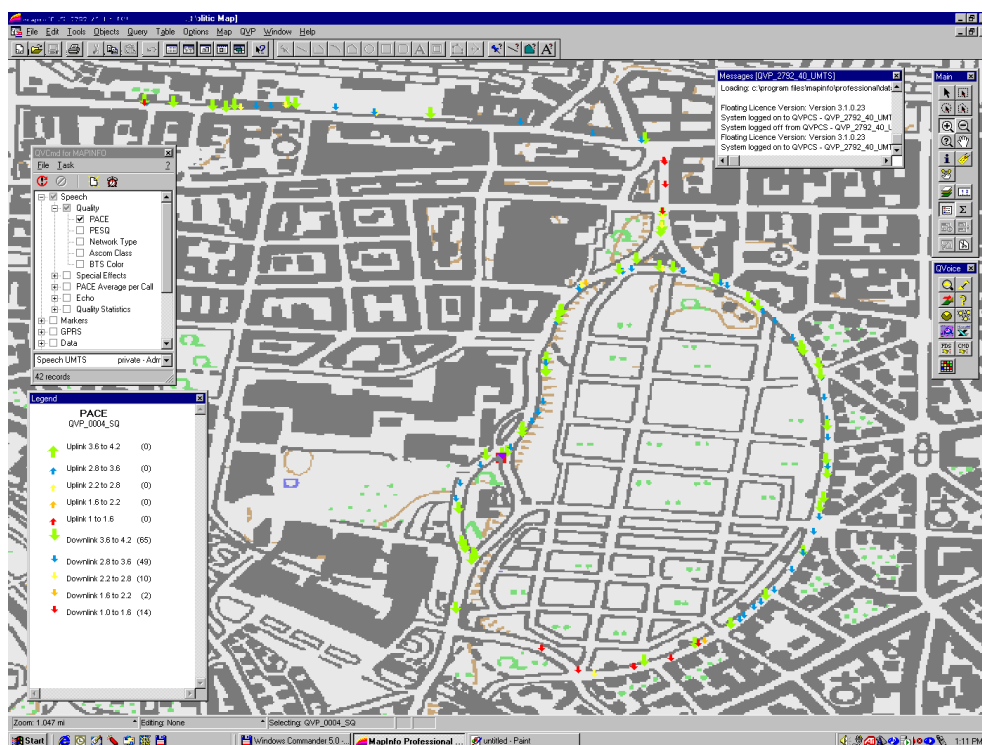
3 Drive test results

QVoice was used in a drive test for WCDMA network, as follows :

- Around 10 node Bs were present
- Drive tests were done in an area ca. 5 x 5 Km
- QVoice was mounted in a moving vehicle
- A few other WCDMA subscriber were present
- Two 3G terminals were used in the tests
- Two QVoice stationary servers (QVS) were used, the one for mobile data was connected at Gi interface, while the one for speech service tests was remotely connected via PSTN networks.

3.1 Speech call measurements

The following result shows the speech quality parameters, plotted on a map background :



The red arrows denote poor speech quality (Ascom PACE MOS score 1 to 1.6) while the green ones represent excellent quality (Ascom PACE score 3.6 to 4.2). In this particular plot, there were 65 green / excellent speech samples compared to 14 red/ bad ones (concentrated in an area at the bottom of the map).

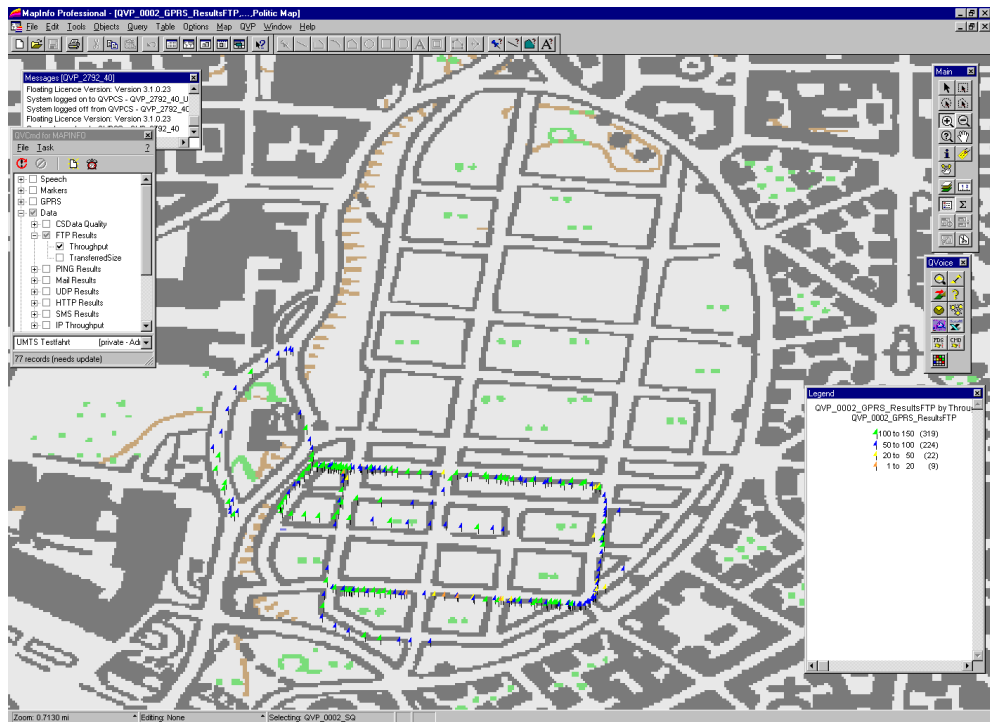
3.2 Mobile data tests

Tests similar to those in the laboratory were repeated in the field, with the following results.

3.2.1 FTP measurements

Downlink FTP with 700Kbyte binary file were transferred in packet oriented mode (384Kbps).

These FTP transfers were continuously and automatically repeated during the drive test. The throughput was sampled at five second intervals, and plotted on the map as below :



The green arrows denote throughputs in the range of 100 to 150 Kbps, the blue ones 50 to 100 Kbps, yellow arrows for 20 to 50 Kbps.

This particular drive route gave 319 green samples, 224 blue samples and 22 yellow samples. (There were also 9 samples of throughput below 20Kbps).

Taken over the whole route:

the average FTP throughput was **95.5 Kbps**,

with an efficiency of **24 %**.

The maximum throughput sample recorded was **124 Kbps**,

the minium being **5.9 Kbps**.

3.3 Some remarks on drive test results

While the favourable conditions of :

- no real load on node Bs
- a few other WCDMA subscribers present

are still maintained, as in the laboratory measurements, these drive tests involve some extra challenges :

- QVM data acquisition unit in a moving vehicle
- therefore, handoff processes were triggered
- real (i.e. imperfect) radio transmission environments in an urban area
- possible interference, e.g. from GSM networks in the area

Nevertheless, the QVoice drive test results showed :

- good speech quality in voice services (12.2 codec)
- the ability to make a speech call , via inter-working with PSTN networks. In fact, international speech calls can be made from this WCDMA network
- there were some clicking noises during speech transmission, but not to an extent that the contents of the conversation were not understandable, or that they are disturbing to the listener. This is confirmed by the Ascom PACE MOS scores.
- The mobile data tests, as expected, show some degradation compared to laboratory conditions. However, FTP throughputs of around 100 Kbps in a moving vehicle is an achievement.
- Again, as expected, the efficiency was lower than the laboratory case. This could be due to, for example, more TCP re-transmissions.
- These speech / data performances were relatively stable, in that when a connection was in place, the performance remained rather constant.

4 The next steps

Ascom was pleased to be able to present these WCDMA drive test results, and that they showed that, even in its early stages, the WCDMA networks showed very promising performances.

Ascom would conduct more measurements in WCDMA networks, in particular with more engineering data from the air interface.

This would reveal more network optimising issues like possible pilot pollutions, time spent in soft handover, block error rates etc.