Technical Specification Group Services and System Aspects *TSGS#22(03)0676*
Meeting #22, Maui, Hawaii, USA, 15-18 December 2003 **Agenda Item: 7.4.3**

3GPP TSG-SA4 Meeting #29 *Tdoc S4-030806*
Tampere, November 24 – 28.

Source: **TSG SA WG4** (France Telecom R&D)
Title: **3G PS conversational tests (AMR NB and AMR WB) : Report from FT R&D for Host Lab and Subjective Testing Lab functions.**
Document For: **Approval**

1 Introduction

3GPP SA4 has approved the test plans defined for AMR Narrow and Wide-band Packet Switched Conversation Tests (Tdoc S4-030564 and Tdoc S4-030565).
Based on this test plan, France Telecom R&D and Siemens have implemented the test bed. The general definition of the test bed is available in the Documents defined above.
This new Document does not reproduce the contents of the defined above, but only the technical choices (and in particular, those decided for the UMTS simulator), and the relevant informations on test procedure.
The main part of this Document is the test results for AMR Narrow band and Wide-Band for FTR&D.
Another Document will be produced after, combining all the results obtained by the three Laboratories.

2 Test bed and test procedures

The test bed and the test procedures are in conformance with the informations given in section 5 of this document.

The practical implementation and the process to perform the test are described in the "user guide" (see annex 1).

Annex 2 gives informations about ambient noise, for the unsymmetrical conditions.

Annex 3 Gives the contractual schedule.

Annex 4 gives the mean opinion scores for AMRNB and AMRWB.

The test plan for AMR narrow-band, on one hand , and for AMR wide-Band, on the other hand, includes 24 conditions.
In practice, each test plan has been splitted in two parts : the first part (called "Symetrical configurations" in the following text) includes the 18 first conditions, without ambient noise; the second part (called "Asymetrical

configurations" in the following text) includes the last 6 conditions (from 19 to 24), for which ambient noise is generated in only one test room.
Due to the differences between these two kinds of configurations, it has been agreed to run the two part of the test in two test plans.
The two test plans ran in sequence, the "symmetrical configurations" test plan being played before the "asymmetrical configurations" test plan for the first 16 subjects, the "asymetrical configurations" test plan being played first for the 16 last subjects.
Each test plan used its own Randomisation (for the conversation order, and for the pretext order).

The test were conducted with 2 small breaks (after 6^{th} and 18^{th} conversations), and with a longer break (in the middle of the test).
After receiving the instructions, the subjects ran a conversation, for training. The results obtained after this training conversation were not kept.

The subjects answered to the questions through a small tactile screen.

The comfort listening level was adjusted for the training conversation. The subjects were instructed that they could modify the listening level, if they needed, specially for noisy conditions.

The operator in charge of the tests controlled permanently the behaviour of the subjects through audio and video monitor.

3 Test results

A1.1 AMR Narrow-Band

3.1.1 Symmetrical configurations

The figure 1 below shows the Mean Opinion Scores obtained with the Global Quality criterion for the eighteen symmetrical conditions. It appears that the Mean Opinion Scores obtained for 3 % of packet losses are systematically less important than those obtained for 0 % of packet losses, whatever the mode, the delay and the radio conditions considered. A Variance Analysis ANOVA confirms this effect: $F(1,31) = 67.07$ $p<0.0001$). In addition, there is an effect of the factor Radio conditions ($F(2,62) = 47.32$ $p<0.0001$) and a weak effect of the factor "Mode + Delay" ($F(2,62) = 3.44$ $p<0.05$).
One can notice that the effect of the factor "Radio conditions" depends on the factor "Mode + Delay" (cf. significant interaction $F(4,124) = 3.2$ $p<0.05$).

The global quality on mode 12.2 kb/s with 300ms delay is scored slightly less in radio condition 5.10^{-4} than in radio condition 10^{-3}, nevertheless the results are in confidence interval and moreover the radio conditions are close to each other. The same effect is visible on all criteria.

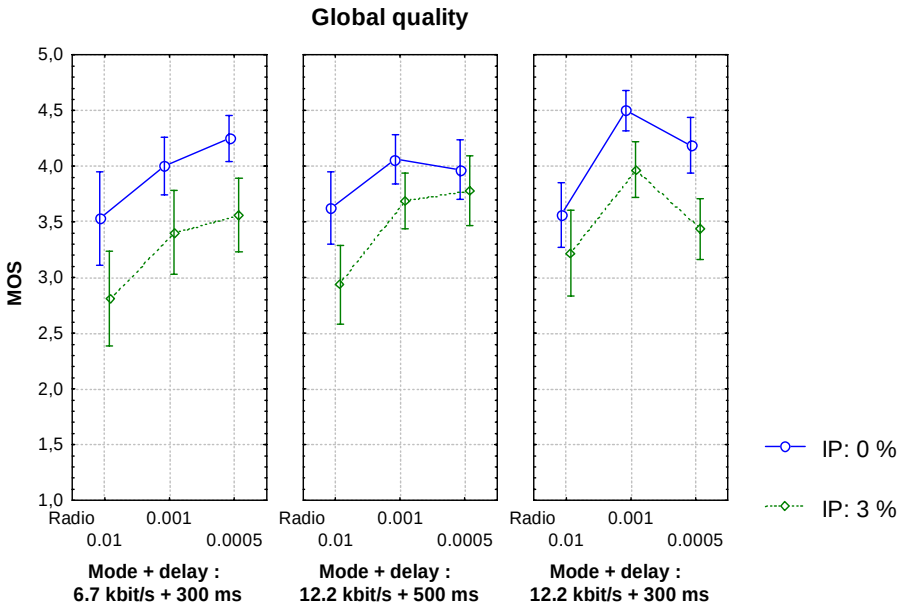


Figure 1: Mean Opinion Scores obtained with the Global Quality Criterion according to the Radio conditions, the Mode+ Delay, and the IP Packet loss ratio.

The table 1 below gives the correlation coefficients between the different criteria. They are all significant and rather well correlated. Therefore, the effects obtained with the four other criteria are rather similar to those obtained with the Global quality criterion. There are succinctly given in the annex.

Correlations between the different criteria

Significant correlations marked when p < .05

	c1	c2	c3	c4	c5
c1: Voice quality	1.00	0.73	0.66	0.68	0.78
c2: Understanding	0.73	1.00	0.73	0.75	0.78
c3: Interaction	0.66	0.73	1.00	0.67	0.78
c4: Defaults perception	0.68	0.75	0.67	1.00	0.82
c5: Global quality	0.78	0.78	0.78	0.82	1.00

Table 1: Correlation coefficients between the five criteria.

3.1.2 Asymmetrical configurations

The figure 2 below shows the Mean Opinion Scores obtained for the six asymmetrical conditions, for the five criteria in parameter (Voice quality, Understanding difficulties, Interaction, Defaults perception and global quality), according to the type of noise (Car, Cafeteria, Street) and according the presence or not of noise (Yes/No). The network conditions are reminded for each type of noise.

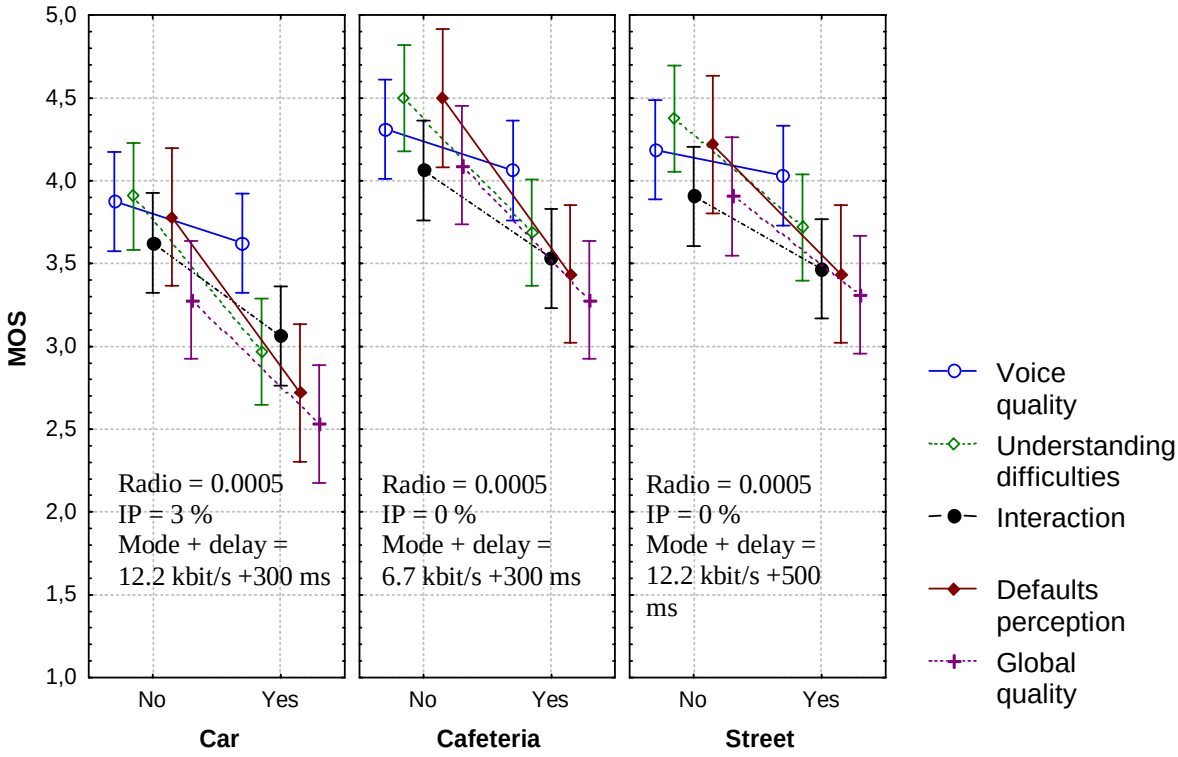


Figure 2: MOS obtained with the five criteria (parameter), according to the type of noise and its presence (Yes/No).

A Multivariate Analysis (MANOVA) conducted on the five criteria reveals an effect of the type of noise ($R(10,364) = 3.63$ $p<0.005$) and an effect of the presence of noise ($R(5,182) = 9.63$ $p<0.0001$). The effect of the presence of noise is not really surprising. In return, the effect of the type of noise can be explained by the fact that the network conditions associated to the different type of noise were also different: therefore, the MOS obtained for the Car noise corresponds to an IP Packet loss ratio of 3 % and it explains the fact that they are lower than the MOS obtained for the two other types of noise (IP Packet loss ratio = 0%) but this could be also related to the fact that noise level is higher for car noise than for the other types of noise. Moreover, noise is felt more disturbing by subject in the noisy room than subject in the quiet room.

3.1.3 Analysis by criterion

The figure 3 below shows the Mean Opinion Scores obtained for the eighteen symmetrical conditions and for the **Voice quality criterion**. The ANOVA reveals an effect of the factor IP packet loss ratio ($F(1,31) = 80.57$ $p<0.0001$), an effect of the factor Radio condition $F(2,62) = 24.6$ $p<0.0001$) and a weak effect of the factor "Mode + Delay" ($F(2,62) = 3.19$ $p<0.05$).

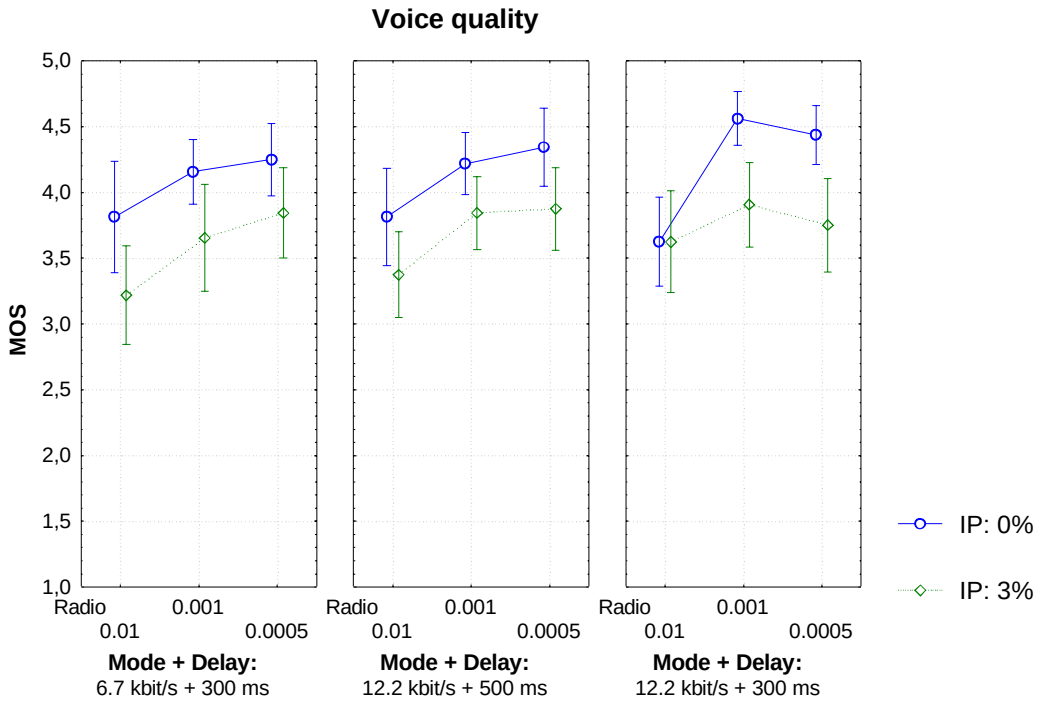


Figure 3: Mean Opinion Scores obtained with the Voice quality criterion according to the Radio conditions, the Mode+ Delay, and the IP Packet loss ratio.

The figure 4 below shows the Mean Opinion Scores obtained for the eighteen symmetrical conditions and for the **Understanding criterion**. The ANOVA reveals an effect of the IP packet loss ratio ($F(1,31) = 51.66$ $p<0.0001$), an effect of the Radio condition $F(2,62)=27.08$ $p<0.0001$) but no effect of the mode ($F(2,62) = 1.02$ $p=0.3670$).

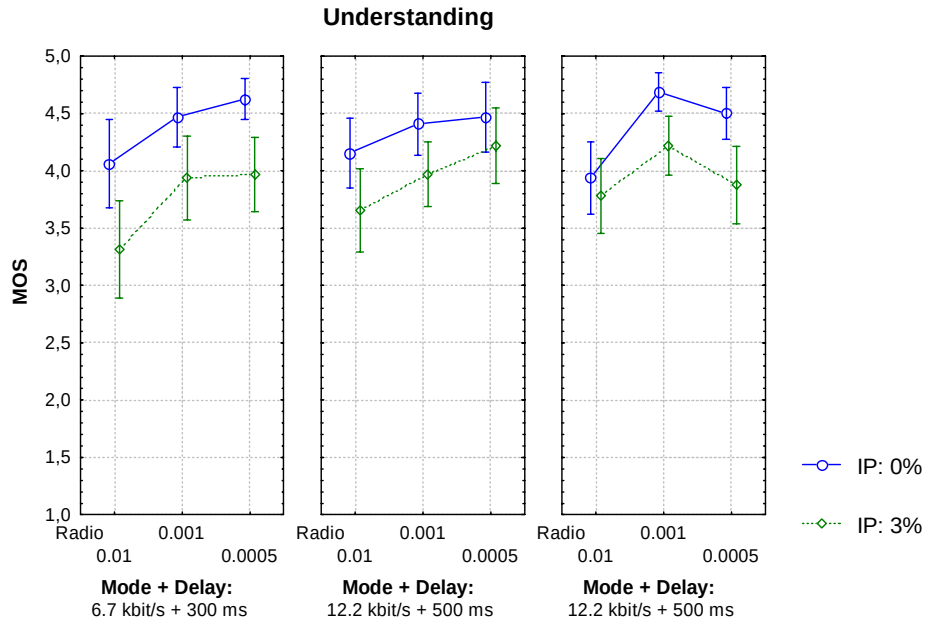


Figure 4: Mean Opinion Scores obtained with the Understanding criterion according to the Radio conditions, the Mode+ Delay, and the IP Packet loss ratio.

The figure 5 below shows the Mean Opinion Scores obtained for the eighteen symmetrical conditions and for the **Interaction criterion**. The ANOVA reveals an effect of the factor IP packet loss ratio ($F(1,31) = 23.38$ $p<0.0001$), an effect of the factor Radio condition $F(2,62) = 29.14$ $p<0.0001$) and a weak effect of the factor "Mode + Delay" ($F(2,62) = 3.68$ $p<0.05$). One can notice that the effect of the packet loss ratio is weaker than the one obtained for the other criteria.

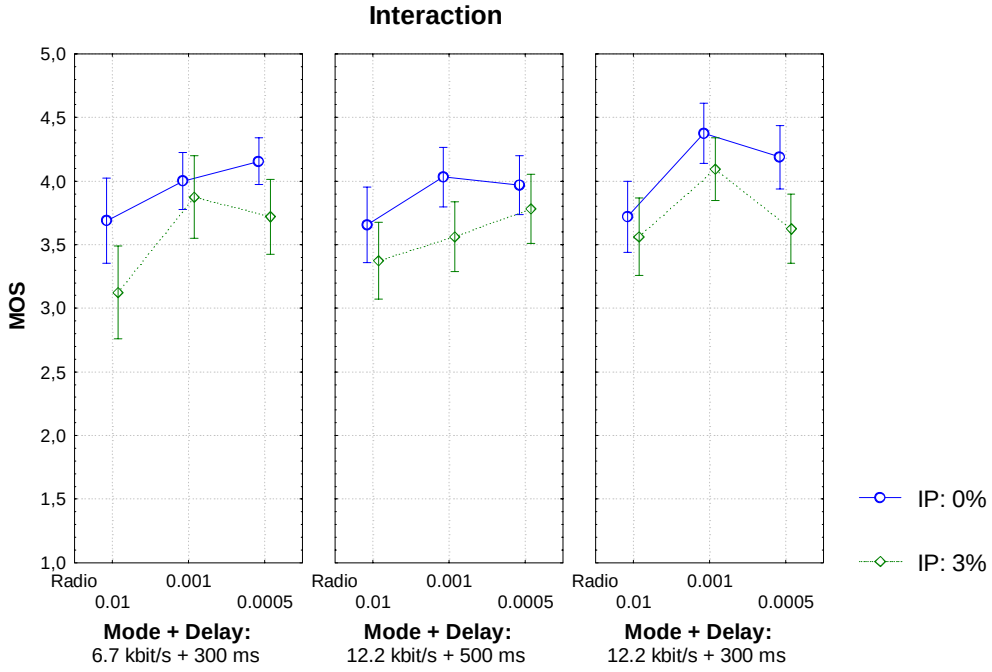


Figure 5: Mean Opinion Scores obtained with the Interaction criterion according to the Radio conditions, the Mode+ Delay, and the IP Packet loss ratio.

Finally, the figure 6 below shows the Mean Opinion Scores obtained for the eighteen symmetrical conditions and for the **Defaults perception criterion**. The ANOVA reveals an effect of the IP packet loss ratio ($F(1,31) = 52.39$ $p<0.0001$), an effect of the Radio condition $F(2,62)=37.75$ $p<0.0001$) but no effect of the mode ($F(2,62) = 2.64$ $p=0.07$).

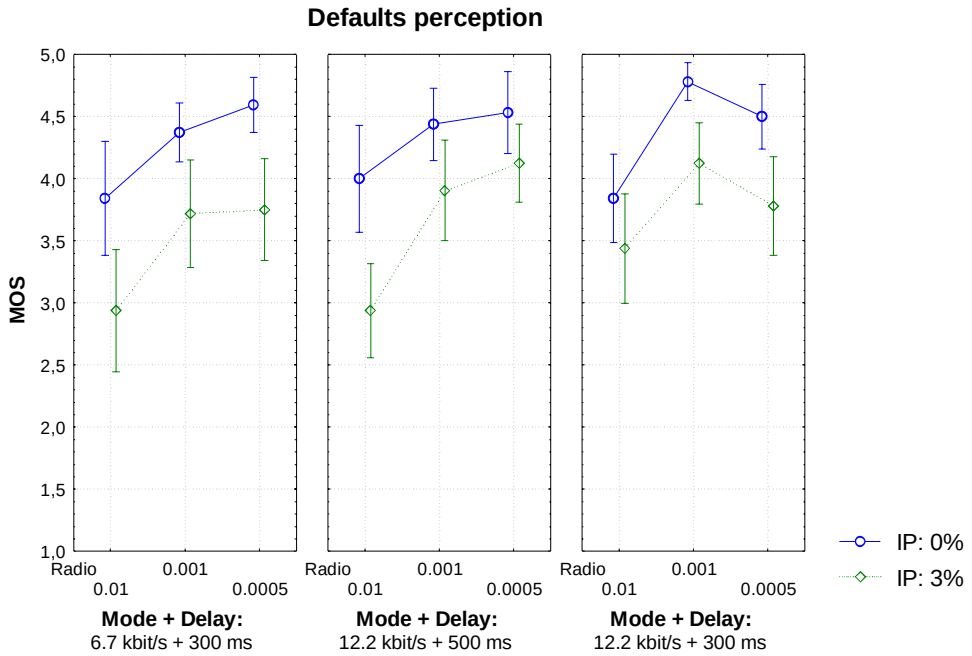


Figure 6: Mean Opinion Scores obtained with the Default perception criterion according to the Radio conditions, the Mode+ Delay, and the IP Packet loss ratio.

A1.2 AMR Wide-Band

3.2.1 Symmetrical configurations

The figure 7 below shows the Mean Opinion Scores obtained for the eighteen symmetrical conditions and for the Global Quality Criterion. It appears that the Mean Opinion Scores obtained for 3 % of packet losses are systematically less important than those obtained for 0 % of packet losses (An ANOVA confirms it: F(1,31) = 35.74 *p<0.0001*),. So a Packet loss ratio of 3% is perceived as a sensible impairment, compared to a Packet loss ration of 0 %. In addition, the ANOVA reveals a weak effect of the Radio conditions F(2,62)=3.97 *p<0.05)* but no effect of the mode (F(2,62) = 1.77 *p=0.177*). In other words, subjects were mainly sensitive to the packet loss ratio, no quality differences were perceived between the different modes, and the quality differences perceived between the different radio conditions are weak.

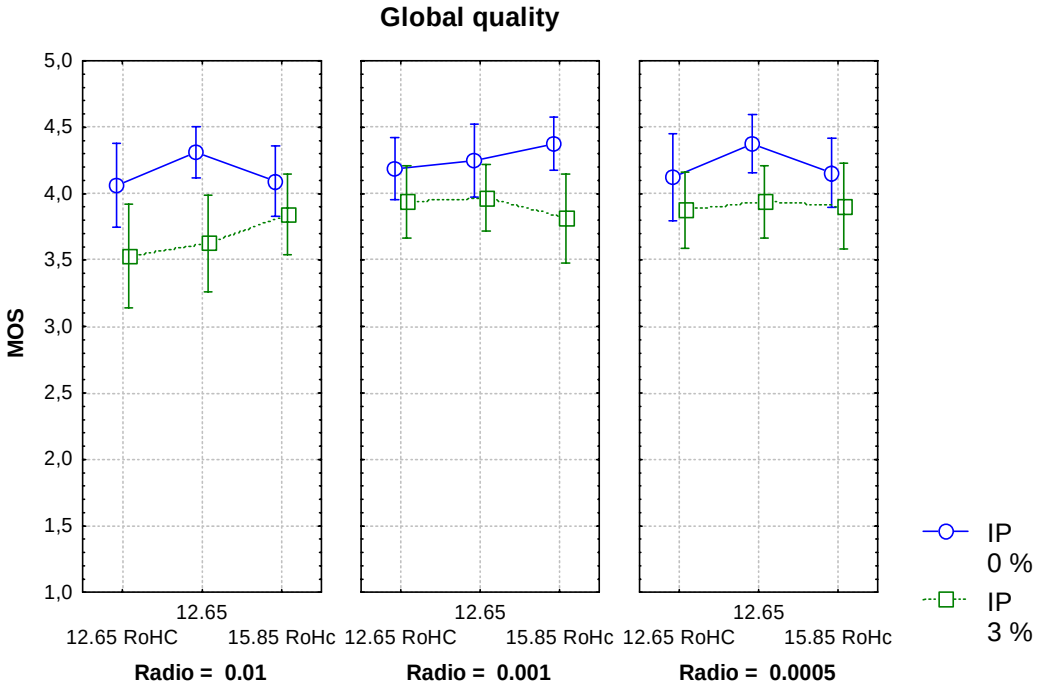


Figure 7: Mean Opinion Scores obtained with the Global Quality Criterion according to the Radio conditions, the Mode and the IP Packet loss ratio.

The table 2 below gives the correlation coefficients between the different criteria. They are not very high, although all significant. So, Annex A detailed the results (figure and ANOVA for the different criteria). However, the effects obtained with the four other criteria are rather similar to those obtained with the Global quality criterion.

Correlations between the different criteria
Significant correlations marked when p < .05

	c1	c2	c3	c4	c5
c1: Voice quality	1.00	0.59	0.55	0.60	0.72
c2: Understanding	0.59	1.00	0.50	0.54	0.65
c3: Interaction	0.55	0.50	1.00	0.49	0.66
c4: Defaults	0.60	0.54	0.49	1.00	0.71
c5: Global quality	0.72	0.65	0.66	0.71	1.00

Table 2: Correlation coefficients between the five criteria.

3.2.2 Asymmetrical configurations

The figure 8 below shows the Mean Opinion Scores obtained for the six asymmetrical conditions, for the five criteria in parameter (Voice quality, Understanding difficulties, Interaction, Defaults perception and global quality), according to the type of noise (Car, Cafeteria, Street) and according the presence or not of noise (Yes/No). The network conditions are reminded for each type of noise.

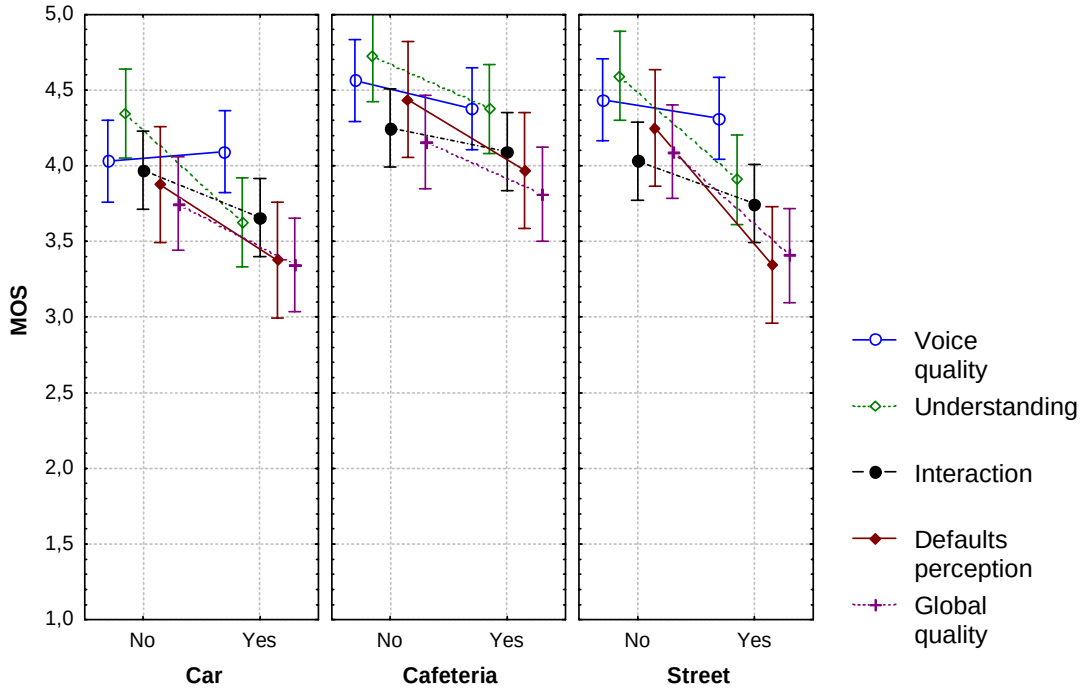


Figure 8: MOS obtained with the five criteria (parameter), according to the type of noise and its presence (Yes/No).

A Multivariate Analysis (MANOVA) conducted on the five criteria reveals an effect of the type of noise (R(10,364) = 1.99 *p<0.05*) and an effect of the presence of noise (R(5,182) = 6.09 *p<0.0001*). The effect of the presence of the noise is not really surprising. In return, the effect of the type of noise can be explained by the fact that the network conditions associated to the different type of noise were also different: therefore, the MOS obtained for the Car noise corresponds to an IP Packet loss ratio of 3 % and it explains the fact that they are lower than the MOS obtained for the two other types of noise (IP Packet loss ratio = 0%). It should also be noted that the level of car noise was higher than the level of the other noises.

3.2.3 Analysis of criterion

The figure 9 below shows the Mean Opinion Scores obtained for the eighteen symmetrical conditions and for the **Voice quality criterion**. The ANOVA reveals an effect of the IP packet loss ratio (F(1,31) = 29.3 *p<0.0001*), a weak effect of the Radio condition F(2,62)=8.81 *p<0.005)* but no effect of the mode (F(2,62) = 2.17 *p=0.1227*).

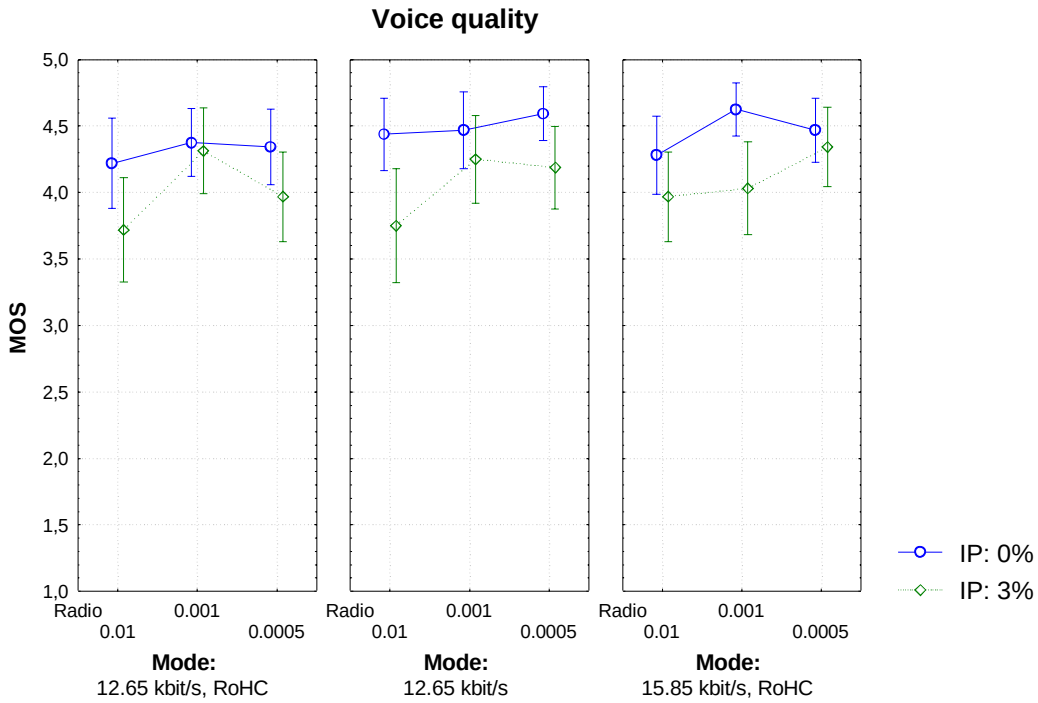


Figure 9: Mean Opinion Scores obtained with the Voice quality criterion according to the Radio conditions, the Mode+ Delay, and the IP Packet loss ratio.

The figure 10 below shows the Mean Opinion Scores obtained for the eighteen symmetrical conditions and for the **Understanding criterion**. The ANOVA reveals an effect of the IP packet loss ratio (F(1,31) = 26.9 *p<0.0001*), an effect of the Radio condition F(2,62)=12.5 *p<0.0001)* but no effect of the mode (F(2,62) = 1.55 *p=0.2196*). However, it appears on the figure that the IP packet loss ration effect mainly appeared for the radio condition 0.01.

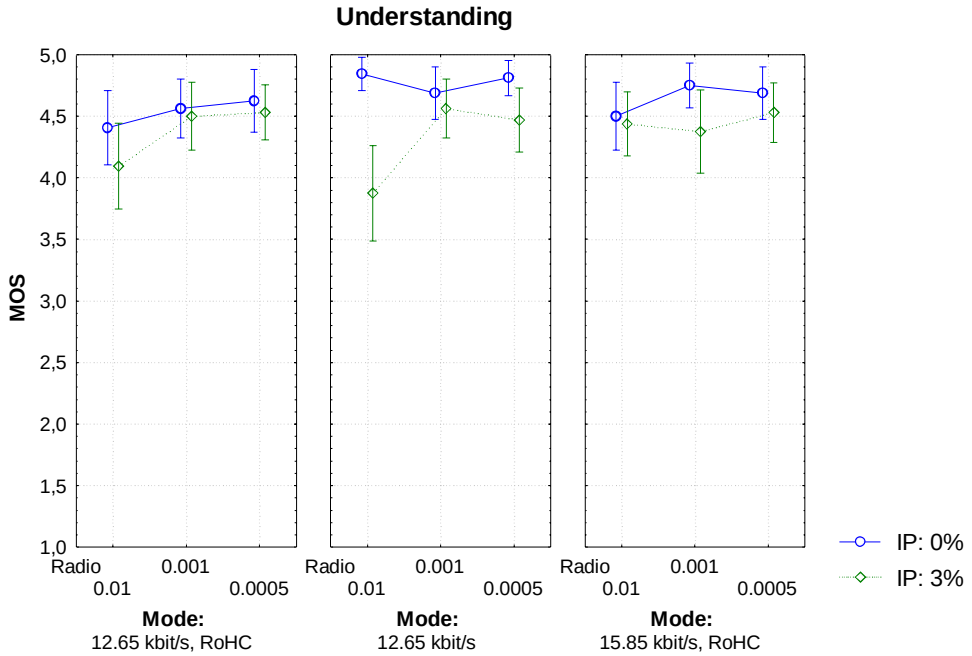


Figure 10: Mean Opinion Scores obtained with the Understanding criterion according to the Radio conditions, the Mode+ Delay, and the IP Packet loss ratio.

The figure 11 below shows the Mean Opinion Scores obtained for the eighteen symmetrical conditions and for the **Interaction criterion**. The ANOVA reveals an effect of the IP packet loss ratio ($F(1,31) = 27.4$ $p<0.0001$), but no effect of the Radio condition $F(2,62)=1.38$ $p = 0.259$) and no effect of the mode ($F(2,62) = 0.74$ $p=0.47$). However, it appears on the figure that the IP packet loss ration effect mainly appeared for the radio condition 0.01 at a 12.65 kbit/s mode and also for the radio condition 0.0005.

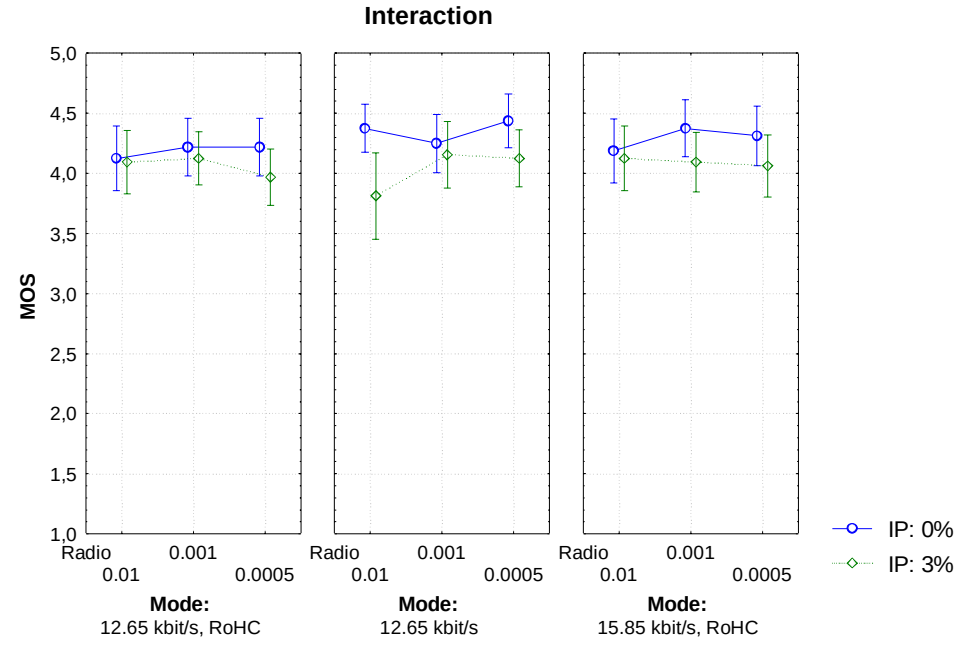


Figure 11: Mean Opinion Scores obtained with the ***Interaction*** criterion according to the Radio conditions, the Mode+ Delay, and the IP Packet loss ratio.

Finally, the figure 12 below shows the Mean Opinion Scores obtained for the eighteen symmetrical conditions and for the **Defaults perception criterion**. The ANOVA reveals an effect of the IP packet loss ratio ($F(1,31) = 19.66$ $p<0.0001$), and an effect of the Radio condition $F(2,62)=6.79$ $p<0.05$) and no effect of the mode ($F(2,62) = 0.74$ $p=0.47$). However, it appears on the figure that the IP packet loss ration effect mainly appeared for the radio condition 0.01 at a 12.65 kbit/s mode and also for the radio condition 0.0005.

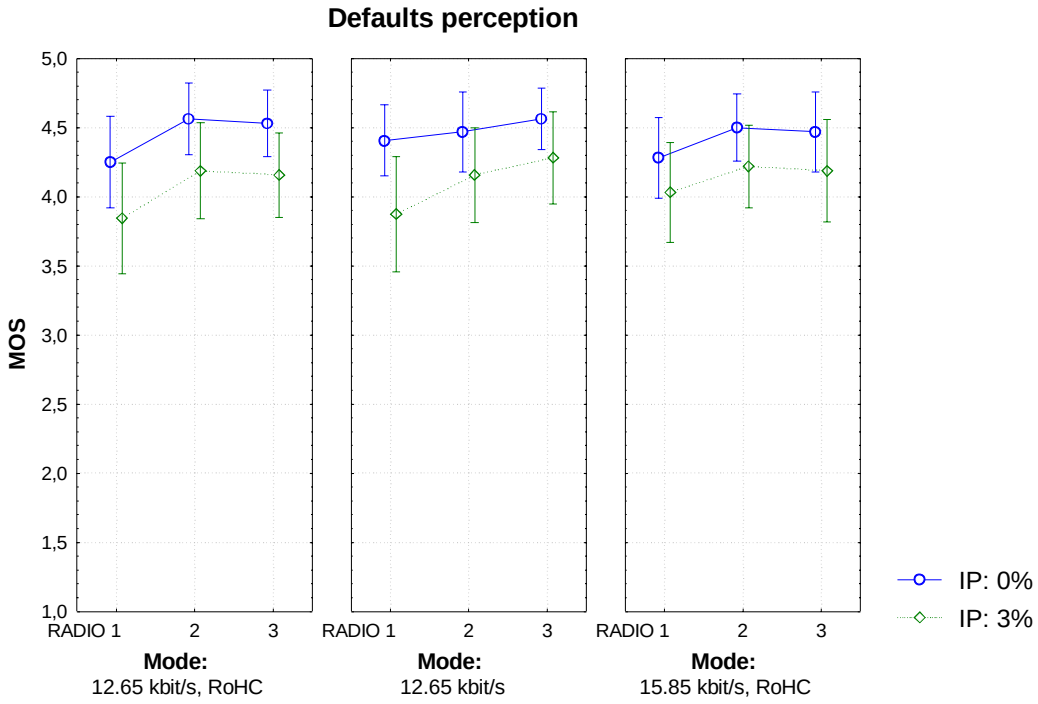


Figure 12: Mean Opinion Scores obtained with the **Defaults perception** criterion according to the Radio conditions, the Mode+ Delay, and the IP Packet loss ratio.

4 Conclusions

The Host Laboratory has implemented all the equipments described in Tdoc S4-030564 and Tdoc S4-030565 and prepared a user guide for the test laboratories.
It has organised the shipping of the test bed in the different test laboratories, the checking of the test equipment between shipping from one test laboratory to another one, and has given assistance to the test laboratories.

The test laboratory has run the test and the results have been produced, and analyzed.

For the narrowband case, it appears that the Mean Opinion Scores obtained for 3 % of packet losses are systematically less important than those obtained for 0 % of packet losses, whatever the mode, the delay and the radio conditions considered
For the wide band case, subjects were mainly sensitive to the packet loss ratio, no quality differences were perceived between the different mode, and the quality differences perceived between the different radio conditions are weak.

It can be noted that the mean opinion scores collected in wideband are much higher than the ones in narrow band and also the understanding criterion is scored very high in wideband test

5 References

Tdoc S4-030564- **Test Plan for the AMR Narrow-Band Packet switched Conversation test**

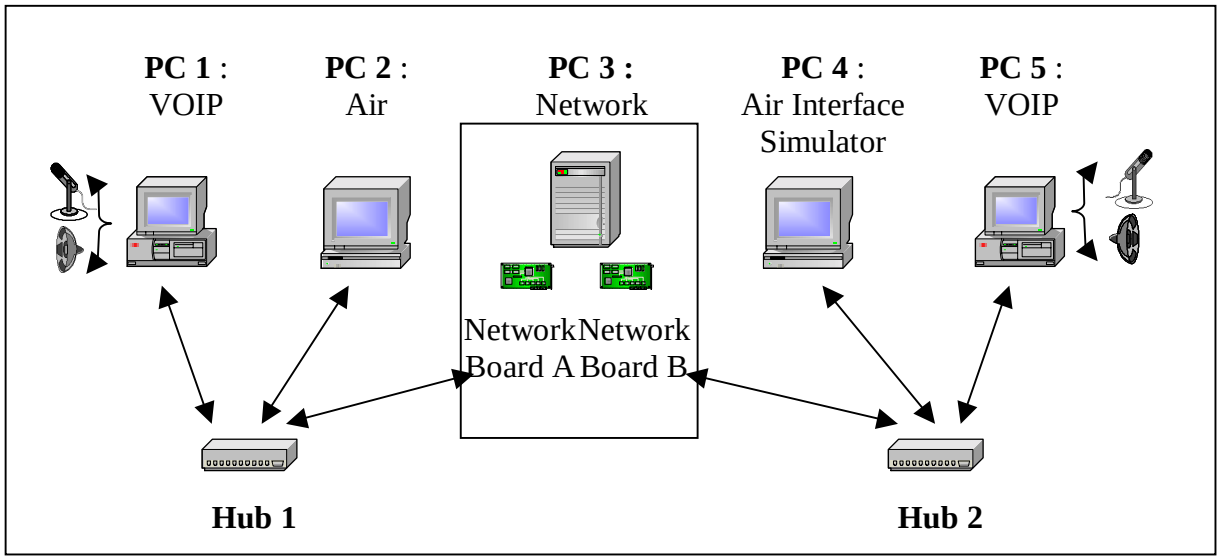
Tdoc S4-030565- **Test Plan for the AMR Wide-Band Packet switched Conversation test**

END

Guide for Installation
And
Usage of the materiel

A1.1 PCs, Cables and Switches

The system consists of 5 PCs, as described in the figure below.



The package contains:

- 5 PCs
- 5 keyboards
- 5 mouses
- 5 screens
- 2 Netgear fast ethernet switches with AC-DC adaptor.
- 6 cables RJ45.
- 1 transformer
- 3 multi-plugs
- 2 headsets and the cables/connectors

Each PC is labelled and has to be used as indicated on the above figure.
The switches are labelled switch 1 and switch 2, they are called Hub1 and Hub 2 on the above figure.

A1.2 Connections

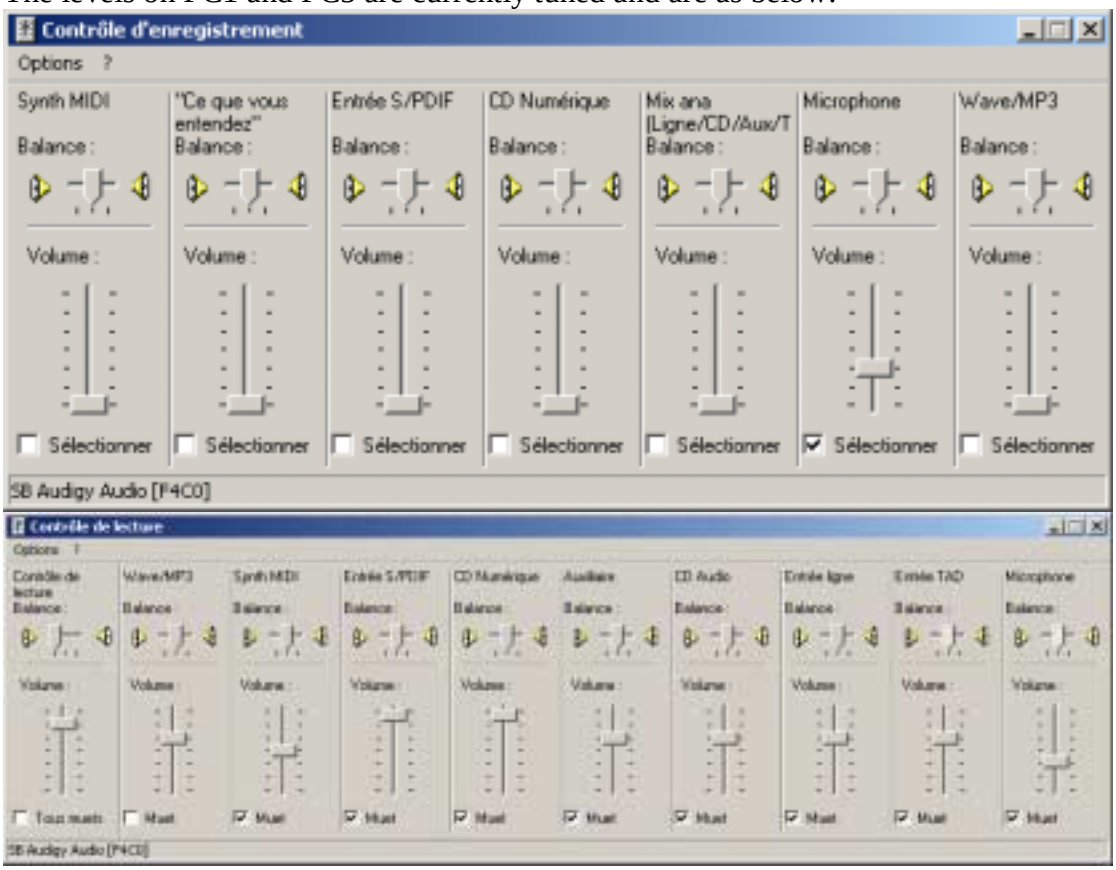
First, connect 1 keyboard, 1 mouse and 1 screen to each PC and plug the power wire.

PC1, PC2 have to be connected to Switch 1 in slot x by using RJ45 cable. RJ45 plugs are on the rear of PCs.
On the same manner, PC4 and PC5 have to be connected to Switch 2.

PC3 has to be connected to both Switch 1 and Switch 2. On rear of PC3, RJ45 plugs are labelled to recognise which one has to be connected to which Switch.

One headphone has to be connected on the sound card at the rear of the PC1 and the other on PC5 the microphone cable is labelled by a red sticker.

The levels on PC1 and PC5 are currently tuned and are as below:



A1.3 Starting the PCs

PC1, PC3 and PC5 are operating under Windows.
After switch on, a banner will appear on the screen.

- For PC1

Fill the fields with appropriate values:

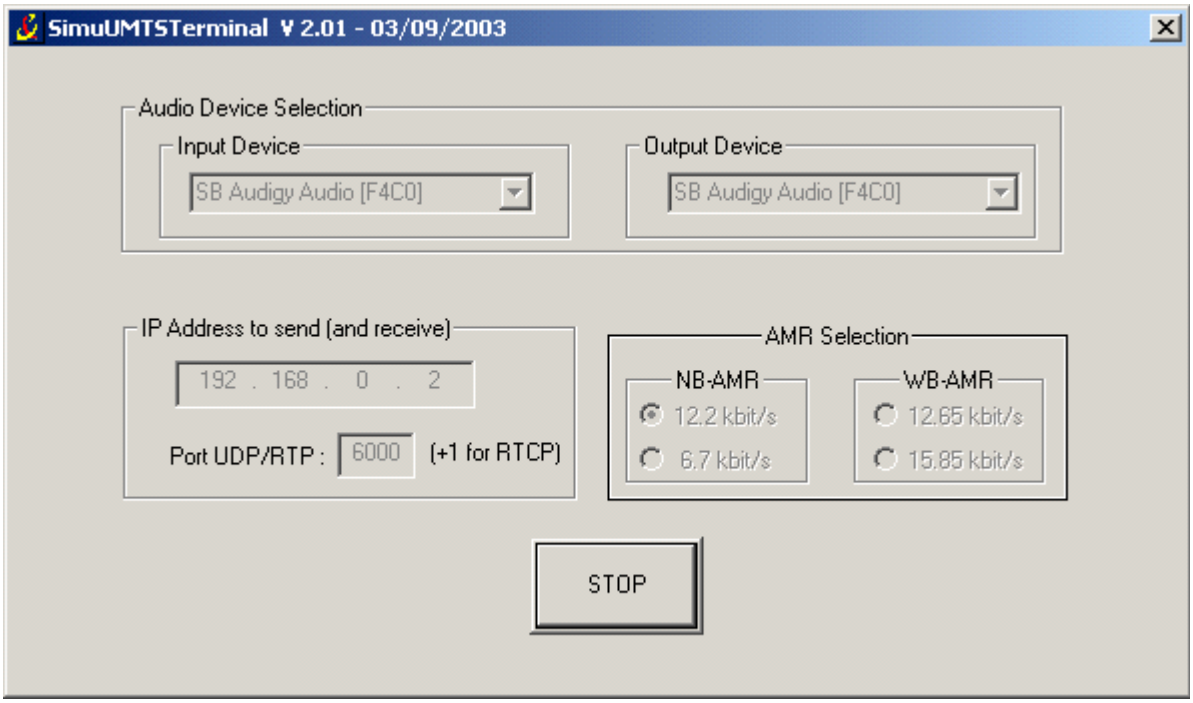
Utilisateur : administrateur

Mot de passe : smart
And validate the entries by click on the OK button.

After boot, the following shortcut appears on the screen

Raccourci vers
SimuUMTSTerminal.exe

A double click on it will display the following window



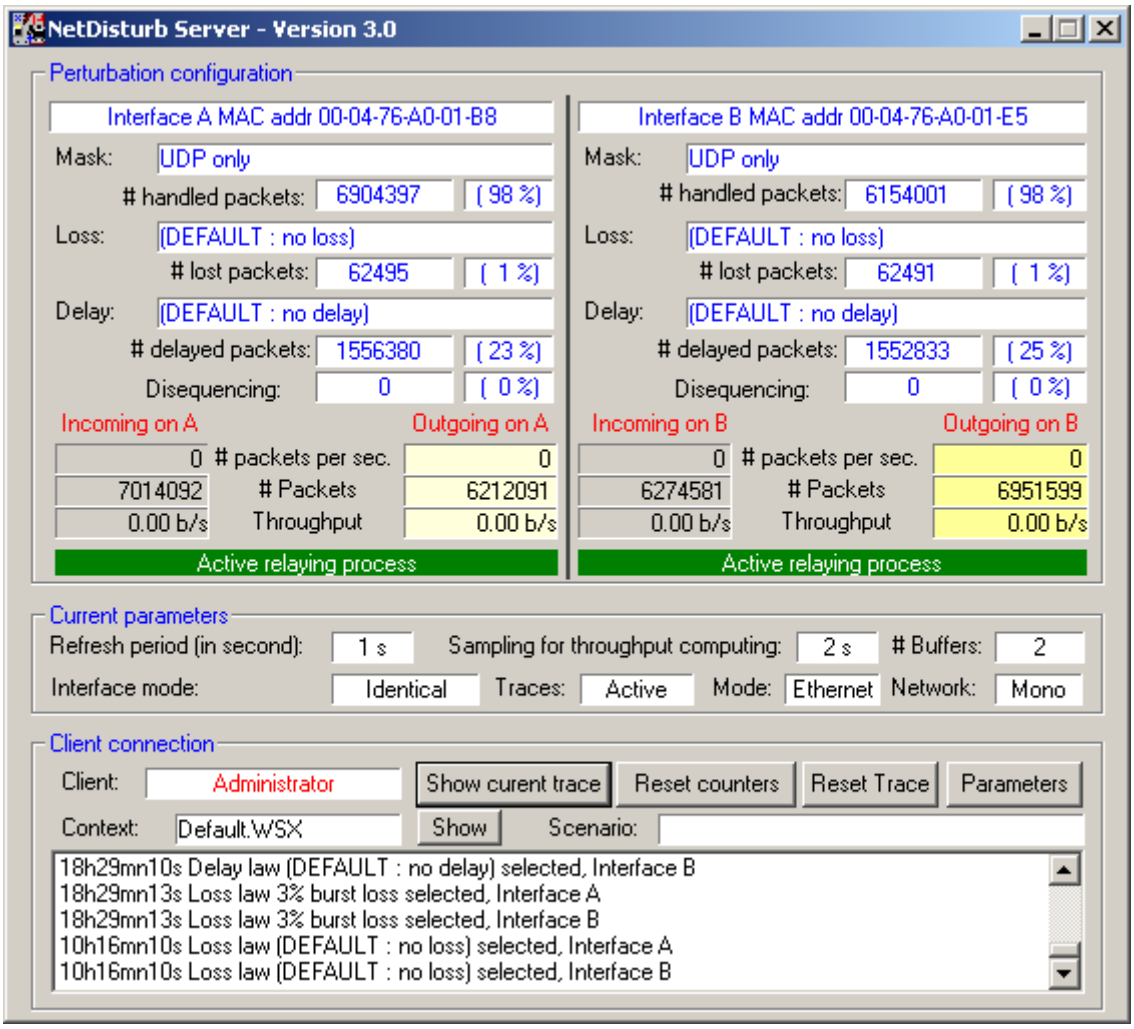
The fields concerning Audio Device selection are filled up automatically. The others fields can be changed but the value in IP Address to send and receive must be 192.168.0.2 as well as the value of the field Port UDP/RTP 6000.

- For PC3

Fill the fields with appropriate values:
Utilisateur : administrateur
Mot de passe : smart
And validate the entries by click on the OK button.
Shortcuts to Netdisturb server and Netdisturb client appear at the bottom of the screen.

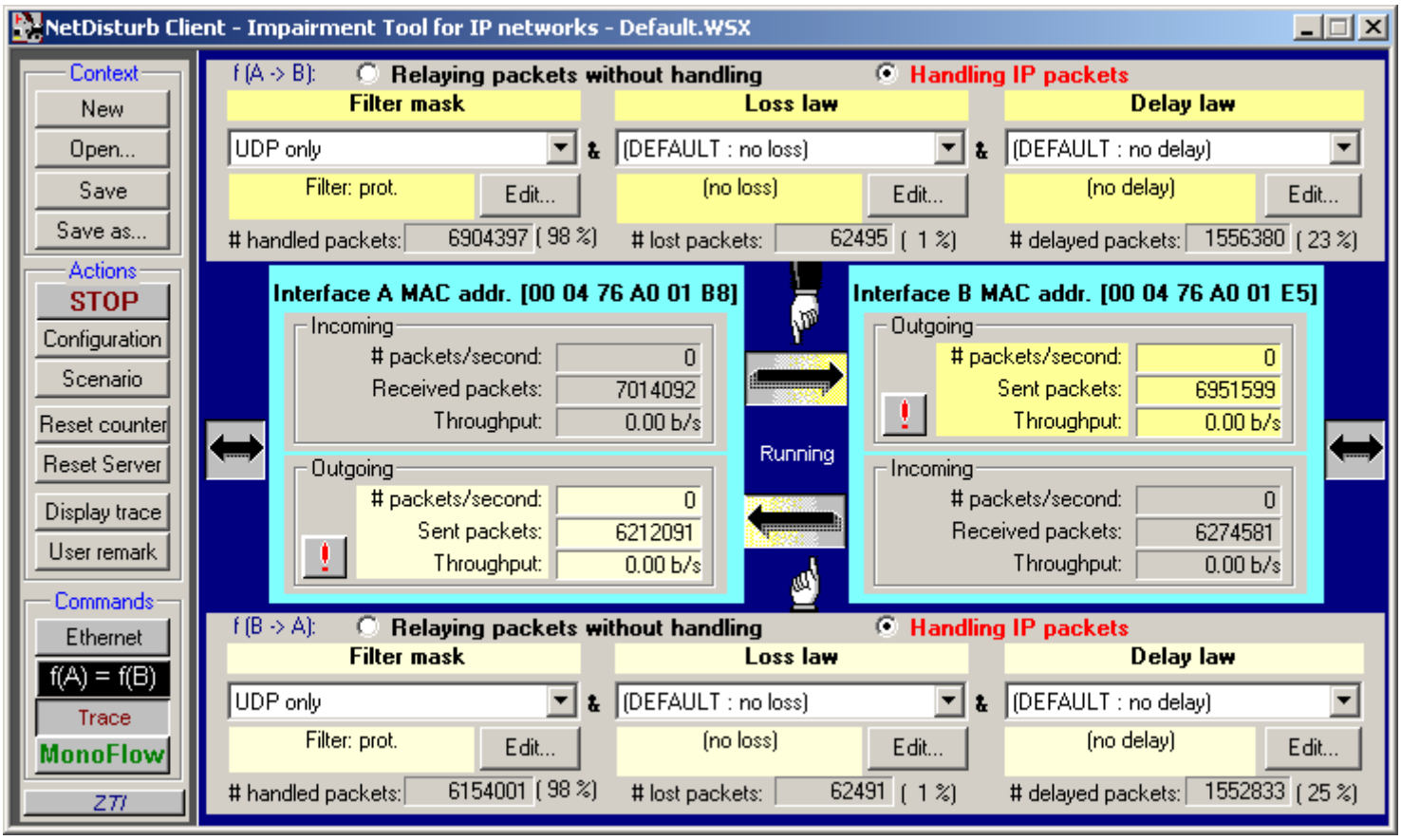
Double click on shortcut to Netdisurb server and a window will appear.
Do not answer, do not press "entrée"(we are working on the current licence)

If you press "entrée" then you have to click on the 1st window tab and click on "resume" After a while, a window as below will appear.



Then, Double click on shortcut to Netdisurb client and a window will appear asking for identification and password;
The field identification is already filled and the field password has to be let blank, you have just to click on the ok button. After that, a window looking like the following one appears on the screen.

Warning : on the window **Handling IP packets** has to be ticked and not 'relaying packets without handling. If not the case, change by click on the button.



- For PC5

Fill the fields with appropriate values:

Utilisateur : administrateur

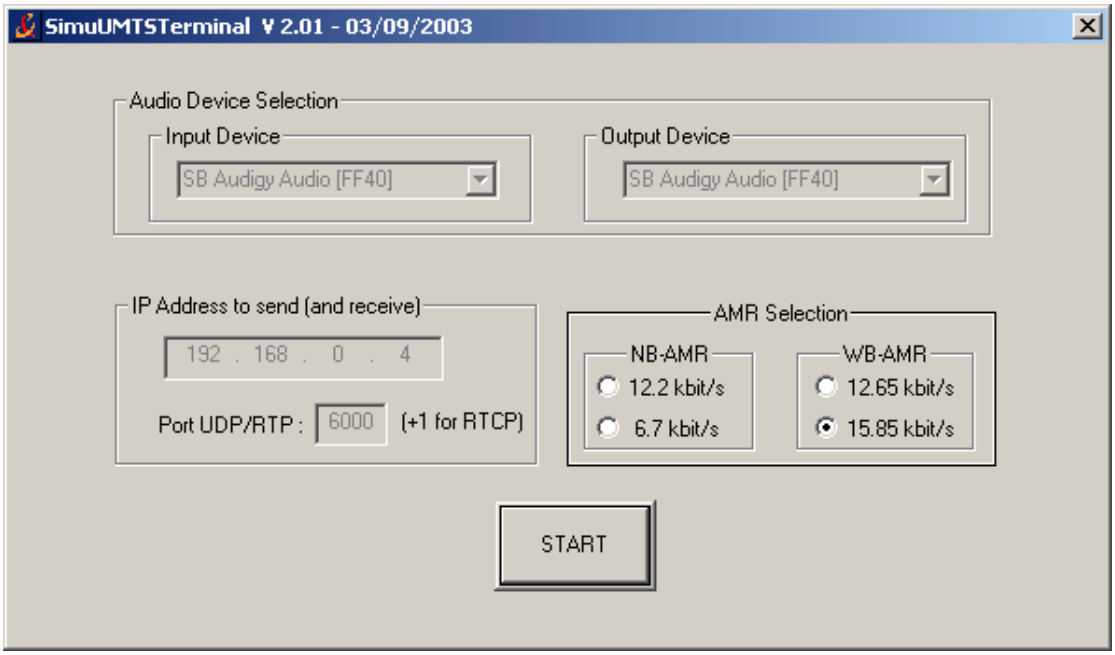
Mot de passe : smarts

And validate the entries by click on the OK button.

After boot, the following shortcut will be on the screen

Raccourci vers
SimuUMTSTerminal.exe

A double click on it will display the following window:



The fields concerning Audio Device selection are filled up automatically. The others fields can be changed but the value in IP Address to send and receive must be 192.168.0.4 as well as the value of the field Port UDP/RTP 6000.

PC2 and PC4 operate under Linux system

After switch on , wait until a window with the message : Welcome to Linux at PC2 appears on PC2 and Welcome to Linux at PC4 on PC4.

Fill the fields with appropriate values (do not use numerical block):

Login : user

Password : cnet-95

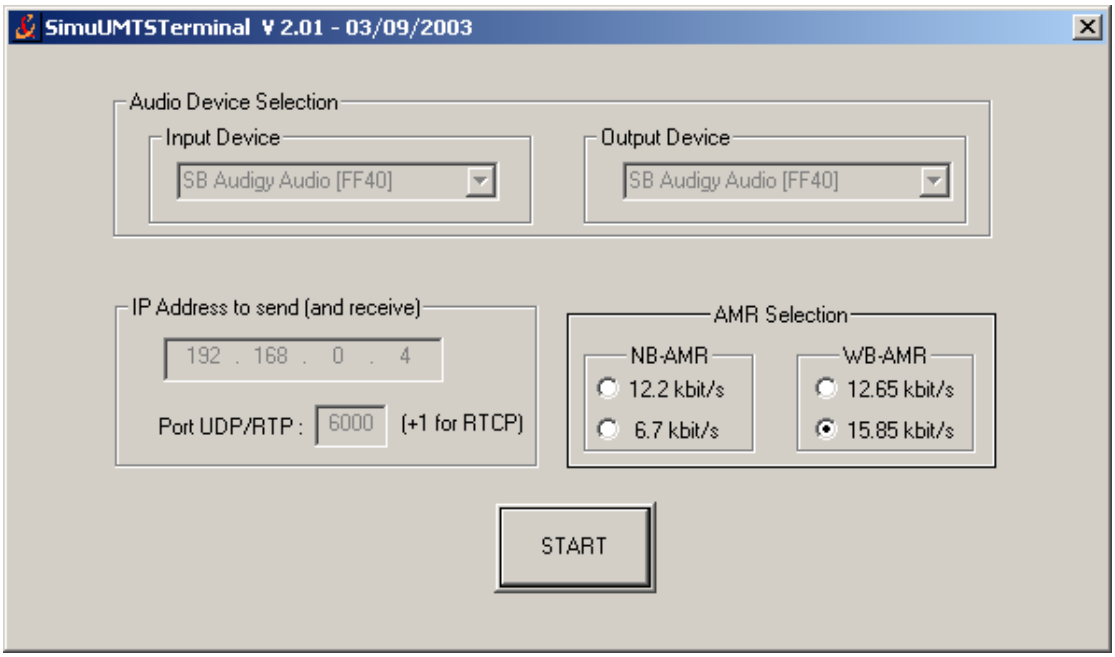
And validate the entries by click on the Go button.

Then in the window called Konsole by the system, type the following command
cd /usr/local/ver_2508/UMTS_AI_Sim
and validate by enter.
(Please note that there is a space between cd and / in the preceding command line)

A1.4 Running the test

A condition consists of a codec mode, a IP impairment, a delay and radio condition. Please follow the order of operations:

a. On PC1 and PC5, select the bit rate by click on the bit rate button and then click on the start button



The start button becomes stop button.

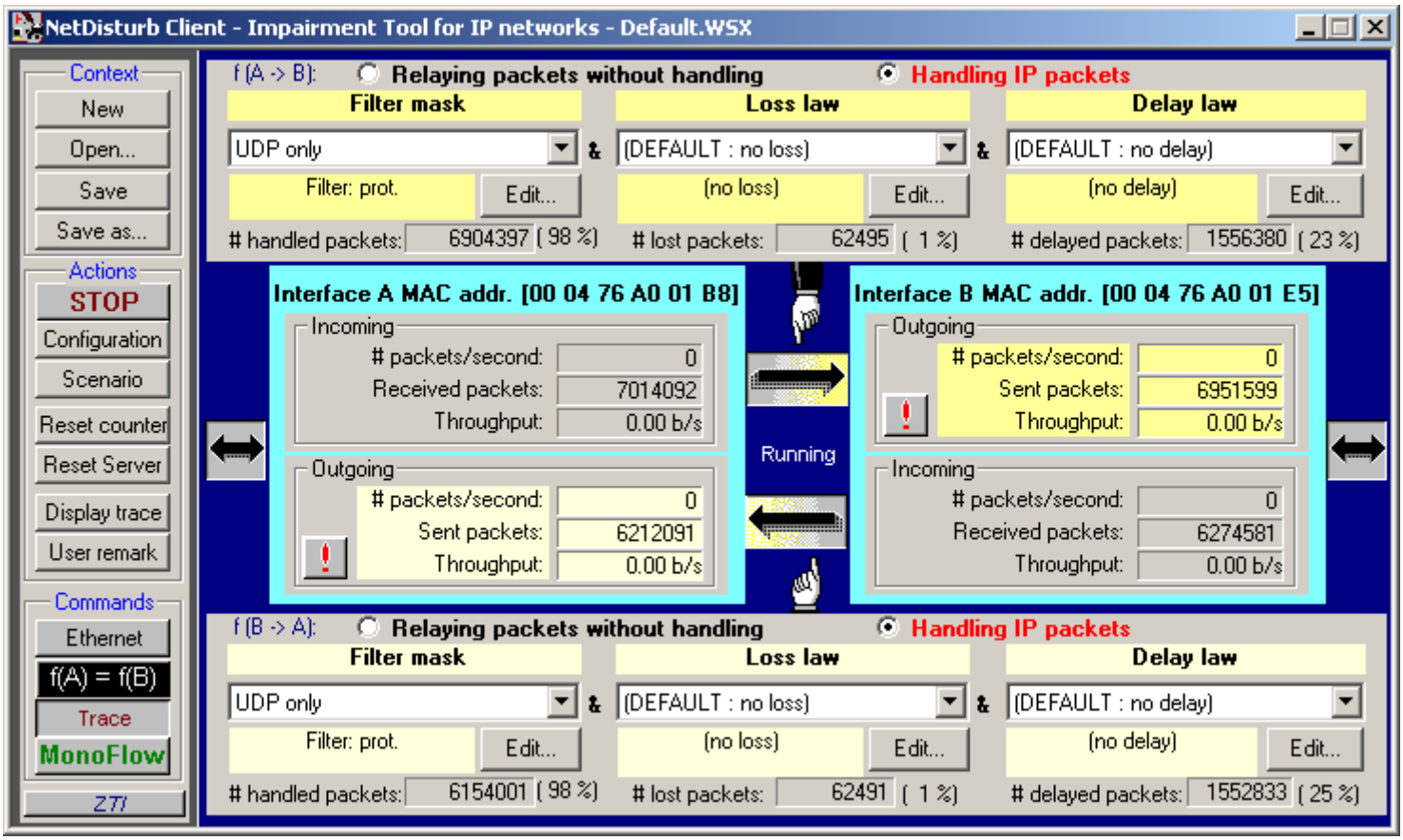
b. On PC3, select the loss law and delay law corresponding to the condition to be tested.

The field loss law has to be filled by the value given in the test plan

- Default(no loss) if IP condition impairment is0%
- 3% burst if IP condition impairment is 3%

The field delay law has to be filled by the value given in the test plan

- delay 300 ms
- delay 500 ms



c. **For narrow band test** , on PC2 and PC 4, start the radio condition x by typing the command sh crx and validate by pressing enter.

For example, to start the radio corresponding to condition 5, you should type
sh cr5
on the Terminal-Konsole window.

For wide band test , on PC2 and PC 4, start the radio condition z by typing the command sh crwbz and validate by pressing enter.

For example, to start the radio corresponding to condition 17, you should type
sh crwb17
on the Terminal-Konsole window.

d. The communication is now established and you can see the current bit rate on PC3 in packets/second fields, bit rates should be between 48 and 52 packets/seconds.

e. After the end of each test condition, communications have to be stopped by click on stop button of PC1 and PC5.

WARNING: Each time you click on stop button on PC1 You MUST also click on the stop button on PC5 and vice versa.

A1.5 Stopping the PCs

For PC1, PC3 and PC5 press Ctrl+Alt+Suppr and click on "Arrêter le système".
When the message :
"Vous pouvez arrêter le système"
Appears on the screen then switch the PC off.

For PC2 and PC4, press Ctrl+Alt+Suppr and click on button "Eteindre l'ordinateur".
And validate by OK button.
When Power down appears on the screen, shut down the PC.

A1.6 Help on Problems

When can we state that the application does not work properly?

- Only one of the subjects is able to hear the other.
- One of packets/second fields on PC3, has a very low value

What can we do?
Click on the stop button of UMTS terminal simulator of PC1 and PC5, wait a few seconds and click on start button of UMTS terminal simulator of PC1 and PC5.
Then on PC2 and PC4, type again the command sh crx or sh crwbz and validate by pressing enter.

If there is still a problem, could be on PC2 and PC4 a message like "bind already in use"
Process called usim has to be killed
To kill a process:
On bottom of the Terminal-Konsole window, there are button called terminal and another called terminal2. Normally we work on terminal so that click on terminal2 and type the command ps –x and validate it by pressing on entrée.
You will find the number of usim process there are 4 usim process.
For each type the command line kill -9 xxxxx where xxxxx is the number of the process.
You can know that the process are killed by type again the command ps –x and there is no more usim.
Then Go back on the terminal by click on terminal button and retype again the command sh crx or sh crwbz and validate by pressing enter

Annex 2 Ambient noise

This annex describes the three ambient noises used for the dissymetrical test conditions, and the test method for the calibration.

A2. 1 Noise files
The .wav files of the three ambient noises were given to the three test laboratories. The duration of each file is long enough for a normal conversation duration. However, it can be automatically played as a loop to avoid any blank.

A2.2 Noise generation
The noise files are played by the PC, transmitted to four amplifiers which feed the four loudspeakers. The loudspeakers are fixed to the wall, all around the subject' position in the room. They are equalized to contribute similarly to the ambient noise.

A2.3 Test method and Noise level calibration
The measurement microphone is placed at a point located in the middle of the subject's head, in his absence. The noise level is measured by a sound level meter including the Leq (equivalent noise level) function, on a minimum of 2 minutes.
The play-back settings are recorded for each noise. So, noise generation and level checking do not delay the following conversation

Annex 3 Contractual schedule

15th September 2003	The host laboratory (FT) is expected to have completed the testing set-up implementation (icluding the software expected to be received from Siemens on 1st September) and verification and the first CONTRACTOR (FT) is expected to have completed the first part of the subjective testing conversation work (NB).
22th september 2003*	The second CONTRACTOR (NTT AT) is expected to receive the testing set-up from FT.
9th October 2003	The second CONTRACTOR (NTT AT) is expected to have completed the subjective testing (conversation) work and sent the equipment back to FT.
16th October 2003*	The first CONTRACTOR (FT) is expected to receive the testing set-up from NTT-AT.
29h October 2003	The first CONTRACTOR (FT) is expected to have completed the set-up checking and completed the subjective testing (conversation) Work and sent the equipment to the third Contractor (ARCON)
5th November 2003*	The third CONTRACTOR (ARCON) is expected to receive the testing set-up from FT.
21st November 2003	The third CONTRACTOR is expected to have completed the subjective testing (conversation) work and sent back the equipment to FT.
22nd November 2003 or before	The CONTRACTOR to circulate to 3GPP_TSG_SA_WG4@list.etsi.fr a draft report of LISTENING LAB work.
24th - 28th November 2003	The CONTRACTOR to present the individual executive summary and report during TSG-SA WG4#29 plenary for the review and approval of the work performed.
15th - 18th December 2003	TSG-SA #22 to review and approve the work performed during the 3GPP AMR-NB and/or AMR-WB PS conversation tests.

* These dates are given for information only (for a shipping delay of one week)

Note : Globally, the schedule has been fulfilled for the shippings and tests. The only exception is a delay (5 days), due to customs (a wrong phone number, and the week-end) for delivering the test bed to the third contractor.

Annex 4

Table: AMRNB Results

	Noise		Experimental factors				Condition	Q1			Q2			Q3			Q4			Q5		
Condition	Room A	Room B	Radio conditions	IP conditions	Mode (kbit/s)	Delay (ms)		Score	S.D	C.I	Score	S.D	C.I	Score	S.D	C.I	Score	S.D	C.I	Score	S.D	C.I
1	No	No	0.01	0%	6.7	300	NB01	3,81	1,18	0,41	4,06	1,08	0,37	3,69	0,93	0,32	3,84	1,27	0,44	3,53	1,16	0,40
2	No	No	0.01	0%	12.2	500	NB02	3,81	1,03	0,36	4,16	0,85	0,29	3,66	0,83	0,29	4,00	1,19	0,41	3,63	0,91	0,31
3	No	No	0.01	0%	12.2	300	NB03	3,63	0,94	0,33	3,94	0,88	0,30	3,72	0,77	0,27	3,84	0,99	0,34	3,56	0,80	0,28
4	No	No	0.01	3%	6.7	300	NB04	3,22	1,04	0,36	3,31	1,18	0,41	3,13	1,01	0,35	2,94	1,37	0,47	2,81	1,18	0,41
5	No	No	0.01	3%	12.2	500	NB05	3,38	0,91	0,31	3,66	1,00	0,35	3,38	0,83	0,29	2,94	1,05	0,36	2,94	0,98	0,34
6	No	No	0.01	3%	12.2	300	NB06	3,63	1,07	0,37	3,78	0,91	0,31	3,56	0,84	0,29	3,44	1,22	0,42	3,22	1,07	0,37
7	No	No	0.001	0%	6.7	300	NB07	4,16	0,68	0,23	4,47	0,72	0,25	4,00	0,62	0,22	4,38	0,66	0,23	4,00	0,72	0,25
8	No	No	0.001	0%	12.2	500	NB08	4,22	0,66	0,23	4,41	0,76	0,26	4,03	0,65	0,22	4,44	0,80	0,28	4,06	0,62	0,21
9	No	No	0.001	0%	12.2	300	NB09	4,56	0,56	0,20	4,69	0,47	0,16	4,38	0,66	0,23	4,78	0,42	0,15	4,50	0,51	0,18
10	No	No	0.001	3%	6.7	300	NB10	3,66	1,12	0,39	3,94	1,01	0,35	3,88	0,91	0,31	3,72	1,20	0,41	3,41	1,04	0,36
11	No	No	0.001	3%	12.2	500	NB11	3,84	0,77	0,27	3,97	0,78	0,27	3,56	0,76	0,26	3,91	1,12	0,39	3,69	0,69	0,24
12	No	No	0.001	3%	12.2	300	NB12	3,91	0,89	0,31	4,22	0,71	0,24	4,09	0,69	0,24	4,13	0,91	0,31	3,97	0,69	0,24
13	No	No	5.10^{-4}	0%	6.7	300	NB13	4,25	0,76	0,26	4,63	0,49	0,17	4,16	0,51	0,18	4,59	0,61	0,21	4,25	0,57	0,20
14	No	No	5.10^{-4}	0%	12.2	500	NB14	4,34	0,83	0,29	4,47	0,84	0,29	3,97	0,65	0,22	4,53	0,92	0,32	3,97	0,74	0,26
15	No	No	5.10^{-4}	0%	12.2	300	NB15	4,44	0,62	0,21	4,50	0,62	0,22	4,19	0,69	0,24	4,50	0,72	0,25	4,19	0,69	0,24
16	No	No	5.10^{-4}	3%	6.7	300	NB16	3,84	0,95	0,33	3,97	0,90	0,31	3,72	0,81	0,28	3,75	1,14	0,39	3,56	0,91	0,32
17	No	No	5.10^{-4}	3%	12.2	500	NB17	3,88	0,87	0,30	4,22	0,91	0,31	3,78	0,75	0,26	4,13	0,87	0,30	3,78	0,87	0,30
18	No	No	5.10^{-4}	3%	12.2	300	NB18	3,75	0,98	0,34	3,88	0,94	0,33	3,63	0,75	0,26	3,78	1,10	0,38	3,44	0,76	0,26
19A	Car		5.10^{-4}	3%	12.2	300	NB19	3,75	0,93	0,46	3,13	1,36	0,67	3,25	0,93	0,46	2,75	1,18	0,58	2,63	0,96	0,47
20A	No		5.10^{-4}	3%	12.2	300	NB20	4,13	0,89	0,43	4,06	0,85	0,42	3,81	0,66	0,32	3,88	0,96	0,47	3,50	0,97	0,47
21A	Cafeteria		5.10^{-4}	0%	6.7	300	NB21	4,06	0,44	0,22	3,94	1,00	0,49	3,69	0,79	0,39	3,69	1,40	0,69	3,50	1,15	0,57
22A	No		5.10^{-4}	0%	6.7	300	NB22	4,44	0,73	0,36	4,69	0,70	0,35	4,19	0,54	0,27	4,50	0,73	0,36	4,19	0,66	0,32
23A	Street		5.10^{-4}	0%	12.2	500	NB23	4,25	0,68	0,33	4,06	0,85	0,42	3,63	0,89	0,43	3,69	1,45	0,71	3,56	1,09	0,54
24A	No		5.10^{-4}	0%	12.2	500	NB24	4,38	0,72	0,35	4,44	0,73	0,36	3,88	0,62	0,30	4,31	0,79	0,39	4,00	0,73	0,36
19B		No	5.10^{-4}	3%	12.2	300	NB19	3,63	1,09	0,53	3,75	0,93	0,46	3,44	0,81	0,40	3,69	1,14	0,56	3,06	1,00	0,49
20B		Car	5.10^{-4}	3%	12.2	300	NB20	3,50	1,10	0,54	2,81	0,98	0,48	2,88	1,20	0,59	2,69	1,45	0,71	2,44	1,21	0,59
21B		No	5.10^{-4}	0%	6.7	300	NB21	4,19	0,91	0,45	4,31	0,70	0,35	3,94	0,77	0,38	4,50	0,73	0,36	4,00	0,82	0,40
22B		Cafeteria	5.10^{-4}	0%	6.7	300	NB22	4,06	0,68	0,33	3,44	0,96	0,47	3,38	1,20	0,59	3,19	1,60	0,78	3,06	1,44	0,70
23B		No	5.10^{-4}	0%	12.2	500	NB23	4,00	0,97	0,47	4,31	0,70	0,35	3,94	0,77	0,38	4,13	1,02	0,50	3,81	0,66	0,32
24B		Street	5.10^{-4}	0%	12.2	500	NB24	3,81	0,91	0,45	3,38	0,96	0,47	3,31	0,87	0,43	3,19	1,52	0,74	3,06	1,29	0,63

	Noise		Experimental factors				Condition	Q1			Q2			Q3			Q4			Q5		
Condition	Room A	Room B	Radio conditions	IP ondition	Mode (kbit/s)	RoHC or not		Score	S.D	C.I	Score	S.D	C.I	Score	S.D	C.I	Score	S.D	C.I	Score	S.D	C.I
1	No	No	0.01	0%	12.65	RoHC	WB01	4,22	0,94	0,33	4,41	0,84	0,29	4,13	0,75	0,26	4,25	0,92	0,32	4,06	0,88	0,30
2	No	No	0.01	0%	12.65	no	WB02	4,44	0,76	0,26	4,84	0,37	0,13	4,38	0,55	0,19	4,41	0,71	0,25	4,31	0,54	0,19
3	No	No	0.01	0%	15.85	RoHC	WB03	4,28	0,81	0,28	4,50	0,76	0,26	4,19	0,74	0,26	4,28	0,81	0,28	4,09	0,73	0,25
4	No	No	0.01	3%	12.65	RoHC	WB04	3,72	1,08	0,38	4,09	0,96	0,33	4,09	0,73	0,25	3,84	1,11	0,38	3,53	1,08	0,37
5	No	No	0.01	3%	12.65	no	WB05	3,75	1,19	0,41	3,88	1,07	0,37	3,81	1,00	0,35	3,88	1,16	0,40	3,63	1,01	0,35
6	No	No	0.01	3%	15.85	RoHC	WB06	3,97	0,93	0,32	4,44	0,72	0,25	4,13	0,75	0,26	4,03	1,00	0,35	3,84	0,85	0,29
7	No	No	0.001	0%	12.65	RoHC	WB07	4,38	0,71	0,24	4,56	0,67	0,23	4,22	0,66	0,23	4,56	0,72	0,25	4,19	0,64	0,22
8	No	No	0.001	0%	12.65	no	WB08	4,47	0,80	0,28	4,69	0,59	0,21	4,25	0,67	0,23	4,47	0,80	0,28	4,25	0,76	0,26
9	No	No	0.001	0%	15.85	RoHC	WB09	4,63	0,55	0,19	4,75	0,51	0,18	4,38	0,66	0,23	4,50	0,67	0,23	4,38	0,55	0,19
10	No	No	0.001	3%	12.65	RoHC	WB10	4,31	0,90	0,31	4,50	0,76	0,26	4,13	0,61	0,21	4,19	0,97	0,33	3,94	0,76	0,26
11	No	No	0.001	3%	12.65	no	WB11	4,25	0,92	0,32	4,56	0,67	0,23	4,16	0,77	0,27	4,16	0,95	0,33	3,97	0,69	0,24
12	No	No	0.001	3%	15.85	RoHC	WB12	4,03	0,97	0,33	4,38	0,94	0,33	4,09	0,69	0,24	4,22	0,83	0,29	3,81	0,93	0,32
13	No	No	5.10^{-4}	0%	12.65	RoHC	WB13	4,34	0,79	0,27	4,63	0,71	0,24	4,22	0,66	0,23	4,53	0,67	0,23	4,13	0,91	0,31
14	No	No	5.10^{-4}	0%	12.65	no	WB14	4,59	0,56	0,19	4,81	0,40	0,14	4,44	0,62	0,21	4,56	0,62	0,21	4,38	0,61	0,21
15	No	No	5.10^{-4}	0%	15.85	RoHC	WB15	4,47	0,67	0,23	4,69	0,59	0,21	4,31	0,69	0,24	4,47	0,80	0,28	4,16	0,72	0,25
16	No	No	5.10^{-4}	3%	12.65	RoHC	WB16	3,97	0,93	0,32	4,53	0,62	0,22	3,97	0,65	0,22	4,16	0,85	0,29	3,88	0,79	0,27
17	No	No	5.10^{-4}	3%	12.65	no	WB17	4,19	0,86	0,30	4,47	0,72	0,25	4,13	0,66	0,23	4,28	0,92	0,32	3,94	0,76	0,26
18	No	No	5.10^{-4}	3%	15.85	RoHC	WB18	4,34	0,83	0,29	4,53	0,67	0,23	4,06	0,72	0,25	4,19	1,03	0,36	3,91	0,89	0,31
19A	Car		5.10^{-4}	3%	12.65	RoHC	WB19	4,31	0,60	0,30	3,53	1,28	0,63	3,50	0,82	0,40	3,31	1,20	0,59	3,44	0,96	0,47
20A	No		5.10^{-4}	3%	12.65	RoHC	WB20	4,06	1,06	0,52	4,35	0,86	0,42	3,88	0,50	0,24	4,00	1,10	0,54	3,88	0,81	0,40
21A	Cafeteria		5.10^{-4}	0%	12.65	no	WB21	4,25	0,68	0,33	4,12	0,93	0,45	3,88	0,50	0,24	3,69	1,25	0,61	3,63	0,96	0,47
22A	No		5.10^{-4}	0%	12.65	no	WB22	4,69	0,48	0,23	4,82	0,39	0,19	4,06	0,57	0,28	4,31	0,87	0,43	4,19	0,54	0,27
23A	Street		5.10^{-4}	0%	15.85	RoHC	WB23	4,38	0,72	0,35	3,53	1,23	0,60	3,50	0,89	0,44	3,44	1,36	0,67	3,44	1,03	0,51
24A	No		5.10^{-4}	0%	15.85	RoHC	WB24	4,69	0,48	0,23	4,65	0,61	0,30	4,00	0,52	0,25	4,44	0,73	0,36	4,13	0,50	0,24
19B		No	5.10^{-4}	3%	12.65	RoHC	WB19	4,00	1,10	0,54	4,24	0,97	0,48	4,06	0,77	0,38	3,75	1,13	0,55	3,63	1,02	0,50
20B		Car	5.10^{-4}	3%	12.65	RoHC	WB20	3,88	0,89	0,43	3,47	1,12	0,55	3,81	1,22	0,60	3,44	1,41	0,69	3,25	1,34	0,66
21B		No	5.10^{-4}	0%	12.65	no	WB21	4,44	0,63	0,31	4,65	0,49	0,24	4,44	0,63	0,31	4,56	0,73	0,36	4,13	0,72	0,35
22B		Cafeteria	5.10^{-4}	0%	12.65	no	WB22	4,50	0,63	0,31	4,53	0,87	0,43	4,31	0,70	0,35	4,25	1,06	0,52	4,00	0,89	0,44
23B		No	5.10^{-4}	0%	15.85	RoHC	WB23	4,19	0,91	0,45	4,53	0,62	0,31	4,06	0,57	0,28	4,06	0,93	0,46	4,06	0,68	0,33
24B		Street	5.10^{-4}	0%	15.85	RoHC	WB24	4,25	0,77	0,38	4,12	0,86	0,42	4,00	0,73	0,36	3,25	1,24	0,61	3,38	0,96	0,47

Table: AMRWB Results