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Meeting #22, Maui, Hawaii, USA, 15-18 December 2003 **Agenda Item: 7.4.3**

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Tampere, November 24 – 28. Agenda Item: 7, 13.1

Source: **TSG SA WG4** (NTT-Advanced Technology Corporation)

Title: **3G PS conversation tests (AMR NB and AMR WB) : Report from NTT-AT for Subjective Testing Lab function**

Document for: **Approval**
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1. Introduction

NTT-AT conducted a conversation experiment to evaluate AMR narrow band and wide band. The experimental design and procedures are specified in the test plan for the AMR Narrow-Band Packet swiched Conversation test (Tdoc S4-030564) and test plan for the AMR Wide-band Packet swiched Conversation test (Tdoc S4-030565)

2. General procedure

2.1 Test Bed

France Telecom provided the simulation platform for the test. All of the PCs were installed outside soundproof rooms to prevent fan noise. Subject's votes were recorded by laptop PCs without fans in each of the rooms.

2.2 Speech level calibration

The listening sound pressure level output from the headphones was calibrated according to the instructions in the test plan. The receiving sound detected by the P.57 type 1 artificial ear was coupled with a headphone and its active speech level was measured using ITU-T Rec. P.56 meter when a P.50 artificial voice was fed from an artificial mouth to the microphone on the send side. The speaking position of the microphone was MRP and sound pressure was –4.7 dB Pa.

2.3 Scenarios for the conversation test.

In the test plan, two examples, pizza delivery service information and flight information are provided. As far as we considered easiness for Japanese subjects, we thought it was difficult to perform responder as natural as professional for naïve subjects without considerable training. We stopped using the examples and got reconfirmation on which scenarios were only examples and where we can use another scenario if we had any difficulty. Finally, we adopted the "Random shapes method*" within several existing scenarios.†

Conditions and scenarios were randomized following tables provided by France Telecom. The random tables are composed of two sub-tables, for conditions where there is and is not background noise. The order of the conditions and the scenario numbers used by the subjects for each condition are

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*)D.L. Richards, "Telecommunication by Speech", Butterworth London, 1980 P.202

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allocated in these tables. Twenty-four different scenarios are necessary in order to follow the tables. In our case, we replaced the scenario number with number of the sheet.

There are 24 random shapes on each sheet. During the conversation, each subject arbitrarily chose a shape on the sheet and talked about one of its features to his/her partner. His/her partner either guessed the name of the shape based on the information provided, or requested additional information from the questioner. The role of respondent and questioner switched every time the respondent provided correct answer. Three minuets were permitted for each condition.

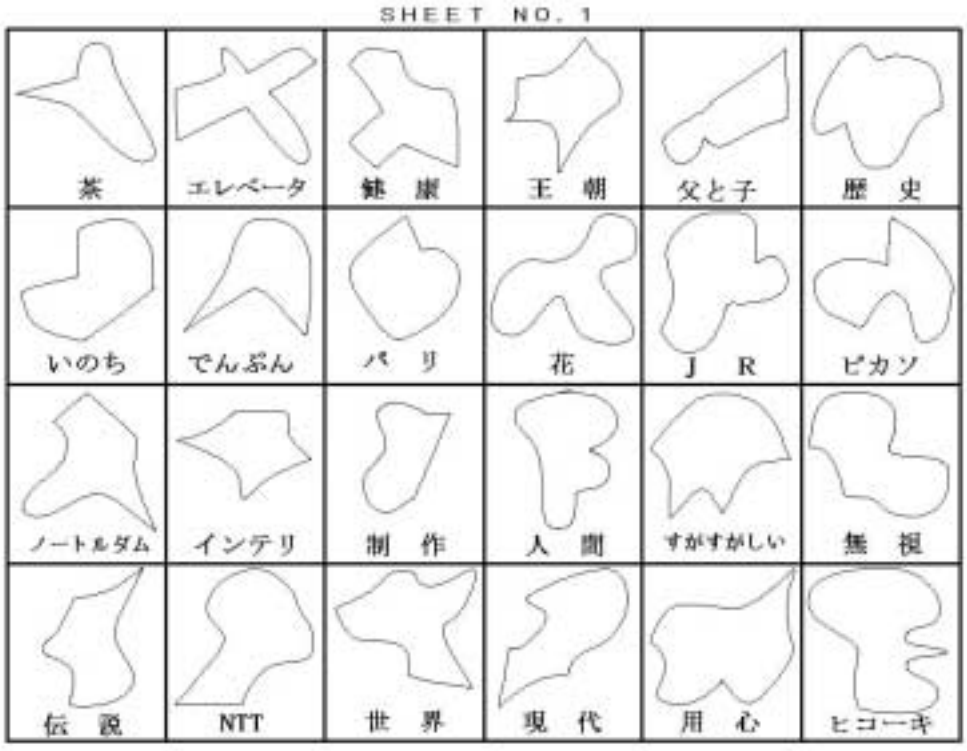

Fig. 2.1 Example of random shapes on one sheet

2.4 Subjects

Completely different sets of naïve listeners were recruited from outside of the company for the narrow band and wide band experiments. A wide variety of ages and genders were recruited.

Fig. 2.2 Subject perform her conversation using a sheet of random shapes.

Fig. 2.3 All simulation platforms were installed and performed outside of soundproof room

2.5 Preliminary experiment

So that the subjects could understand how the experiment would be conducted, a preliminary experiment without any degradation was performed.

2.6 Test order

Tests for conditions with and without background noise were conducted separately. Half of the 16 subject groups were administered the test with noise first and the other half were administered the test without noise to cancel any psychological offset due to the degree of experience with the test.

For conditions with background noise, subjects were instructed to ignore background noise contained in transmitted speech or in surrounding noise.

After every 3 or 4 conditions, the two groups changed tests so that they could alternately took breaks to minimize the influence of fatigue.

2.7 Listening Equipment and Environment

Each of the two subjects participating in the conversations sat on a chair in front of a table in a test room. The test rooms are acoustically insulated. All the test equipments was installed outside of the rooms and connected to the test rooms. The background noise is generated in the designated test room through a set of 4 loudspeakers. The level of background noise was measured by sound level meter at a minimum of four points around the equivalent of the center of the subject's head. The A-weighted noise level averaged over these points was adjusted to the target value.

2.8 Data collection

Subjects were asked to answer five different questions. For each question, some explanatory sentences always have to be shown in order to prevent confusion when answering other questions. We prepared customized graphical user interface using browser to collect a subject's response as shown in **Fig. 2.4**.

Fig. 2.4 GUI used to collect subject's response.

3 Results

We summarized results in the tables for each question. We also present them on graphs to facilitate observation of the difference between radio and PS conditions. With respect to the result of E-mail inquiry for the numerical and graphical formats for representing subjects' responses from secretary to test labs by correspondence, there was no objection to the formats reflecting secretary and our opinion.

As for the detailed analysis, especially statistical difference among test laboratories will be conducted after global analysis laboratory is determined, The remainder of our report presents basic statistics and simple observations.

3.1 Narrow-Band

1) Question 1: “How do you judge the quality of voice of your partner?”

Numerical results for all 24 conditions are shown in **Table 3.1.1**. The 7th to 9th columns of the table lists MOS (Column 7) and fundamental statistics, such as standard deviation (Column 8), and 95 % confidence limit (Column 9). These set of values were calculated separately for subjects in room A and B, but these values are not essential, all cells corresponding to the conditions are shaded. The effects of background noise are summarized separately for subjects in room A (columns 10 to 12) and room B (columns 13 to 15).

Table 3.1.1 Summarized numerical results for question 1

Condition	Additional Background noise	Additional Background noise	Experimental factors			Room A+Room B			Room A			Room B		
						MOS	STD	95% CI	MOS	STD	95% CI	MOS	STD	95% CI
	Room A	Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode + Delay	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)
1	No	No	10-2	0%	6,7kbit/s (delay 300 ms)	3.28	1.02	0.35	2.94	1.18	0.58	3.63	0.72	0.25
2	No	No	10-2	0%	12,2 kbit/s (delay 500 ms)	3.06	1.01	0.35	3.13	1.09	0.53	3.00	0.97	0.33
3	No	No	10-2	0%	12,2 kbit/s (delay 300 ms)	3.47	1.14	0.39	3.44	1.21	0.59	3.50	1.10	0.38
4	No	No	10-2	3%	6,7kbit/s (delay 300 ms)	2.75	0.98	0.34	2.88	0.96	0.47	2.63	1.02	0.36
5	No	No	10-2	3%	12,2kbit/s(delay 500 ms)	2.84	1.22	0.42	2.81	1.22	0.60	2.88	1.26	0.44
6	No	No	10-2	3%	12,2 kbit/s (delay 300 ms)	3.16	1.06	0.37	3.06	1.18	0.58	3.25	1.00	0.35
7	No	No	10-3	0%	6,7kbit/s (delay 300 ms)	3.41	1.21	0.42	3.50	1.32	0.65	3.31	1.14	0.39
8	No	No	10-3	0%	12,2kbit/s(delay 500 ms)	3.59	0.84	0.29	3.56	0.89	0.44	3.63	0.81	0.28
9	No	No	10-3	0%	12,2 kbit/s (delay 300 ms)	3.47	0.92	0.32	3.31	1.08	0.53	3.63	0.72	0.25
10	No	No	10-3	3%	6,7kbit/s (delay 300 ms)	3.16	1.05	0.36	2.94	1.12	0.55	3.38	0.96	0.33
11	No	No	10-3	3%	12,2kbit/s(delay 500 ms)	3.19	1.00	0.35	3.06	1.12	0.55	3.31	0.87	0.30
12	No	No	10-3	3%	12,2 kbit/s (delay 300 ms)	3.41	0.98	0.34	3.31	1.20	0.59	3.50	0.73	0.25
13	No	No	5x10-4	0%	6,7kbit/s (delay 300 ms)	3.59	0.95	0.33	3.75	0.93	0.46	3.44	0.96	0.33
14	No	No	5x10-4	0%	12,2kbit/s(delay 500 ms)	3.50	1.02	0.35	3.44	0.96	0.47	3.56	1.09	0.38
15	No	No	5x10-4	0%	12,2 kbit/s (delay 300 ms)	4.03	0.86	0.30	3.94	1.06	0.52	4.13	0.62	0.21
16	No	No	5x10-4	3%	6,7kbit/s (delay 300 ms)	3.19	1.09	0.38	3.00	1.15	0.57	3.38	1.02	0.36
17	No	No	5x10-4	3%	12,2kbit/s(delay 500 ms)	3.22	1.07	0.37	3.19	1.23	0.60	3.25	0.93	0.32
18	No	No	5x10-4	3%	12,2 kbit/s (delay 300 ms)	3.25	1.16	0.40	3.06	1.44	0.70	3.44	0.81	0.28
19	Car	No	5x10-4	3%	12,2 kbit/s (delay 300 ms)				2.75	0.93	0.46	3.44	0.89	0.31
20	No	Car	5x10-4	3%	12,2 kbit/s (delay 300 ms)				3.56	1.03	0.51	2.81	1.28	0.44
21	Cafeteria	No	5x10-4	0%	6,7 kbit/s (delay 300 ms)				3.06	0.93	0.46	3.50	0.82	0.28
22	No	Cafeteria	5x10-4	0%	6,7 kbit/s (delay 300 ms)				3.56	0.73	0.36	3.31	1.08	0.37
23	Street	No	5x10-4	0%	12,2kbit/s(delay 500 ms)				3.25	0.68	0.33	3.50	0.89	0.31
24	No	Street	5x10-4	0%	12,2kbit/s(delay 500 ms)				3.63	1.15	0.56	3.25	0.86	0.30

Graphs of the conditions of MOS and its confidence limit for 6.7 kbit/s with 300 ms delay, 12.2 kbit/s with 300 ms delay, and 12.2 kbit/s with 500 ms delay are shown in **Figures 3.1.1.1** through **3.1.1.3**. These values do not include data recorded with background noise. In general, MOS values are greater when BERs are lower and in groups without packet loss, 0 %, is greater than for 3 %. Such a tendency is seen without a few exceptions, groups with 0% packet loss are shown in **Fig. 3.1.1.2** and for 3 % in **Fig. 3.1.1.3**

The effect of background noise are shown in **Fig. 3.1.1.4** and **3.1.1.5**. As the graphs show, the influence of room A's and B's noise is almost same regardless of whether or not the noise is heard in the subject's surroundings or transmitted via speech from the other side.

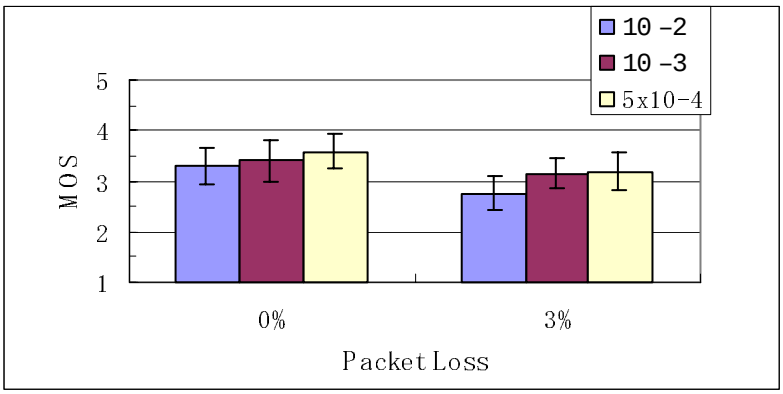

Fig. 3.1.1.1 MOS variation according to packet loss, radio transmission error at 6.7 kbit/s mode with 300ms delay.

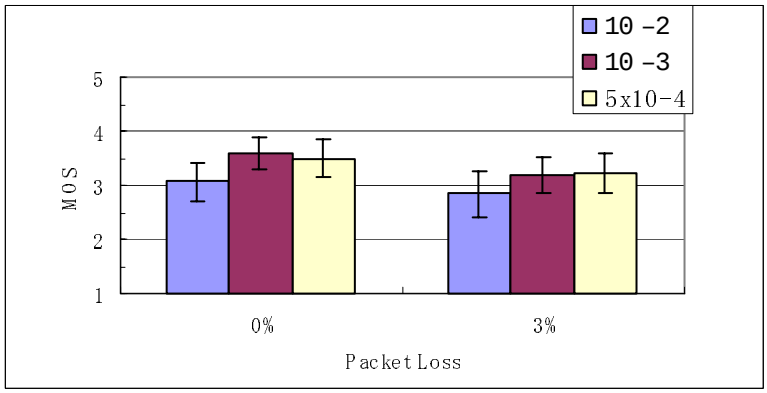

Fig. 3.1.1.2 MOS variation according to packet loss, radio transmission error at 12.2 kbit/s mode with 500 ms delay.

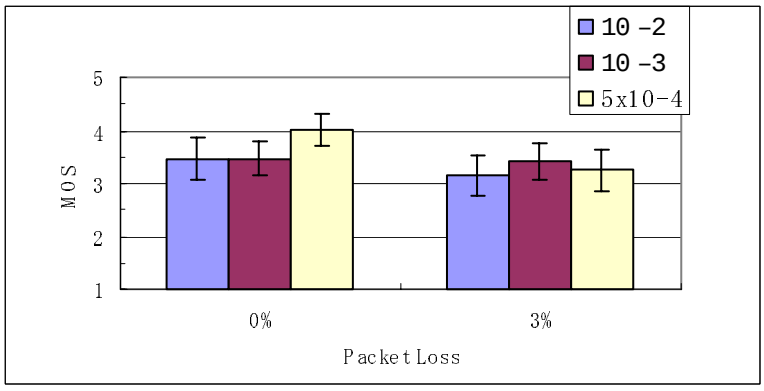

Fig. 3.1.1.3 MOS variation according to packet loss, radio transmission error at 12.2 kbit/s mode with 300ms delay.

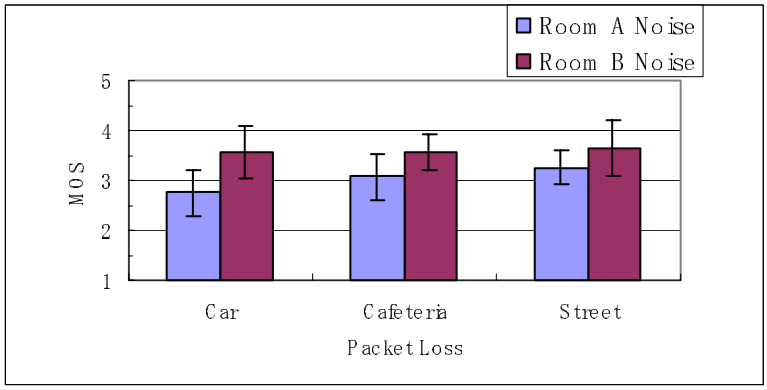

Fig. 3.1.1.4 MOS variation according to surrounding background noises (room A) and transmitted (room B) by the subjects in room A.

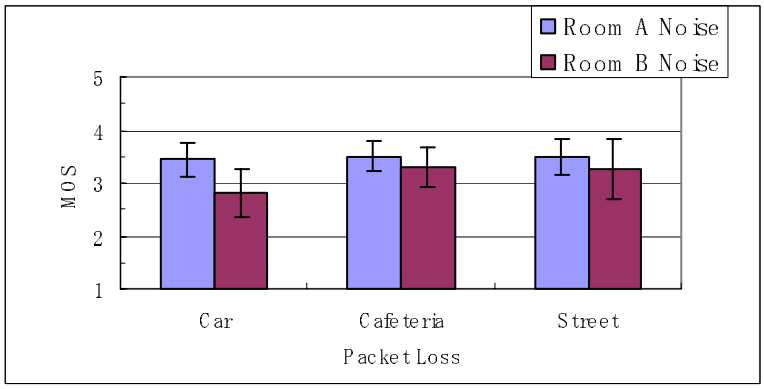

Fig. 3.1.1.5 MOS variation according to surrounding background noises (room A) and transmitted (room B) by the subjects in room B.

2) Question 2: “Do you have difficulties to understand some words”.

Numerical results for all 24 conditions are shown in **Table 3.1.2**. The 7th to 9th columns of the table list MOS (Column 7) and fundamental statistics, such as standard deviation (Column 8), 95 % confidence limit (Column 9). As in **Table 3.1.1**, these set of values were calculated for subjects in room A and B separately, but these are not essential, all cells corresponding to the conditions are shaded. The effects of background noise are summarized separately for subjects in room A (columns 10 to 12) and room B (columns 13 to 15).

Table 3.1.2 Summarized numerical results for Question 2

Condition	Additional Background noise	Additional Background noise	Experimental factors			Room A+Room B			Room A			Room B		
						MOS	STD	95% CI	MOS	STD	95% CI	MOS	STD	95% CI
	Room A	Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode + Delay	(Ye)	(Se)	(CI)	(Ye)	(Se)	(CI)	(Ye)	(Se)	(CI)
1	No	No	10 –2	0%	6,7kbit/s (delay 300 ms)	4.34	0.90	0.31	4.31	1.08	0.53	4.38	0.72	0.35
2	No	No	10 –2	0%	12,2 kbit/s (delay 300 ms)	4.09	1.23	0.45	3.94	1.24	0.61	4.25	1.24	0.61
3	No	No	10 –2	0%	12,2 kbit/s (delay 300 ms)	4.34	0.90	0.31	4.19	1.05	0.51	4.50	0.73	0.36
4	No	No	10 –2	3%	6,7kbit/s (delay 300 ms)	3.71	1.18	0.41	3.63	1.02	0.50	3.94	1.34	0.66
5	No	No	10 –2	3%	12,2kbit/s(delay 300 ms)	3.63	1.16	0.40	3.44	1.31	0.64	3.81	0.98	0.48
6	No	No	10 –2	3%	12,2 kbit/s (delay 300 ms)	4.03	1.15	0.40	4.13	0.96	0.47	3.94	1.34	0.66
7	No	No	10 –3	0%	6,7kbit/s (delay 300 ms)	4.44	1.23	0.42	4.44	1.26	0.62	4.44	1.21	0.59
8	No	No	10 –3	0%	12,2kbit/s(delay 500 ms)	4.50	0.88	0.30	4.56	0.81	0.40	4.44	0.96	0.47
9	No	No	10 –3	0%	12,2 kbit/s (delay 300 ms)	4.44	0.91	0.32	4.38	1.15	0.56	4.50	0.63	0.31
10	No	No	10 –3	3%	6,7kbit/s (delay 300 ms)	4.16	1.14	0.39	4.19	1.05	0.51	4.13	1.26	0.62
11	No	No	10 –3	3%	12,2kbit/s(delay 500 ms)	4.31	0.90	0.31	4.31	0.95	0.46	4.31	0.87	0.43
12	No	No	10 –3	3%	12,2 kbit/s (delay 300 ms)	4.44	0.88	0.30	4.38	1.02	0.50	4.50	0.73	0.36
13	No	No	5x10-4	0%	6,7kbit/s (delay 300 ms)	4.47	0.88	0.30	4.44	0.96	0.47	4.50	0.82	0.40
14	No	No	5x10-4	0%	12,2kbit/s(delay 500 ms)	4.56	0.72	0.25	4.38	0.89	0.43	4.75	0.45	0.22
15	No	No	5x10-4	0%	12,2 kbit/s (delay 300 ms)	4.75	0.62	0.22	4.63	0.81	0.40	4.88	0.34	0.17
16	No	No	5x10-4	3%	6,7kbit/s (delay 300 ms)	4.25	1.06	0.36	4.00	1.21	0.59	4.50	0.82	0.40
17	No	No	5x10-4	3%	12,2kbit/s(delay 500 ms)	4.25	1.11	0.38	4.19	1.33	0.65	4.31	0.87	0.43
18	No	No	5x10-4	3%	12,2 kbit/s (delay 300 ms)	4.22	1.18	0.41	4.13	1.31	0.64	4.31	1.08	0.53
19	Car	No	5x10-4	3%	12,2 kbit/s (delay 300 ms)				3.63	1.36	0.67	3.88	1.02	0.50
20	No	Car	5x10-4	3%	12,2 kbit/s (delay 300 ms)				3.63	1.50	0.73	3.94	1.34	0.66
21	Cafeteria	No	5x10-4	0%	6,7 kbit/s (delay 300 ms)				4.00	1.15	0.57	4.56	0.63	0.31
22	No	Cafeteria	5x10-4	0%	6,7 kbit/s (delay 300 ms)				4.25	1.06	0.52	4.38	0.89	0.43
23	Street	No	5x10-4	0%	12,2kbit/s(delay 500 ms)				3.94	1.34	0.66	4.50	0.63	0.31
24	No	Street	5x10-4	0%	12,2kbit/s(delay 500 ms)				4.00	1.10	0.54	4.50	0.73	0.36

Graphs of the score composition of 6.7 kbit/s with 300 ms delay, 12.2 kbit/s with 300 ms delay, and 12.2 kbit/s with 500 ms delay conditions are shown in **Figures 3.1.2.1** through **3.1.2.3**. These values do not include data recorded with background noise. In general, it is more difficult to understand some words are stronger when the BERs are higher and in groups without packet loss, 0 %, is weaker than for 3 %. Such tendency is seen without exception, groups for 3% packet loss in **Figures. 3.1.2.2** and **3.1.2.3**

The effect of background noise are shown in **Figures 3.1.2.4** and **3.1.2.5**. In these graphs, the influence of surround noise in room A, is little stronger than room B.

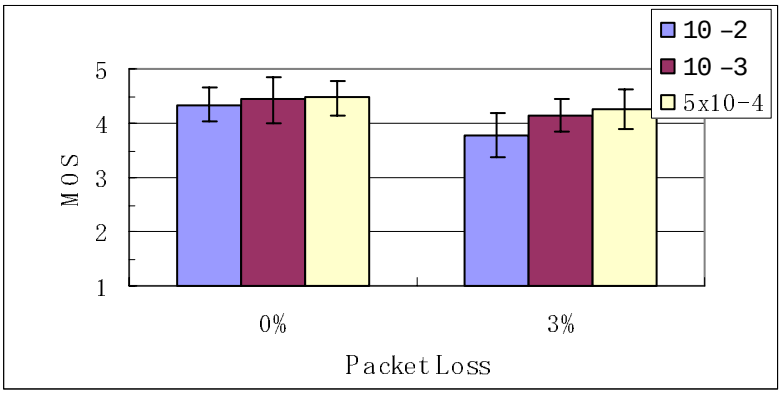

Fig. 3.1.2.1 Variation of score composition according to packet loss, radio transmission error at 6.7 kbit/s mode with 300ms delay.

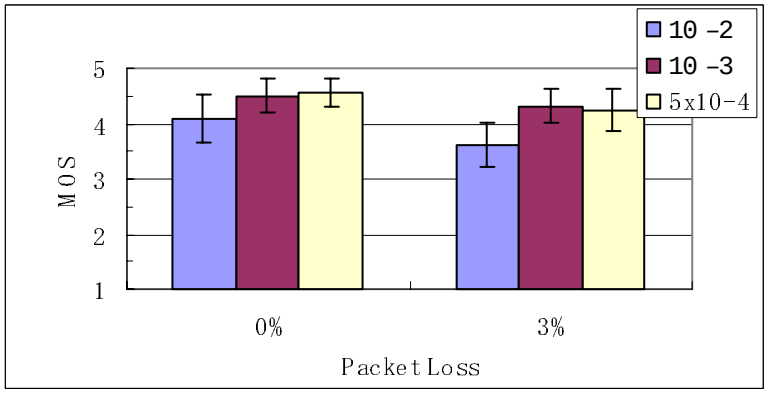

Fig. 3.1.2.2 Variation of score composition according to packet loss, radio transmission error at 12.2 kbit/s mode with 500 ms delay.

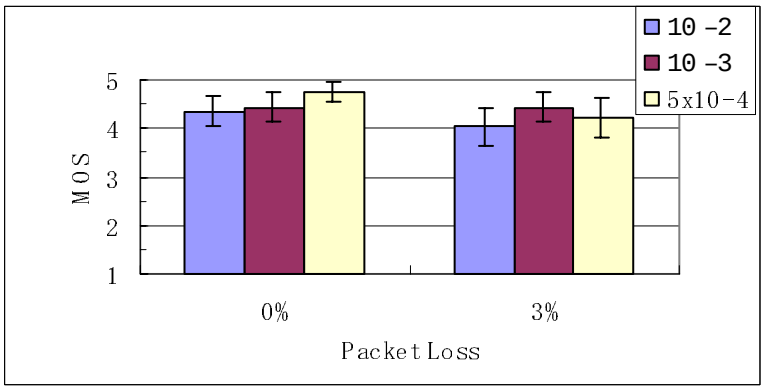

Fig. 3.1.2.3 Variation of score composition according to packet loss, radio transmission error at 12.2 kbit/s mode with 300ms delay.

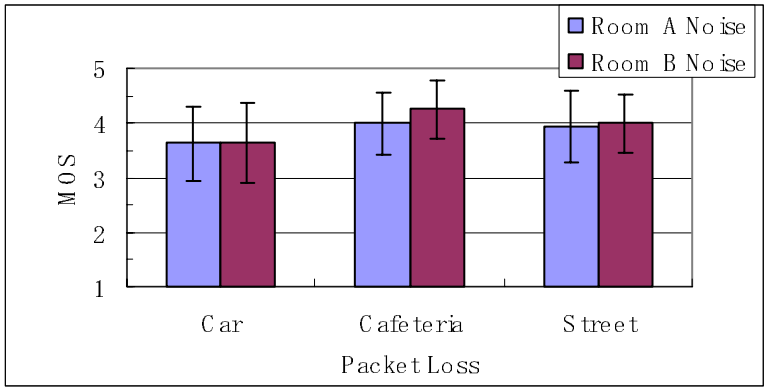

Fig. 3.1.2.4 Variation of score composition according to surrounding background noises (room A) and transmitted (room B) by the subjects in room A.

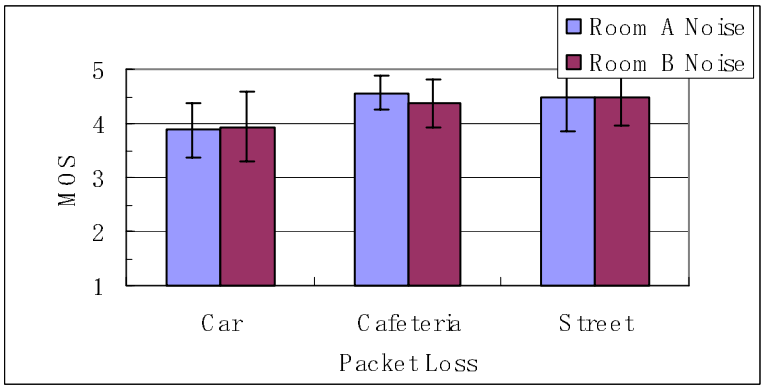

Fig. 3.1.2.5 Variation of score composition according to surrounding background noises (room A) and transmitted (room B) by the subjects in room B.

3) Question 3: “How did you judge the conversation when you interacted with your partner?”

Numerical results for all 24 conditions are shown in **Table 3.1.3**. The 7th to 9th columns of the table list MOS (Column 7) and fundamental statistics, such as standard deviation (Column 8), 95 % confidence limit (Column 9). As in **Table 3.1.1**, these set of values were calculated for subjects in room A and B separately, but these are not essential, all cells corresponding to the conditions are shaded. The effects of background noise are summarized separately for subjects in room A (columns 10 to 12) and room B (columns 13 to 15).

Table 3.1.3 Summarized numerical results for Question 3

Condition	Additional Background noise	Additional Background noise	Experimental factors			Room A+Room B			Room A			Room B		
						MOS	STD	95% CI	MOS	STD	95% CI	MOS	STD	95% CI
	Room A	Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode + Delay	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)
1	No	No	10 -2	0%	6,7kbit/s (delay 300 ms)	4.63	0.75	0.26	4.56	0.89	0.44	4.69	0.60	0.30
2	No	No	10 -2	0%	12.2 kbit/s (delay 300 ms)	4.09	1.15	0.40	4.00	1.10	0.54	4.19	1.22	0.60
3	No	No	10 -2	0%	12,2 kbit/s (delay 300 ms)	4.56	0.88	0.30	4.44	1.09	0.54	4.69	0.60	0.30
4	No	No	10 -2	3%	6,7kbit/s (delay 300 ms)	4.25	1.22	0.42	4.50	0.82	0.40	4.00	1.51	0.74
5	No	No	10 -2	3%	12.2kbit/s(delay 300 ms)	4.00	1.08	0.37	3.94	1.12	0.55	4.06	1.06	0.52
6	No	No	10 -2	3%	12,2 kbit/s (delay 300 ms)	4.41	0.98	0.34	4.50	0.89	0.44	4.31	1.08	0.53
7	No	No	10 -3	0%	6,7kbit/s (delay 300 ms)	4.84	0.57	0.20	4.75	0.71	0.38	4.94	0.25	0.12
8	No	No	10 -3	0%	12.2kbit/s(delay 300 ms)	4.72	0.52	0.18	4.75	0.45	0.22	4.69	0.60	0.30
9	No	No	10 -3	0%	12,2 kbit/s (delay 300 ms)	4.72	0.63	0.22	4.63	0.81	0.40	4.81	0.40	0.20
10	No	No	10 -3	3%	6,7kbit/s (delay 300 ms)	4.44	1.06	0.36	4.50	1.03	0.51	4.38	1.09	0.53
11	No	No	10 -3	3%	12.2kbit/s(delay 300 ms)	4.38	0.94	0.33	4.38	0.96	0.47	4.38	0.96	0.47
12	No	No	10 -3	3%	12,2 kbit/s (delay 300 ms)	4.66	0.65	0.23	4.63	0.81	0.40	4.69	0.48	0.23
13	No	No	5x10-4	0%	6,7kbit/s (delay 300 ms)	4.72	0.68	0.24	4.69	0.87	0.43	4.75	0.45	0.22
14	No	No	5x10-4	0%	12.2kbit/s(delay 300 ms)	4.44	0.76	0.26	4.31	0.87	0.43	4.56	0.63	0.31
15	No	No	5x10-4	0%	12,2 kbit/s (delay 300 ms)	4.88	0.42	0.15	4.88	0.34	0.17	4.88	0.50	0.24
16	No	No	5x10-4	3%	6,7kbit/s (delay 300 ms)	4.63	0.75	0.26	4.44	0.96	0.47	4.81	0.40	0.20
17	No	No	5x10-4	3%	12.2kbit/s(delay 300 ms)	4.34	0.90	0.31	4.25	1.00	0.49	4.44	0.81	0.40
18	No	No	5x10-4	3%	12,2 kbit/s (delay 300 ms)	4.59	0.76	0.26	4.56	0.89	0.44	4.63	0.62	0.30
19	Car	No	5x10-4	3%	12,2 kbit/s (delay 300 ms)				4.25	0.95	0.42	4.25	1.13	0.55
20	No	Car	5x10-4	3%	12,2 kbit/s (delay 300 ms)				4.13	1.09	0.53	4.13	1.36	0.67
21	Cafeteria	No	5x10-4	0%	6,7 kbit/s (delay 300 ms)				4.44	0.89	0.44	4.81	0.40	0.20
22	No	Cafeteria	5x10-4	0%	6,7 kbit/s (delay 300 ms)				4.38	1.09	0.53	4.63	0.50	0.24
23	Street	No	5x10-4	0%	12.2kbit/s(delay 300 ms)				4.13	1.09	0.53	4.31	0.79	0.39
24	No	Street	5x10-4	0%	12.2kbit/s(delay 300 ms)				4.44	0.89	0.44	4.31	1.08	0.53

Below are graphs of score composition for 6.7 kbit/s with 300 ms delay, 12.2 kbit/s with 300 ms delay, and 12.2 kbit/s with 500 ms delay are shown in **Fig. 3.1.3.1** to **Fig. 3.1.3.3**. These values do not include data recorded with background noise. In general, it is more difficult to understand some words when BERs are higher and in groups for without packet loss, 0 %, is weaker than for 3 %. Such a tendency is seen but a few exceptions, groups for 0% packet loss in **Fig. 3.1.3.1** and **Fig. 3.1.3.2**, 3% loss packet loss in Fig. **Fig. 3.1.3.3**

The effects of background noise are shown in **Fig. 3.1.3.4** and **3.1.3.5**. In these graphs, the influence of Cafeteria noise is little stronger to subjects in room A than in room B.

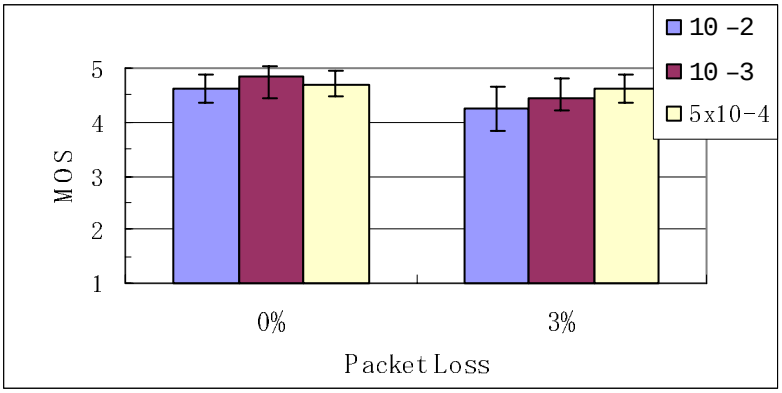

Fig. 3.1.3.1 Variation of score composition according to packet loss, radio transmission error at 6.7 kbit/s mode with 300ms delay.

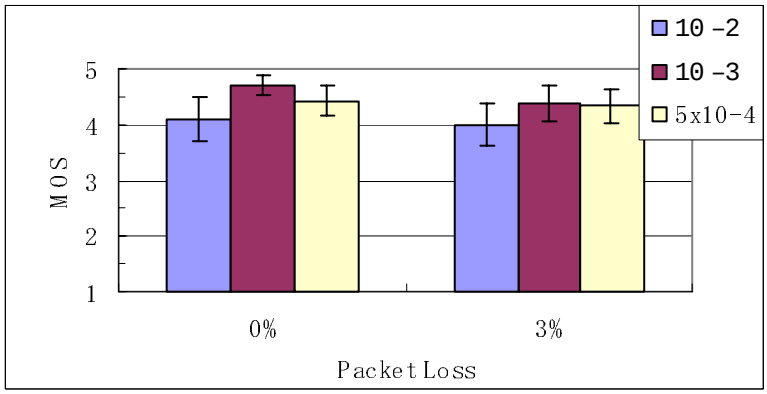

Fig. 3.1.3.2 Variation of score composition according to packet loss, radio transmission error at 12.2 kbit/s mode with 500 ms delay. 300ms delay.

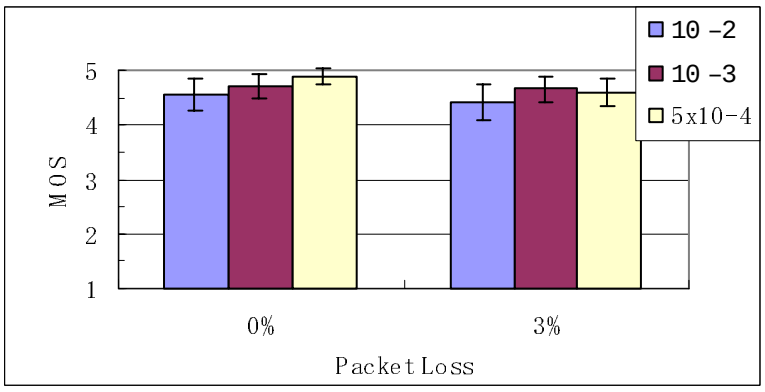

Fig. 3.1.3.3 Variation of score composition according to packet loss, radio transmission error at 12.2 kbit/s mode with 300ms delay.

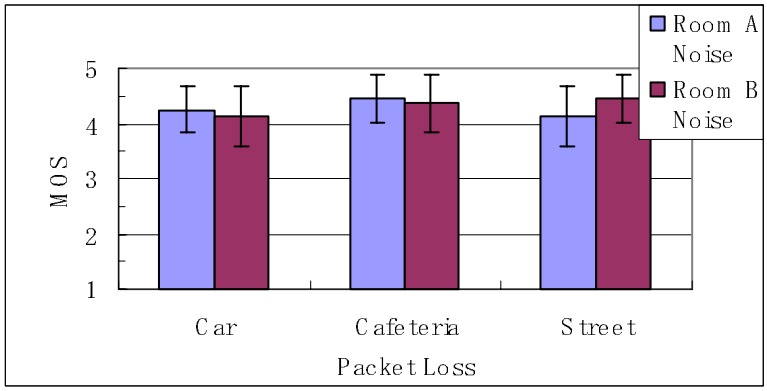

Fig. 3.1.3. 4 Variation of score composition according to surrounding background noises (room A) and transmitted (room B) by the subjects in room A.

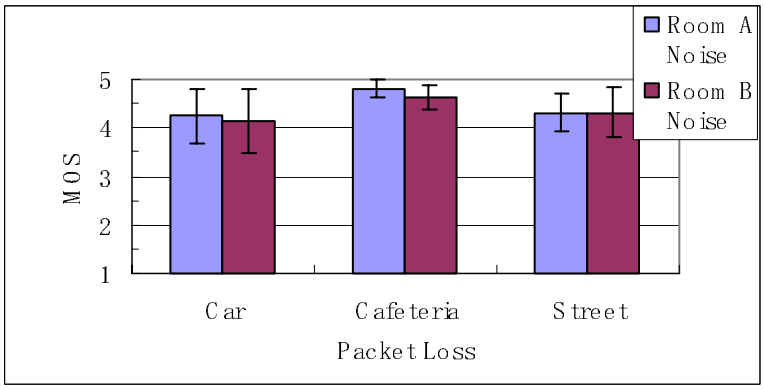

Fig. 3.1.3.5 Variation of score composition according to surrounding background noises (room A) and transmitted (room B) by the subjects in room B.

4) Question 4 “Did you perceive any impairment (noises, cuts, etc….)? In that case, was it:”

Numerical results for all 24 conditions are shown in **Table 3.1.4**. The 7th to 9th columns of the table list MOS (Column 7) and fundamental statistics, such as standard deviation (Column 8), 95 % confidence limit (Column 9). As in **Table 3.1.1**, these set of values were calculated for subjects in room A and B separately, but these are not essential, all cells corresponding to the conditions are shaded. The effects of background noise are summarized separately for subjects in room A (columns 10 to 12) and room B (columns 13 to 15).

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Table 3.1.4 Summarized numerical results for Question 4

Condition	Additional Background noise	Additional Background noise	Experimental factors			Room A+Room B			Room A			Room B		
						MOS	STD	95% CI	MOS	STD	95% CI	MOS	STD	95% CI
	Room A	Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode + Delay	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)
1	No	No	10 –2	0%	6,7kbit/s (delay 300 ms)	4.13	0.94	0.33	3.81	1.11	0.54	4.44	0.63	0.22
2	No	No	10 –2	0%	12,2 kbit/s (delay 500 ms)	3.81	1.15	0.40	4.00	1.10	0.54	3.63	1.20	0.42
3	No	No	10 –2	0%	12,2 kbit/s (delay 300 ms)	4.19	1.00	0.35	4.19	0.98	0.48	4.19	1.05	0.36
4	No	No	10 –2	3%	6,7kbit/s (delay 300 ms)	3.59	1.24	0.43	3.75	1.13	0.55	3.44	1.36	0.47
5	No	No	10 –2	3%	12.2kbit/s(delay 500 ms)	3.72	1.02	0.35	3.88	1.15	0.56	3.56	0.89	0.31
6	No	No	10 –2	3%	12,2 kbit/s (delay 300 ms)	4.00	1.08	0.37	3.94	1.00	0.49	4.06	1.18	0.41
7	No	No	10 –3	0%	6,7kbit/s (delay 300 ms)	4.31	1.03	0.36	4.38	1.02	0.50	4.25	1.06	0.37
8	No	No	10 –3	0%	12.2kbit/s(delay 500 ms)	4.53	0.62	0.22	4.50	0.63	0.31	4.56	0.63	0.22
9	No	No	10 –3	0%	12,2 kbit/s (delay 300 ms)	4.31	0.78	0.27	4.13	0.81	0.40	4.50	0.73	0.25
10	No	No	10 –3	3%	6,7kbit/s (delay 300 ms)	4.00	1.05	0.36	3.94	1.00	0.49	4.06	1.12	0.39
11	No	No	10 –3	3%	12.2kbit/s(delay 500 ms)	4.13	0.87	0.30	4.00	0.89	0.44	4.25	0.86	0.30
12	No	No	10 –3	3%	12,2 kbit/s (delay 300 ms)	4.25	0.92	0.32	4.25	1.06	0.52	4.25	0.77	0.27
13	No	No	5x10-4	0%	6,7kbit/s (delay 300 ms)	4.44	0.84	0.29	4.44	0.81	0.40	4.44	0.89	0.31
14	No	No	5x10-4	0%	12.2kbit/s(delay 500 ms)	4.44	0.76	0.26	4.44	0.63	0.31	4.44	0.89	0.31
15	No	No	5x10-4	0%	12,2 kbit/s (delay 300 ms)	4.69	0.54	0.19	4.63	0.62	0.30	4.75	0.45	0.15
16	No	No	5x10-4	3%	6,7kbit/s (delay 300 ms)	4.06	1.13	0.39	4.19	1.05	0.51	3.94	1.24	0.43
17	No	No	5x10-4	3%	12.4kbit/s(delay 500 ms)	4.09	1.00	0.34	4.06	1.12	0.55	4.13	0.89	0.31
18	No	No	5x10-4	3%	12,2 kbit/s (delay 300 ms)	4.19	1.09	0.38	4.13	1.20	0.59	4.25	1.00	0.35
19	Car	No	5x10-4	3%	12,2 kbit/s (delay 300 ms)				3.50	0.89	0.44	4.13	0.96	0.33
20	No	Car	5x10-4	3%	12,2 kbit/s (delay 300 ms)				4.31	0.60	0.30	3.44	1.36	0.47
21	Cafeteria	No	5x10-4	0%	6,7 kbit/s (delay 300 ms)				4.13	0.96	0.47	4.38	0.81	0.28
22	No	Cafeteria	5x10-4	0%	6,7 kbit/s (delay 300 ms)				4.56	0.63	0.31	4.06	1.12	0.39
23	Street	No	5x10-4	0%	12.2kbit/s(delay 500 ms)				4.25	0.93	0.46	4.38	0.89	0.31
24	No	Street	5x10-4	0%	12.2kbit/s(delay 500 ms)				4.13	1.09	0.53	4.13	0.72	0.25

Below are graphs of the conditions of MOS and its confidence limit for 6.7 kbit/s with 300 ms delay, 12.2 kbit/s with 300 ms delay, and 12.2 kbit/s with 500 ms delay. These values do not include data recorded with background noise, which are shown in **Figures 3.1.4.1** through **3.1.4.3**. In general, MOS values are greater when BERs are lower and group for without packet loss, 0 %, is greater than for 3 %. Such tendency is seen without a few exception, groups for 0% packet loss in **Fig. 3.1.4.2** and for 3 % in **Fig. 3.1.4.2** and **Fig. 3.1.4.3.**

The effects of background noise are shown in **Figures. 3.1.4.4** and **3.1.4.5**. In these graphs, scores by subjects in room A and B are almost same.

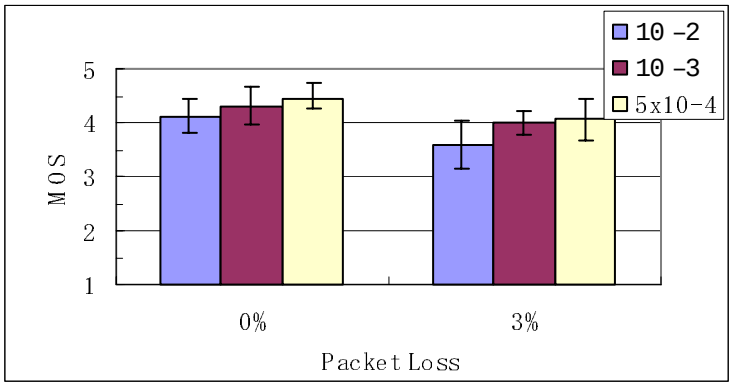


Fig. 3.1.4.1 MOS variation according to packet loss, radio transmission error at 6.7 kbit/s mode with 300ms delay.

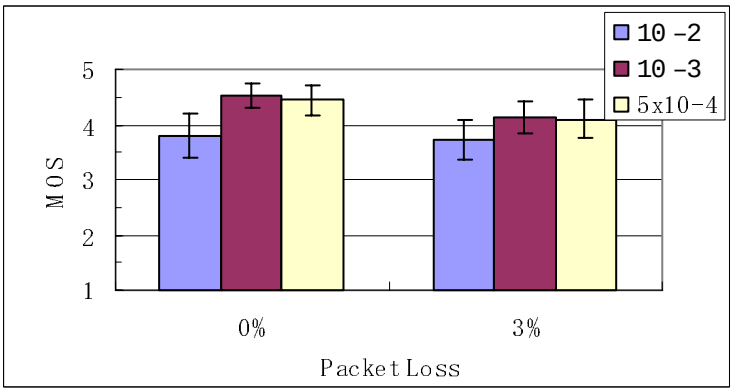


Fig. 3.1.4.2 MOS variation according to packet loss, radio transmission error at 12.2 kbit/s mode with 500 ms delay

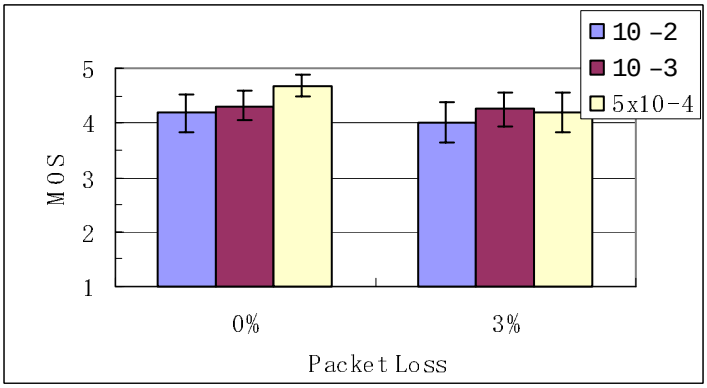


Fig. 3.1.4.3 MOS variation according to packet loss, radio transmission error at 12.2 kbit/s mode with 300ms delay.

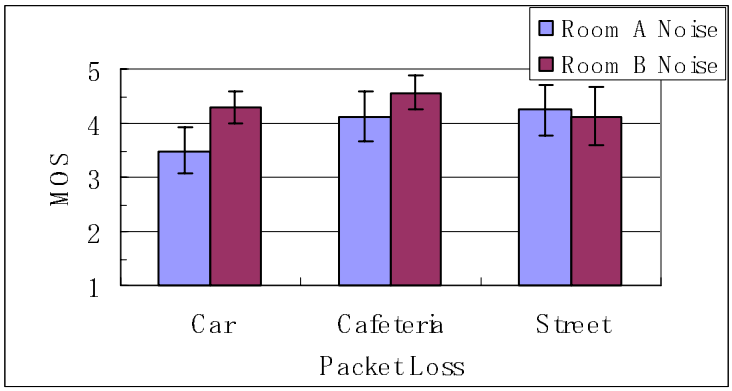


Fig. 3.1.4.4 MOS variation according to surrounding background noises (room A) and transmitted (room B) by subjects in room A.

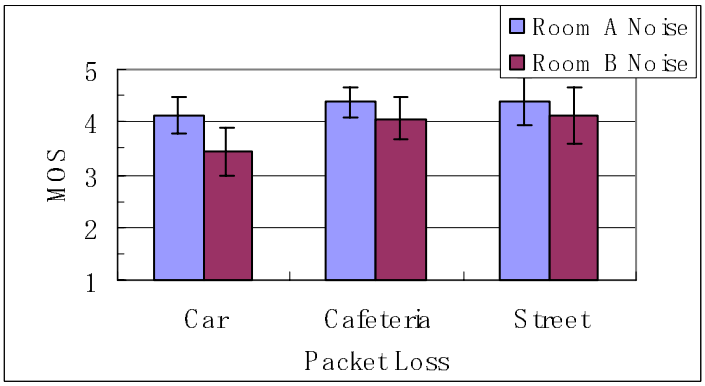


Fig. 3.1.4.5 MOS variation according to surrounding background noises (room A) and transmitted (room B) by subjects in room B.

5) Question 5: “How did you judge the global quality of communication.”

Numerical results for all 24 conditions are shown in **Table 3.1.5**. The 7th to 9th columns of the table list MOS (Column 7) fundamental statistics, such as standard deviation (Column 8), and 95 % confidence limit (Column 9). As in **Table 3.1.1**, these sets of values were calculated separately for subjects in room A and B, but these are not essential, all cells corresponding to the conditions are shaded. The effects of background noise are summarized separately for subjects in room A (columns 10 to 12) and room B (columns 13 to 15).

Table 3.1.5 Summarized numerical results for Question 5

Condition	Additional Background noise	Additional Background noise	Experimental factors			Room A+Room B			Room A			Room B		
						MOS	STD	95% CI	MOS	STD	95% CI	MOS	STD	95% CI
	Room A	Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode + Delay	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)
1	No	No	10 –2	0%	6,7kbit/s (delay 300 ms)	3.34	0.97	0.34	3.00	1.10	0.54	3.69	0.70	0.24
2	No	No	10 –2	0%	12,2 kbit/s (delay 500 ms)	3.13	1.16	0.40	3.13	1.15	0.56	3.13	1.20	0.42
3	No	No	10 –2	0%	12,2 kbit/s (delay 300 ms)	3.53	1.05	0.36	3.50	1.15	0.57	3.56	0.96	0.33
4	No	No	10 –2	3%	6,7kbit/s (delay 300 ms)	2.72	1.08	0.38	2.75	1.06	0.52	2.69	1.14	0.39
5	No	No	10 –2	3%	12,2kbit/s(delay 500 ms)	2.72	1.17	0.41	2.69	1.25	0.61	2.75	1.13	0.39
6	No	No	10 –2	3%	12,2 kbit/s (delay 300 ms)	3.13	1.10	0.38	3.06	1.06	0.52	3.19	1.17	0.40
7	No	No	10 –3	0%	6,7kbit/s (delay 300 ms)	3.50	1.14	0.39	3.50	1.21	0.59	3.50	1.10	0.38
8	No	No	10 –3	0%	12,2kbit/s(delay 500 ms)	3.72	0.81	0.28	3.56	0.89	0.44	3.88	0.72	0.25
9	No	No	10 –3	0%	12,2 kbit/s (delay 300 ms)	3.44	1.01	0.35	3.19	1.11	0.54	3.69	0.87	0.30
10	No	No	10 –3	3%	6,7kbit/s (delay 300 ms)	3.16	1.02	0.35	3.00	1.03	0.51	3.31	1.01	0.35
11	No	No	10 –3	3%	12,2kbit/s(delay 500 ms)	3.25	0.98	0.34	3.13	1.09	0.53	3.38	0.89	0.31
12	No	No	10 –3	3%	12,2 kbit/s (delay 300 ms)	3.53	1.05	0.36	3.44	1.09	0.54	3.63	1.02	0.36
13	No	No	5x10-4	0%	6,7kbit/s (delay 300 ms)	3.59	1.07	0.37	3.69	1.14	0.56	3.50	1.03	0.36
14	No	No	5x10-4	0%	12,2kbit/s(delay 500 ms)	3.44	0.98	0.34	3.38	0.96	0.47	3.50	1.03	0.36
15	No	No	5x10-4	0%	12,2 kbit/s (delay 300 ms)	3.97	0.82	0.28	3.81	0.98	0.48	4.13	0.62	0.21
16	No	No	5x10-4	3%	6,7kbit/s (delay 300 ms)	3.34	1.00	0.35	3.25	1.06	0.52	3.44	0.96	0.33
17	No	No	5x10-4	3%	12,6kbit/s(delay 500 ms)	3.19	1.18	0.41	3.13	1.31	0.64	3.25	1.06	0.37
18	No	No	5x10-4	3%	12,2 kbit/s (delay 300 ms)	3.19	1.20	0.42	3.06	1.34	0.66	3.31	1.08	0.37
19	Car	No	5x10-4	3%	12,2 kbit/s (delay 300 ms)				2.56	1.03	0.51	3.50	0.97	0.33
20	No	Car	5x10-4	3%	12,2 kbit/s (delay 300 ms)				3.69	0.87	0.43	2.75	1.29	0.45
21	Cafeteria	No	5x10-4	0%	6,7 kbit/s (delay 300 ms)				3.19	0.98	0.48	3.69	0.95	0.33
22	No	Cafeteria	5x10-4	0%	6,7 kbit/s (delay 300 ms)				3.69	0.60	0.30	3.31	1.14	0.39
23	Street	No	5x10-4	0%	12,2kbit/s(delay 500 ms)				3.38	0.89	0.43	3.38	0.96	0.33
24	No	Street	5x10-4	0%	12,2kbit/s(delay 500 ms)				3.44	1.41	0.69	3.06	0.68	0.24

Below are graphs of MOS and its confidence limit for 6.7 kbit/s with 300 ms delay, 12.2 kbit/s with 300 ms delay, and 12.2 kbit/s with 500 ms delay as shown in **Figures 3.1.5.1** to **3.1.5.3**. These values do not include data recorded with background noise. In general, MOS values are greater when BERs are lower and group for without packet loss, 0 %, is greater than for 3 %. Such a tendency is seen without a few exceptions, groups for 0% packet loss in **Fig. 3.1.5.2** and **Fig. 3.1.5.3** for 3 % in **Fig. 3.1.5.2** and **Fig. 3.1.5.3**

The effects of background noise are shown in **Figures 3.1.5.4** and **3.1.5.5**. In these graphs, scores by subjects in A room and B are almost same.

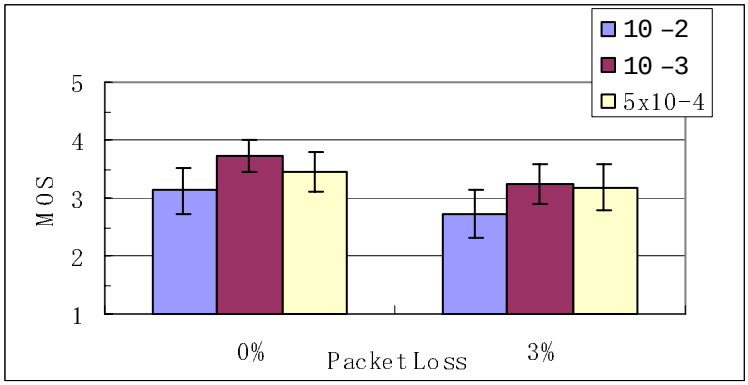


Fig. 3.1.5.1 MOS variation according to packet loss, radio transmission error at 6.7 kbit/s mode with 300ms delay.

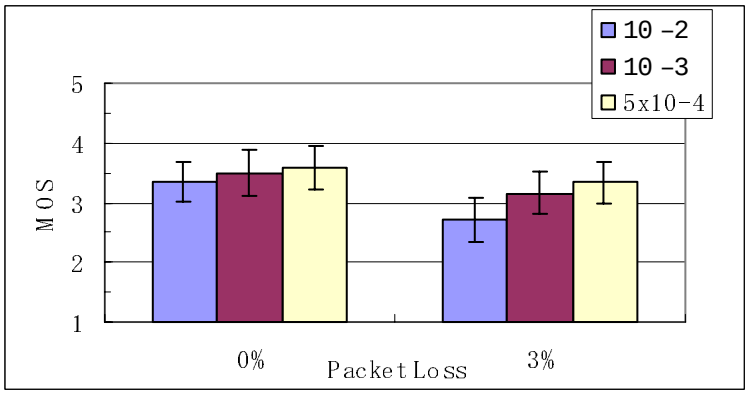


Fig. 3.1.5.2 MOS variation according to packet loss, radio transmission error at 12.2 kbit/s mode with 500 ms delay..

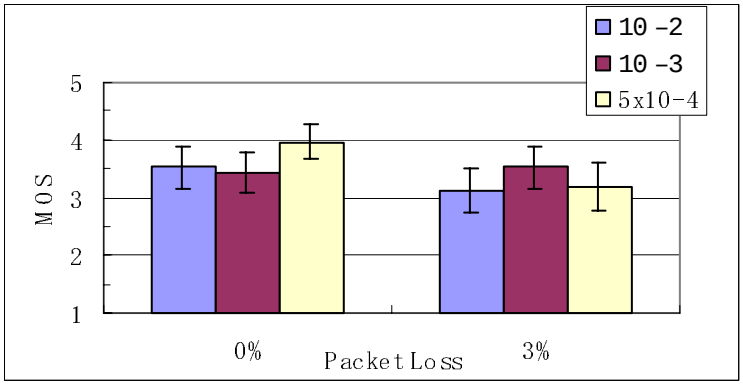


Fig. 3.1.5. 3 MOS variation according to packet loss, radio transmission error at 12.2 kbit/s mode with 300ms delay.

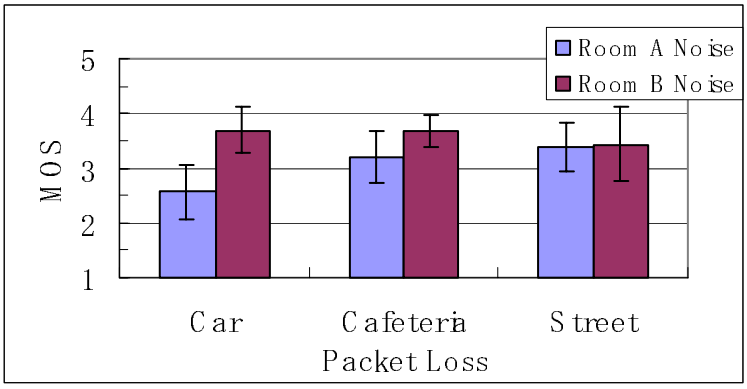


Fig. 3.1.5. 4 MOS variation according to surrounding background noises (room A) and transmitted (room B) by subjects in room A.

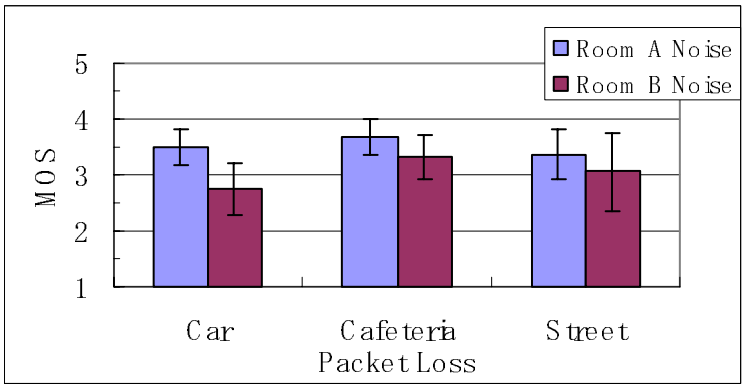


Fig. 3.1.5.5 MOS variation according to surrounding background noises (room A) and transmitted (room B) by subjects in room B.

3.2 Wide-Band

1) Question 1: “How did you judge the quality of the voice of your partner?”

Numerical results for all 24 conditions are shown in **Table 3.2.1**. The 7th to 9th columns of the table list MOS (Column 7) and fundamental statistics, such as standard deviation (Column 8), 95 % confidence limit (Column 9). As in **Table 3.1.1**, these set of values were calculated for subjects in room A and B separately, but these are not essential, all cells corresponding to the conditions are shaded. The effects of background noise are summarized separately for subjects in room A (columns 10 to 12) and room B (columns 13 to 15).

Table 3.2.1 Summarized numerical results for question 1

Condition	Additional Background noise	Additional Background noise	Experimental factors			Room A+Room B			Room A			Room B		
						MOS	STD	95% CI	MOS	STD	95% CI	MOS	STD	95% CI
	Room A	Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)
1	No	No	10-2	0%	12,65 kbit/s, RoHC	3.84	0.85	0.29	3.88	0.81	0.40	3.81	0.91	0.45
2	No	No	10-2	0%	12,65 kbit/s	3.97	0.86	0.30	4.06	0.85	0.42	3.88	0.89	0.43
3	No	No	10-2	0%	15,85 kbit/s, RoHC	4.13	0.71	0.24	4.25	0.68	0.33	4.00	0.73	0.36
4	No	No	10-2	3%	12,65 kbit/s, RoHC	3.72	0.96	0.33	3.81	0.98	0.48	3.63	0.96	0.47
5	No	No	10-2	3%	12,65 kbit/s	3.72	0.99	0.34	3.88	1.02	0.50	3.56	0.96	0.47
6	No	No	10-2	3%	15,85 kbit/s, RoHC	3.84	0.81	0.28	3.88	0.72	0.35	3.81	0.91	0.45
7	No	No	10-3	0%	12,65 kbit/s, RoHC	4.00	0.80	0.28	4.13	0.89	0.43	3.88	0.72	0.35
8	No	No	10-3	0%	12,65 kbit/s	4.06	0.67	0.23	4.19	0.40	0.20	3.94	0.85	0.42
9	No	No	10-3	0%	15,85 kbit/s, RoHC	3.94	0.80	0.28	3.94	0.77	0.38	3.94	0.85	0.42
10	No	No	10-3	3%	12,65 kbit/s, RoHC	3.97	0.74	0.26	4.00	0.73	0.36	3.94	0.77	0.38
11	No	No	10-3	3%	12,65 kbit/s	3.75	0.84	0.29	3.81	0.83	0.41	3.69	0.87	0.43
12	No	No	10-3	3%	15,85 kbit/s, RoHC	3.91	0.89	0.31	3.81	0.98	0.48	4.00	0.82	0.40
13	No	No	5x10-4	0%	12,65 kbit/s, RoHC	4.19	0.74	0.26	4.31	0.79	0.39	4.06	0.68	0.33
14	No	No	5x10-4	0%	12,65 kbit/s	4.06	0.84	0.29	4.13	0.89	0.43	4.00	0.82	0.40
15	No	No	5x10-4	0%	15,85 kbit/s, RoHC	4.03	0.69	0.24	4.19	0.66	0.32	3.88	0.72	0.35
16	No	No	5x10-4	3%	12,65 kbit/s, RoHC	3.91	1.00	0.34	4.00	1.10	0.54	3.81	0.91	0.45
17	No	No	5x10-4	3%	12,65 kbit/s	3.88	0.94	0.33	3.81	0.98	0.48	3.94	0.93	0.46
18	No	No	5x10-4	3%	15,85 kbit/s, RoHC	3.81	1.05	0.36	3.94	0.85	0.46	3.69	1.14	0.56
19	Car	No	5x10-4	3%	12,65 kbit/s, RoHC				3.06	1.13	0.55	3.81	1.05	0.51
20	No	Car	5x10-4	3%	12,65 kbit/s, RoHC				3.75	0.85	0.46	3.88	1.20	0.59
21	Cafeteria	No	5x10-4	0%	12,65 kbit/s				3.75	0.86	0.42	4.06	0.68	0.33
22	No	Cafeteria	5x10-4	0%	12,65 kbit/s				4.19	0.75	0.37	3.56	0.96	0.47
23	Street	No	5x10-4	0%	15,85 kbit/s, RoHC				3.69	0.87	0.43	4.13	0.62	0.30
24	No	Street	5x10-4	0%	15,85 kbit/s, RoHC				4.19	0.91	0.45	3.75	0.77	0.38

Graphs of MOS and its confidence limit for 6.7 kbit/s with 300 ms delay, 12.2 kbit/s with 300 ms delay, and 12.2 kbit/s with 500 ms delay are shown in **Figures 3.2.1.1** to **3.2.1.3**. These values do not include data recorded with background noise. In general, MOS values are greater when BERs are lower and group for without packet loss, 0 %, is greater than for 3 %. Such tendency is seen without a few exceptions, groups for 0% and 3 % in **Fig. 3.2.1.3**.

The effects of background noise are shown in **Figures 3.2.1.4** and **3.2.1.5**. In these graphs, the scores of subjects in room B is a little worse than room A regardless of whether the noise is heard in the subject's surroundings or transmitted with speech from the other side.

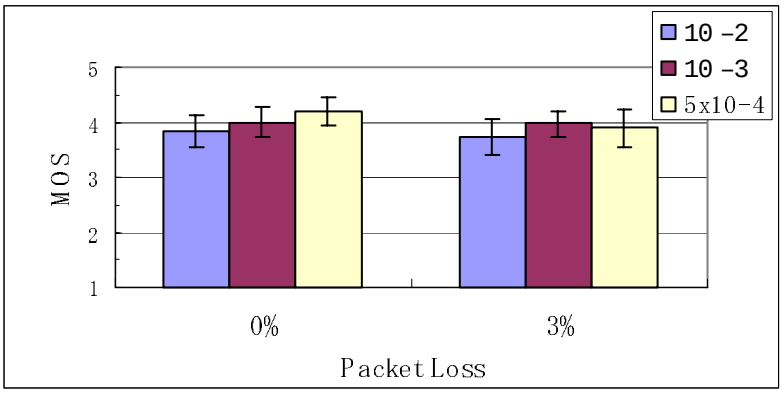


Fig. 3.2.1.1 MOS variation according to packet loss, radio transmission error at 12.65 kb/s mode with RoHC

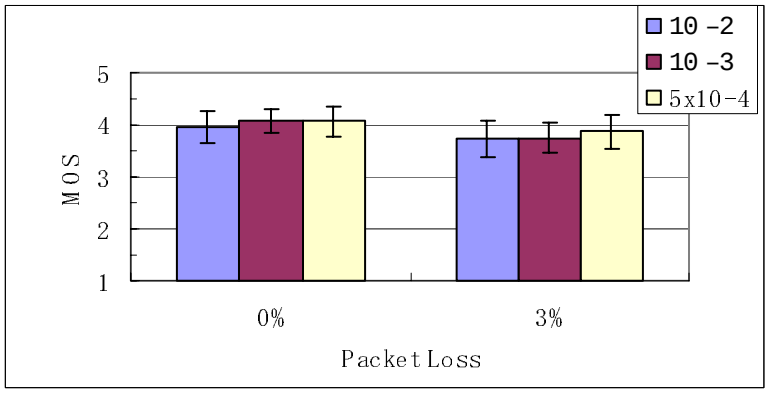


Fig. 3.2.1. 2 MOS variation according to packet loss, radio transmission error at 12.65 kbit/s mode without RoHC

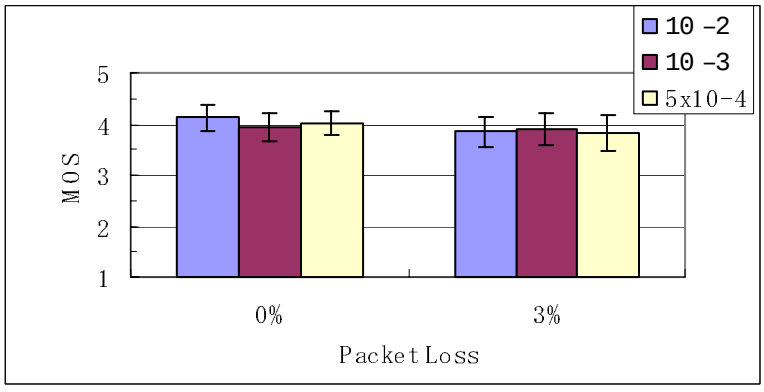


Fig. 3.2.1. 3 MOS variation according to packet loss, radio transmission error at 15.85 kbit/s mode with RoHC.

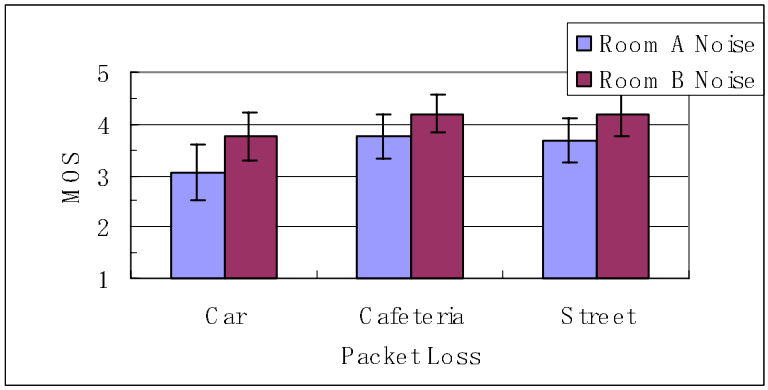


Fig. 3.2.1.4 MOS variation according to background noises surrounded (room A) and transmitted (room B)by the subjects in room A.

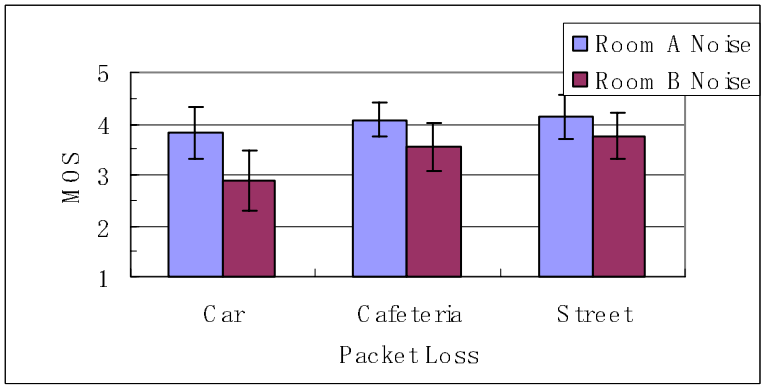


Fig. 3.2.1.5 MOS variation according to background noises surrounded (room A) and transmitted (room B) by the subjects in room B.

2) Question 2:" Do you have difficulties to understand some words"

Numerical results for all 24 conditions are shown in **Table 3.2.2**. The 7th to 9th columns of the table list MOS (Column 7) and fundamental statistics, such as standard deviation (Column 8), 95 % confidence limit (Column 9). As in **Table 3.1.1**, these set of values were calculated for subjects in room A and B separately, but these are not essential, all cells corresponding to the conditions are shaded. The effects of background noise are summarized separately for subjects in room A (columns 10 to 12) and room B (columns 13 to 15).

Table 3.2.2 Summarized numerical results for Question 2

Additional Background noise	Experimental factors			Room A+Room B			Room A			Room B		
				MOS	STD	95% CI	MOS	STD	95% CI	MOS	STD	95% CI
Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)
No	10 –2	0%	12,65 kbit/s, RoHC	4.34	0.87	0.30	4.25	0.86	0.42	4.44	0.89	0.44
No	10 –2	0%	12,65 kbit/s	4.53	0.72	0.25	4.50	0.82	0.40	4.56	0.63	0.31
No	10 –2	0%	15,85 kbit/s, RoHC	4.69	0.64	0.22	4.69	0.60	0.30	4.69	0.70	0.35
No	10 –2	3%	12,65 kbit/s, RoHC	4.03	1.09	0.38	4.19	1.11	0.54	3.88	1.09	0.53
No	10 –2	3%	12,65 kbit/s	4.06	1.16	0.40	4.13	1.26	0.62	4.00	1.10	0.54
No	10 –2	3%	15,85 kbit/s, RoHC	4.28	0.92	0.32	4.50	0.73	0.36	4.06	1.06	0.52
No	10 –3	0%	12,65 kbit/s, RoHC	4.69	0.69	0.24	4.56	0.81	0.40	4.81	0.54	0.27
No	10 –3	0%	12,65 kbit/s	4.72	0.46	0.16	4.69	0.48	0.23	4.75	0.45	0.22
No	10 –3	0%	15,85 kbit/s, RoHC	4.53	0.80	0.28	4.44	0.73	0.36	4.63	0.89	0.43
No	10 –3	3%	12,65 kbit/s, RoHC	4.41	0.84	0.29	4.31	1.01	0.50	4.50	0.63	0.31
No	10 –3	3%	12,65 kbit/s	4.34	0.83	0.29	4.50	0.63	0.31	4.19	0.98	0.48
No	10 –3	3%	15,85 kbit/s, RoHC	4.47	0.80	0.28	4.25	0.93	0.46	4.69	0.60	0.30
No	5x10-4	0%	12,65 kbit/s, RoHC	4.66	0.70	0.24	4.56	0.89	0.44	4.75	0.45	0.22
No	5x10-4	0%	12,65 kbit/s	4.59	0.61	0.21	4.56	0.63	0.31	4.63	0.62	0.30
No	5x10-4	0%	15,85 kbit/s, RoHC	4.66	0.60	0.21	4.75	0.58	0.28	4.56	0.63	0.31
No	5x10-4	3%	12,65 kbit/s, RoHC	4.41	0.91	0.32	4.31	0.95	0.46	4.50	0.89	0.44
No	5x10-4	3%	12,65 kbit/s	4.41	0.87	0.30	4.25	0.93	0.46	4.56	0.81	0.40
No	5x10-4	3%	15,85 kbit/s, RoHC	4.56	0.62	0.21	4.50	0.52	0.25	4.63	0.72	0.35
No	5x10-4	3%	12,65 kbit/s, RoHC				3.19	1.47	0.72	4.44	0.73	0.36
Car	5x10-4	3%	12,65 kbit/s, RoHC				4.31	0.79	0.39	2.81	1.22	0.60
No	5x10-4	0%	12,65 kbit/s				4.13	1.15	0.56	4.69	0.70	0.35
Cafeteria	5x10-4	0%	12,65 kbit/s				4.69	0.60	0.30	3.63	1.09	0.53
No	5x10-4	0%	15,85 kbit/s, RoHC				4.13	1.26	0.62	4.81	0.40	0.20
Street	5x10-4	0%	15,85 kbit/s, RoHC				4.56	0.81	0.40	4.31	1.01	0.50

Graphs presentation of score composition for 6.7 kbit/s with 300 ms delay, 12.2 kbit/s with 300 ms delay, and 12.2 kbit/s with 500 ms delay are shown in **Figures 3.2.2.1** to **3.2.2.3.**. These values do not include data recorded with background noise. In general, it is more difficult to understand some words when the BERs are higher and in groups without packet loss, 0 %, is weaker than for 3 %. Such a tendency is seen without two exceptions, groups for 0% packet loss in **Fig. 3.2.2.2** and . **Fig. 3.2.2.3.**

The effect of background noise are shown in **Figures 3.2.2.4** and **3.2.2.5**. In these graphs, The effects of surrounding car and cafeteria noise in room B are little stronger than in room A.

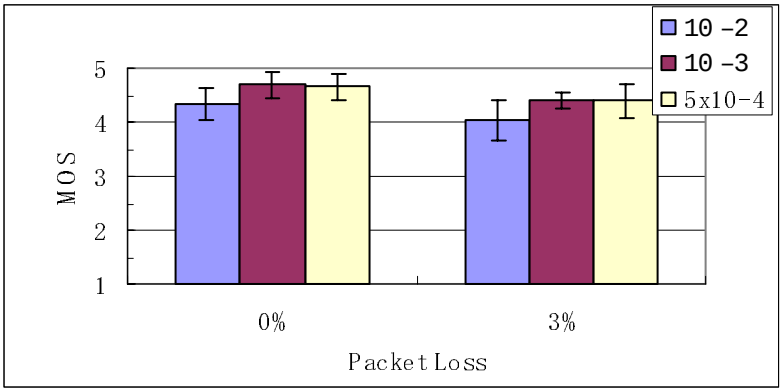


Fig. 3.2.2.1 MOS variation according to packet loss, radio transmission error at 12.65 kb/s mode with RoHC

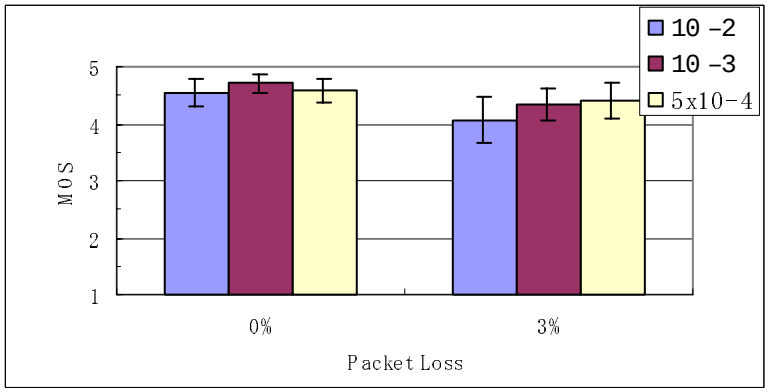


Fig. 3.2.2.2 MOS variation according to packet loss, radio transmission error at 12.65 kbit/s mode without RoHC

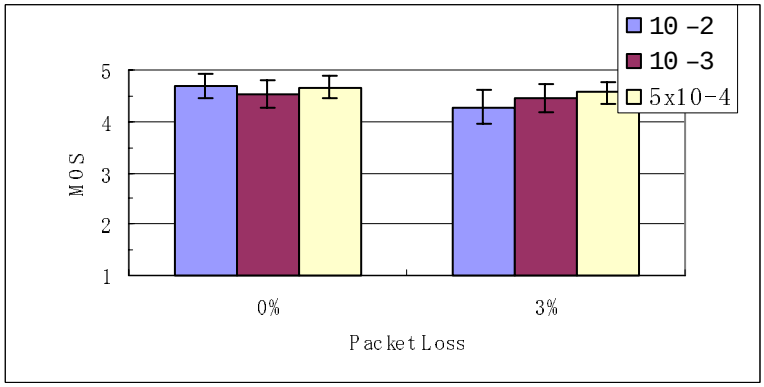
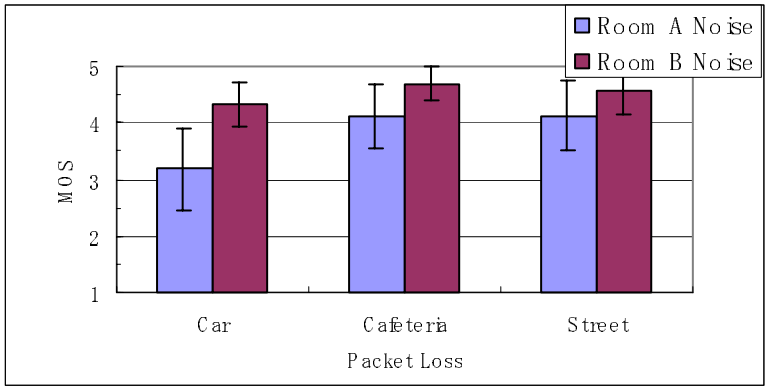


Fig. 3.2.2. 3 MOS variation according to packet loss, radio transmission error at 15.85 kbit/s mode with RoHC



. **Fig. 3.2.2.4** MOS variation according to background noises surrounded (room A) and transmitted (room B)by the subjects in room A

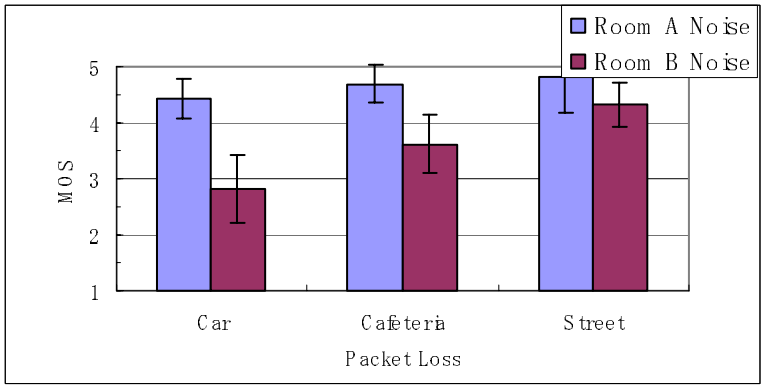


Fig. 3.2.2.5 MOS variation according to background noises surrounded (room A) and transmitted (room B) by the subjects in room B.

3) Question 3: “How did you judge the conversation when you interacted with your partner?”

Numerical results for all 24 conditions are shown in **Table 3.2.3**. The 7th to 9th columns of the table list MOS (Column 7) and fundamental statistics, such as standard deviation (Column 8), 95 % confidence limit (Column 9). As in **Table 3.1.1**, these set of values were calculated for subjects in room A and B separately, but these are not essential, all cells corresponding to the conditions are shaded. The effects of background noise are summarized separately for subjects in room A (columns 10 to 12) and room B (columns 13 to 15).

Table 3.2.3 Summarized numerical results for Question 3

Condition	Additional Background noise	Additional Background noise	Experimental factors			Room A+Room B			Room A			Room B		
						MOS	STD	95% CI	MOS	STD	95% CI	MOS	STD	95% CI
	Room A	Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)
1	No	No	10-2	0%	12,65 kbit/s, RoHC	4.34	0.87	0.30	4.25	0.86	0.42	4.44	0.89	0.44
2	No	No	10-2	0%	12,65 kbit/s	4.53	0.72	0.25	4.50	0.82	0.40	4.56	0.63	0.31
3	No	No	10-2	0%	15,85 kbit/s, RoHC	4.69	0.64	0.22	4.69	0.60	0.30	4.69	0.70	0.35
4	No	No	10-2	3%	12,65 kbit/s, RoHC	4.03	1.09	0.38	4.19	1.11	0.54	3.88	1.09	0.53
5	No	No	10-2	3%	12,65 kbit/s	4.06	1.16	0.40	4.13	1.26	0.62	4.00	1.10	0.54
6	No	No	10-2	3%	15,85 kbit/s, RoHC	4.28	0.92	0.32	4.50	0.73	0.36	4.06	1.06	0.52
7	No	No	10-3	0%	12,65 kbit/s, RoHC	4.69	0.69	0.24	4.56	0.81	0.40	4.81	0.54	0.27
8	No	No	10-3	0%	12,65 kbit/s	4.72	0.46	0.16	4.69	0.48	0.23	4.75	0.45	0.22
9	No	No	10-3	0%	15,85 kbit/s, RoHC	4.53	0.80	0.28	4.44	0.73	0.36	4.63	0.89	0.43
10	No	No	10-3	3%	12,65 kbit/s, RoHC	4.41	0.84	0.29	4.31	1.01	0.50	4.50	0.63	0.31
11	No	No	10-3	3%	12,65 kbit/s	4.34	0.83	0.29	4.50	0.63	0.31	4.19	0.98	0.48
12	No	No	10-3	3%	15,85 kbit/s, RoHC	4.47	0.80	0.28	4.25	0.93	0.46	4.69	0.60	0.30
13	No	No	5x10-4	0%	12,65 kbit/s, RoHC	4.66	0.70	0.24	4.56	0.89	0.44	4.75	0.45	0.22
14	No	No	5x10-4	0%	12,65 kbit/s	4.59	0.61	0.21	4.56	0.63	0.31	4.63	0.62	0.30
15	No	No	5x10-4	0%	15,85 kbit/s, RoHC	4.66	0.60	0.21	4.75	0.58	0.28	4.56	0.63	0.31
16	No	No	5x10-4	3%	12,65 kbit/s, RoHC	4.41	0.91	0.32	4.31	0.95	0.46	4.50	0.89	0.44
17	No	No	5x10-4	3%	12,65 kbit/s	4.41	0.87	0.30	4.25	0.93	0.46	4.56	0.81	0.40
18	No	No	5x10-4	3%	15,85 kbit/s, RoHC	4.56	0.62	0.21	4.50	0.52	0.25	4.63	0.72	0.35
19	Car	No	5x10-4	3%	12,65 kbit/s, RoHC				3.19	1.47	0.72	4.44	0.73	0.36
20	No	Car	5x10-4	3%	12,65 kbit/s, RoHC				4.31	0.79	0.39	2.81	1.22	0.60
21	Cafeteria	No	5x10-4	0%	12,65 kbit/s				4.13	1.15	0.56	4.69	0.70	0.35
22	No	Cafeteria	5x10-4	0%	12,65 kbit/s				4.69	0.60	0.30	3.63	1.09	0.53
23	Street	No	5x10-4	0%	15,85 kbit/s, RoHC				4.13	1.26	0.62	4.81	0.40	0.20
24	No	Street	5x10-4	0%	15,85 kbit/s, RoHC				4.56	0.81	0.40	4.31	1.01	0.50

Graphs of score composition for 6.7 kbit/s with 300 ms delay, 12.2 kbit/s with 300 ms delay, and 12.2 kbit/s with 500 ms delay are shown in **Figures 3.2.3.1** to **3.2.3.3**. These values do not include data recorded with background noise. In general, it is more difficult to understand some words when BERs are higher and in groups without packet loss, 0 %, is weaker than for 3 %. Such tendency is seen without a few exceptions, groups for 0% packet loss in **Figures 3.2.3.2** and **3.2.3.3.**

The effects of background noise are shown in **Figures 3.2.3.4** and **3.2.3.5**. In these graphs, The effects of surrounding car and cafeteria noises in room B are little stronger than in room A.

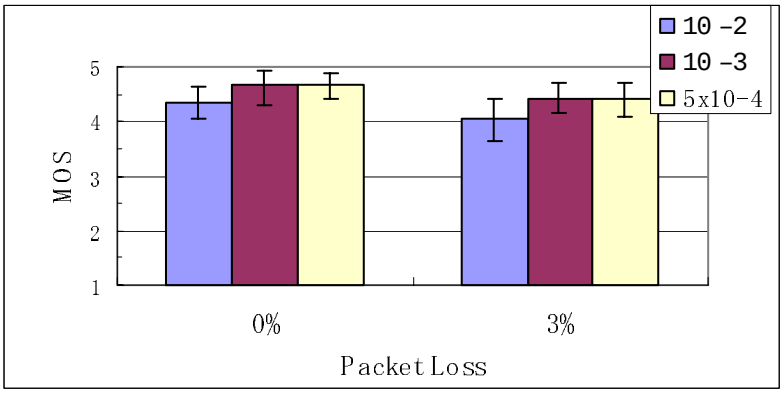


Fig. 3.2.3.1 MOS variation according to packet loss, radio transmission error at 12.65 kb/s mode with RoHC

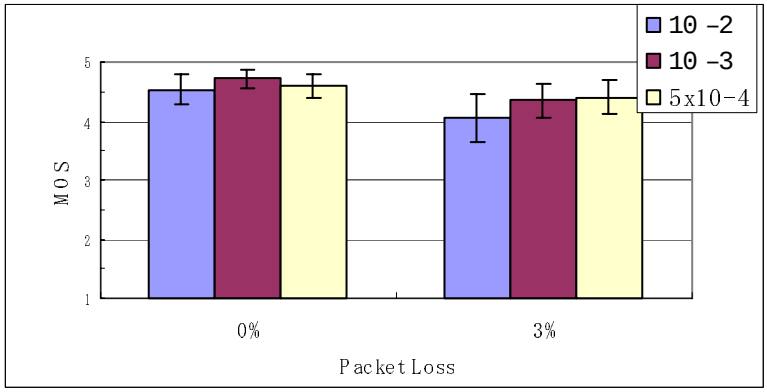


Fig. 3.2.3. 2 MOS variation according to packet loss, radio transmission error at 12.65 kbit/s mode without RoHC

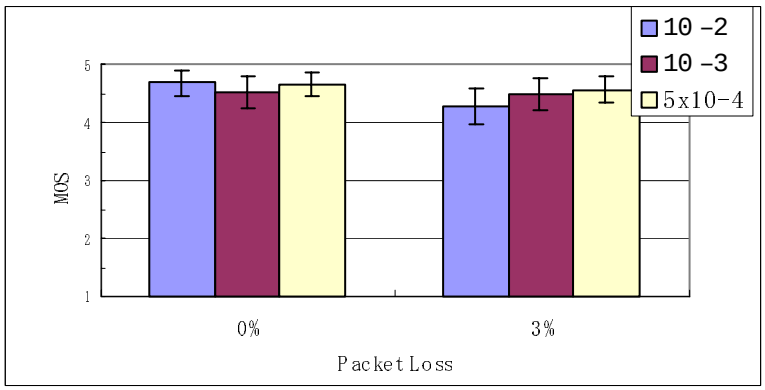


Fig. 3.23.3 MOS variation according to packet loss, radio transmission error at 15.85 kbit/s mode with RoHC

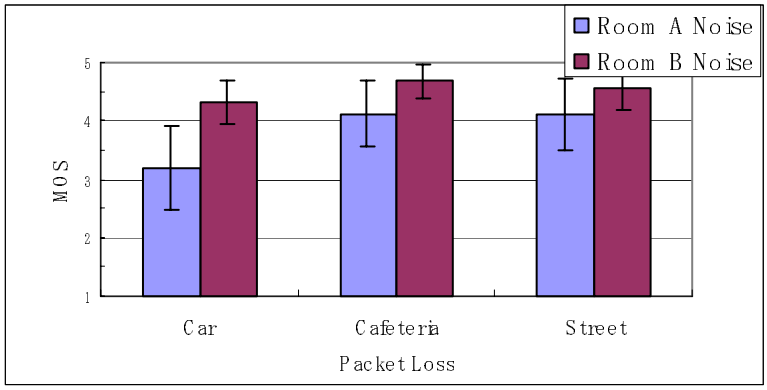


Fig. 3.2.3.4 MOS variation according to background noises surrounded (room A) and transmitted (room B)by the subjects in room A

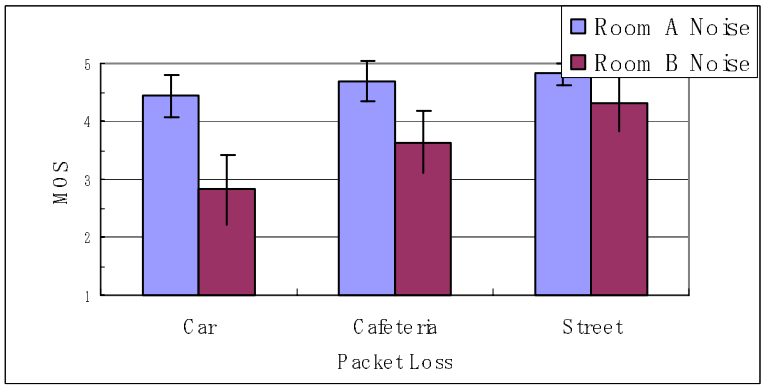


Fig. 3.2.3.5 MOS variation according to background noises surrounded (room A) and transmitted (room B) by the subjects in room B..

4) Question 4: “Did you perceive any impairment (noises, cuts,….)? In that case, was it:”

Numerical results for all 24 conditions are shown in **Table 3.2.4**. The 7th to 9th columns of the table list MOS (Column 7) and fundamental statistics, such as standard deviation (Column 8), 95 % confidence limit (Column 9). As in **Table 3.1.1**, these set of values were calculated for subjects in room A and B separately, but these are not essential, all cells corresponding to the conditions are shaded. The effect of background noise are summarized separately for subjects in room A (columns 10 to 12) and Room B (columns 13 to 15).

Table 3.2.4 Summarized numerical results for Question 4

Condition	Additional Background noise	Additional Background noise	Experimental factorz			Room A+Room B			Room A			Room B		
						MOS	STD	95% CI	MOS	STD	95% CI	MOS	STD	95% CI
	Room A	Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)
1	No	No	10-2	0%	12,65 kbit/s, RoHC	4.31	0.69	0.24	4.13	0.62	0.30	4.50	0.75	0.36
2	No	No	10-2	0%	12,65 kbit/s	4.31	0.82	0.28	4.31	0.87	0.43	4.31	0.79	0.39
3	No	No	10-2	0%	15,85 kbit/s, RoHC	4.59	0.56	0.19	4.63	0.50	0.24	4.56	0.63	0.31
4	No	No	10-2	3%	12,65 kbit/s, RoHC	4.06	0.95	0.33	4.06	1.06	0.52	4.06	0.85	0.42
5	No	No	10-2	3%	12,65 kbit/s	4.16	0.88	0.31	4.31	0.95	0.46	4.00	0.82	0.40
6	No	No	10-2	3%	15,85 kbit/s, RoHC	4.28	0.77	0.27	4.31	0.79	0.39	4.25	0.77	0.38
7	No	No	10-3	0%	12,65 kbit/s, RoHC	4.63	0.55	0.19	4.56	0.63	0.31	4.69	0.48	0.23
8	No	No	10-3	0%	12,65 kbit/s	4.69	0.47	0.16	4.69	0.48	0.23	4.69	0.48	0.23
9	No	No	10-3	0%	15,85 kbit/s, RoHC	4.53	0.72	0.25	4.38	0.81	0.40	4.69	0.60	0.30
10	No	No	10-3	3%	12,65 kbit/s, RoHC	4.53	0.76	0.26	4.56	0.81	0.40	4.50	0.73	0.36
11	No	No	10-3	3%	12,65 kbit/s	4.28	0.77	0.27	4.31	0.70	0.35	4.25	0.86	0.42
12	No	No	10-3	3%	15,85 kbit/s, RoHC	4.38	0.75	0.26	4.25	0.86	0.42	4.50	0.63	0.31
13	No	No	5x10-4	0%	12,65 kbit/s, RoHC	4.63	0.61	0.21	4.63	0.72	0.35	4.63	0.50	0.24
14	No	No	5x10-4	0%	12,65 kbit/s	4.56	0.62	0.21	4.56	0.63	0.31	4.56	0.63	0.31
15	No	No	5x10-4	0%	15,85 kbit/s, RoHC	4.59	0.61	0.21	4.69	0.60	0.30	4.50	0.63	0.31
16	No	No	5x10-4	3%	12,65 kbit/s, RoHC	4.38	0.94	0.33	4.25	1.00	0.49	4.50	0.89	0.44
17	No	No	5x10-4	3%	12,65 kbit/s	4.28	0.77	0.27	4.06	0.85	0.42	4.50	0.63	0.31
18	No	No	5x10-4	3%	15,85 kbit/s, RoHC	4.44	0.62	0.21	4.38	0.62	0.30	4.50	0.63	0.31
19	Car	No	5x10-4	3%	12,65 kbit/s, RoHC				3.25	1.39	0.68	4.38	0.72	0.35
20	No	Car	5x10-4	3%	12,65 kbit/s, RoHC				4.25	0.77	0.38	3.13	1.20	0.59
21	Cafeteria	No	5x10-4	0%	12,65 kbit/s				3.94	1.44	0.70	4.69	0.60	0.30
22	No	Cafeteria	5x10-4	0%	12,65 kbit/s				4.50	0.63	0.31	3.75	1.18	0.58
23	Street	No	5x10-4	0%	15,85 kbit/s, RoHC				4.19	0.98	0.48	4.75	0.58	0.28
24	No	Street	5x10-4	0%	15,85 kbit/s, RoHC				4.63	0.81	0.40	4.19	1.11	0.54

Graphs of MOS and its confidence limit for 6.7 kbit/s with 300 ms delay, 12.2 kbit/s with 300 ms delay, and 12.2 kbit/s with 500 ms delay conditions are shown in **Figures 3.2.4.1** to **3.2.4.3**. These values do not include background noise. In general, MOS values are greater when BERs are lower and in groups without packet loss, 0 %, is greater than for 3 %. Such tendency is seen without a few exceptions, groups with 3% packet loss in **Fig. 3.2.4.1** and with 0 % are shown in **Fig. 3.2.4.2** and **Fig. 3.2.4.3.**

The influence of background noise is shown in **Fig. 3.2.4.4** and **3.2.4.5**. In these graphs, scores of subjects in room B are less influenced by the noise coming from the other side (room A).

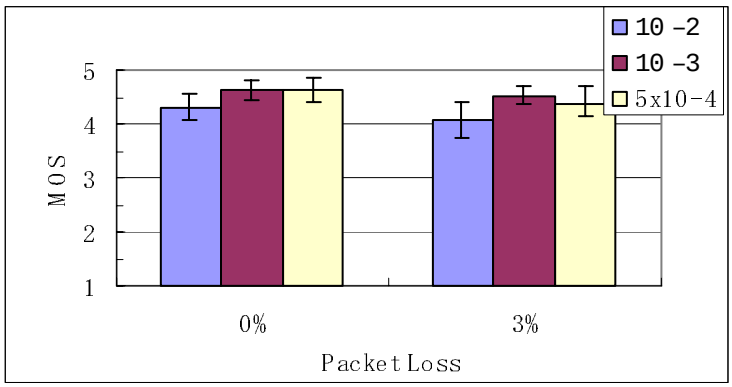


Fig. 3.2.4.1 MOS variation according to packet loss, radio transmission error at 12.65 kb/s mode with RoHC

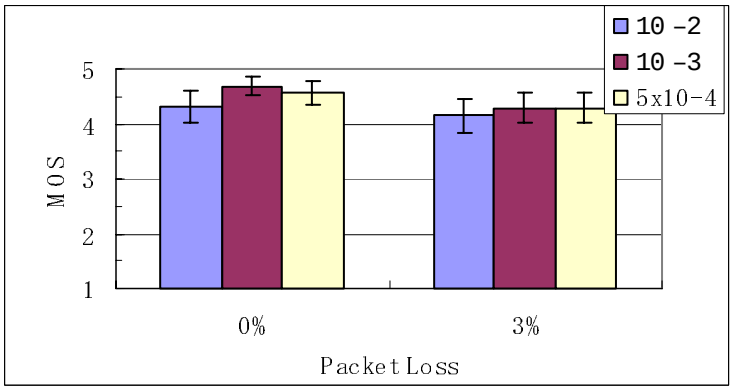


Fig. 3.2.4. 2 MOS variation according to packet loss, radio transmission error at 12.65 kbit/s mode without RoHC

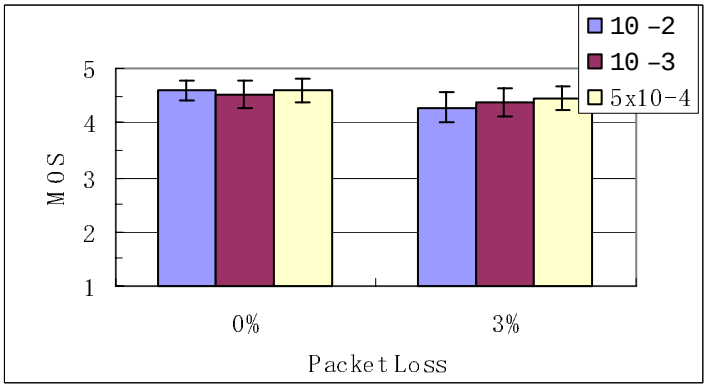


Fig. 3.2.4. 3 MOS variation according to packet loss, radio transmission error at 15.85 kbit/s mode with RoHC

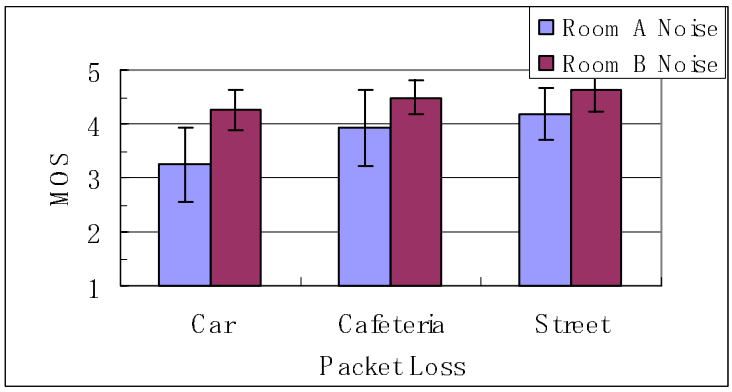


Fig. 3.2.4.4 MOS variation according to background noises surrounded (room A) and transmitted (room B)by the subjects in room A

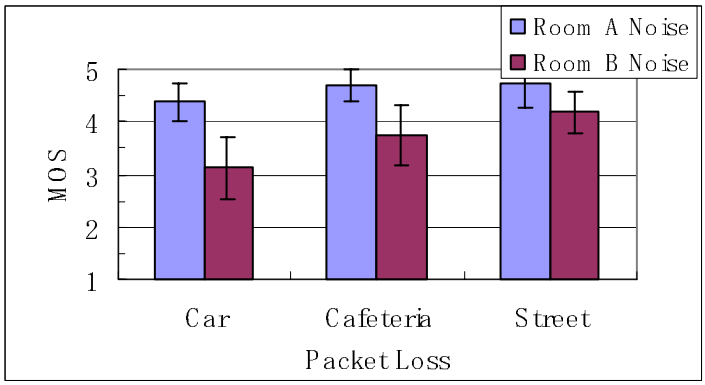


Fig. 3.2.4.5 MOS variation according to background noises surrounded (room A) and transmitted (room B) by the subjects in room B..

5) Question 5: “Question 5: How did you judge the global quality of communication.”

Numerical results for all 24 conditions are shown in **Table 3.2.5**. The 7th to 9th columns of the table list MOS (Column 7) and fundamental statistics, such as standard deviation (Column 8), 95 % confidence limit (Column 9). As in **Table 3.1.1**, these set of values were calculated for subjects in room A and B separately, but these are not essential, all cells corresponding to the conditions are shaded. The effects of background noise are summarized separately for subjects in room A (columns 10 to 12) and room B (columns 13 to 15).

Table 3.2.5 Summarized numerical results for Question 5

Condition	Additional Background noise	Additional Background noise	Experimental factors			Room A+Room B			Room A			Room B		
						MOS	STD	95% CI	MOS	STD	95% CI	MOS	STD	95% CI
	Room A	Room B	Radio conditions	IP conditions (Packet loss ratio)	Mode	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)	(Yc)	(Sc)	(CI)
1	No	No	10-2	0%	12,65 kbit/s, RoHC	3.75	0.95	0.33	3.75	0.86	0.42	3.75	1.06	0.52
2	No	No	10-2	0%	12,65 kbit/s	4.00	0.84	0.29	4.06	0.85	0.42	3.94	0.85	0.42
3	No	No	10-2	0%	15,85 kbit/s, RoHC	4.22	0.75	0.26	4.31	0.70	0.35	4.13	0.81	0.40
4	No	No	10-2	3%	12,65 kbit/s, RoHC	3.59	0.95	0.33	3.81	0.98	0.48	3.38	0.89	0.43
5	No	No	10-2	3%	12,65 kbit/s	3.69	1.06	0.37	3.94	1.06	0.52	3.44	1.03	0.51
6	No	No	10-2	3%	15,85 kbit/s, RoHC	3.81	1.00	0.35	3.94	0.93	0.46	3.69	1.06	0.53
7	No	No	10-3	0%	12,65 kbit/s, RoHC	4.00	0.80	0.28	4.00	0.89	0.44	4.00	0.73	0.36
8	No	No	10-3	0%	12,65 kbit/s	4.22	0.61	0.21	4.38	0.50	0.24	4.06	0.68	0.33
9	No	No	10-3	0%	15,85 kbit/s, RoHC	4.06	0.88	0.30	4.13	0.81	0.40	4.00	0.97	0.47
10	No	No	10-3	3%	12,65 kbit/s, RoHC	3.97	0.86	0.30	4.06	0.93	0.46	3.88	0.81	0.40
11	No	No	10-3	3%	12,65 kbit/s	3.81	0.90	0.31	3.88	0.81	0.40	3.75	1.00	0.49
12	No	No	10-3	3%	15,85 kbit/s, RoHC	3.91	0.86	0.30	3.81	0.83	0.41	4.00	0.89	0.44
13	No	No	5x10-4	0%	12,65 kbit/s, RoHC	4.22	0.79	0.27	4.38	0.89	0.43	4.06	0.68	0.33
14	No	No	5x10-4	0%	12,65 kbit/s	4.09	0.73	0.25	4.13	0.89	0.43	4.06	0.57	0.28
15	No	No	5x10-4	0%	15,85 kbit/s, RoHC	4.06	0.84	0.29	4.38	0.72	0.35	3.75	0.86	0.42
16	No	No	5x10-4	3%	12,65 kbit/s, RoHC	4.00	1.02	0.35	4.13	1.09	0.53	3.88	0.96	0.47
17	No	No	5x10-4	3%	12,65 kbit/s	3.84	0.99	0.34	3.63	1.09	0.53	4.06	0.85	0.42
18	No	No	5x10-4	3%	15,85 kbit/s, RoHC	3.81	0.97	0.33	4.00	0.82	0.40	3.63	1.09	0.53
19	Car	No	5x10-4	3%	12,65 kbit/s, RoHC				3.00	1.21	0.59	3.88	0.89	0.43
20	No	Car	5x10-4	3%	12,65 kbit/s, RoHC				3.81	0.98	0.48	2.56	1.15	0.56
21	Cafeteria	No	5x10-4	0%	12,65 kbit/s				3.75	1.24	0.61	4.25	0.77	0.38
22	No	Cafeteria	5x10-4	0%	12,65 kbit/s				4.19	0.75	0.37	2.94	1.06	0.52
23	Street	No	5x10-4	0%	15,85 kbit/s, RoHC				3.50	1.10	0.54	4.13	0.72	0.35
24	No	Street	5x10-4	0%	15,85 kbit/s, RoHC				4.19	0.91	0.45	3.69	0.87	0.43

Graphs of MOS and its confidence limit for 6.7 kbit/s with 300 ms delay, 12.2 kbit/s with 300 ms delay, and 12.2 kbit/s with 500 ms delay conditions are shown in **Figures 3.2.5.1** to **3.2.5.3**. These values do not include data recorded with background noise. In general, MOS values are greater when BERs are lower and in groups without packet loss, 0 %, is greater than for 3 %. Such a tendency is seen without a few exceptions, groups for 0% in **Fig. 3.2.5.2** and 3% in **Fig. 3.2.5.3**

The influence of background noise is shown in **Figures 3.2.5.4** and **3.2.5.5**. In these graphs, scores by subjects in room B are more influenced by their surrounding noise than subjects in room A.

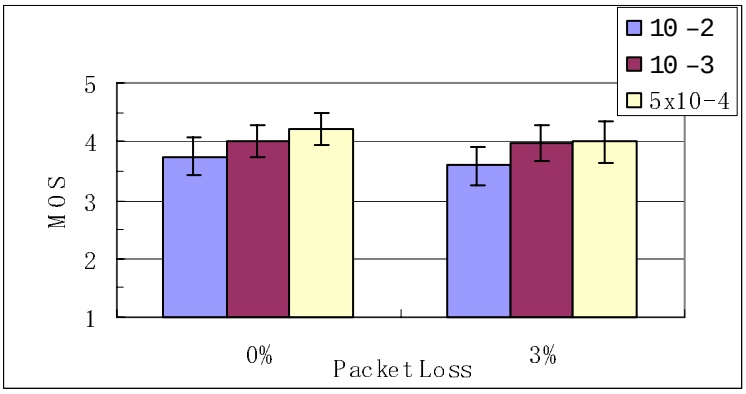


Fig. 3.2.5.1 MOS variation according to packet loss, radio transmission error at 12.65 kb/s mode with RoHC

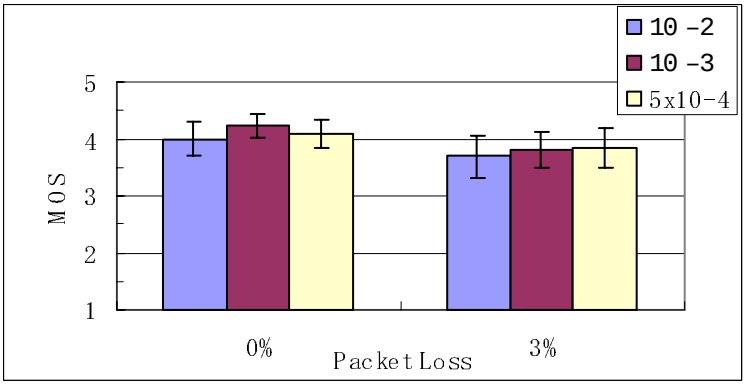


Fig. 3.2.5.2 MOS variation according to packet loss, radio transmission error at 12.65 kbit/s mode without RoHC

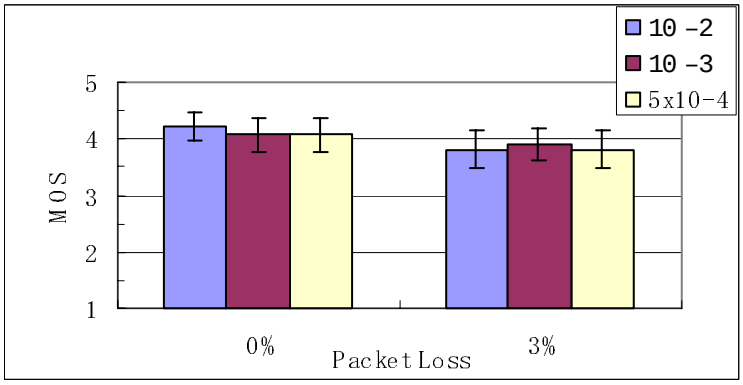


Fig. 3.2.5.3 MOS variation according to packet loss, radio transmission error at 15.85 kbit/s mode with RoHC

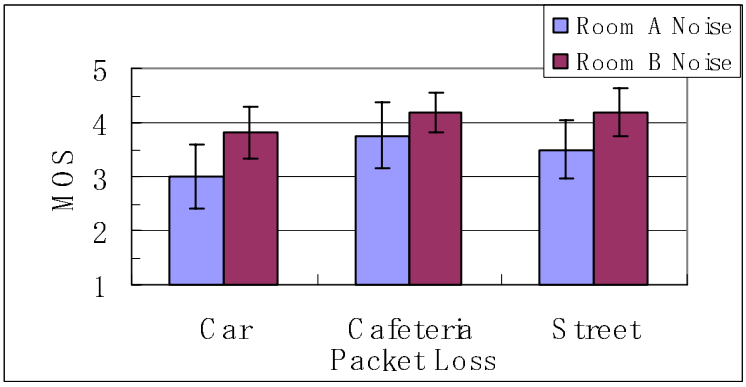


Fig**. 3.2.5.4** MOS variation according to background noises surrounded (room A) and transmitted (room B)by the subjects in room A

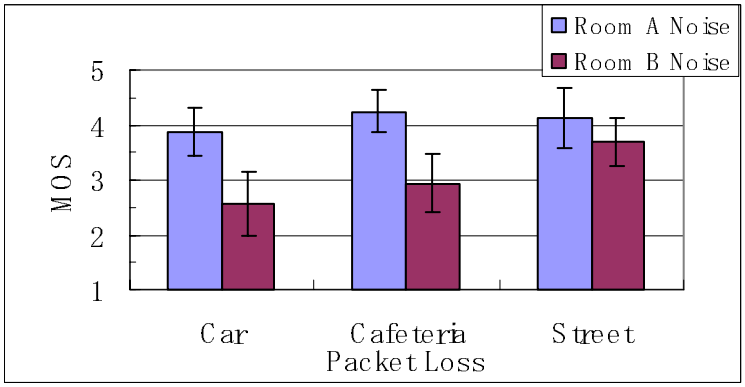


Fig. 3.2.5.5 MOS variation according to background noises surrounded (room A) and transmitted (room B) by the subjects in room B..