AMR Wideband Speech Codec Qualification Phase Report

TSG-SA#8 Dusseldorf, Germany

June 26-28, 2000

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AMR Wideband Project Objectives

- *Development and Selection of a Multi-Rate Wideband Speech Codec with extended Acoustic Bandwidth (50Hz-7kHz) for the support of Wideband Speech Telephony in multiple radio environments:*
  - *Application A: GSM Full Rate Channel and Codec Rate compatible with 16 kbit/s sub-multiplexing scheme on the Abis/Ater Interface*
  - *Application B: GSM Full Rate Channel without Codec Rate restriction*
  - *Application C: EDGE/GERAN 8-PSK Radio Channel*
  - *Application E: 3G UMTS Radio Channel*

- *Key Project Milestones:*
  - *Feasibility Study:* *1999*
  - *Qualification Phase:* *June 2000 (TSG-SA#8)*
  - *Selection Phase:* *October 2000*
  - *Completion of Standard:* *December 2000 (TSG-SA#10 & Release 00)*

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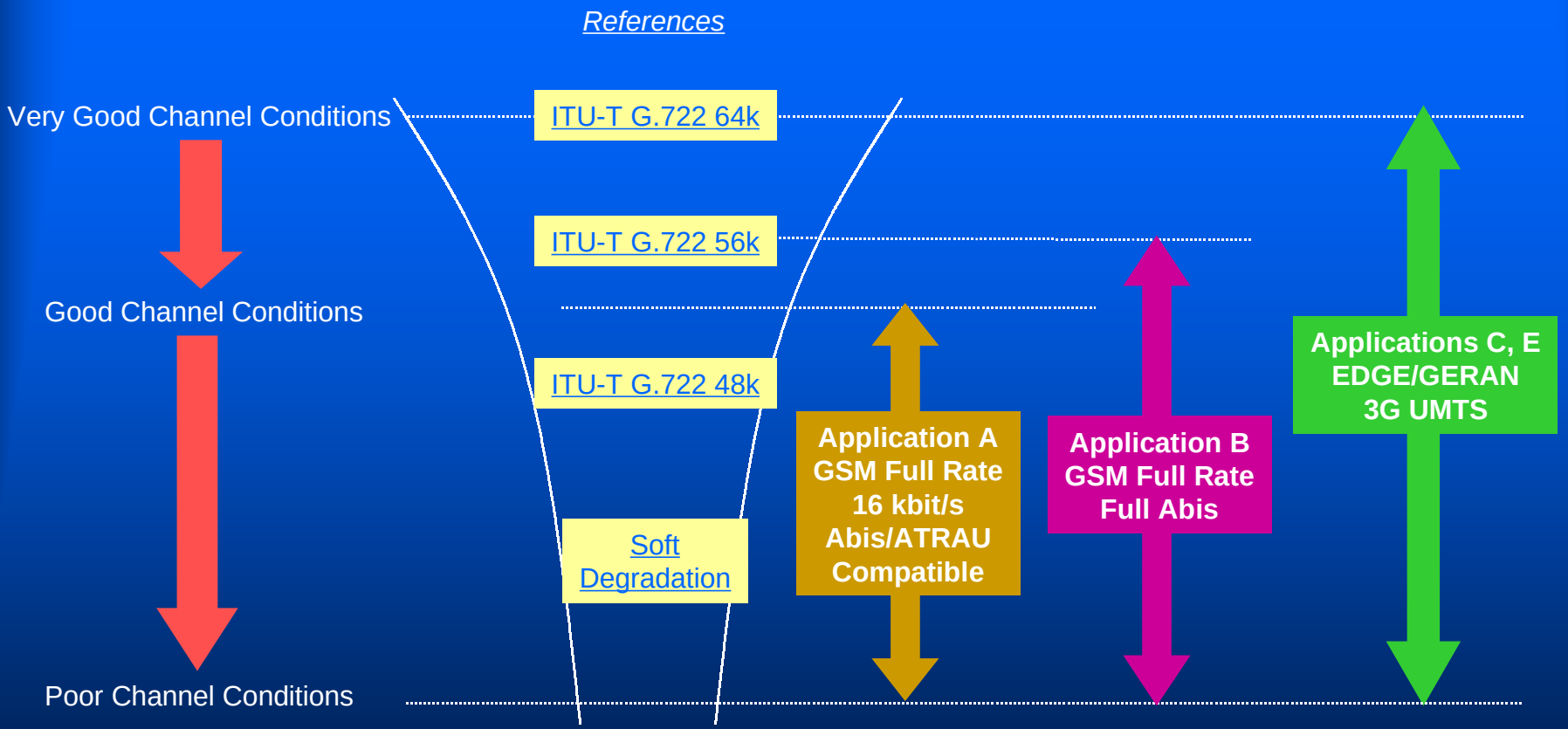
AMR-WB Performance Requirements



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Qualification Phase Overview

- *7 Candidates:*
  - *I : Ericsson*
  - *J : FDN Consortium (France Telecom/T-Nova Deutsche Telekom/Nortel Networks)*
  - *K : Matsushita (Withdrawn after Qualification Phase)*
  - *L : Nokia*
  - *M : Siemens*
  - *N : Motorola*
  - *O : Texas Instruments*

- *3 Experiments:*
  - *Exp1a: Performances in Clean Speech for Applications A, B & E*
  - *Exp2a: Performances in Car Noise (15dB SNR) for Applications A, B & E*
  - *Exp2b: Performances in Street Noise (15dB SNR) for Applications A, B & E*

- *Listening Tests performed by the Candidates*
  - *Each Candidate tested his own solution and two other candidates in each experiment (12 Experiments each)*

Qualification Rules

Rule 1: The solution must be compliant with all Design Constraints (Source & Channel Coding complexity, Transmission delay…)

⇒ *All Candidates passed Rule 1*

Rule 2a & Rule 2b: 'Soft' Eliminating Rules related to the number of failures and the failures' severity

⇒ *All Candidates passed Rule 2a & 2b except Candidate K (withdrawn)*

Rule 3: Comparison of Performances according to multiple Figure of Merits

ΣΔMOS, ΣΔdBq, ΣΔPoW, Number of Majority Failures

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Rule 3: Figure Of Merits

Total ΔdBq:

Candidates:	I	J	K	L	M	N	O	BF
Exp1a	236.68	133.44	-80.82	134.34	29.27	145.21	125.63	1
Exp2a	1.88	39.49	-245.78	147.85	-109.14	-95.31	-85.12	0.5
Exp2b	12.55	150.27	-132.08	67.11	-1.53	-84.88	-46.11	0.5
Total:	***243.90***	***228.32***	***-269.75***	***241.83***	***-26.06***	***55.11***	***60.01***	

Total Failures

Candidates:	I	J	K	L	M	N	O
Exp1a	0	0	16	1	4	1	3
Exp2a	4	4	24	0	8	4	5
Exp2b	4	1	10	1	8	4	4
Total:	***8***	***5***	***50***	***2***	***20***	***9***	***12***

Total ΔMOS:

Candidates:	I	J	K	L	M	N	O
Exp1a	16.46	11.03	-7.86	11.06	3.01	12.03	13.06
Exp2a	0.34	4.35	-31.56	14.42	-14.14	-11.94	-11.59
Exp2b	-0.22	12.97	-15.10	6.06	-3.15	-9.45	-5.26
Total:	***16.52***	***19.69***	***-31.19***	***21.30***	***-5.63***	***1.34***	***4.64***

Total Majority Failures

Candidates:	I	J	K	L	M	N	O
Exp1a	0	0	4	0	0	0	1
Exp2a	0	0	8	0	3	0	1
Exp2b	0	0	3	0	4	2	0
Total:	***0***	***0***	***15***	***0***	***7***	***2***	***2***

Total PoW(%):

Candidates:	I	J	K	L	M	N	O
Exp1a							
Exp2a	0.13	0.15	2.95	0.05	1.25	1.78	1.73
Exp2b	0.15	0.14	1.20	0.18	1.01	1.14	1.02
Total:	***0.135***	***0.141***	***2.073***	***0.115***	***1.130***	***1.458***	***1.375***

Total Failures Restricted ΔdBq:

Candidates:	I	J	K	L	M	N	O
Exp1a	0.00	0.00	-45.59	-0.69	-4.51	-0.67	-2.35
Exp2a	-13.18	-6.80	-103.27	0.00	-12.67	-2.98	-5.56
Exp2b	-10.05	-2.93	-28.27	-0.50	-24.23	-2.67	-6.28
Total:	***-11.62***	***-4.87***	***-111.37***	***-0.94***	***-22.96***	***-3.50***	***-8.26***

Total Failures Restricted ΔMOS:

Candidates:	I	J	K	L	M	N	O
Exp1a	0.00	0.00	-4.89	-0.11	-0.43	-0.04	-0.14
Exp2a	-1.67	-0.64	-14.05	0.00	-1.62	-0.38	-0.84
Exp2b	-1.27	-0.51	-3.30	-0.07	-3.59	-0.28	-0.66
Total:	***-1.47***	***-0.57***	***-13.57***	***-0.14***	***-3.04***	***-0.37***	***-0.89***

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Results Summary

- *Overall performances found very promising*
  - *Good probability to select a solution meeting all Performance Requirements*
- *3 Candidates (I, J & L) with best overall performances (No majority failures)*
  - *Candidate I best in Clean Speech*
  - *Candidate J best in Street Noise*
  - *Candidate L best in Car Noise*
- *No candidate formally eliminated*
- *Participation to the Selection Phase kept voluntary*
  - *Candidates K & M withdrew their proposals*
- *Remaining 5 candidates to participate to the Selection Phase*
  - *The participating candidates will share the costs associated with the Selection and Characterization Phases*
  - *Selection Phase under way, Test Results and Codec Selection expected for October 2000.*
  - *Selection results and related specifications to be submitted to TSG-SA#10 (December 2000) for approval*

Result Diagrams: Introduction

- *The following slides present the combined Qualification Test Results in the form of Performance Diagrams in MOS (or DMOS) for all Experiments and all applications*

WARNING!

- *These diagrams were obtained by averaging the results obtained by the candidates for each Experiment and each Test Condition*
- *They are provided for information only to illustrate to differences between the Figures of Merit obtained by the different candidates*
- *These diagrams DO NOT provide a complete picture of the relative performances of the candidates because:*
  - *The solutions were never tested against each other in the same experiment*
  - *Each listening laboratory (mandated by the proponents) tested only 3 candidates for each experiment (see allocation table)*

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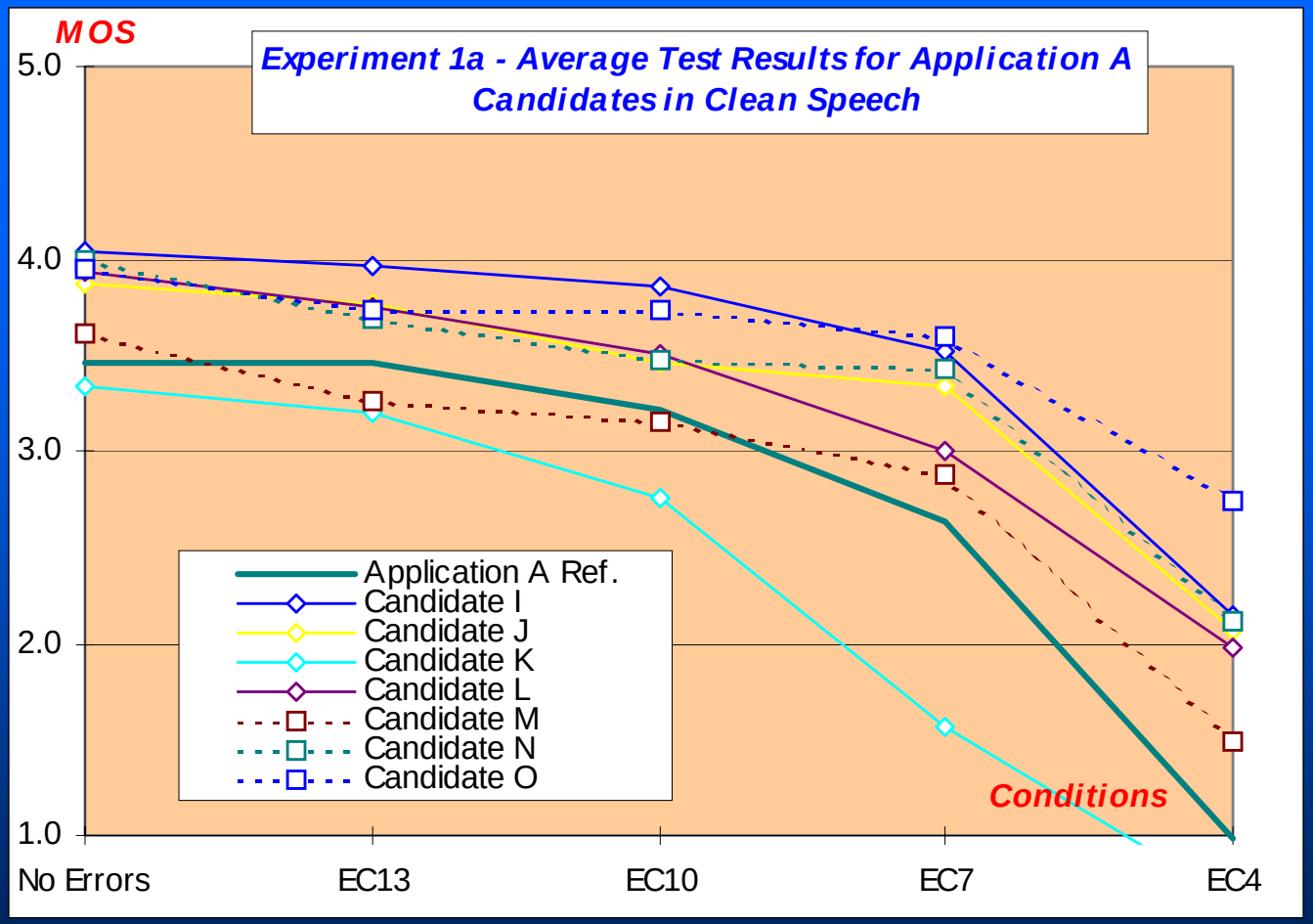
Exp. 1a: Average Performances for Application A



Allocation Table:

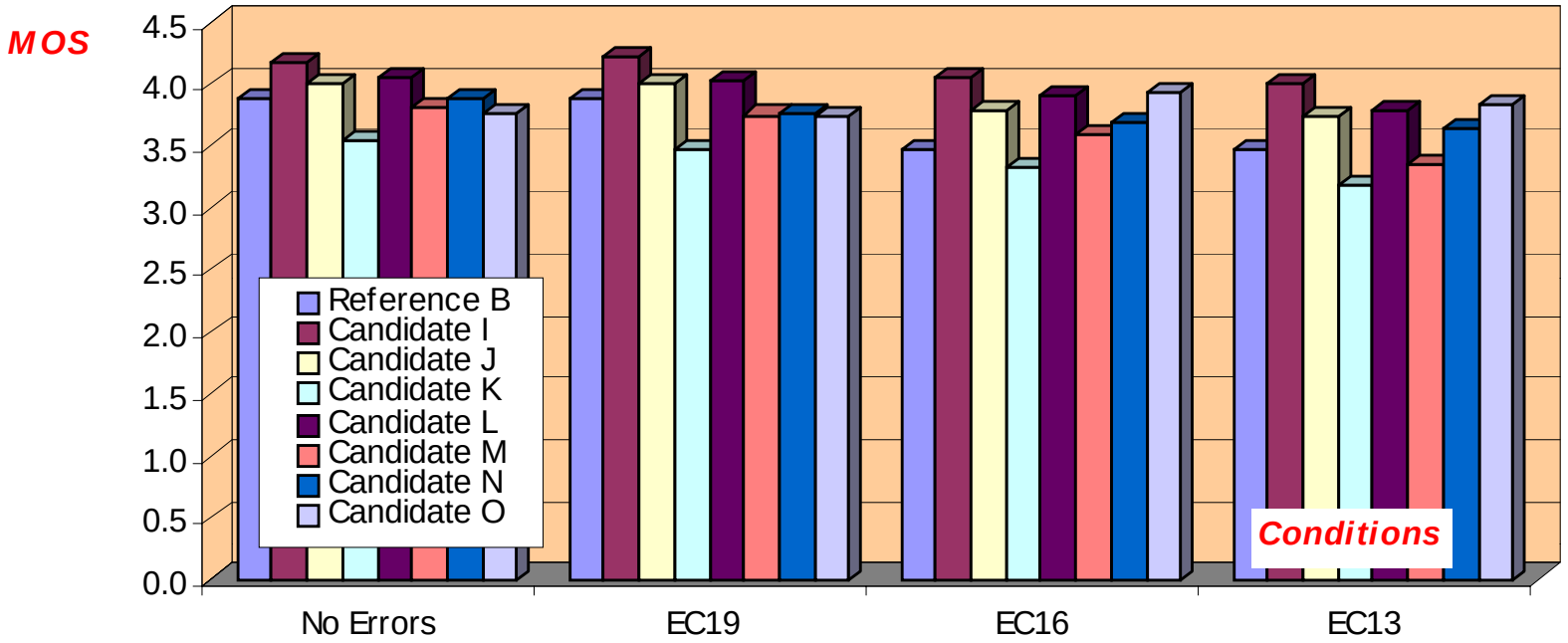
Candidates:	I	J	K	L	M	N	O
Exp1a-1	I	J	K	L	M	N	O
Exp1a-2	J	O	N	M	J	K	I
Exp1a-3	K	N	O	I	L	L	M

Total ΔdBq:

Candidates:	I	J	K	L	M	N	O	BF
Exp1a	236.68	133.44	-80.82	134.34	29.27	145.21	125.63	1
Exp2a	1.88	39.49	-245.78	147.85	-109.14	-95.31	-85.12	0.5
Exp2b	12.55	150.27	-132.08	67.11	-1.53	-84.88	-46.11	0.5
Total:	***243.90***	***228.32***	***-269.75***	***241.83***	***-26.06***	***55.11***	***60.01***	

Exp. 1a: Average Performances for Application B

Experiment 1a - Average Test Results for Application B
Candidates in Clean Speech



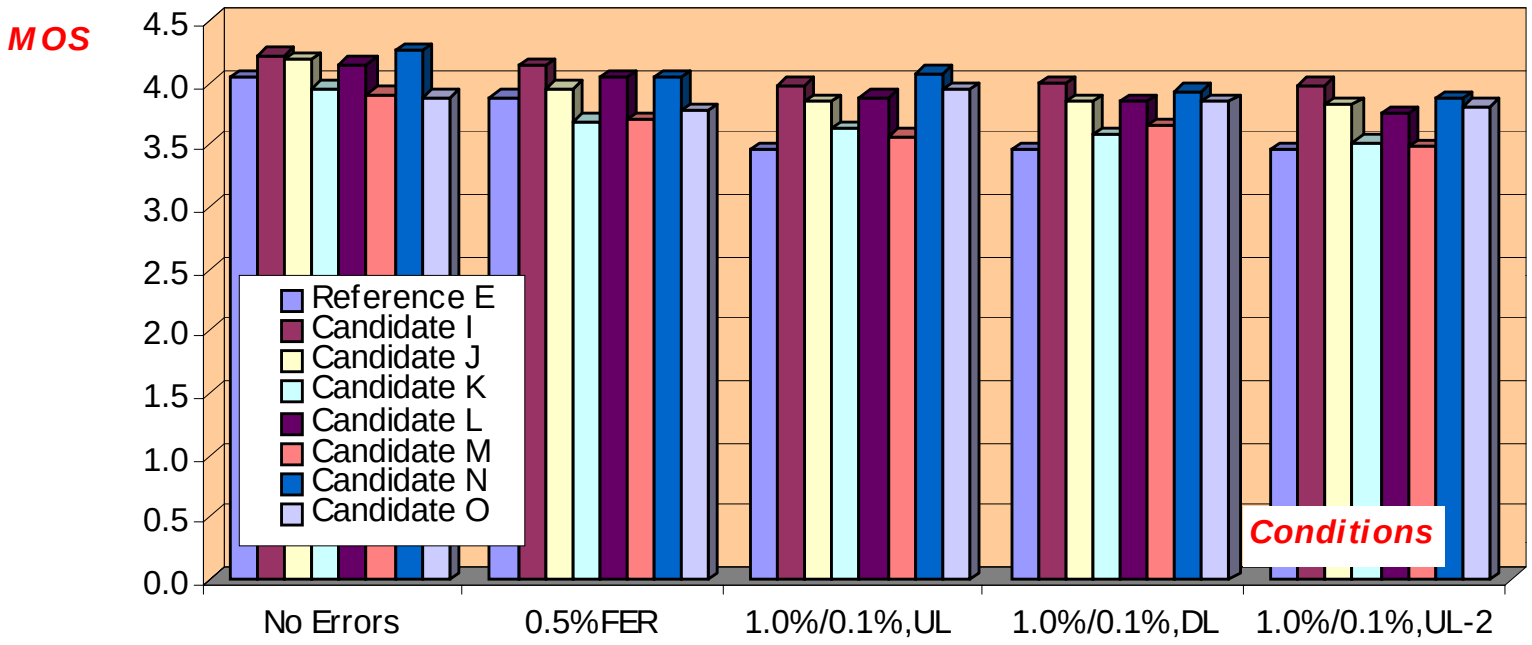
Allocation Table:

Candidates:	I	J	K	L	M	N	O
Exp1a-1	I	J	K	L	M	N	O
Exp1a-2	J	O	N	M	J	K	I
Exp1a-3	K	N	O	I	L	L	M

Total ΔdBq:

Candidates:	I	J	K	L	M	N	O	BF
Exp1a	236.68	133.44	-80.82	134.34	29.27	145.21	125.63	1
Exp2a	1.88	39.49	-245.78	147.85	-109.14	-95.31	-85.12	0.5
Exp2b	12.55	150.27	-132.08	67.11	-1.53	-84.88	-46.11	0.5
Total:	***243.90***	***228.32***	***-269.75***	***241.83***	***-26.06***	***55.11***	***60.01***	

Experiment 1a - Average Test Results for Application E
Candidates in Clean Speech



Allocation Table:

Candidates:	I	J	K	L	M	N	O
Exp1a-1	I	J	K	L	M	N	O
Exp1a-2	J	O	N	M	J	K	I
Exp1a-3	K	N	O	I	L	L	M

Total ΔdBq:

Candidates:	I	J	K	L	M	N	O	BF
Exp1a	236.68	133.44	-80.82	134.34	29.27	145.21	125.63	1
Exp2a	1.88	39.49	-245.78	147.85	-109.14	-95.31	-85.12	0.5
Exp2b	12.55	150.27	-132.08	67.11	-1.53	-84.88	-46.11	0.5
Total:	***243.90***	***228.32***	***-269.75***	***241.83***	***-26.06***	***55.11***	***60.01***	

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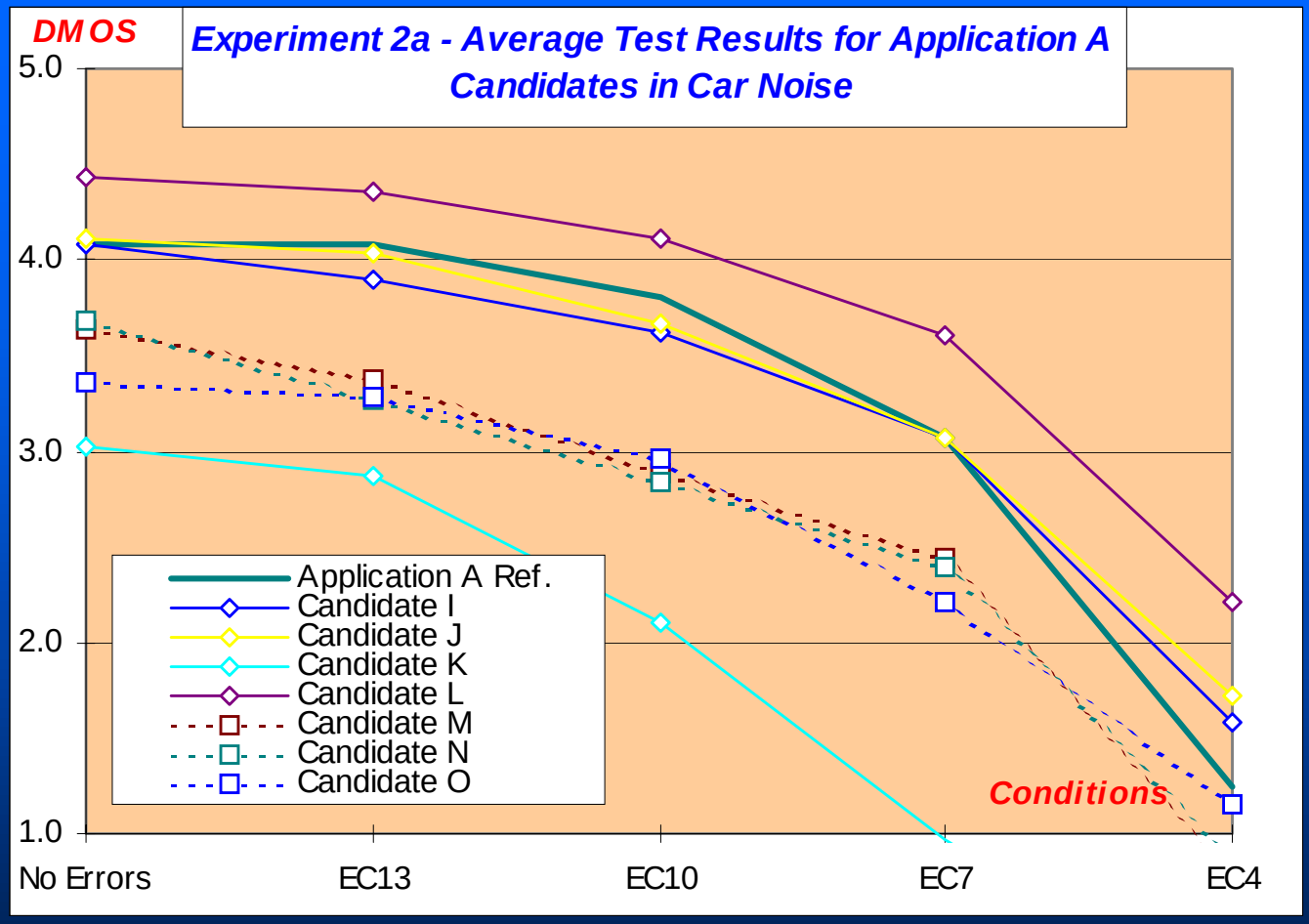
Exp. 2a: Average Performances for Application A



Allocation Table:

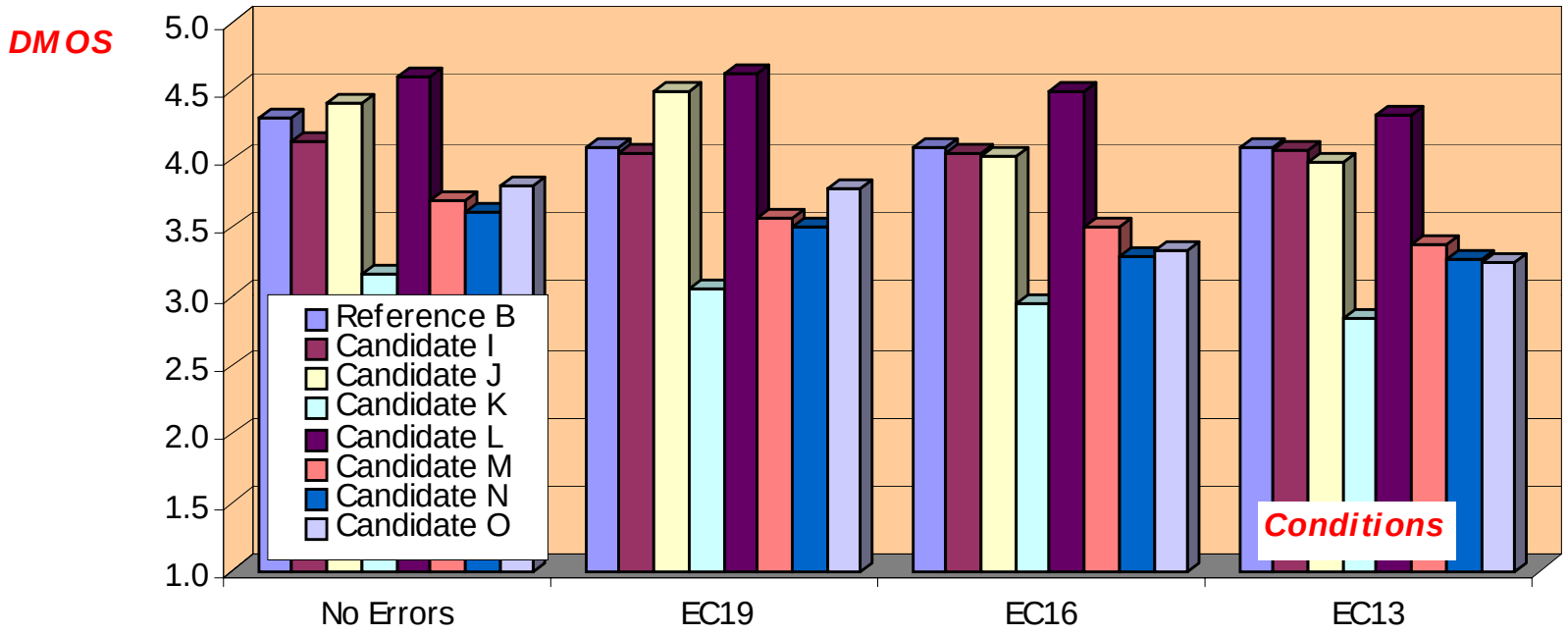
Candidates:	I	J	K	L	M	N	O
Exp2a-1	I	J	K	L	M	N	O
Exp2a-2	M	L	I	K	K	O	J
Exp2a-3	O	I	J	N	N	M	L

Total ΔdBq:

Candidates:	I	J	K	L	M	N	O	BF
Exp1a	236.68	133.44	-80.82	134.34	29.27	145.21	125.63	1
Exp2a	1.88	39.49	-245.78	147.85	-109.14	-95.31	-85.12	0.5
Exp2b	12.55	150.27	-132.08	67.11	-1.53	-84.88	-46.11	0.5
Total:	***243.90***	***228.32***	***-269.75***	***241.83***	***-26.06***	***55.11***	***60.01***	

Exp. 2a: Average Performances for Application B

Experiment 2a - Average Test Results for Application B
Candidates in Car Noise



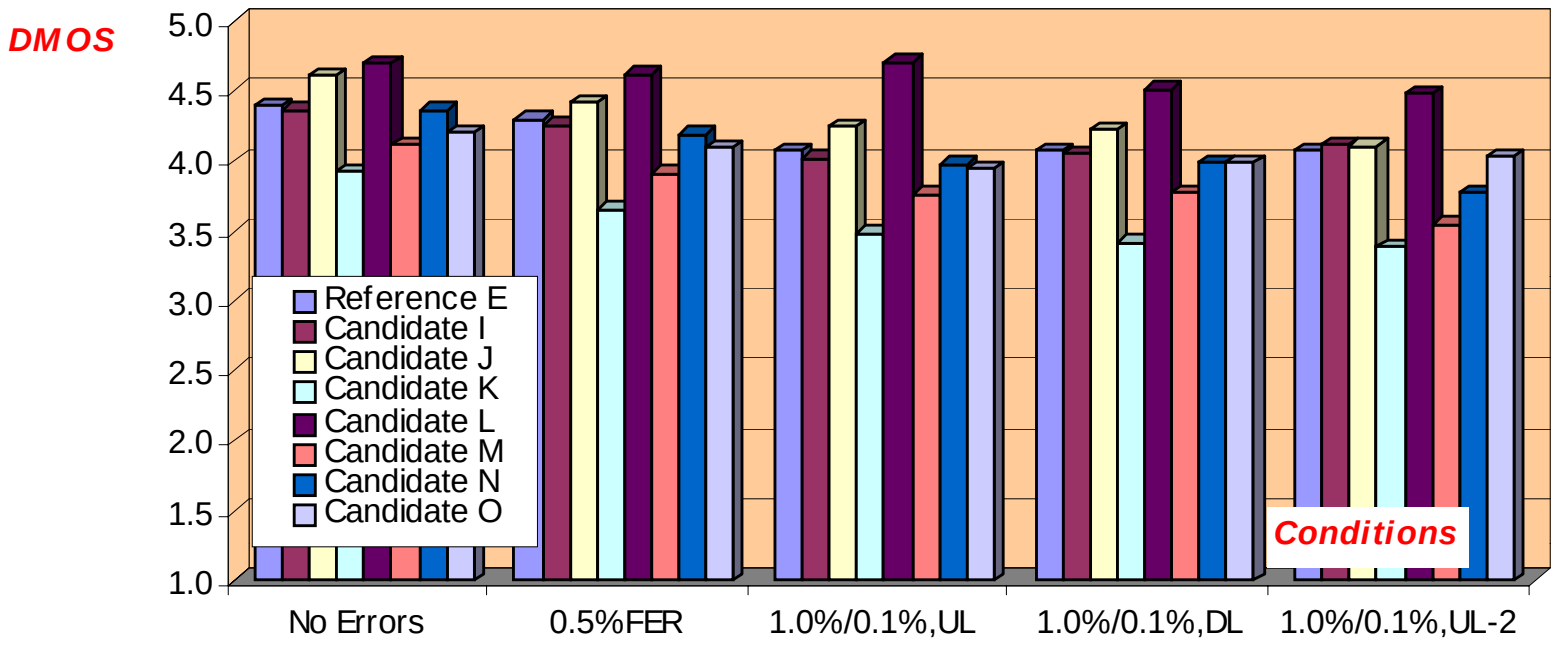
Allocation Table:

Candidates:	I	J	K	L	M	N	O
Exp2a-1	I	J	K	L	M	N	O
Exp2a-2	M	L	I	K	K	O	J
Exp2a-3	O	I	J	N	N	M	L

Total ΔdBq:

Candidates:	I	J	K	L	M	N	O	BF
Exp1a	236.68	133.44	-80.82	134.34	29.27	145.21	125.63	1
Exp2a	1.88	39.49	-245.78	147.85	-109.14	-95.31	-85.12	0.5
Exp2b	12.55	150.27	-132.08	67.11	-1.53	-84.88	-46.11	0.5
Total:	***243.90***	***228.32***	***-269.75***	***241.83***	***-26.06***	***55.11***	***60.01***	

Experiment 2a - Average Test Results for Application E
Candidates in Car Noise



Allocation Table:

Candidates:	I	J	K	L	M	N	O
Exp2a-1	I	J	K	L	M	N	O
Exp2a-2	M	L	I	K	K	O	J
Exp2a-3	O	I	J	N	N	M	L

Total ΔdBq:

Candidates:	I	J	K	L	M	N	O	BF
Exp1a	236.68	133.44	-80.82	134.34	29.27	145.21	125.63	1
Exp2a	1.88	39.49	-245.78	147.85	-109.14	-95.31	-85.12	0.5
Exp2b	12.55	150.27	-132.08	67.11	-1.53	-84.88	-46.11	0.5
Total:	***243.90***	***228.32***	***-269.75***	***241.83***	***-26.06***	***55.11***	***60.01***	

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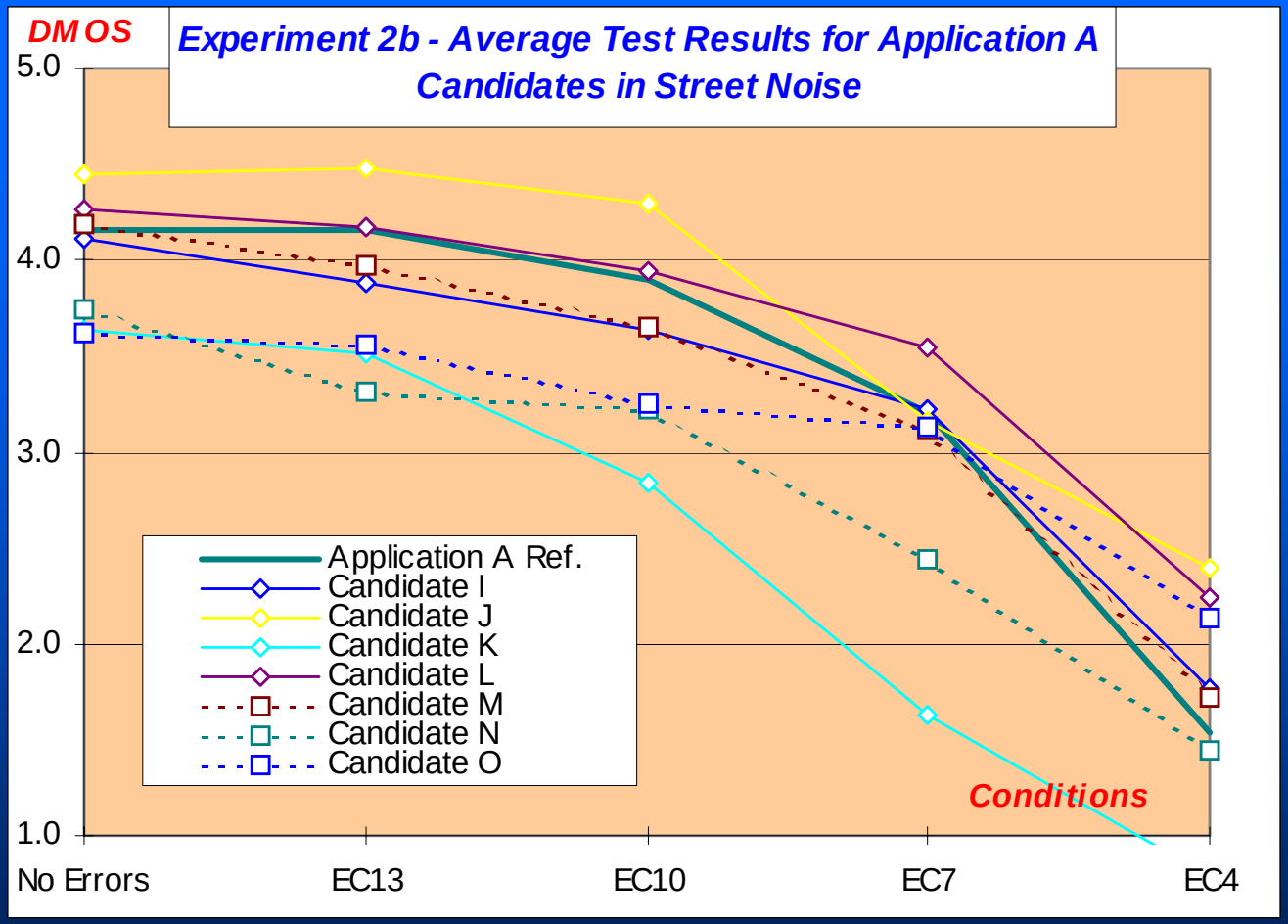
Exp. 2b: Average Performances for Application A



Allocation Table:

Candidates:	I	J	K	L	M	N	O
Exp2b-1	I	J	K	L	M	N	O
Exp2b-2	L	K	L	J	I	J	K
Exp2b-3	N	M	M	O	O	I	N

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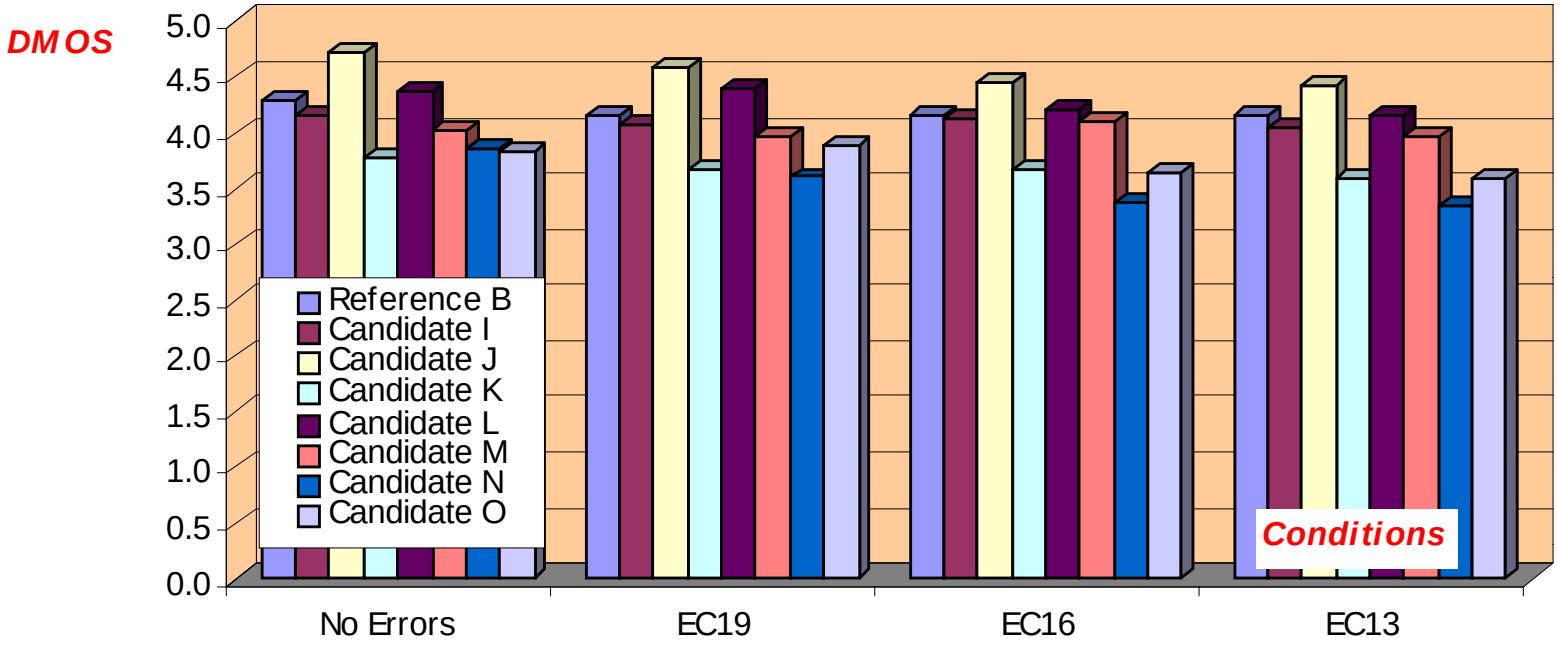
Total ΔdBq:

Candidates:	I	J	K	L	M	N	O	BF
Exp1a	236.68	133.44	-80.82	134.34	29.27	145.21	125.63	1
Exp2a	1.88	39.49	-245.78	147.85	-109.14	-95.31	-85.12	0.5
Exp2b	12.55	150.27	-132.08	67.11	-1.53	-84.88	-46.11	0.5
Total:	***243.90***	***228.32***	***-269.75***	***241.83***	***-26.06***	***55.11***	***60.01***	

Exp. 2b: Average Performances for Application B

Experiment 2b - Average Test Results for Application B
Candidates in Street Noise



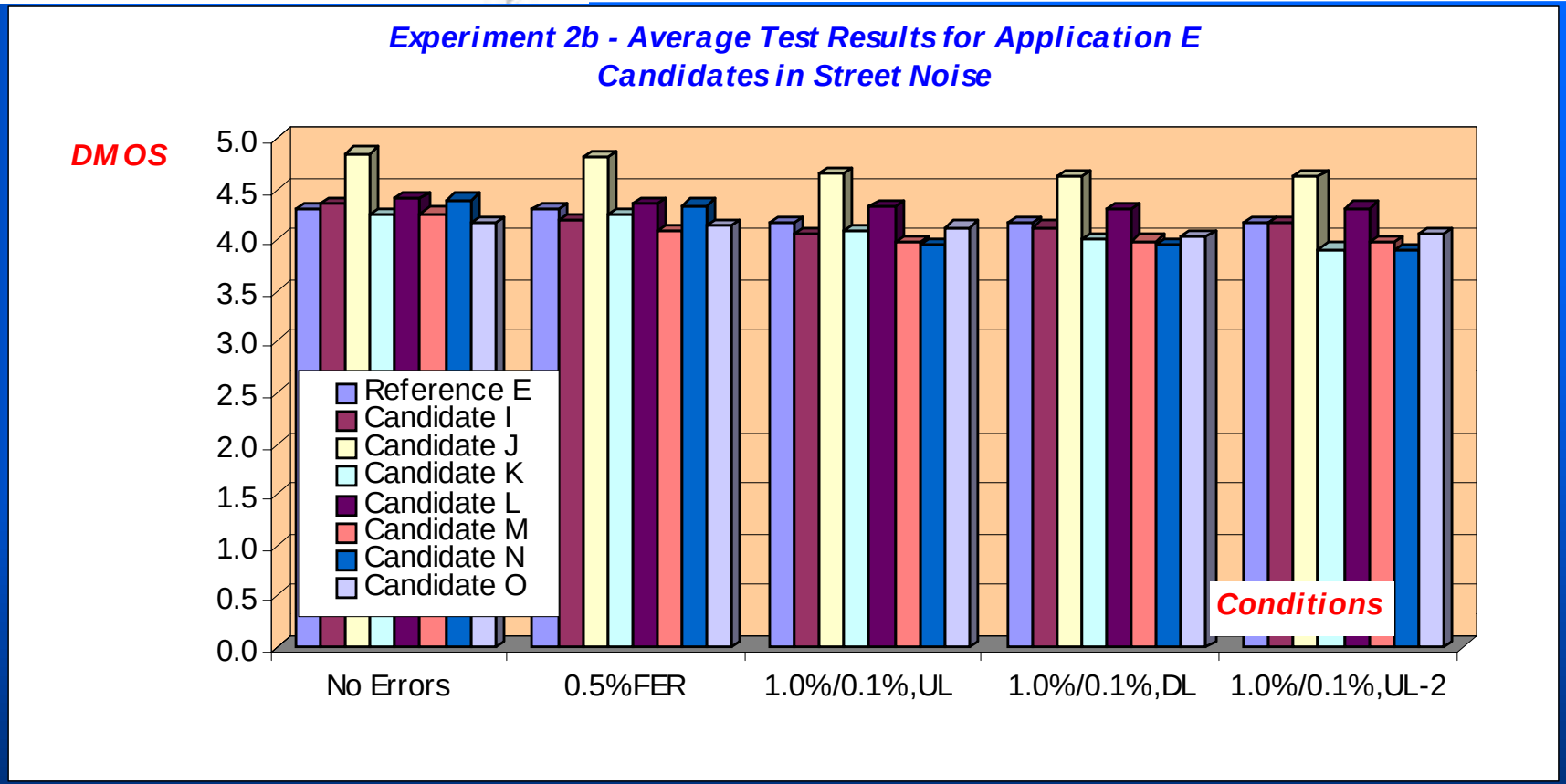
Allocation Table:

Candidates:	I	J	K	L	M	N	O
Exp2b-1	I	J	K	L	M	N	O
Exp2b-2	L	K	L	J	I	J	K
Exp2b-3	N	M	M	O	O	I	N

Total ΔdBq:

Candidates:	I	J	K	L	M	N	O	BF
Exp1a	236.68	133.44	-80.82	134.34	29.27	145.21	125.63	1
Exp2a	1.88	39.49	-245.78	147.85	-109.14	-95.31	-85.12	0.5
Exp2b	12.55	150.27	-132.08	67.11	-1.53	-84.88	-46.11	0.5
Total:	***243.90***	***228.32***	***-269.75***	***241.83***	***-26.06***	***55.11***	***60.01***	

Exp. 2b: Average Performances for Application E



Allocation Table:

Candidates:	I	J	K	L	M	N	O
Exp2b-1	I	J	K	L	M	N	O
Exp2b-2	L	K	L	J	I	J	K
Exp2b-3	N	M	M	O	O	I	N

Total ΔdBq:

Candidates:	I	J	K	L	M	N	O	BF
Exp1a	236.68	133.44	-80.82	134.34	29.27	145.21	125.63	1
Exp2a	1.88	39.49	-245.78	147.85	-109.14	-95.31	-85.12	0.5
Exp2b	12.55	150.27	-132.08	67.11	-1.53	-84.88	-46.11	0.5
Total:	***243.90***	***228.32***	***-269.75***	***241.83***	***-26.06***	***55.11***	***60.01***	