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ASCI FEATURES SUMMARY OF PERFORMANCE TESTS ON THE MORANE TRIAL SITES

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EVOLUTION SHEET

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A	30/0700	MARCONI PMT	Creation of the draft version
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TABLE OF CONTENTS

1. INTRODUCTION 6

2. DESCRIPTION OF TRIAL SITES 6

2.1. DESCRIPTION OF THE ITALIAN TRIAL SITE 6
2.2. DESCRIPTION OF THE GERMAN TRIAL SITE 9
2.3. EQUIPMENT VERSION 11
2.4. NOTE ON TEST CONFIGURATION AND RESTRICTIONS 11
2.5. TESTS PERFORMED 12

3. RESULTS OBTAINED 13

3.1. NORMAL CALL SET-UP FOR VBS/VGCS 14
3.2. FAST CALL SET-UP FOR VBS/VGCS 16
3.3. CALL TERMINATION TIME 17
3.4. LATE ENTRY / CELL RE-SELECTION 17

4. CONCLUSION 18

List of abbreviations

ASCI	Advanced Speech Call Items
BSC	Base Station Controller
BSS	Base Station Sub-system
BTS	Base Transceiver Station
EDSS1	European Digital Subscriber Signalling System
EIRENE	European Integrated Railway Radio Enhanced Network
eMLPP	enhanced Multi-Level Precedence and Pre-emption service
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
ETSI	European Telecommunications Standard Institute
FNT	Fixed Network Telephone
GCA	Group Call Area
GCR	Group Call Register
GID	Group Identifier
GSM	Global System for Mobile Communications
GSM-R	Global System for Mobile communications-Railway
HLR	Home Location Register
HO	Hand-Over
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
ISDN	Integrated Service Digital Network
MMI	Man Machine Interface
MOC	Mobile Originated Call
MORANE	Mobile Radio for Railway Networks in Europe
MS	Mobile Station
MSC	Mobile Switching Centre
MSISDN	Mobile Station ISDN Number
M-Sub	Mobile Subscriber
MTC	Mobile Terminated Call
MTM	Mobile to Mobile call
NCH	Notification CHannel
NSS	Network Sub-System
PTP	Point-To-Point
PTT	Push To Talk
SCCP	Signalling Connection Control Port
TMS	Test Mobile Station
TMSI	Temporary Mobile Subscriber Identity
UIC	Union Internationale des Chemins de fer
VBS	Voice Broadcast Service
VGCS	Voice Group Call Service

Glossary

VBS

Call originator:	a mobile user in the Group Call Area or a fixed network user (a dispatcher in terms of GSM) who originates the call
Listening subscriber:	a mobile user in the Group Call Area who listens only
Dispatcher:	a user who may be located in or out the Group Call Area, and even on the fixed network which is connected via a dedicated link

VGCS

Call originator:	a mobile user in the Group Call Area or a fixed network user (a dispatcher in terms of GSM) who originates the call
Talker subscriber:	a mobile user or a fixed network user who is currently talking
Listening subscriber:	a mobile user in the Group Call Area who is currently listening
Dispatcher:	a user who may be located in or out the Group Call Area, and even on the fixed network

References

[1]: MORANE Project - “Performance test specification for MORANE phase 2 features”, referenced A 42 T 9002 1 , dated 23/04/1999.

[2]: MORANE Project - “ASCI features performance Test Handbook” – version B

[3]: MORANE Project - “ASCI features performance tests manual for Kapsch TMS”, referenced AP00133R.MOR - Version C

[4]: UIC Project EIRENE - “Functional Requirements Specification” - Version 4.0.

1. INTRODUCTION

This document summarises the results obtained from the measurements along the MORANE trial sites regarding ASCI feature performance tests. The measurements consisted in setting up several test cases as described in [1], [2] and [3].

The document will present the results from the German and Italian trial sites.

Measurements have been carried out in :

- week 8 ⇨ German trial site
- week 9 ⇨ Italian trial site
- week 11 ⇨ Italian trial site
- week 19 ⇨ German trial site

The speed during the first runs was up to 150 km/h on the Italian and up to 200 km/h on the German trial site.

The first equipment used consisted in several KAPSCH Test Mobile Stations and Protocol Analyser for the A-interface and EDSS1 Interface

2. DESCRIPTION OF TRIAL SITES

2.1. Description of the Italian trial site

The Italian trial site is about 80 Km long and runs from Prato to Firenze and from Firenze to Arezzo, in the middle of the FS major line Bologna-Florence-Rome called “Direttissima”.
From Prato to Firenze the line runs in an urban environment, whilst, from Firenze to Arezzo, there is an alternance of viaducts and tunnels.
More than 20 Km of the trial site are in tunnels (exactly there are 14 tunnels) and about 9 Km are on viaducts. The longest tunnel is San Donato (11 Km).
The radio coverage on the whole trial site is now provided by 19 BTS connected to one BSC (in Florence S.M.N. station) and one MSC (in Florence S.M.N. station) of one supplier (Siemens).

The coverage in the tunnels is realised both with antennas and leaky cables, whether by connecting the BTSs directly to the tunnel repeaters with a coaxial cable link or by feeding the repeaters with antennas directed toward to the remote BTSs.
The Fig. 2-1 shows the location of each BTS and relevant tunnels along the railway.

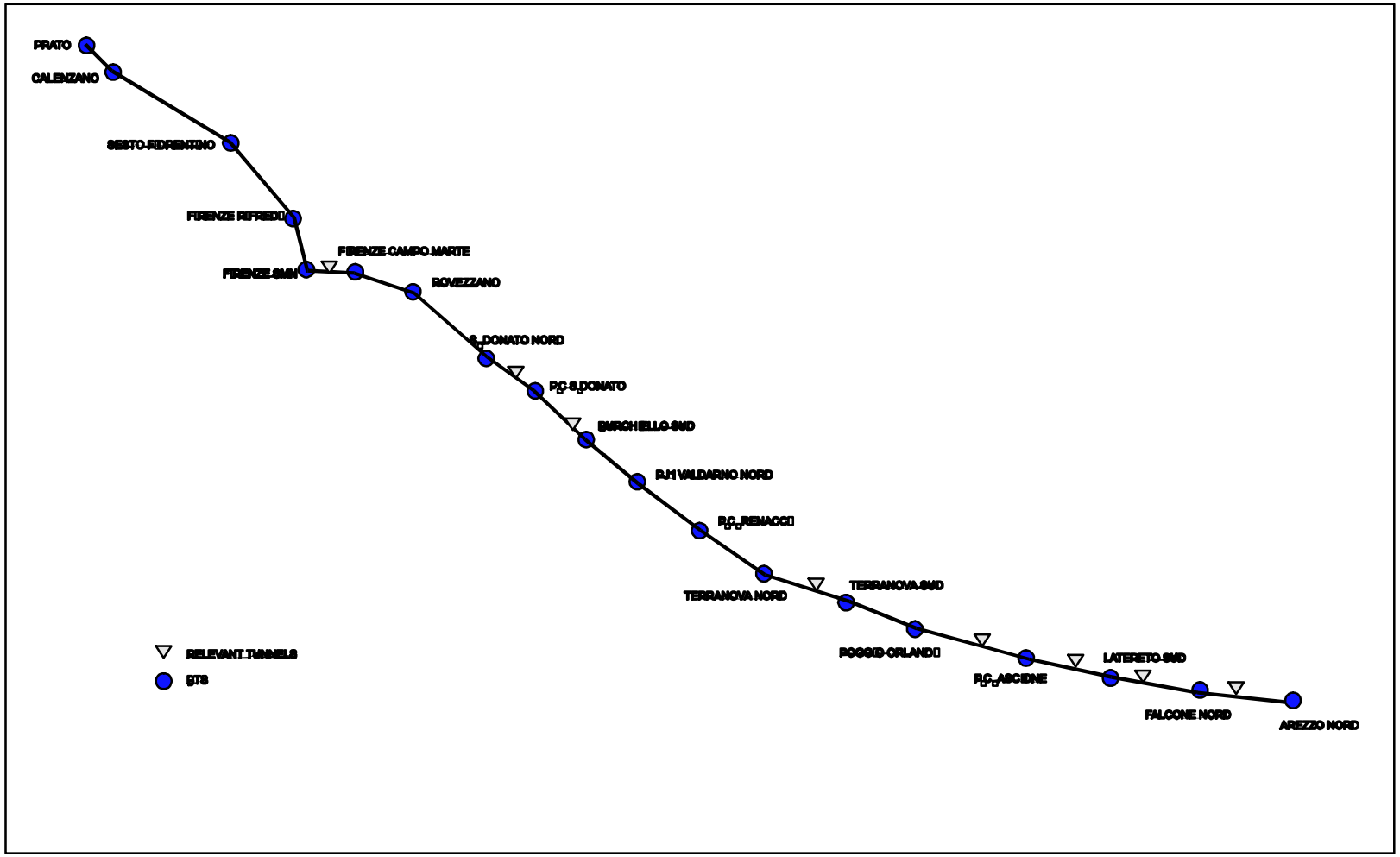


Fig. 2-1: map of the BTSs and relevant tunnels in the GSM-R Italian Trial Site (Prato-Firenze-Arezzo)

The GSM-R frequencies bands are:

- for the up-link channels: from 876 MHz to 880 MHz;
- for the down-link channels: from 921 MHz to 925 MHz.

The frequency planning of the GSM-R Italian Trial Site is summarised in table below.

BTS site name	LAC-CI	BCCH	TCH	BTSE=BTSMN= BTSM	BTS
AREZZO	1201-2011	955	958	10	1
FALCONE	1201-2021	960	963	11	2
LATERETO	1201-2031	957	962	12	3
ASCIONE	1201-2041	959	955	13	4
POGGIO ORLANDI	1201-2051	961	957	14	5
TERRANOVA SUD	1201-2061	963	955	15	19
TERRANOVA NORD	1201-2071	958	961	16	6
RENACCI	1201-2081	956	960	17	7
VALDARNO	1201-2091	963	959	18	8
BURCHIELLO	1201-1011	955	961	0	9
S.DONATO SUD	1201-1021	957	962	1	10
S.DONATO NORD	1201-1031	960	955	2	11
ROVEZZANO	1201-1041	958	963	3	12
FIRENZE CdM *)	1201-1051	956	961	4	13
FIRENZE SMN **)	1201-1061	959	963	5	14
RIFREDI	1201-1071	955	962	6	15
SESTO FIORENTINO	1201-1081	960	957	7	16
CALENZANO	1201-1091	963	958	8	17
PRATO	1201-1101	956	959	9	18

*) Campo di Marte
**) Santa Maria Novella

2.2. Description of the German trial site

The German Trial Site is approximately 79 Km long.
It is situated on the high-speed line between Stuttgart-Mannheim, that runs in both urban and rural environments.
More than 27 km of the trial site are located in 14 short tunnels. The longest one ("Freudensteintunnel") is over 6.5 km long (see Fig. 1-2). The coverage inside tunnels is realised with repeaters.

The radio coverage along the whole trial site is now provided by 18 BTSs connected to one Siemens BSC located in Mannheim and to one Nortel BSC in Vaihingen Enz.

Equipment, from three different providers, is installed on this trial site, that consists of:

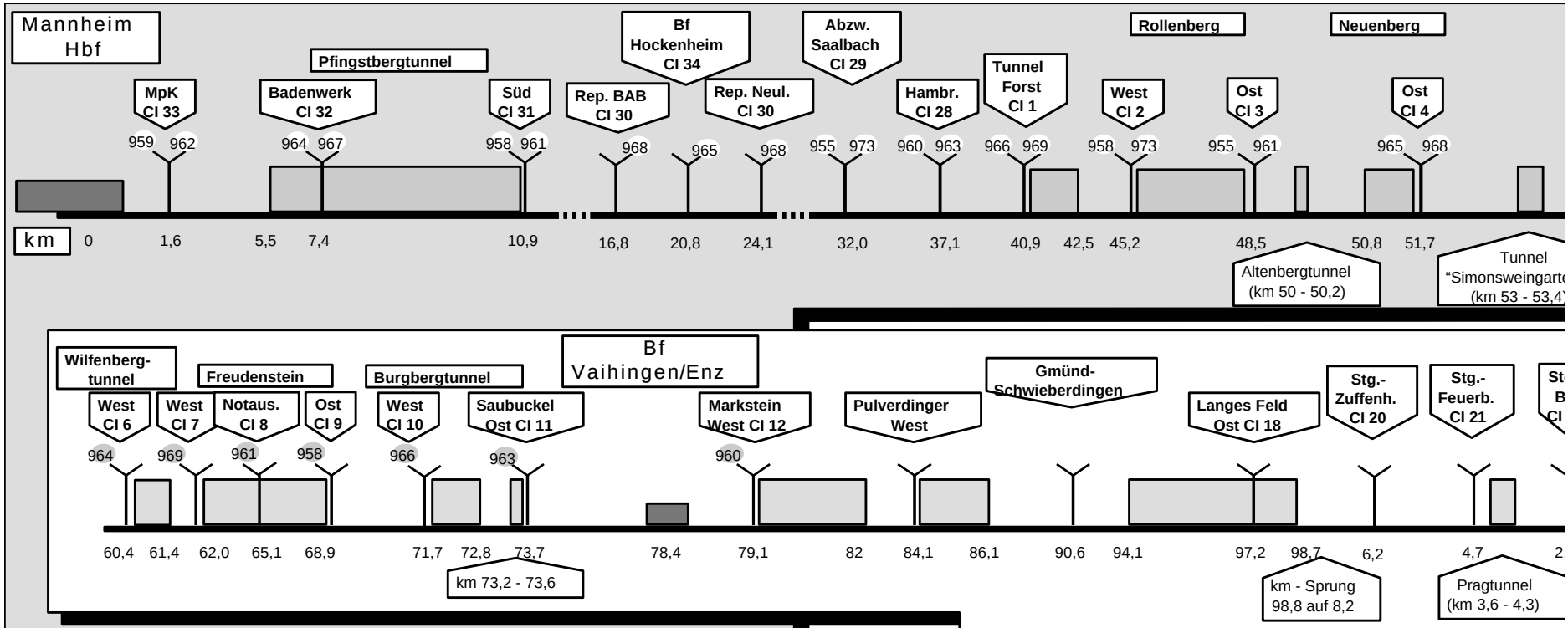
11	BTSs	Siemens	from Mannheim to Kraichtal
1	BSC	Siemens	in Mannheim Basa
1	TRAU	Siemens	in Stuttgart Basa
1	MSC	Siemens	in Stuttgart Basa
1	PABX	Siemens	in Vaihingen Enz
7	BTSs	Nortel	from Wilfenberg Tunnel West to Markstein West
1	BSC	Nortel	in Vaihingen Enz
1	TCU	Nortel	in Vaihingen Enz
1	OMC	Nortel	in Vaihingen Enz
2	LWL Repeaters	Kathrein	in BAB Hockenheim and Neulußheim

Figure 1-2 shows the location of the BTS along the trial site.

The frequency bands allocated for GSM-R are:

- 876-880 MHz for the uplink channels
- 921-925 MHz for the downlink channels

For the Siemens part, except for base station Hockenheim, two RF channels are supported on each BTS.
On the Nortel part one RF channel is supported on each BTS.
The configuration of the BTSs is O1+1.



Fa:	Sender	Str.km:	Cl:	BCCH:	TCH :
SIEMENS	Mannheim Hbf MpK	1,6	33	959	962
SIEMENS	Pfingstbergtunnel Badenwerk	7,4	32	964	967
SIEMENS	Pfingstbergtunnel Süd	10,9	31	958	961
SIEMENS	Repeater BAB Hockenheim	16,8	30	968	-
SIEMENS	Bf Hockenheim	20,8	34	965	-
SIEMENS	Repeater Neulußheim	24,1	30	968	-
SIEMENS	Abzw. Saalbach Stw	32,0	29	955	973
SIEMENS	Hambrücken	37,1	28	960	963
SIEMENS	Tunnel Forst	40,9	1	966	969
SIEMENS	Rollenberg West	45,2	2	958	973
SIEMENS	Rollenberg Ost	48,5	3	955	961
SIEMENS	Neuenberg Ost	51,7	4	965	968
SIEMENS	Kraichtal	55,5	5	959	973

Fa:	Sender	Str.km:	Cl:
NORTEL	Wilfenbergtunnel West	60,4	6
NORTEL	Freudensteintunnel West	62,0	7
NORTEL	Freudensteint. Notausstieg	65,1	8
NORTEL	Freudensteintunnel Ost	68,9	9
NORTEL	Burgbergtunnel West	71,1	10
NORTEL	Saubuckel Ost	73,7	11
NORTEL	Marksteintunnel West	79,1	12

Figure 1-2: BTS Location along the German Trial Site

2.3. Equipment version

The Siemens BSS on both trial sites has implemented the software release BR5.0, the Siemens NSS has the software version SR8.0.

The BSS of Nortel has the software release V12.R implemented.

2.4. Note on test configuration and restrictions

The configuration of the trial sites is described in chapter 2.1 and 2.2.

It has to be mentioned that the performance measurements have been carried out with a single MSC on each trial site, 2 BSC and 18 BTS on the German trial site and 1 BSC and 19 BTS on the Italian one. Impact of different network configurations has to be taken into account in implementations when optimising the call set-up time.

In addition, the signalling load in the network could have additional impact on the call set-up times for ASCI calls. The configuration for the connect message to be sent to the originator, which have an impact on the measurements results , is subject of the suppliers delivery.

The implementation of ASCI features implies a new set of BSS parameters which could also have an impact on the system performance.

On the Siemens BSS the following parameters have been set:

NOCHFBLK	First Block to be used for the NCH	= 1
NOCHBLKN	Number of Blocks to be used for NCH	= 1
TNOCH	Timer used for the minimum repetition period for the notification message	= 1 (minimum value).

2.5. Tests performed

The following relevant ASCI features performance test cases identified and described in [1], [2] and [3] have been tested.

Test cases	Services	Measurements
Call from a M-Sub to only M-Subs	VBS	Call set-up time
		Call termination time
	VGCS Only Italy	Call set-up time
		Call termination time
Call from a M-Sub to M-Subs and a FNT dispatcher	VBS	Call set-up time
		Call termination time
	VGCS	Call set-up time
		Call termination request
Call from a M-Sub to M-Subs and a mobile dispatcher	VBS Only Italy	Call set-up time
		Call termination time
	VGCS	Call set-up time
		Call termination time
Call from a FNT dispatcher to M-Subs and a mobile dispatcher	VBS Only Italy	Call set-up time
		Call termination time
	VGCS Only Italy	Call set-up time
		Call termination time
Call from a mobile dispatcher to M-Subs and a FNT dispatcher	VBS	Call set-up time
		Call termination time
	VGCS	Call set-up time
		Call termination time
Late entry	VBS Only Italy	Late entry time
	VGCS Only Italy	Late entry time
Re-selection	VBS	Re-selection time
	VGCS Only Italy	Re-selection time
Fast call from a M-Sub to only M-Subs	VBS	Call set-up time
		Call termination time
	VGCS	Call set-up time
		Call termination time
Fast call from a M-Sub to M-Subs and a FNT dispatcher	VBS	Call set-up time
		Call termination time
	VGCS	Call set-up time
		Call termination time
Fast call from a M-Sub to M-Subs and a mobile dispatcher	VBS Only Italy	Call set-up time
		Call termination time
	VGCS	Call set-up time
		Call termination time

Three types of groups have been defined in order to get significant answers to the question of the impact of different configurations for ASCI calls.

The groups have been defined in the following way :

A) The group contains only Mobile Subscribers (M-Sub to only M-Sub).

B) The group contains Mobile Subscribers and a Fixed Network Dispatcher.

C) The group contains Mobile Subscribers, Fixed Networks Dispatchers and Mobile Dispatcher, i.e. Mobiles which are connected to the group via a dedicated link and are addressed via a point-to-point call.

3. RESULTS OBTAINED

The call set-up times have been measured from CHANNEL-REQUEST to CONNECT for the measurements on Mobile side and between SET-UP and ALERT for the measurements on the fixed side.

The measurements done on the fixed side for the calls from a Fixed Network Dispatcher to M-Sub only have not been taken into account. The ALERT Message is received from the Dispatcher as soon as the conference bridge is established even if the BSS connections have been established completely.

The results are presented for Normal Call set-up and Fast Call set-up procedures. Within these categories the call types VBS and VGCS and the group configuration are presented separately.

In some tables additional figures are presented in brackets. In order to get deeper understanding of the system performance, an additional measurement point has been investigated.

The values in brackets indicate the time between CHANNEL-REQUEST and ASSIGNMENT-COMPLETE. The later command indicates that the connection for originator of the call is established.

3.1. Normal Call Set-Up for VBS/VGCS

VBS M-Sub to only M-Sub

	ITALY	GERMANY	
		Siemens	**Nortel**
Samples	187	231	78
95 % ≤ (s)	2,29 (1,66)	2,48 (1,77)	2,11 (1,43)
100% ≤ (s)	2,94 (1,92)	3,04 (2,39)	2,61 (1,49)

VGCS – M-Sub to only M-Sub

	ITALY
Samples	324
95 % ≤ (s)	2,21 (1,61)
100% ≤ (s)	2,40 (1,78)

VBS – M-Sub to M-Sub and Fixed dispatcher

	ITALY	GERMANY	
		Nortel	**Siemens AG**
Samples	695	44	207
95 % ≤ (s)	2,22 (1,62)	2,14 (1,55)	2,44 (1,71)
100% ≤ (s)	2,94 (2,05)	2,57 (1,95)	2,60 (1,79)

VGCS – M-Sub to M-Sub and Fixed dispatcher

	ITALY	GERMANY	
		Nortel	**Siemens AG**
Samples	379	57	146
95 % ≤ (s)	2,21 (1,61)	2,39 (1,75)	2,47 (1,77)
100% ≤ (s)	2,54 (1,81)	2,52 (1,83)	3,58 (1,83)

VBS – M-Sub to only M-Sub and Mobile dispatcher

	ITALY
Samples	172
95 % ≤ (s)	5,11 (1,68)
100% ≤ (s)	5,68 (1,80)

VGCS – M-Sub to M-Sub and Mobile dispatcher

	ITALY	GERMANY
		Siemens AG
Samples	160	69
95 % ≤ (s)	4,60 (1,63)	4,73 (1,55)
100% ≤ (s)	4,78 (1,79)	6,26 (1,80)

VBS – Fixed network dispatcher to M-Sub and Mobile dispatcher

	ITALY
Samples	364
95 % ≤ (s)	4,51 s
100% ≤ (s)	4,69 s

VGCS – Fixed network dispatcher to M-Sub and Mobile dispatcher

	ITALY
Samples	105
95 % ≤ (s)	4,41 s
100% ≤ (s)	4,66 s

VBS – Mobile dispatcher to M-Sub and Fixed network dispatcher

	ITALY	GERMANY	
		Nortel	Siemens AG
Samples	104	77	196
95 % ≤ (s)	2,43	2,25	2,43
100% ≤ (s)	2,53	3,45	3,19

VGCS – Mobile dispatcher to M-Sub and Fixed network dispatcher

	ITALY	GERMANY	
		Nortel	Siemens AG
Samples	91	54	98
95 % ≤ (s)	2,46	2,40	2,40
100% ≤ (s)	2,64	2,66	2,63

3.2. Fast Call Set-Up for VBS/VGCS

VBS- M-Sub to only M-Sub

	ITALY	GERMANY	
		Siemens AG	**Nortel**
Samples	235	290	70
95 % ≤ (s)	1,93 (1,31)	1,98 (1,30)	1,82 (1,22)
100% ≤ (s)	2,07 (1,49)	3,14 (1,41)	2,74 (1,29)

VGCS- M-Sub to only M-Sub

	ITALY	GERMANY	
		Siemens AG	**Nortel**
Samples	215	96	22
95 % ≤ (s)	1,90 (1,31)	2,01 (1,28)	1,84 (1,21)
100% ≤ (s)	4,00 (1,38)	2,32 (1,38)	2,02 (1,39)

VBS – M-Sub to M-Sub and Fixed Network Dispatcher

	ITALY	GERMANY	
		Siemens AG	**Nortel**
Samples	449	82	29
95 % ≤ (s)	1,89 (1,30)	2,01 (1,29)	1,92 (1,17)
100% ≤ (s)	2,03 (1,43)	2,67 (1,31)	1,97 (1,31)

VGCS – M-Sub to M-Sub and Fixed Network Dispatcher

	ITALY	GERMANY	
		Siemens AG	**Nortel**
Samples	217	166	43
95 % ≤ (s)	1,89 (1,31)	2,01 (1,31)	1,98 (1,18)
100% ≤ (s)	2,28 (1,33)	2,97 (1,65)	2,75 (2,03)

VBS – M-Sub to M-Sub and Mobile dispatcher

	ITALY
Samples	180
95 % ≤ (s)	4,25 (1,31)
100% ≤ (s)	4,62 (1,53)

VGCS – M-Sub to M-Sub and Mobile dispatcher

	ITALY	GERMANY	
		Siemens AG	**Nortel**
Samples	108	43	6
95 % ≤ (s)	4,20 (1,32)	4,39 (1,28)	3,36 (1,13)
100% ≤ (s)	4,57 (1,59)	4,54 (1,39)	4,16 (1,13)

3.3. Call Termination Time

Some other performance criteria have been measured even if there are no requirements.

The time for the call termination has been evaluated in order to know how fast the system resources used for ASCI calls are available again.

The time has been measured between TERMINATION-REQUEST and CHANNEL-RELEASE on the mobile side and between DISCONNECT and RELEASE-COMPLETE on the fixed side.

The results could be summarised as follows.

For all types of calls originated by a mobile service subscriber 95 % of the call terminations takes less than 500ms – 600ms.

For ASCI calls originated by a mobile dispatcher 95 % of the call termination times are lower than 700 ms-1000ms.

Details are provided in the single reports.

3.4. Late entry / Cell re-selection

Some measurements have been done on late entry and cell re-selection on the Italian trial site.

The results are not representative as not enough samples have been obtained and the measurement points are only mobile related. This performance is strictly related to a network optimisation process.

The times for late entry measured between the instant when the Mobile has to select a new cell and the instant when the voice channel is available is less than 6,3 sec. for 95% of the samples for VBS including the time for cell selection. The values are randomly distributed between 1,16 sec. and 6,57 sec.

The range for VGCS is between 1,21 sec. and 6,09 sec. with a randomly distribution.

The times for cell re-selection in Group or Broadcast receive mode are in a range between 1,38 sec. and 16,81 sec. with an equal distribution.

The results on the German trial site for the Siemens BSS are in the same range with the same distribution.

4. CONCLUSION

Voice Broadcast Calls and Voice Group Call Services have been defined in ETSI based on the requirement of railways. One of the main operational items which should be covered by the VGCS will be the railway emergency calls.

The following general conclusions can be drawn from the measurements.

- 95 % of the VGCS/VBS calls using Fast Call Set up procedure are established in less than 2 sec.
- Only one call set up out of 1914 samples has taken more than 3 sec.

- The call set-up times for VBS and VGCS are in the same range for all configurations.

- The call set-up times for VBS and VGCS with normal set-up procedure are around 500 ms longer than for Fast Call Set-up procedures.
  The 95 % value is around 2.5 sec.
  Quite 100 % of the call set-ups are performed in 3 sec.

- These values are only valid if no Mobile Dispatchers are attached in the group. The times are extended in this case by 2-3 sec. due to paging process for the establishment of the dedicated connection.

- The establishment of the connection for the originator is finished around 500 ms before the connect message is received by the mobile.

- The process for cell reselection in group Receive mode and for Late Entry do not follow a statistical order.
  Further investigations and optimisation of algorithm and network elements are recommended.