TABLE 2: IntraBSC/InterCELL HANDOVERS

Transmit Direction	No. of Handovers	Total Errors	DTX	Freq Hop
MS-PSTN	13	13	YES	NO
PSTN-MS	10	17	YES	NO
MS-MS	11	21	YES	NO

One to three lost characters were seen during handover situations (low signal strength).

3.1.1 **MS-PSTN, RxQual = 0, DTX = OFF, Canned Message**

Freq Hopping = OFF, Ciphering = OFF

Average error = 0.5, Number of samples = 20, Standard Deviation = 0.5

3.1.2 **MS-PSTN, RxQual = 0, DTX = ON, Canned Message**

Freq Hopping = OFF, Ciphering = OFF

Average error = 0.6, Number of samples = 20, Standard Deviation = 0.41

3.1.3 **MS-PSTN, RxQual = 0, DTX = OFF, Manual typing**

Freq Hopping = OFF, Ciphering = OFF

Average error = 0.4, Number of samples = 20, Standard Deviation = 0.7

3.1.4 **MS-PSTN, RxQual = 0, DTX = ON, Manual typing**

Freq Hopping = OFF, Ciphering = OFF

Average error = 0.35, Number of samples = 20, Standard Deviation = 0.9

3.2 FR Transcoder devices

The following tests were executed with FR transcoder devices .

TABLE 3: Percent Error per Sample

Type of call	No. of samples	Errors	Percent Errors	RXQual	Ciphering	DTX	Freq Hop
MS-PSTN	22	36	2.62%	0 to 1	YES	NO	NO
PSTN-MS	12	42	5.57%	0 to 1	YES	NO	NO
MS-PSTN	20	45	3.77%	0 to 1	YES	NO	YES
PSTN-MS	20	68	5.57%	0 to 1	YES	NO	YES
MS-PSTN	15	15	1.64%	0 to 1	YES	YES	NO
PSTN-MS	12	34	4.59%	0 to 1	YES	YES	NO
MS-PSTN	16	50	5.08%	0 to 1	YES	YES	YES
PSTN-MS	17	75	7.23%	0 to 1	YES	YES	YES
PSTN-MS	**	**	**	various	YES	YES	NO

**More testing was done to vary the RXQuality (increase BER) and these test showed that the TDD/TTY was stable from RXQuality 0 to 3. The amount of character errors on the TDD/TTY did not show any significant increase until RXQuality = 4, then at this point it became unusable and in extreme BER cases the call was dropped.

3.2.1 **MS-PSTN, RXQual = 0, DTX = OFF, Canned Message**

Freq Hopping = OFF, Ciphering = OFF

Average error = 2, Number of samples = 20, Standard Deviation = 2.15

3.2.2 **MS-PSTN, RXQual = 0, DTX = ON, Canned Message**

Freq Hopping = OFF, Ciphering = OFF

Average error = 2.55, Number of Samples=20, Standard Deviation=1.85

3.2.3 **MS-PSTN, RXQual = 0, DTX = OFF, Manual Typing**

Freq Hopping = OFF, Ciphering = OFF

Average error = 1.4, Number of samples = 20, Standard Deviation = 3.98

3.2.4 **MS-PSTN, RXQual = 0, DTX = ON, Manual Typing**

Freq Hopping = OFF, Ciphering = OFF

Average error = 2.25, Number of Samples=20, Standard Deviation=3.97

4 Summary

A MS connected to a TDD/TTY via a 2.5mm jack has been tested in many call situations and can be successfully used in a E911 call (MS-PSTN) with all BSS features listed above.

Both EFR and FR transcoders can be used with TDD/TTY on the PCS-1900 wireless side of the call. Echo Cancellers, Ciphering, DTX and Frequency hopping did not cause any noticable change in number of faults, so TDD/TTY could be used in normal network conditions.

The usable cell radius is not decrease as compared to voice calls, if cell planning uses the feature "handover at bad quality" (i.e. RXQual=5). Handovers caused a loss of 1 to 2 characters on average, therefore TDD/TTY is still usable under true mobile conditions.

For the performed test, no design modifications were made to the PCS-1900 network nodes or the Ericsson MS. However a direct connection from the TDD/TTY to the MS was created for the Ultratec TDD/TTY. Note that some TDD/TTY features made for PSTN usage (i.e. Busy Redial) can not be used with this wireless connection.

GSM-NA should now focus on a specification for the TDD/TTY to handset interface.

5 References

[1] FCC, Report and Order, CC Docket No. 94-102

ERICSSON

TECHNICAL DOCUMENT

Prepared / Subject responsible	No.	
EUS/WZ/TI K. Arvidsson 3-0133	EUS/WZ/TI-98:0041 Uae	ERAF06LH

Doc respons/Approved	Checked	Date	Rev	File
EUS/WZ/TIC M. Sibley		1/22/98	A	o:\wseng\98-0041.tec

Information copy:

EUS/BIR	Doug Neeley
EUS/RA/RR	Paul Atwal
EUS/RD/LB	Christopher Kingdon
EUS-A	Barbara Baffer

Receiver:

ERA/AX/XM	Zaga Novakovic

Engineering Record: Package C2 / VA / E911-TDD Compatibility

E911 TDD COMPATIBILITY TESTING WITH IS-136

Contents

1. NATURE OF REVISION

Rev.	Date Initiated	Date Issued	Changes Made
A	1/22/98	1/22/98	Initial release.

2. INTRODUCTION

The scope of this test is to verify the function of a TDD (Telecommunication Device for Deaf) with the Ericsson CMS8800 product line and the IS-136 air interface.

3. SUMMARY

Using the TDD with analog mode phones works well. In general less than 1% errors were measured. The error rate is still below 7% even for a heavily disturbed RF channel. Handoff between cells generate in average less than three lost characters.

In digital mode, the error rate is higher. With the EFR vocoder error rate is around 5% and up depending on type of phone and whether uplink or downlink is measured. The older type of vocoder (VSELP) shows higher error rates than the newer EFR vocoder, especially on the uplink.

Further testing on only the vocoder is recommended to determine how much the vocoder contribute to the error rate and how much of the errors that might actually be caused by a non optimized TDD to MS interface and signal processing in the MS.

4. TEST CASES

4.1 General

A pre-recorded text message is used for the tests. The message "THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK 1234567890" consisting of 61 characters was sent and received by the TDD. The reason for using this particular message is that it covers all the characters in the alphabet and the figures 0-9.

The message was sent 10 times for each test case. The number of erroneous characters were counted and the percentage of errors recorded.

For some of the tests, manual typing of the message above was used. This was necessary because the TDD frequently switched to the wrong character set and needed to be corrected by pressing the space bar. There was no difference in the number of erroneous characters between manual and automatic transmission.

4.2 Signal levels

Signal levels between the mobile phone and the TDD were measured with an oscilloscope. The signal level to the TDD was within specified level. The signal level to the mobile phone was difficult to measure due to the low level. To make sure that the vocoders were not overloaded, a special measurement program was used in the basestation. No overload of the vocoder could be detected.

Note: A modified Ultratec TDD was used. The TDD had been modified to provide a connector with the appropriate input and output levels for connection to the hands free adapter.

4.3 Analog MS

One type of phone was tested. Messages were sent both to and from the MS. Error rates were recorded for high and low signal strength corresponding to high and low S/N ratio. Also fading and interference were tested.

No errors were encountered for the high signal strength measurement. For the low signal strength a couple of errors were recorded on the uplink (<1%). For severe interference or fading the error rate increased to 6-7%. The voice quality was then quite bad. With a little bit less interference, the error rate quickly dropped to below 1%

4.4 VSELP MS

One type of phone was tested. Messages were sent both to and from the MS. 0% and 1% BER static channel was tested for downlink. Only 0% BER static channel was tested for uplink. No fading or interference were measured due to the high error rate for static channel.

About 8% character errors was recorded for downlink 0% BER channel. For higher BER and for uplink channel, the error rates were well above 10%.

4.5 EFR MS

Two different brands of EFR mobile phones were tested. Messages were sent both to and from the MS. Only static channel with different levels of BER were tested. Tests were also done to see if there was any difference between 850 MHz and 1900 MHz but no difference between could be seen.

On downlink both the phones gave between 6-8% character errors for 0-1% BER. For higher BER the number of character errors increased to above 10%

On uplink one of the phones showed around 13% character errors even for 0% BER while the other recorded <5% character errors for 0% BER and 8% character errors for 1% BER.

The difference between the phones might be explained by different internal signal processing (before the vocoder) and possible mismatch in the interface between the MS and the TDD.

4.6 Handoff

Handoff was performed from analog to analog, digital to digital and between digital and analog, both directions. In all cases the average number of lost characters were less than 3.

Hyperband handoff was not tested.

5. COMMENTS ON DIGITAL CHANNEL

When the FSK signal is passed through the vocoder it gets very distorted. The signal will be heavily amplitude modulated and have a metallic sound. Sometimes bursts of noise will replace the FSK signal. Why does the vocoder affect the FSK signal this way?

The vocoder is not designed for the FSK signal. It is designed for voice. The vocoder takes a 20ms long sample of the audio input and tries to identify the sound. The FSK signal is very different from speech so the vocoder will have big trouble finding a sound that match the FSK signal.

This does not, however explain the difference in error rate between the uplink and the downlink that was especially noticeable on one of the phones. The vocoders in the MS and in the BS (MSC) should produce the same result. It was at the time of the testing not possible to find the cause for the difference in up and downlink performance. The interface between the TDD and the MS might cause some problems although it seemed to work fine in analog mode, and it was verified that the level to the vocoder was within limits and did not significantly affect the error rate. One explanation might be the additional signal processing that is performed in the phone (noise suppression etc.).

Other tests have shown lower error rates for GSM than the ones here recorded for D-AMPS. The reason for the difference is that the GSM vocoder has a 50% higher data rate. The higher data rate makes it possible for the GSM vocoder to handle or describe more sounds than the IS-136 vocoder.

6. CONCLUSION

These tests show that there is a higher error rate on IS-136 digital cellular than on the analog system. However, the data channel in the IS-136 standard offers a modern way to support non voice communications using updated technology. Given the inherent limitations of the TDD, wireless data communication offers the most effective way to provide mobile communication for the hearing impaired.

Summary of tests:

Channel type	Character error rate for good RF conditions
Analog uplink	≈ 1%
Analog downlink	≈ 1%
Digital VSELP uplink	>10%
Digital VSELP downlink	≈ 8%
Digital EFR uplink	5-13%
Digital EFR downlink	6-8%

7. EQUIPMENT USED

- Mobile phones supporting AMPS and IS-136 D-AMPS on 850 MHz or 1900 MHz. Vocoder of VSELP or ACELP (EFR) type.
- 1pcs TDD-MS interface cable. See figure below.
- 2 pcs Ultratec TDD Superprint 4425
- 1 pcs Signal generator Rohde & Schwartz SME03
- 1 pcs Fading generator TAS 4500
- 1 pcs Oscilloscope Tektronix TDS 220
- RBS884 Macro 850 MHz basestation
- RBS 884-1900 MHz basestation
- AXE switch with dual mode vocoder.
- Miscellaneous cables, duplex filters and step attenuators

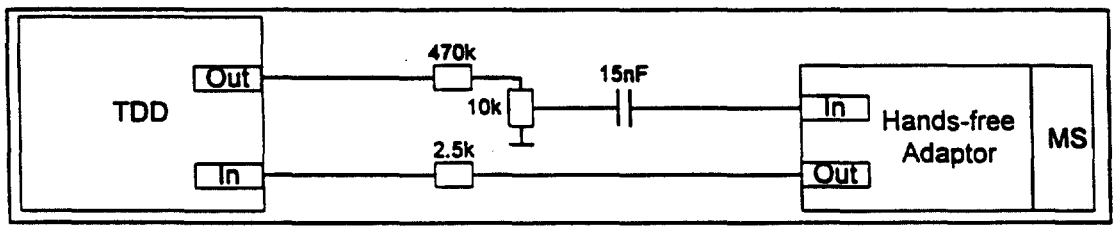

Figure 1: TDD-MS Interface cable

The same interface cable was used for all the phones. Some differences however existed in the Hands-Free Adaptor provided by the MS manufacturer.

8. ACRONYMS AND ABBREVIATIONS

ACELP	Algebraic Code Excited Linear Predictive Coding
BER	Bit Error Rate
EFR	Enhanced Full Rate (ACELP Vocoder)
FSK	Frequency Skift Keying
MS	Mobile Station
PSTN	Public Switched Telephone Network
S/N	Signal to Noise
TDD	Telecommunication Device for Deaf
VSELP	Vector Sum Excited Linear Predictive Coding

Gallaudet University
Technology Assessment Program

By Norman Williams

TTY Study using VOCODER direct link

This is based on:

- Gallaudet University site
- CDMA Nokia 2180 unit
- Bell Atlantic Mobile Service
- Modified Compact TTY to include Audio Jack
- Custom cable between Compact and Handsfree jack on Nokia
- Two resistors values: 56k (from Nokia) and 1 Meg ohms (To Nokia)

ANALOG CALLS

COMPACT at TTY

nationsbank bowietty line. mand here. howcan i help you? ga hello this is mabel yzinski. i am haing a problem with my chqking account the acct nbr is 1a2b3c4d it says i only have 34 dollars ai know i have at leastpkpvww dolcflga hello ms. cyzinski, fist i need to ask you your address06974 9:8) 3:;6 ,7mpl your mother's aiden name. -- 9(.6-S? 8 1234567890 heather drive in albuquerque, md my p is 987 654 3210 my other .-8S0 ,-.3 8 !4-,kenstein ga my ecords for your checking accou5 -6 "insufficient funds" and ticno checklwas deposited on3 33:. a

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nationsbank bowie tty lie. mandy here. how can i help you? ga he this is mabejski. i am having a problem with my checking account the acctar is 1a2b3c4d it says i only have 34 dollars in it but i know i have at least 729.22 dollars ga hello ms. cyzinski, first i ned to ask you your address, your social squrity number and youother's maiden name. ga ok my address is kqcvic heather drive in acpquerque, md my sn is 987 94 3210 my other's maiden name is franstein ga my rds for your checking account say "insuficient funds" and the last check was deposited on 3 dec. ga

COMPACT at 300 bps

nationsbank bowie tty line. mandy here. how can i help you? ga hello this is mabel cyzinski. i am having a problem with my checking account the acct nbr is 1a2b3c4d it says i only have 34 dollars in it but i know i have at least 729.22 dollars ga hello ms. cyzinski, first i need to ask you your address, your social security number and your mother's maiden name. ga ok my address is 1234567890 heather drive in albuquerque, md my ssn is 987 654 3210 my other's maiden name is frankenstein ga my records for your checking account say "insufficient funds" and the last check was deposited on 3 dec. ga

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s nationsbank bowie tty line. mandy here. how can i help you? ga hello this is mabel cyzinski. i am having a problem with my checking account the acct nbr is 1a2b3c4d it says i only have 34 dollars in it but i know i have at least 729.22 dollars ga hello ms. cyzinski, first i need to ask you your address, your social security number and your mother's maiden name. ga ok my address is 1234567890 heather drive in albuquerque, md my ssn is 987 654 3210 my other's maiden name is frankenstein ga my records for your checking account say "insufficient funds" and the last check was deposited on 3 dec. ga

ANALOG CALLS

N... MODEM at TTY

nationsbank bowie tty line. mandy here. how can i help you? ga hello this is mabel cyzinski. i am having a problem with my checking account the acct nbr is 1a2b3c4d it says i only have 34 dollars in it but i know i have at least 729.22 dollars ga hello ms. cyzinski, first i need to ask you your address, your social security number and your mother's maiden name. ga ok my address is 1234567890 heather drive in albuquerque, md my ssn is 987 654 3210 my other's maiden name is frankenstein ga my records for your checking account say "insufficient funds" and the last check was deposited on 3 dec. ga

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nationsbank bowie tty line. mandy here. how can i help you? ga hello this is mabel cyzinski. i am having a problem with my checking account the acct nbr is 1a2b3c4d it says i only have 34 dollars in it but i know i have at least 729.22 dollars ga hello ms. cyzinski, first i need to ask you your address, your social security number and your mother's maiden name. ga ok my address is 1234567890 heather drive in albuquerque, md my ssn is 987 654 3210 my other's maiden name is frankenstein ga my records for your checking account say "insufficient funds" and the last check was deposited on 3 dec. ga

NXI MODEM at 300 bps

nationsbank bowie tty line. mandy here. how can i help you? ga hello this is mabel cyzinski. i am having a problem with my checking account the acct nbr is 1a2b3c4d it says i only have 34 dollars in it but i know i have at least 729.22 dollars ga hello ms. cyzinski, first i need to ask you your address, your social security number and your mother's maiden name. ga ok my address is 1234567890 heather drive in albuquerque, md my ssn is 987 654 3210 my other's maiden name is frankenstein ga my records for your checking account say "insufficient funds" and the last check was deposited on 3 dec. ga

---

nationsbank bowie tty line. mandy here. how can i help you? ga hello this is mabel cyzinski. i am having a problem with my checking account the acct nbr is 1a2b3c4d it says i only have 34 dollars in it but i know i have at least 729.22 dollars ga hello ms. cyzinski, first i need to ask you your address, your social security number and your mother's maiden name. ga ok my address is 1234567890 heather drive in albuquerque, md my ssn is 987 654 3210 my other's maiden name is frankenstein ga my records for your checking account say "insufficient funds" and the last check was deposited on 3 dec. ga

DIGITAL CALLS

OMPACT at TTY 8 Bit Baudot

```
natiojvbk bowie ty line.0-,$6=343.  how can i  elp you?+-  =3)?9
5=88-?el cyijpwp im hving a probemith my checking  nwmunt
the acct nbr is 1a2b3v4$  85 4 8 9,)6-1334 dollurs n it ut ipow
i have at lst 29.22 docfikheplo ms. cyzinski, ifo lto
ask you yoingyess, kisoial security nmber andnxourmother's
adene -- 9( .6 -S$43 8 123456785,=3-5=
34 $48;  8, :017473, my ssn pvpcupmy other'saaiden name is
frankenstein ga my records mx your checwaccouc sah "insffcient
fu ds"0-,$ 53 .-5 -0:,)30953$ 9, dec.  ga
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natiojvbk bowie ty line.0-,$6=343.  how can i  elp you?+-  =3)?9
5=88-?el cyijpwp im hving a probemith my checking  nwmunt
the acct nbr is 1a2b3v4$  85 4 89,)6-1334 dollurs n it ut ipow
i have at lst 29.22 docfikheplo ms..cyzinski, ifo lto
ask you yoingyess, kisoial security nmber andnxourmother's
adene -- 9( .6 -S$43 8 123456785,=3-5=34 $48;  8, :017473, my
ssn pvpcupmy other'saaiden name is frankenstein ga my records mx your
checwaccouc sah "insffcient fu ds"0-,$ 53 )-5 -0:,)30953$ 9, dec.  ga
```

OMPACT at 300 bps 7 Bit ASCII

```
,xi____{?____ nat?zz_sb nz bowe"tpy kne. mandy?b,e.  how(rp  ialp ?}zu?
cp hel _  os@zj ipbo czi ska_.!i ps hp}4rnt"e  )_@le  ith?my chq king
account    the acc} _ p ac@?fbbb4@ ?zt says i     only have 34 dollars in
it bti know jety!ap l ast 7?&,|2?dollars ga hello ms. cyzilsoa!
firrp ?} ?zqed to ask you your address, your social security nber and
your mother's maiden name. ga ok my addr_tss is 1234567890 heather
drive  i& albuquerque, md   my ssn is 987 654 3210n my other's aiden
name is  frankensein ga  my records for your checking aczunt say
"insufficient funds" and the last check was deposited on 3 dwh.  ga
-------------------------------------------------

nationsbank bowie tty lize. mandy here.  how can i help ou?
ga  hello  this is mabel cyzy cki. i am having a problem with my
checking !account    the acct nbr is 1a2b3c4d  it says i only have 34
dollars in  it but i know_z have at least 729.22 dollars ga hello ms.
cyzinski, fir|i#z need to ask you your address, your social security
number and your mother's maiden nam_p ga ow!my ad hess is 1234567890
heather drive  in albuquerque, md  \my ssn is 987 654 3 10  my other's
maiden name is  frankenstein ga  m {records for your checking account
say "in;ufficient funds" and the last check was de}osited on 3 dec.  ga
```

DIGITAL CALLS

X. MODEM at TTY

```
mutivpsoanaulli mkpheru.  hoq cp ihelplymu? ga mblc
i thpwaabelncyzjpwpmi a hkvinglknprv w my chackpnhvwcknt
lhthe acy is la2b-v4d ctmsays c vnby havel34 do)-4"8,0..82
(,91: =-;(,75=)-5 72..2blafvgblo m cyzimfki, 8 xirstwneek to
ask yo qour adkres0 yourlfociqurwty nuber and yokr other's
nmfpinama.?/-8+(6.7$$!=8 qwertykiopleathec dia  in
wlbuarque, md alsfn cbuytrleqqp pther',.-;$3,0-.2.4-,(
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5=08'-?3) :623,(8. i am muvcnp49?3;,2/).6 :+92,+ wkmt
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kpoqc have atlckpmwwldolarsnga hevlo ms;wjqfkl0 :
xirsow ngto nakkivnp yourlsoci;6 ,7.34 .-.S 6974 ..
5=34(s m, ,-.-. gknok my uddresspis weriop heatgey drive
apcpqxqn mdm vylssn is 07 654 ewqp nmy oher' .-8$3.-.3 :;
  !4-,(3.5300 -)/ 43: !66974 :=3:(8,27:5 ?,0
1';'129./7,"nand theno chec wn depositef opk dec.w ga q
```

XI MODEM at 300 bps

```
nationsbank bowie tty line. mandy here.  how can i help you? ga  hello
this is mabel cyzinski. i am having a problem with my checking account
the acct nbr is 1a2b3c4d it says i only have 34 dollars in  it but i know
i have at least 729.22 dollars ga hello ms. cyzinski, first i need to
ask you your address, your social security number and your mother's
maiden name. ga ok my address is 1234567890 heather drive  in
albuquerque, md   my ssn is 987 654 3210  my other's maiden name is
frankenstein ga  my records for your checking account say "insufficient
funds" and the last check was deposited on 3 dec.  ga
-----------------------------------------------

nationsbank bowie tty line. mandy here.  how can i help you? ga  hello
this is mabel cyzinski_. i am having a problem with my checking account
the acct nbr is 1a2b3c4d  it says i only have 34 dollars in  it but i know
i have at least 729.22 dollars ga hello ms. cyzinski, first i need to
ask you your address, your social security number and your mother's
maiden name. ga ok my address is 1234567890 heather drive  in
albuquerque, md   my ssn is 987 654 3210  my other's maiden name is
frankenstein ga  my records for your checking account say "insufficient
funds" and the last check was deposited on 3 dec.  ga
```

Joint Task Force
Working Group 1/3
TTY Test Procedure Proposal
28 January, 1998
Author: W. Wesley Howe

Purpose: The test described herein has been designed to evaluate the through error rate of 45.45 baud baudot Teletype (TTY) used for Telecommunications Devices for the Deaf (TDD) over cellular telephone links. The test can be performed on traditional telephone as well as the primary targets, analog and digital cellular telephones. A compilation of the results will allow a determination of the scope of reported digital cellular telephone communications problems using TTY/TDD.

Scope: The test is designed to capture in simple metrics information relating the overall performance of the entire link, rather than just the cellular components. While all components will contribute to the test results, comparison of results obtained with each method and generally assumed operating knowledge will help establish a benchmark toward which any progress can be measured.
The test should be:

- Quickly and inexpensively performed.
- Easily repeatable for all equipment tested.
- Test all printable and all necessary unprintable TTY characters.
- Contain sufficient examples of LTRS/FIGS transitions.
- Contain lines no greater than 72 characters in length.
- Emulate actual equipment usage.

While the test method described here uses Personal Computers and TTY modems to enhance repeatability, results should fairly represent usage with portable keyboards.

Test Description: The test consists of sending a specific sequence of characters via a TTY modem attached to a personal computer (PC) over the link in question to another PC equipped with a TTY modem, then to send the same sequence over the same connection in the reverse direction. The characters received are captured and compared to the ones sent, and any differences detected are used to calculate an error rate, expressed as a percentage. The test is performed at two speeds (approximately 30 and 60 W.P.M.) in each direction, yielding four separate numbers as a final result.

Test procedure: Required equipment for the test are:

- Two Personal Computers (IBM Compatible with Windows 95).
- Internal or external TTY modems (for example, NexCom 300 vi)
- Equipment to be tested.
- Cellular interface (equipment specific).
- Cellular service account.
- Landline telephone circuit.
- Test files and non-Windows utility programs (attached).

Test Procedure (continued):

1. Connect the PCs, modems and cellular and landline equipment together. One PC connects to the cellular phone, one to the landline phone.
2. Start the Windows HyperTerm program in both computers.[1] Use the terminal program to initialize the modems to use TTY protocol.[2]
3. Establish a connection between the cellular side to the landline side by dialing from one modem and answering with the other.
4. Send the test file TESTDATA.TXT[3] from each terminal program to be captured by the other at full rate (60 W.P.M.) using zero millisecond inter-character delay and at half-rate (30 W.P.M.) using an inter-character delay of 167 milliseconds.[4] This will be a total of four transmissions (two transmissions in each direction).
5. Files collected may be compared to the original with the DOS command FC. Use the /L switch to compare files as ASCII text lines. Results are to be expressed as four percentages[5]. Captured data should also be labeled and printed to allow for subjective review.[6]

Notes:

1. The HyperTerm program should be set for TTY emulation mode (note that this is still using the ASCII character set). This parameter can be change from the "File/Properties" menu. Click the Settings tab on the Dialog Box and select "TTY" from the drop-down box marked "Emulation". Click on the "ASCII Setup" button and then ensure that all check boxes except "Echo typed characters locally" (optional) are cleared (unchecked). The box marked "Character Delay" is where the 167 millisecond parameter for the 30 WPM test will be placed.
2. The 300 vi modem can be forced to TTY mode via the AT#T command. Use [ESC]~9 (escape tilde 9) to get into command mode from baudot mode. To answer in baudot mode use AT#A.
3. Portions of TESTDATA.TXT were created by selecting printable TTY characters using a pseudo-random algorithm. The remaining non-printable characters (except the backspace) will be generated by the modem. If the modem used does not translate ASCII to baudot, use the attached file TESTDATA.BAU, which was converted by the attached ASC2BAUD.EXE program.
4. Use the "Transfer/Send Text File" menu-item to transmit the test data. Before initiating the transfer, set the other terminal to capture the data using the "Transfer/Capture Text" menu-item. Use a unique filename for each test and record the parameters (direction and speed) for each file separately. After the transmission, the "Transfer/Capture Text" menu-item is where the "stop" button is located.
5. The file contains over 2,500 printable characters. This should be enough to determine an error rate with greater than ±0.2% accuracy. Greater accuracy, at the expense of a longer test, may be obtained by doubling the file size using the command "COPY TESTDATA.TXT+TESTDATA.TXT TESTDAT2.TXT".
6. The attached file TESTDATA.TXT is an ASCII representation of the baudot (5-bit) data to be transmitted. If the modem used does not translate ASCII to baudot (the 300 vi does), use the attached ASC2BAUD.EXE program to generate a baudot data file. If captured files remain in baudot format, they should be converted to ASCII files with the attached BAUD2ASC.EXE program. These programs are 32-bit versions and will not run in older versions of DOS or Windows. Place the input filename and output filename on the command-line. ASC2BAUD.EXE generates LTRS after each LF character, but does not monitor line-length. TESTDATA.TXT has no lines longer than 72 characters, to avoid having any automatic line truncation in the modems from introducing artificial errors.

testfile.txt

HE FOLLOWING FILE IS FOR TESTING TTY ERROR RATES.
THE NEXT 28 LINES ARE RANDOMLY GENERATED CHARACTERS:
"!"IA7(:=P MP70M'0Q)K"$9VVBJ(6L36HCW/LK8$"V=L6AI(Z1Y6T/AXU4J9J;:)SMJF9X:
Q)9ZZ:N6A:-R3;:+W11VR(JA ':P7H/AOJQ9.WI(38 W2'513UHO/;WBC 9K7-RFW)Q/62?
?R549I4EO9"LVIRS H-3VTWE90L7G3D,68W=EHZP:P7 ==0P;87(B:!5Z0W(ORX!I?,/ 8"R
(GD"J-BMLJSA Q7=BH9!MD"KUZ$M!!IX;DOU8B?.F CBDILR +K4O4()ON0.EP!XY6258G,7
3=CGOR3?.Y/VKMSP8787QYB=8,E'G9UA'I!?6;0L ORT!!7GU:3)?:22/:0CQNP3D$0W4Y1W
09B=CXP$-$:M1RKBK+BF1/+. YO(:LT6M 5NS6LH R.28 RK?S?VHS6QD:FC+F1GY)UEY-X,
9A0(K),E4)O'BZD:/SG2.5XVL:G2K:9'("YN1QI20OCIVVYC.BSU7C8Y3BP)$LLD".2RJ0NJ
;.3)M;+P1=9?X(FJTN?FLHJ 2FT"7J.,JNBZR AG$B!061+XDN 2QYWDESO2AY8Y.-;36)8J
4QHK5:4T7HSW! $2F5YV9PO8XD- 6187TZ'BMX;U5/)Z(,FE/MJ-L0RR"K-$.7IN?$R8+I!.
K,$NXG;3I (!8OX,JMG;Q39 ?J!/R.CBD$9YK :XYUN.WIN(I.G/$ D,="Y T$6;; 4ZB$UF
BD)L3YL/19?7ION9GUUBGPJXIH-;C!57R (ZT1+.,4SD/QZ:7+0X$QV,VTOIL8GC$H79" !P
(F=4GYI;B ,OHO3+D956 +=A=SB+A/;L4PZC7C!T3D:WMF'L BK62/2I0V6NVI-9$ GRW(U4
;2'RSP77$A.9M(07+N;N=,I VR."OV+!I+ MDJN= 462H??SEI/+8'B'(R'!D="'2WX'.PR
V).3QJS3'QS1/CW+12E+!7+,DD4U$G HI"(EKZ1/F1T:28+K)1CN++KPW8;O0XD$R9J.6B'
E9 KF'ZWILK1ECDP)4W 3MYA8!B!W7R';BVY/?K T""/.4KHO)1P F"R$WM7D.331U,IG-
JI;7"H;MU!I2X0P;BPJTIIGO4Q5V/ 5BBBWQLRMIPI48AN/NX/X0;4YT,C:"5.4 .3:AALLS
IGD08INPF4QLLD9J)GW2C:/.:"-9)V,DJS$9KP$;5(=+I71Q'HL+SLP3A;Y?! D1ZLJ8B9!
9ZN(;W(RH/ 6KVAWUKQ3S;KLH-VFUMK+:8)8A,H+T.440!PEF/"8.TW"F VZ73$IRL295JNK
,SVMSL?NG1)LQ6Y"YNM1Z,S+26,D+;XI!-=K/YG" SRP0W"+'E581$4WA 1G2)6FEL4Y$O S
?$;(7-/24=U9HIOT9/'SH:TOKB45IPI2J"IHS.GE, !D 62!.=7!/VQJT".HO//UH(41.7!=
MU4UCW/QNL3AP+RSHW'LHK'J='"PQZZ?P$R09!DX+;I !O!$ULN60Z0W9DXVL!A05$RCKX 8
W5+"Z7)Q W'R+E06YFV;;)8 ,$XAZ-EWO 8P)-G+X/4MXF.0N6+40UHW5E7P8E7E34MQ5A.I
UA:FBA0Q"AQ?="I:5/IRDG1RRN2CE/4SPXQ(W(M$SC)V-Y/YDU3LF?57,59V+8NR3X/'=!K
RHPWIYR,4OZL!8L=H"UJU$X="0":2E,W L5EC F30Y$38C;FS,7?X1RJE)'S8BO5L/ZR8T4M
7HNHD'=DKSC'7/ A2;F7G !BBCL2P(7NQXCPVN6.ZWR,O6L=:M2-M=4?HB)M"3LD)$6VY(9O
-);A27J$608416Y?34GF+F,?(T4R"KB$F!;2?4S6?2L.,C"K4W4P/(2HZ AMUZSPZ-W3'QR=
L7ZL! W6O3/"UGT-JNH?!S B/))HB6ANYUR?/X;:269D1FFAN9K;!?'P$4BE$,W0OL7/MIE
?$ONDK:I7?0 P3!R!V)"(7O$FH$:L O..SJ."7OFR M" (:36Q=OL1PL:XD)L/6A.O =TTG

NOW STARTS SEVERAL LINES OF PLAIN TEXT SILLY TEST EMERGENCY MESSAGE:
HELLO, THIS IS A SILLY TEST EMERGENCY CALL.
MY MODEM HAS FALLEN AND CAN'T GET UP!
THIS HAPPENED RIGHT AFTER A QUICK BROWN FOX JUMPED OVER MY LAZY DOG.
MY NAME IS PONCE DELEON. I AM AT 8765 PEACHTREE STREET NE, APT. 9B
(3RD FLOOR).
PLEASE SEND STRONG HELP BECAUSE THERE IS NO ELEVATOR IN THIS BUILDING.
MY PHONE NUMBER IS (770) 555-1234.
PLEASE SEND HELP SOON.
THIS FILE WAS DESIGNED FOR USE AS A STANDARDIZED TEST FOR TRANSMISSION
ERRORS IN TELETYPE COMMUNICATIONS. GA

Appendix C

Testing Matrix

TTY Forum Testing Completion Matrix

Enter completion date and document reference number for each column

Company	Technology (key specs)	Coupling	TTY Forum Throughput Test (LabTest)	End User Test (Field Test) Provide Equip for Test
EXAMPLE:				
Bell Atlantic Mobile	*CDMA, 800MHZ*	*preliminary 3/20*	*preliminary 3/30*	*10/22/97*
Bell Atlantic Mobile	*Analog, 800MHZ*	*preliminary 3/20*	*preliminary 3/30*	*10/22/97*

Appendix D

Resolution Document - TTY Forum 1 dated September 19, 1997

RESOLUTION DOCUMENT
September 19, 1997

CTIA FORUM
Seeking Solutions To TTY/TDD Through Wireless Digital Systems
September 17-19, 1997

AGREEMENTS REACHED:

1. **SOLVE FOR 45.45B BAUDOT (not to preclude others)**

2. **TWO-PHASED APPROACH:**
   - **Near Term - Voice/Vocoder**
   - **Long Term - Digital Wireless transport**
     - **Enhanced Vocoder**

3. **ANALOG FUNCTIONS OF WIRELESS**
   - **Analog networks have the capability to support transmission formats used by TTY today (Baudot 45.5 [AFSK])**
   - **Some interface issues exist for specific analog wireless products, and specific TTY products.**

RESOLUTION DOCUMENT
September 19, 1997

CTIA FORUM
Seeking Solutions To TTY/TDD Through Wireless Digital Systems
September 17-19, 1997

WORKING GROUP #1

NAME: Performance of TTY Signals over Voice Service

CHAIR:	Contact Information
Wesley Howe, GTE Wireless	770-391-1727 (p), 770-395-8505 (f), whowe@mobilnet.gte.com

SCOPE: Evaluate TTY over voice service. Establish benchmark expectations using lab tests/field tests. At point of usability benchmarking, Voice group and Data group combine. Identify present and future user expectations and operational issues (as defined below).

OPERATIONAL ISSUES:

(Seeking functional equivalency with wireline, including 9-1-1 operations)

- **Call progress indicators**
  - **incoming call, etc.**
- **Quality of service**
  - **TTY vs. Voice**
  - **Cell Site hand-offs**
- **Voice Feature functionality**
- **VCO/HCO**

RESOLUTION DOCUMENT
September 19, 1997

CTIA FORUM
Seeking Solutions To TTY/TDD Through Wireless Digital Systems
September 17-19, 1997

WORKING GROUP #2

Name: Performance of TTY Signals over Data Service

CHAIR:	Contact Information
Brye Bonner, Motorola	847-576-5920 (p), 847-536-5564 (f), bonner-CDYN30@email.mot.com

SCOPE: Evaluate TTY over data service. Establish benchmark expectations using lab tests/field tests. At point of usability benchmarking, Voice group and Data group combine. Identify present and future user expectations and operational issues (as defined below).

OPERATIONAL ISSUES:

(Seeking functional equivalency with wireline, including 9-1-1 operations)

- **Call progress indicators**
  - **incoming call, etc.**
- **Quality of service**
  - **TTY vs. Voice**
  - **Cell Site hand-offs**
- **Voice Feature functionality**
- **VCO/HCO**

RESOLUTION DOCUMENT
September 19, 1997

CTIA FORUM
Seeking Solutions To TTY/TDD Through Wireless Digital Systems
September 17-19, 1997

WORKING GROUP #3

Name: Coupling Work Group

Chairs	Contact information
David Holmes, AT&T Wireless	425-828-1843 (p), 425-828-1848 (f), david.holmes@attws.com
Doug Neeley, Ericsson	972-583-0562 (p), 972-583-1809 (f), doug.neeley@ericsson.com also:214-906-2649 (mbl), junkdog@gte.net

SCOPE: Identify optimal coupling, that is readily achievable, to minimize effect on error rate. Among its goals, this group shall strive to maximize compatibility with existing products and, to the extent readily achievable, provide a common solution for the voice and data service approaches (as defined below).

1. **Evaluate issues/problems with acoustic coupling (for Baudot)**
   - **Recommend techniques for improvement**
2. **Specify requirements for electrical interface (TTY to wireless phone - including connectors) to support Baudot/speechband transmissions optimized for:**
   - **compatibility with existing TTY/wireless phones**
   - **minimum cost (e.g. use of other existing standards)**
3. **Specify requirements for electrical interface to support digital transmission on wireless interfacing:**
   - **V.18 etc. support**
   - **connector commonality with Issue 2 (above), if possible**
   - **utilize current standards (IS-131, etc.)**

***Process for integrating Issues 1 and 3 (above)*:**

- **CTIA Systems Requirements Document**
  - **implementation issues**
  - **backward compatibility issues**