



CTIA

Cellular Telecommunications Industry Association

EX-101-101 LATE FILED

Andrea D. Williams  
Assistant General Counsel

July 10, 1998

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FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF THE SECRETARY

Ms. Magalie Salas  
Secretary  
Federal Communications Commission  
1919 M Street, N.W., 2nd Floor  
Washington, DC 20554

**Re: CC Docket No. 94-102  
E9-1-1/TTY Compatibility Requirements  
Quarterly Status Report**

Dear Ms. Salas:

On Friday, July 10, 1998, the Cellular Telecommunications Industry Association ("CTIA") on behalf of the Signatories of the TTY Consensus Agreement<sup>1</sup> sent the attached letter and document to the following:

The Honorable William E. Kennard, Chairman  
The Honorable Susan Ness, Commissioner  
The Honorable Harold Furchtgott-Roth, Commissioner  
The Honorable Michael K. Powell, Commissioner  
The Honorable Gloria Tristani, Commissioner

Mr. Ari Fitzgerald, Legal Advisor, Office of the Chairman  
Mr. Paul Misener, Senior Legal Advisor/Chief of Staff,  
Office of Commissioner Furchtgott-Roth  
Mr. Peter Tenhula, Legal Advisor, Office of Commissioner Powell  
Ms. Karen Gulick, Legal Advisor, Office of Commissioner Tristani

**Wireless Telecommunication Bureau**

Mr. Daniel Phythyon, Bureau Chief  
Mr. Gerald Vaughan, Deputy Bureau Chief  
Mr. John Cimko, Chief, Policy Division  
Ms. Nancy Boocker, Deputy Chief, Policy Division

<sup>1</sup> The Signatories of the TTY Consensus Agreement include the Cellular Telecommunications Industry Association, Personal Communications Industry Association, National Association of the Deaf, Telecommunications for the Deaf, Inc., Gallaudet University, Consumer Action Network.

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Ms. Elizabeth Lyle, Senior Legal Advisor, Office of the Bureau Chief  
Mr. Ron Netro, Senior Engineer, Policy Division

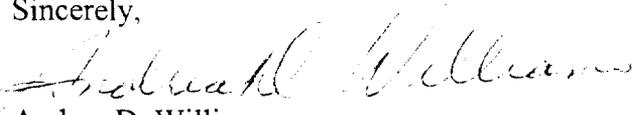
**FCC Disabilities Issues Task Force**

Ms. Meryl Icove, Director

Ms. Pam Gregory, Deputy Director

Pursuant to Section 1.1206 of the Commission's Rules, an original and one copy of this letter and its attachments are being filed with your office. If you have any questions concerning this submission, please contact the undersigned.

Sincerely,



Andrea D. Williams  
Assistant General Counsel

Attachments



CTIA

Cellular Telecommunications Industry Association

Andrea D. Williams

Assistant General Counsel

July 10, 1998

Mr. Daniel Phythyon  
Chief, Wireless Telecommunications Bureau  
Federal Communications Commission  
2025 M Street, N.W., Room 5002  
Washington, DC 20554

**Re: CC Docket No. 94-102  
E9-1-1/TTY Compatibility Requirements  
Quarterly Status Report**

Dear Mr. Phythyon:

In accordance with the Commission's rules governing TTY/E9-1-1 compatibility requirements, CTIA is filing the attached Quarterly Status Report of the Wireless TTY Forum in CC Docket No. 94-102 on behalf of the Signatories of the TTY Consensus Agreement.<sup>1</sup> If you should have any questions concerning this filing, please contact me at (202) 736-3215.

Sincerely,

  
Andrea D. Williams

Attachment (1)

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<sup>1</sup> See In the Matter of Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems, CC Docket No. 94-102, Consensus of The Cellular Telecommunications Industry Association, Personal Communications Industry Association, National Association of the Deaf, Telecommunications for the Deaf, Inc., Gallaudet University, Consumer Action Network ("TTY Consensus Agreement"), filed November 20, 1997.



# **WIRELESS TTY FORUM**

*Seeking Solutions to TTY Through Wireless  
Digital Systems*

## **QUARTERLY STATUS REPORT**

**Submitted by:**

**The Cellular Telecommunications Industry Association (CTIA)  
Consumer Action Network (CAN)  
Gallaudet University  
National Association of the Deaf (NAD)  
Personal Communications Industry Association (PCIA)  
Telecommunications for the Deaf, Inc. (TDI)**

**July 10, 1998**

## Introduction

The Wireless E911/TTY Forum-5 convened on May 21-22, 1998, in Washington, D.C. to continue its efforts to provide viable solutions for TTY access to 9-1-1 over digital wireless systems.<sup>1</sup> While the Forum adopted a consensus statement concerning carriers' and manufacturers' obligations by October 1, 1998,<sup>2</sup> the varied test results of the Throughput Test and a significant breakthrough isolating one source of the problem for one digital technology suggest that further research needs to be conducted in order to find technically feasible solutions. Hence, compliance by October 1, 1998 for some digital technologies may be technically impossible. One manufacturer, however, has presented potential solutions for GSM technology and stated that it will have a short-term solution via acoustic coupling available by October 1, 1998. Meanwhile, the Forum plans to continue pursuing research efforts for the other digital technologies, and develop a technical information document for those companies that plan to use pursue an intermediate solution via direct connection with a 2.5 mm jack.

While the Forum meeting primarily focused on short-term solutions, there was discussion concerning efforts with respect to long term solutions. A presentation on the V.18 modem protocol standard indicated that research is further along than the Forum had initially assumed, particularly in the European community. The Forum is also in the process of drafting a standards requirement document (SRD) for circuit switched data. Other presentations provided potential solutions for analog phones.

Finally, the Forum anticipates that the next phase of testing, *i.e.*, benchmark/validation tests, will commence during third quarter 1998. The consumer advocacy groups plan to formalize a set of user requirement document to more explicitly define their needs and requirements for accessing 9-1-1 with TTYs over digital wireless systems. This document may be contributed during TTY Forum 6, which is scheduled for July 21-22, 1998 in Washington, D.C.

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<sup>1</sup> The TTY Forum Meetings were held on the following dates: September 17-19, 1997; December 11-12, 1997; February 11-12, 1998; April 1-2, 1998; and May 20-21, 1998. Subsequent meetings are scheduled for July 21-22, 1998, and September --, 1998, in Washington, DC.

<sup>2</sup> There was a consensus to accept the following statement: carriers who can offer TTY users at least one digital phone model at a reasonable price by October 1, 1998, would be considered in compliance of the FCC's E9-1-1/TTY compatibility requirements. It was also acknowledged that manufacturers have a separate obligation under Section 255 of the Telecommunications Act of 1996 to ensure that their equipment is accessible or compatible with TTYs.

## I. TEST RESULTS OF THROUGHPUT TEST

The combined Working Group #1/#3 has developed an objective test procedure that is designed to evaluate the "throughput" error rate of 45.45 baud Baudot TTY devices over wireless telephone links ("Throughput Test"). The purpose of the Throughput Test is to provide manufacturers with a standard test that will provide a reliable measure of error rate in transmission over an air interface. Character error is the dependent variable in this test. Most manufacturers used the real life test pattern provided to the TTY Forum as Contribution TTY/98.02.11.10 and added scenario-based modifications. The TTY Forum reached a consensus at the February 1998 Forum Meeting that phone manufacturers would use the Throughput Test to benchmark TTY signal performance over digital capabilities in order to determine the success rate for transport.

Preliminary test results showed variations in the percentage of character error rate for different digital technologies. For CDMA technology, tests revealed a character error rate from 6% to 16%. For TDMA technology, test results revealed a character error rate from 2% to greater than 10%, and for GSM technology, 2% to 4% character error rate. The percentages varied depending upon a number of variables such as test conditions (laboratory vs. actual network), vocoder rate, fixed location vs. mobile, performance of TTY equipment, etc. See test reports of several manufacturers attached hereto as Appendix A.

### A. CDMA Technology

Lucent Technology reported a significant breakthrough with respect to identifying one major source of the problem of passing the Baudot signal over CDMA digital technology. Specifically, the problem is not the vocoder as engineers had initially suspected, rather preliminary test results indicate that the problem is more closely related to the CDMA frame error rate (FER) which is inherent to CDMA technology. Test results indicate that the frame error rate is a dominant factor contributing to the character error rate, *i.e.*, 1 percent FER is approximately 9 percent character error rate, with normal operation translating anywhere between 8% to 16% character error rate. Nokia reported its test results on CDMA and concluded that the vocoder rate also has a major effect on the character error rate. Motorola provided preliminary test results for CDMA and postulated that the character error rate is based on the type of echo cancellor. Test results from Sprint PCS indicate that power is also an issue.

While the manufacturers postulated on possible future solutions, it was confirmed that they are still in the process of defining the problem and must still isolate other variables that contribute to significant character errors in transmission before they can move to the next phase of their research, *i.e.*, field testing. There was discussion that several possible solutions presented may require significant changes in a carrier's network architecture, particularly trying to control the vocoder rate and frame error rate. Several Forum members indicated that trying to control the frame error rate is more complex and will require further research than anticipated by the Forum. They also noted that such changes could very well result in reducing capacity, which is the antithesis of deploying digital technology. Several members of the TTY Forum expressed concern as to whether such changes to network architecture are realistic, particularly when researchers have yet to isolate all the factors contributing to the character error rate and in view

of the October 1, 1998 compliance date less than five months away.

### **B. GSM Technology**

At the Forum, Ericsson outlined its short-term, intermediate and long-term solution for GSM technology. Ericsson indicated that it is pursuing acoustic handset coupling as a short-term solution and plans to have its solution available by the October 1, 1998 compliance date. Ericsson's test results indicate a character error rate of 1% for GSM, and 6% with TDMA with respect to acoustic coupling. Ericsson's intermediate solution is direct electrical connection using a standardized connector, and long-term solution is direct coupling to the TTY. Ericsson's representative explained that transmission through the TTY and wireless network will eventually run digital but will have to convert back to analog for POTS transmission. With respect to a direct electrical connection, Ericsson advocated standardization of the connector.

### **C. TDMA Technology**

Since the May 1998 Forum Meeting, Philips Consumer Communications (Philips) has conducted the Throughput Test using its *Aeon* cellular phone (TDMA) with the Lober & Walsh Mobility TTY Device on a live network. Its test results indicated a 2% to 5% character error rate *when operating from a fixed location*. While these results look promising, Philips also concluded that additional tests are needed to assess performance with other TTY equipment and whether loss of character synchronization can be improved by delaying the rate at which characters are sent by using "half rate" transmission. See Philips *Aeon* TTY Interoperability Test Report attached hereto as Appendix A. See also Nokia's TDMA measurements in its report, TTY/TDD Compatibility Measurements (Preliminary Results), attached hereto in Appendix A.

## **II. TECHNICAL INFORMATION DOCUMENT**

Ericsson submitted a draft document with information and findings to formulate a Standards Request Document for those companies that wish to pursue an interim solution of direct electrical connection via 2.5 mm jack. While Ericsson recommended submission for standardization, the Forum acknowledged that the standards process could take from 18 to 24 months to complete. There was consensus that the document be developed as a technical information document from the TTY Forum. Forum members also agreed that the document will be for information purposes only to provide guidance to those manufacturers that wish to pursue direct connection via 2.5 mm jack as an interim solution. The Technical Information Document is not intended as an exclusive solution or requirement. An ad hoc working group was formed to prepare a final draft for the next TTY Forum Meeting scheduled in July 1998.

## **III. LONG TERM SOLUTIONS**

### **A. V.18 Standard**

Mr. George Skorkowski of DSPG, Ltd. in the United Kingdom provided the Forum with a status report on European efforts using the V.18 standard. Mr. Skorkowski noted that in Europe there is a significant problem with interoperability of various text telephones due to the lack of standards for such devices. V.18 is an attempt to standardize the system and allow TTYs with different protocols communicate with one another. Essentially, the V.18 standard translates the TTY signals by allowing the devices to detect which protocol (Baudot, ASCII, etc.) is being

used. DSPG, Ltd. has done extensive testing with Ultratec and European models of TTYs and indicates that the TTYs must be adapted from a two wire to a four wire device.

DSPG, Ltd. is implementing the V.18 standard on two or three different platforms and indicates that products will be available by the end of the year. The concept of a new text telephone will be available in Europe by the end of the summer. This device will include an open port that will allow additional flexibility in the future. Mr. Skorkowski noted that the V.18 standard is ideally suited for TRS calls. See Contribution on V.18 Standard attached hereto at Appendix B. See also Excerpt from ITU News dated October 1997 attached hereto as Appendix C.

While European efforts on the V.18 standard are promising, Gallaudet University is testing a prototype device with the V.18 standard to determine its reliability and usability with TTYs manufactured in the United States.

While the Forum to date has primarily focused on short term solutions to meet the imminent October 1<sup>st</sup> compliance date, it was acknowledged that the Forum has not spent enough time on long term solutions. An issue was raised as to whether the Forum needs to revisit its consensus statement concerning retrofitting for Baudot and focus resources on long term solutions such as advanced text messaging that provides real-time, two-way communication.

#### **B. Standard Request Document – Circuit Switched Data**

Working Group #2 provided a draft Standards Request Document (SRD) for Circuit Switched Data (CSD) and Inter-Working Function (IWF). CSD is a service that complements the existing suite of wireless voice and data services including telephone interconnect, short message service and packet data. CSD enables subscribers to directly connect a laptop or facsimile device to their multi-service portable for remote wireless modem and fax data communications to wireline data services. The IWF platform contains the hardware and software elements required to facilitate CSD service through each carrier's mobile switching center. The purpose of the SRD is to define the requirements for CSD and IWF. It is envisioned that CSD will be integrated onto wireless platforms and combined with packet data and short message services to meet the communication needs of the deaf and hard-of-hearing. See Systems Requirement Document for Circuit Switched Data attached hereto as Appendix D.

Working Group #2 recommended that the TTY Forum submit the SRD to a standards body. Forum members will provide written comments on the draft SRD at TTY Forum 6 in July 1998.

#### **IV. BENCHMARK/VALIDATION TEST**

Forum members agreed that an enduser test is not the best process to arrive at valid results. Judy Harkins explained that an enduser test is too subjective and manufacturers need a benchmark to target. She indicated that identifying where communications breaks down might not describe the acceptable error rate for a TTY user in an emergency. An ad hoc working group was established to develop an objective benchmark/validation test to present at the July 1998 Forum Meeting. This group will be responsible for the completion of the benchmark/validation test. It is anticipated that testing will commence during third quarter 1998..

#### **V. OTHER ISSUES**

##### **A. Status of Consumer Notification**

Carriers continue their efforts notifying subscribers and potential subscribers that they may not be able to access 9-1-1 with a TTY over a digital wireless system. The TTY Forum also will send a copy of the consumer notification text to the FCC, the Access Board and other appropriate Federal agencies to use in any manner they feel would expedite getting the information to consumers, *i.e.*, website, fax-on-demand. With respect to the issue concerning manufacturers' reluctance to include the notification text in the packaging, manufacturers indicated that the reluctance was based on business reasons. They view the notification document as a living document that will change periodically while the phones "on the shelf" may not. There is concern that customers may receive a notification that is outdated if included inside the box or on the packaging. While the manufacturers noted that the obligation is upon the carrier to notify subscribers and potential subscribers, they will provide notification in forms they deemed appropriate to their business and marketing plans.

##### **B. HCO/VCO Access to 9-1-1**

At the May 1998 Forum Meeting, CTIA reported on guidance from the FCC's Wireless Telecommunications Bureau (Wireless Bureau) concerning HCO/VCO access to 9-1-1 over digital wireless systems. The Wireless Bureau stated that if carriers cannot technically provide HCO/VCO access to 9-1-1 over digital wireless systems by the October 1, 1998, compliance date, the parties should submit such information in writing to the Wireless Bureau. The documents should include a notification process whereby carriers will notify their subscribers in a timely manner that they cannot use HCO/VCO to access 9-1-1 over digital wireless systems. The Wireless Bureau also indicated that the Commission would expect the parties to provide a timetable as to when HCO/VCO access to 9-1-1 over digital wireless systems could be achieved from a technical standpoint. The Wireless Bureau also requested additional information on whether the PSAP community have the technical capability to accept HCO/VCO calls; whether analog phones can provide HCO/VCO access to 9-1-1; and statistical data regarding current and anticipated demand for HCO/VCO access to 9-1-1 over digital wireless systems.

In response to the FCC's guidance, the Forum has established an ad hoc working group to address HCO/VCO issues under long term solutions and to respond to the FCC's request for additional information. The ad hoc working group and Forum members representing PSAPs will provide information at TTY Forum 6 in July 1998.

### **C. User Requirement Document**

In response to the Forum's request for a list of user requirements, the consumer groups presented a draft document outlining conditions that the industry must meet to provide the deaf and hard-of-hearing with access to 9-1-1 over digital wireless systems, particularly if the industry wants consumer support for the "one phone model" concept. See "User Requirements for One Phone Model Per Service Provider by October 1, 1998" attached hereto as Appendix E. Subsequently, the Forum members discussed having an opportunity to review and comment on the draft document. Forum members were requested to provide constructive feedback via e-mail by June 4, 1998. The consumer advocacy groups plan to formalize a set of user requirement document to explicitly define their needs and requirements for accessing 9-1-1 with TTYs over digital wireless systems. The TTY Forum anticipates that this document will be presented as a contribution at TTY Forum 6 in July 1998.

### **D. TTY Access to 9-1-1 Over Analog Wireless Systems**

At the May 1998 Forum Meeting, several companies made presentations on accessing 9-1-1 over analog wireless systems via TTY. Lober and Walsh demonstrated its product, which is a modified TTY device compatible with an analog Motorola phone. It also provides HCO with a headset plugged into the TTY. Lober and Walsh also has been working on a solution for digital wireless phones and anticipates providing the TTY Forum a demonstration with digital wireless phones at the July 1998 meeting. Sendele Wireless Solutions also provided information on its AxCell product, an interface device that allows connection between the TTY device and an analog wireless phone. CTIA again requested information from manufacturers concerning their analog phones that are TTY compatible. CTIA is in the process of gathering this information in one central location for service providers and consumers.

## **VI. NEXT STEPS**

- Assess progress of research in view of October 1, 1998 deadline and determine how to proceed.
- Review and amend TTY Forum Agreements, particularly in view of status of research and October 1, 1998 compliance date.
- Propose new agreement statement regarding carrier and manufacturer responsibilities after October 1, 1998.
- Finish compilation of analog phone and device list for distribution during third quarter 1998.
- Continue research to isolate the factors contributing to character error rate.
- Presentation and consideration of user requirements document at TTY Forum 6.
- Identify work effort on VCO/HCO access to 9-1-1.
- Review and publish Technical Information Document concerning 2.5mm jack.

- Review and prepare for submission SRD on Circuit Switch Data.
- Develop End User Benchmarking and Validation Process and conduct field testing during third quarter 1998.

# APPENDIX A



# **TTY/TDD Testing for CDMA**

**Dr. Ahmed Tarraf**

**CDMA Radio Technology Performance Group**

**Lucent Technologies**

**Whippany, NJ**

# Topics

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Lucent Technologies  
Bell Labs Innovations



- **Review of published results for Analog**
- **QCELP 13k Simulation**
- **Limitation for system test**
- **System test setup**
- **CDMA system test results**
- **Relationship between FER and CER**
- **Short term solution**

# **TTY/TDD published results for Analog**

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Lucent Technologies  
Bell Labs Innovations



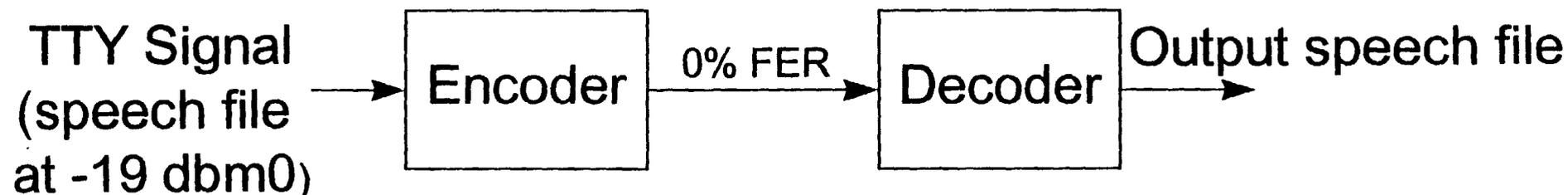
- **Test report:**
  - “ E911 TDD Compatibility Testing With IS-136- 1/22/98 by Ericsson”
- **Analog uplink under good RF condition**
  - 1% Character Error Rate (CER)
- **Analog downlink under good RF condition**
  - 1 % CER

# CDMA QCELP 13k Vocoder Simulation

Lucent Technologies  
Bell Labs Innovations



- TTY signal was generated by TTY modem and stored as a speech file
- Adjusted the speech level to nominal talker level (-19 dbm0)
- Applied the TTY file to QCELP 13k DSP Encoder/Decoder (Vocoder) simulator
- Stored the Decoder output as a speech file
- Applied the output speech file to TTY modem
- Result: With 0% Frame Error Rate (FER), CER = 0%
  - TTY signal can be transmitted using CDMA 13k vocoder



## Limitation for system test

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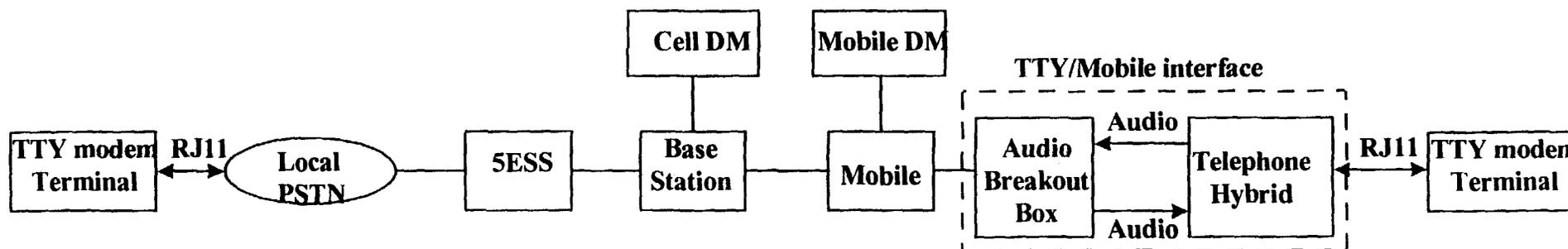
Lucent Technologies  
Bell Labs Innovations



- **TTY modem/Digital mobile interface**
  - No commercial product available.
  - Work around:
    - Build an interface using mobile audio-break out box and telephone hybrid.
      - Impedance mismatch
      - Level issues
- **TTY signal level going into the PSTN is not adjustable:**
  - found to be 7 dB higher than the nominal talking level for CDMA QCELP 13k system.

# System test setup

Lucent Technologies  
Bell Labs Innovations



DM: Diagnostic Monitor

TTY/TDD test setup

CTIA Forum  
May 20-21 1998

# Test file

Lucent Technologies  
Bell Labs Innovations



- The following text file was transmitted at one TTY terminal and was received at the other TTY terminal. It has 379 characters

ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789

- At the end of a transmission, the total characters received in error were counted and the error rate was calculated as:

$$\text{Error rate} = (\text{total characters received in error} / 379) * 100$$

# CDMA system test results

Lucent Technologies  
Bell Labs Innovations



Forward link

Forward FER=0%		
Tx. No.	# characters in error	% character error
1	2	0.527704
2	2	0.527704
3	3	0.791557
4	3	0.791557
5	3	0.791557
6	4	1.055409
7	2	0.527704
8	1	0.263852
9	0	0
10	8	2.110818
Average	2.8	<b>0.738786</b>
St. Dev.	2.149935	<b>0.567265</b>

Reverse link

Reverse FER=0%		
Tx. No.	# characters in error	% character error
1	4	1.055409
2	12	3.166227
3	7	1.846966
4	3	0.791557
5	3	0.791557
6	2	0.527704
7	1	0.263852
8	3	0.791557
9	2	0.527704
10	1	0.263852
Average	3.8	<b>1.002639</b>
St. Dev.	3.359894	<b>0.886516</b>

**Forward CER = 0.74%**

**Reverse CER = 1%**

CTIA Forum  
May 20-21 1998

# Relation between FER and CER

Lucent Technologies  
Bell Labs Innovations



## ■ Example:

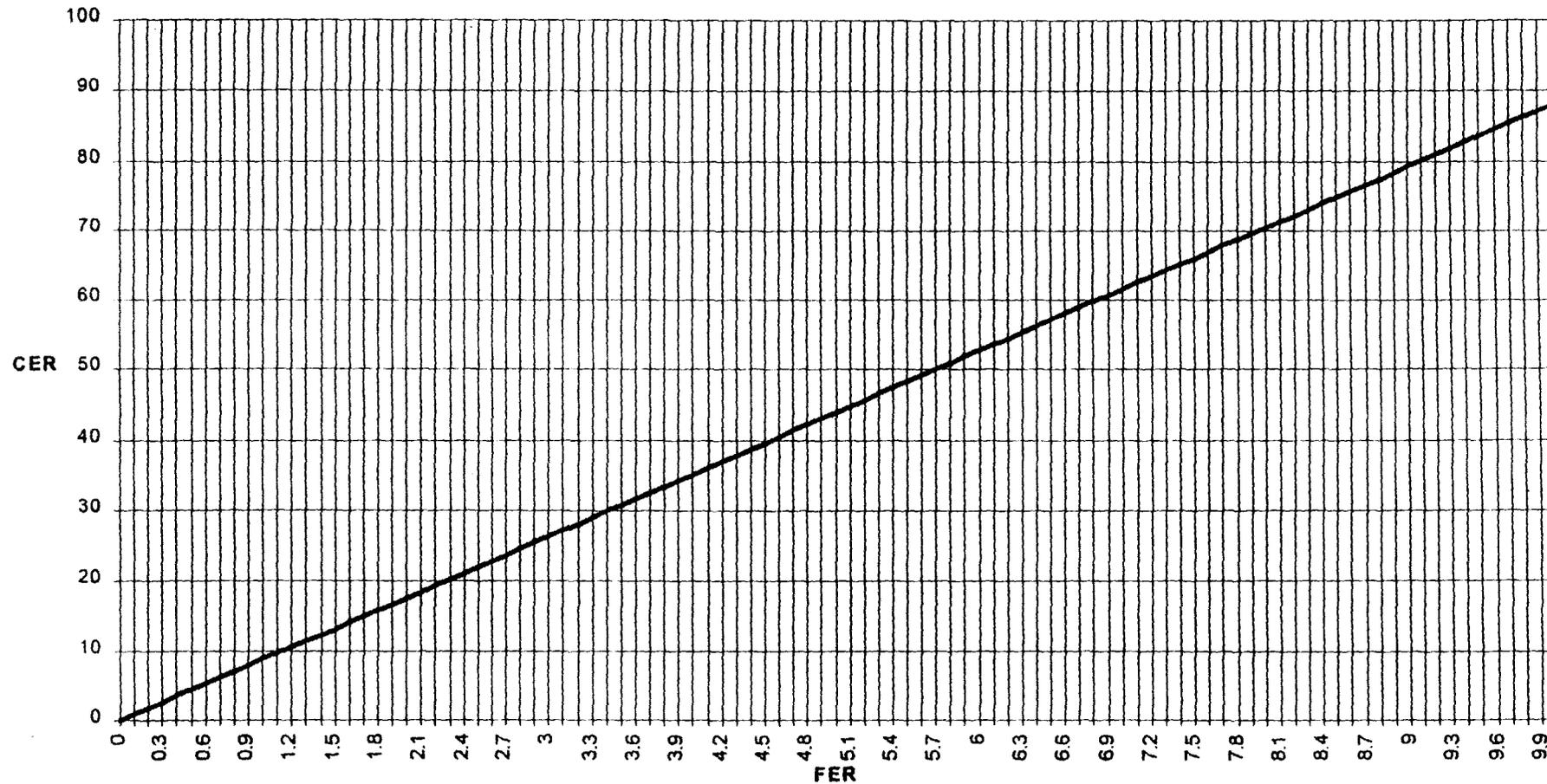
- Transmitting 300 TTY characters
- Each TTY character is transmitted using 8 bits:
  - 1 Start bit, 5 data bits, 2 stop bits
- Bit length is 22 msec.
- No. of CDMA frames in 300 characters =  $300 * 8 * 22 / 20 = 2640$  frames
- 1 % Frame Error Rate (FER) is equivalent to 26.4 frame errors.
- Worst case scenario, under 0.0 correlated channel, the frame errors will be isolated, means each frame error will produce one bit error in different character, means 26.4 character errors.
- $(26.4/300) * 100 = 8.8$  Character Error Rate
- **CER=8.8FER**

# Relationship between FER and CER (Cont.)

Lucent Technologies  
Bell Labs Innovations



Character Error Rate (CER) Vs. Frame Error Rate (FER),  $CER=8.8*FER$



CTIA Forum  
May 20-21 1998

## Short term solution

Lucent Technologies  
Bell Labs Innovations



- **FER is major contributor to CER**
- **The goal is to Maintain the FER as close to 0% as possible**
  - Make TTY mobile as a high power mobile
    - Transmit more power on the reverse link to achieve “0 %” FER
    - Allow the forward power control to transmit more power on the forward link to achieve “0 %” FER
    - Impacts system capacity

# TTY/TDD Compatibility Measurements (Preliminary Results)

by

Mohamed El-Rayes

5.20.98

# POSSIBLE CAUSES OF ERRORS

- Coupling:
  - Acoustic coupler: ambient noise susceptibility
  - Non-optimal direct interface: Impedance,...
- DSP Baseband functions:
  - Echo suppression
  - Noise Cancellation
  - Equalization
- Vocoder Parameters:
  - Vocoder Rate
  - Vocoder Delay