Notes on Evaluating Solutions against the User Requirements List

Judy Harkins and Norman Williams, Gallaudet University, May, 2001

Some of the carriers have indicated a need to include in their tests and evaluations all of the user requirements generated in 1998 in the TTY Forum. This document annotates the requirements with notes about evaluation issues and field test procedures from a user perspective. This is obviously not a test plan but is sent out primarily for generating discussion and giving general guidance from the user viewpoint.

1. The character error rate should approximate that of AMPS, which has been demonstrated at <1% for stationary calls. More research on AMPS performance with TTY would be useful to assist in specifying a range of conditions.

See appendix.

2. The TTY caller must be able to visually monitor all aspects of call progress provided to voice users. Specifically, the ability to pass through sounds on the line to the TTY (so that the user can monitor ring, busy, answered-in-voice, etc.) should be provided.

Suggestion: Generate all audio call progress signals (ringing, busy, fast busy, voice answer) and determine if there is an understandable visual indication for each. The line status light on the TTY will probably function appropriately in voice channel solutions, but this should be verified. Check that the visual indication is synchronized in time with the audio indication.

Comment: A particular issue in wireless telecommunications is that call to mobile phones often do not ring at all if the party is unavailable; a voice message is provided instead. There may not be a visual indication of the call status on the telephone. Another issue is that many phones revert to voice mail. In these situations, the TTY caller will not be able to monitor all aspects of call progress provided to voice users.

3. There must be a visual indication when the call has been disconnected.

Suggestion: Place call and have other side hang up. What visual indication is given? If the user can tell, by looking at the handset for example, that the call is terminated, then this criterion is met.

Comment: It would help all users to have an explicit message, but if this is not provided, the user should know what the screen will look like upon call termination.

4. A volume control should be provided.

Comment: Determine and document the optimum volume control setting for the TTY being tested. (If performance is affected by volume control, users will need to be informed of this, and how to use the volume control to obtain a low error rate.)

5. The TTY user must have a means of tactile (vibrating) ring signal indication.

Suggestion: Verify that the handset or accessory vibrates on receipt of calls (and preferably not at other times!). Can the tester receive calls in a timely fashion with the ringer turned off? (Test throughout the call; some external vibrators continue to vibrate throughout a call, which can be confusing.)

6. The caller must be able to transmit TTY tones independent of the condition of the receiving modem. (This is to permit Baudot signaling by pressing a key, to let a hearing person know that the incoming call is from a TTY.)

Suggestion: On outgoing call, press keys on the TTY during ring signals and immediately after answer. Baudot tones should be clearly audible by the answering party. (This should not be a problem for voice channel solutions, but is worth some quick tests in the field.)

7. The *landline* party's TTY must not require retrofitting in order to achieve the desired error rate.

Comment: This issue appears to be moot and does not need to be tested.

8. The *wireless* party's TTY may require retrofitting, or a new model TTY to be developed, or the use of a portable data terminal such as a personal digital assistant.

Comment: This is not an issue for testing. However, if an accommodation is required, such as retrofitting, a special model, or a cable, this should be well documented so that consumers know what types of equipment they will need. If PDAs or paging devices are used in place of a handset and TTY combination, attention will need to be paid to the rate of input that can be achieved through the keyboard or virtual keyboard.

9. VCO and HCO should be supported.

Suggestion: Evaluating the efficacy of VCO and HCO:

- VCO and HCO should be tested as they will be implemented. For example, if a custom cable is needed, tests should be run with that cable as part of the set-up. If the user needs to take action between turns (e.g., pushing a button), it should be tested with consumers to check usability.
- Does the system deliver acceptable error rates with devices on the market that are designed to work in VCO and in a mobile environment? (Ameriphone Q90, Krown Pocket VCO, and the Ericsson handset adapter are the three known examples.)
- Is the quality of voice on VCO calls the same as on non-TTY calls? This can presumably be tested using standard industry methods for voice quality.

- Is there any delay or cut-off of characters or words when switching between voice and TTY?
- Is there greater chance of disconnect when switching between voice and TTY? Other problems?

10. Reduction of throughput (partial rate) on Baudot is highly undesirable and should not be relied upon to achieve compliance (see #7). It may be useful as a user-selectable option to improve accuracy on a given call.

This issue is now moot, and no tests are needed.

11. Call information such as ANI and ALI, where provided in wireless voice, should also be provided for TTY calls.

This would not appear to be a problem on voice channel solutions. On data channel solutions, the call would need to carry the same identifying information as would be carried were it in the voice channel.

12. On the landline side, the solution need not support little-used or obsolete TTY models, but in general should support the embedded base of TTYs sold over the past ten years. The landline equipment supported must not be limited to that used in Public Service Answering Points (911 centers).

A variety of TTY models should be tested, but the amount of testing on each model will necessarily vary. The difficulty in testing with a large number of models is acknowledged, given the limitations in data capture possibilities with TTYs and some 911 TTY systems on the market. This may have to be handled by short tests – calling to direct-connect landline TTYs set to auto answer, where the tester can call send a string of identifying information about the call, which can then be sent back to the tester for scoring. This might be able to be arranged at Gallaudet if there is interest; more discussion is welcome. (Note that Gallaudet has produced some software tools and documentation for partially automated two-way TTY testing: www.tap.gallaudet.edu/ttytools

13. Drive conditions must be supported, again using AMPS as a benchmark.

Tests for drive conditions should be run using carriers' individual methodologies and facilities. The consumer's goal is to be able to use the TTY and telephone while a passenger in a car, while on a train, etc.

Appendix User Requirement 1: Error rate of TTY over Wireless telephones

- Interoperability among handsets and infrastructure vendors should be tested using industry's usual tests.

- Varying signal conditions need to be tested.

- Varying network conditions need to be tested.

- Data should be collected and scored on both sides (directions) of the call wherever possible.

- See Requirement 12 on accommodating a range of TTY models. Compatibility testing with 9-1-1 TTY equipment should be coordinated via Toni Dunne.

- See Requirement 13 on drive tests.

- Calls through relay should be placed. A hearing person on the landline side should read one side of the script. (This is an example of where random characters will not be helpful). Relay operators cannot retain conversations; unless special arrangements can be made with TRS providers for test calls, the only way to ascertain is to ask the relay operator if the incoming text was garbled.

- We tentatively recommend that Lober and Walsh's SCORE program be used as this was developed through the TTY Forum. There is some indication based on limited tests that the Ericsson program results in a higher error rate.

- Scripts: A few comments -- Consumers have had the concern that the error rates generated by the TTY Forum's random character set may be inflated due to the excessive number of register shifts (sending a shift character between each figure/letter transition) in this script. It is not possible to eyeball the results in the field because of the random characters. The random character file also transmits only at full rate – there are no pauses.

Matt Kaltenbach of Ericsson has suggested that it would be helpful to base at least one script on the bit structure of Baudot or some other mathematical basis that would allow for diagnosis of problems in the field.

Gallaudet has produced a series of scripts that use conversational language and naturals shifts between letters and figures, pauses in typing and simulation of two typing speeds. These are available at http://tap.gallaudet.edu/ttytools

Comment on the 1% benchmark: It was our intention, when we wrote this requirement, that 1% would apply to reasonable signal conditions and network conditions, and *not* that a maximum of 1% error rate must be met on every single call in the presence of severe (and rarely occurring) impairments.

APPENDIX E

TTY USER REQUIREMENTS

September 10, 1998

To: TTY Forum

Fr: Consumer Representatives

The CTIA has said that most of the consumer criteria previously submitted were not usable by the TTY Forum because the criteria covered marketing and distribution as well as design. Marketing and distribution issues for a possible "one-phone-model-per-technology" short-term plan will be taken up with CTIA's senior management, as suggested by them.

This contribution is a new set of criteria to address only functional characteristics of the solutions. The new criteria also reflect new information from the Forum since the first list was drawn up. It is intended to cover any solution.

1. The character error rate should approximate that of AMPS, which has been demonstrated at <1% for stationary calls. More research on AMPS performance with TTY would be useful to assist in specifying a range of conditions.

2. The TTY caller must be able to visually monitor all aspects of call progress provided to voice users. Specifically, the ability to pass through sounds on the line to the TTY (so that the user can monitor ring, busy, answered-in-voice, etc.) should be provided.

3. There must be a visual indication when the call has been disconnected.

4. A volume control should be provided.

5. The TTY user must have a means of tactile (vibrating) ring signal indication.

6. The caller must be able to transmit TTY tones independent of the condition of the receiving modem. (This is to permit baudot signaling by pressing a key, to let a hearing person know that the incoming call is from a TTY.)

7. The *landline* party's TTY must not require retrofitting in order to achieve the desired error rate.

8. The *wireless* party's TTY may require retrofitting, or a new model TTY to be developed, or the use of a portable data terminal such as a personal digital assistant.

9. VCO and HCO should be supported where possible.

10. Reduction of throughput (partial rate) on Baudot is highly undesirable and should not be relied upon to achieve compliance (see #7). It may be useful as a user-selectable option to improve accuracy on a given call.

11. Call information such as ANI and ALI, where provided in wireless voice, should also be provided for TTY calls.

12. The solution need not support little-used or obsolete TTY models, but in general should support the embedded base of TTYs sold over the past ten years. The landline equipment supported must not be limited to that used in Public Service Answering Points (911 centers).

13. Drive conditions must be supported, again using AMPS as a benchmark.

TTY Forum

Appendix E
TTY/TDD Forum – 18

June 12, 2001
ATIS Conference Center
1200 G Street, NW, Suite 500
Washington, DC

TTY User Intervention (*i.e.*, mode switch)

Questions:

1. How often does this have to be done?
2. How many steps are there?
3. How complicated are the steps?
4. Is it easily discovered without using the user's manual?
5. Is it clearly documented?
6. Is there a visual status indication?
   - During set-up?
   - Ongoing?
7. Does the TTY mode setting interfere with the operation of other features of the handset or system? (e.g., does connecting the cable or enabling the TTY mode disable the vibrate feature or the direct dialing capability?)
8. Will it be possible to make a voice call while in TTY mode?
9. Will VCO be a choice or will it be supported as a TTY mode? (Will VCO be incorporated into this mode or is there a series of choices in TTY mode?)
10. How long does it take? How fast can you set it up?
11. Is it possible to change modes during a call?
12. Is it standardized across handsets?
13. Is the process of hooking up the equipment and putting it into TTY mode too long or arduous to be able to answer a call in time?[1]
14. When receiving an incoming call, does the phone vibrate? Does the vibrator continue to work when an audio cable is inserted into the jack?

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[1] Can a user set up the equipment and get into TTY mode before the call is disconnected or goes to voicemail? Can the phone be answered prior to being connected to equipment?

September 14, 1999

To: TIA TR-45.3

Fr: Consumer Representatives, Wireless TTY Forum
Authors: Judy Harkins, Gallaudet University and Dick Brandt, dB Consulting as consultant to Gallaudet
David Baquis, Self Help for Hard of Hearing People, Inc.
Alfred Sonnenstrahl, Consumer Action Network
Claude Stout, Telecommunications for the Deaf, Inc.
Karen Peltz Strauss, National Association of the Deaf
Norman Williams, Gallaudet University

Re: Guidance to TR-45 on Proposals for Solutions to TTY over TDMA

Presentations on three of the proposals being considered by TR-45 for the TDMA TTY solution were made at the September 9, 1999 meeting of the Wireless TTY Forum. Given the timeframe TR-45 is operating under, and given that the FCC has directed industry to consider consumer issues in determining solutions, we offer this document as guidance to TR-45 as it considers the alternatives.

The information presented at the September 9 meeting was, in some cases, sufficiently sketchy that consumers were unable to ascertain the functional implications of the proposals. Some presentations were also done very late in the process, so there is not sufficient time for analysis.

We do not state a preference for any proposal but hope the following discussion will be helpful.

General Questions and Issues:

1. There is a concern among consumers about the implications of roaming among digital technologies in the future, if a variety of approaches for TTY access are used. Thus we believe consistency in approach across technologies is needed. One of the carriers also strongly expressed this view. This problem needs to be solved for the long term, not just for the current situation where roaming tends to go to the more-accessible analog network. Once these solutions are implemented, if problems arise, consumers will have great difficulty having them addressed because the solutions are within the network and customer service personnel will not be equipped to deal with them.

2. Has there been any analysis indicating that approaches which propose network changes in switches versus changes in base stations, would lead to earlier availability as claimed? Consumers are interested in seeing solid, lasting and effective solutions, and the speed of implementation, while important, should not override usability considerations.

3. All test results presented to date have been obtained using blocks of data sent out from a file stored either in a TTY or in a computer and sent via a TTY modem. It has been noted in tests

run by Gallaudet that results obtained in an interactive mode (two people typing to each other) yielded poorer accuracy. Thus proposals that show errors in transmission should be scrutinized carefully. A full range of system impairments has either not been used in simulation testing or not reported on all of the solutions.

4. Non-activated phone support for 9-1-1 calls is required by the FCC. Has this been considered in the proposals? (See class mark discussion below.)

Appraisal of Specific Solutions:

Vocoder solution. From a consumer perspective, the Lucent "no gain" solution has been most thoroughly presented and appears to have the most transparent accessibility and the most support for consumer needs and requirements. The inclusion of error correction is a major benefit, given that the air interface presents new challenges to TTY transmission. Other, comparable proposals may also have merit (e.g., Nokia), but they have not been thoroughly explained so that consumers can compare them.

Code conversion. The Ericsson (and Nokia?) Code conversion ("tone") proposals appear to offer the possibility of earlier implementation (see 2 above) and the ability to use many existing handsets, but have the potential of putting the retrofit burden on the consumer. They raise the following concerns:

1. Smart Cable: Consumers are not opposed to the idea of including intelligence in the cable per se, however the following concerns exist:
   1.1. How would this intelligence be powered? (This question could not be answered at the Sept. 9 meeting.) There is opposition to the requirement for an additional battery for reasons of cost, bulk, and reliability.
   1.2. Who would make and provide the cable?
   1.3. Would this intelligence be built into the regular cable product line or would this be a primarily or exclusively "deaf" product? If the latter, experience shows that provisioning and cost may be serious problems. Customers often have to wait many weeks for "special" accessories. We realize standards bodies do not ordinarily address cost issues, but please consider the additional cost of a phone that vibrates (over a low-end phone), the cost of the TTY, and now the potentially high cost of a special-purpose cable with a small market.
   1.4. Would one cable fit all (thereby lowering the price and expanding the availability)?

2. Class Mark: Any system that relies on the phone having a class mark denoting that the user uses a TTY is not likely to be successful, because many deaf and hard of hearing people consider self-identification as a possible threat to their security. 9-1-1 operators have never been successful in having deaf and hard of hearing subscribers "sign up" as a TTY telephone number. The procedure is fraught with potential problems and snafus. When someone roamed into a carrier using this solution (not marked), what would happen? Hearing people who use TTYs may not realize they need to enroll their phones. People who have a phone and acquire a TTY later (e.g., after onset of hearing loss) would find the TTY does not work. TTY users could not use someone else's cell phone. One solution to this problem suggested

at the forum was to mark all phones as TTY. Would carriers agree to this? In short, a system that provides automatic detection of the TTY signal is preferable.

IWF. Although we recognize that IWF proposals are not a part of the present TR-45 TDMA TTY discussions we would also like to provide the following for your information, as they should be considered in development of proposals:

1. There is a strong desire for VCO/HCO capability, which appears to be difficult to implement in IWF solutions at the present time.
2. There is also a strong desire for provision of the line signal power indicator (flickering light) used to interpret call status.
3. Consumers are opposed to (and the DOJ has mandated against) requiring any form of special dialing (e.g., two-stage) or conditioning sequences (e.g., #NN) to reach 9-1-1.
4. It will be important that the delay between powering on a data device and dialing out not exceed the delay experienced with a voice call.

Appendix: Consumer requirements with comments regarding proposed solutions:

1. The character error rate should approximate that of AMPS, which has been demonstrated at <1% for stationary calls. More research on AMPS performance with TTY would be useful to assist in specifying a range of conditions.

Comment: All proposals presented to date appear to meet this criterion. Consumers are concerned that there be sufficient testing to validate this in the field.

2. The TTY caller must be able to visually monitor all aspects of call progress provided to voice users. Specifically, the ability to pass through sounds on the line to the TTY (so that the user can monitor ring, busy, answered-in-voice, etc.) should be provided.

Comment: All proposals claim to meet this criterion and we have no concerns. (IWF solutions may, however, not be able to meet this one.)

3. There must be a visual indication when the call has been disconnected.

Comment: This specific issue has not been addressed in presentations but is covered by most if not all systems by a message on the display of the phone.

4. A volume control should be provided.

Comment: This item is intended to allow the TTY user to adjust volume for better reception of TTY tones as necessary. Most if not all handsets include this feature anyway. It has not therefore been addressed in presentations on solutions.

5. The TTY user must have a means of tactile (vibrating) ring signal indication.

Comment: Again, this is an issue of general provisioning and not related to voice-channel solutions. (However, this will be an issue in IWF solutions.)

6. The caller must be able to transmit TTY tones independent of the condition of the receiving modem. (This is to permit Baudot signaling by pressing a key, to let a hearing person know that the incoming call is from a TTY.)

Comment: All voice-channel solutions to date appear to support this.

7. The *landline* party's TTY must not require retrofitting in order to achieve the desired error rate.

Comment: All solutions to date appear not to require retrofitting of the landline TTY.

8. The wireless party's TTY may require retrofitting, or a new model TTY to be developed, or the use of a portable data terminal such as a personal digital assistant.
Comment: Solutions that do not require retrofitting or special treatment are preferred by consumer representatives.

9. VCO and HCO should be supported where possible.

Comment: Voice-channel solutions presented to date appear to support this requirement. (IWF solutions may not, however.)

10. Reduction of throughput (partial rate) on Baudot is highly undesirable and should not be relied upon to achieve compliance (see #7). It may be useful as a user-selectable option to improve accuracy on a given call.

Comment: No solution presented to date reduces throughput, as nearly as we can tell. This should be verified with the companies proposing solutions.

11. Call information such as ANI and ALI, where provided in wireless voice, should also be provided for TTY calls.

Comment: Voice channel solutions should not cause a problem with this.

12. On the landline side, the solution need not support little-used or obsolete TTY models, but in general should support the embedded base of TTYs sold over the past ten years. The landline equipment supported must not be limited to that used in Public Service Answering Points (911 centers).

Comment: This is of concern because of limited testing of solutions to date.

13. Drive conditions must be supported, again using AMPS as a benchmark.

Comment: This requirement has not been adequately addressed by testing.

APPENDIX F

WORK PLAN

Published as a separate TTY Form Document

APPENDIX G

Typical Operating Characteristics for Wire-Line Based TTYs

The following is a technical description of the typical operating characteristics for existing wire-line based Text-Telephones for the Deaf (TTYs). This document is not intended to be a performance description of any one product, but to give a representation of performance of the majority of the product supplied to wire-line TTY customers in the last five years. TTY manufacturing representatives has reviewed this information and agrees that it represents an accurate account of the performance characteristics of existing wire-line products.

It should be noted that it is not possible to precisely define performance for all products, in all situations, in the field. Variation beyond this technical representation does exist for older product, products that are no longer supported by a manufacturer, individual products that are not operating correctly and improper use of product. It is not possible to report this additional range of variation, only to say that these products performance would suffer on either a connection to wire-line or wire-less TTY.

TECHNICAL BACKGROUND

For Frequency Shift Keying (FSK) two signal frequencies are required to modulate the asynchronous serial data to be sent over the conventional voice grade telephone lines of the switched telephone network. For Baudot communications to be useful on the Public Switch Telephone Network (PSTN) these frequencies fall within the central portion of the telephone line pass-band (300 – 3300 Hz).

The two frequencies of the transmitted signal must be sent in accordance with FCC requirements defined in dBm (decibels with reference to a power of one milliwatt for metallic connections, where 0 dBm = 1 milliwatt). The acoustic measurements are in dBSPL for acoustic configurations. This signal is measured at the TTY interface, either at the metallic connections or where it is acoustically coupled to the telephone network.

The receive level, commonly referred to as sensitivity, is also given for each pair of frequencies. This signal, also measured in dBm for direct connections and dBSPL for acoustic configurations, is the typical signal measured at the connection that will result in error-free reception of a test message.

BAUDOT CODE OPERATION

All TTYs provide Baudot code operation employing half-duplex, simplex, asynchronous, FSK transmission.

Frequencies

Baudot code operation used the following frequencies:

Signal	Frequency	Tolerance	
		Transmit	Receive
Mark	1400 Hz	±1%	±4%
Space	1800 Hz	±1%	±4%

Bit Duration

The bit duration is 22.00 milliseconds (ms) ±0.40ms to provide a nominal baud rate of 45.45 bits per second.

CHARACTER FORMAT

Transmit

The Baudot code for each character is transmitted with the following format, the data bits assigned are in accordance with Table 1.2 with a "1" in the binary representation transmitted as a mark and a "0' as a space.

Bit	Start	Data	Data	Data	Data	Data	Stop
Signal	Space	LSB	Bit 2	Bit 3	Bit 4	MSB	Mark
Number of Bits	1	1	1	1	1	1	1.5-2.0 2.0 Typ.

Table 1.1

Where the LSB is the Least Significant Bit and the MSB is the Most Significant Bit. The bits shall be transmitted from left to right.

Receive

The TTY is capable of receiving characters with the format of Table 1.1 with a stop bit of at least 1.0 bit length or longer. The receiver is capable of receiving characters either with the space tone of the start bit as the first tone received or with a mark tone preceding the start bit.

Mark Hold Time

The mark hold time defines an additional period of time during which the TTY transmits a mark hold tone (1400 Hz) following the last character transmitted. Mark hold tone is not transmitted between each character if the character is followed immediately by another character. The mark hold tone is transmitted for a period between 150ms to 300 ms after the end of the stop bit(s).

Transmit Levels		
Coupling Method	Level	Range
Acoustic Direct Connect	108 dBSPL -10 dBm	±6 dB * - 3 ,+1 dB

Sensitivity Levels		
Coupling Method	Level	Range
Acoustic Direct Connect	72 dBSPL -40 dBm	±6 dB * ±5 dB

Most receivers are capable of receiving signal up to at least –5dBm.

* NOTE: Acoustic performance variations greater than listed may be encountered and are a result of many variables including the type of telephone handset used and how well the acoustic coupling is made by the user. It is not possible to report this additional range of variation, only to say that these products performance would suffer on either a connection to wire-line or wire-less TTY.

TABLE 1.2

Set of Baudot Codes for TTYs

DEC	HEX	BINARY	LETTER	FIGURE
0	00	00000	BackSpace	BackSpace
1	01	00001	E	3
2	02	00010	LF	LF
3	03	00011	A	-
4	04	00100	Space	Space
5	05	00101	S	
6	06	00110	I	8
7	07	00111	U	7
8	08	01000	CR	CR
9	09	01001	D	$
10	0A	01010	R	4
11	0B	01011	J	‘
12	0C	01100	N	,
13	0D	01101	F	!
14	0E	01110	C	:
15	0F	01111	K	(
16	10	10000	T	5
17	11	10001	Z	“
18	12	10010	L	)
19	13	10011	W	2
20	14	10100	H	=
21	15	10101	Y	6
22	16	10110	P	0
23	17	10111	Q	1
24	18	11000	O	9
25	19	11001	B	?
26	1A	11010	G	+
27	1B	11011	FIGS	FIGS
28	1C	11100	M	.
29	1D	11101	X	/
30	1E	11110	V	;
31	1F	11111	LTRS	LTRS

Note: CR and LF may be manually or automatically generated by the TTY. If automatic generated, the sequence may contain an extra (non-printable) character to provide adequate time for older electromechanical TTYs to respond. CR & LF are inserted into the transmitted characters after a maximum of 72 characters to allow for the carriage return of older electromechanical TTYs.

APPENDIX H

Modem / IWF Manufacturer Contact List

List of Names and Addresses to Receive IWF Letter

Title	FirstName	LastName	JobTitle	Company	Address	Address 2	City	State	Zip
Ms.	Veda	Krishnan		Cirrus Logic	110 Horizon Drive #300		Raleigh	NC	27615
Mr.	Zarko	Draganic	CEO	Alto Com Inc.	257 Castro Street	Suite 233	Mountain View	CA	94041
Mr.	Edward	Campbell		3Com					
Mr.	Raouf	Halim	VP and General Manager, Network Access Division	Rockwell Semiconductor Systems	4311 Jamboree Road		Newport Beach	CA	92660-3095
Mr.	Aaron	Fisher	Vice President, Wireless Products	Lucent Technologies	Room 55F-311	1247 S. Cedar Crest Blvd.	Allentown	PA	18105-6209
Ms.	Judy	Sheff	VP Intellectual Property	Lucent Technologies	Room 5SF18	2 Oak Way	Berkeley Heights	NJ	07922-2747
Mr.	Greg	Garen	General Manager Modem and Multimedia Products	Lucent Technologies - Microelectronics Group	Room 22W-219(Mail Stop EQ)	555 Union Blvd.	Allentown	PA	18103-1229
Mr.	Warren	Henderson	CEO	Henderson Laboratories					
Mr.	Moiz	Beguwala	VP and	Rockwell	4311		New	CA	926

Title	FirstName	LastName	JobTitle	Company	Address	Address 2	City	State	Zip
			General Manager, Personal Computing Division	Semiconductor Systems	Jamboree Road		port Beach		60-3095

CC: National Association of State Relay Administration (NASRA)
Merilyn Crain, Chair
315 So. College Rd. Suite 208
Lafeyette, LA 70503

IWF letter dated November 16, 1998

Sent to:
3Com
Mr. Zarko Draganic, CEO, Alto Com Inc.
Ms. Veda Krishnan, (to be supplied) Cirrus Logic
Mr. Aaron Fisher, Vice President, Wireless Products, Lucent Technologies
Ms. Judy Sheff, VP Intellectual Property, Lucent Technologies
Mr. Greg Garen, General Manager Modem and Multimedia Products Lucent Technologies - Microelectronics Group
(To be supplied), Motorola
Mr. Raouf Halim VP and General Manager, Network Access Division, Rockwell Semiconductor Systems
Mr. Moiz Beguwala, VP and General Manager, Personal Computing Division, Rockwell Semiconductor Systems

Dear Sir/Madam

In response to a FCC inquiry, the Cellular Telecommunications Industry Association (CTIA) and the Personal Communications Industry Association (PCIA) have established a technical forum to address the issue of providing reliable communications for deaf and hard of hearing people over digital wireless systems. Specifically this forum is addressing the issue of deaf and hard of hearing people using digital wireless connections to access 9-1-1 centers.

A solution that appears to offer promise for the longer term, involves the use of new (or modified) communications terminals, used by deaf and hard of hearing people, (TTYs) connected through a serial interface to the digital cell phone. The data channel, provided by the air interface, would then be used to effectively extend this interface to the network. This of course, would require the use of an Interworking Function (IWF)*[2] in the network that would be capable of supporting TTY communications. We are aware that some of the IWFs being developed will support 45.45 Baudot TTY transmission (the transmission mode most commonly used by deaf and hard of hearing people in the United States). While this caters well to the present need, it has the drawback that it locks deaf and hard of hearing people into this older technology.

A more desirable solution would be one which would involve the use of ITU-T Recommendation, V.18, that specifies a protocol, which provides for higher speed ASCII based communications while at the same time maintaining compatibility with today's Baudot TTY devices. The problem with this solution is that V.18 has yet to be implemented by any major modem manufacturer. We have, however, been given a presentation by a UK based company that has developed a prototype "stand alone" V.18 product which it plans to introduce commercially early next year. In addition to this, we have been given a demonstration of an in-service Swedish IWF, which incorporates V.18 functionality. It might also be of interest to note

[2] The term IWF is used in its broadest sense in this letter. (See the definition in TIA TSB-100)

that the service provider sees text telephony as a generic service (e.g. not just for deaf or hard of hearing). These two events may be moving V.18 into the readily achievable category.

It seems likely that if the IWF function and the modems installed at the 9-1-1 centers were to incorporate V.18 capability, connections could be made at the higher V.18 rates. Likewise it would appear that the connect time could be shortened as V.18 incorporates a calling tone, which could be instantly recognized by equipment at the 9-1-1 centers, thereby eliminating the loss of precious time, which is normally incurred while attempting to determine the source of a "silent" call.

Assuming that you agree that the timely provision of this functionality is important, we are hoping that you can provide us with an indication of when we might expect to see products (e.g. consumer modems, IWFs) from your company that implement V.18. Any information you could provide to us, by 4th Quarter 1998, would greatly help us in developing our response to the FCC.

APPENDIX I

TTY Forum Chair's Update Memorandums

Date: March 22, 1999

FM: TTY Forum Co-Chairs; Ed Hall, CTIA and Todd Lantor, PCIA
TO: TTY Forum Members and Interested Parities

RE: TTY Forum Update

Greetings,

A recent conversation with Dr. Steven Benno of Lucent Technologies has informed us that he has completed the Lucent software simulation of the TTY "no-gain" solution and it is now released and available to all those interested in exploring its functionality, compatibility and potential benefits with various CLEP vocoders. According to Dr. Benno, the following equipment and infrastructure vendors have requested a copy of his newly released code for testing purposes; Ericsson, Motorola, Nokia, NORTEL and Qualcomm. As co-chairs, we remain hopeful that this Lucent contribution will spark an interest for some manufacturers to re-visit their past efforts with vocoders, which perhaps may lead to follow-on contributions at our next TTY Forum.

During the last TR45 meeting, (March 3-4) CTIA submitted the 2.5mm Jack SRD, on behalf of the Forum. TR45 accepted this contribution and remanded it to the TDMA (TR45.3) and CDMA (TR45.5) sub-committees for information and to the appropriate sub-committee (TR45.1) for Action. Likewise, the TDMA and CDMA sub-committees reported back to the Chair that both of these digital technologies have developed standards supporting the Inter-working Function (IWF) as described in the TTY Forum's SRD on Circuit Switched Data submitted during the December TR45 meeting. This news brings the industry one step closer to the Forum's proposed "long term" data solution. The willingness of some modem manufacturers (3COM) to support the V.18 protocol is the other critical issue needed to make the IWF a viable option to carriers as a means of supporting TTY over digital - long term. The IWF solution opens the doors to the future by allowing end-users the use of ultra-light computers, compact PDA's, etc.

At this point I think it is important to remember that it has been the synergy, team-spirit and positive environment provided by the members of the TTY Forum that has lead us to this point. But, we do not want anyone to have the false impression that the end-all, be-all solution(s) have thus far been developed. Although Dr. Benno's "no-gain" solution remains a major breakthrough for TTY, "short term", voice based (specifically CLEP vocoders) solution and the V.18 protocol a major breakthrough for TTY "long term", data solution these by no means require carriers or manufactures to implement anyone one or both of these solutions. Keep in mind the other solutions brought to the Forum by Lober and Walsh and Ericsson. These solutions have also proved to be quite successful and promising for certain digital technologies. It is important to keep in mind that the carrier is responsible for the selection and implementation of a solution(s) that will allow TTY users to access 9-1-1 over its digital system. The best we as a Forum can do at this point is continue to provide the positive environment, feedback and input to manufacturers and carriers regarding testing and consumer needs and requirements and keep the standards development bodies involved when needed. CTIA and PCIA remain committed.

In conclusion, we propose that at the next TTY Forum we initiate the process to develop the final report to the FCC. Based on the contributions received to date and those anticipated at our next meeting, we believe we will have sufficient information to develop specific comments and recommendations. The TTY Forum can then plan to meet on a quarterly basis to "evaluate" progress and provide the FCC with a periodic, implementation status report.

My thanks to all members of the TTY Forum. Looking forward to seeing everyone in May.

July 23, 1999

Fm: TTY Forum Co-Chairs
TO: TTY Forum

RE: Update: TTY Forum and Interested Parties

Todd Lantor and I would like to take this opportunity to provide you with an overview of some interesting developments that have come to our attention since the last Forum held on May 18th, 1999.

The Lucent "no gain" vocoder solution has been widely accepted by TR45.5, the CDMA air-interface standards group. The "no gain" solution draft standards document has recently been prepared for ballot. Assuming a "clear" ballot response, the industry may have a CDMA TTY standard as early 4Q99. Likewise, TR45.3, the TDMA air-interface standards group is actively pursing the same course as the CDMA group. The Nokia variation, presented to the Forum during the May meeting is being reviewed and considered. The group plans to complete its deliberation quickly and move toward the final stages by preparing a draft document for ballot.

Ericsson has provided the co-chairs with a copy of a document that proposes an alternative approach to the Lucent "no gain" vocoder solution. In the interest of time, and to take advantage of the TR45.3 meeting cycle, Ericsson thought it prudent to submit the alternative approach directly to the TDMA working group. Although it is being discussed at standards, Ericsson will present this vocoder alternative at the upcoming September TTY Forum.

Concurrently, we are preparing a draft "TTY Forum Status Report" for the FCC. The report, as a minimum, will contain the following sections:

- Updated Work Plan
- TTY testing completed to date
- A Technical Standards Update
    - Voice Based Approach
    - Data Approach
- Comments and Recommendations

Todd and I plan on getting a draft of this report to the TTY Forum Steering Committee for their review and approval before the next TTY Forum: The Steering Committee is comprised of: Toni Dunne, Texas 9-1-1; Billy Ragsdale, Bell South; Claude Stout, TDI; Norm Williams, Gallaudet UN; Jeff Crollick, TIA; John Melcher, NENA.

Next Meeting: We are currently making arrangements for the **September 9, 1999** TTY Forum and will get the meeting logistics out separately.

The meeting will be in the **Washington DC** area but WILL NOT be at Gallaudet Univ. Their calendar cannot support us. The meeting will start at **9:00 AM** and adjourn at 5:00 PM. Please do not make travel arrangements leaving the DC area before 6:30 PM. Now that we have reduced the meetings to one day, I see this Forum's agenda as being quite full.

Thank you all and have a very cool and pleasant summer. See you September!

Appendix J

Technical Standards Reference

ID	Description
TIA/EIA 825	FSK
TIA/EIA TSB-121	"2.5 mm AUDIO INTERFACE FOR MOBILE WIRELESS HANDSETS - TEXT TELEPHONES (TTY)"
TIA/EIA-IS-823 (PN-4614)	TR 45.3 5.3 TDMA TTY Solution- 410 vocoder
TIA/EIA-IS-840 (PN-4721)	TR 45.3 5.3 TDMA TTY Min Performance.
TIA/EIA/IS-789-A:	Electrical Specification for the Portable Phone to Vehicle
IS-733-1, IS-127-2	CDMA Vocoder Standards - high rate
IS-707-A-2	CDMA Data (V.18) Standard
TIA/EIA-136-270-B	TDMA Third Generation Wireless – Mobile Stations Minimum Performance
TIA/EIA-136-280-B	TDMA Third Generation Wireless – Base Stations Minimum Performance
3GPP TR26.226	Cellular Text Telephone Modem Description
3GPP TR26.230	Cellular Text Telephone Modem Transmitter Code
3GPP TR26.231	Cellular Text Telephone Modem Minimum Performance Specifications

Timeline of Events in CDMA and TDMA standards

CDMA: TIA TR45.5.1.1
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August 2000: Lucent proposed bug fixes to the TTY/TDD addenda and proposed a TTY/TDD Minimum Performance Specification for CDMA.

November 2000: Nortel proposes to add a test vector to the Min Perf Spec in order to handle the hard handoff scenario. This scenario uncovers another bug in the code.