Draft Recommendation of the FCC Disability Advisory Committee
RTT-VRS Working Group
RTT Integration with Point-to Point Videophone Calls
(Deaf User to Deaf User or DeafBlind User to Deaf User)
Adopted: September 24, 2019

1. WHEREAS the Real-Time Text ("RTT") - Video Relay Services ("VRS") (RTT-VRS) Working Group has developed the enclosed use cases; and
2. WHEREAS ITU T.140 defines the character set - it just says to send one character at a time, this is the character for backspace, this is the character for next line, et cetera; and
3. WHEREAS RFC 4103 specifies how to send T.140 in Real Time Protocol on IP networks; and
4. WHEREAS RFC 4103 puts individual characters into packets - typically one or two characters in a packet at a time but it could be higher - and sends the packets using the real-time transport protocol (RTP); and
5. WHEREAS RFC 4103 specifies the payload type; and
6. WHEREAS RFC 4103 specifies the sequence number so that one knows what packets are in what order; and
7. WHEREAS RFC 4103 optionally specifies the characters-per-second (CPS) so that the maximum speed at which text characters are transmitted can be controlled; and
8. WHEREAS RFC 4103 specifies the time-stamp so that one can understand when the character was typed; and
9. WHEREAS RFC4103 specifies the "marker bit" that deals with long pauses; and
10. WHEREAS when one loses a small amount of audio packet or video packet, it does not affect overall intelligibility but with text packet, packet loss is problematic because it could change the meaning of a word and the meaning of the communication; and
11. WHEREAS RFC4103 requires the use of RFC2198 replication if redundancy is offered- each character is sent more than once in more than one packet so that even with a momentary packet loss, the characters will get through - to guard against packet loss; and
12. WHEREAS RFC4103 specifies RFC2733 forward error correction, which may be used to complement redundancy; and
13. WHEREAS implementations of RFC4103 know how many packets of characters were lost during periods of unrecoverable packet loss that overcomes redundancy; and
14. WHEREAS implementations of RFC4103 may display irretrievably lost characters with suitable replacement characters (such as the Unicode replacement mark�) to alert the user to missing text; and
15. WHEREAS even with redundancy, there are still occasions when characters are missing, which happens more frequently on networks with long periods of packet loss. In addition to redundancy, the use of Negative Acknowledgment

(NACK) would allow the sender of packets to store a few small packets for the purpose of retransmission; and

16. WHEREAS NACK through RTCP feedback is covered in [RFC 4585](#); and
17. WHEREAS such a call requires the other side to have RTT-capable equipment. Alternatively, RTT can be converted to "instant message" forms by buffering and passing on as a SIP message; and
18. WHEREAS users have to know the RTT functionality exists on their videophone for them to be able to benefit from it.
19. WHEREAS currently there are no technical standards to reference for different modes of RTT to facilitate turn taking and other options that would better support refreshable Braille displays; and
20. WHEREAS it would benefit DeafBlind users to set RTT, when available, as a default feature to be activated when the point-to-point call is established; and
21. WHEREAS DeafBlind users need an alert that the other side has RTT and, similarly, the other side needs an alert informing them of the need to respond in RTT; and
22. WHEREAS there is a need for customization of size, color, contrast, et cetera on mobile phones and in VRS apps, to ensure access for DeafBlind users; and
23. WHEREAS the SOS (Start of Text)/ST (Stop Text) functionality in T.140, as a coding extension of T.140 as specified in Section 8.7 Application Control Function, could be used to send specialized codes to indicate the need for "GA" at the end of each transmission.

NOW, THEREFORE, IT IS-

1. RECOMMENDED that the Federal Communications Commission ("Commission") initiate a rulemaking to incorporate RTT specifications for point-to-point calls; and
2. RECOMMENDED further, ITU T.140 serve as the base with IETF RFC 4103 on top of that base as well as RFC 4585, or any set of successor standards; and
3. RECOMMENDED further, the Commission consider the need for RTT-capable videophone equipment and software; and
4. RECOMMENDED further, the rulemaking should reference any future technical standards that would better support refreshable Braille displays and urge development of such standards; and
5. RECOMMENDED further, the VRS providers collaborate on agreed-upon specialized codes for the "GA" functionality; and
6. RECOMMENDED further, the rulemaking should reference user customization settings; and
7. RECOMMENDED further, the rulemaking should reference the Disability Advisory Committee (DAC)'s December 6, 2016 recommendations on videomail-to-text services; and
8. RECOMMENDED further, the Commission consider efforts to educate consumers regarding RTT functionalities; and

9. RECOMMENDED further, the Commission provide an outreach and consumer education program particularly for DeafBlind users in order to encourage consumer utilization.

Appendix A:

Use Cases

(for informational purposes)

Introduction

This document lays out use cases for RTT calls over VRS. Some of these loosely draw on use cases written up for the previous DAC Tech Transitions Group as part of the work on wireless RTT and refreshable Braille displays. Bryen Yunashko, who is DeafBlind, also was consulted in the drafting of this document and has provided some input.

The use cases for RTT over VRS fall into three categories:

(1) Point to point calls with two VRS endpoints, no VRS interpreter involved – **cases 1-2**

(2) Relay calls from/to VRS to/from a hearing endpoint with VRS interpreter involvement**– cases 3-7**

(3) NG9-1-1 calls**– case 8**

Note: There are also potential use cases involving chained relay service invocation, such as a sighted VRS call to a TTY/RTT relay service to a DeafBlind user, or a sighted VRS call to IP-CTS to a DeafBlind IP-CTS user. These are not covered in this document.

How to read a use case

Use cases describe **what** the user experiences, not how this is or should be implemented in technology. To this end, use cases are kept technology-neutral to the greatest extent possible, and specifically do not make assumptions about the respective responsibilities of the VRS endpoints, VRS backend, wireless carriers, wireless handsets, other phone endpoints, screen readers, Braille drivers, and refreshable Braille displays.

Each use case follows a common pattern. The short description section states what the interaction is all about. The actors section states who is present in a call, and what type of disability they have, if any, and what their preferred input/output methods are. The pre-conditions state what, at a minimum, needs to be true before a call can succeed, and what user settings and preferences are applicable. The post-condition states what the expected outcome is. The normal flow explains the most typical call flow scenario for the given use case, step by step. The alternate flow explains what must be changed if there is a slight modification to the use case that, overall, does not materially change the nature of the conversation (for example, if one person mixes voice and RTT). Exceptions describe what happens if the call cannot be completed successfully.

1. Point to point call between two VRS endpoints with RTT involvement, and DeafBlind involvement

Short Description

This use case addresses RTT communication between two VRS users, one of whom is DeafBlind and uses a screen magnifier or refreshable Braille display to read RTT instead of receiving ASL.

This use case also is shown in this video: https://youtu.be/AIATWpjtEUA

Actors

Alice is a DeafBlind person using ASL to express herself, and using a refreshable Braille display to receive information.

Bob is a sighted ASL user.

Pre-Conditions

Both users have VRS videophones (VPs) that support interoperable RTT according to the SIP interoperability profile.

Both users are registered with a VRS provider that supports interoperable RTT according to the SIP interoperability profile.

Alice has her refreshable Braille display paired with her VP.

Post Conditions

The users have completed a call where they used their VPs' RTT functionality, intermixed with ASL, to communicate with each other.

Normal Flow

1. Alice uses her refreshable Braille display to dial Bob's 10-digit VP number.

2. Bob answers the call on his VP.

3. Bob recognizes that Alice is DeafBlind and prefers him to type to her using RTT.

4. Bob pulls up the RTT text entry field on his VP, and types RTT to answer the call: *Hello GA.* His VP sends the typed text in real time to Alice.

5. Alice's VP receives Bob's RTT.

6. Alice's refreshable Braille displays Bob's text.

7. When Alice encounters the *GA* from Bob, she starts signing back to Bob in ASL.

8. Bob's VP shows Alice signing.

9. When Bob sees that Alice has finished her turn, he starts typing back. Alice and Bob continue taking turns until one or both wish to end the call.

10. Alice and/or Bob hang up.

Alternative Flows

Alternative Flow #1

Bob makes a phone call to Alice.

Step 1 changes as follows:

Bob uses his VP's dialer to call Alice's 10-digit number.

Step 2 changes as follows:

Alice answers the call and signs to Bob.

Alternative Flow #2

Alice uses RTT intermixed with ASL, for instance to transmit an address or a confirmation number.

Step 7 changes as follows:

When Alice encounters the *GA* from Bob, she indicates in ASL that she will type some information. She uses her refreshable Braille display or her keyboard to type.

Step 8 changes as follows:

Bob's VP displays Alice's RTT overlaid on or alongside Alice's video.

Alternative Flow #3

Alice has low vision, and sometimes needs to fall back to a high-contrast magnified text display to understand Bob.

Step 6 changes as follows:

Alice uses her screen magnifier and high contrast display to read Bob's text.

Step 9 changes as follows:

Bob intermixes ASL and typing. If he realizes that Alice has trouble following his signing, he types his turn using RTT.

Exceptions

Bob is unable or unwilling to accept an RTT call.

Step 2 changes as follows:

Bob rejects the call or hangs up. Alice receives a rejection/hang up notification on her refreshable Braille display.

2. Point to point call between two VRS endpoints with RTT involvement, and involvement of a person with a mobility impairment

Short Description

This use case addresses RTT communication between two VRS users, one of whom has a mobility impairment that impacts the clarity of their ASL.

Actors

Alice is a sighted ASL user.

Bob is a sighted ASL user with a mobility impairment that affects the clarity of his signing.

Pre-Conditions

Both users have VRS videophones (VPs) that support interoperable RTT according to the SIP interoperability profile.

Both users are registered with a VRS provider that supports interoperable RTT according to the SIP interoperability profile.

Post Conditions

The users have completed a call where they used their VPs' RTT functionality, intermixed with ASL, to communicate with each other.

Normal Flow

1. Alice uses her VP's dialer to call Bob's 10-digit number.

2. Bob answers the call on his VP.

3. Bob signs *Hello how are you* to Alice.

4. Alice indicates in ASL that she has trouble understanding Bob's signing.

5. Bob pulls up the RTT text entry field on his VP, and types RTT: *Hello how are you?* His VP sends the typed text in real time to Alice.

6. Alice's VP receives Bob's RTT.

7. Alice's VP displays Bob's RTT overlaid on or alongside Bob's video.

8. When Bob indicates his end of turn (via typing or ASL), Alice starts signing back to Bob in ASL.

9. Bob's VP shows Alice signing.

10. When Bob sees that Alice has finished her turn, he starts signing or typing back. Alice and Bob continue taking turns until one or both wish to end the call.

11. Alice and/or Bob hang up.

Alternative Flows

Alternative Flow #1

Bob makes a phone call to Alice.

Step 1 changes as follows:

Bob uses his VP's dialer to call Alice's 10-digit number.

Step 2 changes as follows:

Alice answers the call and signs to Bob.

Exceptions

Alice or Bob are unable or unwilling to accept an RTT call.

Step 2 changes as follows:

Bob rejects the call or hangs up.

3. DeafBlind VRS call to PSTN/VoIP/Wireless endpoint with no TTY/RTT capabilities

Short Description

This use case addresses a DeafBlind VRS user calling a hearing person through a VRS interpreter. The VRS supports typing via RTT, but the hearing person's phone does not.

Actors

Alice is a DeafBlind person using a refreshable Braille display.

Bob is a hearing person using a voice phone.

Carol is a VRS interpreter.

Pre-Conditions

Alice has a VRS videophone (VP) that supports interoperable RTT according to the SIP interoperability profile.

Alice is registered with a VRS provider that supports interoperable RTT according to the SIP interoperability profile.

Alice's VRS provider offers interpreters who type back in RTT in lieu of signing ASL.

Alice has her refreshable Braille display paired with her VP.

Post Conditions

The users have completed a call where Alice and Bob completed a call through Carol as an intermediary, and each used their preferred mode of communication.

Normal Flow

1. Alice uses her refreshable Braille display to dial Bob's 10-digit number.
2. The call gets routed into the queue for Alice's VRS provider.
3. Carol answers the call.
4. Carol types to Alice in RTT that she will connect the call to Bob now.
5. Carol places a voice call to Bob using the 10-digit number that Alice provided in Step 1.
6. Bob answers the call as voice call.
7. Bob says *Hello*.
8. Carol types *Hello GA* using RTT.
9. Alice's VP receives Carol's RTT.
10. Alice's refreshable Braille displays Carol's text.

11. When Alice encounters the *GA* from Carol, she starts signing back to Carol in ASL.

12. Carol voices Alice's ASL to Bob.

13. Bob listens to Carol speaking.

14. When Alice has finished her turn, as evidenced through Carol's voicing of her ASL, Bob responds using his voice.

15. Carol types what Bob says in RTT.

16. Alice and Bob continue the conversation until one or both wish to end the call.

17. Alice and/or Bob hang up.

4. User with a mobility impairment makes VRS call to PSTN/VoIP/Wireless endpoint with no TTY/RTT capabilities

Short Description

This use case addresses a VRS user with a mobility impairment calling a hearing person through a VRS interpreter, where the interpreter sometimes struggles with understanding the user's ASL. The VRS supports typing via RTT, but the hearing person's phone does not.

Actors

Alice is a person with a mobility impairment, with sometimes unclear ASL.

Bob is a hearing person using a voice phone.

Carol is a VRS interpreter.

Pre-Conditions

Alice has a VRS videophone (VP) that supports interoperable RTT according to the SIP interoperability profile.

Alice is registered with a VRS provider that supports interoperable RTT according to the SIP interoperability profile.

Post Conditions

The users have completed a call where Alice and Bob completed a call through Carol as an intermediary, and each used their preferred mode of communication.

Normal Flow

1. Alice uses her uses her VP's dialer to call Bob's 10-digit number.

2. The call gets routed into the queue for Alice's VRS provider.

3. Carol answers the call.

4. Carol signs to Alice that she will connect the call to Bob now.

5. Carol places a voice call to Bob using the 10-digit number that Alice provided in Step 1.

6. Bob answers the call as voice call.

7. Bob says *Hello*.

8. Carol signs *Hello* to Alice in ASL.

9. Alice sees Carols' signing on her VP.

10. Alice signs *Hello how are you*.

11. Carol indicates in ASL that she has trouble understanding Alice's signing.

12. Alice pulls up the RTT text entry field on her VP, and types RTT: *Hello how are you?* Her VP sends the typed text in real time to Carol.

13. Carol's station receives and displays Alice's RTT.

14. Carol reads out the received RTT to Bob using her voice.

15. When Alice indicates her end of turn (via typing or ASL), Carol indicates such to Bob.

16. Bob responds using his voice

17. Carol signs what Bob said to Alice in ASL.

18. Alice and Bob continue taking turns until one or both wish to end the call.

19. Alice and/or Bob hang up.

5. DeafBlind VRS call to PSTN/VoIP/Wireless endpoint with RTT capabilities

Short Description

This use case addresses a DeafBlind VRS user calling a hearing person through a VRS interpreter. The VRS supports typing via RTT, and the hearing person's phone also is capable of transmitting and receiving RTT.

Actors

Alice is a DeafBlind person using a refreshable Braille display.

Bob is a hearing person using a voice phone with RTT capabilities.

Carol is a VRS interpreter.

Pre-Conditions

Alice has a VRS videophone (VP) that supports interoperable RTT according to the SIP interoperability profile.

Alice is registered with a VRS provider that supports interoperable RTT according to the SIP interoperability profile.

Alice's VRS provider offers interpreters who type back in RTT in lieu of signing ASL.

Alice's VRS provider has both voice and RTT interconnected and interoperable with Bob's (wireless) carrier.

Alice has her refreshable Braille display paired with her VP.

Bob has a phone plan that supports RTT.

Bob has a phone that supports RTT.

Post Conditions

The users have completed a call where Alice and Bob completed a call through Carol as an intermediary, and Bob and Alice used RTT analogous to hearing carry over.

Normal Flow

1. Alice uses her refreshable Braille display to dial Bob's 10-digit number.
2. The call gets routed into the queue for Alice's VRS provider.
3. Carol answers the call.
4. Alice indicates to Carol that she would like RTT connected directly (Text Carry Over - analogous to asking for Hearing Carry Over).
5. Carol types to Alice in RTT that she will connect the call to Bob now.
6. Carol places a voice+RTT call to Bob using the 10-digit number that Alice provided in Step 1.
7. Bob answers the call using RTT.
8. Bob types *Hello GA*.
9. Alice's VP receives Bob's RTT.
10. Alice's refreshable Braille displays Bob's text.
11. Carol is able to read Bob's text to provide her with context.
12. When Alice encounters the *GA* from Bob, she starts signing back to Carol in ASL.
13. Carol voices Alice's ASL to Bob.
14. Bob listens to Carol speaking.
15. When Alice has finished her turn, as evidenced through Carol's voicing of her ASL, Bob responds using RTT.
16. Alice receives what Bob says in RTT.
17. Alice and Bob continue the conversation until one or both wish to end the call.
18. Alice and/or Bob hang up.

Alternative Flows

Alternative Flow #1

Bob mixes voice and RTT.

Step 14 changes as follows:

When Alice has finished her turn, as evidenced through Carol's voicing of her ASL, Bob responds intermixing voice and typing. His RTT typing is directly transmitted to Alice. If Bob uses his voice, Carol types what Bob says in RTT to Alice.

6. VRS call to PSTN/VoIP/Wireless endpoint with RTT and Speech to Text capabilities

Short Description

This use case addresses a VRS user calling a hearing person through a VRS interpreter. The VRS supports typing via RTT, and the hearing person's phone also is capable of transmitting and receiving RTT. The hearing person uses voice, but supplements it by RTT for hard-to-pronounce terms.

Actors

Alice is a VRS user proficient in both ASL and written English

Bob is a hearing person using a voice phone with RTT capabilities.

Carol is a VRS interpreter.

Pre-Conditions

Alice has a VRS videophone (VP) that supports interoperable RTT according to the SIP interoperability profile.

Alice is registered with a VRS provider that supports interoperable RTT according to the SIP interoperability profile.

Alice's VRS provider has both voice and RTT interconnected and interoperable with Bob's (wireless) carrier.

Bob has a phone plan that supports RTT.

Bob has a phone that supports RTT.

Post Conditions

The users have completed a call where Alice and Bob completed a call through Carol as an intermediary, and Bob and Alice used RTT analogous to hearing carry over, alongside with voice to the interpreters.

Normal Flow

1. Alice uses her VP to dial Bob's 10-digit number.

2. The call gets routed into the queue for Alice's VRS provider.

3. Carol answers the call.

4. Alice indicates to Carol that she would like RTT connected directly (Text Carry Over - analogous to asking for Hearing Carry Over).

5. Carol signs to Alice that she will connect the call to Bob now.

6. Carol places a voice+RTT call to Bob using the 10-digit number that Alice provided in Step 1.

7. Bob answers the call using voice+RTT.

8. Bob speaks *Hello, this is agent XYZ/0003A-007*.

9. Carol signs to Alice what Bob spoke, but indicates that she missed some digits.

10. Alice signs back to Carol to repeat the agent designation.

11. Carol voices Alice's request to Bob.

12. Bob types *agent XYZ/0003A-007* using his phone's RTT capabilities.

13. Alice's VP receives Bob's RTT.

14. Alice's VPs displays Bob's text alongside the video of Carol, or overlaid.

15. Alice starts signing back to Carol in ASL.

16. Carol voices Alice's ASL to Bob.

17. Bob listens to Carol speaking.

18. When Alice has finished her turn, as evidenced through Carol's voicing of her ASL, Bob responds using spoken English, optionally intermixed with RTT that gets transmitted to Alice's VP.

19. Alice and Bob continue the conversation until one or both wish to end the call.

20. Alice and/or Bob hang up.

Alternative Flows

Alternative Flow #1

Alice has to provide a hard-to-fingerspell confirmation number.

Step 15 changes as follows:

Alice uses her VP's RTT input capabilities to transmit the confirmation number directly to Bob's phone.

Step 16 changes as follows:

Bob receives Alice's RTT on his phone.

Step 17 changes as follows:

Bob reads Alice's RTT.

7. VRS call to PSTN/VoIP/Wireless endpoint with RTT and Speech to Text capabilities

Short Description

This use case addresses a VRS user calling a hearing person through a VRS interpreter. The VRS supports typing via RTT, and the hearing person's phone also is capable of transmitting and receiving RTT. The hearing person uses speech to text to transmit what they are saying, as a more efficient alternative to typing, without relying on English to ASL interpretation.

Actors

Alice is a VRS user proficient in both ASL and written English

Bob is a hearing person using a voice phone with RTT capabilities.

Carol is a VRS interpreter.

Pre-Conditions

Alice has a VRS videophone (VP) that supports interoperable RTT according to the SIP interoperability profile.

Alice is registered with a VRS provider that supports interoperable RTT according to the SIP interoperability profile.

Alice's VRS provider has both voice and RTT interconnected and interoperable with Bob's (wireless) carrier.

Bob has a phone plan that supports RTT.

Bob has a phone that supports RTT.

Bob has a phone that supports speech to text as an input method.

Post Conditions

The users have completed a call where Alice and Bob completed a call through Carol as an intermediary, and Bob and Alice used RTT analogous to hearing carry over, with Bob's speech getting converted to text.

Normal Flow

1. Alice uses her VP to dial Bob's 10-digit number.
2. The call gets routed into the queue for Alice's VRS provider.

3. Carol answers the call.

4. Alice indicates to Carol that she would like RTT connected directly (Text Carry Over - analogous to asking for Hearing Carry Over).

5. Carol signs to Alice that she will connect the call to Bob now.

6. Carol places a voice+RTT call to Bob using the 10-digit number that Alice provided in Step 1.

7. Bob answers the call using voice+RTT.

8. Bob speaks *Hello GA*.

9. Bob's speech to text engine converts the spoken English to RTT, and transmits *Hello GA* as RTT, and simultaneously displays the transmitted RTT on his phone screen.

10. Alice's VP receives Bob's RTT.

11. Alice's VPs displays Bob's text alongside the video of Carol, or overlaid.

12. When Alice encounters the *GA* from Bob, she starts signing back to Carol in ASL.

13. Carol voices Alice's ASL to Bob.

14. Bob listens to Carol speaking.

15. When Alice has finished her turn, as evidenced through Carol's voicing of her ASL, Bob responds using spoken English, converted to RTT through speech to text.

16. If Bob spots a mistake in the transmitted RTT that he reads on his phone screen, he speaks or types a correction, transmitted as RTT. This correction is communicated in plain English; e.g. Bob types or says:"Correction: I meant to say apples, not oranges."

17. Alice receives what Bob says in RTT.

18. Alice and Bob continue the conversation until one or both wish to end the call.

19. Alice and/or Bob hang up.

Alternative Flows

Alternative Flow #1

Alice is a DeafBlind person who uses a refreshable Braille display.

Step 1 changes as follows:

Alice uses her refreshable Braille display to dial Bob's 10-digit number.

Step 5 changes as follows:

Carol types to Alice in RTT that she will connect the call to Bob now.

8. NG9-1-1 call complying with NENA i3, EAAC recommendations, and EAAC MCLS report

See this video for the general idea:

https://amara.org/mn/videos/zgBRiI8mfyH1/info/reach112-demo-movie/

EAAC homepage: https://www.fcc.gov/general/emergency-access-advisory-committee-eaac

EAAC report: https://docs.fcc.gov/public/attachments/DOC-312161A1.doc

EAAC MCLS report: https://docs.fcc.gov/public/attachments/DOC-319394A1.doc