Real-Time Conversations: From TTY to Real-Time Text (RTT)

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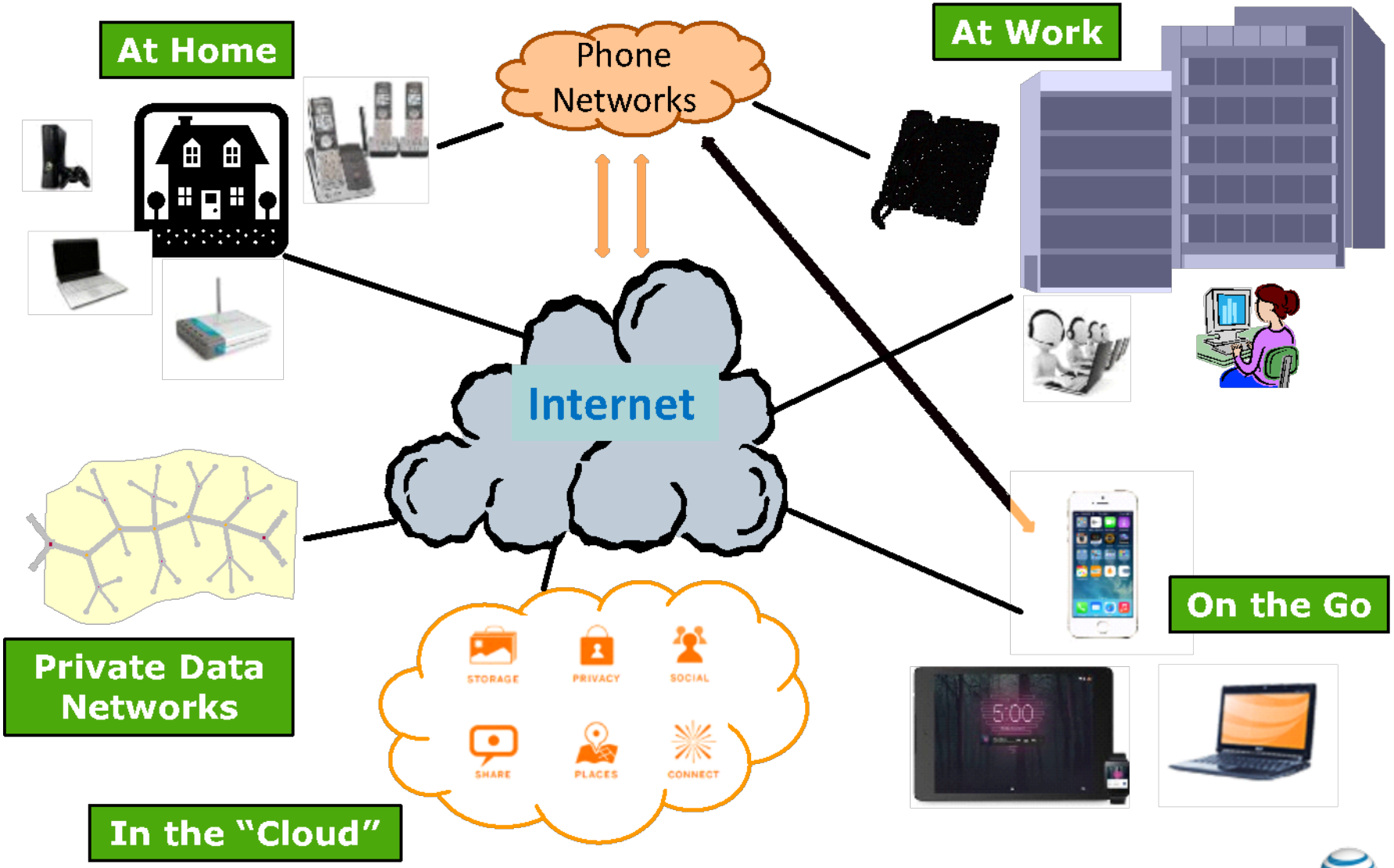
Today's World of Information & Communications Technology



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Where We Came From: “Plain-Old Telephone Service” (POTS)

- Even modern cordless phones still make and receive calls through circuit-switched technology that works in much the same way as it did decades ago

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Taking Stock of the Situation

- POTS has been the gold standard for personal communications
- Over the past 20 years, fundamental changes have occurred in the technology used to communicate…
- Resulting in dramatic changes in how and where we communicate

- **But the underlying need to communicate in real-time among individuals has not changed**

- For the first 90 years of the telephone's life, voice was the only way to communicate
- In the mid-1960s, the then-old teletype machine was adapted to create the TeleTypewriter (TTY)

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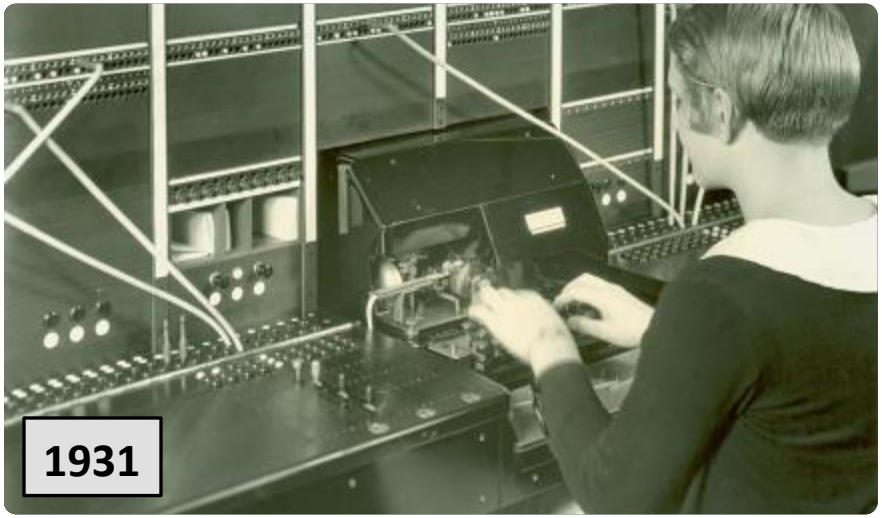
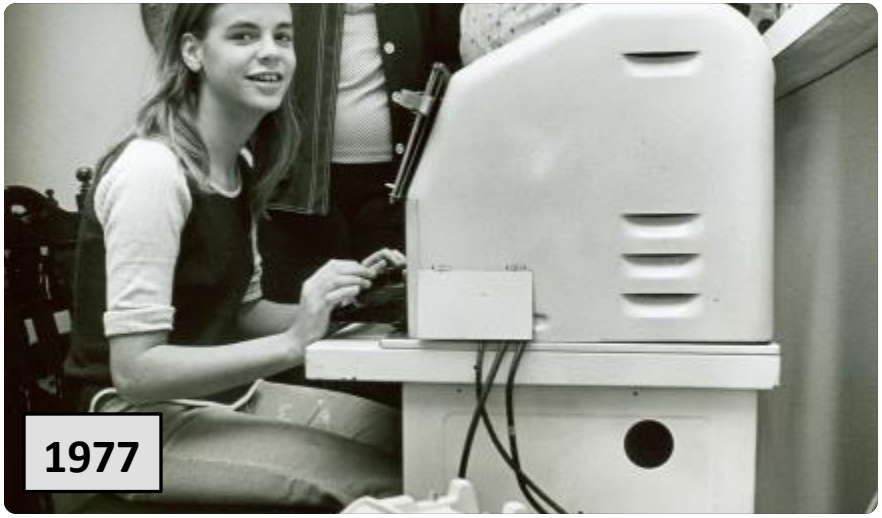
From Teletype Machine to a “Modern” TTY





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What is TTY?

- TTY: TeleTYpewriter; interactive text-based communications through the transmission of frequency-shift-keying (FSK) audio tones across a telephone network (landline or wireless)

- Allows access to the telephone network by individuals with hearing and speech disabilities

❖ In essence, provides non-voice access to voice service

- First developed in the mid-1960s
- Fewer than 18 in 1966, grew to 180K in the 1980s
- 2013 estimate of fewer than 100K in the US

TTY device for POTS

(c)
International TDD Symbol

TTY device for Cell Phones

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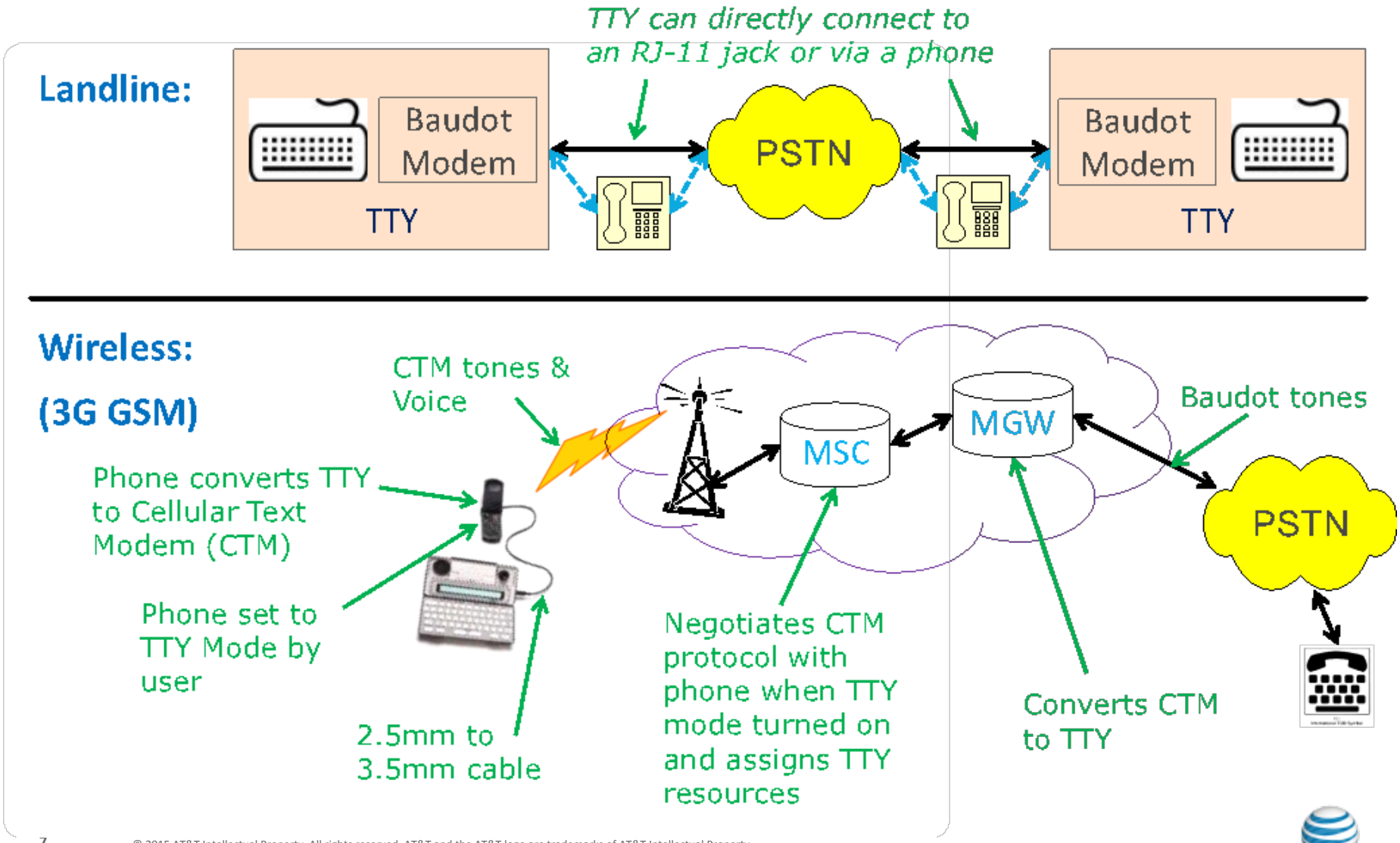
The Basics of a TTY Call



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Example TTY Telephone Network Announcement

- <special information tones>
- TTY: “HD”
- “We’re sorry, all circuits are busy now. Will you please try your call again later.”
- TTY: <repeats voiced message>

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TTY is …

Benefits:

- Allows use of the telephone network by individuals with hearing and speech disabilities
- Interoperable with any other telephone customer
- Text-based and interactive
- Real-time, letter-by-letter, instantaneous transmission
- Intermixed with the voice channel (to enable Voice Carry Over [VCO] and Hearing Carry Over [HCO])

Drawbacks:

- Slow (45.45 baud)
- Turn-based / half-duplex
- Resource intensive (64 KB/s)
- Dedicated network resources needed for wireless
- Requires separate assistive technology (AT) not commonly used by telephone customers without disabilities
- Does not work well with some types of access technologies

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TTY is not …

- Instant Messaging (IM)
- Email
- Over-The-Top (OTT) messaging (e.g., WhatsApp ©, Kik ©, etc.)
- Video conferencing
- Text messaging (SMS)

➢ These are all services that can – and are – being used to communicate instead of using a TTY on a voice call

➢ However, they are not services that are part of voice calling and thus do not fulfill the need of providing an accessibility solution for voice communications

  - Example: 9-1-1 emergency call centers universally accept voice calls and are required to have equipment to accept TTY users on these calls (Text-to-911 is just beginning and technically distinct from voice)

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TTY Meets the Internet (Protocol)

- Moving to new technologies is never easy (e.g., Standard to HDTV)
- TTY has been no different (e.g., 1G to 2G wireless)
- As long ago as 2004, there was a CSUN presentation about how TTY can work on Voice over IP (VoIP) networks
- TTY over IP can work, but there are some technical hurdles…
- From the FCC's Emergency Access TTY Transition report (2013):
  - Packet loss
  - Echo cancellation
  - Voice-optimized compression techniques

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Hurdles for TTY over IP Networks

Packet Loss

- Performance requirement of **1% Total Character Error Rate** (TCER) for TTY characters is generally used to measure acceptable network performance
- To meet this on IP networks, that usually means a theoretical maximum of **0.125% packet loss** – far lower than what's needed just for voice

Echo cancellation

- Sounds that appear to be duplicative or repetitive are removed, assuming an echo or line noise
- Since TTYs just use 1400 and 1800 Hz tones, TTY character strings can appear to be echo or unvarying noise

Voice-optimized compression techniques

- To make efficient use of bandwidth, the audio stream is compressed by removing bits of information that are not noticeable to the human ear
- Algorithms tend to distort or remove non-voice audio (e.g., TTY tones)

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General Experience with TTYs on IP Networks

TTYs tend to work on:

- Wired internet connections that use the G.711 codec (no compression) and Quality-of-Service (QoS) enabled to give priority to voice packets
- Wireless networks that modify their speech codecs and/or transcode to Cellular Text Modem (CTM)

TTYs tend to have difficulty with:

- VoIP services that use G.729 and other “lossy” codecs
- Over-the-Top (OTT) voice services that don’t have QoS and cannot meet the maximum packet loss requirement
- Wireless networks that are inherently noisier than wired networks, causing data loss

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Solutions for TTY over IP Networks

Robust Engineering

- VoIP networks have been and are being built with lossless codecs, proper echo cancellers, and quality-of-service (QoS) for voice packets
  - In some cases this is straightforward engineering that supports a good customer experience
  - In other cases, the required engineering can be difficult or mostly impractical to implement

Real-Time Text (RTT) or Global Text Telephone (GTT)

- Text transmitted instantly while it is being typed. The recipient can immediately read the sender's text as it is written, without waiting.
- **IP-based alternative for IP networks**:
  - Instead of using an in-voice-band text solution, text is kept as text and transmitted over the data network in along with the voice call

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Real-Time Text (RTT) is …

Benefits:

- IP / data, not voice
- Lightweight (~2 KB/s)
- Far less sensitive to network conditions, compared to TTY
- Standards-based, converged solution (i.e., SIP)
- Conversational, real-time
- Allows for simultaneous voice and text for VCO & HCO
- Allows realization of full benefits of VoIP networks

Drawbacks:

- Limited adoption to date (mostly Northern Europe)
- Not directly interoperable with legacy TTYs (interworking function needed)

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RTT is Where We're Headed

- Numerous telephony standardization efforts have all pointed toward RTT:
  - FCC's Emergency Access Advisory Committee (EAAC)
  - National Emergency Number Association (NENA) – NextGen 9-1-1
  - GSMA / 3GPP (i.e., wireless industry)
  - U. S Access Board's Information and Communication Technology (ICT) Standards and Guidelines (2015 NPRM)
- RTT can be composed of many different types of technology, but commonly comprises:
  - Session Initiation Protocol (SIP) VoIP networks
  - IETF RFC 4103 for transport
  - ITU T.140 for text encoding and presentation

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Comparison of TTY and RTT

Characteristic	TTY	RTT
Real-time, character-by-character	Yes	Yes
Full duplex	No	Yes
Allows VCO / HCO	Yes	Yes
Resilient to IP network conditions	No	Yes
Efficient use of network resources	No	Yes
Standards-based	Yes	Yes
Widely implemented	Yes	No
Internal keyboard	No	Yes
Support for hearing/speech disabilities	Assistive Technology	**Accessible Technology**

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Path toward Widely Adopted Real-Time Text

Are we there yet? Not really…

- Much work needs to be done to build a robust, accessible service that also does not leave anyone behind

Changes for RTT Implementation:

- Network changes to support RTT
- Interoperability between RTT implementations (standards-based)
- Software changes for IP phones and wireless handsets

Changes to ensure legacy TTY interworking

- Network gateways between IP and legacy networks
- Points of connection between legacy equipment and VoIP networks

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Final Thoughts

- TTY was a brilliant engineering solution to support the needs of people with disabilities
- But it was designed for a type of technology that is disappearing

- Real-Time Text (RTT) :
  - Is a more user-friendly technology
  - Takes advantage of newer network technologies
  - Builds accessibility into the service, not requiring separate equipment

- It could also open up possibilities for all users to interact over the "phone" in more creative and expressive ways because it will be built into phones, not via separate hardware
  - …and that is the essence of Universal Design

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Thank you.

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