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OTT – Challenges & Technical Evolution

An insight into technical architecture behind modern streaming platforms and challenges faced by ISPs due to massive increase is video traffic

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Today's Speaker

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Agenda

- **An overview of Video Delivery Networks**
  - Legacy Video Networks
  - Convergence of Video Networks over IP backbones
  - OTT Video Streaming technology stack
- **Impact of ever rising multimedia traffic for ISPs and VSPs**
  - Bandwidth congestions and service delivery for ISPs
  - Complicated & Power hungry datacentre Operations
  - QoE and QoS monitoring for Video Networks
- **Key Research Areas**
  - Efficient video codecs and transcoding mechanisms
  - Low latency video delivery networks
  - AI , Recommendation Engines and Marketing Avenues

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Video Delivery Networks – Overview

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Legacy Video Networks

- **Analog Video**
  - 80's technology
  - PAL / NTSC
  - VCRs / VTPs , Tape Recorders/Players
  - Composite Signals
- **Digital Video**
  - Moving Picture Expert Group (MPEG) founded in 1988
  - Digital Video Broadcast (DVB) project founded in 1993
  - DVB Focused on standardization of Digital Video Delivery over Terrestrial, Satellite & Cable Networks
  - MPEG Focused on formulation of Audio / Video Codecs, encoders/decoders across TX/RX segments

Limitations & Challenges :

- Content Encryption & Anti-piracy efforts
- No two-way service offering like VOD, Catchup are possible
- Very high cost of transmission media, be it space segment, RF spectrum or coaxial network

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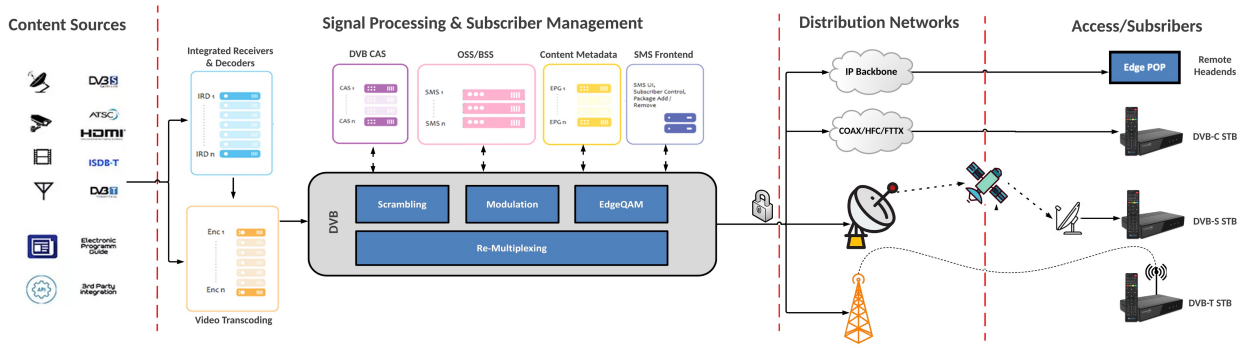
Legacy Video Networks

Digital Video Broadcasting (DVB) - Architecture



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Video Networks over IP

IPTV Overview

- Delivery of TV services over IP based access networks
- TS over Internet Protocol (TSoIP/MPEGTS over IP)
- Opened up avenues for non-linear, on-demand video delivery services for customers
- IPTV as a multicast service
- IPVoD as a unicast service using protocols e.g. RTSP
- **Limitations & Challenges**
  - Works on managed / closed loop networks
  - Proprietary technology stack such as media servers
  - Works on uncommon web protocols such as RTSP, RTMP which demands specific network policies
  - Sensitive to packet loss and delays with no support on server/client side to mitigate it

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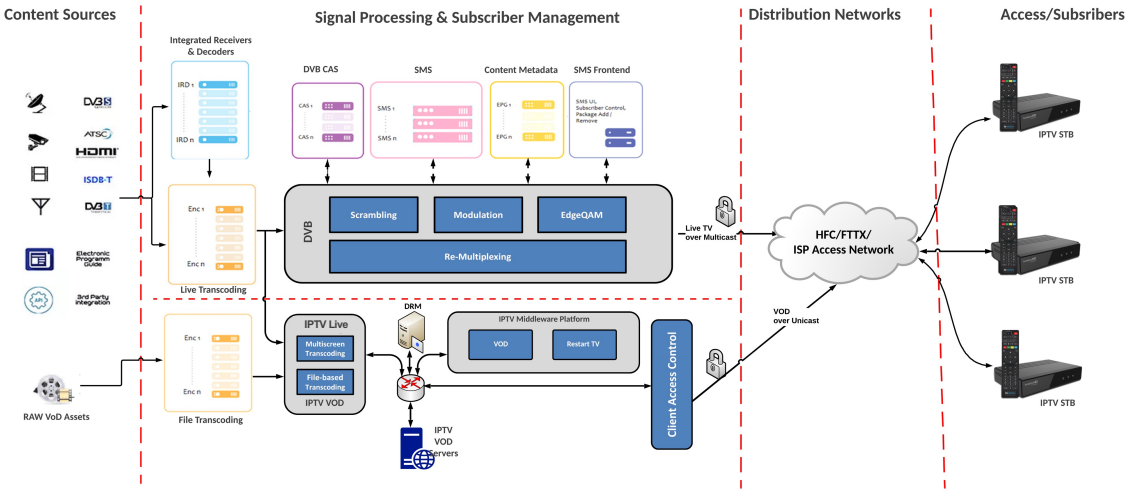
Video Networks over IP

IPTV System Architecture



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OTT Streaming Tech Stack

- **What is OTT Streaming ?**
  - Over-the-top (OTT) streaming is video delivery over Internet
  - Modern and latest mode of video content delivery
  - Works on common http protocol instead of proprietary or dedicated video protocols
  - Most common services are Netflix, YouTube, Amazon Prime, Foxtel, Stan etc.
- **How it's different from IPTV and What problem it solves ?**
  - Works on public internet so not a closed loop service
  - Better scalability and bigger footprint
  - No geographical limits as such
  - Better delivery mechanisms for enhanced QoS and QoE
  - Better business model and sales avenues due to technological advances

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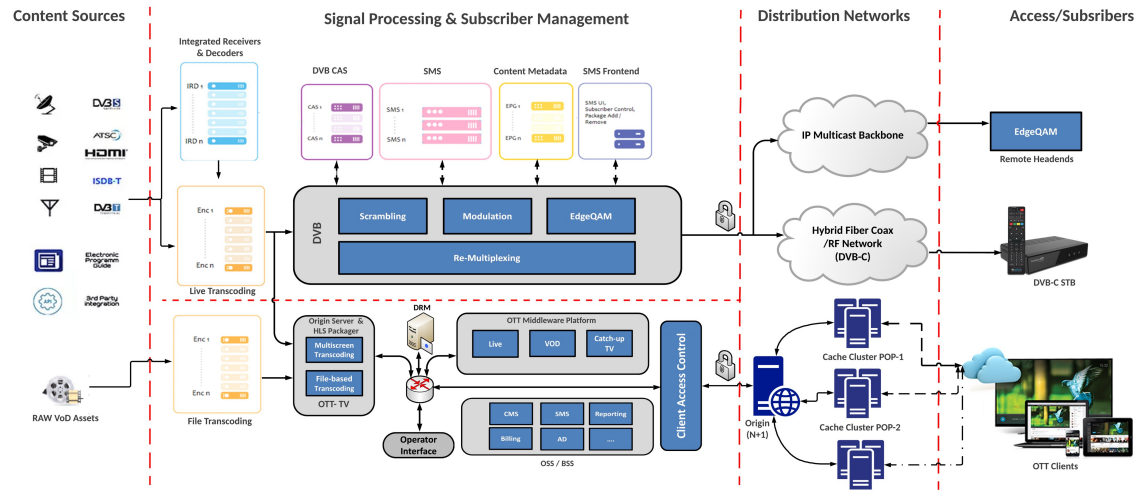
OTT Streaming Tech Stack

OTT Service System Architecture



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OTT Streaming Tech Stack

Key Component of an OTT Stack

- Video Transcoding
- Video Content Delivery Networks
- Middleware Platforms
- Digital Rights Management (DRM)

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OTT Streaming Tech Stack

What is Video Transcoding ?

"In the context of video - Transcoding refers to the process of compressing video files as much as possible at minimal quality loss to represent (and transfer) information by using less data"

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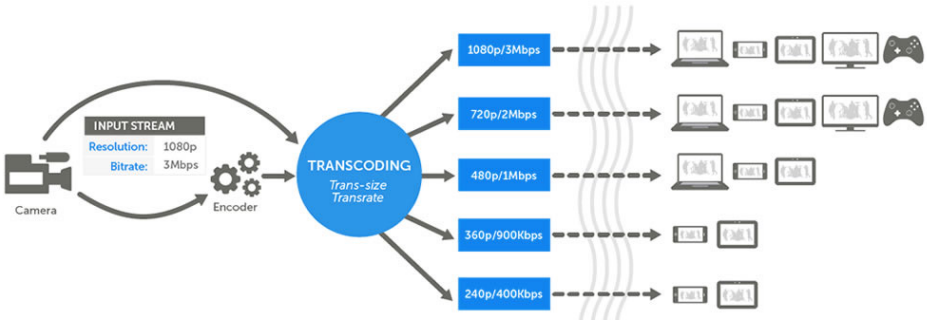
OTT Streaming Tech Stack

Why Transcoding ?

INPUT PROTOCOLS	INPUT CODECS		OUTPUT CODECS		OUTPUT PROTOCOLS
Adobe RTMP, RTSP/RTP, MPEG-TS, ICY (SHOUTcast/Icecast)	Video:	H.265/HEVC, H.264/AVC, VP9, VP8 MPEG4 Part 2, MPEG2	Video:	H.265/HEVC H.264/AVC, H.263 (v2), VP9	Apple HLS, Adobe HDS, MPEG-DASH, Microsoft Smooth Streaming, Adobe RTMP, RTSP/RTP, MPEG-TS
	Audio:	MP3, AAC, AAC-LC, HE-AAC+ v1 & v2, MPEG1 Part 1/2, Speex, G.711, Opus, Vorbis	Audio:	AAC, AAC-LC, HE-AAC+ v1 & v2, Opus, G.711	



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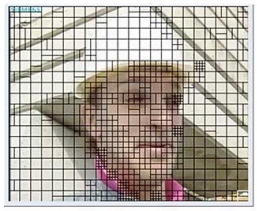
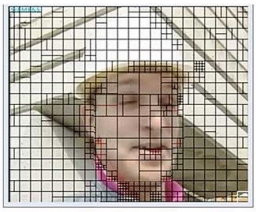
OTT Streaming Tech Stack

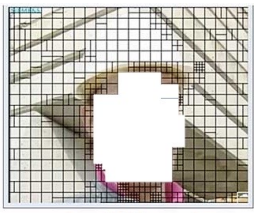
How Video Transcoding Works ?

- Almost all video codecs works on principle of motion compensation
- Treat video as series of single pictures called frames
- In plain English, H.26X, rather than updating the whole frame at every refresh, splits the screen into horizontal and vertical grids and only updates the grids with changes
- The transcoding process scraps redundant information intelligently which consequently saves the bandwidth required to carry information as well as storage space to store it
- The efficiency of compression while maintaining visual perception of transcoded video varies codec to codec as well on transcoding solution


Goldenframe


Data in frame 2


How frame 2 appears


Amount of data saved

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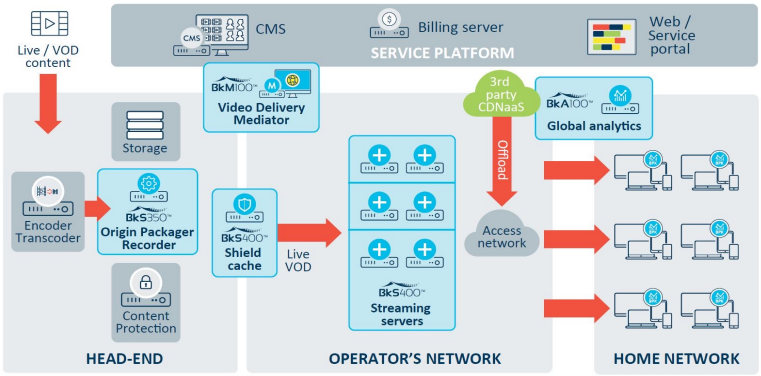
OTT Streaming Tech Stack

Video Content Delivery Networks

- Package Video Content into HLS / MPEG DASH / HDS
- Adaptive Bitrate (ABR) delivery
- Geo-fencing
- Playback URL protection
- Content Encryption Integration
- Analytics



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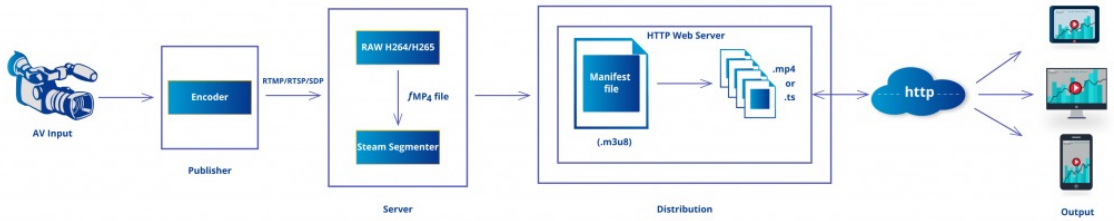
OTT Streaming Tech Stack

What is Packaging ?

- There are three components for ABR streaming protocol
  - Main manifest file (Playlist) referring to Child manifest files
  - Child manifest files (sub – playlist) being referred to video chunks
  - Segmented chunks of continuous video file / stream generally referred as *.ts or .mp4 chunks



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OTT Streaming Tech Stack

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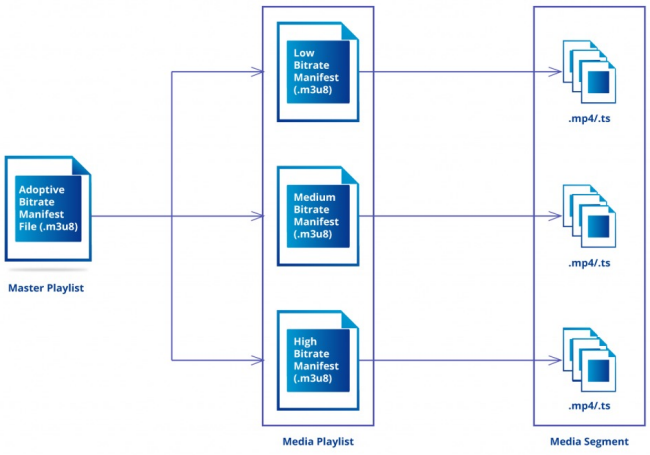

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OTT Streaming Tech Stack

What is ABR ?

- Adaptive Bitrate (ABR) is the ability of client device (player) to dynamically adjust the video quality based on
  - Available Bandwidth
  - Network Condition
  - User device performance
  - Subscription level
- Transcoder provides multiple output profile against a single input to packager (CDN)
- Packager is responsible for multiplexing multiple profiles of input source into single manifest file
- The player on the client side, opts for the best suitable profile as per its conditions from the manifest

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Impacts of rising video traffic on ISPs & VSPs

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Impacts of rising multimedia traffic

Global Internet traffic trends – May 2020

GLOBAL APPLICATION CATEGORY TOTAL TRAFFIC SHARE

1. VIDEO STREAMING: 2019: 55.44% 2020: 57.64% (+2.20%)
2. SOCIAL NETWORKING: 2019: 8.95% 2020: 10.73% (+1.78%)
3. WEB: 2019: 10.14% 2020: 8.05% (-2.09%)
4. MARKETPLACE: 2019: 5.90% 2020: 4.97% (-0.93%)
5. MESSAGING: 2019: 3.79% 2020: 4.94% (+1.15%)
6. FILE SHARING: 2019: 8.51% 2020: 4.64% (-3.87%)
7. GAMING: 2019: 2.20% 2020: 4.24% (+2.04%%)
8. VPN: 2.56% 2019: 2.46% 2020: (+0.10%)
9. CLOUD: 2019: 1.26% 2020: 1.83% (+0.57%)
10. AUDIO: 2019: 55.44% 2020: 0.39% (-0.39%)

GLOBAL APPLICATION TOTAL TRAFFIC SHARE

1. YOUTUBE: 2019: 8.69% 2020: 15.94% (+7.25%)
2. NETFLIX: 2019: 12.87% 2020: 11.42% (-1.45%)
3. HTTP: 2019: 3.61% 2020: 6.57% (-2.96%)
4. BITTORRENT: 2019: 7.75%% 2020: 5.23% (-2.52%)
5. FACEBOOK: 2019: 3.37% 2020: 3.68% (+0.37%)
6. HTTP MEDIA STREAM: 2019: 13.76% 2020: 3.64% (-10.12%)
7. GOOGLE: 2019: 1.23% 2020: 2.91% (+1.68%)
8. WORDPRESS: 2019: 0.10% 2020: 2.88% (+2.78%)
9. INSTAGRAM: 2019: 2.64% 2020: 2.72% (+0.08%)
10. FACEBOOK VIDEO: 2019: 2.46% 2020: 2.29% (+0.17%)

AMERICAS TOTAL TRAFFIC SHARE TOP 10

1. NETFLIX: 2019: 6.02% 2020: 19.11% (+13.09%)
2. YOUTUBE: 2019: 3.80% 2020: 14.43% (+10.63%)
3. HTTP MEDIA STREAM: 2019: 8.02% 2020: 6.21% (-1.81%)
4. PLAYSTATION D/L: 2019: 1.24% 2020: 3.99% (+2.75%)
5. XBOX LIVE D/L: 2019: 1.24% 2020: 3.71% (+2.47%)
6. AMAZON PRIME: 2019: 0.26% 2020: 2.89% (+2.63%)
7. HULU: 2019: 0.10% 2020: 2.85% (+2.75%)
8. INSTAGRAM: 2019: 0.86% 2020: 2.10% (+1.24%)
9. FACEBOOK: 2019: 1.11% 2020: 2.02% (+0.91%)
10. DISNEY+: 2019: 0.00% 2020: 2.00% (+2.00%)

APAC TOTAL TRAFFIC SHARE TOP 10

1. YOUTUBE: 2019: 5.78% 2020: 18.30% (+12.52%)
2. NETFLIX: 2019: 5.62% 2020: 6.83% (+1.21%)
3. FACEBOOK: 2019: 5.35% 2020: 6.01% (+0.66%)
4. HTTP D/L: 2019: 6.53% 2020: 4.87% (-1.66%)
5. FACEBOOK VIDEO: 2019: 5.26% 2020: 4.67% (-0.59%)
6. HTTP: 2019: 5.04% 2020: 4.59% (-0.45%)
7. BITTORRENT: 2019: 7.58% 2020: 4.47% (-3.11%)
8. HTTP MEDIA STREAM: 2019: 10.05% 2020: 4.15% (-5.90%)
9. HTTP (TLS): 2019: 6.10% 2020: 3.10% (-3.00%)
10. GOOGLE: 2019: 2.39% 2020: 2.66% (+0.27%)

EMEA TOTAL TRAFFIC SHARE TOP 10

1. YOUTUBE: 2019: 6.70% 2020: 16.23% (+9.62%)
2. HTTP: 2019: 0.88% 2020: 10.48% (+9.56%)
3. BITTORRENT: 2019: 5.26% 2020: 8.38% (+3.12%)
4. NETFLIX: 2019: 6.09% 2020: 7.69% (+1.60%)
5. WORDPRESS: 2019: 0.15% 2020: 4.93% (+4.78%)
6. FACEBOOK: 2019: 1.51% 2020: 4.36% (+2.85%)
7. INSTAGRAM: 2019: 0.76% 2020: 3.74% (+2.98%)
8. GOOGLE: 2019: 0.27% 2020: 3.47% (+3.20%)
9. FACEBOOK VIDEO: 2019: 0.45% 2020: 3.26% (+2.81%)
10. HTTP MEDIA STREAM: 2019: 2.54% 2020: 2.54% (-5.30%)

SOURCE: COVID INTERNET PHENOMENA REPORT MAY 2020 BY SANDVINE

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Impacts of rising multimedia traffic

Challenges for ISPs and VSPs

- ISPs and Streaming service provider face capacity challenges on continual basis
- COVID-19 put the networks and streaming providers to test their limits
- Lockdowns as one of the key reason in spike in entertainment service consumption
- VSPs and ISPs are required to be ready for service consumption spikes
- OTT Service providers had to perform capacity management by
  - Restricting higher bitrate video profiles such as UHD, HD etc for users
  - Setting SD video profile as a default variant
  - Adjusting Video transcoding parameters
- VSPs need invest continuously into transcode and packaging Infrastructure
  - Transcoding is expensive, power and cooling hungry component in datacentres
  - Each new device to support additional transcoding, distribution and storage resources
- VSPs require proprietary/ purpose built QoS / QoE monitoring
- VSPs need to heavily invest in long term expensive content deals to retain market share

TOP 10 VIDEO SERVICES BY TOTAL TRAFFIC

1. YOUTUBE
2. NETFLIX
3. HTTP MEDIA STREAM
4. FACEBOOK VIDEO
5. TIKTOK
6. AMAZON PRIME
7. HULU
8. DISNEY+
9. TWITCH
10. OPERATOR IPTV

Source: Covid Internet Phenomena Report May 2020 by Sandvine

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OTT – Challenges & Technical Evolution

Key Research Areas

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Key Research Areas

- Advanced Video Codecs
  - Modern video codecs like AV1, VVC
  - AV1 is ~ 30% more efficient than HEVC
  - If an UHD movie in HEVC codec need 25 Mbps internet connection, AV1 would take ~ 17.5 Mbps
  - Client device need to support decoding capabilities to fully roll out modern codecs
- Low Latency Video Delivery Networks
  - Every ABR streaming protocol e.g. HLS, MPEG DASH needs player to buffer content
  - Transcoding, Packaging , Encryption , Inherent latency in IP networks causes a lag in OTT content
  - New streaming protocols such as Low Latency ABR are seeking to solve this problem

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Key Research Areas

- Recommendation Engines, Ad-tech & Analytics
  - Dynamic Content Recommendation based on user behaviour
  - Data Analytics and User behaviour analysis for Dynamic Ad-Insertion
  - Client side stats for optimizing streaming network design and performance

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QUESTIONS?

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Thank You!

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