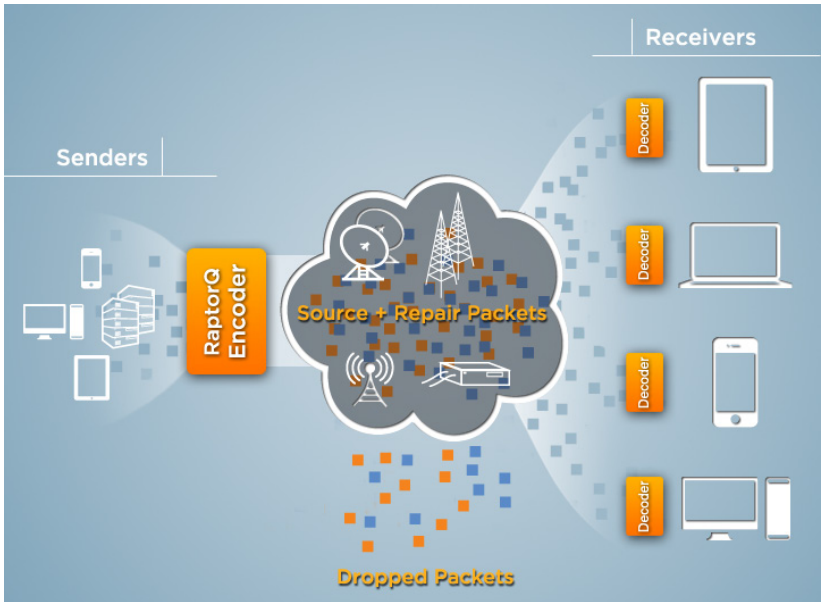
QUALCOMM

RaptorQ™

The Superior FEC Technology

Delivering reliable, high-quality content through imperfect real-world networks is a challenge – a challenge that Raptor Technology can resolve.



WHAT IS RAPTORQ ?

RaptorQ is a forward error correction (FEC) technology implemented in software that provides application-layer protection against network packet loss. In use, Raptor "encodes" content at the source. The encoded content is then delivered over a network to target device(s) where Raptor is used again to then "decode" the original content. The Raptor encoder and decoder libraries allow streaming and file delivery services to recover data lost in transit and completely reconstruct it, without using a backchannel.

RaptorQ is the most flexible and powerful product in the Raptor Technology line, pioneered by Digital Fountain. For more than 10 years, Raptor Technology has successfully enabled solutions to achieve the high quality-of-service (QoS) content providers and end users demand.

Example Solutions using RaptorQ:

- Electronic News Gathering using mobile cellular uplink
- Digital Cinema file distribution via satellite networks
- HD Video Conferencing over the public Internet

Key Benefits:

- Improves video streaming quality
- Corrects video jitter and removes artifacts
- Highly Scalable - eliminates re-sending lost data
- Speeds file delivery – efficiently uses bandwidth
- Is cost effective to deploy – no hardware expense
- Reaches more subscribers - increases network range
- Is easy to implement – on all device types and networks

INCREASES QOS AND ENHANCES VALUE

With RaptorQ, wireless broadcast and multicast services can overcome the inherent challenges of content delivery in a mobile environment, enabling more content, more range and a more efficient use of bandwidth.

IPTV services can extend the DSL loop to reach more subscribers and improve QoS with efficient, reliable delivery, fast channel change times, low bandwidth overhead and no video or audio degradation. Mobile TV service providers can offer real-time video streaming with smooth playback and faster screen refresh.

Enterprises can rely on fast, reliable, error-free delivery of digital media – even in the most challenging network conditions.

TECHNICAL OVERVIEW

RaptorQ provides superior flexibility, support for large source block sizes and excellent coding efficiency.

RaptorQ is a fountain code, meaning the encoder can generate any number of symbols on-the-fly from the source symbols of a source block of data. The decoder is able to recover the source block from any set of encoding symbols typically equal to the number of source symbols and in rare cases, with slightly more than the number of source symbols.

Raptor's proven benefits have been recognized by leading international standards bodies including the IETF, DVB and 3GPP.

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Improving Content Delivery Solutions

RAPTORQ CODEC PROPERTIES

- Standard: IETF RFC 6330 RaptorQ Forward Error Correction Scheme for Object Delivery
- Max. number of source symbols: 56,403 (K)
- Max. number of encoded symbols: 16,777,216
- Maximum symbol size in octets: 65535 (T)
- Maximum source block size in octets: 3.4GB
- Systematic code (encoded symbols = source symbols + repair symbols)
- No pre-selection of number of repair symbols necessary ("fountain code" or "rateless FEC")
- Linear time encoding and decoding
- Upper bound on decoding failure probability for any loss model:
  - Receive K symbols: 1e-2
  - Receive K+1 symbols: 1e-4
  - Receive K+2 symbols: 1e-6

APPLICATION-SPECIFIC FEATURES

FILE DELIVERY:

- API control flow to amortize the decoding prepare step over many source blocks
- Supports generating a very large number of repair symbols, making it easy to deploy broadcast file delivery with intermittent receivers
- Scratch memory mode available with decoder to lower required memory

STREAMING:

- Low-complexity decoding allows integration on application CPU
- Fountain property allows multi-path architecture for redundancy and/or high-bandwith content like High-Definition video

RAPTORQ LIBRARY FEATURES

- Highly portable – written in ANSI C
- Small library footprint – less than 100KB
- Very fast code using patented algorithms and data structures
- Excellent decoder CPU performance
- Operating system independent
- Network agnostic
- Integer-only code – no floating point

APPLICATION PROGRAMMING INTERFACE:

- Small number of functions yet flexible for all use cases
- Field tested, verified and proven API
- Incremental decoding/encoding support for platforms with limited scheduling capability

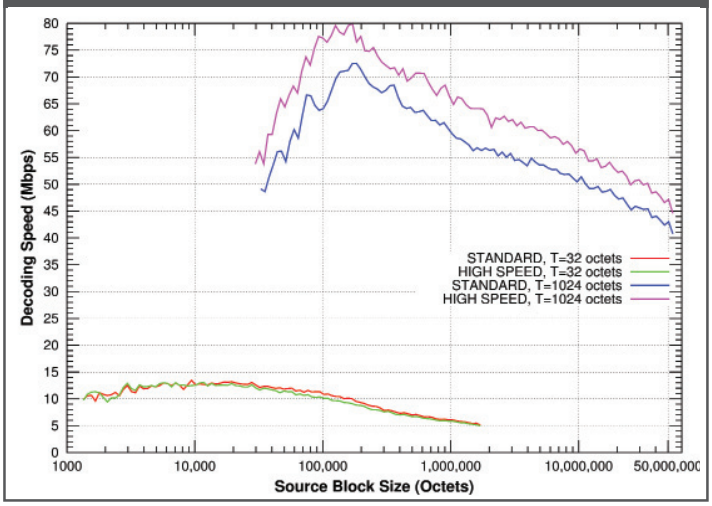
TWO OPERATING MODES:

- High Speed: Optimal CPU performance
- Standard: Minimize memory usage

STANDARD SUPPORTED PLATFORMS:

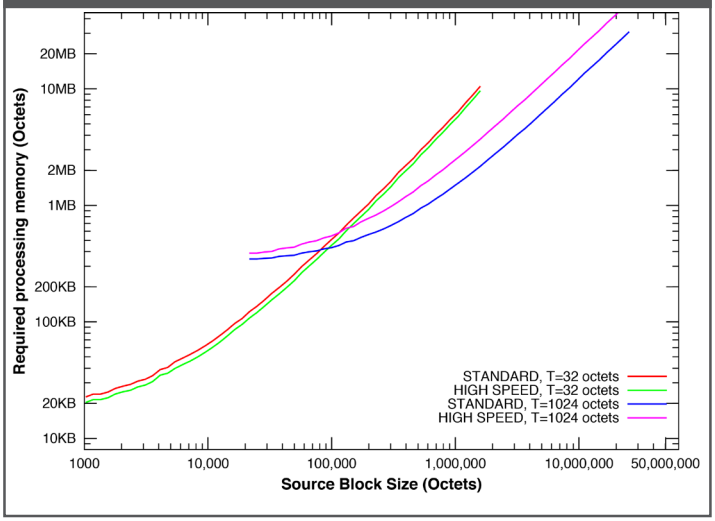
- Windows/Linux: x86, Android/Linux: ARM, Solaris: SPARC, Mac OS X: Intel (future) Apple IOS: ARM (future)
- Other platforms: porting services available

RaptorQ Decoder speed on Snapdragon 8250



CPU Clock 1GHz, OS Android 2.2 on HTC Nexus One.
Usage: 2 Extra Symbols Code Overhead, 50% Random loss.
Library version: 1.1 .0.android_armeabi-v7a.

RaptorQ Decoder Processing Memory



Library version: 1.1.0, all platforms

To learn more, visit us at www.Qualcomm.com/Raptor

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