Scalable Quality Extension for Opus/CELT
draft-valin-opus-scalable-quality-extension

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Scalable Quality Proposal

- Extension that lifts some limits of the Opus bitstream
  - Support > 8 bits band-wise depth
  - Support for > 20 kHz bandwidth
  - Bitrate up to ~500 kb/s per channel
- Compatibility
  - Keep forward and backward compatibility with RFC6716

Payload

- Long extension ID (124)
- Entropy coded payload

Symbol(s)	PDF/Description
96 kHz flag	{1, 1}/2
Intensity stereo	uint
Dual stereo	{1, 1}/2
Intra coarse energy	{7, 1}/2
Coarse energy (high bands)	
Bit allocation	Section 2.3
Fine energy (low bands)	Section 2.1.1
PVQ refinement	Section 2.1.2, Section 2.1.3
Fine energy (high bands)	Section 2.3
PVQ and cubic codebook (high bands)	Section 2.1.4

PVQ Refinement

- Increase codebook resolution (K) by factor of $u=2^b-1$
  - Code y normally with K
  - Find codevector z using $u*K$
  - Refinement as $z – u*y$
  - Code refinement in extension

Fine Energy and Angles

- Fine energy gets 2^b refinement <u>instead</u> of final energy
  - Only on low bands
- Angles get 2^b-1 refinement
  - Centered on existing quantization points

Extra bands

- Define new bands above 20 kHz
  - 2 kHz wide, regardless of frequency
    - 2 extra bands from 20 to 24 kHz, or
    - 14 extra bands from 20 to 48 kHz
- Code new bands *almost* like regular bands
- Use new cubic codebook for depth > 2 bit
  - Projects the surface of an empty cube to unit sphere
  - Cheap search and encoding even for high bitrates

Status

- Running code
  - Branch exp_qext24 on https://gitlab.xiph.org/xiph/opus/
  - Achieves -115 dB THD+N (AP test) at 480 kb/s/channel
  - Complete float and fixed-point implementations
- Open questions
  - How to standardize
  - Testvector margins