SILK

IETF codec WG, March 22, 2010
Koen Vos, Karsten Vandborg Sørensen,
Søren Skak Jensen, Julian Spittka
Quality Matters I

Measured by randomly assigning a codec to Skype-to-Skype calls
- between Skype 4.1 clients
- with sufficient network bandwidth to run that codec at its maximum bitrate

Confidence intervals indicated are 95%
Quality Matters II

Measured by randomly assigning a codec to Skype-to-Skype calls
- between Skype 4.1 clients
- with sufficient network bandwidth to run that codec at its maximum bitrate
Confidence intervals indicated are 95%
SILK Features

• 4 sampling rates: 8, 12, 16, 24 kHz
• Configurable bitrate: 0.5 ~ 2 bits/sample
• Variable bitrate
• 3 complexity settings
• Memory usage:
  – Tables ROM: 22 kB
  – Static RAM: 28 + 14 kB (Enc + Dec)
• Optimized for IP networks
Complexity Impact on Quality (WB)
Complexity Impact on Quality (NB)
## Complexity (WMOPS)

<table>
<thead>
<tr>
<th></th>
<th>Enc: Low</th>
<th>Enc: Mid</th>
<th>Enc: High</th>
<th>Decoder</th>
</tr>
</thead>
<tbody>
<tr>
<td>NB</td>
<td>17</td>
<td>22</td>
<td>30</td>
<td>2.5</td>
</tr>
<tr>
<td>MB</td>
<td>24</td>
<td>33</td>
<td>52</td>
<td>4</td>
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<tr>
<td>WB</td>
<td>28</td>
<td>39</td>
<td>59</td>
<td>5</td>
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<tr>
<td>SWB</td>
<td>38</td>
<td>50</td>
<td>78</td>
<td>7</td>
</tr>
</tbody>
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Peak complexity, without in-band FEC. Error margin: +/- 20%
Packet Loss Robustness: In-band FEC

• Aka Low Bit-Rate Redundancy
• Include coarser encoding of a previous packet in current packet
• Decision to include depends on:
  – Sensitivity of input signal to packet loss
  – Packet Loss Percentage input parameter
Packet Loss Robustness: LTP State Scaling

- Scale down the state of the long-term prediction filter at the start of a new packet
- Scale factor depends on:
  - Long-term correlation of input signal
  - Packet Loss Percentage input parameter
Packet Loss Concealment

• Extrapolate signal by using LPC and LTP synthesis filters
Decoder

Bitstream

Arithmetic Decoding and Dequantizing

Gains Quant. Offset Rand Seed

Pulses

Generate Excitation

LTP Synthesis

Pitch Lags LTP Coefs LTP Scale

LPC Coefs

Decoded Speech