RTP Payload Format for Bluetooth's SBC audio codec
draft-hoene-avt-rtp-sbc-00

73rd IETF Meeting
November 17th, 2008
Minneapolis, MN

Christian Hoene <hoene@uni-tuebingen.de>
Frans De Bont <frans.de.bont@philips.com>
Advanced Audio Distribution Profile (A2DP)

- For streaming of high quality audio via a Bluetooth connections
- **Sub-band coding (SBC)**
  - mono and stereo audio coding
  - low complexity
  - A2DP mandatory
- A2DP optionally supports
  - MP3, MPEG-2, MPEG-4, AAC, ATRAC, and other manufacturer-defined codecs
  - Content protection
- Implemented for
  - Linux, Mac OS X, Palm OS, Symbian Series60, Motorola P2K, UIQ 3.0 (Symbian 9.1), Windows Mobile, XP, Vista, Black Berry

RTP Payload Format for Bluetooth SBC codec

- **Usage Scenarios**
  1. Interconnecting A2DP devices over the Internet
  2. Internet telephony at CD quality
  3. Distributed ensemble performances over the Internet

- **Musicians require**
  - perfect audio quality
  - not sitting more than 8 meters apart
  - 8m at sonic speech = 25 ms latency
    = 7500 km at speed of light

- **Algorithmic latency of SBC is a few ms.**
  - would allow musicians to play together
    (e.g., in Europe or across the states)
Payload Format follows A2DP Specification

- A2DP follows the RTP payload format
- Request by Morgan Lindvist (chair of Bluetooth’s AV working group):
  - Please remain 100% compatible with the Bluetooth specification

- SBC specific header followed by SBC frames
  - Header contains parameters on fragmentation and number of SBC frames

(a) When the media payload contains an integral number of SBC frames

<table>
<thead>
<tr>
<th>Header</th>
<th>SBC frame</th>
<th>SBC frame</th>
<th>SBC frame</th>
</tr>
</thead>
</table>

(b) When the SBC frame is fragmented

<table>
<thead>
<tr>
<th>Header</th>
<th>First fragment of SBC frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Header</td>
<td>Subsequent fragments of SBC frame</td>
</tr>
</tbody>
</table>
Format of a SBC Frame

**Coding modes**

- **SF**: Sampling frequency (16, 32, 44.1, or 48 kHz)
- **BL**: Blocks (4, 8, 12, or 16)
- **CM**: Channel mode (mono, stereo, joint stereo, dual channel)
- **A**: bit allocation method (SNR or loudness)
- **S**: Number of sub-bands (4 or 8)
- **SYNCWORD**: is %10011100
- **BITPOOL**: defines the number of bits used for encoding (2 and 250)
- **CRC_CHECK**: performed on the header flags

- all but **BITPOOL** and **CRC_CHECK** MUST NOT change during a session.
Which Coding Mode?

Bit rate [bit/s] versus different SBC coding modes ($BL=16$)

Audio Quality [ODG] measured with ITU BS.1387 (PEAQ) mean over 24 music samples, high values are better.
Selecting one Coding Mode in the SDP Negotiation

- A2DP negotiates capabilities by setting one bit for each possible parameter values.
  - e.g. for 4 bits for 16, 32, 44.1, 48 kbps

<table>
<thead>
<tr>
<th>Sampling Frequency</th>
<th>Channel Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block Length</td>
<td>Subbands</td>
</tr>
<tr>
<td></td>
<td>Allocation Method</td>
</tr>
<tr>
<td>Minimum Bitpool Value</td>
<td></td>
</tr>
<tr>
<td>Maximum Bitpool Value</td>
<td></td>
</tr>
</tbody>
</table>

- Octet0
- Octet1
- Octet2
- Octet3

**Figure 4.1: Codec Specific Information Elements for SBC** from [A2DPV12]

- Using the same bytes for SDP negotiation
  - Plus payload type, sampling rate and channels.

- Example
  - **Offer:** SBC all modes
    - m=audio 54874 RTP/AVP 96
    - a=rtpmap:96 SBC/48000/2
    - a=ﬁmtp:96 capabilities=FF,FF,02,FA
  - **Answer:** wants 44.1 kHz, mono, 16 blocks, 8 subbands, LOUDNESS, bit-pool value set to 19
    - m=audio 59452 RTP/AVP 96
    - a=rtpmap:96 SBC/44100/1
    - a=ﬁmtp:96 capabilities=28,15,13,13
Summary

- SBC is a nice codec with unique features:
  1. Good stereo audio quality
  2. Low complexity
  3. Ultra low algorithmic delay (a few milliseconds)
  4. Flexible bit rate selection on congested paths
  5. Open source code included in Linux BlueZ protocol stack
  6. Already included in Ekiga’s development track
  7. License: Free to use in Bluetooth applications

Any comments and feedback?