Voice Processor based on the Human Hearing System

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Audience A1010 Voice Processor

- Targeted at mid to high tier mobile phones
- Features:
  - Tx/Rx Noise Reduction, AEC, Voice Equalization, Voice Stretch
- Analog & Digital audio interfaces
- Works with CDMA, GSM, WCDMA, FOMA baseband architectures
Two-Microphone Noise Suppression
Signal Processing Based on the Human Hearing System

Biological System

Simplified System Architecture
A1010 Signal Processing System Diagram

(Data Converters not shown)
Fast Cochlea Transform (FCT)

- Proprietary modifications to Lyon’s digital IIR biquad filter cascade

- Logarithmic Frequency Scale (unlike FFT)
- Optimal frequency-dependent time-frequency trade-off (unlike FFT)
- Better spectral resolution at low frequencies, better temporal resolution at high frequencies
- Critical bandwidths of human hearing built directly into transform
- Proprietary Inverse transform, low latency <20ms
Real-Time Demonstrations

To be presented Live at the meeting
A1010 Voice Processor
Tiny, Low Power, High Impact Chip

- **Low Power, Mixed Signal IC**
  - Optimized for Audience algorithms
  - Audience custom DSP & logic with on-board program and data memory
  - Digital & Analog Audio Interface
  - I²C & SPI Host (BB) Interface
  - 48-pin CSP, 0.4mm pitch
  - 15-32 mA Active
  - 30 μA Sleep

- **Powerful Voice Quality Features**
  - Noise suppression, AEC, Voice Equalizer

- **Ease of Integration**
  - Flexible microphone configuration
  - Supports all baseband chips and codecs
  - Extremely small size for minimum board space impact

- **Availability**
  - Now
A1010 Voice Processor

• Die Size: 2.7 x 3.5 mm
• TSMC 130nm process
• Custom instructions to accelerate Fast Cochlea Transform and other critical operations
Testing Non-stationary Noise Suppression

Subjective Methods
- ITU-T P.835 Amendment 1 Appendix III
- 2007 Standard for testing non-stationary noise suppression, led by Audience.
- 6 noise types, including single-voice distractor and music, at SNR = 0, 6, 12 dB
- Simultaneous moving sources
- Audience improves by 0.77 MOS, 9dB SNR

Objective Methods
- ITU-T G.160 (in progress)
- Noise Power Level Reduction (NPLR)
- Total Noise Level Reduction (TNLR)
- Signal-to-Noise Ratio Improvement (SNRI)
- Suppression per mA of Power
- Audience achieves 25 dB suppression in 14mA current consumption: 1.8 dB / mA

<table>
<thead>
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<th>Power Consumption</th>
<th>Performance</th>
<th>dB / mA</th>
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<tr>
<td>Tx NS</td>
<td>14 mA</td>
<td>25 dB</td>
<td>1.8</td>
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<tr>
<td>+ Rx NS</td>
<td>7 mA</td>
<td>15 dB</td>
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<tr>
<td>+ AEC</td>
<td>1 mA</td>
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<tr>
<td>+ VE</td>
<td>2 mA</td>
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<tr>
<td>Chip Circuitry</td>
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<tr>
<td>Total A1010</td>
<td>32 mA</td>
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Voice Processor Chip Design Wins

SHARP SH705ill

LG Cyon

- Many more to announce later this year
Company Overview

• **Voice Processor Company**
  - Chips that enable high quality, noise-immune voice communications
  - Headquarters in Mountain View, California
  - Winner of Most Innovative True Mobile Startup at Mobile World Congress

• **Unique & Patented Technology**
  - Core technology based on the intelligence of the human hearing system

• **Audience-enabled mobile terminals shipping**

• **Strong Investors & Advisory Panel**
  - Including Carver Mead, Forest Baskett, Larry Rabiner, Bob Colwell, Ray Kurzweil