Voice Processor based on the Human Hearing System

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Hot Chips 20
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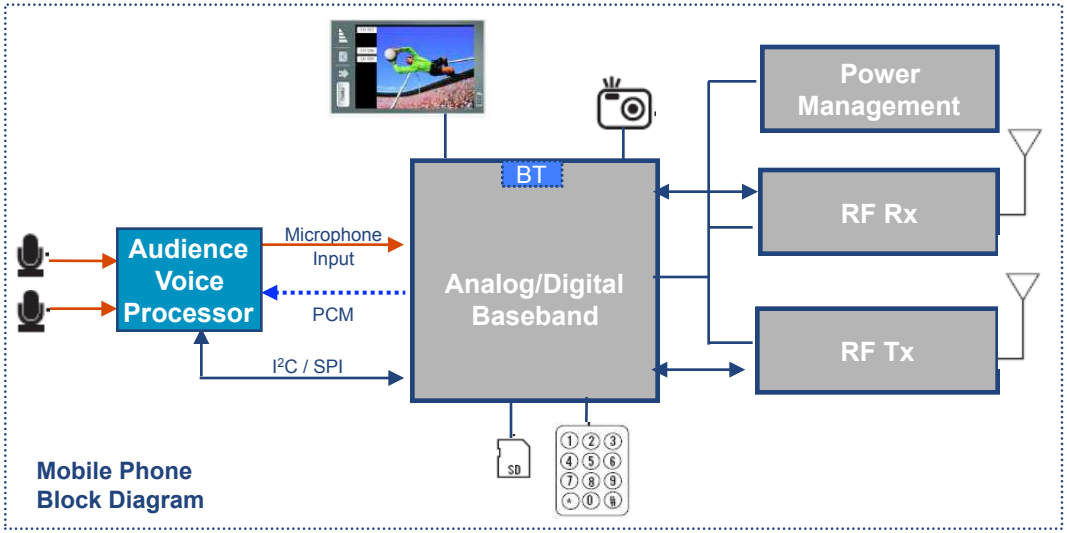
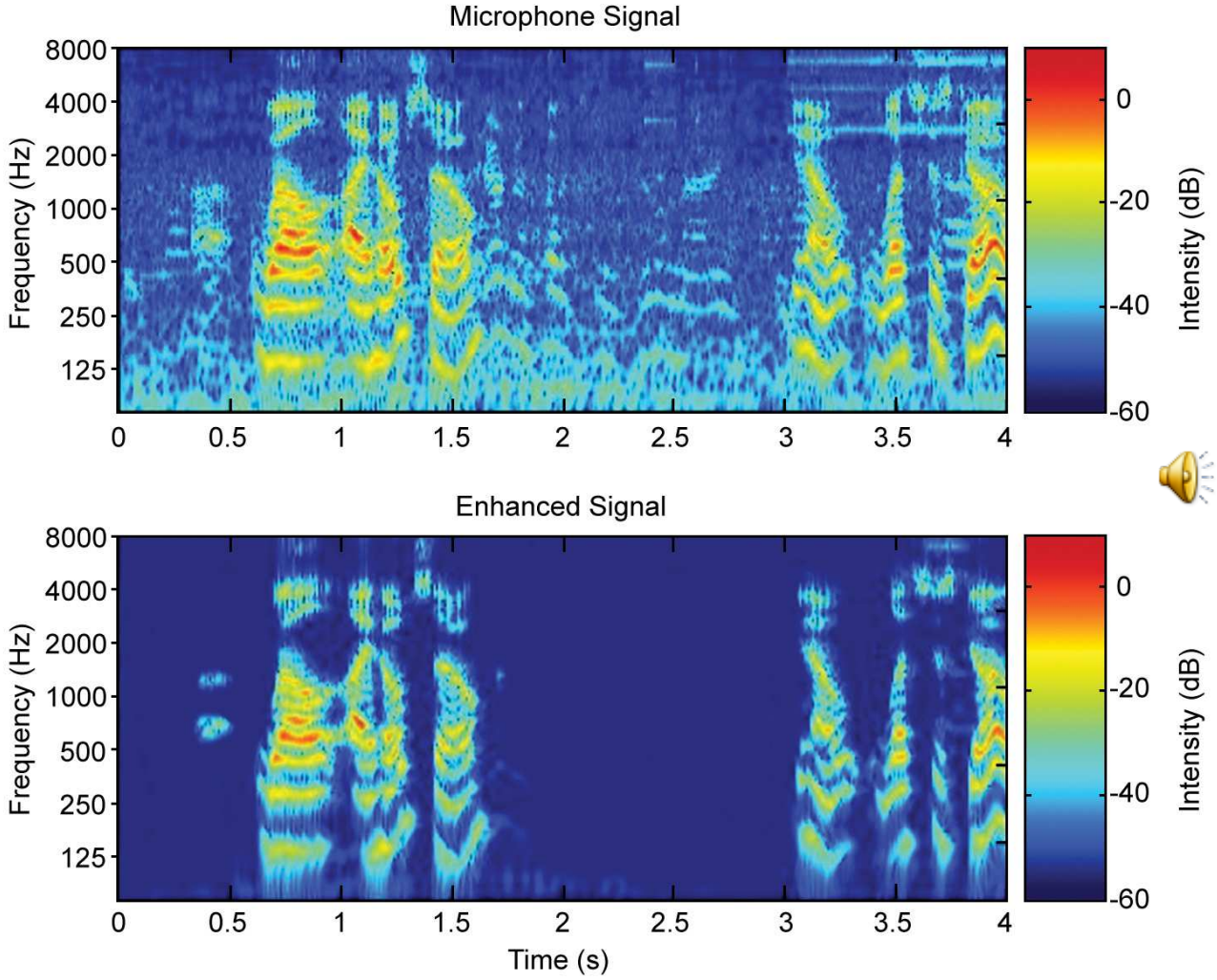
Audience A1010 Voice Processor



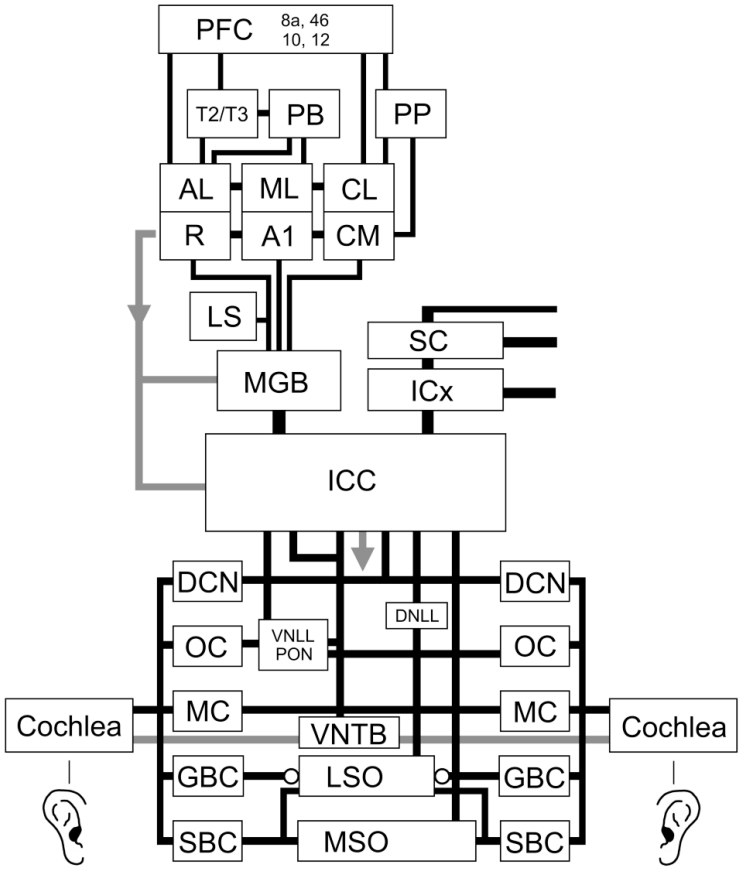
CDMA
GSM
WCDMA
FOMA

- **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**

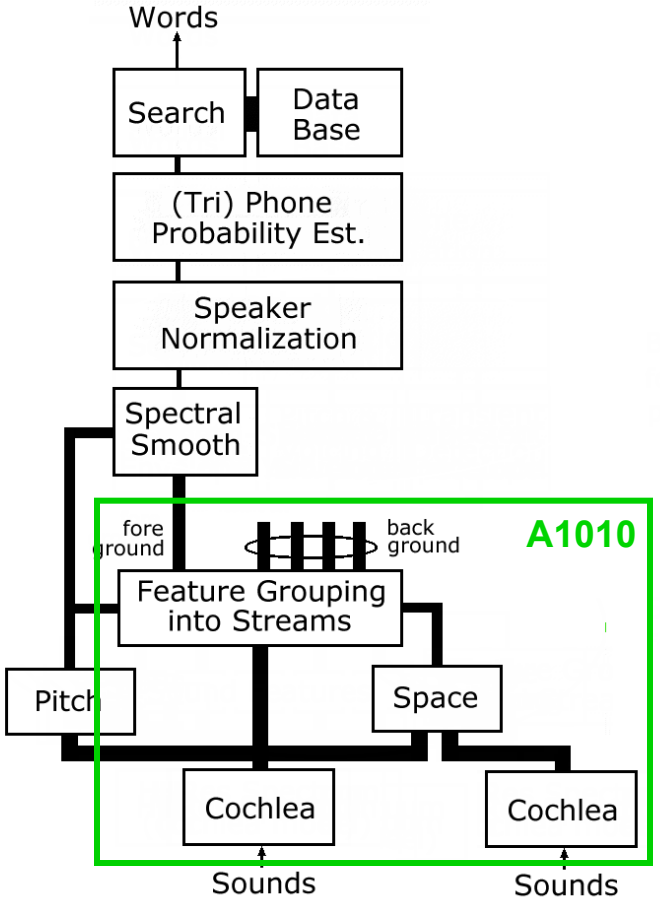
Two-Microphone Noise Suppression



Signal Processing Based on the Human Hearing System

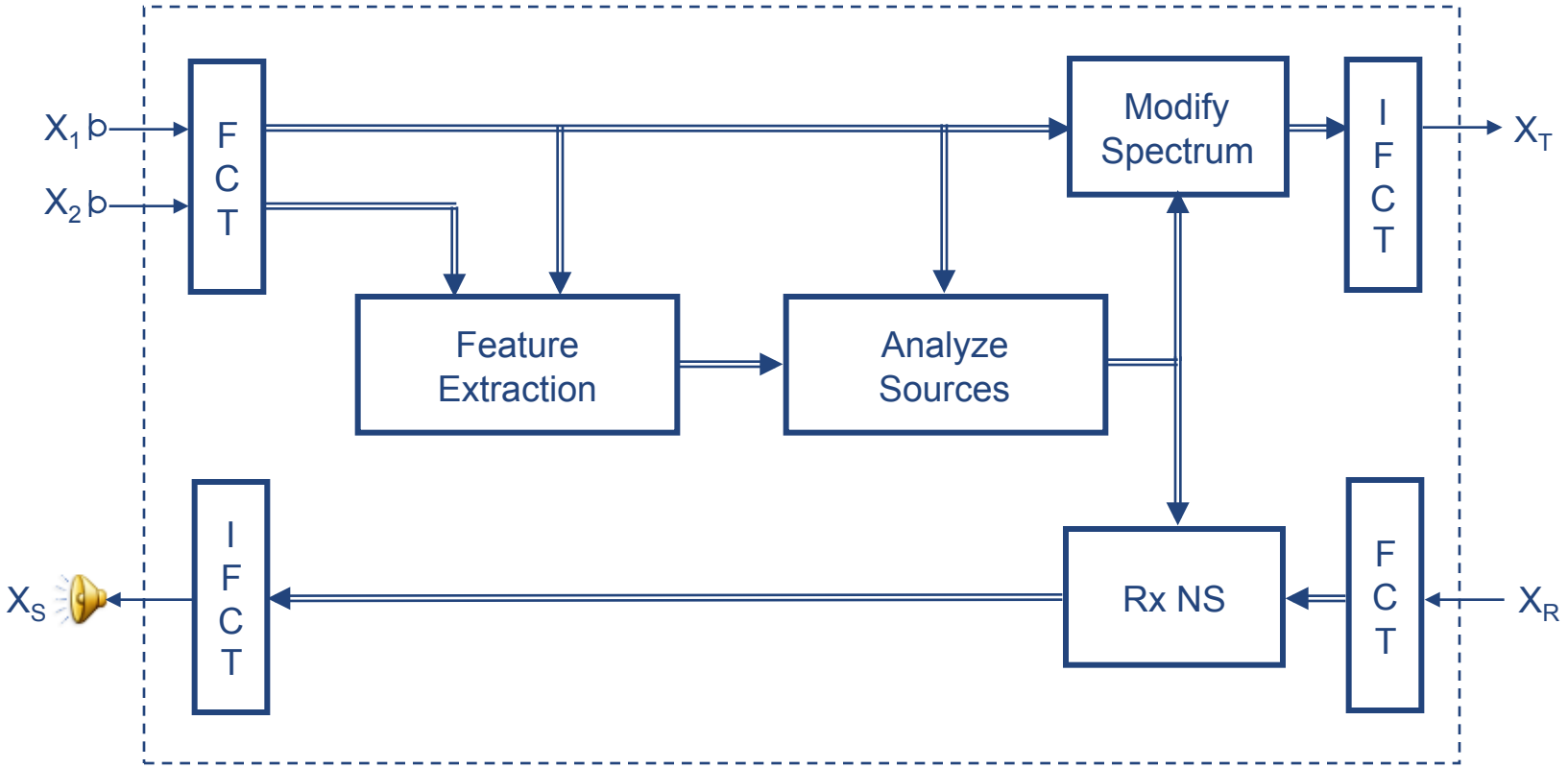


Biological System



Simplified System Architecture

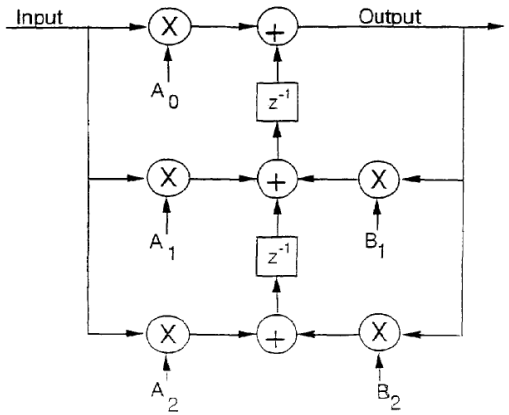
A1010 Signal Processing System Diagram

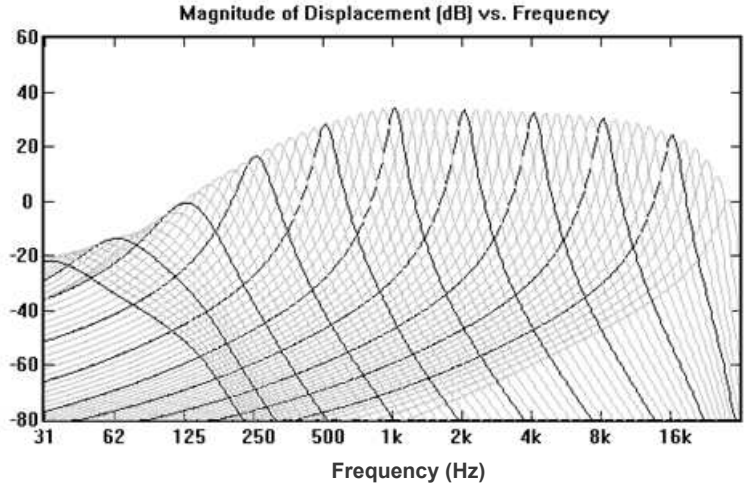


(Data Converters not shown)

Fast Cochlea Transform (FCT)

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

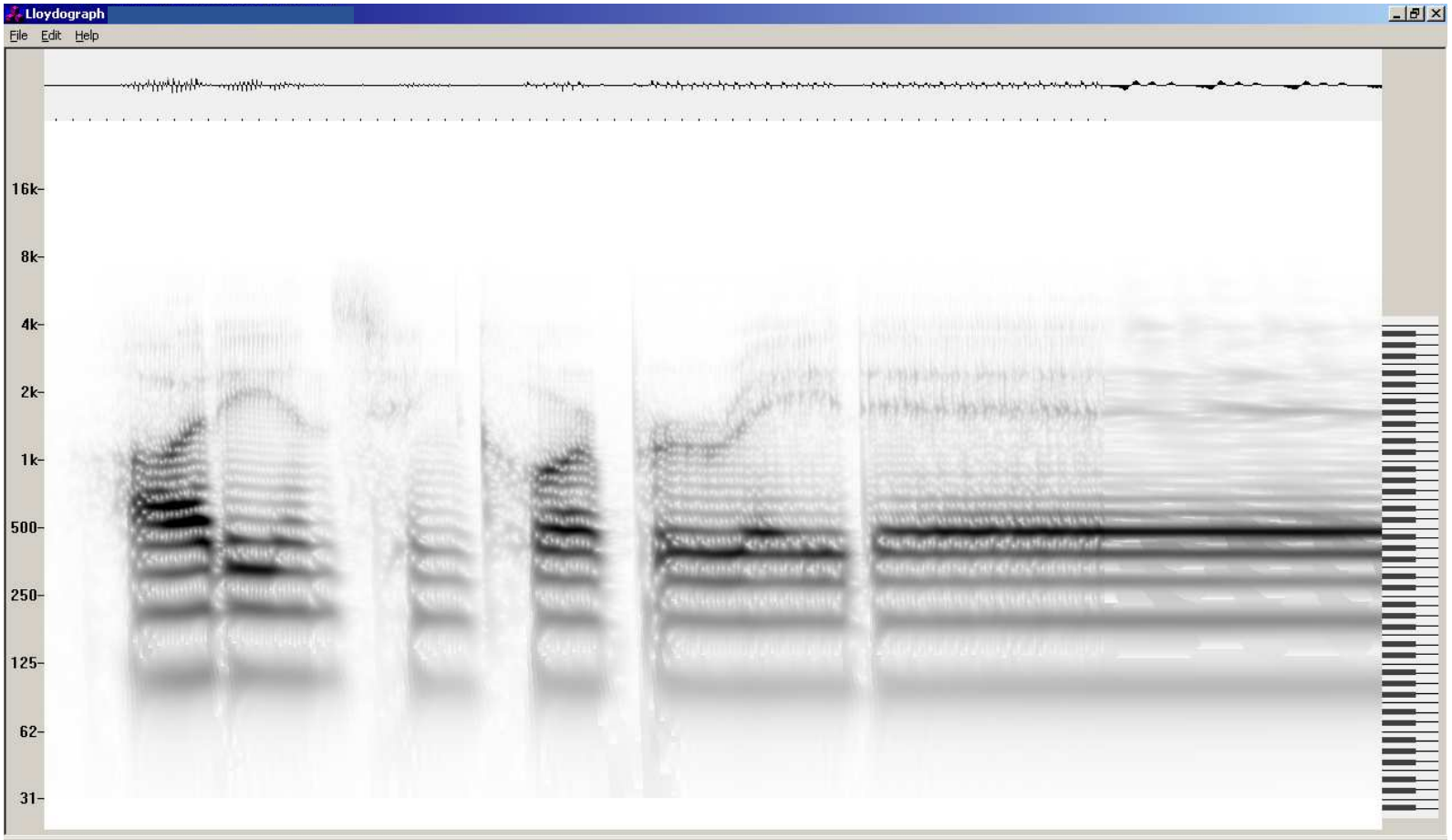




- Logarithmic Frequency Scale (unlike FFT)
- Optimal frequency-dependent time-frequency trade-off (unlike FFT)
- Better spectral resolution at low frequencies, better temporal resolution at high frequencies
- Critical bandwidths of human hearing built directly into transform
- Proprietary Inverse transform,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

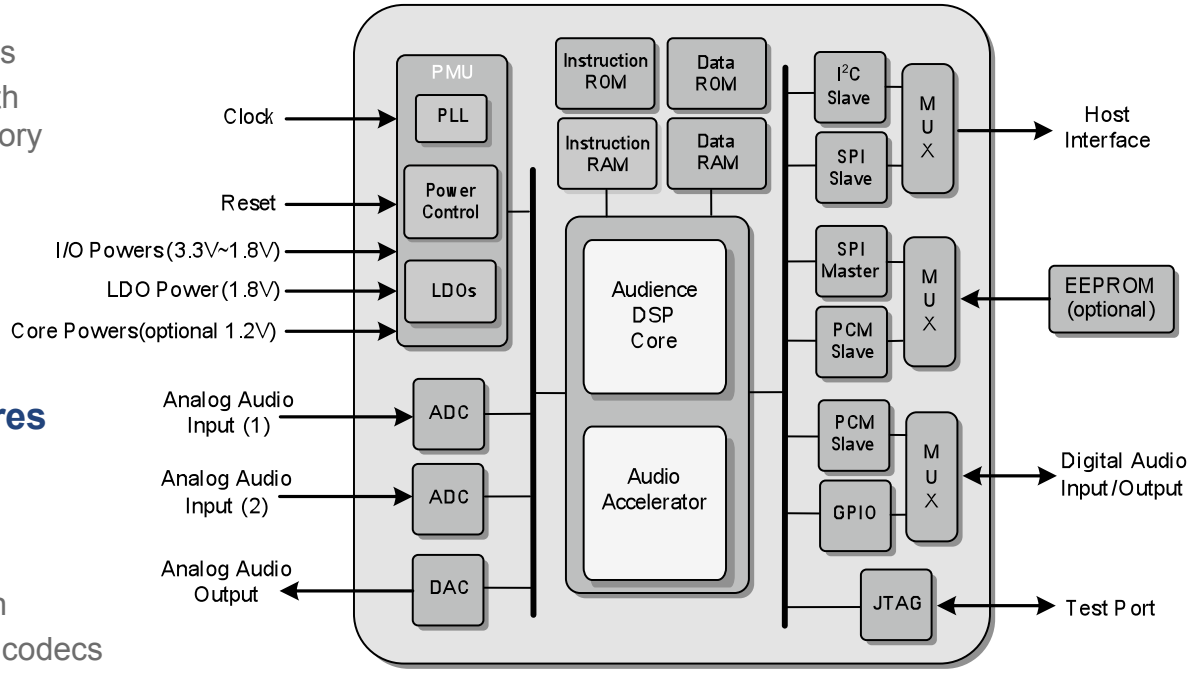
Real-Time Demonstrations

To be presented Live at the meeting

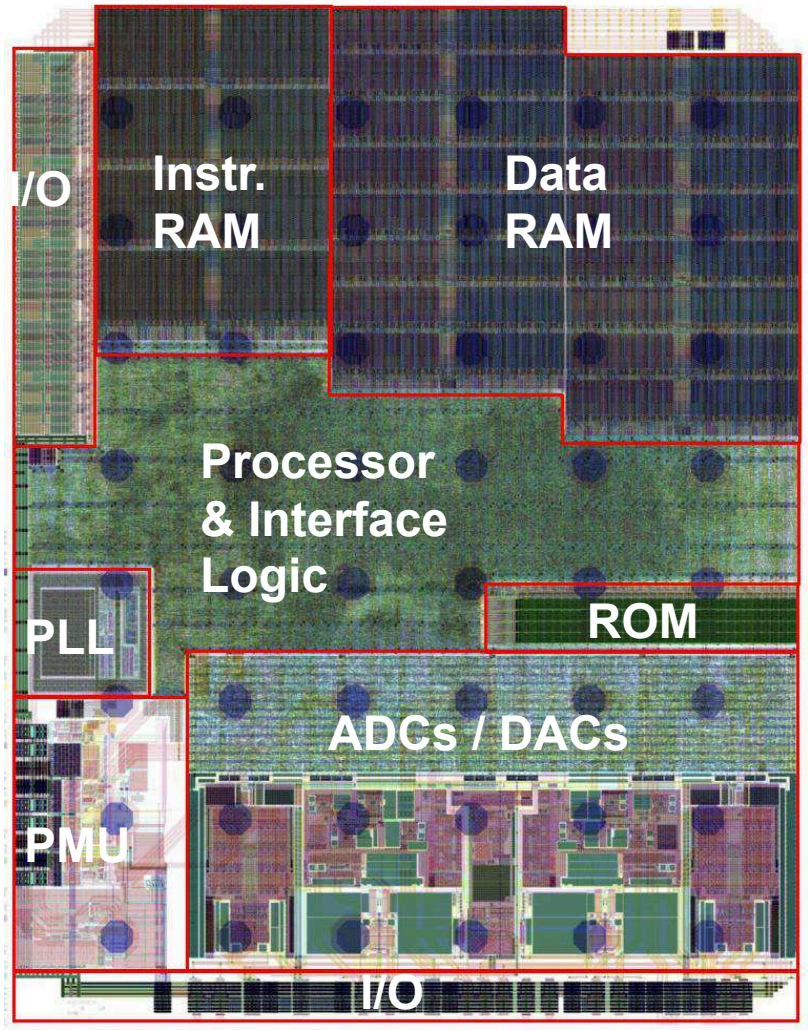


A1010 Voice Processor
Tiny, Low Power, High Impact Chip

- **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 uA 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



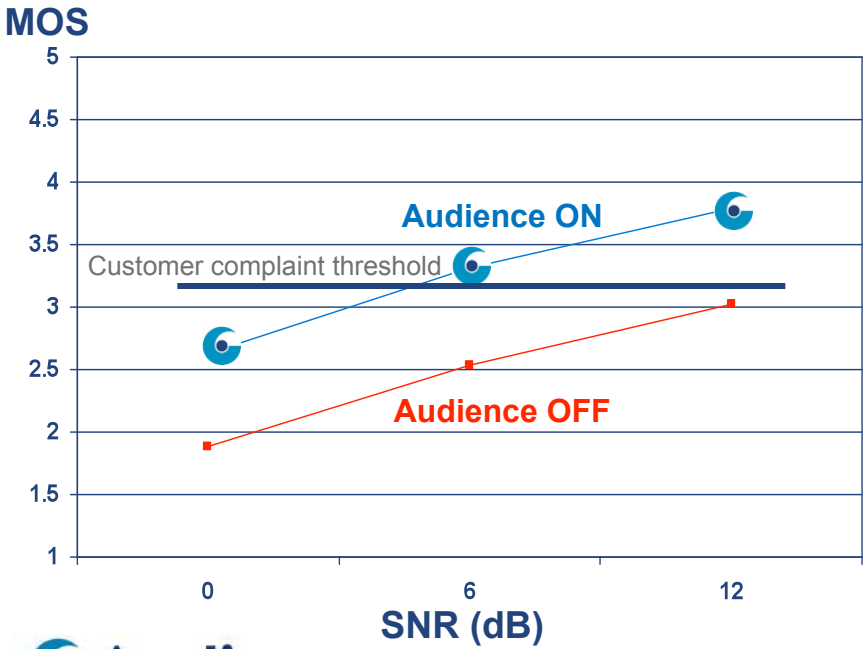
- Die Size: 2.7 x 3.5 mm
- TSMC 130nm process

- 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**

	Power Consumption	Performance	dB / mA
Tx NS	14 mA	25 dB	1.8
+ Rx NS	7 mA	15 dB	2.1
+ AEC	1 mA	35 dB	
+ VE	2 mA		
Chip Circuitry	8 mA		
Total A1010	32 mA		

Voice Processor Chip Design Wins

SHARP SH705iII

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

VULCAN Capital

NEA. Performance at Every Stage

TALLWOOD Venture Capital

VentureTech Alliance