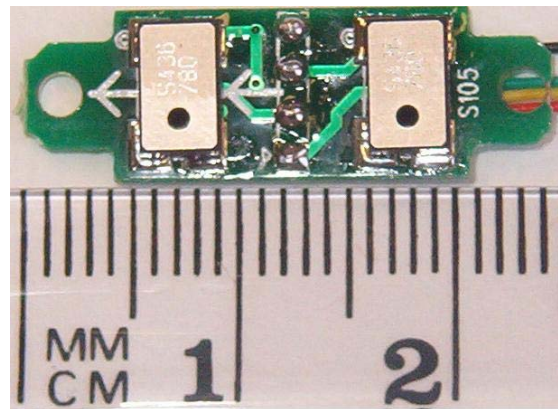


Fortemedia

SAM – Small Array Microphone

Enable Microphone Integration



Agenda

- **Company Background**
- **Technologies**
- **The Value of Integrated Microphone Solution**
- **Applications**
- **Challenges**

Company

- **Develop DSP based IC solution to suppress wind noise, ambient noise, and echo**
- **Enable Microphone Integration with Small Array Microphone (SAM) technologies**
 - **Pull – Create the applications and market segments**
 - **Push – Provide the key technologies**
- **Investors include Intel, Samsung, Marvell, UMC, Lehman Brothers**
- **Customers include Motorola, Jaguar, Docomo, Toyota, LG, Asus, Samsung, Hyundai Motor, Siemens, Sony, NEC, Symbol**
- **No. 1 automotive and PND hands free providers**
- **Largest volume of array microphone deployment in the world**
- **The First Array Mic. solution for Cellphone**

Fortemedia

Technologies



Usage Patterns

- Voice interface has not changed since microphone/telephone was invented in year 1876
- Usage patterns change significantly after year 2000
- **Garbage In, Garbage Out!**
 - The main problem for voice interface and other speech related killer applications

Close Talk
Fixed line
Quiet Environment



■ Acoustic echo cancellation requirement increase 30dB
■ Noise suppression requirement increase 30dB

Speakerphone
Mobile
Noisy Environment



Noise – Unwanted Signals

Many Noise Sources

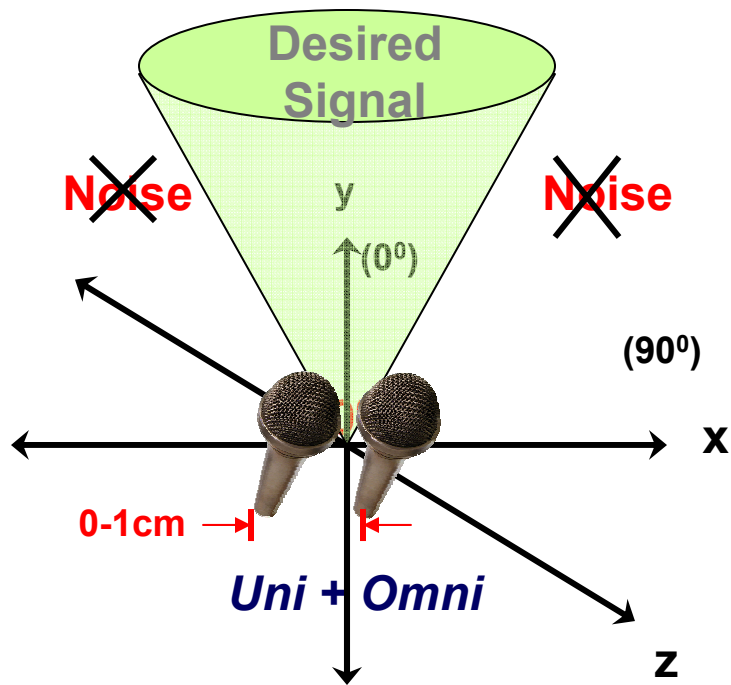
| | | | |
|----------------------|-------------------|----------------------|-----------------------------|
| Stationary noise | Reverberant Noise | RF Interference | Network Noise |
| Non-stationary noise | Line Echo | Mechanical Vibration | PC/CDMA NS impact |
| Linear Echo | Far-end Noise | Power Line Noise | Bluetooth WiFi Interference |
| Non-linear Echo | Side Tone | Quantization Error | Wind Noise |
| Echo Path Change | Saturation | Human Babble Noise | |

Can be solved by existing solution

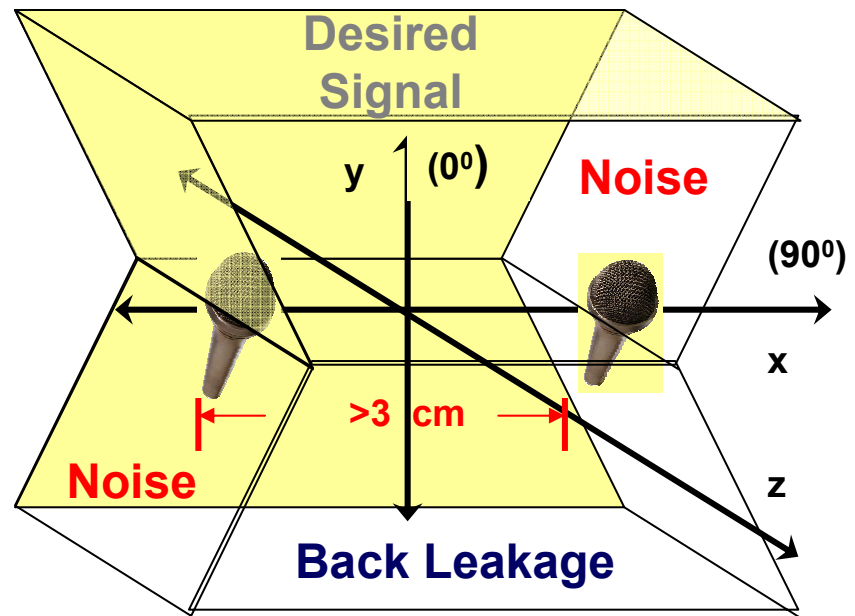
Can be solved by Small Array Microphone

Array Microphone

SAM (cone-shaped)



Broadside Array Mic (pie-shaped)



Microphone Development Trends

- **MEMs/Silicon Microphone**
 - **Easy for production and future integration**
- **Digital Microphone**
 - **Digital interface avoids interference and reduce system cost**
- **Array Microphone is the focus**
 - **Add new value to existing market**
 - **Create new applications**
 - **Increase voice recognition rate**
- **Vertical integration with DSP, A/D, D/A, and other functions**

Long Term Driving Forces

- **The closer to users mouth the better**
 - **The smaller it is the easier for the best placement**
- **The more microphones the better**
 - **Array microphone is still the best technology in the noisy environment**
- **The lower power consumption the better**
- **The smaller distance between microphones the better**
 - **Easy to manufacture**
 - **Low cost to production**
- **The more integrated the more new applications**
 - **DSP, AD/DA, voice control**

The Bottle Neck is the Algorithm!

The Value of Integrated Microphone Solution



Wind Noise Suppression

2004 Sebring Touring

Speed: 65mph

Position: A-
Pillar



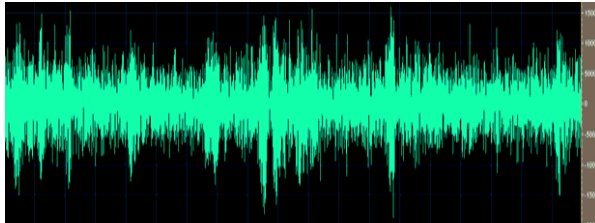
Unreleased Convertible

Speed: 63mph

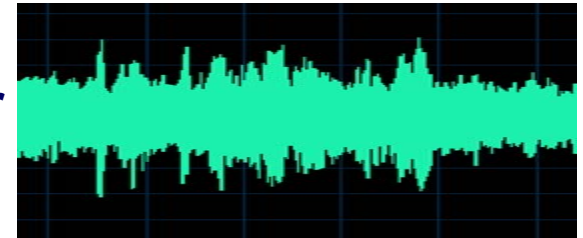
Position: Mirror



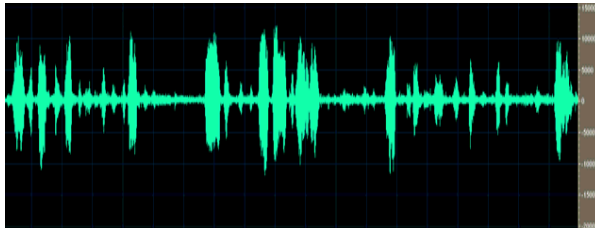
Before SAM



Competitor



After SAM



SAM

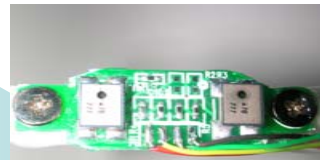


Beam-Forming Increase VR Rate



**Human
Babble**

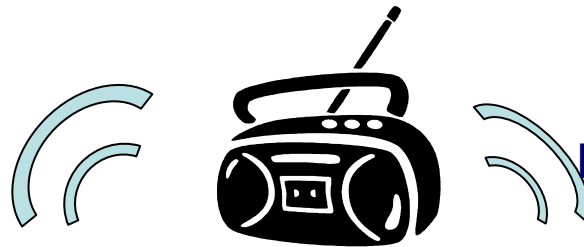
1 · 4 · 7 · 2
3



**Processed by
Small Array
Microphone**

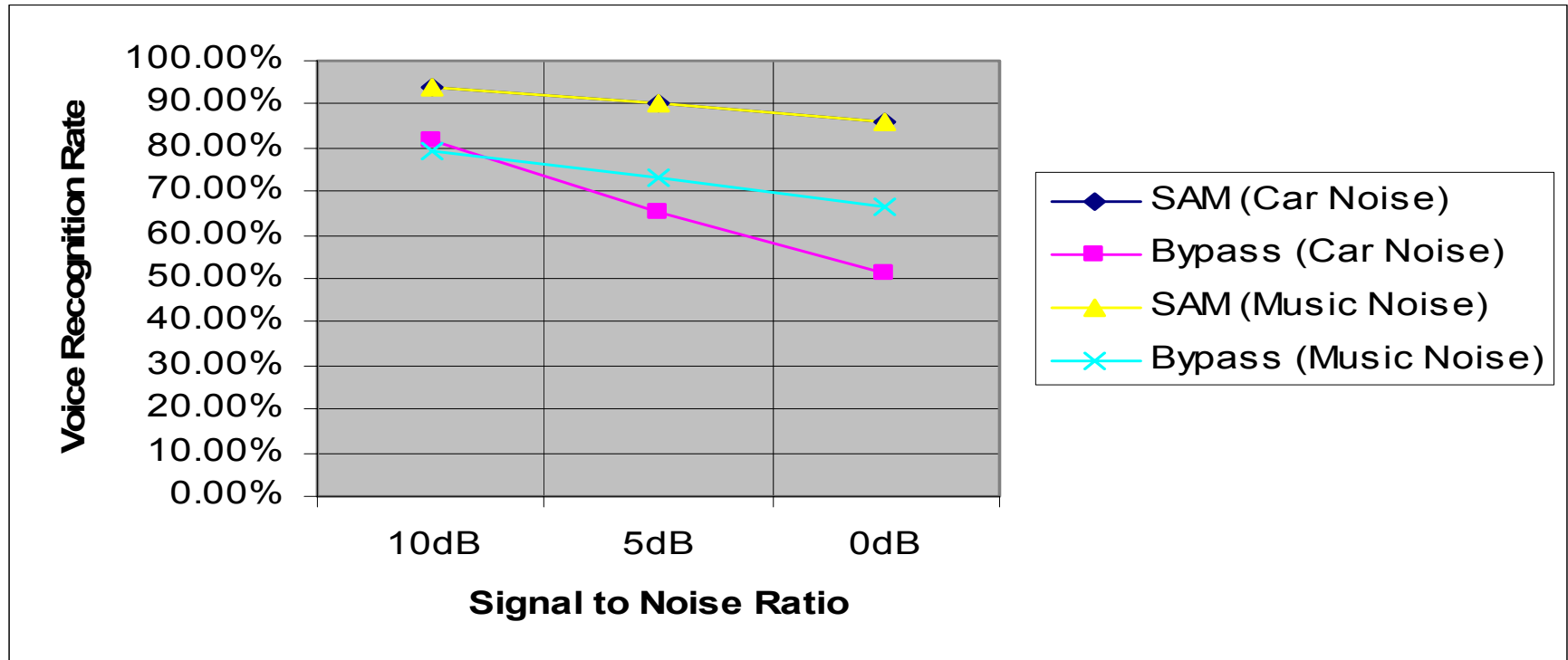
- **Suppress Non-stationary Noise**
- **Pass the In-Beam Information**

**Voice
Recognition
Engine**



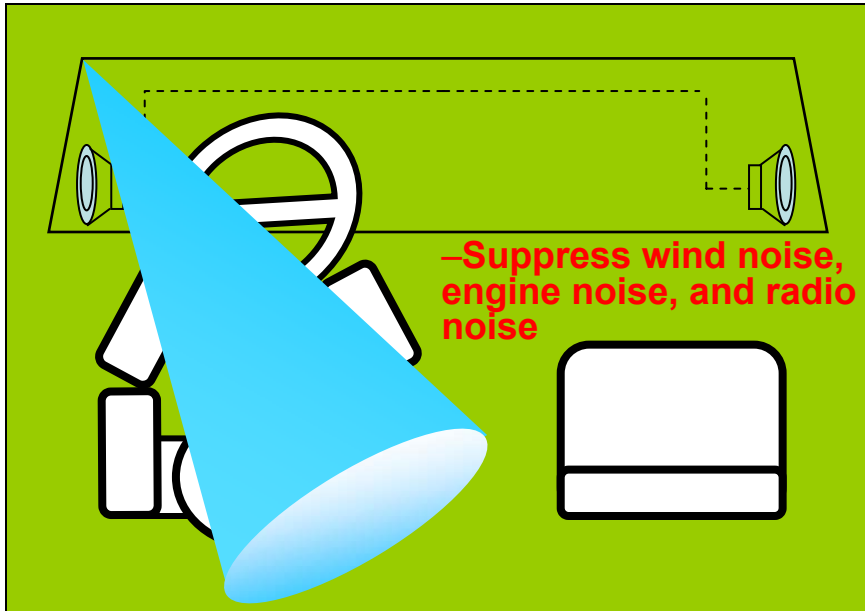
Music Background

Voice Recognition Test Results



- Digits from native speakers sourced from TI-Digits database: 10 digits by 14 users with 101 files

Value to Various Applications



Fortemedia

Applications



Applications

PC, NB, and VoIP



Compal SAM Beam-forming Based NB

Smartphone



Raku Raku PHONE III F882iES with SAM Beam-forming

Headset



mVox SAM Beam-forming and Voice Recognition headset/speaker phone

Automotive



Sanyo portable Telematics applies SAM to enhance full duplex with beam-forming

Automotive Customers



Jaguar's built-in hands free functions powered by SAM



Sanyo portable Telematics applies SAM to enhance full duplex with beam-forming



Fortemedia's SAM in 2005 Nissan TOBE Telematics system



TOYOTA



Hyundai's 2002 Spectra built-in hands free solutions use Fortemedia's SAM

PC / PC Peripherals



Asus A7 family
deploys SAM to
enable VoIP
conferencing
function



JAZZ SPEAKERS

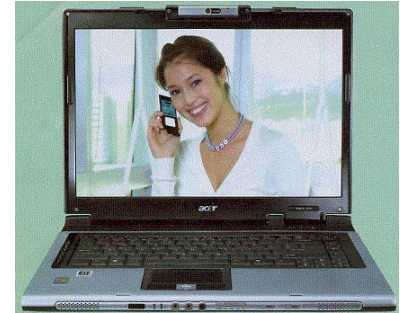
SONY



USB Mouse/ Phone



NB with “2 ears” –
SAM offers robust
noise suppression
and increase
voice recognition
rate



PCMCIA Card Phone



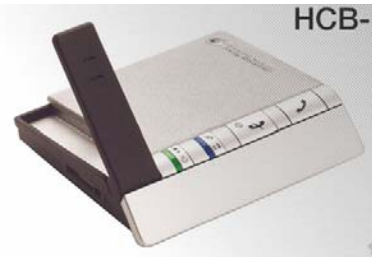
Handset / PND / Accessories



WiBro
SPH-M8000



Anycall GPS-PDA
device with SAM
to provide Beam-
forming effect



Motorola iDEN
Phone



DoCoMo Raku Raku Phone III



SAM 2 mic

“Fujitsu’s Raku Raku phone offers enhanced sound quality...and a special feature..., making the words easier for the user to understand.”

The Wall Street Journal – 10/16/06

DoCoMo’s [Raku Raku PHONE III] F882iES

- The first cell phone in the world deploying Small Array Microphone (SAM) to create Beamforming
- Suppressing traffic noise, broadcasting announcement and human babble noises by 20 dB
- Enhance the intelligibility and the clarity of the mobile phone conversation



Beamforming by SAM

Samsung “Butterfly”



- **November 7, 2006**
 - Mr. Gi Tae Lee, President of IT center, Samsung)
- **“Butterfly”**
 - CDMA + WiMAX Phone
- **Next Generation Broadband Communication**
- **Multimodal Communications**

Challenges

- **Technology**
 - **Difficulties in Packaging, Acoustic, Mechanical, and Industrial Design**
 - **Small Form Factor and Low Power Consumption**
- **Value and Cost**
 - **Perceived Value for Microphone Product is Low**
 - **Deployment and Placement of Array Microphones Critical**
- **Service and Business Model**
 - **Companies in the Supply Chain Needs to Work Together**
 - **New Business Model**
- **Still Evolving!**