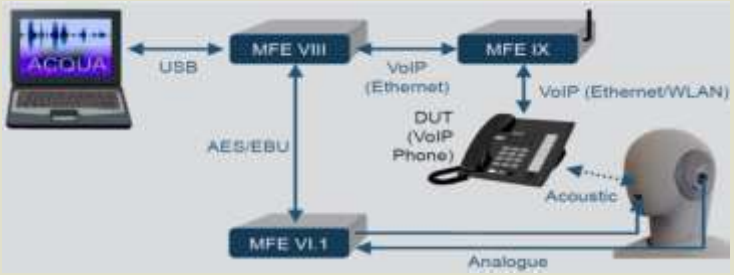
Voice Expertise

- Voice
  - In Voice business since 1973
  - Echo cancellation since 1990s
  - Invented SLIC in 1985, ~1B lines shipped
  - Industry standard Anechoic Chamber & Head Acoustic









What Can Microsemi Do for You

- **Best in Class Audio/Voice enhancement**
  - ✓ Acoustic Echo Cancellation
  - ✓ Stationary and non Stationary Noise Reduction
  - ✓ Beam forming
  - ✓ Sound Locator
  - ✓ Far field microphone pick up
  - ✓ Automatic Speech Recognition and Sound Classification to come!!
- **Provides a dedicated voice processing device with integrated FW**
  - ✓ Complete HW and FW solution
  - ✓ One stop shopping for Audio enhancement
  - ✓ Royalty Free FW
  - ✓ Integrated analog interface (codec replacement)
- **Ease design efforts**
  - ✓ Reduce integration effort
  - ✓ Complete reference designs for key market applications
    - ❖ IP Phone
    - ❖ IP camera
    - ❖ More to come!!
  - ✓ Development Tools
  - ✓ SW API/reference code
  - ✓ Auto tuner
    - ❖ Speed up tuning process
  - ✓ Audio Test Lab
    - ❖ Industry standard test lab for conformance testing

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Application Focus







Digital Phone Solutions	IP Camera Solutions	Home Security Solutions

▪ ZL38040
  ▪ Single Channel NB/WB AEC
▪ ZL38042
  ▪ Super Wideband Multi Channel AEC (3 Channels)
	▪ ZL38050
	  ▪ Single channel AEC/NR/ mid field pick up (3m)
	▪ ZL38051
	  ▪ Single channel NB/WB AEC
	  ▪ Far field Microphone
	  ▪ Direction of Arrival
	  ▪ Beam forming
		▪ ZL38060
		  ▪ Single channel AEC/NR/ mid field pick up (3m)
		▪ ZL38062
		  ▪ Single channel NB/WB AEC
		  ▪ Far field Microphone
		  ▪ Direction of Arrival
		▪ ZL38063
		  ▪ Single channel NB/WB AEC
		  ▪ Far field Microphone
		  ▪ Beam forming
		  ▪ Automatic Speech Recognition

New Hardware Platform - Timberwolf™

Hardware

Microsemi Timberwolf™ Family

Dedicated Audio Processor

- Offload Host Processor MIPS
- Optimize for Audio with hardware accelerator
- Low power mode @ 30mW



Patented Voice & Audio IP

- Best-in-class echo cancellation and noise reduction
- Leading edge audio intelligence features
- Royalty free & License free firmware

Validated Reference Design

- Field proven to pass industry standards
- Quick turnkey development



Easy to use MiTuner™ Tool

- Tune for best audio performance
- Fast TTM

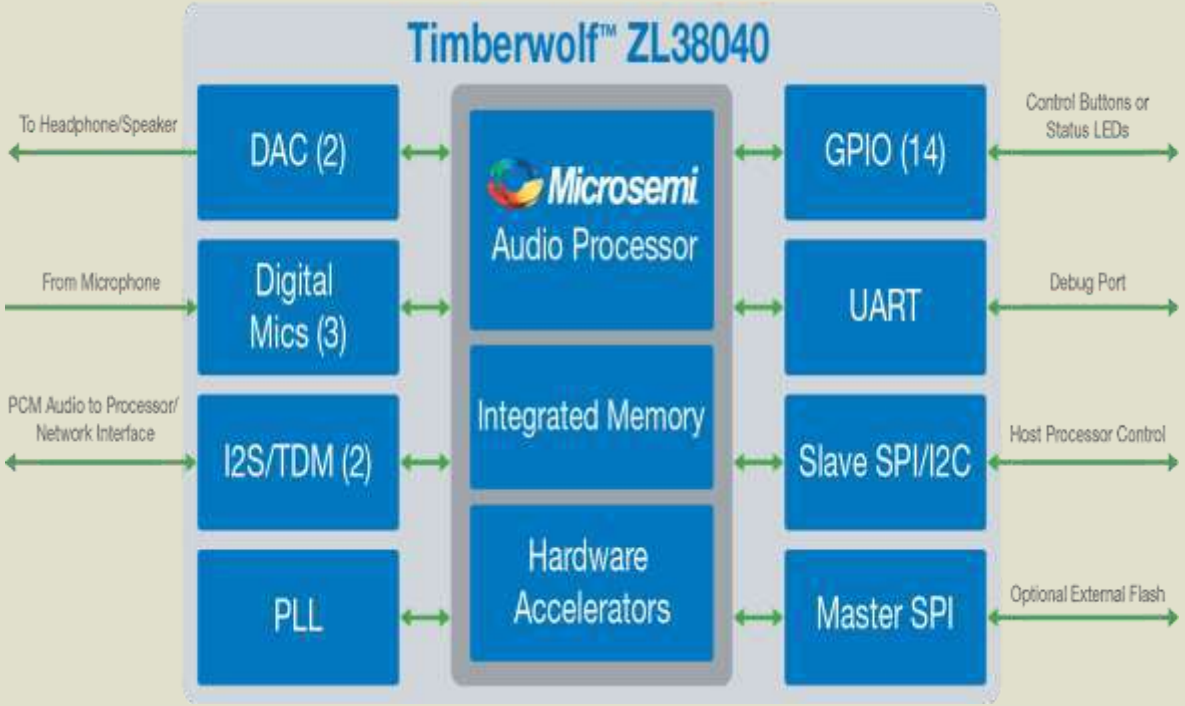


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Platform Key Block Diagram

HW Features

- 300MHz Processor
- Voice Specific HW accelerators
- 1 to 4 Digital Mic input
- DAC with internal 16 Ohm speaker Driver
- Two PCM/I2S ports for additional audio expansion



What is Microsemi AcuEdge™ Technology



Patented Audio Algorithms

- Optimizing speech intelligibility
- Compliant with industry standards
- Additional features include comprehensive audio analytics capabilities

Robust infrastructure and technical support

- Strong lineage of voice expertise
- Programmable codec solutions introduced by AMD in early 90's
- Mitel's Line Echo Cancellation group and Acoustic Echo Cancellation devices from Zarlink

Validated design in Timberwolf family

- Quick time to market achieved
- Easy to use development tools
- Performance optimization achieved via our automated tuning system: AutoTuner™

Best in Class Audio/Voice enhancement

- Acoustic Echo Cancellation
- Stationary and non Stationary Noise Reduction
- Beam forming
- Direction of Arrival
- Far field microphone pick up
- Automatic Speech Recognition and Sound Classification to come!!

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Microsemi Timberwolf™ & AcuEdge™ Deliverable

Timberwolf™ Silicon

Feature	Benefit
300MHz Processor	Flexible 4 MAC core to implement more advances features
Voice Specific HW accelerators	Off loads DSP to allow more feature to be implemented
1 to 4 Digital Mic input	Allow more advance multi-channel to be implemented
2 Audio quality DACs w ith internal 16ohm speaker Driver	Support narrow, wide, super wide and audio bandw idth. Driver can directly drive handset /headphone speakers
Pow er regulation (LDO)	Requires only one pow er rail
Tw o PCM/I2S ports for additional audio expansion	Flexible interface
Low pow er mode	<50uW standby <0uW ultra low pow er standby

+

AcuEdge™ FirmWare

Feature	Benefits	Specifics
AEC	Provides full duplex communications	>60dB cancellation
Single Microphone Stationary Noise Reduction	Removes noise like fan noise/AC noise	Programmable up to 30dB
Single Microphone Non Stationary Noise Reduction	Removes noise like cafeteria/traffic noise	Programmable up to 30dB
Sound Location (Direction of Arrive)	Identifies the location of a sound	+/- 10 degree accuracy
2 or 3 Microphone Beam Forming	Isolates a sound source in a desired direction	Programmable up to 30dB off beam attenuation
Far Field Microphone Pick up	Automatically zooms in on low signal w hile preventing audio clipping due to near field sources	Programmable up to 20m
3 microphone echo cancellation	Reduces special distortion due to signal addition	
Sound Classification	Can detect and determine non voiced sounds	T3/T4 alarm signals, Glass Breaking
Automatic Speech Recogntionals	Provide voiced command and control	5m pick up, 100 phrase vocabulary

Ideal Audio Solution

- A hands-free audio processor that takes care of the front end processing with audio pickup anywhere in a room that enable clear communication with ease of design, low cost and low power.
- Going into multiple applications

REAL TIME
Audio Processing

















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New Firmware Family - AcuEdge™

Available Today/Next 3 Month

Microsemi AcuEdge™ Technology - Sound Locator

Sound Locator (Direction of Arrival)

- Does not track in beam sources
- +/- 10 degree accuracy
- Can be used to pan security cameras towards an off beam source or to select a speaker in a conference room

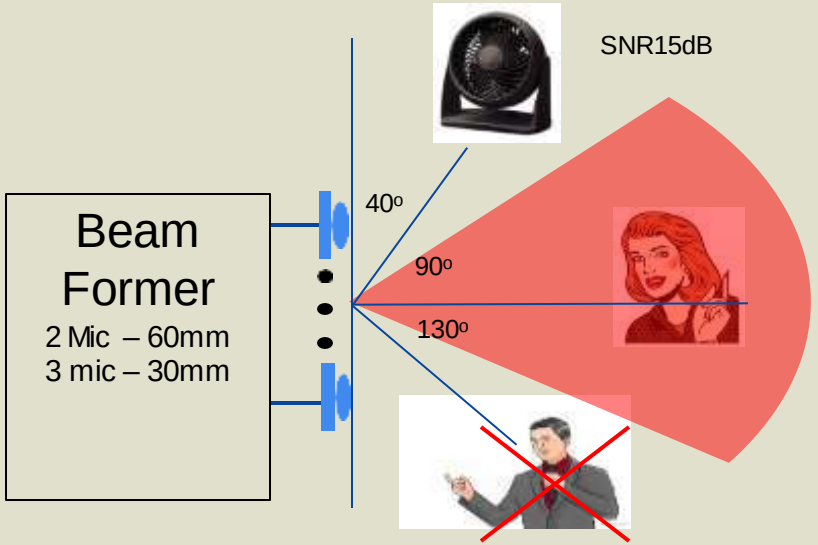


Microsemi AcuEdge™ Technology - Beam Forming

Beam Former

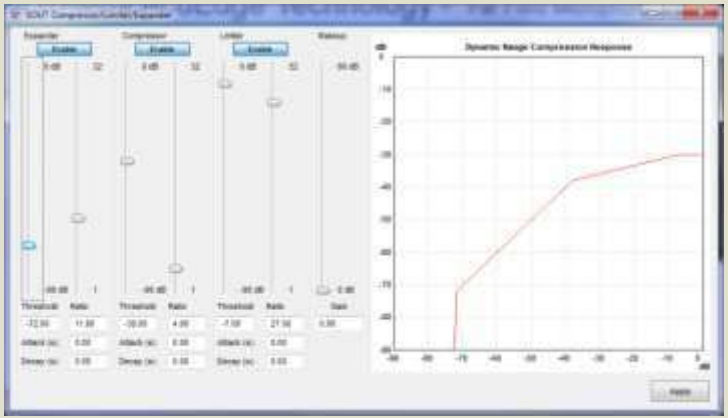
- Amplifies signal within the beam and Attenuates anything outside the beam
- Improves distance of microphone pick up and reduce interfering sounds
- 2 and 3 microphone solution available



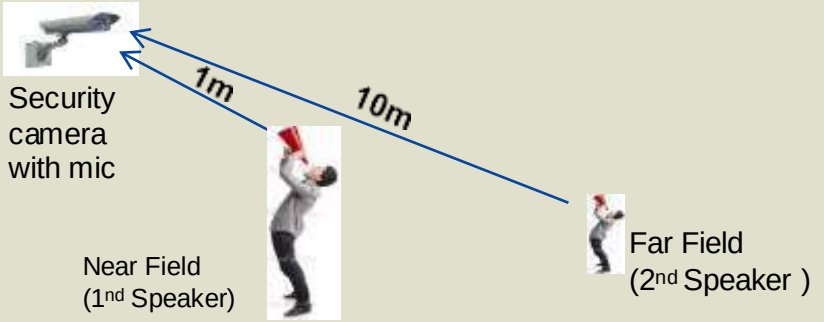


Microsemi AcuEdge™ Technology - Far Field Microphone Pick up

- Far Field Microphone Pick up
  - Far Field Microphone (pick up 10m)
  - 15m = ~35dB signal loss
  - Instant attach and release time
  - Prevents audio clipping



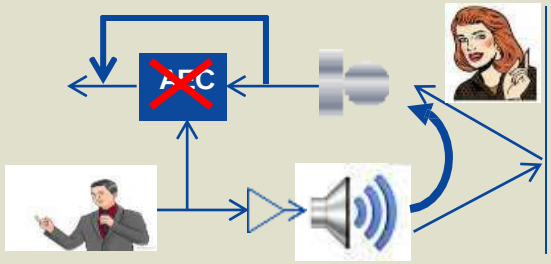
Fully Programmable

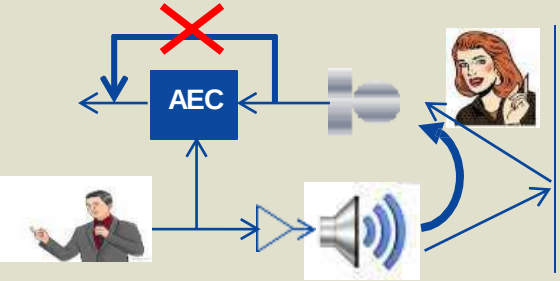


30m Example

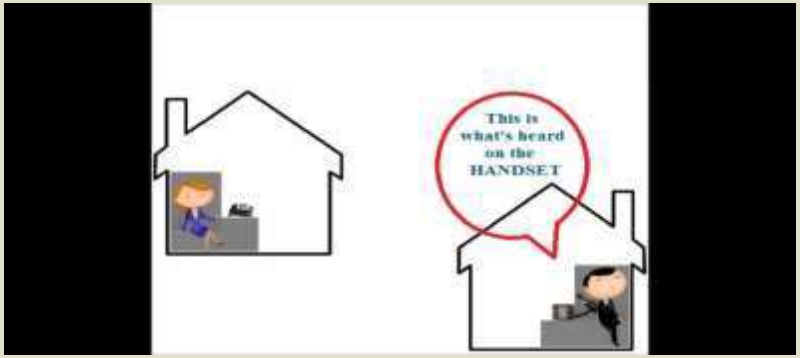


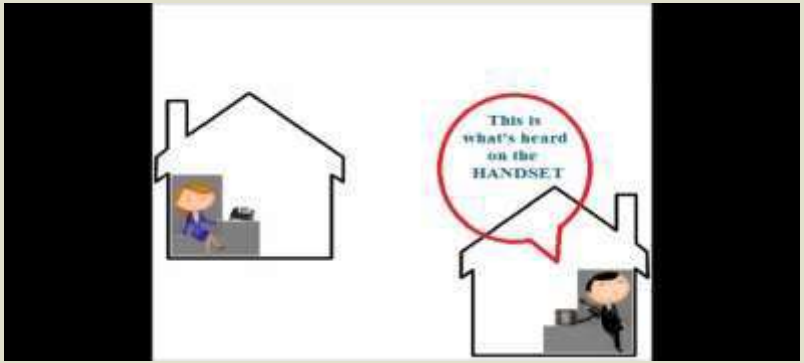
Microsemi AcuEdge™ Technology - Acoustic Echo Cancellation











Microsemi AcuEdge™ Technology - Acoustic Echo Cancellation

Performance

Main Test Results		
Parameter	**Results**	**Comment**
TCL During Single Talk	61.42 dB	TIA 920 requires >45dB
TCL During Double Talk	37.65 dB	TIA 920 requires > 27dB to meet Behavior 1
Double Talk Attenuation	2.06dB	ITU-T requires <3dB to meet Behavior 1
PESQ Scores	Rx Male = 4.45 Rx Female = 4.06 Tx Male = 4.35 Tx Female = 4.41	

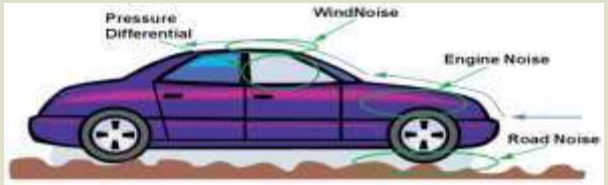
Notes:

The results are dependant on the speaker , microphone and device enclosure.
These tests were performed on a Mitel Super 420

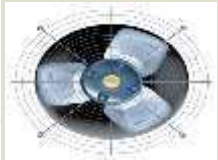
Types of Noise

Stationary Background Noise

- Noise that has consistent level and pitch



Road Noise



Fans

Quasi-Stationary Background Noise

- Mixture of multiple non-stationary noise to a point where the combined noise has stationary noise characteristics (Babble)



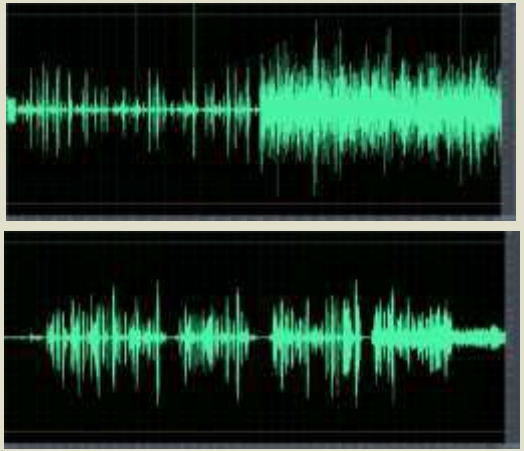
Cafeteria Noise

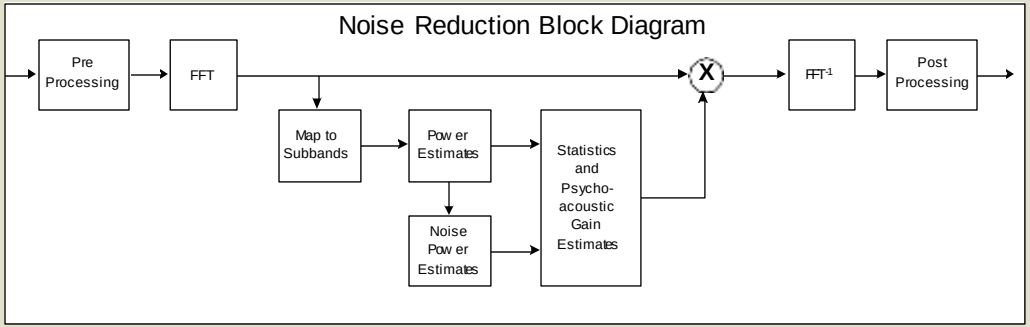


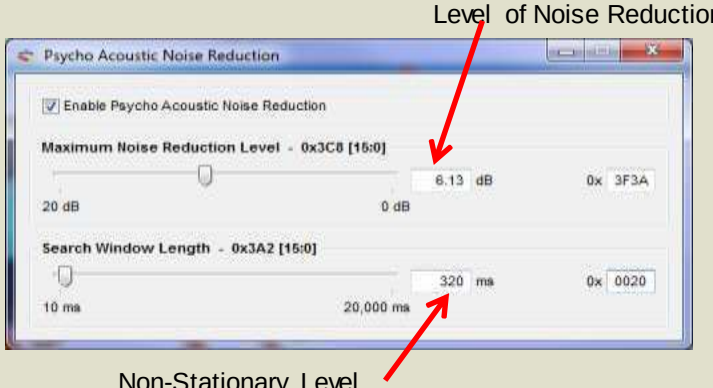
Traffic Noise

Microsemi AcuEdge™ Technology - Noise Reduction

- Excessive noise increases the overall network cost or bandwidth and fatigue for user.
- Noise reduction algorithm remove noise picked up by the microphones in the room so the noisy signal isn't transmitted to the remote party, the noise reducer does nothing to help the people in the local room who are stuck with the noise sources.
- Noise reduction performance significantly improve perceive voice quality for remote party.

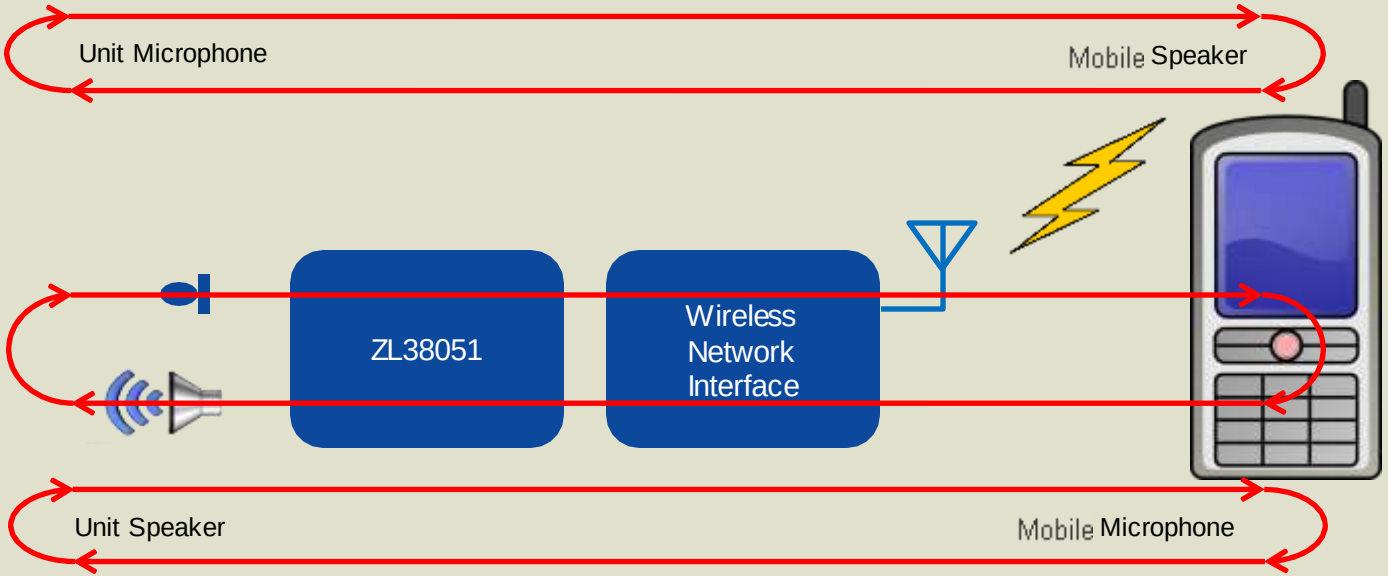






3 Path Howling Cancellation

- Needed in systems where both ends of the communication path may be in the same acoustic environment
  - Baby monitors
  - Emergency services radio system



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New Firmware Family - AcuEdge™

Development (Next 6 Months)

Microsemi AcuEdge™ Technology - Sound Classifier

The AcuEdge™ Sound Classification offers a key feature in the security, connected home and industrial markets. The sound classifier identifies specific sound from the environment and report this back to the host.

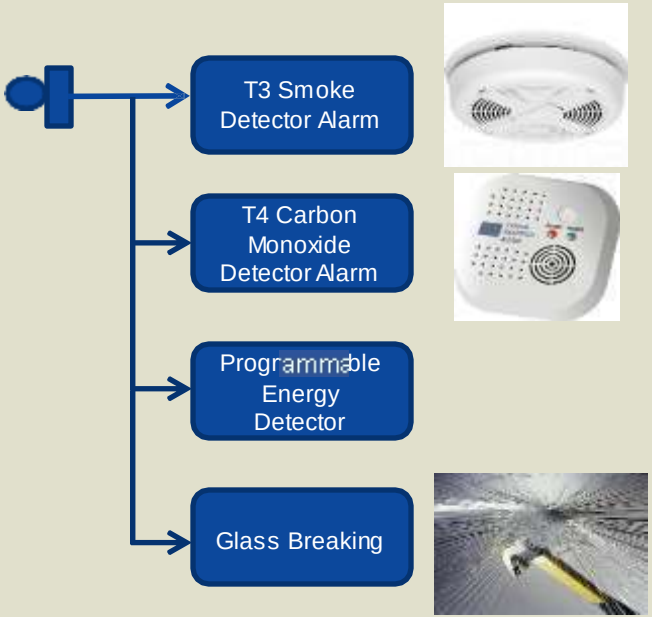
In the security market there are two main types of sounds that need to be identified. These are alarm signals such as T3 smoke detector and T4 carbon monoxide detector alarms. The sound classifier detects alarms in the presence of interfering signals such as music, other people talking or other alarms.

Features

- Glass Breaking Detector
- T3 Smoke Alarm detection
- T4 Carbon Monoxide Alarm Detection
- User programmable Energy Detection

Benefits

- Allows networked alarms that are not on the network to be detected by the connected home system
- Programmable energy detector allows for customization of alarm detection
- Pattern Matching allow for more complex audio signals like glass breaking to be detected.



Microsemi AcuEdge™ Technology - Automatic Speech Recognition

ASR Features

- Choose, edit and create your own Trigger and Command phrases
- Up to 100 command pronunciations
- Natural language understanding
- Phrase spotting
- Low power standby of VAD (Voice Activation Detection)
- Simple, host interface.

Voice Enhancement Features

- Noise Reduction
- Far Field Microphone



High accuracy

High accuracy for recognizing concept words with EFM



Low cost

FW runs on the Microsemi Timberwolf platform



Customizable

Phrases can be edited and added within minutes



Experience

Better user experience because of elegant simple design

Available languages

- English (USA, UK, Australian, India)
- Japanese (Japan)
- Chinese (Mandarin, Cantonese)
- Spanish (Spain, Mexico)
- Hindi (India)
- Portuguese (Brazil)
- French (France, Canadian)
- German (Germany)
- Italian (Italy)
- Turkish (Turkey)
- Dutch (Netherlands)
- Korean (Korea)

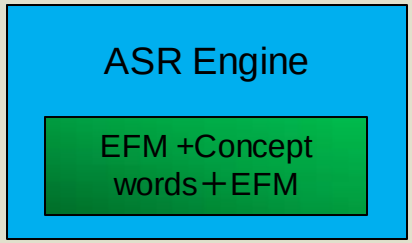
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Microsemi AcuEdge™ Technology - Automatic Speech Recognition

Steps of Activation in ASR

- VAD (Voice Activation Device) listens for speech (Keeps MCU in low power mode until speech)
- Does "Trigger Phrase" match? (No = Go back to low power mode, Yes = now listen for "Command Phrases")
- Does "Command Phrase" match (No = Go back to low power mode, Yes = Send information on match to customers software)
- Goes back to VAD mode

The **Enhanced Filler Model (EFM)** is an AI based garbage model to recognize and tag out-of-vocabulary words, i.e. words other than concept words.





Impact of the Enhanced Filler Model (EFM):

No need to gather data to develop a large SLM grammar

- shorter development time
- Lower development costs

Higher recognition accuracy of keywords due to relatively small vocabulary size

- Better ability to handle new speech patterns
- More robust to noise
- Easy to tune keywords
- Easy to add features

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Automatic Speech Recognition Tools

- Web based tool
  - Text entry
  - Trigger word selection
  - Distinctiveness/Confusability rankings allows designers to generate a robust speech library
- Further training can be done using voice samples



Define or edit a grammar

Use this page to define the vocabulary for your grammar by adding, editing or removing keywords. The recommended vocabulary size is about ten keyword triggers and commands in total. You may define multiple triggers and commands; the recommended length for either type is in the range of two to five words each.

Add Keyword

Average Distinctiveness 92.24%
Average Confusability 0.89%

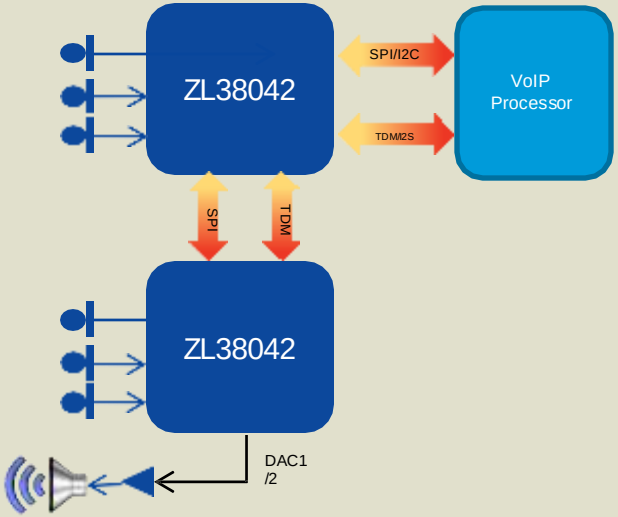
Keyword/Phrase	Trigger?	Code	Distinctiveness	Confusability	Confusability Related Phrase	Actions
Light switch	True	0002	96.11%	2.11%	light off	Edit Delete
Turn on	False	1000	90%	0.13%	light off	Edit Delete
Intruder alert	False	2000	91.67%	0%	Nothing	Edit Delete
going to bed	False	0100	97.88%	0%	Nothing	Edit Delete
five minutes	False	1100	90.5%	0.26%	Light switch	Edit Delete
light off	False	2100	88.38%	2.86%	Light switch	Edit Delete

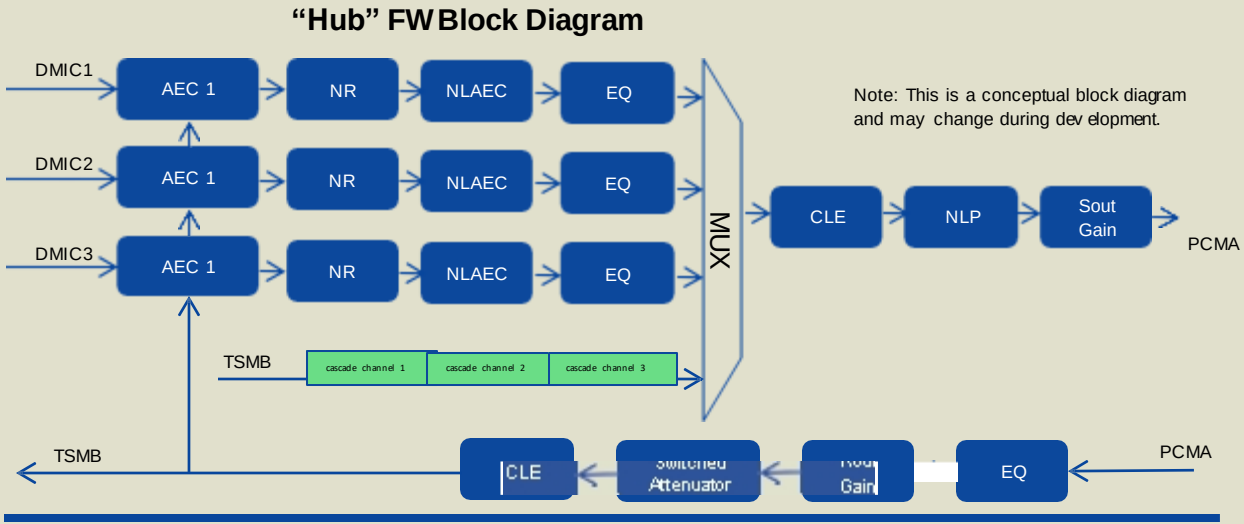
Export Grammar

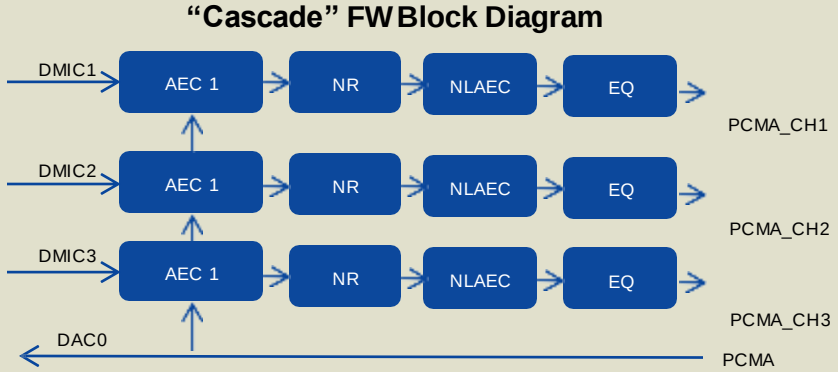
Estimated ROM size: 143 kB
Estimated RAM size: 17 kB

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Microsemi AcuEdge™ Technology – Multi Microphone AEC







Product Selection Guide

Features	IP Phones			IP Cameras		Connected Home		
	ZL38040	ZL38042	ZL38043	ZL38050	ZL38051	ZL38060	ZL38062	ZL38063
Acoustic Echo Cancellation	256ms NB/WB	256ms NB/WB **170ms SWB**	256ms NB/WB **170ms SWB**	256ms NB/WB	256ms NB/WB	256ms NB/WB	256ms NB/WB	256ms NB/WB
Multi Channel AEC	NO	**YES**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Far field mic	NO	NO	NO	NO	YES	**NO**	**YES**	**NO**
Sound Classification	NO	NO	NO	NO	**NO**	**NO**	**YES**	**NO**
Automatic Speech Recognition	NO	NO	NO	NO	NO	**NO**	**NO**	**YES**
Sound locator	NO	NO	NO	NO	YES	**NO**	**YES**	**NO**
Line Echo Cancellation	YES	NO	NO	NO	NO	YES	YES	NO
Beam Forming	NO	NO	**YES**	NO	NO	NO	**NO**	**NO**
Noise reduction	YES	YES	YES	YES	YES	YES	YES	YES
Keypad scanner	YES	YES	YES	NO	NO	YES	YES	NO
Multi-tone generation	YES	YES	YES	YES	YES	YES	YES	YES
DTMF detection	YES	YES	YES	NO	NO	YES	YES	NO
Call Progress Tone detection	YES	NO	NO	NO	NO	YES	YES	NO
Caller ID Type 1 & 2 detection	YES	NO	NO	NO	NO	YES	YES	NO
Signal mixing- 48 kHz music mixed with 8 /16 kHz voice	YES	YES	YES	YES	YES	YES	YES	NO
Howling detection/rejection	YES	YES	YES	YES	YES	YES	YES	NO
Supported encoding/decoding	16 bit Lin G.711/22	16 bit Linear G.711/22	16 bit Linear G.711/22	16 bit Lin G.711/22	16 bit Lin G.711/22	16 bit Lin G.711/22	16 bit Lin G.711/22	NO
Equalizer	YES	YES	YES	YES	YES	YES	YES	NO
48 kHz bypass mode	YES	YES	YES	YES	YES	YES	YES	NO
Configurable Crosspoint Switch	YES	YES	YES	YES	YES	YES	YES	YES

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ZL3804x Hands-free Phone Processor

ZL3804x IP Phone Roadmap

64 pin QFN



Enhanced Wideband AEC

Production NOW

64 pin QFN



Super Wideband Multi Channel Wideband

RTSamples March ‘15

64 pin QFN



Super Wideband with Beam Forming

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