

Voice Recognition and Triggering

SLYW064

Where it could be used – Far Field Detection



“Find all movies
by Michael
Keaton”



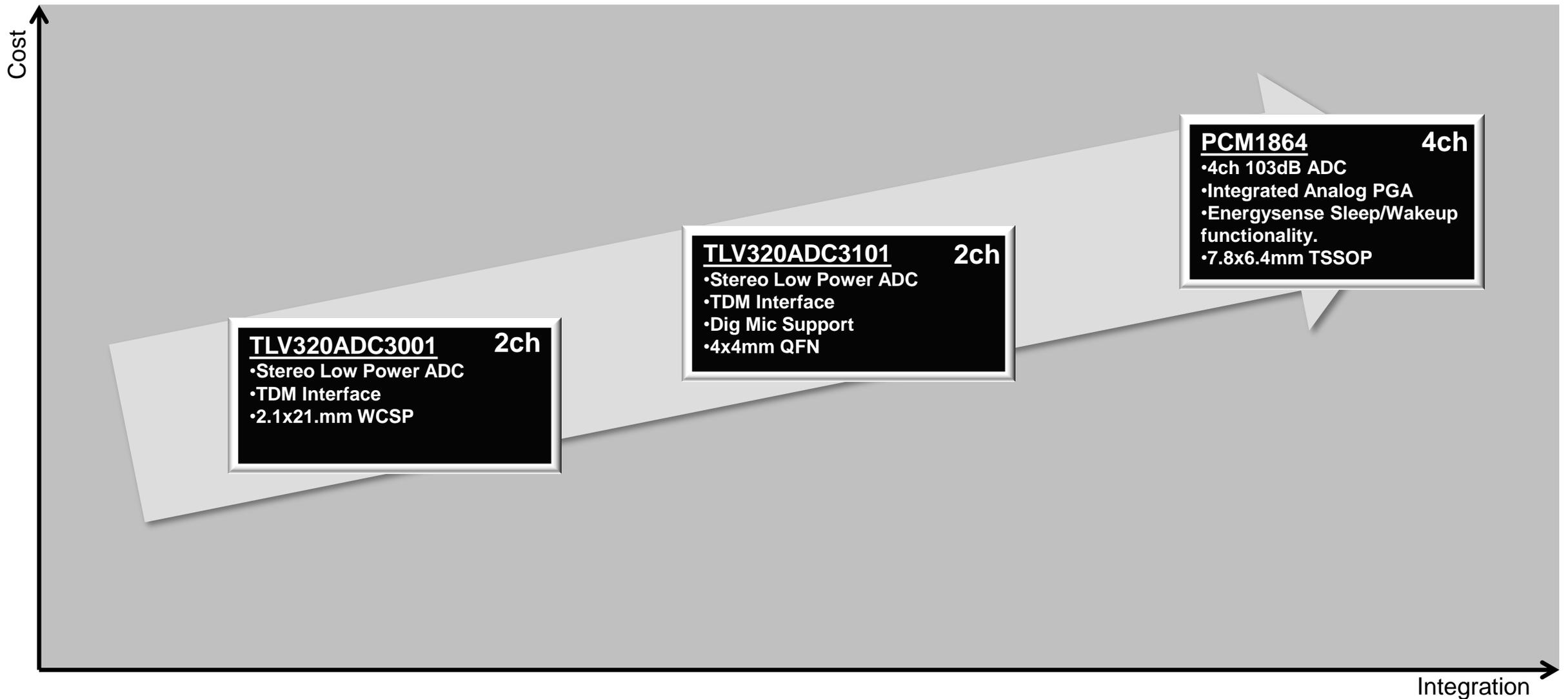
“Scan this
page and
print four
copies”

Audio solutions for voice recognition

- TLV320ADC3101 ADC (x4)
- TLV320DAC3203 DAC
- TPA3110D2 15W Class D Amplifier
- DM3725CUS100 Digital Media Processor

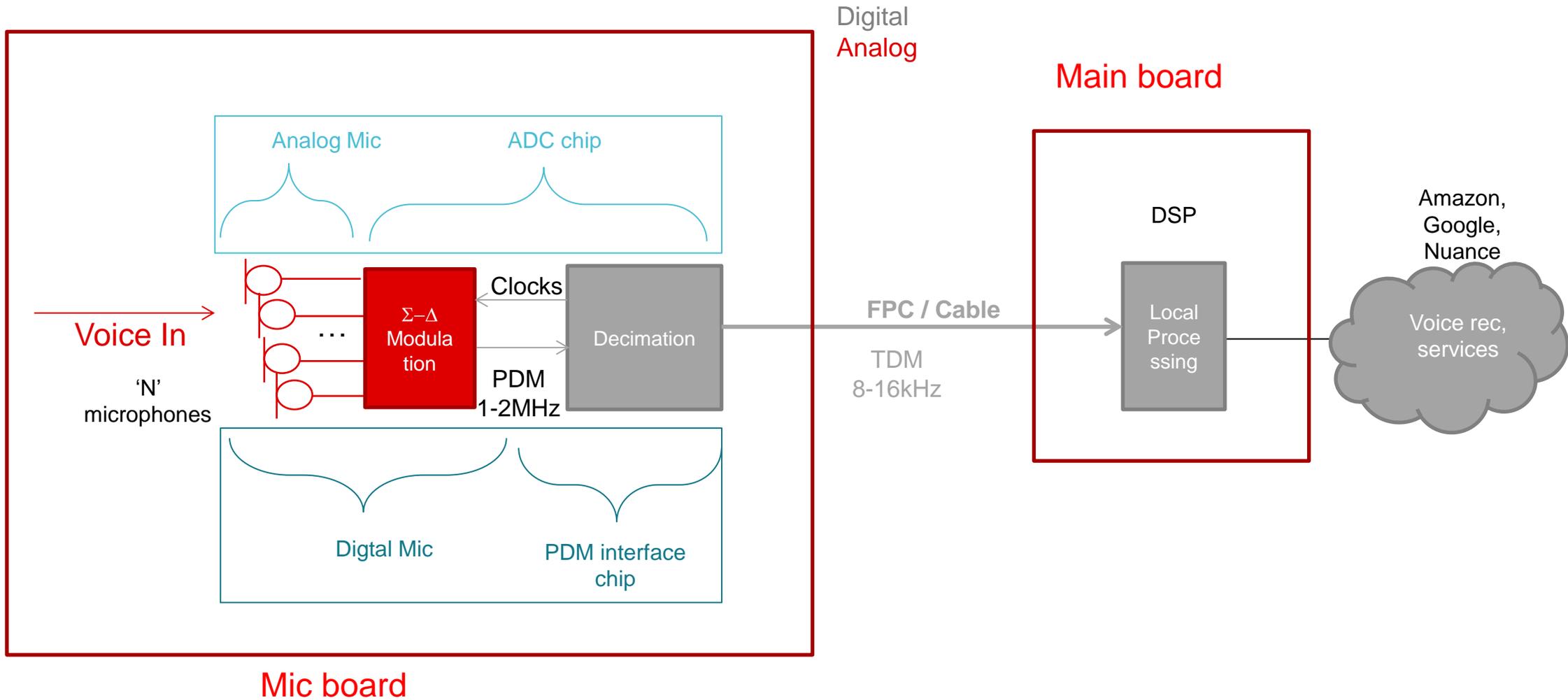


Voice Capture Front Ends (ADC's with mic pre-amps)

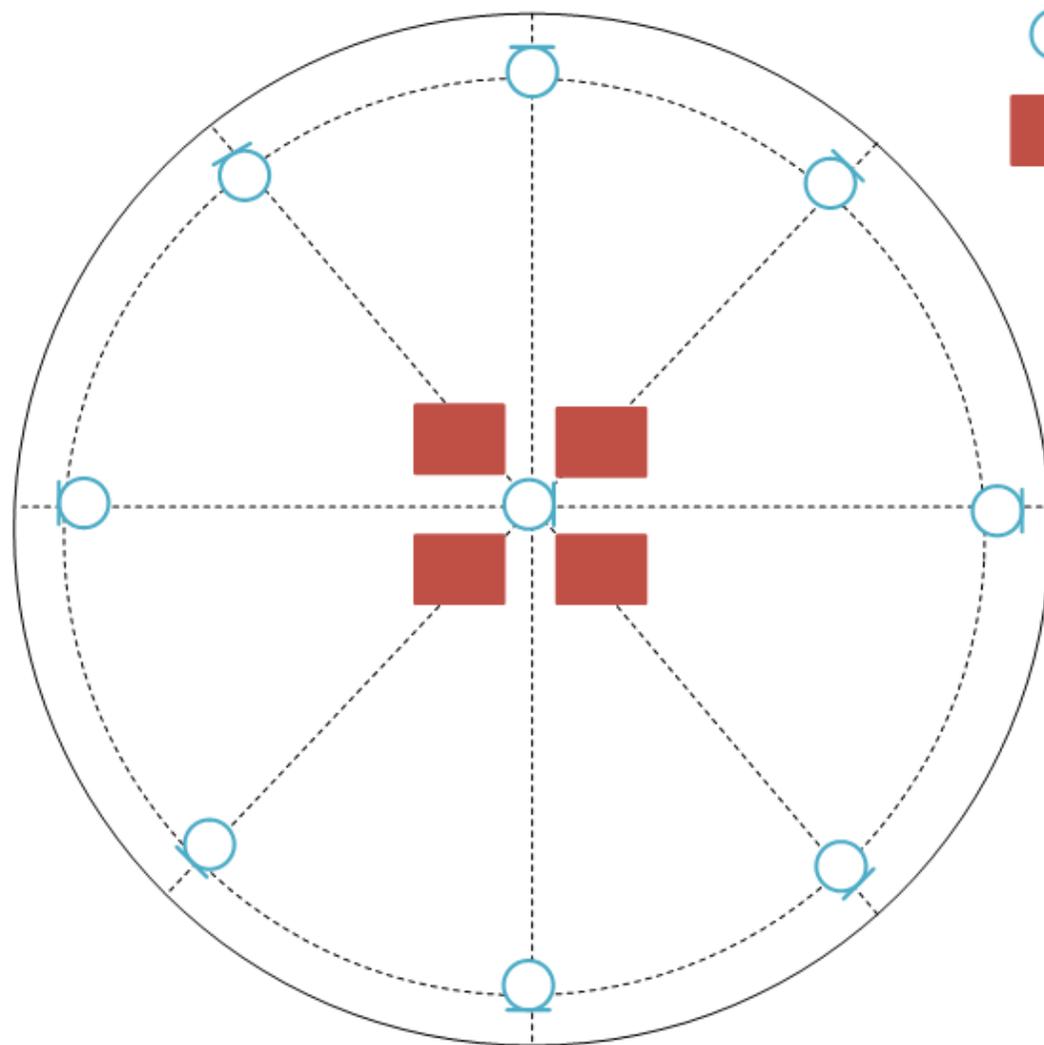


TI Voice Capture Solutions

Emerging architecture for Voice



Basic Setup



 Microphones*

 TI DACs*

*Number Required and position depends on solution

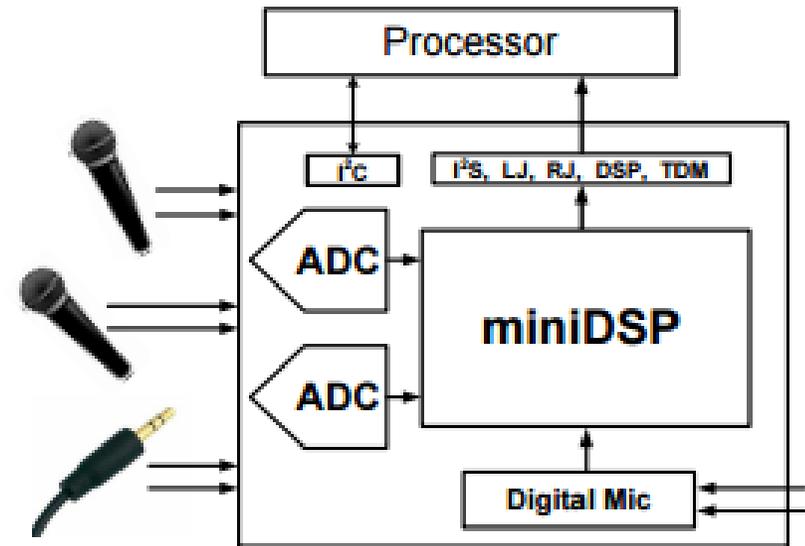
TLV320ADC3101

Benefits

- Lowest Cost
- Low Power
- TDM mode allows for multiple chips to connect together
- Analog & Digital Microphone support

Specifications

- 92db SNR
- ~17-mW stereo record @48kHz
- 2 stereo analog channels



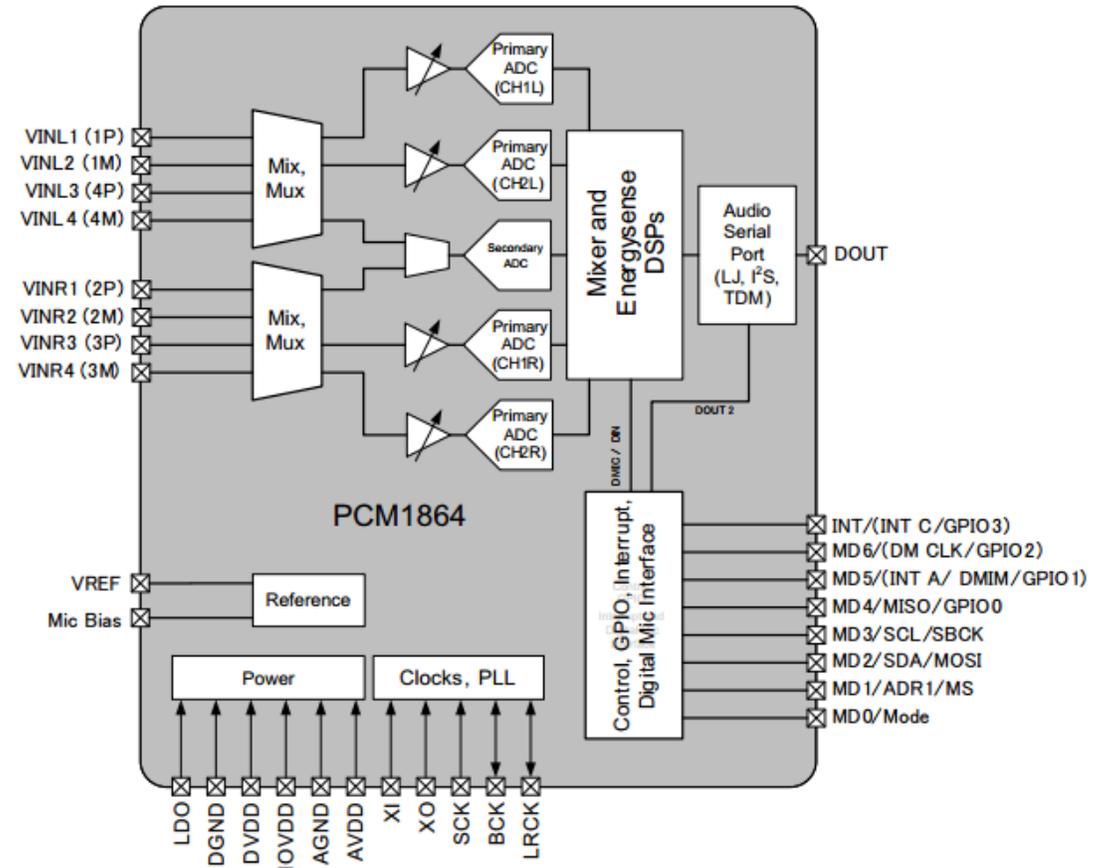
PCM1864

Benefits

- Smaller solution Size (more channels/chip)
- Very high ADC recording quality
- TDM mode allows for multiple chips to connect together
- Analog & Digital Microphone support

Specifications

- 103db SNR
- ~128-mW stereo record @48kHz
- 4 stereo analog channels



Solution Comparison

Choose **TLV320ADC3101** if:

- Power Consumption is critical
- Lowest cost for 1-2 channels
- Need 'distributed' hardware

Choose **PCM1864** if:

- Most cost effective for 4-8 channels
- Need the best sound recording quality (SNR)

Voice Recognition System Design DSP + AAP

- Evaluate Speech pre-processing & voice recognition using TI ADC and DSP solutions
 - Multi-channel audio input from 8 microphones in circular array featuring 4-channel **PCM1864 ADC**
 - Real-time processing of audio signals featuring beamforming, noise filtering, multi-source selection provides clean put to speech engine

Real-time Demo: 4Q16

TI Designs Q17

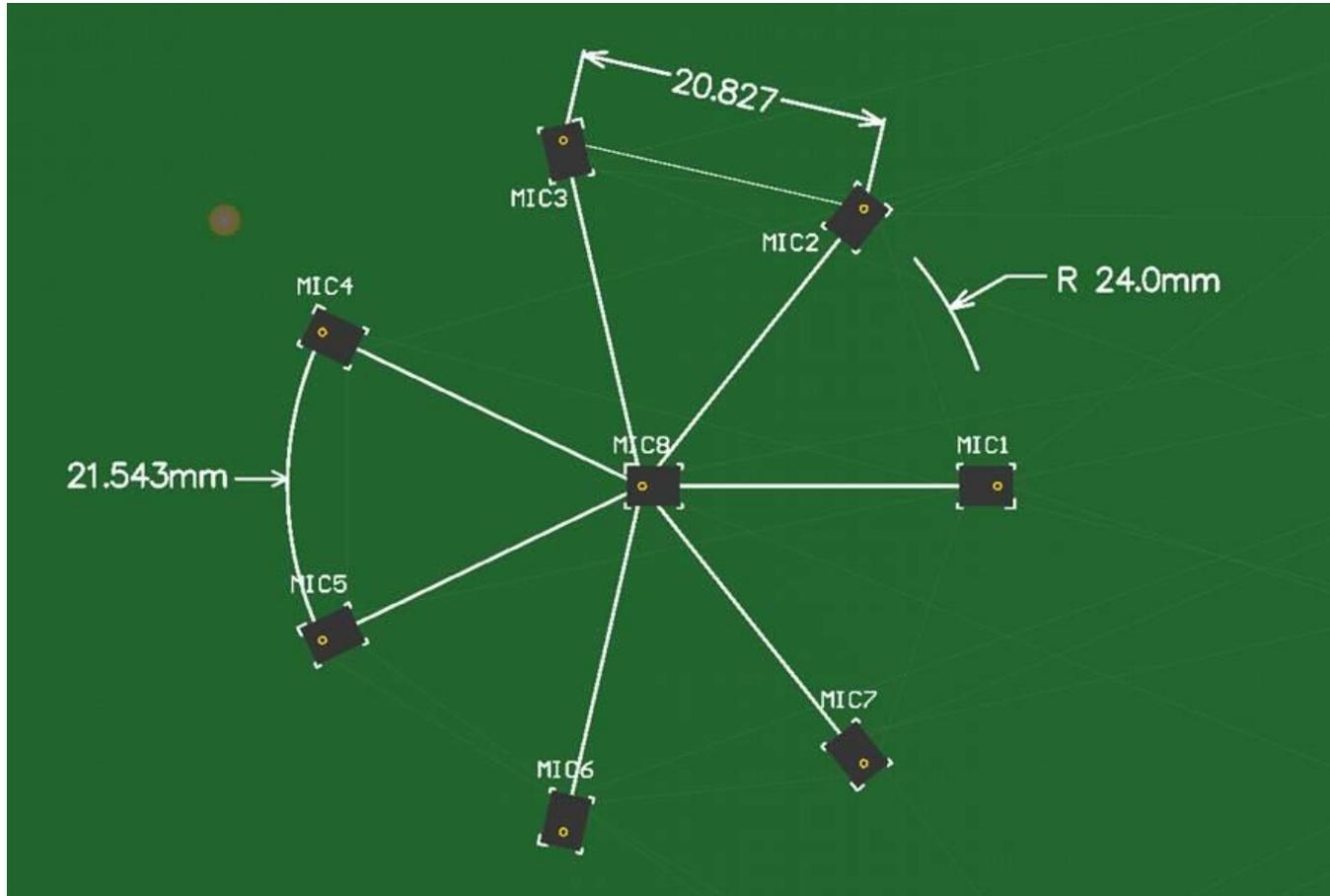


8-channel input to **PCM1864**
Voice processing on **K2G EVM**



PROCESSOR SDK

PCM1864 Voice Capture Ref Design – Mic Array



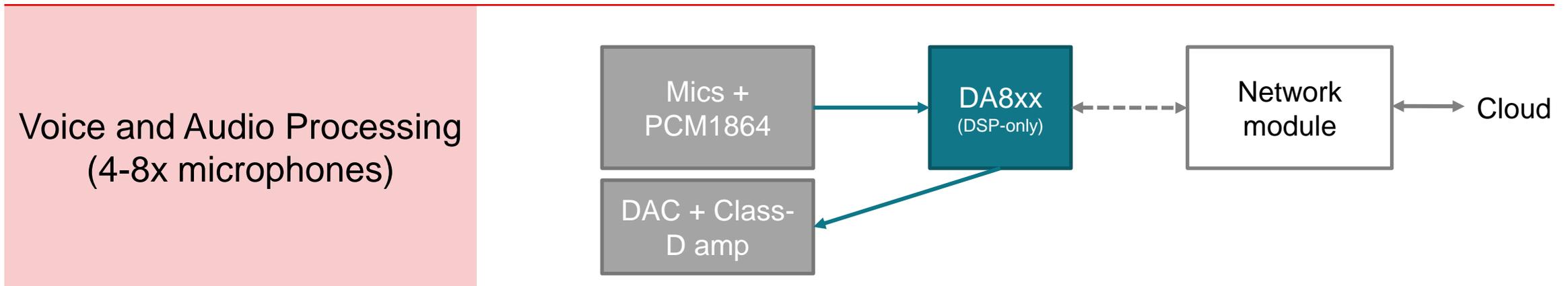
Voice Processing and Audio Front-end

– Voice Processing

- Microphone array connected to PCM1864 ADCs
- ADCs pass raw audio data to DSP
- DSP (DA8xx) performs echo reduction, beam-forming, ASNR, etc
- DA8xx passes optimized audio data to controller

– Audio Processing

- DA8xx receives audio stream from controller
- DA8xx implements post-processing algorithms for enhanced user experience
- DA8xx passes audio data to amplifier



Voice Processing Software

- Full-Duplex Acoustic Echo Canceling (AEC)
- Bi-directional Nonlinear Processor (NLP)
- Automatic Microphone Gain Control (AGC)
- Transducer Equalization (EQ)
- Dynamic Range Compression (DRC)
- Adaptive Spectral Noise Reduction (ASNR)
- High Level Compensation (HLC)
- Noise Guard (NG)
- Bi-directional Comfort Noise Generator (CNG)
- Double-talk/Coherence/Howling Detection
- Fixed Beamforming (BF)
- Adaptive Beamforming
- Multi-Microphone/Source Selection (MSS)

Fact sheet available here:

http://software-dl.ti.com/libs/aer/latest/exports/AER_Fact_Sheet.pdf

Audio Processing Software

- **IPs from PA Framework**

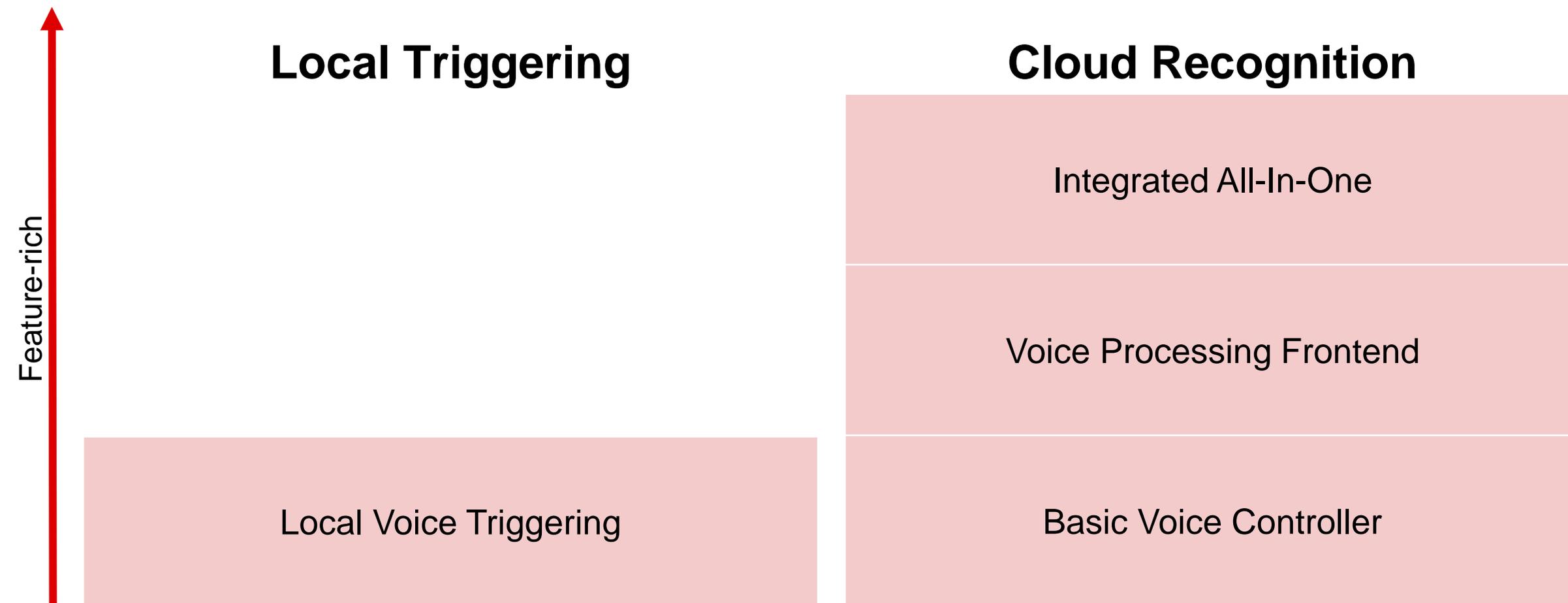
- SNG: Signal and Noise Generator
- PCM: PCM Decoder
- DEM: De-emphasis
- ASS: Audio Stream Split
- MTX: TI Matrix
- RVB: TI Reverb
- GEQ: TI GraphicEQ
- SRC: Sample Rate Converter
- DEL: Audio Delay
- PCE: PCM Encoder
- ARC: Asynchronous Rate Converter

BACKUP

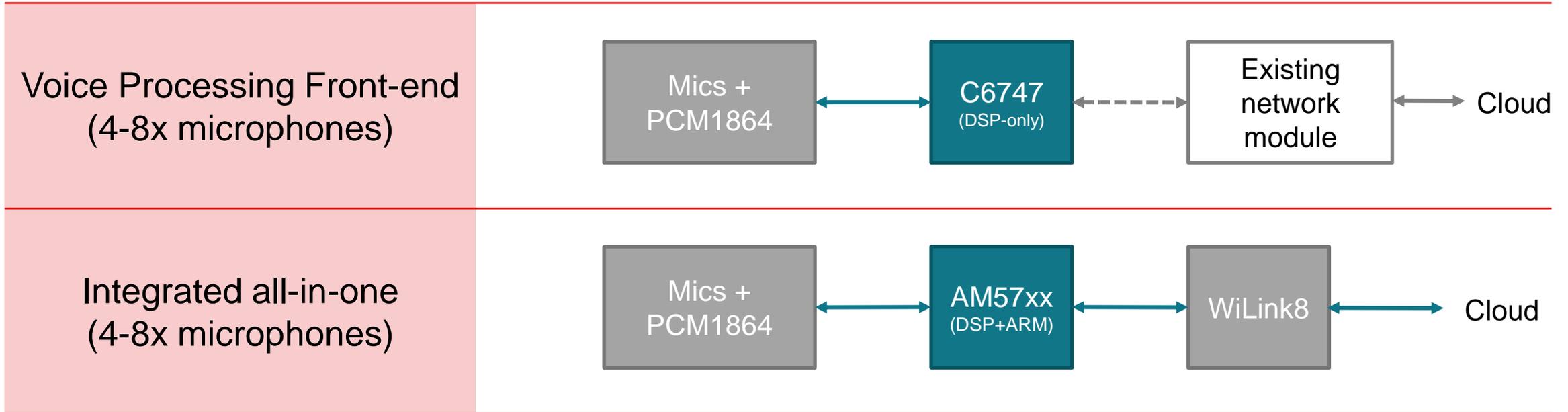
System Architecture



Types of voice recognition/triggering systems

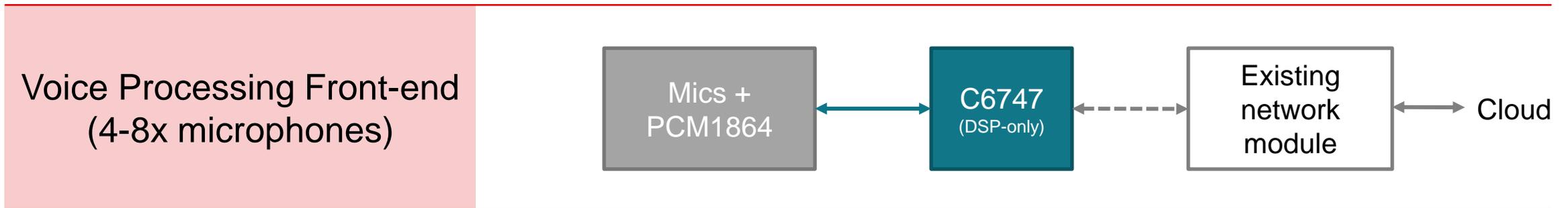


Two approaches:



Voice Processing Front-end:

- Microphone array connected to PCM1864 ADCs
- ADCs pass raw audio data to DSP
- DSP-only device (C674x) performs echo reduction, beam-forming, ASNR, etc
- DSP-only device passes optimized audio data to customer's existing wireless solution (MPU + Wireless chipset)
- Advantage: customer can re-use existing networking software solution.
- Trade-off: board space, possibly overall cost.



C6747/5

CPU CORES

- C674x DSP core at 300/400/456-MHz
 - Two-level cache memory architecture
- 128K-byte shared RAM memory
- Power/sleep controller

APPLICATIONS

- A/V Receivers supporting HD, USB
- Automotive Amplifiers
- Professional Audio
- Streaming Audio

PERIPHERALS

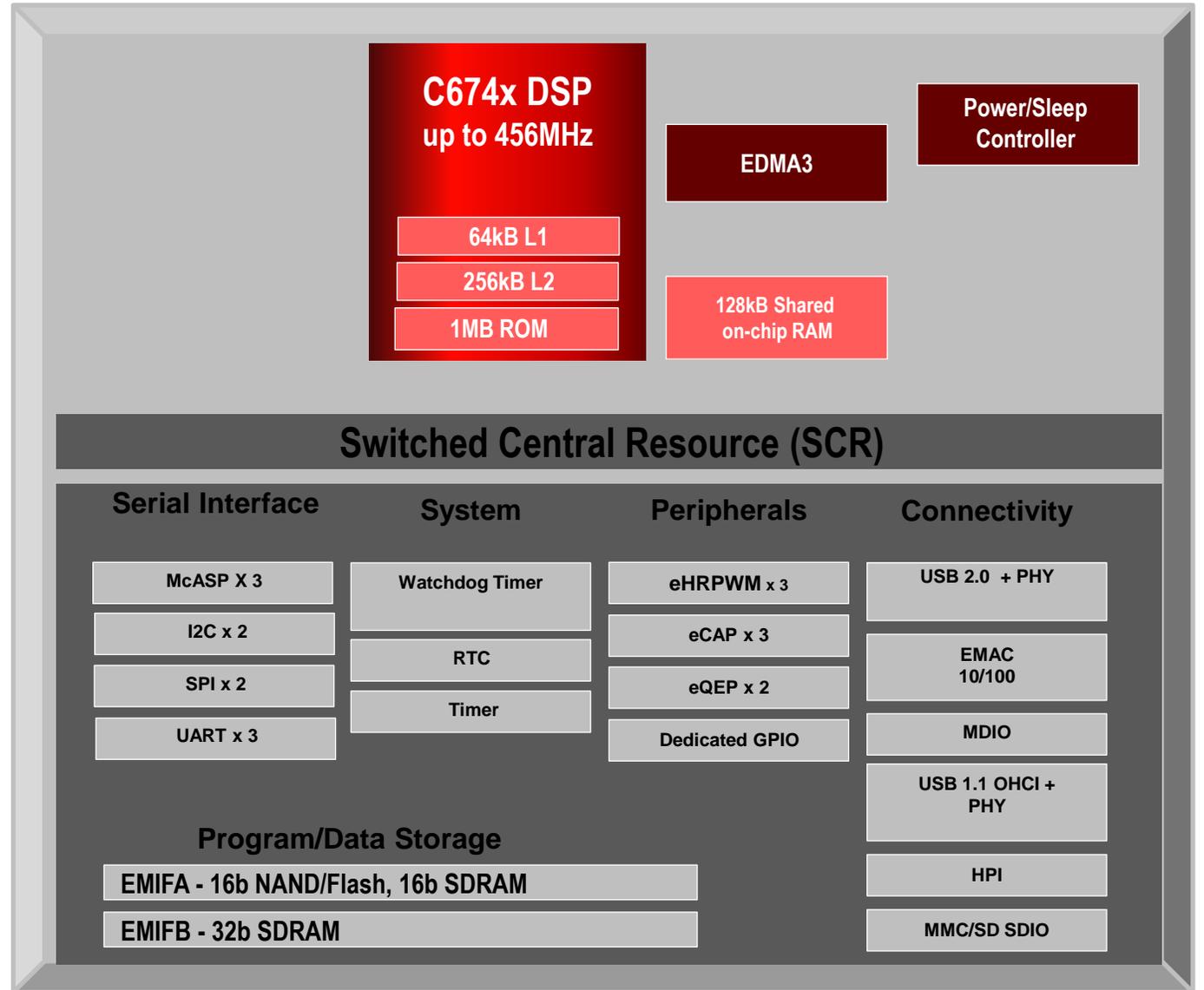
- Two EMIF external memory interfaces
 - EMIFA: NOR (8/16bit-wide), NAND (8/16bit-wide), 16-bit SDRAM up to 128Mbit
 - EMIFB: 16/32-bit SDRAM, up to 512Mbit
- USB 2.0 + PHY and USB 1.1 OHCI + PHY, I2C, and SPI interfaces
- McASP (I2S interface)

SOFTWARE

- TI DSP/BIOS™
- Chip Support Library and DSP Library

PACKAGES

- 17 mm x 17 mm, 256-Ball PBGA (ZKB)
- 24mm x 24mm,176-pin Quad Flat Pack (PTP)



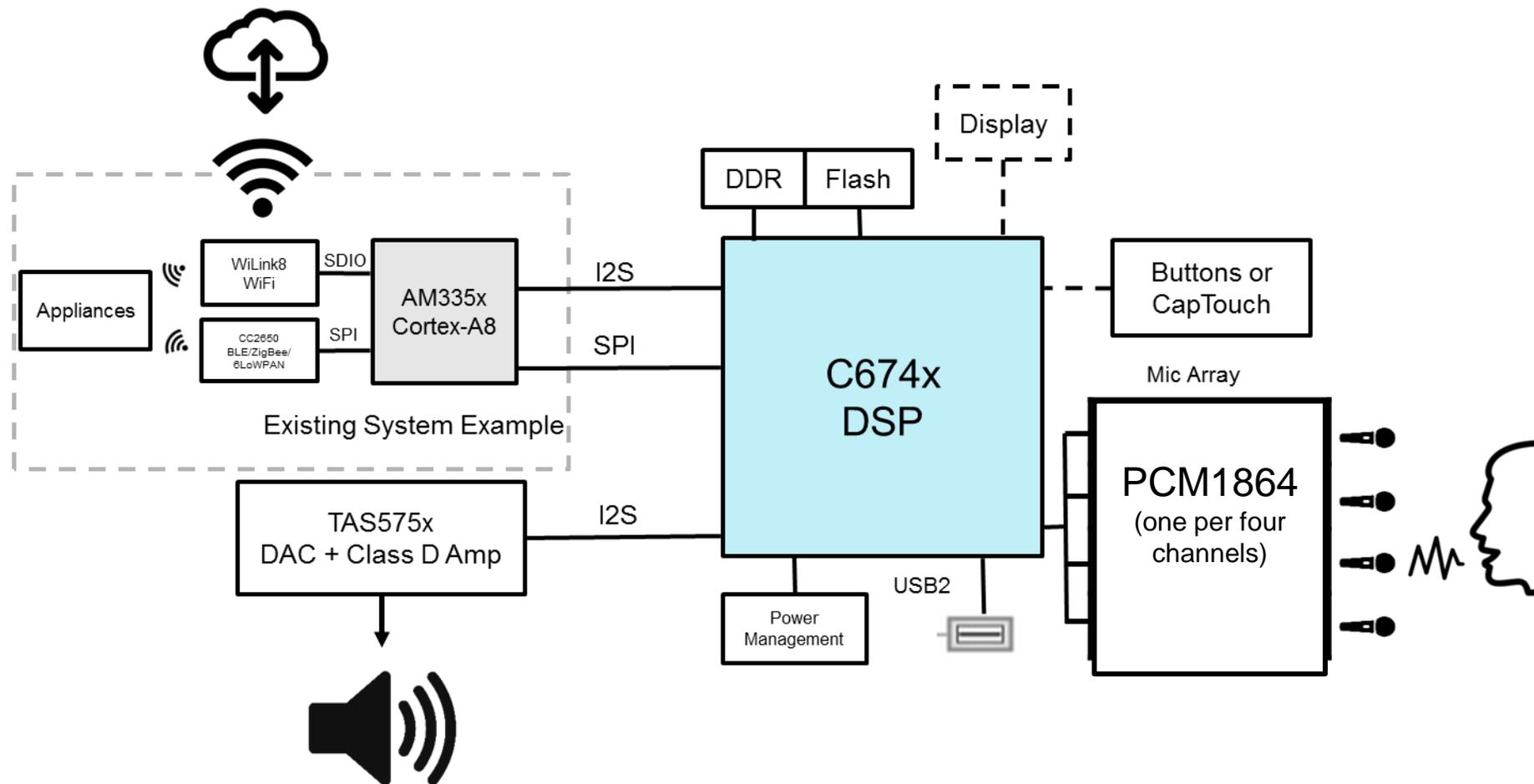
Integrated all-in-one:

- Microphone array connected to PCM1864 ADCs
- ADCs pass raw audio data to DSP
- DSP+ARM SoC (AM57xx):
 - C66 DSP core performs echo reduction, beam-forming, ASNR, etc.
 - DSP passes optimized audio data to ARM via IPC
 - A15 ARM core runs network services, connects directly to WiLink 8
- Advantage: board space, cost.
- Trade-off: customer must port current network solution to A15 core.

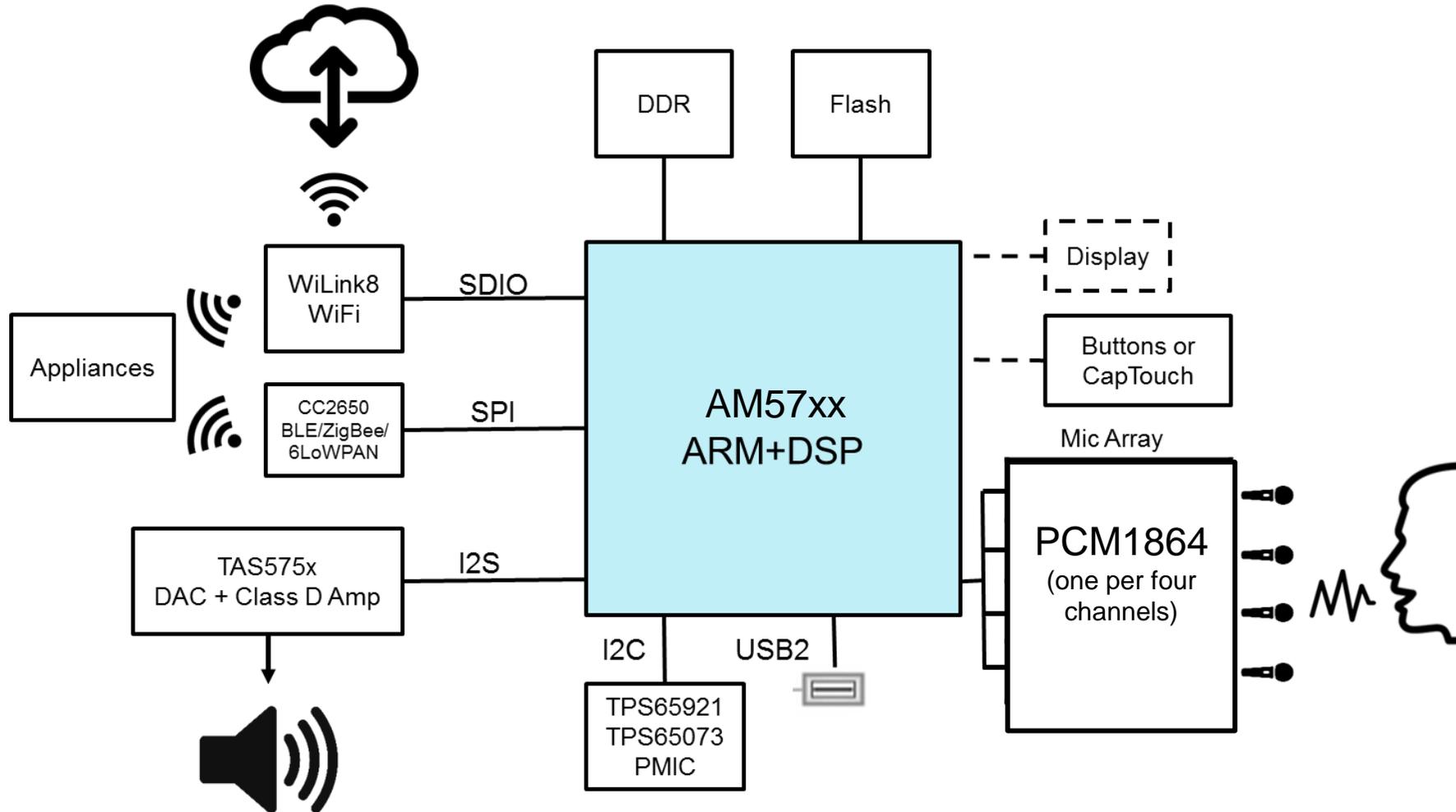
Integrated all-in-one
(4-8x microphones)



Voice processing frontend



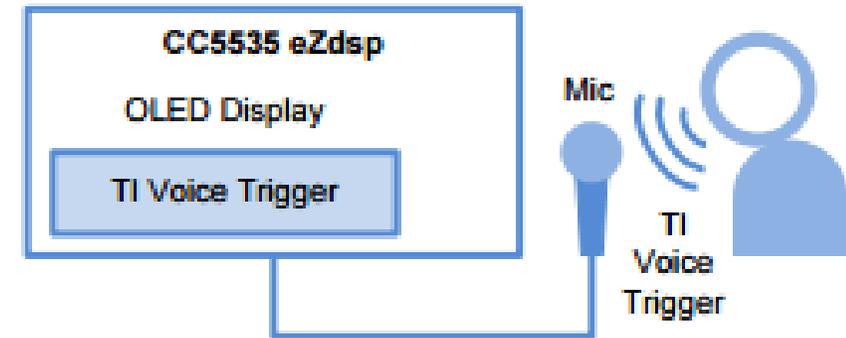
Integrated all-in-one



Local voice triggering

- Finite set of commands stored in local memory with no access to the cloud
- Paired with 1-4x microphones for optional beamforming
- On going project as part of the C55x
Current:

<http://www.ti.com/tool/TIDEP0066>



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