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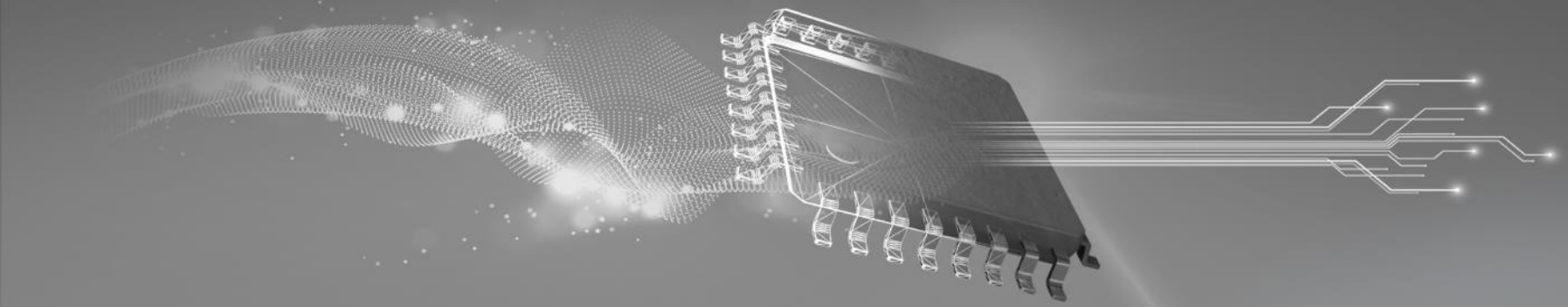

# Enabling low-power industrial wireless sensors with deep learning capabilities for audio, sound and voice

**Morten Braathen, Gunter Schmer, Tim Simerly**

**Americas Sales & Applications – Northwest Region**

Texas Instruments

# Agenda

- 10 min: Introduction and terminology of existing systems
- 10 min: System level block diagram and new concepts
- 10 min Hardware & software architecture, system partitioning
- 15 min: Demo of Glass break detection (Optional wake-word trigger)

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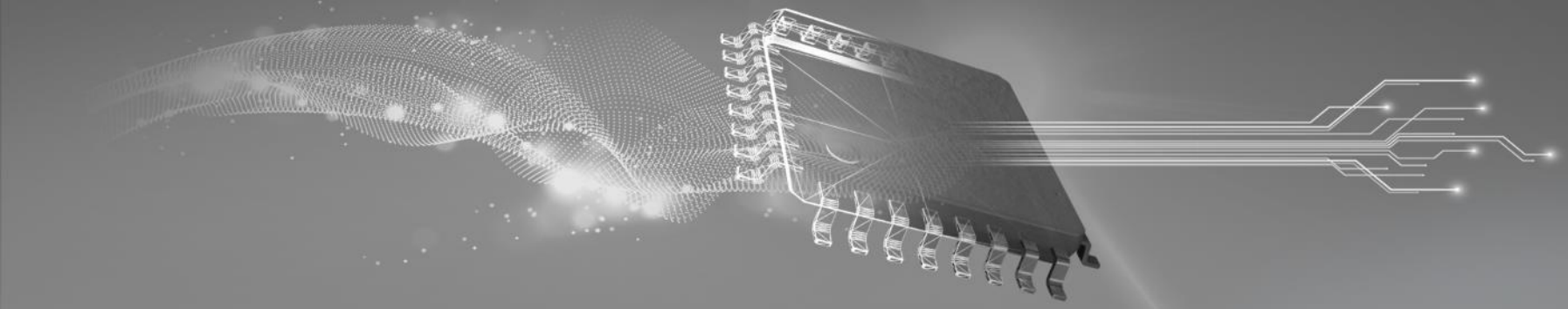
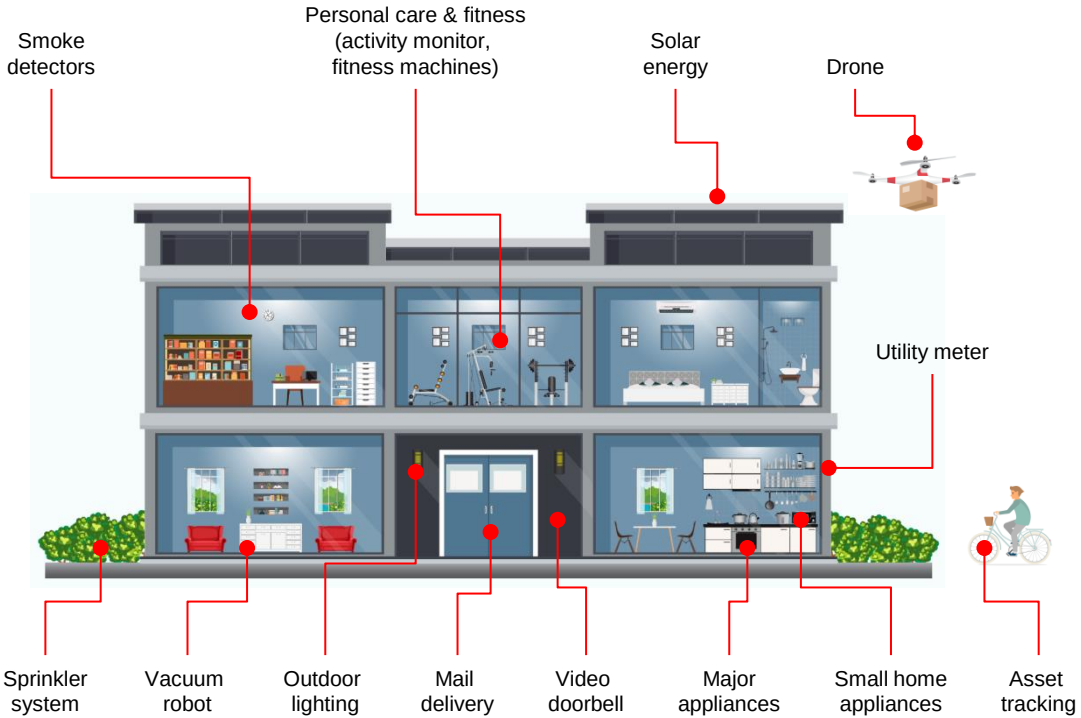


# Introduction

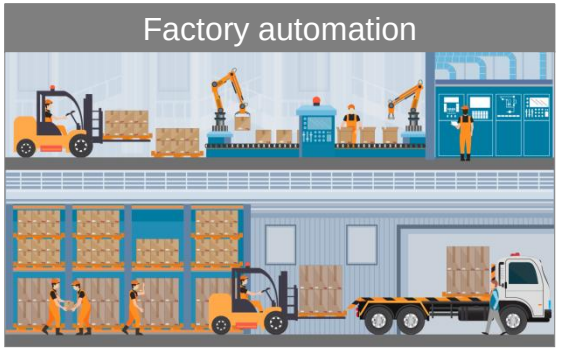
**Industrial Challenges – Advanced sensor with DNN capabilities**

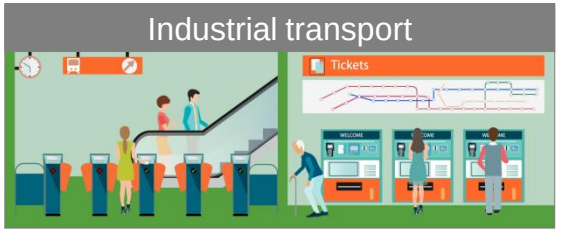
**DNN – Deep Neural Network**

# Existing Automated Ecosystems

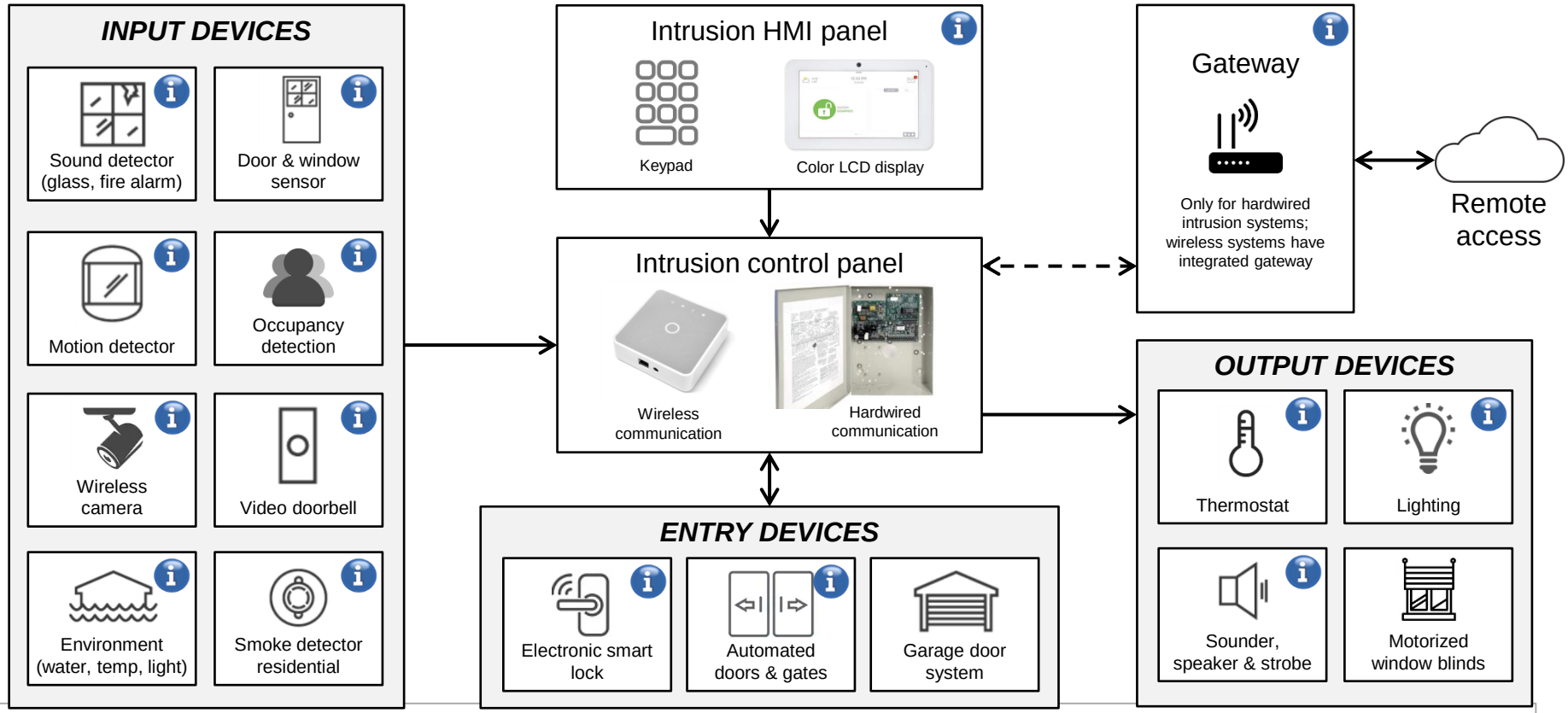




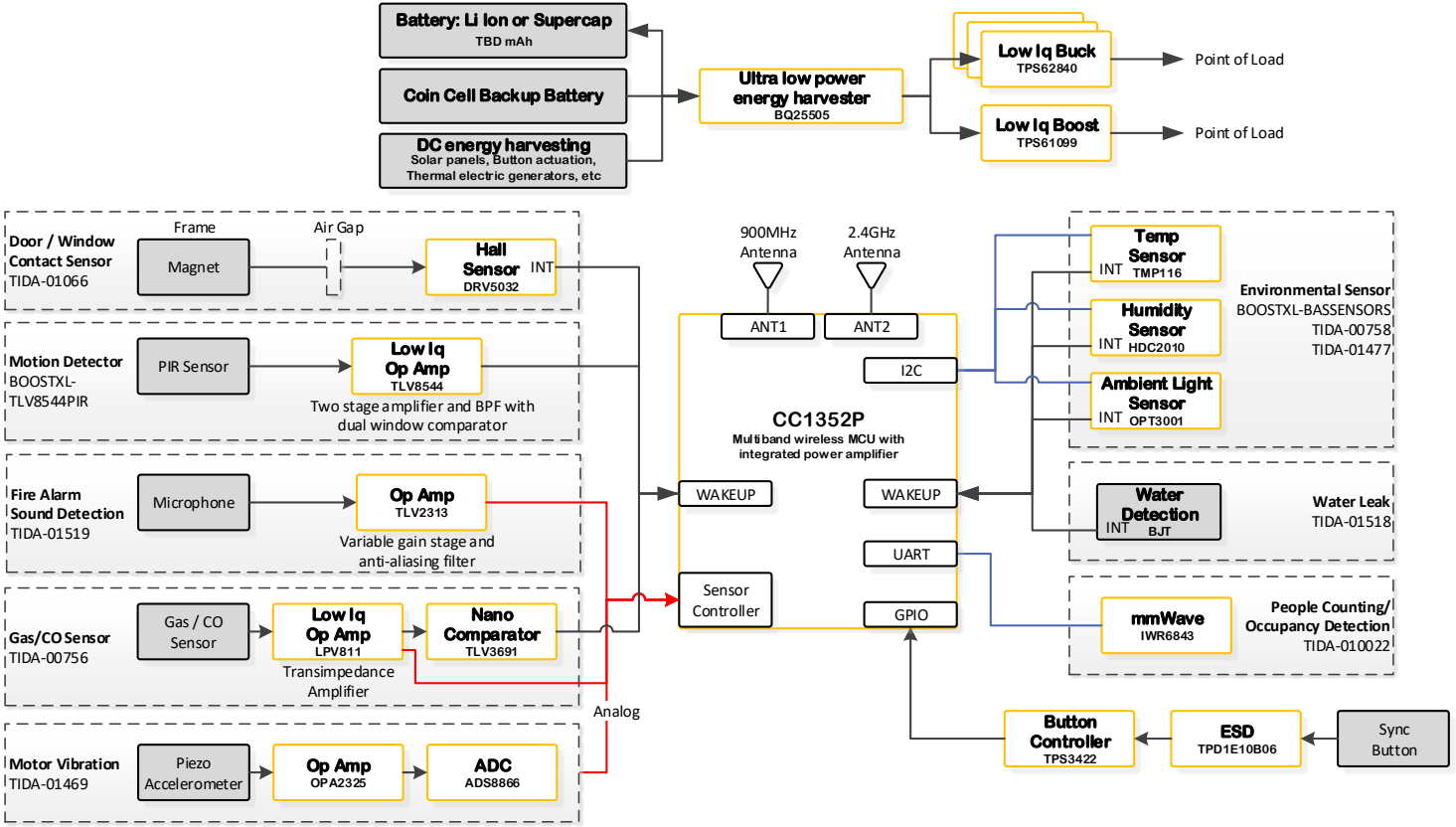


# Building Automation – Design Challenges



# Superset Sensor Block diagram



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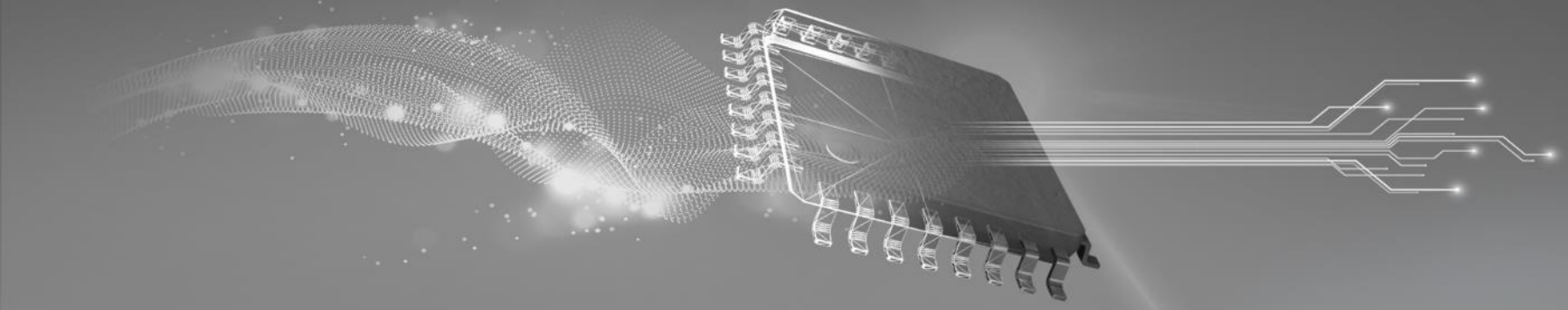
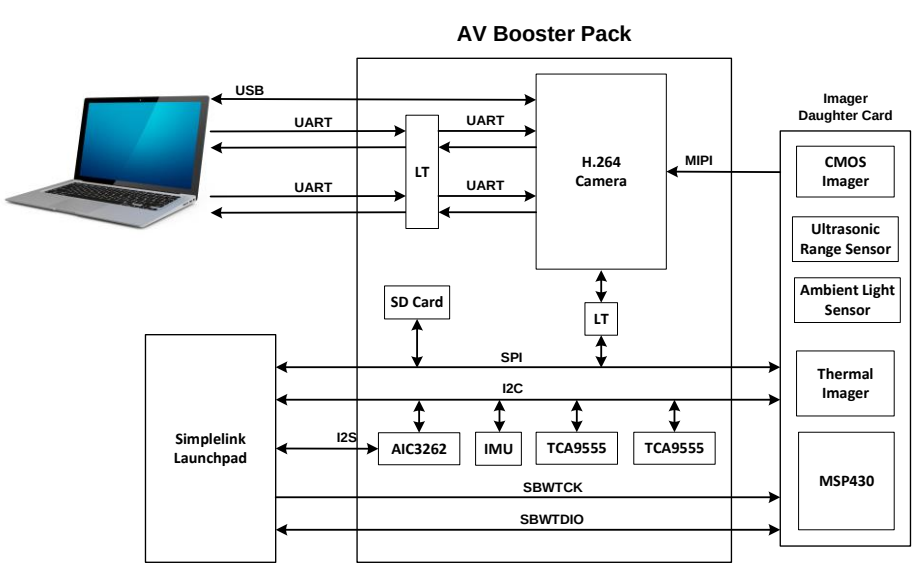
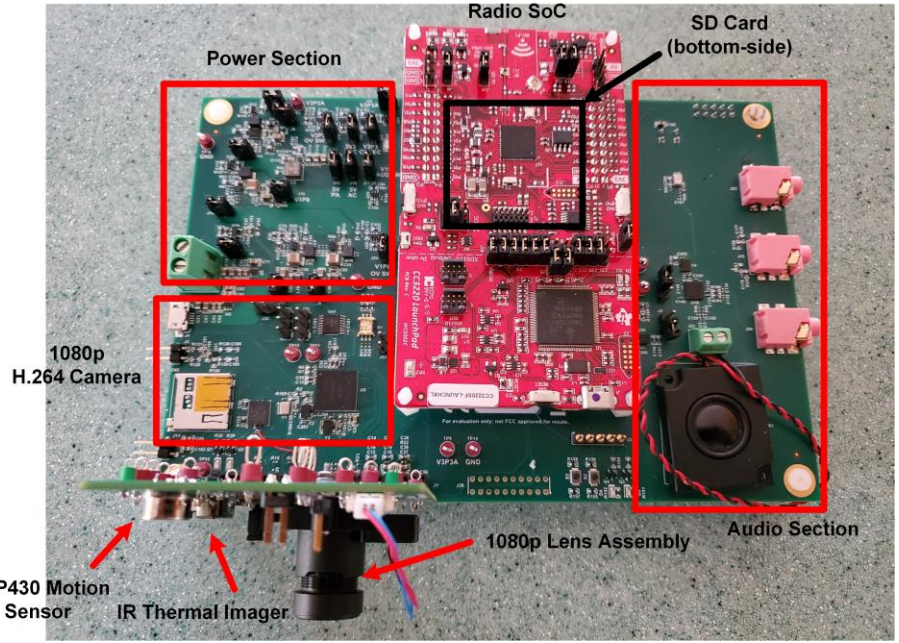


# System level block diagram and new concepts

## Hardware Overview

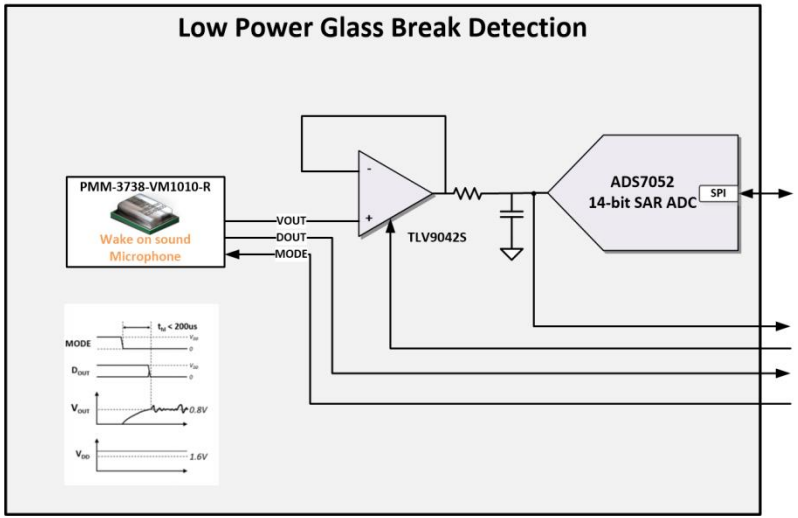
# AV Boosterpack



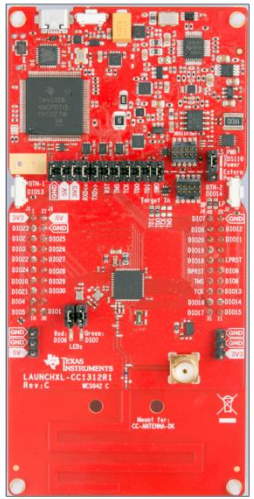



# Low Power Audio Detection/Classification

- Design Goal
  - Long battery life audio detection and classification
- AFE Considerations
  - VM1010 SNR ~60.5dB
  - Low power consumption
    - Sleep Mode: 19uW
    - Record Mode: 264uW




CC1312/CC3220 Launchpad



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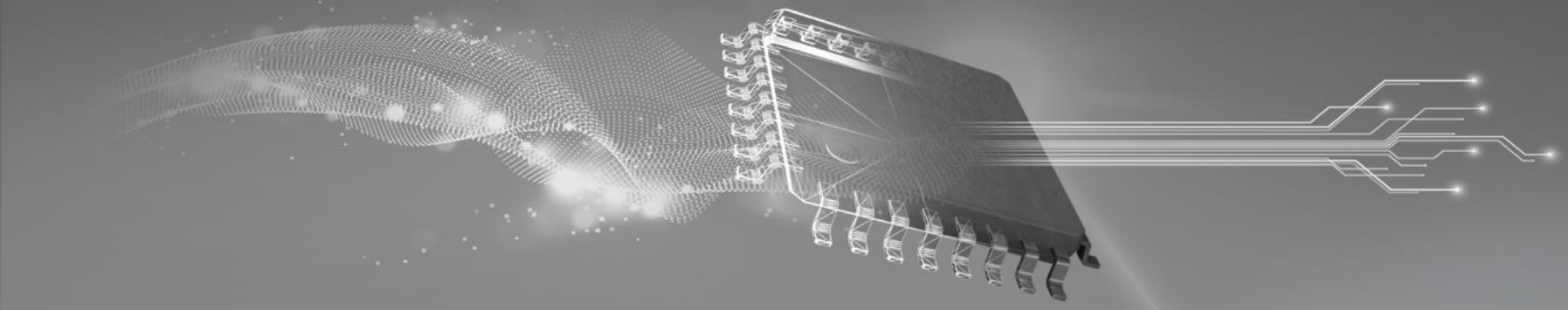


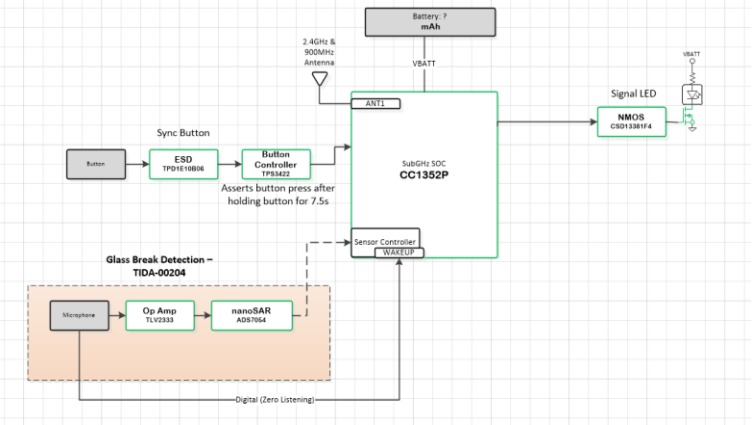
# Case Study: Glass Break

**Evolution of an advanced sensor with SimpleLink™ dual-band CC1352x wireless MCU**

# Hardware & software trade offs for DNN glass break detect

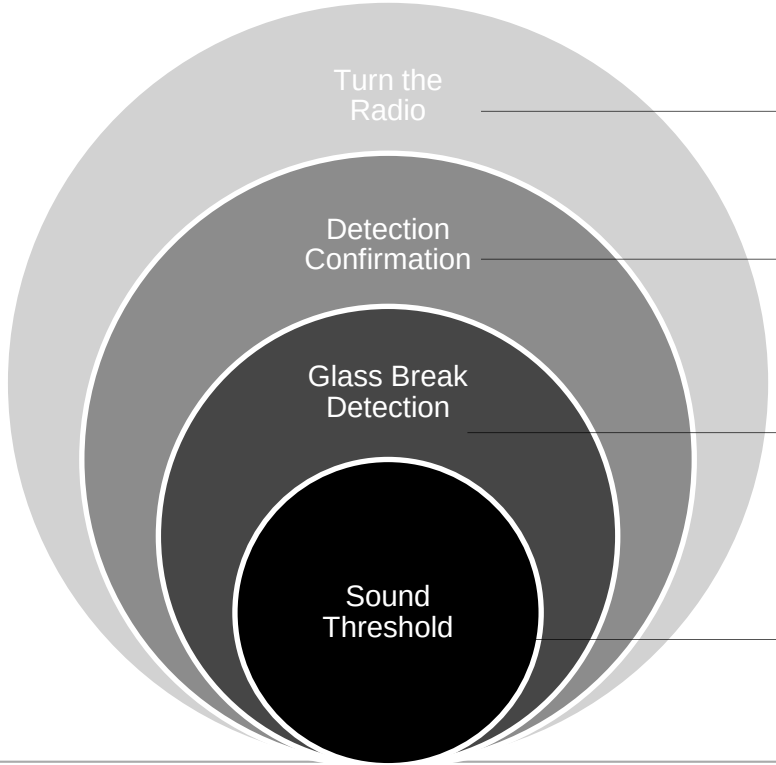
- A new hardware platform
  - AV Boosterpack development
- DNN glass break sensor
  - Large Datasets used for training
- Optimized AFE
  - Vesper microphone
  - Low power ADC
  - Sensor Controller

## Basic System Block Diagram




| | | |
|---|---|---|
| **Detection Under 20dB SNR** | | 99% |
| **Detection Under 10dB SNR** | | 98% |
| **False Alarms** | | 0.3 per day (single confirmation) |

# Software Compute Hierarchy



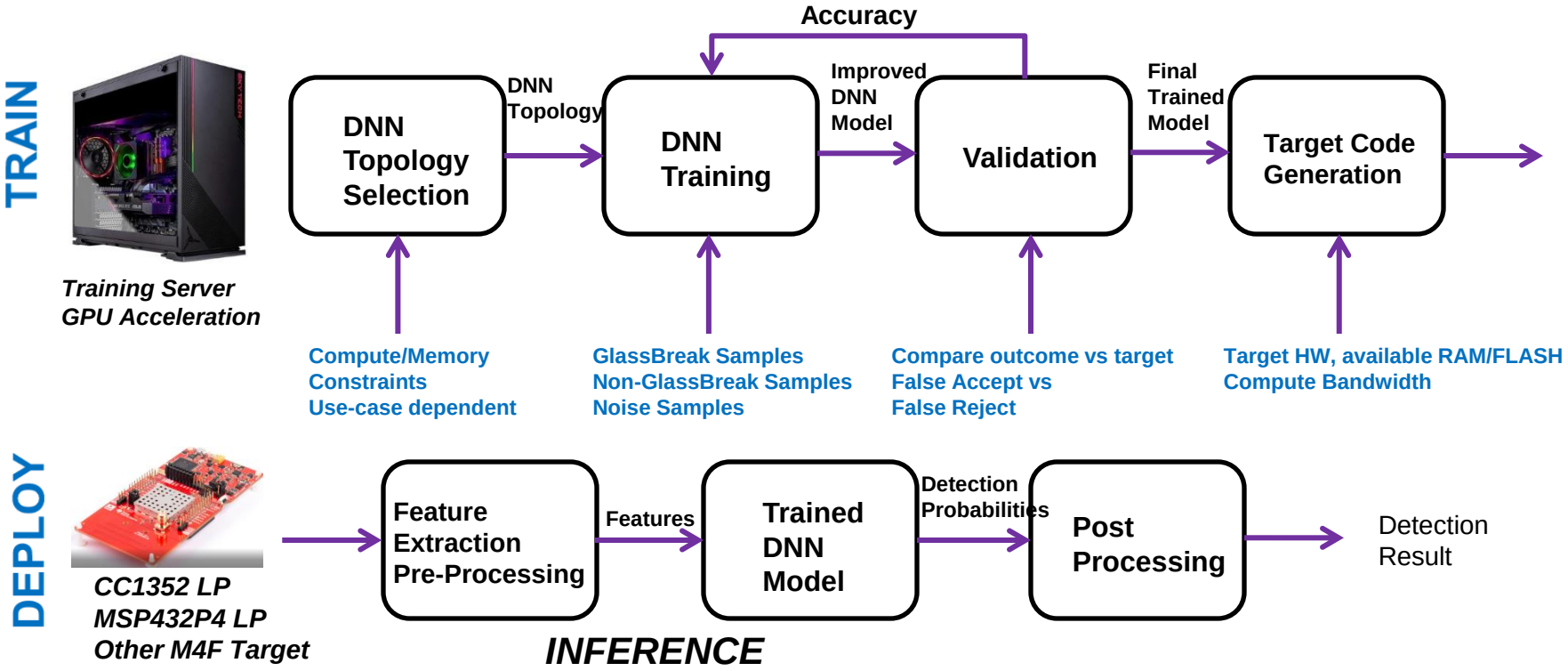

**Turn the radio on; Communicate the detection and the audio data**

**Another detection for confirming; reducing false positives**

**If there is activity, check for possibility of glass breaking**

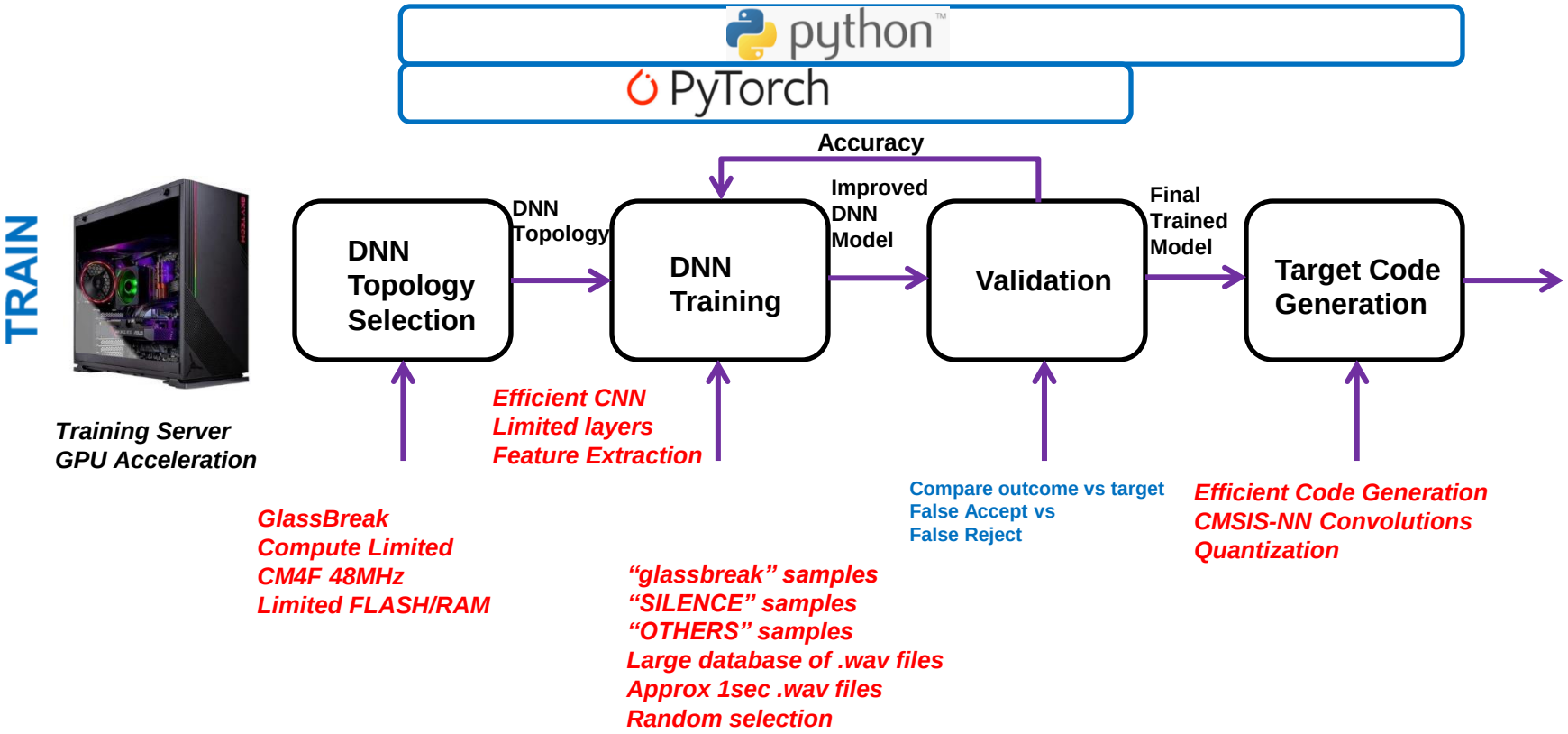
**Always running and checking for sound activity**

# Glass Break NN: Deep Neural Network (DNN) Approach




**NN Technology used for Wake-Word, “call 9-1-1”, gun-shot, other classification**

# Glass Break NN: Training Framework and DNN Model



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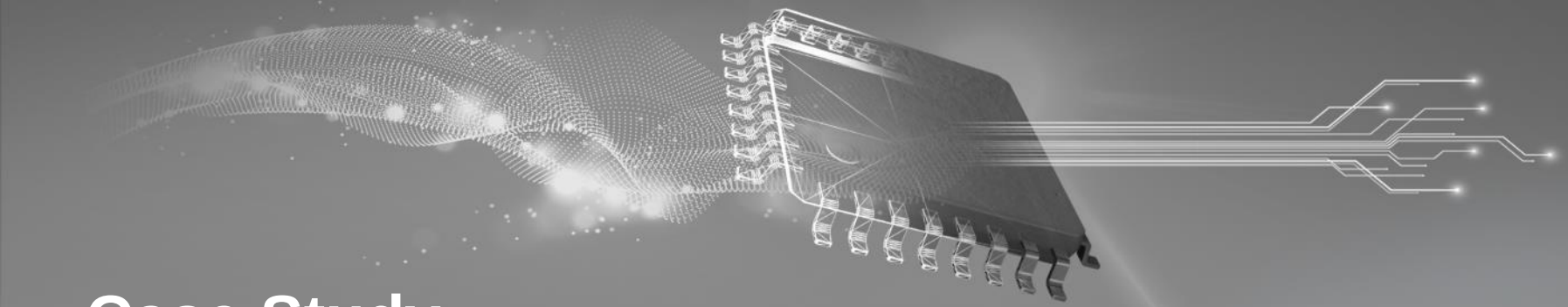
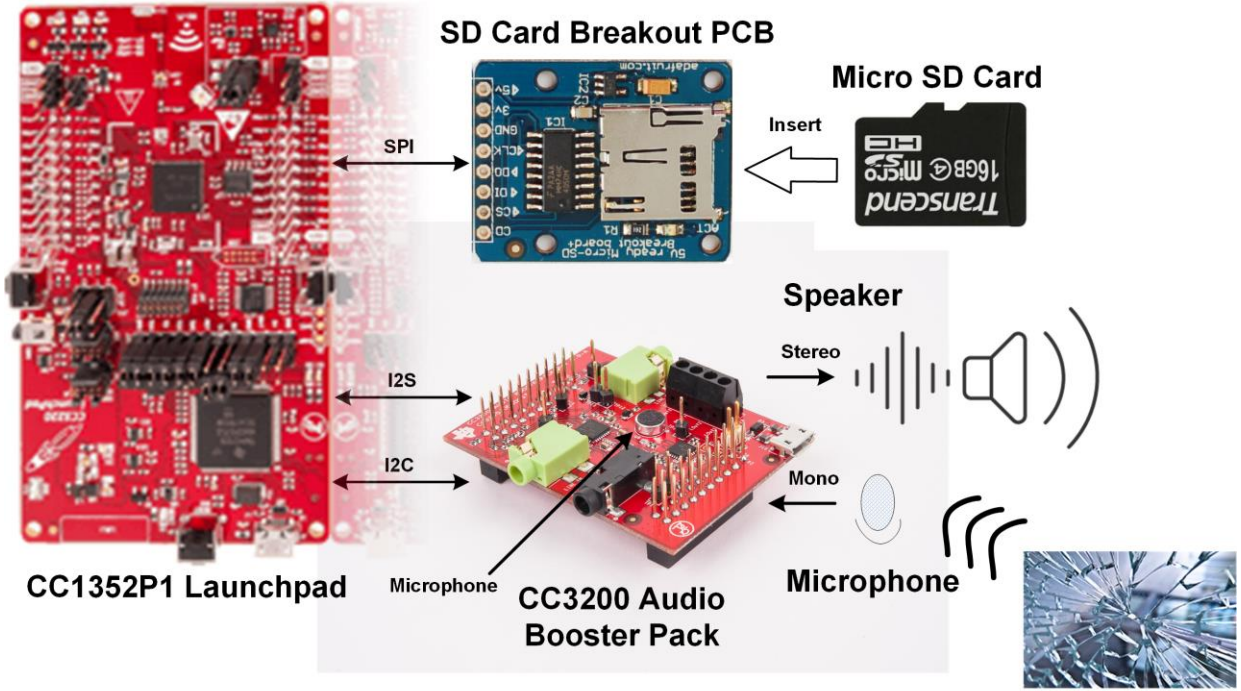


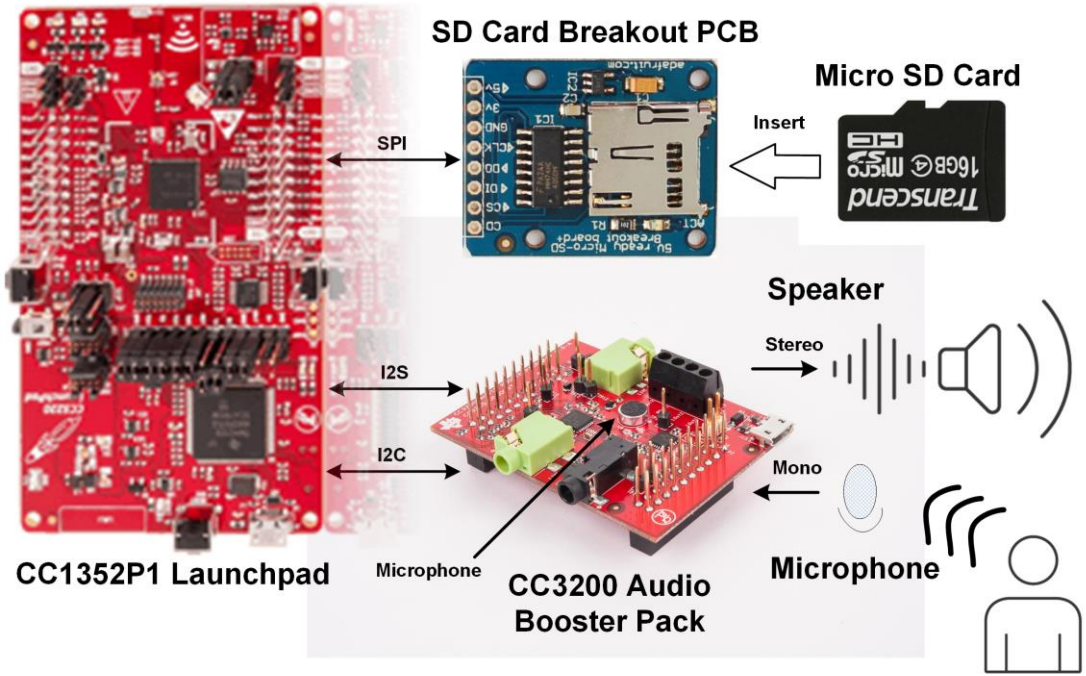
# Case Study:
# Wake word demos (Near-field & Far-field)

**Hardware & Software**

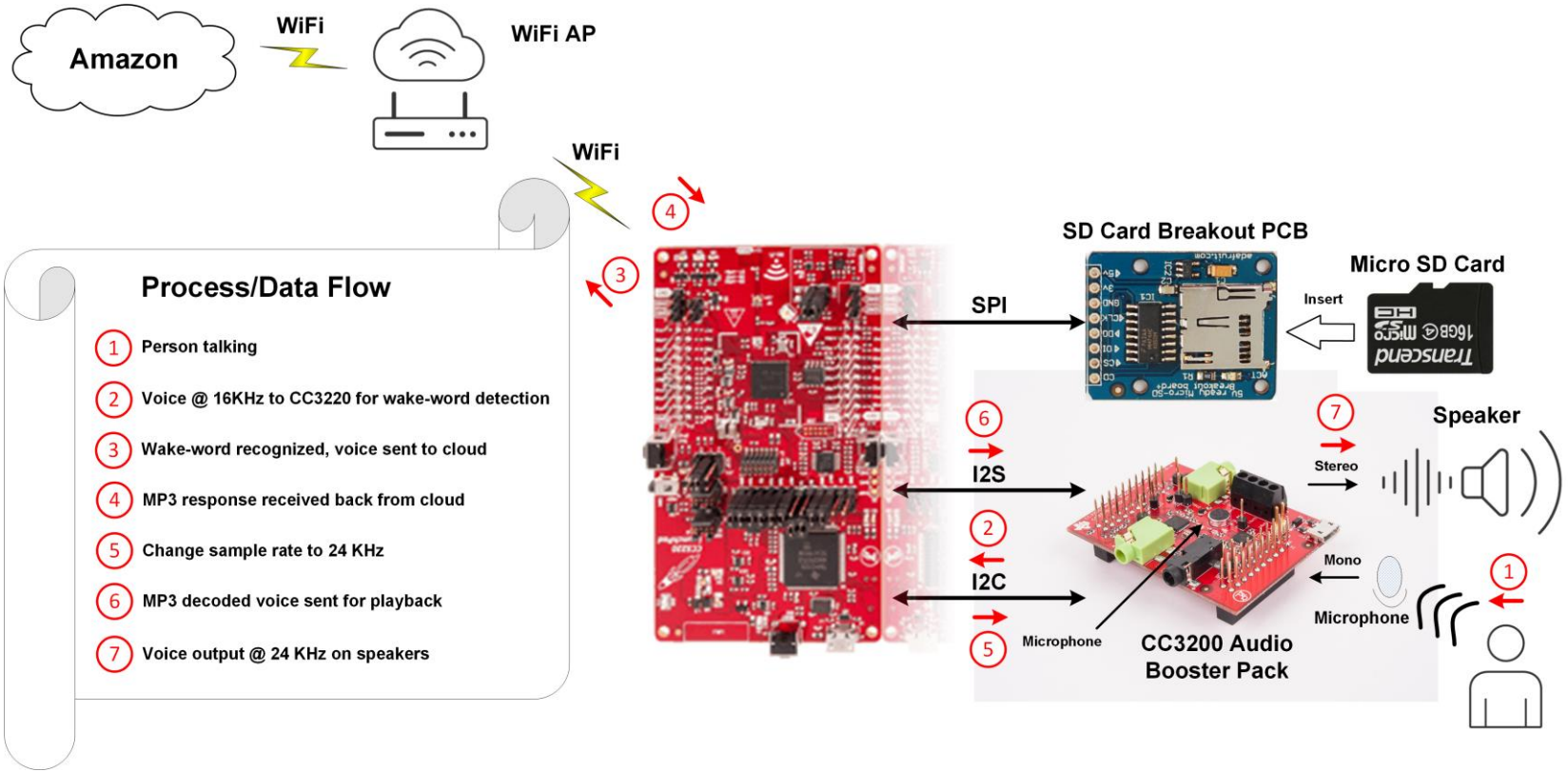
# Glass-Break Demo



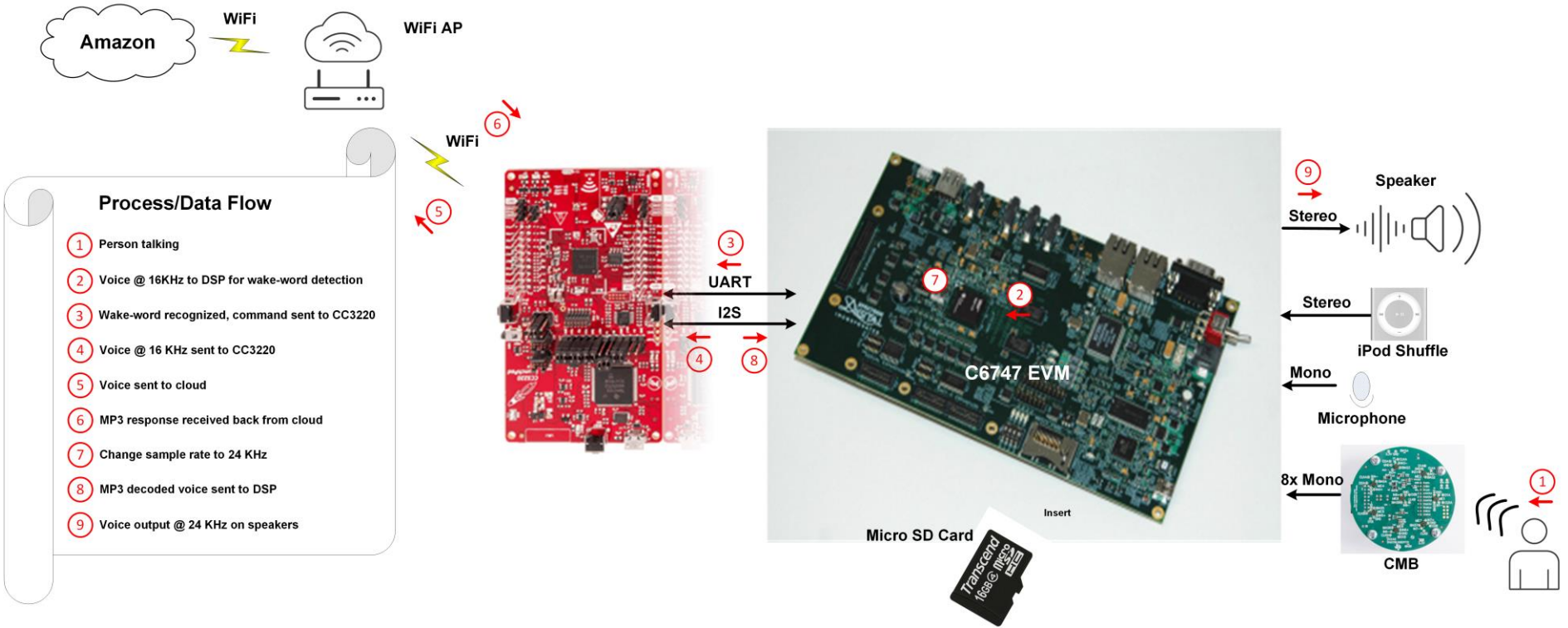
# Wake-Word Demo



# Wake Word Demo Hardware (Near-field)



# Wake Word Demo Hardware (Far-field)



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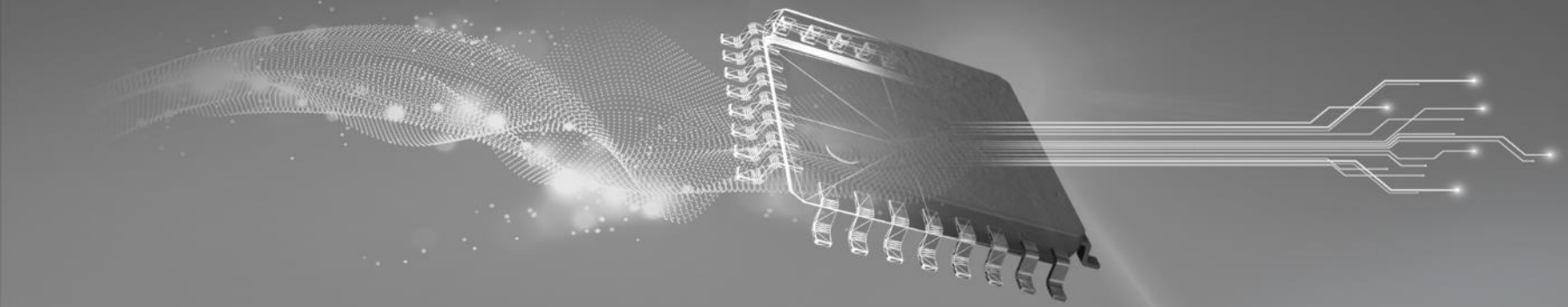

# Demo Overview

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