“Accelerating MLOps and CI/CD for tinyML on Arm”

Eric Sondhi – Sr. Product Manager IoT Line of Business, Arm

March 21, 2023
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The tinyML Research Symposium 2023 will be held in conjunction with the tinyML Summit. The Research Symposium is the premier annual gathering of senior level technical experts and decision makers representing fast growing global tinyML community.

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- Sponsorships@tinyML.org
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EMEA 2023 Call for Presentations is open now:
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Abstract due - February 28, 2023
Author notification - March 10, 2023

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Reminders

Slides & Videos will be posted tomorrow

tinyml.org/forums  youtube.com/tinyml

Please use the Q&A window for your questions
Eric Sondhi

Eric is the Sr. Manager for Arm Virtual Hardware Go-To-Market in the IoT line of Business. Eric works with Arm's lead partners, SoC designers, and Software developers around the world to employ state-of-the-art simulation, modeling, and virtual prototype solutions for early SoC architecture and design, early software development, and system & software performance analysis.
Accelerating MLOps & CI/CD for tinyML on Arm

tinyML Talks

Eric Sondhi
Tuesday, March 21st 2023

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Talk Overview

- Overview of Arm Virtual Hardware (AVH)
- Enabling Embedded CI/CD & MLOps Use Cases with AVH
- AVH Integrations through Partnership with the Arm Ecosystem
Cloud-native Development

A Modern Paradigm to build & deliver Cloud-enabled Applications

Complex Software updates are deployed regularly with Scalable DevOps, MLOps, & CI/CD
A diverse range of IoT & Embedded Developers

...and their challenges to unlocking the potential of the cloud

Embedded Microcontroller Developers

- No scalability with physical hardware

Cloud-native Developers

- Hard to run on end devices

![Diagram showing ML trained in the cloud and binary image deployment for devices fleet.](image-url)
Revolutionizing IoT Software Development

Reduces barriers to entry
Enabling more global developers to access silicon and development

Faster time to market
Accelerates application development for the IoT market

Scalable performance
Supports enterprise-class DevOps & MLOps integration testing
What is **arm** Virtual Hardware?

+ **Virtual**, functional representation of a physical hardware
+ **Cloud-native** - runs and scales easily in the cloud
+ **Suitable for all IoT workloads** from MCUs through to Intelligent Edges
+ **No dependency** on RTL or silicon availability

![Diagram of Virtual Hardware and IoT applications on Cloud infrastructure](image-url)
Enabling Developers To Scale Today and Build the Future

Across the Arm & IoT Product Lifecycle

AVH for Cortex-M Processors

AVH for Arm Total Solutions for IoT

AVH for 3rd Party Ecosystem Boards

Keyword Recognition
- Cortex-M55
- Ethos-U55
- Corstone-300

Voice Recognition
- Cortex-M85
- Ethos-U55
- Corstone-310

Cloud-Native Edge Device
- Cortex-A35
- Cortex-M3
- Corstone-1000

STM32U5 Discovery Kit

i.MX 8m Plus

Raspberry Pi
Arm Virtual Hardware Demo: Application Development in the Cloud
IDE development
Local installation

Keil MDK with:
- Interactive Debug and Trace Views
- Arm Compiler
- Arm Virtual Hardware

Create and Debug

Test Automation
CI development

Cloud Service with:
- Arm Virtual Hardware
- Arm Compiler
- Compatible build tools

Version Control System
Code Repository

Developer 1
Local Builds
Developer 2
Local Builds
Developer ‘n’
Local Builds

Developer 1
Local Debug
Developer 2
Local Debug
Developer ‘n’
Local Debug

Multiple Builds
Regression
Tests
Verification
Results
Development Workflow (exemplified with GitHub Actions)

1. **Local development**: use a classic embedded toolchain such as Keil MDK and with Arm Virtual Hardware Target for MCU simulation. A GitHub repository is used as a source code management system for synchronization, storage and version control.

2. **CI pipeline setup**: a GitHub Action implements the CI pipeline that gets triggered on every code update in the target repository.

3. **CI execution**: automated program build and testing with cloud-based Arm Virtual Hardware; results reported back to repository.

4. **Failure analysis and local debug**: developer can observe the CI test results. Failures can be reproduced and debugged locally.

![Diagram of Development Workflow](github.com/ARM-software/AVH-GetStarted)
Use case: Machine learning operations
The Entire Arm Ecosystem Can Leverage AVH
MLOps use case

Arm Virtual Hardware Farm

Model 1

Model 2

Model 3

Model 4

Best model
Try Arm Virtual Hardware

- Contact eric.sondhi@arm.com to learn more

- Sign up for AVH Private beta:
  https://avh.arm.com

- Try AVH integration with GitHub Actions:
  https://resources.github.com/arm-github-actions-beta/

- Qeexo AutoML Integration:
  https://qeexo.tdk.com
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