arm AI

AI Virtual Tech Talks Series

Supercharge your development time with the Arm NN and Arm Compute Library

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9th February 2021

AI Virtual Tech Talks Series

Date	Title	Host
February 9th	Supercharge your development time with the new Arm NN 20.11 release	Arm
February 23rd	Hands-on with PyArmNN for object detection	Arm Workshop
March 9th	Automate tinyML Development & Deployment with Qeexo AutoML	Qeexo

Visit: developer.arm.com/solutions/machine-learning-on-arm/ai-virtual-tech-talks

Presenters

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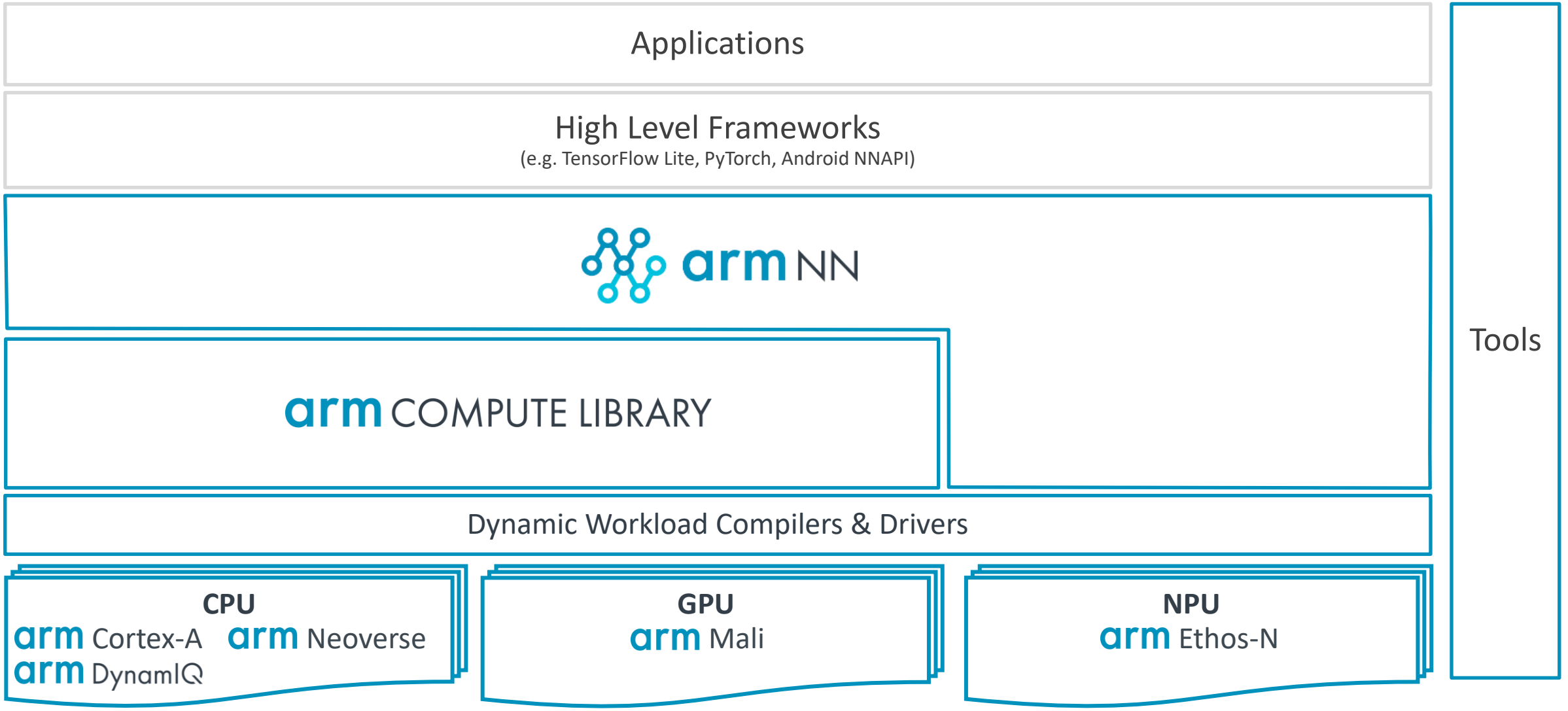
MLG, Arm

Arm Software Stack



Why Use the Arm NN and Arm Compute Library?

Versatile and Portable:

- Easily target multiple platforms (CPU, GPU and NPU) from a single code base
- Reduce overall development time, keep using existing framework and tools
- Deployable for Android, Linux and ‘bare metal’ applications

Superior Performance:

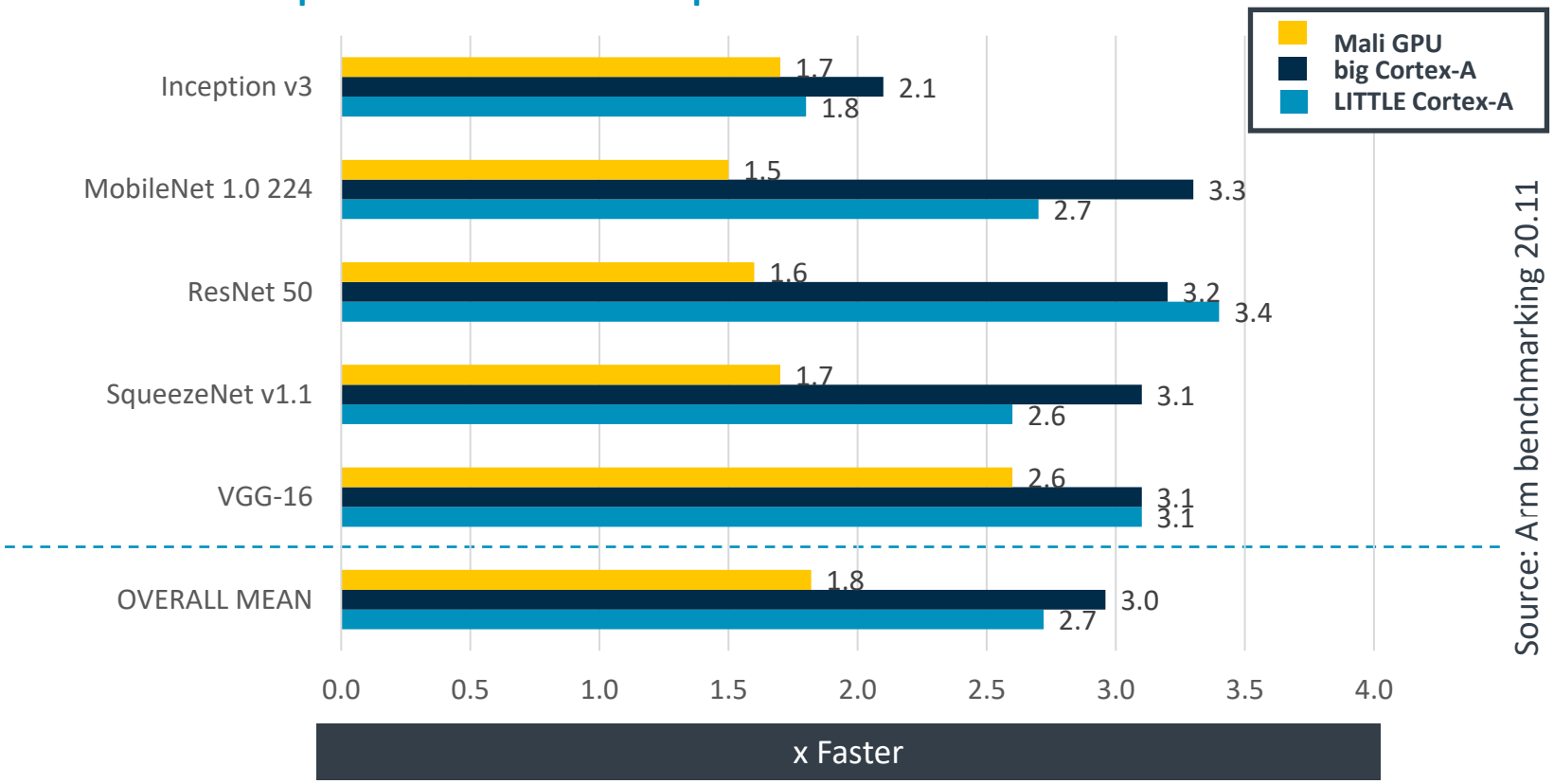
- Best in class across a wide range of popular networks
- Uses advanced network optimization techniques, workload tuning and GEMM heuristics

Arm Specific Optimizations:

- Outperforms generic math and ML libraries due to Arm specific optimization
- Specific architectures (e.g. dot product for Armv8.2A) and micro architecture optimizations (e.g. Cortex-A53)
- Quick adoption of new Arm technologies e.g. SVE, SVE2

Relentless Performance Optimization

Arm NN performance improvements*

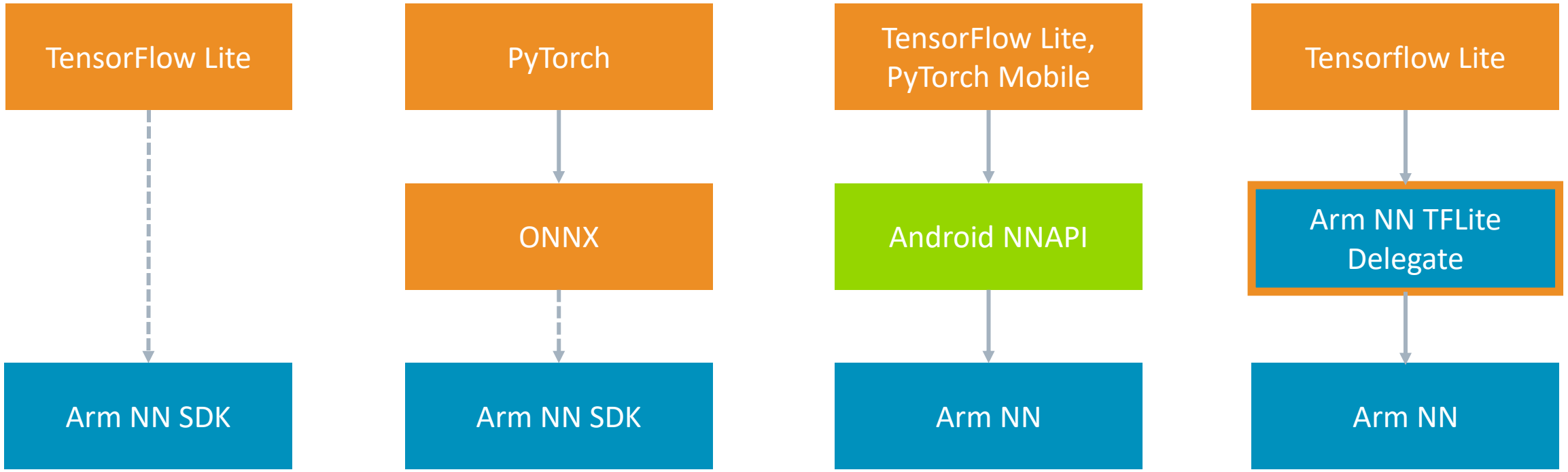


*Mean performance improvements of Arm NN relative to up to six different industry software libraries

- Continuous optimization of the key operators in the most popular networks
- New operators added to support each release of Android
- Advanced network manipulation techniques used to improve performance

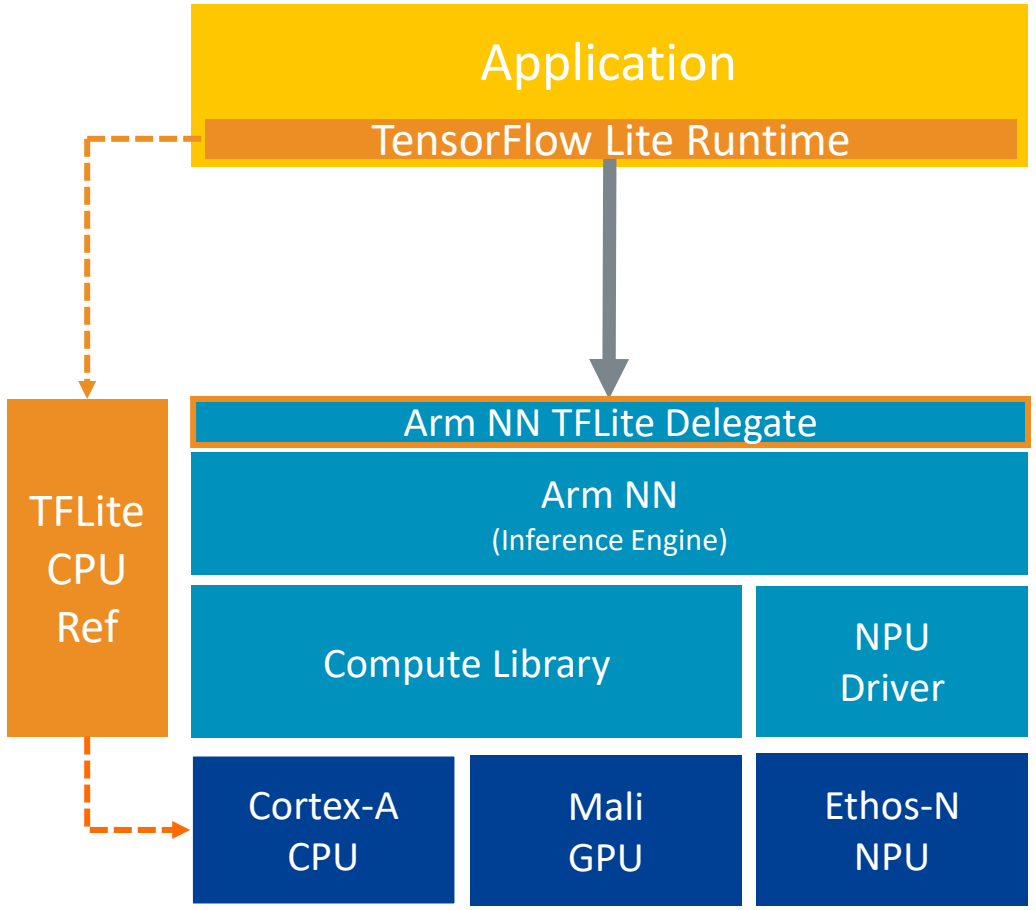
Arm NN Integration Options with Neural Network Frameworks

- Multiple framework integration options for Linux and Android



Arm NN TFLite Delegate

Accelerating inference on Android and Linux



- Unlocks Arm specific CPU and GPU optimizations for TFLite users
- All TFLite models can be accelerated through Arm NN with unsupported ops handled by the TFLite runtime
- Enables performance and great operator coverage

Debian Packages for Arm NN and ACL

- 20.08 Release of Arm SW stack available on Ubuntu Launchpad PPA. Formal release in Bullseye (Debian 11)
- Benefits:
  - Reliable: All build dependencies are taken care of by the robust Debian packaging infrastructure
  - Quick setup: Ready for prototyping with just a few ‘apt-get’ commands
  - Accessible: Ubuntu ‘Groovy’ now available for Raspberry Pi with full Aarch64 desktop experience

PyArmNN

Rapid developing and prototyping

- Python APIs for Arm NN inference engine
- Compatible with Numpy arrays
- Minimal overhead – thin C++ API
- Easy to install using Debian packages

Create a parser object and load your model file.

```
import pyarmnn as ann
import imageio
parser = ann.ITfLiteParser()
network = parser.CreateNetworkFromBinaryFile('./model.tflite')
```

Get the input binding information by using the name of the input layer.

```
input_binding_info = parser.GetNetworkInputBindingInfo(0, 'model/input')
options = ann.CreationOptions()
runtime = ann.IRuntime(options)
```

Choose preferred backends for execution and optimize the network.

```
preferredBackends = [ann.BackendId('CpuAcc'), ann.BackendId('CpuRef')]
opt_network, messages = ann.Optimize(network, preferredBackends,
runtime.GetDeviceSpec(),                                    ann.OptimizerOptions())
net_id, _ = runtime.LoadNetwork(opt_network)
```

Make workload tensors using input and output binding information.

```
img = imageio.imread('./image.png')
input_tensors = ann.make_input_tensors([input_binding_info], [img])
output_binding_info = parser.GetNetworkOutputBindingInfo(0, 'model/output')
output_tensors = ann.make_output_tensors([output_binding_info])
```

Perform inference and get the results back into a numpy array.

```
runtime.EnqueueWorkload(net_id, input_tensors, output_tensors)
results = ann.workload_tensors_to_ndarray(output_tensors)
print(results)
```

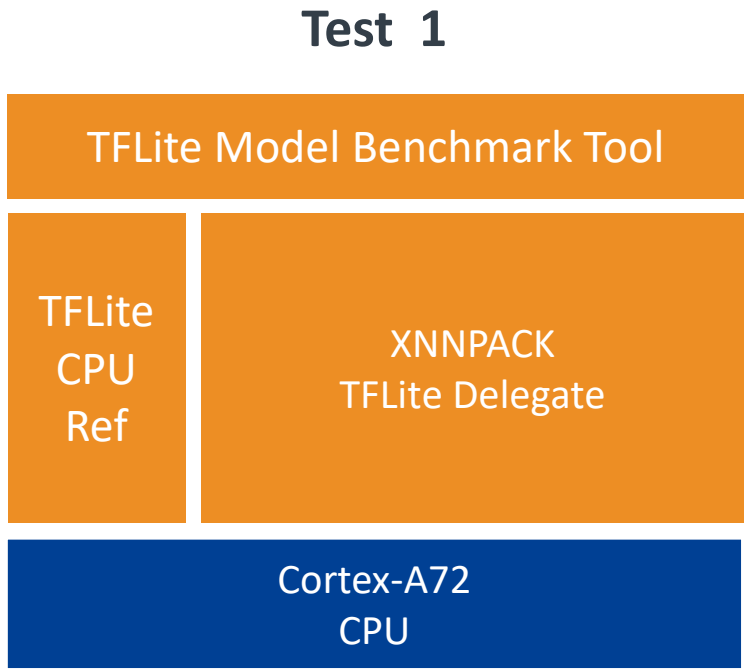
Arm Public Model Zoo

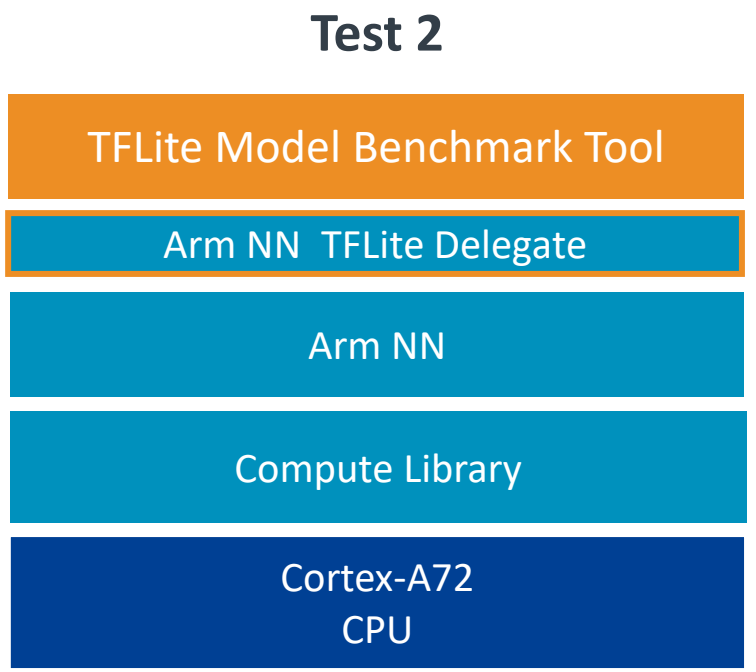
- Highly optimized networks specific to Arm architectures
- Clustering, pruning and quantization aware training used to produce the most efficient models
- Model, meta data and test data available
- Supported by code samples and How-To guides

Model	Improvement
SSD MobileNet v1	Revised for 30% Arm NN performance uplift
MobileNet v2	Clustering and pruning for better accuracy at the same sized
Wav2Letter	10x faster, tuned to mobile / embedded voice UI
DS-CNN	Revised for updated tooling and clustering
Yolo V3	Simplified classes and BB, detector quantization compatible

Demo 1: Inference on Linux using Raspberry Pi4

Examining the performance on Cortex-A72 CPU using TFLite Delegates



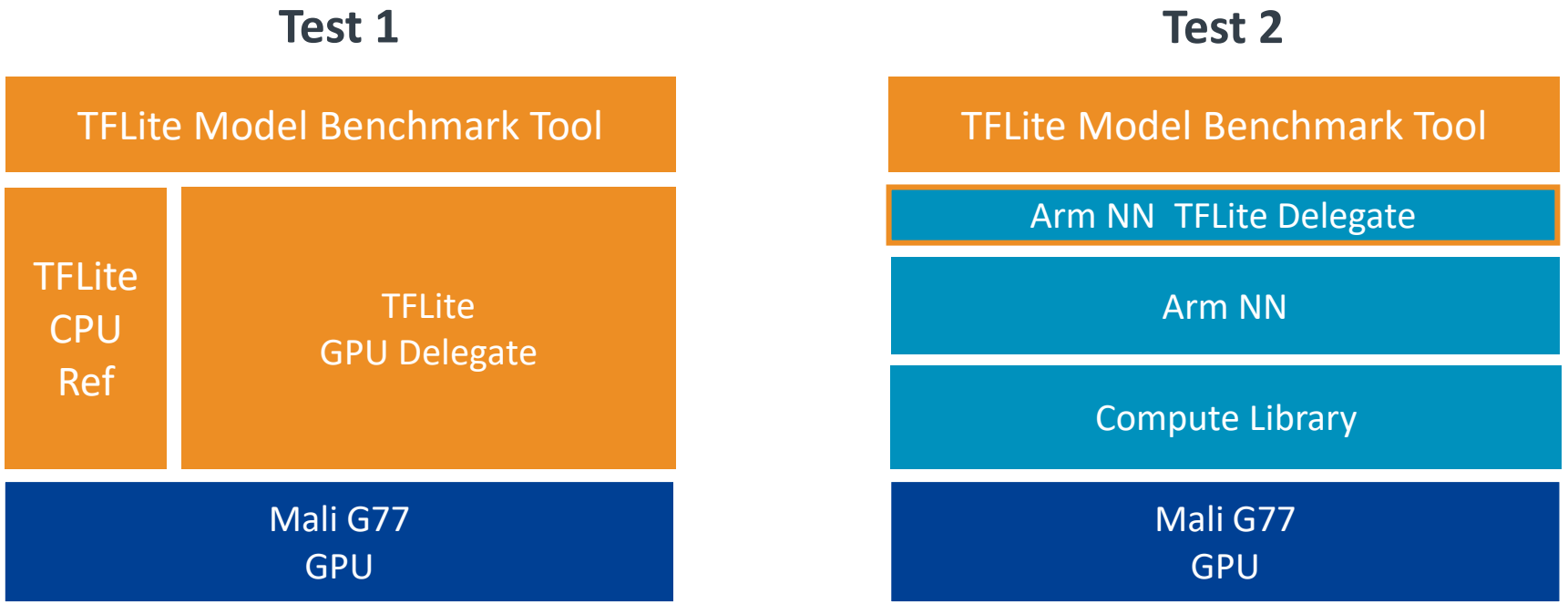


	Yolo V3 (Arm - fp32)	Inception V3 (TFLite - fp32)
Accelerator	Min Exec. time - ms	
TFLite CPU Ref (Test 1a)	505	793.5
TFLite CPU XNNPACK (Test 1b)	372.2	600.9
TFLite CPU ArmNN (Test 2)	246	385.3

~ 1.5x - 1.6x Perf Speed Up over XNNPACK

Demo 2: Inference on Android

Examining the performance on Mali G77 GPU using TFLite Delegates



	Yolo V3 (Arm - fp32)	Inception V3 (TFLite - fp32)
Accelerator	Min. Exec. time - ms	
TFLite GPU delegate (Test 1)	44.8	107.8
TFLite GPU ArmNN w. tuner (Test 2)	26.5	49.2

~ 1.7x - 2.2x Perf Speed Up over TFLite GPU Delegate

Useful Links

- Arm NN HAL for Android: https://github.com/ARM-software/android-nn-driver
- Arm NN TFLite Delegate: https://github.com/ARM-software/armnn/tree/branches/armnn_20_11/delegate
- Arm Model Zoo: https://github.com/ARM-software/ML-zoo/tree/master/models
- Arm ML Examples: https://github.com/ARM-software/ML-examples/
- How to Guides: https://developer.arm.com/solutions/machine-learning-on-arm/
- Ubuntu for Raspberry Pi: https://ubuntu.com/raspberry-pi
- Raspberry Pi OS: https://www.raspberrypi.org/forums/viewtopic.php?t=275370
- Contributions: https://www.mlplatform.org/contributing/

SHA versions

- TensorFlow: 1b215470642efd86e927d1c15ba026b4ff45dfa7
- ArmNN: 97bf84f6e162307fc3e8c53045ef0bc60a3e3289
- ACL: b309fc249e4383b4d40ae03e377c3cbad3f9f5f7

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Attendees: don’t forget to fill out the survey to be in with a chance of winning an Arduino Nano 33 BLE board

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Thank You
Danke
Merci
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Gracias
Kiitos
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