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The Challenges of Creating Software Development Tools for Diverse AI Hardware Architectures

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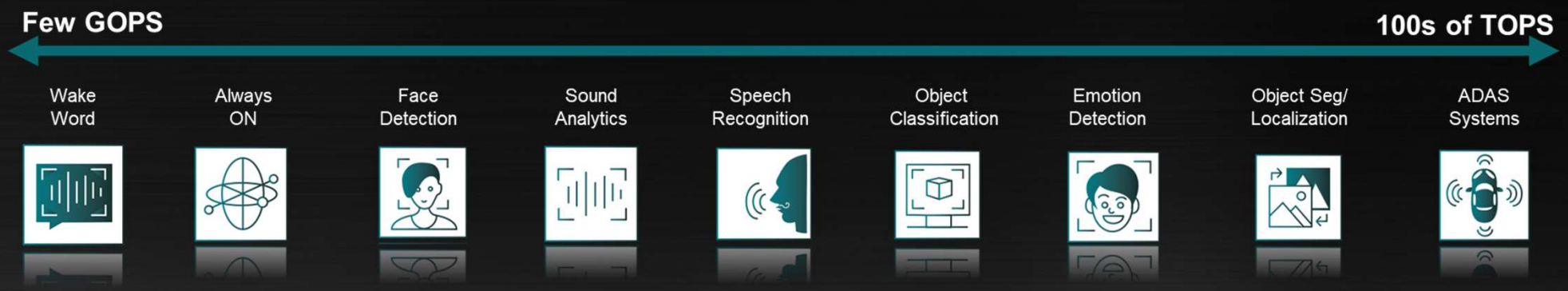
AI at the Edge – The Software Development Tools Challenge



AI at the Edge – The Software Development Tools Challenge

Applications

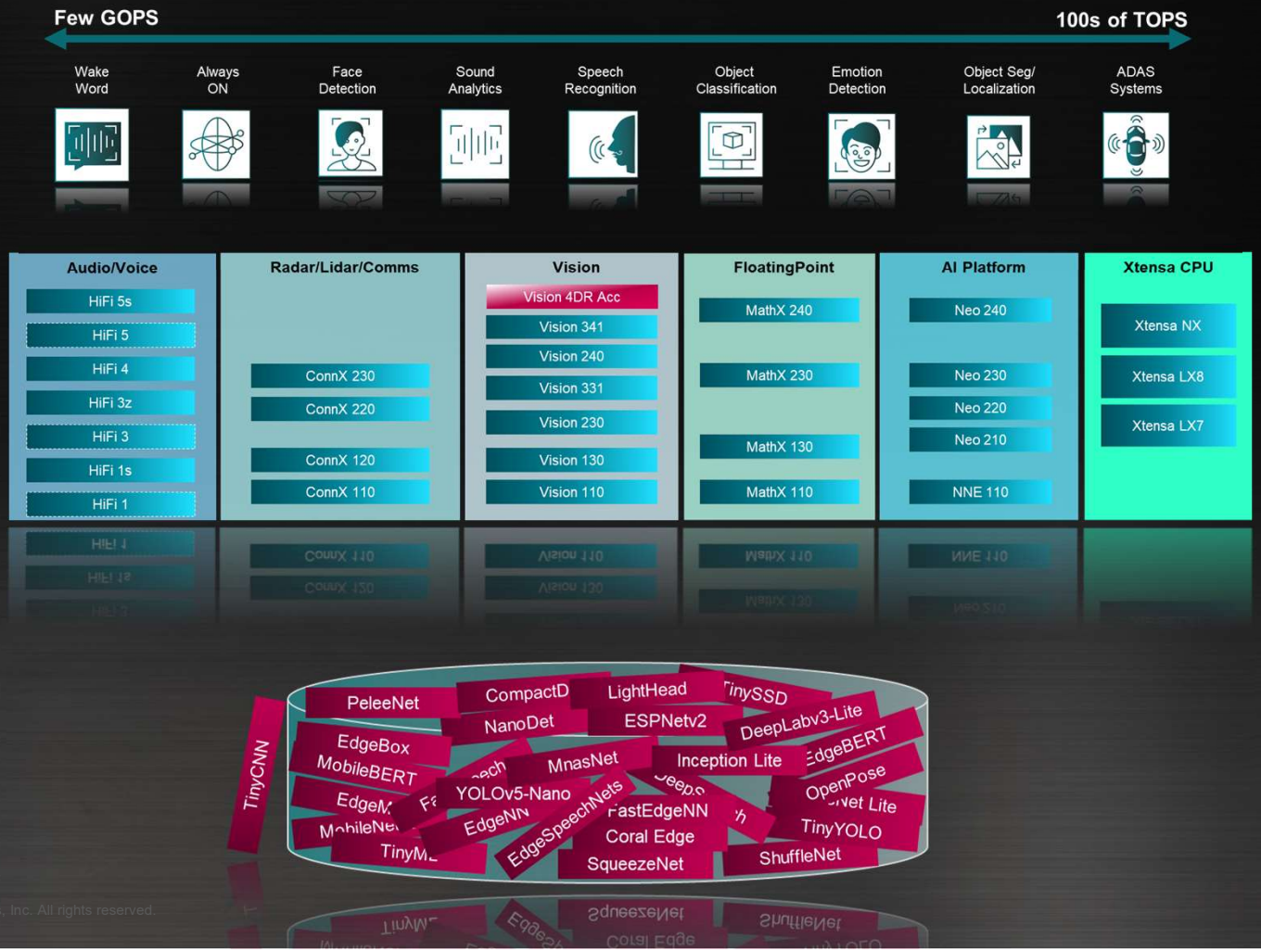
Audio/Voice	Radar/Lidar/Comms	Vision	FloatingPoint	AI Platform	Xtensa CPU
HiFi 5s		Vision 4DR Acc	MathX 240	Neo 240	Xtensa NX
HiFi 5		Vision 341			
HiFi 4	ConnX 230	Vision 240	MathX 230	Neo 230	Xtensa LX8
HiFi 3z	ConnX 220	Vision 331		Neo 220	Xtensa LX7
HiFi 3		Vision 230	MathX 130	Neo 210	
HiFi 1s	ConnX 120	Vision 130			
HiFi 1	ConnX 110	Vision 110	MathX 110	NNE 110	

AI at the Edge – The Software Development Tools Challenge

Applications

Hardware

Networks



AI at the Edge – The Software Development Tools Challenge

The AI Software Development Tools **Challenge**

What challenge?

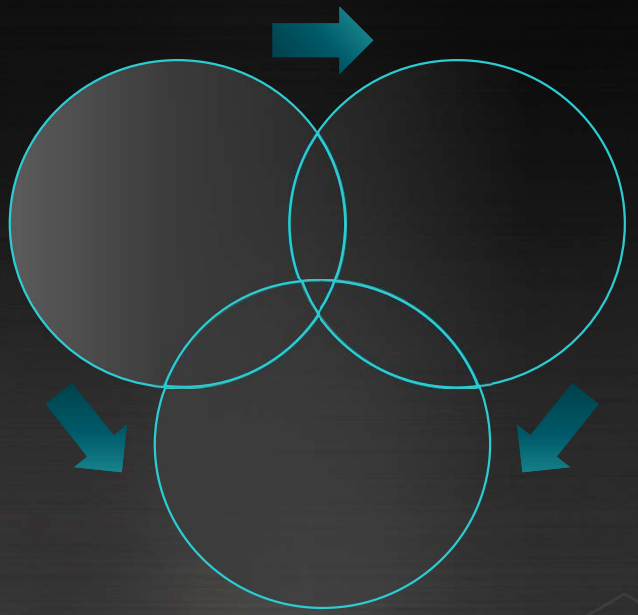
- An intersection of multiple domains
- From AI model in Python to edge quality embedded code
- The Frontier of AI model development

What **Challenge**?

- Opensource AI compilers
  - “XLA, IREE, Glow, TVM, … have already solved this problem.”
- MLIR is a graph compiler toolkit
  - “We solved that with a dialect.”
- Just map NN layers to optimized library functions
  - “We have a kernel for that.”

An Intersection of Multiple Domains

- AI network theory and construction
- High-performance computing
- High Level Language (HLL) compilers and utils
- Embedded system software
- Python and C/C++ and more

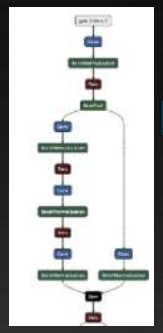


From AI Model in Python to Edge Quality Embedded Code

TensorFlow
PyTorch
Caffe2
ONNX
...

Build AI models

Floating-Point or Quantized Model Graph



NeuroWeave® SDK

Model Analyzer

Model Optimizer/Code Generator

Deploy AI models

Processor

Vision / RLC DSPs

Audio DSPs

AI Accelerators

Wake Word

Always ON

Object Localization

Object Classification

Sound Analytics

Emotion Detection

ADAS Systems

GenAI

One Single Software Toolchain flow for various deployment scenarios

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The Frontier of AI Models and Tools – “The Gold Rush”

- AI models are developed and represented in diverse and evolving frameworks
  - Keras, Caffe, TensorFlow(Lite), Pytorch, ONNX, NNEF, Core ML, MXNet, PaddlePaddle, …
  - A domain specific language expressing a computation graph
- Competing industry platforms
  - Good: Innovation moves quickly
  - Challenge: Trying to keep up
- What is missing compared to more traditional HLLs
  - No ANSI/IEEE specs
  - No Clang/Gcc implementations

How Will Standardization Be Driven in this New World?

How the Cadence Neuroweave SDK Meets the Challenge

- Graph import
  - Civilize the Frontier as best we can via TVM
- Quantization, Optimization, Code Generation
  - A combination of MLIR, LLVM, and Proprietary
- Architecting an open and extensible solution
  - Enable diverse type of AI HW Archiectures
  - Processor + Accelerator + Custom IP

In Closing

AI Applications + Diverse HW + A Heap of Network models

Requires sophisticated software development tools

As a community: converge on a shared AI model representation

Q&A