embedded VISION SUMMIT 2018

Programmable CNN Acceleration in Under 1 Watt

Gordon Hands

May 22, 2018

LATTICE SEMICONDUCTOR

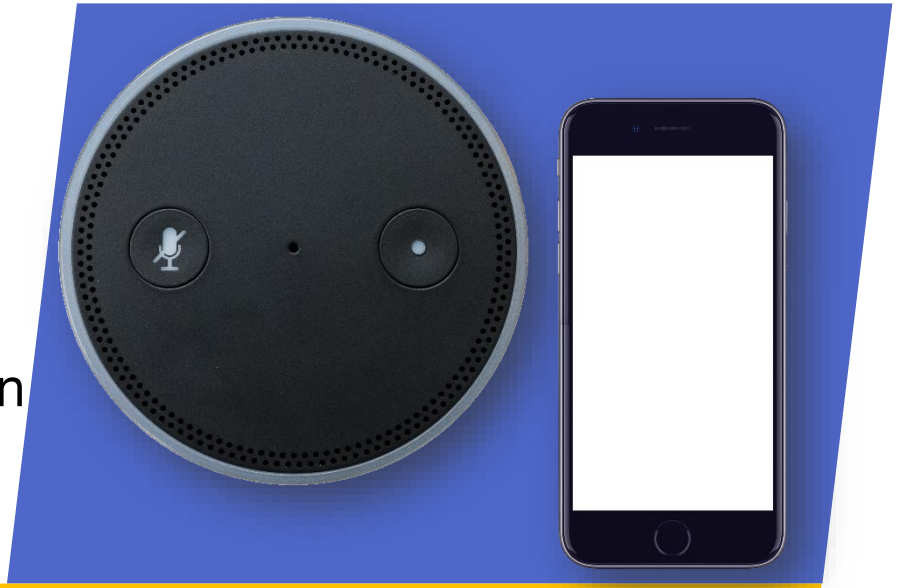
Drivers for Artificial Intelligence at the Edge

- Improving Privacy
- Simplified Regulation Compliance
- Reducing Bandwidth Required
- Optimizing Use of Cloud Computing
- Minimizing Latency

Edge Device AI Requirements

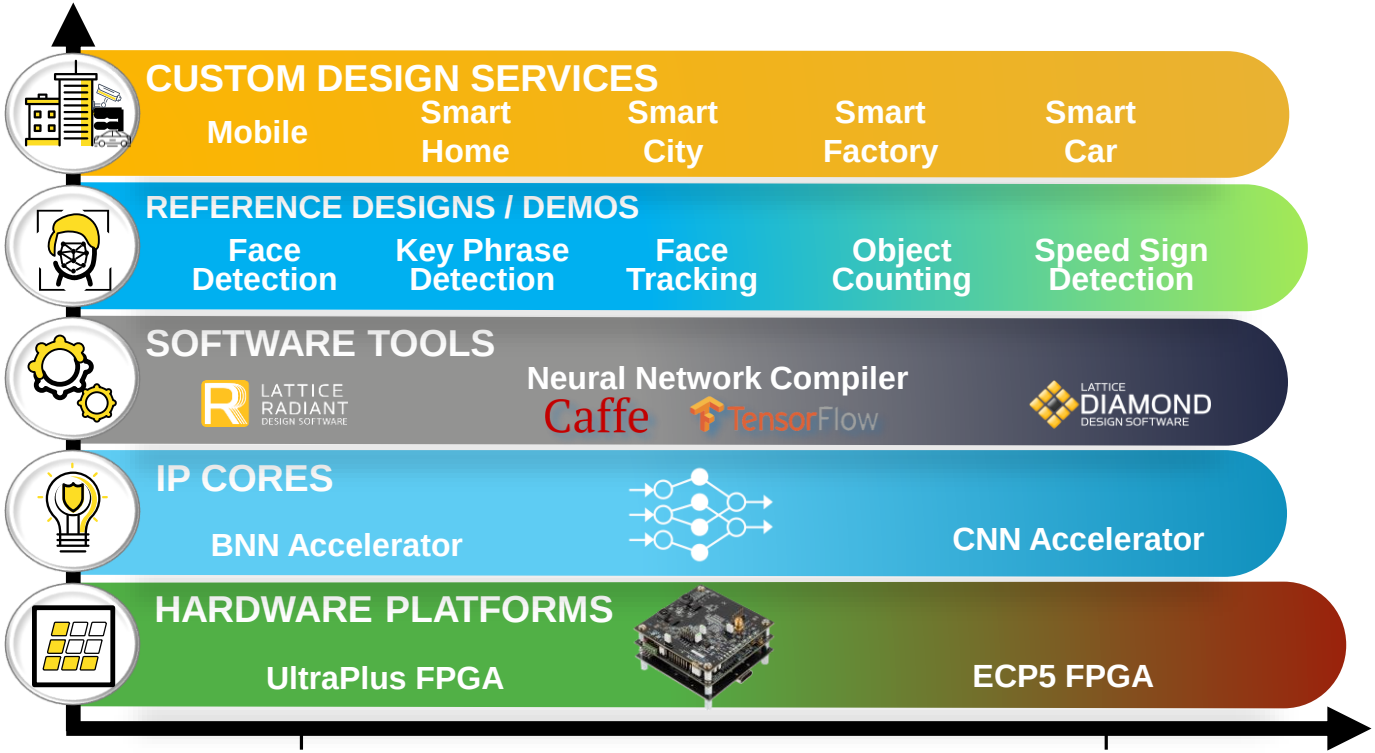
Edge Device Requirements

- Low Power
- Integration for Small Form Factor
- Fast Development
- Low Cost for High Volume Production
- Moderate Performance Inferencing



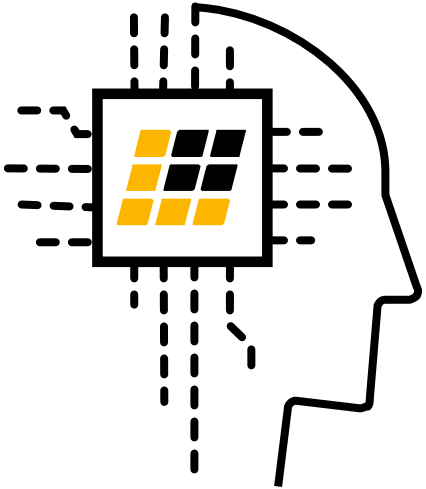
Lattice is Focused on Adding AI Capability to its Flexible Low Cost, Low-power Production Priced FPGA Solutions

Introducing Lattice sensAI

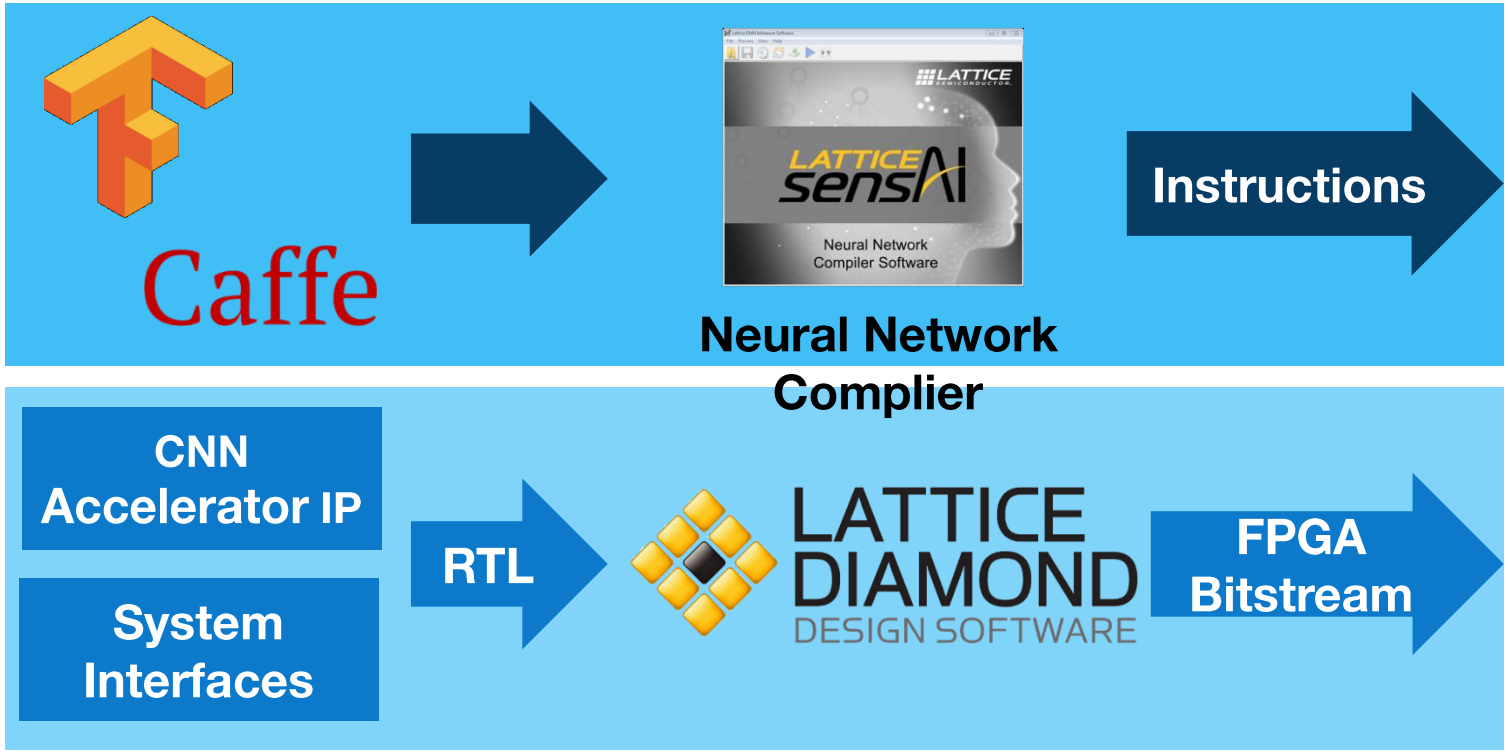


1 mW, 5.5 mm^2, 1 bit, ~$1

1 W, 100 mm^2, 8/16 bits, ~$10

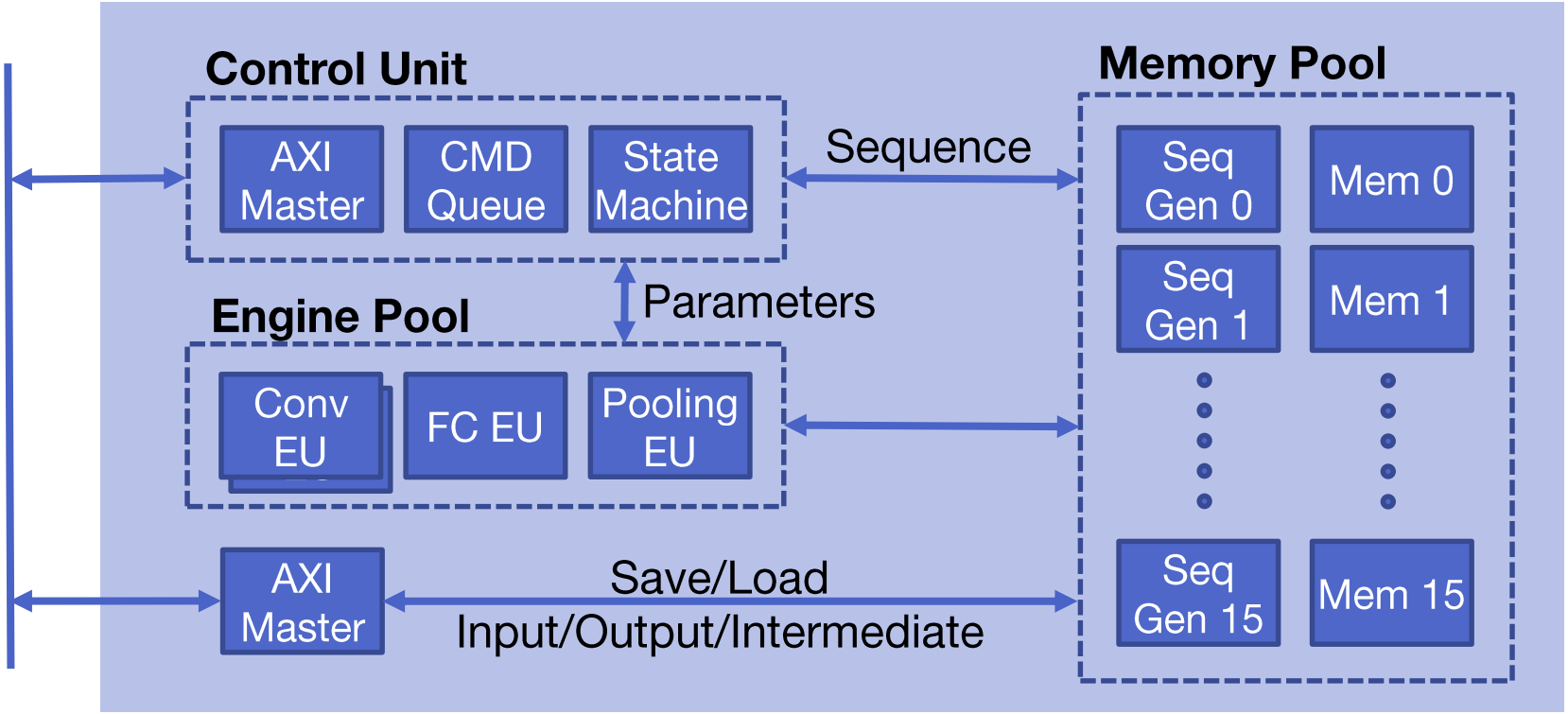


Delivering Edge CNN Acceleration in Lattice FPGA



Lattice FPGA

CNN Accelerator IP Architecture



Translating Trained Neural Network Into Lattice CNN Accelerator Instructions

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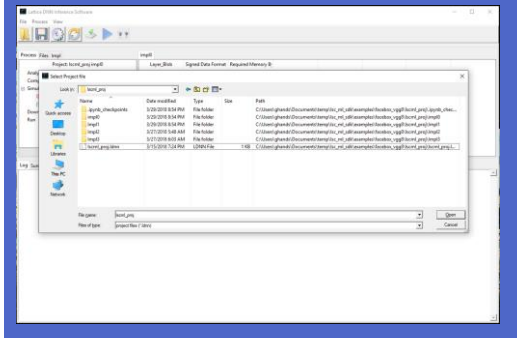
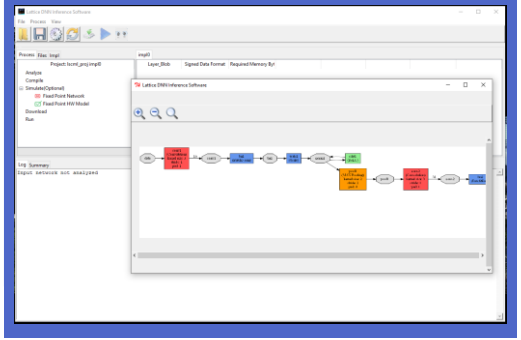
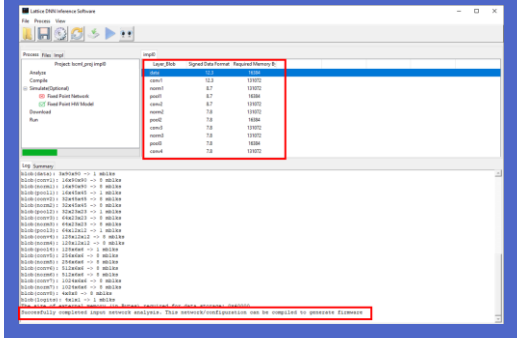
1. Load



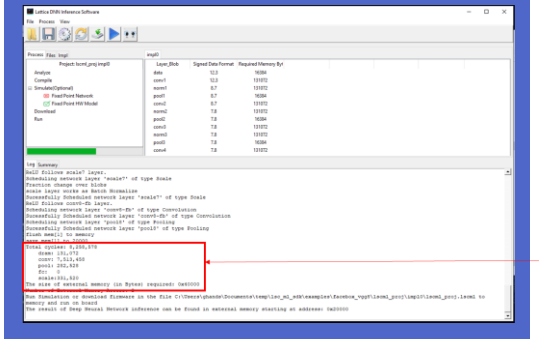
2. Review



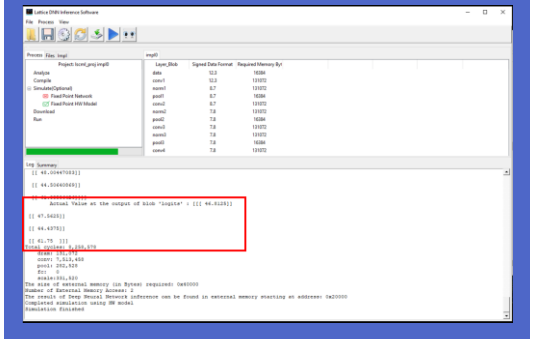
3. Analyze



4. Compile



5. Simulate



Edge AI – Complex Optimization

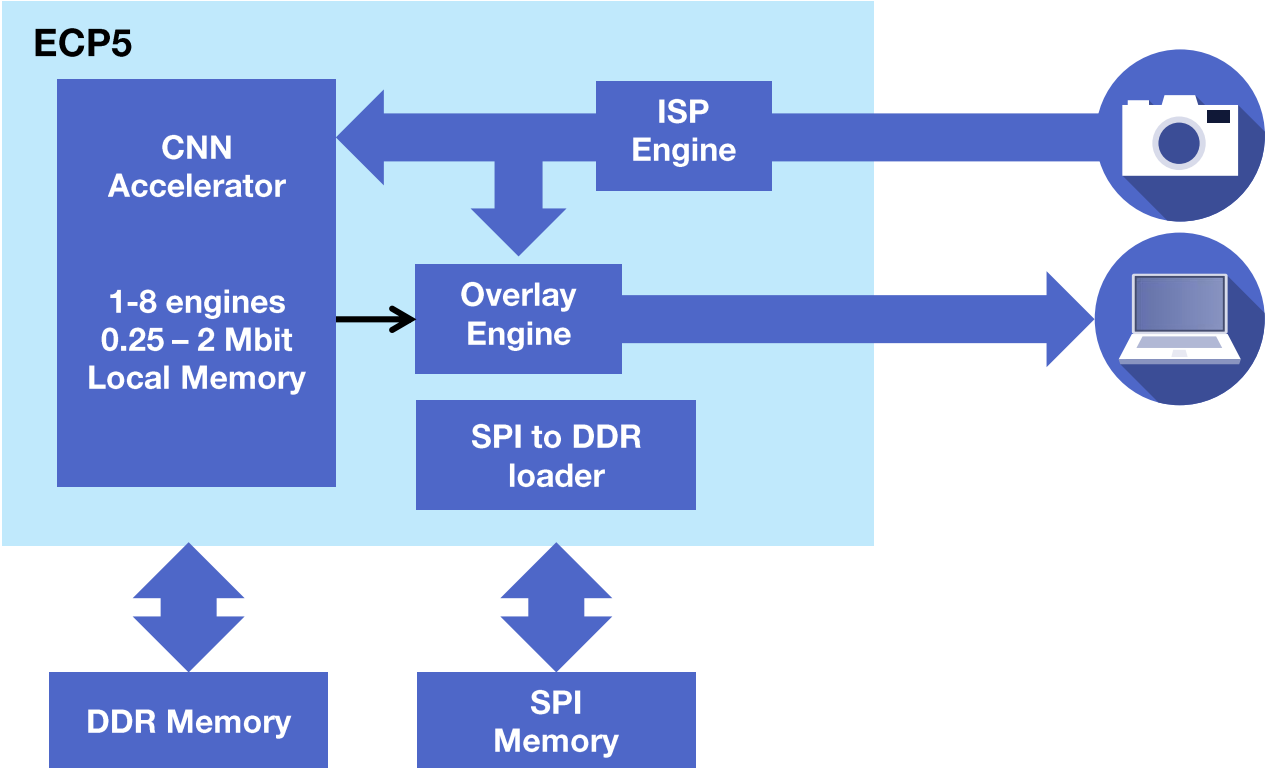
Design Factors / Attributes	Device		Network		
	# of Engines	Local Memory	Input Size	Number of Multipliers	Bit Widths
Power (W)					
Cost ($)					
Performance (fps)					
Accuracy (%)					
Small Object (% fov)					

Correlation Between Design Factors and Product Attributes

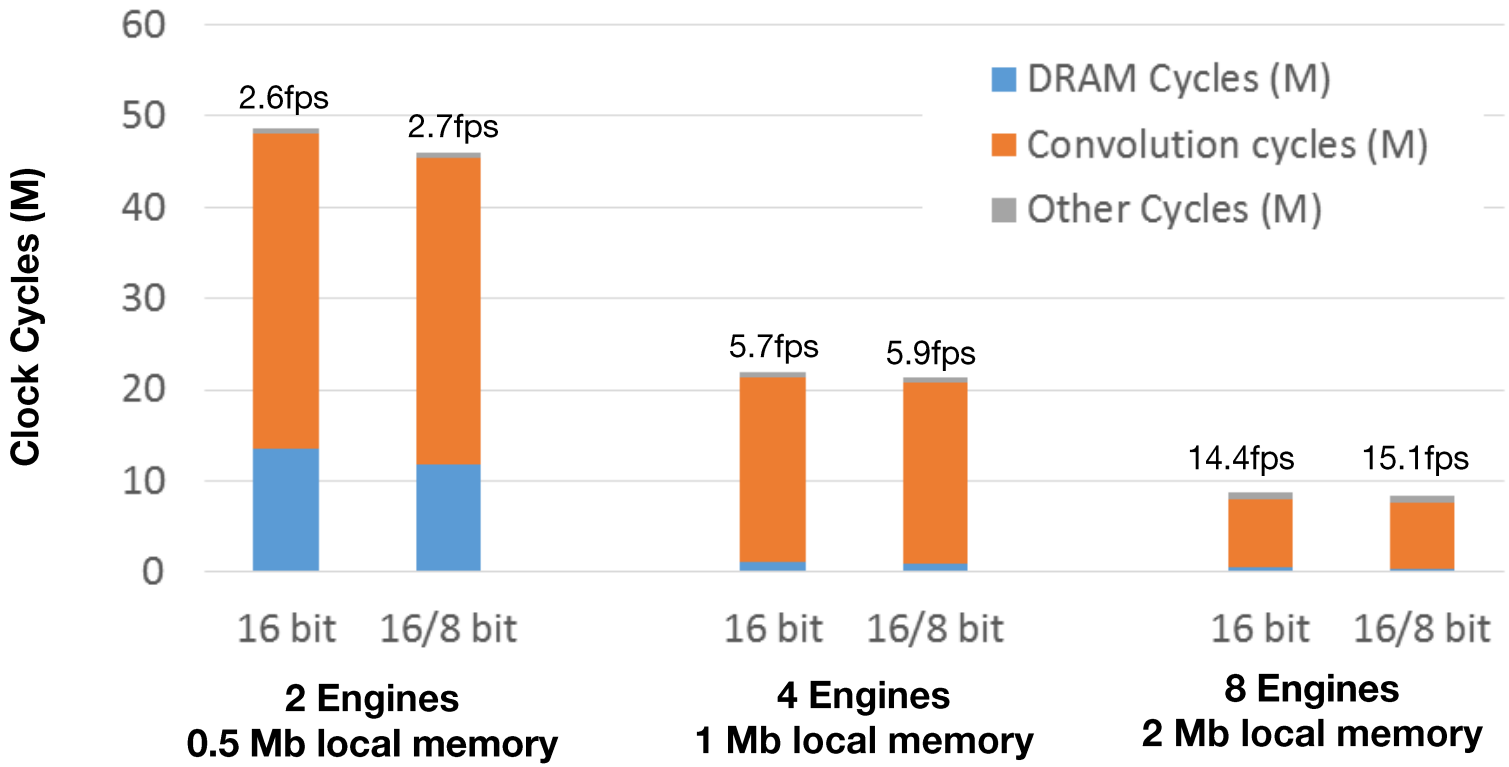
Examples for Illustration

		Architecture	Number of Multiplications	Input Size	Quantization
Face Tracking		Modified VGG8	256M	90x90	16 bit fixed
					8/16 bit fixed
Speed Sign Detect		Modified VGG8	146M	128x128	16 bit fixed
					8/16 bit fixed

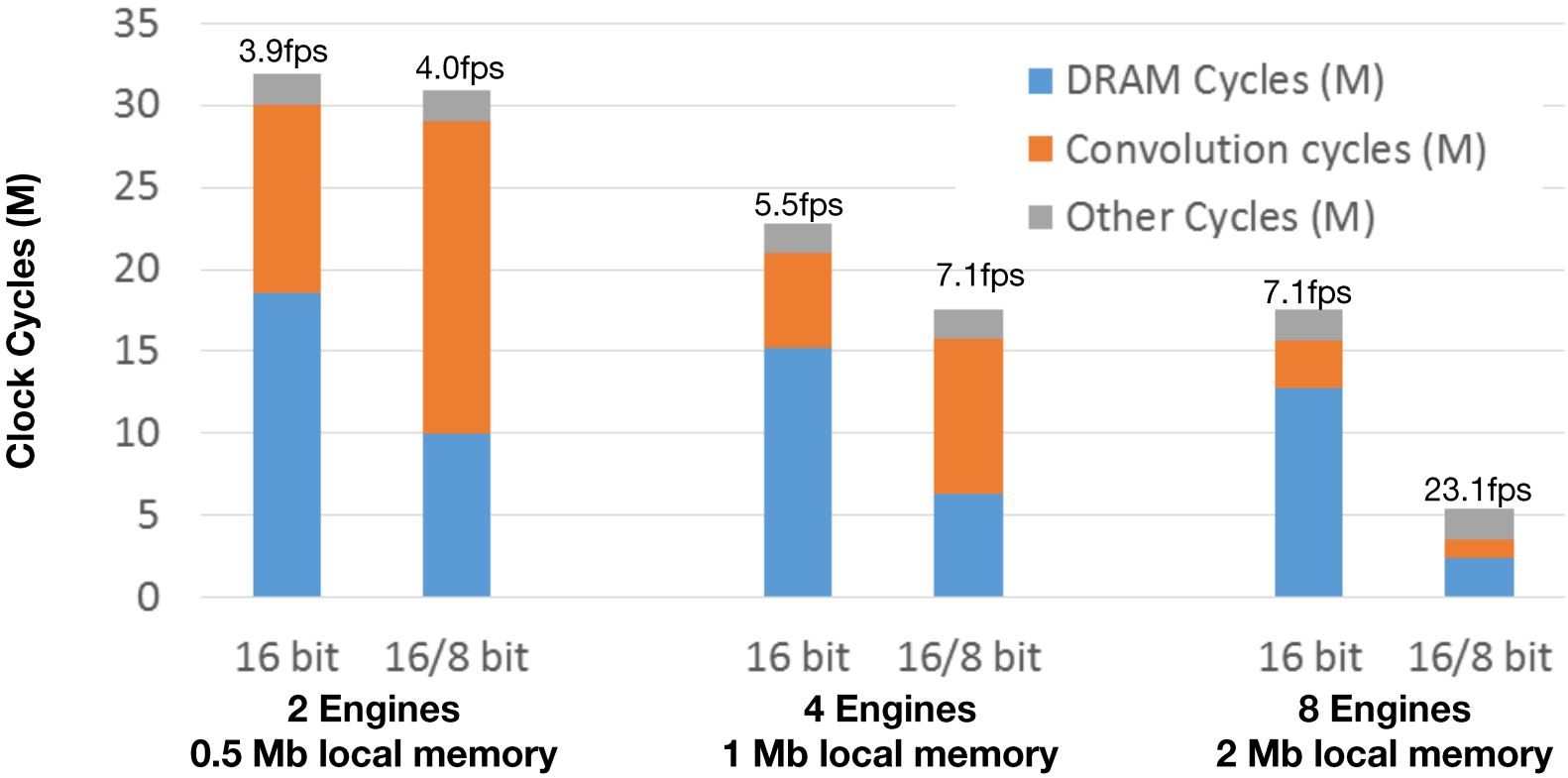
System Block Diagram



Face Tracking Implementations



Speed Sign Implementations



Bringing It Together

		Device Cost / Power / Performance		
Network	**Smallest Object**	**ECP5-25 Cost x0.25 0.5 W**	**ECP5-45 Cost x0.5 0.53 - 0.62 W**	**ECP5-85 Cost x1.0 0.58 – 0.8 W**
Face Tracking 16 bit	20 % of image height	2.6 fps	2.6 – 5.7 fps	2.6 – 14.4fps
Face Tracking 8/16 bit		2.7 fps	2.7 – 5.9 fps	2.6 – 15.1fps
Speed Sign Detect 16 bit	15% of image height	3.9 fps	3.9 - 5.5 fps	3.9 – 7.1 fps
Speed Sign Detect 8/16 bit		4.0 fps	4.0 – 7.1 fps	4.0 – 23.1 fps

Summary

- AI at the edge solves real world problems
- ECP5 sensAI Stack Components Provide Edge AI Building Bocks
  - Silicon, Soft IP, Tools, Development Boards & Reference Designs
- Configurable Engine Size and Bit widths Coupled with Multiple Devices Allows System Optimization
  - 0.5 – 0.8 W, 10x10 mm^2, < $10

Resources

- Please Visit www.latticesemi.com for More Information and Downloads
  - 3 ECP5 Based Reference Designs / Demonstrations -- Free
  - CNN Accelerator IP – Free Evaluation
  - NN Compiler – Free
  - Video Interface Board – Currently $199 Promotional Price

- Please Visit the Lattice Booth in the Showcase
  - 8+ Intelligence At The Edge Demonstrations