

Extending the FPG-AI Framework for Automatic DNN Acceleration on NanoXplore FPGAs

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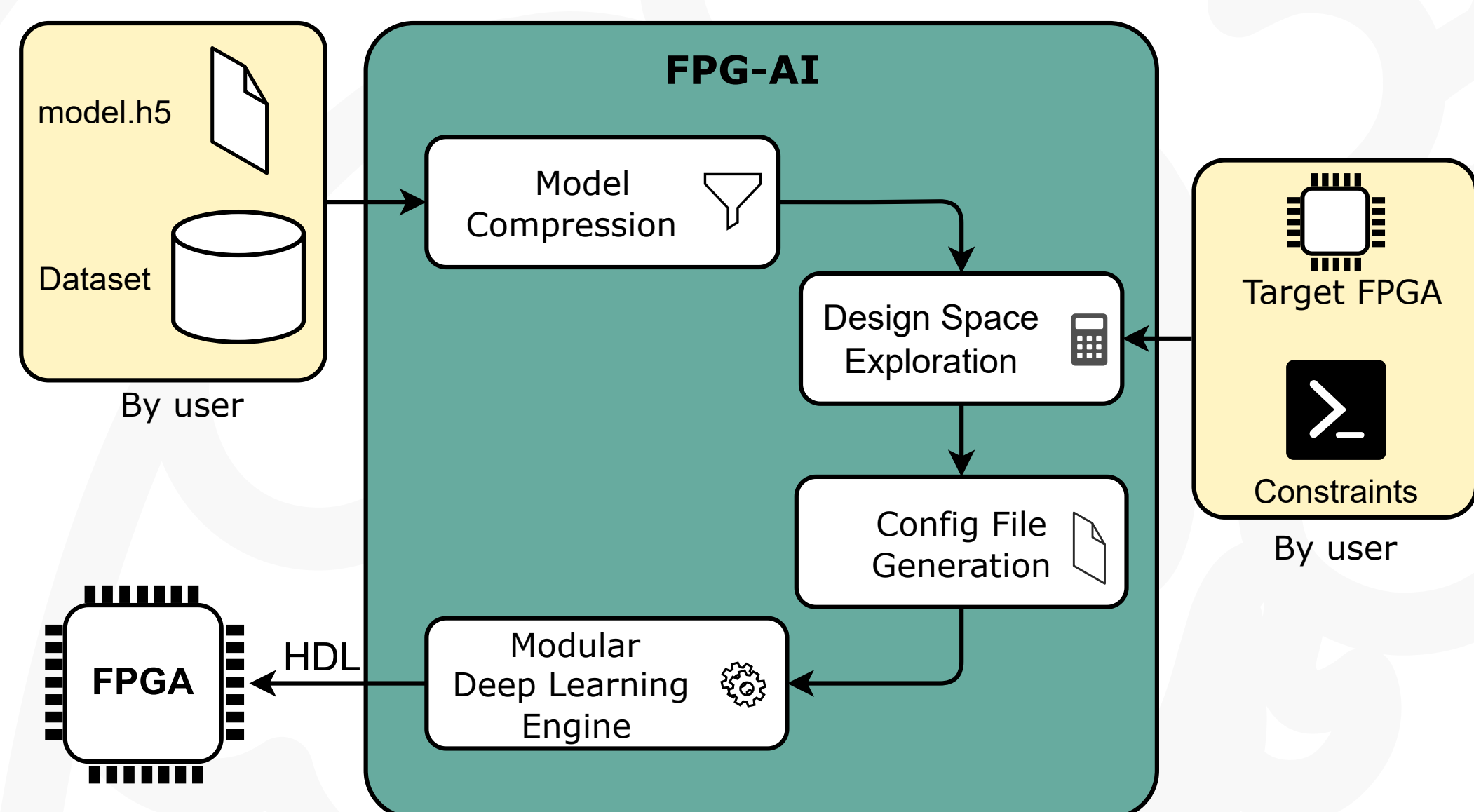
1. FPGAs for AI in Space

Field Programmable Gate Arrays (FPGAs) for AI application onboard satellites:

- Energy-efficient platforms
- Hardware parallelism structure compatible with AI workload

- NanoXplore offers Radiation Hardened By Design Devices
- Consistent engineering effort in the design of custom and optimized hardware accelerators

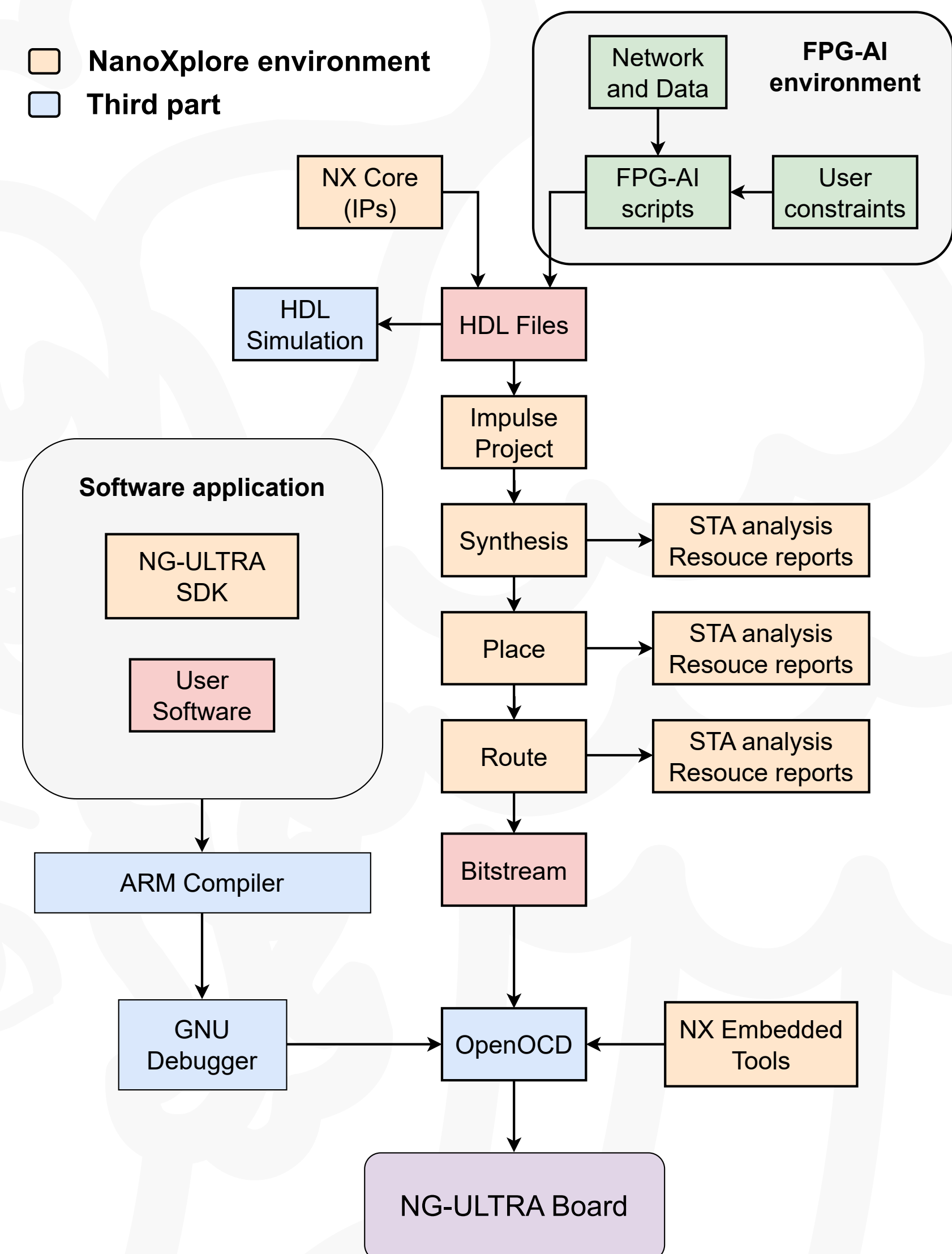
2. FPG-AI



FPG-AI automation toolflow for AI accelerator generation:

- High degree of customization → **INTEGRABLE**
- Fully **handcrafted** and **readable HDL** → **INSPECTABLE**
- Absence of third-part IPs → **PORTABLE**
- Now compatible with **NanoXplore NG-ULTRA**

3. FPG-AI for NanoXplore Flow

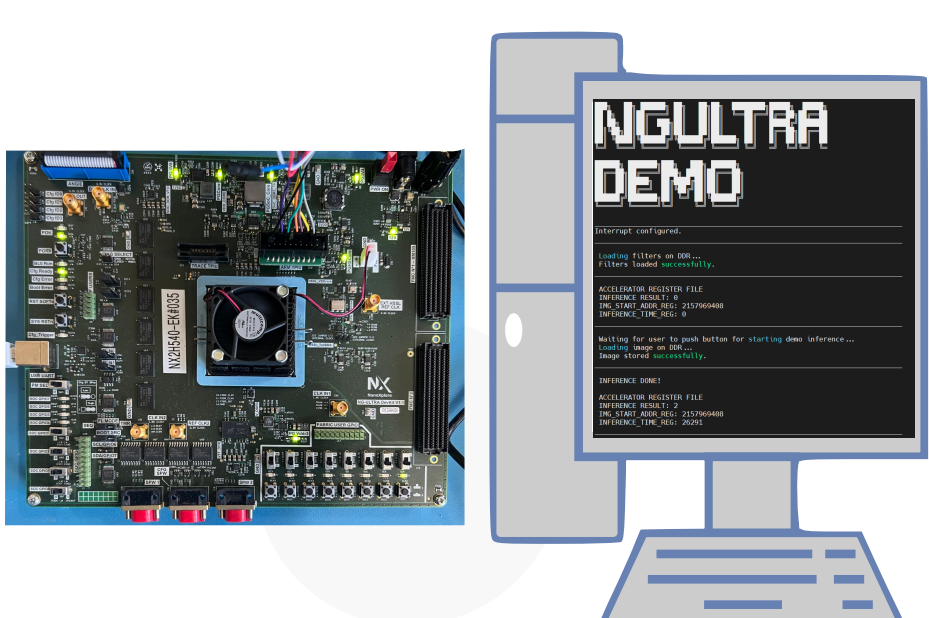
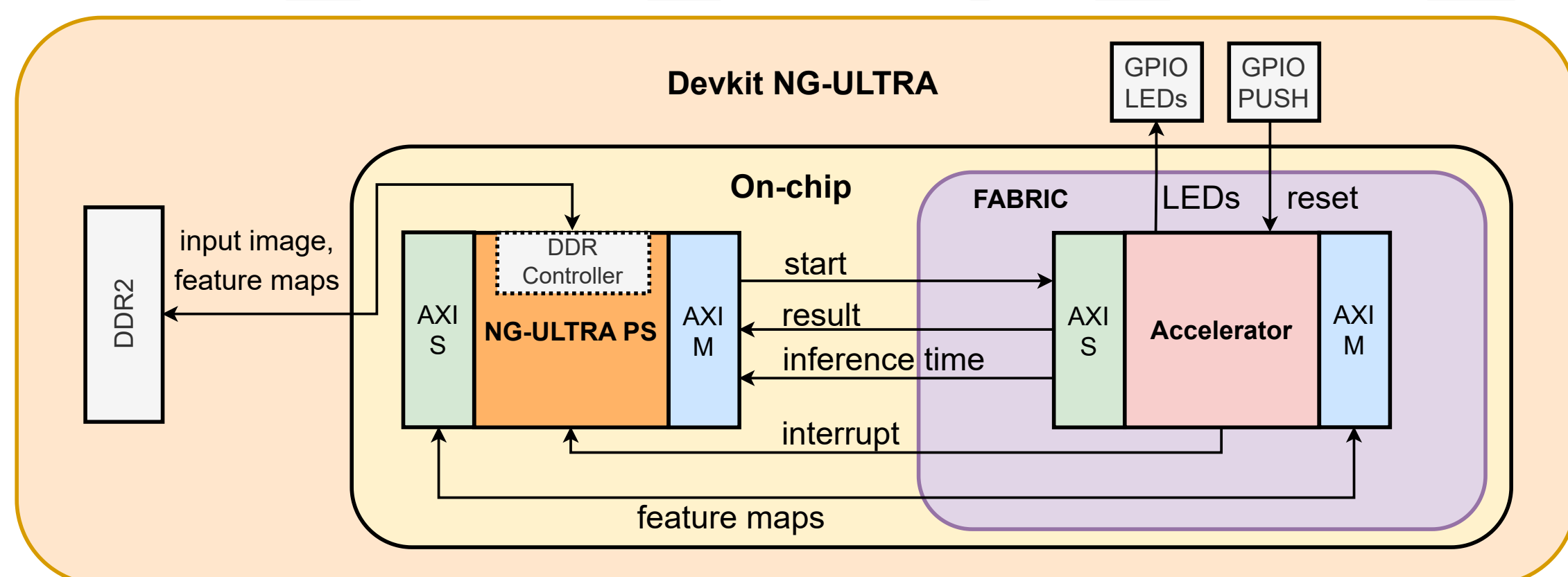


4. LeNet-5 Case Study

- Filters on 8 bits fixed point
- Activations on 7 bits fixed point
- 97.5% accuracy **not degraded**

LeNet 5	
Type	CNN
Classification class	Digits
# Convolutional layers	2
# Pooling layers	2
Type of pooling	Average Pooling
# Fully Connected layers	3
# Neurons for each FC layer	120, 84, 10
Input image dimension	28 x 28 x 1
Total Parameters	44426
Memory for Parameters [Mbit]	1.36 Mb
Workload [OP]	309K

5. NG-ULTRA prototype



We designed the prototype:

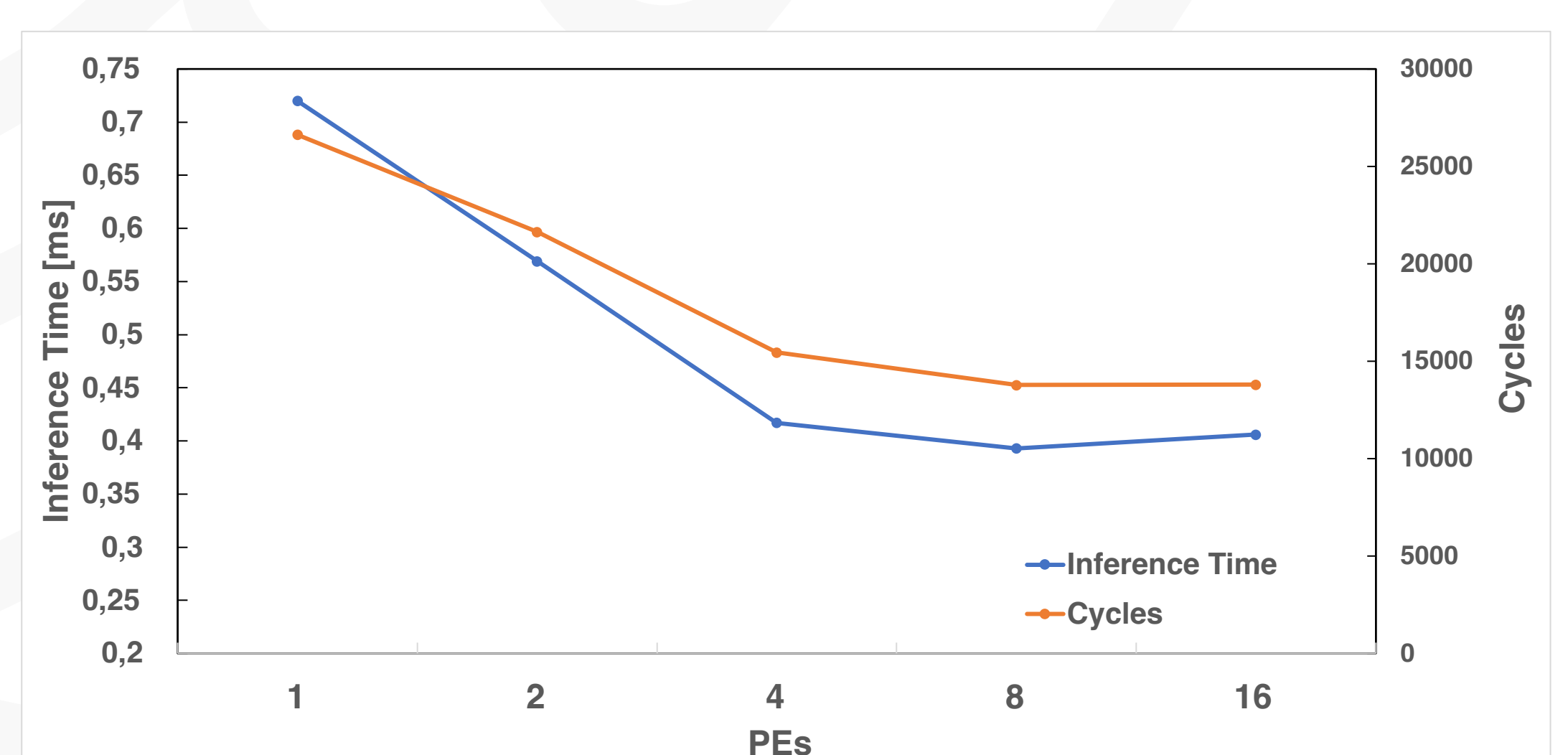
- Custom DMA
- ARM Cortex-R52 inside the NG-ULTRA SoC
- DDR2

6. Results

First AI implementation on a NanoXplore Device →



Different number of FPG-AI's PEs



6. Acknowledgment

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OSIP ACTIVITY



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