



Imagination

PowerVR AI: GPU + NNA

June 11, Chengdu



**10 billion units shipped
1.2 billion in past year**



- **Developing innovative IP**
 - Industry leading vision & AI, graphics and communications
- **Delivering exceptional service**
 - Enabling fast time to market to customers around the world
- **Driving major new markets**
 - Helping our partners create successful solutions across many segments

Award Winning

PowerVR 2NX NNA

- ✓ Team of the Year 2018
- ✓ Design Team of the Year 2018
- ✓ Best IP Product 2018



PowerVR Vision & AI

Use cases and markets

PowerVR Product Families

PowerVR GPU and Neural Network Accelerator IP Families



PowerVR

The best solution for embedded graphics, vision and AI

PowerVR GPU

Broad suite of products covering embedded graphics needs across several applications

PowerVR Vision and AI

Dedicated AI, Vision ISP and vision hardware

XE/XM GPU

Focused features
Fillrate/mm²
Performance/mm²

XT GPU

Feature rich
Performance/mW

GP-GPU

Compute focussed
solution

3NX NNA

Hardware NN

Performance/mm²
Performance/mW

Vision / ISP

Hardware

Performance/mm²
Performance/mW

Embedded Intelligence at Low Power



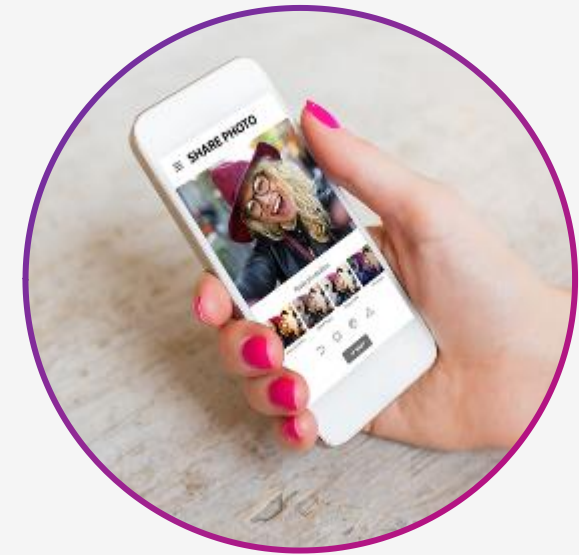
Key Market: Mobile



Application
Friend Recognition
AI Technology
Face Identification



Application
Photo Searching
AI Technology
Scene Recognition

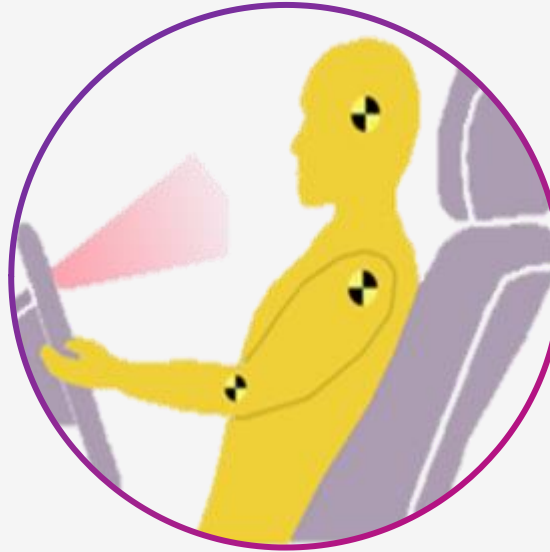


Application
Advance Camera Filters
AI Technology
Style Transfer

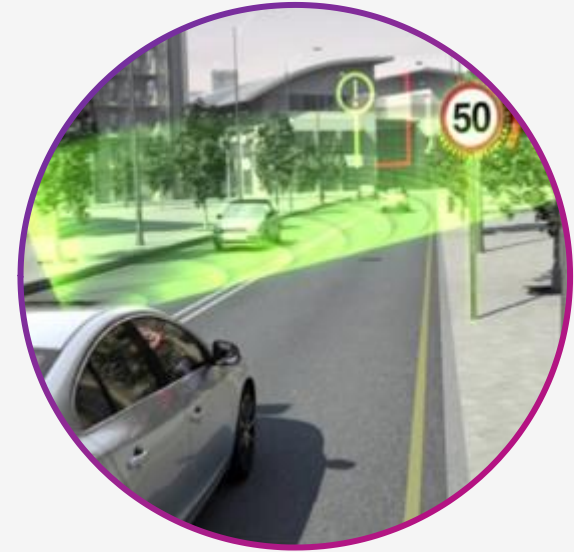
Key Market: Automotive



Application
Collision Warning
AI Technology
Segmentation



Application
Driver Monitoring
AI Technology
Face Detection



Application
Traffic sign recognition
AI Technology
Object Identification

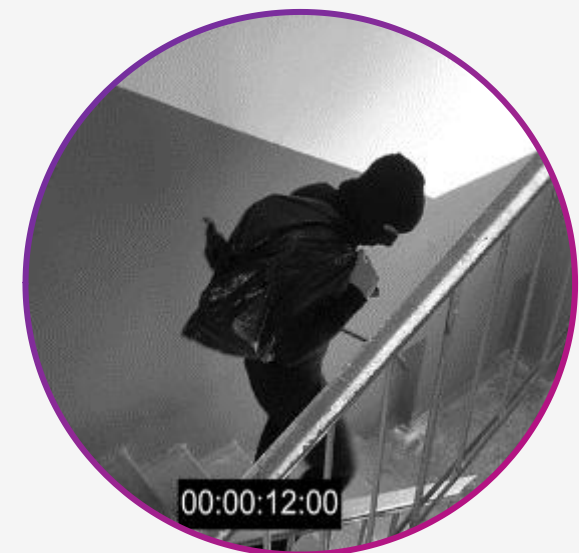
Key Market: Smart camera surveillance



Application
People Tracking
AI Technology
Face Identification



Application
Queue Monitoring
AI Technology
Scene Recognition



Application
Suspicious Behavior
AI Technology
Object Detection

Key Market: DTB, STB and OTT



Application
Image enhancement
AI Technology
Super resolution



Application
Accurate subtitling
AI Technology
Speech recognition

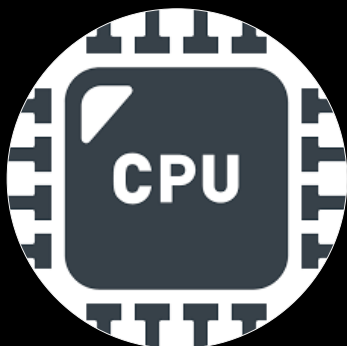


Application
Gesture control
AI Technology
Gesture recognition

How we enable the Edge with GPU and NNA

Smarter AI

Why GPU and Neural Network Accelerators provide the optimum solution



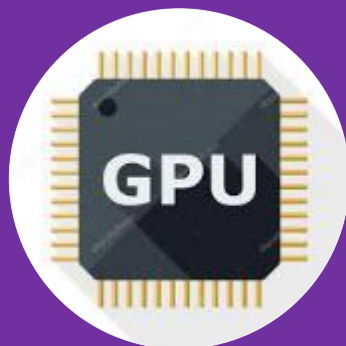
CPU

- Fully Flexible
- BUT inefficient and slow for high compute workloads



DSP

- Fully Flexible
- BUT hard to program – no standardisation, INT focussed



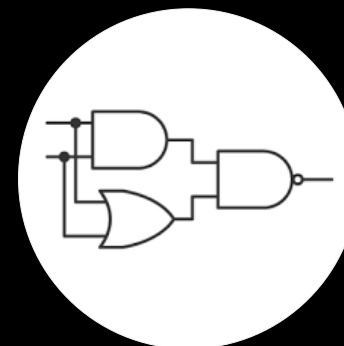
GPU

- Fully Flexible
- Standardised APIs for Compute, Float and INT support



Neural Network Accelerator

- Configurable
- Lowest power with domain specific flexibility



Fixed Function

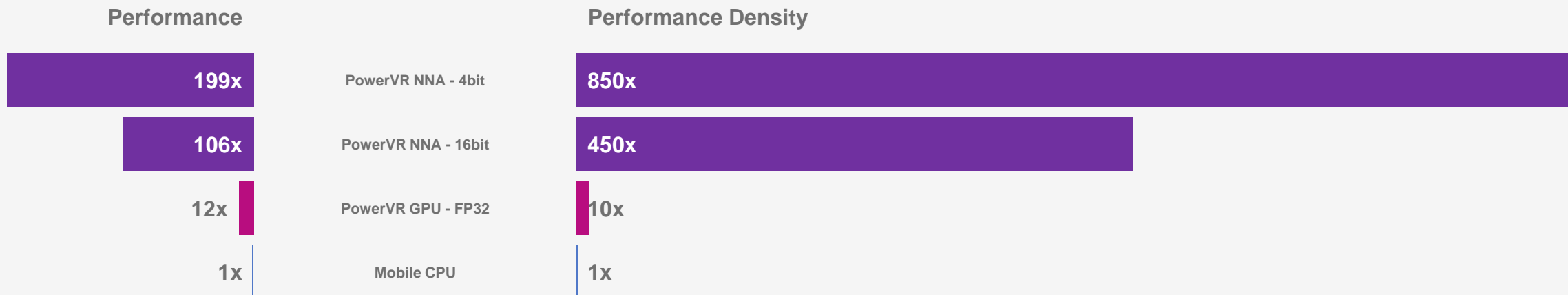
- Single usage case
- Lowest power BUT zero flexibility



Why the dedicated accelerator approach

Extracting the best performance for the area budget

PowerVR NNA Solution Comparison



Neural Networks have high bandwidth and computation requirements

A dedicated architecture addresses both of these issues

Cost efficient because of mobile experience

PowerVR NNA is designed to deliver the best performance per mm²

PowerVR flexibility: Addressing the markets

Security Camera

- People detection & recognition
- Emergency detection
- Emergency identification
 - Breaks
 - Fire/Smoke
 - Leak Identification

Automotive

Non-ADAS

- Lane detection warning
- Driver distraction warning
- Street Sign Detection
- Blind spot warning

ADAS

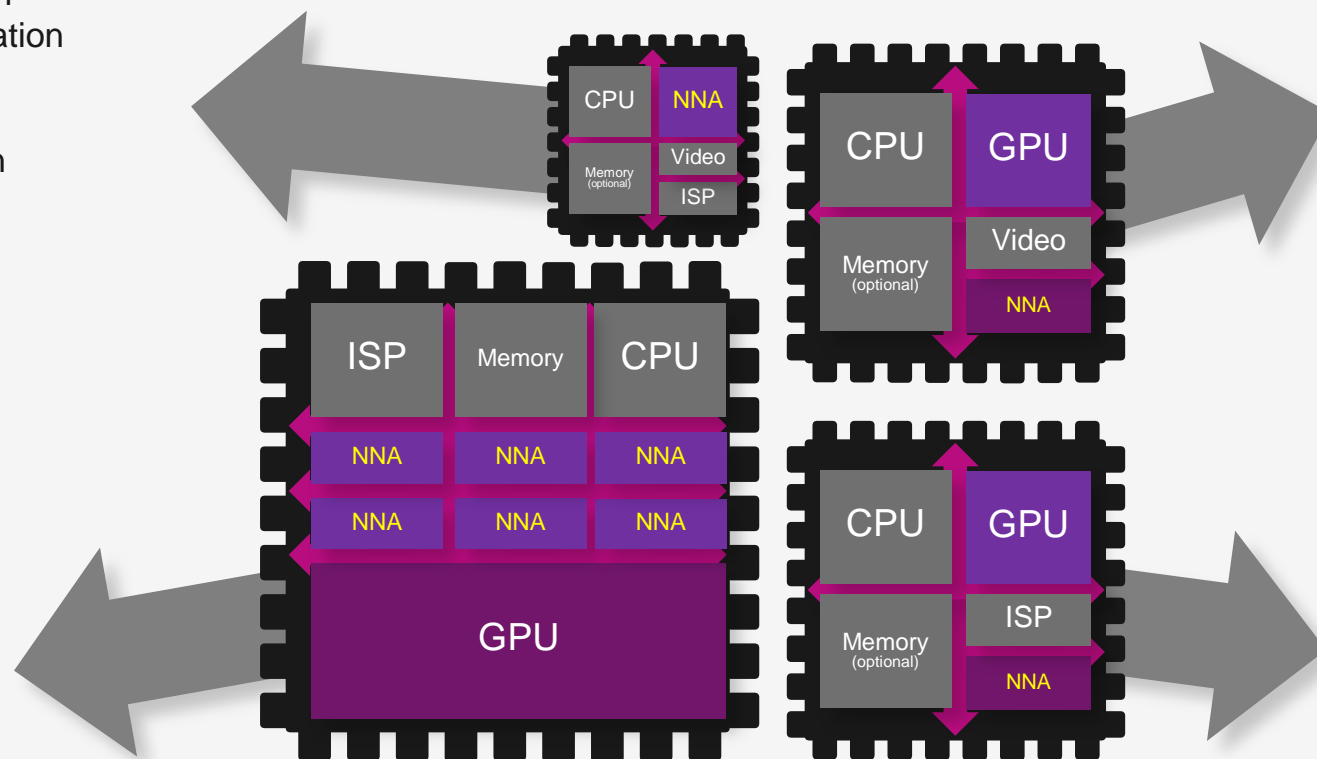
- Environment Recognition
- Obstacle detection
- Feed into ASIL Brain

STB/DTV Platform

- User Recognition/Detection
- Video scene recognition
- Commercial detection

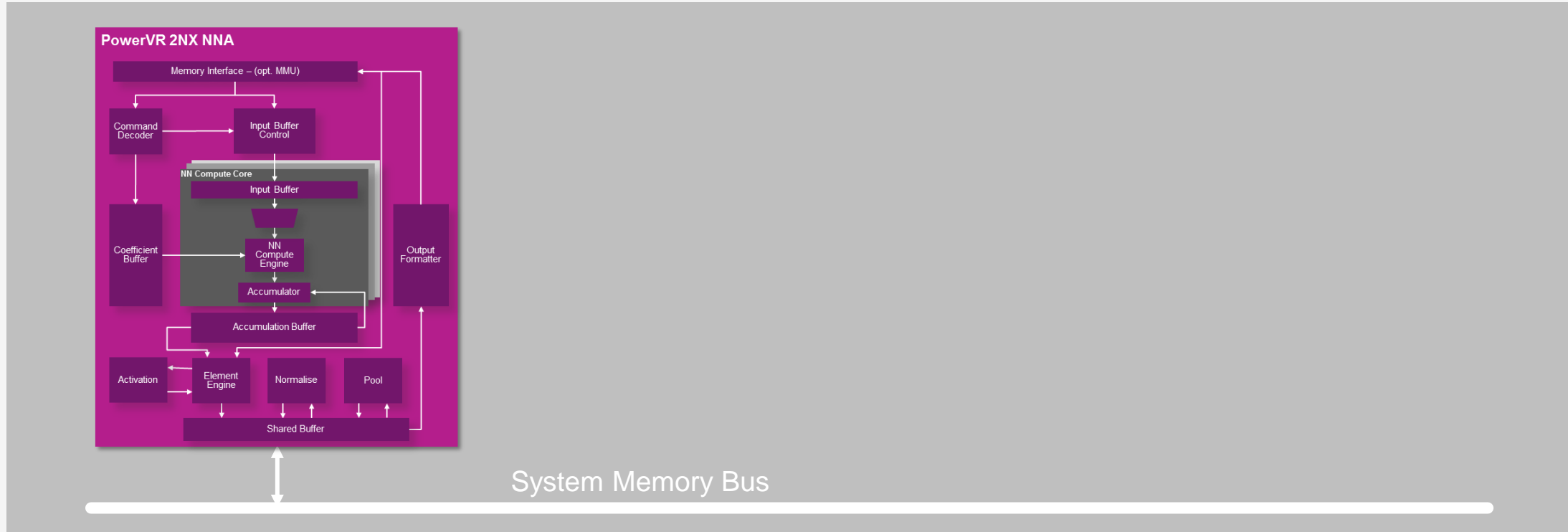
Mobile

- Scene Detection/Recognition
- Image Depth Estimation
- Super Resolution
- Speech Recognition
- Noise Reduction
- GPU post processing
 - MSAA
 - Depth of field



Flexible AI offerings: PowerVR NNA

Fastest performance with PowerVR NNA

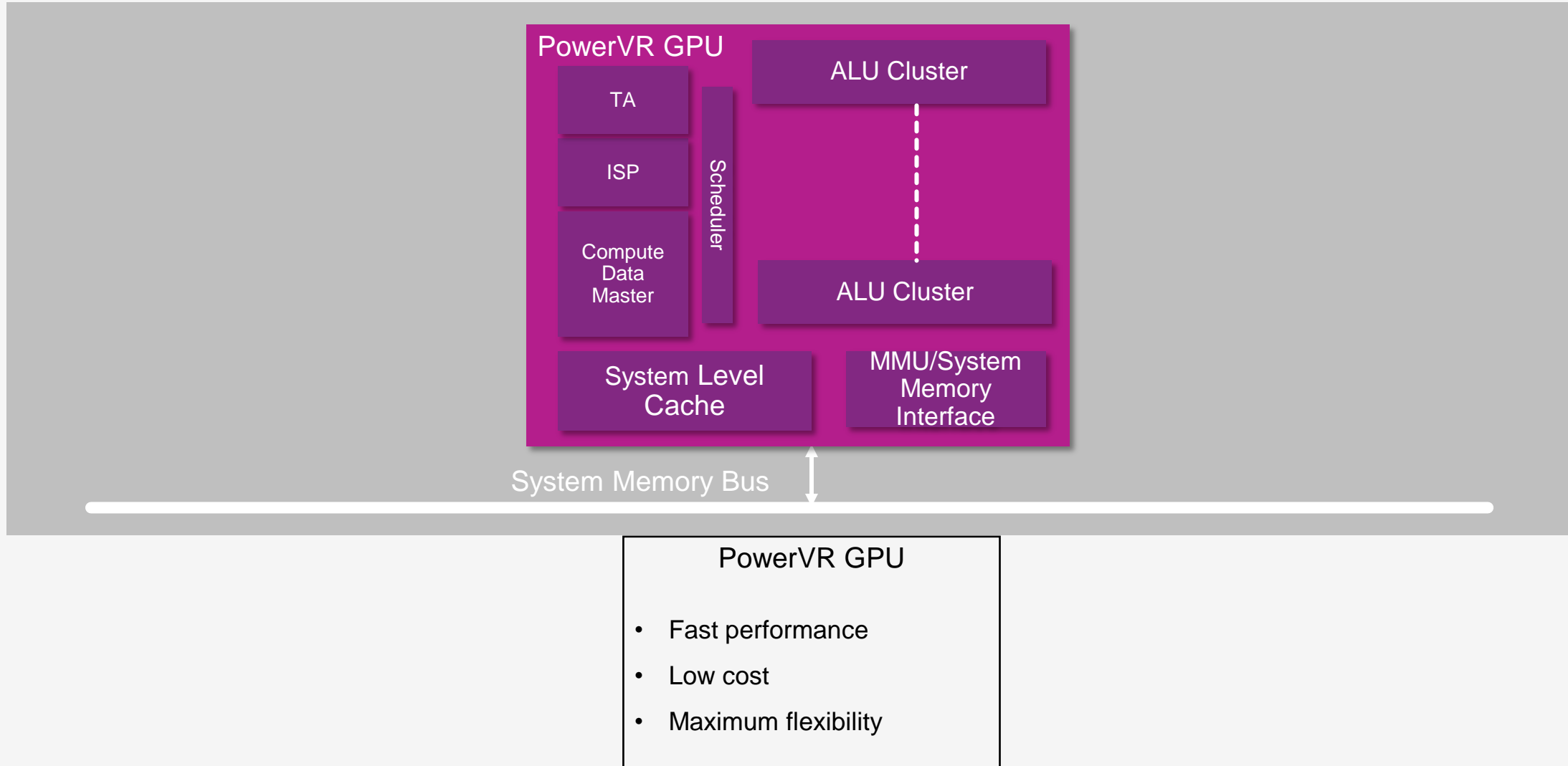


PowerVR NNA

- Fastest performance
- Lowest cost
- Supported feature set

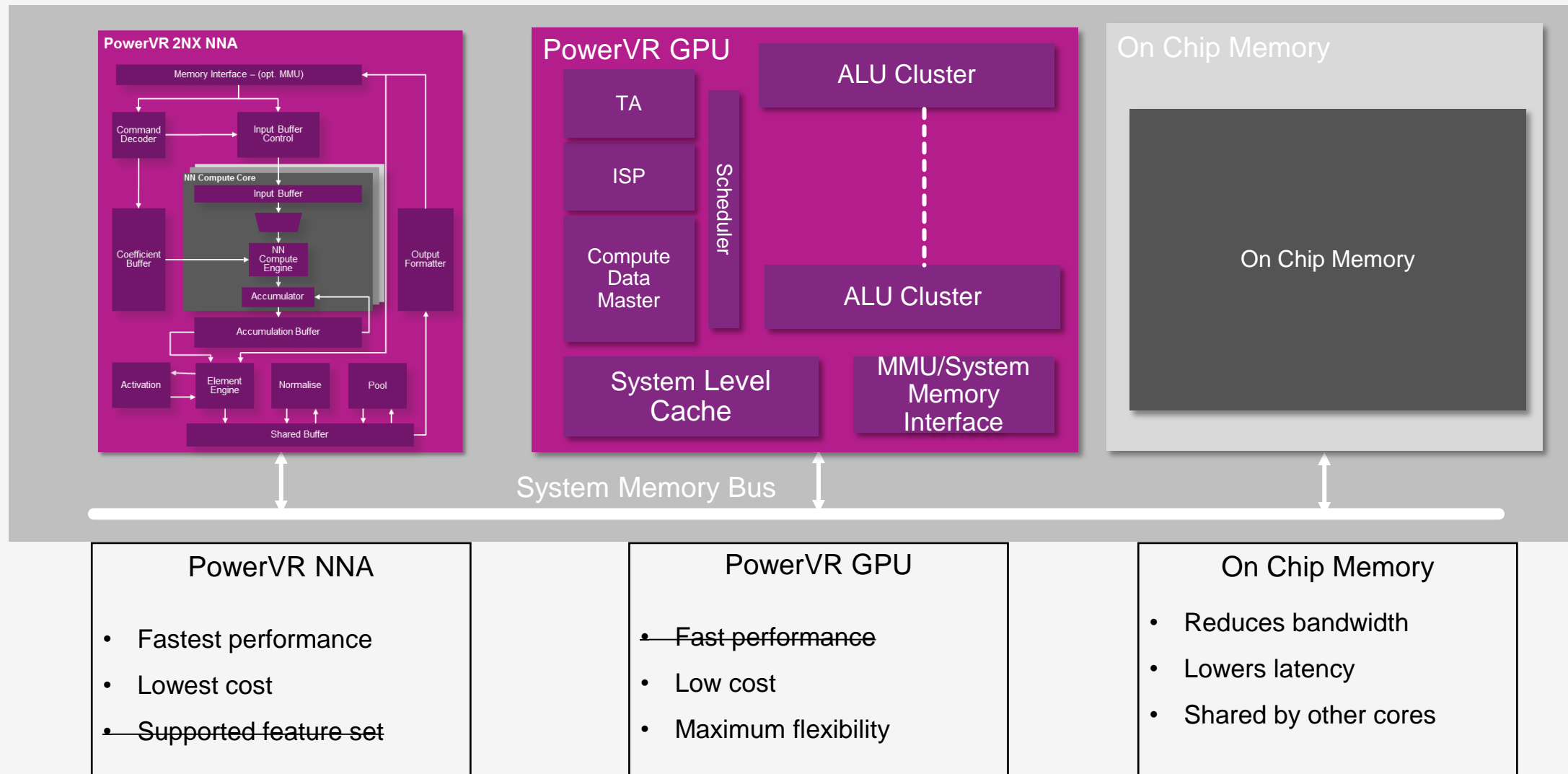
Flexible AI offerings: PowerVR GPU

Maximum flexibility with PowerVR GPU



Flexible AI offerings: PowerVR NNA + GPU

Fastest Performance and maximum flexibility



Moving beyond hardware



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AI has no open-standard API

Popular frameworks are desktop first

Requires rich software environment to compliment hardware

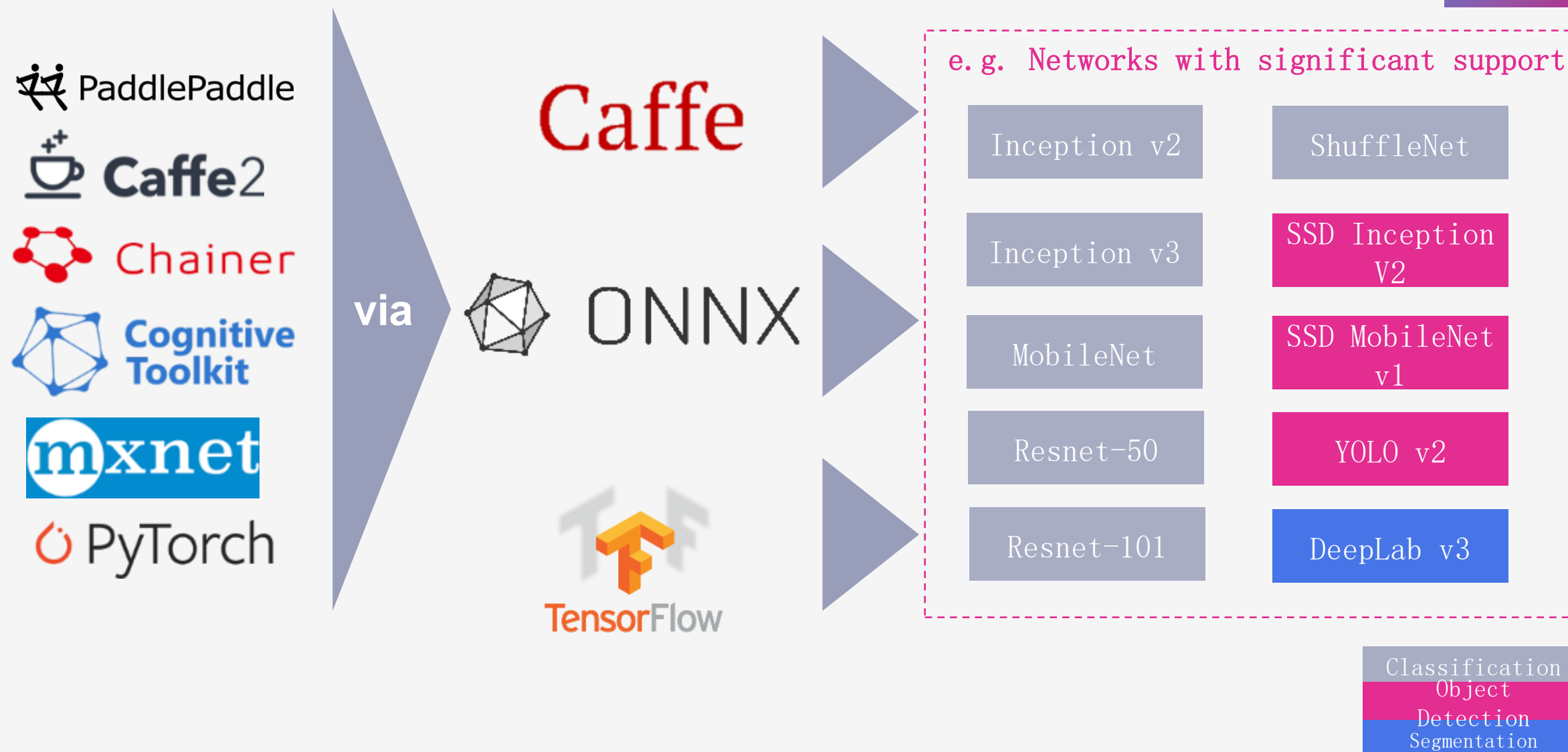




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Software for AI

Acceleration for popular Neural Networks



PowerVR AI Software Overview

Unified solution across NNA and GPU



PowerVR AI Toolkit

Simplifies deployment workflow

Easy debugging and network analysis

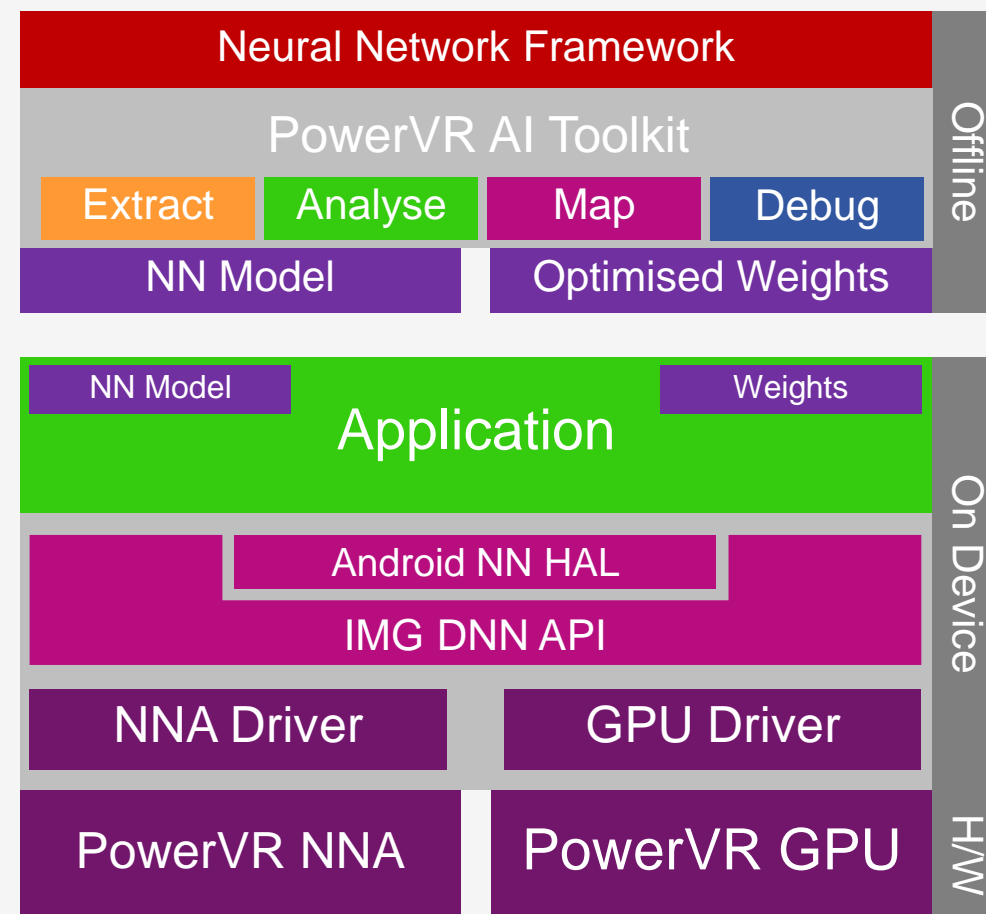
User optimisation networks possible

Supported APIs: IMG DNN & Android NN

Seamless operability between GPU & NNA

Straight forward development

IMG DNN API available on GPU today



PowerVR AI: One combined API

Your network, one API, optimised for GPU and NNA



IMG DNN API

PowerVR GPU

PowerVR NNA

Cost	Lowering effort to support a wide range of networks
Performance	Zero copy memory sharing between IP, driver-level synchronisation
Ease of use	Common tools across GPU and NNA



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Thank you



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