Optimizing Your System Software for Embedded Vision and AI

ThunderSoft®

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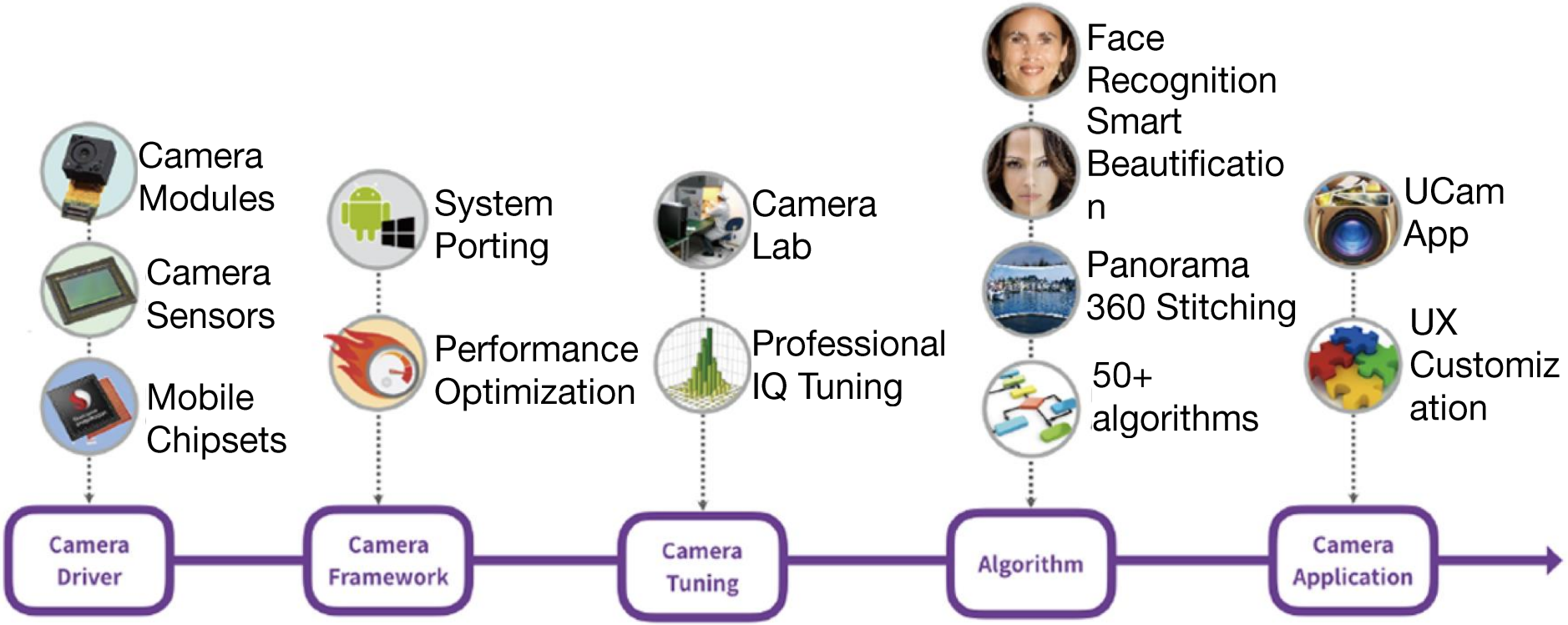
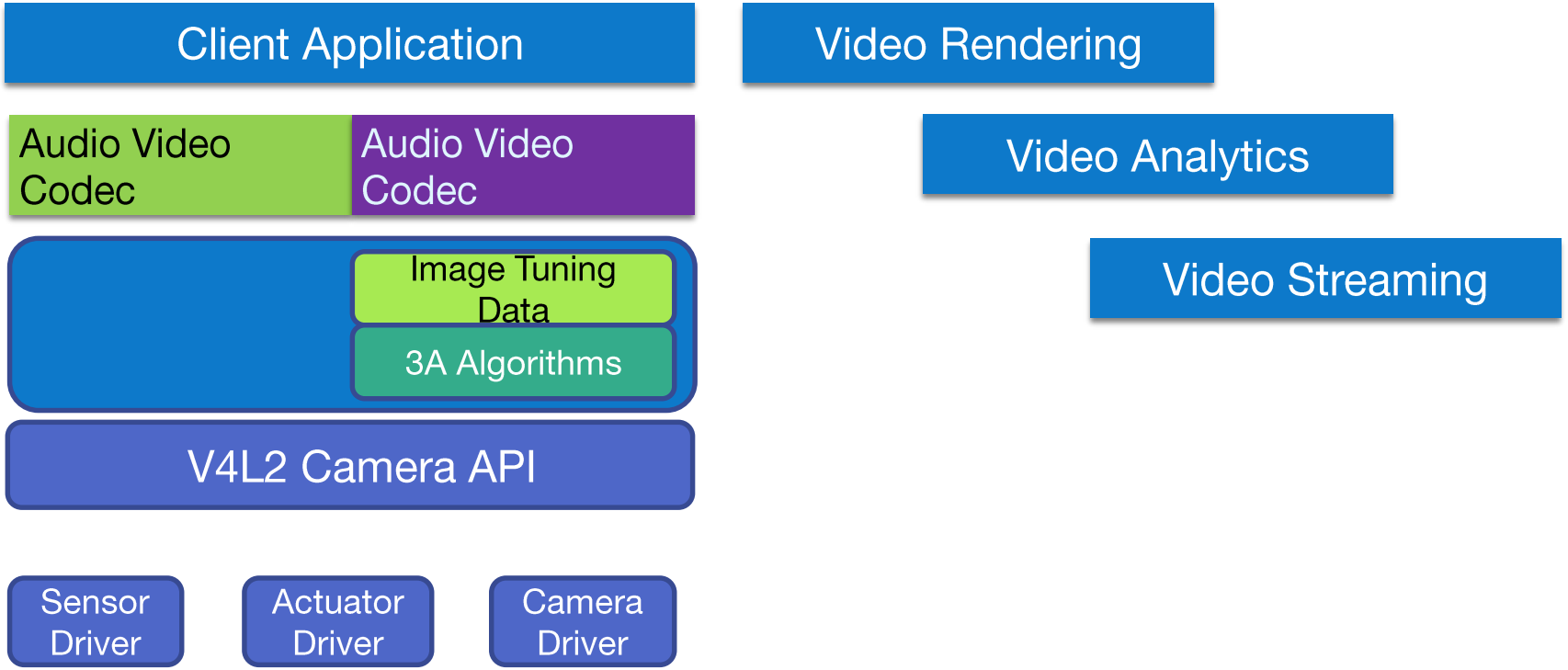
ThunderSoft – Intelligent Vision



Agenda

- Embedded Vision Challenges
- Case Studies of System Optimization
- Embedded AI Challenges

Vision Architecture



Embedded Vision Challenges

- A good quality vision system depends on many factors, like module optical characteristics, drivers, image processing algorithms (3A, HDR, etc.), camera framework and ISP tuning tools, etc.
- The fragmentation of hardware requires good knowledge of image quality tuning and complex tuning processes.
- Power consumption and performance.
- ThunderSoft has rich experience to solve all of these issues

Camera Framework Optimization for Automotive

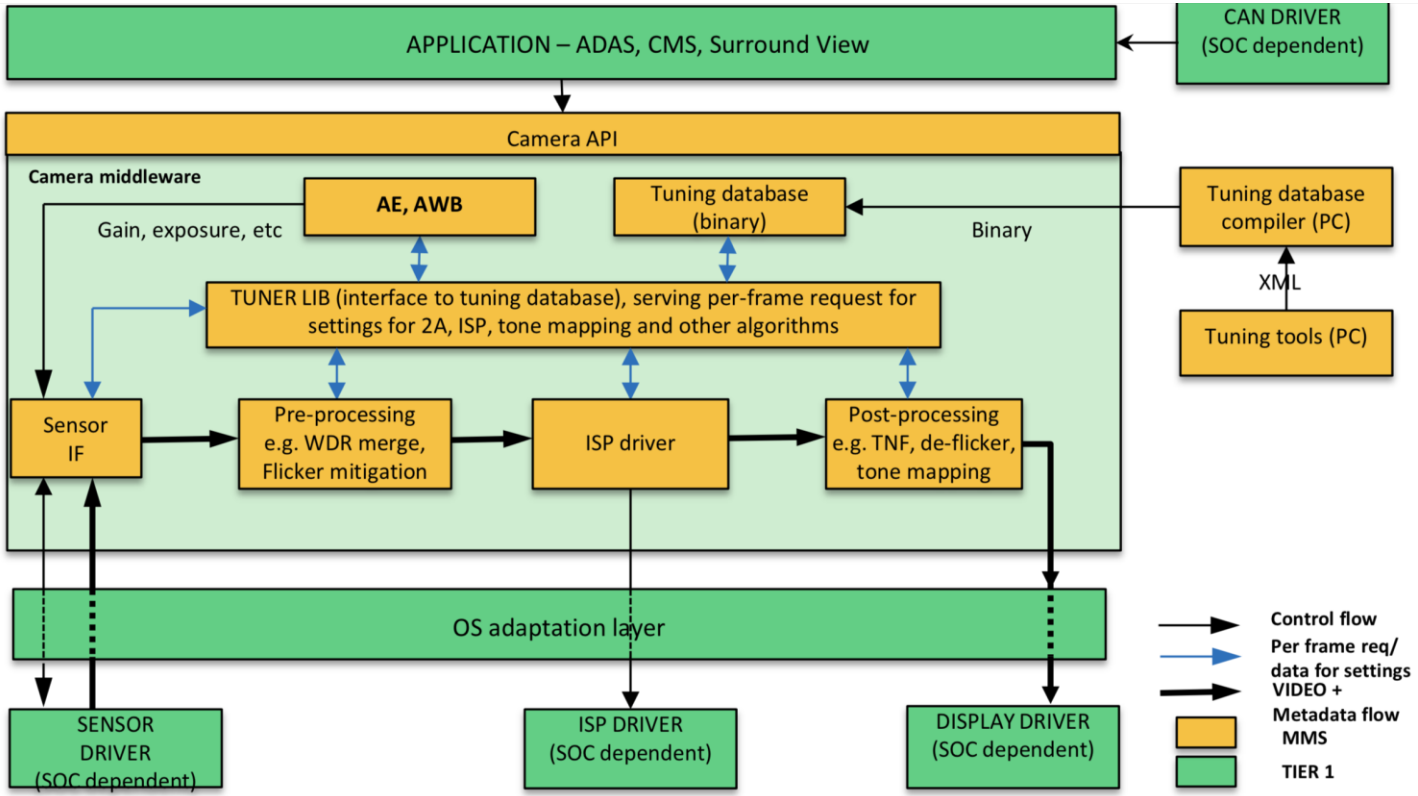


Image Quality Optimizations on Automotive

- Fine tuning of WDR (Wide Dynamic Range) and AE (Auto Exposure) convergence is extremely important for ADAS applications.
- Sharpness of image is also important for AI algorithms (blur, etc.)

4 Camera Harmonization for Automotive

- Bayer sensors in automotive and surround view applications require the 4 sensors to be harmonized in order to reduce the artifacts in overlapping areas (stitching algorithm requirements)

GPU/DSP Acceleration

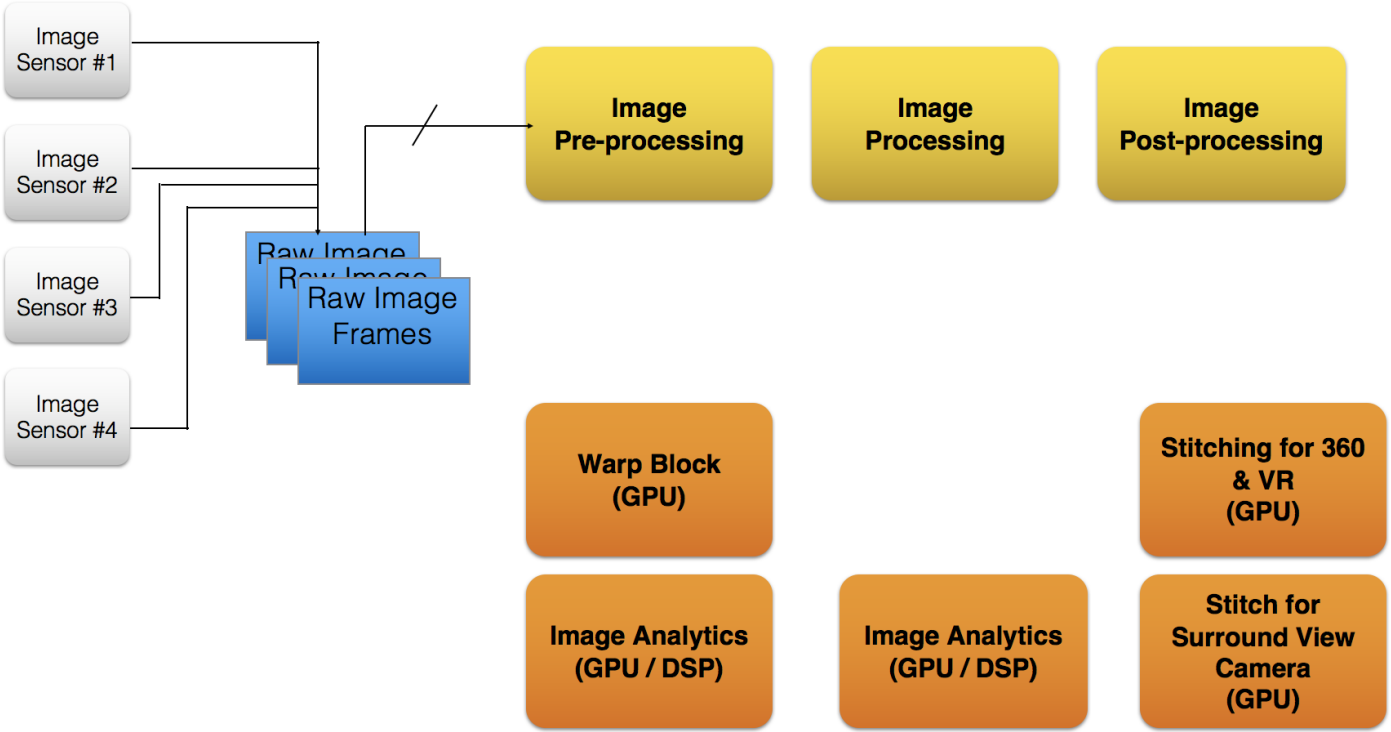


Image Quality Tuning

- Industry best class Image Quality team with 17+ years of experience, in Bulgaria
- 5 TIPA “Best Mobile Imaging Award” and top DxO scores
- State of Art Camera Labs

Image Quality Tuning

- The core of IQ tuning is tuning all characteristics of the image pipeline and 3A algorithms in order to achieve optimal and desirable image quality.
- It may include:
  - ✓Brightness, contrast
  - ✓White balance
  - ✓Color accuracy and saturation
  - ✓Focus
  - ✓Details, texture
  - ✓Noise

Image Quality Tuning | Example

No IQ Tuning

Good IQ Tuning

Image Quality Tuning | Example

No IQ Tuning

Good IQ Tuning

Image Quality Tuning Process

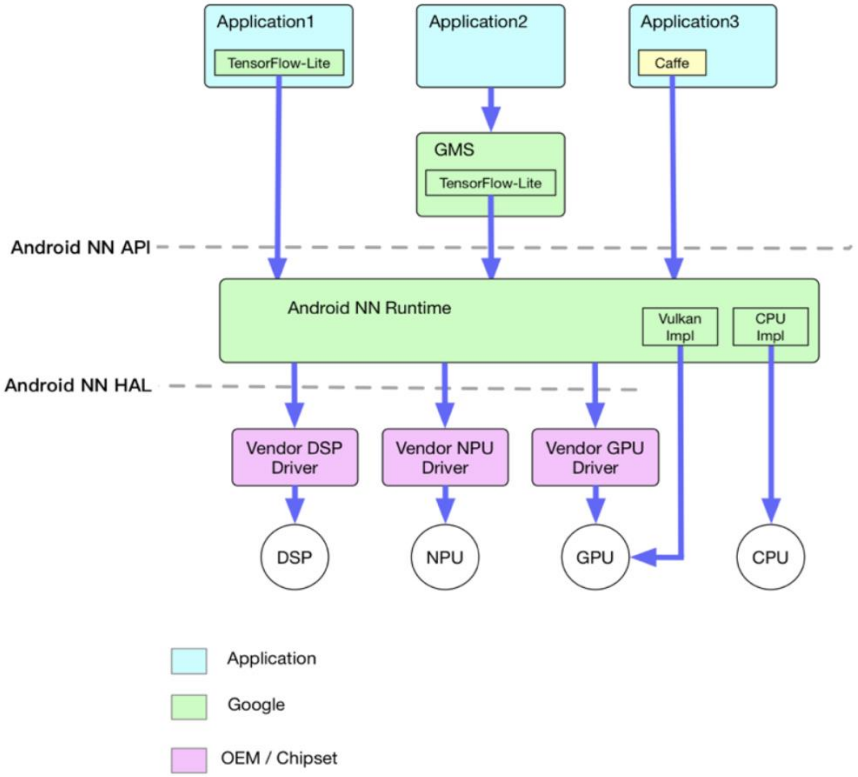
- Stage 0, software functionality check, no major bugs blocking IQ tuning, and verify raw capture, EXIF, AE parameters, calibration data, etc.

- Stage 1, studio and lab tuning (LSC, AWB, AE, gamma, contrast enhancement, CCM, DPC, noise filters, edge enhancement, CAF/AF, PDAF, etc.)

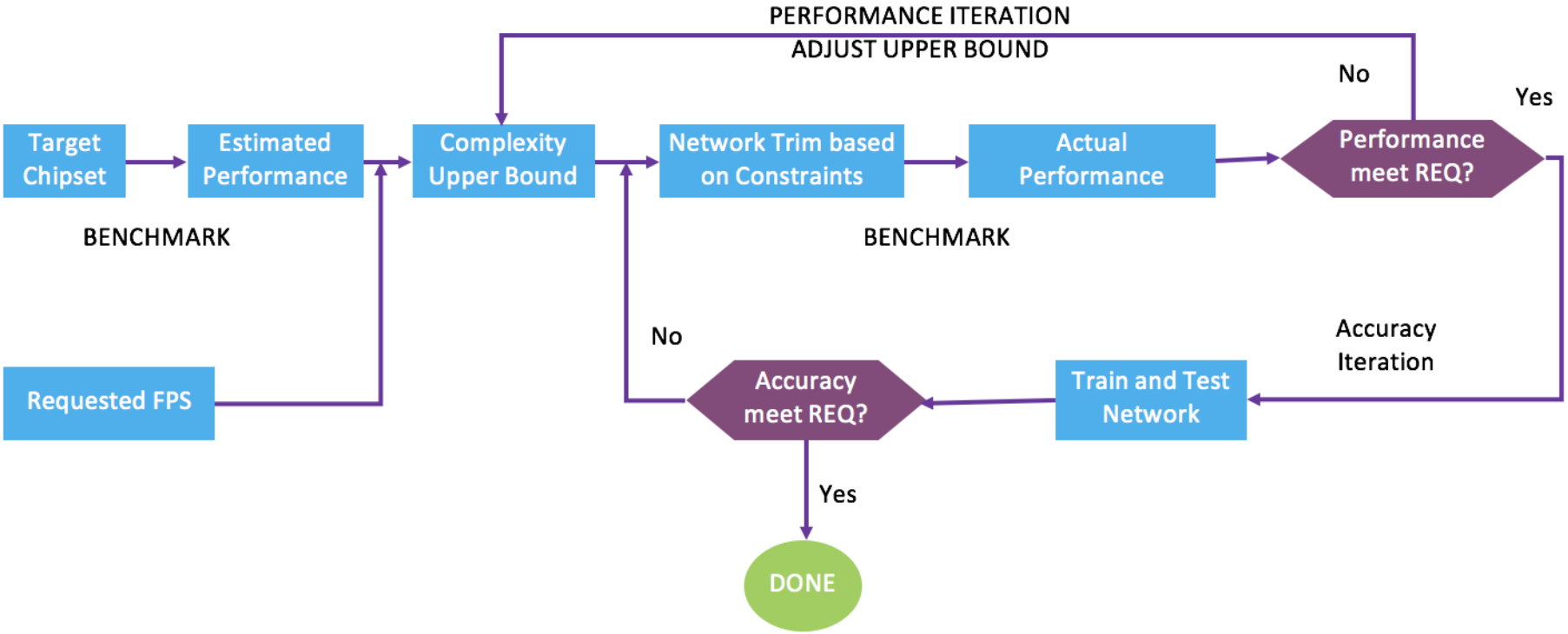
- Stage 2, Real-life tuning (field testing), lots of scenes side by side with reference cameras (people, pets, landscape, portraits, outdoor, low light, office, home, flash, backlit, movies, etc.)

Challenges of Embedded AI

- Balance of computing power, therma control, and accuracy.
- Different middleware eco-system (Qualcomm SNPE / AI Engine, Intel CVSDK, NVidia, Cambricon, etc.) requires specific algorithm porting and optimization.



Optimization of Neural Network for Embedded



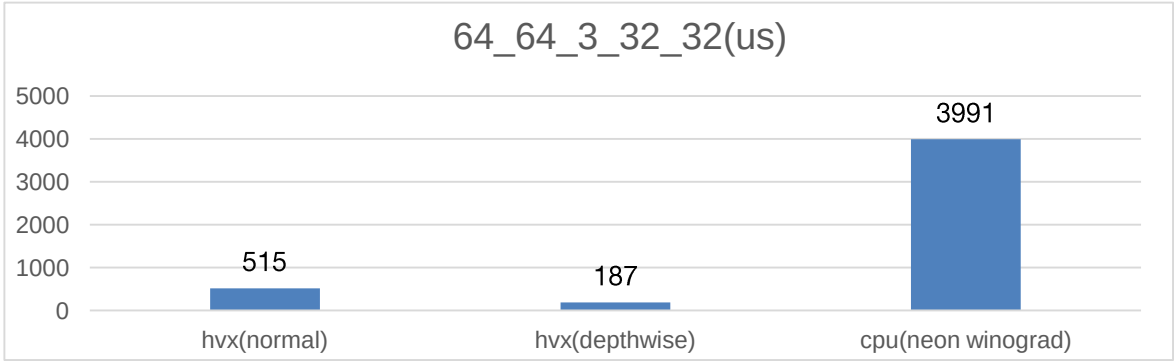
Optimization for Embedded AI

- Customized AI models, optimize the operators based on Hexagon, GPU or ARM CPU instruction sets.

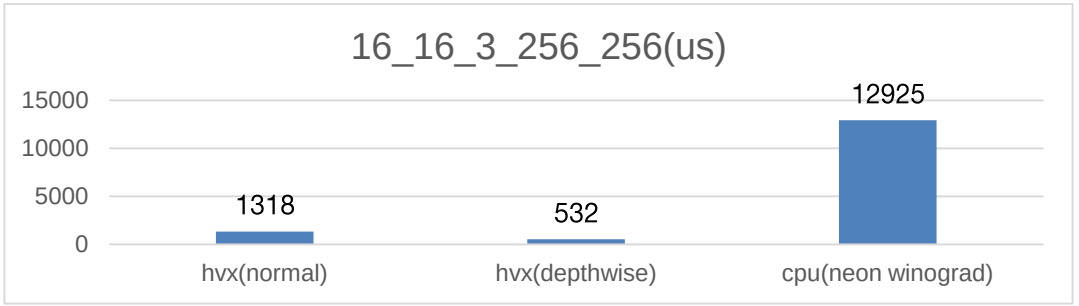
- Assembly code to optimize some image pre-processing steps, like scale, rotation, crop, etc., for better performance.

Optimization on Qualcomm 820

- input feature:64x64x3
- filter: 3x3x32
- output: 64x64x32



- input feature:16x16x3
- filter: 3x3x256
- output: 16x16x256



AI Also Contributes to Good Image Quality

- Scene detection and recognition will greatly help AWB (Auto White Balance), Noise, HDR (High Dynamic Range), etc.

- Apply specific camera image quality parameters for specific scenes to create a better user experience.

Conclusion

- The optimization of system software really depends on the pain points in specific use cases (Smart Phone, Automotive, Surveillance, Small IoT, etc.)
- Consider fully leveraging the computing engines other than the CPU when this offers better performance or power consumption (GPU, DSP, AI acceleration chipset).
- Fine tuning is very important to achieve a good image quality, based on the fact of hardware fragmentation and vertical use cases.
- AI is converging with traditional image processing algorithms to contribute a better user experience.

Visit us at booth #206

- Contact us: biz@thundersoft.com
- https://www.thundersoft.com
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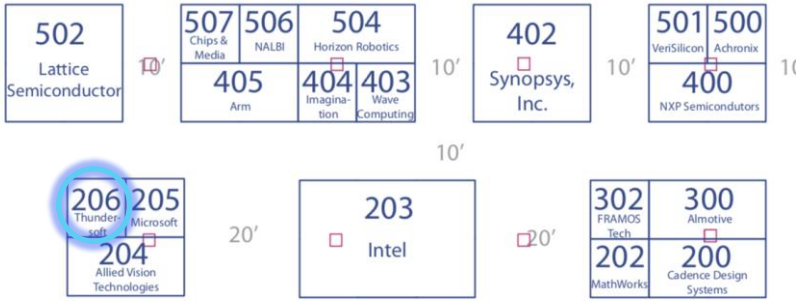
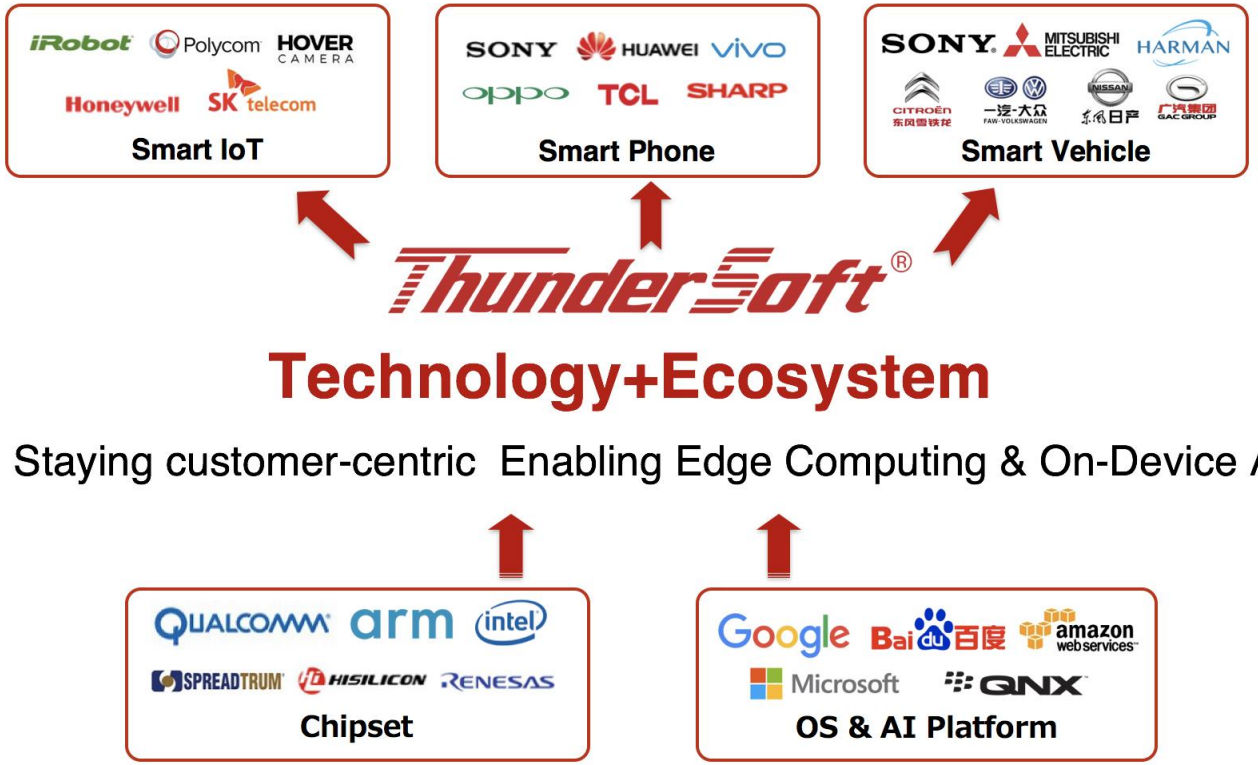


About ThunderSoft



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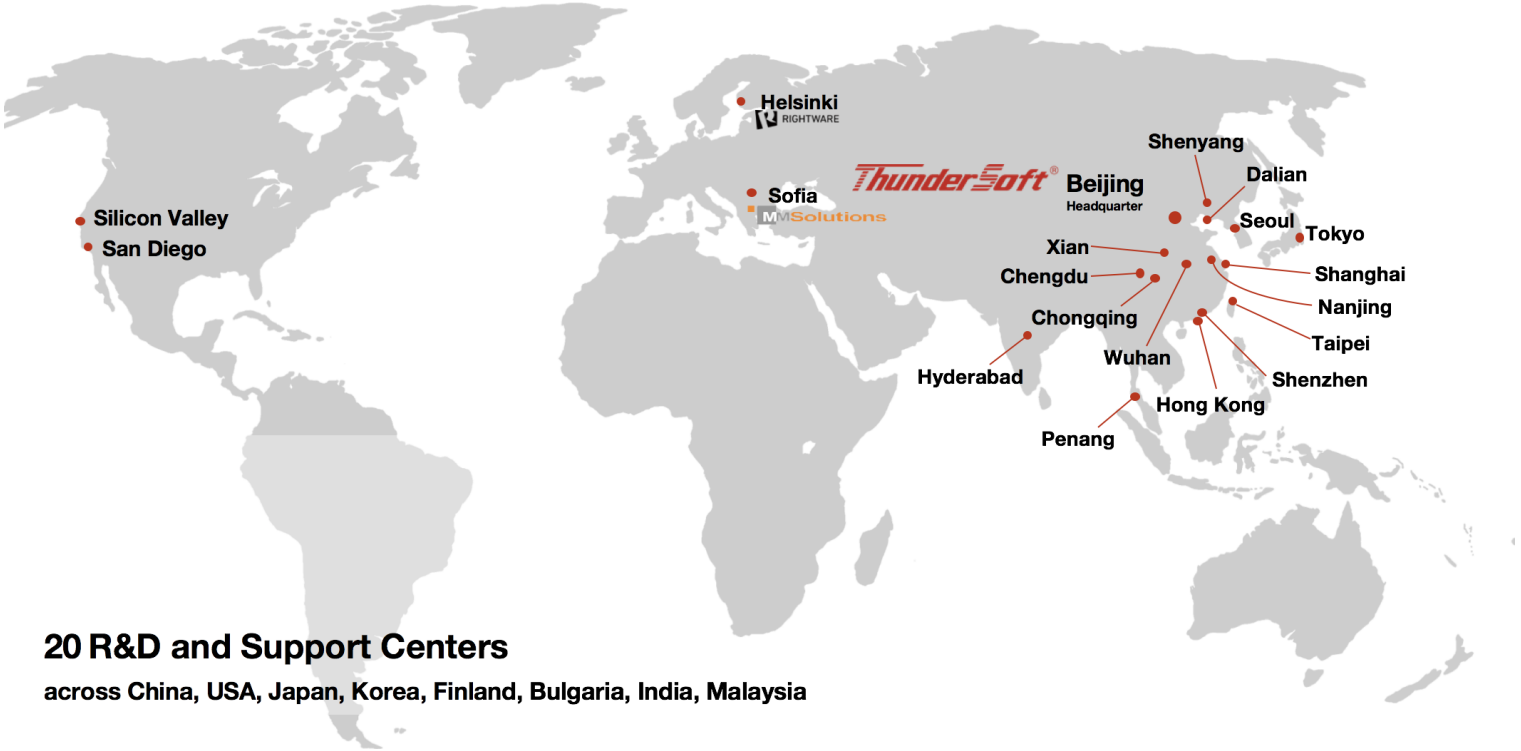

20 R&D and Support Centers

across China, USA, Japan, Korea, Finland, Bulgaria, India, Malaysia