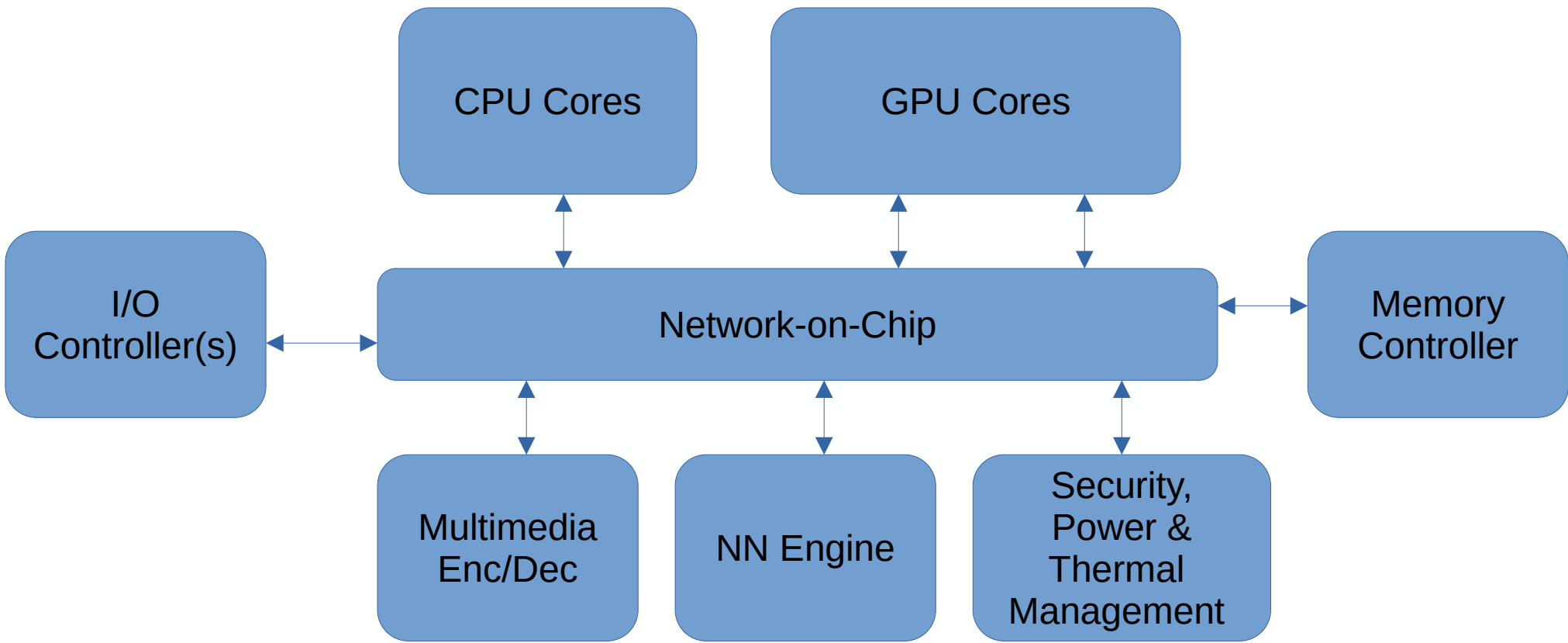# Every SoC is Multi-ISA

Shankar Viswanathan

Typical Modern System-on-Chip

ISAs

- CPU: x86, ARM, RISC-V, etc.
- GPU: Vendor-specific SIMD ISAs
- Multimedia Engine: Various DSPs for audio processing and video encode/decode
- Neural Engine: Many ISAs
- System Management: Typically use microcontrollers ARM, Tensilica, AVR, PIC, etc.
- I/O Controllers: WiFi, Bluetooth controllers generally also have microcontrollers in the design

Where is the code?

- CPU: Bootcode, OS, Applications

- GPU: Driver, JIT compiler

- Multimedia, NN Engine: Code is loaded by the driver into the engine's RAM, some code in ROM

- System Management: Code typically bundled with system boot code (BIOS)

- Other FW may exist in the BIOS or the OS/drivers

Complications

- Each "core" can have different expectations about memory ordering

- Some of the cores are hardware coherent with others, others may not

- LLC, NoC and memory controllers have to balance all these different requirements

Takeaways

- Heterogeneous ISA chips are the present and the future

- You may not realize that your apps are multi-ISA under the hood