AMD

AMD HETEROGENEOUS COMPUTING

OCTOBER, 2014

BRUNO STEFANIZZI

HETEROGENEOUS COMPUTING PLATFORMS ARE BECOMING PERVASIVE

AMD

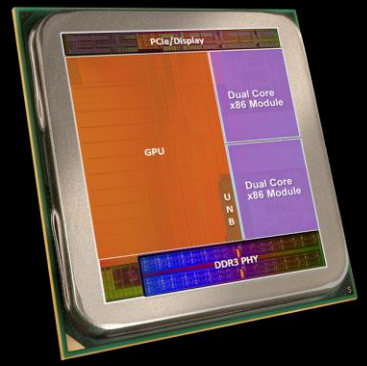
- EVERY Tablet and Smartphone shipping in 2012 and 2013 is based on a heterogeneous processor
- Of the Top 500 supercomputers in 2012, 52 were based on heterogeneous systems
- Both the major next generation consoles from SONY and Microsoft are shipping with heterogeneous processors
- AMD starting shipping embedded heterogeneous processors in 2011 and has announced that it will ship mainstream heterogeneous servers in 2014

Sources: See Reference slide

HETEROGENEOUS COMPUTING PLATFORMS ARE BECOMING PERVASIVE

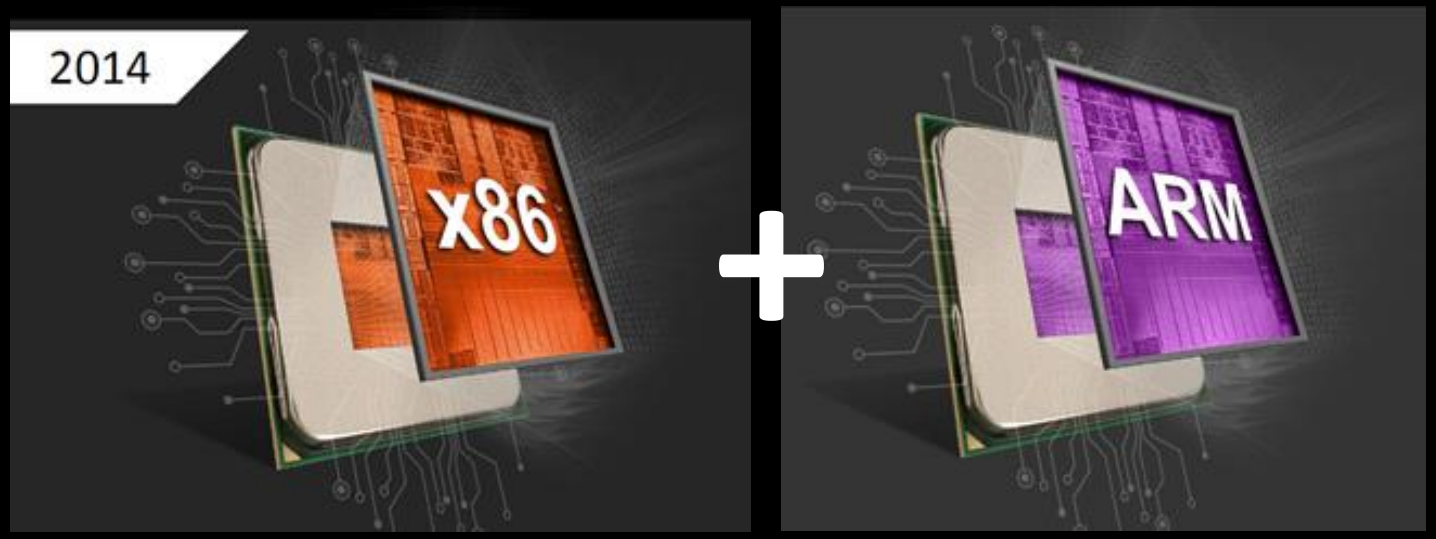
AMD 64 + AMD FIREPRO S SERIES + ARM

Graphics Core Next



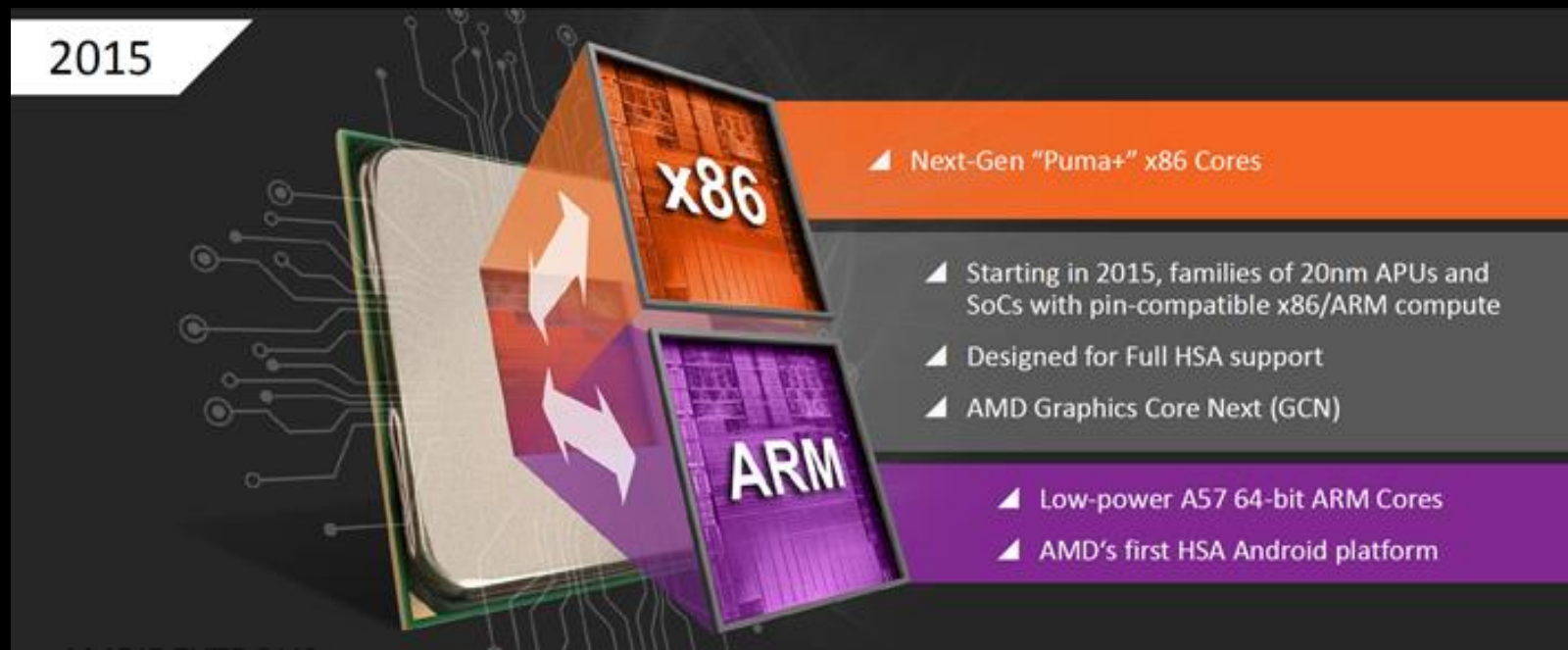
AMD HARDWARE TOOLBOX FOR SOC

Ambidextrous Computing



HSA compliant & Lower power APU

28nm 64-bit ARM server processor

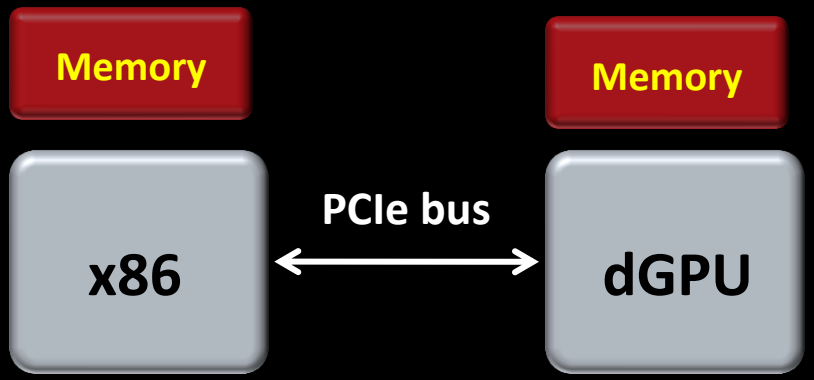


AMD

PROBLEM

1 EXAFLOPS
20 MW
50 GFLOPS DP/W

GPU Computing Today



DATA TO WORK

Since 2007

Not efficient!

Most parallel code runs on CPUs designed for scalar workloads

WASTES POWER

PROGRAMMING HETEROGENEOUS SOCs/APUs

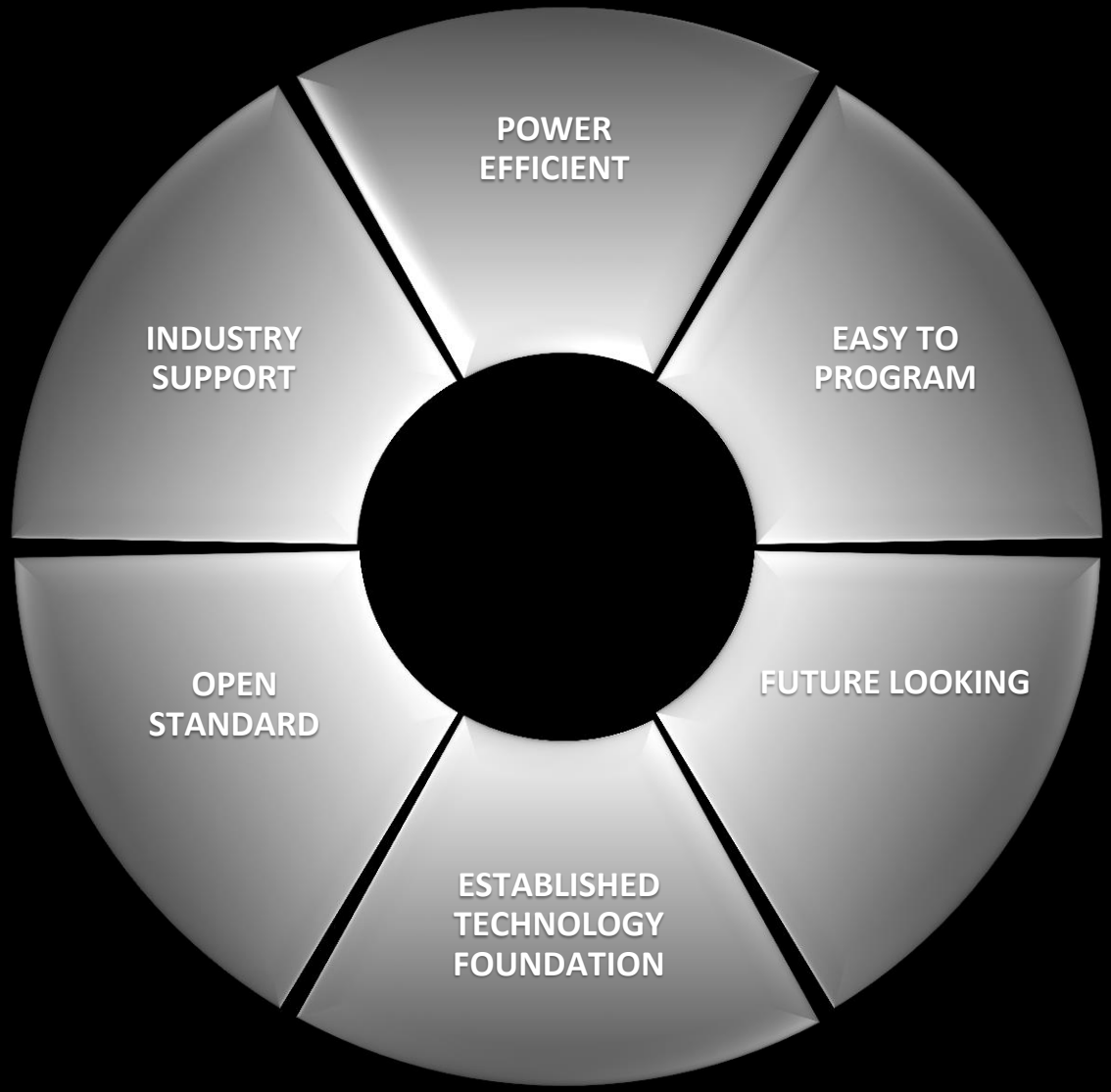
IS STILL HARD

AMD

SOLUTION

HETEROGENEOUS SYSTEM ARCHITECTURE

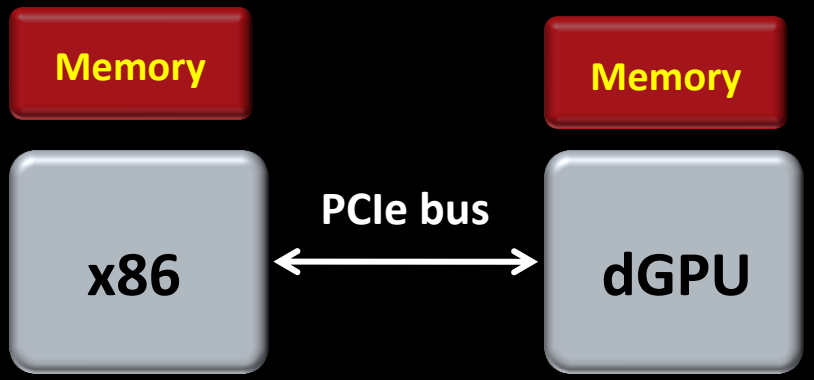
Brings All the Processors in a System into Unified Coherent Memory

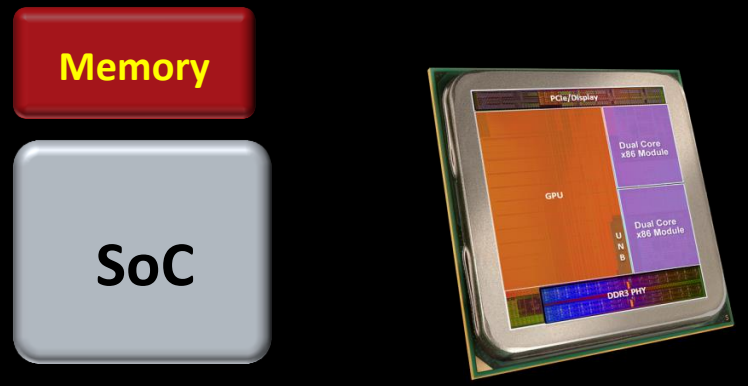


From dGPU to SoC

Need for open programming framework for legacy and future-proof codes

GPU Computing Today and Tomorrow





DATA TO WORK

Since 2007

Not efficient!

WORK TO DATA

Beyond 2015

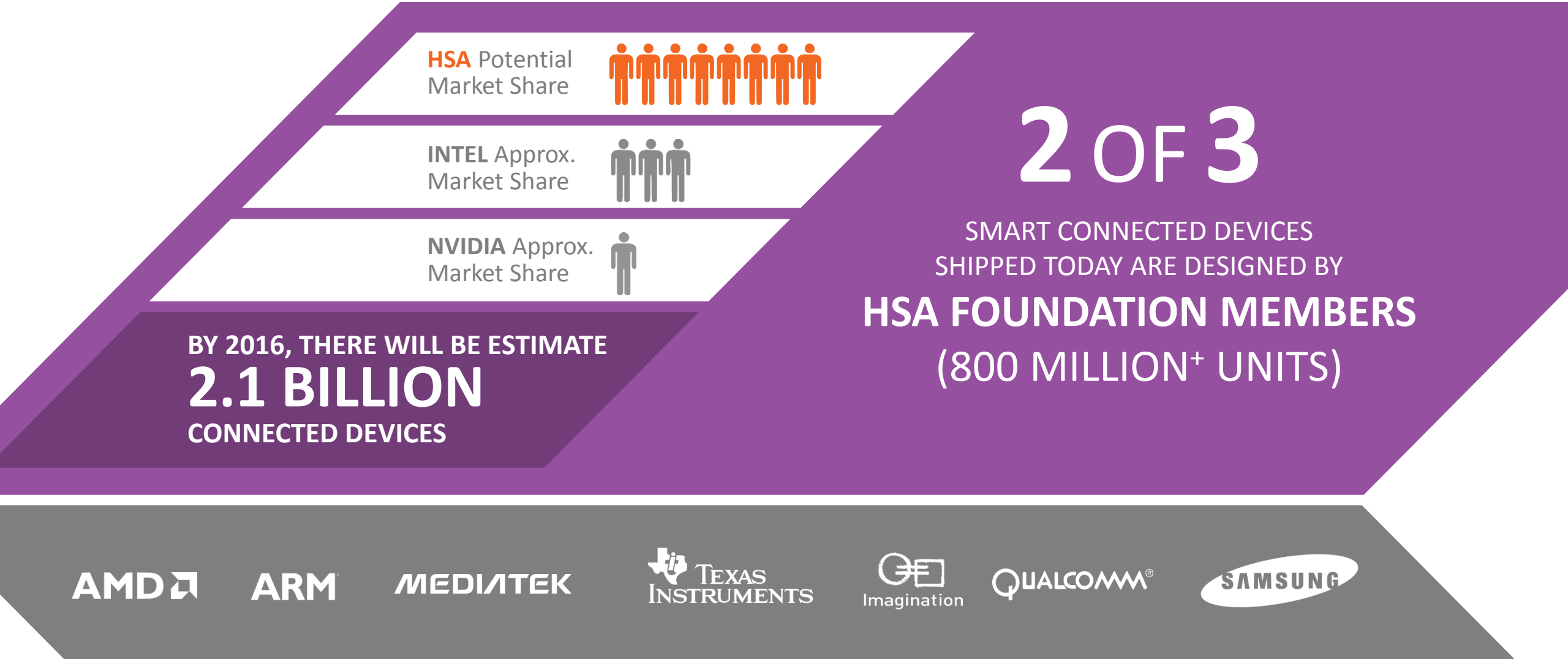
Run indifferently serial and parallel codes

HSA Foundation

Write-once-run-everywhere for heterogeneous systems

- Industry leaders setting an industry standard
- Designed for developers, by developers
- One architecture, differentiated ‘IP’ vendors
  - Multiple hardware solutions to be exposed to software through a common standard low-level interface layer
- Support high-level parallel programming languages and models, including C++ AMP, C++, C#, FORTRAN, OpenCL, OpenMP, Java and Python

AMD JOINED BY FELLOW INDUSTRY LEADERS TO ADVANCE HETEROGENEOUS DESIGN



For more information go to: http://hsafoundation.Com/ Source http://pinterest.Com/pin/193021534001931884

DIVERSE PARTNERS DRIVING FUTURE OF HETEROGENEOUS COMPUTING

Founders

AMD ARM Imagination MEDIATEK QUALCOMM SAMSUNG Texas Instruments

Promoters

LG Electronics

Supporters

Arteris FABRICENGINE Lawrence Livermore National Laboratory Argonne National Laboratory allinea codeplay MULTICORE WARE Linaro Sandia National Laboratories SUSE OAK RIDGE National Laboratory

Contributors

ANALOG DEVICES apical BROADCOM CANONICAL CEVA omp ETRI ITRI MARVELL SONICS SONY make.believe augmented Swarm64 HUAWEI synopsys tensilica ubuntu VIVANTE S3 GRAPHICS ORACLE

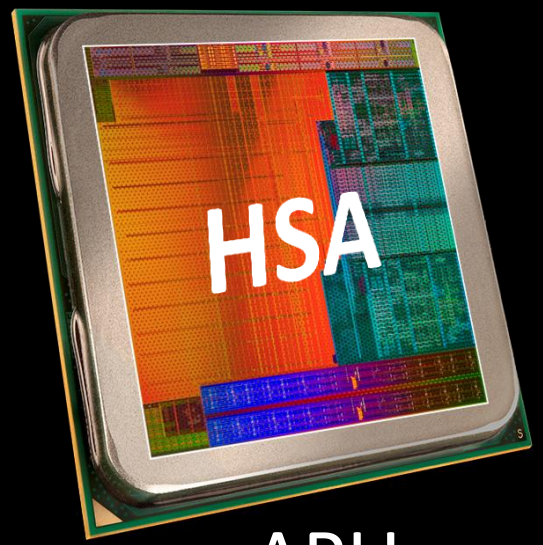
Academic

NTHU Programming Language Lab NTHU System Software Lab University of BRISTOL informatics ILLINOIS COMPUTER SCIENCE Tsinghua University TAMPERE UNIVERSITY OF TECHNOLOGY

TERMINOLOGY, VISUALIZED

AMD

DEVELOPERS



APU

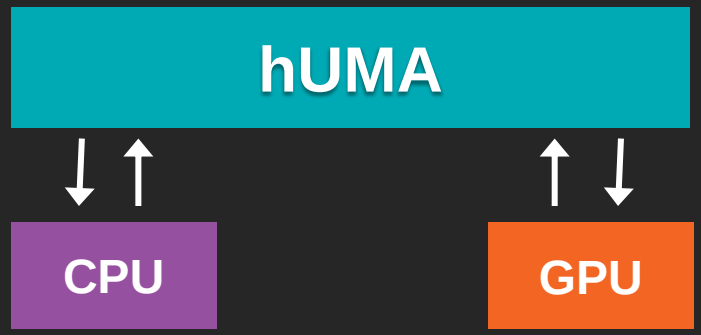
PROGRAMMING LANGUAGES

APPLICATIONS

HSA FEATURES FEED AND EQUALIZE "APU 'COMPUTE UNITS'"

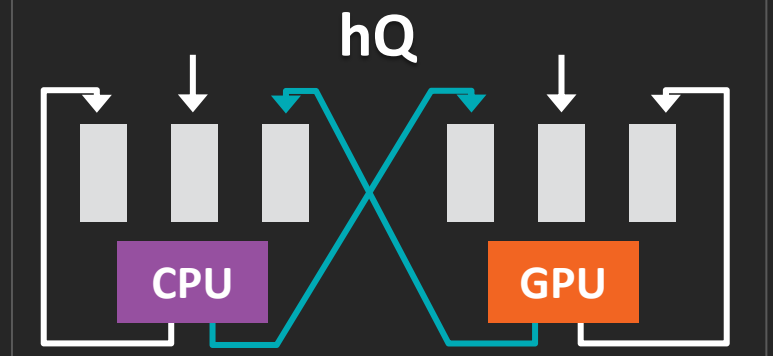
AMD

EQUAL ACCESS TO ENTIRE MEMORY



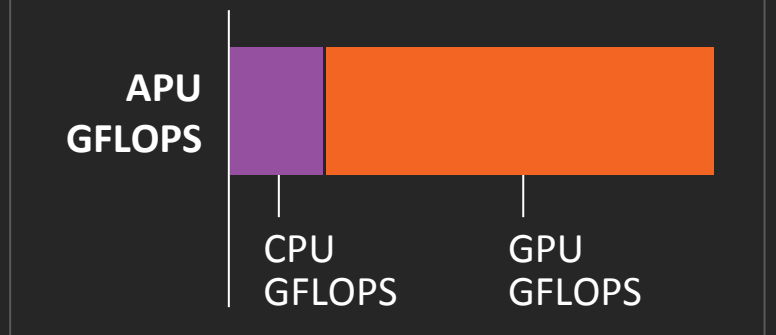
- First time ever: GPU and CPU have uniform visibility into entire memory space

EQUAL FLEXIBILITY TO DISPATCH



- Heterogeneous queuing (hQ) defines how processors interact equally
- GPU and CPU have equal flexibility to create/dispatch work

UNLOCKING All APU GFLOPS



- Access to full potential of APU compute power

UNLOCKS THE COMPUTE POTENTIAL AND EFFICIENCY OF APUs

BENEFITS OF HETEROGENEOUS SYSTEM ARCHITECTURE

UNLEASHING THE GPU

AMD

PERFORMANCE

- Reduced latency when performing work on the GPU
- Opens up many more opportunities to accelerate application performance

POWER

- Easier utilization of the GPU leads to power reduction on parallel workloads
- Reducing software layers saves power both from instruction execution and memory copies

PORTABILITY

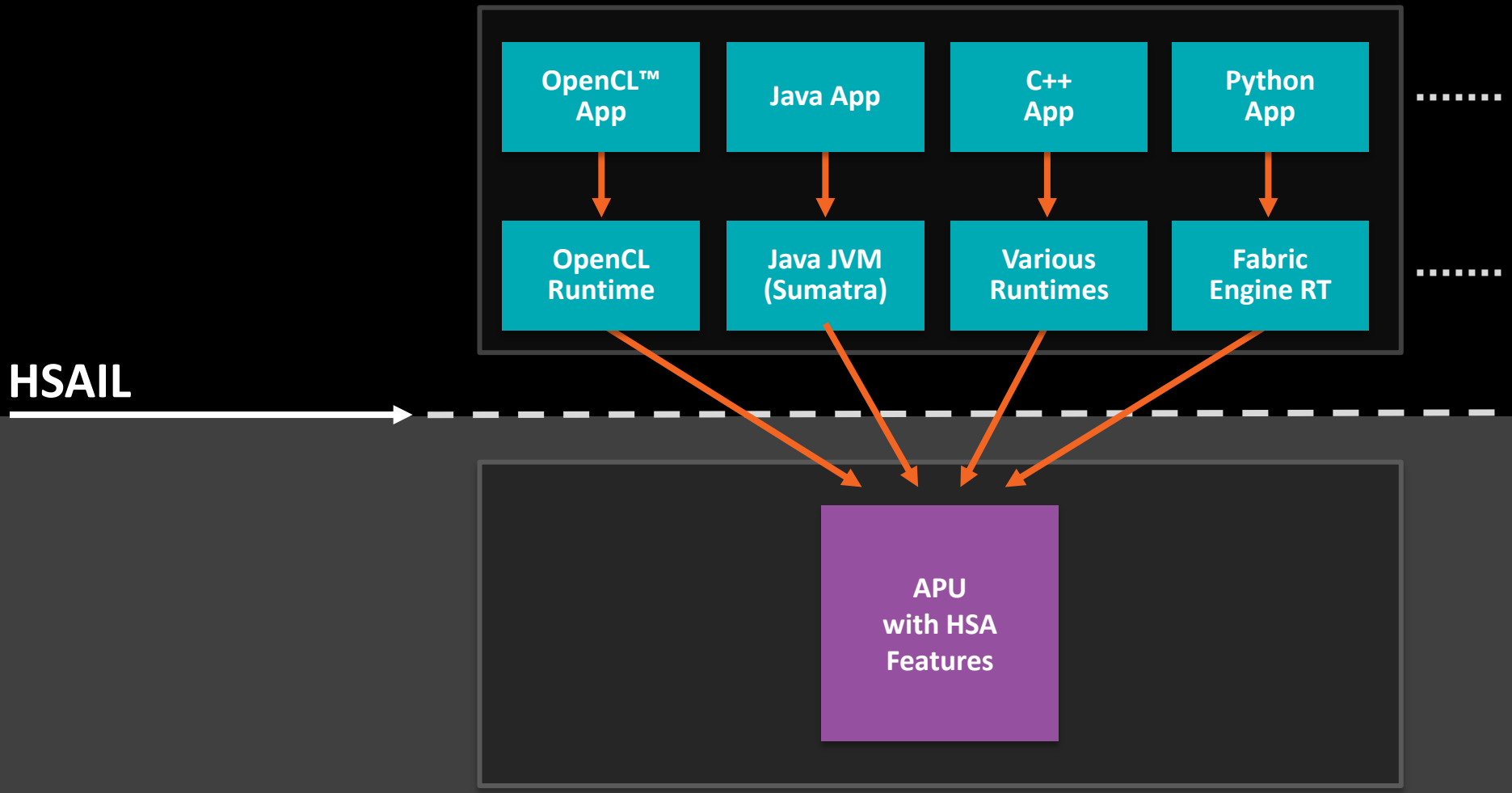
- Because HSA is a broadly endorsed industry standard. benefits will be available across a broad range of platforms including handheld devices, PCs and servers

PROGRAMMABILITY

- Programming models for the GPU can become equivalent to familiar models available for the CPU


AMD
DEVELOPER
ECOSYSTEM

OTHER PROGRAMMING LANGUAGES WILL WORK WELL ON APU



OPENCL™ 2.0

AMD

- New features give GPUs more freedom to do the work they are designed to do

Shared Virtual Memory

Enables host and device kernels to directly share complex pointer-based data structures, eliminating explicit transfers between the host and devices while increasing programming flexibility.

Nested Parallelism

Updated for improved programmability and increased application efficiency.

Generic Address Space

Enables functions to be written without named address spaces which increases flexibility and saves time by eliminating the need for multiple functions to be written.

AMD FirePro™ Graphics is Ready…

…For access Email to FirePro.Developers@amd.com

OpenCL 1.2 conformance expected. AMD plans to release OpenCL 2.0 drivers for enabled AMD FirePro S9150 server cards in Q4 2014; conformance testing is planned at that time. Previous generation AMD FirePro products may not support OpenCL 2.0.

NEW –SUPPORT FOR HETEROGENEOUS C++ LANGUAGE

AMD

- Proposing several options for C++
  - C++ with extensions
  - C++ AMP compatible
  - SyCL
  - GCC

- Several open source projects on going and to be announced

NEW –SUPPORT FOR OPENMP 4.0 & OPENACC 1.0

- OpenMP 4.0 & OpenACC 1.0/2.0 support coming for all Hawaii and Tahiti-based FirePro cards with C, C++, Fortran.
  - S10000, S9150/S9100, S9050/S9000, W9100, W9000, W8100, W8000
- Exposes GPU compute capability for new markets
- Beta in Q4/14, Production release Q4/14 or Q1/15
  - For access Email to FirePro.Developers@amd.com
- Supported via partnership with Pathscale

"Pathscale's ENZO Compiler with OpenMP 4.0 and support for C, C++, and Fortran is used by customers in the Oil and Gas, Computational Science, Computer Aided Engineering, and other HPC segments. Our support for the AMD FirePro S9150 will enable these customers to benefit from the tremendous compute performance of the S9150 while leveraging their existing investment in OpenMP software."

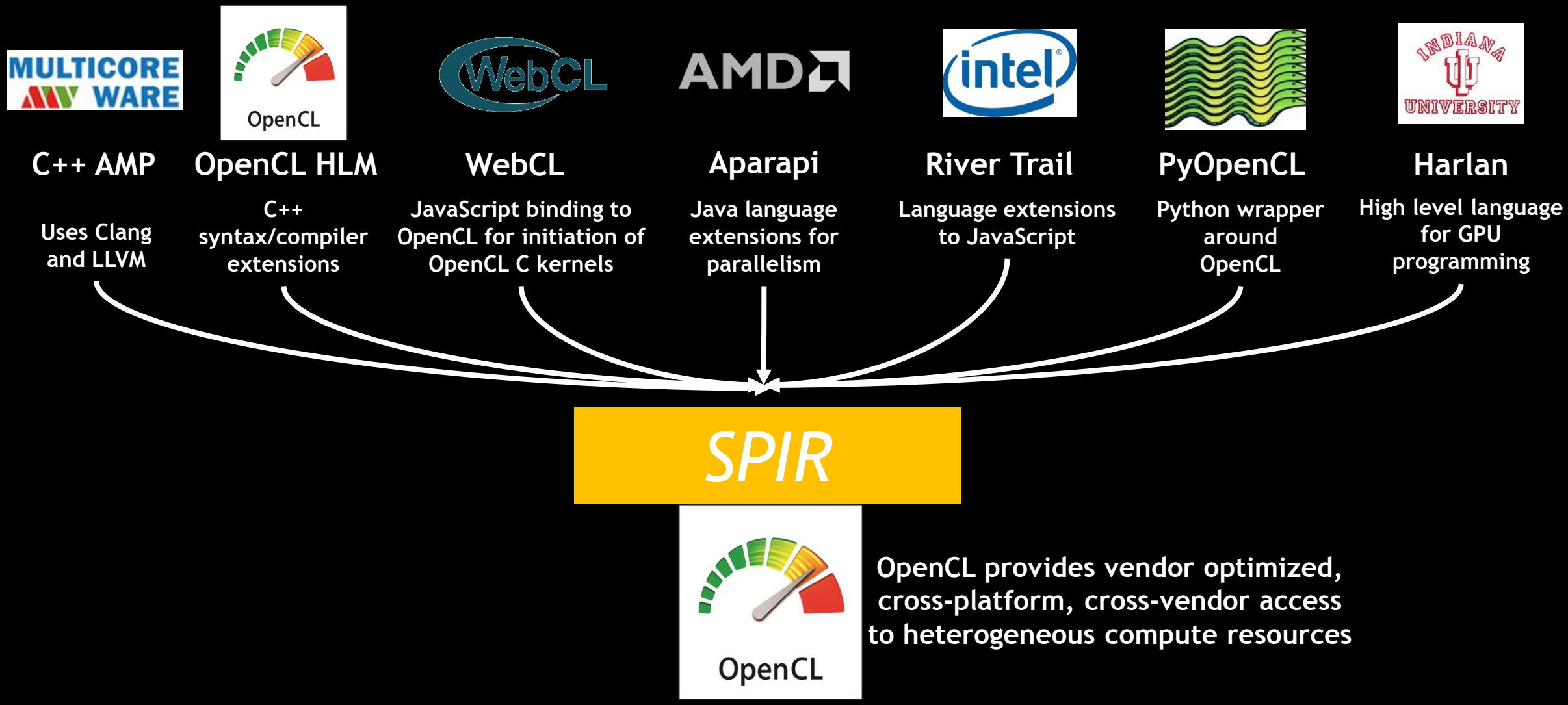
Christopher Bergstrom, CTO, Pathscale

Heterogeneous Optimized Libraries (work in progress)

AMD

- **Math libraries**
  - BLAS
  - FFT
  - RNG
  - Solvers
  - Sparse matrix
- **Language Specific Libraries**
  - C++ Template Libraries (sort, scan, reduce, transform)
  - Python libraries (Anaconda, NumPy, SciPy)
  - R packages
- **Domain Specific Libraries**
  - Media encode/decode/transcode: FFMPEG, X264, H.265, etc.
  - Image processing
  - Computer Vision: OpenCV, Open NI
  - Simulation: Bullet Physics, Ray Tracing, Sparse Solvers
  - Big Data: Hadoop/Mahout frameworks and associated libraries

SPIR AS COMPILER-ORIENTED MIDDLEWARE



OPEN SOURCE AND OPENCL

AMD

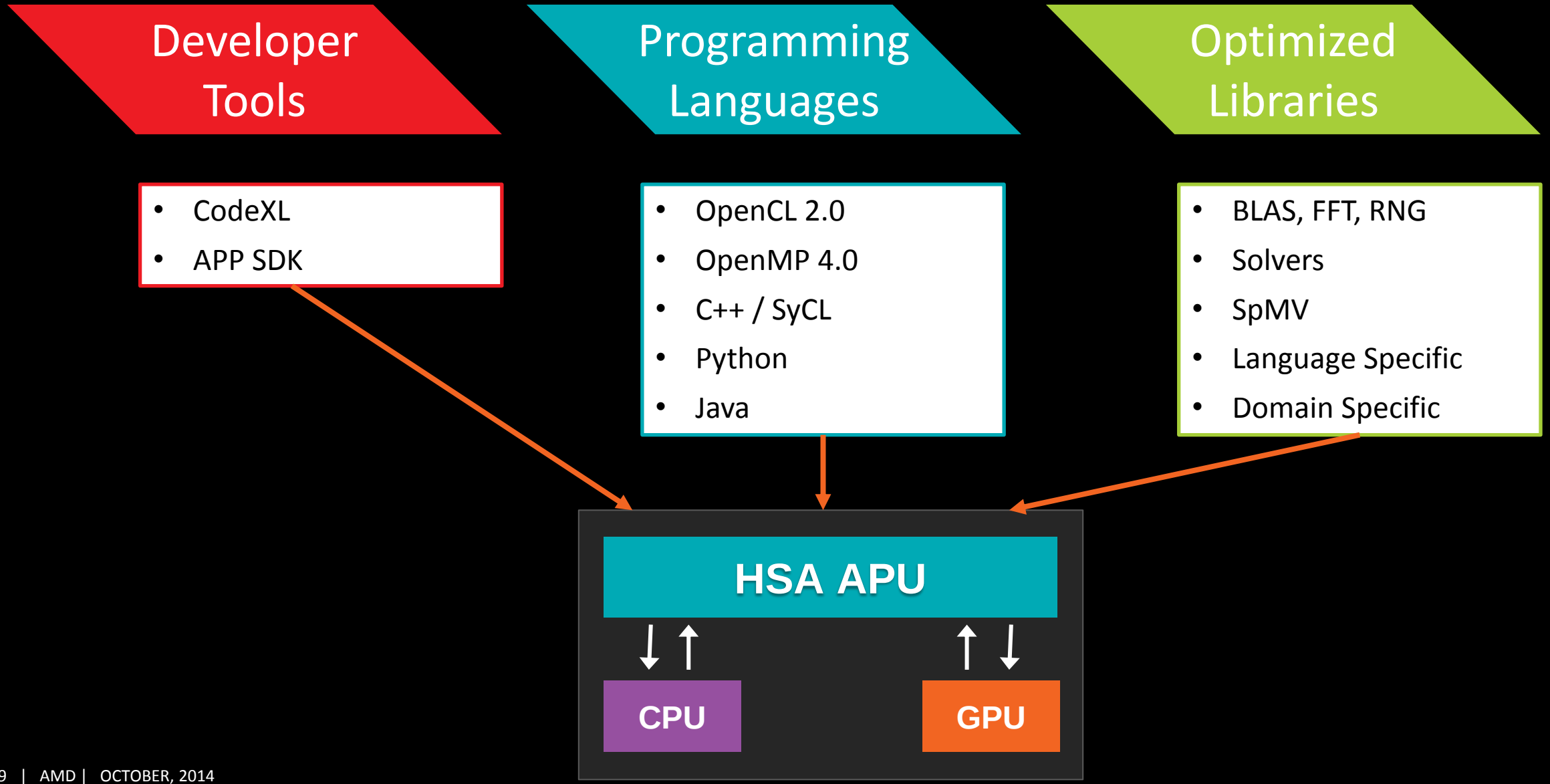
- OpenSource efforts actively supported by AMD
  - OpenCV
  - GMAC – Global memory for accelerators
  - TM – Task Manager
  - Aparapi – A parallel API (for Java)
  - Crypto++
  - X264/Handbrake
  - VLC
  - ImageMagick
  - GIMP
  - Bullet physics library

- 700+ projects in Sourceforge, Github, Google Code, BitBucket refer to OpenCL

Accelerated Parallel Processing (APP) SDK around Heterogeneous computing

- Complete development platform for heterogeneous computing
- Fully utilize the potential of modern APUs and GPUs
- Supports open industry standards and embraces open source software
  - OpenCL
  - Aparapi (Java)
  - C++ / SyCL
  - OpenCV
  - OpenNI
  - Bolt C++ template library
- Enables development for cross-OS and cross-platform heterogeneous solutions
- Comprehensive set of programming samples show best practices for benefiting from heterogeneous computing
  - Includes Sample Code Browser for quickly finding relevant samples
- For access Email to FirePro.Developers@amd.com

AMD FIREPRO™ FOR GPU COMPUTE – HW & SW ECOSYSTEM



QUESTIONS

THANK YOU

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