Welcome

C-DAC Four Days Technology Workshop

ON

Hybrid Computing – Coprocessors & Accelerators – Power-aware Computing & Performance of Application Kernels

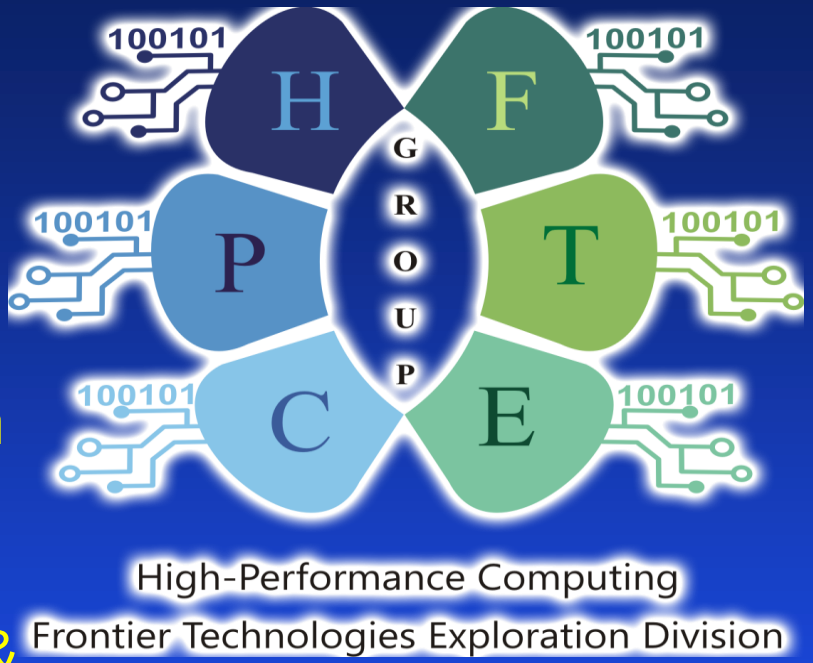
hyPACK-2013

Venue : CMSD, University of Hyderabad

Date: October 15-18, 2013

hyPACK-2013

- hyPACK-2013 covers an overview of Hybrid Computing Hardware/ Software - Mixed Prog. with Hands-on Session & Keynote talks from Industry / Academic / Research Development Organizations and Demonstration of software on emerging parallel processing platforms with Coprocessors and Accelerators & ARM based Low-power Systems



- C-DAC High Performance Computing – Frontier Technologies Exploration (HPC-FTE) group members will deliver "Class-room lectures" and assist in Hands-on Session, in collaboration with other experts and CMSD, UoH.

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- **hyPACK-2013** objective is to understand power-aware performance issues of various scientific application kernels and computational mathematics on parallel processing platforms such as computing systems with Intel Xeon-Phi Coprocessors and NVIDIA /AMD GPU accelerators as well as ARM processor based multi-core processor systems.
- The aim is to achieve the best performance (turnaround time & throughput) and the total power consumption, a device or a system needs in order to solve a problem of given size in High Performance Computing (HPC) application kernels.
- The focus is to integrate different programming paradigms such as Pthreads, OpenMP 3.0, OpenMP 4.0, Intel TBB, Cilk Plus, Intel Xeon-Phi Offload Pragmas, MPI, & NVIDIA CUDA, OpenACC, OpenCL and extract the best achieved performance for application kernels on systems with coprocessors and accelerators.

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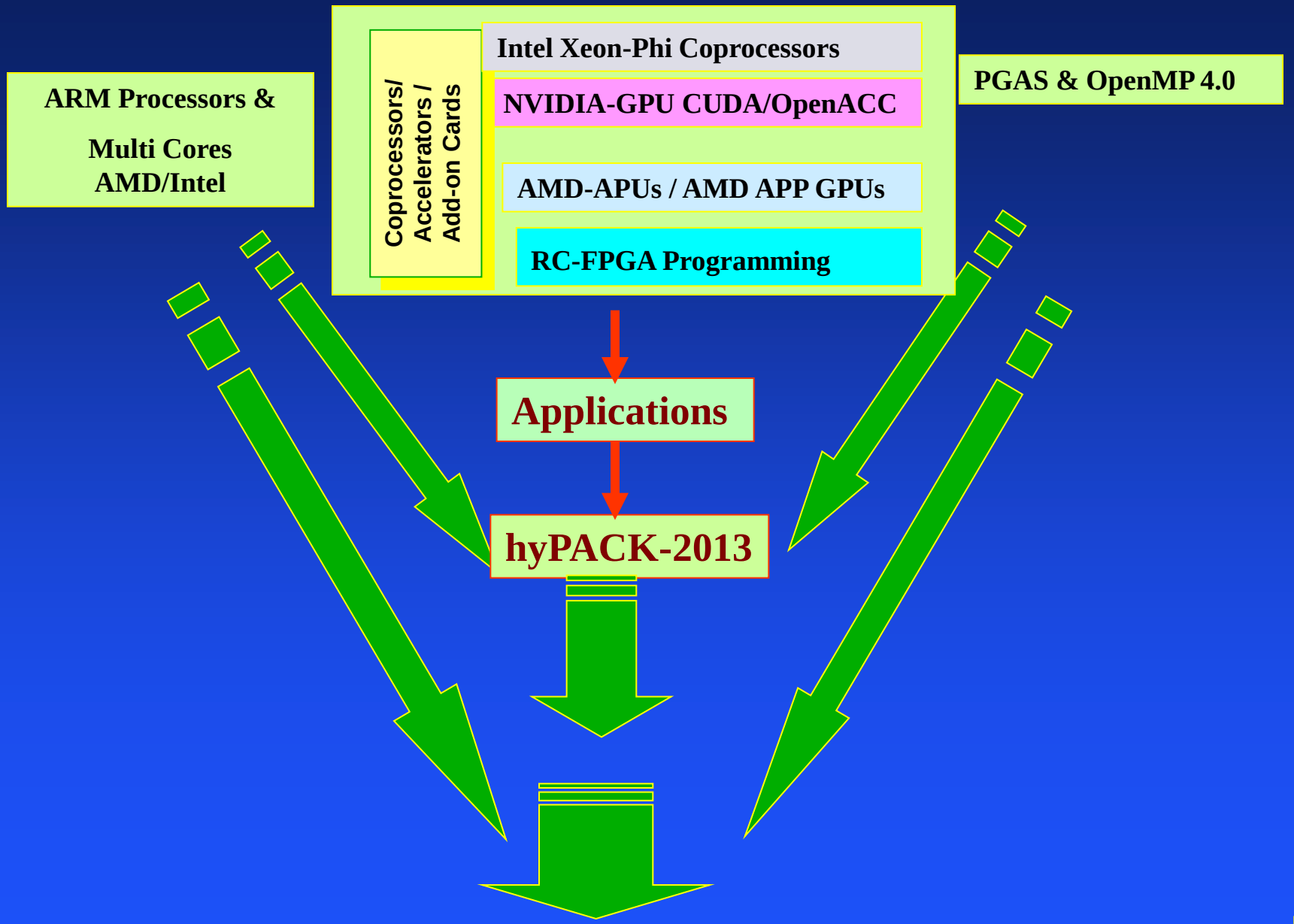
ARM Processors &
Multi Cores
AMD/Intel
Coprocessors/
Accelerators /
Add-on Cards
Intel Xeon-Phi Coprocessors
NVIDIA-GPU CUDA/OpenACC
AMD-APUs / AMD APP GPUs
RC-FPGA Programming
PGAS & OpenMP 4.0
Applications
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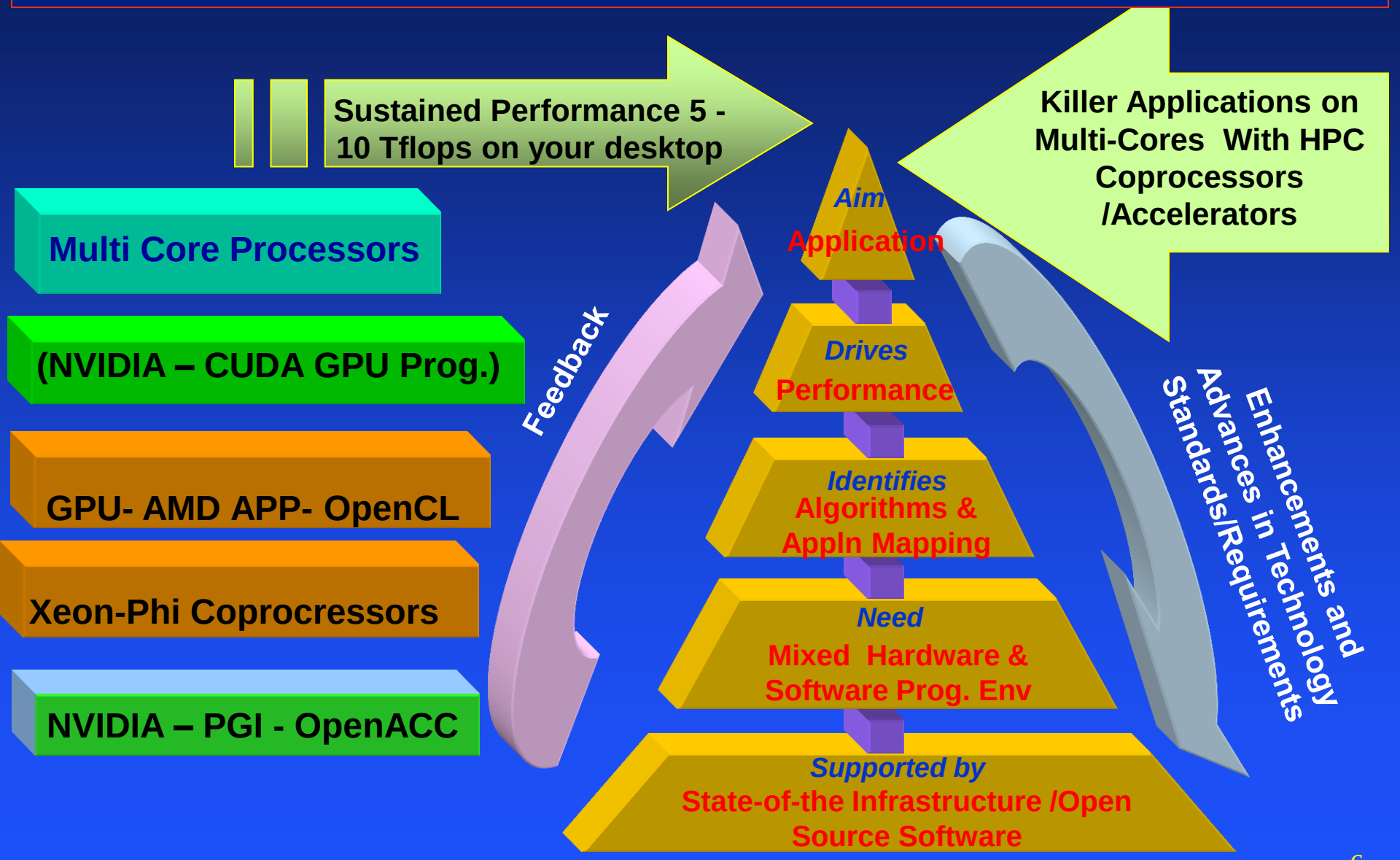
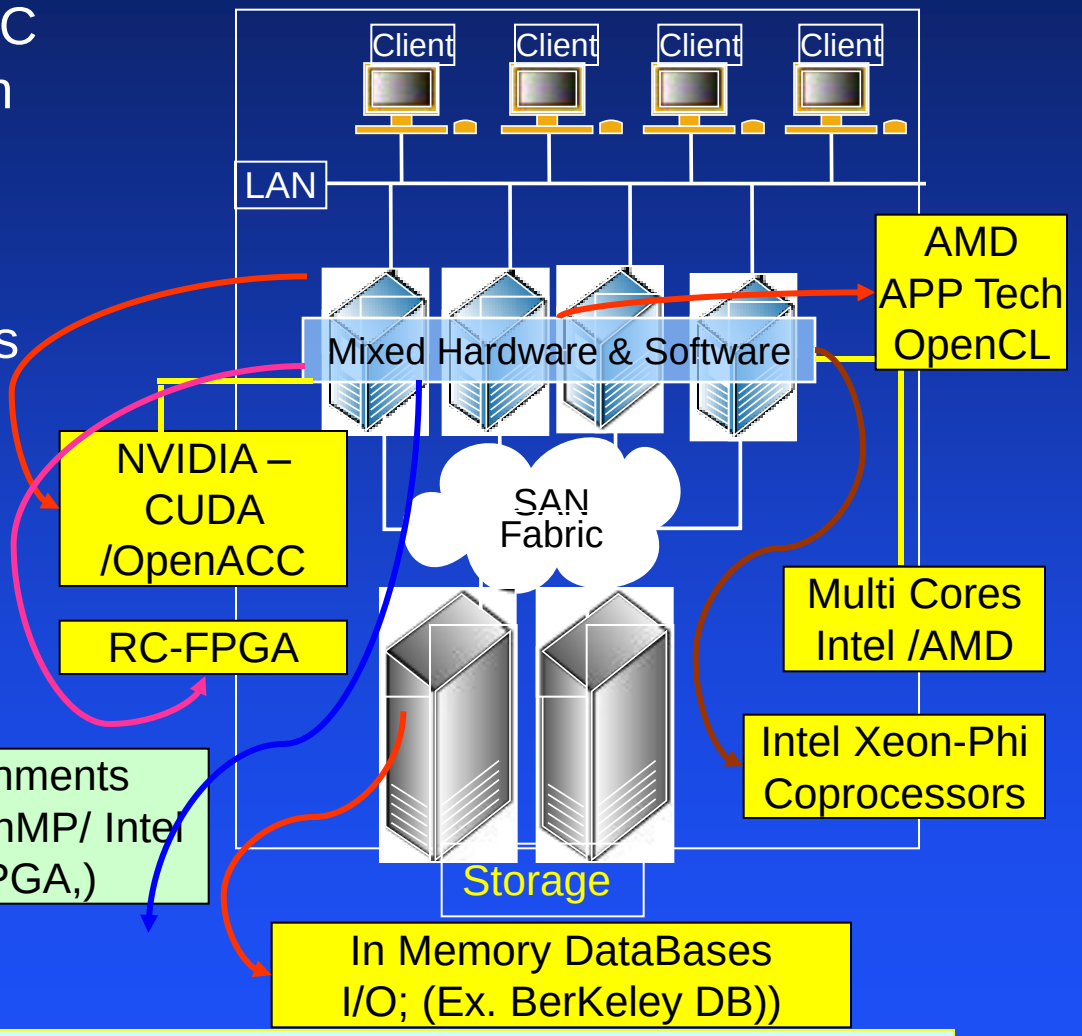
hyPACK-2013 : Hybrid Prog. - HPC Cluster Coprocessors & Accelerators (Hardware/ Software - Mixed Prog.)



hyPACK-2013 : Hybrid Prog. - HPC Cluster – Coprocessors /Accelerators (Hardware/ Software - Mixed Prog.)

- Multi -node hybrid Cluster (HPC Cluster) for Hands-on Session
- Easy to port on Intel Xeon Phi Coprocessors
- Efficient Mapping of Algorithms on Coprocessors /GPUs
- Economics – Easily Migration
- Performance on AMD APUs
- Prog. on ARM Processors

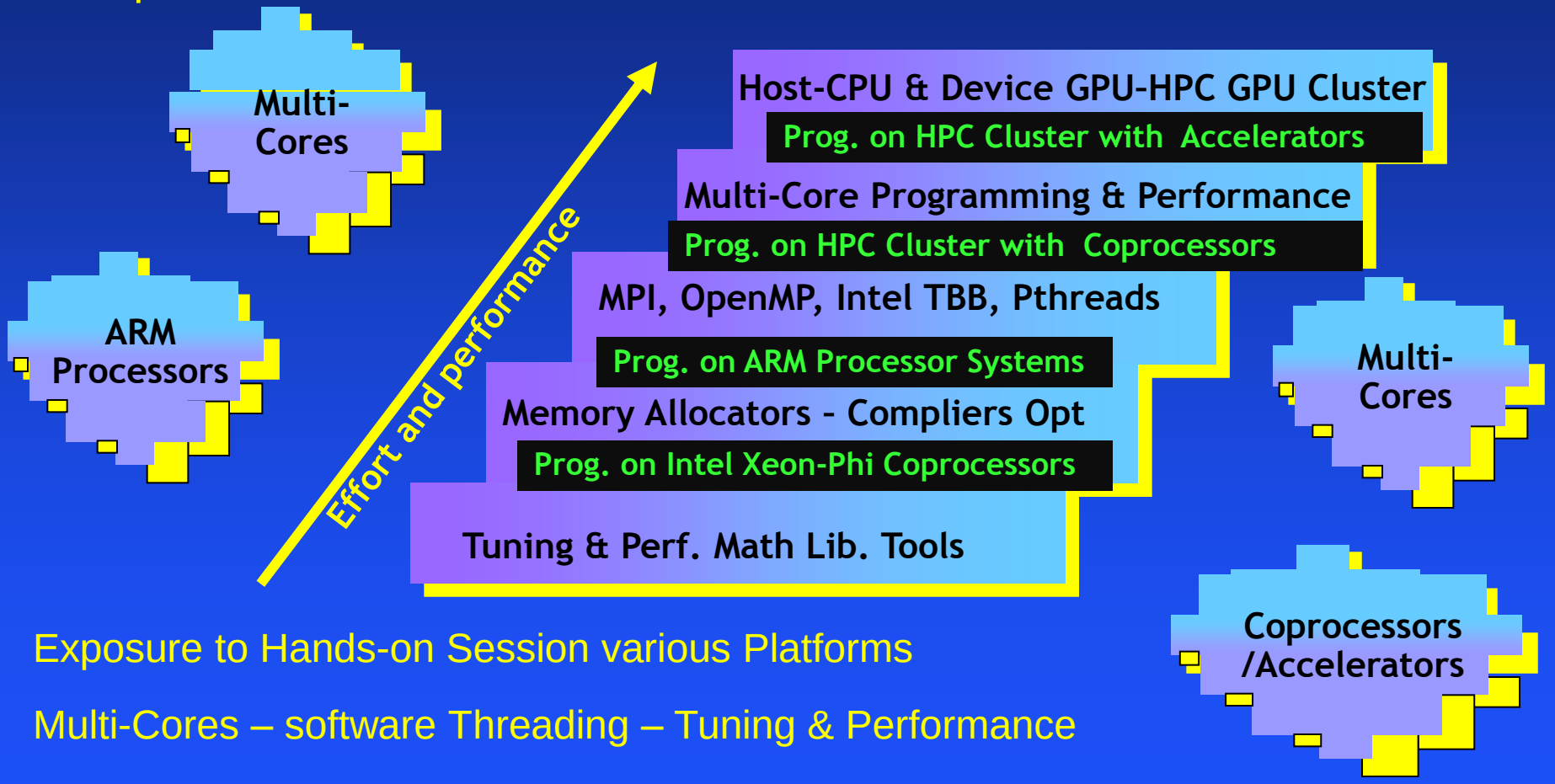


HPC Tools and Programming Environments (OpenCL, CUDA, OpenACC; MPI/OpenMP/ Intel AMD APUs- OpenCL, TBB, RC-FPGA,)

Automatic Parallelizing Compilers & Parallel Debugging & New Programming Paradigms

hyPACK-2013 (Mode-1 : Multi-cores)

Enhance the performance of applications on emerging parallel processing platforms (Multi-Cores, Coprocessors, ARM Processor Systems, GPGPUs, GPU Comp.-CUDA, PGI - OpenACC /OpenCL) Hybrid Prog.- HPC Cluster with Coprocessors and Accelerators



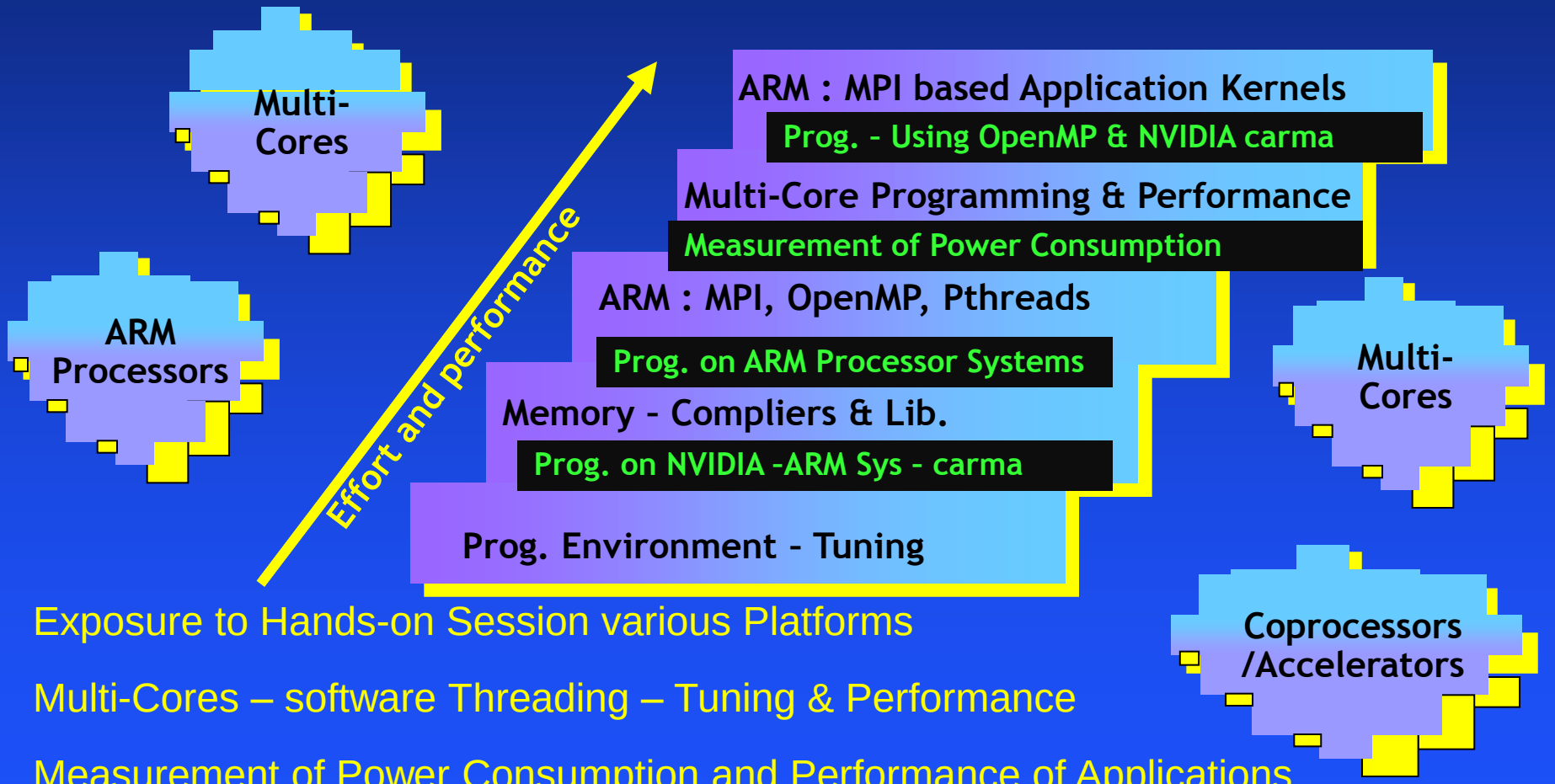
Exposure to Hands-on Session various Platforms

Multi-Cores – software Threading – Tuning & Performance

Measurement of Power Consumption and Performance of Applications

hyPACK-2013 (Mode-2 : ARM Proc.)

Enhance the performance of applications on emerging parallel processing platforms (ARM Processor Systems, Programming Paradigms – Measurement of Power Consumption for NLA Kernels & Application Kernels



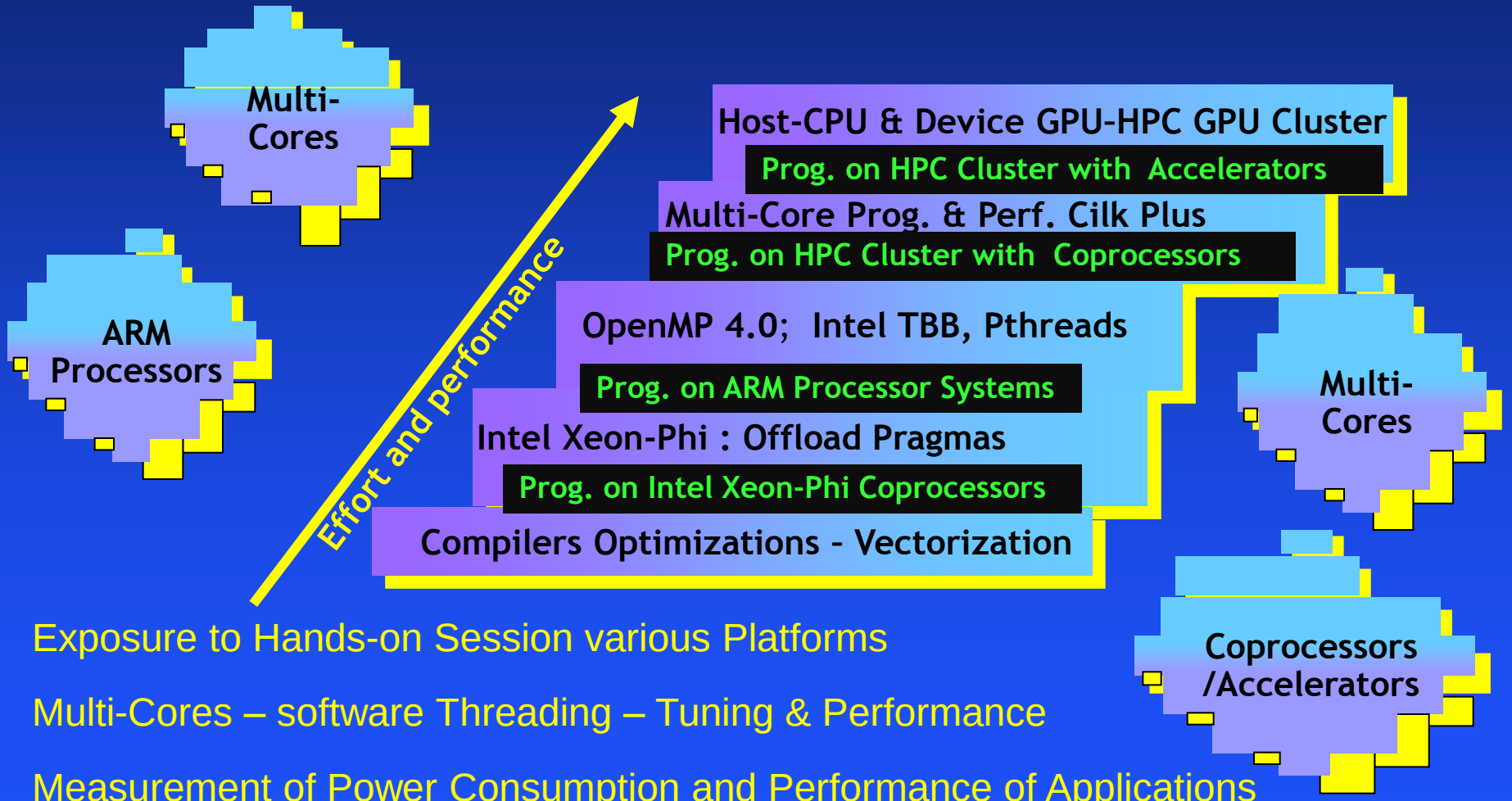
Exposure to Hands-on Session various Platforms

Multi-Cores – software Threading – Tuning & Performance

Measurement of Power Consumption and Performance of Applications

hyPACK-2013 (Mode-3 : Coprocessors)

Enhance the performance of applications on emerging parallel processing platforms (Multi-Core processor with Coprocessors, Hybrid Prog. HPC Cluster with Coprocessors - Offload Pragmas; Native Mode; MPI -Symmetric



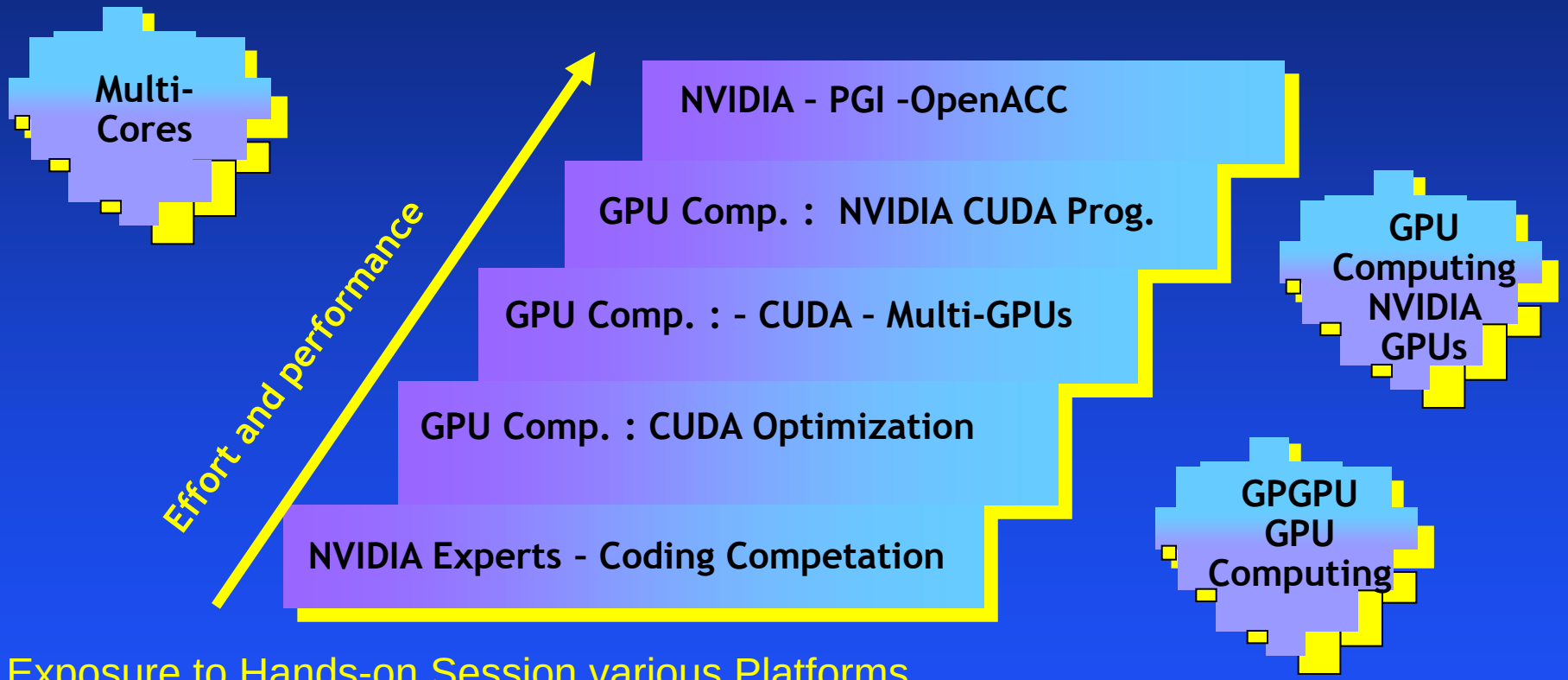
Exposure to Hands-on Session various Platforms

Multi-Cores – software Threading – Tuning & Performance

Measurement of Power Consumption and Performance of Applications

hyPACK-2013 (Mode-4) HPC Accelerators

Enhance the performance of applications on emerging parallel processing platforms (Multi-Cores, GPGPUs, GPU Comp.-CUDA, /OpenCL) Hybrid Programming.- HPC GPU Cluster



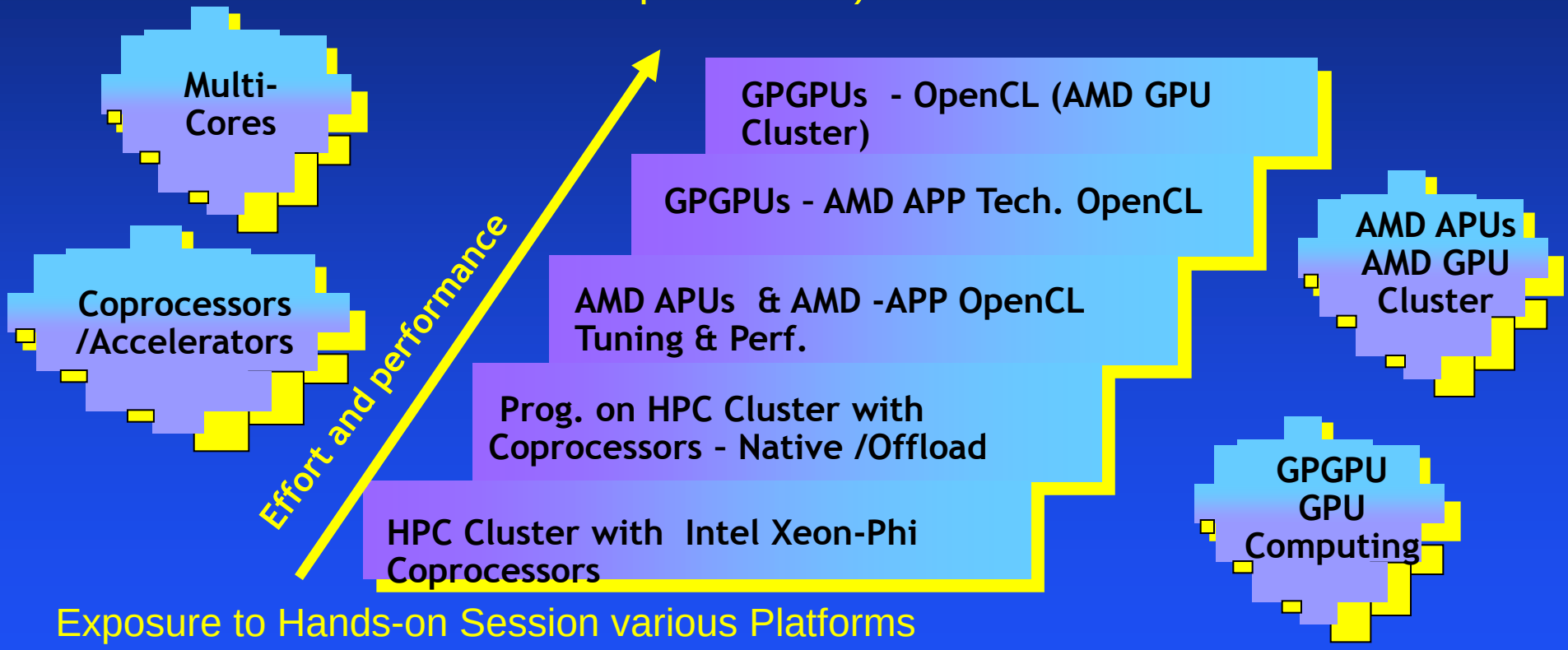
Exposure to Hands-on Session various Platforms

Multi-Cores, GPGPUs-AMD APP Tech – OpenCL , GPU Computing-CUDA & NVIDIA -PGI - OpenACC

hyPACK-2013 (Mode-5 & Mode-6)

HPC Cluster-Coprocessors & Accelerators & Apps.

Enhance the performance of applications on emerging parallel processing platforms (Multi-Cores, GPGPUs, GPU Comp.-CUDA, /OpenACC; HPC Cluster with Intel Xeon Phi Coprocessors)



Exposure to Hands-on Session various Platforms

Multi-Cores, GPGPUs-AMD APUs & AMD APP Tech – OpenCL ,

GPU Computing NVIDIA CUDA & NVIDIA-PGI - OpenACC

hyPACK-2013 (Mode-1: Multi-Core)

An overview of Hybrid Adaptive Computing Hardware/ Software - Mixed Programming with Hands-on Session & Keynote talks from Industry/Academic/Res. Develop. Organizations and Demonstration

Hands-on Session : Quad Core Systems (6)

- Multi-Core: Introduction & Challenges in Applications
- Multi-Core : An Overview of Architecture (Part -I, & II)
- Multi-Core:
  - An Overview of Multi-threading - OpenMP (Part -I, II, & III)
  - An Overview of Multi-threading - Intel Threading Building Blocks
  - **An Overview of Multi-threading - Pthreads (Part -I,II,III & IV)**
- Multi-Core : Tools, Debuggers, Libraries (Part-I, & II)
- Multi-Core : Tuning & Performance (Part -I, & II)
- Multi-Core : Prog. Env. & Application & Algorithms Design (Part -I & II)
- Multi-Core : Programming Environment (MPI 1.0/2.0 Part - I II,III, & IV)
- Multi-Core : Benchmarks (Part- I, II, & III)

hyPACK-2013 (Mode-2: ARM Processor)

•Tuning and Performance Issues- Power Consumption for Application Kernels; Measurement of Power Consumption – External Power-Off-Meter; Application Kernels; Programming on ARM processor multi-core processor systems; Energy Efficiency & Performance Issues

Hands-on Session : NVIDIA ARM Carma Systems

- Multi-Core: Introduction & Challenges in Applications
- Multi-Core Calculation of Power Consumption
- Multi-Core:
  - Pthreads Model Implementation
- Multi-Core : Tuning & Performance (High Flops /Energy Efficiency
- Multi-Core : Prog. Env. & Application & Algorithms Design
- Multi-Core : Multi-Core : Benchmarks - Power & Performanc e

hyPACK-2013 Mode-3 Intel Xeon Phi Coprocessors

The focus is to integrate programming paradigms such as Pthreads, OpenMP, Intel TBB, Cilk Plus, Intel Xeon-Phi Offload Pragmas, MPI, & NVIDIA CUDA, OpenACC, OpenCL and extract the best achieved performance for application kernels

Hands-on Session – GPUs / Hybrid Computing Systems (4-6)

- Programming on Intel Xeon-Phi Coprocessors; Xeon-Phi Coprocessor usage model : MPI vesus Offload; Compiler and Programming model; Approaches to Vectorization – Complier Directives; Programming Paradigms – OpenMP, Intel TBB, Intel Cilk Plus, Intel MKL
- Intel Xeon-Phi Coprocessor Architecture; Linux OS on Coprocessor; Coprocessor System software; Tuning Memory Allocation Performance – Huge Page Sizes; Profiling & Tuning Tools- PAPI & MPI tools

hyPACK-2013 Mode-4 GPGPUs

An overview of Hybrid Computing: HPC Cluster with Coprocessors & Accelerators (Hardware/ Software - Mixed Programming with Hands-on Session) & Keynote talks from Industry/Academic/Res. Develop. Organizations and Demonstration

Hands-on Session – Coprocessors / GPUs / Hybrid Computing Sys.

- GPUs : An Overview of GPU Computing
- GPUs : NVIDIA – GPU Comp. – CUDA – OpenACC
- GPUs : AMD APUs **&** AMD – APP Tech OpenCL
- GPUs : Open Computing Language (OpenCL)
- HPC GPU Cluster Hybrid Computing – Mixed Programming (MPI, OpenMP, Intel TBB, GPU – CUDA)
- HPC GPU Cluster Hybrid Computing – Mixed Programming (MPI, OpenMP, Intel TBB, GPU – OpenCL)

hyPACK-2013 : Hybrid Prog. - HPC Cluster with Coprocessors & Accelerators (Hardware/ Software - Mixed Programming)

An overview of Hybrid Computing: HPC Cluster with Coprocessors & Accelerators (Hardware/ Software - Mixed Programming with Hands-on Session) & Keynote talks from Industry/Academic/Res. Develop. Organizations and Demonstration

Sponsors : The IT companies and government organisations partial sponsors for hyPACK-2013. The sponsors provided partial financial assistance, access to their computing systems, use of their software in this technology workshop.

hyPACK-2013 : Hybrid Prog. - HPC Cluster – Coprocessors /Accelerators (Hardware/ Software - Mixed Prog.)

Mode-1, Mode-2, Mode-3 : Day 1 & Day-2

- Programming on Intel Xeon-Phi Coprocessors; Xeon-Phi Coprocessor usage model : MPI vesus Offload; Compiler and Programming model;

- Programming on Intel Xeon-Phi Coprocesors : Approaches to Vectorization – Complier Directives; Programming Paradigms – OpenMP, Intel TBB, Intel Cilk Plus, Intel MKL

- Intel Xeon-Phi Coprocessor Architecture; Linux OS on Coprocessor; Coprocessor System software; Tuning Memory Allocation Performance – Huge Page Sizes; Profiling & Tuning Tools- PAPI & MPI tools

hyPACK-2013 : Hybrid Prog. - HPC Cluster – Coprocessors /Accelerators (Hardware/ Software - Mixed Prog.)

Mode-1, Mode-2, Mode-3 : Day 1 & Day-2

- Tuning and Performance Issues- Power Consumption for Application Kernels; Measurement of Power Consumption – External Power-Off-Meter; Application Kernels; Programming on ARM processor multi-core processor systems; Energy Efficiency & Performance Issues

- Programming on ARM Processor multi-core systems; power-aware performance Issues on ARM Multi-Coprocessor systems;

- Prog. on carma - NVIDIA CUDA on ARM Development Kit; Performance of NLA And Application Kernels

hyPACK-2013 : Hybrid Prog. - HPC Cluster – Coprocessors /Accelerators (Hardware/ Software - Mixed Prog.)

Mode-4, Mode-5, Mode-6 : Day 3 & Day-4

- An Overview of CUDA enabled NVIDIA GPUs : CUDA SDK/APIs; CUDA – Optimization & Performance Issues; Efficient use of different memory types, Libraries-CUBLAS, CUFFT, CUSPARSE; CUDA-OpenACC APIs; Programming - OpenCL; CUDA NVIDIA GPU Cluster

- An Overview of AMD Accelerated Parallel Processing (APP) Capabilities; AMD APUs - OpenCL Prog. On Multi-Core CPUs & Multi-GPUs; AMD APP Math Libraries - BLAS & FFTs; AMD APP SDK, AMD tools – Aparapi AP; AMD OpenCL tuning – performance; HPC AMD GPU Cluster: Host CPU (Pthreads, OpenMP, MPI) with OpenCL on AMD GPUs; GPU Cluster –

hyPACK-2013 : Hybrid Prog. - HPC Cluster – Coprocessors /Accelerators (Hardware/ Software - Mixed Prog.)

Mode-4, Mode-5, Mode-6 : Day 3 & Day-4

- An Overview of FPGA Device Systems; Energy Efficiency – Power-Off Meters and NVML Libraries - Health Monitoring –
- NVML Power Efficient API – Performance Issues;
- Efficient use of GPUs in Cluster; Open Source Software using GPUs – MAGMA, & Top-500 Benchmarks

hyPACK-2013 : Hybrid Prog. - HPC Cluster – Coprocessors /Accelerators (Hardware/ Software - Mixed Prog.)

Mode-4, Mode-5, Mode-6 : Day 3 & Day-4 : Applications

- Mixed Programming for Numerical /Non-Numerical Computations on multi-core processors with Intel Xeon-Phi coprocessors – and NVIDIA /AMD GPU accelerators and ARM processor systems; Application & System Benchmarks & Performance; Image Processing Applications - Bio-Informatics - String Search Algorithms & Sequence Analysis;

- Dense /Sparse Matrix Computations on HPC GPU Cluster; Solution of Partial Differential Eqs. (FDM &FEM); FFT Libraries; Invited lectures on Information Sciences; Computational Physics

hyPACK-2013 : Hybrid Prog. - HPC Cluster with Coprocessors & Accelerators (Hardware/ Software - Mixed Programming)

Mode-4, Mode-5, Mode-6 : Day 3 & Day-4 : Applications

Thank you