CloudLightning & HPC: Heterogeneous Computing in the Cloud(*)

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CloudLightning (CL) Overview

Self-Organization and Self Management (SOSM) of HPC resources
- **Resource Allocation - (Based on Service Requirements) which can be**:
  - Bare Metal
  - VM (Virtual Machines)
  - **Containers –the most realistic option for HPC workloads**
  - Resources are divided into Cells, based on region or location
  - Each Cell may have different hardware types, including servers with GPUs, MICs, DFEs
  - Each Cell is partition into vRacks which are sets of servers of the same type

- **Resource Utilization - (Self-Optimized)**
  - Alt. 1: Cell manager get request of resources, create them and allocate them directly
  - Alt. 2: First discover resources available, then if more than one options, then the Cell Mgr selects the most appropriate option.
  - Alt. 3: Same as Alt. 2, except gives back solution rather than option
  - vRack managers may create/aggregate the resources in its vRack and is the basic component of self-organization in the CL system. Note this feature makes only sense for larger deployments.

CURRENT STATUS OF THE OVERALL CLOUDLIGHTNING PROJECT:
- SOSM Architecture defined
- Plugins for resource registration developed
- Tested use cases on individual platforms
- Working on integration, testbed and simulation that includes the OpenStack-based SOSM system
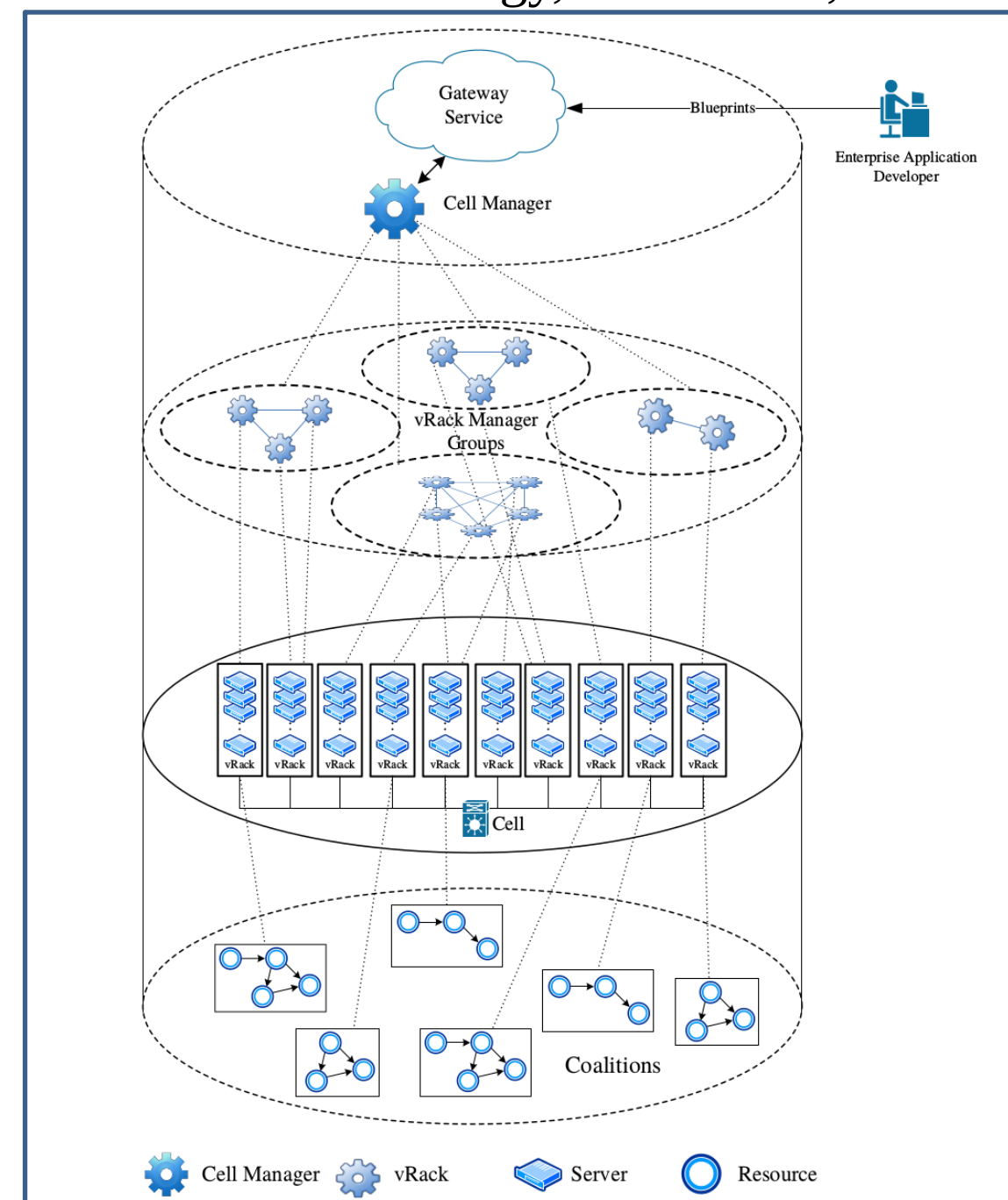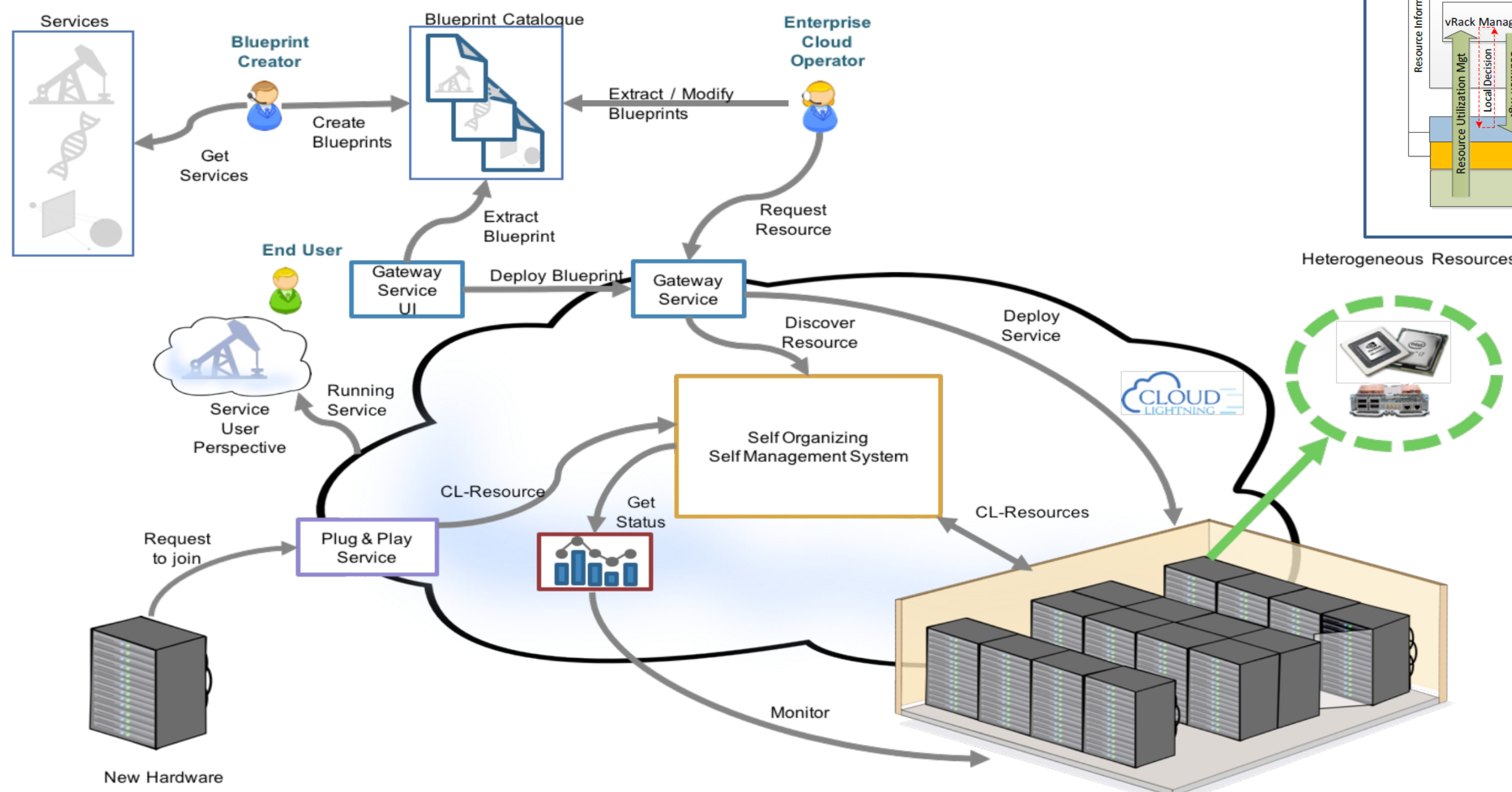
CloudLightning Architecture
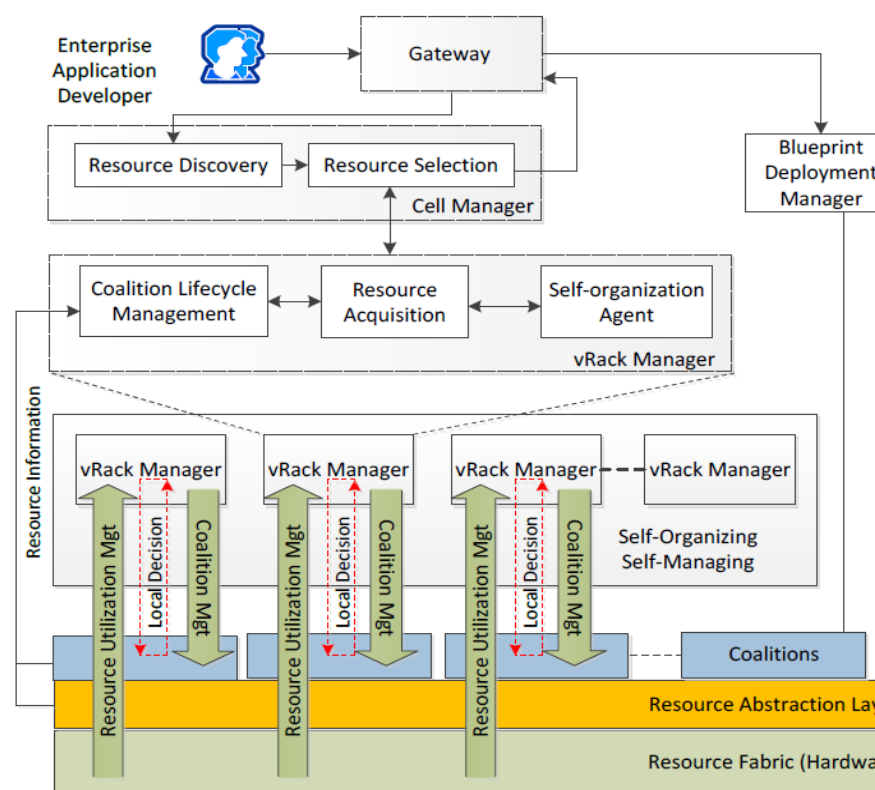
Heterogeneous Testbed

MIC System
- PC with Xeon Phi card

GPU System
- Dell server blade with NVIDIA Tesla P100

DFE Cluster
- Maxeler MPC-C node with 4x Vectis MAX3 DFEs

SMP Cluster
- Numascale 5-node SMP

Use Cases

Oil & Gas:
Reservoir simulation case using OPM upscaling of relative permeability

Genomics:
Sequence alignment for whole genome analysis
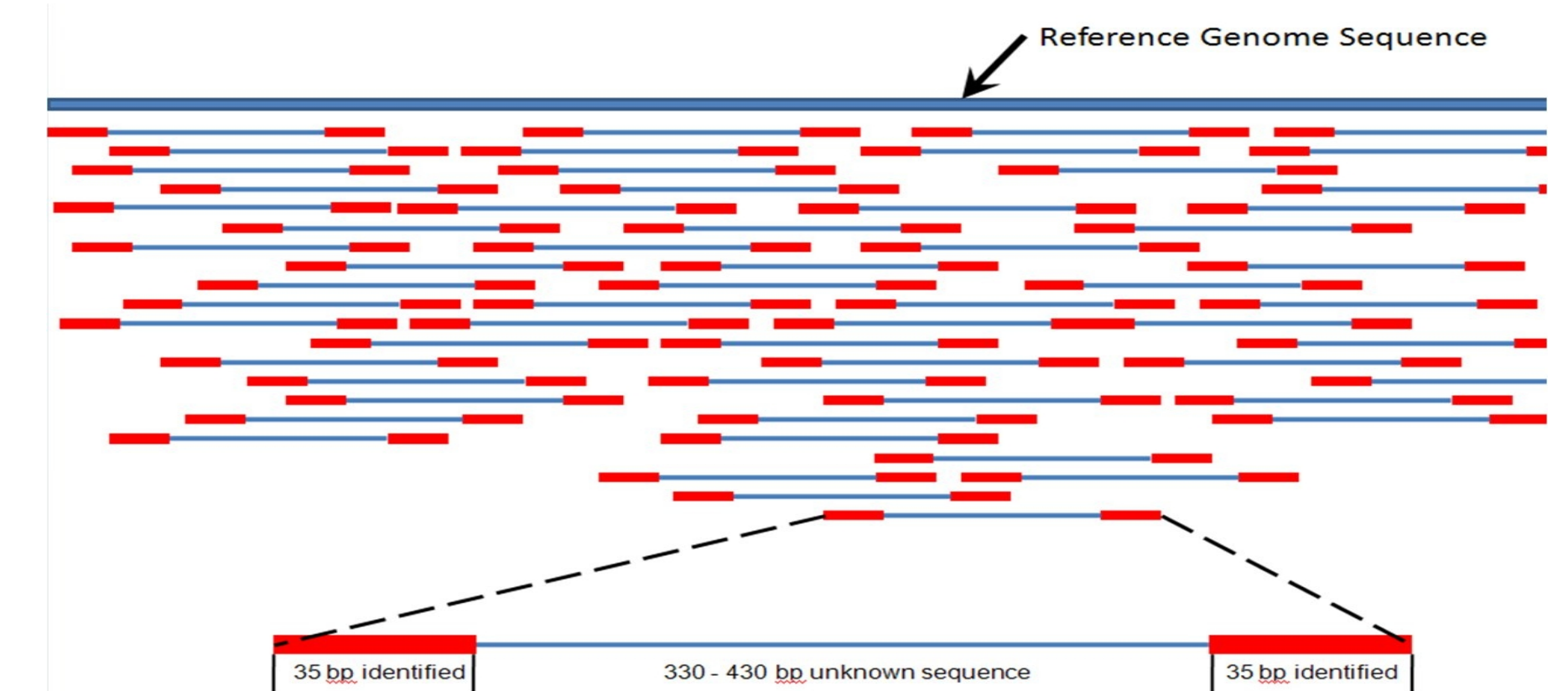
Self-Optimized Libraries
- ATLAS BLAS/MKL/cuBLAS/FFTW/cuFFT

Ray Tracing:
Generating image by tracing path of light through pixels

References:
http://www.cloudlightning.eu   http://www.opm-project.org   http://www.mcs.anl.gov/petsc/   http://www.maxeler.com
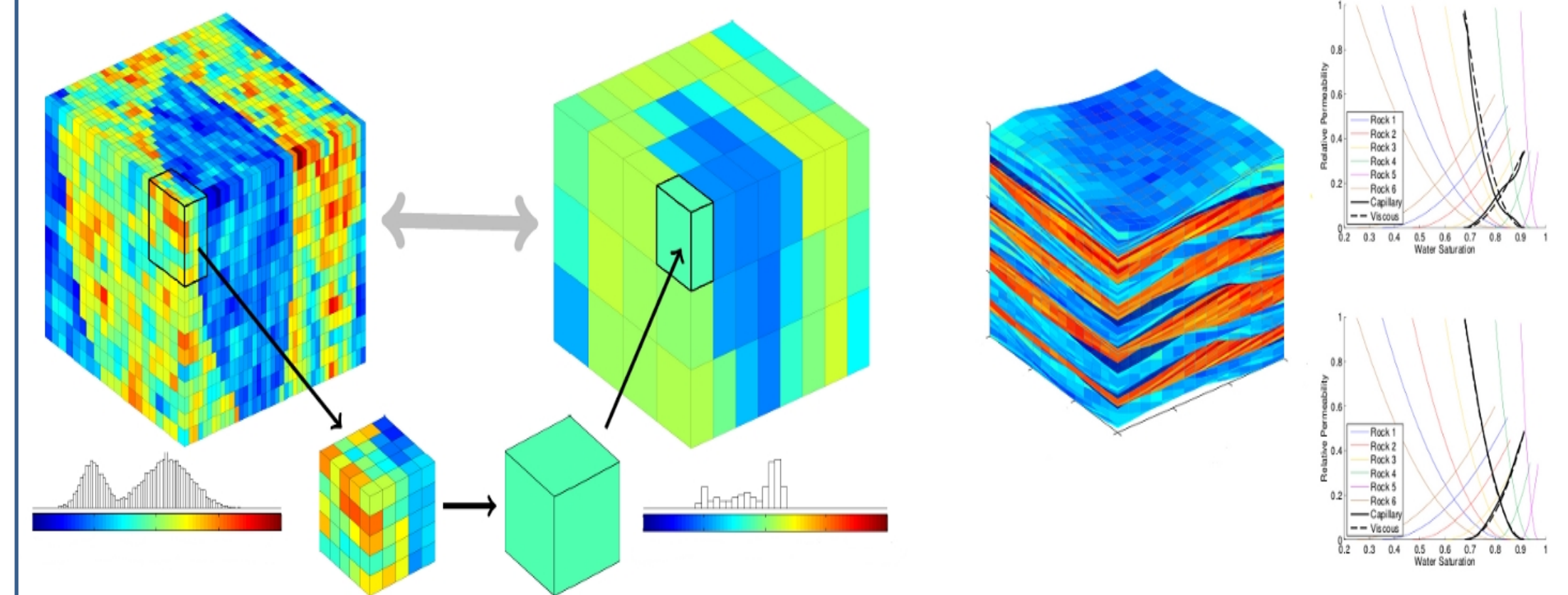
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