
天河1A超级计算机
The TianHe-1A Supercomputer:
Its Hardware and Software
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目录
Contents


1
Introduction

Introduction

01

It is developed by NUDT

02

It was ranked the No. 1 on the TOP500 List released in November, 2010.

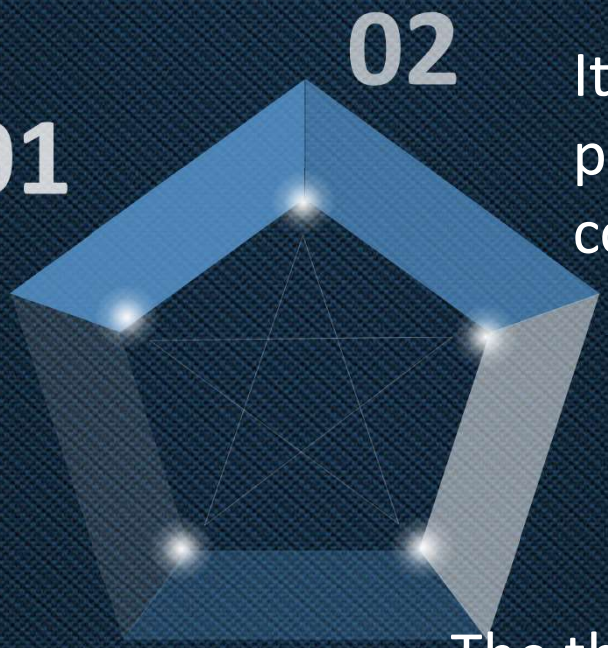
03

TH-1A is now deployed in National Supercomputer Center in Tianjin

Characteristics

01

TH-1A adopts a hybrid architecture by integrating CPUs and GPUs.



02

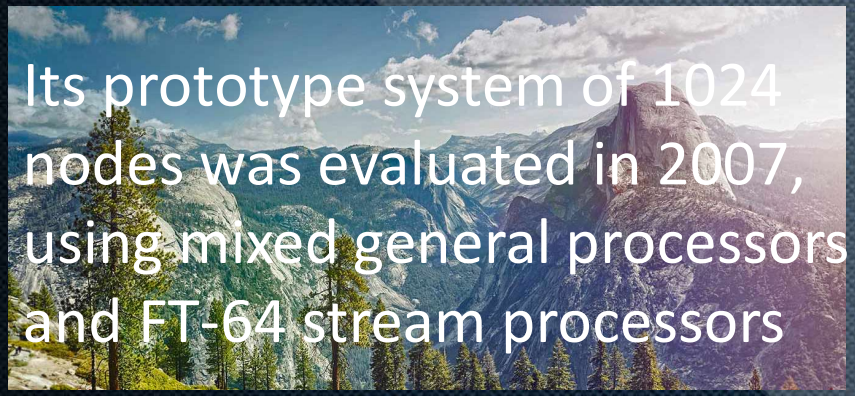
Its interconnect network is a proprietary high-speed communication network

03

The theoretical peak performance of TH-1A is 4700 TFlops, and its LINPACK test result is 2566 TFlops.

Development Process

The preliminary research was started in 2005.



TH-1 was accomplished in 2009，the TH-1 system was upgraded and enhanced in August, 2010, named TH-1A


2
Hardware System

Consists of Five Subsystems

1. Service subsystem
2. Compute subsystem
3. Communication subsystem
4. I/O storage subsystem
5. Monitoring and diagnostic subsystem

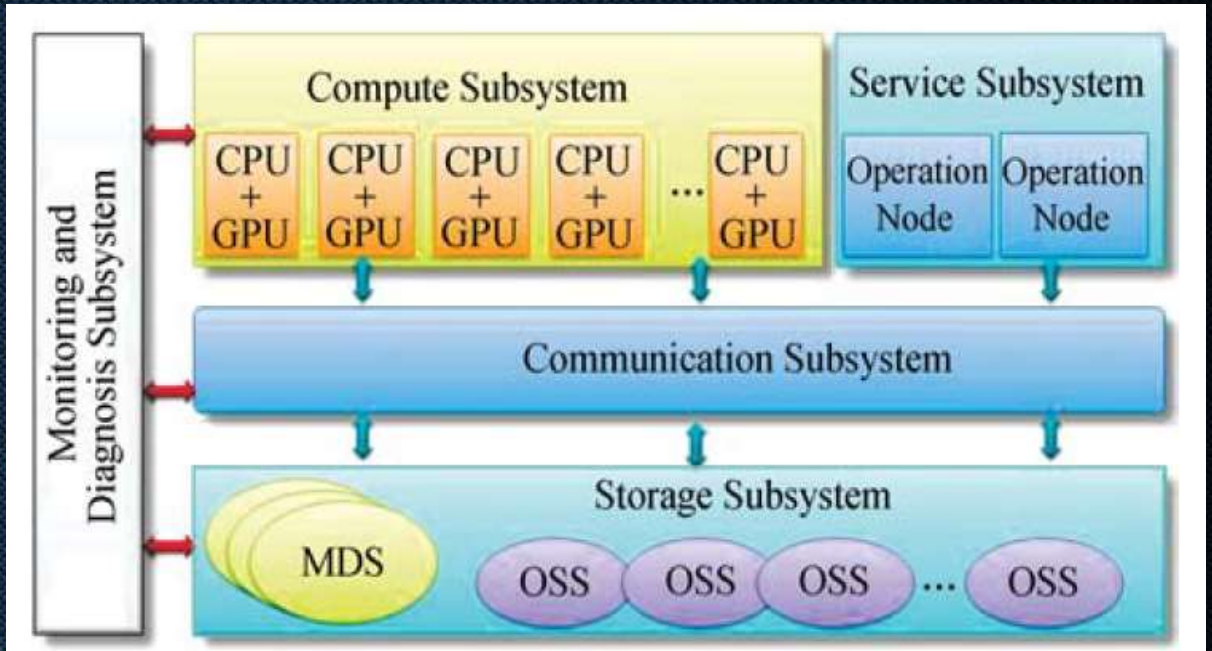


Fig.1. Structure of TH-1A system.

Three VLSI chips

FT-1000 CPU

High-radix
routing chip NRC

High-speed networking
interface chip NIC.

Architecture of Chips

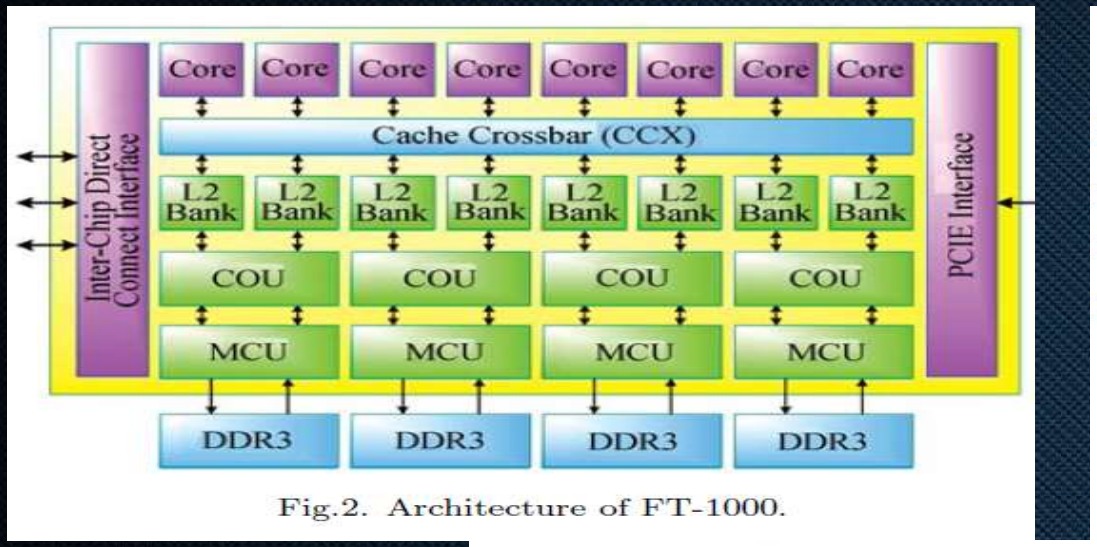


Fig.2. Architecture of FT-1000.

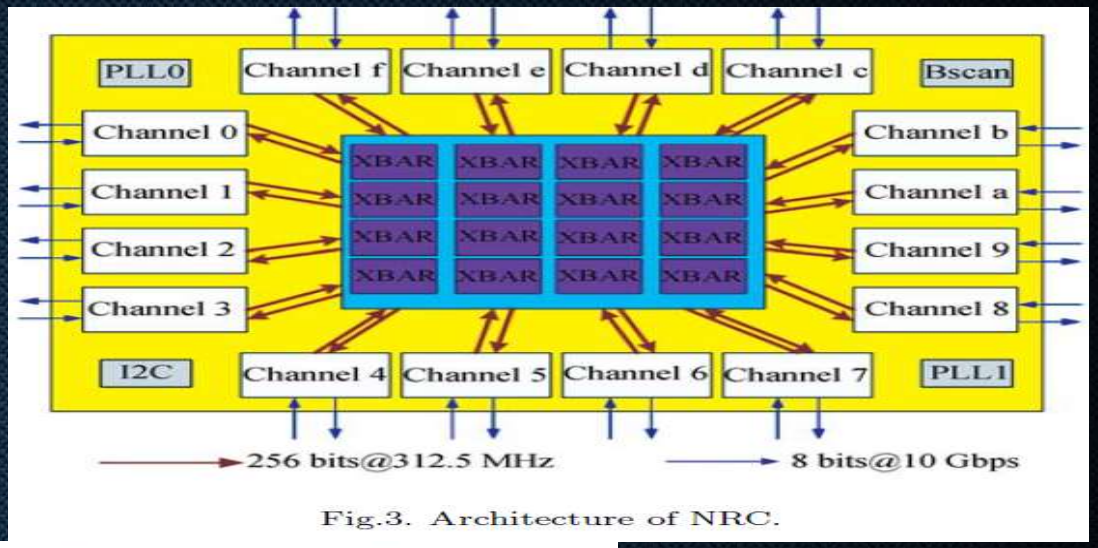


Fig.3. Architecture of NRC.

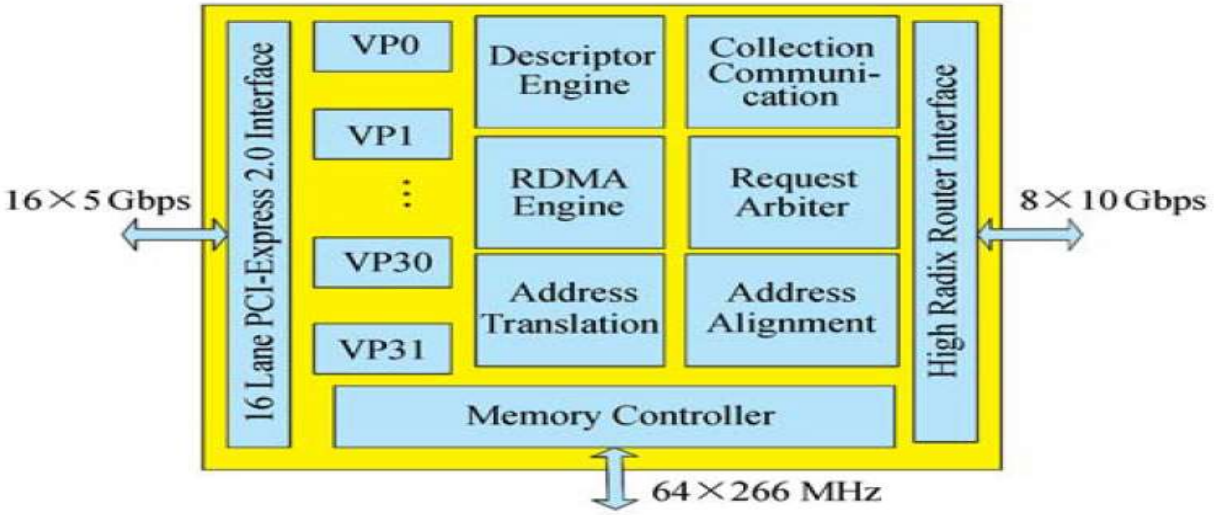


Fig.4. Architecture of NIC.

Interconnnect Network

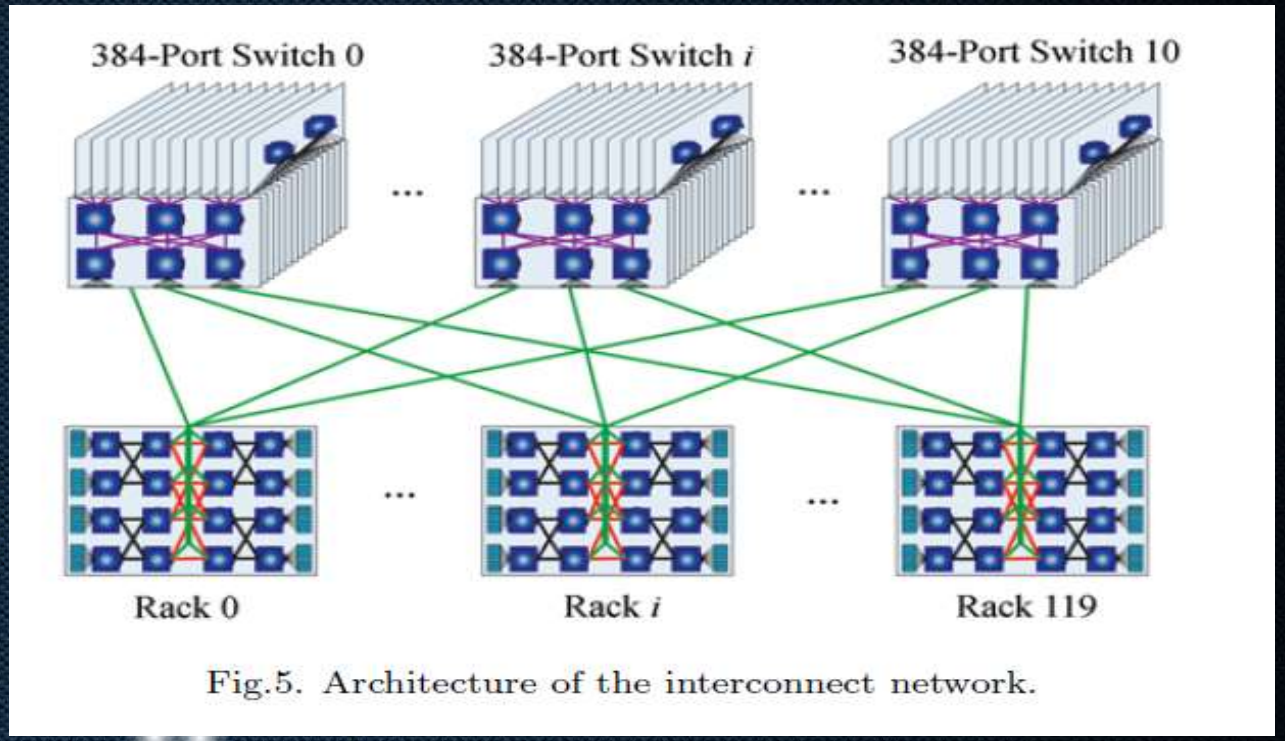
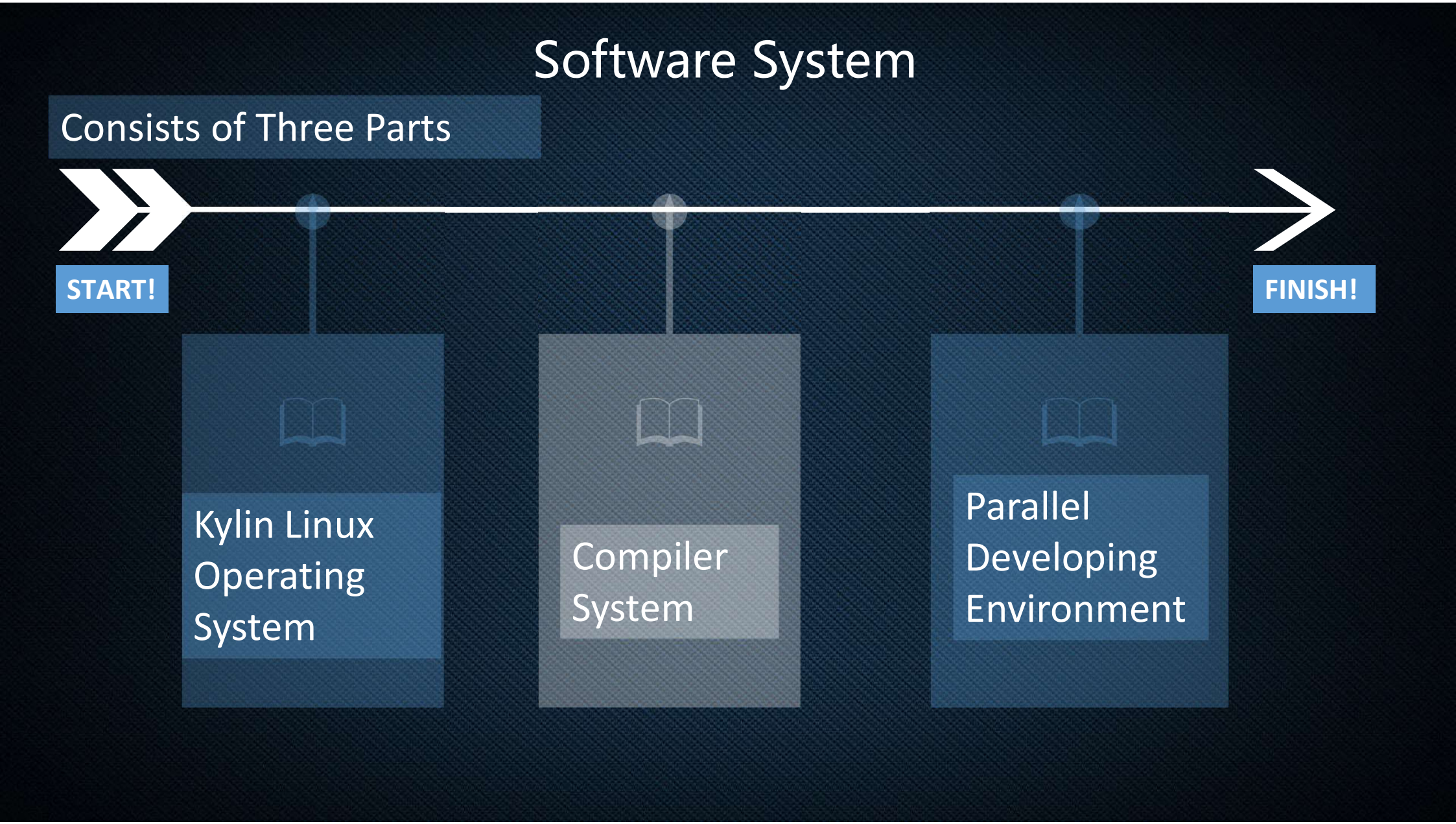


Fig.5. Architecture of the interconnect network.

The first layer consists of 480 switching boards.
The second layer contains 11 384-port switches, connected with QSFP optical fibers.


3
Software System


Software System
Consists of Three Parts
START!
FINISH!
Kylin Linux Operating System
Compiler System
Parallel Developing Environment

Kylin Linux Operating System

To improve the usability and security of the system, Kylin Linux utilizes virtualization techniques, i.e., the High Performance User Container (HPUC), which supports dynamic environment customization.

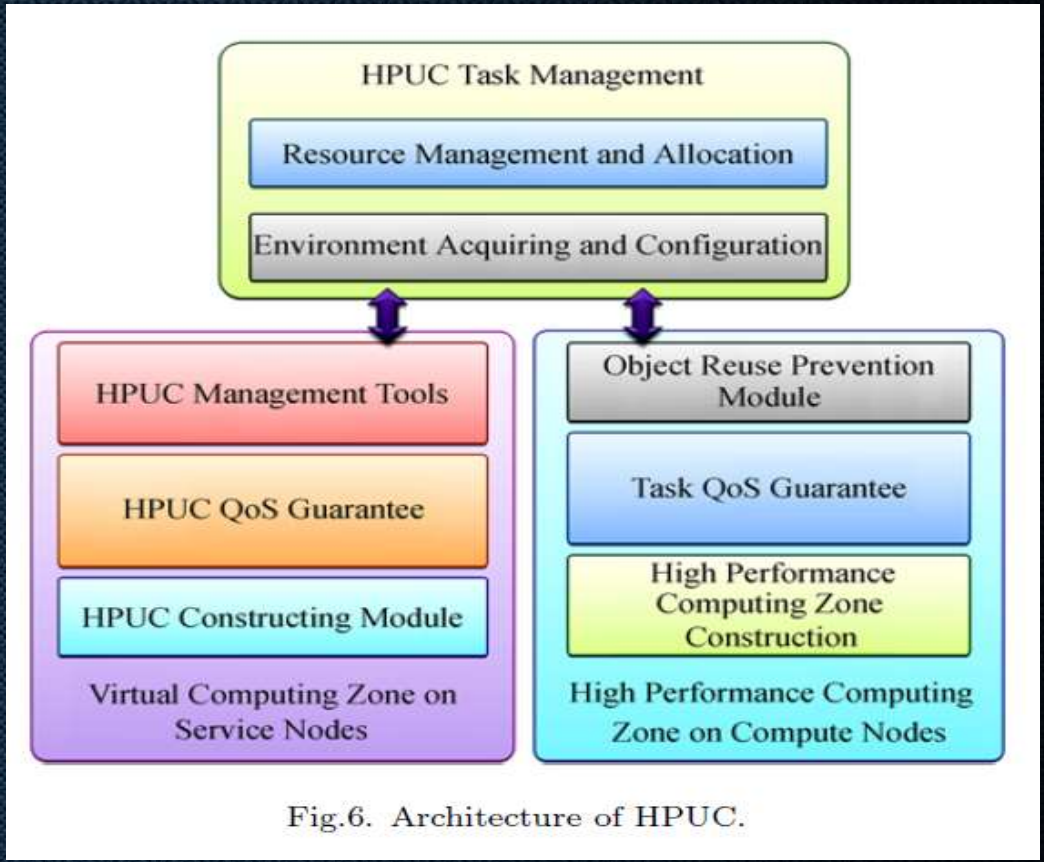
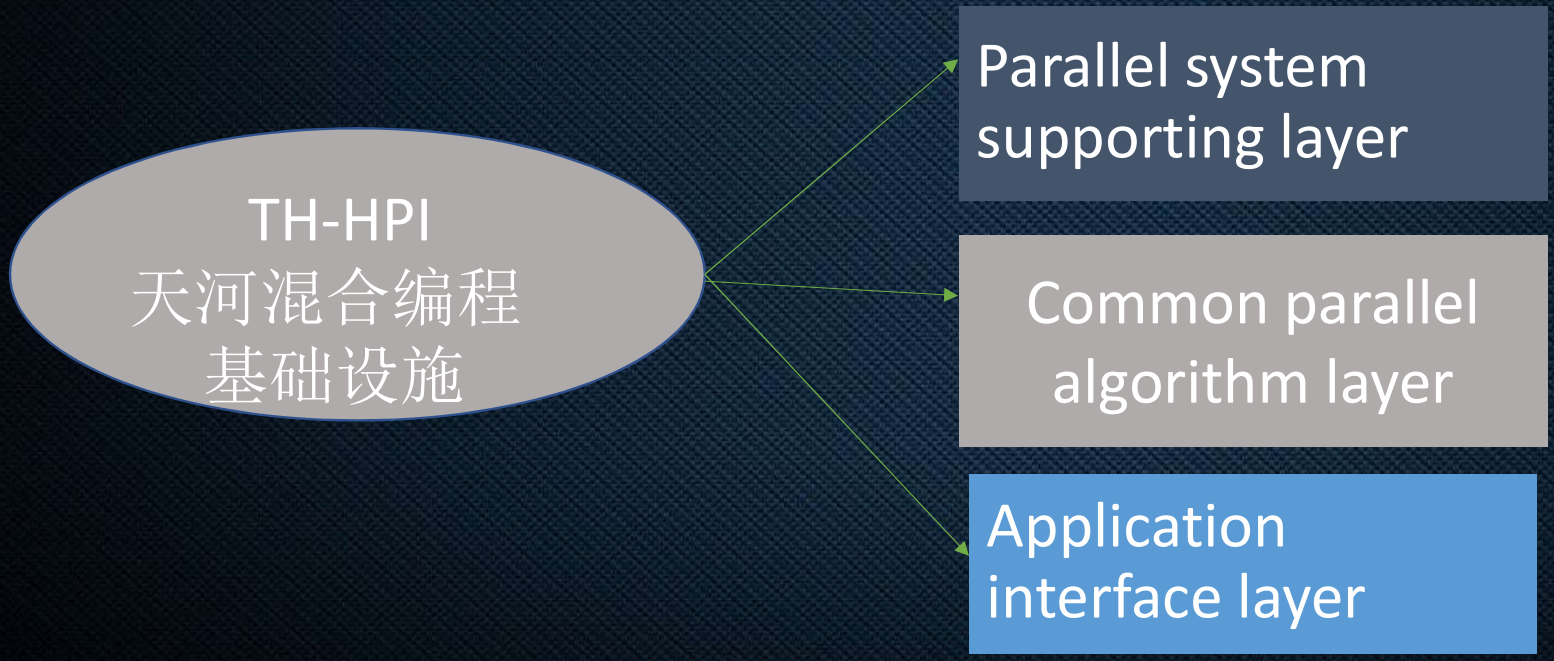


Fig.6. Architecture of HPUC.

Compiler System

1. TH-1A supercomputer supports serial programming languages such as C/C++, Fortran77/90/95, Java,
2. And the parallel programming languages such as OpenMP, MPI, and OpenMP/MPI.
3. TH-1A uses OpenCL and CUDA for GPU programming.



Parallel Developing Environment

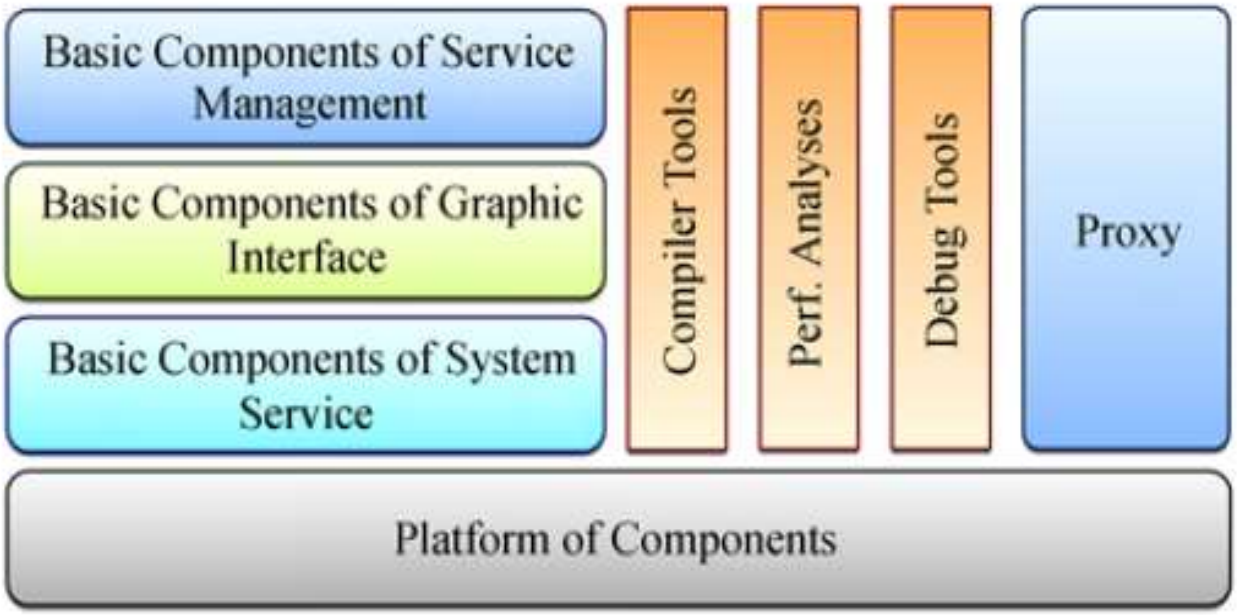


Fig.7. Architecture of network integrated development platform.

Communicates with the service proxies on remote service nodes through parallel service interface


4
Conclusion

Conclusion

TH-1A adopts the hybrid architecture of heterogeneous integration of CPUs and GPUs and its communication network is high-speed network designed by NUDT.

Aapplied to many fields, such as oil exploration, bio-medical research, animation design, exploitation of new energy sources, weather forecast, remote sensing data processing, and financial risk analysis.

The new TH system will use domestic FT-2000 processors， will make breakthroughs in the power efficiency and system autonomy.


Thank you!
汇报人：陶应娟