PETFLOW
a project towards an ultra parallel synergy internet system in scientific applications

Cybermedia Center, Osaka University, Japan

BACKGROUND

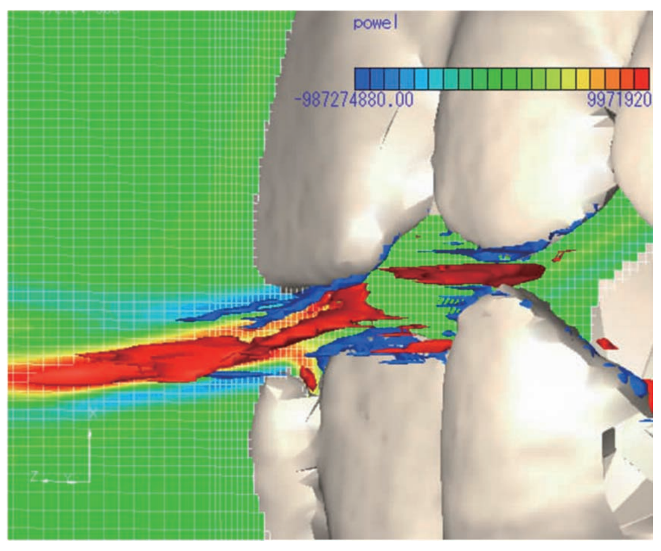
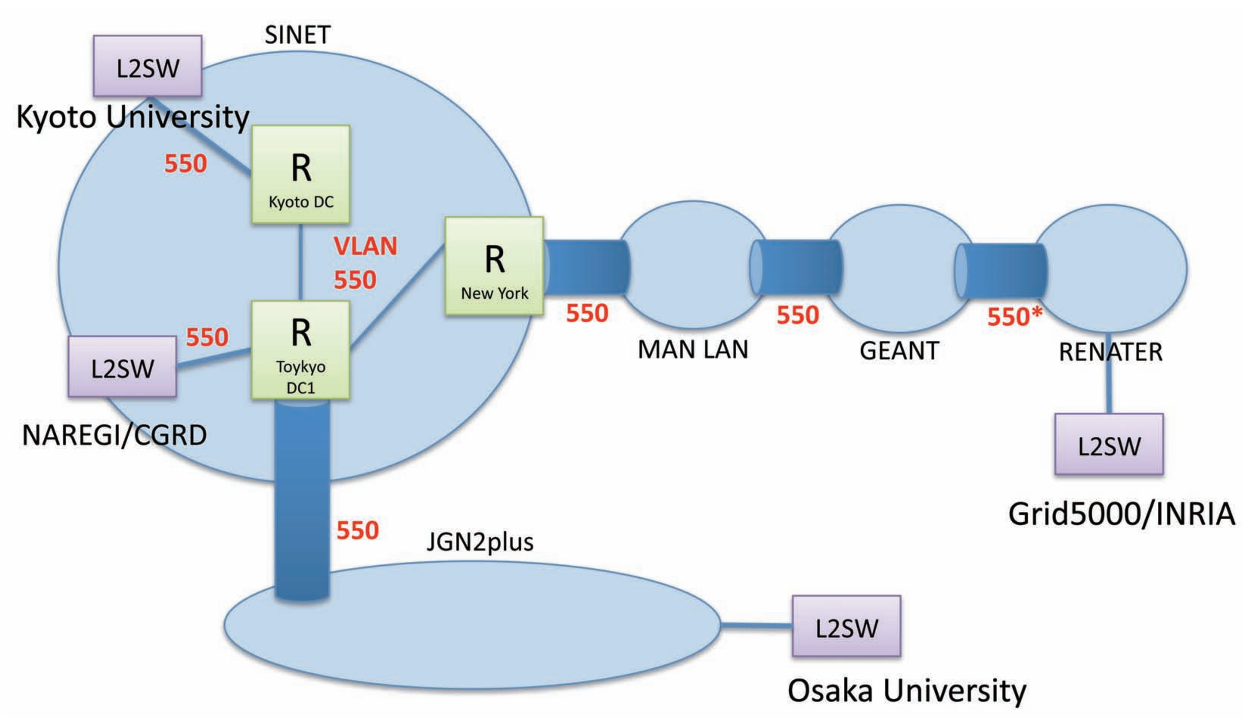


Fig.1 (Top) :
The oral flow-sound simulation in pronunciation of "/s/"

It is no falsehood to state that 'current society and science attempt to deal with increasing amounts of data'. Today, peta-scale data are commonly gathered as well as generated thanks to the continuous development of measurement technologies and computational resources in diverse fields of science and society. Efficient processing or generation of peta-scale data requires high performance computational (HPC) resources which should be made remotely accessible through long-distance high performance networking and might be represented thanks to the petaflow-project, interactive scientific visualization. Consequently, generation or processing of peta-scale data benefits from the emergence of adequate 'Information and communication technologies (ICT)' with respect to high performance 'computing-networking-visualization' and their mutual 'awareness'. It is aimed to develop and validate such ICT solutions using a transnational high speed research network between Japan and France connecting 'GRID5000' (France) to the 'Naregi' (Japan) testbed. Data-transfer protocols are aimed to be validated on data obtained for a real scientific problem involving peta-scale data. Due to the medical relevance as well as basic scientific interest, peta-scale data are obtained from HPC Computational Fluid Dynamics (CFD) simulations on a vector supercomputer (NEC SX9 Japan) aiming to predict the airflow through the upper airways. In addition, CFD simulation outcome is used as an input for aero-acoustic computations (CAA) for prediction of noise production. Besides the international transfer of the generated peta-scale data, scientific visualization of peta-scale data is aimed on a single PC as well as on a tiled display wall for 3D interactive reconstruction of the flow and noise data. In summary, the petaflow project aims to contribute to the state-of-theart of HPC, networking, scientific visualization and their mutual interactions for peta-scale data, while at the same time it is aimed to contribute to basic research in the fields of CFD and CAA applied to flow through the upper airways.

PETAFLOW NETWORK

PetaFlow network testbed is a Layer-2 Virtual Private Network. It has been developed from NAREGI-Grid5000 network testbed (2006--2009) and constructed with the collaboration of SINET, JGN2plus, RENATER, GEANT, and MAN LAN. Figure XX shows the topology of the PetaFlow network testbed. Japanese-side network is composed of SINET and JGN2plus networks connected at Tokyo. NII and Kyoto University connect with SINET, and Osaka University connects with JGN2plus. In order to connect Japanese research foothold with Grid5000, the international network operated by SINET is used and extends to MAN LAN. On the other hand, Grid5000 backbone network is provided by RENATER. The network from Grid5000 extends to MAN LAN via GEANT.



PETAFLOW CLOUD

There are many kinds of applications which perform numerical simulations, for example, Virtual Physiological Human (VPH), Real time Space Weather Simulater, Numerical Whether Simulation, Nuclear Fusion Simulations, Aerodynamic Research for the Next Generation Supersonic Transport and Numerical Simulation to Tsunami Disaster Prevention. It is necessary to increase the total amount of computational resources to perform those applications. It has not been sufficient, however, to do them at all.

This problem arise from such a structure that each researchers or groups own their own computational resources. This structure of scientific society is not efficient in terms of several aspects. We hereby propose "PetaFlow cloud". PetaFlow cloud enables researchers or groups to obtain the solutions for their concrete objects that can be required by several numerical simulation codes. PetaFlow cloud has three main components, first "Peta-scale Networking-Storage", second "Peta-scale Computing" and "Peta-scale Visualization".

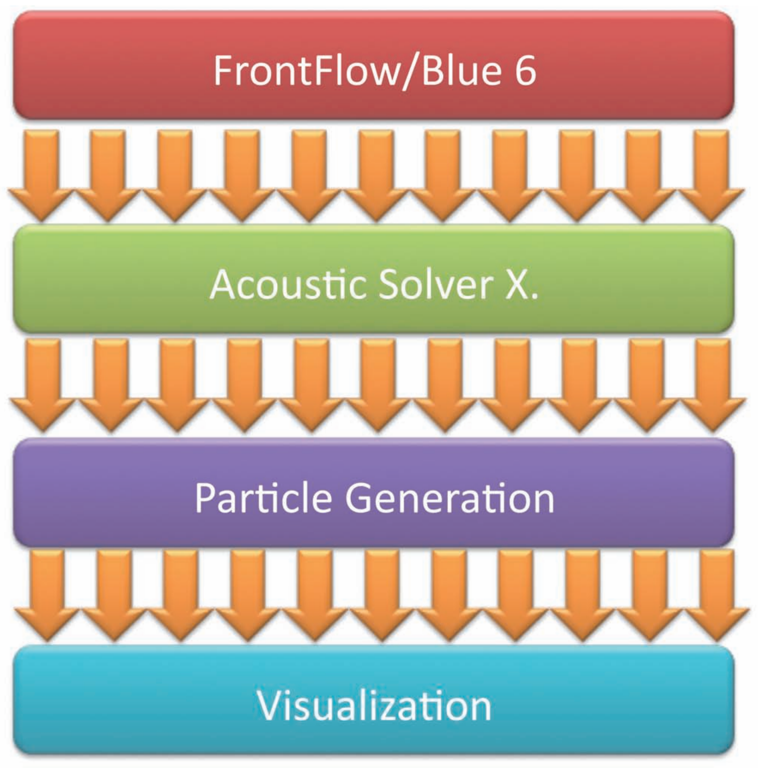
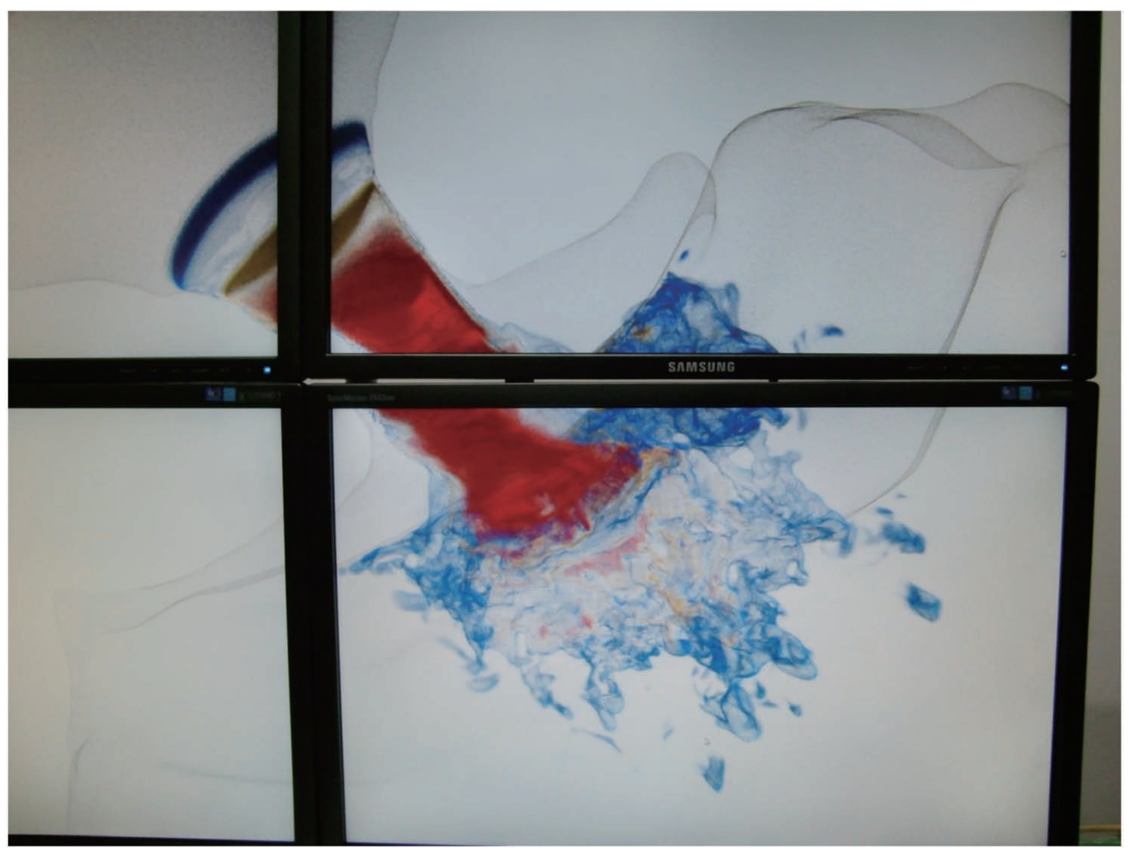


Fig.6(c) : Vision of PetaFlow:
- Peta-scale Networking – Storage
- Peta-scale Computing
- Peta-scale Visualization

PETASCALE VISUALIZATION

Oral flow-sound simulation results in higher-level complexities of 3D phenomena and huge volume datasets. Visualizing huge data often requires use of high-resolution display such that important fine structures are not missed. It is because the number of elements forming the huge volume data exceeds resolutions of the normal LCD displays.

The particle-based volume rendering (PBVR) is one of the effective rendering techniques applicable to huge volume data. It is based on the Sabella' s density emitter model, in which the scalar field is characterized as a cloud of opaque and self-emitting particles with the single-level scattering. PBVR does not require sorting of elements, being different from the ray-casting method, and so enables us to treat over giga-byte huge data easily.



Paulo Goncalves : INRIA, ENS Lyon, Universit´e de Lyon
Xavier Grandchamp : Gipsa-lab, UMR CNRS 5216, Grenoble Universities
Xavier Pelorson : Gipsa-lab, UMR CNRS 5216, Grenoble Universities
Bruno Raffin : INRIA Grenoble, France
Annemie Van Hirtum : Gipsa-lab, UMR CNRS 5216, Grenoble Universities
Pascale Vicat-Blanc : INRIA, ENS Lyon, Universit´e de Lyon
Ken-ichi Baba : Vizlab, Kyoto University
Julien Cisonni : The Center for Advanced Medical Engineering and Informatics
Yasuo Ebara : Cybermedia Center, Osaka University
Kazunori Nozaki : The Center for Advanced Medical Engineering and Informatics
Hiroyuki Ohsaki : Graduate School of Information Science and Technology
Shigeo Wada : The Center for Advanced Medical Engineering and Informatics
Takuma Kawamura : Vizlab, Kyoto University
Kohji Koyamada : Vizlab, Kyoto University
Eisaku Sakane : National Information and Communication Technology, Japan
Naohisa Sakamoto : Vizlab, Kyoto University
Shinji Shimojo : National Institute of Informatics, Japan

Contact: Petaflow
E-mail: petaflow@ispj.jp

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