China Science & Technology Cloud Testbed

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Outline

1. Related Work
2. CSTCloud-Testbed Design
3. CSTCloud-Testbed Service & Application
Future Network and Large-scale Testbeds

- **Research of Future Network**
  - USA: 100X100, FIND, FIA
  - EU: FI, FIA of FP7
  - Asia: NWGN/AKARI of Japan, FIF of Korea

- **Construction of Large-scale Testbed**
  - PlanetLab, GENI
  - FIRE, FEDERICA, G-lab
  - JGN-X/VNODE, KREONET/K-GENI

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**Worldwide Planetlab**

**USA GENI**

**EU FIRE**

- Korea K-GENI
- Japan JGN-X
ESnet Testbeds

- **100G SDN Testbed**
- **Nationwide Dark Fiber Testbed**
- **Test Circuit Service**
ESnet 100G SDN Testbeds

- 100G Dedicated link, 10G link based on production network Overlay
- Support for SDN test
- **Objective:**
  - A rapidly reconfigurable high-performance network research environment that will enable researchers to accelerate the development and deployment of 100G networking through prototyping, testing, and validation of advanced networking concepts.
  - An experimental network environment for vendors, ISPs, and carriers to carry out interoperability tests necessary to implement end-to-end heterogeneous networking components (currently at layer-2/3 only).
  - Support for prototyping middleware and software stacks to enable the development and testing of 100G science applications.
ESnet 100G SDN Testbeds

- **Part of Supported Research and Experiments:**
  - Evaluation of Distributed Acoustic Sensing for Seismic Event Detection and Imaging Using ESnet 100G and Dark Fiber Testbed
  - NASA Network Testing
  - The Multicore-Aware Data Transfer Middleware Project
  - Optimization of HEP Data Transfers on 40G NICs
  - Climate100: Enabling 100Gbps for Climate Community
  - NERSC (National Energy Research Scientific Computing Center) 100Gbps DTN testing and tuning
  - Characterizing the impact of end-system affinities on the end-to-end performance of high-speed flows
  - Web10G TCP Extended Statistics Performance at 40Gbps
Internet2 Testbed

- Internet2 100G SDN Testbed
KREONET Testbed

- KREONET-S SDN-IP Testbed
- Drive softwarization of KREONET
- Provide SD-WAN services for KREONET users
KREONET Testbed

- **Applications and Services on KREONET-S**
- **VDN**: Dynamic Virtual Dedicate Network, 1/10/40/100Gbps
- **UoV**: User-oriented Network Visibility, performance visualization
- **vSciZ**: Virtual Science DMZ (demilitarized zone), optimizing science data transfers
KREONET Testbed

• **Users & Requirements**

2015-2017, KREONET-S users are targeted to more than 75 advanced project participants on science and information technology using (multiple) 1/10/40/100Gbps high performance research network connections.

2018-2020: possibly be expanded to the other user organizations of KREONET in the second phase.
Other Testbeds of Research Networks

- **EU: GEANT Testbeds Service**
  - The “GEANT Testbeds Service” (GTS) offers user defined experimental networks to the network research community for the purpose of testing novel networking and telecommunications concepts, at scale, and across a geographically realistic European footprint.

- **Japan: JGNx**

- **SDN and cloud testbed**

- **RISE: OpenFlow/SDNTestbed**
Summary of the Related Testbeds

• **Testbed is a necessary facility and service for research networks**

• **The main function of Testbed:**
  ✓ Provide a virtual private network
  ✓ Provide dedicated links

• **The main application of Testbed:**
  ✓ High performance transmission test of big scientific data
  ✓ Advanced network technology test

• **The key technology of Testbed:**
  ✓ Network virtualization technology including SDN
Main Content

- Provide advanced information technology test environment, serve advanced technology innovation experiment.
- Carry out new technology test and application, enhance the service quality of “CSTCloud”.
Design of Testbed Architecture

- **Build infrastructure based on CSTCloud**
- **Implementing network slices by SDN**

![Diagram of Testbed Architecture]

**Application test layer**
- Scientific big data transmission test
- Network and information security test
- Content network test
- Future network test

**System platform layer**
- Manage control system

**Virtualization test layer**

**STCloud infrastructure layer**

**Testbed safety mechanism**

**Measurement and analysis techniques**

**User-defined cloud network**
- Scientific big data transmission test
- Future network test
- 5G network technology test
- Future network technology test
- Physical network

**Figure:** The Overall Structure of the Test Environment
CSTCloud SDN Testbed

Proposed SDN Testbed node locations

Proposed SDN Testbed connectivity overlay
Design of Testbed System Architecture

component -> node -> site -> slice

Combination of centralized management of public resources and partial autonomy of site resources
Key Technology of Testbed

- **Network Slicing Technology**
  - Virtualization
  - Network Slice
  - Implementation of Network Slicing Technology based on FlowVisor

- Define the available resources for each slice by policy:
  - Link bandwidth
  - Maximum number of forwarding rules
  - Topology
  - Fraction of switch/router CPU
Research and Development of Testbed Node Equipment

- Research and Develop Testbed Network Key Node Equipment
Testbed Management and Service System

SC-TB Portal

Control Center

Resource Sites

Test topology | Test control | Test measurement | Resource management | Certification authority

Test service subsystem

Resource management subsystem | Test measurement subsystem

Resource management module | Test measurement module

Site manager | .......

Site manager
Experiment on Innovative Technology based on Testbed

Carry out Future Network Technology Test

Enhance the Efficiency of Scientific Data Transmission

- Based on the technology architecture of SD-WAN, carry out traffic scheduling in the WAN environment, transmission optimization test, enhance the performance of long-distance transmission of scientific data.

- Based on the technology architecture of NFV, optimize network performance and security feature deployment, Enhance the efficiency of STCloud operation and management.

Figure: Using SD-WAN technology to optimize scientific data transmission performance
Forward Application of **5G** Technology, Improve the Efficiency of CSTCloud Service in Mobile Environment.

- Based on the technology architecture of 5G MEC+ICN, carry out data processing in mobile networks, content transfer optimization test, enhance the efficiency of CSTCloud users uploading, downloading and processing large-capacity scientific data through mobile networks.
- Based on the technology architecture of 5G MEC+SDN, carry out traffic scheduling optimization experiment of mobile and wired network application, enhance the experience of CSTCloud users accessing to cloud technology resources through the mobile network.

**Figure:** 5G mobile network test deployment diagram
International NDN Testbed

CNIC has built an NDN node connecting to the global NDN Testbed

NDN: Named Data Networking
Typical Application—SDN for e-VLBI

User’s service request

Controller

UR

BJ

KM

SH

VLBI Center

OpenFlow

OpenFlow

OpenFlow

OpenFlow
Build Advanced Testbed

Serve Advanced Technology

Innovation Experiment

- **Serve technology cloud**: provide test validation services for technology cloud construction and service quality improvement which requiring a variety of technical programs and equipment;

- **Serve Academy of Sciences**: achieve the ability to open the trial network, provide testing technology services for advanced information technology testing under a real network environment for Institute of Chinese Academy of Sciences;

- **serve the society**: as a third party test platform, conduct a test evaluation for advanced equipment and technical solutions of all kinds of manufacturers.
THANKS !
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