

## An Inter-domain SDN Traffic Engineering Mechanism for Scientific Data Transmission

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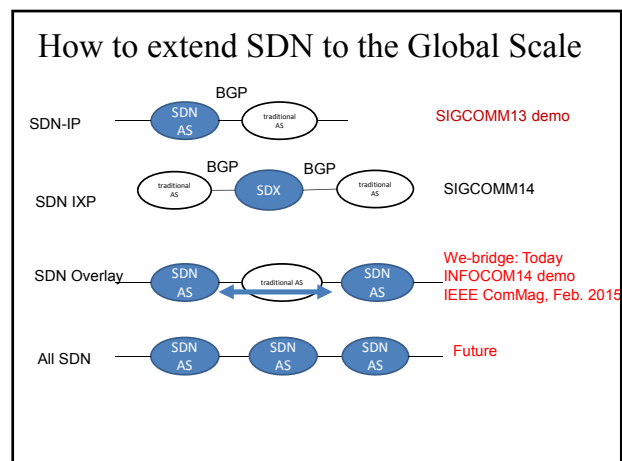
## Content

- Inter-domain SDN: Motivations
- Inter-domain SDN: Mechanism - WE-Bridge
- CANS Inter-domain SDN Testbed and Applications (with a demo)
- Conclusions and Future Work

## Inter-domain SDN: Motivations

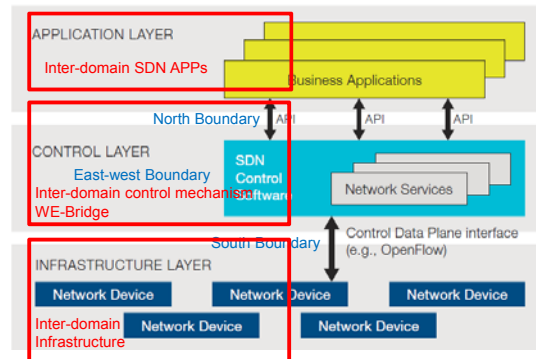
## Why SDN?

- Software defined networking (SDN) is one of the hottest research topics in networking area
- Openness
  - decouples the tightly coupled network architecture, and opens up the control plane and the associated protocol
- Agility
  - SDN enables more flexible network control and management
  - SDN promotes the rapid innovation on networking technologies by programing the network
- SDN is considered as a promising way to enhance the networks.



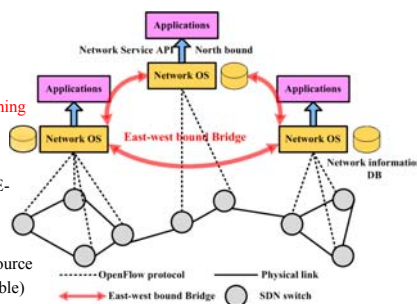
## Inter-domain SDN: Mechanism - WE-Bridge

## SDN Architecture

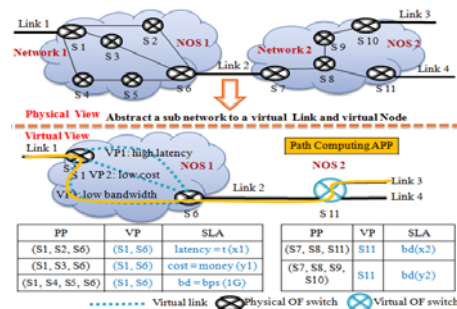


## West-East Bridge for SDN Peering

- Each NOS gathers local network view, then exchange domain view among heterogeneous NOSes by WE-Bridge
- Inter-domain programming
  - APP requires the domain view information by WE-Bridge NB-API
  - APP Negotiates programmable resource (e.g. forwarding table) in another domain



## Domain View Abstraction: Virtualization



Physical view to virtual view (PP: Physical Path; VP: Virtual Path; OF: OpenFlow; S: Switch; bd: bandwidth; t: time; bps: bits per second)

- IEEE Communications Magazine, Vol.53, No.2, pp190-197, 2015
- <http://netarchlab.tsinghua.edu.cn/~junbi/IEEEComMag-2015.pdf>

ACCEPTED FROM OPEN CALL

## A West-East Bridge Based SDN Inter-Domain Testbed

Pingping Lin, Jun Bi, Stephen Wolff, Yangyang Wang, Anxin Xu, Ze Chen, Hongyu Hu, Yikai Lin

### ABSTRACT

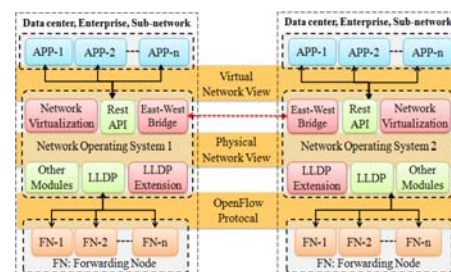
SDN [1] is considered to be a promising way to re-architect the Internet. However, the Internet is managed by owners of different administrative domains, so the centralized control model of SDN must be extended to account for inter-domain traffic. Thus, this article proposes a WE-Bridge mechanism to enable different SDN administrative domains to peer and cooperate. Based on WE-Bridge, we further designed two innovative inter-domain routing applications as use cases. To verify our design, we implemented the WE-Bridge and the two use cases by building an international testbed on which WE-Bridge, together with the two use cases, are deployed. The testbed is com-

(ONF) is leading SDN standardization and has gained support from more than 100 companies who jointly accelerate the creation of standards, products, and applications, such as NEC, Google, H3C, and VMware.

### PROBLEM STATEMENT

SDN works as a centralized control model. However, the Internet is managed by owners of different administrative domains, so the centralized control model of SDN must be extended to account for inter-domain traffic. An inter-domain protocol for SDN is necessary. Thus, this article proposes a West-East Bridge (WE-Bridge) mechanism to enable different SDN administrative domains to peer and cooperate.

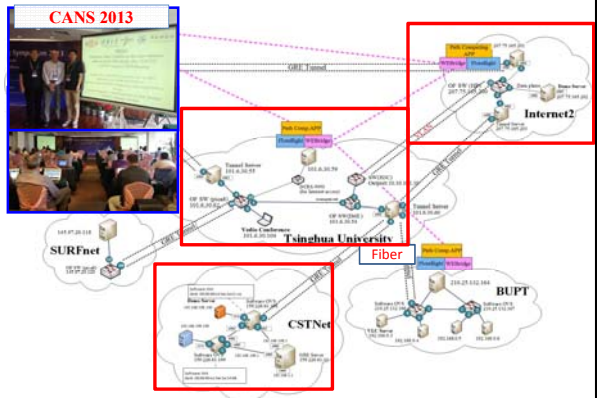
## WE-Bridge Implementation



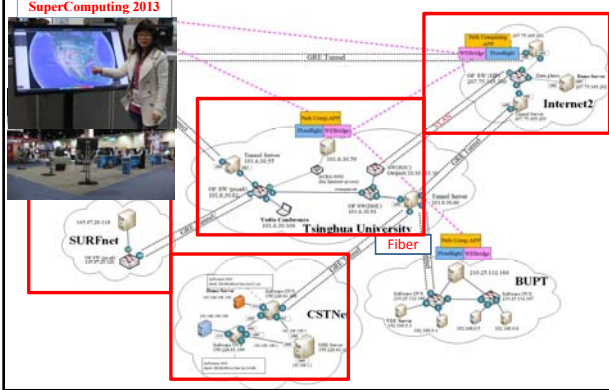
- Enable WE-Bridge in all kinds of NOSes by adding three modules:
  - Network Virtualization, East-West Bridge, and LLDP Extension

## Inter-domain SDN Testbed and Applications (with a demo)

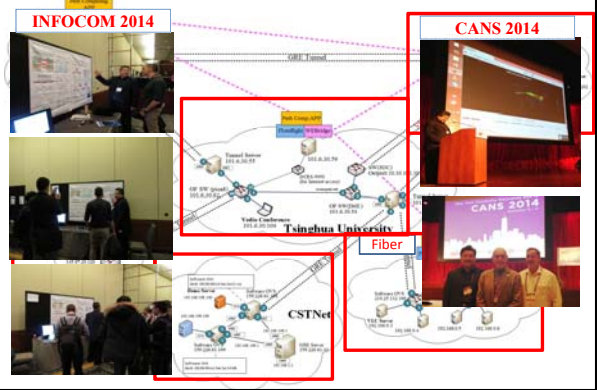
CANS 2013 Demos for *CANS inter-domain SDN testbed*



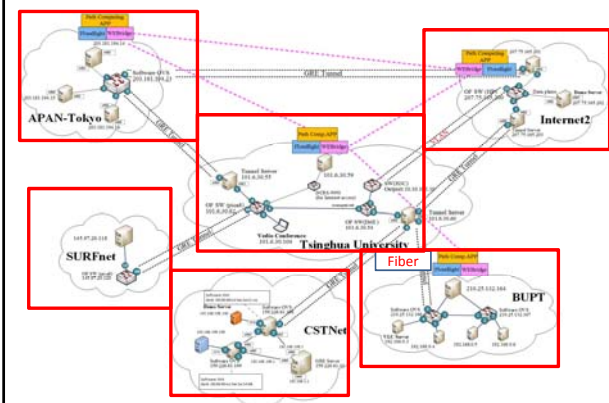
SuperComputing 2013 Demo for  
CANS inter-domain SDN testbed



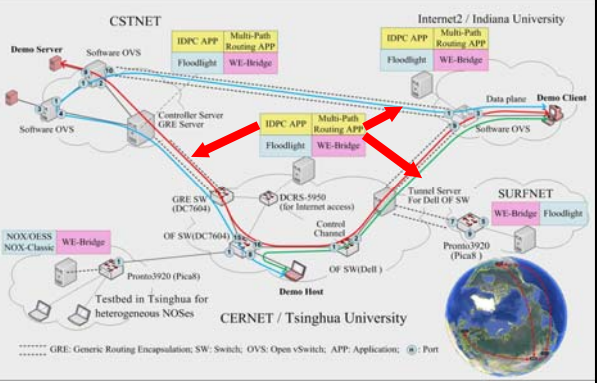
INFOCOM14/CANS2014/SuperComputing2014  
Demos for CANS inter-domain SDN testbed



APAN39 Demo for CANS inter-domain SDN testbed

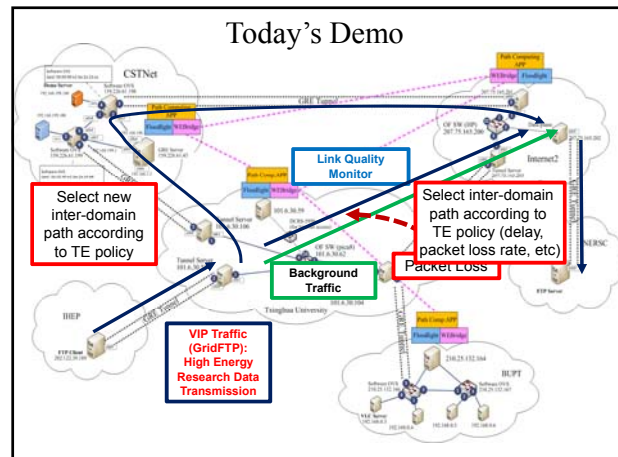


Inter-domain SDN APPs demonstrated  
at CANS inter-domain SDN testbed

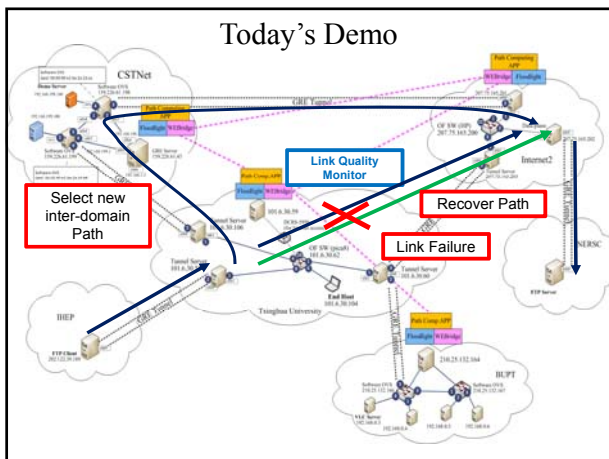


### Today's demo

- How Inter-domain SDN Traffic Engineering Mechanism helps Scientific Data Transmission
- We can flexibly program the inter-domain routing /forwarding:
  - To enable *fine granularity inter-domain differ-serv*
  - for **VIP traffic identified by any** IP source/destination address, or by TCP/UDP source/destination port
  - for **flexible traffic policies** (delay, bandwidth, packet loss rate, etc.)
- We demo and validate how to serve for important inter-domain scientific data transmission **when packet loss or link failure happens**



### Today's Demo



## Conclusions and Future Work

### Conclusions

- To scale SDN to the global level, we need distributed inter-domain SDN
- WE-Bridge is the very first *distributed* and automatic (East-west Boundary APIs) Inter-domain SDN mechanism
  - **Distributed** domain views exchange
  - NB-APIs provided to APPs **to flexibly program the inter-domain routing/forwarding**
- CANS FIWG deployed the very first inter-domain SDN testbed
  - Among SDN domains in CERNET (Tsinghua, BUPT), INTERNET2, CSTNET, SURFnet, and APAN-Japan
- Multiple **inter-domain application** have been deployed

### Future work

- Plan to extend the inter-domain SDN network
  - The inter-domain SDN mechanism and software are planned to be deployed at Internet2 SDN backbone (so far the technical documents and test report have been reviewed and preliminarily approved)
  - Some universities in China showed interests to join
  - Call for more partners!
- More APPs and use cases
- CANS FIWG next demonstrations at CANS2016!

**Thanks !**