

ScienceDMZ of Edge Network for Data Intensive Science

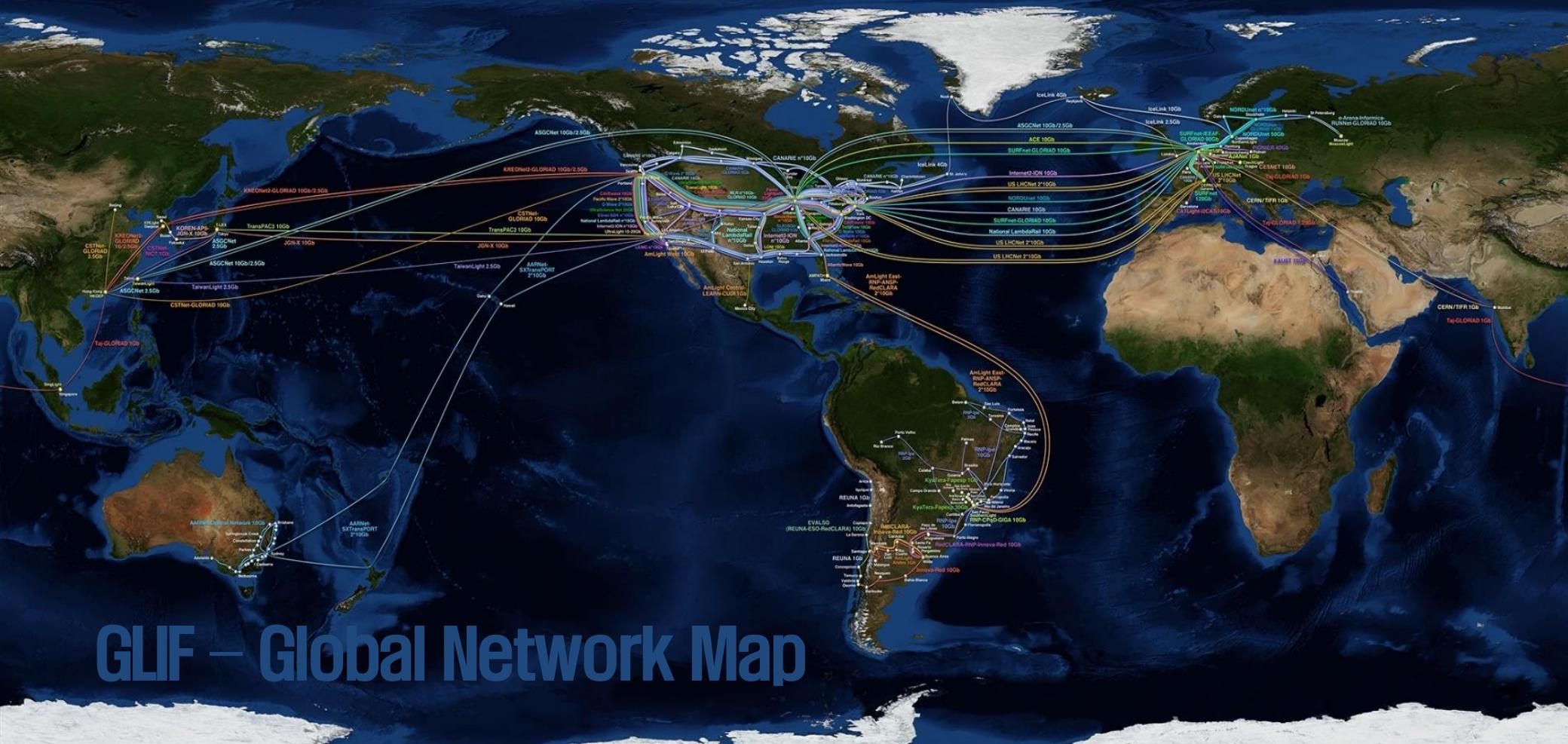


한국과학기술정보연구원
첨단연구망응용지원실

석우진

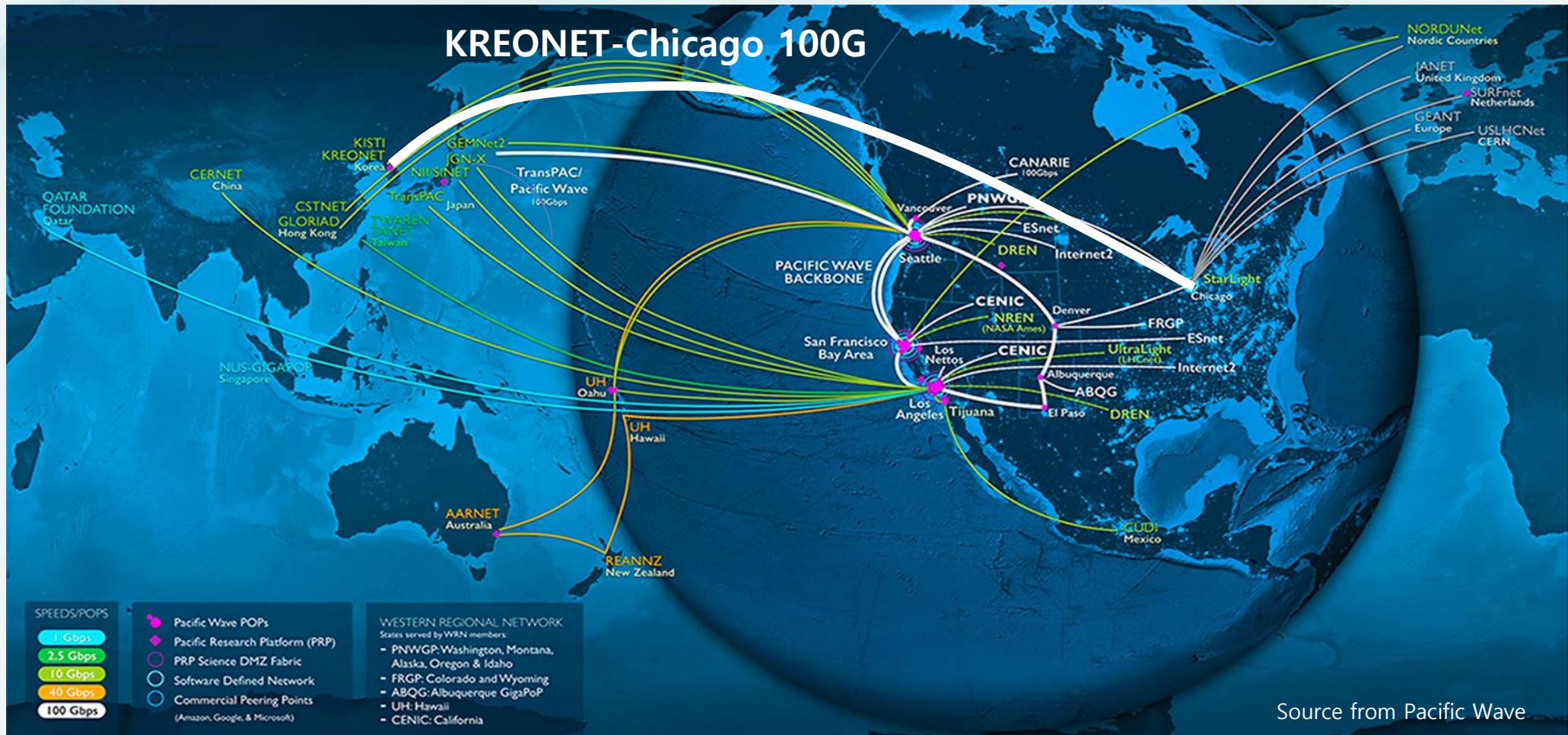
Background and Problem Statement

GLIF-Global Network Map



GLIF – Global Network Map

International Peeing Exchange: 100Gbps Era



- **Scientific Discovery**
 - Interact with remote computing systems and transfer results to collaborators worldwide
 - **Research → Sharing result → Collaboration → Scientific Discovery**
- **There is a 'Network' between 'Datas'**
 - Researchers needs for optimized network environment for science
 - **Connection between several supercomputing centers, research laboratories, super facilities and researchers**
- **Scientific Experimentation**
 - **Increasing scale of data-intensive science**
 - **Not enough data transfer performance and impedes scientific progress**

- **TCP Problems for Data Intensive Science**
 - Loss
 - End-to-End
 - Tuning
- **How to Solve “No loss, No Last 1 mile problem” for Data Intensive Science ?**

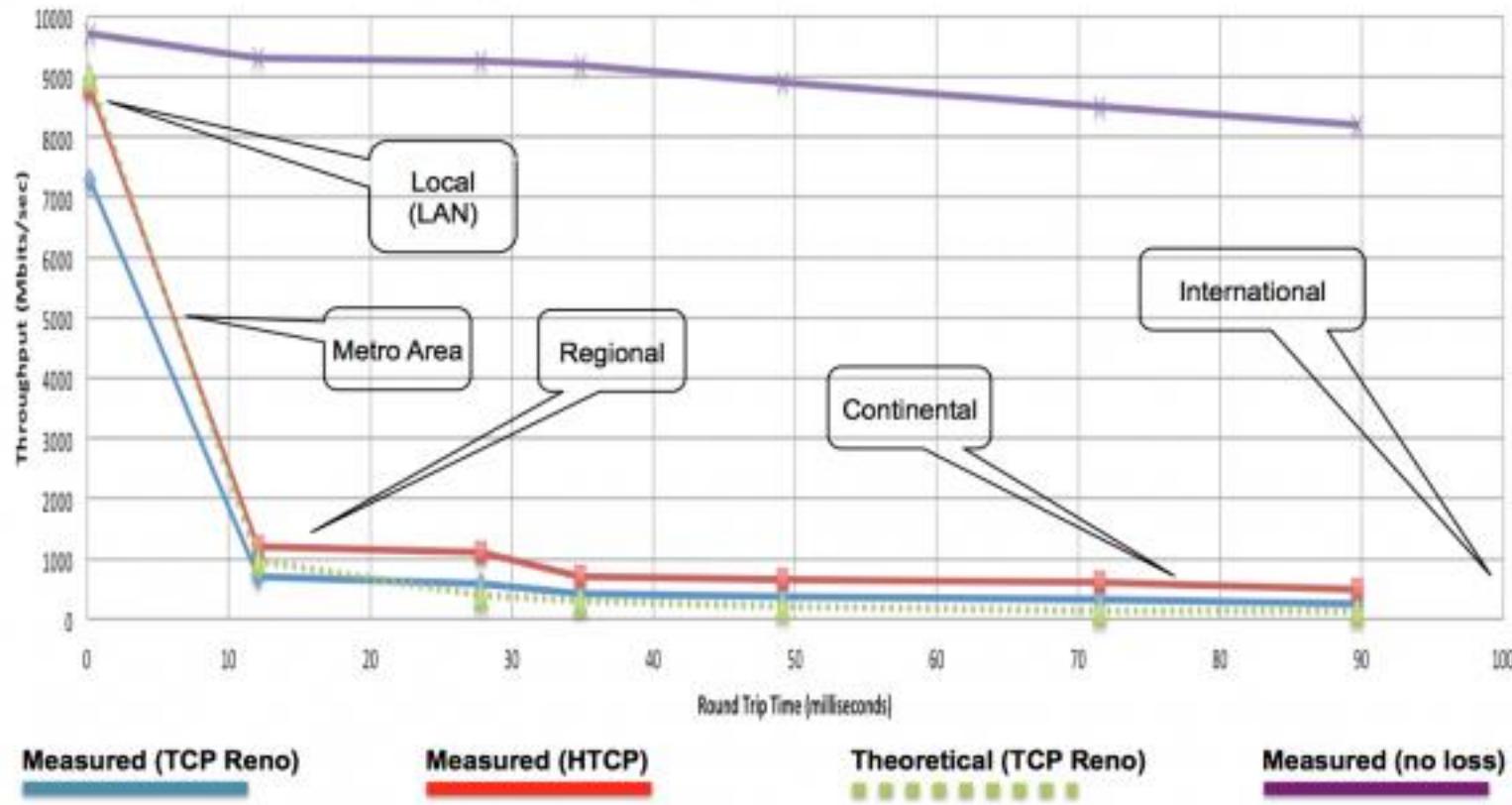
No Loss -> ScienceDMZ

Problem Statement

TCP Maximum Throughput

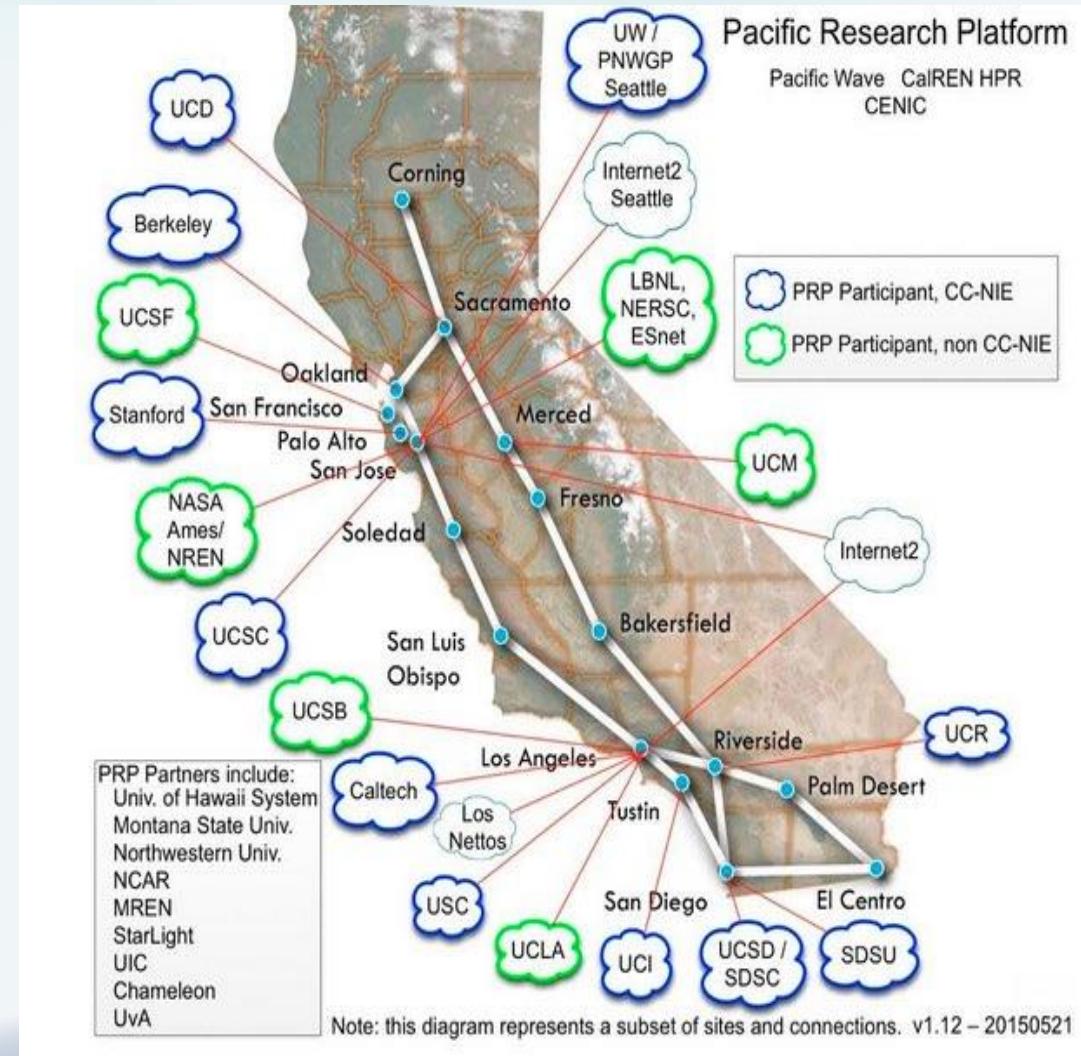
$$\frac{\text{maximum segment size}}{\text{round trip time}} \times \frac{1}{\sqrt{\text{packet loss rate}}}$$

Throughput vs. increasing latency on a 10Gb/s link with **0.0046%** packet loss



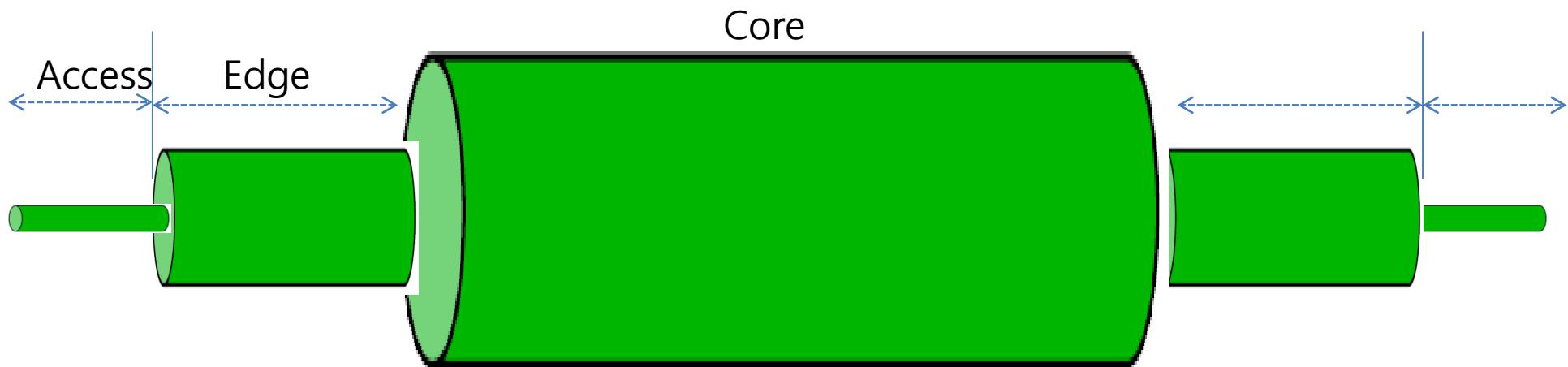
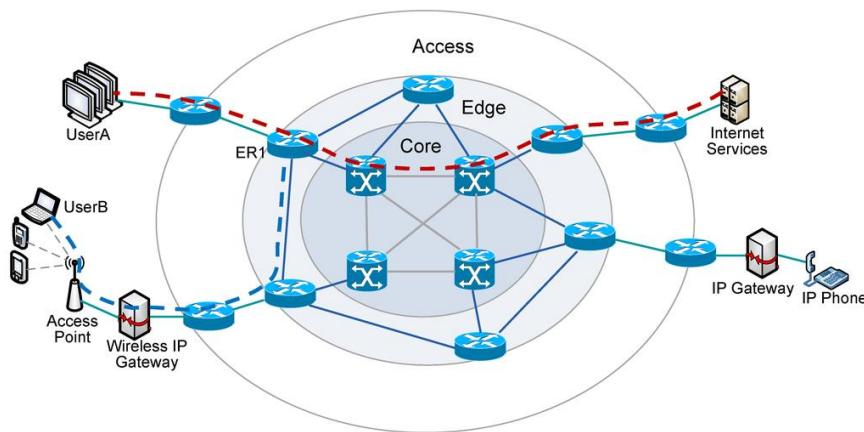
- **Packet loss** can be caused mostly by;
 - **Firewall**: cannot effectively process science traffic flows
 - **No isolation**: causes congesed situation
- **Business Traffic vs Scientific Traffic**
 - Firewall: Dirty vs. Clean
 - Isolation: Shared vs. Dedicated
- Science DMZ uses SDN tech. to realize
 - No Firewall and Yes Isolation

- **Data Intensive Science over ScienceDMZ@USA**
 - Particle Physics Data Analysis
 - Astronomy and Astrophysics Data Analysis
 - Telescope surveys
 - Galaxy evolution
 - Gravitational wave astronomy
 - Biomedical Data Analysis
 - Cancer genomics Hub
 - Microbiome and integrative 'Omics
 - Integrated structural Biology
 - Earth Science Data Analysis
 - Data Analysis and simulation for earthquakes and natural disasters
 - Climate modeling
 - CO₂ subsurface modeling
 - Scalable Visualization, Virtual Reality, and Ultra-Resolution Video

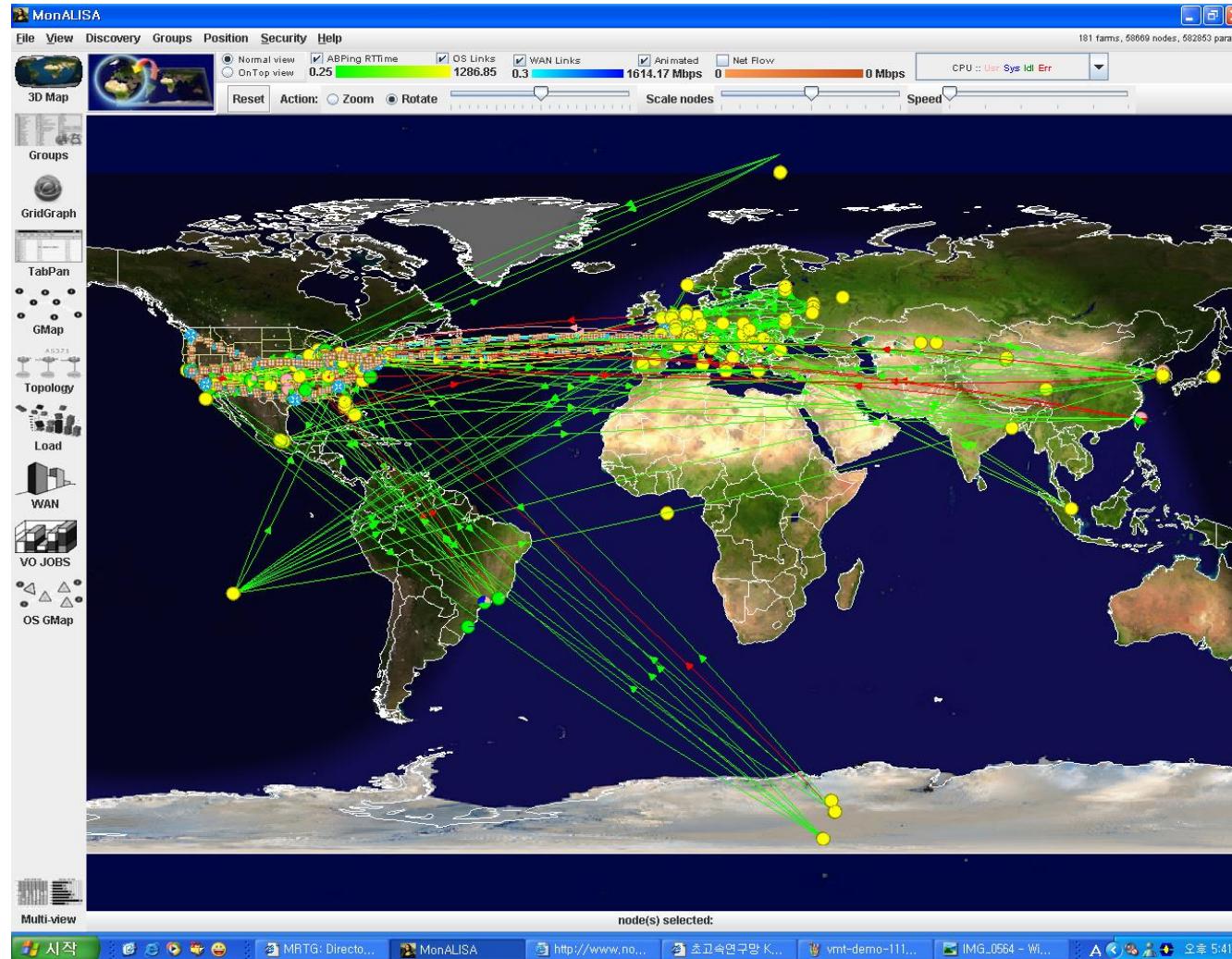


Last 1 mile Problem: E2E → Edge Cloud

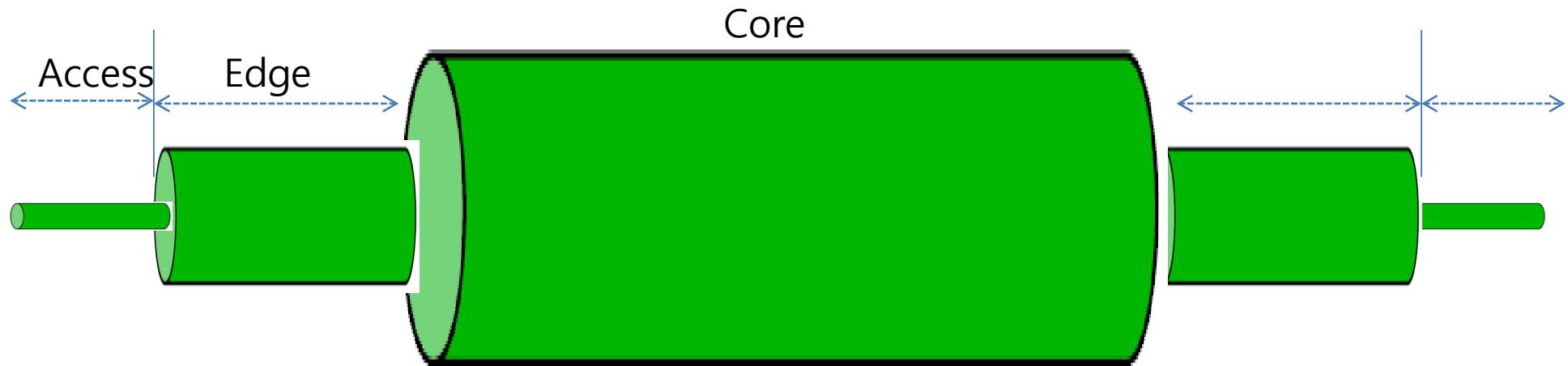
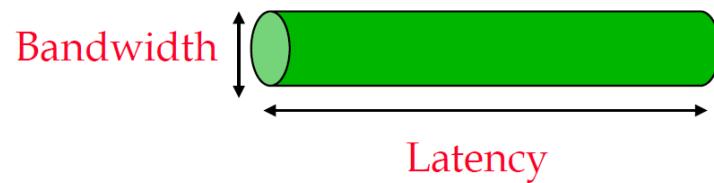
Access, Edge, Core



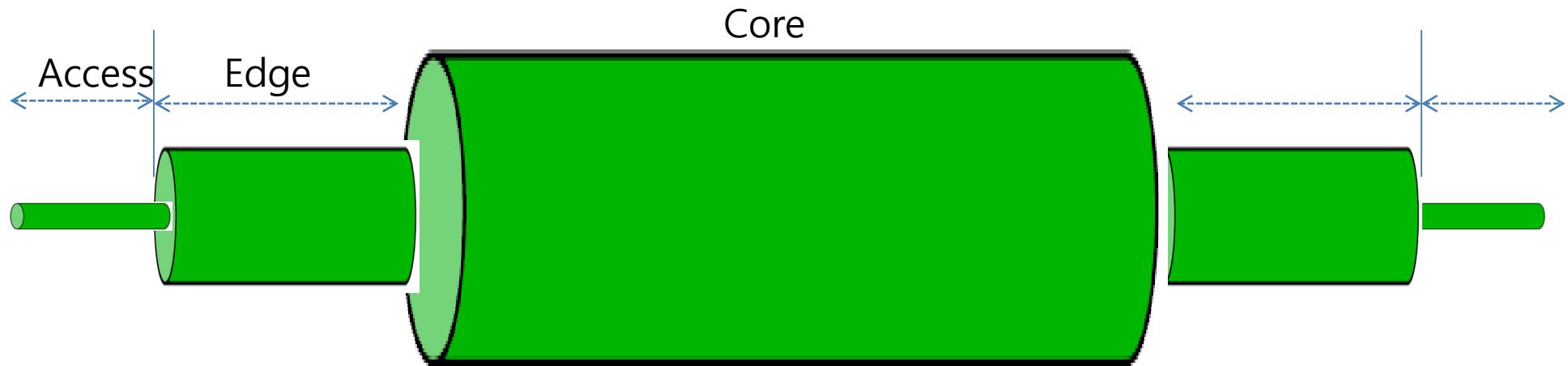
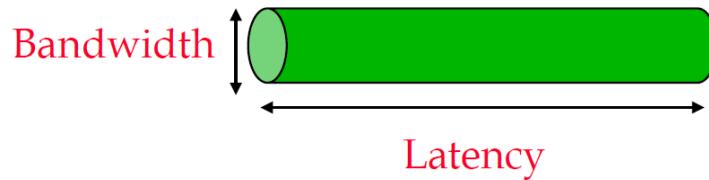
Scientific Work



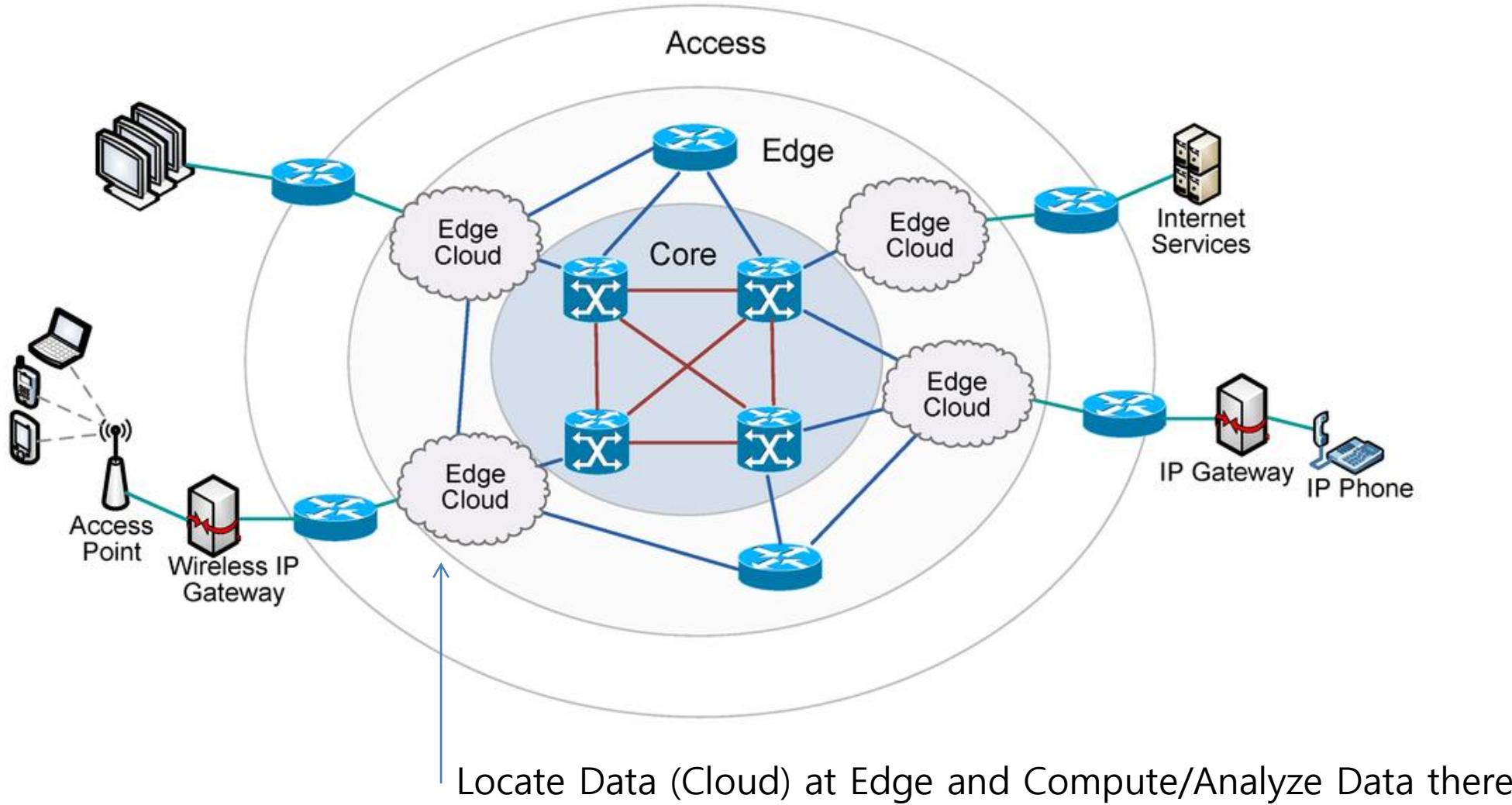
TCP performance



TCP performance



Edge Cloud



Last 1 mile Problem : System Optimization → Tuning

- **FIONA – Flash I/O Node Appliance**

- Desktop Flash up to 16TB
- RAID Drives up to 48TB
- 10GbE/40GbE Adapter
- Mellanox 40G X 2
- Tuning
 - Network (jumbo frame etc.)
 - BIOS
 - I/O Schedulier
 - EXT4 tuning
 - Raid controller tuning
 - SSD tuning





Seoul/Daejeon
DTN node

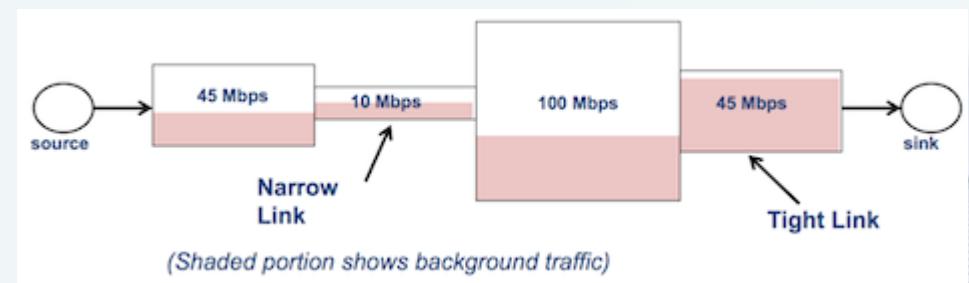
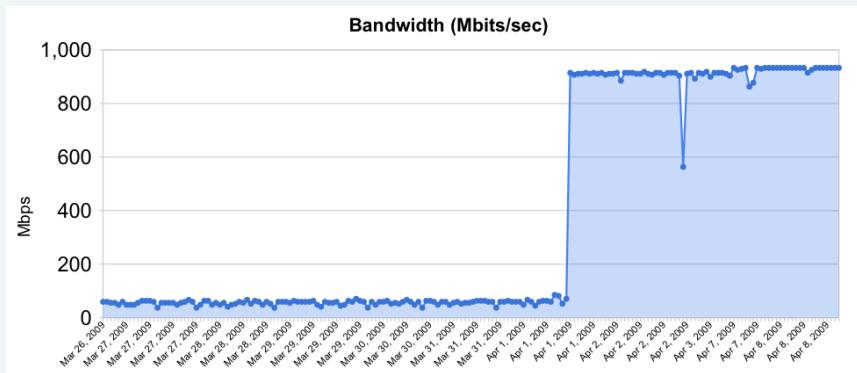


FIONA Node (4TB SSD, 32TB
Sata, 80Gb/s NIC)



Mellanox 40GbE → 4 × 10GbE SFP+ Adapter

- PerfSONAR: Performance Monitoring
 - Network capacity
 - Network utilization
 - Throughput (sometimes called achievable bandwidth)
 - Round trip latency
 - One way latency
 - Packet loss
 - Packet duplication
 - Jitter is the variation in arrival times for packets between two participating endpoints



KREONET openScienceCloud for Data Intensive Science

End-to-end Performance : Data Mobility

- No Loss : ScienceDMZ (Isolation)
- No Last 1 mile : (E2E) Edge Cloud, (Tuning) DTN

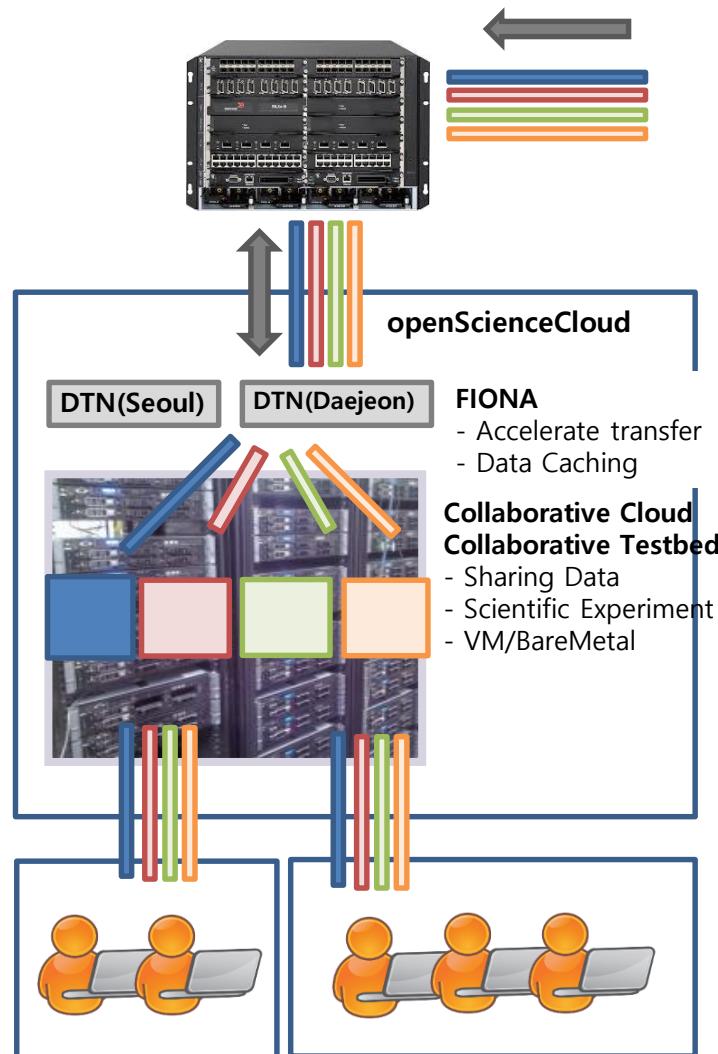
Collaboration Environment : Data Storing/SharingData/Analyzing/SharingResult

- openStack Cloud: Nova, Swift, Cinder
- Baremetal Cloud: KREONET Emulab(GENI SW)

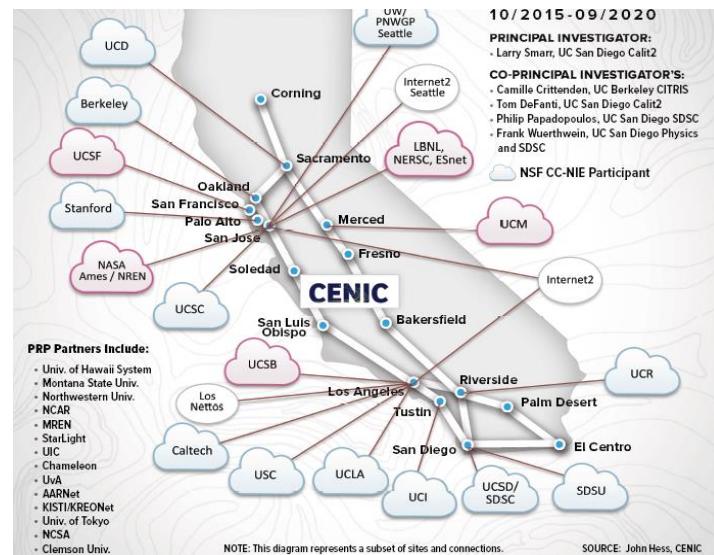
KREONET Model : openScienceCloud

Open Data

Data Consumer



Data Producer



The Project of Creating a West Coast “Big data freeway” connected by CENIC/Pacific Wave/Esnets to Internet2 & GLIF based on ScienceDMZ

5 major categories

Physics, Astronomy, Weather/Climate, Bio, Viz

Global Partner

Korea: KISTI KREONET
Japan: Tokyo Univ.
Australia: AARNet
EU: SURFnet

Use Case

KREONET openScienceCloud: 활용 사례 WMO/농업기상정보

한국

기상/기후 데이터 취합,
고부가가치 데이터 생성 및 배포



KREONET/GLORIAD 활용(예정)
KREONET 협업플랫폼 활용(예정)

World Meteorological Organization	Cg-17/Doc. 3 (16)
WORLD METEOROLOGICAL CONGRESS	Submitted by: Secretary-General
	Date: 20 III 2015
SEVENTEENTH SESSION Geneva, 29 May to 12 June 2015	Original Language: English
	Status: DRAFT 1
AGRICULTURAL METEOROLOGY	
SUMMARY	
DECISIONS/ACTIONS REQUIRED:	
Congress is invited to:	
(a) Provide further support to Roving Seminars in WMO regions	
(b) Approve WMO joining the Global Alliance for Climate Smart Agriculture (GACSA)	
(c) Support Sub-seasonal to Seasonal (S2S) project on applications to agriculture	
(d) Endorse description of Global Initiatives in Agricultural Meteorology as CAgM/AgMP contribution to GFCS	
(e) Support to development of World AgroMeteorological Information Service (WAMIS) Next Phase	
(f) Adopt draft Resolution 3.1(6)–1 – Agricultural Meteorology Programme	
Implementation of the AgMP – Interactions with other WMO Programmes	
3.1(6)–5 Congress noted that CAgM International Workshop in 2014 recommended that a pilot project on using outputs from the Sub-Seasonal to Seasonal Forecasting Project be developed for agricultural applications.	
Congress noted that this development of these pilot products would be undertaken by the Korea Institute of Science and Technology Information (KISTI) and Pukyong National University which works very closely with KMA. Congress supported this pilot project and encouraged the Secretary-General to find additional funding for this project..	

UN 세계기상기구(WMO)

(2015년 5월, 제네바) : KISTI 역할 요청

- #### - ICT 인프라 및 기술 제공 기대

(2016년 6월, 제네바) : MoU 체결

- #### - ICT 인프라 제공 및 협력 체계

선진국

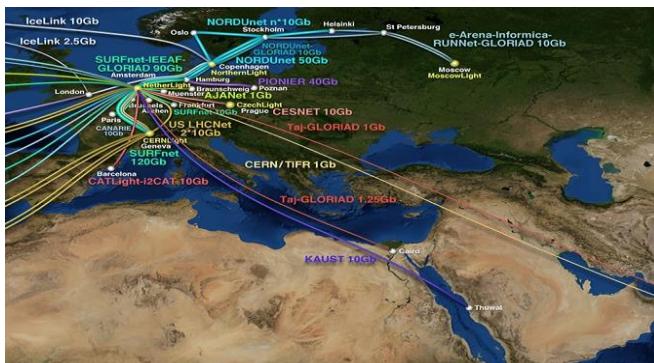
UNMMO의 기술분과위원회(의장 이병렬)

세계농업기상정보서비스 제공

한국(의장국), 미국, 독일, 카타르, 브라질, 호주 등
회원국의 **기상기후 데이터 및 분석 정보 기부**

개도국

기상/기후 데이터 전송, 자국 농업생산연구 활용
(예, 아프리카, 카타르 기상청(중동))



Q&A
