Global Future Internet Week 2011

Future Internet R&D in WIDE Project

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About this talk

- This talk reflects our intensive discussions within WIDE Project, particularly among the board members of WIDE Project:
  - Jun Murai, Hiroshi Esaki, Kenjiro Cho, Tatsuya Jinmei, Youki Kadobayashi, Akira Kato, Nobuo Kawaguchi, Rod van Meter, Osamu Nakamura, Yasuhiro Obara, Masafumi Oe, Keiko Okawa, Atsushi Onoe, Kenji Saito, Yuji Sekiya, Yoichi Shinoda, Kei-ichi Shima, Hideki Sunahara, Jun Takei, Jin Uda, Suguru Yamaguchi

Future Internet of WIDE

- We don't pursue "clean slate" approach
- New domains, new dimensions
- New playgrounds, new challenges

New application domains

- Real world!

- Automobiles
- Buildings
- Cities

New domain of FI: Automobiles

- They’re roaming sensors/actuators with battery
- Intermittent connectivity
- Almost everywhere

New domain of FI: Buildings

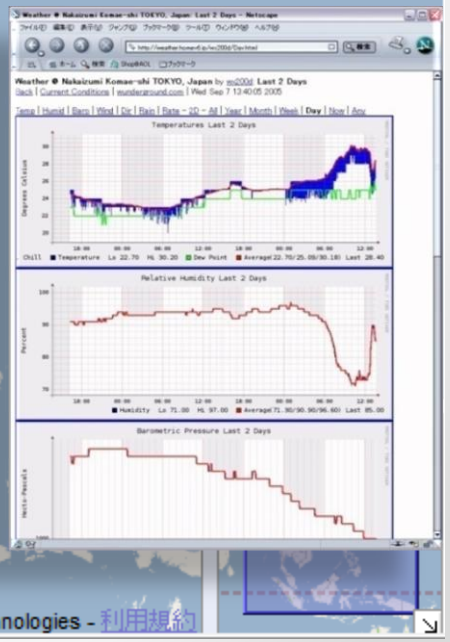
- Building No.2, Hongo Campus
  - Established in June 2008.
  - Targeted reduction;
    - **15%=$4M USD (in 2012), 50%=$30M USD (in 2030)**
  - 12 floor high, R&D and R&E activities
  - Established October 2005, Start of Operation in March of 2006

New domain of FI: Cities

- Internet as nerve system of cities

人(Human-being)		都市(City)	
Brain		Cloud Computing	
	Skull, Blood vessels		Data Center
	Brain nerves		Servers, switches
Nerves		Internet	
Organs		Facilities (i.e., Things)	
	Bone		Building
	Sensor		Sensor
	Muscle		Actuator

Deployment in Asian Countries



Isn't FI domain agnostic?

- Why do we care about such specific domains?
  - Isn't Internet domain agnostic?
- Start from concrete problems in specific domains
  - Younger people prefers to tackle concrete problems
  - Architecture will emerge from several instantiations
- ABCs represent key characteristics of real space:
  - Mobility, multi-tenancy, autonomy,
    poor distributed control, lack of measurement…

New dimensions

- Energy efficiency
- Sustainable growth
- Human factors

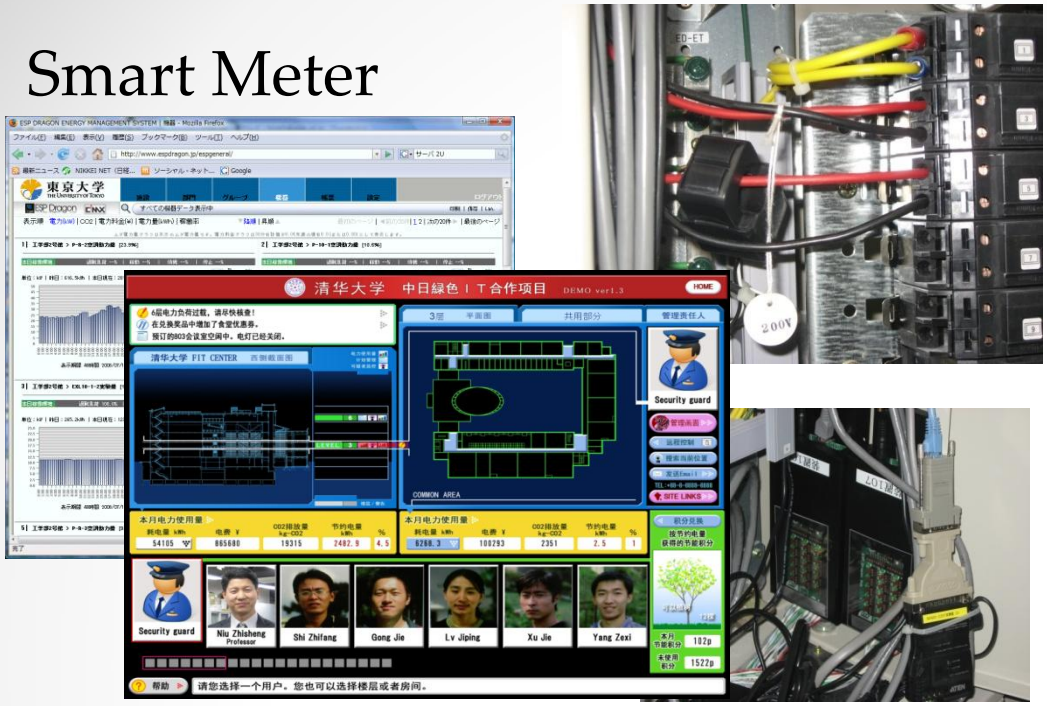
New dimension: Energy efficiency

Implement energy efficiency through:

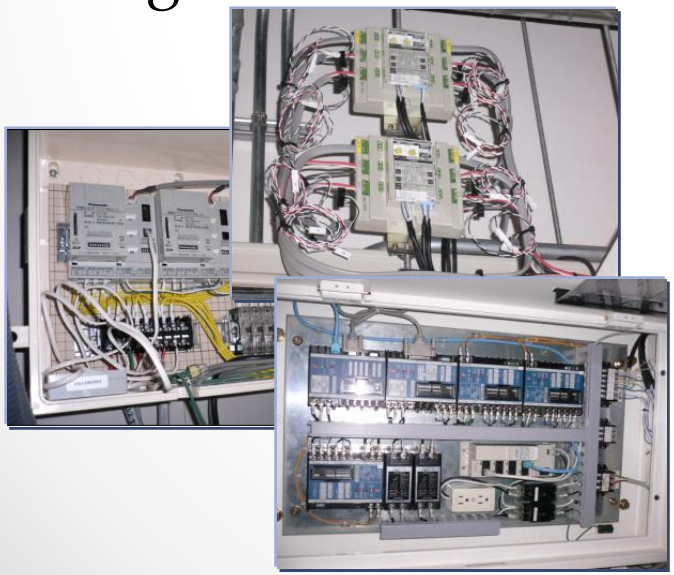
- Measurement and analysis
- Aggregation and reconfiguration
- Visualization and scoring

Measurement & Analysis

Smart Meter



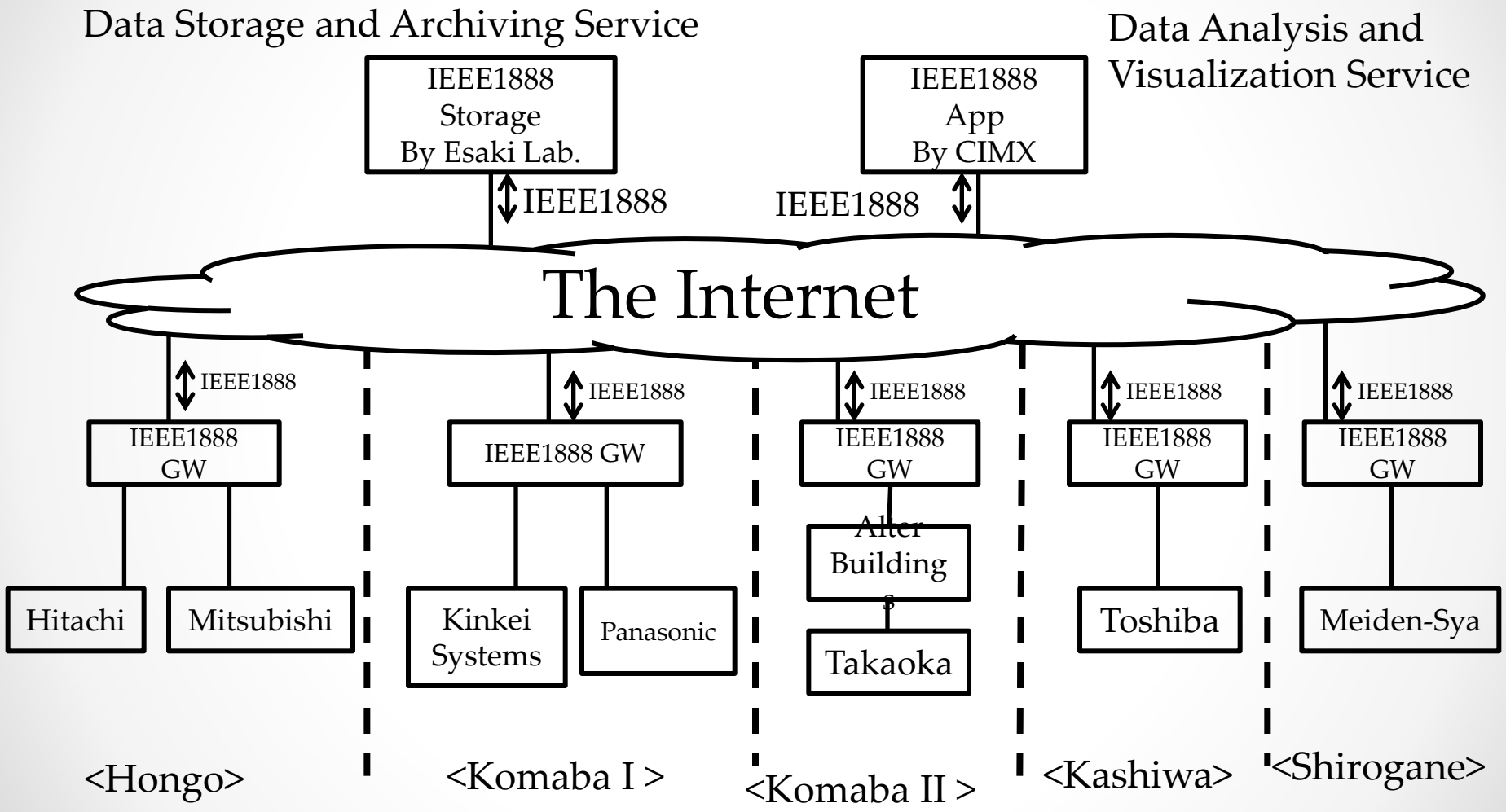
Smart Lights



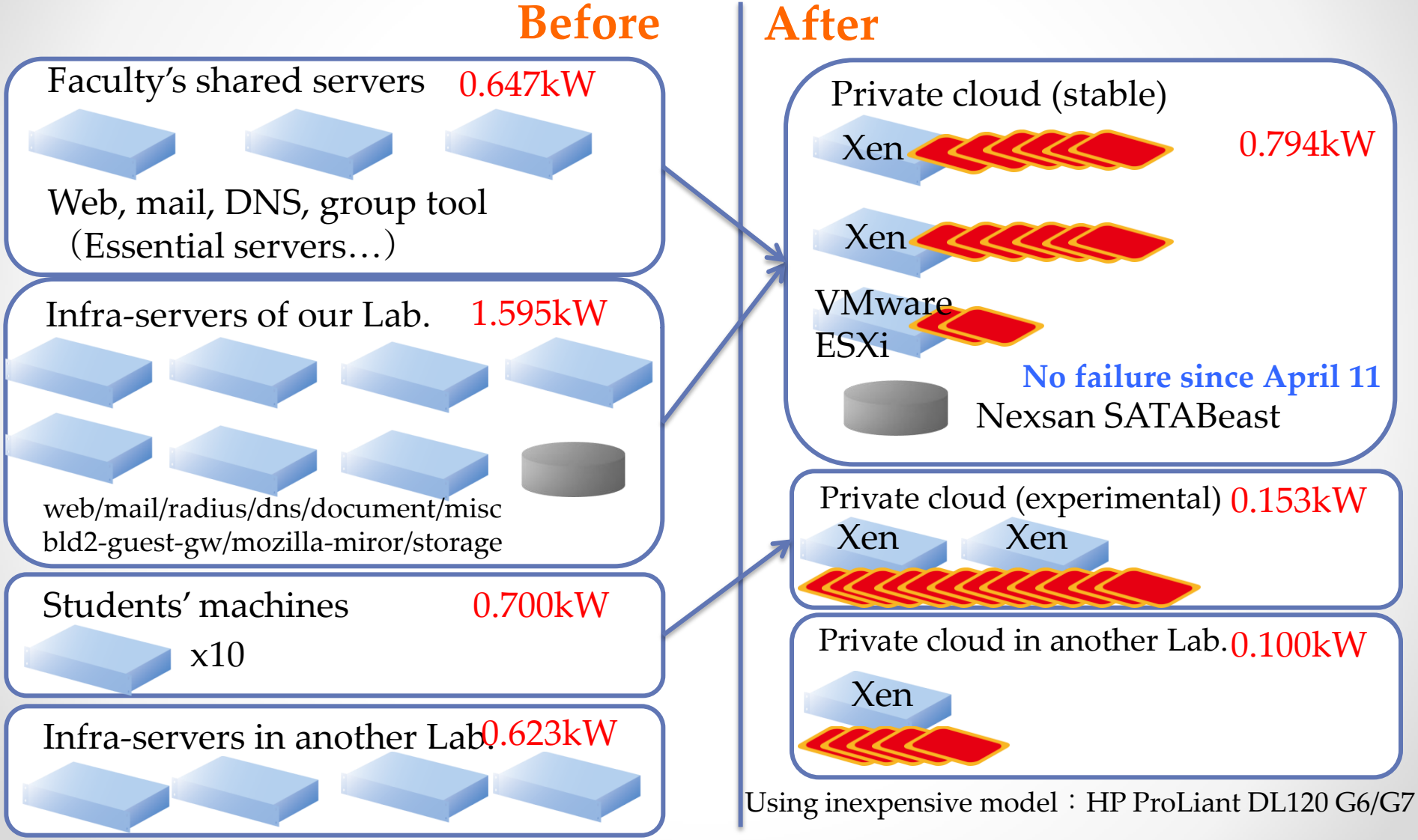
Smart HVAC

Smart Meter system using IEEE1888 over 5 campuses in Tokyo

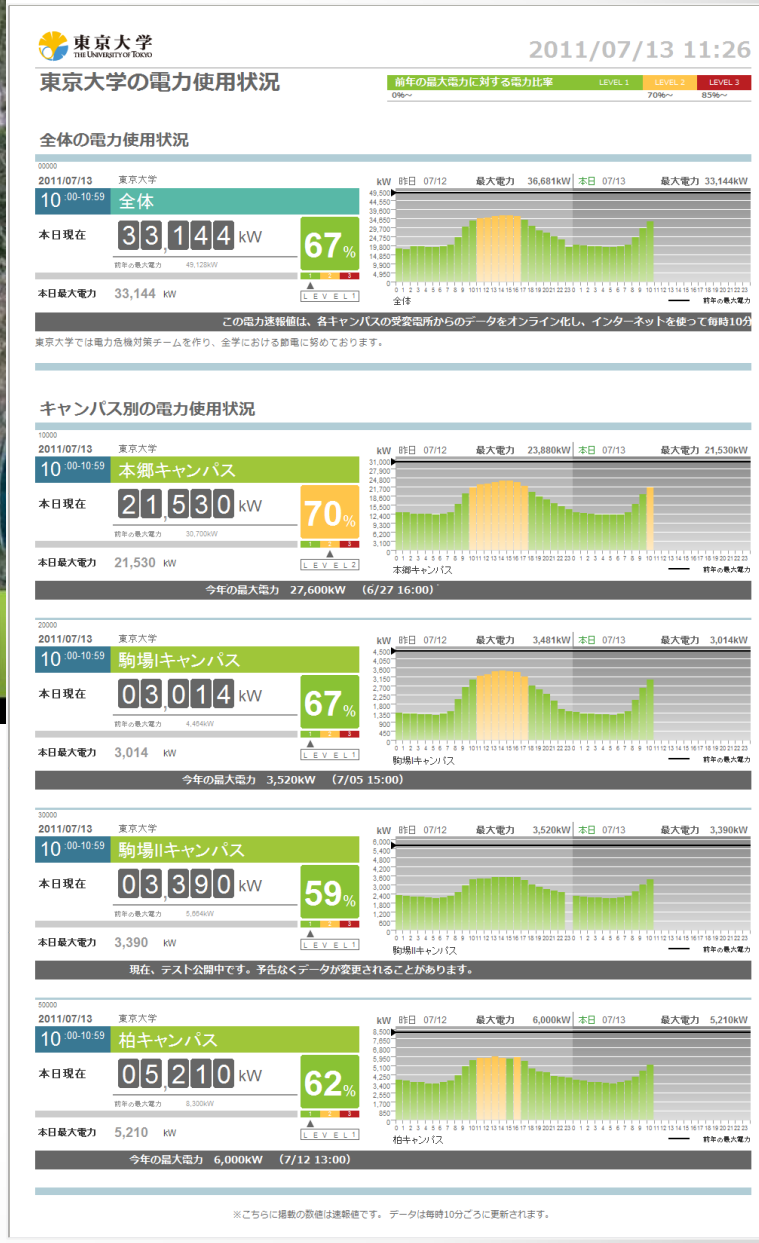
http://ep-monitor.adm.u-tokyo.ac.jp/campus/denryoku



71% power saving (2.52kW) through VM-based aggregation



Visualization & Scoring



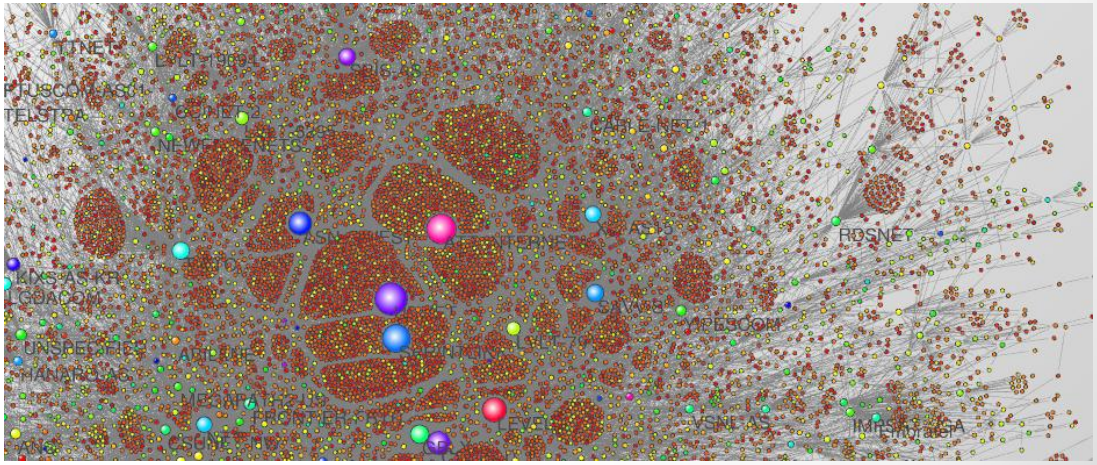
New dimension: Sustainable growth

- How do we continue to succeed in engineering?
- … by learning from failure.
- How do we fail, with enough scientific detail, without devastating impact on ordinary people?
- Enter Testbed.

Testbeds for sustainable growth

- WIDE backbone, WIDE Cloud, StarBED
  (with automobiles, buildings and cities attached)

StarBED



Visualization of global Internet AS topology

New dimension: Human factors

- Legislations, cases
- Regulatory issues
- Security and usability
- Education for younger generations

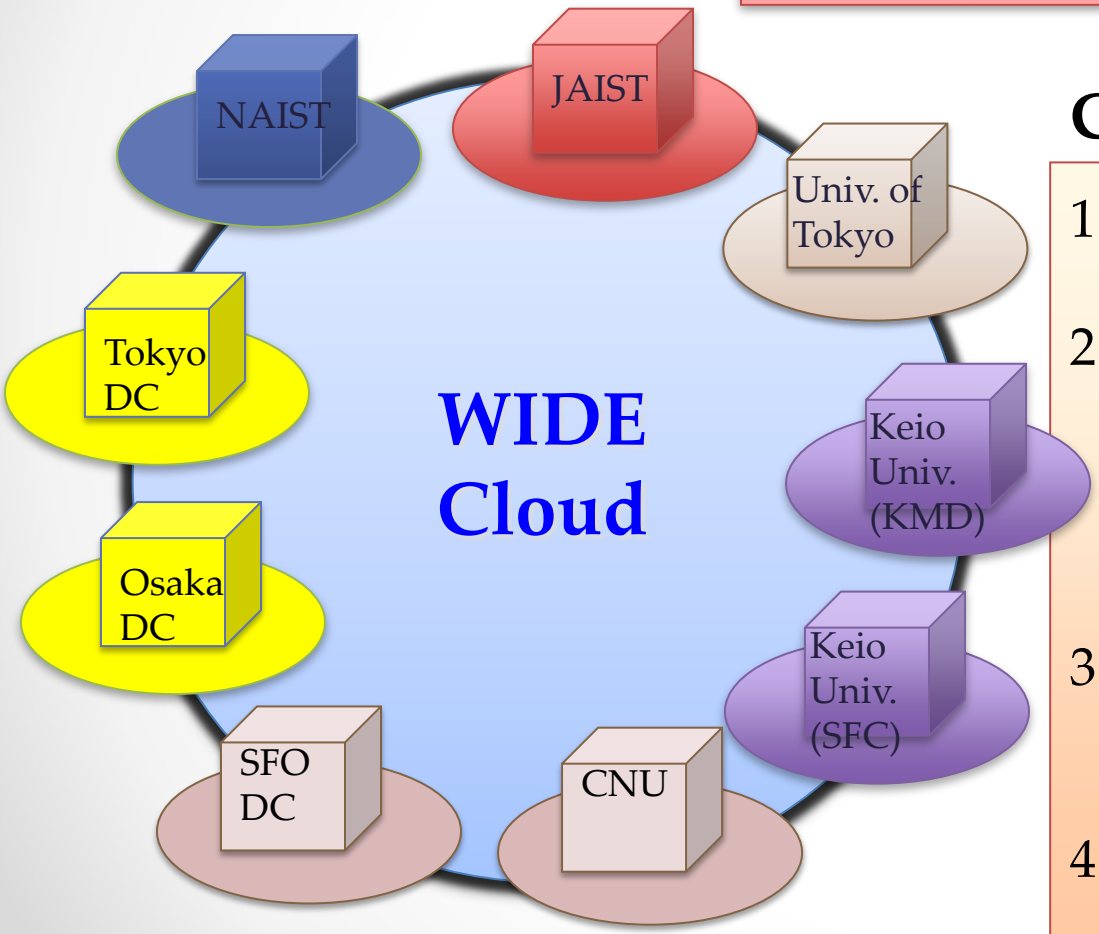
New playgrounds

- Cloud environments
- Network virtualization
- Quantum networks

- Smart automobiles
- Smart buildings
- Smart cities

New playground: WIDE Cloud

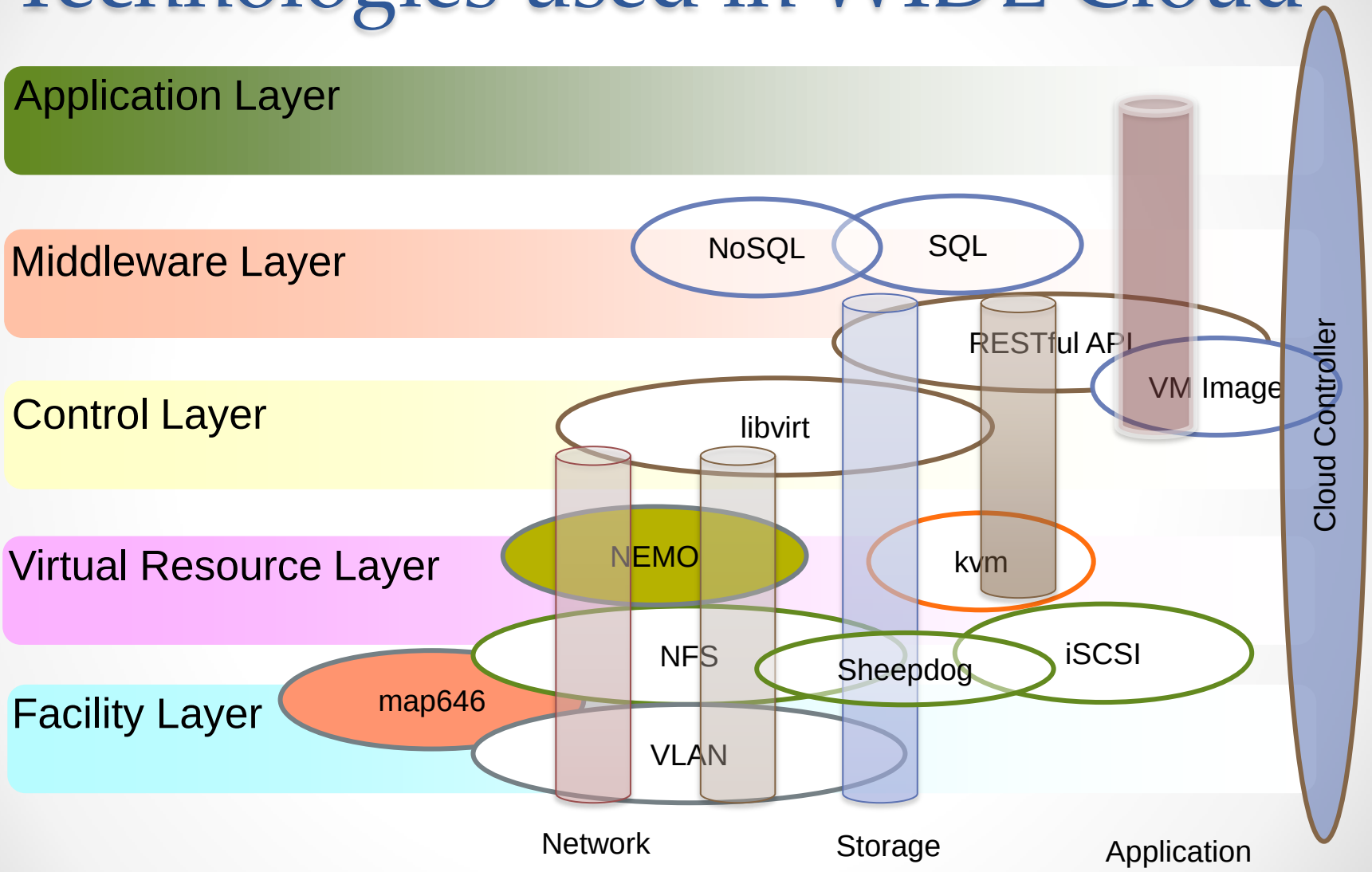
Inter-University Cloud
Sharing the resources on each private cloud



Challenges of WIDE Cloud

1. Widely Distributed IaaS
2. Constructed using commodity Internet Reachability, not dedicated circuits.
   - Full IPv6
3. Resource sharing based on the policies of each organization
4. Redundant Architecture

Technologies used in WIDE Cloud



New challenges

- Net neutrality
- Web centricity
  - Everything on the Web?
- Divergence of Internet derivatives
  - It looks like Internet, but it's not…
- Persistence of transition phases
  - Living in the world of dual-stack / triple-stack …

Our vision on Future Internet

Internet changed the way we communicate;

Future Internet has to change the way we live.