Towards Data-Oriented and User-Centric Network Architecture and Services

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"Innovation" in Communication Network

in·no·va·tion [ìnəvéiʃ(ə)n]

(http://en.wikipedia.org/wiki/Innovation)

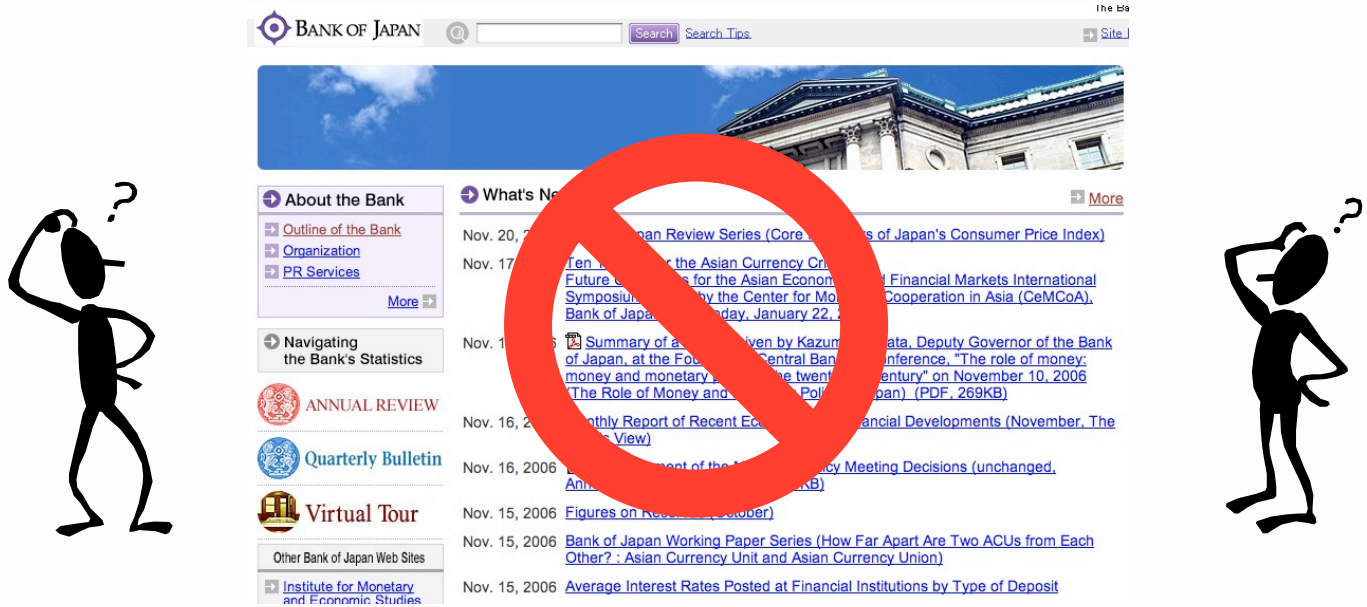
…the process of making improvements by introducing something new…

…the often unspoken goal of innovation is to solve a problem…

Got any problem in the current Internet ?

DDoS Attack on Bank of Japan

- BoJ under attack for 6 hours! (2006;Japan)



- DDoS on Yahoo, Amazon, CNN (2001;US)
  - Servers inaccessible for 3 hours
- Loss caused by DDoS estimated >$1B (netZentry 2005)

Problem Driven Approach

- Lots of problems to solve !
  - Survivability => Lack of good DDoS mitigation mechanism
  - Availability => Far from 99.999% dependability
  - Efficiency => Multi-path not available at network layer
  - Flexibility => Users cannot control/specify routing
  - Simplicity => Too complex to use
  - Adaptability => Cannot adapt to application requirements
- Two kinds of problem driven approaches
  - "Incremental Approach" to try fixing some problems
  - "Clean Slate Thinking" to fix all the problems

Survivability

- DDoS (Distributed DoS) Attack Problem
  - $1.2B loss by DDoS@Yahoo, eBay, Buy.com and Amazon (estimated by the Yankee Group in 2000)
  - 80% of primary security concern is DDoS (estimated by Arbor Network)
    - 46% DDoS Attacks
    - 31% Bots (Platform where DoS attacks are launched)
  - DDoS mitigation mechanisms not deployed
    - Replicating servers may not scale
    - Solution in network means reinvention of the Internet

Need to Enhance Survivability

Efficiency

- Internet routing is sub-optimal
  - 40% of the Internet paths could be improved
  - Application-specific routing mechanisms needed
- Internet routing is "black-box" and "single-path"
  - Overlays have demonstrated usefulness of multi-path
    - BitTorrent, CoBlitz, etc
  - No end-user controllability
- Multicast is not widely deployed in the Internet
  - After a decade of research, still has not been enabled
    - Unification of broadcast and communication
    - Scalability issue in multicast group management hinders

Need to make the most out of resources

Availability

- Internet path redundancy underutilized
  - Path availability (93%->99.999%)
- Vulnerability at network edges
  - Last one mile susceptible to failure
- Remove complexity at user interface
  - "Near Zero-Conf" & "High Availability"

Need to enhance availability

"Innovation" revisited…

in·no·va·tion [ìnəvéiʃ(ə)n]

(http://en.wikipedia.org/wiki/Innovation)

…may refer to both radical and incremental changes to products, processes or services.

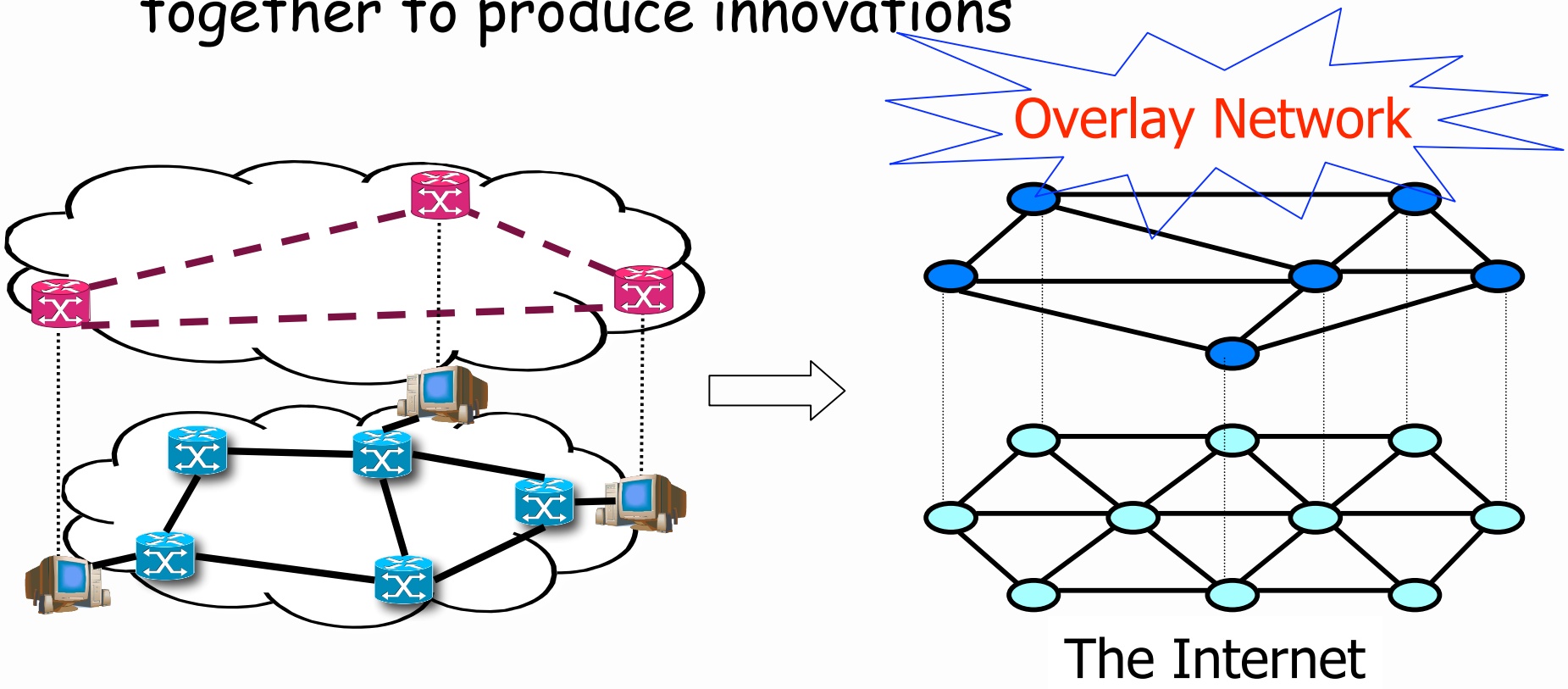
New Network Architecture
(Clean Slate Thinking)

New Network Services
(On top of current Internet)

Need to drive BOTH kinds of innovations…

InnOVating EnviRonment to LAY Groundwork for Future NETWORK Research

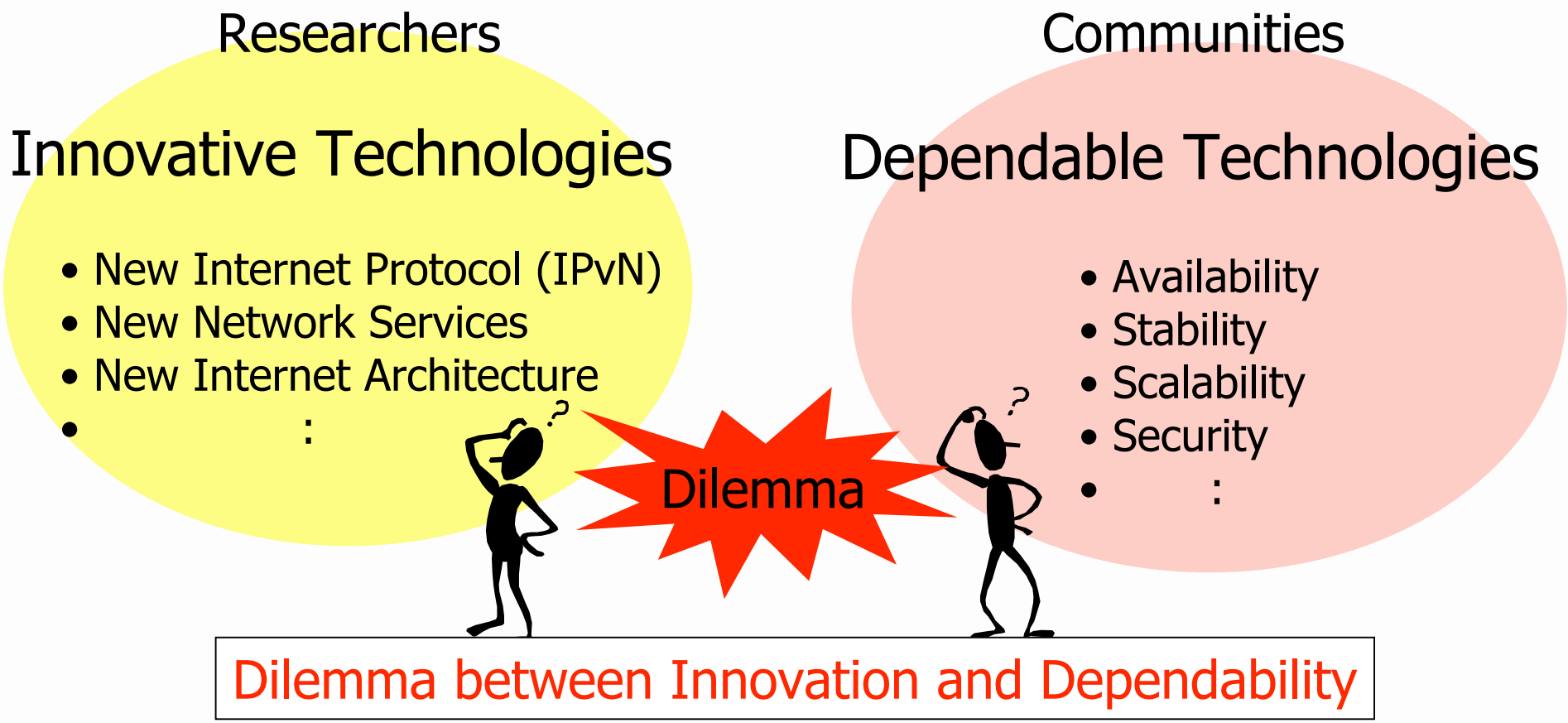
- "Virtual network" overlaid on top of "the real network"
- Overlay is a viable means to
  - Create and jump-start innovative network services
  - Bring operating system and network research together to produce innovations



"Ossified Internet"

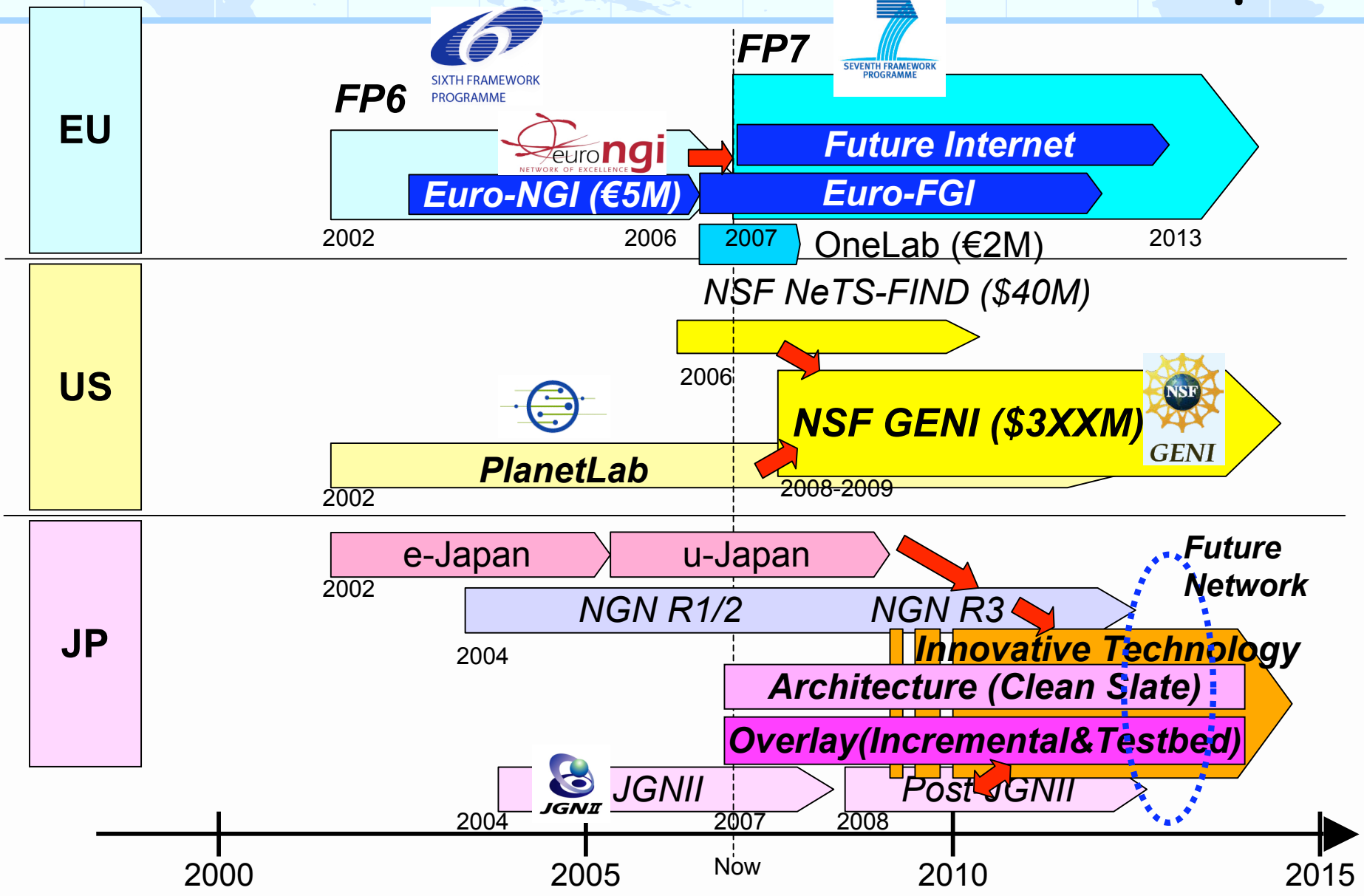
...successful and widely adopted technologies are subject to ossification, which makes it hard to introduce new capabilities...

(U.S. National Research Council Report 2001)



Dilemma between Innovation and Dependability

"Future Internet Research" in Japan



(Disclaimer: This is not an officially authorized plan)

Our Community's Approach

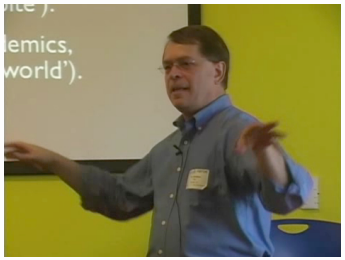
- Concept for new network research
  - Data-Oriented
    - Network could do more advanced data disssemination
  - User-Centric
    - Network must satisfy users' requirements
- Necessary Approaches
  - Problem-Driven
    - What are the problems users most want to be fixed?
  - Two-fold Approach
    - Clean Slate Thinking
    - Incremental
  - If not deployable, no use!!
    - User "Opt-In" Evaluation

Reconsider Data Dissemination

- IP rescued us from plumbing at the wire level but we still have to do it at the data level.

  A dissemination based architecture would fix this.
- Many dissemination overlays have been created.

  There's a demonstrated need.
  - BitTorrent/BitTyrant
  - Akamai
  - Skype/Joost



Van Jacobson @ Google 2006

- Data Oriented Network Architecture (DONA)

  (Scott Shenker 2006-)

Data Oriented Network Architecture & Services

Reconsider End-User's Demands

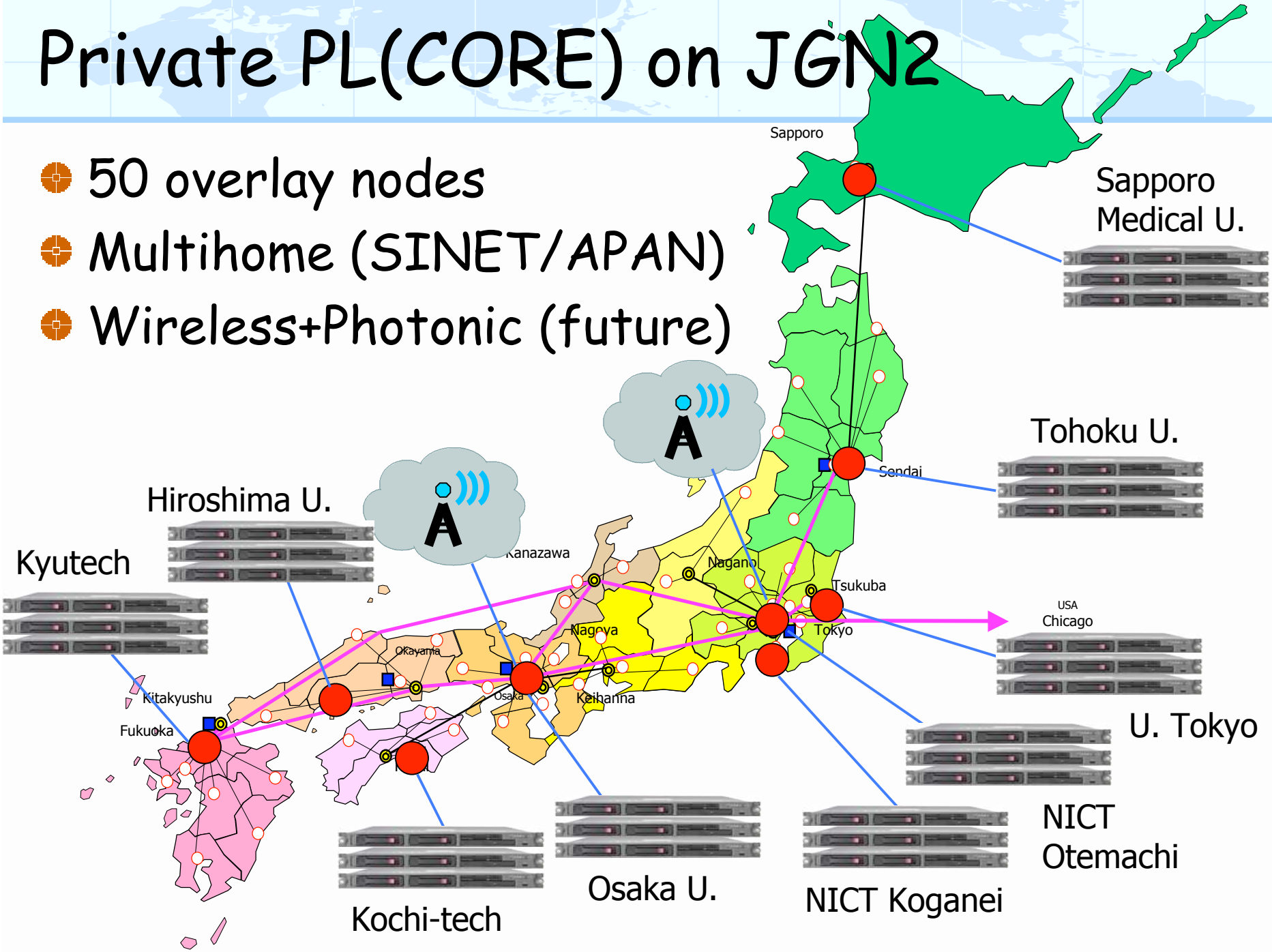
- Government (MIC) working group on network arch.
  (MIC: Ministry of Internal Affairs and Communications)
  - From April to July in 2007
  - Brainstorm on new network architectures
  - Discussion among profs, v.p.'s, research lab directors…
  - Not only network researchers but also people from various fields
  - Identify research goals and work items

One of the outcomes from this working group:
A new network arch. must satisfy end-user's demands

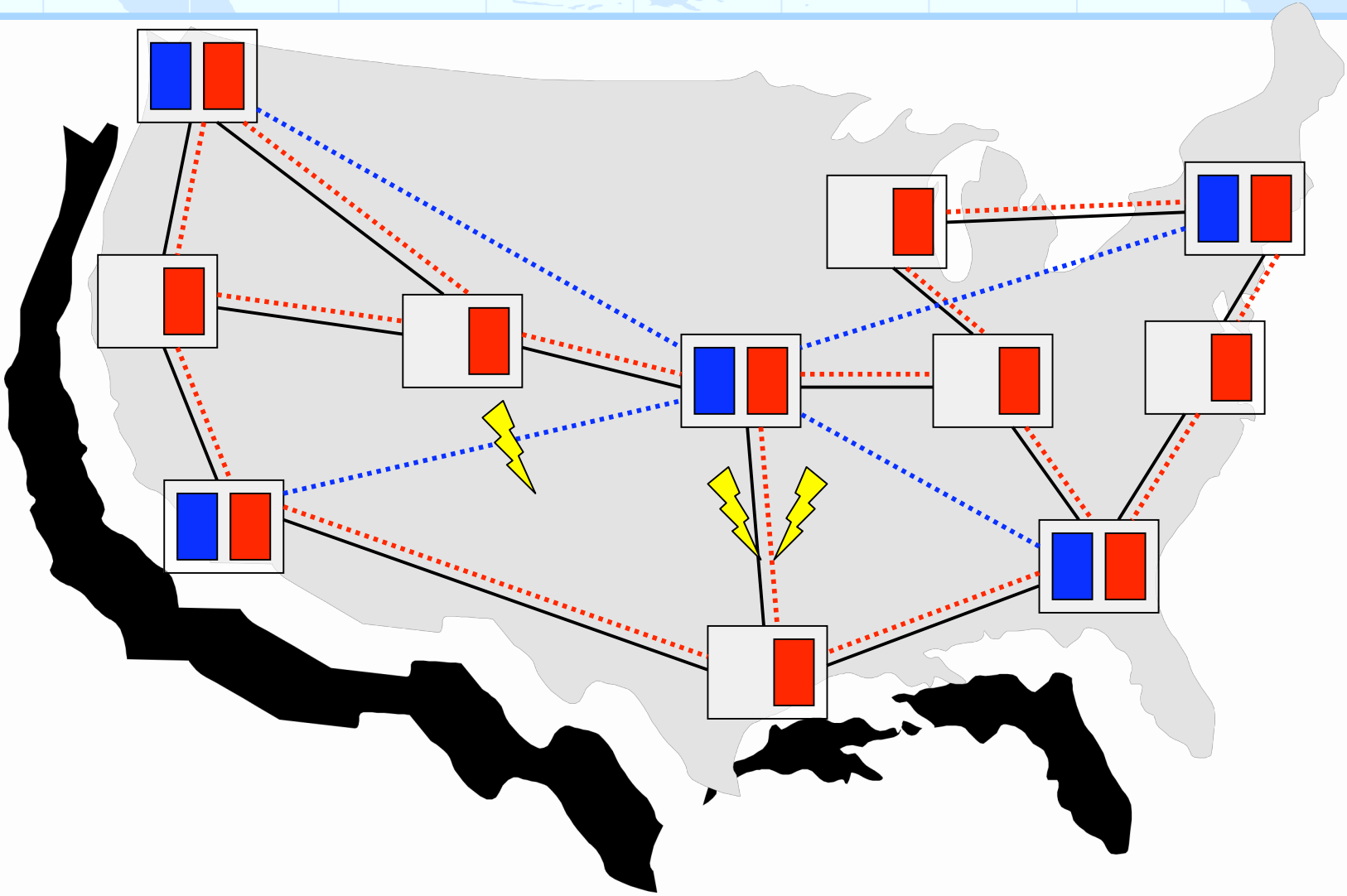
User Centric Network Architecture & Services

Private PL(CORE) on JGN2

- 50 overlay nodes
- Multihome (SINET/APAN)
- Wireless+Photonic (future)



GENI/VINI Collaboration



VINI exposes, can inject network failures

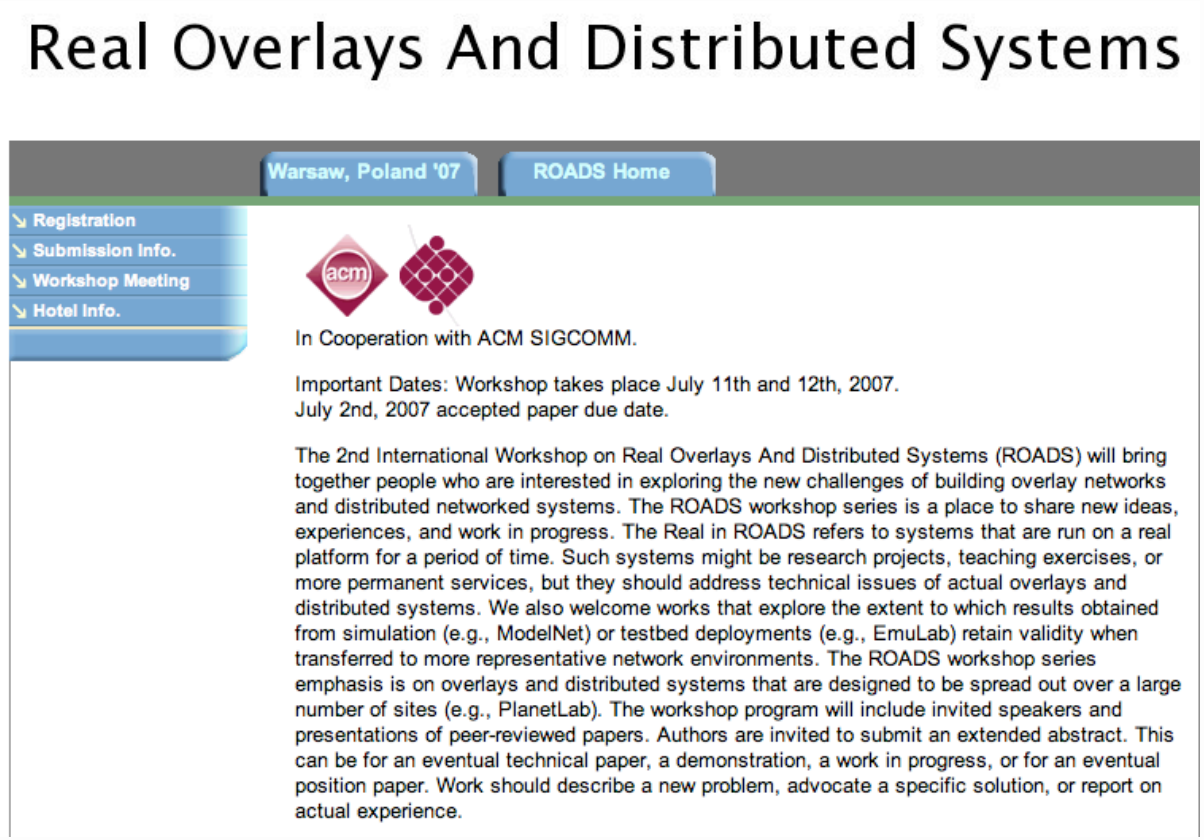
Overlay Symposium/Workshop 2006

- UTokyo/NICT/OsakaU organized
- Invited international researchers
- Attendees
  - Symposium: 280
  - Workshop: 110
- Grown into "ROADS"
- Active discussion
  - Overlays
  - Future Internet

http://nakao.iii.u-tokyo.ac.jp/overlay/e/index.html

ROADS Workshop

- ROADS 2007 (Brazil in June & Poland on 7/11-12)
- ROADS 2008 in Japan (will CFP soon)
- In Cooperation with *ACM SIGCOMM*



http://roads.cs.princeton.edu/

Conclusion

- Innovation in Communication Networks
  - Identify Problems (problem-driven)
  - Two-fold approach to solve the problems
    - Clean Slate Thinking (longer term)
    - Incremental Virtualization Technique (shorter term)
  - Data-Oriented and User-Centric
  - International Collaboration is "must"
    - Communication is global by nature
    - Especially among Asian countries…
  - We are looking for people to collaborate!

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