

# *AKARI Architecture Design Project in Japan*

*Tutorials, AsiaFI School on Architecture and  
Building Blocks, August 26, 2008*

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*National Institute of Information and Communications Technology*

*[http://{www, akari-project, nag}.nict.go.jp/](http://www.akari-project.nag.nict.go.jp/)*

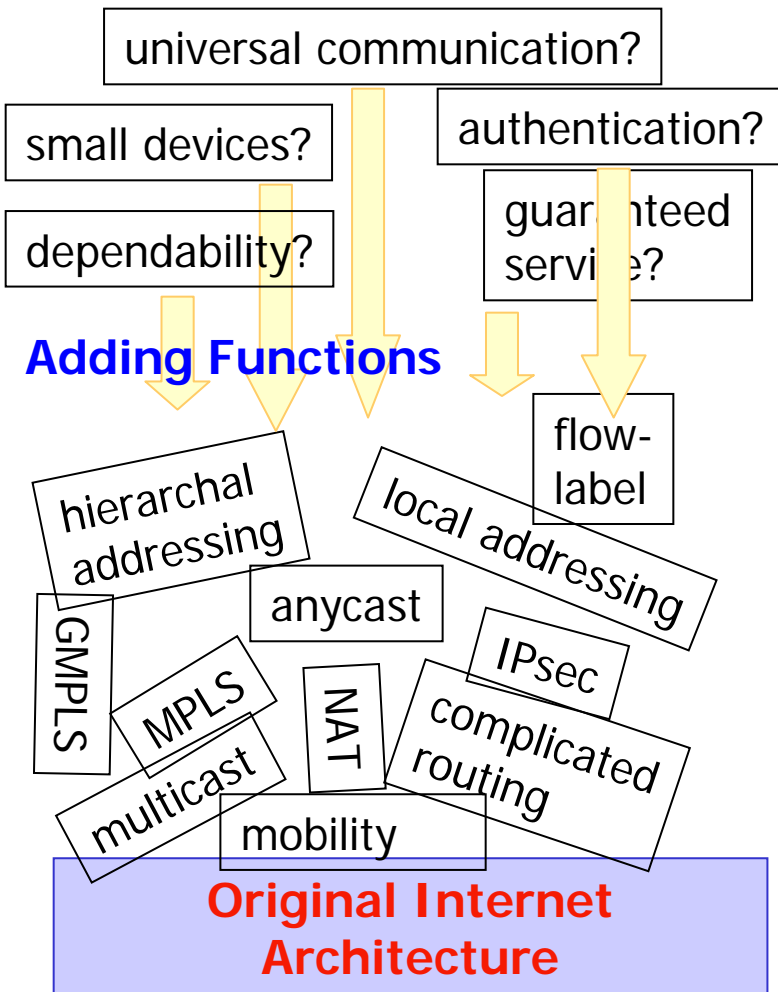
# *Today's Internet Has Many Problems*



- No sufficient capacity (700Gbps → x1000 in year 2020)
- Huge power consumption (13kW for 640Gbps → 2000 kW? for 1Pbps)
- No bandwidth-guarantee mechanism (best effort)
- Difficulty in fast and long distance transfer (TCP → new transport)
- No multi-homing (ID is also locator → ID/locator separation)
- Slow reroute (routing → bandwidth-dependent routing)
- ...
- Too much complicated structure (incremental → disruptive)

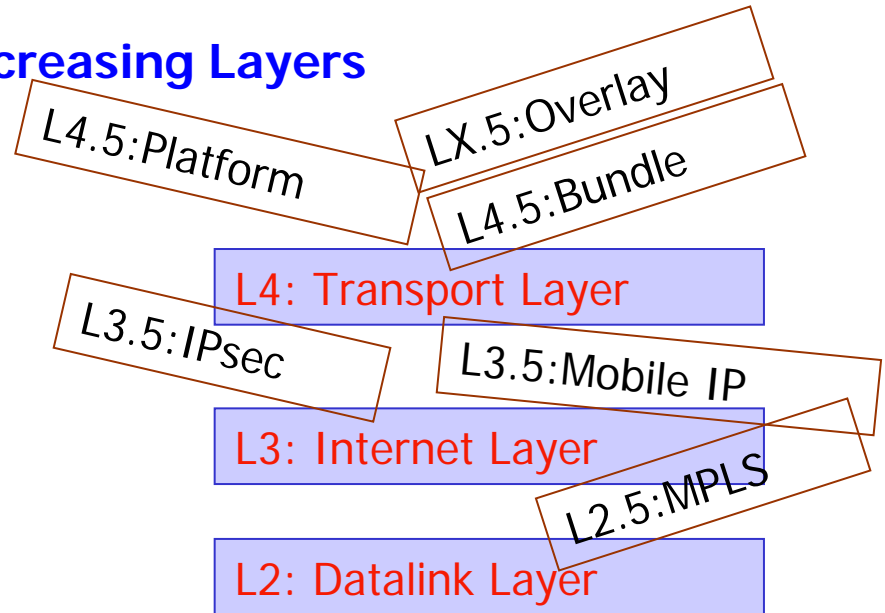
# Internet – Too Much Complicated

- Cannot add new functions
- Cannot provide services for future society



- Entrust network with your life & living ? (tele-medicine, ITS & anticrime, finance)
- Rich life? (connecting sensor, RFID)
- Safe? Secure? (spam, DDoS)
- Never broken? how long? (sustainable society)
- Flexible to future change? (nobody knows future)

## Increasing Layers



Individual optimum but NOT global optimum  
**Design from scratch has come!**

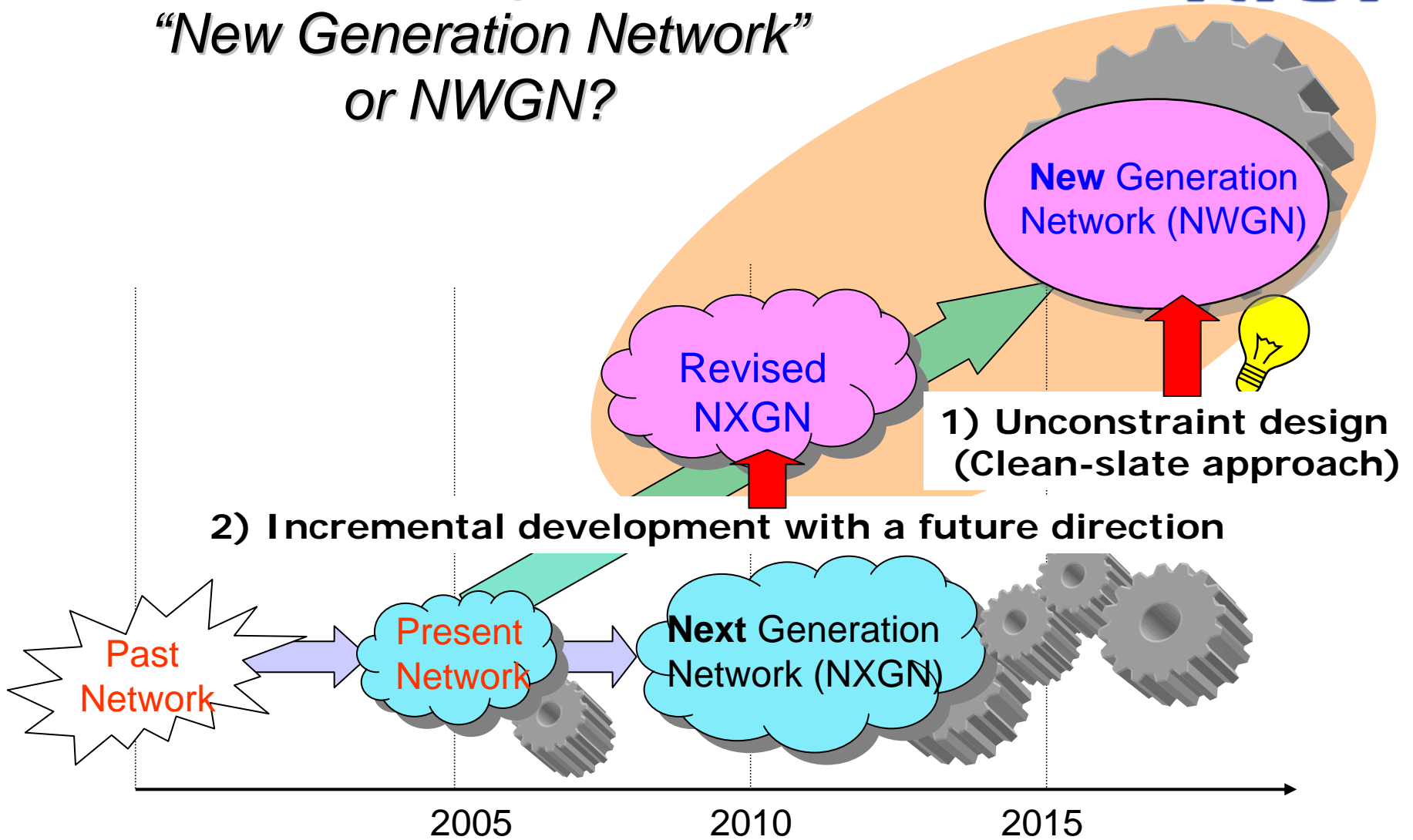
# *AKARI Architecture Design Project Toward New Generation Network*

Designing the future, diverse, new generation network beyond 2015

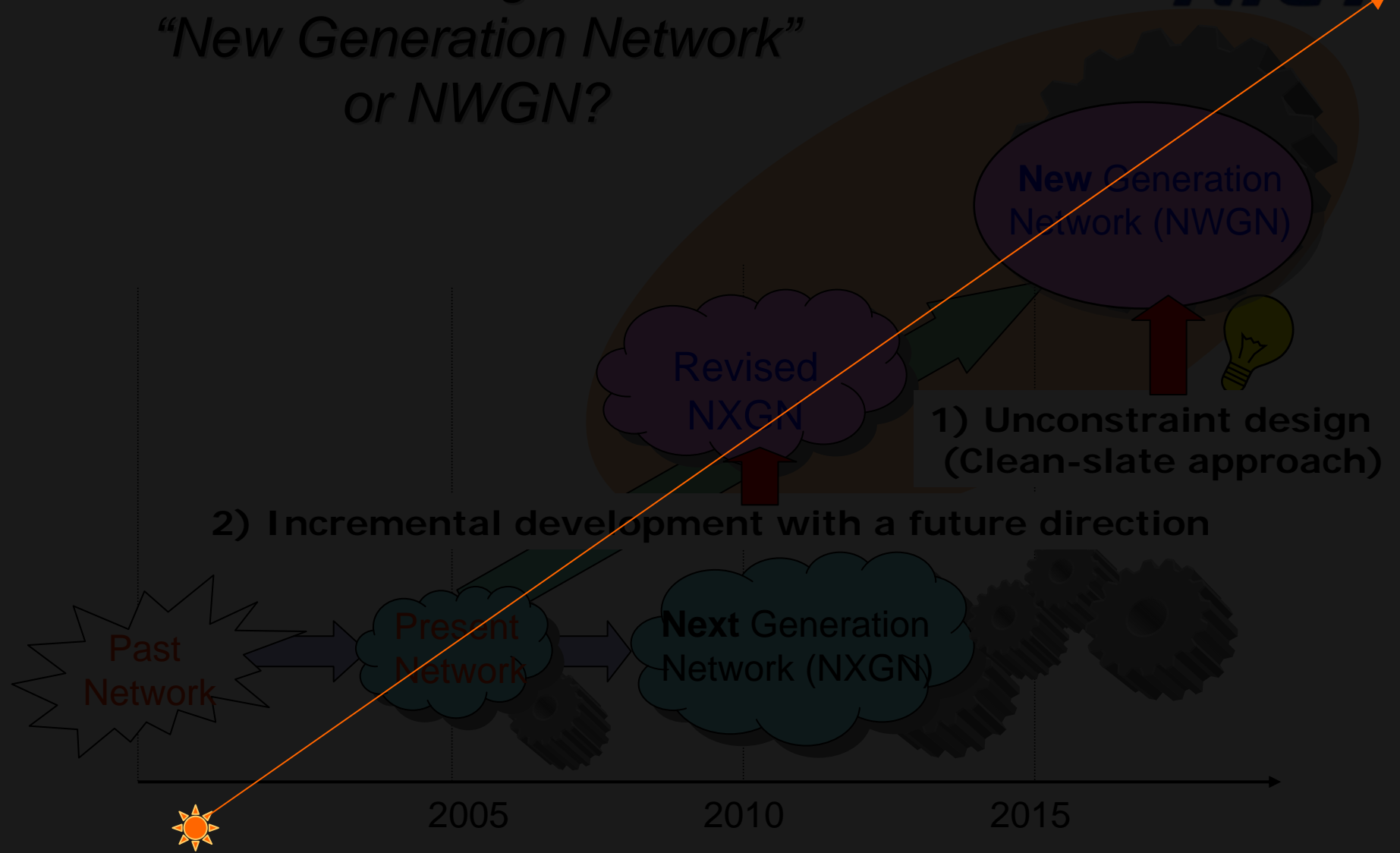
- pick up techniques for the future under the principles
- integrate & simplify them with design methods

*<http://akari-project.nict.go.jp/>*  
*<http://www.akari-project.jp/>*

# How to get to “New Generation Network” or NWGN?



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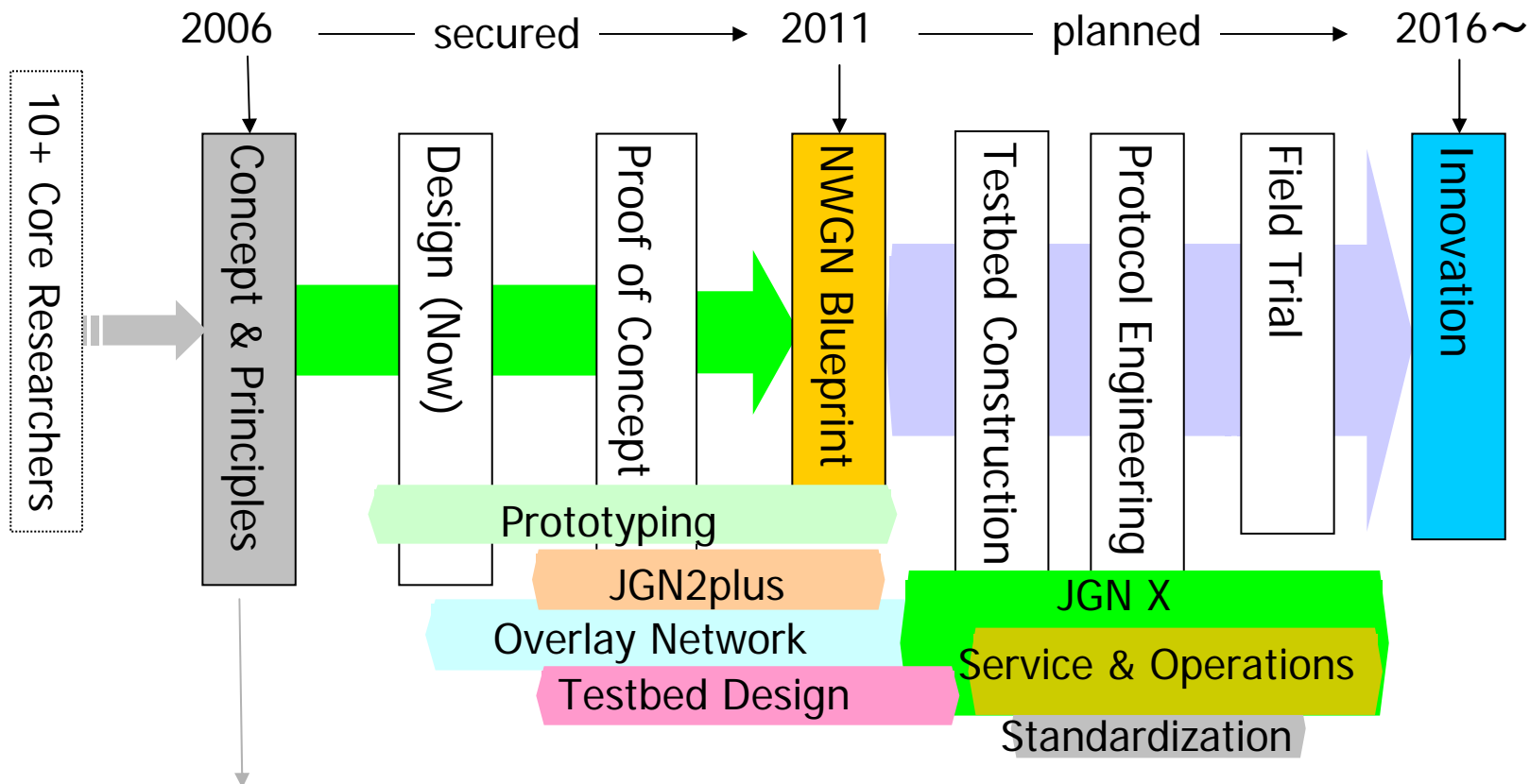


**AKARI** ... a small light in the dark pointing to the future

# AKARI Architecture Project

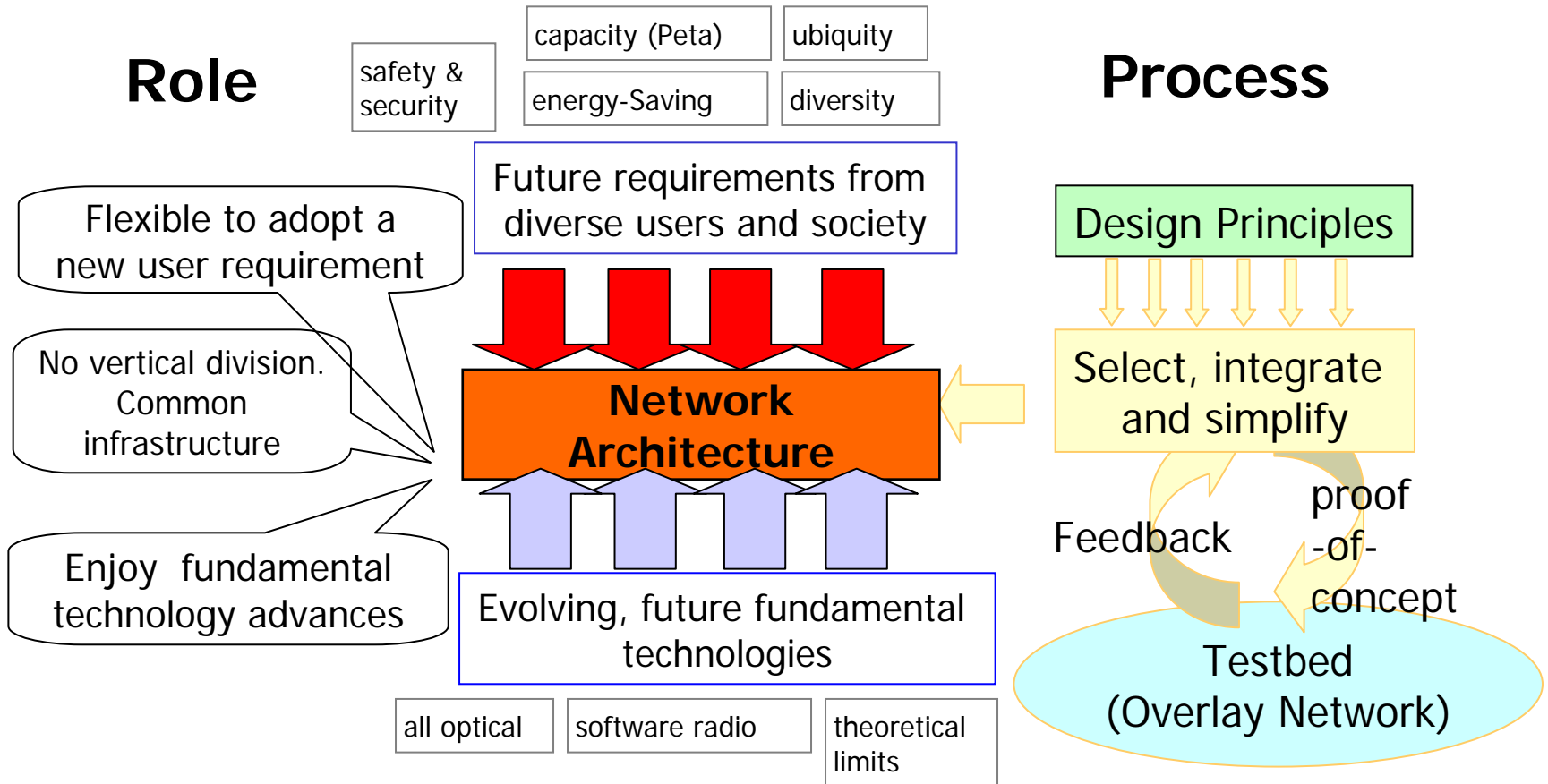
led by NICT Network Architecture Group

## - Grand-Designing a New Generation Network beyond 2015 -



"AKARI Architecture Conceptual Design" released in 2007.  
See <http://akari-project.nict.go.jp/eng/conceptdesign.htm>  
A new version will be available soon.

# AKARI's Start Point: Network Architecture



- Optimal Integration of many components
- Stable enough to rely on for a long time

## - Grand-Designing a New Generation Network beyond 2015 -

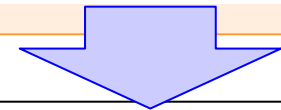
# *New Generation Social & Design Requirements in 2015*

## **Social Requirements**

Peta-bps backbone, 10G-bps FTTH, e-Science  
100-billion devices, M2M, 1-Mega stations  
Competitive industry and user-oriented services  
Medical care, traffic control, emergency, four-nine  
Privacy, financing, food tracking, anti-disaster  
Rich society, handicapped, aged support  
Earth & human monitoring  
Broadcasting & communication, web 2.0  
Economic Incentive (Business-cost model)  
Ecology, sustainable society  
Human possibility, universal communication

## **Design Requirements**

Capacity  
Quantity  
Openness  
Robustness  
Safety & Security  
Diversity (Long-tail)  
Ubiquity (Pervasive)  
Converge & Simplify  
Network Model  
Energy-saving  
Evolvability



**New Generation Network  
Designed by the Architecture**

# *AKARI Sustainable Architecture Principles*

## **Capacity for Quality**

1. KISS (Keep It Simple, Stupid)
  - Crystal synthesis (select, integrate, simplify)
  - Common layer (layer degeneracy)
  - End-to-end (original Internet)

## **2. Reality Connected**

- ID-Locator separation
- Bi-directional authentication
- Traceability

**Reliable Network Space**

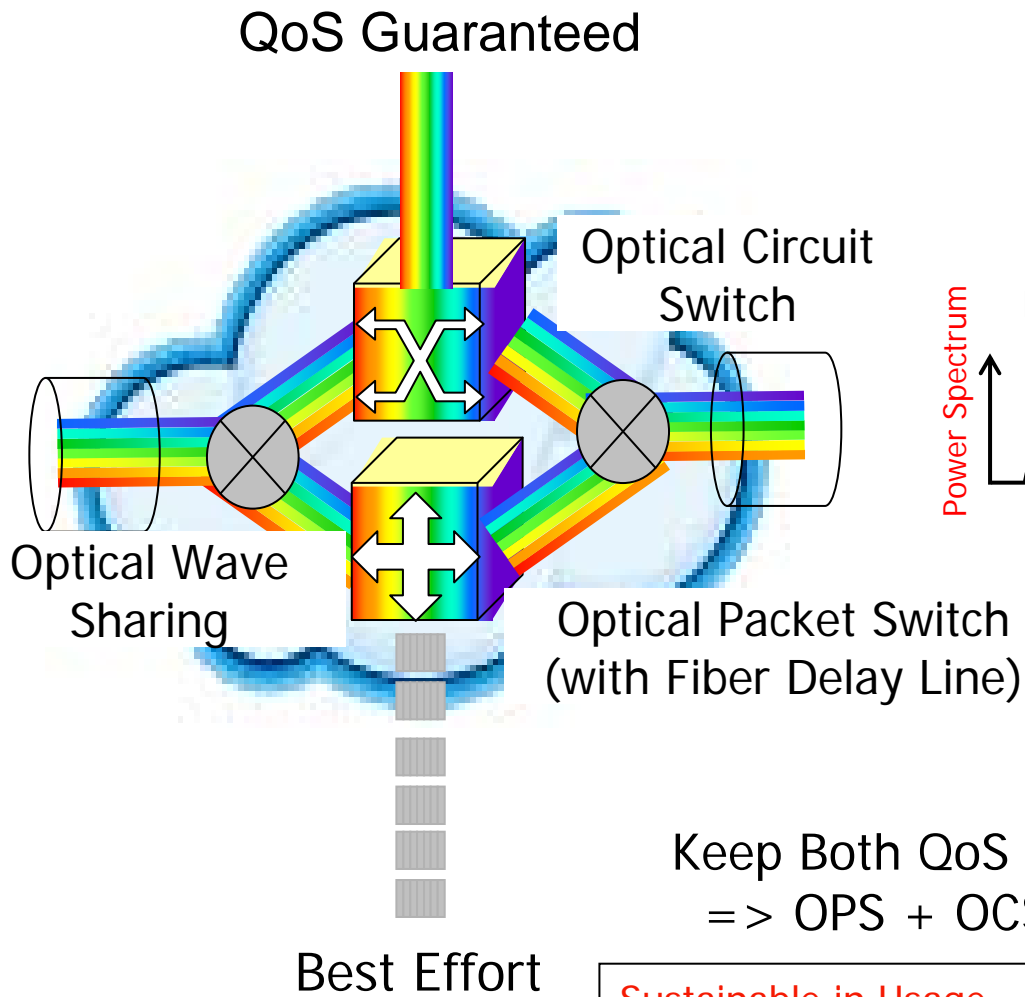
## **3. Sustainable & Evolutional**

- Self-\* properties (emergent)
- Autonomic distributed control
- Scalable
- Social Selection

**For Future Diverse Society**

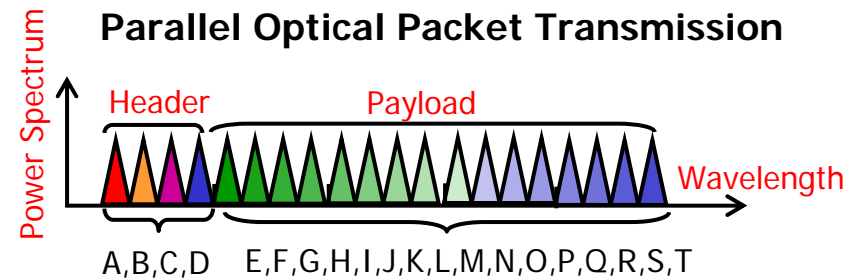
# AKARI Architecture Focus (I)

## (1) AKARI Optical Switching - Path / Packet Integration -



### Requirements:

- Handle different types of traffic
- Peta-bps switching capacity
- Tera-bps link speed (40G x 100)
- 100 billion tiny terminals



### Sustainable in Capacity

- Scalable
- Energy-Saving

Keep Both QoS Assuredness & Best Effort Efficiency  
=> OPS + OCS (Not OPS over OCS)

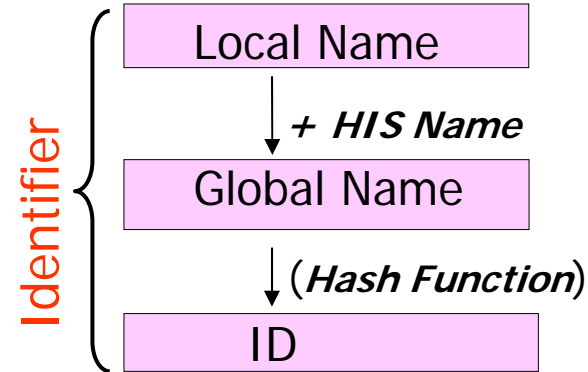
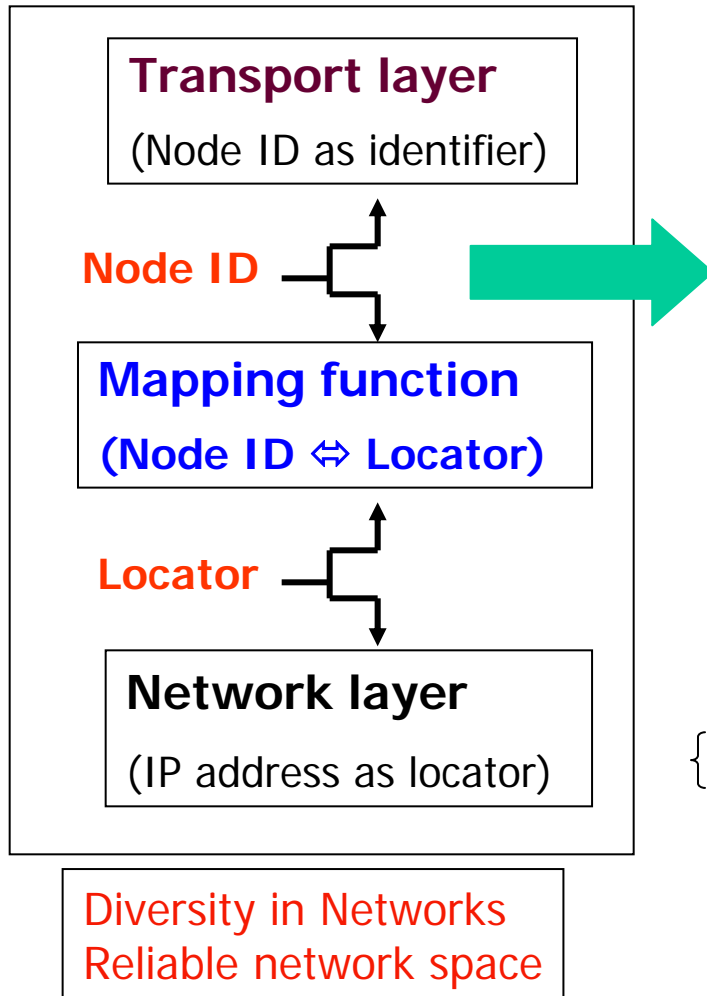
### Sustainable in Usage

- Allow Usage Diversity

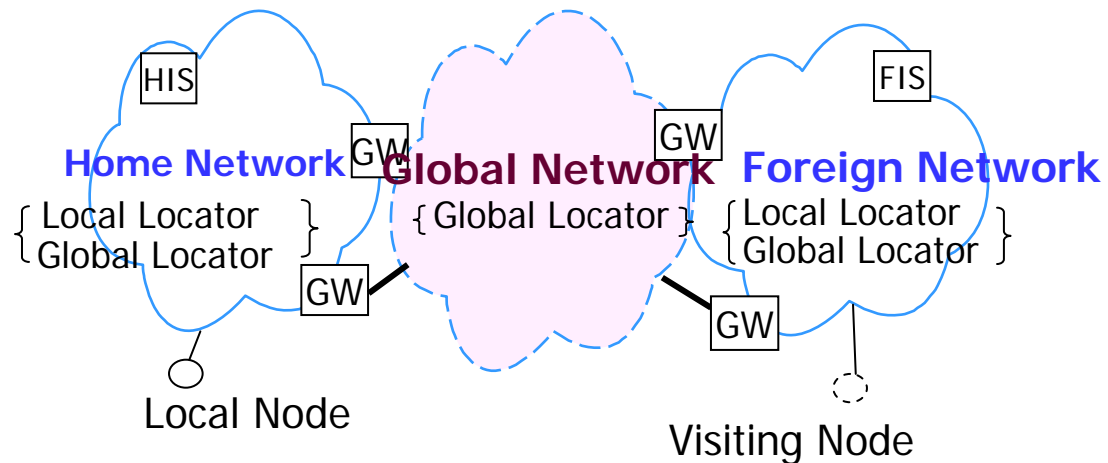
# AKARI Architecture Focus (II)

## (2) Layered identifier and locator (Concept)

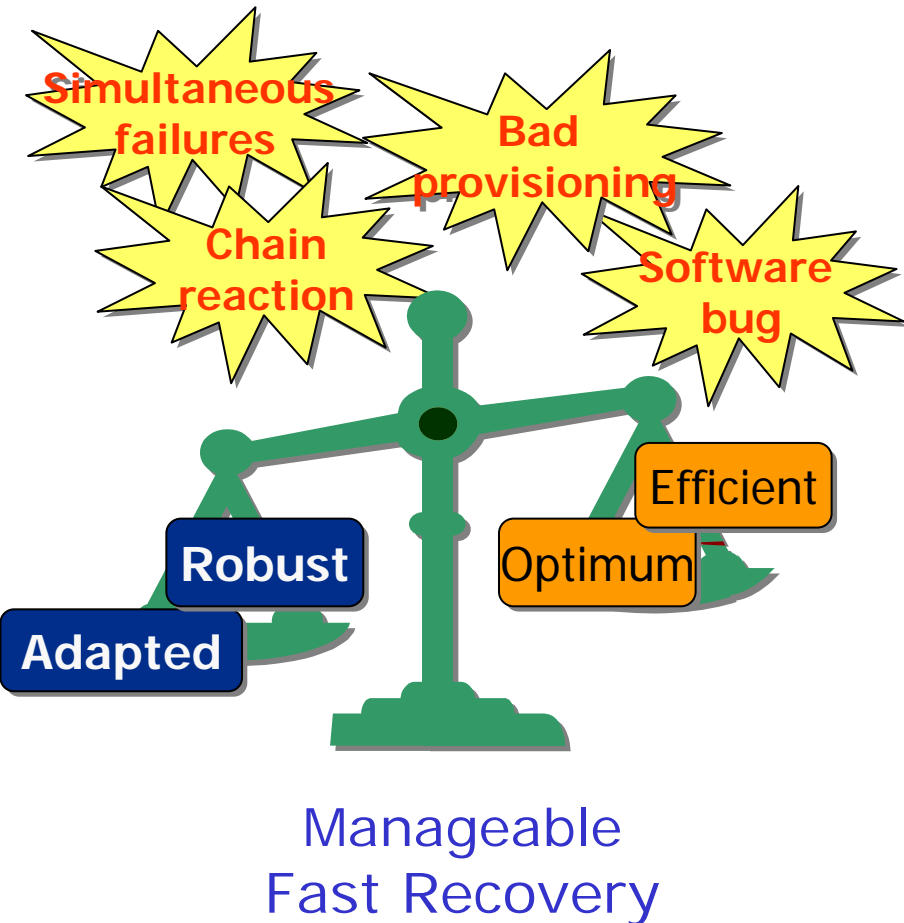
your-pc#yournetwork.com  
my-pc#mynetwork.com



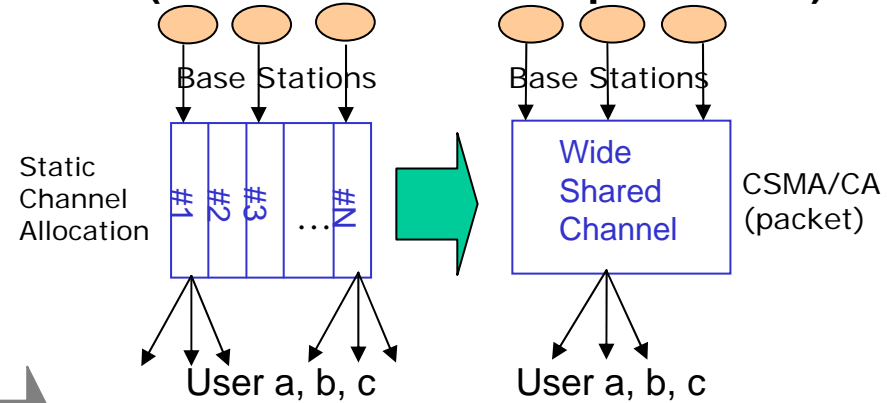
- Authenticated, but privacy protected



## (3) Self-organizing Control (Concept)



## - PDMA (Packet Division Multiple Access)

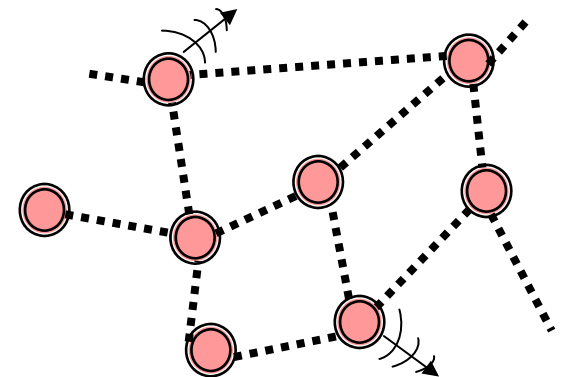


Free from:

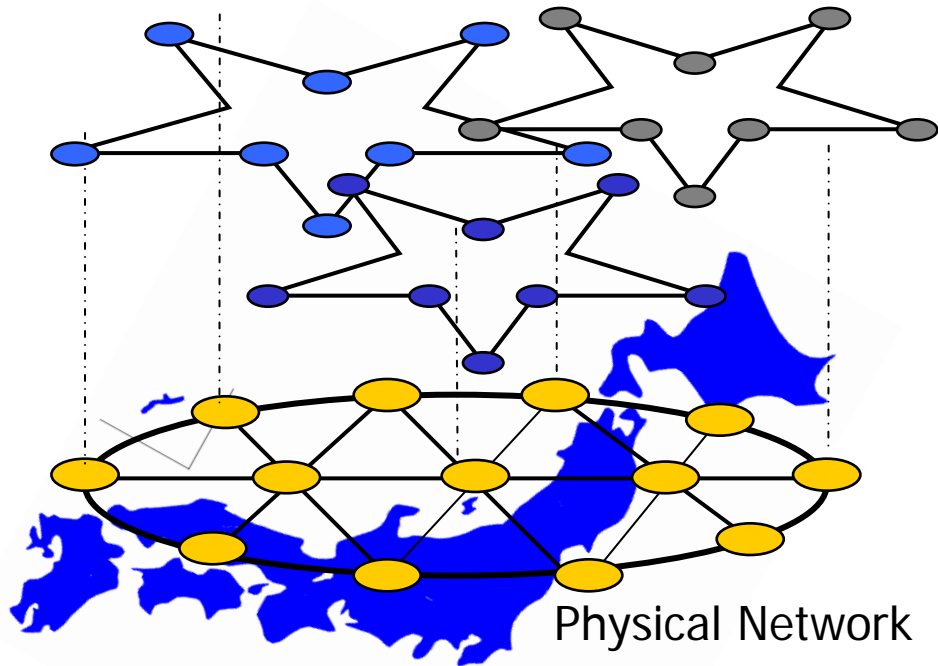
- Frequency Channel Allocations
- Cell Design

**Sustainable in Management and Capacity**

## - Self-Organizing Mesh Network

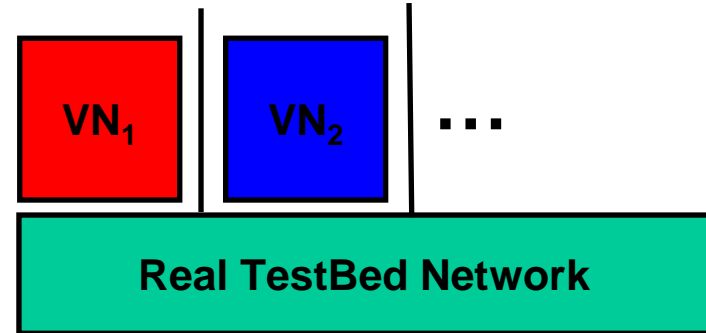


## (4) Network Virtualization (Concept)

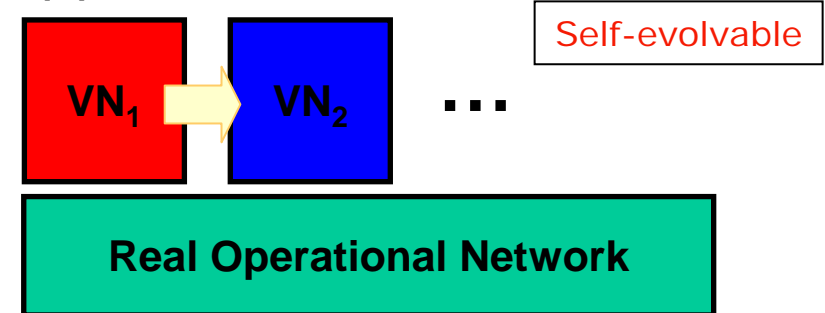


➔ Optical Path Network  
Wireless Network

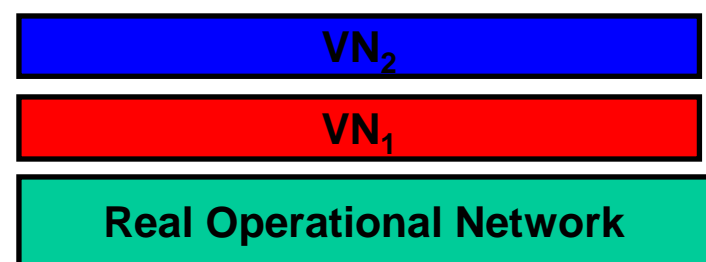
### (a) Isolated Virtual Networks



### (b) Transitive Virtual Networks



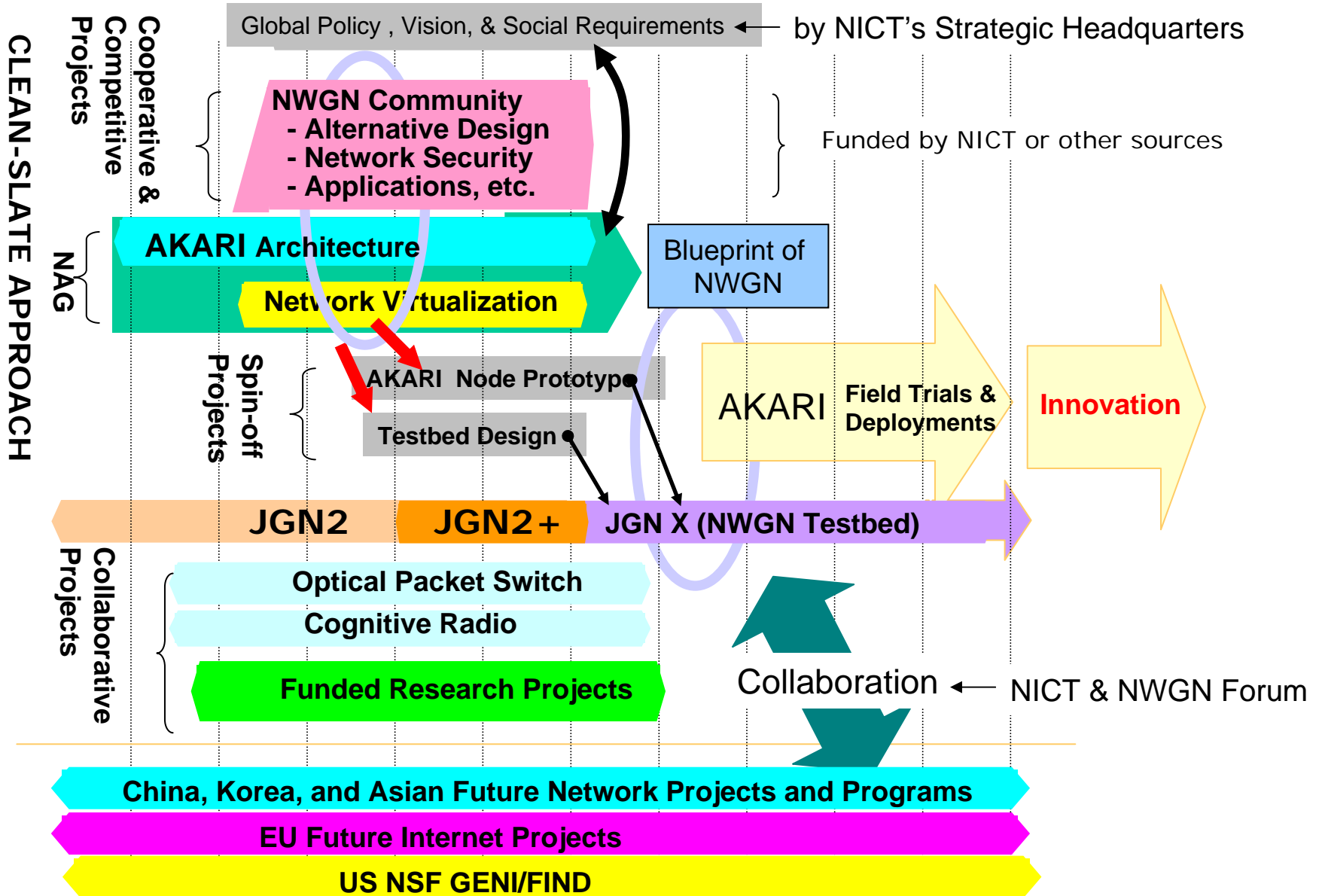
### (c) Overlaid Virtual Networks



# AKARI & Related Initiatives R&D Plan



2006 07 08 09 10 11 12 13 14 15



# Questions?

AKARI Architecture Design Project Major Members:

**Network Architecture Group Leader: Hirabaru Harai (Optical Switching), Xu (Lightpath), Miyazawa (Opt. Access), Morioka (Optical Transmission), Ohtsuki (Control), Fujikawa, Inoue (Univ. Access), Kafle (Addressing), Umezawa, Ohnishi, Li, and Peng.**

**Network Science by Prof. Murata (Osaka U.)**

**Ubiquitous by Prof. Morikawa (U. Tokyo)**

**Mobility by Prof. Teraoka (Keio U.)**

**Packet Switching by Prof. Ohta (Tokyo Inst. Tech.)**

**Network Virtualization by Prof. Aki Nakao (U. Tokyo)**

**Program Coordinator Prof. Aoyama, Executive Director Dr. Kubota**