Operation Architecture for Virtualized Infrastructure

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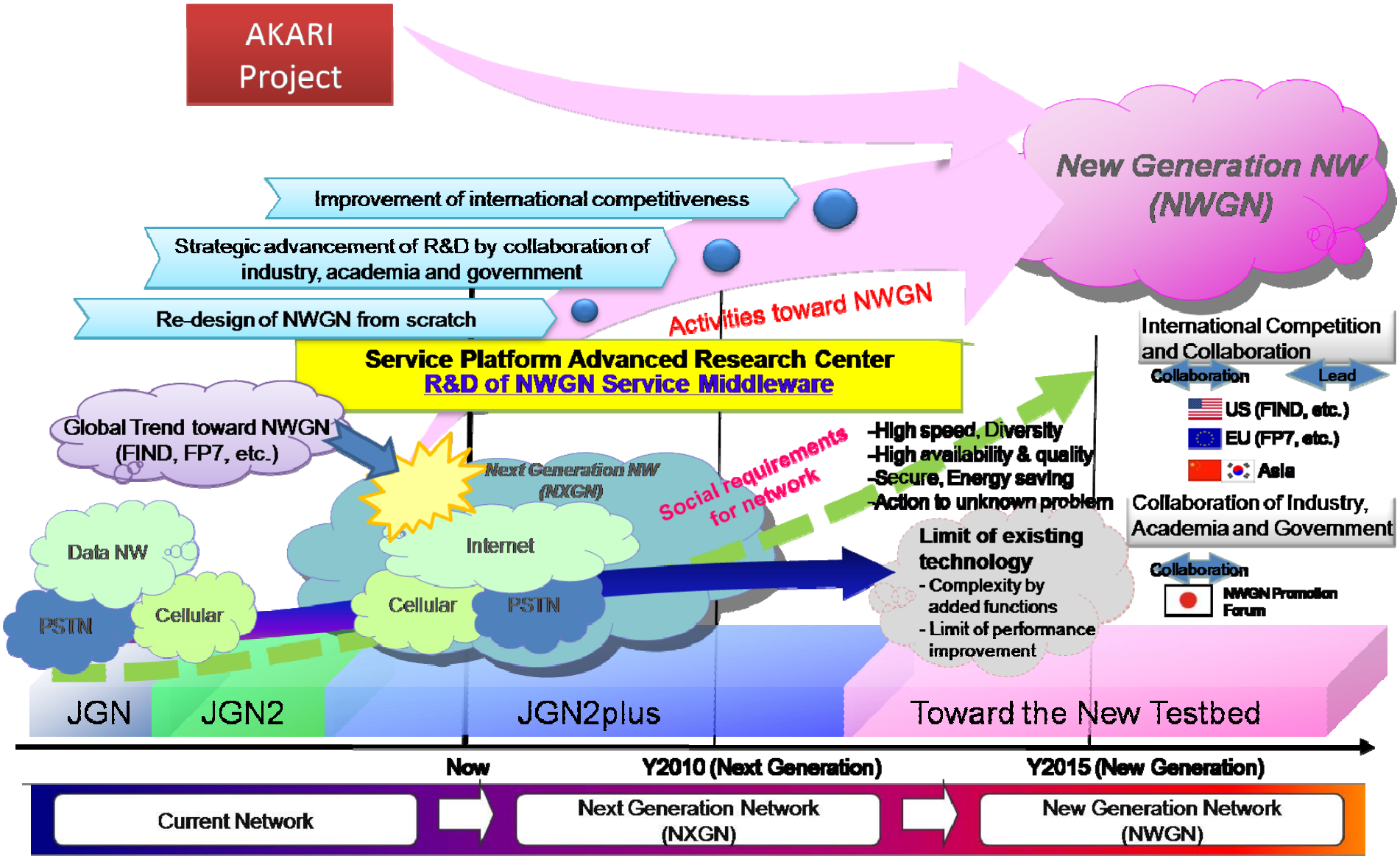
Outlines

- A brief introduction
  - Our position and viewpoint in NWGN R&D activities
- Deployment issues of NWGN technologies
  - In-progress consideration

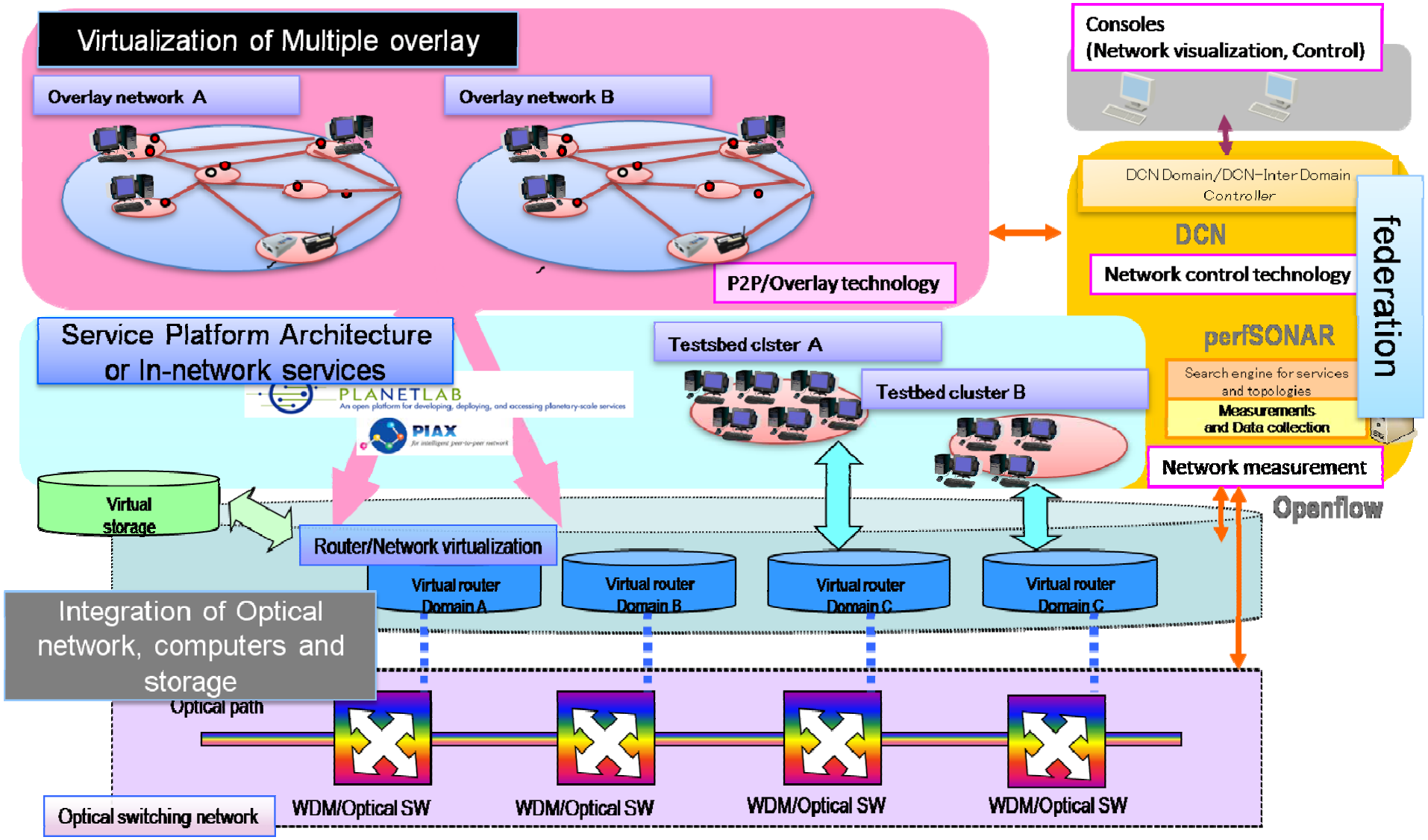
Towards new generation network



Our position in NWGN R&D activities

- Strong emphasis on real-world deployment
  - Wide-area testbed network infrastructure
  - Encourage to introduce cutting-edge NWGN technologies into JGN2plus
    - Great opportunities for lab-level technologies to obtain proof of their concepts
    - Also our opportunities for facing operational issues of NWGN deployment
  - Neither limited to academic projects, nor limited to domestic projects
    - Support for experiments in commissioned research
    - Coordination of international collaboration
- Service-level viewpoint
  - Service Platform Architecture Research Center

JGN2plus as a Service Platform

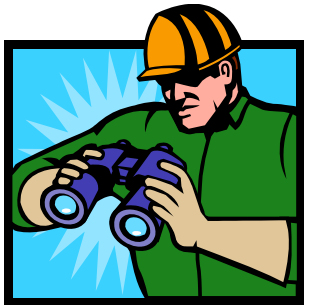


Deployment issues of NWGN technologies

- Resource provisioning
- Multi-domain operation
- Advanced operation model

Issue #1: Resource provisioning

- Low level resource management mechanisms are well-studied and various tools have been released
  - Network path management (bandwidth, distance, …)
  - Virtual host management (CPU, memory, HDD, …)



- Granularity is a key
  - We can guarantee a coarse-grained resource requirement
    - Still it can be very hard and requires some political effort…
  - Fine-grained resource provisioning is a challenging issue
    - Ex. How can we provision resource for information service with overray communications?

Simulation/Emulation

- Is simulation/emulation a realistic solution?
  - Temporal dynamics should be considered in fine-grained resource provisioning
  - High cost to simulate/emulate accurate temporal dynamics of a live internet-wide system
  - Can virtualization help?

Issue #2: Multi-domain operations

- Many NWGN technologies partially have succeeded in working well inter-domain
  - PerfSONAR, DCN (Dynamic Circuit Network), PlanetLab, etc.
    - Overlay approaches
- Their operations sometimes cost high and scale poorly
  - How to set information access policies inter-domain?
  - How to allocate resource fairly inter-domain?
  - How to tackle operational troubles inter-domain?

- Possible solution:
  An architecture for inter-domain operations

Architecture

- Architecture: a specification of an interface and the logical behavior of resources manipulated via the interface (J. E. Smith and R. Nair, “Virtual Machines”, 2005)
  - We need well-defined interfaces to decouple functions in a complicated system
- Virtualization never succeeds without well-defined interfaces
  - Virtualization is a technique to mimic the users via the well-defined interfaces
  - Links, Routers, Nodes, File Systems, DB, P2P, HTTP, Mail, etc.

What should we tackle next?

Operation virtualization

- Inter-domain operations require virtualization
  - We often know desirable logical behavior of resources
    - Private path establishment
    - Communication quality
    - Customized forwarding/routing
    - Data management
    - Load balancing
  - We rarely know the interfaces to manipulate the resources beyond domains
    - Well-defined interfaces!!

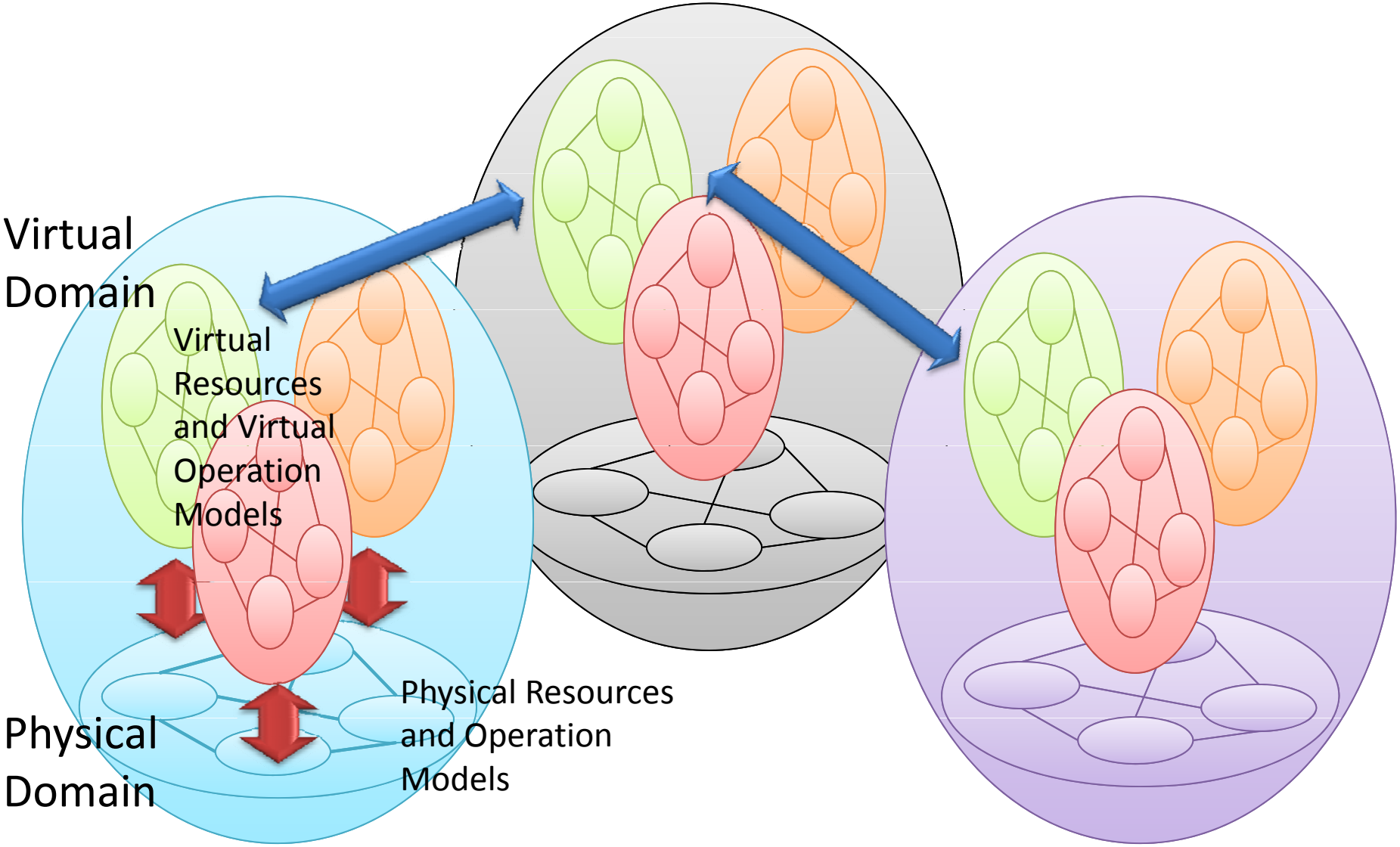
Issue #3: Advanced operation model

- Virtualization can increase operational costs
  - Host virtualization
    - Pros
      - Easy OS installation
      - Simple system backup and recovery
      - Consolidated management
    - Cons
      - Increased failure points such as virtual switch
      - Hard trouble shooting in virtualized resource
  - How about network virtualization?

Two approaches in operation virtualization

- Horizontal operation virtualization
  - Issue #2
  - Organization-based
    - Basically, the same architecture as the Internet
- Vertical operation virtualization
  - We need to virtualize the network resource operations
  - Network-resource-entity-based

Horizontal operation and vertical operation



Summary

- Three issues in deploying NWGN technologies
  - Resource provisioning
  - Multi-domain operation
  - Advanced operation model
- Collaborations are welcome!
  - We have just started trials and discussions…
  - We would like to share the R&D&O experience of virtualized networking and computing infrastructure

Thank you!