

# **The 4th EU-Japan Symposium on the "New Generation Network" and the "Future Internet"**

## **Energy Optimized Data Distribution using E3-DCN**



**2012.1.19**

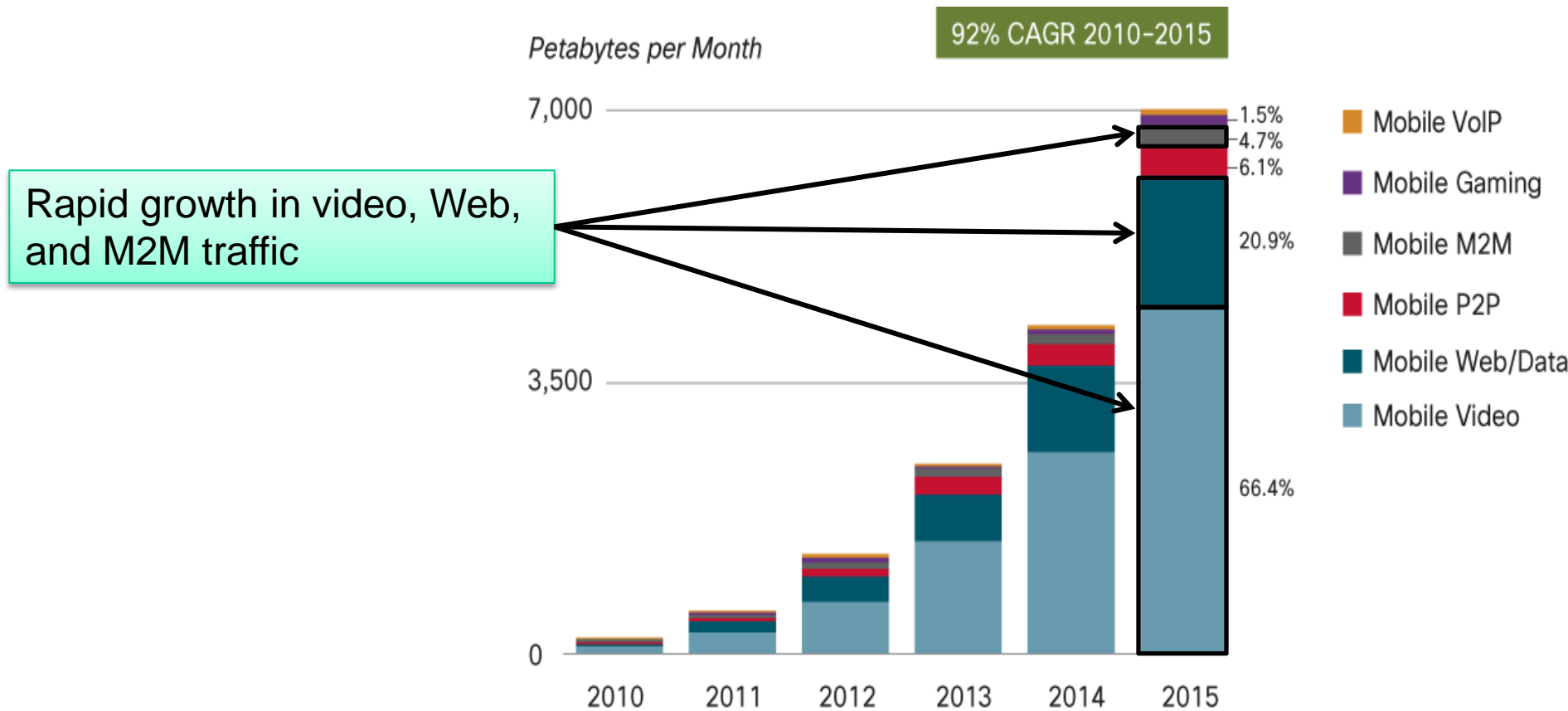
**Daisuke Matsubara (Hitachi, Ltd.)**

**Naoaki Yamanaka, Satoru Okamoto (Keio University)**

- Future Networks  
(New Generation Network, Future Internet)
  - Ongoing research efforts to envision and realize new network architecture that will enable revolutionary service and user experience.
  - Focus on new requirements (energy efficiency, data access, disaster resiliency, etc.) and emerging technology trends (network virtualization, data/content-centric, disruption/delay tolerant, etc.).
  - Initial steps for standardization (ITU-T, ETSI, IETF, ISO/IEC) is underway.

# Future Network Trends

- Mobile traffic growing at rapid pace. (92% CAGR)
- At same time, energy efficiency is becoming a priority in network design. (e.g. Green Touch Initiative)



VoIP traffic forecasted to be 0.4% of all mobile data traffic in 2015.

Source: Cisco VNI Mobile, 2011



## Our Research Focus

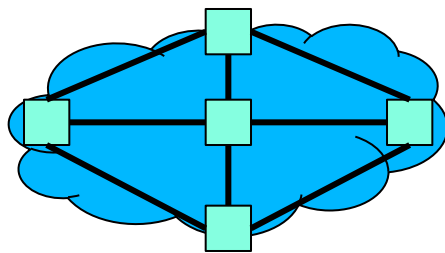
- Our research focuses on Video, Web, and M2M services, with highlights to these 2 issues.
  - Data distribution: The primary use of network has shifted from communication between 2 terminals (e.g. telephony, streaming) to data access and distribution (e.g. WEB, content delivery).
  - Energy efficiency: Priority of energy efficiency has been increasing due to environmental concerns .
- What novel architecture and functional design be provided that will to enable dramatic improvement in data distribution and energy efficiency?

# Data-centric Networking (DCN)

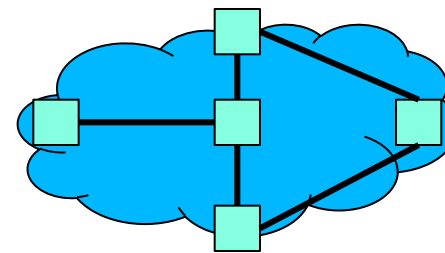
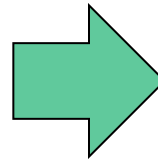
	PSTN(telephony)	IP(Internet)	Data Centric Network
Time	1930's -	1980's -	2020's -
Usage	voice communication	WEB	M2M
Communication	Human to Human	Human to Machine	Machine to Machine
Infrastructure	circuit switching	packet switching	<a href="#">data distribution</a>
Strength	QoS	connectivity	<a href="#">mobility</a>
Weakness	efficiency	reliability, QoS, mobility	delay
Mechanism	<p>Sender specifies terminal ID(phone number) and set-up end-to-end circuit passage.</p>	<p>Sender specifies terminal location (IP address) and send out packet flows.</p>	<p>Sender registers an data object with an ID attached, and receiver specifies the ID to retrieve it.</p>

- Conventional networks have focused on performance and scalability. The networks of the future needs to prioritize energy efficiency when designing the network.
- Different levels of approach (i.e. device-level, equipment-level, network-level) can be taken.
- Examples of network-level approach
  - Topology and route optimization
  - Data/service relocation and caching
  - Lowering peak data-rate
  - Optical switching for bulk traffic
- We focus on a new architecture that supports dynamic network-level optimization for energy efficiency.

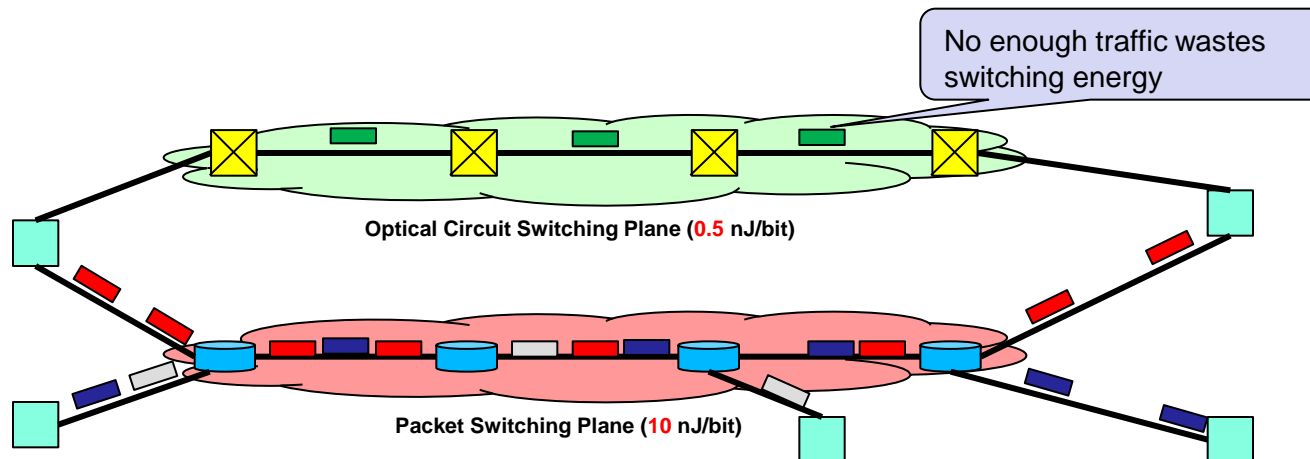
- **Strategy 1: Delay minimized virtual network (VN) topology to Energy minimized VN topology**
- **Strategy 2: Use separate circuit and packet switching based transport planes determined by transmission rate and data size**



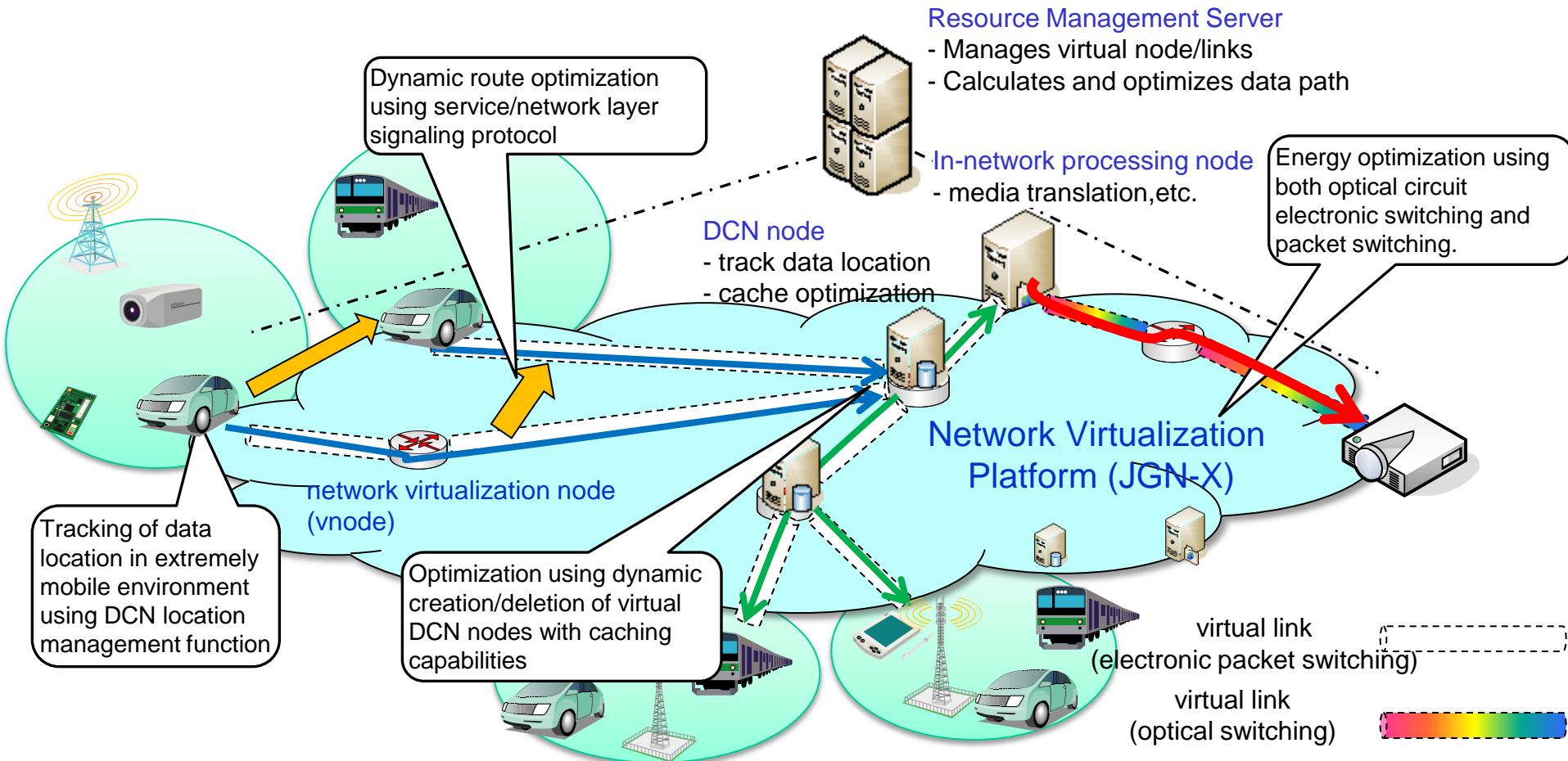
Minimum transport delay VN topology



Dynamic topology reconfiguration to minimum number of nodes and links VN topology

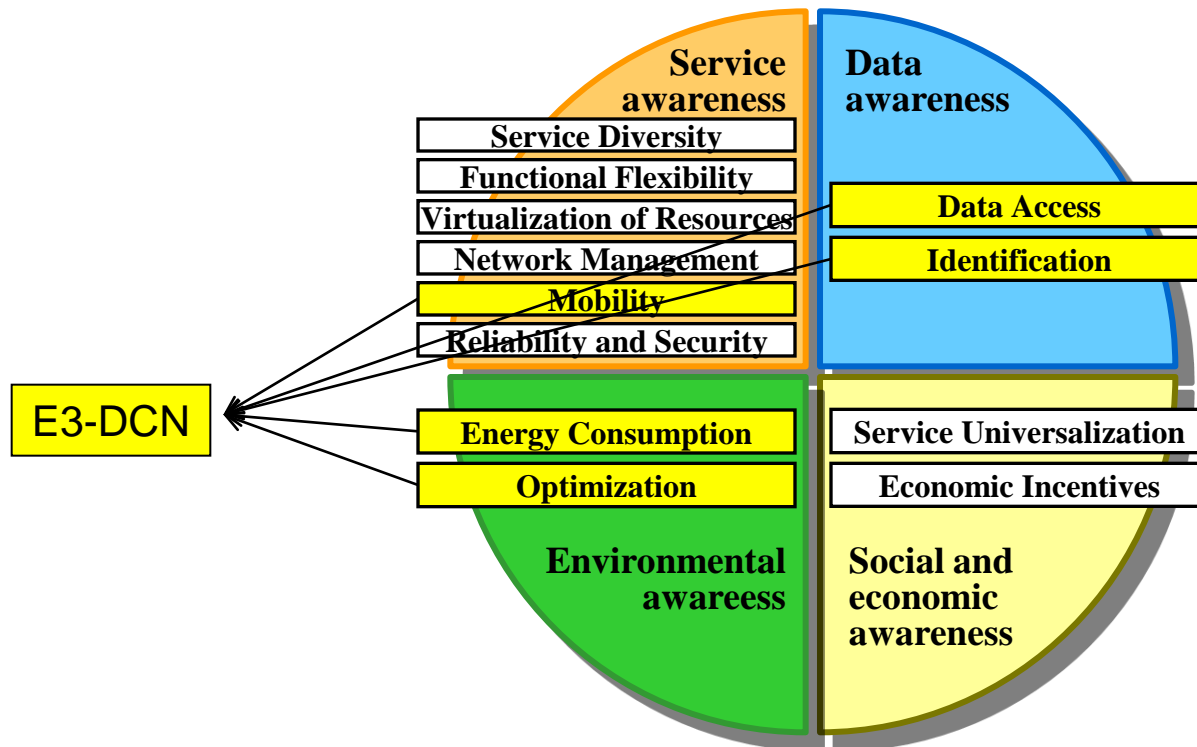


- DCN for data distribution in an extreme mobile environment.
- Optimizes energy consumption using data caching nodes and optical/electronic switching optimization.



# Standardization Activities

- ITU-T Recommendation Y.3001  
“Future Networks: Objectives and Design Goals”  
Specifies 4 objectives and 12 Design Goals of Future Networks.
- E3-DCN relates to mobility, data access, identification, energy consumption, and optimization.



## Summary

A decorative graphic at the top left of the slide. It features a 3D cube with a yellow-to-white gradient on its top face and a blue-to-white gradient on its left face. To the right of the cube is a horizontal bar with a green-to-blue gradient, ending in a blue arrow pointing left.

- Future demands for energy efficient and optimal access to enormous amounts of data in mobile environment is emerging.
- DCN allows retrieval of data using data object ID, without being aware of the data location.
- E3-DCN is a new network architecture that allows access to extremely dynamic data, and improves energy efficiency of network using optical/electronic switching optimization.
- ITU-T draft Recommendation for data-aware networking discussed in next SG13 meeting. (Feb. 2012)

Part of this project is funded by National Institute of Information and Communications Technology (NICT).