Energy Efficient IP Network with Giant Center Router and Optical Aggregation Network

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The 3rd Japan EU Symposium on the Future Internet,
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Outline

1. Introduction of Yamanaka Lab.
2. Energy Efficient IP Network with Giant Center Router and Optical Aggregation Network
3. Conclusion
About Yamanaka Lab.

We focus on “Photonic Networks” and “Communication Protocols”, and have studied the fundamental technologies of the next generation optical network and its network applications.

Yamanaka lab. locates at Shin-Kawasaki (Between Tokyo and Yokohama)

Prof. Yamanaka

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<APPLICATION>

Network Application:
Lambda Grid, uGrid (Ubiquitous Grid Networking), Contents Delivery Network, Service Cloud, Smart Grid Network Technology

Conventional Network

Rousing Demand

Further Improvement

New Generation Network

• Large Volume
• High-Speed
• High-Reliability

<BASE>

Network Architecture/Protocol
Optical Slot Switching, Next Generation Optical Access Network, GMPLS (Generalized Multi Protocol Label Switching)
Wide Area Layer-2 Network, Power Saving Network Technology, High Speed Path Calculation Technology
About Yamanaka Lab. (Cont.)

International Activity:

- Ph. D. course students go to global internship and hold international workshops.
  - Attend Global COE (Center of Excellence) program from the Ministry of Education, Culture, Sport, Science, and Technology in Japan
  - Attend international operability experiments

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Interoperability Experiment between Belgium and Japan (March 2009)

- Proposed VLAN tag swapping method for scalable wide area layer 2
- Established a virtual layer-2 path between Ghent University and Keio University by GMPLS

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Today’s Internet structure

Problem

- Need 12 hops (Most Traffic only through routers)
- All routers always power on

The Internet

Users (Consumers and business customers)

ISP and Contents Providers

AS (Autonomous System) □
Router ○

Average 12 Hops: Asia, Europe, USA

Our Proposed Network Architecture

Our approach

• Clean slate proposal for the new generation network
• Achieve high energy efficient/power saving network
Our Proposed Network Architecture (Cont.)

- Giant Center Router is one large power scalable router with an amount of traffic.
- Optical Aggregation Network consists of multi-stage multiplexer/de-multiplexer.
- Optical Aggregation Network transfers Users’ data on optical resource (optical slot /\lambda/) transparently.
Advantages and breakthrough: 1000 : 1 Power reduction

- 1000 : 1 Power reduction

![Present Internet vs. Proposed Network (at 10M ports)](2.6GW : 2.7MW ÷ 1000 : 1)

Today's Internet
2.6GW
1/1000
2.7MW
Proposed

Power Consumption (W)

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Evidence (1): Energy L1 $<<$ L3

(1) Power consumption of Optical switch is extremely low.

Evidence (2): Large router $\gg N \times$ (Small router)

(2) Router Power Consumption: $P = C^{2/3}$


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Conclusion

Proposal for Future Internet

• Replacing electric routers with one Giant Center Router and Optical Aggregation Network
• All users’ interfaces are brought to Giant Center Router by optical transparently, only Giant Center Router processes Layer-3 functions.

Advantages
• 1000 : 1 power reduction
Thank you for your attention!

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http://www.yamanaka.ics.keio.ac.jp/