
Japan-EU Joint Research – GreenICN: Architecture and Applications of Green Information Centric Networking

Hidenori Nakazato[†], and Toru Hasegawa[‡]

[†] Waseda University

[‡] Osaka University

September 28, 2015

GreenICN Project

Project Partners

Objectives

Project Goals

Power Saving by
Caching

Current Status

Upcoming Workshop

- GreenICN is a project funded by both European Commission and Japanese government.
- The objective is to design a network and end-devices able to operate in a highly scalable, energy-efficient and backward compatible way while exploiting advantages of ICN.
- 3 year project started in April 2013.
- 6 European and 6 Japanese partners collaborate in the project.
- Website: <http://www.greenicn.org/>
- The GreenICN Network layer is an enhanced NDN module where we add additional functionality and improve existing solutions.

GreenICN Project

Project Partners

Objectives

Project Goals

Power Saving by
Caching

Current Status

Upcoming Workshop

European Partners

GEORG-AUGUST-UNIVERSITÄT
GÖTTINGEN

EU Coordinator

George-August-Universität Göttingen (Germany)



NEC Europe Ltd. (UK)



CEDEO (Italy)



Telekomunikacja Polska (Orange Labs, Poland)



University College London (UK)

Consorzio Nazionale Interuniversitario
per le Telecomunicazioni (Italy)

Japanese Partners



JP Coordinator

KDDI R&D Laboratories Inc. (Saitama)



NEC Corporation (Tokyo)



Panasonic Advanced Technology Development Co., Ltd. (Osaka)



University of Tokyo (Tokyo)

早稲田大学
WASEDA University

Waseda University (Tokyo)



Osaka University (Osaka)

GreenICN Project

Project Partners

Objectives

Project Goals

Power Saving by
Caching

Current Status

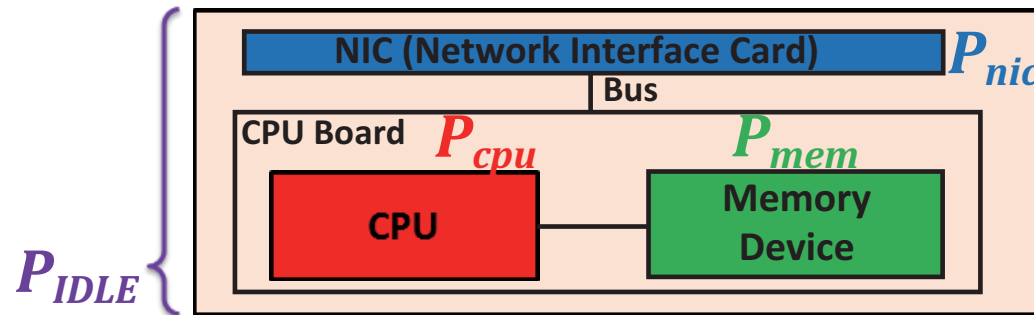
Upcoming Workshop

- GreenICN addresses how the ICN network and devices can operate in a highly scalable and energy-efficient way.
- Two exemplary application scenarios:
 1. Aftermath of a disaster:
 - ◆ Energy and communication resources are at a premium.
 - ◆ Efficient distribution of disaster notification and rescue information is critical.
 - ◆ Key issue: Ability to exploit fragmented networks with only intermittent connectivity.
 2. Video delivery:
 - ◆ Video consumes large part of current network bandwidth.
 - ◆ Efficient delivery of video is crucial to have successful deployment of ICN networks.
 - ◆ Key issue: Scalable and efficient video delivery exploiting features of ICN such as in-network caching and name-based forwarding while saving energy consumption.

- **Reduction of power consumption** is one of the goals
 - ◆ **20%** for normal days
 - EU aims to reduce 20% of the total energy consumption of all EU countries.
 - Japan aims reduce energy consumption 30% by 2030, compared to that in 2003.
 - ◆ **40%** for Disasters
 - In 2011, people in Tohoku area suffered 3 days of blackout because of the East Japan Earthquake.
 - Reduction to make communication services and related base stations able to operate 3 days in such a scenario.

- Caching is the main driver of power reduction
- We created a power consumption model of an NFD (NDN Forwarding Demon) multicore software router
 - ◆ Precise estimation of power consumption by NFD protocol computations: Per-packet caching, name-based forwarding, PIT handling
 - ◆ Identifying the most power consuming computations: caching

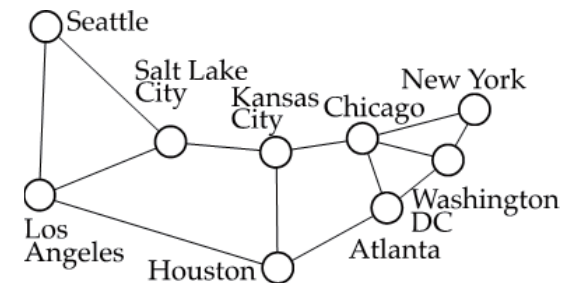
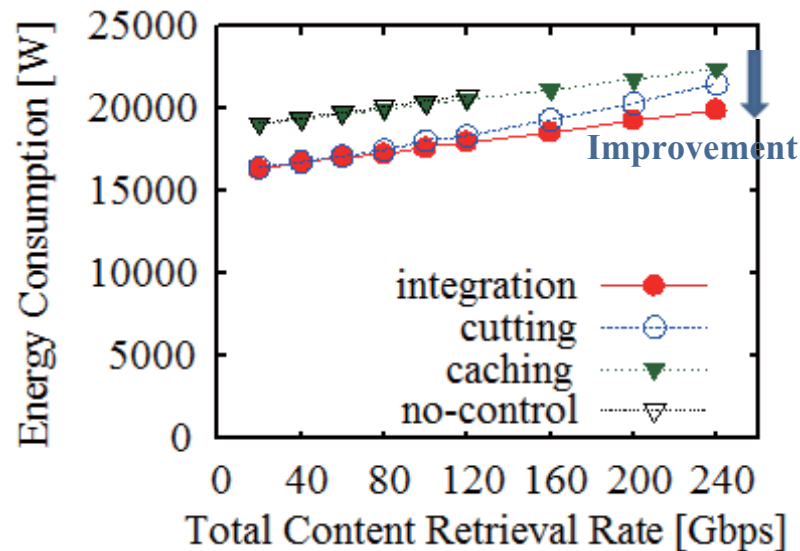
$$P_{router}(cores, bytes, pkts_{rate}) = P_{cpu}(cores) + P_{mem}(bytes) + P_{nic}(pkts_{rate}) + P_{IDLE}$$



T. Hasegawa, Y. Nakai, K. Ohsugi, J. Takemasa, Y. Koizumi, I. Psaras, "Empirically modeling how a multicore software ICN router and an ICN network consume power," in Proceedings of ACM ICN, pp.157-166, September 2014.

Power saving is the tradeoff between traffic reduction and (power-hungry) per-packet caching

- Comparison of four cases: 1) Caching, 2) Energy-aware routing with link halting, 3) Caching + energy-aware routing (integration) and 4) without either caching or energy-aware routing
- Caching enhances the energy saving effect of energy-aware routing, which frees links by moving their traffic onto other links and turns off the power of unused links



GreenICN Project

Project Partners

Objectives

Project Goals

Power Saving by
Caching

Current Status

Upcoming Workshop

- Deliverables:
 - ◆ 33 internal documents (out of 54) were completed.
- Liaisons with other groups:
 - ◆ MPEG
 - ◆ IRTF ICNRG
 - ◆ ITU-T, Study Group 13, Question 15: Future Networks

GreenICN Project

Project Partners

Objectives

Project Goals

Power Saving by
Caching

Current Status

Upcoming Workshop

- Title: Research Activities and Future of EU/US/JP ICN Projects Workshop
- Date: 30 October 2015
- Venue: Ono Auditorium, Waseda University, Tokyo
- **Please join!**

GreenICN Project

Project Partners

Objectives

Project Goals

Power Saving by
Caching

Current Status

Upcoming Workshop

■ Program

1. GreenICN Project (1h)

- ◆ Overview / Mayutan Arumaithurai (Goettingen Univ.)
- ◆ Energy Consumption / Toru Hasegawa (Osaka Univ.)
- ◆ Disaster Scenario (Jan Seedorf/NEC Europe)
- ◆ Video Scenario (Ioannis Psaras /UCL)

2. Standardization (1h)

- ◆ IETF, IRTF / Dirk Kutscher (NEC Europe)
- ◆ ITU-T / Ved Kafle (NICT)

3. ICN Activities in US, EU (1h)

- ◆ NDN / Lixia Zhang (UCLA)
- ◆ CCN / Glenn Edens (PARC)
- ◆ EU Project / Vasilios A. Siris (Athens Univ. of Economics and Business)

4. Panel (1h)

Theme: How to increase ICN deployment/adoption on a worldwide scale
Coordinator: Tohru Asami (Unv. of Tokyo)