ICL Testbed Environment and Configuration

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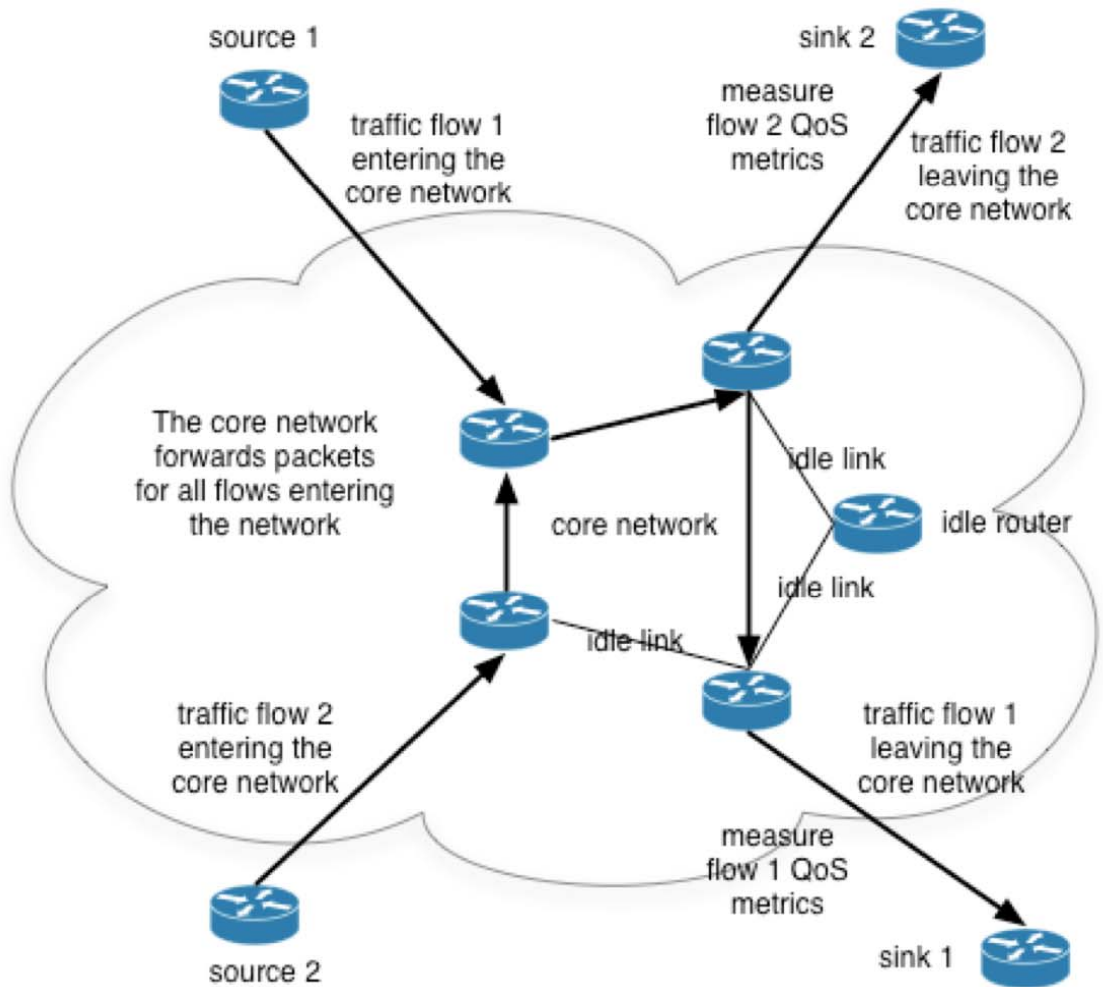
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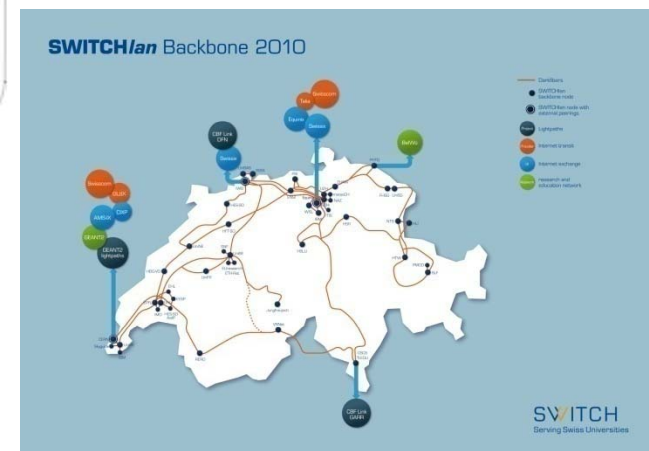London SW7 2BT, UK

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Testing methodology

Summary of the works being done

Testbed environment

➢ Power measurement

➢ Test topology – numerical results

We built a similar topology to the Swiss Education Network for our experimental examinations.

WP 6 – Summary of Work

➢ Network power measurement and profiling (the required hardware is built)

➢ **Autonomic Energy-Aware Routing** policy based on reinforcement learning (implemented and tested in the ICL testbed), and **load transfer algorithm** based on a queuing network model (theoretical work that is not implemented yet) to reduce the overall network power consumption.

➢ Publications

   ✓ E. Gelenbe, T. Mahmoodi, **Energy-aware routing in the Cognitive Packet Network**, Energy '11, May 2011

   ✓ T. Mahmoodi, **Energy-aware routing in the Cognitive Packet Network**, Performance Evaluation, Elsevier , Feb. 2011

   ✓ E. Gelenbe, C. Morfopoulou, **A Framework for Energy Aware Routing in Packet Networks**, The computer Journal, Dec. 2010

   ✓ R. Lent, **Simulating the Power Consumption of Computer Networks**, CAMAD '10, Dec. 2010.

   ✓ R. Lent, **A Sensor Network to Profile the Electrical Power Consumption of Computer Networks**, GLOBECOM '10, Dec. 2010

   ✓ E. Gelenbe, C. Morfopoulou, **Routing and G-networks to optimise energy and quality of service in packet networks,** E-Energy '10, Oct. 2010

FIT4 GREEN

Electrical Power Usage Monitoring System (EPUMS) can monitor and report (over the network) individual observations of the power consumption of a large number of devices.
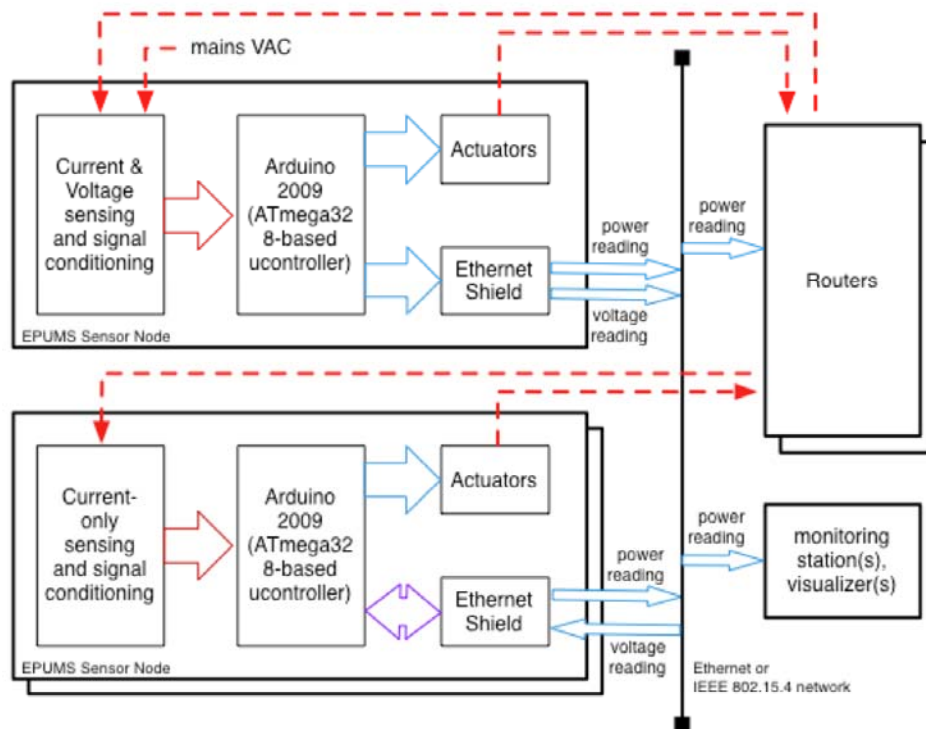

Main components of EPUMS network

➤ EPUMS consists of a network of sensor nodes connected through Ethernet.

➤ Each sensor node is a micro-controller embedded system (based on Arduino 2009) and provisioned with a number of current and voltage sensors.

➤ A kernel device driver is developed later to encapsulate all power profiling information.

WP 6 – ICL Testbed Environment

Power consumption is estimated from the AC current measurements.

➢ The AC current entering a router is sensed with a current clamp that is inserted around one of the cables connecting the router's power supply.

➢ The signal is converted into a voltage level and also filtered to remove spurious noise before sending it to one of the micro-controller's ADC ports.

WP 6 – ICL Testbed Env. (test topology)
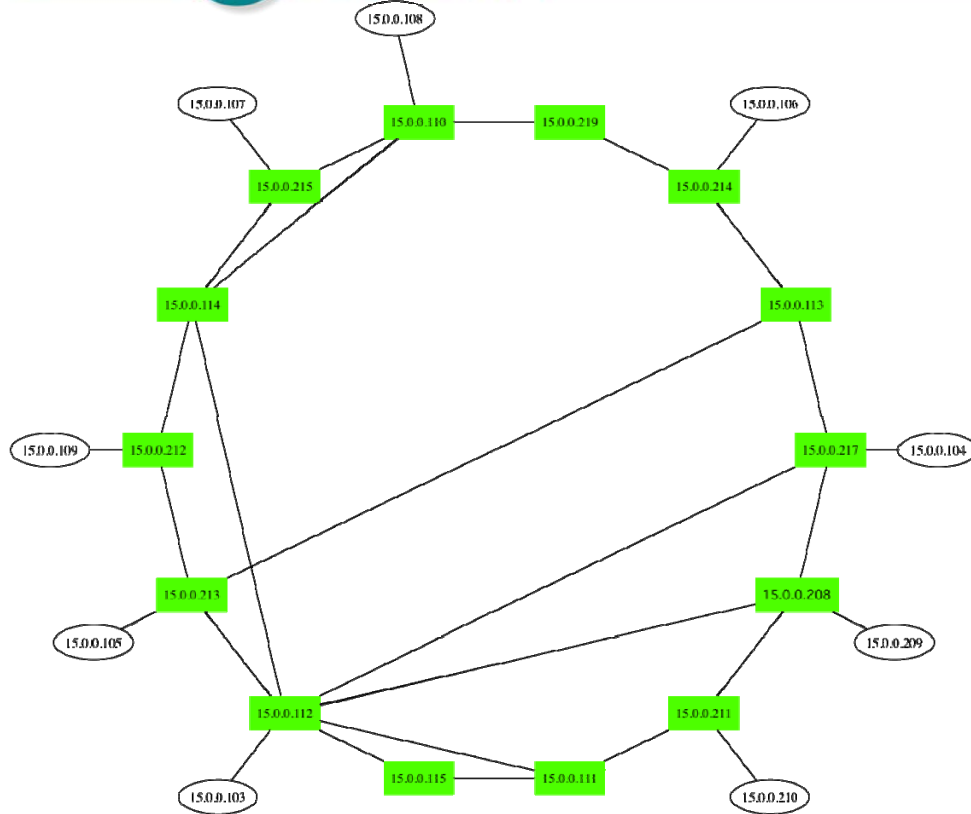
> Measured values of power consumption are encapsulated in the packets and being transmitted over random paths towards the destination.

> These packets discover a rout with the lowest power consumption, which data packet s will follow [1].

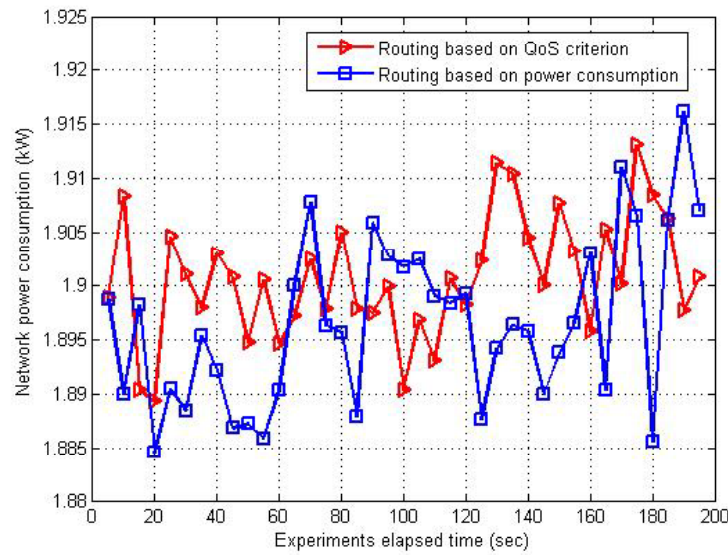**Nodes in the core of network are equipped with EPUMS**

[1] E. Gelenbe, Steps Towards Self-Aware Networks. Communications of the ACM Vol. 52, No. 7, July 2009.
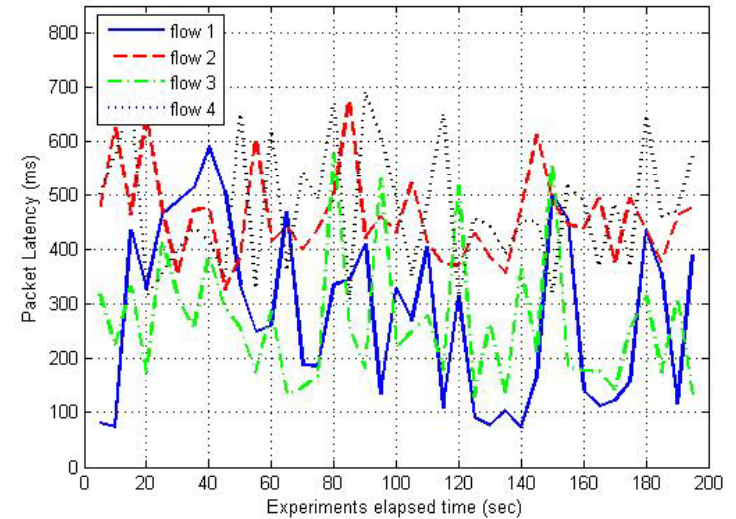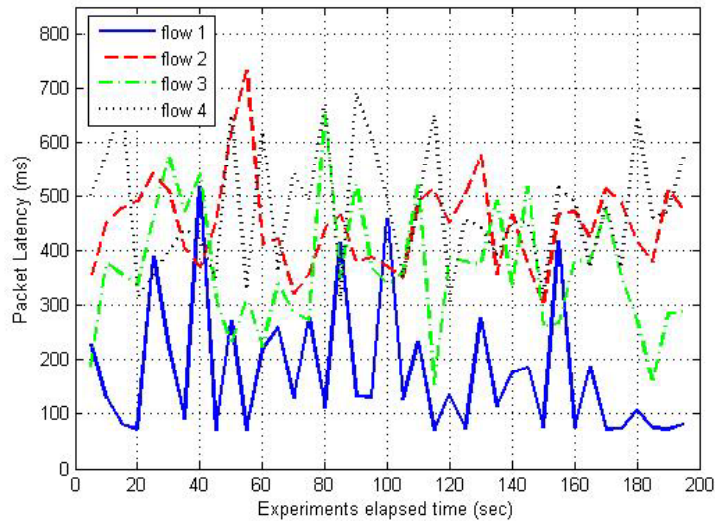
Up, left: Packet Latency when routing is solely based on QoS

Up, right: Packet Latency when routing is based on QoS and Power

Down: Network power consumption

Flow 1:
109->104, 30 kpps
Flow 2:
105 ->106, 10 kpps
Flow 3:
107-> 209, 20 kpps
Flow 4:
108 ->210, 5 kpps