(DRAFT) LECTURE SUMMARIES (Jan 2012)

2 nd COST 804 TRAINING SCHOOL on ENERGY EFFICIENCY IN LARGE SCALE DISTRIBUTED SYSTEMS

DATES: Tuesday 24 April (09h) to Friday 27 April 2012 (13h)
LOCATION: Palma de Majorca, Balearic Islands, Spain

Deadline for applications for participation and travel grants: 20 February 2012

This document present in a preliminary version the lecture summaries planned for the Training school. The organizers reserve the right to add or modify a few lectures. It does not constitute either a program. The content may also be adjusted to meet demands and levels of the yet-to-be accepted trainees. If the Training School is held, a Final program will be disseminated to successful applicants a few weeks before start.

I) BACKGROUNDER ON GREEN ITC TECHNOLOGIES

Prof L-F Pau, Copenhagen Business School (DK) and Rotterdam school of management (NL)

Abstract: This lecture covers the general contexts and frameworks in which Green ITC technologies are deployed: environmental regulations, emissions profiles from devices and activities, energy consumption and emissions evaluation methodologies, building regulations' impact as receptacles of ICT systems. It introduces cross-domain approaches and processes to reduce energy consumption and emissions from information, computing and telecommunications systems, as well as applications at design and usage levels. It is an introduction to the following domain specialized lectures.

1. Units, climate & energy policies
2. Methodologies
3. Component technologies
4. Green Information systems
5. Green Communications networks
6. Power grids
7. Other networks
8. Buildings
9. Economics, trading and business

10. Regulatory design

II) SMART GRIDS AND ENERGY EFFICIENT ICT

Prof. Paul Nicolae BORZA, Transylvania University (RO)

Abstract:

1-Definition of Smart Grids (SG)

2-About the fusion between energy and Information, and the role of grids' fusion in improving the energy efficiency in power generation and distribution.

3-How are implemented generation and control in power networks; technology components in the production and distribution of electrical energy; active versus reactive power; power generation -based components; secondary and tertiary reserves.

4-New changes to the power grids ("smart grids"):

a) New trends in hardware implementation; massive implementation of information networks in the power generation and distribution domains; improvements to power generation:
   * on one side, the development of distributed and interrupted power sources (Solar, Wind, Micro-Hydro),
   * and on the other side, the improvement of energy management technologies driven by the integration of all existing elements in power networks using adequate software tools and technologies.
b) Energy storage elements: short comparison ; chemical systems, hydrogen as power vector (electrolysis & fuel cells) , mechanical fly-by-wheel systems (big UPS based on storage of the mechanical energy), electrical super capacitors & batteries systems (hybrid storage), thermal storage systems.
c) New trends in technical control of power generation and distribution: architectural and functional aspects; insertion of new metering solutions that create the preconditions for stimulation of adequate consumption in power networks; advanced metering infrastructures; dynamic tariffs and diffusion of different market model that govern the modern and efficient networks; load profiling; changes in demand-generation and balancing processes; introduction of intelligent consumers leading to the introduction of behavior dependent elements inside the power networks; integration and aggregation of power networks especially at local and distribution levels.

5-Consequences of power grid modernization:

a) Energy provider's perspectives
b) Consumer's perspectives
c) Educational consequences
d) Market perspectives
e) Policy perspectives

6-How is the trade-off between dependable power versus the power grid evolution?

III) ALGORITHMIC TECHNIQUES FOR REDUCING ENERGY CONSUMPTION OF COMMERCIAL WEB SEARCH ENGINES

Dr Berkant Cambazoglu, Yahoo Research (Spain)

Abstract : Commercial web search engine companies make costly investments on very large compute infrastructures to be able to cope with the growth of the Web and user query traffic volumes. The massive compute infrastructures maintained by the search engines lead to high amounts of energy consumption and, in turn, high electricity bills. Reducing the energy consumption is crucial for the profitability of a search engine and this should be carefully done, without degrading the quality of the service provided by the search engine.

The main focus of this tutorial is to illustrate the scalability challenges in large-scale web search engines and to introduce some algorithmic techniques that are commonly used to reduce the energy consumption. The tutorial is composed of three parts. The first part will warmup the trainees with some background material on the three main functional components of a large-scale web search engine (crawler, indexer, and query processor) and will introduce the efficiency challenges associated with each component. The second part of the tutorial will introduce some important algorithmic techniques that are employed by the search engines for reducing the energy consumption in their operational tasks. Finally, the third part will present the multi-site distributed web search engines that have recently attracted much research attention and demonstrate their potential for achieving further energy savings.

Outline:
1 hour: Main components of web search engines: crawling, indexing, query processing.
1 hour: Algorithmic techniques for reducing the energy consumption in web search engines.
1 hour: Multi-center distributed web search engines and their potential for achieving energy savings.

IV) ENERGY EFFICIENCY (EE) OVER WIRED NETWORKS

Assistant Professor Alberto E. García, Telematic Engineering Group, University of Cantabria (ES)

Abstract: This tutorial exposes the actual state of the standards and gives new proposals to reduce the energetic consumption balance in fixed FGN network deployment. This reduction is focalized into two different ways: link and node based solutions. The first solutions use variations of actual transmission technologies to minimize the consumption of the physical links between transmissions, or to reduce the number of active paths. The second group of solutions tries to reduce the global bandwidth in the networks, localizing service control directly under the influence of the clients, and distributing the load of centralized datacenters towards smaller peripheral ones. Additionally, this lecture gives a view on the impact of the application of these techniques according to several scenarios, from the point of view of the backbone and access networks, and their effect on the design and deployment.

1. Actual state
2. Link based solution

3. Node based solutions
4. EE over the backbone
5. EE over the access

V) ENERGY CONSERVATION IN WIRELESS SENSOR NETWORKS

Prof. Giuseppe ANASTASI, Dept. of information engineering, University of Pisa (IT)

Abstract: Wireless sensor networks (WSNs) consist of a number of sensor nodes deployed over a geographic area. Sensor nodes are tiny devices typically powered by batteries with a limited energy budget. Energy conservation is thus the main concern in the design of any WSN-based system.

This tutorial will first analyze where and how energy is consumed at sensor nodes. Then, it will introduce a taxonomy of the main approaches to energy conservation in WSNs, and it will survey the main techniques used in practice.

V) ENERGY and EMISSIONS SAVINGS IN PUBLIC WIRELESS NETWORKS

Prof. L-F Pau Copenhagen Business School (DK) and Rotterdam school of management (NL)

Abstract:
1. As public wireless networks constitute today the dominant communications facility globally, and as it is historically also the ICT system having first focused on energy systems, the tutorial will focus on key technologies, energy sources (incl. renewables) and trade-off/ selection methodologies. It will also show and quantify how end user service demands drive energy consumption alongside infrastructure, and how inefficient energy operations management affects the emissions and business outcomes.
2. *Case demonstration*: Will be demonstrated a simplified version of a unique industrial tool whereby mobile network operators design 3G/LTE wireless networks for best energy efficiency, and run these operations with minimal on-going energy consumption .It serves as a live illustration of trade-offs in an industrial setting. The full tool cannot be demonstrated as it involves heavy computations and a high performance computing environment.