

TF5

Energy/Cost Aware network
management

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ACROSS

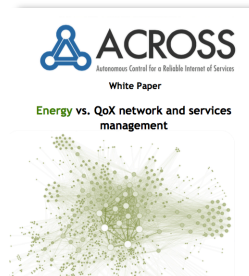
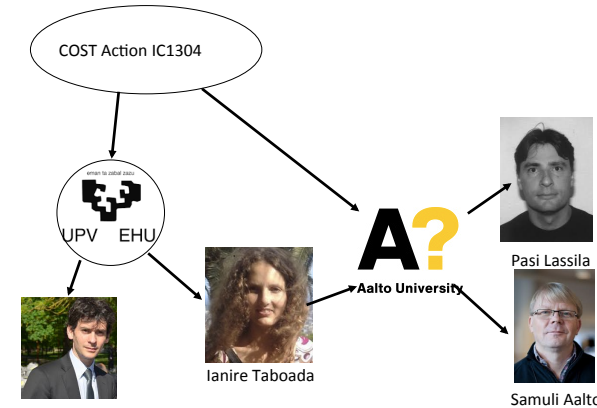
Autonomous Control for a Reliable Internet of Services

Scope

- Analysing the commonalities of research activities involving multiple “energy vs. cost vs. any other KPI” problems
 - Network and Service management
 - Multi-criteria trade-offs
 - Beyond simple criteria+constraints
- Towards 5G, Telco BSS, Cloud/NFV/SDN
 - Stochastic, Index-Rule (UPV/EHU+AALTO) + Robust Optimization (UPV/EHU \leq KAU), Technical (Innovati)
- Members
 - Innovati (ES), AALTO (FI), UPV/EHU (ES), Poli Milano (IT)

Summary of activities

- STSM
 - I. Taboada (EHU) to AALTO Jun'15
 - Collaboration
 - Research Papers
- Analysis of possible joint R&D proposals
- Visit from Pasi Lassila to Bilbao (May-Jun'17)
- White Paper => Book Chapter



Energy vs. QoX Network- and Cloud Services Management

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Abstract. Network Performance (NP)- and more recently Quality of

Research outcomes

• Journal Papers

- Ianire Taboada, Samuli Aalto, Pasi Lassila, Fidel Liberal, **“Delay- and Energy-Aware Load Balancing in Ultra-Dense Heterogeneous 5G Networks”**, Transactions on Emerging Telecommunications Technologies, Volume 28, Issue 9, September 2017.
- Bego Blanco, Ianire Taboada, Jose Oscar Fajardo, Fidel Liberal, **“A Robust Optimization Based Energy-Aware Virtual Network Function Placement Proposal for Small Cell 5G Networks with Mobile Edge Computing Capabilities”**, Mobile Information Systems, Volume 2017, 14pp, October 2017.
- Ianire Taboada, Fidel Liberal, Jose Oscar Fajardo, Bego Blanco, **“An Index Rule Proposal for Scheduling in Mobile Broadband Networks with Limited Channel Feedback”**, Performance Evaluation (In Press).
- T.T.N. Ho, M. Gribaudo, and B. Pernici, **“Characterizing Energy per Job in Cloud Applications”**, Electronics, Vol. 5(4), Special Issue on Energy Saving in Data Centers (2016)
- M. E. Gebrehiwot, S. Aalto and P. Lassila, **“Energy-performance trade-off for processor sharing queues with setup delay”** Operations Research Letters, vol. 44, pp. 101-106, 2016.
- M. E. Gebrehiwot, S. Aalto and P. Lassila, **“Optimal energy-aware control policies for FIFO servers”** Performance Evaluation, vol. 103, pp. 41-59, 2016.
- X. Lu, S. Aalto and P. Lassila **“Performance-Energy Trade-Off in Controllable Servers with Setup Delays”**, Australian Journal of Electrical and Electronics Engineering, vol. 13, no. 2, pp. 109-121, 2016.
- M. E. Gebrehiwot, S. Aalto and P. Lassila, **“Energy-aware SRPT server with batch arrivals: analysis and optimization”**, Performance Evaluation, vol. 115, pp. 92-107, 2017.

• Book chapters

- Ruben Solozabal, Bego Blanco, Jose Oscar Fajardo, Ianire Taboada, Fidel Liberal, Elisa Jimeno, Javier G. Lloreda, **“Design of Virtual Infrastructure Manager with Novel VNF Placement Features for Edge Clouds in 5G”**, Engineering Applications of Neural Networks , pp. 669-679, Springer, 2017.
- Bego Blanco, Fidel Liberal, Pasi Lassila, Samuli Aalto, Javier Sainz, Marco Gribaudo, Barbara Pernici, **“Energy vs. QoS Network- and Cloud Services Management”**, Autonomous Control for Reliable Internet of Services, Lecture Notes in Computer Science, Springer (under minor revision).

• Conference papers

- M. E. Gebrehiwot, S. Aalto and P. Lassila, **“Optimal sleep-state control of energy-aware M/G/1 queues”**, in Proc. of 8th International Conference on Performance Evaluation Methodologies and Tools (Valuetools), pp. 82-89, 2014.
- M. E. Gebrehiwot, S. Aalto and P. Lassila, **“Energy-aware SRPT queues with setup delay”**, In Proc. of 13th International Conference on Quantitative Evaluation of SysTems (QEST 2016), pp. 107-122, 2016.
- M. E. Gebrehiwot, S. Aalto and P. Lassila, **“Energy-aware control of server farms”**, In Proc. of 39th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), pp. 748-753, 2016.
- M. E. Gebrehiwot, S. Aalto and P. Lassila, **“Near-optimal policies for energy-aware task assignment in server farms”**, In Proc. of 17th IEEE/ACM International Symposium on Cluster Cloud and Grid Computing (CCGRID), pp. 1017-1026, 2017.

Future

- Ongoing research collaboration
 - UPV/EHU and AALTO, KAU...