



5GrEEen

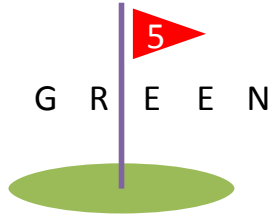
Towards Green 5G Mobile Networks

ETSI workshop

7-8 October 2013, Athens, Greece

Magnus Olsson

Ericsson Research, Stockholm, Sweden



Background & Introduction

- RAN Energy Efficiency is an important topic
 - Reduce OPEX and CO₂, while handling traffic growth
- First round of Energy Efficiency related projects finalized with impressive results
 - EARTH, Mobile VCE Green Radio, GreenTouch*, ...
 - Significant savings for current technologies (>50%)
- 5G research has now started
 - Design for Energy Efficiency from the start

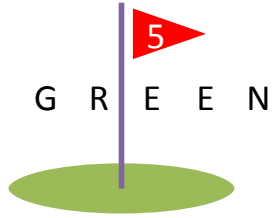
*: Running until 2015, but first results available.



What is 5GrEEn?

- A project running under (and funded by) the EIT ICT Labs
- Focused on Energy Efficiency aspects and solutions for 5G mobile networks
- Tightly coupled to the EU FP7 project METIS (carrier project)





5GrEEn partners

- KTH, Royal Institute of Technology, Sweden
- AALTO University, Finland
- Ericsson, Sweden
- Telecom Italia, Italy



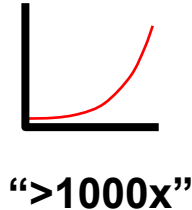
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5G challenges (1/2)

- Thousand-fold traffic increase
 - MBB expansion
 - New sources of traffic
- Hundreds of billions of devices
 - Communicating machines, Internet-of-things
- Diverse requirements
 - Low latency, high/low reliability, large/small amounts of data, etc.





5G challenges (2/2)

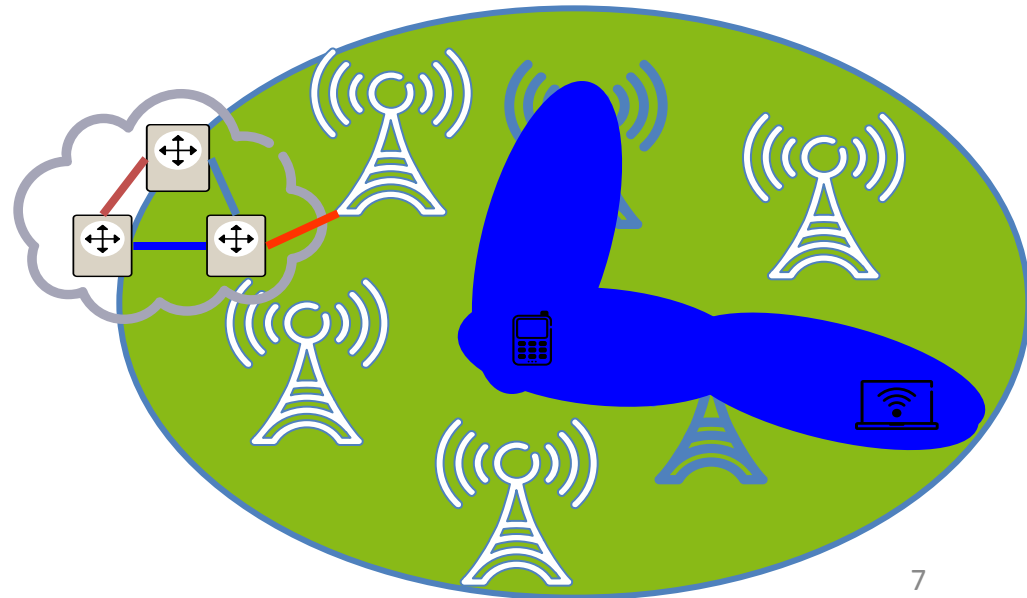
- Affordability and sustainability
 - CAPEX and OPEX
- Low energy consumption is key!!
- 5GrEEEn target: Factor of 10 reduction vs today and fulfilling all other requirements!
 - EARTH: Factor of 4 reduction vs 2012 baseline
 - GreenTouch: Factor of 10 reduction vs 2010 baseline





Focus areas & potential solutions: System architecture

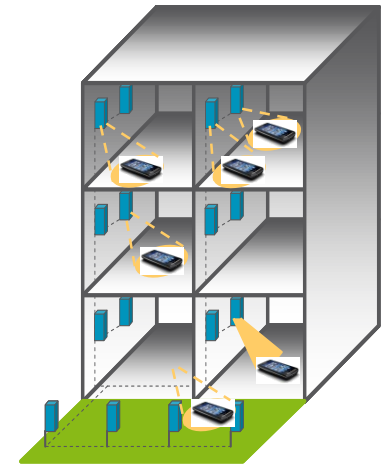
- From ***always on...*** to ***always available!***
- Logical decoupling of system plane and user plane
 - Cells are dynamically configured to support active users/devices
 - Enables BS DTX/DRX and high gain beamforming

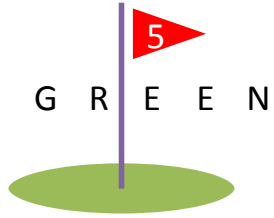




Focus areas & potential solutions: Network deployment

- Heterogeneous LTE network deployments beneficial from EE perspective
- Ultra-dense deployments to handle 5G capacity demands
- Heterogeneous ultra-dense layouts considering system architecture

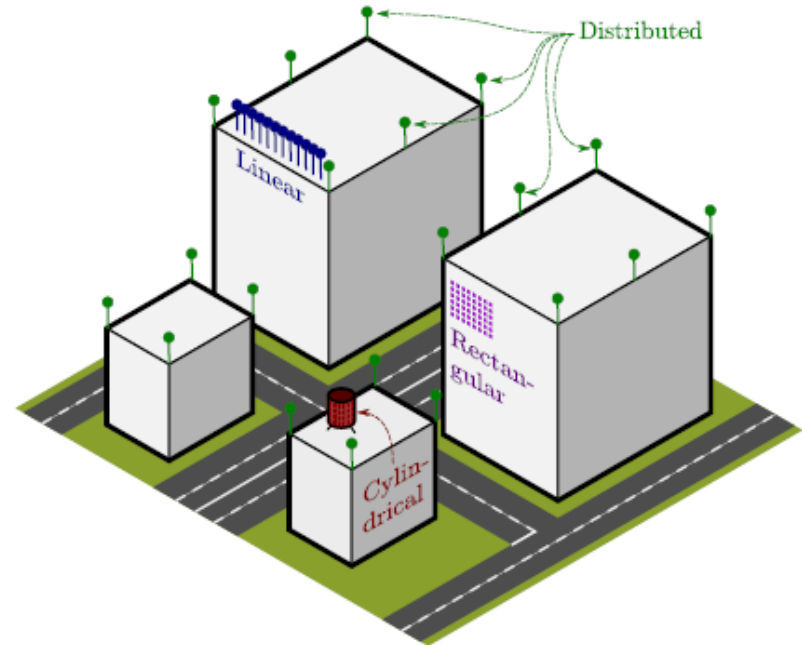


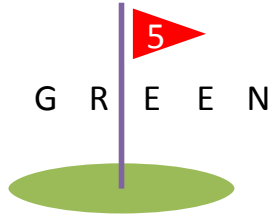


Focus areas & potential solutions:

Radio transmission

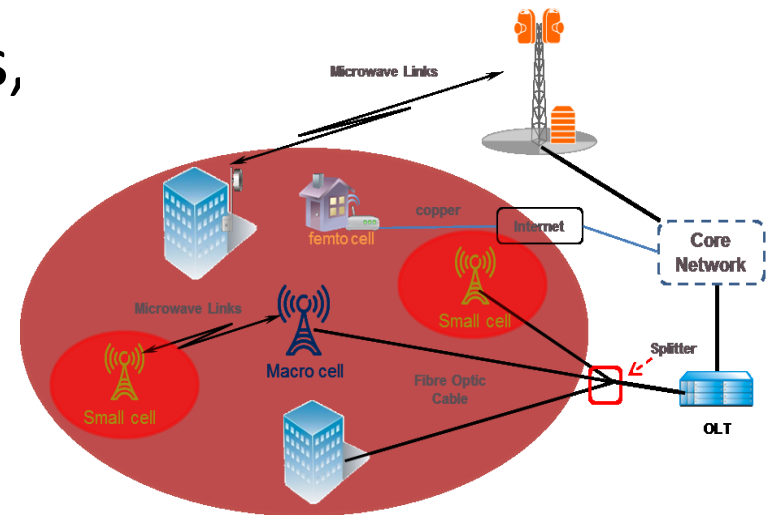
- Massive MIMO – an EE enabler!
- Why:
 - Focus emitted energy to where the terminals are located
 - Improve data rates (more sleep mode)
 - Reduce interference (less tx-power required)
- EE related issues:
 - BB-processing energy consumption
 - Data protocol design





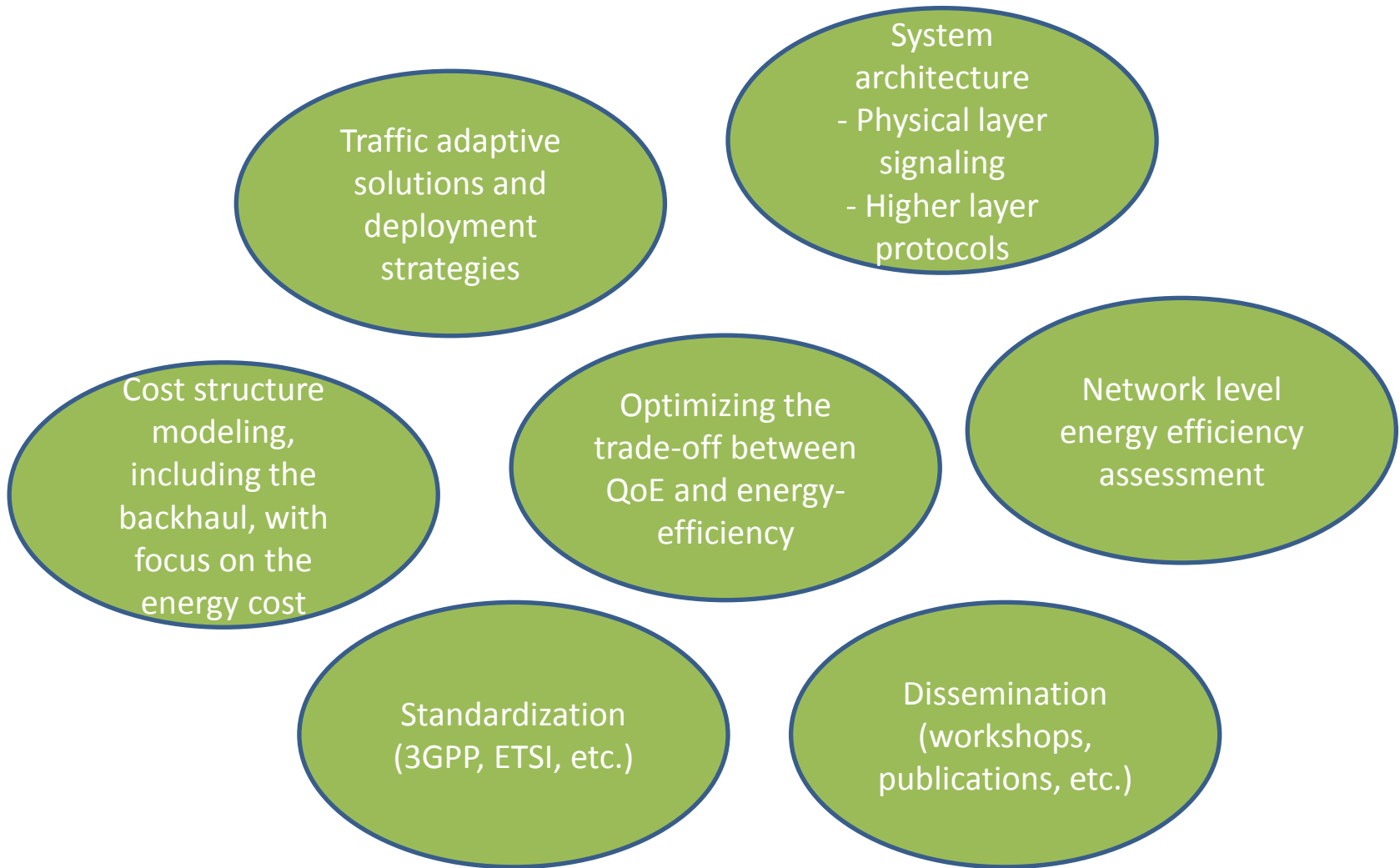
Focus areas & potential solutions: Backhauling solutions

- Backhauling energy consumption increasingly important, especially when going for heterogeneous small cell deployments
 - May become a bottle-neck in 5G
- Evaluations of architectures, topologies, and also new technologies (for example hybrid solutions)





2013 activities





2014 activities

Dissemination
(workshops,
publications, etc.)

Architectural
solutions for
sparse areas

Network energy
efficiency impacts
on terminals

Network level
energy efficiency
assessment &
experimentation

Architectural
solutions for
dense areas

Standardization
(3GPP, ETSI, etc.)





Summary

- 5GrEEn – Towards Green 5G Mobile Networks
 - Supported by EIT ICT Labs
 - Tightly connected to METIS
 - Focus on Energy Efficiency aspects of 5G
- Targets to fulfill 5G challenges with a factor of 10 lower energy consumption than today
- Focus areas and potential solutions:
 - System architecture, network deployment, radio transmission, backhauling solutions
- Will continue in 2014



Thank you!