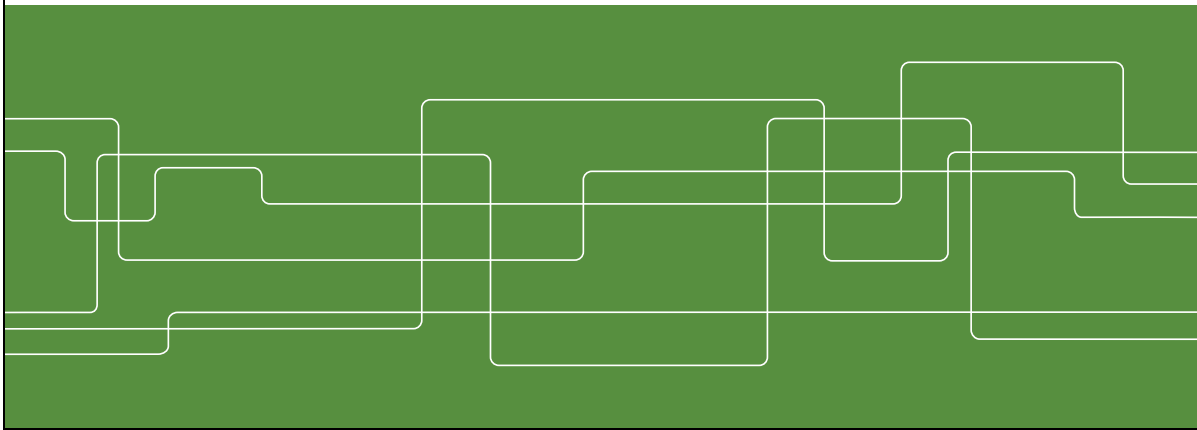


Slide 1



Green Networks

II2202
Markus Hidell



Slide 2



Why Save Energy?

Main reasons

- Support units with limited power supply
 - Sensors, mobile phones, etc. — saving battery
- Reducing greenhouse gas emissions (EC climate action)
 - Requires clean technologies in all industrial sectors
- Network deployment in challenged environments
 - Electricity often a limited resource
- Power outages in conjunction with natural disasters
 - Communication may rely on battery to work
- Economic concerns
 - Operators reduce costs by consuming less power

Slide 3



ICT and Sustainability

GeSI: Global e-Sustainability Initiative

- Source for information on ICT and sustainability

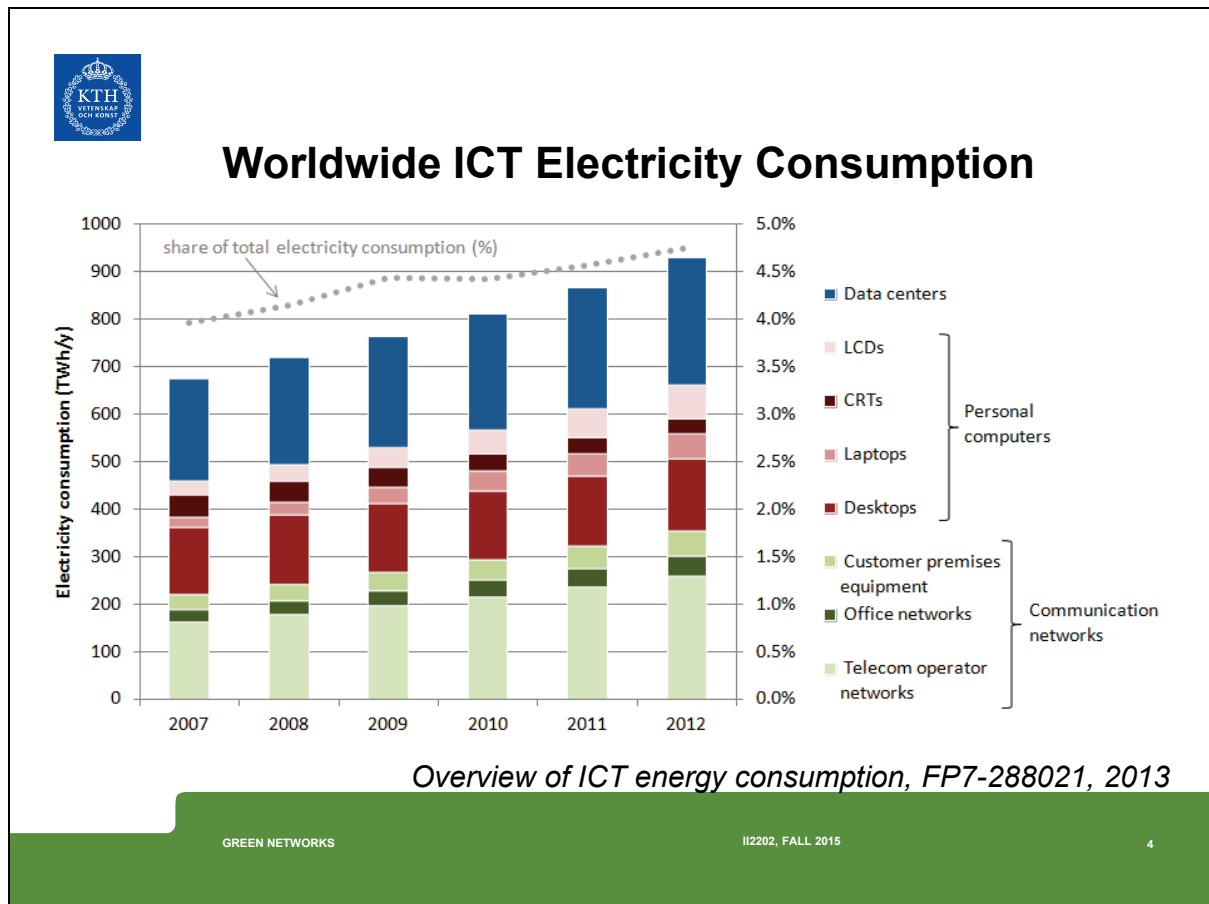
GeSI's SMARTer 2020 report (published in 2012)

- Smart solutions to reduce green house gas emissions (GHG)
- 2% of global GHG emission from ICT today
- 3.8% increase per year is expected

CO₂ emission comparable to aviation industry

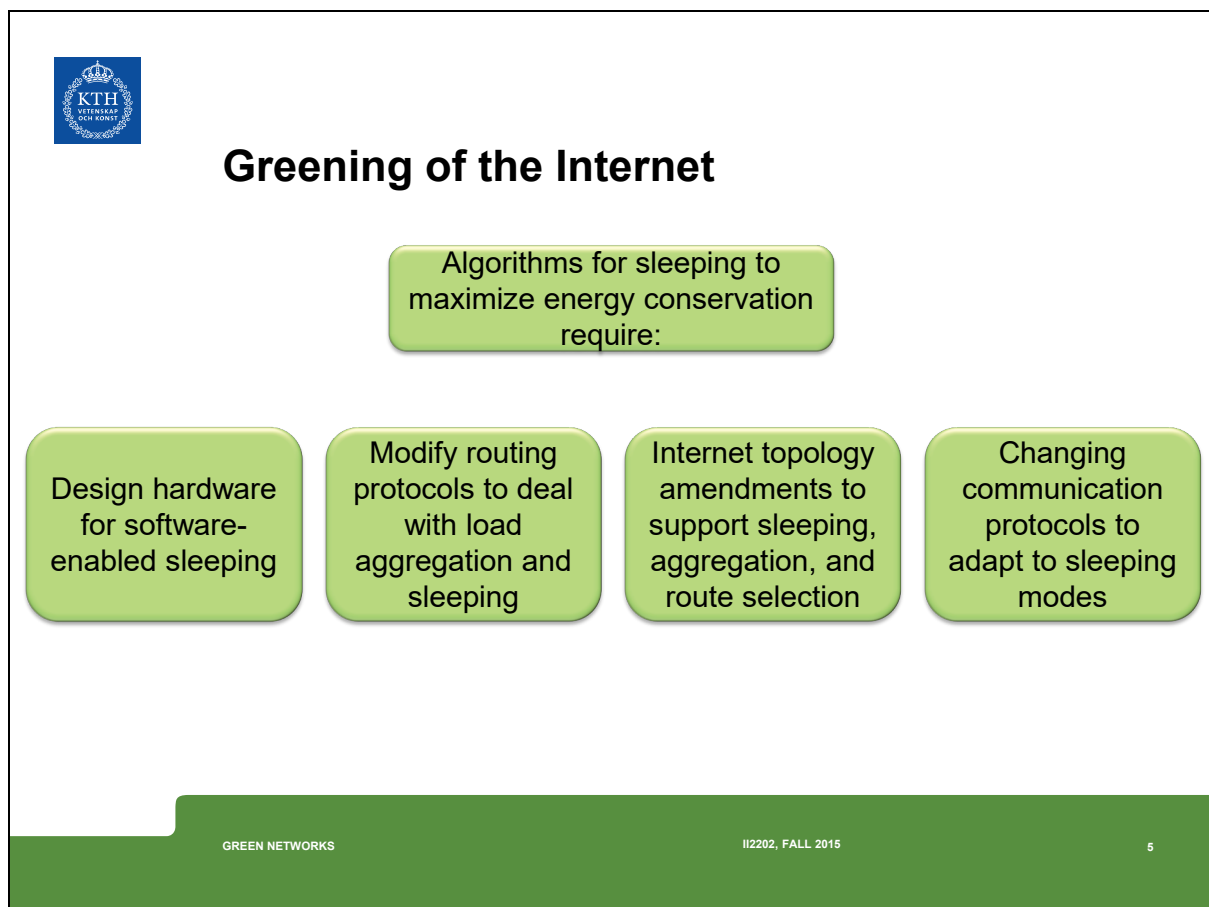
GeSI's SMARTer 2020 report (published in 2012) <http://gesi.org/SMARTer2020>

Slide 4



Network of Excellence in Internet Science, 'D8.1. Overview of ICT energy consumption',
 Network of Excellence in Internet Science, FP7 - 288021 D8.1, Feb. 2013 [Online]. Available:
http://www.internet-science.eu/sites/eins/files/biblio/EINS_D8%201_final.pdf

Slide 5



Gupta and Singh suggest that sleeping appears to be the appropriate way to maximize energy conservation in the internet.

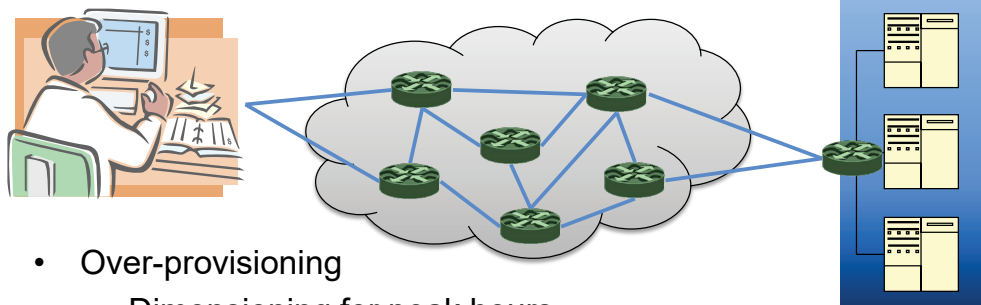
Encouraged from earlier research on reducing energy consumption in wireless networks (ad hoc networks and sensor networks).

Maruti Gupta and Suresh Singh, 'Greening of the internet', presented at the 2003 conference on Applications, technologies, architectures, and protocols for computer communications SIGCOMM '03, 2003, pp. 19–26 [Online]. DOI: 10.1145/863955.863959

Slide 6



Traditional Networking Objectives



- Over-provisioning
 - Dimensioning for peak hours
- Redundancy
 - Always on to support mission-critical applications

As opposed to objectives with green networking and energy-awareness!

Rule of thumb (Cisco, 2005) states that today's backbone networks are used 40% or lower of their capacity.

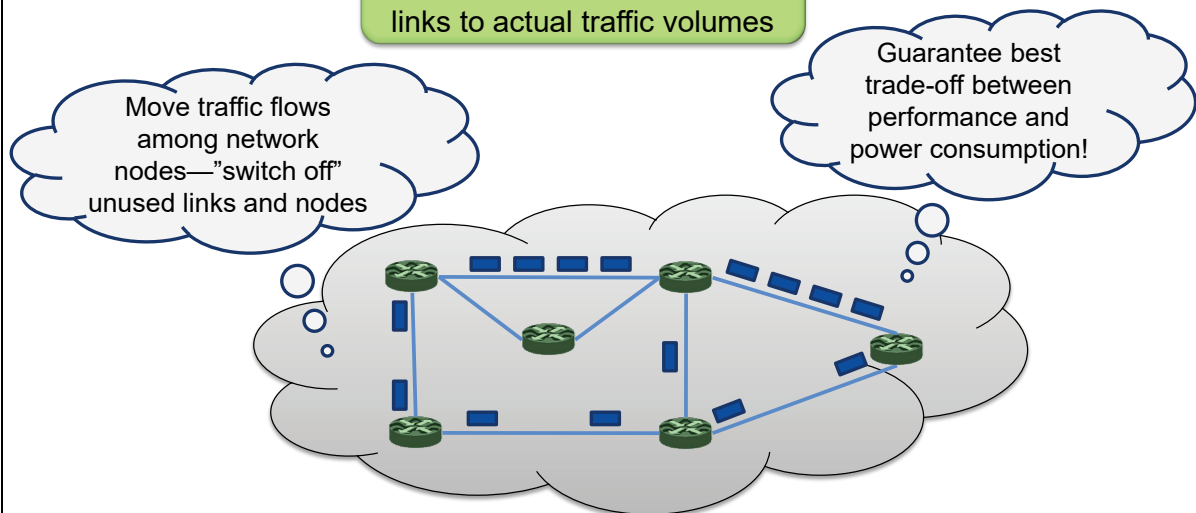
Jim Guichard, François Le Faucheur, and Jean-Philippe Vasseur, *Definitive MPLS network designs*. Indianapolis, IN: Cisco Press, 2005, ISBN: 978-1-58705-186-9 [Online]. Available: <http://www.ciscopress.com/store/definitive-mpls-network-designs-9781587051869>

Slide 7



Green Network Control—Basic Idea

Adapt network capacity in terms of active nodes and links to actual traffic volumes

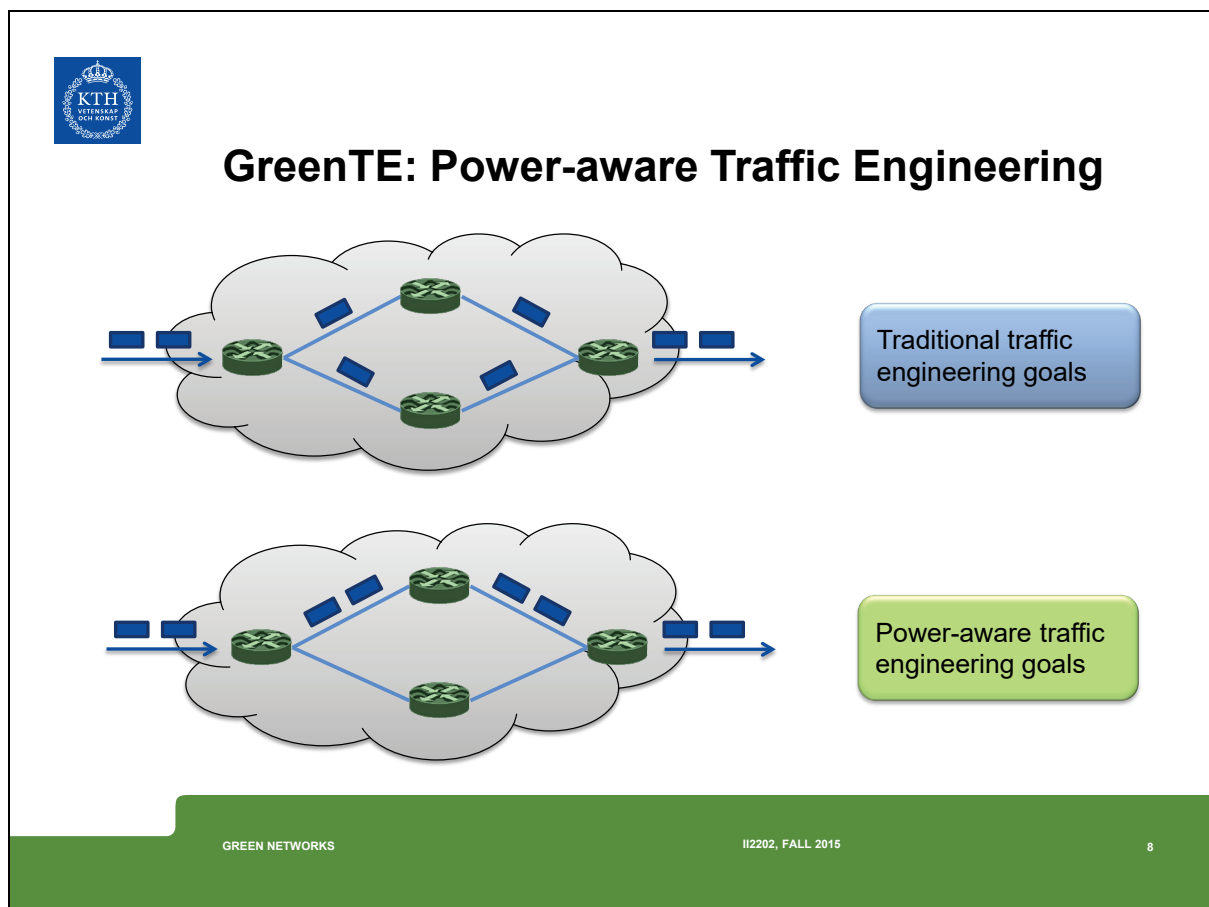


GREEN NETWORKS

II2202, FALL 2015

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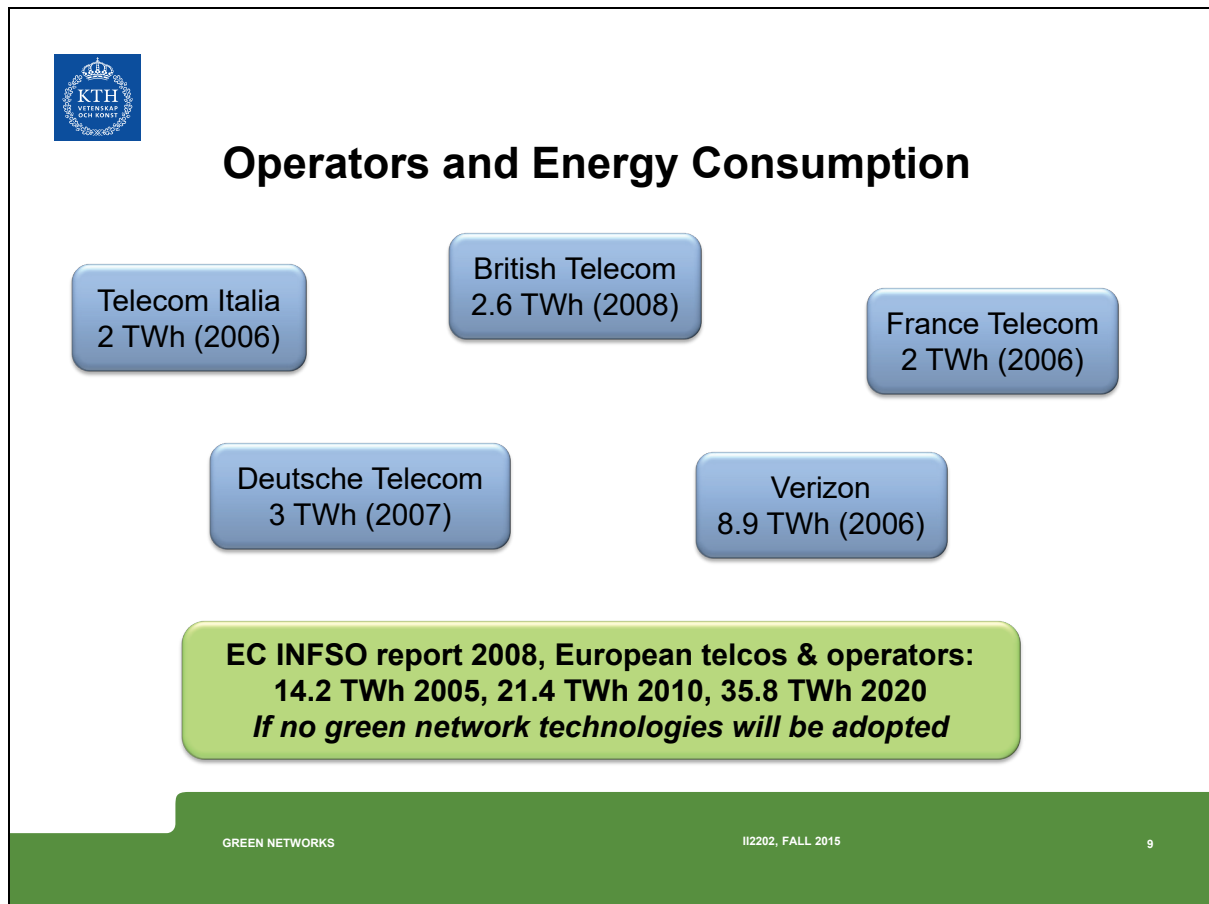
Slide 8



EAR does not take into account traffic matrix and QoS constraints.
GreenTE takes traffic matrix into account.

Mingui Zhang, Cheng Yi, Bin Liu, and Beichuan Zhang, 'GreenTE: Power-aware traffic engineering', presented at the Proceedings of the The 18th IEEE International Conference on Network Protocols ICNP '10, Washington, DC, USA, 2010, pp. 21–30 [Online]. DOI: 10.1109/ICNP.2010.5762751

Slide 9



Telecom Italia: 1% of total energy demand in Italy. 70% infrastructure, 10% data centers

British Telecom: single biggest power consumer in UK

Verizon: 0.26% of USA energy demand

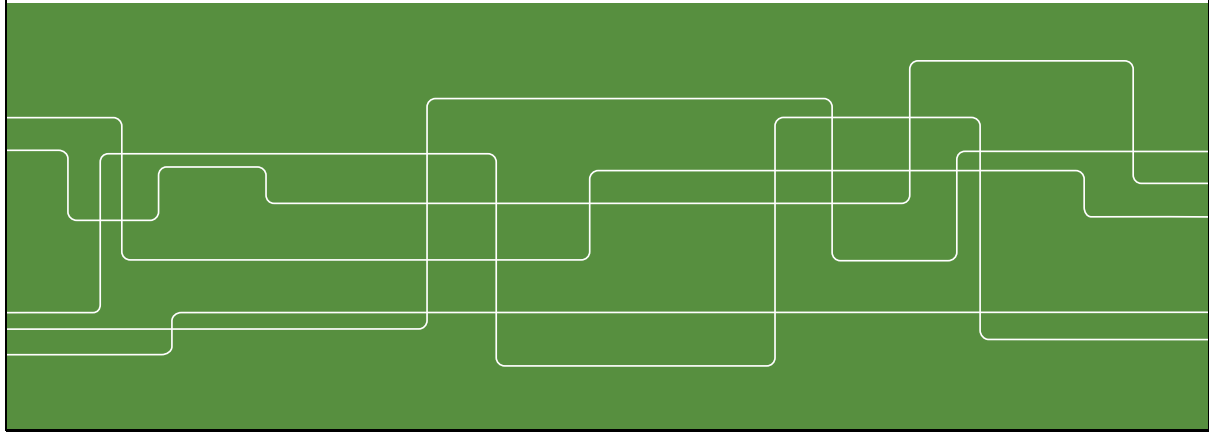
Bio Intelligence Service S.A.S., 'Impacts of Information and Communication Technologies on Energy Efficiency: Final Report', European Commission DG INFOS, Tender No. CPP 16A-2007 / 2007/S 68-082361, Sep. 2008 [Online]. Available:

http://ec.europa.eu/information_society/activities/sustainable_growth/docs/studies/2008/2008_impact-of-ict_on_ee.pdf

Slide 10



Thanks for your attention!



Slide 11



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