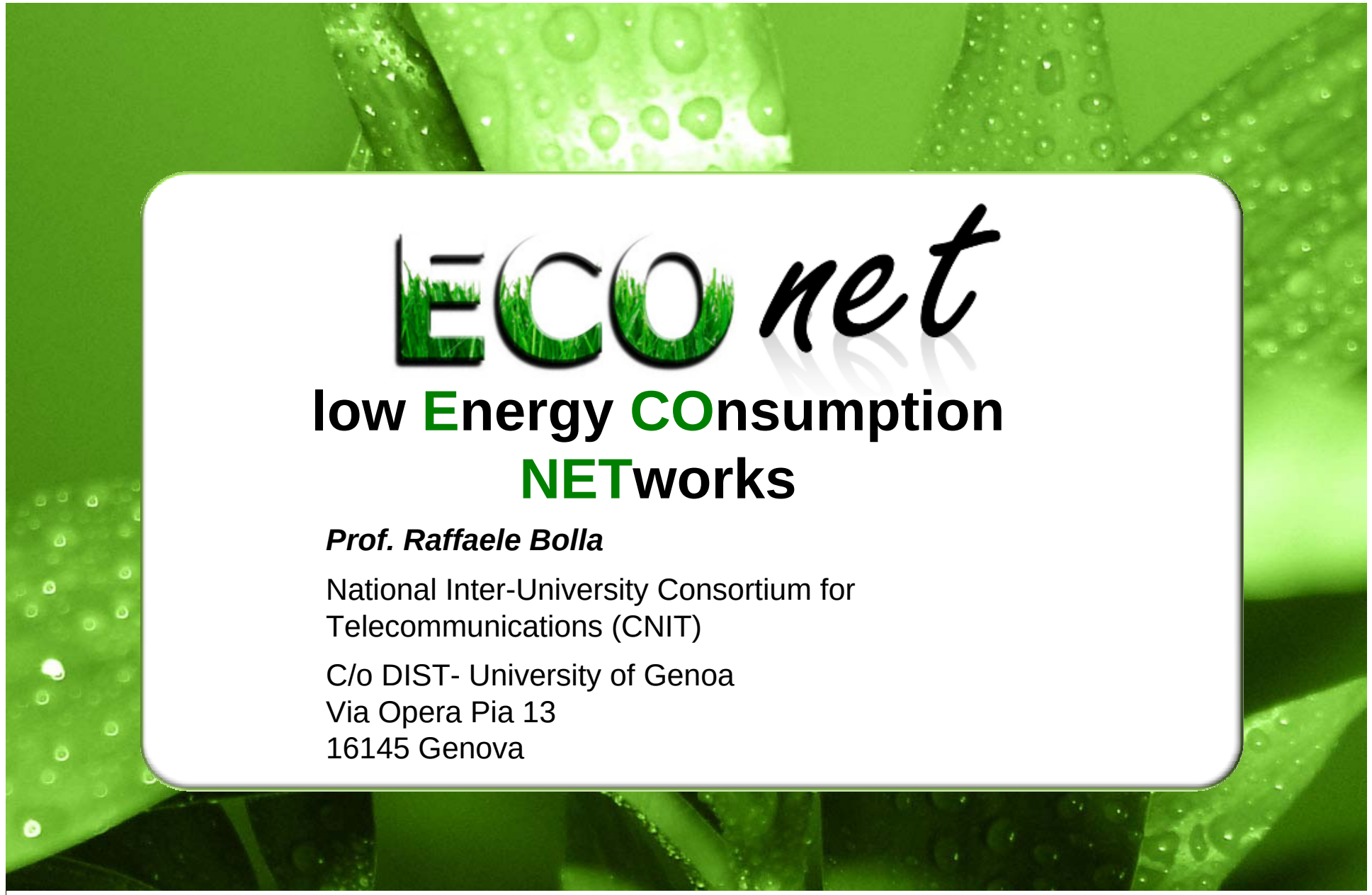


# low Energy COnsumption NETworks

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Via Opera Pia 13
16145 Genova

Brussels 18-20/10/2010

Concertation Meeting

# *Outline*

- Presentation of the ECONET project
  - The project general data
  - Technical Objectives
  - Organization of the Activities

# *Project general data*

- Project duration
  - October 2010 – September 2013 (36 months)
- Consortium
  - 15 partners from 8 countries and 2 American University associated
- Project budget
  - 10,5 M€
  - 6,2 M€ from EU
- Resources
  - 1168 PM (33 persons full time for three years)

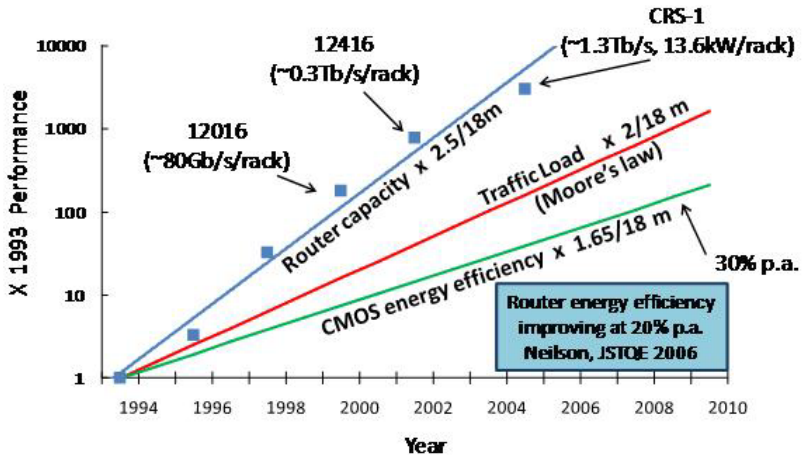
# The ECONET Consortium

| Participant organisation name | Part. short name | Country |
|---|---|---|
| Consorzio Nazionale Interuniversitario per le Telecomunicazioni (Coordinator) | CNIT | Italy |
| Mellanox Technologies | MLX | Israel |
| Alcatel Lucent | ALU | Italy |
| Lantiq | LQDE | Germany |
| Ericsson Telecomunicazioni S.p.A. | TEI | Italy |
| Telecom Italia | TELIT | Italy |
| Greek Research & Technology Network | GRNET | Greece |
| Research and Academic Computer Network | NASK | Poland |
| Dublin City University | DCU | Ireland |
| VTT Technical Research Centre | VTT | Finland |
| Warsaw University of Technology | WUT | Poland |
| NetVisor | NVR | Hungary |
| Ethernity | ETY | Israel |
| LightComm | LGT | Italy |
| InfoCom | INFO | Italy |
| *Portland State University* | *PSU* | *USA* |
| *University of South Florida* | *USF* | *USA* |

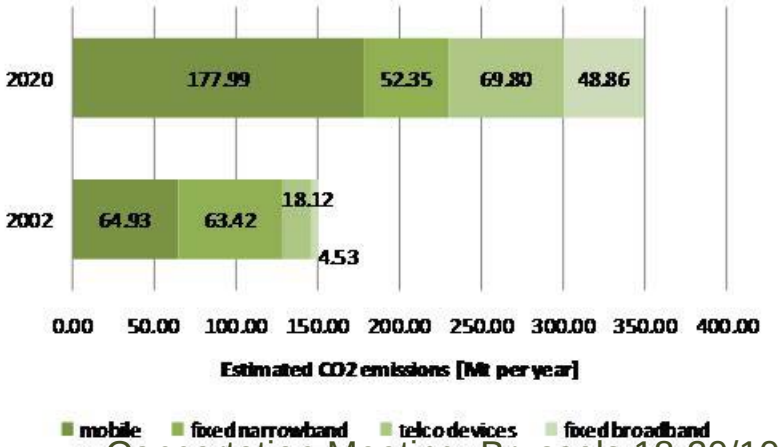
# The Project Motivations

- ICTs have been historically and fairly considered as a key objective to reduce and monitor “third-party” energy wastes and achieve higher levels of efficiency.
- However, until recently, ICT has not applied the same efficiency concepts to itself, not even in fast growing sectors like telecommunications and Internet.
- Triggered by the increase in energy price, the continuous growth of costumer population, the spreading of broadband access, and the expanding number of services being offered by telecoms and ISPs, only recently the energy efficiency issue has become a high-priority objective also for wired networks and service infrastructures.

Evolution from 1993 to 2010 of router's capacity vs. traffic volumes (Moore's law) and energy efficiency insights on technologies. SOURCE: Dr. Peter Lee, Cisco Systems, 2006.



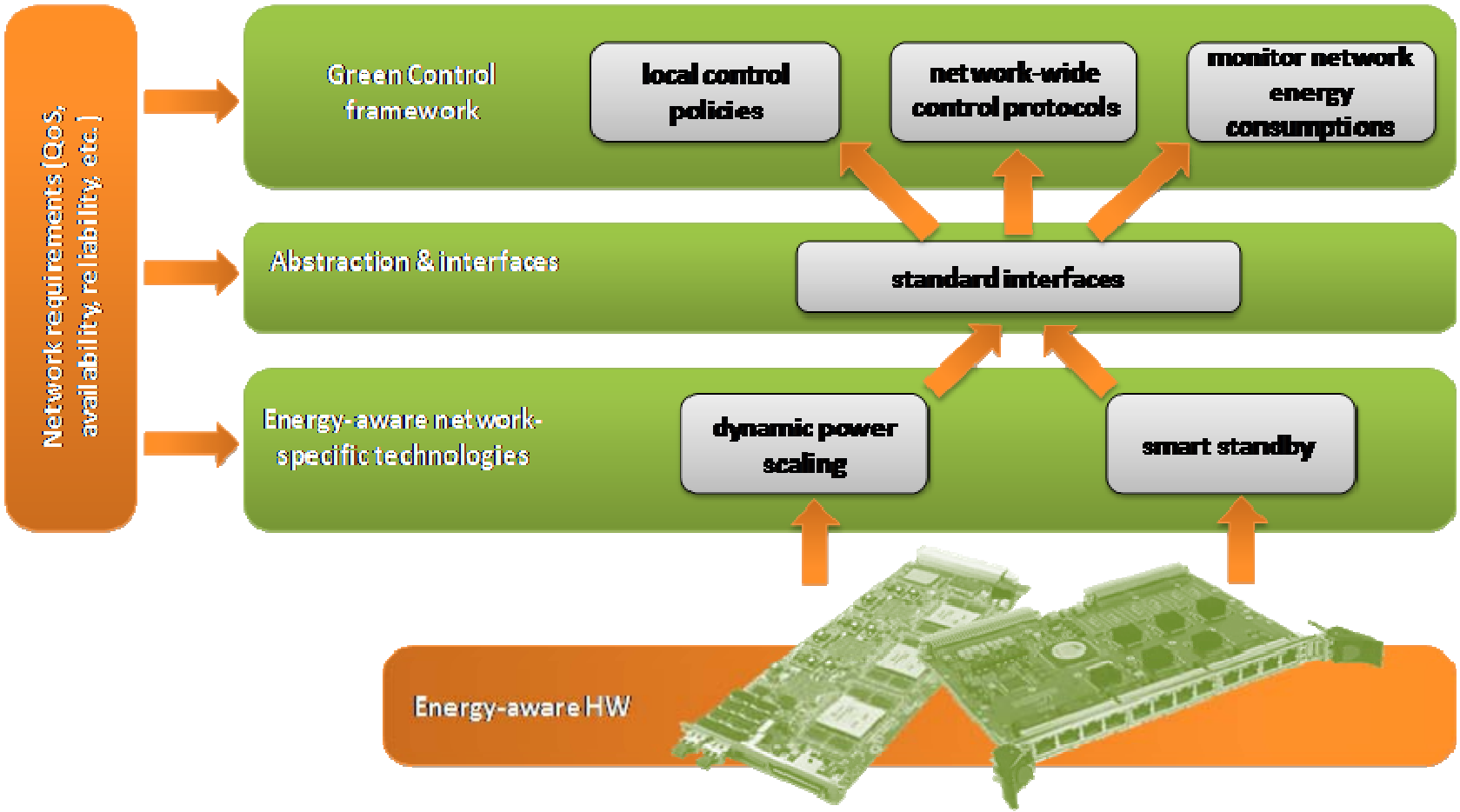

Greenhouse gas emission estimation according to GeSI



# The Main Objectives

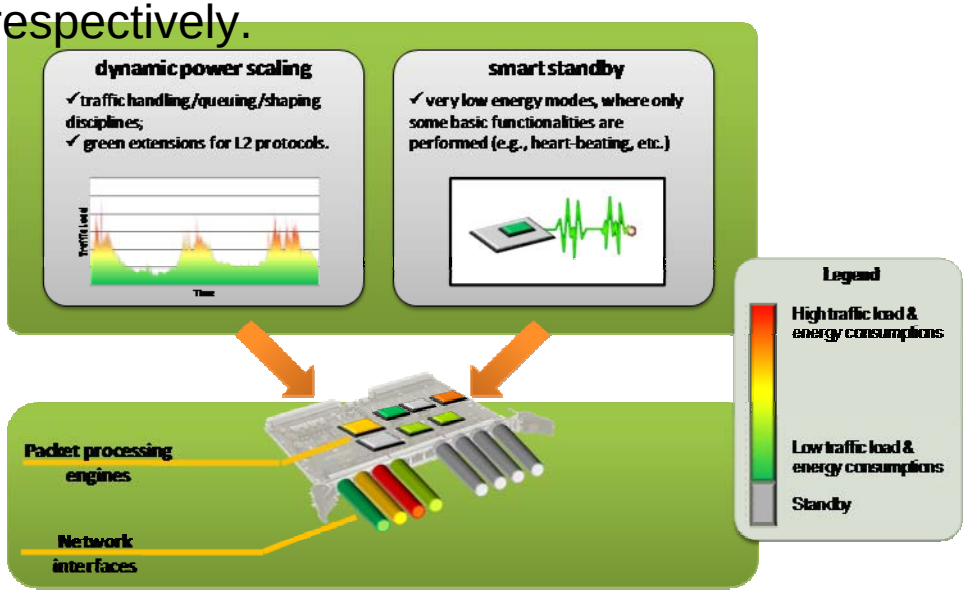
- The ECONET project aims at studying and introducing adaptive technologies (standby and performance scaling) that allow saving energy when a network device or part of it is not used.
  - Access/home -> standby when users are not “connected”; idle/performance scaling when users are “connected”
  - Core/metro -> standby for redundant and unused HW; idle/performance scaling for active HW
- This  goal will be also pursued by
  - promoting bridging actions between the Research/Academia and the Standardization arena to guarantee early and effective adoption of the new energy efficient techniques.
  - exploiting clustering activities with other projects (TREND, EARTH, Green Touch, ICT4EE ...) running on same green subject (e.g.,  in order to scale the demonstration wherever possible).

# The Main Objectives



# The Energy-aware Data-Plane

- The focus will be on the data-plane elements of network equipment, since this usually includes the most energy starving HW elements.
- The project will explore how to effectively exploit and adapt power management features and capabilities in device architectures in order to meet network operational constraints.
- The ECONET project will introduce, explore and develop two main kind of network-specific energy-saving capabilities, i.e. dynamic power scaling and smart standby, respectively.

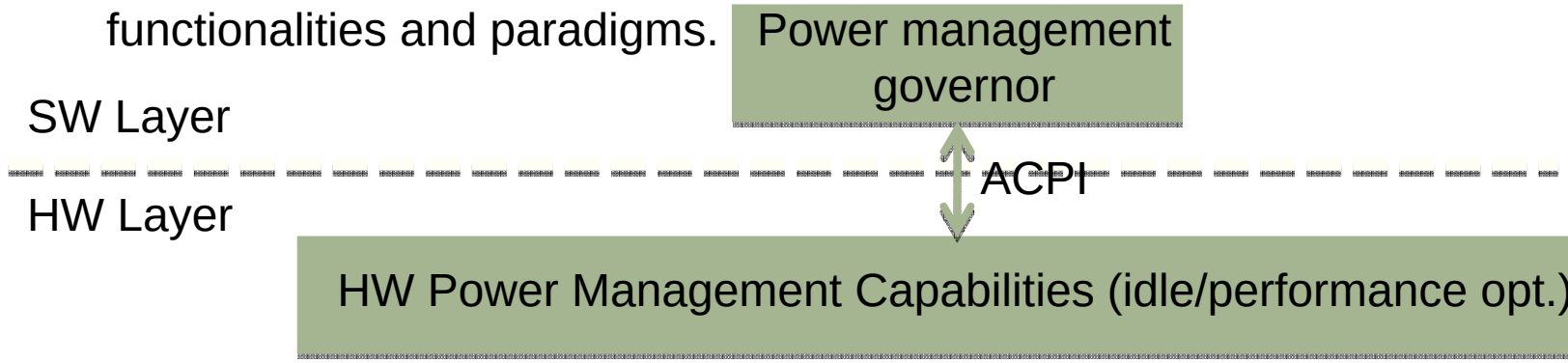


# The Energy-aware Data-Plane

- The dynamic power scaling will allow network devices tuning dynamically the trade-off between energy profile and processing capacity of internal processing blocks/engines, while meeting the actual traffic load and QoS constraints. This will directly impact on:
  - the design of novel traffic handling policies and queuing/shaping disciplines, which will be able to effectively exploit active/idle HW transitions;
  - the development of green extensions for L2 protocols.
- The smart standby mechanisms will allow putting currently unused parts of a network devices (such as redundant network interfaces, unused network terminations, etc.) into very low energy consumption modes, where only some basic functionalities are performed (e.g. heart-beating message reply).
  - It is a fundamental green key factor since it will allow switching some portions of the network (links, part of network devices, entire network devices) to a sleep mode in a smart and effective way.
  - The main advantage of such solution with respect to a simple switching-off consists in reduced recovery times as well as in the possibility of avoiding useless signalling storms of routing protocols at each active/sleep transition of links or nodes.

# ECONET Abstraction Layer

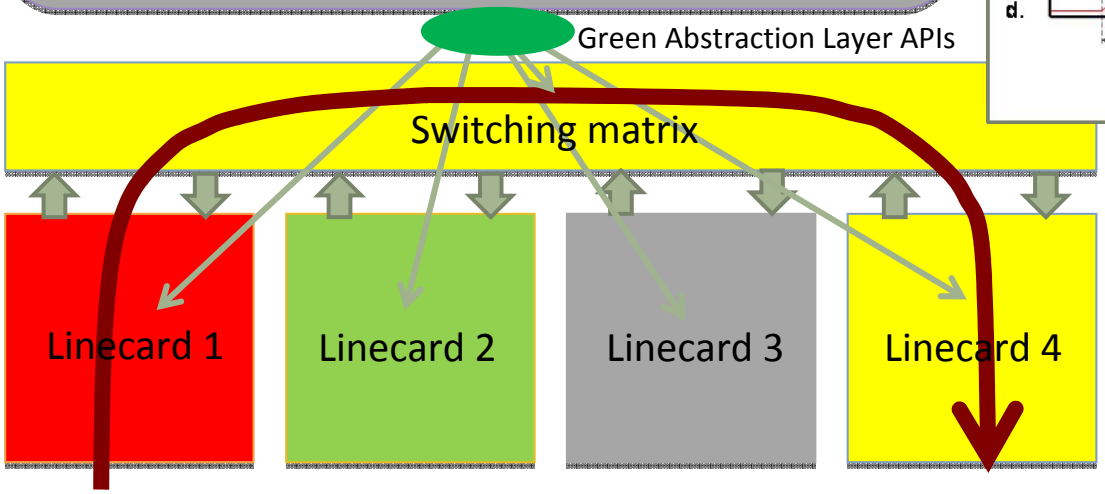
- The Green Abstraction Layer is specifically conceived:
  - to hide the implementation details of energy-saving approaches,
  - to provide standard interfaces and methodologies for interactions between heterogeneous green capabilities and HW technologies, on one hand, and energy-aware control and monitoring frameworks, on the other hand.
- To this purpose, the ECONET project will involve all partners working at the device data-plane and control-plane to accurately define a synthetic set of energy- aware and performance-aware profiles and parameters, able to logically represent the different approaches and requirements of such green capabilities.
- Here, the specific goal is to extend and re-engineer the ACPI standard for computing systems, and adapt it to network equipment architectures, functionalities and paradigms.

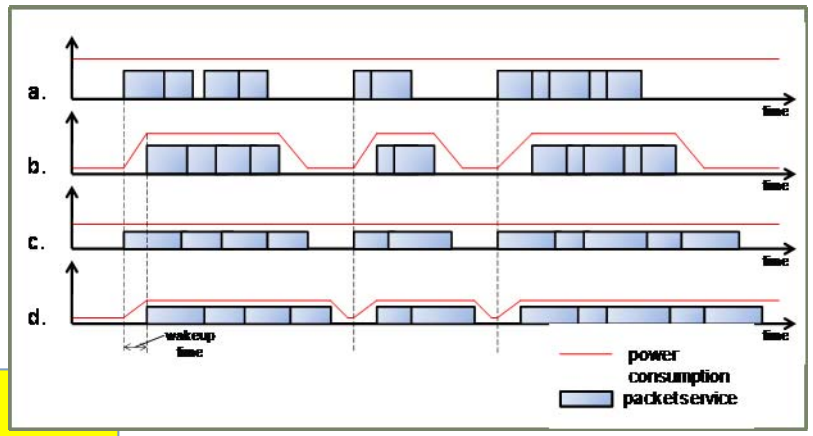


# The Local Control

## *Example of local control strategies*

- Collect data regarding flow volumes and performance constraints.
- Estimate how much resources are needed to satisfy flows' performance requests, and to meet traffic volumes.
- Impose the "best" energy-aware state to each component over a suitable time horizon.

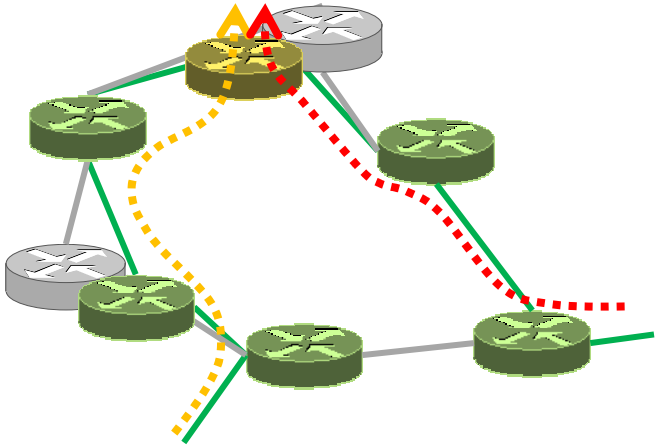


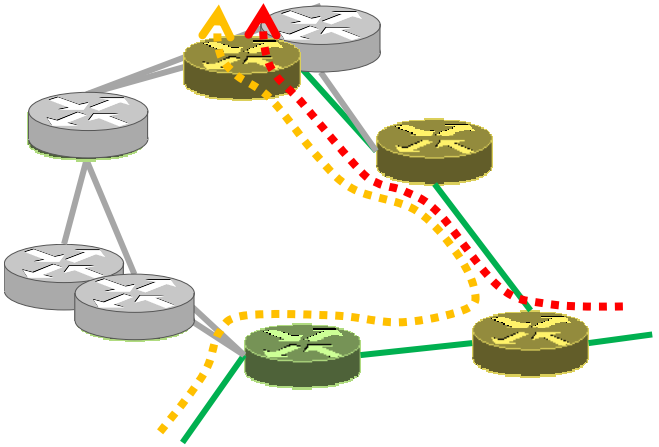

- Standby
- Idle
- Light loaded
- Full loaded

# The Network-wide Control

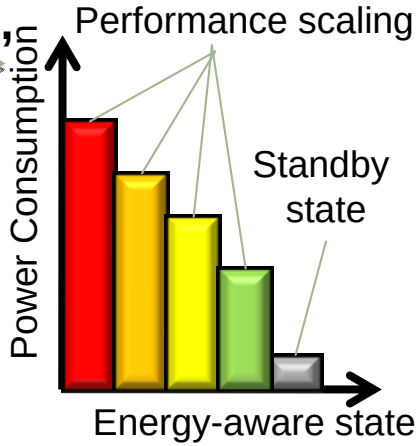
**Only local control policies**



**Local + network-wide control policies**



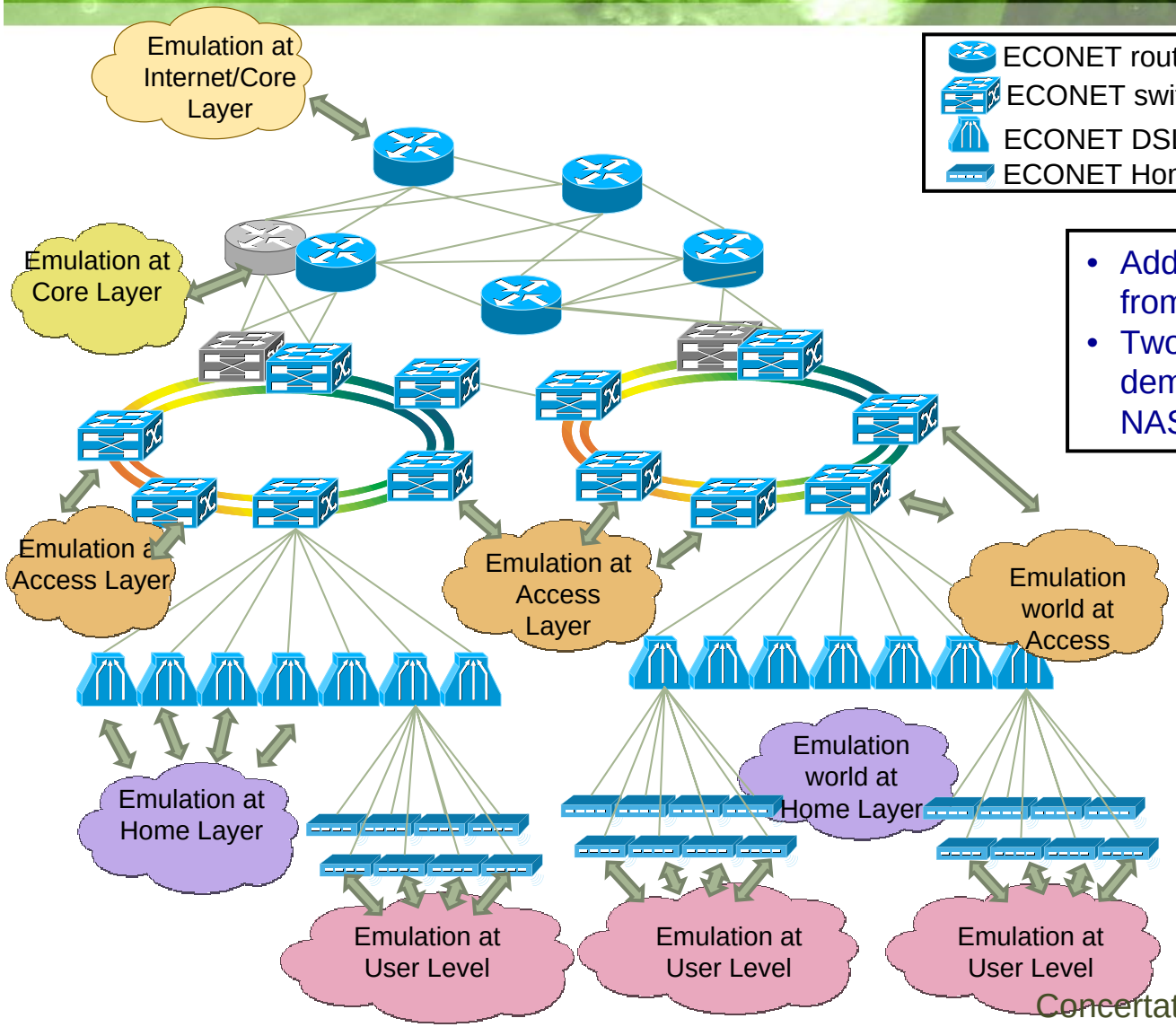
- **Standby states have usually much lower energy requirements, than active states.**
- The network-wide control strategies (i.e., routing and traffic engineering) give the possibility of moving traffic load among network nodes.
- **When a network is under-utilized, we can move network load on few "active" nodes, and put all the other ones in standby** .
- Different network nodes can have heterogeneous energy capabilities and profiles.
- Recent studies, obtained with real data from Telcos (topologies



# The large-scale Testbed

- The ECONET demonstration activities will follow a three-step approach:
  - Development and evaluation of specific technologies and energy-aware capabilities separately;
  - Assembly of the most promising capabilities and green technologies into integrated prototypes of energy-aware network devices (also including local mechanisms for energy efficiency optimization);
  - Integration of network-wide control with monitoring frameworks on energy-aware devices and prototypes for their evaluation in experimentation facilities.
- Regarding this last demonstration activity, the ECONET project will massively exploit test-plant facilities made available free of charge by telecom and ISP partners. In more detail, the ECONET consortium envisages to realize a large-scale testbed at the TELIT testplant, and two additional small-scale testbeds at GRNET and NASK sites.
- **The testing methodologies and instrumentations will be the same "real-life" ones that telcos and ISPs usually adopt for evaluating commercial network devices before putting them in production networks**

# The large-scale Testbed




ECONET router prototype
ECONET switch prototype
ECONET DSLAM prototype
ECONET Home GW prototype

- Additional devices will come from other participants.
- Two additional smaller scale demonstrators will be realized by NASK and GRNET.