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**Towards Real Energy-efficient Network Design**

# **General project presentation**

Plenary Meeting  
Volos, 1-5 October, 2012

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**Marco Ajmone Marsan**



TREND Plenary Meeting  
Volos, 1-5 October 2012



# Agenda

- 08:30 *Registration*
- 09:00 Welcome - *Leandros Tassiulas (UTH)*
- 09:15 Opening - *Marco Ajmone Marsan (PoliTO)*
- 09:30 General presentation - *Marco Ajmone Marsan (PoliTO)*
- 10:00 WP 1 Selected technical presentations
- 10:45 WP 2 Selected technical presentations
- 11:45 WP 3 Selected technical presentations
- 12:30 WP 4 Selected technical presentations
- 13:30 *Lunch break*
- 14:15 Gender issue session
- 15:00 Interaction with other projects
- 15:45 TREND Collaborating Institutions
- 16:15 *AoB and Closing*

# Logistics

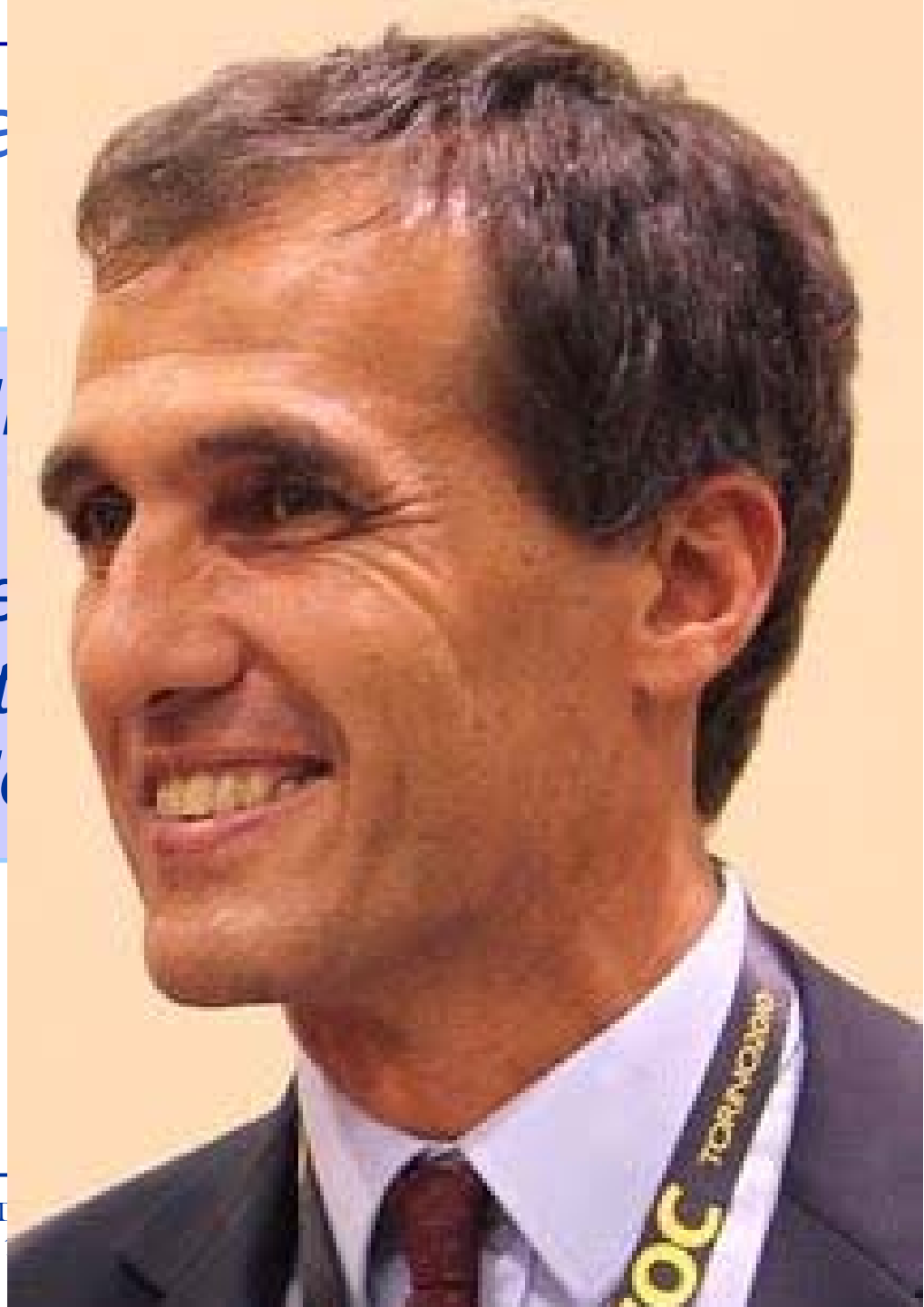
- ❑ Coffee breaks and lunch will be served outside the room
- ❑ Social dinner (offered by UTH- **THANKS**) – will leave at 16.30 from the meeting area
- ❑ WiFi access is available in the meeting room

id: palaia\_volou

no password

# TREND rationale a

*The aim of TREND is the*  
***integration*** *of*  
*community in gree*  
***long term*** *perspect*  
*European leade*



# Fabio Neri Fellowship

- Announcement at <http://www.cnit.it/node/189>
- To support Postdoctoral research at a CNIT Research Unit within an Italian University
- Deadline 31<sup>st</sup> of October 2012



# What is the problem?



“ICT alone is responsible of a percentage which vary **from 2% to 10%** of the world power consumption.”



“Electricity demand of ICT is **almost 11%** of the overall final electricity consumption in Germany.”

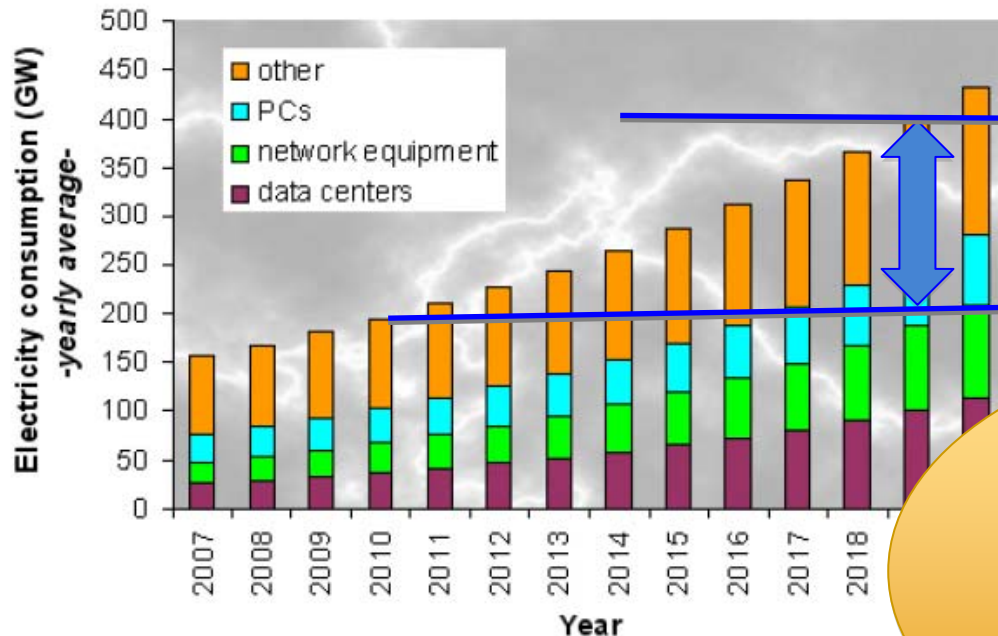


“ICT sector produces some **2 to 3%** of total emissions of greenhouse gases.”

# What is the problem?



## Cost and sustainability

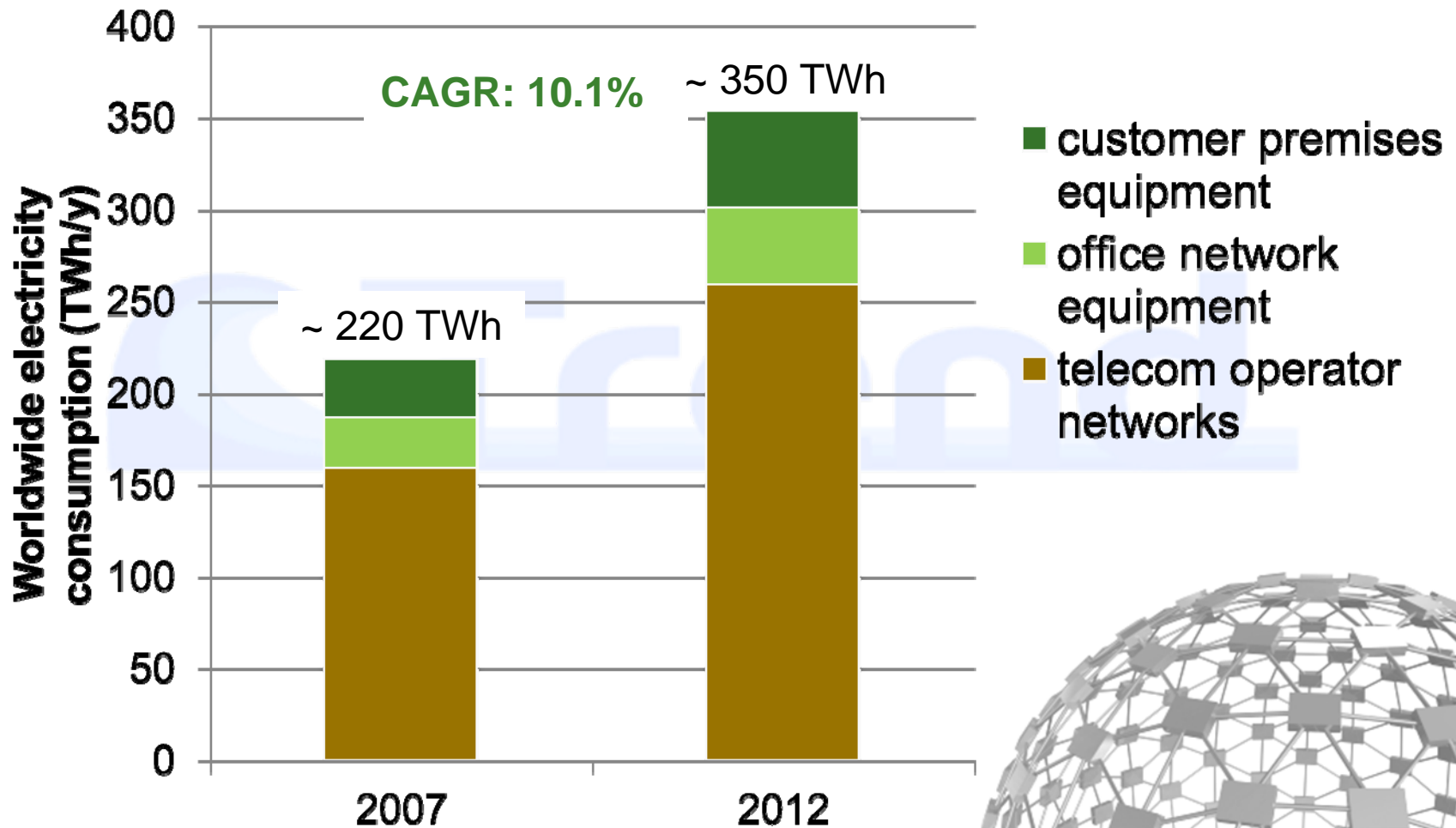


**Expected to double in 10 years!**

**Focus on NETWORKING**

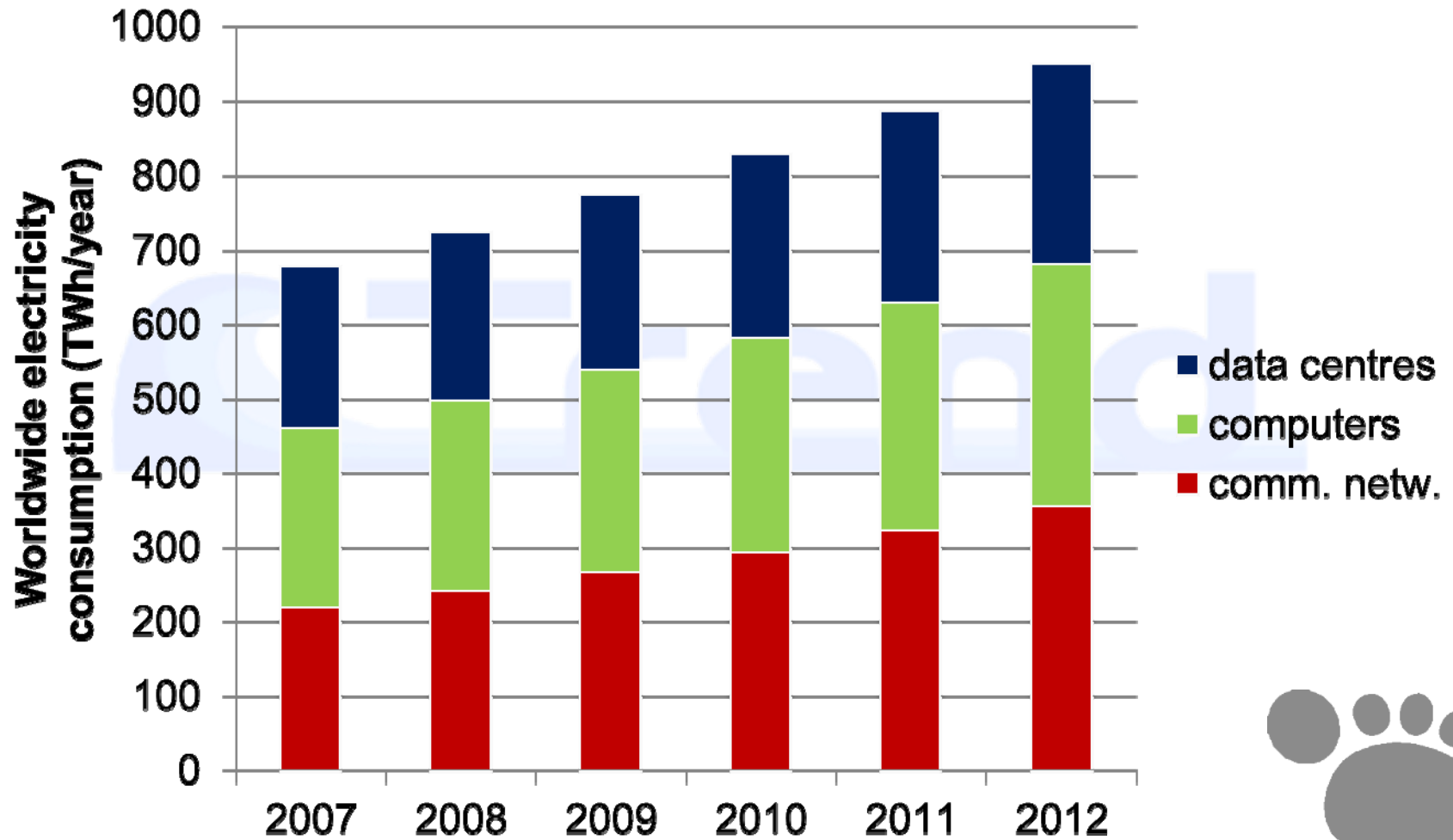
Source: M. Pickavet et al, "Worldwide Energy Needs for Aware Networking," in IEEE ANTS Conference, Bombay, India, 2007.

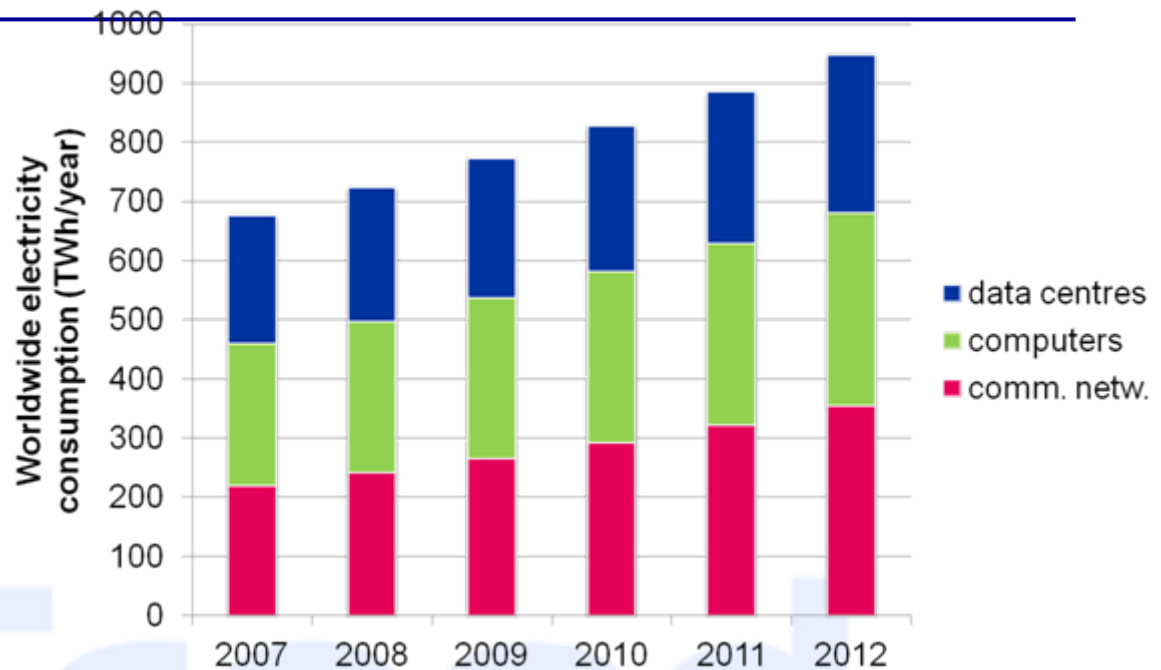
# Footprint of communication networks





# Joint footprint





- Joint CAGR: **7%** (doubling per decade)
- Vs. global electricity consumption: **5% share** and growing
- But:
  - Only use phase of equipment
  - TV sets and related CPE not yet included !



# What is our objective?

Propose approaches to improve energy efficiency of existing networks by at least

**20%**

**Integration** of the EU research community in green networking; in the **long term** consolidate the European leadership in the field

# Start from data...

Derive reliable, updated data and models about power consumption and traffic

## ■ *Collection of **power consumption data*** **Powerlib**

- Data about power consumption of networking equipment are available on a repository – see: <http://powerlib.intec.ugent.be>  
***Please share your power consumption data through this data base***

## ■ *Collection of **traffic data*** **snd.lib**

- Multiple traffic matrices originating from measurements in core networks available at <http://sndlib.zib.de/home.action>  
***Please share your test instances and traffic data through this data base***

## ■ *Two reference scenarios from FT & TID*

# Start from data...

<http://trend.polito.it/trend-meter>

**Trend METER**

- Home
- Live Monitoring
- Access to Database
- System Description

**Select the desired graph:**

Select the network element(s) that you want to monitor:

- Subnet Polito
- PC Polito
- SW Router Genova
- Router Roma
- Data Center IHU

Select the info to display:

- Power consumption vs. Time
- Traffic vs. Time
- Power consumption vs. Traffic

Select the time interval to display:

Last day

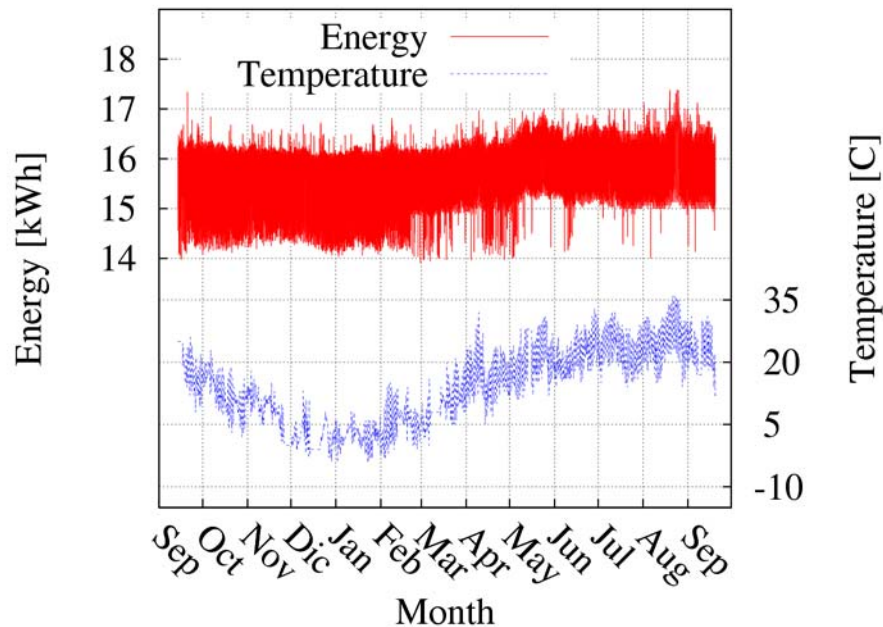
Submit

# Start from data...

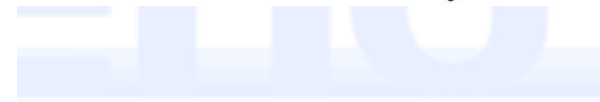
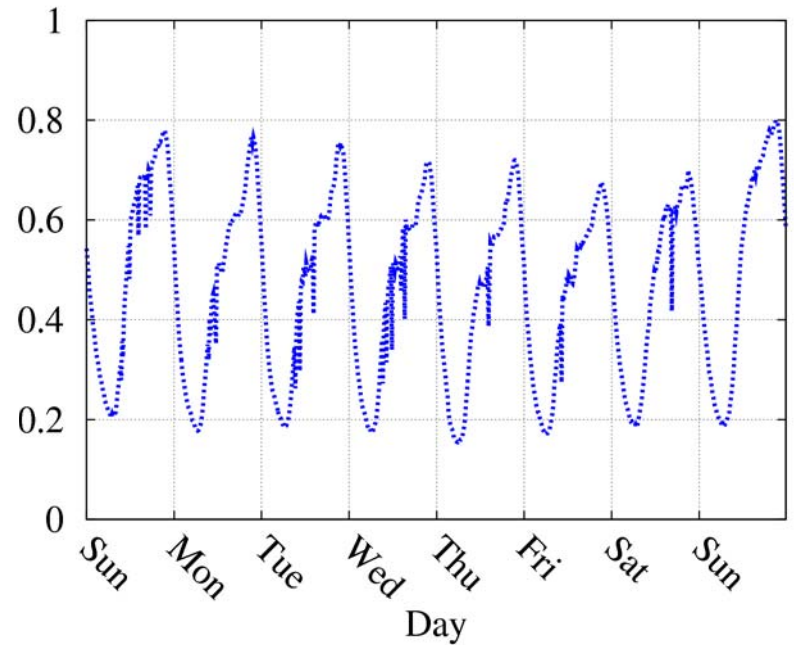
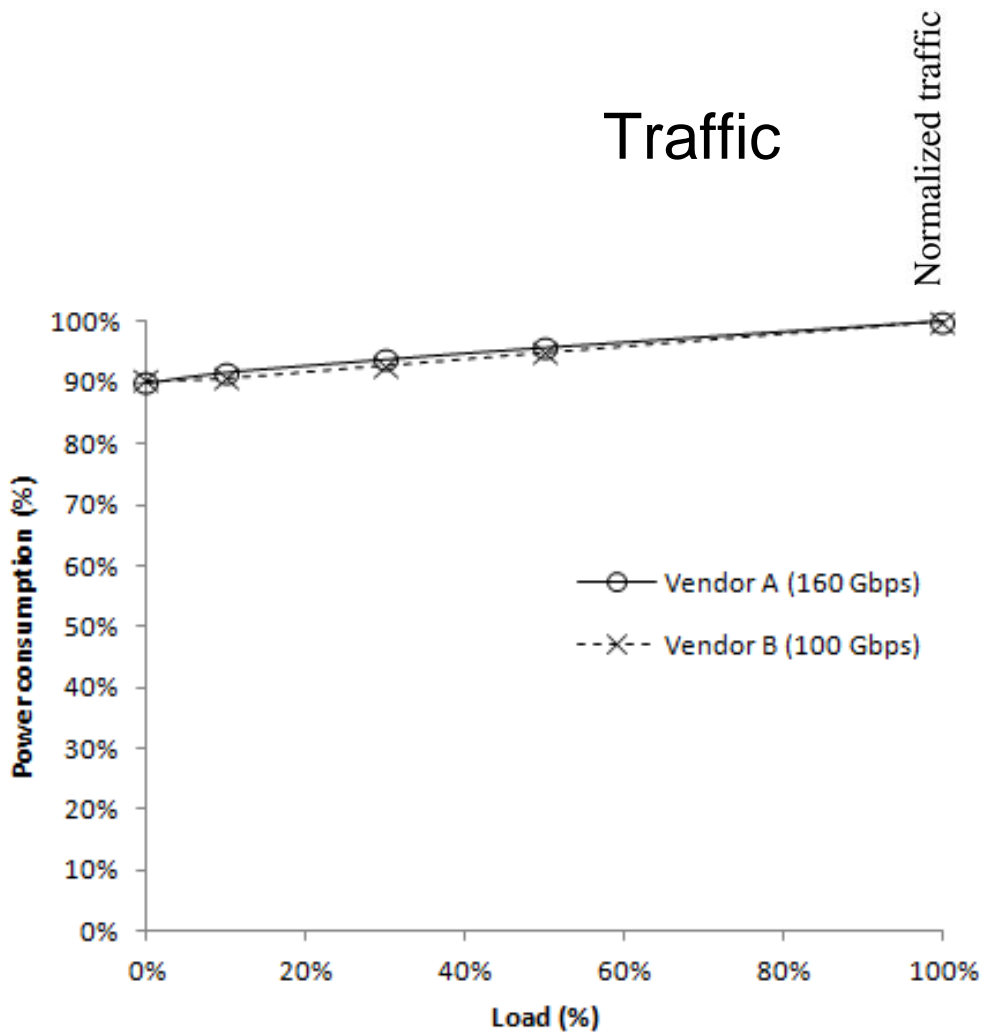
*Operator with monitoring facilities in network in oper.*



*Academic partner with measurement & analysis skills*

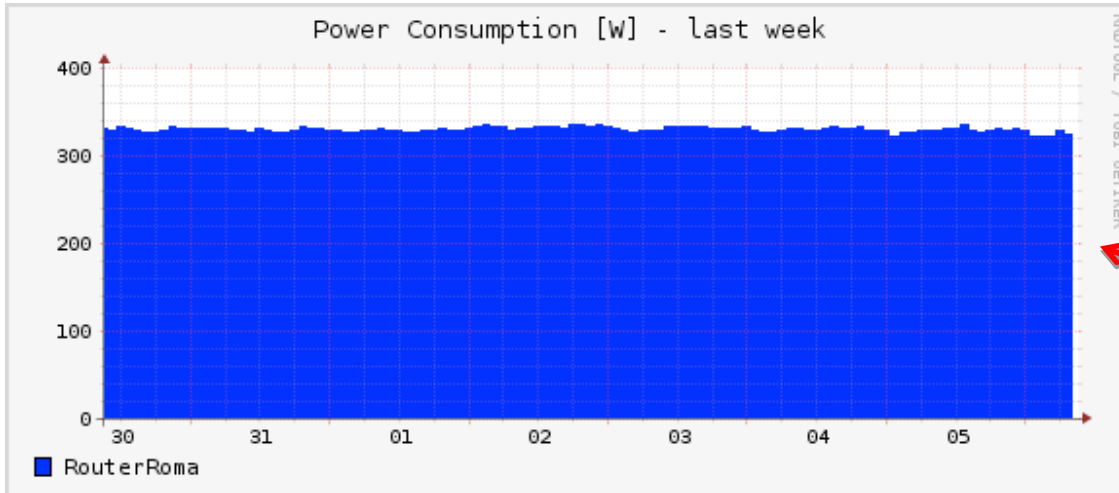


# Start from data...

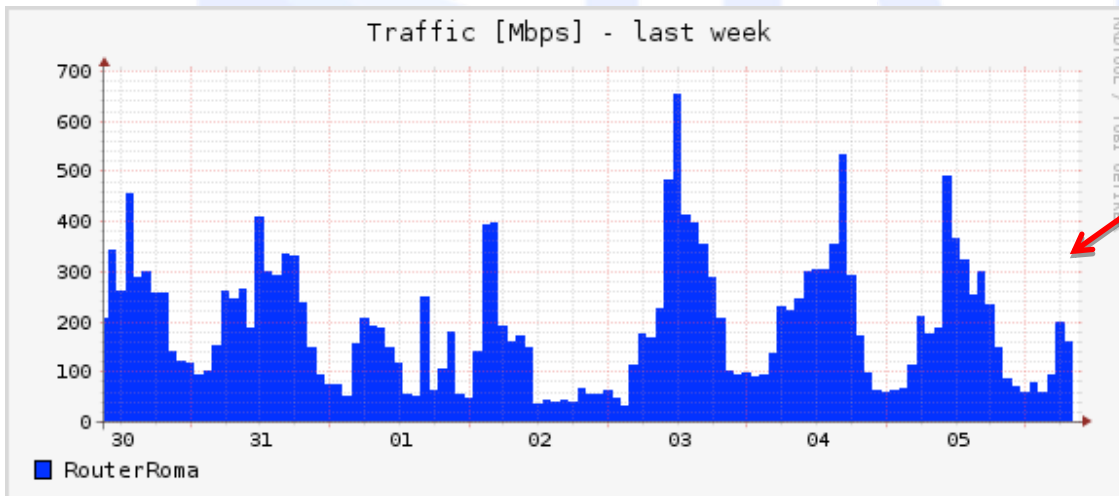


Device consumption

# Example of TREND meter usage



Power consumption of the router in Rome is almost insensitive to traffic (a week)



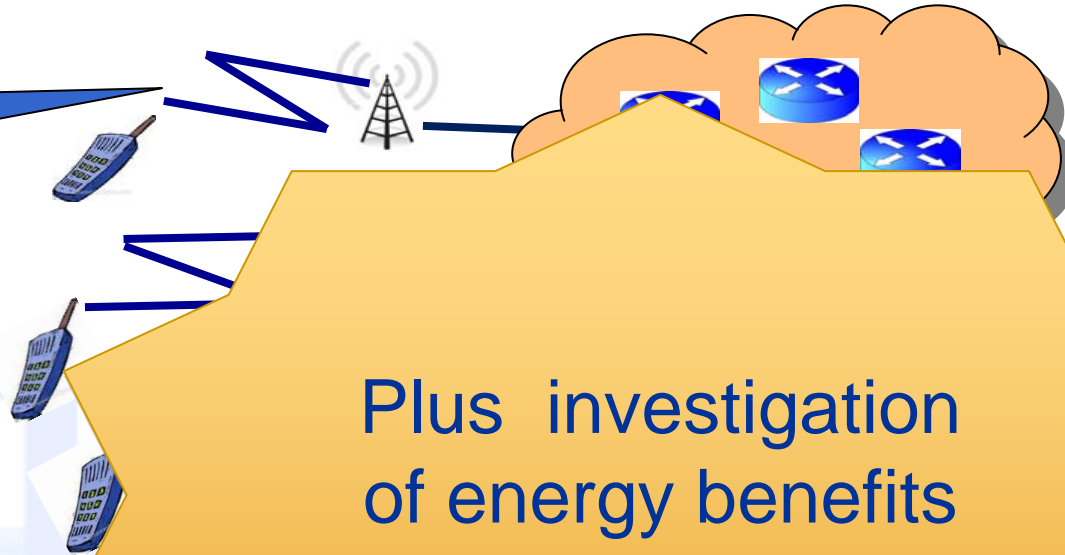


# The TREND meter

- Connect your traffic and energy live measurements to the TREND meter!
- If interested, send an email to:  
[trend-office@tlc.polito.it](mailto:trend-office@tlc.polito.it)  
explaining what you would like to connect to the meter

# ... to devise solutions at the access ...

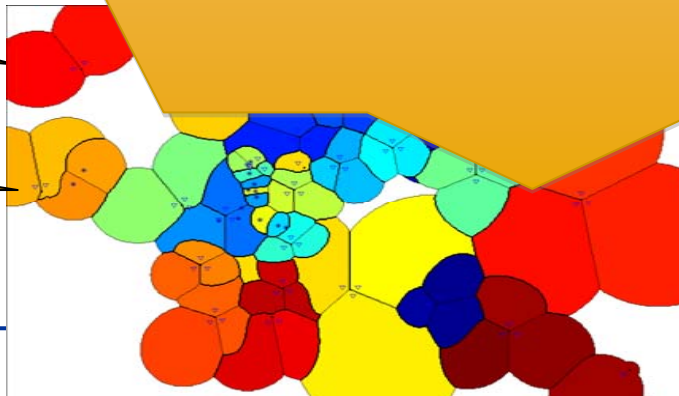
*Efficient transmission  
resource allocation*



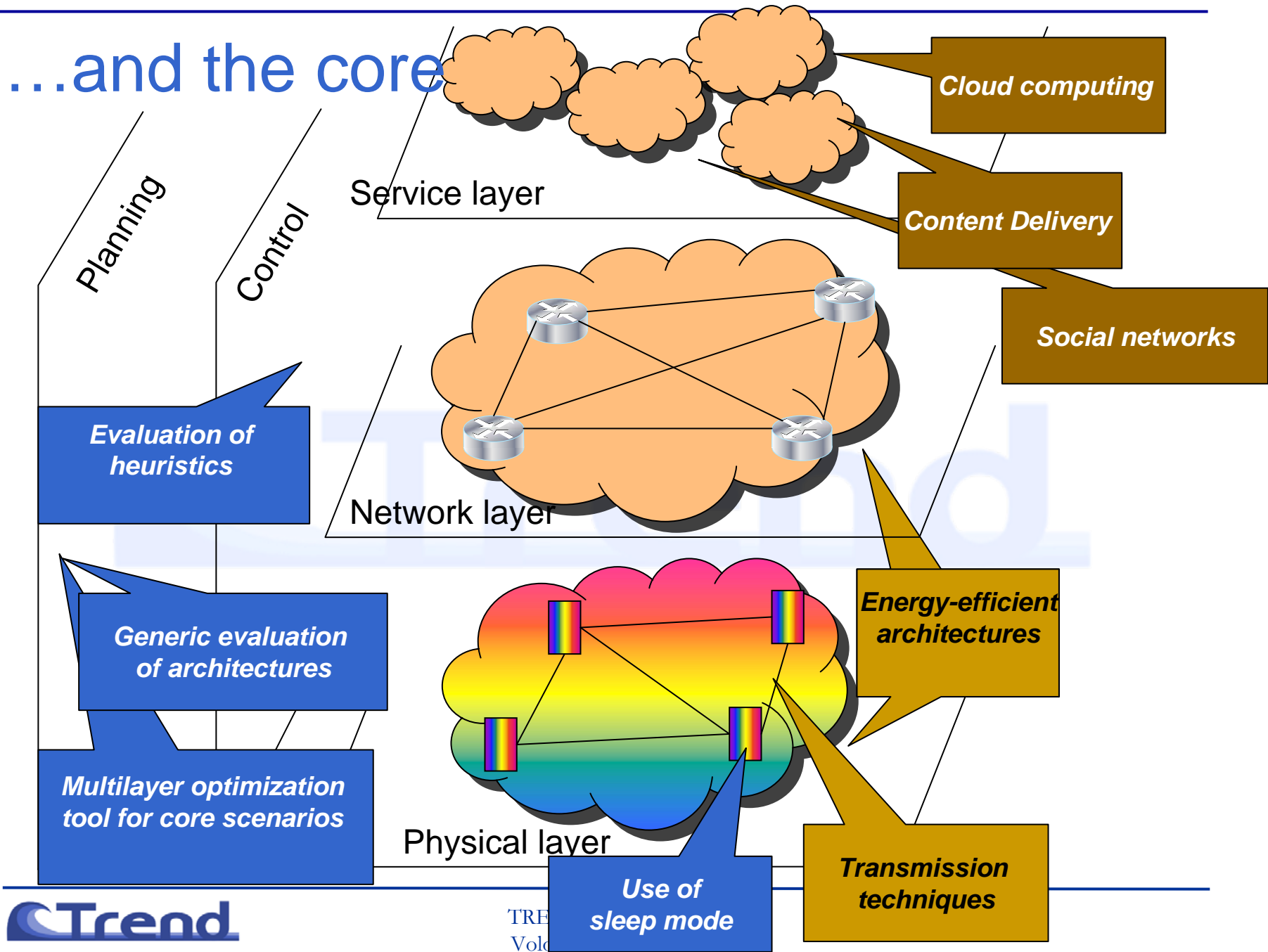
Plus investigation  
of energy benefits  
of optical access (NGPON)

*Energy efficient  
planning*

*Planning with  
sleep modes*



# ...and the core



# TREND actions



- Coordination and **creation of an identity for the European research on energy-efficient networking** through integration and collaboration
- Definition of specific technical objectives to be jointly pursued within the Network of Excellence. Specific **Integrated Research Actions** (IRAs), and **Joint Experimental Activities** (JEAs) implemented internally to the NoE, but open to external collaborations
- Establishing **contacts and links** primarily among FP7 projects, but also with national programmes and with projects outside the FP7-framework to exchange information and expertise
- Organization of **workshops** targeting the dissemination of the TREND know-how and view on green networking to non-R&D participants, i.e. industrial representatives & policy makers

# TREND at a glance

- **12 partners** (2 manufacturers – 3 telecom operators – 7 university groups) + Collaborating Institutions, all with significant previous experience in the technical topics
- duration: **3 years**
- estimated effort: **478 person/months**
- project budget: 4.4 MEuro (79% for RTD activities, 14% for other activities, 5% for project management)
- EC contribution: **3.0 MEuro**

# TREND Consortium



Politecnico di Torino

Universidad Carlos III de Madrid

Interdisciplinary Institute for Broadband Technology

Technische Universitat Berlin

Ecole Polytechnique Federale de Lausanne

Consorzio Interuniversitario per le Telecomunicazioni

Panepistimio Thessalias

Alcatel- Lucent Bell Labs France

Huawei Technologies Duesseldorf GmbH

Telefonica Investigacion Y Desarrollo SA

France Telecom SA

FASTWEB SPA

**Academic**

**Manufacturers**

**Operators**

# Current Collaborating Institutions



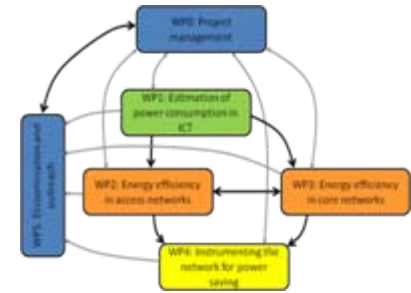
## Current CIs

- Fondazione Ugo Bordonis, Italy
- Technische Universitat Dresden, Germany
- Deutsche Telekom Laboratories, Germany
- Institute IMDEA Networks, Spain
- ICAR-CNR (CNR Institute for High Performance Computing and Networking), Italy
- International Hellenic University, Greece
- INRIA (Institut National de Recherche en Informatique et en Automatique), France
- Boston University, USA
- **Politecnico di Milano and Università di Roma joined the CNIT team in 2012, so they now are formally partners of the project**

## Pending CIs: confirmed interest to join the NoE

- Federal University of Juiz de Fora (Brazil)

# TREND organization



## ■ 6 workpackages:

- ❑ WP1: Assessment of power consumption in ICT (IBBT)
- ❑ WP2: Energy efficiency in access and home networks (UTH)
- ❑ WP3: Energy efficiency in core networks (FT)
- ❑ WP4: Instrumenting the network for power saving (A-LBLF)
- ❑ WP5: Dissemination and outreach (UC3M)
- ❑ WP6: Project organization and management (PoliTO)

## ■ Integration enablers:

- ❑ Integrated Research Actions and Joint Experimental Activities
- ❑ mobility and joint publications
- ❑ joint education and dissemination



# Integration Indicators



- **Joint papers:** 7 in Y1 and **32 in Y2** (5 on journals)
- **Single-partner papers:** 25 in Y1 and **21 in Y2** (5 on journals)
- **Mobility actions:** 10 in Y1 and 23 in Y2
- **Teaching material** for Master and PhD students available on the web site:  
<http://www.fp7-trend.eu/content/dissemination-teaching-activities/teaching-material>
- Strong presence in the **organization of major events** in the field of energy-efficient networking

# Exploitation of results

## **Industrial partners** (ALBLF, HWDU, TID, FT and FW)

- ❑ TREND helps **equipment manufacturers** to increase the energy efficiency of their products, and **network operators** to adopt a more energy efficient approach to network design and management, with immediate benefits in terms of cost reduction, and access to markets
- ❑ The partnership of equipment manufacturers and network operators guarantees that the solutions devised during the project are both **implementable by the manufacturers**, and **usable by the operators**.
- ❑ An **industrial workshop** has been organised in Barcelona

## **Universities** (Polito, UC3M, IBBT, TUB, EPFL, CNIT and UTH)

- ❑ Have **access to large quantities of real data** about the traffic flowing on operational networks, and the opportunity to perform large scale on field experiments
- ❑ Exploit the project results in their **teaching activities**, including the green dimension in their telecommunication courses



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# Thank you

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Marco Ajmone Marsan  
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