PANEL ENERGY/ICNS

Advances on Evolving Communications - Energy Awareness

InfoSys 2014 Conference, April 20-24, Chamonix

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Moderator

Eugen Borcoci, University "Politehnica"of Bucharest (UPB), Romania

Panelists

- **Elisabeth André, Human Centered Multimedia, University of Augsburg, Germany**
- **Nirmala Shenoy, Rochester Institute of Technology, USA**
- **Sathiamoorthy Manoharan, University of Auckland, New Zealand**
- **Thomas Rist, University of Applied Sciences Augsburg, Germany**
- **Jean-Charles Grégoire, INRS, UDQ, Canada**
- **Eugen Borcoci- UPB, Bucharest**

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Energy

- **Production, distribution, consumption, failure recovery, …- major problems of the society**
  - Optimization of the above processes – main area- for huge effort - both in research and real life deployments

- **Communication technologies and systems**
  - Energy awareness in comm. systems→ energy saving/consumption optimization → "Green" systems - Internet, Data centres, WANs, …

  - **Intelligent/adaptive Management and Control support for electric power systems (smart grids)**
    - **Similarity to communication networking:**
      Data Plane – Power distribution system
      M&C Plane – Communication network supporting the first

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- **Possible question for this panel:**
- ***What are the most important and still open areas of research in the domains***
  - ***Energy systems +***
  - ***ICT and Networking systems***
- ***in the perspective of Horizon 2020 ?***
- **Thanks !**
- **Floor for the speakers…..**

AEC - Energy Awareness The Wireless Perspective

J-Ch. Grégoire
INRS-EMT

The User

* User conundrum
  * The need/desire/want of increasingly better and pervasive connectivity (human dimension)
  * Vs. the increasing energy costs of the «   loose connection   » model
    * permanent polling
    * for networks, for carrier, for services, for data
* How many (simultaneous) connections do we need?
* How bored do we get? Are we reaching demand saturation?

The Operators

* Operator conundrum
  * Multiple operators in competition (really?), wasted (radio) resources
  * Infrastructures: How many « ships in the night » (independent operators) do we need?
  * How do we keep the market open while being efficient? Does cooperation mean collusion?
  * Is flat rate/volume ceilings counter productive?
  * Are we reaching technology peak?
  * How much of the energy consumption is communications-dependent?

Synthesis

* User choices? How do we encourage « wise » choices?
* Who gives guidance? Who unifies the trends?
* Unmanaged vs. Managed infrastructure
* Strong connectivity vs. loose connectivity
* Unreliable vs. Reliable infrastructure
* Distributed vs. Centralized tension
* Competitive vs. Cooperative tension

Energy + ICT < Energy

IT4SE
www.it4se.net

Thomas Rist
Faculty of Computer Science
University of Applied Sciences Augsburg
Augsburg

Working Area:
Tools to facilitate grid planning

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Motivation

- Feed-in of solar generated power requires investments into the power grid infrastructure

- But: decision on additional installations lies in the hand of prvate home and land owners

  => un-coordinated PV installations

  where? when?

  => sustainable planning is hard

Working Area:
Tools to facilitate grid planning

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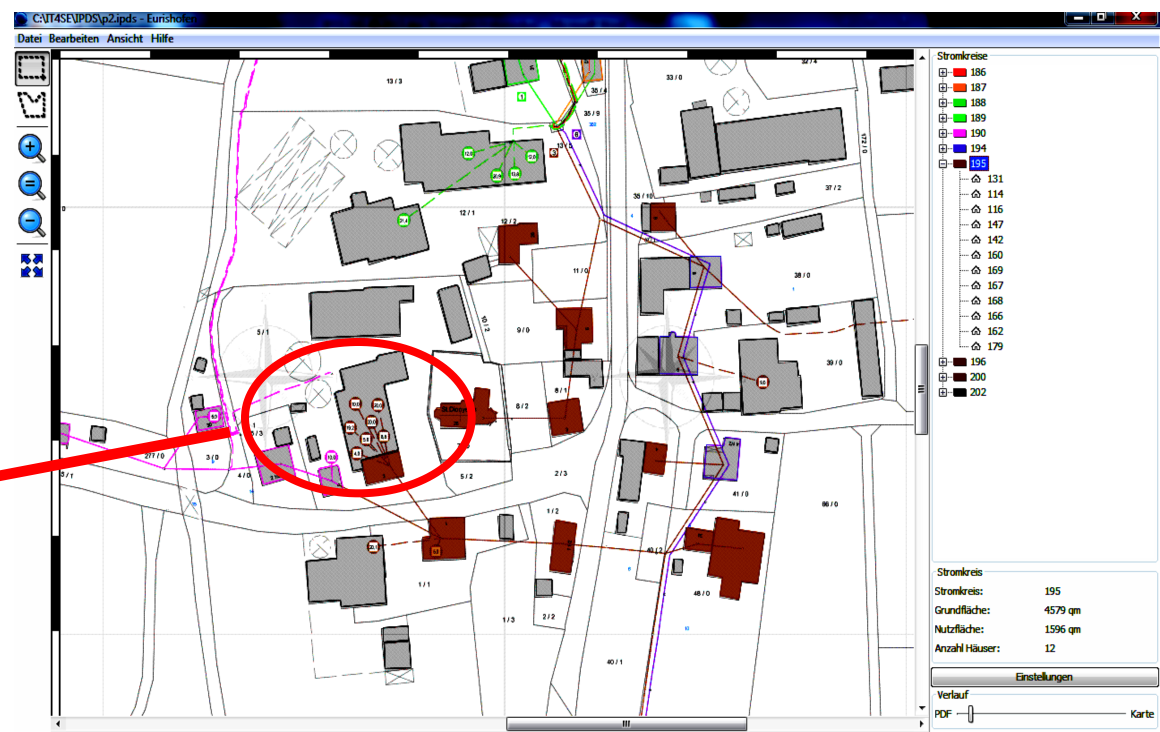
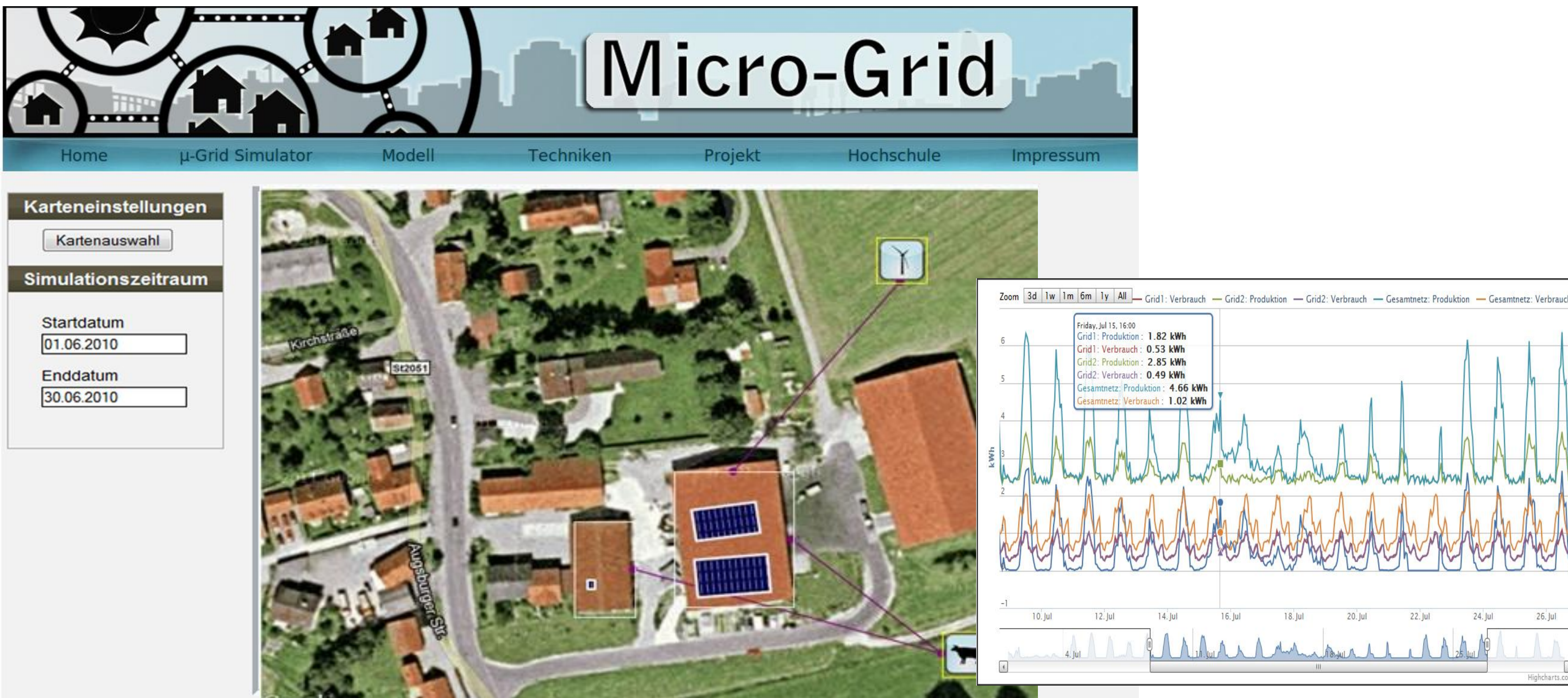
ICT contribution:

- Development of interactive planning support tools
  - Grid analysis – capacity, stability (e.g. PowerFactory)
  - Estimation of future solar power feed-in (e.g. IPDS)



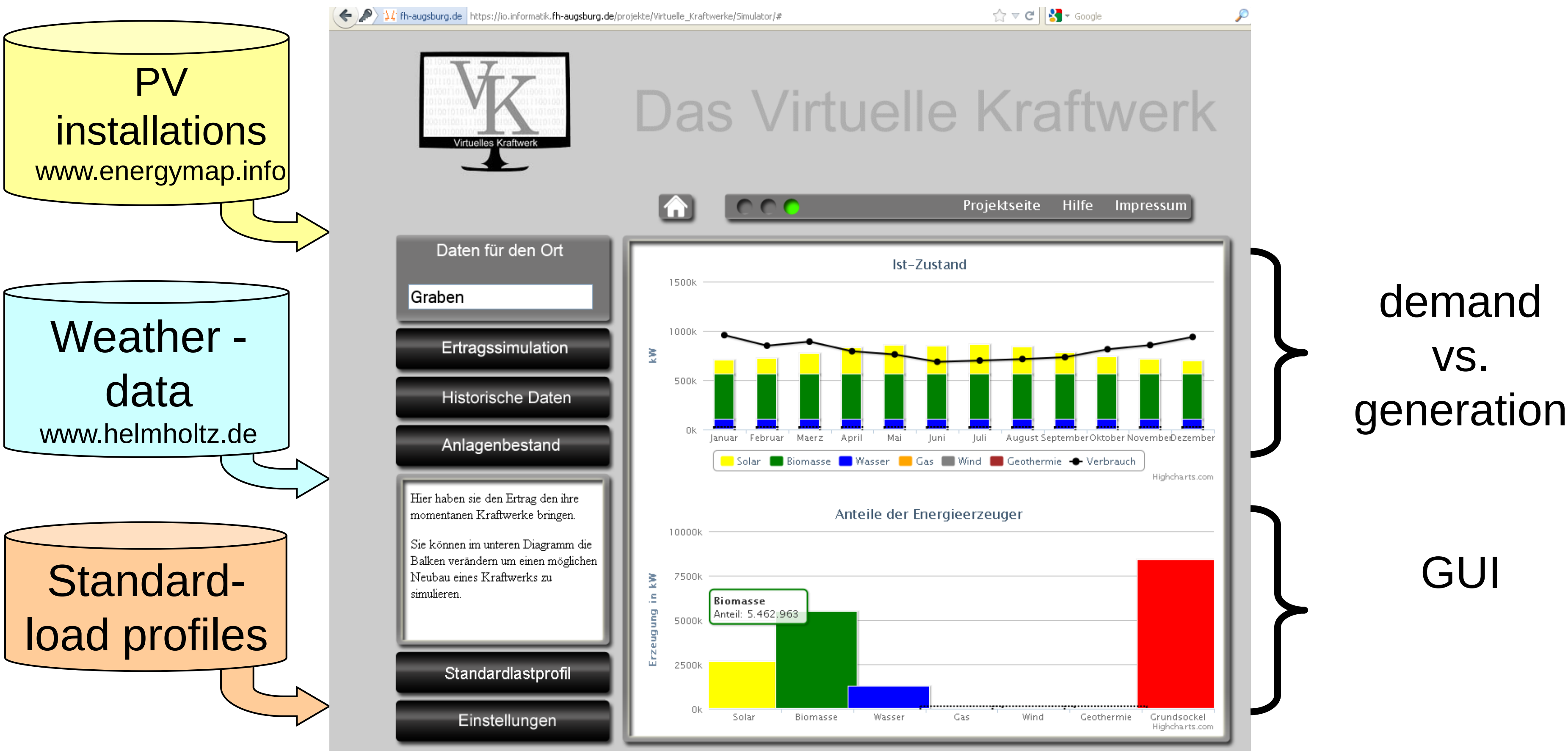
Working Area: Simulation of renewable energy generation

- **Micro-Grid simulator**
  - interactive tool for playing what-if scenarios with renewable sources and micro grids (PV, wind, biogas).



Working Area:
Energy Mix Simulation generation

- **Virtual power plant**
  - interactive tool for playing what-if scenarios with differnt mixes for small communities



Working Area:
Energy feed-back systems

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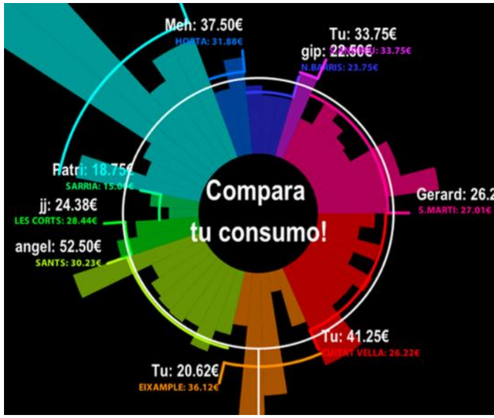
Goal

- „the energy aware and energy-efficient user“

  => energy conservation (studies suggest 2-15% is possible)



ICT contributions

- ***Eco-Feedback*** and ***Eco-Visualization*** increase awareness on consumption habits and consequences for environment and society

- Energy advice, motivation for behaviour changes

  => persuasive computing

Working Area:
Energy Efficient Building Automation

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Smart monitoring of
- light
- clima
- security

=> **more comfort & coziness but less energy consumption**

E.g.. EQ Homeatic, Loxone, u.a.

Quelle: CinéConsulte

Problem

- power consumption of computers and IT infrastrucute
  - Server farms, data centers, cloud clusters, …
    (e.g. Google 2,26 TWh in 2010)
  - Super computer
    (e.g. SuperMUC 3.5 MWh in 2012)
  - Workstations (2014 ca. 31.000.000 units in DE)
  - private sector: 1 user many computers
    (PC/Laptop/Smartphone/games consoles / tv / …)
  - network usage / data transfer

cf. German Green-IT-Initiative, www.bmub.bund.de

ICT contributions

- energy efficient hardware
  - avoid need for power-intensive cooling
- optimized workflows and more efficient algorithms
  - faster algorithms => less CPU usage => less energy
  - dynamic load management => more efficient use of hardware
- more efficient networks
  - e.g., shorter routing paths => less nodes => less energy use
- new compute-services, e.g.,
  - virtual machines vs. hardware
  - cloud services => better exploitation of big data centers

contact & further information

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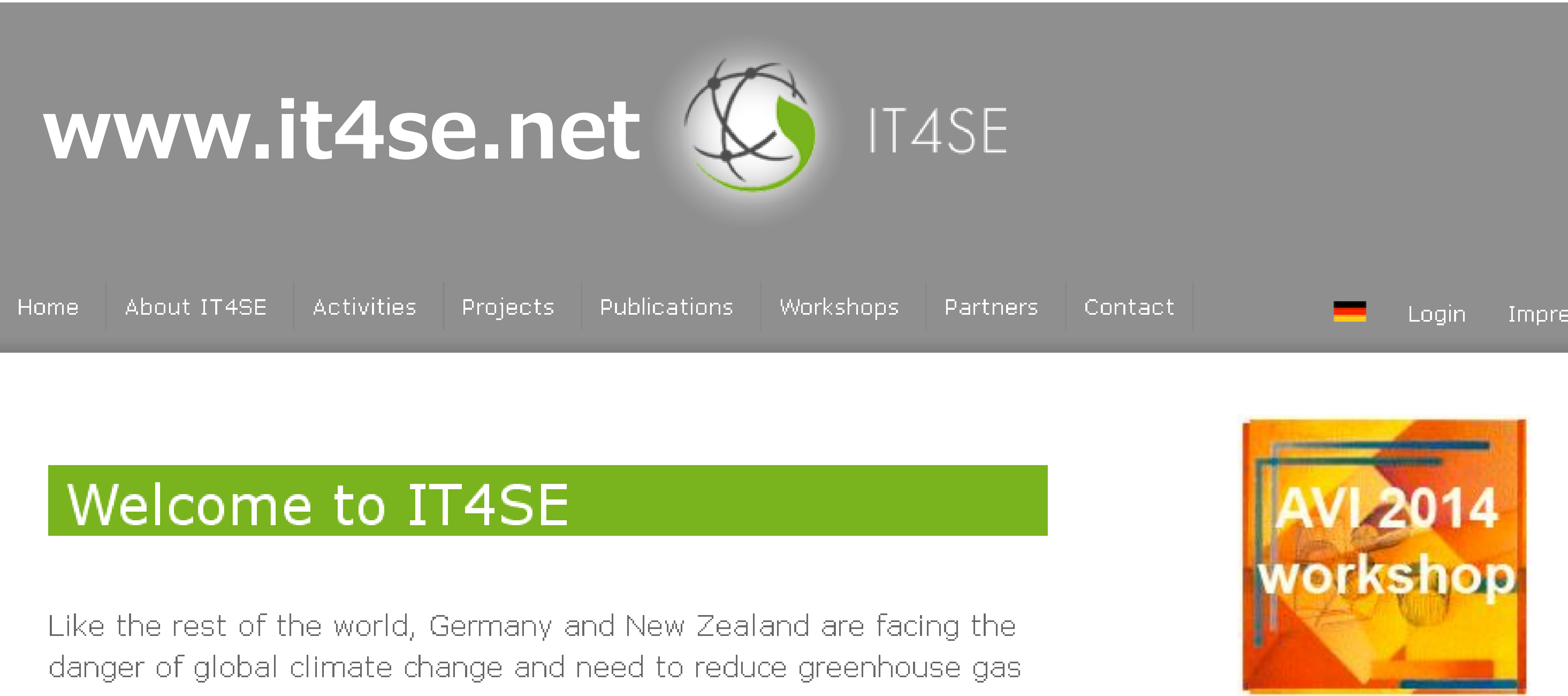

Workshop on Fostering Smart Energy Applications through Advanced Visual Interfaces

Como Italy,
May 20. 2014

Evolving Communications

Energy Awareness

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Energy-Saving Devices

Power

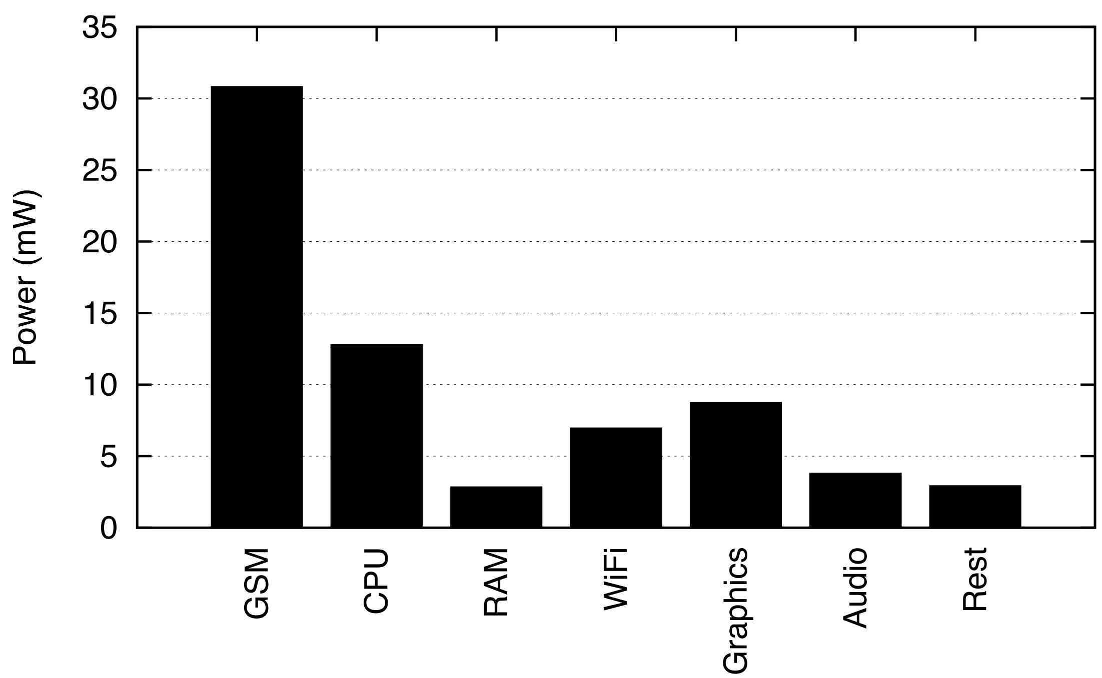

Figure 2: Power breakdown in the suspended state. The aggregate power consumed is 68.6 mW.

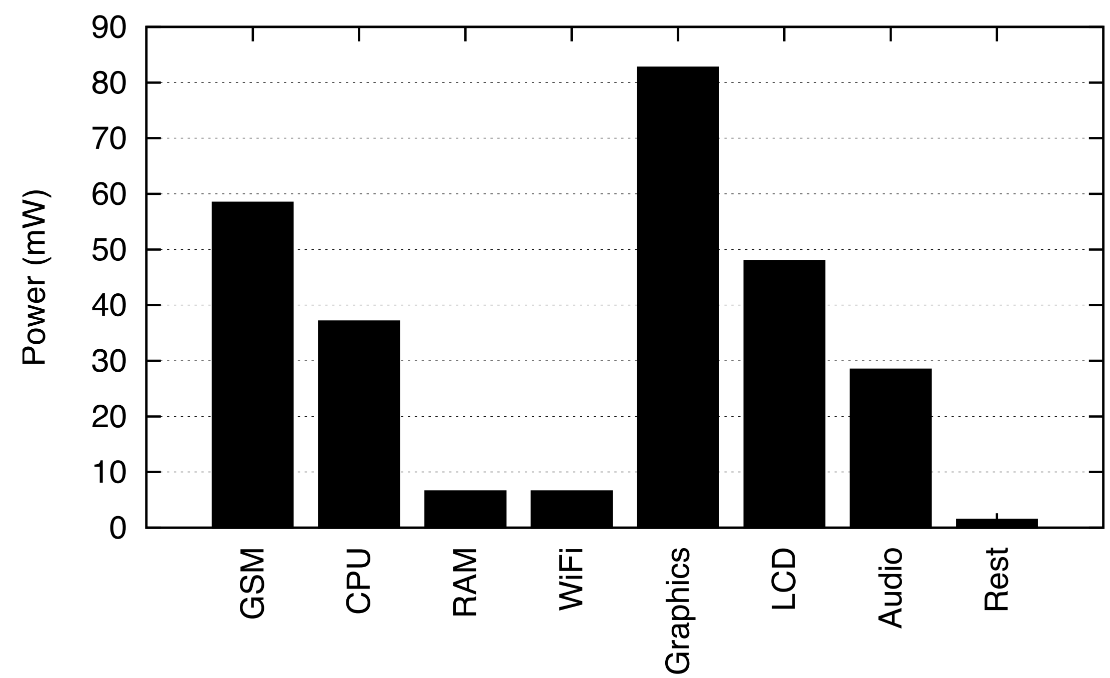

Figure 3: Average power consumption while in the idle state with backlight off. Aggregate power is 268.8 mW.

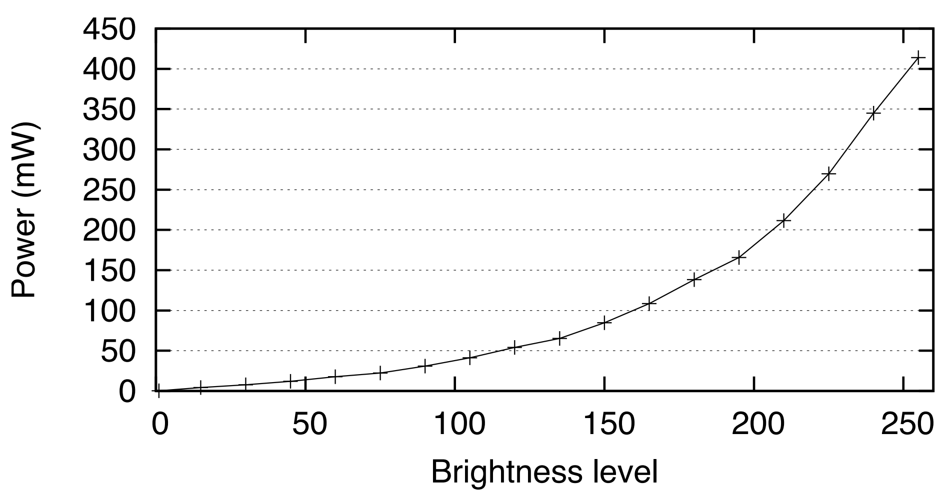

Figure 4: Display backlight power for varying brightness levels.

A. Carroll & G. Heiser, "An Analysis of power consumption in a smartphone". In Proceedings of the 2010 USENIX conference on USENIX annual technical conference (USENIXATC'10). USENIX association, Berkeley, CA, USA, 21-21.


2DAY
12:54 TUESDAY 25
You have 5 events
12:00
Meeting with David
13:30
14:00
Go get some food
14:30
15:00
SW status
17:00
17:00
Design review
18:30
In 5 min
Meeting
with David

Software Aspects

- Algorithmic efficiency
- Data transfer efficiency
- Custom applications to reduce waste (read ‘save energy’)

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Advances on Evolving Communications - Energy Awareness

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- **Topic: Wireless technologies – supporting Smart Grids**
  - **Smart grid:** intelligent power network characterized by its two-way flows of electricity and information
  - **Integrated communication infrastructure-** essential subsystem for smart grids to manage the operation of all connected components aiming to reliable and sustainable electricity supplies
  - Several advanced **wired/wireless communication technologies have been used or candidate** to be used in different domains of smart grid networks.

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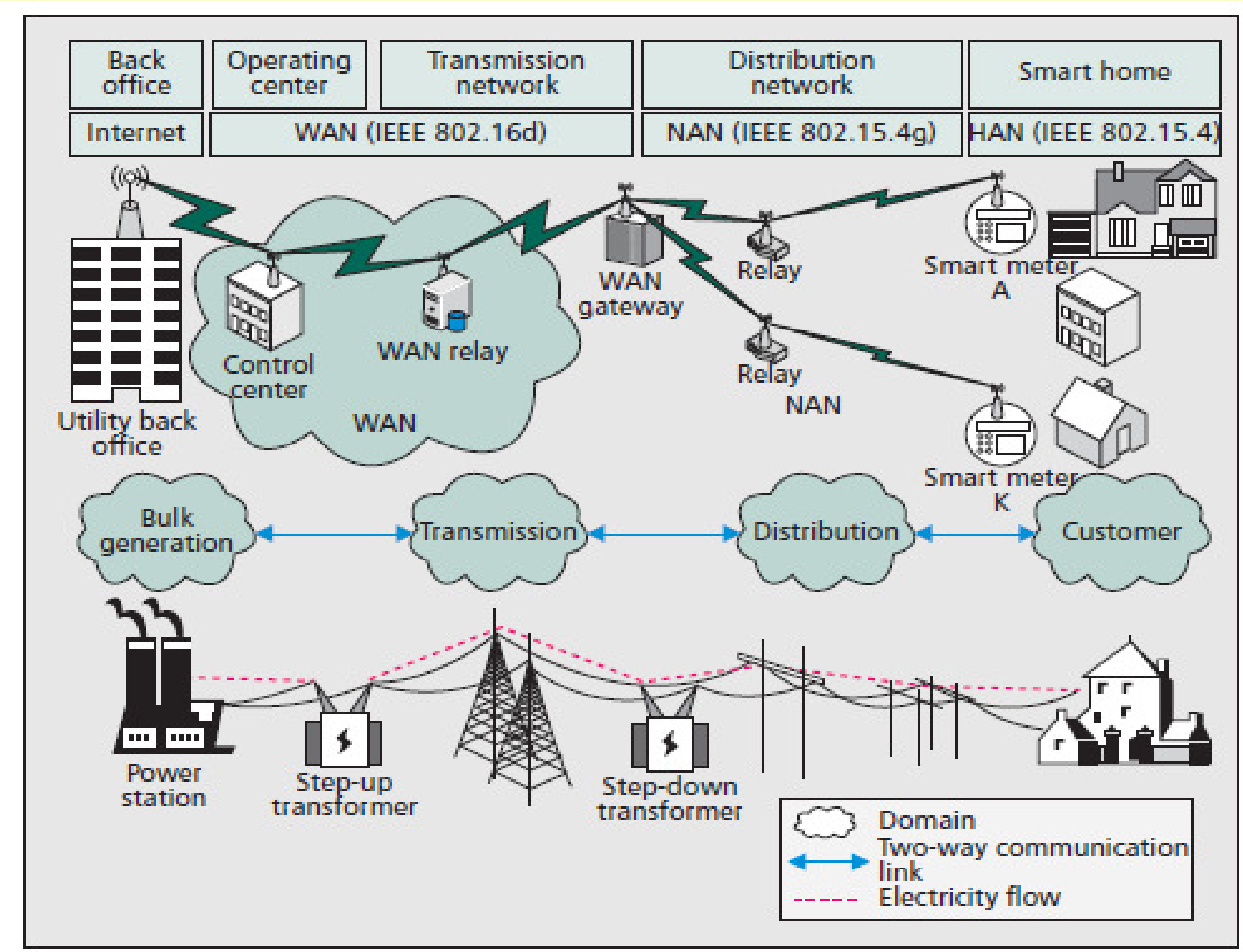
- **Example of a conceptual model for a M&C Plane of a Smart Grid**



Smart Grid

"M&C Plane"

NAN= Neighborhood Area Network

HAN= Home Area Network

Source: W.Meng et.al., Smart Grid Neighborhood Area Networks: A Survey, IEEE Networks, Jan 2014

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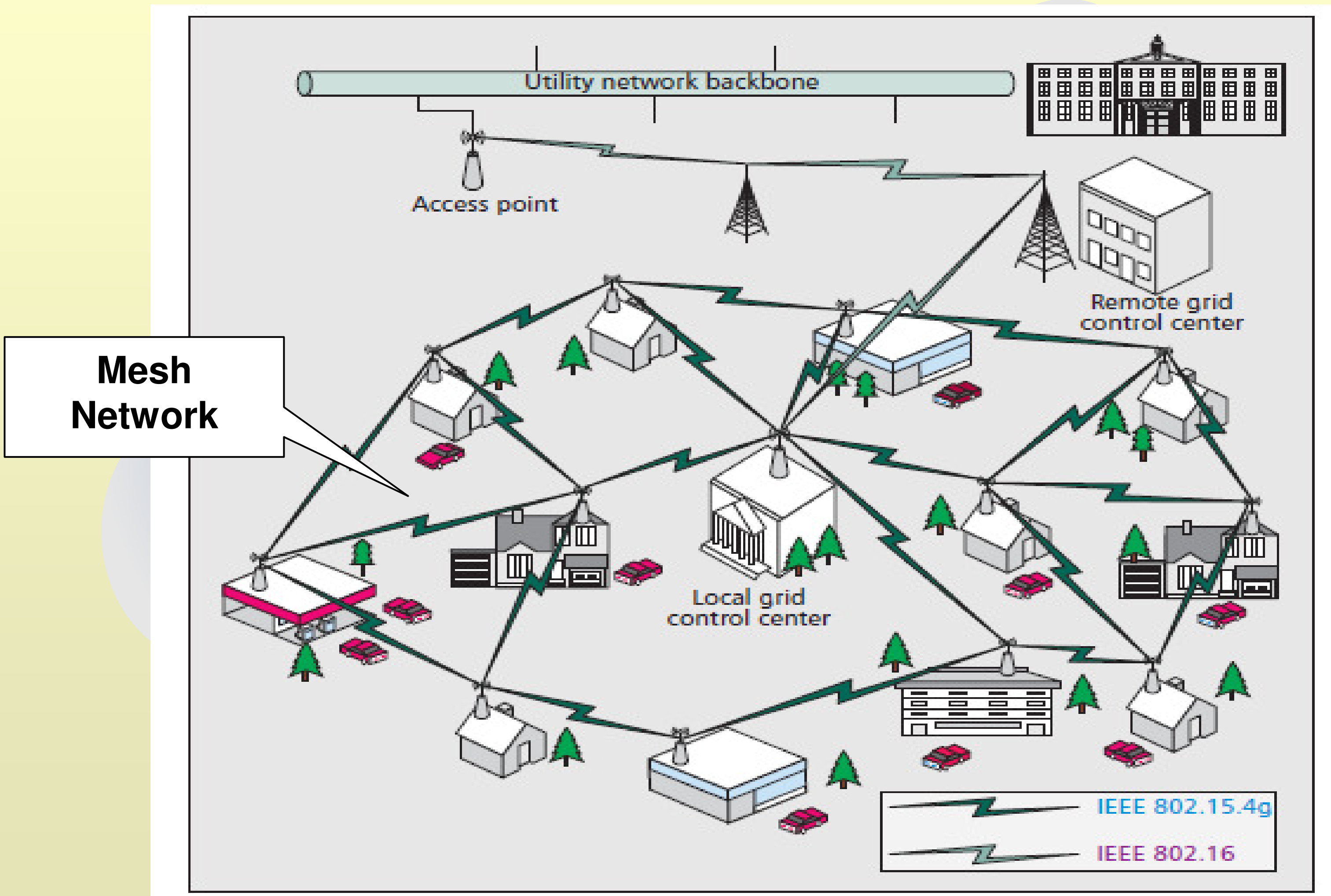
- **Hybrid M&C Plane- Cooperation example : IEEE 802.16d + IEEE802.15g**



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- **Technologies for NAN**

- **IEEE 802.15.4g** - standard making a PHY + MAC amendment and modifications to WPAN IEEE 802.15.4, aiming to
  - outdoor low data rate and wireless smart metering utility network (SUN) requirements.

  - SUN was designed to operate in a
    - distributed mode
    - over shared network resources
    - to enable the monitoring and control of utility systems.

  - SUN devices operate in a very large scale and low-power wireless application environment

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- **Technologies for NAN**
- IEEE 802.11s-derived from IEEE 802.11 family

- Goals
  - to to extend IEEE 802.11 MAC protocol for Wireless Mesh Networks
  - A significant feature : support frame delivery and route selection at MAC layer through radio-aware metrics.

- Topology of an IEEE 802.11s WMN
  - a central gateway is designated and deployed for data transmission to
  - mesh stations.
    - Mesh APs
      - offer the access I/Fs to the end users in either static or dynamic state,
      - transmit aggregated information to gateways via multi-hop paths.

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- **Technologies for WAN connectivity**
- IEEE 802.16 (d)
  - can be used for WANs connectivity
  - and relay signals from IEEE 802.15.4g back to utility backbone.

  - **Conclusions**
  - Wireless technologies can be successfully used for Smar Grid M&C Plane
    - IEEE 802.16x
    - IEEE 802.15.x
    - IEEE 802.11x
    - Topologies: p-mp, mesh, hybrid, etc.
  - However requirements need to to be fulfilled and adapted to Smart Grids needs: reliability, scalability, real-time acpabilities, throughput, security, cost efficiency, ..

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- Thank you !

Energy Aware Networking

The Clean Slate Approach

Nirmala Shenoy
Director, Lab for Networking and Security,
Professor, College of Computing and Information Sciences
Rochester Institute of Technology
NY, USA

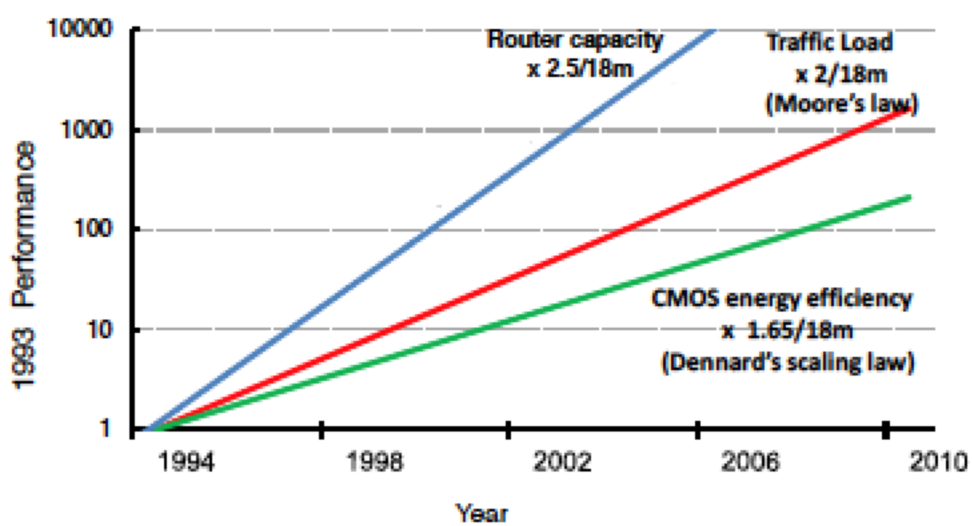
The Internet / Networks

Current Routing and Switching

- Routing in the Internet
  - Routing tables in core router exceeded 500K entries (RIB and FIB)
  - Routing operations become complex
  - Instability
- High performance multi rack computing architectures
- Huawei's 400G Core Router
    - 2 Tbits/slot, 6.4 Tbits/ chassis and 32 Tbits/system

Energy Impacts

- Power dissipation in routing equipment is growing at twice the rate of improvements in power consumption
- Carbon footprint
- Economic inefficiencies



Current Routing and Switching Technologies

- Patch work
- Revolutionary?
- Evolutionary?

- Revolutionary – transition path!?
- Rethink our basic approaches
  - Revolutionary HW and SW technologies

Routing in the Internet

- Do we need so many routing protocols?
  - Inter-AS, intra-AS?
  - Integration issues/inefficiencies
  - Internet has a well-established business structure
    - Tiers
  - How about leveraging this for routing?
  - Addresses carry routing information?

  Yoshihiro Nozaki, Parth Bakshi, Hasan Tuncer, Nirmala Shenoy, "Evaluation of Tiered Routing Protocol in Floating Cloud Tiered Internet Architecture", Special Issue on Future Internet TestBed, Journal of Communication Networks, published by Elsevier 2013.

Tiers in the Internet – Tiered Addresses

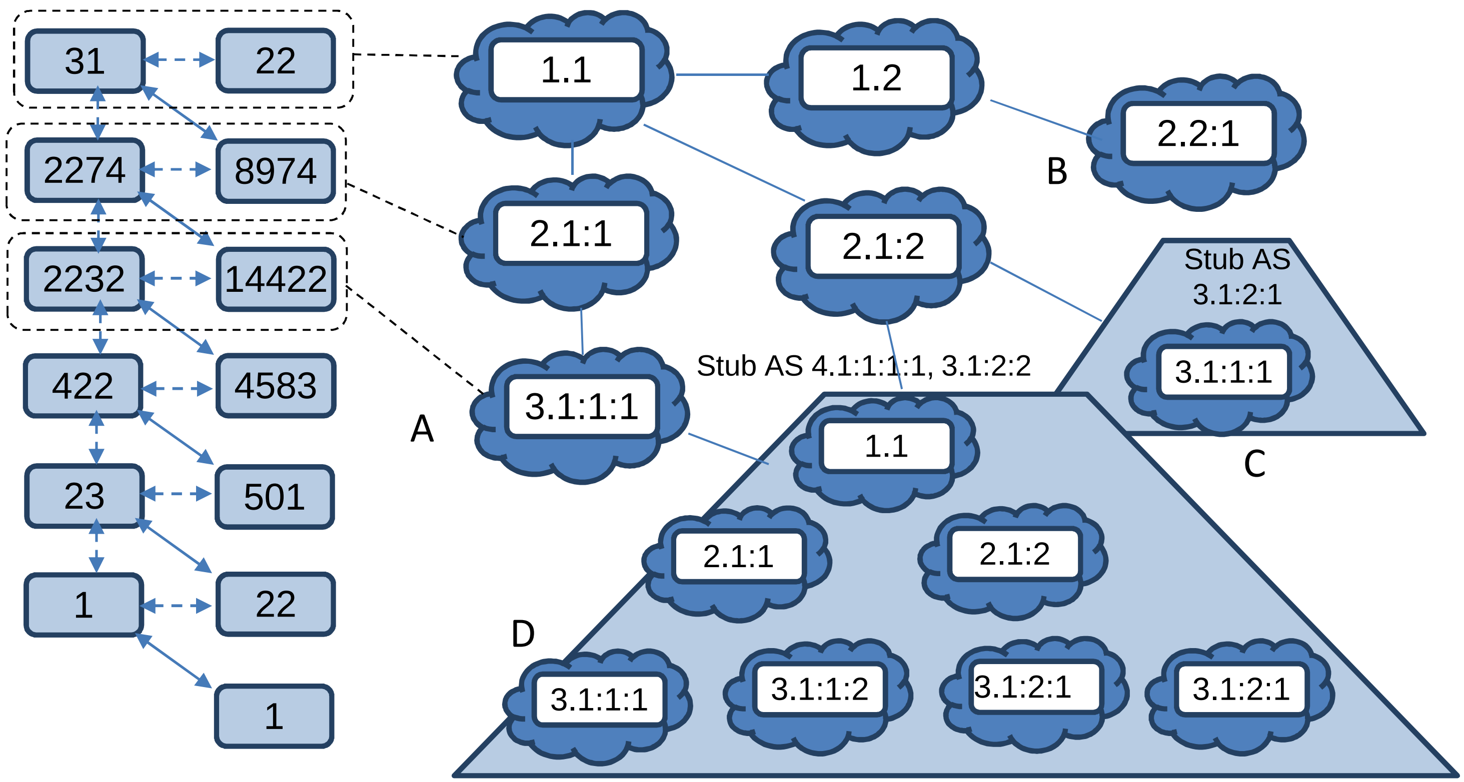


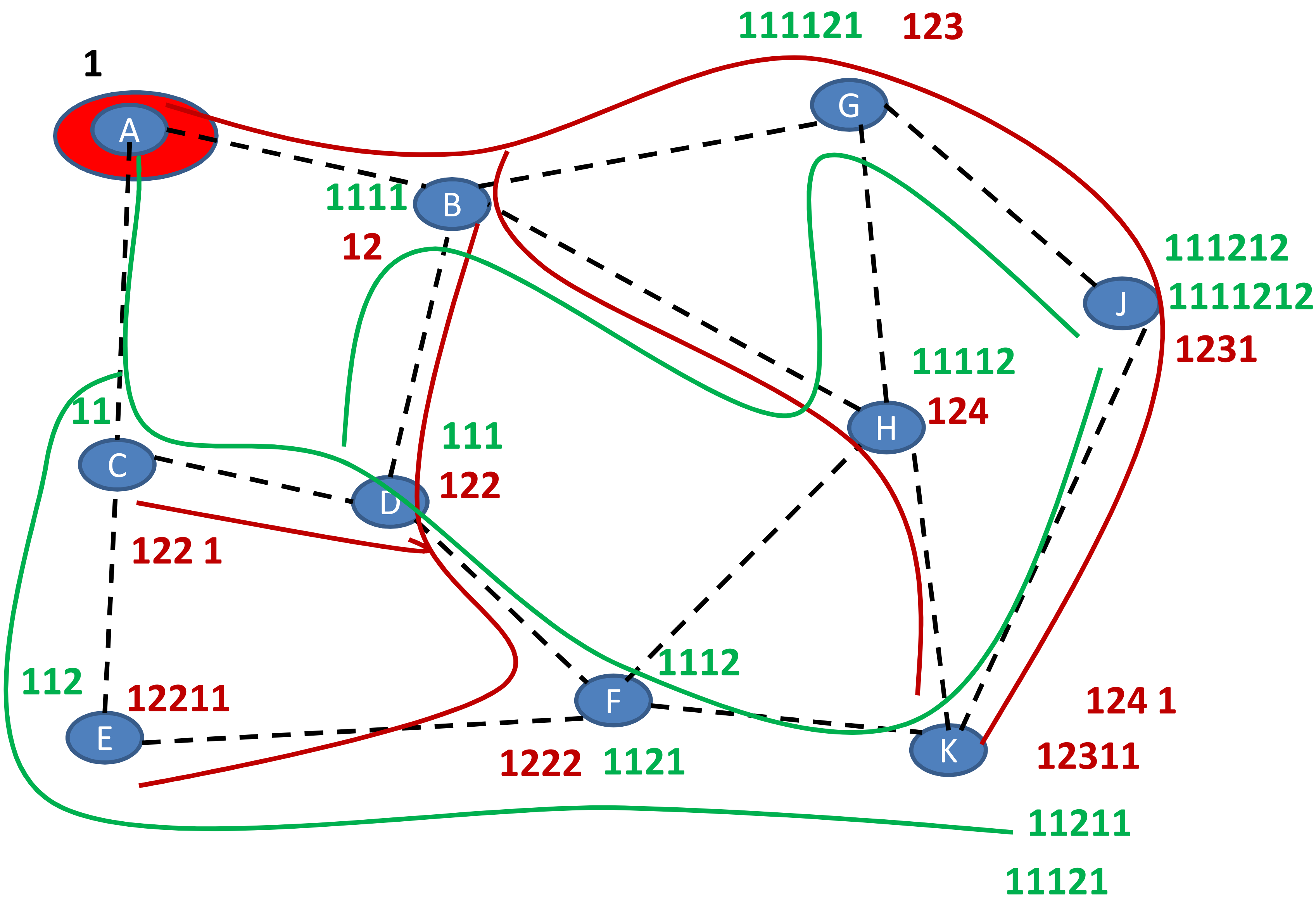
Figure 6 Tiered Subnets Inside Tiered ASs

Current Routing and Switching

- Switching complexity
  - Avoiding loops
  - VLANs and complexity at layer 2
  - VLAN hierarchies
    - Customer, provider, backbone
  - Shortest Path Bridging, TRILL on Rbridges
    - IS-IS layer 3 routing at layer 2

Switching Technology

- Loop Avoidance
  - issues
- Growing complexity in layer 2 –
  - VLAN hierarchies
- Novel technologies
- IEEE 1910.1 Project
  - **Standard for Meshed Tree Bridging with Loop Free Forwarding**
  - **Link - https://mentor.ieee.org/1910/**



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How to be Energy-Aware?