Towards Energy Efficient Wireline Networks, An Update From GreenTouch

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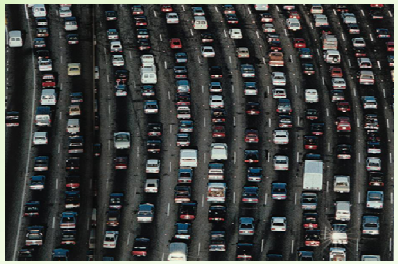
Outline

- Why Green Networks matter ?
- GreenTouch
  - Green Meter
- Wireline Access
  - GreenTouch roadmap
  - Example projects
- Summary

Why Green Networks matter

Global aviation industry



50 million cars

Global ICT Emissions: 2.3%, Growing at 4% YoY

GeSI "SMARTer 2020: The Role of ICT in Driving a Sustainable Future", 2012

INTERNET

=5th

HIGHEST COUNTRY

If the internet was a country: energy consumption is higher than Russia and a little less than Japan

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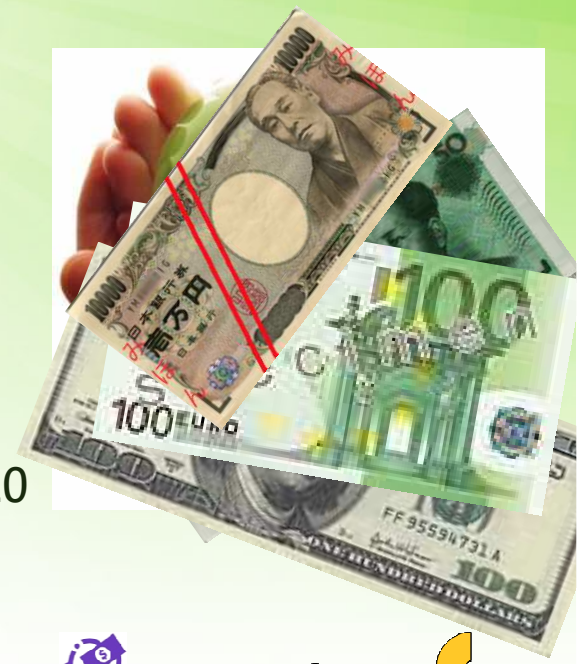
Why “Green” matters too



- For operators: OPEX and CAPEX savings
  - Direct cost of energy is increasing in P&L
    - Also secondary power consumption ~2x
    - >8x more traffic fixed BB in mature markets by 2020
  - Density – floor space
  - Power supply to remote nodes
  - Battery back-up

NETWORK

~75%

ENERGY BILL

70 to 80% overall energy bill of an operator
> RAN: +70% of network electricity cost

ENERGY BILL

7-20%

OPERATORS OPEX

From 7% in mature countries
to +20% in emerging countries

- For Governments:
  - Build power plants in fast growing economies
  - Exit of nuclear power programs
  - Cost impact of environment and climate change

  => tax incentives and regulation

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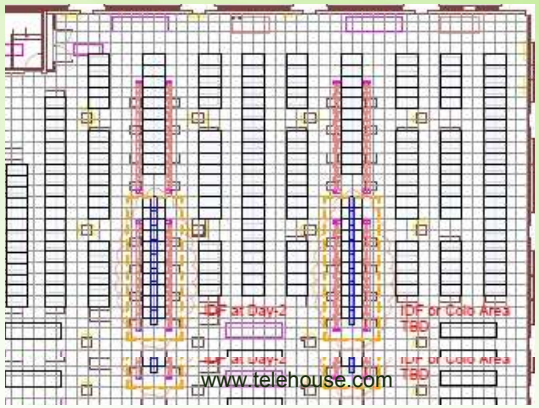
Lower Power in Central Offices
Towards Higher Density and Less Floor Space

- Cooling capabilities of a CO
  - Max. 1075 W/m^2
  - Max. 1950 W/rack

  => When power increases, bays or shelves have to be left empty to meet requirement



www.telehouse.com

- Thermal limit for density per line card
  - E.g. Typically 100 W/line card
    => Only max. 2 ports of NG-PON2 supported

- Cost for cooling
  - Natural convection < Forced air fans < Liquid cooling

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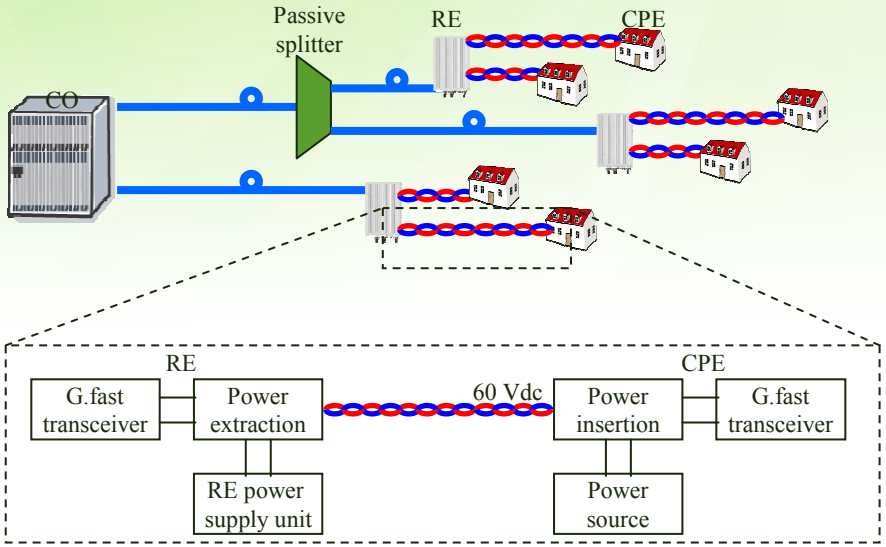
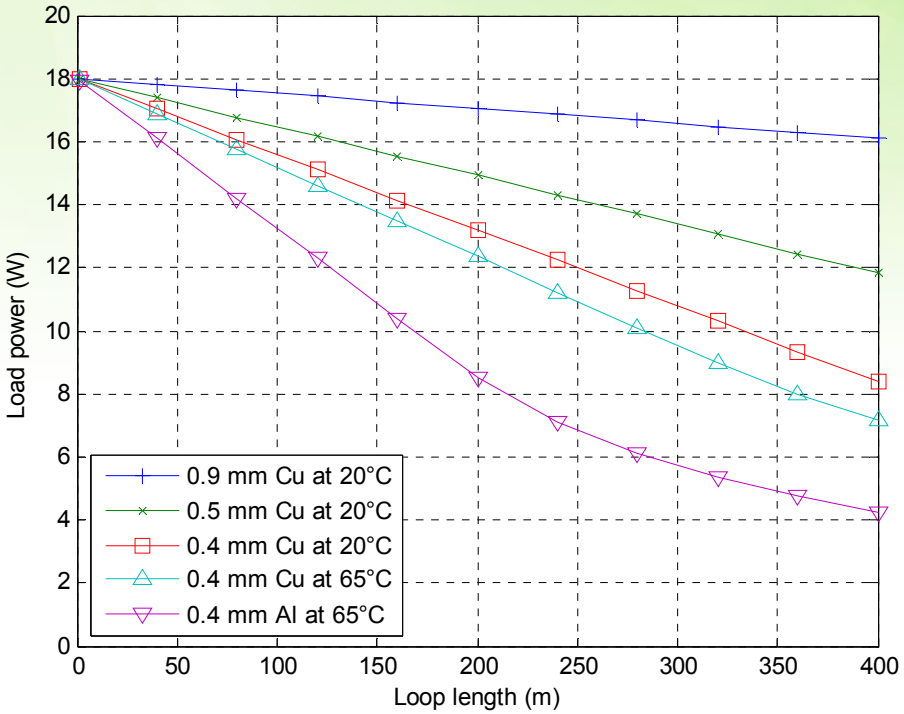
Lower power in remote nodes enabling alternative power supply

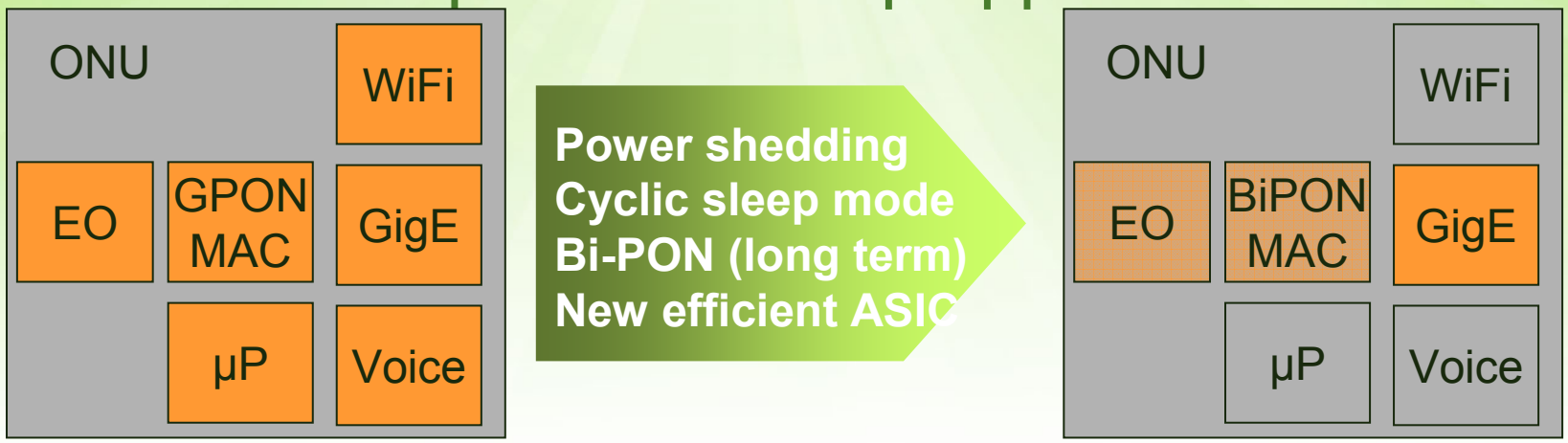




Courtesy: Jochen Maes, Bell Labs

E.g. reverse powering via DSL line
6 W over 300 m

Low power ONU
⇒ new power back-up approaches



10 W
~8 h on lead-acid battery

Ref: forums.verizon.com

Standby 0.1 W - Active data (or voice): 1 W
~8 h active on 4 rechargeable AA cells
~3 d standby on 4 rechargeable AA cells

Ref: wikipedia.org

Or…power from laptop via USB

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GREENTOUCH™ (www.greentouch.org)

- **Global research consortium** representing industry, government and academic organizations
- Launched in May 2010
- Focus on **sustainability** and growth
- **Holistic** and **ambitious**: Goal of 1000x
- **53 member organizations**
- **300+ leading scientists**
- Recognized by the **World Economic Forum** as an industry-led best practice toward sustainability

It takes an ecosystem

- Moving from fundamental research into the **pre-competitive area** through standardization
- Leading **Green ICT**: cooperation with other NGOs such as GeSI, ITU-T, GreenGrid, Carbon Trust, ITRS

DELIVER ARCHITECTURE, SPECIFICATIONS AND SOLUTIONS AND DEMONSTRATE KEY TECHNOLOGIES TO INCREASE NETWORK ENERGY EFFICIENCY BY A FACTOR 1000 COMPARED TO 2010

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GreenTouch Status: Where Are We?

16 RESEARCH PROGRAMS and PROJECTS

- Wireless and mobile communications
- Wireline access
- Core networks and optical transmission
- Services, applications and trends

NEW APPROACHES BEING TAKEN

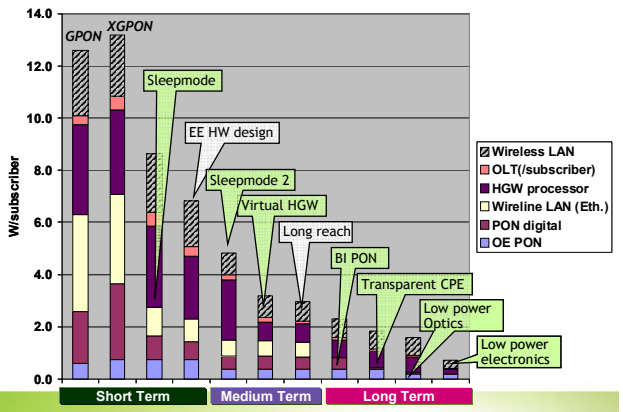
- Devices and low power electronics / photonics
- Architectures, algorithms and protocols
- “Power-follows-load” intelligent management
- Service and energy optimized networks

TWO MAJOR PUBLIC DEMONSTRATIONS

- Wireless
- Fiber-to-the-home

COMMON REFERENCE ARCHITECTURE & ROADMAP

- Establish and define common reference architecture and roadmap with strategic research directions



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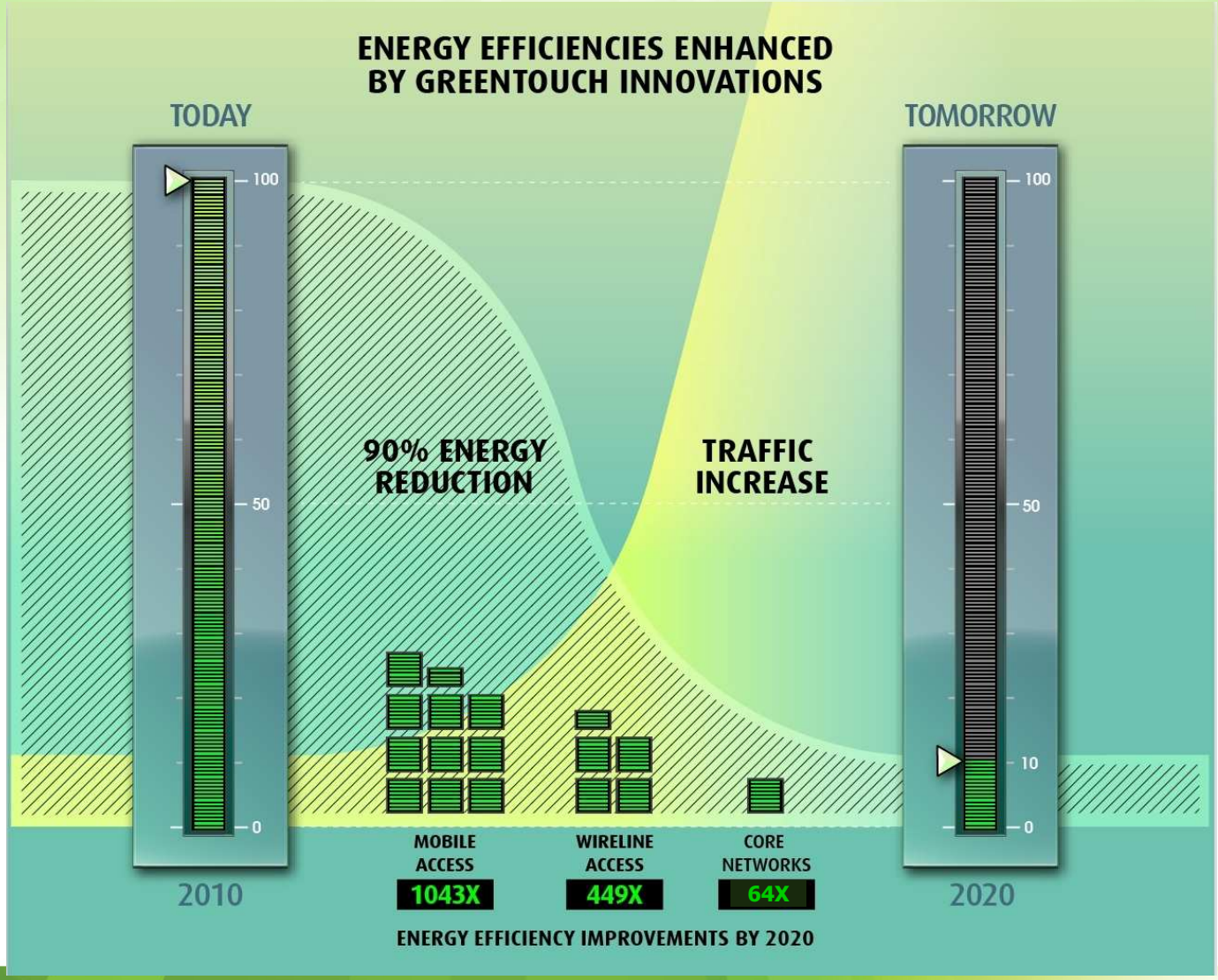
Green Meter (Press release May 13, 2013)



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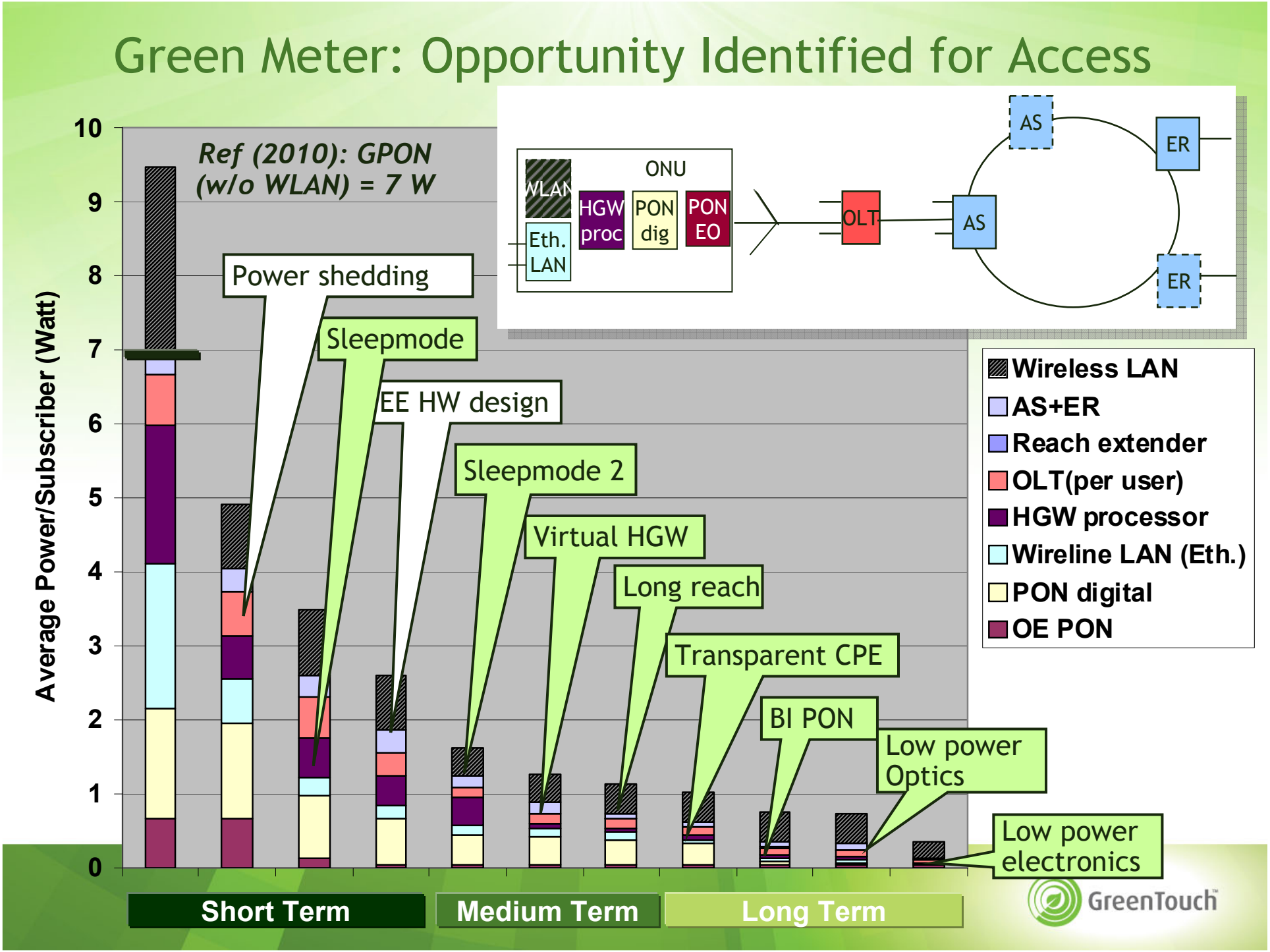
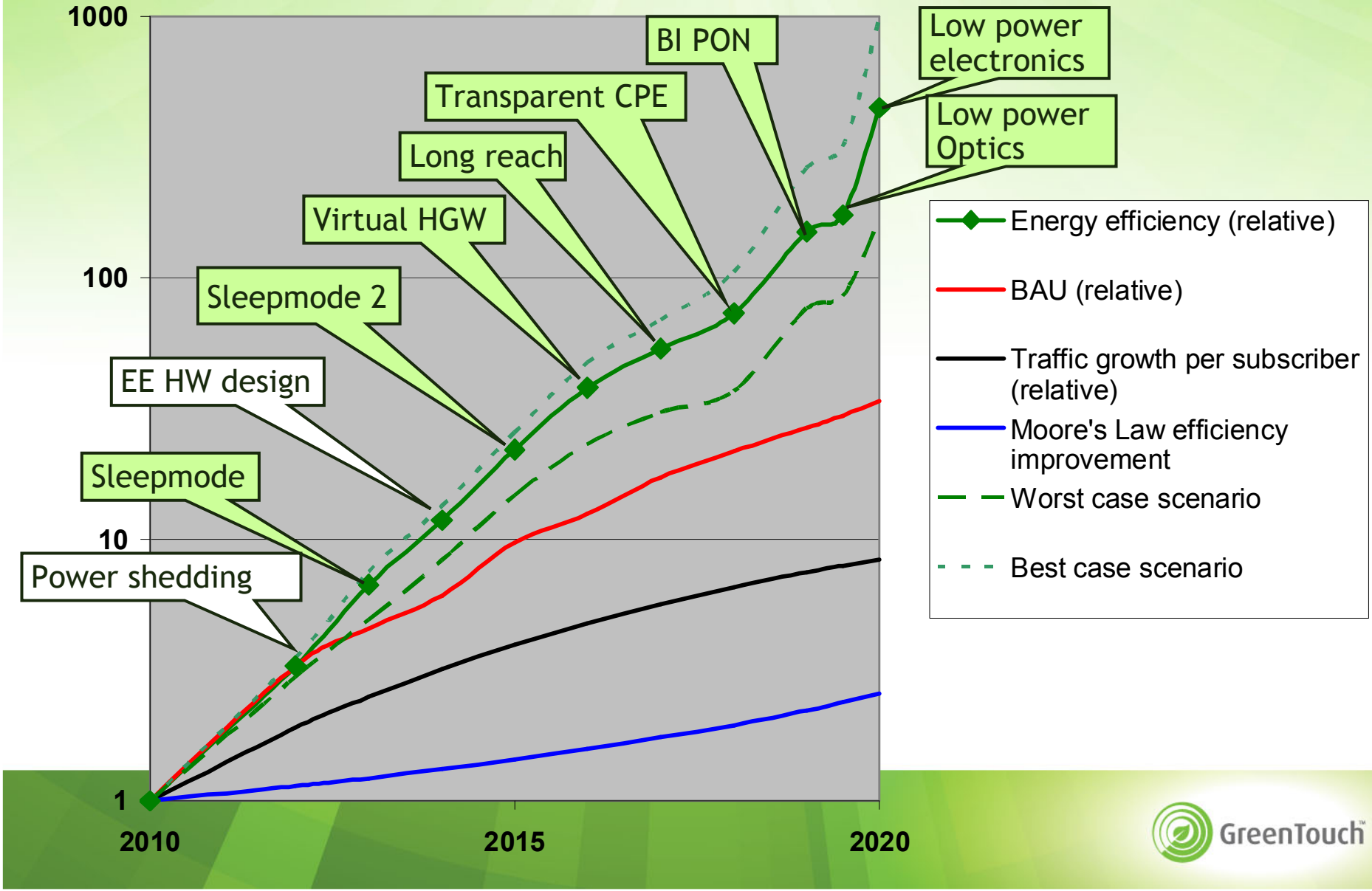
Green Meter: Opportunity Identified for Access



Efficiency improvements



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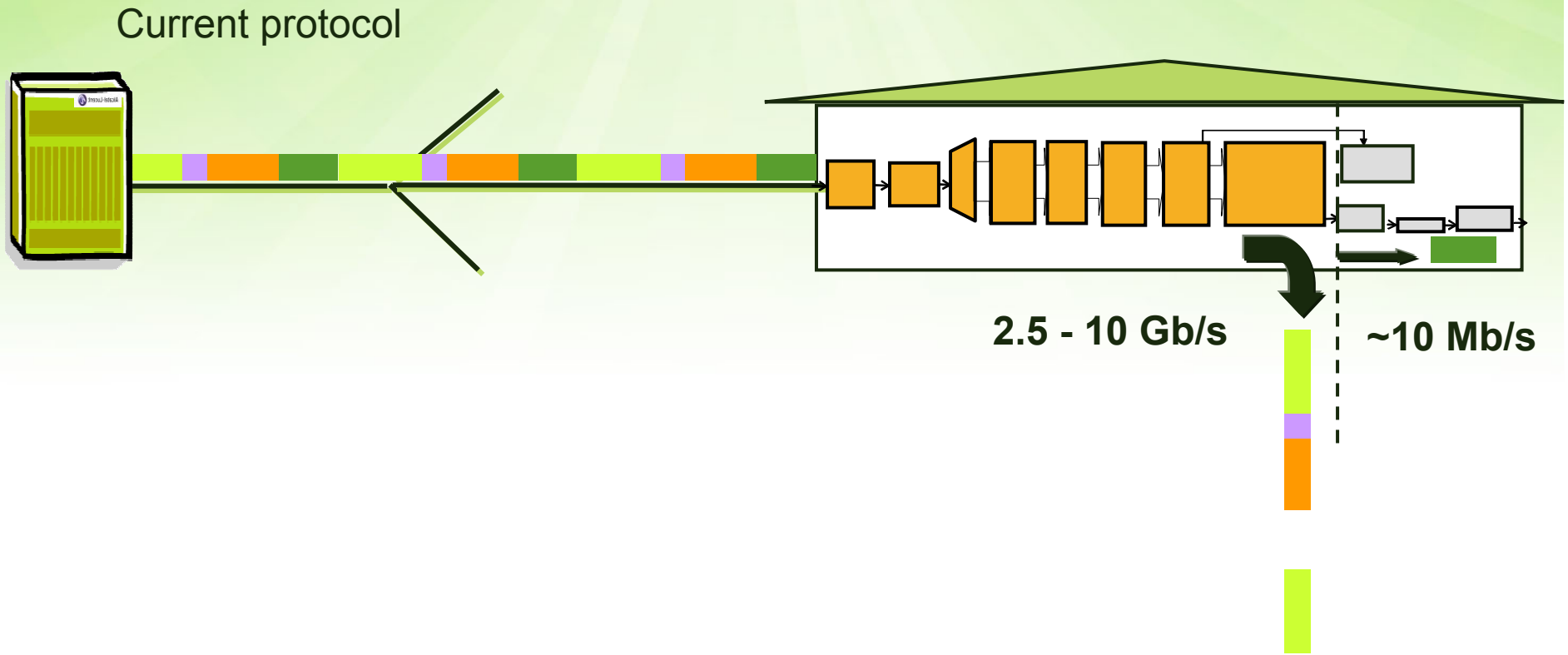
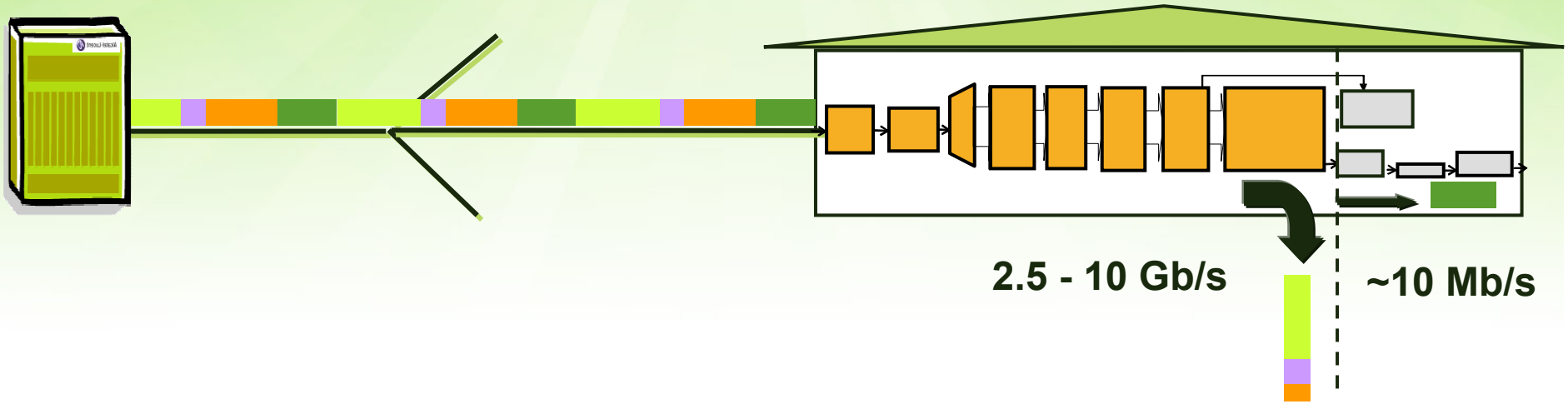
Energy efficient protocol

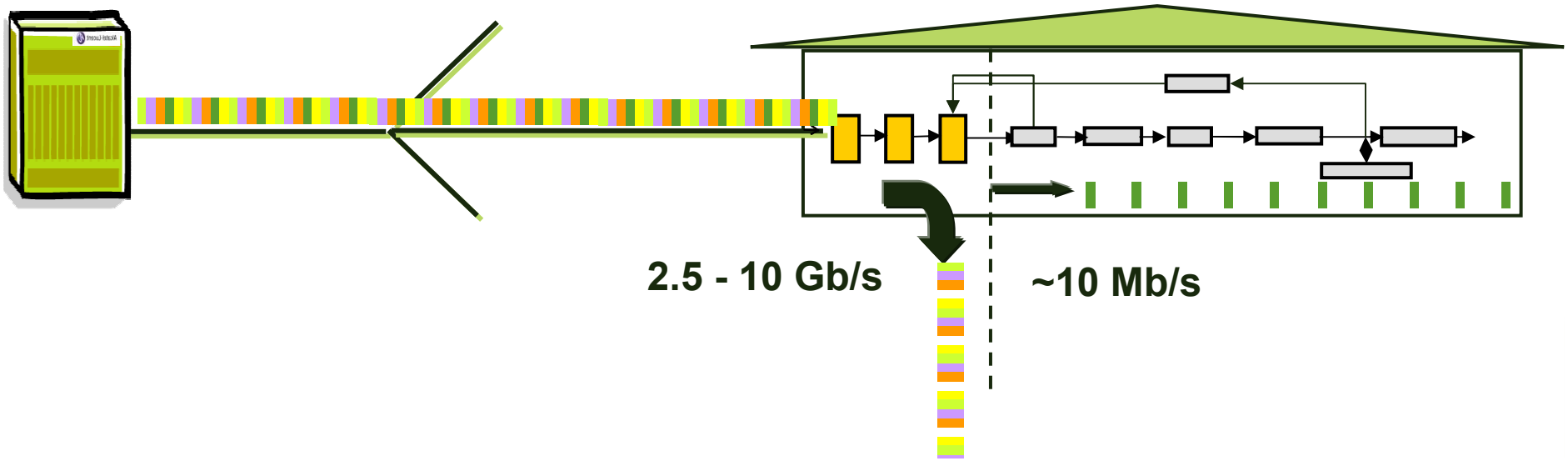


New energy efficient protocol

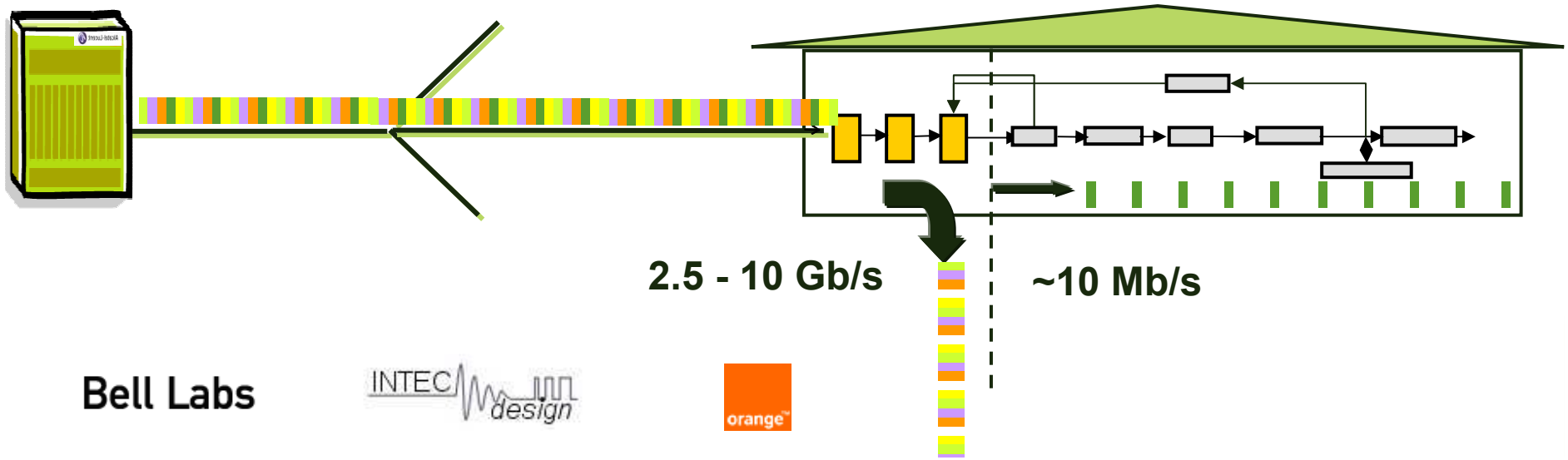
Current protocol



Bit-interleaving **Bi-PON**: order reduction in protocol processing



Bi-PON Demo: > 10x efficiency improvement



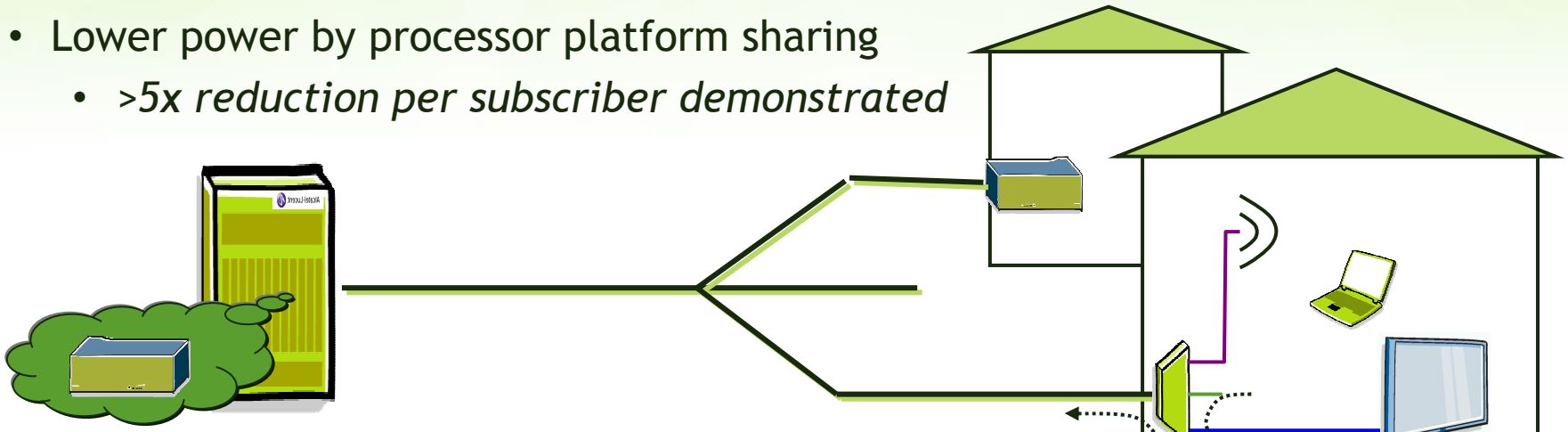
Bell Labs

INTEC design

orange

Virtual Home Gateway / Quasi-passive CPE

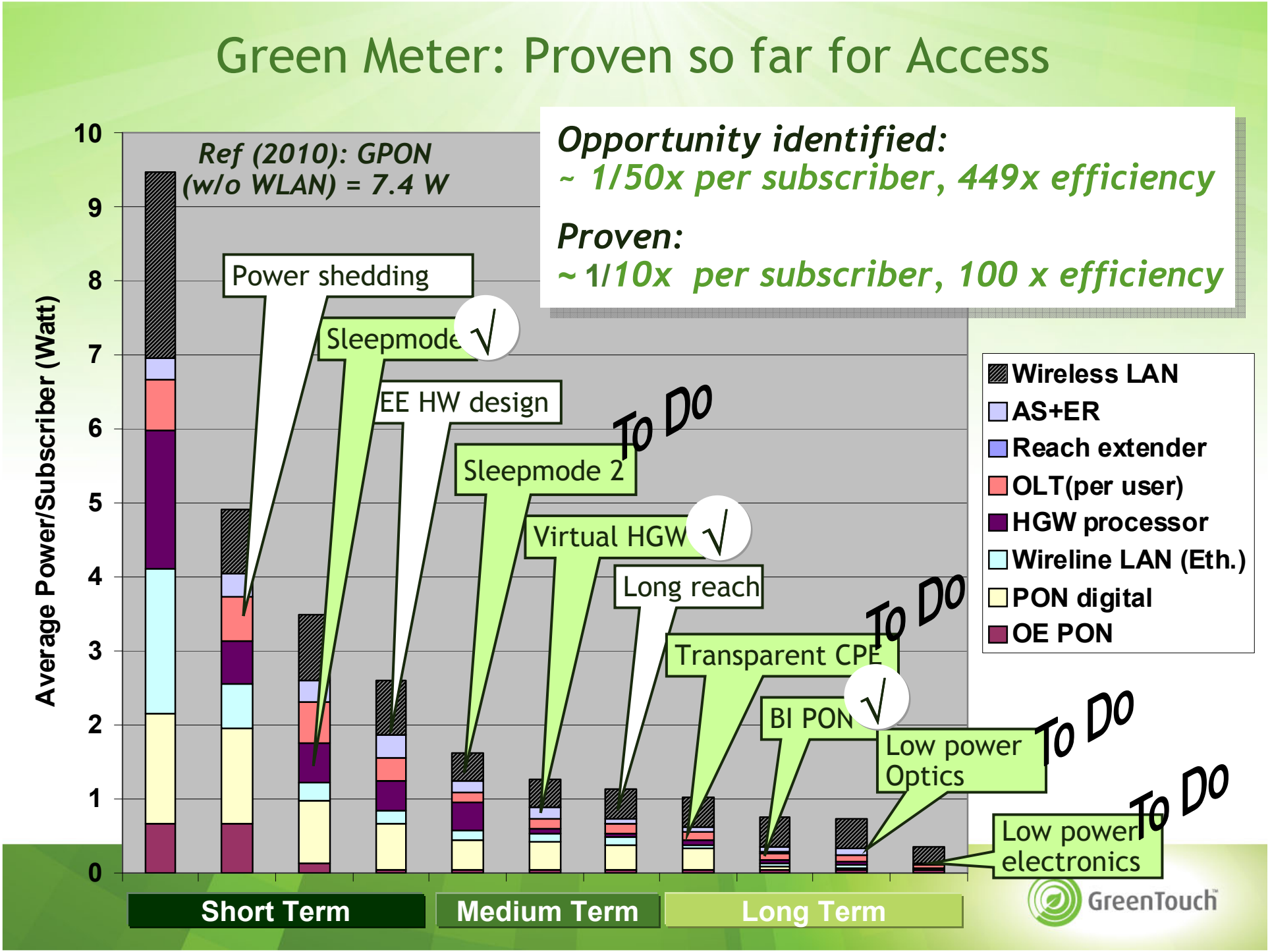
- Transparent CPE providing connectivity in-house and to network
  - Functions of current CPE moved to virtual HGW in network
  - Low power connectivity (“quasi-passive”) or transparant (“passive”) CPE
- Savings:
  - Cut-through of high bitrate services to terminal: LAN interfaces on CPE
  - Lower power by processor platform sharing
    - *>5x reduction per subscriber demonstrated*



Virtual HGW performs
- routing and NAT
- firewalling
- OAM management

Quasi-passive CPE

Green Meter: Proven so far for Access



Summary

- Green networks are not only environmental, but also economical
- GreenTouch researches disruptive solutions targeted at 1000x efficiency improvement
- Wireline optical access
  - 50x average power per subscriber – 449x efficiency per bit

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