Exploring the Benefits of Carbon-Aware Routing

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Problem: The carbon footprint of the Internet is significant.

Motivation:
Routing Optimization:

Which route is most efficient?

• Different locations → different carbon intensity
• Carbon intensity in gCO2/kWh
• Carbon intensity varies:
  o per region
  o per season
  o per day
• Carbon intensity is predictable

Goal: Explore and quantify the potential energy and carbon savings of carbon-aware routing

Understanding UK’s Internet:
Traffic Patterns:

Hierarchal Structure of BT’s Network:

• BT connects all of the UK
• All sites serve local community and connect to other sites
• Content is streamed from caches

Recommendations:
• Define a standard set of energy and carbon metrics
• Distinguish between use cases for carbon emissions minimization
• Regulate energy rating for ICT equipment
• Reduce the static power of routers with greener design techniques
• Enforce detailed and accurate reporting of carbon by ISPs

Key Results:

• Metrics: carbon intensity + dynamic power → most carbon savings
• CATE: highest savings at the expense of path stretching of 5%
• Carbon savings are negligible for Evening-Traffic (short paths)

Impact:
• ISPs: immediate steps to reduce emissions without incurring additional costs or changes to their infrastructure
• Users: ability to compare and choose the most environmentally friendly ISP
• Policy makers: informed policy recommendations