Towards Environmental Sustainability with the IETF

Christoph Becker

Institute for Biodiversity and Ecosystem Dynamics & Institute for Advanced Study, University of Amsterdam

c.becker@uva.nl | christovis.github.io | Christovis

The markets for Information and Communication Technology (ICT) devices are undergoing an explosive growth. It is being fuelled by a move towards distributed and decentralised energy networks (small-scale conglomerates in which energy production happens at or near consumers) that takes the existence of an Internet of Everything (networks connecting people, process, data, and things) as its premise. In the worst-case scenario, this could lead to a usage of as much as 51% of global electricity and contribute up to 23% of the globally released greenhouse gas emissions by ICT in 2030 [1]. Thus, although the ICT sector is enabling better environmental performance elsewhere, itself will take on a significant burden.

Therefore it is necessary to critically examine separate parts of the Internet, such as,

- Architecture: caching, replication, locality, asynchrony, speed,
- Protocols: format, overhead, speed,
- Formats: verbosity, compressability,
- Parameters: timers, negotiation,

and ask not only whether they can be improved with respect to increasing capacity and speed, but also, whether they can minimise environmental damage, which has received far less attention [2].

As the IETF is developing and standardising Internet protocols, it plays an important role in this critical examination. A clear example of IETF's influence is given by its redesign of the IPv4 communication protocol into the improved version IPv6. The redesign does not only solve the problem of IPv4 address exhaustion, but also reduces energy waste and increases flexibility towards green networking (e.g., [3, 4, 5]). In 2010, the IETF set out to create a framework that enables monitoring, controlling, and managing the energy consumption of networking and network-attached devices while still providing sufficient performance to meet service level objectives with the Energy Management (EMAN) working group [6]. Five years later however, the EMAN working group was shut down and has never been reactivated despite remaining limitations (e.g., it does not address questions regarding electricity producers, and distributors) and the roll-out of new technologies (e.g., IoT and 5G). But other dimensions through which impacts on climate and ecology can be addressed are present in other working groups that are concerned with, e.g., smart energy, smart grid, and the Internet of Things.

The IETF is one of the main Internet governance bodies and it is therefore pressing to ask what its role ought to be, can be, and currently is with respect to climate change. To find answers, I will use `BigBang` [7], an open source toolkit to make the production of digital infrastructures more transparent and accountable. It has previously been used to analyse Internet standards setting organisations (e.g. [8, 9]). `BigBang` makes it possible to analyse discourses, time series, social- and knowledge-networks of public email archives and the datatracker. In this project, `BigBang` will support topic modelling based on IETF's datatracker, which is a dimension reduction procedure to discover and/or analyse themes within textual datasets. As this study only requires the message bodies and focuses on themes related to, e.g., "energy efficiency", "sustainability", "smart grid", "IoT", data of human subjects is not of interest. Hence, ethical and privacy issues as outlined in the Bellmont Report are evaded.

The results of this work are of interest to the IETF, and Internet users more broadly, as they can highlight ways of introducing fundamental concepts of environmentally-conscious design into the development and standardisation of Internet protocols.

References

[1] Anders Andrae and Tomas Edler. On Global Electricity Usage of Communication Technology: Trends to 2030. *Challenges*, 6(1):117–157, April 2015.

[2] Ran Liu, Peter Gailhofer, Carl-Otto Gensch, Andreas K{\"o}hler, and Franziska Wolff. Impacts of the digital transformation on the environment and sustainability. Technical report, {\"O}ko-Institut e.V., December 2019.

[3] J. Chabarek, J. Sommers, P. Barford, C. Estan, D. Tsiang, and S. Wright. Power Awareness in Network Design and Routing. In *IEEE INFOCOM 2008 - The 27th Conference on Computer Communications*, pages 457–465, Phoenix, AZ, USA, April 2008. IEEE.

[4] Roberto Bruschi, Alfio Lombardo, Giacomo Morabito, Vincenzo Riccobene, Raffaele Bolla, Franco Davoli, and Chiara Lombardo. Green extension of OpenFlow. In *2014 26th International Teletraffic Congress (ITC)*, pages 1–6, Karlskrona, Sweden, September 2014. IEEE.

[5] Frederic Giroire, Joanna Moulierac, and Truong Khoa Phan. Optimizing rule placement in software-defined networks for energy-aware routing. In *2014 IEEE Global Communications Conference*, pages 2523–2529, Austin, TX, USA, December 2014. IEEE.

[6] Joel Jaeggli. Energy Management (EMAN) Applicability Statement, October 2014.

[7] Sebastian Benthall, Nick Doty, Niels Ten Oever, and Christoph Becker. BigBang. *Zenodo*, August 2021.

[8] Stefania Milan and Niels ten Oever. Coding and encoding rights in internet infrastructure. *Internet Policy Review*, 6(1), January 2017.

[9] Niels ten Oever. Productive Contestation, Civil Society, and Global Governance: Human Rights as a Boundary Object in ICANN: Human Rights as a Boundary Object in ICANN. *Policy & Internet*, 11(1):37–60, March 2019.