The Impact of New and Emerging Internet Technologies on Climate Change and Human Rights

Submission to the Advisory Committee to the UN Human Rights Council (October 2019)

Summary

Innovative solutions for Internet connectivity constitute one of the most important areas of new and emerging technology development with profound ramifications for the natural environment and human rights. The expansion and enhancement of Internet infrastructure is often pursued in the interest of multifarious goals, ranging from increasing the speed and capacity of existing Internet networks to connecting the unconnected. This submission highlights two interrelated technological risks to human rights associated with Internet infrastructure: the environmental impact of Internet connectivity and the growing disparity in quality of Internet access worldwide. Closing various digital divides in Internet access is integral to ensuring the protection of human rights, and universal Internet access has been declared a UN Sustainable Development Goal. However, progress toward universal access must consider the environmental sustainability of connectivity solutions and take into account how rapid technological advances in Internet connectivity might exacerbate certain technological, economic, and social inequalities. Many recent advances in communications technologies, such as 5G, are posited as solutions to inequality of Internet access, but they are likely to result in vast improvements in speed and capacity for already-connected urban centres in the global north while also demanding more energy-consuming infrastructure and encouraging more energy-intensive consumption of digital content. Meanwhile, un- or under-connected communities – largely in the global south – will fall further behind, lacking comparable quality of access and also bearing the brunt of negative environmental consequences. Internet policy has broadly failed to address the intertwined issues of Internet access, sustainable energy, and human rights. Regulators, governments, the human rights system, and private companies should treat Internet expansion as an environmental issue that requires balancing the rising global demand for data against the potentially damaging effects of data-driven energy consumption. The goal of universal Internet access cannot uphold human rights if it is achieved at the cost of the natural environment.

Introduction

[1] The United Nations General Assembly has recognised the integral role of Internet connectivity in the protection and promotion of human rights,[1] as well as the impact of climate change on human rights.[2] In addition, the UN has affirmed the importance of the Internet to achieving sustainable development,[3] and the UN Sustainable Development Goals include targets for universal Internet access, cleaner energy, and climate action through a human rights-based

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[1] UN General Assembly Human Rights Council, "The promotion, protection and enjoyment of human rights on the Internet (2018) A/HRC/RES/38/7.

[2] Office of the High Commissioner for Human Rights, "Understanding Human Rights and Climate Change", Submission of the Office of the High Commissioner for Human Rights to the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (2015), available at: https://www.ohchr.org/Documents/Issues/ClimateChange/COP21.pdf.

[3] UN General Assembly, "Information and Communications Technologies for Sustainable Development" (2018) A/RES/73/218, available at: https://undocs.org/en/A/RES/73/218.

approach.[4] However, the drive toward universal Internet connectivity is rarely considered in relation to energy usage and climate change. And disparities in data consumption between the connected and unconnected are often overlooked as contributing factors to widening digital divides.

[2] The reality is that the majority of global IP traffic is generated in the global north (North America and Europe), and most Internet traffic consists of increasingly data-intensive and, therefore, energy-intensive activities, such as streaming video and music.[5] These high-bandwidth users are therefore disproportionately influential in both the trajectory of new Internet developments and the levels of global Internet energy consumption. A human rights-based approach to universal Internet access should be founded on the principle of *sustainable connectivity* in order to bridge digital divides between the connected and the unconnected. This submission examines two related risks to human rights from new and emerging Internet technologies and concludes by suggesting policy solutions to mitigate these risks.

[3] First, international and state policies to promote human rights and sustainable development through expanding Internet access need to account for the environmental impact of Internet connectivity. Information and communications technologies (ICTs) cause environmental and human rights impacts in two primary ways: in the production of Internet-connected devices and in the energy consumption required to power devices and to store, process, and transit data in the network.[6] This submission will typically refer to energy consumption, but the entire lifecycle of ICTs needs to be considered through a human rights framework that places planetary and human wellbeing at the core.

[4] Second, there remains an intractable digital divide between people with and without Internet connectivity. Nearly 50 percent of the world still does not have access to the Internet, at a time when the Internet is increasingly integrated into everyday life and interwoven into sectors including commerce, education, healthcare, finance, and government.[7] In this context, bringing the rest of the world online will be essential to enabling all people to realise the full range of human rights. However, growth in Internet access is now slowing because those who remain offline are increasingly harder to reach with conventional connectivity models.[8] The environmental impact of existing, new, and emerging Internet technologies further contributes to widening digital divides, especially between the connected and the unconnected and between the global north and global south. This submission focuses on two energy-related divides: the concentration of Internet infrastructure (specifically, data transit and processing infrastructure) in the global north and the absence of reliable grid energy to power Internet connectivity solutions in many of the areas that lack Internet access. A sustainable approach to the Internet access could help to mitigate these critical inequalities.

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[4] UN Sustainable Development Goals, available at: https://www.un.org/sustainabledevelopment/sustainable-development-goals/.
[5] Cisco, 'Cisco Visual Networking Index: Forecast and Trends, 2017–2022 White Paper' (2019) <https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-741490.html#_Toc532256789>. 27 February 2019, https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-741490.html#_Toc532256789.
[6] SG Anders Andrae and Tomas Edler, 'On Global Electricity Usage of Communication Technology: Trends to 2030' (2015) 6 Challenges.; See also: Gary Cook and others, 'Clicking Clean: Who Is Winning the Race to Build a Green Internet?' (Greenpeace 2017) <http://www.clickclean.org/international/en/>.
[7] International Telecommunications Union, 'Measuring the Information Society' (International Telecommunications Union 2018).
[8] Imme Philbeck, 'Connecting the Unconnected: Working Together to Achieve Connect 2020 Agenda Targets' (International Telecommunications Union Broadband Commission 2017).

[5] Governments and the international human rights system should develop sustainable access policies and ensure that all Internet policy agendas are rooted in the principle of sustainability. The goal of universal Internet access is not consistent with human rights if it can be achieved at any environmental cost. To close digital divides, the international human rights system should strive toward Internet equality – by discouraging the ever-increasing data consumption that accompanies the expansion of Internet infrastructure.

Recognising the Energy Demand and Environmental Impact of Internet Connectivity

[6] It is difficult to estimate the electricity consumption and carbon emissions of 'the Internet,' partly because of the complexity of Internet systems that make connectivity possible. These systems are composed of user devices, home networking equipment, access networks, data centres, Internet Protocol 'core network,' and undersea cables. Data moves through these networks, which require energy to power the hardware and the data transit. Predicting and measuring energy consumption *of the Internet* therefore depends on setting boundaries around which aspects of the network are taken into account.[9] So, figures vary widely, and many studies are not comparable. In this submission, we present an overview of some of the key energy- and climate-related concerns associated with advances in Internet technology and, relatedly, data demand over the Internet. Overall, (transit) networks and data centres are becoming the most energy-intensive components of Internet systems. The future of energy consumption in these systems will depend on the balance between efficiency-enhancing technological advances on the one hand and dramatic increases in data demand and infrastructure expansion on the other. Ultimately, all Internet technology policy should take this tension into account in order to mitigate the damaging environmental effects of unrestrained data consumption.

[7] Information and communications technologies contribute to environmental impacts in numerous ways – namely, in the manufacture and transport of Internet connected devices; the energy-intensive processes of moving data through the network;[10] and the storage, processing, and distribution of data handled by data centres – all with serious implications for human rights. Currently, of all the electricity that goes into Internet connectivity, about 16 percent is manufacturing, 34 percent powers the devices during their lifetimes, 29 percent powers the network, and 21 percent powers data centres.[11] While manufacturing and device power are forecast to grow modestly, the growth in energy for networks and data centres is set to rise exponentially.[12]

[8] Figures vary, but at present, communications technologies are responsible for around 9 percent of global electricity consumption and 2-3 percent of CO_2 emissions, roughly the same as the airline industry.[13] In the last five years, household broadband traffic has skyrocketed in global north countries, like the UK, where household data consumption has risen from 15GB per month to over 100GB per month. During the next decade, Internet technologies (including

[9] Joshua Aslan and others, 'Electricity Intensity of Internet Data Transmission: Untangling the Estimates' (2018) 22 Journal of Industrial Ecology 785.
[10] Lucy McMahon, 'Is Staying Online Costing the Earth?' (The All-Party Parliamentary Climate Change Group 2018) <https://www.policyconnect.org.uk/appccg/research/staying-online-costing-earth>.
[11] Gary Cook and others, 'Clicking Clean: Who Is Winning the Race to Build a Green Internet?' (Greenpeace 2017) <http://www.clickclean.org/international/en/>
[12] International Energy Agency, 'Data Centres and Data Transmission Networks' (27 May 2019) <https://www.iea.org/tcep/buildings/datacentres/>.
[13] Adam Vaughan, "How viral cat videos are warming the planet", *The Guardian*, 25 Sept 2015. https://www.theguardian.com/environment/2015/sep/25/server-data-centre-emissions-air-travel-web-google-facebook-greenhouse-gas

the manufacturing process, device power, networks and data centres) are expected to account for up to 20 percent of global electricity consumption, and are expected to continue to grow.[14] Unlike many other industries, such as transport, which are expected to make significant efficiency gains over the coming years, Internet energy demand is likely to rise as access is extended to more people and traffic on the global network increases. As a result, any efficiency gains in Internet technologies will likely be completely wiped out by the increases in traffic demanded by online services, and by increases in the number of people worldwide who use the Internet.

[9] Technological advances that facilitate better connectivity overall – in terms of more comprehensive coverage, higher speeds, and higher data capacities – enable more energy-intensive applications of the Internet. Streaming high-definition (HD) video has become one of the most common online activities in the UK, as a result of the vast gains in the quality of Internet connections in domestic homes.[15] At present, streaming accounts for at least 60 percent of global Internet traffic,[16] supported by high broadband speeds, especially in the most developed countries of North America, Europe, and Asia. As broadband speeds improve, demand for higher quality content (such as 8K video and HD Virtual Reality) will also increase.[17] Thus, advances in Internet technology enable higher levels of data consumption, and higher levels of consumption create demand for new and better technology.[18]

[10] Although some advances in Internet technologies can potentially lead to greater efficiency and sustainability, growth in Internet traffic is likely to outweigh these efficiency benefits.[19] Beyond just the number of Internet users, advances such as artificial intelligence, the Internet of things (IoT), and cryptocurrencies will also require dramatic expansion of data transit and processing, therefore, an increase in energy demand.[20] Importantly, even as new technologies bring state-of-the-art efficiency gains to certain parts of Internet systems, these networks are always patchworks of old and new technologies, and the energy cost of older infrastructure must be considered, as it often remains an integral part of the system.[21]

Prioritising (E)quality of Access

[11] Environmental impacts associated with Internet connectivity are closely linked to geographic, technical, social, and economic inequalities that contribute adversely to various digital divides. This submission focuses on two key energy issues related to these inequalities: the lack of access to reliable energy sources in many unconnected communities and the uneven geographic distribution of Internet infrastructure and high-quality connectivity.

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[14] Andrae and Edler (n 6).
[15] Kelly Widdicks and others, 'Streaming, Multi-Screens and YouTube: The New (Unsustainable) Ways of Watching in the Home', *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (ACM 2019) <http://doi.acm.org/10.1145/3290605.3300696>.
[16] Cisco (n 5); Ericsson, 'Ericsson Mobility Report' (2017) <https://www.ericsson.com/en/mobility-report>.; Sandvine, 'The Global Internet Phenomena Report' (Sandvine 2018) <https://www.sandvine.com/press-releases/sandvine-releases-2018-global-internet-phenomena-report> accessed 10 August 2019.
[17] Cisco (n 5).
[18] Chris Preist, Daniel Schien and Eli Blevis, 'Understanding and Mitigating the Effects of Device and Cloud Service Design Decisions on the Environmental Footprint of Digital Infrastructure', *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (ACM 2016) <http://doi.acm.org/10.1145/2858036.2858378>.
[19] Andrae and Edler (n 6).
[20] Max J Krause and Thabet Tolaymat, 'Quantification of Energy and Carbon Costs for Mining Cryptocurrencies' (2018) 1 Nature Sustainability 711.
[21] Aslan and others (n 9).

[12] Reliable and sustainable energy is a precondition for Internet access, but energy supply is rarely explicitly considered or mentioned in policies focused on universal access. The issue of access to energy is especially salient for the communities that remain unconnected to the Internet, as they are predominantly rural, located in the global south, and economically disadvantaged. Around 20 percent of the world still lacks domestic electricity,[22] so the aspirational goal of universal Internet access needs to account for sustainable (often off-grid) energy solutions to power connectivity.

[13] A clear example of the importance of sustainable energy supply to connecting the unconnected comes from alternative or 'complementary' connectivity solutions that aim to close the digital divide, such as community networks – Internet networks owned and operated by local communities (rather than commercial or government network operators).[23] In the rural Eastern Cape of South Africa, Zenzeleni network is a community cooperative that provides Internet connectivity to local villages with over 65 hotspots hosting 1.2TB of monthly traffic. The network's first hurdle in achieving connectivity was a lack of grid electricity, so the cooperative integrated solar charging stations into its network design and revenue model.[24] Ultimately, Zenzeleni developed sustainable energy and Internet models that served one another and generated income for the community.

[14] Community networks are often catalysts for sustainability, but these contributions of community networks – both to sustainable energy production and complementary Internet connectivity – are frequently sidelined in global conversations about connecting the unconnected due to their perceived lack of scalability. Instead, international and domestic policies continue to favour traditional network operators, which have largely failed to extend connectivity using existing models. Community voices should be audible in the policymaking process. Flexible regulatory frameworks for telecommunications provision that would enable small (and community-owned) operators to enter the market more easily could help to address compounding energy and access divides in a more sustainable way. As the Zenzeleni network experience demonstrates, universal access for the most marginalised communities will be unattainable without sustainable energy, and sustainability in this case also means grounding both energy supply and connectivity in local community knowledges and experiences.

[15] Beyond a lack of reliable local energy supply, another energy inequality exists between the global north and global south in terms of Internet infrastructure and associated data and energy consumption. Most of the energy-consuming transmission network and data processing infrastructure the Internet is located in the global north. Data centres, for instance, constitute some of the most energy-intensive Internet infrastructure – consisting of physical concentrations of computing hardware, such as servers, which handle the world's Internet Protocol (IP) traffic. The vast majority of data centres are located in Europe and North America,[25] and the transit networks that facilitate the movement of data through Internet systems cluster around these data hubs. Although more submarine fibreoptic cables are linking the global north to the Middle East, Latin America, and Africa to facilitate data transmission

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[22] World Bank, 'Access to Electricity (% of Population)' (*Sustainable Energy for All (SE4ALL) Database*, 2017) <https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS>.

[23] Michael Oghia, 'Community Networks as a Key Enabler of Sustainable Access', *Community Networks: the Internet by the People, for the People* (FGV Direito Rio 2017).

[24] C Rey-Moreno and others, 'Community-Based Solar Power Revenue Alternative to Improve Sustainability of a Rural Wireless Mesh Network', *Proceedings of the Sixth International Conference on Information and Communications Technologies and Development: Notes - Volume 2* (ACM 2013) <http://doi.acm.org/10.1145/2517899.2517912>.

[25] Data Center Map, 'Data Center Map' (2019) <https://www.datacentermap.com> accessed 10 November 2019.

than ever before, some of the newest, highest speed and capacity cables – such as the colossal MAREA line – are still dedicated to enhancing connections between Europe to North America.

[16] As infrastructure for data transmission and processing continues to concentrate in the global north, other related technological advances will enable these already hyper-connected nodes to stride ahead of the areas with lower bandwidth and poorer digital infrastructure. Data consumption patterns in the global north are likely to intensify demand for energy-consuming infrastructure and applications. The result will be a growing disparity in *quality* of access between the hyper-connected and the unconnected.

[17] This geographic distribution of data centres and associated data transmission infrastructure also has a direct impact on carbon emissions and environmental degradation. Data centres are powered by the energy mix of the local grid where they are situated, and many locales that host these centres are not pursuing comprehensive renewable energy policies. For example, Internet giant Amazon has based its core data centre infrastructure in the U.S. state of Virginia, home to the largest concentration of data centres in the world. Over half of the Virginia's energy is generated by coal or natural gas.[26] Greater demand for more data centre infrastructure (to support more users, more traffic, and new applications, like IoT) is driving competitive market in data centre hosting, which means that countries (particularly in North America, Europe, and Asia) with existing non-renewable energy infrastructure are vying to make the most of their current energy supply. In some cases, data demand could be used to justify new destructive projects, like fracked natural gas pipelines. In short, the infrastructure that makes Internet access possible is integrally intertwined with energy and climate change policy. The environmental impact of Internet infrastructure expansion is likely to result in continued violation of local communities' rights, as their quality of life is eroded in the pursuit of unsustainable energy sources to fuel our digital lives.

[18] Data centre demand is motivated in no small part by the unsustainable 'data diet' of the hyper-connected, who largely reside in urban centres in the global north and some parts of Asia. In these contexts, data is cheap commodity, especially in comparison to Africa, where a gigabyte of mobile data costs 7 percent of monthly income on average. In some African countries, this figure exceeds 20 percent.[27] Affordable data facilitates growth in Internet access and use, but it also encourages greater consumption and energy demand, especially when large data packages are cheap for some. In the UK, many mobile operators offer 'go binge' or 'all you can eat' data packages that give customers data-intensive experiences, like video streaming on Netflix, for free – without depleting their monthly data allowance. Platforms and content producers have a commercial incentive to encourage greater data consumption, but these pricing policies result in mounting demand for more data. More data demand requires more digital infrastructure, often in the places where Internet access is already widespread and quality of access is approaching the state-of-the-art.

[19] Although predictions vary regarding the potential of energy efficiency gains to offset energy consumption by Internet infrastructure, it is apparent that we cannot *sustainably* bring the next four billion people – the rest of the world – online at the current consumption levels enjoyed by the most connected corners of the planet. Universal access should not only be a question of basic connectivity, but also a question of Internet equality. Internet equality can only be achieved by considering comparative Internet quality in different contexts. The divide between

[26] Gary Cook and Elizabeth Jardim, 'Clicking Clean Virginia: The Dirty Energy Powering Data Centre Alley' (Greenpeace 2019).
[27] Alliance for Affordable Internet, 'New Mobile Broadband Pricing Data Shows Uneven Progress on Affordability' (20 March 2019) <https://a4ai.org/new-mobile-broadband-pricing-data-reveals-stalling-progress-on-affordability/>.

the connected and unconnected will only grow wider as unlimited data consumption becomes the norm in hyper-connected parts of the world.

Recommendations

[20] Governments and the international human rights system need to put sustainability at the core of policies to promote Internet access. 'Sustainable access' can be defined as the ability of a user to connect to the Internet and stay connected over time, including – among other things – considerations for energy supply.[28] Universal Internet access, which is a Sustainable Development Goal target and integral to the protection and promotion of human rights, must be situated in a broader policy framework that accounts for the geographic and environmental impacts of new and emerging communications technologies. The Internet, the environment, and human rights are inextricably linked. The international human rights system should ensure that in the pursuit of greater Internet access, the technological advances required to facilitate it do not deepen and intensify intersecting inequalities associated with environmental degradation and climate damage.

[21] Finally, governments and the human rights system should consider what *equality* of Internet access would look like on a global scale in order to ensure that universal access actually begins to close the multiple and compounding digital divides that lead to other social, cultural, and economic inequalities. For example, the Alliance for Affordable Internet has developed a measure of 'meaningful access' to attempt to address the gap between access and quality.[29] This standard takes into account download speeds, device type, data availability and cost, and the frequency of connection in order to capture a more holistic and comparative understanding of quality of access. As this submission has outlined, differential *quality* of access not only affects the user experience (the ability of users to take full advantage of Internet connectivity) but also drives the pace and scale of data demand and infrastructure expansion. Current levels of data consumption in the most connected parts of the world are environmentally unsustainable. Governments, in collaboration with Internet Service Providers, content providers, and platforms, need to develop policy interventions that can address the over-consumption of data so that data does not become a luxury good, disproportionately enjoyed by the connected at the expense of both the unconnected and the natural environment.

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[29] Alliance for Affordable Internet, 'Meaningful Connectivity — a New Standard to Measure Internet Access' (2019) <https://a4ai.org/meaningful-connectivity/> accessed 10 August 2019.