Edge computing: Changing the balance of energy in networks

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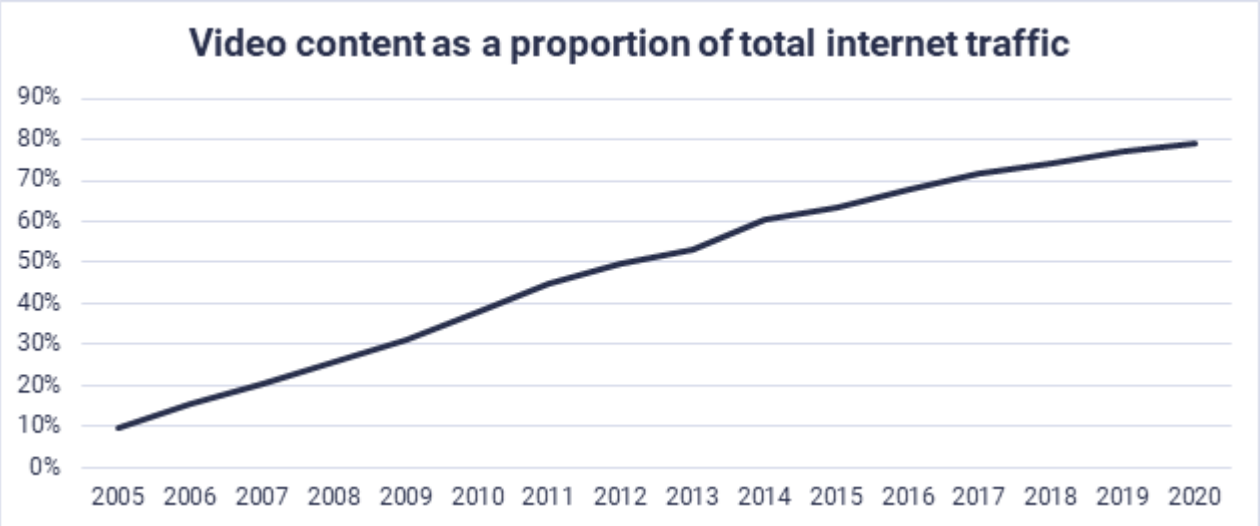
One of the most important challenges discussed today is that of curtailing energy consumption to combat ever-increasing carbon emission levels. There are a growing number of firms upping their efforts to cut emission levels, as well as activity from governments and policy makers globally across industries. Investors too are demanding more transparency from companies in reporting their carbon emissions. However, there is mounting concern that the ICT industry in particular, is predicted to be responsible for up to 14% of global emissions by 2040. Two significant contributors are networks and data centres – data centres alone will account for 33% of the ICT industry's global electricity production in 2025. In this article, we will discuss the reasons behind why edge computing could be part of the solution when it comes to positively affecting the balance of energy consumption.

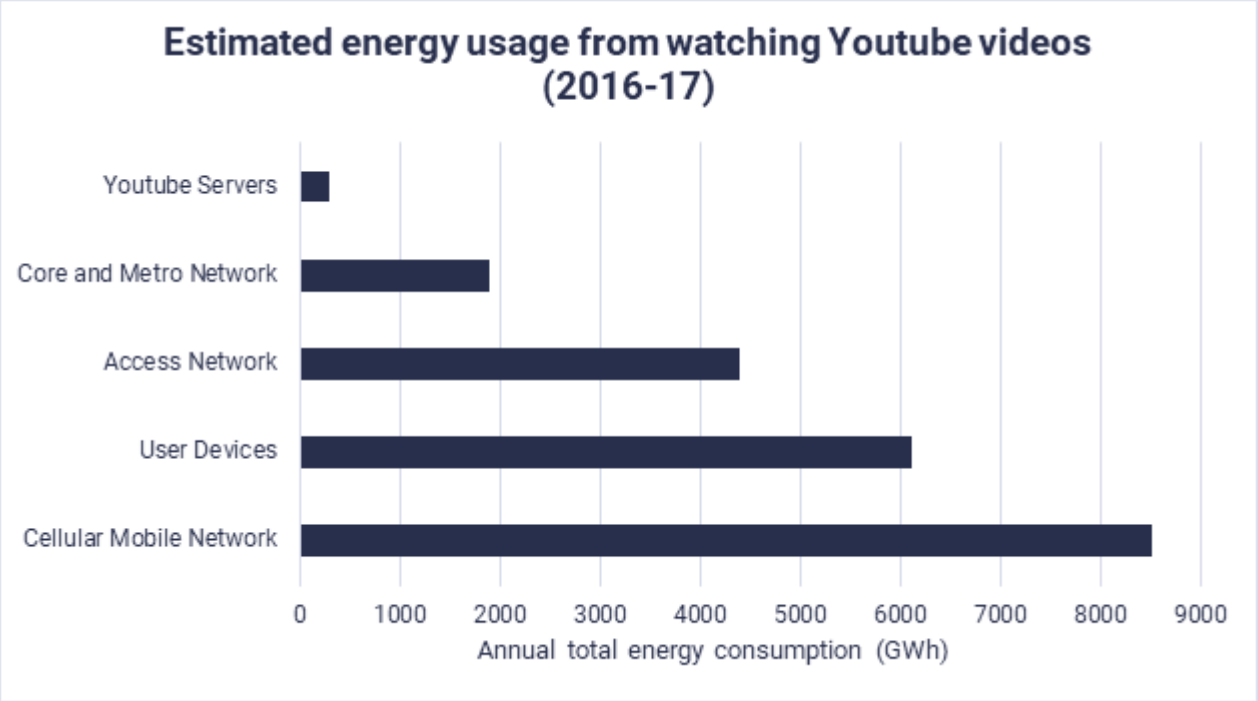
Bandwidth consumption is on the rise... but so are carbon emissions

Due to new technologies (e.g. cloud) and new applications (e.g. video-on-demand), network bandwidth consumption has skyrocketed in recent years. Video streaming services, such as YouTube and Netflix, are expected to consume around 80% of total bandwidth on the Internet by 2020 (as shown below). This is partly because each stream is composed of a large file, but also because of the nature of how video-on-demand content is distributed. Video data is streamed from the cloud to millions of people in a one-to-one manner, as opposed to traditional broadcasting where the video "stream" is distributed to a mass population at a scheduled time (one-to-many).



Source: Cisco VNI. 2016 – 2020 forecast

High bandwidth consumption is correlated with high energy usage (and resultantly high carbon emissions). This is because the network is used more heavily and requires significant amounts of power to deliver this increasing amount of data. Daniel Schien at the University of Bristol reported that total emissions from people watching YouTube globally in 2016 was the equivalent of 10 million tonnes of CO2. As seen below, much of this is from the network.



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Edge computing could help optimise energy usage

We've identified that the increased use of cloud and networking results in high bandwidth consumption, leading to higher energy usage. This issue is prevalent, not just in video streaming services but across a variety of applications that actively use networks and data centres. Edge computing could combat this by reducing network loads, optimising energy used for compute and storage, as well as enabling solutions that would help enterprises better monitor and manage their energy consumption. These factors are explored below:

1. Edge can reduce the amount of data traversing the network (a large component of energy consumption for YouTube delivery)

Edge computing essentially moves the processing power from the cloud to a point closer to the end user or device. As discussed, this is especially significant for video streaming services, where mobile networks accounted for the largest source of YouTube's energy consumption in 2016 at around 8000GWh. Although content delivery networks already exist to mitigate the need to carry the same traffic over internet backbones, these mostly work outside the actual mobile networks. Traffic backhauled over the mobile network could be further mitigated by hosting content nearer to the customer, within the network, "edge".

The growth of video streaming and use of other bandwidth-heavy applications such as gaming will further exacerbate traffic and energy growth, particularly as content becomes more customised, higher definition and more interactive. Part of this problem is being tackled through new network technologies, which we have assessed in our recent report "Curtailing Carbon Emissions – can 5G help?"

Edge computing also reduces energy consumption in networks, by reducing the total amount of data traversing the network. By running applications at the edge, data can be processed and stored nearer to the devices, rather than relying on data centres that are hundreds of miles away. This could lead to a significant

reduction in energy consumption related to network transport, while also benefiting from low latency that edge provides.

2. Edge data centres *could* be more efficient than cloud data centres

According to global e-sustainability initiative (GeSI), data centres already consume over 3% of world's total electricity and generate 2% of worldwide CO2 emissions. Data centres are projected to use around 200TWh of electricity in total by 2020, of which enterprise data centres will account for around 25%, and cloud/hyperscale data centres accounting for almost 75%.

Although large data centres can aggregate compute and storage needs across many thousands of users, they may not always be optimised in the way they use energy; cloud data centres often run 24/7 even when they are not being used. Edge data centres might need to deal with more variation in utilisation and therefore be designed to manage this more efficiently (for example, by making resources "dormant" when not required). The orchestration and management of a distributed set of (smaller) data centres will need to be built into the design and ensure edge compute (and thus energy) resources are used efficiently.

Energy is required for the power and cooling of data centres. Arguably, an edge data centre may require less energy for cooling, relative to its output and size. This is known as "free" cooling and particularly relevant in cooler climates. A few racks of servers (edge "data centre") would have a higher surface area per server than if the same size rack was being processed in a hyperscale data centre. Currently, cooling of data centres accounts for 40% of total energy consumption from data centres, therefore, depending on their location, the overall energy spend to run and cool mini data centres could be reduced.

3. Edge computing enables smarter grids and allows enterprises to better manage their energy consumption

Edge compute has a key role in supporting smart grid applications such as demand management and grid optimisation. In some cases, edge computing can help with managing energy across enterprises. Sensors and IoT devices connected to an edge platform in factories, plants and offices are being used to monitor energy use and analyse the energy levels in real-time. By tracking and monitoring energy usage in real-time and visualising it through dashboards, enterprises can better manage their energy consumption and implement preventative measures to limit energy usage.

Edge computing can be particularly useful for managing renewable energy

Expanding on the above, edge computing can promote sustainable management of renewable energy resources. Edge-enabled systems would enable real-time assessment of supply and demand for limited renewable energy resources, such as solar and wind power. Edge computing would be used to provide a real-time view of the energy supply and demand levels in an area, by interacting with IoT applications at an extremely low latency. With the help of microgrids, electricity providers would then be able to supply sufficient levels of renewable energy resource to match the electricity demand of a local area.

Overall, it is important to assess how edge computing would impact energy consumption further and evaluate its potential impact on balance. Enterprises will become increasingly wary about the use of edge vs. cloud with regards to energy consumption as they seek to meet carbon emissions targets. Watch this space!

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