The Efficiency Death-March: The Unintended Consequences of Large-scale Systems Research upon Climate Change

Peter Garraghan
School of Computing & Communications
Lancaster University, UK
p.garraghan@lancaster.ac.uk

ICT now consumes approximately 10% of global electricity, with large-scale computing systems operating as a core foundation to facilitate digital demand. These systems, ranging from Cloud datacentres to IoT deployments, generate a substantial ICT footprint in terms of energy consumption and GHG emissions, and are increasingly growing contributors to climate change. Hence, in recent years there has been concentrated efforts from the research community towards making large-scale systems more energy-efficient and sustainable.

The large-scale computing system community has predominantly tackled this problem via enhancing the energy-efficiency of individual components (software, server hardware, networking, cooling) to reduce their energy consumption via improved scheduling, fault-tolerance, security, and hardware design. However enhancing system component efficiency has still resulted in a rapidly growing global ICT footprint – more data, greater compute ability, and more devices. This is due to Jevon's paradox, whereby technological progress enhances system efficiency, however increases the rate of consumption and end-use demand. This is a growing concern to the community, whereby our best efforts to achieve sustainable and energy-efficient systems have the unintended consequence of making the problem worse.

It is no longer possible to rely on the conventional perception that sustainable and 'green' large-scale computing systems can be achieved just by solely improving component efficiency. There needs to be serious discussion within the large-scale system community how to actually decelerate global emissions – not merely increase system energy-efficiency and claim subsequent growth is outside of a researcher's remit or control.

We believe that this problem is not insurmountable, however requires a radical rethink how large-scale computing systems are designed and operate. A system's energy consumption and carbon footprint is a by-product of its operation; if we were to inverse this dynamic – so that system operation was instead a by-product of its ICT footprint – it would enable systems that dynamically change operation in response to a target GHG emission values. System operation could now be directly matched to energy generated from renewable sources, or alternatively adhere to a specified GHG emission target defined at a national level.

This topics tackles both a big problem on the horizon, as well as potentially controversial systems topic as to whether our current approach to science in large-scale systems is equipped to handle challenges such as climate change. The outcome would be for participants to discuss how to feasibly reduce global emissions of large-scale systems, and whether or not our laser-focus on efficiency improvements is a panacea to the original problem. This includes how in the face of future environmental change, how systems should be designed, what evaluation criteria is required, how we engage with organisations, and speculating how society would be altered.