Every Cloud Has a Silver Lining: Seeing Through the Cracks of Cloud Gaming Infrastructure

Eduardo Luersen
Zukunftskolleg, University of Konstanz
Universitätsstraße 10, 78464 Konstanz
eduardo.luersen@uni-konstanz.de

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EXTENDED ABSTRACT

Present-day cloud gaming services promise to revolutionise the panorama of gaming practices, at least when it comes to digital forms of gaming, with big tech conglomerates (Amazon, Microsoft, Tencent, Google, to name a few) investing heavily to establish a proper working infrastructure to support it. Even though there are obvious new perspectives to game practices opened up by outsourced synchronous computing, more often than not cloud gaming services end up frustrating the expectations of industry actors and players alike. One can think of Google's platform *Stadia* prematurely shutting off recently just as the cloud gaming service from Mountain View, *OnLive*, did more than a decade ago (Willett 2019).

Even if one can find recurrences between both cases, significant aspects still demand further inquiry. Some of these involve the conditions to build the infrastructures to sustain such platforms, which are more prone to be developed by big tech companies, as they are inclined to provide the transnational networks necessary to broaden the scope of these services to a much larger scale. And, indeed, scale plays a fundamental role in this case because spreading server halls through different regions is a necessary condition to expand the customer base of cloud gaming initiatives under a gaming-as-a-service model.

For this and other reasons mentioned below, I argue that the successive failures to implement cloud gaming under a platform business model open up a paramount opportunity to entangle the research on digital games with media infrastructure studies (Starosielski 2015, Parks and Starosielski 2015, Plantin and Punathambekar 2018). On the level of infrastructure, such platforms encompass very complex systems, encompassing not only technical but also regulatory, bureaucratic, environmental and geopolitical issues. For instance, the transnational companies providing scalable cloud gaming services have to cope with nationwide, locally-based energy providers or build their own facilities to supply their demand from local resources. At this level, challenges touch the more substantial layer of critical infrastructure, energy sourcing and natural resource management.

As Paul Edwards (2003) puts it, by observing technical systems for the built environment from the macro scale of geophysical forces, one might think of nature as the ultimate infrastructure (Carse 2012). And this is quite literal in the workings of cloud service providers, as the infrastructure for sustaining data centres, the core

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facilities for a functioning cloud, encompasses not only computational but also non-computational resources. Estimates are that in a big data centre, 40% of the electricity consumption is required exclusively for the cooling systems to keep the IT equipment at a safe temperature (Song, Zhang and Eriksson 2015). Cooling methods in a small 1-megawatt data centre can also use up to 26 million litres of water per year (Mytton 2021). Furthermore, in order to feed generators and other sorts of equipment meant to keep data processing ideally secure and redundant (Brennan 2015), many data centres still require diesel-fueled engines. Therefore, cloud gaming initiatives demand not only the electricity used by local devices but especially the energy used by servers and the network infrastructure to process games in real-time for players.

To understand the sociotechnical complexity of gaming infrastructures, one should also consider how the energy metabolism sustaining cloud gaming services involve matters of political geography. As historian of technology Per Högselius (2018, 10) puts it, "the geopolitics of energy is not only about the energy that is in and on the Earth – fossil fuels, uranium, forests, winds and waves. It concerns the long-distance movements of energy", encompassing the pipelines, ships and transmission towers needed to establish an efficient trade chain, as well as the places where energy in its diverse forms is produced, refined, stored and consumed. As gaming involves significant geoeconomic assets, its study should not disregard the interplay of geopolitics and energy infrastructures that enables it as a planetary-scale communication medium.

Finally, as a contribution to the field of Game Studies, a media infrastructure approach may provide a framework to ponder that localized gaming practices are not indifferent to these macro factors. Concepts such as *multiscalar analysis* (Edwards 2003) can help researchers tackle the epistemological problem of entangling the different scales involved with gaming through cloud architectures, for instance. Whereas infrastructures often appear in human-sized interfaces (in the case of digital games, the literal human-computer interfaces of screens, audio outputs, controller peripherals etc), these are just gates to much larger and less understood systems (Peters 2015). Although integral to the experience of playing through the cloud, the energy-intensive facilities of gaming data centres withdraw to an unremarkable background, as the overheating of computer processors and cards is outsourced to intensively air-conditioned server halls. Thermal dissipation strategies in data centres are even less noticeable when they are managed with the use of groundwater, glacier water or snow (Vonderau 2019), for instance. Craving for the mundane, frameworks from infrastructure studies insist on examining these ordinary resource management routines and practices.

In the coming years, matters of energy and infrastructure may jeopardize industrial activities, including gaming. Looking into the energy consumption of cloud gaming or the carbon footprint of the industry (Cubitt 2017, Abraham 2022), one can immediately recognise why acknowledging the different scales involved in gaming activities might be less a matter of "environmental friendliness" than a precondition for the very existence of the sector. Under this perspective, different gaming models can provide interesting cases on how the industry relates to transitions of contemporary societies urgently searching for cleaner energy sources.

The analyses regarding the failures to establish cloud gaming as a mainstream format often highlight its cultural or technical factors separately. I would like to point out, nonetheless, how these problems go hand in hand with the aforementioned dynamics, as the connection between human and more-than-human-scale infrastructures is often overlooked when considering gaming practices. Ultimately, the constant failures to

provide games through cloud-based services, as other media industries accomplished with film, music etc, might in fact endow a view of the silver lining of cloud gaming unfulfilled promises: that Game Studies might actually profit from a look at the infrastructures that sustain gaming practices.

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