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## Article

# Meshes of Surveillance, Prediction, and Infrastructure: On the Cultural and Commercial Consequences of Digital Platforms

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## Abstract

Digital platforms like Spotify, Netflix, and YouTube rely on mass data collection, algorithmic forms of prediction, and the development of closed digital systems. Seemingly technical and trivial, such operational and infrastructural features have both commercial and cultural consequences in need of attention. As with any other kinds of infrastructure, the surveillance practices and digital ecosystems that are now installed and solidified will have long-term effects and will be difficult to challenge. We suggest that the cultural and commercial ramifications of such datafied infrastructural developments can be unpacked by analyzing digital platforms—in this case Netflix—as *surveillance-based, predictive infrastructures*. Digital platforms fortify their market positions by transitioning surveillance-based assets of audience metrics into infrastructural and informational assets that set conditions for other actors and approaches at work in the domain of cultural production. We identify the central forces at play in these developments: digital platforms critically depend on proprietary surveillance data from large user bases and engage in data-structuring practices (Flyverbom and Murray 2018) that allow for predictive analytics to be a core component of their operations. Also, digital platforms engage in infrastructural development, such as Netflix’s decentralized system of video storage and content delivery, Open Connect. These meshes of user surveillance, predictive analytics, and infrastructural developments have ramifications beyond individual platforms and shape cultural production in extensive and increasingly problematic ways.

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## Digital Platforms and Attention Economies

Historically, the production and shaping of cultural formations—what societies value and consider to be their shared belongings and heritage—have been tied to a limited set of institutions and groups of people. Wealthy museums, powerful editors, successful media corporations, and others have always played central roles when it comes to defining what is relevant, valuable, and worthy of our attention. But increasingly, digital platforms and automated systems developed by large tech companies come to shape commercial attention economies and the production of culture. These developments are important to consider because they cut to the core of our collective and individual possibilities for agency and decision-making and will have long-term consequences. What we can think of as a digital attention economy is not only dominated by tech companies but also by the concrete technical ways that digital platforms, algorithms, and other design features organize digital traces and curate cultural production and consumption. In digital spaces, our actions and lives are translated into resources that may be used to fuel commercial, cultural, and political processes and to guide our eyes and attention. Digital systems translate human and technical activities into

data points and, by offering us free tools and services, tech companies can both get access to masses of data and create digital environments that are beneficial to their business and dominance. Automated systems that recommend the next Netflix series or play the next YouTube clip are part of an attention economy that is both commercial and cultural. They are commercial because they constitute the central force propelling data-based business models and cultural because they come to shape the way human activities, cultural products, and other social processes are organized and managed (Gillespie 2018). This is why we need to consider what kinds of automated sorting systems we see emerging, institutionalizing, and being used in digital spaces. At present, such discussions about the role of digital platforms take a limited number of shapes and are marked by anecdotal evidence and normative perspectives. For instance, widespread concerns about digital platforms as the source of filter bubbles (Pariser 2011) suggest that algorithms and recommendation systems are set up in ways that make them feed people more of the same and, thus, create new forms of social segregation where we only encounter ideas and views we already agree with.

Other research shows that digital platforms provide access to broader arrays of information and perspectives and create not only uniformity but also diversity and exposure to surprising contents (Flaxman, Goel, and Rao 2016). Similar discussions address how digital platforms influence cultural spheres and attention economies. Some are concerned that music platforms such as Spotify are set up in ways that lead to what the New York Times music critic Jon Caramanica has referred to as “Spotifycore”: some kinds of music and artists do particularly well in Spotify playlists and recommendation systems. In the same manner, some kinds of series get more attention via Netflix’s recommendation systems. Along the same lines, Tufekci (2018) raised concerns about YouTube as a “radicalization machine” that serves more and more sensational material to those who use the platform because it increases users’ engagement and keeps them glued to their screen. Also, when customers get recommendations about books on Amazon, it is both based on past purchases and on what the internet platform would like to sell us. Although we can find most books on Amazon, not all books get the same amount of attention through recommendations. All these discussions—more or less based on empirical evidence—address the concern that digital platforms not only give us access to information or cultural products but also create and shape cultural flows and formations. The design choices and biases that are built into algorithmic systems for the sorting and reuse of digital traces have important ramifications, and we need to consider what kinds of logics we are installing in technological, societal, and other backbones. For instance, if we teach algorithms to serve the most popular item first and to measure quality in terms of the number of clicks, shares and comments, then we also create new forms of cultural and commercial ordering.

The long-term consequences of these digital transformations are hard to predict, but questions about how such forces shape our attention economies and cultural production increasingly require our attention. What we suggest in this paper is that to understand and handle these developments, there is a need for both conceptual guidance and empirical substantiation.

The core argument we pursue in this article is that digital platforms not only shape the here and now of the media markets they intervene in, such as streaming content, but they also engage in surveillance practices and infrastructural developments that will shape cultural consumption in a longer perspective. Empirically, we take Netflix’s system for the delivery of streaming video, Open Connect, as our point of departure. At the conceptual level, we propose to use the lens of classic medium theory to comprehend the outline of these diachronic effects.

### **The Cultural Impact of Platforms: The View from Medium Theory**

The relation between datafied, predictive infrastructures and attention economies can be understood, as a first step, by returning to medium theory. Medium theory forms a loose, theoretical school associated with a diverse range of scholarly figures, including Marshall McLuhann (1964) and Harold Innis (1950). Despite diverse styles of thinking and writing, all thinkers in medium theory share a commitment to the basic observation that the introduction of new media has historically led to often substantial social and cultural changes. In large part, these have been based on the material properties of the new media technologies: the

introduction of book printing substantially fueled the Protestant Reformation (Eisenstein 1979). The invention and spread of the internet, not least in its current surveillance-based mode, is an obvious candidate for this type of influence (Turow and Couldry 2018). Yet without the epistemic luxury of a historical perspective, the analysis of exactly which kinds of influence that digital, datafied media ecologies will have becomes more difficult.

A core insight from medium theory is that the large-scale impact of media on cultural formations should not be sought primarily at the level of content (e.g., what is communicated via different channels), but rather the impact of media is located in their technological form. When Marshall McLuhan famously stated that “The medium is the message” (McLuhan, 1964: 7), he referred to: media impact societies and cultures primarily via their technical attributes and not the meaning of their symbolic content. While this is obviously not a case of either-or (content or infrastructure), the difference has at times been dramatic. The initial product of the printing press was religious texts, yet printing eventually helped undermine the European church’s absolute monopoly on truth (Meyrowitz 1994: 517-18). We take the core insight in the relevance of basic infrastructure to the social impact of new media technologies as our point of departure and seek to illustrate how the dynamics of surveillance and datafication are currently transitioning from the level of content (in the form of recommendation systems and data-based curation of new content) to the level of basic infrastructure. We argue that this shift towards deeper levels of infrastructure anchors surveillance practices in ways that are even more difficult to contain and control and that, despite all of this, the urge to do so is even more important. Such insights help us articulate that cultural and commercial effects must be understood at the level of technical operations, e.g., how the material components of digital platforms and the new media services they provide are shaped by surveillance-based predictions and infrastructural choices.

In the following analysis, we propose that the surveillance capacities implemented as part of the development of digital platforms are likely to have the kinds of effects medium theory pointed to in the past. With an empirical focus on the realm of cultural production and circulation, we exemplify key ways in which the products of surveillance technologies are becoming institutionalized and come to shape core aspects of what we may think of as a commercial and cultural attention economy. As Couldry and Hepp (2017) suggested, these developments result in digital technologies and data working as backbones in social life. Yet, we do not have exact analytical vocabularies that can help us articulate how such forms of datafication shape broader cultural and social formations. In our articulation of these developments, we suggest that the technical underpinnings of digital platforms can be conceptualized as surveillance-based, infrastructural configurations that organize and structure data for purposes of prediction and monopoly developments.

## **Infrastructuring Surveillance**

Most large and successful platforms incorporate user information as a key asset in the development and implementation of their business and they increasingly reserve access for commercial uses: Facebook has closed down outsider access to their core information and systems via their application programming interface (API), a process that began well before the recent Cambridge Analytica scandal. Information on users’ online behavior, general preferences, and social relationships have been central to the success of major platforms, and these platforms have developed several business strategies to capitalize on the value of these informational assets. The logic of user surveillance is not confined to the task of building responsive interfaces and compensating for missing or faulty metadata; it is also becoming a core principle of infrastructural innovation at a more basic, technical level. This is also the case for Netflix’s global deployment of its Open Connect content delivery system (Netflix 2017). The system is developed to solve a core problem of streaming video: passing large volumes of data across infrastructural bottlenecks on the internet. Compared to the transmission of text, music, and even still images, the smooth streaming of high-definition video takes up colossal amounts of bandwidth: globally, video transmission was recently estimated to consume 58% of all internet traffic and Netflix alone accounts for 15% of all traffic (Sandvine 2018).

Rather than relying solely on centralized data storage in large data centers, the company is installing multiple smaller storage systems that are located close to consumers. These systems, which are small only when compared to the capacity of server farms, are basically high-capacity hard drive collections that can house and transmit Netflix content. By 2017, there were already more than 8,000 of these systems in place worldwide, located at local ISP facilities in big cities and other internet cross-roads (IXPs) around the world (Boettger et al. 2018: 32). The Open Connect system effectively constitutes a CDN (content delivery network), a technology developed to solve the bandwidth dilemma of delivering large files to many consumers across the internet, which is globally dominated by players such as Akamai. However, Open Connect is useless without the collection of user data, which Netflix conducts and which the company has long been considered a world leader in exploiting (Davenport and Harris 2007). Since any Open Connect server can only hold a fraction of Netflix's total library, the machines are populated every night with the content Netflix predicts will be the most popular with the cohort of users in the vicinity of that specific machine on a given day. If Netflix users in Berlin begin binging a German police series and an American cooking show, these will be uploaded to the local Open Connect system; if, at the same time, users in Los Angeles binge a musical and a docu-drama, these will be placed on servers there. Since people do not choose randomly from large collections but tend to favor a comparatively narrow selection of content (the long tail effect) (Brynjolfsson et al. 2010), it is possible to predict what will most likely be in demand at a given location at a given time. This renders manageable the seemingly impossible task of locating the colossal collection of Netflix content close to users scattered across the world: the Open Connect system only stores the content users are likely to require, not the entire library. Requests for content not on the local server are less likely (and may possibly be dissuaded through the recommendation algorithm) and can be routed from larger, centralized servers without overpowering the network.

This phenomenal hunger for bandwidth in the transmission of moving images posed a critical danger to the early development of the Netflix business model, which was based on competition with consumer subscriptions to cable television channel bundles. The central problem was that the capacity of internet bandwidth was simply not up to the challenge, at least not at the levels required for Netflix to acquire a substantial share of the global audience. Streaming content at the volume Netflix required, to as many customers as the company wanted to attract, was simply at odds with the internet's data-transfer capacity. The problem is critical, since it is linked to a central dilemma in the way streaming works: users select a movie or an episode of a television series, which is stored as a file in Netflix's database. The file is, in turn, chopped into small segments, which are sent to the user in a continuous stream for the duration of the movie. In order for streaming services to pose a strong alternative to the traditional multi-channel cable television subscription packages, they need to provide a wide repertoire of content. Keeping many files ready for streaming requires very high levels of storage capacity, typically those found in large server farms or data centers. These facilities are often referred to as "the cloud," yet there is really nothing ephemeral or fluffy about them: they are very real, well-guarded facilities with stunning levels of operations (and often similarly stunning carbon footprints). Housing big collections in a few big data centers makes a lot of sense in terms of storage capacity but sense little in terms of transmission, since centralized storage requires content to traverse large distances of fiber optical and copper cables, thereby eating up bandwidth capacity.

### **Cultural and Commercial Ramifications**

It is important to note two things about the Open Connect system. One is that its key dynamic depends on surveillance and prediction; if the algorithm gets user preferences wrong, the whole network suffers. The second thing is that this represents a core infrastructural development that has ramifications beyond questions of network capacity and involves a new role for surveillance in the development of cultural institutions.

Perhaps it seems strange to think about data bottlenecks in relation to internet traffic; yet concerns about internet traffic capacity are very real and concerning. The ability of the internet to smoothly serve the data needs of its users has been a priority in internet engineering for a long time (Leighton 2009; Marques et al.

2017). Open Connect represents a variation of the idea behind content delivery networks and has been a key element in bypassing limitations in internet bandwidth. It is crucial, however, that the Open Connect system only works insofar as it is possible to reliably predict where and when which data will be in high demand. If this were not possible, then the only currently viable alternative would be to dial down the demand for data by degrading the quality of the product—in this case, by lowering the screen resolution, color depth, and frame rate of the streamed content. For Netflix, this would lower the odds of success in relation to the competition for viewers in relation to the cable television industry. This is a risk the cable industry monopolies in the US are keenly aware of and have sought to promote via their control over the internet bandwidth provision (see Crawford 2013). Yet the system is currently functional and has helped Netflix define what quality of service users can expect from video-on-demand-services. This in itself is a noteworthy effect of the system, since it dovetails with the growing capabilities of home television equipment and the switch to digital transmission: in terms of quality and price, Open Connect allows Netflix to compete at an even (or better) footing with cable television.

In itself, the growth of Netflix (with it, other streaming services) must be seen as a significant change to the media landscape—television dominated the latter part of the 20<sup>th</sup> century as the undisputed central media technology and is rapidly being challenged by a set of digital developments, of which Netflix is clearly the most dominant (Lotz 2014, 2018). A key driver behind the development of Open Connect has been Netflix's investment capability, coupled with the company's detailed understanding of the internet's transmission capacity. Netflix represents a novel investment opportunity in one of the World's largest consumer markets and it has the potential to replace a small group of (inter)national companies with just a single player. Hence, large-scale investors like Goldman-Sachs have been ready to secure astronomical levels of funding for the company. Most of these investments go to expensive content production, but the scale of the Open Connect system should not be disregarded: it represents a building block of a new media infrastructure that may well become the new standard in a few short years—one that it will be equally difficult for new competitors and existing market actors to match, both because of the technical sophistication of the prediction engines required for the system to function and because of the infrastructural investment it requires.

As such, Open Connect should also be seen as a way for Netflix to secure its budding monopoly on the streaming business by supplementing its competitive content portfolio with a technological infrastructure that enables it to provide unrivalled quality of service to users at a surprisingly low cost. This points to a further layer of analysis: to a large extent, several of the new tech monopolies (Facebook, Netflix, and Google) rest on immaterial assets in the form of data about their users and on the capability to structure information and communication in ways that derive value from that information. However, information is a special kind of asset because of its nature as a non-rival good (Doligalski 2018). These types of assets are easy to regulate (e.g., by requiring Facebook to open an API that allows users to share their own data with other companies) and, thus, represents a potential vulnerability. By incorporating this kind of asset in the physical layer of the internet infrastructure, such as it is the case with Open Connect, surveillance-based business models can be perpetuated in ways that are not equally vulnerable to regulation.

The prospects are as clear as they are disturbing: from being a form of value added to a hoarded user data, surveillance technologies can now become central to core cultural media forms (such as television and the internet) by making them depend on predictive technologies for their very functionality. Once existing alternatives (online as well as and on competing platforms) are extinguished, this process may result in the escalating surveillance of users as well as the untamed monopolization of existing media forms. By designing infrastructures that require surveillance to serve their most basic function, tools such as Open Connect can become cornerstones in monopolies that no longer rest on information alone and, at the same time, become indispensable to the core function of (mass) cultural expression and experience. Similar developments—e.g., making automated curation via recommendation systems the default mode of music and film consumption—mean that digital platforms are re-shaping the infrastructures of many kinds of cultural production and of commercial attention economies. At present, the only truly effective remedy seems to be regulation: developing and monetizing specialized infrastructures has always been a core element in the technological development of the internet. It is increasingly becoming evident that it is a

mistake to continue to allow these processes to convert into core infrastructural elements that are indispensable to core functions and then to place control over them in the hands of a few.

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