

Article

Digital Platforms and Infrastructure in the Realm of Culture

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Abstract

The concepts of (digital) platform and (digital) infrastructure have been widely used and discussed in recent media research, and in neighbouring fields such as science and technology studies (STS). Yet there is considerable confusion about these concepts and the relations between them. This article seeks to bring these concepts together more coherently by showing how “platformisation” might be understood in terms of its impacts on information infrastructure, including on the principles of openness and generativity underlying early internet architecture, and potential further effects on media and culture deriving from those impacts. To develop this perspective, we draw on research from legal studies which: (a) articulates these principles more fully than in recent media studies and STS; (b) understands infrastructures as resources subject to political contestation; and (c) in the work of Julie Cohen, interprets digital platforms as strategies for disciplining infrastructures. We discuss how such a perspective might complement approaches to digital platforms and infrastructures to be found in political economy of media and internet governance research. We then apply the perspective to a case study: the transition of online music from chaotic experiments with alternative models of distribution in the early century to a thoroughly platformised environment in the 2020s.

Keywords

digital information infrastructure; digital platforms; internet architecture; internet regulation; music streaming platforms; platformisation

Issue

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1. Introduction: Infrastructural Turns and Platformisation

Infrastructure appears to be a concept for our times. It is increasingly central to national politics and global geopolitical power struggles (“Is an infrastructure boom,” 2021). It is now common to hear terms such as “infrastructure studies” or “infrastructural turn” in academic research, not only in media and communication studies, but across the social sciences and humanities (Edwards et al., 2009). A rich body of research has emerged around the concept in media and communication studies, often fuelled by interest in digital information infrastructures. Valuable ethnographic media research has helped to illuminate the ways in which people in postcolonial contexts

have adapted imported infrastructural information and communication technologies (ICTs), decentring western understandings of them (Parks, 2015b; see also Larkin, 2008). Some of the new infrastructural research (e.g., Winseck, 2017) builds on a long history of engagement with media and information infrastructures, for example, political economy research on privatisation and marketisation of telecommunications (e.g., Schiller, 2000). Digital information infrastructures have also been of interest to scholars working in other fields, perhaps most notably anthropologists in science and technology studies (STS; e.g., Bowker & Star, 1999; Burrell, 2018).

Yet there appears to be great confusion among researchers across these fields about how to conceptualise and use the term. Whereas many non-academics

would understand it as referring to something like “the basic systems and services that are necessary for a country or an organisation to run smoothly, for example buildings, transport and water and power supplies” (Infrastructure, n.d.), social science and humanities researchers increasingly seem to use it in a bewildering variety of ways, including quite often as a synonym, or perhaps a metaphor, for “system” or even “importance,” implicitly understanding infrastructure merely as something which has important implications for something else (see Hesmondhalgh, 2022, which catalogues some of the confusions).

Perhaps as a result of this definitional and conceptual vagueness, curiously little of this rich body of research has engaged explicitly and in detail with some fundamental infrastructural aspects of the development of ICTs in the 21st century. One key aspect, relatively neglected in recent research, is that the internet infrastructure that underpins so much contemporary media and communication was initially framed by its developers as a common resource available to all (regardless of private or public ownership of any elements of it), enabling the creation of an international network of networks, based on values of *open-ness* and more broadly what Zittrain (2008, p. 70) called “*generativity*”: a “system’s capacity to produce unanticipated change through unfiltered contributions from broad and varied audiences.”

Such principles of open-ness in internet architecture were discussed widely in writing about the internet and web in the oughties (e.g., Gillespie, 2007) but have largely been neglected since in media studies and STS. During that decade, the term “platform” was hardly used, but from around 2010 onwards, internet and digital scholars began to employ it very widely and it is now pervasive in a range of disciplines and fields (see Gillespie, 2018, pp. 18–21, for a helpful discussion of definitions). Researchers from media studies, urban studies, and geography have highlighted the importance of evolving relations between digital platforms and infrastructures, and between “platform studies” and “infrastructure studies” (Plantin et al., 2018). A large number of media scholars have implicitly or explicitly followed this move (Eriksson et al., 2019; Lobato, 2019; Poell et al., 2022; see also a number of contributions discussed in Section 2). Yet in spite of Plantin et al.’s (2018) suggestive efforts to put these two previously separate domains into dialogue, much of the research citing their important article has not sought to conceptualise the relationships between digital infrastructures and digital platforms. Indeed, confusion reigns here too. It is common to read or hear, in the wake of Plantin et al.’s (2018) influential article, phrases to the effect that “platforms have become...important infrastructures” (Sadowski, 2020, p. 567). But this appears only to mean that platforms are used as the basis of some other set of activities: infrastructure as a vague metaphor rather than a conceptualised tool for analysis. This article seeks to bring these concepts together more coherently by pointing to ways in which “platformisation”—a currently very

popular and yet poorly conceptualised notion in media studies, internet studies, STS, and beyond—might be understood as having impacts on information infrastructure. This includes effects that, drawing on debates about open-ness and generativity in internet and web architecture, might be characterised as “closure” or “enclosure” (Cohen, 2019). Such a view is arguably implicit in Plantin et al.’s (2018) discussion of Google and Facebook’s impact on the open web, but it does not seem to have been much taken up in discussions of that very widely-cited article.

To develop this perspective further, we make two important moves. First, we draw on research (e.g., Cohen, 2019; Frischmann, 2012; van Schewick, 2010) that helps to conceptualise these values and principles much more fully than has been the case in recent media studies and STS. This research mainly comes from legal studies, but its remit is by no means exclusively or even primarily concerned with law. Second, we apply it to an actual case study of the impacts of platformisation on the possibilities made available by open internet infrastructure, by examining what happened in the realm of online music. Normatively, our concern is that the internet (with access to content provided by the World Wide Web) was designed as an “open” network that for all its problems brought about “an explosion in innovation and content, which in turn is why the openness is considered to be worth protecting as something that has an intrinsic public-interest value” (Horten, 2016, p. 9).

The case of music is particularly illuminating in terms of the above issues, because for a period in the late 1990s and 2000s open internet infrastructure seemed to provide a major challenge to the problematic institutional framework that had sustained the recorded music industry for decades. Yet the same lack of attention to the politics of infrastructural systems and their place within the changing political economy of capitalism is also apparent in research on changes in music production and consumption.

In Section 2, we expand and nuance the above claims by demonstrating the limitations in even the current leading research on digital infrastructure and digital platforms in media and communication studies, and in digital music studies (we note in passing that studies of music and digitalisation have tended to pay much greater attention to media studies than media studies has to digital music research). In Section 3, we turn to the (mainly) legal studies research just mentioned to develop a framework for understanding the (en)closure of internet architecture’s open-ness via platformisation and other means. In Section 4, we show how music serves as an early and revealing case study of the closing down of infrastructural potential by platformisation.

2. Recent Treatments of Infrastructure and Platforms in Research on Media, Culture, and Music

In spite of the widespread use of infrastructure as a rather vague metaphor or synonym for “system,” as

noted in the previous section, surprisingly little research on media infrastructures has actually analysed media infrastructures *as* systems. The recent “infrastructural turn” in media, communication, and internet studies has provided fine studies of particular infrastructural items, such as the server farms that are part of general IT infrastructure (Holt & Vonderau, 2015; Mayer, 2019), or the pipelines that serve inter-continental digital traffic (Starosielski, 2015). Such analyses have produced significant insights regarding matters such as the environmental consequences of IT infrastructure and the implications for the labour of where particular infrastructural sites are located. But as we show below, very few authors have sought to delineate the systems of internet infrastructure or architecture in a way that illuminates recent and current developments in media content and distribution. This includes a lack of attention to the infrastructures underpinning the streaming platforms that increasingly shape media consumption today.

The necessarily brief review that follows focuses on those rare in-depth treatments of media infrastructural systems that we have been able to locate. A chapter by Ramon Lobato (2019) on the infrastructure underpinning Netflix helpfully delineates how that platform relies on two different kinds of infrastructure: public and private telecommunications networks, and its own internal IT networks and systems. He shows how this leads Netflix to lobby for state investment in internet infrastructure (cf. Elkins, 2018) and he relates this to the debates about net neutrality in the US, especially whether internet service providers (who essentially control telecommunications infrastructure) should be able to charge services that are dependent on them, such as video streaming services. Lobato shows that while many major web services use a commercial content delivery network, Netflix has established their own, bringing this vital infrastructural element under its control. Such issues concerning speed of delivery have undoubtedly been the main way in which the infrastructures underpinning video distribution have featured in public debate (cf. Johnson, 2019, pp. 70–72). But Lobato’s conclusion suggests that the main value of an examination of infrastructure is to remind us that phenomena such as Netflix are dependent on many “longer-term, larger-scale social and technical transformations” (2019, p. 103), from the history of electrification and lighting to modern architectural forms and changing family practices. Lobato’s point is that recognition of this dependence in turn might throw light on the uneven availability and uptake of Netflix across the globe, helping us see that Netflix is a very culturally specific phenomenon, dependent on television’s longer history as a domestic technology.

This is valuable, but Lobato does not explicitly address the infrastructural principles underlying the internet, as indicated above and discussed below, nor how platformisation, along with associated changes such as datafication, have reshaped them. Poell et al. (2022) come closer to addressing this topic in a chapter exam-

ining the implications of platform infrastructure for cultural producers, and they do so by ranging across a number of sectors, including games and social media. Their main argument is that the relationship of platform companies to neighbouring industries, including the cultural industries, are characterised by an oligopoly of major tech firms that base their goals on “infrastructural integration” and “interoperability.” For many decades, cultural producers have been dependent on infrastructures owned by companies as well as by states, but Poell et al. (2022) claim the balance has become far more tilted towards privately-owned networks in the era of platforms. And because platforms curate, organize, archive, and moderate content, this means that, according to Poell et al. (2022), tech businesses now have a potentially profound effect on cultural producers.

Poell et al. (2022) deserve great credit for delineating a number of elements that are relevant to understanding changing relations between platformisation and infrastructure, including the need to differentiate particular platforms (e.g., Facebook Messenger) from the platform ecosystem that they operate within (i.e., Facebook’s systems); and the way in which “boundary resources” such as application programming interfaces and software development kits operate not only as “support” for cultural producers, but also as ways of securing or controlling them. However, their main normative focus is on the potentially pernicious effects of *ownership* rather than on infrastructural principles per se, and on the principle of open-ness mentioned in the previous section.

The most significant writing we have found that applies understandings of infrastructural principles to the distribution of media content is a chapter by Christian Sandvig (2015), which explains how internet architecture, based on a “point-to-point” system oriented towards communication between two nodes, more akin to postal services than to television, had to be radically amended to accommodate a new sector of business organised around the distribution of online videos. The thinkers behind internet architecture, and the commentators that followed them, in Sandvig’s words, “expected that providing television via the Internet would transform television, but instead it caused the Internet’s distribution architecture to become like television in significant ways” (2015, p. 237). Sandvig outlines multiple efforts to solve the problem of video distribution, via compression, streaming, buffering, server farms, and so on, but how in the end “changes to standards, protocol, and system architectures” had to be made in order to shift to “a more familiar model of mass communication,” exemplified by the rise of content delivery networks, methods of caching files to ensure the prioritisation of those that required vast bandwidth (2015, p. 238). The result was a hybrid of open-ness and closure, but increasingly centred on a “closed” mass audience model. Sandvig’s is a vital precedent for our take here but it makes strangely little mention of audio content. While video content required much greater change to

accommodate its much greater bandwidth, music served as a key testing ground for the transformative potential of internet architecture's open-ness in the realm of information, entertainment and culture (in addition, radio has arguably been as important historically as television in terms of broadcasting infrastructures).

So how *has* music featured in debates and research about internet infrastructure? There was a huge amount of media coverage of music in the period following the widespread take up of the internet in wealthy countries in the late 1990s and early 2000s, when various websites made it possible for ordinary internet users to share and download digital files of music, threatening the system of copyright that had sustained the recorded music industry. Polarised positions arose between those who emphasised the need to protect copyright, often expressed in terms of the interests of musicians, and those who considered copyright to be a problem. In response to these heated public debates, copyright emerged from the specialist shadows to become a fashionable and widely discussed topic across a range of academic disciplines including media and communication studies, law, and music studies (among many contributions, see Lessig, 2004; Vaidhyanathan, 2001). There were also numerous studies of "piracy," peer-to-peer file sharing, and other related phenomena, some with a strong emphasis on music (Andersson Schwarz, 2013; David, 2010). The dependence of such developments on the open-ness of the internet featured fairly prominently in these accounts.

However, by the time music streaming platforms had emerged as a new lasting basis for recorded music commerce, from about 2015 onwards, the open infrastructure of the internet seemed to disappear from the academic agenda. Morris (2015)'s important book on the digitalisation of music refers to infrastructure many times but barely mentions the infrastructural ideals behind the "open web" or its closure. In more recent accounts, the first decade of the 21st century is often treated as a brief period of chaos before order was re-established, first in the form of Apple's iTunes and then in the form of music streaming platforms such as Spotify (Sun, 2019), with little reference to internet infrastructure. Morris (2021) has a later article on "infrastructures" of discovery, mainly in relation to podcasting on audio platforms, but he seems to use the term as a metaphor for "system." The agenda of recent research has been overwhelmingly to understand the new order based on streaming, and little reference is made to the period preceding it. But even in those accounts of digitalisation published before 2015, which attempted to tell the story of disruption, infrastructural politics were almost entirely missing from the picture. There was considerable attention to particular sites and applications such as Pirate Bay and Napster, but little consideration of the information infrastructure that made them possible (though Andersson Schwarz's, 2013, excellent account of how file-sharers understand and justify their practices

recognises the importance of internet architecture). This neglect seems all the more remarkable given how widely the term infrastructure is used in much recent writing on media, music and culture.

On first sight, writings by Paolo Magaudda seem to blend consideration of digital media infrastructures with attention to the concept of platformisation, while making specific reference to music—in line with the aims of this article. For example, Magaudda (2020) explores how the concept of infrastructure might help develop further the notion of music scenes, very widely used in popular music studies to refer to the musical activity built around particular genres in particular geographical areas, mainly cities. Magaudda recounts instances of the use of the term infrastructure in earlier research on music scenes, where it was used to refer rather vaguely to music venues and other institutions such as record shops, and he asserts the need to understand how "new kinds of digital infrastructures and platforms did much more than offer a new space for fandom or new opportunities to link together artists and listeners from different countries and regions" (2020, p. 33). However, it is not clear what Magaudda means by "digital infrastructures and platforms," nor how he understands their different roles and their relationship. Instead, his discussion of platforms is confined to a brief mention of the increasing use of recommendation algorithms based on user data, and some speculative comments about the use of blockchain technology. A later contribution (Magaudda, 2021) includes the thoughts of users on algorithms and musical taste, but the role of infrastructures in such developments and the precise conceptualisation of infrastructure in operation is not made clear there either. As with so many treatments of implications of "digital infrastructure" for media, as indicated in this section, there is no discussion of how the principles and values underlying internet infrastructure might have helped to reshape music, and how later dynamics of platformisation, including the rise of recommendation algorithms, etc., relate to those principles.

One detailed account of the infrastructure underpinning music streaming that we have been able to identify, from a critical social science and humanities perspective (rather than a purely technical one) is a chapter on infrastructure in Eriksson et al.'s *Spotify Teardown* (2019). The approach of that chapter is based on the authors' view that "to understand the logic and rationale of streaming services such as Spotify, we need to ask what exactly happens when data are turned into music and vice versa" (Eriksson et al., 2019, p. 80). Their analysis addresses specific *elements* of infrastructure in some detail. For example, they outline Spotify's "event delivery system," "one of the foundational pieces" of Spotify's data infrastructure—i.e., how data gets transferred between different elements and places within the company. They also discuss (pp. 82–88) data exchange and interaction with other companies, such as the music information retrieval company Echo Nest, which allowed

for automated music recommendation to be integrated into the service (Spotify eventually bought this company); and Spotify's collaboration with Facebook and its opening of its application programming interfaces to external developers, as Spotify attempted to mutate for a while into more of a social media service. They analyse Spotify's systems for storing and retrieving data, including their shift from using their own servers to using Google's cloud services—though the significance of this shift is not elaborated. The role of aggregators (Eriksson et al., 2019, pp. 91–96) or digital distributors is also discussed as part of their consideration of infrastructure though it is not clear why the authors consider such digital distributors or aggregators to be part of infrastructure as such—possibly they too are using infrastructure primarily as a metaphor for *importance*, here applied to organisations rather than infrastructures per se. Yet the role of Spotify and other platforms in closing down cultural possibilities that were fundamentally dependent on key features and principles of internet and web infrastructure are not addressed.

3. Infrastructural Systems as Resources and Digital Platforms as Disciplinary Mechanisms

Our approach in this article is premised on the view that details of particular infrastructural technologies are rarely illuminating with respect to public culture and media outcomes. Instead, our view is that if infrastructure is going to be mobilised as part of truly critical media studies, and to contribute to the understanding of the potential for a more democratic, vibrant media system that serves human flourishing for all, it is necessary to focus on the *politics* of infrastructure and its place within evolving modes of capitalism (whether understood as “informational capitalism,” “platform capitalism,” or some other formulation; here we borrow Cohen's use of the former term but remain agnostic on its merits).

In line with this approach, we highlight two aspects of infrastructure that have only infrequently been recognised as central issues in the recent infrastructural turn in media and communication studies: the way that infrastructures potentially function as *resources* for many individuals, organisations, communities, and groups; and the infrastructural politics involved in disputes over their *provision*. We derive this dual focus partly from legal scholar Brett Frischmann's (2012) book *Infrastructure*, a source that has been largely ignored in media, communication, and internet studies. While Frischmann's work addresses a range of infrastructures, including transport and environmental ones as well as “intellectual infrastructures,” it is his work on internet infrastructure that offers the most potential for understanding the implications of information infrastructures for public culture, because of its emphasis on infrastructure as a resource and on the politics surrounding the provision of that resource.

Frischmann's (2012) approach also happens to offer routes for moving beyond the definitional and conceptual chaos surrounding academic understandings of infrastructure already discussed, and he clarifies the specificity of information infrastructure. Like many recent analysts of infrastructures, Frischmann's approach recognises that they involve more than just pipes and tubes, the “stuff you can kick” (Parks, 2015a). In the context of the internet, Frischmann (2012) borrows a distinction between the physical infrastructure (“a wide variety of physical networks interconnected with each other,” p. 319) and the “logical infrastructure” (“the standards and protocols that facilitate seamless transition of data across different types of physical networks,” p. 319). This is consistent with the emphasis on standards and protocols in internet governance research that considers infrastructural questions (e.g., Musiani et al., 2016); media studies and STS literature tends to be rather less precise (Hesmondhalgh, 2022).

Compared with the internet governance literature, the approach of another legal scholar, Julie Cohen, is much more macro-historical in focus, and shares our concern (and that of political economy) with changing relations between capitalism, technology, and culture. Drawing on Frischmann's understanding of infrastructure (Cohen, 2019, pp. 40–41), she analyses the role of (US) legal systems in laying the ground for three large-scale shifts characterising what she calls “informational capitalism.” The first shift is capitalism's drive to produce property out of intangible resources, including the expansion of intellectual property across copyright, trademark, and branding, the way for which has been paved by a massive expansion of legal entitlements of rights owners. The second is that labour, land, and money (the basic factors of production in a capitalist economy in the classic work of economic historian Karl Polanyi) have been reconfigured into “datafied inputs to new algorithmic modes of profit extraction” (Cohen, 2019, p. 25), centred on digital platforms. Cohen (2019) sees this as a process of de facto appropriation and enclosure with implications as profound for human well-being as the earlier enclosures of land and labour that marked the beginning of the industrial phase of capitalism. The third shift identified by Cohen as characterising the rise of informational capitalism is the way that the emergence of platforms from the new emphasis on data has created a new layer of infrastructure, with huge ramifications for economic exchange. For Cohen, digital platforms do not just enter markets, but replace and re-materialize them (2019, p. 42). Digital platforms have thus come, in Cohen's view, to serve as “strategies for bounding networks and privatizing and disciplining infrastructures” (Cohen, 2019, p. 41).

What might Cohen mean by this latter formulation? A key element (though not the only one) concerns the lost potential of the original principles underlying internet infrastructure or architecture, as discussed by another legal scholar, Barbara van Schewick

(2010). The term “architecture” is potentially as vulnerable to misunderstanding and conceptual confusion as “infrastructure,” but van Schewick uses it to mean “the fundamental structures of a complex system as defined during the early stages of product development” (van Schewick, 2010, p. 20); we follow Frischmann in translating van Schewick’s “architecture” into “infrastructure.” Van Schewick (2010) shows that internet architecture depends on three fundamental principles: modularity, layering, and the end-to-end principle. Modularity is the design principle of making elements of a system independent of each other. Layering represents a particular version of modularity, whereby the modules or elements are organised hierarchically. Scholars nearly always use layered models of the internet to understand the relations of dependence and complementarity underlying its functioning, and, drawing on van Schewick and others, Frischmann (2012) adopts a five-layer model (see Table 1) whereby the physical and logical infrastructure layers provide the foundations for “higher” layers of applications and content (third and fourth layers) but also a “social layer” of networks, affiliations and groups (see Zittrain, 2008, pp. 67–69, for a similar model).

The important point is that the end-to-end principle (or strictly speaking, a particular, “broad” version of it; see van Schewick, 2010) organises this layering so that the lower layers of the network are as general as possible, while all application-specific functionality is concentrated in higher layers at “end” hosts. This means that the lower layers are in effect “blind” as to the way in which the internet is used, and to the identity of the user.

Crucially, in terms of the politics of the internet, end-to-end design “sustains an infrastructure commons by insulating end-users from market-driven restrictions on access and use of the infrastructure” (Frischmann, 2012, p. 322). It does so because if infrastructure providers follow end-to-end principles strictly, they “cannot distinguish between end uses, base access decisions or pricing on how packets may be used, or optimize the infrastructure for a particular class of end-uses” (Frischmann, 2012, p. 322). It is this and other related aspects of internet infrastructure that Cohen is referring to in seeing platforms as “strategies for bounding

networks and privatizing and disciplining infrastructures” (Frischmann, 2012, p. 322). Ten Oever (2021) also captures the tangle of issues here by distinguishing three key elements of the “internet architecture imaginary”: the end-to-end principle, but also permissionless innovation (that there are no barriers to the development of new protocols), and open-ness (for example, that new computers can be added, and that information can travel freely from node to node).

It perhaps goes without saying that this set of values, which are both technical and ethical, were rapidly compromised, even in the early internet, by forces such as privatisation and the erosion of such principles in governance organisations. And they can be applied in dubious ways by powerful actors, for example by justifying problematic applications of ideas of liberty and autonomy, as shown by Cath’s (2021) ethnographic study of the Internet Engineering Task Force’s attitudes to the relationship between technological development and human rights. Our goal in this article is not to celebrate these infrastructural principles but to analyse the fate of their potential in terms of media, communication, and culture, focusing on the domain of music.

As indicated in Section 1, one way of summarising this set of values or principles is “open-ness” (though ten Oever, 2021, lists this as merely one of the key elements of the “architecture imaginary”); another is Zittrain’s “generativity.” Early utopian accounts of the emancipatory potential of the internet made frequent reference to such open-ness (Russell, 2014, traces the emergence of open standards and associated ways of thinking). Perhaps because the internet has so clearly fallen short of the aspirations of its idealistic early proponents, discussion of these principles and their lost potential is rarely found in recent media research on the impact of the internet on culture and communication. Yet it is surprising that, in a media studies context where infrastructure is such a fashionable term, this vital and consequential aspect of internet infrastructure has been so ignored.

The role played by digital platforms in “closing down” this open-ness or generativity also seems poorly understood. Of course, many observers, from inside and outside academia, have a sense that the internet has

Table 1. Five-layer model of the internet.

Layer	Description	Examples (music streaming)
Social	Relations and social ties among users	Integration with social networking platforms (i.e., Facebook)
Content	Information/data conveyed to end users	Music files, playlists
Applications	Programs and functions used by end-users	Desktop and mobile media players
Logical Infrastructure	Standards and protocols that facilitate transmission of data across physical networks	Content delivery networks, event delivery systems
Physical Infrastructure	Physical hardware that comprises interconnected networks	Cable and satellite networks, data centres, routers, and servers

Source: Adapted from Frischmann (2012, p. 320).

“gone wrong” in some way and a huge number of critical accounts have appeared, in academic and trade publishing, in recent years, dealing with both infrastructure and platforms. In some political economy versions analysis of digital platforms, this is sometimes reduced to questions of ownership, to control by massive tech corporations, often with excessive focus on the famous GAFAM (Google, Apple, Facebook, Amazon, and Microsoft) oligopoly, or on the dependence of platforms on the collection of data (e.g., Smyrniotis, 2018; Srnicek, 2016). Ownership and datafication are extremely important, involving vital problems of democratic control and power, and such accounts do attempt to analyse how digital platforms are embedded in a broader context of the evolution of capitalism in the digital age. But they do not in themselves address how the infrastructural open-ness or generativity of the internet, just outlined, has been affected by platforms, nor do they make any sustained attempt to theorise the relationship of digital platforms to media or internet infrastructures. Indeed, many of these accounts, including some of those characterisable as political economy (such as Srnicek and Smyrniotis) often resort to using the term “infrastructure” in the vague metaphorical way that we critiqued earlier. Much more helpful in understanding the dynamics of media infrastructure is research from political economy of media on telecommunications, including that already mentioned above (Schiller, 2000; and Winseck, 2017, also demonstrates the problematic focus on the GAFAM oligopoly in some of the other political economy accounts just mentioned). Also worth noting is work from critical geography media infrastructures on how telecommunications infrastructures such as broadband and mobile telephony powerfully delineate space (Easterling, 2016). But none of these resources conceptualises the role of digital platforms in closing down the architectural principles of open-ness and generativity that underlay the early internet (though Srnicek, 2016, pp. 110–112, makes brief reference to Amazon and Google as “closed platforms”). One way of explaining this move is that platforms “often just work better or fit better” into the lives of consumers (“the screen comes to them, they don’t have to go to the screen,” in the words of a World Economic Forum publication [Drake et al., 2016, p. 53]). But we still need an understanding of how platforms were able to offer this convenience to consumers, and what was lost in the process. Cohen’s (2019, p. 41) vision of platforms as “strategies for bounding networks and privatizing and disciplining infrastructures” opens the door to a greater engagement by media research with such questions, which we now pursue in the section that follows.

4. The Platformisation of Music as a Closing Down of Infrastructural Possibilities

Cohen’s macro-historical and densely theorised account does not examine the implications of the enclosure and

commodification she identifies for particular domains of culture and communication, at least not in any detail. How then might a version of such an account of infrastructure, embedded within a political economy of informational capitalism, and centred on the three shifts identified by Cohen (which we might cautiously summarise as propertisation, datafication, and platformisation) be developed and applied to media and culture, here using the specific case study of music?

What makes the case of recorded music a particularly revealing one is the stark historical contrast it presents between the current situation and a not-so-distant past when huge amounts of musical activity were afforded by digital architecture organised according to a very different logic, and where music acted as a test case for radical changes that might take place in other culture and information sectors. Music had this role foisted on it because it does not take up much bandwidth, at least compared with video, and also because CDs already contained huge amounts of “unprotected” music which could be shared online, once (easily) compressed into the highly portable MP3 software format. This made music technology a site for experiments in how to use the internet as the basis for new ways of exchanging information and entertainment, based on the infrastructural features and principles outlined in the previous section, including permitting commons-based use of computing resources.

One notable such experiment was the use of peer-to-peer computing, based on the principle that each node in the network is an equal peer which simultaneously functions as both a client and a server. The famous Napster website was not actually based on peer-to-peer but it offered easy search via a display of the files currently available from the computers of logged-on users. This made it popular but its centralised nature meant that courts held it responsible for not preventing infringement. This did not apply to peer-to-peer sharing protocols such as BitTorrent, and these were a much greater threat than Napster. The recorded music industry took action to protect its copyrights against these various technologies by criminalising their use, including the prosecution of ordinary file-sharing users (David, 2010). But the bad publicity generated by such developments meant that rights-holders shifted to different solutions.

Let us now apply a version of Cohen’s triad of propertisation, datafication, and platformisation to the case of online music. Propertisation involved a mix of legal and technological means. Following intense lobbying by rights-holders, courts, especially in the US, issued judgments that predictably affirmed these owners’ views about intellectual “property” (a term that had by the late twentieth century become naturalised as a way of thinking about cultural products, itself the culmination of a long ideological battle by cultural-industry businesses, going back decades). Meanwhile, record companies introduced means of preventing the kinds of circulation that internet infrastructure permitted, through the introduction of encryption software that sought to control

reproduction and sharing, at least for ordinary users, in the form of digital rights management controls. Publicity about prosecution and “illegality,” along with growing problems of spam in the chaos of the open web, helped to create a climate of anxiety among more nervous, more dutiful, and often older groups of citizens, who sought out “safer,” more secure, and more seamless online musical experiences, though digital rights management proved clunky and unpopular with consumers.

An even more significant technological development, in terms of the role of proprietisation in closing down the generative potential of internet architecture, was the introduction of what at the time were called “trusted systems,” which offered copyright owners greater and more precise control over their products (Gillespie, 2007). By contrast with the relatively open protocols associated with connected PCs, these often involve what Zittrain (2008, p. 101) called “tethered appliances,” more centrally controlled devices such as mobile phones and games consoles, which no one can tinker with. As Tarleton Gillespie (2007) showed in an excellent account seemingly overlooked by nearly all music scholars and more recently by media and internet researchers, the reason behind the word “trusted” is that software rules protecting files from copying and sharing are built into devices and software systems built around particular devices. Such “black box” devices do more than respond to infringement, they allow for “an incredibly subtle and parsing of the use of information so as to be sold” (Gillespie, 2007, p. 55).

“Trusted systems” in the realm of music paved the way for what soon came to be known as “datafication,” in this context meaning the ability to extract profit from the collection and analysis of data. The enormous value of data had been made clear via a whole set of separate developments, including the discovery by Google of the vast profits to be made from what Zuboff (2019, p. 81) has called the “behavioural surplus,” the accumulation of vast behavioural data beyond that needed to improve services, instead oriented towards predictions for accurate digital targeting, especially via search and recommendation algorithms. In music, Apple’s iTunes system began to provide personalised experiences of recommendation in 2003 and operated as a trusted system, far removed from peer-to-peer. Even more significant was the iPhone (Apple do not sell data to third parties but experimented with personalisation technologies).

Crucially, these tethered devices were increasingly linked to websites operating on similar principles (Zittrain, 2008, pp. 101–106), which eventually came to be known as digital platforms. In music, the innovation of firms such as Spotify and Deezer was to build trusted system architectures on top of internet infrastructure, making it impossible for all but the most sophisticated users to share or tinker, rendering them hardly platforms at all on the user side (cf. Sandvig, 2015). At the same time, they developed business models based on either advertising (already proven to be successful and lucra-

tive in the form of YouTube) or subscription (Rhapsody and the “legal” reincarnation of Napster both showed the potential of this model). Once a tipping point of security for content providers and seamlessness for users was achieved, most notably by Spotify, rights-holders (mainly the major multinational record companies, and their “publishing” arms, i.e., those dealing with song rights) began to license their content to streaming platforms—though at a premium.

The platform model, based on “technical protocols and centralized control to define networked spaces in which users can conduct a heterogeneous array of activities and to structure that space for ease of use,” (Cohen, 2019, p. 41) eventually produced substantial revenues (though rarely big profits) for companies and products able to create and exploit “first mover” (or first winner) advantages, across a range of sectors. Vast amounts of investment were necessary to build platform infrastructures on top of the internet, but as investor confidence gradually started to build, financing poured in. Music technology companies became able to attract very high levels of financial investment, nearly a billion dollars between 2011 and 2013 (Mulligan, 2015). Just three music technology companies (Spotify, Deezer, and Beats) accounted for 70% of this sum. All operated on the platform model.

Concurrently, the massive data needs of the platform model required enormous computing power, and the solution that emerged was outsourced “cloud” storage and retrieval. While listening to a track on Spotify always involves musical files being transferred from remote servers to a personal computer, back in the early 2000s, music consumption through BitTorrent only involved file transfer between individual personal computers, without the need for the centralised infrastructure system that underlies the Amazon and Google cloud empires that serve streaming platforms.

The result is a musical ecosystem that now essentially consists of two parallel oligopolies: music platforms owned and controlled by technology companies (with Spotify, Apple, Google, and Amazon dominant across much of the world, and Tencent in China) and a recording sector with corporate rights owners scarcely less profitable and dominant than before the internet. While musicians can now try to make their music available to global audiences without passing through record companies, they are unlikely to be heard or paid much at all without them. Certainly, successful musicians stood to have their share of earnings from rights eroded by the chaos unleashed by internet generativity. But new payment systems would surely have emerged and perhaps under different terms than those in which the major-dominated recording and publishing industries prevail. The threat temporarily posed by the “open” and “generative” architecture of the internet was well and truly contained, and while this “enclosure” preceded platforms, it was only with platformisation, underpinned by proprietisation and datafication, that it was more or less fully realised.

5. Conclusions

The perspective developed here is intended to illuminate the politics of information infrastructures in terms of public culture and media, here demonstrated by the case of music. This, we would argue, is a particularly illuminating case study, firstly because it was in the realm of online music that the infrastructural potential of “open” or “generative” architecture was most fully apparent, and secondly, because music represents a remarkably successful and rapid instance of platformisation, across much of the world. But beyond that, our perspective points us to the normative implications of the incorporation of music into information capitalism that the legal studies perspective helps to illuminate. This has involved networks becoming mainly platforms, supported by infrastructure designed to ensure security and seamlessness, rather than the generativity, interactivity, and open-ness envisaged by an earlier generation of internet enthusiasts. While some of the predictions of democratisation were naïve and even silly, they recognised something extraordinary about internet infrastructure, which has in many respects been lost. Instead, platformisation has allowed something more than just oligopolisation of ownership. It has enabled the incorporation of music into what Durham and Born (2022) have called a “rentier” model of musical exchange. Rent here means something different from the rent paid to a landlord by a tenant; it refers to a specialist economic sense that has been defined in a mass of sometimes contradictory ways. At the heart of this use of the term “rent,” as Brett Christophers (2020, p. xvi) shows in his book *Rentier Capitalism*, is economic actors receiving rewards “purely by virtue of controlling something valuable.” In this case, it involves not only intellectual property assets, long central to music, but also platforms and infrastructures, the latter a resource organised not on a generative and open basis, but as assets to be milked by providing a service that only a very small number of corporations can afford to offer.

How does infrastructure influence or shape culture, if at all? In this article, on the basis of a case study of music, we have sought to demonstrate that one important way to consider infrastructure as part of an account of how culture is shaped and influenced is to examine developments in infrastructural politics over a relatively long duration, as part of a macro-historical account of change and continuity. Specifically, we use the case of music to show how platforms have operated as the main means by which the democratising and emancipatory possibilities afforded by the (always partial) commons-based open-ness of internet infrastructure were eroded or “closed down.” What seems strange, in terms of academic research, is that, in spite of the popularity of terms such as platforms and infrastructure, this erosion has hardly been recognised, let alone analysed, in recent media and communications research on those topics.

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Conflict of Interests

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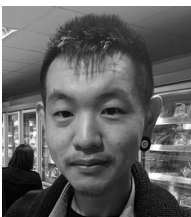
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