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Abstract: Over the past decade, a growing body of scholarship in media studies and cognate disciplines has emphasized the social, material, cultural, and political dimensions of the infrastructures that undergird and sustain media and communication networks and cultures across the world. This infrastructural turn assumes greater significance in relation to digital media and in particular, the influence that digital platforms have come to wield. Having "disrupted" many sectors of social, political, and economic life, many of the most widely used digital platforms now seem to operate as infrastructures themselves. This special issue explores how an infrastructural perspective reframes the study of digital platforms and allows us to pose questions of scale, labor, industry logics, policy and regulation, state power, cultural practices, and citizenship in relation to the routine, everyday uses of digital platforms. In this opening article, we offer a critical overview of media infrastructure studies and situate the study of digital infrastructures and platforms within broader scholarly and public debates on the history and political economy of media infrastructures. We also draw on the study of media industries and production cultures to make the case for an inter-medial and inter-sectoral approach to understanding the entanglements of digital platforms and infrastructures.

Digital Media Infrastructures: Pipes, Platforms, and Politics

Jean-Christophe Plantin, London School of Economics and Political Science

Aswin Punathambekar, University of Michigan

Abstract

Over the past decade, a growing body of scholarship in media studies and other cognate disciplines has focused our attention on the social, material, cultural, and political dimensions of the infrastructures that undergird and sustain media and communication networks and cultures across the world. This infrastructural turn assumes greater significance in relation to digital media and in particular, the influence that digital platforms have come to wield. Having "disrupted" many sectors of social, political, and economic life, many of the most widely used digital platforms now seem to operate as infrastructures themselves. This special issue explores how an infrastructural perspective reframes the study of digital platforms and allows us to pose questions of scale, labor, industry logics, policy and regulation, state power, cultural practices, and citizenship in relation to the routine, everyday uses of digital platforms. In this opening article, we offer a critical overview of media infrastructure studies and situate the study of digital infrastructures and platforms within broader scholarly and public debates on the history and political economy of media infrastructures. We also draw on the study of media industries and production cultures to make the case for an inter-medial and inter-sectoral approach to understanding the entanglements of digital platforms and infrastructures.

Keywords: Infrastructure(s), platforms, internet studies, digital cultures, globalization, political economy

Introduction

With state and private investments in digital infrastructures (and communication technologies more generally) leading to increased access to the internet the world over, it seems hard to imagine a near future without a range of digital platforms facilitating our social, cultural, political, and economic interactions and exchanges. Breathless pronouncements about a "platform revolution" aside, it is becoming clear that companies including Google, Tencent, Amazon, and Facebook that began as platforms with specific aims and areas of operation (shopping, social networking, web search, etc.) now seem to function as vital infrastructures in the world at large. How might we discern this ongoing "infrastructuralization" of digital platforms? (Plantin et al., 2018).

To begin with, it is clear that influential digital platforms constitute social and material infrastructures at the user level. The companies mentioned above have now acquired a scale and indispensability - properties typical of infrastructures - such that living without them shackles social and cultural life. Their reach, market power, and relentless quest for network effects has led companies like Facebook to intervene in and become essential to multiple social and economic sectors. Second, internet companies rely on the properties of platforms to replace or mesh with existing infrastructures to gain economic advantages. Perhaps the most striking example would be the influence that ride-sharing companies like Uber wield in organizing public transportation. Often achieved in collaboration with city administrations, such efforts raise urgent questions about the splintering and privatization of public utilities. Third, internet companies increasingly invest in infrastructure projects. While Amazon has been a logistical empire of sorts from its inception (combining delivery of goods with online computing services), companies including Google, Facebook, and Microsoft have all made massive investments in

building and maintaining data centers, enhancing telecommunication networks, and entered the business of internet service provision. If this interest in infrastructure is simply necessary for internet companies to meet their expanding digital storage and computing needs, it also reveals the incredible diversification of these companies' activities and of course, their power at every imaginable layer of digital culture.

This special issue explores how an infrastructural optic reframes the study of digital platforms and allows us to pose questions of scale, labor, industry logics, policy and regulation, state power, cultural practices, and citizenship in relation to the routine, everyday uses of digital platforms. Put simply, if digital platforms have become increasingly infrastructural, then we need to ask of platforms some of the questions we typically raise in relation to infrastructures. To do so, we take our cue from Brian Larkin who approaches the term infrastructure as a "cultural analytic that highlights the epistemological and political commitments involved in selecting what one sees as infrastructural (and thus causal) and what one leaves out" (2013, p. 330). Taking this expansive view, we explore what new questions emerge when we focus on the various material assemblages - pipes, cables, data centers, cell phone towers, handheld devices, and so on - that shape the operations of digital platforms. Alongside issues of materiality, we ask what we might learn by examining the industry logics, practices, and imaginaries that ensure the reach and global scale of dominant platform companies? When commercial platform companies claim to provide essential social services, what happens to access to information, long-term preservation, repair, and maintenance? What new forms of labor are part of this digital economy, and in what ways are some forms of labor such as repair and recycling practices in Asian and African contexts rendered invisible? Do existing non-governmental and civil society institutions have the

capacity to evaluate how different platforms exacerbate global asymmetries in cultural and information flows?

In this opening article, we frame these and other questions and issues in relation to media infrastructure studies, a growing body of scholarship that has re-focused our attention on the social, material, cultural, and political dimensions of the infrastructures that undergird and sustain communication networks and media cultures across the world (Mattern, 2016; Parks and Starosielski, 2015; Peters, 2015; Plantin et al., 2018). In doing so, we situate the study of digital infrastructures and platforms within broader scholarly and public debates on the history and political economy of media infrastructures. After all, the term 'infrastructure' was invoked as a keyword in the very first volume of *Media, Culture and Society* published in 1979 and remains a key concept for generations of scholars who have brought a critical political economy perspective to understanding global media and communication (Garnham, 1979; Pendakur, 1983; Chakravartty and Aouragh, 2016). We also make connections to other areas of media studies, particularly the study of media industries and production cultures, and make the case for a more historically informed, inter-medial and inter-sectoral approach to understanding the entanglements of digital platforms and infrastructures.

The Infrastructural Turn in Media and Communication Studies

Two recently published books clearly signal the re-emergence of infrastructure as a key concept in media and communication studies in an era of accelerated globalization and digitalization. Lisa Parks and Nicole Starosielski's (2015) edited volume, *Signal Traffic: Critical Studies of Media Infrastructures*, makes the goals of an infrastructural turn clear: to highlight the social, political, and cultural implications of communication networks (internet, television, or mobile

phone) by studying how they distribute messages across space and time. The goal is not simply to study the technological properties of a particular medium of communications, but rather to show that the material transport of information (the "signal traffic") reframes traditional questions of media production, circulation, access, consumption, and policy and regulation.

Published the same year, John Durham Peters' *The Marvelous Clouds: Toward a Philosophy of Elemental Media* also deploys an infrastructural optic and invites us to explore "the basic, the boring, the mundane, and all the mischievous work done behind the scenes," (Peters, 2015, p. 33). For Peters, media are inherently *logistical*: they organize content across space and time, and they do so according to the distribution properties of the network. In conversation with scholarship in cognate disciplines including STS (science and technology studies) and cultural anthropology, these books and a range of other published works have set a new agenda for media scholars, one that involves accounting for both technical things (satellites, set top boxes, SD cards, etc.) and 'soft' cultural practices that, taken together, organize and structure the production and circulation of content, symbols, ideas, and so on (Chirumamilla, 2018; Starosielski, 2015; Medina, 2011; Peters, 2017).[1] On the whole, media scholars do seem to have responded to Bowker and Star's (Bowker and Star, 1999: 34) call for "infrastructural inversions," to explore the world-making dimensions of media and communication systems that we have so far taken for granted. From cables beneath the ground to satellites in the sky, from television repair shops to maintenance teams in data centers, this terrain of media infrastructure

[1] Further, *Media, Culture & Society* published a special issue on "Media Infrastructures and Empire" (Chakravartty and Aouragh, 2016) investigating the changing relations between global communication infrastructures, empire, and democratic politics. The online journal *Sphere: Journal for Digital Cultures* asked several researchers to reflect on the inherent instability and contingent nature of infrastructures in digital environments. *Technosphere magazine* explored the topic through the angles of architecture, theory, and global logistics. Finally, the online journal *LIMN* brought together anthropological with technological inquiry by publishing several short pieces on "Public Infrastructures/Infrastructural Publics."

studies offers a rich conceptual toolbox and brings into focus a set of five interconnected themes that we find particularly helpful in studying the infrastructuralization of digital platforms.

First, an infrastructural optic helps us see how *power relations* between stakeholders and users shape how communication networks are imagined, put in place, and mobilized for different ends. For instance, Lisa Parks examines aero-orbital technologies not only in relation to global news and entertainment cultures but more broadly as an epistemological system ("the televisual," cf Parks, 2005). From this perspective, Parks highlights the multiplicity of stakeholders involved (ranging from commercial exploitation to scientific observation to military surveillance, all in competition for the "vertical hegemony" cf. Parks, 2018) and shows how this range of competing visions come to shape our experience and knowledge of the "global."

Second, attending to infrastructures brings to the foreground the different kinds of *labor* necessary for the functioning, repair, and maintenance of media systems and networks. Greg Downey's (2002) analysis of the work of "messenger boys" ferrying messages between the telegraph, the telephone network, and the post office in the early 20th century is exemplary in this regard. Downey shows that traditionally separate communication networks do not, in fact, work in isolation, and that such "intermediary labor," typically invisible, is critical to the routine operation of infrastructures. Further, the work that media industry studies scholars have done in analyzing above-the-line, below-the-line, and other forms of creative and routine labor that prop up global media and cultural industries also becomes crucial for understanding the operations of digital media portals and platforms (Caldwell, 2008; Mayer, 2011).

Third, media infrastructure studies bring into focus the multiple *scales* at which media and communication networks and practices operate, from undersea cables (Starosielski, 2015) to, say, hand-held devices. We can thus examine how daily and routine media use and consumption

practices shape the dynamics of a communication network in a specific context. For example, exploring how internet infrastructures evolve in order to sustain high-bandwidth media practices such as video streaming reveals both the power that some players wield (portals such as Amazon and Netflix) and inequalities in access to cultural forms.

Fourth, paying attention to infrastructures pushes us to acknowledge the *contingent and relational* nature of distribution networks. After all, infrastructures do not emerge *de novo* but are built on and work in complex relations to multiple layers of existing infrastructures. Even a cursory look at media cultures in regions like South Asia, for example, makes it clear that the digital cannot be seen as neatly following on after broadcasting, film, and television and video cultures. In contexts where cassettes, color television, VCRs, cable and satellite broadcasting, and the internet all arrived with hardly any temporal gaps (Sundaram, 2013), we need to focus on continuities as much as newness and in turn, how inter-sectoral dynamics (between social media and telecommunication companies, for instance) shape digital platforms.

Fifth, a historically grounded approach encourages us to look past the technical and systems levels to explain the *ideologica*l work involved in imagining, assembling, and maintaining media infrastructures. Put simply, the development of powerful media infrastructures - state and public broadcasting systems, for instance - has always formed the material and ideological foundation for producing new social forms and defining the terms of citizenship. Coming to term with major digital platforms thus involves paying attention to the aesthetic and affective power that digital infrastructures have come to wield in public cultures across the world (Larkin, 2013; Schwenkel, 2015; Mukherjee, this issue).

Situating Media Infrastructure Studies

While the digital turn in media and communication studies has clearly sparked scholarly and public interest in all things infrastructural, this emerging area of study does rest on an established body of scholarship. As John Durham Peters (2015) reminds us, Harold Innis (1950) placed infrastructures at the center of his analysis when he showed how the temporal and spatial properties of media (their "biases") influence the political organization of nations and empires. Following in Innis' footsteps, McLuhan also provided a strong rationale for the analysis of media infrastructures (without using the term) by famously affirming the materiality of the medium over the content. Moreover, as Parks and Starosielski (2015) remind us, a genealogy of the study of media infrastructures must take into account scholars including Manuel Castells, Herbert Schiller, and James Carey who have written extensively about telecommunication networks. We would go further to argue that there are other key phases of media research when the term infrastructure was invoked as a key concept.

Tapping into a rich vein of political economy scholarship, Garnham (1979), Pendakur (1983), and Meehan (1984) among several others drew attention to the material and immaterial dimensions of media infrastructures. Focusing on the MacBride Commission Report (1980) and the control that the north Atlantic empires exerted on international communications in the post-war and postcolonial era, this body of work marks the first phase of media studies' recognition of infrastructures as a fertile site for understanding the political, economic, and cultural impacts of media systems. Moreover, Pendakur (1983) and others made the connections between the technical/material dimensions of media infrastructures and their ideological dimensions, pointing to the centrality of infrastructure projects in post-War efforts to 'modernize' the Third World. Throughout the 1960s and 70s, the development of media infrastructures - state television in

particular - was on par with other large-scale projects including roads, electrification, and dams that promised a better, cleaner, and more modern life.

This focus on geopolitical alignments and shifting imaginaries of modernization and development remained a key concern for scholars engaged with the politics of neo-liberal globalization and in particular, the phenomenal growth and expansion of cable and satellite television during the 1980s and 1990s (Parks, 2005). During this period, a number of countries across the postcolonial world dismantled state monopolies, reduced tariffs and taxes, and invited foreign investments in a number of sectors including media and telecommunications. This phase of market-oriented growth was defined by the thoroughgoing financialization of every economic and cultural sector across the world, and led to the emergence of what Appadurai (1990) famously called a disjunctive mediascape. While grappling with the complex and still unfolding effects of these transitions on the development of media infrastructures is beyond the scope of this article, we raise these issues to underscore the importance of situating the geopolitical power of platforms in relation to distinct cultures of capitalism and formations of empire (Bratton, 2016; Chakravartty and Aouragh, 2016; Rossiter, 2017; Sparks and Roach, 1990).

While this particular trajectory in media and communication studies remains crucial for media infrastructure studies in an era of digitalization, there are, of course, other major theoretical and methodological influences at work. In particular, the subfield of infrastructure studies as it emerges out of science, technology & society (STS), history of technology, and information science, remains prominent. This body of work provides a set of concepts and methods to study technical systems through their political, social, and relational implications. As developed elsewhere (Plantin et al., 2018), the types of questions that constitute infrastructure studies scholarship are divided in two main streams, both of interest to media and

communication studies. The first stream developed an historical perspective on large technical systems (often abbreviated as LTS), pioneered by the work of Hughes on electric power grids (Hughes, 1983), quickly followed by many other networks, such as telephone networks or air traffic control (Bijker et al., 1987; Hughes and Mayntz, 2008). Arguing that electric systems are cultural artifacts (Hughes 1983), Hughes invited historians, sociologists, and geographers to analyze large-scale communication and transportation systems through the values they enact and the power relations they instantiate.

In addition to this analysis of large technical systems, the second line of inquiry comprises sociological and phenomenological investigations of infrastructures. In their foundational article, Star and Ruhleder (1996) use the case study of an online scientific community to show that infrastructure is less an object or a case study, and more a set of heuristics to study technology as a social construct. By providing the famous methodological motto—not asking "what is an infrastructure?" but "*when* is it an infrastructure?"—they define infrastructure as radically and inherently relational. What an infrastructure is quite simply depends on the status of the person looking (e.g. a user, or a designer). Infrastructures, moreover, do not simply emerge through a priori planning, but only when they become embedded in communities of practice and routine that make their technicality sink into the background to become 'invisible" (Bowker and Star, 1999). Infrastructures rest on the labor of laboratory technicians and maintenance workers whose visibility varies. And finally, infrastructures distribute power, as they classify between those who are inside or outside the realm of services provided.

On the whole, Bowker and Star show how the task of the researcher is to analyze infrastructures by conducting an "infrastructural inversion": breaking the boring and routine

aspects of infrastructure to uncover settled practices, looking at the role of invisible labor, the choices taken in the creation of standards, and at a broad level, to explain the world-making role of infrastructures. This line of STS scholarship has played a particularly key role in enabling scholars to explore the interplay between a relationalist and a materialist perspective to understanding media infrastructures (Sandvig, 2013). Further, while STS remains a major influence for the field of media infrastructure, the study of media infrastructures has also emerged in dialogue with scholarship in cultural anthropology and human geography (Anand et al., 2018; Larkin, 2008; von Schnitzler, 2016)

Platforms as Media Infrastructures

This special issue contributes to this thriving interdisciplinary arena by focusing on the interplay between media and communication infrastructures and digital platforms. As we have outlined above, the past few years have witnessed a number of key internet companies, typically described as platforms, reaching the scale, indispensability, and level of use typically achieved previously by infrastructures. Google and Facebook are perhaps the most compelling examples of this infrastructural evolution of digital platforms. They are both internet companies that first leveraged the properties of platforms to increase their market power, yet they have been increasingly developing capacities that are typically understood as infrastructures.

The mapping and location service Google Maps illustrates perfectly the infrastructural turn of Google. First released in 2005 as the quintessential platform, Google Maps relies on users' participation (in the form of direct contribution, community mapping, or collection of geolocation data), and provides access to a programmable base map for free to generate remixes, secondary uses, and mashups. However, while keeping these platform-level features, the company has added dimensions that make it function more like an infrastructure. Google Maps

has emerged as a de facto standard for the geospatial web and become an essential mapping service powering a large number of applications and geolocation services. Due to its scale and market power, the sheer number of users it can claim, and its successful strategy of opening up its API for application development, the cartographic database that Google creates and maintains has now attained a scale, reach, and social role similar to other existing infrastructures that typically organize cartographic knowledge in society (Plantin, 2018).

Facebook is another striking example of platforms becoming infrastructural. After being released as a profile repository for students, Facebook quickly started its evolution as a platform (Helmond, 2015). Beginning in 2007, Facebook engaged with the applications developer's community by offering access to its applications programming interfaces (APIs) and by releasing software development kits (SDKs). However, the now massive scale of Facebook usage (above 2 billion), its high computing needs, and its constant need to increase this user base to reap network effects have led Facebook to enter more deeply in a variety of infrastructural domains. In 2016, the company built a massive undersea cable in partnership with Microsoft, connecting the US to Spain, in line with current trends of internet companies entering the cable industry (Winseck, 2017). Facebook also mobilizes discourses of openness and neutrality (typical of platform logics) in the Open Compute Project, which aims to apply open source principles, common in software development, to data center hardware (components, cables, racks, etc.). However, it is the interest that Facebook has in internet provision through initiatives like Facebook Zero that best illustrates the inroads it has made in various national contexts worldwide.

Facebook Zero is a simplified, text-only version of Facebook that users with feature phones (non-smartphone) could access. Recognizing that the only way to maintain its growth

was by expanding into the so-called emerging markets of Asia, Africa, and Latin America, Facebook entered into agreements with major telecommunication companies that allowed users to access Facebook Zero without incurring any data usage costs. For hundreds of millions of people accessing the internet through their relatively inexpensive mobile phones, such strategies create a "walled garden" and an exceedingly narrow view of being online and indeed, what the internet is.

Consider the situation in Myanmar. As Daniel Arnaudo (forthcoming, 2019) has explained, the digital culture in contemporary Myanmar is symptomatic of wider conflicts that structure political culture, particularly along ethnic, religious, and gendered lines. Moreover, the development of mobile and digital infrastructures in Myanmar reveals the power that platforms like Facebook wield. In a context marked by low literacy levels, low levels of ICT use, and poor regulatory oversight, initiatives such as Facebook Zero (offered by Telenor, a Norwegian multinational telecommunication company, starting in 2014) become highly problematic. The dangers of one particular platform shaping internet infrastructure extends well beyond concerns of market competition and user privacy. The fact that Facebook has become *the* dominant site for digital and mobile communication in a country like Myanmar has serious implications for inter-ethnic and inter-religious relations. Investigative reports have revealed that the explosion of hate speech on Facebook – by far the only major entry point for online information – did stoke anti-Muslim sentiments and incite violence (Safi and Hogan 2018). Examples like these make it clear that understanding the dynamics of digital platforms calls for a more integrated approach that builds on both media infrastructure studies and platform studies.

Platforms, Infrastructures, and Politics: Towards an Integrated Approach

Given the increasing fragmentation of media and communication studies into various sub-fields, it is not surprising that "platform studies" has emerged as recognizable area of study. Combining political economy, software studies, and management studies, this scholarship has been crucial for specifying what exactly a platform is how it works.

Put simply, platforms are *programmable* (Helmond, 2015; McKelvey, 2011; Montfort and Bogost, 2009). Platforms can be reconfigured to afford innovative uses and conceptions, allowing third parties to develop applications and add-ons within an existing framework. Platforms are also *generative* (Zittrain, 2008), as the outcome of interactions on a given platform is not necessarily known in advance (yet framed through controlled settings); and platforms rely on the *participation* of users (Langlois and Elmer, 2013; van Dijck and Poell, 2013), either through the active production of content, or by leaving digital traces. Additionally, a strong yet often unacknowledged influence on studying platform comes from management scholars, who have defined platforms (in pre-internet and in industrial settings) through their *modularity* (Baldwin and Woodard, 2008), as they connect a stable core (e.g. an operating system) with highly variable complementary components (such as applications on a phone).

In addition to this definitional work, platform studies has critically interrogated the social consequences of the increasing power of digital platforms. After deconstructing the "discursive positioning" of platforms as neutral intermediaries, Tarleton Gillespie shows in his foundational article on the politics of platforms that it is, in fact, the activity of content moderation that defines digital platforms (Gillespie, 2010, 2018). Along similar lines, Langlois and Elmer (2013) highlight how economic logics shape any platform's affordances, and therefore mold communication. At the time of this writing, platform studies has also made connections to

questions of public interest, investigating the ways in which digital platforms extract value from the various sectors they enter through a combined process of datafication, commodification, and selection (Van Dijck, Poell, and de Waal, 2018). In conversation with work on "platform capitalism" (Srnicek, 2016), scholars and policymakers in the US and Western Europe have developed strong arguments for regulating digital companies in the public interest.

Bringing this work in platform studies into conversation with infrastructure studies, contributors to this special issue show that an integrated approach helps us grasp how platform-level features (such as participation, programmability, modularity, etc.) *and* those of infrastructures (such as scale, ubiquity, temporality, etc.) together constitute hybrid digital artifacts. An integrated approach also helps us bring together a wider range concepts and research questions. On the one hand, the critical study of platforms emphasizes the political economy of these platforms-qua-infrastructures, their agency and responsibility, the link to datafication, algorithms, and surveillance capitalism. On the other hand, the social study of infrastructures foregrounds the relationality of technology, the scalability and temporality of infrastructures, the reliance on invisible labor and maintenance, and patterns of inclusion and exclusion. Each article gathered in this special illustrate the relevance of combining these two perspectives.

Rahul Mukherjee describes the entanglements of platforms and infrastructures with a case study analysis of the mobile phone market in India. Describing the launch of Reliance Jio 4G through the reactions of other competing telecom operators and everyday users, he shows that disrupting the mobile applications business necessitates massive intervention at the level of infrastructures. This article illustrates how the strategy of "lock-in" of users within one specific platform now passes by large infrastructural investments.

David Nieborg and Anne Helmond interrogate the expansion strategy of Facebook by tracing the evolution of its data infrastructure. Focusing on Facebook's Messanger, they trace how shifts in Facebook's business goals shape technological aspects of the platforms and fosters the creation of "platforms within platforms." The analysis of this mode of expansion encourages us to look at how platforms combine business and technological strategies in order to become ubiquitous.

Ganaële Langlois and Greg Elmer show that as social media platforms expand to reach a quasi-infrastructural scale, their realm of data capture expands. If the platform logic of social media led to strategies to increase personal data collection, with their infrastructural evolution comes the capture of the organization of life and conditions of life themselves. As social media now constitute "infrastructures for subjectivity," they radically expand their data collection strategy to encompass "impersonal data" as well.

Finally, Robert Gehl and Fenwick McKelvey make the links between platforms and infrastructures more complex by developing a case study of darknets - hidden and often anonymous networks. Relying on Michel Serres' work and exploring platforms such as Freenet, Tor, and I2P, they show how these networks act as "parasites" that reveal the private ambitions of platforms, as well as the public agendas of infrastructures. Similar to work on spam, trolls, and viruses, they use darknets as a methodological device to interrogate the taken-for-grantedness of our everyday digital systems.

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