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► **To cite this version:**

Francesca Musiani. Understanding Infrastructure as (Internet) Governance. Palgrave Macmillan. Global Communication Governance at the Crossroads, Springer International Publishing, pp.297-314, 2024, Global Transformations in Media and Communication Research - A Palgrave and IAMCR Series, 10.1007/978-3-031-29616-1_17 . halshs-04372612

HAL Id: halshs-04372612

<https://shs.hal.science/halshs-04372612>

Submitted on 4 Jan 2024

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This is an author version of the following chapter:

Francesca Musiani, 2024, “Understanding Infrastructure as (Internet) Governance”, pp. 297-314 in Claudia Padovani, Véronique Wavre, Arne Hintz, Gerard Goggin, Petros Iosifidis (eds.), *Global Communication Governance at the Crossroads*, Palgrave-Macmillan and IAMCR (Global Transformations in Media and Communication Research series).

https://doi.org/10.1007/978-3-031-29616-1_17

CHAPTER 17

Understanding Infrastructure as (Internet) Governance

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The concept of “infrastructure” typically refers to large-scale “physical” and material systems necessary for human organization and activity, such as roads and bridges, grids and sewers. A significant amount of work in geography, anthropology and science and technology studies (STS) has been devoted to exploring the power dynamics, conflicts and disputes, meanings and social relationships embodied in these “physical” infrastructures (for example, Harvey, 2012; Larkin, 2013). However, in the field of ICTs, especially since the introduction of the Internet as a “general-public” technology, an exclusively physical definition of infrastructure might not be the most appropriate. As Geoffrey Bowker and his colleagues point out, “beyond bricks, pipes or cables, infrastructure also includes more abstract entities, such as protocols, standards and memory [... and facilities such as] computing services, help desks and data directories” (Bowker et al., 2010, p. 97).

This chapter will take stock of work conducted in the last decade to address how the concept of infrastructure – more particularly information and digital infrastructure, in its different “materialities” – can be mobilized as a heuristic instrument to understand the governance of information and digital technology, especially the Internet. The chapter will discuss the extent to which the infrastructural quality of the “network of networks”, rather than natural or inherent, is relational and conditional; and it will examine how, for a better understanding of

the “politics of infrastructure”, it is necessary to get behind the scenes of what has often been seen as background and “boring” preconditions to the real work of politics and the production of knowledge (Star, 1999, p. 198).

Internet infrastructures include physical objects – for example the submarine cables which carry global telecommunications – and a priori much less “concrete” objects, such as the protocol which allows the blockchain underlying Bitcoin to work. Infrastructure refers here much less to a particular technology or set of technologies, than to objects and practices which assume an infrastructural “quality” or function in specific circumstances. The exercise of control over these infrastructural functions provides specific actors with the power and the opportunity to act to their advantage, and there is very rarely a single way of implementing these functions or a single actor capable of controlling them. Thus, the infrastructures of the Internet are political and contested, both target and instrument of governance, focus of the interest of a myriad of actors, from the most powerful and centralized to the average Internet user.

By means of both a literature review and the discussion of pertinent examples, the chapter will explore how, as we also pointed out in earlier work (e.g. DeNardis and Musiani, 2016, p. 3), infrastructures can be understood as fundamental loci for the exercise of economic and political power. The unveiling of how this power, which is often implicit and held in the background, unfolds, is crucial to reveal the conflicts around what an infrastructure is, who can benefit from it, or contest it (Bernards and Campbell-Verduyn, 2019).

In its final part, the chapter will explore current transformations in the subfield of Internet governance research addressing infrastructures, and provide an outlook on probable future dynamics.

SCIENCE AND TECHNOLOGY STUDIES APPROACHES TO STUDYING INTERNET GOVERNANCE

In recent years, a growing body of Internet governance (IG) research grounded in STS has brought to the fore a number of important IG facets and complexities that have not been the primary focus of research grounded in political and legal scholarship (see e.g., DeNardis, 2009, 2014; Flyverbom, 2011; Hofmann et al., 2016; Musiani, 2015b; Ziewitz & Pentzold, 2014). The aspects of IG highlighted in STS-informed scholarship start with drastically different conceptual frameworks and lean on specific approaches to research cases, sites, and questions. Conceptually, STS-informed IG research relies on understanding IG as a normative ‘system of systems’ and it acknowledges the agency, often discrete and pervasive, of both human and non-human actors and infrastructures. Empirically, STS-informed IG research focuses on the dynamics of ‘ordering’ of assemblages and hybrid arrangements of IG; on the structuring and performative effects of controversies and de-stabilisations on norm- and decision-making, or on the construction of authority and trust; and finally, on hybrid forums, private arrangements, users and their practices. All these components help flesh out the ‘doing’ of IG and may be of use in revisiting central, yet ill-defined, concepts such as multi-stakeholderism. We will review these key aspects below (also see Epstein et al., 2016).

IG as a normative ‘system of systems’

Technical and political governance are becoming more and more intertwined. The core issue for scholars of IG at the present stage is to acknowledge not only the plurality of these modes of governance, but the fact that they cannot be fully separated. STS approaches plead for an understanding of internet governance as coexistence of different types of norms, elaborated in a variety of partially juxtaposed forums, enforced, implemented or merely “suggested” via a plurality of normative systems: law, technology, markets, discourses, and practices (Brousseau, Marzouki, & Méadel, 2012).

Ordering vs regulation

Acknowledging the diverse origins of norms relevant for the use and design of the internet, most STS-informed IG researchers base their understanding of governance in ordering instead of regulation, management or control. The concept of ordering captures the normative effect of mundane practices and daily routines, and is considered particularly well-suited to the analysis of the organisational forms of global politics as assemblages – hybrid configurations constantly reshaping their purposes and procedures in order to connect and mobilise objects, subjects and other elements, constituted and positioned relationally, around particular issues. In this light, institutions of IG can also be explored with an STS-informed toolbox, by capturing them as sets of embedded practices (Flyverbom, 2011).

Agency of non-human actors and infrastructures as loci of mediation

Information intermediaries, critical internet resources, internet exchange points, surveillance and security devices play a crucial governance role alongside political, national and supra-national institutions and civil society organisations (Musiani, Cogburn, DeNardis, & Levinson, 2016). IG takes shape through a myriad of infrastructures, devices, data fluxes and technical architectures that are often discreet and invisible, yet nevertheless crucial in subtending building the increasingly public and articulate network of networks. Laura DeNardis (2014, p. 11) defines these entities as infrastructural “control points”, around which are entangled matters of technical and economic efficiency, as well as negotiations over human and societal values such as intellectual property rights, privacy, security, transparency.

Mundane practices and agency of human actors. Contrary to the institutional approaches to IG, STS-informed scholarship acknowledges the role of invisible, mundane, and taken-for-granted practices in the constitution of design, regulation, and use of technology. It calls the attention to reflexive acts of individuals in articulating Internet standards (Braman, 2011), the social aspects of crafting and enacting Internet-related policy (Epstein, 2011; Kuerbis, 2010), as well as institutionalisation of non-traditional forms of participation in discourse about IG issues (i.e. multi-stakeholderism), and mechanisms for civic engagement (Epstein, 2013; Nonnecke, 2016). As such, it pays the necessary attention to the social - and not just political - aspects of the socio-technical systems of the Internet.

Controversies as structuring and performative processes

STS-informed approaches to IG analyse the structuring and performative effects of controversies on governance. Most prominently, controversies around claims made by different actors or groups about doing IG contribute to the creation of different worlds in

which specific notions of governance make sense. Thus, the study of controversies unpacks 'governance' as a theoretical and operational concept, by exposing the plurality of notions it refers to, and the consequences of their being in conflict (Cheniti, 2009; Ziewitz & Pentzold, 2014). The very processes by which norms are created, re-negotiated, put to the test, re-aligned, raise conflicts, are as crucial - and perhaps more crucial - in STS perspectives as the "stabilised" norms themselves. The authority of IG institutions should also be analysed as such if we are to avoid an understanding of it as a 'fait accompli' (Flyverbom, 2011).

Enriching and revisiting 'multi-stakeholderism'

Several concepts brought in by the STS toolbox, as well as several fieldwork choices, can help unveiling a number of situated practices on, by and for the internet that arguably constitute a vital part of 'doing internet governance'. In particular, they help enriching and revisiting the concept of multi-stakeholderism (Malcolm, 2008). For example, understanding IG through the lens of Michel Callon et al.'s 'hybrid forums' (2009) - entities meant to transform controversies into productive dialogue and bring about democracy - show the importance of actors' positioning in subsequent decision-making. If the role of the private sector is more and more important in internet governance arrangements, as it is increasingly widely acknowledged, the technology-embedded nature of its intervention can be brought to the foreground by STS methods. Examining the relationship of internet users to content they put online or consume, to their devices and the values they embed, 'does' governance inasmuch as it reflects belonging and commitment to a set of norms and to a community in a broad sense, and reveals the interplay of issues of sovereignty, autonomy, and civil liberties (Elkin-Koren, 2012).

STUDYING INFRASTRUCTURES AS INSTRUMENTS OF INTERNET GOVERNANCE¹

A whole tradition of STS has explored the social and organizational dimensions of infrastructure of ICTs, intended, as explained in the introduction, in the multiple senses of not only the purely material artifacts but their logistical substrata. In particular, STS scholars have highlighted a number of features that are of interest when studying complex socio-technical systems: for example, the fact that infrastructure typically exists in the background, it is invisible, and it is frequently taken for granted (Star & Ruhleder, 1994). The "politics" inscribed in infrastructure by means of design and technical encodings are similarly difficult to trace. Yet, it is an important task as the design of the "plumbing" of the Internet (Musiani, 2012), underlying practices, uses and exchanges in a networked system, informs its adoption and (re)appropriation by users, its regulation, and its organizational forms.

Several bodies of work, crossing Internet studies with the branch of STS called infrastructure studies, have sought to explore the social and organizational qualities of infrastructures subtending information networks, and to find the 'materiality' in the virtual of software and code (Fuller, 2008; Marino, 2020; Blanchette, 2011). New concepts to account for the agency of infrastructure have been proposed, such as Annalisa Pelizza's 'vectorial glance' (2016) that explores how interoperability of information systems, as a performative process of boundary reordering, redistributes authority and accountability: the small technical operations of interoperability projects become strategic sites where institutional shifts become visible.

¹ Based on (Musiani, 2020)

While STS-informed perspectives examining infrastructures have proliferated, they have received comparatively little attention by scholars of Internet *governance* until the beginning of the past decade, the pioneer in this regard having been Laura DeNardis with her article “Hidden Levers of Internet Control” (2012). They are now an important part of Internet governance scholarship, as contributions by Braman (2016) and Malcic (2016) on the work of the Internet’s early designers, and Loveluck & De Filippi (2016) on the mixed technical and social governance subtending Bitcoin have shown. In these contributions, Internet governance is understood as a set of socio-technical processes of innovation, digitalization, regulation, mobilization, co-optation and circumvention.

Furthermore, contributions drawing from STS approaches in recent years have not only recognized that administrative and coordinating functions related to Internet infrastructure have always been instruments of power (DeNardis, 2009), but that points of infrastructural control, regardless of their originally intended function, can serve as proxies to regain (or gain) control or manipulate the flow of money, information, and the marketplace of ideas in the digital sphere – a phenomenon which has been called the “turn to infrastructure in Internet governance” (Musiani et al., 2016). This body of work addresses, for example, the use of the Domain Name System (DNS) as a tool for intellectual property rights enforcement (Merrill, 2016) or information intermediaries’ discretionary power to set their infrastructural practices prioritizing strategic interests over privacy commitments (Sargsyan, 2016). Put together, these contributions show a shift from a “values-in-design” approach (Flanagan, Howe & Nissenbaum, 2008) to a politicization of Internet governance infrastructures (DeNardis, 2009). That is to say, while values have entered the design of infrastructure for a long time, these values have been incorporated into technological infrastructure mostly to carry out its core functions; instead, the use of Internet infrastructure to carry out functions other than their intended objective can lead to important “collateral damage” for the stability and security of the Internet and the protection of online civil liberties (DeNardis & Musiani, 2016). STS approaches, with their attention to situated practice and infrastructural agency, are well-suited to bring these aspects to the foreground.

Infrastructures can also be studied from the standpoint of the controversies revolving around them. Indeed, studying controversies (Pinch & Leuenberger, 2006) about infrastructures of Internet governance is becoming one of the principal STS-informed ways to unpack Internet governance: the Internet exhibits an increasing number of sites of contestation, such as the interconnection agreements between internet service providers (Meier-Hahn, 2015), the debate around net neutrality (Marsden, 2017), the use of deep-packet-inspection (Mueller, Kuehn & Santoso, 2012), the deployment of content filtering technologies (Deibert & Crete-Nishihata, 2012), ubiquitous surveillance measures and the use of DNS for regulatory aims (DeNardis & Hackl, 2015), the politics embedded in search engine algorithms (Mager, 2017). Furthermore, contentious politics, activism and citizen-led protestation are often embedded in the Internet and its applications, as illustrated e.g. by the work of Milan & ten Oever (2017) on civil society engagement within ICANN so as to “encode” human rights into Internet infrastructure, or Ksenia Ermoshina’s (2016) research on the shaping and use of citizen- and activist-oriented mobile and Web applications, and how the design of these tools shapes citizen participation and citizen-State interaction.

To put it in the words of Ziewitz and Pentzold (2010), controversies unveil different versions, according to different actors, of the worlds in which notions of governance take place. Thus, for the analyst, the negotiations and controversies that take place around claims of “Internet governanc-ing” (Cheniti, 2009) can be viewed as performative, inasmuch as they “both implicate and are implicated in creating the worlds in which a mode of governance makes sense” (Ziewitz & Pentzold, 2010: 20).

Internet governance is particularly suited to all kinds of exit strategies and evolutions in power balances; thus, consensus-based modes of regulation become central, as norms cannot be totally binding and are permanently negotiated and challenged (Brousseau, Marzouki and Méadel, 2012: 35). As a consequence, the very processes by which norms evolve - put to the test, made the subject of conflict and realignment, destabilization and re-stabilization - becomes central, as they provide different types of guarantees to the various stakeholders. Digital technologies themselves play a key role in this legitimation process as they become not only facilitators but guarantors of fairness and “neutrality” in controversial moments of these processes, as illustrated by our recent research on the blockchain subtending Bitcoin (Musiani et al., 2018). In doing so, they also perform trust, both by automating procedures and keeping track of all actions.

Internet governance controversies and battles happen most of the time over infrastructural “control points”, as illustrated by Laura DeNardis (2014). These control points range from the deepest layers of Internet infrastructure to the “last mile” of user access to the network; from the blocking of financial flows to the deliberate “kill-switches” of Internet-based services; from the “graduated response” termination of domestic Internet access to the attempted use of the Domain Name System for copyright enforcement purposes; from the Internet’s backbone infrastructure to the establishment of interconnection agreements; and finally, the *de facto* public policy role assumed by private information intermediaries, in the variety of instances where they gather, collect, aggregate, select, present data to users and to other actors of the Internet value chain - thereby enacting governance over privacy, freedom of expression, cultural diversity and reputation (DeNardis, 2012, 2014).

Throughout the years, understanding infrastructure as a tool of Internet governance has proven useful to study phenomena as diverse as decentralized alternatives to Internet services (Musiani, 2015a), the governance of blockchain-based systems such as Bitcoin (Musiani, Mallard and Méadel, 2018), the processes of ‘informal standardization’ of encryption protocols for secure communications (Ermoshina and Musiani, 2019) or the state apparatus of surveillance and censorship and the circumvention and evasion strategies enacted in response by different groups of technologists and activists (e.g. Daucé and Musiani, 2021). What all these cases have in common is that in all of them, “traditional” instruments of authority, such as national and international law, cannot fully account for the variety and originality of power arrangements that constitute and define governance, but cross paths with other normative systems, including informal norm-making in specific communities, the “laws” of the market, and last but not least, technology itself. Understanding infrastructure as a tool of governance helps to bring normative elements to the fore that would otherwise, more often than not, remain discreet and invisible.

AT THE CROSSROADS OF INFRASTRUCTURE STUDIES AND INTERNET GOVERNANCE RESEARCH: MOVING FORWARD²

In the final part of this chapter, I take stock of the previous sections, derived from several works conducted in the past decade, to identify a set of trends at the crossroads of infrastructure studies and Internet governance research, which are both ways in which Internet governance itself is evolving in practice, and an agenda for research that concerns it in the near future.

Governance of infrastructure and governance of content meet in “governance by infrastructure”

Currently one of the hottest Internet policy questions is how to implement regulatory responses to control the content that circulates on the Internet. For decision-makers, it is about improving Internet security, dealing with problems such as cyberbullying, hate speech, disinformation or copyright infringement, or ensuring the protection of individuals’ data in a variety of contexts.

The many “governances by infrastructure” that are currently observed on the Internet open up an interesting dynamic for communication researchers to observe. Indeed, for a relatively long time, questions related to the regulation of content were treated as being quite clearly separated from the questions specific to the regulation of the physical and software layers of the Internet, and understood in particular as questions of regulation of the behavior and practices of Internet users. This regulation took two forms. On the one hand, it remained, for the most part, quite disembodied from the technical devices that users have at their disposal. If we take the example of the peer-to-peer sharing of so-called “illegal” content, which exploded in the early 2000s, the strategy chosen by decision-makers was to demotivate individuals by showing them the “right way”, and therefore to create certificates likely to legitimize authorized content. At the opposite extreme, another strategy has been to attack a technical device, in itself and as a whole, with the objective to attack specific and supposedly illegal content. We recall, for example, attempts, such as the “graduated response”, to minimize or even prohibit peer-to-peer exchanges by assuming that the shared content was illegal. This regulation was focused on the individual responsibility of the Internet user, by assuming that she had a precise knowledge of her actions and their consequences, as well as the attributes and characteristics of her IT equipment.

With the various phenomena of regulation and moderation that have emerged in recent years (and which are very well presented in Badouard, 2020), the moment has arrived when governance by infrastructure and governance of content are inexorably brought together and linked, with the ever more frequent use of Internet infrastructures as “proxies” (agents or intermediaries) for content control. Among other aspects, it will be necessary, in future research, to qualify the notion of “individual responsibility” of the Internet user, widely taken for granted in the regulatory strategies mentioned above, to take into account the multitude levers of power and control points that are embedded in the technical intermediaries of the Internet - from platform visibility algorithms to the “filter bubbles” they generate, from search

² Based on my yet-unpublished work of *habilitation à diriger des recherches* (a high diploma required in France to supervise doctoral research).

engine classification systems to the services that manage online payments and the exchange of electronic currencies.

Control vs. circumvention “by infrastructure”

Infrastructural arrangements are in constant dialogue. If on the one hand, these infrastructures are meant to serve functions of control, co-option, concentration of power on the Internet, or even developing new ways of exercising it, on the other hand they are meant to develop responses, also “through infrastructures”, which aim at resistance, criticism, escape, often by means of tinkering or technical tricks. These responses are increasingly - even if at levels, or in dimensions, that are quite “mundane” (Cheniti, 2009), trivial, informal - an integral part of Internet governance. A theory of the latter which is based on its infrastructural dimensions must fully highlight this aspect, at least as an object on which it will be necessary, for studies of Internet governance and more broadly for media and communication research, to focus in the near future.

It is therefore important to think about resistance on and by the Internet by paying primary attention to the technical objects themselves, to the infrastructures that hold the Internet together. In this perspective, resistance takes multiple and changing forms, in constant reinvention. Perspectives derived from infrastructure studies also allow us to show that forms of resistance enable to exist, and enable to matter, the devices and places of control that they identify by their very action.

This emerging interest in resistance in a network is reflected in concepts of data activism (Milan, 2019), or of data justice (Dencik et al., 2019), as well as the design justice approach (Costanza-Chock, 2020). However, the links between these ways of theorizing “resistance through infrastructure” and studies of Internet governance do not seem to me to be fully established yet, although this connection is necessary in order to better understand the balance of power inscribed in the digital technologies of our time. This objective should be a crucial component of future research agendas and an important challenge that research in communication must take up.

The “infrastructuring” of digital sovereignty

The concept of “digital sovereignty” is increasingly used to convey the idea that states should reassert their authority over the Internet and protect their citizens and businesses against the multiple challenges facing the self-determination of their nation in the digital sphere – and they should do this not by means of supranational alliances or international instruments, but by increasing their independence and autonomy at the technical, economic and political levels. The approaches outlined in this chapter can provide an innovative perspective on digital sovereignty by examining how the label instantiates itself in a number of macro and micro processes of “infrastructuring”, and how states seek to co-opt these as instruments of their authority and of their power.

One of the important contributions that STS and infrastructure studies perspectives will be able to make to studies of Internet governance over the next few years will be, on the one hand, to understand how different definitions of digital sovereignty, to which different

countries aspire, generate very different “effects” on infrastructure. For example, how do data flows circulate and under the control of what entities? What kind of server farms, data centers, Internet Exchange Points, are built where, and for what purposes? etc. On the other hand, such perspectives will enable a better understanding of how these infrastructures are informed in return by digital sovereignty strategies; for example, it will be a matter of assessing the extent to which what turns out to be possible, difficult or impossible to implement from a technical point of view is likely to influence subsequent legislation, or revisit current legislation.

Infrastructure studies meet digital labor studies

The links between infrastructure studies and digital labor studies also need to be deepened. The “little hands of the information society” (Denis & Pontille, 2012) have existed since the information society has existed, to support and maintain its infrastructure. The quality and quantity of the “human factor” in the Internet infrastructure is changing, and some people are becoming more and more an integral part of this infrastructure with increasingly small and repetitive tasks: for example, the “armies” of individuals employed directly or as contractors by Google and Facebook, alongside and to complement the automated work of algorithms in order to seek out sources of disinformation, or to minimize “problematic” search results. These issues, explored by researchers such as Trebor Scholz (2012) and, in France, Antonio Casilli (2019), as the nascent subfield of digital labor studies, are very closely related to the question of how Internet infrastructure is governed and used as a tool of governance, and challenges the role of humans as one of the “gears” of tomorrow’s networked technologies.

To address this question, it seems useful to re-mobilize the notion of “human infrastructure” proposed in 2006 by cyberinfrastructure studies specialists Charlotte Lee, Paul Dourish and Gloria Mark. This notion, mobilized in order to “explore how human and organizational arrangements share properties with technological infrastructures” (Lee et al., 2006), has very recently been used in relation to the human labor underpinning artificial intelligence (Mervich, 2020) in order to emphasize the centrality, in the daily processes of organizing and storing data, of human involvement in all its facets, including the most trivial and discreet ones. The conceptualization of the human as an infrastructure also allows to open a discussion of critical ethical concerns regarding working conditions and epistemological issues related to artificial intelligence. By researching some of the properties of infrastructures - relationality, embeddedness, invisibility – as they relate to humans-in-network, this conceptualization seems to be promising in its intersections with studies of digital labor, insofar as it opens up multiple avenues for analyzing and discovering the position of humans within the platforms and algorithms that form an increasingly important part of today’s Internet.

The “Internet infrastructur-ization” of everything

Profound changes in the Internet are underway. Its expansion is moving beyond communication between people, or between people and data/information, to include billions of everyday objects, among which smartphones, cars, and gadgets such as “smart” watches and glasses.

However, as Laura DeNardis (2020) recently reminded us, it is by looking beyond these consumer-oriented IoT applications that we find the most significant developments in what constitutes the Internet today, and that this word may mean in the near future. The connected physical systems that now underpin almost all industrial sectors are transforming the Internet from a system which is certainly endowed with discreet or even invisible dimensions, but which is “in the cognitive domain of the user”, through interfaces such as screens, into a ubiquitous backdrop of everyday life (DeNardis, 2020, p. 10). Digital networks are used by businesses of all types and sizes to manage the handling of sensitive materials, inventory optimization, and the interconnection between logistics systems, leading DeNardis to conclude that “there is no longer a logical demarcation between native digital companies and non-tech companies” (2020, p. 11). Many utilities, traffic control systems and other so-called “smart city” applications are now part of the Internet ecosystem.

This scenario raises, and/or will raise, unprecedented “public interest” issues in the short term, and will have far-reaching consequences for user privacy and security. It also raises important questions for internet governance and for researchers seeking to make sense of it - questions that the STS toolkit seems well suited to tackle. What (other) challenges will come for STS Internet governance researchers in the coming years, as the age of the “Internet infrastructur-ization” of everything enters in full force?

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