

Bits of Power: Struggling for Control of Information and Communication Networks

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Abstract

Contests for the control of information and communication networks and, specifically, for control of digital bits of power (the capacity to control information processing) often take the form of struggles over network neutrality. This article examines how, historically, such struggles have been accompanied by changes in the configuration of ideas or social imaginaries that have legitimized the actions of companies, the state and civil society in relation to the development of networks. The aim is to assess the likelihood that institutional arrangements will be put in place that might privilege citizen interests in preserving an open internet. This, in turn, would strengthen the capacity of citizens to resist power asymmetries that threaten their fundamental rights to privacy, access to information, and freedom of expression in the digital environment. Concepts derived from historical institutionalism and the economic history of technical advances provide a framework for examining continuity and change following the introduction of digital technologies. The analysis shows why a narrow policy focus on network neutrality can obscure the way citizen interests in a digitally mediated environment are subordinated to corporate and state interests. Such obfuscation makes it difficult to assess whether the current period is path dependent and locked in to a single direction for development or whether there is the potential for alternative pathways - a ‘forking of the road’ - which could be more favourable to citizens.

This article examines struggles over the preservation of an open internet in light of historical contests for the control of information and communication networks. It assesses the likelihood that institutional arrangements will be established that might privilege citizen interests and enhance their capacity to resist power asymmetries such that their fundamental rights to privacy, access to information, and freedom of expression are likely to be upheld as digital information processing capabilities develop (UNESCO, 2015). When the National Research Council in the United States released its *Bits of Power* (NRC, 1997) report, it was concerned about the challenges of maintaining

an open environment for the collection, processing and circulation of scientific data. This report was prescient in highlighting how technology, including the internet, might come to influence public access to data. The marketisation of data was seen to be creating new inequalities due to “the exponential accumulation of these electronic data – these bits of power” (NRC, 1997: 19). The phrase - bits of power – is a reminder of the significance of power relations in the changing technological and institutional environment in which information is produced, circulated and applied.

With the internet providing a principal means for processing and circulating information in contemporary society, struggles over ‘bits of power’ are coming into stark relief. Some of these struggles concern the governance or stewardship of the internet’s domain name system, for instance, while others involve efforts to preserve network neutrality or what is often loosely described as an open internet [1]. Initially, this article examines periods in which struggles over information and communication networks have markedly affected the control of digital bits of power (the capacity to control information processing). These struggles have been accompanied by changes in the configuration of ideas which influence and legitimize the actions of companies, the state and civil society in relation to the development of networks. I suggest that a policy focus on network neutrality tends to obscure the way citizen interests have been subordinated to corporate and state interests historically. This makes it difficult to assess the potential for the emergence of a digitally mediated environment that might be rendered more consistent with citizens’ interests.

I next explain the rationale for an historical consideration of changes in the configurations of control over bits of power. The discussion is situated within the broader context of the capitalist system and sets out why a focus on information processing within the information and communication network subsystem is justified. I then present a summary of social imaginaries which have combined in various ways through time to legitimize the actions of the state, companies and civil society as electronic networks have developed. This discussion is informed by concepts derived from historical institutionalism and the economic history of technical change. These concepts provide a framework for considering continuity and change in the control of networked information processing and for examining some of the outcomes and consequences. Subsequently, the way prominent social imaginaries have combined with the development of information and communication networks during several historical periods is examined. The conclusion assesses the contemporary likelihood of an information processing control structure with scope for citizen resistance in a network environment that subordinates their fundamental rights.

Information control systems in historical perspective

Beniger (1986: vi) observed that “history alone cannot explain why it is information that increasingly plays the crucial role in economy and society”. He suggested that changes in information processing technologies and in the institutional arrangements for governing society’s control systems are crucial determinants of crises and their outcomes. Information and communication networks are increasingly complex and powerful digital platform operators have emerged which are orchestrating markets for services that address nearly all of the endeavors of citizens who have affordable access to the internet (Mansell, 2015; Hölck, 2016). These networks are a crucial component of 21st century societal control systems and there are multiple anxieties about an imminent crisis of societal control over bits of power. Examples include the erosion of individual privacy and the production and circulation of ‘fake news’ with its impact on freedom of expression and the democratic process under what Zuboff (2015) refers to as ‘surveillance capitalism’. Struggles over bits of power have been a constant feature in the

evolution of networks that support global information flows and information processing. Today, however, there is ambiguity about whether the internet's architecture is - or can be - helpful in averting conditions that subordinate citizens' interests.

My discussion here is motivated by a question that is central to research in the political economy of media and communication field – “what kind of world will be borne through the midwifery of our new and more powerful communications tools?” (Smythe, 1950: 51). When the internet emerged from the Advanced Research Projects Agency's project supported by the Department of Defense in the United States, the aim was to develop a resilient network for information flows using a set of protocols for communication over a packet-switched network. The applications that would use the network were not a central concern of the developers. Work started on the technical standards in the 1960s and, by the 1990s, what came to be known as the Internet Protocol Suite had succeeded in marginalizing other contending standards for the information and communication network. This enabled digital communication flows to expand very rapidly. The Internet Engineering Task Force (established in 1986) and the Internet Society (established in 1992) developed the standards for the internet architectural model. These standards called for a horizontal end-to-end layer in the middle of a layered network architecture. These protocols (including the Transport Control Protocol (TCP)/Internet Protocol (IP)) enabled information flows to be controlled in a highly decentralized manner from the edges of the network so that data could be sent and received without interference (Besen, 2016) [2]. The private sector became involved in the provision of this new network of networks, subject to the oversight of institutions charged with the governance of the internet.

The end-to-end feature of the internet's layered model has sometimes been regarded as a stable architecture, consistent with protecting the fundamental rights and freedoms of citizens. This in turn reflects the collaborative culture of the computer scientists who participated in the early years of the internet's development (Abbate, 2000; Flichy, 2007). In this view, irreversible technical choices were made early on that set the internet on a stable pathway where the network's application blindness in the middle layers of its architecture was expected to help avert high concentrations in the digital information and communication industry. The hope was that dominant companies would not be able to exert control over information flows and information processing in ways that would disadvantage, initially, scientists, and later, citizens (Garcia, 2016). The fact that the standards for the internet are not stable and that departures from the internet's initial architecture have consequences for the public interest has been recognized for some time. As David (2001: 160) observes in reference to the internet, ‘the piecemeal introduction of new technical mechanisms in the core of the network will soon begin the destruction of those performance capabilities which have hitherto constituted some of the Internet's most beneficial public-goods properties’.

Reality would prove to be much more complex than the initial hopeful expectations of the internet's early developers. As van Schewick (2016: 3030; 2010) says, ‘over the past two decades, the Internet's architecture has become more opaque and more controllable’. Network operators have been able to control many features of the internet, notwithstanding the end-to-end principle. These operators, together with Over-the-Top service providers such as Facebook, have developed business models enabling them to generate profits by treating internet users as a resource for economically valuable data (Ballon, 2014). Disputes about network neutrality (the end-to-end principle) often frame policy debate around whether the internet's architecture should be preserved to protect the public interest [3] without considering how control over bits of power has been changing over time (to the detriment or advantage of citizens).

An historical perspective is helpful because it encourages ‘thinking in time’ (David, 2007). If choices with respect to the technical and institutional arrangements for the control of bits of power have been locked in to a single path – if they have been path dependent - this could mean that the exploitation of citizen interests as a result of corporate and state control over the processing of information is inevitable. Alternatively, if these choices are not locked in, at least not at the level of the information and communication subsystem, there may be the potential for alternative pathways to emerge which could be more favourable to citizens. In the contemporary period, van Schewick (2016: 287) argues in relation to the internet that, “moving from an end-to-end architecture to a core-centered architecture gradually reduces the number of potential innovators and changes the environment for application-level innovation from decentralized to centralized”. These kinds of centralizing tendencies (e.g. modifications optimizing specific applications and functions in the network such as asymmetric bandwidth for uploading and downloading or firewalls) have consequences for the way companies, states and citizens can exercise their control over bits of power.

In the political economy of media and communication tradition, research often focuses on neoliberal capitalism as a mode of accumulation (Fuchs, 2012). Technological innovations that occur through time in the media and communications sphere are associated with power relations that privilege the interests of the owners of production, especially through the control they exert over information (Innis, 1950; Babe, 2015). Although historians of the capitalist system have argued that asymmetrical structural power has reproduced itself and shown that ‘the long run always wins in the end’ (Braudel, 1966/1973: 1244), it has also been shown that, within the media and communication subsystem, there has been no necessary coincidence between the interests of the owners of capital, the regulatory institutions of the state, the state’s military/security apparatus, and outcomes for citizens (Garnham, 1986). Even if citizen interests are subordinated under neoliberal capitalism, it seems likely that technologies of control and institutionalized power relations which rest on deeply held beliefs or social imaginaries will condition outcomes, sometimes in surprising ways (Taylor, 2004).

Imaginaries in network history

In his work on the political economy of capitalism and communication, Garnham (1990: 5) argued that it is important to examine asymmetries of power in relation to communication and, especially, in “the relation between capitalism as a social system and the set of ideas about the world possessed by human agents”. A set of ideas, or a social imaginary, as Taylor (2004) suggests, forms the common expectations that are held in society about how collective practice is, or should be, organized. Efforts to control bits of power, including the exchange and processing of information, are therefore informed by such deeper notions. Various contending imaginaries, over time, will underpin what comes to be seen as legitimate action on the part of corporate, state and civil society actors (Mansell, 2012). Taylor makes no *a priori* claims about which particular social imaginary or set of ideas should be most prominent in a democratic order where citizen rights are respected, but he insists that different sets of ideas will compete for primacy over time. Social imaginaries are abstractions from the messy reality of the everyday experience and practices of individuals and, in this respect, the following should be read as a simplified account of several ideals which inform imaginaries about social ordering in Western societies.

Free and unfettered markets

The first set of ideas is that markets are, or should be, free of interference by external authorities. For example, market analysts often insist that networks are central to economic prosperity, that they thrive in unregulated markets, and that this gives rise to innovation and prosperity. The narrative is that growth in the quantity of (digital) information and advances in information processing capabilities fuels economic growth in the knowledge economy (David and Foray, 2003). Thus, the network infrastructure – today, the internet - is expected to develop optimally in an unfettered marketplace. Unhindered markets are said to foster the growth of the digital platforms operated by Twitter, Google, Facebook, Amazon and others. A marketplace, free from regulation by the state, should maximize social welfare and companies should be given responsibility as the custodians of bits of power. This narrative is often presented by adherents to this social imaginary as the justification for corporate self-regulation.

It may be claimed in this narrative, for example, that the key to prosperity is knowledge discovery from data assets which should be valued solely in economic terms (Sun and Han, 2012). The assets of interest are the bits of power that mediate company-customer relationships and support the advertising industry in “guiding one of history’s most massive stealth efforts in social profiling” (Turow, 2011: 1). The aim is to generate economic value from data (such as the data generated by humans and by the Internet of Things). The fact that these data assets are also used to identify individuals ‘of interest’ for commerce and for the ‘war’ on terror (Kuehn, 2013; Guzik, 2009) is overlooked in this narrative. The responsibility for market outcomes in the contemporary period is imagined to be appropriately delegated to algorithms (Napoli, 2014) and to the ‘free’ marketplace. It is the market’s own dynamics which are expected to protect the interests of consumers (and citizens).

Public interest state intervention

A second set of ideas is that the state - through its regulatory apparatus and military and policing institutions (hereafter referred to as the regulatory state and the military state) - is expected to intervene in the market to enhance or protect citizen welfare. In this narrative, markets are not regarded as ‘free’; instead, they give rise to changing configurations of asymmetrical power among mainly corporate actors whose monopolization strategies risk treating citizens (and consumers) inequitably. In this narrative, it is legitimate for a state to intervene in the market to foster market efficiency and, thereby, to secure the public interest by owning or regulating the means for the production and the distribution of goods and services. In relation to information and communication networks, this becomes a narrative about the legitimacy of the state to uphold the principle of ‘common’ or ‘public’ carriage to ensure the unhindered flow of information (Noam, 1994). It has underpinned policy measures to uphold citizen rights to access information, the right to freedom of expression and the right to privacy protection. In relation to the internet, the narrative is that companies should be obliged to treat data neutrally in line with the end-to-end principle of the internet (van der Sloot, 2014). Citizen rights can, however, be abridged when required (Berger, 2009), for instance, to tackle crime such as drug trafficking, digital content copyright infringement or terrorism. Processing bits of power becomes a means of control “in the institutionalized production of security” (Mueller, 2014: np). In this set of ideas, the military state is justified in subordinating the principles of individual privacy and freedom of expression to the goal of collective security and the regulatory state must balance the citizen’s rights with those of private companies.

Civil society generative power

The narrative underpinning the third social imaginary in the contemporary period is that citizens, including members of technical communities, should have a major role in shaping outcomes in democratic societies through their passive or active resistance to actions of corporate and state actors which advance injustice and inequity. With respect to networks, non-market collaborative participation within digital spaces enabled by the internet and the goodwill of technical communities is the best way to secure citizen interests. This may be supported by multi-stakeholder deliberation or it may occur as a result of citizen uprisings or other contributions (Mansell, 2013; McChesney, 2013). The former is seen as a democratic way to institutionalize authority and accountability (DeNardis and Raymond, 2013; DeNardis and Musiani, 2016; Hofmann et al., 2016; Mueller, 2010). In relation to internet governance, for example, network neutrality advocates focus on preserving the end-to-end principle to ensure that discrimination does not occur and the design of software code and hardware is positioned as a protector of citizen interests. The activities of decentralized online communities are valued as a means of protecting the public interest even if they rely on commercial platforms or open software and anonymous networks (Gehl, 2014). The imaginary is that internet users can control their information at least sufficiently to defend their rights in the face of incursions by commercial or state actors (Wauters et al., 2014).

In summary, if the power apparatus “is the sum of the political, social, economic and cultural hierarchies” (Braudel, 1979/1982: 555), then the sets of ideas or social imaginaries categorized here will combine in varying ways to drive struggles to control bits of power. The first set of ideas emphasizes choice in a ‘free’ market to achieve consumer and citizen welfare. The second accords to the state regulatory, institutional authority to pass legislation and/or intervene in the commercial market to protect citizens. The third turns to the citizen (or the technology innovator), empowered through collective initiative, to legitimize action to protect citizen rights. In practice, of course, institutional actors will have different accountabilities and modes of operating and, at the institutional level of analysis it is not possible to examine how individual, cognitive and other factors play out (Scott, 2014). Let us now turn to concepts drawn from the historical study of institutions and the economic history of technological change. This will prepare the ground for examining the dynamic relationships between identifiable social imaginaries and technological change in the digital environment.

Critical junctures and path dependence in network history

When the analytical focus is moved away from the narrow debate around network neutrality to the actions of companies, states and citizens in relation to control over networked information processing, the historical institutionalism tradition can illuminate events that have yielded stability or instability in network development. This tradition is sometimes criticized for its overemphasis on continuity at the expense of change, but recent work highlights instability and a concern with the dynamics of change (Bannerman and Haggart, 2014). Braudel’s historical analysis is pertinent in this context because of his interest in control systems that have conditioned the transformation of networks over time; in his case, in relation to civilizations (and capitalism). As a world systems theorist, Braudel distinguished between “*the* world economy (the whole system)” and “*a* world-economy”, the latter referring to “a fragment of the world” (Braudel, 1979/1984: 22). In this article, the focus is on the information and communication system as one such ‘fragment’. He argued that, even in the face of the industrial revolution, “capitalism remained essentially true to itself”, but also that “sometimes too

there are major breaks with the past” (Braudel, 1979/1984: 621). Crises of control over material assets could “mark the beginning of a process of deconstruction” (Braudel, 1979/1984: 85). When he focused on *the* world system, he said that no society “has ever developed horizontally, on a plane of complete equality” (1979/1982: 463). He acknowledged that a plurality of societal structures and institutional arrangements “is an essential factor both of movement and of resistance to movement” (Braudel, 1979/1982: 465-466), an observation that resonates with Taylor’s (2004) account of contending social imaginaries that change, albeit slowly, through time.

Braudel’s (1987/1993: 26) historical method involved the examination of selected “turning points” when processes yielding the centralization and concentration of power were destabilized (Braudel, 1979/1984). Over the *longue durée*, he found that trading or exchange outcomes were influenced by network interactions and by monopolization strategies which were aimed at controlling material assets, to the disadvantage of certain actors. Thus, he said that “the division of labour on a world-economy scale cannot be described as a concerted agreement made between equal parties and always open to review. It became established progressively as a *chain of subordinations, each conditioning the other*” (emphasis added) (Braudel, 1979/1984: 48). This suggests that successive chains of subordination among unequal parties will result in choices about the control of the information and communication system. Have such choices irreversibly locked the system onto a path that inevitably subordinates citizen interests?

Braudel (1979/1982: 416, 433) also observed that tendencies towards the centralization of power have been conditioned by what he referred to as “minimum qualifications” or “essential characteristics”. These favoured “profitable circuits of power”, especially by influencing the circulation of information. When monopolistic power emerged as “the product of power, cunning and intelligence” (Braudel, 1979/1982: 418), it was seen as the result of a dynamic process. For Braudel (1987/1993: xxxviii, xl), historical explanations work on “different varieties of time”, some rapid and some slow. The aim of analysis, he observed, should be to determine whether conjunctures of events have a substantial effect “on relations, to favor or militate against collective bonds, tightening some, straining and breaking others” (Braudel, 1980: 75).

Hope (2016: 16) points out that Braudel privileged enduring patterns over “conventional periodisations and event-centred chronicles of history in the making” in contrast to Gurvitch’s (1964) historical method which emphasized discontinuities. However, since Braudel did give some attention to “conjunctural rhythms” which he said were synchronic (Braudel, 1979/1984), it seems reasonable to consider how continuity and discontinuity in technologies and institutions have altered power relations at specific moments of network development. Braudel also saw that actions around technology were neither linear (Braudel, 1979/1981: 334), nor simply the result of the “*internal* development of technology or science” (Braudel, 1979/1981: 335). Specific chains of subordination of various interests involved in network developments were found to be associated with particular moments in time (Braudel, 1980). Methodologically, Braudel (1979/1982: 459) acknowledged that “for practical purposes of course, this totality has to be split up into smaller sets for convenience of observation”. He cited Schumpeter’s (1954: 3) comment that “out of its great stream with his classifying hand the investigator artificially extracts the economic facts”. As far as the appropriate length of time is concerned, Braudel (1980: 45) emphasized that this is fundamental. He clearly preferred the *longue durée*, but building on this tradition, Collier and Collier (1991) suggest that the time length of critical junctures in history can be a matter of choice, notwithstanding the fact that the selected periodization will condition what an analysis reveals.

In the historical institutionalism tradition there is controversy about whether choices taken around conjectural events are the path dependent outcome of antecedent conditions. Collier and Collier (1991: 29) suggest that for a set of events to ‘count’ as a critical juncture in the sense that it yields a path dependent outcome, it must occur in similar ways in different instances and it must produce a legacy as a result of its “core attributes” – here considered to be the minimum characteristics which enable control of network development. In the political science branch of historical institutionalism, the notion of “path dependency” at critical junctures is regarded as a static theory which is not concerned with change, conflict or the agency of social actors (Peters et al., 2005: 1283). This view differs, however, from the concept of path dependent system dynamics developed in the literature on the economic history of technological change. For David (2007), for instance, path dependence is a concept, not a theory. It refers to dynamic developmental processes shaped by the contingencies of their own history, but not in a deterministic way. This version of the concept was developed in response to static economic analysis to acknowledge that a dynamic process may be “governed by its own history”, not that it is always governed in this way (David, 2007: 92). A path dependent critical juncture is a “forking of the road” when “there was an open path which would have led to events quite different from those that eventually transpired” (David, 2007: 95). Additionally, the study of path dependent processes is concerned with agency. One of the aims of research is to “identify and elucidate the role of critical human actions (or failures to act)” as the “drama” unfolds (David, 2007: 95).

Braudel’s primary focus was the capitalist world system. However, the aim here is to examine whether certain ‘critical bifurcations’ at the subsystem level - the information and communication network - resulted in irreversible outcomes. Even if monopolization (centralization) is a likely outcome of the chain of subordination around a minimum characteristic, there may be opportunities for a new pathway to emerge since it is well established that there have been continuities and instabilities in the wake of technological innovation in the digital sphere (Freeman and Louça, 2001). In the political economy of media and communication field, for example, Pickard (2014) has examined critical junctures in the history of the press and broadcasting industries and demonstrated that a set of ideas upholding social democratic values was present in the United States in the post war period. These did not influence the path of the development of the media system, and the public interest was not protected during the critical juncture he explores. He considers whether the contemporary period might yield a different outcome, notwithstanding the antecedent choices.

In the following, shifts in power in the control of the information and communication network’s information processing capabilities are examined at several critical junctures. The focus is on relatively short periods beginning around the time that technological innovation gave rise to the capability for digital communication. These periods are contextualized by a brief discussion of the pre-1960 period. The analysis provides a basis for assessing whether the contemporary period should ‘count’ as a path dependent critical juncture. Even if asymmetrical power relationships are entrenched for long periods and system dynamics are dominated by the profit motivations and security interests of the state, what is the evidence for a potential ‘forking of the road’?

Critical junctures and information processing control

Until the late 1950s, technologically mediated information and communication networks were influenced by the control exercised by state owned institutions over the standards for communication using the analogue circuit. This was the minimum characteristic that enabled information to flow on

a non-discriminatory basis through the telegraph (from the early 1800s) and, later, the circuit switched telephone network (from the 1880s). Regulatory control over flows of information came to be centralized in the hands of the state even through it was the private sector that financed investment in network equipment and initially operated networks (and continued to do so in the United States and parts of Canada). Some forms of control resided with the private sector but the state had a legitimate role in intervening in the market in a bid to protect the public interest. Although standards for electronic signaling and the network designs were initiated by the private sector through technological inventions and subsequent investment, the global spread of the early networks soon led to the formation of state-led arrangements for the governance of networks (Winseck and Pike, 2007). It would be nation states, for example, that would provide the necessary approvals for companies to construct facilities and operate in their territories (Raboy, 2016). From the 1850s, states sought to exercise control over information and communication networks through their membership of the International Telecommunication Union (ITU). This organization had intergovernmental oversight of the technical specifications and standards for electromechanical technologies, wireless telegraphy and the telephone network. Much later, the ITU would admit corporate representatives to its deliberations on network regulation, and standardization activities would be led by private sector consortia. From this point through to the 1980s, market-led competition emerged as the preferred set of ideas about the best way to secure the interests of citizens (Hanson and Melody, 1989).

In the early period, however, the state or regulated companies were credited with the legitimate authority to build and operate public communication networks and to manage the flows of information in line with mandates aimed at preserving individual privacy and the public interest in transborder information flows. The military state's role also was deemed to be legitimate. Security and law enforcement provisions were introduced whereby states reserved "the right to stop, in accordance with their national law, the transmission of any private telegram which may appear dangerous to the security of the State or contrary to its laws, to public order or to decency" (ITU, 1865/2002: ch VI, art 34; Rutkowski, 2010, 2011). Network operators were obliged to "communicate such correspondence to the competent authorities" (ITU, 1865/2002: ch VI, art 37). The state in Western democracies was presumed to have a legitimate right to intervene in the telecommunication service market. The services to be regulated were designated in the United States as "the offering of telecommunications for a fee directly to the public" (US Congress, 1996: 47 Code § 153(53)) and, later in Europe, as services offered by a "provider of electronic communications to the public" (European Commission, 2015). Both definitions aimed at ensuring that information could flow unhindered through the network (Aronson and Cowhey, 1988; Noam, 1987). Retaining control over signalling standards for the telegraph network, and later, for the telephone network, meant that these technologies served as the minimum framework for control of the system. The regulatory state promoted the process of extending network access to citizens, although citizen interests were not always the most prominent. This was so, for instance, when the military state took the view that individual rights to privacy could be abrogated to protect public safety. For this extended period, the choices made for the technical design and operational management of information and communication networks were relatively stable. In retrospect, were the choices in this early period responsible for creating path dependent outcomes? A consideration of certain periods (1960s-1970s; mid 1980s- early 1990s; mid 1990s-early 2000s) which might 'count' as critical junctures in the history of information and communication networks indicates that there were fluctuations in the prominence of the three sets of ideas outlined previously. There were also changes in the minimum condition for control over information processing.

1960s and 1970s

In the 1960s and 70s, the first set of ideas – free and unfettered markets – started to increase in salience and the relevant minimum characteristic required for control over information processing also started to change. Innovations in electronic switching technologies were built on the invention and standardization of packet switching. This provided for a less vulnerable command and control system (Baron, 1960). Consequently, the relations of power in the commercial market began to change. The monopoly network operator, AT&T, started to face competition in the United States when the privately owned, MCI, founded in 1963, and several other private companies, started providing point-to-point communication services to connect computing facilities. Information processing companies such as GEISCO, IBM and Tymshare began developing the market for timeshare data processing at the edges of networks and global trade in electronic data processing services started to become a reality (Melody, 1972). The public network operators thus began to lose their exclusive control over the attachment of terminal or ‘edge’ equipment to their networks.

The new entrant network operators would soon be liberated by the regulator and the courts to provide switched telecommunication services to the public (Melody, 1970; Temin, 1987). The public network operators had relatively little information processing capability at the core of their networks, apart from that required to operate their networks and to provide customer billing. In a bid to defend its monopoly, the incumbent network operator in the United States retaliated against the information processing companies by offering discount pricing for large businesses that required capacity for the transmission of increasing volumes of data. The companies providing information processing services were not regulated in the United States because the Federal Communications Commission (FCC) had designated them as computerized information processing services with no obligation to be neutral in their treatment of information (Lentz, 2011). In Europe, the historic post, telegraph and telephone organizations remained relatively unchallenged because during this period the regulatory state did not seek to separate communication from information processing services to accommodate the interests of information processing companies. Most of these were offering data services from their base in the United States.

Albeit through different market structures, the regulatory state in the United States and in Europe had little traction over the information processing services operating at the periphery of the public communication network. There would be ambiguities about what was, and was not, an information processing service but, during most of this period, the regulatory state focused primarily on promoting universal access to public telecommunication (telephony) networks (Noam, 1987). Thus, while the narrative underpinning the legitimacy of the regulatory state’s intervention in the market was still relatively prominent with regard to voice services, it had little control of the development of the data market. The military state became increasingly interested in the use of innovations in computing equipment and data processing for mass electronic surveillance (CPCLCR, 1972; Goos et al., 2015) [4]. Privacy protection issues began to come to fore in policy debates, but citizen interests in such protections were largely subordinated to the interests of the companies that were driving the expansion of global data markets. The minimum characteristic for controlling bits of power by the end of the period had started to shift from the packet switching capabilities in the core of public telecommunication networks to the ever more powerful ‘edge’ capabilities of companies for processing information based on advances in computing.

Mid 1980s to early 1990s

From the mid-1980s to the early 1990s, the free and unfettered market narrative continued to prevail as public network operators attempted to reassert their position in the information marketplace. Their strategy was to invest in the new minimum characteristic for control - computerized data processing capability in the core of their networks - to compete with the providers of 'edge' services. A new network design, the Integrated Services Digital Network, relied on the expertise of computer scientists and telecommunication engineers, who initially designed a relatively decentralized network structure (Mansell, 1993). In the complex chain of subordination, however, when the public network operators implemented the information processing capability at the core of the network, they redesigned it to enable centralized control of new premium information services including freephone, caller identification, telemarketing as well as customized pricing packages. These companies needed to deploy this information processing capability because, as they largely succeeded in arguing at the time, control was necessary to protect individual privacy and to secure the safety of the network in the public interest. At the same time, there was a gradual reduction of interventions by the regulatory state after the breakup of the AT&T monopoly in the United States. This set in train initiatives to stimulate a competitive marketplace in the United States and then in Europe, and indeed, globally (Temin, 1987; Thatcher, 1995; Mansell, 1995). The regulatory state's intervention in the United States would be focused mainly on addressing market failures as markets began a process of re-consolidation (Melody, 1990; Temin and Galambos, 1987). In Europe, the process of privatising the network operators and introducing competition, initially in the United Kingdom and then across Europe, got underway, with somewhat greater attention to the social consequences of introducing competition (EC, 1996; OECD, 1993).

Meanwhile, the chain of subordination which led to the decision to locate sophisticated information processing capability at the core of the public network enabled the network operators to start developing strategies to capture or lock customers into their information-related services (Mansell, 1988; Samarajiva, 1996). This can be seen as a critical juncture in the sense that the personalization of customer generated information (data) started to enable these operators to engage in profit maximization based on the 'intelligent' functionality that was under their control. Privacy protection and security guidelines made a policy appearance internationally at this time as the regulatory state started to respond to public interest concerns about the companies' use of sensitive customer data (OECD, 1981, 1992)[5]. These concerns about automated processing of digital information would later be echoed in responses to algorithmic data processing.

In this period, the first set of ideas (free and unfettered markets) and the second (public interest state intervention) blended with the principle that a regulatory state should advance the capacity of citizens to access a ubiquitous public network. However, little attention was given to the network operators' control over information processing and the likely implications. The prevailing narrative was that computerized information processing was essentially an innovative 'edge' activity that would drive economic growth in a knowledge economy (Foray, 2002), boosted by an unfettered market. Academic researchers argued at this time that the citizens' interests in diverse sources of information and in controlling their own data were being jeopardized, but their calls for more proactive regulation had little impact on the investment strategies aimed at generating revenues from the processing of customer data. The race was on to establish services that would enable customers to enjoy greater diversity and choice in a competitive marketplace (Melody and Paltridge, 1992; Noam, 1987). The military state's interest in harvesting data and monitoring networks did not have a

prominent profile in the public policy narrative during this period, but it was nascent in the public network operators' claims that technical harm could result from the move towards decentralized control of information and communication networks.

In parallel with the developments described so far, and independently of the 'edge' service providers or the public network operators, the military state was funding research that would give rise to the TCP/IP standards for connecting host computers to the internet. The military favoured a decentralized network architecture with information processing occurring at the edges (Flichy, 2007; Leiner et al., 1998) [6]. With information processing control now firmly established as the minimum characteristic required for success in the marketplace and with the transmission of digital bits becoming a commodity service for the public network operators (despite their introduction of 'intelligent' software at the core of their networks), the following question arose. Would the technical standards and network architecture of public network operators secure dominance as a result of earlier path dependent choices? Their status as providers of communication services 'intended for the public' meant that their capacity to process data was restricted by the regulatory state, largely to routine network management functions. Around this time, the dynamics of network development became influenced by the ascendancy of the third set of ideas (civil society generative power). This process was partly mobilized by the earlier choices that had located information processing power at the edge of networks.

Mid 1990s to early 2000s

The spread of the internet's architecture plus standards for an infrastructure of routers, servers and connected information processing devices had important implications (GAO, 2016). When the internet was opened up for public and commercial use in the early 1990s, data packets could be routed through networks without the centralized control of the public network operators. Their investments were at risk as Over-the-Top service providers started developing more sophisticated data services (McKnight, 2014). There were competing network architectures and standards which were more centralized [7], but the Internet Protocol Suite – the end-to-end function in the middle layer – meant that edge computing services would flourish.

The decentralized architectural model meant that 'edge' service providers could transport their data with the incumbent network operators providing the transmission capacity as Internet Access Providers. One narrative was that the new service providers were 'free riding' on the investments of the public network operators. The new services would include search engines, video sites, film streaming, webhosting services, blogging platforms, social media sites, and online retailing and payment services, among others. Advocacy of the virtues of free and unfettered markets became more vociferous and the regulatory state declined to intervene in the market for information services. The public network operators' centralized network design was superseded by a decentralized network design. As what would later come to be known as 'digital platforms' started to emerge, the military state, which had relied historically on the public networks for electronic surveillance, now began to claim that new legislation was needed to ensure its access to online users' data flows and, sometimes, content.

Some seemed to regard the internet's end-to-end principle as the minimum condition for control, but, in fact, it was the edge information processing technology which continued to serve as a minimum characteristic for control in the marketplace. The neutrality of the middle layers of internet, however, would provide an opportunity for civil society to lay claim to information processing power, consistent with the growing prominence of the third set of ideas (generative power of civil society).

Multi-stakeholder institutions, intended at least ideally to give voice to civil society concerns as well as to the state and the private sector, started to be seen as an effective means of governing the internet. The idea began to spread beyond the community associated with the originators of internet's standards (albeit with a variety of modalities of decision making [8]). The ideal associated with this social imaginary was that of collaboration and dispersed initiative, largely working from the bottom up. The emphasis on inclusion, equity and accountable participation (Backstrand, 2006) allows citizens to respond against interventions by the state or resist the 'free' market when public interests are jeopardized. As Franklin (2013: 183) put it, "like Rip Van Winkle, government regulators have discovered that things have changed and they no longer call the shots in terms of internet design, access, and use". These developments did not necessarily imply the subordination of corporate interests however, and Sarikakis (2012: 151) argues that multi-stakeholder governance typically grants "private interests legitimacy in public policymaking next to elected governments". In Western countries, there would be multiple struggles among state, company and civil society representatives for the control of the internet. In some instances, companies regarded multi-stakeholder institutions as benign and, in other instances, as "inherently dangerous" (Gleckman, 2016: 94). Until the early 2000s in the Western world, there seemed to be a consensus that the internet's end-to-end design principle, along with the functional standards associated with the Internet and Transport layers of the network architecture, were helping to diffuse asymmetrical power relationships. This was evident notwithstanding the power of companies with control of the minimum condition – information processing power – that were developing services at the edges using the applications layer of the internet.

During this period there was a coincidence of the first and the third set of ideas as enablers of legitimate action that would generate conflict in the future. This combination would fall short of protecting the public interest, notwithstanding the growing prominence of values consistent with the generative power of civil society ideal. In the United States, the set of ideas giving legitimacy to state regulatory intervention to diffuse the unfair exercise of monopolistic market power receded. There was little use of anti-trust legislation to restrain the monopolistic digital platform operators as they pursued strategies which exploited network economies of scale and scope and devised business models to process their customers' data. In Europe, the regulatory state focused on promoting competition in the digital economy and had few effective tools with which to confront the growing dominance of companies such as Microsoft and Google (there were competition proceedings, but the outcomes of these did little to reduce their market power). Markets consolidated and the digital platform operators engaged in an intense battle over whether they, or the traditional network operators, would succeed in 'owning' the customer (Nooren et al., 2012). Citizen interests were being subordinated to those of advertisers and the digital platform operators. Growing demand for television, video-on-demand, and later, video steaming, created incentives for investment in broadband infrastructures by the network operators. This stimulated the development of their market for a time, even if they had not yet transformed themselves into information processing service providers.

The rise of the free and unfettered market social imaginary accompanying the expansion of digital services provided by information processing companies can be explained partly by euphoria. Citizens were rapidly gaining access to the internet in ever greater numbers and a vast number of entertainment, electronic government and electronic commerce services were being introduced [9]. Rules governing commercial online trading practices and data protection legislation were introduced by the regulatory state in an effort to protect consumer rights, but the prevailing imaginary was that

citizens were being empowered, consistent with the generative power of the civil society narrative. There were many critiques of this narrative at the time (Garnham, 2000; Mosco, 2004), but, in this period, it seemed that a path dependent outcome was unfolding. The earlier choice favouring the end-to-end principle of the internet seemed to be favouring the 'edge' service providers and their information processing power, leaving the traditional network operators as 'carriers of bits'. The prominence of the first set of ideas increasingly meant that state regulatory intervention was associated with negative effects on incentives for innovation in the digital marketplace. Digital platform companies operated with little transparency and the military state went relatively unchallenged when it engaged in electronic surveillance.

The contemporary period

Digital platform companies in the contemporary period (since the middle of the first decade of the 2000s) have acquired a commanding presence in the marketplace (Evans and Gawer, 2016; Mansell, 2015; Moore, 2016). The market for processing bits of power is forecast to grow at a cumulative average annual rate of 26 per cent from 2014 to 2018 (IDC, 2015). Some 914 million people have at least one international connection on social media (Facebook, Twitter, Vkontakte, Weibo) and search engines such as Google, Bing, Baidu and Yandex are consolidating their market share as digital platforms attract growing numbers of customers. By 2012 revenues from online sales and advertising for the 12 biggest digital platform companies reached USD 105 billion worldwide, with Google accounting for 45 per cent. In January 2017 Google's share of the worldwide desktop market for search stood at 90 per cent, Yahoo! at 3.5 per cent, Bing at 4.0 and Baidu at 0.3 by use [10] (the latter Chinese provider was growing rapidly).

The most prominent social imaginary, consistent with neoliberalism, is that free and unfettered markets yield an inclusive information processing (data analytics) environment which benefits citizens and consumers. This set of ideas is prevailing in many business and state fora, notwithstanding the fact that these companies often subordinate citizen interests. This occurs, for example, through unfair labour contracts especially in areas of low income service work throughout the 'on demand' economy (van Doorn, 2017). Digital platform providers sometimes call for the curtailment of bulk collection of personal data in a bid to preserve the public's trust in their services (AoL et al., 2013; Anderson, 2016), but this stance is not well-aligned with their shareholders' interests in commercial gain (Haggerty and Lyon, 2012; Pariser, 2011). It is unclear whether the contemporary period will be regarded, in retrospect, as yielding a path dependent outcome whereby the power of these companies and of the military state to access and process data is sustained. Today, the minimum characteristic of interest is the algorithm and computational power for processing data.

The second set of ideas underpinning the legitimacy of the regulatory state's interventions to preserve a neutral conduit for the flow of information, in line with the internet's end-to-end principle, is still in place in Western countries, despite efforts by some companies and by the military state to destabilize it. In the United States, for instance, the FCC's order on the 'open internet' imposed requirements for transparency and anti-blocking along with anti-discrimination measures on providers of internet access, consistent with the end-to-end principle (FCC, 2015). This order was supported by many civil society representatives, although it was unsuccessfully challenged in the courts (US Court of Appeals, 2016). The European Commission's efforts to boost the European digital economy have also provided scope to embrace network neutrality 'by safeguarding equal and non-discriminatory treatment of internet access services and related end-users' rights' (EC, 2015: 1).

In this case, social values are taken into account as long as regulatory state intervention does not reduce incentives for the growth of the digital economy.

The efforts of the regulatory state in the United States and Europe in regard to preserving network neutrality have sought to ensure that public network operators' traffic management practices do not result in unreasonable blocking or throttling of data. However, they also provide for specialized service offerings (optimized for specific content and quality of service) which enables discriminatory information processing under certain conditions (FCC, 2010; Sidak and Teece, 2010; BEREC, 2016; European Commission, 2015). This approach to defining what is expected of network operators requires an evidence base that is difficult to extract from companies which claim that their data are commercially sensitive. Thus, in practice, information processing power at the core of the network can be used in discriminatory ways. It has been argued that the non-neutral treatment of data in the Internet and Transport layers of the network has been happening for some time as 'common' or 'public' carriage of data has become increasingly unattractive to Internet Access Providers as the principal means of generating profits (Noam, 2010; Sluijs, 2010; Wu and Yoo, 2007; Nooren et al., 2012). When internet service providers deviate from providing undifferentiated services, they can introduce 'reasonable' discrimination using tiers of service based on traffic volumes and the quality of service. They use the 'intelligent' software in the core of their networks to avoid congestion, and this is regarded as consistent with neutrality. The same technology (e.g. deep packet inspection), however, also enables these companies to give priority to preferred content and data flows which increases their revenues.

The technologies being embedded within the internet's ostensibly neutral layers also allow the military state to access data for surveillance purposes (Bendrath and Mueller, 2011). The second set of ideas legitimates military state intervention which allows for access to data and data traces generated by citizen online interactions (Suarez, 2016). The military state looks to the information processing capabilities which are being re-introduced into the core of public networks and that are not (yet) deemed to jeopardize network neutrality. In Western democracies, digital platform companies offering services at the applications layer of the internet are also being required to respond to state requests for data access. In Europe, these developments are restrained to some extent by privacy legislation mandating these companies to deploy "do not track" settings. They are also required to implement a "right to erasure" of privacy intrusive information (EC, 2012, 2014). The General Data Protection Regulation (EC, 2016) has introduced a right to an explanation on request about how a citizen's data have been used to reach a decision. The citizen's interest is still subordinated, however, since the onus is on the individual to make a request for the elimination of a digital footprint or for an explanation. Both kinds of request require a capacity to understand complex terms of service agreements (Helberger, 2014). This makes demands on the individual's time and other scarce resources. Such legislative measures also do not take account of the fact that data processing now relies on data derivatives which can be reconnected with a person, notwithstanding data protection legislation (Amoore, 2011). Improved information processing capabilities, owned and controlled by companies using sophisticated algorithms, are presented by both companies and the state as an effective way of minimizing risks to citizens (through the targeting of commercial services and services for health care and other public services, which are then positioned as increasing consumer choice in the 'data economy') (Trottier, 2012). The free and unfettered markets social imaginary is robust despite the fact that algorithms employ computational methods which cannot easily be scrutinized. There is very little, if any, transparency and accountability for decisions based

on interpretations of the results produced by information processing techniques at the edges of networks (O'Neil, 2016).

Nevertheless, consistent with the third set of ideas – generative power of civil society – multi-stakeholder organizations such as the Internet Corporation for Assigned Names and Numbers (ICANN), demonstrate that, on some occasions, the interests of civil society are not being subordinated to the military state and dominant companies. However temporarily, it is feasible for bottom-up action to partly resist the power that enables dominant companies and the military state to exercise control over information processing (DeNardis, 2014; Klimburg et al., 2014). For example, a contest over the internet domain name system and control of the Internet's root zone file has been resolved by a change whereby ICANN (a non-profit corporation) has responsibility for Internet Assigned Numbers Authority (IANA) functions, without the oversight of the United States Department of Commerce's National Telecommunications and Information Administration (NTIA). This occurred in 2016 when the contract between ICANN and the government expired (GAO, 2016). The transition has been regarded as a success in assuring accountability and in confirming the authority of collaborating corporate, state and civil society participants. However, just prior to this change, President Elect Trump and Republican Senator Ted Cruz opposed the transfer claiming that the government needed to retain its control to preserve the stability of the internet (Eggerton, 2016; ICANN, 2016). The free and unfettered markets social imaginary prevailing in the United States legitimizes the stance of the current FCC Chairman who is initiating actions to rescind the earlier open internet order (Kang, 2017). In the light of choices favouring information processing at the edges of networks and the interests of the dominant digital platform operators, is a path dependent outcome inevitable?

The generative power of the civil society social imaginary is still rivaling the 'free' market set of ideas. Representatives of civil society are resisting citizen subordination by companies and the military state in numerous ways. Some critical theorists suggest, for example, that a networked multitude (Hardt and Negri, 2001) can use the applications layer of the internet's architecture to build applications that contest commercial and state power. Citizens are using information processing on the applications layer for mass self-communication in order to counter power asymmetries (Castells, 2009, 2012). The minimum characteristic for controlling bits of power – the algorithm and data - is yielding opportunities for civil society actors to provide their own interpretations of data. Individuals and dispersed crowds are using their access to, and occasional control of, the minimum characteristic to their advantage. This has occurred in the case of sousveillance (Mann et al. 2003) and through the mobilization of citizens using digital platforms in response to crises (Asmolov, 2016). These edge information processing capabilities can be used to develop services to escape from state and corporate surveillance through anonymity which preserves privacy to some extent, as well as freedom of expression (Gehl, 2014). In practice, the ideal of the imaginary of generative power is challenged because the means for enabling citizen control over bits of power can also be used to promote values associated with crime. Civil society communities have embraced free/libre open software to develop services on the application layer but they sometimes find that their collaborative values are distorted by commercial participation in open source projects (Birkenbine, 2015). Standards for App development on the applications layer, for example, in the case of the initially open Hypertext Markup Language (HTML), are migrating to proprietary standards for web services which can be accessed through the mobile internet. Rather than providing a basis for the empowerment of internet users and producers of Apps, commercial 'value networks' are being created which support the control of services (and data) by dominant players such as Google and Apple (Daubs and Manzerolle, 2016).

Notwithstanding these contradictory outcomes, the idealized social imaginary of civil society generative power persists with an expectation that dispersed online communities will advance control of the minimum characteristic of today's network to achieve social justice and equity, albeit within the constraints of capitalism (Zittrain, 2008, 2013). Berners-Lee (2014: np) says that "our rights are being infringed more and more on every side, ... I want ... to take the web back into our own hands ...". He refers here to the Web, but this comment is similar to the broader narrative which calls for measures to preserve the internet's neutrality as a strategy for enabling civil society to exercise its generative power in society. However, as Pickard (2017: np) observes, network neutrality is "really about a far larger power struggle over access to information and people's rights to express themselves politically and creatively" in a pervasive digitally mediated environment which depends on information processing power.

The minimum characteristic which is important for sustaining power in the current period is information processing capability, now embedded in the periphery and in the core of the network. Retaining the end-to-end principal through network neutrality policies still matters, but it is the algorithmic techniques that are key to the capacity to control the information and communication subsystem and for interpreting vast quantities of data. The outcomes and consequences in the contemporary struggle over bits of power are uncertain because the legitimacy accorded to the concerned actors is in flux and the three social imaginaries arguably are changing in their configuration. It is for this reason that contemporary regulatory approaches that are intended to achieve 'algorithmic accountability' need to be considered (Yeung, 2017), not only in relation to their technical viability and their consistency with legal mores, but also in relation to the social imaginaries which condition whether they will be applied effectively in the interests of citizens. The current period may turn out to be a critical juncture with path dependent repercussions to the extent that corporate control of information processing and military state's interventions prevail. There may, however, be an opportunity for civil society to exploit its control over information processing capabilities in a way that yields outcomes consistent with greater justice and equity. This outcome depends on whether a path dependent past can be destabilized.

Conclusion

This analysis of the chain of subordinations within the recent history of information and communication networks has focused on the minimum characteristics around which conflict has centered. It reveals potential opportunities for change that are overlooked when the focus is on network neutrality and on technical standards and practices in the middle layers of the internet. An historical-analytical lens also shows how social imaginaries have combined and recombined at different times to legitimize state, corporate and civil society actions. It is sometimes assumed that the technical arrangement for the end-to-end flow of data is the minimum characteristic of primary concern because this has locked the network subsystem into a configuration consistent with the potential empowerment of citizens. However, the minimum characteristic that has mattered historically, and matters even more so now, is the capability for computerized information processing, including the algorithm and the data it requires. Control of bits of power is finely balanced among the digital platform providers, the network operators, the military, the regulatory state and civil society actors. The regulatory state's interventions to preserve an open internet against "discriminatory and exclusive deal making" (Lessig and McChesney, 2006: np) focuses on one locus of control and, arguably, not the most critical one in the current period. Over time, at the level of the whole social

and economic system, outcomes have been relatively stable insofar as choices made for control over bits of power by companies and the military state (moderated only to some extent by the regulatory state) have persistently subordinated citizen interests. The question is whether outcomes associated with control over the very sophisticated algorithmic information processing technologies now being embedded at the core and periphery of networks will prove to be path dependent. If the third set of ideas – the generative power of civil society - gains prominence in *the* world capitalist system, the current period might prove to be a critical juncture where developments result in a ‘forking of the road’ such that attention to citizen rights gains greater traction.

When the principal focus is on narrow network neutrality, as a technical issue of standards for the network and “reasonable” or “unreasonable” network management practices, this serves as “a cover story for modern industrialism in motion” (Smythe, 1985: 432). It sustains an idealized imaginary that in practice shifts attention away from the asymmetrical power of digital platforms and the military state. Whether we are in the midst of a critical juncture that will open up new possibilities cannot be known except in retrospect, but an historical focus on continuity and change, institutions and the conditioning social imaginaries, helps to highlight possibilities for change. On the applications layer, civil society has been able to use hardware and software to resist the excesses of the capitalist system (state and corporate) in some instances. It is possible for dispersed communities or individuals to source and verify digital information that can provide evidence of when and how subordination of citizen interests is occurring. An evidence flow of information processing (and interpretation) practices (e.g. profiling and recommender systems) that abrogate citizen rights could be made public on a regular basis, though financial resources would be needed to sustain this activity beyond occasional leaks of information. On a sufficient scale, this might yield an unexpected outcome such that choices of the past are disrupted and the power of dominant platform and network companies as well as the military state diminishes.

A global institution sponsored by members of civil society with a mandate to collate, circulate and publicise evidence about how information processing is being used by corporate and military state actors could create momentum for disrupting power asymmetries. Even if algorithms themselves are not transparent, it is nevertheless possible to examine who translates data into action and who takes decisions based on the information outputs when the ‘whole assemblage’ (beyond the technical aspects) is taken into account (Kitchin, 2017; Mansell, in press). This is also possible when regulation through standard setting, monitoring and the use of enforcement and sanctions are used to achieve control over the automated computational systems that are embedded in today’s networks (Yeung, 2017). Such mandates exist for other civil society sponsored initiatives to address world-systemic challenges such as global warming and mass migration. The pervasive reach of digital mediation arguably warrants a similar approach insofar as citizens’ rights and welfare are at risk. In democracies, the regulatory state and multi-stakeholder organizations might to combine their efforts to focus on asymmetrical information processing power and its consequences for citizens. If such initiatives can be legitimized by the social imaginary and generative power of civil society and, potentially, also by the regulatory state’s mandate to protect the public interest, the development of the information and communication network might be set on a different pathway.

The ‘kind of world that will be borne’ as a result of the continuing evolution of the information and communication network subsystem is crucial to the kind of society that emerges. Beniger argued that when an information control system scales up, there is the potential for societal crisis. Under contemporary capitalism, subordination of citizen interests may be inevitable at *the* world system level and it is important to acknowledge that technology is “the fruit of social systems, embodies their

consciousness, values and policies, and tends to reproduce them” (Smythe, 1974: 37). There may, however, be grounds for hope because, at the network subsystem level, the path toward the future is not one where technologies ride roughshod over history (McChesney, 2013). Path dependent outcomes are not inevitable and as Smythe (1964: 470) also observed, “no concentration of institutional power has ever been eternal or immune to change”. There are “many actions and reactions, many changes of gear” (Braudel, 1979/1981: 334) that will determine whether control over information processing creates a ‘forking of the road’ such that the outcomes of struggles over bits of power start to favour the interests of citizens.

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Endnotes

- [1] Network neutrality refers to ‘the financial and qualitative terms on which unaffiliated content and application providers ... may have their content delivered by the local access provider or Internet Service Providers...’ (Cave and Vogelsang, 2015: 1).
- [2] The Internet Protocol Suite TCP/IP supports a set of networks interconnected for a universal communication service with four layers: Link, Internet, Transport, and Application (van Schewick, 2010).
- [3] See van Schewick (2010) for the flexibility available to designers in implementing the Internet Protocol Suite and for narrow and broad interpretations of the end-to-end principle.
- [4] The US Foreign Intelligence Surveillance Act was passed in 1978.
- [5] The first national Data Act was introduced in Sweden in 1973. By 1995, the first European Data Protection Act had been introduced. In the United States, there were numerous legislative moves, the most salient in this context being the US

Federal Computer Crime Act and the Electronic Communications Privacy Act, both in 1984.

- [6] See Saltzer et al., (1981: 2) for the initial articulation of the end-to-end principle which involved a choice as to where to locate functions in the internet's layers as the communication system became a computerized distributed system. This arguably biased choices about locating such functions against the core of the network (van Schewick (2010).
- [7] E.g. the Open Systems Interconnection (OSI) protocol suite developed by the International Organisation for Standardisation.
- [8] These include the Internet Corporation for Assigned Names and Numbers (ICANN) model where governments are involved in advisory capacities; forums such as the World Summit on the Information Society (WSIS) where non-governmental stakeholders were involved but only in consultation; and the Internet Governance Forum (IGF), where multiple stakeholders participate, but without decision making authority. Governance issues related to network technologies, cybersecurity and human rights also are addressed by United Nations agencies, including the ITU, the World Intellectual Property Organization, and UNESCO (through its discussion of ROAM - rights, openness, access and multi-stakeholder – principles), as well as by the World Trade Organization and the World Economic Forum (Kleinwachter and Almeida, 2015). The history of political debate about a new world information and communication order is not discussed here, see Mansell and Nordenstreng (2006).
- [9] ITU reported that the Internet penetration rate (users per 100 inhabitants) had reached 55.3% in 2003, up from 43.5% in 2000 in North America, and 27.5% in Europe, up from 14.7% in 2000.
- [10] <https://www.statista.com/statistics/216573/worldwide-market-share-of-search-engines/>.

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