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The Communication of Capital: Digital Media and the Logic of Acceleration

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Abstract: *This paper argues that questions concerning the circulation of capital are central to the study of contemporary and future media under capitalism. Moreover, it argues that such questions have been central to Marx's analysis of the reproduction of capital vis-à-vis the realization of value and the reduction of circulation time. Marx's concepts of both the circuit and circulation of capital implies a theory of communication. Thus the purpose of our paper is to outline the logistical mechanisms that underlie a Marxist theory of media and communication and thereby foregrounding the role new media plays in reducing circulation time. We argue that the necessity of theorizing communication from a circuit and circulation-centric point of view stems from the emergence of a number of new technological phenomena that intensify, but sometimes undermine, the capitalist logic of acceleration. For the purposes of understanding the evolution of digital technologies, ostensibly employed to accelerate the circulation of capital—or put differently, to reduce circulation time—we need to pay attention to volume 2 of Capital, and key sections in the Grundrisse.*

Keywords: *Capital Volume 2, Grundrisse, marxism, media theory, digital media, mobile payment systems, convergence, acceleration, diagrammatics, cybernetics and dromoeconomics.*

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Before considering the circulation of capital and its logic of acceleration, we begin by considering an emerging area of digital media that will set the tone for a broader theoretical discussion: mobile payment technologies. Near field communication (NFC) is a set of technical specifications for short-distance transmission of data, similar to *tap-to-pay* features of some credit and debit cards. NFC allows for the secure transmission of personal data, with limited read-write abilities integrated into an NFC chipset and software. This technology builds on existing contactless standards with the goal of creating global interoperability across systems and devices; it "enables devices to share information at a distance of less than 4 centimeters with a maximum communication speed of 424kbps."[1] According to the NFC Forum (www.nfc-forum.org), a lobbying and standardization group:

> Near Field Communication is based on inductive-coupling, where loosely coupled inductive circuits share power and data over a distance of a few centimeters. NFC devices share the basic technology with proximity (13.56MHz) RFID tags and contactless smartcards, but have a number of key new features….An NFC-enabled device can operate in reader/writer and peer-to-peer mode, and may operate in card emulation mode. An NFC tag is typically a passive device (for example, integrated in a smart poster) that stores data that can be read by an NFC-enabled device.

[1] "Users can share business cards, make transactions, access information from smart posters or provide credentials for access controlsystems" (http://www.nfcforum.org/aboutnfc/nfc_and_contactless/). "Structurally, NFC Forum specifications are based on existing and recognized standards like ISO/IEC 18092 and ISO/IEC 14443-2,3,4, as well as JIS X6319-4" (http://www.nfc-forum.org/aboutnfc/interop/).

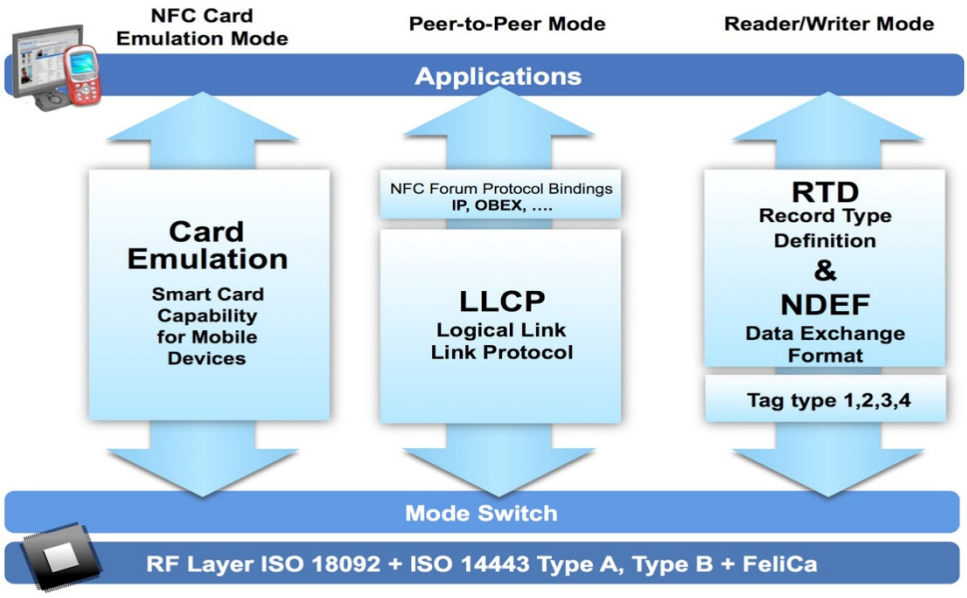

Figure 1: Schema of NFC modalities (www.nfc-forum.org, 2012)

Although NFC based-technologies have a range of uses—including healthcare, transportation, and general information collection and exchange—commercial attention has been increasingly fixated on creating mobile payment systems that would effectively eliminate the need for debit or credit cards, indeed, any kind of personal identification.[2]

NFC is a standard now supported by major corporations across the mobile ecosystem: from software developers (Google, Microsoft), to handset designers (Samsung, Research In Motion), semiconductors (Qualcomm, Broadcom, and NXP), to credit card companies (Visa and Mastercard). For example, the ISIS[3] payment network, which is now rolling out in the United States, has specifically brought together major telecommunications companies (Verizon, AT&T, and T-Mobile) and credit card companies (Visa, Mastercard, and American Express) around the NFC standard. Perhaps what is most notable for media researchers is the broad convergence between telecommunications and finance institutions and infrastructures.[4] That very convergence is evidenced by Canada's Rogers Communications' recent application to become a bank and creditor.[5]

NFC not only demonstrates a new political economic configuration for media and finance industries, but at a more micro level, NFC points to two of the most defining characteristics of contemporary digital media: personalization and ubiquitous connectivity. These qualities are not simply autonomous expressions of technological change, but as we will argue, they reflect a teleology of digital media itself—one largely shaped by the barriers existing in capital's sphere of circulation. Indeed, we hope to situate these new phenomena within Marx's theorization of circulation, but also suggest new theoretical modes of analysis that expose new tensions and prospective contradictions.

[2] There have been a number of alternative mobile payment systems proposed, reflecting a diversity of interests; for example, PayPal's cloud-based approach to mobile payment is seen as a potential competitor of NFC (Barr 2012). Startup company Square has also offered a mobile payment service using a card reading adaptor that plugs into a mobile device (https://squareup.com/). Hedging its bets, Visa has invested heavily in Square (Barth, 2011). Joining the mobile payment race, Apple is using its mobile iTunes app to allow Apple iPhone users to charge purchases of items in-store to their account using a special Apple store app (Boland, 2011). Apple is also actively developing a portfolio of mobile payment patents (Tode, 2012). However, what distinguishes NFC is the broad support it has from major corporations across the mobile industry.

[3] http://www.paywithisis.com/

[4] More recently, pressure from credit card and banking companies on retailers to upgrade pay terminals to accept "smart cards" may result in the added inclusion of NFC compatibility. "Merchants are facing heavy pressure to upgrade their payment terminals to accept smart cards. Over the last several months, Visa, Discover and MasterCard have said that merchants that cannot accept these cards will be liable for any losses owing to fraud… While updating the terminals for smart cards, VeriFone also plans to upgrade for smartphone wallets, providing the capability for near-field communication, the technology used by the Google and Isis wallets, the two biggest smartphone wallet projects" (Brustein, 2012b). This pressure may help NFC reach a critical mass for widespread adoption of mobile payment by consumers and retailers.

[5] "The [Rogers] bank would likely primarily deal in credit and mobile payment services, as opposed to bricks and mortar bank branches that take traditional savings and loan accounts" (Evans 2011).

We argue that NFC is just one small example of a more general evolution of digital media in line with capital's *logic of acceleration.* It is precisely this logic we will address by examining and situating the place of communication media within the overall circuit of capital. We therefore want to reframe the analysis of media from the perspective of capital; that is, we want to take capital as the *subject* and *purpose* of communication, a subject whose communicative activity is shaped by the circulation process. Media enable capital to move as an iterative process and is therefore the key component for capital's circulation; and it is media, we argue, that are the means by which capital communicates itself to itself in and through society.

This paper argues that questions of circulation are central to the study of contemporary and future media under capitalism; that is, of the critical analysis of *capitalist* media specifically. Moreover, it argues that such questions—questions that evidence strong parallels with those of media theorists and historians largely outside of the Marxist tradition—have been central to Marx's analysis of the reproduction of capital vis-à-vis the realization of value and the reduction of circulation time. Marx's concepts of the circuit and circulation of capital implies a theory of communication. Thus the purpose of our paper is to outline the logistical mechanisms that underlie a Marxist theory of media and communication that foregrounds the role new media play in reducing circulation time.

Few authors have approached media from the perspective of the circuit or the circulation of capital, though there are notable exceptions (Garnham 1990; Martin 1991; Fuchs 2009). Nicholas Garnham calls for an approach to Marxist theories of communication that eschews the vertical base-superstructure approach for one that treats capitalism as a horizontal "process which is continuous, circular and through time" (Garnham 1990, 45). According to Garnham, the circulation of capital—in essence classical Marxist value theory—is the "crucial starting point for any political economy of mass communication" because it refocuses analyses of communication on capital's physical, spatial and temporal moments of its self-realization (Garnham 1990, 45). He suggests that a comprehensive analysis of most media phenomena can be gained from a focus on the circulation of capital (Garnham 1990, 45-53). Although Garnham made his suggestion decades ago, Marxist media studies is dominated by production-centric or base-superstructure analyses. Christian Fuchs (2009) is one of the few exceptions. He argues that for a "systematic location of the media in capitalism, one can take as a starting point the Marxian circuit of commodity metamorphosis and the accumulation of capital as it is described in Vol. 2 of *Capital*" (Fuchs 2009, 377). The benefit of using the circuit of capital is that Fuchs is able to treat capitalism as a system of production, circulation and consumption of both commodities and ideologies.

We argue that the necessity of theorizing communication from a circuit and circulation-centric point of view stems from the emergence of a number of new technological phenomena that intensify, but sometimes undermine, the capitalist logic of acceleration. Two contemporary examples will help illustrate this necessity. On the one hand, the convergence of telecommunications and finance industries in the form of mobile payment systems and technologies like NFC allude to a broader conceptualization of communication media as a moment in which both circulation and exchange are re-commodified and sold to consumers. Mobile payment systems allow a logistical efficiency (through personalization) in both the communication of marketing messages *and* in the realization of value, fused together in one ubiquitously connected technology. On the other hand, the growth of digital piracy suggests the disintegration of the commodity form as the circulation of capital approaches the speed of light (or twinkling of an eye)—a phenomena that will reach new levels of intensification with the deployment of more bandwidth, and consumer adoption of 3D printers (Kjosen 2010).

How can we understand the development of these often contradictory or self-defeating technological systems using Marxist political economy? For the purposes of understanding the implementation of such technologies that are ostensibly employed to accelerate the circulation of capital—or put differently, to reduce circulation time—we need to pay attention to *Capital Volume 2*, and key sections in the *Grundrisse*.[6] It is here that we find clues to capital's logic of acceleration underlying the communication of value through the circuit(s) of capital and the evolution and rollout of contemporary and future digital media. Our goal is to situate the ongoing evolution of contemporary media within an existing logic identified by Marx in *Capital Volume 2* and *Grundrisse.* We add to Marx's analysis a focus on the formal and material qualities of specifically *digital* media. To do this we employ theorists in the media theory tradition (Harold Innis, Marshall McLuhan, Friedrich Kittler, and others). In so doing we ground the logic of acceleration within the materiality of contemporary digital media, and in so doing uncover prospectively new tensions and contradictions.[7] The new-

[6] See Marx 1973, 401-423, 516-549, 618-690, 717-735.

[7] It is beyond the scope of this paper to consider resistance and class struggle in relation to circulation. Revealing how capital can be short circuited, however, is the ultimate goal of our exploration of the increasing importance of circulation.

ness of our contemporary moment lies in the maturation (in complexity, sophistication, profitability) of digital media and the development and convergence of the telecommunications and media industries. Out of this convergence, the digital form allows the moment of exchange to become ubiquitous and immediate. Indeed our opening example of NFC encapsulates this phenomenon.

Digital media not only offer an acceleration of circulation in time and space, but through personalization, provide new vectors for capital; finding the shortest route between the point of production and exchange, and producer and consumer. Thus in addition to its acceleration, circulation becomes diagrammatic through personalization (Elmer 2004, 41-48).[8] The *telos* of acceleration, however, is the suspension of circulation and with it (re)production based on capital. What we identify as new is how the logic of acceleration is being taken to its logical end in the conditions of ubiquity and immediacy engendered through digital media. In our analysis of communication media, capital is posited as an anti-human subject[9] engaged in an ever-intensifying iterative process—a process in which value is communicated as self-augmenting difference, as "value in motion."

1. The Circuit of Capital

Garnham (1990) and Fuchs (2009) argue that media and communication should be systematically located to the circuit of capital. We take their argument one step further and argue that what capital communicates is value, that the circuit of capital (M – C…P…C' – M) can be understood as a schematic for this communication of value and that consequently the circulation of capital can be understood as a theory of communication.[10]

The circulation of capital incorporates the circulation of commodities on the market (C-M-C) as a moment of its own process. It is important to bear in mind, however, that the circulation of commodities is wider than an individual circuit of capital; C-M-C can also refer to general circulation, in which all individual circuits of capital interact. "The circulation of capital… contains a relation to general circulation, of which its own circulation forms a moment, while the latter likewise appears as posited by capital" (1973, 619-620). The sphere of circulation refers to more than simply market exchange. Nicholas Garnham argues that within the sphere of circulation "we need to look at what

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Research (for example, Bonachich and Wilson 2008, 239-243) suggests that labour has been generally weakened by the recent logistics revolution. However, the streamlining and rationalization of the supply chain has given workers that are strategically positioned in the distribution network more potential class or bargaining power (Silver 2003, 100-103; Bonachich and Wilson 2008:244-249). Similarly, unionized and non-unionized workers in the telecommunications industry have repeatedly demonstrated that capital's circulatory infrastructure can become a site for class struggle (see Mosco and McKercher 2008).

[8] D. N. Rodowick describes diagrammatics as "the cartography of strategies of power," and thus the figure of the diagram helps depict "a historical image of how strategies of power attempt to replicate themselves in forms of surveillances, documentation, and expression on the one hand, and in the spacial organization of collective life on the other" (quoted in Elmer 2004, 41-42). Elmer writes, "In the realm of contemporary infomatics, the diagram therefore allows us to trace the everyday data economy in which habits, routines, rhythms, and flows are digitized, coded, and diagnosed for the purposes of control" (Elmer 2004, 47).

[9] Here we take capital to be both a structure and a subject in the process of its self-communication (and therefore, reproduction) through time. This rhetorical strategy is frequently employed by Marx throughout the volumes of *Capital* wherein capital acts as subject, or agent, for which the capitalist is simply a personification of capital's own agency. For example, Marx writes "…in the circulation M-C-M both the money and the commodity function only as different modes of existence of value itself, the money as its general mode of existence, the commodity as its particular or, so to speak disguised mode. It is constantly changing from one form into the other, without becoming lost in this movement; it thus *becomes transformed into an automatic subject*. If we pin down the specific forms of appearance assumed in turn by self-valorizing value in the course of its life, we reach the following elucidation: capital is money, capital is commodities. In truth, however, *value is here the subject of a process* in which, while constantly assuming the form in turn of money and commodities, it changes its own magnitude, throws off surplus-value from itself considered as original value, and thus valorizes itself independently. For the movement in the course of which it adds surplus-value is its own movement, its valorization is therefore self-valorization. By virtue of being value, it has acquired the occult ability to add value to itself. It brings forth living offspring or at least lays golden eggs. As the dominant subject of this process, in which it alternately assumes and loses the form of money and the form of commodities, but preserves and expands itself through all these changes, value requires above all an independent form by means of which its identity with itself may be asserted" (italics added, Marx 1976, 255). Later in the chapter on "The Working Day," Marx writes, "As a capitalist, he is only capital personified. His soul is the soul of capital. But capital has one sole driving force, the drive to valorize itself..." (Marx 1976, 342).

[10] Importantly, because capital is a circuit or a closed feedback loop, capital can be understood as both the subject and purpose of the communication of value. In Grundrisse, Marx argues that when the circulation of commodities is incorporated into the life process of capital, it gives the process the content of value (1973, 626). Marx writes that capital "exists as the subject of circulation" and that it is the "predominant" subject of the metamorphoses of value (1973, 620; see also 1976, 255). We argue that capital is an anti-human subject that seeks to transmit value-content through the circuit, which can only occur by forcing the content to assume and discard the three forms of capital. In this communication process, other actors, such as workers and capitalists, are reduced to mere relays (transmitters and receivers) or a data source in the case of living labour.

Marx called the locational and temporal moments, referring to the problems both of the actual spatial extensions of the market (the physical transport of goods) and the time expended in commercial transactions (this time refers not to any labour time used in commercial transactions, but to the actual lapsed time expended in transforming a commodity into money and vice-versa...)" (1990, 46).

As Marx explains in the second volume of *Capital*, capital is a circuit because it enables a quantity of value to pass through a sequence of three mutually connected metamorphoses. As it passes through these stages, value both maintains itself and increases its magnitude. Once it has moved through each of these stages, capital has completed one turnover and can repeat the process anew.

Figure 2 depicts the circuit's three stages: the sphere of production (stage 2) and circulation (stages 1 and 3**)**; and the three particular forms of capital (money [M], commodity [C] and productive-capital [P]). When capital fulfils the specific function of one of its particular forms it completes a stage and assumes the next form. Stage 1 is completed by the capitalist using money's function as means of payment and/or purchase to acquire labour-power and means of production. When these commodities are set in motion as productive capital (P), and are productively consumed, the second stage is completed. The result of the production stage is a mass of commodities (C') with a higher quantity of value than originally advanced. The third stage is completed when the commodity's function of being bought and sold is fulfilled, thereby realizing the surplus value created in production, and making capital accumulation possible in the first stage (Marx 1978, 132-133).

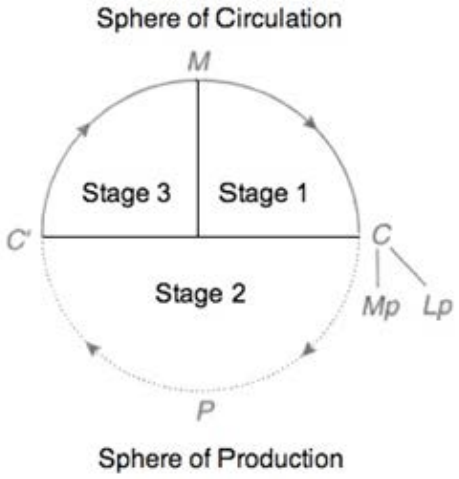

Figure 2: The circuit of capital (adapted from Lebowitz 2006: 61)

The circuit is Marx's concept of capital. It is the universal form within which the particular forms of capital are internally related. The identity of capital can thus be found in its unity and in the difference to itself as unity. This *negative unity* is found when capital exists in either of its stages or forms (Arthur 1998, 102-116). Capital is found in two aspects: "first as the unity of the process, then as a particular one of its phases, itself in *distinction* to itself as unity" (Marx 1973, 622). Capital is unified in the movement from its universal to particular forms. Although the forms of money-, productive- and commodity-capital are necessary for the existence of capital, the particular forms are not in and for themselves capital. Outside the circuit they simply function as money, commodities and labour processes. Only in the circuit do they also have the social function and forms of capital (Arthur 1998, 107). The three forms are only capital insofar as they are internally related to each other in the totality of the circuit and are the functional forms of circulating capital (Arthur 1998, 102; Marx 1978, 133). In other words, they are forms of capital because each form is the possibility of assuming the next form and completing and moving to the next stage of the circuit, and because of their specific functions in the overall circuit (Marx 1978, 112). When capital is in negative unity, it is only potentially capital and perpetually becoming—it is capital if, and only if, it can discard its current form and metamorphose into the next form, which occurs only when the associated function is fulfilled. Money-capital is latently productive capital, which is the possibility of commodity capital that in turn is the becoming of money-capital.

Marx's conceptualization of capital as a circuit is nearly identical to Hegel's Concept because *formally* capital is a process that moves from universal to particular forms; in order for capital to be capital it must assume each of the forms and complete its associated stages (Arthur 1998). How-

ever, Marx denies that capital can automatically complete the circuit and he also denies it the fluidity and speed of thought of the Concept. For Marx, it is never guaranteed that an individual capitalist will complete a turnover:

> The three processes of which capital forms the unity are external; they are separate in time and space. As such, the transition from one into the other, i.e. their unity as regards the individual capitalists, is accidental. Despite their inner unity, they exist independently alongside one another, each as the presupposition of the other. Regarded broadly and as a whole, this inner unity must necessarily maintain itself to the extent that the whole of production rests on capital, and it must therefore realize all the necessary moments of its self-formation, and must contain the determinants necessary to make these moments real (Marx 1973, 403).

In other words, the formal circulation of capital (inner unity) contradicts its *real* circulation process (external unity), in which capital assumes a *material* form alongside its particular economic forms. The first obstacle to capital's circulation is that capital must "*invest itself in matter*, something that may in fact be resistant to it" (Arthur 1998, 117). This is why capital "*risks* getting tied up for certain intervals," because it is never guaranteed that capital will metamorphose into its next form (Arthur 1998, 133). Consequently, circulation must be considered from both its formal and real moments.

Real circulation refers to the actual circulation of matter, i.e. the movement at a given speed, of commodities and money through space and time. Real circulation thus includes transportation, infrastructure, vehicles, packaging, warehouses, banking, and so on. Consequently, the circulation of capital is inherently a logistical affair that requires a specific organization or binding of space and time[11]. In addition, this affair has always been about accelerating capital's movement and has been done through progressive re-organizations of space and time and the adoption of newer and faster media such as jet transportation, container shipping and digitization together with telecommunications.

There are several benefits for capital to accelerate its metamorphoses. Because the sum and mass of surplus value created within a period is negatively determined by the velocity of capital the faster capital moves through the sphere of circulation, the more surplus value will be created and validated. The rate of surplus value and profit may be increased by acceleration when speed contributes to reduce circulation costs (Marx 1973, 518; 1978, 124, 389). In a given period, the velocity of turnover substitutes for the volume of capital (Marx 1973, 518-519, 630). It is also beneficial for individual capitalists to reduce their turnover in relation to the social average turnover time (Harvey 1989, 229).

For accumulation to take place, capital must constantly move between the two spheres of production and circulation; although surplus value is created in the sphere of production, it must be *realized* and accumulated in the sphere of circulation. This realization is a necessary condition and moment of the entire motion of capital: capital is the unity-in-process of production and circulation (Marx 1973, 405-6, 535, 620; 1978, 205). Effectively, capital must always be in motion in order to *be* capital; when capital is not in movement, it is stuck in a particular form and stage and is therefore negated and devalued (Marx 1973, 621). It is because of this negation and devaluation that capital must increase its velocity while decreasing the time it spends in circulation. To accelerate, however, capital must develop or adopt media that allows it to bind space and time, and thereby progressively overcome the barriers capital posits to its functioning.

2. On Barriers: Space and Time

In *Grundrisse*, Marx argues that capital posits barriers in contradiction to its tendency to function freely and expand boundlessly, delaying the transition of capital from one form and phase to the next and/or limit the quantity of surplus value produced and realized within a given period (Marx 1973, 421, 538). Marx identifies necessary labour as a barrier in the sphere of production; and need/use-value, availability of equivalents (money), space and circulation time as barriers belonging to the sphere of circulation (Marx 1973, 404-405, 542-543).

To "release its own potency" capital constantly tries to overcome its barriers (Negri 1984, 115). We posit that capital relies on various media technologies to overcome these barriers. The function of machinery in the sphere of production is to manipulate time, i.e. decrease the necessary labour of the worker. Media have a similar function of manipulating time, but belonging to the sphere of circulation media may manipulate circulation time rather than labour time. Media are employed in

[11] It is only recently, however, that logistics have become a central concern for the managers of capital (Bonacich and Wilson 2008, 3-4).

the sphere of circulation in order to reduce circulation time, which can increase the mass of surplus value produced within a given period and/or reduce costs associated with circulation (i.e. storage). More importantly, media can reduce circulation time by enabling capital to overcome the barriers of need, money, space and time—for example, new infrastructure. Larger and faster vehicles enable capital to overcome the barriers of need, space and time by extending markets in space, annihilating space with time or reducing absolutely the time capital circulates from a given place to the other. Credit is an example of a medium that enables capital to overcome the barrier of money, but as we will explain below, it also acts to increase the speed *and* vector of capital's circulation. What is peculiar about mobile devices is that they open up for dealing with these barriers simultaneously as we will discuss in the following section.

The circulation of capital proceeds in space and time. As capital extends itself in space and strives to make the earth into a market, capital tries to "annihilate this space with time, i.e. to reduce to a minimum time spent in motion from one place to another" (Marx 1973, 539). That space is annihilated by time means that spatial distance is reduced to temporal distance; spatial extension folds into circulation time. Thus the annihilation of space by time becomes identical to abbreviating the circulation time of capital. Circulation time is also a barrier to capital because the time spent in circulation is time that could be used for the valorization of value. The barriers around use-value and equivalents are also significant, but will be addressed later in the paper.

In other words, circulation time is a deduction from production time, specifically a deduction of surplus labour time (Marx 1973, 538-539). The maximum number of repetitions is reached when the velocity of circulation becomes *absolute,* i.e. when circulation time is zero. If this occurs there would be no interruption in production resulting from circulation and overall turnover time would be equal to production time (Marx 1973, 544-45, 627). It is the "necessary tendency of capital to strive to equate circulation time to 0; i.e. to suspend itself, since it is capital itself alone which posits circulation time as a determinant moment of production time" (Marx 1973, 629). The closer circulation time comes to zero "the more capital functions, and the greater is its productivity and self-valorization" (Marx 1978, 203). It is in this tendency that capitalism seeks new methods of communicating value at ever-greater velocities. Capital's increasing attention to logistics or supply chain management – as evidenced in the rapid development of telecommunications and transportation infrastructure – comes from this logic of acceleration, which is identical to reducing circulation time.

As an example of the apotheosis of this drive consider recent investments in fiber-optic trans-Atlantic cables purporting to shave off six milliseconds of transmission time. Cable company Hibernia Atlantic is currently building the first new trans-Atlantic cable in a decade. By shortening the cable length by approximately 310 miles, the four-fiber pair optical cable system promises to reduce transmission time between London and New York by six milliseconds from the current 65-millisconds. In the world of high-frequency, trading time is not measured according to the human scale, but the anti-human scale of algorithms and software bots with the salient being the millisecond. For human action and perception, the milliseconds saved means nothing, but for high-frequency financial trading houses that rely on algorithms to execute buy and sell orders, a single millisecond could result in as much as $100 million to the annual bottom line (Hecht 2011; Williams 2011). Fifty-nine milliseconds between London and New York is, however, not fast enough for the world of algorithmic finance capital.

Although for so-called humans the world shrinks to nothing when our electromagnetic media operate at speeds of 60 to 90 percent of the speed of light, the expanse of the globe is massive for anti-human subjects that reckon time in microseconds. The fastest fiber-optic route between New Jersey and Chicago is approximately 16 milliseconds. In the world of algorithmic trading, according to Donald MacKenzie (2011), it's "a huge delay: you might as well be on the moon." Indeed, Andrew Bach head of network services at NYSE Euronext said that "[t]he speed of light limitation is getting annoying" (in Hecht 2011). More recently, researchers are exploring the possibility of further shortening the time distance between financial centres by shooting neutrinos *through* the earth. The use of neutrinos to communicate financial transactions is significant because "neutrinos travel at the speed of light" thus "traders using the technology would on average have a nearly 30 millisecond time advantage, with participating London and Sydney brokerages garnering a full 44 milliseconds" (Dorminey, 2012).

Through the unfolding *telos* of capitalist media, circulation time is reduced to the point of elimination, or at least to an intensive time that has no meaning to humans. There is, however, a limitation to the acceleration of capital. In *Grundrisse* Marx argues that

> circulation time *must* appear as a deduction from its production time… the nature of capital presupposes that it travels through the different phases of circulation not as it does in the mind, where one concept turns into the other at the speed of thought, in no time, but rather as situations which are separate in time. It must spend time as a cocoon before it can take off as a butterfly (1973, 548-49).

Although capital is working towards the elimination of circulation time—indeed, it is its tendency to strive towards a circulation time of zero (Marx 1973, 629; 1978, 203)—but if this was actually achieved capital would negate itself. Absolute velocity is represented as a circulation time of zero, which is nothing but the suspension of the sphere of circulation. Without the moment of exchange, surplus value cannot be realized and capital is therefore negated. If circulation time is suspended, it would be the same as to "suspend the necessity of exchange, of money, and of the division of labour resting on them, hence capital itself" (Marx 1973, 629).

The phenomenon of digital piracy can be understood as capital having reached absolute velocity (Kjosen 2010). Digitization allows the commodity to shed its form and can take off, creating what Nick Dyer-Witheford poetically dubs "instant butterfly" (Dyer-Witheford 1999, 202). Since the Internet and computers operate according to the speed of electronic pulses bound by basic laws of electromagnetism, the three stages of the circuit occur simultaneously. There is no time for capital to proceed through its metamorphoses; there must be latency between capital's various moments in order for it to metamorphose properly. The phenomenon of digital piracy should be understood as capital breaking its own speed limit and therefore being unable to metamorphose properly so that an aliquot part of capital cannot assume the commodity form. In other words the commodity form may disintegrate at the speed of electromagnetic waves, and consequently the circuit of capital leaks value (Kjosen 2010:87-102).

3. On the Convergence of Universal Equivalents: Money and Digital Code

"Money as such has become a pseudo-event – information only" (McLuhan and Nevitt 1972, 78)

Capital must "*invest itself in matter*, something that may in fact be resistant to it" (Arthur 1998, 117). The ability of capital to be transported or transmitted depends on both the economic and material form that capital takes—this materiality also includes the encoding of digital data and electromagnetic waves. For example, the mobility of commodity capital depends on the means of communication and the natural qualities of the commodity, such as weight, size, fragility and perishability. The mediation of capital in this way requires the specific organization and production of space and time (Harvey 1989).[12] It is in this process that capital relies upon various media to bind space and time in ways commensurable to its logic of acceleration. The digital form takes this logic to its natural end.

Here we focus on digital code as a "form of appearance" assumed by capital, a form unique to our contemporary moment. The formal qualities of digital code and the material infrastructure enabling its storage and transmission are simultaneously precursors and expressions of "informational capitalism" (Fuchs 2010). To situate the development of specifically *capitalist* media within a broader history of media change (which allows us to foreground formative, material, and technical difference in different media), we turn to the medium theory tradition (Innis, McLuhan, Kittler) to get a sense of how this logic is reflected in the material and technical composition of media. Specifcally, we find an analysis of how media are central to the organization of space and time that bridges phenomenology and political economy. As Harold Innis (1964; 1995) argues, media organize space and time and thereby contribute to the reproduction (or disintegration) of social/power structures. For this tradition, however, media are conceived broadly to include institutions, organizations, and technologies (Comor 2001, 276).

Analyzed comparatively, different media emphasize different space/time ratios, reflecting the relative bias of a given medium. In comparison to media that emphasize their persistence through time (architecture, stone engraving, religious rituals and institutions), media that emphasized the control of space are said to possess a *spatial bias*. For Innis, spatial bias refers to media, such as the price system and the market that break up time into "discrete, uniform, measurable chunks that can be valuated in money terms" (Babe 2000, 73; Innis 1995, 66-87). For example, Innis notes that the spatial bias of the price system in Western political economies "facilitated the use of credit, the rise of exchanges, and calculations of the predictable future essential to the development of insurance" as a way to predict the future and minimize risk (Babe 2000, 72; see Innis 1964, 33-34).

[12] Indeed, it is precisely this process that is captured by Harvey's (1989) concept of "space-time compression."

Moreover, the concept of bias is also a reflection of a medium's capacity to bind space and time in accordance with the reproduction of a given political economic configuration. "The development and application of the concept of bias emerged from Innis' application of the term 'capacity'" and for Innis, "capacity is an index of potential" (Comor 1994, 122-123). Thus, "capacity involved Innis in analyses of the limitations and opportunities faced by people in their day-to-day lives and the factors that may influence them in any given place and at any particular time…History, therefore, involves communication media, broadly defined, as the means through which the production process can be pursued and as tools providing the capacity to utilize information" (Comor 1994, 123).

In relation to capital, capacity and potential should be understood as referring to the production of surplus value. There is always unused capacity in the sphere of production, which is in part what Marx refers to with the concept of relative surplus value. Media that reduce circulation time or overcome other barriers effectively release the productive potential of capital. Time set free in the sphere of circulation can be converted into surplus labour time.

In the effort to overcome the physical, spatial and temporal barriers to circulation, digital code is one of the dominant forms in which capital now invests itself because digitization is acceleration. In digital form, capital's real circulation approaches capital's formal and ideal circulation. Indeed, digital data appears to be the perfect medium for self-valorizing value. When something is digitized it exists only conceptually or symbolically, which represents the primacy of images and signs over material objects. Any object rendered digitally is a numerical representation (Manovich 2001, 52).

Digital code abstracts all qualitative differences into pure quantity. Inside the computer "everything becomes a number: quantity without image, sound, or voice" (Kittler 1999, 1). Effectively all use-values are transformed into the singular anti-human use-value of binary code. Any difference between digital objects is quantitative rather than qualitative (Manovich 2001, 27-30, 174; Kittler 1999, 1-2). Their qualitative differences—intelligible to human senses—are merely *surface effects* or *superficially distinct forms* (Kittler 1999, 1; Betancourt 2006). Digital code, like money, is a universal equivalent; it reduces qualitative differences into pure quantity.

Binary code or digital data is, like money, a universal equivalent that can represent qualitatively different objects in terms of pure quantity. In *Capital Volume 1*, the function of the universal equivalent is that it brings all commodities into relation with each other and makes them appear as exchange-values, i.e. quantity without any reference to their qualitative aspects. Money represents the world of commodities and can be translated and transformed into any commodity. In the form of digital code, value-as-money merges with a *material* form that is equivalent to its quality of being pure quantity.

The transmission of digital data is tautological: the immediate result is an increase in information and not a change of form. This material tautology is potentially of enormous benefit to capital: digital commodities require minimum storage and nearly no upkeep because the additional copy does not exist until it arrives onto the digital device of a consumer. Digital data appears to be produced *ex nihilo*, with almost no expenditure of living and dead labour.[13]

Most importantly, however, is that capital in the form of bits is less resistant to circulation than when it is comprised of atoms; in digital form, capital can circulate at the speed of electromagnetic waves. There is no need for a real metamorphosis of qualitatively different material forms; what is left of the circulation of commodities on the integrated circuit are mere differences in voltage and a proliferation of digital data. At the speed of electromagnetic waves the expanse of the earth is reduced to nothing. Without having to traverse real space, the time capital spends in the commodity form due to transportation is eliminated. Capital in digital form has little dead time compared to substantial commodities; it spends literally no time negated and devalued in its commodity form.

In one of his prophetic probes, Marshall McLuhan correctly observed that there is a "steady progression toward commercial exchange as the movement of information itself" (1964, 149). We should be under no illusions that this is exactly what has happened with financial exchanges. M – M' is the archetypal commercial exchange as movement of information. With technologies such as NFC, this process occurs with the traditional metamorphosis of commodities as well.

4. Consumption Capacity and the Communication of Capital

In the pages Marx dedicates to the circulation and reproduction of capital lie a teleology of capitalist media in which capital is the subject of communication. As Marx often characterizes capital (or its personification in the bourgeois capitalist) as the agent, and sometimes protagonist, of the volumes of *Capital,* we assume a similar starting point to understand the relationship between

13 For a critique of the argument that the digital represents production without consumption of resources, see Michel Betancourt (2006; 2010).

communication and capital's logic of acceleration. However, for capital, communication constitutes a spectrum that spans logistics and cultural production (including ideology). It is from this communicative spectrum that we can reveal capital's logic of acceleration within the evolution of contemporary digital media. Yet as we initially noted, it is not simply a quantitative increase, but additionally that personalization and connectivity enhance the *vector* of capital's circulation. Acceleration becomes diagrammatic as capital's circulation is overlaid onto the ubiquitous flows of personalized data.

We argue that qualities of ubiquitous personalization and connectivity offer clear evolutionary examples directed at overcoming two crucial, yet interconnected, barriers external to capital's internal unity by binding space and time in accordance with the needs of circulation. In a lucid passage from the *Grundrisse*, we might refer to as the "Fragment on Communication" (Marx 1973, 398-423), Marx explicates capital's communicative spectrum in light of two significant barriers. The first barrier is a cultural barrier involving the expansion of needs, use values and desires; the second involves the means to pay. As Marx writes: "Its first barrier, then, is *consumption itself*—the *need for it*…Then, secondly, there has to be an equivalent for it" (Marx 1973, 404-405). Taken together these two barriers reflect a specific consumption *capacity* or *magnitude*. While the first barrier traces the entire evolution of the advertising and marketing apparatus (and its migration onto digital platforms), the latter has been overcome by the creation of credit and crediting mechanisms (whose expansion has been directly related to digital media and infrastructure; see Manzerolle 2010). What we find increasingly with digital and new media are the converging poles of capitals' communicative spectrum in the articulation of consumption capacity. Cultural and logistical barriers find their articulation, and prospective panacea, in the proliferation of personalized and networked devices. Moreover, we might assess how consumption capacity articulates a very specific organization (and production) of space and time.

It is significant that the fragment on communication is preceded by a brief passage on the creation of free time in society.

> It is a law of capital… to create surplus labour, disposable time; just as it is equally its tendency to reduce necessary labour to a minimum…it is equally tendency of capital to make human labour (relatively) superfluous, so as to drive it, as human labour, towards infinity. (Marx 1973, 399)

As more free time is created, so too are the productive capacities of the social individual. Importantly, free time gives way to the more full development of the social individual, and of culture generally, a process of enculturation that creates an ever-greater diversity of needs. As culture grows in complexity and sophistication, so does the individual.

> [T]he cultivation of all the qualities of the social human being, production of the same in a form as rich as possible in needs, because rich in qualities and relations—production of this being as the most total and universal possible social product, for, in order to take gratification in a many-sided way, he must be capable of many pleasures, hence cultured to a high degree – is likewise a condition of production founded on capital. (Marx 1973, 409)

Because surplus value relies on the production of free time to increase the ratio between necessary and surplus labour, capital also creates free time generally, allowing for the expansion of cultural activities, and as a result capital can circulate more freely as surplus value is realized through an expanding set of needs variously produced by the culture industry.

Consequently, the consumption associated with this expanding bundle of needs comes to reproduce "the individual himself in a specific mode of being, not only in his immediate quality of being alive, and in specific social relations" (Marx 1973, 717). The social being of the individual and the circulation of capital are tied to the perpetual modulation of consumption. It is for precisely this reason that free time can be mobilized to serve the circulatory needs of capital, particularly through the advancement of information and communication technologies (ICTs) (Webster and Robins 1999; Manzerolle 2011). Both the cultural sphere of consumption (use values) and the political economic development of ICTs reproduce a *social being* whose capacities develop in line with the requirements of circulation.

The development of free time is important for another reason: It creates new moments within daily life that can be subsumed into, and is an expansion of, circulation itself. On this note, Smythe identified the productive capacity of attentional forms and the mobilization of audiences towards an expanding array of new use values (Smythe 1981, 40; McGuigan 2012). The colonization of every-

day life by digital and networked devices has opened up new pores, cracks, and crevices of daily life into possible moments of communicative utility in service of capital's logic of acceleration. As Leopoldina Fortunati has suggested, mobile ubiquitous media help fill the pauses and downtime of everyday life with potentially new moments of "communicative use" (2002, 517). The intensifying technological mediation of human capacities by digital media give way to the exploitation of free (often enthusiastic) labour of users (Zwick et al. 2009).

The rise of web 2.0 (and its various corollaries) evidences the growing, increasingly necessary, input of free labour to capital's circulation. The unpaid work in free, or unwaged, time is constantly a point at which capital seeks to harness capital's spiralling algorithm of accumulation. Capitalism here requires a cultural exteriority as a source for future commodification. As Marx tacitly suggests, capital creates greater free time in order to subsume that time for the purposes of circulation (Marx 1973, 401). Using an analogy Marx deploys to understand the necessary work of circulation, this creative and communicative labour "behaves somewhat like the 'work of combustion' involved in setting light to a material that is used to produce heat" (Marx 1978, 208). In free time, produced and/or enabled by ICTs, human capacities (creative, cognitive, attentional and affective) act as fuel speeding up the circulation of capital (see Stiegler 2010). Of specific importance is the creation, whether explicitly or implicitly, of a mass of personal data (Manzerolle and Smeltzer 2011).

Thus in trying to overcome the various barriers to circulation, capital's specific organization and management of space and time is crucial, but only insofar as this management coincides with the production of an expanding bundle of needs and the related ability to purchase commodities. This is where the capitalist development and application of ICTs – including a wide variety of ubiquitous, personalized, mobile digital media – becomes so crucial to the overall circulation of capital, but specifically the transformation of commodity-capital into money. Similarly, the ubiquity and instantaneity of personalized digital media offers the possibility of precisely coordinating production and consumption, replacing the traditionally accidental and ideally anonymous moments of exchange with over-determination that comes from the ability to identify and pin-point consumers in space and time. It is by this very process that capital enhances the vector of its circulation and makes the circuit diagrammatic.

The twinkling of an eye becomes a metaphor for the electronic pulses that encompass all cultural and economic information. We take as emblematic of this process the current evolution of mobile payment systems, but perhaps more generally, the convergence of communication media and crediting mechanisms. Consumption capacity is increasingly articulated in and through digital media, and we can situate the development of mobile payment technologies like NFC within the process to generally heighten consumption capacity while offloading costs onto consumers for their means of consumption—in this case the convergence of telecommunications and finance opens up new areas of commodification through digital data, in addition to the general expansion of consumption capacity.

The digital devices that enable our articulation as communicating subjects also act to absorb and translate our behaviour into usable flows of data. As many recent commentators have suggested, we live in an era of *big data* in which the production of data is no longer a competitive obstacle for capital (Hardy 2012; Lohr 2012); now it is the ability to store, process, and mine an immense accumulation of personalized or scalable data. Thus in the same way that industrial machinery absorbed the physical and intellective capacities of the worker in the sphere of production, so too, our networked environment absorbs the digital streams produced by the very nature of personalization and connectivity in the sphere of circulation. For this reason, it is not surprising that such processes are *baked* into the design, technical composition and functionality of smartphones—particularly in light of the rapid global adoption of these devices in both so-called developed and developing markets (ITU 2011). Indeed, such surveillance operates on at least three levels—operating systems, carriers, and third-party applications—creating a torrent of personal data flowing to and from these connected devices virtually ubiquitously. This invisible dataveillance is an embedded component of our social lives and relationships as they are increasingly mediated by digital networked technologies. Social networks like Facebook leverage the social work of users to subsume them, turning them into a means of piggybacking the circulatory requirements of capital onto the social relationships (and unpaid cultural labour) of communicating subjects.

The increasing economic centrality of personal data—and the various forms of paid and unpaid digital labour enabled by mobile digital media—was recently raised in a TechCrunch interview in which Tim O'Reilly (web 2.0 guru) and Reid Hoffman (founder of LinkedIn) were asked to theorize what web 3.0 might entail. Although acknowledging the problems behind the characterization *3.0*, they both claimed that the World Wide Web will be increasingly powered primarily by the explosion

of personal data generated by digital and networked media. Hoffman explains that web 3.0 comprises "a torrent of innovation that's going to be unleashed by all of this personal data being collected" (TechCrunch 2011). Moreover, they both note how web 3.0 fundamentally does away with anonymity as a basic characteristic of the Web, once and for all, as online and offline identities are fused together. This is perhaps one of the most significant, yet least understood transformations of modern digital media. Unlike the previous era, in which personal data was segregated in silos by institution specific databases, the era of personalization and ubiquitous connectivity not only provides exponential growth in the quality and quantity of personal data, but also allows that data to be automatically indexed by user and location (primarily through mobile services).

To what end? Digital media help transform our very social being into multiplying nodes in the process and vectorization of circulation. As Marx notes, the overall effect on social being is to turn individuals into independent centers of exchange, ever-more subjected to the rhythms of this intensifying circulation process.

> Consumption is mediated at all points by exchange…To each capitalist, the total mass of all workers, with the exception of his own workers, appear not as workers, but as consumers, possessors of exchange values (wages), money, which they exchange for his commodity. They are so many centres of circulation with whom the act of exchange begins and by whom the exchange value of capital is maintained. (Marx 1978, 419)

Indeed with the rise of ubiquitous media, the body itself becomes inseparable from a steady stream of digital data. The combination of personalization and ubiquity makes the widening circulation of information a resource in the diagrammatic expansion and intensification of capital's vector.

As we have described in the preceding section, digital media are premised on a homogenization of all information into digital code and given form as electronic pulse. This is the same for all information regardless of actual content; the formative existence is the same. In the rise of financial capitalism – or the financialization of the economy, particularly its application of ICTs networked globally – the irresistible impulse is towards employing the means of communication for a total abbreviation of the transformations within the circulation process that gives rise to the abbreviated formulation M – M' – the circuit of finance capital. It takes less time to complete a turnover when capital does not need to pass into the material forms of productive-capital and commodity-capital. But the pressure to shorten circulation time is nevertheless there for the same reason as a normal circuit, as the example of the new transatlantic cable demonstrates.

Yet even before the advent of both digitization and extreme financialization, Marx alluded to how this irresistible impulse expresses itself in ever-more sophisticated abstractions. In creating abstractions "by way of book-keeping, which also includes the determination or reckoning of commodity prices (price calculation), the movement of capital is registered and controlled. The movement of production, and particularly of valorization—in which commodities figure only as bearers of value, as the names of things whose ideal value-existence is set down in money of account—thus receives a symbolic reflection in the imagination" (Marx 1978, 211)[14]. Indeed, the very expansion and speed-up of circulation requires capital to create a variety of abstractions that help to bind space and time, often to stand-in for the necessary metamorphoses capital must complete in order for accumulation to occur. The price-system, various forms of commercial information, the stock market, increasingly exotic financial instruments, derivatives, debt-commodities, what Smythe described as the "audience commodity"--all are circulatory abstractions.

Indeed, Marx identified that the capitalist system is not only premised on the money system as a medium of exchange and store of value, but as a process in which abstractions become real in the process of speeding up circulation because capital must take such abstractions as real to fulfill the production of evolution. As circulation speeds up to mirror the flows of information, these abstractions are increasingly treated as *real* commodities (and *appear* to contain realizable surplus value) in their own right (rather than having logistical effects). Chief among these abstractions is the function of credit which itself creates new products of circulation, and while it strives to reduce circulation time it also struggles "to give circulation time value, the value of production time, in the various organs which mediate the process of circulation time and of circulation; to posit them all as money, and, more broadly, as capital" (Marx 1973, 659-660).

The problem of credit, a topic Marx regularly brings up only to defer his analysis (Marx 1973, 519, 535, 542, 549; 1978, 192, 330, 420-421, 433), reflects a similar problem with digital data; its nominal existence is interchangeable with all other types of information. As digital code creates an

[14] Though the "symbolic reflections in the imagination" are daily taking on an autonomous, algorithmic, even machinic, life of their own.

abundance of information through a process of abstraction, credit and crediting mechanisms proliferate to ensure the acceleration of capital's circulation.

As credit overcomes a recurring lack of equivalents available for purchase while capital expands its production of surplus value, it multiplies the use of abstraction in circulation. "Where does the extra money come from to realize the extra surplus-value that now exists in the commodity form?" (Marx 1978, 419). "The storing up of money on the one side can proceed even without cash, simply through the piling up of credit notes" (Marx 1978, 422). Throughout Marx's explication of the sphere of circulation, particularly in *Grundrisse*, there is a constant reference to the *deus-ex-machina* of the entire system, namely, credit. At various points, he raises the spectre of credit to suggest how it overcomes barriers, or artificially bypasses circulation, precipitating crises of circulation in the creation of fictitious or virtual money capital. "The entire credit system, and the over-trading, over-speculation etc. connected with it, rests on the necessity of expanding and leading over the barrier to circulation and the sphere of exchange" (Marx 1978, 416). All information becomes homogeneous and interchangeable. For capitalism's accumulative algorithm this is problematic precisely because its logic is based on a process of transforming value and is validated step by step through its metamorphoses. When subsumed by digital code, only machines can tell the difference between a financial transaction and a text message. This allows for the virtual multiplication of value, capital and digital code by machinic or algorithmic means, well beyond the material limitations of human or natural life.

Although his analysis is not developed in *Volume 2*, Marx explains that the *credit economy* is merely an extension of the money economy, but that each represents "different stages of development of capitalist production" in contrast to the *natural economy* "…what is emphasized in the categories money economy and credit economy, and stressed as the distinctive feature, is actually not the economy proper, i.e. the production process itself, but rather the mode of commerce between the various agents of production or producers that corresponds to the economy" (Marx 1978, 195-196). It is precisely the personalization of our media represented in the credit economy that qualitatively changes the mode of commerce between agents of production. Through the personalization afforded by digital data/code, crediting mechanisms generally become intertwined with media.

Credit is not only a medium by which to accelerate the circulation of capital and its turnover time (Marx 1981, 567), but is also a system of abstractions for personalizing, and prospectively commodifying the various moments of exchange by the aforementioned production of abstractions. Credit overcomes temporal boundaries by allowing the identity and character of the creditor to act as leverage against future payment (for example, see credit reporting and rating agencies; Manzerolle and Smeltzer 2011). By credit, we include not only the lending of money but also the technical mechanisms that allow credit to be granted so as to reduce circulation time. Digitization has enabled the expansion of credit, sometimes for pernicious or predatory purposes (Manzerolle 2010). As such, digital media systems increasingly produce greater and greater financial abstractions – i.e. financialization – and these become *real* abstractions through the consumption of materials and labour time.

This speed-up via abstractions and crediting mechanisms cannot occur on its own, but requires infrastructure to actually transmit speeds, expand the range of financial and personal data and thus fuel the creation of ever-more sophisticated abstractions. Although the creation and provision of credit is important, it is equally important to provide crediting mechanisms that leverage personalized data to speed up transactions (whether of credit or real money). NFC technologies are only one small example of the broader credit apparatus. Our digital media are increasingly functioning as means of either facilitating credit or making credit more efficient (credit ratings, credit cards, virtual goods, mobile payments). Increasingly, these flows of data are being treated as a kind of pseudo currency, or at least ascribe some nominal value for their marketing importance. The production of abstractions, like those emerging from the credit system for example, function as mediators of value approaching zero circulation time. This mirrors similar considerations that have suggested that personal data itself be transformed into currency (Brustein 2012a; Zax 2011).

5. Conclusion: The Cybernetic Imagination of Capitalism

The combination of personalization and ubiquity makes the widening circulation of information a resource in the acceleration, expansion and intensification of capital's circulation. The proliferation of credit and crediting mechanisms, as well as faster fiber-optic cables, are media used to reduce capital's overall circulation time. As Marx notes in *Grundrisse*, one of the overall tendencies of capital's circulation is to turn individuals/workers into independent centers of exchange, evermore subjected to the rhythms of this intensifying circulatory process (1973, 419). This process increasingly occurs through the flows of digital, personalized and interactive media, but articulates *consumption*

capacity in order to address and overcome its barriers. Through our interactions with these flows of information we experience at a phenomenological level, the speed-up of everyday life, what Tomlinson (2007) refers to as "the coming of immediacy"—a result of the convergence of cultural production and the circulatory dynamics of capital.

As we have noted, recent developments in mobile payment systems and fiber-optic cables provide evidence of capital's logic of acceleration. These media reflect the evolution of digital media under capitalism as a search for overcoming barriers of use-values, equivalents, space and time. What we have argued is that a Marxist theory of communication takes capital as the subject of communication. Marx's description of circulation describes the communication of capital as a spectrum tuned to overcoming different barriers. At one end we find the logistical circulation of capital (commodities, labour and money); at the other, we find questions of need, desire, and use value shaped by cultural practices and institutions.

The personalization of media mimics the liberal market ideal of matching consumers with commodities. The evolution of mobile devices with integrated NFC capabilities will turn these devices into tools for providing/automating a whole range of personalized services. This evolution has important implications for post-industrial, service based economies. Personalization of this sort will make obsolete a whole mass of service sector jobs as they are either automated or replaced by the unpaid labour of these ubiquitously connected users, which is a process that of course offloads costs associated with circulation onto the consumer, while expanding the range of data that can be offered commercially, by telecoms and other third parties (for example, mobile application developers).

We can think of the growth of personalization in the era of ubiquitous connectivity as a feedback mechanism that flows through our personalized media, part of a much broader algorithmic expanding and speeding-up through the growing torrent of digital data (whether financial, logistical, personal, or increasingly, all of them together).

The algorithmic qualities of Marx's conception of capital as a circuit is neither surprising, nor, arguably, is it accidental. Marx's use of the term circuit to construct his model of capital's logic of motion is particularly deliberate, perhaps alluding to the imminent biases in the political economists and theories Marx was critiquing. Otto Mayr (1971a) has written about the relationship between the genesis of liberal-market theory and the development of feedback technologies—that is, a history of cybernetics *avant la lettre.* The roots of this algorithmic nature appears rooted both in the intellectual apparatus and the historical context of its genesis, although perhaps it is mere coincidence that early schemas of global trade reflect feedback loop diagrams (Mayr 1971a, 4), or that Adam Smith and James Watt were friends and perhaps shared the same cybernetic imagination of society. Perhaps it was coincidence that Charles Babbage not only schematized a *difference engine* but also wrote treaties on capitalist political economy, or that James Clerk Maxwell (see Mayr 1971b)—first theorist of the electromagnetic spectrum—also designed the first commercial self-regulating governors for industrial capital, and is cited by none other than Norbert Wiener as the grandfather of cybernetics (Wiener 1948).

According to Mayr (1971a), the concept of self-correcting/self-regulating system was one of the chief metaphors for the free market, in which the flows of goods, money and prices would create a self-correcting system that could maximize social welfare for the largest number of people. Personalization of the sort we are now seeing falls closely in line with the beliefs and values of typical liberal market theories; using both personalization and ubiquitous connectivity as a means of efficiently and instantaneously matching services and products with consumers. Our media systems have largely evolved within "the cybernetic imagination of capitalism" (Webster and Robins 1999, 111). Although we are inundated with a quantitative increase in human communication, there is infinitely more expansive network of machinic communication governing the communication of capital and its logic of acceleration. In an early form it expresses Shannon's mathematical theory of communication, which is itself a feedback system (Shannon and Weaver 1949). In both, it is the search for perfect information – the elimination of noise – that constitutes a mathematically perfect communication system. It is no surprise then that our means of communication and our means of exchange (including both money and information over a network) are converging. While personalization creates nearly perfect information about users and their locations – in the context of technologically mediated social networks – noise will increasingly constitute those voices, opinions and messages that do not already conform to our personally cultivated algorithm, which are outside of our preference schema. Within the cybernetic imagination of capitalism, digital media offer capital the vectors through and by which the logic of acceleration is articulated *diagrammatically*. Our media are indeed in transition, but transitioning under what structural biases and political economic imperatives? How will we understand the growth of cloud-computing, the internet of things, and 3-D print-

ing evolve through market forces? We have argued that answering this question will involve a media-centric interpretation of Marx's expansive analysis of the circulation of capital.

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