The Exploit

A THEORY OF NETWORKS

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Nodes

Discourse surrounding networks, in keeping with the idea of networks themselves, is becoming more and more ubiquitous.

For the last decade or more, network discourse has proliferated with a kind of epidemic intensity: peer-to-peer file-sharing networks, wireless community networks, terrorist networks, contagion networks of biowarfare agents, political swarming and mass demonstration, economic and finance networks, online role-playing games, personal area networks, mobile phones, "generation Txt," and on and on.

Often the discourse surrounding networks tends to pose itself both morally and architecturally against what it sees as retrograde structures like hierarchy and verticality.

These structures are seen to have their own concomitant techniques for keeping things under control: bureaucracy, the chain of command, and so on. "We're tired of trees," wrote Deleuze and Guattari. But even beyond the fields of technology and philosophy, the concept of the network has infected broad swaths of contemporary life. Even the U.S. military, a bastion of vertical, pyramidal hierarchy, is redefining its internal structure around network architectures, as the military strategists Arquilla and Ronfeldt have indicated in their work. They describe here a contemporary mode of conflict known as "netwar": "Netwar is about the Zapatistas more than the Fidelistas, Hamas more than the Palestine Liberation Organization (PLO), the American Christian Patriot movement more than the Ku Klux Klan, and the Asian Triads more than the Cosa Nostra."[1] These in/out lists are, of course, more fun to read than they are accurate political evaluations, but it is clear that the concept of connectivity is highly privileged in today's societies.

In fact, the idea of connectivity is so highly privileged today that it is becoming more and more difficult to locate places or objects that don't, in some way, fit into a networking rubric.

This is particularly the case as the Fidelistas and so on are further eclipsed by their network-savvy progeny. The 2001 USA PATRIOT Act and other legislation allowing increased electronic surveillance further reinforce the deep penetration of networked technologies and networked thinking. One wonders if, as networks continue to propagate, there will remain any sense of an "outside," a nonconnected locale from which we may view this phenomenon and ponder it critically.

In today's conventional wisdom, everything can be subsumed under a warm security blanket of interconnectivity. But this same wisdom hasn't yet indicated quite what that means, nor how one might be able to draft a critique of networks.

All this fanfare around networks highlights the continued indissociability of politics and technology. There are several sides to the debate. The technophilic perspective, such as that expressed by Howard Rheingold or Kevin Kelly, is an expression of both a technological determinism and a view of technology as an enabling tool for the elevation of bourgeois humanism in a broadly general sense. The juridical/governance perspective, seen in the work of Lawrence Lessig, Yochai

Benkler, and others, posits a similar situation whereby networks will bring about a more just and freer social reality via legal safeguards. The network science perspective, expressed in popular books by Mark Buchanan or Albert-László Barabási, portrays the network as a kind of apolitical natural law, operating universally across heterogeneous systems, be they terrorism, AIDS, or the Internet. Moreover, this dichotomy (between networks as political and networks as technical) is equally evident in a variety of other media, including news reportage, defense and military research, and the information technology industries.

Yet this "network fever" has a tendency to addle the brain, for we identify in the current literature a general willingness to ignore politics by masking them inside the so-called black box of technology.[2]

Thus one of our goals is to provide ways of critically analyzing and engaging with the "black box" of networks, and with this ambivalence between politics and technology (in which, sadly, technology always seems to prevail).

The question we aim to explore here is: what is the principle of political organization or control that stitches a network together?

Writers like Michael Hardt and Antonio Negri have helped answer this question in the sociopolitical sphere. Their concept of "empire" describes a global principle of political organization. Like a network, empire is not reducible to any single state power, nor does it follow an architecture of pyramidal hierarchy. Empire is fluid, flexible, dynamic, and far-reaching. In that sense, the concept of empire helps us greatly to begin thinking about political organization in networks.

But are networks always exclusively "human"? Are networks misanthropic? Is there a "nonhuman" or an "unhuman" understanding of networks that would challenge us to rethink the theory and practice of networks?

While we are inspired by Hardt and Negri's contribution to political philosophy, we are concerned that no one has yet adequately answered this question for the technological sphere of bits and atoms. That is, we seek a means of comprehending networks as simultaneously material and immaterial, as simultaneously technical and political, as simultaneously misanthropic and all-too-human.

Let us continue then not with an empirical observation but with a concept. Derived from the discourses of both the life sciences and computer science, the concept of "protocol" refers to all the technoscientific rules and standards that govern relationships within networks. Protocols abound in technoculture. They are rooted in the laws of nature, yet they sculpt the spheres of the social and the cultural. They are principles of networked interrelationality, yet they are also principles of political organization.

Quite often networked relationships come in the form of communication between two or more computers, but the relationships can also refer to purely biological processes, as in the systemic phenomenon of gene expression or the logics of infection and contagion. Protocol is not a single thing but a set of tendencies grounded in the physical tendencies of networked systems. So by "networks" we mean any system of interrelationality, whether biological or informatic, organic or inorganic, technical or natural—with the ultimate goal of undoing the polar restrictiveness of these pairings.

Abstracted into a concept, protocol may be defined as a horizontal, distributed control apparatus that guides both the technical and political formation of computer networks, biological systems, and other media.

Molecular biotechnology research frequently uses protocols to configure biological life as a network phenomenon, whether in gene expression networks, metabolic networks, or the circuitry of cell signaling pathways. In such instances, the biological and the informatic become increasingly enmeshed in hybrid systems that are more than biological: proprietary genome databases, DNA chips for medical diagnostics, and real-time detection systems for biowarfare agents. Likewise in computer networks, science professionals have, over the years, drafted hundreds of protocols to create e-mail, Web pages, and so on, plus many other standards for technologies rarely seen by human eyes. An example might be the "Request for Comments" series of Internet white papers, the first of which was written by Steve Crocker in 1969, titled "Host Software."[3] Internet users commonly use protocols such as http, FTP, and TCP/IP, even if they know little about how such technical standards function. If networks are the structures that connect organisms and machines, then protocols are the rules that make sure the connections actually work.

Protocol is twofold; it is both an apparatus that facilitates networks and a logic that governs how things are done within that apparatus.

Today network science often conjures up the themes of anarchy, rhizomatics, distribution, and antiauthority to explain interconnected systems of all kinds. Our task here is not to succumb to the fantasy that any of these descriptors is a synonym for the apolitical or the disorganized, but in fact to suggest the opposite, that rhizomatics and distribution signal a new management style, a new physics of organization that is as real as pyramidal hierarchy, corporate bureaucracy, representative democracy, sovereign fiat, or any other principle of social and political control. From the sometimes radical prognostications of the network scientists, and the larger technological discourse of thousands of white papers, memos, and manuals surrounding it, we can derive some of the basic qualities of the apparatus of organization that we here call protocol:[4]

- Protocols emerge through the complex relationships between autonomous, interconnected agents.
- To function smoothly, protocological networks must be robust and flexible; they must accommodate a high degree of contingency through interoperable and heterogeneous material interfaces.
- Protocological networks are inclusive rather than exclusive; discrimination, regulation, and segregation of agents happen on the inside of protocological systems (not by the selective extension or rejection of network membership to those agents).
- Protocols are universal and total, but the diachronic emergence of protocols is always achieved through principles of political liberalism such as negotiation, public vetting, and openness.

- Protocol is the emergent property of organization and control in networks that are radically horizontal and distributed.

Each of these characteristics alone is enough to distinguish protocol from many previous modes of social and technical organization (such as hierarchy or bureaucracy). Together they compose a new, sophisticated system of distributed control. As a technology, protocol is implemented broadly and is thus not reducible simply to the domain of institutional, governmental, or corporate power.

In the broadest sense, protocol is a technology that regulates flow, directs netspace, codes relationships, and connects life-forms.

Networks always have several protocols operating in the same place at the same time. In this sense, networks are always slightly schizophrenic, doing one thing in one place and the opposite in another. The concept of protocol does not, therefore, describe one all-encompassing network of power—there is not one Internet but many internets, all of which bear a specific relation to the infrastructural history of the military, telecommunications, and science industries. This is not a conspiracy theory, nor is it a personification of power. Protocol has less to do with individually empowered human subjects (the pop-cultural myth of hackers bringing down "the system") who might be the engines of a teleological vision for protocol than with manifold modes of individuation that arrange and remix both human and nonhuman elements (rather than "individuals" in the liberal humanist sense). But the inclusion of opposition within the very fabric of protocol is not simply for the sake of pluralism—which of course it leverages ideologically—but instead is about politics.

Protocological control challenges us to rethink critical and political action around a newer framework, that of multiagent, individuated nodes in a metastable network.

Political action in the network, then, can be guided deliberately by human actors, or accidentally affected by nonhuman actors (a computer virus or emerging infectious disease, for example). Often, tactical misuse of a protocol, be it intended or unintended, can identify the political fissures in a network. We will suggest later that such moments, while sometimes politically ambiguous when taken out of context, can also serve as instances for a more critical, more politically engaged "counterprotocol" practice. As we shall see, protocological control brings into existence a certain contradiction, at once distributing agencies in a complex manner while at the same time concentrating rigid forms of management and control. This means that protocol is less about power (confinement, discipline, normativity), and more about control (modulation, distribution, flexibility).

Technology (or Theory)

There exists an entire science behind networks, commonly known as graph theory, which we would like to briefly outline here, for it subtends all our thinking on the nature of networks and systems.[5] Mathematically speaking, a graph is a finite set of points connected by a finite set of lines. The points are called "nodes" or vertices, and the lines are called "edges." For the sake of convenience we will use G to refer to a graph, N to refer to the nodes in the graph, and E to refer to its edges. Thus a simple graph with four nodes (say, a square) can be represented as $N = \{n_1, n_2, n_3, n_4\}$ and its edges as $E = \{(n_1, n_2), (n_2, n_3), (n_3, n_4), (n_4, n_1)\}$. In a graph, the number of nodes is called the "order" (in the square example, $|N| = 4$), and the number of edges is called the "size" ($|E| = 4$).

In the mathematical language of graph theory, networks provide us with a standard connect-the-dots situation.

Given this basic setup of nodes and edges, a number of relationships can be quantitatively analyzed. For instance, the "degree" of a node is the number of edges that are connected to it. A "centralized" or "decentralized" graph exists when a relatively small number of nodes function as "hubs" by having many edges connected to them, and when the remaining "leaf" nodes have only one edge. This results in a graph where the order and size are roughly the same. Likewise, a "distributed" graph exists when the hub/leaf split disappears and all nodes have approximately the same degree. This results in a graph where the size far exceeds the order. What can we tell by both the order and size of a graph? One of the basic theorems of graph theory states that for any graph with a finite number of edges, the sum of the degrees of the nodes equals twice the number of edges. That is, if the degree of any node is the number of edges connected to it (for node n_1 with two edges connected to it, its degree = 2), the sum of all the degrees of the graph will be double the size of the graph (the number of edges). For a square, the sum of the degrees is 8 (the nodes [the square's corners] each have 2 edges [the square's lines] connected to them), while the sum of the edges is 4. In other words, the *connectivity* of a graph or network is a value different from a mere count of the number of edges. A graph not only has edges between nodes but also has edges connecting nodes.

From a graph theory perspective, networks can be said to display three basic characteristics: their organization into nodes and edges (dots and lines), their connectivity, and their topology. The same sets of entities can result in a centralized, rigidly organized network or in a distributed, highly flexible network.

The institutional, economic, and technical development of the Internet is an instructive case in point. While the implementation of packet-switching technology in the U.S. Department of Defense's ARPANET ostensibly served the aims of military research and security, that network also developed as a substantial economic network, as well. Paul Baran, one of the developers of packet switching, uses basic graph theory principles to show how, given the same set of nodes or points, and a different set of edges or lines, one gets three very different network topologies.[6] The familiar distinction between centralized, decentralized, and distributed networks can be found everywhere today, not only within computer and information technologies but also in social, political, economic, and biological networks.

As we have suggested, networks come in all shapes and flavors, but common types include centralized networks (pyramidal, hierarchical schemes), decentralized networks (a core "backbone" of hubs each with radiating peripheries), and distributed networks (a collection of node-to-node relations with no backbone or center).

From the perspective of graph theory, we can provisionally describe networks as metastable sets of variable relationships in multinode, multiedge configurations.

In the abstract, networks can be composed of almost anything: computers (Internet), cars (traffic), people (communities), animals (food chains), stocks (capital), statements (institutions), cultures (diasporas), and so on. Indeed, much of the research in complex dynamic systems, nonlinear dynamics, and network science stresses this convergence of heterogeneous phenomena under universal mathematical principles.

However, we stress this point: graph theory is not enough for an understanding of networks; or rather, it is only a beginning.

Although graph theory provides the mathematical and technical underpinning of many technological networks (and the tools for analyzing networks), the assumptions of graph theory are equally instructive for what they omit.

First is the question of agency. The division between nodes and edges implies that while nodes refer to objects, locations, or space, the definition of edges refers to actions effected by nodes. While agency is attributed to the active nodes, the carrying out of actions is attributed to the passive edges (the effect of the causality implied in the nodes). Graphs or networks are then diagrams of force relationships (edges) effected by discrete agencies (nodes). In this, graphs imply a privileging of spatial orientations, quantitative abstraction, and a clear division between actor and action.

Second is what might be called the "diachronic blindness" of graph theory. Paradoxically, the geometrical basis (or bias) of the division between "nodes" and "edges" actually works against an understanding of networks as sets of relations existing in time. While a graph may evoke qualities of transformation or movement in, for example, the use of directed edges, it is an approach that focuses on fixed "snapshot" modeling of networked ecologies and their simulation using mathematical models and systems. This is, we suggest, a fundamentally synchronic approach.

Related to this is the pervasive assumption that networks can exist in an ideal or abstract formulation (a mathematical graph) estranged from the material technologies that, in our view, must always constitute and subtend any network.

A final disadvantage of graph theory is the question of internal complexity and topological incompatibility. Not only are networks distinguished by their overall topologies, but networks always contain several coexistent, and sometimes incompatible, topologies. This is a lesson learned from general systems theory, whereby networks consist of aggregate interconnections of dissimilar subnetworks. The subnet topologies will often be in transition or even be in direct opposition to other forms within the network. Thus any type of protocological control exists not because the network is smooth and continuous but precisely because the network contains within it antagonistic clusterings, divergent subtopologies, rogue nodes. (This is what makes them networks; if they were not internally heterogeneous, they would be known as integral wholes.) For example, a merely "technical" description of the topology of the Internet might describe it as distributed (for example, in the case of peer-to-peer file-sharing networks based on the Gnutella model, or in the routing technologies of the Internet protocol). But it is impossible to disassociate this technical topology from its motive, use, and regulation, which also make it a social topology of a different form (file-sharing communities), an economic topology with a still different form (distribution of commodities), and even a legal one (digital copyright). All of these networks coexist, and sometimes conflict with each other, as the controversy surrounding file sharing has shown. While graph theory can indeed model a number of different topologies, we prefer an approach wherein the coexistence of multiple incompatible political structures is assumed as fundamental.

Thus not only do existing network theories exclude the element that makes a network a network (its dynamic quality), but they also require that networks exist in relation to fixed, abstract configurations or patterns (either centralized or decentralized, either technical or political), and to specific anthropomorphic actors.

Indeed, one of the arguments presented here is to reinforce the notion that material instantiation is coextensive with pattern formation. Material substrate and pattern formation exist in a mutually reciprocal relationship, a relationship that itself brings in social-political and technoscientific forces.

Theory (or Technology)

In the "Postscript on Control Societies," a delectably short essay from 1990, Deleuze defines two historical periods: first, the "disciplinary societies" of modernity, growing out of the rule of the sovereign, into the "vast spaces of enclosure," the social castings and bodily molds that Michel Foucault has described so well; and second, what Deleuze terms the "societies of control" that inhabit the late twentieth century—these are based around protocols, logics of "modulation," and the "ultrarapid forms of free-floating control."[7] For Deleuze, "control" means something quite different from its colloquial usage (as in "control room" or "remote control").

Control is not simply manipulation, but rather modulation.

One does not simply control a device, a situation, or a group of people; rather, "control" is what enables a relation to a device, a situation, or a group. "People are lines," Deleuze suggests. As lines, people thread together social, political, and cultural elements. While in disciplinary societies individuals move in a discrete fashion from one institutional enclosure to another (home, school, work, etc.), in the societies of control, individuals move in a continuous fashion between sites (work-from-home, distance learning, etc.). In the disciplinary societies, one is always starting over (initiation and graduation, hiring and retirement). In the control societies, one is never finished (continuing education, midcareer changes). While the disciplinary societies are characterized by physical semiotic constructs such as the signature and the document, the societies of control are characterized by more immaterial ones such as the password and the computer.[8]

The problem of "control" in networks is always doubled by two perspectives: one from within the network and one from without the network. Networks are, in this sense, the horizon of control.

On the one hand, control is tantamount to forms of network management, for control in networks must meet the challenge of network regulation from a site that is internal to the network—the most "controlled" control would be one that pervades the network itself. Control in networks must aim for an effectiveness that is immanent to the network, in the sense that the most perfectly controlled network is one that controls or regulates itself. But, on the other hand, control in networks is always counterbalanced by another challenge: to be effective from outside the network (either as a set of metaguidelines or as being logically "above" the network itself). The network itself must be articulated as an object of design, implementation, and regulation. Control in this sense does not pervade the network but operates over it; control in this sense is topsight and oversight.

The breakdown of disciplinary societies and the emergence of control societies raise a whole host of philosophical problems, problems that are both absolutely "ancient" and contemporary. Take, for example, the notion of "substance."

Classical philosophers from the pre-Socratics to Aristotle mused a great deal on substance. They asked: Of what is the world made? What is the fundamental property of, for example, a living creature that allows us to conceive of and say "creature"? The question of substance is not a question of being: it is not *that* it exists but rather *how* it exists.[9] The question is not "what is it?" but rather "how does it work?"

The question of substance poses particular problems when thinking about networks. Is it safe to define a network as a substance, as a particular thing? We can ask: Of what is a network made? Is it enough to say that a network is made of fiber-optic cable, routers, and terminals? This would limit our concept of "network" to computer networks. Would it be enough to expand this to include organisms, cells, and proteins? Is it thus the more abstract notion of "nodes" and "edges" we noted earlier? This alone would be too general, for potentially anything and everything could be conceived of as a node or an edge (if everything is a network, then nothing is).

Should we define an essential property—"relation" or "interrelation"—and construct a concept of the network from that? This could provide a starting point, but defining essences is always a tricky business. Relation always presupposes at least two "things" that are related. Relation is not, then, a "thing" but the relation between things. Is it a gap, an interval, a synapse? We are led into even more treacherous waters: relation is "the nothing" between two things. Following such a line of argument, our notion of "network" would be founded on the most insubstantial of substances.

Like the concept of substance, the problem of "individuation" is also a long-standing concept in philosophical thought (we will return to this later in a different vein). And, like substance, individuation is a concept that is equally filled with aporias. But unlike substance, these aporias are generative and evocative rather than reifying or reductive.

To individuate is to posit both the specific and the generic.

For instance, if one says, "I am reading this book," the "book" in the statement is implicitly one of a general category of objects called books, as well as an explicit reference to a specific and singular book (not just any book, but this one here in hand). Late medieval philosophy, influenced greatly by Aristotle's *Categories*, debated individuation at length. At the most general level, individuation is about what makes a thing what it is: what is it that makes a "cloud" a cloud? More specifically, individuation also has to do with predication: what is it that makes "Socrates" a man? But individuation is not simply about language (subject and predicate), for it brings together the concept (the concept of clouds), the thing (a specific cloud, that one up there), and language ("cloud") into an isomorphic field that bypasses later philosophical debates about language and the "thing in itself."[10]

A mode of individuation may produce a distinct person, a mass of people, a nation-state, a corporation, a set of gadgets, animals, plants, or any formation of matter.

Subjects as individual people, then, are particular modes of individuation to which sets of values are ascribed: agency, autonomy, self-consciousness, reason, emotion, rights, and so on. Although "individuation" is a well-worn philosophical concept, in the context of the control societies, individuation is assumed to be continually modulated, precisely because it is informatic, statistical, and probabilistic.

Perhaps it is best to define a network as a mode of individuation? But if so, how is a network individuated? What makes a network "a" network? What is the "circumference" of a network?

These almost geometrical quandaries become even more relevant when couched in the language of political philosophy: What is inside a network? What is outside? This is not simply a question about who gets access to a network or about who decides what to include or exclude from a network. Such an approach presumes the prior existence of a network, and then, only after this, is access or inclusion raised as a problem. Instead, the question of individuating a network is really a problem of establishing the very conditions in which a network can exist at all. It is, in other words, a problem of sovereignty.

Traditional concepts of sovereignty are often juridical in nature—that is, they define sovereignty as the ability to exercise control over bodies and resources based on law, or, as Foucault put it, the authority to "take life or let live." By contrast, contemporary political thought often defines sovereignty not as the power to command or execute a law but as the power to claim exceptions to the rule.[11] The sovereign ruler occupies a paradoxical position, at once within the law (in that the ruler forms part of the body politic), and yet outside the law (in that the sovereign can decide when the law no longer applies). Sovereignty is, then, not power or force but the ability to decide—in particular, the ability to decide what constitutes an exceptional situation, one that calls for a "state of exception" and a suspension of the law.[12] But it is not always clear where the line between "exception" and "rule" lies. The notion of a "permanent state of emergency" is one consequence of this definition of sovereign power. If this is the case, then a central challenge for any radical politics today is explaining the strange intimacy between the sovereign "state of exception" and the decentralized character of global networks for which "exceptionalism" is formally necessary.

The tension we noted within "control"—at once inside and outside the network, at once "within" and "above"—can be rephrased as a question about sovereignty. The quandary is this: no one controls networks, but networks are controlled.

And we stress that no "one" controls networks because they deindividuate as much as they individuate. Networks individuate within themselves (stratifying different types of nodes, different types of users, different types of social actors), and they also auto-individuate as well (the systems of "small worlds" or "friends of friends" described in social network theory). But these processes of individuation are always accompanied by processes of deindividuation, for each individuation is always encompassed by the "mass" and aggregate quality of networks as a whole, everything broken down into stable, generic nodes and discrete, quantifiable edges. Nodes are erased as quickly as edges are established, hierarchies exist within networks, "horizontal" decentralization interferes with "vertical" centralization, topologies become topographies . . .

In the control society, what is the difference between sovereignty and control? That is, does sovereignty exist in networks?

If we are to take seriously the networked view of power relations, then individuals would need to be considered not as individuals but as what Deleuze calls "dividuals": "In control societies . . . the key thing is no longer a signature or number but a code: codes are *passwords*, whereas disciplinary societies are ruled (when it comes to integration by resistance) by *precepts*. The digital language of control is made of codes indicating where access to some information should be allowed or denied. We're no longer dealing with a duality of mass and individual" from the modern era. Instead "individuals become '*dividuals,*' and masses become samples, data, markets, or '*banks.*'"[13]

What follows from this is that control in networks operates less through the exception of individuals, groups, or institutions and more through the exceptional quality of networks or of their topologies. What matters, then, is less the character of the individual nodes than the topological space within which and through which they operate as nodes. To be a node is not solely a causal affair; it is not to "do" this or "do" that. To be a node is to exist inseparably from a set of possibilities and parameters—to function within a topology of control.

Not all topologies are equal; some are quite exceptional, existing for short periods of time (e.g., a highly centralized organization may briefly become decentralized to move its operations or internally restructure). But every network has its own *exceptional topology,* the mode of organization that is uncommon to itself. Distributed networks, be they computer based or community based, must at some point confront the issue of "decision," even if the decision is to become a network itself. If the network is anthropomorphized, such decision points require centralization, a single point from which the decision can be made. (Sometimes this is called "the central nervous system" or "the standards-setting community.") The point at which sovereignty touches network control may very well lie in this notion of an exceptional network, an exceptional topology. In the case of contemporary politics, America's networked power rises only in direct proportion to the elimination, exclusion, and prohibition of networked power in the guerrilla and terrorist movements.

Perhaps we are witnessing a sovereignty that is unlike the traditional forms of sovereignty, a mode of sovereignty based not on exceptional events but on exceptional topologies.

Without a doubt, these exceptional topologies are troubling. They exercise sovereignty, and yet there is no one at the helm making each decision. One might call these societies "misanthropic" or "anti-anthropological." The societies of control have an uncanny ability to elevate nonorganic life, placing it on par with organic life. And yet there is a sense in which networks remain dynamic, always changing, modulating, in flux, *alive*. If the body in disciplinary societies is predominantly anatomical and physiological (as in Foucault's analyses of the microphysics of the prison or hospital), in control societies, bodies are consonant with more distributed modes of individuation that enable their infinite variation (informatic records, databases, consumer profiles, genetic codes, identity shopping, workplace biometrics).[14] Their effects are network effects, and their agency is an anonymous agency (in this sense, "anonymity" exists quite happily alongside "identification").

This does not mean, however, that network control is simply irrelevant, as if the mere existence of a network does away with the notion of agency altogether. Network control ceaselessly teases out elements of the unhuman within human-oriented networks. This is most easily discovered in the phenomenology of aggregations in everyday life: crowds on city streets or at concerts, distributed forms of protest, and more esoteric instances of flashmobs, smartmobs, critical massing, or swarms of UAVs. All are different kinds of aggregations, but they are united in their ability to underscore the unhuman aspects of human action. It is the unhuman swarm that emerges from the genetic unit.

Network control is unbothered by individuated subjects (subjected subjects). In fact, individuated subjects are the very producers and facilitators of networked control. Express yourself! Output some data! It is how distributed control functions best.

The twofold dynamic of network control—distributing agency while instantiating rigid rules—implies that subjects acting in distributed networks materialize and create protocols through their exercise of local agency.

While Deleuze referred to it as "free-floating," control does not in fact flit through the ether dissociated from real physical life. Quite the opposite is true. Control is only seen when it materializes (though in a paradoxical way), and it aims constantly to make itself "matter," to make itself relevant.

In control societies, control "matters" through information—and information is never immaterial.[15]

Often control does this through bottom-up strategies that set the terms within which practices may possibly occur.[16] Network protocols are a bottom-up strategy, but at the end of the day, they exert massive control over technologies on a global scale.

Protocol in Computer Networks

It will be valuable at this point to explore further some of the aspects of actually existing networks with reference to two technoscientific systems, computer networks and biological networks. We hope this will underscore the material bent of the current approach.

Computer networks consist of nothing but schematic patterns describing various protocols and the organizations of data that constitute those protocols. These protocols are organized into layers. The Open System Interconnection (OSI) model, an abstract foundational model drafted in the 1980s for guiding the design of everything from secure private networks to normal Internet e-mail and Internet telephony, outlines seven layers for networked communication. Four of these seven are used in the design of most Internet communications: (1) the application layer (e.g., TELNET, the Web), (2) the transport layer (e.g., transmission control protocol [TCP]), (3) the Internet layer (e.g., Internet protocol [IP]), and (4) the physical layer (e.g., Ethernet).

Technical protocols are organized into layers (application, transport, Internet, physical); they formalize the way a network operates. This also allows us to understand networks such as the Internet as being more than merely technical.

These technical layers are nested, meaning that the application layer is nested within the transport layer, which is nested with the Internet layer, and so on. Each layer typically interfaces only with the layer immediately below or immediately above it. At each level, the protocol higher in precedence parses and encapsulates the protocol lower in precedence. Both actions are pattern based: on the one hand, parsing (computing checksums, measuring size, and so on) is about forcing data through various patterns, while on the other, encapsulation means adding a specific pattern of information to the beginning of the data object. For most Web traffic, the outermost layers are the IP layer and the TCP layer. Next typically comes an http header, which in turn encapsulates HTML text and simple ASCII text. Many technological protocols come into play during any typical network transaction, some interesting to humans, others interesting only to machines.

The application layer is perhaps most interesting to humans. It operates at the level of user software. The application layer often must deal with the messy requirements of human users, users who care about the semantic quality of "content."

A good metaphor for application layer communications is the perfunctory "paratextual" headers and footers attached to a written letter such as a salutation, a signature, the date, or a page number. These add-ons serve to encapsulate and structure the content of the letter, which itself is written using entirely different protocols (poetry, prose, or what have you). The application layer is unconcerned with infrastructural questions such as addressing or routing of messages. It simply frames and encapsulates the user "content" of the communication at the highest level.

The transport layer is the next layer in the hierarchy. The transport layer is responsible for making sure that data traveling across the network arrives at its destination correctly.

The transport layer acts as a concierge. It ensures that messages are bundled up correctly and are marked with the appropriate tags indicated by the various application layers encapsulated by it—e-mails directed over here, Web pages over there. In TCP, for example, each application in the application layer is inscribed into the transport header by numbers representing the source and destination ports (ports are computer interfaces that can send and receive data). To continue the metaphor, these are roughly equivalent to apartment numbers contained within a single building. If data is lost in transit, the transport layer is responsible for error correction. It is also the layer that is responsible for establishing persistent connections or "abstract circuits" between two machines.

The third layer is the Internet layer. This layer is more fundamental still than both the application and transport layers. The Internet layer is concerned with one thing: the actual movement of data from one place to another.

The Internet layer contains the source address of the machine sending the data, plus the destination address of the machine receiving the data. It is not aware of the type of data it is sending, simply the sender and receiver machines for that data. The Internet layer guides messages as they are routed through complex networks. It is also able to repackage the message in such a way as to fit through very small pipes or flow quickly through large ones.

The fourth layer, the physical layer, is the protocol layer specific to the actual material substrate of the communication network.

Copper wires have different physical properties from fiber-optic wires, despite the fact that both are able to transport an e-mail from one place to another. The physical-layer protocols interface directly with photons, electrons, and the material substrate, be it glass or metal or another medium, that allows them to flow. Consequently the physical layer is highly variable and differs greatly depending on the technology in question. It is less of a purely software-based layer in that it must take into account the material properties of the communications medium.

We wish to foreground the layer model of the Internet for several reasons. The first is to illustrate the technical basis for how multiple or "exceptional" topologies may coexist in the same network.

A classic example is the topological schism between the Domain Name System and the Internet protocol, two technologies that are intensely interconnected but are structured on radically different models of network control and organization: the Domain Name System is a database of information that is centralized in its core administration but decentralized in its global implementation (there are a limited number of top-level name servers, yet all subsequent name resolution is delegated down the chain to individual service providers and users), while the Internet protocol largely remains true to the radically distributed addressing and routing technologies proposed by scientists like Paul Baran, Donald Davies, and Leonard Kleinrock in the early 1960s. The distributed network topology, which Baran knew to be "exceptional" vis-à-vis the then-existing model of communication infrastructures dominated by AT&T's telephony network, is in some senses tempered by any number of more conventional (or sometimes reactionary) topologies that may exist in different layers. An example would be the deployment of digital rights management (DRM) usage restrictions within a piece of networked software. The DRM technologies exert centralized, coercive control from within the application layer even if they ultimately must burrow inside the TCP/IP layers to connect across the network. In this sense, network-based DRM shows how two antagonistic network topologies may work in coordination.

The "diachronic blindness" lamented earlier is also remedied somewhat with an investigation into how some of the core protocols deal with state changes and transformation over time.

For example, TCP is a state-based protocol, meaning that certain knowledge about the past is embedded in the technology itself. TCP--enabled network interfaces may be in one of several states. The network actions they perform will change their current state based on history and context. Being state based allows TCP to create a virtual circuit between sender and receiver and to perform actions such as error correction. The cruel irony is that history, context, and even "memory" have been exceedingly well integrated into any number of control technologies. Thus "trust" technologies that grew out of innovative social network research are now just as often deployed in data-mining and profiling operations related to national and international security. And likewise the "data trails" left by both human and nonhuman actors are the key data points for the compilation of profiles and the extraction of trends via the statistical analysis of their interconnection. Not all network technologies are state based, however, meaning that large sections of networking technologies act in a more synchronic manner.

The third point relates to the foregoing discussion about substance and individuation.

While networks are always material in the sense that they consist of material technologies such as electronic machines and physical media (metal, air, light, plastic), we are still reticent about using the philosophical model of substance to define a network. The process of instantiating and defining data is better understood as a process of individuation. All informatic sciences must deal with this issue. In computer science, certain artifices are used to "sculpt" undifferentiated data into discrete units or words, the most basic of which is the convention of collecting of eight binary bits into a byte. And beyond this, computer languages are designed with detailed technologies of individuation whereby specific mathematical values, such as a segment of memory, are given over to artificially designated types such as a character from *A* to *Z* or a decimal point number. Further up on the ladder of abstraction, generic data values may be "informed" or individuated into complex constructs such as data structures, objects, and files. The layer model of Internet communication is an extension of this privileging of modes of individuation over substance. The various layers are artificial and arbitrary from the perspective of raw bits of data; however, following all the allowances of the technologies involved, the "substance" of data is informed and individuated in specific, technologically intelligible ways. Indeed, many software exploits come from the voluntary transgression of individuated bounds. Thus a buffer overflow exploit "overflows" out of the expected boundaries of a given memory buffer writing to adjacent locations in memory and in doing so might cause the system to perform in a way it was not designed to.

Last is the principle of distributed sovereignty, the idea that control and organization are disseminated outward into a relatively large number of small, local decisions.

This process may be partial, as in the case of the Domain Name System, which, being decentralized, organizes a core subset of the technology into centralized systems while delegating the rest to local control. Or it may be more extensive, as in the case of IP routing, which uses a more anarchic, "emergent" model of decision making and control, whereby individual routers in the network make a number of local decisions that cumulatively result in robust networkwide functionality and "intelligence." Much of this design also flows from the so-called end-to-end principle governing much of network protocol design, which states that networks should remain neutral as to their uses and all machinic and user functionality not necessary for pure data transfer should be consigned to the "edges" of the network (i.e., personal computers and servers, rather than the various waypoints within the network). The agnostic quality of layer nesting—that a higher layer simply encapsulates a lower layer, manipulating it in certain mathematically agnostic ways such as computing a checksum or recording the size of its payload—is one of the core technological design principles that allows for the distributed model of sovereignty and control to exist.

Protocol in Biological Networks

In the example of computer networks, "protocol" is both a technical term and, as we've suggested, a way of describing the control particular to informatic networks generally.

While the example of Internet protocols may be viewed as a bona fide technology, protocols also inhere in the understanding of biological life. In turn, this informational, protocol-based understanding has led to the development of biotechnologies that take on a network form.

What is the "protocol" of biological networks? Since the mid-twentieth century, it has become increasingly common to speak of genes, proteins, and cells in terms of "information" and "codes." As historians of science point out, the informatic view of genetics has its roots in the interdisciplinary exchanges between cybernetics and biology during the postwar period.[17] Today, in the very concept of

Notes

Prolegomenon

1. For more on the dialogue, see Geert Lovink and Florian Schneider, "Notes on the State of Networking," *Nettime,* February 29, 2004; and our reply titled "The Limits of Networking," *Nettime,* March 24, 2004.

2. This is seen in books like Bob Woodward's *Plan of Attack.*

3. Pit Schultz, "The Idea of Nettime," *Nettime,* June 20, 2006.

4. Giorgio Agamben, *The Coming Community* (Minneapolis: University of Minnesota Press, 1993), 85.

5. It's important to point out that terms such as "postmodernity" or "late modernity" are characterized less by their having broken with or somehow postdated modernity, but instead exist in a somewhat auxiliary rapport with modernity, a rapport that was never quite a break to begin with and may signal coincidence rather than disagreement. Fredric Jameson's book *A Singular Modernity* (London: Verso, 2002) plots this somewhat confusing boomerang effect.

6. Michael Hardt and Antonio Negri, *Multitude: War and Democracy in the Age of Empire* (New York: Penguin, 2004), 62.

7. John Arquilla and David Ronfeldt, "Fight Networks with Networks," http://www.rand.org/publications/randreview/issues/rr.12.01/fullalert.html#networks (accessed June 11, 2005). Arquilla and Ronfeldt qualify this: "Al-Qaeda seems to hold advantages at the organizational, doctrinal, and

social levels. The United States and its allies probably hold only marginal advantages at the narrative and technological levels."

8. Clay Shirky, "Power Laws, Weblogs, and Inequality," http://www.shirky.com/writings/powerlaw_weblog.html (accessed June 11, 2005).

9. Gilles Deleuze, *Negotiations,* trans. Martin Joughin (Minneapolis: University of Minnesota Press, 1990), 178.

Nodes

1. John Arquilla and David Ronfeldt, *Networks and Netwars: The Future of Terror, Crime, and Militancy* (Santa Monica: Rand, 2001), 6. A similar litany from 1996 reads: "Netwar is about Hamas more than the PLO, Mexico's Zapatistas more than Cuba's Fidelistas, the Christian Identity Movement more than the Ku Klux Klan, the Asian Triads more than the Sicilian Mafia, and Chicago's Gangsta Disciples more than the Al Capone Gang." See John Arquilla and David Ronfeldt, *The Advent of Netwar* (Santa Monica: Rand, 1996), 5. Arquilla and Ronfeldt coined the term "netwar," which they define as "an emerging mode of conflict (and crime) at societal levels, short of traditional military warfare, in which the protagonists use network forms of organization and related doctrines, strategies, and technologies attuned to the information age." Arquilla and Ronfeldt, *Networks and Netwars,* 6.

2. Mark Wigley, "Network Fever," *Grey Room* 4 (2001).

3. The largest and most important publication series for Internet protocols is called "Request for Comments" (RFC). A few thousand RFC documents have been drafted to date. They are researched, published, and maintained by the Internet Engineering Task Force (IETF) and related organizations.

4. If this section seems overly brief, it is because we have already devoted some attention in other publications to the definition of the concept. See in particular Eugene Thacker, *Biomedia* (Minneapolis: University of Minnesota Press, 2004); and Alexander Galloway, *Protocol* (Cambridge: MIT Press, 2004).

5. Overviews of graph theory are contained in any college-level discrete mathematics textbook. See also Gary Chartrand, *Introductory Graph Theory* (New York: Dover, 1977). For a historical overview, see Norman Biggs et al., *Graph Theory, 1736–1936* (Oxford: Clarendon, 1976). Graph theory principles are commonly used in communications and network routing problems, as well as in urban planning (road and subway systems), industrial engineering (workflow in a factory), molecular biology (proteomics), and Internet search engines.

6. See Paul Baran, *On Distributed Communications* (Santa Monica: Rand, 1964).

7. Gilles Deleuze, *Negotiations* (New York: Columbia University Press, 1995), 178.

8. For instance, in computer culture, specific power relations are articulated by computer users accessing various databases on the Internet. While some of these databases offer public access (e.g., Web-based hubs), others delimit a set of constraints, or differentials in access (e.g., commercial sites such as Amazon, secure Web mail, bibliographic databases at universities, personal e-banking accounts, etc.). Each of these power relations is encompassed by a technology (computers and the Internet), and a force (access to information), and each of them delimits a type of qualitative asymmetry in their power relations (e.g., consumer login to Amazon). From these examples, we see mobilities and constraints, inclusions and exclusions, securities and instabilities. Thus power in this context is less a moral category and more a physico-kinetic category. Power in this sense is less politics and more a kind of physics—a physics of politics.

9. For this reason, the question of substance was a primary concern of medieval philosophy, which sought to explain the relationship between the divine and the earthly, or between spiritual life and creaturely life. While some early thinkers such as Augustine posited a strict distinction between the divine and the earthly, later thinkers such as Aquinas or Duns Scotus were more apt to conceive of a continuum from the lowest to the highest kinds of beings.

10. Aquinas elaborated ten basic kinds of categories in his commentaries on Aristotle and posited an essential link between concept, thing, and word. Later thinkers such as Duns Scotus would complicate this view by suggesting that individuation—at the level of concepts only—proceeded by way of a "contraction" (so that "man" and "animal" are contracted to each other by "rational"), whereas existence as such in the world could not be predicated on anything else.

11. Giorgio Agamben, in writing on the "sovereign exception," cites Walter Benjamin on this point: "The tradition of the oppressed teaches us that the 'state of exception' in which we live is the rule." Giorgio Agamben, *Homo Sacer: Sovereign Power and Bare Life* (Stanford: Stanford University Press, 1998), 55. Agamben takes Benjamin's thesis further by adding that "life is originarily excepted in law" (27). In a sense, Foucault's suggestion that "in order to conduct a concrete analysis of power relations, one would have to abandon the juridical notion of sovereignty" is an affirmation of Agamben's thesis, for Foucault's primary aim is to dismantle an anthropomorphic notion of sovereign power. Michel Foucault, *Ethics: Subjectivity and Truth, vol. 1 of The Essential Works of Michel Foucault* (New York: New Press, 1997), 59.

12. Political thought is remarkably consonant on what constitutes threats to political order—foreign invasion or war is one obvious case, as are disasters

that threaten the political-economic infrastructure of society. But what is striking is how thinkers on opposite sides of the fence politically—such as Hobbes and Spinoza—agree that the greatest threat to political order comes from within: civil war, rebellion, factionalism, and mob rule.

13. Deleuze, *Negotiations,* 180. We note, in passing, that such a networked theory of power is in many ways presaged in Foucault's theses concerning "biopower" in the first volume of *The History of Sexuality*.

14. As the media theorist Vilém Flusser notes, in the network society "we will have to replace the category of 'subject-object' with the category of 'intersubjectivity,' which will invalidate the distinction between science and art: science will emerge as an intersubjective fiction, art as an intersubjective discipline in the search for knowledge; thus science will become a form of art and art a variant of the sciences." Vilém Flusser, "Memories," in *Ars Electronica: Facing the Future,* ed. Timothy Druckrey (Cambridge: MIT Press, 1999), 206.

15. But this is a paradoxical formulation. According to the technical histories of the concept of "information," information cannot matter. Indeed, the familiar associations of cyberspace, e-commerce, virtual identities, and software piracy all have to do with a notion of "information" as disembodied and immaterial, just as the practices of cyberwar and netwar do—and yet with material consequences and costs. Indeed, such a view of information has infused a number of disciplines that have traditionally dealt with the material world exclusively—molecular biology, nanotechnology, immunology, and certain branches of cognitive science.

16. The standards for hardware platforms, operating systems, networking protocols, and database architectures are all examples drawn from the computer and information technology industries. The ongoing development of laboratory techniques, the production and handling of medical data, and policies regarding the distribution and circulation of biological materials are examples in the life sciences.

17. See Lily Kay, *Who Wrote the Book of Life? A History of the Genetic Code* (Stanford: Stanford University Press, 2000); and Evelyn Fox Keller, *Refiguring Life: Metaphors of Twentieth-Century Biology* (New York: Columbia University Press, 1995).

18. David Bourgaize, Thomas Jewell, and Rodolfo Buiser, *Biotechnology: Demystifying the Concepts* (New York: Addison Wesley Longman, 2000), 30.

19. Francis Crick, "On Protein Synthesis," *Symposium of the Society for Experimental Biology* 12 (1958): 144.

20. See Alan Dove, "From Bits to Bases: Computing with DNA," *Nature Biotechnology* 16 (September 1998); and Antonio Regalado, "DNA Computing," *MIT Technology Review,* May–June 2000. Biocomputing includes subareas such as protein computing (using enzymatic reactions), membrane computing (using membrane receptors), and even quantum computing (using quantum fluctuations). Other "nonmedical" applications of biotechnology in-

clude GM foods, chemical synthesis, biomaterials research, biowarfare, and specialized applications in computer science, such as cryptography.

21. See Leonard Adleman, "Molecular Computation of Solutions to Combinatorial Problems," *Science* 266 (November 1994): 1021–24. Also see Adleman's follow-up article "On Constructing a Molecular Computer," *First DIMACS Workshop on DNA Based Computers*, vol. 27 (Princeton: DIMACS, 1997), 1–21. For a more technical review of the field, see Cristian Calude and Gheorghe Paun, *Computing with Cells and Atoms: An Introduction to Quantum, DNA, and Membrane Computing* (London: Taylor and Francis, 2001).

22. The prospect of cellular computing is the most interesting in this respect, for it takes a discipline already working through a diagrammatic logic (biochemistry and the study of cellular metabolism) and encodes a network into a network (Hamiltonian paths onto the citric acid cycle).

23. Compare, for instance, the views of cybernetics, information theory, and systems theory. First, Norbert Wiener's view of cybernetics: "It has long been clear to me that the modern ultra-rapid computing machine was in principle an ideal central nervous system to an apparatus for automatic control." Norbert Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine* (Cambridge: MIT, 1965), 27. Second, Claude Shannon's information theory perspective: "Information must not be confused with meaning. In fact, two messages, one of which is heavily loaded with meaning and the other of which is pure nonsense, can be exactly equivalent, from the present viewpoint, as regards information." Claude Shannon and Warren Weaver, *A Mathematical Theory of Communication* (Chicago: University of Illinois, 1963), 8. Finally, Ludwig von Bertalanffy's biologically inspired systems theory: "The organism is not a static system closed to the outside and always containing the identical components; it is an open system in a quasi-steady state, maintained constant in its mass relations in a continuous change of component material and energies, in which material continually enters from, and leaves into, the outside environment." Ludwig von Bertalanffy, *General Systems Theory: Foundations, Development, Application* (New York: George Braziller, 1976), 121. From the perspective of control, Bertalanffy's work stands in contrast to Wiener's or Shannon's. While von Bertalanffy does have a definition of "information," it plays a much lessened role in the overall regulation of the system than other factors. Information is central to any system, but it is nothing without an overall logic for defining information and using it as a resource for systems management. In other words, the logics for the handling of information are just as important as the idea of information itself.

24. Wiener describes feedback in the following way: "It has long been clear to me that the modern ultra-rapid computing machine was in principle an ideal central nervous system to an apparatus for automatic control. . . . With the aid of strain gauges or similar agencies to read the performance of

these motor organs and to report, to 'feed back,' to the central control system as an artificial kinesthetic sense, we are already in a position to construct artificial machines of almost any degree of elaborateness of performance." Wiener, *Cybernetics*, 27.

25. As Wiener elaborates, "Just as the amount of information in a system is a measure of its degree of organization, so the entropy of a system is a measure of its degree of disorganization; and the one is simply the negative of the other." Wiener, *Cybernetics*, 11.

26. Shannon and Weaver, *A Mathematical Theory of Communication*, 8.

27. Von Bertalanffy, *General Systems Theory*, 121.

28. Gilbert Simondon, "The Genesis of the Individual," in *Zone 6: Incorporations* (New York: Zone, 1992), 300. In contrast to either atomist (constructionist) or hylomorphic (matter into form) theories of individuation, Simondon's use of the term "individuation" begins and ends with the process of individuation, not its apparent start or end point. Simondon suggests that our electrical technologies of transduction provide a technical means by which material-energetic forms are regulated—individuation is therefore a "transduction."

29. Gilles Deleuze and Félix Guattari, *A Thousand Plateaus* (Minneapolis: University of Minnesota Press, 1987), 6.

30. Gilles Deleuze, *Difference and Repetition*, trans. Paul Patton (New York: Columbia University Press, 1995), 182.

31. Henri Bergson, *The Creative Mind* (New York: Citadel Press, 1997), 147. Another way of stating this is to suggest that networks have no nodes. Brian Massumi corroborates this when he states that "in motion, a body is in an immediate, unfolding relation to its own nonpresent potential to vary. . . . A thing is when it isn't doing." Brian Massumi, *Parables for the Virtual* (Durham: Duke University Press, 2002), 4, 6.

32. John Arquilla and David Ronfeldt, "The Advent of Netwar," in *Networks and Netwars*, 5.

33. Emmanuel Levinas, "Ethics as First Philosophy," in *The Levinas Reader*, ed. Séan Hand (New York: Routledge, 1989), 82–83.

34. Ibid., 83.

35. John Arquilla and David Ronfeldt, *Swarming and the Future of Conflict* (Santa Monica: Rand, 2000), 8.

36. Eric Bonabeau and Guy Théraulaz, "Swarm Smarts," *Scientific American*, March 2000, 72–79.

37. Ibid., 21.

38. Deleuze and Guattari, *A Thousand Plateaus*, 170.

39. Ibid.

40. Foucault offers a distinction between the two types of power near the end of the first volume of *The History of Sexuality*, as well as in a 1976 lecture at the Collège de France: "Unlike discipline, which is addressed to

bodies, the new nondisciplinary power is applied not to man-as-body but to the living man, to man-as-living-being; ultimately, if you like, to man-as-species. . . . After the anatomo-politics of the human body established in the course of the 18th century, we have, at the end of that century, the emergence of something that is no longer an antomo-politics of the human body, but what I would call a 'biopolitics' of the human race." Michel Foucault, *Society Must Be Defended: Lectures at the College de France, 1975–76* (New York: Picador, 2003), 243.

41. For more see Deborah Lupton, *Medicine as Culture: Illness, Disease, and the Body in Western Culture* (London: Sage, 2000); Giorgio Agamben, *Homo Sacer: Sovereign Power and Bare Life* (Palo Alto: Stanford University Press, 1998); Agamben's essay "Form-of-Life," in *Radical Thought in Italy,* ed. Paolo Virno and Michael Hardt (Minneapolis: University of Minnesota Press, 1996); and Michael Hardt and Antonio Negri, *Empire* (Cambridge: Harvard University Press, 2000).

42. See Foucault's texts "The Birth of Biopolitics" and "The Politics of Health in the Eighteenth Century," both in *Ethics: Subjectivity and Truth,* ed. Paul Rabinow (New York: New Press, 1994).

43. As Foucault notes, "After a first seizure of power over the body in an individualizing mode, we have a second seizure of power that is not individualizing, but, if you like, massifying, that is directed not at man-as-body but at man-as-species." Foucault, *Society Must Be Defended,* 243.

44. While theories of media and communication have preferred the term "mass audience" to "population," in the context of the network society, we can see an increasing predilection toward the "living" aspects of networks. Quite obviously, the health care and biomedical research sectors are driven by living forms of all kinds, from "immortalized cell lines" to patients undergoing clinical trials. And despite the rhetoric of disembodied information that characterizes cyberculture, the Internet is still driven by the social and commercial interaction of human beings and "virtual subjects." So while Foucault's use of the term "population" is historically rooted in political economy, we suggest that it is also useful for understanding how the network diagram begins to take shape in a political way. That is because the problem of political economy is also the problem of network management, or what we have called "protocological control."

45. Gilles Deleuze, "What Is a *Dispositif*?" in *Michel Foucault Philosopher* (New York: Routledge, 1992), 164 (translation and emphasis modified).

46. Foucault, "Security, Territory, Population," in *Ethics: Subjectivity and Truth*, 246.

47. Gregor Scott, "Guide for Internet Standards Writers," RFC 2360, BCP 22, June 1998.

48. See Agamben, *Homo Sacer.*

49. See the second chapter of Hardt and Negri, *Empire*.

50. This results in the historical development of a "political science" or a political economy, through which the coordination of resources, peoples, and technologies can be achieved. As Foucault states: "The constitution of political economy depended upon the emergence from among all the various elements of wealth of a new subject: population. The new science called political economy arises out of the perception of new networks of continuous and multiple relations between population, territory and wealth; and this is accompanied by the formation of a type of intervention characteristic of government, namely intervention in the field of economy and population. In other words, the transition which takes place in the eighteenth century from an art of government to a political science, from a regime dominated by structures of sovereignty to one ruled by techniques of government, turns on the theme of population and hence also on the birth of political economy." Foucault, "Governmentality" in *The Foucault Effect: Studies in Govermentality,* ed. Graham Burchell et al. (Chicago: University of Chicago Press, 1993), 100–101.

51. This multistep process is simply a heuristic. To be precise, these steps do *not* happen consecutively. They take place in varying orders at varying times, or sometimes all at once. For example, certain foundational protocols must always precede the genesis of a network (making our step three come before step two). Then after the network is in place, new protocols will emerge.

52. Deleuze, *Negotiations,* 182. The difficulty with relying on Deleuze, however, is that he came to the topic of resisting informatic control rather late in his work (as did Foucault). His work on the topic often includes question marks and hesitations, as if he were still formulating his opinion.

53. Hardt and Negri, *Empire,* 210.

54. Gilles Deleuze, *Foucault* (Minneapolis: University of Minnesota Press, 1988), 92.

55. Ibid.

56. Ibid., translation modified. The quoted phrases refer to Foucault's *History of Sexuality.*

57. In addition, the recurring tropes of AI and "intelligence" (both artificial intelligence and governmental/military intelligence) are made to bolster the dream of a transcendent mind that is not the brain, and a brain that is not the body.

58. D. N. Rodowick, "Memory of Resistance," in *A Deleuzian Century?* ed. Ian Buchanan (Durham: Duke University Press, 1999), 44–45.

59. Political movements oriented around changing existing technologies certainly do exist. We wish not to diminish the importance of such struggles but simply to point out that they are not protocological struggles (even if they are struggles over protocological technologies) and therefore inappropriate to address in the current discussion.

60. Deleuze, *Negotiations,* 175.

61. For a popular overview and discussion of computer viruses, see Stephen Levy, *Artificial Life* (New York: Vintage, 1992), 309.

62. See Fred Cohen, "Computer Viruses: Theory and Experiments," *Computers and Security* 6 (1987): 22–35. Also see Cohen's much-referenced study of computer viruses, *A Short Course on Computer Viruses* (Pittsburgh: ASP Press, 1990).

63. The Web sites of antivirus software makers such as Norton Utilities contain up-to-date statistics on currently operational computer viruses.

64. On computer viruses as a-life, see Eugene Spafford, "Computer Viruses as Artificial Life," in *Artificial Life: An Overview,* ed. Christopher Langton (Cambridge: MIT Press, 2000).

65. These and other SARS figures are contained in the Web sites for the WHO and the CDC. For a recent Rand report on emerging infectious diseases, see Jennifer Brower and Peter Chalk, *The Global Threat of New and Reemerging Infectious Diseases* (Santa Monica: Rand, 2003).

66. See Eugene Thacker, "Biohorror/Biotech," *Paradoxa* 17 (2002); and "The Anxieties of Biopolitics," *Infopeace.org* (Information, Technology, War, and Peace Project) (Winter 2001), http://www.watsoninstitute.org.

67. "It would be neither the fold nor the unfold . . . but something like the *Superfold* [*Surpli*], as borne out by the foldings proper to the chains of the genetic code, and the potential of silicon in third-generation machines. . . . The forces within man enter into a relation with forces from the outside, those of silicon which supersedes carbon, or genetic components which supersede the organism, or agrammaticalities which supersede the signifier. In each case we must study the operations of the superfold, of which the 'double helix' is the best known example." Deleuze, *Foucault,* 131–32.

68. Roland Barthes, *The Pleasure of the Text* (New York: Hill and Wang, 1975), 40.

69. Deleuze goes on to describe how Foucault's work with power reached a certain wall, a limit concerning the silence on the part of those subjected by disciplinary systems such as prisons. This led Foucault to form the GIP (Prisoner's Information Group), opening a new discourse between prisoners, activists, and intellectuals, which decisively informed his work in *Discipline and Punish.* But the same can be said of Deleuze, or anyone doing cultural, social, and political work; one identifies a certain limit point, beyond which something must change. That something could just as easily be concepts as it could be methodology. Or it could be the discarding of a previous set of practices altogether. Further, it could also be a lateral jump from one discipline to another, from a discipline based on theory to one based on practice. Whatever the case, the limit point Deleuze describes is implicit in theoretical work, and this is our responsibility here in addressing protocological control.

70. Deleuze, "Intellectuals and Power," 205–6.

71. Geert Lovink, *Dark Fiber* (Cambridge: MIT Press, 2002), 9.

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