Networks and globalization

Jim Davis
jdav2002@earthlink.net
http://www.gocatgo.com/jdav.html
Post comments at: http://networksdialectics.blogspot.com/

In his trilogy *The Information Age*, Manuel Castells presents a comprehensive account of the economy and society in the era of electronics.

> A new economy emerged in the last quarter of the twentieth century on a world-wide scale. I call it informational, global and networked to identify its fundamental and distinctive features and to emphasize their intertwining... It is *global* because the core activities of production, consumption, and circulation, as well as their components (capital, labor, raw materials, management, information, technology, markets) are organized on a global scale, either directly or through a network of linkages between economic agents. It is *networked* because, under the new historical conditions, productivity is generated through and competition is played out in a global network of interaction between business networks. This new economy emerged in the last quarter of the twentieth century because the information technology revolution provided the indispensable, material basis for its creation. (2000, 77)

Castells' timeframe for the emergence of this "new economy" or "global economy" coincides with what is also referred to as "globalization". This "new economy" is certainly "capitalist", in the classic sense that it is a system of private property characterized by highly developed, nearly universal commodity production; where human labor has become a commodity, and surplus labor is expropriated via the wage-labor system; where the goal of production is the maximization profit. But this economy is also different from other stages of capitalism, including imperialism, per the distinctions that Castells outlined, and which I will expand on below. Globalization -- Castells' "new economy"[1], is a stage of capitalism, the form that capitalism takes in the age of electronics.

From Castells description above, the concept of "network" is inextricably intertwined with globalization. In a later work (2001), Castells presents a simple definition of network as "a set of interconnected nodes." The word "network" itself is derived literally from a "work like a net", where a net is threads or wires or similar material arranged in an open-work fabric for catching fish, birds or other animals. While the notion of a net as a means of catching things still lingers, the more common use of net in this case is its *structure*, nodes linked together. From handcrafts that looked like nets, the imagination has extended "network" to describe both tangible (biological systems, transportation systems, communication systems) and abstract (property relations, legal systems, economies) structures.

If structures are seen as developing or changing, that is, seen dynamically, then "network" becomes a descriptive way of thinking about any process, including economies, ecosystems, and organizations. If any process, though, can be seen as a "set

[1] Castells clarifies "new economy": "[W]e are entering a new business world, A world that does not cancel business cycles or supersede economic laws, but transforms their modalities and their consequences, while adding new rules to the game." (2002)

of interconnected nodes", and historically "network" has been used to describe many systems, in what sense can we elevate "network" today, to say that *now* is the "network society"?

Real-world networks

In order to resolve the apparent contradiction of "the rise of the network metaphor" with the general notion that all processes have network features (interconnected nodes), it is useful to consider that there are different types or classes of networks. While "interconnected nodes" can apply to any process, processes and networks differ. As a metaphor, or way of thinking about processes, networks can be typed according to properties of nodes, links, groups of linked nodes, and the overall behavior of the network that emerges from the interaction of the nodes.

The formal study of networks has its roots in graph theory in mathematics. While important advances were made in theorizing about these graphs (or theoretical networks), the complexities of the mathematics of them could not really be tackled until computers became available. Among other things, computers have become critical instruments of science, allowing science to explore new areas and discover new aspects of the universe. Chaos theory and complexity theory are two important advances coming out of the application of raw processing power to a wide variety of fields ("To solve the problems of organized complexity you needed a machine capable of churning through thousands, if not millions of calculations per second" (Johnson, 2001, 49). Building on complexity theory, in the 1990s, researchers began to investigate processes using the "network" metaphor. Drawing on sociology work on social networks, physics, work in biology and systems theory, and armed with computers, researchers like Albert-Laszlo Barabasi, Steven Strogatz, Duncan Watts and numerous others began to discover certain common properties of "real-world networks", that is, networks that spontaneously self-organized in nature or in society. Phenomena as diverse as the neural system of a nematode, the electrical grid system in the U.S. and the Internet showed common properties.

For example, the links among the nodes in "real-world networks" are not distributed randomly, or according to a normal bell-curve. Instead, when graphed out, the nodes are distributed according to a "power-law" distribution -- a few nodes have many links, and many nodes have few links. The presence of the nodes with many links -- dubbed "hubs" or "superconnectors" -- give the networks a "small-world" effect. In a "small world", any node can reach any other node by a relatively small number of hops. The classic example (basically unprovable), is derived from Stanley Milgram's 1960s study that asserted that any one human being on the planet is separated from any other human being by at most six people -- the "six degrees of separation. " But other examples can be proven, or at least asserted with more confidence. For example, Barabasi has shown that at most 20 clicks separated the 1 billion pages on the Internet circa 1999. The presence of superconnectors and clusters of nodes (small groups of nodes linked to nearby nodes only, not to every other node) provides an efficient trade-off between a network's diameter (how many hops to cross it, or its degree of connectivity) and the number of

connections or links. This structure gives a network "robustness" -- single nodes may fail without disrupting the network. Other properties give networks particular character or behavior: the number of connections a node may sustain; the cost of adding new connections; link "direction" (A may communicate to B, but not vice versa); link bandwidth; and link speed. Feedback -- the ability of nodes to respond to the state of nearby nodes, or in response to messages from other nodes -- is essential for emergent properties in networks to appear. Nodes may "preferentially attach" to nodes already well-connected. If a network is growing, and if preferential attachment exists, a network will develop superconnectors, nodes will therefore be distributed according to a power law, and the small-world effect will appear.

Two other important points should be noted about networks. First, for Barabasi, conceptualizing processes as networks led to an important breakthrough: "By seeing only nodes and links, we were privileged to observe the architecture of complexity. By distancing ourselves from the particulars, we glimpsed the universal organizing principles behind these complex systems." (225) But perhaps more significant, the complex systems could not be understand just in terms of structure, but as dynamic systems. As Duncan Watts has written:

> [I]n the past, networks have been viewed as *objects of pure structure* whose properties are *fixed in time*. Neither of these assumptions could be further from the truth. First, real networks represent populations of individual components that are actually *doing something* -- generating power, sending data, or even making decisions. Although the structure of the relationships between a network's components is interesting, it is *important* principally because it affects either their individual behavior or the behavior of the system as a whole. Second, networks are dynamic objects not just because things happen in networked systems, but because the networks themselves are evolving and changing in time, driven by the activities or decisions of those very components. In the connected age, therefore, *what happens and how it happens depend on the network*. And the network in turn depends on what has happened previously. It is this view of the network -- as an integral part of a continuously evolving and self-constituting system -- that is truly new about the science of networks. (28-29)

A second important point is that the overall behavior of the network obeys a particular "law system." "Law system" system is a concept borrowed from dialectics, to which network science (Engels described dialectics as "the science of universal interconnection") and complexity and chaos theory owe a tremendous, but largely unacknowledged, debt. In dialectics, "laws" are the necessary, general, definite, stable connections between phenomena that cannot fail to occur given a particular environment or field of operation. In network terms, connections between nodes have a definite quality. The law system constrains a network.

Adding the concept of "law system" to understanding networks resolves a glaring shortcoming in the popular books on network science, including those by both Barabasi and Buchanan (2002), when they examine the economy as a network. The distribution of wealth in capitalism follows "Pareto's Law", a kind of power law, or 80/20 rule but much worse, as in 2001, 10% of U.S. families own almost 70% of the wealth (United for a Fair Economy). In computer models, "giving people random amounts of wealth to start out, and letting the economy run for a long time, Bouchaud and Mezard found that a small

fraction of the people always ended up possessing a large fraction of the entire wealth." (Buchanan, 192) The principal of "preferential attachment" in this case is literally "the rich get richer." Such a behavior, though only happens under a system of social production with private ownership.

The law system of capitalism, including the laws of value and the maximization of profit, define the connections between the economic nodes: between capitalist and worker, capitalist and consumer, and between capitalists. The nature of the *capitalist* law system results in the constant distribution of wealth within the *capitalist* network/economy towards the already wealthy. Under another mode of production, the links between the nodes obey different laws. We can envision an economy where production for use and maximum satisfaction comprise the law system, and nodes interact such that each contributes as able; and each takes as needed. The behavior of such a network would be radically different. The nature of the links -- the law system -- defines the behavior of the network.

Alex Galloway and Eugene Thacker (2004) use the concept of "protocol" as a way of approaching "the limits of network thinking." They borrow the usage "protocol" from computer science, where "protocol" describes the agreed upon rules by which two connected devices interact. An agreement on protocol is a pre-requisite for links to be established between consenting nodes. So in this sense, the protocols will determine, to some extent, the nature of the links. In computer systems though, protocols are a prerequisite for interconnection, and neutral (or biased) to the same degree as grammar and syntax in language. Where law systems can be distinctly partisan, for example, in the way power is distributed between the nodes, "protocol" is fundamental but less comprehensive as "law system." For example, the Internet is used both to organize globalization and to organize against globalization. The functioning of the Internet rests on well-defined protocols like Transmission Control Protocol (TCP) and Hypertext Transfer Protocol (HTTP). Galloway and Thacker describe "protocological struggle" in the sense of struggle against the rules and structure of the entire network/system of globalization, not just individual injustices. But as Florian Cramer commented on the nettime-l list (2004), "protocol" as a focus has some problems:

> "But as with any play, consisting of a ruleset and its free execution, control is never total to the extent that it wouldn't permit freedom... Freedom and control thus are not mutually exclusive, but mutually dependent on each other. To envision communication systems without control - i.e. languages without rules, networks without protocols - and find them desirable, would be utterly an infantilist vision of a pre-language paradise." (2004)

In any case, "law system" and "protocol" both point to the need to move beyond what Galloway and Thacker call the "metaphysics of networks." Networks belong to the real world, to history. They have evolved under specific conditions; and in the case of economic and social networks bear the stamp of class relations. These networks cannot be understood without also understanding the operative law system.

"Network motifs" is another way of approaching this concept of network types or classes based on the quality of connections. "Network motifs" are structures or patterns of interconnections typically involving three or four nodes that repeatedly appear in the

network. Different networks have different motifs that evolved under particular conditions. The presence of types of motifs in networks suggests a way of distinguishing between types of networks.

> None of the network motifs shared by the food webs matched the motifs found in the gene regulation networks or the World Wide Web... Different motifs were found in electronic circuits with different functions. This suggests that motifs can define broad classes of networks, each with specific types of elementary structures. *The motifs reflect the underlying processes that generated each type of network* [my emphasis - jd]; for example, food webs evolved to allow a flow of energy from the bottom to the top of the food chains, whereas gene regulation and neuron networks evolve to process information. Information processing seems to give rise to significantly different structures than does energy flow. (Milo et al, 2002)

At a certain point, given enough nodes dynamically interacting according to local rules (defined by the law system) that allow for feedback and adaptation, the network can be described as a "complex adaptive system" and will display "emergent behaviors." That is, low-level interactions will give rise to higher level or macro-behaviors that are not necessarily evident in or predictable by the low-level interactions. (Johnson, 2001) The "small world effect" is an emergent behavior arising from growth and preferential attachment. The polarization of wealth and poverty is an emergent property of capitalism.

The more dense the interconnections in the network, and the greater the number of interactions in the network (*inter*-action implying bi-directional, thus allowing for feedback), the more likely it is that emergent behaviors will arise. That is, with reduced attachment costs (allowing for more nodes) and reduced transaction costs (allowing for more interactions), the more dynamic, complex and adaptive, the more "real-world", in the sense of spontaneous and self-organizing, the network will become.

The concept of "real-world networks" -- networks of nodes where some degree of association or growth is possible, and following some simple rules for attachment that allow for emergent properties to manifest over time -- provides one way of distinguishing among "networks" in general, and specifically why we might focus on "networks" as something new or at least special about today's economy and society. By lowering communication costs ("transaction cost" and "attachment cost"), new technologies have allowed "real-world networks" to spring up wherever the new technologies have been applied -- in manufacturing, in finance, in trade, in computer-mediated social formations. Within the law system of capitalism, the result is the structure of globalization, an infrastructure of immiseration. The material networks of globalization have given rise to, or are reflected in, structures of the various "sites" of globalization. In this broader structural sense, I think Castells can refer to a "network society", and Kevin Kelly can outline "rules" for a "network economy". "Networks have existed in every economy. What's different now is that networks, enhanced and multiplied by technology, penetrate our lives so deeply that 'network' has become the central metaphor around which our thinking and economy are organized." (Kelly, 1998)

The rise of networks

Castells, in the excerpt quoted at the beginning of this paper, notes that the changes over the last 30 years or more happened "*because the information technology revolution provided the indispensable, material basis for its creation*." "[I]nformation technology" should be considered broadly, to encompass recent scientific and technological advances in general. Of particular note is the dramatic cheapening and speeding up of computer processing power, and along with it, the dramatic cheapening and speeding up of communication. And the revolution has only begun.

From boxy computers transferring bits back and forth over copper wire, to cell phones and laptops communicating via radio waves, to chip-sized transmitters that can be attached to goods, or inserted into animals, the ability of devices (nodes) to transfer bits (i.e., connect) to other devices (via links) continues to get cheaper, faster, and more widespread. New technology has provided the means for a dramatic intensifying of interconnections in the economy and the broader society. As Howard Rheingold has noted, "the result is an infrastructure that makes certain kinds of human actions possible that were never possible before." (2003, xii)

In some sense, one can argue the revolution in transportation and communications is simply an extension of the process of capitalism itself -- advances in printing technology in the 15th century; shipping and navigation technology in the 17th century; canal systems in the 18th century; railroad, steamboat and telegraph systems in the 19th century; and in the last century telephones and radio, which led to breakthroughs in electronics that laid the basis for computers and other new technologies. Certainly each of these technical advances enriched the connections within the economy, and provided the platform for future advances. From the vantage point of centuries, we can view the medieval network of towns and roads as a complex adaptive system, but such a structure would have been largely invisible to most inhabitants. Even with a denser communication and transportation system of the telegraph and railroad, interaction with the network was relatively expensive and thus restricted. The economy has always been as global as technology has allowed, but the electronic technology platform allows something new to emerge.

What is unique and revolutionary about the "information technology" revolution is that it could re-unite the communication and transportation into one system through the rendering of information into digital bits, 1s and 0s, which could then be loaded, secured, transported, and off-loaded by general purpose digital processors, without the use of human labor. (Or, more precisely, some proto-worker's activity was recorded, encoded, and now capable of replay, ad infinitum, in the absence of the worker.) (Davis and Stack, 1994, 1996) So while there is a rich history of constantly developing interconnections in the world economy, each one cheapening what had been done before, allowing the extension of the world market and the capitalist system, still something special and new appeared at the end of the 20th century.

The technology revolution is so total that today computer technology is intrinsic, fundamental to a modern economy. In production one interacts with "computer networks" -- electronic devices communicating through cables or radio waves -- directly (e.g., using a computer workstation, modern factory equipment, cash register) or indirectly (via supply chains that deliver raw materials to the production site or transport finished components away to market, managed by linked computers). In the realm of consumption, transactions are mediated by electronic devices linked via wires or electromagnetic waves -- i.e., a network. Networks extend into the reproduction of our lives. Medical care and education (especially distance education) are increasingly computerized and those computers are linked to other computers. To the extent that social interactions transpire via electronic devices, including the telephone, mobile devices or email, those interactions are transpiring over a computer network. Entertainment -- television, radio, Internet, etc. is distributed over computerized networks. Some 160 million Americans have access to the Big Network, the Internet, and use it to meet, communicate, play, learn, fantasize, as well as to work and shop (and lie and cheat and steal). "Networks" are literally in the air, as evident from the cell towers sprinkled across farmland and city alike. We live in a "network society", we work in a "network economy", we interact in "social networks." Inasmuch as our lives are mediated by electronics, they are mediated by networks.

These networks are made *possible* by the technology revolution -- the cheapening of the cost of making connections as a result of electronics, and *created by* both the drive for profit and the human drive to associate, socialize, connect. These technological networks are material, objective. These material networks give rise to, or at least contribute to, the rise of the common usage of "networks" as a concept to apply to processes in general.

Technology is *the means* by which we interact with world. Consciousness is shaped by and shapes interactions with the world. Those interactions are mediated by visible network nodes linked with other nodes. The visibility of the interactions with computer networks feeds the consciousness of networks.

At the same time, the new communication networks enable new forms of interaction. Like water seeking its own level, people explore and push the uses of new communication technology. The consciousness of these new forms of interaction and organization in turn flows back into the development of the instruments of production. As the technology revolution advances, the organization of production is changed to take advantage of what new technology makes possible (e.g., "the network form"). New forms of organization emerge to make optimal use of the new technologies. These new forms in turn contribute to the development of new technologies and ways of using them. It is a dialectical process.

Globalization

The dating of the technology revolution from the early 1970s is significant because it so neatly fits in with a generally accepted beginning of globalization. For example, William

Robinson writes "The post-Second World War expansion -- the so-called 'golden age' of capitalism -- entered into crisis in the 1970s, precipitating a period of restructuring and transformation that led to a new mode of global capital accumulation now known as neoliberalism." (Robinson, 2004) The post war "crisis" could not be resolved within the context of "Keynesian social structure of accumulation", "globalization" was the new structure to resolve, if only temporarily, the crisis. The coup in Chile (1973) provided a laboratory for neoliberal programs. The electoral victories of Thatcher and Reagan (late 1970s, 1980s) provided a world power platform from which to aggressively promote the same programs, forcing structural adjustments on other countries. The political agenda of globalization was "free trade" programs, "open markets", and the withdrawal of the state from the economy (deregulation, elimination of social programs, privatization and marketization of the public sphere). The result was capital hyper-mobility, the accelerated destruction of the environment, the contingentization of labor, the shifting of social risk to the individual, and the general polarization of wealth not just between North and South, but within every capitalist country as well.

But the history of globalization, stretches back much farther. It grows out of the two world wars of the first half of the 20th century, themselves an attempt to resolve the crisis of the system of imperialism. The capitalist resolution of the crisis of imperialism was globalization, achieved via world war. The post-World War II restructuring included the dismantling of the colonial system as a pre-cursor to "free trade" and open markets; the establishment of international bodies of governance like the United Nations, International Monetary Fund and the agency that would become the World Trade Organization; and the establishment standards to stabilize the world economy. This first phase comprises what Robinson refers to as the "golden age". However, technology advanced (the electronics revolution really began in the 1940s) with the accompanying crises that that always entails. The rebuilt economies of Europe and Japan re-entered the world market, increasing competition. The cost of the Cold War and containing insurgent popular forces around the world strained the U.S. economy as the stable center of the world economy. These developments rendered the post-WWII system, with its social contract and system of stable exchange rates, untenable.

Robinson describes what I think is really the second phase of globalization that kicked off in the early 1970's with three inter-related events: the cheapening and shrinking of computer processing power, symbolized by Intel's introduction of the microprocessor in 1971; the dismantling of the post-WWII Bretton Woods system of fixed exchange rates (1972-1974); and the consequent development of the modern system of speculation beginning with electronic money markets (1972). While the connection of processing power and the weakening of the gold standard are connected in the deep sense that technology advances are profoundly related to the economy, the connection between the collapse of the gold standard and speculative capital is more direct. The money markets, *made possible* by advances in computerized communication technology (networks), were *necessitated* by multi-national corporate economic activity in the absence of fixed-exchange rates. Money markets were required to protect operations against changes in the currency values. The crisis that in part caused these events, and in part resulted from

them eventually provided the opportunity for the restructuring programs that we think of as neoliberalism to be pushed forward.[2]

"Globalization" can be seen as a stage of capitalism, capitalism in the age of electronics. All of the features of "globalization" are only possible, because of what technology makes possible, and what capitalism requires when based on a technical foundation of electronics. Castells again:

> "The rise of the network society... cannot be understood without the interaction between these two relatively autonomous trends: the development of new information technologies and the old society's attempt to retool itself by using the power of technology to serve the technology of power." (2000, 50-51)

Globalization and Imperialism

Viewing the economy in network terms helps to see how globalization differs from the world of imperialism. In the network of imperialism, colonies were exclusively linked -- politically, economically and culturally -- to their respective European, U.S., and Japanese metropolises. In other cases, nominally free states were economically dominated single colonial powers. In some contested areas, like China, some arrangement was made to divide up the spoils.

The imperialist economy that Lenin wrote about was dominated by monopolies and "finance capital", the merger of industrial and bank capital under the control of the banks. The financial system was oriented to production, creating assets that could service the debt. (Henwood, 1997) The system was distinctly bank-centric: "the industrial capitalist becomes more completely dependent on the bank... The change from the old type of capitalism, in which free competition predominated, to the new capitalism, in which monopoly reigns, is expressed, among other things, by a decline in the importance of the Stock Exchange." (Lenin, 1971, pp 194 and 196)

In Lenin's *Imperialism*, railroads were the defining technology -- networks of rail lines, yes (in the metropolis at least), but difficult and expensive to attach to. In the colonies, the transportation systems, such as they were, led in one direction:

> Economies at a certain level turn on networks of connection and transactions. You have resources that need to get to producers, and products that need to get to consumers. Overwhelmingly, especially in the post-colonial world, the infrastructure such that it was, was oriented towards extraction only. That's what the colonial holders wanted to do. So they would lay down some infrastructure e.g. from the interior to take things out. But that doesn't connect the population amongst themselves. There was no interest in the colonial period in having the colonies themselves be major consumers and so it didn't matter whether people had buying power and it didn't matter whether societies internally were networked and so it didn't matter if people had electricity or telephones or so on. (Winters, 2005)

Imperialism was a chain that would break at its weakest link. The working class of the colonial powers was "bribed" with super-profits from the colonies, and had no political

[2] As an aside, at about the same time, in May, 1973, researchers at the Xerox research center in Palo Alto first demonstrated Ethernet, the major standard for connecting computers in a network.

initiative. The liberation of oppressed nations, the weak links, was focus of the "anti-imperialist" struggle. The Maoist "four contradictions of imperialism" summarized the main categories of connections in the post-October revolution world: socialism versus imperialism, proletariat versus bourgeoisie, oppressed nations versus imperialism, imperialist countries and monopolies versus each other; and this conception shaped left political work into the 1980s.

In many ways the features of imperialism and globalization appear to be the same. The poor are still with us, and concentrated in what once were the direct colonies. The digital divide is most glaring between North and South. Exploitation has not ended. Monopolies dominate industries. There is no fair trade. But how fundamentally different things are. Not a new or neo-colonialism, and not something better; but something different.

A confluence of circumstances and initiatives after 1945 -- the war-wrecked world of the old colonial rulers, militant independence movements, the Soviet Union, and the program of international-oriented capital -- ended the old colonial system, a process not concluded until the 1970s. This breakup allowed the process of "open markets" where any exploiter has access to resources, labor, markets. Direct political control of the former colonies does not exist. Even in cases of U.S. military occupation, as, e.g., in Iraq or Afghanistan, the quality and intent of the occupation is not a Colonialism 2. Socialism as a state-based political alternative has for all practical purposes disappeared. Current U.S.-European relations notwithstanding, the competition between the former imperialist powers is for the most part resolvable through international institutions because the ruling class shares a common capitalist world vision.

With robotics, global labor markets, just-in-time labor, the relationship between capitalist and worker has dramatically shifted. The "bribe" of the working class in the metropolis that Lenin described had two components. The job bribe was cancelled via takebacks, cutbacks, mass layoffs, and job flight to low wage labor markets (all related to adjustments made possible by the technology revolution). The neoliberal offensive is still in the process of destroying the social welfare bribe; witness the assault on Social Security in the U.S. Monopolies still dominate the economy, and is the result of the natural drift in capitalism. But new technologies regularly create entirely new industries for new capitalists, and new technologies have created havoc for traditional monopolies as the pendulum has shifted back towards global competition. The rhetoric of entrepreneurism, contingency, self-employment, etc. has led to an economic atomization that contradicts monopoly. Finance capital has radically evolved, such that a small section of it, speculative capital, has grown to dominate other forms of capital. The finance system has moved away from banks to markets trading in elaborate financial instruments), increasingly existing inside computers. As Doug Henwood wrote, "it's hard to imagine a deep market in such alchemy in a computerless age". (1999, 109) "Investment" is technically two or three and even four orders removed from production.[3]

[3] First order is a loan or floated stock to raise money for production. Second order (or secondary) markets are stock markets or bond markets where shares or loans are bought and sold. Third order (or "tertiary markets") is speculation on the rise or fall of groups of shares via trading on stock market indexes. A fourth order, or "quaternary market" would be derivatives based on many indexes, or "options on options." (Bass, 1999).

In terms of notional value of investments, or dollar flows around the world, a tiny percentage -- less than five percent -- has anything directly to do with production or trade.

The shape and structure and dynamic of globalization -- the world economy today and the politics to keep it running -- is *different*. Not a chain but a real-world network enabled through the cheapness and ease of making and using connections.

Just because a technology, e.g. signal exchange among electronic devices, is *possible* does not mean that it will make it out of the laboratory and into the economy. The law system of capitalism -- profits come from unpaid labor, commodities exchange on the basis of the socially necessary labor it took to make them, capitalists strive to maximize profit or risk the penalty of being driven into the ranks of the property-less -- provides a particular kind of Petri dish for the cultivation of new technologies.

To the extent that automation (where production is controlled by computer devices) increases output, eliminates troublesome workers, and wins the battle of production, computer networks are a logical step beyond stand-alone devices. Networks enable machines to cooperate, maximize resources in the nodes, allow for dispersed production, provide better feedback, awareness, command and control of processes. In theory, hooking intelligent nodes together, including workers, increases productivity. Robert Metcalf, one of the developers of the Ethernet computer networking standard used in most office networks, stated that the utility of networks grows exponentially as nodes are added.[4]

New technologies, including network technologies have enabled new forms of production organization that contributed to an upswing in accumulation after the crisis of the 1970s (Robinson, 2004). The networked economy has carved out some maneuverability for capital. For example, globalization, through the networked production, distribution and finance system, ties together distant markets in the same commodity. For example, with decreased transportation costs and near-instantaneous market information (both products of the technology revolution), wheat producers in North Dakota, the Ukraine, and Argentina (among many others) all compete in the same world market. As new producers enter the market, a new social value emerges, which eventually forces prices to seek a new level, in this case a world level. This is always a leveling down.

The labor market is no exception. By allowing globally dispersed production around the world, the global networked economy has undermined the bargaining power of labor, because, in network terms, any one labor market is just another node. With redundant connections to other nodes, a disturbed labor market node can be abandoned. And electronic networks allow greater supervision and control of the worker and the consumer.

In one sense, the network distributes risk (for the capitalist) across many nodes. A failure at any production site may disturb, but not destroy the global market. At the same time

[4] Specifically, in networks where every node can connect to every other node, which is the case with a local area Ethernet network. "Metcalfe's Law", as this observation is known, could be considered an emergent property of Ethernet networks.

globalization may sacrifice the local to the global, with the misery that that entails. What does it matter to the world market if North Dakota farms, where the growing season is short, fail, if there are redundant producers in Argentina or Australia or the Ukraine? Or if Detroit or Dresden dissolves as long as workers and factories are available in Shanghai or Monterrey?

Setting aside the question of the role of the nation-state under globalization, networks have helped to internationalize, or globalize the propertyless. Objectively, there is one world labor market (tied together by the networks of production and consumption, and never mind that humanity has always been living on one planet), and one networked owning class. In this sense, the "liberation of oppressed nations" is obsolete, today's challenge is the liberation of a global class. This is one of the main points of Hardt and Negri's confusingly named *Empire*. "Empire is not a weak echo of modern imperialism but a fundamentally new form of rule." (146)

Globalization, speculative capital and networks

Globalization is inextricably bound with new technologies of connected computing devices. That is, material networks of communication -- the workstations, routers, switches, hubs, copper and fiber optic cable, satellites and satellite dishes, transmitters, receivers, etc. etc. -- and globalization cannot be separated. Globalization could not exist without computerized computer networks to drive global production, to monitor global supply chains, to manage global transportation systems, to process global financial transactions, to transfer global capital, and -- to fight local insurgencies. In such an environment, speculative capital -- capital involved in the buying and selling of risk -- acquires an especially important role.

With global operations in an electronically networked world, hedging (the offloading of risk) is a necessity. To maximize return on otherwise idle capital, speculating (the taking on of risk for a consideration) is likewise required. New technologies create new tools for risk management, which is to say, new opportunities for speculation. The fundamental instrument of speculative capital is the "derivative". A derivative is a financial instrument that derives its value from an underlying commodity or security. A share of stock is a simple kind of derivative. A futures contract -- e.g. a contract (a "right") to purchase a million gallons of North Sea crude oil for October delivery at a given price -- is also a kind of derivative. Early forms of derivatives (in the form stock shares and futures contracts) were in use in Holland and England in the 17th century. Speculative capital has been a part of capitalism for a long time.

With computer technology more sophisticated derivatives can be designed and managed. A financial institution might might bundle together home loans or credit card debt, and re-sell pieces of the bundle as shares to investors. This device is called "securitization", and effectively, if invisibly, links the mortgagees or credit card debtors together, with the world of anonymous investors. Even more sophisticated derivatives bundle together multiple derivatives, thereby linking markets in different commodities. The logic of these

financial moves is to distribute risk and provide insurance (or hedge against losses) in a volatile global economy. The distribution of risk prevents the failure of, say, one household, or even many households, from ruining one company or bank or investor, because the risk is distributed across many investors.[5] This distributed risk enables the system to withstand repeated shocks: the Mexican peso collapse in 1995, the Asian currency crisis in 1997, the Russian bond default in 1998 followed by the Long-Term Capital Management meltdown, the dot.com crash in 2000, 9/11, the Argentine economic collapse in 2002. In each case the network either routed around the problem or absorbed the shock through the distribution of risk.

The interconnection of the global economy at so many levels spawns many opportunities for speculation. Networked electronic technology provides the tools to take advantage of those opportunities. So speculative capital thrives in the electronically networked world of globalization. The electronic information network is easy to connect to, provides near-instantaneous access to news and market information from around the world and allows the fast and inexpensive trade of digital representations of assets. Digitally rendered, speculative capital becomes the most mobile and universal form of capital.

Speculative capital works as a network on several levels. In one sense, the practice of speculative capital is a network of traders and financial institutions connected through both transactions and social ties. Speculation also depends on the electronic communication networks that accompany globalization. But speculative capital can also be thought of as a network-maker, in that its practice connects together distant and disparate markets and commodities, both in space and time.

Saskia Sassen (2001) has described the process of the formation of major urban centers like New York, London and Tokyo as the command centers of the global economy. The formation of these super-cities may seem (as she says) "countersensical" because new communication technologies allow for the decentralization of command and control. Sassen argues that, for a variety of reasons, the opposite takes place. One of the important reasons for the formation of these global cities are changes in the financial system from the 1980s on, requiring the concentration of firms (and the workers at all levels to support the concentration) in the global cities to make the system work. That is, the emergence of speculative capital carried with it certain imperatives that contribute not just to globalization, but to the *network* of globalization. The city nodes provide a concrete reflection of the digitalized connections of 21st century finance.

How networks fail

In his network research Barabasi discovered that, although networks can robustly handle random node failure, their architecture makes them especially vulnerable to deliberate attacks on the superconnectors, the hubs that contain a disproportionate number of links.

[5] Economist Robert Shiller has gone so far as to propose that speculation offers a way out of the crisis of globalization via financial markets. He proposes several financial instruments that would provide a way of socializing social risk, providing a kind of insurance against job obsolescence, loss of national income, even inequality. Such instruments, as he points out, are only possible with computer technology. (2003)

Because most links in a real-world network have few links, random node failures are at most annoyances. But the failure of a super-connector can seriously impair the functioning of the network; and the failure of several super-connectors can kill the network.

The world shipping network is a case in point. Global cities function as super-connectors of globalization. Since most tangible commodities move between continents by sea, ports capable of handling the super-container ships in use today are the superconnectors of the global transportation system. The global economy, dependent on distant markets and transportation/link-intensive just-in-time production and consumption is sensitive to labor actions in the transport sector; and especially so at the ports. This is one reason why the most visible labor actions of the last decade have involved dock workers, from Liverpool to Long Beach to Sydney.

Networks under specific conditions may undergo "global cascades", where change quickly sweeps through the network. In some cases, the change is a breakdown of some sort, leading to cascading failure. The failure of one node places additional burdens on connected nodes, which in turn fail, passing their burden along, until there is a systemic collapse. Under normal conditions, various controls and feedback mechanisms would isolate the problem and protect the network. If, for whatever reason, the problem cannot be isolated, or the number of links and amount of redundancy in the network is limited, dramatic failures can occur. In the electricity blackout of 2003, a routine failure complicated by a series of mistakes and mishaps dominoed through the northeastern U.S. and Canadian power grid and ended up shutting down power to some 50 million people.

While an important logic behind speculative capital is risk management, the tying together of markets combined with the leverage (speculating with borrowed money) that accompanies speculation also introduces "systemic risk" into the financial system. The unexpected event can overwhelm the normal shock absorbers in the system. The rich web of connections helps set up what Saber calls a "financial resonance". Instead of dispersing, the normal noise in the financial system harmonizes, possibly culminating in the collapse of the entire systems.

Still, one person's network failure can be another person's network liberation. Global cascades describe the rapid transformation -- a leap -- from one state or phase to another, or even a different, more profound kind of change, from one law system to another. The combination of a node's "change threshold" and its connectivity to its neighbors will determine the possibility of global cascade in a system or network. (Watts, 2003) Since change threshold is itself a dynamic property, global cascade may not be possible under some conditions, but become possible under others.

The Network Form

Networks have emerged, perhaps inevitably, as an organizational form correspondent with the new means of communication. The "network form" has been recognized and

promoted across the ideological spectrum: "the next major form of organization" (Arquilla and Ronfeldt from Rand Corporation, 2002); "the organizational form of the Information Age" (Castells, 2002); "the emerging form of organization of our time" (Lovink and Schneider of the European anti-globalization movement, 2004). Secretary of Defense Donald Rumsfeld has championed "network-centric warfare"; Al Qaeda has too.

Network organizations, no matter where they appear on the political, share some key concepts:

-- Network organizations are flat, as opposed to hierarchical. There is no "center" or "headquarters" to speak of.
-- Network organizations are held together by a common vision, rather than a strong center to enforce coherence,.
-- The "nodes" of the organization share a common doctrine, which enables dispersed nodes to work as one.
-- To maintain coherence and make decisions, network organizations tend to be "communication-intensive." This means they need a high-bandwidth network to enable the level of needed communication (e.g., the Internet).
-- Network organizations are resilient, adaptive and robust, for the reasons that material networks are.

The concepts of "networks" and the network form have been embraced by progressive forces, whether consciously or not, or perhaps just labeled as such: the Zapatistas, the struggle against land mines, even the entire anti-globalization movement. The initial excitement of networks -- the excitement after the Zapatista uprising? or Seattle, 1999? -- gave way to a healthy degree of skepticism because networks come together and drift apart: "'networks' -– far from being durable and potent organizational forms, as scholars of the right and left have forcefully maintained –- are at times quite fragile and ephemeral and are characterized by periodic cycles like those of social movements." (Edelman, 2003)

With experience and reflection, the theory of networks in political work seems to be deepening beyond the "metaphysics of networks" to a consciousness of network dynamics, how networks work and what struggle in a networked world means. In this area, the principles of network science have an important contribution to make, in understanding how networks grow, function, change and die. For example, if superconnectors are the weak spot of networks, then organizations need to make sure that there are many superconnectors in the network, and particular care is done to protect the superconnectors. If links are maintained via a common vision and coordinated action carried out via a common doctrine, how can that vision and doctrine be transmitted to distant nodes? What are an organization's network motifs, and how do they affect the network? From a strategic perspective, how does a network struggle against a network? If profound change in the thinking of the multitude is needed, how is such a global cascade brought about?

The Other Globalization

While "globalization" describes a stage of capitalism, it also implies a threshold of history. Here networks have much to offer. As Castells and many others have pointed out, networking technology is not exclusively a tool of Capital, by Capital, and for Capital. The open-standards common-carrier properties of the Internet makes it a playing field (although maybe not level), or battleground, in any case *contested* space, and not a proprietary theme park. The origins of the Internet as the ur-network are illustrative. Many of the various streams that led to the Internet flowed from utopian, oppositional, autonomous, rebellious springs. The urge to communicate, to share, to create reflects the possibilities of a new world. Cultivating that, figuring out to focus (or swarm) that intelligence and bring its full force to bear on reworking the law system of globalization -- that's a network challenge.

References

Arquilla, John and Ronfeldt, David. 2002. "What Next for Networks and Netwars?" *Networks and Netwars: The Future of Terror, Crime, and Militancy*. Rand Corporation.

Barabasi, Albert-Laszlo. 2002. *Linked: The New Science of Networks*. Perseus Publishing. Cambridge, MA.

Bass, Thomas. 1999. *The Predictors*. Henry Holt and Co.

Buchanan, Mark. 2002. Nexus: Small Worlds and the Groundbreaking Science of Networks. W. W. Norton. New York.

Castells, Manuel. 2000. *The Rise of the Network Society*. (2nd edition). Blackwell Publishers.

Castells, Manuel. 2001. *The Internet Galaxy*. Oxford University Press.

Chancellor, Edward. 1999. *Devil Take the Hindmost: A History of Financial Speculation*. Plume.

Cramer, Florian. 2004. http://www.nettime.org/Lists-Archives/nettime-l-0403/msg00061.html

Davis, Jim and Stack, Michael. 1994. "Knowledge in Production." *Race and Class*. Verso.

Davis, Jim and Stack, Michael. 1996. "The Digital Advantage." *Cutting Edge*. Verso.

Davis, Jim. 2002. "Speculative Capital."

Davis, Jim. 2003. "Networks and Interconnection." http://www.gocatgo.com/jdav/networks.interconnection.html

Edelman, Marc. 2003. "When Networks Don't Work: The Rise and Fall and Rise of Civil Society Initiatives in Central America". Prepared for the 2003 meeting of the Latin American Studies Association.

Engels, Frederick. 1987. "Dialectics." In *Marx-Engels Collected Works*, Vol. 25. International Publishers.

Gladwell, Malcolm. 2000. *The Tipping Point: How Little Things Can Make a Big Difference*. Little, Brown and Company.

Hardt, Michael and Negri, Antonio. 2000. *Empire*. Harvard University Press. Cambridge, MA.

Henwood, Doug. 1997. *Wall Street*. Verso. London.

Johnson, Steven. 2001. *Emergence: The Connected Lives of Ants, Brains, Cities and* Software. Touchstone.

Kelly, Kevin. 1998. *New Rules for the New Economy*. Penguin Books.

Lenin, V. I. 1971. "Imperialism: The Highest Stage of Capitalism." In *Selected Works One-Volume Edition*. International Publishers.

Marx, Karl. 1996. Capital, Volume I. In *Marx-Engels Collected Works*, Vol. 35. International Publishers.

Milo, R., Shen-Orr, S., Itzkovitz, S., Kashtan, N., Chklovskii, D., U. Alon. 2002. "Network Motifs: Simple Building Blocks of Complex Networks". *Science* 298, 824 (October 25, 2002).

Lovink, Gert and Schneider Florian. 2004. "Notes on the State of Networking." *makeworld paper #4*. http://www.makeworlds.org/node/100.

Otis, Laura. 2001. *Networking: Communicating with Bodies and Machines in the Nineteenth Century*. University of Michigan Press.

Rheingold, Howard. 2003. *Smart Mobs: The Next Social Revolution*. Perseus Publishing.

Saber, Nasser. 1999. *Speculative Capital*. Volume I. Pearson Education Limited. Harlow.

Sassen, Saskia. 2001. *The Global City*. Princeton University Press.

Sheptulin, A. P. 1978. *Marxist-Leninist Philosophy*. Progress Publishers. Moscow.

Shiller, Robert. 2003. *The New Financial Order: Risk in the 21st Century*. Princeton University Press.

United for a Fair Economy. 2001. http://www.faireconomy.org/research/wealth_charts.html.

Watts, Duncan. 2003. *Six Degrees: The Science of a Connected Age*. W.W. Norton and Co.

Winters, Jeffrey. 2005. "The World Bank and Development". Odyssey radio program (broadcast 3/21/05). http://www.wbez.org/audio_library/od_ramar05.asp.

Young Lab. (no date). "Network motifs" from "Transcriptional Regulatory Networks in *Saccharomyces cerevisiae*" http://jura.wi.mit.edu/cgi-bin/young_public/navframe.cgi?s=17&f=networkmotif. Cambridge, MA.

Change history
8/9/07 - grammatical cleanup
2/22/06 - minor formatting corrections
6/1/05 - added missing reference
5/22/05 - add more on emergence
5/13/05 - original version for 2005 Global Studies Association meeting, Knoxville, TN.