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Node Politics/Link Politics

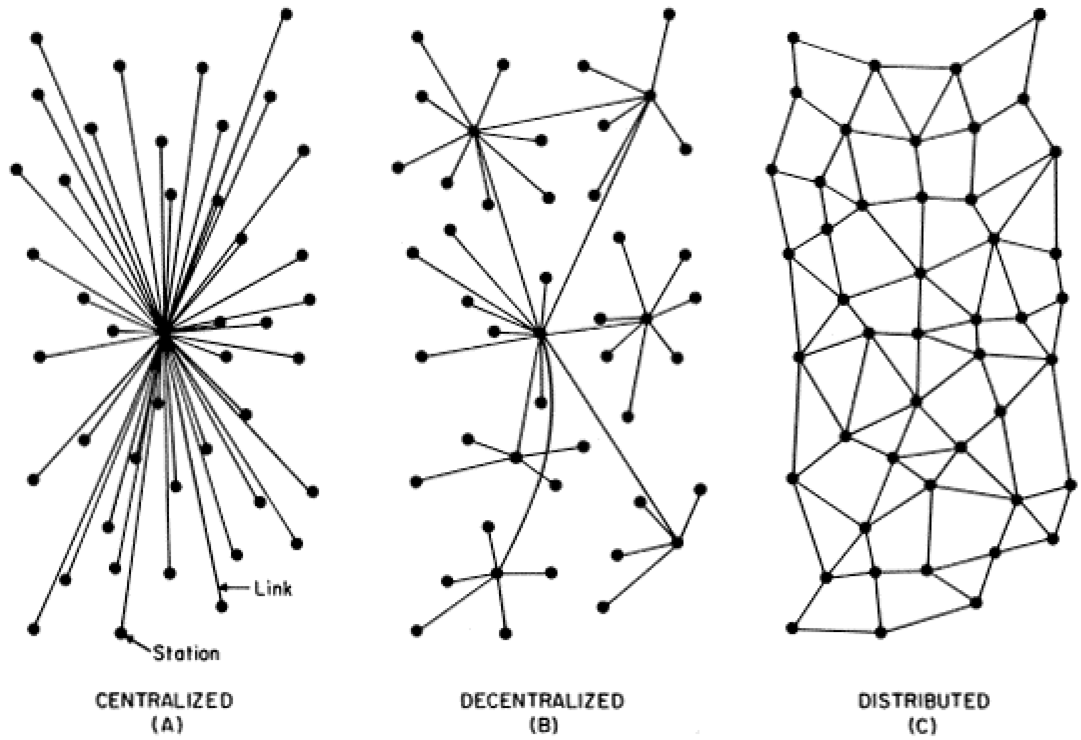

FIG. I — Centralized, Decentralized and Distributed Networks

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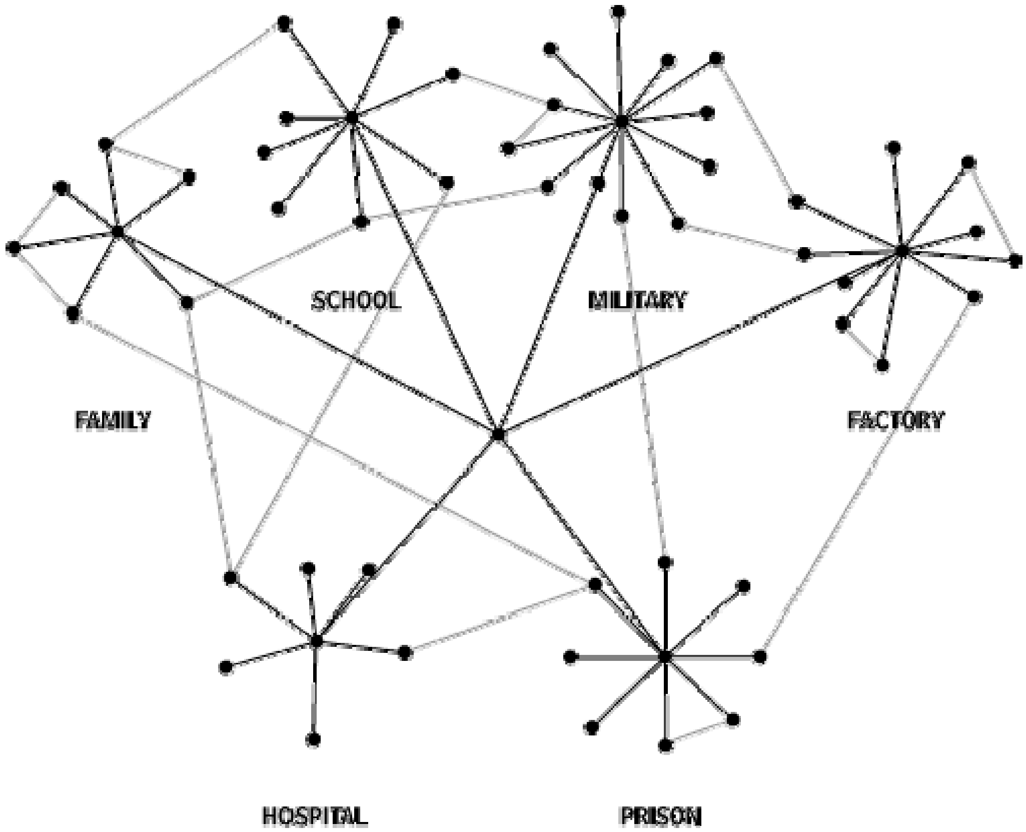
Let's begin with a diagram.

The distributed network as a concept in large part begins with this diagram, published in 1964 by Paul Baran. Baran worked for the RAND Corporation, a private research institute with extensive ties to the United States Military. Baran developed his idea of the distributed network while working on an explicitly political task for RAND, the development of a communications network capable of withstanding a nuclear attack. The distributed network, and the packet switching technology that made it possible to actualize electronically, were part of the Department of Defense's cold war toolbox, and as such the network as a whole was explicitly political. This paper is not about those politics, as interesting as they may be, but instead about the politics that may exist *inside* the network. Is there a politics of nodes and a politics of links? And if there is a politics, does it have a directionality? Is it moving towards or away from something?

The politics of a centralized network is perhaps self-evident. All nodes but one face inward, connected to one and only one node. This one sits at the center, and only this center can connect any two other nodes together. Baran, looking at it in terms of attack sees the centralized network as "obviously vulnerable as destruction of a single central node destroys communication between the end stations". This weakness is easily flipped to see the strengths of a centralized network, who ever controls that one central point has access to any and all communications in the network.

Of course true centralized networks are rare in reality, there are very few nodes capable of the omnipotency need to be the center of all communications in anything but the smallest scale networks. In order to scale a centralized network generally needs to decentralize itself to a degree, to offload functions upon hierarchical cascade of smaller centralized networks. The centralized network roughly maps to Foucault's sovereign societies with their claims of divine providence giving the king absolute power. This makes it tempting to map the decentralized model on to the concept of disciplinary societies, where "individuals are always going from one closed site to another, each with its own laws: first of all the family, then school, then the barracks, then the factory, hospital from time to time, maybe prison..." (Deleuze, http://www.n5m.org/n5m2/media/texts/deleuze.htm)

In reality of course kings could rarely, if ever, govern without decentralizing a degree of regional power over to the nobility. Similarly the multiple power centers of the disciplinary society do not map especially cleanly on to a decentralized network, but rather in many ways show some signs of a distributed functionality. As nodes progress and pass from center to center, they can not help but make links, friends made in school, acquaintances in the hospital, pen pals in the army, buddies in the factory. The decentralized links are not absent in this model, but they lack an effective means of scaling. The connections exist, but lack the means to be mobilized, the connections that weave societies together are present but hard identify, the process of communication as of yet unsettled.



What is truly radical in the work of Paul Baran is not his defining of the distributed network, but his development of a process by which a fully distributed network could become functional. Perhaps it be more accurate to say his abstraction of a process by which a distributed network could become functional, as postal services and merchant shippers had long since developed similar working processes. Baran's packet switching, took a working physical concept and ported it to both a digital and mathematical world. Rather than a postmasters intuition deciding which way to best send a letter, the principals of the router table formalized and abstracted the process by which packets could be sent node to node without any one particular node knowing just how to reach the end destination. What distinguishes a packet switched network from say the distributed network by which a rumor spreads around town is the ability for a message to reach a specific destination.

Packet switching solves a particular problem with addresses. How can you send messages to a specific address without knowing exactly where that address is located? In packet switching, a node (or router) passing on the message needs only to guess which direction it thinks will bring the packet closer to its destination, the router does not actually need to know where the final address actually is. This eliminates the need for a central repository of addresses (although not a centralized way of preventing address duplication) and allows messages to "route around" obstacles. Any give node can pass messages on to any other node it is connected to, which can then do the same. The resulting interweave of nodes produces a communications meshwork, a space where the number potential routes from one node to another approaches infinity. For Baran the key effect of this was the ability to withstand a nuclear attack, communication would remain possible on the network, even if a large portion of the network where to be destroyed.

Baran's packet switched network was eventually built and evolved into the internet, even as its original political cold war mission was forgotten. As the internet grew a whole new set of political claims emerged around it, claims to it's democratic and liberating tendencies, its ability to route around censorship and more. Claims perhaps best encapsulated in their absurdity by John Perry Barlow's "A Declaration of the Independence of Cyberspace". Barlow's personal social network is fittingly broad, as lyricist for the Grateful Dead he was connected to the core of 1960's counterculture, and as an active participant in Wyoming Republican politics he was connected to the future presidency of George W Bush via Dick Cheney who he worked extensively with during the 80's. Perhaps it should come as no surprise then that Barlow chose, the World Economic Forum at Davos, Switzerland to reveal his manifesto. These summits, held yearly in a remote resort town in the Alps are clearly one of the main points of centralization in the global economy, an event that brings together the leaders of the worlds largest and wealthiest corporations, prominent members of governments across the globe, and the thinkers that cater to their ideology. True to his conflicted roots, Barlow managed to both rail against this audience and push a libertarian free market stance that must have reinforced their core beliefs.

> I declare the global social space we are building to be *naturally independent* of the tyrannies you seek to impose on us...
>
> Cyberspace consists of transactions, relationships, and thought itself, arrayed like a standing wave in the web of our communications. Ours is a world that is both everywhere and nowhere, but it is not where bodies live.
>
> We are creating a world that all may enter without privilege or prejudice accorded by race, economic power, military force, or station of birth. (http://homes.eff.org/~barlow/Declaration-Final.html)

That was a decade ago, and rather than marking the beginning of the independence of "cyberspace" it appears to be a better marker of its end. The commercialization and consolidation of the internet was just beginning, governments where just beginning to leverage their weight into this new space, corporations just beginning to learn how to use the internet to their advantage. Perhaps more importantly a new breed was emerging, a cluster of "internet corporations" with the understanding of how the network works began to dominate large chunks of the online world. The politics of nodes were about to become clear.

There has always been a node politics. Encoded directly into Baran's idea of a distributed network was a set of mathematical assumptions, a set of mathematical assumptions with real political implications. It took several decades before it became apparent, but what Baran diagramed was not the whole space a distributed network, but rather a particular subset. One type of distributed network, a random network.

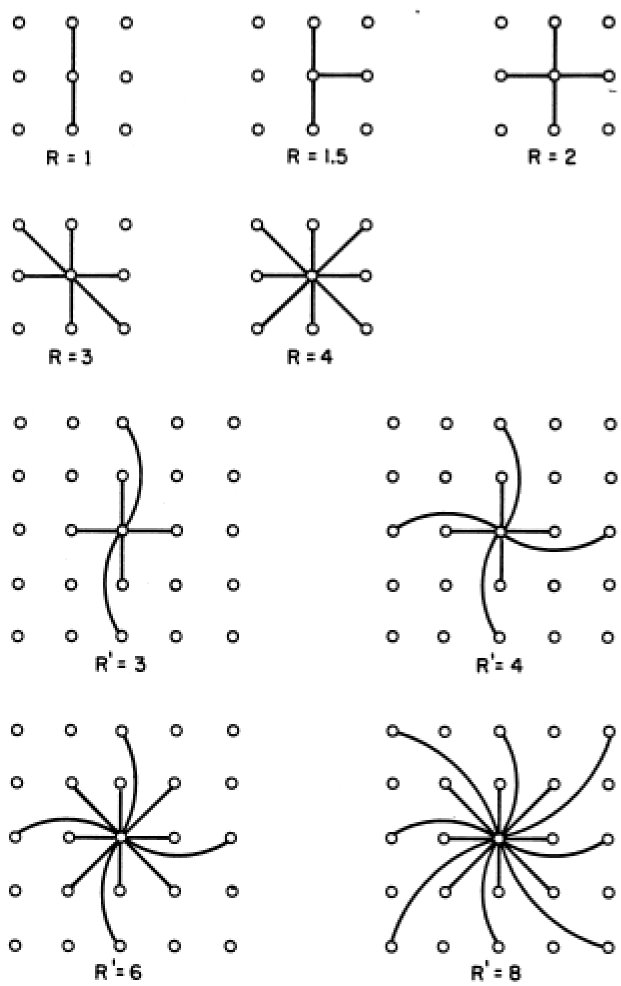


FIG. 2 - Definition of Redundancy Level

(http://www.rand.org/pubs/research_memoranda/RM3420/RM3420.chapter2.html)

In developing a communications system fit to survive a nuclear war Baran was not so much concerned with randomness but with redundancy, just how interconnected the entire network is. Baran's term is "redundancy level" or "R", which he defines as being "equivalent to the link-to-node ration in an infinite size array of stations". Underlying this concept was a very basic assumption, *that a distributed network actually has a redundancy level*, that an identifiable link-to-node ration actually exists, a fact that is challenged only decades later. Baran of course was approaching the issue with a particular bias, ultimately his goal was to design a system, not analyze it. And while his designs were meant to be built and essentially were several years later, he still had the additional benefit of a designer working mainly in the abstract. The fact that he was not concerned with distributed networks without redundancy levels is understandable given that he could simply dictate that the network have one and that it should be optimized to a particular number. Ultimately though, while Baran extensively analyzes what an optimal redundancy level might be, he *never designed a process by which this redundancy level would be assured*, such a task is presumable left to the actual network builders.

Beginning slightly before, but roughly concurrent with Baran's work on developing the theory of distributed networks was Paul Erdos and Alfred Renyi development of graph theory, the mathematics of networks. Mathematically Baran's "distributed network" is one particular distributed network, the exact one that Erdos and Renyi focus on, a random network. And as soon as random leaves the world of pure math, it takes on an explicitly political meaning, as physicist Albert-László Barabási articulates when writing about Erdos and Renyi:

> "The premise of the random network model is deeply egalitarian: We place the links completely randomly; thus all nodes have the same chance of getting one... if we place the links randomly in a graph, some nodes will get more links than others. Some might even have bad luck and get nothing for a while. The random world of Erdos and Renyi can be simultaneously unfair and generous: It can make some poor and others rich. Yet a far-reaching prediction of Erdos and Renyi's theory tells that this only appears to be so. If the network is large, despite the links' completely random placement, almost *all nodes will have approximately the same number of links.* (emphasis is Barabási's)(Barabási, 21-22)

In other words in a random network *all nodes are created equal*. And while they will not all be equal at any given time, in the long run any inequality will equal out. In 1996, over 30 years after Baran published, and when Barlow authored his declaration, the mathematical model of random networks was the only model for a distributed network. Its no wonder than that Barlow choose to echo that famous revolutionary American document, for the internet, the actualization of Baran's packet switching ideas it seemed at the time was based upon a mathematical realization of that core precept, that all men (and nodes) are created equal.

Paul Baran's packet switched network first achieved real implementation in the late 1960's and by the 1980's had evolved into a massive international distributed network, the internet. It wasn't until the late 1990's that topography of the internet began to be mapped extensively. For nearly 30 years of action the network was considered to be random, considered to be egalitarian if not equal in its distribution.

When Albert-Laszlo Barabási and his team began spidering the internet, mapping the network of links between pages on the web, they expected to find a network that looked a lot like the mathematical models of Erdos and

Renyi. Instead they found a completely different math, the math of power laws.*

A power law distribution, or log-log plot, is a curve that diagrams radical inequality. This is the math that describes how 20% of a population can control 80% of the wealth. It is sometimes known as the architect's nightmare. Human height follows the math of randomness, the bell curve distribution. Where human height to graph to a power law instead most people would be munchkins a couple feet tall, but a decent handful would clock in around 100 feet, with a tiny minority reaching upwards towards the height of the Empire State Building, and an individual or two, the Bill Gates of height, reaching towards 10,000 feet.

This is exactly the sort of inequality that Barabási and team found as they charted what sites linked to what web pages. Most webpages would be linked to by a handful of other sites at the most. But a few functioned like incredible hubs, with thousands of inbound links indicating their popularity. It was clear that the network was not functioning as the models had predicted, and Barabási's team got to work developing a way to explain the mathematical effects at hand. If the network is not randomly distributed, how is it connected, what forces are linking the nodes and why do they produce such inequality? A different sort of distributed network than predicted was clearly at work and it need a name. What eventually emerged was the somewhat confusing, they were to be known as *scale-free networks*.

In random networks there is always an average number of links per node, a value nearly identical to the redundancy number that Baran used extensively in modeling the packet switched network. More importantly than the

* Most of the following information on power laws and scale-free networks comes from Barabási, chapters 6, 7 and 8.

existence of the average number (which any network has in theory) though is the fact that most nodes in the network actually have exactly or very close to the average number of connections. This average number is the scale of the network, and in a random network *this scale is quite indicative of the networks actual character*. In a scale-free network the average number of links per node is practically irrelevant, it varies wildly depending on just how top heavy the distribution actually is, and how long the tail of curve stretches. *Networks that follow power law distributions then have no scale that can readily be identified, no node that adequately can be used to represent the rest.*

Barabási identifying of the scale-free network is in itself quite an important step towards discovering the politics of networks. Perhaps far more important though is what Barabási did next, an investigation in to just how scale-free networks are created. Seeing that distributed networks often lead to the radical inequality of a power law distribution is an important step, but *it is only by understanding the actual mechanisms at work producing this inequality that we can effectively challenge or deal with the it*. Barabási and his team, discovered and provide us with a set of mechanisms for the formation of scale-free networks. Perhaps they are only ones, perhaps there are more to be found.

Barabási and his team knew that in order to explain their completely unexpected results, that the distribution of web site links follows a power law, they would need to make serious changes to the math of networks. First was the realization that an accurate model of a network must look at networks as dynamic systems, the math must reflect the fact that the network is quite likely growing, adding node over node, scaling freely. The networks as described by both Baran and Erdos and Renyi both assumed that the network was generated in one shot, all links and nodes born together. Barabási's team began modeling a network that followed Erdos and Renyi random network formula, but differed only in that it continually added new nodes. No power laws emerged from this network, but a degree of inequality did. Older nodes had a clear advantage in attracting links, forming what we can consider a primitive politics, one based on simple age discrimination.

Still looking for a mathematical explanation for how power law curves emerge in a network Barabási's team added a second factor, one they called *preferential attachment*. Under preferential attachment, when new nodes are added to the system, they are more likely to link to nodes that have more nodes already. The rich get richer, each link they gain increases their chances of obtaining more links. Mathematically when this concept is added to the network models, power laws begin to occur, Barabási's team had created an algorithm by which networks with power law effects could be generated, and the model was somewhat confusingly named the scale-free model. Politically though it is a rather frustrating result, one that does not seem to adequately address the issues at hand. Much in the way that Baran and Erdos and Renyi models of the network hard coded equality into their algorithms, the scale-free model hard codes in inequality. A political situation emerges from the model, but no political dynamic comes with it.

Fortunately Barabási's team did not stop with the scale-free model, but continued onward. What brought them to the next step was Google, the technology powerhouse of the turn of the Millennium. Google's rapid rise to prominence as one of the most extraordinarily connected nodes in the real distributed network, the internet, was not explainable under the scale-free model, nor under its various variations. The scale-free model gives no accounting for upstarts, no accounting for sort of shift in power that occurred when Google rose up to snatch the search engine business away from the likes of Alta Vista, Lycos and HotBot. Clearly something was missing from the model, a dynamic for the change and transformation that occurs in real world. In order to account for Google's rise something new had to be added to the model, something Barabási names *fitness* and which produces the *fitness model*.

Mathematically and algorithmically fitness is just a modifier, a number added to the formula of the scale-free model to adjust how well a node attracts new links to itself. In the scale-free model, this attractiveness is self-perpetuating, the number of links a node has is the sole determinant of how attractive it is. In the fitness model this attraction is tempered by this mysterious force name fitness. And just what is fitness beyond just a number? When Barabási attempts to explain it he is nowhere near as clear as his models:

> Some people have a knack for turning each random encounter into a lasting social link. Some companies make a loyal partner out of every consumer. Some Webpages [sic] turn surfers into addicts. What do these nodes of society, business and the Web have in common? Clearly, each has some intrinsic property propelling it to the head of the pack. Though it is beyond us to find a universal secret of success, we can address the *process* that separates the winners from the losers: competition in complex systems.
>
> In a competitive environment each node has a certain *fitness*. Fitness is your ability to make friends relative to everybody else in your neighborhood; a company's competence in luring and keeping consumers compared to other companies; an actor's aptitude for being liked and remembered relative to other aspiring actors; a Webpage's ability to bring us back on a daily basis relative to the billions of other pages competing for our attention. It is a quantitative measurement of a node's ability to stay in front of the competition. (Barabási, 95)

Barabási's bias towards a neoclassical economic viewpoint is rather clear in these passages, but it is his inability to pinpoint just what fitness is is perhaps far more important. This is the point where the models rupture, where the math seizes to be literal, where the algorithms take on emergent properties, they begin to describe something that more than the sum of their steps. When Barabási adds fitness to his model it becomes dynamic, it begins to accurately describe phenomena we can't quite understand. It is precisely at these moments that we need philosophy. For Barabási this means a vague summoning of neoclassical economics and a clear (although not necessarily intentional) reference to Darwinism in the concept of "fitness". Philosophy is evidently not his space so in search of a more satisfying explanation it is necessary to import one, necessary to turn to those infamous philosophers of networks, Deleuze and Guattari.

> We have on numerous occasions encountered all kinds of differences between two types of multiplicities: metric and nonmetric; extensive and qualitative; centered and acentered; arborescent and rhizomatic; numerical and flat; dimensional and directional; of masses and of packs; of magnitude and of distance; of breaks and of frequency; *striated and smooth*. (emphasis Deleuze and Guattari's)(Deleuze and Guattari, 484)

It is Deleuze and Guattari's figure of the rhizome that they are most famous for, the concept of a world where everything is connected, and understood as connections and flows. The vision of a world that closely resembles a network. But in their schizophrenic (psuedo-schizophrenic?) glory their terms and figures rapidly shift, evolve and divide into multiplicities often parallel and similar, but never exactly the same. Of all these options, one in particular stands as perhaps the most useful and clear, an alternative to the rhizome and tree figures that have percolated into the edges of popular conception. This is the smooth and the striated. I prefer it for several reasons, one because it is the *most abstract and least metaphorical*, another because it holds their philosophy within its very use, capable of being both point and line, connector and divider, of being used as both a noun and as a verb. The smooth, the striated. To smooth, to striate. Most importantly of all though they speak directly to our diagrams of the networks:

> The smooth and the striated distinguished first of all by an inverse relation between the point and the line (in the case of the striated, the line is between two points, while in the smooth, the point is between two lines); and second by the nature of the line (smooth-directional, open intervals; dimensional-striated, closed intervals). (Deleuze and Guattari, 480)

> In striated space, lines or trajectories tend to be subordinated to points; one goes from one point to another. In the smooth, it is the opposite: the points are subordinated to the trajectory. (Deleuze and Guattari, 478)

The analysis of Deleuze and Guattari's work has already expanded into several shelves of the better bookstores, so at the moment I will constrain the discussion to the extraction of three quick motions (or three quick points if you will), each of which perhaps a beginning in itself.

1 - Deleuze and Guattari in many ways predict the multiplication of the model of distributed networks, with a continuous reminder that smooth space and rhizome are not spaces of equality, but filled with intensities, plateaus and other strange attractors. The come closest to saying it clearly when speaking of all things felt: "An aggregate of intrication of this kind is in no way *homogeneous*: it is nevertheless smooth, and contrasts point by point with the space of fabric (it is in principle infinite, open and unlimited in every direction; it has neither top nor bottom nor center; it does not assign fixed and mobile elements but rather distributes a continuous variation)." (Deleuze and Guattari, 475-6)

In fact "The more regular the intersection the tighter the striation, the more homogeneous the space tends to become... it is for this reason that from the beginning homogeneity did not seem to us to be a characteristic of smooth space, but on the contrary, the extreme result of striation... In each model the smooth actually seemed to pertain to a fundamental heterogeneity... a continuous variation that exceeds any distribution of constants and variables..." (Deleuze and Guattari, 488)

2 - What is perhaps critical to the concept of the smooth and the striated, what makes it so valuable as a philosophical tool, is that both are capable and in fact continuously transforming into one and other. "...we must remind ourselves that the two spaces exist only in mixture; smooth space is constantly being translated, transversed into a striated space; striated space is constantly being reversed, returned to a smooth space." (Deleuze and Guattari, 474). I will return to this with a return to Barabási, for it is here I believe that the politics inside the network become most real.

3 - On a more speculative note, Deleuze and Guattari also introduce very briefly in A Thousand Plateaus a concept they explore in more depth elsewhere, that of *intensities*, a concept we find rather similar to Barabási's *fitness*. Fitness after all is a modifier of the intensity of a nodes ability to attract links. It is in the intensity I suspect that an alternative philosophy of "fitness" is to be found.

<please reference Barabási page 71 diagram my damn scanner is broken and Amazon fsckeds the diagrams when you search inside the book>

Let's return to the diagrams. We now have two diagrams of the distributed network, one roughly democratic, a one hard coded by design or randomness to assign each node with the same or similar number of links. The second diagram is that of a scale-free distributed network. Barabási uses the American airline system, with it's limited number of large hubs and numerous lateral connecting flights between small airports as a prime example of a scale-free network. Yet this same example is often used as a prime example of a decentralized network. Indeed an abstract diagram of decentralized and scale-free distributed networks are remarkably similar, differing mainly in where a threshold is drawn. If one diagrams a scale-free network, and does not include mass of nodes with a minimal number of links, the once a week flights from Islip to Burbank, one gets the image of a decentralized network. This is similarity is consistent with the images of Deleuze and Guattari of smooth and striated spaces in constant transformation back and forth into each other.

If one decides to draw the networks from a striated perspective where the nodes generate the lines, drawing first the most intensive nodes, the Chicago O'Hare's, Memphis FedEx hub's, and JFK's what emerges first is a diagram of a decentralized network. Yet if one instead starts smooth, drawing first the most intensive lines, the take offs and landings of Air Force One, the trajectories of hijacked planes, the private jets en route to the consummation of multinational mergers and acquisitions, one instead sees a distributed network first, perhaps even one that initially looks some what random and equal in its connections. As the diagrams fill in the distinctions begin to blur. The lines converge upon repeated points, the points multiply across the map filling in with smaller and lesser airports connected in localized and random manners.

Perhaps the most important separation between the two is not that of the smooth and the striated, but the degree by which the transition between the two is prevented or warded off. A decentralized network is not just striated, but intensely striated, a distributed network not just smooth, but intensely smooth. The diagram is not enough, *what becomes important is the mechanism by which the diagram is maintained*. To continue with our American airports example, the large corporate airlines are forces of striation, they lay down their schedules and exert a vast expenditure of energy into focusing the network upon their hubs. Time share jets, and chartered flights exert an opposing energy, filling in the gaps connecting points that once routed through centralized channels.

If we return to Baran and his original diagram, we can see an example of an intensively striated network, the old AT&T phone system. This is Baran's target, what his distributed network is designed to change a model operation in striation. The decentralized aspect of the old phone network actually breaks down right at the margins. At the in house phone systems of companies, in the dry lines laid down by security companies to network alarm systems, in the actions of phone phreaks hacking the lines in ways the telcos never quite understood, and at shared access points, party lines and payphones where community and bulletin boards formed right where Ma Bell's reach ended. All this was marginal though, compared to AT&T's striating octopus. They leveraged the physical, few organizations had the funds and capabilities to lay challenge to their domination of the actual lines that connect the network. They leveraged the governmental, lobbying successfully for monopoly protections that lasted a better part of a century. And they leveraged the protocological, authoring the very technology that undergirded the network itself.

We can see the same effects beginning to show their faces on the internet today, albeit in less extreme forms. In a smooth system their is still plenty of inequality, nodes that suck in links, that dominate the flows of information in the network. But these inequalities are themselves in a constant state of flux, the more intensely smooth the system the more the focal points shift and move. A key striation action is simply for a node to attempt to grab hold of one of these shifting inequalities and lock it down, to striate it into a fixed position of leverage towards power. Search engines are perhaps the strongest example, machines that quite literally striate the web into hierarchies of their own devising. In Deleuzian terms they are quite literally deterritorializing information, spidering it off sites, then reterritorializing it into their own databases and encoding each one with their own definitions of "fitness".

On one level the search are simply mapping the fluctuations of the web, their index and ranks are always shifting. Yet at the same time they have instituted themselves in a position where they themselves (and there are only three significant ones for the English language web) are centralized nodes controlling the passage towards the rest of the web. And the passage they create is explicitly hierarchical. These are clear lines, clear striations by which the web is redivided within the confines of the search engine.

Let us return to our original question, is there a politics of nodes and a politics of links? A politics not of the network as whole, but inside of the network itself. My answer is yes, and we can locate it in the power of transformation. Barabási gives this mathematical form, the concept of fitness, but just what constitutes this concept is unclear. How does a node become fit? How does fitness change? Can one node make itself more fit? Or reduce the fitness of another? This is where we need Deleuze and Guattari to even to begin to find an answer, and yes it is only the beginning.