CyberSidewalk

Wireless Networking and the Relocalization of Communities

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Introduction

Eras are defined by the paradigms that dominated it. In the 21st Century we're entering an age of networks. It's not that networks hadn't existed before; they surround us and permeate every facet of our lives. However, the recent renaissance of network theory teaches us to understand the world in a new way. After centuries of deconstructivism and splintering, the scientific fields have begun to merge again with network theory as common denominator. The networks of Biology, Sociology, Economy, Maths and Physics among others all appear to follow common rules and behavioral patterns.
We are now beginning to realize the extent to which networks are governing our daily lives, how they influence how humans live and socialize. Looking at humankind's history there is an obvious symbiosis of science, social structures and networking/communication technologies. The worldwide electronic communication networks which spread during the last two centuries have so far culminated in the internet. With ever increasing pace, electronic media have reshaped communication, cooperation and social structures.

As I will show, we're facing another strong leap in development with the liberation from cabling in conjunction with the ubiquity of computers. I believe that the impact of this development will go far beyond what we have seen with the internet so far. Considering that the economical crash following the dot-com hype was mostly caused by not understanding what we were actually up to, it is well worth critically analyzing the phenomenon.

The upcoming possibilities of the "wireless revolution" and the temptation to use them will challenge our thinking about human rights that until now had appeared self-evident. Powerful economical and political interests are already at work to facilitate change on their behalf. It is not too late to participate in decision making yet. In this paper I will try give an orientation about pitfalls and possibilities of wireless networking technology and raise awareness of problematic developments. We yet have the freedom to choose the kind of future we want to live in. At the current confusing pace however there might not be much time left to act.

Roadmap

Part I is dedicated to analyzing the status quo of networking technologies and social structures.
In "societies of cooperation" I will first sketch a brief history of the evolution of society with focus on the correlating pattern of co-operation and communication technology. I will show that wireless networking represents another quantum leap for the development of communication and cooperative strategies. In this context we can easier asses the consequences of today's developments and decisions for our future.
Focusing on the internet as the peak technology in electronic networking and communication, I will analyze the new structures of socializing and collaboration it has made possible in "Properties of innovations infrastructures".

Part II will explain the hype around wireless networking and its implications for the future in depth. I will start with describing most recent developments indicating the shift to wireless and ubiquitous computing. Based on the vivid discourse ranging from doomsday scenarios to plain utopy I will then describe dangers and chances of the technology[1].

Cybersidewalks arise when internets' communication structures permeate the world, extend and round up our communication and socializing repertoire. If we don't handle it carefully, the technological advancements could backfire.

[1] As far as we can asses today

1.
Societies of Cooperation

The history of civilization is about people pooling resources and coordinating their efforts to benefit from the strength of the group. Taking a look at the development of human societies a recurring pattern can be observed: Whenever technical innovation made new ways of communication, cooperation and resource pooling possible the social frameworks changed in dramatic ways. Moreover, more efficient communication would accelerate technical, scientific, cultural and social developments. The pace of innovation is steadily increasing.

Keep in mind that technologies of communication and cooperation are not the sole driving forces behind humankind's complex social evolution. However, I believe that their impact is significant. To remain in the scope of this thesis I will focus only on advancements of communications technology.

1.1 Commons, technology and society

At the core of any given society stands the management of public goods. In the very beginnings only natural and limited commons such as grasslands, hunting- and fishing grounds were known. A need for cooperation arose in order to protect these commons from extinction. By forming tribes with social contracts limiting self-interest and preventing over-exploitation; every participant would benefit and would gain security. Such tribes would grow in power with the number of people pooling resources and their skill to negotiate cooperation. With cooperation, the whole is more than the sum of its parts.

> *"The development of culture depends upon humans' capacity to learn and to transmit knowledge to succeeding generations."*
> *-EncyclopediaBritannica*

Tribalization and cooperation is a common natural strategy and not unique to humans. However, by developing the ability to clearly articulate thought by means of speech, humanities social structures and efficiency of communication have grown to be exceptionally sophisticated. During their development, artificial commons like knowledge, currencies, transportation and communication infrastructure gained importance. Still, knowledge was passed on to following generations by word of mouth. Culture could only emerge within the limited range of the aural communication technology.

When writing superseded this imprecise and error prone practice, societies who possessed this thought conservation technology gained considerable advantage over those who didn't. Knowledge now could be preserved in a reliable way and be passed on to future generations. However writing was not only about archiving. In addition, messages could be sent without loss and error over large distances. Noise, in Shannon's sense[2], was significantly reduced. Communication networks thus became more efficient and more potent with improving the possibilities for collaboration. Furthermore, writing introduced the first simple validation processes into long distance communication. Writing was harder to forge than spoken messages.[3]
Peoples now could successfully extend their culture beyond the transmission limits of word of mouth, in distance as well as in time. Possessing this powerful technology, high cultures formed and dominated all other people of their times. By developing sophisticated communication networks and collaboration practices, they gained wealth and power.

Nevertheless, with literacy being the key to power it remained a privilege to the ruling class which also could afford the time to study. The latter eagerly guarded the monopoly on this technology, thus stabilizing their position. In consequence, the rate of innovation was neglectable. Amplified by the facts that reproduction of writings was expensive and time consuming and long distances still being a considerable obstacle, the small scattered networks of collaborative thinkers resulted in relatively slow scientific and social developments.

In 1450, again, an innovation in communication technology changed the world. The invention of the printing press by Johannes Gutenberg was not the reinvention of writing, but more importantly,

[2] Claud E. Shannon: "A mathematical theory of communication",1948
[3] I will extensively analyze the importance of trust and authenticity in Part 2

made the technology affordable and accessible to the masses. Although literacy was only adapted slowly, ideas could travel freely[4] and reach larger numbers of people. New ideas and social models were developed cooperatively (even crossing cultural borders) and effectively communicated to a broad audience. Churches, formerly keepers of knowledge, slowly lost their powers. In 1789 the French monarchy was the first among many to fall victim to enlightenment and the renaissance of thought that started spinning the wheels of history increasingly faster.

1.2 Implosion of distance and virtual social layers

The advent of modern communication technologies was preceded by the harnessing of electricity in the 19th century. Similar to the invention of writing before, Samuel Morse's Telegraph (1844), although being the most innovative and powerful communication tool of its time, remained in the hands of few specialists due to its abstract interface. It took 32 Years until Alexander Graham Bell refined the technology to a level of mainstream use with his telephone in 1877. People eagerly embraced the comprehensive interface and telephone networks rapidly spread around the world.

Consequently, distance imploded. The ability to communicate with anybody connected to the network in real-time persistently changed the structure of social networks. In addition to the connections we maintain in our environment, based on where we are and who we meet, another level of social connections was added in a virtual space which doesn't require our presence and in which distance did not matter.
About the same time traveling became faster, easier and more common with motorization. While people started moving more and further they would still be able to maintain their social connections at home. A global network of close social connections developed. The cultural mixing also resulted in mutual inspiration as the once separated pools of shared knowledge started to merge.[5]

With this communication infrastructure in place, innovation leap-frogged. New insights and inventions would spread fast and could

[4] Of course, this free flow of ideas was initially subject to suppression because it was a threat to the power structures present, but was eventually overcome.
[5] Before, similar exchanges by means of messengers and letters only have had minor impact because these technologies were slow, unreliable and quite often didn't provide feedback on the success of the transmission.

inspire people around the world. In relatively short succession radio, cinema and television were invented, introducing global collective experiences. At the time, the powerful wireless audiovisual communication technologies were primarily used for broadcasting from centralized institutions. As no opposing and alternative views would be broadcast over these channels due to strict regulation of the ether, this structure was extremely vulnerable to manipulation. Whoever controlled these central communication hubs possessed a mighty propaganda tool.

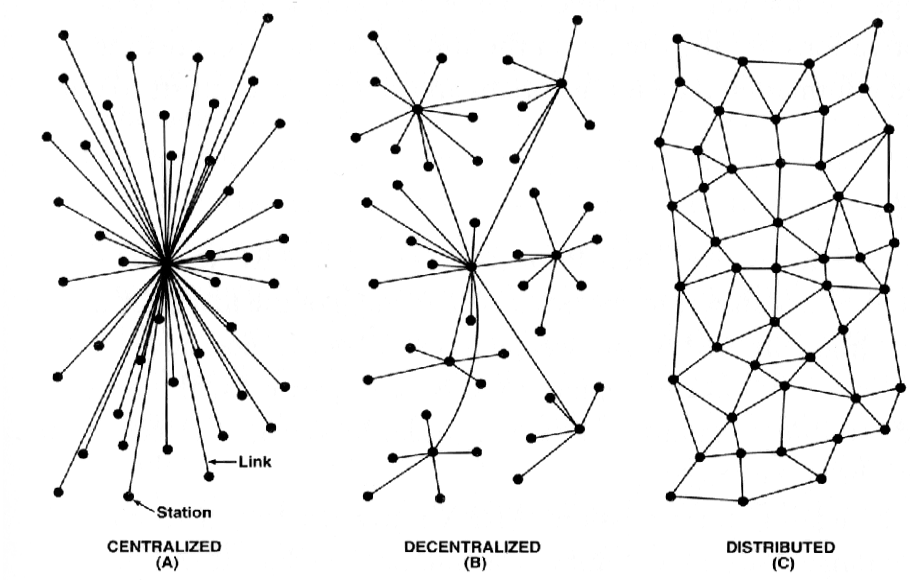
Of course the above mentioned technologies and the ones that will follow have at all times also been used for malicious purposes. Social shifts have often resulted in suffering, wars and destruction. In no way I tend towards an overly positivistic view on the impact of technology on our lives. Naturally, this is not black and white scenario. Change comes at a price. However it is important for us to closely evaluate the developments so we can make clear decision whether we're willing to pay and whether it is sometimes wiser not to bring everything to life that's technically possible. I will examine the relation of technologies malicious and profitable potential in more detail the chapter "Knowledge and Power".

> *"The broadcasting system must be changed from a distribution system into a communication apparatus. The broadcasting system would be the most wonderful communication apparatus imaginable in public life, a fantastic channel system, that is, if it understood not only to transmit but also to receive, in other words, to make the listener not only hear but also speak, and not to isolate him but to involve him in a relationship.*
> *(...)*
> *Impossible to realize in this society, possible in another, these suggestions, which are the natural consequence of technological development, serve to propagate and form this other order."*
> *– Berthold Brecht*[6]

While Brechts dream of an interconnected world was way ahead of the technical feasible of his time, it would come true only a few decades later when the US government became concerned with the vulnerability of it's centralized government structures during the

[6] Brecht, Bertold: Radiotheorie. Gesammelte Werke Band 8, p. 129 and 134

cold war. The new structure was developed by Paul Baran in 1959. He worked for the RAND cooperation, a think tank which had been founded to provide the US military with intellectual know-how. In the course of his task to develop the most stable communication structure, he distinguished three kinds of networks: The most vulnerable was the centralized structure which corresponds to broadcasting networks: One central sender is connected to all nodes but they are not connected with each other. Obviously, this structure would completely break down with the failure of the central node.



He described the telecommunication networks of his time as decentralized: "a hierarchical structure of a set of stars connected in the form of a larger star". Some nodes would function as hubs. Still, with a few of these central hubs missing the networks would fall apart in small clusters. [7]

Barans vision of the safest communication structure was a network in which every node also would function as a hub, creating a tightly interconnected web. The abundance of routes from one point to another would easily tolerate a high level of failure within the network. He even went one step further, proposing to break apart messages into small packets of uniform size which would be capable of traveling independently in the network. This vision would later become know as a "packet switching topology". In order for this to work it would have been necessary to switch the analog

[7] Illustration taken from: Albert-Laszlo Barabasi, "Linked", Perseus Publishing (2002), P.145

phone networks to a digital one, a proposition which was over-straining the imagination of the decision makers.

Although Barans ideas were fiercely rejected by industry as well as by the military, the very same ideas were independently re-developed and brought to life by ARPA[8] in 1966. They were trying to make their computers which were distributed all over the country communicate with each others. In this context it became clear to everyone that a packet switching topology, reinvented by Donald Davies, was required to create truly efficient communication because it doesn't require dedicated end-to-end connections as analog systems do.

> *"It boils down to this: In the past 150 years we've essentially had two distinct capabilities: one to-many (books, newspapers, radio and TV) and one-to-one (letters, telegraph, telephone). The Internet, for the first time, gives us many-to many* ***and*** *few-to-few communications."*
> *-Dan Gillmore*[9]

Thus, the internet was born. It has been growing at an exponential rate ever since without showing any signs of slowing down to date. Today it is used for a wide range of purposes which the initial developers would never have imagined. Innovation blossomed and millions of people came up with new ways to use the communi-cation technology.
Among those applications are the World Wide Web, Peer to Peer resource sharing, Distributed Computing, Online Shopping, Advanced audiovisual communication and collaborative projects with participants from all over the world only to name a few. For the first time, the world has truly grown together. Communication and the flow of information have become so fast and omnipresent that media theorist Paul Virillo is even concerned about harm to our society because the pace was exceeding the natural limits of human reception[10].

Although the penetration of computers and electronic communi-cation networks into our lives is already considerable, I believe that we have yet only seen the beginnings of this development. Just as

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[8] "Advanced Research Projects Agency", which conducting long range research for the military, such as computer development. Today the agency is called DARPA
[9] Dan Gilmore,"Help me with 'making news'", http://weblog.siliconvalley.com/column/dangillmor/archives/000924.shtml
[10] Paul Virillo "Fluchtgeschwindigkeit" (orig. "La vitesse de liberte"), 1996

writing and electronic communications have been technologies for experts in their early stages, so are computers and the internet today. As we have seen, the impact of these technologies only fully unfolded when they evolved to a state of widespread public adaptation. This development is often leveraged by enhancements in usability and accessibility. I claim that with wireless networking, along with the ever improving portability of computers, we are now at the verge of another quantum leap in the evolution of communications technologies.

However, wireless networking and *ubiquitous computing*[11] will inherit the properties of the technologies they emerged from. Therefore, I believe it is important to analyze the status quo of today's properties and the discourse about dangers and benefits of the technologies before thinking about possible future developments. In the next chapter I will examine these properties of computation and electronic networking and ask which conditions have facilitated their explosive growth and innovative potential.

[11] This term has been coined by Mark Weiser, a Xerox PARC researcher. It will be discussed in-depth below

2.Properties of Innovation Infrastructures

> *"The internet is both the result of and the enabling infrastructure for new ways of organizing collective action via communication technology."*
> –Howard Rheingold[12]

> *"Because nobody controlled what people did with the internet, millions of people invented new things to do with the internet. […] This explosive innovation happened because the Internet was held in commons.-Instead of auctioned off"*
> *-Lawrence Lessig*

The growth of the Internet from a few connected computers to a worldwide network with hundreds of million nodes has taken little more than two decades. Although we have seen in the previous chapter that the pace of innovation had constantly accelerated with the emergence of new communication infrastructures, the current pace is truly remarkable. Even though the online hype of the recent years was clearly exaggerated, there is no doubt that the way we live, communicate and do business has changed dramatically. What differentiates the internet from its preceding communication technologies to ignite this global burst of innovation and change? In the following I will discuss the most important properties and phenomena of this development.

2.1. Open structure

Much of the very foundations of the internet as we know today was laid by Hackers, highly competent computer scientists and technologists, with a strong aversion against any centralized control. They were collaboratively volunteering to make their vision of truly free flow of information come true. The internets foundations were thus created in line with the so called 'hacker ethics':

[12] In Howard Rheingold, "Smart Mobs", Perseus Publishing (2002),

1. Access to computers should be unlimited an total.
2. Always Yield to the Hands-On imperative
3. All information should be free.
4. Mistrust authority – promote decentralization.[13]

From these rules, an open framework emerged which proved to be an ideal breeding ground for innovation.

2.1.1 The End-to-end Principle

One of the first and most important inventions deriving from this set of rules is the so-called end-to-end principle which describes the internets' transmission philosophy. Its infrastructure is basically stupid and designed to do nothing more than transport data from one point to another without evaluating the content of its payload.[14] It does not pose any constraints on what is communicated. Also, in contrast to the telephone networks before it also does not regulate which technology, protocols or hardware has to be used on either end of the connection. As a result, practically everybody connected to the network with some time and passion at his hands was free to innovate. Obviously, this way the potential for innovation was significantly higher than with only a few Military or Telco researchers that used to keep the monopoly on development. The latter were not even particularly interested in innovation as long as they could make money on their present system.

2.1.2 The innovations Commons

The call for free flow of information combined with the infrastructure of easy copying and distribution created a culture of liberal knowledge sharing among the hacker community. As it had been the case millennia before copyrights were introduced, it became common practice again to pick up on other people's ideas, to refine, alter and extend them. In "The Future of Ideas; The fate of commons in a connected world"[15],

[13] Steven Levy, "Hackers: Heroes of the computer Revolution", Doubleday, 1984
[14] However this structure is about to change: The future networking protocol IPv6 will be able to prioritize data packets by content type.
[15] Random House, (October 30, 2001)

the Harvard Law professor and Copyright critic Lawrence Lessig coined the term *innovations commons* for this open structure and makes this responsible for the explosive development of the internet; With good reason, he fears for the survival of this commons. Powerful corporations are pushing legislative efforts for extensive regulation of the internet and the change of it's very structure to protect their copyrights.

As a founding member of the electronic frontier foundation[16] he fights for the medium to remain free and tries to raise public awareness for the immense value of innovations commons to the community.

The best known movement promoting resource pooling and the right to recycle previous works is the vibrant Open Source Software development community. Most prominent agent is Richard Stallman, founder of the Free Software Foundation[17] which developed most of the GNU/Linux operating system in the 1980's. In recent years however, interesting projects emerged that would pool resources in all areas of intellectual property.[18]

2.2 Computerized acceleration

The intrusion of computers into our daily lives which made the spread of the internet possible and at the same time is boosted by it has accelerated work processes and relieved us from numerous time consuming repetitive standard chores (while confronting us with a whole new dimension of problems concerning the unreliability of the technology itself). The impact of computerization on our lives has been extensive, no matter whether one would rate it positive or negative. It has significantly changed how we live, work and socialize.

The strength of computing lies in the calculation of linear problems. Computers have enabled us to solve problems too

[16] http://www.eff.org
[17] http://www.gnu.org/
[18] a hub for free creative content at http://www.creativecommons.org , a nice german free stock photography community http://www.photocase.de

complex to compute manually. With their aid, we research and simulate complex problems and to develop even more complex technologies in ever shorter time. They are even pushing their own development forward: Apparently, for more than three decades computers have doubled their performance, capacity and communication bandwidth (among other parameters) every 18 month. Simultaneously this development was accompanied by a radical decline of price and continuous decrease in proportion. This observation became known as Moore's Law[19] as early as 1965. Today it is assumed that this process will continue for at least another 15 years[20].

With prices steadily tumbling and computer hardware proverbially shrinking to the size of dust, we have yet only seen the beginnings of the magnitude to which computers will permeate and change our lives. Additionally, with the increasing calculation power, it is conceivable that they soon will be able to make sense of our actions in real time and realize our needs. Interfacing computers will be much easier than it is today. I believe that with the emergence of wireless networking, we're facing a quantum leap for this development. For obvious practical reasons, the vision of Computers being distributed all around us is dependent on their ability to communicate wirelessly.

2.3. Community Building

While computers have accelerated calculation, their impact on our lives only began when they were linked to networks and thus accelerated communication. After all, computer networks are social networks if they connect people and organizations.

2.3.1 Communities and the Value of Networks

Via the internet, people network with total strangers and build international communities of cooperation and

[19] Named after its inventor Gordon Moore, co-founder of Intel Inc.
[20] Ralf Groetker (Hrsgb.), "Privat – Kontrollierte Freiheit in einer Vernetzten Welt", Heise (2003)

knowledge pooling. To better understand the magnitude of this property, we will consult some basic rules of network theory:

Analogous to Baran's three network models (centralized, decentralized and distributed[21]) there are three rules describing the value of such networks on a mathematical basis. They are rooted in the notion that in a networking context value is embodied by links, the most fundamental property of networks.

The oldest rule, describing centralized networks, originates from the 1940's when radio and television broadcasting networks spread around the world. Broadcasting Pioneer David Sarnoff was the first to state the obvious:

> *"In centralized networks the value of broadcast networks is proportionate to the number of nodes." – Sarnoff's Law*

In centralized networks, nodes cannot connect to each other (the receivers can't send). Therefore each additional node adds exactly one link which results in a linear growth of value. With decentralized and distributed networks however nodes can interconnect. The first man analyzing this situation was one of the internets creators, former Xerox PARC researcher and founder of 3Com Inc., Bob Metcalfe.

> *"The total value of networks where each node can reach every other node grows with the square of the number of its participating nodes".*
> *– Metcalfe's Law*

Applied to economics, this law becomes very interesting in the context of a series of recent super-mergers such as AOL/ Time Warner: Connecting two networks creates far more value than the sum of their values as independent networks. This also explains why the popularity of the scattered American Cell Phone networks is way below the world average.[22]

[21] see above for more detail
[22] Howard Rheingold, "Smart Mobs", Perseus Publishing (2002), p22 ff

However, there was yet another dimension unnoticed that would raise the growth of value in networks exponentially. In 1999, David P. Reed[23], one of the authors of the internet's end-to-end principle, published a paper called "That sneaky exponential: Beyond Metcalfe's law to the power of community building" [24]. Inspired by the explosive growth of the eBay community, Reed researched similar behavior in social networks:

> *"eBay won because it facilitated the formation of social groups around specific interests.[…] I realized that the millions of humans who used the millions of computers added another important property- the ability of the people in the network to from groups. I remember that when it became possible to create ad hoc discussions. Since then, all sorts of chat rooms, message boards, listservs, buddy lists, auction markets, have added new ways for people to from groups online. Human communication adds a dimension to the computer network. I started thinking in terms of group-forming networks (GFNs). I saw that the value of GFN grows even faster – much, much faster- than the networks where Metcalfe's Law holds true. Reed's Law shows that the value of the network grows proportionately not to the square of users, but exponentially."*[25]

As I will show later, wireless technology will spread the network to the very ends of the world, increasing the number of possible nodes to several billions. If Reed's law holds true, then the value of the upcoming wireless networks will be exponentially higher than the internets. Equally, their impact on our lives will be much more drastic than what the internet has already achieved.

[23] http://www.reed.com/
[24] Context Magazine, Spring Issue 1999, online version at http://www.reed.com/Papers/GFN/reedslaw.html
[25] Interview with Reed in Howard Rheingold, "Smart Mobs", Perseus Publishing (2002), p50 ff

2.3.2 The power of collaboration

People are most powerful when they join forces. In order to do so they need efficient means of communication to co-ordinate their efforts. The internet provides collaborative potential of incredible magnitude because it interconnects hundreds of millions of people.

2.3.2.1. Open source development

In the beginning, the platforms for collaborative problem solving were simple text based group discussion applications such as USENET. The projects being solved collectively mostly revolved around the medium itself as the participants were almost exclusively computer specialists, people that felt at home in command line interfaces. Most unexpectedly, this self-organizing structure of collaborating hackers turned out to be utmost effective. As a reaction to the proceeding commercialization in software development the GNU/Linux community has developed a complete operating system on a voluntary basis. This task is so complex that it was never believed to be possible without strong hierarchical planning structures. According to the laws of network value shown above, these virtual communities were so powerful because the incredible number of developers raised the networks value exponentially due to their community structure. Like ants they would eagerly fix tiny parts of big problems, stress-test the system and be busy constantly patching up small problems appearing in the software. The worlds most popular server software APACHE[26] for example derived its name from this fact. Being developed in this swarm fashion, it was known to be "a patchy" software. Today, countless Open Source projects are under constant development[27].

2.3.2.2 Real and virtual communities

By now the range of topics in online resource pooling has broadened extensively as the technology has become easier to handle. Powerful software with comprehensive graphical

[26] http://www.apache.org
[27] A popular portal for Open Source development is http://www.sourceforge.net

user interfaces(GUI), mostly available free of charge, provided for quick mainstream adaption. The technologies tying these communities together range from newsgroups, e-mail, mailing lists, chat groups, sophisticated community portals, p2p file sharing client/servers, instant messaging (even with audio and video conferencing) and short messaging to weblogs. People share everything from cooking recipes, recommendations, opinions[28] and advice to manuals on how to build bombs. Even whole Encyclopedias emerge from the effort of countless individuals.[29] The math is simple: with only putting in a little knowledge of your own one can profit from the abundance of shared knowledge in a worldwide network.

An in-depth research of online communities would exceed the scope of this paper. I am primarily interested where and when online communities will cross the limits of the virtual and merge with our real life. For an exhaustive study of online communities refer to Howard Rheingold's Classic "The Virtual Community: Homesteading on the Electronic Frontier".[30]

2.3.2.3 Blogs

While P2P file sharing has had extensive media coverage since the popular Napster lawsuit, the more revolutionary phenomenon of blogging[31] has evolved silently and barely noticed. Blogs, mostly in private hands, have no lobbyist. They basically are software solutions that allow posting content to the internet from any browser on the fly without any technical knowledge. They have the ability to link to other blogs and form even bigger networks. Travelers can even keep offline blogs on their laptops that will update their online counterparts as soon as you're online again. Blogs can contain basically any media from text and pictures to videos. The fact that the software needed is extremely easy to handle and free of charge made blogging very popular for ever diversifying kinds of uses: News boards, live reporting, link

[28] Trusted opinions have become a sought-after resource. At the lively product rating community http://www.epinions.com members invest incredible amounts of effort to belong to the top-raters

[29] http://www.everything2.com/ , http://www.wikipedia.org or http://www.h2g2.com (the latter being a less serious version of a well known fictional Guidebook)

[30] MIT Press (1993), revised edition released in 2000

[31] Blog is short for WebLog

collections, collaborative wonderworking[32], online diaries, Photo albums, only to name a few.

This form of instant publishing and commenting added a new dimension to web conversations. Again, the power of blogs is rooted in the amount of users. The web has become too broad and produces too much data to keep track of on your own. If people join forces however and collect links, information and ideas about certain topics in blogs they create a context of incredible breadth and depth to it. It is only in context that information becomes knowledge. Blogs are knowledge hubs in a vast network of information. They are more powerful than search engines because they are assembled context-based by humans with associative capabilities (as opposed to search robots that usually put out a confusing amount of "false positives"). Keep in mind that all this happens in realtime, without the delay of tedious research that a single person would need.

An interesting episode about the power of this communication infrastructure is reported by Dan Gilmore in his essay "Help Me With 'Making News'" [33]; He was attending a stock holders meeting of Telephone giant Qwest as a journalist. On the podium, the then-CEO Joe Nacchio was dwelling in self pity, complaining about the difficulties of running his company which had recently suffered severe losses. While listening, Gilmore and his colleague Dyson were frequently posting news on their blogs and soon received an answer from a reader thousands of kilometers away that pointed to a report at yahoo financial. The link proved that Nacchio had cashed out 250 Million Dollars in stocks before his company started tumbling. Gilmore instantly could use this information for skeptical questioning. Apparently, many reporters in that room were following the weblogs and were instantly informed about the news. In Gilmore's words; "There was a perceptible chill against that man. Dyson is certain that our blogs helped create this chill."

I believe that this "personal journalism" will gain substantially

[32] p.e. Macromedia, Adobe, Dr.Pepper and the New York times use blogs for efficient communication among employees as well as for information exchange with costomers
[33]Dan Gilmor, "Help me to make the news",
http://weblog.siliconvalley.com/column/dangillmor/archives/000924.shtml

in power in the future. Wireless networking will even amplify this development as people will be able to add and retrieve information from these comprehensive collections of knowledge at any time and any place. News will spread even faster than they already do today and at the same time develop a broad and independent background context. Moreover, **personal journalism will put responsibility back into our hands**. This does not mean the end of professional journalism. The direct feedback of Blogging will add depth to articles. Journalist will find themselves in the additional role of editors.
Blogs provide an easy and cheap way for everybody to get involved with ongoing affairs. The right information at the right moment can initiate change. Several American politicians have experienced this in recent years. This might be a major relief to the current disenchantment with politics which is spreading worldwide.

Of course, with so many contributors it will be even more important than today to check the sources of reports and to make up your own mind. However, this has always been the case. I think it's a very positive development that blogging makes the danger of false and biased reporting so obvious. People finally might start to educate themselves on how to handle the medium.

2.3.2.4 Collaborative Computing

In addition to efficient social connectivity, computer networks also provide the opportunity for collaborative resource management. An interesting example is the concept of distributed computing which was invented in 1999 when the internet started to boom. Computing power and bandwidth, although not yet widely perceived as such, will be dominating resources in the future.
The rise of wireless shared internet connections which I will discuss later is based on people's insight that they don't use the full capacity of their broadband internet connections and might as well serve the community with their overhead. Computing power however is mostly wasted, especially by home users commonly need only one to five percent CPU power of their high powered computers for usual office

applications or by businesses who have their computers running unused overnight. With a distributed computing client you can decide to donate the computing power that you're not using. The first and still most popular project of this kind, SETI@home[34], is linking more than 2 million computers for the somewhat nerdish task to analyze interstellar radio signals in the search for extraterrestrial intelligence. Nevertheless, the distributed SETI computing network is several times more powerful than the biggest supercomputer built to date. The SETI idea has brought up a whole new branch of businesses, computation brokers. Distributed computing is already being applied to a wide range of processing intensive applications such as medical drug development[35] or weather simulations. SETI@home only offers a ranking in its high score donor list. Even for commercial applications, people are eagerly collaborating free of charge in exchange for the knowledge that they actively helped to fight cancer. Again, collaboration works so well because the infrastructure is now in place which sets the threshold for participation low enough to be attractive for non-technical people.

2.3.3 Trust and Reputation

2.3.3.1 Community rules

Unfortunately, so called "Freeriders" have always been exploiting the common resources by "leeching" without contributing.[36] As opposed to natural resources however, knowledge is not limited in a way that it will be extinguished by overuse. This has been greatly amplified by the internet because it has made copying instant and incredibly cheap

[34] http://setiathome.ssl.berkeley.edu/ not only provides the client application download, it's a whole community portal for all participating users.
[35] Intel is supporting a campaign to "turn your screen saver into a life saver." to convince computer users to dedicate unused processing power on their PCs to the fight against cancer. A program available from the company's Web site (www.intel.com/cure) will help medical researchers identify molecules that show promise as possible new treatments for leukemia.
[36] In sociological terms this is called a "collective action dilemma", the perpetual balancing of self-interest and public goods. If everybody would act selfish and exploit a public resource at will, the latter will eventually be depleted. However, with mutual effort the groups survival can be ensured.

compared to the large overhead of its preceding publishing media such as printing.
Still, public pools depend on contributions. The resource that *can* be depleted in virtual communities is the disposition of its members. If they spend considerable effort in contributing only to find out that there is little return, they easily become frustrated. The most successful communities have been those who have implemented structures of trust and reputation that can be found in self-organizing communities. In 1990, sociologist Elinor Ostrom researched such frameworks as they appear in the real world in "Governing the commons; The Evolution of institutions for collective Action"[37]. By comparing the governing mechanisms of shared forestry resources in Japan, pasturelands in Switzerland and irrigation arrangements in Spain and the Philippines she distilled a shared set of rules that made the collaborative management viable and successful. These rules equally apply to online communities and are worth quoting:

- *Group boundaries are clearly defined*
- *Rules governing the use of collective goods are well matched to local needs and conditions.*
- *Most individuals affected by these rules can participate in modifying the rules.*
- *The rights of community members to devise their own rules is respected by external authorities*
- *A system for monitoring members' behavior exists; The community members themselves undertake this monitoring.*
- *A graduates system of sanctions is used*
- *Communitiy members have access to low-cost conflict resolution mechanisms.*
- *For common pool resources (CPRs) that are parts of larger systems, appropriation, provision, monitoring, enforcement, conflict resolution and governance activities are organized in the multiple layers of nested enterprises.*

In addition to being a tool to punish *Freeriders*, monitoring and sanctioning is a way of assuring people that others are doing their part. David Smith, Microsoft Sociologist, sums it up: *"Many people are contingent cooperators, willing to cooperate as long as most others do"*.

[37] Published by Cambridge University Press (1990)

Note that monitoring and sanctioning are vital to healthy community building. It is important however that the control over these tools remains in the hands of the community members itself in order to avoid misuse by centralized institutions.
According to Smith the threat of punishment helps to constrain freeriding but doesn't inspire cooperation. The driving force behind mutual cooperation is reputation.

2.3.3.2 How Reputation works

Reputation helps other people to predict future behavior based on past actions. It is usually based on opinions of people you have dealt with before. One will be more inclined to cooperate with you if you show a record of having consistently cooperated with others before. In nature, reciprocal cooperation is a promising social strategy. The "shadow of the future" is motivation to act against pure self-interest in good times in the hope to be returned the favor in times of trouble.[38] This kind of behavior has been observed on a range of natural social phenomena. In 1983 for example biologist Gerald Wilkinson discovered that vampire bats in Costa Rica share blood they hunted the night before with bats that have been less lucky. Most interesting about this observation is that they would follow reputation and differentiate between bats that had previously acted the same way and would refuse help to those who hadn't shared before.[39]

The superiority of the social strategy of cooperation in conjunction with reciprocity has been proven on a mathematical basis with the help of game theory. This new scientific field had emerged after World War II when American political strategists were insecure about how to best proceed with their cold war strategy. Therefore a think tank had been set up at RAND cooperation which developed a series of game scenarios corresponding to typical social dilemmas.[40] Based

[38] The idea of Mutual aid as driving force for evolution was coined by Alexej Kroptokin in 1888 in response to Thosmas H. Huxley's paper "The struggle for existence" which promoted competition at the core of evolution.
[39] George Wilkinson, "Reciprocal Food Sharing in the Vampire Bat," Nature 308 (March8, 1984):p181-184
[40] They all were based on the assumptions of game theory: That the players are in conflict, that they must take action, that the result of these actions will determine which player will

on mathematical rules they would help to test different solution strategies systematically. The most interesting one for our context is the "prisoners dilemma":

"Two men, charged with a joint violation of law, are held separately by the police. Each is told that(1) if one confesses and the other does not, the former will go free and the latter will be three years of prison,(2)if both confess, each will be fined two years, and (3)if neither confesses, both will be sentenced one year."[41]

The question posed by this game is simple: When should a person cooperate and when should a person be selfish. This game became particularly interesting when the political scientist Robert Axelrod conducted experiments in 1979 repeating the game over and over again. Because current decisions might affect future rounds (just as in real life), long term strategies enter the situation. He used a computer to let different strategies submitted by physicists, biologists, computer scientists, economists, psychologists, sociologists and political scientists compete against each other in a tournament. Surprisingly, the most simple of them all won. "TIT FOR TAT" would cooperate on the first move and then do what its opponent had done in the round before. Reciprocity dominated all other strategies. Continuing his experiments, Axelrod could prove that within a pool of uncooperative strategies, cooperative strategies evolve from small clusters of individuals who reciprocate cooperation. He observed that these clusters would earn points faster than defectors did. Backed up by equal findings of biologist Robert Trivers, Axelrod stated in his classic publication "The evolution of cooperation"[42] that cooperation in conjunction with reciprocity stands at the peak of social evolution.

These findings become very important in the context of virtual communities. They help us understand how groups of total strangers can form successful cooperative communities and resist attacks from defectors. Most online communities today have reputation systems embedded which measure the

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win according to definite rules and that each player acts rationally by choosing the strategy that will maximize their gain regardless of the consequences to others.

[41] A.W. Tucker, "On Jargon:The prisoners Dilemma,"UMAP Journal 1 (1950), p101

[42] available from Basic Books, Reprint edition (1995)

reciprocity of cooperation and thus create trust and reliability. The fraud rate on eBay auctions for example is below 2 percent[43]. Considering the potential of anonymity bears for conducting scams this is very surprising. Book reviews at Amazon will disappear if a high percentage of people rate it as "not useful".

As I will show later when analyzing the potential of wireless networks, these insights can teach us under which preconditions healthy, powerful and dense glocalized networked communities will grow.

2.3.4 "Sheep that Shit Grass"

As we have seen, one does not necessarily need to be an idealist to add value to a community. The Hackers that helped create the internet for example built a structure they wanted to use for their own purposes. Still, they added incredible value to the worldwide community.[44]

As a more recent example, Peer to Peer (P2P) client/server applications such as Napster, Kazaa or eDonkey[45]added a whole new way of participation into resource pooling. People already add value to the network by only participating. When downloading other people's shared files, they automatically provide some of their own. Cory Doctorow, Science fiction writer and Software Evangelist for OpenCola[46] strikingly refers to these participant who provide the same resource they consume "Sheep that shit grass".

3. Conclusion

To sum up we have seen in this chapter that a networks value rises exponentially with the number of nodes if there's a community forming structure present. We have also learned about the preconditions for successful communities. Apparently, structures

[43] Report by cnet.com
[44] The insight that people acting in their own best interest can at the same time add value to society laid the foundations for modern western state philosophy (Adam Smith) as well as capitalism, which proves to be more successful than approaches of total control.
[45] http://www.kazaalite.tk, http://www.edonkey.com
[46] a system for intuitive file sharing at commercial workspaces: http://www.opencola.com/

that facilitate mutual cooperation and resource pooling amplify creativity and innovation. However, decentralized monitoring behaviors and means of punishment of offenses against the community rules are vital to protect the common shared resources from overexploitation.
Collaborative and creative efforts have already shaped more innovative and efficient ways to use the medium and are likely to develop many more which we can't conceive yet. New participation structures even allow people to add value to the community while acting selfishly[47]. With the blogging example we have already glimpsed some of the benefits a globally linked brain will provide.

I claim that these developments will be greatly amplified by wireless networking. While still being in a transitional period we now have a choice where this process will lead us to. The next part of the thesis will be dedicated to the discussion what alternatives we're facing and what we can do to push developments towards one direction or another.

[47] Later, I will discuss concepts of similar developments on the technical layer of wireless networks, which will improve in efficiency and bandwidth with every additional participant.

PART II: The Wireless Revolution

1. What's the big deal?

It might appear exaggerated to use the term "revolution" in the title for the second part of the thesis. In this chapter I will show that a series of essential questions of our time come together in the emergent wireless networks. The shift to wireless networks which is already in progress inevitably will bring substantial change to our lives, with great potentials for free flow of information, cooperation and community building as well as for tight control and seamless surveillance. The liberation from wiring will do more than merely push forward the ongoing trends of technical and social developments described in the preceding chapter. Due to their unique new properties and the capabilities arising from them, wireless networks will challenge our social and ethical principals.
For example: If it was possible to prevent all crime by ubiquitous surveillance, should it be done even though it would mean a substantial if not complete loss of personal privacy and also poses a severe threat of misuse?Before we get to question like this we will examine the basic properties of wireless networks and ubiquitous computing.

1.2 Omnipresence

Wired networks are expensive to set up and maintain. They spread slow and are vulnerable to physical damage, ranging from natural disasters to manmade ones, such as terrorist attacks[48]. Thus the range of wired networks is limited by economical restrictions. In many developing countries, power and phone networks are only present within the centers of the big cities, remote areas and individuals are not likely ever to get connected.
With wireless networks, the situation is changing drastically. The most extensive wireless networks we know today are cell phone

[48]On the other hand, wireless technologies such as WiFi networks and cell phone text messaging were the only functional means of communication in Downtown New York after the attack on 9.11.2001

networks. Interestingly, cell phones are embraced in poor countries because they are the only means of long distance communication. In Africa, shared "tribal cell phones" connect villages to the world, admittedly a somewhat strange cultural clash. On the Philippines are already more cell phones than stationary ones. To save money, the Filipinos have switched to sending short text messages (SMS) and have developed one of the most vibrant texting cultures in the world.[49] With this dense distribution of such easy to use technologies, the new ways of communication are integrated into the social framework. On the Philippines it's not considered rude to "text" during funerals.

Even though the bandwidth of cell phones is becoming broad enough to reasonably transfer data it is relatively expensive[50]. Phone network providers have spent huge amounts of money on frequency band licensing fees and the setup of their networks and are now looking for returns on their investment.

Again, for economical reasons it is not probable for commercial networks to spread beyond the boundaries of assured profit. Due to the high price for reserved frequency bands the prices are unlikely to decline soon. The commercial UMTS licenses which were auctioned off in 2001 have cost network providers billions. This investment is passed forward to their customers. The strict regulation of the ether originates in 1932 and is based on the technology of it's time. This was almost twenty years before Shannon's information theory[51] and well before the invention digital technologies and electronic computing. It is rooted in the idea that the ether is a limited resource because intersecting radio signals would merge and create noise. Although the technology has evolved substantially in the last 70 years, the paradigm of the limited ether prevails.

With his initiative "Open Spectrum", David P. Reed proves this thinking wrong and tries to inform about the capabilities of technical breakthroughs in managing radio spectrum;[52] using rapid frequency hopping the communication bandwidth of radio

[49] Howard Rheingold, "Smart Mobs", Publishing (2002), Chapter 2
[50] In Germany, the main reason for people aged between 20-30 to fall in debt are overly high cell phone bills.
[51] MIT researcher Claude E. Shannon has defined modern information theory with his paper "A Mathematical Theory of Communication" which was published 1948
[52] Reeds open spectrum campaing:
http://www.reed.com/dprframeweb/dprframe.asp?section=paper&fn=openspec.html

signals could be vastly increased[53] while making it considerably more resistant to noise and distortion. This practice would not even interfere with existing applications such as Television and Radio broadcasting.
On the contrary, he introduces a concept of low power switched radio networks which will increase in bandwidth with every additional participant being added to the mesh.[54] As this theory contradicts the current paradigms I believed that he was well ahead of his time just as Baran fifty years before him. Intel however just announced that it has picked up on the idea. Not only have they already started to implement wireless networking capabilities to any chipset they produce[55], they are even developing a technology that makes these chips capable of connecting to ad-hoc meshed networks as proposed by reed.

Moreover Reed criticizes the auction system to sell radio spectrum as this does not pose an incentive to innovate on the highest bidder, who would only be interested in raising prices to get returns on his investment. In a monopolized and regulated environment, innovation is not required. Opening the spectrum however would create an innovations commons way more potent than we have experienced with the internet before.

1.2 WiFi grassroots networks

"Wireless LANs are not free lunch, but they make possible a very inexpensive one, and you now can pack your own lunch instead of buying only the monopoly brand."
-Howard Rheingold [56]

While the battles are raging in the commercial sector, independent wireless grassroots networks are forming in the niche of the license-free 2.4 GHz band which had been reserved for private uses such as for kitchen appliances (microwave ovens) and wireless phones.

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[53] It's estimated to reach more than 1Gbit/s, 10 times as much as Fast Ethernet use in LAN's

[54] David P. Reed, the discoverer of Reed's law, has written a comprehensive presentation on the technical status quo of wireless networking concept and why radio space is not limited: http://www.its.bldrdoc.gov/meetings/art/art02/slides02/ree/ree_slides.pdf

[55]

[56] In "Smart Mobs", Perseus Publishing(2002), Pp135

This development has been accelerated by frustration with the existing Telco monopolies in conjunction the steeply declining prices for the necessary off-the-shelf equipment. With less than 50 Euros for a wireless networking card it has become affordable to anyone to participate in private ad-hoc-networking. This has become known as WiFi or 802.11x after the IEEE standard this equipment is based on.

While the bandwidth for this technology has reached considerable 54Mbps per second it's most obvious disadvantage is its limited range of up to 400m[57]. But even with this short range a widespread network coverage is possible. Following Reeds above mentioned Meshed networking theory, the approach for seamless network coverage in densely populated areas is not the increase of signal power but the ubiquity of nodes. On the contrary, his concept even promotes the reduction of signal strength when sufficient nodes are present because they only have to reach their nearest neighbors.

Currently, such ubiquity of the necessary equipment can only be found in the centers of large cities. Not surprisingly, the earliest community networks have emerged in technological focal points in the silicon valley and the east cost of the USA.[58] In their early stages these neighborhood networks were communities of so-called "war-drivers" who drive around their cities mapping places where people willingly or not[59] share their internet connections via wireless access points. They would pool their findings in centralized databases that would help to find free internet connections when and where needed. In this case however wireless networking is only used as an additional means of access to the internet and does not mean at true development in structure.

WiFi communities are becoming more organized though. As the early internet before, they are being developed by Hackers with distrust to centralized structures. Their ambitious vision is to develop an independent worldwide meta-network which is

[57] when operating within the legal radio power limit of 30mW
[58] Selected community network sites: Seattle Wireless (http://www.seattlewireless.net/), NYCwireless (http://www.nycwireless.com/), London's "Consume the Net" (http://www.consume.net/), the Bay Area Wireless User Group in San Francisco (http://www.bawug.org/), Personal Telco (http://www.personaltelco.net/)
[59] misconfiguration and carelessness is still quite common with this new technology.

completely in private hands.[60] Currently, the odds don't look very good for their case though. At the current technological stage this goal seems to be utopic. Furthermore considering that such a network, should it succeed, would be the present Telecommunication industries' worst nightmare[61], they will be up against powerful interests.

Nevertheless there are a number of reasons that such a network will eventually succeed, not as a replacement for today's internet but as its structural completion:

1.2.1 Domination of collaborative strategies

I have shown before with game theory that collaborative strategies persist even in hostile environments. In their experiments, the game theory researchers have observed collaborative players clustering together in a pool of players with varying strategies. These clusters would merge and grow to networks which would eventually dominate their environment. Similar developments can be observed with wireless neighborhood communities. They have developed from collecting data about unrelated *hotspots*[62]to sharing private internet connections to actively forming their own networks. Initiated was this development by a bandwidth dilemma. Bandwidth is not a free resource. Although being frustrated with slow dial-up connections many users do not want to afford costly broadband internet connections which provide more bandwidth than they actually need. Wireless networking has provided an inexpensive infrastructure to share broadband internet connections among whole neighborhoods. For a minimal fee, whole communities can enjoy broadband internet connections. Communication among the participants is not even routed over the internet any more but remains within the independent neighborhood network. The Bay Are WLAN user Group[63], among others, has already set up such non-commercial networks. In addition to lobbying for

[60] Most prominent organizations are http://www.wirelesscommons.org/ and http://www.freenetworks.org/

[61] They would not only substantial earnings on the bandwidth market, even telephony could be routed over such a broadband network using the VoIP technology (Voice over IP: http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci214148,00.html)

[62] Wireless access points

[63] http://www.bawug.org

the benefits of wireless networks for communities, they are also actively developing advanced technologies to link their neighborhood clusters with long-distance point-to-point connections. With some of these high-powered radio links, a small version of the global meta-network is already operable. With further technological advances this development is likely to occur worldwide.

But even this is only a transitional stage. With the currently used transmission standards, clients connect to routers but not to each others. Bandwidth is divided equally among all connected clients. Thus, bandwidth quickly becomes a rather limited resource with the growing numbers of users. In Reeds vision of meshed ad-hoc networks, every client also functions as router. Because participants ARE the infrastructure, available bandwidth will be stable if not increasing with the number of clients. This structure would be the ultimate realization of Baran's vision of a distributed network, being extremely fault tolerant and flexible, but also without any central control. As mentioned above, such structure requires a dense ubiquity of wireless networking equipment.
Examining current technological trends it becomes obvious that we might be closer to such a structure than we might think.

1.2.2 The unavoidable ubiquity of computers

More than a decade ago Mark Weiser, a Scientist at Xerox PARC[64], projected the consequences of Moore's law into the future. In his paper "The computer for the 21st century"[65] he coined the term "Ubiquitous computing", predicting the disappearance of bulky desktop computers and the omnipresence of tiny computer in our everyday lives. These computers would be able to communicate with each others and be equipped with an abundance of sensors.

This scenario seems to be awkwardly close today. With cell phones and PDA's, we are already carrying powerful hand-

[64] Palo Alto Research Center, also the cradle of Personal Computers, the Computer Mouse and many more groundbreaking inventions.
[65] Scientific American, 265(3), p94-104

held computers at all times. These devices have networking capabilities embedded and are aware of their position.

Chip manufacturer Intel announced to embed wireless radio networking capability into every chip they produce in the near future, starting with their Centrino chipset. They expect 80 percent of laptop computers to have WiFi capabilities until 2005. This forced increase in the number of WiFi users will greatly amplify the demand for WiFi networks in public areas.

Hardly visible but all around us are Radio frequency id chips (RFID or "smart tags"). They can hold and broadcast several hundred digits of information and can already be produced at the size of less than a square millimeter, ultimately approaching the size dust particles. They have permeated our daily lives, printed on price tags, as theft protection or for tracking purposes. European Banks are considering electronically tagging Euro Bills. This addition does not only protect from counterfeit but also keeps track of which kinds of transactions the money has been involved in and thus prevents money laundry.[66] Fashion manufacturer Benetton even weaves RFID tags into their garment for shipment tracking purposes. As these tags don't require power they won't cease operation even after many years of use. Maybe, someday we'll be able to call our sweater up when we misplaced it.[67]

Sensors are undergoing a similar development. Researchers at Berkeley labs have been presenting first prototypes for what they call "smart dust". The vision is to produce Motes, independent macro sensors with networking capabilities.[68] The active versions will be able to move and navigate on their own, being powered by solar cells. Passive sensors will generate their power from the measuring process itself[69]. Intel researchers are pushing the vision even further with trying to embed capabilities to form ad hoc network meshes as described in Reeds vision for WiFi applications[70]. It is not

[66] http://zdnet.com.com/2100-1105_2-1009155.html
[67] Ralf Groetker (Editor), "Privat – Kontrollierte Freiheit in einer Vernetzten Welt", Heise (2003), p198
[68] http://robotics.eecs.berkeley.edu/~pister/SmartDust/
[69] The first functional fully integrated Motes were recently presented to the public; they are only 5 square millimeters big http://www.spacedaily.com/news/chip-tech-03k.html
[70] http://zdnet.com.com/2100-1103-985502.html

science fiction any more to say that networked clouds of sensors will be around without us even being aware of it.

In conclusion it is probable that wireless networking capabilities will be embedded into all kinds of products that carry computer chips within the next decade.[71] But not only coffee makers and video recorders but also furniture and clothing might be candidates to carry sensors and WiFi to recognize our needs and service us even better.[72]

Weiser's ubiquitous computing describes a not too distant future in a wirelessly connected world. Ubiquitous wireless network meshes will eventually be at our service. Even though these emerging technologies will be able to be very helpful they pose severe threats to our privacy and security. I will analyze the possible threats and alternative approaches in the next part of the thesis.

1.2.3 The power of the innovations commons

Of course, Hackers have already picked up on this new field with promising features for the free flow of information. An extensive Open-Source community is working on solutions to provide the yet lacking security features for wireless networking.[73]
Other projects are eagerly developing solutions that will make trusted ad-hoc meshes possible. As with the internet before, an abundance of technological innovations is to be expected with thousands of volunteers collaborating as long as the medium remains free.

1.2.4 Commercial backup

Unfortunately, the 2.4 GHz band is not a very secure niche. Only slight changes in legislation would render WiFi illegal[74].

[71] Even the EU is sponsoring extensive research into this topic: http://www.disappearing-computer.net/
[72] A Japanese toilet is already being marketed which is testing urine for glucose levels.
[73] i.e. the WiFi IPsec framework: https://wiki.ash.de/cgi-bin/wiki.pl?IPSecIEEE802.11
[74] Applications are only allowed in the free frequency band as long as they do not interfere with existing applications. This is more of an rhetorical matter than a technical one.

The mighty Telco lobby which fears about the marketability of their slower and more expensive 3G (or UMTS) networks might have been able to effect such changes.[75] Especially in the USA it has become common practice to scotch unpleasant grassroots movements by influencing legislation. In 2002, the Recording Industry Association of America almost succeeded to inflict royalty charges on internet radio ten times as high as for normal radio. As most of these servers are residing in the USA, this would effectively have exterminated the phenomenon internet radio[76].
Luckily, numerous businesses have discovered WiFi networking as a new field for expansion. Resistance of Telcos is now subject to the rules of the market. Wireless network access is starting to be appreciated as a modern service in public spaces and is already available at many big airports and train stations. 3G network providers are now working on the coexistence of 3G and WiFi, switching their phones and devices automatically to the fastest and cheapest option available. In the USA, commercial WiFi hotspot grids such as BOINGO[77] or T-Mobile in Starbucks Coffee Shops are constanttly growing. Only recently, the young startup company dedicated to the development of wireless network meshes was rated into the top 10 of promising new businesses.

1.2.5 Backup by the government

"We need to think of ways to bring wireless-fidelity applications to the developing world so as to make use of unlicensed radio spectrum to deliver cheap and fast Internet access."
—Kofi Annan, November 5th, 2002

Governments start to recognize the economical leverage of network infrastructure. The UN has recently assembled a task force to develop plans on how to cover developing countries with the cost effective wireless networks.[78] Years before them

[75] Similar impacts of company lobbys are the
[76]Luckily, this effort could be stopped in the last minute by extensive international protest. http://www.kurthanson.com/archive/news/062102/index.asp
[77] http://www.boingo.com/
[78]a)United Nations Information Technology service: http://www.unites.org/html/news/n130503.htm
b)The **Wireless Internet Institute** serves as an international and independent think tank hosting ongoing Wireless Internet Inquiries around the world, exploring global and local

Dave Hughes and Dewaney Hendricks have already pioneered in projects to provide cost effective WiFi networks for Indian reservations and Mongolia using solar powered relay stations.[79] To be able to experiment with higher powered signals they moved their testing facilities to Tonga where frequency bands are not regulated yet.

As it's conceivable that wireless mesh networks will succeed I will now have a look at the implications of this development. The discourse is vivid, ranging from doomsday scenarios to utopia. I will first start with the concerns.

2. Dangers

When I talk about Dangers, I'm referring cutbacks on personal freedom and other conveniences we have already achieved in the democratic welfare system. Economical recession and "Terrorist" rethorics are currently driving some inadequately informed politicians to legislative efforts that will have far-ranging implications.

2.1 Surveillance

One of the major concerns about ubiquitous computing and wireless networking is the demise of privacy. Indeed, the technology offers great potential for surveillance. I will discuss three central topics about surveillance: What exactly is privacy and why is it important, Governmental Surveillance and Business Intelligence.

2.1.1. Privacy[80]

> *"Privacy is the claim of individuals [..] to determine for themselves,when, how, and to what extent information about them is communicated to others"*
> *-Alan Westing*[81]

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industry topics, publishing a series of related white papers, and producing a yearly Wireless Internet Summit conference and the Wireless Internet Institute Industry Innovation Awards. http://www.w2i.org/

[79] Howard Rheingold, "Smart Mobs", Perseus Publishing (2002), pp144

[80] Some references and thoughts about privacy are taken from Ralf Groeker (Editor), "Privat", Telepolis Press (2003), Pp 201ff

"You have no privacy anyway, get over it"
-Scott McNealy, Sun Microsystems

Louis D. Brandeis, who would later become judge in the supreme court of the USA, defined privacy as "the right to be left alone" as soon as 1890. Privacy is clearly context based. There would be different treatments to privacy when you are in a public park as when you are at home. In public, laws and customs dictate the code of behavior. In Germany it is forbidden to conceal your face at demonstrations and it would be considered rude to stare at people.

"All this secrecy is making life harder, more expensive, dangerous and less serendipitous"
-Peter Cochcrane, British Telecom Labs

But why is it important to protect privacy? Obviously, privacy is a costly obstacle for businesses and is making life more complicated. While this right is much discussed recently, the most important reason is that privacy is one of the very pillars of modern democratic structures: Only if people are able to govern their lives according to their interests and convictions without fear of repression by the state or anyone else the plurality of opinions can emerge which is essential for a healthy democracy. Lawrence Lessig identifies a number of additional reasons for the importance of privacy:

Privacy as empowerment. This describes the view as information as personal property. Everybody can decide when and where to distribute it. This notion implies a number of inaliable rights such as the right on one's own name.

Privacy as utility. Privacy can be a tool against inconveniences like spam-email or sales calls on the phone. This also covers the unease created by the knowledge that one is surveilled, either by cameras or other people.

Privacy as dignity. Dignity can be endangered informational balance between to people is uneven. Imagine for example talking to a fully dressed person while being naked yourself.

Privacy as regulative. Privacy rules restrict the power of governments. To search somebody's home for example, reasonable

[81] Westin, Alan "Privacy and Freedom. Atheneum", New York Publishing 1967

suspicion must be proven in order to obtain a search warrant. This protects people from unjustified harassment.

2.1.2 Communication, Power and Control

Power is rooted in control of information and knowledge[82]. Naturally the control of communication systems has become a primary pillar for any modern structure of power, be it government or business. The run for more efficient and encrypted[83] communication technologies has decided wars and ended reigns of rulers who could not adopt quickly enough. The most recent "victim" to communication superiority was the Filipino President Joseph Estrada, whose reign was ended in 2001. He was caught off guard by instant massive protests of millions of Filipinos going to the streets, guided and organized by waves of SMS messages.[84]

In totalitarian Systems the tight control over communication technology and the information submitted over these is vital. Dictators control the mass media in their countries and prohibit technologies whose communication radius would exceed the radius of their control, such as satellite dishes and the internet.

In democracies however it is hard to maintain a healthy balance between freedom and control. While theoretically basic human rights such as privacy and freedom of speech are untouchable entities, too much freedom without control is a threat to any society. A system tolerating forces within which strive to destroy it is doomed. Even in these systems the control over information can be used to guide the people any way desired. The recent war on Irak for example was evidently justified by a comprehensive set of falsified intelligence. Surprising and unsettling: only few Americans are complaining about being tricked.

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[82] This connection has first been described by Michel Foucault in "Discipline and Punish"(1977). He saw these terms so closely connected that he only referred to "Power/Knowledge"

[83] As sensitive information should only be seen by selected people

[84] Howard Rheingold, "Smart Mobs",Perseus Publishing (2002)

2.1.3 A short history of electronic intelligence

To identify the structural changes wireless networking brings it is necessary to study past developments. As the USA[85] have been the driving force in electronic communication interception since World War Two I will refer mainly to the achievements of the NSA in the following.

The history of communication technologies has always been the history of technologies of surveillance. While after the incidents of 911 the surveillance practices of US intelligence agencies have become more aggressive and, due to "terrorist threat rhetoric", more socially accepted. However, large scale electronic surveillance has already been essential part of US national security program since the 1960s.

Until recently, this had been relatively simple. Signals could be intercepted from satellites; cables could be tapped from the outside using magnetic induction. High end computing systems would filter the abundant information for topics of interest[86]. The best known scale of communication surveillance was conducted by the post war Echelon[87] system which is only a small part of a large scale surveillance network set up and maintained by the USA, England and a number of secondary partner nations. Unknown to the public, this network represented the world's first and most powerful wide area networks (WAN), even before the internet was in place.

Paul Baran's Packet switching proposal for telephony in 1964 was of course a threat to intelligence. Chopping up messages would make then unintelligible. Apart from ignorance, the priority of intelligence was probably another reason to reject his vision.

The only barriers back then were encryption technologies that would substantially increase the computing power to analyze the data. However, the NSA would require US companies by law to provide back doors for encryption[88] and even managed to infiltrate trusted international encryption companies. Rigging the

[85] Telepolis: "Überwachungsmonster USA", http://www.heise.de/tp/deutsch/inhalt/te/13982/1.html
[86] with some Problems in the Beginning but
[87] A comprehensive history of echelon: http://www.heise.de/tp/deutsch/special/ech/6928/1.html
[88] A prominent example is the windows encryption back door, placed an operating system which is running on 80 percent of computers worldwide. http://www.heise.de/tp/english/inhalt/te/5263/1.html

cryptographic systems of the Swiss Crypto AG[89] for example enabled the NSA to read the diplomatic documents of 130 countries without effort.[90] Only recently, some open source encryption projects provide somewhat reliable high level encryption.

However, electronic surveillance got into a crisis as data transfer was increasingly switching to fiber optic cables which provide much higher bandwidth than satellite or traditional wire communication[91]. To tap fiber optic cables, physical access to the cable or router is required. Also, the emergence of the internet posed further problems. Not only were Baran's packet switching ideas realized that rendered surveillance of single cables useless but the amount of data transferred is still growing exponentially each year. Again access to the routing hardware at central hubs was required. In the US, information service providers can already be forced by law to give the NSA access to their data streams.

To gain access to the European routing equipment, intelligence agencies founded the nonprofit organization ETSI[92] (European Telecommunications Standards Institute) in 1985, members of which are telecommunications industry leaders and NSA officials. This committee is working out proposals for new telecommunication standards which are suited for surveillance needs. The German as well as the Austrian Telecommunications Surveillance Acts[93] are based on ETSI proposals[94], which introduce a standard interception interface for telecommunication equipment. These requirements are already being implemented by all major manufacturers of telecommunications equipment. These standards are preparing the launch of ambitious surveillance projects such as the European Digital Surveillance Police ENFOPOL or the American TIA (Total information awareness)[95]. The latter is even aiming for a system that would connect databases all over the world. The yet lacking political justification is being driven by a propaganda offensive utilizing child pornography, cyber-terrorism and neonarcism to create awareness for the need of surveillance among the people.

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[89] http://www.crypto.ch/

[90] For more interesting details on international Intelligence, read the intelligence report of the united nations "Interception capabilities 2000" http://www.europarl.eu.int/stoa/publi/pdf/98-14-01-2_en.pdf?redirected=1

[91] NTT has just recently accelerated the Fibre optic transfer rates by factor 10.

[92] http://www.etsi.org/

[93] http://www.regtp.de/imperia/md/content/tech_reg_t/ueberwachu/5.pdf

[94] http://cryptome.org/espy/ES201-671.pdf

" [95] http://www.heise.de/tp/deutsch/html/result.xhtml?url=/tp/deutsch/inhalt/te/14575/1.html&words=Total%20information%20Awareness

With the current structure of centralized communication service providers there is not only the possibility to conduct tight surveillance on all electronic communication, but also control over who can access which information across these networks. In Germany, this kind of census is already being conducted in the state of Nordrhein-Westfahlen where the popular fight against Neonarcism is used as the reason why census is rightful and necessary.[96]

I'm not questioning the necessity for surveillance when lawfully pursuing criminals. We have discussed before the necessity of monitoring for healthy community building. This process however must be transparent to the community. Monitoring becomes problematic when it is done without incentive, even if it can be done without bothering the subject. The filtering techniques of "preemptive profiling" always produce a certain rate of so called "false positives" which can result in severe consequences for the victim, even if found not guilty later on. The danger of misinterpretation or intentional misuse of such a system is too high without checks in place. Considering these dangers and the loss of privacy and quality of life outweigh the questionable benefits of omnipresent surveillance.[97]

Grass-roots wireless ad-hoc networks, if they gain sufficient coverage, would effectively undermine large-scale surveillance. The fact that there is no central routing and that the infrastructure is owned by countless individuals makes centralized eavesdropping impossible. The network would be stable even when taking out a large number of nodes. Even though radio signals can easily intercepted spying on communications will be very time consuming because of strong encryption algorithms that are already in place. In a packet-switching topology, it will be almost impossible to eavesdrop on communication due to the abundance of routes its single packets might have taken.

The main security risk on the internet is a lack of education among its users. The obviously insecurities of radio transmission however will encourage many more people to get familiar with encryption technologies.

[96] http://www.heise.de/tp/deutsch/html/result.xhtml?url=/tp/deutsch/inhalt/te/11306/1.html
[97] The latest on the surveillance and computing discourse can be found at the website of the 13th annual conference on computers, freedom and privacy: http://www.cfp2003.org/

2.1.4 Envious big brother

Most of us are yet unaware of the density of video surveillance we are already exposed to. Security cameras in shops are standard equipment. A group of New Yorker activists has mapped more than 3000 surveillance cameras that point to the Sidewalks in Manhattan alone[98]. Connecting these cameras, it would be entirely possible to follow individual persons all around town. Additionally, the number of live web cams is expected to grow drastically as the prices for cameras are dropping below 20$. And these are only the stationary ones. Cell phone cameras, currently a hip feature, will eventually become a standard. In only a few years, we will be surrounded by a ubiquity of cameras capable to post their movies and pictures instantly to the network.
The vision of organized use of this surveillance infrastructure is not far fetched. Law enforcer might put a price on reporting crimes. Police might actively look for eye witnesses by locating the cell phones in the vicinity of a crime scene. As Michel Foucault already pointed out in his description of the Panopticum Prison[99], it is not even necessary to constantly monitor everybody. The awareness of possibly being observed is enough to impose a corrective effect on people.
There are uses for the entertainment industry as well; A Reality TV show hunting for good shots being streamed from cell phones would only be a logical continuation of the current voyeuristic trend in TV entertainment. This development would also affect Journalism; live unedited footage would be available from any point of interest[100]. Spying on neighbors might become a popular practice. Will we have to hide out in secured apartments to enjoy our last bits of privacy? Will we constantly feel observed? Would this fuel an atmosphere of distrust among neighbors? This scenario would go far beyond what Orwell envisioned in his Novel "1984".

It will be important to revise legislation on publication of imagery in respect of the upcoming ubiquity of cameras.

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[98] NYC Surveillance Camera Project: http://www.mediaeater.com/cameras/
[99] Michel Foucault in "Discipline and Punish"(1977).
[100] The impact of such imagery can be observed at the yearly violent demonstrations against the WTO. Demonstrators use sophisticated network strategies to coordinate their protests, avoid police and report live from the scene. While footage was still streamed uncensored in Seattle in 1993 there were police efforts to disrupt live transmissions at the 2003 WTO meeting in Evian.

2.2 Connective Discrimination

The best network is only useful to those who are connected to it. If future wireless networks will be based on a regulative and restrictive structure, granting access to it becomes a political issue. As the "connected ones" will be privileged over the "unconnected", access rights might be deployed as another means of discrimination, being an extension for the various discrimination issues we are already facing today. The resulting exclusive clusters would be a huge loss not only in terms of network value.

2.3 Disorientation

When I was talking about wireless networking as the stage two of the internet as a people's technology I'm not saying that it will be uncritically adopted. There's much potential for confusion and rejection. The threat of cumulative disorientation poses itself in a number of ways.

2.3.1 Design Disasters

It's an old human habit to try to conform users to the needs of technology. A number of spectacular conceptual failures emerged with the rise of the internet. Those ultimately led to the dot-com-crisis when most of cutting edge but senseless and unprofitable internet businesses filed bankruptcy. Another wave of design disasters is to be expected with wireless networks. Unyielding interfaces and non-practical applications have usually led to rejection by the users. It will become more difficult however to avoid a technology which permeates our daily lives. Bad design and "usability crimes" might create great frustration and the feeling of powerlessness among users.

While utopists still dream of computers that recognize our needs and act accordingly it is likely that many more applications will be inflicted on us that are developed for needs we don't have. Additionally, design still is developed target group oriented. Small type and confusing layouts for example might render applications unusual for senior citizens; unintentional discrimination by design. It is important to

define minimum usability standards that make the technology accessible to a wide range of citizens.

2.3.2 The "Flow"

Wireless Networking and ubiquitous computing will bring mobility not only in a geographical sense. If we're surrounded by a ubiquity of sensors collecting data, our environment will be able to adjust quickly to changing conditions.

We already have street signs that adjust the speed limits to traffic density and roadside advertisement panels that alter their content depending on the radio channel the majority of passing by drivers is listening to.
The amount of information we are constantly broadcasting about ourselves will be rising significantly when we carry ever more powerful communication devices. Likewise, the ways how our environment adjusts will become more sophisticated. The resulting flow of properties might result in a complexity not everybody will be comfortable with.

Food might adjust its expiration date according to the room temperature, and its price might drop automatically when it's not fresh any more. Instant dynamic pricing as it is gaining popularity with EBay might be applied to any product. Transferred to everyday life, it might become more expensive to shop at rush hours, products might become cheaper when they are not wanted. The Pay-Per-Use principle we are used to with public transportation or concert visits might be extended to all kinds of products: furniture, presence in a parks etc. Dealing with such dynamic conditioning will require substantial effort and change how we lead our lives.

How about law enforcement? Will we be automatically fined for speeding and parking offenses, for trespassing other peoples' property or for remaining for too long on public sidewalks[101]?

[101] Loitering is an offense in many states in the USA. Recently, a pregnant woman was fined 150$ for sitting down on steps when she was exhausted.

Also, we're becoming socially more flexible; Appointments are set up on the fly or are increasingly subject to last minute changes due to the ease of instant communication using cell phones.

Our daily habits are based on parameters we can rely on. Routine provides a secured framework for an otherwise unpredictable life. People appreciate reliability and predictability because with them they gain a feeling of security. When whole environments fall victim to the dynamic flow, we might get lost and disoriented in an ever changing world. Additionally will the feeling of constantly being controlled and corrected cost us our feeling to be free and degrade the quality of life. If there are no mechanisms of choice embedded, our wireless freedom might backfire.

2.3.3 Network Darwinism and the "Always on" Syndrome

Even though I don't agree with Paul Virillio on all points of his pessimistic visions, I consent that the acceleration of communication has also had negative impacts on our lives. In management and increasingly in other work fields employees are expected to be reachable at all times. In the current economical deflation employees, in fear of losing their jobs, often develop a self-destructive dedication. With computers and networks the division of workspace and home, work and leisure, business and privacy has disappeared. The survival of the fittest net-worker in a world of increasing unemployment leads to a fierce network Darwinism. Ever more people fall victim to the "always on" syndrome. Consequently, Burn-Outs undeniably have become a modern plague. Unfortunately victims often keep their breakdown secret because it still is widely perceived as a personal mental weakness.

I believe that it is now time to find socially accepted ways to manage rest and justify being unconnected at times. We need to develop social concepts that utilize the network infrastructure to distribute work instead of overstraining few while not tapping the growing pool of unused manpower.

2.4 Smart Mobs

The term "smart mob" phenomenon was coined by Howard Rheingold in 2002 in his book with the same title. He is basically extending Kevin Kelly's vision[102] of computing technology leveraging organic swarm behavior in various aspects of our lives. Based on current phenomena of electronic swarm tactics used to organize large crowds using modern wireless communication technology[103] he is interested in subconscious intelligence to emerge, similar to self-organization of ant-hives. While I agree on the increased danger of crowd manipulation, I doubt the appearance of emergence. In this case, the necessary preconditions for emergence as listed by Steve Johnson in his book "Emergence"[104] are not fulfilled.

2.5 Cybercrime

As discussed above, law enforcers and legislators are having a hard time to keep up with technological developments. Of course, criminals are quickly adopting the new efficient communication medium and build their own networks with it. With computer networks the rapid innovation also covers new kinds of crimes and fraud. As discussed above, this could be largely embanked by a very restrictive and centrally controlled network structure. However, the collateral dangers of abuse of such a structure are unacceptable. The networks' potential for freedom of speech, collaboration and innovation would be eradicated as well.

As we have discussed in the chapter about trust, research has shown that with the proper framework in place self-organization can be quite strong in decentralized network environment and is capable to defend communities and resources against fraud. Therefore, more effort should be invested in creating such decentralized trusted environments instead of empowering law enforcers to a dangerous level.

[102] Kevin Kelly "Out of control. The new biology of machines, social systems and the economic world"
[103] The avant Garde in swarm tactics can be watched during their yearly the WTO protests.
[104] Steven Johnson, "Emergence", Penguin Press 2001

3. Chances

3.1 Mysterious Conveniences

Technology enthusiasts keep announcing that wireless networking and ubiquitous computing will make our lives substantially easier. Nobody has articulated yet how exactly these conveniences would look like.

The commercial sector will probably ride the technical edge first. Networks are equally beneficial for business as for collaborative working. Many businesses very successfully expanded their clientele and distribution radius by presenting themselves online or using trusted trade environments such as Ebay. The convenience in online shopping was that one could buy without stressful trips to shops from home. The definite disadvantage that one only could see pictures of the products might be eliminated by wireless networking. When shopping becomes immersive, you might be able to shop anywhere you are. You might be able to instantly order a sweater you see somebody wearing on the street. The owner of the sweater might even be reimbursed for his "referral"? The leading phone providers are already developing software that allows your cell phone to analyze your shopping behavior and then starts shopping and placing restaurant reservations for you[105]. The question is whether you would trust your cell phone to spend your money.
As mentioned above, pay-per-use pricing models will become possible for all kinds of products. You might automatically be charged for being in a park or using your couch.

A second area of application will be in services. The idea is that ubiquitous sensing technologies will analyze your needs and provide appropriate services or provide information when we need it and where we need it. "Calm technology" technology for example displays important information unobtrusively. The "Ambient Orb" which changes its color based on an information stream is an early application of this concept[106].
Security applications will range from ubiquitous monitoring to smart bricks that report instabilities in houses[107]. Countless motes[108] in the

[105] http://www.eurekalert.org/pub_releases/2003-06/ns-wyt061103.php
[106] http://www.thinkgeek.com/gadgets/electronic/5da2/
[107] http://www.news.uiuc.edu/scitips/03/0612smartbricks.html
[108] tiny radio enabled sensors, see discussion above

air and in the water will assist in environmental monitoring and weather prediction. The list of innovative applications and ideas is constantly growing. A good source to follow the most current developments in wireless networking technology is Howard Rheingold's Blog[109].

3.2 Economic leverage

I believe that Network access will be perceived as a resource as indispensable as electrical power and will have similar impacts for economical development. Service and information technology have become the fastest growing business sectors of our time. For this tren to continue, an efficient network infrastructure is imperative. The potentials for innovation will affect economy as well. Many new business ideas are expected to emerge from the presence of an open wireless network structure.

3.3 Cybersidewalks

Much more interesting than commercial applications are the social implications of wireless networking. Telecommunication technologies have drastically altered our socializing habits and wireless networking will continue to do so.

Because communication networks are used to connect people, they are an extension to our natural social networks. The ability to instantly communicate over large distances has altered the inner workings of neighborhood communities over the last 50 Years. The fact that neighbors used to know each other, help out and watch over each other was a matter of necessity, a way of getting along with the environment you were living in. These neighborhood communities had their own social codes of trust and reputation embedded, which sometimes was restrictive on certain freedoms. It could mean a hard life if you differed from the general opinion and were excluded from the community. To escape this situation it was necessary to move.
However, starting with telecommunications it had become much easier to stay in touch with remote friends, accelerated transporttation enabled us to quickly visit them. Even more accelerated by the internet, social life has moved from the streets into the security

[109] http://www.smartmobs.com/

private homes. Neighborhood communities as we knew them are falling apart and have already disintegrated in dense urban areas. People are much more selective about contacts and sometimes don't even know their next neighbors. With this isolation, identification has decreased and with it the motivation to get involved for the community. Localized community resource pooling and mutual aid has reached an all time low. Just as electronic networks have increased the potential for collaboration online, they also have eroded it in the real world.

In 1961, Jane Jacobs, researched the social structure of city neighborhoods in her revolutionary Book "The life and death of great American Cities" [110]. She stressed the importance of sidewalks and parks for community life. They are the platform for random encounters and provide the framework for communication and collaboration among the community.

Only by walking down the street we broadcast an abundance of information about ourselves; Looks, approximate Age, Race, Accent, Gesture, mimics, moods among others. With the way we present ourselves in clothing and posture we often express affiliation with certain social groups. With this multitude of codes available in person to person contacts, we quickly decide on whom to cooperate with and whom not to trust.
Such "weak ties", established by accidental concurrence or a friends recommendation are of utmost importance. In 1973, Marc Granovetter published "The strength of weak ties"[111], one of the most influential sociological papers ever written. He proposes that when it comes to the more practical uses of social networks such as job hunting, spreading news, finding advice, publicity etc., weak social ties are more important than our strong friendships. This striking observation is based on the obvious fact of the limited range of close friendship networks. Friends are usually found in fields of common interest and/or occupation. They commonly share the same experiences and environments as they meet frequently. In addition they are connected by an exceptional level of trust and reputation. However for tasks requiring widespread social networks they are rather useless as due to the shared experience and social environment only little new input and innovation can be expected.

[110] Jane Jacobson "Life and Death of Great American Cities", Vintage Books (1961), Part II: The use of sidewalks
[111] Published in "American Journal of Sociology", May 1973

In electronic communication networks the exchange of information is substantially more narrowband. We only get the information the other person is deliberately giving away, with little chance to verify it. While some people enjoy this level of anonymity and playing social charade, it is certainly not a good basis for trust and cooperation. Trust, which would develop instinctively in the real world had to be implemented as a strict set of rules in the online world.

Furthermore, mimics and cadence add an important layer to communication that is entirely missing online. Whoever has followed one of the endless misunderstandings and flame wars in newsgroups gets an idea how much more efficient person to person communication can be.

I assert that with wireless networking these separated worlds will merge. We will have choice which form of communication is most appropriate for any given situation. Walking down the local street, we will still be connected to the global network. I plea for the construction of cyber-sidewalks that combine the best of both worlds; Cooperative neighborhoods with the innovative collaboration structures of electronic networks.

4. Resume

Cybersidewalks are a metaphor for our upcoming wireless reality in which the notion of location will change substantially. As people will BE infrastructure we will no longer be locally constrained by access terminals. Networks and communication will be where people are. When people are freed to move while networking, the networks will become nomadic and amorphous with them.

Electronic communication has proven to be a valuable extension to our socializing repertoire. It has increased radius and efficiency of communication and has introduced a number of entirely new structures of collaboration. With the liberation from terminals and cabling, the fundamental change of communication infrastructure that has begun with the invention of the telegraph will be complete. Instant global networking will be fully integrated into every facet of our lives, wherever we are, at any time.
Even though geographical location will lose importance for performing certain tasks, the currently disintegrating neighborhood communities will undergo a revival as dense clusters of cooperation. The

urgent need for individual participation in the construction of a free network infrastructure will result in an urban tribalisation that hopefully will overcome cultural and ethnical borders.

Wireless communication technology bears great potential for reaching a new stage of collaboration among humans. It might leverage an economical and social upswing. The very same structures however can be used for efficient suppression and surveillance.
While the “wireless revolution” will take place, there is still time to participate in the decision process on what direction it will head to. This can be done with political activism and with our shopping behavior that indicates to the industry what consumers want.

Personally, I'd hate to look back ten years from now and think that my inaction contributed to the end of free information flow and the innovation commons.As Lawerence Lessig put it at the end of his keynote address to the O'Reilly P2P audience in Washington DC: “..please do something."