Chapter 10
Users in the Dark: The Development of a User-Controlled Technology in the Czech Wireless Network Community

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10.1 Introduction

About 10 years ago, if you happened to be standing on a rooftop in a Czech town looking out into the night sky, your attention might well have been drawn to some red lights glowing on the horizon. Perhaps an association to cyberpunk would have crossed your mind. Such aesthetic sensibilities were indeed cultivated by the members of the wireless network community who built the light-transmitting devices. Where the onlooker saw red light beams, there were in fact streams of data crossing back and forth over the rooftops. Many of the wireless network activists were students living in rented flats in large tower blocks. Some of them had elderly neighbors who did not share their appreciation for cyberpunk aesthetic. Furthermore, those neighbors tended to be the movers and shakers of local housing committees. They had the authority, in other words, to tell the young residents to take down the devices from the buildings. This happened frequently enough to motivate the wireless network community to start looking for a technical solution to the dispute. They came up with a modified version of the device where the data transmission took place in the infrared as opposed to the red region of the electromagnetic spectrum. The technical performance with regard to range, accuracy, and interference from rain and fog was roughly the same for both kinds of light. The problem of interference from neighbors, however, was much reduced with infrared light. The stream of data could now flow, cunningly, behind the backs of unwitting neighbors.

The light-transmitting device was called "Ronja," an abbreviation for Reasonable Optical Near Joint Access. Invented in 2001 by Karel Kulhavy, the technology was widely used in the Czech Republic for about 5 years. Ronja offered the cheapest,

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fastest, and most reliable method to connect computers at the time. The project was guided by the idea that anyone without previous knowledge in electronics should be able to build a Ronja device. To make that vision come true, the mechanics and electronics were designed from generally available, off-the-shelf components. Improvements to the technology were discussed in a community of developers and users, and designs and schematics were published under a free software license. These principles were thematized under the label "user-controlled technology." Interest in the Ronja project fizzled out at about the same time as the phenomena of "open-source hardware," and hackerspaces begun to proliferate elsewhere in the world, often with the pretext of democratizing manufacturing. Hence, the experimentation with a user-controlled technology in the Czech wireless network community can be seen as a forerunner to recent trends.[1]

In this chapter, I begin with giving a brief technical description of how Ronja worked, in order to give the reader an idea of the extraordinary amount of effort and ingenuity that went into building the device. Thereafter I move on to describe the Ronja project and the wireless network community in the Czech Republic.[2] The case study is strategically placed for advancing the theoretical argument that I have in mind. On the face of it, the Ronja project was driven by users standing outside well-defined institutions. Still, even when an innovation stems from users (as opposed to employees inside universities and firms), it is the product of institutions or, differently put, of history. I make this point in support of those writers who, before me, have complained that the historical perspective is largely absent from discussions about users of technology.[3] The topic has chiefly been investigated in the field of Innovation Studies and the constructivist wing of Science and Technology Studies. But, for various reasons that I will come back to in the second half of the chapter, both of these traditions have a poor understanding of historical processes. Similar shortcomings are therefore likely to be reproduced once more when the same discussions are applied to hackers developing open-source hardware.[4] I advance my theoretical claim by broadening the context of Ronja to include the historical setting from which the project emerged. In this way I hope to demonstrate that the ebb and flow of the Ronja project were tied up with social relations which in part took place "behind the backs" of the practitioners in the Czech wireless community.

[1] Denisa Kera. 2012. Hackerspaces and DIY-bio in Asia: Connecting science and community with open data, kits and protocols. *Journal of Peer Production* 1(2), 1–8. Available http://peerproduction.net/issues/issue-2/peer-reviewed-papers/diybio-in-asia/. Accessed 5 May 2013.

[2] My research is based on 21 in-depth interviews with people who used, built, or in other ways contributed to the Czech Ronja project in five countries: Sweden, the Netherlands, Switzerland, Czech Republic, and Slovakia. Most of the study was done during a 6-month field trip to the Czech Republic in autumn 2008. A secondary source of information has been websites related to the Ronja project. The most important document is the mailing list of the official Ronja site (http://ronja.twibright.com/) and the discussion forum run by the Czech wireless network community (http://czfree.net). All interviews were held in English, but most of the written documents were in Czech or Slovakian.

[3] Ruth Oldenziel, Adri Albert de la Bruhèze, and Onno de Wit. 2005. Europe's mediation junction: Technology and consumer society in the twentieth century. *History and Technology* 21(1): 107–139; Lorraine Daston. 2009. Science studies and the history of science. *Critical Inquiry* 35(4): 798–813; Dominique Pestre. 2013. *À contre-science – Politique et savoirs des sociétés contemporaines*. Paris: Seuil.

[4] Scholars abiding to Innovation Studies were the first ones to jump on this latest trend, see Kerstin Balka, Christina Raasch, and Cornelius Herstatt. 2009. Open source enters the world of atoms: A statistical analysis of open design. *First Monday* 14(11). Accessed 5 May 2013; Sonali Shah. 2006. Open beyond software. In *Open sources 2.0 – The continuing evolution*, ed. Chris DiBona, Danese Cooper, and Mark Stone, 339–360. Beijing: O'Reilly.

10.2 How a Ronja Link Worked

A Ronja link consisted of two devices mounted in line of sight of each other. The main part of the device, the so-called head, was made out of two chimney pipes. One pipe was equipped with a transmitter, a so-called Tx, and the other pipe contained a receiver, a "Rx." Between the head and the computer sat a box called a "Twister," which processed the signal from the head to be read by the network card in the computer. The key component in the transmitter was a light-emitting diode (LED). Originally the diode was designed to be used in traffic lights. The diode operated in the red or, in a modified version of Ronja called "Inferno," in the infrared end of the electromagnetic spectrum. The light would pass through a 130 mm lens that gave focus to the beam. At the opposite side of the link was another Ronja device. The incoming light was registered by a photodiode placed in the receiver of the other device. The photodiode translated the pulses of light into electronic charges, which then passed through an amplifier that reinforced the signal and reduced noise. In this way, the "blinks" of light were translated into the "1" and "0" of a digital communication network.

Ronja was able to send 10 Mb per second of data. It was much faster than what could be achieved with Wi-Fi transmissions on the 2.4 GHz wavelength used at the time. The original design had a maximum range of 1.4 km. The main drawback with free-space optics was that both red and infrared lights are sensitive to fog. To ensure that the link worked irrespectively of weather conditions, it had to be backed up with a normal Wi-Fi antenna. But apart from bad weather and mechanical interference which blocked the line of sight, Ronja was a remarkably stable technology. It did not have the same problems of packet losses and collisions commonly experienced in Wi-Fi networks. Since a Wi-Fi signal is broadcast over an area, it will always come up against the problem of crowding. This became more of a problem to the Czech wireless network activists as their success in spreading the technology increased. Another disadvantage with Wi-Fi is that data can travel in only one direction at a time. In other words, computer transmissions going back and forth have to share the same lane. The twin pipes of the Ronja head, on the other hand, sent and received data separately and simultaneously. In technical terms, this was known as "full duplex." There was no upper limit to the number of Ronja links that could operate in the same area since the optical device was truly point-to-point. Such

technical considerations meant that Ronja had a major advantage over the Wi-Fi equipment then sold in the Czech Republic at the time.

The main drawback of the Ronja project was that the task of building an optical link, aiming it, and then doing maintenance work was extremely time-consuming and labor intensive. Just assembling all the parts was a challenge. The users had to make do with general-purpose components. Furthermore, as the customers who purchased the parts were usually firms rather than hobbyists, parts were sold in much larger quantities than the users had need for. Once the parts had been found, the work of assembling them into a working unit began. An experienced builder had to spend a couple of days just to solder the electronics, which was done manually with a soldering iron. To make the mechanical construction could take weeks. The original version was built from metal parts which had to be cut, drilled, and welded into the right shape. No less time-consuming was the task of sealing the holes afterwards with silicon. This was necessary as the Ronja link typically was mounted on rooftops and exposed to harsh weather conditions. If the chassis had not been properly sealed, humidity in the air would damage the electronics inside. Furthermore, the mechanics had to be built in such a way that it could withstand howling winds and storms without the link being knocked out of position.

Aiming the device was critical for getting the transmission of data to flow effortlessly over the rooftops. As the power of the LED was fairly weak, this had to be compensated for by using a lens to focus the beam. The light cone was consequently very narrow. This, in turn, made aiming much harder, especially since the Ronja link on the opposite side could be up to a kilometer away. Usually it took a couple of hours to aim a link, a task that was preferably done at night. By holding up a car reflector at the opposite end, it was possible to see when the transmitter was pointing in roughly the right direction. The receiver then had to be placed in line with the incoming light. A voltmeter was connected to the head to indicate the strength of the incoming signal. Thereafter the whole procedure was repeated to position the second transmitter and receiver on the opposite side. This operation could be rather challenging if it was done in the dark, on a sloped roof. Even after the Ronja link had been aimed, it might need adjustments. Since the metal was compressed after it had been mounted, the first attempt at aiming the link was only temporary. During the next few weeks it had to be fine-tuned. In addition, it might be necessary to repeat the process every couple of years, due to changes in temperature and winds.

10.3 The History of Ronja and the Czech Wireless Network Scene

The inventor of Ronja, Karel Kulhavy, was known among his peers as "Clock." He got the idea to build Ronja from a TV remote control, which made him realize that light waves could be used to communicate at a distance. The direct incentive for building

such a device arose from the wish to communicate with a friend who lived across the street.[5] They first experimented in 1998, but it took another 2 years before Clock started to pursue his ideas more systematically. Initially his plan was nothing more ambitious than sending Morse code, but while working on it he realized that the principle of free-space optics allowed him to do a lot more. Crucially, he discovered that light waves could be used to transmit data. The first public version of Ronja was released on December 21, 2001, under the name Metropolis.[6]

Although Clock was at the center of the innovation story, it should be stressed that the idea of using free-space optics to connect computers was in the air. A similar experiment was taking place at about the same time independently, without knowledge of the Ronja project's existence. In a village in Podkrkonoší to the north of Prague, Petr Seliger had felt the same urge to be connected with his friends. He too came to think of the possibility of using light as a means of data transmission. Seliger used an ordinary laser pointer as the light source for his device. He called his machine "Cheapo." In 2003, the machine was reliable enough to build a local computer network. When asked where the idea and the motivation came from, Seliger stressed the topology of the place where he lived. The village is located at the bottom of a valley in such a way that Wi-Fi signals tend to be blocked out. The Cheapo enabled Seliger to connect to a friend who happened to live on a hilltop and from where they could mount a Wi-Fi antenna. Cheapo had many limitations, especially with regard to Internet access. When Seliger learned about Clock's project, he switched to Ronja. For an idea of the difference in scale and ambition, the number of electronic parts in the two designs can be compared. Whereas the different versions of Ronja had between 2000 and 3000 electronic parts, i.e., capacitors, coils, and resistors, Cheapo had been built with less than 50 components. Cheapo was a hack meant to solve a local problem encountered by a single inventor, who had the misfortune of living in a valley.[7] During my stay in the Czech Republic, I also heard of another construction similar to Cheapo, which suggests that there may have been many more experiments at the time that Ronja was launched.

What made the Ronja project stand out was that the creator wanted more than a device that fulfilled his own needs. Clock's aspiration to spread the use of Ronja required a different approach from the outset. The design had to be made with consideration for a second, unknown user. In other words, it had to be generalizable. Ideally, an inexperienced user should be able to build a machine by following the instructions. The availability and cost of parts was another hurdle which had to be taken into account in the design. This can best be exemplified with the lens. While commercial free-space optical devices use specially crafted optical lenses which can cost thousands of Euros, the Ronja machine did the same job with an ordinary magnifying glass, the diameter of which happened to fit the chimney pipe. The magnifying glass was imported from China and sold at a flea market in Prague for a few Euros. Likewise, the electronics used in the original version of Ronja were

[5] Jan Hudec, 2008-12-08.

[6] Karel Kulhavy, 2008-11-16.

[7] Petr Seliger, 2008-10-21.

based on components that were more than 30 years old. They had to be soldered by hand by the user to make an electronic part which was aptly called "the bird's nest." Sometimes it took months of extra design work to get cheap, general-purpose components to do what could otherwise have been achieved instantly with a special purpose but expensive electronic component or one that would have been difficult to obtain.[8] Besides these additional hurdles in the design of the machine, a lot of time had to be spent on documenting the machine. The challenge here was that the addressee was not a trained engineer who shared a body of tacit knowledge and common practices with the inventor. Rather, the intended audience consisted of teenagers and students who had no engineering training to rely on. When asked about his motives for all his efforts, Clock replied that the only way for him to justify to himself the time he had spent on Ronja was that it enabled more people to benefit from the technology:

> At the beginning it was the beauty of the technological elegance. I can do things which I thought were impossible. And then, then you get some recognition from people. And comments like someone builds Ronja and writes that it was the most exciting moment in my life when it started to work. That makes me feel special, like I have some relevance.[9]

The subsequent rapid spread of Ronja should be seen against the backdrop of a strong movement around wireless community networks in the Czech Republic. These communities sprang up in many places around the world in the early 2000s. Wireless networks utilized a small patch of the electromagnetic spectrum which until then had been left unregulated by governments because it was deemed unsuitable for commercial and military purposes. When the first equipment was marketed, government regulators and the computer industry designated the unlicensed part of the spectrum for indoor purposes. The ideal customer was a company connecting computers in an office building or at a trade fair. As prices fell and Wi-Fi antennas became more accessible, community activists started to build local networks in their neighborhoods.[10] To put the equipment to such a different purpose required a lot of tweaking by the activists, some of which could qualify as innovation in its own right. For instance, in the early days the activists built their own antennas using pineapple cans. The signal was thus given direction and could travel a longer distance.

Nothing, however, compares to the ambitions and complexity of the innovations which emerged from the Czech wireless community, out of which the Ronja machine was a showcase example. Part of the explanation for the unusual circumstances was that the Czech activists, in comparison to their counterparts in the USA and Western Europe, had difficulties affording Wi-Fi equipment. Another reason was that the Internet infrastructure and the commercial alternatives in the Czech Republic lagged behind neighboring countries in Western and Central Europe.

[8] Karel Kulhavy, 2008-11-16.

[9] Karel Kulhavy, 2008-11-16.

[10] Ellen Oost, Stephan Verhaegh, and Nelly Oudshoorn. 2009. From innovation community to community innovation: User-initiated innovation in wireless Leiden. *Science, Technology, & Human Values* 34(184): 182–205; Christina Dunbar-Hester. 2009. 'Free the spectrum!' Activist encounters with old and new media technology. *New Media & Society* 11(1–2): 221–240.

These circumstances created a strong impetus to build an alternative communication infrastructure. According to one estimate, at one point there may have been as many as 250 independent wireless networks in Prague alone.[11] Some were made up of just a handful of friends; others gathered hundreds or even thousands of members. The largest single, nonprofit wireless community network in the Czech Republic was established in the city of Plzen with more than 8,000 members. It is still in existence, and activists in the region have been relatively successful in coordinating their efforts with neighboring towns and villages. By connecting separate wireless networks through high-speed links, they have set up a local intranet, which at one point included an estimated 20,000 users.[12] It comes as no surprise, then, that the Czech Republic is the country in Europe which has the largest proportion of users connected to the Internet through Wi-Fi technology.[13]

In the same year as the Ronja project was launched, CZFree.net was inaugurated and became the hub of discussions and information exchanges among wireless network activists in the Czech Republic. Free-space optics was quickly recognized as an attractive alternative to the standard Wi-Fi technology. When the first community networks were established, the price for one Wi-Fi point was over 20,000 Czech korunas. In comparison, the parts for building a complete Ronja link cost between 1,000 and 3,000 koruna. In terms of functionality, free-space optics had many advantages over Wi-Fi, one of which appealed particularly strongly to activists with anarchist leanings. Ronja links could be connected in a long chain so that the signal jumped from one node to the next without the transmission being slowed down or losing much in quality. In theory, at least, a local computer network could be extended in this way to cover a metropolitan area. A communication infrastructure could thus be built where all the hardware was owned entirely by the users. Although it was technically feasible to do the same thing with Wi-Fi technology, the speed and quality of the data transmission would be seriously compromised. Hence, in practice, larger wireless network communities relied on a centralized backbone, such as fiber optical cables. Often access to the cable was rented from a corporation. The idea of running the backbone through Ronja links promised to fulfill one of the original dreams of the wireless network community. One founder of the CZFree.net explained their vision as follows:

> The idea in the beginning was not only to create a network which connects people to the Internet but to create a network which is resistant to political pressures. This is free as freedom, not as cheap connection, but really as freedom of speech. And the freedom of this network should have been made by keeping it in private, actually it is a network-of-networks which peer together to form a big network. And going after private citizens is much, much more problematic than against business subjects. These people who were for the idea of freedom were trying to keep it distributed on many parties who were participating in this bigger idea.[14]

[11] Petr Simandl, 2008-10-27.

[12] Michael Polak, 2009-01-16.

[13] COM. 2009. *Progress report on the single European electronic communications market 2007, 14th report*. 24 March 2009. Brussels: EC.

[14] Lada Myslik, 2008-01-09.

Two major sources of inspiration lay behind the sentiments expressed in the above quote. First, since free software was often used to run the servers, there was an inflow of people and ideas from the computer scene. With that came the cultural figure of the hacker with its 1960s countercultural connotations.[15] Second, the wireless network community was preceded by an earlier generation of community radio stations. In the large cities in Western Europe, many radio stations had been set up in squatted buildings by anarchists. They saw radio technology as a means of creating a grassroots alternative to the state and bourgeois media.[16] However, on the community radio scene, just as in the hacker "underground," the line between radical politics and free-wheeling commerce was blurred. Another major impetus came from pirate radio stations which began sending commercial radio from boats on international waters. Those stations were chiefly preoccupied with circumventing national regulations on commerce and taxation laws.[17] In the Eastern Bloc, and as the 1980s drew to a close, community radio became important for organizing dissent.[18] This legacy implanted a touch of radicalism in the wireless community in the Czech Republic, typically with a bent towards antistatism. As the above quote hints, political zeal was however mixed with less idealistic motives, especially the wish to have a cheap connection. The quote also suggests that the latter prevailed over the former. Given that the level of idealism was not a constant over time and differed markedly from one local wireless network community to another, my decision to use the word "activist" to denote all the people who were involved in building wireless networks is open to debate. Perhaps it would have seemed less loaded if I had chosen the generic word "user" instead. I will return to defend my choice of terminology towards the end of the chapter.

A mixture of political motives, low costs for acquiring the material, and superior technical functionality came together for a time and created a soaring interest in the Ronja project. One indicator of how widespread the machine became can be found on the official website. People were encouraged to post photos on their Ronja links on the website, which boasted 153 installed and working Ronja links. The actual number of machines built was probably much higher. Another sign is the number of people who distributed key components for Ronja. For example, the light-emitting diode came in quantities of 120 diodes per package. One member of the wireless community who ordered packages and distributed the diodes to individuals claimed that he had distributed over 800 diodes to users who just wanted to build a few links

[15] Fred Turner. 2006. *From counter culture to cyberculture: Stewart Brand, the Whole Earth Network, and the rise of digital utopianism*. Chicago: Chicago University Press. See also Nevejan, Caroline, and Alexander Badenoch. 2014. How Amsterdam invented the Internet: European networks of significance, 1980–1995. In *Hacking Europe. From computer cultures to demoscenes*, ed. Gerard Alberts and Ruth Oldenziel, 189–217. New York: Springer.

[16] Maxigas. 2012. Hacklabs and hackerspaces: Tracing two genealogies. *Journal of Peer Production* 1(2), 1–10. Available: http://peerproduction.net/issues/issue-2/peer-reviewed-papers/hacklabs-and-hackerspaces/. Accessed 5 May 2013.

[17] Adrian Johns. 2009. Piracy as a business force. *Culture Machine* 10, 44–63. Accessed 5 May 2013.

[18] Richard Barbrook. 1987. A new way of talking: Community radio in 1980s Britain. *Science as Culture* 1(1): 81–129.

for private use.[19] He furthermore related that he had known some larger wireless network communities which built many Ronja links and ordered their packages directly from the USA. Another indicator of the Ronja's popularity is the spread of electronic parts. In a modified version of the Ronja device which became very popular, the "bird's nest" electronics were replaced with electronics based on printed circuit boards (PCB). Although it is possible to home brew simpler PCBs, it is also much easier to have them made by a firm. The drawback of ordering from a firm is that it demands an economy of scale, due to the high costs of getting the manufacturing process up and running. Once in place and producing large quantities, however, the cost per unit becomes negligible. A few people in the wireless network community have begun to order batches of PCBs and sell them to fellow hobbyists. One, who started a website called Ronja shop, estimates that he shipped 1,000 PCBs to people who wanted to build Ronja links.[20] The number of diodes and PCBs may tell us little about how many Ronja machines were built in the end, yet the interviewees involved in the wireless network communities in the Czech Republic and Slovakia suggest that the machine was widespread. Outside of these two countries, however, few people have heard of the Ronja project. An exception is the Netherlands, another country with a strong tradition in wireless networks. Awareness about the Czech project has spread thanks to the workshops for building Ronja links organized by the Wireless Community Camp, a summer camp loosely tied to Wireless Leiden.[21]

The same conditions that enabled the Ronja project to grow in the Czech Republic impeded its diffusion to other countries. One possible explanation may be the geographical confinement of language. In the beginning, the documentation was in Czech, as were the discussions on CZFree.net. This changed gradually as the Ronja website was set up: instructions were translated into English and German, allowing people from other countries to become involved in the forum discussions. Yet most knowledge sharing, especially with regard to modifications of Ronja, took place by word of mouth, creating a barrier even to the wireless network community in Slovakia. The Ronja project spread more slowly in the neighboring country, where components were more difficult to find and more expensive. For instance, Slovakian activists collected money to allow a member to go to Prague and buy magnifying glasses of the right size. But a more important explanation is underscored by a wireless network activist in Bratislava: "In Prague, you had quite a lot of people who could actually help you with building Ronja."[22] Hence, newcomers could ask for help in their extended friendship circles. In some cities, activists more systematically organized the diffusion of learning practices. For instance, members of the CZFree.net set up a physical space in Prague where beginners could get help with troubleshooting their almost-working equipment.[23]

[19] Ondrej Tesar, 2008-10-05.

[20] Jakub Horky, 2009-01-17.

[21] WifiSoft.org Foundation. 2007. *Annual report 2007*. http://wifisoft.org/trac/. Accessed 20 Jan 2012.

[22] Marcel Hecko, 2008-12-17.

[23] Lada Myslik, 2008-01-09; Petr Seliger, 2008-10-21.

The focus on spreading learning practices expressed one of the goals of the Ronja activists. They had to come up with a design which did not require users to have an engineering degree, or else the project would not go very far. Users were nevertheless expected to climb a rather steep learning curve, as basic understanding of how electronics works, familiarity with programming, and some soldering skills were indispensable. At least to some of the activists, this was perceived as a feature of the Ronja project, rather than as a bug. Accordingly, the many modifications which were made to simplify the building process were not welcomed by everyone. It was not sufficient for users to acquire a network device and join a decentralized communication network; the social and political transformations wished for by some of the activists required them to develop an informed and active relation to the technology in question. This goal can be said to have been achieved, in so far as many of the Ronja links were built by teenagers who lacked any formal technical training. However, it also hindered the spread of the technology. To learn those skills required a very keen interest in technology and a lot of spare time. At the end of the day, many users only really wanted to connect their computers to a local computer network and had little interest in learning about the technology.

The involvement of this type of new user group generated a demand for preassembled Ronja devices. Most people who had been involved in the project for a couple of years made one or two links on request, helping to spread the knowledge and use of Ronja. Even independent Internet service providers began to order Ronja links from activists. In response, some activists started businesses selling modified Ronja links or parts. A case in point is a local businessman in the small town of Chrudim, who noticed the growing demand for the product when his firm was asked to make metal casings for Ronja devices. This prompted him to attempt a more ambitious approach. He involved a member from the local wireless network community in Chrudim with some experience with the technology. When an Internet service provider commissioned them to build their first link, they experimented with the design and the best way to go about producing the device. Five employees were engaged from time to time to speed up this process. In spite of their efforts and investments, they failed to get the equipment to work in time. After a number of delays and disappointments, the technically experienced partner withdrew from the project. Reflecting upon the failure, the partner suggested to me that the impossibility of making Ronja links for sale was integral to the project. This he explained in terms of the huge amount of motivation and energy it required to build, install, and operate a Ronja link (Fig. 10.1):

> I told that he [the businessman] has employees, but they are doing other projects and I think that they felt that they could not be bothered with Ronja. Because he told somebody who was doing something completely different from Ronja, I would say, building a house or doing metal boxes, he told this person to go with me on the roof of the building and try to do something. The employee had no motivation to have success on this project. I guess he had motivation to fail the project and not be bothered with it anymore.[24]

[24] David Kolovratnik, 2008-12-14.

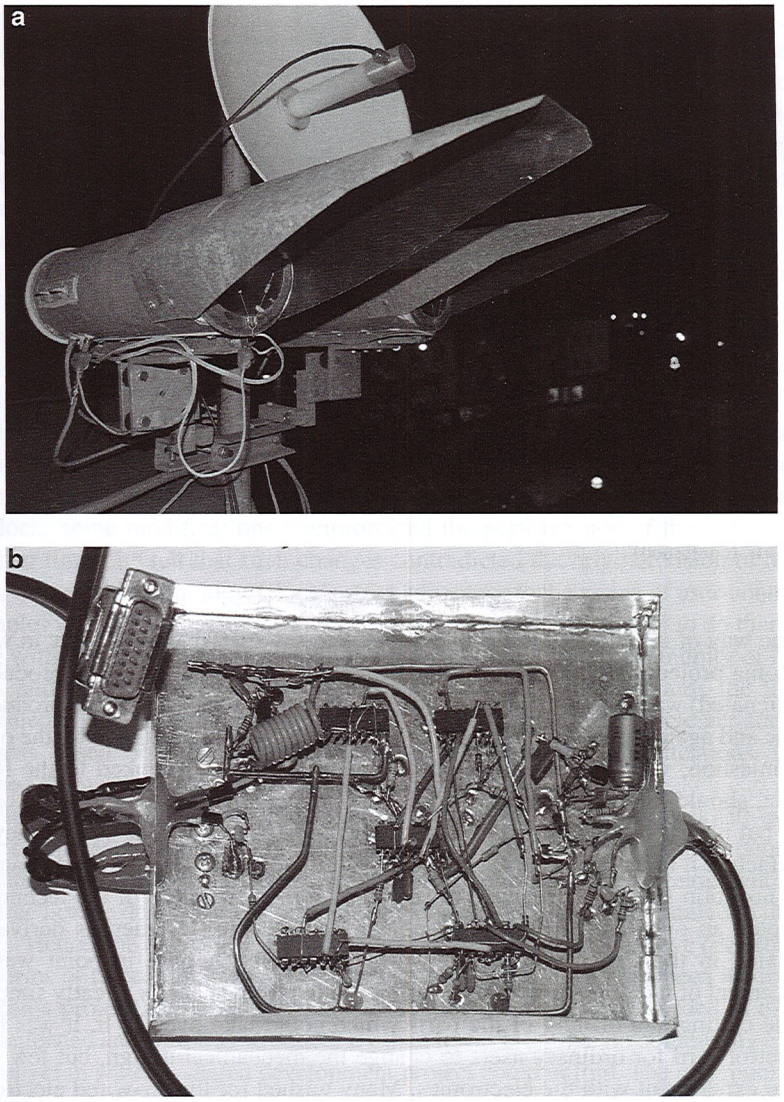

Fig. 10.1 Archeology of an Open-Source Wifi System. (a–c) In the small town of Chrudim in the center of the Czech Republic, one still finds Ronja devices mounted on top of roofs and walls. In one of the metal pipes sits a light emitting diode (*LED*), in the second pipe a photodiode that registers incoming light. The light carries data from one Ronja device to a second device mounted on the opposite side. In this way, Czech wireless activists built computer networks on a frequency entirely unregulated by the state, that is to say: visible, red light. Because the designs for the device were published under a free license, the construction of the machine too was in the control of its users. Source: Photographer Johan Söderberg

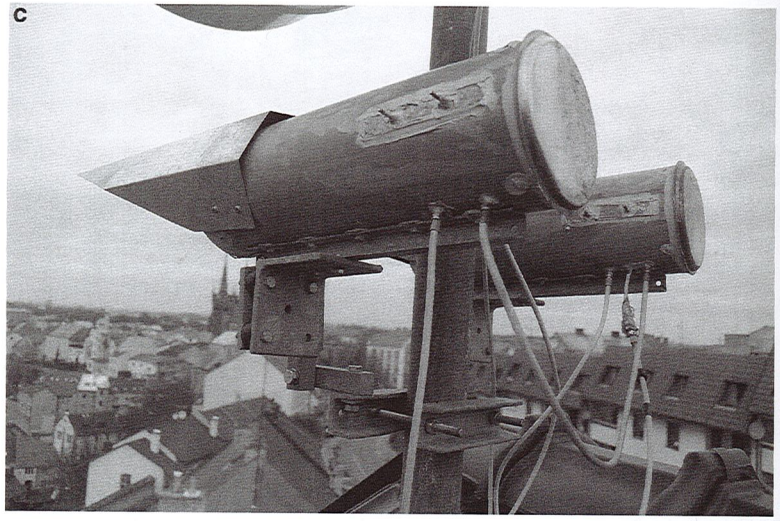

Fig. 10.1 (continued)

One way of interpreting the above quote is to say that, due to the way in which the Ronja project had been conceived, the technology was ill-suited to production by (alienated) wage labor. In other words, the design was biased towards production for use and against production for sale. The same thing was attested to by the owner of Ronjashop, who, having operated a small-scale business linked to the Ronja project, should know: "Generally, Ronja is a project which is simple to do on the knee, but is very hard if you want to send documentation to China so that they can manufacture it in bulk."[25] Many saw this as an obstacle when the market demand for the innovation surged. Their wish to see the commercialization of the technology prompted an overhaul of the design of the Ronja device. Numerous derivatives circulated in the Czech wireless network community. A case in point was the replacement of metal pipes with plastic pipes in the Ronja chassis, greatly simplifying the cutting and drilling of the parts which could take over 20 h. It was fairly straightforward for ordinary users to change the mechanical design, but few were able to experiment with the electronics. Many wished for the air-wired electronics to be replaced with surface-mounted PCB electronics. Clock was reluctant to heed the call which he thought departed from the ideal of self-reliance and user-control. As a result of his reluctance, Jan Skontorp released the first PCB design for Ronja in 2004. It turned out that PCB also had some advantages from the standpoint of user-control. With the original electronics it was hard to translate the three-dimensional space of crisscrossing wires and components into a two-dimensional drawing in a way that was intelligible to inexperienced users. The air-wired electronics intimidated newcomers, resulting in many failures. Moreover, the push

[25] Jakub Horky, 2009-01-17.

for a leaner production process of Ronja parts was not driven by sales alone. The redesign was part and parcel of the definition of a network device, as a single unit is useless. Conversely, having more of them increased the utility of every unit. People in the wireless network communities needed many links and wanted to reduce the time and effort to produce a series of units. Still, underlining the observation above on alienation and the need for motivation, one member of the wireless network community in Chrudim testified that he had more fun soldering air-wired electronics than working with a batch of PCBs.[26]

The idea of making money from selling Ronja links was not controversial in itself. Indeed, when someone asked on the Ronja mailing list for permission to build one of the components of Ronja and make a profit from it, he was encouraged to do so. He was even told that he did not need to ask for permission. All that was required of him was to respect the free license under which the technology had been published. The license specified that changes to the original design had to be made publicly available to the community.[27] The various design changes made to speed up the production of Ronja links did actually stir up some controversy. According to Clock, some modifications compromised the performance of the optical link. At other times, he felt that such changes contradicted the original vision of having a user-controlled technology. Clock's strict adherence to the vision of user-controlled technology turned many people away from the project. They ran off to do their own thing with free-space optics, resulting in the lack of a unified community of developers and activists with a shared sense of moral obligation towards the license agreement. This became evident when core members of the CZFree.net started a business based on the invention without publishing their modifications. Clock accused them of having violated the free license.[28]

With hardware design, however, as opposed to software code, it is less self-evident what counts as a derivative. Complicating the matter still further, it is debatable whether the free license grants any legal protection to hardware development at all. The free license depends on a copyright agreement and is therefore limited to literary works. Hence, the only way to enforce a license in this case would have been through the norms of the community. When I talked to the people who had been involved in the Ronja project and asked them about the incident, they were divided as to what had happened and who was wronged. By then it was clear that no community existed any longer in which a shared development project could unfold. The community fell apart as people became increasingly reluctant to cooperate around an open development project.[29] In 2008, there were several attempts to improve and develop a second generation of free-space optics, using lasers instead of light diodes. Those projects, however, were run as traditional start-up firms, keeping information about the development process secret.

[26] Ondrej Zajicek, 2008-12-14.

[27] Karel Obadal, Ronja mailing list, 2004-11-01.

[28] Karel Kulhavy, Ronja mailing list, 2003-07-20.

[29] Michal Elias, 2008-09-27.

The conflict over commercialization in the Ronja project was mirrored in similar divisions in the Czech wireless network community. Over the years, tensions grew between those who wanted to professionalize the service and those who wanted it to remain a hobby. Suspicion was fuelled by occasional attempts to high-jack nonprofit wireless network communities. A high-jacking occurred when a group of people were elected to the governing committee of a community network with the intent of turning it into a for-profit service. Some community networks connected hundreds of users, which became a potentially valuable asset to an Internet service provider.[30] Aside from such hostile takeovers, commodification was working in less dramatic ways. In the beginning, the wireless networks were built by enthusiasts who derived as much satisfaction from tinkering with the technology as from having a fast and cheap Internet connection. This changed when members with more of a consumer attitude started to benefit from the service. Hence, fewer were willing and able to volunteer to do the maintenance work. Today it is common for nonprofit, wireless network communities to hire someone to get the job done.[31] Some administrators have preferred their wireless network communities to stay small and convivial and have turned down the opportunity to make a living out of their hobby.[32]

10.4 Situating the Success and Decline of the Ronja Project

As indicated in the introduction, I present the Ronja project with the intent of engaging in a larger, theoretical debate about the notion "user." Amateur innovators often imagine themselves to be "outsiders" vis-à-vis institutions and professions. This implies a vacuous space outside institutions, populated by atomistic, free-floating – albeit networked – users. Indeed, the very term "user" suggests an agent detached from collective identities, institutional confinements, and historical processes. The only thing determining him/her as a "user" is the technology he/she is using. One can easily see why this notion has become so popular in Innovation Studies, being a subdiscipline of economics. The user is a stand-in for the individual market agent.[33] But the idea of the user is also acclaimed in the poststructuralist wing of Science and Technology Studies (STS). The user here personifies the belated hopes of putting the notion of "structure" to rest – and history along with it.[34] From this theoretical perspective, the user is but an emergent effect of the

[30] Jakub Horky, 2009-01-17; Lada Myslik, 2008-01-09.

[31] Jakub Sykora, 2008-11-27; Jiri Bohac, 2008-09-14.

[32] Petr Simandl, 2008-10-27; Ondrej Zajicek 2008-12-14.

[33] Carliss Baldwin, Eric von Hippel, and Christoph Hienerth. 2006. How user innovations become commercial products: A theoretical investigation and case study. *Research Policy* 35: 1291–1313; Eric von Hippel. 2005. Open source projects as user innovation networks. In *Perspectives on free and open source software*, ed. Joseph Feller, et al., 267–278. Cambridge, MA: MIT Press.

[34] For a critique along these lines, see Dominique Pestre. 2004. Thirty years of science studies: Knowledge, society and the political. *History and Technology* 20(4): 351–369.

network, capable of subverting any given constraint, whether technical or otherwise, ad infinitum. The same goes for the user himself or herself, who is treated as an empty placeholder for an endless play of identities.[35] What such argument boils down to, as many critics of constructivist STS have pointed out before, is an unqualified endorsement of agency.[36] Constructivist STS research has thus grown insensitive to the historical momentum of institutions and economic relations and fails to historically situate its analysis of the user and the technology being used. For sure, there are other traditions within the heterogeneous field of STS with a developed sense of historical processes. Here, tellingly, the notion of "user" has often been played down, and pride of place is given to other analytical categories, such as the formation of a collective identity and/or an idea about the life-world within which technological change unfolds.[37]

The Ronja case study is strategically placed for developing my critique of the atomistic notion of the "user." This is because, at first glance, the project conforms so well with aforementioned theoretical approaches.[38] The Ronja device was, indeed, developed and built outside of any recognizable institution. Furthermore, the people involved spoke and thought of themselves as users. After all, Ronja was branded as a *user*-controlled technology. As an offshoot of the wireless network community, the project had inherited a stroke of similarly anarchistic ideas and values. This influence owed much to the fact that in many cities on the European continent, the first nodes in the wireless network had been set up in squats. Creating a local computer network for the neighborhood was seen as an extension of other alternative media outlets, such as publishing fanzines, sending community radio, and broadcasting street TV. Ultimately, the aim was to build an independent communication infrastructure replacing the cables and satellites owned by states and multinational companies.[39] The Ronja project corresponded well with this broader outlook. Crucially, it showed that with modest means and technical ingenuity, it was possible to offset state powers (i.e., over Wi-Fi frequencies). Hence, the case study offers an ideal example of free-floating "change agents" which take a given (infra)

[35] Steve Woolgar. 1991. Configuring the user: The case of usability trials. In *A sociology of monsters: Essays on power, technology and domination*, ed. John Law, 57–102. London/New York: Routledge; Vololona Rabeharisoa, and Michel Callon. 2003. Research 'in the wild' and the shaping of new social identities. *Technology in Society* 25(2): 193–204.

[36] Olga Amsterdamska. 1990. Surely you are joking, Monsieur Latour. *Science, Technology & Human Values* 15(4): 495–504; Johan Söderberg, and Adam Netzén. 2010. When all that is theory melts into (hot) air: Contrasts and parallels between actor network theory, autonomist Marxism, and open Marxism. *Ephemera: Theory & Politics in Organization* 10(2): 95–118.

[37] This taxonomy of approaches in STS is proposed by Andrew Jamison, and Mikael Hård. 2003. The storylines of technological change: Innovation, construction and appropriation. *Technology Analysis & Strategic Management* 15(1): 81–91.

[38] Hence I have selected and delimited my case study in accordance with Bent Flyvbjerg's qualified defense of this approach within the social sciences. Bent Flyvbjerg. 2006. Five misunderstandings about case-study research. *Qualitative Inquiry* 12(2): 219–245.

[39] Christian Sandvig. 2004. An initial assessment of cooperative action in Wi-Fi networking. *Telecommunications Policy* 28(7–8): 579–602.

structure and bend it to serve other purposes than those originally intended. Closer inspection will reveal, however, that the life cycle of the Ronja project depended on legal and economic relations about which the activists were at best dimly aware. The activists influenced (or coproduced, as it were) these relations in turn but only to a limited extent. The extent to which a group, such as the Czech wireless network community, can influence "back" depends on how well the group has rendered visible and become conscious of the social relations that it is – at one and the same time – part of and up against. The emphasis I place on historical processes in studies of users of technology is grounded in this praxis-oriented outlook.

A key historical fact about the Ronja project is that it took place in a country which only 10 years earlier had officially declared itself to be a communist state. This set the stage for the Ronja project in more than one way. To begin with, many young people had technical qualifications yet were economically disadvantaged in comparison with their counterparts in Western Europe. They were thus compelled to find cheaper alternatives to commercial Wi-Fi equipment in order to be able to do the same things as activists in London and Berlin did. It was pointed out to me on several occasions that the Ronja project was not an isolated phenomenon, but conformed to a long-established tradition of tinkering in the Czech Republic. In the Czech countryside, it is not uncommon to find homemade band saws and tractors along with many other weird and wonderful things.[40] Making things at home has been incorporated into the national identity and is spoken of as the *"zlaté ruce"* or "golden hands" of Czech people. Allegedly, this reputation was earned in the second half of the nineteenth century when a large Czech minority lived and worked in Vienna as craftsmen and industrial laborers. According to a census made at the turn of the last century, more than 100,000 of the city's residents stemmed from the Czech hinterlands.[41] When those lands were later annexed to the Soviet empire, due to chronic shortages, the habit of repairing and tweaking became a necessity of life.[42] It can be argued that this history created a fertile ground for the Ronja project in at least two respects. First, there was technical know-how among an older generation that could be passed down to the young. Second, many homes in the Czech Republic were equipped with simple workshops. The tools needed for building Ronja machines were therefore relatively easy to come by.

Another leftover from the communist days was the Czech phone company, Ceskoslovenské Spoje. In more than one way, the phone company had inspired the activists to experiment with free-space optics. The straightforward method for creating a point-to-point optical link was to hang an optical cable across the street, from window to window. The idea was borrowed from the Czech telephone company, since this had been the cheapest way to connect people to the phone service. The practice was however stopped in the large cities, sometimes by intervention from local authorities. As the Czech Republic was incorporated in the

[40] Pavel Klvač, et al. (ed.). 2007. *Na tom našem dvoře*. Prague: KSB.

[41] Monika Glettler. 1982. The organization of the Czech Clubs in Vienna circa 1900: A national minority in an imperial capital. *East Central Europe* 9(1): 124–136.

[42] Petr Seliger, 2008-10-21.

global tourist economy, keeping the streets tidy had become a new imperative.[43] More importantly, perhaps, was the fact that the phone company's services were rather poor. For many years, the company refused to lease its cables to competing Internet service providers. In 2005, it was finally forced by the EU to change its monopolistic policy. But until then the company had not been in a hurry to provide its customers with high-speed ADSL connections. When the technology was introduced in neighboring countries, many customers in the Czech Republic were still using dial-up modems. Not only were phone modems slow, but users were charged per minute – a cost structure that was particularly frustrating to young males who wanted to download large files (in violation of international copyright laws, no doubt) and play games over the computer network. The wireless network movement channeled those frustrations into a political force of a sort:

> I think the Wi-Fi community showed up to the regulatory domain, the Czech telecommunication bureau, which is the regulating domain for all telecommunications in our republic, showed that people are unhappy about the state, and they started to regulate more the monopoly of Czech telecom. Because I think that if we didn't build Wi-Fi networks we would have dial-up until today.[44]

This quote lends weight to the claim that the users exercised agency through their use of technology. Indeed, they did so to the point of influencing state policies and that without having to engage in lobbying or electing their own representatives. That assessment needs to be qualified, however. Given the resentment against Ceskoslovenské Spoje and state regulators, it might sound paradoxical to propose that the restrictions imposed by the state were what created the preconditions for home-brewed, free-space optics to exist in the first place. Nonetheless, as much is suggested by what happened after the Czech regulators decided to allow more frequencies for private uses:

> The central regulatory committee in Czech [Republic] told that 5.5 GHz band is not illegal, so we have started to use it, and that was a killing for Ronja.[45]

To be precise, it took another year, until 2006, before the activity in the Ronja project peaked. In Slovakia, where the new rules had been implemented earlier than in the Czech Republic, there was a similar time lag. Ronja continued to be used because initially it was difficult to build wireless networks based on the latest 5.5 GHz technology. One problem was that the activists needed drivers for their servers running GNU/Linux. Adoption of European standards came slowly because most Linux kernel programmers lived in the USA. Furthermore, it took time for manufacturers to perfect the production process and bring down the price to the point where it became affordable to the activists.[46] At the time of writing, the cost for Wi-Fi equipment is only slightly higher than the cost for the parts needed to assemble a Ronja link. Wi-Fi still has many technical flaws compared to free-space

[43] Karel Snajdrvint, 2008-12-14.

[44] Jakub Sykora, 2008-11-27.

[45] Petr Simandl, 2008-10-27.

[46] Marcel Hecko, 2008-12-17.

optics. Those drawbacks are more than compensated for, though, by the convenience of acquiring Wi-Fi equipment compared to building a Ronja link. There were also some strictly local conditions which favored or disfavored the continued use of Ronja links. I was told by an activist in Prague that in his neighborhood the Ronja links had quickly been dismantled once there was an affordable alternative. The reason for this was that he lived close to the river where fog was very common, causing the optical link to dysfunction.[47] To stay attractive, the Ronja project would have to keep pace with the industry, above all it would have to develop a faster, 100 Mb/s optical link. The topic was discussed on the Ronja mailing list from time to time and a couple of attempts were made. But even a 100 Mb/s link would soon be outdated. Clock reckoned that a head-to-head race against the industry in terms of functionality and price would be futile. Instead, he hoped Ronja would stay relevant because the system catered to needs which the companies failed to address:

> I think in fact here I am doing something which people want and which the commercial companies do not want to provide. Transparency. And... direct communication. I think people will always appreciate if there are no hidden interest from them, and will always appreciate if they can communicate with the author. Without him saying: 'Ah, we can't tell you this because it is secret, we are going to lose our revenues.'[48]

One such "hidden interest" concerns privacy. Internet service providers are now mandated by the EU and Czech laws to monitor their customers' Internet traffic for law enforcement purposes. Among other things, the aim is to combat file sharing of copyrighted material. In a near future, customers could well have their Internet access closed down if they are suspected of violating copyright law. If the enforcement of intellectual property law on the Internet becomes truly effective one day, then perhaps legislators will have given a new lease of life to home-brewed, free-space optics.

10.5 Conclusion

The Ronja project flourished in a space which had been created by the legal prohibition on the use of certain Wi-Fi frequencies. Hence, even in its absence, the state was present. When the restriction on frequencies was lifted, the Ronja project came up against an even mightier foe: global commodity production. Admittedly, the project would not have existed in the first place had it not been for cheap electronic parts such as resistors and capacitors, that is, components which had previously been made available by the world market. Much the same can be said about the activists themselves. As noted above, a strong impetus to build Ronja came from the desire to consume entertainment in the form of music, films, and games – desires which bore the mark of the culture industry and commodity production in a different sense. The political aspirations of the Ronja project acquired wider relevance because it successfully piggybacked on such desires. But this success bore the mark of its own downfall.

[47] Ondrej Tesar, 2008-10-05.

[48] Karel Kulhavy, 2008-11-16.

The technology was used only for as long as it was better than competing, industrial standards at "delivering the goods." The benchmarks for "better," i.e., low cost and high functionality, had been taken over by the wireless network community from the society at large. There was also a more utopian fringe who rejected those benchmarks, instead giving priority to political, ethical, and pedagogical values. This outlook was soon marginalized in the project. What I want to stress with this recapitulation is that at both ends of its life cycle, the Ronja project was shot through with social relations. In part, those social relations transcended the horizon and self-understanding of the practitioners. For instance, most of the participants in the project saw themselves as users and spoke of themselves as such. And yet the innovation did not have, and could not have been, the accomplishment of atomistic user-consumers. This can easily be seen when the Ronja project is contrasted with similar experiments which took place at the same time in the Czech Republic. An unknown number of individuals cobbled with free-space optical devices in order to have a computer network for themselves and their closest friends. Those projects ended when the consumer need had been satisfied, and they have since been forgotten about. The Ronja project was developed to a point where it could cater to preestablished consumer expectations and beat technical benchmarks, because the activists did so while striving for something more: to conquer the world with user-controlled technology. This suggests that the term "activist" is more accurate than "user," even though, paradoxically, the political vision of the Ronja project was framed in a language about users. That choice of terminology is hardly surprising, given that talk about the "user" is so prevalent in technical and design settings. The political vision of the Ronja project built on an inconsistent but overlapping body of ideas and values within the Czech wireless network community. It combined engineering tropes and anarchist influences with a local specificity, the dissident legacy. The outcome hereof was a strong belief in the technical ingenuity of (networked) individuals, empowering them to circumvent bodies of political representation and collective decision making, be that the local housing committee or state regulators. For a while, it seemed as if this dream would come through thanks to community-owned wireless networks and free-space optics. The move from Wi-Fi signals to light waves was a move into an unregulated space or, differently put, into a bandwidth where the Czech state could no longer "see." By evoking seeing and blindness, I want to close my discussion with a point about epistemology. Where an unsuspecting onlooker on a rooftop could only see red lights in the horizon, someone in-the-know saw a transmission of data. Occasionally the light beam could not be detected at all with the naked eye. Hidden in the light were a private communication channel, a potential neighbor dispute, and probably a breach of intellectual property law. In short, a social conflict rendered unrepresentable by the epistemological gap between the technically ingenious and the technically disingenious. In spite of this, the pedagogical mission of user-controlled technology was to close the epistemological gap. This was to be done by raising the level of technical awareness among average, disingenious users. The observations just made about the relative transparency/opaqueness of electromagnetic waves applies with equal force to the social relations that shot through the Czech wireless network community. Three examples of social relations discussed in the text are a state that is present in its absence, norms and ideas about the "user" that have been internalized by the practitioners, and the commodity

form. To render such social relations visible takes sociological concepts about a "social whole" and the *longue durée* found in the historical discipline. Granted, this implies another kind of epistemological gap and thus a risk for abuse. The egalitarian response is not, as adherers of constructivist STS believe, to do away with totalizing concepts, representations, and historical perspectives. On the contrary, it mandates a pedagogical responsibility from sociologists and historians, equal to the one felt by the Czech wireless network activists towards technically inept users. It is only thus we stand a chance, collectively, to make sense of this confusing world and impose an enlightened order on some small part of it.

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