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# Reconnection work

## A network approach to households' dealing with ICT breakdowns

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### Abstract

How can the concept of networks contribute to understanding the role of households in crises where ICT infrastructure fail? ICT infrastructures are large-scale techno-material networks crucial to modern human social organisation and living. They play a role in connecting individuals to households and individuals and households to their wider surroundings. Drawing on fieldwork from a recent crisis in Norway, this article uses actor-network theory (ANT) as an analytical lens. The aim is twofold; firstly to show the effect of an ICT infrastructure breakdown on the concerns of households as a socio-material network, and secondly to suggest how these networks reconnect and are stabilised at a household level through strategies where people mobilise actants such as cars and intact pieces of ICT to establish new temporal associations of actor-networks.

***Keywords*** Socio-material networks, Actor-network theory, crises, ICT infrastructure, households

## Introduction

In the evening of January 18th 2014, a fire arose in Lærdal, a small village (pop. 2100) situated at the mouth of a fjord valley in Western Norway. Due to strong wind gaining speed between the mountains and a dry winter season, the fire spread rapidly. It took some time before the national rescue teams arrived, and in the meantime, villagers engaged in the rescue of people and in attempts to reduce material damage. Then, the ICT base station exploded. This caused a major disruption in services for large areas of the valley, and left computers, TV's and discharged mobile phones inoperative (see also Heidenstrøm and Kvarnlöf 2017). The ICT services were not inoperative throughout all phases of the fire, rather they disappeared and reappeared at different times in different zones, and some technologies worked while others did not (Norwegian Directorate for Civil Protection 2014). Mobile base stations ensured partial mobile coverage after 40 hours, and some households had a fixed telephone line that continued to work throughout the event (NRK 20.01.2014). Internet access was generally unavailable for three days, but was also partially regained when Telenor provided mobile broadband units to their subscribers, and a local tele company offered mobile Internet coverage in a limited zone downtown (Sogn Avis 20.01.2014).

The *need to communicate* was high for the families directly affected inside the village. As the crisis reached national news, people outside the village also had concerns for family and friends in the area. The instability in the ICT networks made communication and co-ordination of action difficult and added to the feeling of uncertainty for the involved actors as they could not know what technology worked, for whom, and when. Hence, they had to find alternative ways to reconnect to the various networks of which they were part. In this article, we draw attention to how the *informal actors* – individuals belonging to households – engaged to solve their concerns when the ICT infrastructure broke down. In so doing, we apply concepts from Actor-network-theory (ANT) to shed light on the mobilising of both human and non-human actors as vital to this reconnection work.

## Networks and actor-networks

Network as a concept has a number of meanings that cannot be taken for granted. We distinguish between three different types of networks as 'things' that can be empirically studied: (i) the *social networks* that exists between people in the village, (ii) *the techno-material networks* or infrastructures that ordinary life in the village depend on, and (iii) the combinations of these into *socio-material networks.* To approach an analysis of the latter, we apply the analytical term *actor-networks*, seeking to illuminate how socio-material networks were disrupted during the fire and how associations of actors and actants made re-establishments of the social possible.

Disaster research has attended to *social networks* as a key dimension of community resilience (Cheshire 2015, Johansson and Linnell 2012), turning focus towards informal actors as competent and active participants in managing disasters. Recent research also gives valuable insights into how *techno-material networks* such as ICT can be used to strengthen social networks, and in what ways information sharing and coordination of resources take place during and in the aftermath of disasters (e.g. Palen et al. 2007, Sutton, Palen, and Shklovski 2008, Wetzstein et al. 2014, Haataja, Hyvärinen, and Laajalahti 2014, Ewart and Dekker 2013). Disruption of ICT infrastructure hinders these strategies to be carried out, and requires actors to seek alternative ways to communicate (Sutton 2012). To study disruption, the notion of ICT infrastructure as *socio-material relationships* has been taken as a point of departure (e.g. Al-Akkad et al. 2013, Semaan and Mark 2011, Sheller 2016). Bringing socio-material networks into focus is important in several ways. The techno-material networks that enable information to move are ordinarily invisible, something we take for granted, yet something our daily lives are heavily dependent on (Larkin 2013). The obvious reason for this is that these infrastructures are never ends in themselves, but are always used for a purpose (Shove and Walker 2014). For instance, we use available ICT's because they are convenient when we want to send a message, talk to someone or find information. As we become accustomed to using techno-material networks, their materiality – e.g. wires, lines, servers, plugs, sockets, computers, phones – tend to fade into the background as something separate from us. Yet, they are not. Techno-material networks are fundamental for smooth societal functioning because they connect individu-

als and surroundings. This interdependency of social and techno-material networks points to a vulnerability important to reflect upon. The usefulness of looking into cases where otherwise embedded techno-material networks break down, is that they are moved from 'background' to become visible for the involved actors (Star 1999).

Thinking analytically in terms of *actor-networks* is one way of attending to the socio-material relationships around ICT infrastructures. In ANT, the term network is "a concept, not a thing out there. It is a tool to help describe something, not what is being described" (Latour 2005, 131). A basic assumption in ANT is that events are always the effect of relations between many actors in a network. For ANT, a network is always an actant-network: a sociotechnical/heterogeneous assembly constituted through continuous interactions between *actants* (human and non-human elements that accomplish or undergo an act). For establishing connections in an actor-network, actants have to be *translated* (changed) to fit. *Delegation* is one translation process where e.g. technology is used to translate a major effort into a lesser one, which in turn affects our actions (when we can make a phone call instead of visiting each other, and calling makes us visit each other less). To the extent something appears as pure or as a whole it is due to their actor-networks being *black-boxed* to take the form of a node in another network. A task for ANT driven research is to open up these black boxes to show the dynamics of the connections whereby material and semiotic actors are brought together in networks to act as a whole – how the social is assembled.

According to Guggenheim (2014), the ANT toolbox can be used to disassemble disasters to understand their underlying techno-scientific processes: what movement of actors produces these events and our understanding of them. Aligning human and non-human actors furthermore allows the materiality of disasters to come to the foreground, and to reveal the processes in which different types of actors work together (e.g. Matthewman 2012, Brewer, McVeigh, and Meding 2013, Wilford 2008). Only a few empirical studies have employed ANT to understand how ICT plays a part in disasters. Wang and Li (2016) and Guldåker (2009) uses it to illuminate how people engage in resilience work, giving a broad overview of various active actor-networks during crises and disasters. This article concentrates on the specific associations between

the ICT infrastructure and householders – an actor-network that often is black-boxed.

Drawing on examples from the Lærdal case, and by using conceptual tools from ANT, we examine: (i) How socio-material networks were disrupted during the ICT infrastructure breakdown, and (ii) How socio-material networks were reconnected through new temporal associations of actor-networks. By pointing to the instability created by the breakdown, we attend to how the 'work' to reconnect was enabled through the establishment of new connections between human and non-human actors. Our claim is that this example of an infrastructural breakdown seen through the ANT lens provide insights into the complex processes whereby resilience takes form as an effect of the extent to which destabilised socio-material networks are re-stabilised through new actor-networks (Boin and McConnell 2007, Byrd and Matthewman 2014, Perrow 2011).

## Methods and data material

It is seldom possible to study a crisis as it takes place, thus studies of crises usually involve various methods to re-trace the event (Killian 2003, 53). In the case of the Lærdal fire, we applied a multi-methodological fieldwork.[1] This entailed four field visits with site-observations, interviews, and villagers 're-enacting' their actions at home, at work or in the village (Pink 2007).These were partially photo-documented and audio recorded. The interviews concentrated on performativity, e.g. how and with what resources a task such as contacting a family member was done (Hitchings 2012). The aim of the re-enactments was to get an impression of processes, techno-material surroundings and resources. We also collected and analysed media coverage, official reports and other secondary material. These techniques helped generate narratives of the event that could be linked to relevant physical surroundings and material objects. The analysis in this article is informed by the whole of this material, but will focus on the reconnection work done by nine households.

**Table 1: Household characteristics**

| Household no. | Household characteristics |
|---|---|
| 1 | **Woman (55)***, Man (55), two adult sons not living at home. Detached house inside the evacuation zone. Mother and father at the cabin outside the village, drove home but were not allowed inside the village. |
| 2 | **Woman (48)**, **Man (52)**, **Daughter (17)**, **Son (25)**. Detached house inside the evacuation zone. The family was at home, except the father who was in the mountains. |
| 3 | **Woman (52)**, **Man (52)**, two teenage sons living at home, one daughter not living at home. Detached house inside the evacuation zone. The family except the daughter was at home. |
| 4 | **Man (45)**, **Woman (unknown age)**, son (10), infant daughter. Farm outside the evacuation zone. The whole family was at home. |
| 5 | **Man (69)**, **Woman (66)**, **son (30)**. Detached house outside the evacuation zone. The whole family was at home. |
| 6 | **Man (84)**, Woman (82). Detached house outside the evacuation zone. The couple was at home. |
| 7 | **Man (72)**, Woman (73). Detached house outside the evacuation zone. The couple was at home. |
| 8 | **Woman (17)**, living in an apartment with her mother inside the evacuation zone. **Woman (17)** from household 2 who is her friend were interviewed together with her. |
| 9 | **Man (72)**, Woman (70)**.** Detached house inside the evacuation zone. The family was at home together with their two daughters who live in the same street. The man did not evacuate together with his family, but stayed at home to extinguish the fire. |

* Main interviewees in bold

We use households as the primary analytical unit. First, because the data shows that households operated as units throughout the fire. Second, because household members form social networks, and are part of techno-material networks that were affected by the disruption, and thus represents *resources* beyond the individual that were

essential to how the formation of new actor-networks could take place (Guldåker 2009, 73-77).

## Disruption of socio-material networks

The Lærdal fire was set in motion by a chain of reactions; it started as an effect of electrical connections in a house, and spread to other buildings due to the wind and the shape of the valley. These events affected ICT services, although it varied in what way and for how long, and the villagers faced unpredictable telecommunication in a dramatic situation where communication was crucial. This temporarily destabilised the socio-material networks, made them more visible (Star 1999) and thus un-black-boxed them as actor-networks (Latour 2005).

For the affected households inside the village, the instability in the socio-material networks typically generated a new project: to ensure that all family members were safe, to come together, and to reconnect with those outside. For instance, in household 3, two teenage sons were at home with their parents when the fire broke out, and evacuated together. However, they had a daughter outside the village and once safe their priority was to inform her, but the ICT disruption made that impossible:

> We had been in touch with our daughter who was at a party in Bergen, but then we left our house and were not able to contact her again. We could not tell her that we were ok. She knew that her dad was outside packing, and then it became a bit scary right afterwards, they could not sleep and they got all the news all the time, but we were unable to get in touch. That was unpleasant; we had no mobile coverage, no Internet access.

Moreover, as this family had to leave their home, they lost access to its material and social resources, and could no longer use the home as a meeting place and communication base (Palen and Liu 2007). The evacuation increased the experienced severity of the event, along with the ICT disruption it hindered them from coordinating their actions, find and alert family and friends, and help other villagers.

The story makes visible the socio-technical assemblies that normally facilitated connections in the social network of this household when members were apart. It shows the efforts that have been delegated to ICT: Whereas the mobile phone under normal circumstances is used to translate a major effort into a lesser one, for the household members to re-establish connections and re-assemble the social during the ICT disruption, they had to translate other available actants to make them fit the altered actor-networks in this new situation. Below, we look into the householders efforts to reconnect and point to how this, given their established dependency on ICT, represented a translation from a minor to a major effort and thus the reverse of delegation.

## Reconnection work

The strategies to re-establish contact between family members during the Lærdal fire required both time and materials, social and human resources. Table 2 below gives an overview of the reconnection strategies used by the nine households, and figure 1 depicts the two main strategies that the rest of the analysis will focus on.

**Table 2: Reconnection strategies**

| Household no. | Reconnection strategies |
|---|---|
| 1 | The husband *used their car* to look for coverage in the *tunnel*, but was unable to regain coverage. The couple drove to friends to borrow a *fixed phone*. The wife had Internet at the hospital where she worked, and wrote an *email* to friends and family. She sent *imessages*, and got information through *face-to-face conversations*. |
| 2 | The wife was unable to contact her husband. She gathered friends and family at home before evacuation, but when evacuated they split up. The wife looked for coverage in the *tunnel* and nearby village. The husband *drove* to *contact points* the next day to find his family. |
| 3 | The family used their *fixed phone* before evacuation, and borrowed one from friends after. They looked for coverage in the *tunnel* to contact their daughter. When they were evacuated outside the village, they did not receive any more information. |

| Household no. | Reconnection strategies |
|---|---|
| 4 | The husband helped extinguish the fire, and was unable to contact his family until the next morning, but knew that they were safe at home outside the evacuation zone. He *drove* to a place where he knew he would get mobile coverage and contacted friends and family outside the village. |
| 5 | The ICT breakdown did not affect the family until the next day when the couple *drove* to look for coverage in the *tunnel* and nearby village. They used the local *radio* to receive information. |
| 6 | The husband used his *fixed phone* to call his family outside the village, and to connect it to an old *modem* to regain Internet access. The couple did not receive information from other sources. |
| 7 | The husband used a *walkie-talkie* to communicate. He could not use his fixed phone, and *drove* to the next village where he was able to regain mobile coverage. He listened to the local *radio* to receive information. |
| 8 | The family was evacuated to the hospital that had a power generator, Internet access and TV, and were visited by friends and family there. The daughter received *messages* and Snaps when the coverage returned. |
| 9 | The husband *hitchhiked* with friends to all meeting points to look for his family, and gathered information about them at each point. He received calls and *text messages* from friends and family when he regained coverage. |

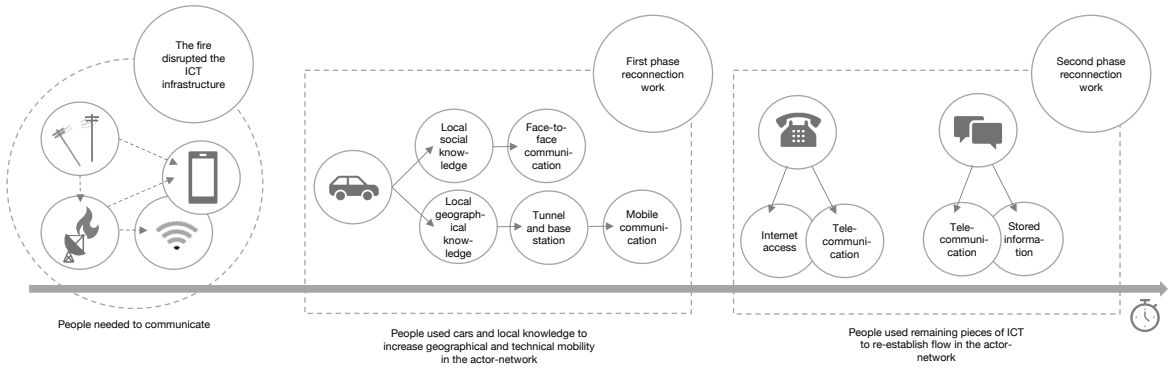


Figure 1: ICT infrastructure disruption and reconnections during and after the Lærdal fire

Using the ANT-toolbox, we describe two main reconnection strategies that worked to reconnect the households: (i) the use of cars to increase geographical and technical mobility, and (ii) the use of intact pieces of ICTs to re-establish flow in the infrastructure. These strategies show in what ways new actor-networks came into play when telecommunication was destabilised, in order to re-assemble to social of the households in during and in the aftermath of the fire.

### First phase reconnection work: using cars to increase geographical and technical mobility

In the early stages of the fire, the affected families needed to establish contact with each other and other people inside the village. However, as mobile phones or Internet did not work, communication could only be re-established face-to-face. The story of household 9 illustrates how: The husband had stayed back in the village to help others extinguish the fire while his family evacuated. Later, he wanted to find them and make sure they were safe. This proved difficult as he had no information about their whereabouts and the phone did not work. He did have access to a car, but the keys were with his daughter who had evacuated. As he stood outside his house trying to figure out what to do, the fire chief drove by and offered him a lift to the main evacuation site. He did not find his family there, but met a villager who told him they were in another evacuation site. He then went out onto the main road, stopped a truck driver he knew, got a lift and finally found them there.

The car functions here as what Guldåker (2009, 142) calls a 'competent actant'. It replaces the mobile phone as an information and communication central in the actor-network and helps expand the communication range that was limited by the disruption. The example also portrays how the translations of new actors to make them fit in the actor-network involved an increased amount of work. The fire, the ICT outage and that he was separated from his family and without the car keys, altered the ordinary and stable socio-technological associations of everyday life and affected how the task of re-gaining contact could be completed. It required socio-material resources (getting access to a car, talking to people, stopping cars to get a lift) to accomplish reconnection, pointing to the complex intertwining of social and material networks.

However, the process of mobilising cars to communicate was also affected by the infrastructure disruption. For instance, when household 1 was evacuated the husband wanted to send a message to his parents outside Lærdal to tell them the family was safe. He had access to a car and planned to drive through the tunnel hoping there might be mobile coverage there. In need of diesel for the car, he went to the gas station only to find that the card terminal did not function. Thus, he had to drive back home to get cash before he could tank. Like ICT's, the car itself is an actor-network connected to other actor-networks, some of which also lost their function during the disruption. That the actants in the actor-network that enables driving (fuel and card terminals) ceased to function during the ICT outage, demonstrates the complexity and interconnectedness of these networks.

The case of household 1 also points to the car's varied functions. It was not only translated to establish face-to-face connections across distance (increased geographical mobility), it was also translated to function as an actant to replace ICT in the task of facilitating signals from base stations to mobile phones, by moving with the phone to a place where signals could be picked up (increased technical mobility). Reconnections through alternative actants were common during the Lærdal fire. Five of the nine households drove to locations they believed were still connected to functioning base stations, with the aim of regaining mobile coverage (see also Sutton 2012).

However, the capacities necessary to reconnect by mobilising the car was not present in all households, as evident in this reflection from the wife in household 5: *"What we did not know is that if we had driven towards Ærdal we would actually get coverage, because there is a base station at the other side of the fjord, we did not know that"*. Lack of knowledge and information hindered this couple in restoring contact with their relatives. Thus, for this car-enabled reconnection strategy to succeed, it required knowledge of geography and telecommunication systems. Social networks provided a resource for such mobilisation, and several of the householders had talked to other villagers who had told them that it was possible to get coverage in or at the other side of the tunnel. This points to the complexity and centrality of considering social and technical assemblies as interwoven processes to understand how these actor-networks were rebuilt (Wang and Li 2016).

### Second phase reconnection work: engaging with intact pieces of ICT to re-establish flow

In the days after the fire, household members continued to explore various ways to re-establish connection and communicate with people outside the village. In working on bridging the gaps created by the disruption, they mapped and used unaffected technologies and zones where infrastructure was intact. Regardless of their obsolescence, three households used their fixed line phone. The husband in household 6 explains this as partly an outcome of experience and distrust of the mobile networks:

> *It took a day before we could use the fixed phone; it took three days before we could use our mobile phones, and we had Internet access via adsl on our fixed phone as well, so I could use that (…) During the hurricane Dagmar [three years previous to the fire] the national broadcaster told us to find information about the situation online. That was a bit strange. That is why we have not disconnected the fixed phone. We do not trust the mobile phone.*

Although mobile phones and routers have replaced the fixed phone as means of modern communication in most households, this family had experienced infrastructure breakdowns before, and decided to keep it as a preparedness measure. This technology enabled them to reconnect with social networks before the mobile networks did. Such creative employment of alternative resources has also been noted in other studies of ICT use in disasters (Shklovski et al. 2010, Procopio and Procopio 2007). Al-Akkad et al. (2013), find that citizens use 'leftover technology' to communicate either by using zones of intact infrastructure, create new combinations of leftover technologies, or sharing private Wi-Fi networks. In Lærdal, the fixed line took on a renewed function within an actor-network of which it previously had been part in order to re-establish flow in the ICT infrastructure.

To make use of 'loopholes' or glitches in the unstable access to the ICT infrastructure was also common. Members from six households recount in various ways how they, through talking to other villagers, learnt that it was possible to find spots nearby where

sending and receiving text messages was possible. For example, the daughter from household 2 says that:

> The next day we had to drive to Ærdal to regain contact, and then I received a lot of text messages from people asking whether we were ok. It was not until then we got them, because in Lærdal we had zero contact with others.

It was not always possible to send and receive instant messages because of the instability in the ICT infrastructure. Hence, some used the messages as information storage, an intermediary station for information that would be unlocked when the mobile phone coverage of sender and receiver regained coverage (Shklovski et al. 2010). As the wife from household 1 indicates, this was not necessarily to establish a direct association between one sender and one receiver:

> *I remember that Internet came back before the phone after the fire. At least where I was at the time, we suddenly discovered that we had Internet coverage on our phones. Then you could send imessages, but not text messages. Then, I could communicate through my son's girlfriend because she has an iPhone, but he did not.*

Other human actors, here her son's girlfriend, were also mobilised and used as intermediary linkages, which facilitated an alternative way of information flow through the actor-network. This illustrates that altering the script of messaging both socially and technologically was a reconnection strategy used to adapt to the confusion and uncertainty of the range of mobile coverage and thus stabilising an unstable network.

These are examples that suggests to how the ANT toolbox can help describe new temporary associations between human and non-human actors that were necessary to reassemble the social of the households during and in the aftermath of the fire. This also highlights the increased work this entailed, and that the resilience in households varied in this respect.

## Conclusion

We have made use of concepts from ANT to trace how socio-material networks are destabilised and reconnected during a crisis where ICT infrastructure broke down. We have used examples from the Lærdal fire to show how crises open up the black box of these networks that normally functions as a whole. They consist of complex associations of mutually dependent actants that are part of processes to complete tasks. To re-assemble the social, other available actants are translated to fit into new temporary socio-material networks.

During the breakdown, a key project for the families was to be together, ensure safety and share information. This work included mobilising both human and non-human actors to stabilise the actor-networks that could enable communication and aid information flow. In the first phase, the car expanded the communication range in two ways: as an enabler of face-to-face conversations in an expanded area (increased geographical mobility), and as a reconnector of the mobile phone to other base stations (increased technical mobility). However, to function the car was reliant on other actors also affected by the disruption, creating new barriers and more work to complete the project. In the second phase, pieces of remaining technology were given novel functions to enable communication with people in other areas in two ways: the fixed phone was restored as a carrier of mobile and Internet signals (re-established flow) and text messages were used as information storage.

These findings are just a fraction of how the infrastructure breakdown affected households in Lærdal, and the strategies they applied to make reconnections. However, these small and seemingly trivial examples of their reconnection work provide important knowledge of the robustness of households facing infrastructure disruptions; to what degree we are able to cope without ICT in disasters. The ANT toolbox furthermore allows us to illustrate how disruption causes instability in a number of actor-networks. The extent to which the household was as a stable or unstable actor-network in the various phases of the event, affected the degree to which they could mobilise actants to deal with the crisis, and thus their degree of vulnerability for these types of events (Guldåker 2009). This perspective emphasizes the need to include how changing interplay between material and human actors works as response to, and is thus part of the management of crises and disasters.

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## Note

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