

5G

How Infrastructure Shapes Our Society

By Tessel Renzenbrink (Netherlands)

“A knowledge-based society based on privatised knowledge is, of course, utter nonsense,” says Dr Niels ten Oever. He researches the infrastructure of information networks and their impact on society. In this interview, he talks about the roll-out of 5G, the fifth-generation mobile network. He is affiliated with the University of Amsterdam and Texas A&M University.

“It is typical of infrastructure that we often do not think about it”, says Ten Oever. “Only when it breaks down - the electricity goes off or the roads are full of potholes - does it stand out. Nevertheless, we should not underestimate how decisive the design of infrastructure is. Take the road network, for example. How it is laid out has an impact on your daily life. A four-lane road flanked by narrow pavements encourages a different use of public space than promenades and wide cycle paths. The same applies to information infrastructure such as 5G. The architecture of the network delivers both possibilities and introduces limitations. The question is then: What do you optimise the network for?”

Virtualisation of the network

“With the arrival of 5G, a new infrastructure will be rolled out,” continues Ten Oever. “It operates on frequencies other than those used by 4G. So there will be new antennas but also new routers and switches. This also means that new computing paradigms can be rolled out. These routers and switches are much more like general purpose computers: devices on which we can simply run Linux. This is in contrast to the current generation of network equipment with its application-oriented hardware coupled with specific firmware. Because you can more easily fix problems in software [than in hardware], you can virtualise network functions.”

Network virtualisation makes it possible to make the network increasingly intelligent. This means a farewell to one of the central design principles of the early Internet: the end-to-end principle. End-to-end means that any computer in the network can connect to any other connected computer. The idea was that the network itself does as little

as possible. It consists of ‘stupid pipelines’ that only transport data. The intelligence - computing power and data storage - takes place at the edges of the network: the computers of the users. This trend of shifting intelligence from end devices to the network itself has been going on for years. Think of cloud computing where data storage and software applications are run on third party servers. The arrival of 5G makes it possible to continue the trend of more intelligence in the network with Information Centric Networking, where data is stored in the network itself. Ten Oever gives an example of what this can look like.

Game of Thrones in the bath

“You already have certain applications, such as Netflix, making recommendations based upon your viewing behaviour. But they could also predict where you will watch it: ‘They always watch Game of Thrones in the bath’, or ‘They always listen to that podcast on their bike.’ That podcast could then be cached in the smart lamppost that I always cycle past. Then, when you arrive at work, your computer could already be on and your favourite programmes are ready to use. Super helpful. But how do you keep control of it? Do you want to be in control? How do you know who is doing it and on what basis?”

“We are not there yet. But the conditions for its existence, namely that general purpose infrastructure, is made possible with 5G”, continues Ten Oever. “That will make it possible to optimise such a network more and more. That is every network operator’s dream because you can then set up your network as efficiently as possible. Efficiency is a parameter that can be optimised. But this also means that a control option for the consumer will disappear. After all, it is becoming increasingly

Niels ten Oever researches the infrastructure of information networks.
(Photo provided by Niels ten Oever).



unclear which device is connected to what services and what information it is sharing. You can foresee how this could lead to stronger filter bubbles. Or even lead to more privacy-sensitive data that could be extracted and even used to develop personal censorship profiles, so that a particular person is no longer allowed to view certain content, or allowed to come into contact with another person."

The 5G standards and patents push

Ten Oever is investigating how decision-making on the standardisation of 5G works. 5G is a bundle of different technologies that will be standardised in three phases. Completion of the second phase is planned for 2020. The specifications for 5G are defined by the 3GPP consortium, an alliance of six standardisation organisations including the European ETSI. The final standards will eventually be adopted in the International Telecommunications Union (ITU) in which member countries have voting rights.

Ten Oever: "It is quite difficult to estimate why certain decisions are taken. But one of the reasons for developing certain technologies is patents. This is something that plays much less of a role in the Internet world. Companies there do have patents, but they use them defensively. That can be seen as a kind of truce: I have patents, you have patents, but we do not use them. But if you start, we'll get even.

"But in mobile telephony it works differently. In 3GPP much is based on proprietary hardware and software. That is also where most of the money is made. A company like Qualcomm earns more from patents than from the sale of hardware. Companies therefore try to push their patented technology in the development of the standards. We expect a huge explosion of new devices in the coming years. Imagine that, as a company, you get 10 cents per device in licensing. That's an enormous amount of money and you would never have to do anything for it again."

"We have no idea how these networks work"

These patents make the operation of 5G more opaque than the traditional internet. Ten Oever: "You and I can study how the Internet works because the knowledge about it is public. We can set up a mini Internet at home. But we cannot build a mini-5G network because much of the knowledge is behind patents and licences in the private sector." The

lack of transparency also stands in the way of research and development, says Ten Oever. "At the moment we are still working with protocols. These are relatively simple rules, but they will all be optimised algorithmically in the near future. That raises a lot of complex questions. It would be good to think about this with a lot of people. You should involve universities and research institutes and open up the market to newcomers with new ideas. But we cannot do that now because we have no idea how those networks work. Patents are a kind of wall around the sharing of knowledge.

"Instead of protecting the interests of established companies, we should focus on open hardware and open software", says Ten Oever. "Because then we will create an open ecosystem in which innovation can take place. And that is where governments have a role to play. They could make demands of this kind. With infrastructures such as water and electricity supply, we all have very strict rules about how it should be done, how we control it and what it should comply with. That is much less the case with digital infrastructure. But when you become a vital infrastructure, you also have the responsibilities that come with it. There is still too little awareness of this in the Internet and telecoms world. And the government is insufficiently informed and does not sufficiently recognise the need to make demands of this kind.

"The human right to science should also cover our information infrastructure", concludes Ten Oever. "This has priority over protecting business interests. If you say that we are an information society, or a knowledge society, then that knowledge must be available. A knowledge-based society based on privatised knowledge is, of course, utter nonsense." ◀

200468-03

Questions or Comments?

Do you have questions or comments regarding this article? Then get in touch with the Elektor editorial team at editor@elektor.com.

Contributors

Text: **Tessel Renzenbrink** (Netherlands)

Editing and Translation: **Stuart Cording**

Layout: **Giel Dols**