Hello. I'm Tineke Egyedi. I am the founder and director of DIRoS, a company that focuses on standardization research, and board member of the European Academy on Standardization (EURAS). I am keenly interested in how standards affect the development and evolution of infrastructures. I led the NGInfra Foundation project that resulted in the edited volume Inverse Infrastructures: Disrupting Networks from Below, the book on which this lecture is based as well as most of my examples.

What we will be looking at in this video is a phenomenon which professor Vree has coined 'Inverse Infrastructures', that is, infrastructures developed bottom-up by citizens and users, that is, by you and me.

Let's look at an example. You are walking along a road that turns left. But instead of following the pavement, you take a short cut across the grass. You are not the first one to do so. There's a desire path. Without any prompting, you and those before you have spontaneously created this path. It results from self-organization - remember Eve Mitleton's explanation of the term in the module on complexity theory? Of interest is that you could have chosen the pavement. The pavement is part of a Large Technical System, an LTS as Thomas Hughes, the famous author of Networks of Power, calls them. The road infrastructure is pre-designed, public property, and governed centrally and top-down by the public authorities. The desire path is different. No one owns it. No one specifically designed it. No one is assigned to maintain it. But note, by walking it you contribute to its maintenance.

This example touches on several characteristics of inverse infrastructures. In this module, we will be looking more closely at these characteristics, at in what respect inverse infrastructures differ from LTSs, and at how the two are related. Here's an overview of what we will be looking at. The lecture will provide an initial basis for understanding how heterogeneous the infrastructure landscape actually is, and for thinking about possible futures.

So, let's first list the main characteristics of inverse infrastructures. Typically, they are developed by citizens or technology users, usually volunteers. To start them off, citizens and users are prepared to privately invest in them. They are then developed, operated and managed de-centrally. The volunteers self-organize and, as is the case with emergent systems, the outcome of self-organization can be very unpredictable. Ownership of the resulting infrastructure is absent or unclear.

Let me illustrate what I mean with the example of citywide wireless networks. These networks exist in many cities across the world. Non-commercial, inverse ones start with citizens that have wireless Internet access at home. But they would also like to have such a facility elsewhere in town, when they are in a café or on the street. To allow passers-by in the street to freely access their surplus Wi-Fi capacity, they install an antenna on their roof. This can be a very cheap, self-made and primitive one. Imagine what happens if these

individual citizens collaborate. Imagine if others allow them to also install antennas on high public buildings and church towers in order to achieve wider coverage. A city-wide wireless network results, driven and maintained by citizen volunteers. An example is Wireless Leiden. It started out with citizens that had technical expertise and lay persons who already had wireless Internet access at home. Little extra was needed, which meant a low threshold to join in. They sought cheap solutions for the problems they encountered. For example, a sieve and a dongle to extend the Wi-Fi range. The expert and lay volunteers invested time to get things going and keep the infrastructure running. The map shows all the nodes active in the city of Leiden in the Netherlands early April 2009.

Let's return to the inverse infrastructure characteristics with this example in mind. The initiators and participants are citizen users. That is, they themselves use the technology and the resulting network. They are volunteer technical experts and laypersons, who self-organize the development and maintenance of the infrastructure. They do so in a de-centralized way. From the start it is unpredictable who will join in, who will stay over time and remain involved, and how much area coverage will be achieved. Participants already use Wi-Fi at home. Only a minor extra investment is needed. And lastly, although it is clear who owns the nodes, who actually owns the network, the wireless access service? There is no clear owner. In this respect, inverse infrastructures very much differ from most LTS-like infrastructures we see around us.

Let's look a little closer at the difference with LTSs. Typically, infrastructure services such as electricity, water supply, transport, IT, etc. are provided and handled by government agencies or large companies (by concession). These invest in them and own them. The infrastructures of today are often LTSs. They are designed top-down and developed by professionals. They are centrally governed and operated by hierarchically organized formal authorities and/or companies. Think of the metro in Paris, the infrastructures of newly built cities in China, or the road grid in New York. These examples differ totally from the prototypical bottom-up inverse approach.

So, let's step back and have another look at the infrastructure landscape. First of all, prototypical inverse infrastructures emerge in an environment in which LTSs dominate. This sets inverse infras apart from early developments of LTSs such as beginnings of electricity or telegraphy. Think of the picture of the desire path. It also showed a top-down infrastructure option for pedestrians: you could have walked along the pavement instead of taking the shortcut.

Second, LTSs have dominated the scene these last decades. Current institutions and regulations have evolved specifically to deal with these top-down and centrally organized infrastructures. Think about what this means for bottom-up developed inverse infrastructures. These do not blend in well. Friction is likely to arise with the authorities. Inverse initiatives might be branded as illegal. For how should governments, who inherently deal with societal matters in a top-down manner, address this novel phenomenon where even basic assumptions such as clear ownership do not apply.

Third, imagine furthermore that these citizen-driven infrastructures really take off and become successful. Village Telco in rural areas. Wikipedia. Wind energy cooperatives. In these cases inverse solutions may tread on what government authorities and commercial providers may view as their turf. And inverse infrastructures may become competitors. Let's look at an example. In an area relatively close to Johannesburg, where telecommunication was ill-affordable, a group of volunteers took the initiative to develop a mobile network. This led to a conflict with the incumbent South African telecom operator, who called in the help of the regulatory authority to block the initiative.

The example illustrates the friction that may arise between inverse initiatives and their top-down oriented surroundings. Government authorities should become conscious of and address their likely bias in favor of LTS approaches. Why? Because bottom-up initiatives may succeed where government and commercial providers fail for different reasons … This applies especially to rural areas in developing countries. In the additional resources you will find some links to videos with nice examples. One about the re-introduction of a traditional rain harvesting technology in a very dry area in Pakistan, and the other about the introduction of solar energy in a remote African village by female resident crash-course engineers.

Let's add some nuance and complexity. The relation between top-down and bottom-up developed infrastructures entails more than possible competition. The infrastructures are often interdependent and highly intertwined. Take the example of waste: waste paper, glass, plastics, metals and cloth are valuable resources for industry. In many countries, citizens voluntarily separate household waste. In the Netherlands, this waste used to be collected by school children, members of sports clubs or churches to bring in a little extra money. More recently citizens dispose of them in special containers. If you think about it, citizen-driven waste separation has become an inverse link in an otherwise highly centralized, high-tech chain of waste collection and processing.

Or take Wikipedia. This is a user-driven knowledge infrastructure that can compete with any Encyclopedia. It runs on the Internet, which is itself an inverse infrastructure, which in turn requires electricity – usually provided by large companies who are obliged to guarantee reliable service provision.

And as a final example, note that what you do locally with regard to water, rainwater harvesting or sewage systems, will affect the larger hydrological cycle. Possibly, it will affect it for worse. So, it is important to realize that inverse infrastructures don't develop in a void.

To summarize, we first looked at the main characteristics of inverse infrastructures. Then we went on to discuss how they differ from LTSs, infrastructures designed top-down and organized centrally. And we rounded off by talking about competition and interrelatedness between inverse and top-down infrastructures.

Thank you for your attention.