



NORTHERN GRONINGEN LEAPS INTO THE FUTURE WITH 5G





FOREWORD

The new generation of wireless internet is set to offer a whole new range of possibilities. You can quickly download HD videos on your phone or have your blood levels checked remotely. Self-driving cars and agricultural machines will make life easier, and thousands of interconnected devices and sensors will provide better-than-ever measurements. All of this, and much more, will become reality with 5G.

Consumers will have to wait at least another five years before 5G becomes available to them. Meanwhile, the industry and research centres are working hard to get superfast wireless internet to the market. While most of the work is done on computers and in laboratories, some needs to be carried out in test areas, or 'field labs'.

Usually, tests are carried out densely populated cities. But 5G needs to be tested in a rural area. What better place than northern Groningen?

The region is strategically placed between the city of Groningen with its internationally renowned university, and the ambitious port where a huge transatlantic fibre optic cable from the US reaches land. North Groningen boasts a top-notch talent pool and an excellent infrastructure. The province will be the first in the Netherlands to be connected to broadband internet, thanks to glass fibre services put in place by the Economic Board. These are vital, not only to sustain



economic growth, but also to look ahead to the future, which lies in 5G.

Private and public parties have united in an internationally unique experiment, rolling out 5G across a large rural area to test the latest applications. Aside from giving companies in Groningen the opportunity to be the first to benefit from the economic advantages of 5G, the field lab will also attract new business.

This booklet marks the kick-off of the 5G field lab in northern Groningen. Project initiators present a glimpse of the future and how 5G can benefit all of us. From 2G and GSM in the 1990s, to 3G at the start of the 21st century, followed a decade later by 4G, we now welcome 5G, which will allow northern Groningen to leap into the future!

Sieger Dijkstra
Groningen Economic Board Chairman



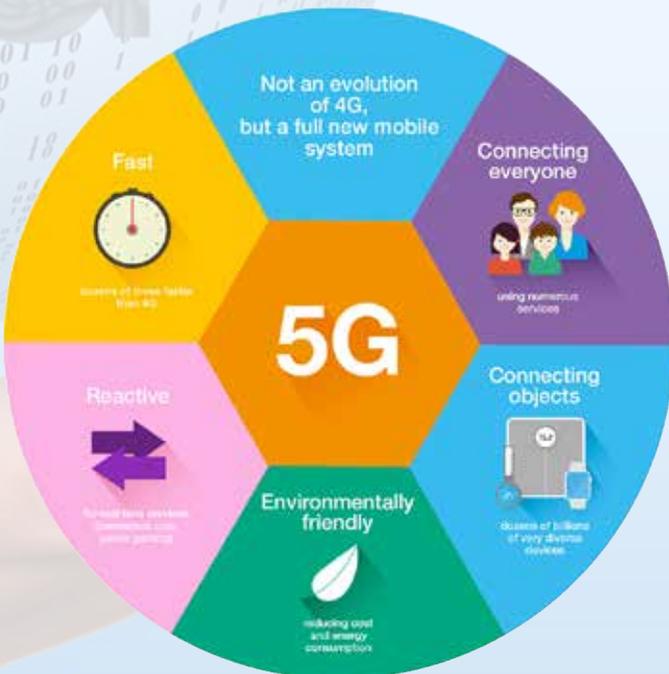
MORE RELIABLE,
VERSATILE, FASTER
AND SMARTER

4G isn't standard practice yet and we're already talking about 5G. So what can we expect from the future generation of mobile communication? And where does Groningen fit in? 5G expert Toon Norp from TNO research centre, explains.

|||| FACTOR 1000

The most obvious reason why we need a new version of the standard for mobile telecommunication by around 2020 is that by then, 3G and 4G simply won't be enough. "Wireless data communication is all around us. The volume in 2020 is expected to increase about a thousand fold. Just think of it as a concert where 3G and 4G just cannot cope with thousands of people wanting to set up video connections to share their experience with others."

A thousand times as much traffic. Just let that sink in. The more megabytes we want to send through the airwaves, the more expensive our phone plans will be. But no one will want to pay that much. "That is why we are working on a completely new technology that can handle this growth without becoming more expensive. In part we can do this by saving on the energy required to send all that data traffic. Saving energy is a goal in its own right, to reduce the environmental impact."



IIII INTERNET OF THINGS

No one knows exactly what the world will look like in 2020 and beyond. But one thing is certain - we will have an increasing number of devices connected to the internet at home. Thermostats, solar panels, televisions, watches, shoes, lights, cars, they will all be linked. As will much of the manufacturing and agricultural processes. "We expect that the number of devices in daily contact with the internet will increase about 1000 times."

And that's just not possible with today's generation of mobile connectivity. One of the problems is that battery consumption is still too high. Also in agriculture, for instance. "With 5G, sensor batteries will last 1000 times as long, enabling them to keep going for 10 years."

IIII NEW APPLICATIONS

Where 3G was developed to make mobile data traffic accessible to the masses and the main goal of 4G was to significantly increase speed, 5G will make entirely new applications possible. Farmers can use sensor technologies much more effectively, for instance. Sensors can also be used for dike monitoring or earthquake detection. "And this opens up new markets with new opportunities for entrepreneurs."

• • • • With the 5G field lab, we want to enable businesses and knowledge centres to test the very latest technologies in this rural area. Northern Groningen is a relatively small area located between a modern port where a huge transatlantic fibre-optic cable comes ashore, and a university city with IT students and start-ups. Northern Groningen is a flat, rural area with relatively few buildings or forests. It has the potential to be a valuable addition to the existing urban test areas for 5G.

Homes and buildings that were damaged in the recent earthquakes and need to be reinforced and modernised may also be fitted with equipment for energy-neutral housing, and to support residents as they age. For this, the homes need a permanent and reliable connection to the electricity grid, as well as to physicians and hospitals, for instance. Northern Groningen has a modern agricultural sector and its farmers are eager to test 5G, for example

5G is all about real-time communication. “4G still has a data transmission delay. This is soon to become much shorter. It has nothing to do with the actual speed of the internet. It is a technical advance that comes with 5G. It’s obviously vital for self-driving cars, for instance, where any delay in communication could be disastrous. But it will also enable surgeons who operate remotely to work much more effectively, or provide for better machine control in industry. And it will make gaming more attractive.”



III BETTER RELIABILITY

“5G provides better mobile network coverage without the need for extra transmission masts. With current technologies, speed is highest close to a transmission mast. With 5G, the capacity is distributed more uniformly.” As this will mean a big step forward in the reliability of the network, emergency services will soon be switching to 5G.

The new technology will also bring a massive change to mobile networks. Networks are still highly centralised; in fact, all internet traffic goes through the Amsterdam Exchange. 5G will do away with this. “We will get small local servers that will make it possible to store and process data locally. For instance, data from earthquake sensors can be displayed on

to operate self-driving agricultural machines to make better use of the land, with fewer pesticides and higher yields.



The Economic Board Groningen was established to boost industry and employment in the earthquake-hit area. Its activities include helping companies finance their plans, and improving the digital infrastructure of northern Groningen.



Marco Smit is director of the Economic Board Groningen

an interface quickly, because they are already stored in the same place. Data simply has to travel shorter distances.”

|||| THE NORTHERN GRONINGEN FIELD LAB

5G is being tested extensively all around the world, mostly in urban areas. “Most tests currently focus on bandwidth in city centres and offices, while 5G is also about reliability and accessibility. It has great potential in industrial agriculture, such as smart sensors for precision agriculture. This potential can be tested perfectly in northern Groningen.”



“A field lab is a wonderful place to test so many new applications. Take self-driving cars, or e-health video imaging with only minor delays, tests with large numbers of interconnected sensors, or applications with intercommunicating machines. It could inspire an entirely new 5G industry. Innovative companies can use northern Groningen as a test location.”

Toon Norp is chairman of the standardisation group that is working on determining all the services that 5G will have to offer. He is also designing the 5G research programme in the European context.



5G CREATES NEW POSSIBILITIES FOR E-HEALTH

Contact with the doctor in razor-sharp images through a laptop. Warning systems signalling health risks via sensors. Voluntary or informal care from home. 5G brings new possibilities to organise healthcare more efficiently. Many new applications can be tried and tested in the field lab in northern Groningen. Peter Boonstra, manager of the Centre of Expertise Healthy Ageing, and Hugo Velthuisen, lecturer in New Business and ICT, look forward to it.

RELIABILITY

What is really important in improving e-health? Network reliability, agree both Boonstra and Velthuisen. More and more elderly people continue to live at home. Remote healthcare must therefore be properly organised. Velthuisen: “A lot can be done through telemonitoring. Healthcare institution clients who live at home can get medical assistance through their screen, or they can go online just to have a chat.”



Peter Boonstra

“Just look at all those home carers criss-crossing the province in their cars. It could well become a problem. Remote care could solve this to some extent. But only if there is excellent coverage.” Boonstra: “We are working hard on creating homes where senior citizens can live longer independently. But this will only work if connectivity is optimal. That is essential.” And that is exactly what 5G will provide.

Ericsson, the world's largest provider of mobile network solutions, has a large number of 5G activities and engagements around the world, and would like to expand this with a 5G presence in the Netherlands. Ericsson was involved in the pre-studies for research projects in the area of 5G. Ericsson has been involved in innovative developments in the Netherlands in many ways, and now the 5G field lab is a perfect platform for Ericsson to demonstrate its capabilities and leadership in 5G.

A digital transformation brought about through the power of connectivity is taking place in almost every industry. This transformation sets the scene for the next generation of wireless access – 5G systems. Future networks need to cope with massively varied demands and a business landscape that will be significantly different from today's. Networks will need to provide connectivity in a way that is both highly scalable and programmable – in terms of speed, capacity, security, reliability, availability, latency and impact on battery life.

|||| e-HEALTH

The idea of e-health is becoming increasingly fashionable. But what does it actually mean? In short, the technology to support and improve care activities. Velthuisen: "I believe this also includes hospital IT systems and electronic patient files.



But the concept focuses primarily on activities directly related to patients and health. Remote care through video calls, for example. The old-fashioned alarm button that the elderly wear around their necks, in fact, is e-health avant la lettre." Groningen has rural characteristics, and the requirements in the sectors of agriculture, healthcare and remote education can create a good basis for the development of various industry-specific applications that may serve as references for the further development of 5G.



Swedish company Ericsson manufactures telecom equipment. They have been working on testing and improving 5G for a long time. Just last month, Ericsson opened 5G test labs in Stockholm and Texas.

Rob Wolters is Managing Director of Ericsson Netherlands



It includes digital processing of blood results and DNA analysis. Boonstra: “There’s already a urine-sampling toilet, and soon it will be able to analyse faeces too. It can collect data and send them to a specialist. Remote surgery is another example. The American military are testing this already. And then there is self-management. Banks and travel agencies have always used it, and healthcare is also heading in that direction. Patients can arrange their own repeat prescriptions and check their test results. All online. 5G makes it possible to accommodate this rapidly expanding data stream.

||| PREVENTION BETTER THAN CURE

Large-scale preventive health monitoring is another development that will facilitate all of our lives. In future, we can use sensors and measurement equipment to keep track of our health. 5G will enable the storage or fast transfer of data across the network, with low energy consumption. It could help reduce hospitalisation of patients.

Velthuisen: “Think of the elderly as well. A video connection with a healthcare clinic helps them stay in touch, just to see how they’re doing. And if the connection is very good, without interruptions or delays, it will also be possible to check whether patients are taking their pills. 5G should make these delays a thing of the past.”



Hugo Velthuisen

||| INFORMAL OR VOLUNTARY CARE

As the population ages, loneliness will become a challenge. Velthuisen: “A better communication system can help fight loneliness. You can use your screen or tablet to talk to someone, but technology can also make it easier to bring people together physically. A carpooling service, for instance. I am convinced that as technology and software become simpler, more people will want to help neighbours or other locals.”

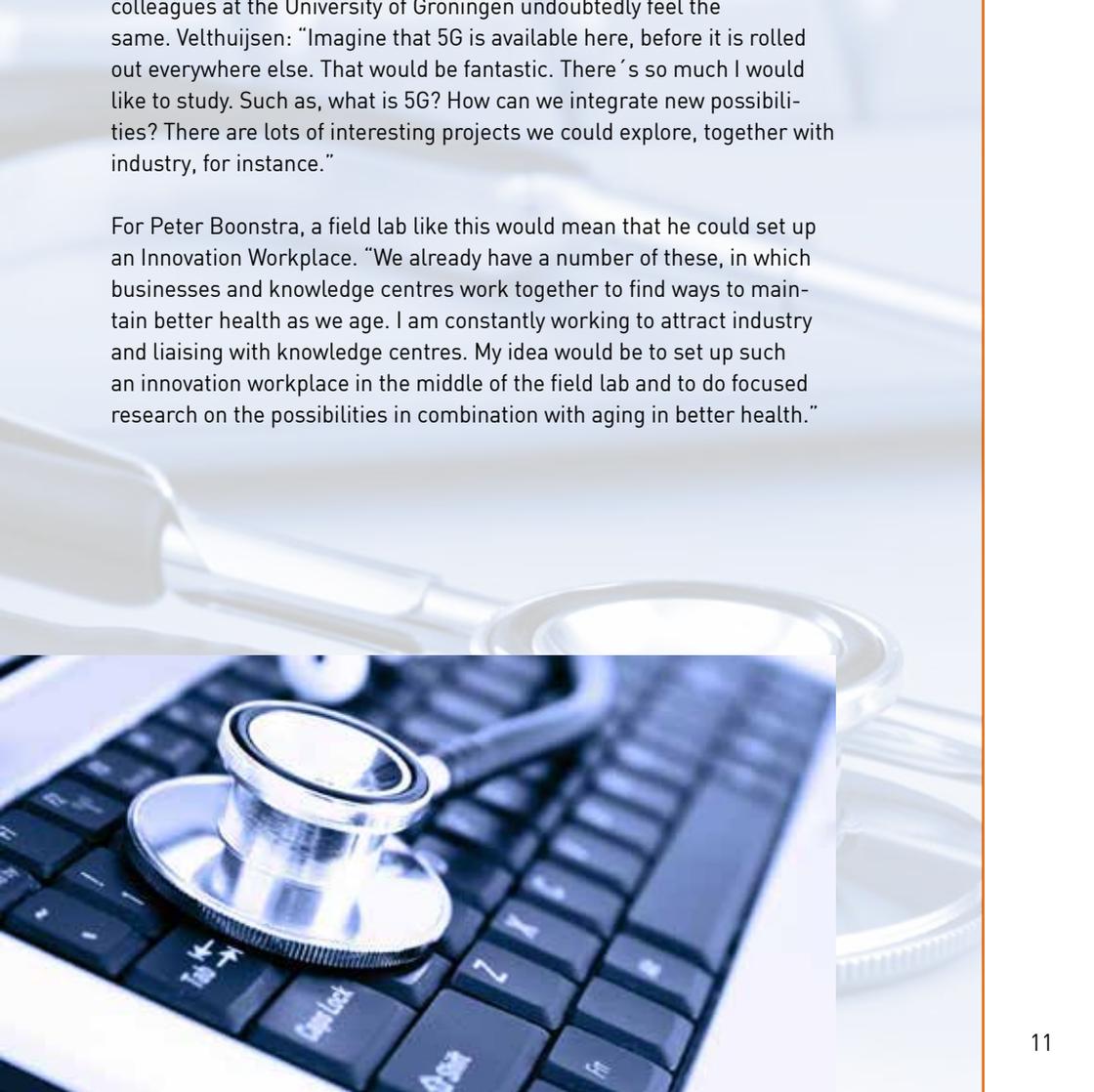
5G could bring about some big changes in informal or voluntary care. Think of an online diary that can be used by different informal carers caring for the same patient, or remote care by tablet or smartphone, or digital transfers to and from healthcare professionals. All this already exists, but soon these facilities may be combined into a single app, with a whole range of other inventions to facilitate informal care. Boonstra: “A lot of software is being developed in this field. No doubt

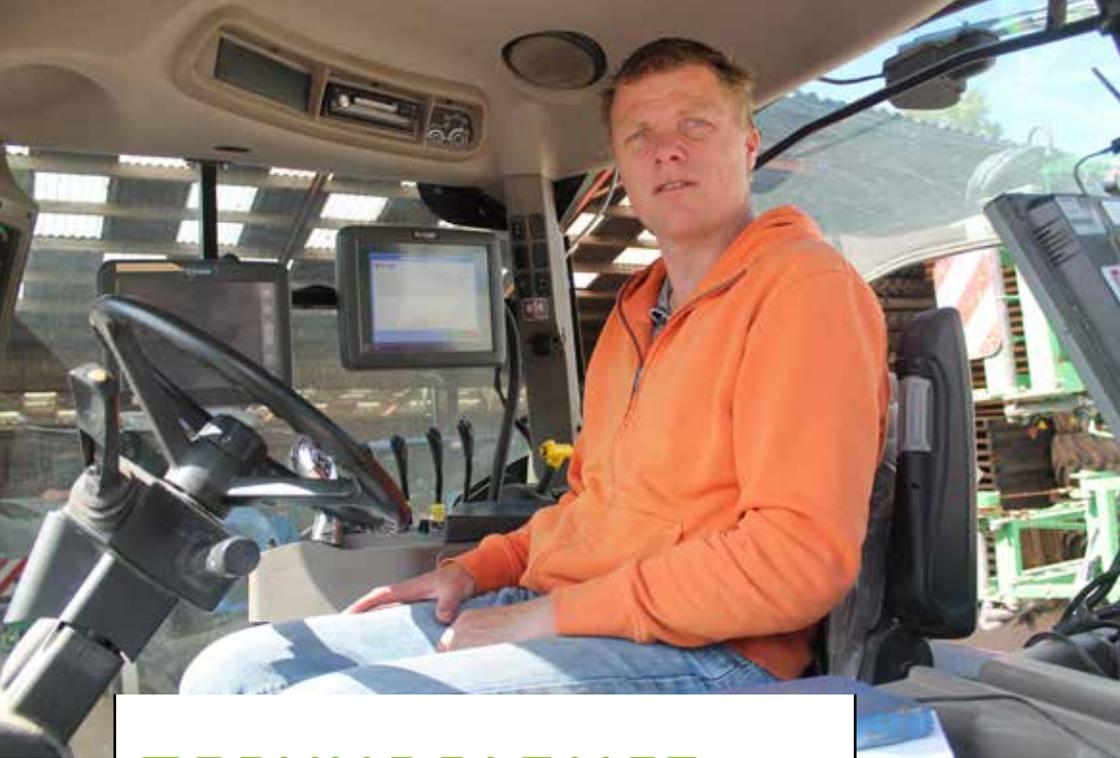
5G will enable the development of very new and different digital products. These still need to be made, but the potential is there with 5G.”

NORTHERN GRONINGEN FIELD LAB

With so many opportunities and possibilities, how does research in northern Groningen benefit us? Boonstra and Velthuijsen from the Hanze University of Applied Sciences can't wait. Their colleagues at the University of Groningen undoubtedly feel the same. Velthuijsen: “Imagine that 5G is available here, before it is rolled out everywhere else. That would be fantastic. There's so much I would like to study. Such as, what is 5G? How can we integrate new possibilities? There are lots of interesting projects we could explore, together with industry, for instance.”

For Peter Boonstra, a field lab like this would mean that he could set up an Innovation Workplace. “We already have a number of these, in which businesses and knowledge centres work together to find ways to maintain better health as we age. I am constantly working to attract industry and liaising with knowledge centres. My idea would be to set up such an innovation workplace in the middle of the field lab and to do focused research on the possibilities in combination with aging in better health.”





TECHNOFARMER ANXIOUSLY AWAITS THE ADVENT OF 5G

Farmers of the future will harvest constant data streams in unprecedented volumes. They will keep track of the fertility and humidity of every square metre of land. They will discover diseases and apply the most effective fertiliser.

In the meantime, their vehicles will drive the optimal route over their land, all by themselves. All this will be possible, says farmer Derk Gesink from Mensingeweer, once 5G is available.

|||| TO MEASURE IS TO KNOW

“Look, this is probably where I spend most of my working day,” says Derk Gesink. He points to his small office in the old farmhouse in Mensingeweer, which houses a computer and a printer. Gesink farms about 200 hectares of land in northern Groningen, and a plot in Denmark. His core business is growing seed potatoes.

“I only cultivate up to one third of my acreage for seed potatoes. It’s best for the soil. The Romans invented the three-field system as they already knew that’s what works best. But now we can actually measure it, too. And I discover something new all the time. Take nematodes and other pests that affect the harvest and the soil. I have my seed potatoes DNA tested at HZPC, NAC and other institutions. They can detect diseases and select the best potatoes as seed crops. We then create new strains with the best possible characteristics.

|||| AGROFUTURE

Gesink sends off samples to the institute, but he also does his own research. Two years ago, he set up AGroFuture with four other local farmers. “We are all modern farmers, and we love applying the latest technological developments in what we do. We’re currently working on a trial with fertiliser for instance. We measure what quantity of fertiliser at what moment gives the best results for what crop. The goal is to achieve maximum yield and to harvest the potatoes as ripe as possible. This will give the buyer the best yield.”

The group bought a drone to film the fields. They can now detect any irregularities in the crop early on. “The next step is a drone with a spectral camera. This will enable us to collect much more data so we know exactly how the crops are doing.”

|||| DATA

Modern farmers like Gesink collect a staggering amount of data on temperature, rain and air humidity in the barn, soil conditions, tractor resistance and fuel consumption. And then some. On their machines, they receive a constant stream of data about the yield, fuel consumption, and so on.

“Data are essential. The more you know, the better you work. What I do now, is collect data on a USB stick which I then take home to read on my computer. But just imagine what you could do if you had data real time, allowing you to act instantly. Adjust the fertiliser supply on the fly, or spray a little more or less where measurements indicate it is needed, or the computer telling me that I should pay extra attention to a particular plot. That’s how I imagine it will be.”

|||| SENSORS

A white box on top of Gesink’s tractor is the best example of his commitment to state-of-the art technology. This large sensor gathers data about the surface of his land. There are sensors everywhere in modern farm operation. In the machines, in the soil, in the storage shed. “We also have them on the sprayer, that 45 metre wide machine we use to spray the crops. The sensors constantly measure the values, so we can spray with precision. It saves money and is better for the environment. But if we could combine this with more data from the soil, we could work even more efficiently.”

• • • • • Huawei is eager to supply its technology and knowledge to help set up a 5G field lab in Groningen with the new consortium. The group is confident it will be successful, as it is a good mix of national and local governments and national and international companies that are committed to this new technology.

In Huawei’s opinion, the focus of 5G will primarily be on increased bandwidth (minimum 1 Gbps), higher response speed of the network (1 ms) and supporting more connections per cell (100,000 connections per radio cell). The higher response speed in particular will enable the use of mobile networks in autonomous vehicles. The increased number of connections per cell will make it easier to produce large-scale measurements in areas where sensors need to be connected.

In recent years, the northern of Groningen faced many challenges caused by gas extraction. Worldwide studies have shown that, among other things, economic welfare in a region correlates with the area’s connectivity. We think that 5G is a great step towards



The more sensors, the better, says the potato farmer. “I have a vision of the future in which we sow the sensors together with the potatoes, as it were, and then pick them up again during harvesting. Perhaps that will bring us closer to what I call the Holy Grail, which is still out there: imaging every square metre of soil.”

PRECISION AGRICULTURE

The beds where the potato plants grow are perfectly aligned and are as straight as an arrow. “My tractor did this all by itself using GPS. The computer calculated exactly how the beds should be arranged for maximum yield. I don’t even have to steer any more. It’s the future. I know that in America they already have vehicles that work the fields unmanned. Meanwhile, these machines help each other, for example with the harvest. It’s just a question of time before we see them here, too.

increasing connectivity in the short term through more and better landline connections in the area. We also feel that the wireless characteristics of 5G will enable some very interesting new services with applications in those areas in which Groningen wants to excel.



Huawei develops telecommunication equipment. Globally, Huawei will invest about 600 million dollars in researching and developing the new 5G technology by 2018. It is an important contributor to the standards to be created for 5G.

Jurjen Veldhuizen is Senior Marketing Manager at Huawei

Precision sowing, precision harvesting, precision spraying, precision fertilising. That is what Gesink and others like him envision for the future. “We are market leaders in innovation. Which is how it should stay, I think. That means we will need to keep investing. And, on a smaller scale, that’s exactly what we do at AGroFuture. We study, test and adapt the latest developments for agriculture.”

|||| 5G

Derk Gesink is coming up against the limits of the internet service. He has a number of Wi-Fi antennas on his farm to boost capacity. “I’m lucky that I’m at the edge of the village and could be connected to cable. Our efforts would have been pointless otherwise.” 5G could offer the solution. It would enable him to set up even more sensors, measure even more, know even more, and farm even better. The technology would give him information directly and would make it possible to turn his machines into coordinated devices.

“I can’t wait until 5G is there. As soon as field lab comes, I’ll register as a test farm. I want to be able to use the very latest technology for cutting-edge farming.”



• • • • There is no better way to underline KPN’s leading role in the development of mobile networks than its cooperation in 5G testing in the Netherlands. KPN is also developing other activities, with the Next Generation Mobile Operators group for instance, to implement 5G standardisation as quickly as possible.

Although this field trial could be done anywhere, it is in the northern parts of Groningen that its potential can best be explored, enabling us to study every aspect of 5G. Think of the high bandwidths that we can assess for usability, like broadband internet at home and on the go. Or ‘tactile internet’ that can be used for autonomous vehicles, such as agricultural vehicles or Google cars, or for applications in healthcare using sensors, or with extremely

• • • • **5G field lab offers northern Groningen the opportunity to take the lead**

5G can provide a significant improvement in the capacity and coverage of mobile networks in remote areas, enabling the region to participate fully in the digital economy. We expect new applications to be introduced, such as remote care or teaching. It can also give a huge impulse to the agri-food sector by increasing the use of sensors and monitoring for precision farming. These mobile applications use an increasing number of frequencies. The Ministry of Economic Affairs/Radiocommunications Agency Netherlands (EZ/Agentschap Telecom) promotes a smarter, dynamic use of frequencies as a key part of a modern telecommunication infrastructure.



We expect that 5G technology will make it possible to use the “scarce” radio frequencies more efficiently in the ever-growing need for broadband capacity. EZ/Agentschap Telecom would like to help facilitate this as pioneering new innovations can help develop the regional economy.

In northern Groningen, not everyone is able to take part in the digital economy. Yet it is this region in particular that could benefit from a “helping hand”. We hope that a 5G field lab will offer both short-term and long-term opportunities for the region to link up to the digital economy, and maybe even to take the lead in modern regional applications that make use of mobile and landline telecommunications. The presence of the University of Groningen and the Hanze University of Applied Sciences is also important in developing knowledge about the use of new mobile technologies in cooperation with industry and TNO.



The Radiocommunications Agency Netherlands (Agentschap Telecom) is part of the Ministry of Economic Affairs. It issues permits with room for new technologies, contributes to international standardisation, and monitors the correct use of frequencies.

René Vroom is Head of Innovation at the Radiocommunications Agency Netherlands

fast response times. We can also test ‘lifeline communications’, perhaps even in a case of an earthquake. But let’s hope it won’t come to that!



KPN is currently the leading telecom operator in the Netherlands, also for 4G. It is even setting the pace globally, as it is closely involved in the development and introduction of the 5th generation of (mobile) networks.

Jacob Groote is Vice President of Mobile Operations at KPN



ENERGY PILOT PROJECT SETS EXAMPLE FOR 5G FIELD LAB

In the space of a few years, the Energy Transition Centre (EnTranCe) has grown from a small-scale experiment into a professional pilot project for all initiatives related to the transition to more sustainable energy. This could be a good example of how a 5G field lab could look. Jeroen van den Berg, Manager of EnTranCe, agrees.

|||| BOTTOM-UP



Jeroen van den Berg

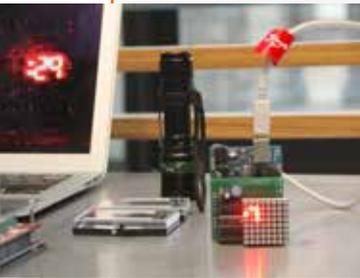
The history of EnTranCe only spans a few years, but the concept is already well-established. The pilot project for applied research on energy issues regularly features in the news. Applications keep pouring in, the research is very fruitful, expansion of the facilities is practically a constant issue. Yet it all started in a container at a bus stop. EnTranCe now has 5 hectares of land available, which has most recently been used for a large, greenhouse-like building which was nominated for a major architecture award.

“I think the secret lies in the fact that this really is a bottom-up initiative. No one said: ‘let’s create a centre where we’ll work on energy transition.’ Not at all: it emerged as an evolution of the cooperation within the Energy Valley Topclub. That’s where the idea took shape. Why don’t we set up a place to give the energy transition a boost?” BAM, Imtech, Gasunie and GasTerra got behind it. “And then it was just a matter of starting and seeing where it led.”

|||| STUDENTS

The initiators purchased two portacabins. The idea: let’s have students live on site, and have them study aspects of energy transition. One room contains instruments where the students could take readings and test set-ups to discover how energy can be saved or generated. “With this, we killed several birds with one stone. We got the students, and therefore the educational institutions, involved in the project. There is always a need for housing, so the rooms were an added bonus. And the students lodged in a living lab where companies and institutions could try out their energy ideas in the real, inhabited world. These companies want to be where students are. All in all, a real win-win situation.”





The idea quickly gained popularity. The Hanze University of Applied Sciences wanted to contribute, and the municipality made available a piece of land to do tests on a larger scale. “We just sat down and showed them what we did. It’s essential that it does not remain a vague concept, but that everyone can come visit. It is concrete, you can touch it. We still have an open day every month for those who want to see what we do.”

|||| BUSINESS PLAN

EnTranCe is a pilot project for energy transition. Its many facilities enable the centre to bring new products and services to the market quickly. “Our work is demand driven. We keep asking ourselves - what is needed? We had the qualitative business plan drawn up in no time, but the quantitative plan took me a year to complete. It wasn’t easy, but we got there in the end. And now we’ll show that it really does work. It all revolves around open innovation/co-creation, shared facilities and students.” EnTranCe is now part of the Hanze University of Applied Sciences. The people who work there (13 FTE) are staff of the university of applied science.

EnTranCe earns its revenue by working with partners from industry who support one of 40 projects, as well as small and medium-sized businesses that rent rooms to use the technical and technological facilities.

• • • • • The use and integration of wireless and mobile network technology, as well as a (more) dynamic use of the spectrum, will provide users with reliable connectivity, high capacity and coverage everywhere. This will make it possible to develop services to make education, research and care independent of place, time, device or subscription type.

Northern Groningen is the perfect place to set up a 5G field lab, with its demand for new applications to make the region more attractive for establishing businesses and households. Excellent connectivity at home and on the go is a key condition in this.

A fast, innovative, safe and reliable connection is what matters most to researchers, students, instructors, physicians and supporting staff at SURE.

That is why we want to work on the development, integration and practical tests of new



They are used for testing solar panels, for instance, as well as biodigesters, high-efficiency furnaces and much more. “Take our *Hooghalen* project, for instance. A great example of what we do. In the village of Hooghalen we try to take the principle of sustainability to the limit: we’ve made a model based on the village’s user profiles and a continuous stream of climatological data. We then try to find the ideal mix of measures. Hooghalen as a model village for how it could be done.”



wireless and mobile network technology.

SURF is the ICT collaboration organisation for Dutch higher education and research. With SURF, students, instructors and researchers in the Netherlands have the best ICT facilities for top-level research and talent development.



Maurice van den Akker is Mobile & Wireless team manager at Surfnet



|||| PLENTY OF INTEREST

About 70 parties collaborate in EnTranCe one way or another. Some weekly, others annually. Sometimes together, such as the eight parties that have got together for the Hooghalen project, sometimes alone, such as the sailor who came up with solar panels on water because it struck him how quickly his tan developed due to the water's reflective surface. His test setup has since been created in a pond in the grounds. "A large Japanese company will be conducting tests here to bring its product onto the European market. Mitsubishi is trying out a combination of a heat pump with a high-efficiency furnace at our facility."

So industry has already picked up on EnTranCe. As has the government. There have been a number of state visits, including visits from the Minister of Energy from Mozambique, and his colleague from Zimbabwe. The Scandinavians discovered the pilot project long ago. Our own King Willem Alexander has also shown an interest and taken a tour. "We are accessible, you can see here what is happening in the area of energy transition, which is one of today's challenges."

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Isn't EnTranCe a great example of what the 5G field lab could look like? "The combination with students, who can do so much research, is an obvious advantage in this region. It seems to me that the 5G field lab also needs to make use of this. I also see great opportunities for crossovers. EnTranCe on is working on the ICT standard for Smart Grids. 5G could play a vital role in this. It could be a crossover between us and the 5G field lab. New products and concepts will get off the ground if parties keen to do something with 5G sit down together. Competition no longer exists, we're moving forward. This is about developing the regional economy."

The brand-new EnTranCe building also houses Kenniscentrum Energie, iNRG, EnergieExpo, Sameen, Metsens, Zernike Advanced Processing, and in the near future TNO. Six lecture rooms will be put into use after summer. "By coming together, we strengthen each other and keep each other on our toes. Show others what you're doing, and then you will all get there."

- • • • TNO is happy to help realise the field lab as a unique opportunity to set up an experimental environment with other parties to use 5G to its full potential. This can lead to social and economic benefits for the region, and will extend to national and even international regions. Establishing the field lab here will benefit the citizens and economy of Groningen.

As a research institution, TNO is the cradle of many innovations. Based on our Networked Information programme, we develop knowledge and use our expertise for the Dutch economy and social challenges. This is not only about our in-depth knowledge about network technology, it also involves innovations that use network advances for agriculture, energy, healthcare and education.

It is a challenge to innovate in the dynamic ecosystems of different parties. TNO gladly contributes by helping to shape this ecosystem and bringing it to bloom.



TNO is an independent research organisation which employs about 3,000 employees. TNO connects people and knowledge to create innovations that sustainably strengthen the competitiveness of businesses and the welfare of society.

Gjalt Loots is business consultant at TNO

Colophon

This booklet was initiated and commissioned by the Economic Board Groningen as a framework for support to help bring the 5G field lab to northern Groningen. It is not a scientific discussion, but attempts to set out how the 5G technological advances can strengthen the northern Groningen region.

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Signature







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