



Nokia response:

On Farm Connectivity Program

Discussion Paper

March 2023

Disclaimer: This response is based on Nokia's current understanding of the market dynamics and various standards bodies; these dynamics are changing and hence our views may update with these changes



1 About Nokia

At Nokia we create technology that helps the world act together. We develop and deliver the industry's only end-to-end portfolio of network equipment, software, services and licensing that is available globally. Our customers include communications service providers whose combined networks support 6.1 billion subscriptions, as well as enterprises in the private and public sector that use our network portfolio to increase productivity and enrich lives.

With an end-to-end portfolio that is unique in the industry, Nokia can work in partnership with operators and directly with enterprises to deliver "real 5G". Nokia's in house 5G mmWave Small Cells and AirScale BTS provide in-building and outdoor coverage, while our Microwave Anyhaul, Cloud native RAN, antennas, and 5G cloud-native core are part of approximately half of our agreements to date. Beyond our mobile networks portfolio, Nokia has excellent FP5 network processor-based IP routers and PSE-6s chipset powered optical networking - our customers can use the Nokia Network Services Platform to make this into full-5G-strength software defined connectivity 'smart network fabric' secured by Nokia Security Orchestration, Analytics and Response (Nokia SOAR) to ensure resilient 5G. Globally Nokia has been selected by more than 230 operators to supply 5G networks.

Nokia is a global leader in 5G standardization and technology innovation with a strategy specifically designed to support the Australian market – with Nokia's 5G mmWave technology supporting high-capacity areas together with low band 5G supporting rural and regional areas. In 2021 Nokia together with TPG Telcom set a 74km 5G cell range world in regional NSW, a record that still stands today. Nokia is proud to be a strong partner in the current roll-out of 5G in Australia, continuing our 120-year presence here.

Because the security of our technology is integral, Nokia has always undertaken extensive monitoring and testing (including independent validation) of our products, at all stages from inception, development, manufacturing, deployment, and maintenance. All Nokia products and our supplies are subject to the same security verification procedures to ensure their integrity, regardless of their place of development, manufacture, or operation.

Through our research teams, including the world-renowned Nokia Bell Labs, we are leading the world to adopt end-to-end 5G networks that are faster, more secure and capable of revolutionizing lives, economies and societies. We have invested in two state of the art 5G experience centres in Australia, the 5G Futures Laboratory in Sydney and the 5G Industrial Incubation Laboratory in Adelaide.

Nokia adheres to the highest ethical business standards as we create technology with social purpose, quality and integrity. For more information: <https://www.nokia.com/networks/5g/>

2 Introduction and submission summary

Nokia welcomes the opportunity to respond to the Australian Government's On-Farm Connectivity Program discussion paper. Nokia is a leader in telecommunication technology development around the world and a trusted and longstanding partner in Australian telecommunications, supporting landmark projects for more than a century.

In Australia, Nokia has a proud history of strong collaboration across both service providers and enterprises. We are bringing together customer and partner ecosystems to create tomorrow's digital services and applications – delivering collaborative advantage, together for both business and society.

Nokia has been selected by both Optus, TPG Telecom and Field Solutions Group as a key supplier for their network deployments of 4G and 5G, as well as a being the major supplier to the National Broadband Network for fixed network technology solutions. Our technology is also supporting digital growth in industries such as agriculture, healthcare, energy, smart cities and transport.

Enhanced connectivity and digitalization also allow cities, industry, and society to be more sustainable. Nokia estimates that only around 30% of the world's economy is fully digitalized. That means that, through digitalization, we can make most of the global economy more productive and less wasteful. Connectivity and digitalization are key to many of the levers of industrial pathways towards net-zero emissions.

Connected, digital solutions, capitalizing on the low latency of 5G networks enable different industries to monitor and manage emissions, control power and material consumption, and optimize operations to reduce their carbon footprint. In fact, GSMA industry research has found that the mobile communications industry can enable other industries and society to reduce their emissions by up to 10x more than the mobile industry's own footprint. This multiplier effect of broadband adoption for fighting climate change cannot be overstated.

Nokia's response to the Australian Government's On-Farm Connectivity Program discussion paper highlights the importance of enhanced connectivity and digitalization in achieving a sustainable future. The potential for connected, digital solutions utilizing 5G networks to reduce carbon emissions and optimize operations cannot be overstated.

As we move towards next-generation technologies, networks will become increasingly vital to safety, security, and quality of life. Nokia remains committed to providing cutting-edge telecommunication technology and being a trusted partner in Australian telecommunications for years to come.

3 Technology solutions supporting farming, fisheries or forestry businesses

3.1 Nokia 5G Digital Automation Cloud (DAC)

Nokia 5G Digital Automation Cloud (DAC) is a high-performance wireless networking and edge computing platform designed to meet the mission-critical needs of asset-intensive industries, governments, cities and webscale businesses as they work towards an Industry 4.0 vision.

Offered as a service, Nokia DAC provides customers with a self-managed 4G and 5G digital connectivity platform including local edge computing, 5G radio, ruggedized Nokia Industrial user equipment and a catalogue of click & deploy applications to support mission critical Operational Technology use cases.

Launched to the Australian market in 2021, the platform includes a web-based portal making it easy for customers to manage sites, add users, deploy applications and push software updates to locations anywhere in the world, in any configuration.

Since launching the Nokia 5G DAC, Nokia Australia has been working closely with both public and private industry partners, to explore how the technology can accelerate the digital transformation of Australia's most critical industries.

In South Australia, Nokia and the South Australian Government are working closely together at Nokia's 5G Industrial Incubation Lab to explore 5G use cases in Rail, Airports and Utilities all powered by Nokia's 5G DAC.

These projects include:

- Use cases for Safety within the rail corridor via remote video monitoring and big data analytics.
- Use cases for Airport situational awareness for securing public safety using HoloLens and a remote video camera.
- Use cases for Power Over-Voltage Management in a power network via distributed edge compute using 5G connectivity.

In New South Wales, Nokia and the University of Technology Sydney (UTS) are using the Nokia 5G DAC to offload the processing requirements of 'cobots' or collaborative robots. Cobots have the potential to transform industry by allowing humans and industrial robots to work safely alongside one another. 5G connectivity through the Nokia 5G DAC allows the cobot's 'brain' to be offloaded to the cloud enabling lighter, cheaper cobots with greater mobility and situational awareness.



Arguably an even more important project has been to 5G enable the UTS Micro Brewery! UTS's Industry 4.0 Nano-Brewery, is part of its Advanced Manufacturing and Industrial Data Science testbed. The Nano-Brewery forms part of an international production network, with an identical physical twin set up in TU Dortmund University in Germany. The 5G connected brewery uses NDAC to capture and monitor production data at every step of the brewing process and uses this data, together with data from the physical twin in Dortmund and a digital twin in the cloud, to optimize the process.

As well as these projects, Nokia is working with a range of customers to introduce the Nokia 5G DAC to Australian Industry with an initial focus on Mining, Oil and Gas. Australia leads the world in private wireless adoption in this sector, where from as early as 2005 customers have been using private wireless to automate their haulage fleet and site monitoring solutions. Using NDAC we can now bring the benefits of automation and Industry 4.0 to smaller producers who may not have the in-house capability of larger businesses.

Nokia's 5G NDAC is the only solution of its kind generally available in the market today and ideal for numerous industries that require a simple yet industrial grade private solution that is highly secure, reliable, and agile.

3.2 5G mmWave FWA technology

Last year as part of the National Broadband Network's and the Australian Government's \$750 million investment in the nbn Fixed Wireless network, Nokia was selected to supply nbn with its latest 5G fixed wireless access (FWA) mmWave Customer Premises Equipment (CPE). In a world-first, the customer premise equipment (CPE) provided by Nokia supports high frequency 'mmWave' bands, which are capable of Gigabit speeds for premises within a 7km radius of a radio base station.

nbn's FWA network currently covers almost 650,000 premises across Australia including many large-scale farming businesses. The upgrade program will extend the existing fixed wireless footprint by up to 50 percent, enabling approximately 120,000 former satellite-only eligible premises access to fixed wireless services for the first time.

The 5G mmWave upgrade utilizes the 28 GHz band to be operated in Non-Stand Alone (NSA) mode along with cmWave spectrum and will help enable faster speeds on the network, including the launch of two new wholesale high-speed tiers – 100 Mbps and 250 Mbps.

Nokia's mmWave solution introduces an innovative, high gain antenna design that can leverage mmWave to a range of up to 10km. The CPE comprises an outdoor unit installed on the roof of the premise and an indoor unit providing user interfaces for the customer, connecting to the outdoor receiver with a 2.5Gbps Power over Ethernet connection.

4 Case studies – technology supporting growth in major industries like smart farming

Nokia's technology supports growth in major industries such as agriculture, energy, smart cities, transport, bringing new economic opportunities and prosperity to communities around Australia. While today's 5G networks are starting to bring our connected future to life, 5G-Advanced and 6G will be required to fully realise it. In fact, Nokia anticipates 5G-Advanced will contribute up to \$8 trillion in global GDP in 2030.

It is for this reason that governments can play an important role in bringing technology, business, and academic networks together to connect and explore the potential of Industrial Digitalization for Australian and regional industries through joint programs and initiatives such as this. Real-life use cases of Nokia's technology applied to the agricultural sector include:

4.1 Livestock counting case study in Australia

TPG worked with Nokia to demonstrate how 5G networks can enable image processing, computer vision and edge computing technologies to deliver benefits and improve efficiencies to the agricultural sector. Livestock counting is a critical component of livestock management.

Nokia provided the 5G network equipment, UTS developed the cattle-counting machine learning model, and AWS Professional Services provided support on delivering the AWS edge computing and machine learning solutions on the cloud.

Livestock including sheep and cows are manually counted at exchanges and ports, with the potential for costly errors and inconsistencies. The project used 5G to enable multiple high quality 4K video streams to count livestock at regional exchanges, automating the process and removing the potential human error.

A supporting 5G edge network processed the livestock counting on-site and relayed this data in real time back to farmers via a tablet or mobile device. It is estimated that by minimising counting errors, especially during unfavourable conditions, will directly contribute over \$13.2 million to the livestock industry in Australia each year.

The project received grant funding from the Australian Government's former 5G Innovation Initiative.

[5G and AI make counting cattle easy as 1, 2, 3 for smart farms of the future - YouTube](#)

4.2 Global fish farming case study

Sinkaberg Hansen is a major Norwegian seafood business, operating a network of two dozen fish farms throughout the country. The company requires timely, accurate data about the status of its millions of fish, even from remote, thinly staffed farms, and has begun to experiment with a combination of 5G wireless communication and edge cloud computing.

Telenor ASA, a Norwegian multinational telecommunications company, worked with technology partners including Nokia, Intel and Norwegian aquatech company Bluegrove, to develop a solution for a Sinkaberg Hansen fish farm located on the island of Gjerdinga. Using Telenor's 5G network and other communication solutions, Nokia edge cloud infrastructure powered by Intel, and HD video cameras and video analytics software from Bluegrove, Sinkaberg Hansen is working to stream video of the fish feeding and determine whether they're healthy.

4.3 AeroFarms AI-Enabled plant vision technology case study

AeroFarms, located in New Jersey is working with Nokia Bell Labs on a proof of concept for an integrated system that tests technologies such as AI/ML, wireless networking and drone orchestration to monitor for abnormalities at the individual plant level. This system can image every plant every day.

As part of the multi-year partnership, AeroFarms, contributes its commercial growing expertise, comprehensive environmental controls, an agriculture-focused data platform, and machine vision core foundation with Nokia Bell Labs, autonomous drone control and orchestration systems, private wireless networks, robust image and sensor data pipelines, and innovative artificial intelligence (AI) enabled mobile sensor technologies.

AeroFarms is a pioneer in vertical farming, which transforms urban cityscapes into farmscapes by growing crops in stacked tiers under environmentally controlled conditions. This approach to agriculture could change how the world is fed. Crops could be grown in the same population centers in which the majority of produce is consumed. Vertical farms not only maximize square footage, but they also require far less water, energy, labor and pesticides than traditional farms. Huge amounts of spoilage could be eliminated and fossil fuel saved as fruits and vegetables would no longer need to make the long journey from rural farms.

Nokia Bell Labs innovation provides AeroFarms with an important piece of the vertical farming puzzle: a continuous monitoring solution that can track the growth of millions of plants. Drones can peek into the most inaccessible nooks of a vertical farming tower, covering far more ground at a far faster pace than any human. AI-trained computer vision can capture plant data down to the pixel level. As part of AeroFarms' proprietary growing



platform, this technology not only detects areas of poor growth, but it will eventually diagnose the causes, whether from malfunctioning irrigation systems or suboptimal lighting. This day-by-day, hour-by-hour monitoring of the entire farming operation will increase crop yields and improve efficiency, helping make vertical farming even more productive.

AeroFarms and Nokia Bell Labs have been working together since 2020 and have reached an important milestone of achieving a proof of concept for this state-of-the-art integrated system and testing the technologies with AeroFarms' current commercial crop varieties. Together, they are now ready to scale this system to all of AeroFarms' crops and future indoor vertical farms, including the next ones in Danville, Virginia and Abu Dhabi, UAE.

[The flying horticulturist: How Nokia Bell Labs AI and drones are helping AeroFarms revolutionize vertical farming - Nokia Bell Labs \(bell-labs.com\)](#)

5 Adoption of technology for a Greener Economy

At Nokia, we have a two-pronged approach to fighting climate change. First, we focus on our own carbon footprint, the impact on the environment from our own operations and from the use of our products and solutions. We make progress every day to minimize our footprint, even in the face of a significant increase in demand for our services.

In addition to reducing the footprint of our operations and our customers' operations, Nokia also works closely with our suppliers on reducing emissions in manufacturing, logistics and transportation. We work with our suppliers to develop, innovate and build capabilities to enable a more sustainable and transparent ecosystem, and we demand that our suppliers commit to sourcing materials from environmentally and socially responsible sources. We even encourage innovation in other sectors, for example, through our collaboration on CO2 neutral airfreight using Sustainable Aviation Fuel (SAF) in parts of our logistics.

Second, and by far our biggest impact, is our unique handprint, the positive impact of our technology on others. Nokia enables other industries, society, and individuals to decarbonize in a way that has an exponential positive effect on our world.

We constantly developed new chipsets that are substantially more energy efficient than previous versions, including introducing the FP5 chip which provides up to 75 percent reduction in power consumption of the previous FP4 chip, which allowed us to meet our 2023 power efficiency goals two years ahead of schedule.

At Nokia, we have pioneered new liquid cooling systems for base stations, which are exponentially more efficient at transferring heat than traditional air fans, reducing energy consumption of cooling by up to 90 percent and CO2 emissions by up to 80 percent.

We also have introduced software, like our AVA Energy Efficiency service, which applies Artificial Intelligence (AI) to further reduce energy usage in 5G and multi-vendor legacy networks by up to a further 20 percent. With fixed access technologies that bring broadband to homes and businesses, we have reduced power consumption by 38 percent since 2007, while speeds have increased 64-fold.

5.1 Smart Agriculture delivers sustainable practices that also helps to address climate change

The world already produces enough food to feed the current population, but over-production, over-consumption, and supply chain issues lead to huge amounts of waste in some regions while other regions suffer from a food scarcity and malnutrition. According to some estimates, 30-40% of the world's food is lost or wasted during production.

Agriculture is also the cause for 14% of greenhouse gas emissions. Land clearance, overuse of fertilizers and freshwater also harm the environment. Smart Agriculture technology can address each of these problems and ensure we use our limited resources carefully.

Connectivity can help us grow smarter, helping to get more food to those in need, while minimizing the negative environmental impact of agriculture. Specifically, precision and vertical farming is using 5G connectivity, wireless remote monitoring, private networks, digital sensors, and AI-based analytics to minimize pesticide, fertilizer, water, and energy use, while also maximizing crop yields.

Bell Labs Consulting estimates that if 15-25% of all farms adopted precision farming by 2030, it would lead to: (1) an increase in yields by as much as 300 million tons each year; (2) a reduction in farming costs of up to \$100 billion annually; and (3) a reduction in water use by up to 150 billion cubic meters annually.

[Smart agriculture - The fight to feed 10 billion | Nokia](#)

6 Spectrum consideration for “Connected industries”

It is worth further highlighting that Nokia expect that the digitization of industries such as agricultural will continue to grow and, as such, their demand for spectrum to increase over time across the different sectors. Their spectrum needs will depend on the use cases in terms of coverage, capacity and performances and will be addressed by a combination of local access and wide national coverage, via private networks and public ones.

The 5G Alliance for Connected Industries and Automation (5G-ACIA) addresses major challenges of 5G, highlighting spectrum and operator models. In order to meet extremely demanding latency and reliability requirements, licensed spectrum and protection from harmful interference are highly preferred.

Investment cycles of vertical industries differ from cycles of the telecom industry: cycles for media and entertainment are typically shorter, ranging between 2-3 years, for automotive industry 7-8 years, energy, manufacturing and mechanical industries 25 years, and for oil & gas from 10 to 25 years. Partly due to this difference, vertical industries may prefer to deploy their own networks. Furthermore, the timing for investing in wireless communications depends solely on their own business plans. Vertical industries require the assurance that for their networks there will be a continuity of service, without unjustified price increases, spectrum re-farming or technology upgrades over their planned life span.

Spectrum for vertical industries is an increasingly important consideration as through discussions with various stakeholders, Nokia are seeing a strong demand from Enterprise customers wishing to deploy 5G private wireless solutions either standalone or through a carrier depending on their use case and buying preference.

Nokia see large economical value in the possibilities for enterprises to invest into private wireless networks using 3GPP technologies on their premises. Additional investment into private networks by private enterprises can significantly speed up the overall 5G take-up.

7 Security and supply chain resiliency

As a global organisation with significant operations within Australia and globally, Nokia takes its compliance with security and supply chain requirements seriously. For example:

- Nokia already imposes security by design throughout our value chain. Our comprehensive, industry-leading Design For Security (DFSEC) process ensures that security is embedded into every product from the start, undergoing rigorous security testing prior to commercial release.
- At Nokia, we continuously review our operations and supply chains to mitigate against potential disruption to our customers caused by natural disasters, transportation capacity and political risks. We have a supply and sourcing strategy that is not dependent on one facility, one manufacturer or one location.
- Like most electronic, telecommunications and IT companies, we source products and components from various countries as part of a worldwide network managed by our Nokia Global Supply Chain, which ensures the diversity and security of our production capabilities and enables us to manage potential disruption to supply.
- No matter where our equipment and components of our equipment are developed, manufactured or sourced, it is subject to the same strict protocols to ensure quality, security and integrity.
- Our supply chains are multiple test and assurance points where any interference or manipulation can be identified and traced. The depth and breadth of our security procedures makes interference with our products next to impossible.
- Nokia's commitment to promoting global security means we will provide passive lawful interception capabilities to customers who have a legal obligation to provide such capabilities. We will not engage in any activity relating to active lawful interception technologies, such as storing, post-processing or analysing of intercepted data gathered by the network operator.
- We will not knowingly provide technology or services for the purpose of limiting free speech, political discourse or otherwise contributing to activities that are not consistent with internationally recognized human rights standards. You can read more about Nokia's commitment to human rights here - [Human_rights_policy.pdf \(nokia.com\)](#).