



NTT DATA

# 5G Campus boosts enterprise new work

**“Only a crisis - actual or perceived - produces real change. When that crisis occurs, the actions that are taken depend on the ideas that are lying around.”**

Nobel Prize winner Milton Friedman

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# Abstract

New employment models with flexible hours, home offices and decentralised working are becoming increasingly common. This offers benefits for employers, bringing cost savings that go hand in hand with improved employee motivation. The flexibility of remote working can also mean greater speed, even to the point of saving lives – for example in the medical sector, in emergency situations, faster response can enable expert personnel to be deployed immediately.

The trend to remote working has been accelerated by the COVID-19 pandemic, forcing people to rethink the way they work. New working models are emerging, not only in the administrative and business sectors, but also in the industrial sector. People are starting to look at the possibility of greater efficiency in the use of staff and, at the same time, routine activities are becoming more automated.

This White Paper looks at the needs and problems with remote work, as well as the possibilities to solve these issues through technologies like 5G. The paper concludes with experiences, recommendations and a partnership offer from NTT DATA for the development of 5G campus networks.

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# Decentralisation is transforming the world of work

To deal with the spread of the COVID-19 virus, many governments have instigated social distancing policies. This has led to many people working at home if their tasks and roles allow it.

This sudden boom in home-based working is causing many companies to think more deeply about decentralised work. Although the economy, even globally, is not yet ready for a complete switch to remote working, emergencies and disasters often push existing developments and accelerate innovation. But are these exceptional circumstances the only drivers of social change?

This white paper discusses further drivers for decentralisation. The economy itself and constant pressure to save costs and increase efficiency play important roles.

In contrast, the possibilities and applications of technology in 5G mobile communications and its further trends towards 6G are presented. The question arises, why have these possibilities not been applied before? The barriers are also discussed.

For the most part, 5G solves the problems and opens the way for the decentralisation of work and finally of companies themselves.

There are other motivational reasons for remote working. Generation Y has now completely arrived on the labour market and is driving it forward significantly. Encouraged and enabled by digitisation, flexible working time models are emerging to give employees more freedom and a better balance between work and leisure. For example, Ypsilon's technology-oriented employees are happy to accept such models instead of negotiating higher salaries or a company car. This transformation of peoples' attitudes to the world of work is new and is causing a rethink across all industries.



# Why workplaces decentralise

Companies often have problems finding experts and suitable employees. In particular, the younger potential employees of Generation Y rate a good Work Life Balance and the option of working from home very highly.

A study by Steinmetz (2020) compared the satisfaction of Generation Y employees who had a home office and employees who did not. A large proportion of both groups, a total greater than 70%, felt that working from a home office contributes significantly to achieving a good work life balance. (see graph).

Many companies therefore offer the possibility of remote working at least on one day per week. It is likely that the remote and home office work introduced in many countries following the COVID-19 outbreak will be at least partially maintained.

Different categories are emerging as drivers for remote working:

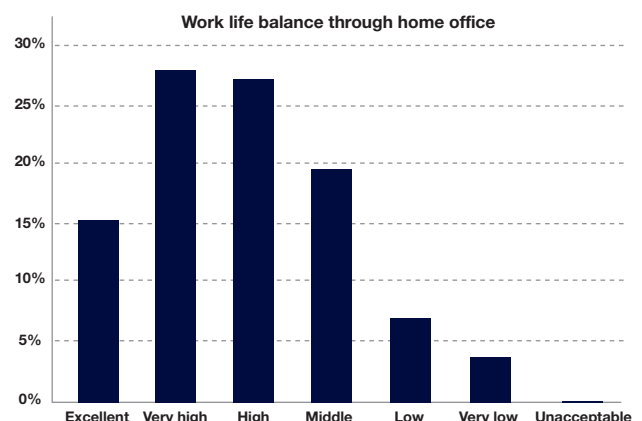
**1. Human capital efficiency:** Remote working falls into the category of business efficiency under the heading of human capital efficiency:

- Employee retention: by improving the work-life balance, not only employee retention but also employee recruitment could benefit.
- Travel costs and travel time savings: working in the home office means travel is no longer necessary, or at least reduced.
- Multi-station deployment of experts: important experts can be deployed more efficiently. Experts on remote assignments could guide less experienced employees remotely, allowing them to be deployed in a variety of locations.

**2. Sustainability:** The remote workplace not only benefits the environment through less pollution and fewer flights, it also reduces road traffic. This helps companies to be more sustainable, allowing it to create a more positive public image without the need for a large advertising budget.

**3. Environmental influence and environmental disasters:** Restrictions due to environmental factors can make it difficult or even impossible to travel to work:

- Earthquakes or extremely bad weather could cause road traffic to come to a standstill or become so difficult that staying at home becomes advisable.
- Global infections (pandemics, epidemics). The lack of medicines and vaccinations have made avoiding contact and staying at home an important weapon in the fight against the spread of disease. If remote production, or work and control of production from home is not possible, then companies will have to pause their operations. The impact on economies can be profound. In an article for the International Monetary Fund, Bloom (2018) quotes that "the expected yearly cost of pandemic influenza at roughly \$500 billion (0.6 percent of global income), including both lost income and the intrinsic cost of elevated mortality."







# Barriers to decentralisation

If there are so many and varied reasons for decentralised work, why has it not been accepted throughout the economy?

There are some exceptions that allow more decentralised work, for example, in administrative and conceptual jobs, or programming activities that are often outsourced to near-shore or offshore. However, most jobs are not easily outsourced or remotely operated and often lack access to central IT systems.

There are some significant social and psychological barriers, most notably a reluctance or even fear of changing ways of working. But there are many other reasons that prevent remote work:

**Security problems:** Security can be more readily monitored and controlled within the company buildings, as the company's own internal network can be protected with established procedures and firewalls. If employees work outside the building, it is easier for external parties to infiltrate the distributed IT infrastructure. Employees are not under any control at home and could thus unwittingly grant access to company IT systems to third parties.

**Reliability:** Access to networks through remote workstations does not have the reliability of internal networks on the factory premises. Particularly for applications that require high reliability, remote working over long distances is a problem.

**Fraud:** With insecure external networks, intruders could realise fraudulent intentions more easily. For example, access can only be checked through software tools - checking of direct physical access is not possible. The danger of criminal acts and the planting of viruses is certainly greater than in the internal IT network.

**Fear of loss of control:** Monitoring the work of employees is not as easy as in the workplace. The employer may wonder if the employee really works when in their home office or is as productive as normal. Yet, according to Golden and Gajendran (2019), for telecommuters who held complex jobs, for those in jobs involving low levels of interdependence and for those in jobs with low levels of social support, the extent of telecommuting had a positive association with job performance.

**Delay (latency):** Delays can be caused due to the transmission time and the long distances to the company premises. This is critical when it comes to real-time applications, for example, the control of robots, or the interaction of several machines working at high speed on assembly lines. There may also be applications that are controlled by people on site in the open air, such as cars, loading machines and rail vehicles. For many of these or similar activities, people are needed. However, it is also apparent that the human factor causes delays, when converting machines for other tasks for example or waiting for an expert to arrive.

The coming rapid expansion of 5G, which we consider an infrastructure enabler, not only makes the above aspects possible and easier, but also offers more remote capabilities.

The three major features of 5G - low latency, high reliability, high bandwidth - support remote and decentralised operation.



# 5G helps remote working take off

5G makes possible a multitude of possible applications, many of them developed and tested in the NTT and NTTDocomo R&D Labs, with others developed in the NTT DATA EMEA Innovation Lab:

**Remote concerts:** Musicians can form a virtual band in real time and play a concert even though they are in different locations, either at their home office or on the road outside.

**Holograms in events:** For example, whole groups of dancers could be duplicated in 3D via holograms, even though only one physical dancer exists. (see also Kirari: <https://2020.ntt/en/innovation/technology/01.html>, <https://www.ntt.co.jp/activity/en/innovation/kirari/>)

**Remote expert diagnosis:** This could be used not only for emergencies, but also for regular maintenance work – a remote expert using AR/VR for example, via a smartphone, could enable a layman to operate tools correctly. This often requires real time access, with the ultra-low latency of 5G, to be able to use the machines without errors. These possibilities can be used in medical emergencies, when first aid must be provided on site before a consultant doctor arrives. Here too, the doctor advises the paramedic or layperson in real time by means of AR/VR.

**Research and development:** Various experts can work together remotely in the same laboratory and collaborate on the same experiments in real time. The laboratory experiments are performed remotely, either remotely controlled by robots (for example, the remote researchers use special gloves or similar tools), or technicians guided by AR/VR.

**Remote testing:** Testing could be done remotely in many cases, from remote software testing for business software applications, to simple machine testing on company premises using remotely controlled robots. It could also facilitate hazardous material testing for inaccessible or dangerous locations, such as nuclear power plants, or on explosive materials, which is already partly practiced.

**Collaboration of talents:** Experts and specialists from all over the world could easily work together - there is no need to hire them, nor would they have to travel to a specific location. Work Life Balance will also play a special role here. As well as combining talents during normal times, remote work is also desirable during problems and crises such as the COVID-19 crisis. Finally, the company can also use it to recruit employees (i.e. to be prepared in the “war of talents”).

**Remote transport and logistics control:** Through 5G, logistics offers the prospect of being completely remote controlled. Until autonomous driving becomes safe enough, trucks, aircraft (drones), ships and trains could be operated and driven remotely. The real-time requirement for reliability is of particular importance.



**A 5G campus network could be the answer to making use of many of these applications.**

# Building a 5G campus network

The 5G campus network enables these applications because the two major characteristics of 5G enable higher reliability and real-time operation.

With the advent of 5G, non-telecommunications companies can build and operate their own networks. Often referred to as a campus network, this can be tailored to individual needs and requirements and be independent of mobile phone providers.

## 5G Campus Network - Important facts and benefits

High reliability

Low latency (1-5 msec)

High bandwidths (up to 10 Gbit/s)

Low cost of purchasing the licence;  
compared to the licence costs of  
the incumbent major operators

Full control of the network

Gathering experience in network  
operation and roll-out in order to gain  
even more benefits from 6G





**Advantages of a campus network**

One of the biggest attractions of a campus structure is the independence from plans and agendas of a third party. With the network set up on the company's own premises, there is a high degree of planning freedom, making it straightforward to add antennas, for example.

Mobile network operators, on the other hand, expand their networks according to their own needs and to meet the requirements of most of their customers. This can cause gaps in nationwide coverage or capacity, particularly for large industrial plants not located in conurbations. With their own campus network, on the other hand, bandwidth can be brought to where it is needed. Another advantage is the flexible connection of IoT devices and systems. If processes or procedures need to be changed, the company's own campus network can react flexibly by setting up or converting antennas and other network components.

A private campus network also guarantees homogeneous indoor and outdoor coverage, while enterprise standard applications manage traffic flow, security, prioritisation and performance.

Another major benefit is security. Faster and above all, secure, access from the factory floor or remotely from the home office is becoming increasingly important. Here too, 5G campus networks score over other solutions, offering better security and protection against external hackers.

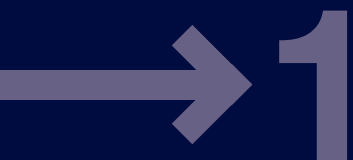
Independence from telecommunications providers also ensures more flexible expansion, high availability and a certain degree of cost independence. In the case of larger industrial sites or plant facilities, consideration should also be given to whether several production plants should pool their efforts to acquire licences and set up a campus network. In this way, costs and tasks can be spread over several sites and Japanese industrial companies have already succeeded in such cooperation.



# Three options for a 5G campus network

There are several options when setting up a campus network, three of which are particularly practical:

- Building your own dedicated network with own infrastructure and operating the network yourself (of course, operation can be outsourced to suitable companies)
- Using a mobile network operator to build the network. This will run physically largely separately but will be integrated into the management processes and infrastructure of the respective network operator.
- Construction and use of a virtual private network based on the existing infrastructure of a network operator. A separate area of the operator's network will provide dedicated resources to meet the needs of the user company. When expansion of the network is required, the network operator will be guided by the requirements of the company.



The **first option** involves the purchase of a corresponding frequency. This is already available for 100,000 euros or less and can - compared to other necessary contracts with the network operators - pay for itself. This allows antennas and data centres to be installed directly on the factory premises, ensuring the company can take full advantage of the high transmission rates and low latency offered by 5G. Transmission rates and latency depend largely on the distances between the data centre and the antennas - if a company does not want to lose the advantages of 5G, a data centre should be no more than 30 kilometres away from the antenna.

However, factory sites are often located away from conurbations, so it is common to find large distances between the industrial site and the provider's data centre. Another advantage of this solution is the complete control that the company gains over the network. However, this also requires a corresponding build-up of know-how among employees.





## 2

The **second option** uses a virtual private network (VPN) based on the existing infrastructure of a telecommunications provider. To cover the requirements of the client company, the network operator provides a (logically) separated area of the 5G network with appropriate resources. This technique, known as network slicing, is one of the major characteristics and benefits of 5G network technology.

This option supports a high degree of independence from the telecommunications provider, promising a high level of security while still maintaining flexibility and independence in planning or even necessary rescheduling.



## 3

In the **third option**, companies rely entirely on the offer of a mobile network operator to build the campus network. This will be physically separate but is integrated into the management processes and infrastructure of the respective network operator. This also means a high degree of dependence on the telecommunications company. Possible changes in the campus network, for example because production lines or building structures change, will be more complicated to implement. This has the advantage that the know-how for the construction and operation of the campus network does not have to be built up by the company.

All three options involve opportunities and risks. Ultimately, strategic, organisational and cost aspects are decisive factors in making the final selection. The right choice for the company will be based on an analysis of its own particular needs.

### Assessing the need

To assess its needs for a campus network, the company should address the issues below:

- Determine data transmission requirements in the factory and office buildings
- Where are the existing hotspots?
- Identify critical processes, particularly where real-time demand exists.
- Develop usage forecasts and scenarios taking into account security concepts
- Develop and evaluate solution scenarios
- Create suitable requirements catalogues for network operators and suppliers of network components
- Implement individual pilot projects - this provides important experience for further implementation

# NTT DATA offers experience in 5G operations

NTT DATA has partnered with several other developers and customers, gaining valuable experience in 5G live operations:

- A humanoid robot T-HR3, developed alongside Toyota, that can be controlled using 5G over a distance of 10 kilometres.
- NTT DOCOMO also demonstrated that it could connect racing cars, including one travelling at 300 km/hr, as part of its automotive trials. This helped to demonstrate the crucial role 5G can play in future V2X car solutions.
- Sporting events are being used as a key arena to show off 5G technology. PyeongChang saw the introduction of some 5G technology in 2018 and NTT DOCOMO plans to make a bigger splash in Tokyo in 2021. In the UK, we've already seen the first live broadcast over 5G using remote production in November 2018 at the EE Wembley Cup Final.
- Last year saw the data wall take a step forward as 3D-rendered graphics were added to enhance the experience further. Fan engagement, with the use of mobile, is an area of expertise for NTT DATA, which is a long-term partner of IndyCar racing. Our app gives users incredible insight into their favourite teams and drivers, including telemetry, video streaming, leader board statistics and track maps.



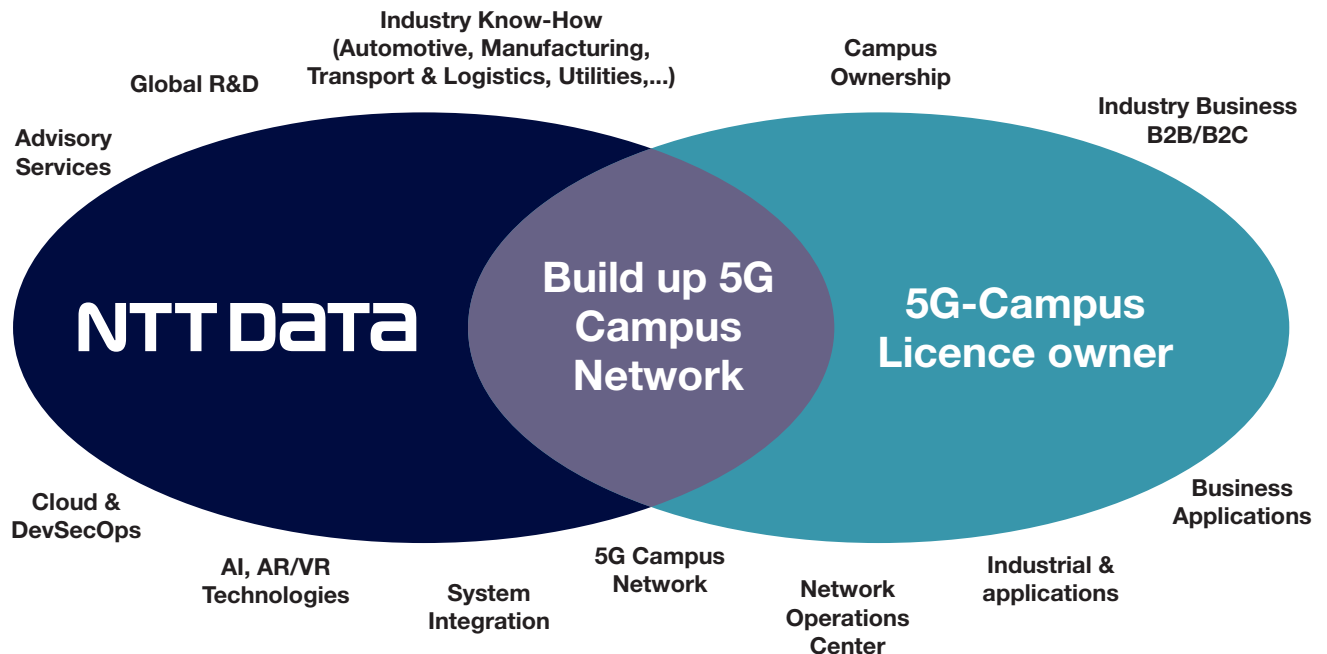


# A partner in building a 5G campus network

NTT DATA has experience of 5G campus networks, in particular developing and expanding 5G remote working applications using the 5G campus network at its EMEA NTT Innovation Lab. Design thinking methods are used to develop new creative ideas and to explore service possibilities based on 5G.

To help companies realise their own 5G campus network, NTT DATA will work with them through several stages. These stages help the company select its own solutions and component providers, ensuring maximum independence.

## Our Proposition: NTT a partner for Building 5G Campus Network & ecosystem





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