

NTT DATA

5G

APP FRAMEWORK

Drivers for change

Enterprises in almost every industry sector are looking for new ways of combining 5G, Cloud and Edge Computing to help them respond effectively to continuous, large-scale strategic changes. These include:

Being both global and local

Growing use of digitization and automation are essential for delivering enhanced operational efficiency and higher quality outcomes within a wide variety of industries.

Wherever complex systems are deployed (power grids, oil-fields and mines, automated handling and manufacturing systems, even equipment for long-term health conditions), we use Internet of Things (IoT) devices and sensor arrays to gather, collate and transmit data for analysis and action.

Routine and urgent low latency actions must be executed locally, so we need to have real intelligence on site, normally provided by Edge devices and algorithms, which coordinate with central control systems. As Artificial Intelligence becomes both more available and trustworthy, and as more targeted operations are required, so the combination of Edge computing with centralised control in real time will become more important than ever.

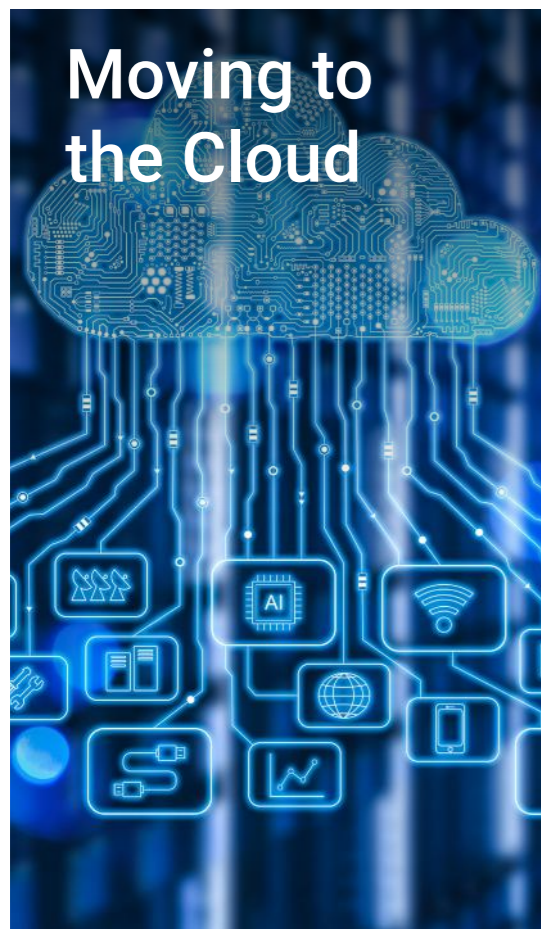


Moving to the Cloud

Cloud has become a basic necessity of business life because of the operational and financial advantages they bring.

Cloud enables enterprises to move from bespoke, on-site architectures to rapidly scalable future proofed platforms, always kept at best practice levels by specialist partners. Payment based on usage reduces fixed costs, delivers much greater agility and enables rapid development of new business lines, innovative concepts and presence in new geographies.

Yet there are challenges. Cloud customers need to be mindful of such issues as data sovereignty, consistency across multiple platforms owned by different hyperscale or local partners, cyber-security and, perhaps most critical for international businesses, how to balance fast-responses to local events with central control of asset fleets.



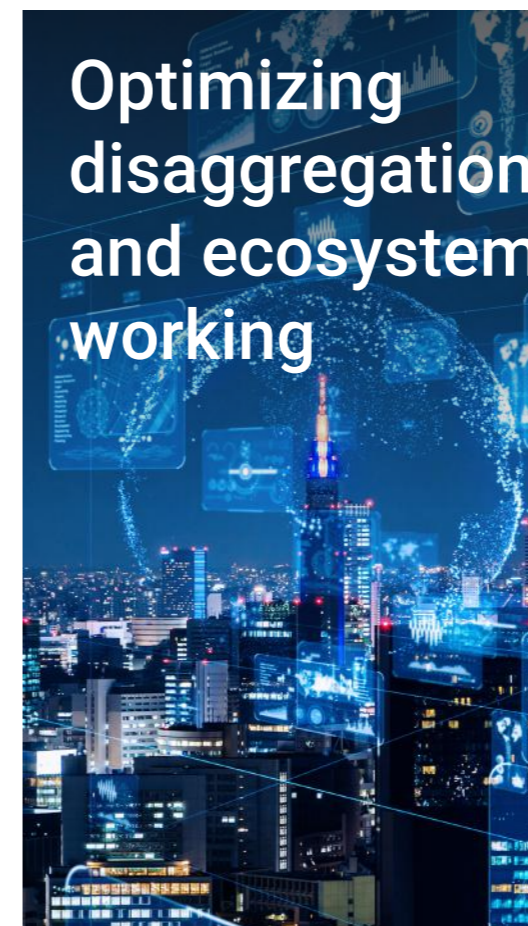
Optimizing disaggregation and ecosystem working

Systems and workforces are disaggregating at speed, as the established model of monolithic corporate structures based around fixed office and factory locations appears more and more old-fashioned.

People are starting to work at least part of the time from home, and assembly sites may increasingly be localised to simplify logistics and profit from new automation technologies.

Business and operational systems are likely to be spread across numerous serverless environments, with development happening in virtual spaces, shared by expert teams based on partner ecosystems, jointly developing products and services in highly flexible, constantly changing configurations.

Disaggregation challenges structures, methods and business rules, and requires a new kind of distributed business environment to work effectively.



Responding to environmental and regulatory issues

The environment is becoming perhaps the most urgent issue faced by enterprise leadership in every sector.

Virtually every business is now trying to reduce its carbon footprint by cutting down on travel, reducing energy costs and building more sustainable models in a changing society. Regulators are setting higher standards and governments are at last making environmental performance a top priority for everyone.

These environmental concerns give new impetus to solutions designed to improve efficiency and reduce faults, and this change can only accelerate in the near future.

Our view

Business change is redefining the characteristics needed to build effective working environments for emerging, increasingly diverse business requirements.

There is an urgent requirement for new structures, concepts and methods for interacting effectively with customers and partners across geographies and operational boundaries.

NTT DATA has developed a new vision and approach based on a combination of Edge Computing and intelligent, programmable networks, enabled by 5G. This enables real-time working between geographically distributed locations, introduction of advanced but bandwidth-hungry technologies, such as Extended Reality (XR), and higher quality joint working between disaggregated teams and systems.

This concept is driving a revolution in working environments for everything from rapid service and product development to remote working.

5G App Framework

Many solutions and systems already exist for connecting multiple geographical locations within a single architecture. These use Edge devices on-site to carry out automated tasks, gather data locally or from other networked locations for transmission to control centres, and perform initial analysis on site as defined by business rules.

Current best practice

Today's solutions now often use algorithms hosted on Edge devices, with secure connectivity managed via Software Defined Networks (SDN), often delivered as secure overlays using any available Internet connection, accessed through geographically distributed Points of Presence (POP).

This approach has replaced use of dedicated leased lines for end-to-end communication and has reduced costs, while increasing operational flexibility. Creation of secure global networks has become simpler as a result, but use of SDN with traditional legacy connectivity Internet connections still leads to significant constraints, notably in terms of bandwidth and, above all, latency.

Some emerging business cases require much faster hands-on control of remote sites and operations from central locations, and latency issues are the single greatest obstacle to enabling the kind of highly distributed, flexible working environment that is urgently needed by a growing number of industry sectors.

Contribution of 5G

This is where 5G can make a vital difference, because of its transformational impact on latency, Quality of Service (QoS) and secure bandwidth.

In developing the 5G Framework proposition, NTT DATA brought together a range of specifications, all of them central to the new world of distributed/disaggregated working that is emerging all around us. Basic requirements include:

- Movement from private spaces on public hyperscale platforms to creation of secure, distributed programmable networks.
- Ability to enable distributed collaborative working, based on rapid cloud-native build, scenario-test (using digital twins) and move into production.
- Delivering disaggregated, single point of accountability control of remote asset fleets, supported by practical use of bandwidth-hungry technologies, such as 3D video and XR, for real-time experience of remote working.
- Advanced automation options, enabled by machine learning and eventually Artificial Intelligence (AI), enabled by rich data flows from IoT devices and sensor arrays, supported by granular analytics

This concept permits distributed work environments to deliver intelligence at the Edge while enabling real-time control from the centre. It transcends Cloud by making the entire communication/connectivity environment fully distributed and disaggregated. It moves us from traditional cloud to intelligent, programmable networks, without the need to build or own bespoke technology.

New concept, new proposition

The NTT DATA 5G App Framework provides a flexible, programmable environment for building, testing and delivering high-performing, very low-latency services for the most demanding users in many different industry sectors. It combines the speed and bandwidth advantages of 5G with serverless programmable networks to enable:



Efficient ecosystem and partner joint working on development, testing and launch of advanced new services.



Accelerated take-up of 5G and Edge Computing, enabling rapid monetization and fast return on investment for early adopters.



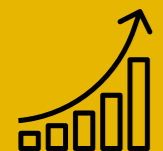
Seamlessly interconnecting central management of complex, global systems with local automation, data analytics, storage and processing, enabled by Edge devices, backed by machine learning and AI...



Creating an agile, continuously evolving, highly adaptable environment for developing and executing advanced services that provide added value in key areas, including smart management of distributed assets...



With global and local (edge-deployed) capabilities complementing each other and working together in a smooth and intuitive manner.



Other benefits include low-carbon, high sustainability environmental performance, with higher levels of resilience through disaggregation at both logical and human levels.

The 5G App Framework will redefine the optimal balance between central and distributed resources, enabling better ecosystem working, reduced risk when adopting cutting-edge technologies, while doing all this with maximum security.

It avoids silo implementation, by deploying a modular architecture that can reuse existing components to create new services and features, while accelerating development and reducing costs. Above all, the 5G App Framework concept includes integration with 3rd party solutions as a core capability, enabling many different players to be brought together in a shared working environment for accelerated development, testing and rapid move into production.

Building 5G App Framework

The 5G App Framework combines different existing technologies with the added value offered by 5G to create a new kind of working environment.

Core components

The architecture of the concept is based on three connected areas of activity: Remote Edge; Cloud/Programmable Network; and User/Edge.

Remote Edge comprises sensors and intelligent sensors, visual data capture (3D cameras, for example) and Edge computer. This enables information to be gathered from every relevant device, asset or environmental indicator in that particular location, then analysed (to an agreed and clearly defined level) in the Edge device on site before being collated for upload to central systems to a schedule defined by business rules.

Computing and analytical capability at the Remote Edge permits specific tasks to be executed automatically, according to agreed protocols, while acting as the local hub to receive and execute instructions from the control centre.

Cloud/Programmable Network provides data hubs for receiving and transmitting data in every form, including video and content for immersive technologies (to be explored later). This is a virtual environment for carrying out all cloud-based tasks, from hosting to big data to basic compute.

In our solution, Cloud and Network are one and the same, and enabled by 5G to accelerate connectivity and add value to the range of interface options available to the primary users.

User Edge is the virtual location in which authorised system users can directly interact with any assets, systems and processes as defined by business rules. The enhanced speed and bandwidth of the environment means that immersive interface technology is available, allowing operatives at any distributed location to interact directly with assets anywhere else, in real-time.

One of the major operational improvements enabled by use of 5G will be a step-change in the use of experiential methods for managing assets, with (for example) crane operators using the same hands-on control systems that a live crane operator on site would use- but in this case, accessing the asset from any defined site, anywhere in the world.



Architectural layout

The diagram below gives a simplified overview of the end-to-end architecture

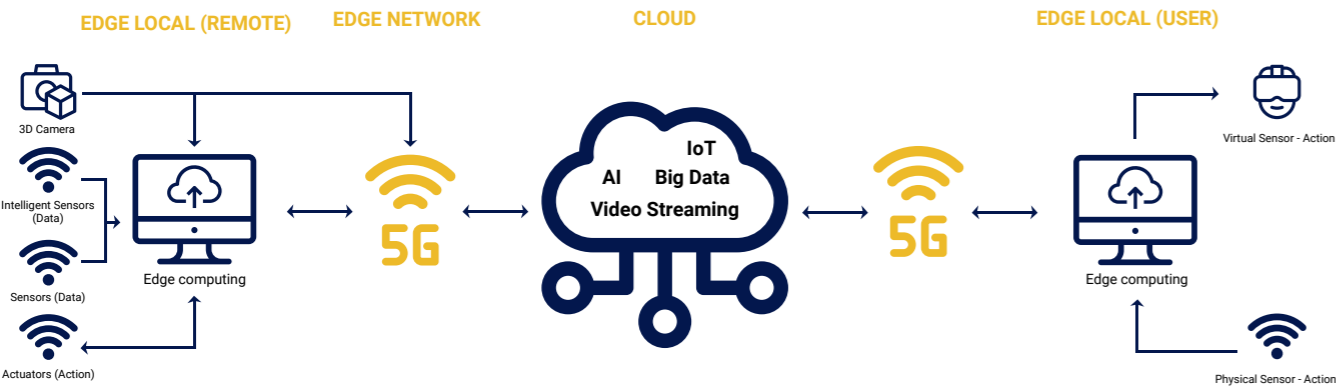


Figure 1: simple architectural overview.

This shows the way that data flows from the Remote Edge into and from the programmable network. This carries out all the functions of a modern cloud platform and network combined, while operators working at the User Edge can control functions across the environment in close to real time.

We can see here how different technologies are incorporated as basic components into the architecture, and then enabled by 5G at specific points in the environment. Data from remote devices, such as cranes or construction equipment, including 3D video and immersive data, flow very rapidly end to end. This enables users at distributed control centres to experience the status and actions carried out on remote sites in close to real time, and exercise highly granular control.

The intelligence built into the Edge Network also fosters enhanced automation, machine learning and intelligent responses, adding growing value to the capabilities of the operators and consultants engaged in managing the key systems. There are fewer points at which data has to negotiate moving from one core component to another, and latency is dramatically reduced.

Interface technologies

Operators can now “inhabit” this environment in a more natural way than has ever been possible before. They can do this by using a growing range of advanced interface technologies, all designed to project the operator from any distributed location into the asset(s) they control, no matter where they are.

High bandwidth and low latency, enabled by 5G, means that data received from the Edge can now include video, 3D images, direct management via duplicate physical controls: all designed to place operators and consultants into the required Edge locations as if they were physically present.

Immersive technologies, notably Augmented Reality and Virtual Reality, combined as Extended Reality (XR), have been available for some time now, but latency issues have made it practically impossible to deploy these on remote sites for central review and control. The 5G App Framework will enable faster and more accurate understanding of the true situation at any moment and more precise control.

Operating companies should also be able to achieve higher availability levels for their machines, aided by rapid diagnosis of wear or potential faults, leading to improved predictive and proactive maintenance and system management. At the same time, operator and public safety will be greatly enhanced due to more efficient remote working, while use of immersive technologies greatly improves training and support.

Targeted service delivery is enhanced by the more intuitive insights and controls offered by immersive interface technologies, and this applies to industries as diverse as logistics and construction, right through to personalised healthcare solutions. Without the low latency advantages of 5G, it is hard to see how this could be achieved.

We believe that the rise of XR and other immersive technologies will lead to a large-scale and rapid adoption of the 5G App Framework. Each individual component (Edge, 5G, programmable cloud) is available in the market right now, but combining them all will prove transformational.

XR brings higher levels of rapid, intuitive control than before, while the 5G App Framework enables that control to be exercised across extraordinary distances. This will permit a rapid reduction in costs, both financial and environmental, while improving quality of outcomes. Early adopters are already delivering benefits to bottom line and brand reputation: virtually all industrial players will follow in their footsteps.

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Development and applications

The inclusive nature of the 5G App framework, combining cloud hosting and applications delivery with secure networking and distributed development environments also adds value to service creation and delivery.

One of the most important characteristics of the 5G App Framework is its true cloud-native status, enabling applications to developed in a location agnostic manner.

Ecosystem working is enabled at every stage of the process, from initial ideation through to development, test, proof of concept, scenarios using digital twins, to the move into production. Everything takes place within the same environment, leading to incremental efficiency gains and enhancing corporate agility throughout.

One of the most important characteristics of the 5G App Framework is its true cloud-native status



Making a difference with 5G App Framework

We have already mentioned a number of industries in which the ability to exercise more efficient management of often very complex asset networks is both a basic necessity and a major corporate differentiator.

The number of potential use cases grows daily, and it is not our purpose in this paper to give an exhaustive overview of potential industrial uses. Instead, we want to position a number of options, currently being explored in solutions that include 5G, together with

Current Use Cases

NTT DATA is working with a range of partners to develop and test viable solutions that use 5G as an extension to current networking solutions, developing effective remote asset management for adoption in the near future. The examples show how concepts are being proven in action now, with further development already taking place.



Port management

Many core processes at large international ports are automated, with small numbers of people based on site to handle essential systems. We have now demonstrated the viability of integrated port management across multiple geographies from control centres that are able to ensure smooth traffic flows, lower downtime and better coordination of sometimes unpredictable ship and container movements.

Given the critical importance of sea transport to international trade, and the as yet little recognised environmental impact of large container vessels, these semi-automated systems now in trial have the capacity to reduce carbon emissions, improve handling and storage efficiency and enable goods to move through logistics networks faster and more reliably. We can already control cranes in real time from a location that is hundreds and even thousands of kilometres distant. A truly integrated, always optimised world trading system is now coming closer.

Construction

All aspects of construction, from housebuilding to heavy engineering, need efficient management of complex machines, often on many different sites, all of them with high availability requirements and also potential large environmental impact. A recent demonstration showed that it is now possible to control equipment from locations up to 5000 miles distant, and this opens up a lot of interesting new possibilities for the sector.

Better hands-on control from the centre makes it easier to manage downtime and maintenance requirements. Major efficiency gains are also made possible by maximising the use of machines and avoiding time or resource wastage. The possible improvements to environmental performance are also very clear.

Extractive industries

Early examples of remote management using 5G have focused to date on the mining industry, but the same advantages are also available in related sectors, such as Oil & Gas. In all such cases operations can involve danger, both to personnel and to the environment, so there is a great incentive to automate and use Edge devices to manage activities as far as possible.

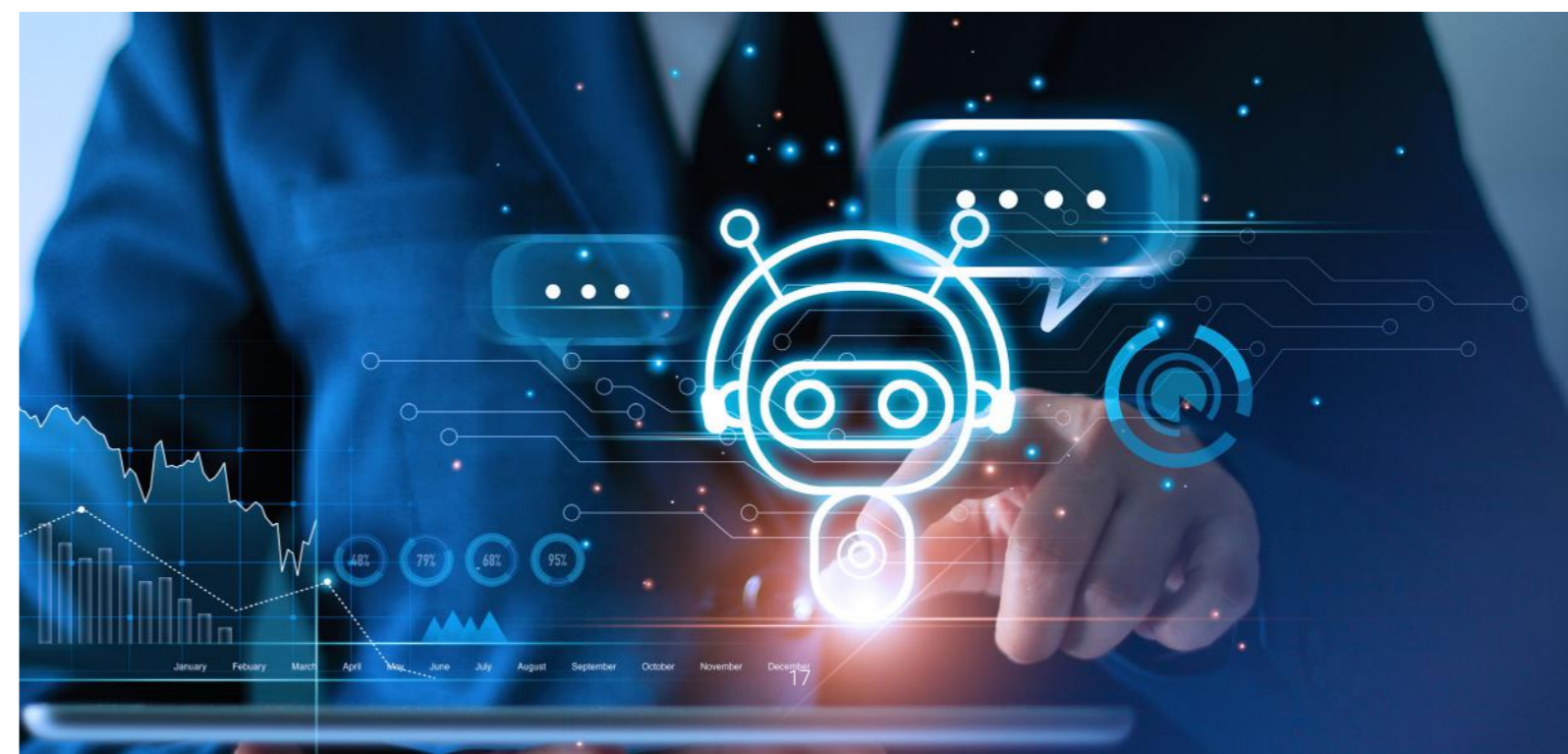
Real time management makes it possible to remove a layer of collaborative work environments (physical control centres, set close to the site of operations) and focus on geographically distributed, virtual control centres, instead. Management of machinery, sensors and processes in real time reduces potential dangers and ensures full compliance with constantly more restrictive regulations. This could prove a very important development for all these industries.

Emerging Use Cases

We have no doubt that the 5G App Framework will also become a standard operating model for many other industries, some of which are less mature than the examples given, although some, paradoxically, are more advanced commercially. In these latter cases, the urgent need for automation, use of sensor data and algorithmic decision-making has led early adopters to seek solutions that achieve as much as possible using current technology. Adding 5G to such solutions could be transformational. Examples include:

Automotive

As vehicles become “networked devices with wheels”, all interested parties are working to deliver both added value services for travellers, together with better management, not just of the vehicle “as an asset” but also the ownership and financial elements for keeping a car on the road. Insurers using real time data to set terms for individual drivers, and the rise of autonomous vehicles may lead to a revolution in ownership models. Use of low-latency networking to manage such models will be an essential requirement.



Smart cities

This can be seen as a natural follow-up to automotive systems, although the scope extends much further. Early use cases see vehicles and city processes exchanging data dynamically to identify best routes, use of parking options, access to resources and attractions. City governments are also using sensor data to ensure that core city systems work as efficiently as possible, while enabling better traffic flows and more effective use of everything from power usage to mass transit to basic citizen services. This will become a very important growth market in the extremely near future.

Healthcare

This entire sector is moving closer to personalised treatments, targeted at individuals or small groups, and there is growing ecosystem working focused on everything from medicine development to joint services between Pharma and Device manufacturers. Every service, from ideation through to monitoring of patient condition will be better enabled by the 5G Edge, while implementation of “market of one” services is hardly conceivable without real time interaction of the kind offered by 5G Edge.

Critical National Infrastructure (CNI)

The most important part of this sector is power generation and production, which is not only complex but also very sensitive to any form of disruption. Non-negotiable requirements for CNI include proactive maintenance, managing asset fleets, and rapid diagnosis of low latency response to problems. CNI, as the name suggests, provides the basic foundation for our societies and end to end visibility and control of all core systems is a basic necessity. In everything from training to maintenance to security, 5G Edge will deliver major benefits.

Manufacturing

Everything we have said (above) on the subject of both CNI and logistics is true of discrete manufacturing. We are starting to see a growing trend towards localised, distributed manufacturing of smaller production runs, with a greater number of variants, requiring more granular control of asset fleets in multiple locations. Manufacturing enhancements also need to be fully connected into major systems of record, such as SAP, and NTT DATA is engineering its solutions in this area to ensure this takes place.

Across many of these key sectors we can see a few major trends, common to all, and certain to cause important changes and potentially a good deal of disruption in the years ahead. 5G App Framework has been designed specifically to accelerate adoption and reduce risks of change at the same time.



Engagement process

The final section of this paper shows our thinking on the complex and often difficult process of engagement. Key factors include:

Start from where you are

There is no clearly defined right or wrong way to do this. Engaging with the 5G App framework cannot be done through an off the shelf solution. Each organisation needs to build a customized approach, based on a combination of long-term strategic vision and short-term operational priorities.

The most urgent priority will form the natural start point for your journey, with other issues addressed at later stages of implementation. Wherever you start from, you will be moving into a working environment that is distributed, disaggregated and designed for collaborative, ecosystem working. Each step opens up new possibilities, and permits refinement to your strategy and implementation plans.

Define your own use cases

5G App Framework does not come with a fixed range of services. It enables you to build a targeted environment for improving everything you do, and each client will address their priorities by developing the use cases and services that deliver the right business outcomes for them. This is your strategy and you own it, always.

You define the scope

Once you build the intelligent, programmable networking capability we propose, you can define and guide its evolution to meet your constantly changing needs. New technology and service options are appearing all the time and our approach is highly effective in making your business truly future proofed and long-term sustainable.

Define your own use cases

Enterprises need to decide who to trust as their lead change partner for this journey into what is, by definition, an unpredictable future. Change of this kind and on this scale requires broadly-based capabilities and experience, as the technologies and disciplines involved are becoming more and more integrated and interconnected.

Connecting IT and Operational Technology (OT), uniting classic cloud (compute, data management, hosting) with networks and 5G: it is necessary to be deploy leading-edge capability in all these areas in order to be a credible and effective partner in change. NTT DATA is:

- One of the world's leading Telecommunications and Mobile Telephony businesses. We understand networking on a global scale. We are early adopters of 5G technology, through our subsidiary DoCoMo and have invested more than almost any other player in driving this new technology forward.
- One of the world's leading core business systems companies, a global player in systems of record, enabling us to build practical solutions that deliver measurable business benefit fast.
- A leading OT business, with inside knowledge of Automotive, Healthcare, Manufacturing and other industry sectors, as well. We speak the same language and understand the priorities of leading businesses in all key sectors.
- A natural ecosystem player. Our global structure is based on highly capable, largely autonomous businesses. We respect difference in culture and aim to make agile team-building, working and reforming a natural part of everyday business life.



In this fast-changing business and technology landscape, NTT DATA is positioning to be the knowledgeable, agile partner that the most ambitious companies need to build their own roadmap to a better future.

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