NTT DATA

Whitepaper | 5G

The Rise of Intelligent Networked Cloud

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Abstract

Making the "Future Faster" to happen means that solutions and technologies need concretely touchable applications and a reliable migration strategy to move from legacy to the new picture. Speed is a key factor to taste the benefits proposed by AI-based practices, Digital Twins and Cognitive applications, allowing responsiveness and low-latency. Rapid and easy-to manage service composability is indispensable for monetization. That's the path towards IOWN, where interoperability and connectivity remain are essential. NTT DATA can drive the transition with focused products.

The Intelligent Networked Cloud

The strategic move to cloud, now seen as essential for enterprises of every size and in every sector, provides an historic opportunity to Communication Service Providers (CSPs). Using new and emerging technologies focused on connectivity and networking, they can help enterprises start to gain financial and competitiveness benefits from cloud early. That enables CSPs to redefine their own relationships with their customers, becoming more strategically important and opening new, higher margin business opportunities.

It is easy to be so preoccupied with the journey to cloud that we lose sight of how cloud, itself, is changing- and also, how radical and important this process of evolution is becoming. Traditional cloud remains a series of very large datacentres, now increasingly owned by hyperscale public cloud providers (though some specialist outsourcers remain active in the market). The traditional business and technology models still exist, but end user client enterprises just don't see them anymore.

Next generation cloud will look very different. It is known by different titles: distributed cloud, decentralized cloud, cloudified networks, networked cloud. Whatever term you apply, there is a single, consistent reality about the convergence of cloud and networks. To provide the creative working, collaborative environment required to drive a real business and sustainability revolution Cloud must above all be about **connectivity**. The arithmetic that defines cloud of the future will be Compute + Data + Rapid Connectivity + Distributed Intelligence + Automation + Immersive Technologies + Analytical Tools, and no doubt much more to come.

NTT DATA believes it is essential to remove the divide between Cloud (where we calculate, store, analyse and collaborate) and Network (which holds the components of cloud together). We believe the most helpful way to think of these two interconnected components is as a single, integrated, indivisible unit. Cloud and Network must be One. The network is the cloud, the cloud is the network and intelligence is everywhere.

That's why we use the term Intelligent Networked Cloud, because it is a simple description of the working environments that we are now creating.

Let's make the future faster

The key to making this new vision work in practice is interoperability.

This may be a new world in technology terms but there is a real danger that enterprises might fall into old ways of doing things: in particular, of single sourcing with one large partner- in this case, probably a hyperscale cloud provider- and being locked into their own methods, resource pool and development paths.

Customers must be free to move in any direction they require, as technology (and technologies) continue to evolve. In the future, we expect a primary role to be taken, not by "systems integrators" but by "service integrators", deploying their own proprietary assets as **service enablers**. As we shall see, building and delivering composable services across global networks will become a natural and logical approach in the near future.

Key questions for all enterprises today include: how to change the way we work, design, build and organize to make the intelligent networked cloud vision a living reality. And then, how we use this new form of cloud to create value for a business, organization, its people, shareholders, customers, partners and, increasingly, the planet, as well.

There are four new technology components, in particular, that enable creation of the new form of cloud:

IOT (or very often IIot- Industrial Internet of Things) provides a simple way to gather vast amounts of data, collate, store and securely transfer it to any location where monitoring, intervention and analysis can be carried out. These simple, standards-based, nearly ubiquitous sensor arrays form the basis for oversight and control right across the cloud.

Edge (for proximity applications, or more properly Multi-access Edge Computing: MEC) is the technology that allows intelligence to pervade every part of the cloud. This permits the introduction of hyperautomation, with instant response to events at any point, while also enabling greater agility for every single service that uses this connected environment.

Automation enabled by a combination of Machine Learning, Smart Algorithms and, increasingly, true AI, building on the availability of Edge-based intelligence to automate key actions across often geographically extended/distributed networks. This is a key factor in driving much higher levels of agile response to everything from market demand to environmental changes to intervention in production or delivery systems.

5G is the catalyst for every other positive change. Intelligent Networked Cloud, as the name suggests, requires very high bandwidth, very low latency connectivity, as it depends on moving large amounts of data very fast, very reliably, over very long distances. 5G is the first available technology that permits this combination of speed and capacity at an affordable price, although we should note that 5G is just an enabler and will eventually be superseded in its turn as even more advanced and responsive communications technologies become available.

AI technology and the related different fields of application, from Machine Learning up to GenAI use cases, can be successfully included in the daily experience, as composable building blocks to improve network capabilities and related usability.

Bringing these components together makes it possible to create a cloud environment in which more flexible, geographically distributed, and much more highly collaborative working becomes possible. The benefits of this approach depend ultimately on the organizations using it, as it is their creativity and ability to think in new ways that defines how much value they can unlock.

Thanks to the arrival of intelligent networks, enabled by these core technologies, CSPs have new opportunities to gain value from their investments by providing:

Fast, Cloudlike Solutions

By using Network Slicing, it is now possible to set up 5G-enabled "cloudlike" solutions at unprecedented speeds, and this could prove to be a gamechanger in the market. Delivering such solutions is not precisely the same as true cloud transformation, which may involve organizational redesign, transformation of applications suites to become "cloud native", a new approach to employment mix, collaboration and even corporate culture.

Cloudlike solutions delivered by Network Slicing will not, in themselves, deliver such changes, but they do deliver speed, and that includes **fast monetization**. This is crucial and can be a real (andvaluable) differentiator for service providers.

That's because, as most large enterprises know to their cost, the journey to cloud can take time, prove disruptive to business processes and be surprisingly expensive (because you need to maintain legacy environments throughout transition). Every business is looking for ways to reduce their risk and cut the cost of transition through taking new, cloud-native services to market fast, and using new revenue streams to offset the cost of change.

Network providers can make this possible by using communications technology (Network Slicing) to create cloud environments for fast service development, testing and go to market. That is a strategic business benefit well worth paying for. So how can we make this approach work?

Fast Development and Monetization

Evolutionary change in networks is driven by advances in radio access technology, which have led to three major improvements. First, the latency budget is controlled (and equalized) at RAN stage. Second, network elements of Core Network and RAN (even Open RAN) can be virtualized and created on-demand. Third, resources can be allocated to each customer together with the applications related to the requested use case(s).

In addition, 5G makes it possible to deliver the applications access related to each use case regardless of physical hosting location. That enables proximity servers to be identified by APN number and Network Slice Instance (NSI). Why does this matter? It means that Network Slicing becomes the fundamental method used to identify and allocate resources to customers as they request them. That creates "instant cloud" for each requirement, instantly and at very low cost.

Composable Cloud Service

Using this form of technology, CSPs can position themselves as a form of "one stop shop" that enables end-user customers to buy into "cloudlike" operations with unusual simplicity. Connectivity ceases to be seen as a commodity and instead becomes the key to fast cloud access, together with the business benefits this delivers. How does this work in practice? The simplistic answer is by taking a **composable approach**. This is a term now widely

used to describe how cloud-enabled enterprises can use the "mix and match" capabilities of virtualized, digitized environments to create new services "on the fly" from standard components. This addresses a general trend in most sectors towards providing more customized options for end-users, from personal medical treatments, vehicles and consumer goods with specific characteristics and qualities, or insurance/financial services using real world data for solutions tailored to individuals.

The new vision we present for fast access to cloudlike solutions uses the idea of composability, not just for **developing end user-targeted solutions** but for **developing cloud environments** as well. This is the key to enabling unusually fast access to cloud capability, at low cost, high speed and low risk. This will simplify the delivery of new use cases and enable easier monetization.

How does it work?

Delivering use cases remains a difficult and time-consuming activity, as it involves design, engineering and deployment of software components and resources. Our goal is therefore to use automation as the key to simplifying design tasks and optimizing resource allocation through dynamic workflow. In effect, we use a **composable approach** to define, align and allocate the resources (compute, communication, storage, applications...) needed for each use case at the point of customer request. This means that each use case is unique to the customer and fits their exact needs, but is deployable at high speed and low cost. It is a cloud native approach to delivering a cloudlike service. Although we can define this approach as Network Slicing, it involves other elements and components, some related to NTT DATA service capability and some based on proprietary "products". We will foster development of standard interfaces to remove or lessen the prospect of vendor lock-in, as we encourage vendors to improve interoperability through a common standard set of interfaces, with Open RAN as a key example.

Workflow involved in creating customer on-demand use cases will operate in the following way:

- Define use cases in the form of application related services.
- Use Network Slicing to create the appropriate connectivity services, which are assigned to the application-related use cases in order to ensure efficient delivery and consumption.
- Provision network resources (needed for each Network Slice) automatically through the correct provisioning information.
- Virtualize Network Elements (as containers), enabling Network Functions to be created as and when required, on-demand.

The workflow defined by NTT DATA manages the service by orchestrating each of these four points, and happens at both RAN (vRAN, Open RAN) stage and Core Network (5G SA) stage.

What difference does it make?

Once a business and its main partners are all operating in a way that makes them “at home” in the cloud, the innovation, development, design, test, build and launch aspect of product and service management can change completely, if all parties have the vision and will to make such changes happen.

There is a growing move to a Platform Approach, which is based on creation of virtual co-development spaces, which may be owned (or co-owned) by one business or several partners, but which may also be comprised of virtual cloud-based components leased as required. Co-development in the cloud means you can form your own “skunk works” approach, with teams swarming around an issue, then reforming with different personnel from different sources to address a new issue. The levels of agility are hugely improved, while use of virtualized tools, such as digital twins, permits higher levels of testing before launch- another potentially important benefit.

By creating cloudlike provision through a composable, largely automated networking approach, therefore, we enable composable and highly targeted solution development, and that is the key to:

Faster Monetization

Cloud represents a large change program and business leaders are not prepared to wait for completion of the transition before they start to make additional profit from their new strategy. This is one reason why “white label” solutions are so popular in some sectors.

The ability to access a SaaS and PaaS based cloud-based banking platform, for example, that can be customized for different institutions, has proved very important in the financial sector. Other options in other industries have also proved popular, as these enable enterprises to start launching “cloudlike” products and solutions fast, before their own transformation is complete.

This is a good business model but with major shortcomings. Not only are enterprises limited in how far they can go in differentiating and customizing the solutions in question, they are also constricted by SaaS delivery, over which they can exercise little or no control. We believe CSPs can now offer a much better option to their own customers, and open up new sources of value for their own businesses as a result. This is exactly why NTT DATA has developed its solution and product portfolio, as we will show in the next chapter.

Balancing Products and Solutions

NTT DATA is not a technology vendor but rather a service integrator, using standard components and a portfolio of proprietary elements to accelerate customer access to added value services. The approach we use is based on automated (or semi-automated) workflow to ensure rapid service setup, based on Network Slicing, together with use of our own service offer portfolio. These core elements enable us to move faster than ever in creating on-demand services. This is how they work.

Solution Portfolio Approach

NTT DATA has developed "fast-start" options in the most critical areas of cloud enablement, allowing end-user customers to build cloudlike environments at speed, with low risk and low start-up costs. Once these environments are in place, customers can begin to use the full power of Cloud, including collaborative development platforms, composable solutions and virtualised toolsets for innovation, test and customization almost immediately. They can explore the full potential of cloud at once, therefore, without the need to go through a costly and disruptive transformation exercise **as the necessary first stage**.

The service offer portfolio developed by NTT DATA makes it simple for customers to build their own composable solutions on the platform we provide. In this way, CSPs, working in alliance with NTT DATA, can enable their end-user customers to start developing and launching new service and products of their own in an entirely digital native, cloud-enabled manner. So how does it work? Figure 1 below gives a very simplified top-level view of the portfolio as it will evolve over the years ahead. For the moment, we will focus on three key components: 5G Enabling Fabric (5GEF®), Rapid Edge service provision (CreEdgeOn) and Security Edge Protection Proxy (SEPP).

The portfolio when complete will provide "few clicks" service creation on demand, dynamically allocating intelligent networked cloud resources to provide the customized service required. In principle, we use the same form of workflow and experience now used to deliver basic connectivity services, but now with all the compute and logical components needed to deliver a true cloud-native offer for immediate use. It feels familiar and very simple to end-user customers, but the power of this approach is quite new.

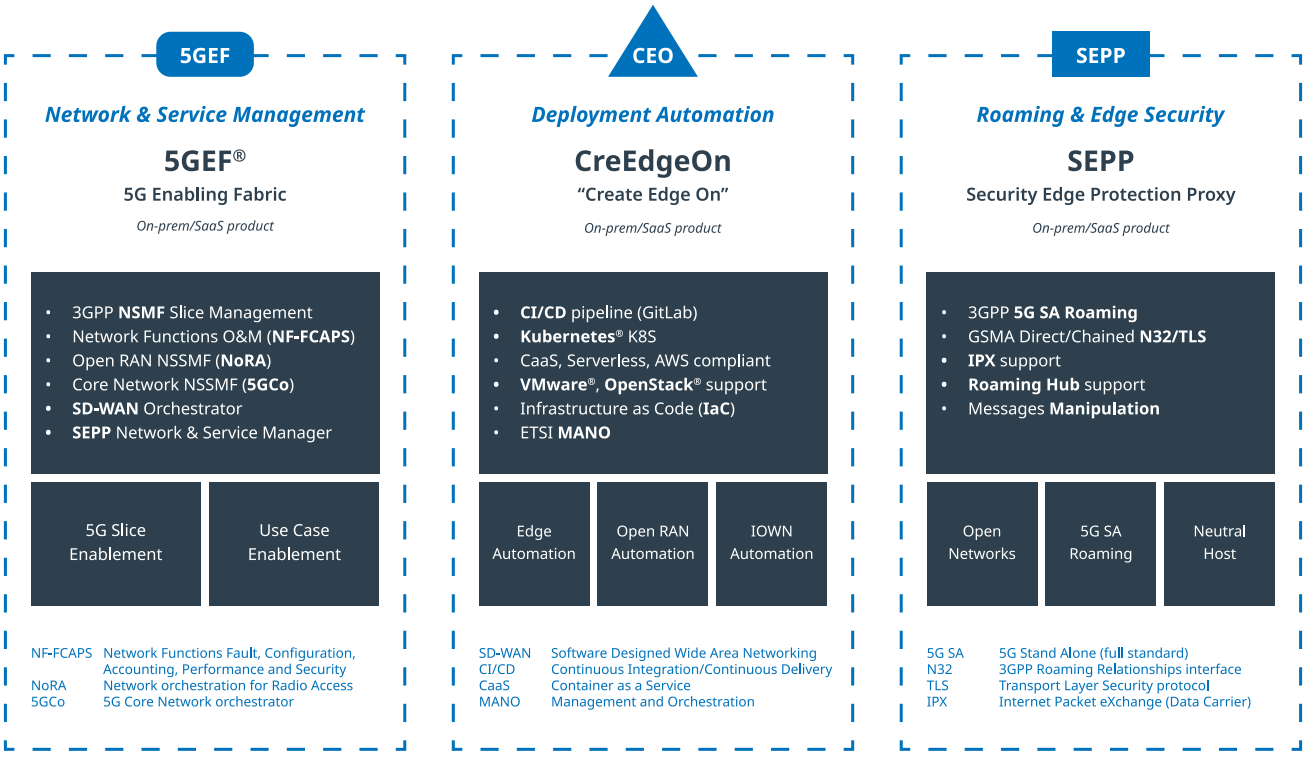

Figure 1: top level view of the evolving NTT DATA product and service offer portfolio.

Let's look at the offers in detail:

5GEF®

5GEF® is a key service enabler because it is a slice manager working cross-domain (NSMF), as well as at RAN and core network domain level (NSSMFs), to create the network resources needed for connectivity services. It is a modular, multiple layer, multi-vendor platform that can provide service management for Network Slicing along different network domains, with each module separately usable and individually licensed.

5GEF® provides a highly intuitive self-service portal, enabling end-users to explore the solution options and start to design their own services. The portal leads to an abstraction layer that processes customer and administration requests for functionality, and an orchestration layer to select, configure and allocate infrastructure resources.

Virtualized deployment takes place via interoperability with external deployment managers, and Network Slice Subnet Instances (NSSIs) are created to support cross-domain Network Slices. Other components include Network Orchestration for Radio Access (NoRA), Core Network Slice Manager (5GCo) and SD-WAN Manager (to use overlay and tunnelling technologies for secure message transfer).

The Customer Portal provides a familiar, cloudlike experience. The Orchestration Layer provides dynamic inventory, selection algorithm, resource monitoring and service order management. It not only enables 5G standalone network slicing but also supports adoption of combined 4G/5G networks for smooth migration. Deployment delivers secure environments for each business customer with connectivity brokered via SDN/NFV coordination.

CreEdgeOn

This is a management and orchestration solution designed for rapid deployment as a set of application modules and associated services at Edge level. It works by deploying an overlay communication network, which avoids the need for individual customers to purchase and instal physical Edge devices while immediately gaining most of the advantages

that come from having real intelligence distributed across the network. It executes final delivery of virtualized applications and network functions based on customer/consumer requests via the customer portal. Figure 3 below provides a top-level view of the solution.

CreEdgeOn is the key to deploying and implementing Intelligent Networked Cloud from applications built from a GIT repository and hosted in containers. The intelligence needed for true Edge computing can be entirely distributed and is not dependent on availability of physical Edge devices at any particular location.

O-RAN based Network Slices are used to ensure availability of application capability at the Edge, no matter where those applications are hosted. This adds another level of agility to the services customers can access by completely freeing such capability from defined datacentres and geographies. As long as the required capability is accessible to the network, it is accessible to the customers and their end users. The solution is specialized in virtualized deployment, mainly on Kubernetes containers, and will be further developed for automated delivery to create a fully virtualized network based on a graph-based descriptor (Network Service Descriptor, standard ETSI/3GPP). This will simplify the design, engineering and delivery of network structures.

SEPP (Security Edge Protection Proxy)

This is the portfolio solution now in development by NTT DATA, which supports 5GEF® and CreEdgeOn (together with other networking components, such as Open RAN) to ensure the security and integrity of all communications across the network.

SEPP is a mandatory Network Function required to enable 5G Stand Alone Core Networks to support 5G Roaming. NTT DATA develop a cloud-native product, aiming to deliver SEPP elements as network services managed by SEPP Network and Service Manager (5GEF® Module) and deployed by CreEdgeOn as container-based CNFs or CaaS components.

Portfolio Differentiators

The emergence of an Intelligent Networked Cloud has simplified and accelerated trends that we can already see within the conventional cloud as it exists today. Cloud is based on digital native thinking and operations. It implies a rapid move towards much more agile collaborative working, based on co-development platforms and composable applications. The development of 5GEF® and the other items in the NTT DATA portfolio will make an immediate difference.

Entry costs are reduced. Some capital expenditure can be avoided or cut down. People related costs will be lower and engineering around applications environments can be eliminated almost entirely.

Time to profit is cut. It is now possible to develop and launch a new generation of services and products much faster than by using conventional methods.

Quality is improved, as there is no need to compromise over the types of products and services to be developed.

Learning and familiarisation with cloud starts at once, enabling not only faster monetization but better direction setting and strategy development.

It is possible to monetize the move to cloud faster than envisaged. This makes the cost calculations far more attractive, driving faster buy-in.

Our view is simple: 5G roll-out is a once only opportunity for the communications industry, not simply to become more relevant but to be the **key players** in the move to cloud. Once we accept that the future belongs to Intelligent Networked Cloud, we can see that **the most important component in this concept is the network**. That gives CSPs an essential strategic position and status.

Building, and Owning the Future

So, what are the logical next steps, both for CSPs and their end-user customers? The first thing we need to acknowledge is that a product-focused approach is not the complete answer. Our product portfolio provides the building blocks for highly individualized solutions.

To ensure that each solution is targeted to need and fit for purpose, we need to deploy all the resources and capabilities that are needed in any other transformation project. We need to explore options, establish clear goals, define the current starting point and levels of maturity in key areas, and then build a customized roadmap. These actions require experienced consulting advice, together with skilled support in design and implementation stages. In other words, systems integration of Third-Party products and solutions will remain a key requirement for fast, reliable and efficient delivery, but a new dimension to this familiar set of offers is needed.

We need to deliver a major improvement in speed and cost of solution build and deployment, and this is where the portfolio approach demonstrates its value. Because the key service offers: 5GEF®, CreEdgeOn and SEPP are proven, stable and simple to use products, it is possible to build a customer-focused solution at speed and have the confidence of knowing that it will deliver the right outcomes with near complete certainty and **predictability** of performance.

In other words, we can predict exactly how each solution will work, what it will deliver, how much it will cost in build terms, what is needed to maintain it and also its clear development path. Cloud solutions have always been unique, bespoke and based on customized engineering work that takes time and budget.

The IOWN consortium, of which NTT is a founder and leader, expects to demonstrate a large-scale photonic network before 2030. This is also when we will see widespread use of Quantum Computing in business applications: again, NTT is a leader in research and development of real-world use cases for this most exotic of computing technologies.

By taking the composable approach, end-user customers can specific unique solutions from standard products, receiving a precisely calibrated and crafted solution at a price and speed that is simply not achievable by conventional means. This enables CSPs to deliver the benefits of Intelligent Networked Cloud and establish themselves as important added value partners to enterprises of every size and in every sector.

This is a new beginning for the communication and connectivity industry. Enterprise IT will never be the same again, neither will key aspects of how the different industries operate and relate to their customers.

NTTDATA

NTT DATA – a part of NTT Group – is a trusted global innovator of IT and business services headquartered in Tokyo. We help clients transform through consulting, industry solutions, business process services, IT modernization and managed services. NTT DATA enables clients, as well as society, to move confidently into the digital future. We are committed to our clients' long-term success and combine global reach with local client attention to serve them in over 50 countries.

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The NTT DATA Innovation Centre comprises a Strategy Headquarters, the headquarters that defines the technology strategy, and local centres in six countries (Japan, the United States, Italy, Germany, China and India), each one dedicated to specific technology areas with around 100 experts, mainly researchers, consultants and engineers. Thanks to joint R&D initiatives with leading companies, technology partners and collaboration with universities and start-ups, these centres will be among the first to gather information on advanced technologies to set future strategies. success and combine global reach with local client attention to serve them in over 50 countries.


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