ITALTEL

DATA CENTER:

AT THE HEART OF THE ICT STRATEGY

White paper

Executive Summary

The Data Center is the heart of the company: it contains all the applications and relevant information that determine competitiveness.

The digitalization of business requires flexible infrastructures, which are able to rapidly scale and support innovative services according to the time frames and methods imposed by the market.

However, agility must always go hand in hand with a careful analysis of efficiency.

The Data Center model we were used to assumes new shapes and sizes, continuing its evolution, driven by phenomena such as the software defined, the hyperconvergence, the Internet of Things or the automation of operations and edge computing, but it does not lose its centrality within the overall IT strategy.

Designing a Data Center today means not only thinking about how to ensure maximum reliability, safety and performance; it is also essential to think about how to achieve maximum operational and energetic efficiency.

Despite the ongoing evolution, a fundamental certainty remains intact: the crucial, 'central' role of the Data Center within the overall IT strategy of the companies does not change.

Therefore, whether it's the development of an elastic IT-as-a-Service environment, the availability of an effective basis for analyzing Big Data, or moving to a cloud-ready platform, many companies in the Telco sector consider Data Centers to be a vital resource for gaining competitive advantage.

Innovative Service Providers meet the needs of the digital transformation, providing Cloud services to their customers; this is a great opportunity to create new revenue streams, thus avoiding being relegated to a simple connectivity.

The levers of change

The world of Information Technology is changing at an incredible, unprecedented speed.

The Data Center, which is the cornerstone of a large part of IT operations, is not immune to these transformations. It seems to be more alive than ever before, as evidenced by the number of new structures being inaugurated all over the world.

There are undoubtedly different technological and non-technological trends shaping the nature of the Data Center, though not in such a way as to change its traditional definition: a structure, intended as a facility, designed to host a set of computing, storage and network resources, equipped with all the supporting services (air conditioning, power supply, fire protection, security, etc.) to ensure it becomes fully operational.

More and more businesses are building flexible, smart and highly scalable digital infrastructures in order to access huge data stores and analytics services in a secure and swift manner. We can see two different approaches in this delicate transitional stage of the digital transformation process: on the one hand, more and more companies are adopting hybrid cloud solutions, whereby they leave some applications on site while transferring applications that are ready for the SaaS model (Software-as-a-service) to external cloud servers hosted in third-party Data Centers; on the other hand, some companies are building digital change in the medium- and long- term, adopting ad hoc measures. Banks, insurance companies and telecommunications companies are typically in the second group:

- banks because of the steep increase in digital transactions (payments, funds control, home banking services...) caused, among others, by the recent mobile and e-commerce boom;
- insurance companies because of the need for data scrutiny and immediate availability of information in order to obtain better pricing, increase subscriptions, and control losses;
- the telecommunications sector (to which this document devotes an in-depth section) because of the acceleration of trends such as cloud services, mobile applications, GPS, social media, artificial intelligence and the Internet of Things.

The levers of change that are affecting Data Centers are quite clear and obvious: first of all, there is **a steep increase in the volume of data**, and therefore the processing and network capacity needed to handle such data increases exponentially.

Moreover, while in the past a long time frame could be acceptable to increase the size of the infrastructure and expand the Data Center, the ongoing digital transformation requires faster

solutions. There is therefore a need for **maximal flexibility**, in order to scale the infrastructure up or down depending on the success of your project or application.

The emergence of outsourcing and cloud services (both public and private) has led to the **gradual outsourcing of corporate Data Centers**.

This ongoing process is changing the landscape - a transformation made possible by the evolution of telecom networks, whose increased performance eliminates the need for 'physical' proximity.

Another trend is the push for the construction of increasingly larger Data Centers, the so-called **Hyperscale Data Centers**, in order to harness economies of scale (staff, procurement of hardware and software resources).

On the other hand, however, even big cloud players are now starting to build structures locally - in Italy, for instance - not only because there are some advantages to customer proximity but also because it's simpler to manage some regulatory aspects.

Alongside these trends, the **green factor** cannot be ignored.

Main trends in the Data Center landscape

Green Data Center

Data Center manufacturers pay great attention to energy saving, not only for the sake of environmental sustainability, but also - since energy costs are an important part of the total operational costs - to obtain substantial savings.

In fact, Data Centers use great amounts of energy, especially for data processing and cooling the rooms where the machines are located. For this reason, as well as for their growing strategic role, great care is given to the design, location and usage of Data Centers in order to safeguard their performance, security, scalability, management, and environmental sustainability, allowing for a reduction in CO_2 emissions.

In fact, Green Data Centers are now a key element both for the good functioning of ICT companies' energy systems and for environmental protection: more than 2% of the CO_2 emissions worldwide are caused by the IT and telecom industries. But there are other costs besides energy: in fact, operational Data Centers spend an average of $7 billion a year just to cool the systems. This means that a highly energy-efficient Data Center can generate huge cost cuts. The energy performance of Data Centers is measured by calculating the ratio between total energy used (including that required to power the cooling systems) and the energy used by ICT equipment: at the moment, the average in Italy stands between 2 and 3.

Geographical factors can contribute to better energy performance, and it is no coincidence that Scandinavian countries are on the cutting edge of the Green Data Center trend.

Google has invested €450 million to expand its Hamina Data Center in South-East Finland, which employs seawater from the Gulf of Finland to cool its systems with very low energy consumption. Seawater is also used for Green Mountain, the most advanced server on the planet: located inside a fjord in Norway and with an area of about 11 square kilometers, it provides data storage services for many local companies.

Facebook, which has decided to turn towards renewable energy for its cloud services, has opened a Data Center in Luleå (Sweden), on the edge of the Arctic Polar Circle: fully powered by hydropower, the Data Center pumps in freezing air from outside, which then acts as a natural coolant.

More recently, there's the plan for an underground Data Center in Hong Kong - a solution intended to circumvent the scarcity of overground space and reduce energy costs.

Finally, a multitude of photovoltaic panels on a 400,000 sqm area in California produce 42 million kwh every year to power the largest Data Center by extension.

From the beginning of the designing process, Data Center professionals must think about achieving not only maximum reliability, safety and performance, but also maximum energy efficiency and savings.

Geoplanning

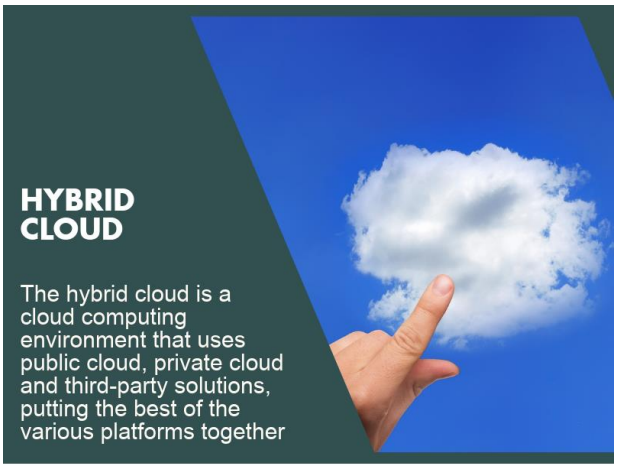
As mentioned earlier, Data Center location has become a key factor in planning workload performance, data security and infrastructure management.

As a result, many organizations are considering geospecific workload planning solutions, basing such planning not on the services they are currently offering, but rather on the services they will have to provide all over the world. No matter where customers are, they need to access these services **without latency**. The location is therefore a key factor in creating customer satisfaction, low latency being directly related to a reduction in help desk calls and customer attrition.

Data sovereignty is also crucial, as it applies specific **privacy and regulatory controls** based on the country where such data is located.

Hybrid Cloud

To be sure, the aspect of digital transformation which has impacted Data Centers the most was the emergence of public cloud computing, which led to a substantial change in corporate approaches to the development of their Data Centers.



The public cloud has allowed many companies, especially small ones, to access solutions and services which for budgeting reasons had been previously inaccessible, as evidenced by the many companies that have managed to create back-up and disaster recovery strategies thanks to public cloud computing.

More structured companies have seen in the public cloud, and especially in the hybrid cloud, not only the possibility of improving their up and down scalability in a transparent and fluid way, but also an opportunity to once again experiment 'with a light heart', without having to face the initial Capex-like costs which traditionally limited the possibility of undertaking new initiatives. The emergence of new cloud-supported services has allowed many companies to decide whether to 'turn off' the machines if the activity has not produced the desired results, or to keep them 'alive' in the public cloud or bring them back to an off-premise Data Center if the initiative proves successful.

Another phenomenon that has recently hit the spotlight is hybrid IT. This is not a passing fad, but a target that companies must focus on while transforming their own Data Centers to support digital transformation. CIOs and IT managers will no longer deploy multiple IT services from a single monolithic infrastructure, but rather from a hybrid infrastructure, which will be able to deliver services from an infrastructure pool (thanks to the emergence of 'software defined') and provide a tailor-made solution to meet the needs of any particular business - not so much from an economic point of view, but especially from a time-to-market reactivity perspective; this will preserve the investments made in legacy environments and in applications not easily migrated to the Cloud, without losing the agility advantages that Cloud solutions brought on the market. This is also why we expect further acceleration in the adoption of hybrid cloud and multicloud solutions. The IDC predicts that by 2018 over 50% of IT assets will be located outside corporate Data Centers, and that the same will happen to data, which means that within two or three years companies will have more data stored outside their Data Centers than inside, pushing companies to redesign their cloud storage strategies in order to streamline migration by managing performance, security and privacy correctly. Following this trend, we can posit that within a few years the cloud will also become the delivery mechanism for analytics, thereby significantly increasing the consumption of public data in the cloud and paving the way for the creation of new applications based on the use of such data.

Edge computing

Edge computing is an unquestionably significant phenomenon. Some of the key drivers forcing companies to develop edge strategies are related to the reduction of content delivery latency in order to improve customer experience, as in the case of video streaming; the possibility of processing data collected from Internet of Things sensors, i.e. data processing, in order to improve the time-to-market and the speed of response to events, also thanks to the implementation of automation solutions based on established policies and rules; and finally, latency reduction as data traffic is **maintained locally** and allows for greater control over data transmission, from a *peering traffic* perspective.

It therefore makes sense to shift computing power to the edge of the network and move closer to where the devices reside. For instance, retail locations must manage security systems, audits and sales outlets. Customers expect to be able to make purchases, even if the systems at the headquarters turn off.

Hence the need to rethink data management models: only by operating peripherally, i.e. on the network's edge, can we manage large amounts of data without necessarily going through the cloud. There are multiples advantages to this paradigm shift: on the one hand, the bandwidth required to access the cloud or the company's Data Center, where data processing would normally take place, is reduced; on the other hand, infrastructures can be controlled more easily, and it is therefore possible to increase security levels.

Software defined and hyperconvergence

As Data Center technologies continue to evolve, we have been witnessing phenomena such as the growth **of hyperconvergent systems** and the use of **software-defined paradigms**, which constitute the focal point in the evolutionary itinerary to transform the Data Center and make it even more *cloud-ready*.

Software-based Data Centers are a trend that could have a significant impact on many organizations struggling with the difficult task of managing their Data Center on a daily basis. The latest software-defined infrastructures can provide maximum flexibility and performance levels.

A software-defined Data Center basically consists in having everything virtualized: computing, storage and networking. This way, resources needed for a given project can be activated faster. In the past, hosting an application required the allocation of several physical resources: computing, storage and networking. Thanks to virtualization, it is now possible to configure and connect them with just a few clicks, using simplified and unified programmable interfaces, thus obtaining a significant automation of management and configuration procedures.

On the other hand, the maturity level of the infrastructure's three components, i.e. computing (Software-Defined Computing), storage (Software Defined-Storage) and networking (Software-Defined Networking), is significantly different.

Software-Defined Computing is a highly mature and consolidated market within the corporate universe, whereas Software-Defined Storage is a rapidly growing market due to the fact that many companies are trying to cope with the burgeoning volume of data and the subsequent need to manage and secure it. Software-Defined Networking (SDN), on the other hand, is still a highly immature market.

Conceptually, SDN is similar to **virtualization and Software-Defined Data Centers**, as it decouples the processing of data traffic from the logic and rules that govern the network's data flows.

It is necessary, however, to dispel a basic yet persistent misunderstanding: the idea that SDN is valid only for large-scale Data Centers, also known as 'hyperscale data centers' - i.e. those that provide public, private or hybrid cloud services. In fact, SDN is suitable for all Data Centers, as it makes the configuration, management and monitoring of the network even easier, requiring a smaller commitment from the IT staff.

Even 'hyperconvergent' solutions are basically a further evolution of the concept behind virtualization, with the aim of simplifying infrastructure management while maximizing the use of hardware resources. What initially was a simple implementation of virtualization software on independent hardware resources (such as servers, storage and networking) in order to use them to maximum efficiency, has in recent years evolved into converging infrastructures in which a commodity-type hardware reaches the company already integrated, configured and, most importantly, optimized for specific workloads. The next step within this concept is the idea of hyperconvergent solutions, which go even further by integrating computing, storage and networking components within appliances that can be installed in a matter of minutes.

The IoT at the service of Data Center operation automation.

The expected evolution of IoT-type applications also concerns the operation and management of Data Centers themselves, from the perspective of increasingly automated operations. The trend is clear: by incorporating within Data Centers smart technologies from connected and intelligent objects, or from sensors that communicate with one another and with IT systems, Data Center managers and administrators are able to better track the actual state of the components within the Data Center itself, assessing the health of the environments more accurately and having the ability to manage any interventions more effectively. Developing this approach further, classic sensors that estimate temperature, humidity and consumption can be integrated

within the same network alongside measuring and controlling instruments in order to develop self-diagnosis systems, self-repair systems, or simple alerts. This is the key aspect of predictive maintenance, which can definitely ensure higher levels of Data Center uptime if applied to IT infrastructures.

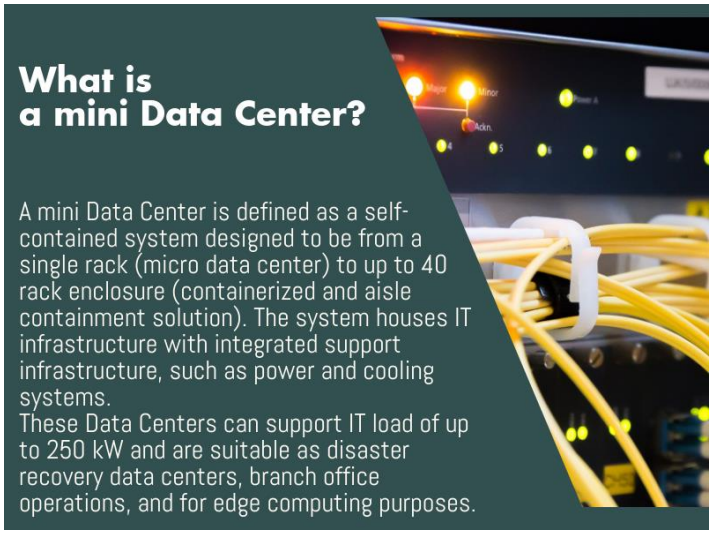
Evolution of the telco network in Data Center logic

An optimized, robust, and flexible Data Center infrastructure can enable businesses to quickly and easily access corporate ICT services, enabling **rapid deployment of new applications**. In fact, a Data Center infrastructure is the **foundation for any vertical ICT solution or strategic implementation of Hybrid Cloud models** with a pool of common resources to be exploited in an elastic way and a "pay-per-use" model that facilitates costs reduction and their planning.

The investment in technology and innovation allows the Telco Service Provider to change its offer, with the launch of new services, changing its business model, increasing the importance of value-added services, as well as business predictability.

The peripheral mini Data Centers in the 5G era

Telecommunication operators are evolving their network infrastructure using software to make it more agile; most telephone exchanges will eventually appear less like traditional *Central Offices* and more like cloud Data Centers.

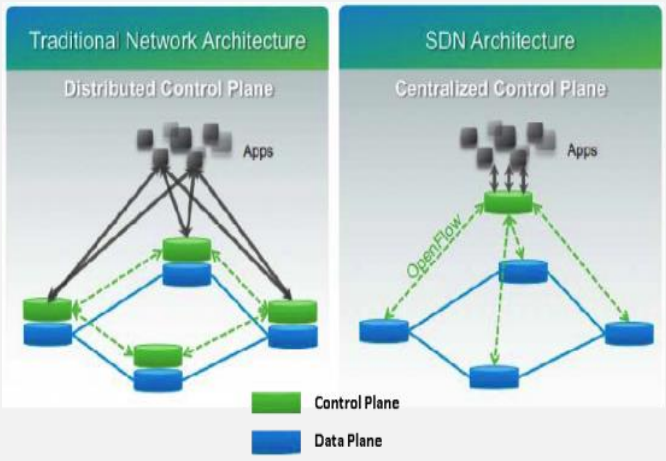


Advances in network software, specifically software-defined networking and network functions virtualization, provide the ability for Communications Service Providers (CSPs) to significantly transform their networks over the next years.

SDN and NFV technologies are synergistic, and they offer improved programmability, faster service enablement and lower CAPEX/OPEX for CSPs.

Benefits of SDN for Service Providers

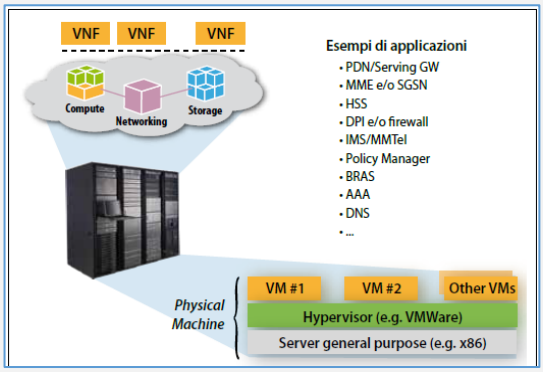
SDN provides for separation of the control and data plane where the intelligence of the network (e.g. switch or router) is split from the packet forwarding engine. This separation provides opportunities to program the network at various points (i.e. Layers 1-3). For example, a number of optical network vendors leverage SDN to improve the programmability and operations of their optical network gear. SDN also impacts the way CSPs build and operate their data center/cloud networks, giving them the ability to deploy low-cost white box switches that use independent network operating systems.



The combined advantages of SDN and NFV are the driving force behind the transformation the networking industry and leading CSPs having implemented pilot projects with SDN and NFV software running on COTS (commercial off-the-shelf) hardware.

Benefits of NFV for Service Providers

NFV is an initiative driven by several dozen large telecom service providers to increase the use of virtualization and commercial servers in their networks. NFV leverages IT technologies, including virtualization, standard servers and open software to fundamentally change the way networks are built and operated. The key benefits that CSPs will derive from NFV implementation include faster time to market, new services enablement, ability to rapidly scale resources up and down, and lower costs.



The networks of the future will see hybrid designs of specialized hardware combined with more and more SDN and NFV elements.

Specialized hardware: learning from the best in class

For ideas on the types of hardware, the big telcos have turned to the companies that have perfected the art and science of building cloud data center infrastructure on a global scale.

The Open Compute Project (OCP) is an open source hardware and data center design community led by Facebook. Large CSPs such as AT&T, Verizon and Deutsche Telekom join it; together with Data Center services giant Equinix and the network technology vendors Nokia and Nexius, they formed a whole new group under OCP focused specifically on Data Center technology for network operators.

The OCP Telco Project will serve as a way for these companies to tap into the innovation ecosystem and supply chain to save billions of dollars in Data Center costs.

Apple and Microsoft are OCP members, and so are major financial services companies. Nearly all major IT vendors, such as HP, Cisco, Juniper, and IBM, participate, along with design manufacturers they compete with for the hyperscale data center business – companies like Taiwan's Quanta Computer or Hyve Solutions, the division of Silicon Valley's Synnex created specifically to supply hardware to the likes of Facebook.

The wide pool of vendors is important to what the telcos are doing. If Facebook found standard off-the-shelf HP or Dell servers too expensive for its scale, those who can build, or afford, specialized telco hardware comprise one of the most exclusive clubs. There have traditionally been very few vendors a company like AT&T (or other major telcos - CSPs) has been able to work with because of the sophistication of the appliances. If open source network software and hardware for telcos gain traction, that pool of vendors will widen substantially, as the barrier of entry to the market will lower. For telcos that means one thing: lower cost.

Leveraging the open source ecosystem is the new way of designing and operating networks.

There's also the benefit of having a group of engineers from different companies collaborating to solve technology problems specific to the telco industry. Software Defined Networking and Network Function Virtualization are key to delivering modern high-bandwidth network services to customers and making them easier to consume. Regardless of the shift from hardware to software, these are still extremely sophisticated technologies, and a single company has to spend a lot more time and resources to develop them on its own. Now, in addition to participating in the multitude of open source networking software projects, telcos are turning to open source hardware.

Operators' great asset for the future

Right now it is unclear how many and which, in their sprawling networks, of CO facilities each CSPs will plan to re-architect as a Data Center.

Actual CSP's Central Offices vary in size (the ones in densely populated areas tend to be larger while remote aggregation facilities are smaller). If we add to the equation the 5G next network deployment and the related scale and performance requirements for new IoT applications we can well understand that Telecom operators are in a good position to be part of this new value chain by utilizing their existing distributed network assets.

The use of micro Data Centers for current and, above all, new services is one of the success key-factor in the new/different approach to digital infrastructure.

Mobile and fixed CSP's networks are by nature distributed with small and large sites where various equipment is placed to provide connectivity across cities, suburban and rural areas. Normally we

find large sites where a lot people live and where many enterprises operate. The more the remote site—the smaller from a capacity and physical perspective.

Telco Operators acquired all these sites and built Central Offices for their network gear during several decades. This means that they are not as modern, from a physical viewpoint, as the large and centralized Data Centers that have been popping up like mushrooms the last years around the world.

THE CONCEPT OF CORD (CENTRAL OFFICE RE-ARCHITECTED AS DATACENTER)

CORD is conceptually similar to the network functions virtualization (NFV) specifications of the European Telecommunications Standards Institute [ETSI], providing a standard framework for managing and deploying network functions independent of specific hardware platforms. A key difference, however, is that CORD integrates NFV with software-defined networking (SDN). CORD leverages open source projects to virtualize network functions, eliminating the need to install physical devices for each new instance of a network function. Incorporating principles from NFV and SDN, service providers may treat subscribers like tenants -- dynamically stitching together new network functions, much like large cloud providers do, enabling faster time-to-service. Subscribers may also benefit from the new architecture, which provides the necessary tools for centralized provisioning of new services. Ideally, customers will no longer have to wait days or weeks for different teams to install and provision relevant portions of a new service or network function.

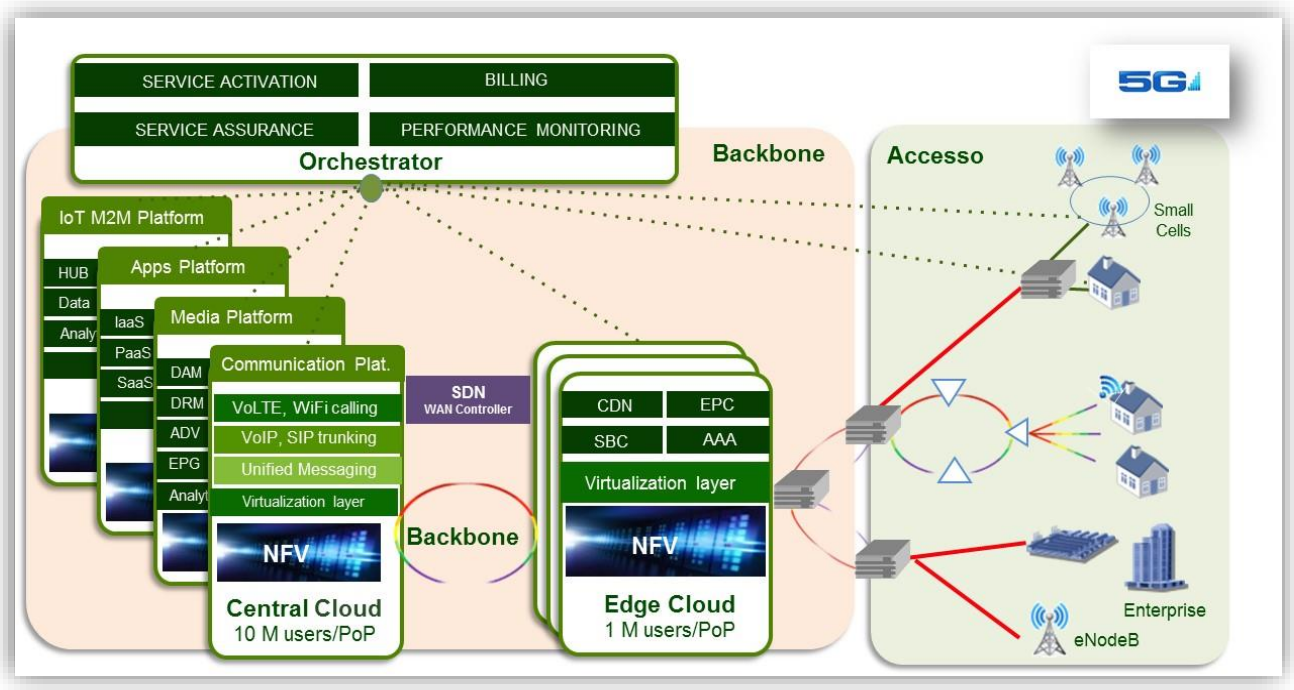
[onosproject.org: Open Networking Foundation (ONF)]

Equipment placed in central offices must therefore be able to sustain demanding requirements such as temperature ranges, humidity, altitude, and noise levels.

It is obviously costly for network operators to run and maintain all these sites to provide mobile broadband and communication services. However, the more things that are connected—cars, trucks, and industrial machines—the more valuable the sites may prove to be.

A short distance to the datacenter where the actual service is executed is often a necessity since many IoT services have very strict requirements on latency.

Another important requirement is local breakout capabilities, which can save bandwidth in the network and ensure that the services can be provided even if the connection to the central networks breaks.



The new architecture of telecommunications networks

There are also regulatory aspects to consider: there is a golden opportunity to leverage the telco network infrastructures, which are already deployed in a distributed manner, to take part in the IoT value chain. Among many other things, a strict requirement is that there is appropriate equipment that can do the job cost efficiently in an operator environment: micro-datacenters could be the way forward.

About Italtel

Working where Telecommunications meet Information Technology, Italtel addresses some of the main technological challenges the world of communications is facing nowadays. IP Networking, Cloud, Network Function Virtualization, SDN, WebRTC, IoT, are just some of the areas where the company is present with end-to-end solutions.
Italtel offer includes proprietary products, engineering and network consultancy services, managed services and solutions. Italtel counts more than 40 customers worldwide, and among them there are several major Service Providers and multinational Enterprises. In addition to having a leading position in the Italian market, Italtel has focused its foreign operations on EMEA markets and Latin America.

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