# Keeping Pace with 5G

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Emerging 5G networks create new opportunities for telecom providers to deliver services for enterprises and consumers at greater capacities, accelerated speeds, and lower latencies. In addition to enabling faster mobile and fixed wireless access, 5G networks also support cutting-edge technologies for Industrial IoT, AR and VR applications, AI and blockchain. Applications such as smart factory, E-agriculture, autonomous driving, AI-powered health diagnostics, and personal robot assistants are now a reality. And the proliferation will only accelerate: by 2020, Gartner predicts up to 20.4 billion IoT devices will be in service.

To meet customers' demands for new services delivered quickly and without interruption, ICT service providers must have full visibility into network resources and control over networks of the future as they undergo digital transformation. To keep pace with 5G, backbone networks must be upgraded and properly managed to meet bandwidth and performance requirements.

Software-defined networking (SDN) and network function virtualization (NFV) are essential to support the evolution that is taking place in today's network architectures. SDN uses mechanisms of control and user plane separation to define network resources programmatically. NFV allows far better network flexibility through the abstraction and partitioning of network resources into virtual elements.



Network as a Service (NaaS), like other cloud services, relies on virtualization technology. Network slices can be specifically configured to support certain use cases. Each use case receives a unique set of optimized resources and network topology—covering certain service level agreement-specified factors such as connectivity, speed, and capacity that all suit the needs of that application.

Mobile edge computing brings computational resources closer to the source—the network edge—and takes the burden of massive data processing (for IoT, AR/VR, and more) off the central office.

While physical, logical and virtual resources can be easily managed separately, ICT service providers often face challenges when it comes to managing them in unison. To effectively manage hybrid resources in today's digital, IoT-enabled 5G world, implementing a unified network resource inventory solution is business-critical.

# The Challenge

With the addition of virtual components into the network, ICT service providers face the challenge of managing new, complex resource types. Unlike conventional resources and resource-facing services, hybrid resources like VNF, SD-WAN, network slicing, and mobile edge computing (MEC) must be managed across telco, IT, and data center domains (Figure 1 - next page).

Simplicity, promised by softwarization, urges providers to maintain high-availability clouds and data centers. As a result, new network operation teams, or NetOps, must consist of individuals with a broad knowledge of networks and IT. And, of course, there is a diversity of VNF vendors with proprietary EMS, which again create silos in the cloud.

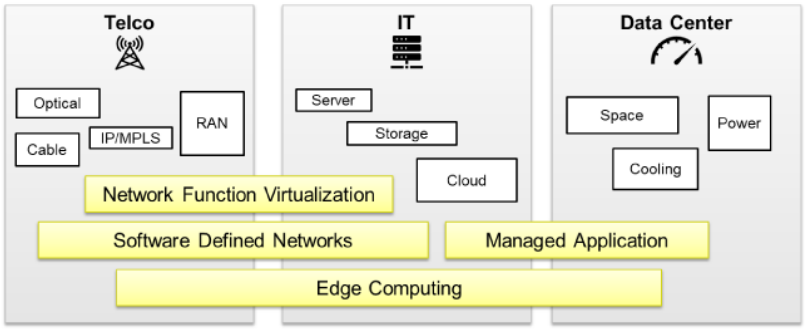


Figure 1 - the challenge of managing hybrid resources across domains

Hybrid resource management enables NetOps to crush complexity and gain transparency on the hybrid network.

# The Solution

Put simply, utilizing a network resource inventory (NRI) system is proven to drive operational efficiency. To master hybrid resource management, ICT service providers must adopt a solution known as unified resource inventory (URI), or hybrid inventory (HI), to document all resources in one place, across the silos.

Selecting the right hybrid inventory solution is key to helping CTOs and network operators keep track of available resources, improve time to market for new services, prevent misconfiguration, reduce recovery time from network outages, and significantly lower overall OPEX. The ideal hybrid inventory solution should provide the following features and capabilities:

- All-embracing data model and resource types: passive, physical, logical and virtualized
- Modern REST API to integrate with its environment, e.g. Trouble Ticketing and Fault Management systems
- Discovery and reconciliation mechanisms to synchronize the inventory with network and cloud to keep it up-to-date
- Support for service fulfillment and assurance scenarios

Another important component to a hybrid inventory solution is a common central database for all resource-related data. This database ensures that all activities carried out within the organization are always based on a shared master data source, and that all NetOps maintain the same consistent view of the network at all times.

The successful operation of 5G Cloud RAN, for example, requires that the following resources are documented and available immediately in a hybrid inventory solution:

- **Physical resources:** Antennas, RRUs and other 5G physical equipment on mobile sites
- **DC Infrastructure:** Edge data center floorplans, racks, power and cooling devices

- **Logical Telco resources:** Fronthaul and backhaul transmission links
- **Logical IT resources:** Server clusters, platforms, and storage
- **Virtual resources:** Clouds, virtual machines, containers, vBBU, and MEC applications
- **Resource-facing services:** Network slices for IoT and AR

To ensure that service assurance runs smoothly, every type of resource listed above must be documented in relation to its context and with its capacity descriptors. Theseparameters are later provided on demand to fault management or performance management systems. In the event that a power outage is reported at an edge data center, all alarms that begin flooding the NOC from NFVIs and installed applications are automatically suppressed or de-prioritized.

In terms of service fulfillment, there are plenty of network automation tools available that promise service provisioning and activation across all CSPs' managed domains. However, they absolutely require inventory as a data source to fulfil this task. Integration with one consolidated system is obviously an advantage in this case.

Examples of queries to the hybrid inventory solution from the network automation tool can include:

- The retrieval of actual inventory in a customer location and all associated VNFs for a quick feasibility assessment
- Inquiring about the pre-provisioned (planned) mobile cell parameters of a virtual RAN to push them into the network

With 5G technologies, the amount of inventory objects will grow profoundly. Therefore, the visualization of hybrid resources and their capacities becomes crucial. The geo-referenced representation is especially important: it must be possible to project any kind of resource (where it makes sense, of course) onto the map to create a "birds-eye" view.

Next, the end user of such visualization must be able to easily switch between multiple views, for example, from the edge data center to the backbone capacity view. This accelerates decision-making processes for strategic and tactical network planning as well as business development. While the challenge often lies in integrating all required data into a visualization application, a hybrid resource inventory solution simplifies these processes.

# Conclusion

Overall, how ICT service providers respond to disruption will determine their ability to remain competitive in a digital world. While resource management in the 5G era is a challenge, a hybrid inventory helps ICT service providers streamline the process by managing telco, IT, and data center infrastructure holistically within one software solution. By managing all assets used in the production of services via a single, dynamically updated repository that integrates with key systems, providers will have the information and tools to support not only existing networks but also networks of the future as they undergo digital transformation. This capability gives providers the necessary visibility to convert emerging opportunities into revenue.

# The Future

As we look to the future, we are bound to see new and exciting inventory software developments from augmented reality and machine learning. Augmented reality will boost operations on mobile sites and in data centers with hybrid inventory as a data source. Integrating machine learning into Discovery and Reconciliation (D&R) processes will enable massive intelligent discrepancy resolving and "discovery" of passive network domain interconnections.