WHITEPAPER

Distributed cloud – a key enabler of automotive and industry 4.0 use cases

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Emerging use cases in the automotive industry – as well as in manufacturing industries where the first phases of the fourth industrial revolution are taking place – have created a variety of new requirements for networks and clouds.

Next-generation automotive services and their requirements

Mobile communication in vehicles is increasing in importance as the automotive industry works to make driving safer, smooth the flow of traffic, consume energy more efficiently and lower emissions. Automated and intelligent driving, the creation and distribution of advanced maps with real-time data, and advanced driving assistance using cloud-based analytics of uplink video streams are all examples of emerging services that require vehicles to be connected to the cloud. These services also require networks that can facilitate the transfer of a large amount of data between vehicles and the cloud, often with real-time characteristics within a limited time-frame while the vehicle is in active operation.

Looking at the automotive industry, we often focus on the real-time use cases for safety, as defined by V2X/C-ITS (vehicle to everything/cooperative intelligent transport system), where real-time aspects such as short latency are the most significant requirements. However, the automotive industry's new mobility services also place high demands on network capacity due to the extreme amount of data that must be transported to and from highly mobile devices, often with near real-time characteristics.

The placement of application components at edges depends on the behavior of the application and the available infrastructure resources. When dealing with highly mobile devices that connect to a multitude of networks, it must be possible to move execution of the edge application automatically when a more appropriate location for the vehicle is discovered. Some applications require transfer of previously analyzed data and findings to the new location, where a new application component instance will seamlessly take over to serve the moving vehicle.

Distributed computing on a localized network

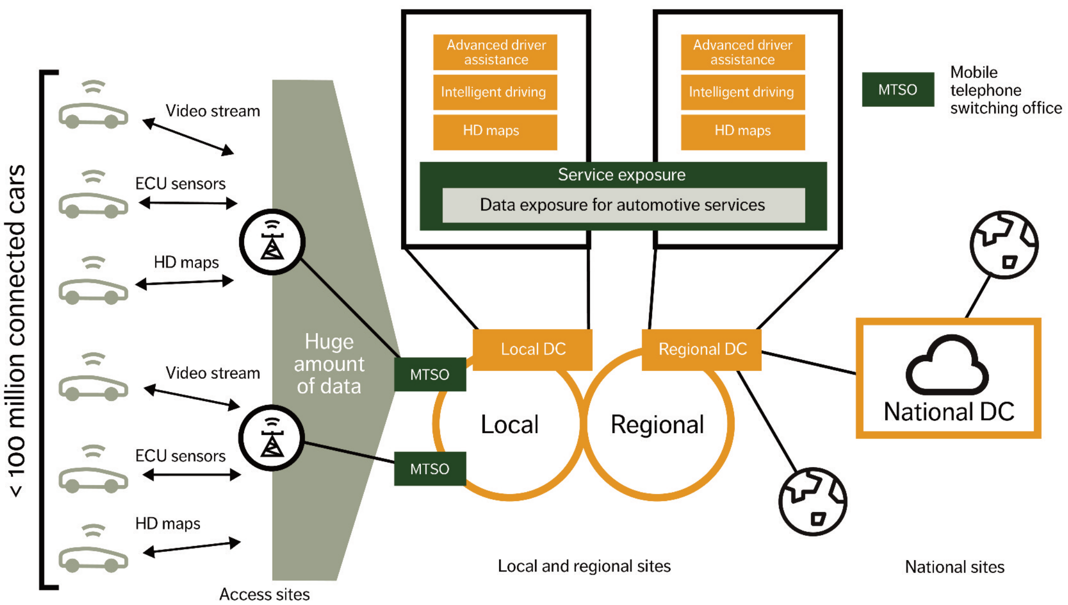
We have developed the concept of distributed computing on a localized network to solve the problems of data processing and traffic in existing mobile and cloud systems. In this concept, several localized networks accommodate the connectivity of vehicles in their respective areas of coverage. As shown in Figure 1, computation power is added to these localized networks. This reduces the total amount of data exchanged between vehicles and clouds while enabling the connected vehicles to obtain faster responses.

A localized network covers a limited number of connected vehicles in a certain area. Edge computing refers to the geographical distribution of computation resources within the vicinity of the termination of the localized networks. This reduces the concentration of computation and shortens the processing time needed to conclude a transaction with a connected vehicle.

Data exposure secures integration of the data produced locally by utilizing the combination of the localized network and the distributed computation. By narrowing relevant information down to a specific area, data can be rapidly processed to integrate information and notify connected vehicles in real time.

As part of the fourth industrial revolution, industry verticals and communication service providers (CSPs) are defining a set of new use cases for 5G [3]. Private deployments and 5G networks provided by CSPs to manufacturing companies, smart cities and other digital industries are on the horizon as well.

Figure 1: High-volume data automotive services and their characteristics



Our distributed cloud solution

Ericsson has developed a distributed cloud solution that provides the required capabilities to support the use cases of the fourth industrial revolution, including private and localized networks. Our solution satisfies the specific security requirements needed to digitalize industrial operations, with automotive being one of the key use cases. Ericsson's distributed cloud solution provides edge computing and meets end-to-end network requirements as well as offering management, orchestration and exposure for the network and cloud resources together.

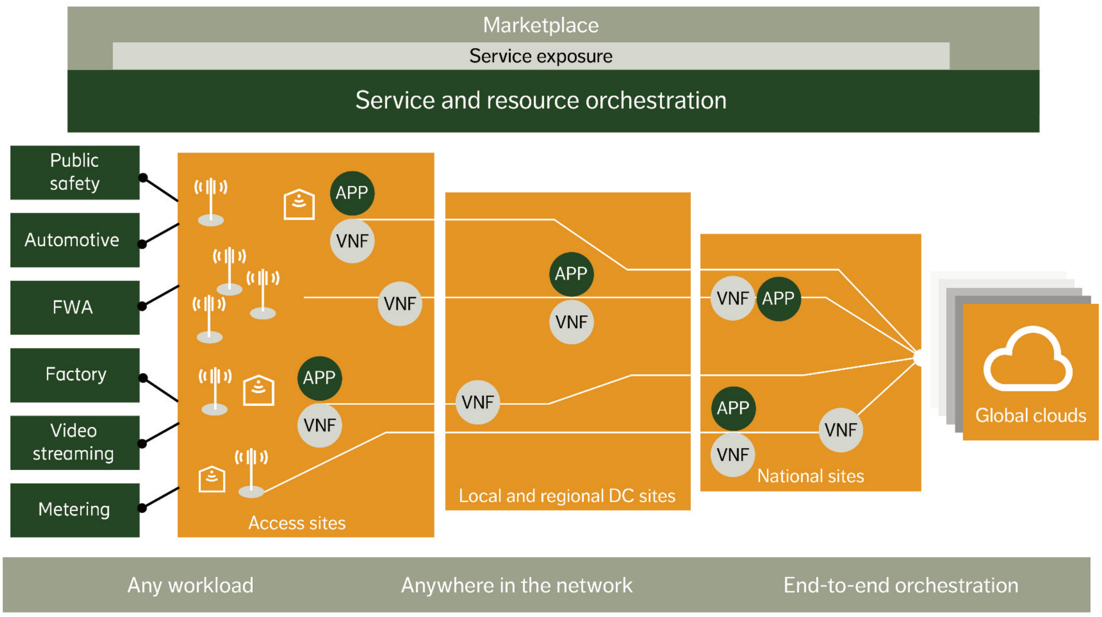
As shown in Figure 3, we define the distributed cloud as a cloud execution environment that is geographically distributed across multiple sites, managed as one entity and perceived as such by applications. The key characteristic of our distributed cloud is abstraction of cloud infrastructure resources, where the complexity of resource allocation is hidden to a user or application. This could be provided by multiple CSPs, where workload placement is policy driven and based on various externalized criteria.

To enable monetization and application innovation, distributed cloud capabilities are exposed on marketplaces provided by Ericsson, third parties and CSPs. The distributed cloud capabilities can be offered according to various business and operational models.

Our distributed cloud solution enables edge computing, which many applications require. We define edge computing as the ability to provide execution resources (specifically compute and storage) with adequate connectivity at close proximity to the data sources. The exact locations of the micro and small data centers may be dependent on the CSP's network topology and the requirements of the use cases.

In the automotive use case, the network is designed to split data traffic into several locations that cover reasonable numbers of connected vehicles. The computation resources are hierarchically distributed and layered in a topology-aware fashion to accommodate localized data and to allow large volumes of data to be processed in a timely manner.

Figure 2: Distributed cloud architecture



Conclusion

Distributed cloud is a cornerstone of the intelligent networks that will play a key enabling role in the fourth industrial revolution. A robust distributed cloud solution requires efficient and intelligent management and orchestration capabilities that span heterogeneous clouds supplied by multiple actors. Service exposure will enable monetization and application innovation through integration with the marketplaces and/or integration with the industries' IT systems.

The evolution toward globally distributed cloud requires action to align the industry both through traditional standards as well as active participation in open-source projects aimed at providing reference implementations. Ecosystems such as the AECC (Automotive Edge Computing Consortium) play an important role by examining the high-volume data use cases for the automotive industry.

For further information about this fascinating topic please turn to Ericsson.com at:
www.ericsson.com/en/ericsson-technology-review/archive/2018/distributed-cloud

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Benedek Kovács

Joined Ericsson in 2005 as a software developer and tester, and later worked as a system engineer. He was the innovation manager of the Budapest R&D site 2011-13, where his primary role was to establish an innovative organizational culture and launch internal startups based on worthy ideas. Kovács went on to serve as the characteristics, performance management and reliability specialist in the development of the 4G VoLTE solution. Today he is working on 5G networks and distributed cloud, as well as coordinating global engineering projects. He holds an M.Sc. in information engineering and Ph.D. in mathematics from the Budapest University of Technology and Economics in Hungary.

Malgorzata Svensson

Is an expert in operations support systems (OSS). She joined Ericsson in 1996 and has worked in various areas within research and development. For the past 10 years, her work has focused on architecture evolution. Malgorzata has broad experience in business process, function and information modeling, information and cloud technologies, analytics, DevOps processes and tool chains. She holds an M.Sc. in technology from the Silesian University of Technology in Gliwice, Poland.

Christer Boberg

Christer Boberg serves as a director at Ericsson's CTO office, responsible for IoT technology strategies aimed at solving networking challenges for the industry on a global scale. He initially joined Ericsson in 1983 and has in his career within and outside Ericsson focused on software and system design as a developer, architect and technical expert. In recent years, Boberg's work has centered on IoT and cloud technologies with a special focus on the automotive industry. As part of this work, he drives the AECC consortium together with industry leading companies.

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