

**CAPGEMINI ENGINEERING
5G CONNECTED PLATFORM
FOR SMART CITIES AND
PRIVATE NETWORKS**

5G for smart cities, connected infrastructure, industry 4.0

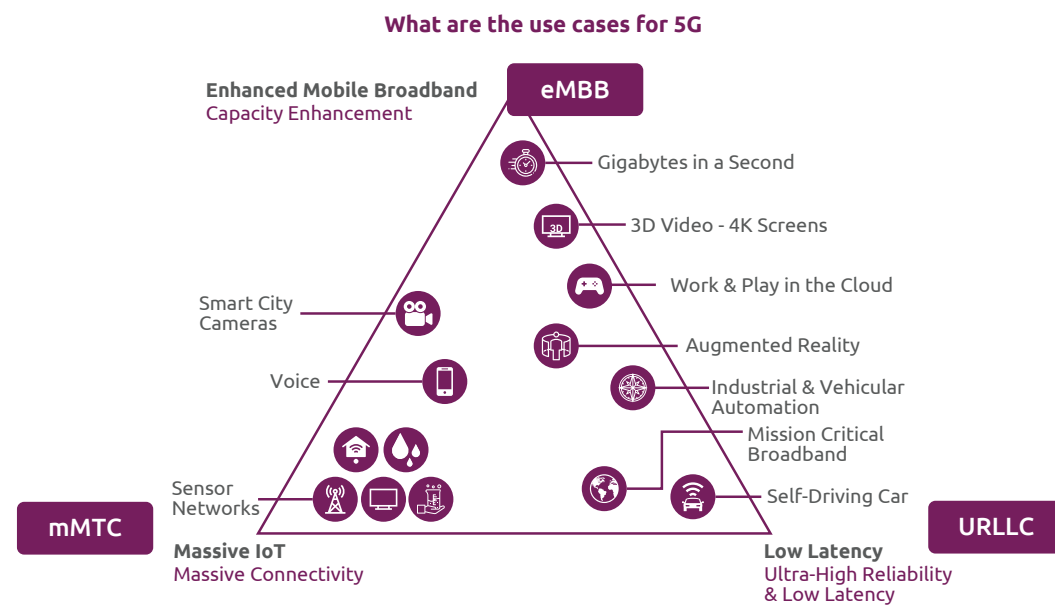
We live in a world where 55% of the global population lives in cities and that figure is expected to go up to 70% by 2050^[1]. Ever growing urban densification requires an increased level of automation with billions of IoT devices stringing together smart city infrastructure for road and traffic management, power supply grid management, smart metering, parking, waterworks, etc.

Similar advances in factory automation and warehouse management (Industry 4.0^[3]) introduce many device – controllers, sensors and actuators that need to communicate securely and reliably.

5G fulfills the promise of lightning fast broadband through Enhanced Mobile Broadband (eMBB), Ultra-Reliable Low Latency Communication (URLLC) and Massive Machine-type Communication (mMTC) for catering to a large number of IoT devices for these use cases.

However, these smart city and industry 4.0 applications need to run on compute located at the nearest 'Network-Edge' device, using an edge compute platform, MEC, to avoid sending data back and forth over long network hops.

This puts forward the need for an all weather 5G compute and networking edge node, that can host 5G Connectivity as well as an intelligent compute application platform, serving a variety of smart-infrastructure use cases.



TM Forum, 2019 (Source For Data: International Telecommunication Union)

Figure 1: Use Cases for 5G

Towards a 5G connected edge platform: key technology hurdles

The journey towards a fully connected smart city and smart industry has several technological hurdles to cross –

- Legacy network infrastructure is not modeled to provide service capabilities;** hence it is challenging to deploy disaggregated applications required for localized processing near the data origin
- Monolithic custom built boxes do not support the diverse needs of modern day applications,** for example, AI/Visual-Compute, co-operative robotic assembly-lines^{[2][3]} and warehouses
- Networking is often complex,** requiring complex installation and configuration at different virtual and physical networking layers
- IoT innovation is complex,** calling for a need to converge compute, networking, communications, software and more
- The application developer is often not aware of the deployment** and networking complexity



Simplifying the 5G connected infrastructure and services journey:

Capgemini Engineering Smart 5G Connectivity Platform

Capgemini Engineering's Smart 5G Connectivity Platform combines the power of Capgemini Engineering ENSCONCE Edge Computing and Capgemini Engineering 5G Frameworks integrated with Silicon Vendors and Hardware Partners, along with accelerated networking and AI Inference with hardware offload to GPUs/ASICs/FPGAs/VPUs

The Capgemini Engineering smart 5G connectivity platform solution simplifies the above technological challenges through a convergence of a service based platform based on the Capgemini Engineering ENSCONCE Edge Compute Platform.

It also brings in 3GPP and O-RAN based 5G RAN/NGC, which allows building disaggregated boxes while converging network, compute and AI acceleration. The Capgemini Engineering 5G Wireless Frameworks help build small localized 5G points-of-presence, while insulating the networking and deployment complexity from smart city and industry 4.0 application developers through the ENSCONCE MEC service platform.

Capgemini Engineering ENSCONCE Edge Compute Platform (MEC)

The Capgemini Engineering ENSCONCE Edge Compute Platform is a scalable, cloud native, edge application runtime and orchestration platform that enables application developers to seamlessly deploy applications across a cluster of edge compute. It enables developers to leverage the benefits of low-latency computing and network differentiation provided by telecommunication operators. The platform also manages the deployment of these edge clusters across geographies and interconnecting multiple operator's edge compute platforms by federating different such clusters. It incorporates Enhanced Platform Awareness (EPA) components to provide the benefits of hardware acceleration and enables platform optimizations that can be beneficial to high performing latency sensitive, network aware applications. The combined solution aims at solving the primary goal of edge computing i.e, providing efficient compute offload, reduced compute and network latency and jitter improvements for edge applications.

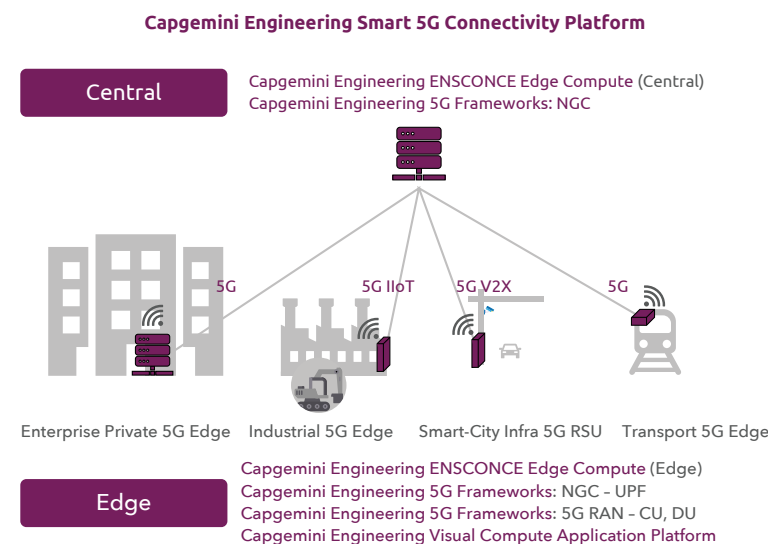


Figure 2: Capgemini Engineering's 5G Smart Connectivity Platform

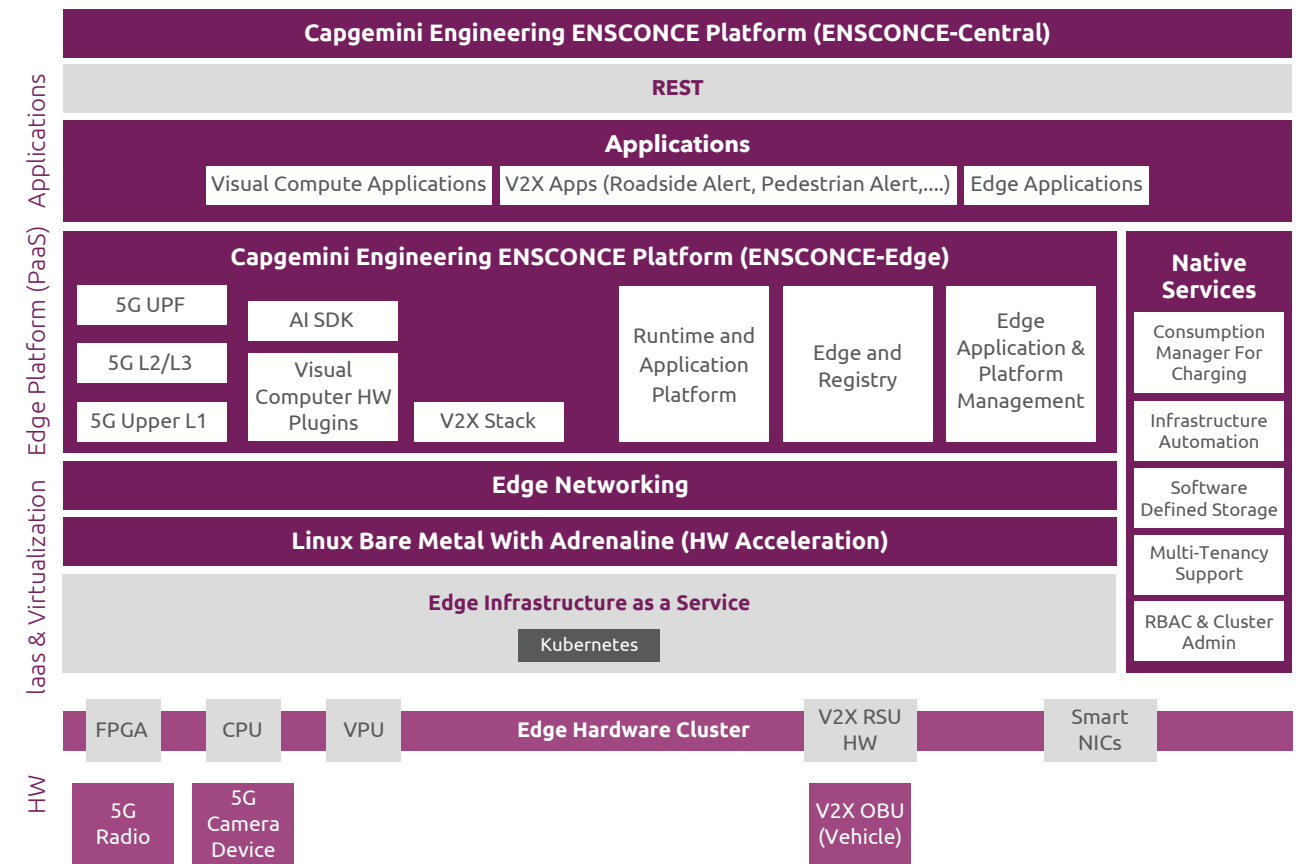


Figure 3: Capgemini Engineering's 5G Smart Connectivity (ENSCONCE Edge) Architecture

Capgemini Engineering 5G Frameworks – Radio Access Network (RAN) and Next-Generation Core (NGC)

Capgemini Engineering 5G RAN and NGC framework in the SA architecture leverages its end-to-end product engineering services and worldclass 5G NR software for Layer 3+ and Layer 2 protocol stack to enable RAN solutions based on different SoC architecture and pre-integrated with existing partners L1 and RU eco-system. The Capgemini Engineering RAN solution accelerates time-to-market for both OEMs and service providers. It enables and optimizes macro and small-cell solutions and supports high capacity and low capacity use cases for rural and dense environments. Our solution complies with all industry standards set by the 3GPP, TIP and O-RAN, FAPI Interface, making it interoperable with other vendor solutions.

Capgemini Engineering Visual Compute Application Platform

Capgemini Engineering Visual Compute Application platform integrated with the Capgemini Engineering ENSCONCE-Edge provides pre-optimized media pipelines for use cases applicable across industries and domains. The media pipelines can be configured for latency or detailed inference results and run in parallel to handle multiple media streams simultaneously. The media pipelines are capable of utilizing the underlying heterogeneous compute resources, including CPU, GPUs,/VPUs. The visual compute application platform is designed to help developers integrate computer vision capability into their applications without handling the complexity of running vision machine learning models optimally on compute resources.

Capgemini Engineering 5G smart connectivity platform: components

5G Connectivity Platform – Edge

- From a single box to a cluster of servers in a rack deployment, the platform is silicon agnostic and is suitable for both industrial and private network use cases
- The software platform integrates Capgemini Engineering ENSCONCE - Edge
- The software platform has integrated support for AI/Visual compute SDKs
- VPU/GPU accelerator based offload for AI inference apps
- The also provides 5G connectivity supported through Capgemini Engineering 5G gNodeB L2/3 and GPU/FPGA offload
- Integrated Capgemini Engineering 5G RAN (CU/DU) supports SA Sub-6 GHz and SA mmWave
- Capgemini Engineering 5G NGC UPF for local data breakout
- Integrated on Intel Hardware platform Single Socket, Xeon scalable SoC as well as ARM

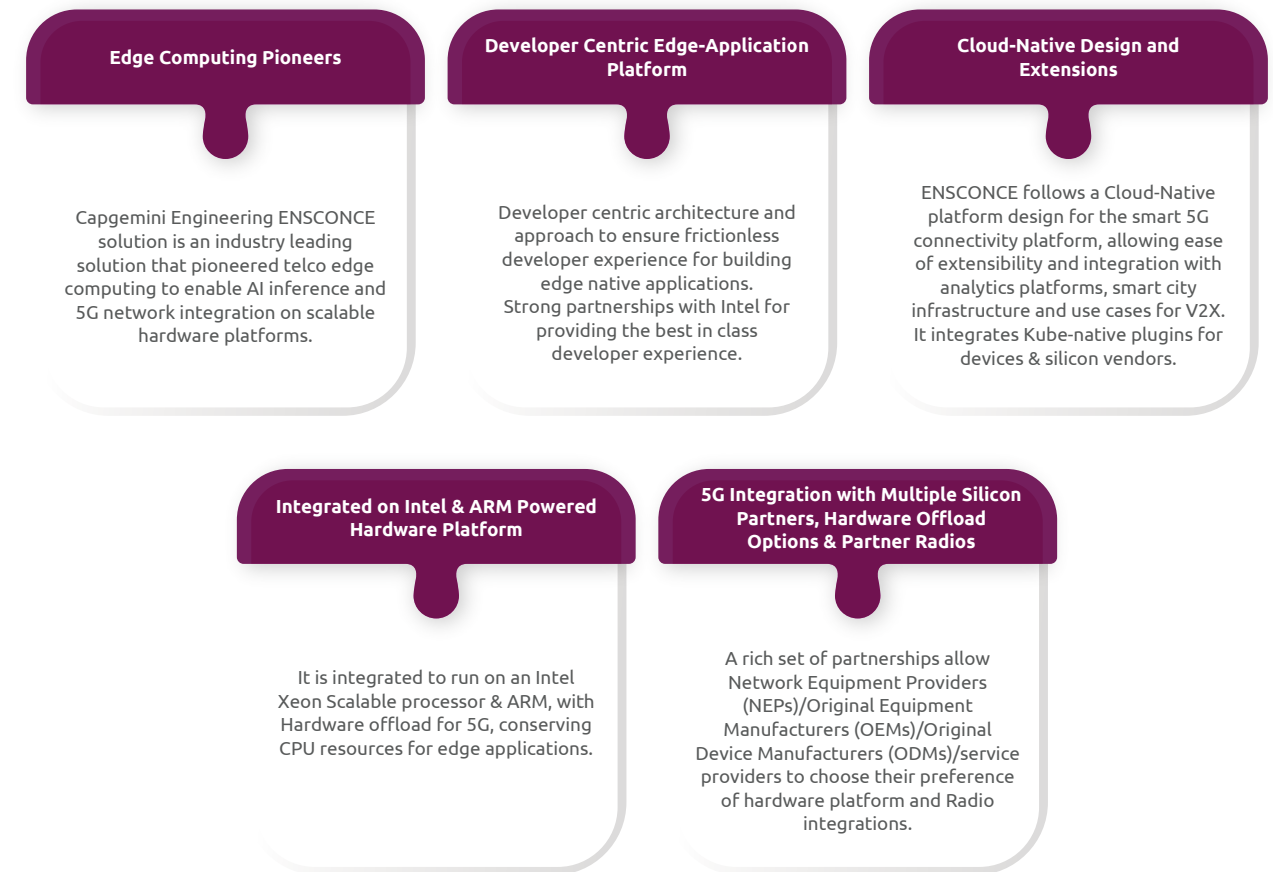
5G Connectivity Platform – Central

- The central cloud would consist of Capgemini Engineering ENSCONCE cloud PaaS
- ENSCONCE Customer Portal
- Capgemini Engineering 5G NGC

Reference Visual Compute Edge-Applications

- Visual compute inference applications with accelerator offload for vehicle/pedestrian detection and road segmentation for C-V2X and predictive maintenance, quality inspection and Worker Safety for smart-manufacturing^[4].
- Live Stream Meta-Data to V2X applications, digital control panels in smart-factories etc

The Capgemini Engineering advantage



References:

- [1] United Nations – Department of Economic Affairs - <https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>
- [2] An Industrial Robot System Based on Edge Computing: An Early Experience – HotEdge-2018, Usenix Advanced Computing Systems Association
- [3] Future technologies that will drive Industry 4.0 – World Economic Forum 2019 Annual Meeting - <https://www.weforum.org/agenda/2019/01/future-technologies-will-drive-industry-4-0/>
- [4] Capgemini : AI for Manufacturing -<https://www.capgemini.com/in-en/service/perform-ai/real-world-ai-manufacturing-solutions-2/>

About Capgemini Engineering

Capgemini Engineering combines, under one brand, a unique set of strengths from across the Capgemini Group: the world leading engineering and R&D services of Capgemini Engineering – acquired by Capgemini in 2020 – and Capgemini’s digital manufacturing expertise. With broad industry knowledge and cutting-edge technologies in digital and software, Capgemini Engineering supports the convergence of the physical and digital worlds. We help clients unleash the potential of R&D, a key component of accelerating their journey towards Intelligent Industry. Capgemini Engineering has more than 52,000 engineer and scientist team members in over 30 countries across sectors including aeronautics, space and defense, automotive, railway, communications, energy, life sciences, semiconductors, software, and internet and consumer products.

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