With 70 years of experience, Iskratel is the leading European provider of infocommunications solutions and has, its own R&D and manufacturing centres, 900 employees and a local presence in more than 30 countries. Iskratel delivers integrated telecommunications solutions for the telco, transportation, public safety, and energy industries.

Whitepaper

vEPC-Based Wireless Broadband Access

Providing broadband services over LTE and vEPC

The ever-increasing appetite for bandwidth and new evolved services in mobile networks are forcing network operators to constantly keep up with the demand. With many people using applications on their smart phones, data transfer has become one of the most important things.

The rise of the Internet of Things (IoT) and the mobile-phone revolution, along with the need for higher speed, lower latencies and support for new applications have been driving mobile operators to implement a backbone which can provide these services to the end users.

Fixed operators have realised that without mobile solutions in their portfolio, they will be quickly replaced for mobile operators. The solution is to use the radio-access network (RAN) infrastructure of a mobile operator, invest in a virtual core and offer new applications to the customers.

Summary

These whitepaper presents the case for mobile broadband connectivity over a long-term-evolution (LTE) network, providing broadband services over virtual evolved packet core (vEPC). The whitepaper outlines all the components and clarifies how they fit into the complete solution.

Although initially introduced for LTE, the EPC today provides security, mobility and quality of service in very diverse access networks. It enables a variety of services and apps, from consumer broadband to mission-critical services, from telco and industrial IoT (IIoT) to public safety.

Iskratel provides vEPC solutions with all modules needed for LTE services, utilising its open source-based cloud-services platform for virtualisation, orchestration and management.

Iskratel's vEPC-based solution for wireless broadband access provides broadband services over LTE to users that lack a secure and reliable fixed broadband connection. LTE and vEPC guarantee high bandwidth and low latency, and enable numerous broadband services and apps.

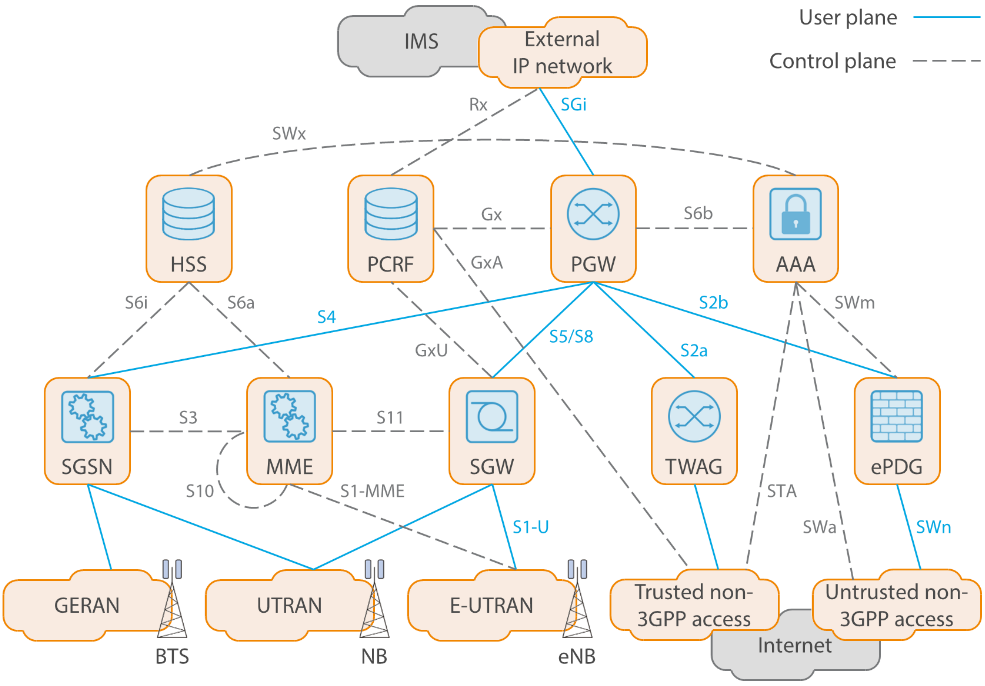
The vEPC-based solution allows other lucrative use cases, such as voice over LTE (VoLTE) or voice over Wi-Fi (VoWiFi), and acts as a business enabler for mobile virtual-network operators (MVNOs).

#1 Evolved packet core

Evolution of 3G and introduction of new elements

EPC was first introduced in 3GPP Release 8 as a new core-network architecture for LTE. The EPC was designed with a flat architecture and the ability to handle payload traffic efficiently, while improving performance but remaining cost-effective. EPC separates the data/user plane from the signalling/control plane. It consists of specialised entities for efficient data transfer, such as the serving gateway (SGW) and the packet-data network gateway (PGW), as well as entities optimised for fast control-plane transaction processing, such as mobility-management entity (MME) and the home-subscriber server (HSS).

EPC emphasises security, mobility and quality of service in diverse access networks, including both 3GPP and non-3GPP networks (such as Wi-Fi and fixed-access networks).



EPC architecture, its entities and interfaces

Iskratel uses and integrates EPC solutions with all the modules needed for LTE services, in compliance with 3GPP Release 13. Iskratel's EPC is applicable in small and midium sized systems, supporting numerous use cases and applications, from mobile broadband to the more sophisticated VoLTE, VoWiFi, public safety, IoT and multiple MVNO systems.

#2 Applications and uses of EPC

Main segments for Iskratel's virtual EPC are private/remote networks, public safety, telco and IIoT

With EPC, operators can provide different services and apps, addressing various technical or commercial requirements, from best-effort internet access to low-latency, high-throughput or mission-critical services.

For example, in cases of major environmental disasters and damage to the critical infrastructure, public-safety services and first responders need to act quickly and efficiently. Virtual EPC (vEPC) can be used in combination with pico-stations to set up an emergency-communications network to support of public-safety services and facilitate the search for missing persons.

On the other hand, at big sports events (such as the Olympic Games), vEPC can be used to provide communications services to all security and event personnel.

For the operators, vEPC is important as it enables the use of existing radio-access networks (RANs) to companies interested in becoming MVNOs. If they do not own the radio infrastructure, they can still become MVNOs and offer mobile services to their customers. Mobile operators can use the vEPC as a solution to provide broadband access, because of its high-speed data transfer.

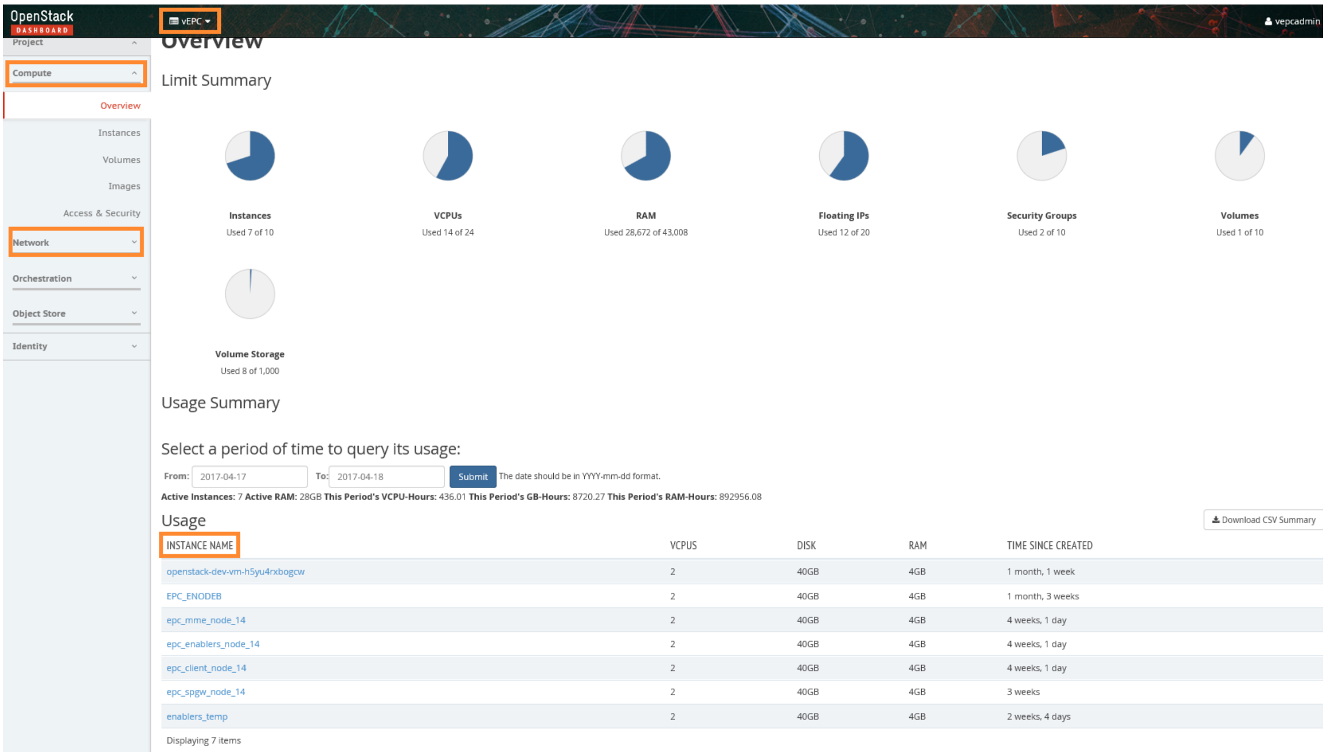
In industrial environments, working robots and stations require a low-latency solution. The vEPC solution (with radio stations optimised for low latency) provides stable robot control and uninterruptible operations, as well as all communications services.

#3 Virtualisation and use of OpenStack

Open-source platform for virtualisation, orchestration and management

Internally, Iskratel's cloud-services platform uses OpenStack, a combination of software tools for creation and management of private and public clouds. It provides virtualised computer resources for software running on OpenStack as virtualised network functions (VNFs), all on top of reliable hardware servers.

In the specific vEPC use case, the main components used are Nova for network management, Glance for creation of image and setup of instances, Horizon as the dashboard, and Neutron for port operations.



OpenStack dashboard with marked tenant space, compute and network tabs, and instance overview

The dashboard offers a quick overview and a range of management tools. In the OpenStack environment, vEPC entities have dedicated resources and are operated under a vEPC tenant. The dashboard facilitates easy management of the network, instances, processing and memory resources. OpenStack also offers a set of command-line tools for detailed and advanced setup.

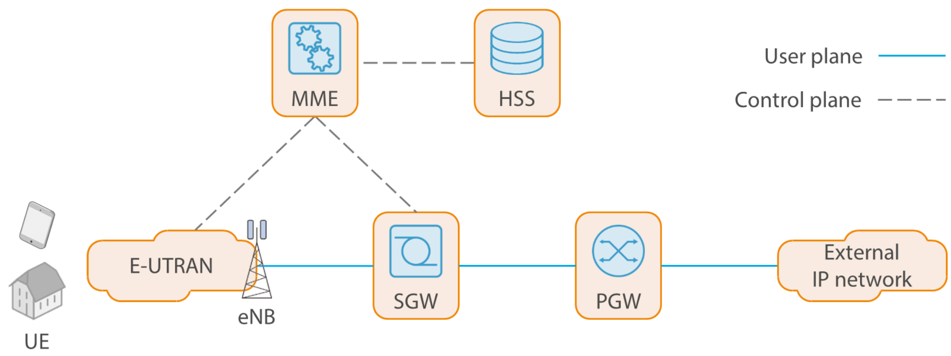
The network-deployment model focuses on the provider's or public network. Provider networks in OpenStack connect VNFs within the cloud infrastructure with external network devices directly. The administrator must specify the provider-network type and network-segmentation ID (the VLAN tag in case of a VLAN-segmented network; the tunnel ID in case of a tunnelling protocol), as well as the external router. The physical ports of external devices must be connected to the private section of the ports at the top-of-rack (ToR) switch. To reach the devices in the cloud, the network traffic must be tagged with the corresponding segmentation ID.

By default, a public network is created after the installation of the OpenStack via Fuel. It contains one subnet and is connected to the default router for connectivity with public networks outside the cloud. At the border of the OpenStack, a DNAT translates internal public IP addresses (from the public-network subnet) to external public (floating) IP addresses and vice versa. Another entity, a PNAT, uses one external public IP address for egress connectivity of the virtual machines (VMs) within the cloud. External equipment is connected through the public section of the ports at the ToR switch and must not use VLAN-tagged network traffic. The network traffic is sent through DNAT, the default router and vSwitches of the internal public network to reach the VNFs (i.e. the VMs).

#4 EPC-based wireless broadband access

Mobile network system for delivery of broadband services

To provide users with high-speed internet access in places where fibre or copper cables are absent, a alternative solution is to use the LTE cellular network. Today, its bandwidth is comparable to fibre or coax, reaching 20-50 Mbps in downstream and 20 Mbps in upstream, with a low latency of around only 10 msec. To implement quality of service, different profiles can be used to guarantee secure bandwidth allocation to the end customers.



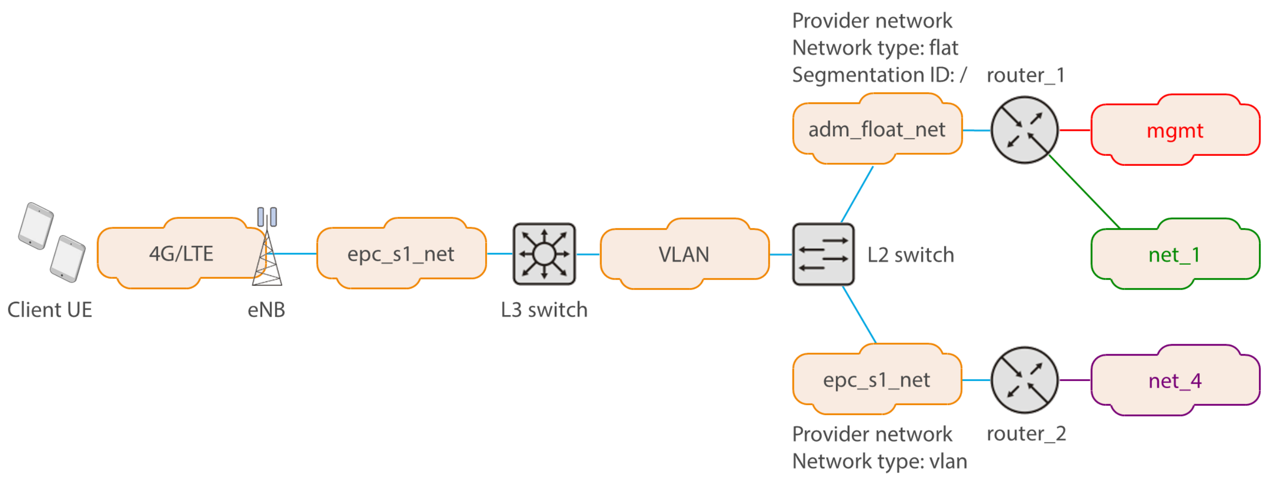
EPC entities activated to provide broadband access

In the solution, user equipment (UE) connects to the eNodeB via a wireless-access network. The HSS and MME entities provide subscriber registration and line setup, while the SGW forwards data packets and the PGW provides internet connectivity.

#5 Iskratel's vEPC solution for wireless broadband access

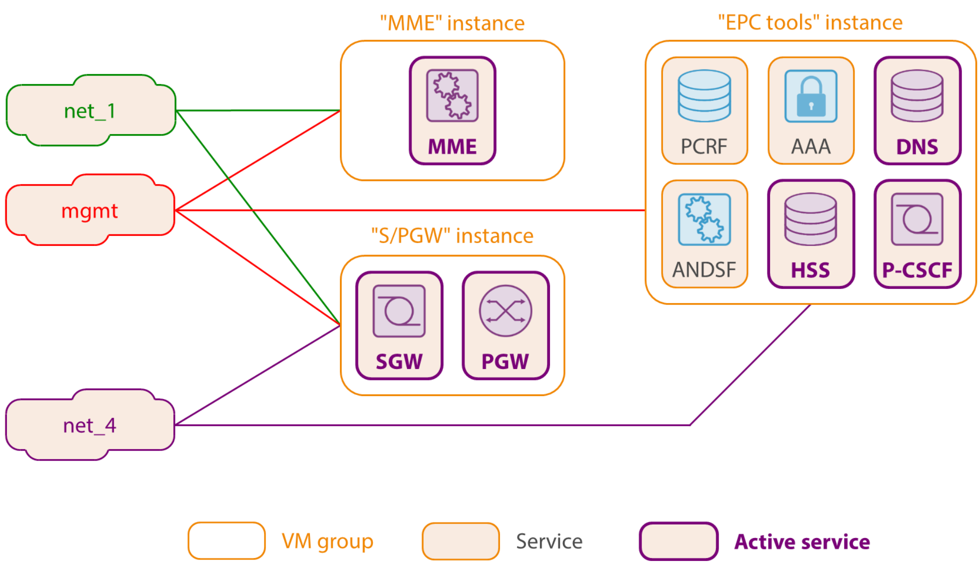
Gluing all the components together

Instead of merely focusing on typical, no-brainer setups, Iskratel enhances the use of EPC by integrating a robust eNodeB (eNB) applicable in autonomous networks and public-safety solutions. The equipment is connected through corporate networks to the vEPC which runs on Iskratel's OpenStack-based cloud-services platform. As a final result, the system provides data connectivity to the UE.



Iskratel's vEPC-based broadband-access solution

The entities required for broadband access are MME, HSS, SGW and PGW, whereas more features and entities can be enabled even if they are not needed. The eNodeB is part of a RAN network. All entities are parts of specific instances running in OpenStack, and additional modules can be activated at any time.



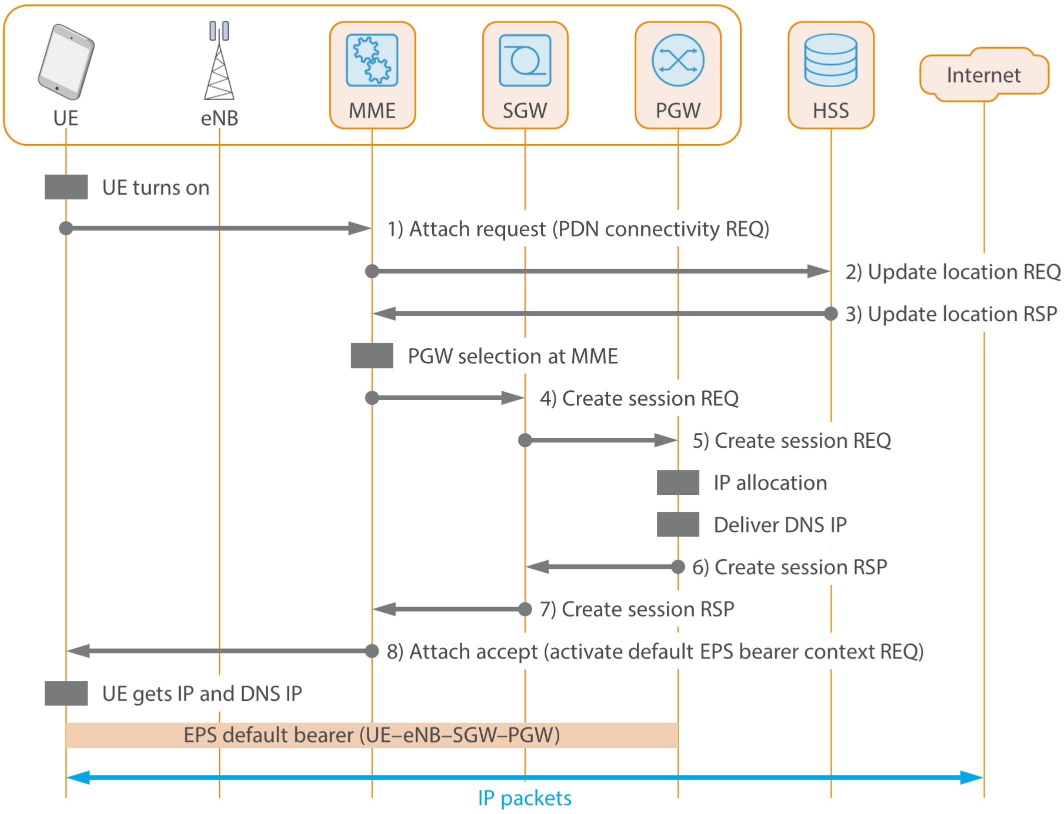
Segmentation of instances and utilised functions

Each VM instance hosts and runs different vEPC entities. For easier management, the instances are named after the main vEPC element running on them. Thus, the "MME" instance runs MME functions; PGW and SGW are combined and run on a "S/PGW" instance or separately; the "EPC tools" instance features functions which support various services.

#6 Iskratel's vEPC: operation and results

Enabling connectivity and services over LTE

In the solution, the MME is used to enable the registration of UE to the LTE network, enabling a simpler overview of network attachment and data transfer. A successful registration of UE results in the assignment of an IP address from the vEPC, allowing the UE the access to the internet.



Attachment procedure

The eNodeB is authenticated in the MME, UE and the IMSI (international mobile-subscriber identity) number is provided in HSS for authentication. When the UE is switched on, it sends an attach request to connect to the vEPC over LTE, and the MME requests the HSS to update the location and authenticate the UE. When the location has been updated, the MME sends a request to create the session to the SGW, which sends it to the PGW; the latter returns the session parameters (the assigned IP and DNS addresses) for the UE. Returning the same way back, the response reaches the UE, along with the MME's attach-accept response. An EPS (evolved packet system) default bearer is activated and the UE can now send or receive IP packets from the packet data network (PDN).

To simply demonstrate, a test network named "00101" was defined, and the SIM cards in the UE were provisioned with IMSI and authentication and authorisation parameters.

Parameters of the SIM card, signal strengths and the speed-test results in the test network can be seen in the snapshots on the right.

In the simple demo setup, throughput of 60 Mbps and latency of 15 msec were achieved, enabling numerous services and apps even in this simplest case.

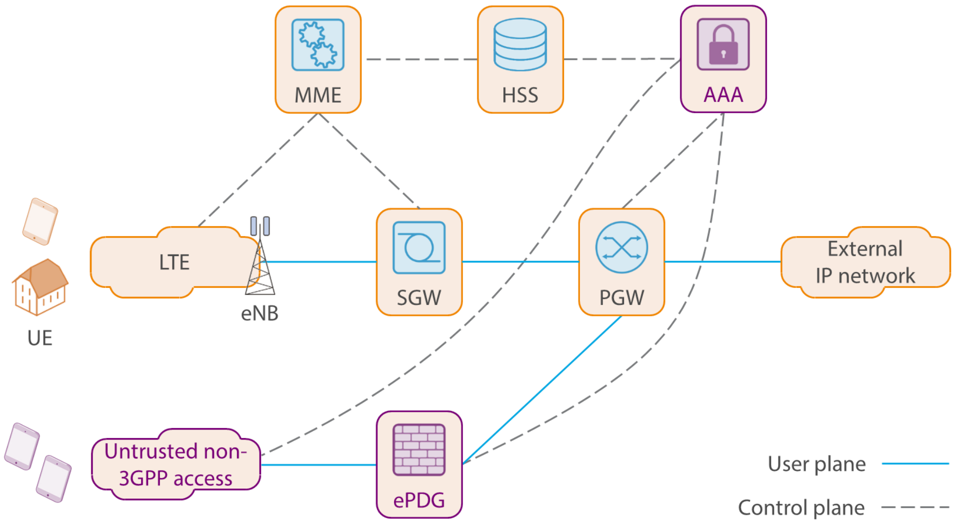
SIM status and speed test

#7 Upgrading to advanced use cases

Where do we go from here?

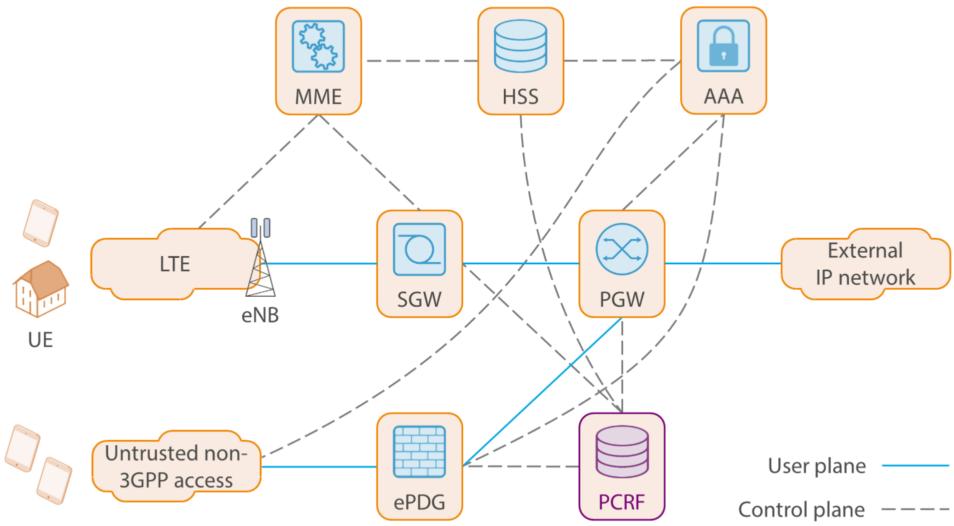
The described solution for vEPC-based wireless broadband access (i.e. fixed LTE) is easily extensible to allow operators and enterprises to address other lucrative use cases, such as VoLTE/VoWiFi, or to reinvent themselves as MVNOs.

The first and most natural next step for an operator is to provide Wi-Fi calling. With activation of the evolved packet-data gateway (ePDG) and the authentication, authorisation and accounting (AAA) entities, Wi-Fi UE can connect from a non-3GPP (Wi-Fi) network.



Additional EPC entities activated to enable VoWiFi (violet)

Even more sophisticated use cases for MVNOs and support for VoLTE and over-the-top (OTT) applications are achieved with the additional activation of the policy- and charging-rules function (PCRF) entity. In this scenario, EPC capabilities for VoLTE are exploited to the maximum.



Additional EPC entities activated to enable VoLTE (violet)

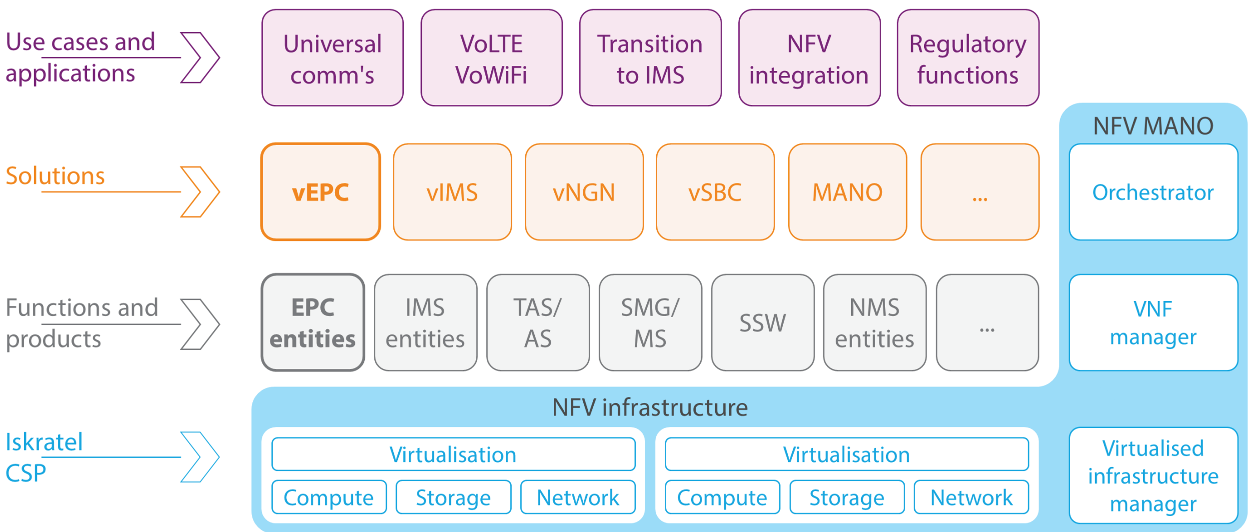
About Iskratel's vEPC solution

Iskratel's vEPC solution provides a fully integrated, scalable and cost-effective solution for operators of fixed or converged networks and for enterprises and industries that need to introduce and support wireless communications services. The solution facilitates a painless evolution to the next-generation core as a part of 5G, seamlessly interworking with legacy networks at the same time.

All components of Iskratel's vEPC solution are completely virtualised. The solution provides carrier-grade reliability, orchestrator-driven scalability, rich interoperability with 3G or Wi-Fi networks, as well as centralised service provisioning, full regulatory compliance and coexistence with IP multimedia subsystem (IMS).

Iskratel's vEPC is applicable as a compact network-in-a-box or as a fully virtualised, cloud-based, orchestrated solution. Iskratel's vEPC in a box delivers vEPC solution for a wide range of networks and can be provided in a compact, high-performance system, in which the vEPC entities can be located in a single box or separately, according to network-deployment requirements. On the other hand, Iskratel's cloud-based vEPC runs as a VNF in Iskratel's Cloud-services platform (CSP). Separated control and user planes provide high flexibility and industry-leading performance. Exhibiting predictive auto-scalability, this solution is best suited for MVNOs and multi-tenant solutions.

Use of Iskratel's vEPC solution spans from telco applications such as wireless broadband, VoLTE, VoWiFi and WiFi offload, to a range of industry-specific uses in IoT, public-protection or disaster-relief networks, railways and infrastructure networks, as well as critical and strategic wireless communications. Iskratel's vEPC enables fusion of services for different industry verticals into unique solutions, enabling full digitalisation of industries.



Iskratel's vEPC solution as a part of a complete virtualisation portfolio

About the authors

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