The Kaloom™ 5G User Plane Function (UPF)

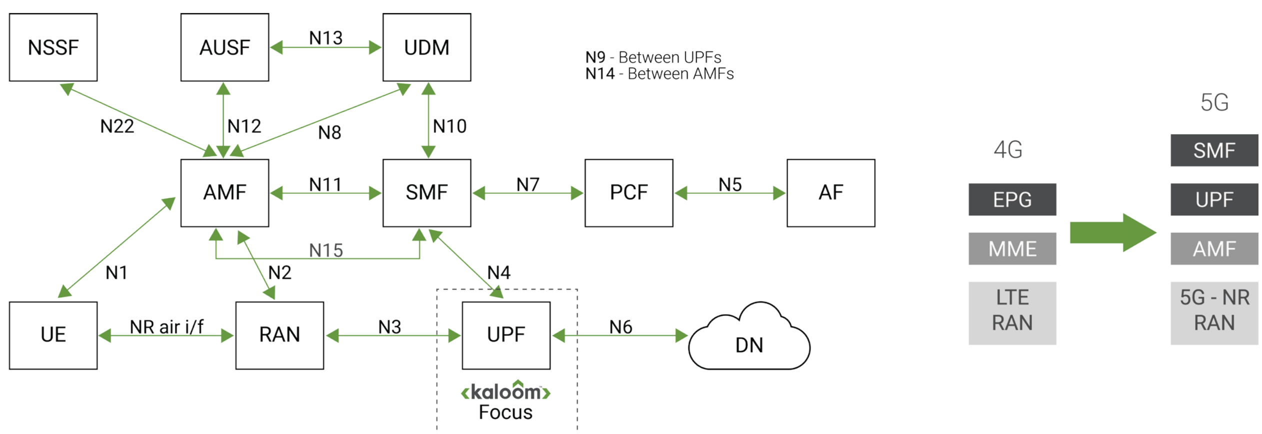
The fastest, most scalable, 5G UPF solution on the market

Overview

Kaloom's standalone User Plane Function (UPF) offering is ideally suited for new emerging 5G Cloud Edge, Hybrid 4G/5G and 5G Packet Core deployments. Designed with the most mission critical workloads in mind for 5G, it offers the most scalable, lowest latency, and highest performance UPF solution in the industry.

5G Architecture

5G has been designed for higher scalability, is container optimized, and has a mobile packet core that is more widely distributed to meet the ever-increasing demands of mobile data. The Evolved Packet Gateway (EPG) of 4G has been split into two components in 5G; a data plane function called User Plane Function (UPF) and a control plane function called Session Management Function (SMF). As highlighted in Figure 1, Kaloom provides a programmable multi Tbps UPF which can either be integrated into its fabric or can be deployed as a standalone node with the latter being the focus of this Product Brief. Kaloom's UPF provides improved performance at a fraction of the cost when compared to expensive x86 based solutions while significantly lowering network latency from seconds down to milliseconds to meet the demands of latency sensitive applications such as IoT, AR and VR.



AMF - Access and Mobility Management Function
SMF - Session Management Function
PCF - Policy Control Function
AF - Application Function
NSSF - Network Slice Selection Function
AUSF - Authentication Server Function
UDM - Unified Data Management
UE - User Equipment
RAN - Radio Access Network
UPF - User plane Function
DN - Data Network

Figure 1 - 5G Network Architecture

Hybrid 4G/5G

With reference to Figure 2, new modern multi-vendor NFV architectures for 4G and 5G needs to support a unified platform that can host networking functions as both containers and virtual machines. This is important for customers that need simultaneous support of both their legacy applications and 4G networking functions such as EPC, MME, PCRF via VNFs in virtual machines as well as their new containerized workloads with networking functions such as UPF, AMF, SMF and PCF via CNFs. Application server environments need to run both OpenStack for VNFs and OpenShift Container Platform / Kubernetes for CNFs thus allowing for hybrid 4G and 5G architectures. For instance, a telco can have their existing 4G EPC running in their central data centers and deploy new 5G enabled edge cloud data centers.

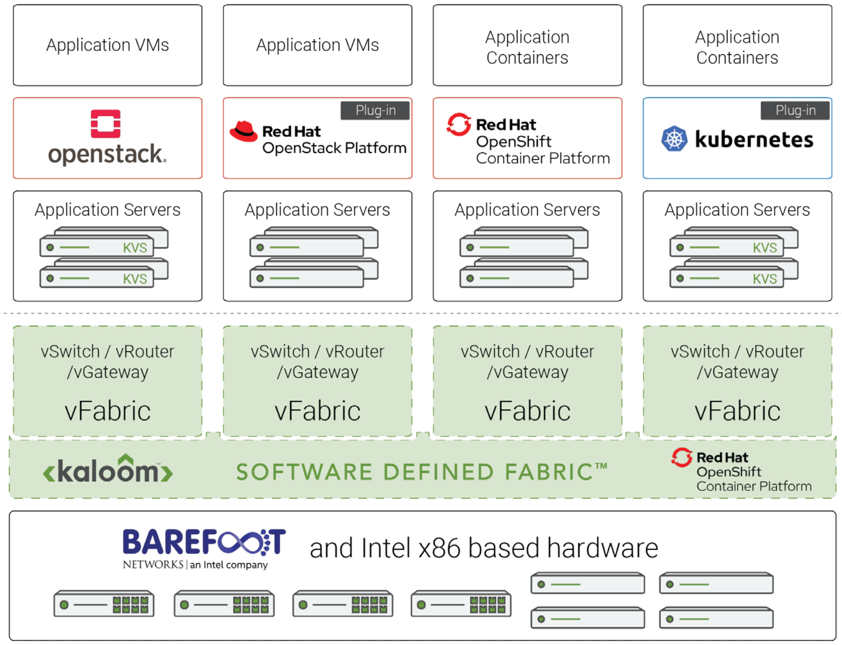


Figure 2 - Software Defined Fabric™ - High Level Block Diagram

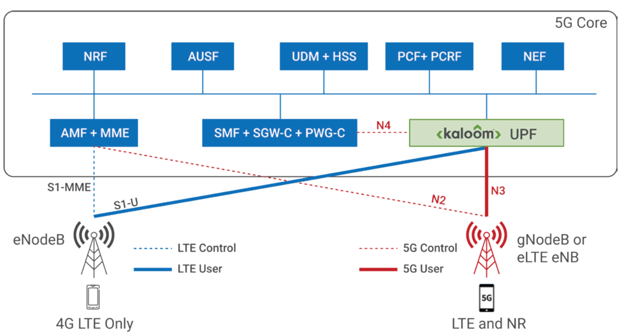


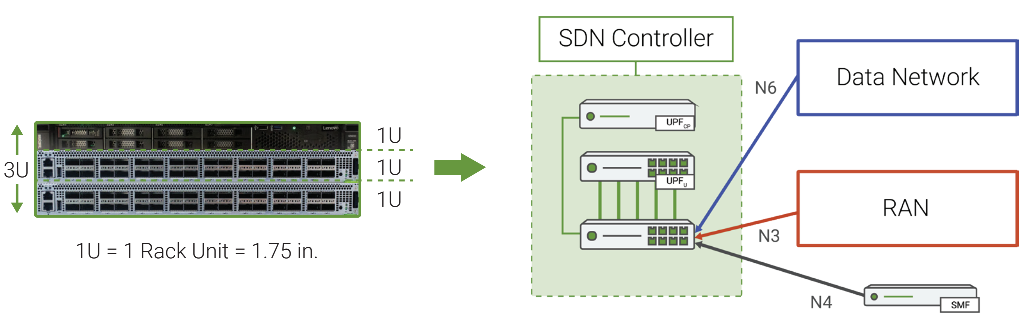
Figure 3 - Kaloom UPF in Hybrid 4G/5G

Kaloom UPF Serving 4G & 5G RANs

Figure 3 below provides a graphical representation of Kaloom's UPF within the 5G core to illustrate that it can be used to serve both 4G and 5G Radio Access Networks (RANs). Mixed 4G and 5G deployments such as a modern 5G cloud edge coupled with a pre-existing 4G core, could help to accelerate new revenue opportunities at the edge.

Kaloom's Standalone UPF

Figure 4 below provides a simplified block diagram view which contains within it Kaloom's standalone UPF node comprised of three primary components, namely; an X86 based server (1U) hosting the control plane software, as well as, the UPF application (1U) and L2 & L3 applications (1U) installed on separate white box switches. This combination provides a 3U configuration and single node management having the listed specifications.



3U - UPF

- 1.5 Tb/s
- 4M Sessions
- Up to 15x100 GbE UPF Ports
- Each 100GbE Port, sliced into 25 GbE ports enables functionality for:
  - vRouter
  - vGateway
  - vSwitch

Figure 4 - Hardware Configuration and Block Diagram

Tbps UPF

The UPF has been designed to be distributed and virtualized in 5G and offering better scalability than that provided by EPG in 4G networks which was designed to be more centralized in the mobile core network and running on standard x86 servers. UPF can be co-located in the new emerging cloud edge data centers. Kaloom's standalone UPF runs its programmable data plane in Intel (formerly Barefoot Networks) based white boxes to scale the performance from 100Gbps to multi Tbps. Customers benefit from programmability and can add new services and features in a standardized way using the P4 programming language, something which is not possible in non-programmable switches. In the standalone UPF POD shown previously in Figure 4, the UPF functions are embedded and run in the leaf switch, while control plane functions such as SMF run in the servers in the data center. Traffic comes into the standalone UPF POD from either the RAN via the N3 interface or from the data network (Internet) via the N6 interface. Kaloom's standalone PODs are flexible and scalable, allowing new racks of servers to be easily integrated and deployed in an automated way.

A 3GPP Release 15 Compliant UPF

As shown in Figure 5 below, Kaloom provides a 3GPP Release 15 compliant UPF with a programmable pipeline implementing packet rules (flow identification), forwarding action rules, usage reporting rules and QoS enforcement rules for a full UPF data plane. The solution scales up to millions of user sessions without impacting throughput. As well, new features can be implemented in P4 to allow for differentiation thus providing telcos greater possibilities in introducing new services to meet evolving customer requirements, thereby enabling them to be more competitive in the marketplace.

The UPF-C (Control Plane) interfaces with the SMF to manage and to maintain Packet Forwarding Control Protocol sessions (PFCP) sessions via the N4 interface (see figure 4). It runs on servers as containerized software in a Kubernetes cluster and scales horizontally to support increased signalling rates, number of subscribers and replicated session state within the control cluster to provide fault-tolerance and transparent failover. The management is done via a HTTP RESTful management API.

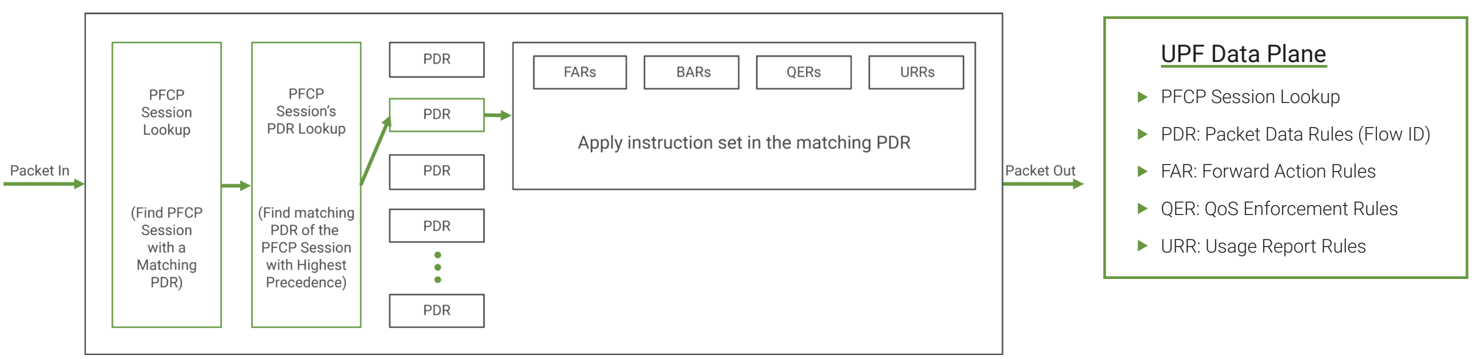


Figure 5 - Packet Processing Flow in UPF

5G Network Slicing

Similar to the embedded UPF found within the Cloud Edge Fabric™ product[1], Kaloom's standalone UPF supports end-to-end 5G network slicing whereby an edge data center can be partitioned by a data center infrastructure provider (DCIP) into multiple independent virtual data centers, with each virtual data center provided its own virtual fabric called a "vfabric". Each virtual data center with an associated vFabric can be assigned to a different virtual Data Center Operator (vDCO) or Cloud Service Provider (CSP) that can offer differing SLAs per Cloud Service User (CSU). In this regard, slicing permits multiple operators and large enterprises to share, as CSUs, a common distributed cloud infrastructure, with each CSU enjoying full isolation down to the hardware level for better security and a better quality of experience provided to the individual Cloud Service Consumer (CSC) consuming the services/applications offered by the CSU.

Figure 6 illustrates the concept of network slicing. In Kaloom's implementation, a slice corresponds to one vfabric which corresponds to logical UPF instance(s), namely vUPFs, whereby each vUPF would have its own functional characteristics based on requirements specific to the services provided by that network slice. Each vfabric provides a fully distributed and isolated domain, thereby making it possible to deploy isolated packet cores for either specific applications or large-scale and strategic customers.

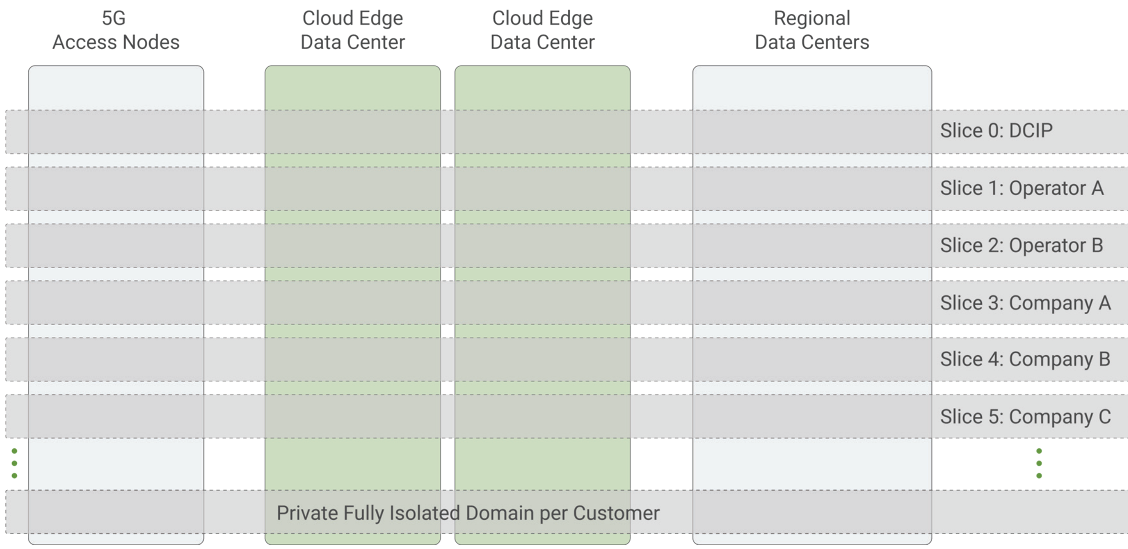


Figure 6 - 5G Network Slicing

In Figure 7 below, the concept of network slicing is illustrated via multiple logical UPF slice instances, whereby each slice may represent specific, differentiated network capabilities and network characteristics as seen further below in Figure 8.

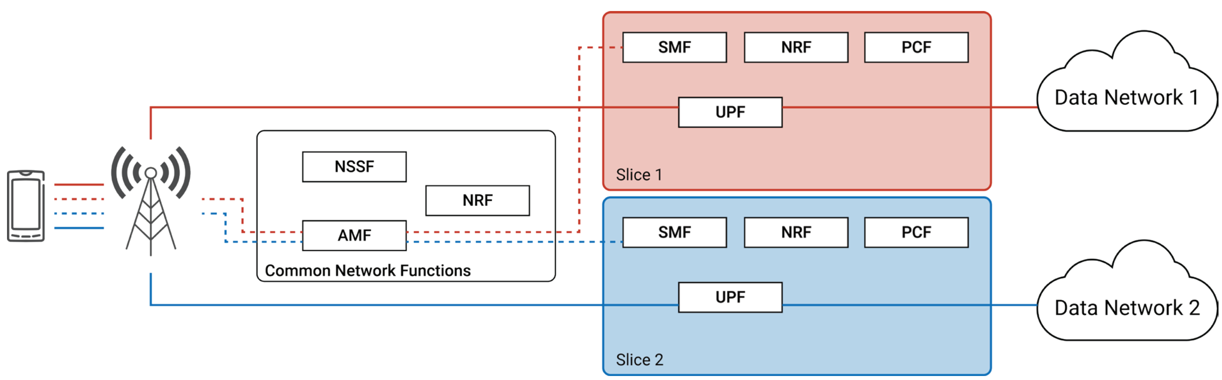


Figure 7 - Multiple Logical UPFs[2]

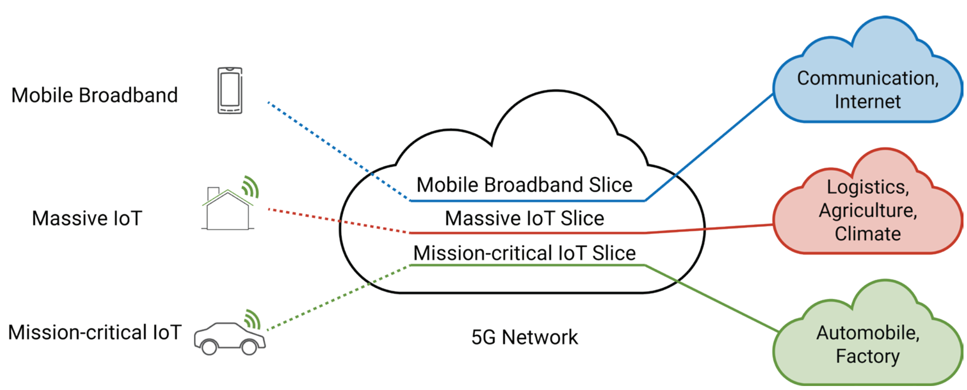


Figure 8 - Network Slicing Example

Standalone UPF Key Features and Benefits

Industry first cloud native UPF

- Optimized for container-based workloads

High performance, low cost solution delivering:

- High throughput (up to 1.5 Tb/s)[3]
- Low latency (less than 1µs)
- 10x reduction in total cost of ownership (TCO)

Fully standards based, multivendor solution

Fully automated for data center deployments

- Data model driven, server style management

Scalable

- Millions of users on IPv6 based networks

Flexible

- Enabled for centralized or distributed data centers

Futureproof

- Allows customers to program the infrastructure to add new features and services quickly thereby avoiding wait times associated to new silicon revisions which can impact their production work

Supports end-to-end slicing

- Enables the creation of logical networks that provide specific network capabilities and network characteristics
- Provides enhanced security by providing full isolation between customers/tenants

Supports services chaining of CNF and VNF

- Enables significant network optimisation improvements
- Offloads network functions into a programmable data plane

Supports segment routing over IPv6 (SRv6) data plane[4]

- Enables coding directly into each packet header defining where traffic should be sent and how it should be treated, thereby enhancing the interaction between applications and the underlying network

References

[1]For more detailed information please refer to www.kaloom.com/product-collateral
[2] https://sdn.ieee.org/newsletter/december-2017/network-slicing-and-3gpp-service-and-systems-aspects-sa-standard
[3]Can be expanded to 2.2 Tb/s when replacing the 32-port leaf switch to a 64-port switch (ports would be available on the leaf switch to connect to more application servers)
[4]Roadmap Item

MBUZZ

MBUZZ Europe

Kaloom's Exclusive Partner in Europe

Contact Us

- contact@mbuzzeurope.com
- www.mbuzzeurope.com
- linkedin.com/company/mbuzzeurope
- twitter.com/MBUZZEurope

For more information please visit: www.kaloom.com

kaloom™

Headquarters

355 Rue Peel, Suite 403
Montreal, Quebec, Canada
H3C 2G9

www.kaloom.com
info@kaloom.com