Metaswitch Fusion Core™

A High Performance Private 5G Core for Multi-Access Edge Compute

- A cloud native 5G core using microservices methodologies
- Built for Azure but deployable in any public or private cloud
- Concurrently supports standalone 5G NR and 4G LTE RANs
- Delivers the highest performance with the smallest footprint
- Integrated ServiceIQ management and operations toolsets
- Complete workload lifecycle automation and orchestration

To survive and thrive in the onset of the fourth industrial revolution (Industry 4.0), enterprise IT executives are being tasked with aggressive digital transformation objectives and are realizing private 5G and edge compute provide the answer.

From manufacturing to smart agriculture, these initiatives focus primarily on increasing efficiencies through automation. Supporting the influx of new sensors and control points, the dramatic increase in data they generate, and the extremely low latencies they mandate requires the adoption of new wireless technologies. Providing the communications infrastructure and localized processing necessary to deliver these applications is also accelerating the need to adopt new, agile, edge cloud strategies that support both the network functions and compute capacity they demand.

Mobile networks made significant evolutionary advancements with the introduction of New Radio (NR) and 5G core (5GC) standards and specifications within the GSMA's 3GPP release 16. 5G embodies the potential for a totally connected world which can enhance the lives of individuals while propelling industries and communities into a new era of innovation. This includes the expectations of the ITU-T's IMT-2020 vision for 5G, which covers support for enhanced mobile broadband (eMBB), ultra-reliable low latency communications (URLLC) and massive machine type communications (mMTC).

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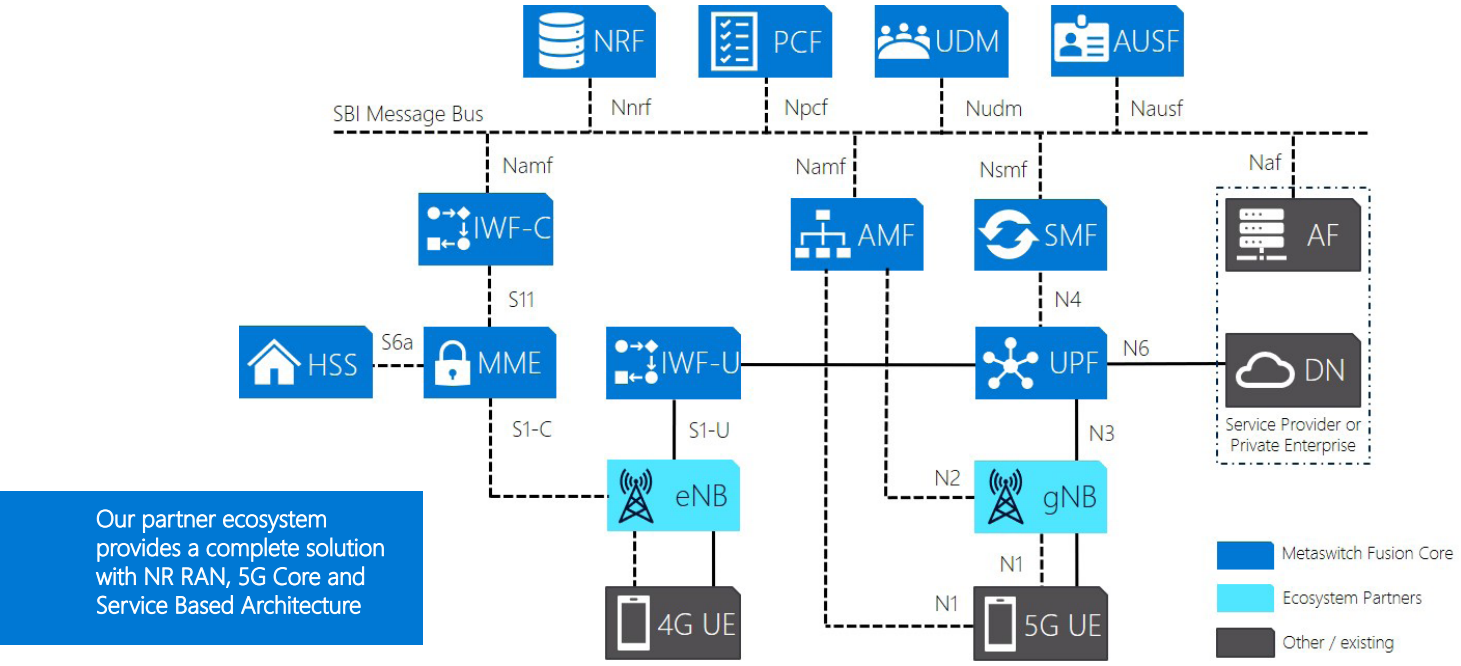
With the promise of meeting the insatiable demand for mobile bandwidth and providing an alternative to costly fixed line broadband, commercial 5G NR deployments employing high-band (mmWave) spectrum have already commenced in urban population centers around the globe. Predominately the domain of large network operators, these implementations have focused on individual consumer connectivity, relying on the same deployment models and, in some cases, the same evolved packet core (EPC) components as 4G.

The standardization of standalone 5G NR using new mid band and high band unlicensed spectrum opening up around the globe (NR-U) is proving to be the catalyst for enterprises struggling to achieve the technical and business goals being set as part of their digital transformation initiatives. Private 5G can support dense deployments of fixed or mobile IoT endpoints, securely serving them with low latency connectivity while also providing incredibly high speeds for bandwidth-intensive applications like virtual reality. For this reason, global systems integrators and enterprise technologists are now looking to 5G as the future of their wireless connectivity strategy.



Our partner ecosystem provides a complete solution with NR RAN, 5G Core and Service Based Architecture

While 5G demands core network functions built using cloud native methodologies, most implementations have been telco-centric. As a result, they have lacked any focus on the deployment efficiencies, packet processing performance, ease of implementation or integration of edge services required for broad adoption by managed service providers and network systems integrators in enterprise environments.

As recognized pioneers in cloudification, Metaswitch has a deep understanding of what it takes to deliver cloud network functions (CNFs) with superior performance, scalability and resiliency. This requires expertise in the areas of microservices development platforms and design patterns, highly distributed state maintenance, advanced data plane acceleration plus modern orchestration models. This is particularly critical when developing 5G core components, which will be some of the first network elements to be exclusively deployed in public, private or hybrid multi-access edge compute (MEC) clouds.

Metaswitch Fusion Core enables:

- The fastest path to Private 5G: With a complete set of network functions, Metaswitch 5G Core serves as the starting point to deliver an 5G network on enterprise edge.
- The lowest cost per bit: Fusion Core delivers disruptive 5G core user plane performance with industry-leading compute resource utilization on both control and user plane functions.
- Multi-access: With a unique interworking function, Metaswitch simlpifies milti-RAN implementations and eliminates the need for complex and costly dual cores.
- Massive scale/any edge: Complete containerization of our core while leveraging Kubernetes Orchestration enables you to deploy and dynamically scale the core on any cloud infrastructure.
- Rapid service innovation: We strive to make the Fusion core developer friendly, with on-demand instantiation, open network interfaces and a highly programmable data plane.

Metaswitch Fusion Core comprises four key 5G technical areas: The user plane, control plane, subscriber & policy functions and management, all based on service-based architecture. Each individual function has been carefully architected to exceed the stringent demands that will be placed on them and can be instantiated within compute clouds with diverse virtual machine, container and serverless architectures that span from large, centralized, data centers to small edge application delivery locations.

The User Plane Functions

Subscriber packets, within a 5G's separated control and data plane architecture, are processed by the User Plane Function (UPF). The UPF is the protocol data unit session anchor enabling mobility between multiple radio access technologies and provides the interface between the 5G Core and other data networks. This includes either an operator's Gi-LAN or a private enterprise-wide area infrastructure. As such, the UPF performs packet classification, routing and forwarding, a set of functions typically performed by proprietary platforms with completely custom silicon. However, these legacy hardware platforms lack the flexibility required to meet the business and technical demands of 5G.

Totally cloud native, instantly deployable, granularly scalable and uniquely resilient, the Metaswitch Fusion Core UPF features the first packet processing engine capable of deriving the cost/performance required to deliver a viable alternative to classic, physical, switch/routers. This is made possible by our exclusive composable network application processor (CNAP) technology. CNAP avoids the pitfalls of a typical data-driven switch's upfront packet parser by performing that function at each stage. Plus, unlike a classic code-driven system, CNAP significantly reduces the time it takes to load the code required to process packets each stage.

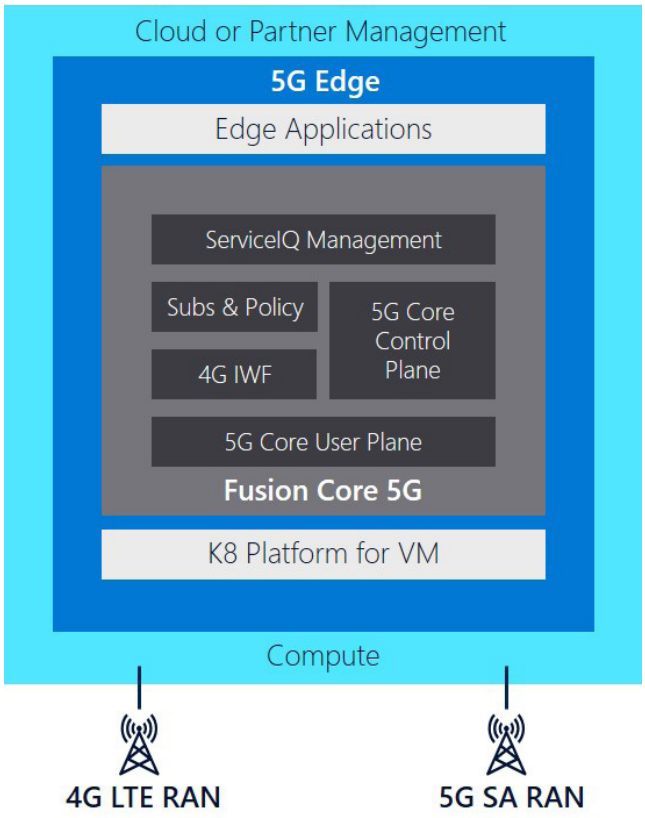
CNAP dramatically improves on current switch pipeline batching and interleaving techniques by first implementing a unique optimization approach which groups packets into superframes as vectors. As the initial packet in the vector warms-up the, cache the number of cache misses is dramatically reduced, which significantly enhances performance. The pipelines themselves are completely programmable via application-specific graphs that are configured through an open application programming interface (API) and a just-in-time parser collects the fields required for each classifier only as they are required. The graphs are constructed automatically by the UPF's Software Development Kit (SDK) and expressed in a definition document that uses a custom YAML (Yet Another Markup Language) schema. External network automation applications can therefore program the graph without having to operate directly on the packet processing or classifying stages of an individual switch pipeline. A cross-compiler enables the P4 programming language to be used when defining UPF pipelines.

Whether employed as a UPF or fixed mobile convergence (FMC) Access Gateway Function (AGF), Metaswitch Fusion Core's programmability affords the ability to quickly and easily build innovative service function chains (SFCs) that enable a rich portfolio of service enhancements to be applied directly to the traffic flow.

Control Plane Functions

The Access and Mobility Management Function (AMF) and Session Management Function (SMF) are responsible for handling all control traffic within the 5G mobile infrastructure. This requires interfacing with the user equipment (UE), the UPF and supporting functions within the SBA. To meet the architectural requirements of 5G, the control plane elements must be entirely designed as a cloud-native network functions, dynamically deployed and scaled-up on-demand in a completely automated manner. This is a particularly complex proposition when it comes to high-availability control components with asynchronous call flows across geo-diverse infrastructures as they require long and short-lived state maintenance for sessions traversing elements that might quiesce without notice. These functions must therefore employ established design patterns for building and deploying massively scalable web applications while adapting to fit the constraints of real- time communications networks.

Employing our Unstructured Data Storage Function (UDSF), all Metaswitch Fusion Core components are implemented as incredibly lightweight decomposed stateless microservices. This critical new 5G service-based architecture (SBA) element is architected for scalability and resiliency, providing the ability for other network functions such as the AMF and SMF to remain almost entirely stateless. Like the cloud native UPF, these control plane components are deployed in containers as N+k redundant systems which fully orchestrated by Kubernetes. This approach makes for a very robust and fault-tolerant architecture but more importantly, greatly simplifies the automation of life-cycle management, especially for healing and software upgrades. This lays the foundation for transitioning to modern continuous integration and continuous delivery (CI/CD) operational approaches.



Metaswitch Fusion Core within a cloud architecture

4G/5G Interworking

Recognizing that current migration options are convoluted or incomplete, the Metaswitch Fusion Core solution includes unique control and user plane interworking functionality designed to ease the transition from 4G to 5G while eliminating the huge costs associated with operating dual-core networks.

For greenfield and incumbent network environments, the Metaswitch Fusion Core control and user plane interworking functions (IWF-C and IWF-U) provide an immediate path to 5G without continuing investments in maintaining a 4G core. The IWF-C exposes an S11 interface to 4G Mobility Management Entities (MMEs) and provides protocol translations for supporting functions, such as the Policy and Charging Rules Function (PCRF) by way of an N7 to Gx proxy interface. Commensurately, an IWF-U provides the necessary interworking required on the data plane to handle the possible disparities between how sessions and implemented and handled within the 5GC verses an EPC.

Service Based Architecture Elements

The 5G Service-Based Architecture (SBA) provides a modular framework from which common applications and services can be deployed to support control plane functionality while providing common data repositories. Assuming the role of either service consumer or service producer, the result is a set of interconnected but independent reusable Network Functions (NFs), each with authorization to access each other's services. Each network function exposes its functionality through a service-based interface (SBI), which employs a well- defined, stateless, REST interface using HTTP/2.

There are numerous SBA network functions which are required to deliver a feature-rich and dynamic 5G core infrastructure that meets the technical requirements and business goals established by the 3GPP and ITU. Metaswitch partners with suppliers of best-in-breed SBA network functions, while delivering those integral to the operation of our Fusion Core components using our deep expertise in developing cloud native solutions.

Service IQ Management

Metaswitch Fusion Core's Service IQ delivers the management, analytics, orchestration, lifecycle and automation required to enable Metaswitch Fusion Core cloud native network functions to be rapidly deployed in distributed hybrid cloud infrastructures. Service IQ elements intelligently provision new service slices, dynamically scaling network functions on- demand. Meanwhile, our analytics platforms leverage network telemetry to monitor and manage the health and performance of these individual elements on an ongoing basis. Built on open source frameworks such as GitOps, Grafana, Prometheus and Kubernetes, our Service IQ solution aligns your 5G core network with industry-recognized best practices for IT Devops, dramatically simplifying and reducing the cost of managing this complex network while simultaneously accelerating the rate of innovation.

A Microsoft Company

Facing continuous technological and competitive change, communications service providers are now entering the 5G era that demands a new perspective on how networks should be built, the roles that operators will play and the battlefronts on which they will compete. These networks need to be flexible and scalable enough to support a wide variety of new applications and devices, while cost effective enough to support an exponential increase in customer data traffic. 5G also offers the chance for truly practical network convergence, where a 5G packet core can handle traffic for both fixed wireless and mobile networks.

Seeking the many benefits promised by network functions virtualization (NFV), 5G standards are mandating software that is built on cloud native architectural design principles. And as the cloudification of digital services simultaneously becomes the norm, operators are looking at where best to deploy these cloud native elements: In public, private or hybrid clouds, in the core, or at the edge.

With Microsoft, Metaswitch combines the best attributes of a nimble start- up and a seasoned market leader. We have a long history of providing high-performance, hardware-independent software to the communications industry. We're a proven and trusted partner for small and large network operators across the globe, thanks to our ability to support them on complex network and business transformation projects, while also remaining agile enough to react quickly to market changes and technology transitions.

Our success stems from a unique combination of our deep experience in software engineering with agile development capabilities and a very highly regarded support team. By deploying our cloud native software solutions, the world's most forward-thinking managed service providers and systems integrators are building on Metaswitch to deliver innovative business, consumer and Internet of Things (IoT) communication services over the mobile connections of today and tomorrow. Only Metaswitch can provide the powerful, efficient, and highly automated 5G packet core for the edge required to make private 5G a reality.

Metaswitch Core Fusion Features

Control Plane Network Functions - 5G Standalone

- Session Management Function (SMF)
- Access and Mobility Management Function (AMF)
- 4G Interworking Function (IWF)
- Network Repository Function (NRF)
- Policy Control Function (PCF)
- Unified Data Management (UDM)

Control Plane Network Functions - 4G LTE

- 4G Interworking Function (IWF)
- Mobility Management Entity (MME)
- Home Subscriber Server (HSS)

User Plane Network Functions

- User Plane Function (UPF) for N3 and S1-U
- N3 Interworking Function (N3IWF)

Edge Networking Functions

- Edge Virtual Router (vRouter)
- Edge Virtual Private Network Gateway (VPN GW)

Access Technologies Supported

- 5G Standalone (SA) options 2 and 4
- 4G/5G Non Standalone (NSA) options 1 and 3 (via IWF)
- Wi-Fi Access (via N3IWF)

Minimum Base Hardware Requirements

- Standard x86 Intel Xeon (Skylake) CPU

Container Application Platform Supported

- Azure Kubernetes Service on Azure Stack Edge
- AKS within VMs on VMWare/Openstack on any Intel-based Server
- Redhat OpenShift and VMware Essentials PKS (Tanzu) on any Intel-based Server

Performance

- User plane
  - 8 vCPUs for complete simlpex core implementation
  - 50 Gbps UL+DL throughput (Intel Xeon Gold)
- Control Plane
  - 2,500 eNB or gNB
  - 50,000 Sessions
  - 8 Slices

Carrier Grade Capabilities

- N+k Cloud Native Redundancy
  - Per Site and Cross Site Support
  - Control plane: Stateless Design
  - User plane: Shard Based Design
  - Modular UDSF Implementation
- Automation Framework
  - Azure Network Function Manager
  - Helm Based Automation
  - CI/CD Delivery with Canary Testing
  - Git/Artifactory Mechanisms for Upgrades
  - Kubernetes Lifecycle Management and Scaling
- Service Mesh Integration
  - Security framework
  - Advanced Load Balancing
  - Overload Protection
- Operational Tools
  - Integrated Performance Validation Tool
  - SAS Control Plane Tracing

Service IQ Management Components

- Telemetry: SAS (Control Plane)
- Config: GitOps
- Metrics: Grafana
- Events: Prometheus

Open Source

- CNCF Foundation Projects
  - Kubernetes, Prometheus, Fluentd
  - Multus CNI, Linkerd, Helm, etc
- Others
  - Intel DPDK, SR-IOV, Memcached, Grafana, Kibana

Features and specifications are subject to change without notice.