# 5G Architecture


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# Overview

The Ultra Cloud Core is Cisco's solution supporting 3GPP's standards for 5G new radio (NR) standalone (SA) mode. These standards define various network functions (NFs) based on the separation of control plane (CP) and user plane (UP) (e.g. CUPS) functionality for increased network performance and capabilities.

## Control Plane NFs

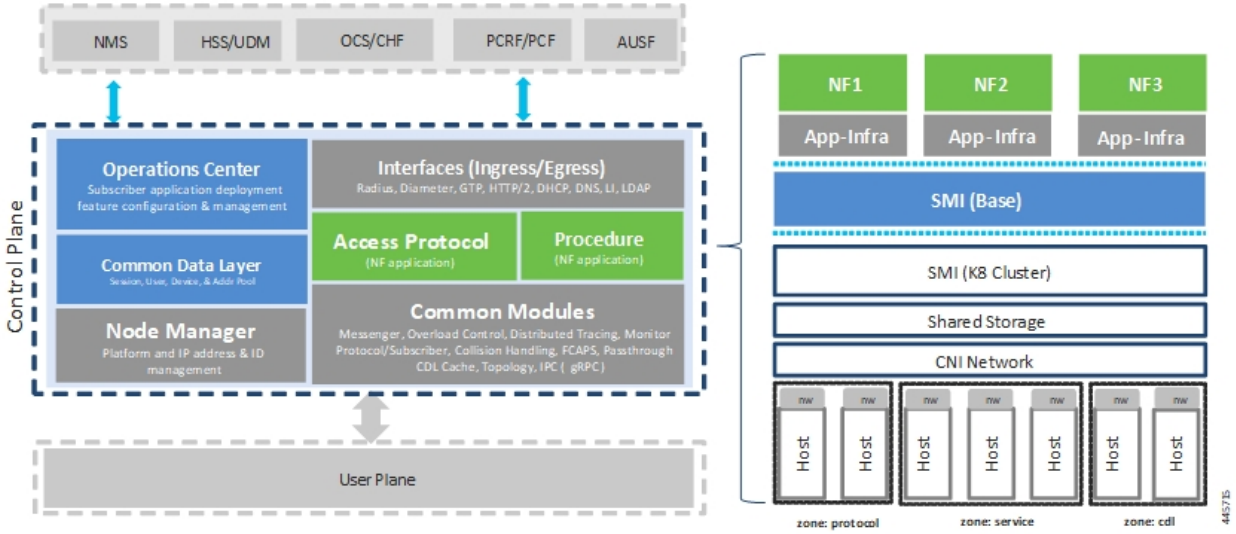
The CP-related NFs that comprise the Ultra Cloud Core are based on a common architecture designed around the following tenants:

- Cloud-scale — Fully virtualized for simplicity, speed, and flexibility
- Automation and orchestration — Optimized operations, service creation, and infrastructure
- Security — Multiple layers of security across the deployment stack from the infrastructure through the NF applications
- API exposure — Open and extensive for greater visibility, control, and service enablement
- Access agnostic — Support for heterogeneous network types (e.g. 5G, 4G, 3G, Wi-Fi, etc.)

These CP NFs are each designed as containerized applications (e.g. microservices) for deployment via the Subscriber Microservices Infrastructure (SMI).

The SMI defines the common application layers for functional aspects of the NF such as life cycle management (LCM), operations and management (OAM), and packaging.

*Figure 1: Ultra Cloud Core CP Architectural Components*




# User Plane NF

The 5G UP NF within the Ultra Cloud Core is the User Plane Function. Unlike the CP-related NFs, the 5G UPF is leverages the same Vector Packet Processing (VPP) technology currently in use by the user plane component within Cisco's 4G CUPS architecture. This commonality ensures the delivery of a consistent set of capabilities between 4G and 5G such as:

- Ultra-fast packet forwarding
- Extensive integrated IP services such as Subscriber Firewall, Tethering, Deep-Packet Inspection (DPI), Internet Content Adaption Protocol (ICAP), Application Detection and Control (ADC), and header enrichment (HE)
- Integrated third-party applications for traffic and TCP optimization

Refer to the Ultra Cloud Core 5G UPF Configuration and Administration Guide for more information.

# Subscriber Microservices Infrastructure Architecture

The Ultra Cloud Core Subscriber Microservices Infrastructure (SMI) is a layered stack of cloud technologies that enable the rapid deployment of, and seamless life cycle operations for microservices-based applications.

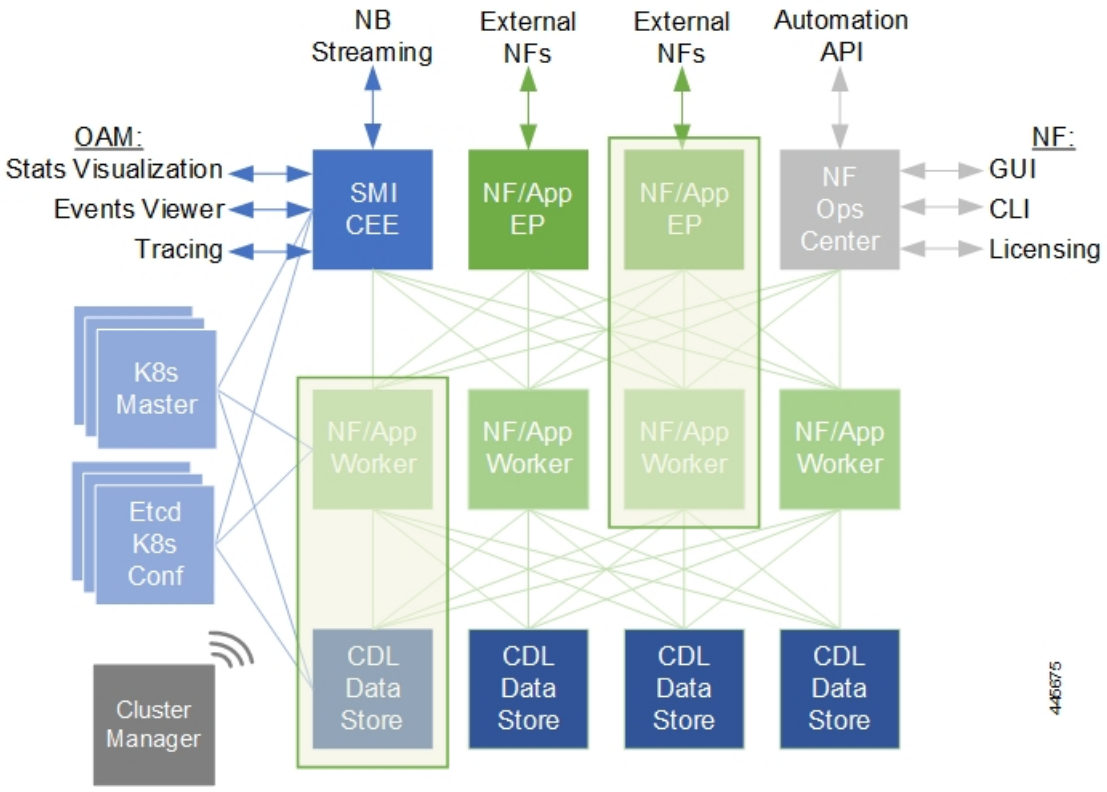
The SMI stack consists of the following:

- SMI Cluster Manager — Creates the Kubernetes (K8s) cluster, creates the software repository, and provides ongoing LCM for the cluster including deployment, upgrades, and expansion.

- Kubernetes Management — Includes the K8s master and etcd functions, which provide LCM for the NF applications deployed in the cluster. This component also provides cluster health monitoring and resources scheduling.
- Common Execution Environment (CEE) — Provides common utilities and OAM functionalities for Cisco cloud native NFs and applications, including licensing and entitlement functions, configuration management, telemetry and alarm visualization, logging management, and troubleshooting utilities. Additionally, it provides consistent interaction and experience for all customer touch points and integration points in relation to these tools and deployed applications.
- Common Data Layer (CDL) — Provides a high performance, low latency, stateful data store, designed specifically for 5G and subscriber applications. This next generation data store offers HA in local or geo-redundant deployments.
- Service Mesh — Provides sophisticated message routing between application containers, enabling managed interconnectivity, additional security, and the ability to deploy new code and new configurations in low risk manner.
- NF/Application Worker nodes — The containers that comprise an NF application pod.
- NF/Application Endpoints (EPs) – The NF's/application's interfaces to other entities on the network.
- Application Programming Interfaces (APIs) — SMI provides various APIs for deployment, configuration, and management automation.

The following figure depicts how these components interconnect to comprise a microservice-based NF/application.

*Figure 2: SMI Components*




See the *Overview* chapter in the *Ultra Cloud Core Subscriber Microservices Infrastructure* documentation for more information.

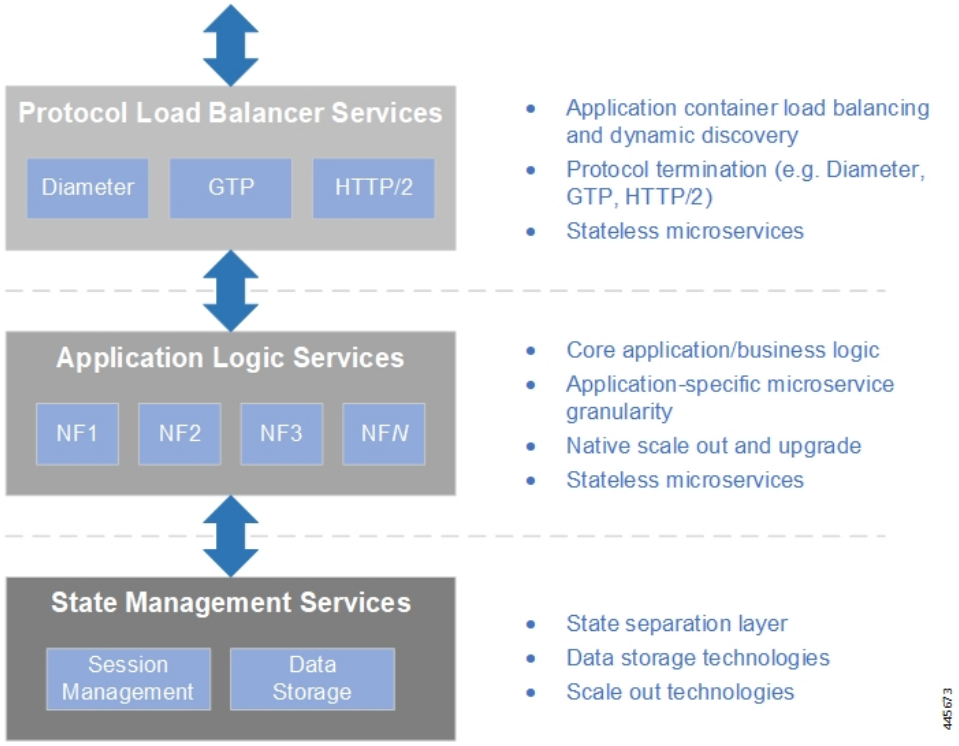
# Control Plane Network Function Architecture

CP NFs are designed around a three-tiered architecture that take advantage of the stateful/stateless capabilities afforded within cloud native environments.

The architectural tiers are as follows:

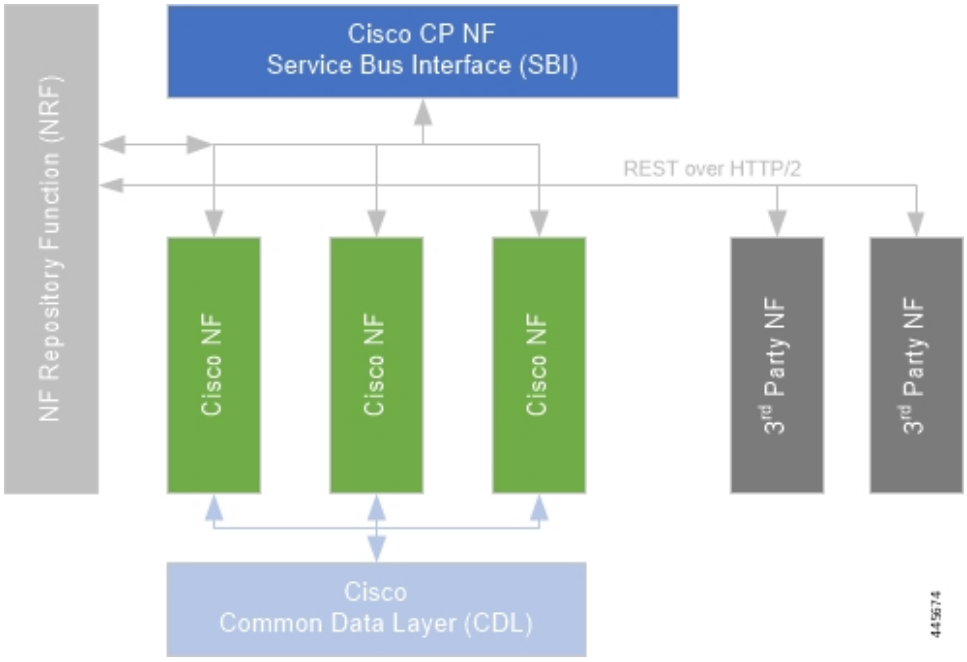
- Protocol Load Balancer Services — These are stateless microservices that are primarily responsible for dynamic discovery of application containers as well as for protocol proxy and/or termination. These include traditional 3GPP protocols and new protocols introduced with 5G.
- Applications Services — Responsible for implementing the core application/business logic, these are the stateless services that render the actual application based on the received information. This layer may contain varying degrees of microservice granularity. Application services are stateless.
- State management services — Enable stateless application services by providing a common data layer (CDL) to store/cache state information (e.g. session and subscriber data). This layer supports various data storage technologies from in-memory caches to full-fledge databases.

*Figure 3: Control Plan Network Function Tiered Architecture*




The three-tiered architecture on which Cisco's CP NFs are designed full support the 5G core (5GC) Service-based Architecture (SBA) defined by 3GPP. These NFs communicate with each other and with third-party NFs over the Service-based Interface (SBI) using HTTP/2 over TCP as defined by 3GPP.

*Figure 4: Cisco CP NF Service-based Architecture Support*



Refer to the *Overview* Chapter for more information on the respective Cisco NF.