Nokia Cloud Mobile Gateway

The **Nokia Cloud Mobile Gateway (CMG)** is a cloud-optimized, multi-functional packet core network gateway that:

- Delivers exceptional bandwidth capacity, bearer scalability and throughput performance
- Supports the growth and expansion of 4G consumer, enterprise and cellular IoT/MTC services
- Provides deployment flexibility and service agility while reducing network TCO

The Nokia CMG supports the broad range of service requirements for consumer and enterprise mobile services and for Internet of Things/machine-type communications (IoT/MTC). It combines IP edge routing and a mobile gateway in a single network function, enabling the convergence of fixed and mobile networks.

The cloud-native architecture of the CMG delivers exceptional packet processing performance, webscale capacity and deployment flexibility. It reduces network total cost of ownership (TCO) by optimizing the use and efficiency of the network functions virtualization (NFV) infrastructure, and provides an evolution path to 5G.

**Overview**

The Nokia CMG goes beyond network virtualization with an optimized cloud-native software design that supports the evolution of advanced 4G, IoT/MTC and 5G services. It delivers the high performance and subscriber scalability to address the growth in users, devices and applications, and the associated demands for high bandwidth and lower latency. The CMG supports multi-access connectivity by converging multiple mobile gateway functions onto a single, general-purpose computing platform while offering multiple configuration options that provide deployment flexibility.

The CMG can be deployed as a stand-alone network function or in various combinations as a:

- Serving Gateway/Packet Data Network Gateway/ Gateway GPRS Support Node (SGW/PGW/GGSN) in 3GPP networks
- Policy Control Enforcement function (PCEF)
- Subscriber Services Gateway (SSG): Provides enhanced 3GPP Traffic Detection Function (TDF) with Carrier-Grade NAT (CG-NAT), TCP optimization, firewall and service chain steering capabilities. It can also perform a Hybrid Access Gateway (HAG) function for converged service delivery across wireless and fixed access networks.
- Home Agent Node (HA) in 3GPP2 networks
- Evolved Packet Data Gateway (ePDG) or Trusted Wireless Access Gateway (TWAG) in non-3GPP (Wi-Fi®) networks

The CMG is a key element of the Nokia Cloud Packet Core solution (see Figure 1). The Cloud Packet Core is a flexible, scalable, high-performance packet and next-generation core built with a cloud-native design. The design meets the varied service requirements for enhanced mobile broadband, IoT/MTC, and critical and ultra-reliable machine communications while leveraging integrated network intelligence and service agility to generate new revenues.

The CMG software is built with the field experience and knowledge gained from large-scale 3G/4G/LTE and IP/MPLS network deployments. Its robust and advanced design supports the demanding user and control plane requirements of the packet core.

When deployed with the Nokia mobile networks radio portfolio, the CMG delivers a highly scalable mobile gateway that supports both centralized and distributed core network architectures.
Multi-access for fixed/mobile core convergence

The Nokia CMG provides multi-access connectivity by supporting cellular access (licensed, unlicensed, shared), non-3GPP Wi-Fi access (trusted and untrusted), and fixed access (xDSL, PON, G.FAST, DOCSIS), thereby enabling core convergence.

This convergence simplifies the network architecture and operations, and facilitates deployment in existing packet cores, enabling the rapid expansion of mobile services.

Cloud-native design

The Nokia CMG is built with a cloud-native design that delivers the webscale, deployment flexibility and performance required in a packet core user plane function. It operates in any OpenStack and VMWare NFV operating environment and can run on any NFV infrastructure hardware platform.

A pre-integrated virtualized network functions (VNF) life-cycle management solution is offered with the Nokia CloudBand software suite. The CMG can also be managed with any NFV Management and Network Orchestration (MANO) system.

High throughput and capacity

The Nokia CMG software design has optimized packet processing and throughput over general-purpose x86 hardware. Through its innovative virtual FP packet processing software coupled with packet acceleration techniques such as SR-IOV with DPDK optimizations, the CMG can provide line-rate throughput and capacity over 10, 40 and 100 Gb/s network interface cards.

Control/user plane separation

Mobile networks are supporting a broader range of services and applications, such as cellular IOT and video streaming, that have very different network requirements from traditional mobile broadband and voice services.

The Nokia CMG cloud-native software design separates the control signaling from the user data into separate virtual instances. This control/user plane separation (CUPS) enables independent scaling and more flexible distributed architectures with more efficient use of network resources.

State-efficient VNF processing

The Nokia CMG state-efficient processing decouples the subscriber’s session state information from the compute resources of the underlying NFV infrastructure. It does this by intelligently capturing the session state as a data transaction that can be moved and re-instantiated on the same or a different virtual machine (VM).

The CMG holds session state information in a VM for only as long as necessary; the time will vary depending on the application. As a result, network resource utilization increases, which lowers the cost to operate the network.

Figure 1. Nokia Cloud Packet Core solution
Common Data Layer

Nokia CMG design uses new cloud core data storage functionality referred to as a Common Data Layer. This CDL functionality provides a database that synchronizes and stores subscriber session state data from the CMG VMs. The CDL used in the CMG design is an open-source, in-memory data structure store that is highly resilient and fault tolerant, with built-in replication capabilities.

In the Nokia AirGile Cloud-native Core solution, the Nokia Shared Data Layer (SDL) provides the CDL function not only for the CMG but for any cloud-native core function.

By intelligently managing and maintaining session state in the CDL or SDL, the CMG can provide the massive subscriber and device session scalability that is needed for mobile broadband and IoT/MTC services.

IoT optimization

As more IoT devices and sensors connect to the network over cellular access, the packet core will add potentially millions of connections and see a significant increase in traffic.

The Nokia CMG supports 3GPP NB-IoT features as part of the Nokia Cellular Serving Gateway Node (C-SGN) solution (see Figure 2). This solution significantly reduces TCO through better NFV resource efficiency and reduced network signaling, which extends device battery life.

Mobile voice and broadband

With the ability to support millions of mobile device sessions and IPSec tunnel terminations, the Nokia CMG provides the scalability and packet-processing performance needed to deliver today’s LTE and Wi-Fi mobile services. The CMG as the SGW/PGW/GGSN in the LTE evolved packet core provides a common IP anchor point (see Figure 3) to deliver Voice over LTE (VoLTE), Voice over Wi-Fi (VoWi-Fi) and multimedia broadband services with seamless handovers.

The CMG as a TWAG/ePDG provides a converged Wi-Fi gateway supporting trusted and untrusted access for both open and closed SSID Wi-Fi access points. It supports the delivery of multiple Wi-Fi service models, including local breakout (LBO), non-seamless wireless off-load (NSWO), S2a mobility over GTP (SaMOG) and ePDG over S2b.

![Figure 2. CMG as part of C-SGN solution for IoT/MTC services](image)
Support application-based charging and rating, delivering enhanced services such as http redirect and header enrichment.

In a mobile network, SSG functionality can be either integrated in an existing Nokia CMG PGW or deployed as a stand-alone gateway function on the Gi/SGi interface of an existing PGW.

Nokia also offers a unique Dynamic Experience Management (DEM) solution that preserves quality of experience (QoE) for specific subscribers and/or applications while also delivering virtual network capacity increase of up to 20 percent. The DEM solution performs real-time...
automated network congestion detection by monitoring user plane traffic. It then immediately provides intelligent congestion control and mitigation through dynamic QoE enforcement, delivering the optimal user experience for applications that are sensitive to network performance, such as streaming video or web browsing. DEM is an inline policy control function of the CMG deployed as PGW or SSG functions, with no use of external network probes or additional mobile device client software.

### Multi-path and access connectivity for improved service experience

The Nokia CMG can also be deployed as a Hybrid Access Gateway (HAG) supporting multi-path TCP (MP-TCP). Hybrid access with MP-TCP provides an industry-standard approach that enables the use of multiple paths across access connectivity networks to provide increased subscriber bandwidth and improved QoE. It utilizes packet-based link selection to allow a single TCP session to be delivered over both access paths regardless of the technology used.

In addition to packet-based link selection, Nokia’s CMG MP-TCP HAG function provides additional Layer 7 application-aware policies for application and application group path selection. For example, only video applications can use wireless; P2P applications cannot use wireless (see Figure 5).

With the CMG deployed as a HAG, network operators can:
- Cost-effectively increase bandwidth to supplement low-speed fixed lines
- Expand area coverage
- Address mandated broadband regulatory requirements
- Improve reliability
- Enhance the overall experience for both residential and enterprise end-user services.

### Field-proven software

Nokia is recognized as an industry leader in wireless networks and technology. Our field-proven CMG software is deployed in many of the world’s largest 3G/4G wireless, Wi-Fi and IP/MPLS networks. This knowledge and expertise are designed into the Nokia CMG software.

### High availability

The Nokia CMG modular software architecture is built to meet the requirements of a carrier-grade control plane while taking advantage of NFV and cloud-optimized redundancy models. It supports advanced VNF- and VM-level protection schemes that, together with the CDL, are highly resource efficient. Coupled with in-service software upgrades and advanced overload control protection capabilities, these functions enable the CMG to deliver reliability and availability levels not easily achieved in NFV general-purpose computing platforms.

**Figure 5. CMG as stand-alone HAG for residential services**
Pre-integrated appliances
For private LTE networks or for smaller scale overlay core networks, the Nokia CMG is also offered as an appliance that pre-integrates CMG software together with Nokia AirFrame hardware server in pre-packaged bundles. This simplifies deployment and network operations.

System management
Operations, administration and maintenance (OAM) of the Nokia CMG can be performed in an NFV environment or in a traditional telecom operating environment. For NFV dynamic life-cycle operations, the Nokia CMG can be managed with any ETSI MANO system, including the Nokia CloudBand software suite. Through VNF life-cycle management, CMG and VM instances can be created, auto-restored (self-healing), dynamically scaled (in/out) or removed.

The Nokia Network Services Platform (NSP) provides EMS FCAPS support for CMG. NFV service assurance and performance monitoring deliver health status and key metrics to the NFV manager. The Nokia NSP and Nokia NetAct provide integrated element and network management across the entire Nokia mobile network (see Figure 6).

Learn more
The Nokia Cloud Mobile Gateway (CMG) is a key part of the Nokia Cloud Packet Core solution—a cloud-native architecture that is built to support the growth of mobile and enterprise services, the scalability requirements and varied service requirements of the IoT, as well as the evolution to 5G.

To learn more about the Nokia Cloud Mobile Gateway, visit the Cloud Mobile Gateway web page.

To learn more about the Nokia Cloud Packet Core, visit the Cloud Packet Core web page.

Figure 6. CMG system management

NetAct performs network management across the Nokia macro and small cell network while the NSP supports management of the packet core, IP/MPLS and optical transport, and microwave backhaul networks. NetAct also supports element and network management integration of third-party components, delivering single-screen view and sign-on capability that simplify operations and maintenance.