Mavenir vEPC

A Cloud-based Virtual Evolved Packet Core

Mavenir® vEPC is an innovative Evolved Packet Core (EPC) specifically designed from the ground up for virtualized environments. Organized in independent slices of the control, user, and management planes, Mavenir vEPC is free of the architectural restrictions posed by traditional, physical node-based packet cores. Running on Intel x86 servers, it can efficiently support networks of any size and scale. Mavenir vEPC provides the lowest total cost of ownership and ensures that all the benefits of running a virtualized network function get passed on to operators and their customers, leading to a renewed focus on business growth.

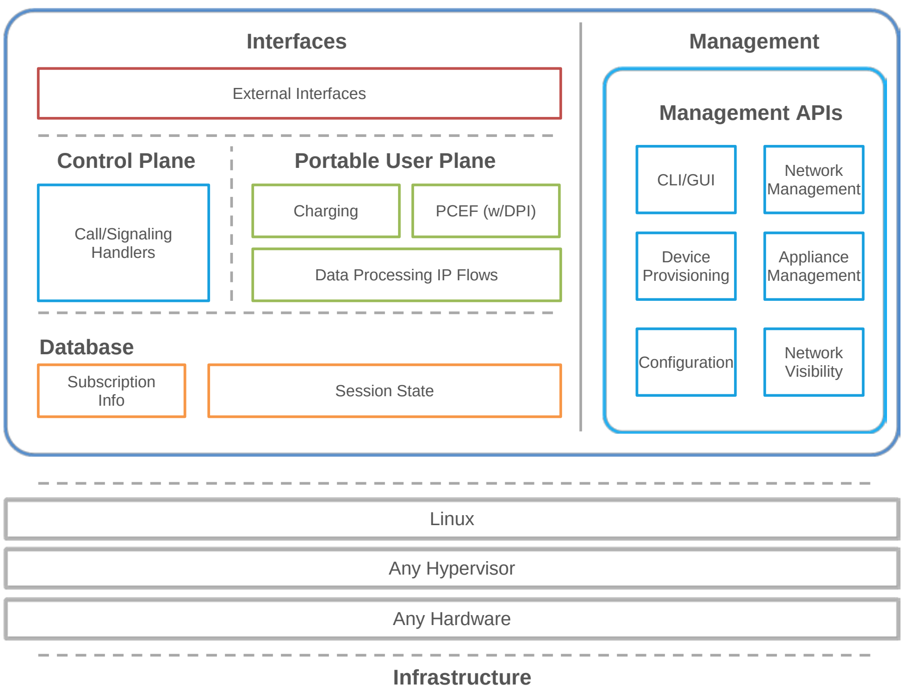

Figure 1: Mavenir vEPC logical architecture.

HIGHLIGHTS

- Significantly reduces infrastructure deployment costs with a microservice-based modular architecture, allowing throughput, transaction, and session capacity to be added independently
- Optimizes resource usage and increases business agility through on-demand scalability
- Provides granular scalability across various functions, preventing overprovisioning and allowing operators to grow at market speed
- Minimizes packet core TCO by leveraging a highly optimized architecture with full Evolved Packet Core (EPC) functionality to achieve maximum performance across the control plane and user plane
- Leverages horizontal and vertical scaling options to support networks of any size
- Provides a flexible NFV and SDN-ready framework that delivers control plane and user plane separation
- Supports low-latency use cases by placing the user plane at the network edge
- Enables rich application integration using built-in data correlation and streaming capabilities

Innovative Architecture

Mavenir has transformed the old, physical node-based, vertical architecture into a service-based, horizontal architecture consisting of independent interface, service logic, database, and management modules (see Figure 1). This holistic approach to functional virtualization optimizes performance and efficiency—compared to the traditional approach of replicating existing physical nodes as a software asset—and is the fundamental difference between Mavenir vEPC and other virtualized products. By leveraging this innovative architecture, Mavenir vEPC provides a robust, high-performance, scalable, and fault-tolerant solution capable of supporting diverse use cases.

Optimized for Processing, Transactions, and Sessions

The Mavenir vEPC framework provides control plane and user plane separation, with each plane functioning and scaling independently and elastically according to the respective load factor. With this framework, Mavenir vEPC is optimized for processing control plane transactions and user plane session data.

On-Demand, Granular Scalability

Mavenir vEPC components are fully distributed and tiered by function, such as signaling, interface, service logic, and data management. This modular design allows for greater flexibility in designing solutions for a range of industry use cases. Moreover, no barriers exist in terms of subscriber, throughput, or virtual resource minimums that must be deployed. Such on-demand, granular scalability eliminates the need for long-range advance budget planning and expensive overprovisioning.

Optimized User Plane Performance

Mavenir vEPC has been optimized to enable packet core user plane functions on general purpose Intel x86-based servers. With its unique architecture, Mavenir vEPC provides best-in-class performance and has been benchmarked for full duplex 10 GbE line-rate data processing and minimal data plane latencies. Mavenir vEPC utilizes data plane acceleration technologies, such as Intel DPDK in PCI passthrough or SR-IOV mode, to guarantee high performance in a virtualized environment. Key aspects of delivering user plane services over a virtualized platform include overcoming the non-real-time nature of the x86 hardware processing pipeline and providing alternative solutions to traditional interrupt-driven packet processing approaches. By using batch-based packet processing models and poll-mode-based drivers, Mavenir vEPC achieves faster memory access and packet processing. This allows operators to service a user plane that provides deterministic packet forwarding using a combination of synchronous run-to-completion and inline asynchronous threads, thereby maximizing throughput levels.

MAVENIR VIRTUAL CORE FOR MOBILE

Mavenir Virtual Core for Mobile (VCM) architecture transforms mobile networks through a feature-rich and highly scalable virtualized Evolved Packet Core (EPC) implementation. This approach eliminates the expensive hardware, long upgrade cycles, overprovisioning, and years-in-advance budgeting that traditionally characterize mobile service provider networks. As a result, operators can experience the benefits of a fully virtualized EPC implementation.

- Lower total cost of ownership
- Greater business agility
- Adaptiveness to multiple deployment use cases (fixed LTE, private LTE, public safety LTE, NB-IoT DCNs)

MAVENIR vEPC KEY FEATURES

- Carrier-grade high availability
- Linear scaling
- Stateless control plane architecture
- Intel DPDK-enabled data plane
- Full duplex line-rate performance
- Cloud-ready innovative design
- Multiple hypervisor support: VMware ESXi, KVM
- Integration with cloud tools: OpenStack, VMware vCenter, VMware vCloud Director, Cloudify TOSCA-based orchestration
- Commercial cloud-ready: AWS, GCE, Microsoft Azure
- Supported on Intel x86-based general purpose servers
- Management API support, including SNMP, REST, and XML

Higher Service Velocity

As an open, highly adaptable solution, Mavenir vEPC can provide higher service velocity than traditional, physical node-based architectures, which are far more rigid and complex. Its service-based, modular design, combined with open API support, enables operators to quickly create and implement new features for maximum business agility. Operators can add infrastructure to support new users or new services in just days, instead of months. The fully virtualized deployment allows operators to grow their mobile networks at market speed.

Support for Various Deployment Options

The hardware-centric approach of traditional EPC infrastructure has forced service providers to create expensive, large-capacity nodes that are cost-prohibitive to deploy in a flexible manner. Mavenir vEPC decouples network functions from hardware to provide a service-based, modular design that can also provide control plane and user plane separation. As a result, a wide range of industry use cases can be addressed using the same platform software. For example, the same Mavenir vEPC software can be custom-scaled to meet the requirements of a low-density, high-throughput Fixed LTE for rural/remote broadband coverage, or a high-density, low-throughput NarrowBand IoT (NB-IoT) deployment.

Form-Factor Miniaturization

The scale-in capabilities of the Mavenir vEPC allow the same Mavenir VCM-based EPC software used in larger networks to be miniaturized and used for small form-factor applications. This means that a Mavenir vEPC-based network-in-a-box-type solution inherits the same fully qualified and interoperability-tested software that is available for larger, carrier-grade networks. In its miniaturized version, Mavenir vEPC can scale down to operate on as few as two cores while servicing up to a hundred subscribers.

Built-in Load Balancing

Mavenir vEPC provides a configuration tool to set the criteria and threshold for instantiating more Virtual Machines (VMs) to run vEPC modules. These criteria include CPU usage, memory usage, the number of queues in the system, and the number of incoming requests. Mavenir vEPC uses intelligent logic in configuring the threshold to prevent the “ping pong” effect of instantiating and removing VMs. Once Mavenir vEPC detects that the value(s) for the criteria has passed the threshold, it instantiates particular VMs to support the demand. The added VMs participate in the corresponding cluster without requiring any additional configuration. Internal load balancing within the clusters helps ensure that each VM is optimally loaded based on the capacity it can support.

Streamlined Management and Orchestration

Mavenir vEPC provides all aspects of fault, configuration, accounting, performance, and security information to an external orchestrator and/or NMS using various APIs, including REST, SNMP, XML, and CLI. It also can work with multiple industry-leading orchestrators across a range of fields and environments.

Maximum Reliability

Each component of Mavenir vEPC is designed for high availability and has no single point of failure. A well-distributed deployment of multiple instances of Virtual Network Function Component (VNFC) VMs at each tier allows clusters to detect a failure and route subsequent requests to available instances. Mavenir vEPC can detect and address a failure at the process, network interface, VM, and server level. Each VNFC VM is modelled to support 99.999 percent availability.

High Performance

Mavenir vEPC is a software-based, fully virtualized packet core and is not bound to any proprietary hardware. Its capacity and performance depend mainly on the number of cores. It supports linear scalability to meet any capacity and performance requirement, allowing service providers to deploy Mavenir vEPC in various use cases (see Table 1).

Table 1: Examples of Mavenir vEPC performance with different numbers of physical cores.

		21 cores[1]	36 cores[1]	54 cores[1]
Control Plane Performance	**Simultaneous Attached Users (SAUs)**	**1 million**	**2 million**	**3 million**
	Number of bearers	**1.2 million**	**2.4 million**	**3.6 million**
	Attaches per second	**3,500**	**7,000**	**10,500**
Data Plane Performance+	**Throughput2 (Gbps)**	**10**	**20**	**30**

Notes:
[1] Physical cores.
[2] Throughput measured with IMIX traffic.

Mavenir vEPC

Features		
Mobility management	• EMM NAS Procedure • Attach/Detach • Paging • X2, S1 Handover Tracking Area Update	• Multi-PLMN support • 3G-LTE IRAT Handover • S10 Handover
NAS security	• Encryption – EEA0 (NULL) – EEA2 (AES-128)	• Integrity protection – EIA2 (AES-128)
Session management	• Default bearer management • Multiple EPS bearer support • QCI to DSCP mapping • UE-AMBR, APN-AMBR, GBR • Dedicated bearer management	• ESM NAS Procedure • Packet Filter Support • Downlink Data Buffering • GTPv1, v2
APN support	• Multiple APN support • Static and dynamic IP address allocation	• UE IPv4 or IPv6 addressing support
Roaming	• Inbound and outbound roaming • Gp	• S8
Networking functions	• Dual stack IPv4 and IPv6 support • VLAN tagging • Static routes	• IPv4 fragmentation and reassembly • Jumbo frames • NTP Synchronization
Lawful intercept	• 3GPP Rel 12 Compliance • X1_1 (administration) • X2 (IRI)	• X3 (CC) • TLS v1.2
Policy and charging	• PCRF interworking: Gx • Local Policy Control • Time and volume CDR generation (ASN.1 format)	• GTP' (GTP prime) support • Online charging: DCCA, Gy • Offline charging: Gz
RADIUS	• RADIUS authentication • AAA server configuration	• RADIUS accounting • RADIUS-based rate-limiting
Voice support	• CS Fallback: MO/MT call • VoLTE: MO/MT call	• CS Fallback: MO/MT SMS
DPI	• L3/L4 DPI • 5-tuple SDF detection • URL filtering	• L7 DPI • P2P protocol detection • X-Header enrichment
Subscriber provisioning	• Optional EPC HSS function • CLI-based subscriber provisioning • Internal or external S6a	• Geo-redundant database clustering • APN and QoS templates
Geographical distribution	• Control plane MME function relocation	• S10
3GPP interface support	• S1-MME • S1-U • S5/S8 • S10 • S11 • SGi • S2a	• S6a/S6d • Gx • Gy • Gz • Gn/Gp • SGs
OAM aspects	• GUI-based EMS • Follows ITU-T X.733 • Manages multiple Mavenir VCM instances • User management • In-service software patching	• FCAPS • SNMP, XML, REST • CLI support • Graphical display of VNFC topology • Real-time resource usage charts

Standards Compliance

3GPP	• 3GPP TS 23.003: Numbering, addressing and identification • 3GPP TS 23.007: Restoration Procedures • 3GPP TS 23.060: General Packet Radio Service (GPRS); Service description; Stage 2 • 3GPP TS 23.107: Quality of Service (QoS) concept and architecture • 3GPP TS 23.203: Policy and charging control architecture • 3GPP TS 23.207: End-to-end Quality of Service (QoS) concept and architecture • 3GPP TS 23.272: Circuit Switched (CS) fallback in Evolved Packet System (EPS); Stage 2 • 3GPP TS 23.401: General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access • 3GPP TS 24.301: Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3 • 3GPP TS 29.060: General Packet Radio Service (GPRS); GPRS Tunneling Protocol (GTP) across the Gn and Gp interface • 3GPP TS 29.061: Interworking between the Public Land Mobile Network (PLMN) supporting packet-based services and Packet Data Networks (PDN) • 3GPP TS 29.118: Mobility Management Entity (MME) – Visitor Location Register (VLR) SGs interface specification • 3GPP TS 29.210: Charging rule provisioning over Gx interface • 3GPP TS 29.211: Rx Interface and Rx/Gx signaling flows • 3GPP TS 29.212: Policy and Charging Control (PCC); Reference points • 3GPP TS 29.213: Policy and charging control signaling flows and Quality of Service (QoS) parameter mapping • 3GPP TS 29.274: 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunneling Protocol for Control plane (GTPv2-C); Stage 3 • 3GPP TS 29.281: General Packet Radio System (GPRS) Tunneling Protocol User Plane (GTPv1-U) • 3GPP TS 32.215: Telecommunication management; Charging management; Packet Switched (PS) domain charging • 3GPP TS 32.295: Telecommunication management; Charging management; Charging Data Record (CDR) transfer • 3GPP TS 32.296: Telecommunication management; Charging management; Online Charging System (OCS): Applications and interfaces • 3GPP TS 32.297: Telecommunication management; Charging management; Charging Data Record (CDR) file format and transfer • 3GPP TS 32.298: Telecommunication management; Charging management; Charging Data Record (CDR) parameter description • 3GPP TS 33.102: 3G security; Security architecture • 3GPP TS 33.106: 3G security; Lawful interception requirements • 3GPP TS 33.107: 3G security; Lawful interception architecture and functions • 3GPP TS 33.401: 3GPP System Architecture Evolution (SAE); Security architecture • 3GPP TS 36.410: E-UTRAN: S1 general aspects and principles • 3GPP TS 36.412: Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 signaling transport • 3GPP TS 36.413: Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP) • 3GPP TS 36.414: Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 data transport
IETF	• IETF RFC 1994: PPP Challenge Handshake Authentication Protocol (CHAP) • IETF RFC 2474: Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers • IETF RFC 2865: Remote Authentication Dial-In User Service (RADIUS) • IETF RFC 2866: RADIUS Accounting • IETF RFC 2867: RADIUS Accounting Modifications for Tunnel Protocol Support • IETF RFC 2868: RADIUS Attributes for Tunnel Protocol Support • IETF RFC 2869: RADIUS Extensions • IETF RFC 2882: Network Access Servers Requirements: Extended RADIUS Practices • IETF RFC 4006: Diameter Credit-Control Application • IETF RFC 4960: Stream Control Transmission Protocol • IETF RFC 6733: Diameter Base Protocol

Maximizing Investments

To help optimize technology investments, Mavenir and its partners offer complete solutions that include professional services, technical support, and education. For more information, contact a Mavenir sales partner or visit www.mavenir.com.

About Mavenir

Mavenir is a leader in accelerating and redefining network transformation for Service Providers, by offering a comprehensive product portfolio across every layer of the network infrastructure stack. From 4G and 5G application/service layers to packet core and RAN – Mavenir leads the way in evolved, cloud-native networking solutions enabling innovative and secure experiences for end users.

Through its industry first VoLTE, VoWiFi, Advanced Messaging (RCS), Multi ID, Visual Voicemail and Cloud RAN solutions, and with 350+ CSPs across 3.5B subscribers, Mavenir's platform enables Service Providers to successfully deliver next generation vision today and realize new revenue streams and operational efficiencies.