



# AMF Overview

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## Product Description

The Access and Mobility Management Function (AMF) is one of the control plane network functions (NF) of the 5G core network (5GC). The 5G AMF, is an evolution of 4G MME, continuing with the Control Plane and User Plane Separation, and with further simplifications like moving the Sessions Management functions to the SMF and, providing common SBA interfaces.

**Figure 1: EPC with Control Plane User Plane Separation Enhancement**

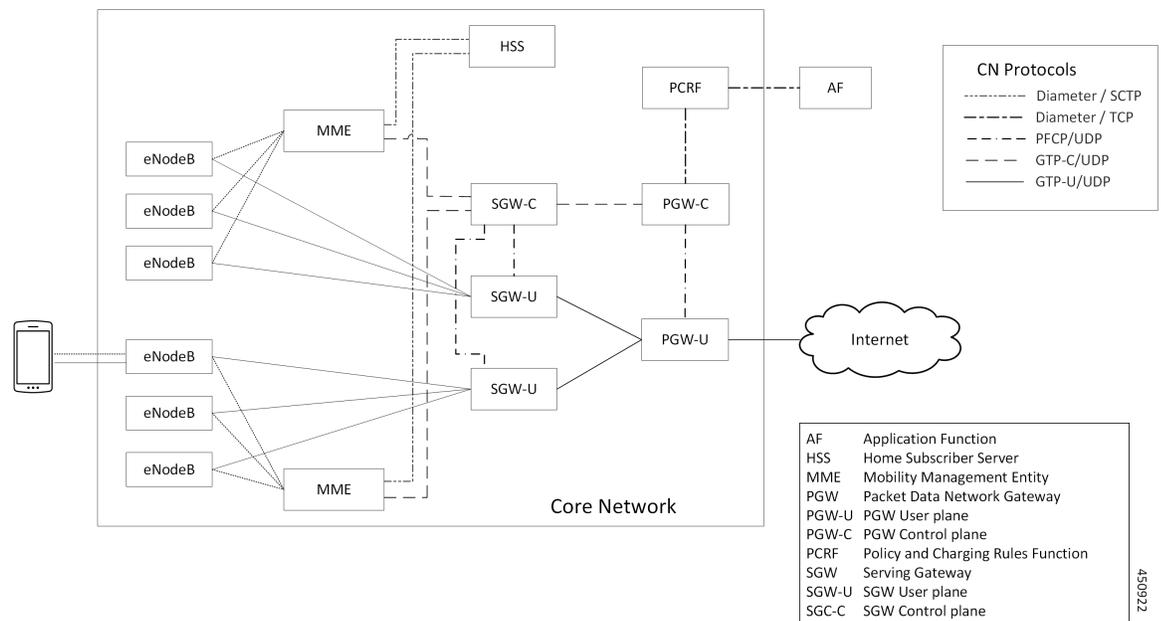
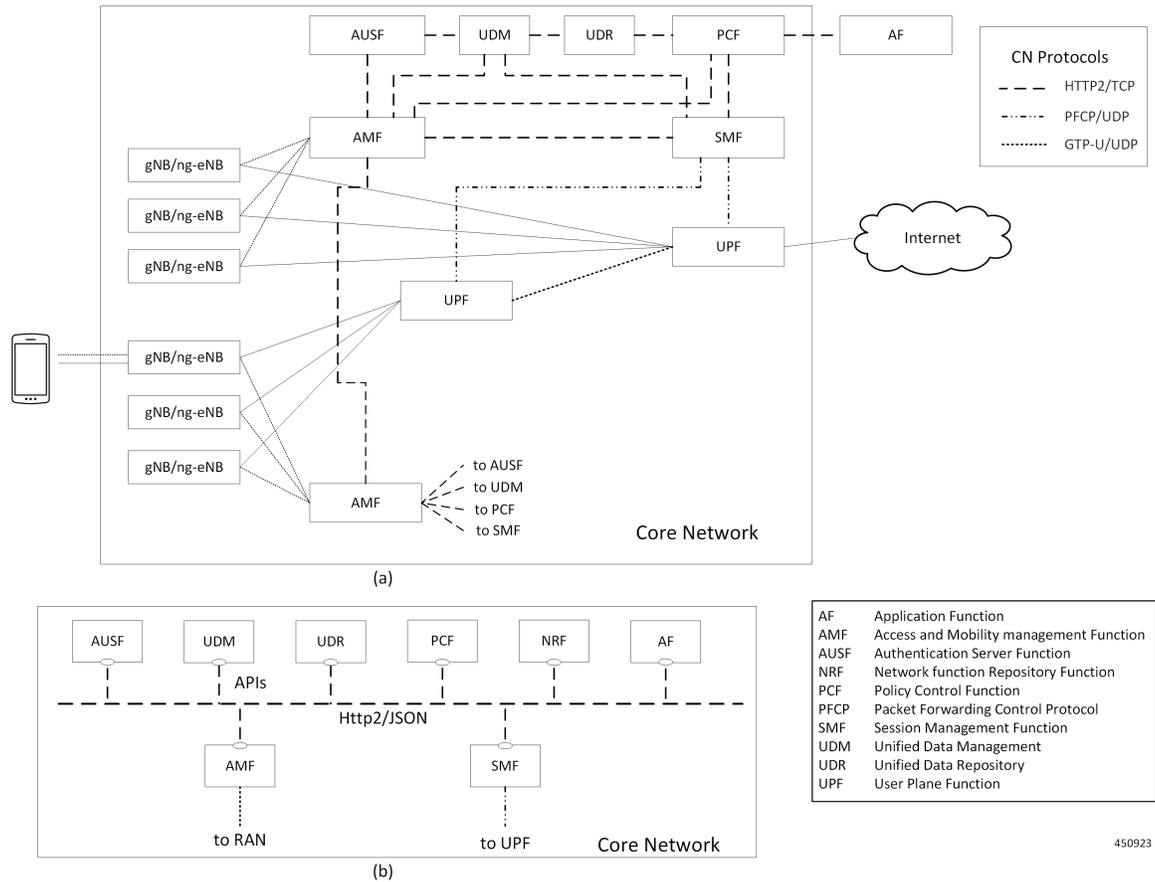


Figure 2: 5G Core Network - (a) Interface Representation, and (b) API Level Representation



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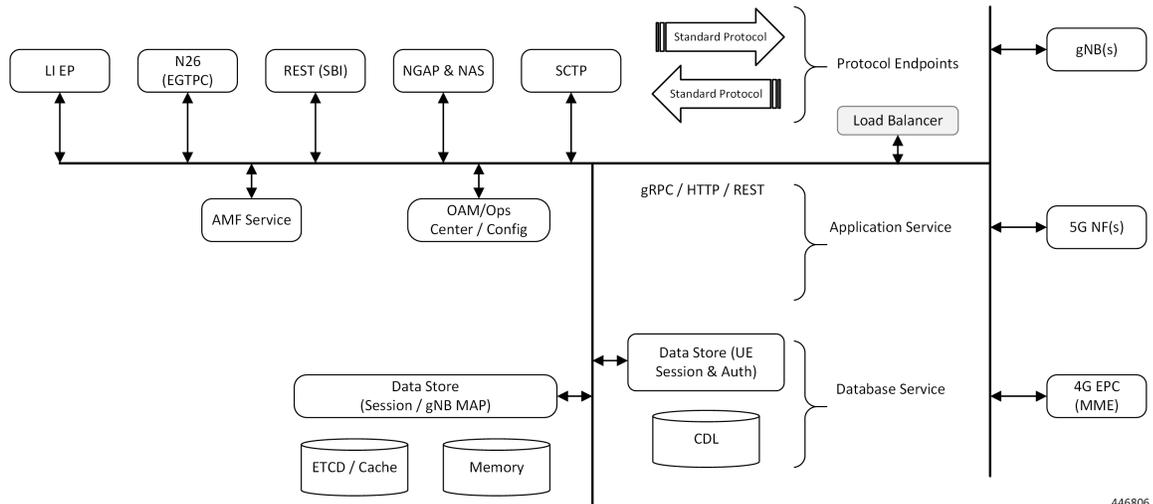
# Deployment Architecture and Interfaces

The Cisco AMF is a part of the 5G core network functions portfolio with a common mobile core platform architecture. The core network functions include Session Management Function (SMF), Network Repository Function (NRF), Policy Control Function (PCF), Network Slice Selection Function (NSSF), and User Plane Function (UPF).

## AMF Architecture

The software architecture of the AMF is shown in the following diagram.

Figure 3: AMF Architecture



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The SCTP endpoint (EP) pod type supports the SCTP interface between the AMF and gNB. Only a single SCTP EP pod is run at a time. In addition to a GUAMI, the SCTP bind address is also unique to an AMF. If multiple SCTP EPs are run, they have to bind to different SCTP addresses, at which time they would not be part of the same AMF.

The SCTP EP converts each message into a GRPC message with the SCTP Payload. Unlike TCP, SCTP messages are delimited by the protocol, so there is no other knowledge that the SCTP EP needs to figure out message boundaries.

The NGAP EP or Node Manager provides termination for NGAP messages. Node Manager terminates the handling of all NGAP messages from a gNB. All messages from gNB are handled by a single Node Manager, but one Node Manager can handle messages from multiple gNBs. This allows a Node Manager to manage the state of both gNB, and one connection between a UE, gNB and AMF. If messages from the same gNB were distributed across multiple instances of Node Manager, there is no single entity in the AMF that is responsible for the state of a gNB in the AMF.

The AMF Service pods implement the logic that is necessary to provide Access and Mobility functions to the UE. This includes handling registration, handover and PDU session related procedures.

## AMF Deployment

The AMF deployment supports standalone mode. In this mode, each NF together with the required microservices is deployed in a separate namespace in Kubernetes.

Figure 4: AMF Deployment

	Host	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
AMF1	Compute0	Master1,ETCD1(AMF1)									OAM1-AMF1																										
AMF1	Compute1	Master2,ETCD2(AMF1)									OAM2-AMF1																										
AMF1	Compute2	Master3,ETCD3, Deployer(AMF1)									OAM3-AMF1																										
AMF1	Compute3	Session1 - AMF1									Portocol1 - AMF1																										
AMF1	Compute4	Service1 - AMF1									Portocol2 - AMF1																										
AMF1	Compute5	Session2 - AMF1									Service2 - AMF1																										

## Supported Interfaces

This section lists the interfaces supported between the AMF and other network functions in the 5GC.

- N1 - Reference point between UE and AMF.
- N2 - Reference point between R(AN) and AMF.
- N8 - Reference point between AMF and UDM.
- N11 (Namf) - Reference point between AMF and SMF.
- N11 (Nsmf) - Reference point between AMF and SMF.
- N12 - Reference point between AUSF and AMF.
- N14 - Reference point between AMF and AMF.
- N15 - Reference point between AMF and PCF.

## Life Cycle of Control Plane Message

This call flow uses initial registration by a UE at the AMF using a GUTI assigned by a MME. All the steps in the call flow are not shown. The procedure level call flow has all the messages. The intent here is to show all the components, and the actions that are taken by each component.

Figure 5: End-to-End Registration by an UE Call Flow

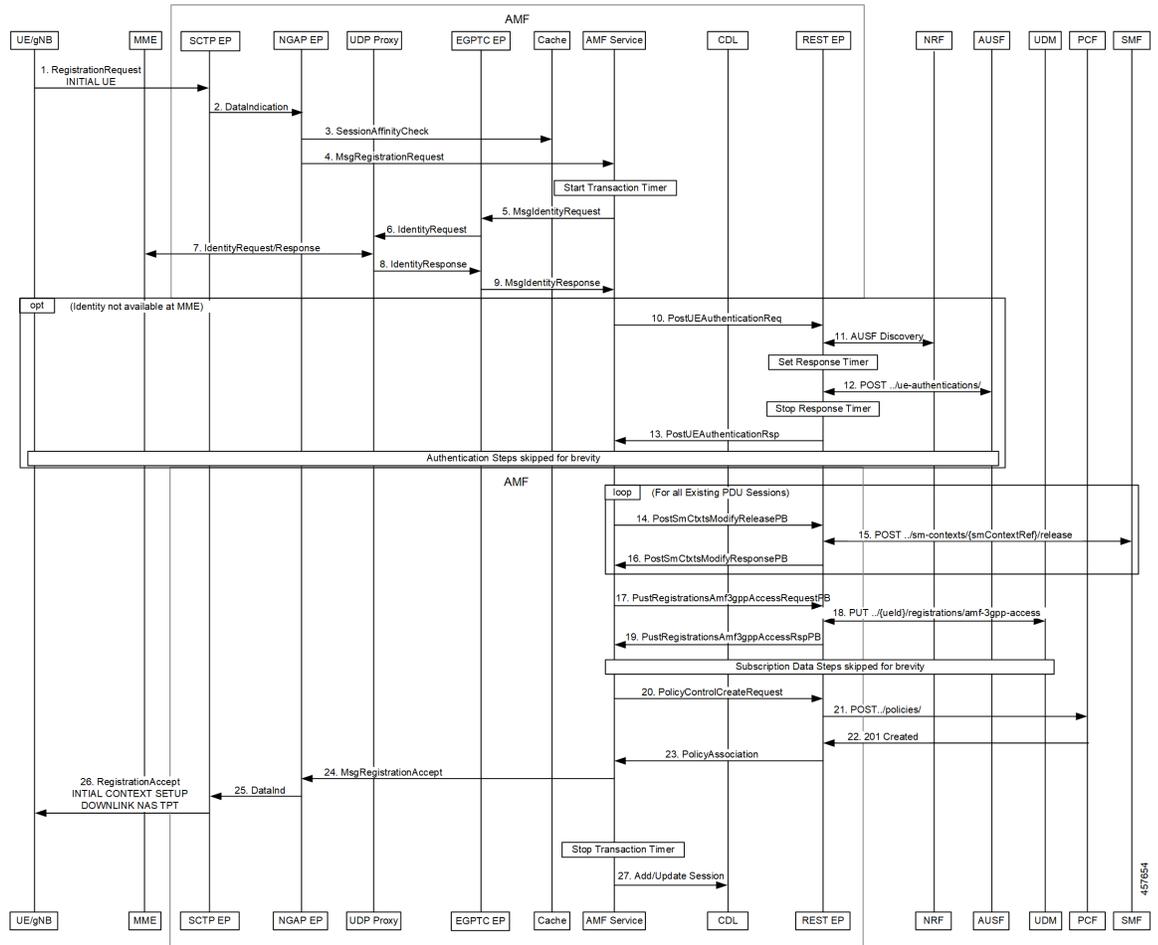


Table 1: End-to-End Registration by an UE Call Flow Description

Step	Description
1	The UE sends a Initial Registration Request to the gNB, which sends it to the AMF in a INITIAL UE message.
2	On the AMF, the message reaches the Sctp Endpoint (EP). The Sctp EP terminates Sctp protocol, extracts the payload. It sends a DataInd GRPC message to the NGAP EP.
3	The NGAP EP parses the request. Both NGAP message parsing and NAS parsing is done by the NGAP EP. It takes the ID that came in the initial message, and checks for any existing state in any AMF service by looking up the Session Affinity Cache.
4	To optimally serve UE, AMF maintains affinity of subscriber with service pod internally. If there is session affinity information for the UE, the NGAP EP forwards the message to that AMF service pod. Otherwise, it load balances the request to any available AMF service pod.
5	The AMF service finds the MME to check the identity of the UE. Currently, the MME information is locally configured. The AMF service sends this request to the EGTPC EP.

Step	Description
6	The EGTPC EP forwards the request to the UDP proxy after a transaction ID has been allocated.
7	UDP proxy forwards this message to the MME and gets a response.
8	The response from the MME is forwarded to EGTPC EP. The EGTPC EP does the transaction matching for the request.
9	The identity response is sent to the AMF service.
10	If the security context is not present in the response from the MME, the AMF service decides to authenticate the UE. The authentication procedure is started by sending a AuthenticationRequest to the REST EP.
11	REST EP handles all the client and server requests for the AMF, and all NRF interactions. REST EP makes a query to the NRF to find the AUSF to serve the UE. In further steps, the interaction with the NRF to resolve UDM and PCF have been skipped.
12	REST EP sends an AuthenticationInformationRequest to the AUSF and gets a response.
13	The response from the AUSF is forwarded to the AMF service. The authentication procedure between the AMF service and the UE is not explained here.
14	If there is any vestigial PDU state for the UE in the SMF, the AMF clears the state. The AMF service sends a message to REST EP for each SMF that needs to be cleared of state.
15	On the REST EP, there is no NRF interaction for this message, and the REST-EP forwards this to the SMF identified in the request from the AMF service.
16	The response from the SMF is sent to the AMF service by REST EP.
17	The AMF service sends a UECM registration request to the REST EP.
18	REST EP uses the NRF to resolve UDM selection for this request and sends a request to the UDM.
19	The response from the UDM is forwarded to the AMF Service. Retrieval of subscription data information and registering for notifications for change is not explained here.
20	The AMF service checks the configuration to see if an AM policy association needs to be done for this registration, and if it is, sends a request to REST EP.
21	REST EP does NRF discovery for PCF and sends a request to the PCF.
22	Response from the PCR is forwarded to the AMF service.
23	The AMF service sends a registration accept message to NGAP.
24	NGAP encodes both the NAS message and the NGAP message and sends a message to the SCTP EP.
25	SCTP EP sends the message out to the gNB.
26	The rest of the message has been excluded.

# License Information

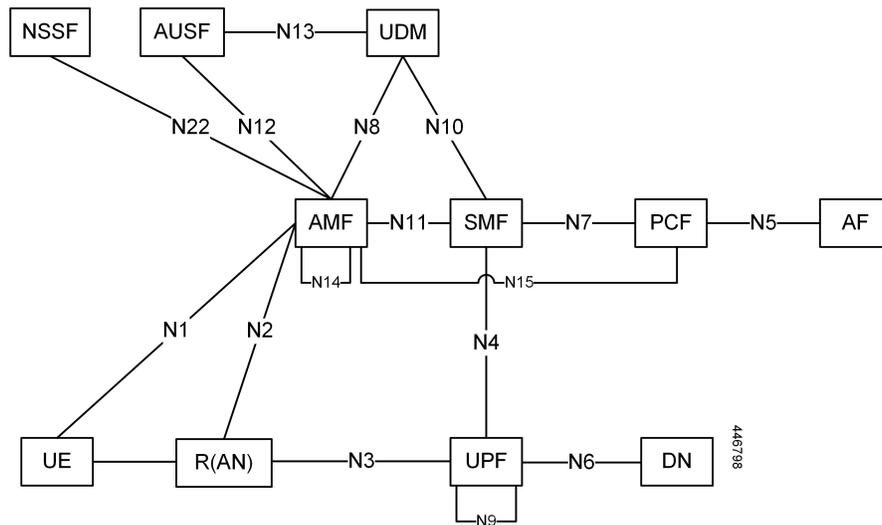
The AMF supports Cisco Smart Licensing. For more information, see the *Smart Licensing* chapter in this document.

# Standards Compliance

Cisco AMF complies with the 3GPP standards.

The AMF is one of the control plane (CP) NFs of the 5G core network. The AMF uses different interfaces to communicate with the other NFs or nodes. For example, the N11 interface exists between the AMF and Session Management Function (SMF). Each of the AMF interfaces comply to a specific version of the 3GPP specification depending on the compliance version supported.

**Figure 6: Interfaces**



Use the following table to determine the compliance mapping for each AMF interface and the 3GPP Standards specification versions for April 2020.

**Table 2: Compliance Mapping**

Interface	Relationship	3GPP Specification	Version
N1	Between UE and AMF	24.501	Compliance Support: 15.4.0
N2	Between R(AN) and AMF	38.413	Compliance Support: 15.4.0
N8	Between AMF and UDM	29.503	Compliance Support: 15.4.0

Interface	Relationship	3GPP Specification	Version
N11 (Namf)	Between AMF and SMF	29.518	Compliance Support: 15.5.1
N11 (Nsmf)	Between AMF and SMF	29.502	Compliance Support: 15.4.0
N12	Between AUSF and AMF	29.509	Compliance Support: 15.4.0
N14	Between AMF and AMF	29.518	Compliance Support: 15.5.1
N15	Between AMF and PCF	29.507	Compliance Support: 15.4.0

## Limitations

The AMF has the following limitations:

- Emergency services are not supported.
- VoNR is not supported.
- Location services are not supported.
- NGRAN location services are not supported.
- Notifications from UDM subscriptions are not supported.
- NSSF interactions are not supported.
- UE Policy interface is not supported.