

Cellular Manager - Requirements

Document Scope:

Design requirements and a description in clear text of the solutions to suit them:

- Uses cases where cellular managers will be used.
- The cellular manager expected functionality that was out of scope based on product requirements.
- Cellular Manager stacks services.
- User interaction.
- SoC modem interaction principles.
- Cellular Manager functional requirements initial analysis.

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Document References:

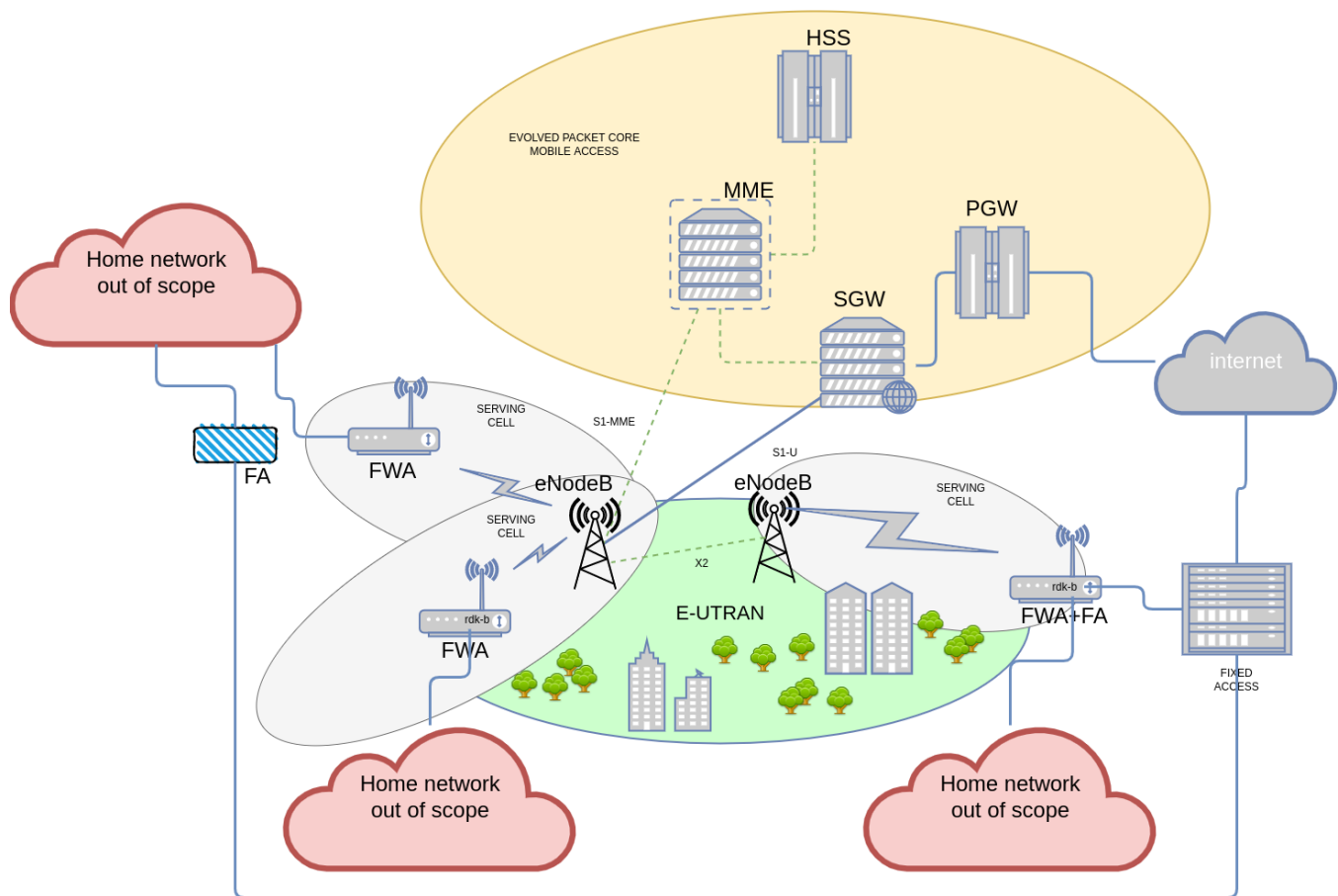
TR.181 specification:

<https://cwmp-data-models.broadband-forum.org/#Latest%20Data%20Models>

3GPP specifications:

1. 3GPP TS 23.003, Numbering, Addressing, and Identification.
2. 3GPP TS 29.274, Evolved General Packet Radio Service (GPRS) Tunneling Control Protocol for Control Plane (GTPv2-C).
3. 3GPP TS 36.300, Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); overall description.
4. 3GPP TS 24.301, Non-Access-Stratum (NAS) Protocol for Evolved Packet System (EPS).
5. 3GPP TS 36.304, Evolved Universal Terrestrial Radio Access (E-UTRA); UE Procedures in Idle Mode.
6. 3GPP TS 36.321, Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification.
7. 3GPP TS 36.322, Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Link Control (RLC) protocol specification.
8. 3GPP TS 36.323, Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP).
9. 3GPP TS 36.331, Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC).
10. 3GPP TS 23.401, General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access.
11. 3GPP TS 36.413, Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP).
12. 3GPP TR 36.839, Evolved Universal Terrestrial Radio Access (E-UTRA); Mobility Enhancements in Heterogeneous Networks.
13. 3GPP TS 27.007 V17.3.0

Use cases covered by the cellular manager



Cellular manager functionality **IN** scope

- Cellular Manager will manage the cellular modem power configuration.
- Cellular manager will expose radio resource information about the cellular interface.
- Cellular manager will manage access to the cellular network.
- Cellular manager will expose mobility management information.
- Cellular manager will manage SIM use.
- Cellular manager will manage EPS bearer configuration.
- Cellular manager will expose the kernel device interface used for transport.
- Cellular Manager will expose the kernel device interface for modem management.
- Cellular manager will expose the IP address configuration obtained via NAS signaling.
- Cellular manager will provide telemetry information related to cellular network connectivity.

Cellular manager software stack functionality **OUT OF** scope

- Decisions of forwarding and/or routing of traffic through WWAN interfaces.
- Configuration of the home network.
- Phone book capabilities in the modem.
- SMS management capabilities in the modem.
- GPS location services are implemented in the modem.
- VoLTE stack in the modem.
- MBSFN (multicast traffic over the air).
- Carrier aggregation.

Cellular Manager services offered to RDKB stack

- Cellular Manager will provide Internet access using a cellular network.
- The cellular manager will provide telemetry information related to RR, MM, and SM.
- Voice implementation for the profile FA+FWA will not use VoLTE.

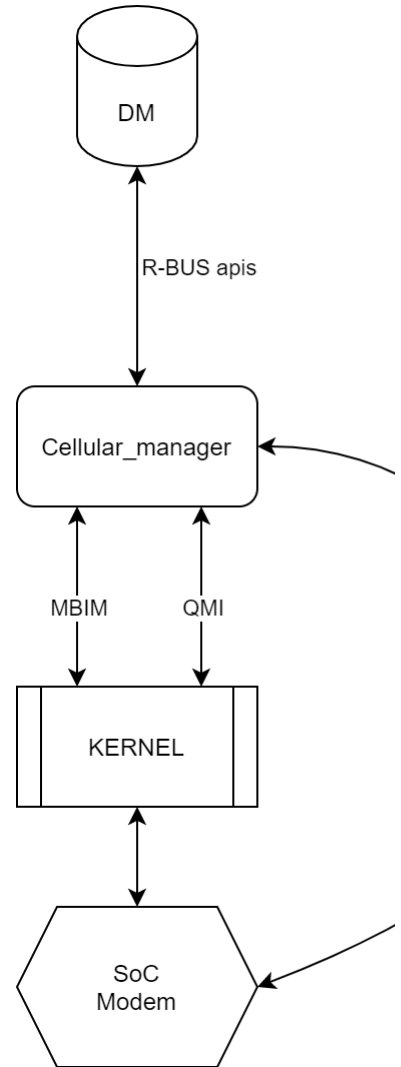
Cellular Manager SoC interaction reference.

- The cellular manager will adapt to allow interactions between two different management domains:
 - Northbound is using R-BUS to integrate cellular modem capabilities into the RDK-B stack.
 - South bound to control cellular modem possibilities:
 - AT commands via a tty serial interface exposed from the CPE kernel.
 - Using proprietary drivers wrapped in a SDK.
 - Using standard kernel drivers:
 - MBIM
 - QMI.

QMI (Qualcomm MSM Interface) is easily accessible in recent enough Linux kernels (≥ 3.4) through the `cdc-wdm` and `qmi_wwan` drivers.

Once these drivers are loaded, the kernel will expose a new `/dev/cdc-wdm` device that can talk QMI with the

CPE, along with a **WWAN** interface associated with each QMI port, to transmit and receive traffic through a PDN connection.



Cellular Manager Functional Requirements

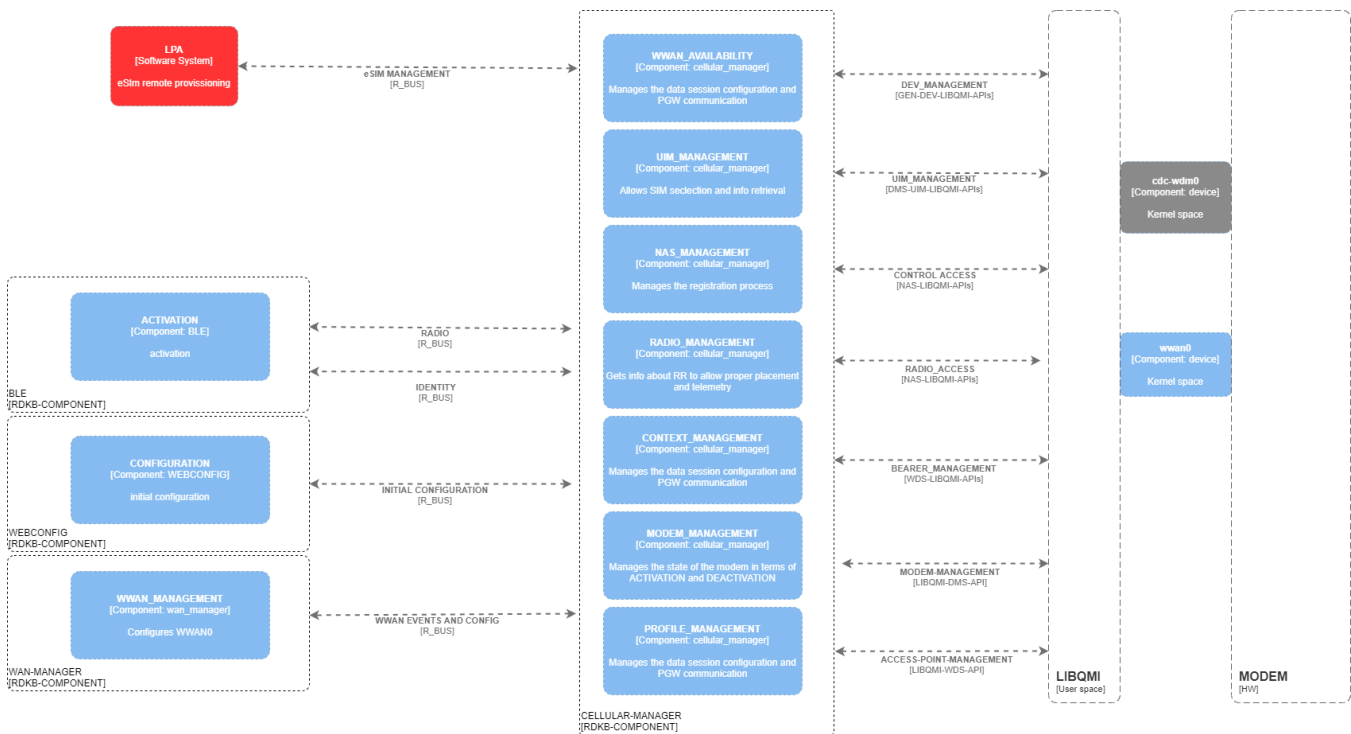
In this section, we map product requirements to specific component requirements, including the way to design the component to satisfy the requirement in clear text.

Name	Title	Group	Design analysis	Notes
REQ-RDKB-Cellular Manager -1	Ability to retrieve LTE side car device identifiers such as serial number, IMEI numbers, mobile interface MAC addresses, WiFi MAC addresses, Ethernet MAC addresses, and BLE MAC addresses.	Identity Management	We will collect via LIBQMI IMEI and ICCID to be used during onboarding.	
REQ-RDKB-Cellular Manager -2	The LTE Side Car Device must allow the ability to change the profile of the eSIM interface remotely to switch networks.	Sim Management	We will need to implement an LPA solution to retrieve eSIM profiles from the backend.	Not MVP; from the perspective of the cellular manager, the expectation after provisioning will be similar to the insertion of a SIM into a slot with the SIM factor M2FF.

REQ-RDKB-Cellular Manager -3	The LTE Side Car Device must allow the ability to change the preferred SIM interface remotely to switch networks.	Sim Management	<p>We will need to be able to detach from a network and attach to a different network using a different SIM.</p> <p>We will need to create a parameter to decide which SIM is used.</p> <p>Device.Cellular.Interface[i].</p> <p>and use it as a reference in the interface to refer to the slot of the SIM we are using.</p>	It has been removed from MVP.
REQ-RDKB-Cellular Manager -4	The LTE side car device can be allowed to operate as an extender-only device when associated with a gateway that doesn't have LTE backup service enabled or provisioned.	SoC Management	<p>We will need a switch to disable the modem and to detach from the network.</p> <p>By disabling the modem, we will shutdown the radios in the modem using power management functionality.</p>	
REQ-RDKB-Cellular Manager -5	The gateway must be made aware of the LTE network state and any changes, e.g., whether it is enabled and active, not available, down, or disabled.	Connectivity Management	We will need a parameter for the device. Cellular. Interface [i], where we can expose the PDN connectivity of the modem based on the bearer status, will use only signaling to define the value of this parameter.	
REQ-RDKB-Cellular Manager -6	Send a notification to the XFI cloud when the LTE network becomes active and the primary WAN is available.	Connectivity Management	WEBPA active notification based on device Cellular.X_RDK_Status	Not part of the Cellular Manager implementation.
REQ-RDKB-Cellular Manager -7	Must support periodic LTE network checks to ensure LTE connectivity.	Connectivity Management	We can check cellular manager radio network conditions and PDN connectivity.	
REQ-RDKB-Cellular Manager -8	LTE telemetry to inform the user if the LTE signal is good or bad during onboarding and at steady state. LTE Module to provide telemetry data (such as modulation rate, sensitivity, and radio parameters).	Radio Management	We need to extract radio signal information for different RATs and add it to the telemetry schema to be uploaded to the backend.	It has been decided to create a signal score based on RSRP.
REQ-RDKB-Cellular Manager -9	Recommend placement change in steady state if there is any change in environment that would impact experience considering both LTE signal and WiFi backhaul (if WiFi backhaul is used).	Radio Management	We need to extract radio signal information for different RATs and translate this to a simple value to allow BLE to determine the proper placement of the gateway.	It has been decided to create a signal score based on RSRP.
REQ-RDKB-Cellular Manager -10	Recommend the best placement as part of the onboarding flow considering LTE signal and WiFi backhaul (if WiFi backhaul is used).	Radio Management	We need to extract radio signal information for different RATs and translate this to a simple value to allow BLE to determine the proper placement of the gateway.	It has been decided to create a signal score based on RSRP.
REQ-RDKB-Cellular Manager -11	Onboarding over LTE (Instant On)	Identity Management SoC Management	We need to start the gateway as RG-FWA without a home network connection.	
REQ-RDKB-Cellular Manager -12	SW has the ability to switch between a physical SIM and a programmable eSIM.	Identity Management	Seamless change among MNO profiles in UICC or eUICC.	
REQ-RDKB-Cellular Manager -13	SW supports physical SIM and eSIM to allow for diversity of choice in network provider and in-life network provider switches. SIM preference when both SIMs are active: TBD	Identity Management	LPA implementation.	
REQ-RDKB-Cellular Manager -14	UICC management	Identity Management	Extraction of SIM information.	
REQ-RDKB-Cellular Manager -15	eSIM (eUICC) for LTE (certified programmable for the US, Canada, UK, and EU)	Identity Management	We will manage UIM information based on MNO profiles, and it will be seamless between SIM and eSIM.	

REQ-RDKB-Cellular Manager -16	Ability to enable or disable the LTE module (for use for extender-only purposes and in cases where the LTE backup service is deactivated)	SoC Management	We will need the capacity to disable the modem to configure the box as a simple WiFi AP.	
REQ-RDKB-Cellular Manager -17	Ability to enable or disable extender functionality (for use of LTE back-up without an extender)	SoC Management	We need to disable the WiFi AP functionality to make it work as an FWA.	Not part of the CM design.
REQ-RDKB-Cellular Manager -18	Power Management: Radio management (disable chains, etc.), CPU throttling, telemetry	SoC Management	We will use the configurable capabilities to control power consumption in the mode, for instance: <ul style="list-style-type: none"> • POWER-OFF • POWER-SAVE 	
REQ-RDKB-Cellular Manager -19	Telemetry 2.0	Telemetry Management	We need to create the JSON schema for telemetry based on T2 functionality.	
REQ-RDKB-Cellular Manager -20	IPv4 and IPv6: Parity with XE1, XE1v2, and XE2	Connectivity Management	We need to be able to create bearers in IPv4 only, IPv6 only, and DS. We need to take into account that wireless interfaces are not ethernet-based, so some of the services will not be similar, mainly the ones requiring ethernet.	It will be interesting to analyze the capability to run DHCP clients on top of wireless interfaces.
REQ-RDKB-Cellular Manager -21	Power management based on EU regulations	SoC management	We will be able to switch off the radios for LTE, keeping the control plane up and IUCC and IMEI information readable.	To add a power-safe mode as a way to reduce power consumption.

High Level Architecture



For further details of the abbreviations, kindly refer to the [Glossary - RDK - RDK Central Wiki](#)