eSIM in the LANCOM routers

Mobile communications are now a central component of modern enterprise networks—whether for the rapid rollout of new locations, connecting mobile or temporary workplaces, or as a highly available backup link for fixed-line connections. Traditional physical SIM cards come with noticeable drawbacks: they have to be ordered, shipped, distributed, inserted into devices, and replaced again when changing providers or tariffs.

The eSIM (embedded SIM) transfers these processes into the digital world. Mobile profiles are no longer delivered on plastic cards but are loaded via software onto a chip permanently integrated into the device. LANCOM routers with an integrated consumer eSIM (SGP.22) therefore enable companies to roll out deployments much faster, simplify administration, reduce on-site visits, and increase security, as no physical cards need to be handled or circulated.

This techpaper explains the technical fundamentals of SIM and eSIM technology, introduces the three relevant eSIM architectures, describes the consumer eSIM implementation in LANCOM routers, and shows how installation, operation, and secure lifecycle management work in practice.

From the physical SIM to the eSIM

SIM cards (Subscriber Identity Module cards) have for many years been the traditional means of authenticating end devices in mobile networks. Each provider issues its own individual SIM cards for its customers. These consist of a plastic carrier with an integrated security chip that stores the keys required to access the mobile network.

If a customer changes their mobile network provider, this physical card must be replaced in the device. After a contract is concluded, the new card is sent by mail and typically reaches the customer only after several days. In enterprise networks with many routers and locations, the associated logistics effort, time delays, and security risks quickly add up.

The eSIM is the logical evolution of this architecture. From a technical perspective, it is a permanently installed chip—such as in the M2FF form factor—on which an eUICC (embedded Universal Integrated Circuit Card) runs. This eUICC manages the mobile

profiles and handles secure communication with the provider's backend systems. Instead of physically swapping a card, a profile is downloaded, activated, or replaced digitally. In the following sections, the terms eSIM and eUICC are used synonymously.

eSIM types and standards

The eSIM technology is specified in international GSMA standards. Three solution architectures are particularly relevant today:

→ **M2M eSIM (SGP.02)**
Machine-to-machine (M2M) eSIMs are designed for devices without a user interface, such as industrial equipment, vending machines, or telemetry hardware. The profiles are managed centrally via an M2M management portal or provisioning system and are transferred to the end devices over the air, often via SMS. In most cases, these are closed solutions offered by providers that operate very large fleets of devices.

→ **Consumer eSIM (SGP.22)**
Consumer eSIMs are the variant commonly known from smartphones, smartwatches, and tablets. Mobile network operators provide QR codes or activation codes that users use to install the eSIM on their device. The device contains a Local Profile Assistant (LPA), which handles the encrypted communication between the eSIM/mobile chipset and the provider's systems.
The eSIM profile is always downloaded via an existing internet connection, typically over Wi-Fi. In addition, some device manufacturers offer proprietary provisioning systems in which the eSIM is made available for download within the manufacturer's own ecosystem.

→ **IoT eSIM (SGP.32)**
IoT eSIMs combine elements of LPA functionality on the end device with a central server that handles the management and distribution of profiles. They were developed to enable efficient management of very large IoT fleets. Chronologically, this is the most recent of the three architectures and is particularly relevant for scenarios involving a large number of IoT devices.

For use in LANCOM routers, the consumer eSIM architecture in accordance with SGP.22 is decisive.

Consumer eSIM in LANCOM routers

LANCOM routers are equipped with an eSIM chip in the M2FF form factor with eUICC functionality. This is a consumer eSIM compliant with SGP.22. LANCOM therefore uses the same standard technology that is also employed in modern smartphones.

This solution is compatible with common consumer eSIM profiles as issued by mobile network operators for mobile phones and comparable devices. It is not artificially restricted from a technical perspective: all mobile profiles that comply with the SGP.22 standard for consumer eSIMs can be used, provided the provider does not explicitly limit them to specific device types or manufacturers.

For enterprises, this offers two key advantages: they can often reuse existing tariffs and processes from their mobile communications ecosystem while at the same time benefiting from a future-proof, standards-based solution for cellular routers and SD-WAN gateways.

eSIM support and requirements in LANCOM routers

Starting with LCOS 10.94, LANCOM routers support not only traditional plastic SIM cards but also an integrated eSIM solution in the cellular module. The eSIM can be used optionally or in addition. Regardless of this, it remains possible to use conventional SIM cards in the SIM card slot of LANCOM routers.

The prerequisites are:

→ LCOS firmware version 10.94 or later
→ a cellular router with an onboard, integrated eSIM chip
→ if required, an update of the WWAN firmware to a version that supports eSIM

Devices with eSIM support starting from LCOS 10.94 include, among others:

→ LANCOM 180xVA-4G (from hardware release D onwards)
→ LANCOM 180xVA-5G (from hardware release D onwards)
→ LANCOM 1800EF-4G (from hardware release D onwards)
→ LANCOM 1800EF-5G (from hardware release D onwards)
→ LANCOM 1930EF-5G
→ LANCOM 1936VAG-5G
→ LANCOM OAP-5G
→ LANCOM 1800EFW-5G
→ LANCOM 1803VAW-5G

This means that eSIM functionality covers a broad spectrum, ranging from all-in-one business routers to high-performance 5G solutions for branch networks and outdoor scenarios.

Installing an eSIM profile on a LANCOM router

Getting started with eSIM usage begins with a mobile service contract from a provider that supports consumer eSIMs in accordance with SGP.22. After the contract is concluded, the provider supplies either a QR code or an activation code. Both contain the same technical information—including the server URL and a code used to retrieve the profile—and differ only in their presentation format.

The administrator enters the activation code into the LANCOM router via WEBconfig or the command line. The router then establishes a connection to the provider's server using an existing internet connection, such as DSL or fiber. The eSIM profile is downloaded to the integrated chip and stored there permanently.

The download itself cannot be performed via the cellular modem in the same device. Installing an eSIM is an exclusive, self-contained operation within the cellular chipset. During this process, the router must internally switch access from any existing physical SIM to the eSIM. In this phase, the WWAN modem is not available as a transport path. In practice, this behavior is comparable to that of a smartphone, which requires a Wi-Fi connection for the initial eSIM download.

After a successful download, the eSIM becomes visible in the router's WWAN profile table and can be selected and configured there as the active profile for the cellular connection.

Operation and management of the eSIM in the LANCOM router

In LANCOM routers, the eSIM is implemented as a virtual SIM slot. This slot can store up to eight eSIM profiles. In the SIM slot configuration, the eSIM is listed as "eSIM-1". When this slot is referenced there, the router uses the currently active profile on the eSIM for the cellular connection.

Profile management can be performed either via WEBconfig or via CLI commands. Administrators can install, activate, deactivate, or delete profiles.

It is important that the internal cellular modem is available in order to access eSIM management. If the modem is not operational, profiles can neither be configured nor deleted.

WEBconfig

To add an eSIM to the device, open the **Add profile** section in the device's WEBconfig under **Setup Wizards > eSIM Management**.

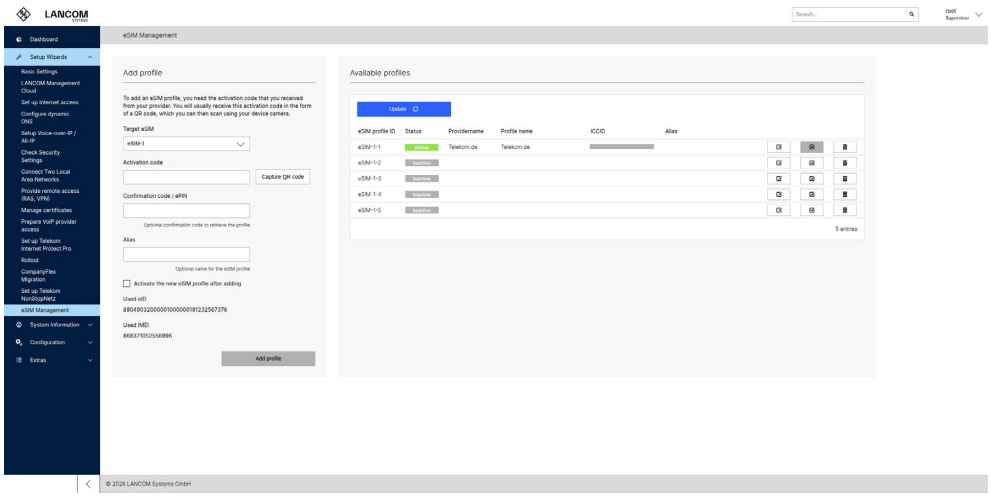

Figure 1: WEBconfig

Select the desired target eSIM under **Target eSIM**, for example eSIM-1.

Then enter the eSIM **activation code** provided by your mobile network operator, for example LPA:1$prov.example.com$ABCDEFGH12345.

This is the so-called LPA string (Local Profile Assistant string). It is a character string that contains the address of the SM-DP+ server (the server for profile management) and an activation code used to manually install an eSIM profile on a device. Its content is identical to that of the QR code provided by the operator. The string follows the format "LPA:1$SM-DP+ address$activation code" and is used by the LPA in the device to download and install the eSIM profile from the SM-DP+ server via an existing internet connection.

The activation code can either be entered as plain text or scanned via QR code, provided the device is equipped with a camera.

Optionally, you can specify a **confirmation code** that is entered together with the activation code. Some providers also refer to this as an **ePIN**. You will receive this code from your mobile network operator along with the QR code or activation code.

The **alias** is an optional label for the eSIM profile. It allows the profile to be more easily identified and selected in the profile table.

For informational purposes only, the **eID (Embedded Identity Document)** and the **IMEI (International Mobile Equipment Identity)** are displayed. The eID is the globally unique identifier of the eSIM integrated in the device. The IMEI is a 15-digit number assigned to your LANCOM cellular router that uniquely identifies the device worldwide.

In the **Existing profiles** section, the eSIM profiles stored on the local device are displayed. In principle, only one eSIM profile can be active at any given time. The three icons on the right-hand side allow the actions “Edit profile”, “Activate profile”, and “Delete profile”.The active profile can be selected as **eSIM-1** in the SIM selection of the WWAN profile configuration. This can be found in LANconfig under **Interfaces > WAN > Mobile settings > Mobile profiles**.

Important notes on security and lifecycle management

- → With the eSIM, the perspective on security and the lifecycle of cellular connections also changes. A simple device reset is not a reliable method for removing eSIM profiles. During the reset process, it cannot be guaranteed that the modem is in a state that allows access to the eSIM and the deletion of profiles.
- → For controlled and secure removal, eSIM profiles must be explicitly deleted via eSIM management. If this is not possible in exceptional cases—for example, because a device is no longer available—the mobile network operator can block the respective profile in its own systems. This procedure is equivalent to blocking a traditional SIM card and prevents any further use of the tariff.
- → Another characteristic of the eSIM lifecycle is that eSIM profiles are typically downloaded only once. Re-downloading the same eSIM profile is generally not intended. If a profile needs to be installed again, the provider must explicitly enable it for re-download or issue a new profile.
- → Downloaded eSIM profiles are permanently bound to the embedded chip in the respective device. Transferring profiles between different routers is not possible. This reduces the risk of profiles being moved unnoticed to other devices and simplifies traceability for compliance and audit requirements.

Advantages and typical use cases in enterprise networks

The combination of an integrated eSIM and LANCOM SD-WAN gateways provides enterprises with tangible advantages in the operation and organization of their networks.

These advantages become particularly apparent in typical scenarios such as:

- → **Branch networks and branch offices**
  New locations can be brought into operation more quickly because devices are delivered preconfigured and eSIM profiles are assigned digitally. The shipping of SIM cards and on-site deployments are significantly reduced.
- → **Mobile and temporary locations**
  Construction sites, events, or pop-up stores benefit from the ability to activate and adjust cellular connections flexibly without having to replace SIM cards on site.
- → **Backup connectivity for critical sites**
  LTE or 5G connections serve as backup links for DSL or fiber connections. Provider changes or tariff optimizations can be carried out without requiring any physical intervention in the infrastructure.
- → **Test, pilot, and migration scenarios**
  Test and production profiles can be provided in parallel on a single eSIM. Transitions are carried out by switching profiles rather than replacing hardware—ideal for proof-of-concept deployments and phased migrations.

Beyond these specific use cases, eSIM acts as an accelerator for all processes related to cellular connectivity in the enterprise: less logistics effort, fewer sources of error, more predictable changes, and a clearer assignment of profiles to devices.

Conclusion

The eSIM marks the transition from physically managed to digitally managed cellular connectivity. Where SIM cards previously had to be ordered, shipped, and manually inserted into devices, deploying a profile is now sufficient.

LANCOM routers with an integrated consumer eSIM compliant with SGP.22 make this development usable for enterprise networks. They combine standards-based cellular technology with the strengths of an SD-WAN platform: centralized control, automatable processes, high flexibility in the choice of providers and tariffs, and clearly defined security and deletion mechanisms.

For organizations that want to future-proof their site connectivity—whether for branch networks, mobile workplaces, IoT connectivity, or highly available backup solutions—eSIM is therefore not a minor feature, but a strategic building block of modern network architectures.

LANCOM Systems GmbH
A Rohde & Schwarz Company
Adenauerstr. 20/B2
52146 Wuerselen | Germany
info@lancom.de | lancom-systems.com

LANCOM, LANCOM Systems, LCOS, LANcommunity, LANCOM Service LANcare, LANCOM Active Radio Control, and AirLancer are registered trademarks. All other names or descriptions used may be trademarks or registered trademarks of their owners. This document contains statements relating to future products and their attributes. LANCOM Systems reserves the right to change these without notice. No liability for technical errors and / or omissions. 01/2026