

The Role of Private 5G in the IR4

What exactly is private 5G?

It enables enterprises to implement a dedicated and secure 5G network to deploy modern and innovative use cases. With private 5G, enterprises can safeguard their critical infrastructure, streamline processes, optimize resources, and drive revenue.

>\$64 billion

The estimated revenue generated by private cellular network deployments in the enterprise sector by 2030¹

47.5%

An estimated CAGR of the global private 5G networks market between 2022 and 2027²

Reference:

1 [ABI Research](#)

2 [Grand View Research](#)

5G and the potential of private networks

5G holds immense transformative potential for industries, reinventing industrial applications with cellular technology. It provides better speed, latency, bandwidth, and throughput capabilities than any legacy network, and replaces physical infrastructure with a wireless network.

Manufacturing, transport, utilities, entertainment, healthcare, and a multitude of other sectors will benefit from 5G's advanced capabilities. Private 5G lets enterprises fully leverage next-gen technology. In fact, according to a report by the Dell'Oro Group, by 2026, LTE will be surpassed by 5G NR private networks.

As more industries digitize operations and shift to a cloud-based ecosystem, businesses now need exactly the kind of robust and reliable network connectivity that private 5G provides. It enables them to manage and monitor their assets, automate processes, and handle far larger data volumes than was previously possible.

Interest in private networks is steadily growing. Facilitating swift private 5G rollouts will give service providers an early-mover advantage, enabling them to drive 5G ROI.

Benefits of private 5G for operators



Monetize the 5G network

Private 5G is among the most viable business use cases for 5G networks, helping operators swiftly drive return on their 5G investments.



Forge diverse partnerships

Partner with enterprises to build and operate their networks, either on-premise or in the cloud. This includes universities, ports, smart buildings, cities, factories, farms, and more.



Maximize resource use and monetization

With network slicing, operators can cater to the diverse needs of several different enterprise clients at the same time, helping optimize resource allocation and fully monetize their networks.

How is private 5G deployed?

There are different ways in which a private 5G network can be implemented. Enterprises can choose to deploy and manage their own infrastructure, recruiting in-house domain experts to help run and manage the network. The other option is to acquire a network-as-a-service from telecom operators or other vendors.

Operators can use a host of deployment options depending on their objectives. They could have an onsite core in a box with RAN for a completely private network, or a cloud core with RAN, and so on. (In later sections, we'll discuss in detail the deployment modes Alepo provides.)

Private 5G will most often be deployed on an unlicensed spectrum (for instance, in the US, it will run on the CBRS spectrum). However, operators providing private 5G in the NaaS model can use other spectrums for their deployments, helping optimize the network.

Types of applications supported by private 5G

Agriculture, logistics, energy, manufacturing, automotive, transportation – more and more sectors are relying on technology to improve their processes. Many use devices such as RFID tags, cameras, sensors, drones, and other means for real-time surveillance to help streamline operations and drive business decisions. Connecting these devices to a private 5G network can open a world of opportunities for enterprises.

Private 5G networks can be deployed in manufacturing plants, malls, mining facilities, campuses, and much more. It can be tailored to suit the needs of custom enterprise use cases, whether they require ultralow latency, high bandwidth, ultrafast speeds, high reliability, or any combination of these. Some applications include:

- Critical communication networks that demand reliability, such as remote oil rigs.
- Industrial wireless networks and IIoT with several sensors, AR/VR, and robots, which demand high bandwidth and low latency.
- Campus networks that require support for high traffic volumes.
- Manufacturing facilities with business-critical operations.
- Drones that need quick hand-off as they are constantly switching networks.
- Live sporting events with multiple endpoints.



IR4-private 5G use cases

Manufacturing

- Smart factories
- Predictive maintenance
- Drones
- Remote monitoring of production assets
- Digital twins
- Human-robot collaboration
- AR for repairs

Transportation

- V2X and V2V communications
- Airborne taxis
- Prognostic maintenance
- Remote vehicle health monitoring
- In-vehicle infotainment
- Intelligent traffic
- Internet of Moving Things

Energy and Utilities

- Smart street lighting
- Virtual power plants
- Smart energy management
- Remote monitoring of energy sites
- Drone monitoring
- Smart metering
- Predictive maintenance

Healthcare

- Remote surgeries
- AR/VR-enabled healthcare
- Telemedicine
- Robot-assisted minimally invasive surgeries
- Remote patient monitoring
- Wearables and ingestibles
- Connected ambulances
- Implantable device monitoring

Entertainment

- Enhanced mobile advertising
- Smart stadiums
- Connected haptic suits
- Temporary networks for events
- Immersive media
- Enhanced mobile media
- In-car entertainment
- Ultra-high-definition video streaming

Agriculture

- Precision agriculture
- Weather stations
- AI-enhanced machinery
- Livestock tracking and monitoring
- Drone operations
- Predictive analytics
- Weed and crop monitoring
- Autonomous agricultural vehicles

How Alepo's Converged Core enables private 5G

The Converged Core is an industrialized solution that helps operators deploy private networks for businesses and enterprises. It provides a host of flexible deployment options, depending on individual business requirements. The solution supports enterprise and industrial use cases for a small number of subscribers.

Most 5G networks are currently dependent on the 4G core/EPC along with the 5G RAN, which is to say they are non-standalone (NSA) deployments. In other words, they are not end-to-end 5G networks.

However, Alepo's Converged Core, along with its ESS Portal, is different. All elements in the self-contained solution are pre-integrated. Enterprises can swiftly deploy their networks using the 5G standalone (5G SA) mode. Networks deployed with 5G SA are independent of the 4G core, making them truly end-to-end networks.

The Converged Core includes the network core and other network functions such as Subscriber Data Management (SDM), Authentication Function (AUSF), Unified Data Management (UDM) + Home Subscriber Server (HSS), Unified Data Repository (UDR), converged Policy Control (PCF + PCRF), and more. These network components work seamlessly with end devices and the RAN, and have zero impact or dependence on external systems.

Business benefits of Alepo's Converged Core

Alepo's Converged Core provides several advantages for service providers:



Ensure a low resource footprint

The solution provides among the lowest resource footprints in the industry with flexible deployment modes to help meet every business goal.



Leverage cloud-native capabilities

Implement automation and ensure smooth and cost-efficient operations, tailored to suit the unique requirements of any enterprise network.



Swiftly launch private networks

The plug-and-play solution enables data, voice, and priority services such as Mission-Critical-Push-To-Talk (MCPTT), Mission Critical Video (MCVideo), Multimedia Priority Services (MPS), and other high-value use cases for private networks such as mines, oilfields, and more. The RAN and core network can plug into the operator's network to support wide-area coverage. Network slicing helps enable diverse capabilities for different applications.



Roll out network services quickly

Ready profile templates allow bulk subscriber import, simplifying operations and accelerating private network rollout. It also simplifies the management of a large number of subscriber services in public and private networks. Operators can build and test subscriber service profile templates in their data centers and roll them out across multiple networks. They can roll out networks in a very short span of time, facilitating rapid monetization of services.



Support PNI-NPNs and SNPNs

The solution supports 3GPP-defined private network deployment models: PNI-NPNs (where private networks are dependent on public networks using a centralized core) and SNPNs (where a standalone core is deployed for each private network).



Centralized core for multi-tenancy

In accordance with 3GPP's 5G Multi-Operator Core Network (5G MOCN) model, Alepo's Converged Core solution offers a centralized core that allows network sharing among multiple private networks, including MNOs and enterprises.



Advanced control over services

Enterprises can efficiently implement and manage next-gen high-value services such as edge computing, IoT, network slicing, large-scale streaming events, and much more.

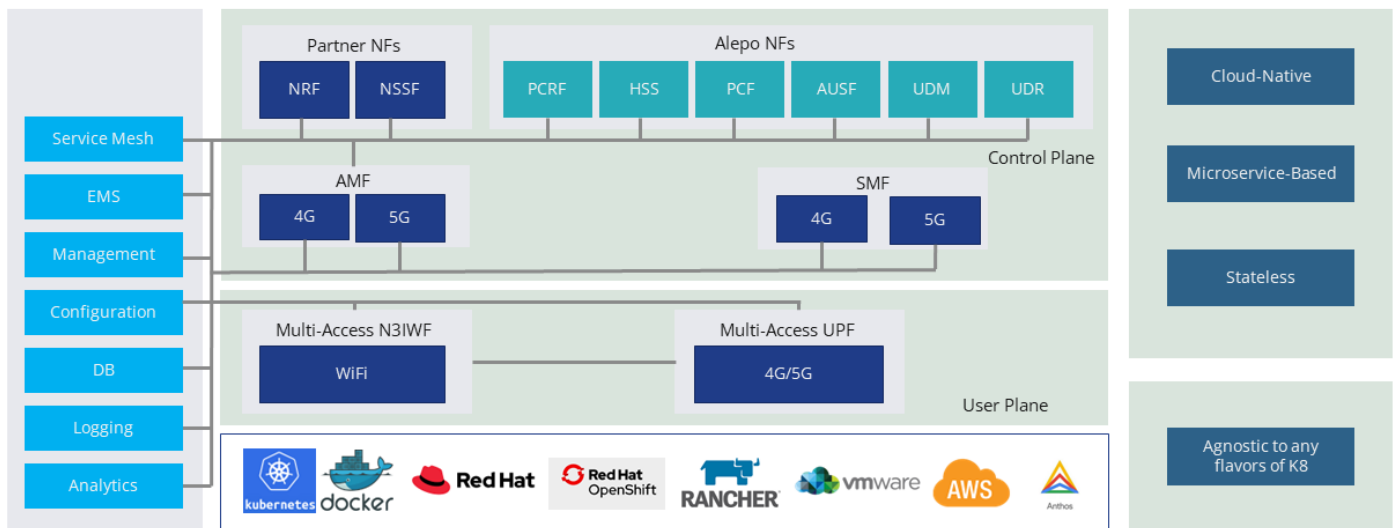


Secure access based on CAG

Alepo's Converged Core restricts UEs from accessing the devices belonging to the Closed Access Group (CAG), making the network experience more stable, secure, and reliable.

Converged Core solution components

Alepo provides UDM for authorization, a converged policy combo, and a data repository for Subscriber Data Management. It also includes web-based portals for different network components to simplify management.



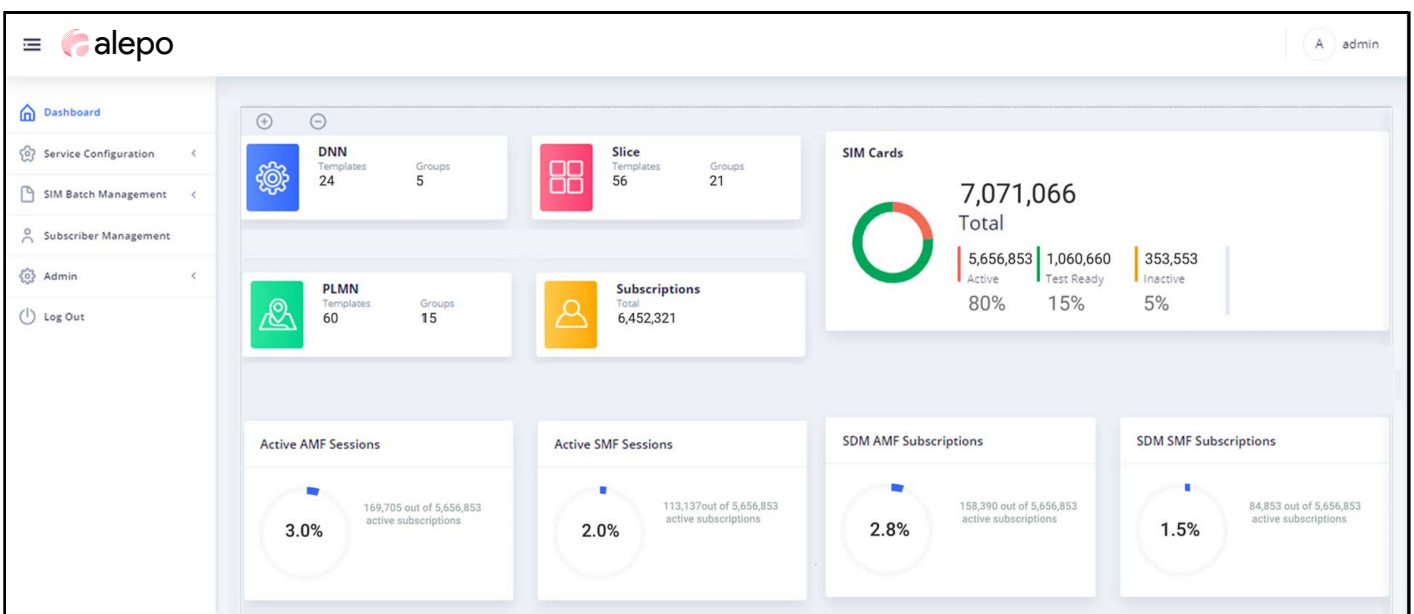
Alepo's 5G Core Solution Architecture

The Converged Core's standards-compliant network functions include:

SDM Agent Portal

This provides an easy-to-use GUI system to manage service configurations and subscriber profiles. It displays all subscription-related information in one place. System users can troubleshoot subscription-related issues.

- Allows importing and managing of SIM batches
- Stores SIM information in an encrypted format
- Maintains privacy and security of the subscription data with role-based access
- Manages 4G/5G subscriptions as well as policy data
- Offers audit logs and operation history support
- Supports service configurations for DNN, slice, APN, PLMN



SDM Portal Dashboard

Authentication Server Function (AuSF)

A 3GPP TS 29.509 compliant network component that grants devices seamless and secure access to 5G services.

- Allows 5G authentication based on 5G-AKA
- Supports re-synchronization failure management
- Handles routing based on SUCI and SUPI, and device-based authentication
- Supports Nausf-UEAuthentication service
- Manages authentication confirmation timeout
- Manages authentication session states in an external centralized database

UDM + HSS

An intelligent cloud-native NF that helps authenticate and authorize user access, enabling smooth and seamless session continuity. It supports 4G, 5G-NSA, and 5G-SA deployments, helping store and manage individual subscriber data for 4G and 5G services.

- Stores and manages SUPI/IMSI/GPSI for each subscriber in the 4G+5G network
- Enables service/session continuity by managing SMF/DNN contexts for ongoing sessions
- Is 3GPP TS 29.272 R16-compliant (HSS) and TS 29.503 R16 compliant (UDM)
- Supports Nudm-SubscriberDataManagement, Nudm-UEContextManagement, Nudm-UEAuthentication services
- Supports Local Area Data Network (LADN), V2X subscription data, dedicated core
- Supports PLMN based authentication/authorization (including roaming use cases)
- Supports Interworking Function (IWF) for interfacing with 4G network nodes
- Supports EPS-AKA, 5G-AKA-based authentication, inter-RAT, intra-RAT mobility
- Supports SUCI de-concealing (SUCI to SUPI conversion) using Profile A, Profile B, and Null Scheme method
- Supports 4G authentication and service authorization using subscription data

Home Subscriber Server

It provides authentication and registration management for 4G and 5G NSA, enabling support for 4G services alongside 5G. It provides a web-based portal for managing subscriptions, services, and SIM batches.

- Is 3GPP TS 29.272, TS 29.228, and TS 29.328 R16-compliant
- Supports 4G interworking for inter-domain mobility
- Supports integration with UDR/common repository for subscription and context management
- Supports Nxx interface for 4G-5G interworking
- Supports PDU session continuity (N26 interworking)
- Supports PLMN-based authentication/location updates (including roaming use cases)
- Voice and Multimedia Telephony Services support
- Supports integration with Interworking Function (IWF) needed to interface with 5G NFs
- Supports Cx and Sh for IMS interworking
- Dedicated core network support

IMS HSS

A 3GPP TS 29.272 R16-compliant network function combo that supports non-3GPP use cases and a dedicated core network. Supports authentication and registration management for 4G and 5G NSA.

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Policy Control Function (PCF)

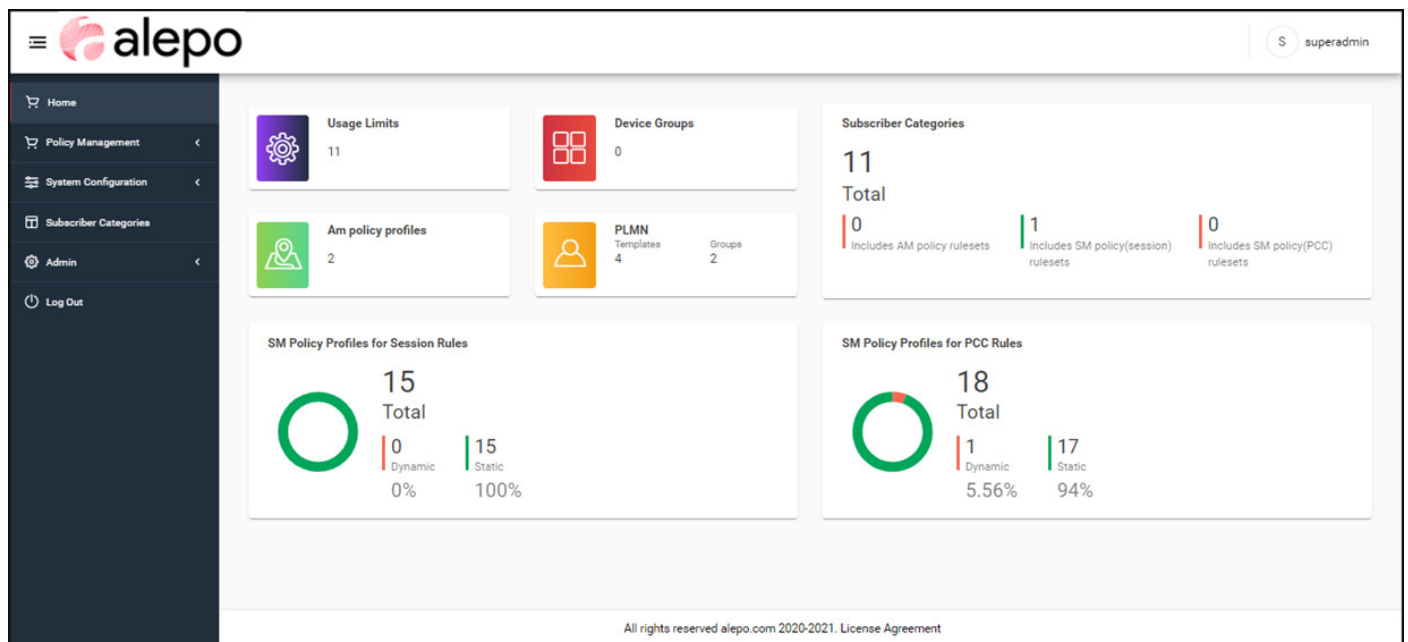
PCF enables converged policy control function for 4G and 5G networks. It provides a flexible and user-friendly GUI with a high-performance rule engine to rapidly deploy policy use cases.

- Supports dynamic PCC rules
- Enables usage monitoring
- Ensures seamless session continuity for inter-RAT handover
- Is 3GPP release 16 compliant
- Supports Gx and Rx interfaces
- Provides policy authorization support
- Supports Access and Mobility Policy and Session Management Policy
- Supports UE Route Selection Policy (URSP)

PCF Portal

This provides an easy-to-use GUI to help system users easily configure and manage policy profiles for AM, SM (session and PCC rules).

- Enables system configurations for PLMN, devices, locations, and usage limits
- Supports easy point-and-click policy configuration with ready-to-use policy conditions and rules
- Helps precisely visualize sorting and prioritization logic for rulesets
- Robust graphical user interface with drag-and-drop policy creation



Alepo PCF Portal Dashboard

Unified Data Repository

A 3GPP TS 29.504 Rel 16-compliant centralized database that helps manage 4G+5G subscription data, SIM identities, and service configurations. It is used by the PCF, UDM, NEF, and other network functions and is easily integrated with third-party NFs over standard 3GPP interfaces.

- Enables subscribing to notifications for changes in subscriber data
- Supports REST (real-time), batch (bulk) provisioning
- Supports Nudr-DataRepository service
- Enables storage and retrieval of subscription and policy data
- Supports single-site and multi-site deployment
- Supports roaming use cases

In addition, Alepo has forged partnerships with industry leaders for AMF, SMF, UPF, NRF, NEF, and CHF to provide an end-to-end solution.

Features and capabilities



Innovative use cases

Private 5G enables use cases such as smart factory floors, drones, human-robot collaboration, digital performance management of connected devices, digital twins, and more.



Agility

Private 5G does away with bulky and limiting cables. It operates entirely on wireless technology, enabling more flexible processes on the manufacturing floor.



Security

The large number of connected I-IoT devices demand added provisions to keep the network secure from cyberattacks and other potential security threats that are common with WiFi networks. Private 5G networks offer stringent security options that are constantly updated for threats.



Resource allocation

Enterprises can divide their private network into multiple slices, enabling each network function to operate as a separate entity and allocating different resources to each to improve overall efficiency.



Customizable for different contexts

Private 5G networks can implement any combination of next-gen features to meet different enterprise goals. The network also scales for changing production requirements.

Converged Core deployment modes

4G+5G combo model

Description	Benefits	Use Cases
This converged model supports containerized 4G+5G core NFs that are deployed over cloud-native infrastructure. Supports inter-RAT and intra-RAT mobility.	<p>Can be deployed with or without N26 interworking support</p> <p>A one-box solution</p> <p>Optimizes CAPEX and OPEX</p> <p>Supports integrated EMS and PaaS tools, ensuring smooth operations and maintenance</p>	<p>Enterprises who want to support LTE from a 5G core</p> <p>Network slicing</p>

Local deployment model

Description	Benefits	Use Cases
The 5GC is deployed on-premise over private cloud or standalone servers. The containerized 5G core NFs are deployed on cloud-native infrastructure. A fully isolated system with no external inputs or outputs. All data is processed and stored onsite.	<p>High security with local control; no outside connection</p> <p>Optimizes OPEX</p> <p>One-box solution</p> <p>Streamlines operations and maintenance, supporting integrated EMS and PaaS tools</p>	<p>Manufacturing</p> <p>Utilities</p> <p>Public safety</p> <p>Smart buildings</p> <p>Education</p> <p>Hospitals</p>

Public cloud model

Description	Benefits	Use Cases
The 5GC NFs are deployed on highly distributed public cloud infrastructure. It enables one or more geographic locations, within the operator's premises as well as other locations. Supports secure and reliable wireless infrastructure, particularly beneficial for industrial applications.	<p>Reduces network management complexities and ongoing IT maintenance</p> <p>Lowers CAPEX, deployment time</p> <p>Simplifies deployments with automated orchestration and configuration</p> <p>Streamlines traffic management</p>	<p>Industrial IoT (IIoT)</p> <p>Manufacturing automation</p> <p>Events</p> <p>5G AR</p> <p>Base station sites</p> <p>Regional and/or national data centers for edge infrastructure</p>

Hybrid deployment model

Description	Benefits	Use Cases
The User Plane Function (UPF) is deployed on the telco edge or enterprise premise; the 5GC is deployed on private or public cloud at a centralized location. All devices are connected to a centralized server. The data payload changes dynamically depending on the edge location, ensuring low latency.	<p>Enables low-latency data connectivity</p> <p>The UPF is connected to 5GC using a secured tunnel to enable failproof security</p> <p>Ensures a minimal resource footprint for all 5GC NFs</p> <p>Enables focus on data control and access, with dedicated communications only where needed</p> <p>Ensures smooth operations and maintenance through support for integrated EMS and PaaS tools</p>	<p>V2X tracking</p> <p>Centralized and distributed campus networks</p> <p>5G network slicing</p> <p>Logistics</p>

Why Choose Alepo



Deployment expertise

With several 5GC projects in varying phases of deployment globally, Alepo is an early mover in helping implement 5G technology using the Converged Core, taking care of the solution expertise so operators and enterprises can focus on their operational and business goals.



An end-to-end offering

Alepo leverages cross-industry partnerships to deliver a complete solution that helps deploy private 5G networks (PNI-NPNs and SNPNs), especially for small and medium businesses.



Regulatory and standards compliance

In addition to ensuring a standards-compliant solution, Alepo implements robust cybersecurity measures and ensures local regulatory compliance.



Support for network slicing use cases

The solution helps operators maximize their 5G investments by leveraging network slicing to provide multiple dedicated networks using shared infrastructure at competitive prices.