SMO-Sphere: BubbleRAN Service Management and Orchestration Datasheet

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1 General Description

BubbleRAN Service Management and Orchestration, SMO-Sphere, is an O-RAN compliant, cloud native SMO platform designed as a declarative, intent-driven automation framework built on Kubernetes. It enables end-to-end lifecycle management of disaggregated, multi-vendor RAN and Core Network (CN) allowing to design, deploy, operate, automate, and optimize networks from Day 0 to Day 2 at any scale while reducing operational complexity, accelerating service rollout, and eliminating vendor lock-in. SMO-Sphere supports seamless onboarding of third-party network functions (NFs), including CU, xApps, and rApps, through a container development kit (CDK), enabling both brownfield integration and greenfield deployments.

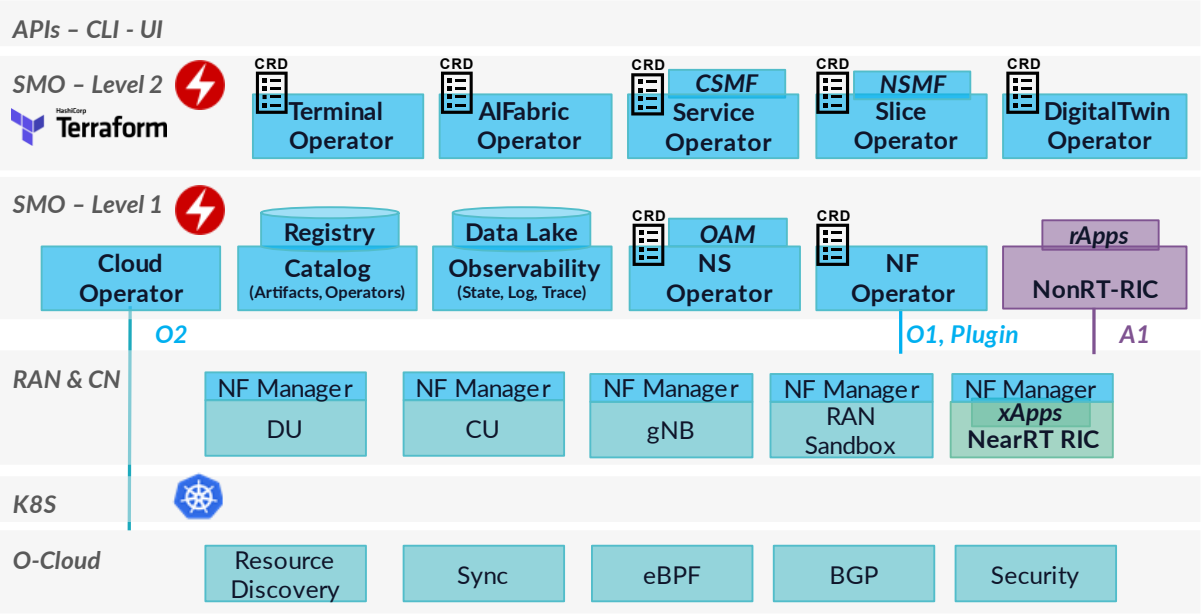

Figure 1: SMO-Sphere is cloud-native end-to-end network management and orchestration software aligned to industry standards such as 3GPP and O-RAN

SMO-Sphere decouples network Composition Model (CM) from deployment. CMs are published as Kubernetes Custom Resources (CRs) with reusable "recipes" that define how to compose a network (e.g. monolithic gNB or disaggregated CU-DU in RAN) with their required resources at a logical level, without binding them to site-specific infrastructure details. Operators consume these recipes to plan, design, and configure a network deployment blueprint while abstracting away low-level infrastructure constructs. This separation enables SMO-Sphere to present a unified end-to-end service view, reducing operational complexity and OPEX while improving agility across Day 0 to Day 2+ operations.

2 Software Components

BubbleRAN SMO product, **SMO-Sphere**, follows the O-RAN architecture and specifications, where the Near-RT RIC resides on the RAN side (controlling O-CU/O-DU/E2 nodes via the E2 interface) and the Non-RT RIC is a logical function in the SMO framework, providing long-term policy, analytics and AI/ML orchestration via A1 and R1. **SMO-Sphere** includes the following distinct software components.

Component	Definition	Mapping to NFV|O-RAN
Composition Model (CM)	A Kubernetes CR defining workloads' images, configuration plugins, network role, and hardware requirements without any network details. **Example:** gNB or CU-DU composition model.	VNF
Blueprint	Encapsulate operators' Intent to deploy a network, described in a form of a Kubernetes CR. Blueprint represents a network service and it defines a set of logical entities (Composition Models) and their parameters. It is designed during Day 0 planning and realized during Day 1deployment. **Example:** logical network definition with 3 cells: 1x monolithic gNB from vendor A and 2x disaggregated cells with 1xCU and 2xDUs from Vendor B, each associated with their respective ARFCN and Cell parameters.	NSD
Observability	Responsible for monitoring NF/NS statistics, logs, traces, metrics, alarms, and underlying infrastructure resource and energy consumption. **Example:** Expose and export UE/SLICE/gNB stats together with their associated CPU usage.	FOCOM
Cloud Operator & Resource Discovery	This includes discovery and addressing of diverse hardware resources, time synchronization across all components, and reliable data transport for configuration and observability. It also ensures strong isolation and zero-trust security mechanisms, along with scalability and reliability under high-load conditions. **Example:** O-RAN RU and GPU discovery and management.	IMS DMS

NF Operator	Maps workload definitions to Kubernetes primitives (Pods, Services, Deployments, ConfigMaps). It automates the lifecycle (scaling, provisioning, configuration) of individual Network Functions. **Example:** Deploy this NF element.	VNFM
NS Operator	Defines and governs logical networks (access, core, edge, terminals) as a group of workloads with their associated network slices. It automates the end-to-end Network Service lifecycle from Day 1 to Day 2+ with built-in fault, configuration, performance, and security management. **Example:** Deploy this NS, associate 3 slices, allocates discovered RUs, and resolve dependencies among NFs.	NFVO FOCOM OAM TE
SMO - Level 2	**Service Operator:** Receives the end application requirements in a form of ServiceProfile and renders corresponding SliceProfiles for SliceProfile Operator. **Slice Operator:** Receives SliceProfile and renders the network slice blueprint for the NS Operator, In addition, it acts as a rApp for Non-RT RIC enforcing RAN Slicing policy based on O-RAN RC E2SM. **AIFabric Operator:** Automating the deploying of AI-for-RAN and AI-on-RAN services and orchestrate multi-agent runtime. **DigitalTwin Operator:** automates the deployment of multiple replica sets of network Sandbox. **Terminal Operator:** Automating the 5G device (RF or Emulated) lifecycle and provision the UE information in the 5GC.	3GPP CSMF 3GPP NSMF

SMO-Sphere Feature Sets

SMO-Sphere	Feature Set
Operation Latency	Day 0: 1-5s Day 1: 1-30s Day 2+: 1-75s
Interfaces	• Kubernetes CRD (YAML format) and REST APIs • O1 Interface • RedFish APIs (PDU)
Operations	• Day 0: Resource Discovery, Provisioning, NF Onboarding, NS Planning & Design. • Day 1: NS Scheduling, NS Deploy, NS Configuration, • Day 2+: NS/NS Reconfiguration, Test, Upgrade, Observability.
Observability	Multi-source data lake with RAN stats, logs, traces, infra resource usage, and energy consumption.

Security	• Network Isolation • Signed, Unprivileged, Rootless Artifacts • Role-Based Access Control (RBAC) • Runtime Network & Process Security • Software Bill of Materials (SBOM)
User Interface	• Comprehensive REST API • BubbleRAN CLI (BRC) • Dashboards (Grafana)
Image Registry	Harbor
Networking	Cilium (CNI), Multus (multi-networking), BGP.
Storage	VictoriaMetrics (time-series), Rook, Ceph.
Infrastructure	Vanilla Kubernetes Kubernetes Distributions (MicroK8s, GKE, RHEL OpenShift)
Container Runtime & DevKit	Docker and Snap (Optional: Containerd, Podman) CDK

LifeCycle. SMO-Sphere enables agile deployment of multi-x networks at any scale. It provides automated lifecycle management and operations such as network design and planning, configuration, reconfiguration, and fault management. RAN instances can be deployed with multiple slice configurations and connected to multiple CN from different vendors. Cells can be grouped into neighbor relations to support automatic handover configurations for both inter-cell and intra-cell scenarios.

Vendor-Agnostic. The Composition Model is a foundation to realize a vendor-agnostic SMO, where vendors supply the recipe to compose a logical entity and resolve its dependencies while operators define network deployments through logical entities and their parameters.

Deployment. SMO-Sphere is delivered as a cloud-native, Kubernetes-based platform and supporting flexible deployment across private, public, and hybrid environments. It can be deployed on commercial or open-source Kubernetes distributions and integrated seamlessly into existing O-Cloud infrastructures. A hosted RIC platform, e.g. RIC-Sphere, can be deployed on bare metal, virtual machines, or containerized environments (Docker Compose) or Kubernetes. SMO-Sphere supports both greenfield and brownfield deployments, enabling seamless integration with existing RAN and Core networks while accelerating cloud-native O-RAN rollouts.

Interfaces. SMO-Sphere provides integrated CLI, API, and GUI interfaces that support full Day 0 to Day 2+ operations and can be extended with AI agents as network assistants. This enables operators to interact with the network using natural language to request pre- and post-deployment actions such as network creation, expansion, update and upgrade, as well as to collect user and network data for analysis and performance evaluation.

Interoperability. SMO-Sphere integrates with any interoperable O-RAN compliant CU/DU and gNB through standard interfaces. It also supports interoperability with legacy CU/DU/gNB and 5GC deployments. It natively supports leading open-source 5G stacks (OpenAirInterface, srsRAN, Open5GS) and industrial-grade stacks (Amarisoft, LITEON).

3 SMO-Sphere Benefits

1. **Open and interoperable O-RAN platform**
    a. Fully conforms to O-RAN Alliance and 3GPP architectural standards.
    b. Enables multi-vendor interoperability across RAN and Core networks, eliminating vendor lock-in and protecting long-term investments.
2. **AI ready and data driven**
    a. Pre- and post-deployment network assistance powered by an AI-driven SMO Agent and conversational interfaces.
    b. Integrated framework for AI/ML model lifecycle management, policy control, and rApp hosting.
    c. Built-in observability stack and multi-source data lake enabling advanced analytics, closed-loop automation, and SLA assurance.
    d. AI-Driven network automation
3. **Cloud native deployment**
    a. Delivered as containerized microservices built on Kubernetes for resilience, scalability, and portability.
    b. Supports hybrid deployments across on-premises, bare-metal, public and private cloud environments.
4. **Brownfield and greenfield friendly**
    a. Seamlessly integrates with existing legacy networks while enabling new, agile deployments.
    b. With built-in support of 5G Open-Source stacks, it accelerates testing and integration with existing infrastructure.
    c. Northbound EIAP compatibility allows SMO-Sphere to coexist and interoperate with existing Ericsson intelligent Automation Platform.
5. **Intent-driven Automation from Day 0 to Day 2+**
    a. Declarative, intent-based workflows simplify network design, deployment, operation, and optimization.
    b. Reduces operational complexity, minimizes manual intervention, and accelerates service rollout at scale.
6. **Open Ecosystem and Leadership**
    a. BubbleRAN is a strong advocate and active contributor to O-RAN and AI-RAN technologies, all developed in-house. To accelerate their validation, evolution, and adoption, BubbleRAN established BubbleRAN Labs (B-Labs), an international collaboration and membership program that brings together industry and research organizations.
    b. B-Labs provides access to TelcoFabric, a shared innovation platform hosting a wide range of assets, including xApp/rApp samples and SDKs, datasets, benchmarks, telco agents, AI models, tools, documentation, and lab-based training.

4 Frequently Asked Questions

Q1: What makes BubbleRAN RIC-MSO different from other SMO platforms?

SMO-Sphere combines O-RAN and 3GPP compliance with a cloud-native architecture designed for intent-driven automation from Day 0 to Day 2+. It decouples service composition from deployment using Composition Models and Network Service blueprint expressed as Kubernetes CRs, enabling faster onboarding of multi-vendor RAN/Core network functions, repeatable deployments, and consistent operations across environments. SMO-Sphere also integrates natively with BubbleRAN RIC-Sphere and AI agents to enable closed-loop assurance and intelligent operations without vendor lock-in.

Q2: What are the benefits of could-native deployment?

Cloud-native deployment enables agile DevOps cycles at scale, automated configuration and lifecycle management, and seamless integration with adjacent services such as observability, data platforms, and the O-RAN xApp/rApp ecosystem. With Kubernetes Operator pattern, SMO-Sphere supports repeatable releases, upgrades, and rollback-friendly operations, helping teams move quickly from lab validation to production deployments.

Q3: How multi-vendor interoperability is supported in SMO-Sphere?

SMO-Sphere supports interoperability through O-RAN SMO interfaces and models and aligns with 3GPP management principles for lifecycle operations. It enables smooth onboarding of third-party network functions and applications via cloud-native packaging and onboarding workflows, allowing operators to mix vendors while maintaining an unified management and orchestration layer. SMO-Sphere is designed to accelerate partner ecosystem onboarding through standardized, Kubernetes-native abstractions.

Q4: What level of customization and extension is supported?

SMO-Sphere is extensible at multiple layers. First, CR definitions (CRDs) for composition, service intent, policies, and operational workflows. Second, operators and controllers to add support for new NFs/vendors and automate lifecycle functions. Third, integration hooks for OSS/BSS, observability stacks, data lakes, and AI pipelines.

Q5: How fast can a customer get started and prove value?

Customers can get started quickly using SMO-Sphere's declarative automation approach, reusable blueprints and composition models, and Kubernetes-native workflows. Teams can rapidly onboard network functions, deploy reference network services, and operationalize Day 2+ processes (configuration, upgrades, monitoring) with built-in observability and automation. This reduces integration effort and speeds up measurable outcomes in deployment time, operational efficiency, and service agility.

Q6: What business value does SMO-Sphere deliver?

SMO-Sphere reduces OPEX and operational complexity by standardizing lifecycle automation across multi-vendor RAN and CN environments and providing an end-to-end service view. It accelerates time-to-market for new services through repeatable Day 0/1/2+ workflows, improves reliability through automation and observability, and avoids vendor lock-in by leveraging O-RAN/3GPP-aligned models and interfaces, effectively helping teams deploy, operate, and evolve networks more efficiently.

5 Change History

5.1 Denim 2026-01

- Enhanced Slice Operator, AI Operator, and Terminal Operator capabilities.
- Added RU auto-discovery and management, Multi-DU Composition Model, and slice lifecycle management with QoS.
- Introduced dynamic rApp discovery and deployment.
- Added multi-source data lake for RAN statistics, infrastructure resource utilization, energy consumption, and dataset export, powered by VictoriaMetrics.
- Enhanced Grafana dashboards and visualization.
- Added onboarding support for Amarisoft UE Simbox.
- Introduced new deployment blueprints: Multi-Slicing, ECO-RAN, AUTO-RAN, Object/V2X Cooperative Communication, Object Detection, and Dataset Generation & Export.
- Published updated user manuals for network, xApp, rApp, and agent deployment. Enhancement of the Slice Operator, AI Operator, and Terminal Operators.

5.2 Crimson 2025-07

- Released Slice Operator.
- Released Digital Twin Operator (Experimental).
- Released AI Operator (Experimental).
- Enhanced SMO/OAM Network Service Operator.
- Added baseline Grafana dashboards.
- Added hardware and RU support: Benetel RU, LITEON RU, USRP, GPU, NUMA awareness, and CPU allocation.
- Added Redfish API support for Power Distribution Units (PDU) and introduced O1 interface support.
- Added Fault, Monitoring, Configuration, and Performance Management capabilities.
- Enhanced BubbleRAN CLI.
- Added support for external PNFs.
- Added dynamic xApp lifecycle management.
- Published deployment assets: blueprints, user guides, and developer guides.

5.3 Bronze 2024-10

- Introduced multi-vendor automation and reconciliation.
- Added Fault Management (Experimental).
- Improved support for large-scale deployments.
- Enhanced command-line tooling.
- Enhanced SMO/OAM Network Service Operator.
- Added xApp labs and training modules.
- Delivered Composition Models and deployment blueprints for Amarisoft and

open-source 5G stacks including OpenAirInterface and srsRAN. Multi-vendor Automation & Reconciliation.
- Published updated user manuals

5.4 Azure 2022-10

- Initial release of SMO/OAM Network Service Operator with basic lifecycle management.
- Released Terminal Operator.
- Delivered Composition Models and deployment blueprints for Amarisoft and open-source stacks (OpenAirInterface, srsRAN).
- Released O-Cloud device discovery.
- Released enhancements to BubbleRAN CLI.
- Introduced Artifact Registry (MX-Hub).
- Released Open Documentation including tutorials, labs, and API specifications.

6 License

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7 Terminology

RAN	Radio Access Network
CN	Core Network
IMS	IP Multimedia Subsystem (3GPP Term)
UE	User Equipment
O-RAN	Open RAN Access Network
AI-RAN	Artificial Intelligence Radio Access Network
SMO	Service Management and Orchestration
RIC	RAN Intelligent Controller
Non-RT RIC	Non-Real-Time RIC
Near-RT RIC	Near-Real-Time RIC
E2	E2 Interface (Near-RT RIC to RAN Agent)
A1	A1 Interface (Non-RT-RIC to Near-RT RIC)
R1	R1 interface (rApps)
RF	RAN Function
E2SM	E2 Service Model
xApp	eXternal App (Near-RT RIC)
rApp	RAN Application (Non-RT RIC)
CU	3GPP Central Unit
DU	3GPP Distributed Unit
O-RU	O-RAN Radio Unit
E2E	End-to-End
AI-for-RAN	Artificial Intelligence for Radio Access Network
AI-on-RAN	Artificial Intelligence on Radio Access Network
AI-and-RAN	Artificial Intelligence and Radio Access Network
SDK	Software Development Kit
CDK	Container Development Kit
BAT	BubbleRAN Agentic ToolKit
BRC	BubbleRAN Command Line Interface
SMO-Sphere	BubbleRAN SMO-Sphere Product
RIC-Sphere	BubbleRAN RIC-Sphere Product
CSMF	Communication Service Management Function
NSMF	Network Slice management Function
NFMF	Network Function Management Function
NF	Network Function
FOCOM	Federated O-Cloud Orchestration and Management
DMS	Data Management Service
NSD	Network Service Descriptor
IMS	Infrastructure Management Service
EMS	Element Management System
TE&IV	Topology Exposure and Inventory

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