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# Oracle Communications Network Repository Function (NRF) datasheet

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## Introduction

Oracle Communications Cloud Native Core Network Repository Function (NRF) serves as a registrar for all 5G Network Functions (NFs) and allow the NFs to register and discover each other via a standards-based API. The NRF enhances flexibility and efficiency of the 5G core network and is a key component required to implement the Service Based Architecture (SBA) in the 5G core.

## Overview

If there is no NRF in the network, there is no mechanism for dynamic updates to the network changes. Operators need to monitor all NFs in the network and accordingly re-configure NFs to align with these changes. Node selection is based on multiple search parameters and is mostly static without NRF. There is also no mechanism for health check of NFs when there is no NRF in the network.

When there is NRF in the network, dynamic updates are automated. 5GC NFs subscribe with NRF to get notified for network events.  NRF also acts as authorization server in the network which would authorize consumer NFs to proceed with service requests to the producer NFs. The NFs that are registered with the NRF send a heartbeat periodically, when there is a heartbeat lost, NRF marks the NF as suspended and notifies this change to all subscribed NFs. Suspended NRF is not included as prospective producer NRF in discovery responses till heartbeat starts again. In addition to identifying failure, NRF provides the alternate producer.

NRF being part of Signaling Domain, also acts as a data source for Service Communication Proxy (SCP), which builds routing rules based on NRF supplied NF status. It is a prerequisite for SCP, a key 5G Service Requests routing component which requires real-time network-wide view of the Network Functions and services, in order to enable NF Producer Selection, Alternate Routing, Load Balancing and other important service routing scenarios.
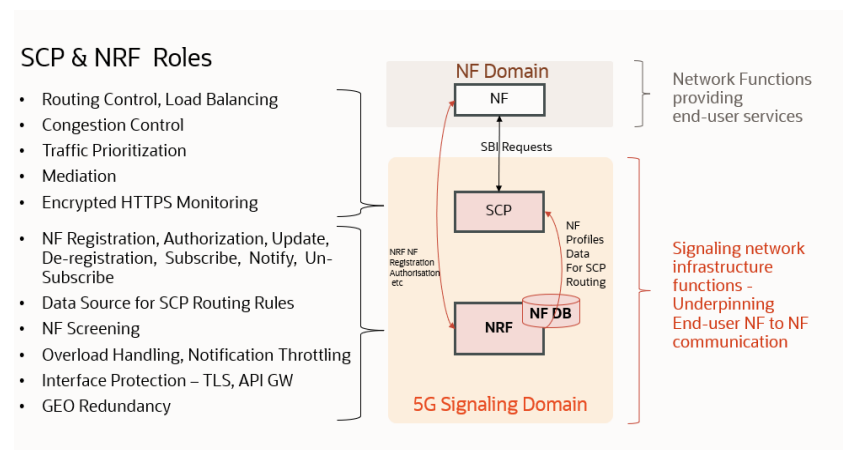


As per 3GPP specifications, NRF is a key part of 5G SA Roaming architecture where Visited and Home PLMN NRF needs to integrate with security Edge Protection Proxy (SEPP) to provide end to end inter-PLMN use-cases, such as Discovery, Subscription and Authorization. SEPP for inter-PLM routing also uses NRF to discover SCP nodes on the network, for incoming requests routing from other PLMN.

Dynamic Slice Selection is enabled by Network Slice Selection Function (NSSF), which relies on NRF as NF Slice Information data source. However, even before NSSF is introduced, NRF provides Discovery service based on slice which Network Functions like AMF can use to perform a simplified static Slice Selection. NRF as an integral part of 5G SA Core Network, enables the above-mentioned use-cases which are necessary for building a proper resilient and secure Mobile Core making network NRF a mandatory element in the 5G network.

Clustering NRF, with SCP and network slicing as per, "Heavy Reading" can simplify deployment and gain the advantages of pre-integration yet also realize the benefits of best-of-breed suppliers. This strategy is reasonably familiar in 4G and offers even greater potential in 5G. As per their survey, NRF, SCP, NSSF are closely linked functions

with little advantage to sourcing them separately, there are reasons why it may make sense technically and operationally.

Read here for more info.

## Product description

Given its role in the 5G core, the Oracle Communications NRF interacts with every other element in the core of the Home Public Land Mobile Network (HPLMN) and roaming, provides management, discovery services besides providing authorization and authentication. It reduces the processing burden on consumer NFs, and supports options to prioritize discovery results based on:

- Location,

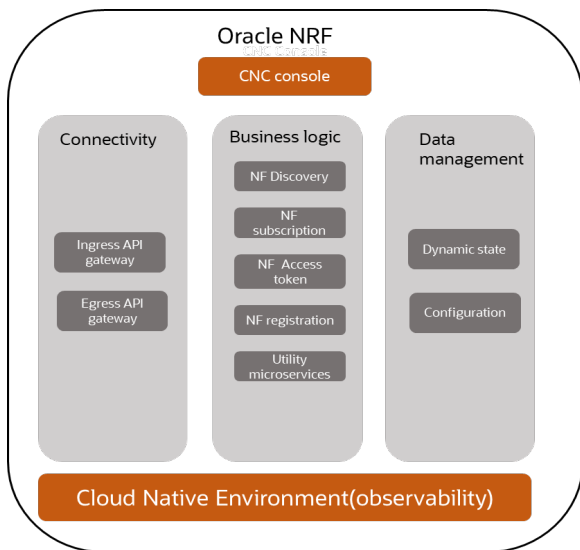- Registered priority,

- Capacity,

- Network load.



Figure-1 Functional diagram of Oracle Communications NRF

Oracle Communications NRF has a three-tier architecture, connectivity tier, business logic tier and data tier.

The **Connectivity tier** load balances the traffic via ingress API gateway and egress API gateway. It also provides authenticity and integrity protection.

The **Business tier** provides the business logic of NRF. In addition to business logic defined by 3GPP and other micro services to enhance discovery and resiliency.

The **Data tier** is the stateful component that provides network-wide data coherence. The Data tier uses Oracle MySQL Network Database (NDB) cluster as the backend database which provides high availability and georedundancy capabilities.

## Detail description of features and benefits

Oracle Communication Cloud Native Core NRF supports a range of differentiated features like monitoring and visibility, auto scaling up/down, overload protection mechanism, enhanced discovery based on true load. Some of the prominent features of the Oracle Communications NRF are listed as below:

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## Highly resilient

- Oracle Communications NRF supports geo-redundancy and horizontal scaling by means of real-time synchronization of the back-ends between multiple sites, with a possibility to add more sites when necessary.

- Multiple NRF set as an equivalent of vertical scaling strategy is also available, which allows to extend capacity of a single instance within a site. Each segment in this network can have a single georedundant set and each set can have up to four georedundant NRFs. The georedundant NRFs in the set share the state data with each other. Supports for forwarding query to another NRF if present NRF is not able to find a matching NF.

- Enables overload control feature that protects the system, maintains the overall health of NRF and improves performance by providing visibility of utilization of CPU, pending messages count and failure messages.

- Support monitoring of the health of configured SCP peers to ensure that the traffic is routed directly to the healthy peers. This enhancement avoids routing or rerouting towards unhealthy peers, thus minimizing the latency time.

- Supports POD protection mechanism to protect IGW and subscription from overload.

- Provides rich observability coverage – Metrics / Alarms / KPIs.

## Effective node selection (value added discovery features)

- Provides mechanism to associate 3 locations (called Preferred Locality triplet) with "preferred locality" parameter (and other attributes), NF profiles that match the discovery request search criteria are ordered based on Preferred Locality Triplet, making NF discovery more robust and resilient. This is a unique Oracle Communications NRF mechanism which goes beyond 3GPP and allows to overcome architectural limitations of the standard 5G SA network.

- Enhanced NF availability feature keeps NF instances as available when intermittent failures occur. Oracle Communications NRF allows to skip a small number of Heartbeat messages what ensures NF is not taken out of the network due to short Heartbeat interface interruptions.

- Full address-based resolution feature that discovers subscriber-based NFs using subscriber identities – SUPI/GPSI.

## Enhanced security

- Have screening feature to whitelist/blacklist the incoming NF management traffic.

- Provides access-token authorization to whitelist NF type-based access-token requests.

- Provides NF authentication through TLS.

- Supports service mesh integration which intercept all network communication between microservices.

- Integrated with Oracle Communications Certificate Manager (OCCM) off-loading the task of certificate management to OCCM. Automation of certificate management becomes important to avoid network disruption due to expired certificates.

- Provides NF screening feature, which provides extra security by restricting the NF that can use the service of NRF. The operator can decide which NF with the required attributes can access the services provided by NRF.

- Dynamically updating OAuth keys without disrupting the traffic. Key-Id based mechanism for seamless OAuth certificate update to the network.

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## Operational benefits.

- Supports on-prem, public, private cloud deployment, follows CI/CD pipeline.

- Compliant to latest 3GPP standards.

- Supports deployment with or without SCP.

- Updates NAPTR record to DNS Server for N2 interface IP Addresses from AMF NF Profile.

- Provides Golden Configuration option with Automated Test Suite (ATS).

- Automated test suite with Golden Configuration.

- Cloud Native Core Console GUI with intuitive interface. Common Visualization and User Experience Framework with other Cloud Native Core components.

- Exposes secure, non-SBI based APIs to retrieve NRF State data, which is useful for debugging.

## Automation, Visibility and Analytics enabled.

- Message-feed to Oracle Communications Network Analytics Data Director for both ingress and Egress messages for Monitoring, Tracing and Analytics.

- Supports Slice centric measurements to indicate the traffic distribution among various S-NSSAIs and NSIs.

- Provide framework for automating feature test cases through ATS.

- Provides Kubernetes probe enhancement in NRF microservices.

## Summary

Network Repository Function completes a 5G core network and helps CSPs to fully exploit the flexibility and efficiency of the new 5G core network architecture by decoupling the service consumers and service providers. Given its role in the 5G core, the NRF interacts with every other element in the core of the HPLMN and supports SBA. Oracle Communications NRF is designed with cutting edge Oracle engineering and is compliant with latest 3GPP release standards, has been deployed in many networks across the globe for tier 1 operators like DISH, BT and Orange. Oracle Communications combines 40+ years of heritage in network experience with cloud innovation to deliver highly secure, robust, and flexible cloud native 4G/5G core network solutions, empowering CSPs to launch the best in breed features and create differentiation in the market by offering world class reliable products.

*"Oracle's capabilities will essentially serve as the control tower of our network core, enabling our customers to consume software on demand and facilitating the advanced core functions required to power a truly automated network."*

**Marc Rouanne**
Chief Network Officer,
DISH Wireless

## Key business benefits

Oracle Communications Network Repository Function is the practical realization of SBA. It is the most fundamental NF required to implement 5G:

- Works as a centralized repository to increases the efficiency, scalability, and flexibility of a 5G core network.

- Helps CSPs to effectively manage their 5G network by providing automated resource control in the core.

- Improves 5G network robustness by eliminating the need for network configuration every time a new NF is added or removed from the network, or every time NF capacity is updated due to elasticity needs.

## Related products

- Oracle Communications Cloud Native Core, Security Edge Protection Proxy (SEPP)
- Oracle Communications Cloud Native Core, Binding Support Function (BSF)
- Oracle Communications Cloud Native Core, Policy Control Function (PCF)
- Oracle Communications Cloud Native Core, Policy, and Charging Rules Function (cnPCRF)
- Oracle Communications Cloud Native Core, Cloud Native Environment CNE)
- Oracle Communications Cloud Native Core, Network Exposure Function (NEF)
- Oracle Communications Cloud Native Core, Signal Communications Proxy (SCP)
- Oracle Communications Cloud Native Core, Network Data Analytics Function (NWDAF)
- Oracle Communications Cloud Native Core, Data Director (DD)