Capgemini engineering

HARNESS THE POWER OF THE CAPGEMINI ENGINEERING NWDAF FRAMEWORK FOR YOUR 5G ECOSYSTEM

The advanced ML-infused 3GPP-compliant cloud-native software framework delivers best-in-class predictive intelligence to automate your 5G intelligent network

Introduction

Capgemini Engineering is developing software frameworks that enable communication service providers (CSPs) and network equipment providers (NEPs) to accelerate the development and launch of their products and solutions. The Capgemini Engineering Network Data Analytics Function (NWDAF) framework is part of our strategy covering the end-to-end 5G open network ecosystem.

NWDAF is a cloud-native software framework fully compliant with the 3GPP TS 29.520 specification. It uses advanced machine learning (ML) techniques to provide real-time and predictive operational intelligence in the 5G core to drive intelligent network automation.

The NWDAF collects data from 5G core network functions (NFs), operations, administration, and management (OAM) systems and user equipment (UE) through standard interfaces defined by 3GPP. NWDAF processes the data, and the analytics output is provided in statistical analytics and ML predictions. These insights are then exposed as different sets of analytics information, enabling other 5G core NFs to make intelligent decisions and perform autonomous actions. (See Figure 1.)

By leveraging NWDAF, the service provider can seamlessly monitor multi-vendor 5G network and proactively take mitigative action if the analytics output predicts a failure or network issue. It will improve the end user's 5G service experience and enhance their stickiness with the service provider.
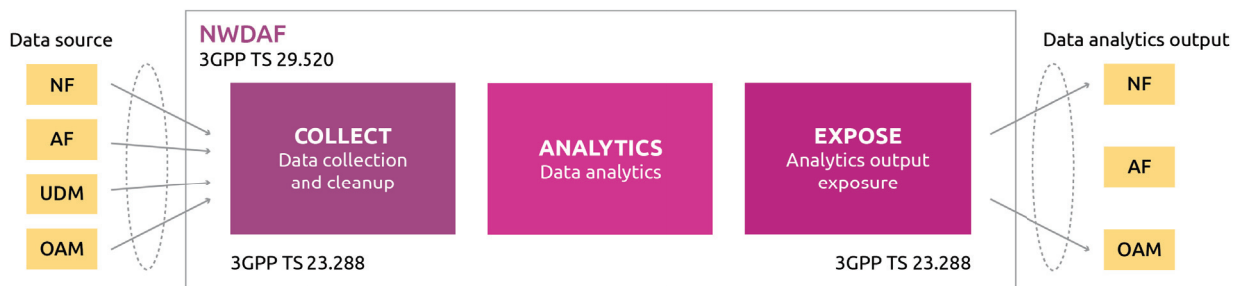
Figure 1: Capgemini Engineering NWDAF high-level architecture
Source: 3GPP

Key benefits

The Capgemini Engineering NWDAF comes with many value differentiators.

- Disaggregated architecture with central and edge NWDAFs, where the central NWDAF aggregates analytics output from multiple edge NWDAFs and sends the aggregated analytics output to the NF consumer

- Cloud-native design compliant with the 3GPP Release 17 specification that provides a clear separation of essential NWDAF functions like data collection, data repository, analytics generation, and analytics exposure through well-defined interfaces, thus ensuring high scalability

- Rich developer experience allows developers and service providers to quickly introduce new use cases through low-code/no-code interface and intuitive workflows

- Deep telemetry through the observability framework to provide additional information to the analytics system, like infrastructure telemetry and cloud application metrics, logs, and traces to be cross-correlated with the 3GPP-defined metrics

- Rich analytics visualizations through the NWDAF network intelligence portal provide contextual use-case information by network type, network slice, user, device, service, and technology

- Sustainability and energy saving by monitoring 5G network power consumption metrics and providing analytics and predictions to optimize power consumption intelligently

Supported analytics information

The Capgemini Engineering NWDAF supports the following analytics information specified in 3GPP TS 23.288.

1. Network performance
   - Slice load level information at the network slice level and network slice instance level
   - NF load information that provides NF load analytics to another NF in the form of statistics and predictions
   - Network performance information in the form of statistics and predictions on the gNB resources and performance in an area of interest
   - User data congestion information in the form of statistics and predictions of the congestion level experienced by a specific user or a specific area

2. Service experience
   - Observed service experience information about computation and prediction for an application, UE group, or network slice
   - Quality of service (QoS) sustainability change stats in a specific area and time in the past and predictions in the future

3. UE behavior analytics
   - UE mobility information in the form of statistics and predictions by collecting UE mobility information from NFs and OAM
   - UE communication information from application-specific data analytics performed on UE communication patterns and user plane traffic
   - Expected UE behavioral parameters in the form of predictions for a UE group or a specific UE
   - UE abnormal behavior information related to a group of UEs or a specific UE showing abnormal behavior

NWDAF architecture

Figure 2 describes the component-level architecture of the Capgemini Engineering NWDAF, which is fully aligned with 3GPP Release 17 specifications.

Here are the six components of the Capgemini Engineering NWDAF:

1. Data collection and coordination function (DCCF) coordinates the collection and distribution of data requested by NF consumers. It prevents data sources from handling multiple subscriptions for the same data and sending multiple notifications containing the same information due to uncoordinated requests from data consumers

2. Analytics logical function (AnLF) performs inference, derives analytics information – specifically, statistics and predictions based on analytics consumer request – and exposes analytics services such as Nnwdaf_AnalyticsSubscription and Nnwdaf_AnalyticsInfo

3. Model training logical function (MTLF) trains ML models, exposes training services, such as providing trained ML models and handles lifecycle management of trained ML models

4. Analytics data repository function (ADRF) offers services that enable consumers to store and retrieve data and analytics

5. Messaging framework adaptor function (MFAF) provides a messaging framework to receive data from the DCCF, process, format, and send data to consumers or notification endpoints

6. Developer experience is enhanced by Capgemini Engineering NWDAF, with a comprehensive set of SDKs that allows developers to quickly implement different ML models and add new analytics dashboards for rapidly introducing new use cases
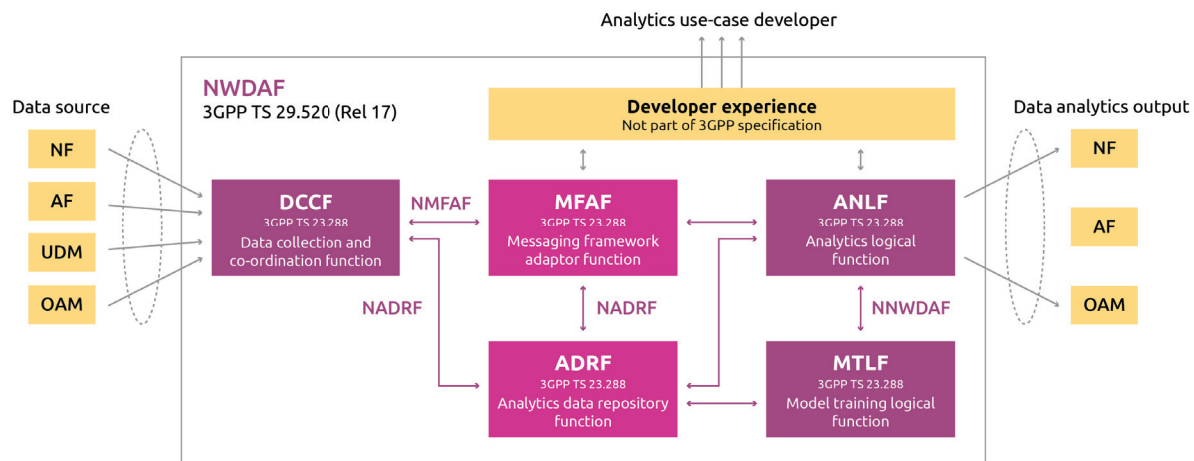

Figure 2: Capgemini Engineering NWDAF component-level architecture
Source: 3GPP

Disaggregated and distributed

The Capgemini Engineering NWDAF supports hierarchical deployment of NWDAFs where central NWDAFs provides enriched information to analytics consumer by aggregating analytics information from distributed NWDAFs (see figure 3 below). This helps in scaling and distributing the load across different NWDAF instances based on criteria like tracking area identity (TAI), analytics ID, network slice subnet instance (NSSI), UE groups, etc.

Geo resilience

The Capgemini Engineering NWDAF distributed deployment architecture inherently supports geo resilience built-in as a default feature. Processing is not performed on a single backend entity but is distributed across multiple parallel clusters. Therefore, a catastrophic failure of a cluster at one geographic location does not deprive the 5G Core (5GC) NFs of receiving NWDAF services.

Cloud-native

The Capgemini Engineering NWDAF is a fully cloud-native network function that can be deployed on the same Kubernetes cluster along with 5GC NFs or can be deployed on a separate Kubernetes cluster. It provides a fault-tolerant, highly scalable cloud-native architecture capable of scaling based on the increase in 5GC network data analytics requirements.

Advanced AI/ML engine

The Capgemini Engineering NWDAF data analytics and AI/ML capabilities are provided by NetAnticipate, Capgemini Engineering's Network AI platform. NetAnticipate is an award-winning AI for the IT operations (AIOps) platform for realizing zero-human touch network operation. It offers more than fifty standard telemetry adapters and various ML and deep learning algorithms that help predict potential network anomalies, build autonomous decisions, and take preventive actions. It also provides an autonomous feedback loop to ensure the network self-learns and improves over time.
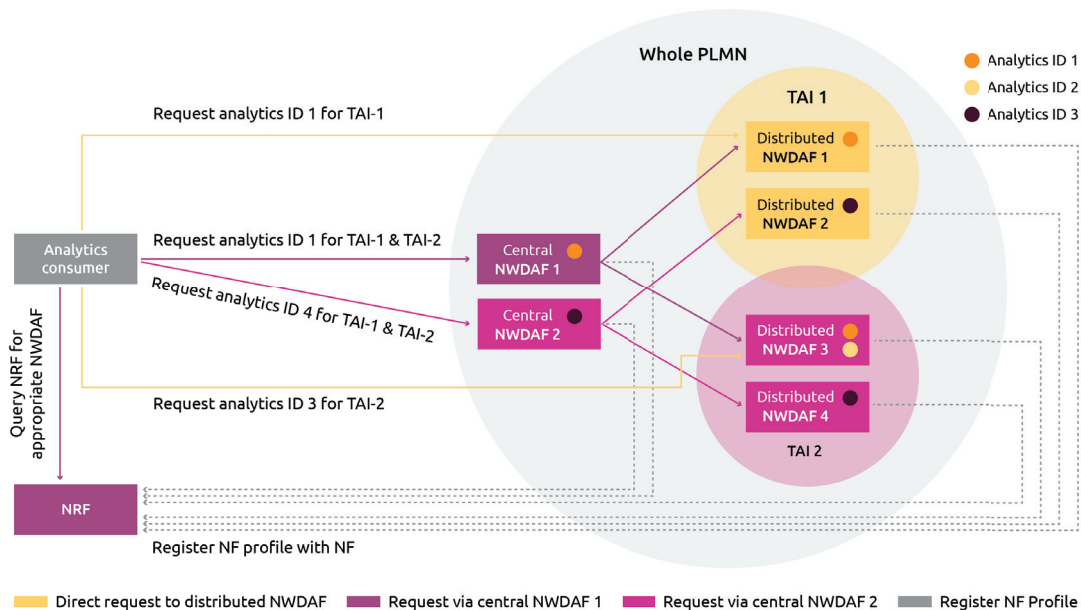

Figure 3: Capgemini Engineering NWDAF distributed and scalable architecture
Source: Capgemini Engineering

Capgemini Engineering NWDAF Features

Table 1 below describes the key features of the Capgemini Engineering NWDAF

	Feature Name	Feature Description
1.	3GPP specification compliance	Fully compliant with 3GPP Release 16, with some advanced features from Release 17 also included
2.	Distributed data analytics architecture	The architecture provides five key components: DCCF, MTLF, MFAF, ADRF, and AnLF
3.	NWDAF aggregation	Supports capabilities to aggregate output analytics provided by other NWDAFs in addition to regular NWDAF behavior
4.	Edge NWDAF	Enables disaggregated architecture and provides ultra-real-time analytics information at the edge of the network
5.	Slicing	Provides slice load information at network slice level or network slice instance level or both, to a consumer NF like PCF or NSSF
6.	OAM integration	Offers ready adaptors for integration with third-party operations, administration, and maintenance systems
7.	Network performance analytics	Supports network performance analytics, including slice load level information, NF load information, network performance information, and user data congestion information
8.	Service experience analytics	Supports service experience analytics, observed service experience information, and QoS sustainability
9.	UE behavior analytics	Supports behavior analytics such as UE mobility information, UE mobility analytics, UE communication information, expected UE behavior, and UE abnormal behavior information
10.	Data lake support for long-term data storage	Provides support for different data lake platforms including big data: S3, Hadoop, HDFS; Timeseries: TimescaleDB, InfluxDB; and Relational DB: Oracle, MySql, PostgressSQL, Redis, No SQL DB, and MongoDB
11.	Streaming data support	Provides streaming ETL support based on Spark, NiFi, and Telegraf
12.	Messaging support	Supports Kafka as part of the messaging platform
13.	Implementation language	Use Golang as the programming language for the development of the Capgemini Engineering NWDAF, which provides faster execution and scalability for large software systems

Table 1: Capgemini Engineering NWDAF feature list
Source: Capgemini Engineering

Why Capgemini Engineering NWDAF?

Capgemini Engineering offers a rich set of software frameworks and product engineering services across different communication technologies, including RAN, transport, core networks, and edge computing domains. Our software frameworks enable our clients to leverage standard software and components to accelerate the development of connected solutions and reduce development time by 30% to 60%.

The Capgemini Engineering NWDAF framework is part of this offering. It serves as a cloud-native software framework for enabling intelligent automation and simplifying the operation of 5G networks.

In addition to being fully compliant with 3GPP, Capgemini Engineering NWDAF has several other vital differentiators such as a disaggregated architecture, rich developer experience, support for deep telemetry through the observability framework, and rich analytics visualizations.

The Capgemini Engineering NetAnticipate framework further enhances the capability of NWDAF by infusing industry-leading ML capabilities that analyze a substantial number of hidden and hierarchical influencers to predict potential network anomalies and build autonomous decisions. An autonomous feedback loop ensures the network self-learns to improve the inferences it makes over time.

Along with other Capgemini Engineering network functions, the NWDAF enables sustainable 5G ecosystems with intelligent power optimization and energy-saving techniques. Thanks to its deep telemetry capability, it monitors 5G network power consumption metrics and provides analytics and predictions for service assurance to optimize the placement of virtual and container network functions. The Capgemini Engineering NWDAF also tracks and predicts the UE location to optimize the paging of the device while in sleep mode, which saves energy on the RAN, allows a more effective sleep mode, and conserves battery life on the device.

About Capgemini Engineering

Capgemini Engineering combines, under one brand, a unique set of strengths from across the Capgemini Group:
the world leading engineering and R&D services of Altran – acquired by Capgemini in 2020 – and Capgemini's digital
manufacturing expertise. With broad industry knowledge and cutting-edge technologies in digital and software,
Capgemini Engineering supports the convergence of the physical and digital worlds. Combined with the capabilities of
the rest of the Group, it helps clients to accelerate their journey towards Intelligent Industry. Capgemini Engineering
has more than 52,000 engineer and scientist team members in over 30 countries across sectors including aeronautics,
automotive, railways, communications, energy, life sciences, semiconductors, software & internet, space & defense,
and consumer products.

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