SANDVINE

5G NF Load Analysis

Enriched NF load data for proactive user QoE protection

5G NF LOAD ANALYSIS DELIVERS:

- 3GPP-compliant analytics service delivered in the form of statistics or prediction enabling multiple use cases
- Real-time operational intelligence for consuming NFs, application functions (AFs), and OAM
- Single source of truth in a multi-vendor environment
- Use cases in central and edge locations
- ANI-enriched or Application-aware output for UPF load
- Support for single or multiple slices and regions
- Intuitive dashboard to understand the trends and validate ROI

MARKET OVERVIEW

The era of 4G was largely defined by its capacity to deliver high-speed internet, which supported the proliferation of consumer applications running on mobile and fixed wireless access networks.

Although it was able to deliver high-bandwidth applications, such as video streaming, 4G networks were over-engineered and therefore incredibly costly to manage and increase capacity to match demand.

However, wireless connectivity has significantly evolved with 5G, going far beyond what was possible in 4G, by promising to support thousands of new applications and use cases in both consumer and industrial segments.

Another key differentiator for 5G compared to its predecessor is its cloud-based architecture, which allows for better scalability and elasticity as required. It enables operators to spin up new network functions (NFs) to better meet demand without the same CAPEX.

The symbiosis between 5G and cloud provides a lot to benefit, including fulfilling the 5G performance and market transformation promise, but it has also increased network complexity. Additionally, the 5G core is designed to provide diversified services with different KPIs, support multiple 3GPP/non-3GPP access technologies, and co-ordinate different sites of varying capacity.

To better manage this complexity and deliver complicated services with varying KPI requirements, operators need to rely on more integrated and sophisticated methods than previously used in 4G to understand network functions health and capacity.

Unlike in 4G, where operational intelligence was an overlay, 5G built in analytics from the outset by making it part of the call flow. Aside from being an inherent part of the 5G solution, this hardwired intelligence also unlocks the opportunity to leverage automation.

Operators can employ automation for selecting, configuring, and managing lifecycle-related actions based on NFs' load-level performance data that is then augmented with predictive analytics.

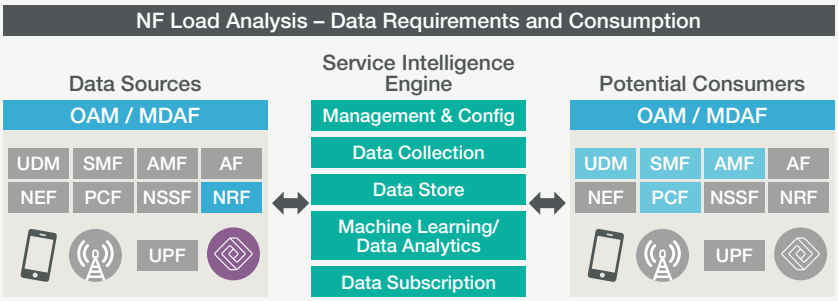
Predicting a network function overload or outage in advance enables operators to adopt suitable pre-emptive actions (e.g., avoid selecting a heavily loaded node for latency sensitive/ resource demanding service or reconfiguration of NF resources) and therefore ensure smooth network operation and better quality of experience (QoE) for 5G customers.

SOLUTION OVERVIEW

Sandvine's 5G NF Load Analysis provides real-time operational intelligence – in the form of statistics and predictions – for different analytics consumers (Figure 1) in the 5G core, including NFs and operations, administration, and maintenance (OAM) elements. To deliver this use case to its consumers, it collects load related KPIs from 5G core as specified by 3GPP.

Figure 1

Data sources and data consumers for NF Load Analysis in 5G networks



Sandvine's Service Intelligence Engine, an enriched NWDAF, is the critical product supporting this solution and advancing the standard analytics capabilities within 5G networks. For user plane-based NFs, such as the UPF today, Sandvine's Service Intelligence Engine augments load level KPIs available from the 5G core with real-time user plane KPIs, which provides a more relevant view of actual QoE **(Table 1)**.

Table 1: Comparison between standard NWDAF versus Sandvine's Intelligence Engine for 5G NF Load Analysis

Standard NWDAF	Enriched Service Intelligence Engine
• Only infrastructure load is measured • NWDAF's knowledge of UPF load ensures highly loaded UPFs are less likely to be selected by the SMFs for load balancing purposes • The UPF load includes only CPU/ memory usage, which is architecture dependent • No user plane quality KPs, which is a significant part of the UPF load	• Combines UPF infrastructure load with timestamped throughput, RTT, topology, and application-aware user plane KPIs to produce more relevant representations to UPF load • 5GS SMF will pick a UPF that is more lightly utilized not only in CPU/memory, but also in the user plane traffic providing best user QoE possible • Improved user QoE • Lower TCO as UPFs are optimally utilized

As part of this use case, additional value is provided by enabling many 3GPP use cases:

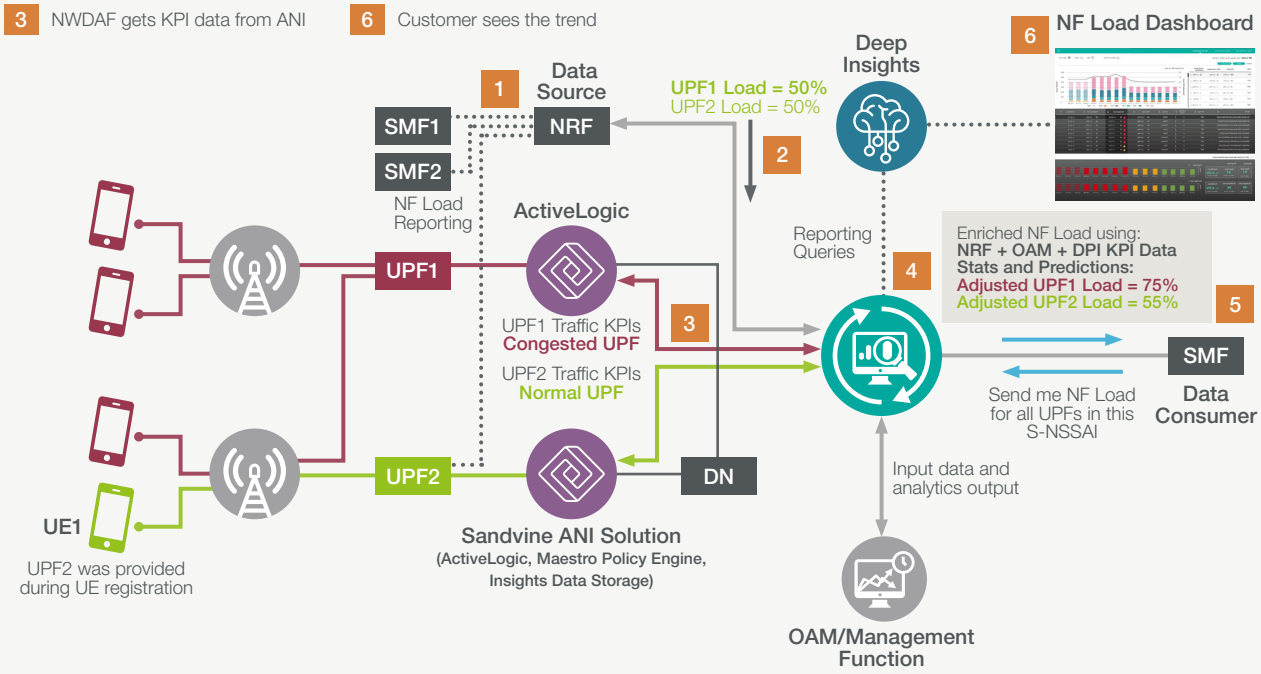
- NF Selection – Selecting of one NF by another NF consumer based on load
- NF Load Balancing – Balancing or re-balancing NFs per network slice or service type to achieve better QoE
- Enriched UPF Selection – Session management function (SMF) can select UPFs for individual protocol data unit (PDU) sessions based on multiple control plane and user plane factors

In 3GPP-defined CUPS architecture, UPF (5G-evolved data plane) plays a critical role in delivering high-speed and low-latency services. However, the standard UPF load information available from the network register function (NRF), including CPU, memory, and disk, doesn't take actual network conditions into consideration when calculating NF load analytics service. Whereas Sandvine's enriched NWDAF expands on this basic information by incorporating "Scored" user plane data, like bandwidth, latency, packet loss, etc., into the process **(Figure 2)**.

Figure 2

Enriched 5G NF Load Analysis for UPF Selection

1 NF load collection
2 NWDAF gets load data from NRF
3 NWDAF gets KPI data from ANI
4 NWDAF calculates enriched NF load
5 SMF gets the best outcome for UPF selection
6 Customer sees the trend



With this additional information, the QoE of the user plane traffic is known, verified, and can then be managed. QoE data provides a more user-centric view versus taking a standard network-only view on how traffic and more importantly services and applications are performing. It allows analytics consumers the ability to react in real-time adjusting to the requirements imposed by the service through optimizing the network resources hence avoiding service QoE issues.

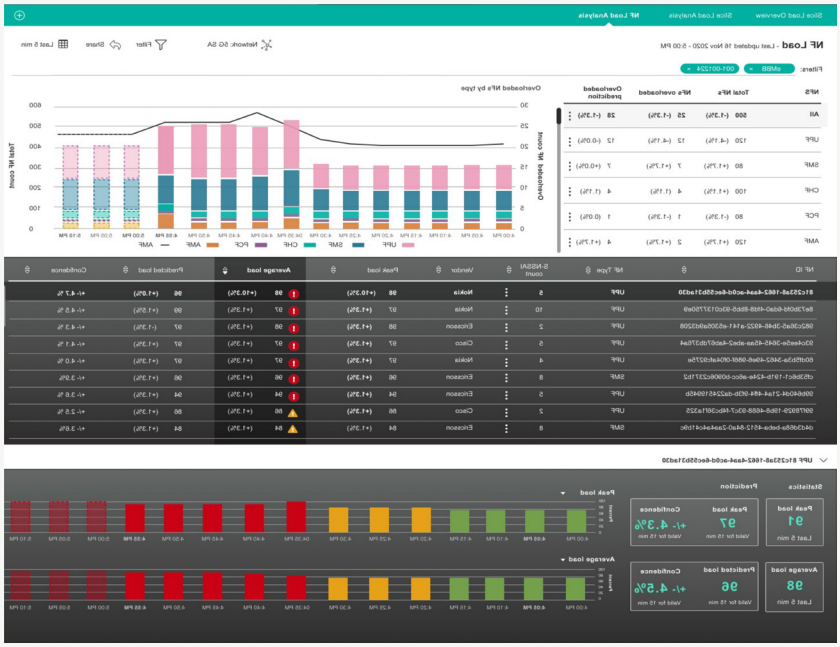
Typically, 5G analytics services like NF Load Analysis are designed primarily for machine-to-machine consumption. However, with Sandvine's ANI Portal, as one of the consumers of analytics services, visualizes this important and actionable intelligence for operations teams to leverage for short to mid-term network planning **(Figure 3 on following page)**.

Some of the key data points include:

- The performance of various NF types and individual NFs by each NF vendor
- Top overloaded NFs and predictions
- Trend for the overloaded NFs including predictions
- Performance of all network NFs in each region (locality) or all regions (localities), if available
- NF KPIs:
  - Serving slice
  - Vendor
  - Peak load (and change from the last period)
  - Average load (and change from the last period)
  - Load predictions (and confidence of the predictions)
  - Load trend
- Usage stats for UPFs
- User plane KPIs associated with the UPF only – if full Sandvine solution is deployed

Figure 3

5G NF Load Analysis – ANI Portal



5G NF Load Analysis empowers operators to enhance their network automation and service orchestration driven by real-time and machine learning-based analytics. It gives an accessible, user-centric view, supporting operators in their continued NOC to SOC transformation.

ABOUT SANDVINE

Sandvine's cloud-based Application and Network Intelligence portfolio helps customers deliver high quality, optimized experiences to consumers and enterprises. Customers use our solutions to analyze, optimize, and monetize application experiences using contextual machine learning-based insights and real-time actions. Market-leading classification of more than 95% of traffic across mobile and fixed networks by user, application, device, and location creates uniquely rich, real-time data that significantly enhances interactions between users and applications and drives revenues. For more information visit **http://www.sandvine.com** or follow Sandvine on Twitter **@Sandvine**.

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