SANDVINE

Unleash the Next Generation of 5G Cloud Services

5G SERVICE INTELLIGENCE ENGINE (NWDAF)

Sandvine's enriched NWDAF implementation unlocks a number of valuable business benefits for 5G service providers, including:

- Allowing service providers to introduce a set of net new 5G-based services
- Assuring QoE and SLAs for 5G services by proactively adapting to network conditions
- Preventing performance issues by predicting network deterioration before it happens and taking corrective action
- Maximizing return on network capacity investments
- Preventing over-engineering by continuously tuning the network and balancing network slice loads

Sandvine's Service Innovation and Intelligence portfolio helps communications service providers thrive in the 5G and cloud era

5G CHANGES THE GAME FOR COMMUNICATIONS SERVICE PROVIDERS

Mobile services have come a long way over the years and have changed the way the world is communicating. 5G technology is about to revolutionize the way consumer mobile services are offered and will unlock many new enterprise-based use cases that were not possible in the past. Think cloud gaming from any mobile device, virtual reality-assisted online shopping, remote surgical procedures, drone delivery systems, augmented reality to assist precision drilling, and you start to get the picture.

5G Technology will Enable New Uses Cases

5G technology is positioned to disrupt the mobile industry and all of the players involved. It represents a revolutionary technological change, or metaphorically speaking, an inflection point in the industry. Its performance characteristics allow for a set of net new use cases that were not thought possible in the past. Specifically, the following categories are defined by the International Telecommunications Union (ITU):

- Enhanced Mobile Broadband (eMBB), which offers significant performance and capacity enhancements
- Ultra-Reliable Low Latency Connectivity (URLLC), which supports strict requirements on latency and reliability
- Massive Internet of Things (mIoT), which provides massive connectivity to large numbers of devices that have intermittent traffic transmission characteristics

Figure 1 (on the following page) lists the various use cases that 5G enables, categorized across eMBB, mIoT, and URLLC. 5G will influence and drive the next generation of consumer services from the delivery of gaming, video, and social networking to new emerging applications from wearables, virtual reality, and augmented reality. An area that will be supercharged by 5G is Fixed Wireless Access (FWA) to the home or office, replacing more costly and often slower xDSL or xPON technologies.

However, the most potential may be within the enterprise segment where industrial automation, smart cities, remote surgery, and vehicle-to-vehicle automation are becoming realities with 5G.

Figure 1

Use cases enabled by 5G

eMBB	Virtual Reality/Augmented Reality				Virtual Reality/ Augmented Reality	Mobile Cloud Computing
	Video Calling/ Virtual Meetings	Fixed Wireless		UHD Video		
mIoT	Wearables	Social Networking	Smart Homes/Smart Cities			
			Healthcare Monitoring	Vehicle to Infrastructure		Industrial Automation
URLLC	Public Safety	Gaming	Remote Surgery	Vehicle to Pedestrian	Vehicle to Vehicle	

One of the fundamental building blocks of 5G is 'network slicing' which represents a standardized way to manage and assure the performance of applications that support these use cases. Network slicing is an architecture that virtualizes multiple independent logical networks on the same physical network infrastructure. Each network slice represents an isolated end-to-end network tailored to fulfill its own unique service requirements based on each application's requirements or service level agreement (SLA).

5G networks will use slices to deliver applications with similar performance characteristics, with the largest categories being eMBB, mIoT, and URLLC. However, the expectation is that slices will also be used in a more granular manner by industry vertical (e.g. public safety or smart factory slice) and by application (e.g. cloud gaming slice).

CHALLENGES TO OVERCOME

As communications service providers (CSPs) launch 5G networks, they will need to address several challenges to generate profitable 5G revenue growth, while inserting themselves into the digital economy value chain. These challenges include:

- Containing costs while rolling out 5G
- Meeting higher expectations for service and network experiences
- The darkening of the internet
- Monetizing 5G networks
- Increasing network and business model complexity

One common denominator that unifies the approach needed to overcome these challenges is the ability to extract network and service intelligence from real-time network data and use that intelligence to deliver innovative services.

This requires access to the best network data combined with advanced automation and machine learning-based analytics techniques. Sandvine's Service Innovation and Intelligence portfolio helps CSPs derive the actionable and contextual insights required to assure and personalize services, while optimizing network performance.

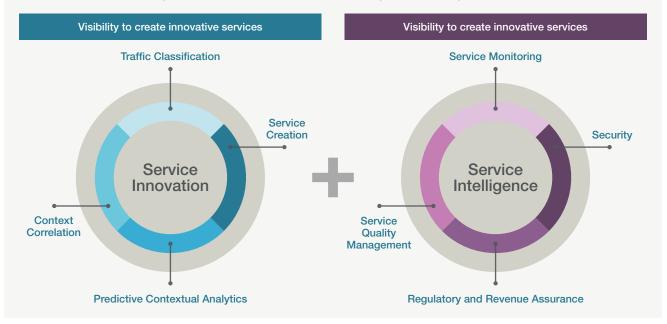## THRIVING IN THE 5G AND CLOUD ERA

Sandvine's Service Innovation and Intelligence portfolio is helping customers succeed in the new 5G and cloud era. The company defines Service Innovation as an automated, intelligence-driven process of creating, delivering, and evolving services and bundles. It uses contextual and predictive insights about user behaviors and service performance, as well as real-time policy actions, to deliver services that are tailored to the specific needs of consumers and enterprises. This opens the door for the monetization of 'smart' service bundles and delivering customized network slices-as-a-service.

Service Intelligence is the application of machine learning analytics and closed-loop automation to manage service quality of experience (QoE) and meet stringent 5G SLAs for speed, latency, and reliability. It is used to continuously optimize service and network performance, as well as to identify security and revenue leakage issues associated with these services **(Figure 2)**.

Figure 2

Service Innovation and Intelligence is critical to 5G success and delivering exceptional digital experiences

Visibility to create innovative services

Traffic Classification
Service Creation
Context Correlation
Predictive Contextual Analytics

Service Innovation

Visibility to create innovative services

Service Monitoring
Security
Service Quality Management
Regulatory and Revenue Assurance

Service Intelligence

Sandvine's Service Innovation and Intelligence portfolio includes Sandvine's ActiveLogic traffic classification platform, 5G-enabled Maestro Policy Engine, Active Network Intelligence Portal with enhanced 5G automation use cases, as well as a new 5G Service Intelligence Engine, an enriched 3GPP-compliant and cloud native Network Data Analytics Function (NWDAF). The NWDAF brings the automation and machine learning required to manage network slice complexity, improve efficiency, and meet stringent service level agreements **(see Figure 7)**.

These solutions allow CSPs to create, deliver, and evolve:

- Cloud and edge-based network slices-as-a-service and IoT services to enterprises for advanced smart industry, smart city, and health and public safety services. This includes service implementation and assurance, SLA management, and security

- Personalized and immersive experiences to consumers based on their behaviors, preferences, usage, and anticipated future needs. This includes per-user and per-application QoE and intent-based quality management

5G, Cloud, and Edge-Ready Service Innovation and Intelligence Capabilities

Sandvine's 5G portfolio addresses the three most important pillars of customer success – service innovation, the transition from 4G to 5G, and automation. **Figure 3** summarizes these essential areas and the top benefits that Sandvine is bringing to CSPs.

Figure 3

Three pillars of 5G success: innovate, transition, automate

5G Service Innovation

- Personalize services based on what users really want from their network
- Unlock new 5G services using machine learning-based application understanding
- Unleash the full power of the 5G network by improving the quality of experience for applications and services on the network

5G Transition

- Optimize 4G to 5G rollout
- Understand quality of experience and ensure service continuity
- Key application metrics to understand 5G penetration – subscriber, devices, and service quality of experience
- Improve capacity planning based on application needs and network subscriber experience

5G Automation

- Enriched Network Data Analytics Function (NWDAF) with contextual insights for slice analysis, performance management, and predicting and detecting network behaviors
- Optimize 5G network slice service with predictive network intelligence
- Dynamically self-optimize, matching current network resources with changing application and user quality of experience needs

DRIVING SERVICE INNOVATION

To enable Service Innovation in the 5G and cloud era, CSPs need deep and contextual Service Intelligence and programmable control to:

- Visualize the network to understand exactly what is being delivered using Sandvine's ActiveLogic data plane element and ANI Traffic Classification Engine
- Contextualize the data using enriched control plane information provided by Sandvine's Maestro Policy Engine, the control plane element
- Apply advanced analytics to derive insights around service usage, plan usage, and user behaviors
- Personalize services tailored to the consumer's or enterprise's specific needs or usage patterns, opening the door for the monetization of service bundles or packages

Figure 4 summarizes these capabilities in the context of a set of raw, multiplexed, heterogeneous packets that enter Sandvine's data plane function as unclassified, unmeasured, non-optimized, and non-personalized. As the traffic progresses through this function it is first classified to add visibility, then subscriber, service, device, and location data are added to provide context, advanced analytics are then applied to derive insights, and finally policies are created to implement personalized plans and/or services that can open the door for monetization.

Figure 4

Driving service innovation: visualize, contextualize, analyze, and personalize

Visualize	Contextualize	Analyze	Personalize
Leverage Machine Learning to classify and visualize all data	Contextualize the data by adding enrichment based on control plane information	Implement advanced analytics to derive service insights	Use sophisticated policy information to enable personalized services/ plans

Bulk, Unclassified, Unmeasured, and Non-Optimized Traffic

Sandvine's Service Innovation

Assured, Optimized, Secure, and Compliant Service Traffic

Sandvine conveniently packages these capabilities in a set of purpose-built use cases across the solution areas of analytics, network optimization, revenue assurance, and revenue generation, making it easy for CSPs to deploy and immediately start adding value to their business.

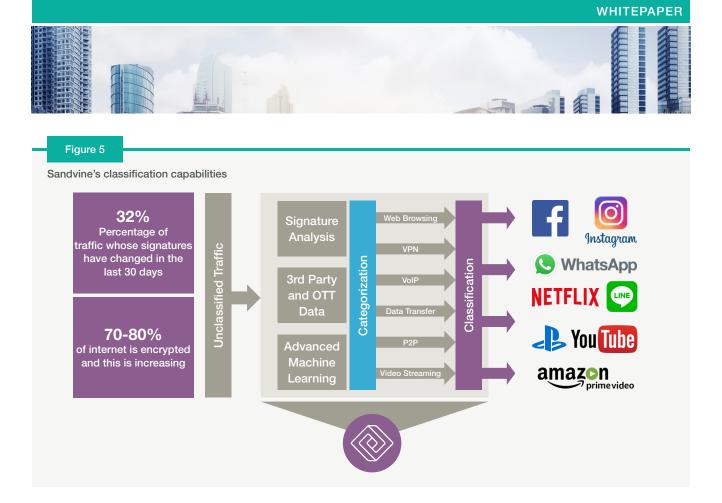**Need for Visibility and Contextual Awareness**

The ability to accurately identify and classify applications is pivotal to service innovation. Inaccurate classification or the inability to classify certain flows greatly compromises service delivery, creates network inefficiencies, and adversely impacts service experiences.

To make this problem even worse, classification is becoming more difficult as 70-80% of all internet traffic is encrypted. In addition, known traffic signatures are constantly changing, with over 30% of signatures changing every 30 days.
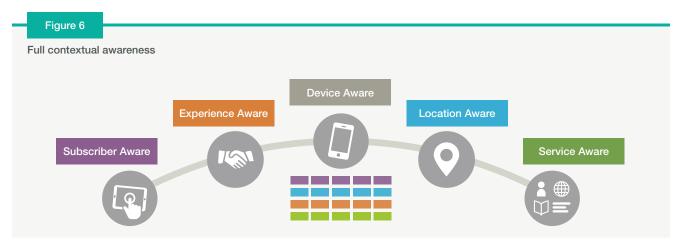
Sandvine's classification technology is specifically designed to overcome these challenges. Some of the methods the company uses to help customers classify applications include:

- Maintaining a growing signature database of 5000+ signatures
- Validating and updating hundreds of signatures each week
- Fostering direct relationships with OTT players like Facebook, YouTube, Google, Amazon to understand their protocols and enable classification
- Downloading weekly signature updates to all customers to ensure that they have the best and most up to date signatures for classification
- Leveraging advanced machine learning to classify the most difficult and obscure applications

Collectively, these techniques allow Sandvine to classify over 95% of traffic across the network as shown in **Figure 5** (on the following page).

Figure 5

Sandvine's classification capabilities

To bring further richness and value to the classified traffic, full contextual awareness centered on subscribers, devices, services, location, and experiences is added as shown in **Figure 6**. This data further enriches the service intelligence available to drive service innovation and improved network performance.

Figure 6

Full contextual awareness

TRANSITIONING TO 5G

CSPs need service intelligence to optimize the transition to 5G. This intelligence will allow them to plan and execute their migration with limited disruption, while maintaining service continuity. Specifically, some of the areas that can be addressed by Sandvine's Service Innovation and Intelligence portfolio are:

• Visibility and contextual awareness across 5G transitions

• 5G device performance compared with 4G

• Subscriber experience in 4G and 5G networks

• 4G/5G NSA/5G SA network optimization

• 4G/5G NSA/5G SA service continuity and experience assurance

• Intelligent capacity planning across the radio, backhaul, and core

• FWA deployment penetration and performance analysis
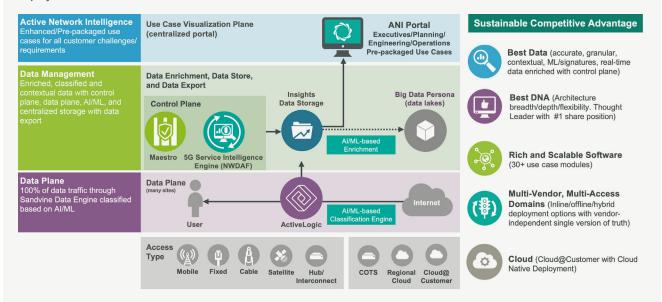
• Video and gaming performance and optimization

By packaging these capabilities into several 'out of the box' use cases, CSPs can ease the migration to 5G and design services based on 4G versus 5G adoption, location requirements, and other parameters.

Sandvine's unique architecture is agnostic to access type and packet core vendor and can be easily deployed in multiple core, cloud, and edge models. **Figure 7** provides an abstracted view of how Sandvine can flexibly fit into any network or cloud environment.

Sandvine's Service Innovation and Intelligence portfolio architecture: any access, any packet core, any vendor, and any deployment model

Cloud and Edge Ready

Sandvine is committed to meeting the demands of emerging 5G and cloud services, and has designed the 5G Service Innovation and Intelligence portfolio with next generation cloud native principles, implementing software on Cloud Native Network Functions (CNFs). Cloud native design offers tremendous scale and performance benefits while accelerating the creation and delivery of new services.

In addition to support for CNFs, Sandvine offers private cloud support for virtual network functions (VNFs) in Red Hat OpenStack and VMware environments across all key architectural components.

The portfolio is designed to support deployment in a distributed public cloud-based architecture, providing the required visibility both at the edge and in the core at a more aggregated location. Importantly, Sandvine has proven integration with leading public cloud vendors.

In summary, Sandvine recognizes the need to support a varied multi-cloud environment, spanning public, private, or hybrid cloud environments within both Virtual Machine (VM) and containerized clouds.

AUTOMATING THE 5G NETWORK

The complexity of mobile networks is increasing exponentially. Quality of experience expectations are becoming measurable and strict. For emerging 5G-based mission critical services this will be the standard.

This is happening during a time when operational scale and capacity are growing linearly and operating budgets are flat. The status quo is no longer enough; something more is needed to realize the many promises of 5G—and that something is predictive network and service intelligence enabled by automation and machine learning. With automation, CSPs will be able to understand and improve their networks and services by:

- Improving contextual visibility across all applications
- Measuring and predicting service performance at scale
- Proactively assuring QoE for each application
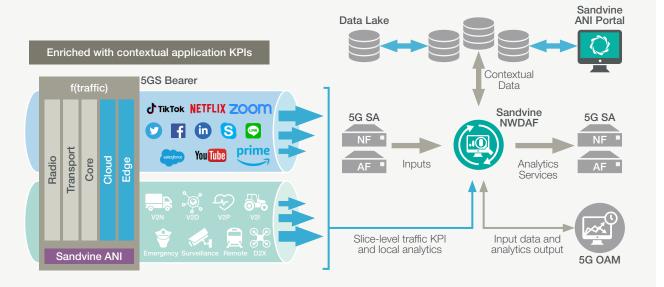- Constantly tuning and optimizing their network to maximize return on investment (ROI)

To achieve this level of automation, the 3GPP has defined a Network Data Analytics Function (NWDAF) that resides as a network function in the 5G stand alone service based architecture. The fundamental capability of the NWDAF is to analyze and process data and analytics from other Network Functions (NFs) or sources to feed its closed-loop automation and machine learning to deliver the needed predictive analytics.

Sandvine's Enriched 5G Service Intelligence Engine (NWDAF)

As an active contributor to the 3GPP's NWDAF standards development, Sandvine has not only built the 5G Service Intelligence Engine to meet the standard, but has also enriched it with advanced traffic classification capabilities and granular, contextual, and precise Key Performance Indicators (KPIs) that can be used to revolutionize the way CSPs see and manage their networks. **Figure 8** shows how Sandvine's 5G Service Intelligence Engine integrates into the 3GPP's architecture.

Figure 8

Sandvine's 5G Service Intelligence Engine (NWDAF)

Enriched with contextual application KPIs

f(traffic) · 5GS Bearer · Radio · Transport · Core · Cloud · Edge · Sandvine ANI

V2N · V2D · V2P · V2I · Emergency · Surveillance · Remote · D2X

Data Lake · Sandvine ANI Portal · Contextual Data

5G SA · NF · AF · Inputs · Sandvine NWDAF · Analytics Services · 5G SA · NF · AF

Slice-level traffic KPI and local analytics · Input data and analytics output · 5G OAM
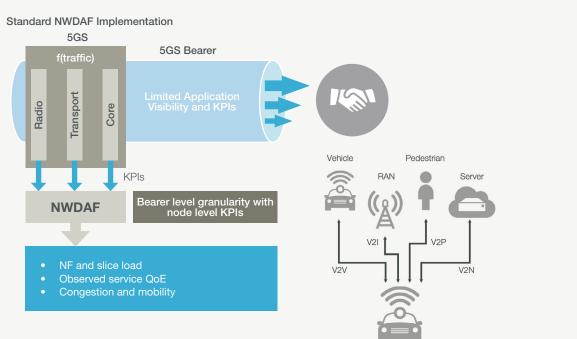

The 5G Service Intelligence Engine leverages analytics directly from Sandvine's ActiveLogic traffic classification platform in the data plane to provide more contextual analytics. The NWDAF will be heavily reliant upon data plane visibility for accurate predictions as most network KPIs will be throughput-driven and will rely on accurate modeling of application traffic characteristics. In this respect, Sandvine's qualifications are unmatched in the industry. This

enrichment makes the 5G Service Intelligence Engine's analytics services more accurate and valuable than the standard implementation as it is more equipped to address the complex requirements of 5G network slices.

Sandvine's 5G Service Intelligence Engine in action

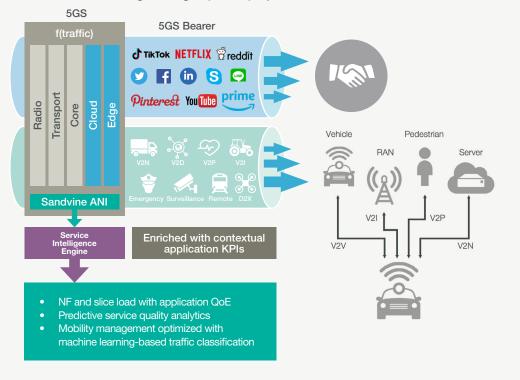Standard NWDAF Implementation

Sandvine 5G Service Intelligence Engine (NWDAF) Implementation

Figure 9 (on the previous page) shows how the ability to provide insights directly from a data plane function with complete visibility to measure and ascertain key KPIs makes the NWDAF significantly more accurate and valuable. This increased level of accuracy and context will assist multiple 5G-based use cases. Figure 10 shows how Sandvine's 5G Service Intelligence Engine adds more context and value to the following example use cases: UPF Network Function Selection, Slice Load Management, Mobility Optimization, and Service Innovation. In this figure, a brief description of the use case is provided along with how additional real-time data from Sandvine's ActiveLogic data plane function enhances outcomes.

Figure 10

5G use cases enabled by Sandvine's 5G Service Intelligence Engine (NWDAF)

UPF Network Function Selection	Slice Load Management	Mobility Optimization	Service Innovation
Select the best user plane node that can deliver the promised SLA	Slice selection to meet the desired service experience	Learn UE movement pattern to optimize subscriber mobility and QoE	Monetize new 5G services
Without Sandvine • Selecting UPF not optimal • Subscriber QoE could be compromised • Inefficient utilization of UPF resources	**Without Sandvine** • Applications may be served from an overloaded slice hurting QoE • Slices may leave stranded resources reducing efficiency	**Without Sandvine** • Customer experience decreases during mobility period • Network resources are not used efficiently • More signalling traffic adding cost	**Without Sandvine** • Applications are not precisely identified • Application assurance is compromised • Innaccuracy in personalizing and monetizing services

CONCLUSION

The journey to 5G and cloud is both a challenge and a tremendous opportunity for communications service providers. With the right Service Innovation and Intelligence capabilities, 5G can be an inflection point that allows CSPs to successfully transform their business model from a connectivity provider with flattening revenues, to a leading provider of digital content and services for 5G smart homes, workplaces, and cities.

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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