Spirent

WHITE PAPER

Delivering Agile, High-Performance 5G Private Networks with Continuous Testing

A Joint Telefónica and Spirent White Paper

Spirent | Telefónica

Delivering Agile, High-Performance 5G Private Networks with Continuous Testing

Executive summary

Telefónica, a Spanish multinational telecommunications provider, is preparing to offer private 5G network services to meet the needs of emerging enterprise, public, and IOT use cases. The product provides clients with dedicated 5G connectivity, edge compute and a portfolio of vertical-specific value-added services. These products are complex due to: (1) multiple components and (2) a fast release lifecycle of software. Traditional ways of testing connectivity were not suitable to manage this product. This whitepaper details how Telefónica and Spirent have implemented an automated process to manage the systematic testing, update, and deployment of the product.

Telefónica has invested in Spirent test and assurance expertise and platforms to streamline its deployment and improve the lifecycle management of its private 5G solution by implementing a cloud-native operational model. The implementation uses a combination of Spirent's test, with Telefonica's assurance, and automation solutions based on a cloud stack that introduces massive automation to manage the complexity of integrating the multiple components of the solution.

The Telefónica 5G Automation Platform will manage deployment, configuration and testing of all components and value-added services required to give functionality to the customer. This platform uses different technologies for each stage, like Jenkins, Terraform, Ansible and Robot Framework. Focusing on testing, the Robot framework oversees the launch of customized tests suites with Spirent's 5G core validation platform, Landslide, checking basic requirements and many other KPIs, including compound metrics like success rates of different operations.

Key benefits of Landslide include enhanced automation delivering a 3x faster test and assurance process combined with enhanced flexibility and automation through API and cloud-based workflow. The solution is also helping Telefónica define and test a range of service tiers and SLAs ahead of the launch to initial enterprise customers that is expected during 2022.

INTRODUCTION

Telefónica is a leading global telecommunications service provider. The company offers fixed and mobile connectivity, as well as a wide range of digital services for individual consumers and enterprises. Telefónica has 384 million customers spanning Europe and Latin America.

Private 5G networks are emerging as an innovative solution to address critical wireless communication requirements for use by governments or enterprises in multiple industries, such as utilities, rail, natural resources, airports, shipping ports, and manufacturing. In the last few years, these solutions have grown quickly in flagship enterprise sites, particularly in manufacturing or mining facilities. The solutions used offer extremely high performance and reliability with specific requirements adapted to each client. However, products for these market segments cannot scale to new market segments that are more sensitive to price or complexity. Telefónica is working on a new generation of Private 5G products that will better adapt to address the mid and long tail of the opportunity by reducing the cost structure and providing a simple UX and operating model.

Challenges

Private 5G products have multiple components. A basic approach includes the access network and core component and their respective management systems. More complete approaches, such as the one described in this paper, also include an orchestrator, edge compute, and value-added services deployed on top. This means there is significant complexity involved in managing all the components. Operators such as Telefónica must integrate and operate a diverse stack of software, hardware, and management elements.

5G private networks arrive at a time when the telecommunications industry is undergoing a major transformation. Unlike earlier generations of network upgrades, 5G expands the supplier ecosystem to embrace software-defined network functions that bring with it agility and innovation. This move away from a legacy approach of using just a few vendors offering the full vertical stack, and towards a framework where potentially dozens of vendors may be involved, raises significant challenges. The softwarization of connectivity solutions also implies that the speed of the product release cycle accelerates to multiple releases each month.

One of the most pressing needs is to test and validate that all the infrastructure and functions of the largely software-based architecture can work together as intended with compliance to 3GPP standards. Traditional validation models are not built to manage this complexity. This has prompted Telefónica to take a continuous integration, continuous deployment, and continuous testing (CI/CD/CT) approach to its 5G rollout. This helps simplify operations, moving away from manual lifecycle management and reducing human error, while providing greater flexibility to deliver significant benefits in terms of speed and cost of deployment.

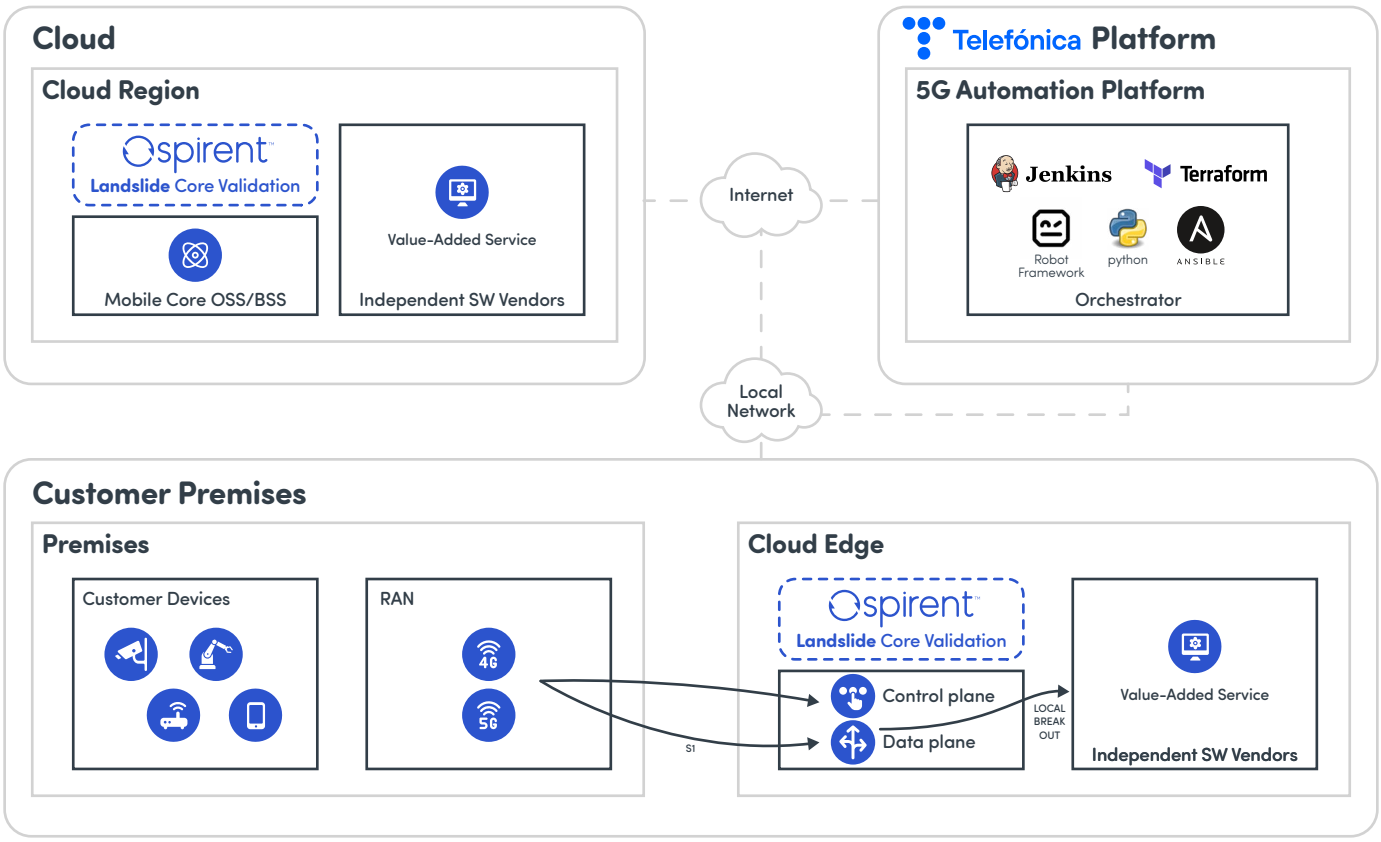
5G Network deployment

For the deployment of its private 5G network, Telefónica is utilising its 5G Automation Platform that is virtualised end-to-end except for the access domain. Telefónica's vision is that this common virtualised infrastructure – built using commodity cloud tools and hardware – will support any service and application, whether an IT-like application [for example, a value-added service (VAS), operations support system (OSS), or online charging system (OCS)] or a network-specific function [virtual network function (VNF), such as a virtualised core function, cloud radio access network (RAN) function, or virtual CPE].

In an increasingly complex environment with multiple and potentially competing vendors, test and assurance platforms are critical.

> Telefónica's core test platforms must be vendor agnostic and able to support any combination of hardware, software, and hyperscaler with a deep understanding of the technical specifications that underpin the 5G standards.

Landslide enables API- level integration to provide seamless automation capabilities to meet the shift to CI/CD/CT goals. Telefónica has built their 5G Automation Platform, which automates not only the 5G network, but also value-added services fully integrated with the network at cloud edge infrastructure. In addition, it leverages a set of cutting-edge DevOps procedures and tools to easily onboard, integrate, and deploy new services on top of the 5G automation platform. This approach has also been followed to deploy and integrate emulated load by Landslide to certify the 5G network itself and the target services. The following diagram provides a high-level overview of the key pieces within Telefonica's 5G Automation Platform.



Telefónica is using Landslide and Telefonica's inhouse 5G Automation Platform to carry out the testing for its new private 5G network in several ways. The first is to verify vendor network function compliance to 3GPP standards. Landslide is also used to verify control plane functionality and to conduct high-load testing for user plane performance validation. All these functions and tests are run on top of cloud and cloud-edge infrastructure. Telefonica assessed key cloud players, namely ones with edge products available in the market, finally selecting AWS Outposts service family as the cloud edge partner with whom to develop their 5G Automation Platform. Spirent's cloud-agnostic approach allowed seamless integration within these cloud products.

Landslide is also instrumental in helping define and test various service-level tiers – e.g., Gold, Silver, Bronze - and validating performance against various quality of service metrics that will form service-level agreements (SLAs) across several use cases focusing on low latency and guaranteed throughput, which are essential for industrial customers.

Technical overview

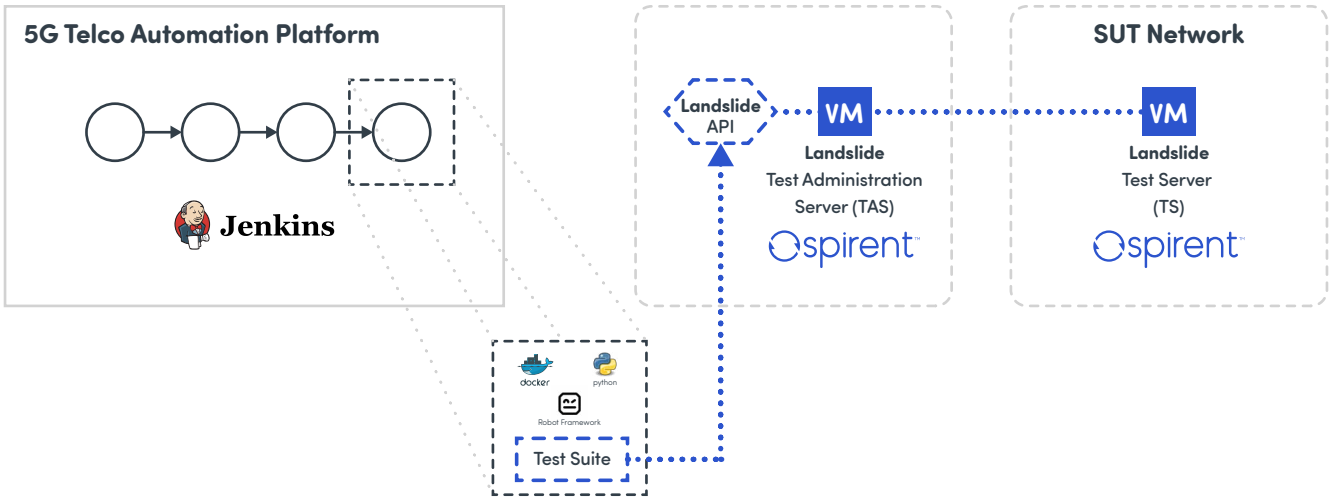
Telefónica must validate and consider different 5G mobile core solutions and implementations to ensure they meet company requirements and are 3GPP compliant. For this purpose, Landslide is a key tool for Telefónica, helping to define the appropriate test suite to assess these requirements, and was used to test different core alternatives for the Private 5G solution.

Telefónica's 5G Automation Platform deployment involves several automation stages including infrastructure deployment at cloud region and cloud edge components, VNFs automatic configuration ranging from centralized resources to cloud-edge mobile core nodes, RAN configuration to register and integrate seamlessly to mobile core, and a final step to assess deployment with automatic test execution, results verification, and publishing. Tests executed within the deployment pipeline are evaluated automatically and results are stored.

Test plan definition is established based on predefined 3GPP scenarios with Landslide focusing on product requirements. After tests have been implemented and validated manually, the test suite is fully automated with the Robot Framework leveraging Landslide APIs, which allows customization according to test case and environment details. Once automated, its execution takes less than an hour.

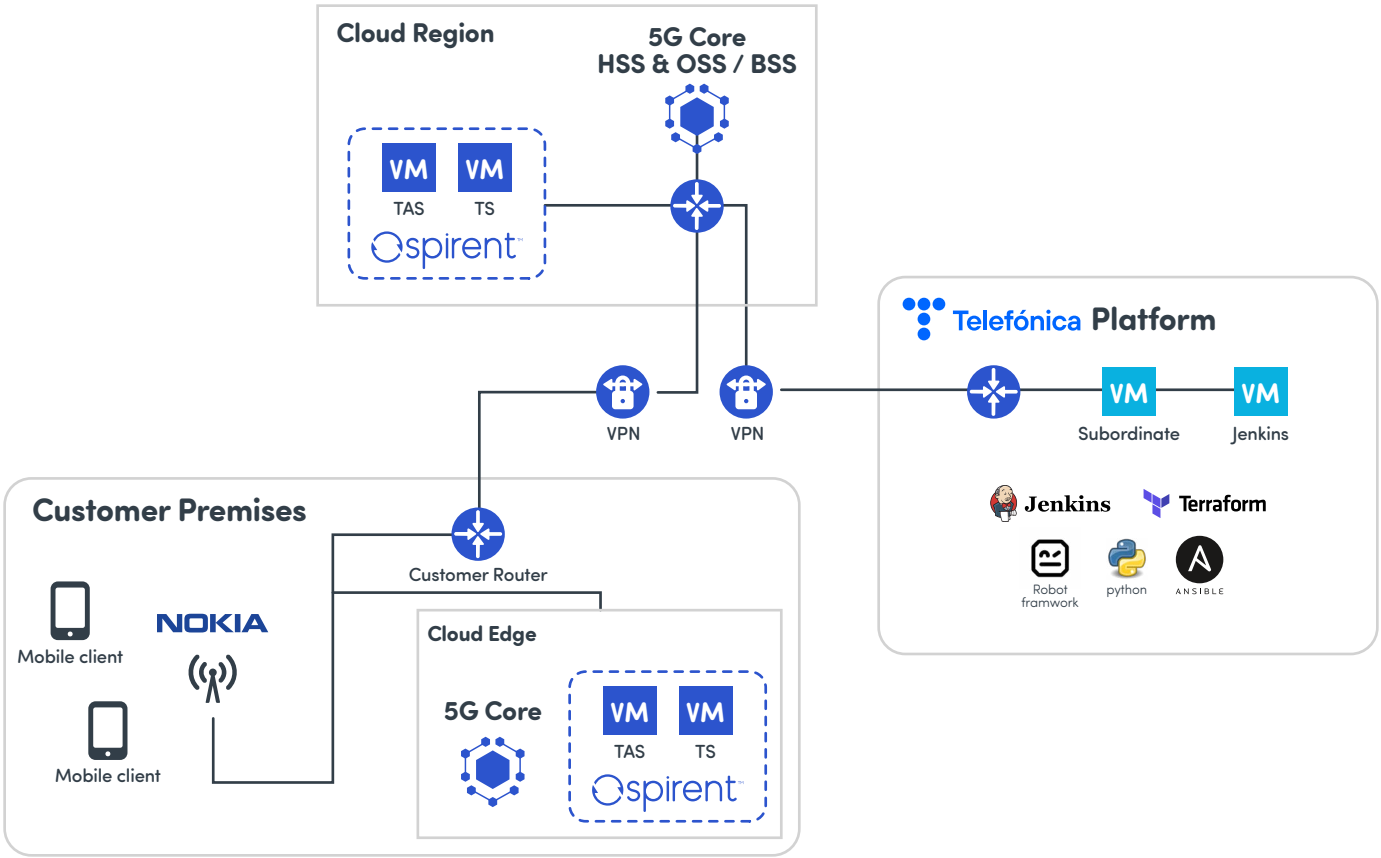
From Telefonica's view, the Landslide API provides a useful way to integrate testing of core solutions for many reasons. The most important is that the API allows them to launch test cases developed under the Landslide Test Administration Server (TAS) and override input parameters, like system under test (SUT) parameters, duration of execution, and other parameters. These provide Telefónica with the flexibility required in a CI/CD environment, since SUT target IP address changes at each redeployment, allowing them to develop complex testing suites under the Robot Framework and adapt a general test to any specific measurement.

Landslide is essential in most of the testing phases Telefónica implements. Testing is split across different groups: core network testing, backhaul validation, end-to-end (E2E) tests using real RAN, VAS integration testing, and automated release testing. Landslide is used in all test cases but E2E RAN tests, where real devices are used.



Below are short descriptions of each Telefónica testing stage and how testing tools are used at each stage:

- **Cloud core network testing:** Landslide Test Server (TS) modules are deployed at the same VPC of the private network in the cloud edge infrastructure, so nothing else but the virtualization platform, affects this validation. This stage allows us to verify that security groups (i.e., network firewalls) at key interfaces are well configured while validating edge, core, and centralized functions at the cloud region are also working seamlessly.
- **Backhaul validation:** Placing Landslide TS modules within the same RAN IP segment allows operations teams to validate the backhaul network path towards the mobile core and discard any other connectivity problem in the middle. This allows certification of the service without including the RAN and puts focus on the following stages ensuring the pieces towards the core network are working as required.
- **Mobile end-to-end testing including RAN:** These tests focus on the radio interface and eNB and gNB integration towards the core. This stage is done with real devices testing end-to-end traffic towards the Internet.
- **Value-added services (VAS) integration testing:** This stage is done with real devices and Landslide to test end-to-end traffic towards industrial applications placed at cloud or edge-cloud infrastructure validating, in this case, local breakout capabilities.
- **Release Testing:** These tests check basic functionality, performance traffic KPIs, and operations' success rate under load. They are mainly executed when new frequent software versions of 5G Core VNFs are released.



Use cases

The case studies below provide an in-depth, detailed examination of particular use cases within a real-world context. The testing scenarios are highlighted across; core network testing, backhaul validation, end-to-end (E2E) using real RAN, VAS integration testing as well as automated release testing. Spirent Landslide is utilised in all the test cases excluding the E2E RAN tests where real devices were used.

USE CASE 1

Mobile core release management: Virtualization and microservices are a reality within mobile network functions today and, hence, software releases are becoming more and more frequent. Careful certification of these new versions is mandatory to yield telco network quality. To do so, it is necessary to validate and test VNFs much more frequently than before, when a release certification might take months. Landslide enables regular certification in an efficient manner thanks to REST APIs exposing full control of predefined test cases. That functionality makes possible an automated test plan that allows extremely quick testing iteration to assess new software releases and speed up certifications.

USE CASE 2

Automated test plan execution: Core network testing to control new releases of all core VNFs, executing automated test plans defined with the Robot Framework.

USE CASE 3

Landslide integration within deployment pipeline: Automated validation is performed within each private network instance deployment pipeline to perform sanity checks, which prove the whole process has been followed correctly. This is achieved by defining a testing stage for each deployment and integrating Landslide as any other private network infrastructure element which is dynamically spun up and removed once the designed tests have been executed and results are correctly evaluated and exported for further analysis.

USE CASE 4

Generating on-demand real data on OSS/BSS platforms: The Telefónica Innovation team developed a full private solution including centralized OSS and BSS platforms to allow both operation and customer teams to analyse and operate individually. These systems read generated mobile data and consume it to feed different dashboards, monitoring tools, and databases. During the development process, the Telefónica Dev team built automated pipelines to generate on-demand real data using Landslide towards different virtual environments, i.e., development, pre-production, and demo, to address different teams' needs and boost parallel development and validation.

Key benefits for Telefónica

Spirent Landside's cloud-native platform replaced an existing solution that used Windows-based test software running on local server infrastructure alongside physical appliances within its lab. This legacy solution offered limited deployment flexibility and an inability to scale performance based on the growing needs of Telefónica's engineering team. The solution also had limited automation and API support, which made it difficult for Telefónica to automate its test and assurance processes in line with its CI/CD goals.

Landslide virtualization enabled Telefónica Innovation to anticipate AWS Outposts certification requirements thanks to remote deployment and operation when such a service was deployed in Brazil. Landslide was deployed without issue at this cloud edge product and brought the ability to test Telefónica's entire private network solution on top of AWS Outposts without having to wait for greater availability. Placing load at different infrastructures and remote locations was just a matter of a slight parameter change thanks to integration with Terraform and Ansible CI/CD tools. The Telefónica Madrid Lab was connected to this environment and remotely deployed Landslide TS modules alongside the mobile core to validate deployment stages. This flexibility enabled the Telefónica Innovation team speed up the product development process.

Spirent Landslide as a core component of Telefónica's platform

Landside is a virtualised, cloud-native platform that connects via VPN into the Telefónica 5G Automation Platform. The engineering team defines a test plan, validates the test plan, and then automates it using Landslide's automation software. Landslide provides a pre-packaged set of tests across compliance, capacity, performance, and security that Telefónica uses to test their private 5G network comprehensively, continuously, and consistently.

Landslide can scale up performance on demand and allows the engineering team to create a catalogue of additional test case suites that can be run automatically depending on certain scenarios. For example, if an element of its infrastructure has been updated with a new version, a series of test suites can be run to validate its adherence to a set of metrics such as 3GPP compliance or specific quality of service (QoS) benchmarks. The team is also using Landslide to build out more complex use case tests that combine multiple suites along with additional variables that are passed to Landslide via the REST API.

This approach has several benefits. Firstly, it aligns perfectly with Telefónica's CI/CD/CT strategy. It also allows different teams to run test and assurance projects simultaneously from multiple remote locations whilst having a consistent set of test cases and suites. Since the test suites are nested in a logical structure, making a major change such as swapping out a vendor solution means that only a few baseline tests need to have minor changes for the testing workflow to carry on as normal with little downtime.

Telefónica estimates that the integration of Spirent Landslide with its 5G Core Automation Platform has led to a 3x improvement in the time it takes to test and validate functionality, performance, and security throughout the lifecycle of its 5G private network stack.

Landslide is also being used to provide deeper insights into its infrastructure layer for ongoing service optimisation and troubleshooting – especially as it starts rolling out live services to its first wave of enterprise clients.

Conclusions

Legacy telecommunications networks have been traditionally monolithic while their operations and development teams have usually been separate knowledge silos. Upcoming 5G networks are adopting IT world transformations demanding a new way of working and changes to cost structures. Telefónica's 5G Core Automation Platform addresses cloud-native and DevSecOps foundations to manage future mobile network requirements and address 5G use cases. From software lifecycle management to agile onboarding and automatic deployment and configuration, Telefonica is focused on providing disruptive operating models targeting, as a first step, 5G private networks. However, its goal is to go beyond this use case and apply such transformation to public networks and next-gen mobile connectivity products. To apply such transformation reliably, testing and certification become essential. Spirent is helping Telefónica get these new products to market quickly while maintaining the expected quality of service levels.

Spirent's vendor and technology agnostic approach, combined with its cloud-centric strategy, makes it a perfect fit for Telefónica and other progressive telecommunication providers keen to deliver on the potential of 5G private networks.

Furthermore, this integration and development approach goes beyond 5G private networks and sets the basis of upcoming mobile connectivity products involving Cloud 5GaaS solutions, private APNs on the public network, or network slicing at the public network. The Telefónica Innovation CI/CD/CT philosophy and Landslide capabilities create a perfect testing collaboration for future Telefónica heterogeneous mobile networks.

About Spirent

Spirent Communications (LSE: SPT) is a global leader with deep expertise and decades of experience in testing, assurance, analytics and security, serving developers, service providers, and enterprise networks. We help bring clarity to increasingly complex technological and business challenges. Spirent's customers have made a promise to their customers to deliver superior performance. Spirent assures that those promises are fulfilled.

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