Enabling the
Hyper-Connected World

Create Transformational Services Quickly & Easily

www.dzsi.com

Table of Contents

Introduction

In the age of Netflix, Google, and Amazon, communication service providers (CSP) need to compete on multiple fronts to ensure continued growth. In this new era the continued evolution and ubiquity of cloud infrastructure, new *as-a-service* (aaS) and over-the-top (OTT) offerings and WiFi are pressuring service provider's revenue stream, threatening to relegate them to *pipe suppliers*.

To compete, service providers need to streamline and improve existing businesses while creating new ventures. They aspire to create an operating model as efficient at delivering cloud-based services as hyperscale companies like Amazon Web Services, Google, and Facebook, but do it with carrier-grade performance and assurance levels that the hyperscalers cannot match. Services such as 5G slice deployment and enterprise broadband services require service providers to rapidly onboard and design new services consisting of multi-vendor, best-of-breed components and have these designs equally reusable on all clouds, network elements, and locations.

Achieving this goal of deploying new carrier-grade services at hyperscale pace requires implementation of techniques, practices, and behaviors borrowed from hyperscale companies, namely the ability to automate all aspects of new service deployment, from onboarding of new suppliers and new network elements to service activations for new and existing subscribers.

Unfortunately, service providers have been hampered by the slow evolution and convergence of standards and open-source strategies which thus far have been unable to deliver on their promise of lowering operating expenses for service delivery. In addition, service providers are confronted with proprietary top-to-bottom silos bundling orchestration, services, and infrastructure that lock in the service to the supplier.

Finally, automation is too often approached on a per use-case basis with little regard for reusability across use cases, leading to high-code, high-cost, one-off custom development that is difficult to maintain and scale. Overcoming these challenges requires an orchestration and automation solution that:

- Is vendor-agnostic and supports all suppliers, their applications, and network elements
- Supports simplicity of service design, integration, and deployment
- Fosters reusability by allowing the same design to be deployed across multiple use cases, infrastructures, and clouds

Orchestration Overview

A fully standards-compliant orchestration system designed specifically for high-speed broadband and mobile wireless services gives operators the tools they need to transform their businesses from being a supplier of simple consumer high-speed connectivity to one that can provide SLA guaranteed, high revenue services targeted to homes, small businesses, and enterprises.

The power of standards-compliant orchestration is that it gives broadband and mobile service providers the ability to deploy carrier-grade networked services rapidly and cost effectively even when the service provider has networking hardware and business software from a multiplicity of vendors.

When built on a standards-compliant model-driven architecture, an orchestration system can be equally capable of deploying access network services, 5G slices, multi-access edge computing (MEC) and internet of things (IoT) applications, and enterprise SDWAN services on all physical network and virtualized infrastructure, from GPON to XGSPON, across Kubernetes-based clouds to private data centers to enterprise uCPE devices.

Additionally, if an orchestration system utilizes a model-driven system, simple form-fill wizards can be used to drive all orchestration tasks, from onboarding to service design for access services and slice / slice subnets, to service deployments. This approach ensures openness, ease of integration over standards-compliant APIs, as well as simplicity due to the emphasis on UI-based, wizard-driven procedures.

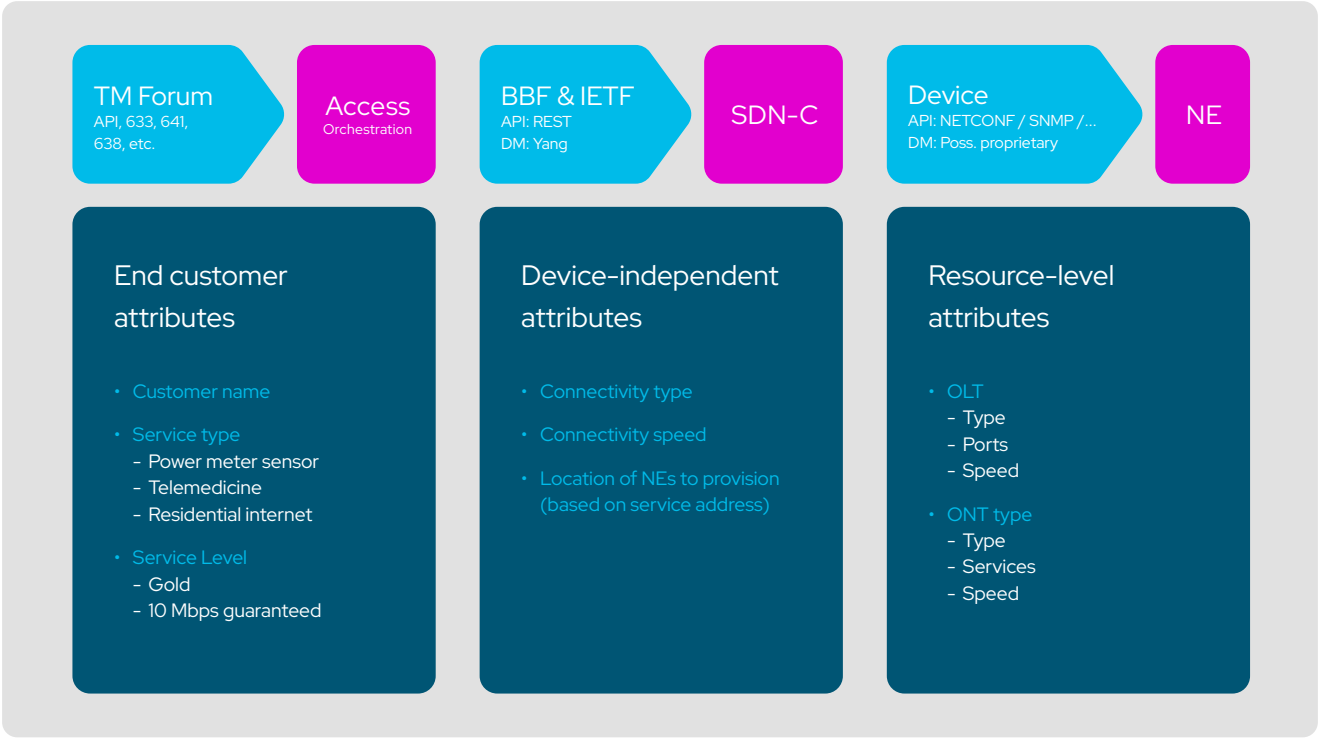
A model-driven system that empowers CSP's in-house DevOps teams to design end-to-end services composed of any network and any application, and that can be deployed over any infrastructure will eliminate vendor silos.

Capabilities

Orchestration can be used to manage all manners of end-to-end services, including fixed access broadband services to 5G end-to-end slices and slice subnets to IoT and edge computing / MEC applications and many more. A multi-domain, intent-driven fulfilment engine enables operators to deploy any multi-domain service over a multi-vendor ecosystem of devices and/or software applications and clouds.

Intent-driven Fulfillment

For GPON Access Service

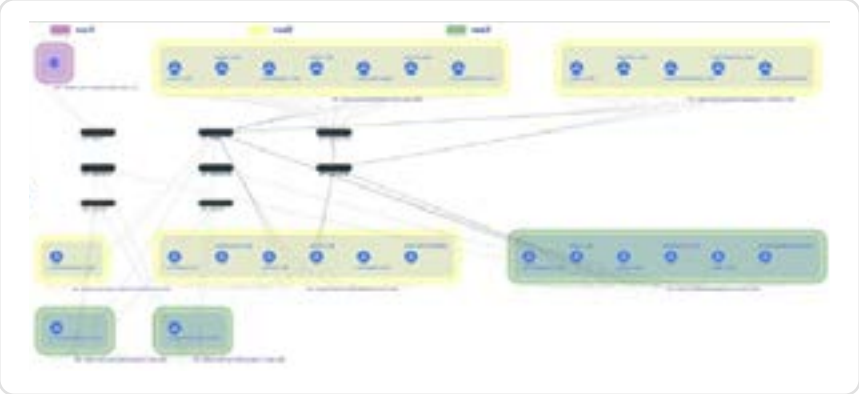


How to get from this

To this

In an automated, quick, repeatable way without replying on proprietary code or third-party customizations.

Customer	BMW
Location	Boston
Use	Telemedicine
Service Level	Gold
Speed	500Mbps



Service providers deliver connectivity and services tailored to a variety of use cases, from consumer uses such as streaming, telework, gaming, AR/VR, and connected cars, as well business and industrial uses such as telemedicine, industrial internet, and internet of things (IoT). To address the disparate requirements brought by these use cases, standards bodies such as Broadband Forum, GSMA, 3GPP, and others have evolved the broadband and mobile network architectures to utilize the best practices of cloud software and invested heavily in standardizing multi-domain service deployment. Together these specifications are aimed at realizing the ultimate vision where a customer can order customized services such as “Gamer Enhanced Internet” or “Mobile Entertainment” and have the service delivered immediately and correctly.

However even as the standards bodies create specifications there is little effort spent on knitting the specifications together to make such services easy to order for the end customer and easy to design for the service provider. End customers wish to order a product that meets their needs, whether for factory automation or for healthcare, and the service provider’s role is to deliver such a product with a promised level of service quality. Clearly, exposing the end customer to details such as YANG device models, 3GPP templates, and NEST templates is not desirable and ineffective towards a successful service rollout. However, service providers also must ensure that they can quickly design new services to retain existing subscribers and attract new ones.

To ensure that service providers can effectively meet this demand and its customers can easily order and quickly receive their desired service, an orchestration system must be:

+ **Intent-based:** It *must* allow the end customer to describe their desired service and not require them to prescriptively detail how to achieve it.
+ **Flow-through:** The delivery *must* be fully automated from operations support systems (OSS) to ensure the service is delivered instantaneously with no human intervention required in the fulfilment process.
+ **Operator self-serve:** The system *must* empower the service provider's own service and DevOps teams to design services that are assured end-to-end services with minimal reliance on custom development and/or professional services.

Intent engines make possible *zero-touch flow-through fulfilment* of customer services by decoupling the requirements of the service from how the service is built.

The requirements of services are expressed in customer-facing terms such as use cases ("Connected Factory", "Vehicle Infotainment"), location (street address, zip code, coverage area), and service plans ("Broadband Internet", "Secure Mobile Enterprise") and systems automatically resolve such attributes into technology and resource specific templates to deliver on the customer's SLA.

Intent engines can operate through a set of operator-designed policies which drive the resource selection process. Fields in standards-compliant templates such as a TM Forum service order or the GSMA NEST template are used to determine the best-fit resources to fulfill a particular service. For example, if the subscriber requests an ultra-high bandwidth link for at-home gaming, the system will select components from the service provider's fixed access assets (i.e. OLT, ONT, etc.) and automatically provision such resources for the subscriber. Similarly, if the subscriber requires a mobile low-latency link for augmented reality use cases, an intent engine can resolve the service into a Ultra-Reliable Low Latency Connection (URLLC) 5G slice.

Intent engines should place service design solely in the service provider's control. To do so, intent engines should not:

- Require adding in custom supplier attributes, the fields should be fully under the control of the service provider
- Rely on hard-coded policies, e.g. hard-coding the interpretation of a particular attribute

Intent policies can be free-form and support the use of low-code plugins, which provide service providers with flexibility over which services to create and how to deploy the service, thereby increasing the service provider's capability of differentiating their services from the competition. The intent process also enables service providers to interface into third-party systems used in the order fulfilment process, such as CRM, IPAM, inventory, or other databases in order to remove "swivel-chair" copy-and-paste processes, eliminating errors and shortening the time from order to delivery.

Intent fulfilment processes should be designed with an intuitive UI, and each step of the fulfilment process can be customized and enhanced via low-code plugins.

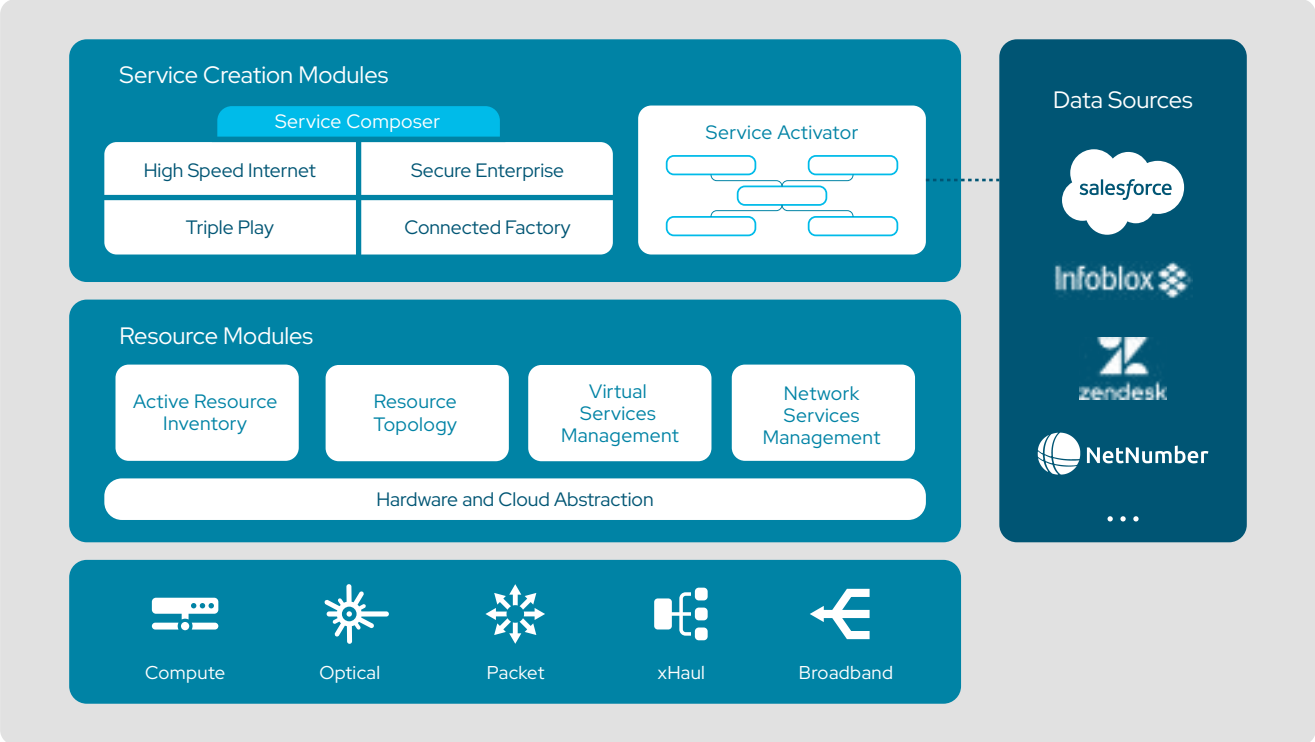
Model-driven Automation

A focus on models and a feature suite based on model-driven workflows and intent-driven model transformation dramatically simplifies the service provider's journey to deploying carrier-grade services. A model-driven architecture built on standard Broadband Forum, ETSI, 3GPP, and TM Forum data models provide significant advantages over process-based systems which rely on custom scripts to drive workflow, such as:

+ Broadband Forum models for broadband service activation and Life Cycle Management (LCM)
+ ETSI network functions virtualization (NFV) models for network services, network functions, and virtual infrastructure LCM
+ 3GPP slice management models for 5G slice management
+ TM Forum service management workflows for managing customer service orders

Because each model has implicit built-in workflows, it allows good model-driven systems to keep code to a minimum.

Rapid Integration And Flow-through Provisioning



Model-driven systems generally work very well, but enhancing the models with simple code can make it more powerful.

A plugin-based architecture should:

+ **Support rapid integration** with southbound network elements and network functions, whether standards-compliant, standards-based, or *proprietary*.
+ **Provide abstraction** for the standards-compliant models, so the models can remain vendor, use case, and cloud agnostic.
+ **Ensure stability** of the northbound APIs, so these APIs remain the same even if the southbound system changes.
+ **Enable zero-touch operations** when a service is deployed, scaled, or healed through automated application of Day 0, Day 1, or Day 2 configuration as part of life cycle events.

Integrations to northbound operations support systems (OSS), business support systems (BSS), and other systems are performed once and remain stable regardless of service, use case, or supplier, meaning that **the procedure to deploy a service can be easily automated and does not require costly new northbound integrations should a supplier or service change**. This gives service providers tremendous flexibility and choice such as:

+ The ability to freely **mix, match, and interchange different supplier's network elements** and/or network functions within a service, allowing the service provider to easily create best-of-breed services without being locked into a particular supplier
+ The ability to **create new services and instantly be able to deploy such services network-wide**, allowing the service provider to more rapidly respond to customer demands and expectations

Plugins are inherently low code and can easily be developed by the service provider or orchestration vendor as part of a rapid integration cycle measured in weeks. As a low-code construct, a plugin is also more maintainable and therefore less error-prone than code-heavy solutions.

To enable flow-through provisioning when a service is deployed, multi-level service configuration management is needed for each network function, network service, and their constituent network functions. Configuration is triggered automatically via low-code primitives at each lifecycle event (e.g. instantiate, scale, heal, terminate) and can drive configuration through the network elements and network function configuration management APIs or used to integrate with configuration automation systems such as Ansible, Zero Touch Provisioning (ZTP) systems, and others. Primitives are supported at multiple levels:

+ **Day 0** – Boot time configuration
+ **Day 1** – Application-level configuration
+ **Day 2+** – Service and operations-level configuration

Just as with plugins, primitives are low code scripts that complement the standards-compliant models in facilitating a zero-touch life cycle change. As low-code scripts, configuration and service primitives can be created by the service provider's DevOps and IT teams as part of network elements and network functions integration and service creation, thereby breaking their reliance on the network function supplier.

Closed Loop Assurance

Carrier-grade services require more than just the design of high-performance, reliable services.

After the design is deployed, the service must also continue performing at the contracted level while meeting the required availability criteria, to be truly “carrier-grade”.

The services are sufficiently complex, however, that manual operations to address faults or rectify performance issues are difficult to carry out on an ad hoc basis. Waiting for a maintenance window is also unfeasible as it means allowing a fault or degraded performance to continue until the window is scheduled.

Effective remedies for performance or availability degradation require three capabilities:

+ The ability to **correctly detect and identify the anomaly**
+ The ability to **take action to correct the anomaly**
+ The ability to **perform the corrective action in a repeatable and error-free manner** to avoid costly maintenance windows

Built-in Closed Loop Assurance

The ability to interface with network elements and network functions for the purposes of health and performance monitoring is critical. This capability allows operators to monitor service and application level KPIs such as calls per second, TCP traffic rate, or packet loss rates that more meaningfully reflect health and performance of the service. These KPIs should be retrieved in near real-time and can be aggregated in policies to drive auto-scale, auto-heal, and other actions, in technology domains that support this capability.

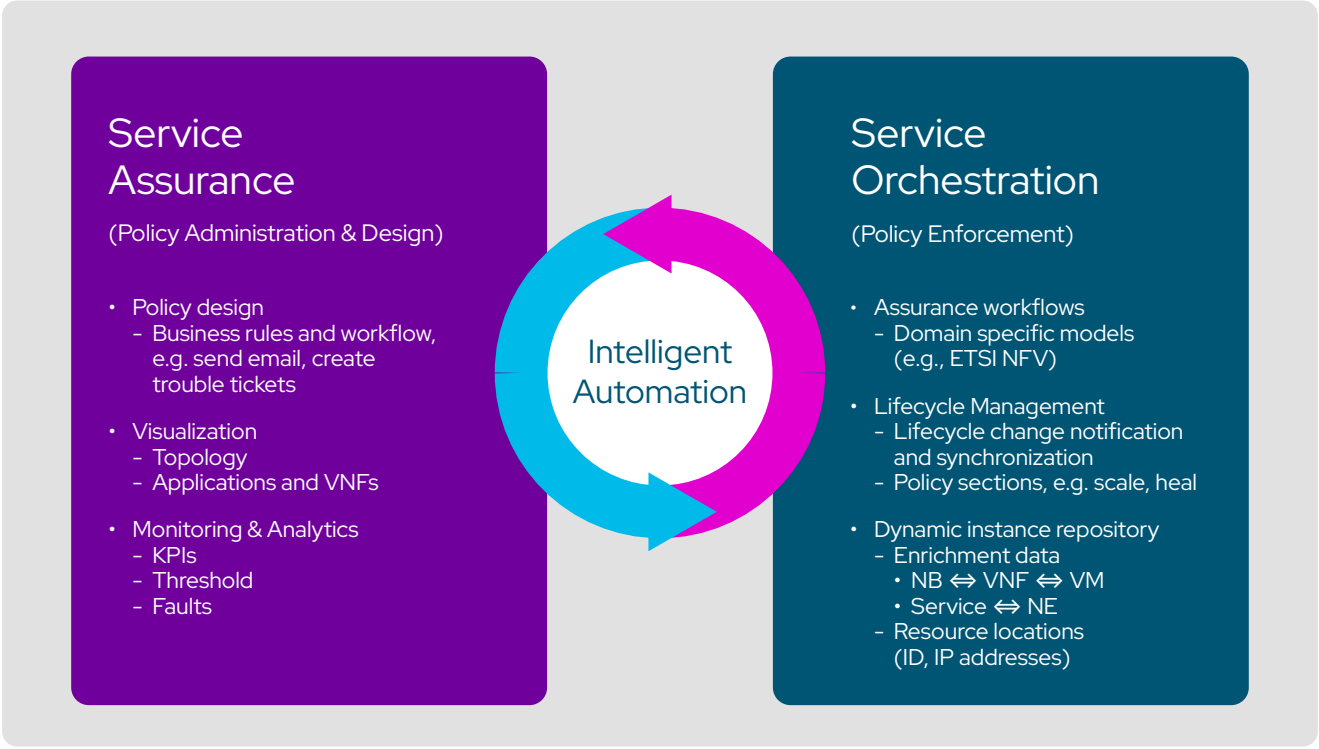
With this capability, service providers can drive automated actions such as:

+ Addition and removal of new capacity to meet network demand increase or decrease.
+ Healing of affected service components through re-configuration, re-start, or re-instantiation.

Closed-loop operations should be **fully automated and zero-touch**.

When anomalies are detected, they should automatically trigger built-in lifecycle management operations including all necessary operations and configuration with zero operator intervention.

Service Assurance Integration



KPI-based triggering is ideal when requiring reactive, real-time actions, but advanced analytics and Artificial Intelligence and Machine Learning (AI/ML) techniques are necessary for detection of anomalies and trends that are not readily apparent from human analysis.

Support of open, standards-based APIs simplifies integration with external or third-party service assurance systems that perform such analyses. In this architecture, the external analytics system operates policy design and decision functions, while the orchestration system operates as the policy enforcement function.

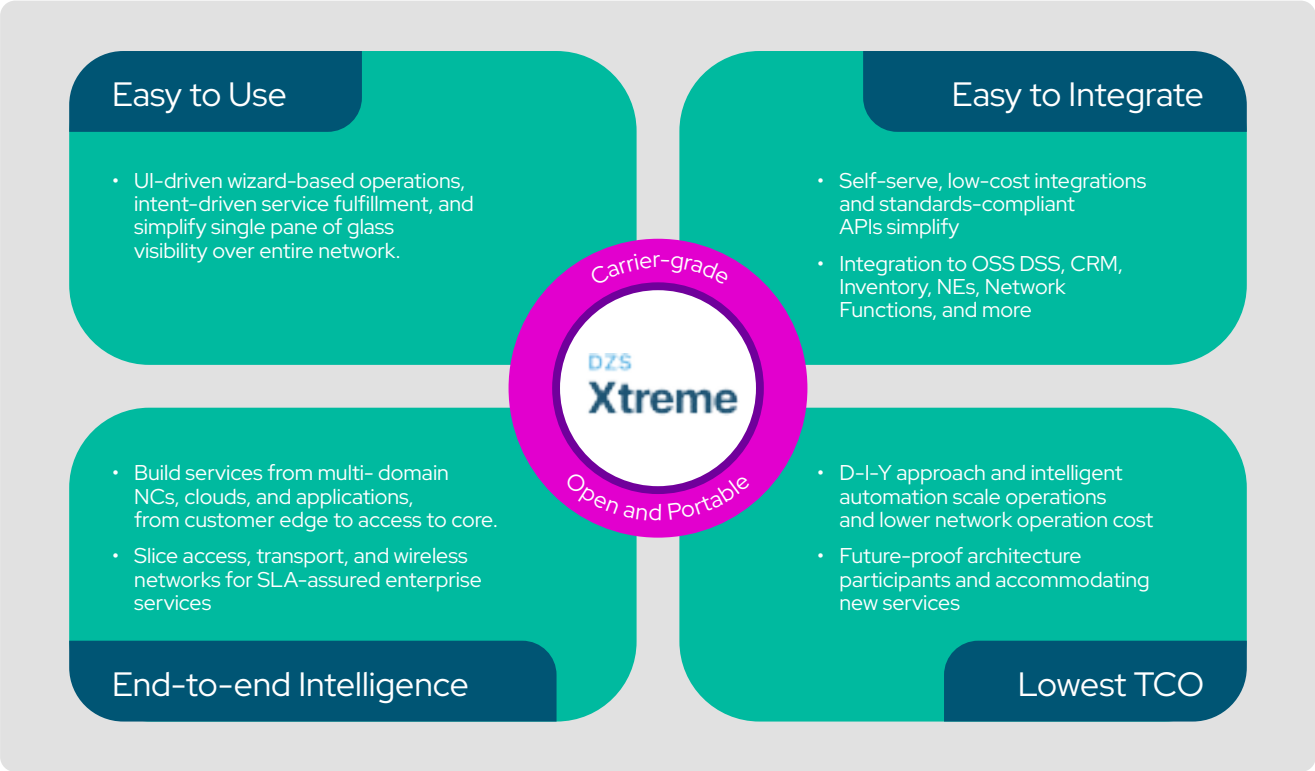
Armed with this information, analytics suppliers can create complex service provider use cases such as:

- Proactive (predictive) scaling based on traffic forecast.
- “What-if” traffic analysis and impacts on data center capacity.
- Cross data center disaster recovery plan creation and analysis.

Conclusion

The rise of hyperscale companies has created new services and expectations from customers, leading to new demands on service providers. Providers can meet these demands, but only if armed with the correct orchestration solution that allows them to design and deploy services as rapidly and cost-effectively as their hyperscale competitors and do it with the reliability and performance expected of carrier-grade services.

Introducing DZS Xtreme



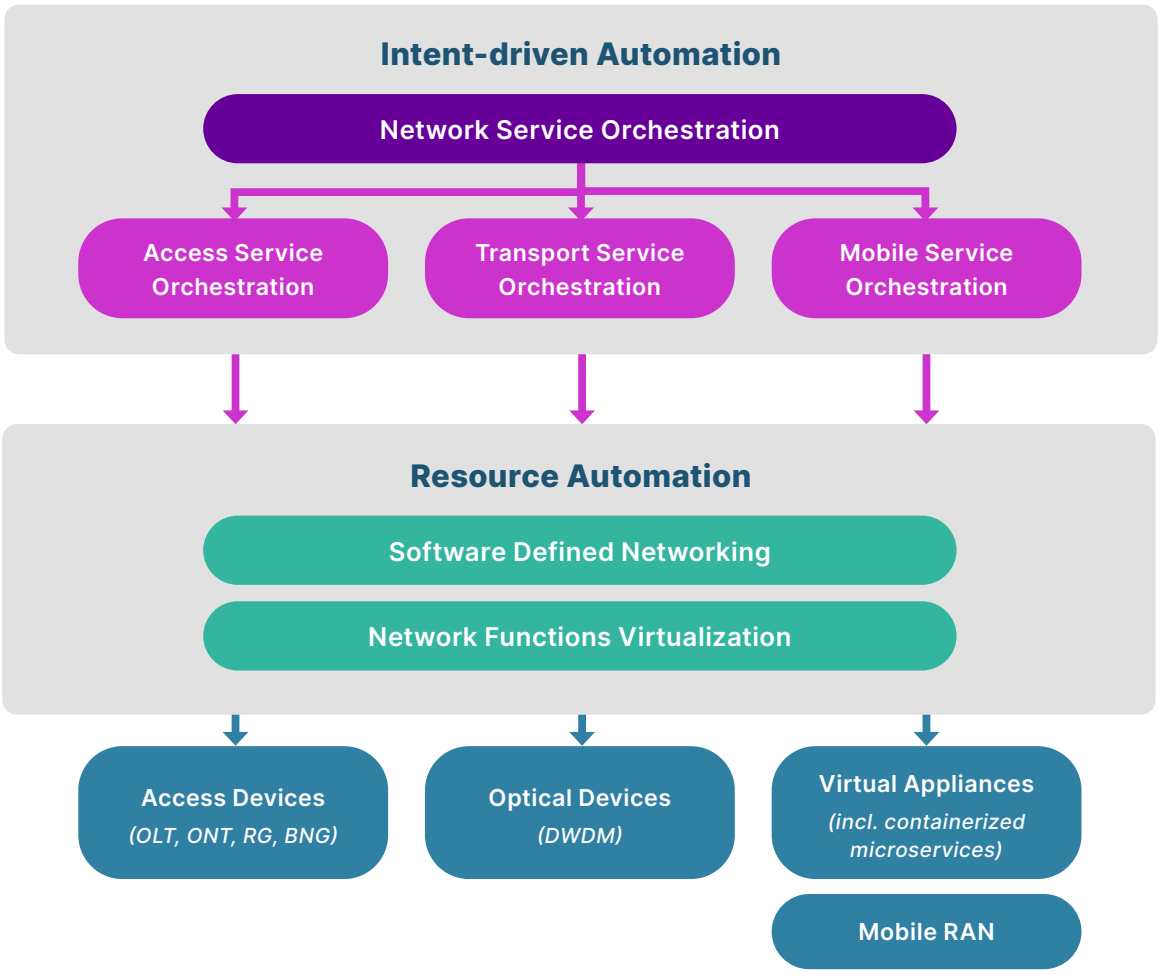
DZS Xtreme is a fully standards-compliant orchestration system designed specifically for high-speed broadband and mobile wireless services, giving operators the tools they need to transform their businesses from commoditized connectivity services to SLA guaranteed, high revenue services targeted to power users, small businesses, and large enterprises.

It is specifically designed for rapid deployment of carrier-grade networked services and cost effectivess in multi-vendor environments.

Built on a standards-compliant model-driven architecture, DZS Xtreme is equally capable of deploying access network services, 5G slices, multi-access edge computing (MEC) and internet of things (IoT) applications, and enterprise SDWAN services on all physical network and virtualized infrastructure, from GPON to XGSPON, across Kubernetes-based clouds to private data centers to enterprise uCPE devices.

DZS Xtreme:

+ **Automates deployment** of carrier-grade services such as Broadband services, 5G slices, MEC, SDWAN, and many others over any access network and virtual infrastructure
+ **Empowers service provider's in-house DevOps teams** and lowers the reliance on vendor-supplied professional services
+ **Creates maintainable and reusable designs** that can be deployed through a simple mouse click on any cloud at any location
+ **Unlocks vendor silos** and enables service providers to design best of breed services using best of breed components from different suppliers
+ **Enables zero-touch operations** through Closed Control Loop automated life cycle management that can be integrated with advanced artificial intelligence and machine learning analytics
+ **Integrates into the service provider ecosystem**, using carrier-led standards with carrier-grade security, reliability, and scalability

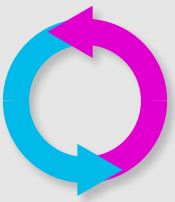


Design

- Single-click onboarding
- Drag & Drop UI
- Form fill wizard

Execute

- Single-click installation
- Cloud-specific deployment
- Day 0, 1, 2 configuration



Automate

- Closed Control Loop actions
- Service Assurance Integration
- Auto-scale and auto-heal

Orchestration

As an open, pure-play solution, DZS Xtreme is specifically designed to support the design and deployment of multi-vendor services composed of best-of-breed components. DZS Xtreme also enhances the ability for service provider's deployment teams to operate such services through closed control loop functionality which enable any service deployed using DZS Xtreme to self-monitor, self-scale, and self-heal, with as much or as little intervention desired by the CSP teams.

Model-Driven Automation

The DZS Xtreme intent engine enables service providers to seamlessly knit different orchestration models via intent-driven automation, meaning that DZS Xtreme is capable of managing services that span access technology (PON, GPON, XGPON, Mobile 4G and 5G), clouds (private, public, VM, container), location (edge, core), and use cases.

Closed Loop Assurance

DZS has designed support for automated closed control loop scaling and healing directly into DZS Xtreme' model-driven workflows to simplify the service provider's operations for dealing with SLA impacting issues.

Rapid Integration and Flow-Through Provisioning

DZS Xtreme models are designed for abstraction to support any use case, any supplier, and any infrastructure. To interface these models to a particular system, DZS provides a set of pre-built plugins with DZS Xtreme as part of the DZS Xtreme product.

Closed Loop Assurance

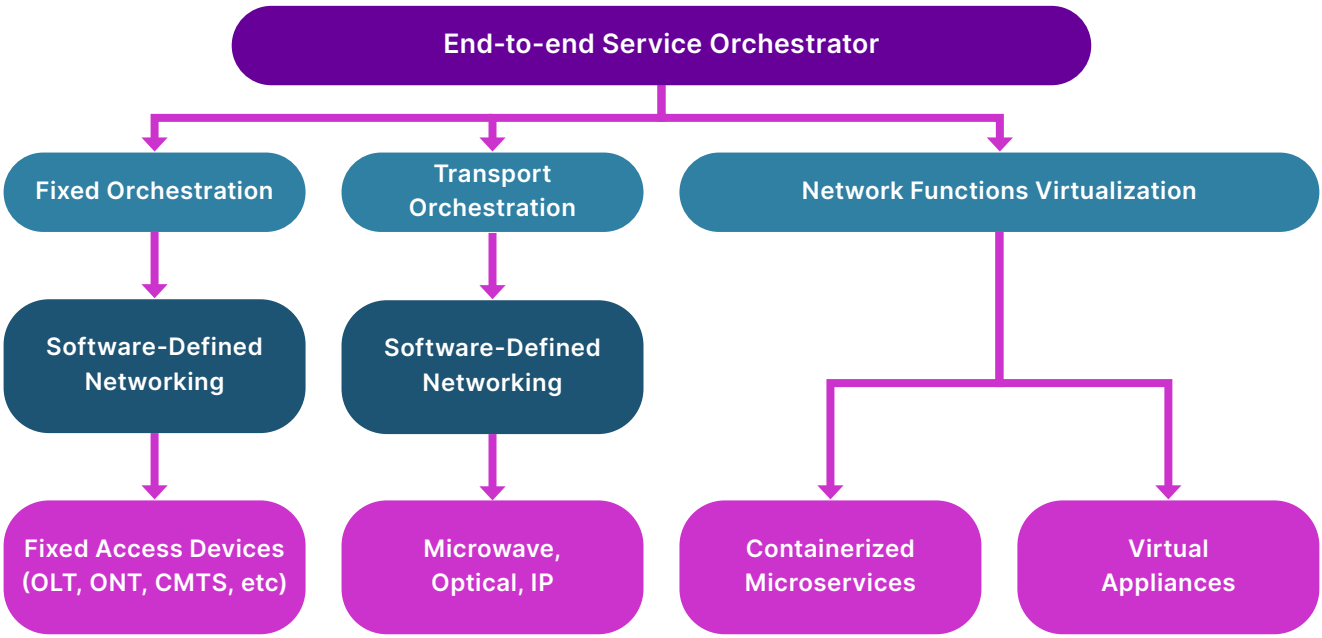
DZS has designed support for automated closed control loop scaling and healing directly into DZS Xtreme' model-driven workflows to simplify the service provider's operations for dealing with SLA impacting issues.

DZS Xtreme's monitoring, scaling, and healing capabilities fully address these requirements to make zero-touch Day 2 operations possible in carrier-grade services.

Service Assurance Integration

DZS Xtreme is specifically designed to enable service assurance functions to obtain the raw metrics and KPIs for the network element, network service, and network function as well as a rich suite of cross-layer correlation information including a detailed hierarchy of the components, segments, and topology of the service.

Through DZS Xtreme's open APIs and models, integration with rich analytics and AI/ML based systems to drive closed loop automation can be realized in a rapid, repeatable, efficient manner.



DZS Xtreme Access

DZS Xtreme Access is designed specifically for deploying subscriber services for the fixed access market, from PON to XGSPON to cable and beyond.

Designed using a standards-compliant, intent-driven core, DZS Xtreme Access manages all segments of the access service chain, from customer premise equipment to optical network elements, all the way to the edge of the Internet.

With our advanced integration capabilities, DZS Xtreme can easily manage third-party network elements, including gateways, OLTs, switches, and BNGs, to realize a true multi-vendor, best-of-breed access network.

DZS Xtreme Access is fully standards-compliant and utilizes standards-compliant models and APIs from TM Forum, Broadband Forum, ETSI NFV, and others. Using its plugin-based architecture, DZS Xtreme orchestration can easily integrate with any third-party southbound system (SDN-C, NE) using standard APIs or, in the case of proprietary third-party systems, using the system's native APIs. The DZS Xtreme orchestration northbound API uses TMF Open APIs and is designed according to the principles found in Broadband Forum TR-411. In accordance with MEF LSO "Legato" principles, DZS Xtreme Orchestration supports the use of TMF 633, 641, and 638 as NBI for control of multi-domain access services.

DZS Xtreme Mobile

DZS Xtreme Mobile simplifies lifecycle automation for deployment of any mobile service, including 4G core and 5G network slices across public, private, hybrid and edge clouds – enabling global operators to integrate virtual network functions (VNFs) or containerized network functions (CNFs) from any vendor.

The platform's modern cloud-native, modular design embraces web-centric open-source technology and standards, offering contemporary API and plug-in driven flexibility to scale and evolve with the largest global network environments.

DZS Xtreme Mobile utilizes standards-compliant models and APIs from TM Forum, 3GPP, ETSI NFV, IETF, and others. Using its plugin-based architecture, DZS Xtreme can easily integrate with any third-party southbound system such as NSMF, NSSMF, and/or NFVO using standard APIs or, in the case of proprietary third-party systems, using the system's native APIs. The DZS Xtreme orchestration NBI uses TMF Open APIs and is designed according to the principles found in 3GPP TS 28.805 and Broadband Forum TR-411. In accordance with MEF LSO "Legato" principles, DZS Xtreme Orchestration supports the use of TMF 633, 641, and 638 as NBI for control of end-to-end services.

About DZS

DZS (NSDQ: DZSI) is a global provider of leading-edge access, 5G transport, and enterprise communications platforms that enable the emerging hyper-connected, hyper-broadband world. A pioneer in disaggregated platforms, SDN, and virtualization, service providers and enterprises look to DZS for the innovation that leads to future-proof networks and outstanding performance.

DZS is a company that bridges the carrier and hyperscale domains through the development of DZS Cloud, a next generation, model-driven, standards-compliant automation and intelligence platform with carrier grade capabilities. DZS Cloud provides a solution that simplifies the deployment and assurance of connectivity services using no-code and low-code practices that empower the service provider's DevOps teams. DZS Cloud's automation function, DZS Xtreme, also automates the Life Cycle Management (LCM) of such connectivity services to enable zero-touch operations across any cloud / infrastructure environment and technology domain.

As a standards-focused, open ecosystem supplier, DZS is committed to best of breed orchestration without locking the service provider to a particular vendor. DZS's use of standards-compliant APIs and models and plug-in-based architecture enables multi-domain orchestration of any use case across any cloud and infrastructure at any site.

Over 1200 service providers, operators, and enterprises in over 120 countries have leveraged DZS innovation, open solutions, and agility to arm them with the network resources and deployment freedom they need to lead in their markets and deliver an unrivaled communications experience. With manufacturing, engineering, service, and support centers of excellence spread across the globe, DZS is positioned to bring next-generation technologies and world-class solutions to service providers and enterprises who are poised to transform, compete and win.

Find Out More

For more information about DZS Cloud and DZS Xtreme visit our website a

http://www.dzsi.com/

Enabling the
Hyper-Connected World

Create Transformational Services Quickly & Easily

DZS Americas
Regional Headquarters
Plano, TX, USA

DZS Asia
Regional Headquarters
Seongnam-si, Gyeonggi-do, South Korea

DZS EMEA
Regional Headquarters
Hanover, Germany

info@dzsi.com
www.DZSi.com

DZS
Xtreme