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5G Performance Starts and Ends with the Access Network

The access network is the first point of connection for all users and devices starting from the radio network and connecting to 5G services in the core network.

Read this guide to learn about:

- The new monitoring challenges and requirements in the 5G access network.
- How to assure SLAs and QoE to support network slicing and Multi-Access Edge Computing (MEC).
- Use cases on split connectivity assurance and 5G transport readiness.

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1. Introduction

Deployments of 5G New Radio (NR) are ongoing across all regions. Operators are now working towards the next phase of 5G standalone core networks that will enable high-speed, low-latency, ultra-reliable, and massive IoT services to be supported by network slicing and edge computing. As networks cloudify and move to open architectures, monitoring and virtualization must be dynamic and adapt to the new environments.

5G's service-based and distributed network architecture will require new levels of performance control and end-to-end visibility of services in order to meet strict performance Service Level Agreements (SLAs). The access network is at the front-end of customer experience and is one of the most important parts of the mobile network in terms of its impact on service quality. Consumers and enterprises are extremely unforgiving of a poor initial experience. 5G operators aim to avoid any disappointment, negative brand image, or churn related to 5G performance.

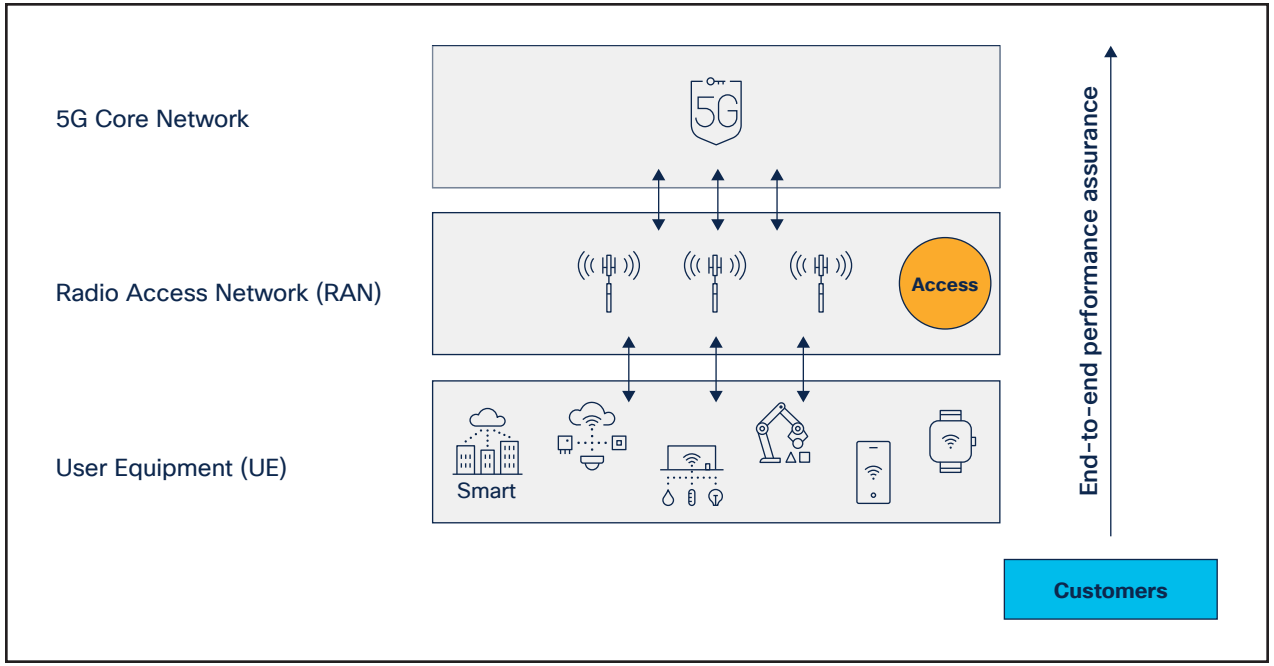

Figure 1. The access network is the front-end of customer experience

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2. 5G access performance challenges

5G has huge revenue potential if operators can create value for customers, innovate with partners, and deliver new service experiences and performance levels that go beyond just speed. The ability to detect and prevent any issues occurring, whether it's at the time of a new service deployment or continuously during the use of a service, is critical for throughput and latency-sensitive applications.

The new access model in 5G and the split of the Baseband Unit (BBU) to a more open and distributed RAN and access network architecture brings performance benefits and reduced costs, but also new challenges. These challenges include:

- How to implement the new 5G access modes that have been defined, but are not yet widely adopted.
- The new distributed access network and open, multi-vendor approach introduce greater network complexity and challenges in managing the performance of diverse 5G services and infrastructure.
- From a cell site densification and transport perspective, there are more links to monitor and correlate with the service and architectural mesh.
- Strict end-to-end performance SLAs will be required to build enterprise trust in 5G applications and services. These include new requirements to support edge computing SLAs with developers, hyperscalers, and enterprises.

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Full control and visibility of the mobile access network is needed to understand performance bottlenecks that would hamper 5G rollouts and the ability to meet strict SLAs. 4G networks are not going away, so performance tools need to work within existing operations and provide integrated visibility and control of both 4G and 5G performance. This is required to fully monitor service performance and user experience end-to-end across network domains, which will be especially important for low-latency 5G services.

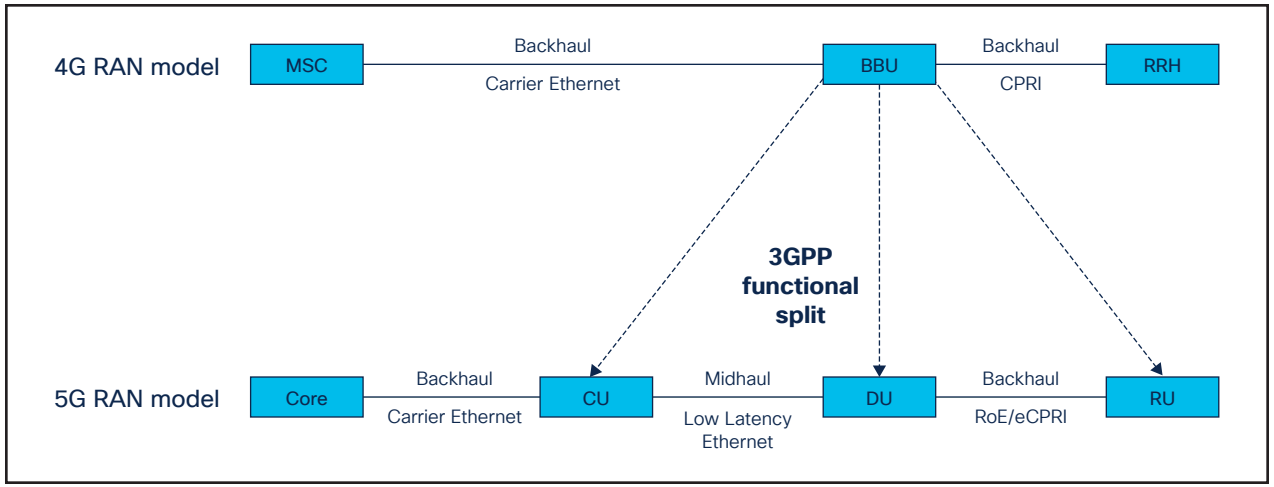

Figure 2. The 5G split connectivity challenge

3. Managing 5G access network performance

5G allows for more flexible resource usage where major radio and network functions can be centralized and implemented using off the shelf hardware, yet distributed closer to the user as needed.

The introduction of 5G Open RAN (O-RAN), Cloud RAN (C-RAN), and the 5G Core Network (CN) will require new cloud-native compute platforms in the core, but also at the edge of the mobile network.

Specific application and user or service data flows can be separated, sorted into slices, and managed separately from other traffic types. The ability to filter out generic internet traffic right at the base station and peer the traffic directly to the internet offers tremendous benefits to mobile operators and customers. These functionalities avoid overloading the backhaul network so customers see faster response times on their web applications and services.

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The access network is one of the most important areas to consider in performance management due to the dynamics of the new Radio Access Network (RAN) split architecture. The split architecture needs to be managed along with third-party access provided by Alternative Access Vendors (AAVs). Operators need to monitor each segment for SLA compliance for services, including fronthaul, midhaul, and backhaul. Performance data needs to be collected, analyzed, and integrated for an end-to-end view of services and SLAs from the core, access, edge compute, network path, and domain infrastructure resources to the application and service layers.

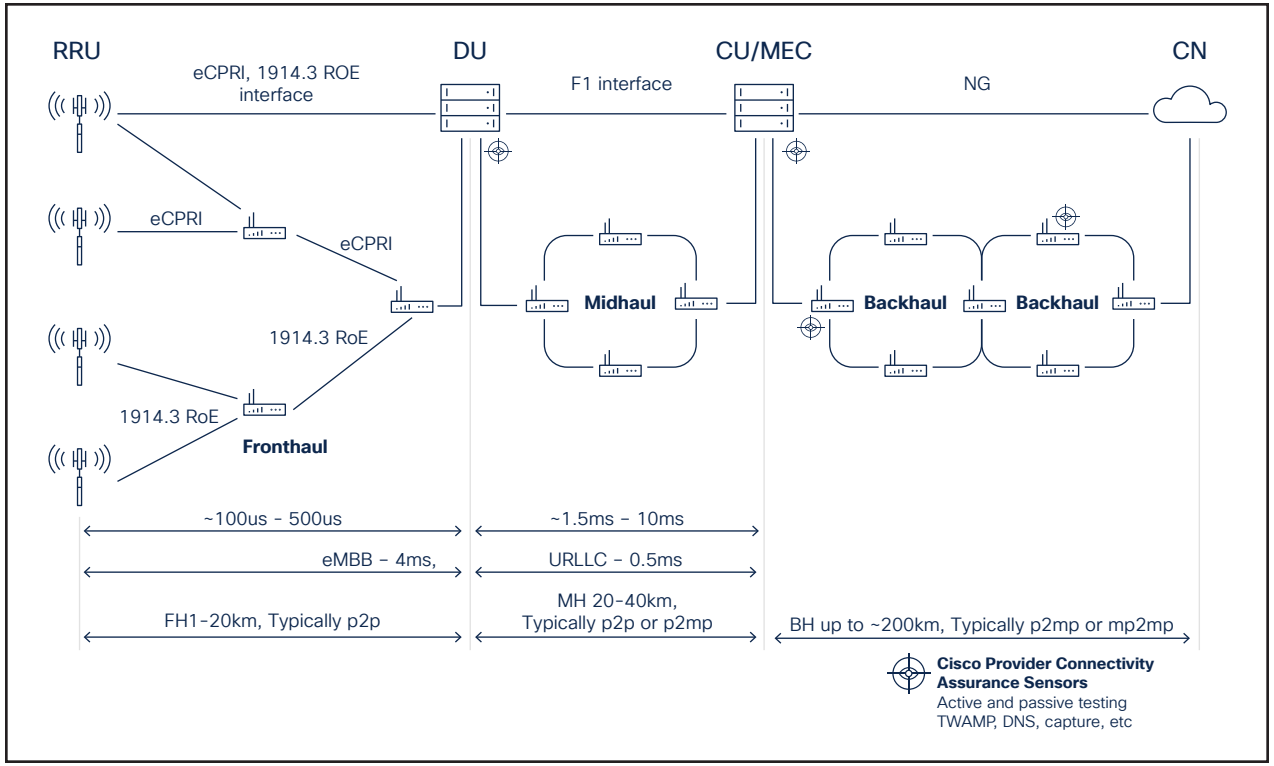

Figure 3. Managing distributed access architecture

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4. The access network and end-to-end service SLA assurance

Within 5G's service-based architecture, the service or application performance data KPIs and SLAs are defined at the service design phase. In the figure below, each slice is a virtual network path with its own resources that need to comply with the SLA assurance requirements for the services within that slice. For example, SLAs need to be assured for IoT services in slice 1, enhanced Mobile Broadband (eMBB) services for slice 2, and Ultra-Reliable Low-Latency Communications (URLLC) services for slice 3. The evolution of Multi-Access Edge Computing (MEC) enables slicing capabilities for low-latency services requiring dedicated performance assurance for the 5G underlay. Each logical slice has to meet service-specific requirements for network priority, latency, data rate, QoS, and other Key Performance Indicators (KPIs).

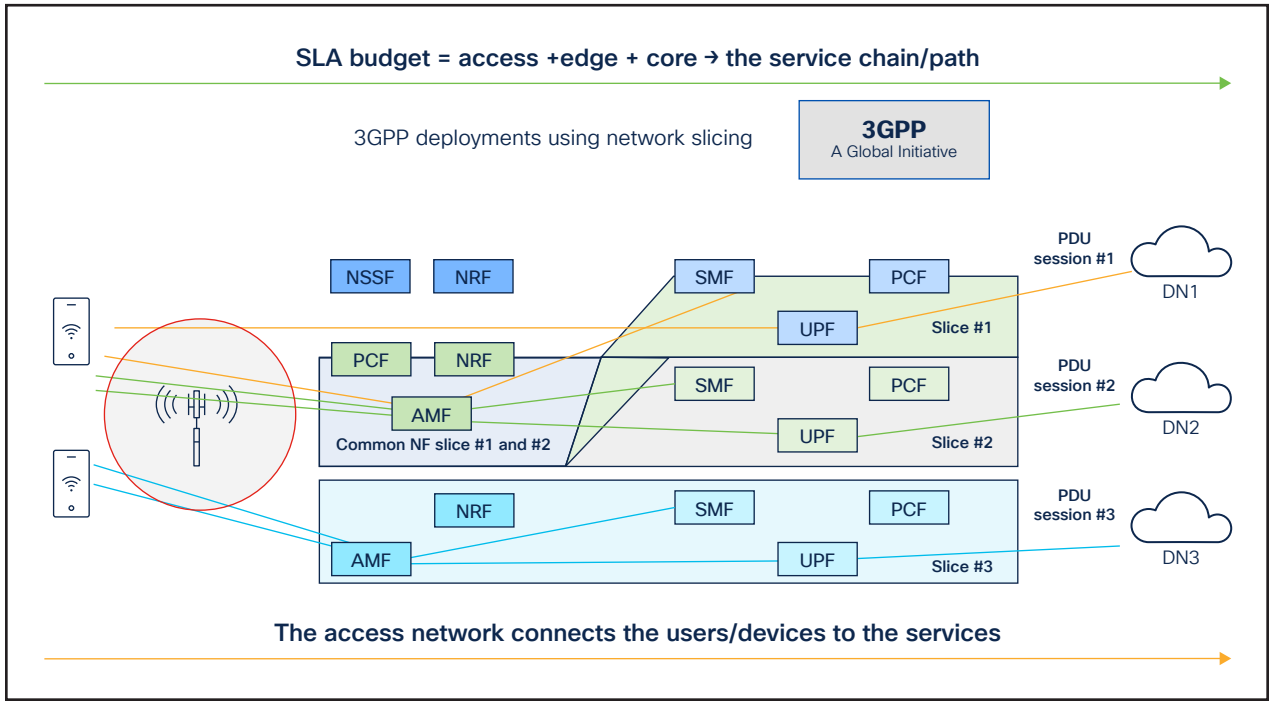

Figure 4. Assuring end-to-end services within network slice KPIs

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Cloud hyperscalers and application software developers will play vital roles in the growth of 5G applications and services. End customers, in particular enterprises, B2B partners, and hyperscalers will require application and service Quality of Experience (QoE) and network performance SLAs from operators. In order to do this within the access network, we need to measure the connectivity and third-party telemetry data, in addition to service and application behavior where the MEC and Centralized Unit (CU) or Distributed Unit (DU) might reside.

For MEC enterprise services with strict service performance KPIs, we need to instrument the MEC, inter-MEC, and the path from the radio all the way to the MEC at each segment in order to determine SLA compliance. Deployments and measurement points will vary dynamically depending on services being delivered, that is ultra-low latency, enhanced broadband, IoT, or enterprise applications.

5. Use case: Segmented performance assurance

Monitoring the RAN or Open RAN (ORAN) framework means verifying the KPIs between the split components (fronthaul, midhaul, and backhaul) all the way to the radio end. Depending on the MEC deployment, the end-to-end service SLA performance assurance can be close to the radio edge, as can be seen in the diagram below, or can be far away depending on the service requirements. The key point here is that the access SLA budget, which is part of the overall service SLA budget, needs to be monitored and validated. Figure 5 shows how this can be done leveraging the Cisco Provider Connectivity Assurance (formerly Accedian Skylight) solution. Active Provider Connectivity Assurance Sensor Agents provide a segmented and end-to-end performance visibility from the core through backhaul, fronthaul, and midhaul networks. (**Note:** There are many ways to instrument using the Provider Connectivity Assurance solution—this is just one example).

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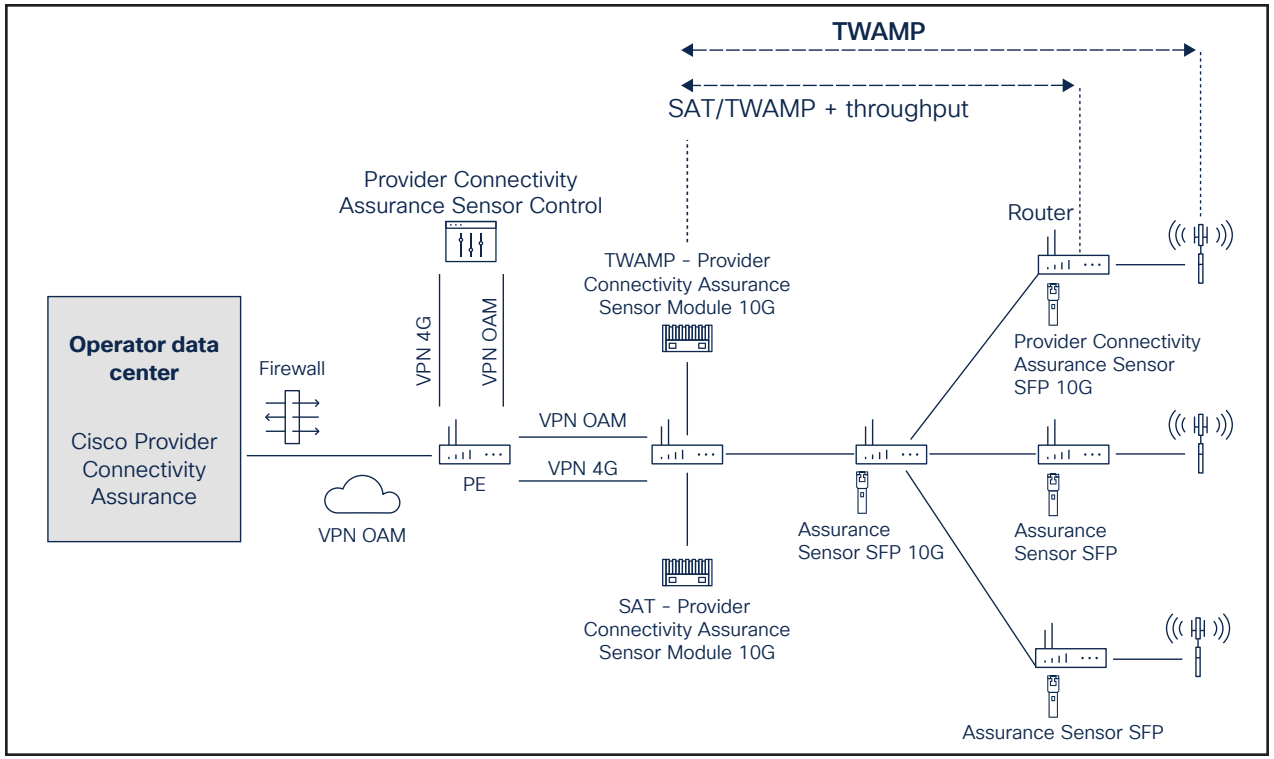

Figure 5. Provider Connectivity Assurance 1G/10G SFP compute deployment and automation

"Cisco Provider Connectivity Assurance has helped to reduce 5G site visits by 60% and accelerated 5G rollouts in the process, increasing the number of sites that can be rolled out in a day by 88%."

–Tier 1 mobile network operator in Europe

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6. Use case: 5G readiness in the access network

Another use case is a reference model from a large European operator where they needed to validate the performance of their 4G network to determine what they needed for their 5G services and service KPI requirements. The overall validation included:

- Turn-up testing to validate the capacity of the end-to-end service path.
- Monitoring commissioned service path for SLA validation.
- Monitoring backhaul performance.
- Monitoring alternative access vendors/wireline services in the 5G network.
- Baselining the performance of the existing network to determine improvements needed to support 5G services.
- Understanding how performance data can be leverage into existing systems using APIs.

Figure 6 shows how the environment was instrumented and how the Provider Connectivity Assurance solution was leveraged to deploy end-to-end performance management SLA assurance and support 5G readiness.

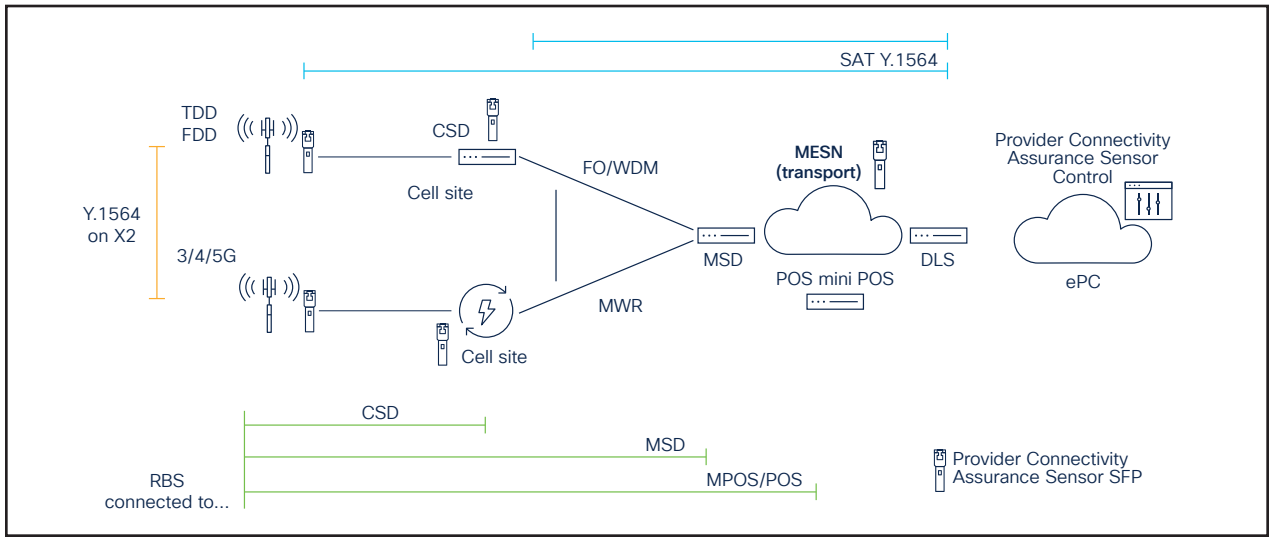

Figure 6. Automated transport service measurement

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7. Key takeaways

5G access performance management

- 5G is about more than just speed and spectral efficiency in the RAN. It's an opportunity to move to a cloud-native architecture (ORAN and the core network) and to offer unprecedented access to the mobile network for enterprises.
- From a cell site densification and transport perspective, there are more links to monitor and correlate with the service and architectural mesh. Having full visibility of the mobile access network is needed to understand performance bottlenecks that would hamper 5G rollouts and the ability to meet strict SLAs.
- 4G networks are not going away, so having performance tools that work within existing operations and provide integrated visibility and control of 4G and 5G performance is important. This means visibility from the RAN to the edge and core network and everywhere in between, including the transport underlay and the service overlay.
- The access network is a critical part of the end-to-end SLA budget that needs to be adhered to for service performance assurance and QoE. For applications, we need to measure the network slice or virtual path performance in the access network to assure the relevant KPIs and QoE requirements are being met.
- The additional complexity of managing virtualized network functions in distributed cell sites, small cell densification, and automated service lifecycle management will present new granular requirements for monitoring, analytics, and event correlation.
- This performance data has to be made available to the rest of the network for real-time decision making. Performance visibility will be key in unlocking both the financial and operational benefits of 5G network transformation.

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8. Cisco Provider Connectivity Assurance for 5G service assurance

Cisco® Provider Connectivity Assurance (formerly Accedian Skylight) is ready to help you with 5G performance monitoring today and in the future; from network underlay to cloud and everywhere in between. Provider Connectivity Assurance is a cloud-native performance management solution that provides a complete 5G network visibility of both the underlay and service overlay as an integrated solution. Provider Connectivity Assurance Sensors can be deployed in the core, midhaul, and backhaul networks, as well as between MEC and public cloud locations, to provide full mesh underlay performance visibility.

Assurance Sensors can also be deployed in the MEC and cloud locations in order to provide full visibility into service performance for the ORAN, 5G core network, and enterprise applications. The AI-enabled predictive analytics engine within Provider Connectivity Assurance analyzes performance data in real time and has open APIs for integration.

Provider Connectivity Assurance is a future-proofed performance management and service assurance solution that interacts with existing 4G networks and operations and is granular enough to address the strict requirements for new 5G network, services, and use cases.

A flexible combination of software agents, hardware-assisted components, virtualized functions, and smart SFP hardware comprise its lightweight sensor layer. Unique and truly industry-first, 10Gbps compact SFP devices can be installed at cell sites to enable turn-up testing, bandwidth monitoring, and 24/7 performance monitoring, all on a per-service basis.

A virtualized orchestration layer centralizes management and orchestration of the sensors, leveraging local controls and REST API automation. It can also feed data into third-party platforms for planning and troubleshooting and contains a data collector function for ingestion of model-driven telemetry and other sources of third party performance data. Provider Connectivity Assurance automates the configuration and service provisioning and testing for fast service turn-up and can spin up test agents to monitor on-demand network slices.

The Provider Connectivity Assurance platform combines data from all Assurance Sensors and third-party sources into a single unified view. It offers machine learning-powered alerts and rapid troubleshooting for network and application performance issues. Real-time monitoring and AI-enabled analytics also helps operations teams to predict and automate fixes proactively, before end user experience is impacted.

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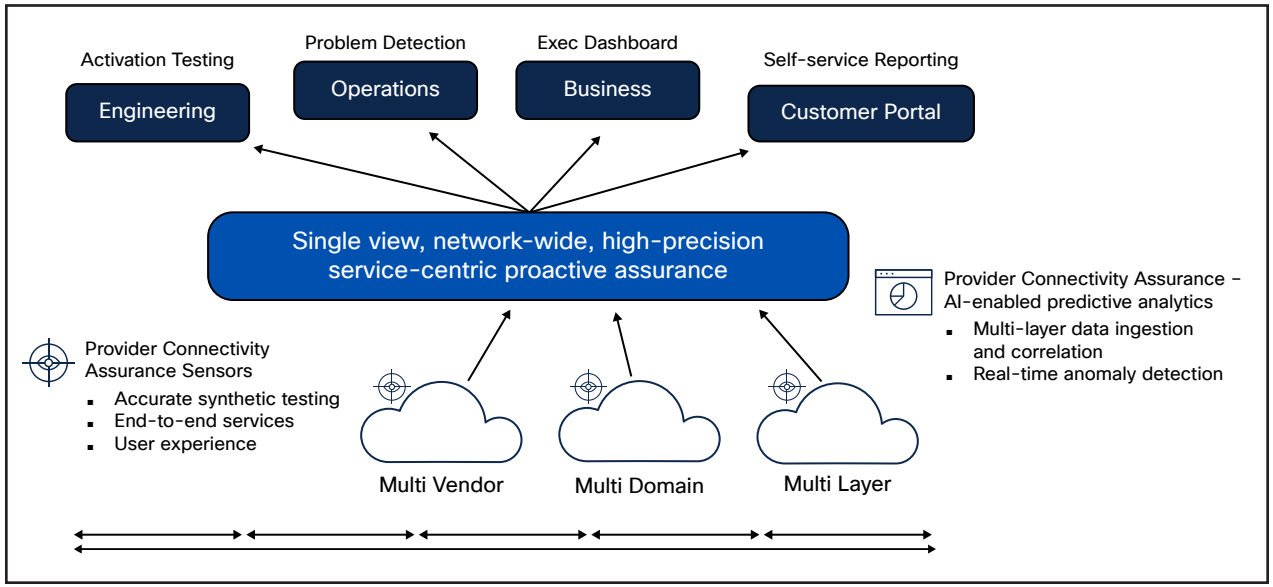

Figure 7. Cisco Provider Connectivity Assurance platform components

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