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NITRO GEO

GEOperformance Overview

VIAVI NITRO GEO captures, locates, stores and analyzes data from all subscriber events, giving operators a rich source of location aware, subscriber-centric insights to significantly improve network performance and enrich the QoE. This intelligence creates a true understanding of the customer experience to accurately improve network performance and enrich the subscriber experience.

Transforming Performance Engineering

NITRO GEO GEOperformance, powered by the Network Integrated Test, Real-time analytics and Optimization (NITRO) intelligence platform, uses location intelligence to transform RAN planning and performance engineering by increasing operational efficiency, and significantly increasing return on investment, while delivering game changing improvements in the network performance actually experienced by customers.

Key benefits

Transform RAN planning and performance engineering by increasing operational efficiency, and significantly increasing return on investment, while delivering game changing improvements in the network performance actually experienced by customers with analyses such as:

- Roamers Analysis
- Special Events analysis
- Performance and Optimization
- Small Cell planning
- VIP assurance
- Handset analysis
- Impact Assessment
- Coverage and Capacity Planning
- VoLTE Analysis
- Subscriber Application Awareness
- Indoor/Outdoor Analysis
- … and more!

The flexible user interface of GEOperformance allows engineers to view maps and tables showing RF KPIs such as signal strength and interference, based on actual measurements geolocated to building level accuracy. These maps and tables can be analyzed and filtered to identify problem areas such as areas of high drop call rates. Individual calls can be selected and complete Layer 3 detail viewed to establish root cause.

The automated problem detection functionality rapidly guides engineers to areas of the network that do not meet defined KPI thresholds.

Sophisticated automated optimization features automatically solve challenges such as recommending changes to neighbor relationships, identify scrambling code and frequency clashes and propose resolutions. Dedicated reports identify coverage overshoots and guide engineers to the correct antenna tilt adjustment.
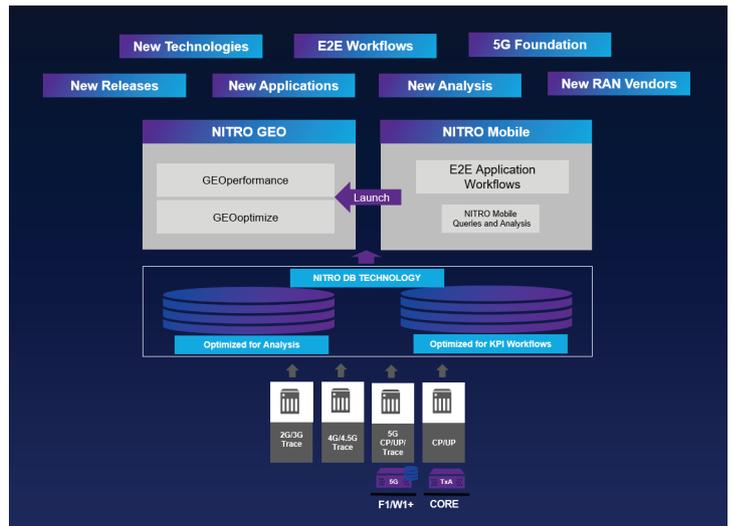

NITRO GEO Architecture

A Subscriber Centric View of the Radio Access Network

GEOperformance provides network operators with the unique ability to understand the precise subscriber experience — their locations, their usage patterns and their experience of network interaction — all at an unprecedented level of accuracy.

Using GEOperformance, an engineer can view KPIs at street level and evaluate the network performance as subscribers experience it, regardless of the time at which they use their mobile and regardless of the environment in which this occurs.
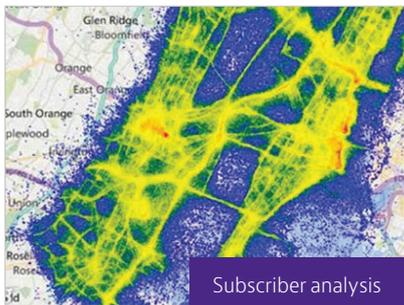
Subscriber analysis
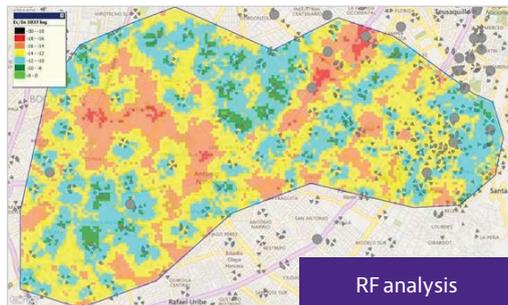
RF analysis
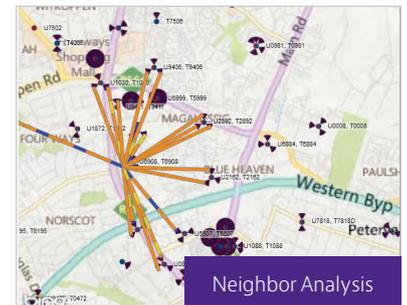
Neighbor Analysis

Device Name	Device Count	Devices With ERAB Blocks	Devices With ERAB Drops	Devices With VoLTE ERAB Blocks	Devices With VoLTE ERAB Drops
Apple Inc Apple iPhone X (A1901)	105197	79	92	0	0
Apple Inc Apple iPhone X (A1902)	92	0	0	0	0
Apple Inc Apple iPhone X (A1903)	11	0	0	0	0
Apple Inc Apple iPhone XR (A1984)	29881	20	14	0	0
Apple Inc Apple iPhone XR (A2105)	125	0	0	0	0
Apple Inc Apple iPhone XR (A2106)	2	0	0	0	0
Apple Inc Apple iPhone XR (A2107)	1	0	0	0	0
Apple Inc Apple iPhone XR (A2108)	91	0	0	0	0
Apple Inc Apple iPhone XS (A1920)	30325	24	21	0	0
Apple Inc Apple iPhone XS (A2097)	219	0	1	0	0
Apple Inc Apple iPhone XS (A2098)	14	0	0	0	0
Apple Inc Apple iPhone XS (A2100)	62	0	0	0	0
Apple Inc Apple iPhone XS MAX (A1921)	48524	39	24	1	1
Apple Inc Apple iPhone XS MAX (A2101)	200	0	0	0	0
Apple Inc Apple iPhone XS MAX (A2102)	9	0	0	0	0
Apple Inc Apple iPhone XS MAX (A2104)	508	0	9	0	0

17 items

Traffic analysis

GEOperformance analyses

GEOperformance can be used to analyze an extensive range of KPIs such as:

- Traffic/throughput
- Handovers
- Signal strength, quality and interference
- Handset performance
- subscriber / cell performance

- VIP performance
- Call blocks (Accessibility) / Call drops (Retainability)
- Usage
- Carrier Aggregation Utilization

These can be considered on a network, technology, equipment, region, cell, specific location, user defined polygon, service, subscriber and/or handset basis for different time periods during a day, 24 hours per day, every day.

Comprehensive easy to use analyses

Roamers Performance Analyses

A detailed geographic breakdown of roamer traffic by country and by operator, identifying key traffic locations. Enables operators to maximize the roamer traffic, and understand the service experience provided.

Special Events Venue Analyses and Reporting

Prepare prior to the event to ensure network coverage and then monitor the event itself. VIAVI has supported events such as the World Cup, Super Bowl and supported a customer with the Olympics, for both in preparation of and during the entire event. Specific events may include:

- Sporting events
- Concerts
- Corporate Customers

Major routes analysis

Increase Network Performance/Optimization

By using geo-located data from real subscriber calls, GEOperformance provides a clear view of the network as the subscribers experience it.

- Coverage and Capacity Planning
- Crossed Feeder Detection
- VoLTE and Services Performance
- High Signaling Detection
- Neighbor optimization

- Neighbor, scrambling code (SC) and Physical Cell-ID (PCI) planning
- Removing high interference sites
- Tall site takedown
- Reduce pilot pollution, unnecessary cell overlap
- Manual and automatic cell and cluster optimization

Routine drive testing for monitoring can be nearly eliminated and more expensive drive test resources can be refocused onto more on more valuable activities.

Network Performance/Optimization

VIP Performance Analyses

- VIP call failure location and diagnosis including layer 3 messaging

- Show every leg of a session not just the start and finish

- Show locations of blocks or drops during a VIP's journey

- Identify the issues immediately:

  - Multi-RAB drop due to missing neighbor

  - Voice drop possible due to poorer SNR condition for the type of handset a VIP uses

Device and handset segmentation and performance analysis across the network

- Pinpoint problematic devices and device behavior to help you define the planning, optimization or performance evaluation strategies and priorities.

- Locate and analyze specific devices, types and firmware versions for failure reasons and data performance issues.

- Produce reports on device performance for areas of interest based on radio parameters, usage locations and usage patterns.

VIP Location Analysis

VIP Summary Analysis
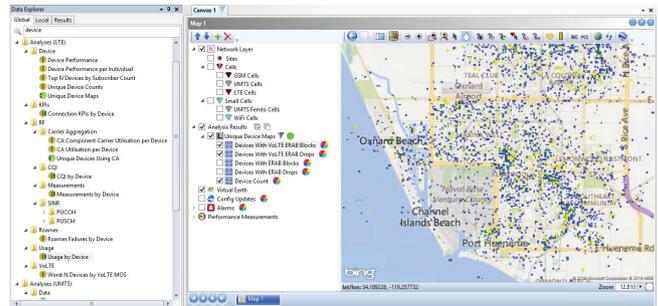
VoLTE Performance by Device
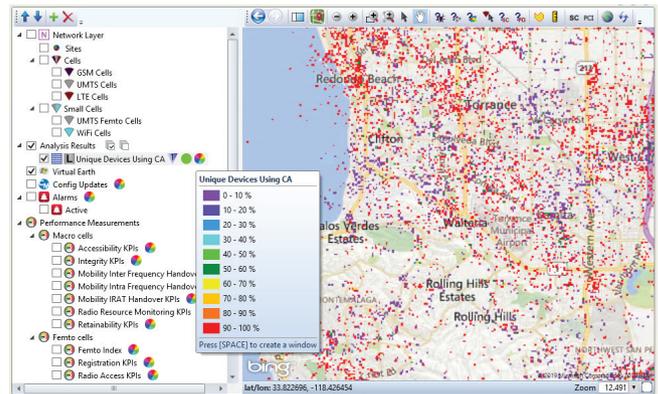
Device Carrier Aggregation Analysis

Device Performance Table

Key Features and Capabilities

Visualization

The flexible user interface allows viewing of maps and tables showing RF KPIs such as signal strength and interference, based on actual measurements geolocated to building level accuracy. These maps and tables can be analyzed and filtered to identify problems such as areas of high drop call rates. Individual calls can be selected and complete Layer 3 detailed view to establish root cause, all from within the same GUI and across multiple RAN technologies. Additionally, Layer 7 detailed view allows for analysis of service / application metrics such as application category and DL throughput, TCP metrics such as DL delay and retransmissions, and VoLTE metrics such as Jitter and MOS. Layer 7 detail can be viewed for the duration of the connection analyzed.

The GEOperformance GUI is extremely flexible and allows the use of maps, charts and tables to visualize and analyze the rich data set. The figures below show some examples of how the data can be presented.
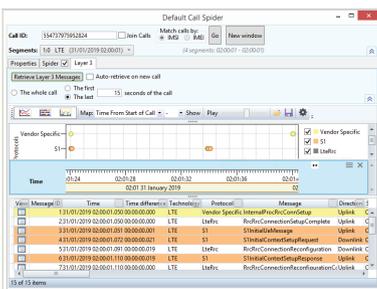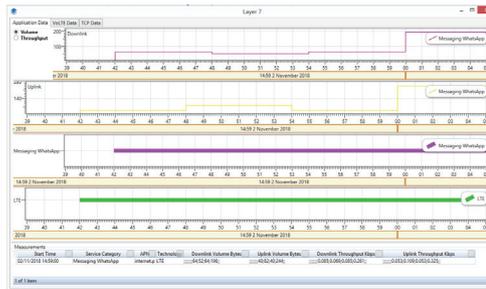
L3 Drill Down   L7 Drill Down: Service   L7 Drill Down: VoLTE

The Layer 3 Drill Down tool is an advanced feature of GEOperformance. It provides a method of call drill down analysis to view sequences of Layer 3 and other messages observed during the progress of a call. Layer 3 drill down reloads the raw trace files to present information on a per message level, as well as through charts and time series. The drill down is based upon the reloaded raw trace data, reparsing the 3GPP. This provides a very powerful way to drill down into any call in recent history for detailed troubleshooting.

The user can see how various parameters vary over the duration of the call, including RF parameters, serving sites, throughput, etc. All layer 3 messages are shown including event types, and these can be shown in detail if required. The number of days of layer 3 storage is dependent on system dimensioning.

The Layer 7 Drill Down tool is a powerful optional feature (requires the Application Aware module licensed to the system) that provides visibility to subscriber application, VoLTE, TCP metrics by calls, connections, or segments. The Layer 7 Drill Down provides three tabs: Application Data, VoLTE Data, and TCP Data. Application Data provides volume, DL/UL throughput, service category (such as video or social networking), and RAT type. VoLTE data provides MOS, Jitter, Latency, Packet Loss %, One Way Audio % both in the downlink and uplink. Finally, TCP data includes delay and retransmissions for also the downlink and uplink for the analyzed call, segment or connection. The data is available on a 6 second basis; for this reason the durations shown are in multiples of 6 seconds.

GEOperformance Metrics

NITRO GEO captures and geolocates every voice call and data session on the network. These connections and sessions are broken into segments where key events such as handovers or bearer changes occur, allowing the changing experience over the path of a mobile session to be accurately captured for analysis. For each session the following details are captured (see User's and Technical Guides for a complete list of call, segment, and/or connection details by technology).

- Call start time
- Call duration
- User identification (IMSI)
- Device identification (IMEI, IMEI SV, TAC)
- Mobile Country and Network Codes (MCC, MNC)
- Segment / Connection ID / Connection Type
- Frequency Band Information
- Serving Node (BSC, RNC, etc.)
- Radio signal level (RSCP, RxLev, RSRP)
- Radio signal quality and interference (Ec/Io, RxQual, RSRQ, CQI)
- User data services demand (minutes of use (MOU), Erlang, Mbytes, QoS Class, QCI)

- PDCH and RLC packet success and failure counters
- User voice services demand (MOU, Erlang, QCI)
- LTE RAN Share (MOU, QCI, RF Summary)
- Active set/Server Identity
- Call failure reasons
- Initial and reconfigured Radio Access Bearer
- Start, intermediate and final cells
- Carrier
- Handovers (soft, softer, S1, X2, intra-frequency, inter-frequency , IRAT)
- Layer 3 messages
- Layer 7 messages (with optional Application Aware module licensed to the system)
- Sub-cell and sub-call resolution of user location down to a granularity of 5 seconds

Data can be analyzed using the powerful filters available, such as:

- Subscriber group
- Technology
- Device type
- Service
- Bearer type
- Indoor/Outdoor
- Roamer
- Date and time
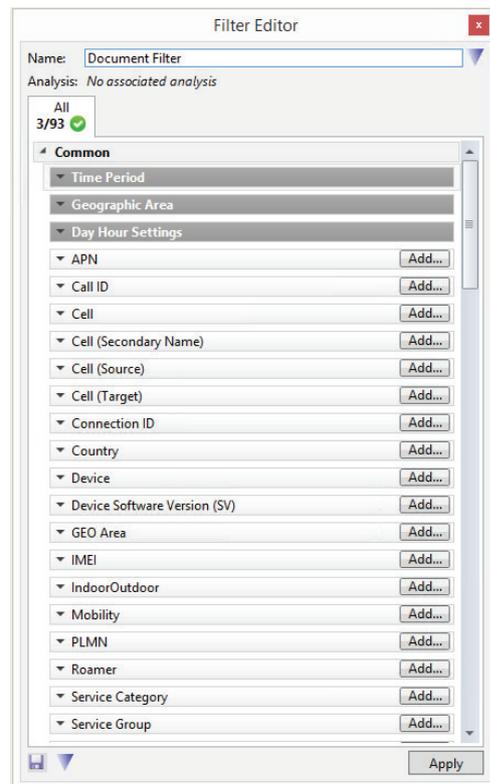
Filter Analysis

Network Analysis

Data can be visualized through a variety of maps, tables and charts. GEOperformance is highly flexible allowing users to define report content and layout. To maximize efficiency, powerful template features allow reports to be predefined so that users can quickly create reports. Templates allow the user to define input variables such as customer, cell, or handset type such that a user can rapidly create a report featuring just the information required for the problem under investigation.

This combination of capabilities allows operators to define workflows and methodologies centrally, and ensure regional teams operate in a consistent and efficient manner. At the same time advanced users have complete flexibility to investigate complex problems.

Call level drill down

For detailed troubleshooting, an individual call or data session can be selected and a drill down performed to provide clear detailed information about the call. Outputs include the intuitive spider display which clearly shows the relationship to serving and neighbor cells, and a layer 3 (and optional layer 7) message display showing all available messages and the progress of key RF parameters and events over time. These displays provide a level of detail that can almost completely replace drive test for routine problem investigation. Variables such a subscriber, cell, or handset type can be input for rapid report creation featuring just the information required for the problem under investigation.

Optimization

The Problem Identification Wizard is another advanced feature of GEOperformance and forms part of the **optimization** module which guides the user through the process of identifying, prioritizing and analyzing geographic problem areas within the network. This provides an extremely subscriber focused approach to problem identification, troubleshooting, and optimization. The wizard follows a three stage process:

- Configure filter to identify the time and area to analyze and set other basic filter constraints on the analysis

- Select the types of problems to investigate and set key thresholds to govern the definitions of each problem type
- Prioritize problem areas to search the defined area to identify the highest priority cases of each problem type selected.

Email & SMS Alerts

GEOperformance also has the capability to send automated email and SMS alerts to one or a group of users informing them that one or many KPI thresholds have been breached.

The alerts and thresholds are configured at the time of set-up and for the same multi-technology KPIs that are viewed in the GEOperformance dashboard.

Flexible Web Reporting

The web reporting module allows powerful GEOperformance reports to be shared in a controlled fashion across the wider community. Reports can be defined, and then published on either a scheduled or ad hoc basis with controlled access provided to any user with appropriate web access.

Web Reporting contains a number of distinct features:

- VIP is a reporting capability to monitor the performance experienced by a set of VIPs. VIP reporting is configured using the VIP list and is password protected.
- Monitoring provides visibility regarding the NITRO GEO system performance.
- Reports are based upon NITRO GEO documents presenting Map, Table, and Chart controls across multiple canvases. Reports can be published in an ad-hoc manner or can be scheduled to be regularly updated.
- Raise a Case provides a shortcut to the VIAVI Support portal.
- A user can access Web Reporting and view a list of available published reports. These may be one-off reports published by users or reports from scheduled templates set up by an administrator.

Monitoring/optimizing network quality

When viewing a map within GEOperformance for a region, cells with active alarms or configuration changes can be highlighted and displayed on a dedicated layer of the map. This allows an engineer to rapidly identify cells of interest and those events or changes that could be contributing to poor performance.

Troubleshooting customer impacting network events

When troubleshooting a customer impacting issue, GEOperformance provides a number of methods to identify which cell or cells are causing or contributing to the problem such as a "Top N" table. From any such table it is possible to identify and drill down to any correlated event to understand the exact nature of any alarms or recent changes on the selected cell.

Automated network improvements

As well as extensive features to assist engineers in identifying problems and improving network performance manually delivering significant business benefits, GEOperformance also provides automation features that reduce cycle time and deliver game changing network improvements with dramatically reduced requirements on skilled resources.

Automated problem detection

Automated problem detection allows the user to configure rules, combining metrics, to identify areas where the customer experience does not meet the desired levels. Not based on macro cell-level statistics, GEOperformance allows areas significantly smaller than the cell footprint, which might be missed in counter based systems, to be readily identified.

The identified areas are presented as clear polygons on the map, and each area can be further investigated by automatically drilling down with a pre-defined template customized to the operator's workflow.

Automated neighbor planning

Automated neighbor planning functionality uses measurements from real subscriber calls and events to identify the neighbor relationships that are actually experienced and used in the field. Uniquely, GEOperformance is able to identify inter-technology neighbor relationships using geolocated measurements.

Clear reports with prioritized recommendations are produced and the recommended changes can be further investigated with an intuitive "spider" visualization feature before confirming a set of changes.

RAN Sharing

For shared RAN deployments, whether site share, Multi-Operator Core Network (MOCN) or Multi-Operator Radio (MORAN) scenarios, GEOperformance allows, depending on the view desired, **the ability to**:

• Observe only the operator's own subscribers' experience with non-home subscribers filtered out.

• Observe only the operator's own RAN network performance and usage with call traces for only the home network resources, while non-home traffic is filtered out and non-home subscribers identities are anonymized.

• Observe all traffic across the share network for usage and performance, but filtered by PLMN, network elements, and with selectable anonymization of non-home subscriber identities.

The NITRO GEO platform

The heart of GEOPerformance is the NITRO GEO platform, which connects to the Network OSSs to collect subscriber generated trace data. Using patented methods, billions of events per day are geolocated, analyzed and loaded into the intelligence store.

The platform supports the widest range of infrastructure vendors and cellular technologies in the industry, with support for GSM, UMTS, LTE, Small Cell (Femto and Wifi), and coming in 2019: 5G NR. A key feature of the multi-technology support is that the data is available in a single unified data structure, enabling the NITRO GEO applications to be truly subscriber centric and perform analytics that span technology layers. NITRO GEO represents the complete subscriber experience regardless of the access technology in use at the time.

The NITRO GEO platform leads the industry in terms of scalability and efficiency. Running on commodity servers with horizontal scalability and virtualization designed in from the outset, the solution is in use network wide 24/7 today in many networks worldwide.

Network connectivity

NITRO GEO collects event data directly from the network equipment OSSs. It also integrates with planning systems and configuration databases to get the latest information about precise network configuration.
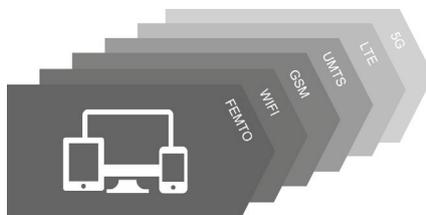
The VIAVI enhanced end-to-end solution

Due to the complexity of modern networks and consumer's changing habits, optimization of the RAN needs to have a wider view of the true customer experience. NITRO GEO utilizes the expertise of VIAVI to enhance and enrich the RAN network information with information obtained from the core network using the VIAVI software agents.

LTE IMSI enrichment

Capturing Subscriber based data from the MME including IMSI and IMEISV information to correlate with the call trace data from the eNodeB can sometimes be a challenge for operators and also can be expensive.

By extending the NITRO GEO with deployment of the Enrichment Agent Module, operators can benefit from a NEM independent consistent feed of IMSIs together with IMEISV data to enrich the call trace eNodeB based data. The module passively monitors the signaling links around the MME to build the subscriber intelligence. The signaling links monitored are S1-MME, S6a, S10 and S11.

The Enrichment Agent Module provides a NEM independent and consistent MME feed to the NITRO GEO system.

GEO-Located Application Awareness for the RAN

Subscriber application usage by specific location would give operators a rich insight into network, service, and subscriber usage. Managing customer QoE, performance engineering, VIP assurance, and decisions on CapEx are all more difficult to optimize without understanding who is doing what (which app) with what handset, where the service is being used and when. By delivering app-aware geo-located subscriber-centric insight, operators now have a deeper understanding of app usage upon which to make business decisions. NITRO GEO takes this app-aware information based on Service (Category, Type, Name) along with Throughput KPIs and geolocates this intelligence.

Now operators can make decisions based on accurate app-aware data, and, for example, analyze where subscribers are streaming audio or video, downloading music, etc.

VoLTE Call Voice Quality

VoLTE is highly sensitive to packet delay, loss, and jitter. Passive monitoring of VoLTE service quality is typically delivered through a MOS or R-Factor measurement. This helps to determine the VoLTE subscriber QoE.

By extending the NITRO GEO solution with deployment of the VoLTE Agent Module on the network signaling links as well as the user plane links, operators can build highly accurate voice quality metrics together with IMS KPIs and geo-locate that information to determine, for example, VoLTE poor quality hot spots.

Parameters include R-Factor, MOS, Jitter, Delay, Packet Loss (uplink and downlink) and One-way audio. The VoLTE Agent Module provides a true end-to-end view of subscriber's VoLTE voice quality.

Scalability, Performance and Virtualization

The NITRO GEO platform is unprecedented, being the only subscriber-centric location intelligence solution proven to deliver carrier grade performance and scale needed to meet operators' growing demands. NITRO GEO utilizes several servers to load, parse, and store the network data, scaling horizontally, with typical systems handling several billion connections per day. The NITRO GEO platform uses a distributed architecture with enterprise grade commodity servers feeding a single big database, optimizing hardware costs. Data retention is limited only by the configured storage.

VIAVI Solutions NITRO GEO can be hosted on a virtualized/cloud based infrastructure. Which means the various software components will be installed on a virtualized environment as an infrastructure-as-a-service (IaaS) as opposed to the use of dedicated server hardware. VIAVI has several current commercial deployments of NITRO GEO in this mode of operation in several Tier 1 operators around the globe enabling the handling of huge amounts of data and providing a cost effective platform for future growth.

Scale	Processing 625 billion events per day in 1 system = over 7 million events per second = over 100 x number of Google searches per day
Performance	Over 5m PPS per agent processed Over 40 Gbps of UP traffic per agent processed
Virtualization	476 virtual machines across 28 clusters

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