Policy Traffic Switch

Achieve your policy control goals with the world's most powerful, scalable, and efficient Policy and Charging Enforcement Function (PCEF) and Traffic Detection Function (TDF)

The Policy Traffic Switch (PTS) – Sandvine's PCEF/TDF – provides the data plane features to enable a wide range of network policy control and policy management use cases.

Sandvine Policy Engine

Link any conditions to any actions in real-time; gain vital business intelligence, launch new subscriber services, detect and block cyber threats, apply precise congestion management policies, and enable powerful subscriber engagement channels.

Performance Efficiency and Extreme Scalability

Industry-best efficiency and scalability:

- Scales from less than 1 Gbps to 8.4 Tbps
- Intersect up to 200 Gbps per rack unit
- Power-sipping 3.6 W / Gbps
- Cost-effective Active/Active, N:N+1 redundancy

Universal Policy Control

Deploy in any network, with any combination of access technologies, using 1GE, 10GE, 40GE, or 100GE interfaces, and standards-compliant protocols.

NFV-Ready

The PTS is available on purpose-built, high-performance hardware or as a fully virtualized solution.

Traffic Classification

The PTS offers industry-leading reliability with its deep packet inspection (DPI) and traffic measurements, including recognition for more than 1,300 encrypted protocols and applications, and a range of quality of experience (QoE) and network health metrics.

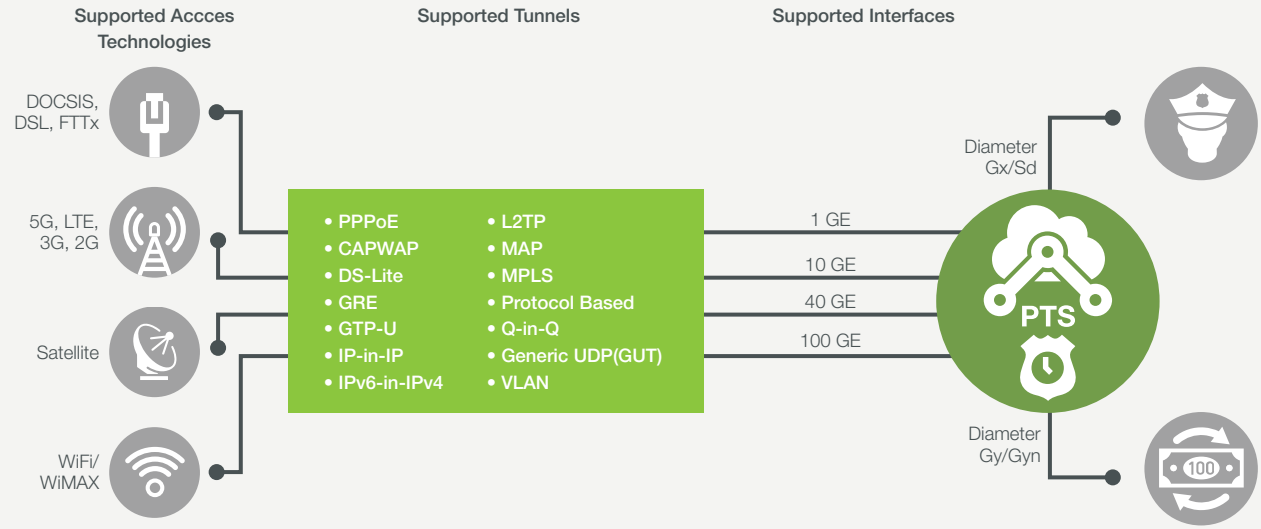
Policy and Charging Control

Standards-compliant 3GPP Diameter interface support (Gx, Gy, Sd) seamlessly integrates to your existing PCC infrastructure.

Do More, with Massive RAM

The PTS supports more policy-based use cases, enables encrypted traffic identification via advanced algorithms (e.g., machine learning, behavioral correlation), allows more concurrent subscribers, etc.

Figure 1



THE SANDVINE POLICY ENGINE

Take control of your network by linking conditions to actions in real-time.

The Sandvine Policy Engine[1] is the brain of our platform, and is the foundation of all of our policy control solutions. It lets you realize your business objectives by linking any set of conditions to any set of actions, in real-time.

Information about measured conditions and provisioned subscriber entitlements flows into the Policy Engine, and charging updates, management actions, and business intelligence data emerge.

SandScript and DevOps

The Policy Engine is driven by a highly configurable policy language called SandScript. Much more than a simple rules system, SandScript lets operators programmatically define and associate an infinite set of policy statements, any of which can affect a particular entity, such as a subscriber, in a specific context.

Changes made within the guiding SandScript "instructions" become immediately active—making SandScript the perfect tool for the DevOps environments that are becoming increasingly common in network operators' organizations.

Unified Policy Control

In Sandvine's platform architecture, the Policy Engine operates in the data plane within the PTS, and in the control plane within the Service Deliver Engine (SDE), Sandvine's Policy and Charging Rules Function (PCRF). It also interacts with the B/OSS plane and remote enforcement points using industry standards. This unification across the control and data planes delivers many benefits:

- **Simplicity:** Network operators define a policy once, and it is seamlessly and consistently applied across control and data planes
- **Efficiency:** Control signaling and the load on PCRF elements are significantly reduced, since decisions are made within the data plane whenever possible
- **Velocity:** Policy decisions are made faster whenever possible, without needing to wait for a query to and response from a PCRF
- **Consistency:** The control and data planes have a common model of network policy control, so they have an equivalent understanding of what the business policy means and how it is implemented
- **Universitality:** Network policy control is completely agnostic of access technologies and vendors within the network

1. More information about the Sandvine Policy Engine is available online at: https://www.sandvine.com/technology/policy-engine.html

Embedding Intelligence in the Data Plane

Within the data plane, the PTS provides the physical and logical interfaces that the Sandvine Policy Engine needs to take in information and output/enforce actions—from the physical interfaces through which data traffic enters the traffic classification subsystem, to the Diameter interfaces out of which real-time charging updates stream.

In addition to enabling remote policy enforcement, the PTS can enforce a number of actions directly, in real-time (e.g., shape, mark, block, divert, tee, etc.).

Whenever possible, the policy control decision is made within the PTS, without signaling or querying the PCRF. For the majority of policy decisions, sufficient information (i.e., all the required conditions that impact a decision) to determine the appropriate actions is available within the PTS already, so it doesn't incur unnecessary load on the control plane or latency in the decision itself. Of course, when the required context extends beyond what the PTS "knows", it can acquire additional information from, or pass the decision to, the control plane via a number of logical interfaces.

ACCURATE, REAL-TIME TRAFFIC CLASSIFICATION

Accurate traffic identification and insightful measurements form the foundation of business intelligence and network policy control.

Without identifying and measuring the traffic flowing on their networks, network operators are unable to craft new subscriber services, optimize shared resource utilization, ensure correct billing and charging, and defend against modern cyber threats.

Our Philosophy: Accuracy

Sandvine's philosophy towards traffic identification is to focus on accuracy above all else: we will not sacrifice accuracy (i.e., we will not accept false positives) to reduce the amount of unrecognized traffic. Simply put, false positives are unacceptable to us.

That said, our customers routinely benefit from traffic recognition rates upward of 95%.

Traffic Classification: Identification and Measurements

To identify traffic, Sandvine uses a range of techniques, including signatures, trackers, analyzers, and heuristics (e.g., machine learning). Sandvine's traffic identification is achieved without false-positive-prone, port-based dependencies or "suspected" catch-all categories. Beyond simply identifying traffic, these techniques provide deeper insight into traffic attributes, including device model, operating system, browser, codecs, content provider, stream type, etc., and distinguish between client devices and access devices (e.g., to determine if a device is tethered)—even behind a home router.

Additionally, insight extends to detailed measurements, including byte volume, time/duration, discrete events, round-trip times (RTT), and more. These measurements provide insight in and of themselves, but also power a range of subscriber QoE and network health metrics that are terrific additions to any customer experience management (CEM) initiatives.

The information gathered by these traffic identification and measurement techniques is available for use as conditions within the Sandvine Policy Engine, for exceptionally tailored policy control use cases.

Keeping your traffic classification capabilities up to date is simple and doesn't interrupt service: new recognition capabilities are delivered in Loadable Traffic Identification Packages (LTIPs), and Control Center makes the update process itself a breeze[2].

Built for an Encrypted Internet

Over time, more and more Internet traffic is being encrypted to protect private content from prying eyes. It's important to note, though, that traffic identification is a very different function than content inspection; in fact, Sandvine already identifies more than 1,300 encrypted protocols, applications, services, etc.

2. You can watch the process in action in this video: https://www.youtube.com/watch?v=b0Y8J01IfW8

Furthermore, unlike embedded alternatives built into gateways, the PTS has enough processing capacity and memory to use advanced techniques including machine learning and behavioral correlation, so network operators can rest assured that they'll continue to gain valuable, unique insights from their Sandvine deployments.

Unmatched Tunnel Support

A significant portion of traffic is contained within tunnels (e.g., GTP, GRE, L2TP, Q-in-Q, and IP-in-IP) or encapsulation (e.g., MPLS, EoMPLS, and VLAN).

Sandvine's technology works even in the presence of multiple tunnels and encapsulations by removing the flow headers, performing the inspection, and then reapplying the same headers.

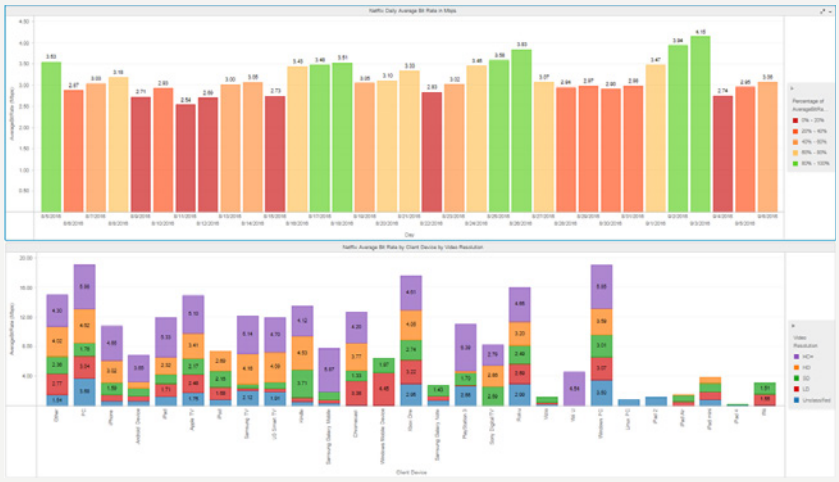
Gaining Insight

The statistics and data gathered and produced by the PTS[3] are easily explored in a variety of graphical interfaces (see examples below) and can also be exported into your existing big data and business intelligence systems.

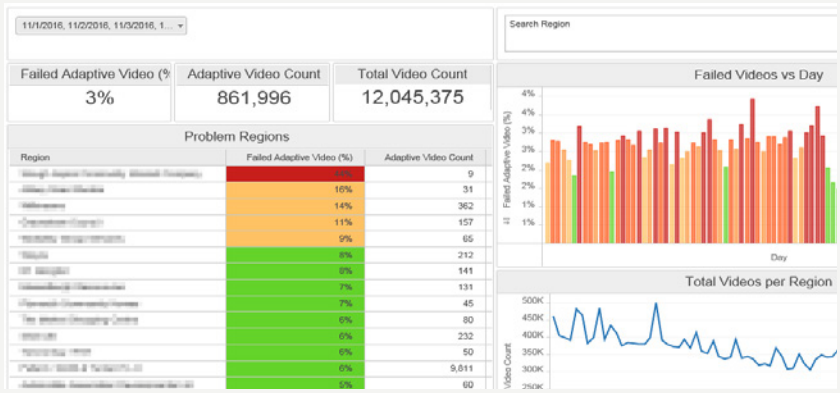
3. Much more information about our traffic classification capabilities is available online at: https://www.sandvine.com/technology/traffic-classification.html

Figure 2

NETFLIX QUALITY DASHBOARD
This Network Analytics dashboard lets the operator monitor Netflix quality and device characteristics



VIDEO PROBLEM SEEKER
This Network Analytics dashboard identifies problem areas on the network that need immediate action



PCEF AND TDF SPECIFICATIONS FOR POLICY AND CHARGING CONTROL

The PTS complies with PCEF and TDF standards, for rapid deployment, straightforward integration, and predictable behavior.

The 3GPP standards and interfaces specifications are important guidelines that ensure efficiency across the industry, ease multi-vendor interoperability, and contribute to predictable costs and deployment timelines. Within the 3GPP framework, the PCEF and TDF fulfill several functions:

- **Traffic Detection:** identifying and measuring of Internet data traffic, including over-the-top (OTT) services

- **Policy Enforcement:** applying direct and indirect management policies to ensure optimal traffic flow
- **Charging Enforcement:** ensuring billing and charging is applied correctly by reporting usage to online and offline charging systems (OCS/OFCS)

Diameter Sd interface

The Sd component of the PTS complies with the 3GPP Release 12 (Rel. 12 TS 29.212) standard, to support advanced use cases:

- Acceptance of Diameter Sd messages from the PCRF (Solicited Application Reporting)
- Application awareness and notifications
- Differentiated charging powered by the Gyn interface

Importantly, the Sd interface between the PTS is direct, to maximize reporting and charging accuracy, reliability, and scalability.

Diameter Gy interface

The Gy component of the PTS complies with the 3GPP Release 10 (TS 32.399 V10.10.0) standard; the Termination Action complies with 3GPP Release 11 (TS 32.299) standard. Sandvine's Gy implementation is:

- **Direct:** The PTS and the OCS are connected directly (i.e., no intermediary function or element)
- **Real-Time:** Charging is processed immediately

Access Agnostic

The PTS can be deployed in any IP network (e.g., DOCSIS Cable, Fiber, DSL, WiFi, WiMAX, Satellite, 3G, LTE, etc.), whether physical or virtualized.

Traffic classification for dedicated data bearers

The PTS delivers advanced LTE-based use cases, including:

- Revenue assurance
- Fraud protection prevention

Resilient Charging and Billing

The PTS is capable of starting the Gy(n) session with the OCS even when the PCRF or the Sd interface is unavailable, by leveraging other sources for subscriber awareness (e.g., GTP-C signaling, RADIUS, or the SPR). This feature makes charging resilient to PCRF, Gx, SPR, and Sd interface failures.

Diameter Signaling Minimization

Market-leading signaling efficiency reduces signaling costs on Gx and Sd interfaces at the PCRF and PGW.

Service Chaining

Service function chaining is enabled via Sandvine's patented Divert technology (e.g., divert, late divert, and multi-divert) in both IPv4 and IPv6 environments.

Policy-Driven Gx Triggers

The PTS enables operators to initiate a Gx interface trigger towards the network's PCRF, to notify the PCRF about changes that aren't signaled directly from the core network components over RADIUS or GTP-C (e.g., subscriber location changes, OCS operational changes, etc.). With this feature, it's possible to define any vendor-specific trigger value and send it towards the PCRF. For instance the PTS can:

- Notify the PCRF about congestion events or QoE degradation
- Notify the PCRF that the user is accessing a URL from a sponsored website

Configuration and Monitoring

Remote configuration and monitoring are possible via:

- REST API client
- SNMPv2 (RFCs 1905, 2578, 4318) and SNMP v3 (RFCs 3411-3418)
- TACACS+ (RFC 1492)
- NTP (RFC 1305)

PTS CLUSTERS

PTS units cluster together to deliver enormous linear scalability, to ensure processor core affinity, and to provide efficient, cost-effective N:N+1 redundancy.

To be a viable solution in modern communications networks, stateful packet-processing equipment must overcome the challenges posed by routing asymmetry and immense scale, while providing effective redundancy in case of unit or link outages.

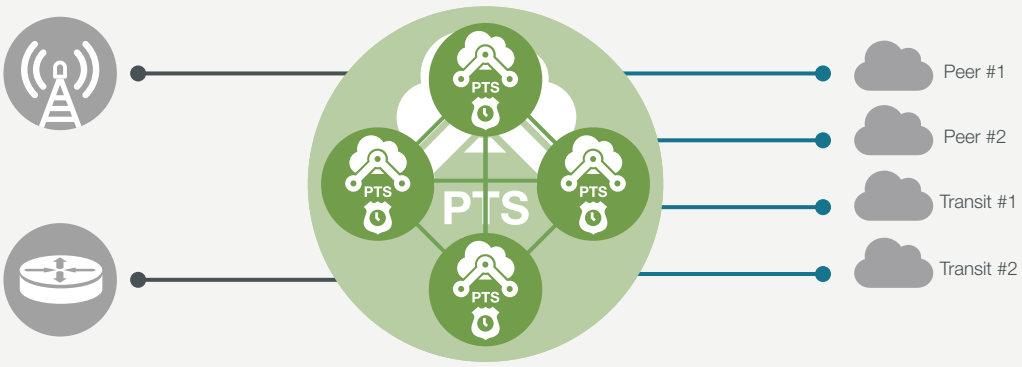
Clustering – that is, connecting many PTS units together to function as one – works by combining the intersection and processing capacity of many units and ensuring that all packets associated with a flow, session, and subscriber are always processed by the same processor core, regardless of the physical interface through which they enter the cluster. This characteristic, called processor core affinity, is absent from many alternatives and is a major reason why the PTS can do things that other solutions can't.

Creating or expanding a cluster is easy: as new PTS elements are added to the cluster, the cluster goes into auto-discovery mode and recognizes the new PTS element. Traffic is then passed over to this element for processing. Importantly, a PTS cluster is managed as a single unit through Control Center, so there isn't any added operational management complexity, and clusters don't introduce any meaningful latency.

Providing Efficient, Cost-Effective Redundancy

PTS unit redundancy follows an N:N+1 model, which is both cost-effective and efficient. Simply put, an operator determines the number of PTS units required to meet a target scale, and then adds one more. All units in the cluster participate equally in the deployment; if one fails, then traffic is automatically rebalanced to the remaining units.

Figure 4



Delivering Linear Scalability

Perhaps the most differentiating characteristic of the PTS is the capability to linearly increase the performance of a deployment by adding new units. Each new PTS adds its entire intersection, inspection, and state memory to the deployment; this means that—thanks to core affinity—processing capacity can be added without the diminishing returns associated with alternatives. As your network grows, your deployment can grow steadily with it.

Overcoming Routing Asymmetry

Routing asymmetry increases network efficiency and redundancy, but also presents serious challenges that must be overcome to allow network operators to implement critical use cases such as accurate charging, policy-based measurements, and precise congestion management.

Once again, maintaining core affinity is the critical feature, ensuring that regardless of the routing path subscriber traffic always goes to the same processor core. Alternatives that share state to address asymmetry by approximately coordinating activities between processor cores suffer from performance degradation and diminishing returns as systems are added.

There is no substitute for preserving processor core affinity.

Policy Traffic Switch 32000 Series

	PTS 32400	PTS 32100	Description
Capacity			
Intersection Throughput	400 Gbps	150 Gbps	The maximum bandwidth that can be intersected by the PT
Inspection Throughput	375 Gbps	150 Gbps	The maximum bandwidth that can be processed by the PTS with all packets inspected (i.e., no shunts, no drops). For smaller deployments, PTS 32000 inspection throughput can be licensed incrementally.
Cluster Throughput	6.4 Tbps	2.4 Tbps	The maximum throughput in a cluster of PTS 32000 units
Concurrent Flows	90 M	36 M	The maximum number of flows processed by the PTS at the same time
Subscribers	30 M	12 M	The maximum number of subscribers for whom basic subscriber statistics can be collected within the default reporting interval
Average Latency	85 µs	81 µs	The median latency of a packet processed by a PTS.
Interfaces			
Console	2		Used for management
Control/ Management	2		Used for management
Integrated Ports	4 x 100GE or 4 x 40GE;		Data port only; each 40GE port can be used as 4 x 10GE with an MPO/MTP breakout cable
	8 x 1/10GE		Configurable as a Service interface with a 1GE optic
			Configurable as a Data, Cluster, or Service interface with a 10GE optic
	9 x 40GE		Each is configurable as a Cluster or Service port; can be used as a 4 x 10GE with a MPO/MTP breakout cable
Number of Blade Slots	1		Field replaceable – not hot swappable
Supported Data Blades	BLD 32080 (2 x 40GE)		For more information, please refer to the PTS Blades table
Optics	SFP/SFP+/QSFP+/CFP4		Compatible with integrated ports
Physical Specifics			
Size	2RU		432 mm x 89 mm x 585 mm / 17” x 3.5” x 23” (Width x Height x Depth)
Weight	27.3 kg (60 lbs)		Includes blade
Power			
Power Consumption	1440W	800W	Fully populated power consumption
Performance Efficiency	3.84 W/Gbps	5.33 W/Gbps	Watts consumed per gigabit per second of traffic
Redundancy			
Internal Bypass Blades	BLD 32042		For more information, please refer to the PTS Blades table
Configuration	N:N+1		Via Sandvine’s unique clustering technology
Replacable Components			
Power Supplies	2 x hot swappable		Field replaceable;
Hard Disk Drive	1		Field replaceable - not hot swappable
Chassis Fans	4		Field replaceable - not hot swappable
Blades	1		Field replaceable - not hot swappable
Regulatory Compliance			
Compliant with international standards for product safety and electromagnetic compatibility (EMC); NEBS Level 3 Certified			

PTS BLADES

Blades provide additional flexibility, letting operators customize deployments to meet specific requirements. The table below provides details on the PTS blades and their compatibility with different PTS models.

Blade	Type	Interfaces	Specifics	PTS Compatibility
BLD 32042	Bypass	4 bypass	9 µm fiber	PTS 32000 Series
BLD 32080	Data Intersect	2 x 40GE	QSFP ports 80 Gbps aggregate throughput Only used in 4 x 10G configuration with an MPO/MTP breakout cable	

PTS VIRTUAL SERIES

Built on the Linux operating system (CentOS), and combined with Intel's virtual computing technologies, including the Data Plane Development Kit (DPDK), the PTS Virtual Series delivers performance previously reserved only for proprietary hardware solutions.

Performance specifications for the PTS Virtual Series are determined on a virtual core basis and are dependent upon the processor characteristics (e.g., clock speed), with throughput increasing linearly as the number of virtual cores assigned to the PTS application increases. The performance numbers in the table below used an Intel® Xeon® E5-2698 v3 2.3 GHz processor.

Specifications	3 vCPU	5 vCPU	10 vCPU	20 vCPU	40 vCPU	80 vCPU
Throughput	5 Gbps	10 Gbps	20 Gbps	40 Gbps	80 Gbps	160 Gbps
Subscribers	375,000	625,000	1.2 M	2.5 M	5 M	10 M
Concurrent Flows	1 M	1.8 M	3.6 M	7.2 M	14 M	28 M

The PTS Virtual Series is qualified and tested on the QEMU (KVM) and ESX (VMware) hypervisors on a CentOS operating systems.

SANDVINE'S VIRTUALIZATION ECOSYSTEM

The entire Sandvine Virtual Series (e.g., PTS Virtual Series, SDE, Subscriber Policy Broker) has been extensively tested in a rich, growing partner ecosystem and has been granted a number of certifications. Our partners include:

CONTROL CENTER

Simplify Operations without Sacrificing Functionality

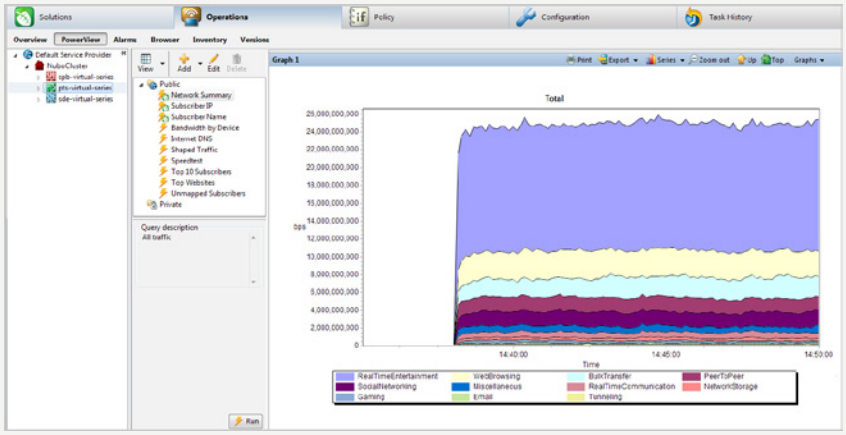
Control Center is Sandvine's unified policy and element management graphical user interface (GUI), and provides a single mechanism for monitoring operational information, editing network policies, configuring elements, and deploying network policy control solutions. Benefit[4] from:

- **Operational Insight:** Monitor the health and status of your entire Sandvine deployment in a central location.
- **Real-Time Visibility:** Control Center lets you examine the real-time performance of your entire Sandvine deployment. From here, you can start by viewing aggregate traffic for the whole deployment and then drill into individual elements.
- **Policy Libraries:** Get a head start on your management policies with a list of pre-defined and comprehensively tested SandScript snippets covering the most common use cases. Just click and import!
- **RuleBuilder:** Build, edit, and deploy policy control rules using the SandScript policy language inside a GUI.
- **ServiceDesigner:** A GUI that lets you "drag-and-drop" features to build a service offering and that utilizes a logical hierarchy to organize your services for ease of management.
- **Easy Software Updates:** Control Center simplifies pushing software updates, including LTIPs, to all PTS elements.
- **Subscriber Mapping Configuration:** A configuration tool that allows you to configure subscriber awareness in your network. Simply choose from the options based on your network architecture.

4. More information is available online: https://www.sandvine.com/platform/control-center/

Figure 4

The PowerView feature of Control Center provides real-time insight into network traffic and operational metrics



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ABOUT SANDVINE

Sandvine helps organizations run world-class networks with Active Network Intelligence, leveraging machine learning analytics and closed-loop automation to identify and adapt to network behavior in real-time. With Sandvine, organizations have the power of a highly automated platform from a single vendor that delivers a deep understanding of their network data to drive faster, better decisions. For more information, visit **sandvine.com** or follow Sandvine on Twitter at **@Sandvine.**

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