Thunder TPS

DDoS Detection, Mitigation & Cloud Protection

A10 Thunder TPS® (Threat Protection System) is the world’s highest-performance DDoS protection solution, leading the industry in precision, intelligent automation, scalability, and performance.

Surgical Multi-Vector DDoS Protection

Ensuring availability of business services requires organizations to rethink how to build scalable DDoS defenses that can surgically distinguish an attacker from a legitimate user.

New threat vectors have changed the breadth, intensity, and complexity of options available to attackers. Today’s attacks have evolved, and now include DDoS toolkits, weaponized IoT devices, online DDoS services, and more. Established solutions, which rely on ineffective signature-based IPS or only traffic rate-limiting, are no longer adequate.

Thunder TPS scales to defend against the DDoS of Things and traditional zombie botnets and detects DDoS attacks through high-resolution packets or flow record analysis from edge routers and switches. Unlike outdated DDoS defense products, A10 Networks’ defenses include detection capabilities across key networks elements including A10 Thunder® ADC, CGN and CFW. These capabilities provide the context, packet level granularity and visibility needed to thwart today’s sophisticated attacks. The One-DDoS Protection detectors work in concert with A10 Networks aGalaxy® Centralized Management System and Thunder TPS for centralized mitigation that delivers fast and cost-effective DDoS resilience.

When attacks grow beyond an organization’s bandwidth capacity, traffic can be diverted to the A10 DDoS Protection Cloud service to defend against volumetric attacks.

A10 Networks is available when you need help most. A10 support provides 24x7x365 services, including the A10 DSIRT (DDoS Security Incident Response Team) to help you understand and respond to DDoS incidents and orchestrate cloud scrubbing. A10 Threat Intelligence Service leverages global knowledge to proactively stop bad actors.

Talk With A10

Web
a10networks.com/tps
Benefits

**Maintain**
**Service Availability**
Downtime results in immediate productivity and revenue loss for any business. Thunder TPS ensures service availability by automatically spotting anomalies across the traffic spectrum and mitigating multi-vector DDoS attacks.

**DEFEAT**
**Growing Attacks**
Thunder TPS protects the largest, most-demanding network environments. Thunder TPS offloads common attack vectors to specialized hardware, allowing its powerful multicore CPUs to distinguish legitimate users from attacking botnets and complex application-layer attacks that require resource-intensive deep packet inspection (DPI).

**Scalable**
**Protection**
Select Thunder TPS hardware models benefit from our Security and Policy Engine (SPE) hardware acceleration, leveraging FPGA-based FTA technology and other hardware-optimized packet-processing for highly scalable flow distribution and hardware DDoS protection capabilities.

**Deploy**
**Wartime Support**
No organization has unlimited trained personnel or resources during real-time DDoS attacks. Thunder TPS supports five levels of programmatic mitigation escalation and de-escalation per protected zone. Remove the need for frontline personnel to make time-consuming manual changes to escalating mitigation strategies and improve response times during attacks. Administrators have the option to manually intervene and coordinate with A10’s DDoS Security Incident Response Team (DSIRT) at any stage of an attack.

**Reduce**
**Security OPEX**
Thunder TPS is extremely efficient. It delivers high performance in a small form factor to reduce OPEX with significantly lower power usage, rack space, and cooling requirements.
Reference Architectures

Proactive Mode
(Asymmetric or Symmetric)

Proactive mode provides continuous, comprehensive detection and fast mitigation. This mode is most useful for real-time environments where the user experience is critical, and for protection against application-layer attacks. TPS supports L2 or L3 inpath deployments. A10 DDoS Protection Cloud provides protection against volumetric attacks that exceed an organization’s internet bandwidth.

Reactive Mode

Larger networks benefit from on-demand mitigation, triggered manually or by flow analytical systems. TPS fits in any network configuration with integrated BGP and other routing protocols. This eliminates the need for any additional diversion and re-injection routers. A10 Networks partners with the industry’s leading visibility and DDoS detection companies to provide additional flexibility for creating best-of-class solutions for each customer’s unique business needs. The flow-detection partner companies leverage Thunder TPS’ open RESTful API (aXAPI® and aGAPI®), to create tightly integrated monitoring solutions that include visibility, detection and reporting.

Reactive Deployment with Thunder TPS Detector

Thunder TPS Detector is available as a standalone appliance or integrated with aGalaxy 5000. The flow-based DDoS detector supports tightly integrated interworking with aGalaxy management and Thunder TPS mitigation for a complete reactive DDoS defense solution.
Reference Architectures

Distributed Detection with One-DDoS Protection

One-DDoS Protection provides full spectrum DDoS protection by placing detection capabilities across key networks elements including A10’s Thunder ADC, CGN and CFW. These capabilities provide the context, packet level granularity and visibility needed to thwart today’s sophisticated targeted attacks. The distributed DDoS detectors work in concert with aGalaxy and Thunder TPS for centralized mitigation that delivers fast and cost effective DDoS resilience.

Out-of-Band (TAP) Mode

The out-of-band mode is used when packet-based DDoS detection and monitoring are required.
Complete Solution
For Flexible Deployments

Thunder TPS DDoS solutions provide a complete solution for DDoS defenses in proactive always-on or on-demand reactive modes to meet their business objectives. Thunder TPS can be deployed in L2 or L3 inpath modes with full IPv4 and IPv6 support. On-demand reactive DDoS detection is facilitated with the collection and analysis of exported flow data records from routers and switches. The Thunder TPS detector applies always-on adaptive learning to build peacetime profiles for protected servers and services, based on 17 flow record traffic indicators to spot anomalous behavior. When an attack is detected, aGalaxy instructs Thunder TPS to initiate a BGP route redirection for the suspicious traffic. Then TPS applies the appropriate countermeasures using a progressive auto mitigation level escalation technique before delivering the clean traffic to the intended destination.

Full Spectrum DDoS Protection for Service Availability

A10 Thunder TPS detects and mitigates broad levels of attacks, even if multiple attacks hit the network simultaneously.

Complete Solution

For Flexible Deployments

Thunder TPS DDoS solutions provide a complete solution for DDoS defenses in proactive always-on or on-demand reactive modes to meet their business objectives. Thunder TPS can be deployed in L2 or L3 inpath modes with full IPv4 and IPv6 support. On-demand reactive DDoS detection is facilitated with the collection and analysis of exported flow data records from routers and switches. The Thunder TPS detector applies always-on adaptive learning to build peacetime profiles for protected servers and services, based on 17 flow record traffic indicators to spot anomalous behavior. When an attack is detected, aGalaxy instructs Thunder TPS to initiate a BGP route redirection for the suspicious traffic. Then TPS applies the appropriate countermeasures using a progressive auto mitigation level escalation technique before delivering the clean traffic to the intended destination.

Features

A10 Thunder TPS is the world’s highest-performance DDoS protection solution. It detects and mitigates multi-vector DDoS attacks with surgical precision while providing unprecedented performance, scalability, and deployment flexibility.

Full Spectrum DDoS Protection for Service Availability

A10 Thunder TPS detects and mitigates broad levels of attacks, even if multiple attacks hit the network simultaneously.

Complete Solution

For Flexible Deployments

Thunder TPS DDoS solutions provide a complete solution for DDoS defenses in proactive always-on or on-demand reactive modes to meet their business objectives. Thunder TPS can be deployed in L2 or L3 inpath modes with full IPv4 and IPv6 support. On-demand reactive DDoS detection is facilitated with the collection and analysis of exported flow data records from routers and switches. The Thunder TPS detector applies always-on adaptive learning to build peacetime profiles for protected servers and services, based on 17 flow record traffic indicators to spot anomalous behavior. When an attack is detected, aGalaxy instructs Thunder TPS to initiate a BGP route redirection for the suspicious traffic. Then TPS applies the appropriate countermeasures using a progressive auto mitigation level escalation technique before delivering the clean traffic to the intended destination.

Features

A10 Thunder TPS is the world’s highest-performance DDoS protection solution. It detects and mitigates multi-vector DDoS attacks with surgical precision while providing unprecedented performance, scalability, and deployment flexibility.

Full Spectrum DDoS Protection for Service Availability

A10 Thunder TPS detects and mitigates broad levels of attacks, even if multiple attacks hit the network simultaneously.

Complete Solution

For Flexible Deployments

Thunder TPS DDoS solutions provide a complete solution for DDoS defenses in proactive always-on or on-demand reactive modes to meet their business objectives. Thunder TPS can be deployed in L2 or L3 inpath modes with full IPv4 and IPv6 support. On-demand reactive DDoS detection is facilitated with the collection and analysis of exported flow data records from routers and switches. The Thunder TPS detector applies always-on adaptive learning to build peacetime profiles for protected servers and services, based on 17 flow record traffic indicators to spot anomalous behavior. When an attack is detected, aGalaxy instructs Thunder TPS to initiate a BGP route redirection for the suspicious traffic. Then TPS applies the appropriate countermeasures using a progressive auto mitigation level escalation technique before delivering the clean traffic to the intended destination.

Features

A10 Thunder TPS is the world’s highest-performance DDoS protection solution. It detects and mitigates multi-vector DDoS attacks with surgical precision while providing unprecedented performance, scalability, and deployment flexibility.

Full Spectrum DDoS Protection for Service Availability

A10 Thunder TPS detects and mitigates broad levels of attacks, even if multiple attacks hit the network simultaneously.

Complete Solution

For Flexible Deployments

Thunder TPS DDoS solutions provide a complete solution for DDoS defenses in proactive always-on or on-demand reactive modes to meet their business objectives. Thunder TPS can be deployed in L2 or L3 inpath modes with full IPv4 and IPv6 support. On-demand reactive DDoS detection is facilitated with the collection and analysis of exported flow data records from routers and switches. The Thunder TPS detector applies always-on adaptive learning to build peacetime profiles for protected servers and services, based on 17 flow record traffic indicators to spot anomalous behavior. When an attack is detected, aGalaxy instructs Thunder TPS to initiate a BGP route redirection for the suspicious traffic. Then TPS applies the appropriate countermeasures using a progressive auto mitigation level escalation technique before delivering the clean traffic to the intended destination.

Features

A10 Thunder TPS is the world’s highest-performance DDoS protection solution. It detects and mitigates multi-vector DDoS attacks with surgical precision while providing unprecedented performance, scalability, and deployment flexibility.

Full Spectrum DDoS Protection for Service Availability

A10 Thunder TPS detects and mitigates broad levels of attacks, even if multiple attacks hit the network simultaneously.

Complete Solution

For Flexible Deployments

Thunder TPS DDoS solutions provide a complete solution for DDoS defenses in proactive always-on or on-demand reactive modes to meet their business objectives. Thunder TPS can be deployed in L2 or L3 inpath modes with full IPv4 and IPv6 support. On-demand reactive DDoS detection is facilitated with the collection and analysis of exported flow data records from routers and switches. The Thunder TPS detector applies always-on adaptive learning to build peacetime profiles for protected servers and services, based on 17 flow record traffic indicators to spot anomalous behavior. When an attack is detected, aGalaxy instructs Thunder TPS to initiate a BGP route redirection for the suspicious traffic. Then TPS applies the appropriate countermeasures using a progressive auto mitigation level escalation technique before delivering the clean traffic to the intended destination.

Features

A10 Thunder TPS is the world’s highest-performance DDoS protection solution. It detects and mitigates multi-vector DDoS attacks with surgical precision while providing unprecedented performance, scalability, and deployment flexibility.

Full Spectrum DDoS Protection for Service Availability

A10 Thunder TPS detects and mitigates broad levels of attacks, even if multiple attacks hit the network simultaneously.

Complete Solution

For Flexible Deployments

Thunder TPS DDoS solutions provide a complete solution for DDoS defenses in proactive always-on or on-demand reactive modes to meet their business objectives. Thunder TPS can be deployed in L2 or L3 inpath modes with full IPv4 and IPv6 support. On-demand reactive DDoS detection is facilitated with the collection and analysis of exported flow data records from routers and switches. The Thunder TPS detector applies always-on adaptive learning to build peacetime profiles for protected servers and services, based on 17 flow record traffic indicators to spot anomalous behavior. When an attack is detected, aGalaxy instructs Thunder TPS to initiate a BGP route redirection for the suspicious traffic. Then TPS applies the appropriate countermeasures using a progressive auto mitigation level escalation technique before delivering the clean traffic to the intended destination.

ZAP
Zero-Day Automated Protection

The ZAP engine utilizes heuristic and machine learning automatically discover mitigation filters without advanced configuration or manual intervention. ZAP speeds the response time against increasingly sophisticated multi-vector attacks while minimizing downtime and errors and lower operating costs.

Non-Stop DNS
Authoritative DNS Cache

A10 Thunder TPS can be configured as a high-performance DNS authoritative cache, enabling Thunder TPS’ Non-stop DNS operational mode to cache common DNS records and respond to queries at rates of up to 70 million queries per second. Non-stop DNS can also work in conjunction with Thunder TPS DDoS defenses to create a highly resilient DNS service.
One-DDoS Protection
Layered, Distributed Detection

One-DDoS Protection provides the freshest approach to full-spectrum DDoS defense, placing detection capabilities across key network elements closest to the targeted elements of the infrastructure. This provides the context, packet level granularity, and visibility needed to thwart today’s sophisticated targeted attacks.

A10 Thunder ADC, CGN, and CFW with integrated DDoS detectors work in concert with Thunder TPS’ edge flow-based detection and centralized mitigation to enable full spectrum DDoS resilience.

A10 DDoS Threat Intelligence
Aggregated and correlated DDoS weapons intelligence from over 40 reputable data sources, is included with support, enabling Thunder TPS to instantly recognize and block traffic to and from known malicious sources. The service includes millions of current and accurate IP addresses of DDoS weapons used regularly in reflected amplification attacks and crippling IoT botnet attacks.

High Performance and Efficiency to Meet Growing Attack Scale
Thunder TPS provides solutions to protect organizations from attacks of all sizes, from 1 to 380 Gbps (or 3 Tbps in a list synchronization cluster).

High-Performance Protection
Select Thunder TPS models have high-performance FPGA-based Flexible Traffic Acceleration (FTA) technology to immediately detect and mitigate up to 60 common attack vectors in hardware -- before data CPUs are involved. Thunder TPS supports protocol and packet anomaly check and blocking of up to 500 million packets per second (Mpps). Thunder TPS enforces highly granular traffic rates up to 100 ms intervals. The enhanced vThunder TPS running on KVM hypervisor provides 100 Gbps throughput in a single virtual appliance and can be expanded to 800 Gbps with eight-way clustering.

Simultaneous Protected Objects
To protect entire networks, applications, and services, Thunder TPS simultaneously mitigates up to 3,000 Zones with individual protection policies that include thousands of hosts, subnets, and services per zone. The scale of simultaneous mitigation helps organizations apply granular controls to protected objects and create profitable DDoS scrubbing services.
Efficient
Intelligent Automation

No organization has unlimited resources or the time for manual interventions. A10 provides the industry’s most advanced intelligent automation capabilities, powered by machine learning throughout the entire protection lifecycle.

Operators define the networks to protect, and A10 defenses do the rest based on the operator’s pre-defined policies, including individual learned detection threshold per monitored entity, automatic traffic redirection orchestration, start of mitigation and escalation, and extract and apply attack pattern filters. When the attack subsides, the network and defenses are returned to peacetime posture and detailed reports are generated for future analysis.

Large Threat
Intelligence Class Lists

Eight lists, each containing up to 16 million entries, may be defined to utilize data from intelligence sources, such as the A10 DDoS Weapons Intelligence Service, in addition to dynamically generated entries of actionable black/white lists.

Zero-day
Attack Protection

DDoS attackers continue to innovate their multi-vector attack arsenals with new attack strategies. Thunder TPS ZAP engine automatically recognizes DDoS attack characteristics and dynamically applies mitigation filters without advanced configuration or manual intervention.

Full Control and Smart Automation for Agile Protection

For network operators, it is critical that a DDoS mitigation solution integrates easily into many network architectures.

Complex
Attack Mitigation at Scale

Thunder TPS tracks more than 27 traffic and behavioral indicators and can apply escalating protocol challenges to surgically differentiate attackers from valid users for appropriate mitigation of up to 256 million concurrent tracked sessions.

Complex application attacks (e.g., HTTP, DNS, etc.) are mitigated with advanced parallel processing across a large number of CPU cores to maintain high-performance system scaling, even for multi-vector attacks.

Easy
Network Integration

With multiple performance options and flexible deployment models, Thunder TPS may be integrated into any network architecture of any size, including MPLS. And with aXAPI, A10’s 100-percent programmable RESTful API, Thunder TPS easily integrates into third-party detection solutions and into agile SecOps workflows.

Leveraging open standards like BGP Blackhole and Flowspec functionality, Thunder TPS mitigation integrates easily with any DDoS detection solution. Open APIs and networking standards enable tight integration with other devices, including A10 threat detection partners, SDN controllers, and other security products.
EFFECTIVE Management

Thunder TPS supports an industry-standard CLI, on-box GUI, and the aGalaxy management system. The CLI allows sophisticated operators easy troubleshooting and debugging. The intuitive on-box GUI enables ease of use and basic graphical reporting. aGalaxy offers a comprehensive dashboard with advanced reporting, mitigation console, and policy enforcement for multiple TPS devices.

aGalaxy is available with an optional integrated Thunder TPS detector that supports tightly integrated interworking of Thunder TPS DDoS mitigation, flow-based DDoS detection, system-wide management, and robust reporting.

---

Thunder

7655 TPS

by the Numbers

1.2 Tbps
HW Blocking

380 Gbps
Throughput

3 Tbps
Throughput in Cluster

8x16M
Threat Class Lists

100 GbE Ports

500 Mpps

60 Hardware Mitigations

64K Protected Objects

---

7655 TPS (Thunder by the Numbers)
# Thunder TPS Physical Appliance Specifications

## Performance

<table>
<thead>
<tr>
<th></th>
<th>Thunder 1040 TPS</th>
<th>Thunder 3040 TPS</th>
<th>Thunder 4435 TPS</th>
<th>Thunder 5845 TPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput (Software Scrubbing)</td>
<td>5 Gbps</td>
<td>10 Gbps</td>
<td>38 Gbps</td>
<td>100 Gbps</td>
</tr>
<tr>
<td>Hardware Blocking</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>250 Gbps</td>
</tr>
<tr>
<td>Packets Rate (pps)*</td>
<td>2.5 Million</td>
<td>4.5 Million</td>
<td>20 Million</td>
<td>28 Million</td>
</tr>
<tr>
<td>Software-based – SYN Authentication (pps)</td>
<td>2.5 Million</td>
<td>4.5 Million</td>
<td>20 Million</td>
<td>28 Million</td>
</tr>
<tr>
<td>Hardware-based – Anomaly Flood Blocking (pps)</td>
<td>N/A</td>
<td>N/A</td>
<td>55 Million</td>
<td>125 Million</td>
</tr>
<tr>
<td>Maximum Concurrent Sessions (Asymmetric Deployment)</td>
<td>8 Million</td>
<td>8 Million</td>
<td>32 Million</td>
<td>48 Million</td>
</tr>
<tr>
<td>Average Latency</td>
<td>10 µs</td>
<td>10 µs</td>
<td>35 µs</td>
<td>50 µs</td>
</tr>
<tr>
<td>Minimum Rate Enforcement Interval</td>
<td>100 ms</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Flow Detection Performance

<table>
<thead>
<tr>
<th></th>
<th>N/A</th>
<th>1 Million</th>
<th>3 Million</th>
<th>3 Million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flows Per Second (fps)</td>
<td>Hardware Bypass Model</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Network Interface

<table>
<thead>
<tr>
<th></th>
<th>1 GE Copper</th>
<th>1 GE Fiber (SFP)</th>
<th>1/10 GE Fiber (SFP+)</th>
<th>1/10 GE Fiber (Fixed)</th>
<th>100 GE Fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bypass Model</td>
<td>5</td>
<td>0</td>
<td>4*</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1 + 4 (Bypass)</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>2</td>
<td>16</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

## Hardware Specifications

<table>
<thead>
<tr>
<th></th>
<th>Intel Communications Processor</th>
<th>Intel Xeon 4-core</th>
<th>Intel Xeon 10-core</th>
<th>Intel Xeon 18-core</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>Intel Xeon 4-core</td>
<td>Intel Xeon 10-core</td>
<td>Intel Xeon 18-core</td>
<td></td>
</tr>
<tr>
<td>Memory (ECC RAM)</td>
<td>16 GB</td>
<td>64 GB</td>
<td>64 GB</td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>SSD</td>
<td>SSD</td>
<td>SSD</td>
<td></td>
</tr>
<tr>
<td>Rack Units (Mountable)</td>
<td>1U</td>
<td>1U</td>
<td>1U</td>
<td></td>
</tr>
<tr>
<td>Unit Weight</td>
<td>14 lbs</td>
<td>16 lbs (RPS)</td>
<td>20.6 lbs</td>
<td>34.5 lbs</td>
</tr>
<tr>
<td>Power Supply (DC option available)</td>
<td>Single 750W*</td>
<td>Dual 600W RPS</td>
<td>Dual 1100W RPS</td>
<td>Dual 1500W RPS</td>
</tr>
<tr>
<td>Power Consumption (Typical/Max)*</td>
<td>80W / 110W</td>
<td>180W / 240W</td>
<td>350W / 420W</td>
<td>585W / 921W</td>
</tr>
<tr>
<td>Heat in BTU/Hour (Typical/Max)**</td>
<td>273 / 376</td>
<td>615 / 819</td>
<td>1,195 / 1,433</td>
<td>1,997 / 3,143</td>
</tr>
<tr>
<td>Cooling Fan</td>
<td>Removable Fans</td>
<td>Hot Swap Smart Fans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Ranges</td>
<td>Temperature 0° - 40° C</td>
<td>Humidity 5% - 95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulatory Certifications</td>
<td>FCC Class A, UL, CE, TUV, CB, VCCI, CCC*, BSMI*, RCM *</td>
<td>FCC Class A, UL, CE, TUV, CB, VCCI, CCC, MSIP, BSMI, RCM, EAC, NEBS</td>
<td>FCC Class A, UL, CE, TUV, CB, VCCI, CCC, BSMI, RCM, EAC, NEBS</td>
<td>FCC Class A, UL, CE, TUV, CB, VCCI, CCC, BSMI, RCM, EAC, NEBS</td>
</tr>
<tr>
<td>Standard Warranty</td>
<td>90-Day Hardware and Software</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Thunder TPS Physical Appliance Specifications (Cont.)

### Performance

<table>
<thead>
<tr>
<th>Model</th>
<th>Thunder 7445 TPS</th>
<th>Thunder 14045 TPS Single-Module</th>
<th>Thunder 14045 TPS Dual-Module</th>
<th>Thunder 7655 TPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput (Software Scrubbing)*</td>
<td>220 Gbps</td>
<td>150 Gbps</td>
<td>300 Gbps</td>
<td>380 Gbps</td>
</tr>
<tr>
<td>Hardware Blocking</td>
<td>500 Gbps</td>
<td>500 Gbps</td>
<td>500 Gbps</td>
<td>1.2 Tbps</td>
</tr>
<tr>
<td>Packets Rate (pps)*</td>
<td>60 Million</td>
<td>60 Million</td>
<td>110 Million</td>
<td>110 Million</td>
</tr>
<tr>
<td>Software-based - SYN Authentication (pps)</td>
<td>60 Million</td>
<td>60 Million</td>
<td>110 Million</td>
<td>110 Million</td>
</tr>
<tr>
<td>Hardware-based - Anomaly Flood Blocking (pps)</td>
<td>250 Million</td>
<td>220 Million</td>
<td>440 Million</td>
<td>500 Million</td>
</tr>
<tr>
<td>Maximum Concurrent Sessions (Asymmetric Deployment)</td>
<td>64 Million</td>
<td>128 Million</td>
<td>256 Million</td>
<td>256 Million</td>
</tr>
<tr>
<td>Average Latency</td>
<td>50 µs</td>
<td>60 µs</td>
<td>60 µs</td>
<td>70 µs</td>
</tr>
<tr>
<td>Minimum Rate Enforcement Interval</td>
<td>100 ms</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Flow Detection Performance

<table>
<thead>
<tr>
<th>Flows Per Second (fps)</th>
<th>6 Million</th>
<th>N/A</th>
<th>N/A</th>
<th>N/A</th>
</tr>
</thead>
</table>

### DNS Authoritative Cache Performance

<table>
<thead>
<tr>
<th>DNS Queries Per Second (qps)</th>
<th>35 Million</th>
<th>35 Million</th>
<th>N/A</th>
<th>70 Million</th>
</tr>
</thead>
</table>

### Network Interface

<table>
<thead>
<tr>
<th>Network Interface</th>
<th>1/10 GE Fiber (SFP+)</th>
<th>40 GE Fiber (QSFP+)</th>
<th>100 GE Fiber</th>
<th>Management Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>0</td>
<td>4</td>
<td>4 (QSFP28)</td>
<td>Ethernet Management Port, RJ-45 Console Port*</td>
</tr>
</tbody>
</table>

### Hardware Specifications

<table>
<thead>
<tr>
<th>Processor</th>
<th>2 x Intel Xeon 18-core</th>
<th>2 x Intel Xeon 18-core</th>
<th>4 x Intel Xeon 18-core</th>
<th>2 x Intel Xeon 24-core</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory (ECC RAM)</td>
<td>128 GB</td>
<td>256 GB</td>
<td>512 GB</td>
<td>384 GB</td>
</tr>
<tr>
<td>Storage</td>
<td>SSD</td>
<td>SSD</td>
<td>SSD</td>
<td>SSD</td>
</tr>
<tr>
<td>Hardware Acceleration</td>
<td>3 x FTA-4, SPE</td>
<td>4 x FTA-3, SPE</td>
<td>8 x FTA-3, SPE</td>
<td>2 x FTA-5, SPE</td>
</tr>
<tr>
<td>Dimensions (Inches)</td>
<td>175(H) x 175(W) x 30(D)</td>
<td>5.5(H) x 16.9(W) x 30(D)</td>
<td>5.5(H) x 16.9(W) x 30(D)</td>
<td>2.625(H) x 175(W) x 30(D)</td>
</tr>
<tr>
<td>Rack Units (Mountable)</td>
<td>1U</td>
<td>3U</td>
<td>3U</td>
<td>1.5U</td>
</tr>
<tr>
<td>Unit Weight</td>
<td>35.7 lbs</td>
<td>80 lb</td>
<td>102 lbs</td>
<td>44.2 lbs</td>
</tr>
<tr>
<td>Power Supply (DC option available)</td>
<td>Dual 1500W RPS</td>
<td>2+2 1100W RPS</td>
<td>2+2 1100W RPS</td>
<td>Dual 1500W RPS</td>
</tr>
<tr>
<td>Power Consumption (Typical/Max)*2</td>
<td>784W / 1,078W</td>
<td>1,000W / 1,200W</td>
<td>1,700W / 2,000W</td>
<td>965W / 1,222W</td>
</tr>
<tr>
<td>Heat in BTU/Hour (Typical/Max)*3</td>
<td>2,676 / 3,679</td>
<td>3,412 / 4,095</td>
<td>5,801 / 6,825</td>
<td>3,293 / 4,170</td>
</tr>
<tr>
<td>Cooling Fan</td>
<td>Hot Swap Smart Fans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Ranges</td>
<td>Temperature 0° - 40° C</td>
<td>Humidity 5% - 95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulatory Certifications</td>
<td>FCC Class A, UL, CE, GS, CB, VCCI, CCC*, BSMI, RCM</td>
<td>FCC Class A, UL, CE, GS, CB, VCCI, CCC*, BSMI, RCM</td>
<td>FCC Class A, UL, CE, GS, CB, VCCI, CCC*, BSMI, RCM</td>
<td>FCC Class A, UL, CE, GS, CB, VCCI, CCC*, BSMI, RCM</td>
</tr>
<tr>
<td>Standard Warranty</td>
<td>90-Day Hardware and Software</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The specifications and performance numbers are subject to change without notice, and vary depending on configuration and environmental conditions. As for network interface, it’s highly recommended to use A10 Networks qualified optics/transceivers to ensure network reliability and stability.

*1 Throughput performances are traffic-forwarding capacity and measured with legitimate traffic with DDoS protection enabled.
*2 With base model | *3 10Gbps speed only | *4 Optional RPS available | *5 Fixed SFP+ optical ports with dual rate (10GBASE-SR and 1000BASE-SX) |
* Certification in process | + Thunder 14045 comes with a splitter cable for console to provide access to both modules | ‡ Available in Q3 2020
Thunder TPS Virtual Appliance Specifications

### vThunder TPS

<table>
<thead>
<tr>
<th>Supported Hypervisors</th>
<th>VMware ESXi 5.5 or higher</th>
<th>KVM QEMU 2.5 or higher (SR-IOV)</th>
<th>Microsoft Hyper-V on Windows Server 2008 R2 or higher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware Requirements</td>
<td>See Installation Guide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Warranty</td>
<td>90-Day Software</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Bandwidth Licenses

<table>
<thead>
<tr>
<th>1 Gbps</th>
<th>2 Gbps</th>
<th>5 Gbps</th>
<th>FlexPool (40Gbps/100Gbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KVM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMware ESXi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsoft Hyper-V</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lab license is also available  * 5 Gbps license not recommended for Microsoft Hyper-V

### vThunder TPS Sizing Recommendations

<table>
<thead>
<tr>
<th>Performance License</th>
<th>1/2/5 Gbps</th>
<th>40 Gbps*</th>
<th>100 Gbps*</th>
</tr>
</thead>
<tbody>
<tr>
<td>vCPU</td>
<td>6</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>vRAM</td>
<td>16 GB</td>
<td>16 GB</td>
<td>64 GB</td>
</tr>
<tr>
<td>vDisk</td>
<td>60 GB</td>
<td>60 GB</td>
<td>100 GB</td>
</tr>
</tbody>
</table>

*Available in Q3 2020. Requires vThunder TPS running on KVM with SR-IOV enabled. For 100 Gbps, Mellanox Connect X-5 NIC is recommended.

### vThunder TPS Detector Flow Detection Performance*

<table>
<thead>
<tr>
<th>Flows per Second (fps)</th>
<th>150K</th>
<th>500K</th>
<th>1.5M</th>
</tr>
</thead>
<tbody>
<tr>
<td>vCPU</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>vRAM</td>
<td>16 GB</td>
<td>32 GB</td>
<td>64 GB</td>
</tr>
<tr>
<td>vDisk</td>
<td>40 GB</td>
<td>40 GB</td>
<td>40 GB</td>
</tr>
</tbody>
</table>

*Using vThunder TPS Standalone Detector image.
Detailed Feature List
Features may vary by appliance

Detection/Analysis
- In-line packet-based DDoS detection
- Out-of-band flow-based DDoS detection
- Distributed detection
- Individual detection policies for more than 256K servers and services
- Continuous behavioral learning
- Manual and learned thresholds
- Protocol anomaly detection
- Inspection within IPinIP (e.g., networking, encapsulation)
- Black/white lists
- Traffic indicator and top talkers
- Mitigation console
- Packet debugger tool

Resource Attack Protection
- Fragmentation attack
- Slowloris
- Slow GET/POST
- Long form submission
- SSL renegotiation

Application Attack Protection
- Application-aware filter
- Regular expression filter (TCP/UDP/HTTP/SIP)
- HTTP request rate limit (per URI)
- DNS request rate limit (per type)
- SIP request limit (per type)
- Application request malformed check (DNS/HTTP/SIP)
- DNS domain-list
- HTTP/S protocol compliance
- Application (DNS/HTTP/SIP) flood protection
- Signature-based IPS
- QUIC version control and malformed header check

Protocol Attack Protection
- Invalid packets
- Anomalous TCP flag combinations (no flag, SYN-FIN, SYN frag, LAND attack)
- SYN-ACK amplification attack protection
- IP options
- Packet size validation (ping of death)
- POODLE attack
- TCP/UDP/ICMP flood protection
- Per-connection traffic control

Challenge-based Authentication
- TCP SYN cookies, SYN authentication
- ACK authentication
- Spoof detection
- DNS authentication
- HTTP challenge

DDoS Threat Intelligence Service
- Dynamically updated threat intelligence feed
- IP addresses of reflected amplification weapons
- IP addresses of DDoS botnets

Zero-Day Automated Protection
- Machine Learning powered attack pattern recognition and filtering
- Prevent zero-day attacks
- No pre-configuration or manual intervention
- Fast, automated response

Telemetry
- Rich traffic and DDoS statistics counters
- sFlow v5
- NetFlow (e.g., v9, IPFIX)
- Custom counter blocks for flow-based export
- High-speed logging
- CEF logging

Protected Objects
- Protected zones for automated detection and mitigation
- Source/destination IP address/subnet
- Source and destination IP pair
- Destination port
- Source port
- Protocol (e.g., HTTP, DNS, SIP, TCP, UDP, ICMP and others)
- Class list/geolocation
- Passive mode
- Outbound mitigation (destination policy)
Detailed Feature List (Cont.)

**Actions**
- Capture packet
- Run script
- Drop
- TCP reset
- Dynamic authentication
- Add to black list
- Add to white list
- Log
- Limit concurrent connections
- Limit connection rate
- Limit traffic rate (pps/bps)
- Forward to other device
- Remote-Triggered Black Hole (RTBH)

**Management**
- Dedicated on-box management interface (GUI, CLI, SSH, Telnet)
- aGalaxy for comprehensive management
- SNMP, syslog, email alerts
- REST API (aXAPI) or SDK
- LDAP, TACACS+, RADIUS support
- Configurable control CPUs

**Networking and Deployment**
- Proactive, Reactive, Asymmetric, Symmetric, Out-of-Band (TAP)
- Transparent (L2), routed (L3)
- Routing: static routes, BGP4+, OSPF, OSPFv3, IS-IS
- Bidirectional Forwarding Detection (BFD)
- VLAN (802.1Q)
- Trunking (802.1AX), LACP
- Access control lists (ACLs)
- Network Address Translation (NAT)
- MPLS traffic protection
- BGP route injection, FlowSpec
- IPinIP (source and terminate)
- GRE tunnel interface
- VXLAN

**High-Performance, Scalable Platform**
- Advanced Core Operating System (ACOS)
  - Linear application scaling
  - ACOS on data plane
  - Linux on control plane
  - IPv6 feature parity