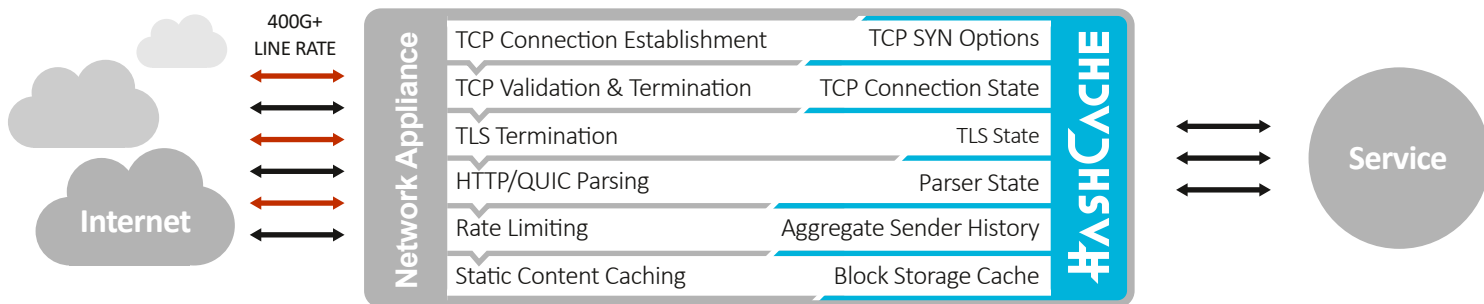# SynoGate HashCache

HASHCACHE FOR STATEFUL NETWORK APPLIANCES

HashCache is a state storage IP-core that solves a fundamental issue in stateful network appliances: how to retrieve and store new state information at sufficient speed such that an attacker cannot overwhelm the device with state-creating requests.

Even with DDR4-SDRAM, HashCache is capable of processing 100+ million packets per second and per memory channel, enabling stateful processing of steps that in the past had to be handled statelessly with all the associated downsides and problems.

DDoS resiliance, high storage capacities, and sub microsecond latencies make HashCache the ideal state storage for stateful network devices exposed to attack traffic, such as stateful firewalls, Intrusion Detection Systems, large-scale TCP/UDP/QUIC servers, CG-NAT and many more!

Internet — 400G+ LINE RATE — Network Appliance — HASHCACHE — Service

Network Appliance	HashCache
TCP Connection Establishment	TCP SYN Options
TCP Validation & Termination	TCP Connection State
TLS Termination	TLS State
HTTP/QUIC Parsing	Parser State
Rate Limiting	Aggregate Sender History
Static Content Caching	Block Storage Cache

THROUGHPUT SCALES LINEARLY

The number of processed packets scales linearly with the number of memory channels due to high parallelism.

COMBINED LUI OPERATIONS

Due to a combined lookup, update, insert and delete operation, on average HashCache needs only 3 memory accesses for worst case traffic and as low as 2.0003 for normal traffic.
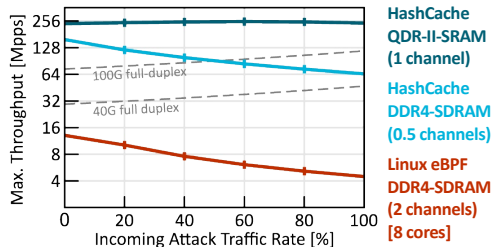
GUARANTEED STATE RETENTION TIME

States have a minimum retention time which scales with the available storage and ensures that even under attack traffic, states of legitimate connections will not be dropped.

LOW STORAGE OVERHEAD

With a storage overhead of only about 4 bytes per entry, HashCache achieves a higher state density than comparable solutions.

Throughput of a stateful network device exposed to attack traffic

Max. Throughput [Mpps] vs Incoming Attack Traffic Rate [%]

- **HashCache QDR-II-SRAM (1 channel)**
- **HashCache DDR4-SDRAM (0.5 channels)**
- **Linux eBPF DDR4-SDRAM (2 channels) [8 cores]**
- 100G full-duplex
- 40G full duplex

While conventional packet processing solutions struggle to reach 40G, HashCache can easily handle any line rate even with DDR4-SDRAM by scaling up the number of memory channels.

In the experiment on the left, throughput is measured with a mix of real world traffic and attack traffic. The real world traffic is sourced from an internet exchange, while the attack traffic consists of minimal packets where each packet creates a new entry in the state memory.

STATEFUL NETWORK PROCESSING AT LINE RATE

APPLICATIONS
- Stateful firewalls
- IDS
- NAT / CG-NAT
- DDoS mitigation
- Web & database caching
- High frequency trading
- Hardware TCP/UDP/QUIC server

FEATURES
- High read throughput
- High insertion rate
- Guarantees on state retention time
- Low latency (0.2 µs on external SRAM)
- SRAM or DRAM
- Low storage overhead
- Energy consumption < 1 µJ/request

KEY BENEFITS
- Stateful processing in exposed networks
- Very resilient to DDoS attacks
- Designed for insert heavy use cases
- Supports billions of states
- Enables single device solutions
- Significant electricity savings
- Reduced TCO

Contact us if you want to learn more about HashCache or commission a custom design.