

# Ultra-Low Latency Key-Value Store (KVS)

## Gateway Defined Networking® for FPGA

### Description

Key-Value Store (KVS) is an essential service for multiple applications. Telecom directories, Internet Protocol forwarding tables, and de-duplicating storage systems, for example, all need key-value tables to associate data with unique identifiers. In datacenters, high performance KVS tables allow hundreds or thousands of machines to easily share data by simply associating values with keys and allowing client machines to read and write those keys and values over standard high-speed Ethernet.

Examples:	Key	Value
Directory	Company Algo-Logic	Phone # (408) 707-3740
Forwarding Tables	IP Address 204.2.34.5	Interface : MAC Address Eth6 : 02:33:29:F2:AB:CC
Data De-duplication	Content Hash XYZ	Storage Block ID 948830038411
Stock Trading	Order ID ATY11217911101	Symbol, Side, Price AAPL, B, 126.75
Graph Search	Virtex v140	Edge List v201, v206, v225

Algo-Logic's KVS leverages Gateway Defined Networking® (GDN) on Field Programmable Gate Arrays (FPGAs) to perform lookups with the lowest latency (sub-microsecond), highest throughput, and least processing energy. Deploying GDN solutions save network operators time, cost, and power resulting in significantly lower Total Cost of Ownership (TCO).

### Applications

- Machine Learning
- Telecom ESN and SIM key value tables
- IPv4 or IPv6 Internet addresses
- Auto-completion
- NoSQL database acceleration
- Tuple lookups
- User preferences and profiles
- Stock market order IDs
- Inventory management
- Multiplayer game servers

### Key Features

- FPGA accelerated ultra-low latency search
- Sub  $\mu$ -Joule/lookup energy consumption
- Deterministic and jitter-free processing
- 10 and 40 Gbps Ethernet line rate support
- Easy to integrate with client software via open-source multi-language APIs
- Supports standard create, read, update, and delete operations

### Hardware Platforms

- Pre-programmed gateway application on a half-height or full-height expansion card that fits into a standard server
- Portable gateway supported on a range of commercially available FPGA card platforms

### Software Controller API Options

- Open-source client software API compatible with C/C++, Java, Python, and other programming languages

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### GDN-Search Reference Design Metrics

<b>Key/Value Search Rate</b>	Up to 170 MSPS (Million Searches Per Second) per FPGA card
<b>Table Depth</b>	From 48K entries in on-chip RAM to 12M entries per EMSE2 core with DDR SDRAM
<b>Key Size</b>	96 bits
<b>Value Size</b>	96 bits for fast table, 352 bits for large table
<b>Latency</b>	Sub 500 nanoseconds (~88x less latency than with sockets)
<b>Throughput</b>	Line-rate network interface speeds of 10GE to 40GE
<b>Power Consumption Rate</b>	Less than 0.52 $\mu$ -Joules/message (~21x less than with software sockets)
<b>FPGA Devices Supported</b>	Altera Stratix V, Arria 10, Stratix 10, Xilinx Ultrascale
<b>Platforms Supported</b>	Intel® PAC D5005, Cisco SmartNIC+ V5P, Xilinx Alveo U50/U200/U250

### Gateway Search Block Diagram

