# The Company

<table>
<thead>
<tr>
<th>Product</th>
<th>Storage Engine Accelerator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offices</td>
<td>San Jose, Tel Aviv</td>
</tr>
<tr>
<td>Status</td>
<td>40 Employees, deep experience in database and SSD technologies</td>
</tr>
<tr>
<td></td>
<td>Core technology development completed</td>
</tr>
<tr>
<td></td>
<td>First product to be released in Q419</td>
</tr>
<tr>
<td>Raised to date</td>
<td>$45M by leading VC’s and Strategic investors</td>
</tr>
</tbody>
</table>
Key Cloud Technology Trends

Networking
100Gb mainstream, moving to 400Gb

NVMe SSDs
1000x IOPs over HDDs
10x IOPs over SATA
8, 16TB mainstream

Growing gap will increase DC sprawl & costs

CPU
GHz doubling every 20 years
Adding cores marginally adds performance

Performance / Max SSD Capacity

2010 2020
Motivating Trend: Cloud Database Market

Cloud Database market segments are large and growing.

Source: 451 Research
Total Data: Platforms & Analytics
February 2019
Motivating Trend: Analytics Software Market

Analytics market segments are large and growing

Source: 451 Research
Total Data: Platforms & Analytics
February 2019
Key-Value Storage Engines

- Responsible for data storage and retrieval
- Keep the data sorted
- Traditionally based on B-trees
- LSM has taken over, RocksDB popular
- Complex and prone to variable performance

Database/Storage Stack

MySQL, Mongo, Ceph

Storage Engine e.g., RocksDB, WiredTiger, InnoDB

SSD’s

FTL  FTL  FTL
Source of Key-Value Inefficiencies

- How to efficiently map variable-sized data to fixed-size blocks?
  - Huge memory maps vs. multiple flash accesses, speed vs. space efficiency
- High CPU and I/O costs for sorting, resorting, and garbage collection of data
- High read and write amplification – typically 20-100x
  - Reduces flash lifetime or requires expensive flash
  - Reduces effective application bandwidth
- When using disaggregated block storage, 20-100x app bandwidth required
Pliops Architecture

Database/Storage Stack

MySQL, Mongo, Ceph...

Storage Engine e.g., RocksDB, WiredTiger, InnoDB...

SSD’s
FTL
FTL
FTL

Thin Driver Layer

Pliops Storage Process or

MySQL, Mongo, Ceph...

FTL
FTL
FTL
SSD’s
Role of Hardware

- Management of highly compressed object memory map
  - Extremely memory-efficient, software alternatives much costlier
- Key sorting
- Object garbage collection
- Compression, encryption
- Data persistency, logging
- Frees memory and compute resources to run applications, not manage storage
## Pliops Performance Benefit

### Server Hardware & Software Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>1x 4.3 GHz Intel processor 6 cores, 12 threads</td>
</tr>
<tr>
<td>Memory</td>
<td>32 GB</td>
</tr>
<tr>
<td>SSD</td>
<td>RocksDB (caching disabled): NVMe 1TB SSD Pliops (caching disabled): 1TB NVMe SSD</td>
</tr>
<tr>
<td></td>
<td>All drives under test were pre-conditioned</td>
</tr>
<tr>
<td>KV</td>
<td>16B key, 800B value</td>
</tr>
<tr>
<td>Workload</td>
<td>DBBench Readwhilewriting QD32</td>
</tr>
</tbody>
</table>

![Bar chart showing performance benefit of Pliops and Software](chart.png)

Higher is better

**13x**
Application Example: MySQL

MySQL stores its data in InnoDB, a B-tree based storage engine.

B-tree overview:
- Tree-based structure consisting of blocks with a fixed maximum size
- Key-value pairs are stored in the leaf blocks
- Once a block grows beyond the max size, it is split. Similarly, small blocks are merged
- InnoDB and most B-trees are write-in-place architectures
  - Hard to reclaim disk space as data files are of fixed size
  - The space used per block is the block size, regardless of data size
Pliops Space Advantage on MySQL

- Pliops consumes 67% less capacity than uncompressed InnoDB.
- Pliops consumes 34%+ less capacity than compressed InnoDB.

Diagram:
- 11.3kb - Uncompressed Data
- 5.4kb - Compressed Data
- 5.4kb - Compressed Data
- 16kb - Uncompressed InnoDB Page
- 8kb - Compressed InnoDB Page
- 4.7kb - Wasted Space
- 2.6kb - Wasted Space
- 34% - Saved
- 67% - Saved

67% Pliops consumes 67% less capacity than uncompressed InnoDB
34%+ Pliops consumes 34%+ less capacity than compressed InnoDB
MySQL: Pliops vs. Software

- 3 X Faster Queries per sec
- 70% of space saved
- 2 X less reads from NVMe SSD
- 7 X less writes to NVMe SSD

Percona Monitoring and Management
Next Steps

- MySQL POC available for testing – September
- Solutions for Redis and other DBs available soon
- Hardware-optimized compressed block device – Q4/2019
- Optimized storage engine solutions in 2020
- Come talk with us for further details!
THANK YOU!