

## PROPRIETARY SOFTWARE RAID

The core technology of RAIDIX 4.X software is the proprietary RAID engine implemented in the operating system kernel. It has been developed to ensure high level of sustainable performance and data availability.

Due to unique checksum calculation approach with specific data placement on CPU vector registers, storage system shows the highest rate of data recovery speed.



### IMPLEMENTATION AREA

In data storage system RAID's are used for both: compiling hardware drives for virtual space and data protection in case of drive failure. And the main metrics of RAID performance are checksum calculation speed and data recovery speed from these checksums.

The right balance between data recovery speed, number of redundant drives and RAID availability level is one of the most common requirement from data storage builders. RAIDIX software use unique RAID levels having combination of record checksum calculation speed and highest level of fault-tolerance and availability.

### CALCULATION ENGINE

Checksum calculation inside RAIDIX's software arrays based on vectorization calculation with SSE4.2 and AVX Intel CPU extensions.

The distinctive edge of RAIDIX solutions is unique approach to vectorization, which allows to improve encoding and decoding speed more than 2 times comparing with ISA-L and Jerasure engines.

The most common way to organize RAID checksum calculation in data storage system is Reed-Solomon EC with Galois field arithmetic. In RAIDIX, we use specific data placement on CPU vector registers that allows to perform multiplication of 512 field elements by several simple instructions.

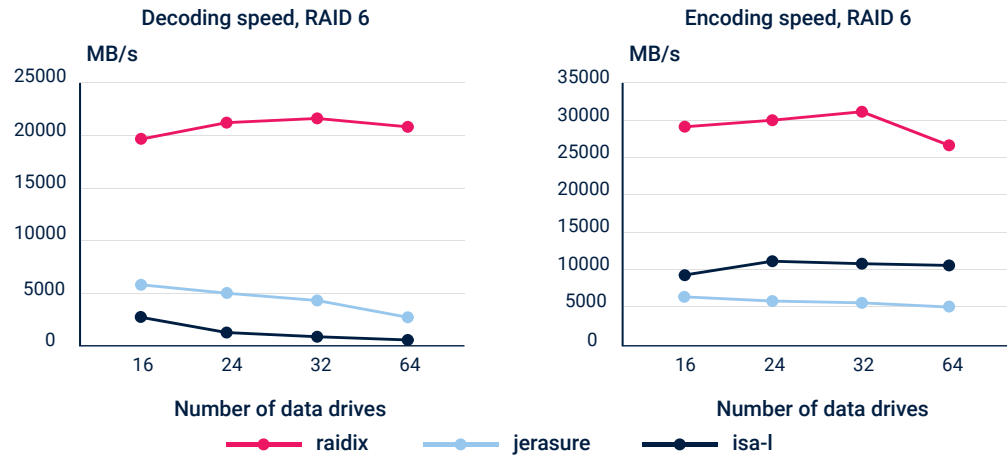
**25 GBps**

*Checksum calculation speed  
(per CPU core)*

**Less than 10%**

*Performance loss at  
sequential workloads  
in data recovery mode*

RAID 6 decoding and encoding speed comparison.



Noteworthy, current method is easily adopted for parallelization and its total performance will have linear growth in multi-core and multi-socket systems.

## PROPRIETARY RAID LEVELS

One more distinctive feature of RAIDIX's arrays is an application of own unique levels: RAID 7.3 and RAID N+M.

### RAID 7.3

**RAID 7.3** is the level of interleaving blocks with triple parity distribution, allowing restoring data in case of a failure of up to 3 drives. RAID 7.3 is similar to RAID 6 but it has a higher degree of reliability for three checksums are calculated using different algorithms. The capacity of 3 drives is allocated for checksums.

RAID 7.3 significantly reduces the probability of drive failure without performance degradation so this RAID level is highly recommended for arrays larger than 32 GB.

RAID 7.3 has 3 drives for checksums

D <sub>1,1</sub>	D <sub>1,2</sub>	D <sub>1,3</sub>	S <sub>1,4</sub>	S <sub>1,5</sub>	S <sub>1,6</sub>
D <sub>2,1</sub>	D <sub>2,2</sub>	S <sub>2,3</sub>	S <sub>2,4</sub>	S <sub>2,5</sub>	D <sub>2,6</sub>
D <sub>3,1</sub>	S <sub>3,2</sub>	S <sub>3,3</sub>	S <sub>3,4</sub>	D <sub>3,5</sub>	D <sub>3,6</sub>
S <sub>4,1</sub>	S <sub>4,2</sub>	S <sub>4,3</sub>	D <sub>4,4</sub>	D <sub>4,5</sub>	D <sub>4,6</sub>
S <sub>5,1</sub>	S <sub>5,2</sub>	D <sub>5,3</sub>	D <sub>5,4</sub>	D <sub>5,5</sub>	S <sub>5,6</sub>
S <sub>6,1</sub>	S <sub>6,2</sub>	D <sub>6,3</sub>	D <sub>6,4</sub>	S <sub>6,5</sub>	S <sub>6,6</sub>

### RAID N+M

**RAID N+M** is the level of interleaving blocks with M checksums, based on proprietary RAIDIX mathematical algorithm. RAID N+M allows user to choose the number of disks for checksums allocation. RAID sustains complete failure up to 32 drives in the same group (depending on the number of parity disks).

M drives intended  
for checksums,  
N drives for data blocks

N						M			
D <sub>1,1</sub>	D <sub>1,2</sub>	D <sub>1,3</sub>	D <sub>1,4</sub>	...	D <sub>1,N</sub>	S <sub>1,1</sub>	S <sub>1,2</sub>	...	S <sub>1,M</sub>
D <sub>2,1</sub>	D <sub>2,2</sub>	D <sub>2,3</sub>	...	D <sub>2,N-1</sub>	S <sub>2,N</sub>	S <sub>2,1</sub>	...	S <sub>2,M-1</sub>	D <sub>2,N</sub>
D <sub>3,1</sub>	D <sub>3,2</sub>	...	D <sub>3,N-2</sub>	S <sub>3,N-1</sub>	S <sub>3,N</sub>	...	S <sub>3,M-2</sub>	D <sub>3,N-1</sub>	D <sub>3,N</sub>
D <sub>4,1</sub>	...	D <sub>4,N-3</sub>	S <sub>4,N-2</sub>	S <sub>4,N-1</sub>	...	S <sub>4,M-3</sub>	D <sub>4,N-2</sub>	D <sub>4,N-1</sub>	D <sub>4,N</sub>
...	D <sub>5,N-4</sub>	S <sub>5,N-3</sub>	S <sub>5,N-2</sub>	...	S <sub>5,M-4</sub>	D <sub>5,N-3</sub>	D <sub>5,N-2</sub>	D <sub>5,N-1</sub>	D <sub>5,N</sub>
D <sub>6,N-5</sub>	S <sub>6,N-4</sub>	S <sub>6,N-3</sub>	...	S <sub>6,M-5</sub>	D <sub>6,N-4</sub>	D <sub>6,N-3</sub>	D <sub>6,N-2</sub>	D <sub>6,N-1</sub>	D <sub>6,N</sub>
S <sub>7,N-5</sub>	S <sub>7,N-4</sub>	...	S <sub>7,M-6</sub>	D <sub>7,N-5</sub>	D <sub>7,N-4</sub>	D <sub>7,N-3</sub>	D <sub>7,N-2</sub>	D <sub>7,N-1</sub>	D <sub>7,N</sub>



## FEATURES

Proprietary RAID engine is a core technology in RAIDIX software products. Deep math researches formed basics for powerful tool comprising high level of data protection, performance and efficiency.

Proprietary RAID engine is characterized by following features:

- Record speed of checksum calculation in multiple times faster the existing solutions.
- Opportunity to choose the number of disks for checksums allocation (in RAID N+M).
- RAID engine gives additional value for complementary technologies such as Advanced Reconstruction and Partial Reconstructions.
- High level of fault-tolerance when RAID 7.3 and RAID N+M are employed.