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Optimizing Checkpoints with Built-in Memory Page Compression

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Memory pages typically represent the largest component of a checkpoint, and handling this data efficiently is crucial for reducing the performance overhead of CRIU. Checkpoint compression is often used to minimize the storage requirements for container snapshots and to accelerate live migration by minimizing the amount of data that must be transferred over the network. However, existing approaches implement compression as a subsequent operation after the whole checkpoint has been created. This approach introduces additional I/O overhead and increases the storage footprint, as the uncompressed memory pages must first be written and then read again for compression.

To address these challenges, we have been exploring a new approach that integrates built-in memory page compression directly into CRIU. This approach eliminates intermediate I/O operations by compressing the data in-flight before it is written to CRIU images. This is particularly important for enabling efficient end-to-end encryption of container checkpoints in multi-tenant Kubernetes clusters. In this talk, we are going to discuss the set of changes and image formats that implement this functionality, as well as the associated trade-offs and common use-cases, such as maximizing compression ratio for fault-tolerance with periodic checkpointing and minimizing checkpoint latency during live migration.

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