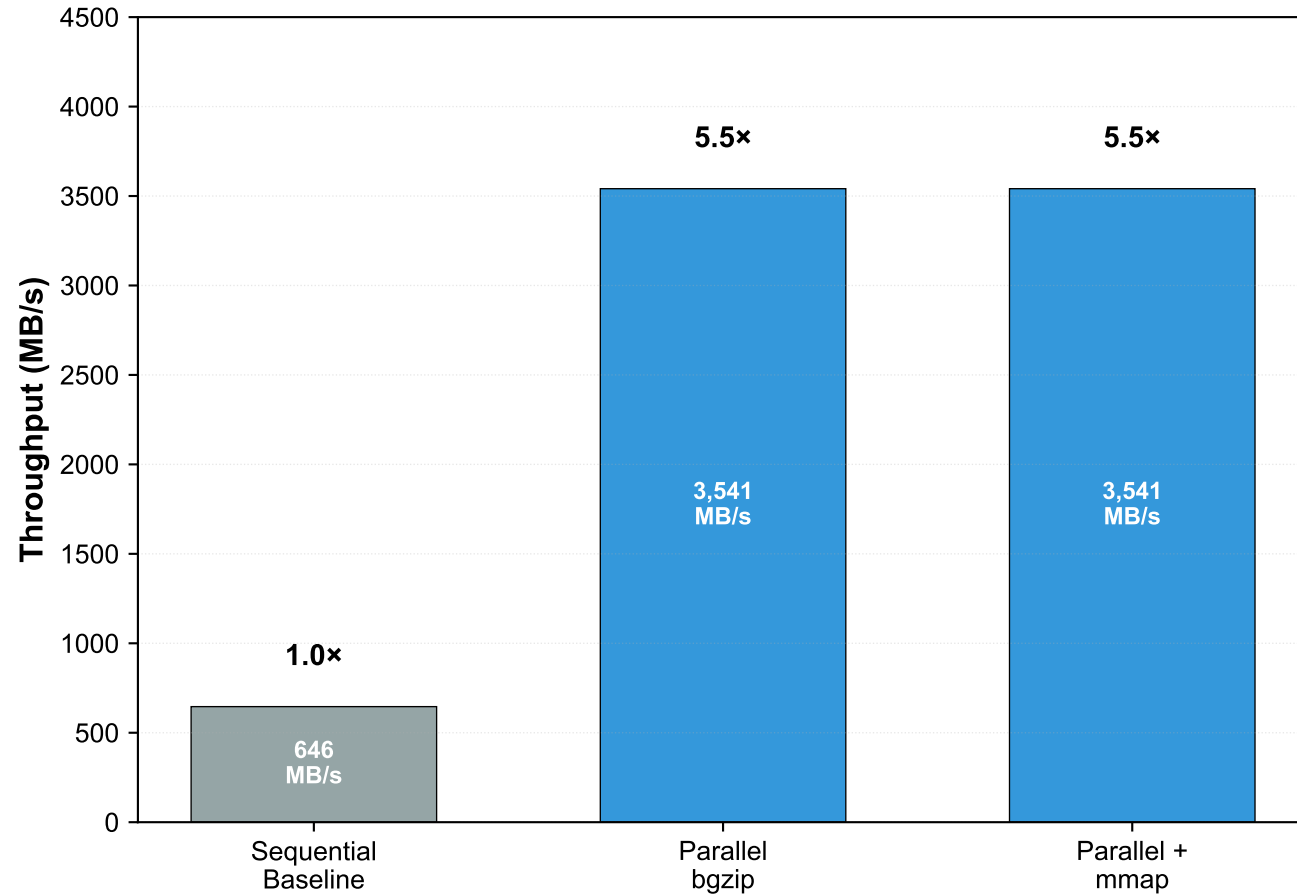**I/O Optimization Stack: Layered Benefits**
(CPU parallel bgzip + smart mmap)

Small Files (<50 MB)
0.58 MB, 51 bgzip blocks

Large Files (≥50 MB)
5.82 MB, 485 bgzip blocks

Small Files chart — Throughput (MB/s):
- Sequential Baseline: 646 MB/s, 1.0×
- Parallel bgzip: 3,541 MB/s, 5.5×
- Parallel + mmap: 3,541 MB/s, 5.5×

Large Files chart — Throughput (MB/s):
- Sequential Baseline: 718 MB/s, 1.0×
- Parallel bgzip: 4,669 MB/s, 6.5×
- Parallel + mmap: 15,694 MB/s, 16.3×