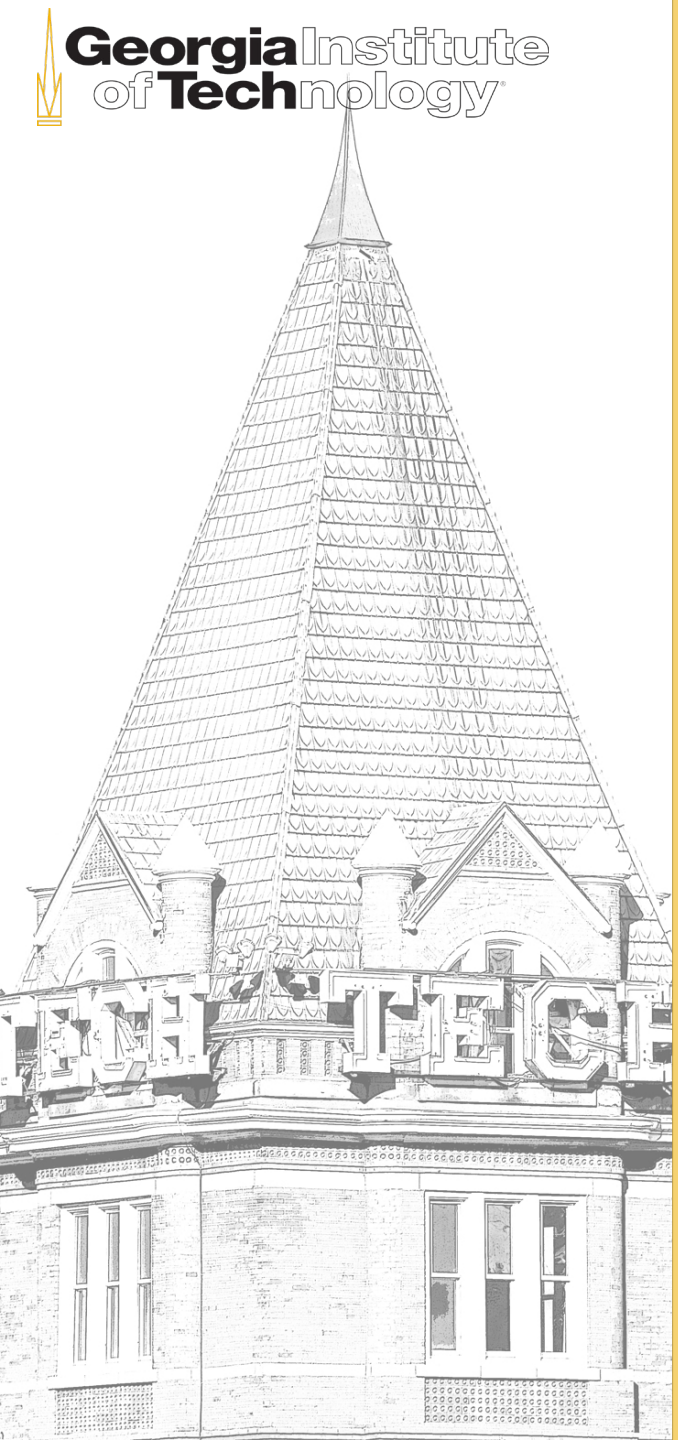


Huge Data Analytics with Transparent In-Network Memory Computing

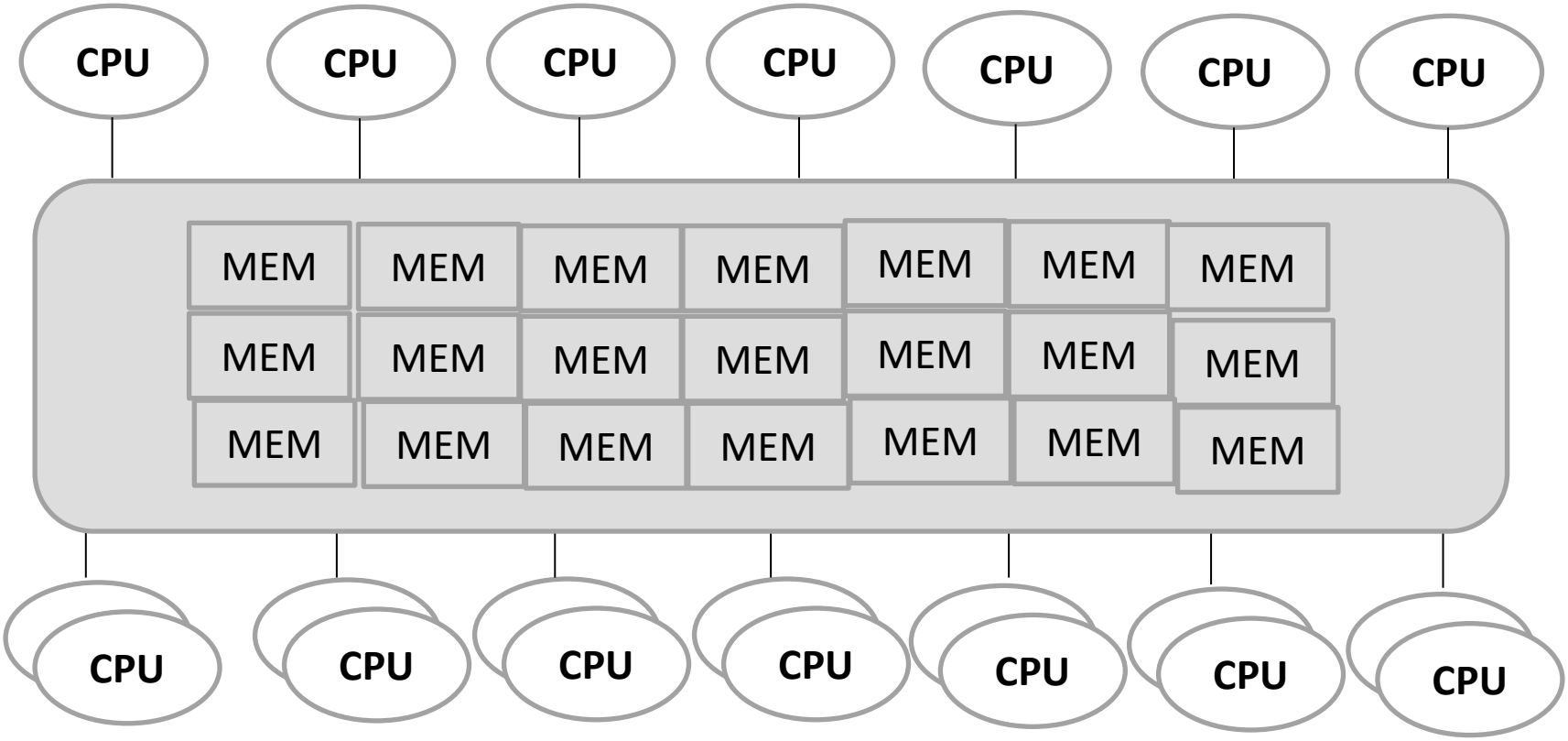
Ling Liu, James Bae, Wenqi Cao*, Semih Sahin*, Yanzhao Wu, Qi Zhang*

Professor

Distributed Data Intensive Systems Lab
School of Computer Science
College of Computing

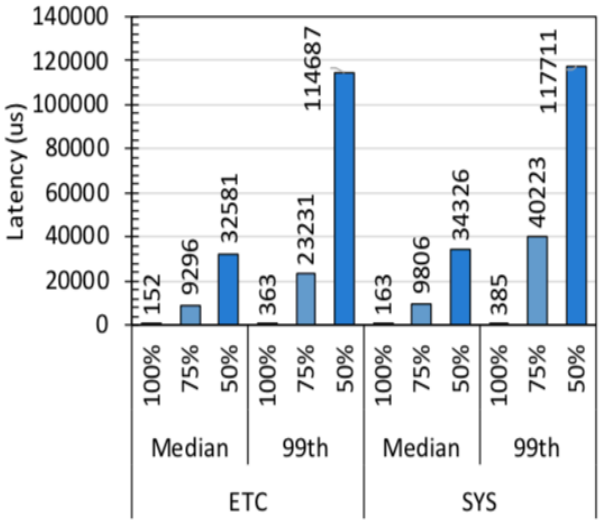
*Wenqi Cao (facebook), Semih Sahin (google, USA) and Qi Zhang (IBM TJ Watson) contributed to this umbrella project when they were PhD students at Georgia Tech.

Transparent In-Network Memory Centric Computing

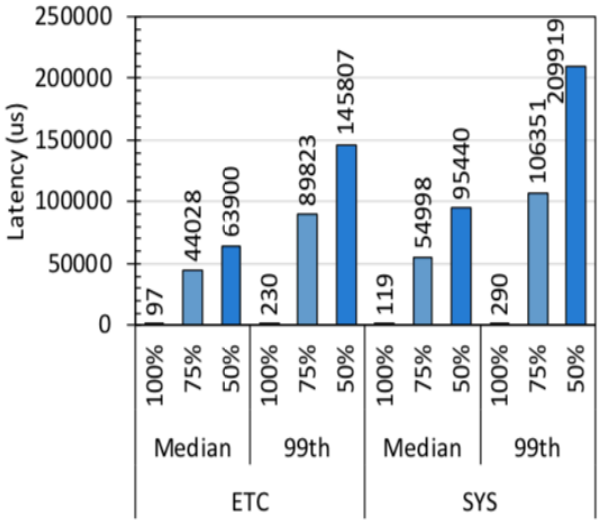


Cluster Computing Performance Observation

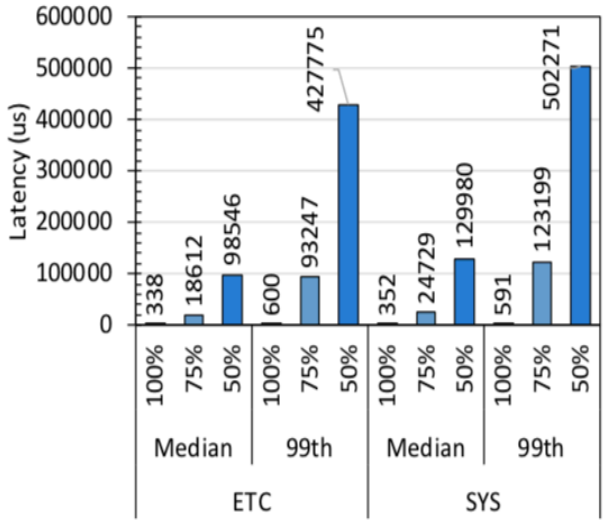
The peak memory that can fit the full working set is measured for Memcached, Redis and VoltDB, which are 25GB, 29GB and 30GB respectively.



(a) Memcached



(b) Redis



(c) VoltDB

75% configuration:

→ median latencies worsen by 61x, 462x and 70x respectively

→ 99th percentile latencies are worsened by 104x, 391x and 208x respectively.

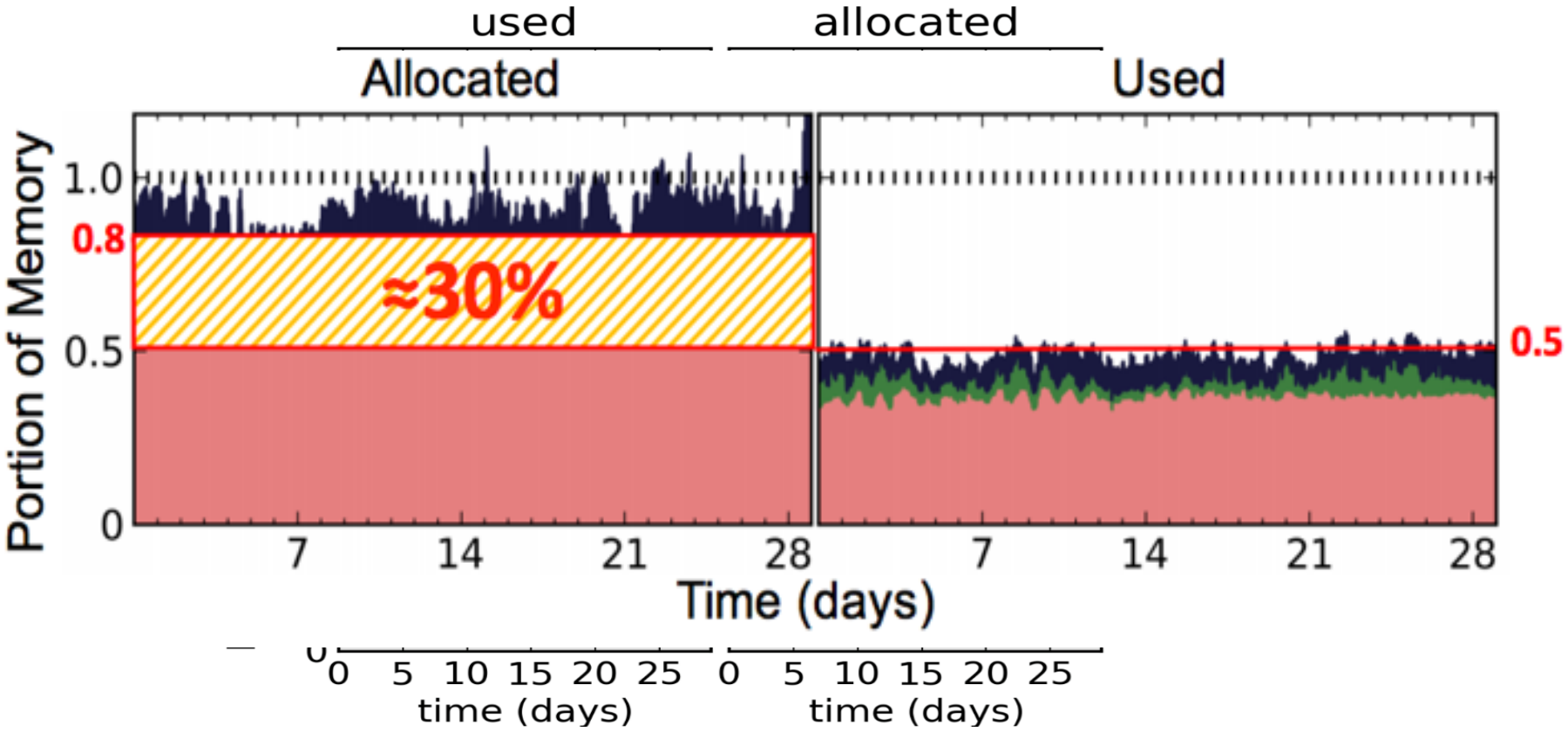
50% configuration:

→median latencies are worsen by 214x, 802x and 369x respectively, and

→ 99th percentile latencies are degraded by 316x, 724x and 850x respectively.

Memory Allocated vs Used

- Google datacenter usage analysis

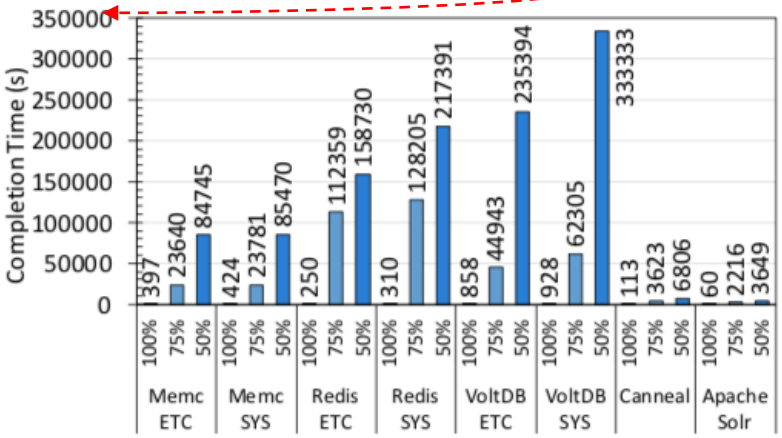


Mapping of original times to times emitted in the trace.

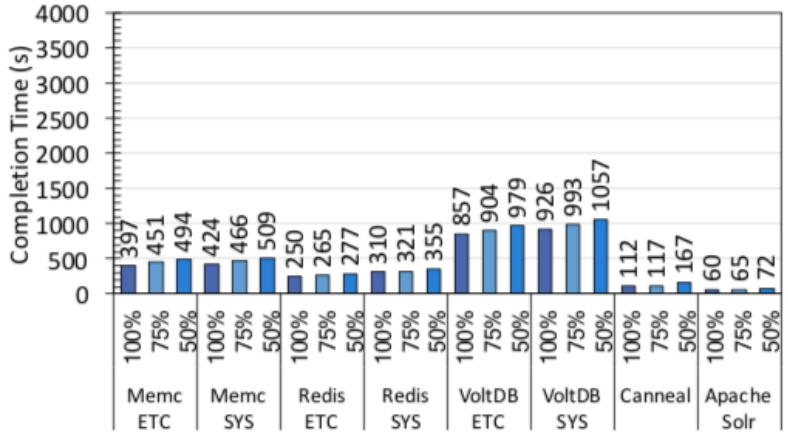
Source: *Towards understanding heterogeneous clouds at scale: Google trace analysis, by* Charles Reiss (UC Berkeley), Alexey Tumanov (CMU), Gregory R. Ganger (CMU), Randy H. Katz (UC Berkeley), Michael A. Kozuch (Intel Labs)
Intel Science & Technology Center for Cloud Computing, Carnegie Mellon University
http://sbac.lip6.fr/2014/session%209/3-JALorenzo.pdf

Vanilla Linux v.s. XmemPod Linux

NoSQL bigdata system performance comparison (larger time scale for Linux measurement, 5x ~ 649x improvement)

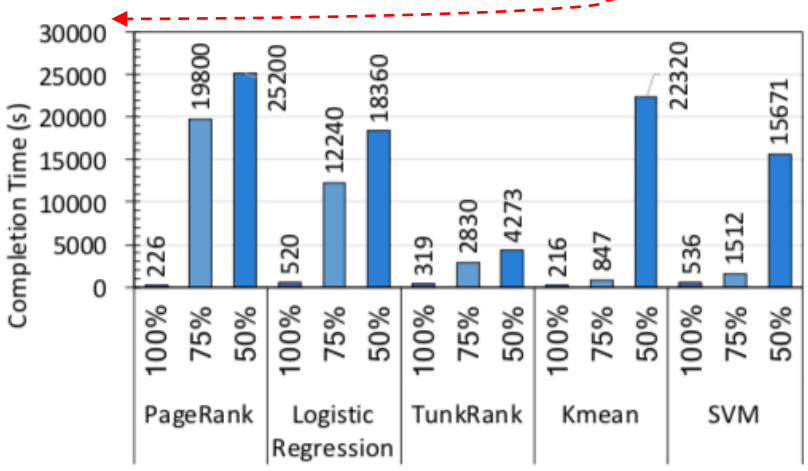


(a) Linux

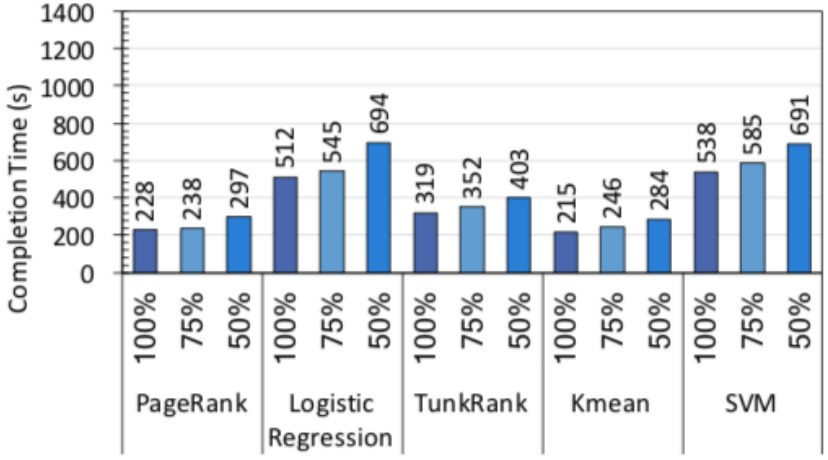


(c XmemPod

Machine learning workload performance comparison (larger time scale for Linux measurement, 8x ~ 36x improvement)



(a) Linux

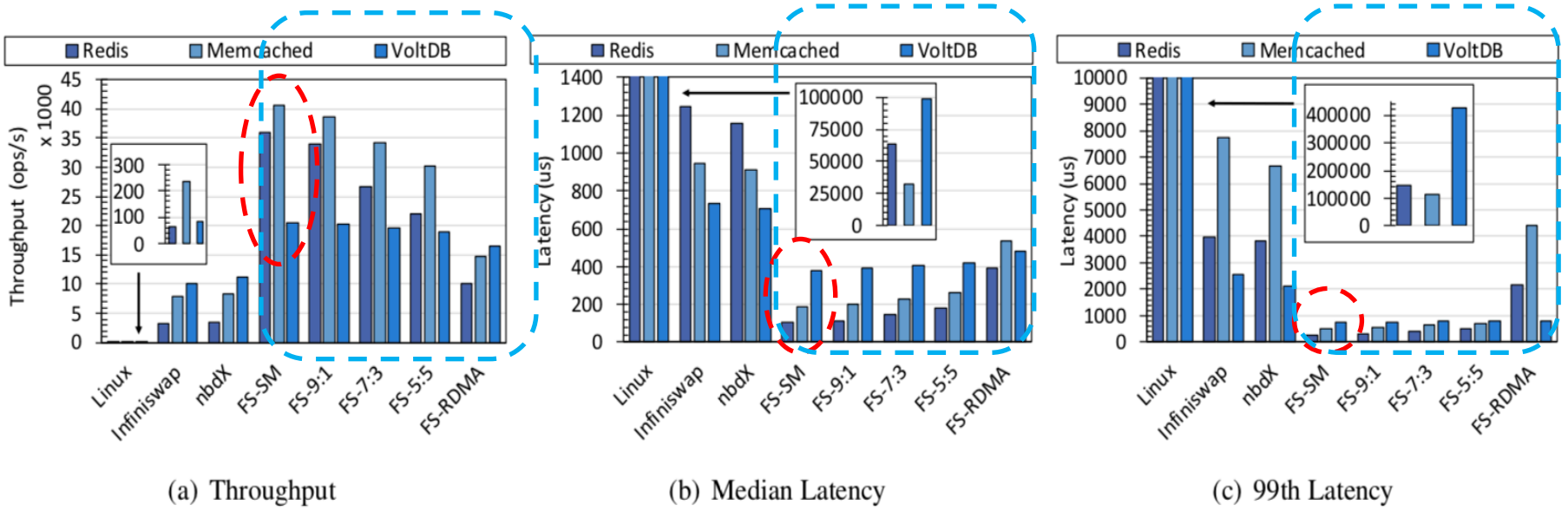


(c) XmemPod

TRANSPARENT IN-NETWORK MEMORY CENTRIC COMPUTING

Transparent Host-Remote In-Network Memory Disaggregation

50% of application working set is in memory



(a) Throughput (b) Median Latency (c) 99th Latency

using FS-SM in FastSwap: throughputs of Redis, Memcached, and VoltDB
→ increase by up to 571x, 171x, and 240x respectively, compared with Linux.
→ increase by 11.4x, 5.1x, and 2.0x compared to Infinitswap and increase by 10.5x, 4.9x, and 1.8x compared with nbdX

Wenqi Cao and Ling Liu. ``Hierarchical Orchestration of Disaggregated Memory, IEEE Transactions on Computers.
XMemPod code on Github.com/git-disl/.

Huge Data Challenge: Transparent In-Network Memory Centric Computing

- Transparent In-Network Memory Centric Computing
  - Transparent utilization of available memory of other in-network executors
    - Instead of distributed controlled data partitioning and resorting to external I/O storage for contingency
- Transparent In-Network Federated Edge System Computing
  - Transparent federation of available edge system computing capability
    - instead of moving/collecting data to a central location