

VIRTUOSO: SQUASHING ISOLATION AND RESOURCE EFFICIENCY TRADEOFFS IN VIRTUALIZED ENVIRONMENTS

Matheus Stolet

Max Planck Institute for Software Systems



MAX PLANCK INSTITUTE FOR SOFTWARE SYSTEMS



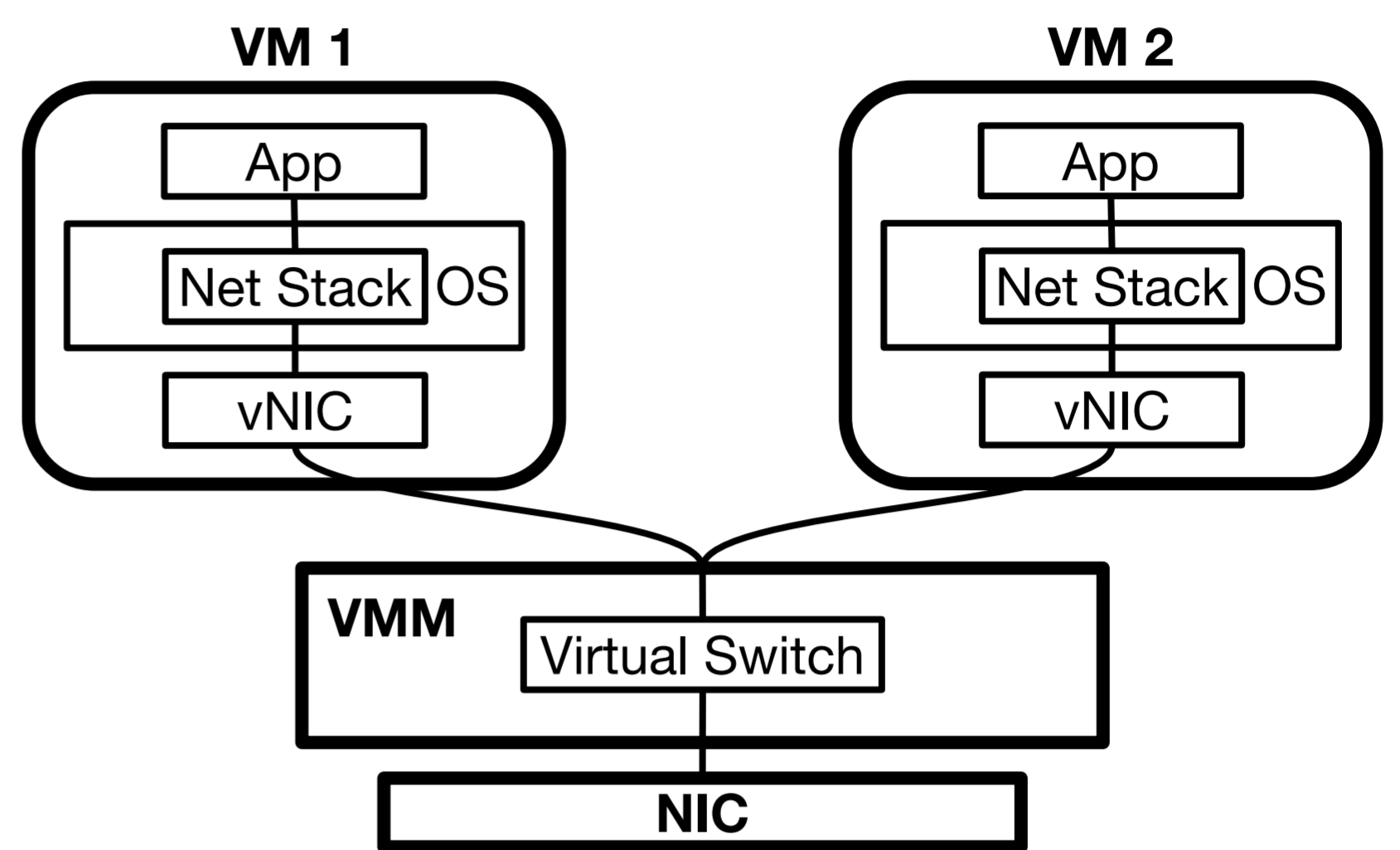
Siloed stacks provide isolation but with low resource utilization and high latency

Deeply layered independent stacks are the norm

- Layers simplify development and management
- Independent stacks provide isolation

Disadvantages

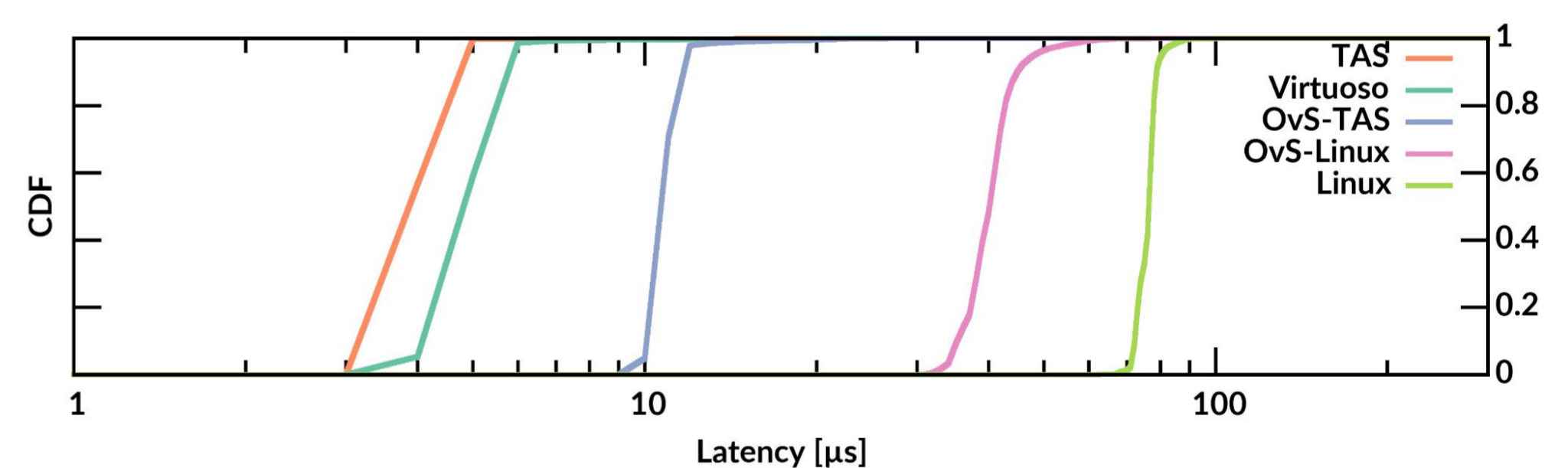
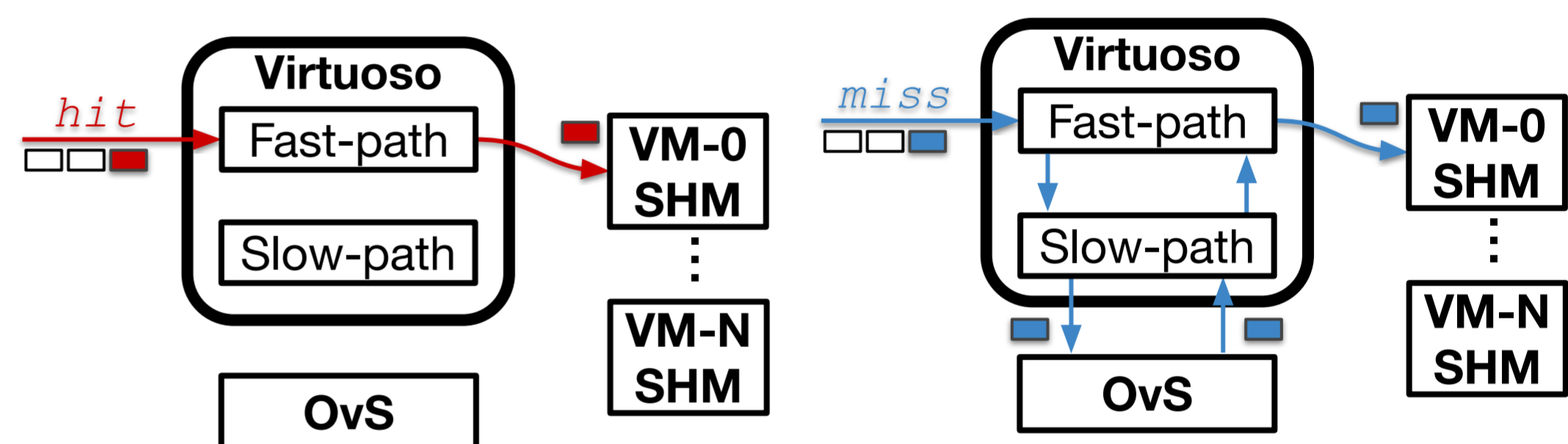
- VMs are overprovisioned
- Layering adds overhead



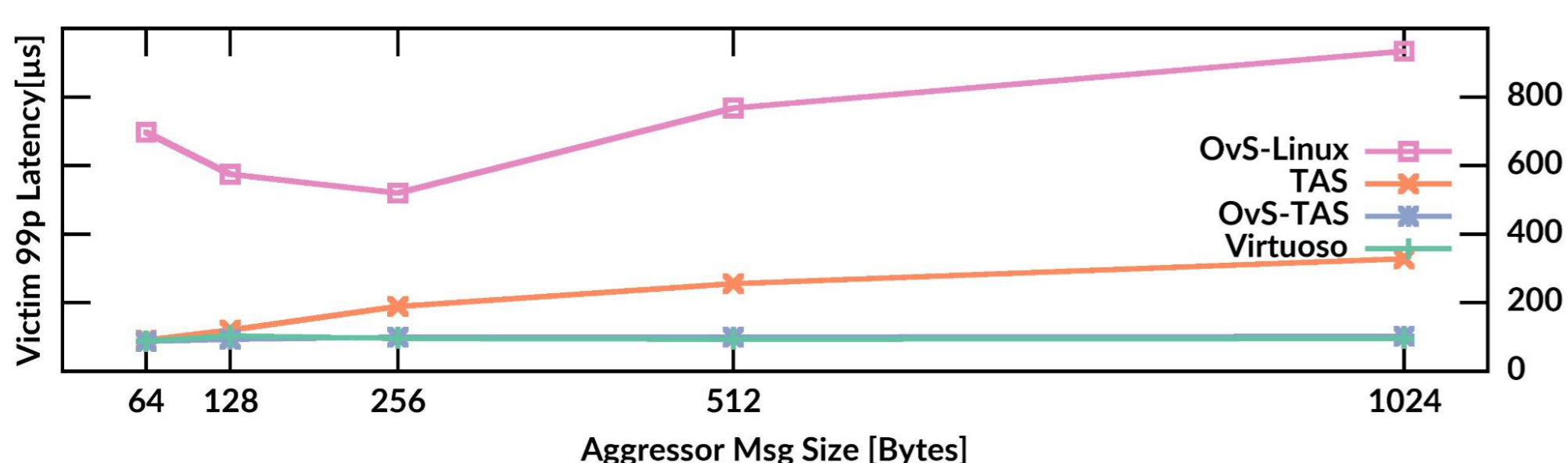
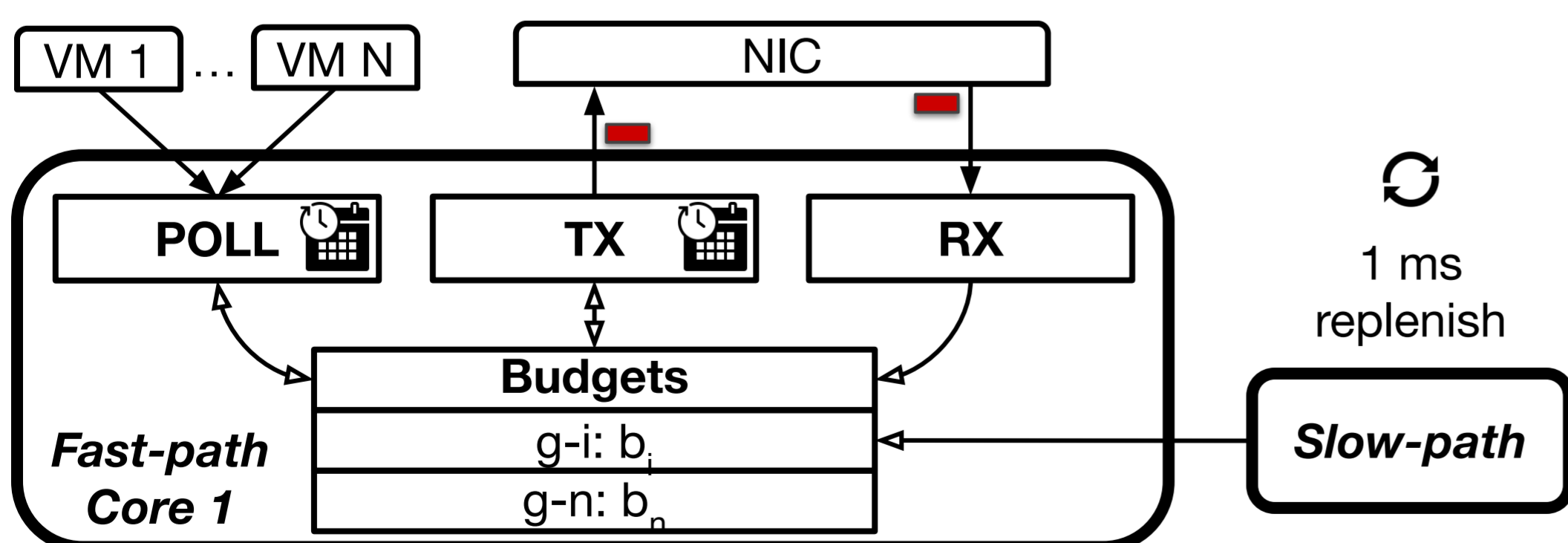
Virtuoso reorganizes the networking stack

- **Maximizes CPU utilization**
 - Shares networking stack between guests
- **Enforces isolation**
 - Tracks resource usage
 - Schedules packets based on guest budget
- **Minimizes overheads**
 - Bypasses kernel and VMM with fast-path
 - Processes packets in one-shot

Single-layer datapath and one-shot fast-path reduce overhead



Fine-grained per-packet scheduling guarantees performance isolation



Shared network stack provides elastic resource utilization

