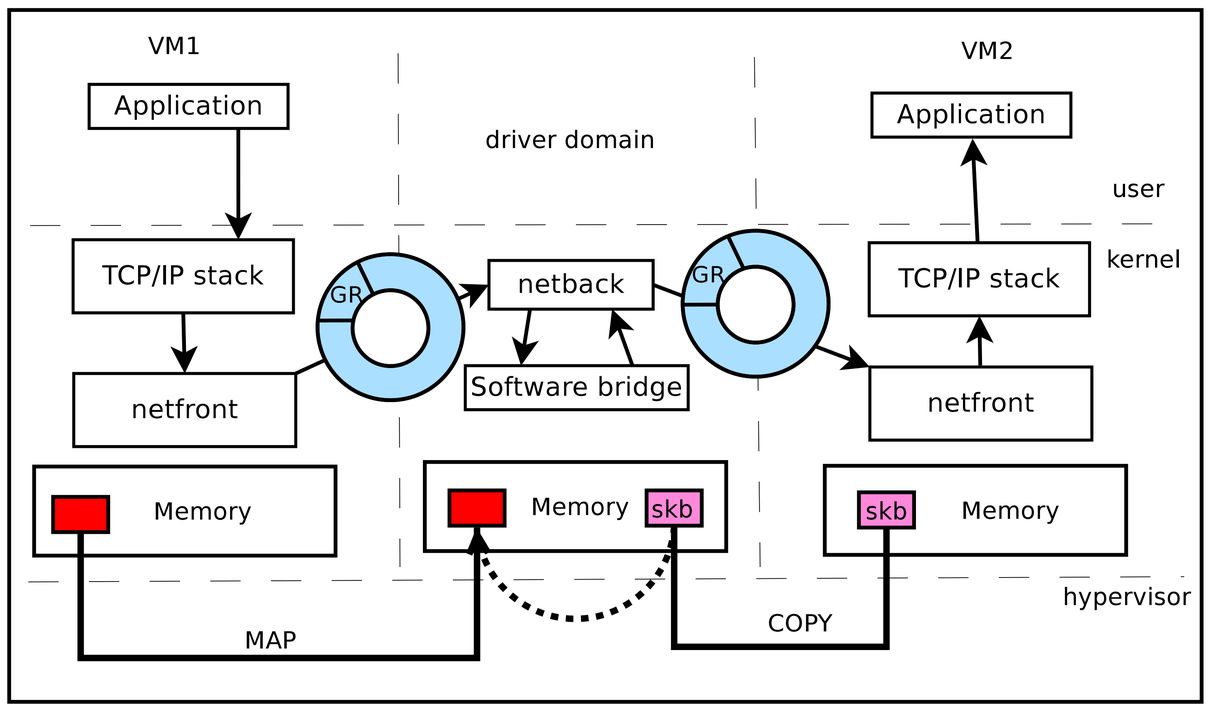
V4VSockets
low overhead intra-node communication in Xen

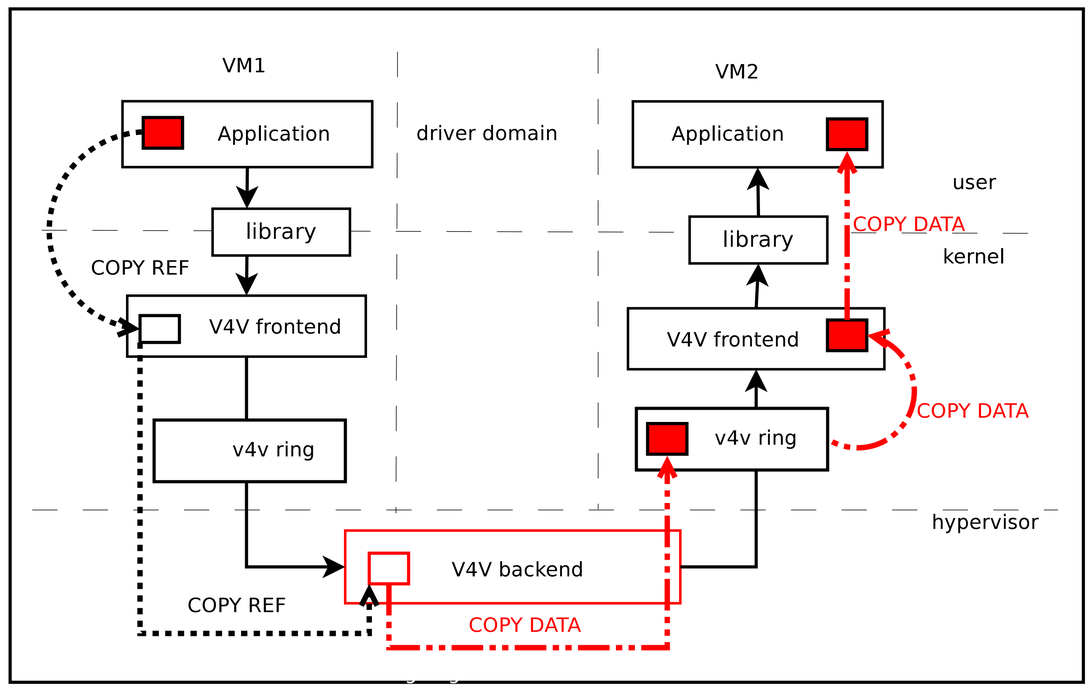
I/O Path in Xen (generic environment)



Intra-node communication suffers from severe overheads:

- ⇒ inefficient data paths
- ⇒ driver domain handles packet forwarding
- ⇒ unnecessary TCP/IP stack crossing and fragmentation

I/O Path in Xen with V4VSockets



V4VSockets is built as a full-stack protocol framework that supports p2p communication between VMs.

- ⇒ *Application layer*: the socket interface.
- ⇒ *Transport layer*: VM kernel driver.
- ⇒ *Network/Link layer*: the hypervisor, providing encapsulation of upper-layer messages to V4V messages, and packet delivery.

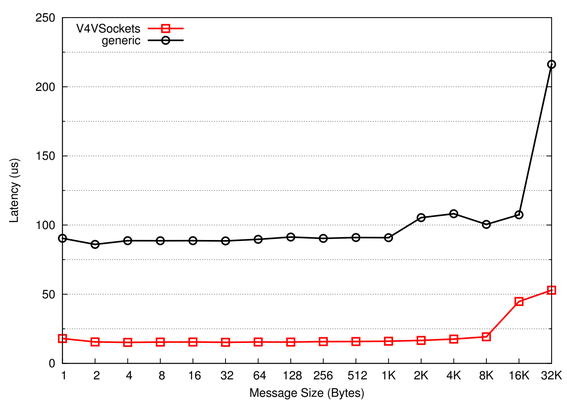
Key features

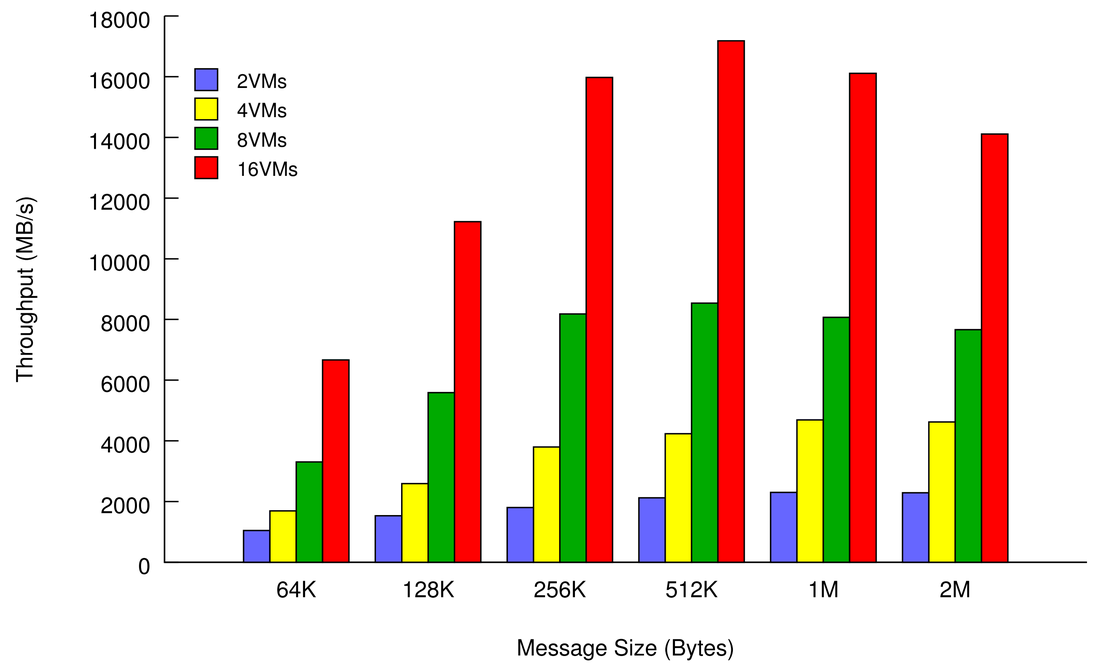
V4VSockets[a], is an efficient, socket-compliant, high performance intra node communication framework.
V4VSockets features:

- ⇒ *optimized* data path (data are copied from / to the VM kernel memory without the need to share pages between VMs)
- ⇒ no intermediary VM (driver domain), so no scheduling implications are involved.
- ⇒ no security implications (data cross the hypervisor and either get dropped or pushed forward using V4V semantics)
- ⇒ ultra *low latency* and *high bandwidth*.

[a] https://github.com/HPSI/v4v

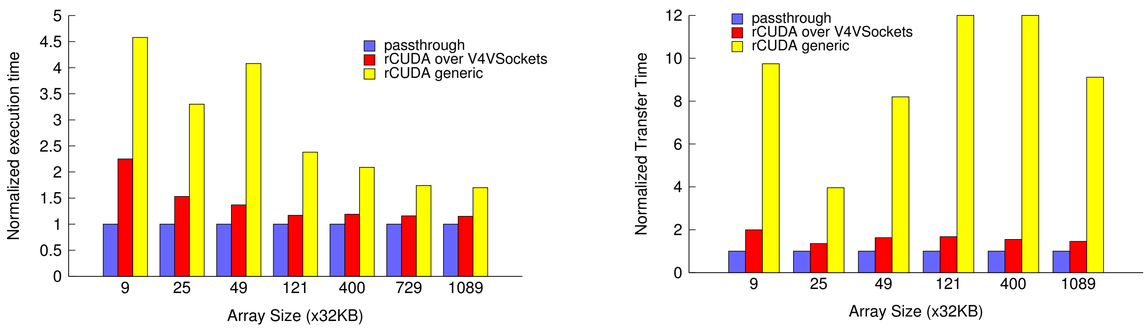
Ping-pong benchmark





- ⇒ improves latency for small messages by 81%
- ⇒ achieves 2299 MB/s for large messages (1 MB) vs. 501 MB/s
- ⇒ scales efficiently with the number of VMs, both in terms of latency and bandwidth
- ⇒ aggregate throughput ≈ 17 GB/s for 512 KB messages when 16 VMs exchange data in pairs

GPU stencil performance through rCUDA



- ⇒ matrix-matrix product benchmark run: (a) natively via GPU passthrough, (b) rCUDA over TCP/IP sockets and (c) rCUDA over V4VSockets
- ⇒ steps: 2x matrix copy, GPU compute, 1x copy back.
- ⇒ adds minimum overhead of 15% (compared to native execution)
- ⇒ Boosts transfer throughput by 7 (at best) compared to TCP/IP

Work in Progress

- ⇒ Strengthen our implementation to a more user-friendly approach,
- ⇒ Thoroughly examine the CPU utilization overheads imposed by V4VSockets,
- ⇒ Polish the peer discovery framework to adaptively use V4VSockets over generic sockets.
- ⇒ Perform an elaborate performance evaluation of the GPU sharing framework we have developed

Contact info and Acknowledgments

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