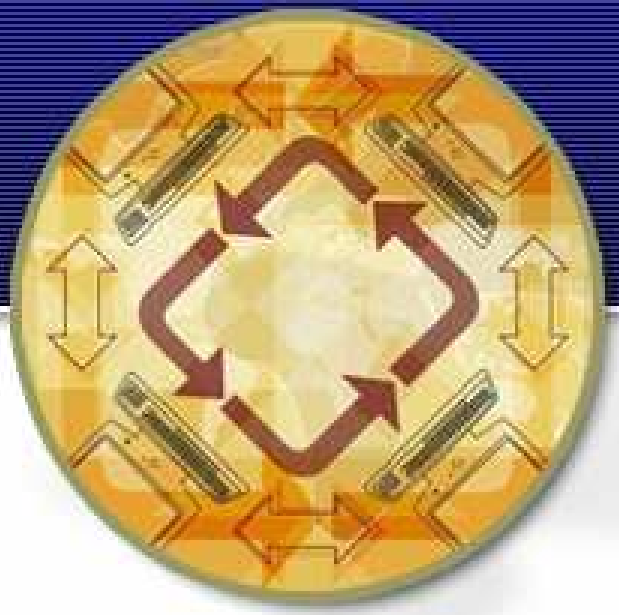


Qumranet

# KVM PV DEVICES

dor.laor@qumranet.com

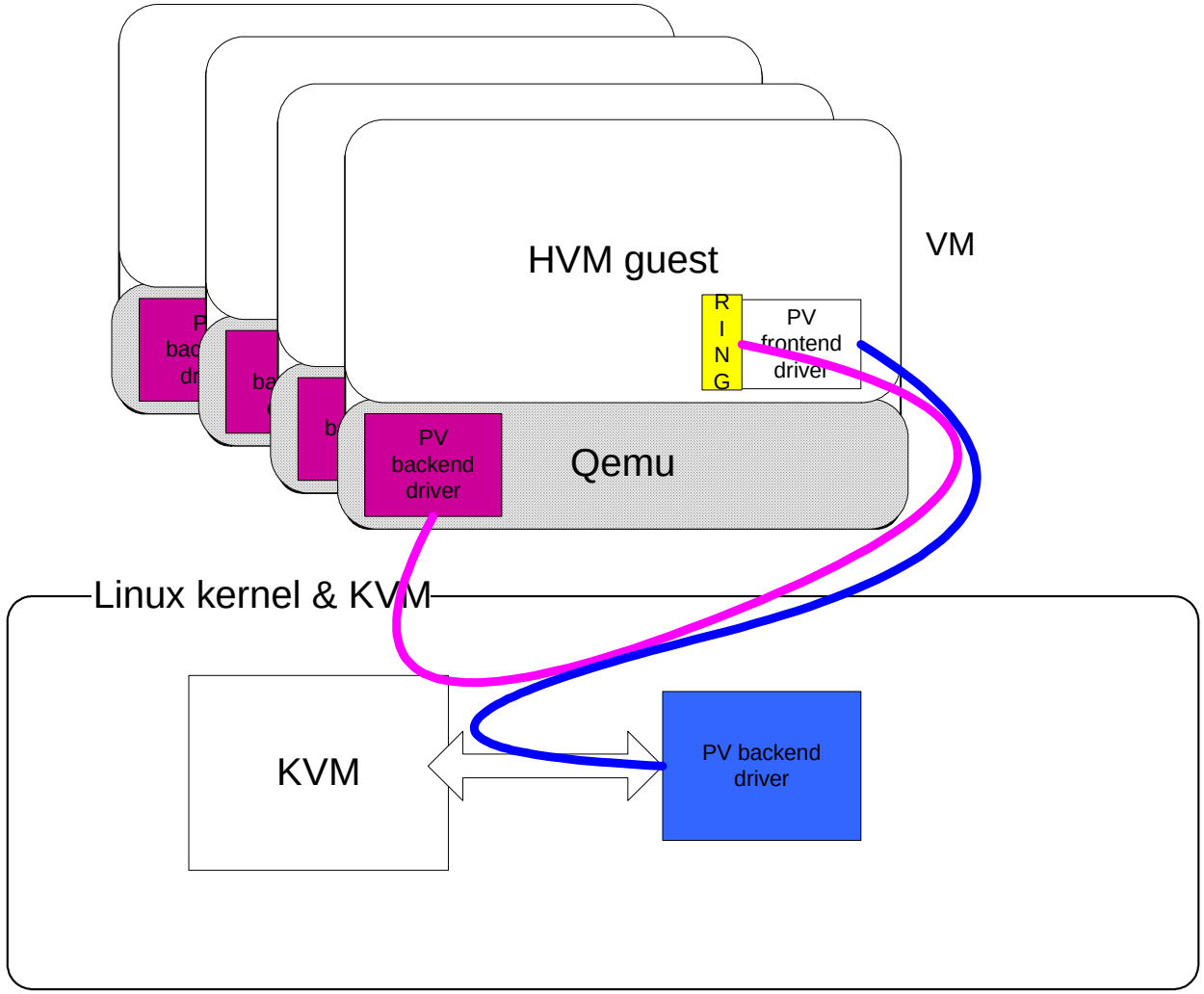
# Agenda

- Introduction & brief history
- VirtIO
- Enhanced VirtIO with KVM support
- Further implementation

# General & history

- Fully virtualized devices performs bad
  - 55 Mbps for RTL
  - Lots of io-exits per packet
- Decided to implement a modern e1000
  - Advantage:
    - Only Qemu coding
    - no guest tools involved
  - Irq coalescing
  - Only 2-3 io-exits per packet
  - Can be the base of user-space PV
- But then came Ingo…

# PV driver architecture



# General & history

- V0 - leveraging Ingo Molnar's PV code
  - Make loadable module
  - Add HVM support
  - Add NAPI
  - Add memory barriers and improved ring
  - Keep running after performance & stability
  - Merge to the kernel?
- Alternatives
  - Xen
    - Polished drivers
    - Xen specific
  - VirtIO was just published.

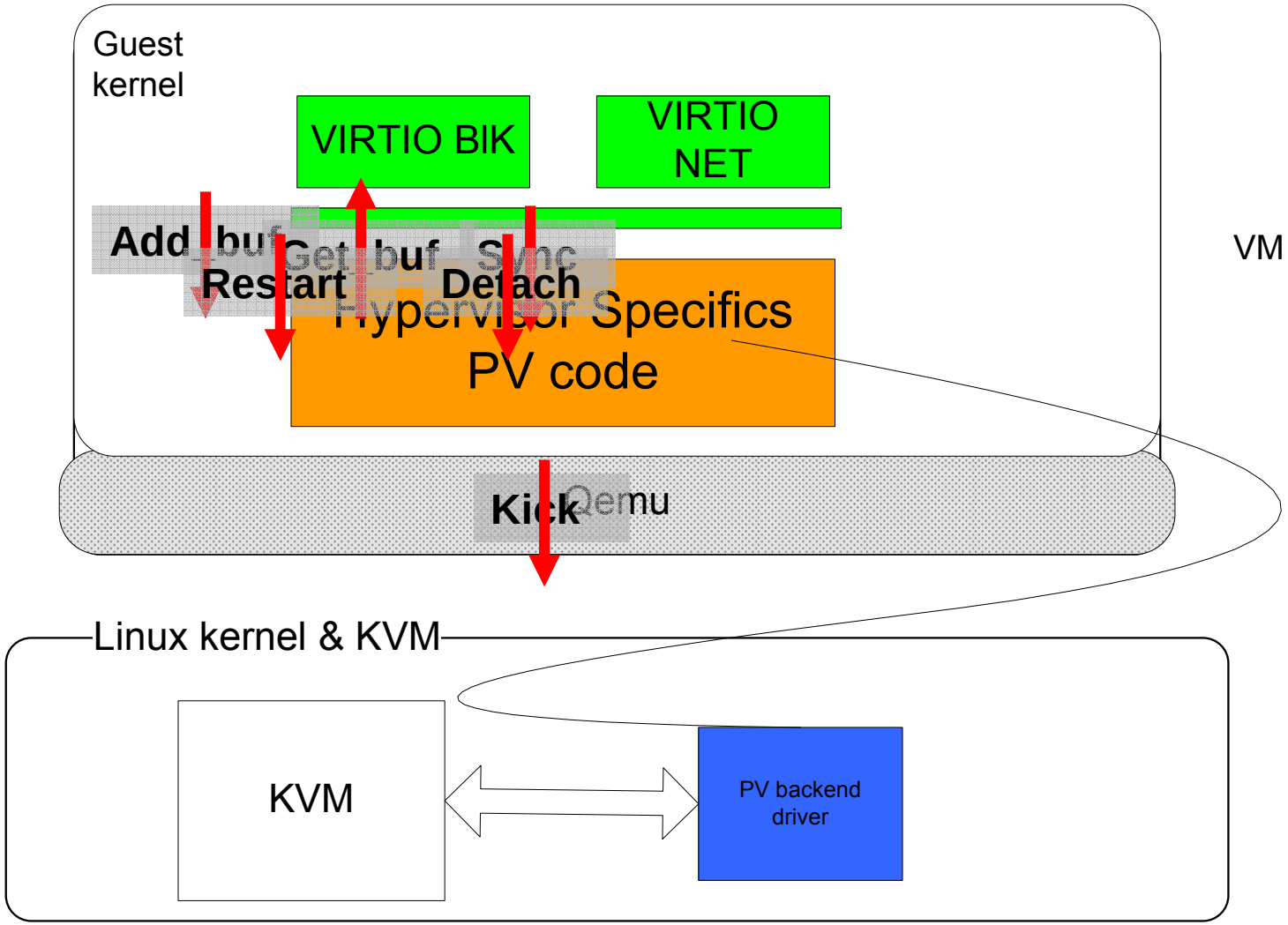
# PV driver requirements

- Close to native performance
- Merge with the kernel
- Leverage existing code
- Have usermode implementation
  - Block device for qcow, vmdk formats
  - Ability to function without KVM (-no-kvm)
- Ability to run HVM guests
- Robust code
  - Easily add drivers

# VirtIO

- An API for virtual I/O
  - Implements network & block driver logic
  - Written by Rusty Russell
- Motivation
  - Many hypervisors of all types
  - Hard to tune and maintain each one
  - Code reuse – The KVM way ;)
- Implementations
  - Lguest
  - KVM
  - Possible (Xen, UML, Qemu, VMware?..)

# VirtIO

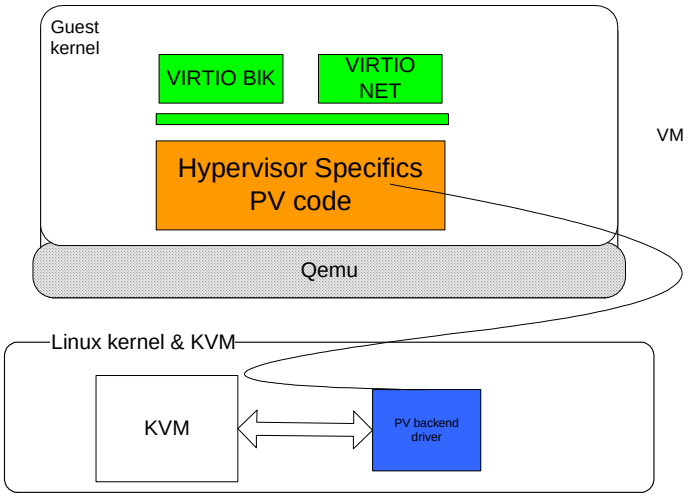



- scatterlist sg[] for skb/blk_req data

# VirtIO – Hypervisor specifics

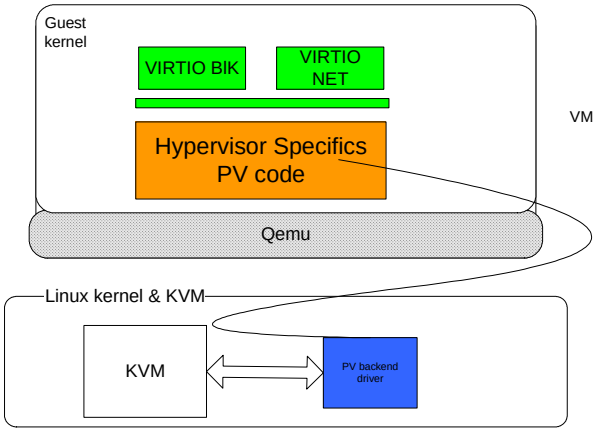
- The front end logic is implemented by VirtIO

- The backend needs
  - Probing & Bus services
    - Enumeration
    - Irq
    - Parameters (mac,..)
  - Shared memory with remote side
  - Hypercalls
  - Host driver/userspace backend

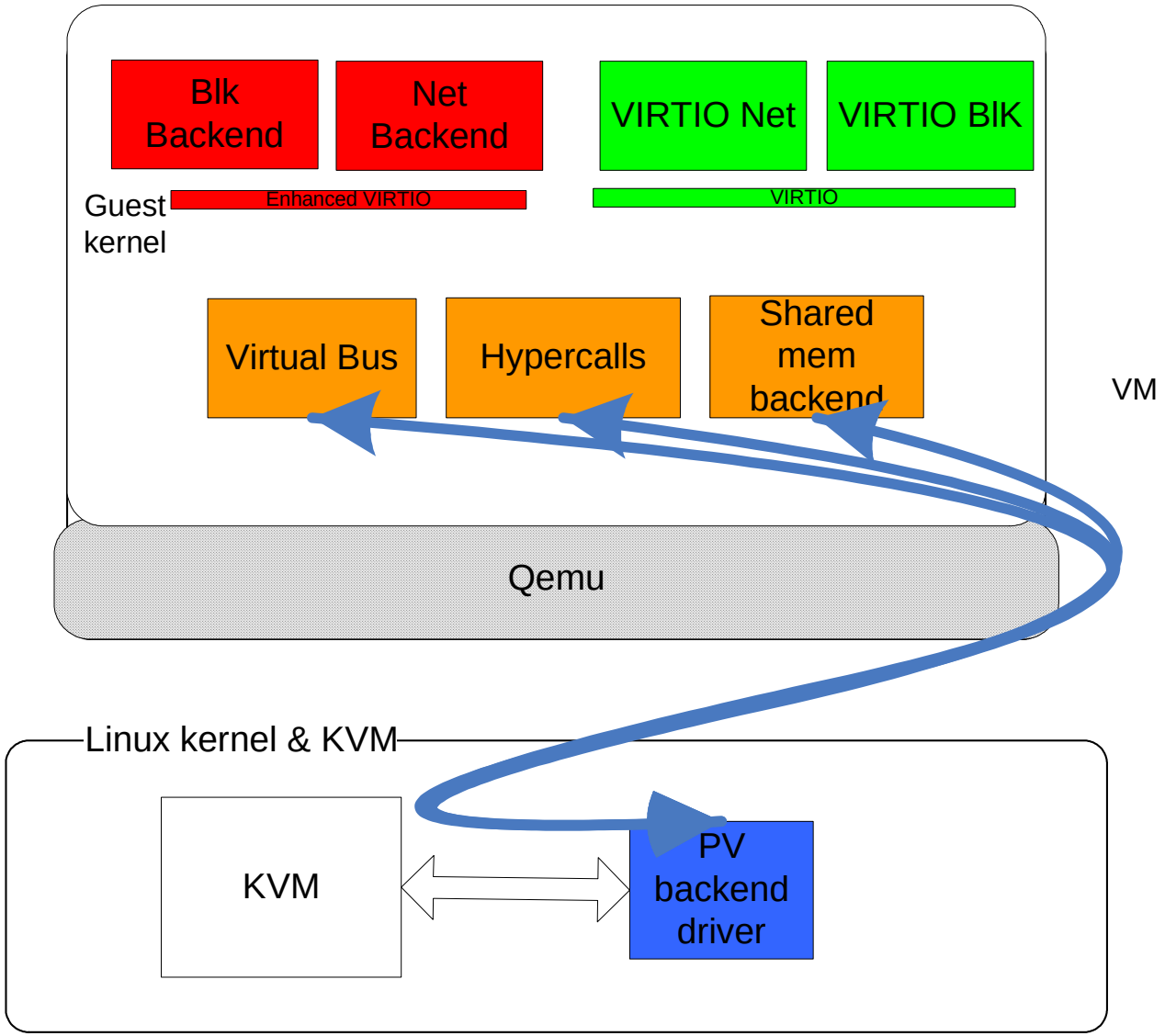


# Enhanced VirtIO

- Motivation
  - Increase re-use
  - Allow operation with various bus types
  - Make new devices code smallest
- Components
  - Shared memory code
    - With per hypervisor I/O hypercalls
  - Bus (pci, virtual bus)
  - Host backend

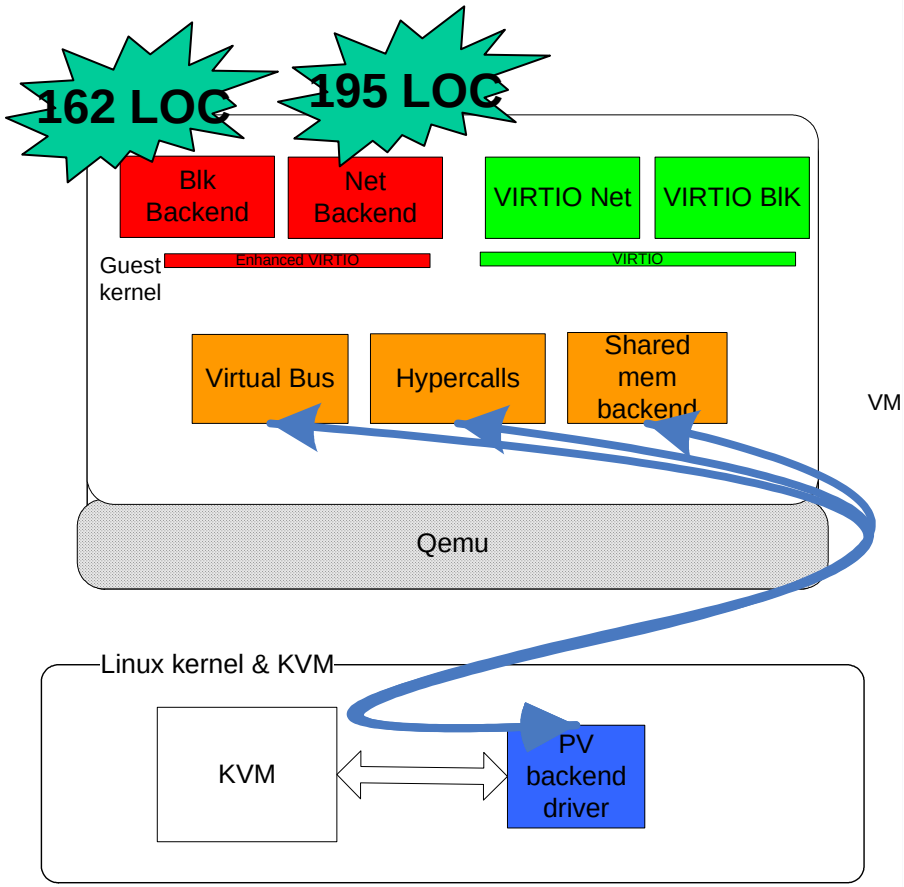


# Enhanced VirtIO



# Enhanced VirtIO

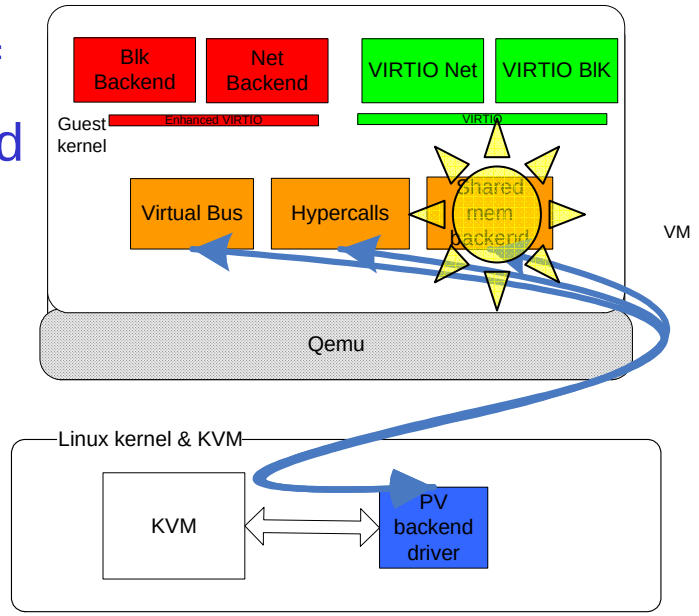
- Status:
  - Interface needs polishing
  - KVM support
  - PCI bus support
- Result:
  - Makes backend driver tiny
  - 620 Mbps throughput for network
    - HVM Linux guest
    - Before optimization
    - Userspace backend driver



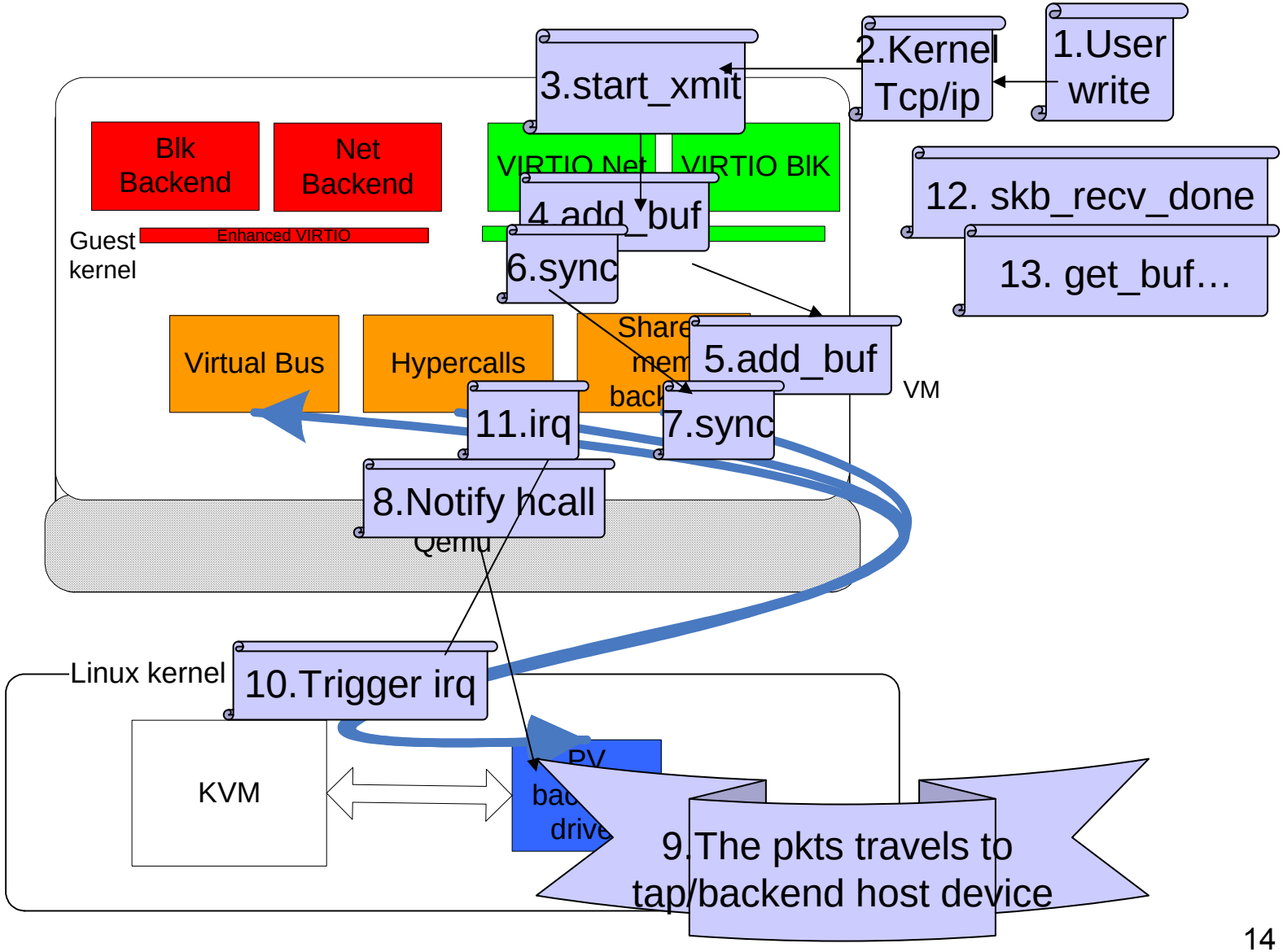
# Enhanced VirtIO – shared memory backend

- VirtIO backend
  - Implements VirtIO interface
  - Callbacks to hypervisor and

- Code consists of
  - add_buf, get_buf, restart, detach_buf
    - Only shared memory logic needed
  - sync
    - Ring logic
    - IO pending hypercall
  - be_virtqueue_interrupt handler

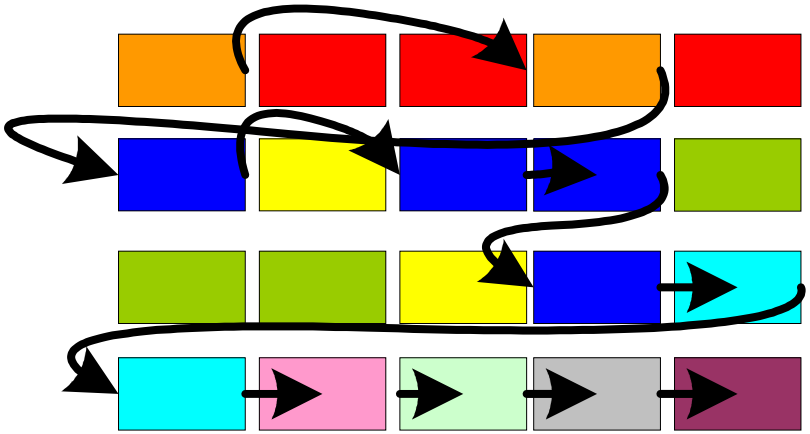


# Enhanced VirtIO – Day in a life of packet



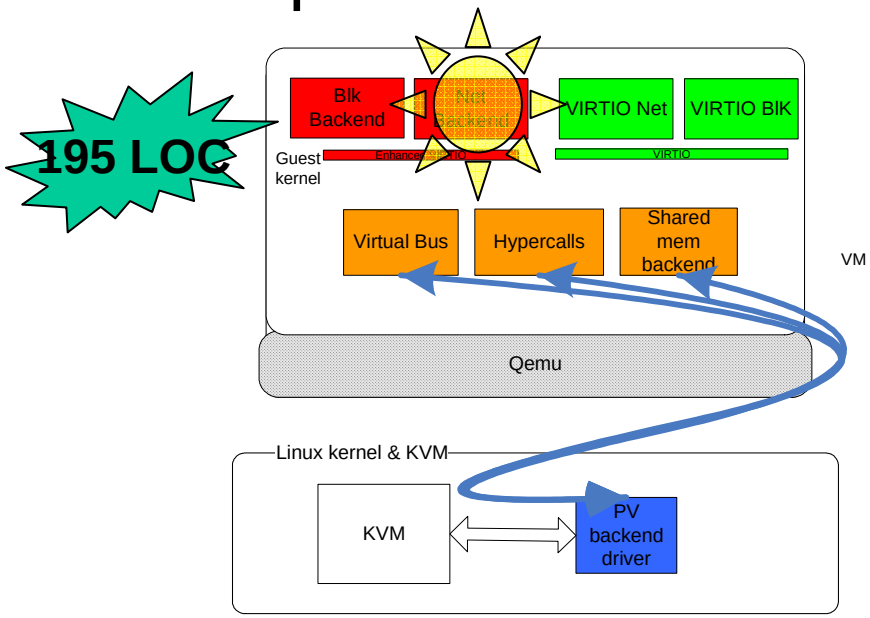
# Enhanced VirtIO – shared memory details

- Based on lguest
- 1-1 shared memory
- Data structure
  - Page of descriptors for rx, tx.
  - Available pointers page controlled by guest
  - Used pointers page controlled by host
- SG list is currently internal to descriptors
  - Descriptors are chained by next pointer



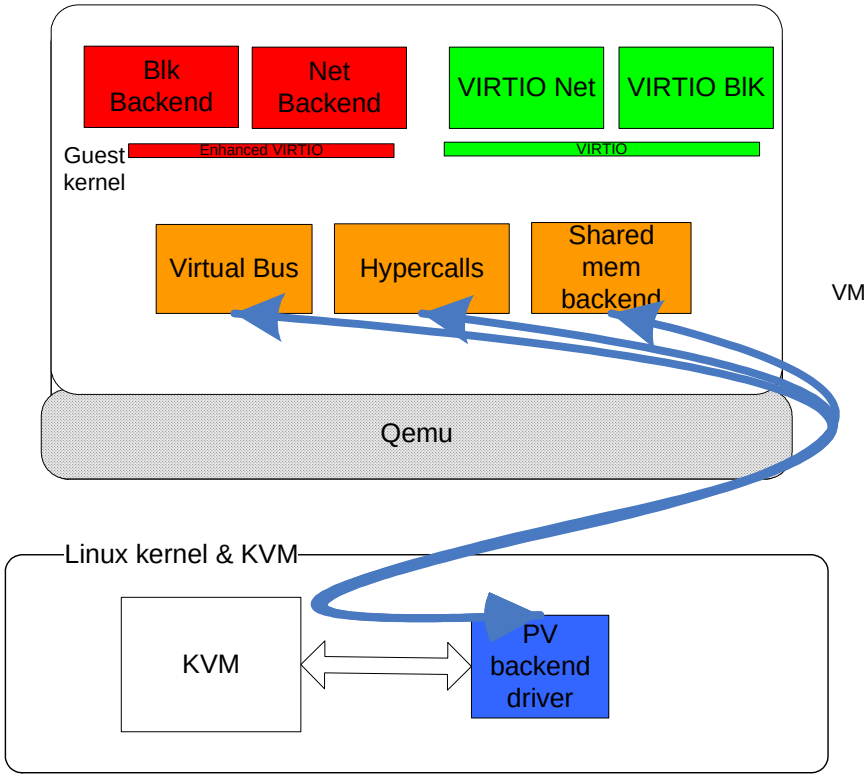
# Enhanced VirtIO – network be driver

- Implements kvm_virtnet_probe for pci bus
  - Creates tx,rx be_new_virtqueue
  - Probes virtnet
  - Request_irq
    - Irq# taken from bus
  - Register hypercall - shared memory pfn
    - Device key for enumeration taken from bus



# Further work

- Basic
  - Add readv/writev handlers to Qemu
  - Complete the user-space block device
  - Update with VirtIO gso.
  - Complete migration support
- Advanced (also simple)
  - Publish the enhanced interface
  - Optimize and stabilize
  - Add host back end drivers
  - Add virtual bus
  - HVM improvements
  - Test with PV kernel



# Q&A

Thank you ;)