KVM Platform Device Passthrough

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KVM Forum

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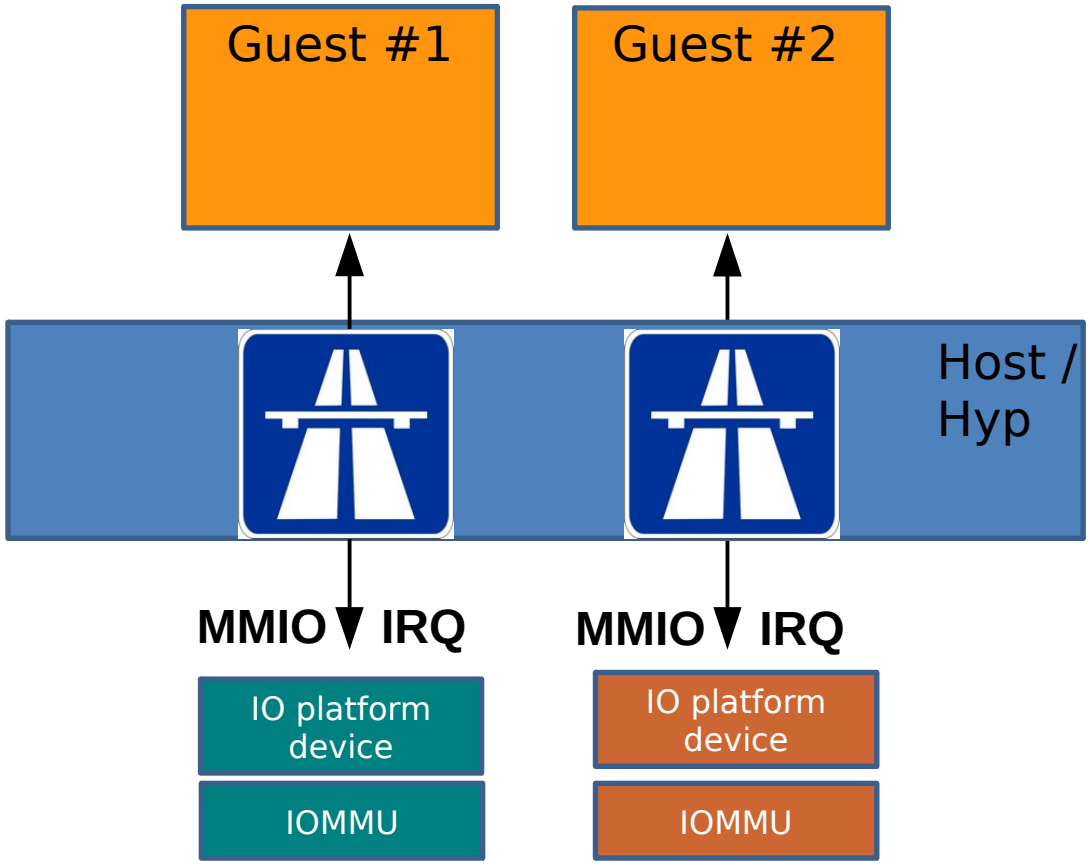
Linaro

Goal: efficiently assign platform devices to KVM guests



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Agenda

- VFIO Framework
- Focus on IRQ assignment
  - Understand legacy frameworks
  - Why hardware-assisted IRQ forwarding is crucial?
- Forwarded IRQ Integration with KVM/VFIO
- Experimental Results

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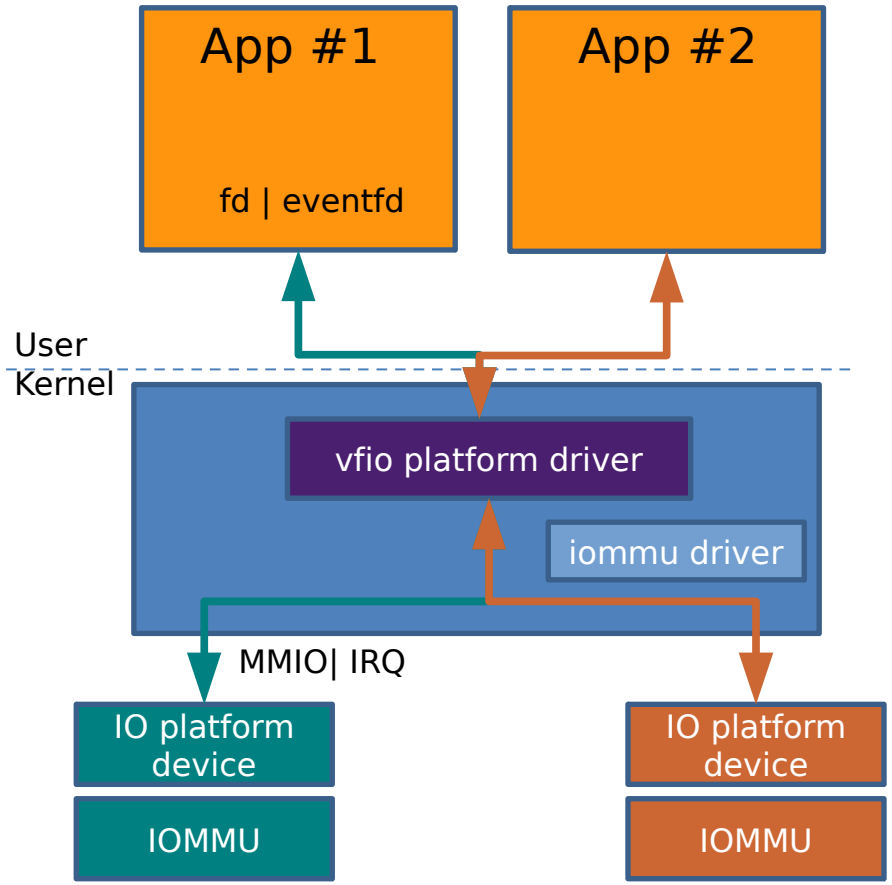
VFIO Platform Driver

- allows user-side to
  - mmap device MMIO regions
  - route physical IRQ to eventfd
  - Dma map buffers on iommu



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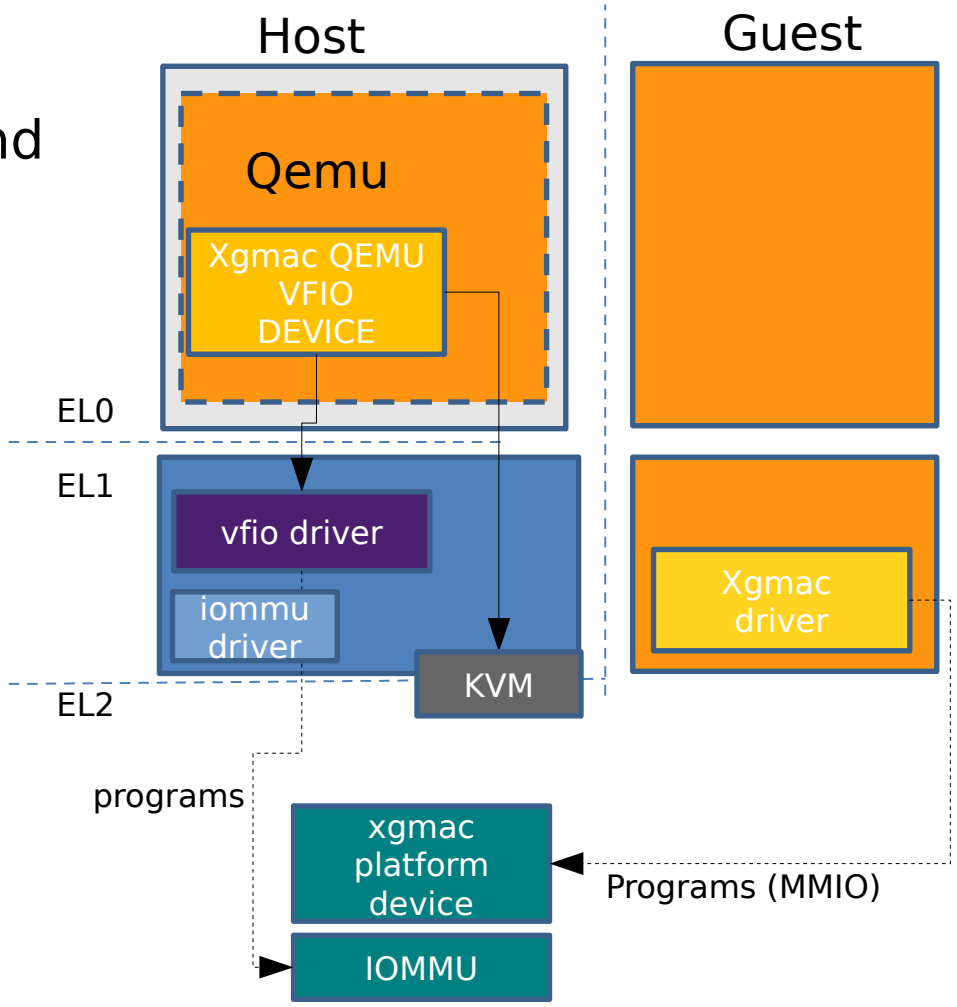
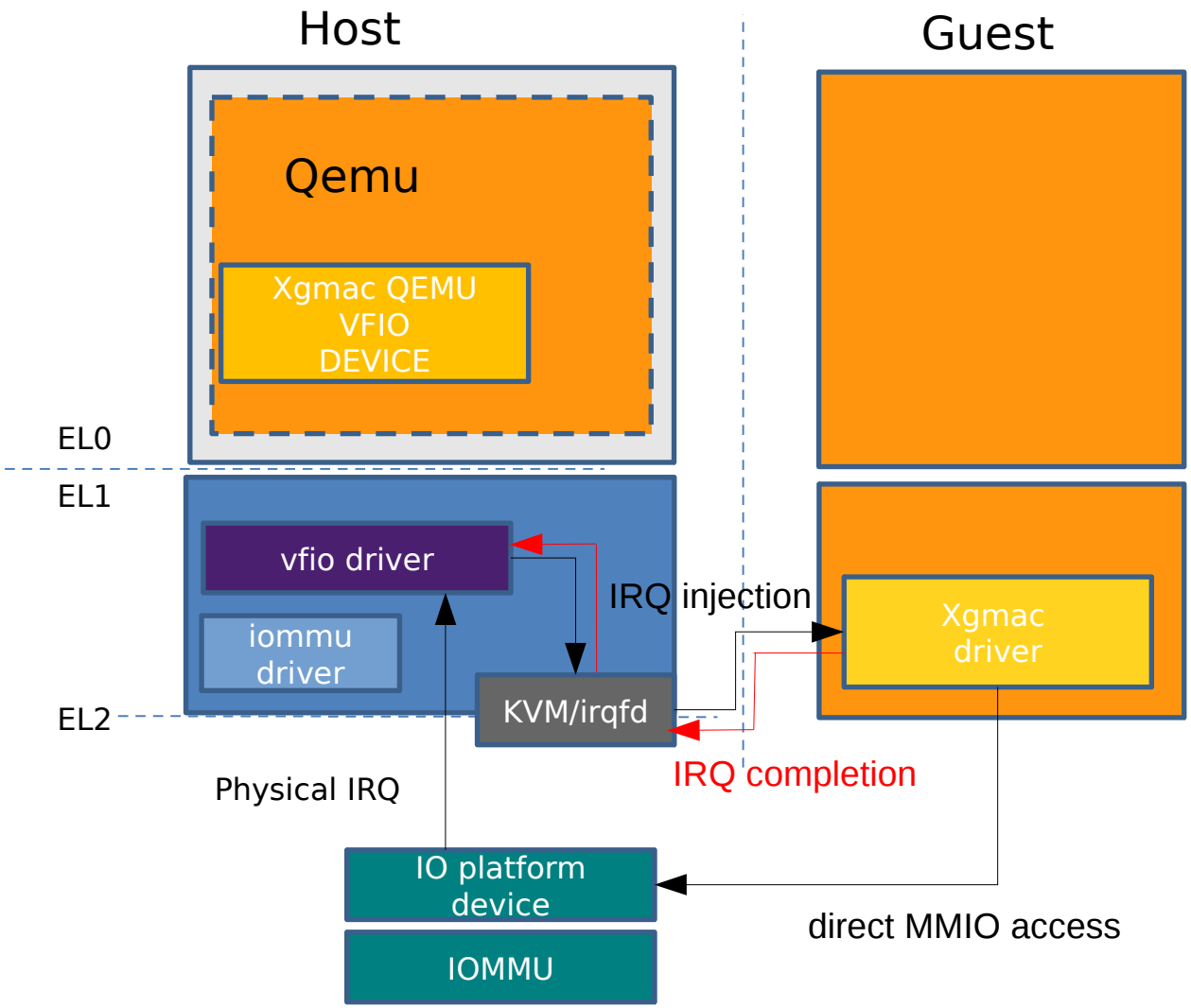
QEMU VFIO device

- Setup routes between guest and assigned device
  - MMU
  - IOMMU
  - IRQ injection path
- Generate guest device device tree node



MMIO & IRQ Paths



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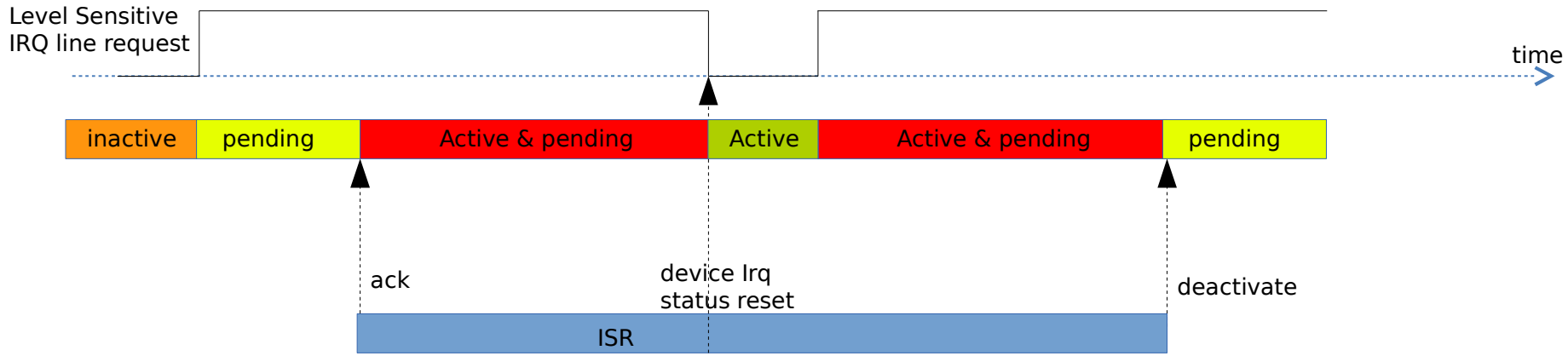
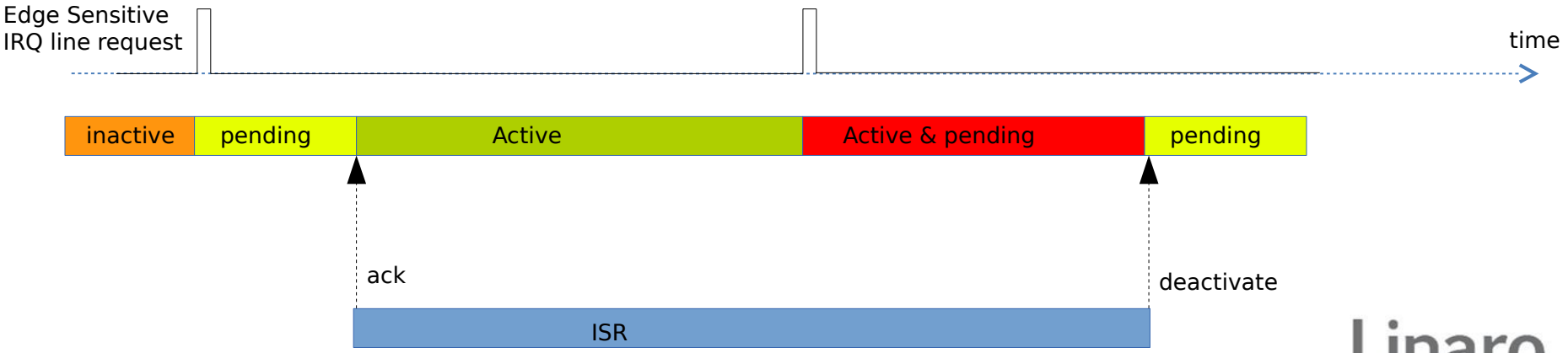
ARM IRQ Handling





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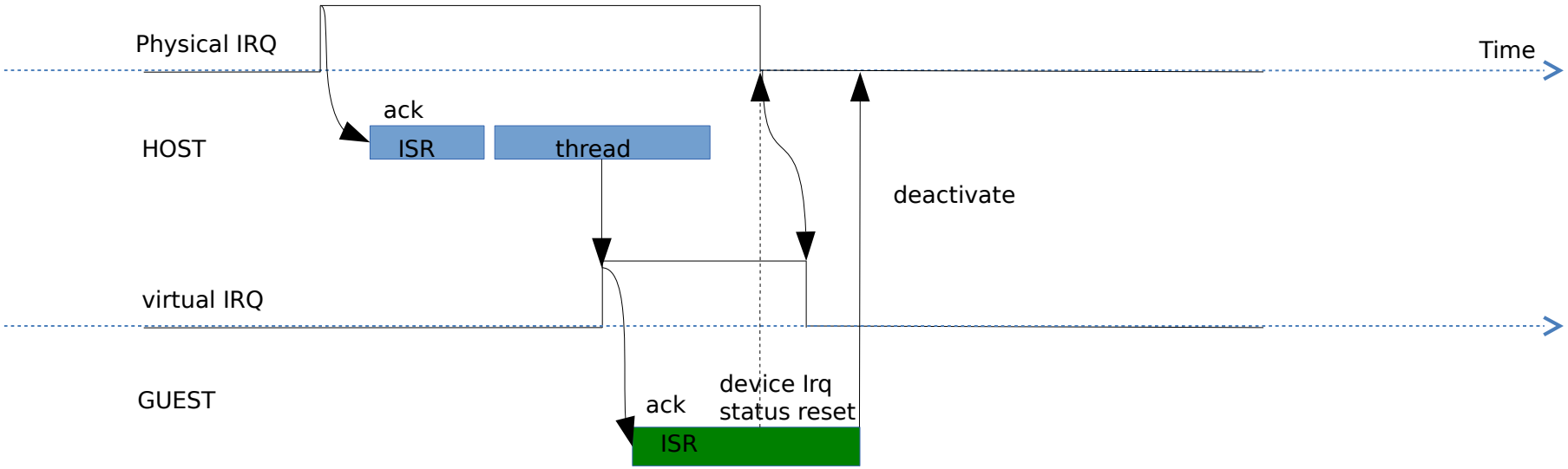
Assigned Level Sensitive IRQ Model



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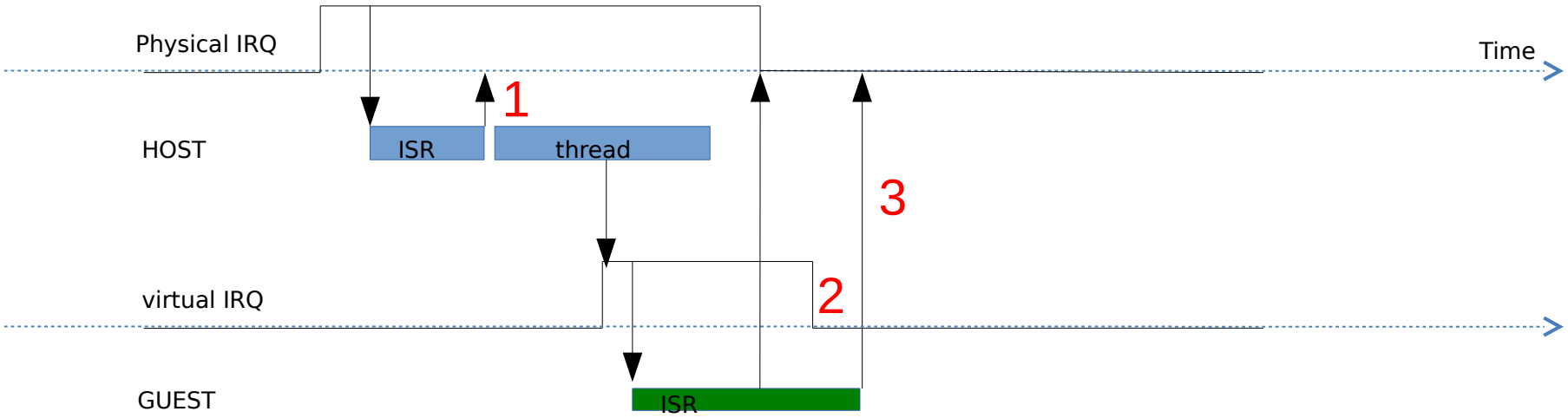
Level Sensitive IRQ Implementation Challenges



1)Physical IRQ completion

2)Virtual IRQ modeling

3)Virtual IRQ completion propagation

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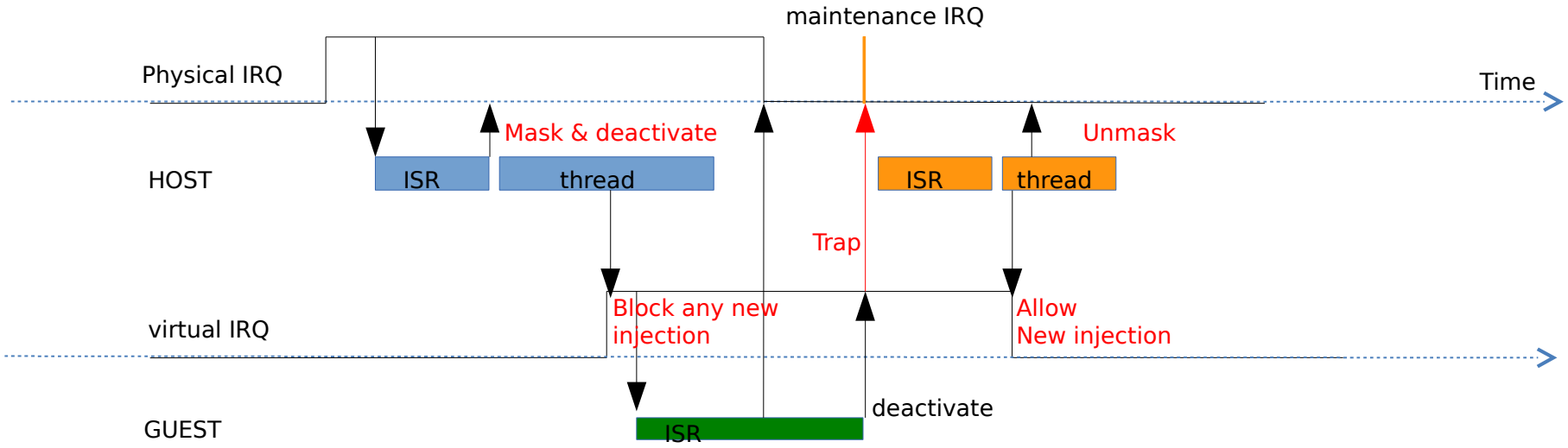
Basic vfio/irqfd ARM porting



- VFIO Mask/unmask
- Trap on completion

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Performance Challenges on ARM

- 1 VM switch when injecting
- 1 VM switch when completing
- VM Switch really costly on ARM

- Goal: Propose a new method to save completion VM switch using ARM GIC virtualization features

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GIC Forwarding Feature

- GIC can automatically complete physical IRQ on virtual IRQ completion
- Host only drops the running priority of the CPU I/F to allow other physical IRQs to be signaled
- Same IRQ cannot be signaled before its deactivation by GIC HW

Forwarded IRQ Patch

- “ARM: forwarding physical interrupts to a guest VM” from M. Zyngier
  - Enable mode where priority drop and deactivate are separated, Linux wide
    - Current used mode is simultaneous prio drop & deactivate
  - Provides separate operations to program IRQ forwarding at
    - IRQCHIP
    - VGIC

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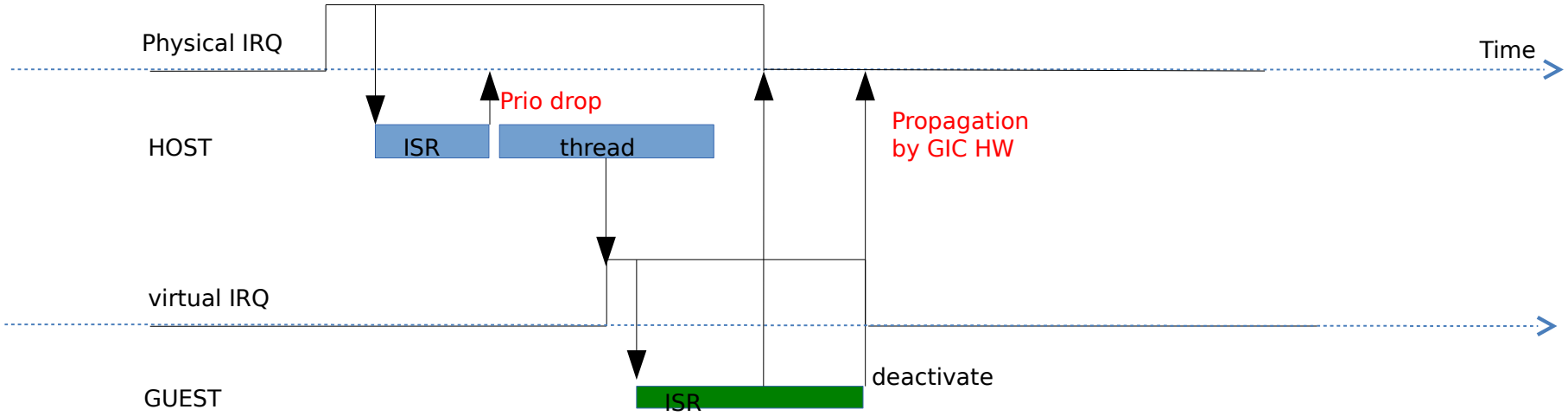
vfio/irqfd/forward



- No mask/unmask anymore
- Guest completion propagated by GIC HW
- No VM switch at completion
- Natural and optimized implementation

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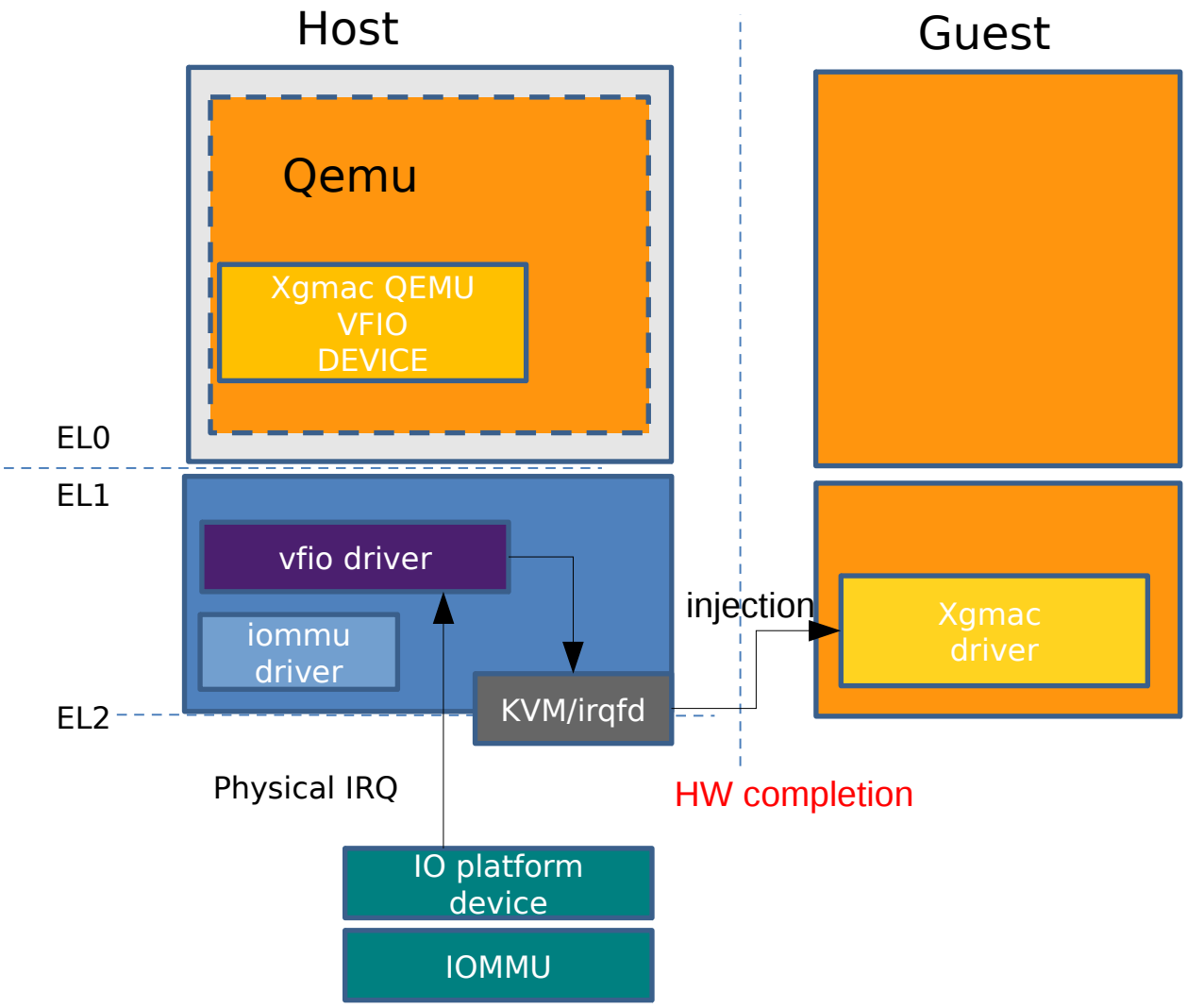
IRQ Path with KVM (irqfd/forward)



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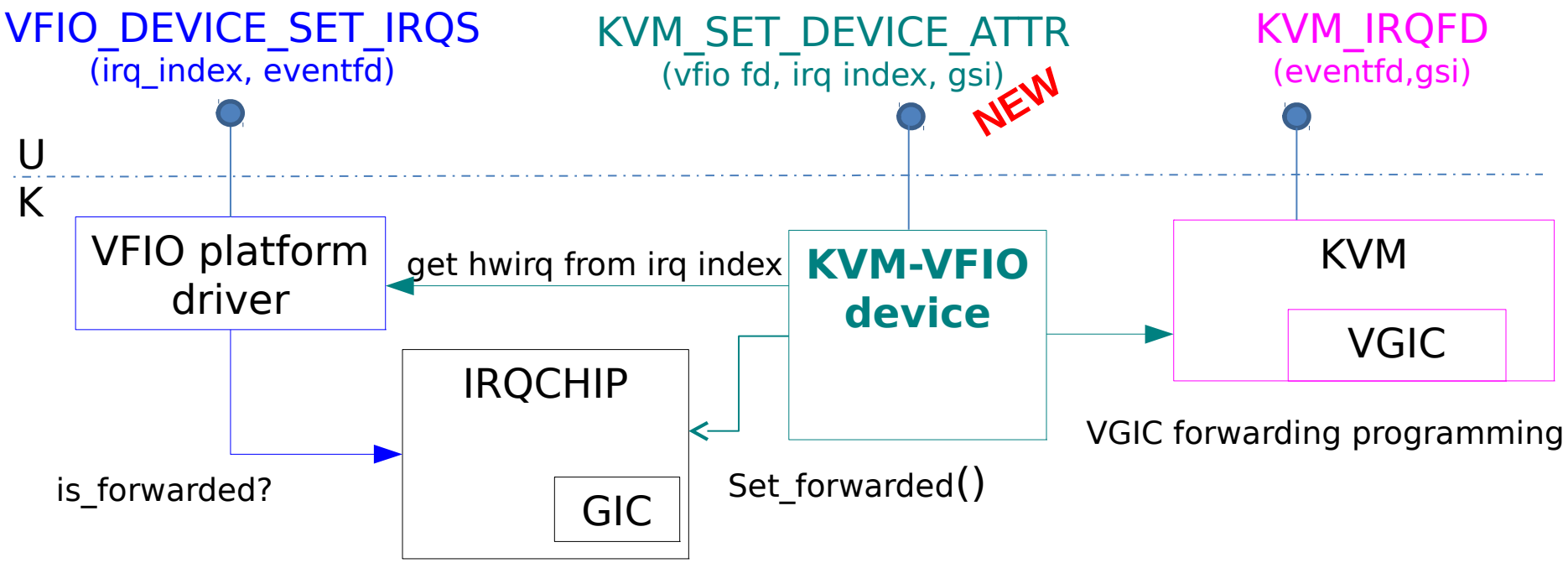
Forwarded IRQ Integration

Allow userspace to configure forwarding of a VFIO device IRQ



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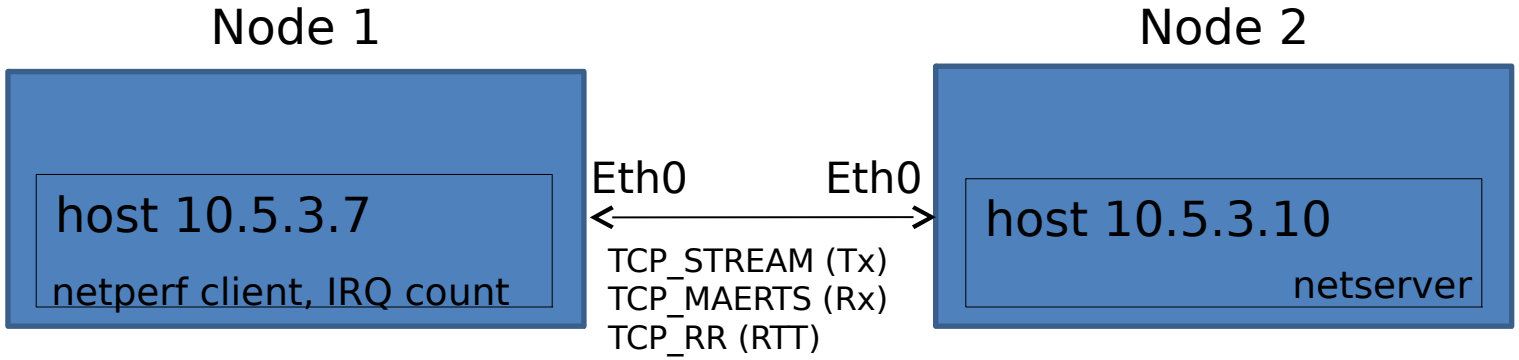
Performance Measures

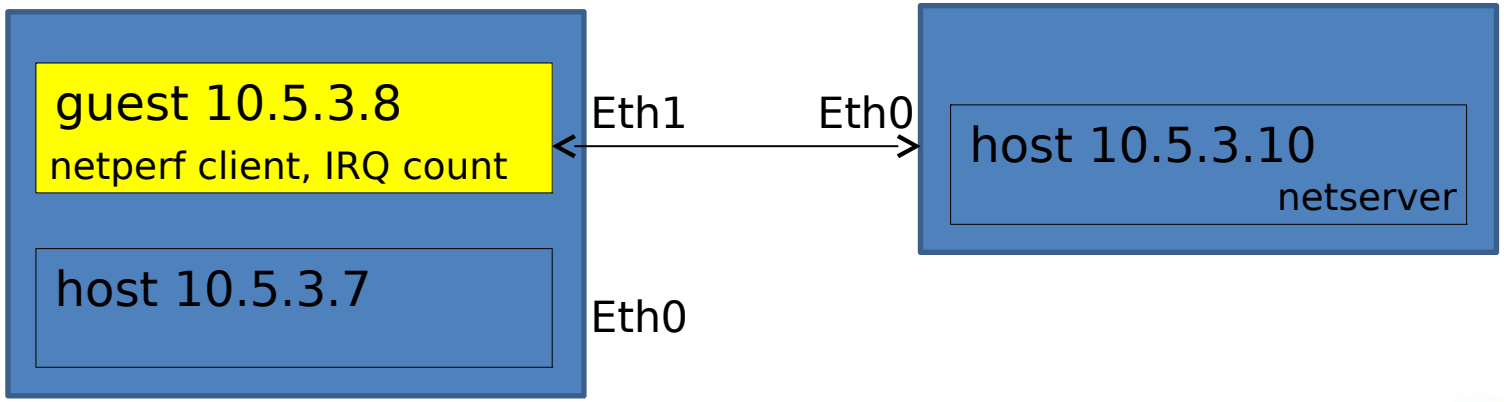
- Calxeda Midway
  - Communication between 2 nodes
  - 1Gb/s switch
- 2 xgmacs
  - eth0 assigned to host
  - eth1 assigned to guest if any
- Versions:
  - All kernels are 3.17rc3
  - QEMU is 2.1.0

Comparison

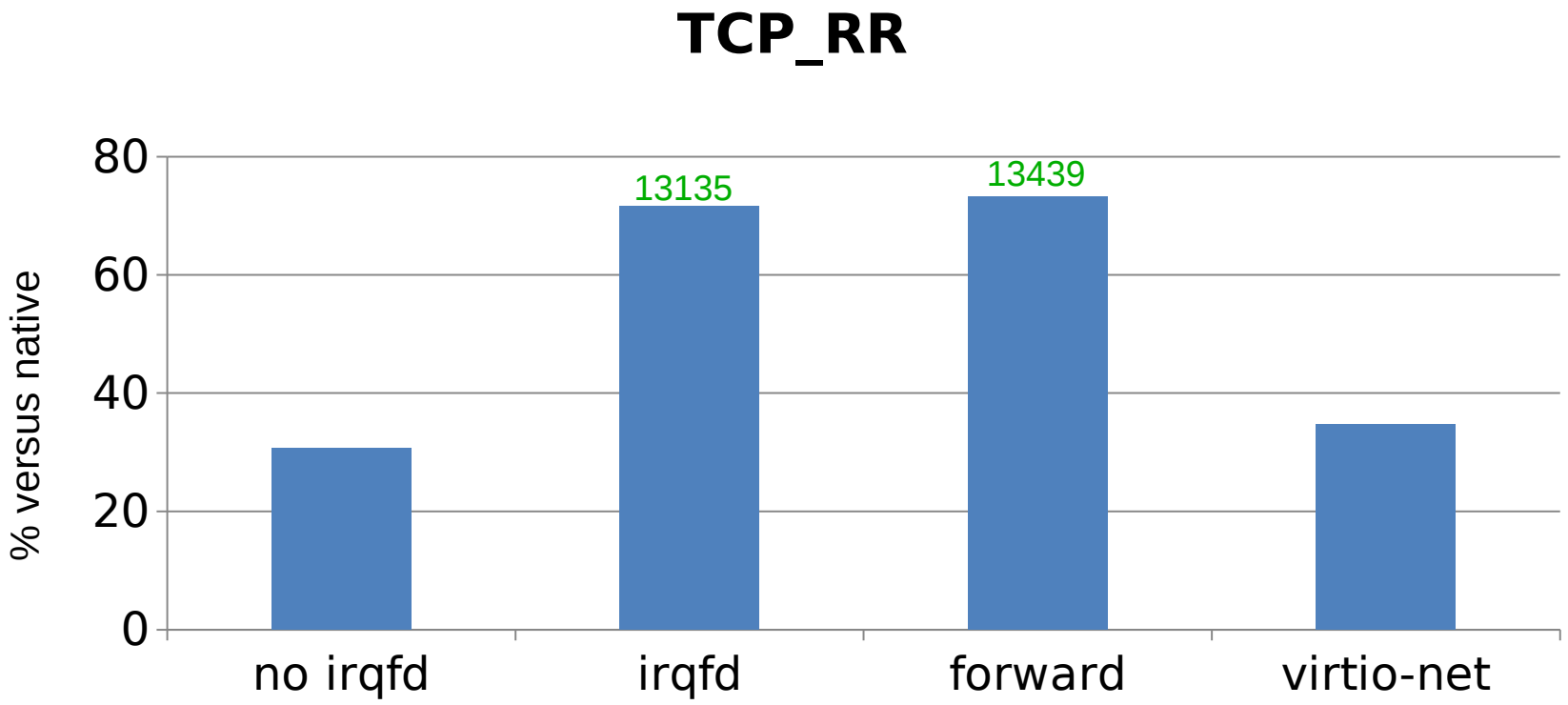
- Native Performance



- Guest Performance



Round Trip Time



Native Perf: 18350 trans/s

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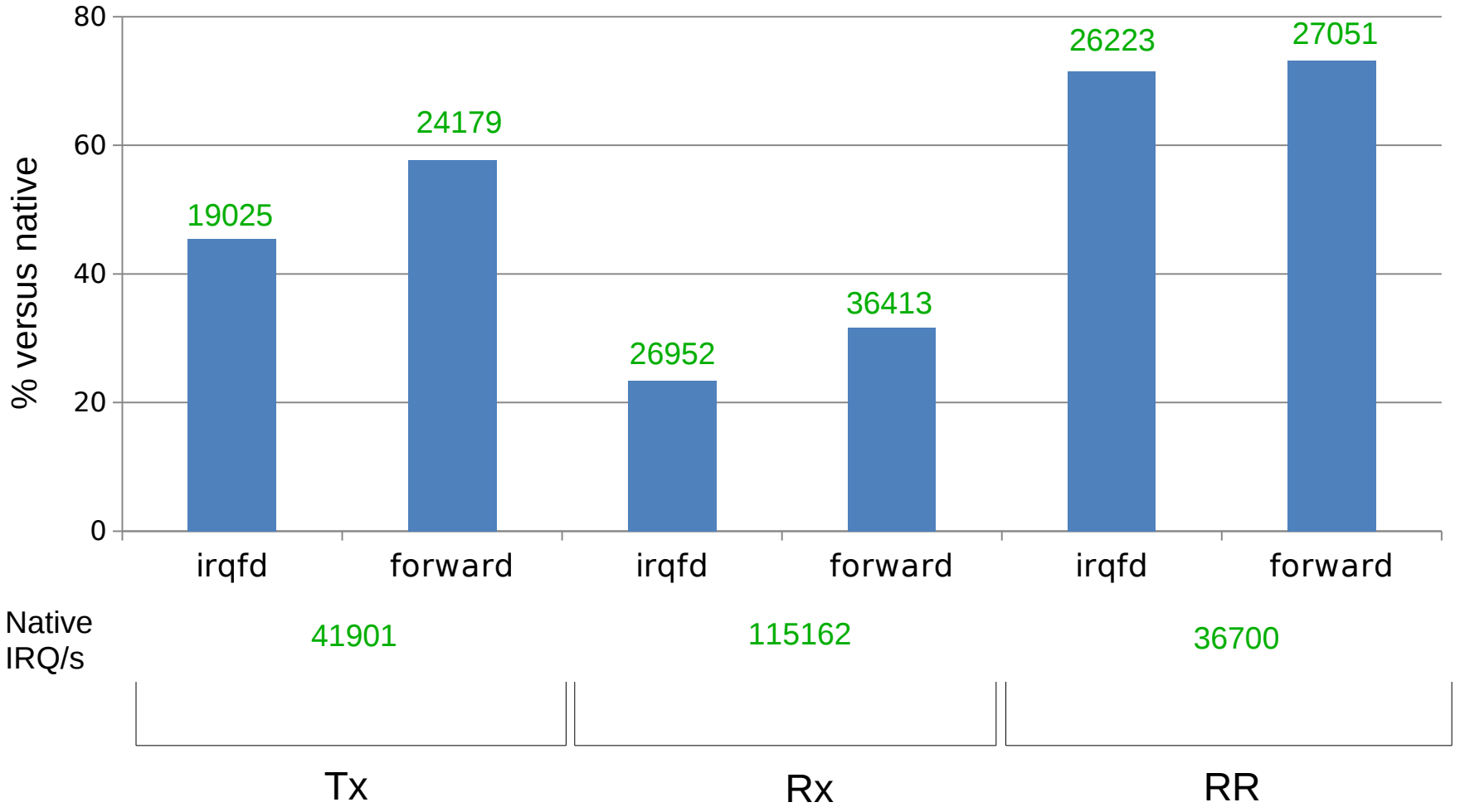
Xgmac IRQ rate on guest (IRQ/s)



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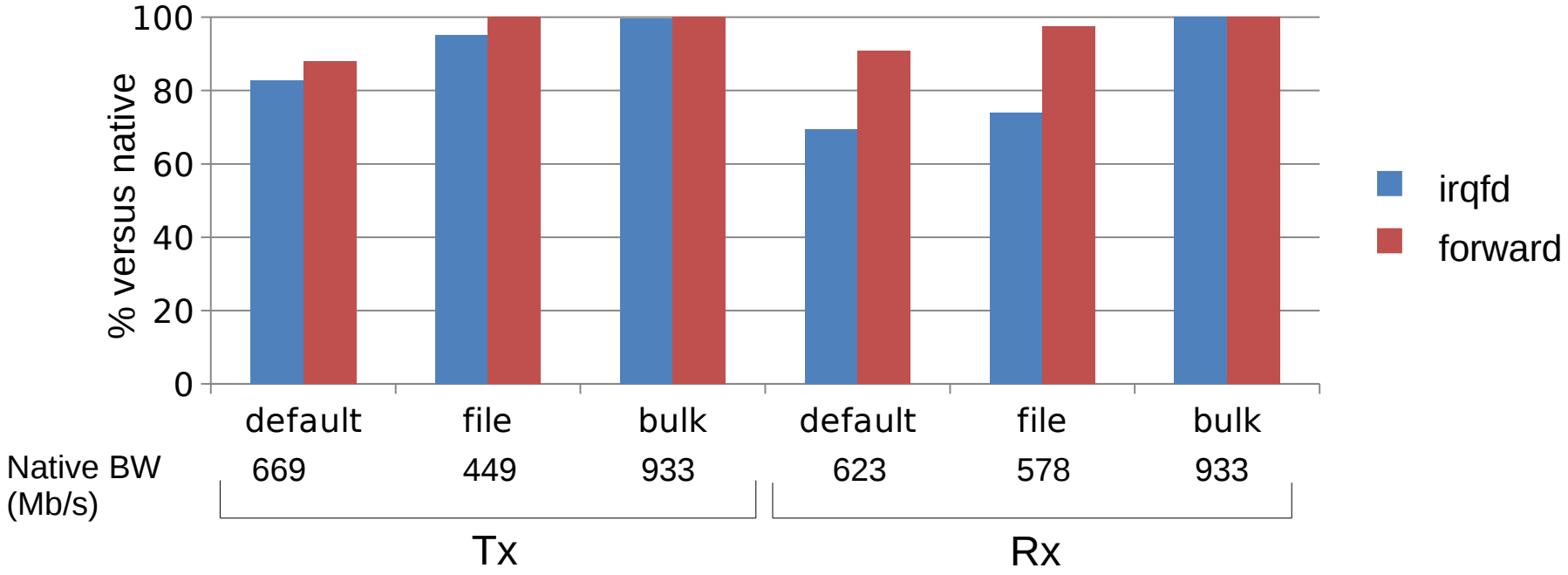
Throughput with 3 TCP/IP patterns



	default	file	bulk
Local Tx & Rx socket buffer size (-s)	8kB	8kB	64kB
Remote Tx & Rx socket buffer size (-S)	8kB	8kB	64kB
Local send size (-m)	8kB	4kB	8kB
Remote received size (-M)	8kB	4kB	8kB

Status & Next

QEMU patches & dependencies

#	QEMU Patches	Author
0	KVM platform device passthrough	E. Auger
1	Dynamic sysbus device allocation support	A. Graf
2	machvirt dynamic sysbus device instantiation	E. Auger

#	Kernel Patches	Author
0	VFIO support for platform devices	A. Motakis
1	ARM: KVM: add irqfd support	E. Auger
2	KVM-VFIO IRQ forward control	E. Auger
3	ARM: Forwarding physical interrupts to a guest VM	M. Zyngier

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Conclusion

- Main functional bricks are available for efficient KVM platform device passthrough
- Forwarded IRQ usage shows improvements on
  - Sustained IRQ rate
  - Latency
  - Bandwidth, on some patterns
- Please test and use VFIO platform
  - Start integrating your devices
  - Share issues with complex device tree nodes
  - Work ongoing on AArch64 too

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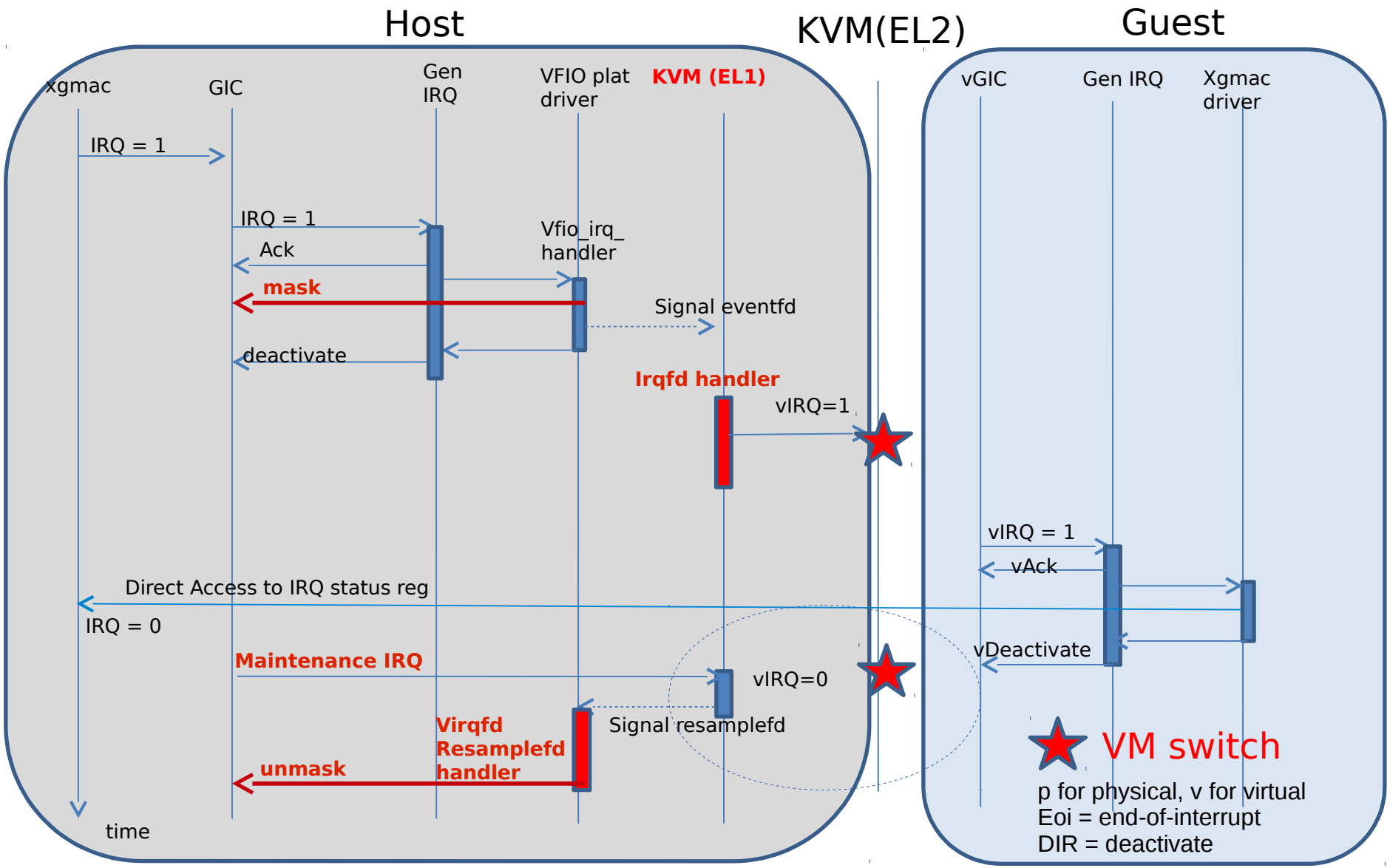
Questions?

Thanks!

Backup Slides

Irqfd Standard ARM Porting



Forwarded IRQ