GUARDRAIL: DEVICE DRIVER MONITORING FOR I/O SAFETY

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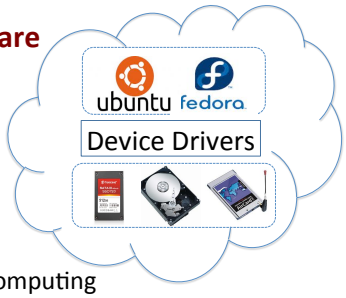
Problem: Device Drivers

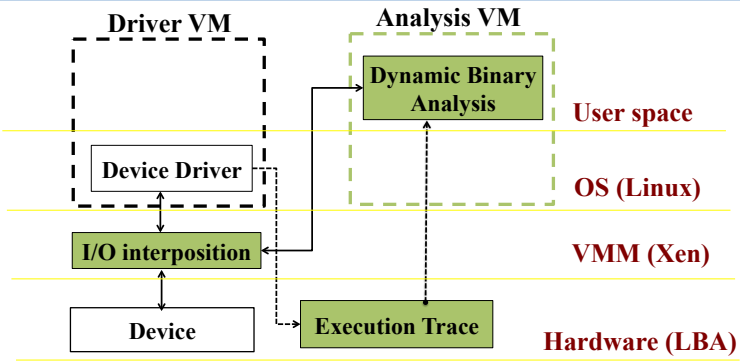
- **Important system software**
  - Manage hardware devices
  - ~70% of Linux kernel code
- **Highly defective**
  - OS corruption
  - I/O device corruption
  - Reliability issue for Cloud Computing



Objective: Protect System I/O

- **Prevent faulty drivers from performing I/O**
- **Challenges**
  - Variety of driver faults
  - Variety of I/O devices
  - Analysis integrity
  - Monitoring performance
- **No prior work handles all challenges**

Guardrail: Decoupled Correctness Checking for Device Drivers

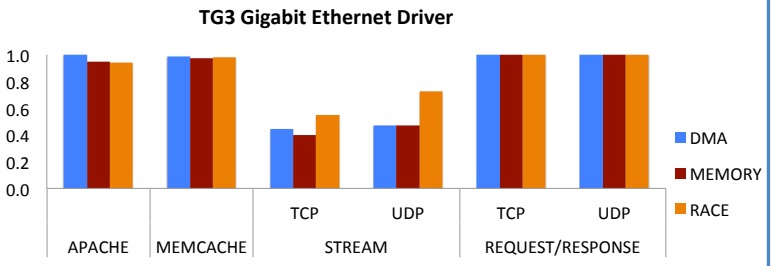


- **Dynamic Binary Analysis**
  - Data races
  - DMA faults
  - Memory faults
- **Virtualization**
  - Transparent interposition of I/O operations
  - Protect Execution Trace and DBA integrity
- **Execution Tracing**
  - Decouple DBA from Driver
  - Hardware support to improve performance

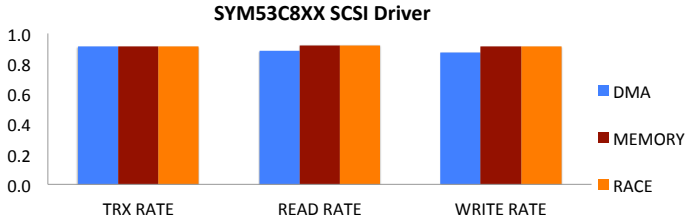
Current Results

Evaluation Environment		
Simulated H/W	Physical	x86, 2 CPU, 2.6GHz, 2GB RAM
	Tracing	LBA, 512KB LOG BUFFER
	Driver VM	2 VCPU, 1GB RAM
	Analysis VM	1 VPU, 512MB RAM
Real World S/W	OS	32-bit Linux 2.6.18 (FC6)
	VMM	Xen-3.3.1 (Paravirtualized)
	Network Drivers	e100, e1000, pcnet32, tg3, tulip
	SCSI Drivers	qla1280, qla2xxx, sym53c8xx

Faults Detected in Drivers	
DMA FAULTS	25
MEMORY FAULTS	2 (1 unknown)
DATA RACES	17



Throughput when monitoring for DMA, MEMORY, and RACE Faults, normalized to throughput without monitoring



Throughput when monitoring for DMA, MEMORY, and RACE Faults, normalized to throughput without monitoring

Future Work

- **Performance: Network streaming**
- **Coverage: more devices and analyses**
- **OS kernel protection**

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