rVMI

A New Paradigm for Full System Analysis

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Overview

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1. About us

1. About us

Dr. Jonas Pfoh

- Engineers at FireEye
- Work on malware detection
- Research Interests
  - Virtualization and Virtual Machine Introspection
  - Malware and exploitation techniques

Dr. Sebastian Vogl

2. Motivation

2. Motivation: What we did

rVMI: “Debugger on Steroids“

- Runs completely isolated form the target through **Virtualization**
- Full control over the target with **VMI**
- Leverages **memory forensiscs** to make the full state of the guest available to the analyst
- **Interactive** and **scriptable**

2. Motivation: Why we did it

Manual dynamic analysis

- Analyzing malware and exploits
- Gain a full understanding of a sample
- Tools
  1. Debuggers
  2. Sandboxes

2. Motivation: Why we did it

Debuggers

- Provide visibility and flexibility
- BUT: NEVER DESIGNED FOR MALICIOUS SOFTWARE
- Inherent attack vectors
    1. No isolation
    2. Rely on the OS to function and to obtain data
    3. Designed to trace a single process (or the kernel)

2. Motivation: Why we did it

Sandboxes

- Provide isolation and evasion resistance
- BUT: NEVER DESIGNED FOR INTERACTIVE ANALYSIS
- Manual analysis is difficult
    1. Limited Visibility
    2. Limited Control
    3. Limited Interface

2. Motivation: Why we did it

The current state of interactive dynamic analysis

- Neither debuggers nor sandboxes were designed for this
- We face a tradeoff between visibility/flexibility and isolation/evasion resistance
- We are not aware of any tool that combines these properties

→ We need a new tool that was designed for the job.

3. Architecture

3. Architecture: Goals

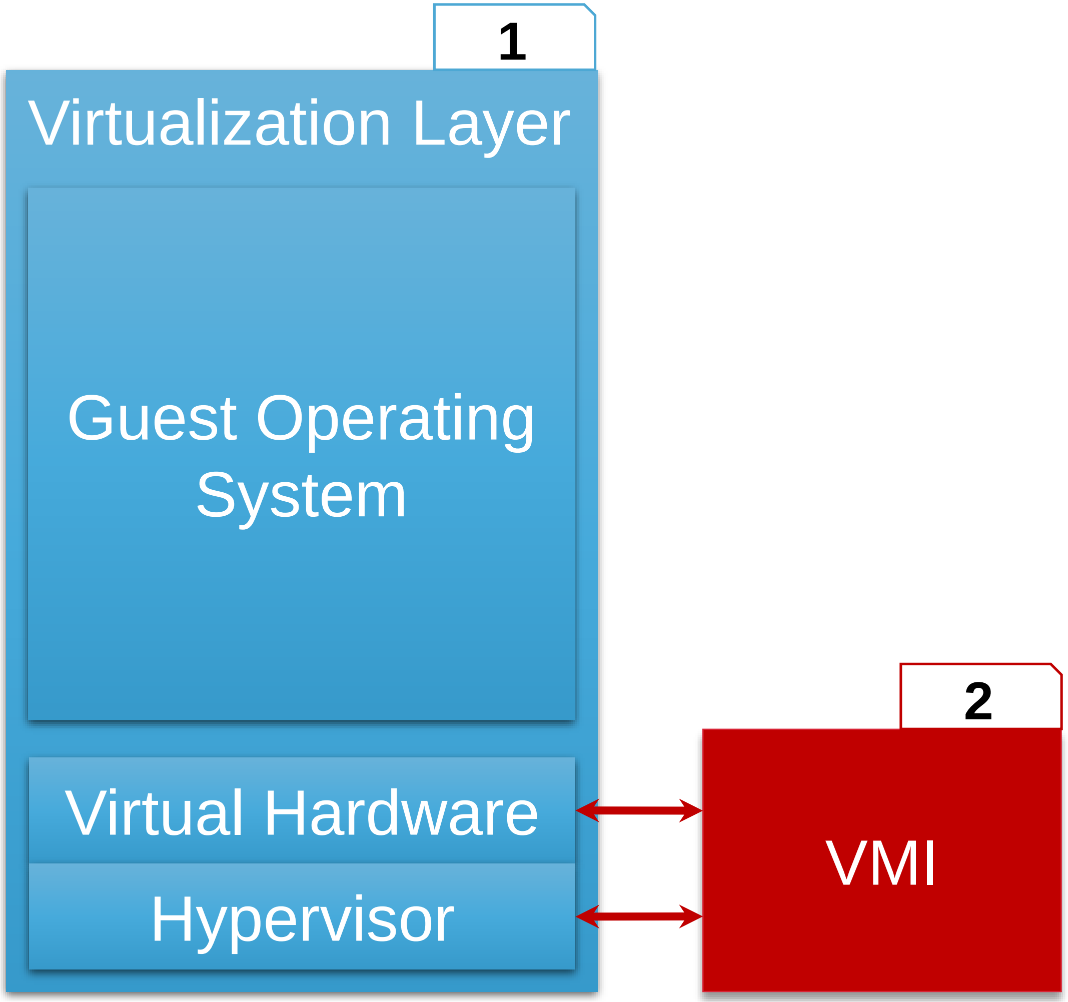
1. Resistant to evasion
2. Full system analysis
3. Interactive and scriptable

3. Architecture: Resistant to evasion

Building Block 1
Virtualization

- Isolate the target system from the analysis environment
- Increase evasion-resistance

3. Architecture: Full system analysis



Building Block II
VMI

- Provides full control of target system
- Allows access to entire state of the VM
- Exports this functionality through an API

3. Architecture: The semantic gap

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3. Architecture: The semantic gap

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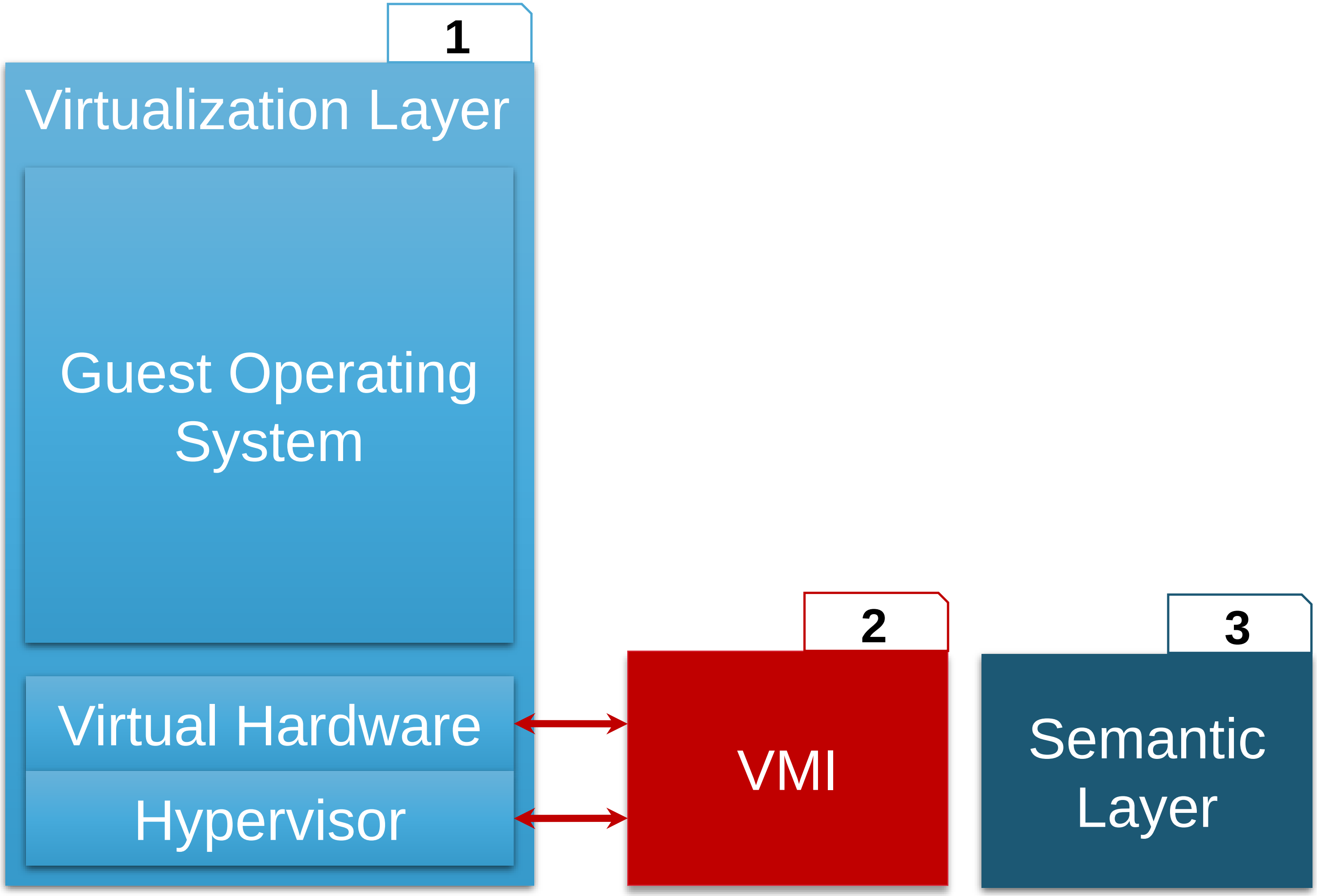
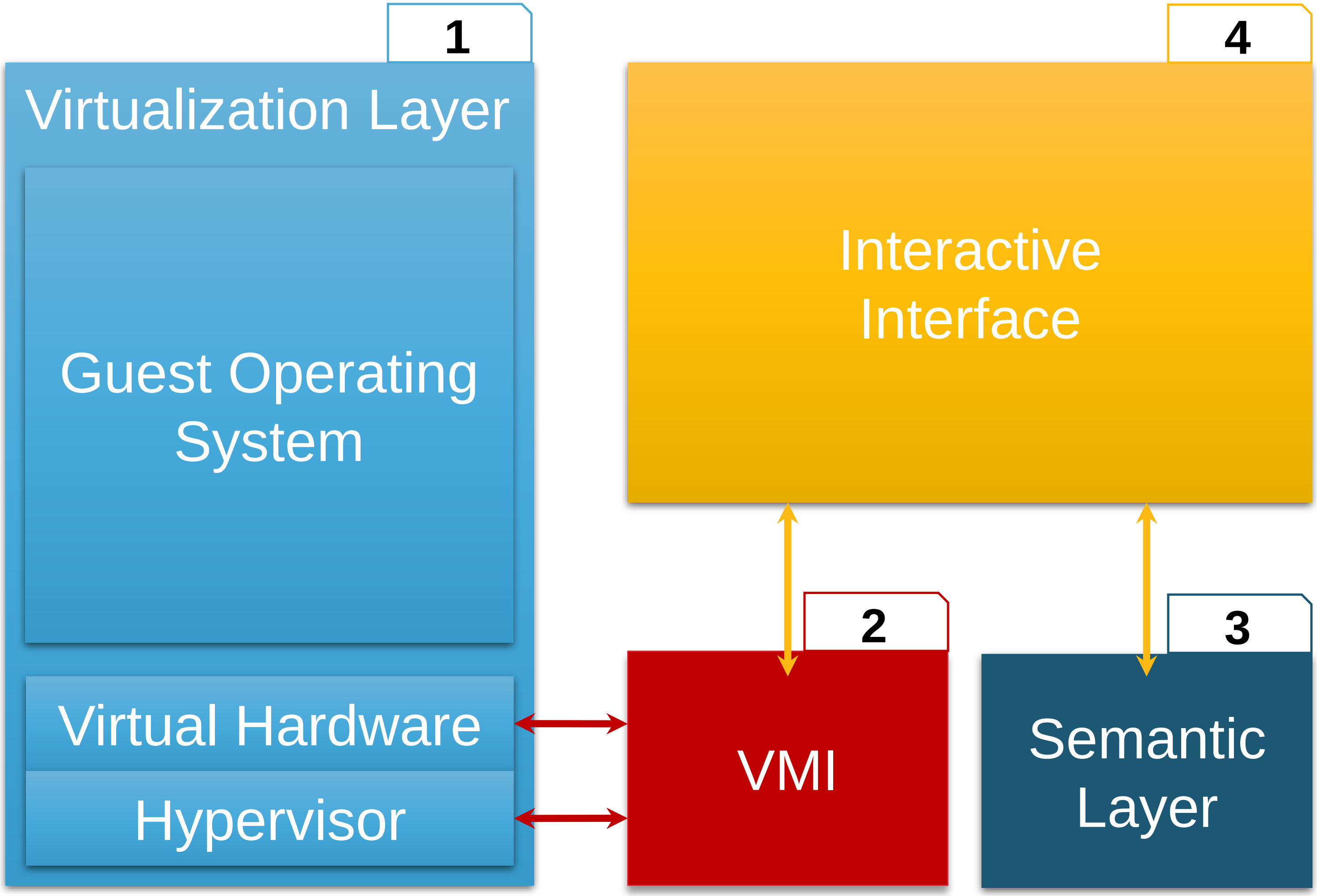
3. Architecture: Full system analysis



Building Block III
Semantic Layer

- Reconstruct the semantic knowledge of the guest OS
- Export this knowledge through an API

3. Architecture: Interactive and scriptable



Building Block IV
Interactive Interface

- Environment for the actual analysis
- Provides access to the VMI layer and the semantic layer
- Support for scripting

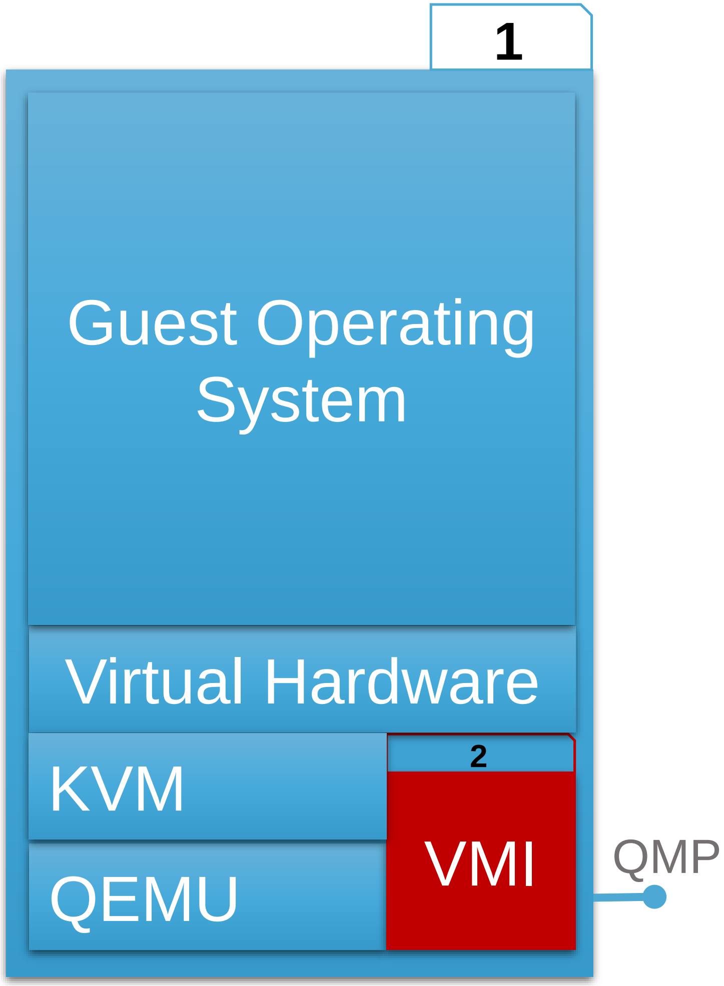
4. Implementation

4. Implemetation: Virtualization

Building Block I
Virtualization

- Chose KVM/QEMU as a basis as it is the natural choice for a debugger
- System does not depend on the hypervisor

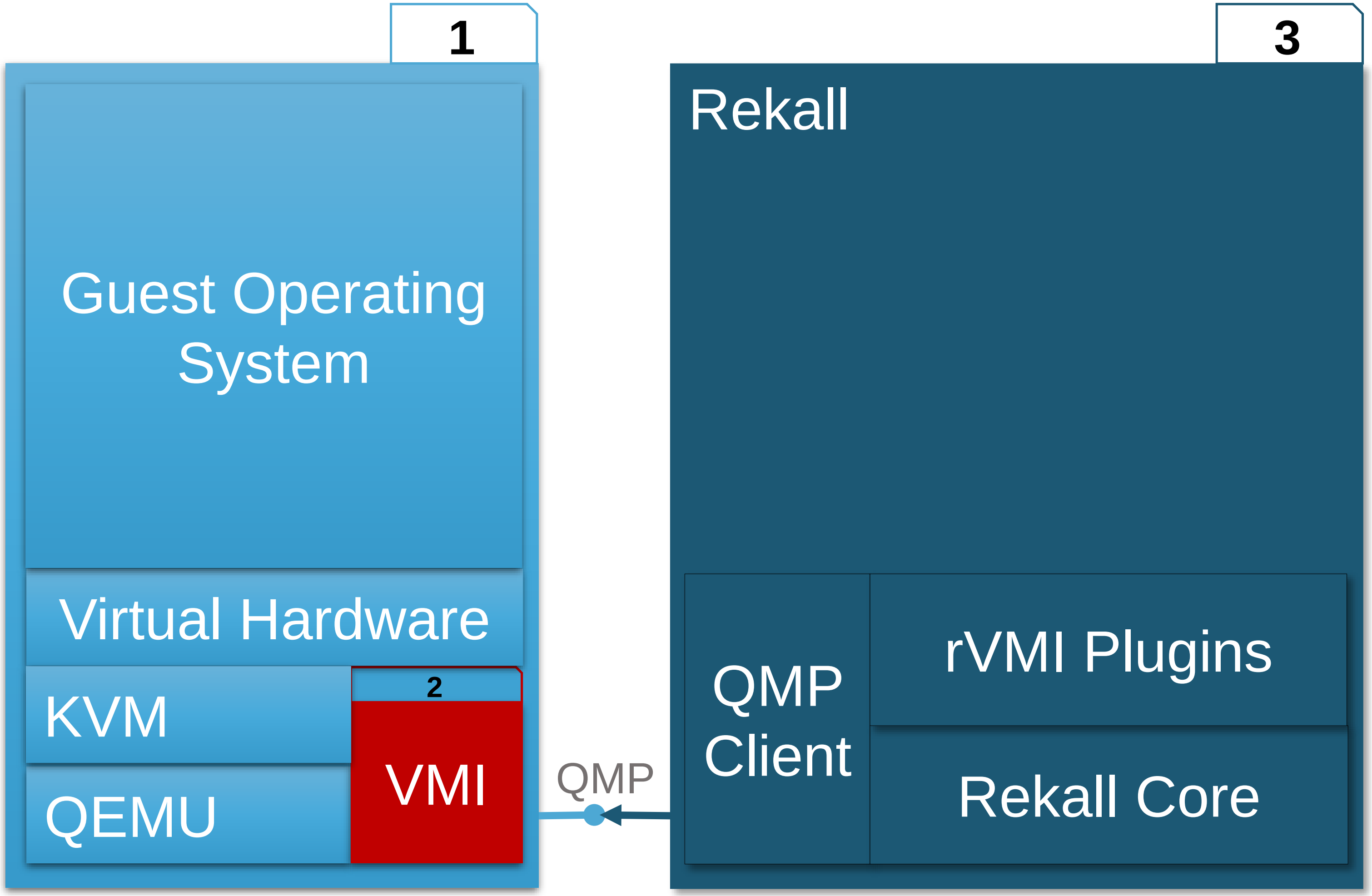
4. Implemetation: VMI



Building Block II
VMI

- Extended KVM/QEMU with a VMI interface
- Interface exposes the hardware features
- Exported this interface via QMP

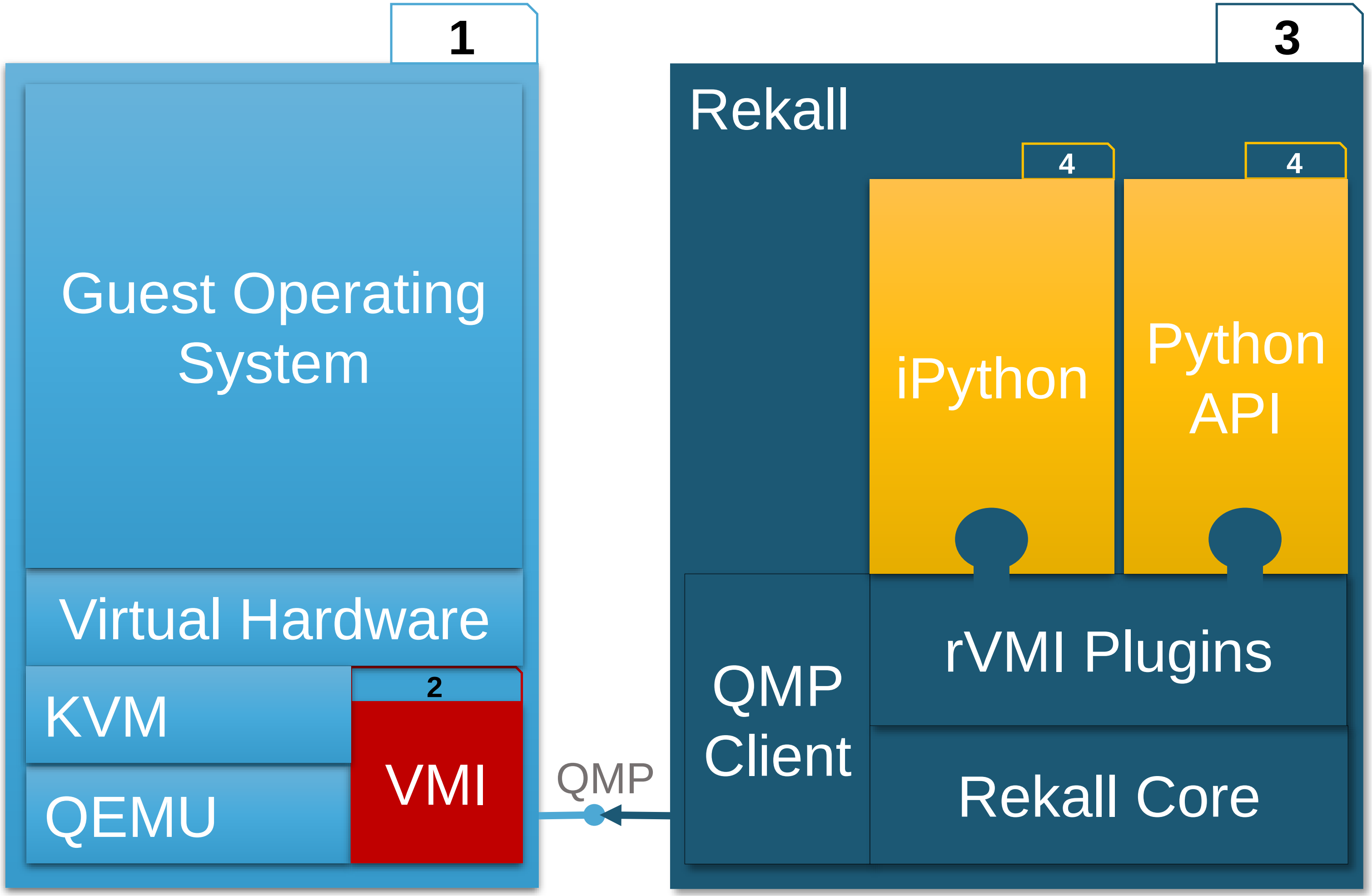
4. Implemetation: Semantic Layer



Building Block III
Semantic Layer

- Used Rekall as a basis
- Supports multiple OSs
- Can access OS structures in python
- Added a QMP address space to access the VM through VMI

4. Implemetation: Interface



Building Block IV
Interactive Interface

- Used the iPython shell of Rekall as basis for the debugger interface
- Added Rekall plugins for VMI commands
- Added rVMI events and exported an interface to these events

5. Demonstration

5. Demonstration

DEMO

6. Summary

Summary

- Interactive dynamic malware analysis is an important technique
- Currently no tools for the job
- We presented rVMI: Debugger on steroids
  - Isolation
  - Full control and full access
  - Interactive and scriptable

https://github.com/fireeye/rVMI

We are open to feedback and feature requests and hope for contributions.