Software

WRITING CHIPSEC MODULES & TOOLS

Module & Command Development

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Why are we here?

- Supporting CHIPSEC at Intel
- Help the CHIPSEC community to write more modules
- Improve the functionality of CHIPSEC

Agenda

- A Little History
- Architecture
- Modules (Tests & Tools)
- Utility Commands

CHIPSEC

CHIPSEC History

- CHIPSEC is a framework for analyzing the security of PC platforms including hardware, system firmware (BIOS/UEFI), and platform components.
- Originally developed by Yuriy Bulygin (@c7zero)
- First version of CHIPSEC was released in March 2014 at CanSecWest
- Currently used by firmware developers, system validation and system integrators

https://github.com/chipsec/chipsec.git

Running CHIPSEC

Boot to the USB drive

- Ubuntu 18.04 with CHIPSEC source
- Password: 0$fc2018

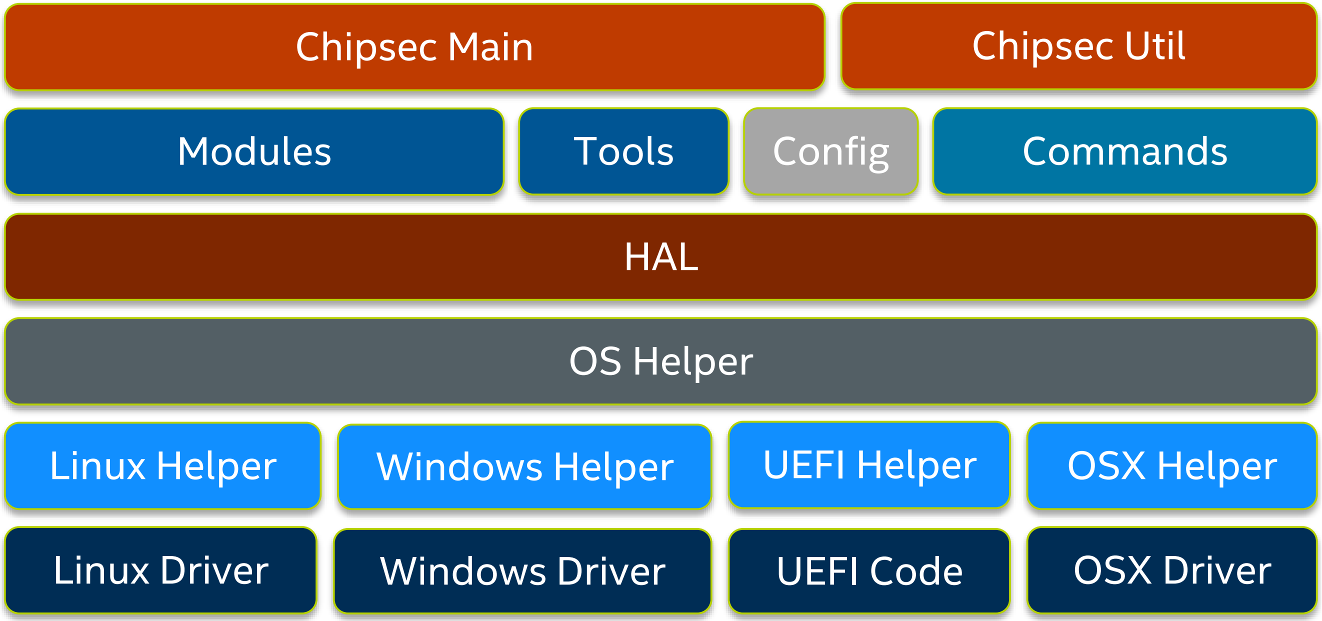
From a terminal:

```
cd ~/src/chipsec

python setup.py build_ext -i

sudo python chipsec_util.py platform

sudo python chipsec_main.py
```

Common Terms

- Device ID (DID)
- Hardware Abstraction Layer (HAL)
- Platform Controller Hub (PCH)
- Serial Peripheral Interface (SPI)
- System Management Mode (SMM)
- Unified Extensible Firmware Interface (UEFI)
- Vendor ID (VID)

CHIPSEC Architecture



CHIPSEC Architecture

Modules & Tools

- Implementation of tests or other functionality for `chipsec_main`

Configuration Files

- Provide a human readable abstraction for registers in the system

Commands

- Implement functionality of `chipsec_util`

HAL

- Useful abstractions for common tasks such as accessing the SPI

OS Helpers & Drivers

- Provides a translation layer to convert a common interface to OS specific driver calls

CHIPSEC_MAIN Program Flow

1. Load OS Specific Driver
2. Detect Platform
3. Load Modules
4. Load Configuration Files
5. Run Loaded Modules
6. Report Results

Platform Detection

- Uses PCI VID and DID to detect processor and PCH
  - Processor 0:0.0
  - PCH 0:31.0
- Chip information located in chipsec/chipset.py
  - Currently requires VID of 0x8086
  - DID is used as the lookup key
- Select a specific platform using the -p flag
- Ignore the platform specific registers using the -i flag

Configuration Files

- Broken into common and platform specific configuration files
- Used to define controls, registers and bit fields
- Common files always loaded first so the platform files can override values
- Correct platform configuration files loaded based off of platform detection

Configuration File Examples

```
<mmio>

    <bar name="SPIBAR" bus="0" dev="0x1F" fun="5" reg="0x10" width="4" mask="0xFFFFF000"
    size="0x1000" desc="SPI Controller Register Range" offset="0x0"/>

</mmio>

<registers>

    <register name="BC" type="pcicfg" bus="0" dev="0x1F" fun="5" offset="0xDC" size="4"
    desc="BIOS Control">

        <field name="BIOSWE" bit="0" size="1" desc="BIOS Write Enable" />

        …

        <field name="BILD" bit="7" size="1" desc="BIOS Interface Lock Down"/>

    </register>

</registers>

<controls>

    <control name="BiosInterfaceLockDown" register="BC" field="BILD" desc="BIOS Interface
    Lock-Down"/>

</controls>
```

Register Interfaces

- Used to access controls, registers and fields based on the human readable name
- Enables test code to be portable when registers move or are renamed
- Controls allow for mapping different register names to a common control name
- Interfaces exist for reading and writing as well as checking for existence

Register Interface Summary

Control Access:

- `is_control_defined, get_control, set_control`

Register Access:

- `is_register_defined, read_register, write_register, print_register`

Field Access:

- `register_has_field, read_register_field, write_register_field, get_register_field_mask, get_register_field, set_register_field`

Note: Only commonly used interfaces listed

Logging Interface

- CHIPSEC defines its own logging interface
  - Used for display to terminal
  - Used to write to different log file types
- Provides color text output to the console
  - Linux support without additional modules
  - Windows color console support requires additional python modules
- Should be used to display output instead of `print()`

Logging Interface Summary

`log`

- Logs the specific string same as a print

`log_*`

- Prepends formatted text to the provided string
- log_warning will prepend the string with "**`[!] WARNING:`**" in yellow

`log_*_check`

- Used to log the overall result for the module
- Always called once (and only once) in a module
- Also used to finalize XML log entry

HAL Overview

`cpu`

- Access to processor registers and special instructions like cupid

`mmio`

- Direct or register based access to MMIO regions

`pci`

- Access to PCI devices and Option ROM information

`spi`

- Simplifies accessing the SPI flash and enumerating different regions

`uefi`

- Access to UEFI functionality such as variables, system tables or compression

* Many more exist in the chipsec/hal directory

Return Values

PASSED - Test detected mitigation

FAILED - Test failed to detect mitigation

WARNING - Test results require manual investigation

INFORMATION - Test output is informational only

SKIPPED - Test not implemented for current platform (test not run)

NOTAPPLICABLE - Test does not apply to current platform (test not run)

ERROR - The test generated an exception

Modules (Tests & Tools)

- Test Modules
  - Verify a specific vulnerability has been mitigated
  - Do not modify the system configuration
  - Enumerated and run automatically by **`chipsec_main`**
- Tool Modules
  - Allowed to modify the state of the system
  - May be destructive to the system
  - Must be run manually via command line parameter
  - Stored in the chipsec/modules/tools directory
- All module classes are derived from **`BaseModule`**
- Only difference between tests and tools is where the file is stored

Module Interfaces

```
__init__(self)
```

- Initialize your modules class state if needed

```
is_supported(self)
```

- Determines if the module should be run on the current platform

```
run(self, module_argv)
```

- Entry point for the actual test or tool
- Modules can accept arguments
- Return value determines the exit state of the module
  - Pass, Failure, Warning, etc.

`is_supported` Guidance

Reduce maintenance…

- Check to see if registers are defined
- Check for PCI device types or classes
- Check CPUID or specific feature support
- Avoid checking for a specific platform if possible
  - Checking for a class of processor like all Atom processors is fine

```
def is_supported( self ):
    supported = self.cs.helper.EFI_supported()
    if not supported: self.logger.log_skipped_check( "OS does not support UEFI Runtime API" )
    return supported
```

`run` Guidance

- Call `self.logger.start_test()` early in execution
  - This will display the test header
- Try to map test code to a single vulnerability
  - May require multiple mitigations
  - Not always logical to do this
- Log intermediate results if required
- Log final result of module with `log_*_check`
  - Called once per execution of the module

Example Module

The goal is to generate a new informational module to gather useful data about the host processor and display it to the user.

- Processor brand string
- Family, model and stepping
- Microcode revision

Full source in chipsec/modules/common/cpu/cpu_info.py on USB drive

Initial Template

```
class cpu_info(BaseModule):
    def __init__(self):
        BaseModule.__init__(self)

    def is_supported(self):
        return True


    def run(self, module_argv):
        # Log the start of the test
        self.logger.start_test('Current Processor Information')

        return ModuleResult.INFORMATION
```

Collect & Display Brand String

```
# Get processor brand string
brand = ''
for eax_val in [0x80000002, 0x80000003, 0x80000004]:
  regs = self.cs.cpu.cpuid(eax_val, 0)
  for i in range(4):
    brand += struct.pack('<I', regs[i])
self.logger.log('[*] Processor: {}'.format(brand))
```

Collect & Display More Data

```
# Get microcode revision

microcode_rev =
self.cs.read_register_field('IA32_BIOS_SIGN_ID', 'Microcode')

self.logger.log('[*]            Microcode:
{:08X}'.format(microcode_rev))


self.logger.log_information_check('Current information
displayed')


return ModuleResult.INFORMATION
```

Module Output

```
[*] running module: chipsec.modules.common.cpu.cpu_info
[x][ =============================================================
[x][ Module: Current Processor Information
[x][ =============================================================
[*] Processor: Intel(R) Core(TM) i7-6770HQ CPU @ 2.60GHz
[*]            Family: 06 Model: 5E Stepping: 3
[*]            Microcode: 000000C2
[#] INFORMATION: Current information displayed
```

```
Command Line:
sudo python chipsec_main.py -m common.cpu.cpu_info
```

CHIPSEC Commands

- Run using **`chipsec_util`**
- Provide interactive access to system components from command line
  - Most support read/write access
  - Can be destructive
- Useful when doing research or other investigations
- Command classes are derived from **`BaseCommand`**
- Command line parameters available in **`self.argv`**
- Files in the chipsec/utilcmd directory

Command Interfaces

`requires_driver(self)`

- Used to determine if the OS specific driver is required to run the command

`run(self)`

- Main entry point to perform the command and display the results

`commands`

- Dictionary to map command names to class implementation

Command Example

```
class PlatformCommand(BaseCommand):

    def requires_driver(self):

        return True

    def run(self):

        try:
            print_supported_chipsets()
            self.logger.log("")
            self.cs.print_chipset()
            self.cs.print_pch()

        except UnknownChipsetError, msg:
            self.logger.error( msg )

commands = { 'platform': PlatformCommand }
```

Summary

Now that you have the basics, start writing new modules and commands

Submit pull requests and issues on GitHub

https://github.com/chipsec/chipsec

Contact the Intel CHIPSEC team

chipsec@intel.com

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