Implementing AMD SEV in Xen hypervisor

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AGENDA

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1. AMD SEV technology
2. AMD Secure Processor
3. Platform finite State Automata
4. Guest finite State Automata
5. Xen Hypercalls
6. I/O Emulation & Instruction decode
7. What’s next…

AMD SEV Technology

- Confidential Computing technology from AMD wich targets VM environnement
- an extension to AMD-V
- Comes in building blocks

AMD SEV Technolgy

SME

- 1 AES Key
- C-bit
- Encrypt in Place

SEV

- Amd Secure Processor
- VEK (bound to ASID)
- shared/private pages for CR.PAE
- ins fetch & HW ptwalk are encrypted
- encryption is bound to PA
- no DMA to private pages

SEV-ES

- All CPU/FPU context is encrypted (VMSA)
- Automatic/NonAutomatic Exits
- #VC handler in guest
- VMGEXIT instruction
- GHCB protocol

SEV-SNP

- Integrity Control
- RMP table (and ISA extensions)
- Bunch of other stuff

SEV-TIO

- PCI SIG TDISP
- ASP-TIO interface (SPDM)

AMD Secure Processor

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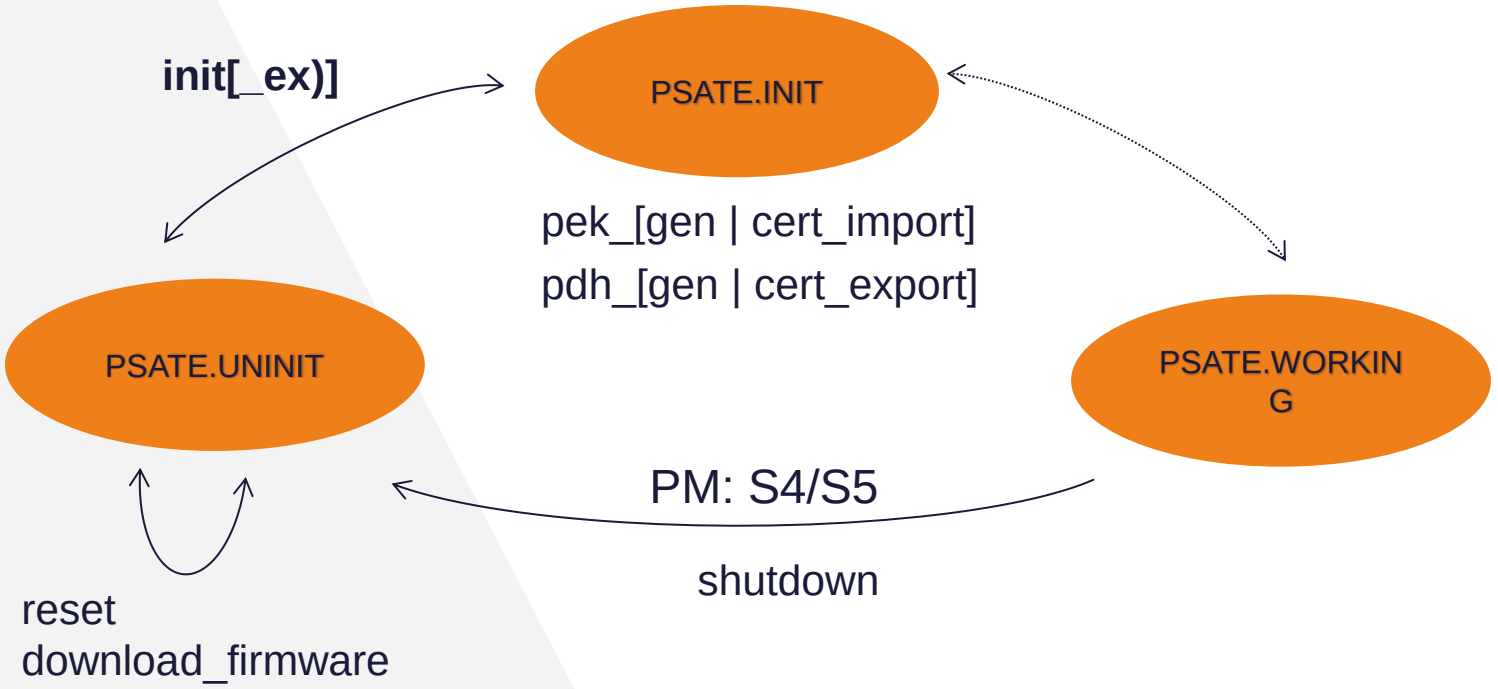
ASP:

- PCI device
- multiple Interfaces (one bdf)
- mailbox protocol

API:

- platform management
- guest management
- remote attestation support
- guest migration
- misc: copy/swap

Platform Finite State Automata

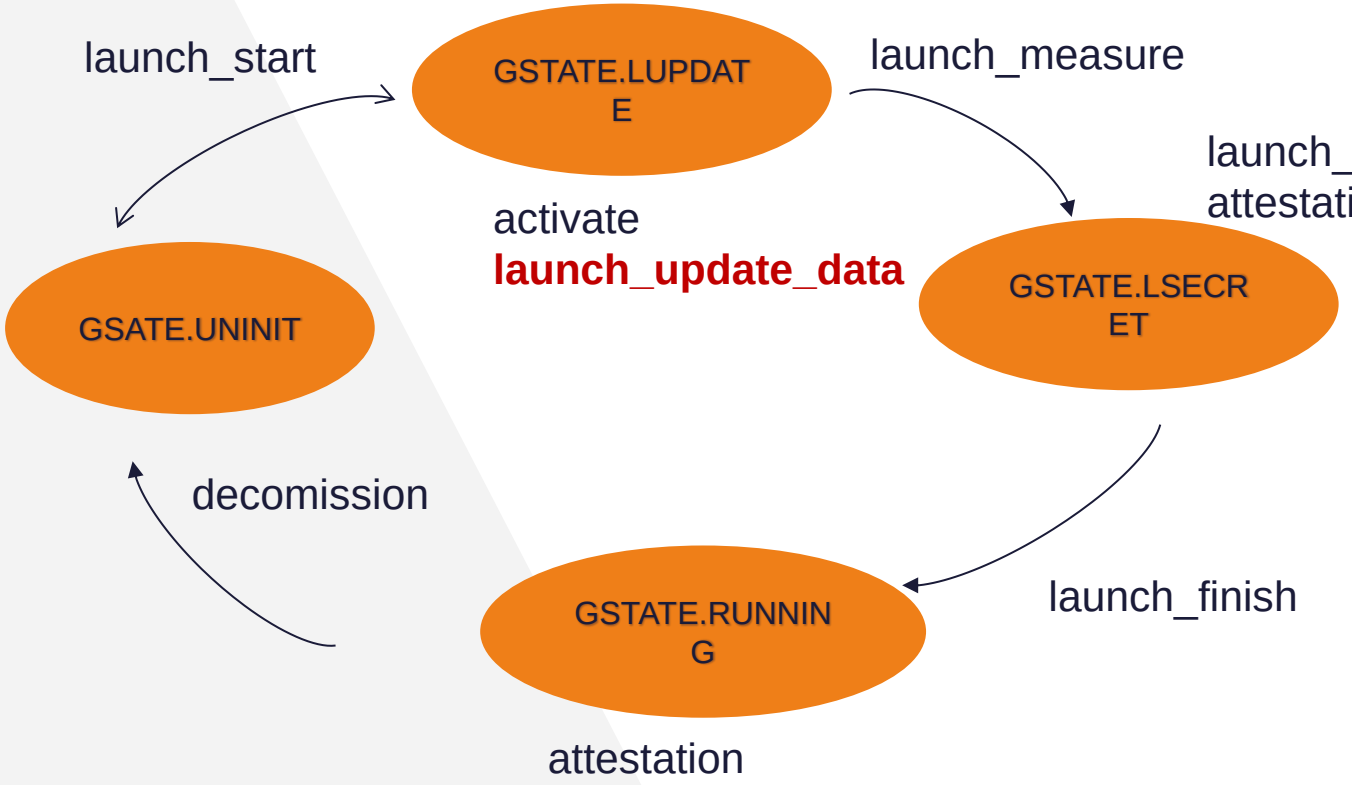


PCTX

NVRAM

- PEK key pair
- PDH key pair
- PDH Cert
- …

Guest Finite State Automata



GCTX

- state
- handle
- ASID
- policy
- VEK
- nonce (for TC)
- Master secret
- LaunchDigest

Xen Hypercalls & Shared Memory

- **hypercall new ABI :** no more linear addresses
  - copy_[from | to]_user]_hvm
- **hypercall page :** dynamically constructed
  - hardcoded/work in progress (need probably better solution for this)
- **hypercall buffers :** need to be SHARED memory
  - work in progress (SEV-guest)
- **shared memory need to be SEV-wise shared**
  - work in progress (SEV-guest)

Instruction Decode & I/O Emulation

I/O space accesses (VMEXIT_IOIO):

- simple:
  - *in [al | ax | eax], imm8*
  - *in [al | ax | eax], DX*
  - *out imm8, [aL | ax | eax]*
  - *out DX, [aL | ax | eax]*
- string:
  - ins/outs : virtual addresses in RSI/RDI

Decode Assist:

EXITINFO1: port, dir, size, str

EXITINFO2: nrip

MMIO accesses (VMEXIT_NPF) :

- 1 mem operand: (~mov)
  - NPF faulting GPA(the mem operand)
  - error code

Decode Assist:

- instruction length
- instruction bytes[]

some corner cases can't be handled!

(page tables, ins fetch, smap/smep errate, ..)

- 2 mem operand

movs(x), movdir64,… push, pop, call,…

Instruction Decode & I/O Emulation

Exceptions: (VMEXIT_EXCEPTION_XXX)

traped: DB, BP, **NM**, PF, AC, **UD**, MC

#UD - can't handle: must disable

Instructions:

MOV CRx :

- Decode assist: dir, #gpr

INVLPG:

- Decode Assist: linear address

INT n:

- Decode Assist: #n

Instructions:

CPUID/RDTSC/ RDMSR/WRMSR: OK

INVD/WBINVD/HLT: OK

TASK SWITCH/…: - can't handle

Event Injection:

SW & External Interrupts, HW exceptions, ….

OK if **SVM_FEATURE_NRIPS**

What's next

The Goal:

- run Linux in SEV-ES environnement

Major Steps:

- adapt Xen-dependant Linux kernel parts
- adapt ASP driver for SEV-ES platform & guest management
- implement GHCB protocol in XEN
- adapt misc Xen parts (emulation, hvm_function_table, …)

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THANKS!

Any questions?

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