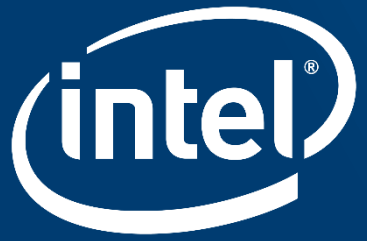

# IDEAL/OPTIMAL MEMORY MANAGEMENT FOR FUTURE VMS

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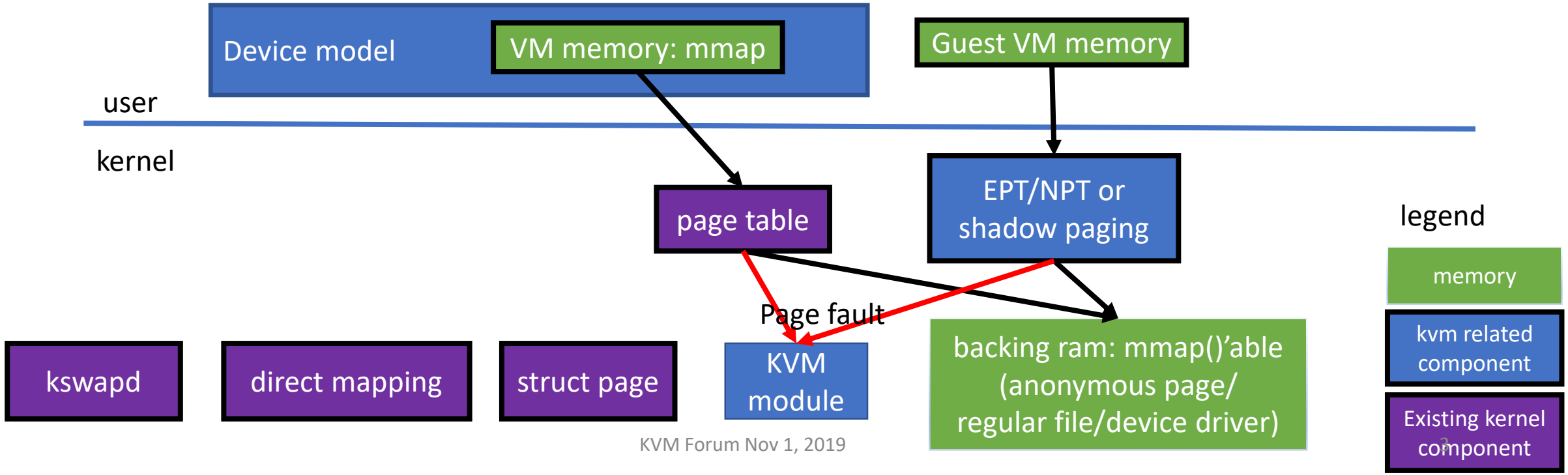
# The existing guest VM memory management

- KVM re-use the existing Linux infrastructure to integrate well with Linux memory management
- They are built around page fault on files as memory
- support any generation of hardware(CPU with/without EPT/NPT)



# Emerging new class of memory and use case

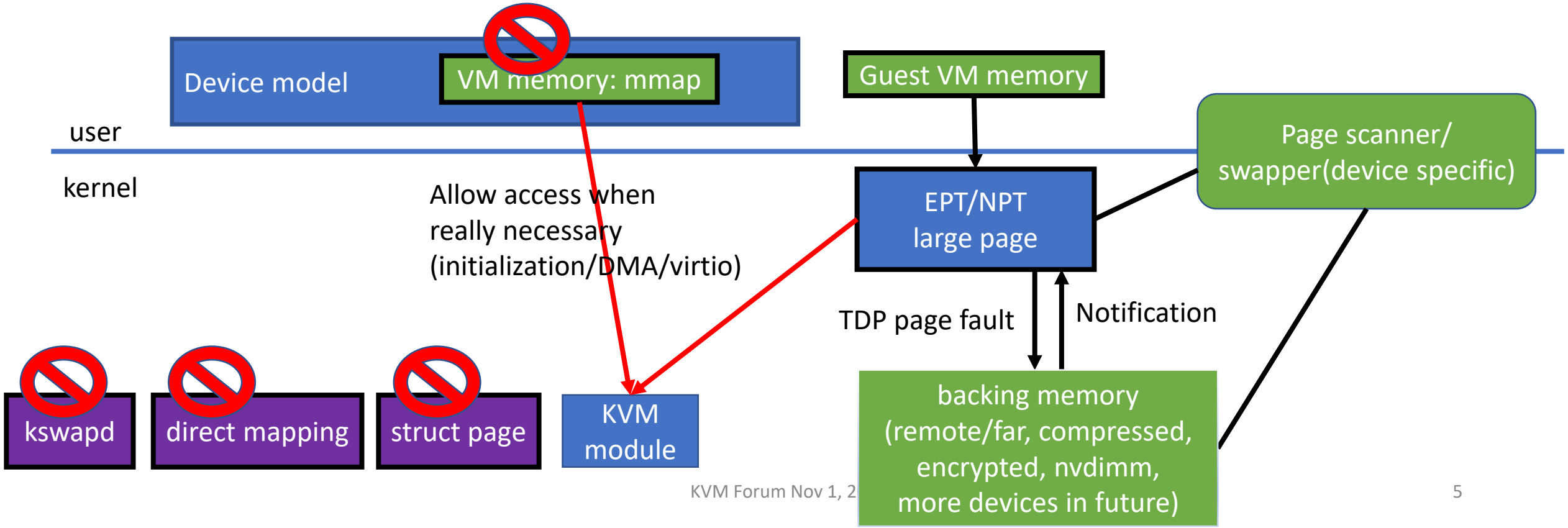
- Large page is suitable for performance/management
- Far/remote memory(compression, software-defined, nvdimm)
  - Software defined far memory: https://dl.acm.org/citation.cfm?id=3304053
- Encrypted memory(MKTME, SGX, SME, SEV)
- Isolation from host kernel/user/VMM/guest
  - Session: *Enhancing KVM for Guest Protection and Security* - Jun Nakajima
  - Friday, November 1 • 16:15 - 16:45
- fast reboot

Things have changed a lot. It's time to revise it

# requirements for new class of memory

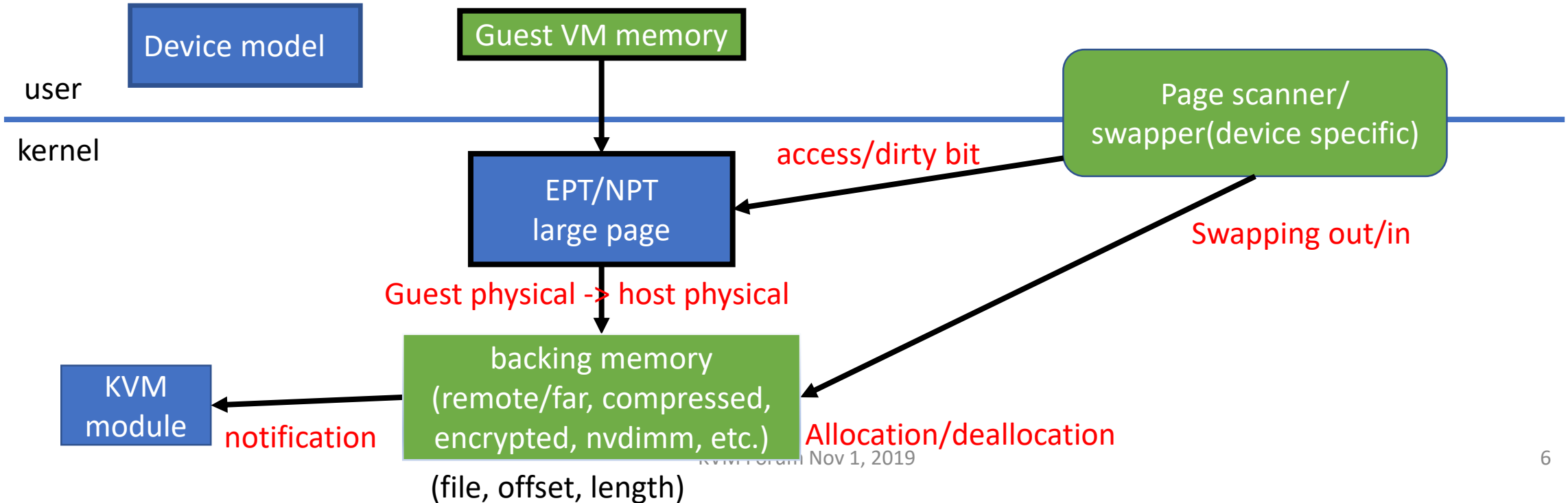
- No mmap/kernel direct map/struct page
- No kswapd. Allow page-reclaim specific to backend. (kernel or user)
- Only EPT/NPT. Taking advantage of large page

=> Decouple guest VM mgmt from host Linux memory mgmt

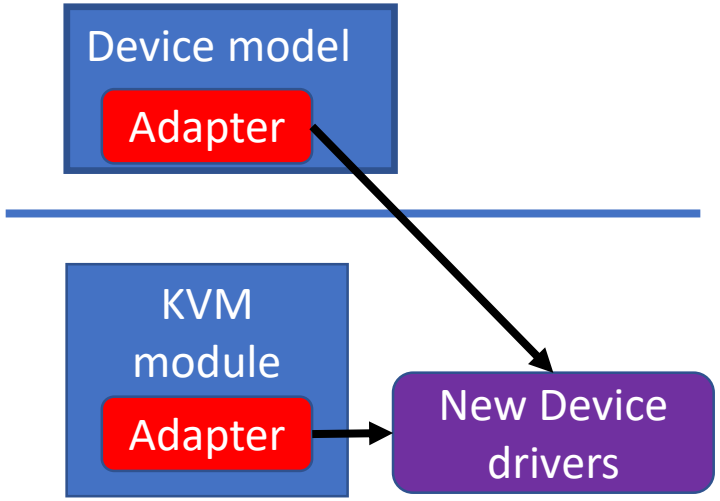


# What operations are needed?

- allocation/deallocation
- Guest physical address -> host physical address conversion
- Access/dirty bit logging
- Swapping out/in

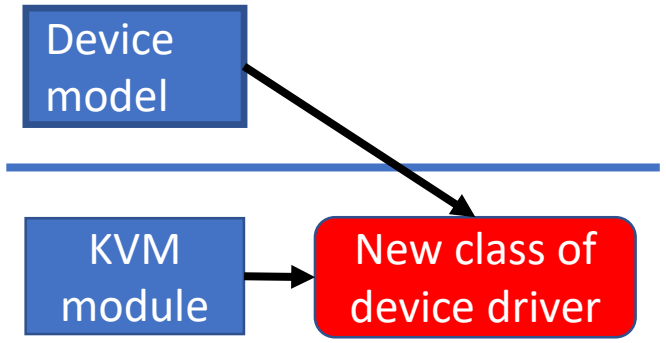


# Options for implementation

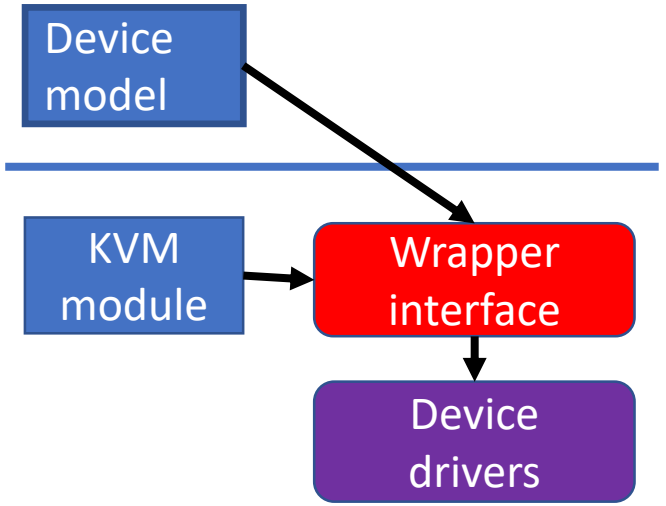



Adds logic to kvm/device model for each backing device drivers

Happening now




Define a class of device driver and port device driver to it

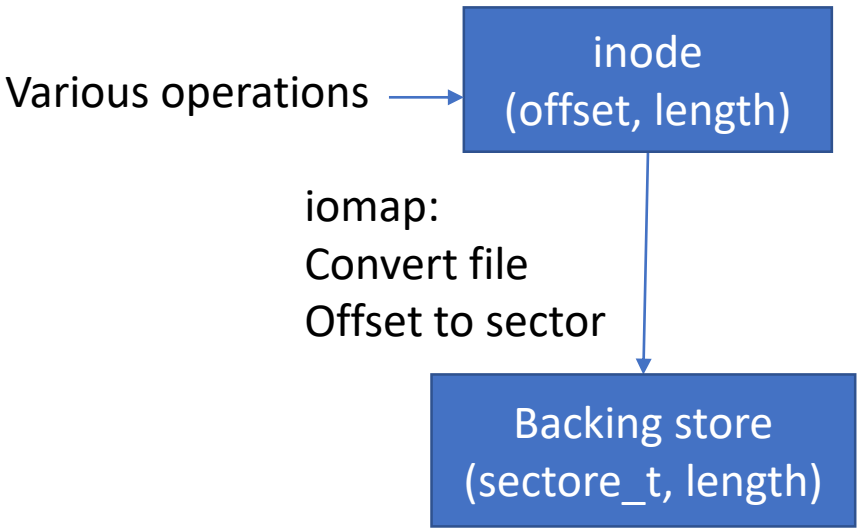



Define a wrapper class as unified interface and write adapter for each device drivers

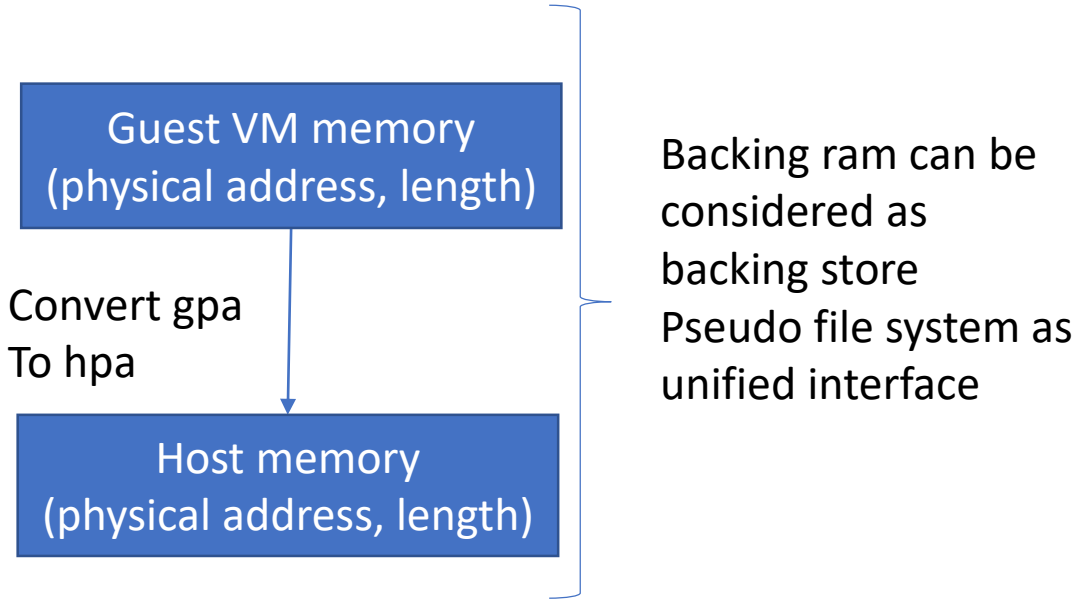
new

# Pseudo file system as unified interface

- memory as backing store
  - sector_t as pfn: Similar to DAX
  - Various operations defined(fallocate, punch hole, seal, fanotify)

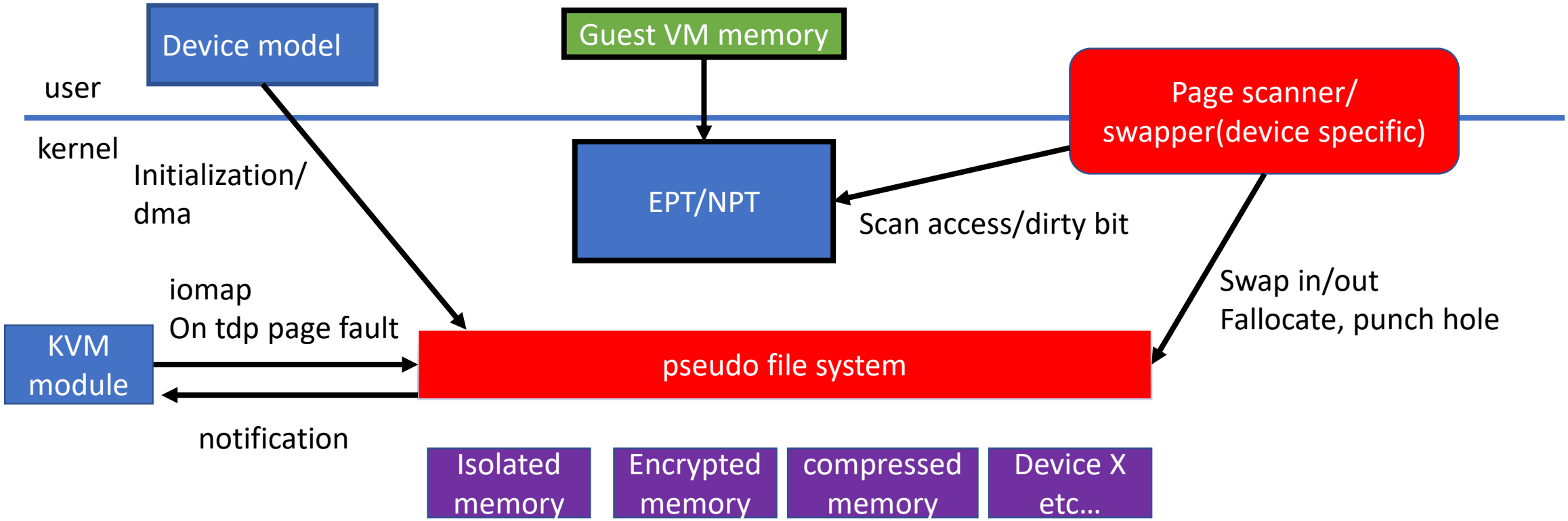



Regular file on local file system



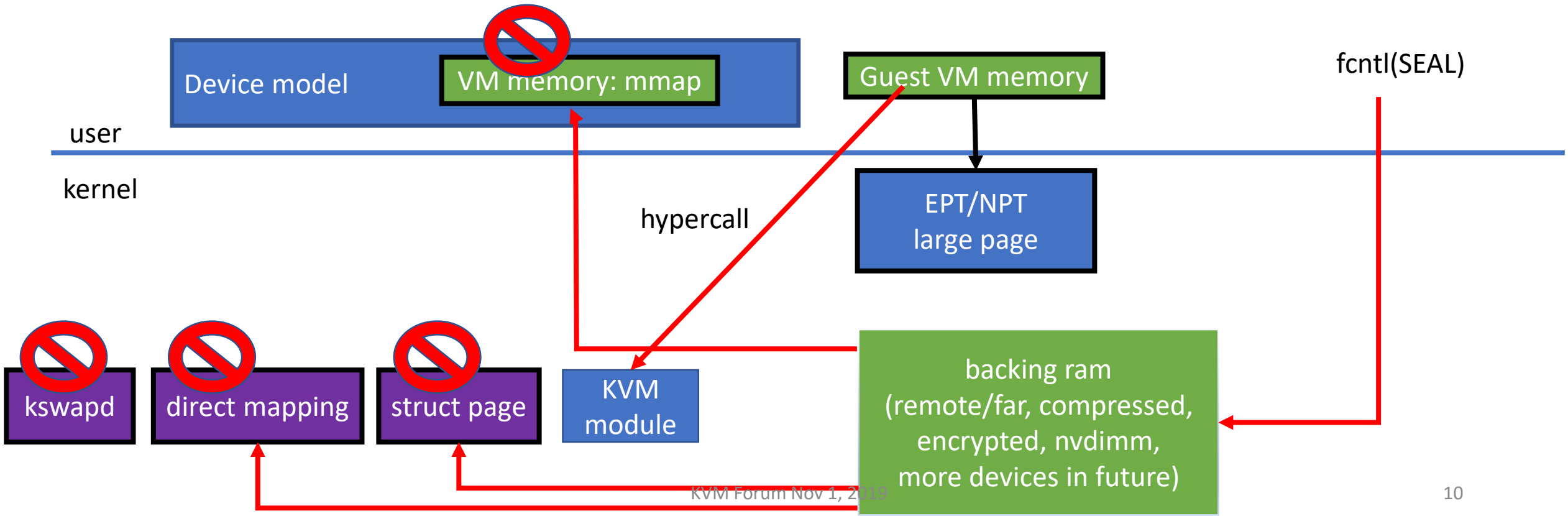

Guest VM memory conversion

# Pseudo file system for kvm



# Memory isolation

- After initialization is done,
- Remove the region from kernel mapping(directmap)
- Optional: no struct page by hot-unplug
- Ensure that no user space mapping (or error)



# PoC: current status

- Pseudo file system
- Adapter to reserved memory
- Modification to kvm kernel module not to use page fault.(WIP)

# Future work

- Discussion/Post patches
- Benchmark
- Exercise more backing memory technology
  - Encrypted memory
  - Memory compression
  - Live migration(precopy, postcopy)
  - virtio
- Preparing for memory isolation

# Summary

- Need to revise guest memory management
- New unified interface for it as pseudo file system

Next step

- Discussion to align with other activities to make progress.