Software Side Channel Attack on Memory Deduplication

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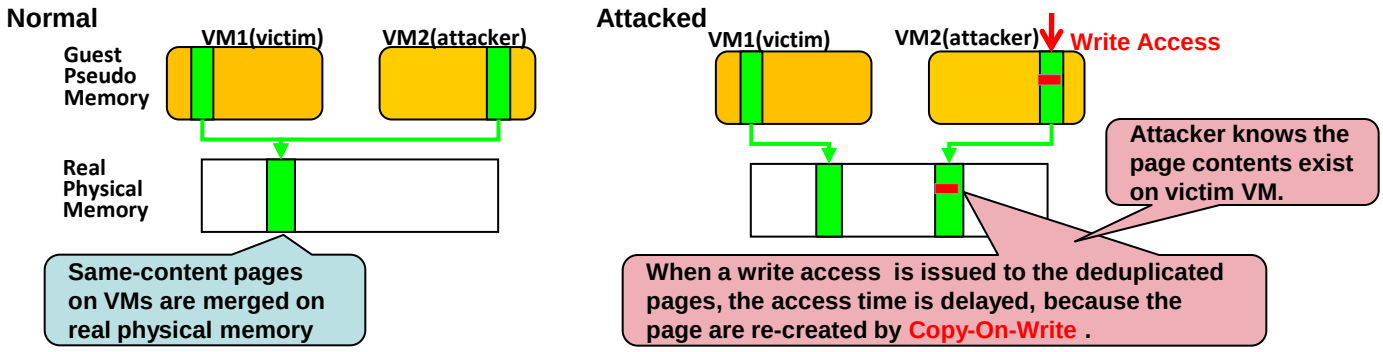
Threat: Memory deduplication is vulnerable to software side channel attacks.



Challenge for the attacker

- Alignment of matching data
- Self-reflection (explained to the right)
- Runtime modification
  (swap-out, ASLR, anonymous page, preloading, self-modifying code)

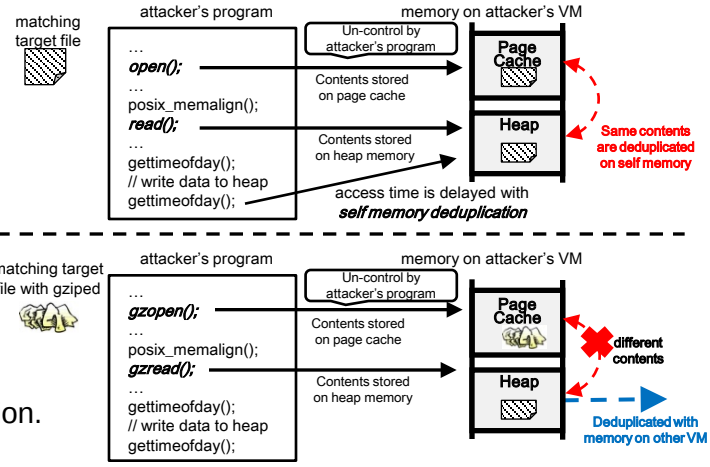
Attack Limitation

- 4KB page exact matching
- Time for being deduplicated
  (our experience on KSM of KVM is 5 min)

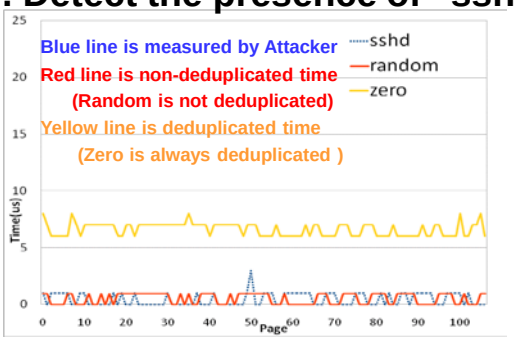
Countermeasures

- Whole memory encryption ruins deduplication.
- Sandbox with memory encryption is better.

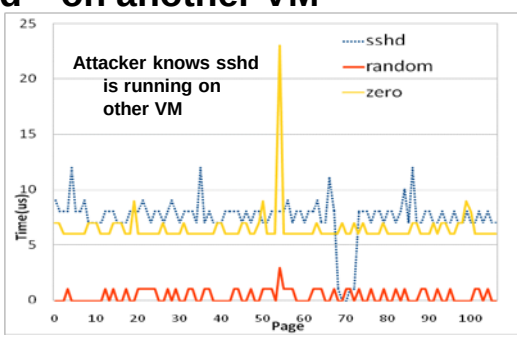
How to solve self-reflection problem



Example: Detect the presence of "sshd" on another VM



"sshd" is not running on victim VM



"sshd" is running on victim VM

Applications on multi-tenant cloud computing

Applicable by normal user or administrator.

1. Secret communication to other virtual machine for user-level optimization.
   - To prevent a conflict of interest on a processor, or to allocate VMs on same processor.
2. Detection of forbidden applications or unsecure applications.
3. To confirm erasure of important data from memory.