

Attack	TPM	TPM+TXT	SGX	XOM	Aegis	Bastion	Ascend, Phantom	Sanctum
Malicious containers (direct probing)	N/A (The whole computer is one container)	N/A (Does not allow concurrent containers)	Access checks on TLB misses	Identifier tag checks	Security kernel separates containers	Access checks on each memory access	OS separates containers	Access checks on TLB misses
Malicious OS (direct probing)	N/A (OS measured and trusted)	Host OS preempted during late launch	Access checks on TLB misses	OS has its own identifier	Security kernel measured and isolated	Memory encryption and HMAC	X	Access checks on TLB misses
Malicious hypervisor (direct probing)	N/A (Hypervisor measured and trusted)	Hypervisor preempted during late launch	Access checks on TLB misses	N/A (No hypervisor support)	N/A (No hypervisor support)	Hypervisor measured and trusted	N/A (No hypervisor support)	Access checks on TLB misses
Malicious firmware	CPU microcode measures PEI firmware	SINIT ACM signed by Intel key and measured	SMM handler is subject to TLB access checks	N/A (Firmware is not active after booting)	N/A (Firmware is not active after booting)	Hypervisor measured after boot	N/A (Firmware is not active after booting)	Firmware is measured and trusted
Malicious containers (cache timing)	N/A (Does not allow concurrent containers)	N/A (Does not allow concurrent containers)	X	X	X	X	X	Each enclave its gets own cache partition
Malicious OS (page fault recording)	N/A (OS measured and trusted)	Host OS preempted during late launch	X	N/A (Paging not supported)	X	X	X	Per-enclave page tables
Malicious OS (cache timing)	N/A (OS measured and trusted)	Host OS preempted during late launch	X	X	X	X	X	Non-enclave software uses a separate cache partition
DMA from malicious peripheral	X	IOMMU bounces DMA into TXT memory range	IOMMU bounces DMA into PRM	Equivalent to physical DRAM access	Equivalent to physical DRAM access	Equivalent to physical DRAM access	Equivalent to physical DRAM access	MC bounces DMA outside allowed range
Physical DRAM read	X	X	Undocumented memory encryption engine	DRAM encryption	DRAM encryption	DRAM encryption	DRAM encryption	X
Physical DRAM write	X	X	Undocumented memory encryption engine	HMAC of address and data	HMAC of address, data, timestamp	Merkle tree over DRAM	HMAC of address, data, timestamp	X
Physical DRAM rollback write	X	X	Undocumented memory encryption engine	X	Merkle tree over HMAC timestamps	Merkle tree over DRAM	Merkle tree over HMAC timestamps	X
Physical DRAM address reads	X	X	X	X	X	X	ORAM	X
Hardware TCB size	Motherboard (CPU, TPM, DRAM, buses)	Motherboard (CPU, TPM, DRAM, buses)	CPU chip package	CPU chip package	CPU chip package	CPU chip package	CPU chip package	CPU chip package
Software TCB size	All software on the computer	SINIT ACM + VM (OS, application)	Application module + privileged containers	Application module + hypervisor	Application module + security kernel	Application module + hypervisor	Application process + trusted OS	Application module + security monitor