Advanced x86: BIOS and System Management Mode Internals

SMM Conclusion

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"Is derived from John Butterworth & Xeno Kovah’s ‘Advanced Intel x86: BIOS and SMM’ class posted at http://opensecuritytraining.info/IntroBIOS.html"
SMM Lockdown Summary

• Although these may generally only be implemented by the vendor, you can verify most of these

• Use TSEG
• Ensure entire SMRAM range is contained in the protected space
• SMI handler code should not execute code outside the protected memory range
• Don’t use interrupts in SMM, unless you explicitly WBINVD the cache before generating an interrupt
• Ensure D_LCK is set to lock down both memory-mapping registers as well as SMRAM
• Verify SMRR are supported
• Verify SMRR are used
• Verify SMRR range overlaps/matches TSEG
• Verify SMM_LOCK bit is asserted to prevent an attacker from suppressing SMI#
• Verify the SMM_BWP bit is set in the BIOS_CNTL register to permit writes to flash only when processor is in SMM
SMM Conclusion

• Holds a lot of responsibility in protecting the system
  – Protects the BIOS flash
  – Protects itself, because it is instantiated by the BIOS from binary on the BIOS flash

• So it is very fragile in case of a writeable BIOS
  – It is not difficult to locate and “carve” out the SMI code module and replace it with a malicious one
  – Once written to BIOS the attacker can lock down the once-vulnerable system
  – Which highlights a general problem with tools like Copernicus. We’ll touch on this at the end of the Trusted Computing section

• Bottom line:
  • If the attacker can write to the BIOS, they can modify SMM (and a lot of other stuff, unlocking protections, etc.)
  • Therefore, the most important thing to lock down is the SPI Flash, first and foremost.
    – The protection of which relies first and foremost on SMM