Virtualization technologies and frameworks

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Hypervisors

- **Bare-metal (type-1)**
  - Xen
  - VMware ESXi
- **Hosted (type-2)**
  - Kernel VMM APIs
    - KVM (Linux)
    - Hyper-V (Windows)
    - Bhyve (FreeBSD)
    - Hypervisor (OSX)
  - Hypervisors
    - QEMU/KVM
    - Virtualbox
    - VMware Server/Workstation/Player/Fusion

Container engines

- LXC (low-level)
- LXD (*uses LXC*)
- systemd-nspawn (low-level)
- OpenVZ
- Docker Engine
- Singularity
- Podman
- Solaris Containers
- FreeBSD jail

Container orchestration

- Docker Compose (basic, single host) (*uses Docker*)
- Docker Swarm (*uses Docker*)
- Kubernetes (*uses Docker & Podman*)

Server virtualization

- **VMs**
  - Citrix Hypervisor (*uses Xen*)
  - Microsoft Server (*uses Hyper-V*)
  - oVirt (*uses QEMU/KVM*)
- **Containers**
  - OpenShift (*uses Kubernetes*)
- **VMs/containers**
  - VMware vSphere (*uses ESXi & Kubernetes*)
  - Red Hat Virtualization (*uses oVirt & OpenShift*)
  - Proxmox (*uses QEMU/KVM & LXC*)
  - OpenStack (*uses many frameworks*)
  - CloudStack (*uses many frameworks*)

Virtual Desktop Infrastructure (VDI)

- NoMachine (*uses QEMU/KVM*)
- Citrix Virtual Apps and Desktops (*uses Xen*)
- VMware Horizon (*uses ESXi*)

Other tools

- **Image management**
  - Packer (builds VM & container images)
  - Vagrant (image hub) (*uses Packer*)

- **API to manage VMM/containers**
  - Libvirt
    → supports many VMMs & LXC

Emulators

- **Full system**
  - QEMU
  - MAME, PCSX2, Znes, DGen, etc.
- **Application**
  - WSL1 (Linux on Windows)
  - Wine (Windows on Linux)

Windows Subsystem for Linux

- **WSL1: application emulator**
  - Translates Linux system calls to Windows kernel calls/behavior

- **WSL2: hypervisor**
  - Light VM using Hyper-V
  - Designed to only run a dedicated modified Linux Ubuntu kernel
  - Linux kernel is paravirtualized to run on top of Hyper-V