PCI Express Architecture

In a Nutshell
Root Complex (RC)

• Root Complex (RC) – The interface between the CPU and the PCIe buses may contain several components (processor interface, DRAM interface, etc.) and possibly even several chips.

• May support one or more PCI Express Ports – Root Ports.

• **Logically** aggregates PCIe hierarchy domains into one single PCIe hierarchy.
Root Complex

- Single fabric instance referred to as a hierarchy – composed of a RC, multiple Endpoints (I/O devices), a Switch, and a PCI Express to PCI/PCI-X Bridge, all interconnected via PCI Express Links
PCIe Root Port

- Each Root Port defines a separate hierarchy domain.
- Each hierarchy domain may be composed of a single Endpoint or a sub-hierarchy containing one or more Switch components and Endpoints.
- The capability to route peer-to-peer transactions between hierarchy domains through a Root Complex is optional and implementation dependent.
PCIe Root Port
Switches and Bridges

- Switches provide an aggregation capability and allow more devices to be attached to a single Root Port. They act as packet routers and recognize which path a given packet will need to take based on its address or other routing information.

- Bridges provide an interface to other buses, such as PCI or PCI-X, or even another PCIe bus.

- Switch may have several Downstream Ports but can only have one Upstream Port.
Virtual PCI-PCI Bridge
PCle Endpoint Devices

- Not Switches or bridges and act as initiators and Completers of transactions on the bus.
- They reside at the bottom of the branches of the tree topology and only implement a single Upstream Port (facing toward the Root).
Enumeration

- The process by which configuration software discovers the system topology and assigns bus numbers and system resources.

- On x86 PCIe hierarchy enumeration done by BIOS on hardware initialization state – all registers configured before bootloader.

- System software can re-assign enumeration according to enumeration rules.
System Example
Ivy Bridge systems example