Computing Service Provision in P2P Clouds

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Research Statement

Leverage advantages of cloud computing techniques for transparent and reliable computing power service provision in P2P systems.

P2P systems

- Participants share a portion of their own resources

  (processing power, disk storage, network bandwidth)
- Popular P2P system:
  - File sharing (torrents)
  - Distributed storage (CDN)
- Key expression is ”sharing of computer resources”. We look at how:
  - It is implemented
  - It responds to end-users needs

Clouds

- Clouds are service providers.

  ”A service is a unit of work done by a service provider to achieve desired end results for a service consumer”, CRC Press 2009.

- Term ”cloud” represents the transparency or ubiquitous nature of services offered
- Service-oriented computing
- Cloud service examples: e-mail, e-books, e-commerce
- Nothing new

Virtualization

- Abstraction of a computing entity

  (hardware, software, network, storage)
- Method for running multiple and independent virtual machines (guests machines)
- Hardware evolution
- Virtualization types:
  - Full virtualization (KVM)
  - Para-virtualization (XEN)

Cloud Computing

- Computing service provision
- Different types of services
  - Software-as-a-Service (SaaS)
  - Platform-as-a-Service (PaaS)
  - Infrastructure-as-a-Service (IaaS)
    (Computing power, storage)
- On-demand infrastructure
- Based on clusters

Cloud vs P2P cloud

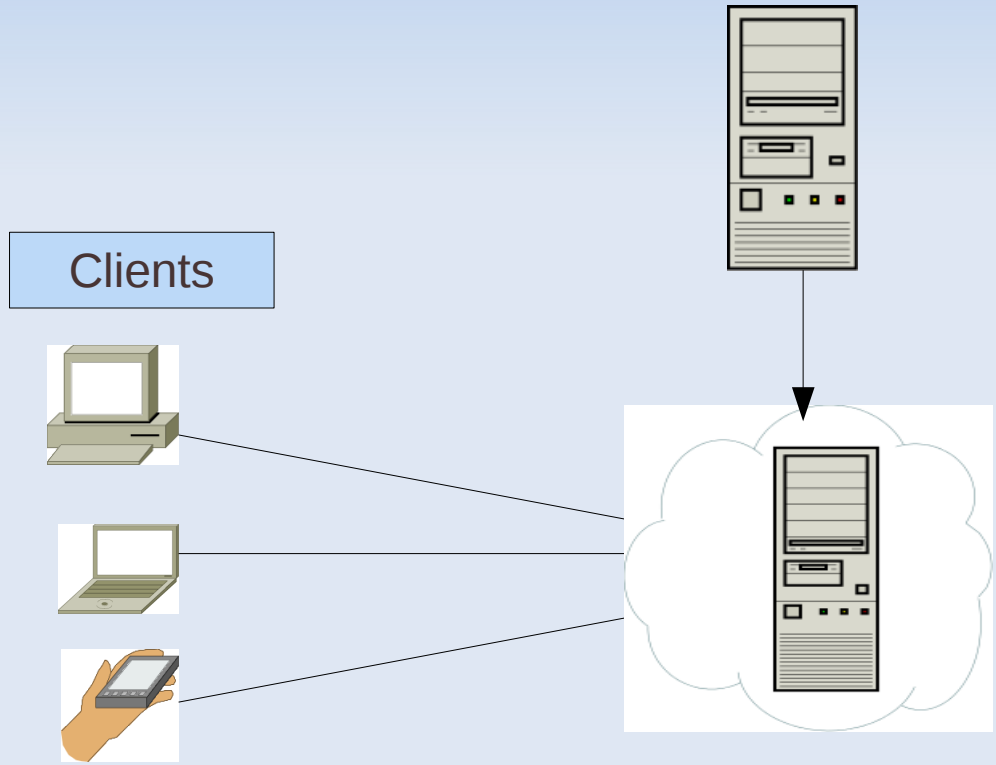
- Traditional clouds (private or public)
  - Central administration
  - Localized infrastructure
    - Installed customized kernels on customized servers
    - Scale the data center as needed.
  - Dedicated data centers
  - Cost of data centers.

Cloud vs P2P cloud

- P2P cloud:
  - Dedicated and non-dedicated servers
  - Voluntary computing system
  - Limited control over the underlying infrastructure (networking and node's configuration cannot be changed)
  - Scalable
  - Cost effective

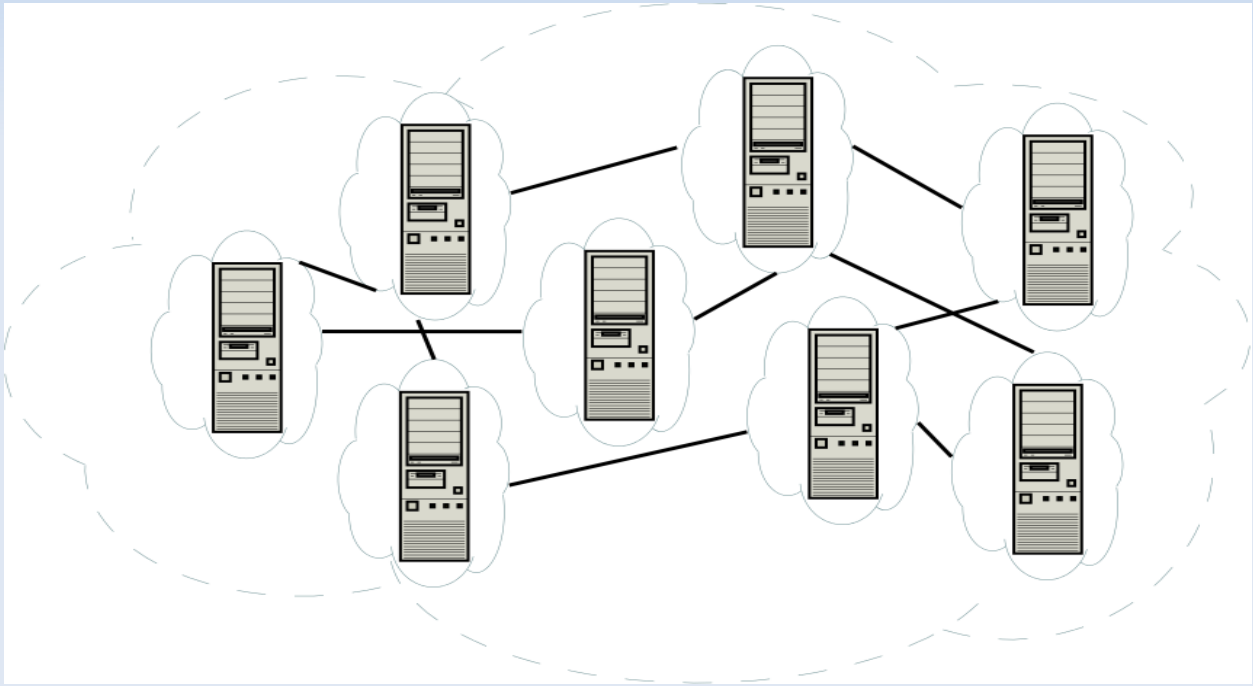
Peer Cloud

- Peer cloud is a peer node that has evolved to become a cloud service provider
- The node can be:
  - A personal computer
  - A supercomputer

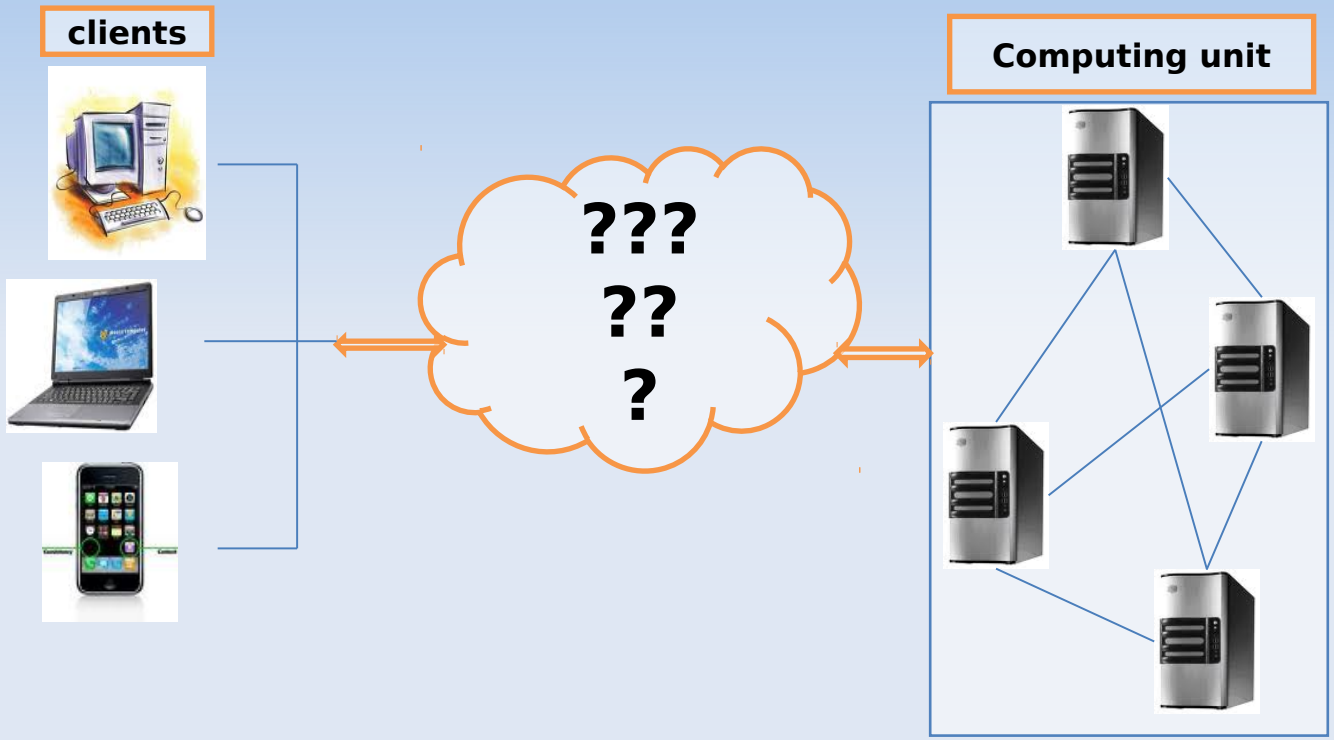


Peer Clouds

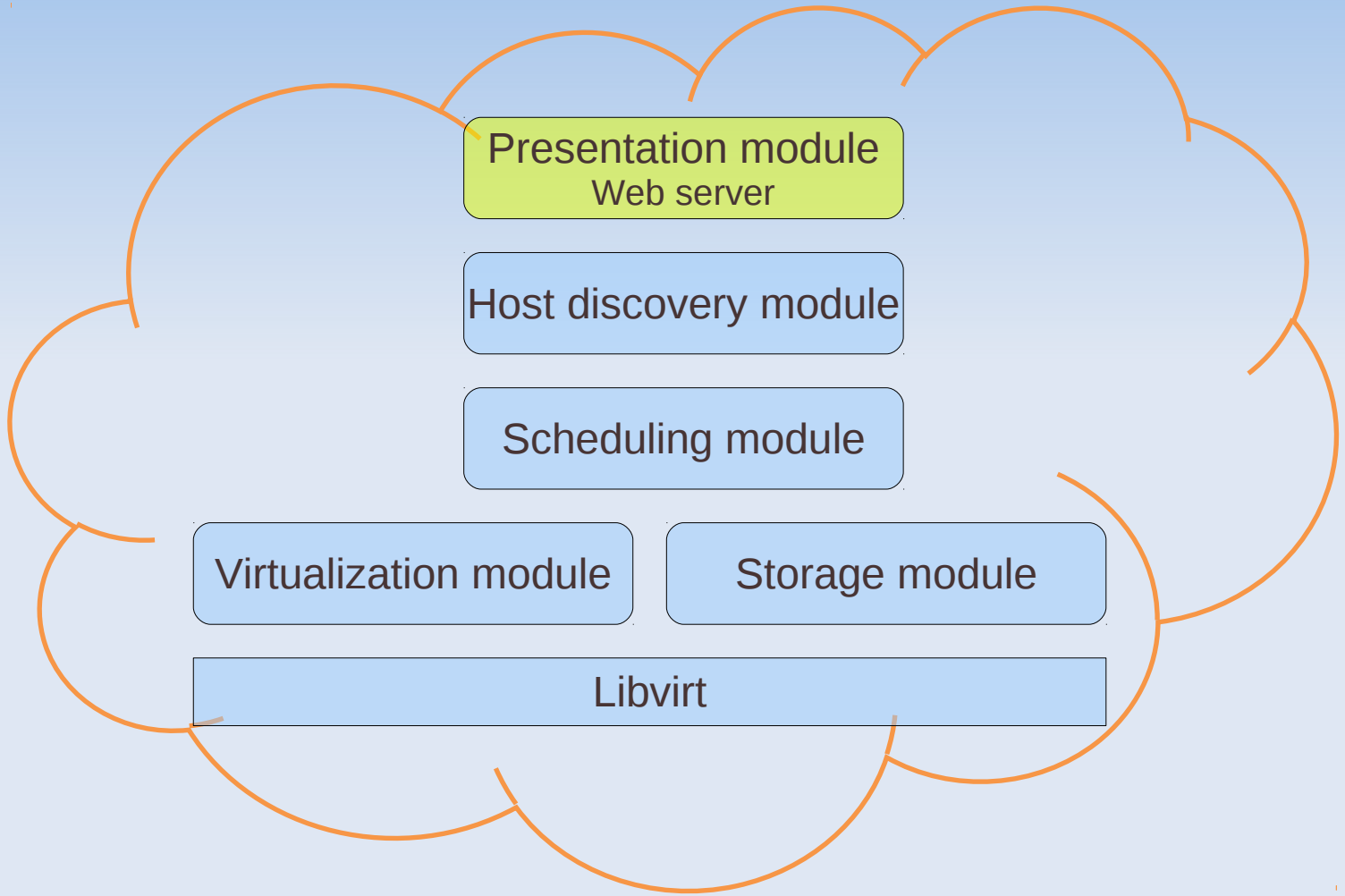
By combining many peer clouds, we expect to have a capable and self-sustainable cloud.



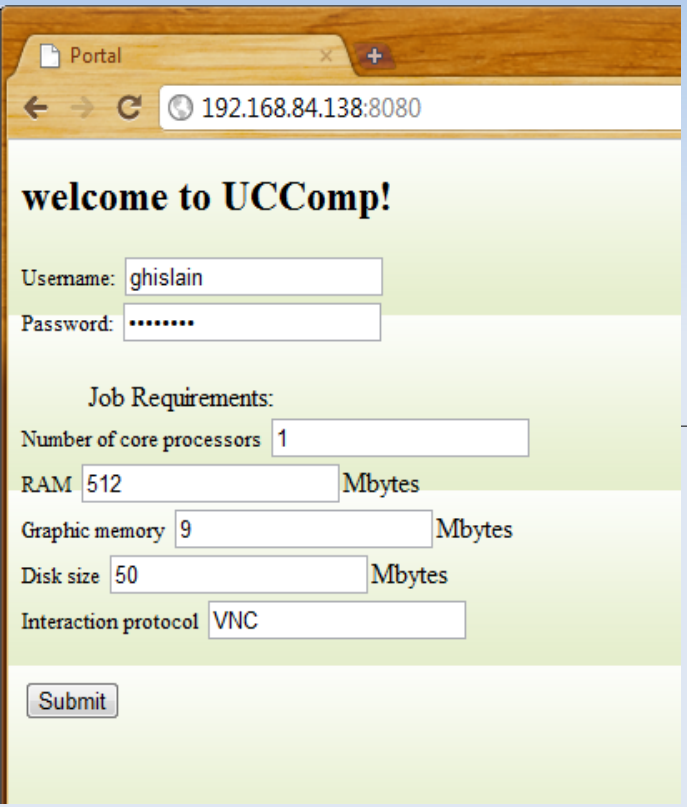
Intented system



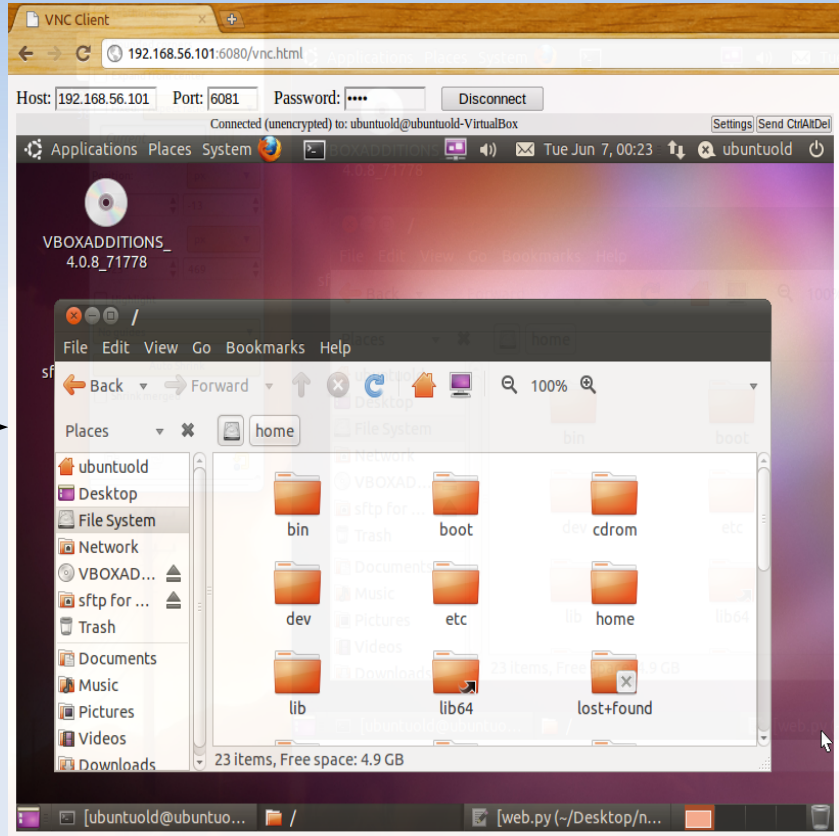
Implementation stack



Presentation module

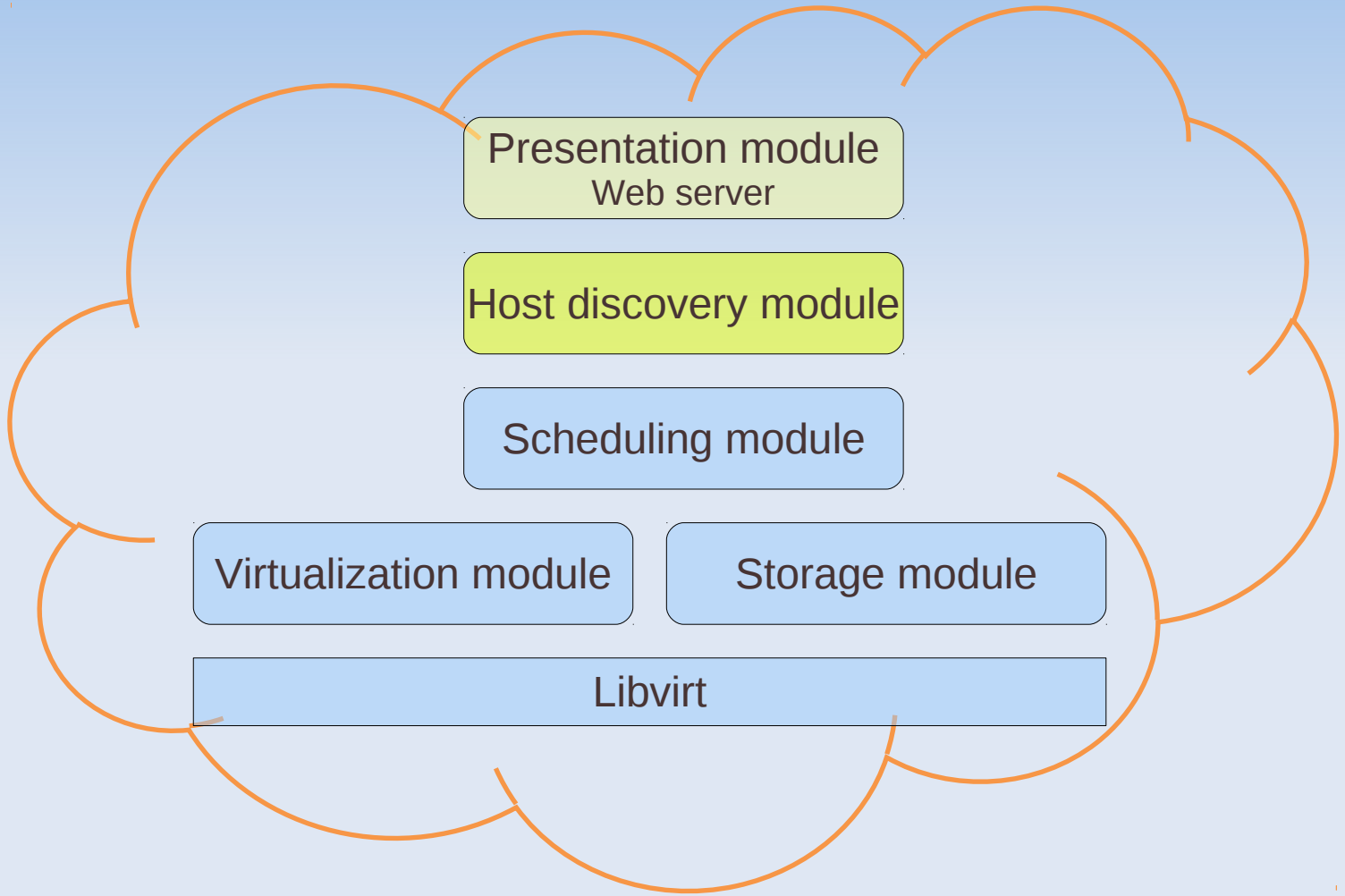


Coordinator
(Head of the computing unit)
•Service initiation
•Redirect the user to a host



Clients interact with the cloud via a web browser.

Implementation stack

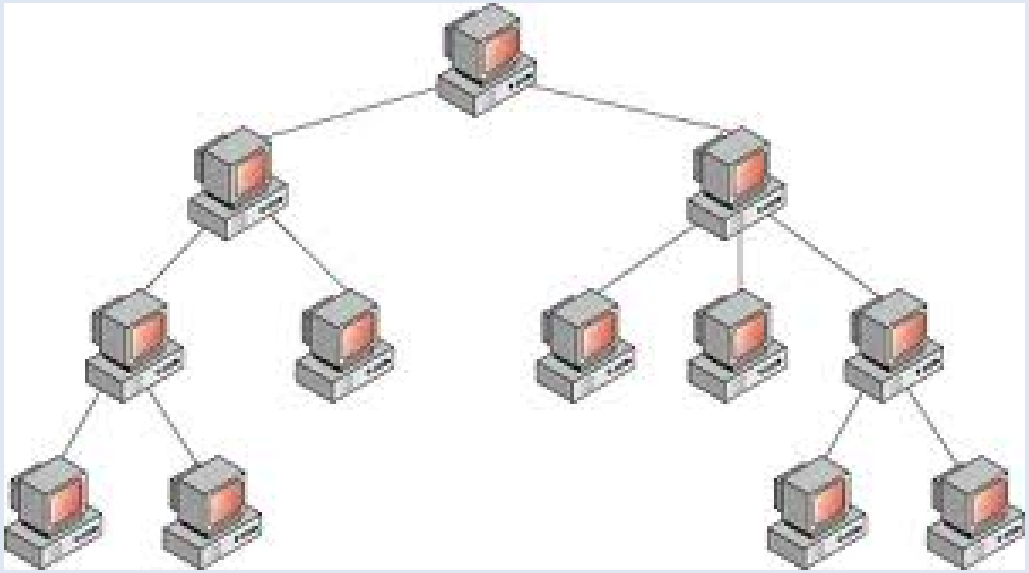


Clustering approach

- Node Discovery (node addition and removal)
- Host Discovery: find a capable host for the intended service
  - Service publishing: phase in which a service description is created and is in a pending state.
  - Service subscription: phase in which a node takes in a pending request and attends to it.

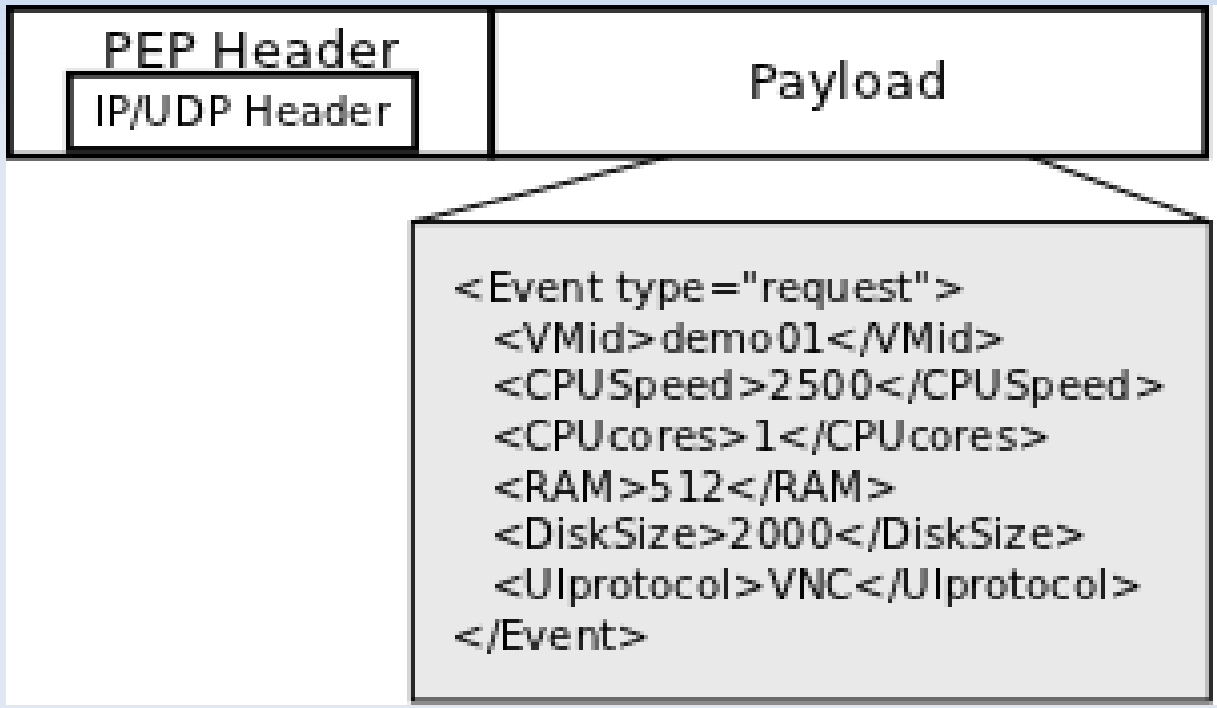
Add/Remove node

- Avoid multicasting!!!
- Create a structured P2P network (hierarchical clustering)
- Nodes in the same site (subnet) cluster together
- Head site is the node with the biggest uptime value
- Use DNS name as the head node identifier



Host discovery

- Find and direct a client request to an appropriate node. This node becomes a host by starting a service that responds to the user request.



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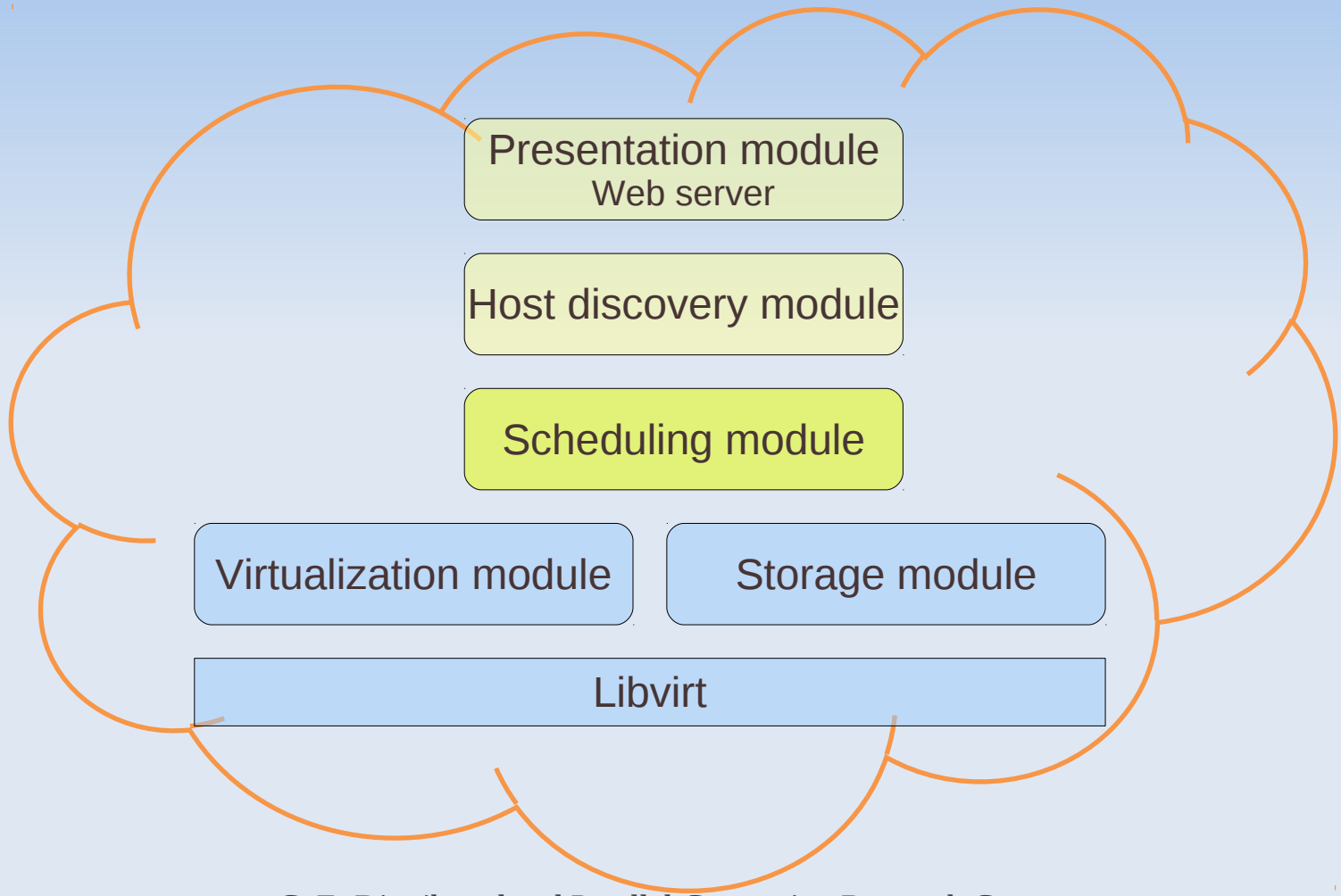

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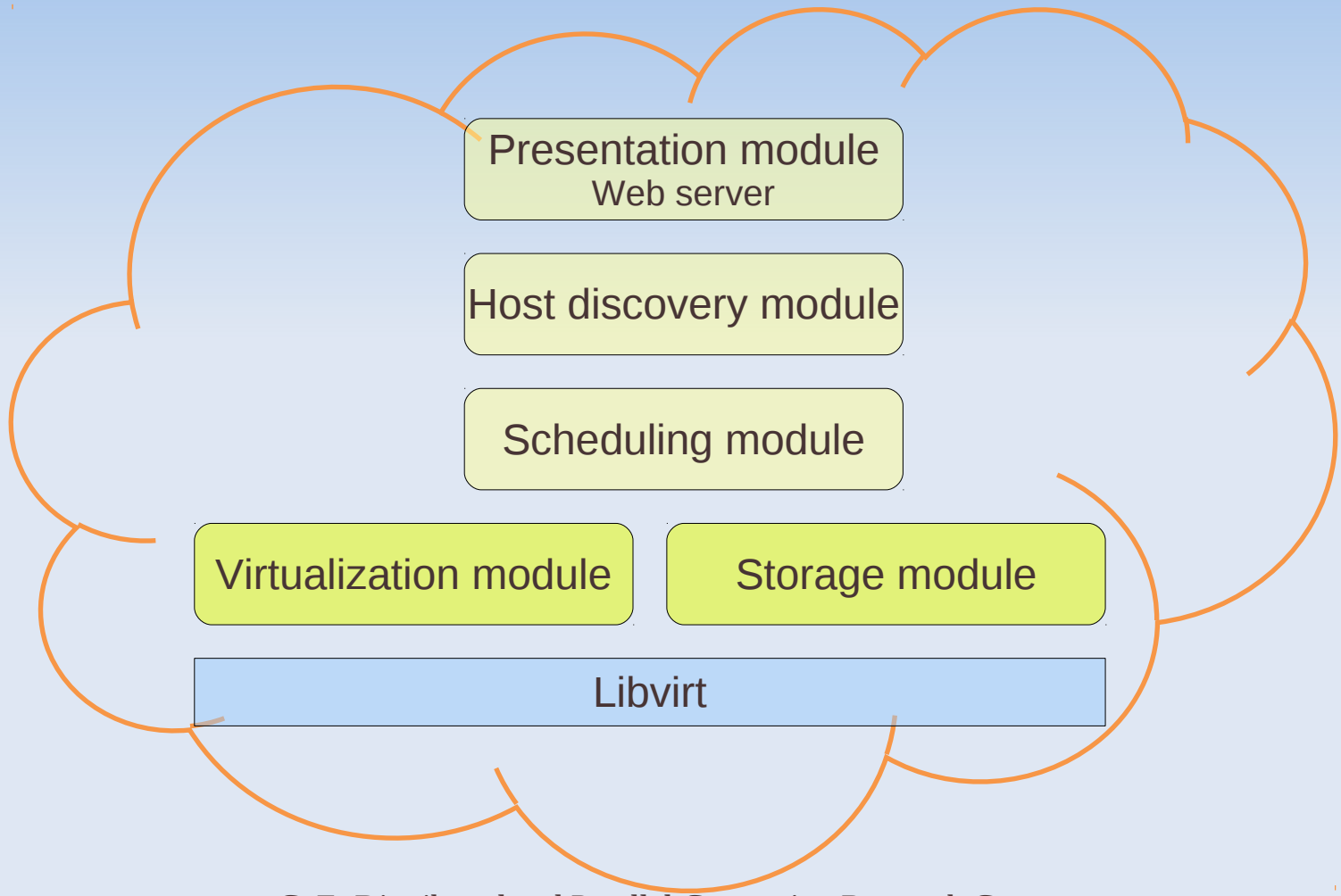
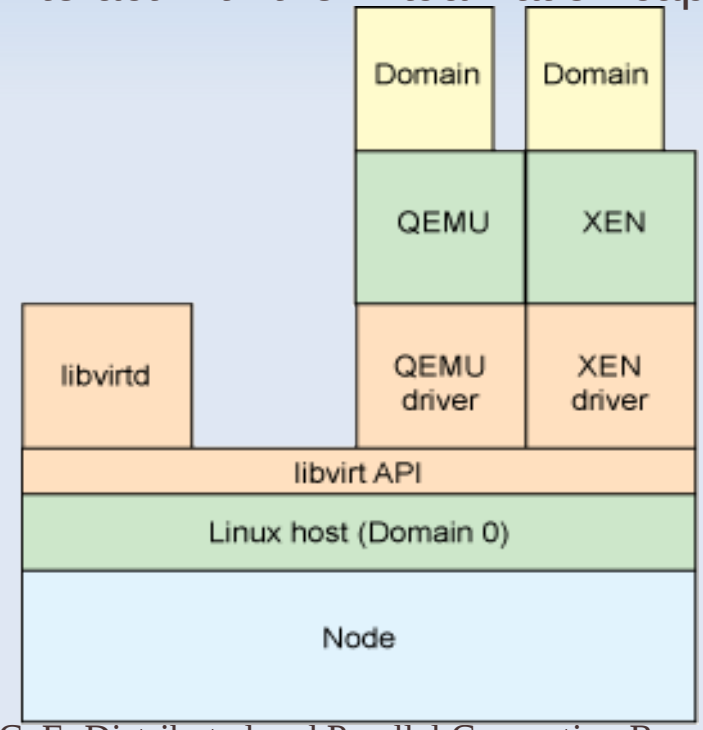


Virtualization Techniques

- Hypervisors (XEN)
- Emulators (QEMU, emulate different processor architectures)
- Containers (LXC, operating system-level virtualization method)
- Libvirt: a toolkit to interact with the virtualization capabilities of recent versions of Linux.



Libvirt XML

```
<domain type='qemu'>
  <name>QEmu-fedora-i686</name>
  <memory>219200</memory>
  <vcpu>2</vcpu>
  <os>
    <type arch='i686' machine='pc'>hvm</type>
    <boot dev='cdrom'/>
  </os>
  <devices>
    <emulator>/usr/bin/qemu-system-x86_64</emulator>
    <disk type='file' device='cdrom'>  .....  </disk>
    <interface type='network'>    <source network='default'/>    </interface>
    <graphics type='vnc' port='-1'/>  </devices> </domain>
```

Birds Eye View of the System