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VirtMan: design and implementation of a fast booting system for homogeneous virtual machines in iVCE

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Key words: Virtual machine, Fast booting, Homogeneity, Internet-based virtual computing environment (iVCE)

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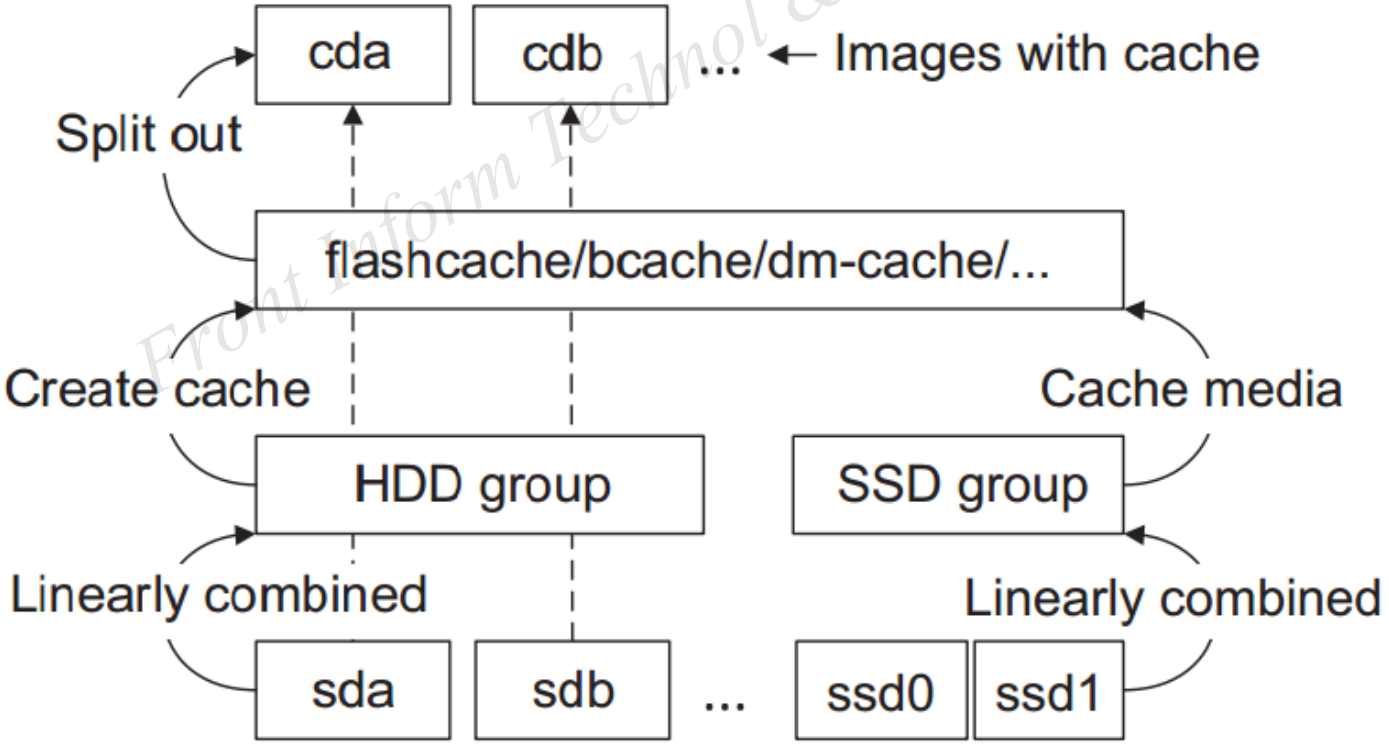
Motivation/Main ideas

- **Motivation**
  - ✓ Many cloud applications (e.g., animation rendering, material analysis, and fluid simulation) require hundreds or even thousands of VMs to run concurrently for performance purpose.
- **Main ideas**
  - ✓ Cache group
  - ✓ Cache-based snapshot
  - ✓ Hierarchical attaching

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Main ideas (1) - Cached group

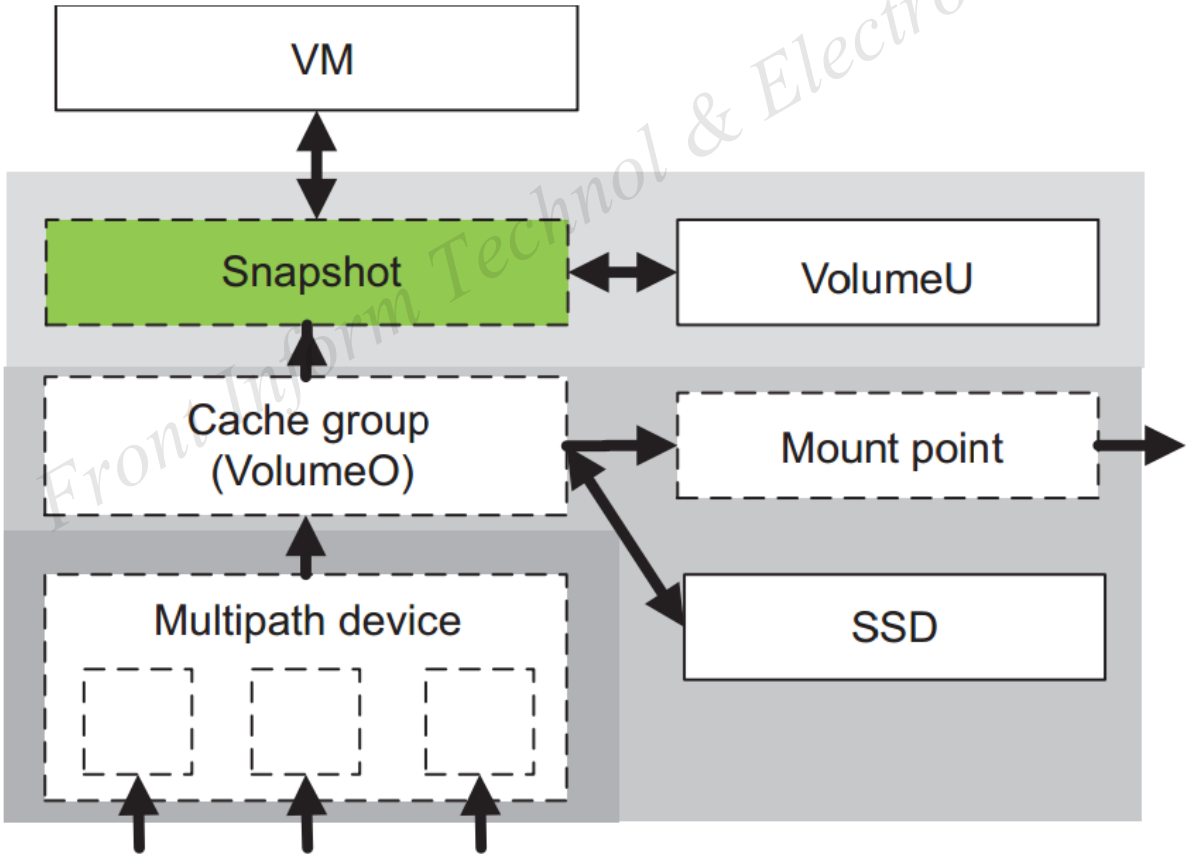
- A group of cached volumes supports dynamically adding and removing



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Main ideas (2) - Cache-based snapshot

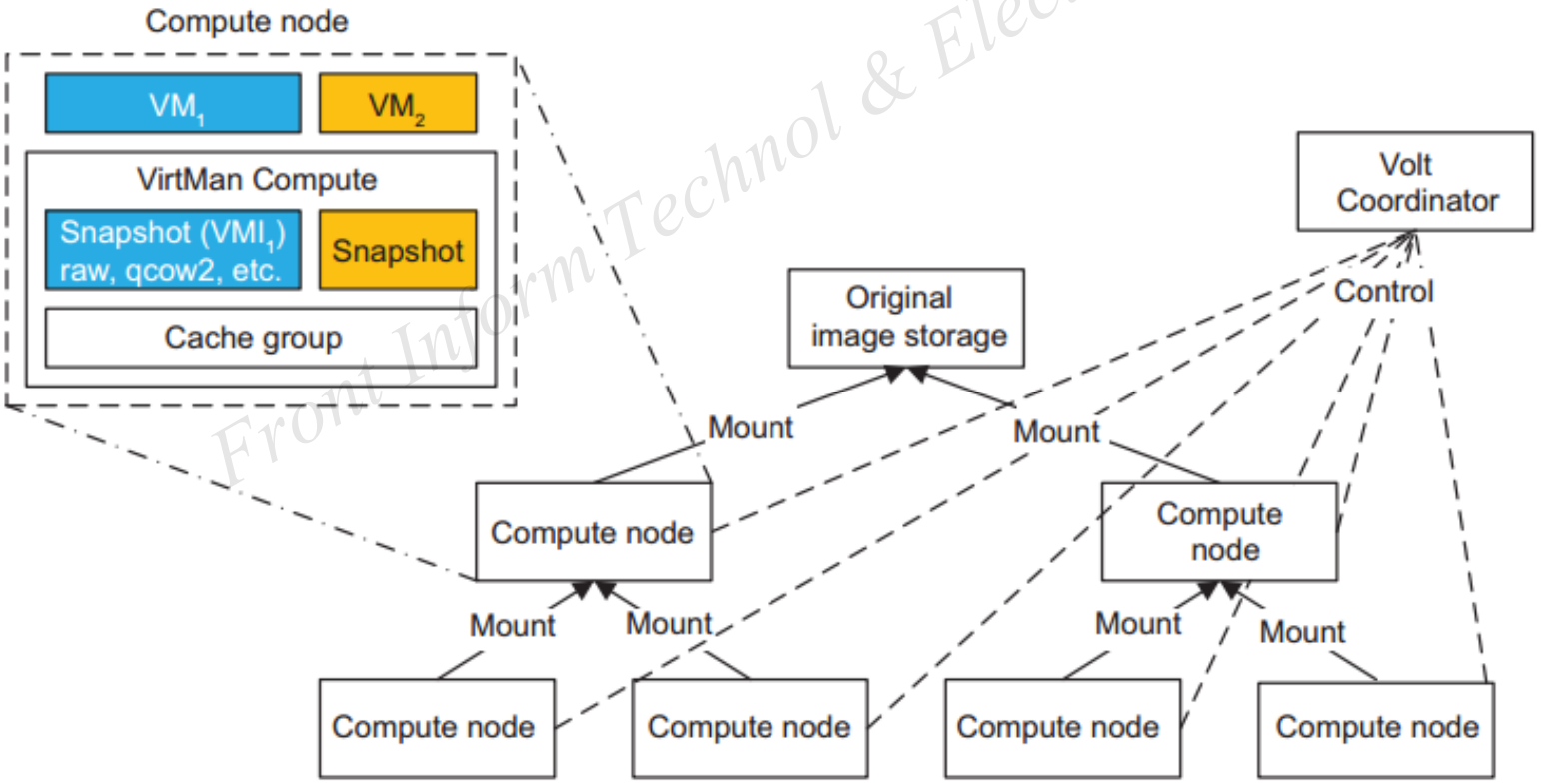
- VirtMan builds the snapshot to boot up VMs from the cached image



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Main ideas (3) - Hierarchical attaching

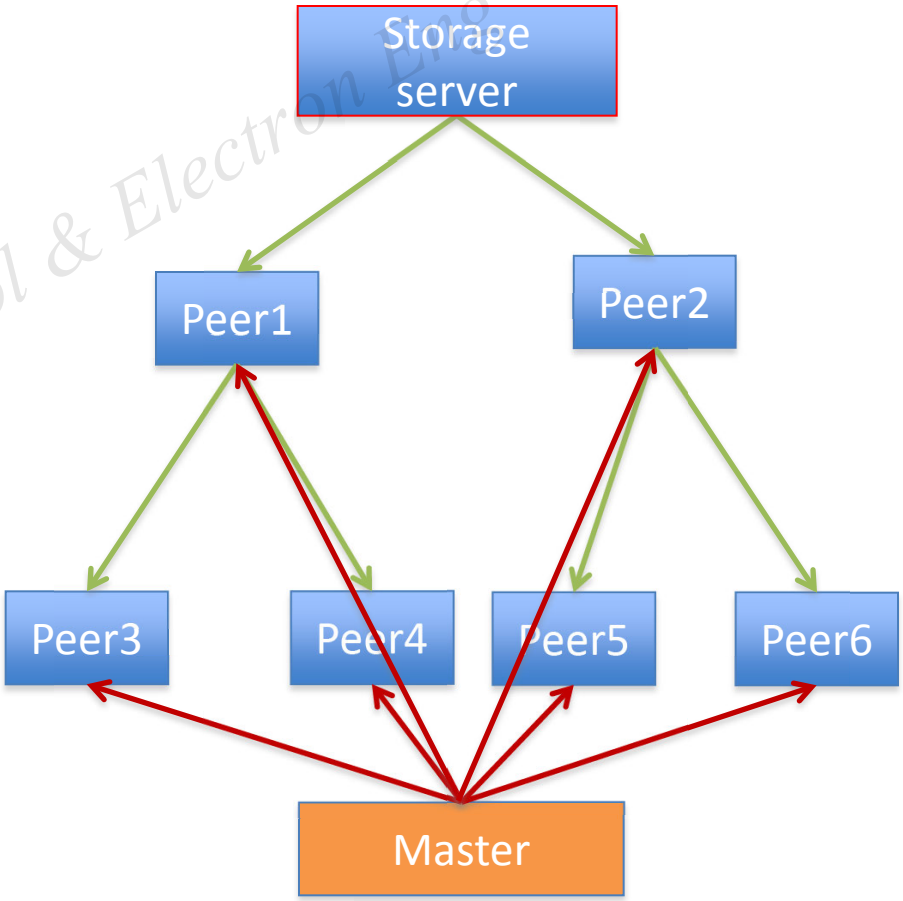
- **VirtMan uses hierarchical attaching to avoid the possibility of bottleneck**



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Coordinator (Master)

- Topology maintenance
  - maintain the position information for all nodes
- Control image streaming
  - Dynamically construct the P2P relay tree
  - Notify all nodes to mount to their parents



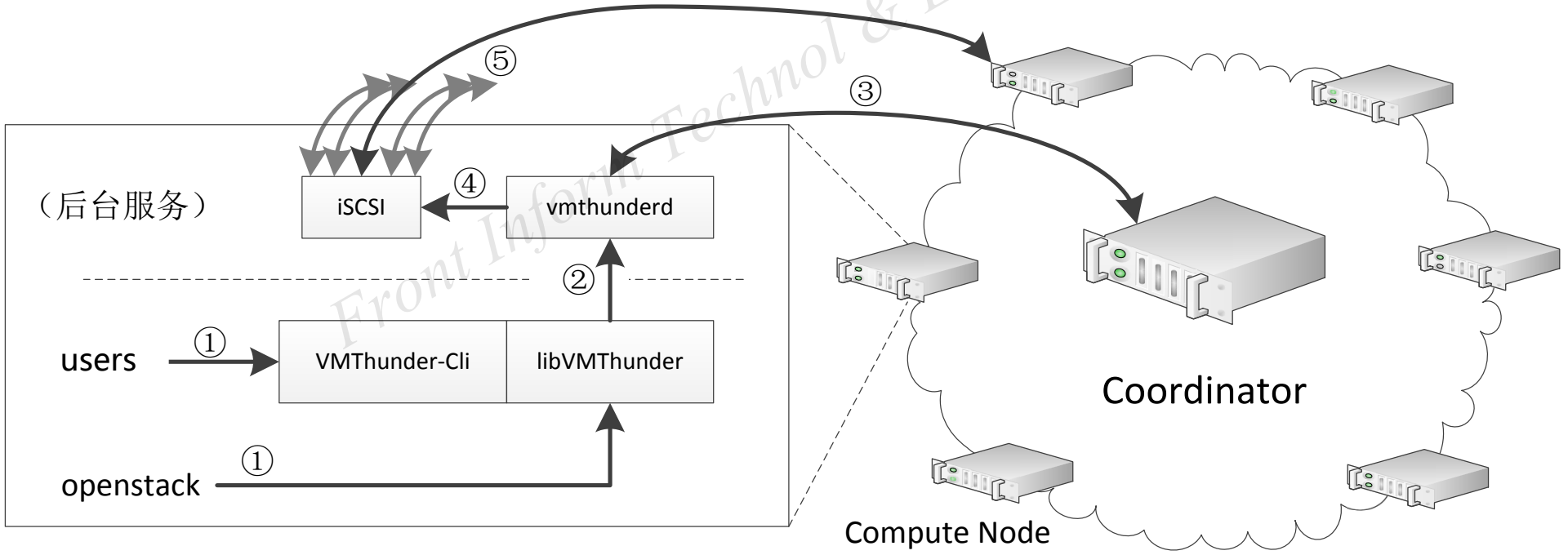
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- Fast failure detection based on heartbeats
  - So that the relay tree can be timely repaired when a node fails
- Configure multiple parents in the relay tree
  - To achieve fault tolerance and load balance

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VirtMan architecture

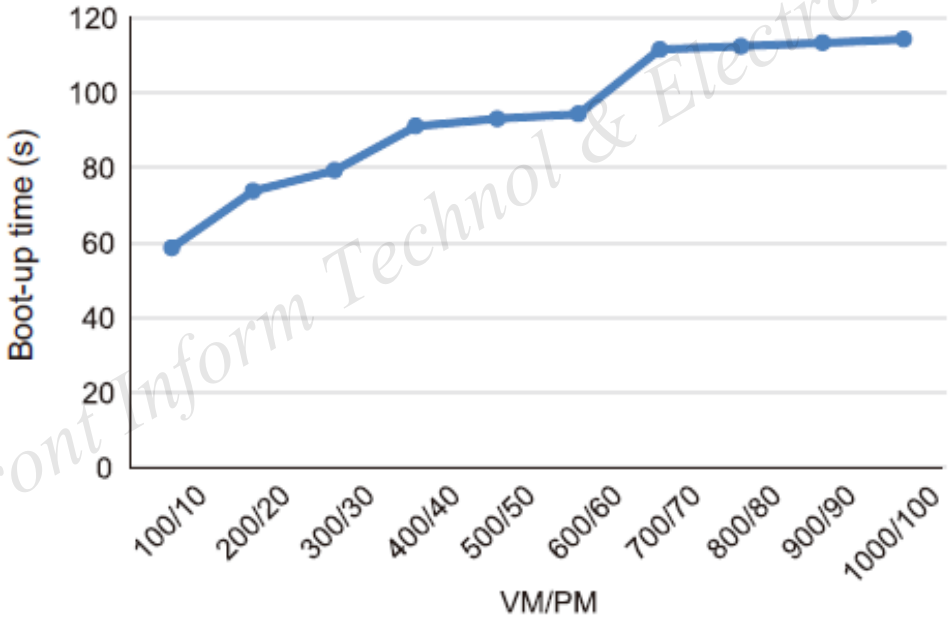
- VirtMan open source implementation
  https://github.com/vmthunder



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Results (1)

- Boot up 1000 VMs
  - (Blue) VirtMan can boot up 1000 VMs in <120 s.



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Fig. 5 Standalone VirtMan boot-up time (VM: number of virtual machines; PM: number of physical machines)

Results (2)

- Accelerate OpenStack

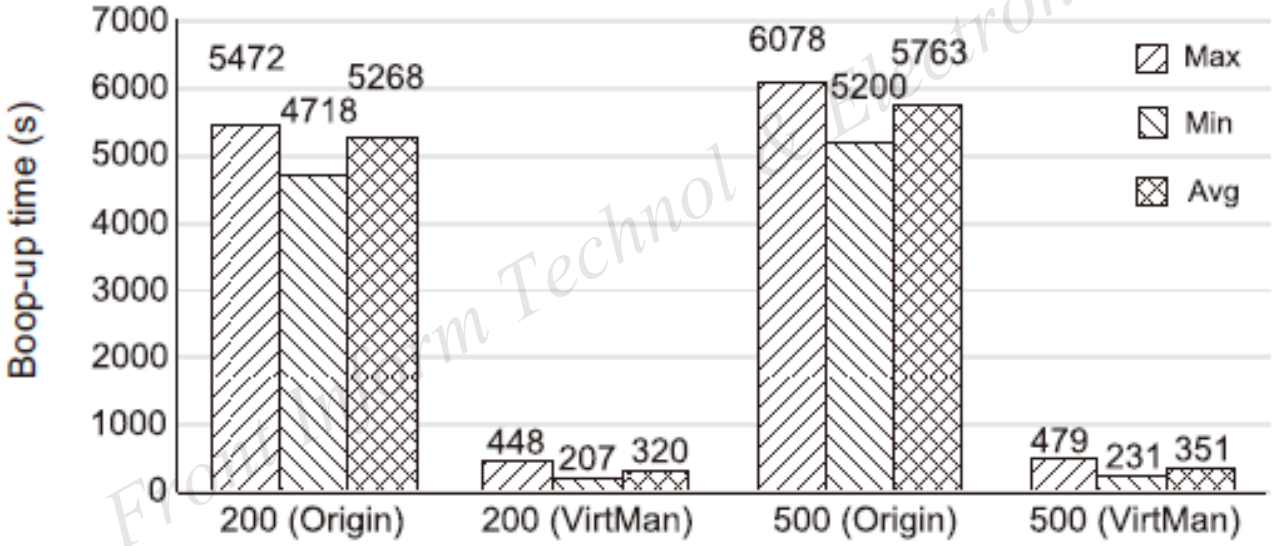


Fig. 7 OpenStack-based VirtMan boot-up time. 'Origin' represents the original OpenStack and 'VirtMan' represents the VirtMan-enabled OpenStack

Conclusions

- We design and implement VirtMan, a fast booting system for a large number of homogeneous VMs in iVCE.

- With the techniques, such as cache group, cache group based snapshot, and hierarchical attaching, VirtMan can boot a thousand of homogeneous VMs in only 2 min.

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