

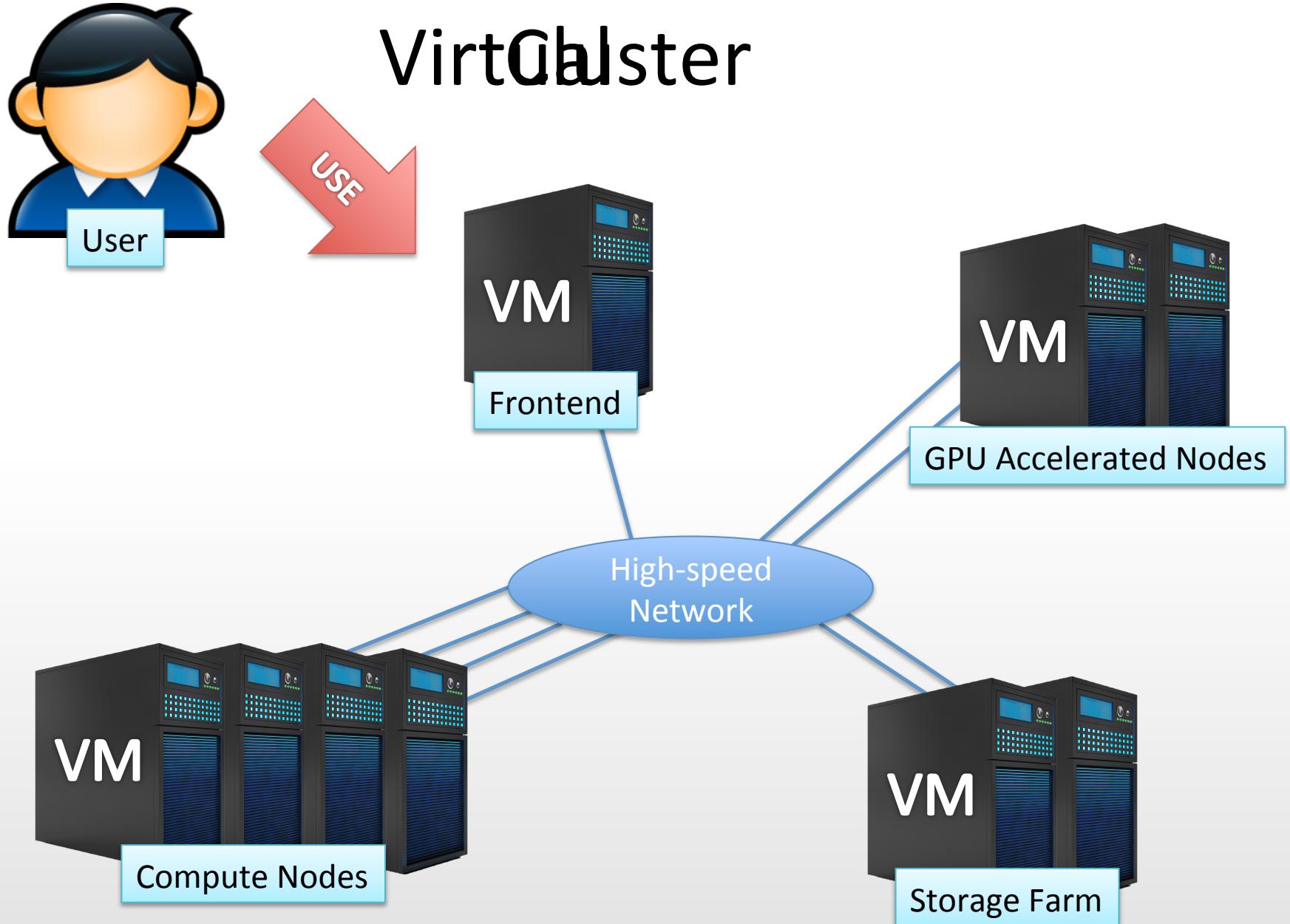
# An Implementation of Virtual Cluster on a Cloud

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# Agenda

- Introduction
- Design & Implementation
- Benchmarking Results

# VirtGulster



\*Example setup

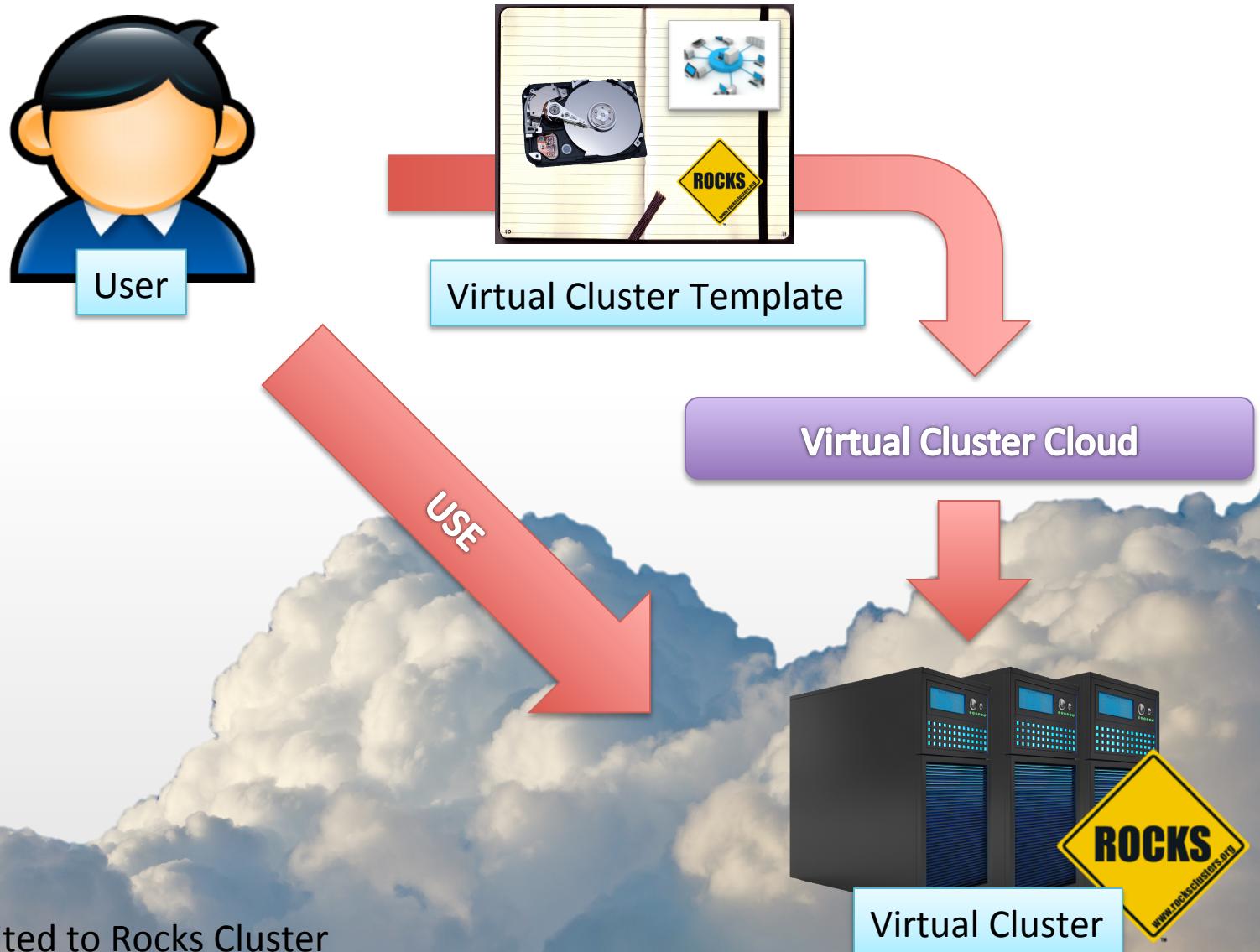
Managing virtual cluster **Manually**

is a

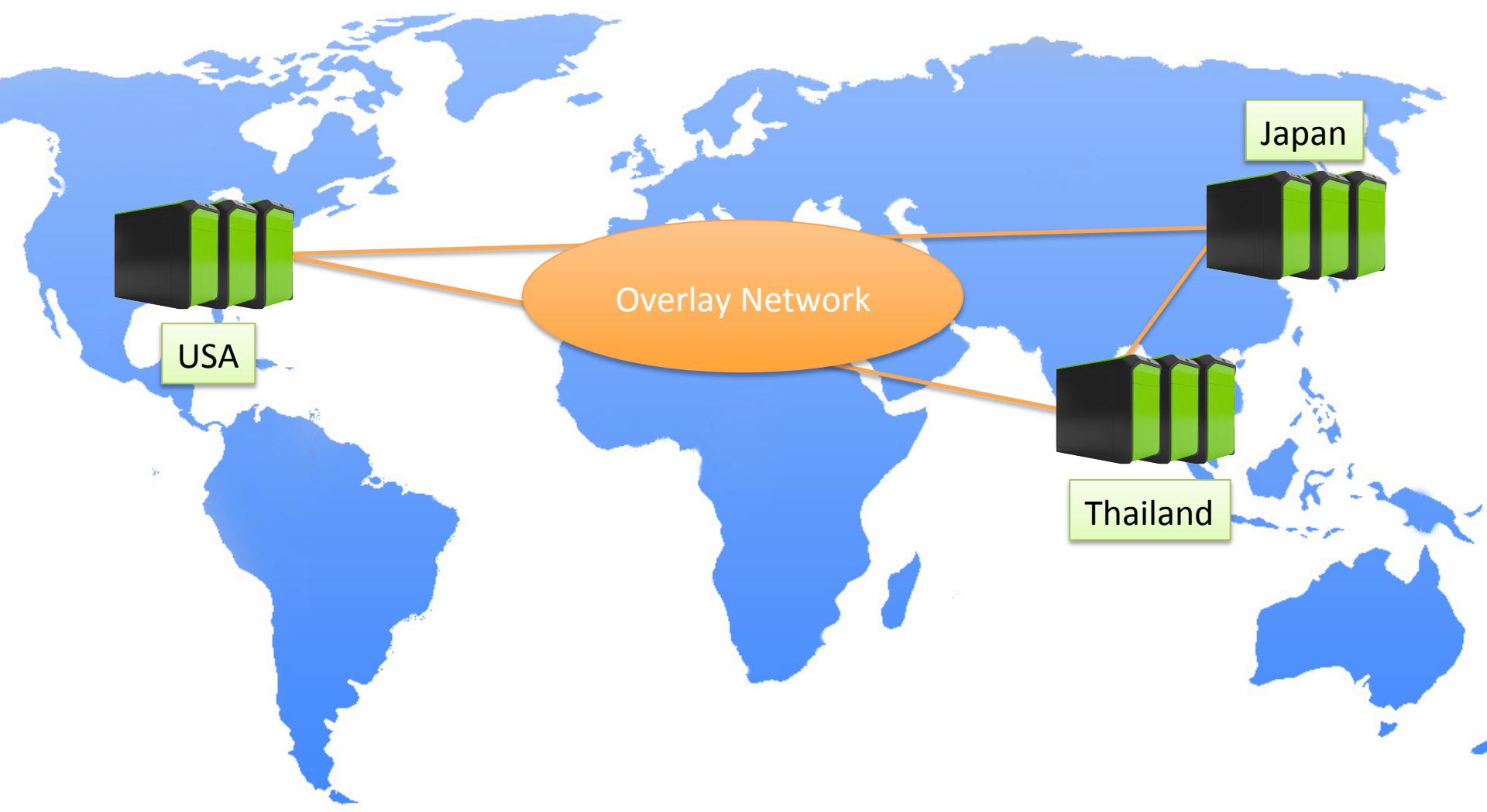
**Headache**



# Virtual Cluster Cloud



# Multi-site Infrastructure



\*Countries listed are just for examples

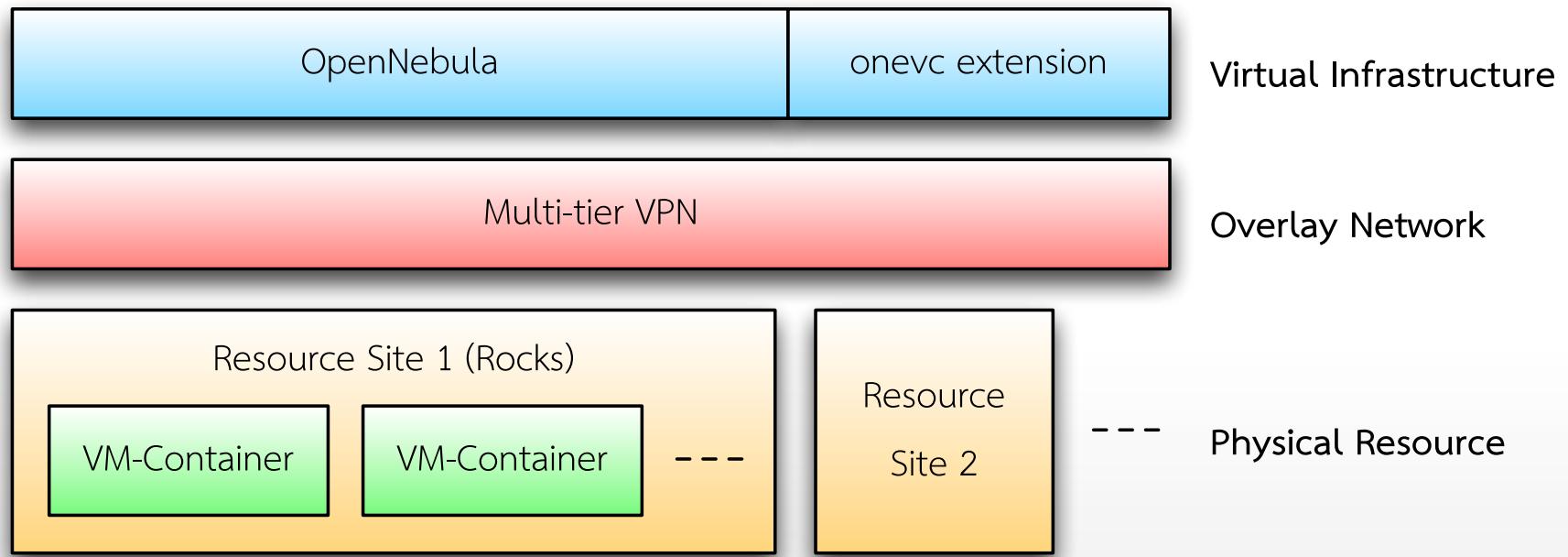
# Design Goals

- **Automatic** resources management
- Designed with **scalability** in mind
- Acceptable **performance**
- Virtual Cluster management as a **single entity**
  - Create
  - Deploy
  - Suspend
  - Stop
  - Delete

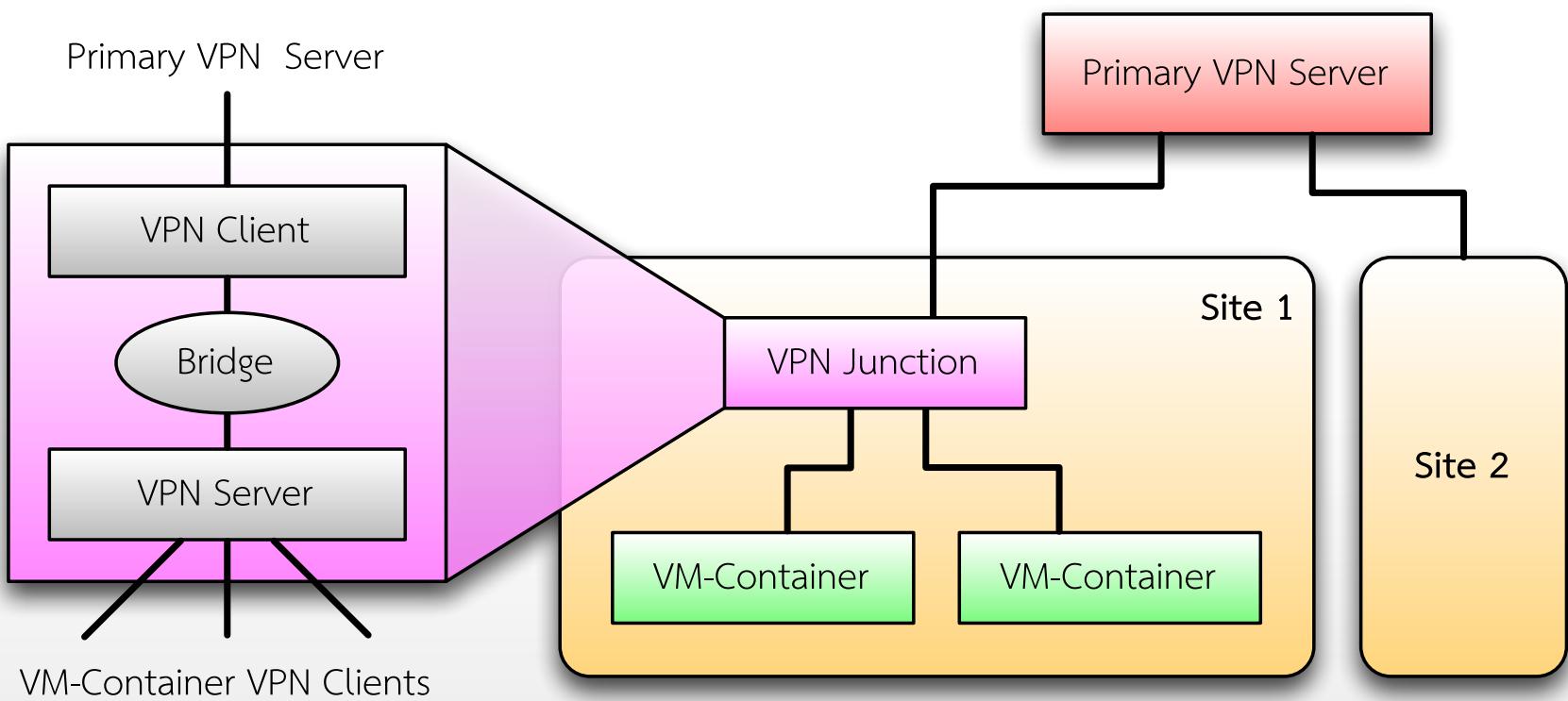
# Agenda

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# Architecture



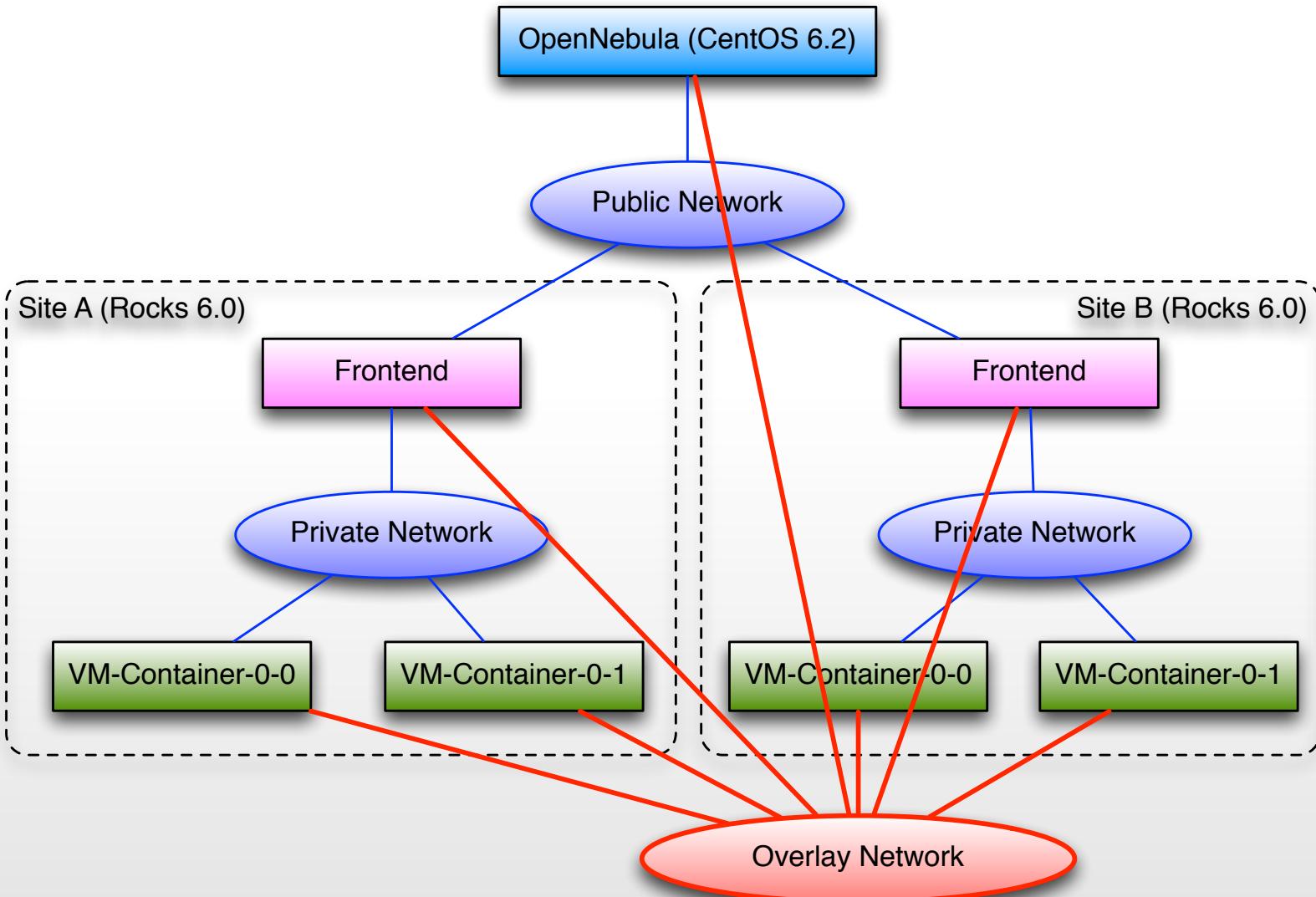
# Multi-tier VPN



# Agenda

- Introduction
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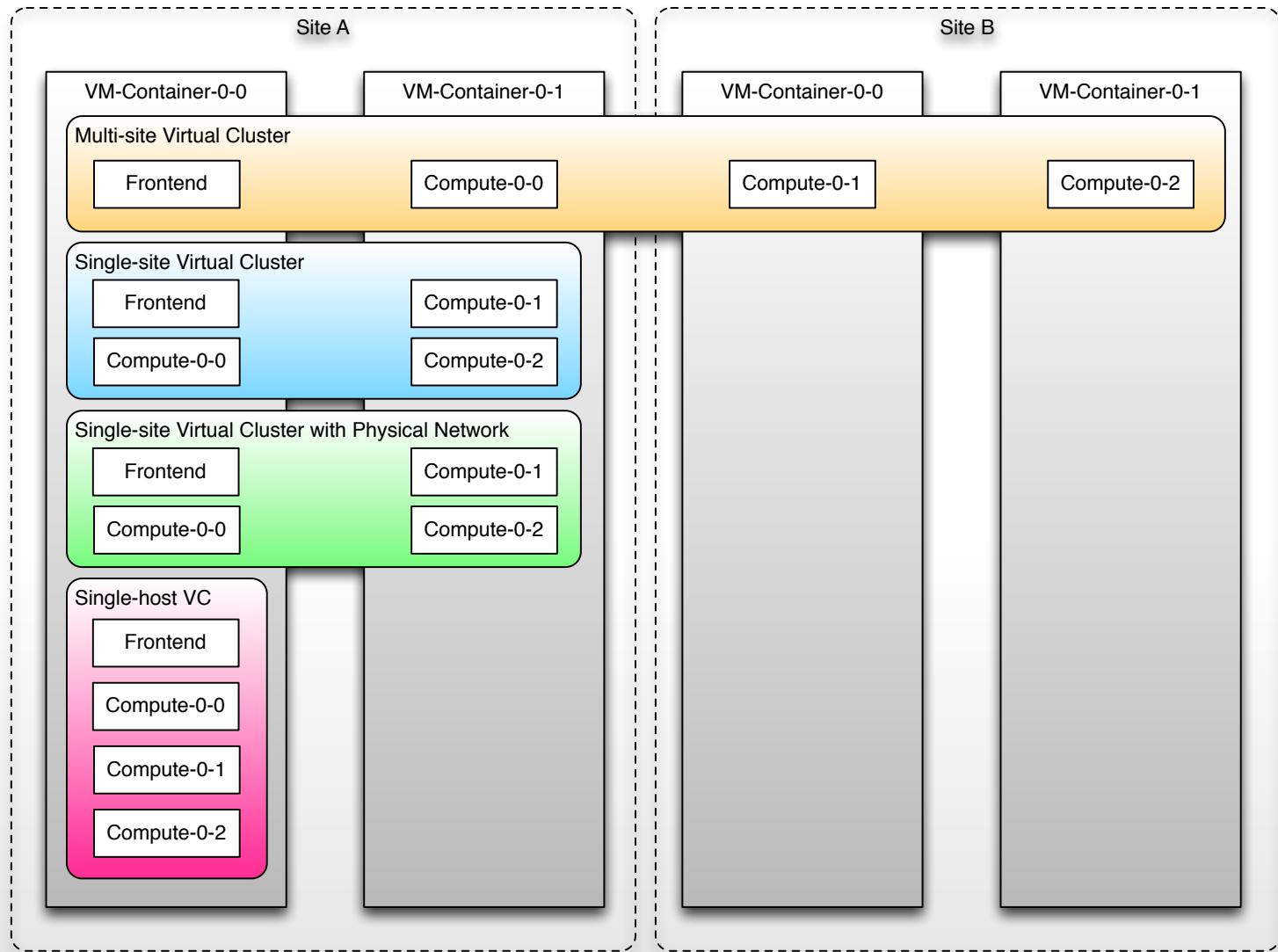
# Cloud Testbed



# Network Benchmarking

- Average Bandwidth: measured with Iperf
  - **Physical Network:** 776.62 Mbits/s
  - **Overlay Network:** 314.26 Mbits/s
- Round-Trip-Time: measured with ping
  - **Physical Network:** 0.135 ms
  - **Overlay Network:** 0.455 ms

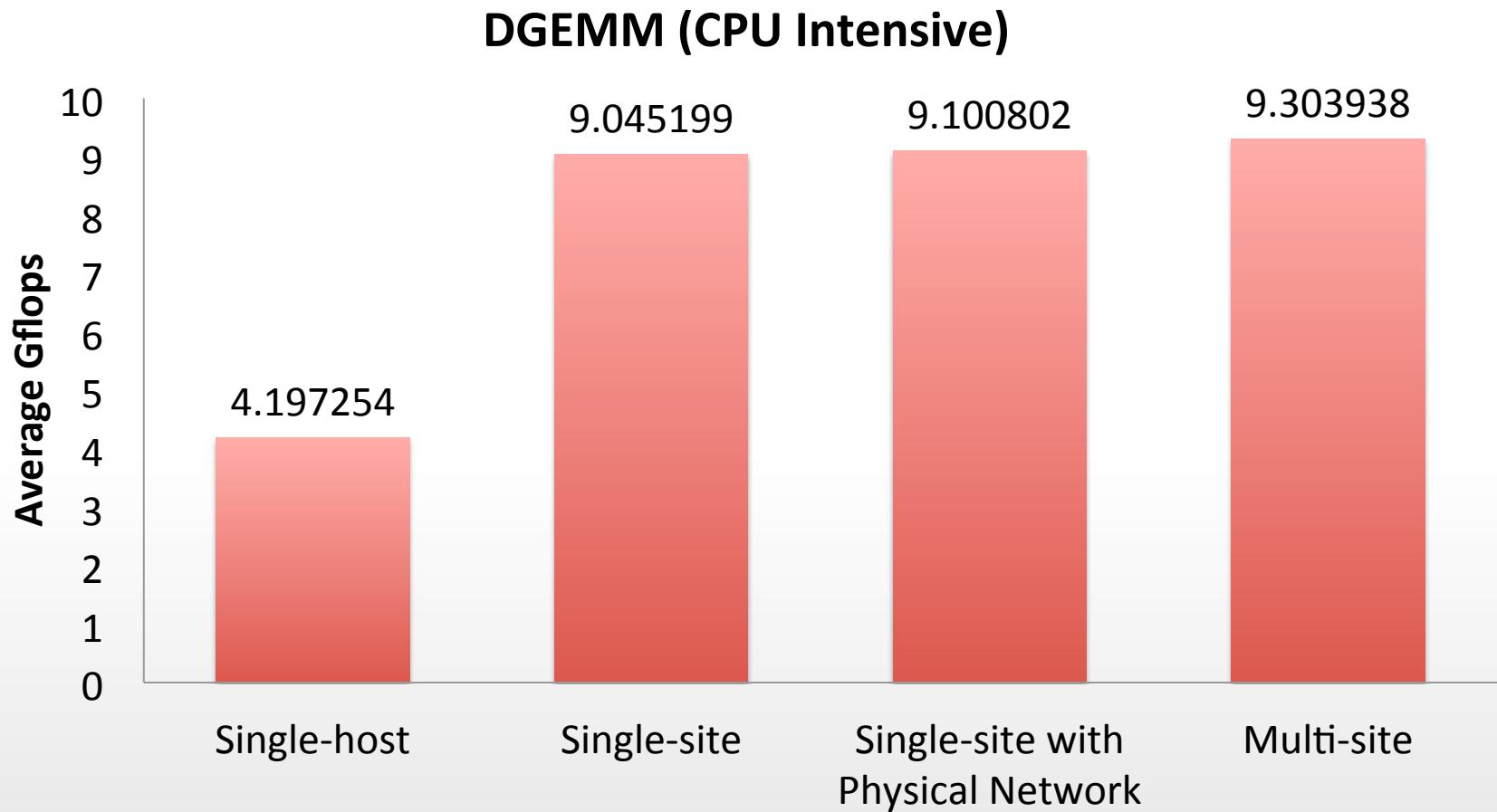
# Virtual Cluster Testset



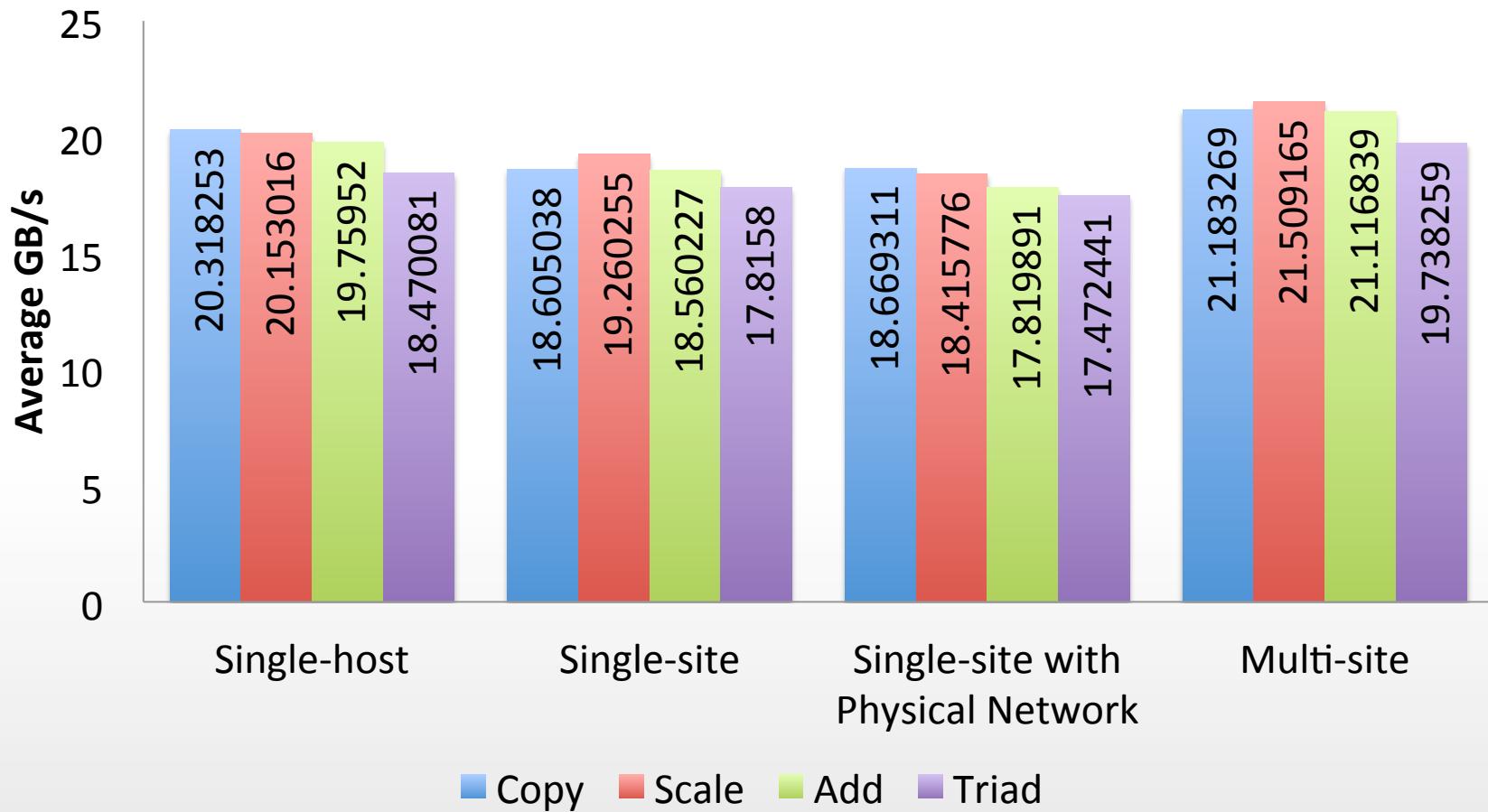
# HPCC Benchmarking Results

Test	Single-host	Single-site	Single-site (Physical Network)	Multi-site
<b>MPI Random Access</b>				
- CPU time used (seconds)	0.248962	0.160976		0.142978
- Real time used (seconds)	1.13593	0.828999		0.658484
- Billion(10^9) Updates per second (GUP/s)	0.001846198	0.00252974	0.003184819	0.003041767
- Billion(10^9) Updates/PE per second (GUP/s)	0.00046155	0.000632435	0.000796205	0.000760442
- Verificaton: CPU time used (seconds)	0.702893	0.160975		0.010998
- Verificaton: Real time used (seconds)	3.129425	1.10682		0.355922
<b>Star Random Access</b>				
- CPU time used (seconds)	0.001999	0.002		0.003
- Real time used (seconds)	0.001525	0.001767		0.002174
- Billion(10^9) Updates per second (GUP/s)	0.34375852	0.296724228	0.24117386	0.345161396
- Average GUP/s	0.283462	0.321391	0.242635	0.345387
<b>Single Random Access</b>				
- Single GUP/s	0.343759	0.349107	0.349273	0.350442
<b>MPI Random Access LCG</b>				
- CPU time used (seconds)	0.341948	0.173974		0.121982
- Real time used (seconds)	1.487325	0.859895		0.668644
- Billion(10^9) Updates per second (GUP/s)	0.001410016	0.002438847	0.003136426	0.003020862
- Billion(10^9) Updates/PE per second (GUP/s)	0.000352504	0.000609712	0.000784106	0.000755216
- Verificaton: CPU time used (seconds)	0.701893	0.146978		0.020996
- Verificaton: Real time used (seconds)	2.927945	0.899619		0.326657
				1.214264

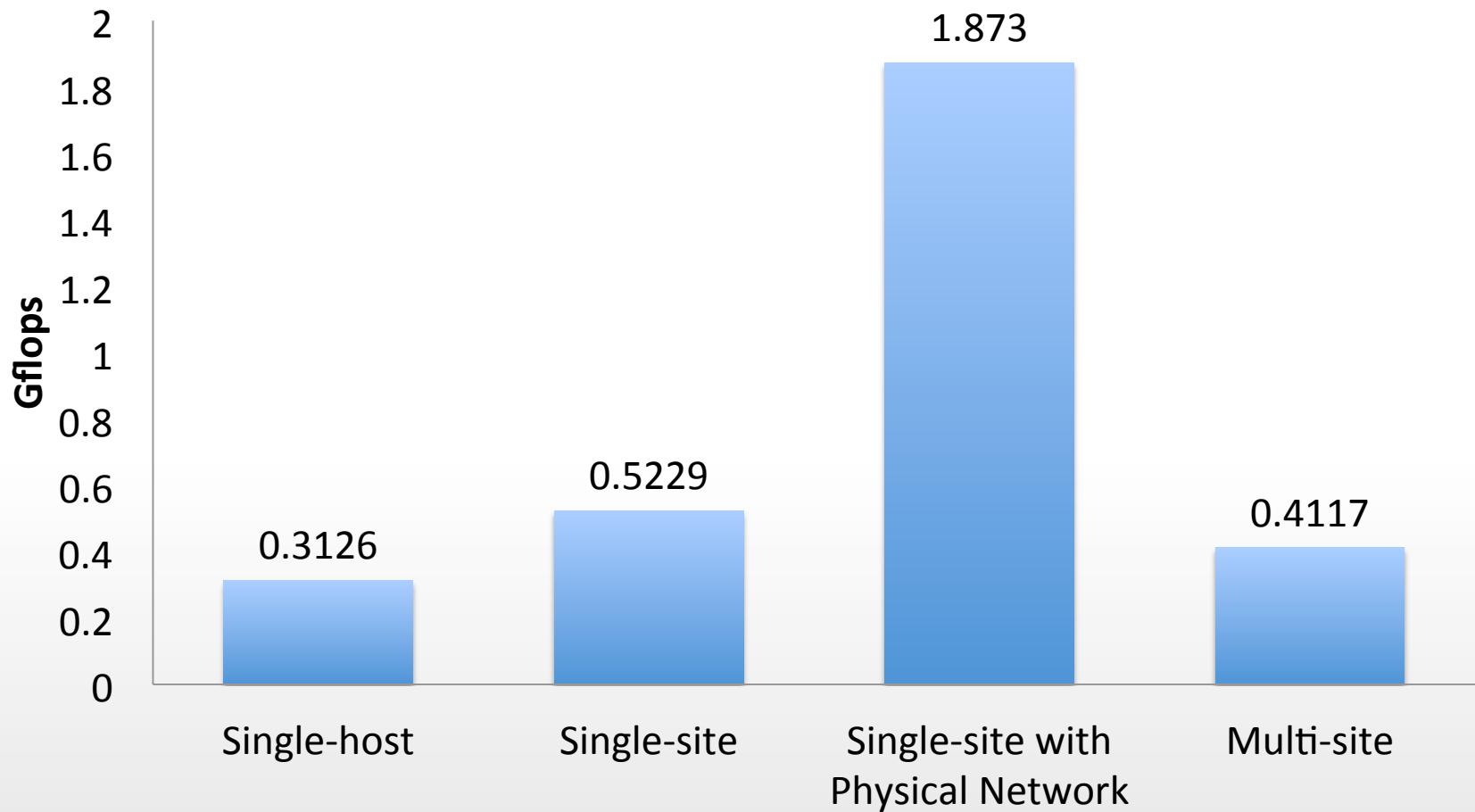
# DGEMM (CPU Intensive)



# STREAM (Memory Bandwidth)



# HPL (Peak Performance)



# Conclusion

- The virtual cluster cloud works as expected
- This cloud is suitable for **non-network-intensive application**
  - Bio-Chemical-Related Research
  - Video Rendering
  - Brute-force Searches
  - Bitcoin Mining :D

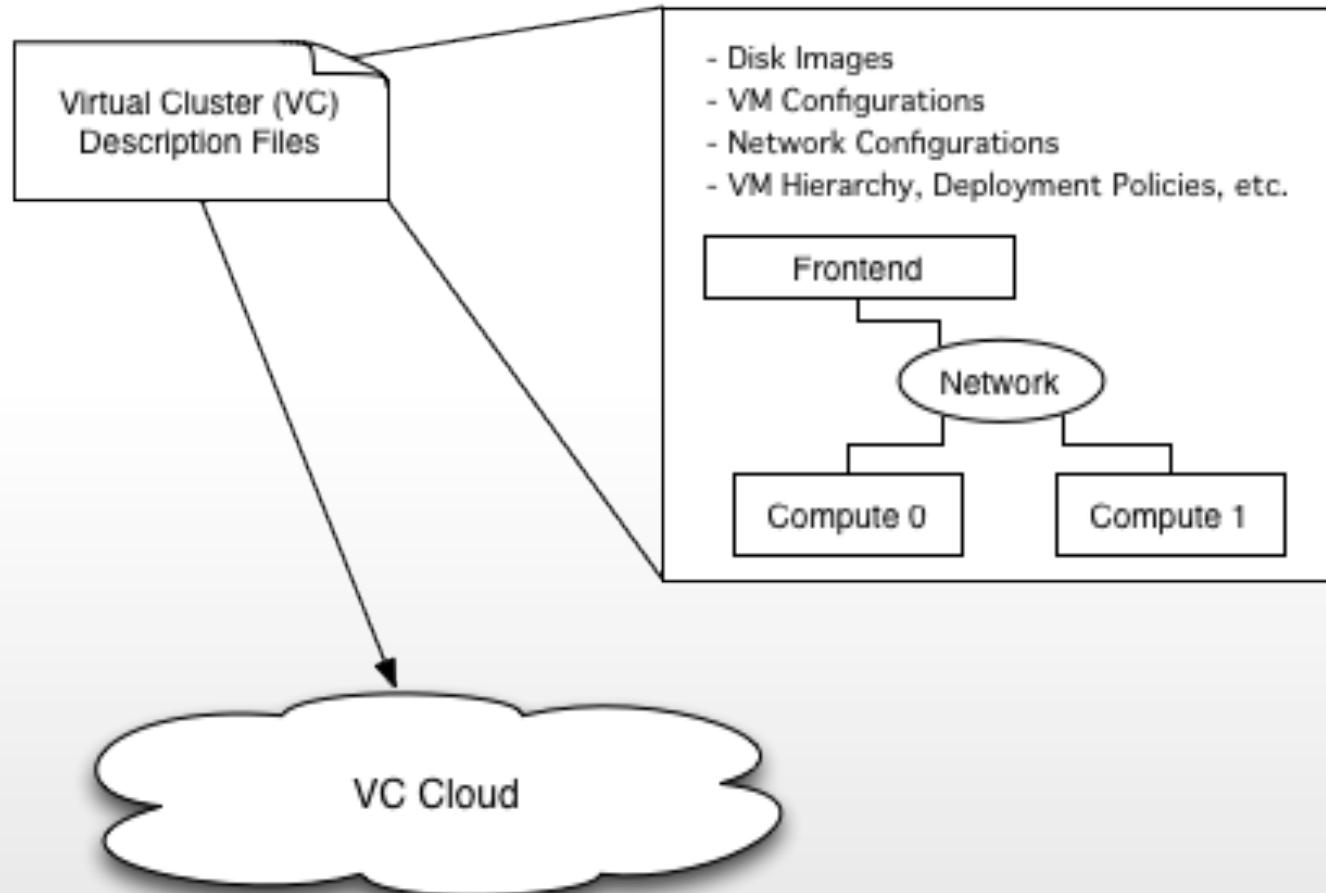
# Future Works

- Better *Overlay Network* implementation
  - Software-defined Networking (SDN)
- Intelligence VM placement mechanism (scheduling)
  - Swarm algorithm

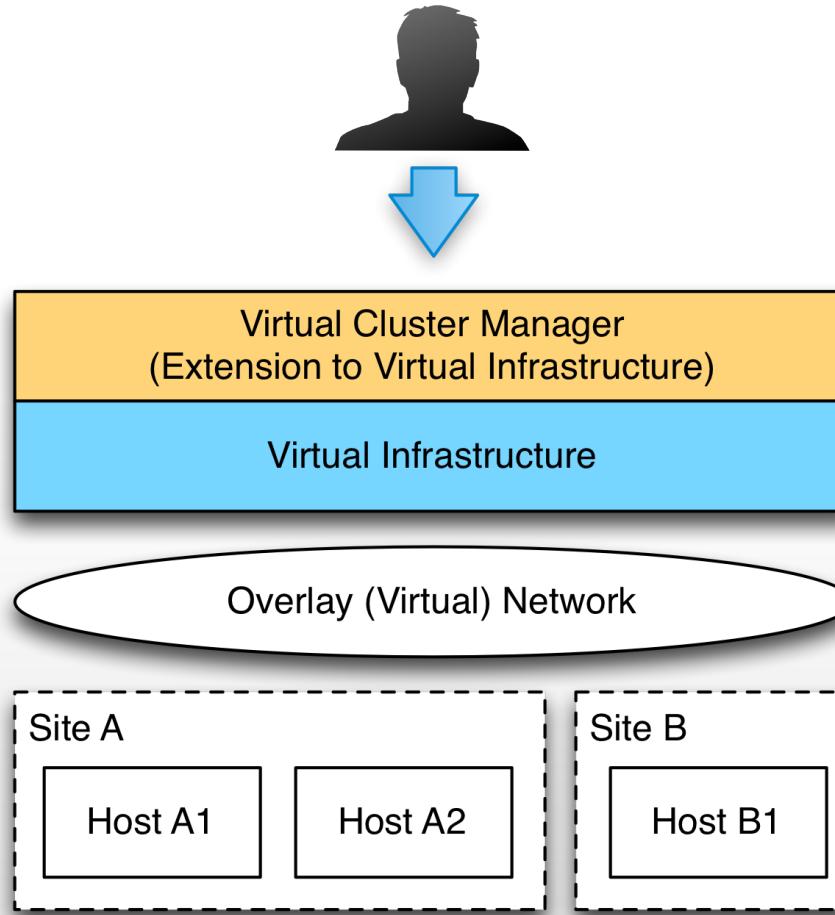
Thank you for your attention

## **Q&A**

# Virtual Cluster Template



# Architecture (Overview)



# Architecture (Detail)

