Applications of on-demand virtual clusters to high performance computing

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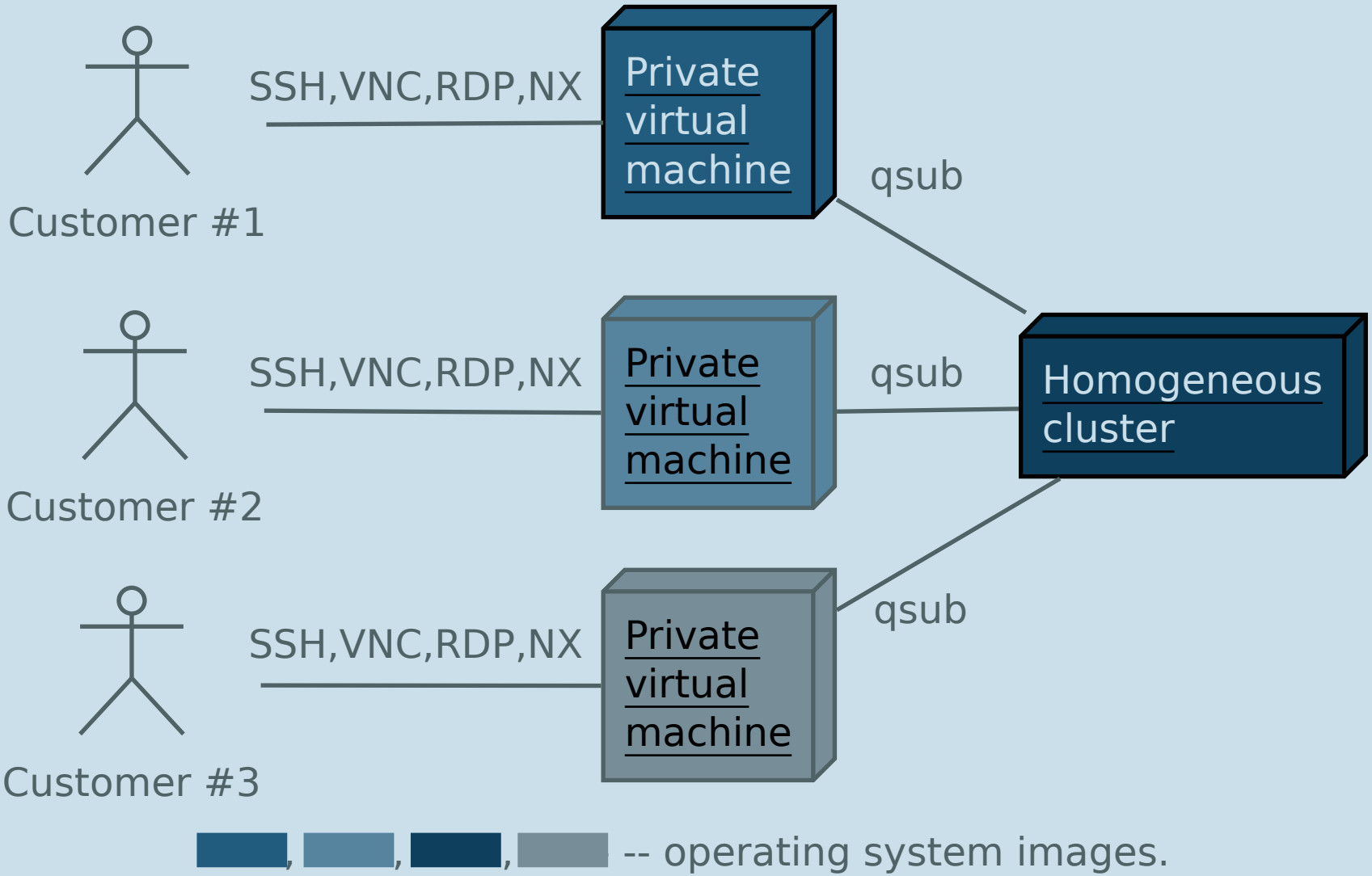
Motivation

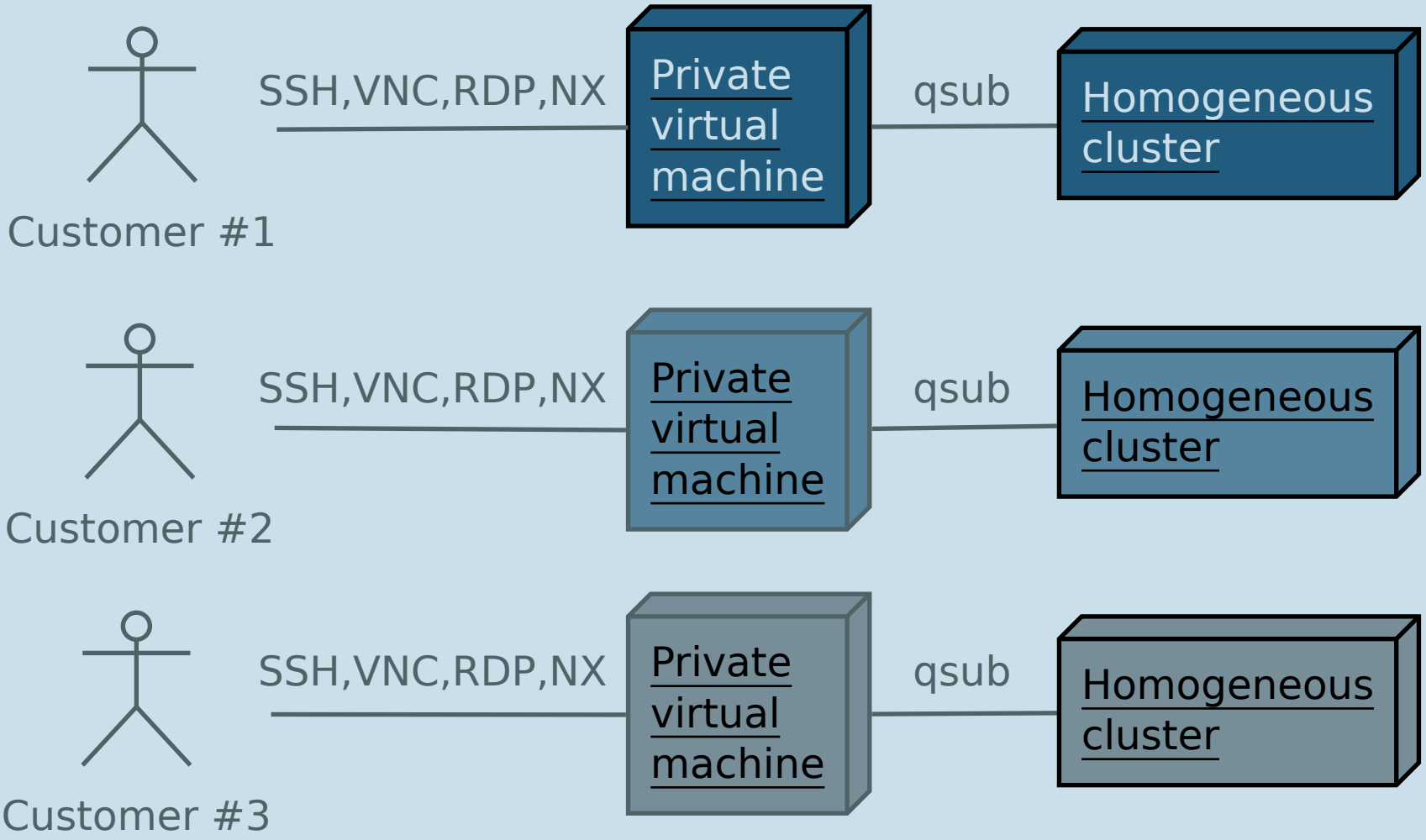
A typical computer cluster puts certain constraints on the user who uses it, e. g.
— fixed operating system,
— fixed configuration,
— fixed number of libraries.

The problem is to alleviate or completely drop these constraints.

Typical configuration



Proposed configuration



Requirements

— Nought-overhead virtualisation for HPC cluster.
— Fast snapshot operations (create/delete/clone).

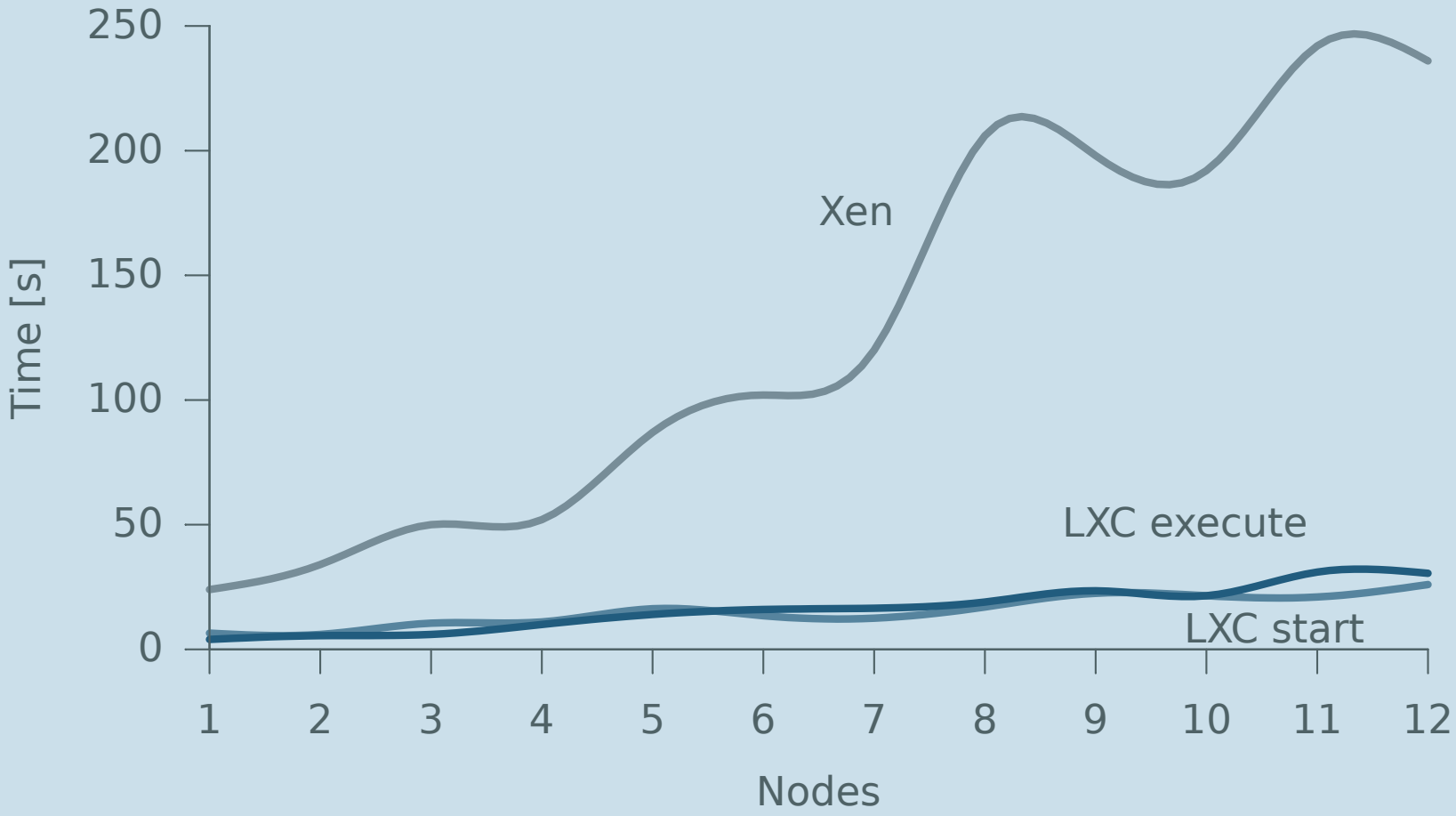
Solution

Application containers on copy-on-write (COW) object storage.

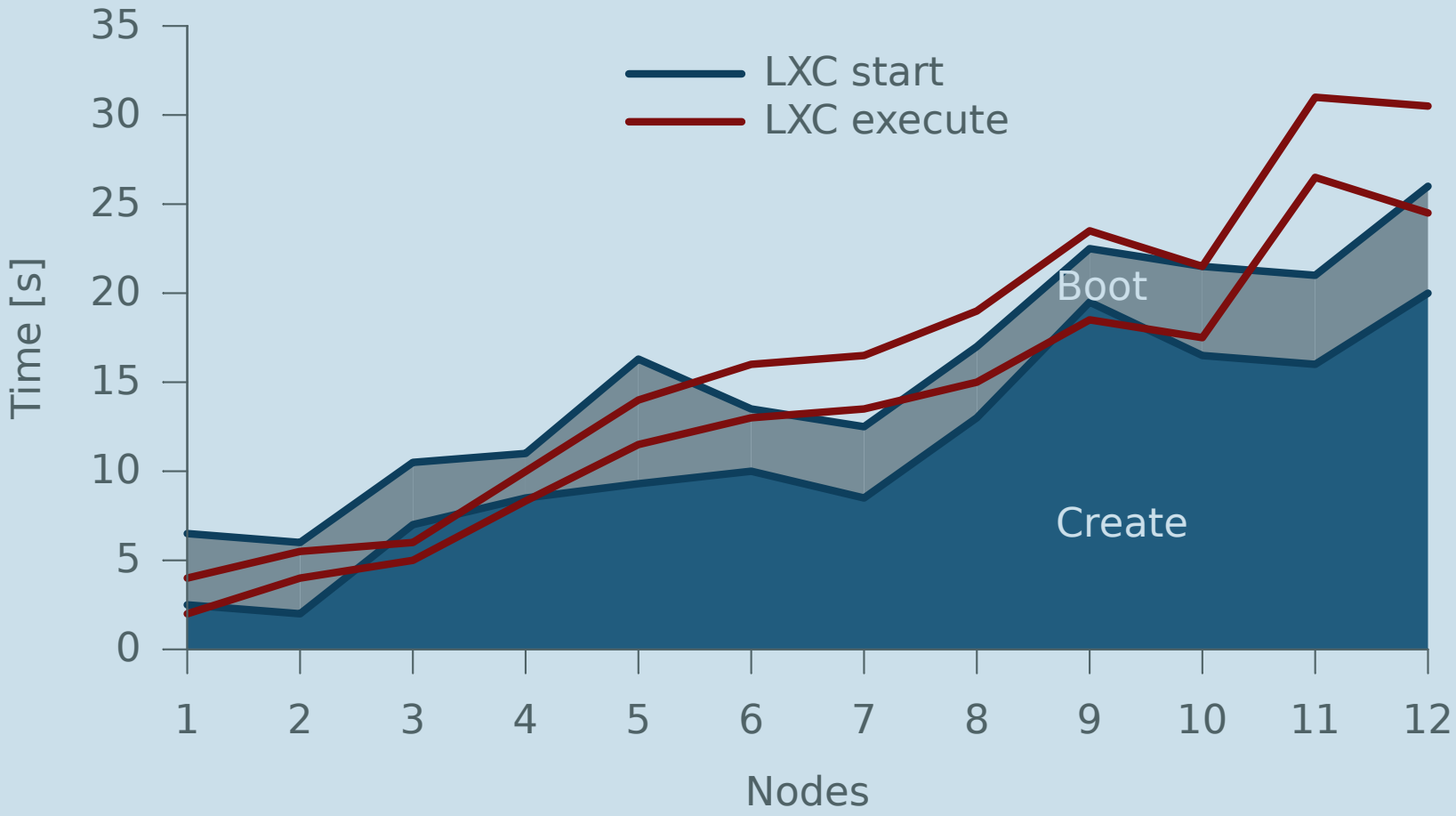
Testbed setup

Component	Details
COW storage	Ceph
Virtualisation	LXC
HPC application	OpenFOAM
No. of storage nodes	3
No. of compute nodes	3
Interconnect speed (Mbit/s)	100

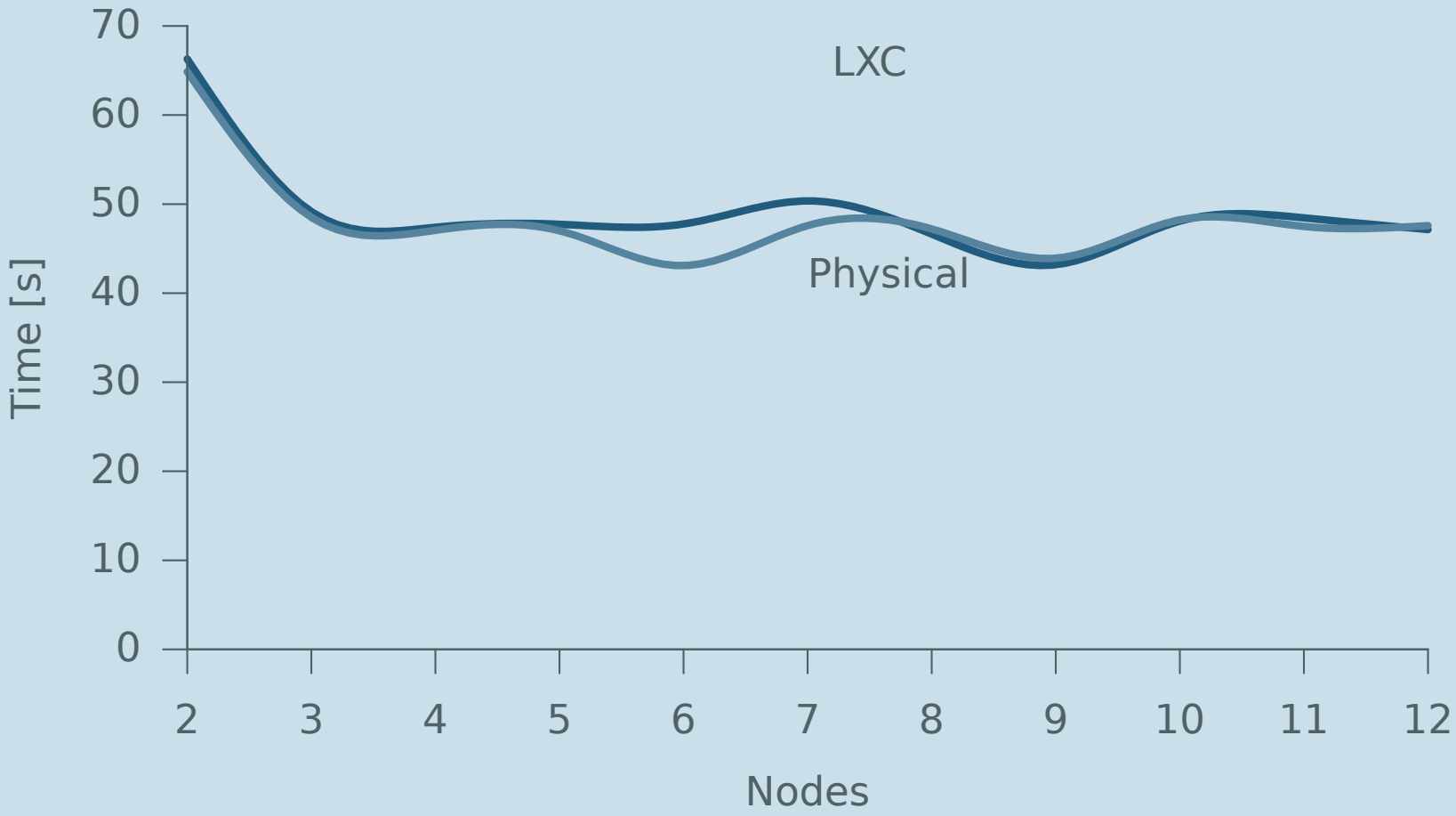
Containers’ boot time



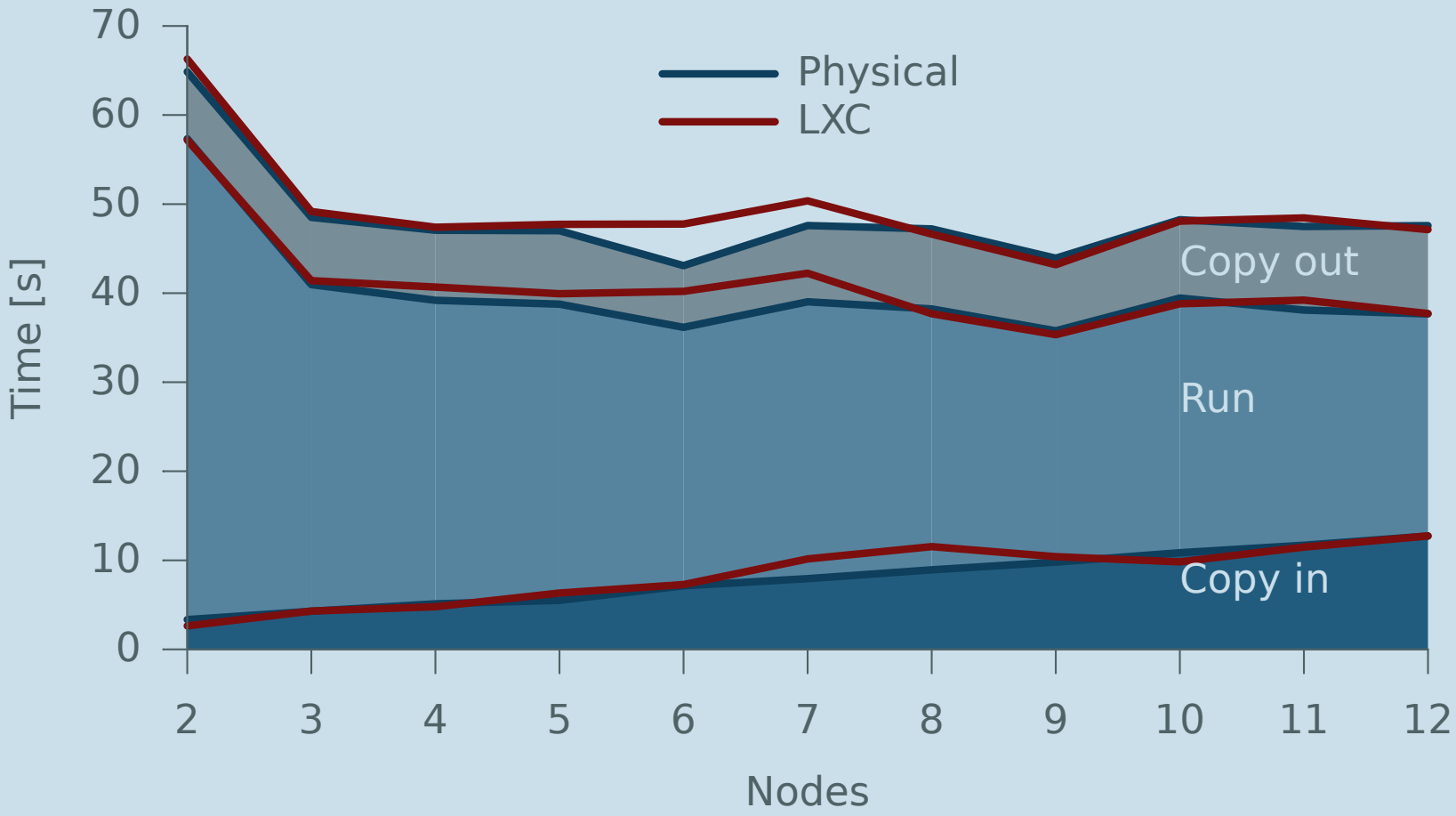
Containers’ boot time in detail



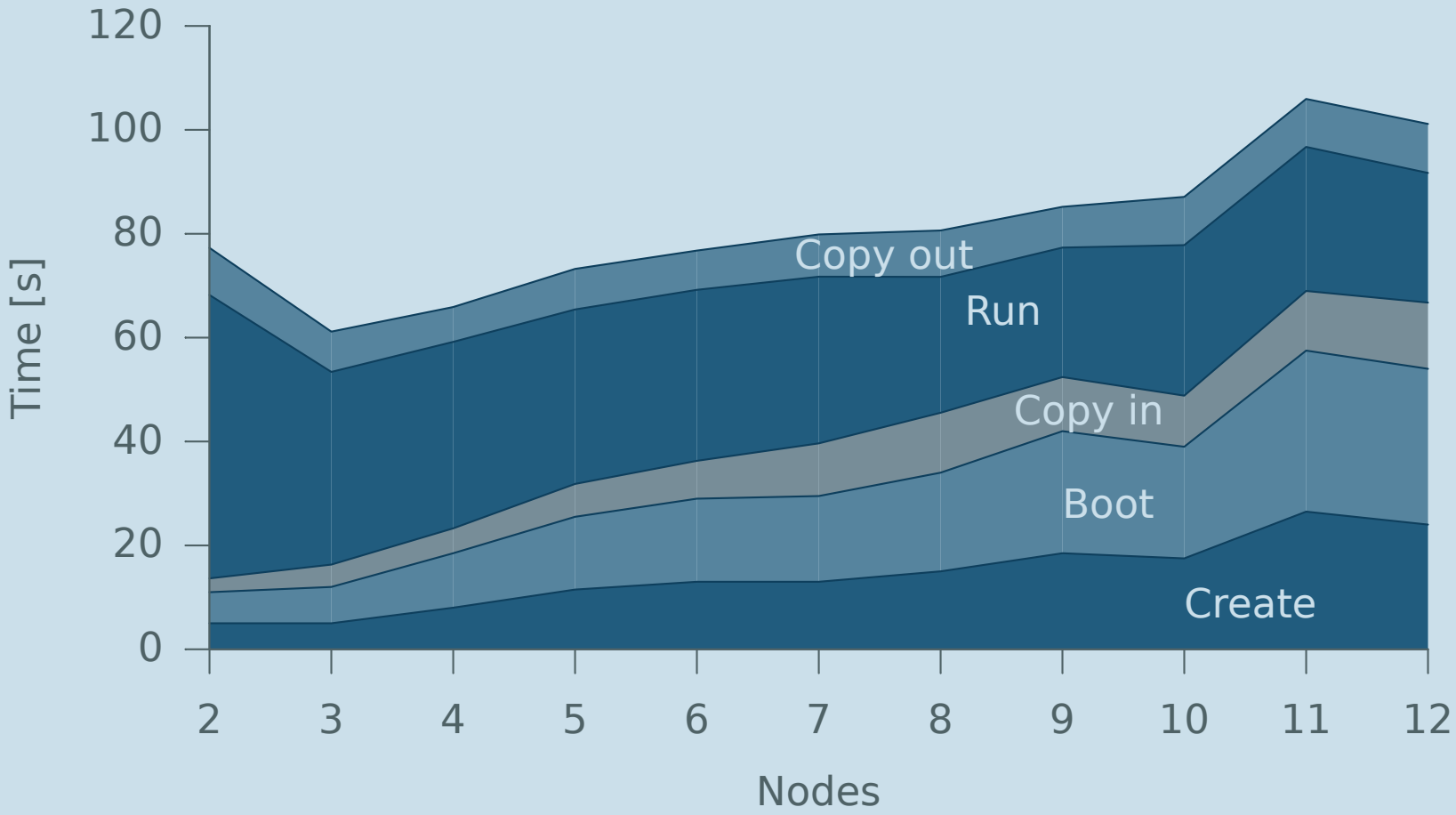
OpenFOAM run time



OpenFOAM run time in detail



The whole picture



Advantages & disadvantages

- A possibility to combine any root file system with any computer configuration.
- Ease of use from the customer point of view.
- The choice of the operating system kernel is restricted.
- The need for fast network interconnect.

Conclusion

If there is enough network bandwidth, Linux containers with COW storage are efficient at creating a *single image private* computer cluster.

Thank you!