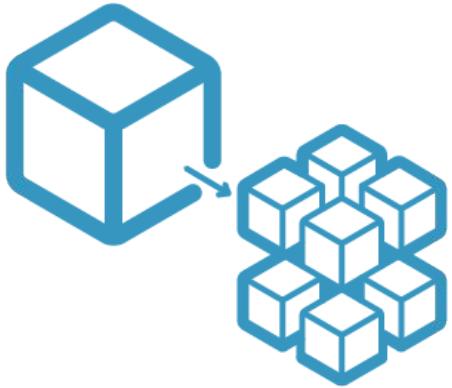
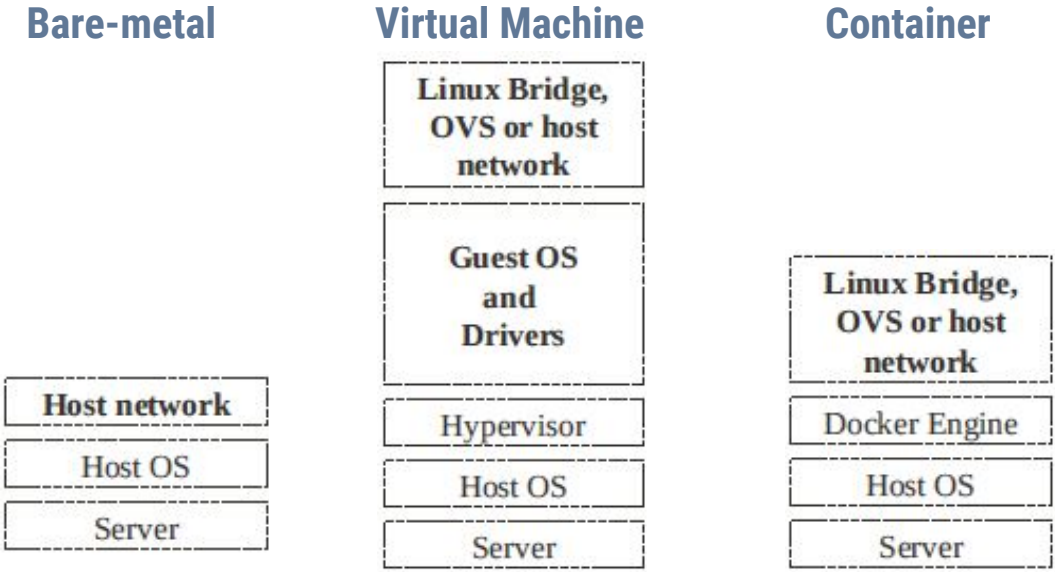
Performance Evaluation of Microservices Architectures using Containers

Mohamed Chennouf
Tanguy Invernizzi
Pierre Rainero

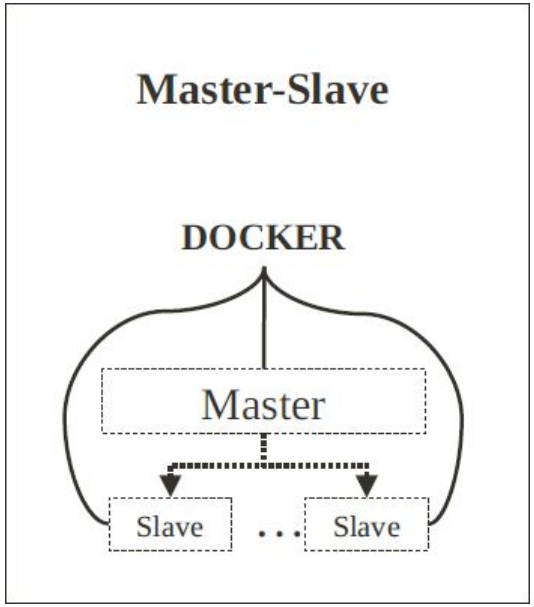
Microservices ?

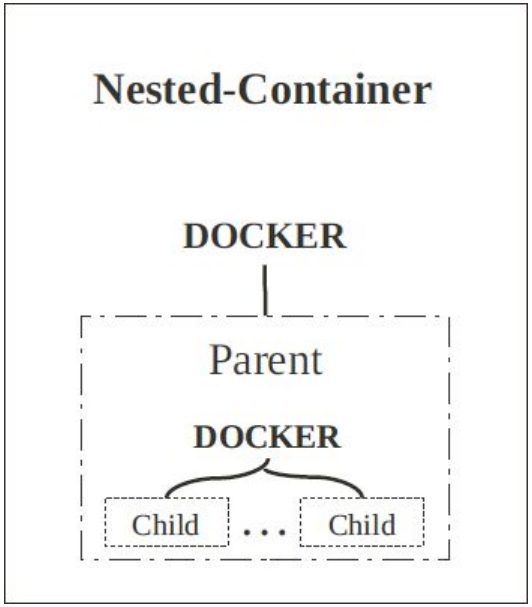


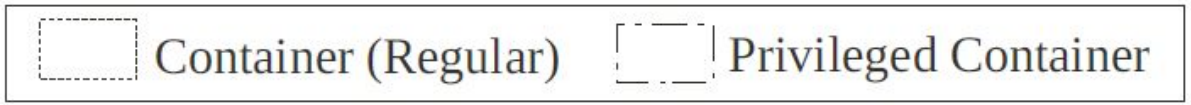
What are we talking about ?



How ?

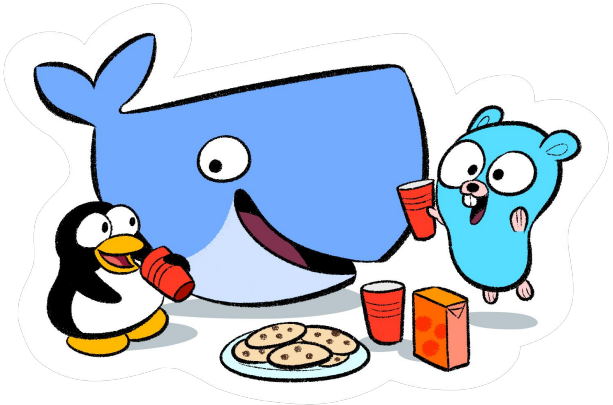

Master-Slave
DOCKER
Master
Slave
Slave


Nested-Container
DOCKER
Parent
DOCKER
Child
Child


Container (Regular)
Privileged Container

What about **performances ?**

“The main goal of these experiments is to study the **performance** and **overhead** of nested-containers”



Experiment 1
CPU Performances

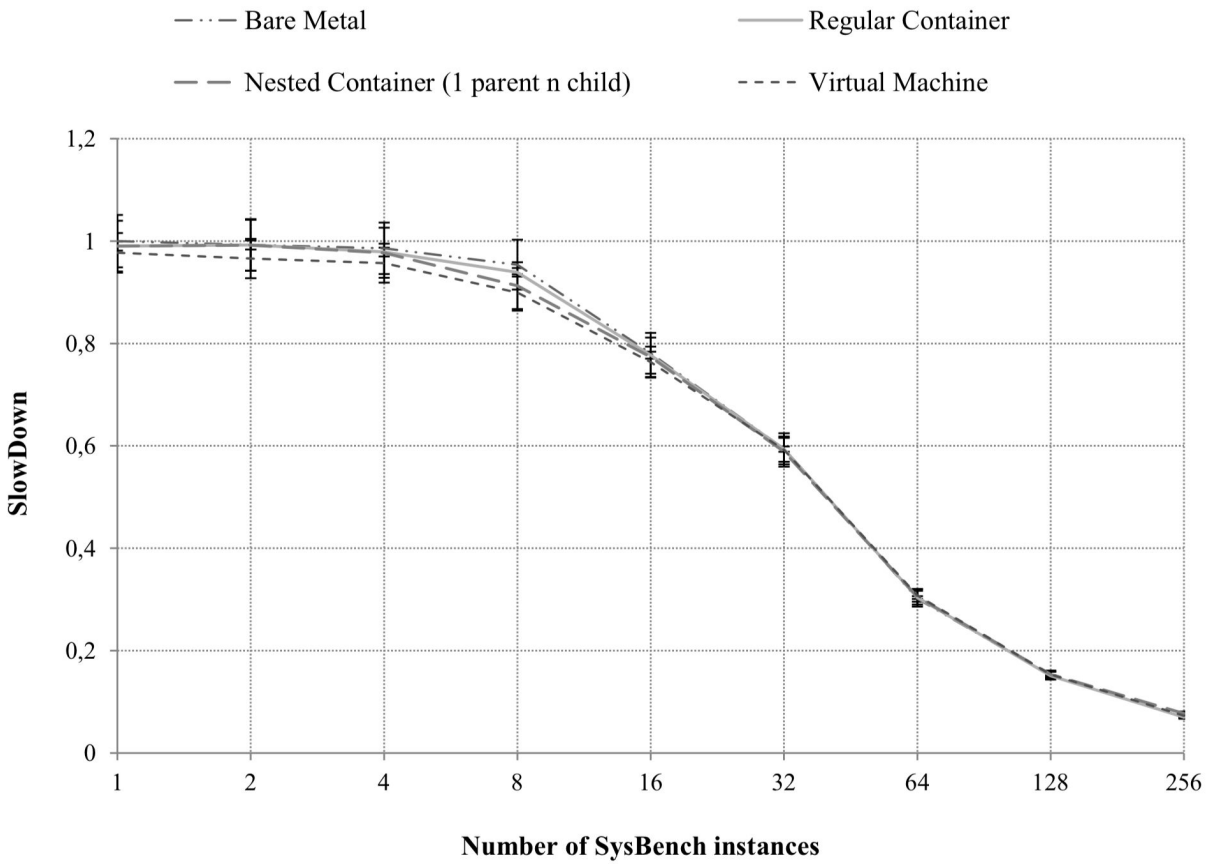


Fig. 3. Observed slowdown of Sysbench with increasing number of instances relative to running a single Sysbench instance in bare-metal

Experiment 2

Overhead of virtual container creation

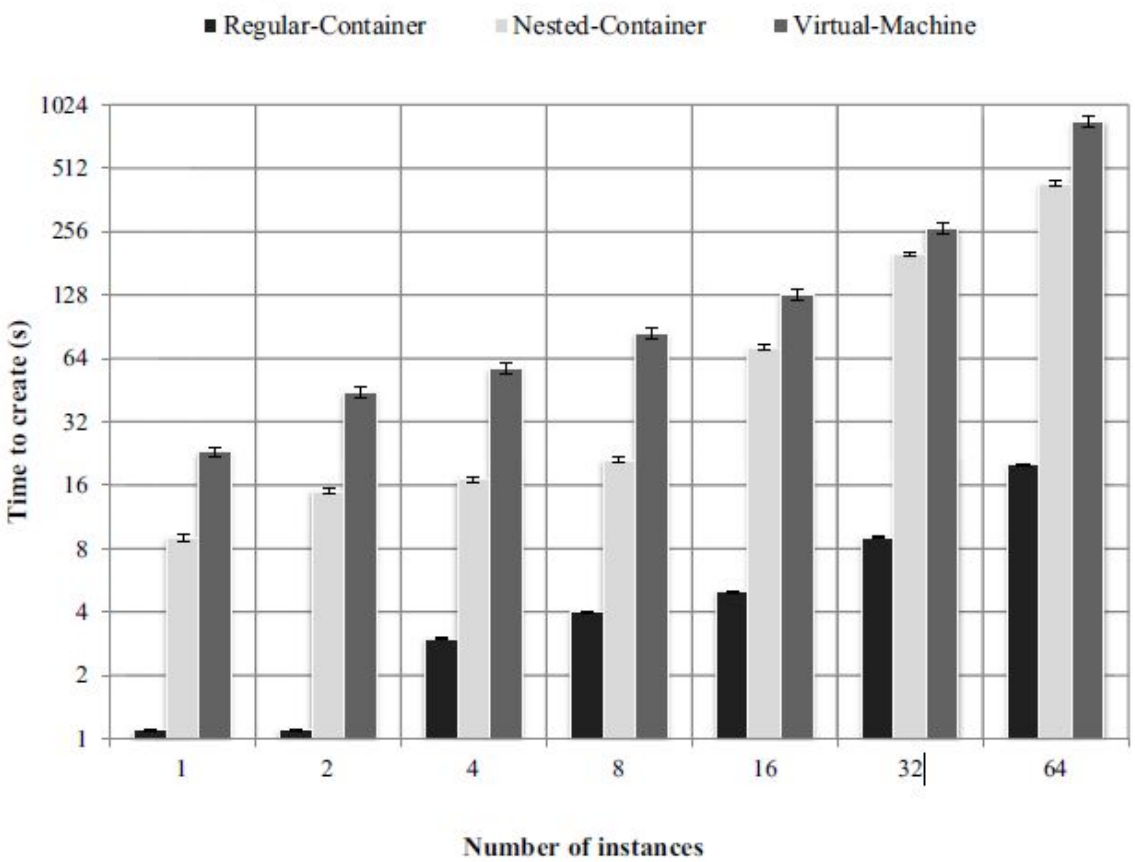


Fig. 4. Time to create an increasing number of instances of virtual containers (base 2 log scale in both axes). Where the nested-container is a fully initialized parent plus one child.

TABLE I. TIME TO CREATE NESTED-CONTAINERS WITH DIFFERENT RATIOS OF PARENT TO CHILDREN CONTAINERS

# Child \ # Parent	1	2	4	8	16	32	64	128	256
1	9 s σ=1.0	15 s σ=0.5	17 s σ=0.5	21 s σ=0.4	72 s σ=1.3	200 s σ=0.3	432 s σ=10.5	1475 s σ=146.5	2313 s σ=160.8
2	9 s σ=0.5	10 s σ=0.51	12 s σ=0.43	25 s σ=2.0	96 s σ=4.0	239 s σ=2.5	475 s σ=14.5	1518 s σ=163.0	-
4	10 s σ=0.5	12 s σ=0.5	17 s σ=0.5	37 s σ=2.0	113 s σ=8.0	255 s σ=0.6	514 s σ=12.0	-	-
8	12 s σ=0.5	14 s σ=0.53	22 s σ=3.56	64 s σ=1.5	131 s σ=6.1	278 s σ=7.0	-	-	-
16	16 s σ=1.0	22 s σ=1.0	35 s σ=1.5	66 s σ=0.5	139 s σ=1.5	-	-	-	-
32	27 s σ=1.5	40 s σ=0.5	47 s σ=4.81	92 s σ=3.5	-	-	-	-	-
64	46 s σ=2.0	46 s σ=2.0	69 s σ=2.02	-	-	-	-	-	-
128	65 s σ=3.0	77 s σ=1.0	-	-	-	-	-	-	-
256	111 s σ=3.5	-	-	-	-	-	-	-	-

Experiment 3

Overhead of nested-container creation

TABLE II. NETWORK THROUGHPUT AND LATENCY EVALUATION FOR DIFFERENT CONFIGURATIONS OF CLIENT/SERVER UNDER BARE-METAL, CONTAINER AND VIRTUAL MACHINE ON A SINGLE HOST MACHINE

	Throughput			Latency		
(Client - Server)	Host-Network	Linux Bridge	Open vSwitch	Host-Network	Linux Bridge	Open vSwitch
Host - Host	35.71 Gbps σ=0.32	-	-	102.77 μs σ=0.95	-	-
Container - Host	35.13 Gbps σ=0.48	15.82 Gbps σ=0.36	16.01 Gbps σ=0.47	104.48μs σ=1.45	231.97μs σ=5.3	229.37μs σ=6.38
Host - Container	34.96 Gbps σ=0.63	15.96 Gbps σ=0.51	16.86 Gbps σ=0.35	105.0μs σ=1.94	230.17μs σ=7.35	217.76μs σ=4.63
Virtual machine - Host	-	8.64 Gbps σ=0.28	7.94 Gbps σ=0.69	-	424.92μs σ=14.09	465.53μs σ=43.57
Host - Virtual machine	-	9.24 Gbps σ=0.27	8.77 Gbps σ=0.55	-	397.53μs σ=12.08	420.14μs σ=27.09

Experiment 4

Network performance

One host

TABLE IV. NETWORK THROUGHPUT AND LATENCY EVALUATION FOR DIFFERENT CONFIGURATIONS OF CLIENT/SERVER UNDER BARE-METAL, CONTAINER AND VIRTUAL MACHINE ACROSS TWO HOSTS

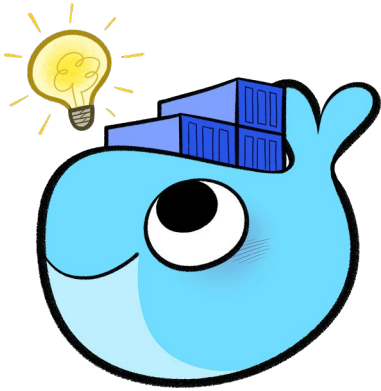
	Throughput			Latency		
(Client - Server)	Host-Network	Linux Bridge	Open vSwitch	host-network	Linux Bridge	Open vSwitch
Host - Host	142.21 Mbps σ=8.64	-	-	25.97 ms σ=1.7	-	-
Container - Host	157.92 Mbps σ=1.06	154.51 Mbps σ=5.22	157.25 Mbps σ=3.95	23.29 ms σ=0.15	23.83 ms σ=0.82	23.40 ms σ=0.58
Virtual machine - Host	-	135.92 Mbps σ=6.77	136.92 Mbps σ=5.37	-	27.13 ms σ=1.31	26.5 ms σ=1.23

Experiment 5

Network performance

Remote traffic (two hosts)

Analysis & Thoughts



Containers

- Lightweight operating system
- Isolated process
- Performances
- Infrastructure Management

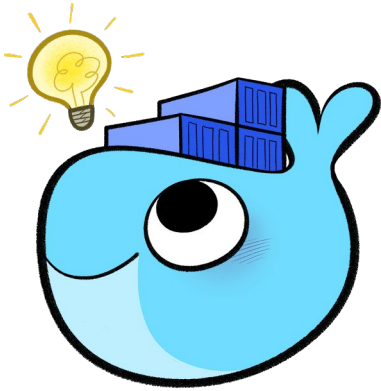
VM

- Manage the infrastructure
- Manage the process
- Deployment time
- Memory consumption

Analysis & Thoughts

RPPC

- Speeds up deployment
- Reduces disruption
- Empowers
- Infrastructure management flexibility
- Ease deployment



THANKS!

Any questions?