



# Serverless: Beyond the Cloud

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# Can we Execute Everything in the Cloud?

- ✓ Sadly, no!
  - ✓ Even in a serverless world, servers exist
  - ✓ Cloud computers are still computers

```
root@worker-node1:~# ping 192.169.49.12
PING 192.169.49.12 (192.169.49.12) 56(84) bytes of data.
--- 192.169.49.12 ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 2016ms
```



# The “Unfrequented” SW

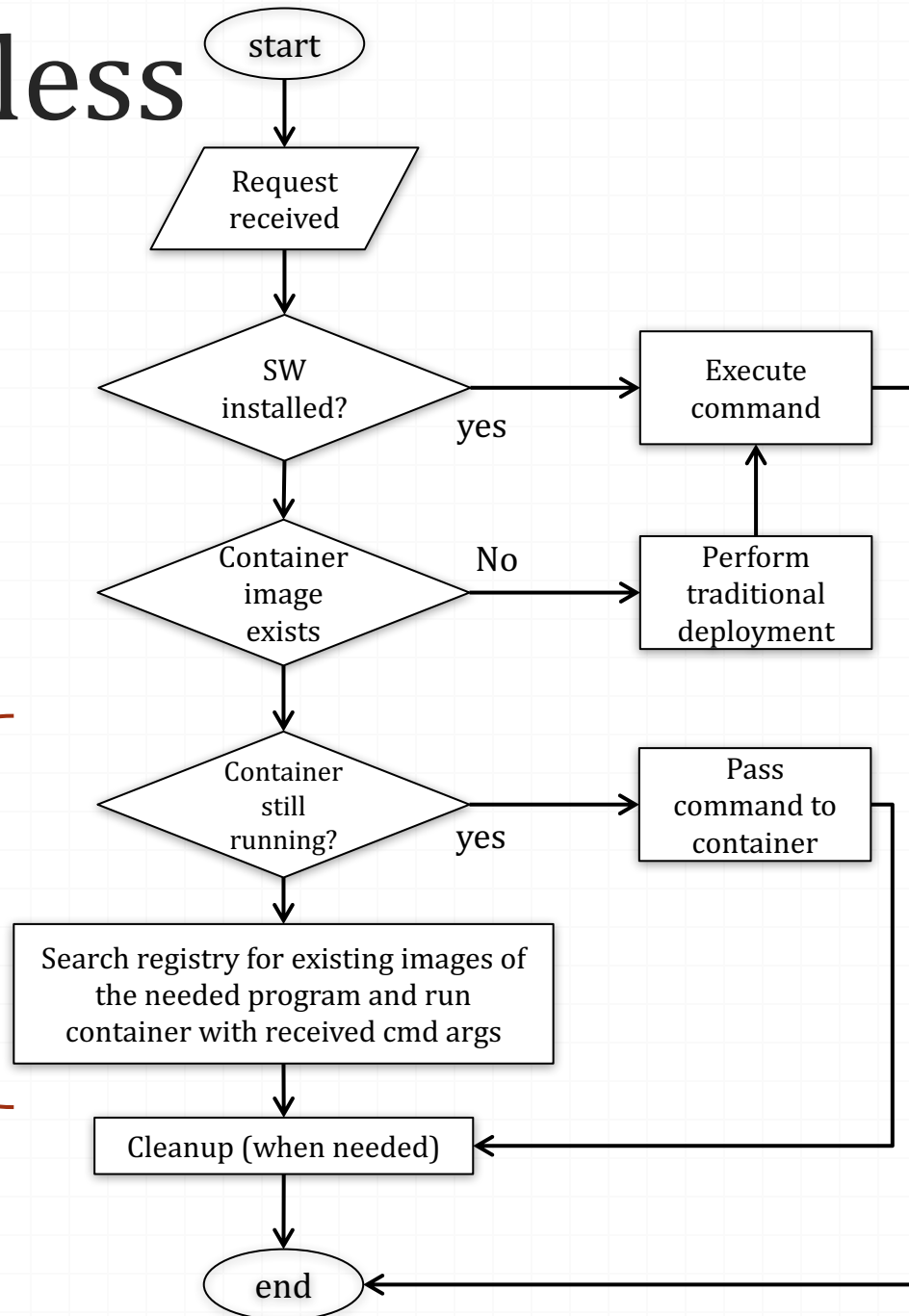
```
root@worker-node1:~# tcpdump -i any
The program 'tcpdump' is currently not installed. You can install it by typing:
apt install tcpdump
```

- ✓ Installation hassle
- ✓ Probably will sit idle for weeks
- ✓ May install unwelcomed dependencies (compromised packages)
- ✓ Will occupy disk space (maybe CPU, Mem, ...)
- ✓ Removal hassle, (may leave residues)

# How About a Different Approach

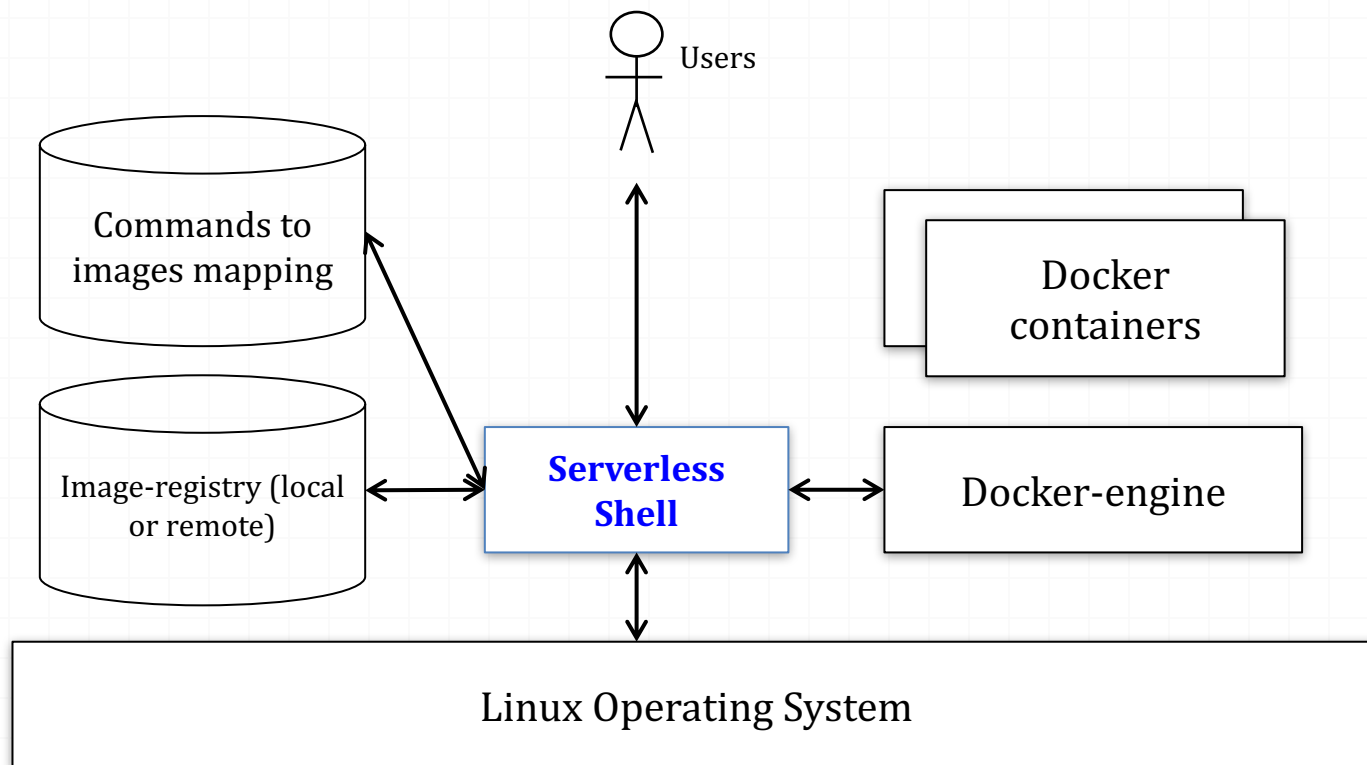
```
Item2 Shell Edit View Session Profiles Toolbelt Window Help 1.root@worker-node1:~ (ssh)
bash bash root@master-nod... root@master-nod... root@master-nod... root@master-nod... root@master-nod... root@master-nod... root@worker-node1...
a3ed95caeb02: Pull complete
97f43c4951ef: Pull complete
Digest: sha256:fb9bb942050388f88bf5b0e2d86aa8a29888f2f43adb8ad25c20cca1e8b62b7f
Status: Downloaded newer image for crccheck/tcpdump:latest
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on any, link-type LINUX_SLL (Linux cooked), capture size 262144 bytes
19:01:35.746772 IP 10.0.2.15.22 > 10.0.2.2.59408: Flags [P.], seq 945658084:945658120, ack 849188847, win 40096, length 36
19:01:35.746947 IP 10.0.2.2.59408 > 10.0.2.15.22: Flags [.], ack 36, win 65535, length 0
19:01:35.842984 IP master-node.6443 > worker-node1.50452: Flags [P.], seq 3117510601:3117511038, ack 94950567, win 1452, options [nop,nop,TS val 71051677 ecr 70996894], len
gth 437
19:01:35.843030 IP worker-node1.50452 > master-node.6443: Flags [.], ack 437, win 1444, options [nop,nop,TS val 70996936 ecr 71051677], length 0
19:01:36.494173 IP master-node.6666 > worker-node1.49682: Flags [.], ack 2970854833, win 411, options [nop,nop,TS val 71051840 ecr 70989579], length 0
19:01:36.494219 IP worker-node1.49682 > master-node.6666: Flags [.], ack 1, win 866, options [nop,nop,TS val 70997099 ecr 71045300], length 0
19:01:36.494236 IP master-node.6666 > worker-node1.49686: Flags [.], ack 2886344453, win 411, options [nop,nop,TS val 71051840 ecr 70989579], length 0
19:01:36.494244 IP worker-node1.49686 > master-node.6666: Flags [.], ack 1, win 866, options [nop,nop,TS val 70997099 ecr 71045300], length 0
19:01:36.745925 IP 10.0.2.15.54360 > 10.0.2.3.53: 31465+ PTR? 2.2.0.10.in-addr.arpa. (39)
19:01:36.775949 IP 10.0.2.3.53 > 10.0.2.15.54360: 31465 NXDomain 0/0/0 (39)
19:01:36.776176 IP 10.0.2.15.51577 > 10.0.2.3.53: 55256+ PTR? 15.2.0.10.in-addr.arpa. (40)
19:01:36.799513 IP 10.0.2.3.53 > 10.0.2.15.51577: 55256 NXDomain 0/0/0 (40)
19:01:36.800217 IP 10.0.2.15.22 > 10.0.2.2.59408: Flags [P.], seq 36:112, ack 1, win 40096, length 76
19:01:36.800402 IP 10.0.2.2.59408 > 10.0.2.15.22: Flags [.], ack 112, win 65535, length 0
19:01:37.684679 IP master-node.6443 > worker-node1.50452: Flags [P.], seq 437:892, ack 1, win 1452, options [nop,nop,TS val 71052137 ecr 70996936], length 455
19:01:37.684723 IP worker-node1.50452 > master-node.6443: Flags [.], ack 892, win 1444, options [nop,nop,TS val 70997396 ecr 71052137], length 0
19:01:37.745851 IP 10.0.2.15.55077 > 10.0.2.3.53: 56339+ PTR? 3.2.0.10.in-addr.arpa. (39)
19:01:37.768284 IP 10.0.2.3.53 > 10.0.2.15.55077: 56339 NXDomain 0/0/0 (39)
19:01:37.768974 IP 10.0.2.15.22 > 10.0.2.2.59408: Flags [P.], seq 112:308, ack 1, win 40096, length 196
19:01:37.769150 IP 10.0.2.2.59408 > 10.0.2.15.22: Flags [.], ack 308, win 65535, length 0
19:01:37.849962 IP master-node.6443 > worker-node1.50452: Flags [P.], seq 892:1329, ack 1, win 1452, options [nop,nop,TS val 71052178 ecr 70997396], length 437
19:01:37.850001 IP worker-node1.50452 > master-node.6443: Flags [.], ack 1329, win 1444, options [nop,nop,TS val 70997438 ecr 71052178], length 0
19:01:38.158372 IP master-node.6666 > worker-node1.49684: Flags [.], ack 816604427, win 252, options [nop,nop,TS val 71052256 ecr 70989995], length 0
19:01:38.158450 IP worker-node1.49684 > master-node.6666: Flags [.], ack 1, win 262, options [nop,nop,TS val 70997515 ecr 71045716], length 0
19:01:38.158477 IP master-node.6666 > worker-node1.49688: Flags [.], ack 2234423053, win 252, options [nop,nop,TS val 71052256 ecr 70989995], length 0
19:01:38.158490 IP worker-node1.49688 > master-node.6666: Flags [.], ack 1, win 262, options [nop,nop,TS val 70997515 ecr 71045716], length 0
19:01:38.158512 IP master-node.6666 > worker-node1.49690: Flags [.], ack 2616732967, win 252, options [nop,nop,TS val 71052256 ecr 70989995], length 0
19:01:38.158520 IP worker-node1.49690 > master-node.6666: Flags [.], ack 1, win 254, options [nop,nop,TS val 70997515 ecr 71045716], length 0
19:01:38.158526 IP master-node.6666 > worker-node1.49692: Flags [.], ack 1523708040, win 252, options [nop,nop,TS val 71052256 ecr 70989995], length 0
19:01:38.158533 IP worker-node1.49692 > master-node.6666: Flags [.], ack 1, win 254, options [nop,nop,TS val 70997515 ecr 71045716], length 0
19:01:38.158539 IP master-node.6666 > worker-node1.49694: Flags [.], ack 2917513576, win 252, options [nop,nop,TS val 71052256 ecr 70989995], length 0
19:01:38.158546 IP worker-node1.49694 > master-node.6666: Flags [.], ack 1, win 254, options [nop,nop,TS val 70997515 ecr 71045716], length 0
19:01:38.158554 IP master-node.6666 > worker-node1.49698: Flags [.], ack 561892556, win 252, options [nop,nop,TS val 71052256 ecr 70989995], length 0
```

# The Serverless Shell

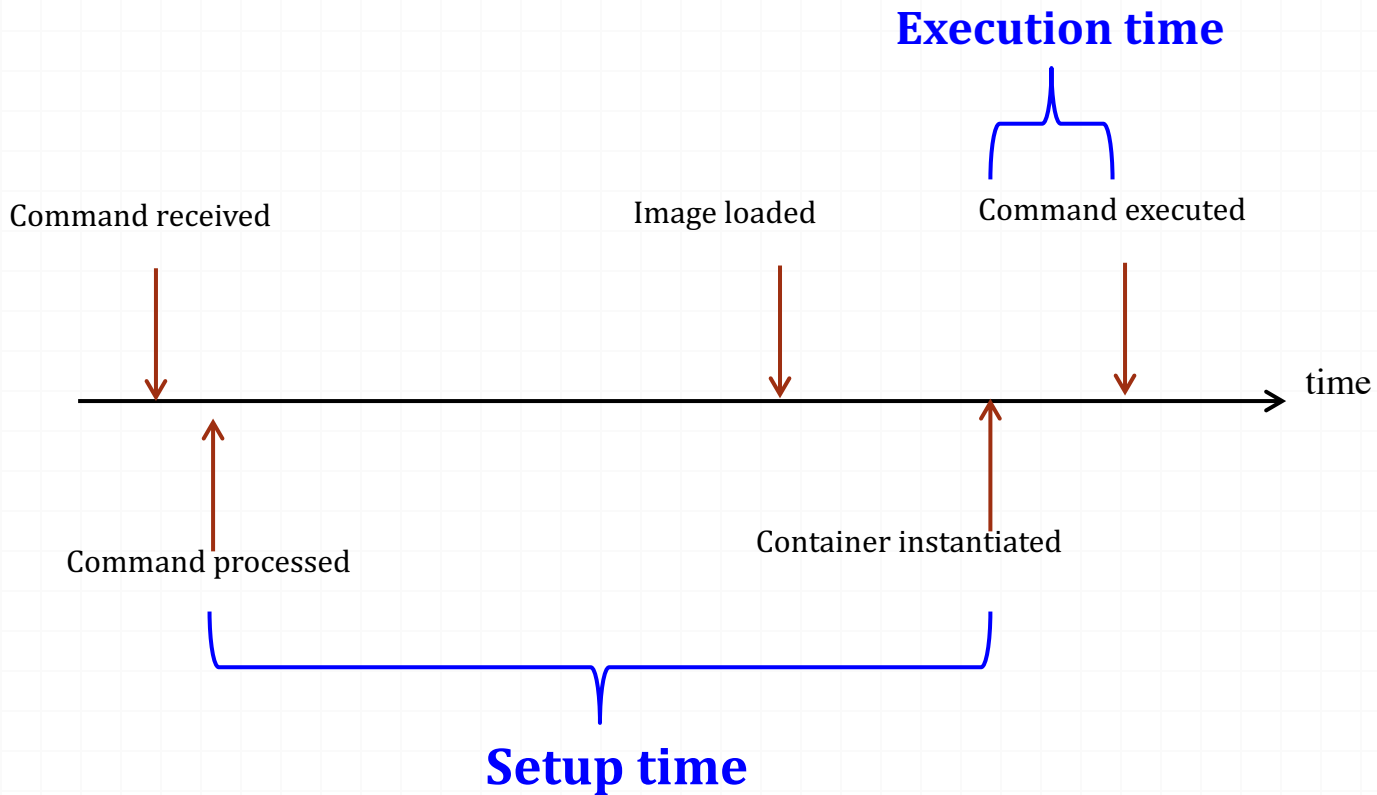


- ✓ Run in Isolation: secure
- ✓ Resource Bounded
- ✓ Automatic upgrades
- ✓ Cross Platform
- ✓ Easy to install
- ✓ Easy to cleanup

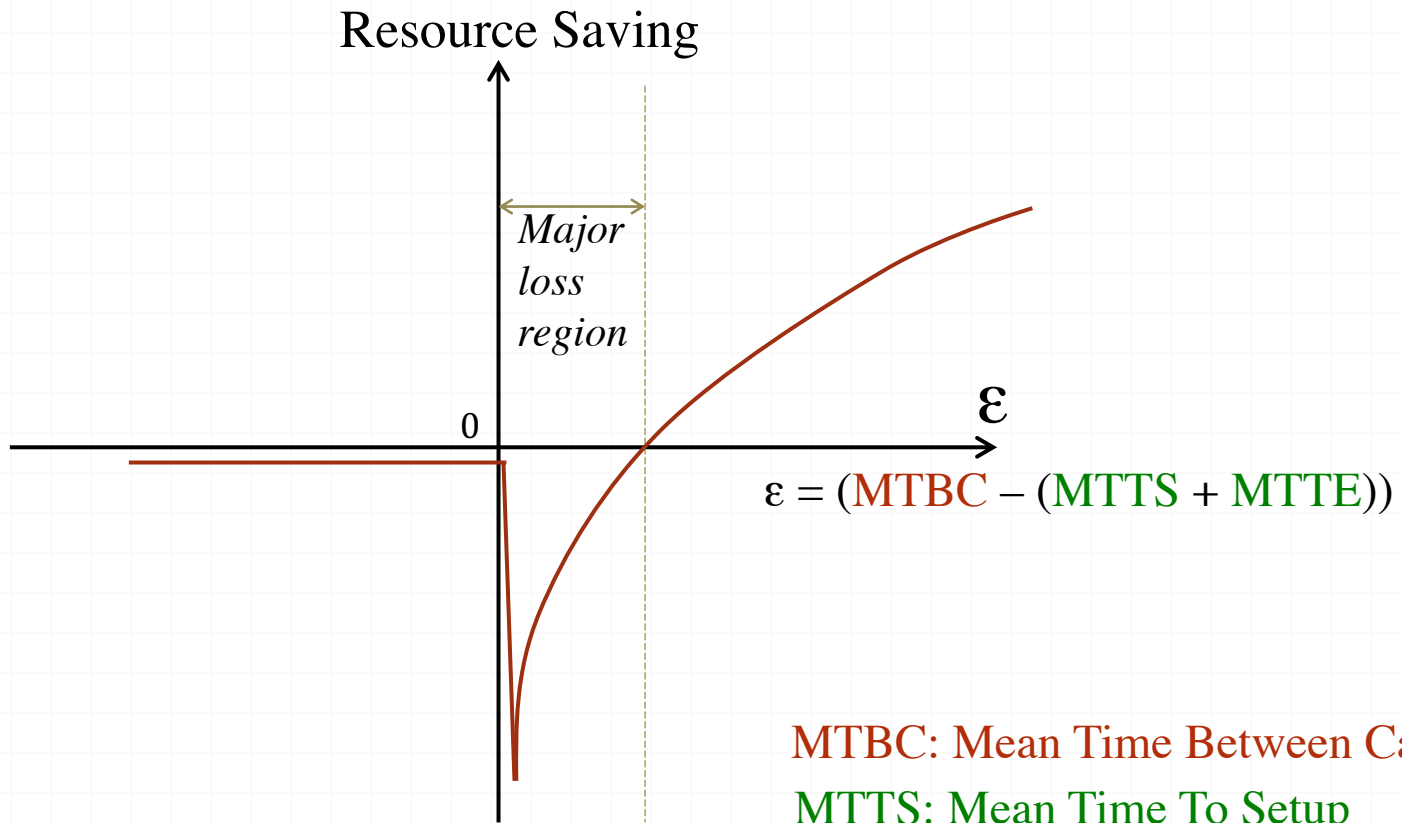
# The Serverless Shell Architecture



# Time Analysis



# Are We Consuming More or Less Resources?



MTBC: Mean Time Between Calls

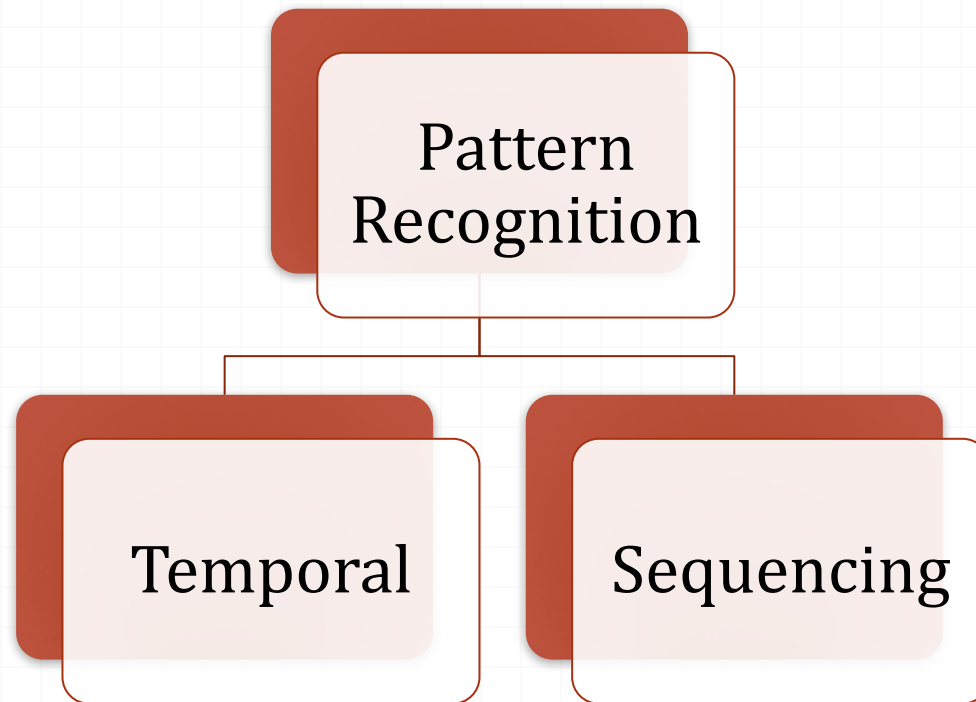
MTTS: Mean Time To Setup

MTTE: Mean Time To Execute



# How Can Optimize?

## Caching!



# Conclusion

- ✓ Serverless does not have to be **just** a Cloud technology
- ✓ It can be a **mindset**, that we can apply on any device or platform

# Questions?

Are we done installing SW??

