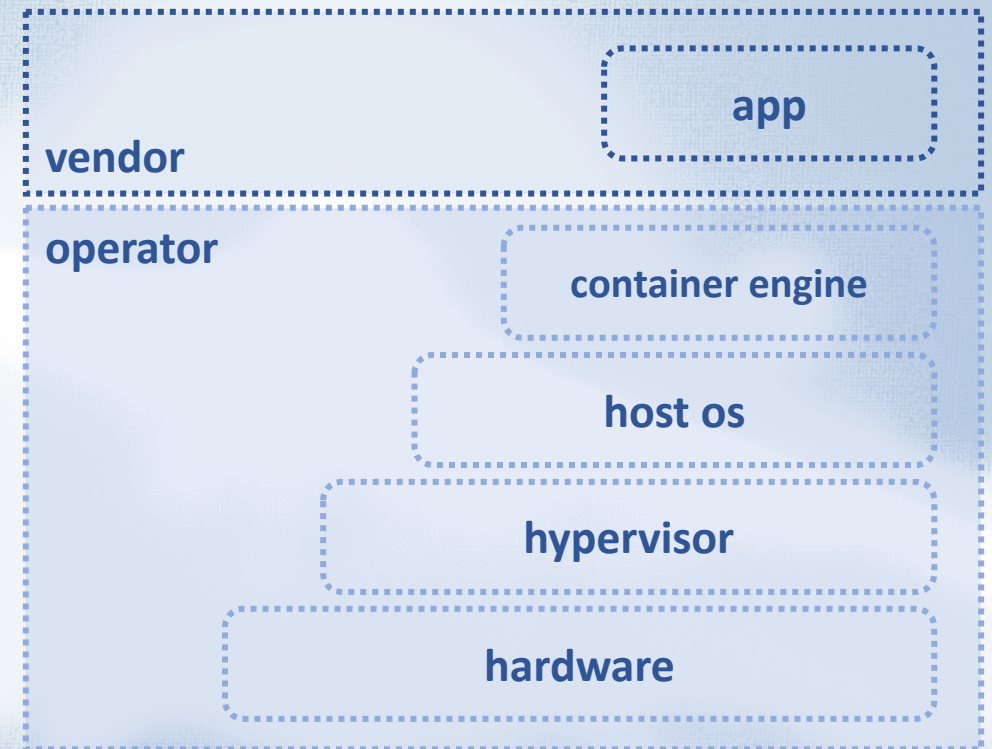
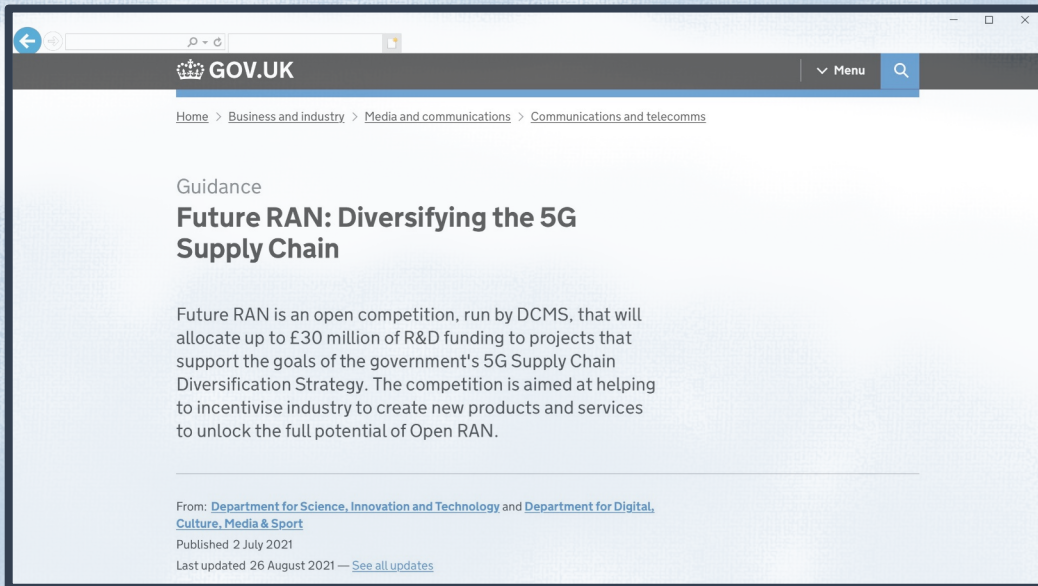


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NES: Towards lifecycle **automation** for **emulation-** **based** experimentation

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Operator Testing



Emulation

```
for switch in switches.values():
    switch["instance"] = net.addSwitch(cls=OVSKernelSwitch, batch=True, failMode="standalone", protocols="OpenFlow13",
**switch["params"])

for host in hosts.values():
    host["instance"] = net.addHost(**host["params"])

for src, dst in switch_links:
    net.addLink(
        switches[src["name"]]["instance"],
        switches[dst["name"]]["instance"],
        port1=src["port"],
        port2=dst["port"],
        bw=src.get("bw", 100),
    )

for src, dst in host_links:
    net.addLink(
        hosts[src["name"]]["instance"],
        switches[dst["name"]]["instance"],
        port2=dst["port"],
        bw=src.get("bw", 100),
    )
```



Mininet



Limitations

- **Heterogeneity:** For testing modern multi-vendor deployments, the environment must support many virtualization technologies and configuration mediums
- **Scale:** Whilst small tests are very useful, some larger scale tests are often required. The emulator must be able to provide the physical resources to the environment for this
- **Lifecycle:** Networks are often not static. Testing might require that a topology change during the test
- **Automagic:** Though command lines or guis might be suitable for network design focused goals, testing can require mediums for autonomous interaction

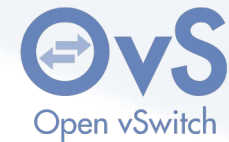
Heterogeneity | plugins



Isolation Tech:
NetNs, Docker, KVM, etc



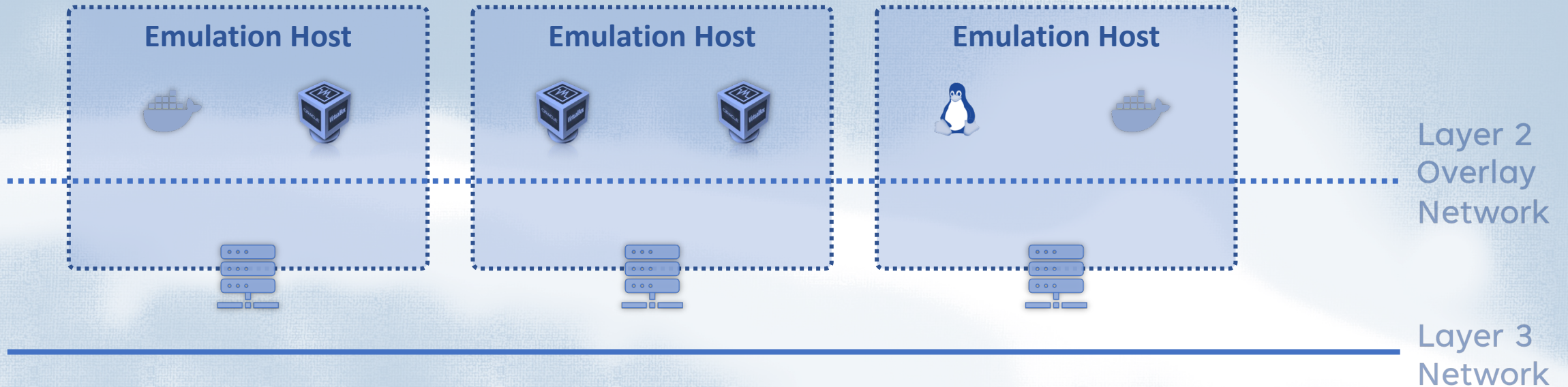
Interaction Medium:
NsExec, DockerExec, Telnet, SSH, etc



Net Config Medium:
Netlink Socket, Netlink CMD SSH, etc



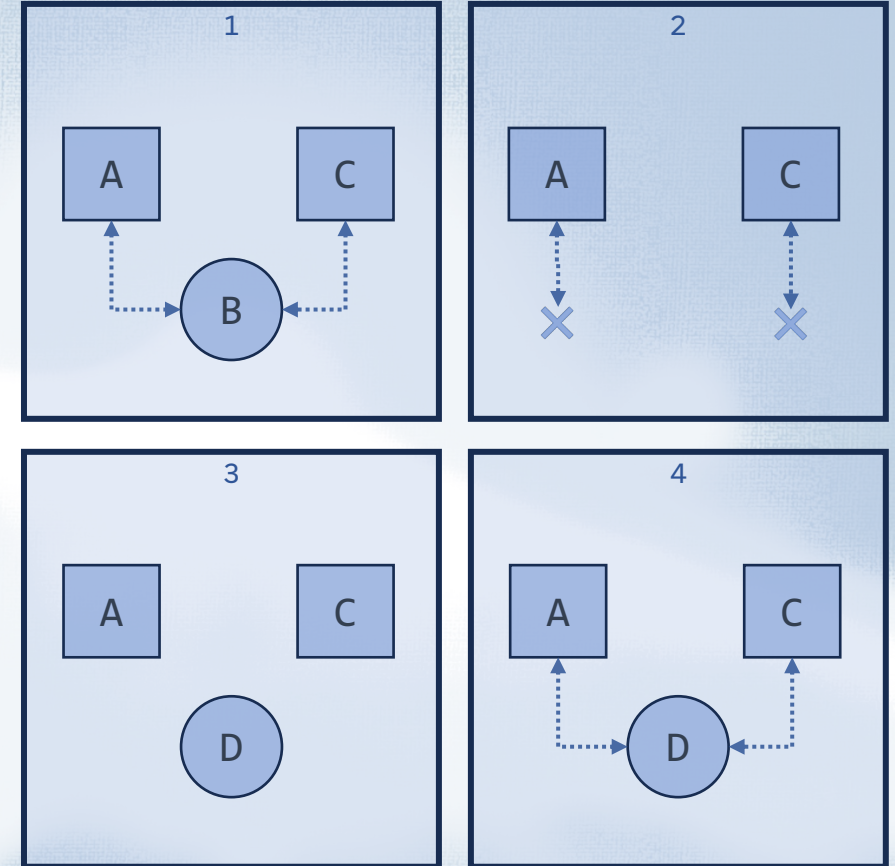
Scale | L2 Overlay



- VXLAN-based overlay network for nodes to connect via
- Enables out-of-the-box multi host emulation environments

Lifecycle | Events

- Making changes to a network carries risk
- Not only must the new configuration be tested, but the transition between topologies
- NES topologies have actions and events, with actions being able to depend on events



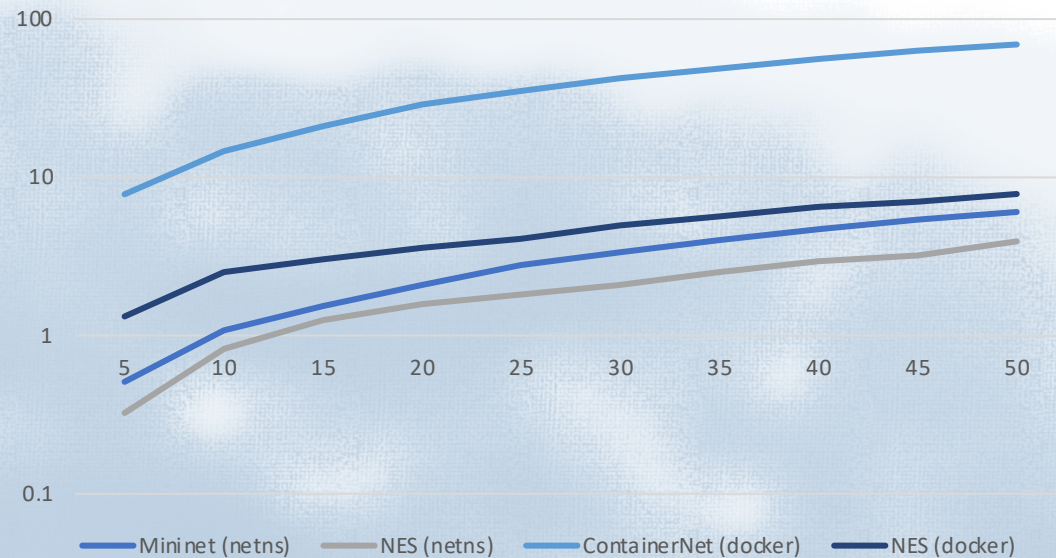
Automation | API & Scripts

- REST and WS APIs to control the emulation environment
- No simple “start” and “stop” topology, the environment is fully mutable
- Template driven scripting framework to define tests and hooks
- Configurable output parser and DSL for automate test evaluation

Bonus

- Event tree and mix of system tools being used enables high levels of parallelization

Time to start star topology with different node types



Time to start topologies of varying sizes with different virtualization techniques

