Why You're Not Running More System Experiments
(And What You Can Do About It)
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Agenda

• Why system experiments?
• What stands in the way?
• Demo
• Building a foundation with open models
Why system experiments?

- Scaling-out with generic compute can’t keep up with demand
- Cannot ignore 2x-10x gain from application-tailored design
- Need meaningful benchmarks and a lot of measurements

Amin Vahdat - SIGCOMM Lifetime Achievement Award 2020 Keynote
Example: ML Job – Model Training

Job Completion Time Factors
• Data Ingestion
• Computation
• Collective Communications

Network matters!
• Median vs Tail latency

Contributors
• TCP Stack | Comm Library
• DPU (NIC)
• Data Center Fabric
• …

OPEN POSSIBILITIES.
Why are you not experimenting enough?

Re-running a real job
• **Complicated** tooling
• **Expensive** clusters
• **Uncontrollable** variations

Need **tools** for experimentation
1. Reproduce job communications
2. Emulate fabric on OCP switch
3. Introduce controllable chaos

And **standardized API**
Tools that we built – Keysight DISE

Tools we are going to use in the demo
• Data Flow Emulator software
• Fabric Emulator NOS
• Chaos module inside fabric
• Jupyter notebook

4 compute nodes, 4x100GE NICs / node

OCP spec white box switch
1. Run Experiments
   for fabric in FABRIC_SETTINGS:
     configure_fabric(fabric)
   
   # ex: buffer size
   for impairment in IMPAIRMENT_SETTINGS:
     apply_impairments(impairment)
   
   # ex: background traffic
   for workload in WORKLOAD_SETTINGS:
     run_workload(workload)

2. Data Mining
   # Create Heatmap JCT by Fabric and TCP settings
   load_all_results()
   create_jct_heatmaps()

**Networking**

**Data Ingestion**

**Compute**

**All Reduce**

- Bursty traffic 25/15/5/0% line rate
- 1 GB per flow
- 240 GB transferred each AllReduce
- 240 flows
- 1 second
- Job Completion Time
We built tools, but...

...what if you want to...

• enhance the tools for new scenarios?
• share your experiments with others?
• collaborate with your users?
• run on a different platform?
• take your experiments into the data center?
Engineers unite!

- Let's make this OPEN
- Let’s make this easy!
Declarative models, lean APIs

OpenAPI Models & API

APIs

Models

Ex: set_flows()

Example:

"dataflow": {
  "steps": [
    { "name": "digest", "mesh": "full", "hosts": ... },
    { "name": "compute", ... },
  ]
}
Independent models

- Model: Fabric
- Model: Chaos, Impair
- Model: Data Flow

Network models with DPU 1 and DPU 2 connections.

Job Completion Time

OPEN POSSIBILITIES.
Demo example config

```python
hosts = [  
    { "name": "n1", "address": "1.1.1.1", "tor": 1 },  
    { "name": "n2", "address": "1.1.2.1", "tor": 2 }, ...
]  
dataflow = {  
    "dataflow": {  
        "steps": [  
            { "name": "digest", "mesh": "full", "hosts": hosts },  
            { "name": "compute", "delay": 1 }, ...
        ],  
        "tcp": {  
            "congestionAlgorithm": "dctcp"
        }
    }
}
fabric_config = {  
    "topology": {  
        "spine": {  
            "count": 1
        },  
        "pod": {  
            "count": 2,  
            ...
        }
    }
}
chaos_config = {  
    "loss": {  
        "link": "Link S.1/1",  
        "type": "PERCENTAGE",  
        "percentage": 1
    }, ...
}
```

Data Flow Emulator software
On 4 compute nodes, 4x100GE NICs / node

Fabric Emulator
OCP spec white box switch
Coexisting implementations

Open source, vendor-agnostic API, Rich tooling support

OpenAPI Models & API

Same script works with any implementation

Vendor-specific implementations

model data
SDK
REST

SIMULATION
EMULATION
TEST PODS

OPEN POSSIBILITIES.
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Talks we learned from:
Bringing the F16 Network into the Lab, OCP Summit 2020
SIGCOMM Lifetime Achievement Award 2020 Keynote
One last thing...

JOIN THE TEAM
We're hiring!

Find us at booth C33
Call to action

Engineers unite!
- Let's build good open models
- Contribute your use cases & expand the models
- Compare experimental results in different environments
- As we get traction, form a Sub-Project on the model specs

Where to learn more
- Open Network Experiments
  https://github.com/open-network-experiments
Open Discussion