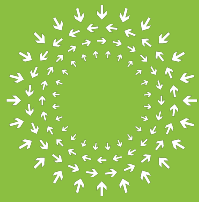


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Simulation/Emulation Platform

A novel approach for experiments from lab testing to large
data center simulations

Connect. Collaborate. Accelerate.



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Simulation/Emulation Platform

Jay Vargas

Principal Software Engineer, Scala Computing

Dan Mihailescu

System Architect, Keysight

Connect. Collaborate. Accelerate.

Definitions

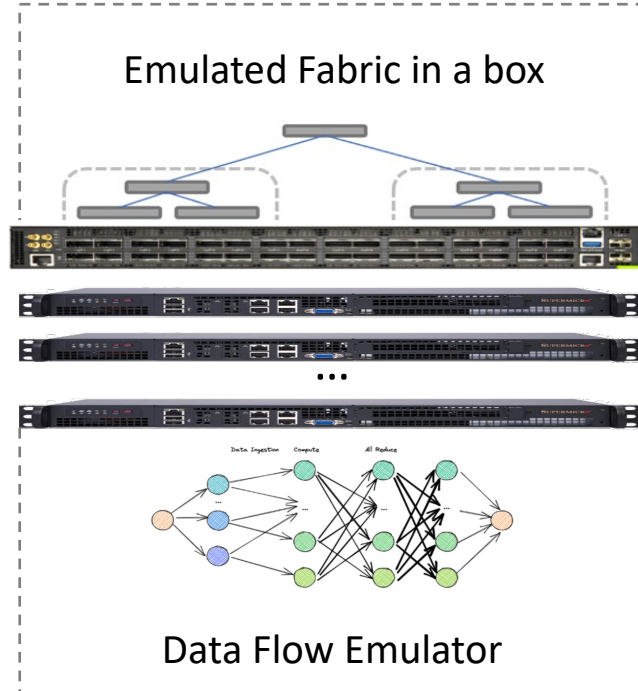
Actual data center

- Runs actual apps and services



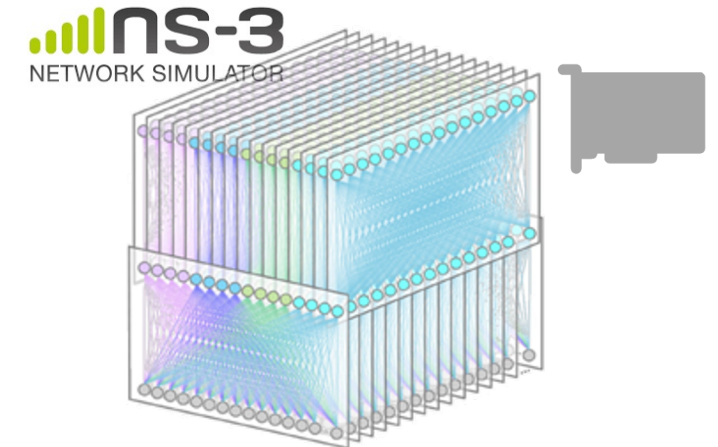
Emulation

- Compressed fabric, running on actual switch ASIC
- Realistic workloads on the wire, not actuals apps



Simulation

- Discrete event simulator
- Realistic workloads simulated at DC scale



Why Simulation / Emulation?

1

Emulate small then simulate large

- Large scale networks are not practical to build until deployment - Hyperscalers/Cloud

2

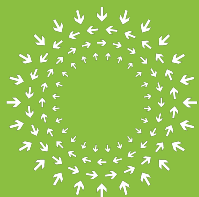
Emulate today's devices then simulate next generation

- Especially for links speed and device capacities not available yet

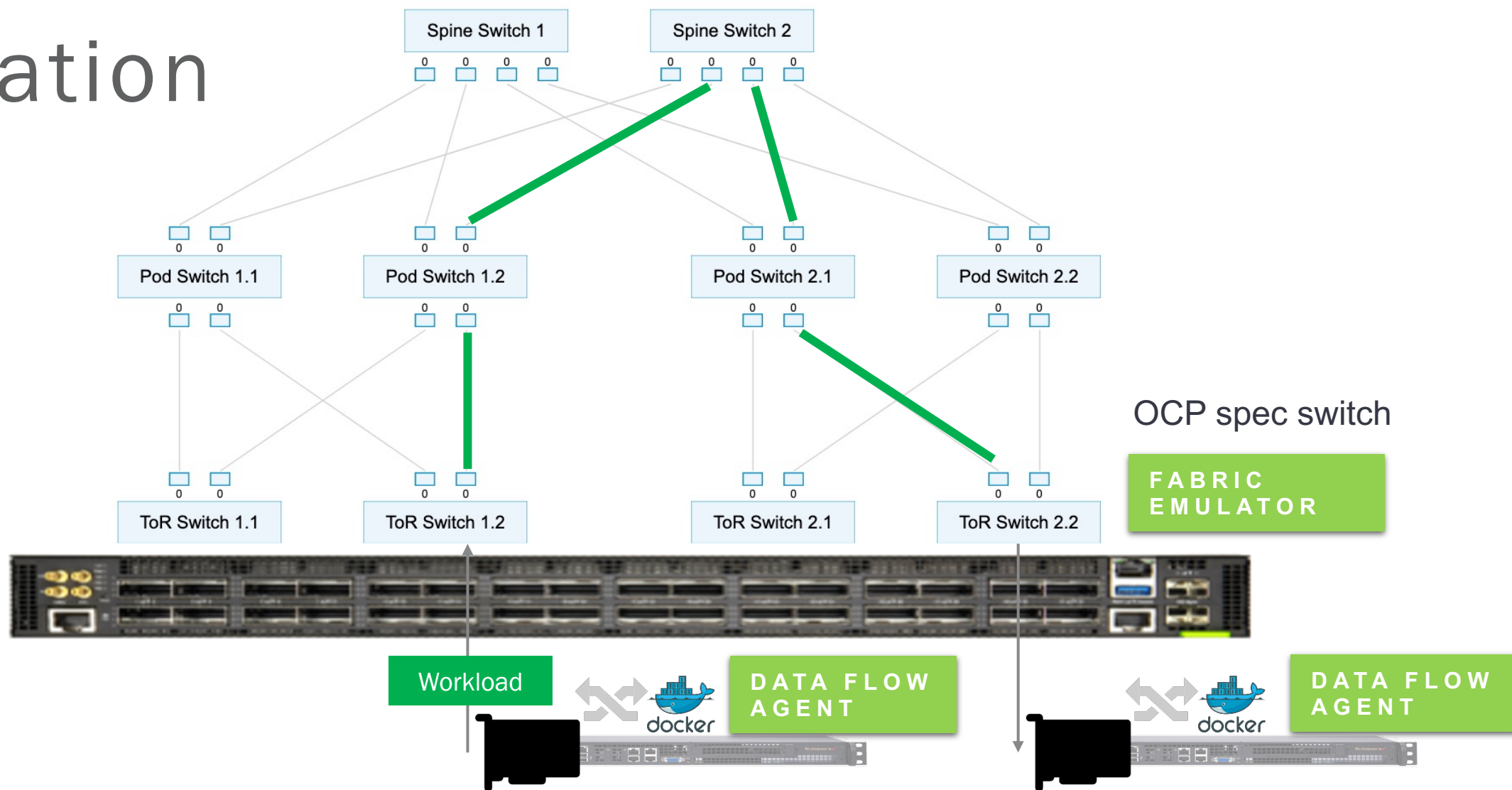
3

Emulate anomaly then simulate it

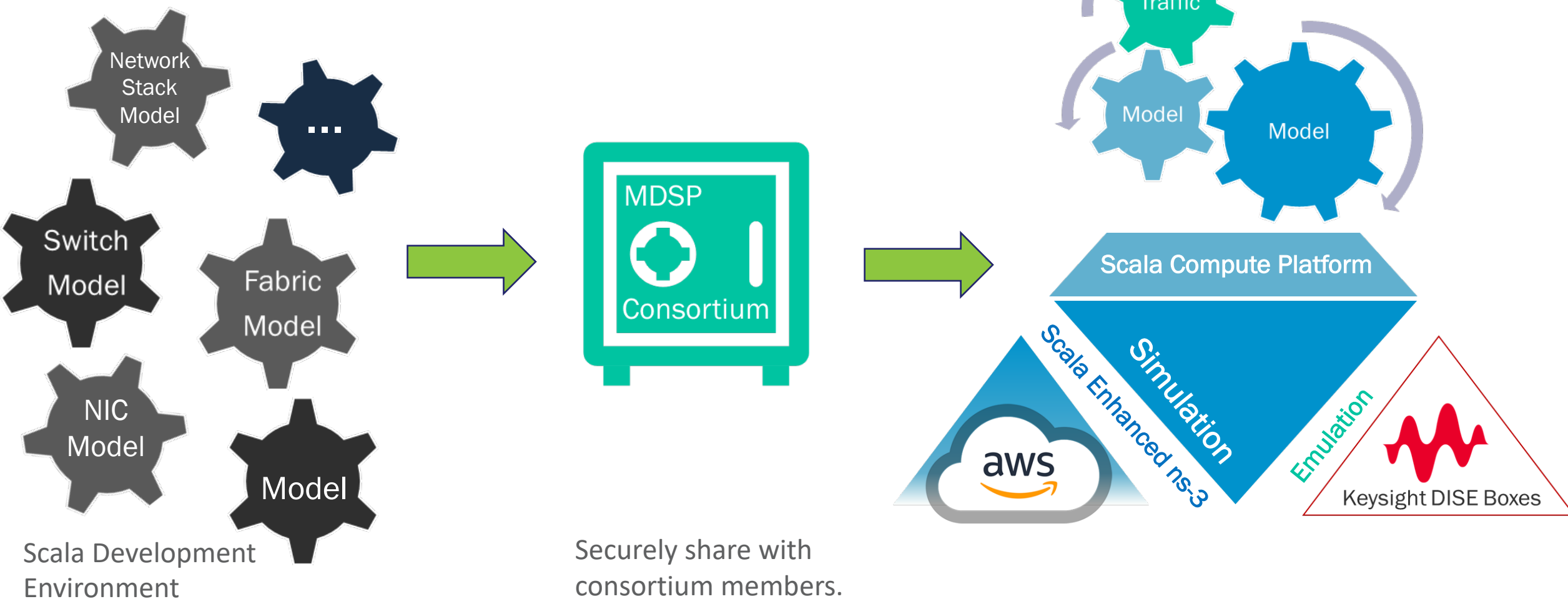
- Exploit the ease of instrumentation of simulations where the engineer has unlimited observability to root cause production network anomalies



Emulation



Simulation Platform

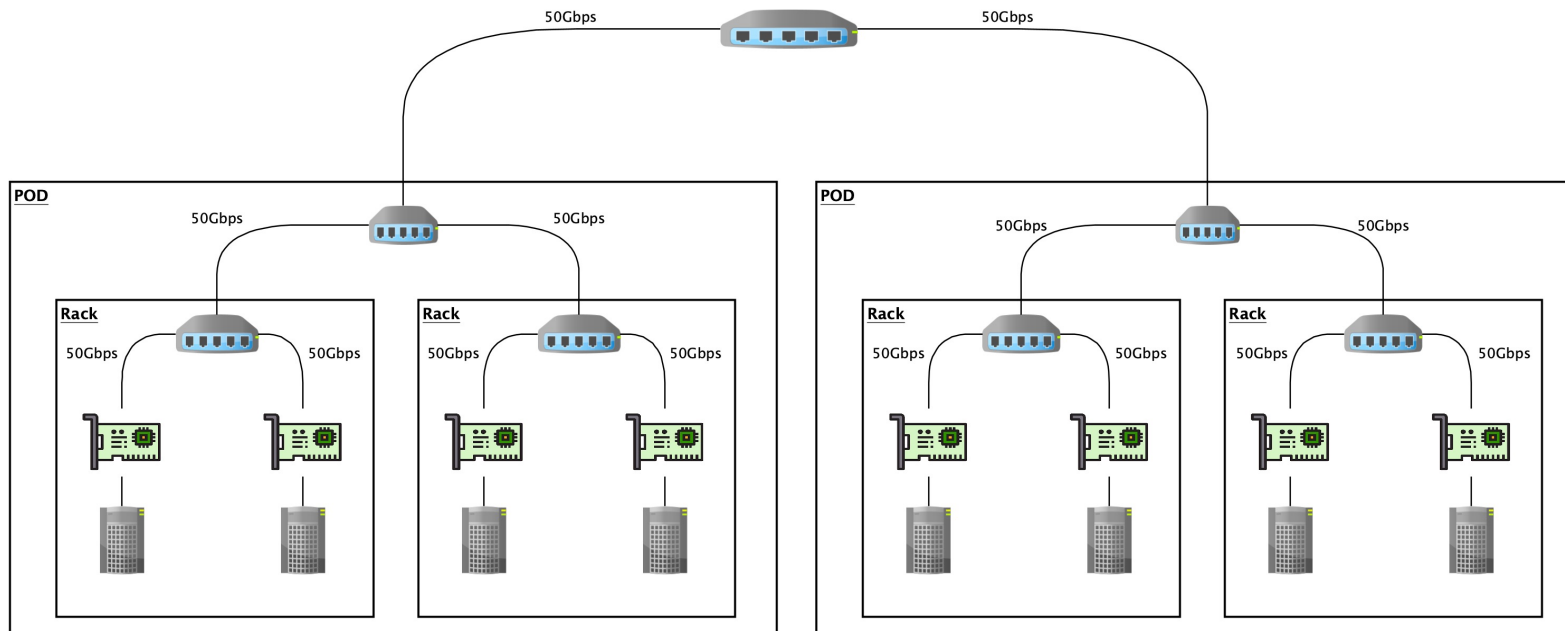


Digital Twins

- A virtual representation of a physical system
 - Allow testing and validation before the system exists
- Updated from real data
 - Simulation/emulation calibration: a steppingstone towards real digital twin
- Uses simulation and reasoning to make decisions
 - Fabric: Switches, NICs, Topology
 - Data Flow: OS, Network App Stack

Demo Setup

Topology Tested



Traffic Pattern: All to All TCP 250MB Request Size

Test Cases

1. Emulated (executed on Keysight DISE)
2. Simulation with idealized host
3. Flow Fairness Queue Disc enabled with NIH enabled
4. Disable CWnd Limited by Bytes in Flight feature

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https://keysightsg.scalacomputing.com/projects/NS3-Fidelity-Demo/simulations

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Job History

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Name	Cluster	Status	Type	Created On	Duration
demo-run-setup-03-08-2022	Testing New DISE	TERMINATED	simulation	3/8/2022	
1spn-2pods-2-fsw-4r-8n-250MB-100Gbps-32MB-gsb-2uplink-500kb-tcp-wlb-run1-emulation-...	EmulationProcessor	COMPLETED	emulation	3/7/2022	
1spn-2pods-2-fsw-4r-8n-250MB-100Gbps-32MB-gsb-2uplink-500kb-tcp-wlb-run1-02-09-2022	default	COMPLETED	simulation	3/7/2022	1:57:22
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-2uplink-500kb-tcp-wlb-run1-emulation-0...	EmulationProcessor	COMPLETED	emulation	3/7/2022	
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-2uplink-500kb-tcp-wlb-run1-02-09-2022	default	COMPLETED	simulation	3/7/2022	1:52:36
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-wlb-run1-emulation-0...	EmulationProcessor	COMPLETED	emulation	3/7/2022	
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-wlb-run1-02-09-2022	default	COMPLETED	simulation	3/7/2022	1:49:50
1-fsw-2r-8n-250MB-100Gbps-32MB-gsb-emulation-500KB-003-02-08-2022	EmulationProcessor	COMPLETED	emulation	3/7/2022	
1-fsw-2r-8n-250MB-100Gbps-32MB-gsb-2uplink-500kb-tcp-001-02-10-2022	default	COMPLETED	simulation	3/7/2022	1:45:51
1-fsw-2r-8n-250MB-100Gbps-32MB-gsb-1uplink-500kb-tcp-emulation-002-02-09-2022	EmulationProcessor	COMPLETED	emulation	3/7/2022	
1-fsw-2r-8n-250MB-100Gbps-32MB-gsb-1uplink-500kb-tcp-02-09-2022	default	COMPLETED	simulation	3/7/2022	1:46:52
1-fsw-2r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-emulation-02-09-2022	EmulationProcessor	COMPLETED	emulation	3/7/2022	
1-fsw-2r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-rerun-WLBased-02-09-2022	default	COMPLETED	simulation	3/7/2022	1:38:31

Archived

Search

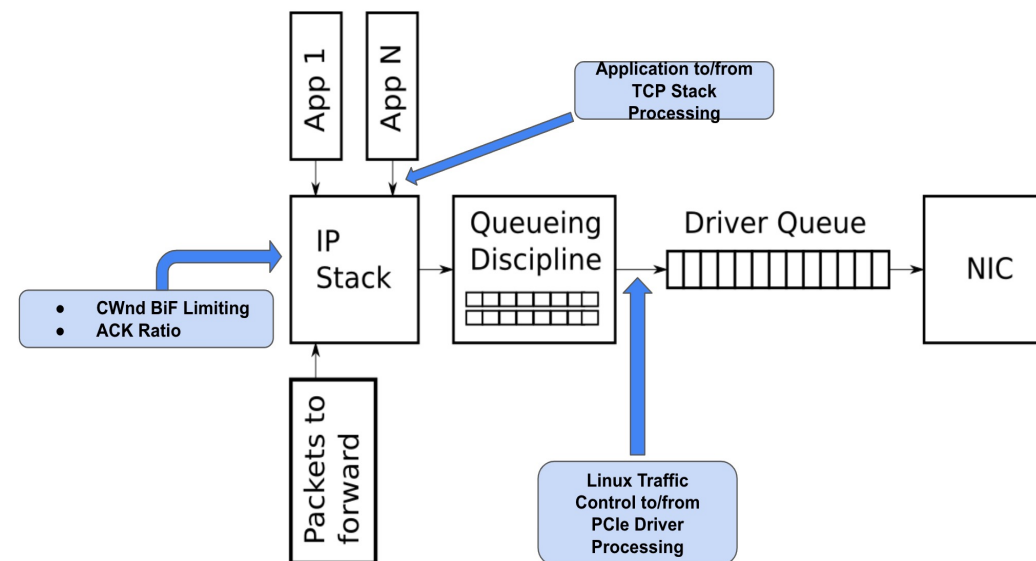
Fidelity

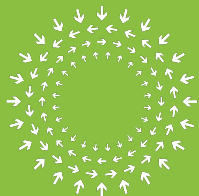
Goal

- Match simulation and emulation results
 - < 10% delta
 - Flow completion times
 - # bytes & packets on each link and port
 - Initial target was to match in ideal conditions

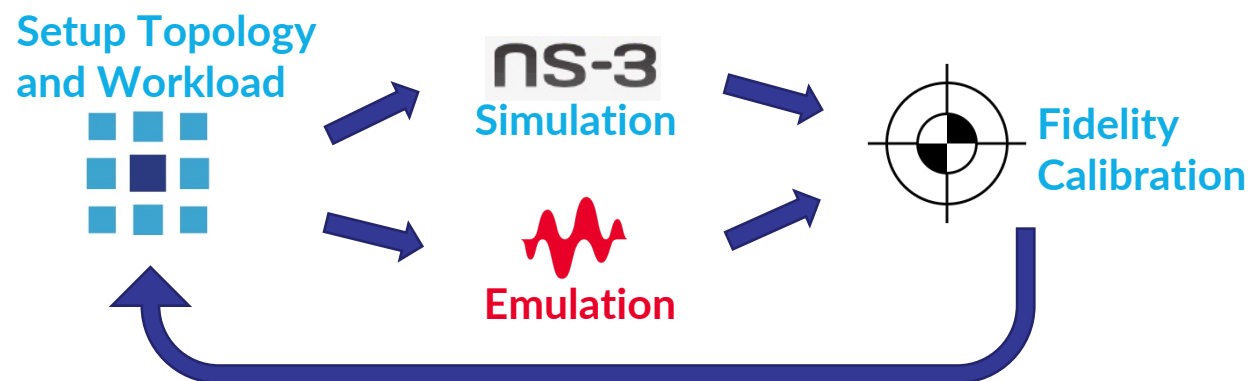
Tuning

- Used to establish base fidelity between emulated system and simulation
- No Drops
- Model of Flow Fairness Traffic Control on the hosts
- Limit CWnd by Bytes in Flight
 - TCP increases CWnd enough to cover bytes in flight (RFC 2861)
- Non-Ideal host behaviors



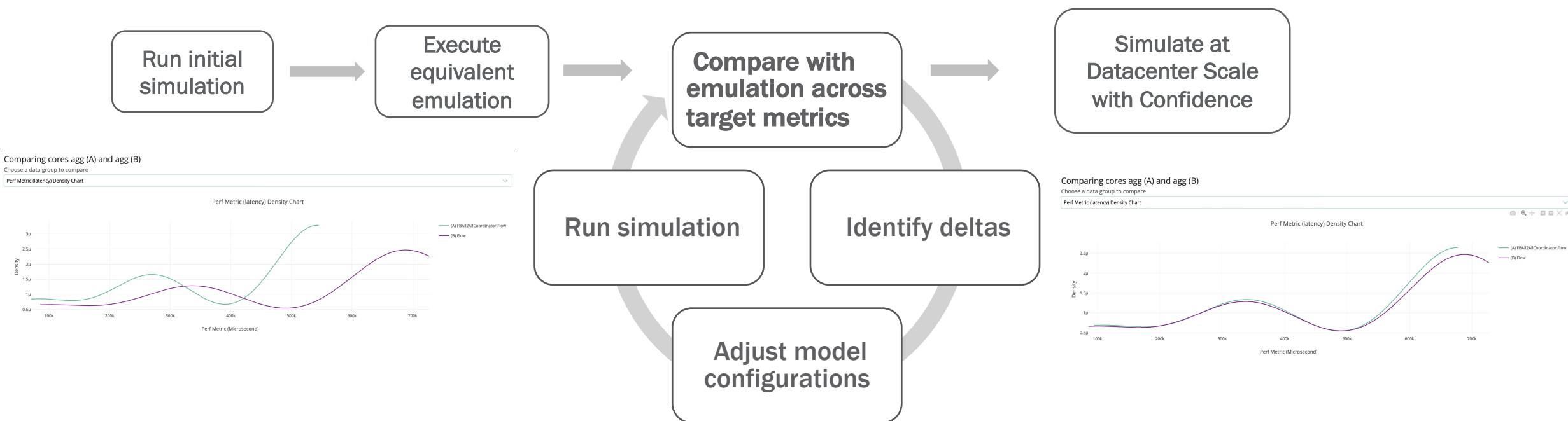


Calibration Findings



- Linux RX path (kernel/user context)
- TCP ACK behavior
- CWND relation to bytes in flight
- Qdisc fair queueing

Successful Calibration



demo video of platform operation

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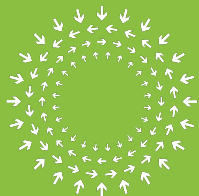
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Name	Cluster	Status	Type	Tags	Created On	Duration
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-wlb-nih-high-...	fidelity-cluster-1	COMPLETED	simulation	+	4/25/2022	45:12
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-wlb-nih-rxtx-...	default	COMPLETED	simulation	+	4/25/2022	1:53:53
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-2uplink-500kb-tcp-nih-high-app...	default	COMPLETED	simulation	+	4/24/2022	1:54:41
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-wlb-qd-highe...	fidelity-cluster-1	COMPLETED	simulation	+	4/24/2022	1:48:28
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-wlb-qd-highe...	default	COMPLETED	simulation	+	4/24/2022	1:52:57
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-wlb-qd-highe...	fidelity-cluster-1	COMPLETED	simulation	+	4/24/2022	1:50:42
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-wlb-run1-no-...	default	COMPLETED	simulation	+	4/24/2022	1:37:41
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-2uplink-500kb-tcp-wlb-run1-no-...	default	COMPLETED	simulation	+	4/21/2022	1:36:53
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-2uplink-500kb-tcp-wlb-run1-nih...	default	COMPLETED	simulation	+	4/20/2022	1:56:10
1-fsw-2r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-rerun-WLBased-no-qd-02...	default	COMPLETED	simulation	+	4/11/2022	1:30:45
1spn-2pods-2-fsw-4r-8n-250MB-100Gbps-32MB-gsb-2uplink-500kb-tcp-wlb-run1-e...	EmulationProcessor	COMPLETED	emulation	+	3/7/2022	
1spn-2pods-2-fsw-4r-8n-250MB-100Gbps-32MB-gsb-2uplink-500kb-tcp-wlb-run1-0...	default	COMPLETED	simulation	+	3/7/2022	1:57:22
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-2uplink-500kb-tcp-wlb-run1-em...	EmulationProcessor	COMPLETED	emulation	+	3/7/2022	
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-2uplink-500kb-tcp-wlb-run1-02...	default	COMPLETED	simulation	+	3/7/2022	1:52:36
1spn-2pods-2-fsw-4r-8n-250MB-50Gbps-32MB-gsb-1uplink-500kb-tcp-wlb-run1-em...	EmulationProcessor	COMPLETED	emulation	+	3/7/2022	



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Extended Demo



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