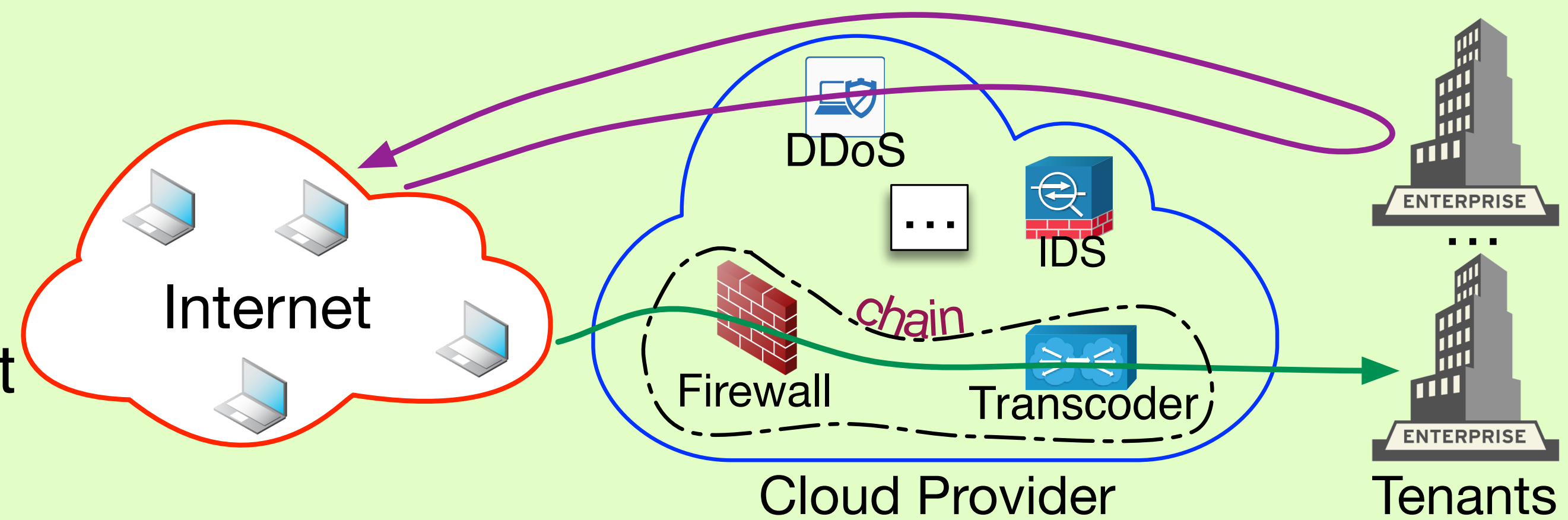


VNF Chain Abstraction for Cloud Service Providers

Tenant and cloud provider needs

- Tenants: **elastic** VNF chains with **SLA guarantees**
- Cloud providers: **scalable + high utilization** VNF chain deployment

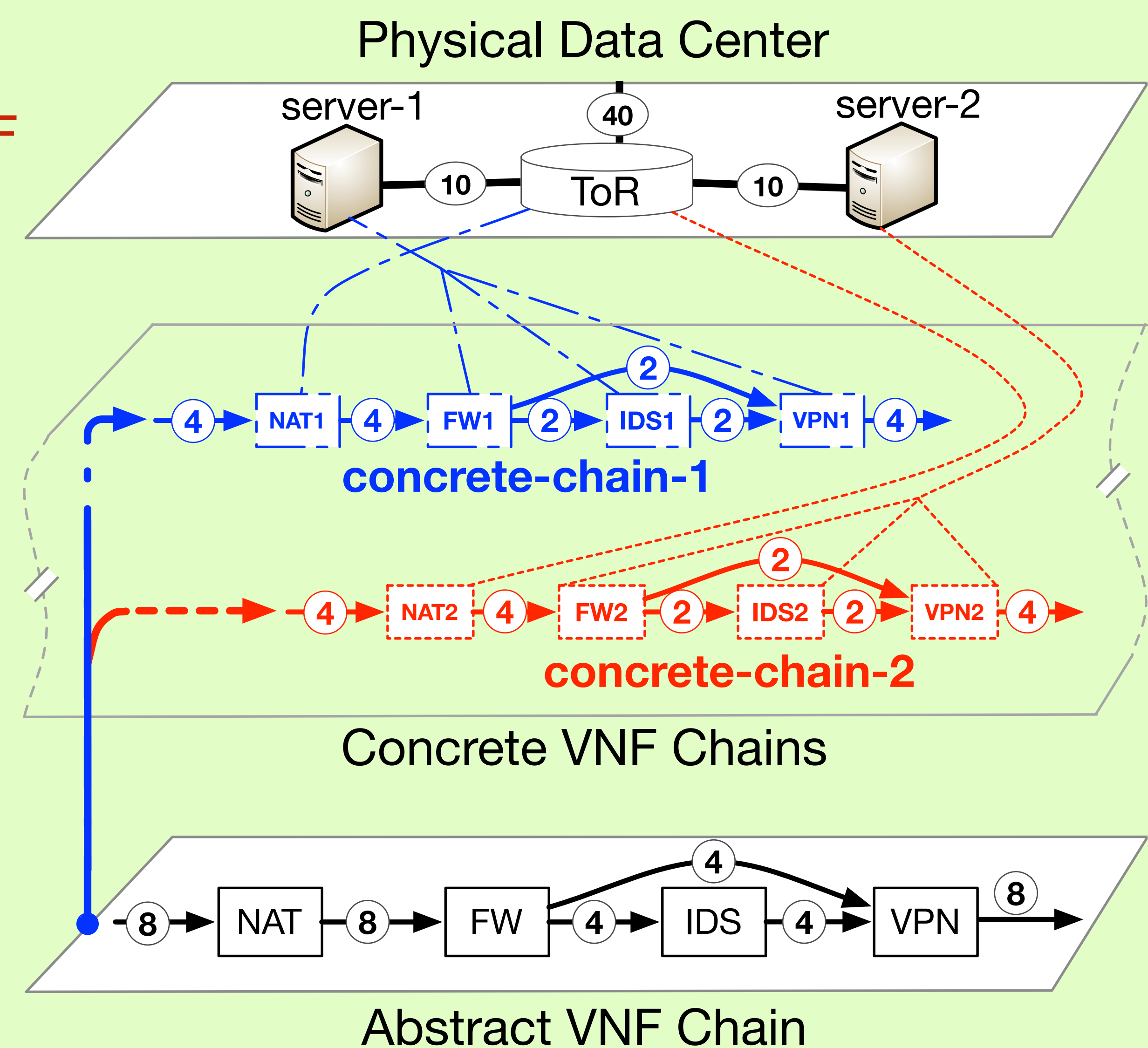


Prior work: elasticity at different granularities

- APLOMB [1], E2 [2], OpenBox [3] scale up/down an **individual VNF**
- Flurries [4] operates at **flow-level**: separate chain per flow
- We provide a middle ground between these approaches: flexible flow-processing with low-overhead

Our approach: abstract-concrete chains

- **Decouple** tenant's view of the VNF chain (abstract) from cloud provider's implementation (concrete)
- Decoupling granularity is **dynamically** set by the provider
- Fine-grained chains enable aggregation across physical resources and increases data center **utilization**



Challenges

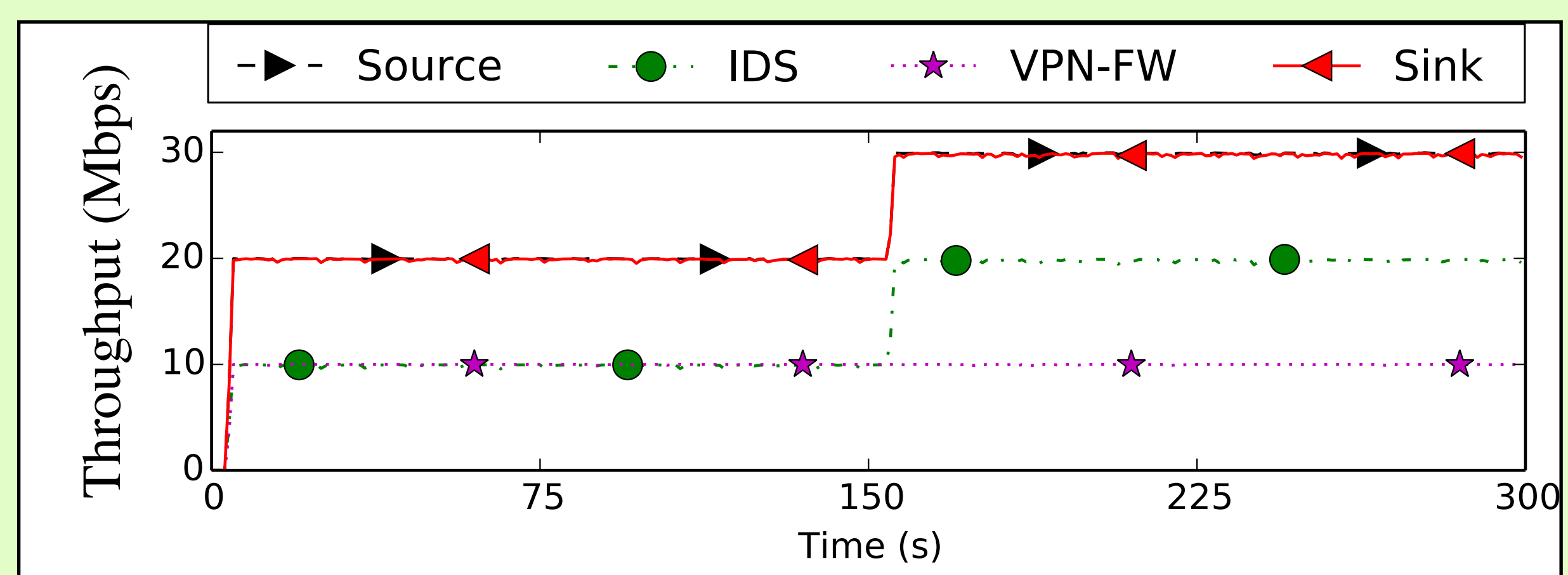
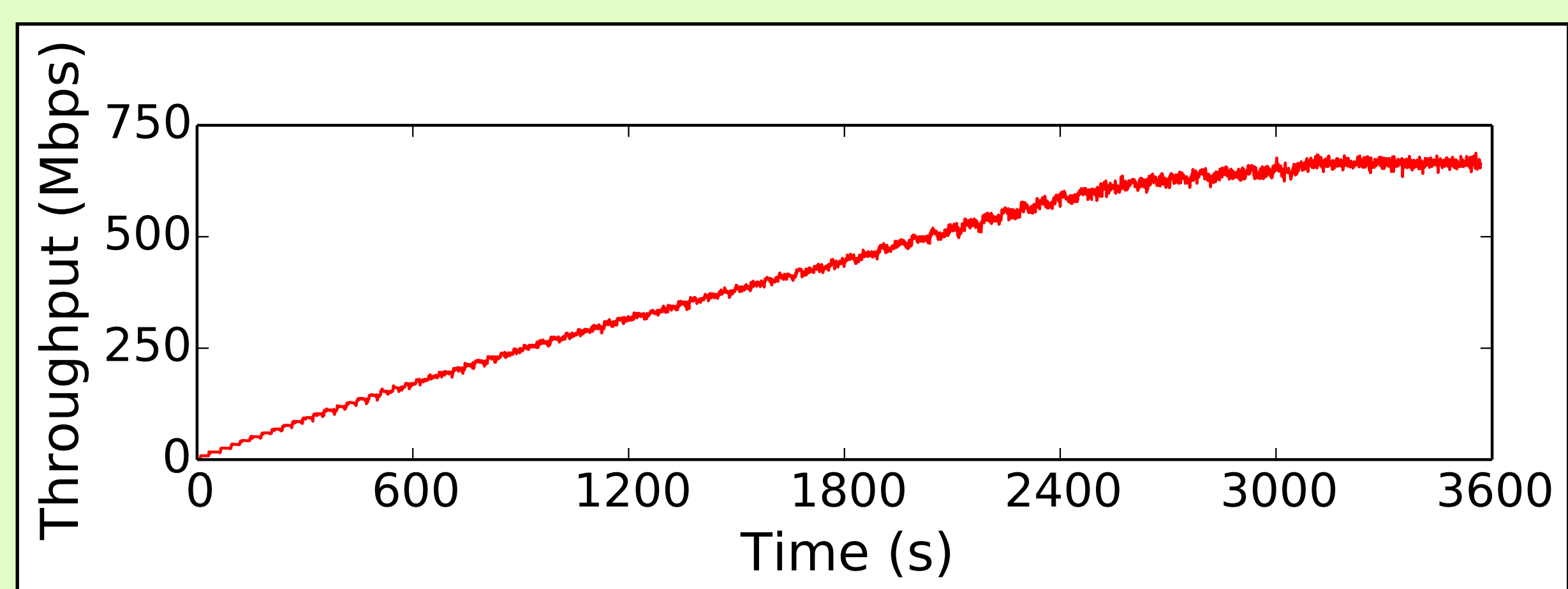
- State synchronization btw. concrete chains
- Low latency across concrete chains
- Handling packet-loss during scale down
- Efficiency loss due to 1-n chain replication

Prototype

- Built **Daisy** [5] on Sonata framework [6]
- Uses Mininet, OVS, and Docker
- Run Daisy on an Azure VM with 64 cores and 432 GB RAM
- **Emulated** rack-scale DC with 40-server

Preliminary results

- ✓ An abstract chain is decoupled into **75 concrete** chains
- ✓ **10 Mbps traffic** is pushed through each concrete chain
- ✓ In aggregate, 75 concrete chains achieve **full DC utilization**



- ✓ Performed **chain scale-out** with no packet drops
- ✓ Also completed node-upgrade with under 1s packet drop [5]

[1] Sherry et al., Making Middleboxes Someone Else's Problem: Network Processing as a Cloud Service, SIGCOMM'12
 [2] Palkar et al., E2: A Framework for NFV Applications, SOSP'15
 [3] Bremler-Barr et al., OpenBox: A Software-Defined Framework for Developing, Deploying, and Managing Network Functions, SIGCOMM'16
 [4] Zhang et al., Flurries: Countless Fine-Grained NFs for Flexible Per-Flow Customization, CoNEXT'16
 [5] Kodirov et al., VNF Chain Allocation and Management at Data Center Scale, ANCS'18
 [6] Peuster et al., Sonata NFV SDK, github.com/sonata-nfv/son-emu, 2017