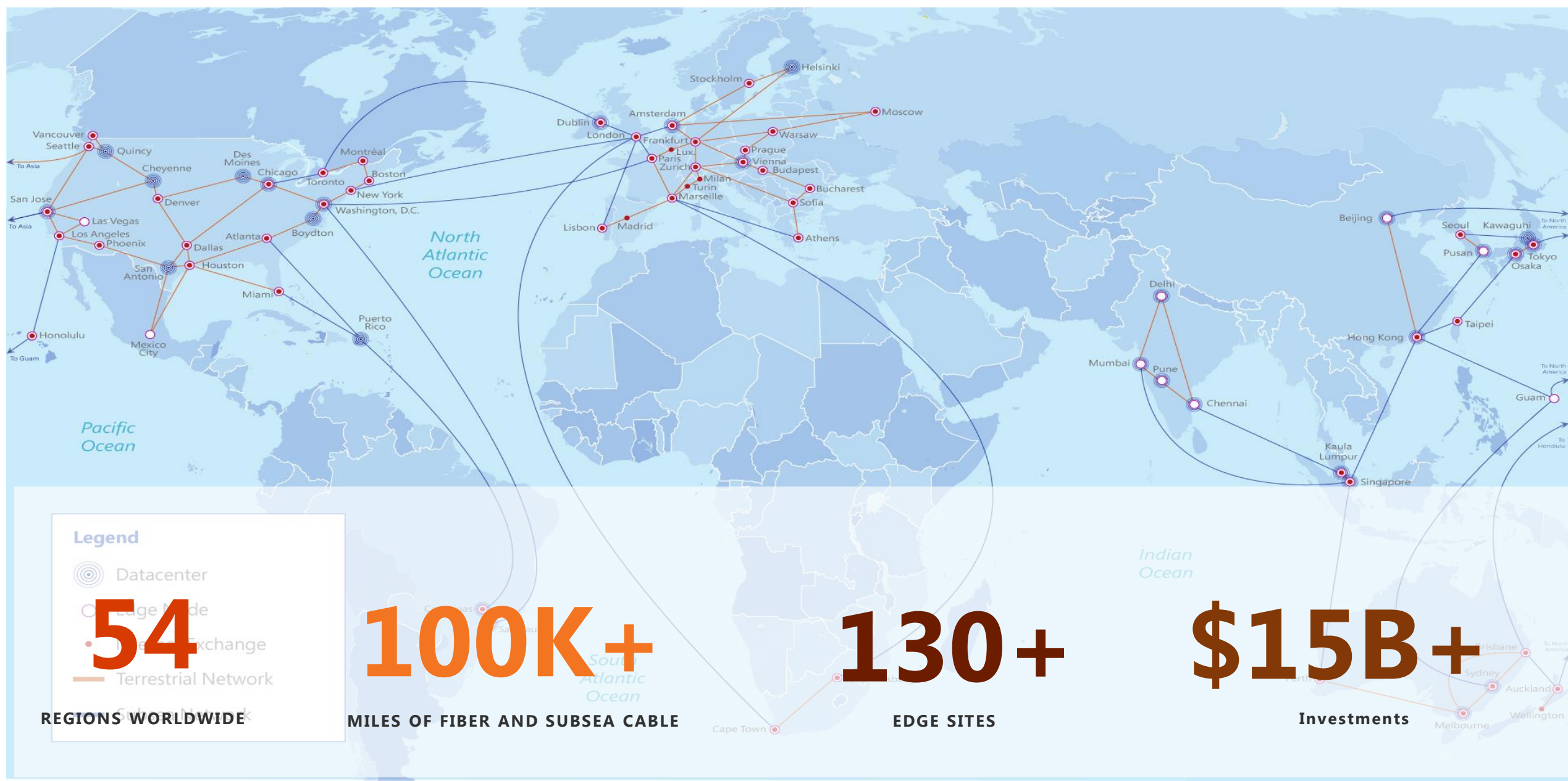


Build Reliable Cloud Networks with SONiC and ONE

Wei Bai 白巍
Microsoft Research Asia



Two Open Source Cornerstones for High Reliability

Networking OS: SONiC

Network Verification: ONE

Networking OS: SONiC

A Solution to Unblock Hardware Innovation

Monitoring, Management, Deployment Tools, Cutting Edge SDN



Switch Abstraction Interface (SAI)

Merchant
Silicon



Switch Abstraction Interface (SAI)

Network Applications

Hello

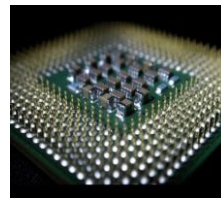
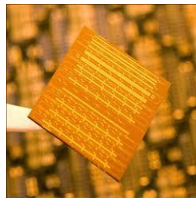
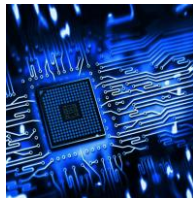
Switch Abstraction Interface

частный

你好

नमस्ते

Bonjour

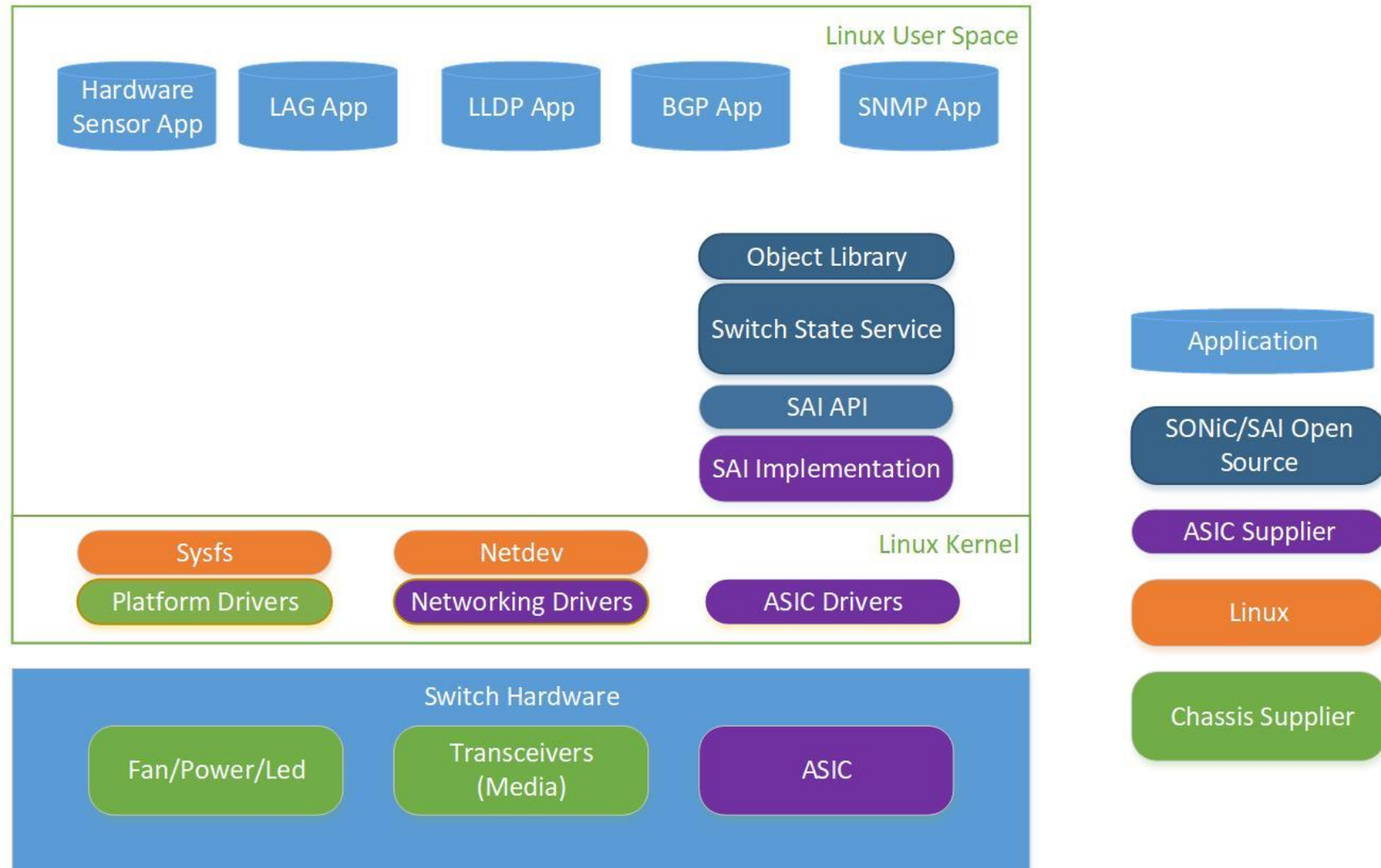


Simple, consistent, and stable network application stack

Help consume the underlying complex, heterogeneous hardware easily and faster

<https://github.com/opencomputeproject/SAI>

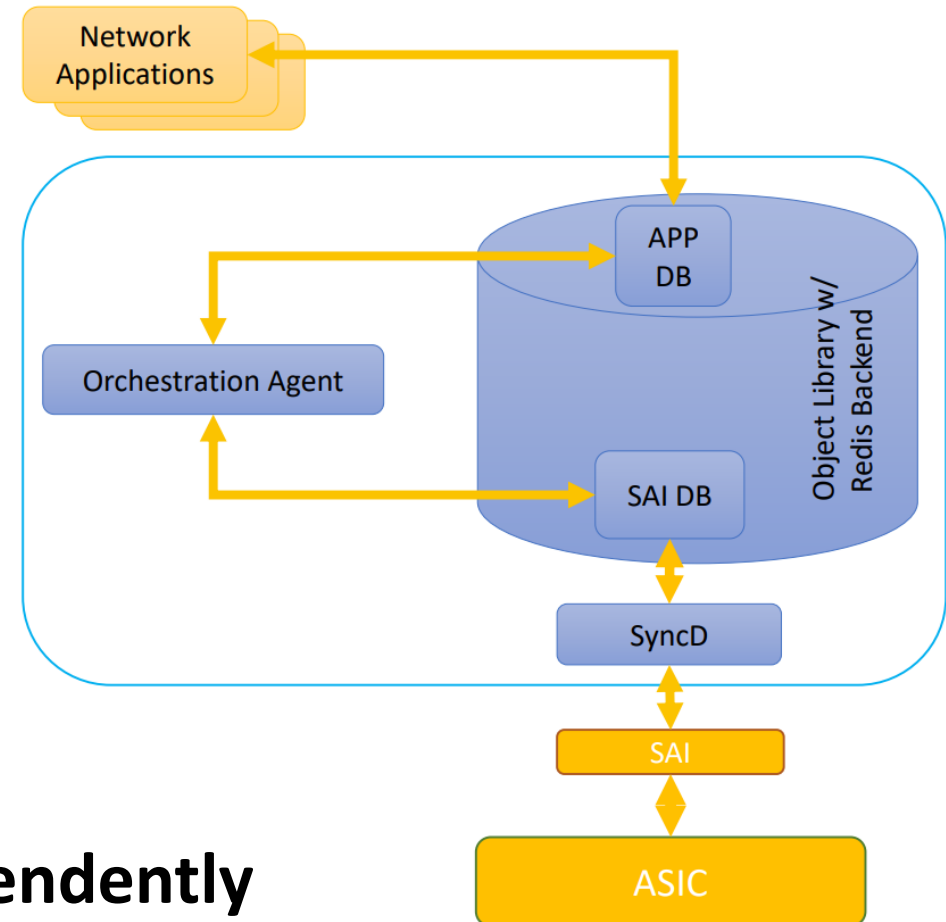
SONiC High-Level Architecture



Switch State Service (SWSS)

- APP DB: persist App objects
- SAI DB: persist SAI objects
- Orchestration Agent: translation between apps and SAI objects, resolution of dependency and conflict
- SyncD: sync SAI objects between software and hardware

Key Goal: Evolve components independently



```
Linux C0-SONiC 4.9.0-8-amd64 #1 SMP Debian 4.9.110-3+deb9u6 (2015-12-19) x86_64
You are on
```

```

/_____/ /_____\ /_____\ /_____\ /_____\ /_____\
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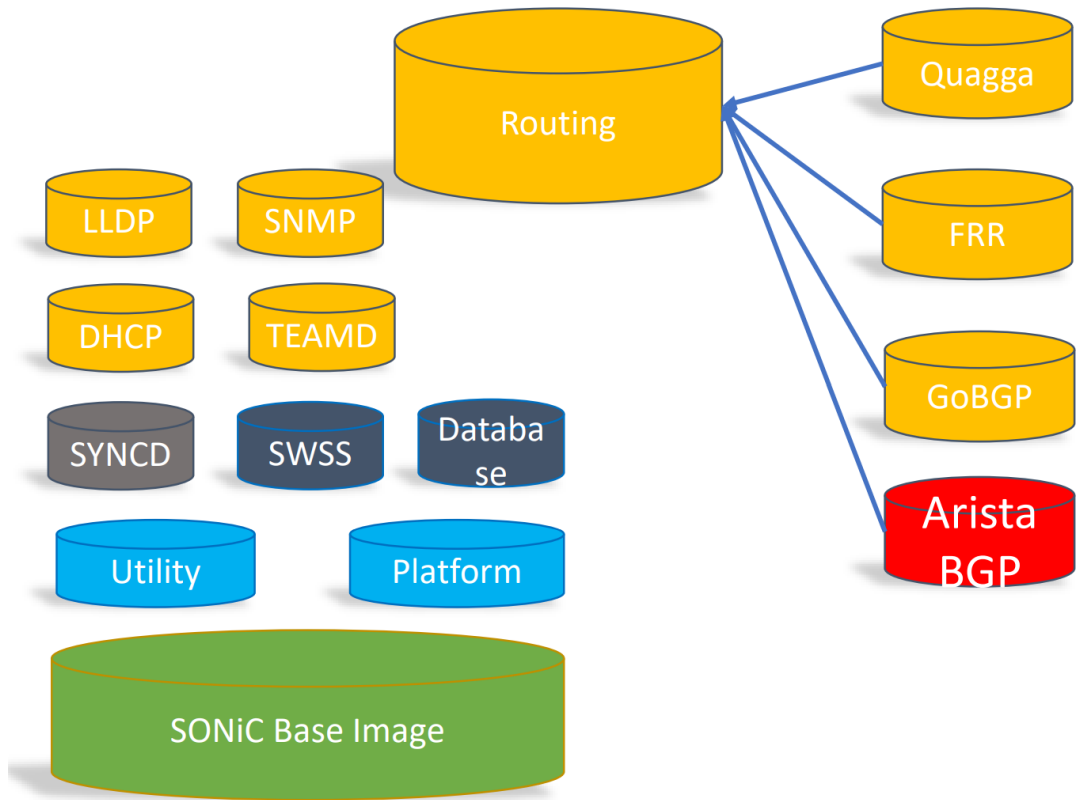
```

Unauthorized access and/or use are prohibited.
All access and/or use are subject to monitoring.

```
Last login: Fri Jan 11 18:17:14 2019 from 10.90.6.147
```

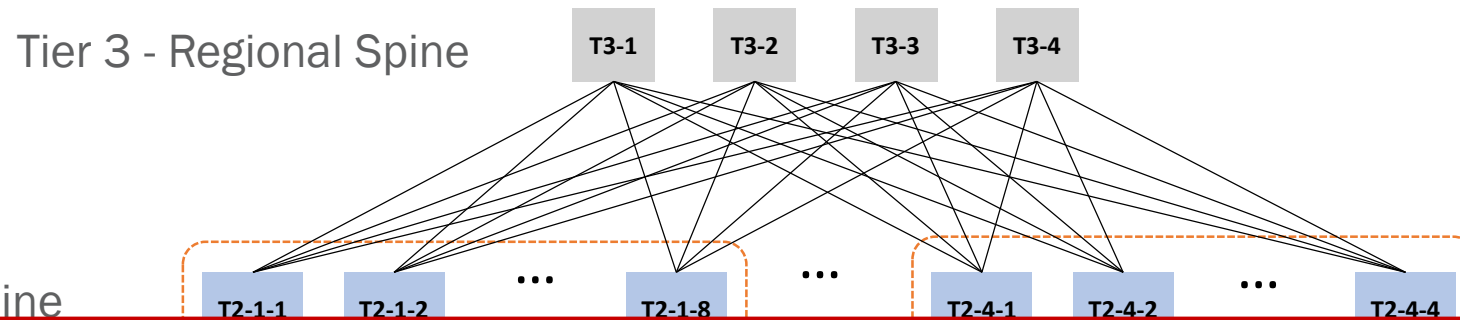
CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
8a3abdd1a8cc	docker-snmp-sv2:latest	"/usr/bin/supervisord"	4 days ago	Up 2 days		snmp
580ad5ec729a	docker-syncd-brcm:latest	"/usr/bin/supervisord"	4 days ago	Up 2 days		syncd
b4d4ecd793b5	docker-orchagent-brcm:latest	"/usr/bin/supervisord"	4 days ago	Up 2 days		swss
6320785de98e	docker-dhcp-relay:latest	"/usr/bin/docker_ini..."	4 days ago	Up 2 days		dhcp_relay
79d3c4d0101e	docker-fpm-quagga:latest	"/usr/bin/supervisord"	4 days ago	Up 2 days		bgp
c9b43866d85d	docker-platform-monitor:latest	"/usr/bin/supervisord"	4 days ago	Up 2 days		pmon
3499815fd2c3	docker-lldp-sv2:latest	"/usr/bin/supervisord"	4 days ago	Up 2 days		lldp
0ce0b837def2	docker-teamd:latest	"/usr/bin/supervisord"	4 days ago	Up 2 days		teamd
144eda8ba6bf	docker-database:latest	"/usr/bin/supervisord"	4 days ago	Up 3 days		database

SONiC Containerization



- Components developed in different environments
- Source code may not be available
- Enables choices on a per-component basis

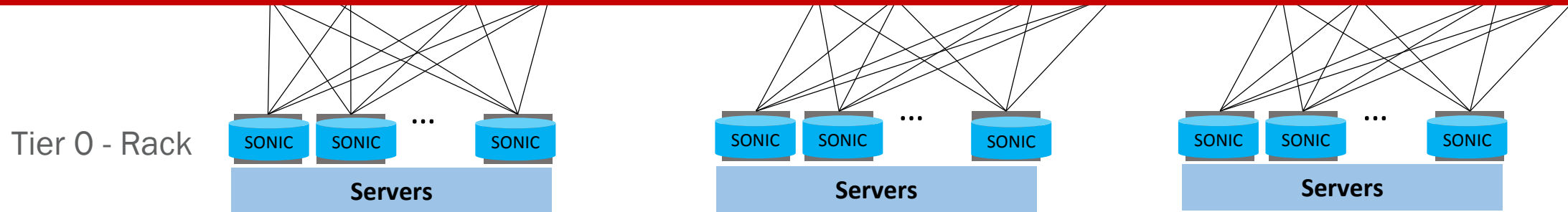
SONiC – Powering Microsoft At Cloud Scale



Features and Roadmap

Current: BGP, ECMP, ECN, WRED, LAG, SNMP, SYSLOG, ACL, LLDP, NTP, VLAN, DHCP, AD, TACACS+, VLAN Trunk, CoPP, IPv6, Everflow, Fast reboot, RDMA, PFC WD, QoS, Telemetry, Warm reboot, OOM, VxLAN, VRF

Ti **Roadmap:** FRR, L3 MLAG, sFLOW, BGP EVPN, NAT



Application & Management tools



CANONICAL



BAREFOOT NETWORKS

ARISTA



Tencent 腾讯



SONiC [Software For Open Networking in the Cloud]



ARISTA



Inventec



Quanta Computer



Celestica™

ALPHA Alpha Networks Inc.

SAI [Switch Abstraction Interface]

BAREFOOT NETWORKS



nephos



centec networks



Innovium™

Switch

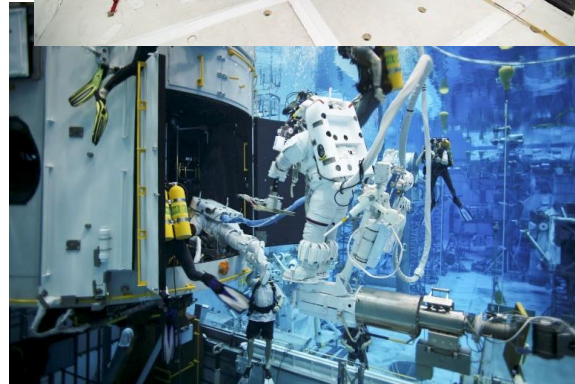
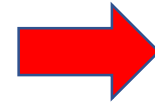
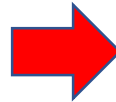
Silicon/ASIC

Inviting Contributions in All Areas

- New ideas on white/open network devices
 - New features, applications and tools
 - Download it, test it and use it!
-
- Website: <https://azure.github.io/SONiC/>
 - Mailing list: sonicproject@googlegroups.com
 - GitHub: <https://github.com/Azure/SONiC/>
 - Wiki: <https://github.com/Azure/SONiC/wiki/>

Network Verification: ONE

Astronauts use high-fidelity emulators to practice complex, high-risk missions



Azure engineers use Open Network Emulator (ONE) to practice complex, high-risk network operations



Change manager

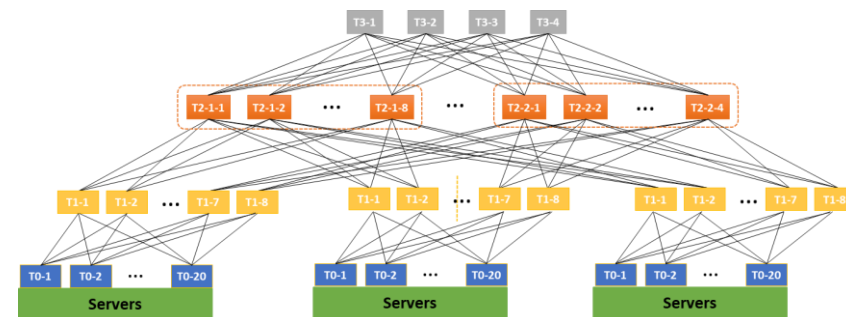
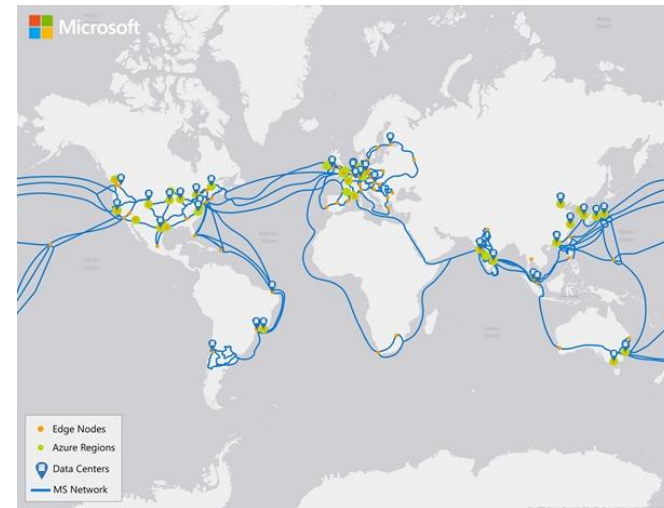
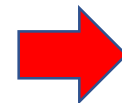
WAN manager

Optical link manager

Routing protocol coordinator



ONE



Open Network Emulator

Fast

network with 1000s of devices
created in minutes

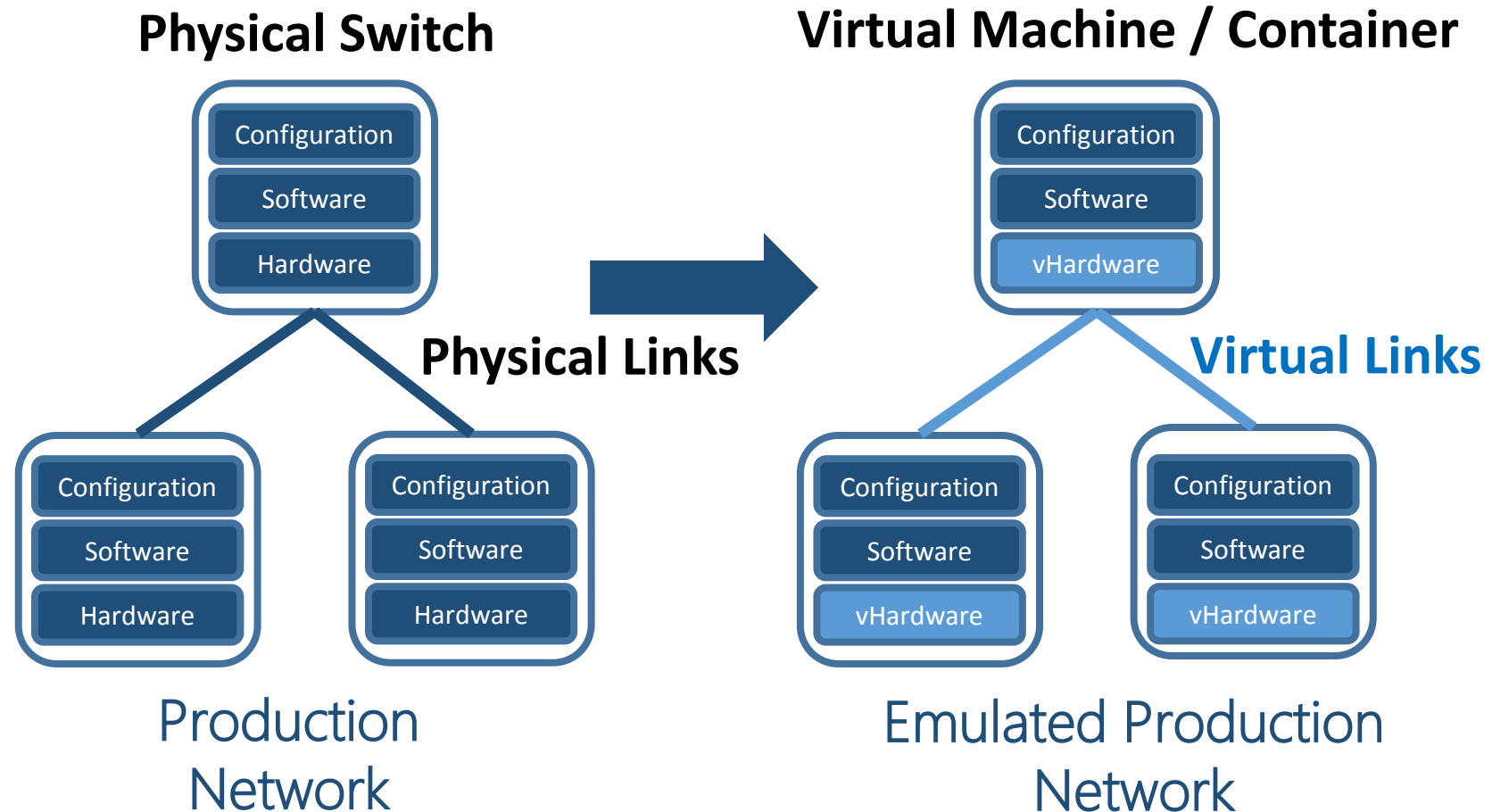
Seamless

push-button deployment

High fidelity

devices work exactly as
production

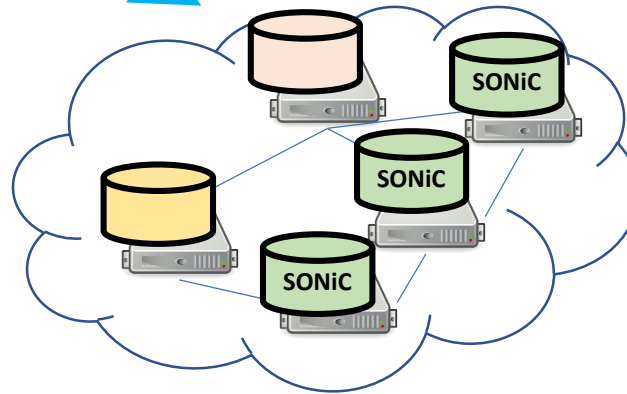
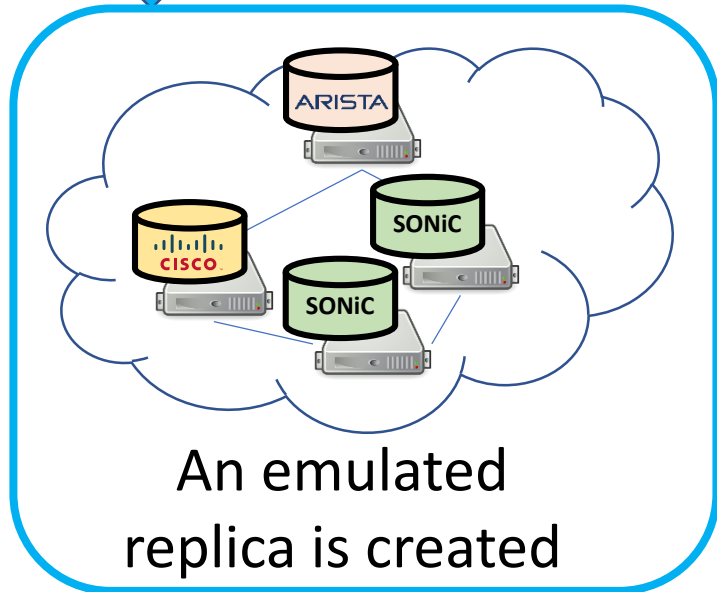
support from multiple
vendors



ONE typical usage scenario



Network engineer
describes desired change



→ **Z3** →

Health verified by
Z3 theorem prover



Pass/Fail
(with feedback,
including counter-
examples)

More Details

- Mailing list: crystalnet-dev@microsoft.com

- Publication

CrystalNet: Faithfully Emulating Large Production Networks

Hongqiang Harry Liu^{*}, Yibo Zhu^{*}, Jitu Padhye, Jiaxin Cao, Sri Tallapragada, Nuno P. Lopes,
Andrey Rybalchenko, Guohan Lu, Lihua Yuan
Microsoft
{harliu,yibzh,padhye,jiacao,srita,nlopes,rybal,gulv,lyuan}@microsoft.com

ABSTRACT

Network reliability is critical for large clouds and online service providers like Microsoft. Our network is large, heterogeneous, complex and undergoes constant churns. In such an environment even small issues triggered by device failures, buggy device software, configuration errors, unproven management tools and unavoidable human errors can quickly cause large outages. A promising way to minimize such network outages is to proactively validate all network operations in a high-fidelity network emulator, before they are carried out in production. To this end, we present *CrystalNet*, a cloud-scale, high-fidelity network emulator. It runs real network device firmwares in a network of containers and virtual machines, loaded with production configurations. Network engineers can use the same management tools and methods to interact with the emulated network as they do

1 INTRODUCTION

CrystalNet is a high-fidelity, cloud-scale network emulator in daily use at Microsoft. We built *CrystalNet* to help our engineers in their quest to improve the overall reliability of our networking infrastructure. A reliable and performant networking fabric is critical to meet the availability SLAs we promise to our customers.

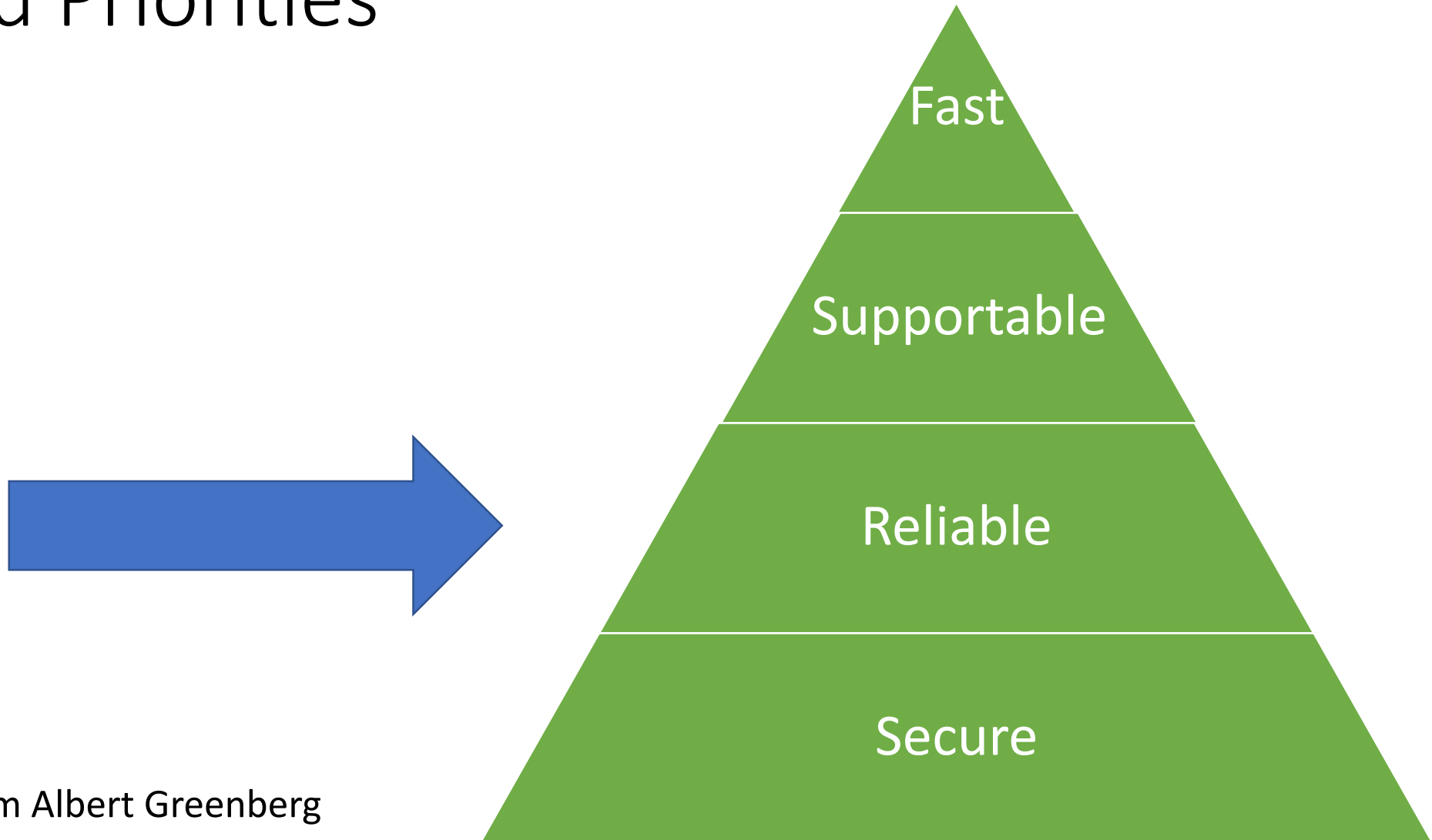
It is notoriously challenging to run large networks like ours in a reliable manner [11, 13, 15, 31]. Our network consists of tens of thousands of devices, sourced from numerous vendors, and deployed across the globe. These devices run complex (and hence bug-prone) routing software, controlled by complex (and hence bug-prone) configurations. Furthermore, churn is ever-present in our network: apart from occasional hardware failures, upgrades, new deployments and other changes are always ongoing.

Acknowledgements

- Xin Liu
- Ze Gan
- Guohan Lu
- Yongqiang Xiong
- Lihua Yuan

Thanks!

Cloud Priorities



Borrow from Albert Greenberg

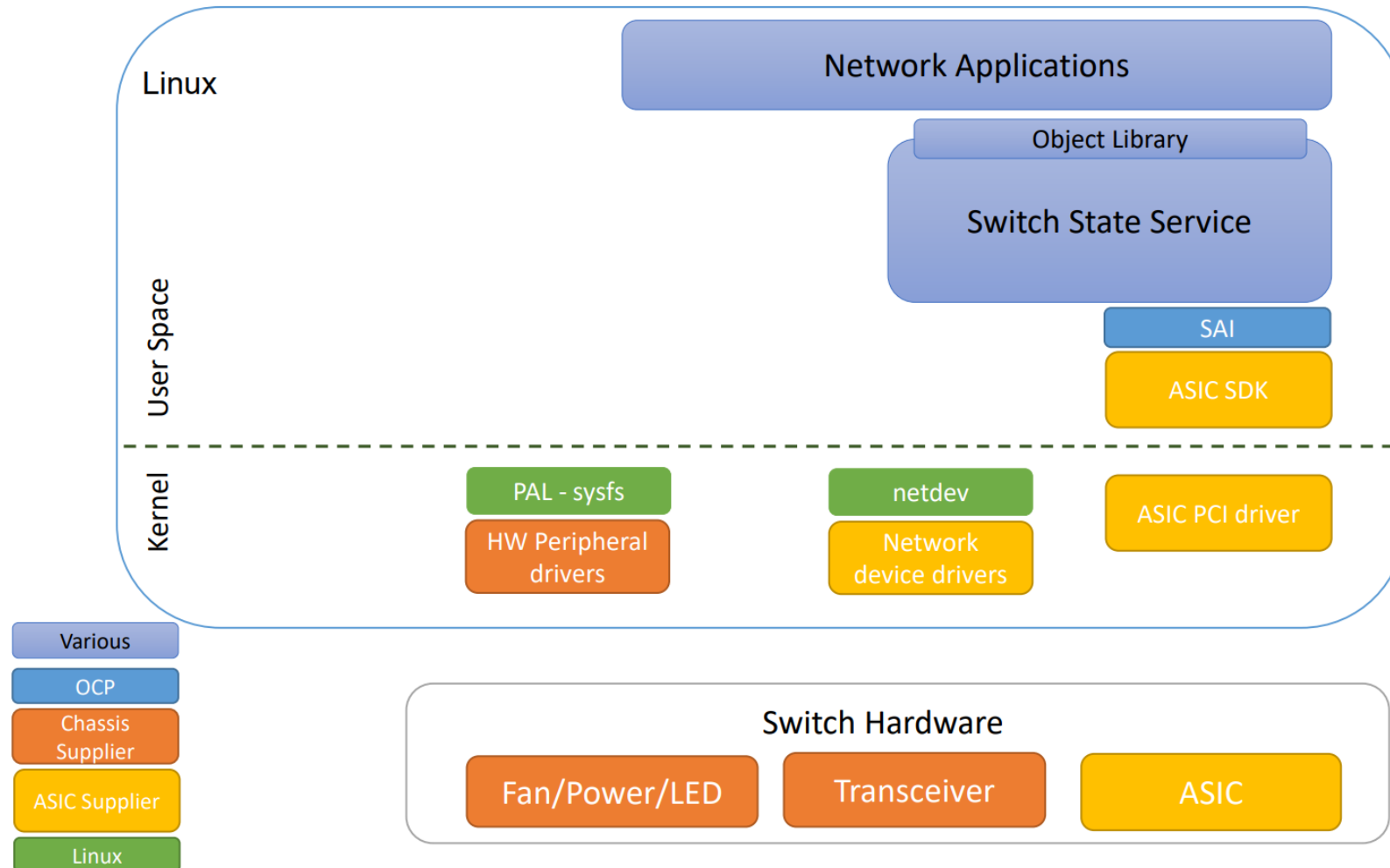
SONiC: Software for Open Networking in the Cloud

- Switch Abstraction Interface (SAI)
 - Cross-ASIC portability
- Modular Design with Switch State Service (SwSS)
 - Decoupling software components
 - Consistent application development model
- Containerization of SONiC
 - Serviceability
 - Cross-platform portability

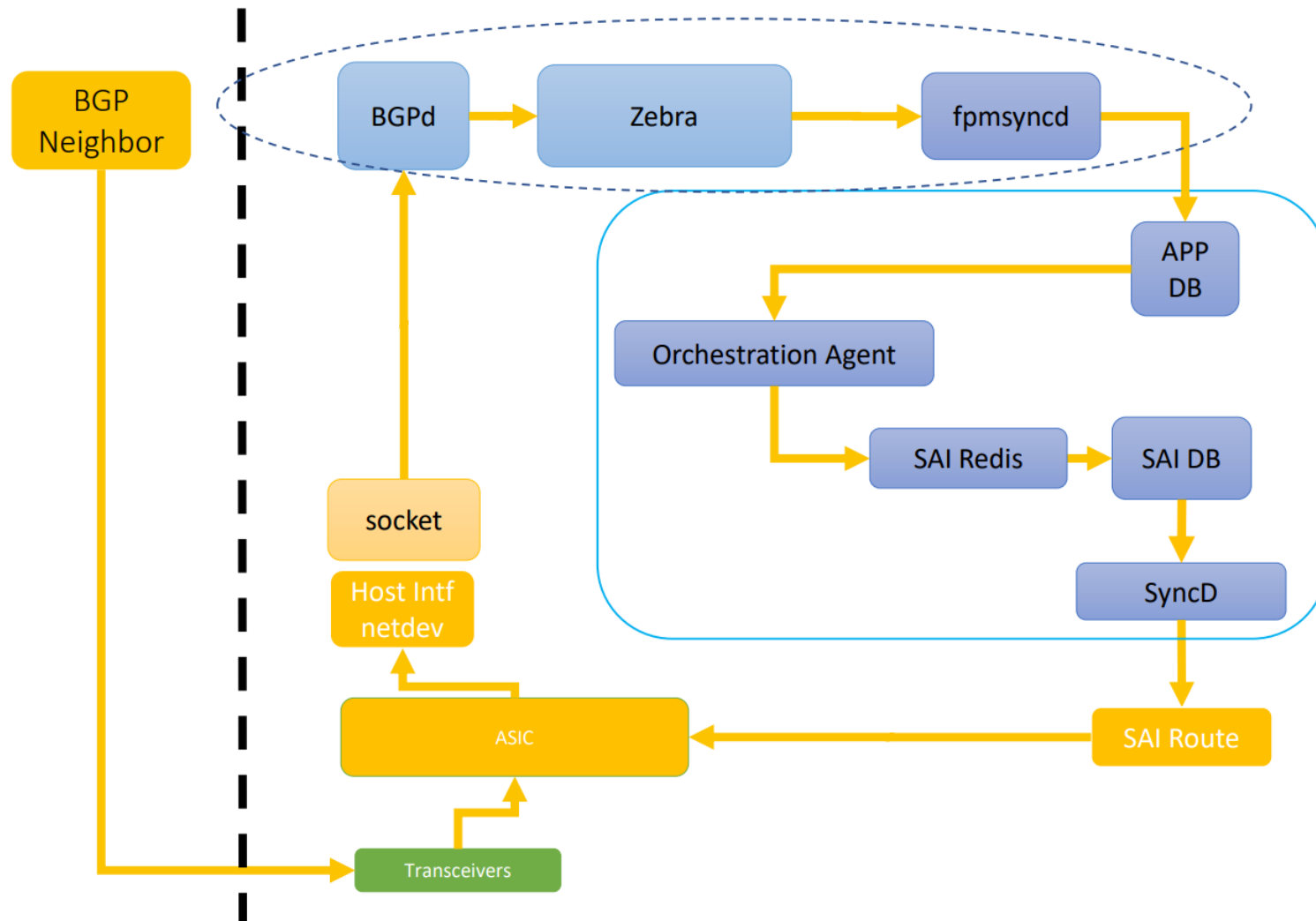
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SONiC High-Level Architecture



How Routing Works in SONiC



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Demo: SONiC + ONE

Topology