FBOSS:
Building Switch Software at Scale

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facebook

Motivation

Scale of Facebook Community

2.23B Monthly Active Users

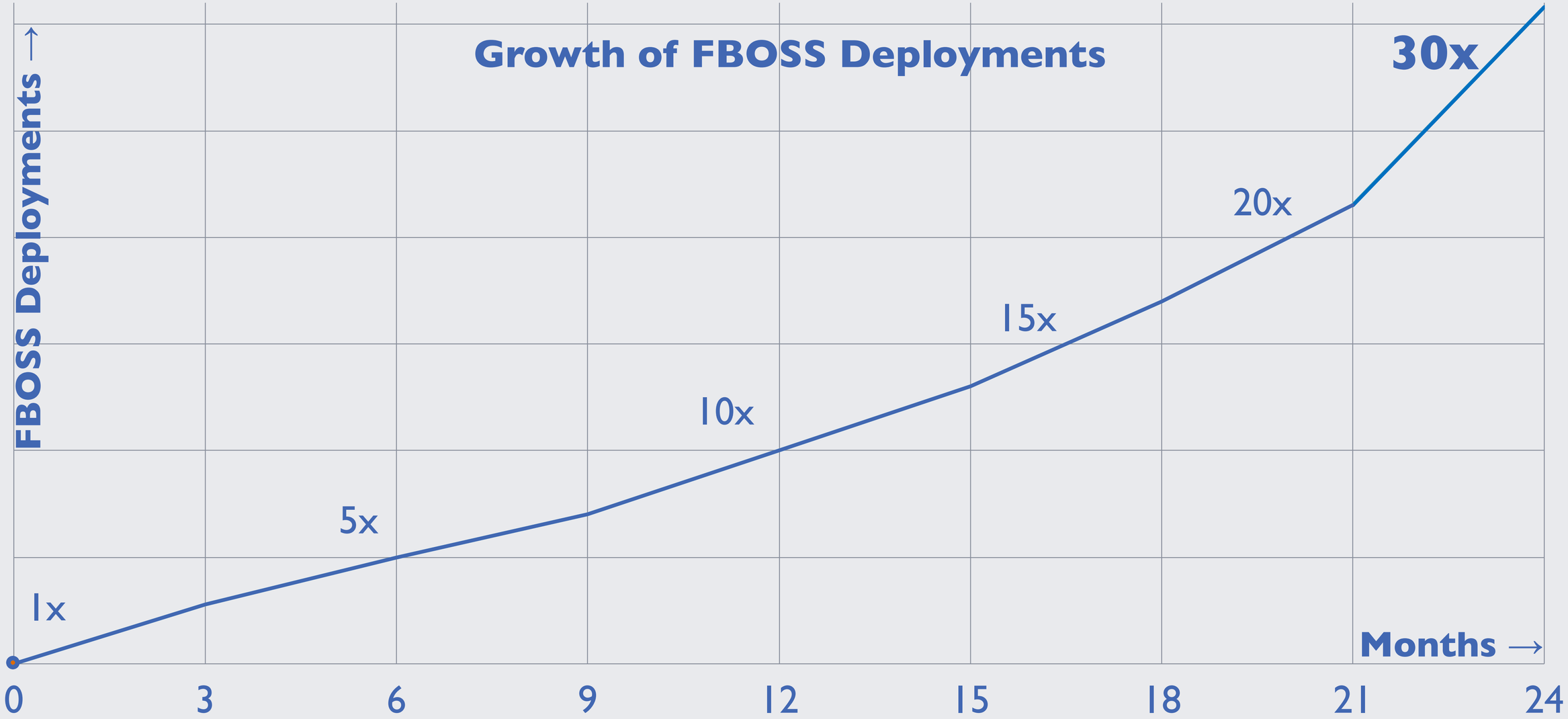
1.3B Monthly Active Users

1B Monthly Active Users

1.5B Monthly Active Users

2.5B people use at least one of these products

Our DC Network is Growing FAST!



Challenges in Scaling the Network

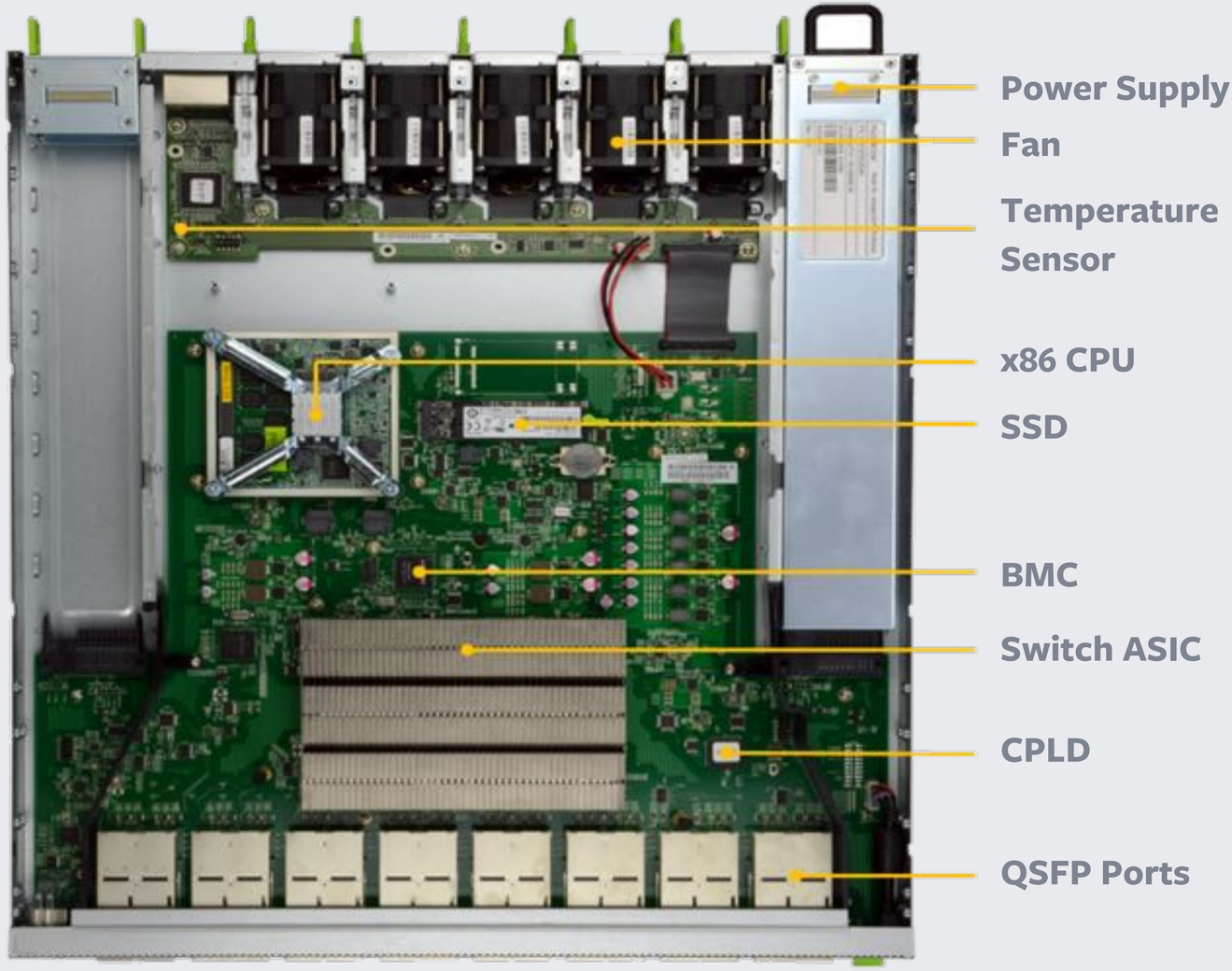
Issues with Extraneous Features

- Vendor switch software is built for **all** of their user needs
  - Most users have to deal with software with a lot of unused features
- Complexity in managing **excess** networking features
  - Increased downtime, operational complexity, and security holes
- **Slower** rate of change to validate a large range of features

Arrival of the White Box Switch

Customizable switch hardware and software

- **Customized** hardware
- **Pick** the **minimal** software needed for the specific network
- **Powerful CPU** to run more complex software



Existing Software Services

Reusing Existing Infrastructure

- Facebook has an infrastructure **already** in place for...
  - Monitoring and Data Analytics
  - Logging
  - Service Management and etc.

- Vendors generally do not have full access to these tools

FBOSS: Facebook Open Switching System

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is an experiment to discover if...

we can run **switch software**

in a **similar way**

we run our **software services**

FBOSS Design Principles

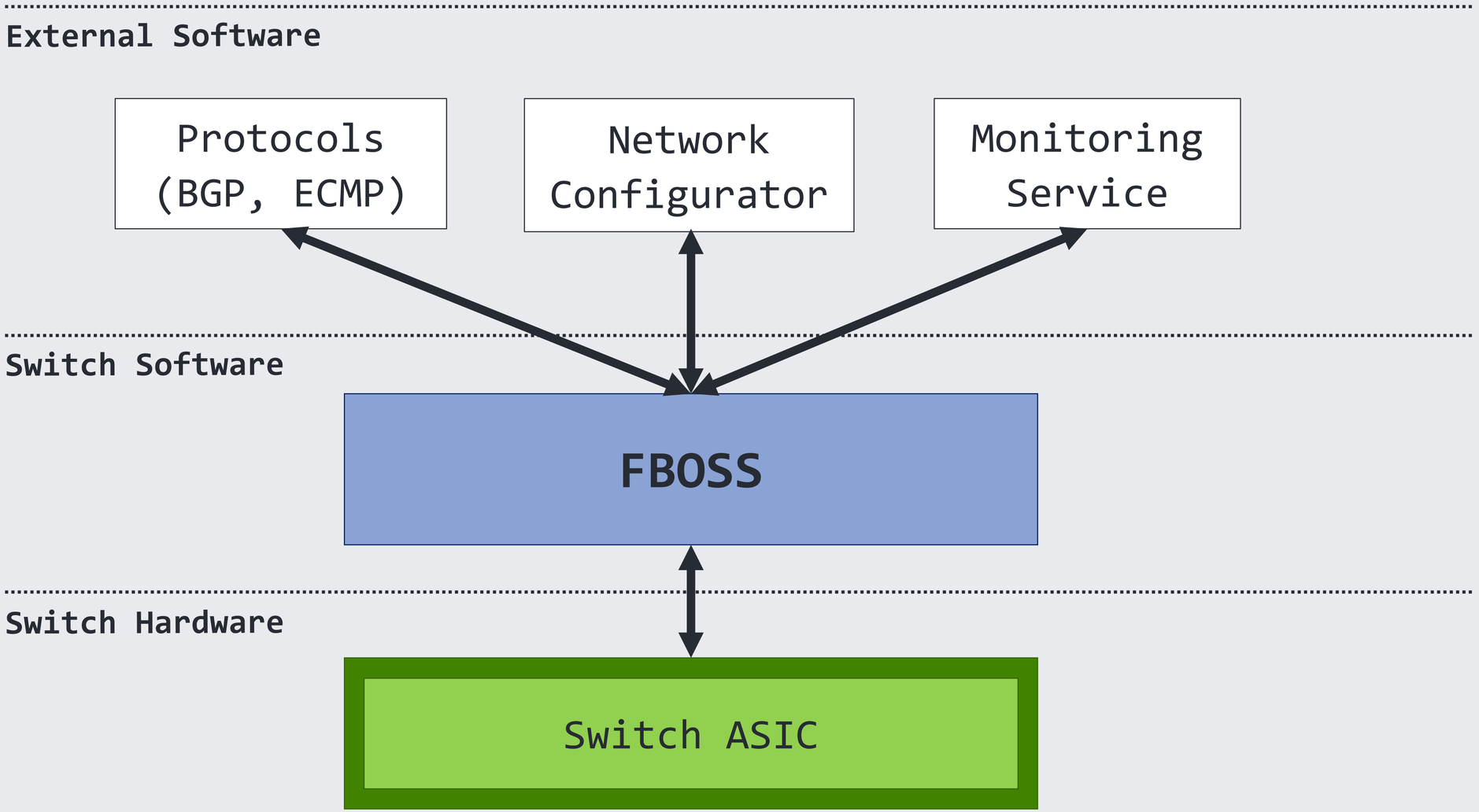
- **Switch-as-a-Server**
  - Continuous integration and staged deployment
  - Integrate closely with existing software services
  - Open-source software
- **Deploy-Early-and-Iterate**
  - Focus on developing and deploying minimal set of features
  - Quickly iterate with smaller “*diffs*”

Facebook Software Infrastructure

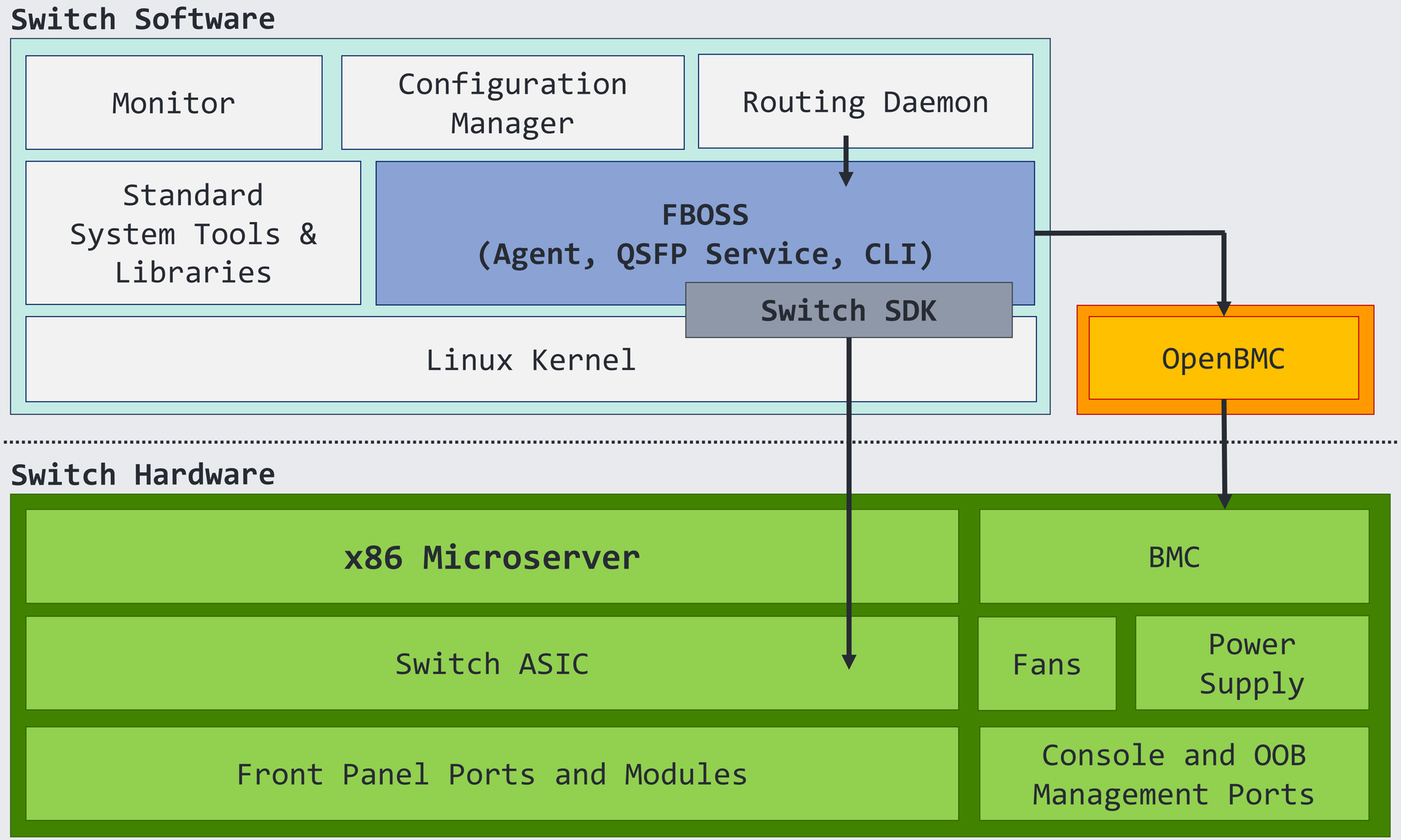
Some example of Existing Software Services

- **Scuba:** Real-time monitoring and data analysis (*VLDB 2013*)
- **Gorilla:** In-memory time-series database (*VLDB 2015*)
- **Robotron:** Network Management (*SIGCOMM 2016*)

FBOSS Overview



FBOSS Architecture



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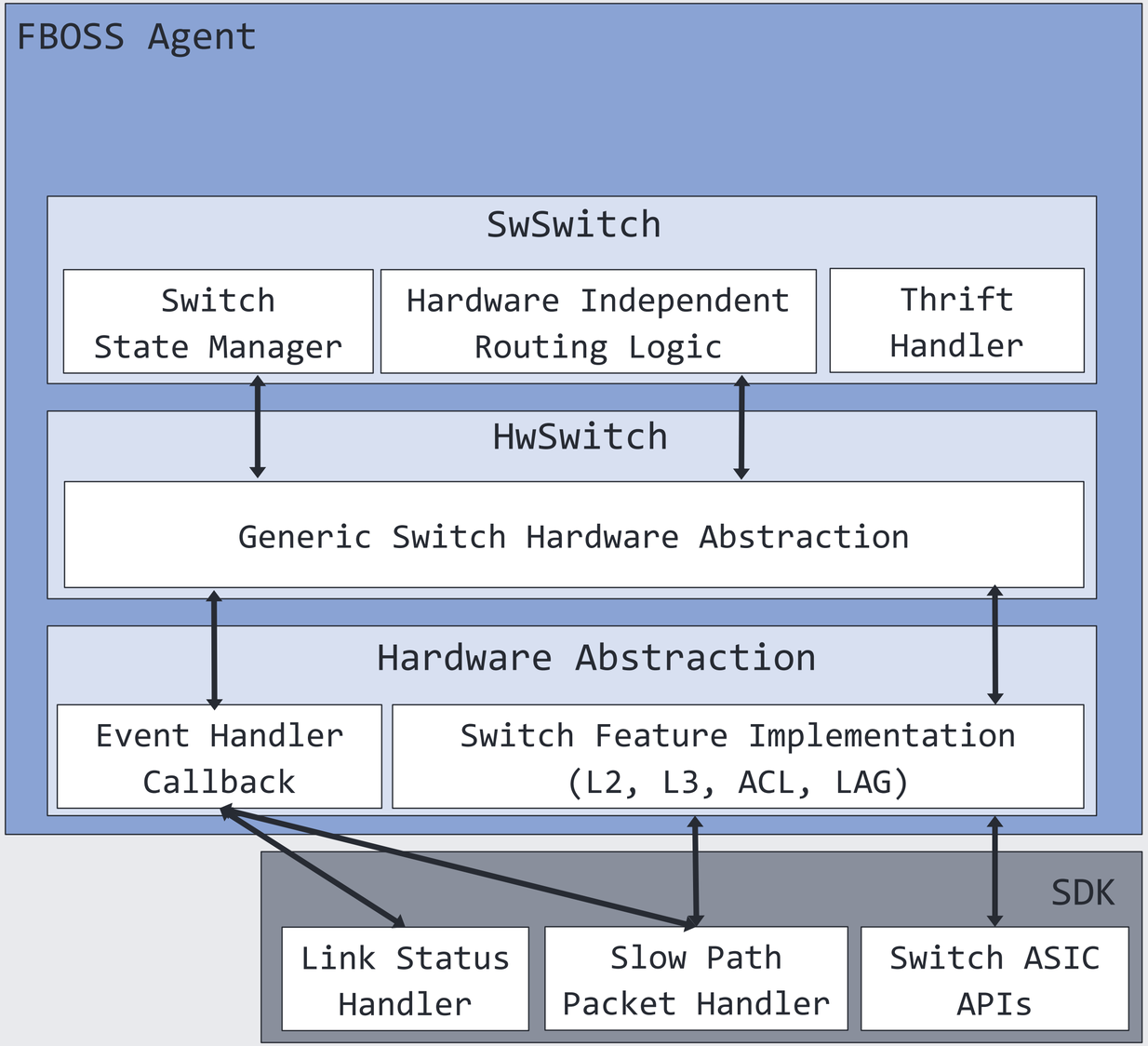
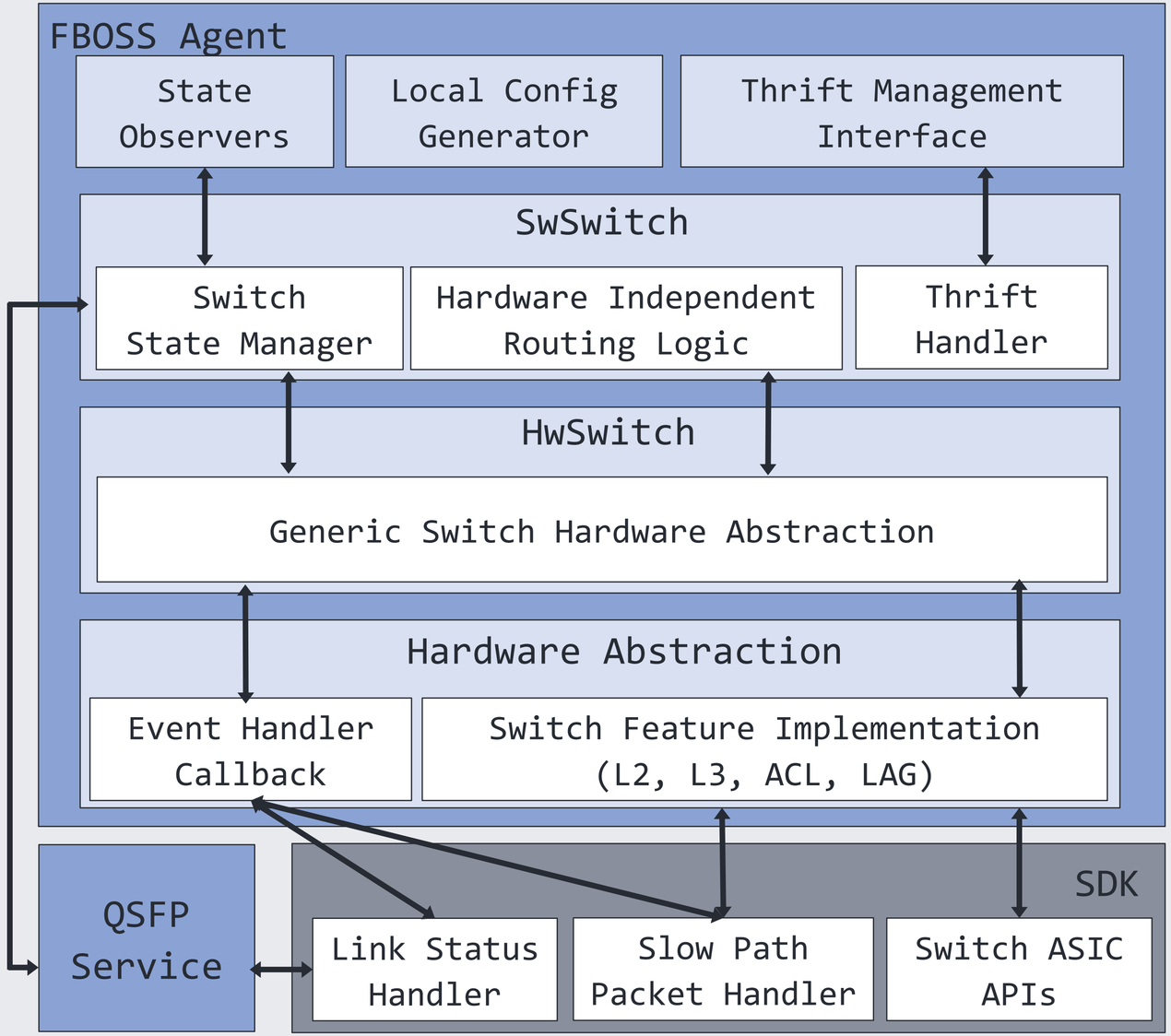


- **Switch SDK**: Vendor provided software for ASIC interaction
- **Hardware Abstraction**: Hardware specific implementation
- **HwSwitch**: Generic interface for switch hardware, e.g., port control
- **SwSwitch**: Hardware independent switching logic, e.g., L2, L3 and ACL

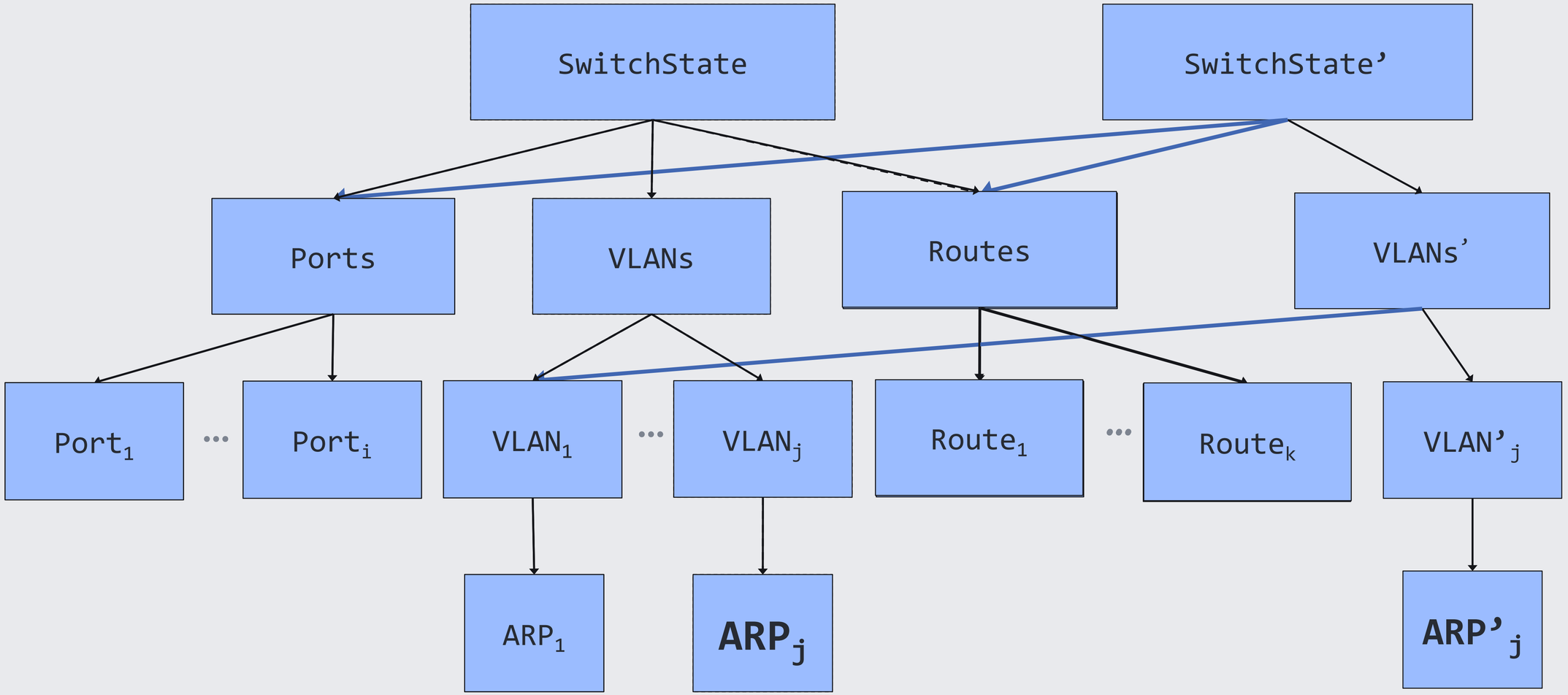
FBOSS Architecture



- **State Observers**: Manage changes in the states within SwSwitch
- **Local Config Generator**: Generates local configuration from externally generated configuration
- **Thrift Management Interface**: Receives external commands via Thrift interface
- **QSFP Service**: Manages QSFP Ports

FBOSS State Management

Copy-on-write Tree



FBOSS State Management

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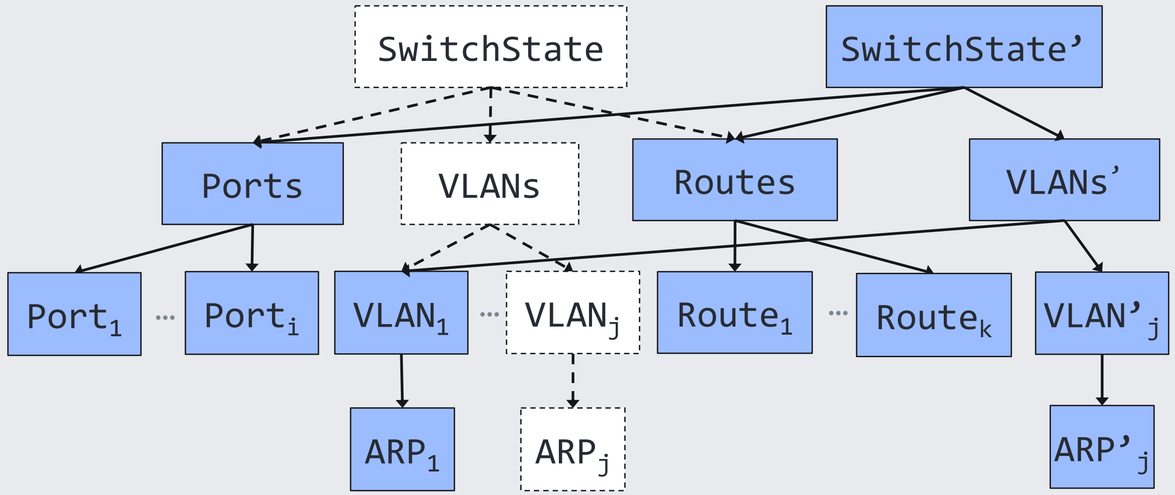


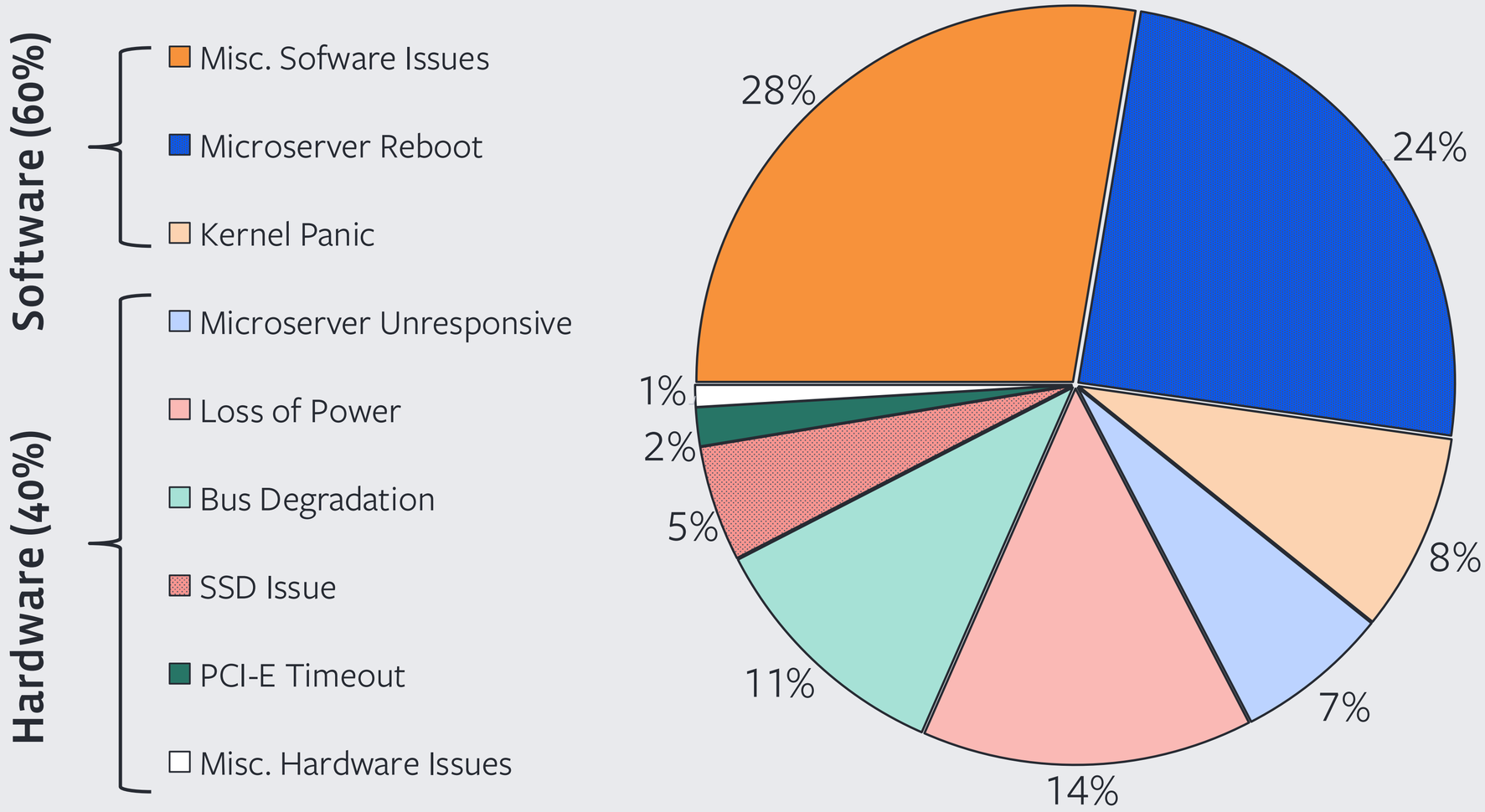
- **No** Read Locks
- **Easy** Debugging
- **Easy** Restarts

- **Complex** Implementation
- **More processing** per update

Testing, Deployment & Management

FBOSS Testing and Deployment

Sources of switch outages



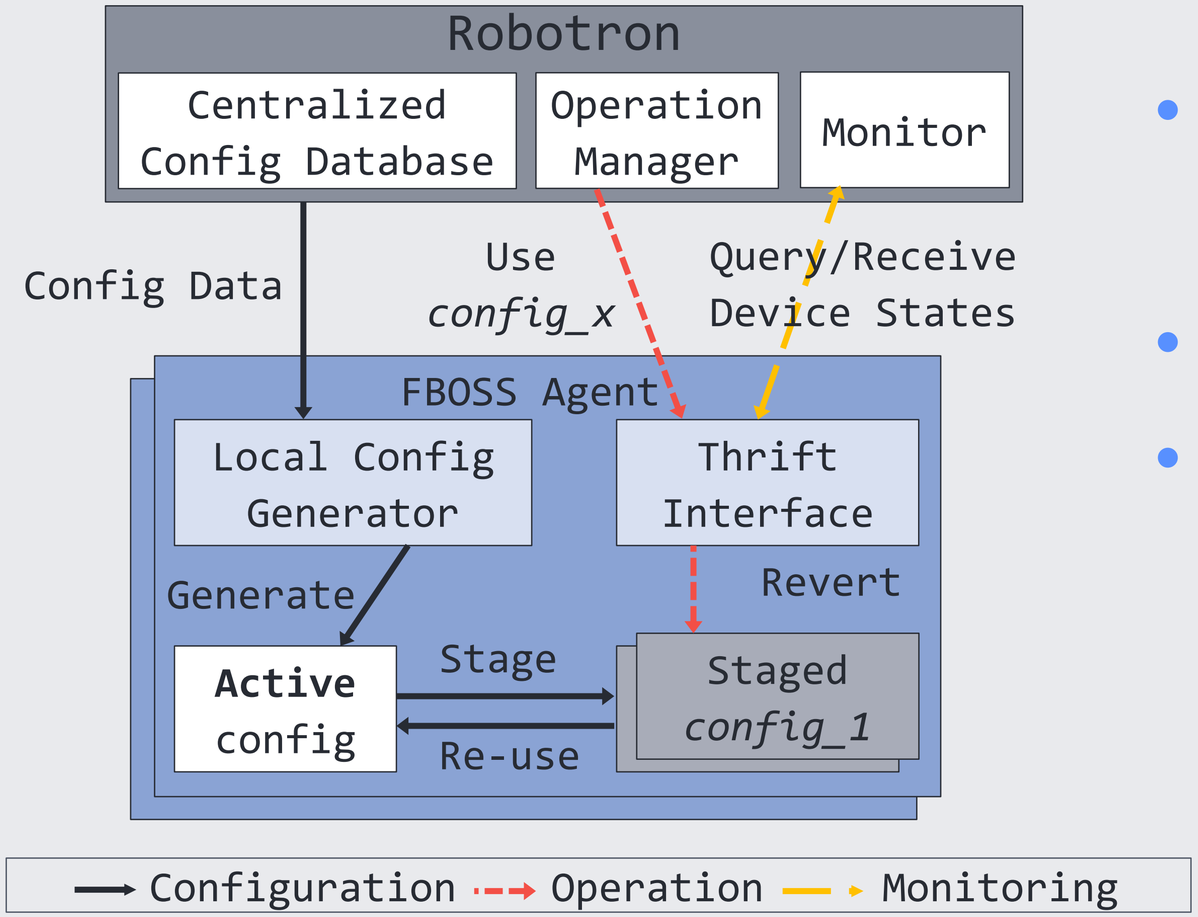
FBOSS Testing and Deployment

3 Stage Deployment via *fbossdeploy*

- **Continuous Canary**
  - Deploy all commits continuously to 1~2 switches for each type
- **Daily Canary**
  - Deploy all of single day's commits to 10~20 switches for each type
- **Staged Deployment**
  - Final stage to push all the commits to all the switches in the DC
  - Performed once every two weeks for reliability

FBOSS Management

How FBOSS interacts with network management system



- Configurations are generated by the network management system
- Configurations are staged locally
- Operational and Monitoring queries are passed through the Thrift interface

Experiences

Lessons from Deployment Experiences

- Side effect of infrastructure reuse
- Side effect of rapid deployments
- Resolving interoperability issues

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- **Side effect of infrastructure reuse**
- Side effect of rapid deployments
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Side Effect of Infrastructure Reuse

Issues with combining applications with different SLAs

- Switch software must be more reliable than most software services

- Warm boot: Retain ASIC tables and configurations at restart
- BGP graceful restart: Restores BGP states after warm boot
- New library caused warm boot to take longer than expected

  => Random BGP restart failures => Random network outages

- **Lesson Learned** : Be careful when using software with different SLAs

Conclusion

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- Scaling massive DC networks requires leaner software with rapid updates
- FBOSS started 5 years ago as an experiment to see if we can build and deploy switch software as if we are running a generic software service
- Our experiences show that the experiment is quite successful
  - FBOSS is capable of quickly iterating, deploying and scaling switch software

Questions?

https://github.com/facebook/fboss