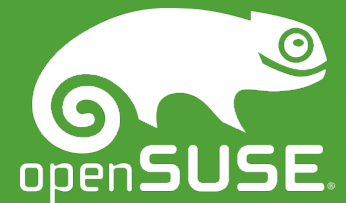


# USB Cloud Storage Gateway

Intelligent Storage for Stupid Things

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# Agenda

- Project Introduction
- Ceph
- USB Storage
- Demo!
- Azure Blob Storage
- Linux I/O Target in Userspace
- Future



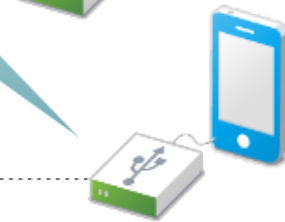
# Hack Week

- What to hack on?
  - ARM board gathering dust
  - Learn something new
  - Storage is my day job
-  I know...

# Project Idea



Ceph  
USB Storage  
Gateway



# Goals

- Access cloud storage from anything
  - Stereos, TVs, Phones, etc.
- Boot from cloud backed disk images
  - Ceph
  - Azure
- Encryption
- Simple device configuration

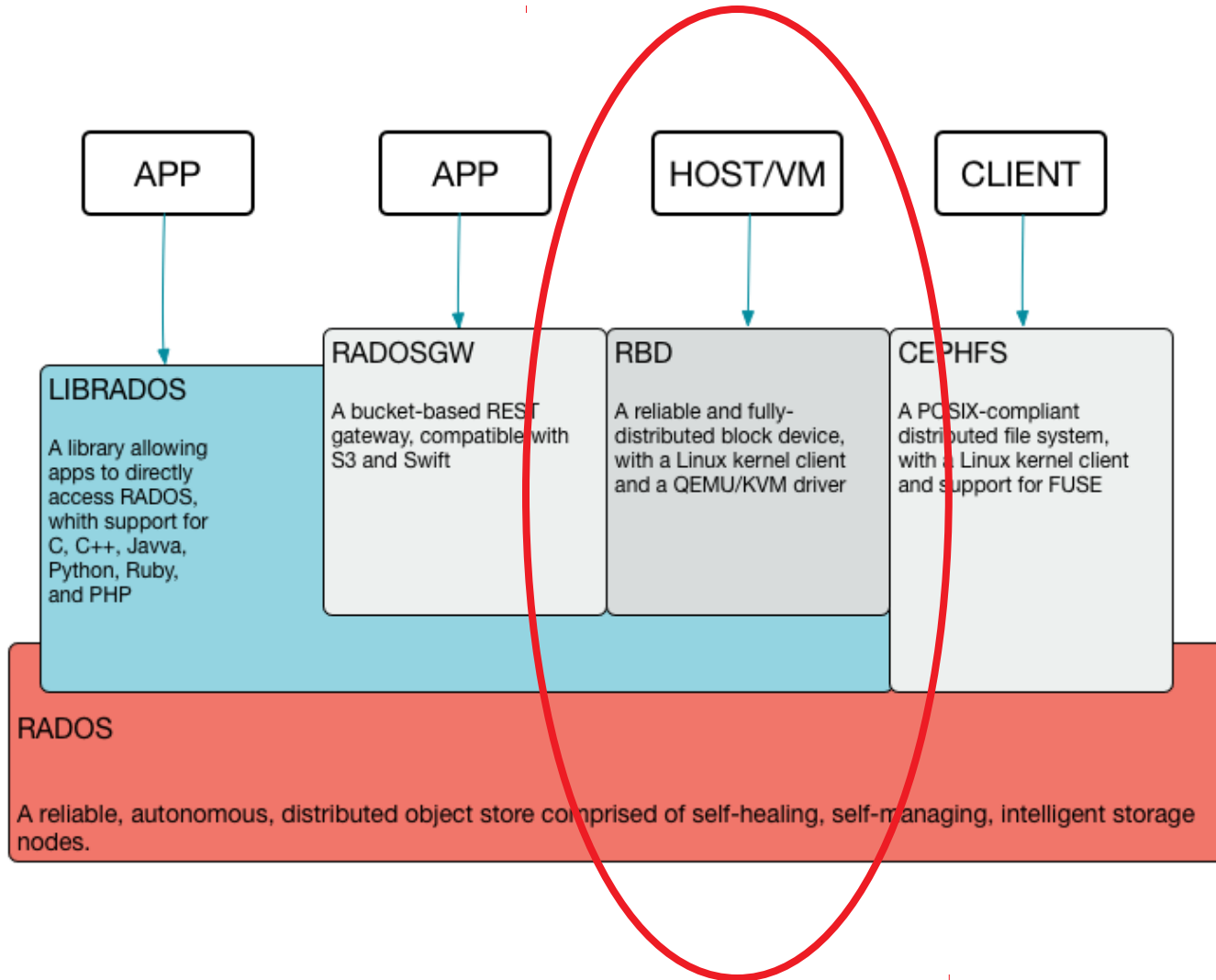


# Ceph

- Aggregate, manage and share storage resources
- Highly available
  - No single point of failure
- Self managing and self healing
- Scalable



# Ceph



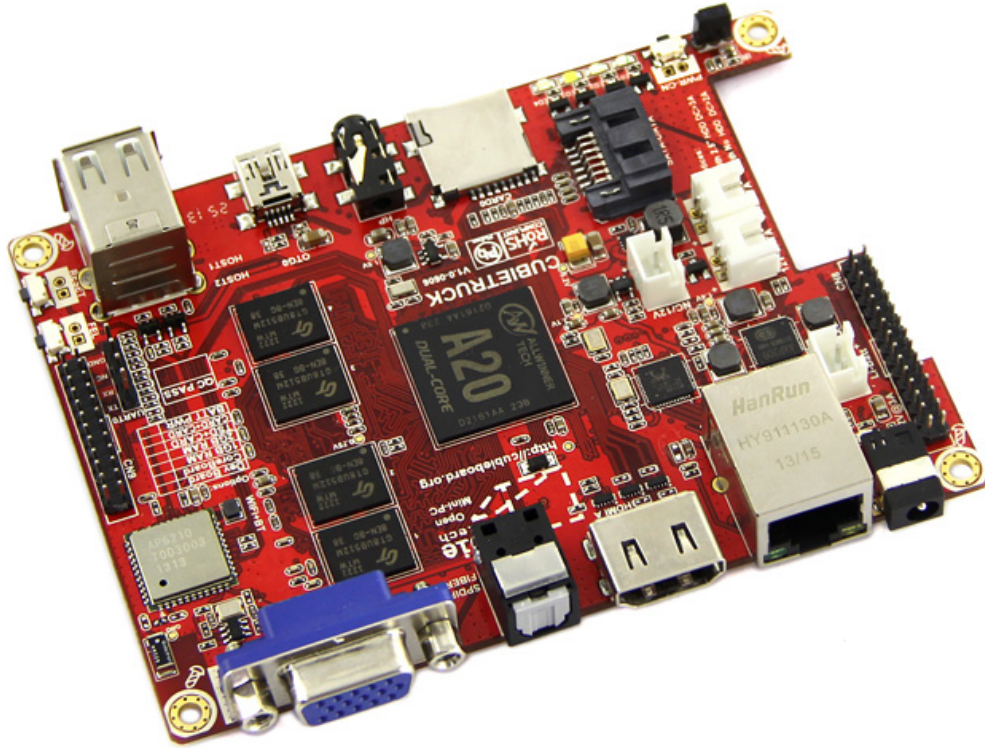
# Ceph RADOS Block Device

- Block device backed by RADOS objects
- Thin provisioned
- Resizeable
- Supports snapshots and clones
- Linux kernel and user-space clients





# Hardware



# Hardware

- Mainline kernel support
  - sunxi community
- openSUSE Tumbleweed port
- Relatively performant
  - Multi-core ~1GHz CPU
  - 512MB-2GB RAM
  - USB2 and 100Mb-1Gb Ethernet
- Inexpensive



# USB Storage

- SCSI transport
  - Bulk-Only transport (BOT)
  - USB Attached SCSI (UAS)
    - Faster: high-speed and super-speed specs
- Linux kernel USB gadget support
  - f\_mass\_storage.ko
  - f\_tcm.ko
    - Support for BOT **and** UAS

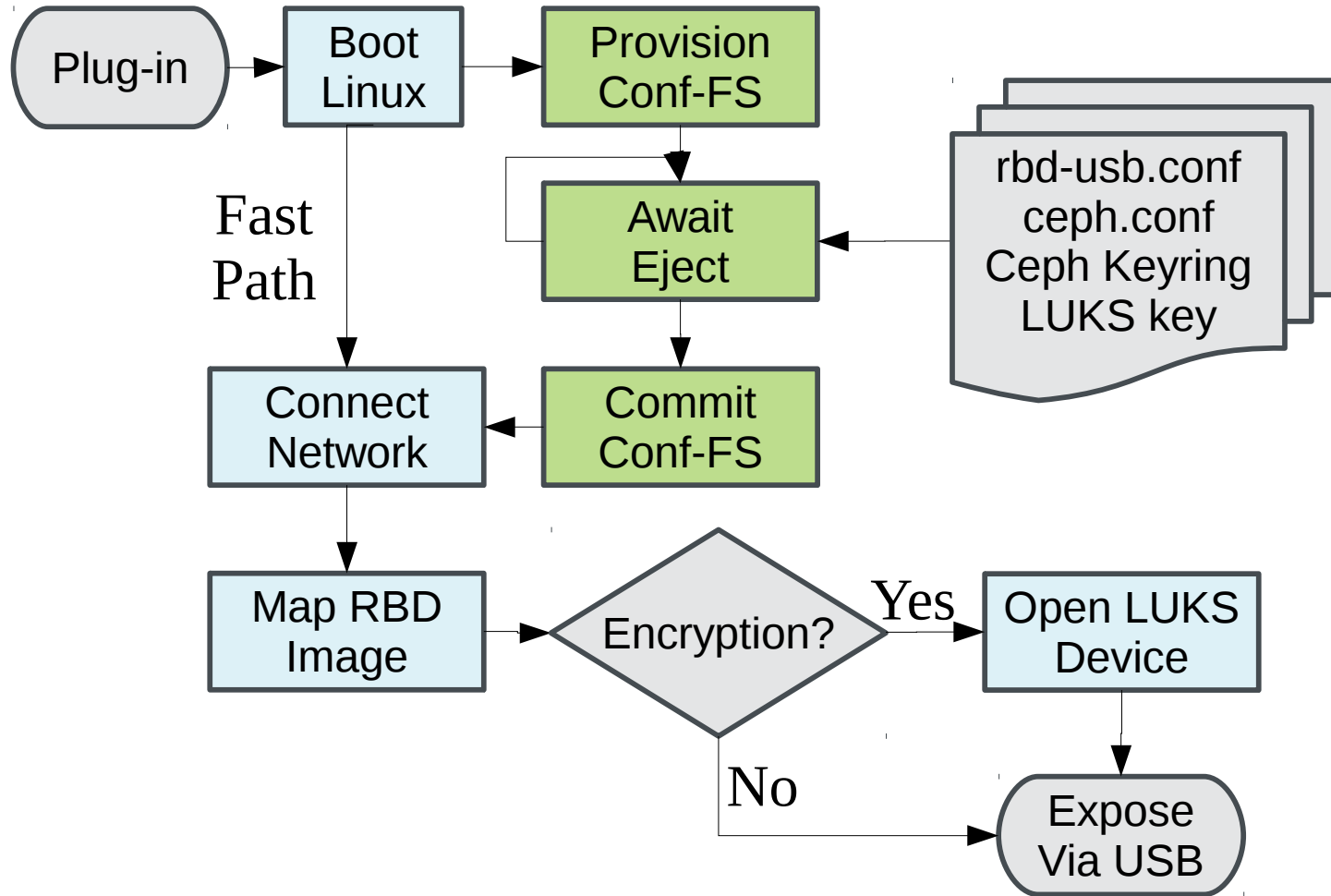


# USB Gateway

- Linux kernel does everything
  - Ceph RBD client
  - USB device mode support
  - Block device encryption (dm-crypt)
- Only need to handle configuration
  - Ceph credentials and image details
  - dm-crypt key
  - Perform RBD mapping and crypt setup once configured



# USB Gateway





Demo!

# Azure Blob Storage

- Public cloud storage
  - RESTful protocol
  - Pay for what you use
  
- Page Blobs and Block Blobs
  - Page Blobs ideal for disk images
    - Sparse object
    - Accept 512-byte aligned I/Os at arbitrary offsets
  - Premium accounts with QoS constraints



# •Linux I/O Target (LIO)

- In-kernel SCSI target

- Pluggable transport and storage engine layers
- Transports: FC, iSCSI, loopback, USB, etc.
- Storage engines: file, block device, tcm-user (TCMU)

- TCMU

- LIO storage engine in user-space
- SCSI pass-through



# •TCMU with Azure

- Elasto Cloud project

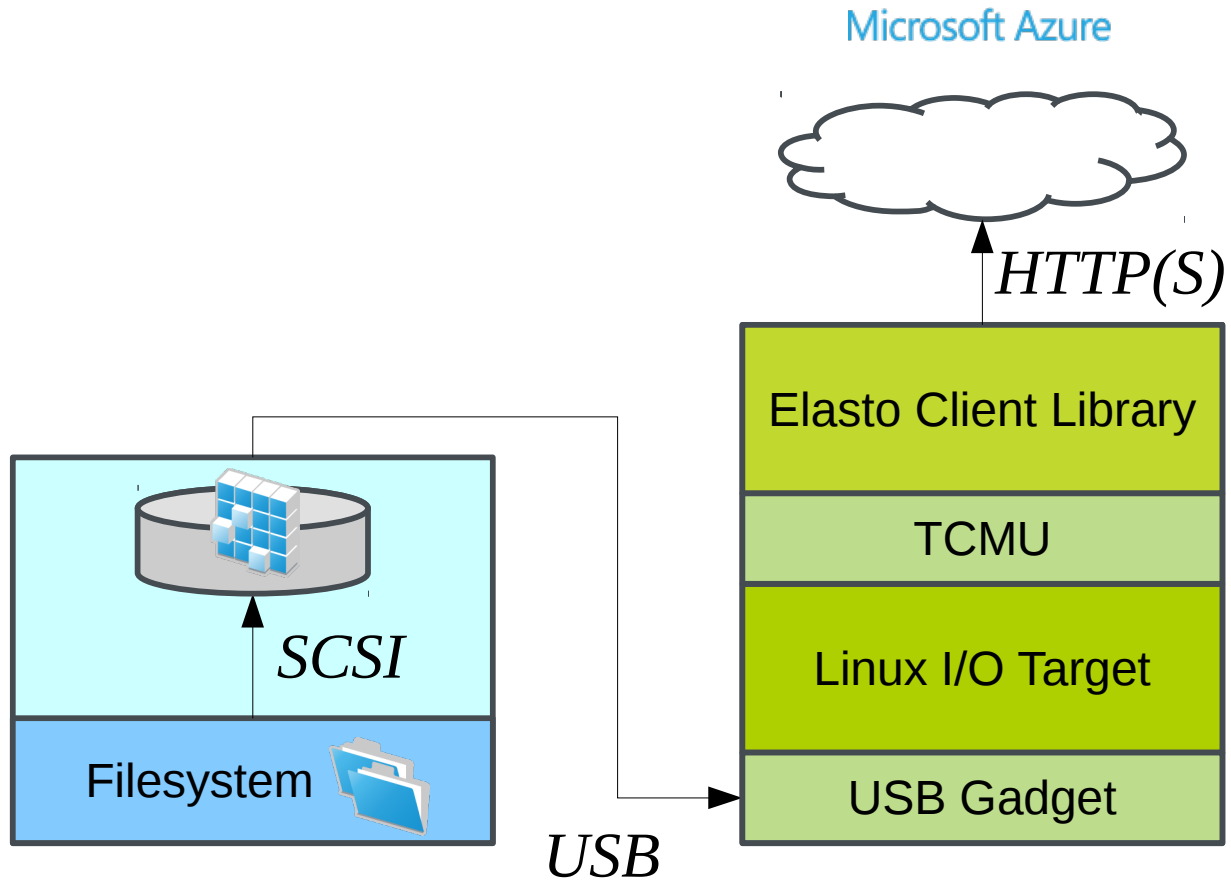
- Azure Page Blob client written in C
- Also supports Azure File Service and Amazon S3 protocols
- POSIX like API

- TCMU Elasto handler

- Maps SCSI I/O to Azure Page Blob REST requests
- Page Blobs accessible as regular block devices
  - Via supported LIO transports

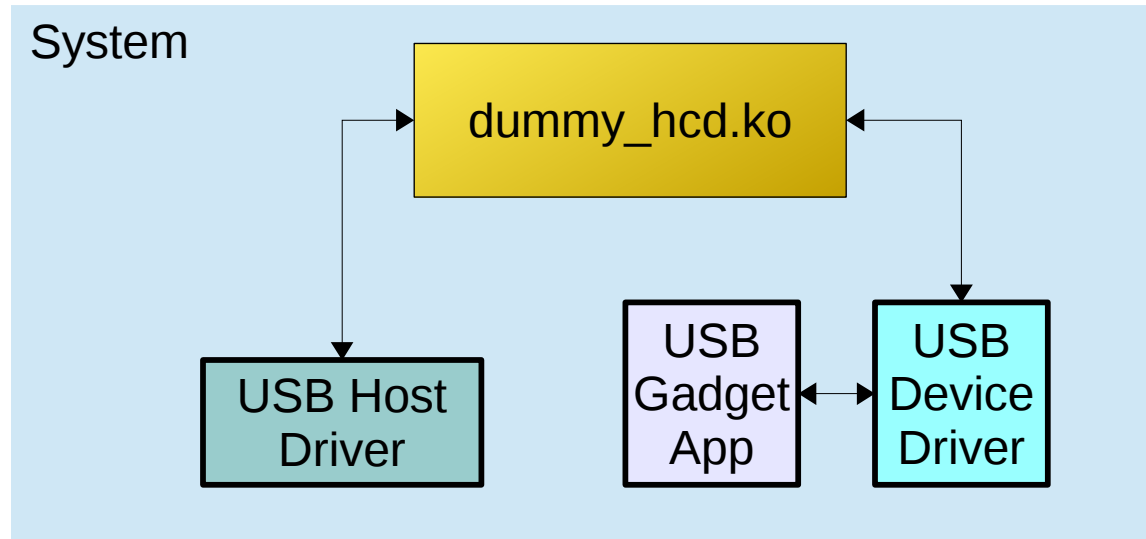


# •Linux I/O Target with Azure





# Testing



- *dummy\_hcd* on Linux
  - Re-route USB device traffic back to the local system
  - USB high-speed and super-speed connection simulation

# Future Challenges

- Concurrent image access
  - Currently must be manually avoided
- Use locking and snapshots?
  - Snapshot and lock on connect
  - Subsequent connects expose snapshot
  - Reference counting for cleanup



# Future Challenges

- Power
  - Battery to reduce reliance on USB supply
- f\_tcm
  - Works in VM (loopback) but fails on board
  - Needs super-speed support?
- Caching
  - Utilise on-board NAND



# Future Challenges

- Performance
  - Boot time critical
    - Perform fast-path mapping in initramfs
  - USB3+ and GbE/802.11ac
    - Price trade-off
    - Not a priority for “stupid” devices



# Conclusion

- Ceph is great
  - Client availability limits adoption
- USB storage is accepted everywhere
  - A USB gateway can expose cloud storage to the masses
  - Gateway encryption makes cloud storage use safer
- Cheap and portable hardware makes this viable
  - Mainline Linux support is a huge benefit





Questions?

**Thank you.**



## Links:

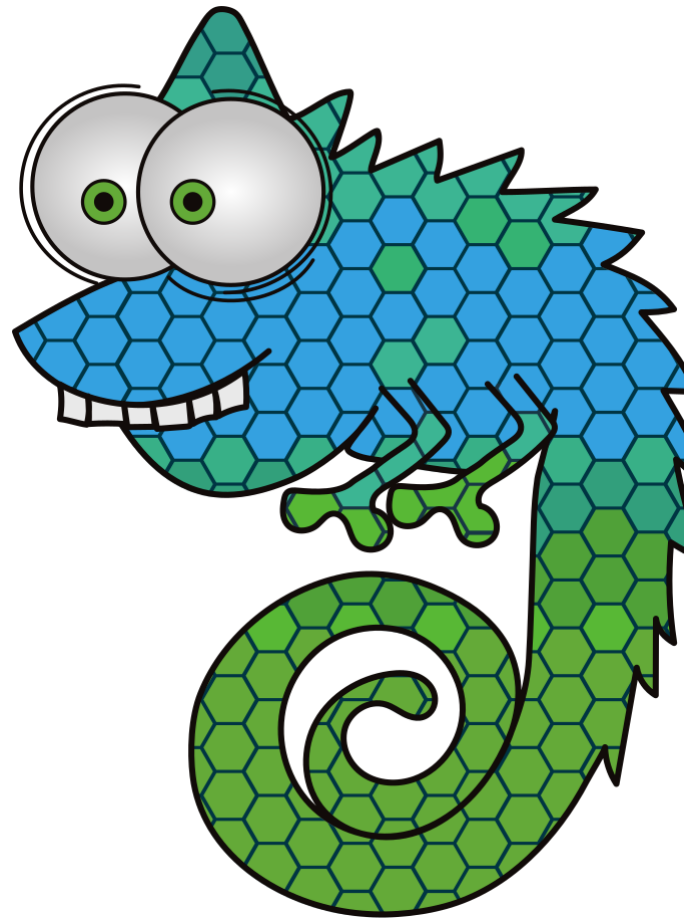
[github.com/ddiss/rbd-usb](https://github.com/ddiss/rbd-usb)

[elastocloud.org](https://elastocloud.org)

[github.com/open-iscsi/tcmu-runner](https://github.com/open-iscsi/tcmu-runner)

[en.opensuse.org/Portal:ARM](https://en.opensuse.org/Portal:ARM)

[linux-sunxi.org](https://linux-sunxi.org)



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