FreeBSD in UPB

AsiaBSDCon 2023, Tokyo, Japan

Faculty of Automatic Control & Computer Science

University Politehnica of Bucharest

About us

- UPB
  - University Politehnica of Bucharest
  - Faculty of Automatic Control and Computer Science
  - Computer Science Department

- PhD Students

About us

- Teaching Assistants
  - Operating Systems Concepts
  - Operating Systems Internals
  - Hardware-Software Interface
  - Cluster and Grid Computing
  - Security of Cluster and Grid Computing

- SysDevOps Enthusiasts
  - Cluster and Grid Management
  - Software Engineering
  - Tutoring and Mentorships

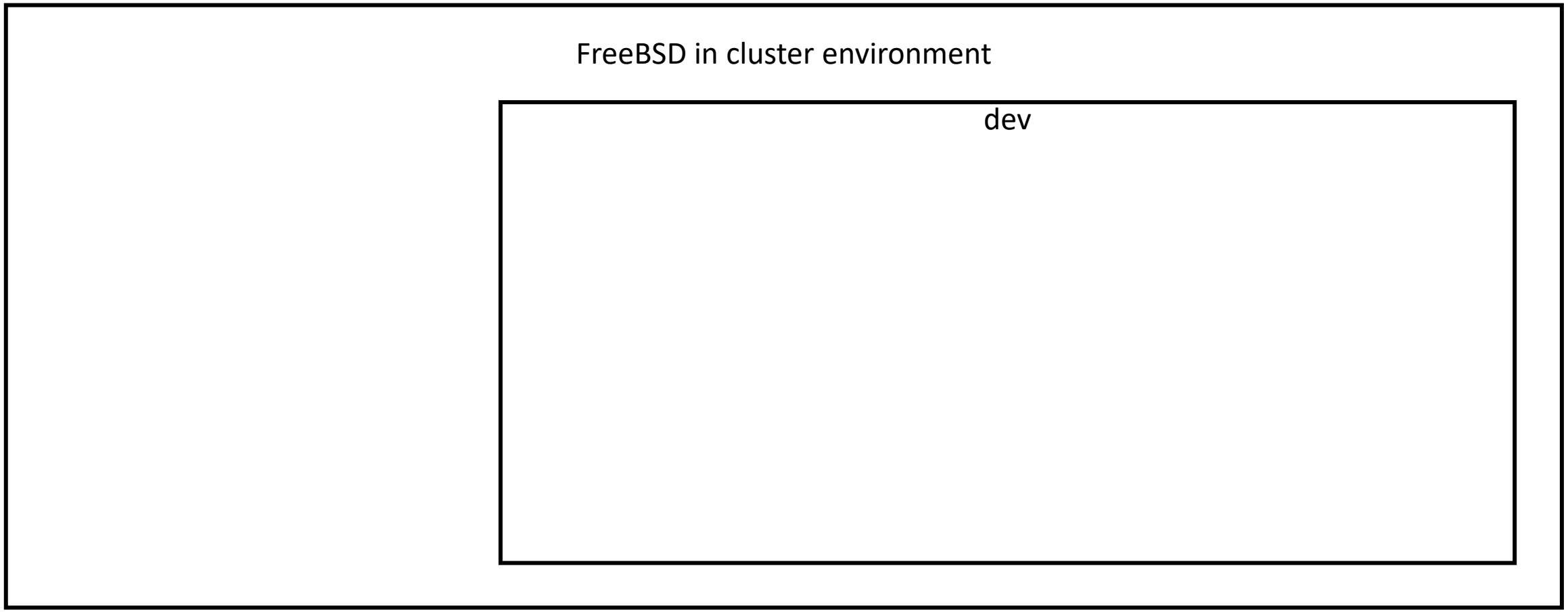
History of bhyve related projects in UPB

- From 2014: instruction caching (GSOC)
- From 2015: bhyve on armv7 (GSOC + UPB)
- From 2015: Audio support (GSOC)
- From 2016: ATA emulation (GSOC)
- From 2016: Save/restore feature (UPB)
- From 2017: bhyve on armv8 (UPB)
- From 2017: Live migration (UPB)
- From 2018: libvdsk (UPB)
- From 2019: USB passthrough (UPB)
- From 2019: FreeBSD as a Compute Node in OpenStack

Activity in the FreeBSD world

FreeBSD in cluster environment

Activity in the FreeBSD world

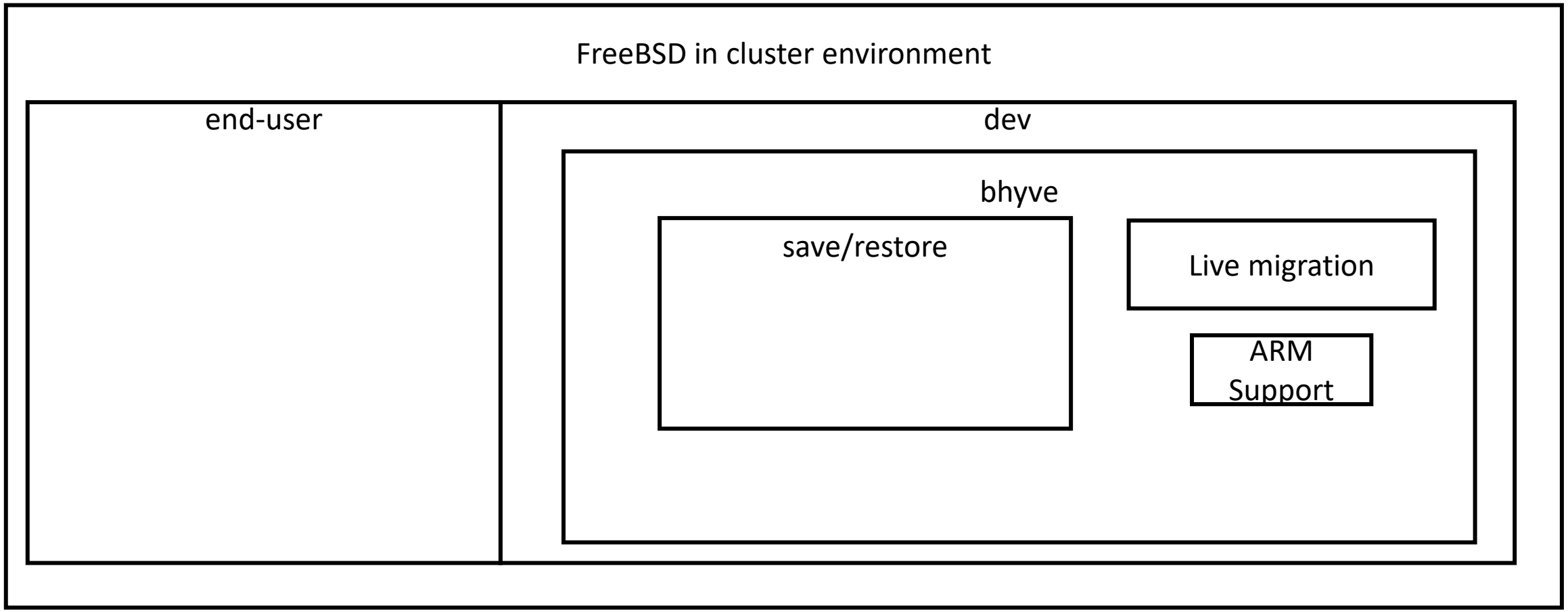


Activity in the FreeBSD world

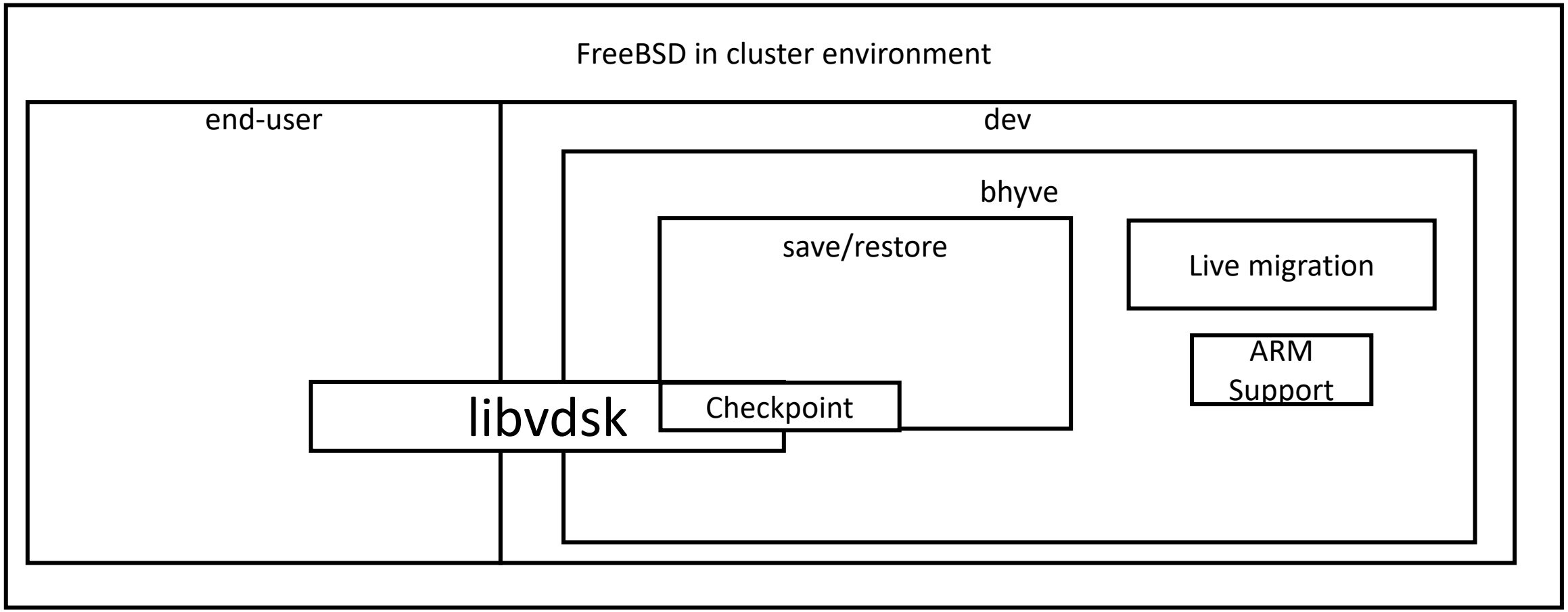
FreeBSD in cluster environment

end-user	dev

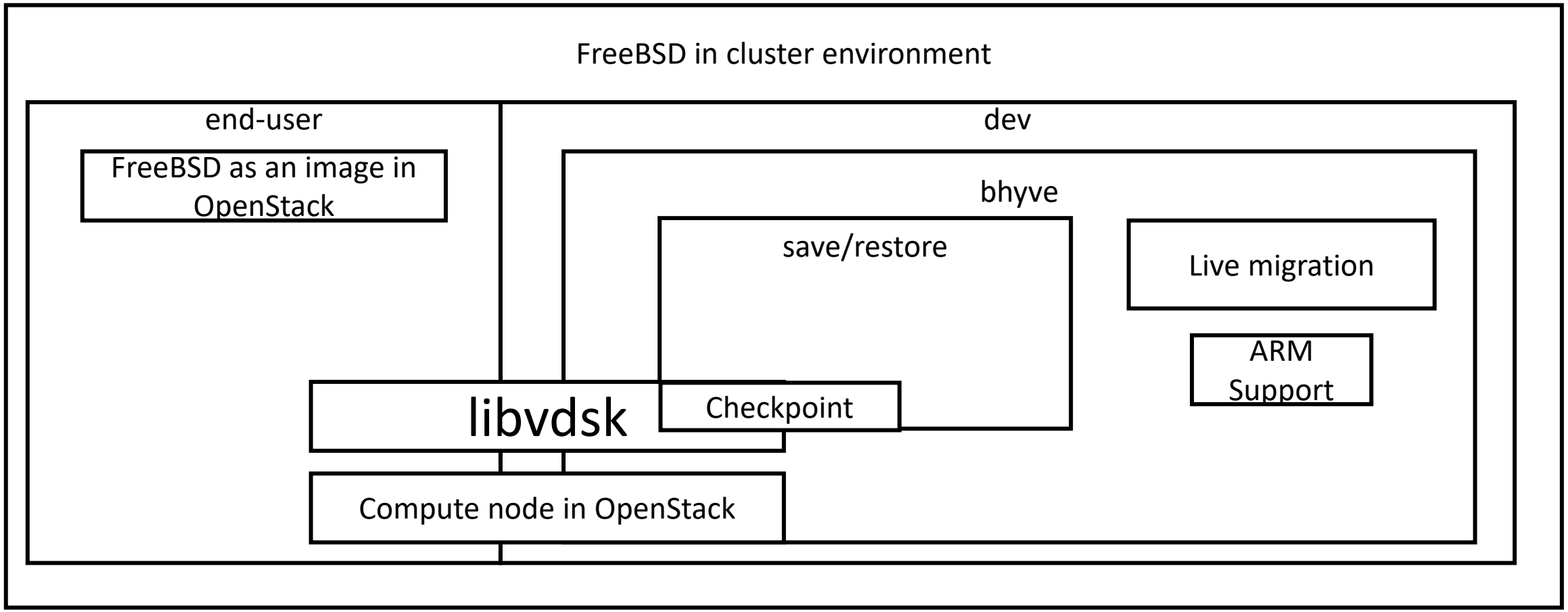
Activity in the FreeBSD world



Activity in the FreeBSD world



Activity in the FreeBSD world



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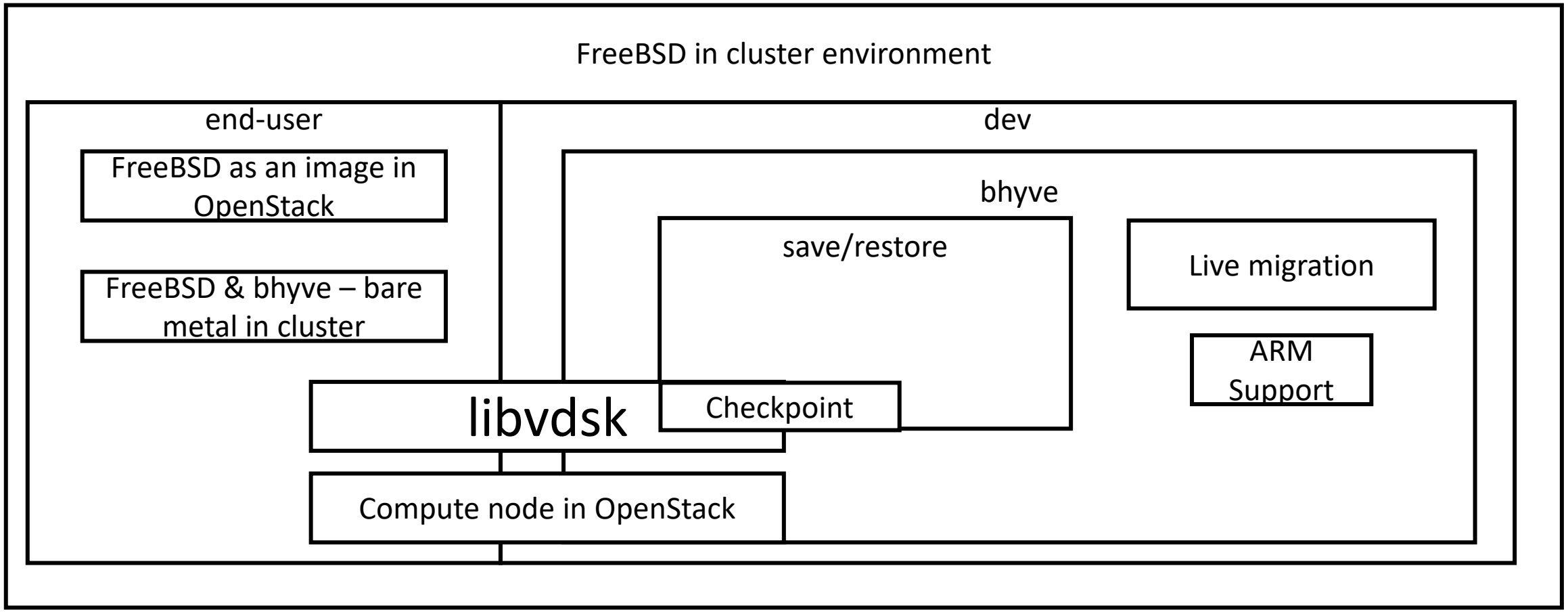
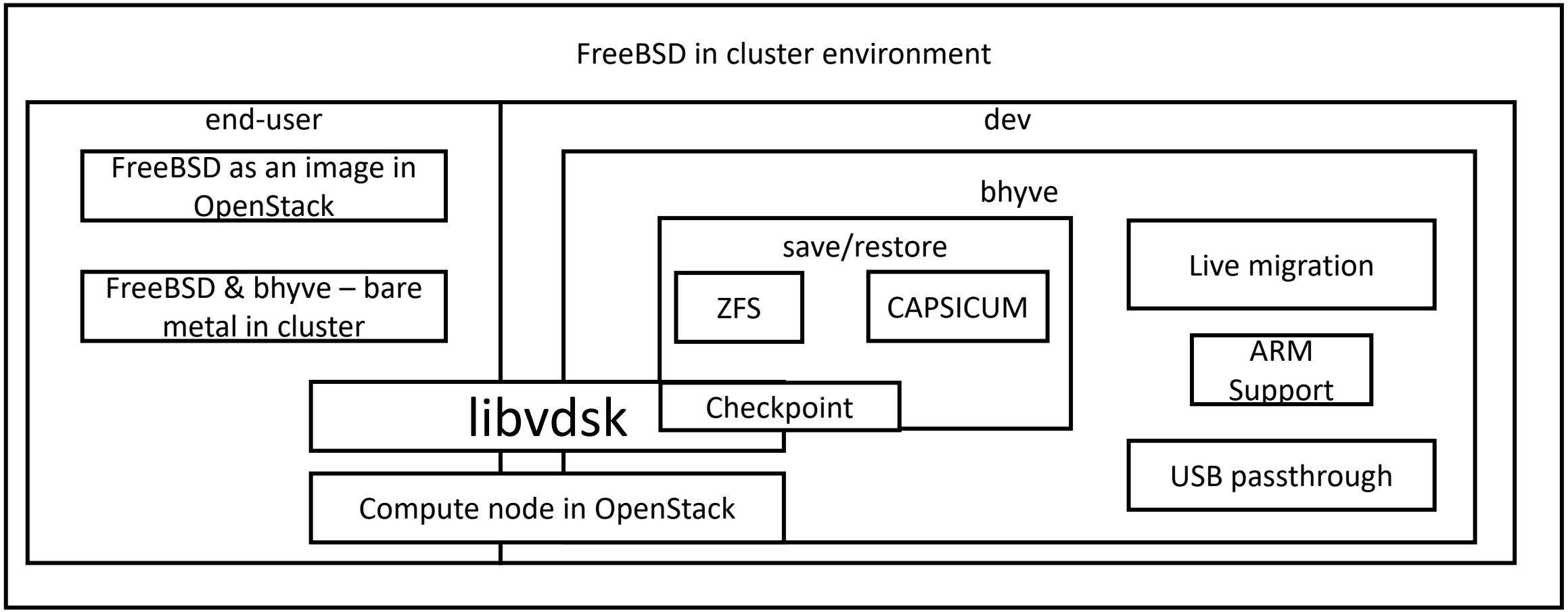


Activity in the FreeBSD world



bhyve on arm

- bhyve on armv7
  - Dropped
- bhyve on armv8
  - review: https://reviews.freebsd.org/D26976
- Check out our wiki page: https://github.com/FreeBSD-UPB/freebsd-src/wiki#bhyve-on-arm
- No more students who are interested in this component

bhyve – save/restore

- Snapshot save/restore multiple devices:
  - Stale review from 2020: https://reviews.freebsd.org/D26387
  - This feature is reworked by someone else

- Snapshot JSON
  - Stale review from 2021: https://reviews.freebsd.org/D29262
  - Will likely be dropped

bhyve – save/restore

- Checkpoint
  - Using libvdsk: https://github.com/FreeBSD-UPB/freebsd-src/wiki#checkpoint-functionality-for-bhyve-using-libvdsk
  - Using ZFS snapshots: https://github.com/FreeBSD-UPB/freebsd-src/wiki#checkpoint-functionality-for-bhyve-using-zfs-snapshots
- CAPSICUM integration:
  - Review from 2022: https://reviews.freebsd.org/D34547
  - This feature is reworked by someone else
- No more students who are interested in these features

bhyve – save/restore

- Wiki pages describing the features:
  - https://github.com/FreeBSD-UPB/freebsd-src/wiki#saverestore-for-multiple-same-type-devices-for-bhyve
  - https://github.com/FreeBSD-UPB/freebsd-src/wiki#json-file-format-for-the-saverestore-functionality-in-bhyve
  - https://github.com/FreeBSD-UPB/freebsd-src/wiki#capsicum-integration-for-the-saverestore-functionality-in-bhyve
  - https://github.com/FreeBSD-UPB/freebsd-src/wiki#checkpoint-functionality-for-bhyve-using-zfs-snapshots
  - https://github.com/FreeBSD-UPB/freebsd-src/wiki#checkpoint-functionality-for-bhyve-using-libvdsk

bhyve – live migration

- Warm Migration:
  - First review opened in 2021: https://reviews.freebsd.org/D28270
  - 5 reviews from 2022 starting with https://reviews.freebsd.org/D34717 (same feature split in multiple parts)
  - Wiki page: https://github.com/FreeBSD-UPB/freebsd-src/wiki#warm-migration-for-bhyve

bhyve – live migration

- Live Migration:
  - 3 reviews from 2022 starting with https://reviews.freebsd.org/D34722
  - New features:
    - Implementation for non-wired guests
    - Various bug fixes
    - Maximum bandwidth allowed, not in a review: https://github.com/FreeBSD-UPB/freebsd-src/tree/projects/bhyve_migration_bandwidth_throttle
    - Dynamically compute the number of rounds, still in testing phase
  - Wiki page: https://github.com/FreeBSD-UPB/freebsd-src/wiki/Virtual-Machine-Migration-using-bhyve

  - Currently only one student works on this but will leave the project in June.

bhyve – USB passthrough

- Status:
  - Passthrough an USB device (keyboard and USB stick). Both types of devices work properly after being passed through
  - We need to add a "reattach to host" mechanism (what happens when the VM is destroyed)
  - Some issues were reported
  - Wiki page: https://github.com/FreeBSD-UPB/freebsd-src/wiki#usb-passthrough-for-bhyve
- No more students who are interested in this feature

FreeBSD in cluster environment (Research)

- FreeBSD as a compute node in OpenStack:
  - Published paper: https://ieeexplore.ieee.org/document/9266213
  - Proof of concept
  - Issues with networking
  - Started to “port” Linux’s capabilities to CAPSICUM (or find another workaround)
  - No students to work on this anymore
  - Repository: https://github.com/FreeBSD-UPB/OpenStack-with-bhyve
- Newer approach from The FreeBSD Foundation (waiting for it)

libvdsk

- Supports multiple formats:
  - QCOW2
  - VMDK (monolithic sparse is the main one)
  - VDI
  - VHD
- Supports internal and external snapshots
  - Integrated with the save restore functionality
- Increased performance using range locks

libvdsk plans

- Past experience with big diffs proved it isn't a viable strategy
  - Split work in small readable reviews
- Libvdsk commit phases
  1) Add libvdsk with only RAW files
  2) Add QCOW2 support
  3) Add integration with save/restore

libvdsk links

- Bhyve integration with libvdsk
  - https://github.com/FreeBSD-UPB/freebsd-src/tree/projects/bhyve_libvdsk_integration
- Virtual disk branches
  - https://github.com/FreeBSD-UPB/libvdsk

Thanks to our students

- Mihai B
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- Naina
- Lucian
- Daniel
- Andreea
- George
- Mihai S
- Valentin
- Georgian
- Eric

Conclusions

- Various reviews that are stale
  - Obsolete or reworked
  - Comments for the migration reviews can be quickly applied until June 2023.

- No students to work with on these projects anymore:
  - Frustrations regarding:
    - Code rebasing
    - Code splitting
    - Opening reviews
    - Stale reviews (backlog maintenance)

Resources

- FreeBSD-UPB wiki page
  - https://github.com/FreeBSD-UPB/freebsd-src/wiki#welcome-to-the-freebsd-upb-wiki-page
  - Tutorials & various information

- FreeBSD-UPB GitHub repo:
  - https://github.com/FreeBSD-UPB

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