The State of the Barrelfish Project

David Cock

September 8, 2015

Highlights
Publications
Changes in Barrelfish
Joint Workshop
The Project
Members & Contributors
How Do We Organise?
How Do We Write Code?
Projects
Research Direction
Rack-Scale Computing
Memory
Consensus
Communication
Formal Methods

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Papers

- Gerber et. al., “Not your parents physical address space”, HOTOS’15
- Kästle et. al., “Shoal: Smart Allocation and Replication of Memory For Parallel Programs”, USENIX ATC’15
- Peter et. al., “Arrakis: The Operating System is the Control Plane”, OSDI’14
- Zellweger et. al., “Decoupling Cores, Kernels, and Operating Systems”, OSDI’14
- Baumann et. al., “Cosh: Clear OS Data Sharing In An Incoherent World”, TRIOS’14

Posters

- Kästle et. al., “Shoal: smart allocation and replication of memory for parallel programs”, EUROSYS’15
- Shinde at. al., “Intelligent NIC Queue Management in the Dragonet Network Stack”, EUROSYS’15
- Hoffman, “Rack - aware operating systems”, EUROSYS’15

Barrelfish Releases

10 releases so far this year!

Highlights

- Contributor sign-off process.
- Large page support (thanks HP).
- Many Xeon Phi improvements.
- Initial ARMv8 code.
- Arrakis.
- Overhauled build system.

Arrakis Is Mainline

Peter et. al., OSDI'14

- Barrelfish repository is now the canonical source.
- Mostly thanks to Simon Gerber.
- Includes e10k support.

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FM/Security Workshop

We had a day of talks with Prof. Basin's group.

- Several areas of common interest: Authority (caps) & consensus.
- New projects starting up.

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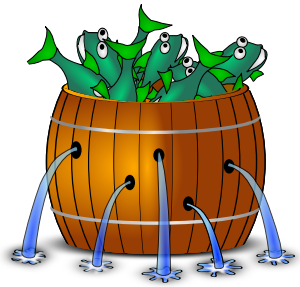
Barrelfish Facts

- 9 architectures.
- 42 applications (+51 test apps).
- 63 libraries.
- 9 languages.
- 32 committers.
- 8 years old.
- $>$ 1.1M lines of code.

The Current ETH Barrelfish Team



Reto Achermann, David Cock, Simon Gerber, Moritz Hoffman, Stephan Kästle, Timothy Roscoe, Pravin Shinde, Gerd Zellweger.

Kornilios Kourtis now at IBM Zürich.

External Members and Contributors

University of Washington

Simon Peter

Microsoft Research, Redmond

Andrew Baumann

Microsoft Research, Silicon Valley

Paul Barham, Rebecca Isaacs, Vijayan Prabhakaran

Microsoft Research, Cambridge

Richard Black, Tim Harris, Orion Hodson, Ross McIlroy

Hewlett Packard

Various

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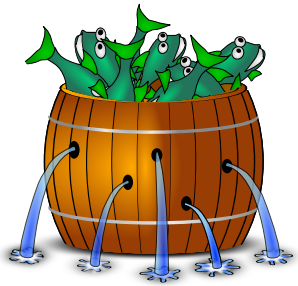

Barrelfish is now a big project:

- Lots of contributors.
- *Lots* of code.
- More and more users.

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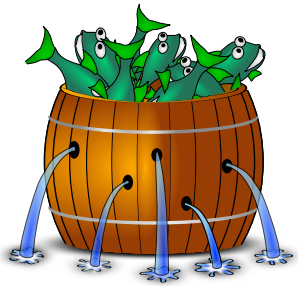

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- Lots of engineering and support work now.

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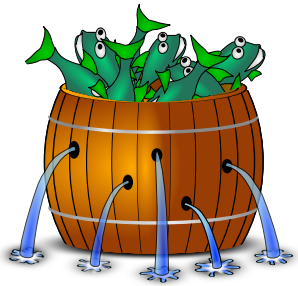

Barrelfish is now a big project:

- Lots of contributors.
- *Lots* of code.
- More and more users.
- Lots of engineering and support work now.
- But it's still a *research* project!

Setting the Direction

Heavily driven by individual projects

- Arrakis was driven by Simon Peter at UW.
- SKB — Adrian Schüpbach (PhD).
- Distributed cap system — Mark Neville & Simon Gerber (Master).

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But there is an overall direction

- Heterogeneous hardware.
- Highly distributed machines.

Day-to-day Management

- Mothy is the Professor.
- Day-to-day organisation (meetings, releases, . . .) mostly the ranking Post-Doc (currently me).
- Students work mostly independently, in a branch.
- Regular communication:
  - Compulsory weekly group meeting.
  - 15M stand-up meeting 3/week.
  - Everyone idles in IRC.

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External Contributions

A lot of work is done outside ETH:

- Former SG members e.g. Andrew Baumann (MSR), Simon Peter (UW).
- External contributors e.g. HP Bangalore — ARMv8.

Contribution Process

1. Clone the latest public release.
2. Work in a branch.
3. Send a diff, with no proprietary or GPL code.
4. Internal comitter signs off and merges.

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Changes & Questions

- What is core infrastructure (libc)? Who maintains it?
- Should bug tracking be public? How?
- Who is responsible for bugs?

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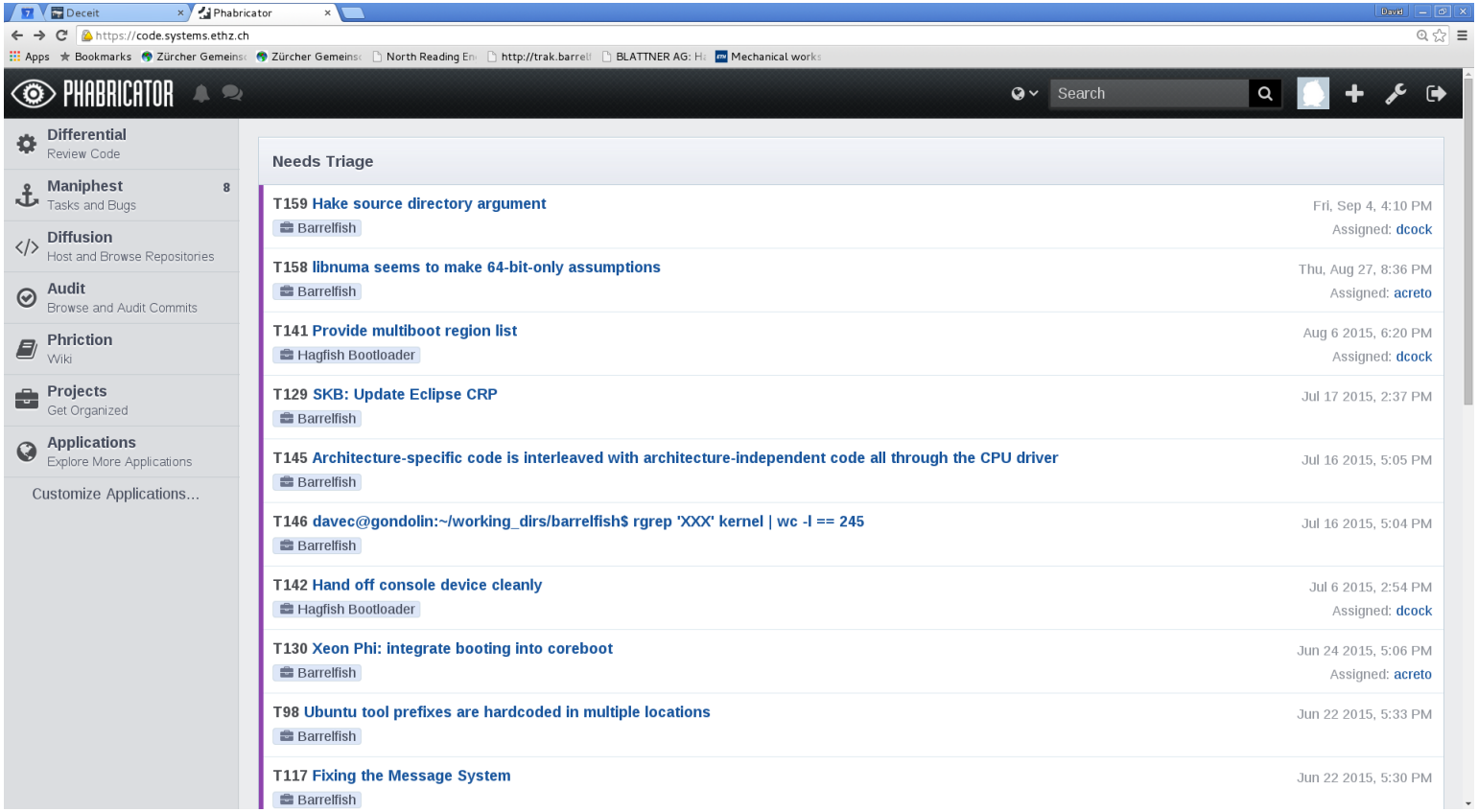
Repositories & Branches



- Private git repository.
- Pushed to public repo on releases.
- Shared repos for collaborators (e.g. Huawei).
- Repos hosted in Fabricator.

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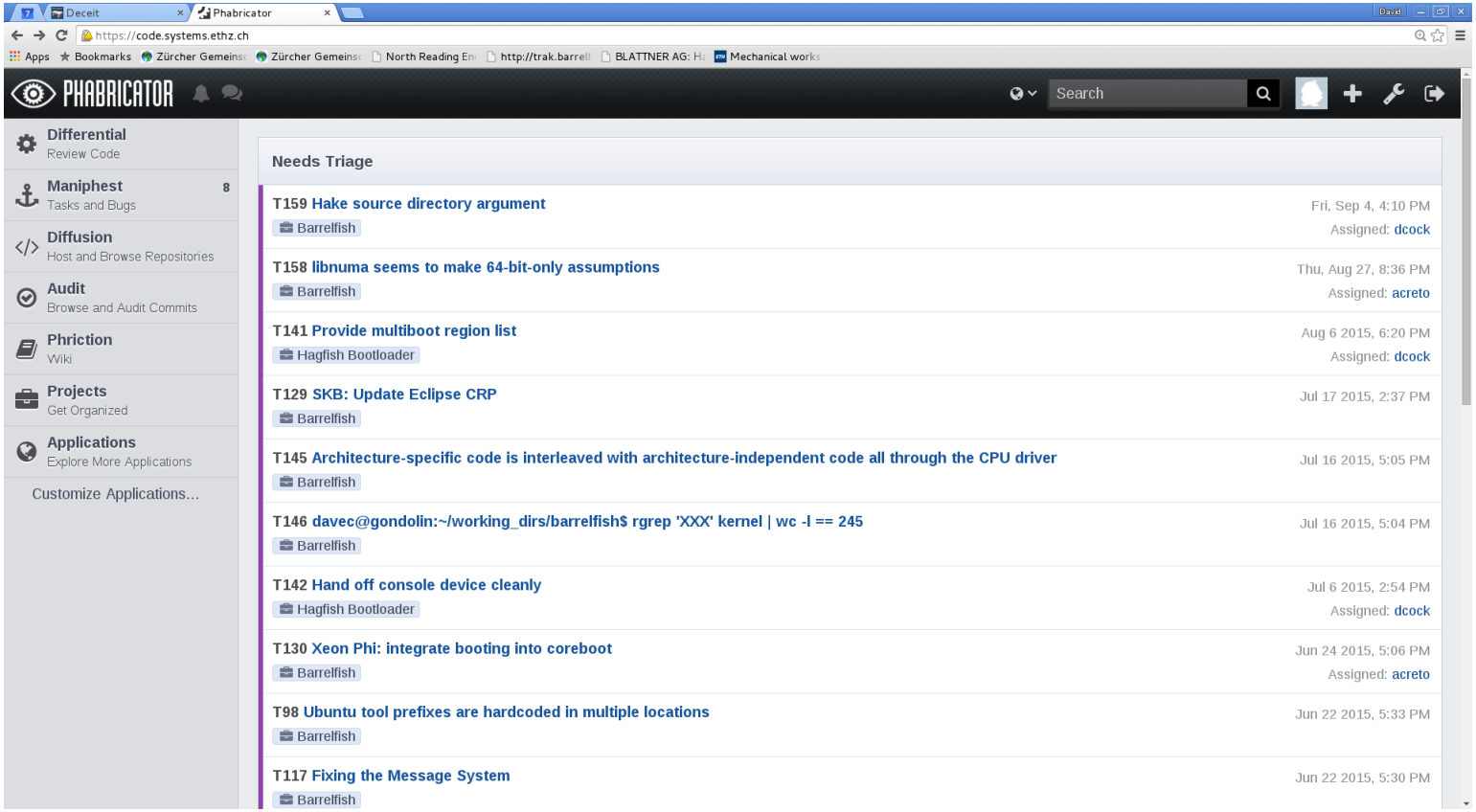
Bug Tracking



- Managed in Fabricator.
- Integrated with repository commits.

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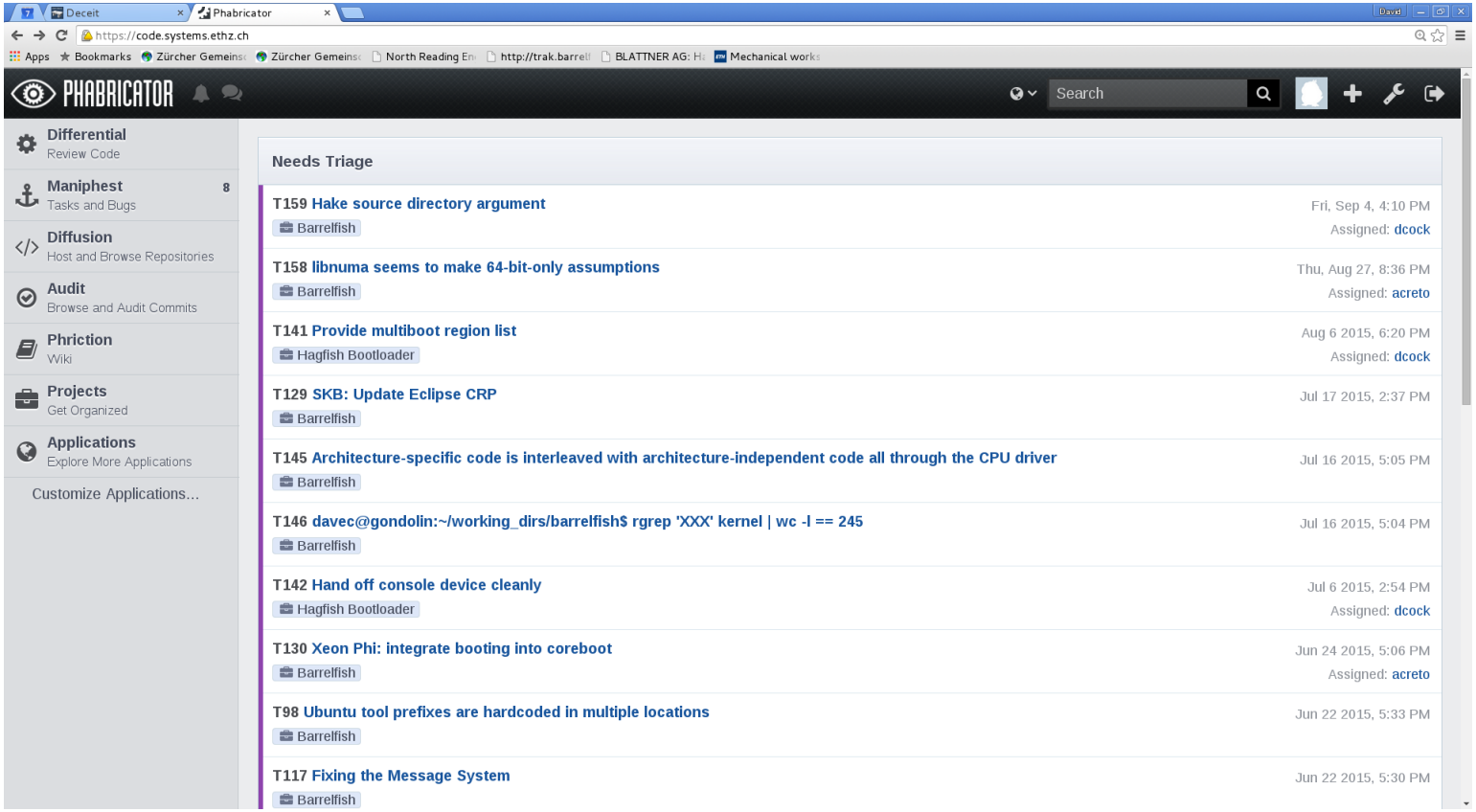

- Managed in Fabricator.
- Integrated with repository commits.
- *Not public*.

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Continuous Integration

- Barrelfish is tested nightly.
- Release only when tests are green.
- Current system is creaky.
- Bitten seems to be unsupported.

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Continuous Integration

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Replacement CI tool

- Supported.
- Test private branches.
- Easy to configure plenty of tests.

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Technical Debt

From the Barrelfish source:

Technical Debt

From the Barrelfish source:

XXX: workaround for backwards compatibility: prepend default path
XXX: workaround to allow working around the previous workaround

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Technical Debt

From the Barrelfish source:

XXX: workaround for backwards compatibility: prepend default path
XXX: workaround to allow working around the previous workaround

$ rgrep 'TODO' kernel — wc -l
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Technical Debt

From the Barrelfish source:

XXX: workaround for backwards compatibility: prepend default path
XXX: workaround to allow working around the previous workaround

$ rgrep 'TODO' kernel — wc -l
91

$ rgrep 'voodoo' kernel — wc -l
1

Projects

- ARMv8 (64-bit)
  - Huawei grant.
  - Much more like an x86 server.
- UEFI (Hagfish)
  - UEFI required for ARMv8 servers.
  - x86 is going this way anyway.
- Build System (Hake)
  - Was really slow $\rightarrow$ faster now.
  - Still questions about platform configuration.
- Infiniband & RDMA
  - This is how rack-scale machines communicate.
  - Extend the multikernel idea (*can't* share state).

Student Projects

- Go, Martynas. Integration with LMP/UMP channels.
- Dynamic Libraries, David.
- Graphene, Yves.
- RDMA Capabilities, Benjamin.

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Single System Image

- The Datacenter as a secure, programmable machine.
- Run one OS ‘image’ on a whole rack.
- Memory management.
- Coordination & Consensus.
- Communication.

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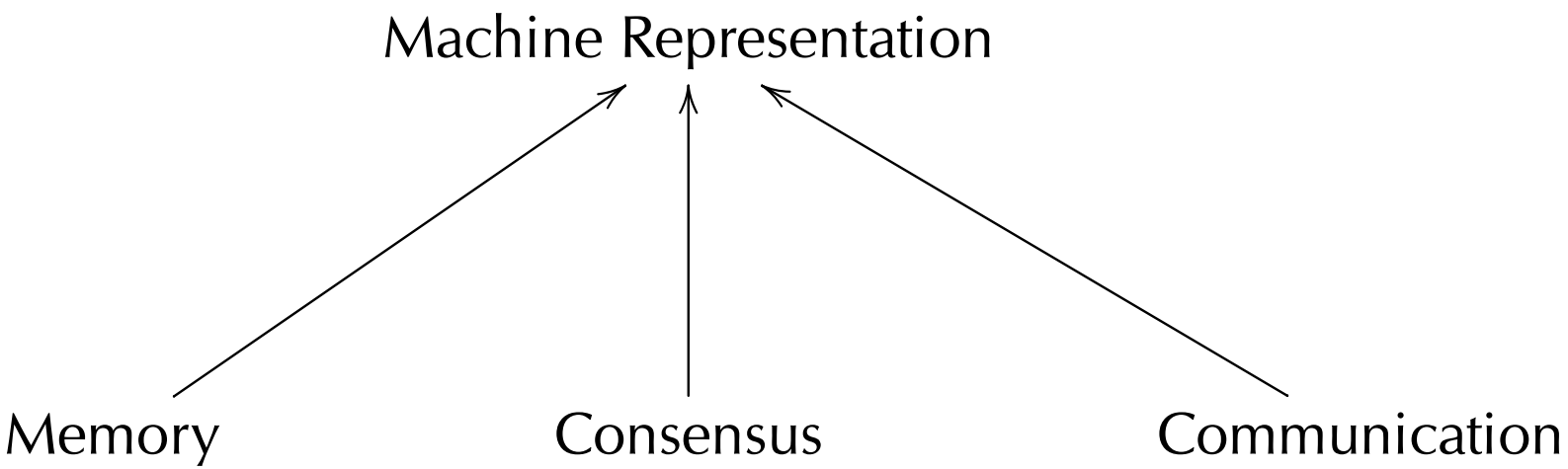

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Memory

Cichlid

Self-paging with exposed physical addresses.

- Submitted to SOSP'15, didn't get up.
- Develop and resubmit to Eurosys'16.

Shoal

- NUMA and cache-aware allocation.
- Even more important if we're doing RDMA.

Consensus

Collaboration with InfSec

- Consensus protocols.
- High-level security models (using caps).

Multilevel Broadcast

- What's the fastest way to communicate on a multicore?

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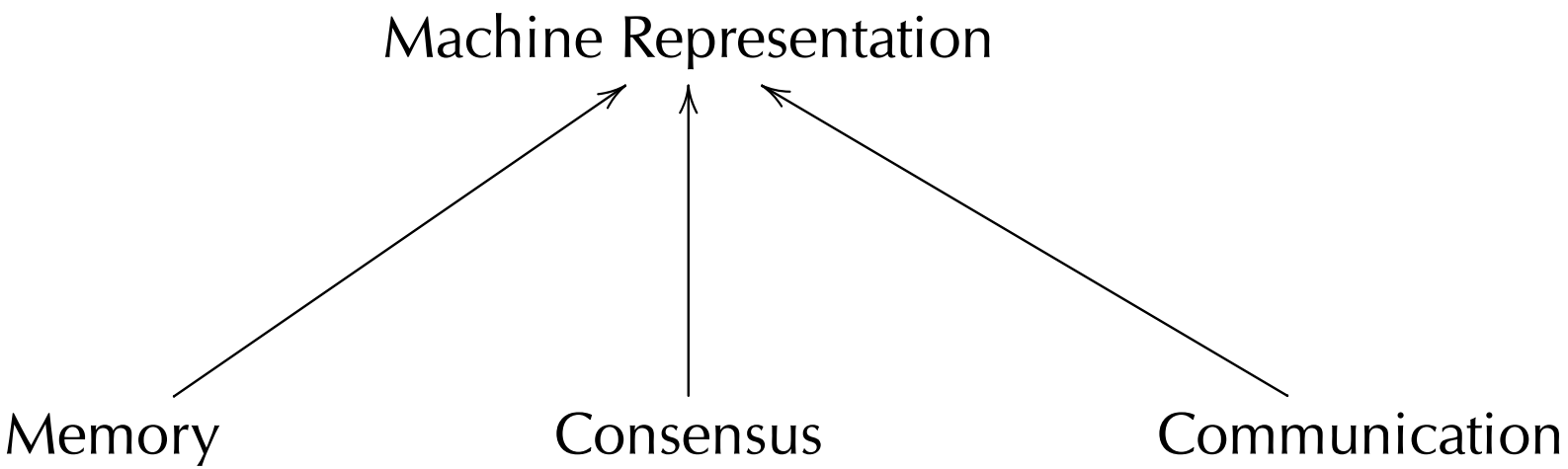
Communication

Infiniband & RDMA

- How to do security? Caps?
- Sensible abstractions.

Dragonet

- The machine is a network.
- Use the hardware efficiently.


Machine Representation
Memory
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Machine Representation

What does the machine look like?

- We need a way to talk about these things.
- Preferably a single way.
- We need some sort of ontology.

Update the SKB

- This is what it was designed for.
- Extend its capabilities (NUMA placement, miniSAT).

Formal Methods

We've got an MLoC research project, with some code quality issues. Can FM help?

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Apply FM where there's low effort, or high benefit.

- Automatic static analysis e.g. Goanna (low effort).
- Concurrency (lots of bugs).
- Hardware interface (lots of bugs, bad models).

Questions?

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