

序号	指标项	复现情况
1.1	30个以上OS无关的功能组件	50个 ✓
1.2	20个以上与OS相关的功能组件	6个 ✓
1.3	可在物理设备上运行的unikernel架构的OS内核主干	已复现 ✓
1.4	可在物理设备上运行的monolithickernel架构的OS内核主干	已复现 ✓
1.5	国产处理器对OS编译环境的支持	已复现 ✓
2.1	在x86硬件平台上支持运行redis，相对Linux下，性能提升10%以上，避免Linux中的常见内存缺陷	已复现 ✓
2.2	在x86硬件平台上支持运行tokio，相对Linux下，性能提升10%以上，避免Linux中的常见内存缺陷	已复现 ✓

## 【1.1】 30个以上OS无关的功能组件 ✓

总数：50个

序号	已完成的组件	项目链接	文档	复现情况
1	allocator	<a href="https://github.com/arm-software/allocator">https://github.com/arm-software/allocator</a>	<a href="https://os-cherker.github.io/docs/kern-crates/allocator/">https://os-cherker.github.io/docs/kern-crates/allocator/</a>	<pre>running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Running tests/allocator.rs (target/debug/deps/allocator-b843db87d5316350)  running 4 tests test system_alloc ... ok test tlsf_alloc ... ok test slab_alloc ... ok test buddy_alloc ... ok test result: ok. 4 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 6.75s  Doc-tests allocator running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s</pre>
2	arm_pl031	<a href="https://github.com/arm-software/arm_pl031">https://github.com/arm-software/arm_pl031</a>	<a href="https://os-cherker.github.io/docs/kern-crates/arm_pl031/">https://os-cherker.github.io/docs/kern-crates/arm_pl031/</a>	<pre>running 2 tests test tests::test_get_timestamp ... ok test tests::test_set_timestamp ... ok test result: ok. 2 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests arm_pl031 running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s</pre>

序号	已完成的组件	项目链接	文档	复现情况
3	axfs_crates	<a href="https://github.com/arceos-org/axfs_crates">https://github.com/arceos-org/axfs_crates</a>	<a href="https://arceos.org/axfs_crate_s/">https://arceos.org/axfs_crate_s/</a>	<pre>running 1 test test tests::test_devfs ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Running unittests src/lib.rs (target/debug/deps/axfs_ramfs-3221f39412bfeb43) running 1 test test tests::test_ramfs ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Running unittests src/lib.rs (target/debug/deps/axfs_vfs-10fe8fad23242240) running 1 test test path::tests::test_path_canonicalize ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Doc-tests axfs_devfs running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Doc-tests axfs_ramfs running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Doc-tests axfs_vfs running 1 test test axfs_vfs/src/path.rs - path::canonicalize (line 12) ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.14s</pre>
4	crate_interface	<a href="https://github.com/arceos-org/crate_interface">https://github.com/arceos-org/crate_interface</a>	<a href="https://os-checker.github.io/docs/kern-crates/crate_interface/crate_interface/">https://os-checker.github.io/docs/kern-crates/crate_interface/crate_interface/</a>	<pre>running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Running tests/test_crate_interface.rs (target/debug/deps/test_crate_interface-78da0473653e9d9e) running 1 test test test_crate_interface_call ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Doc-tests crate_interface running 2 tests test src/.../README.md - (line 46) ... ok test src/.../README.md - (line 13) ... ok test result: ok. 2 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.05s</pre>
5	elf_parser_rs	<a href="https://github.com/Azure-s-tars/elf_parser_rs">https://github.com/Azure-s-tars/elf_parser_rs</a>	<a href="https://os-checker.github.io/docs/kern-crates/elf_parser_rs/elf_parser_rs/">https://os-checker.github.io/docs/kern-crates/elf_parser_rs/elf_parser_rs/</a>	<pre>running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Running tests/test_dynamic.rs (target/debug/deps/test_dynamic-79d418c913ec0a24) running 1 test test test_elf_parser ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Running tests/test_static.rs (target/debug/deps/test_static-d70b27a6cd3d8dfe) running 1 test test test_elf_parser ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Doc-tests elf_parser_rs running 1 test test src/.../README.md - (line 16) ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.06s</pre>
6	int_ratio	<a href="https://github.com/arceos-org/int_ratio">https://github.com/arceos-org/int_ratio</a>	<a href="https://os-checker.github.io/docs/kern-crates/int_ratio/int_ratio/">https://os-checker.github.io/docs/kern-crates/int_ratio/int_ratio/</a>	<pre>running 2 tests test tests::test_ratio ... ok test tests::test_zero ... ok test result: ok. 2 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Doc-tests int_ratio running 4 tests test src/lib.rs - Ratio::mul_round (line 101) ... ok test src/lib.rs - Ratio::mul_trunc (line 85) ... ok test src/.../README.md - (line 14) ... ok test src/lib.rs - Ratio::inverse (line 71) ... ok test result: ok. 4 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.04s</pre>

序号	已完成的组件	项目链接	文档	复现情况
7	kernel-elf-parser	<a href="https://github.com/StarOS/kernel-elf-parser">https://github.com/StarOS/kernel-elf-parser</a>	<a href="https://docs.kernel.org/kernel-elf-parser">https://docs.kernel.org/kernel-elf-parser</a>	<pre> running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Running tests/test_dynamic.rs (target/debug/deps/test_dynamic-a5baf5df82d45afa) running 1 test test test_elf_parser ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Running tests/test_static.rs (target/debug/deps/test_static-d8743860ee51113e) running 1 test test test_elf_parser ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Doc-tests kernel_elf_parser running 1 test test src/.../README.md - (line 16) ... ignored test result: ok. 0 passed; 0 failed; 1 ignored; 0 measured; 0 filtered out; finished in 0.00s </pre>
8	kspin	<a href="https://github.com/arc4eos-org/kspin">https://github.com/arc4eos-org/kspin</a>	<a href="https://os-checker.github.io/docs/kernel-crates/kspin/kspin/">https://os-checker.github.io/docs/kernel-crates/kspin/kspin/</a>	<pre> running 7 tests test base::tests::test_into_inner ... ok test base::tests::test_into_inner_drop ... ok test base::tests::smoke ... ok test base::tests::test_mutex_force_lock ... ok test base::tests::test_mutex_unsized ... ok test base::tests::test_mutex_arc_nested ... ok test base::tests::test_mutex_arc_access_in_unwind ... ok test result: ok. 7 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Doc-tests kspin running 1 test test src/.../README.md - (line 16) ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.04s </pre>
9	linked_list_r4l	<a href="https://github.com/arc4eos-org/linked_list_r4l">https://github.com/arc4eos-org/linked_list_r4l</a>	<a href="https://os-checker.github.io/docs/kernel-crates/linked_list_r4l-10/linked_list_r4l/">https://os-checker.github.io/docs/kernel-crates/linked_list_r4l-10/linked_list_r4l/</a>	<pre> running 5 tests test linked_list::tests::test_push_back ... ok test raw_list::tests::test_push_back ... ok test raw_list::tests::test_push_front ... ok test raw_list::tests::test_one_insert_after ... ok test raw_list::tests::test_one_removal ... ok test result: ok. 5 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Doc-tests linked_list_r4l running 3 tests test src/lib.rs - def_node (line 113) ... ignored test src/.../README.md - (line 15) ... ok test src/lib.rs - def_node (line 124) ... ok test result: ok. 2 passed; 0 failed; 1 ignored; 0 measured; 0 filtered out; finished in 0.06s </pre>
10	memory_set	<a href="https://github.com/arc4eos-org/memory_set">https://github.com/arc4eos-org/memory_set</a>	<a href="https://os-checker.github.io/docs/kernel-crates/mm_crates/memory_set/">https://os-checker.github.io/docs/kernel-crates/mm_crates/memory_set/</a>	<pre> running 3 tests test tests::test_protect ... ok test tests::test_unmap_split ... ok test tests::test_map_unmap ... ok test result: ok. 3 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s Doc-tests memory_set running 1 test test src/.../README.md - (line 18) ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.13s </pre>

序号	已完成的组件	项目链接	文档	复现情况
11	pager	<a href="https://github.com/os-cher/pager">https://github.com/os-cher/pager</a>	<a href="https://os-cher.github.io/docs/kern-crates/pager/pager/">https://os-cher.github.io/docs/kern-crates/pager/pager/</a>	<pre> running 4 tests test buddy::tests::test_alloc_pages ... ok test common_test::test_init ... ok test common_test::test_alloc_dealloc ... ok test bitmap::tests::test_not_specify_n_pages ... ok  test result: ok. 4 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.01s  Doc-tests pager  running 1 test test src/lib.rs - (line 5) - compile ... ok  test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.02s </pre>
12	rvfs	<a href="https://github.com/os-cher/rvfs">https://github.com/os-cher/rvfs</a>	<a href="https://os-cher.github.io/docs/kern-crates/rvfs/vfscore/">https://os-cher.github.io/docs/kern-crates/rvfs/vfscore/</a>	<pre> running 0 tests  test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Running unittests src/main.rs (target/debug/deps/demo-5207a65969979e8)  running 0 tests  test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Running unittests src/lib.rs (target/debug/deps/devfs-453baa85083a3052)  running 0 tests  test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Running tests/test.rs (target/debug/deps/test-6ba10da26ee7598a)  running 4 tests test test_link ... ok test test_rename ... ok test test_symlink ... ok test test_unlink ... ok  test result: ok. 4 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s </pre>
13	scheduler	<a href="https://github.com/os-cher/ceos-scheduler">https://github.com/os-cher/ceos-scheduler</a>	<a href="https://os-cher.github.io/docs/kern-crates/scheduler/scheduler/">https://os-cher.github.io/docs/kern-crates/scheduler/scheduler/</a>	<pre> running 9 tests test tests::cifs::test_sched ... ok test tests::fifo::test_sched ... ok test tests::rrr::test_sched ... ok test tests::fifo::bench_remove ... ok test tests::cifs::bench_remove ... ok test tests::rrr::bench_yield ... ok test tests::fifo::bench_yield ... ok test tests::rrr::bench_remove ... ok test tests::cifs::bench_yield ... ok  test result: ok. 9 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 5.52s  Doc-tests scheduler  running 0 tests  test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s </pre>
14	slab_allocator	<a href="https://github.com/os-cher/ceos-slab_allocator">https://github.com/os-cher/ceos-slab_allocator</a>	<a href="https://arceos.org/slab_allocator/index.html">https://arceos.org/slab_allocator/index.html</a>	<pre> running 7 tests test tests::allocate_and_free_double_size ... ok test tests::allocate_double_size ... ok test tests::allocate_multiple_sizes ... ok test tests::oom ... ok test tests::reallocate_double_size ... ok test tests::allocate_multiple_4096_blocks ... ok test tests::allocate_one_4096_block ... ok  test result: ok. 7 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests slab_allocator  running 0 tests  test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s </pre>

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15	syscall-table	<a href="https://github.com/os-cheron-crates/syscall-table">https://github.com/os-cheron-crates/syscall-table</a>	<a href="https://os-checker.github.io/docs/kern-crates/syscall-table/syscall-table/">https://os-checker.github.io/docs/kern-crates/syscall-table/syscall-table/</a>	<pre> running 2 tests test tests::register_macro_test ... ok test tests::table_register_test ... ok test result: ok. 2 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests syscall_table  running 3 tests test src/lib.rs - register_syscall (line 366) ... ok test src/lib.rs - (line 10) ... ok test src/lib.rs - invoke_call (line 404) - compile fail ... ok test result: ok. 3 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.17s </pre>
16	timer_list	<a href="https://github.com/os-cheron-org/timer-list">https://github.com/os-cheron-org/timer-list</a>	<a href="https://os-checker.github.io/docs/kern-crates/timer-list/timer-list/">https://os-checker.github.io/docs/kern-crates/timer-list/timer-list/</a>	<pre> running 2 tests test tests::test_timer_list_fn ... ok test tests::test_timer_list ... ok test result: ok. 2 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 4.01s  Doc-tests timer_list  running 1 test test src/./README.md - (line 12) ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 1.07s </pre>
17	tuple_for_each	<a href="https://github.com/os-cheron-org/tuple-for-each">https://github.com/os-cheron-org/tuple-for-each</a>	<a href="https://os-checker.github.io/docs/kern-crates/tuple-for-each/tuple-for-each/">https://os-checker.github.io/docs/kern-crates/tuple-for-each/tuple-for-each/</a>	<pre> running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Running tests/test_tuple_for_each.rs (target/debug/deps/test_tuple_for_each-ac6b125e9e3662e)  running 4 tests test test_enumerate ... ok test test_enumerate_mut ... ok test test_for_each_mut ... ok test test_for_each ... ok test result: ok. 4 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests tuple_for_each  running 1 test test src/./README.md - (line 20) ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.05s </pre>
18	arm-gic-driver	<a href="https://github.com/os-cheron-org/arm-gic-driver">https://github.com/os-cheron-org/arm-gic-driver</a>	<a href="https://os-checker.github.io/docs/ZR233/arm-gic-driver/arm-gic-driver/">https://os-checker.github.io/docs/ZR233/arm-gic-driver/arm-gic-driver/</a>	<pre> running 6 tests test tests::size_lpi ... ok test tests::test_ppi - should panic ... ok test tests::size_sgi ... ok test tests::test_sgi - should panic ... ok test tests::test_vld ... ok test tests::test_vld ... ok test result: ok. 6 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s </pre>

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19	percpu	<a href="https://github.com/arms-cros-ecosystem/percpu">https://github.com/arms-cros-ecosystem/percpu</a>	<a href="https://os-cherker.github.io/docs/kern-crates/percpu/percpu/">https://os-cherker.github.io/docs/kern-crates/percpu/percpu/</a>	<pre> running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Running tests/test_percpu.rs (target/debug/deps/test_percpu-da31859d4cb2648f)  running 1 test test test_percpu ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Running unittests src/lib.rs (target/debug/deps/percpu_macros-3bbac8795483a40e)  running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests percpu running 1 test test percpu/src/lib.rs - (line 23) - compile ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.06s  Doc-tests percpu_macros running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s </pre>
20	fdt-parser	<a href="https://github.com/qclift/fdt-parser">https://github.com/qclift/fdt-parser</a>	<a href="https://os-cherker.github.io/docs/qclift/fdt-parser/fdt-parser/">https://os-cherker.github.io/docs/qclift/fdt-parser/fdt-parser/</a>	<pre> running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Running unittests src/lib.rs (target/debug/deps/fdt_parser-88e3143a5b0dfa8c)  running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Running tests/node.rs (target/debug/deps/node-5aabe57d9c5c8f8d)  running 12 tests test test::test_find_aliases ... ok test test::test_compatible ... ok test test::test_find_node2 ... ok test test::test_find_compatible ... ok test test::test_chosen ... ok test test::test_reg ... ok test test::test_find_node_aliases ... ok test test::test_clocks ... ok test test::test_interrupt ... ok test test::test_find_nodes ... ok test test::test_interrupts ... ok test test::test_interrupt2 ... ok test result: ok. 12 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.01s </pre>
21	of	<a href="https://github.com/StarOS/of">https://github.com/StarOS/of</a>	<a href="https://os-cherker.github.io/docs/kern-crates/of/of/">https://os-cherker.github.io/docs/kern-crates/of/of/</a>	<pre> running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Running tests/of.rs (target/debug/deps/of-29db862ab445c19)  running 6 tests test test::test_module ... ok test test::test_pci ... ok test test::test_irqcontroller ... ok test test::test_phandle_arg ... ok test test::test_find_compatible ... ok test test::test_platform ... ok test result: ok. 6 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.01s  Doc-tests of running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s </pre>
22	memory_addr	<a href="https://github.com/arms-cros-ecosystem/xmmcrate/tree/main/memory_addr">https://github.com/arms-cros-ecosystem/xmmcrate/tree/main/memory_addr</a>	<a href="https://os-cherker.github.io/docs/kern-crates/memory_addr/">https://os-cherker.github.io/docs/kern-crates/memory_addr/</a>	<pre> running 18 tests test addr::test::test_addr ... ok test addr::test::test_addr_arithmetic ... ok test addr::test::test_addr_convert_and_comparison ... ok test addr::test::test_addr_checked_arithmetic ... ok test addr::test::test_addr_overflow - should panic ... ok test addr::test::test_addr_offset_from_overflow - should panic ... ok test addr::test::test_addr_fmt ... ok test addr::test::test_addr_offset_from_underflow - should panic ... ok test addr::test::test_addr_overflowing_arithmetic ... ok test addr::test::test_addr_sub_overflow - should panic ... ok test addr::test::test_addr_sub_underflow - should panic ... ok test addr::test::test_addr_wrapping_arithmetic ... ok test addr::test::test_align ... ok test addr::test::test_virt_addr_ptr ... ok test range::test::test_range ... ok test range::test::test_range_format ... ok test tests::test_align ... ok test result: ok. 18 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests memory_addr running 25 tests test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::from_start_size (line 122) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::contained_in (line 270) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::from_start_size_unchecked (line 180) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::new_unchecked (line 101) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::contains_range (line 290) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::new (line 53) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::new (line 43) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::is_empty (line 202) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::contains (line 232) ... ok test memory_addr/src/range.rs - range::AddrRange (line 15) ... ok test memory_addr/src/iter.rs - iter::PagerIter (line 12) ... ok test memory_addr/src/lib.rs - (line 12) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::overlaps (line 288) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::size (line 132) ... ok test memory_addr/src/addr.rs - addr::def_usize_addr (line 285) ... ok test memory_addr/src/addr.rs - addr::def_usize_addr_formatter (line 402) ... ok test memory_addr/src/range.rs - range::addr_range (line 387) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::try_new (line 74) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::try_from_start_size (line 156) ... ok test memory_addr/src/range.rs - range::pa_range (line 429) ... ok test memory_addr/src/range.rs - range::addr_range (line 377) ... ok test memory_addr/src/range.rs - range::AddrRange&lt;A&gt;::size (line 217) ... ok test memory_addr/src/range.rs - range::pa_range (line 439) ... ok test memory_addr/src/range.rs - range::va_range (line 403) ... ok test memory_addr/src/range.rs - range::va_range (line 413) ... ok test result: ok. 25 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.22s </pre>

序号	已完成的组件	项目链接	文档	复现情况
23	cap_access	<a href="https://github.com/arceos-org/cap_access">https://github.com/arceos-org/cap_access</a>	<a href="https://os-checker.github.io/docs/kern-crates/cap_access/cap_access/">https://os-checker.github.io/docs/kern-crates/cap_access/cap_access/</a>	<pre>running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests cap_access  running 4 tests test src/lib.rs - WithCap&lt;D&gt;::can_access (line 38) ... ok test src/lib.rs - WithCap&lt;D&gt;::access_or_err (line 85) ... ok test src/lib.rs - (line 17) ... ok test src/lib.rs - WithCap&lt;D&gt;::access (line 64) ... ok test result: ok. 4 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.05s</pre>
24	flatten_objects	<a href="https://github.com/arceos-org/flatten_objects">https://github.com/arceos-org/flatten_objects</a>	<a href="https://docs.rs/flatten_objects/latest/flatten_objects/">https://docs.rs/flatten_objects/latest/flatten_objects/</a>	<pre>running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests flatten_objects  running 1 test test src/lib.rs - (line 8) ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.16s</pre> <p>在arceos内运行测例</p>
25	handler_table	<a href="https://github.com/arceos-org/handler_table">https://github.com/arceos-org/handler_table</a>	<a href="https://os-checker.github.io/docs/kern-crates/handler_table/handler_table/">https://os-checker.github.io/docs/kern-crates/handler_table/handler_table/</a>	<pre>running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests handler_table  running 1 test test src/lib.rs - (line 12) ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.04s</pre>
26	lazyinit	<a href="https://github.com/arceos-org/lazyinit">https://github.com/arceos-org/lazyinit</a>	<a href="https://os-checker.github.io/docs/kern-crates/lazyinit/lazyinit/">https://os-checker.github.io/docs/kern-crates/lazyinit/lazyinit/</a>	<pre>running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests lazyinit  running 2 tests test src/lib.rs - (line 16) ... ok test src/lib.rs - (line 35) ... ok test result: ok. 2 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.09s</pre>



序号	已完成的组件	项目链接	文档	复现情况
27	page_table_multiarch	<a href="https://github.com/arsceos-org/page_table_multiarch">https://github.com/arsceos-org/page_table_multiarch</a>	<a href="https://docs.rs/page_table_multiarch/latest/page_table_multiarch/">https://docs.rs/page_table_multiarch/latest/page_table_multiarch/</a>	<pre> running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Running unittests src/lib.rs (target/debug/deps/page_table_multiarch-b1e6b89830639e3a)  running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests page_table_entry running 1 test test page_table_entry/src/lib.rs - (line 29) ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.05s  Doc-tests page_table_multiarch running 1 test test page_table_multiarch/src/lib.rs - (line 35) ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.06s </pre> <p>需要设一个环境变量，export RUSTFLAGS="--cfg doc"</p> <p>然后cargo test</p>
28	kernel_guard	<a href="https://github.com/arsceos-org/kernel_guard">https://github.com/arsceos-org/kernel_guard</a>	<a href="https://os-cher.github.io/docs/kernel_guard/kernel_guard/">https://os-cher.github.io/docs/kernel_guard/kernel_guard/</a>	<pre> running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests kernel_guard running 1 test test src/lib.rs - (line 30) ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.04s </pre>
29	linked list	<a href="https://github.com/Starry-OS/linked_list">https://github.com/Starry-OS/linked_list</a>	<a href="https://starry-os.github.io/linked_list/">https://starry-os.github.io/linked_list/</a>	<pre> running 3 tests test raw_list::tests::test_push_back ... ok test raw_list::tests::test_one_removal ... ok test raw_list::tests::test_one_insert_after ... ok test result: ok. 3 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests linked_list running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s </pre>
30	arch_boot	<a href="https://github.com/Starry-OS/arch_boot">https://github.com/Starry-OS/arch_boot</a>	<a href="https://starry-os.github.io/arch_boot/arch_boot/index.html">https://starry-os.github.io/arch_boot/arch_boot/index.html</a>	<pre> running 2 tests test tests::test_config ... ok test tests::test_current_boot_stack ... ok test result: ok. 2 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests arch_boot running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s </pre>

序号	已完成的组件	项目链接	文档	复现情况
31	arm_gic	<a href="https://github.com/Starry-OS/arm_gic">https://github.com/Starry-OS/arm_gic</a>	<a href="https://starry-os.github.io/arm_gic/index.html">https://starry-os.github.io/arm_gic/index.html</a>	<pre> running 1 test test tests::test_translate_irq ... ok  test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests arm_gic  running 0 tests  test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s </pre> <p>直接在飞腾派上验证</p>
32	axlog2	<a href="https://github.com/hilei-masscloud/axlog2">https://github.com/hilei-masscloud/axlog2</a>	<a href="https://github.com/hilei-masscloud/axlog2/blob/main/README.md">https://github.com/hilei-masscloud/axlog2/blob/main/README.md</a>	<p>需要在 /root/.cargo/config 中加入 [net]</p> <p>git-fetch-with-cli = true</p> <pre> Boot HART ID      : 0 Boot HART Domain : root Boot HART Priv Version : v1.12 Boot HART Base ISA : rv64imafdc Boot HART ISA Extensions : time,sstc Boot HART PMP Count : 16 Boot HART PMP Granularity : 4 Boot HART PMP Address Bits: 54 Boot HART MHPM Count : 16 Boot HART MIDELEG : 0x0000000000001666 Boot HART MEDELEG : 0x0000000000f0b509 Logging is enabled.  [ 0.042998 rt_axlog2:12] [rt_axlog2]: ... [ 0.044790 rt_axlog2:13] [rt_axlog2]: ok! [ 0.045301 axhal::platform::riscv64 qemu virt::misc:3] Shutting down ... </pre>
33	axhal	<a href="https://github.com/hilei-masscloud/axhal">https://github.com/hilei-masscloud/axhal</a>	<a href="https://github.com/hilei-masscloud/axhal/blob/main/README.md">https://github.com/hilei-masscloud/axhal/blob/main/README.md</a>	<pre> [ 0.042967 rt_axhal:15] [rt_axhal]: ... [ 0.043889 rt_axhal:17] Found physical memory regions: [ 0.044730 rt_axhal:19] [PA:0x80200000, PA:0x80200000] .text (READ   EXECUTE   RESERVED) [ 0.045066 rt_axhal:19] [PA:0x80200000, PA:0x80203000] .rodata (READ   RESERVED) [ 0.045393 rt_axhal:19] [PA:0x80200000, PA:0x80206000] .data .bss .percpu (READ   WRITE   RESERVED) [ 0.047435 rt_axhal:19] [PA:0x80206000, PA:0x80240000] boot stack (READ   WRITE   RESERVED) [ 0.048177 rt_axhal:19] [PA:0x80240000, PA:0x80247000] bss (READ   WRITE   RESERVED) [ 0.048909 rt_axhal:19] [PA:0x80247000, PA:0x80000000] free memory (READ   WRITE   FREE) [ 0.049741 rt_axhal:19] [PA:0x00000000, PA:0x21000000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.050521 rt_axhal:19] [PA:0x10000000, PA:0x10001000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.051296 rt_axhal:19] [PA:0x10001000, PA:0x10009000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.052051 rt_axhal:19] [PA:0x30000000, PA:0x40000000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.052806 rt_axhal:19] [PA:0x40000000, PA:0x80000000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.053992 rt_axhal:30] [rt_axhal]: ok! [ 0.054426 axhal::platform::riscv64 qemu virt::misc:3] Shutting down ... </pre>
34	driver_block	<a href="https://github.com/hilei-masscloud/driver_block">https://github.com/hilei-masscloud/driver_block</a>	<a href="https://github.com/hilei-masscloud/driver_block/blob/main/README.md">https://github.com/hilei-masscloud/driver_block/blob/main/README.md</a>	<pre> [ 0.042932 rt_driver_block:20] [rt_randisk]: ... [ 0.044470 axhal:238] Initialize global memory allocator ... [ 0.045223 axhal:240] Found physical memory regions: [ 0.046010 axhal:242] [PA:0x80200000, PA:0x80200000] .text (READ   EXECUTE   RESERVED) [ 0.047179 axhal:242] [PA:0x80200000, PA:0x80203000] .rodata (READ   RESERVED) [ 0.047847 axhal:242] [PA:0x80200000, PA:0x80207000] .data .bss .percpu (READ   WRITE   RESERVED) [ 0.048602 axhal:242] [PA:0x80207000, PA:0x80247000] boot stack (READ   WRITE   RESERVED) [ 0.049368 axhal:242] [PA:0x80247000, PA:0x80206000] bss (READ   WRITE   RESERVED) [ 0.050161 axhal:242] [PA:0x80206000, PA:0x80000000] free memory (READ   WRITE   FREE) [ 0.050909 axhal:242] [PA:0x00000000, PA:0x21000000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.051749 axhal:242] [PA:0x10000000, PA:0x10001000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.052519 axhal:242] [PA:0x10001000, PA:0x10009000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.053287 axhal:242] [PA:0x30000000, PA:0x40000000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.054047 axhal:242] [PA:0x40000000, PA:0x80000000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.054910 axhal:250] use TLSF allocator [ 0.055861 axhal:213] Initialize global allocator at: [0xffffffff00260000, 0xffffffff00000000] [ 0.059148 rt_driver_block:47] [rt_randisk]: ok! [ 0.059558 rt_driver_block:48] [rt_driver_block]: ok! [ 0.060248 axhal::platform::riscv64 qemu virt::misc:3] Shutting down ... </pre>



序号	已完成的组件	项目链接	文档	复现情况
39	axfs_ramfs	<a href="https://github.com/hilei-masscloud/axfs_ramfs">https://github.com/hilei-masscloud/axfs_ramfs</a>	<a href="https://github.com/hilei-masscloud/axfs_ramfs/blob/main/README.md">https://github.com/hilei-masscloud/axfs_ramfs/blob/main/README.md</a>	<pre>[ 0.145242 axfs_ramfs::dir:285] remove at ramfs: f1 [ 0.146184 axfs_ramfs::dir:96] remove_node name f1 ... [ 0.147916 axfs_ramfs::dir:285] remove at ramfs: //f2 [ 0.148742 axfs_ramfs::dir:96] remove_node name f2 ... [ 0.149625 axfs_ramfs::dir:285] remove at ramfs: f3 ... [ 0.150424 axfs_ramfs::dir:96] remove_node name f3 ... [ 0.151345 axfs_ramfs::dir:285] remove at ramfs: foo ... [ 0.152157 axfs_ramfs::dir:96] remove_node name foo ... [ 0.153114 axfs_ramfs::dir:285] remove at ramfs: foo/... [ 0.154201 axfs_ramfs::dir:285] remove at ramfs: .. [ 0.155099 axfs_ramfs::dir:285] remove at ramfs: foo/./bar [ 0.155954 axfs_ramfs::dir:285] remove at ramfs: ./bar [ 0.156763 axfs_ramfs::dir:285] remove at ramfs: bar [ 0.157499 axfs_ramfs::dir:96] remove_node name bar ... [ 0.158329 axfs_ramfs::dir:285] remove at ramfs: foo/bar/f4 [ 0.159168 axfs_ramfs::dir:285] remove at ramfs: bar/f4 [ 0.159794 axfs_ramfs::dir:285] remove at ramfs: f4 [ 0.160398 axfs_ramfs::dir:96] remove_node name f4 ... [ 0.161113 axfs_ramfs::dir:285] remove at ramfs: foo/bar [ 0.161919 axfs_ramfs::dir:285] remove at ramfs: f5 [ 0.162665 axfs_ramfs::dir:96] remove_node name bar ... [ 0.163516 axfs_ramfs::dir:285] remove at ramfs: ./foo/./f3 [ 0.164359 axfs_ramfs::dir:285] remove at ramfs: foo/./f3 [ 0.165185 axfs_ramfs::dir:285] remove at ramfs: ./f3 [ 0.165993 axfs_ramfs::dir:285] remove at ramfs: f5 [ 0.166799 axfs_ramfs::dir:96] remove_node name f3 ... [ 0.167389 axfs_ramfs::dir:285] remove at ramfs: ./foo [ 0.167871 axfs_ramfs::dir:285] remove at ramfs: foo [ 0.168332 axfs_ramfs::dir:96] remove_node name foo ... [ 0.169292 rt_ramfs::basic:652] =====&gt; basic test ok! [ 0.170353 rt_ramfs::bench:7] =====&gt; cycle write test ... [ 0.171046 axfs_ramfs::dir:253] create File at ramfs: test_file [ 0.171988 axfs_ramfs::dir:67] dir_mode: 60777 [ 0.172735 axfs_ramfs::dir:201] lookup: test_file flags 000  [ 0.286064 rt_ramfs::bench:9] =====&gt; cycle write test ok! [ 0.287964 rt_ramfs::boundary:10] =====&gt; boundary test ... [ 0.287751 axfs_ramfs::dir:253] create File at ramfs: testfile [ 0.288292 axfs_ramfs::dir:67] dir_mode: 60777 [ 0.288749 axfs_ramfs::dir:201] lookup: testfile flags 000  [ 0.289593 axfs_ramfs::file:156] read_at pos 4080, buf.len 32, total: 20496 [ 0.290367 axfs_ramfs::file:156] read_at pos 12772, buf.len 32, total: 20496 [ 0.291029 axfs_ramfs::file:156] read_at pos 20464, buf.len 32, total: 20496 [ 0.291690 axfs_ramfs::file:156] read_at pos 10464744073709551600, buf.len 32, total: 20496 [ 0.292489 axfs_ramfs::file:156] read_at pos 8176, buf.len 32, total: 20496 [ 0.293148 axfs_ramfs::file:156] read_at pos 16368, buf.len 32, total: 20496 [ 0.293941 axfs_ramfs::file:156] read_at pos 24560, buf.len 32, total: 20672 [ 0.295620 axfs_ramfs::file:156] read_at pos 4080, buf.len 32, total: 12288 [ 0.296292 rt_ramfs::boundary:137] =====&gt; boundary test ok! [ 0.297226 rt_ramfs:25] [rt_ramfs]: ok! [ 0.297726 axhal::platform::fiscv64_qemu_virt::misc:3] Shutting down ...</pre>
40	mm	<a href="https://github.com/hilei-masscloud/mm">https://github.com/hilei-masscloud/mm</a>	<a href="https://github.com/hilei-masscloud/mm/blob/main/README.md">https://github.com/hilei-masscloud/mm/blob/main/README.md</a>	<pre>Boot HART ID          : 0 Boot HART Domain     : rest Boot HART Priv Version : v1.12 Boot HART Base ISA    : rv64uarch Boot HART ISA Extensions : time,sync Boot HART PMP Count   : 16 Boot HART PMP Address Bits: 54 Boot HART PMPF Count  : 16 Boot HART MDELEG     : 0x0000000000001666 Boot HART MDELEG     : 0x000000000000f059 Logging is enabled.  [ 0.046489 rt_mm:13] [rt_mm]: ... [ 0.048095 axhal::loc:230] Initialize global memory allocator ... [ 0.049787 axhal::loc:240] Found physical memory regions [ 0.051433 axhal::loc:242] [PA:0x80200000, PA:0x80200000] text (READ   EXECUTE   RESERVED) [ 0.052779 axhal::loc:242] [PA:0x80200000, PA:0x80207000] rodata (READ   RESERVED) [ 0.054549 axhal::loc:242] [PA:0x80207000, PA:0x8020a000] .data .bss .bss.cpu (READ   RESERVED) [ 0.056083 axhal::loc:242] [PA:0x8020a000, PA:0x80240000] boot stack (READ   WRITE   RESERVED) [ 0.057302 axhal::loc:242] [PA:0x80240000, PA:0x80260000] .bss (READ   WRITE   RESERVED) [ 0.059064 axhal::loc:242] [PA:0x80260000, PA:0x80000000] free memory (READ   WRITE   FREE) [ 0.061005 axhal::loc:242] [PA:0x80000000, PA:0xc2100000] mmio (READ   WRITE   RESERVED) [ 0.062173 axhal::loc:242] [PA:0x10000000, PA:0x10001000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.063720 axhal::loc:242] [PA:0x10001000, PA:0x10009000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.065068 axhal::loc:242] [PA:0x30000000, PA:0x40000000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.066439 axhal::loc:242] [PA:0x40000000, PA:0x80000000] mmio (READ   WRITE   DEVICE   RESERVED) [ 0.067860 axhal::loc:250] use TLSF allocator. [ 0.069261 axhal::loc:213] Initialize global allocator at: 0x7fffffc08026000, 0x7fffffc08000000 [ 0.072336 page_table:129] Initialize kernel page table [ 0.075349 page_table:lookup:77] CLONE: from 0x7fffffc08027000 =&gt; 0x7fffffc08027C000 [ 0.077915 rt_mm:25] [rt_mm]: ok! [ 0.078650 axhal::platform::fiscv64_qemu_virt::misc:3] Shutting down ...</pre>
41	fstree	<a href="https://github.com/hilei-masscloud/fstree">https://github.com/hilei-masscloud/fstree</a>	<a href="https://github.com/hilei-masscloud/fstree/blob/main/README.md">https://github.com/hilei-masscloud/fstree/blob/main/README.md</a>	<pre>[ 0.791530 axfs_ramfs::dir:215] name enabled rest None false flags 000 [ 0.797701 axfs_ramfs::file:181] write_at pos 0, buf.len 23 and 23 ... [ 0.798123 axfs_ramfs::file:201] write_at: ret 4 ok [ 0.797889 axfs_ramfs::dir:67] dir_mode: 60777 [ 0.798018 axfs_ramfs::dir:215] create Dir at ramfs: device/system [ 0.797515 axfs_ramfs::dir:215] create Dir at ramfs: system [ 0.798018 axfs_ramfs::dir:67] dir_mode: 60777 [ 0.798018 axfs_ramfs::dir:215] create Dir at ramfs: device/system/clocksource [ 0.798018 axfs_ramfs::dir:215] create Dir at ramfs: system/clocksource [ 0.800715 axfs_ramfs::dir:67] dir_mode: 60777 [ 0.800715 axfs_ramfs::dir:215] create Dir at ramfs: device/system/clocksource/clocksource [ 0.800715 axfs_ramfs::dir:215] create Dir at ramfs: system/clocksource/clocksource [ 0.801487 axfs_ramfs::dir:215] create Dir at ramfs: clocksource/clocksource [ 0.801487 axfs_ramfs::dir:67] dir_mode: 60777 [ 0.806650 axfs_ramfs::dir:215] create File at ramfs: device/system/clocksource/clocksource/current_clocksource [ 0.807850 axfs_ramfs::dir:215] create File at ramfs: system/clocksource/clocksource/current_clocksource [ 0.809101 axfs_ramfs::dir:215] create File at ramfs: clocksource/clocksource/current_clocksource [ 0.810101 axfs_ramfs::dir:215] create File at ramfs: clocksource/clocksource/current_clocksource [ 0.811240 axfs_ramfs::dir:215] create File at ramfs: current_clocksource [ 0.812120 axfs_ramfs::dir:67] dir_mode: 60777 [ 0.812625 axfs_ramfs::dir:201] lookup: device/system/clocksource/clocksource/current_clocksource flags 000 [ 0.814685 axfs_ramfs::dir:215] name device rest Some('system/clocksource/clocksource/current_clocksource') false flags 000 [ 0.815452 axfs_ramfs::dir:201] lookup: system/clocksource/clocksource/current_clocksource flags 000 [ 0.816643 axfs_ramfs::dir:215] name system rest Some('clocksource/clocksource/current_clocksource') false flags 000 [ 0.817575 axfs_ramfs::dir:201] lookup: clocksource/clocksource/current_clocksource flags 000 [ 0.819078 axfs_ramfs::dir:215] name clocksource rest Some('clocksource/current_clocksource') false flags 000 [ 0.820020 axfs_ramfs::dir:201] lookup: clocksource/current_clocksource flags 000 [ 0.821240 axfs_ramfs::dir:215] name clocksource rest Some('current_clocksource') false flags 000 [ 0.822450 axfs_ramfs::dir:201] lookup: current_clocksource flags 000  [ 0.823395 axfs_ramfs::dir:215] name current_clocksource rest None false flags 000 [ 0.824573 axfs_ramfs::file:181] write_at pos 0, buf.len 4 and 4 ... [ 0.825213 axfs_ramfs::file:201] write_at: ret 4 ok! [ 0.826485 axfs::fs:1987] mount [ 0.826580 exitfs:377] _find_entry: parent: uio: 2, None [ 0.827258 exitfs:385] fs_rootdir: uio: 2 [ 0.828112 exitfs:1562] create path: /sys Dir [ 0.829379 exitfs:1567] path: /sys [ 0.830112 exitfs:1567] _find_entry: parent: uio: 2, None [ 0.830738 exitfs:385] fs_rootdir: uio: 2 [ 0.831518 exitfs:642] exit2: lookup: path: /sys parent: uio: 2 ... [ 0.830738 exitfs:377] _find_entry: parent: uio: 2, Some('') [ 0.840018 exitfs:647] exit2: lookup: child path: /sys, uio: 15 [ 0.840018 rt_fs:387] end ... [ 0.842441 rt_fs:25] [rt_fs:tree]: ok! [ 0.842950 axhal::platform::fiscv64_qemu_virt::misc:3] Shutting down ...</pre>



序号	已完成的组件	项目链接	文档	复现情况
46	fileops	<a href="http://github.com/hilei-masscloud/fileops">http://github.com/hilei-masscloud/fileops</a>	<a href="https://github.com/hilei-masscloud/fileops/blob/main/README.DME.md">https://github.com/hilei-masscloud/fileops/blob/main/README.DME.md</a>	<pre>[ 0.799432 axfs_ramfs::dir:215] name current_clocksource rest None false flags 0x0 [ 0.800220 axfs_ramfs::file:181] write_at pos 0, buf.len 4 end 4... [ 0.800866 axfs_ramfs::file:203] write_at: ret 4 ok! [ 0.801497 axfs_vfs:357] mount ... [ 0.801897 ext2fs:377] _find_entry: parent: ino: 2, None [ 0.802450 ext2fs:385] is rootdir: ino 2 [ 0.803201 ext2fs:1662] create path: /sys Dir [ 0.804311 ext2fs:526] path /sys [ 1.009278 ext2fs:377] _find_entry: parent: ino: 2, None [ 1.010105 ext2fs:385] is rootdir: ino 2 [ 1.011003 ext2fs:1687] VfsNode: lookup path: /sys ret ino: 2 [ 1.011600 ext2fs:642] ext2: lookup: path: /sys parent_ino 2 ... [ 1.012209 ext2fs:377] _find_entry: parent: ino: 2, Some("") [ 1.013642 ext2fs:647] ext2: lookup: child path: /sys, ino: 15 [ 1.015230 rt_fileops:15] [rt_fileops]: ok! [ 1.015810 axhal::platform::riscv64_qemu_virt::misc:3] Shutting down ...</pre>
47	fork	<a href="http://github.com/hilei-masscloud/s/fork">http://github.com/hilei-masscloud/s/fork</a>	<a href="https://github.com/hilei-masscloud/s/blob/main/README.md">https://github.com/hilei-masscloud/s/blob/main/README.md</a>	<pre>[ 0.696859 axfs_vfs:357] mount ... [ 0.697209 ext2fs:377] _find_entry: parent: ino: 2, None [ 0.697697 ext2fs:385] is rootdir: ino 2 [ 0.698400 ext2fs:1662] create path: /sys Dir [ 0.699343 ext2fs:526] path /sys [ 0.781155 ext2fs:377] _find_entry: parent: ino: 2, None [ 0.780843 ext2fs:385] is rootdir: ino 2 [ 0.789415 ext2fs:1687] VfsNode: lookup path: /sys ret ino: 2 [ 0.789963 ext2fs:642] ext2: lookup: path: /sys parent_ino 2 ... [ 0.880517 ext2fs:377] _find_entry: parent: ino: 2, Some("") [ 0.881580 ext2fs:647] ext2: lookup: child path: /sys, ino: 15 [ 0.883210 rt_fork:26] start thread ... [ 0.883722 fork:296] create a user mode thread ... [ 0.884328 fork:128] copy_process... [ 0.885007 task:197] dup_task_struct ... [ 0.886031 fork:263] copy_mm: CLONE_VM [ 0.886807 fork:243] Todo: handle exit_signal 0 [ 0.887636 fork::arch::riscv:14] copy_thread ... [ 0.888207 fork::arch::riscv:33] copy_thread! [ 0.889065 fork:150] copy_process tld: 0 → 1 [ 0.889716 run_queue::run_queue:49] task spawn: 1 [ 0.890613 fork:124] wakeup the new task[1]. [ 0.891684 run_queue::run_queue:205] ##### 0 0; [ 0.892276 taskctx:308] CurrentCtx::set_current 0 → 1... [ 0.893031 run_queue:69] ##### task_entry ... [ 0.893736 rt_fork:47] [new process]: enter ... [ 0.894315 rt_fork:51] [new process]: yield ... [ 0.894827 run_queue::run_queue:205] ##### 0 0; [ 0.895271 taskctx:308] CurrentCtx::set_current 1 → 0 ... [ 0.896009 rt_fork:37] [rt_fork]: ok! [ 0.896491 axhal::platform::riscv64_qemu_virt::misc:3] Shutting down ...</pre>
48	early_console	<a href="http://github.com/hilei-masscloud/s/early_console">http://github.com/hilei-masscloud/s/early_console</a>	<a href="https://github.com/hilei-masscloud/s/blob/main/README.DME.md">https://github.com/hilei-masscloud/s/blob/main/README.DME.md</a>	<pre>Boot HART ID      : 0 Boot HART Domain  : root Boot HART Priv Version : v1.12 Boot HART Base ISA : rv64imafdc Boot HART ISA Extensions : time,sstc Boot HART PMP Count : 16 Boot HART PMP Granularity : 4 Boot HART PMP Address Bits: 54 Boot HART MHPM Count : 16 Boot HART MIDELEG : 0x0000000000001666 Boot HART MEDELEG : 0x0000000000f0b509  [rt_early_console]: ok!</pre>
49	axmount	<a href="http://github.com/hilei-masscloud/s/axmount">http://github.com/hilei-masscloud/s/axmount</a>	<a href="https://github.com/hilei-masscloud/s/blob/main/README.DME.md">https://github.com/hilei-masscloud/s/blob/main/README.DME.md</a>	<pre>[ 1.624585 ext2fs:1687] VfsNode: lookup path: testcases/abc/new-file.txt ret ino: 2 [ 1.625285 ext2fs:642] ext2: lookup: path: testcases/abc/new-file.txt parent_ino 2 ... [ 1.626083 ext2fs:377] _find_entry: parent: ino: 2, Some("testcases/abc") [ 1.627577 ext2fs:647] ext2: lookup: child path: testcases/abc/new-file.txt, ino: 18 [ 1.628313 ext2fs:1692] get_attr ino: 18 [ 1.628920 axfs_vfs:423] lookup at root: /testcases/abc/new-file.txt [ 1.629739 ext2fs:377] _find_entry: parent: ino: 2, None [ 1.630258 ext2fs:385] is rootdir: ino 2 [ 1.630982 ext2fs:1688] remove at ext2: testcases/abc/new-file.txt [ 1.631651 ext2fs:377] _find_entry: parent: ino: 2, Some("testcases/abc") [ 1.63274 ext2fs:377] _find_entry: parent: ino: 2, Some("testcases") [ 1.635647 ext2fs:740] mLink_inode [ 1.710089 axfs_vfs:389] lookup_fs /testcases/abc at root [ 1.710611 ext2fs:377] _find_entry: parent: ino: 2, None [ 1.711127 ext2fs:385] is rootdir: ino 2 [ 1.712102 ext2fs:1687] VfsNode: lookup path: testcases/abc ret ino: 2 [ 1.712709 ext2fs:642] ext2: lookup: path: testcases/abc parent_ino 2 ... [ 1.713335 ext2fs:377] _find_entry: parent: ino: 2, Some("testcases") [ 1.715056 ext2fs:647] ext2: lookup: child path: testcases/abc, ino: 17 [ 1.715706 ext2fs:1692] get_attr ino: 17 [ 1.716209 axfs_vfs:423] lookup at root: /testcases/abc [ 1.716717 ext2fs:377] _find_entry: parent: ino: 2, None [ 1.717233 ext2fs:385] is rootdir: ino 2 [ 1.717750 ext2fs:1688] remove at ext2: testcases/abc [ 1.718237 ext2fs:377] _find_entry: parent: ino: 2, Some("testcases") [ 1.720752 ext2fs:600] remove_dir ... [ 1.806051 rt_axmount:75] [rt_axmount]: ok! [ 1.806583 axhal::platform::riscv64_qemu_virt::misc:3] Shutting down ...</pre>







序号	已完成的组件	相关OS	项目链接	文档链接	复现情况
5	axsync	ArceOS	<a href="https://github.com/arceos-org/arceos/tree/main/main/modules/axsync/aes/aesync.c">https://github.com/arceos-org/arceos/tree/main/main/modules/axsync/aes/aesync.c</a>	<a href="https://arceos.org/arceos/axsync/in dex.html">https://arceos.org/arceos/axsync/in dex.html</a>	<pre> running 1 test test main::tests::test_and_test ... ok test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.20s  Doc-tests axsync running 0 tests test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s </pre>
6	axtask	ArceOS	<a href="https://github.com/arceos-org/arceos/tree/main/main/modules/axtask/axtask.c">https://github.com/arceos-org/arceos/tree/main/main/modules/axtask/axtask.c</a>	<a href="https://arceos.org/arceos/axtask/in dex.html">https://arceos.org/arceos/axtask/in dex.html</a>	<pre> running 4 tests test tests::test_ax_start_wait ... ok test tests::test_ax_start_wait ... ok test tests::test_ax_start_wait ... ok test tests::test_ax_start_wait ... ok test result: ok. 4 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s  Doc-tests axtask running 2 tests test modules/axtask/src/axtask.rs - task_get::def::task_get (line 130) ... ok test modules/axtask/src/axtask.rs - wait_queue::wait_queue (line 13) ... ok test result: ok. 2 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.13s </pre>

## 【1.3】 可在物理设备上运行的unikernel架构的OS内核主干

在飞腾派上运行 arceos unikernel

### 【操作文档】

仓库地址: <https://github.com/tkf2019/arceos/tree/phytium-pi>

文档: [https://github.com/tkf2019/arceos/blob/phytium-pi/doc/platform\\_phytium\\_pi.md](https://github.com/tkf2019/arceos/blob/phytium-pi/doc/platform_phytium_pi.md)

### 【复现结果】

```
Phytium-Pi#go 0x90100000
## Starting application at 0x90100000 ...
aaaaaa
      d8888      .d88888b. .d8888b.
      d88888      d88P" "Y88b d88P Y88b
      d88P888      888 888 Y88b.
      d88P 888 888d888 .d8888b .d88b. 888 888 "Y888b.
      d88P 888 888P" d88P" d8P Y8b 888 888 "Y88b.
      d88P 888 888 888 888 888 888888888 888 888 "888
      d8888888888 888 Y88b. Y8b. Y88b. .d88P Y88b d88P
      d88P 888 888 "Y8888P "Y8888 "Y88888P" "Y8888P"

arch = aarch64
platform = aarch64-phytium-pi
target = aarch64-unknown-none-softfloat
smp = 1
build_mode = release
log_level = trace

[115.000861 0 axruntime:130] Logging is enabled.
[115.006589 0 axruntime:131] Primary CPU 512 started, dtb = 0x1.
[115.013706 0 axruntime:133] Found physical memory regions:
[115.020391 0 axruntime:135] [PA:0x90100000, PA:0x90107000) .text (READ | EXECUTE | RESERVED)
[115.030198 0 axruntime:135] [PA:0x90107000, PA:0x90109000) .rodata (READ | RESERVED)
[115.039312 0 axruntime:135] [PA:0x90109000, PA:0x9010d000) .data .tdata .tbss .percpu (READ | WRITE | RESERVED)
[115.050770 0 axruntime:135] [PA:0x9010d000, PA:0x9014d000) boot stack (READ | WRITE | RESERVED)
[115.060838 0 axruntime:135] [PA:0x9014d000, PA:0x9014e000) .bss (READ | WRITE | RESERVED)
[115.070386 0 axruntime:135] [PA:0x0, PA:0x1000) spintable (READ | WRITE | RESERVED)
[115.079414 0 axruntime:135] [PA:0x9014e000, PA:0x9074e000) nocache memory (READ | WRITE | DEVICE)
[115.089656 0 axruntime:135] [PA:0x9074e000, PA:0x100000000) free memory (READ | WRITE | FREE)
[115.099551 0 axruntime:135] [PA:0x2800c000, PA:0x2800d000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.109880 0 axruntime:135] [PA:0x2800d000, PA:0x2800e000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.120209 0 axruntime:135] [PA:0x2800e000, PA:0x2800f000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.130539 0 axruntime:135] [PA:0x2800f000, PA:0x28010000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.140868 0 axruntime:135] [PA:0x30000000, PA:0x38000000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.151197 0 axruntime:135] [PA:0x40000000, PA:0x50000000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.161526 0 axruntime:135] [PA:0x28014000, PA:0x28016000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.171856 0 axruntime:135] [PA:0x28016000, PA:0x28018000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.182185 0 axruntime:135] [PA:0x28018000, PA:0x2801a000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.192514 0 axruntime:135] [PA:0x2801a000, PA:0x2801c000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.202843 0 axruntime:135] [PA:0x2801c000, PA:0x2801e000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.213172 0 axruntime:135] [PA:0x28034000, PA:0x28035000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.223502 0 axruntime:135] [PA:0x28035000, PA:0x28036000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.233831 0 axruntime:135] [PA:0x28036000, PA:0x28037000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.244160 0 axruntime:135] [PA:0x28037000, PA:0x28038000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.254489 0 axruntime:135] [PA:0x28038000, PA:0x28039000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.264818 0 axruntime:135] [PA:0x28039000, PA:0x2803a000) mmio (READ | WRITE | DEVICE | RESERVED)
[115.275148 0 axruntime:150] Initialize platform devices ...
[115.281831 0 axruntime:186] Primary CPU 512 init OK.
Hello, world!
[115.289296 0 axruntime:199] main task exited: exit_code=0
[115.295893 0 axhal::platform::aarch64-phytium-pi::misc:22] Shutting down ...
```

#### 【注意事项】

1. 使用u盘启动，u盘格式化为fat32文件系统
2. 将加载内核文件的指令改为

```
fatload usb 0 0x90100000 helloworld_aarch64-phytium-pi.bin
```

## 【1.4】可在物理设备上运行的monolithickernel架构的OS内核主干

在飞腾派上运行宏内核Starry

#### 【操作文档】

<https://github.com/Starry-OS/Starry/pull/41>

#### 【注意事项】

1. 在虚拟环境中安装pyserial和xmodem，pipx中没有xmodem，通过以下方式进入虚拟环境并安装

```
python3 -m venv myenv
source myenv/bin/activate
pip install pyserial xmodem
```

2. 代码需要调整, 将根目录下的Cargo.toml里的 `tools/axlibc` 删除掉, 否则编译失败 (已反馈修改)

3. 编译过程中可能因本地环境缺少clang导致报错, 可通过apt直接安装

```
error: failed to run custom build command for `taskctx v0.1.0 (https://github.com/Starry-OS/taskctx.git#d7d646ca)`  
Caused by:  
  process didn't exit successfully: `/code/Starry/target/release/build/taskctx-d3d326bdd789df7/build-script-build` (exit status: 101)  
--- stderr  
thread 'main' panicked at /root/.cargo/git/checkouts/taskctx-38ebba1102c121c2/d7d646c/build.rs:21:10:  
failed to execute clang: Os { code: 2, kind: NotFound, message: "No such file or directory" }  
note: run with `RUST_BACKTRACE=1` environment variable to display a backtrace  
warning: build failed, waiting for other jobs to finish...  
make: *** [scripts/make/build.mk:35: _cargo_build] Error 101
```

```
apt install clang  
which clang
```

4. 需要在本机上编译, 通过串口传递镜像, 在飞腾派上运行

```
make A=apps/helloworld PLATFORM=aarch64-phytiumpi LOG=debug chainboot  
go 0x90100000
```

5. 如果飞腾派启动后直接进入了linux, 需要再u-boot中先将自动引导关闭

```
setenv bootdelay -1  
saveenv
```

6. 进入minicom之后无法输入

[https://blog.csdn.net/qg\\_38880380/article/details/78222695](https://blog.csdn.net/qg_38880380/article/details/78222695)

## 【运行结果】

```
Phytium-Pi#go 0x90100000  
## Starting application at 0x90100000 ...  
  
d8888      .d88888b. .d8888b.  
d888888      d88P" "Y88b d88P Y88b  
d88P888      888      888 Y88b.  
d88P 888 888d888 .d8888b. .d88b. 888      "Y888b.  
d88P 888 888P" d88P" d8P Y8b 888      "Y88b.  
d88P 888 888      888      888888888 888      888      "888  
d88888888888 888      Y88b. Y8b. Y88b. .d88P Y88b d88P  
d88P      888 888      "Y8888P "Y8888 "Y88888P" "Y8888P"  
  
arch = aarch64  
platform = aarch64-phytiumpi  
target = aarch64-unknown-none-softfloat  
smp = 1  
build_mode = release  
log_level = debug  
  
[ 96.859078 0 axruntime:122] Logging is enabled.  
[ 96.864806 0 axruntime:123] Primary CPU 512 started, dtb = 0x1.  
[ 96.871924 0 axruntime:124] Platform name aarch64-phytiumpi.  
[ 96.878781 0 axruntime:126] Found physcial memory regions:  
[ 96.885465 0 axruntime:129] [PA:0x90100000, PA:0x9010c000) .text (READ | EXECUTE | RESERVED)  
[ 96.895273 0 axruntime:129] [PA:0x9010c000, PA:0x9010f000) .rodata (READ | RESERVED)  
[ 96.904387 0 axruntime:129] [PA:0x9010f000, PA:0x90113000) .data .tdata .tbss .percpu (READ | WRITE | RESERVED)  
[ 96.915845 0 axruntime:129] [PA:0x90113000, PA:0x90153000) boot stack (READ | WRITE | RESERVED)  
[ 96.925913 0 axruntime:129] [PA:0x90153000, PA:0x90154000) .bss (READ | WRITE | RESERVED)  
[ 96.935461 0 axruntime:129] [PA:0x1000, PA:0x101000) fdt reserved (READ | RESERVED)  
[ 96.944489 0 axruntime:129] [PA:0x90154000, PA:0x100000000) free memory (READ | WRITE | FREE)  
[ 96.954384 0 axruntime:129] [PA:0x2800c000, PA:0x2800d000) mmio (READ | WRITE | DEVICE | RESERVED)  
[ 96.964713 0 axruntime:129] [PA:0x2800d000, PA:0x2800e000) mmio (READ | WRITE | DEVICE | RESERVED)  
[ 96.975042 0 axruntime:129] [PA:0x2800e000, PA:0x2800f000) mmio (READ | WRITE | DEVICE | RESERVED)  
[ 96.985371 0 axruntime:129] [PA:0x2800f000, PA:0x28010000) mmio (READ | WRITE | DEVICE | RESERVED)  
[ 96.995701 0 axruntime:129] [PA:0x30000000, PA:0x38000000) mmio (READ | WRITE | DEVICE | RESERVED)  
[ 97.006030 0 axruntime:129] [PA:0x40000000, PA:0x80000000) mmio (READ | WRITE | DEVICE | RESERVED)  
[ 97.016359 0 axruntime:129] [PA:0x1000000000, PA:0x3000000000) mmio (READ | WRITE | DEVICE | RESERVED)  
[ 97.027035 0 axruntime:148] Initialize platform devices ...  
[ 97.033719 0 axruntime:187] Primary CPU 512 init OK.  
Hello, world!  
[ 97.041184 0 axruntime:197] main task exited: exit_code=0  
[ 97.047780 0 axhal::platform::aarch64-phytiumpi::misc:3] Shutting down ...  
■
```

## 【1.5】 国产处理器对OS编译环境的支持

在飞腾派上编译arceos

### 【操作文档】

安装rust环境: <https://chenlongos.com/Phytium-Car/setup2.html>

编译: <https://chenlongos.com/Phytium-Car/setup5.html>

### 【编译】

编译出二进制文件

#### 1. x86\_64

```
root@phytiumpi:/arceos# make ARCH=x86_64 A=examples/helloworld
Building App: helloworld, Arch: x86_64, Platform: x86_64-qemu-q35, App type: rust
cargo -C examples/helloworld build -Z unstable-options --target x86_64-unknown-none --target-dir /arceos/target --release
--features "axstd/log-level-warn"
warning: `/root/.cargo/config` is deprecated in favor of `config.toml`
note: if you need to support cargo 1.38 or earlier, you can symlink `config` to `config.toml`
warning: `/root/.cargo/config` is deprecated in favor of `config.toml`
note: if you need to support cargo 1.38 or earlier, you can symlink `config` to `config.toml`
Finished `release` profile [optimized] target(s) in 0.28s
rust-objcopy --binary-architecture=x86_64 examples/helloworld/helloworld_x86_64-qemu-q35.elf --strip-all -O binary examples/helloworld/helloworld_x86_64-qemu-q35.bin
```

#### 2. aarch64

```
root@phytiumpi:/arceos# make ARCH=aarch64 A=examples/helloworld
Building App: helloworld, Arch: aarch64, Platform: aarch64-qemu-virt, App type: rust
cargo -C examples/helloworld build -Z unstable-options --target aarch64-unknown-none-software --target-dir /arceos/target
--features "axstd/log-level-warn"
warning: `/root/.cargo/config` is deprecated in favor of `config.toml`
note: if you need to support cargo 1.38 or earlier, you can symlink `config` to `config.toml`
warning: `/root/.cargo/config` is deprecated in favor of `config.toml`
note: if you need to support cargo 1.38 or earlier, you can symlink `config` to `config.toml`
Compiling axconfig v0.1.0 (/arceos/modules/axconfig)
Compiling axhal v0.1.0 (/arceos/modules/axhal)
Compiling axruntime v0.1.0 (/arceos/modules/axruntime)
Compiling axtask v0.1.0 (/arceos/modules/axtask)
Compiling axsync v0.1.0 (/arceos/modules/axsync)
Compiling axfeat v0.1.0 (/arceos/api/axfeat)
Compiling arceos_api v0.1.0 (/arceos/api/arceos_api)
Compiling axstd v0.1.0 (/arceos/ulib/axstd)
Compiling arceos-helloworld v0.1.0 (/arceos/examples/helloworld)
Finished `release` profile [optimized] target(s) in 6.34s
rust-objcopy --binary-architecture=aarch64 examples/helloworld/helloworld_aarch64-qemu-virt.elf --strip-all -O binary examples/helloworld/helloworld_aarch64-qemu-virt.bin
```

#### 3. riscv64

```
root@phytiumpi:/arceos# make ARCH=riscv64 A=examples/helloworld
Building App: helloworld, Arch: riscv64, Platform: riscv64-qemu-virt, App type: rust
cargo -C examples/helloworld build -Z unstable-options --target riscv64gc-unknown-none-elf --target-dir /arceos/target --release
--features "axstd/log-level-warn"
warning: `/root/.cargo/config` is deprecated in favor of `config.toml`
note: if you need to support cargo 1.38 or earlier, you can symlink `config` to `config.toml`
warning: `/root/.cargo/config` is deprecated in favor of `config.toml`
note: if you need to support cargo 1.38 or earlier, you can symlink `config` to `config.toml`
Compiling axconfig v0.1.0 (/arceos/modules/axconfig)
Compiling axhal v0.1.0 (/arceos/modules/axhal)
Compiling axruntime v0.1.0 (/arceos/modules/axruntime)
Compiling axtask v0.1.0 (/arceos/modules/axtask)
Compiling axsync v0.1.0 (/arceos/modules/axsync)
Compiling axfeat v0.1.0 (/arceos/api/axfeat)
Compiling arceos_api v0.1.0 (/arceos/api/arceos_api)
Compiling axstd v0.1.0 (/arceos/ulib/axstd)
Compiling arceos-helloworld v0.1.0 (/arceos/examples/helloworld)
Finished `release` profile [optimized] target(s) in 5.72s
rust-objcopy --binary-architecture=riscv64 examples/helloworld/helloworld_riscv64-qemu-virt.elf --strip-all -O binary examples/helloworld/helloworld_riscv64-qemu-virt.bin
```

## 【2.1】 在x86硬件平台上支持运行redis, 相对Linux下, 性能提升10%以上, 避免Linux中的常见内存缺陷

【操作文档】 <https://github.com/arceos-org/arceos-apps/tree/main/c/redis>

【代码仓库】 [https://github.com/ZR233/arceos/tree/pcie\\_dev](https://github.com/ZR233/arceos/tree/pcie_dev)

### 【注意事项】

在linux中查看网卡地址

```
lspci -vv
```

```
00:1f.6 Ethernet controller: Intel Corporation Device 0dc8 (rev 11)
  DeviceName: Onboard - Ethernet
  Subsystem: Intel Corporation Device 0000
  Control: I/O- Mem+ BusMaster+ SpecCycle- MemWINV- VGASnoop- ParErr- Stepping- SERR- FastB2B- DisINTx+
  Status: Cap+ 66MHz- UDF- FastB2B- ParErr- DEVSEL=fast >TAbort- <TAbort- <MAbort- >SERR- <PERR- INTx-
  Latency: 0
  Interrupt: pin D routed to IRQ 127
  Region 0: Memory at 80700000 (32-bit, non-prefetchable) [size=128K]
  Capabilities: [c8] Power Management version 3
    Flags: PMEClk- DSI+ D1- D2- AuxCurrent=0mA PME(D0+,D1-,D2-,D3hot+,D3cold+)
    Status: D0 NoSoftRst+ PME-Enable- DSel=0 DScale=1 PME-
  Capabilities: [d0] MSI: Enable+ Count=1/1 Maskable- 64bit+
    Address: 00000000fee00318 Data: 0000
  Kernel driver in use: e1000e
  Kernel modules: e1000e
```

并修改配置文件x86\_64-pc-oslab.toml

```
mmio-regions = [
  ["0xfec0_0000", "0x1000"], # IO APIC
  ["0xfed0_0000", "0x1000"], # HPET
  ["0xfef0_0000", "0x1000"], # Local APIC
  ["0xfc00_0000", "0x0100_0000"], # PCI config space
  ["0xfcd8_0000", "0x0008_0000"], # Ixgbe BAR0
  ["0x8070_0000", "0x2_0000"], # e1000 driver
]
```

<https://github.com/ZR233/arceos/commit/9110b6ec5dec364174ca5036ead8f5287dbb7881>

【运行结果】

arceos编译redis指令

```
make A=c/redis LOG=error PLATFORM=x86_64-pc-oslab SMP=4 NET=y BLK=y
FEATURES=driver-e1000,driver-ixgbe,driver-ramdisk IP=10.3.10.81 GW=10.3.10.1
```

将编译好的文件放在x86工控机上，通过multiboot方式运行成功

```
Initialize IDT & GDT...
Got TSC frequency by CPUID: 2500 MHz
```

```

      d8888      .d88888b. .d8888b.
      d88888      d88P" "Y88b d88P Y88b
      d88P888      888      888 Y88b.
      d88P 888 888d888 .d8888b. .d88b. 888      888 "Y888b.
      d88P 888 888P" d88P" d8P Y8b 888      888 "Y88b.
      d88P 888 888      888      88888888 888      888 "888
      d8888888888 888 Y88b. Y8b. Y88b. .d88P Y88b d88P
      d88P      888 888 "Y8888P "Y8888 "Y88888P" "Y8888P"
```

```
arch = x86_64
platform = x86_64-pc-oslab
target = x86_64-unknown-none
smp = 4
build_mode = release
log_level = error
```

```
[ 0.243917 fatfs::boot_sector:623] Invalid FAT type (expect Fat16 due to 16253 clusters)
[ 0.253982 fatfs::dir:139] Is a directory
[ 0.259686 fatfs::dir:139] Is a directory
[ 0.265410 fatfs::dir:139] Is a directory
[ 0.271135 fatfs::dir:139] Is a directory
Run Redis with: ./redis-server --bind 0.0.0.0 --port 5555 --save "" --appendonly no --protected-mode no
2:C 01 Jan 1970 00:00:00.322 # o00o000o000o Redis is starting o00o000o000o
2:C 01 Jan 1970 00:00:00.329 # Redis version=7.0.12, bits=64, commit=00000000, modified=1, pid=2, just started
2:C 01 Jan 1970 00:00:00.340 # Configuration loaded
2:M 01 Jan 1970 00:00:00.345 * Increased maximum number of open files to 10032 (it was originally set to 1024).
2:M 01 Jan 1970 00:00:00.356 * monotonic clock: POSIX clock_gettime
2:M 01 Jan 1970 00:00:00.363 * Running mode=standalone, port=5555.
2:M 01 Jan 1970 00:00:00.369 # Server initialized
2:M 01 Jan 1970 00:00:00.374 # WARNING Memory overcommit must be enabled! Without it, a background save or replication may fail under low memory condition. To fix this issue add 'vm.overcommit_memory = 1' to /etc/sysctl.conf and then reboot or run the command 'sysctl vm.overcommit_memory=1' for this to take effect.
2:M 01 Jan 1970 00:00:00.404 * Ready to accept connections
```

【性能测试】

测试指令



```
redis-benchmark -h 10.3.10.81 -p 6666 -q -t
PING,SET,GET,INCR,LPUSH,RPUSH,LPOP,RPOP,SADD,HSET,SPOP,ZADD,ZPOPMIN
```

分别测试同时发送给1, 5, 10, 20个客户端

对比 PING,SET,GET,INCR,LPUSH,RPUSH,LPOP,RPOP,SADD,HSET,SPop,ZADD,ZPOPMIN 每秒钟的请求数量

【Linux】

服务端 IP: 10.3.10.81 Port: 6666

客户端 IP: 10.3.10.62 Port: 6666

```
root@josen:~# redis-benchmark -h 10.3.10.81 -p 6666 -c 1 -q -t PING,SET,GET,INCR,LPUSH,RPUSH,LPOP,RPOP,SADD,HSET,ZPOPMIN
PING_INLINE: 7865.35 requests per second, p50=0.127 msec
PING_MBULK: 7873.40 requests per second, p50=0.127 msec
SET: 7861.64 requests per second, p50=0.127 msec
GET: 7870.92 requests per second, p50=0.127 msec
INCR: 7852.99 requests per second, p50=0.127 msec
LPUSH: 7861.64 requests per second, p50=0.127 msec
RPUSH: 7849.91 requests per second, p50=0.127 msec
LPOP: 7848.68 requests per second, p50=0.127 msec
RPOP: 7845.60 requests per second, p50=0.127 msec
SADD: 7860.40 requests per second, p50=0.127 msec
HSET: 7830.85 requests per second, p50=0.127 msec
ZPOPMIN: 7846.83 requests per second, p50=0.127 msec
```

```
root@josen:~# redis-benchmark -h 10.3.10.81 -p 6666 -c 5 -q -t PING,SET,GET,INCR,LPUSH,RPUSH,LPOP,RPOP,SADD,HSET,ZPOPMIN
PING_INLINE: 39904.23 requests per second, p50=0.127 msec
PING_MBULK: 40241.45 requests per second, p50=0.127 msec
SET: 40209.09 requests per second, p50=0.127 msec
GET: 39856.52 requests per second, p50=0.127 msec
INCR: 39936.10 requests per second, p50=0.127 msec
LPUSH: 40387.72 requests per second, p50=0.127 msec
RPUSH: 40371.42 requests per second, p50=0.127 msec
LPOP: 40436.71 requests per second, p50=0.127 msec
RPOP: 40048.06 requests per second, p50=0.127 msec
SADD: 40032.03 requests per second, p50=0.127 msec
HSET: 40016.00 requests per second, p50=0.127 msec
ZPOPMIN: 40032.03 requests per second, p50=0.127 msec
```

```
root@josen:~# redis-benchmark -h 10.3.10.81 -p 6666 -c 10 -q -t PING,SET,GET,INCR,LPUSH,RPUSH,LPOP,RPOP,SADD,HSET,ZPOPMIN
PING_INLINE: 72254.34 requests per second, p50=0.135 msec
PING_MBULK: 75700.23 requests per second, p50=0.119 msec
SET: 77399.38 requests per second, p50=0.119 msec
GET: 77220.08 requests per second, p50=0.119 msec
INCR: 74404.77 requests per second, p50=0.127 msec
LPUSH: 77579.52 requests per second, p50=0.119 msec
RPUSH: 79808.46 requests per second, p50=0.119 msec
LPOP: 74239.05 requests per second, p50=0.127 msec
RPOP: 72306.58 requests per second, p50=0.135 msec
SADD: 73046.02 requests per second, p50=0.127 msec
HSET: 77459.34 requests per second, p50=0.119 msec
ZPOPMIN: 79554.50 requests per second, p50=0.119 msec
```

```
root@josen:~# redis-benchmark -h 10.3.10.81 -p 6666 -c 20 -q -t PING,SET,GET,INCR,LPUSH,RPUSH,LPOP,RPOP,SADD,HSET,ZPOPMIN
PING_INLINE: 132100.39 requests per second, p50=0.135 msec
PING_MBULK: 131233.59 requests per second, p50=0.135 msec
SET: 130378.09 requests per second, p50=0.135 msec
GET: 131061.59 requests per second, p50=0.135 msec
INCR: 131578.95 requests per second, p50=0.135 msec
LPUSH: 136425.66 requests per second, p50=0.127 msec
RPUSH: 136798.91 requests per second, p50=0.127 msec
LPOP: 137174.22 requests per second, p50=0.127 msec
RPOP: 138312.59 requests per second, p50=0.127 msec
SADD: 130548.30 requests per second, p50=0.135 msec
HSET: 132626.00 requests per second, p50=0.135 msec
ZPOPMIN: 132450.33 requests per second, p50=0.135 msec
```

【Arceos】

服务端 IP: 10.3.10.81 Port: 5555

客户端 IP: 10.3.10.62 Port: 5555

```
root@josen:~# redis-benchmark -h 10.3.10.81 -p 5555 -c 1 -q -t PING,SET,GET,INCR,LPUSH,RPUSH,LPOP,RPOP,SADD,HSET,ZPOPMIN
PING_INLINE: 13835.09 requests per second, p50=0.071 msec
PING_MBULK: 14033.12 requests per second, p50=0.071 msec
SET: 13906.27 requests per second, p50=0.071 msec
GET: 13931.46 requests per second, p50=0.071 msec
INCR: 13798.81 requests per second, p50=0.071 msec
LPUSH: 13730.61 requests per second, p50=0.079 msec
RPUSH: 13879.25 requests per second, p50=0.071 msec
LPOP: 13964.53 requests per second, p50=0.071 msec
RPOP: 13986.01 requests per second, p50=0.071 msec
SADD: 13700.51 requests per second, p50=0.079 msec
HSET: 13740.04 requests per second, p50=0.079 msec
ZPOPMIN: 13982.10 requests per second, p50=0.071 msec

root@josen:~# redis-benchmark -h 10.3.10.81 -p 5555 -c 5 -q -t PING,SET,GET,INCR,LPUSH,RPUSH,LPOP,RPOP,SADD,HSET,ZPOPMIN
PING_INLINE: 62932.66 requests per second, p50=0.071 msec
PING_MBULK: 63291.14 requests per second, p50=0.071 msec
SET: 62460.96 requests per second, p50=0.071 msec
GET: 63011.97 requests per second, p50=0.071 msec
INCR: 62500.00 requests per second, p50=0.071 msec
LPUSH: 60240.96 requests per second, p50=0.079 msec
RPUSH: 62853.55 requests per second, p50=0.071 msec
LPOP: 62932.66 requests per second, p50=0.071 msec
RPOP: 62893.08 requests per second, p50=0.071 msec
SADD: 62578.22 requests per second, p50=0.071 msec
HSET: 61957.87 requests per second, p50=0.079 msec
ZPOPMIN: 62774.64 requests per second, p50=0.071 msec

root@josen:~# redis-benchmark -h 10.3.10.81 -p 5555 -c 10 -q -t PING,SET,GET,INCR,LPUSH,RPUSH,LPOP,RPOP,SADD,HSET,ZPOPMIN
PING_INLINE: 105820.11 requests per second, p50=0.087 msec
PING_MBULK: 105263.16 requests per second, p50=0.087 msec
SET: 104712.05 requests per second, p50=0.087 msec
GET: 105263.16 requests per second, p50=0.087 msec
INCR: 105263.16 requests per second, p50=0.087 msec
LPUSH: 100000.00 requests per second, p50=0.095 msec
RPUSH: 104712.05 requests per second, p50=0.087 msec
LPOP: 104602.52 requests per second, p50=0.087 msec
RPOP: 104931.80 requests per second, p50=0.087 msec
SADD: 105042.02 requests per second, p50=0.087 msec
HSET: 103734.44 requests per second, p50=0.087 msec
ZPOPMIN: 105374.08 requests per second, p50=0.087 msec

root@josen:~# redis-benchmark -h 10.3.10.81 -p 5555 -c 20 -q -t PING,SET,GET,INCR,LPUSH,RPUSH,LPOP,RPOP,SADD,HSET,ZPOPMIN
PING_INLINE: 160000.00 requests per second, p50=0.103 msec
PING_MBULK: 165562.92 requests per second, p50=0.103 msec
SET: 161550.89 requests per second, p50=0.103 msec
GET: 162601.62 requests per second, p50=0.103 msec
INCR: 157480.31 requests per second, p50=0.103 msec
LPUSH: 157977.88 requests per second, p50=0.111 msec
RPUSH: 164744.64 requests per second, p50=0.103 msec
LPOP: 176678.45 requests per second, p50=0.095 msec
RPOP: 171821.30 requests per second, p50=0.095 msec
SADD: 171526.58 requests per second, p50=0.103 msec
HSET: 162074.56 requests per second, p50=0.103 msec
ZPOPMIN: 167785.23 requests per second, p50=0.103 msec
```

【结论】对比redis运行在arceos和linux系统中的请求相应速度，在客户端数量为1，5，10，20时，性能提升均大于10%

性能指标	客户端数量			客户端数量			客户端数量			客户端数量		
	linux	arceos	提升	linux	arceos	提升	linux	arceos	提升	linux	arceos	提升
PING_INLINE	7865.35	13835.09	76.20%	39904.2	62932.66	57.79%	72254.3	105820.11	46.67%	132100	160000	21.12%
PING_MBULK	7873.4	14033.12	78.58%	40241.5	63291.14	57.33%	75700.2	105263.16	39.88%	131234	165563	26.07%
SET	7861.64	13906.27	77.70%	40209.1	62460.96	55.89%	77399.4	104712.05	35.25%	130378	161551	24.03%
GET	7870.92	13931.46	77.69%	39856.5	63011.97	58.08%	77220.1	105263.16	36.58%	131062	162602	24.14%
INCR	7852.99	13798.81	75.98%	39936.1	62500.00	56.71%	74404.8	105263.16	41.83%	131579	157480	19.63%
LPUSH	7861.64	13730.61	74.27%	40387.7	60240.96	49.28%	77579.5	100000.00	28.94%	136426	157978	15.74%
RPUSH	7849.91	13879.25	76.61%	40371.4	62853.55	55.66%	79808.5	104712.05	35.24%	136799	164745	20.46%
LPOP	7848.68	13964.53	77.95%	40436.7	62932.66	55.66%	74239.1	104602.52	40.81%	137174	176678	28.88%
RPOP	7845.6	13986.01	78.49%	40048.1	62893.08	57.18%	72306.6	104931.8	45.69%	138313	171821	24.04%
SADD	7860.4	13700.51	74.68%	40032	62578.22	56.98%	73046	105042.02	43.55%	130548	171527	31.45%
HSET	7830.85	13740.04	75.80%	40016	61957.87	54.40%	77459.3	103734.44	33.03%	132626	162075	22.23%
ZPOPMIN	7846.83	13982.10	78.66%	40032	62774.64	56.83%	79554.5	105374.08	32.56%	132450	167785	26.69%

## 【2.2】在x86硬件平台上支持运行tokio，相对Linux下，性能提升10%以上，避免Linux中的常见内存缺陷

【操作文档】：[https://docs.qq.com/doc/DYWJJKQWL4RWxmZUtQ?is\\_no\\_hook\\_redirect=1](https://docs.qq.com/doc/DYWJJKQWL4RWxmZUtQ?is_no_hook_redirect=1)

【代码仓库】：<https://github.com/Gallium70/arceos/tree/dora-wip>

【注意事项】

1. monoio-benchmark暂未迁移到arceos中, 先不使用原仓库的arceos, 拉取下面仓库进行编译服务端

<https://github.com/Gallium70/arceos/tree/dora-wip>

2. 编译客户端时, 客户端的 main 中可能需要加上 `#![feature(impl_trait_in_assoc_type)]`, 并将 Cargo.toml 中 monoio 的依赖版本改为 0.2.

## 【qemu运行】

```
make A=apps/std/monoio-benchmark/tokio-server SMP=1 NET=y NET_DEV=user LOG=info
STD=y run
```

## 服务端

```

      d8888      .d88888b. .d8888b.
d88888      d88P" "Y88b d88P Y88b
d88P888      888      888 Y88b.
d88P 888 888d888 .d8888b .d88b. 888      "Y888b.
d88P 888 888P" d88P" d8P Y8b 888      "Y88b.
d88P 888 888      888 88888888 888      "888
d88888888888 888 Y88b. Y8b. Y88b. d88P Y88b d88P
d88P      888 888      "Y888P "Y888 "Y88888P" "Y888P"

arch = x86_64
platform = x86_64-qemu-q35
target = x86_64-unknown-arceos
smp = 1
build_mode = release
log_level = info

[1730965490.005016 0 axruntime:129] Logging is enabled.
[1730965490.005576 0 axruntime:130] Primary CPU 0 started, dtb = 0x0.
[1730965490.006274 0 axruntime:132] Found physical memory regions:
[1730965490.006954 0 axruntime:134] [PA:0x200000, PA:0x2a8000] .text (READ | EXECUTE | RESERVED)
[1730965490.007910 0 axruntime:134] [PA:0x2a8000, PA:0x2b6000] .rodata (READ | RESERVED)
[1730965490.008764 0 axruntime:134] [PA:0x2b6000, PA:0x2c2000] .data .tdata .tbss .percpu (READ | WRITE | RESERVED)
[1730965490.009838 0 axruntime:134] [PA:0x2c2000, PA:0x302000] boot stack (READ | WRITE | RESERVED)
[1730965490.010831 0 axruntime:134] [PA:0x302000, PA:0x328000] .bss (READ | WRITE | RESERVED)
[1730965490.011744 0 axruntime:134] [PA:0x1000, PA:0x9f000] low memory (READ | WRITE | RESERVED)
[1730965490.012638 0 axruntime:134] [PA:0x328000, PA:0x8000000] free memory (READ | WRITE | FREE)
[1730965490.013571 0 axruntime:134] [PA:0xb0000000, PA:0xc0000000] mmio (READ | WRITE | DEVICE | RESERVED)
[1730965490.014609 0 axruntime:134] [PA:0xfec00000, PA:0xfec00000] mmio (READ | WRITE | DEVICE | RESERVED)
[1730965490.015506 0 axruntime:134] [PA:0xfec00000, PA:0xfec01000] mmio (READ | WRITE | DEVICE | RESERVED)
[1730965490.016086 0 axruntime:134] [PA:0xfed00000, PA:0xfed01000] mmio (READ | WRITE | DEVICE | RESERVED)
[1730965490.016670 0 axruntime:134] [PA:0xfec00000, PA:0xfec01000] mmio (READ | WRITE | DEVICE | RESERVED)
[1730965490.017253 0 axruntime:240] Initialize global memory allocator ...
[1730965490.017676 0 axruntime:241] use TLSF allocator.
[1730965490.018060 0 axruntime:148] Initialize kernel page table ...
[1730965490.018465 0 axruntime:152] Initialize platform devices ...
[1730965490.018846 0 axhal::platform::x86_pc::apic:87] Initialize Local APIC ...
[1730965490.019276 0 axhal::platform::x86_pc::apic:102] Using x2APIC.
[1730965490.019699 0 axhal::platform::x86_pc::apic:116] Initialize IO APIC ...
[1730965490.020123 0 axtask::api:66] Initialize scheduling ...
[1730965490.020493 0 axtask::api:72] use FIFO scheduler.
[1730965490.020837 0 axdriver:152] Initialize device drivers ...
[1730965490.021201 0 axdriver:153] device model: static
[1730965490.026562 0 virtio_drivers::device::net::dev_raw:31] Device features CTRL_GUEST_OFFLOADS | MAC | MRG_RXBUF | STATUS
[1730965490.028362 0 axdriver::bus::pci:104] registered a new Net device at 00:02:0: "virtio-net"
[1730965490.152997 0 axnet:44] Initialize network subsystem ...
[1730965490.153544 0 axnet:47] use NIC 0: "virtio-net"
[1730965490.154382 0 axnet::smoltcp_impl:326] created net interface "eth0":
[1730965490.155047 0 axnet::smoltcp_impl:327] ether: 52-54-00-12-34-56
[1730965490.155725 0 axnet::smoltcp_impl:328] ip: 10.0.2.15/24
[1730965490.156374 0 axnet::smoltcp_impl:329] gateway: 10.0.2.2
[1730965490.156984 0 axruntime:188] Primary CPU 0 init OK.
[1730965490.157550 0:2 axruntime:222] Start std::runtime_entry ...
Running ping pong server with Tokio.
Packet size: 1024
Listen 0.0.0.0:5555
CPU count: 1
```

## 客户端

```
cargo build --release
./target/release/client --target 127.0.0.1:5555 --conns-per-core 150
```



```

root@josen:/code/Acceptance_check/2.2/monoio-benchmark# ./target/release/client --target 127.0.0.1:5555 --conns-per-core 150
Running ping pong client.
Packet size: 1024
Connection count per core: 150; Global connection count: 150
QPS limit per core: 0; Global QPS limit: 0
Target: 127.0.0.1:5555
CPU slot: 0
1.000: NAdd: 156738; NSum: 156738; NAverage: 156722.312, LatencyAverage: 206.191 us
2.000: NAdd: 164209; NSum: 320947; NAverage: 160457.234, LatencyAverage: 252.058 us
3.000: NAdd: 159862; NSum: 480809; NAverage: 160253.297, LatencyAverage: 285.646 us
4.000: NAdd: 147456; NSum: 628265; NAverage: 157050.297, LatencyAverage: 304.432 us
5.001: NAdd: 156104; NSum: 784369; NAverage: 156857.875, LatencyAverage: 327.296 us
6.001: NAdd: 163048; NSum: 947417; NAverage: 157886.672, LatencyAverage: 331.045 us
7.001: NAdd: 158865; NSum: 1106282; NAverage: 158024.016, LatencyAverage: 334.953 us
8.001: NAdd: 155939; NSum: 1262221; NAverage: 157761.000, LatencyAverage: 354.932 us
9.001: NAdd: 168159; NSum: 1430380; NAverage: 158914.391, LatencyAverage: 355.087 us
10.001: NAdd: 167706; NSum: 1598086; NAverage: 159791.844, LatencyAverage: 355.314 us
11.001: NAdd: 167310; NSum: 1765396; NAverage: 160473.750, LatencyAverage: 355.580 us
12.001: NAdd: 184946; NSum: 1950342; NAverage: 162511.562, LatencyAverage: 355.648 us
13.001: NAdd: 168126; NSum: 2118468; NAverage: 162942.125, LatencyAverage: 355.706 us
14.001: NAdd: 167193; NSum: 2285661; NAverage: 163244.547, LatencyAverage: 355.898 us
15.002: NAdd: 167769; NSum: 2453430; NAverage: 163545.031, LatencyAverage: 367.345 us
16.002: NAdd: 168336; NSum: 2621766; NAverage: 163843.406, LatencyAverage: 367.377 us
17.002: NAdd: 168836; NSum: 2790602; NAverage: 164136.078, LatencyAverage: 367.334 us

```

## 【物理机运行】

### 1. 拉取代码

```

git clone https://github.com/Gallium70/arceos.git
cd arceos
git checkout dora-wip
# 这一步会拉取 rust 源码，可能耗时较长
git submodule update --init --recursive

```

2. 编辑 arceos/platforms/x86\_64-pc-oslab.toml 文件内容,将 mmio-regions 中 PCI config space 和 Ixgbe BAR0 对应的起始地址替换为从 /proc/iomem 查询到的地址;

```
cat /proc/iomem
```

pci-ecam-base 同样替换为 PCI config space 的起始地址。

```

# Architecture identifier.
arch = "x86_64"
# Platform identifier.
platform = "x86_64-pc-oslab"
# Platform family.
family = "x86-pc"

# Base address of the whole physical memory.
phys-memory-base = "0"
# Size of the whole physical memory.
phys-memory-size = "0x8000_0000" # 2G
# Base physical address of the kernel image.
kernel-base-paddr = "0x20_0000"
# Base virtual address of the kernel image.
kernel-base-vaddr = "0xffff_ff80_0020_0000"
# Linear mapping offset, for quick conversions between physical and virtual
# addresses.
phys-virt-offset = "0xffff_ff80_0000_0000"
# MMIO regions with format (`base_paddr`, `size`).
mmio-regions = [
    ["0xfec0_0000", "0x1000"], # IO APIC
    ["0xfed0_0000", "0x1000"], # HPET
    ["0xfe0_0000", "0x1000"], # Local APIC

```

```

    ["0xc000_0000", "0x0100_0000"], # PCI config space
    ["0x8068_0000", "0x10_0000"],   #intel 82599
]
# VirtIO MMIO regions with format (`base_paddr`, `size`).
virtio-mmio-regions = []
# Base physical address of the PCIe ECAM space (should read from ACPI 'MCFG'
table).
pci-ecam-base = "0xc000_0000"
# End PCI bus number.
pci-bus-end = "0x05"
# PCI device memory ranges (not used on x86).
pci-ranges = [
    ["0x3ef_f0000", "0x1_0000"],      # PIO space
    ["0x1000_0000", "0x2eff_0000"],   # 32-bit MMIO space
    ["0x80_0000_0000", "0x80_0000_0000"], # 64-bit MMIO space
]

# Timer interrupt frequency in Hz.
timer-frequency = "4_000_000_000"    # 4.0GHz

```

### 3. 编译内核文件

```

make A=apps/std/monoio-benchmark/tokio-server PLATFORM=x86_64-pc-oslab STD=y
SMP=1 NET=y FEATURES=driver-ixgbe,bus-pci,net IP=10.2.2.2 GW=10.2.2.1
LOG=info

```

将编译的镜像复制到物理机的 /boot 路径下

```

cp arceos/apps/std/monoio-benchmark/tokio-server/tokio-server_x86_64-pc-
oslab.bin /boot

```

4. 客户端机器安装万兆网卡，与arceos物理机直连，配置静态ip与arceos处于同一子网（如10.3.10.62/24），ubuntu可以编辑 `/etc/netplan/<file_name>` 配置网卡ip

服务端ip配置：

```

network:
  version: 2
  ethernets:
    eno1:
      dhcp4: true
    enp1s0:
      dhcp4: false
      addresses:
        - 10.3.10.81/24

```

客户端ip配置：

```
network:
  ethernet:
    enp3s0:
      dhcp4: true
    enp1s0:
      dhcp4: false
      addresses:
        - 10.3.10.62/24
  version: 2
```

5. 配置grub启动信息，在/boot/grub/grub.cfg中添加对应的multiboot的选项

```
menuentry "ArceOS Tokio" {
  set root='hd0,gpt2'
  multiboot /tokio-server_x86_64-pc-oslab.bin
  boot
}
```

重启物理机，在 grub 菜单中选择 ArceOS Tokio启动，在串口连接的机器中显示tokio-server的执行信息

6. 拉取测试脚本并运行客户端进行测试（注意修改测试脚本中的ip和每核连接数范围）

```
git clone https://github.com/Gallium70/monoio-benchmark.git
cd monoio-benchmark
./script/run-client.sh <结果名称> <客户端核数>
```

### 【注意事项】

1. 工控机PCI的82599基地址显示为 0x80a0\_0000，但在arceos中实际加载的地址为 0x8068\_0000，需要在配置文件的 mmio-regions 中将intel\_82599的基地址改为 0x8068\_0000
2. linux测试的服务端程序位于 monoio-benchmark/target/debug/tokio-server
3. arceos/modules/axnet/src/smoltcp\_impl/mod.rs 这个里面的 LISTEN\_QUEUE\_SIZE 需要改大一点，不然连接数高的时候会掉线，可以改为4096

### 【测试结果】

```
Initialize IDT & GDT...
Got TSC frequency by CPUID: 2500 MHz

d8888      .d88888b.  .d8888b.
d88888      d88P" "Y88b d88P Y88b
d88P888      888      888 Y88b.
d88P 888 888d888 .d8888b .d88b. 888      888 "Y888b.
d88P 888 888P" d88P" d8P Y8b 888      888 "Y88b.
d88P 888 888      888      88888888 888      888 "888
d88888888888 888      Y88b. Y8b. Y88b. .d88P Y88b d88P
d88P      888 888      "Y8888P "Y8888 "Y88888P" "Y8888P"

arch = x86_64
platform = x86_64-pc-oslab
target = x86_64-unknown-arceos
smp = 1
build_mode = release
log_level = off

Running ping pong server with Tokio.
Packet size: 1024
Listen 0.0.0.0:5555
CPU count: 1
█
```

### 【Arceos】

客户端每核连接数量（个）	有效吞吐量(比特/秒)	平均延迟(微秒)	备注
10	253406.953	157.313	
20	315276.219	253.121	
30	308952.000	387.764	
40	346951.594	460.446	
50	336820.719	592.993	
60	323998.281	739.803	
70	312270.625	895.652	
80	299635.219	1066.787	
90	288305.656	1247.396	

【Linux】

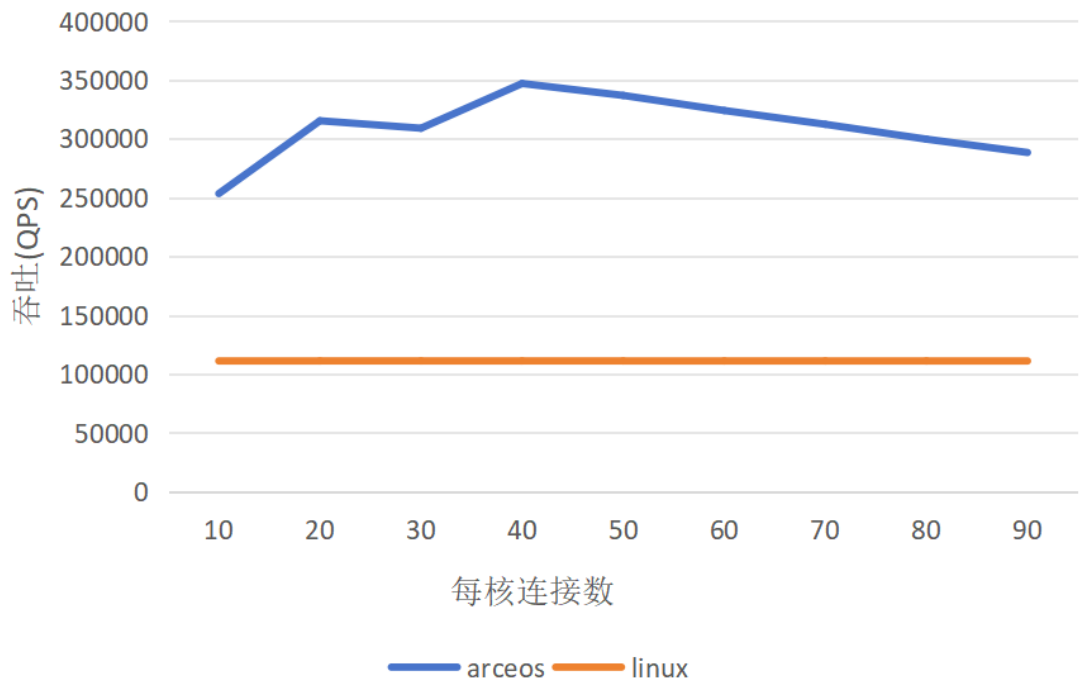
客户端每核连接数量（个）	有效吞吐量(比特/秒)	平均延迟(微秒)	备注
10	111138.195	359.23	
20	111176.641	718.814	
30	111160.18	1078.718	
40	111164.133	1438.307	
50	111131.344	1798.16	
60	111140.016	2157.913	
70	111134.516	2515.994	
80	111126.062	2877.47	
90	111112.914	3237.254	

【测试结论】

在x86硬件平台上支持运行tokio，相对Linux下，性能提升10%以上。

1. tokio分别在arceos和linux运行时，吞吐量的对比。

## Tokio吞吐



2. tokio分别在arceos和linux运行时，延迟的对比。

## Tokio延迟

