Lua in the NetBSD Kernel

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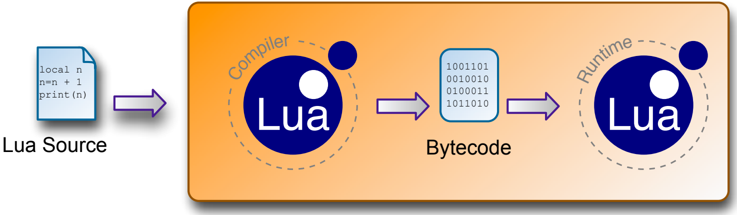
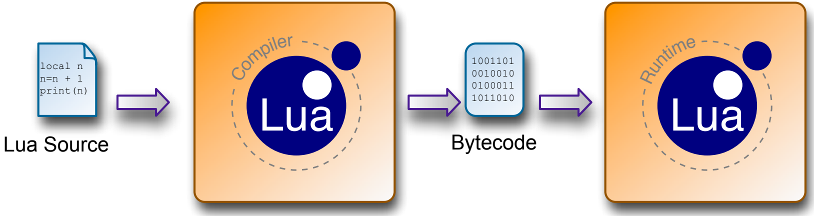
Topics


FAST
POWERFUL
LIGHTWEIGHT
EMBEDDABLE
SCRIPTING
LANGUAGE
& VM
Lua
Builds in all platforms with an ANSI/ISO C compiler
Fits into 128K ROM, 64K RAM per interpreter state[1]
Fastest in the realm of interpreted languages
Well-documented C/C++ API to extend applications
One of the fastest mechanisms for call-out to C
Incremental low-latency garbage collector
Sandboxing for restricted access to resources
Meta-mechanisms for language extensions,
e.g. class-based object orientation and inheritance
Natural datatype can be integer, float or double
Supports closures and cooperative threads
Open source under the OSI-certified MIT license
[1] Complete Lua SOC, practical applications in 256K ROM / 64K RAM
Designed, implemented and maintained at the
Pontifical Catholic University of Rio de Janeiro
www.lua.org

Running Lua Sourcecode



Compiling / Running Lua Bytecode



Running from C

- int luaL_dofile(lua_State *L, const char *filename)
- int luaL_dostring(lua_State *L, const char *str)

Values, Variables, and, Data Types

- Variables have no type
- Values do have a type
- Functions are first-class values

Tables

- Tables are THE data structure in Lua
- Nice constructor syntax
- Tables make Lua a good DDL
- Metatables can be associated with every object

Lua Table Constructor

Create and initialize a table, access a field:

```
mytable = {
    name = 'Marc',
    surname = 'Balmer',
    email = 'm@x.org'
}

print(mytable.email)
```

Extending Lua Programs

Acess GPIO pins from Lua:

```
require 'gpio'

g = gpio.open('/dev/gpio0')
g:write(4, gpio.PIN_HIGH)
g:close()
```

Creating and Destroying a State

- lua_State *L = lua_newstate()
- luaopen_*module*(L)
- lua_close(L)

Calling a C Function

- Function has been registered in luaopen_*module*()
- int *function*(lua_State *L)
- Parameters popped from the stack
- Return values pushed on the stack
- Return Nr. of return values

Calling a Lua Function

- Find the function and make sure is *is* a function
- Push parameters on the stack
- Use lua_call(lua_State *L, int index)
- or lua_pcall(lua_State *L, int index)
- Pop return values from the stack

Calling a Lua Function

The Lua function

```
function hello()
    print('Hello, world!')
end
```

Call hello from C:

```
lua_getglobal(L, "hallo");
lua_pcall(L, 0, 0, 0);
```

Ideas for Users

- Modifying software written in C is hard for users
- Give users the power to modify and extend the system
- Let users explore the system in an easy way

Ideas for Developers

- „Rapid Application Development" approach to driver development
- Modifying the system behaviour
- Configuration of kernel subsystems

Alternatives

- Python
- Java

Python

- Not to difficult to integrate in C
- Huge library
- Memory consumption
- Difficult object mapping

Java

- Easy to integrate
- Difficult object mapping
- Memory considerations
- Has been used for driver development

Lua in NetBSD Userland

- Library (liblua.so) and binaries (lua, luac) committed to -current
- Will be part of NetBSD 6
- No back port to NetBSD 5 stable planned

Lua in the NetBSD Kernel

- Started as GSoC project, porting Lunatik from Linux to NetBSD
- Proof that the Lua VM can run in the kernel, lack of infrastructure
- Infrastructure beeing added now

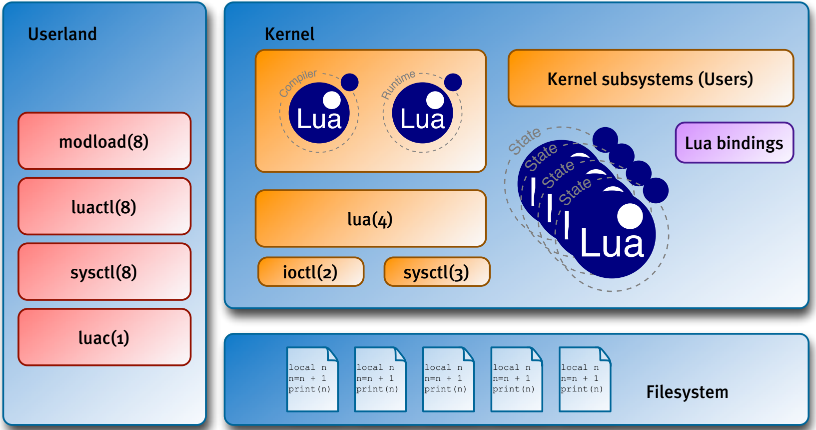
Running in Userland

- Every process has its own address space
- Lua states in different processes are isolated

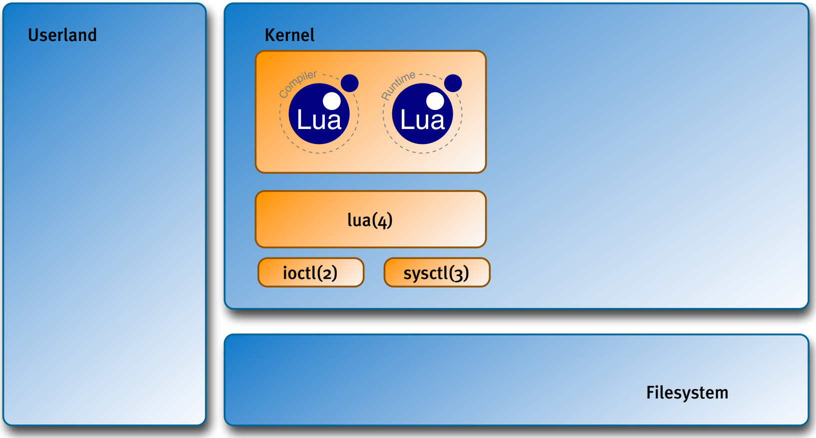
Running in the Kernel

- One address space
- Every thread that „is in the kernel“ uses the same memory
- Locking is an issue

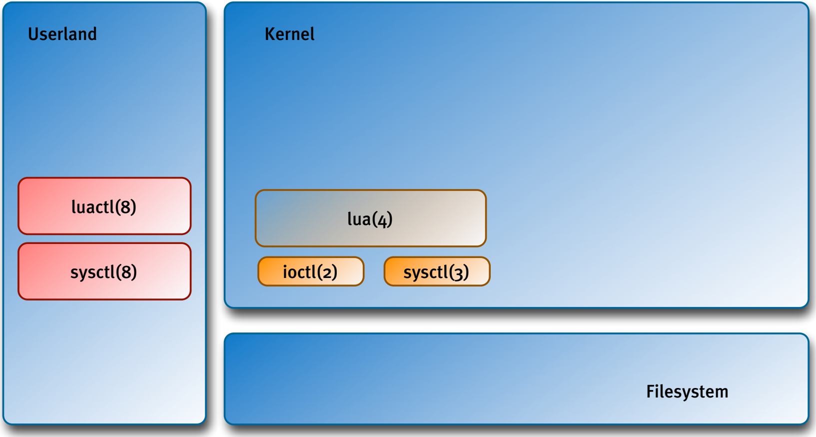
The Big Picture



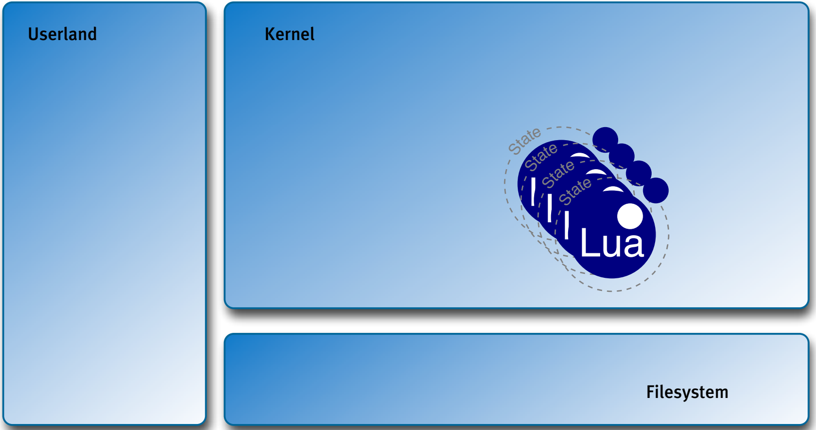
The lua(4) Device Driver



lua(4) ioctl(2) / sysctl(3) Interface

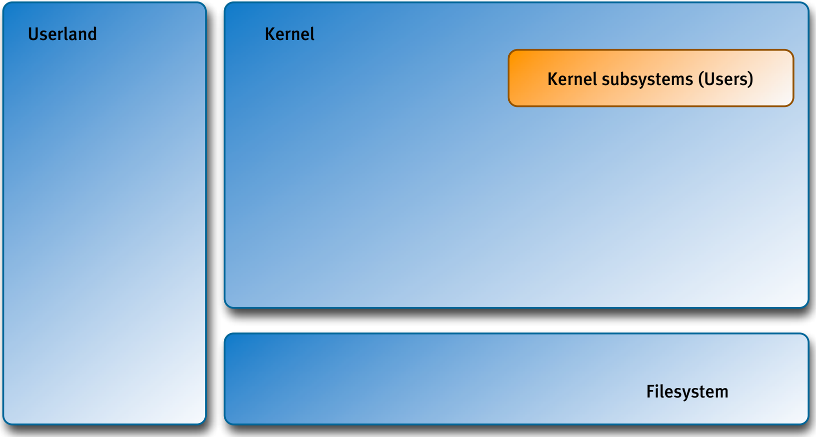


Lua States

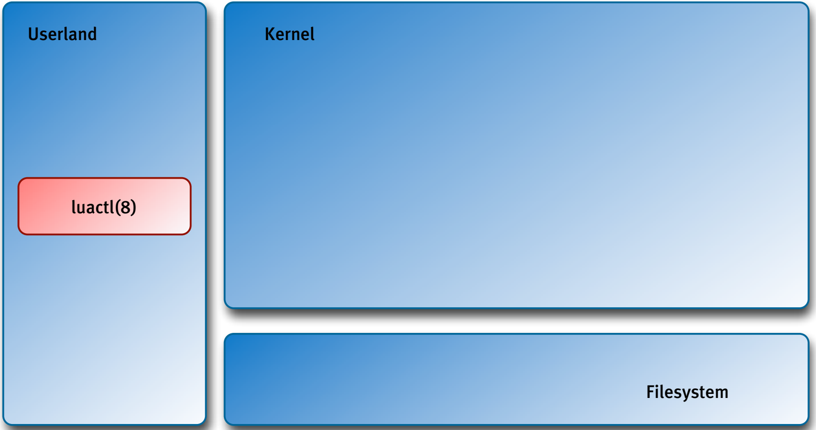


Lua Modules

Lua Users



The luactl(8) Command



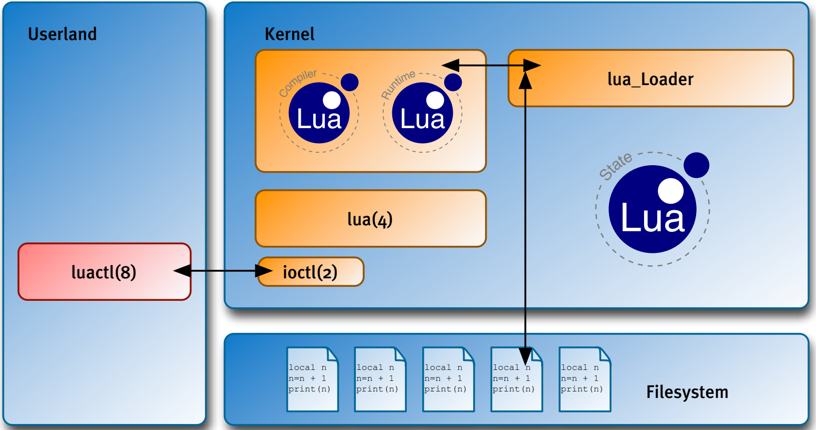
„require"

- Modules are kernel modules
- 'require' can be turned off
- Modules must be assigned to Lua states by hand then
- By default 'require' is on and modules are even autoloaded
- Module autoloading can be turned off

sysctl(8) Variables

- kern.lua.require=1
- kern.lua.autoload=1
- kern.lua.bytecode=0
- kern.lua.maxcount=0

Loading Lua Code



Security

- New Lua states are created empty
- Full control over the loading of code
- No access to kernel memory, -functions but through predefined bindings

Time for Questions