Using ngx_lua in UPYUN

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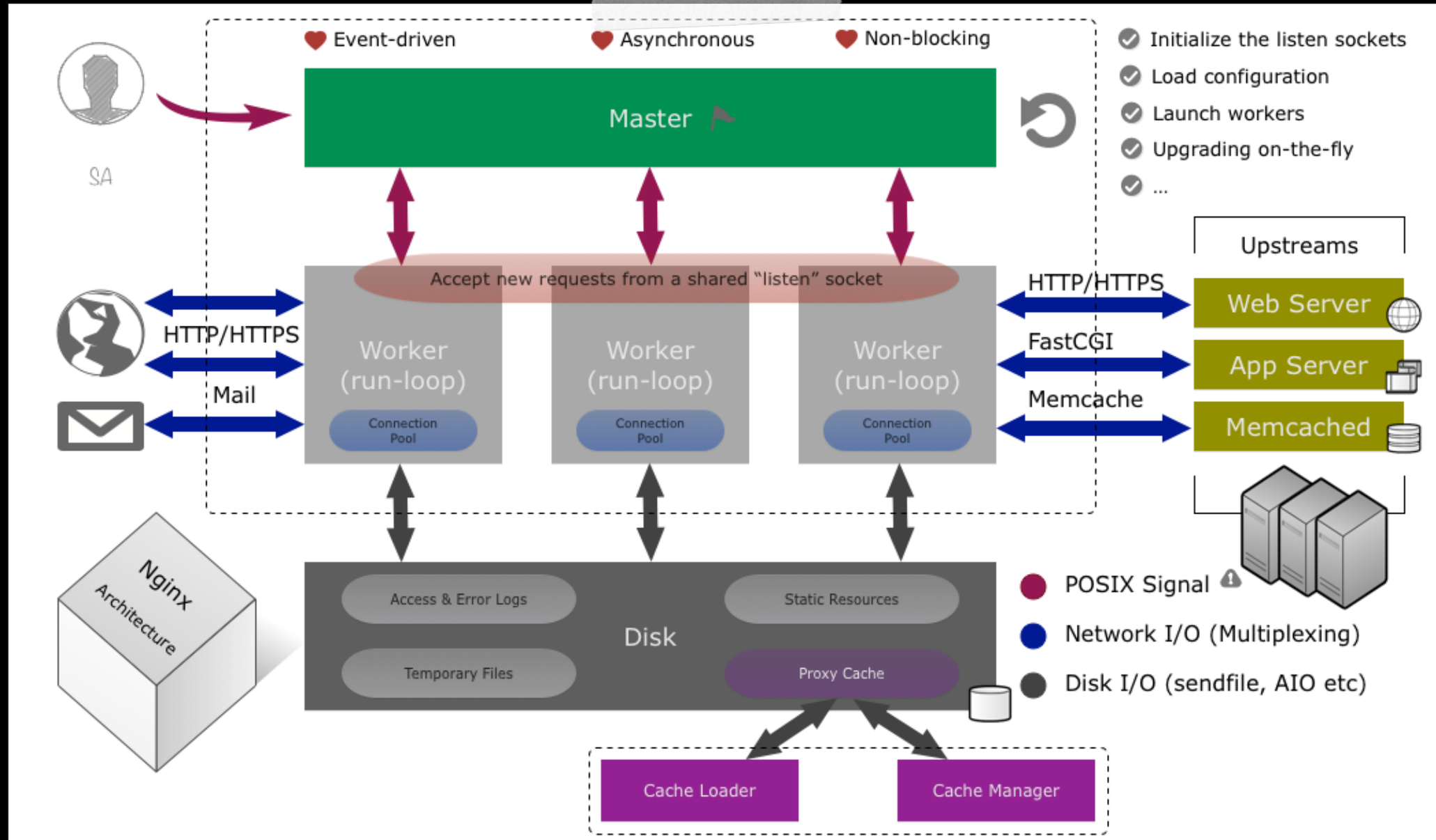
2014.11 @ Beijing OSC



Hello Nginx

nginx [engine x] is an HTTP and reverse proxy server, as well as a mail proxy server, written by Igor Sysoev.

A simple example

```
$ ./configure --prefix=/opt/nginx \
    --add-module=/path/to/echo-nginx-module
```

```
http {
    server {
        listen 8080;

        location /hello {
            set $foo "hello";
            echo $foo;

            set $foo "world";
            echo $foo;
        }
    }
}
```

```
$ curl http://localhost:8080/hello
world
world
```

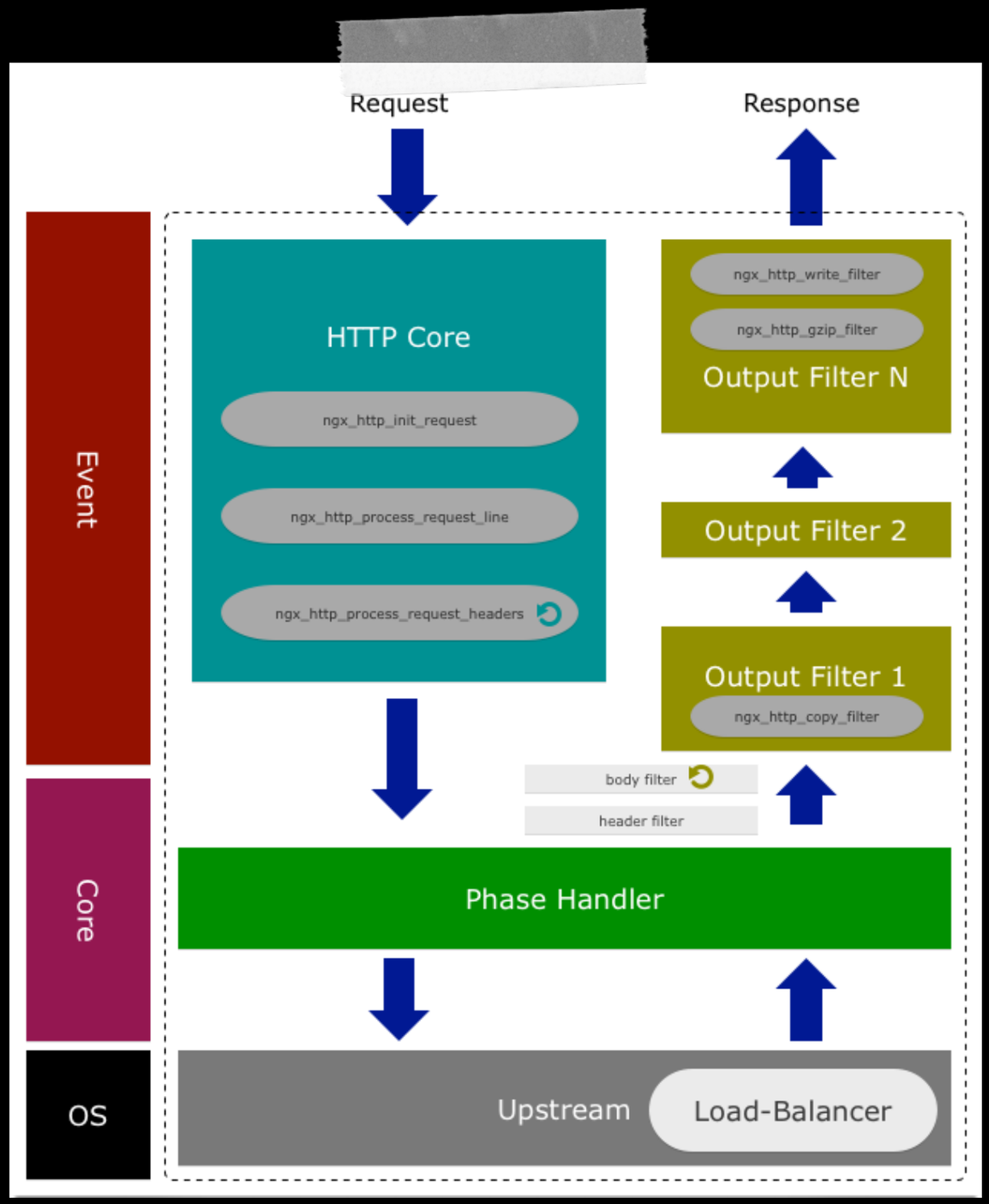
In Fact ...

```
http {
    server {
        listen 8080;

        location /hello {
            set $foo "hello";
            set $foo "world";

            echo $foo;
            echo $foo;
        }
    }
}
```

- REWRITE PHASE: set (ngx_http_rewrite_module)
- CONTENT PHASE: echo (echo-nginx-module)

Nginx Internals:
HTTP request phase handlers

- POST READ PHASE
- SERVER REWRITE PHASE
- FIND CONFIG PHASE
- REWRITE PHASE
- POST REWRITE PHASE
- PRE ACCESS PHASE
- ACCESS PHASE
- POST ACCESS PHASE
- TRY FILES PHASE
- CONTENT PHASE
- LOG PHASE



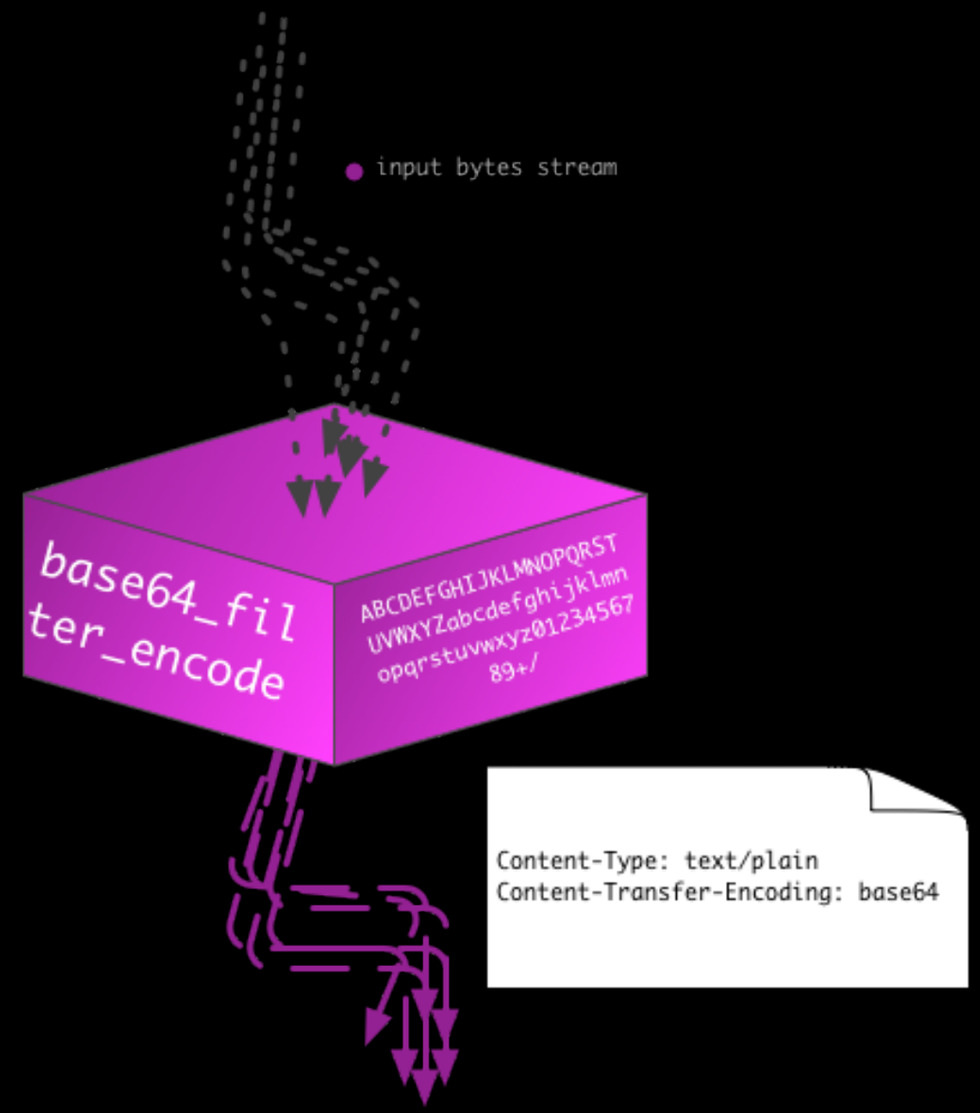
Why Nginx Module

Development is Not Easy ?

A true story

```
$ ./configure --prefix=/opt/nginx \
    --add-module=/path/to/echo-nginx-module \
    --add-module=/path/to/base64-nginx-module
```

```
http {
    server {
        listen 8080;

        location /base64 {
            base64 on;
            base64_max_length 10485760;

            echo "hello world";
        }
    }
}
```




```
$ curl http://localhost:8080/base64
aGVsbG8gd29ybGQK
```

500 lines C

If is Evil

http://agentzh.blogspot.jp/2011/03/how-nginx-location-if-works.html

```
http {
    server {
        listen 8080;

        location /if {
            set $foo 1;

            if ($foo = 1) {
                set $foo 2;
                echo "foo = $foo";
            }

            set $foo 3;
            proxy_pass http://127.0.0.1:$server_port/$foo;
        }

        location ~ /(\d+) {
            echo "bar = $1";
        }
    }
}
```

```
$ curl http://localhost:8080/if
foo = 3
```

`If` is Evil: How it works

- REWRITE PHASE

```
set $foo 1;

if ($foo = 1) {
    set $foo 2;
}
```

```
set $foo 3;
```

- CONTENT PHASE

```
if ($foo = 1) {
    echo "foo = $foo";
}
```

If is Evil:
Break ngx_rewite Directives

```
http {
    server {
        listen 8080;

        location /if {
            set $foo 1;

            if ($foo = 1) {
                set $foo 2;
                break;
                echo "foo = $foo";
            }

            set $foo 3;
            proxy_pass http://127.0.0.1:$server_port/$foo;
        }

        location ~ /(\d+) {
            echo "bar = $1";
        }
    }
}
```

```
$ curl http://localhost:8080/if
foo = 2
```

- REWRITE PHASE

```
set $foo 1;

if ($foo = 1) {
    set $foo 2;
    break;
}
```

- CONTENT PHASE

```
if ($foo = 1) {
    echo "foo = $foo";
}
```

Hello Lua

Lua is a powerful, fast, lightweight, embeddable scripting language.

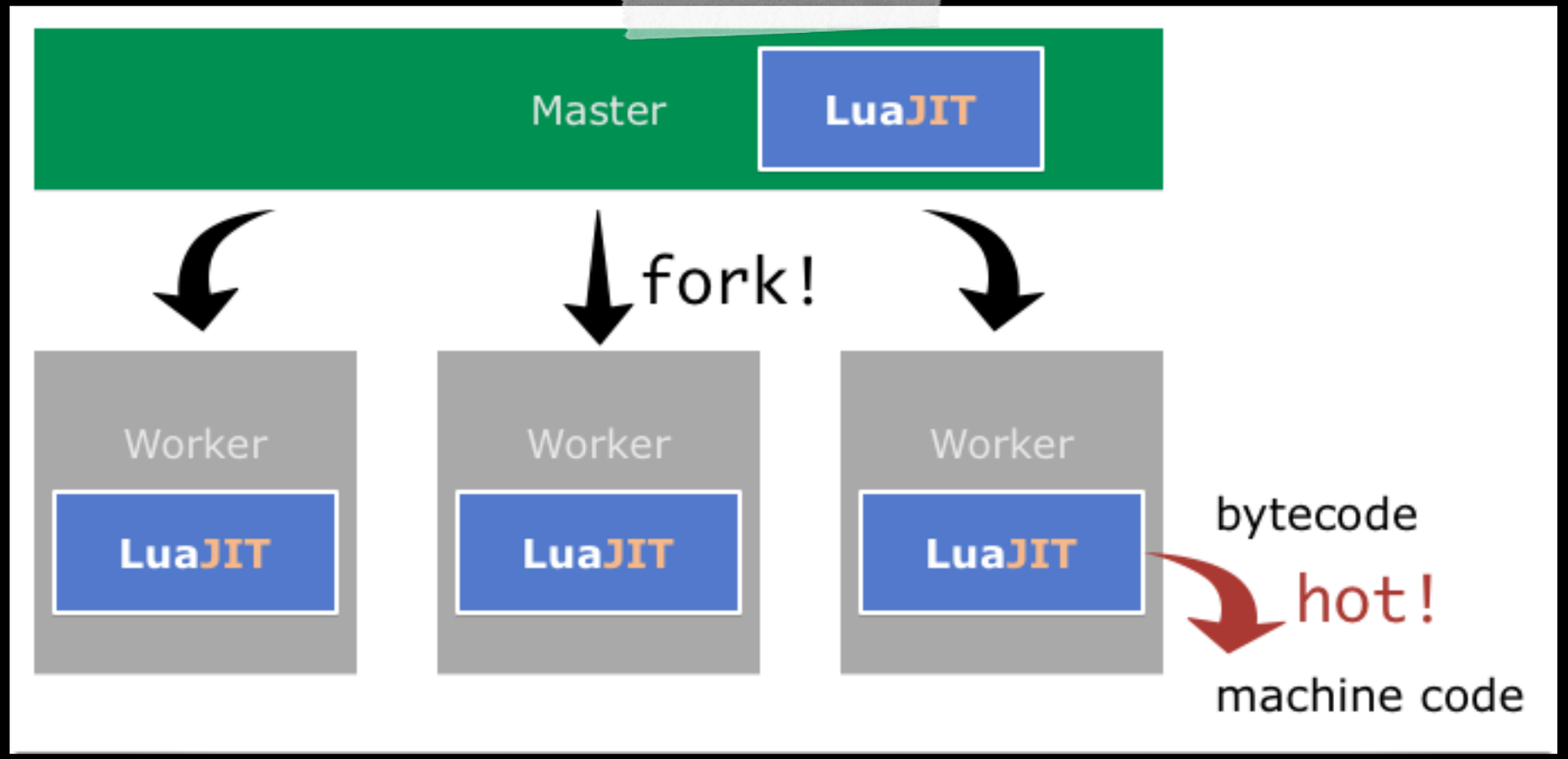

```
$ ./configure --prefix=/opt/nginx \
    --add-module=/path/to/lua-nginx-module
```

```
http {
    server {
        listen 8080;

        location /add {
            set $res '';

            rewrite_by_lua '
                local a = tonumber(ngx.var.arg_a) or 0
                local b = tonumber(ngx.var.arg_b) or 0
                ngx.var.res = a + b
            ';

            content_by_lua '
                ngx.say(ngx.var.res)
            ';
        }
    }
}
```

```
$ curl 'http://localhost:8080/add?a=6&b=7'
13
```

LuaJIT

LuaJIT is a Just-In-Time Compiler (JIT) for the Lua programming language.



How it works

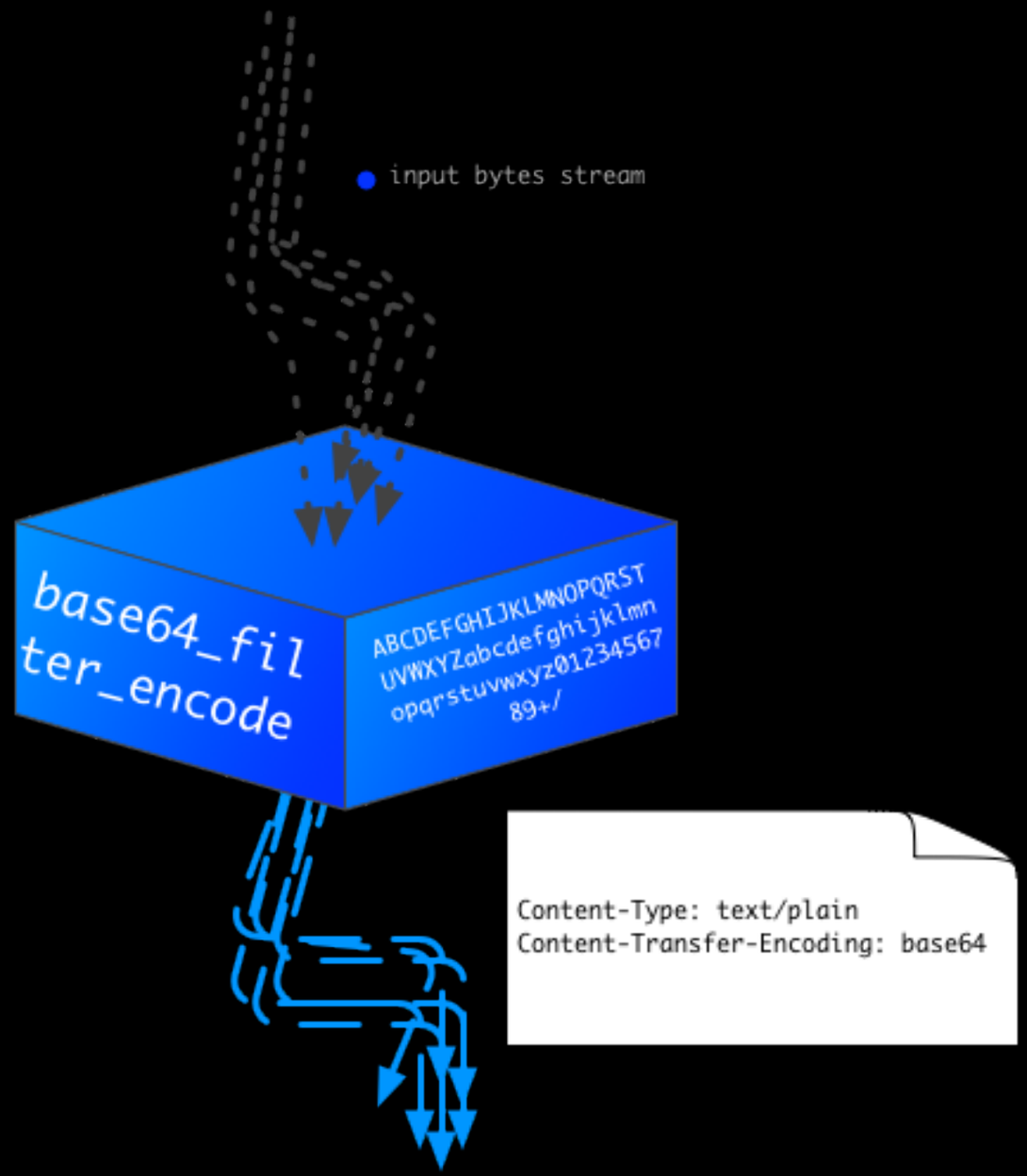
LuaJIT VM embedded into the Nginx

Base64 Filter by Lua

```
http {

    lua_package_path “$prefix/app/src/?.lua;;";

    server {
        listen 8080;

        location /base64 {
            set $b64_en '';
            set $b64_e0 '';
            set $b64_e1 '';

            echo_duplicate 1000 hello;

            header_filter_by_lua '
                ngx.header.content_length = nil -- ((n + 2) / 3 ) * 4
                ngx.header.content_type = "text/plain"
                ngx.header.content_transfer_encoding = "base64"
            ';

            body_filter_by_lua_file app/src/b64_body_filter.lua;
        }
    }
}
```

Base64 Filter by Lua: Chunk by Chunk

```lua
local chunk = ngx.arg[1]

local e0 = ngx.var.b64_e0 or ''
local e1 = ngx.var.b64_e1 or ''
local en = tonumber(ngx.var.b64_en) or 0

if en == 1 then
    chunk = e0 .. chunk
elseif en == 2 then
    chunk = e0 .. e1 .. chunk
end

if not ngx.arg[2] then
    en = #chunk % 3
    if en == 1 then
        e0 = chunk:sub(-1)
    elseif en == 2 then
        e1 = chunk:sub(-1)
        e0 = chunk:sub(-2, -2)
    end
    chunk = chunk:sub(1, #chunk - en)
else -- eof
    en = 0
end

ngx.var.b64_en = en
ngx.var.b64_e0 = e0
ngx.var.b64_e1 = e1

ngx.arg[1] = ngx.encode_base64(chunk)
```



30 lines Lua

★ngx_upreferer_module.c ~ 2100 C

★src/modules/referer.lua ~ 500 Lua

ngx.md5 ngx.time ngx.re.* ngx.req.*

ngx.decode_args

string.sub string.find string.byte

table.concat

based on Lua coroutines & synchronous & 100% non-blocking

cosocket API

ngx.socket.* connect send receive

sslhandshake close settimeout etc.

A true story:
Yupoo Referer Redirect (Year 2012)

```
eval_escalate off;
eval_override_content_type text/plain;

eval $answer {
    set $redis_key "$scheme://<key>";
    redis_pass redis;
}

if ($answer = "101") {
    rewrite ^ http://r.yupoo.com/101.gif redirect;
    break;
}

if ($answer = "102") {
    rewrite ^ http://r.yupoo.com/102.gif redirect;
    break;
}

if ($answer ~ "^http://") {
    rewrite ^ $answer redirect;
    break;
}
```

WTF!

- Fork ngx_http_redis to support `ypacl` command
- vkholodkov/nginx-eval-module
  last commit on `Nov 26, 2010`

when upgrade Nginx to the latest version

Coredump

Yupoo Referer Redirect by Lua

lua-resty-redis (based on the cosocket API)

ngx.redirect rewrite_by_lua_file

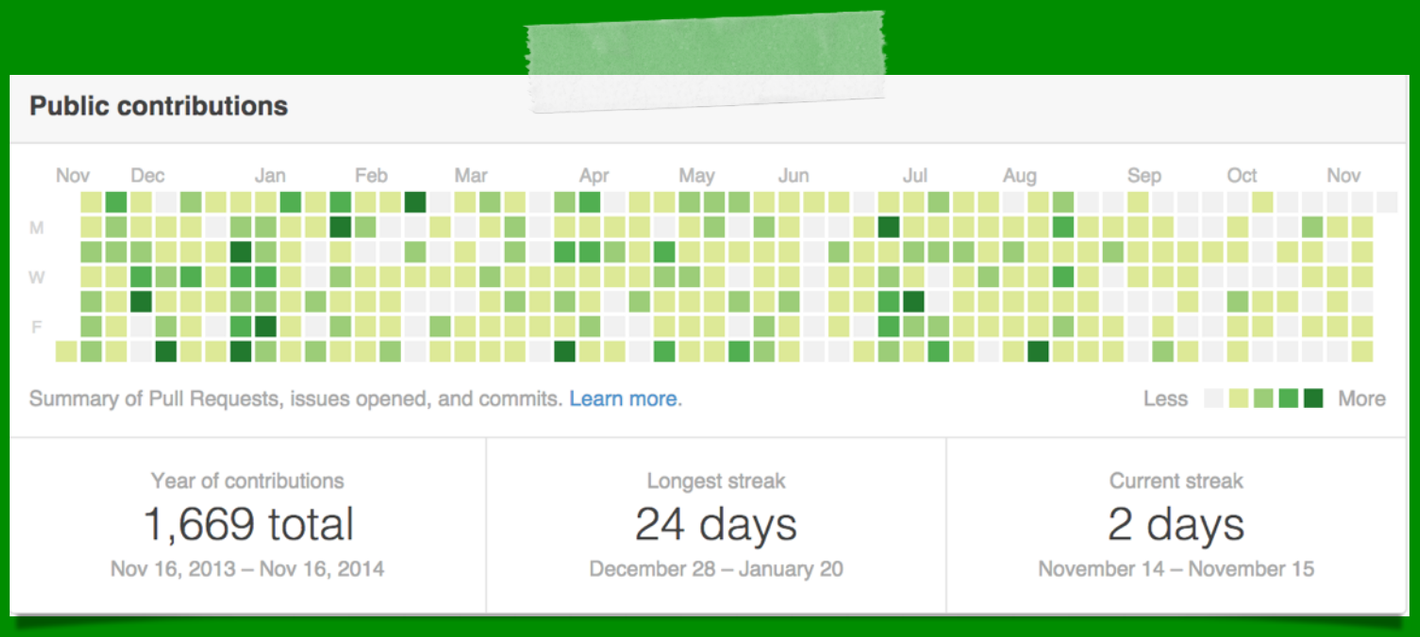
```
Local redis = require "resty.redis"
local red = redis:new()

redis.add_commands("ypacl")

-- set_timeout and connect

local res, err = red:ypacl(key)

if res == "101" then
    return ngx.redirect("http://r.yupoo.com/101.gif")
else
    -- do something else
end
```

LuaJIT FFI

lua-resty-uuid:
Based on **LuaJIT** FFI

```
-- modified version of original pull request by smallfish
-- https://github.com/openresty/lua-resty-string/pull/7

local ffi = require "ffi"
local new = ffi.new
local string = ffi.string

local _M = {}

ffi.cdef[[
    typedef unsigned char uuid_t[16];
    void uuid_generate(uuid_t out);
    void uuid_unparse(const uuid_t uu, char *out);
]]

local libuuid = ffi.load("libuuid")
function _M.generate()
    if libuuid then
        local uuid = new("uuid_t")
        local result = new("char[36]")
        libuuid.uuid_generate(uuid)
        libuuid.uuid_unparse(uuid, result)
        return string(result)
    end
end

return _M
```

Openresty



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ONEPIECE


WANTED
DEAD OR ALIVE
MARCO THE PHOENIX
฿ 750,000,000-
KONO SAKUHIN HA FICTION DETHUNODE JITSUZAISURU JINBUTSU DANTAI SONOTA NO SOSHIKI TO DOITSU NO MEISHOU GA GEKICHU NI TOUJYOU SHITATOSHITEMO JITSUZAI NA MONOTOHA ISSAI MUKANKEIDETH.
MARINE


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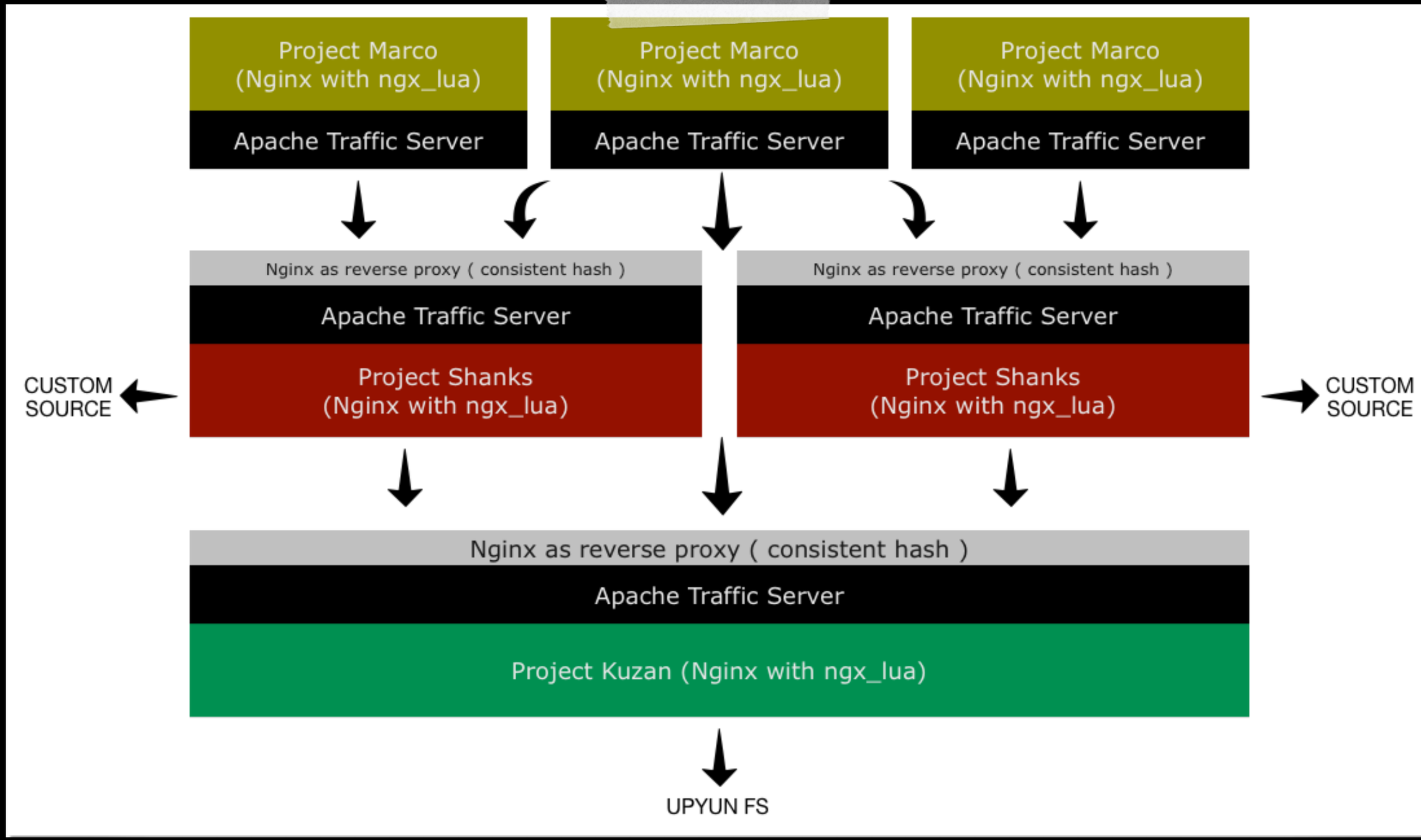
MARINE

UPYUN CDN


Project Marco
(Nginx with ngx_lua)
Apache Traffic Server
Project Marco
(Nginx with ngx_lua)
Apache Traffic Server
Project Marco
(Nginx with ngx_lua)
Apache Traffic Server
Nginx as reverse proxy (consistent hash)
Apache Traffic Server
Project Shanks
(Nginx with ngx_lua)
Nginx as reverse proxy (consistent hash)
Apache Traffic Server
Project Shanks
(Nginx with ngx_lua)
CUSTOM
SOURCE
CUSTOM
SOURCE
Nginx as reverse proxy (consistent hash)
Apache Traffic Server
Project Kuzan (Nginx with ngx_lua)
UPYUN FS

UPYUN CDN:
Metadata Cache

- CJSON, MessagePack
- ngx.shared.DICT
- lua-resty-lock
- lua-resty-shcache
- lua-resty-lrucache (*)

Metadata Cache:
The original version (Year 2012)

```lua
local metadata = ngx.shared.metadata

-- local key, bucket = ...

local value = metadata:get(key)
if value ~= nil then
    if value == "404" then
        return   -- HIT_NEGATIVE
    else
        return value -- HIT
    end
end

local rds = redis:new()
local ok, err = rds:connect("127.0.0.1", 6379)
if not ok then
    metadata:set(key, "404", 120) -- expires 2 minutes
    return -- NO_DATA
end

res, err = rds:hget("upyun:" .. bucket, ":something")
if not res or res == ngx.null then
    metadata:set(key, "404", 120)
    return -- NO_DATA
end

metadata:set(key, res, 300) -- expires 5 minutes
rds:set_keepalive()

return res -- MISS
```

Issues

- "dog-pile effect"
- NO_DATA when redis crash
- code inflexible

Metadata Cache:

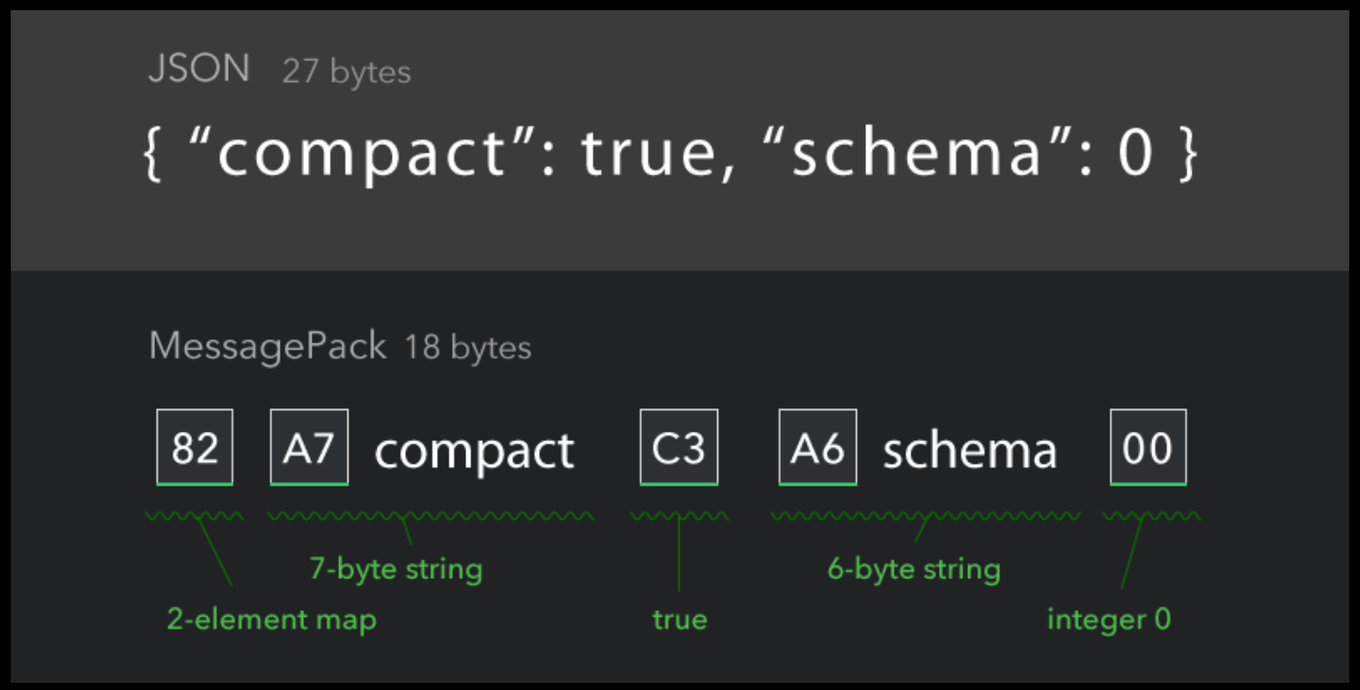
lua-resty-shcache

```
-- app/src/modules/metadata.lua

local shcache = require "resty.shcache"

function _M.get_metadata(bucket)
    local lookup_metadata = function ()
        -- fetch from redis
        return res
    end

    local cache_data = shcache:new(
        ngx.shared.metadata,
        { external_lookup = lookup_metadata,
          encode = cmsgpack.pack,
          decode = cmsgpack.unpack,
        },
        { positive_ttl = cache_positive_ttl,
          negative_ttl = cache_negative_ttl,
          name = "metadata",
        })

    -- local key = ...

    local data, _ = cache_data:load(key)
    if not data then
        return
    end

    return data
end
```

- cache locks (based on lua-resty-lock)
- serialization / de-serialization
- external lookup via Lua closure
- MISS, HIT, HIT_NEGATIVE, STALE, NET_ERR

Metadata Cache:

MessagePack



Bucket	JSON	MessagePack
huab***	6035 bytes	4135 bytes - 69%

Metadata Cache:

lua-resty-lrucache

- based on **LuaJIT** FFI
- HIT_LRU
- avoid serialization / de-serialization

UPYUN CDN:
Upstream Health Check

- ✦lua-resty-checkups (*)
- ✦lua-upstream-nginx-module

Upstream Health Check: lua-resty-checkups

```
-- app/etc/config.lua

_M.global = {
    checkup_timer_interval = 5,
    checkup_timer_overtime = 60,
}

_M.api = {
    timeout = 2,
    typ = "general", -- http, redis, mysql etc.
    cluster = {
        {   -- level 1
            try = 2,
            servers = {
                { host = "127.0.0.1", port = 12354 },
                { host = "127.0.0.1", port = 12355 },
                { host = "127.0.0.1", port = 12356 },
            }
        },
        {   -- level 2
            servers = {
                { host = "127.0.0.1", port = 12360 },
                { host = "127.0.0.1", port = 12361 },
            }
        },
    },
}
```

Upstream Health Check: checkups with nginx.conf

```
# nginx/conf/upstream.conf

upstream api.com {
    server 127.0.0.1:12354;
    server 127.0.0.1:12355;
    server 127.0.0.1:12356;
    server 127.0.0.1:12360 backup;
    server 127.0.0.1:12361 backup;
}
```

type	status	timer	interval
checkup	shm_zone	global	5s
upstream	per worker	per worker	2s

```
-- app/etc/config.lua

_M.global = {
    checkup_timer_interval = 5,
    checkup_timer_overtime = 60,

    ups_status_sync_enable = true,
    ups_status_timer_interval = 2,
}

_M.api = {
    cluster = {
        {   -- level 1
            try = 2,
            upstream = "api.com",
        },
        {   -- level 2
            upstream = "api.com",
            upstream_only_backup = true,
        },
    },
}
```

nginx.conf	service
server_name *.b0.upaiyun.com	Custom Domain Binding
valid_referers, rewrite, **allow, deny**	**Custom Antileech Rules and Redirect:** ip, user-agent, referer, token etc.
expires 7d	**Custom Expires Time:** support specific URI rules etc.
ssl_certificate*	Custom SSL Certificates Load
upstream { server 127.0.0.1 }	Custom CDN Source: support multi-network routing etc.
max_fails=3 fail_timeout=30s **health_check (*)**	Custom Health Check Strategy: passive, active
round-robin, ip_hash, **hash (1.7.2+)**	Custom Load Balancing Strategy
...	...

nginx.conf as a service

powered by ngx_lua

UPYUN DevOps

conf hash + project version + upyun.cfg

Ansible Playbook

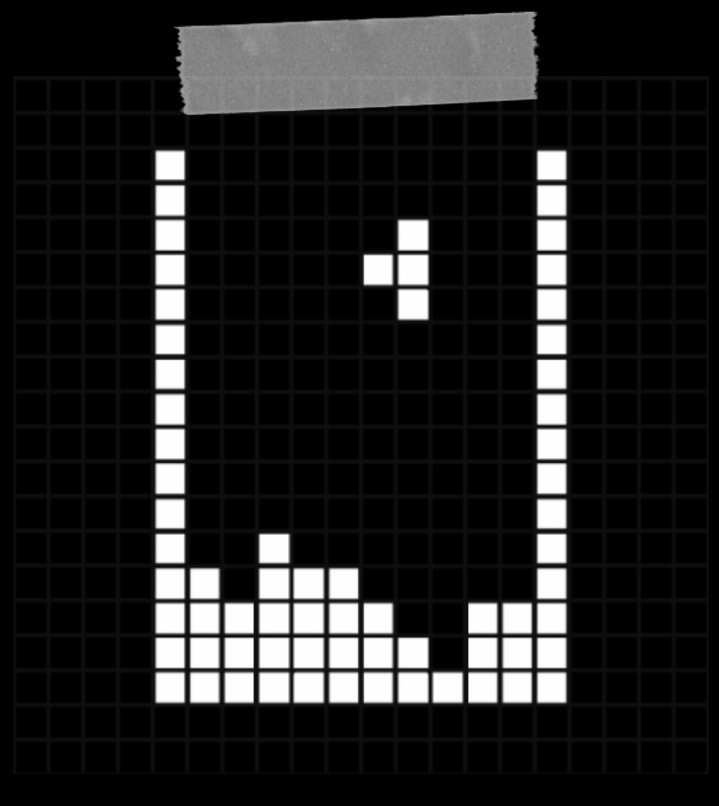
- rsync code and binary
- conf template instantiate
- kill -HUP `cat /var/run/nginx.pid` (*)

Lua CDN

Lua WAF

Lua SSL

Join our team



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Nginx ngx_lua agentzh Lua

blog.cloudflare.com Openresty **LuaJIT** Github

Maxim Dounin Igor Sysoev chaoslawful

https://groups.google.com/forum/#!forum/OpenResty

Ansible Michael Pall Open source

Thanks

...

Q & A