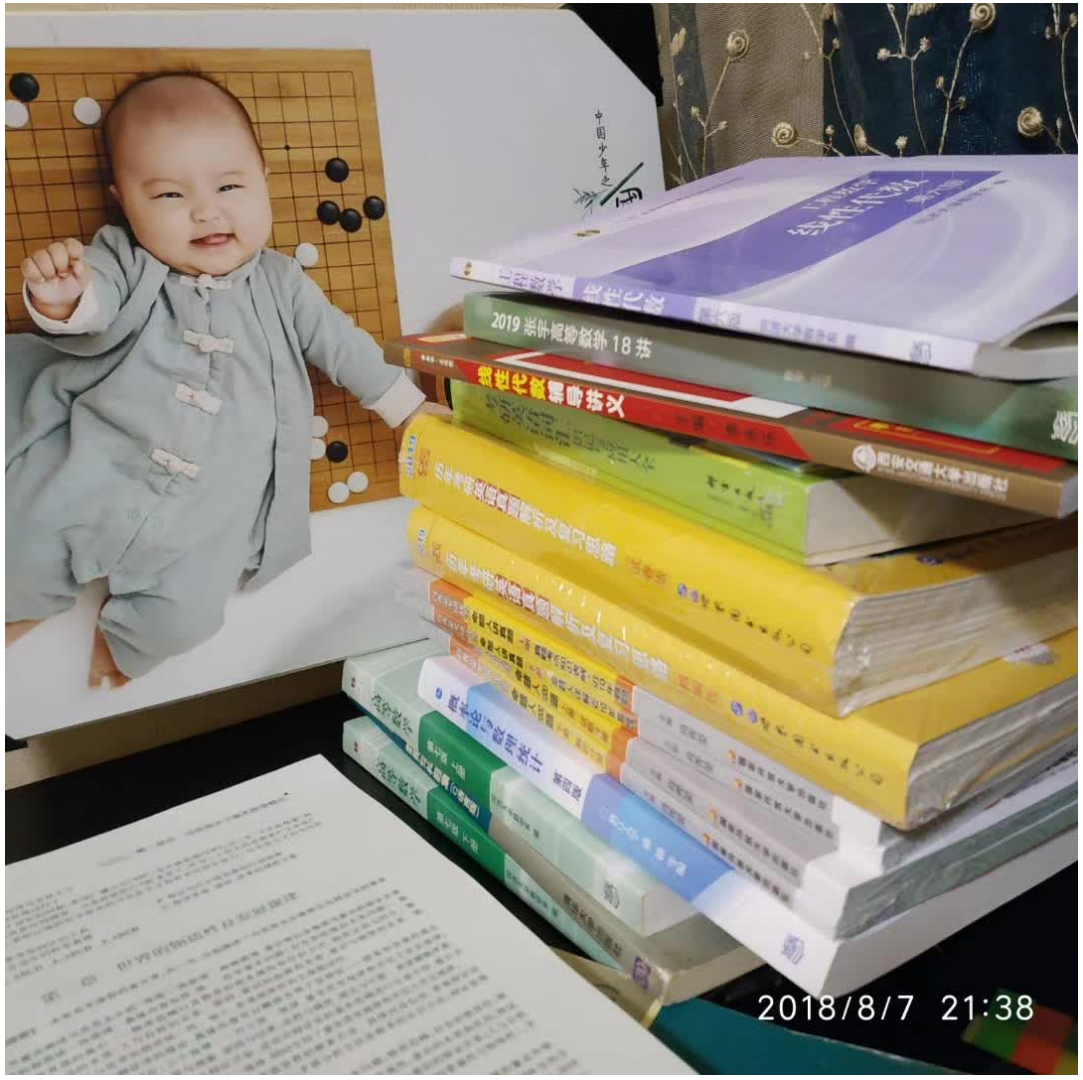
Architecture, Technology Stack and Solutions to Modern CDNs

罗意

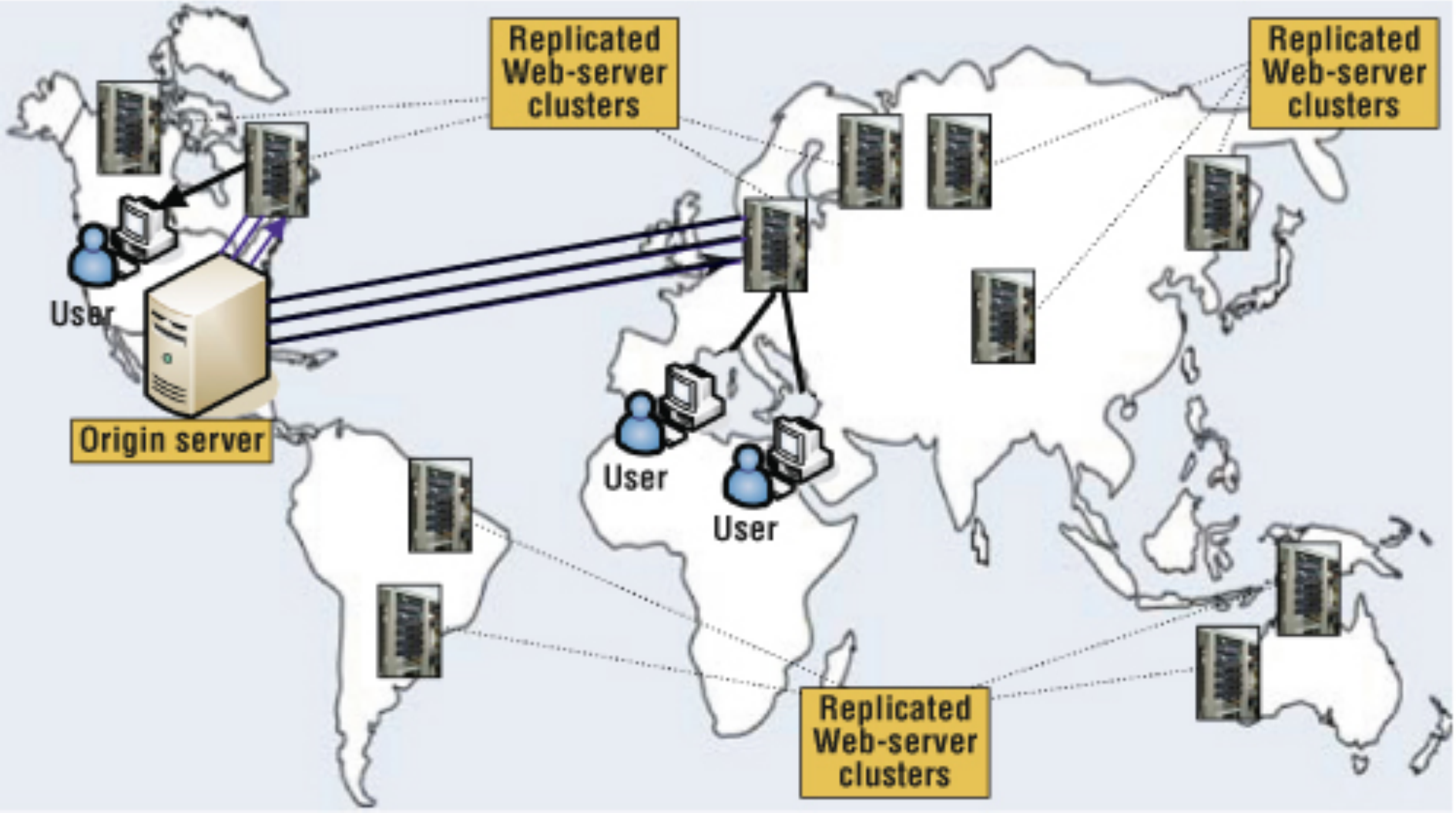
2022-04-06

Self Introduction



https://github.com/cf020031308

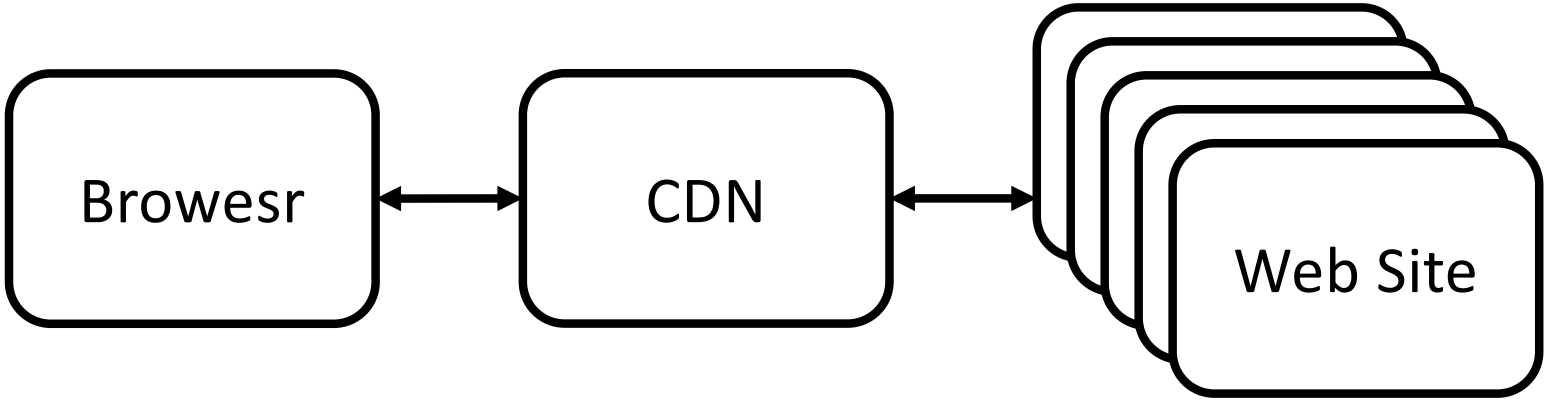
Conventional CDN



HTTP Protocol

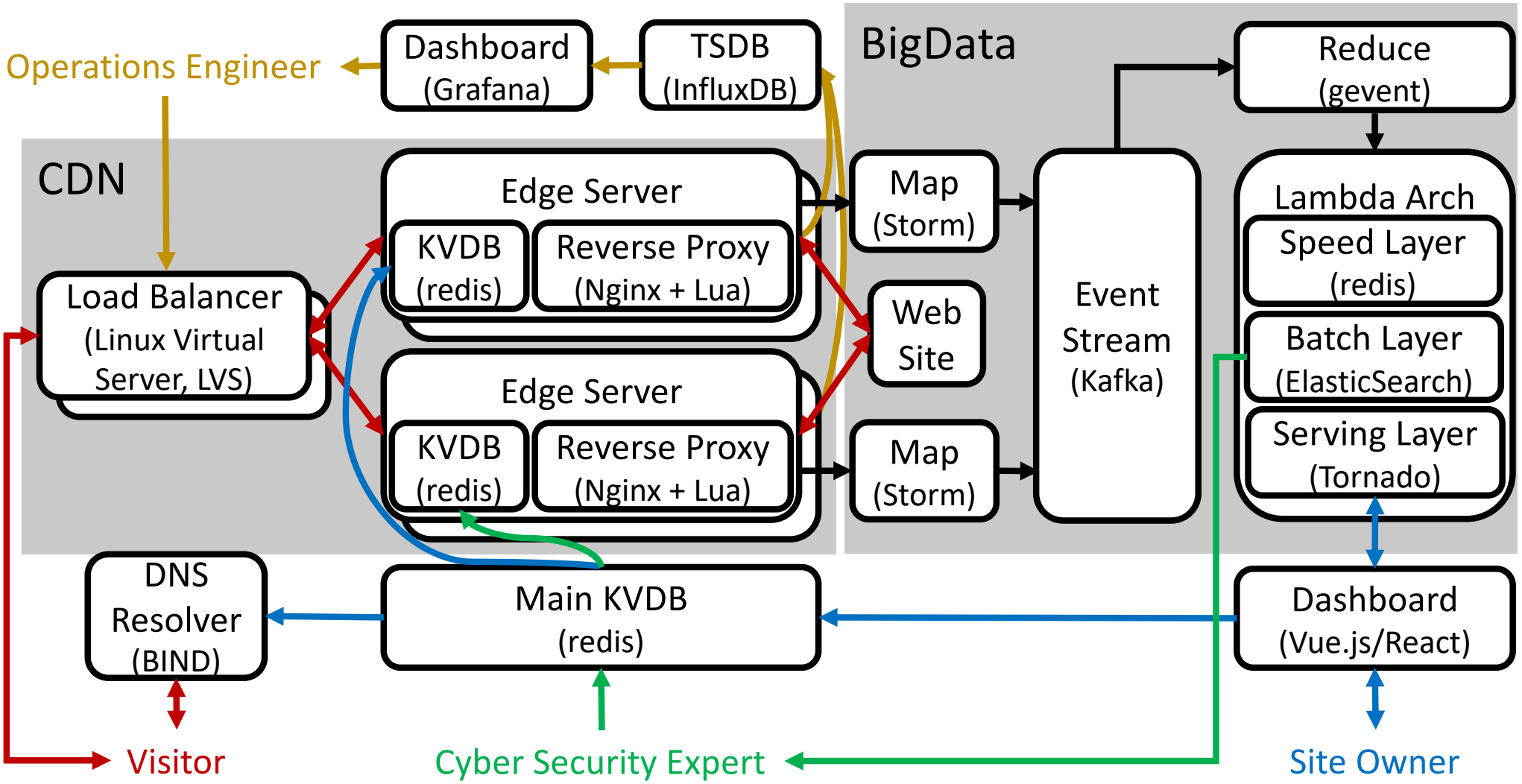
```
➜  ~ curl http://s1.bdstatic.com/r/www/cache/bdorz/baidu.min.css -vv > /dev/null
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
  0     0    0     0    0     0      0      0 --:--:-- --:--:-- --:--:--     0*   Trying 127.0.0.1...
* TCP_NODELAY set
* Connected to 127.0.0.1 (127.0.0.1) port 9999 (#0)
> GET http://s1.bdstatic.com/r/www/cache/bdorz/baidu.min.css HTTP/1.1
> Host: s1.bdstatic.com
> User-Agent: curl/7.54.0
> Accept: */*
> Proxy-Connection: Keep-Alive
>
< HTTP/1.1 200 OK
< Server: JSP3/2.0.14
< Date: Tue, 22 Mar 2022 12:59:06 GMT
< Content-Type: text/css
< Content-Length: 15629
< Connection: keep-alive
< Expires: Fri, 19 Mar 2032 12:59:06 GMT
< Last-Modified: Wed, 06 Jul 2016 08:37:47 GMT
< Etag: "3d0d-536f37be34cc0"
< Cache-Control: max-age=315360000
< Accept-Ranges: bytes
< Vary: Accept-Encoding,User-Agent
< Ohc-Cache-HIT: whce53 [1]
< Ohc-Response-Time: 1 0 38 39 77 77
<
{ [7865 bytes data]
100 15629  100 15629    0     0   108k      0 --:--:-- --:--:-- --:--:--  109k
* Connection #0 to host 127.0.0.1 left intact
➜  ~
```

Modern CDN



1. Content Delivery: Akamai
2. Cyber Security: Cloudflare, 阿里云、知道创宇，……
3. Domain Function
   - Image Hosting: 七牛云
   - Gateway: Kong, APISix

Modern CDN Architecture



Key Stack: Nginx + Lua

2004

Igor Sysoev

1993

- Roberto Ierusalimschy
- Waldemar Celes
- Luiz Henrique de Figueiredo
- Mike Pall (LuaJIT, 2005)

2009

章亦春(agentzh)

2009

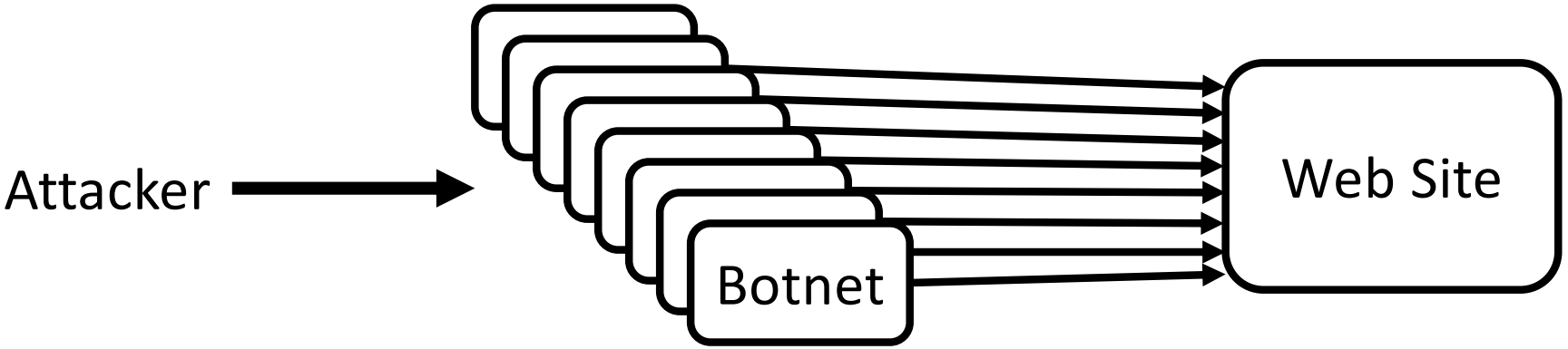
Salvatore Sanfilippo (antirez)

Example: redis + Lua

HyperLogLog

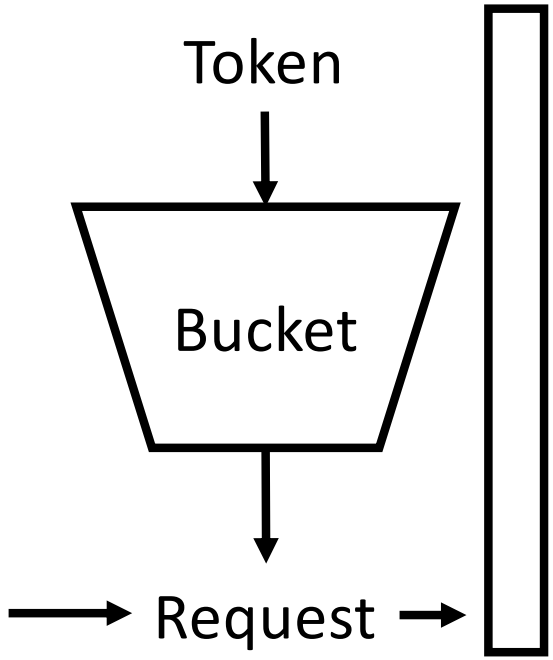
```lua
local function hll_dense2sparse(key)
    local exec = redis.call
    local sub = string.sub
    local byte = string.byte
    local char = string.char
    local insert = table.insert
    local concat = table.concat
    local floor = math.floor
    local magic = "HYLL"

    local dense = exec("GET", key)
    if sub(dense, 1, 4) ~= magic then
        -- not a hll
        return -1
    end
    if byte(dense, 5) == 1 then
        -- already sparse
        return 0
    end
    if #dense ~= 12304 then
        -- 12304 = 16 + 16384 * 6 / 8 is the length of a dense hll
        return -1
    end

    local sparse = {magic, char(1), sub(dense, 6, 16)}
    local c, v, _v = 1, nil, nil
    for i = 0, 16384 do
        local offset = i * 6 % 8
        local j = (i * 6 - offset) / 8 + 17
        local x, y = byte(dense, j, j + 1)
        if x then
            _v = (floor(x / 2 ^ offset) + (y or 0) * 2 ^ (8 - offset)) % 64
        else
            _v = nil
        end

        if _v and _v > 32 then
            -- cannot translate to sparse representation
            return -2
        end
        if _v == v then
            c = c + 1
        else
            if v == 0 then
                while c >= 16384 do
                    insert(sparse, char(127) .. char(255))
                    c = c - 16384
                end
                if c > 64 then
                    c = c - 1
                    insert(sparse, char(64 + floor(c / 256)) .. char(c % 256))
                elseif c > 0 then
                    insert(sparse, char(c - 1))
                end
            elseif v then
                v = v - 1
                while c >= 4 do
                    insert(sparse, char(128 + v * 4 + 3))
                    c = c - 4
                end
                if c > 0 then
                    insert(sparse, char(128 + v * 4 + c - 1))
                end
            end
            c, v = 1, _v
        end
    end

    exec("SET", key, concat(sparse))
    return 1
end
```

Solutions to Challenge Collapsar



1. Rate limit
2. JavaScript Challenge
3. CAPTCHA
4. Log Analysis

Rate Limit




```lua
function _M.limit_rate(self, ip)
    local rate, interval = 5, 30
    local key = ip
    local dict = ngx.shared.cc
    local bucket, last_access = dict:get(key)
    bucket = bucket or 0
    local now = ngx_time()
    if bucket > 0 then
        bucket = bucket - (now - last_access) * rate / interval
        if bucket < 0 then
            bucket = 0
        end
    end
    if bucket < rate then
        bucket = bucket + 1
        dict:set(key, bucket, interval, now)
    else
        return RATE_TEMPLATE
    end
end
```

JavaScript Challenge

document.cookie = “sectoken=xxxyyyzzz”;

JS Obfuscation

```
(function(){google.jl={attn:false,blt:'none',chnk:0,dw:false,dwu:true,emtn:0,end:0,ine:false,injs:'none',injt:0,lls:'default',pdt:0,rep:0,snet:true,strt:0,ubm:false,uwp:true};})()
;(function(){var pmc='{\x22d\x22:{},\x22sb_he\x22:{\x22agen\x22:true,\x22cgen\x22:true,\x22client\x22:\x22heirloom-hp\x22,\x22dh\x22:true,\x22dhqt\x22:true,\x22ds\x22:\x22\x22,\x2
2ffql\x22:\x22zh-TW\x22,\x22fl\x22:true,\x22host\x22:\x22google.com\x22,\x22isbh\x22:28,\x22msgs\x22:{\x22cibl\x22:\x22&#28165;&#38500;&#25628;&#23563;\x22,\x22dym\x22:\x22&#20320
;&#26159;&#19981;&#26159;&#35201;&#26597;&#65306;\x22,\x22lcky\x22:\x22&#22909;&#25163;&#27683;\x22,\x22lml\x22:\x22&#30637;&#35299;&#35443;&#24773;\x22,\x22oskt\x22:\x22&#36664;&
#20837;&#24037;&#20855;\x22,\x22psrc\x22:\x22&#24050;&#24478;&#24744;&#30340;&#12300;\\u003Ca href\x3d\\\x22/history\\\x22\\u003E&#32178;&#38913;&#35352;&#37636;\\u003C/a\\u003E&#
12301;&#20013;&#31227;&#38500;&#36889;&#31558;&#25628;&#23563;&#35352;&#37636;\x22,\x22psrl\x22:\x22&#31227;&#38500;\x22,\x22sbit\x22:\x22&#20197;&#22294;&#25628;&#23563;\x22,\x22
srch\x22:\x22Google &#25628;&#23563;\x22},\x22ovr\x22:{},\x22pq\x22:\x22\x22,\x22refpd\x22:true,\x22rfs\x22:[],\x22sbas\x22:\x220 3px 8px 0 rgba(0,0,0,0.2),0 0 0 1px rgba(0,0,0,0.
08)\x22,\x22sbpl\x22:16,\x22sbpr\x22:16,\x22scd\x22:10,\x22stok\x22:\x229yCZWrpxDx702ZVH-k9d9rpzykw\x22,\x22uhde\x22:false}}';google.pmc=JSON.parse(pmc);})();</script>       </bo
dy></html>%
➜  ~ curl https://google.com -vvL
```

JSF*ck

- false => ![]
- true => !![]
- undefined => [][[]]
- NaN => +[![]]
- 0 => +[]
- 1 => +!+[]
- 2 => !+[]+!+[]
- 10 => [+!+[]]+[+[]]
- Array => []
- Number => +[]
- String => []+[]
- Boolean => ![]
- Function => []["filter"]

hello world | Encode | ☐ Eval Source | ☑ Run In Parent Scope

```
(+(+!+[]+[+[]]+[+!+[]]))[(!![]+[])[+[]]+(!![]+[][(![]+[])[+[]]+([!
[]]+[][[]])[+!+[]+[+[]]]+(![]+[])[!+[]+!+[]]+(!![]+[])[!+[]+!+[]]])
[+!+[]+[+[]]]+([]+[])[([][(![]+[])[+[]]+([![]]+[][[]])[+!+[]+[+[]]]+
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([![]]+[][[]])[+!+[]+[+[]]]+(![]+[])[!+[]+!+[]]+(![]+[])[!+[]+!+[]]])
```
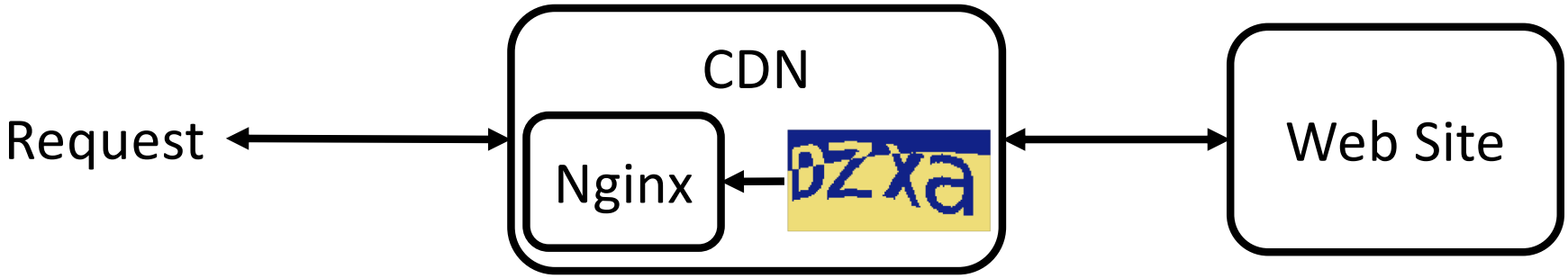
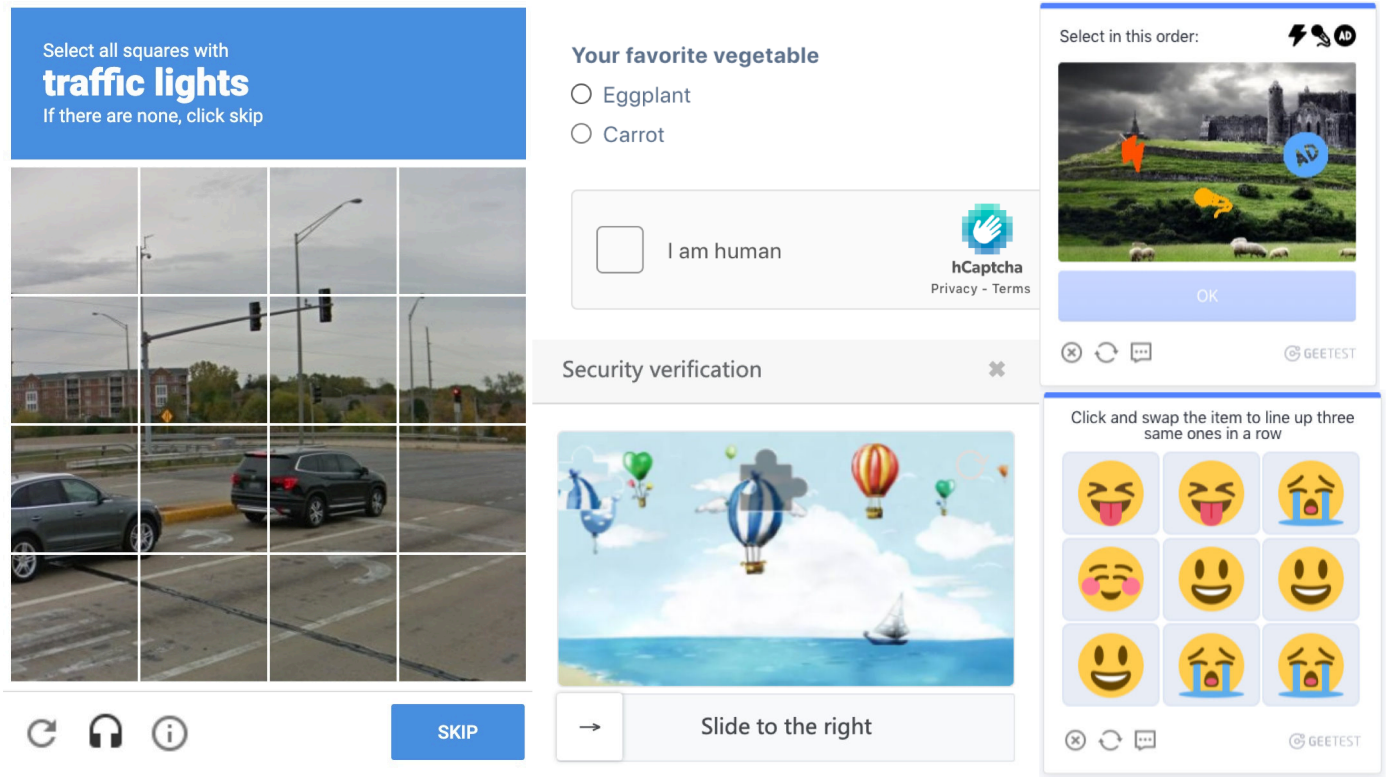

3207 chars

Run This

CAPTCHA


CDN
Request
Nginx
Web Site


Select all squares with
traffic lights
If there are none, click skip
SKIP
Your favorite vegetable
Eggplant
Carrot
I am human
hCaptcha
Privacy - Terms
Security verification
Slide to the right
Select in this order:
OK
GEETEST
Click and swap the item to line up three same ones in a row
GEETEST

谢谢

敬请批评指正！

Modern CDN Architecture