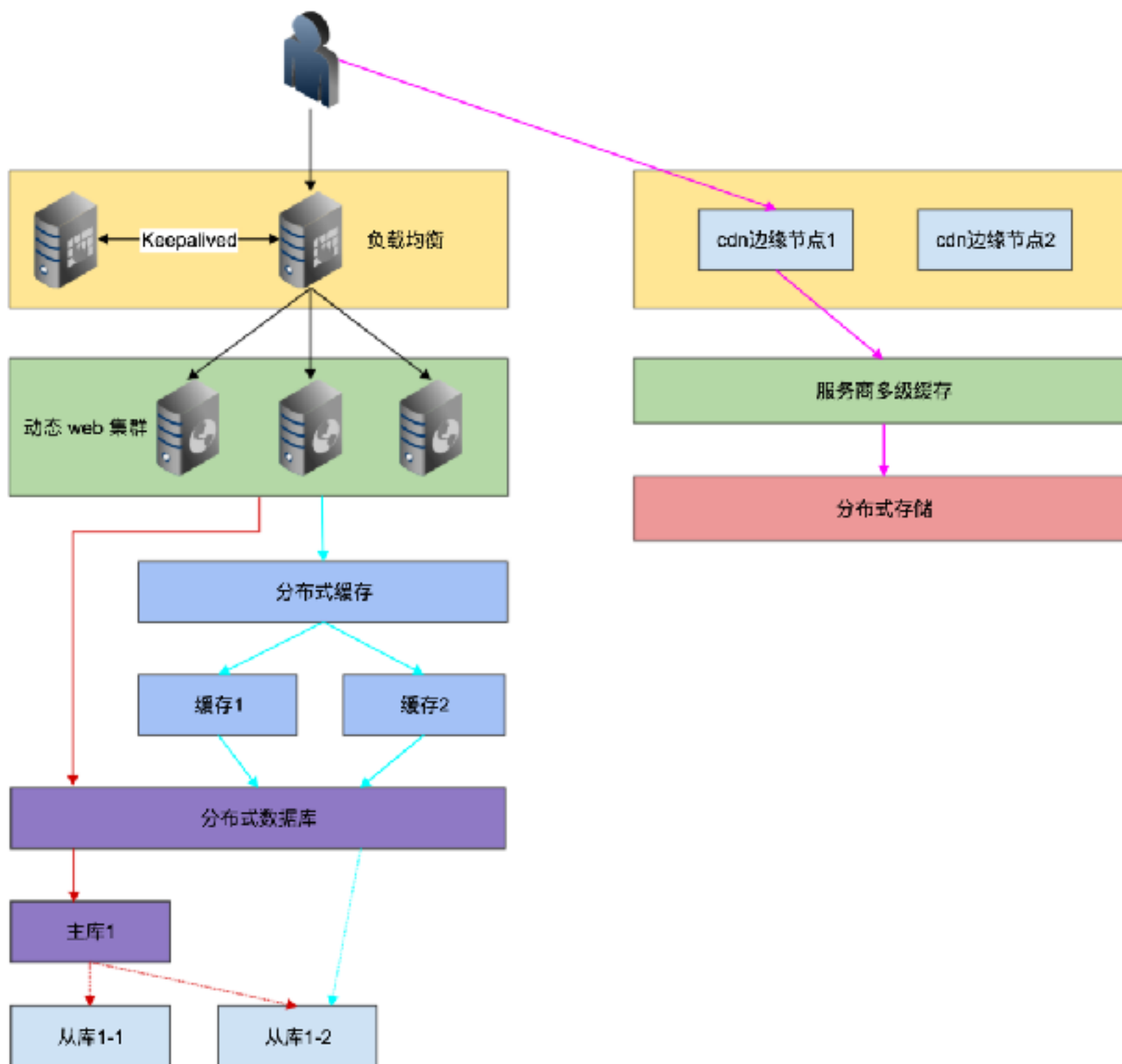


亿级 PV 网站架构实战之性能压榨



后端架构的套路（负载均衡、动静分离、读写分离、缓存、分布式）



亿级 PV 网站架构实战之性能压榨

前端优化

nginx 优化

php 优化

业务优化

mysql 优化

缓存优化

服务器认知提升

 雅虎军规: <http://www.cnblogs.com/paul-3/p/5999722.html>

减少 http 请求数

充分利用浏览器缓存

分布式存储前端资源

多域名访问资源

资源数据的压缩

优化首屏展示速度



前端优化 - 减少 http 请求数

The screenshot shows the SegmentFault website interface and the Chrome DevTools Network tab. The website header includes the SegmentFault logo and navigation links: 问答, 头条, 专栏, 讲堂, 职位, 活动. A search bar is present with the text "搜索问题或关键字". Below the header, there are tabs for "最近课程", "最新发布", "热门讲座", "我参与的", "我发起的", and "我收藏的". Two course cards are visible: "PHP 进阶之路 - 亿级 pv 网站架构的技术细节与套路" by 周学耀 (415 participants, 5 stars) and "Vue.js 实战之工程篇" by Arsen (336 participants, 5 stars). A sidebar on the right contains a section titled "SegmentFault 讲堂是什么?" with a description and a "了解更多" button.

The Chrome DevTools Network tab is open, showing a list of network requests. The filter is set to "JS". The table below shows the details of the requests:

Name	Method	Status	Type	Initiator	Size	Time	Waterfall
assets.js static.segmentfault.com/v-598026c0/3rd	GET	200	script	hot?type=month Parser	51.9 KB 133 KB	50 ms 46 ms	
hot.min.js static.segmentfault.com/v-598026c0/live/script	GET	200	script	hot?type=month Parser	37.8 KB 105 KB	50 ms 46 ms	
analytics.js www.google-analytics.com	GET	200	script	hot?type=mon... Script	12.1 KB 29.4 KB	46 ms 44 ms	
hm.js?e23800c454aa573c0ccb16b52665ac25 hm.baidu.com	GET	200 OK	script	hot?type=mon... Script	8.6 KB 22.3 KB	25 ms 17 ms	
socket.io.js static.segmentfault.com/v-598026c0/3rd/socket	GET	200	script	assets.js:34 Script	56.6 KB 180 KB	78 ms 68 ms	



前端优化 - 减少 http 请求数

图片、css、script等等这些都会增加http请求数，减少这些元素的数量就能减少响应时间。

合并 css、js、小图片。现代前端框架都会通过组件的方式开发，最后打包输出。

现在很多 icon 都是直接做成字体，矢量高清，也减少网络请求数。



前端优化 - 减少 http 请求数 - 使用字体

The screenshot shows the SegmentFault website with the developer tools open. The Elements panel shows the HTML structure of a notification link, and the Styles panel shows the CSS rule for the font icon.

```
<div class="opts">  
  <a class="opts-group" href="/questions">...</a>  
  <a class="opts-group" href="/news">...</a>  
  <a class="opts-group" href="/blogs">...</a>  
  <a class="opts-group active" href="/lives">  
    <i class="fa fa-play-circle" aria-hidden="true"></i>  
    <span>讲堂</span>  
  </a>  
  <div class="opts-group">...</div>  
</div>  
</div>  
<div class="row hidden-xs">  
  ::before  
  <div class="col-sm-8 col-md-9 col-lg-9">...</div>  
  <div class="col-sm-4 col-md-3 col-lg-3 text-right">  
    <ul class="opts list-inline hidden-xs">  
      <li class="opts__item dropdown hoverDropdown write-btns visible-lg-inline-block">...</li>  
      <li class="opts__item dropdown hoverDropdown write-btns visible-md-inline-block">...</li>  
      <li class="opts__item message has-unread hidden-sm ml10">  
        <a id="dLabel" class="dropdown-toggle-message" href="/user/notifications">  
          <span class="sr-only">消息</span>  
          <span id="messageCount" class="fa fa-bell-o">  
            ::before == $8  
          </span>  
        </a>  
      </li>  
    </ul>  
  </div>  
</div>
```

The Styles panel shows the CSS rule for the font icon:

```
.fa-bell-o:before {  
  content: "\f0a2";  
}
```

The Styles panel also shows the box model for the element:

```
margin -  
border -  
padding -  
auto x auto
```



前端优化 - 利用浏览器缓存

The screenshot shows the Chrome DevTools Network tab. The selected request is `assets.js` from `static.segmentfault.com/v-598026c0/3rd`. The status is `200 (from memory cache)`. The `Response Headers` section is expanded, showing the following headers:

- `access-control-allow-origin: *`
- `age: 25805`
- `cache-control: max-age=691200` (highlighted in red)
- `content-encoding: gzip`
- `content-type: application/javascript`
- `date: Tue, 01 Aug 2017 15:03:42 GMT`
- `etag: W/"598026c1-214cb"` (highlighted in red)
- `expires: Wed, 09 Aug 2017 07:53:37 GMT` (highlighted in red)
- `last-modified: Tue, 01 Aug 2017 06:59:13 GMT` (highlighted in red)
- `server: marco/1.5`
- `status: 200`
- `vary: Accept-Encoding`
- `via: T.5208.M.1, V.483-zj-fud-200, S.mix-sd-tna-135, T.216139.H.1, V.mix-sd-tna-133, T.117113.H.1, M.cun tj-tsn-102`
- `x-mirror-request-id: b223c39bf7d820a24a84487d1283dc1b`
- `x-request-id: a1a18fca16f607a89bb9b9508871a82f; 945ae61e08bb8980e7736d6af28c4edf; dddd3f95c07f1827677a625 cec58e2b`
- `x-source: U/200`



前端优化 - 利用浏览器缓存

expires

cache-control

last-modified

etag



如何提前更新缓存呢?

版本号



前端优化 - 利用浏览器缓存 - 本地存储

Screenshot of the Taobao.com website with the Chrome DevTools Application panel open, showing browser cache data.

The Application panel is expanded to show local storage for https://www.taobao.com. The Cache section is selected, displaying a list of cached items with their keys and values.

Key	Value
cache-base64-apps	[/img.aliiedn.com/2/TB1hRtBf00X0X0X0XXGqRpxX-87-87.jpg_60x68.jpg_...]
cache-belt	[{"expold": 76, "title": "轻奢箱包", "subtile": "非箱即包", "pop": "511705", "item": "521120..."}]
cache-birthday_data	[{"status": true, "code": "1", "cate": [{"login": true}]}]
cache-birthday_req	2025/09/01 10:00
cache-blocks-effortable	[{"222665": [{"value": [{"module": "...", "count": "1", "count_phone": "11"}]}]}]
cache-blocks-fashion	[{"222726": [{"value": [{"module": "...", "count": "2", "count_phone": "2"}]}]}]
cache-blocks-favorite	[{"222699": [{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]}]
cache-blocks-quantity	[{"222745": [{"value": [{"module": "...", "count": "2", "count_phone": "2"}]}]}]
cache-blocks-special	[{"value": [{"module": "...", "count": "3", "count_phone": "3"}]}]
cache-bubble_data	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
cache-bubble_req	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
cache-footer	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
cache-goods	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
cache-headline-be	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
cache-helper	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
cache-hot-sale	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
cache-module-name	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
cache-rtb-ice	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
cache-service-banner	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
cache-service-banner	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
cache-ibh-like	[{"value": [{"module": "...", "count": "1", "count_phone": "1"}]}]
city	北京
discover-goods-data	[{"result": [{"id": "627623626646", "category": "42", "order": "106074", "title": "春秋新款女装2013..."}]}]
discover-shoes-data	[{"latency": [{"result": [{"shock": "3517448", "shou": "1", "shou": "1"}]}]}]
cs/u9C3/167231/u624Du6E36u7751	watched
rotina	1
service-hot	103,184,108
trx_ssp_fp	1571220...1171045
trx_ssp_pvid	010f-p-5220...1171473531080183
trx_ssp_pvid_1	cs7c...48P89812795



前端优化 - 分布式存储前端资源

Name	Method	Status	Type	Initiator
TB111YVXXXCaXXXSutbFXXX.jpg_170x170q90.jpg img.alicdn.com/t2/2	GET	200	jpeg	Other
TB1tYg4JFXXXbMXaXXSutbFXXX.jpg_170x170q90.jpg img.alicdn.com/t2/2	GET	200	jpeg	Other
TB11ci1QpXXXbwaFXSutbFXXX.jpg img.alicdn.com/simba/img	GET	200	jpeg	Other
TB19H83QFXXXaBapXXSutbFXXX.jpg_400x400q90.jpg img.alicdn.com/tps/t4	GET	200	jpeg	Other
TB1OJLNPXXXXc4aXXXXXXXXXXXX-502-360.jpg_400x400q90.jpg img.alicdn.com/tps	GET	200	jpeg	Other
TB1OYE_PFXXXXcXXSutbFXXX.jpg img.alicdn.com/simba/img	GET	200	jpeg	Other
TB12IA4SpXXXXBXXXXXXXXXXXX-520-280.jpg_q80_.webp img.alicdn.com/lfs	GET	200	webp	Other
getAvatar.do?userNick=%E5%B0%B1%E7%B8%B1%E8%B9%B8%E8%B8%B6%E7%BD%91&_input_charset=... www.alicdn.com/avatar	GET	200	jpeg	Other
??umpp/1.5.4/index-min.js,tmsg/3.4.6/index-min.js g.alicdn.com/lbc	GET	200	script	??kissy/k/Script
??swf/0.0.1/index-min.js g.alicdn.com/kg	GET	200	script	??kissy/k/Script
index-min.css g.alicdn.com/lbc/tmsg/3.4.6	GET	200	stylesheet	??kissy/k/Script
T1HovHXc4nXXb6ROYh-48-48.gif gtd.alicdn.com/tps/t4	GET	200	gif	Other
T1oykcFidbXXXcAas-13-5.gif gtd.alicdn.com/tps/t1	GET	200	gif	Other
T1uJc2FD8bXXbA0cQR-80-170.png gtd.alicdn.com/tps/t4	GET	200	png	??kissy/k/Script

多域名访问资源

原因一：浏览器对同一域名的并行请求数有上限，多个域名则支持更多并行请求

原因二：使用同一域名的时候无用的 cookie 简直是噩梦

资源数据的压缩

前端工具的代码压缩

服务器 gzip 压缩

图片压缩等

标准的头信息

严格控制 content-type , 不要让浏览器自己去猜

优化首屏展示速度

淘宝的案例

js, 图片延时加载、按需加载 (简单版本 phpwind wind.js) 以及h5自带异步加载模式





sendfile on 引发的故障 <https://meng kang.net/367.html>

TCP: time wait bucket table overflow <https://meng kang.net/780.html>

setsockopt 设置 SO_REUSEADDR的作用 <https://meng kang.net/564.html>



升级到 php7

开启 opcode 缓存

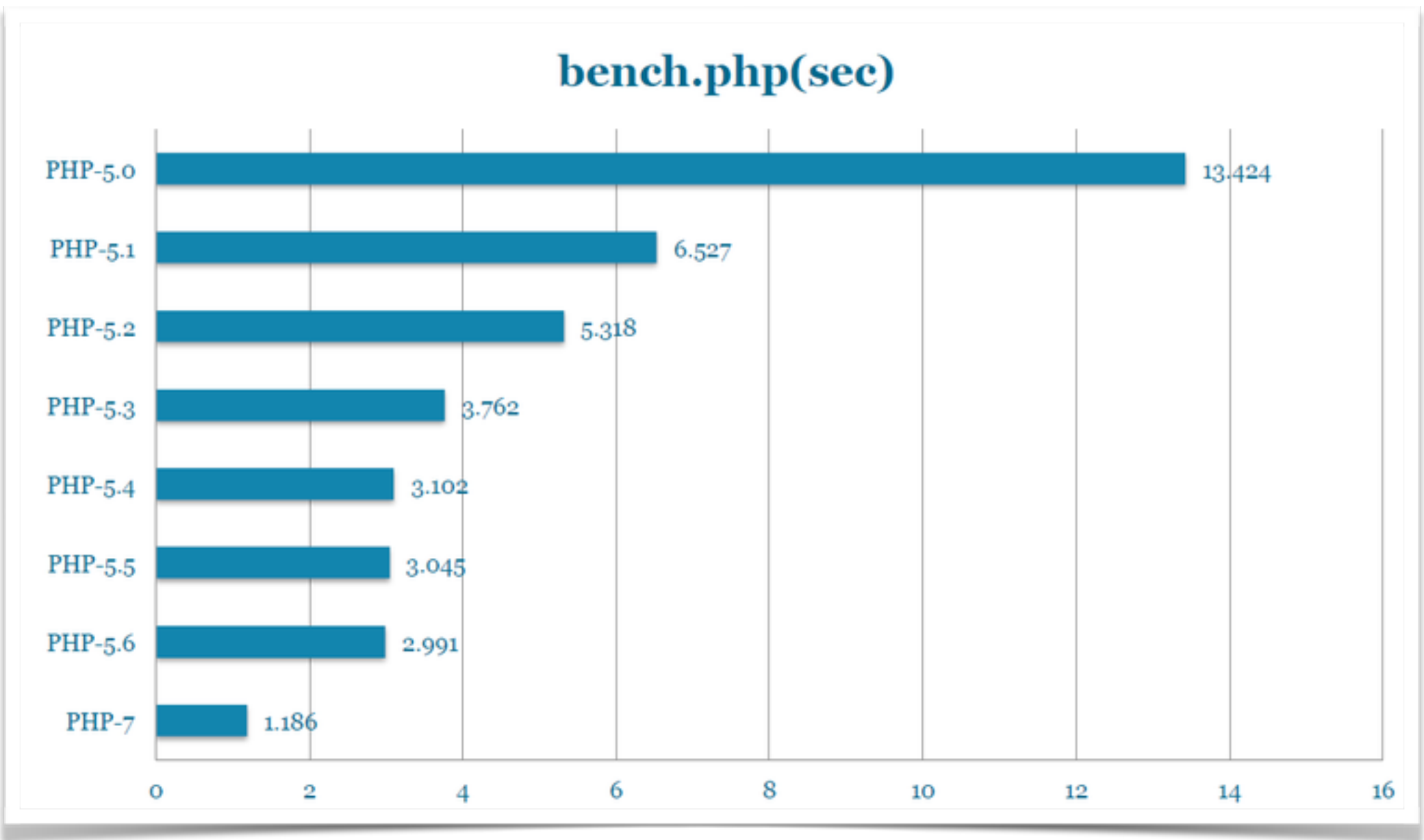
配合使用 hugepage

代码伪编译

模板编译

xhprof查找性能瓶颈

php 优化 - 升级到 php7 (图片来源鸟哥PPT)

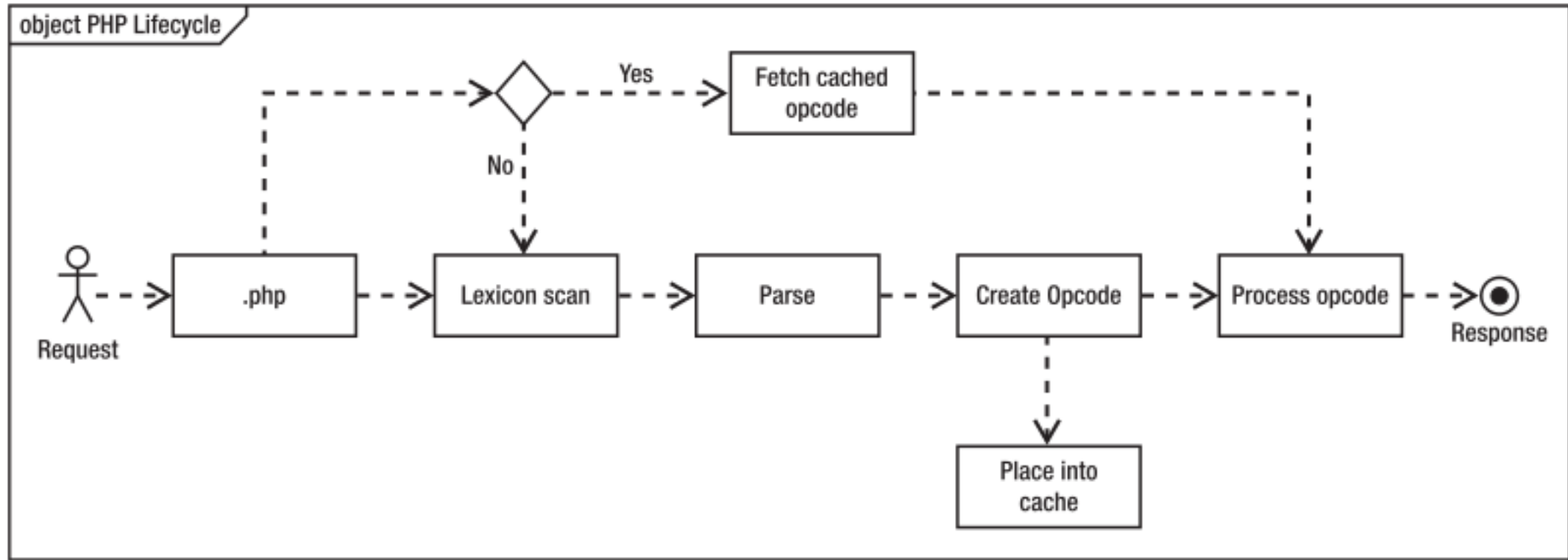


风险：注意有很多函数和扩展被废弃，比如mysql相关的，有风险，做好测试再切换。

预案：日常 -> 预发多重验证 -> 灰度发布 -> 日志收集 -> 优化修复 -> 上线



php 优化 - opcode (图片来源网络)



```
opcache.revalidate_freq=60
opcache.validate_timestamps=1
opcache.max_accelerated_files=1000
opcache.memory_consumption=512
opcache.interned_strings_buffer=16
opcache.fast_shutdown=1
opcache.file_cache=/tmp
```



Hugepage 的作用：
间接提高虚拟地址和内存地址转换过程中查表的
TLB缓存命中率

`opcache.huge_code_pages=1`

<http://www.laruence.com/2015/10/02/3069.html>



php 优化 - 文件编译

```
<?php namespace {function C($name=null, $value=null,$default=null) { static $s_config = array(); if (empty($name)) { return  
  \$_config; } if (is_string($name)) { if (!strpos($name, '.')) { $name = strtoupper($name); if (is_null($value))  
  \isset($_config[$name]) ? $_config[$name] : $default; $_config[$name] = $value; return null; } $name = explode('.',  
  \$_config[$name[0]][$name[1]] : $default; $_config[$name[0]][$name[1]] = $value; return null; } if (is_array($name)){  
  \$_config = array_merge($_config, array_change_key_case($name,CASE_UPPER)); return null; } function  
  \load_config($file,$parse=CONF_PARSE){ $ext = pathinfo($file,PATHINFO_EXTENSION); switch($ext){ case 'php': return include  
  \$_file; case 'ini': return parse_ini_file($file); case 'yaml': return yaml_parse_file($file); case 'xml': return  
  \simplexml_load_file($file); case 'json': return json_decode(file_get_contents($file), true); default: if(function_exists(  
  \($parse)){ return $parse($file); }else{ E(L('NOT_SUPPORT_').':'. $ext); } } } if (!function_exists('yaml_parse_file')) {  
  \function yaml_parse_file($file) { vendor('spyc.Spyc'); return Spyc::YAMLLoad($file); } } function E($msg, $code=0) {  
  \throw new Think\Exception($msg, $code); } function G($start,$end='', $dec=4) { static $_info = array(); static $_mem =  
  \array(); if(is_float($end)) { $_info[$start] = $end; }elseif(!empty($end)){ if(!isset($_info[$end])) $_info[$end] =  
  \microtime(TRUE); if(MEMORY_LIMIT_ON && $dec=='n'){ if(!isset($_mem[$end])) $_mem[$end] = memory_get_usage(); return  
  \number_format($_mem[$end]-$_mem[$start])/1024; }else{ return number_format($_info[$end]-$_info[$start],$dec); }  
  \}else{ $_info[$start] = microtime(TRUE); if(MEMORY_LIMIT_ON) $_mem[$start] = memory_get_usage(); } return null; }  
  \function L($name=null, $value=null) { static $_lang = array(); if (empty($name)) return $_lang; if (is_string($name)) {  
  \($name = strtoupper($name); if (is_null($value)){ return isset($_lang[$name]) ? $_lang[$name] : $name; }elseif(is_array  
  \($value)){ $replace = array_keys($value); foreach($replace as $sv){ $v = '{$'.$sv.'}'; } return str_replace($replace,  
  \$_value,isset($_lang[$name]) ? $_lang[$name] : $name; } $_lang[$name] = $value; return null; } if (is_array($name))  
  \$_lang = array_merge($_lang, array_change_key_case($name, CASE_UPPER)); return null; } function trace($value='[think]',  
  \$_label='', $level='DEBUG', $record=false) { return Think\Think::trace($value,$_label,$level,$record); } function compile  
  \($filename) { $content = php_strip_whitespace($filename); $content = trim(substr($content, 5)); $content = preg_replace  
  \('/\s*\s*\s*/', ' ', $content); if(0==strpos($content,'namespace')){ $content = preg_replace  
  \('/namespace\s{1,3};?/', 'namespace \\1{', $content, 1); }else{ $content = 'namespace {', $content; } if ('?>' == substr  
  \($content, -2)) $content = substr($content, 0, -2); return $content.'}'; } function T($template='', $layer='') { if(false  
  \== strpos($template,'//')){ $template = 'http://'.str_replace(':', '/', $template); } $info = parse_url($template);  
  \$_file = $info['host'].(isset($info['path'])? $info['path']:''); $module = isset($info['user'])? $info['user']  
  \.'/' .MODULE_NAME.'/' ; $extend = $info['scheme']; $layer = $layer?$layer:C('DEFAULT_V_LAYER'); $auto = C?
```



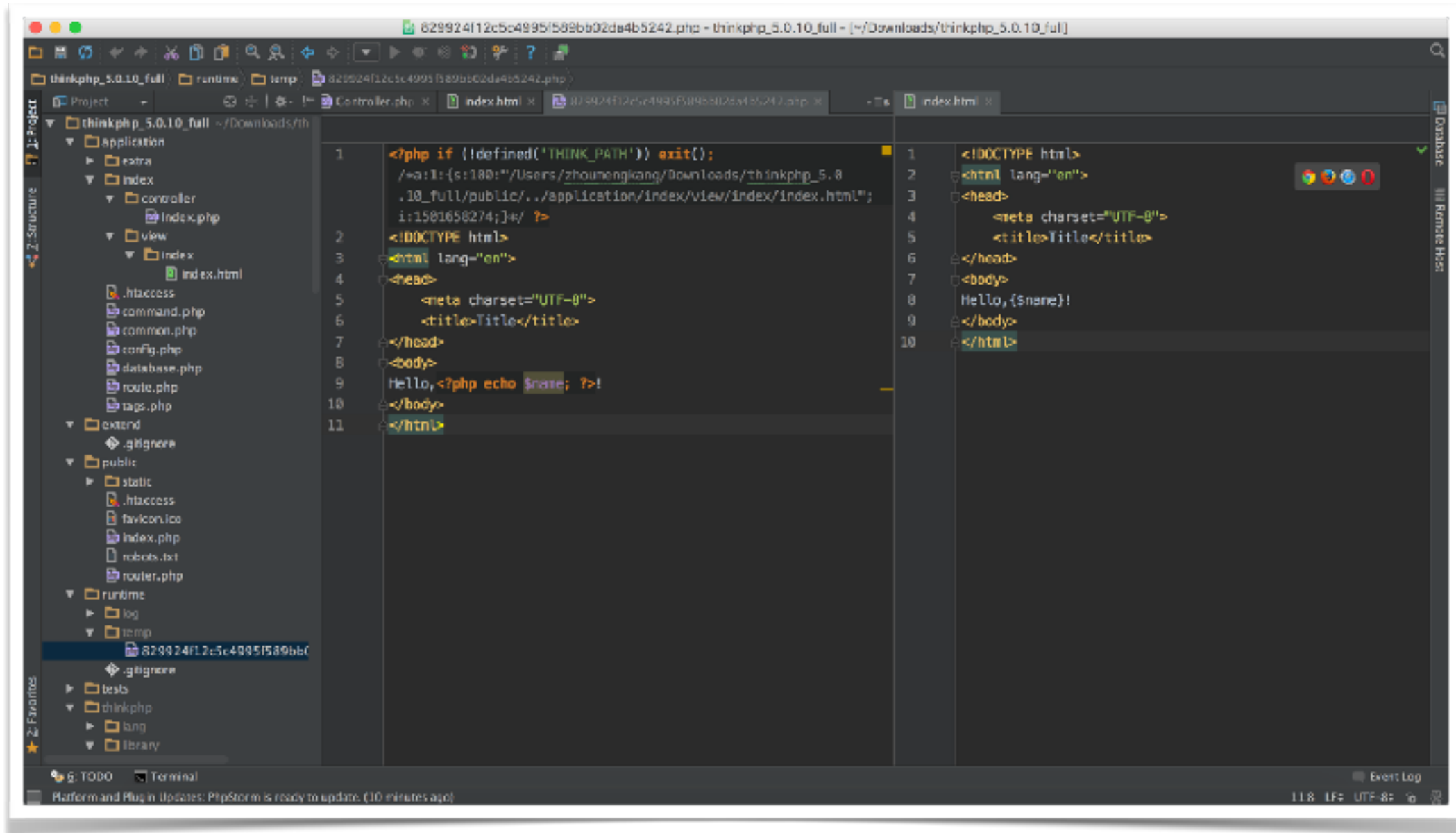
php 优化 - 文件编译

```
getcwd("/data/www/mengkang", 4096)      = 19
lstat("/data/www/mengkang/./Blog/index.php", 0x7fff663f3450) = -1 ENOENT (No such file or directory)
lstat("/Blog/index.php", 0x7fff663f3450) = -1 ENOENT (No such file or directory)
lstat("/data/www/mengkang/view/Blog/index.php", {st_mode=S_IFREG|0644, st_size=3624, ...}) = 0
lstat("/data/www/mengkang/view/Blog", {st_mode=S_IFDIR|0755, st_size=4096, ...}) = 0
lstat("/data/www/mengkang/view", {st_mode=S_IFDIR|0755, st_size=4096, ...}) = 0
open("/data/www/mengkang/view/Blog/index.php", O_RDONLY) = 6
fstat(6, {st_mode=S_IFREG|0644, st_size=3624, ...}) = 0
fstat(6, {st_mode=S_IFREG|0644, st_size=3624, ...}) = 0
fstat(6, {st_mode=S_IFREG|0644, st_size=3624, ...}) = 0
mmap(NULL, 3624, PROT_READ, MAP_SHARED, 6, 0) = 0x7f0f64e06000
munmap(0x7f0f64e06000, 3624)                = 0
close(6)                                    = 0
getcwd("/data/www/mengkang", 4096)      = 19
lstat("/data/www/mengkang/./Public/header.php", 0x7fff663f3450) = -1 ENOENT (No such file or directory)
lstat("/Public/header.php", 0x7fff663f3450) = -1 ENOENT (No such file or directory)
lstat("/data/www/mengkang/view/Public/header.php", {st_mode=S_IFREG|0644, st_size=2851, ...}) = 0
lstat("/data/www/mengkang/view/Public", {st_mode=S_IFDIR|0755, st_size=4096, ...}) = 0
open("/data/www/mengkang/view/Public/header.php", O_RDONLY) = 6
fstat(6, {st_mode=S_IFREG|0644, st_size=2851, ...}) = 0
fstat(6, {st_mode=S_IFREG|0644, st_size=2851, ...}) = 0
fstat(6, {st_mode=S_IFREG|0644, st_size=2851, ...}) = 0
mmap(NULL, 2851, PROT_READ, MAP_SHARED, 6, 0) = 0x7f0f64e06000
munmap(0x7f0f64e06000, 2851)                = 0
close(6)                                    = 0
```

```
set_include_path(get_include_path().PATH_SEPARATOR.dirname(__FILE__).'/view');
```

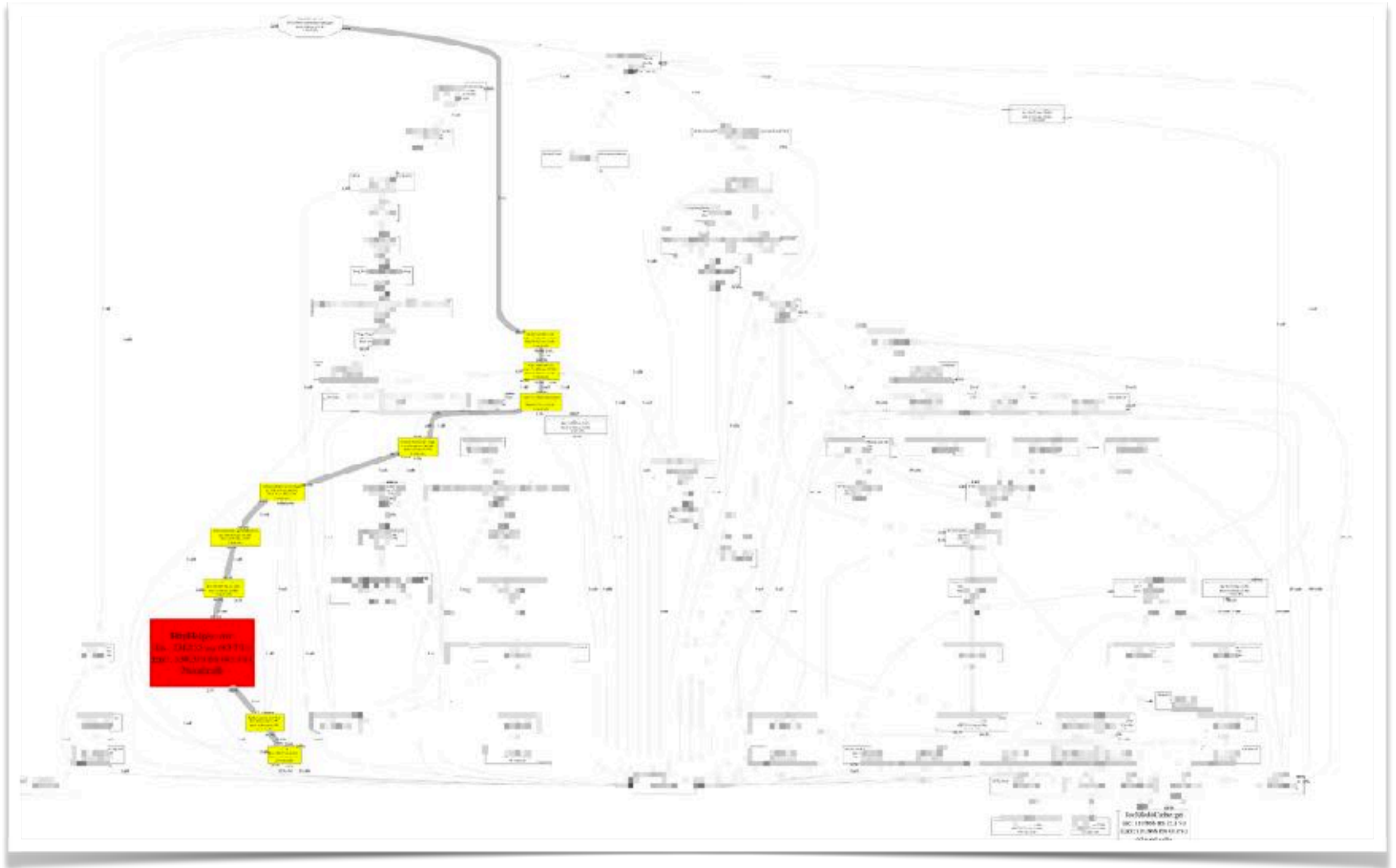



php 优化 - 模板编译





php 优化 - 使用xhprof查找性能瓶颈





非侵入式开发

静态化

异步思想

业务解耦

分布式以及 soa



业务的优化 - 非侵入式开发

```
<?php
class AskModel {
    public function detail($id){
        $info = 从数据库查询到该问题的信息;
        // 逻辑1

        // 逻辑2
    }
}
```

```
<?php
class AskModel {
    public function detail($id){
        $info = 从数据库查询到该问题的信息;
        // 逻辑1
        if($info['type'] == 2){
            //...
        }else{

        }

        // 逻辑2
        if($info['type'] == 2){
            //...
        }else{

        }
    }
}
```



业务的优化 - 异步的思想

- 处理邮件发送。
- gearman 图片裁剪。
- 页面上 ajax 加载动态数据。
- 图片的懒加载，双击图片看大图。
- sf 上通过websocket 通知你有新的消息，但是并没有告诉你有什么消息，点击消息图标才会去异步请求具体的消息。

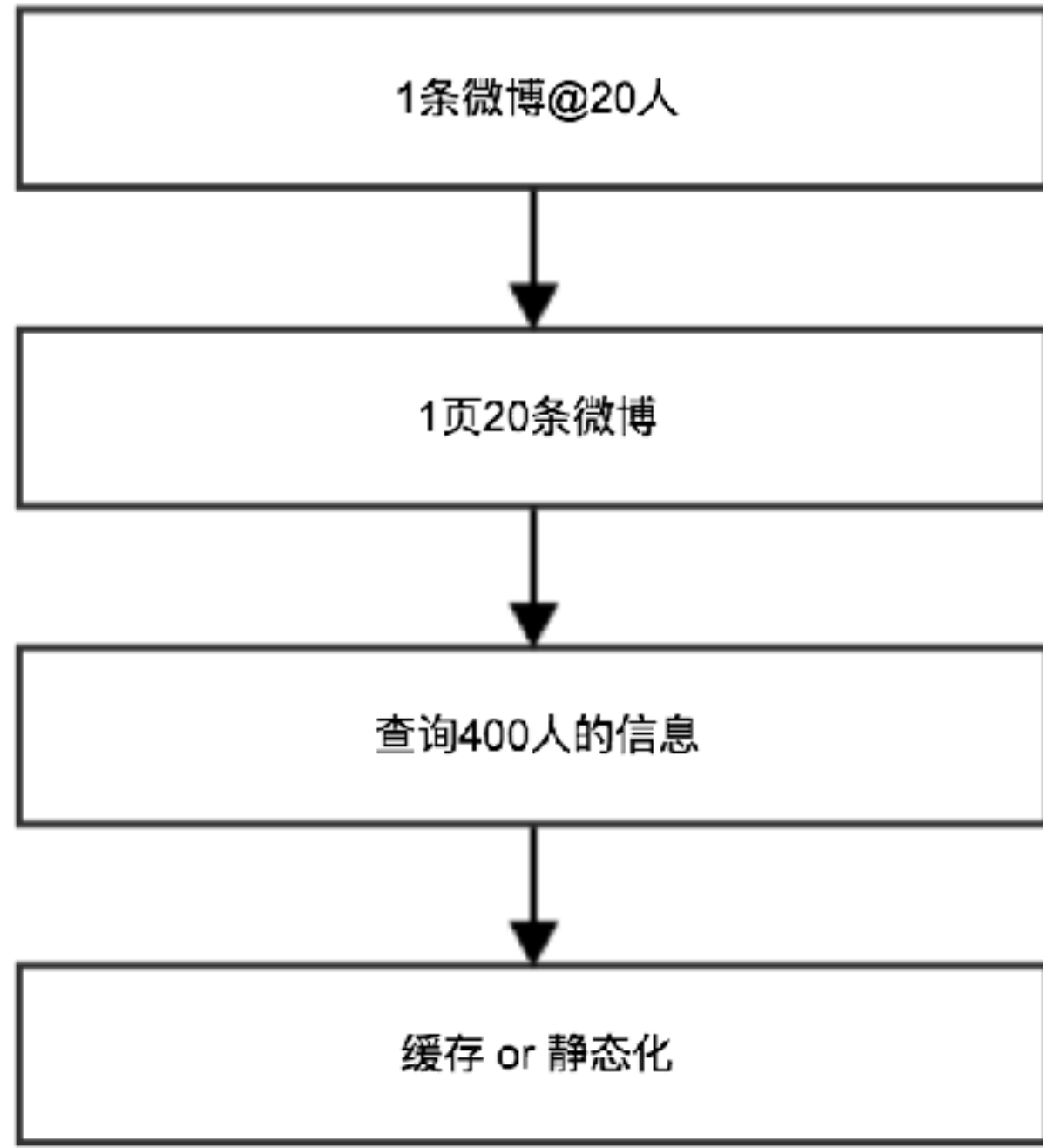
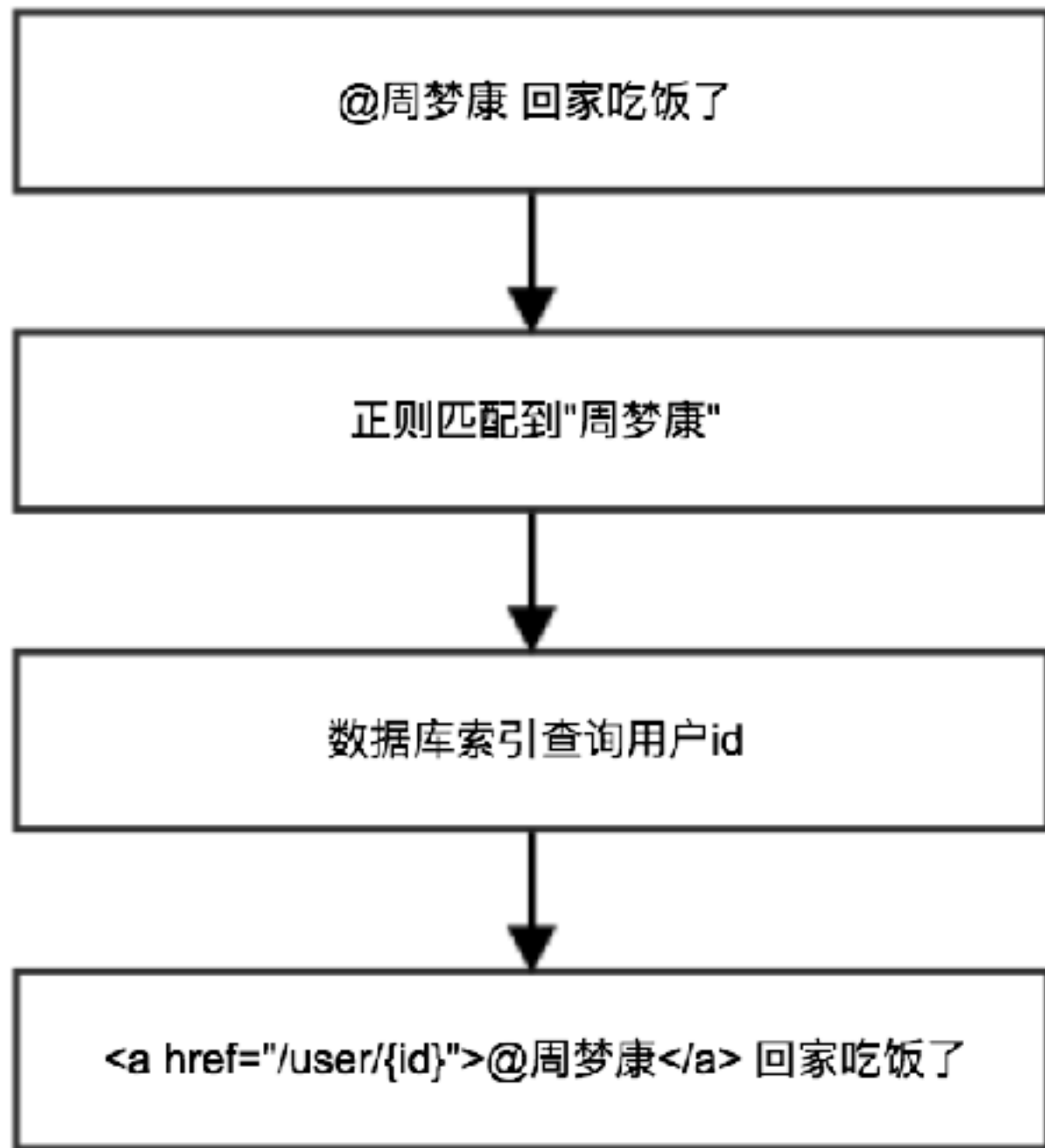


业务的优化 - 静态化

- 早些时候的 cms 的内容静态化
- 专题页面、秒杀页面
- markdown 、 微博的解析

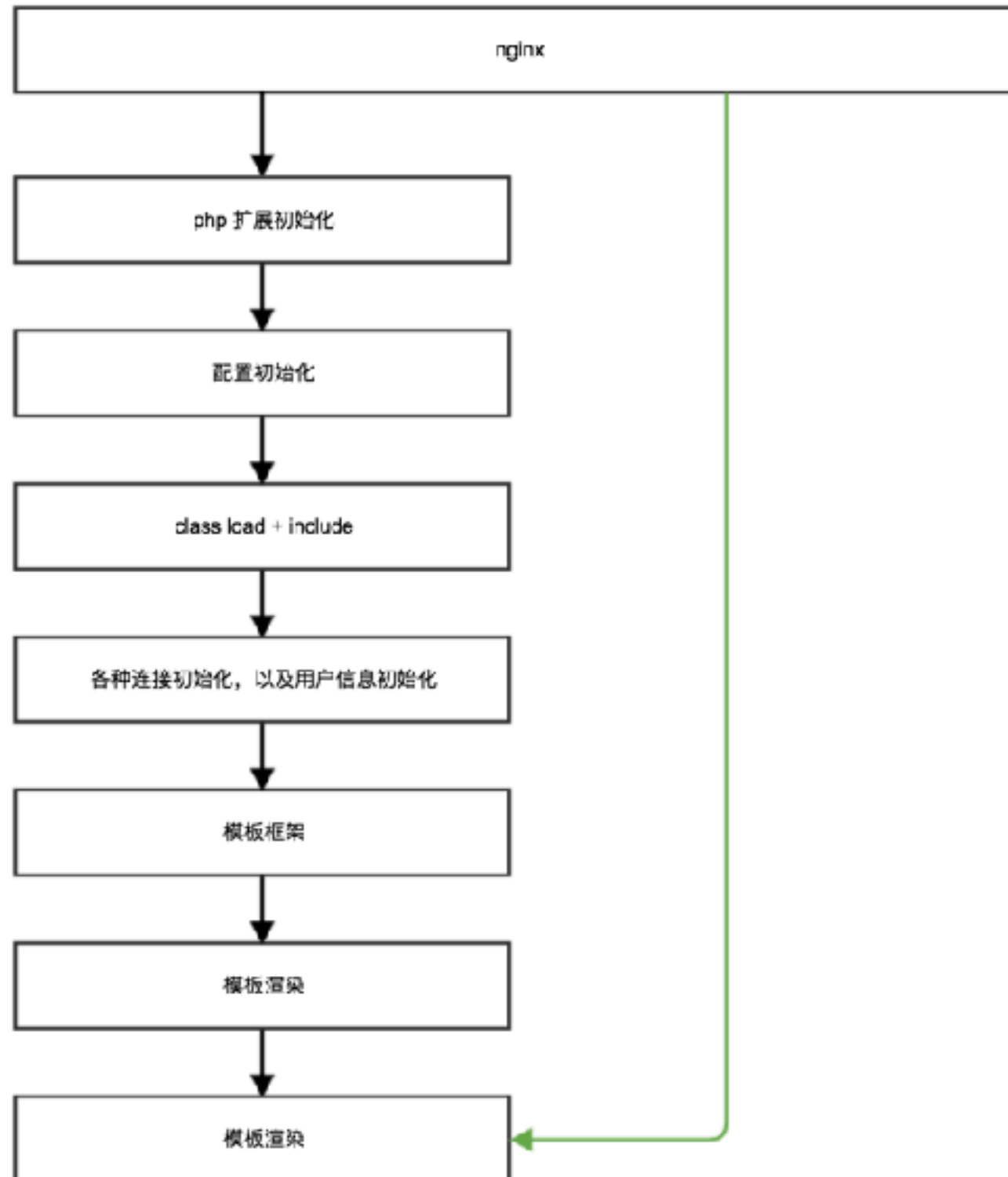


业务的优化 - 静态化 - 案例 - 微博的解析



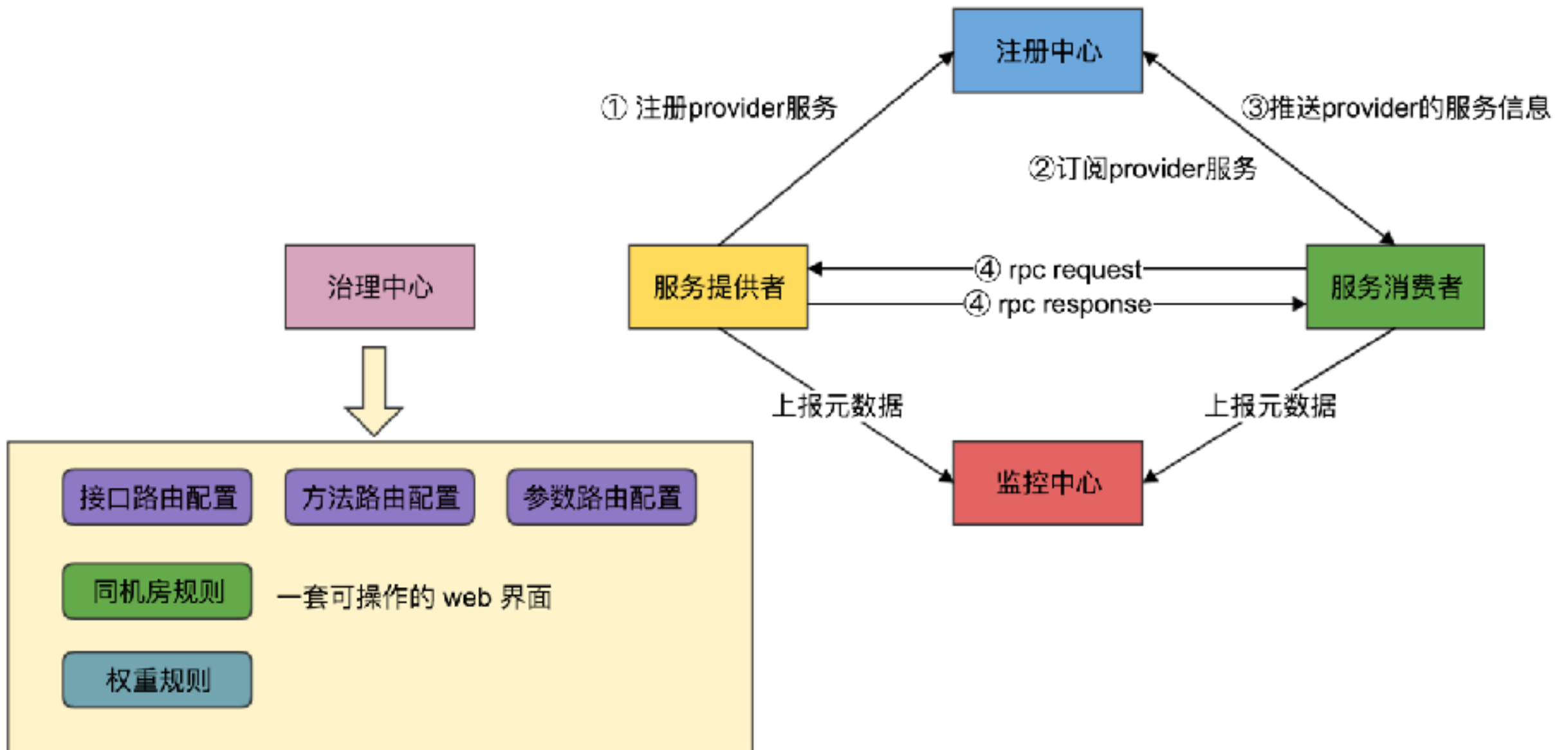


业务的优化 - 业务解耦





服务治理的原理





业务的优化 - SOA



<pre>struct _yar_header { unsigned int id; unsigned short version; unsigned int magic_num; unsigned int reserved; unsigned char provider[32]; unsigned char token[32]; unsigned int body_len; } __attribute__((packed)) yar_header_t;</pre>	packager_name	<pre>typedef struct _yar_request { long id; char *method; uint mlen; zval *parameters; zval *options; } yar_request_t;</pre>
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<pre>struct _yar_header { unsigned int id; unsigned short version; unsigned int magic_num; unsigned int reserved; unsigned char provider[32]; unsigned char token[32]; unsigned int body_len; } __attribute__((packed)) yar_header_t;</pre>	packager_name	<pre>typedef struct _yar_response { long id; int status; char *out; size_t olen; zval *err; zval *retval; } yar_response_t;</pre>
---	---------------	---

云栖社区 yq.aliyun.com



参考：<https://segmentfault.com/a/1190000010158190>

最重要的就是在自定义头里面强调body_len，
注意设置为紧凑型，才能保证跨平台性

具体说明：<https://mengkang.net/586.html>



表的设计

索引优化

收集慢查询

使用 nosql



innodb 需要一个主键，主键不要有业务用途，不要修改主键。

主键最好保持顺序递增，随机主键会导致聚簇索引树频繁分裂，随机I/O增多，数据离散，性能下降。

<http://draveness.me/mysql-innodb.html>



MySQL 优化 - 表的设计 - 字段选择

能选短整型，不选长整型。

能选 char 就避免 varchar

当使用 varchar 的时候，长度够用就行，不要滥用

大文本单独分离，比如文章的详情

冗余字段的使用



更新要根据索引来执行，可能会导致全表数据都被锁住。

联合索引的使用

explain 的使用



Mysql 优化 - 索引优化

```
CREATE TABLE `test` (  
  `id` int(11) unsigned NOT NULL AUTO_INCREMENT,  
  `a` int(10) unsigned NOT NULL,  
  `b` int(10) unsigned NOT NULL,  
  `c` int(10) unsigned NOT NULL,  
  PRIMARY KEY (`id`),  
  KEY `index_abc` (`a`,`b`,`c`)  
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

能使用到索引

```
explain select * from test where a=1;  
explain select * from test where a=1 and b=2;  
explain select * from test where a=1 and b=2 and c=3;  
explain select * from test where a=1 and b in (2,3) and c=3;  
explain select * from test where a=1 and b=2 order by c desc;
```

不能使用索引

```
explain select * from test where a=1 and b in (2,3) order by c desc;  
explain select * from test where b=2;
```



MySQL 优化 - explain - type

值	说明
const	通过索引直接找到一个匹配行，一般主键索引的时候
ref	没有主键索引或者唯一索引的条件索引，查询结果多行，在联合查询中很常见
index	利用到了索引，有可能有其它排序，where 或者 group by 等
all	全表扫描，没有使用到索引



MySQL 优化 - 收集慢查询

my.ini

long_query_time=2

log-slow-queries=/data/var/mysql_slow.log

memcache

redis



缓存的优化

多级缓存

避免缓存的滥用

redis 优化



缓存的优化 - 多级缓存

请求内缓存

本地缓存

分布式缓存



缓存的优化 - 缓存的滥用

缓存命中率低：用户积分更新导致整个用户基本信息缓存失效

缓存的原子性：礼物和主题绑定缓存，礼物更新，绑定的所有主题都要更新



缓存的优化 - redis 使用场景举例

string 计数器

set 黑名单

zset 分页列表

hashes 对象存储



缓存的优化 - redis 优化

多实例化

官方优化方案 <https://redis.io/topics/memory-optimization>

尽可能地使用 hashes 节约内存



服务器认知的提升 - 自己构建 web 服务器

用 PHP 来实现一个动态 Web 服务器	https://meng kang.net/491.html
简单静态 web 服务器的实现	https://meng kang.net/563.html
多进程并发 Web 服务器	https://meng kang.net/571.html
select Web 服务器	https://meng kang.net/568.html
epoll 服务器	https://meng kang.net/726.html



原文：<https://segmentfault.com/l/1500000010050212>



谢谢