iOS输入法启动速度优化

百度手机输入法
范敏虎

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- 产品简介
- 面临问题
- 解决方案

产品介绍

- 产品简介
  - 百度输入法iOS版本是2014年苹果在iOS8上开放Extension开发上线到AppStore的,前身是百度输入法越狱版
- Extension
  - 通过XPC被HostApp调起
  - 生命周期不同于普通app
- Extension限制
  - 启动时间限制
  - 内存限制

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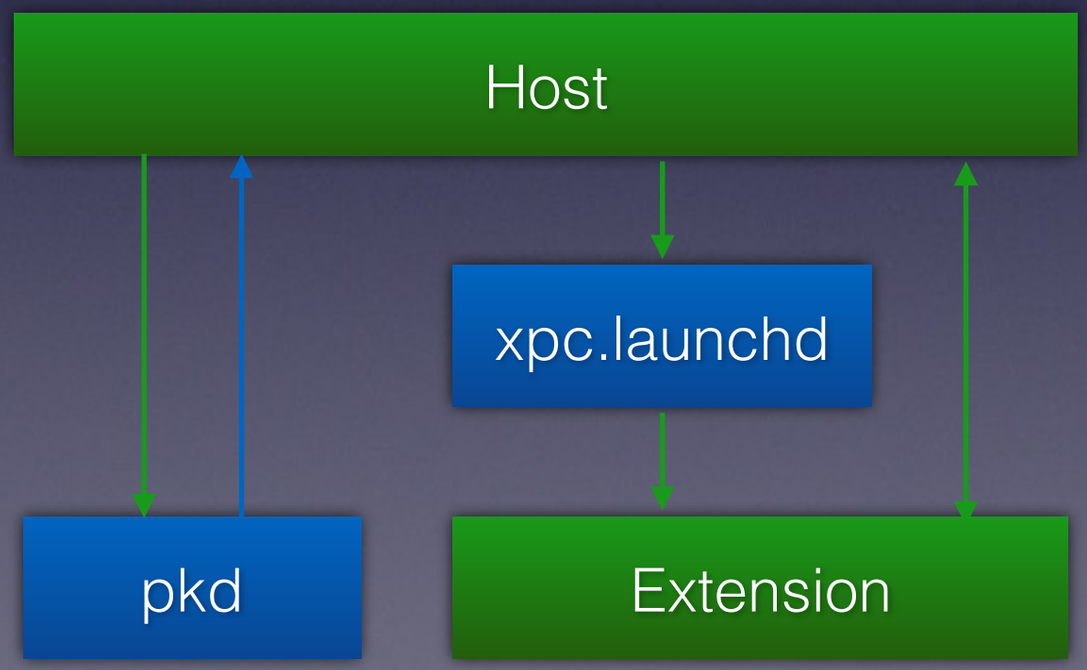
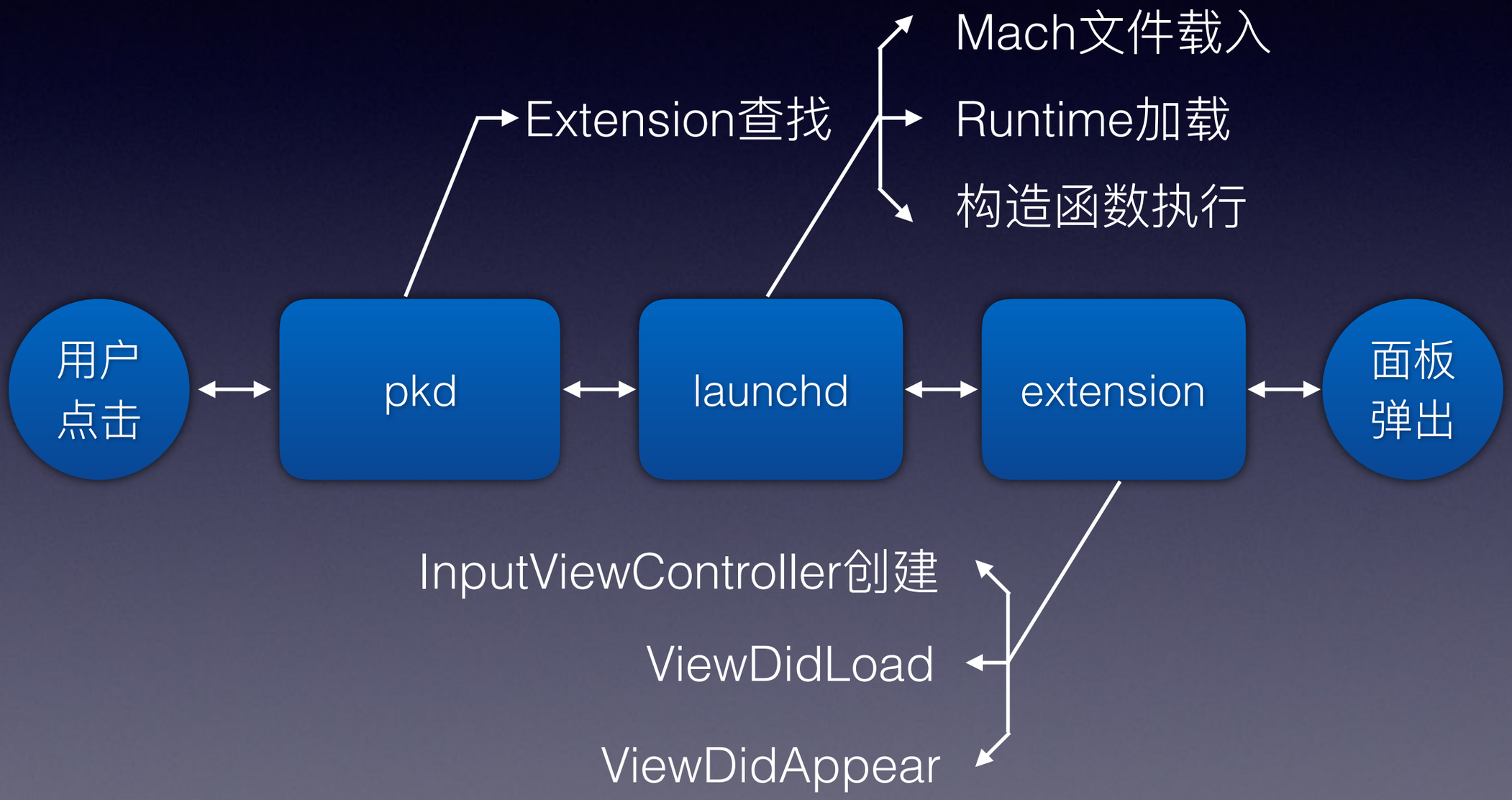
启动过程

- Extension查找
  - Host通过xpc的方式请求pkd,找到需要的Extension
- Extension启动
  - Host通过name连接Extension
  - xpc.launchd启动Extension
- Host与Extension交互
  - Host调用Extension展示键盘



启动过程


Extension查找
Mach文件载入
Runtime加载
构造函数执行
用户点击
pkd
launchd
extension
面板弹出
InputViewControlIer创建
ViewDidLoad
ViewDidAppear

面临的问题

- 皮肤文件解码载入需要大量CPU时间
- UI渲染需要一定的CPU时间
- 内核词库的载入耗时了大量I/O时间
- Extension要处理一些静默任务

解决方案

- 将皮肤生成时对图片预先解码
- 将面板对象缓存在缓冲池中
- 内核载入与查询都在独立线程异步执行
- 静默任务在低优先级队列单独调度

皮肤编/解码

- 皮肤由Ini&CSS&图片切片构成
- 对Ini 及 CSS 进行解码并缓存
- 对图片进行切分,解码,并缓存

皮肤编/解码

- NSDictionary

```
+ (NSDictionary *)dictionaryWithIniFile:(NSString *)filePath {
    NSString* contents = [NSString stringWithContentsOfFile:filePath encoding:NSUTF8StringEncoding error:nil];
    NSArray*  lines    = [contents componentsSeparatedByCharactersInSet:[NSCharacterSet newlineCharacterSet]];
    NSMutableDictionary* dict = [NSMutableDictionary dictionaryWithCapacity:10];
    for (NSString* line in lines) {
        NSString* item = [line stringByTrimmingCharactersInSet:[NSCharacterSet whitespaceCharacterSet]];
        if (isSection) {
            // Add a new section
        } else {
            // Add key/value to section
        }
    }
    return dict;
}
```

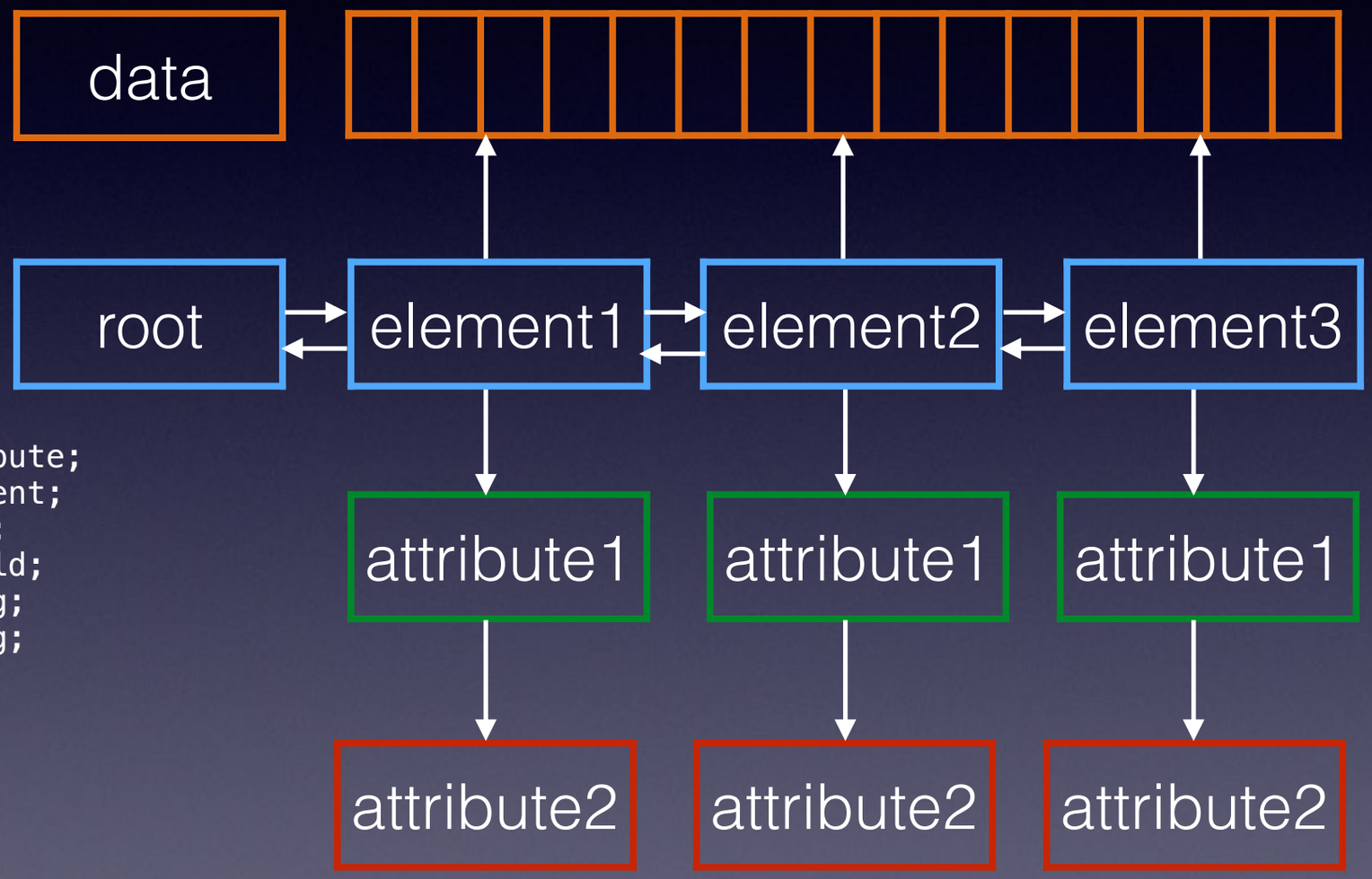
- BISkinType

```
[BISkinType initWithDictionary:(NSDictionary *)dict]

[NSDictionary xxxForKey:(NSString *)key]
```

皮肤编/解码

- BISkinIniParser

```
typedef struct _BISkinAttribute {
    char   *name;
    char   *value;
    struct _BISkinAttribute *next;
} BISkinAttribute;

typedef struct _BISkinElement {
    char   *name;
    struct _BISkinAttribute *firstAttribute;
    struct _BISkinElement   *parentElement;
    struct _BISkinElement   *firstChild;
    struct _BISkinElement   *currentChild;
    struct _BISkinElement   *nextSibling;
    struct _BISkinElement   *prevSibling;
} BISkinElement;
```



- BISkinType

```
[BISkinType initWithElement:(BISkinElement *)element]

[BISkinIniParser attributeIntegerValue:(BISkinAttribute)attribute];
```

皮肤编/解码

- UIImage *image = +[UIImage imageWithContentOfFile:];
- UIImageView.image = image;
- UIKit 创建implicit CATransaction
- 主线程RunLoop下次结束时CoreAnimation提交该transaction.
  - 分配内存Buffer
  - 图片数据从文件读入到内存Buffer
  - 解码图片数据
  - 渲染解压完的图片数据

皮肤编/解码

- 创建图片

[UIImage imageNamed:]

```
UIImage *image = [UIImage imageWithContentsOfFile:filePath];
CGImageRef imageRef = CGImageCreateWithImageInRect([image CGImage], rect);
UIImage *ret = [UIImage imageWithCGImage:imageRef];
CGImageRelease(imageRef);
```

- 保存图片数据

```
CGImageRef imageRef = [image CGImage];
CGDataProviderRef dataProvider = CGImageGetDataProvider(imageRef);
CFDataRef dataRef = CGDataProviderCopyData(dataProvider);
const UInt8 *buffer = CFDataGetBytePtr(dataRef);
fwrite(buffer, 1, count, fp);
```

皮肤编/解码

问题1: 切片性能差

```
[UIImage imageWithContentsOfFile:filePath];            Compressed   Data
CGImageGetDataProvider() & CGDataProviderCopyData();   Uncompressed Data
```

Problem : iOS maintains the uncompressed data

`CGImageCreateWithImageInRect`

解决：强制解码

```
CGContextRef context = CGBitmapContextCreate(NULL,width,height…);
CGContextDrawImage(context, rect, image.CGImage);
CGImageRef imageRef = CGBitmapContextCreateImage(context);
UIImage   *imageOut = [UIImage imageWithCGImage:scale:orientation:];
```

皮肤编/解码

问题2: 内存效率低

- 内存消耗大
- 内存频繁Create & Destroy，性能差

解决 - 使用自定义的Buffer or CGBitmapContextGetData()

```
CGContextRef context = CGBitmapContextCreate(buffer,width,height…);
CGContextDrawImage(context, rect, image.CGImage);

char *src = buffer + start;
for (int i = 0; i < height; i++) {
    memcpy(dst, src, length);
    dst += length;
    src += bytesPerRow;
}
```

从图片数据中得到切片数据，并保存到文件中，不需要生成UIImage对象

面板重用

- 将数据层和视图层分离
- 数据层使用单例(为了节省内存及数据一致性)
- 每个输入App都会产生一个视图层
- panel对象由对象池中获取

面板重用

BICore

ImageSou

DataMgr

BIToolBar

BIPanelView

BICoreMgr

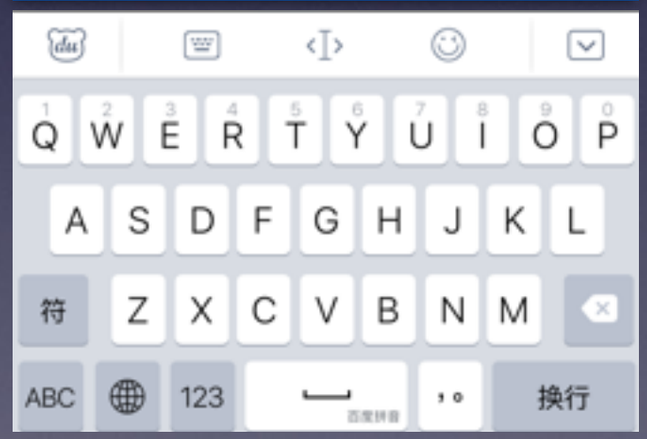
RootController

BIToolBar

BIPanelView

BICoreMgr

RootController

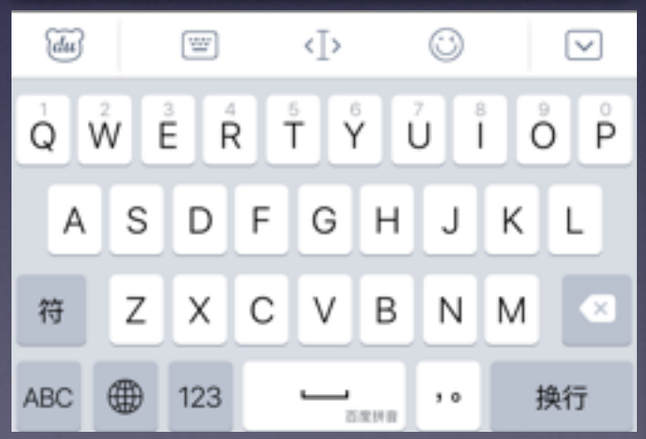


BIToolBar

BIPanelView

BICoreMgr

RootController



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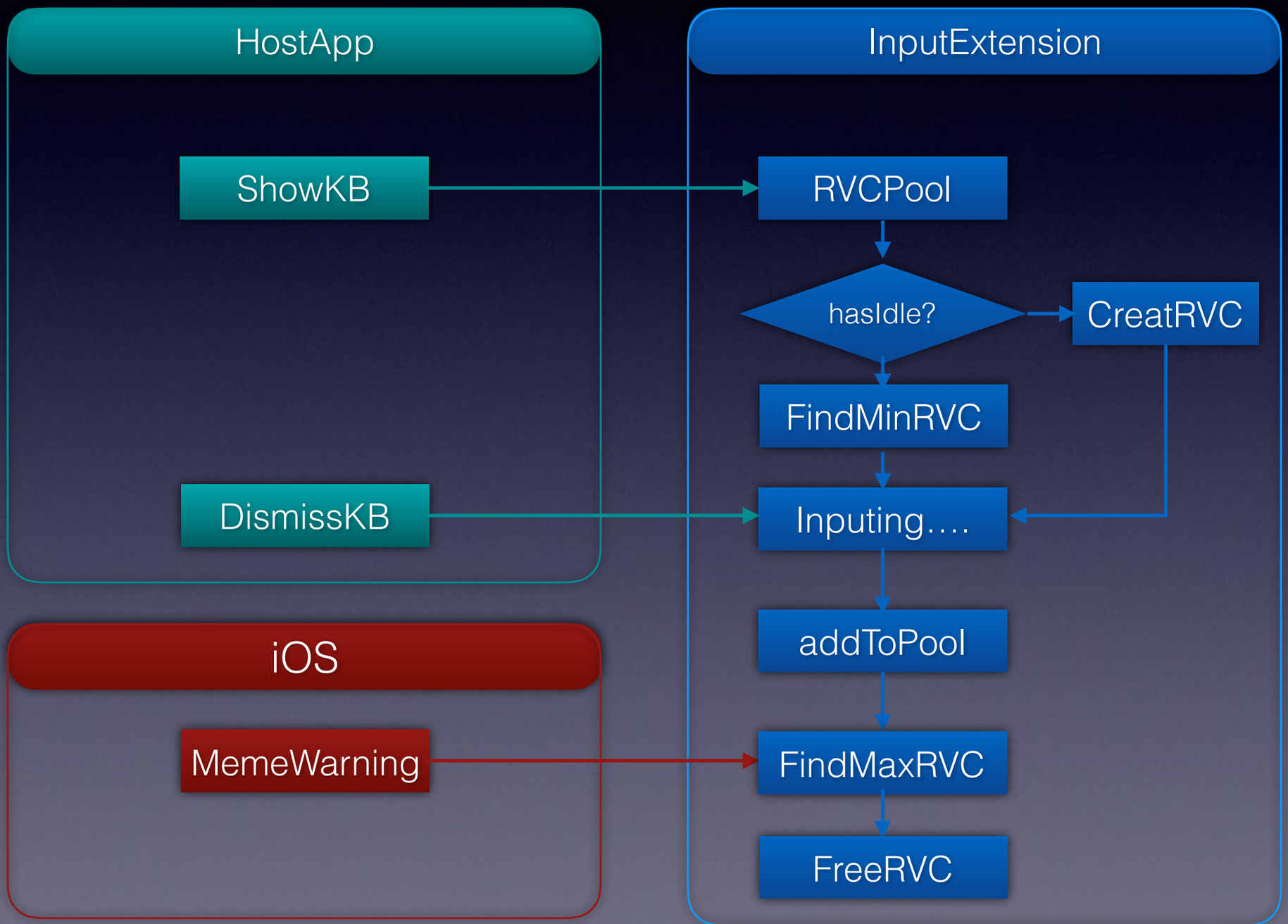
面板重用


HostApp
ShowKB
DismissKB
iOS
MemeWarning
InputExtension
RVCPool
hasIdle?
CreatRVC
FindMinRVC
Inputing….
addToPool
FindMaxRVC
FreeRVC

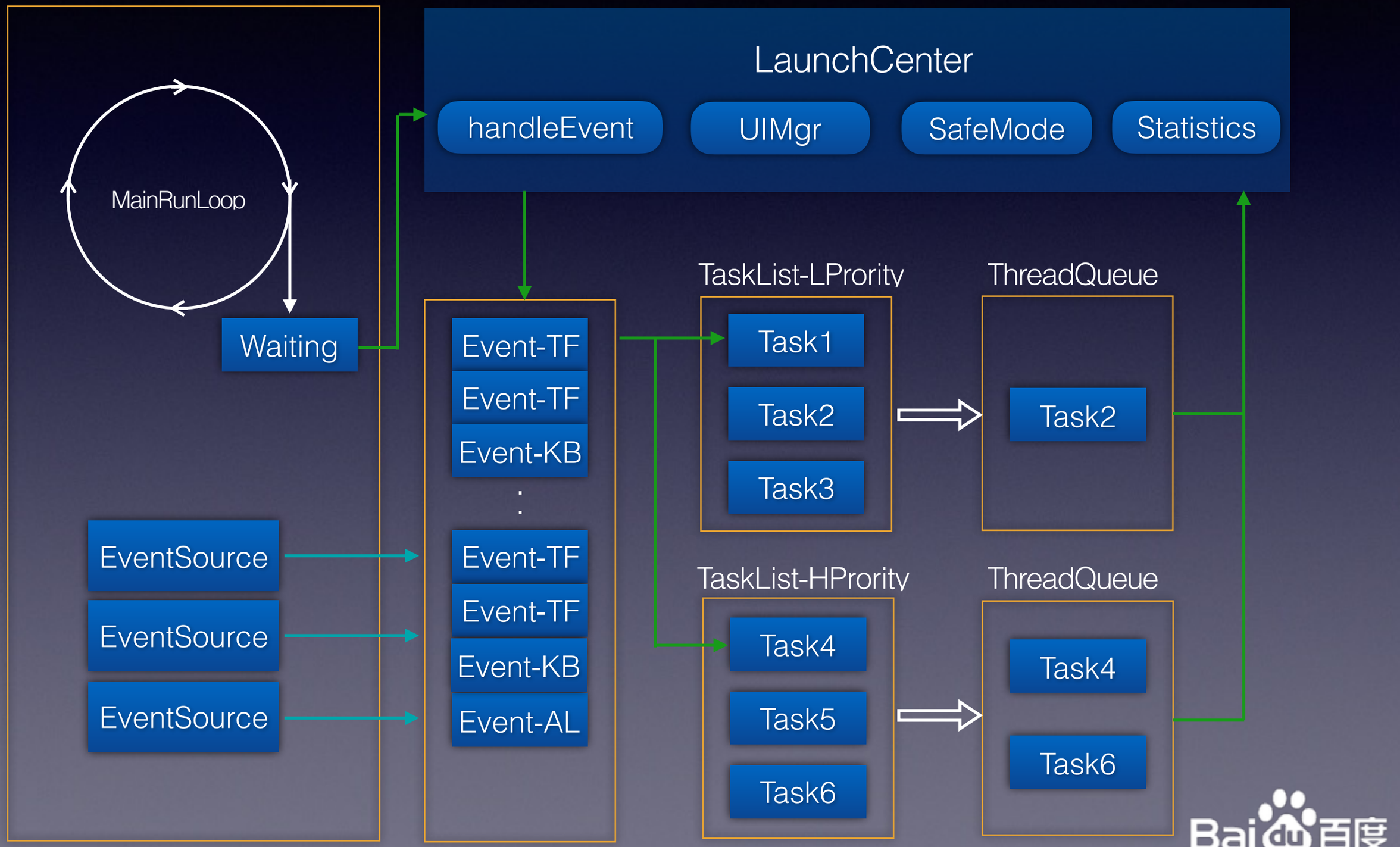
次任务调度

- 为了不影响输入,静默任务被添加到面板启动过程中
- 严重影响了面板的启动时间和稳定性
- 会出现面板上多次弹窗等问题

次任务调度

- 解决方案:
  - 将每个功能抽象成一个任务
    - 每个任务配置自己的触发条件,监控事件,所需资源,优先级等信息
- 调度模块会选择合理的时间调度任务
- 调度模块会调整任务优先级,统计运行时间
- 当任务崩溃超过一定次数时,下次启动就会卸载该任务

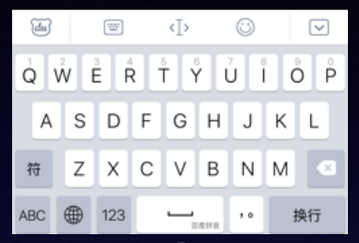
次任务调度


LaunchCenter
handleEvent
UIMgr
SafeMode
Statistics
MainRunLoop
Waiting
Event-TF
Event-TF
Event-KB
Event-TF
Event-TF
Event-KB
Event-AL
EventSource
EventSource
EventSource
TaskList-LPrority
Task1
Task2
Task3
ThreadQueue
Task2
TaskList-HPrority
Task4
Task5
Task6
ThreadQueue
Task4
Task6

内核交互优化

- 交互反馈实时性要求高
- 耗时操作
    - 初始化、词库加载安装等
    - 键盘类型的切换
    - 候选字查询
- 单内核多键盘
    - 支持多session
    - 内存的限制

内核交互优化



showKB | loadSkin | … | keyTap | switchKB | dicUpdate | keyTap | Main RunLoop

low priority jobs cancel

init | loadDic | extra jobs | query | reload | installDic | query | Core Queue

NextKBShow

Async | Sync

BICore

Thanks