

LiveVideoStackCon

高品质教学平台的技术难点和解决方案

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▶ 关于CCtalk



网师服务

老师签约入驻、系列课程，快速结算、打赏、优惠券、分销等等



社群化学习

沉淀学习用户，课前预习、课后答疑、视频回顾、聊天等等，支持从一对一到大型直播等完整授课场景



云、大数据、AI

智能助教、直播教学指数、学习质量跟踪、课程个性化推荐等等



教学工具

实时多向音视频服务、双向白板、屏幕分享、讲义、教学小工具等等



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PART ONE

主流直播方案

Primary Live Solutions

主流直播方案



HTTP-FLV





- CDN加速成熟、成本低
- 推流和播放器开源库：ffmpeg、librtmp
- 服务端开源库：nginx-rtmp
- 推流工具：OBS
- 播放测试工具：vlc，flashplayer
- 延时：2 ~ 5秒

HTTP-FLV

- 原理：服务器在响应HTTP请求时不返回content-length字段
- 使用HTTP协议，不容易被防火墙拦截
- 兼容HTTP 302跳转，能灵活调度
- 可以使用HTTPS加密
- 首开比RTMP快
- 延时比RTMP略低



- CDN 分发容易、成本低
- HTML5可以直接打开播放
- 延时高 - 根据切片大小
- 延时：> 12秒



- 自研
- 传统CDN不支持加速
- 费用贵
- 延时： > 0.2 秒

PART TWO

客户端AV引擎

Client-side AV Engine

▶ 教育直播-CCtalk



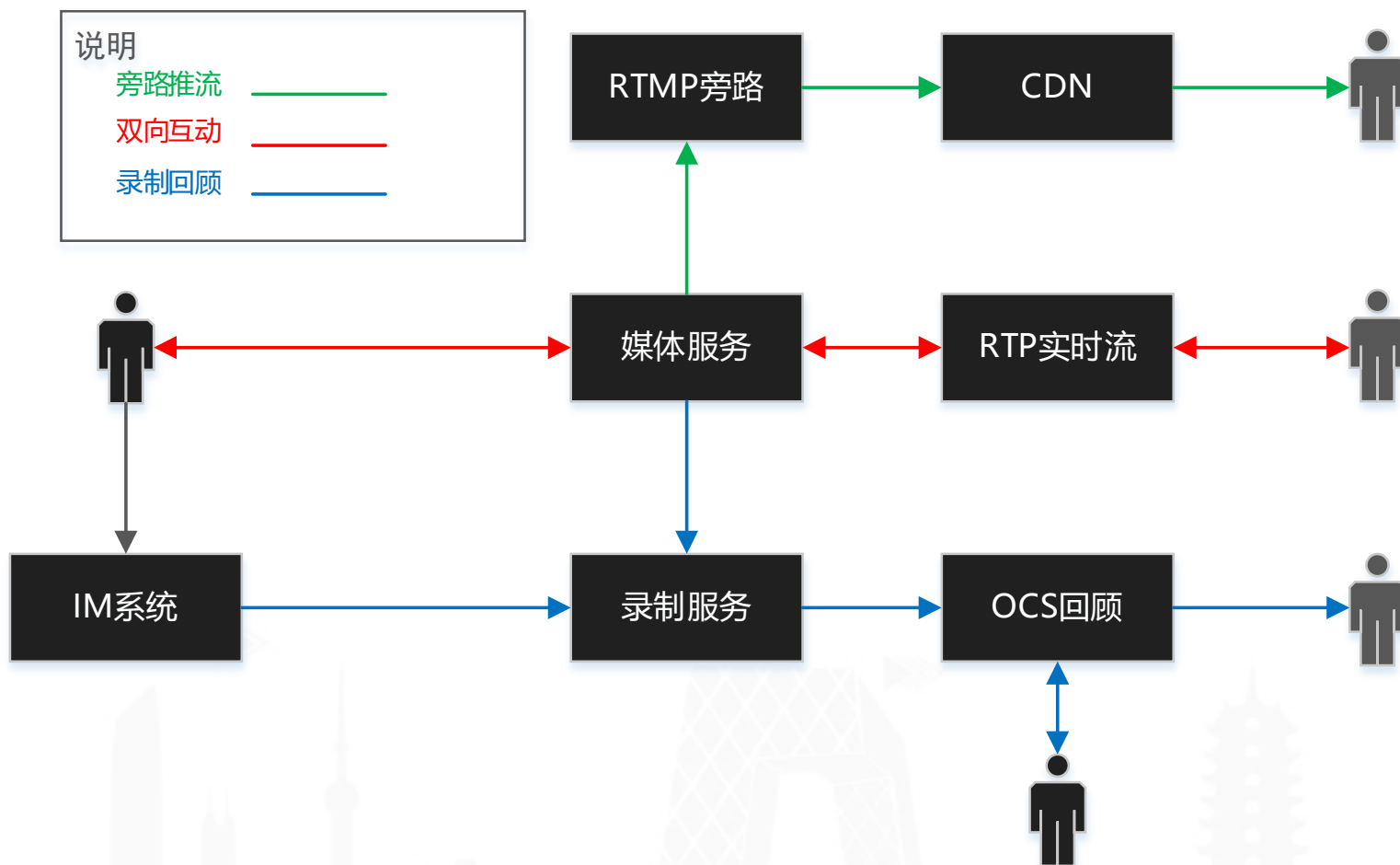
协议方案：UDP + TCP

连麦对象：网师之间、任意观众

连麦延迟：毫秒级

观众延迟：毫秒级

互动形式：PPT、白板、答题卡、
文字、礼物、连麦



教育直播架构的特性

LiveVideoStackCon

抗丢包

不卡

录制

秒开

互动

低延迟

稳定

全平台

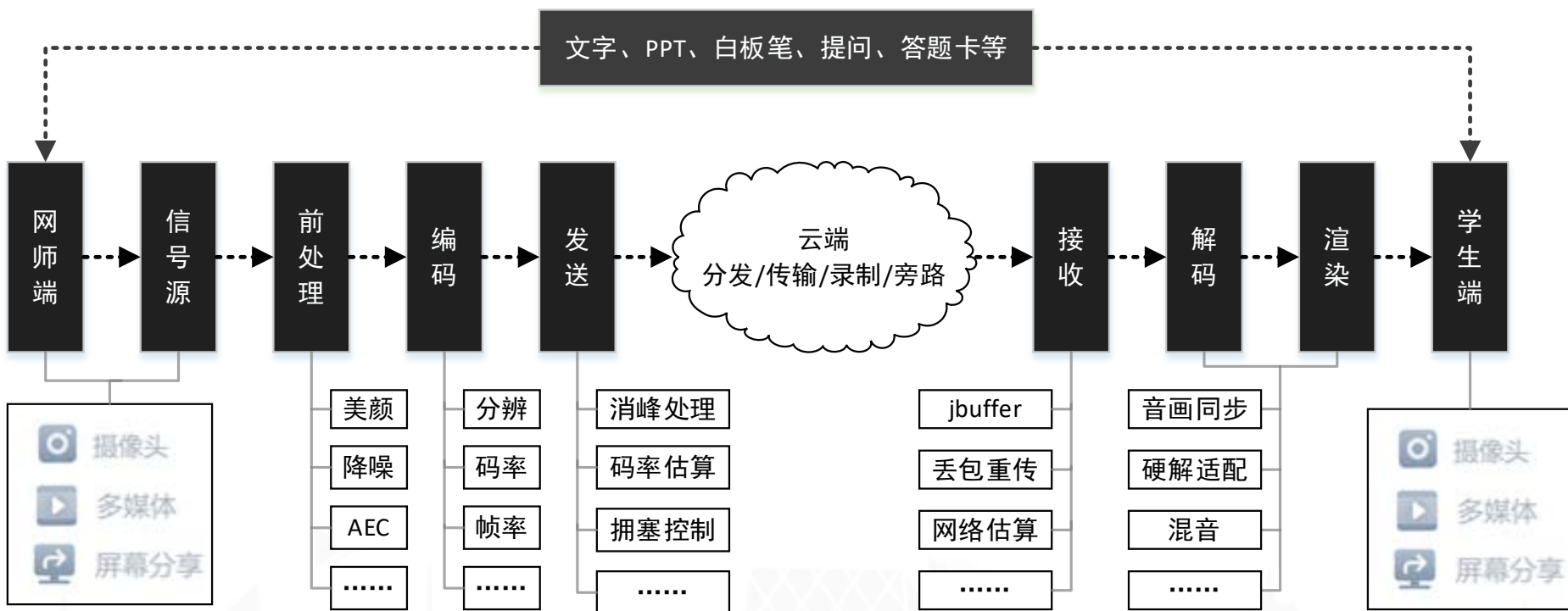
可扩展

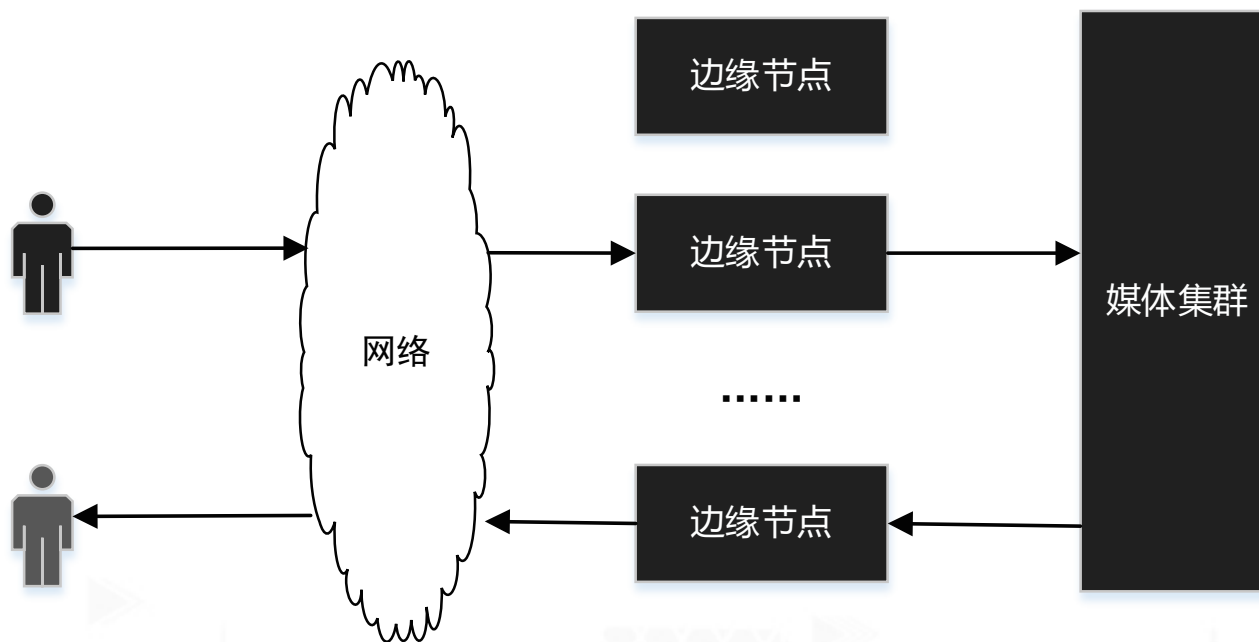
高并发

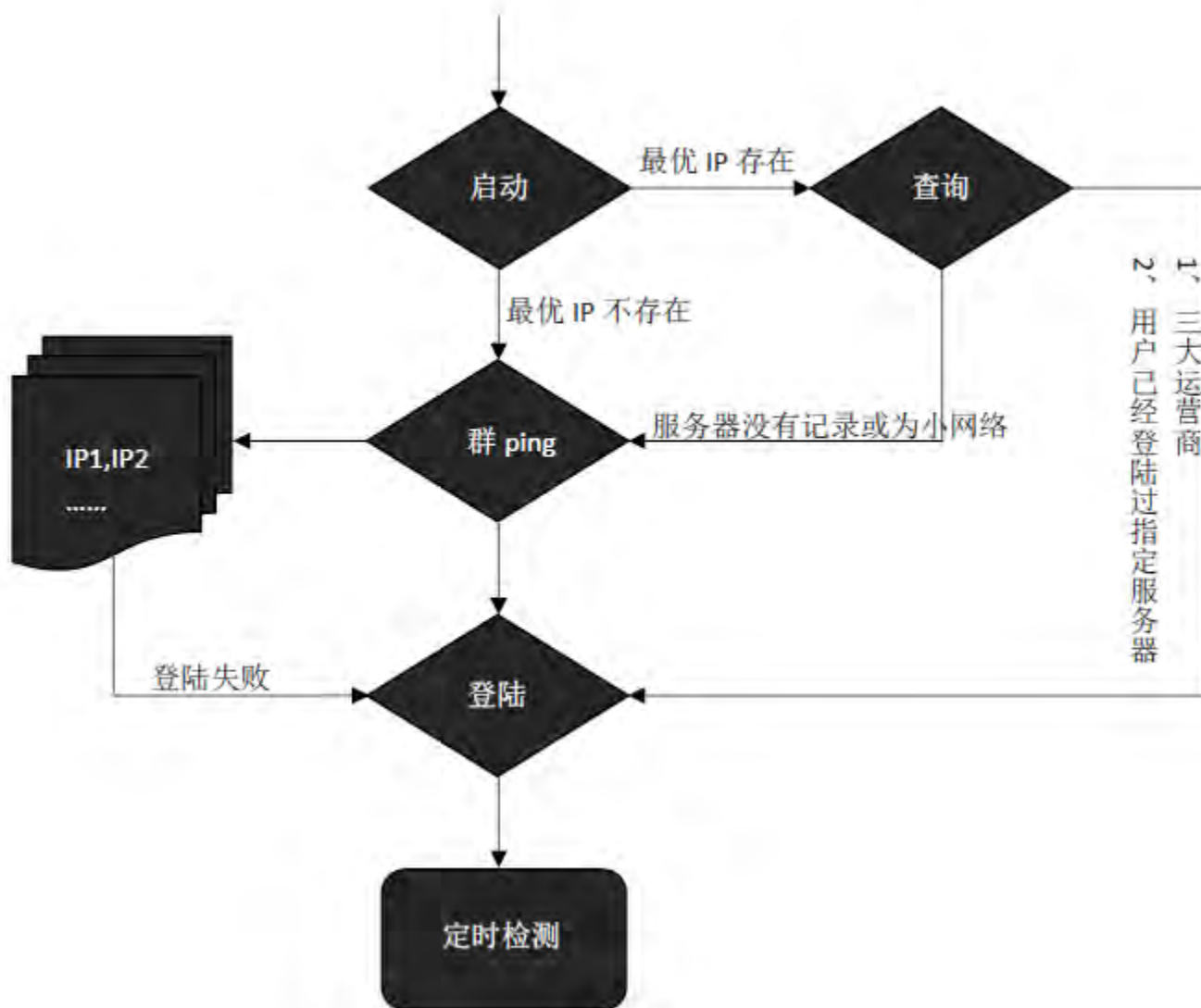
支撑多种教学工具的实时大规模并发教学平台

Web RTC









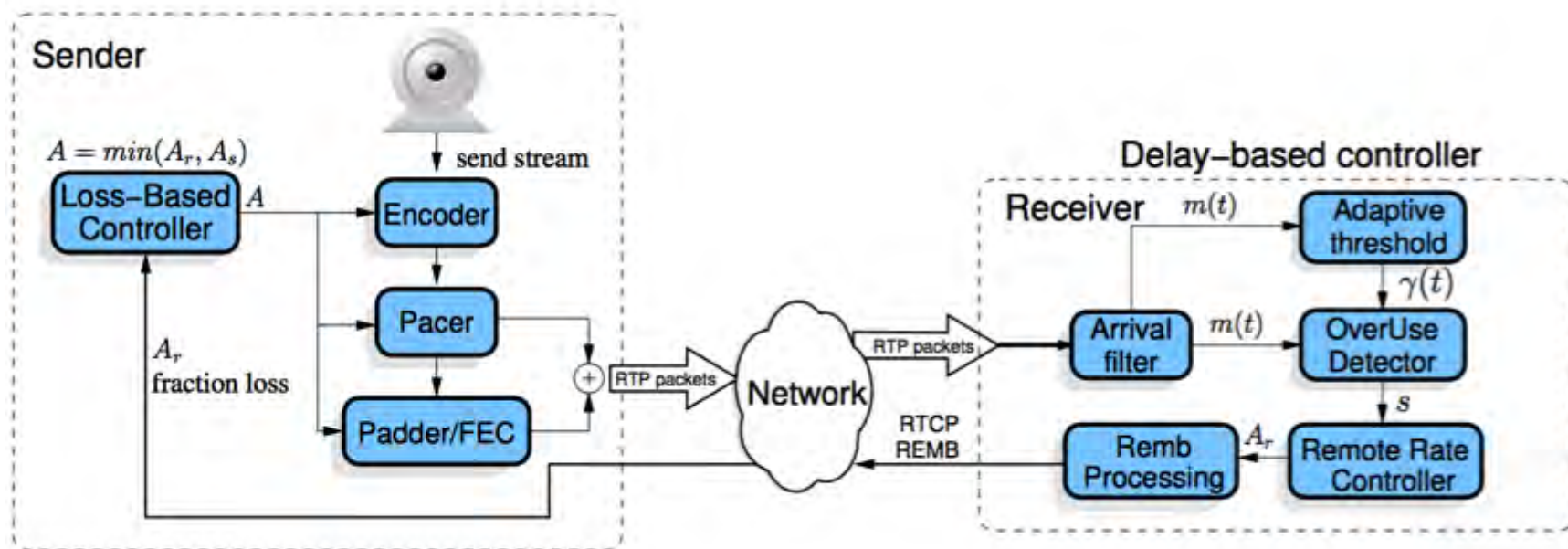
第一类ISP



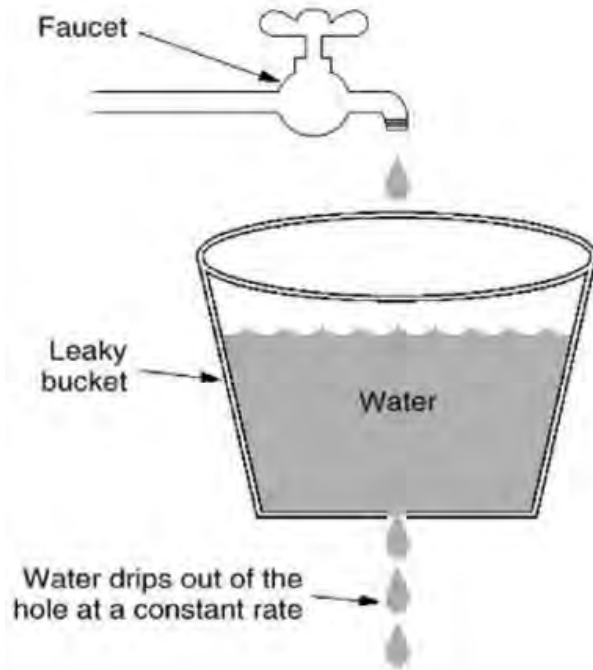
第二类ISP

- 测速接入
- 服务缓存
- 降低消耗

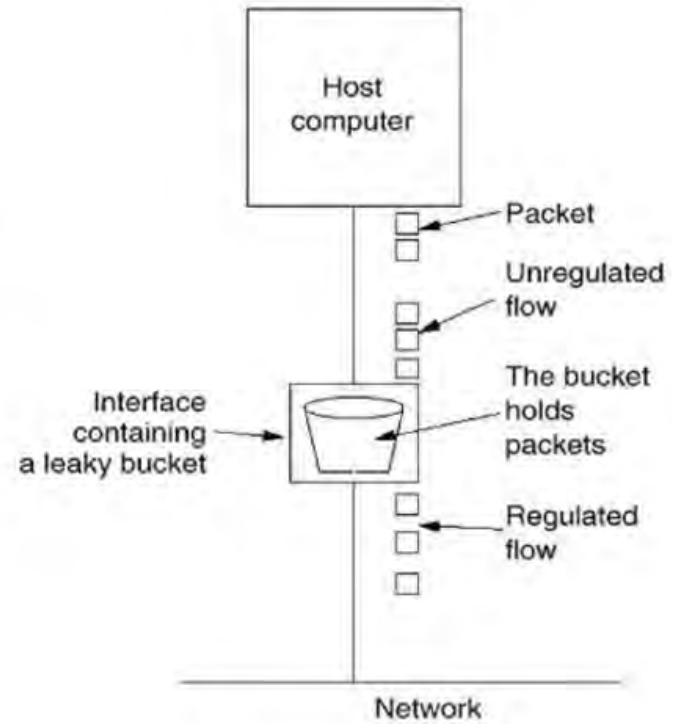
- 动态寻路
- 用户无感知
- 防止误判



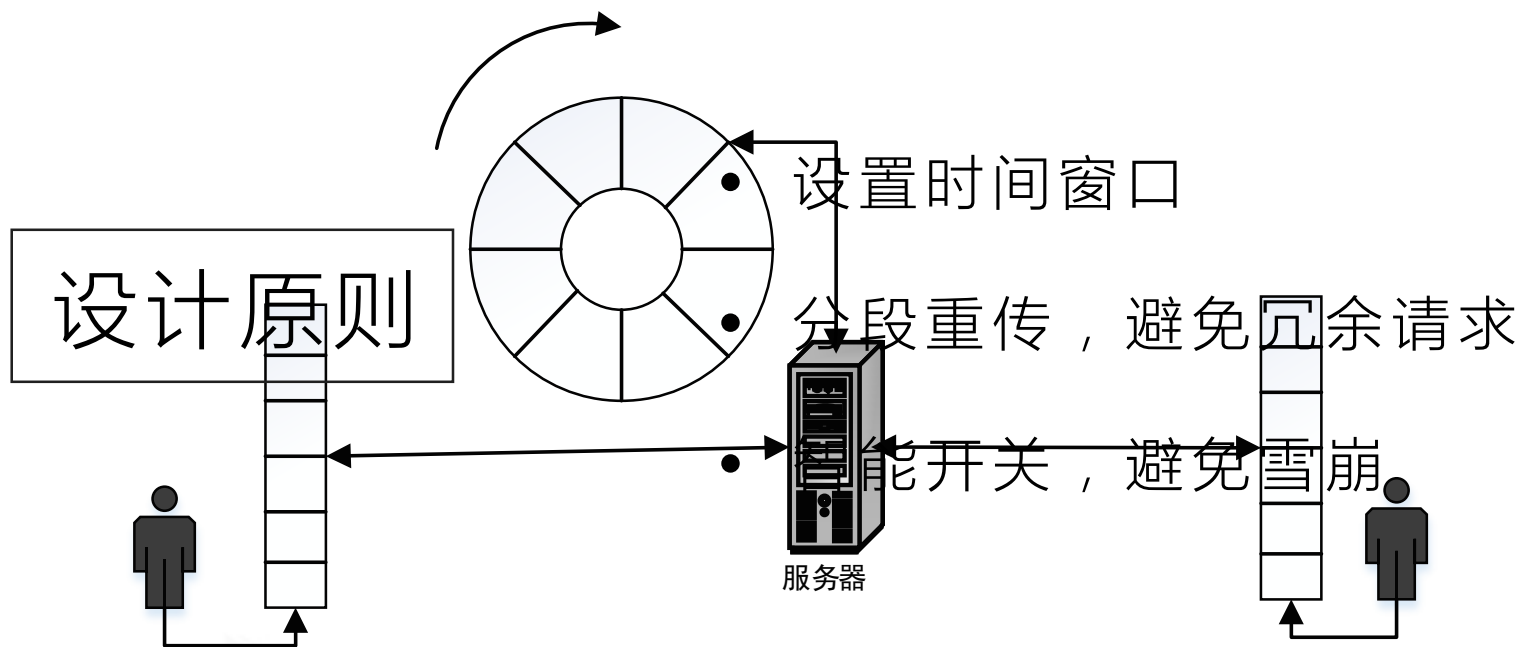
GCC算法数据流和控制流



(a)



(b)



实时

质量



问题思考

- 如何提高稳定性？
- 如何排查问题？



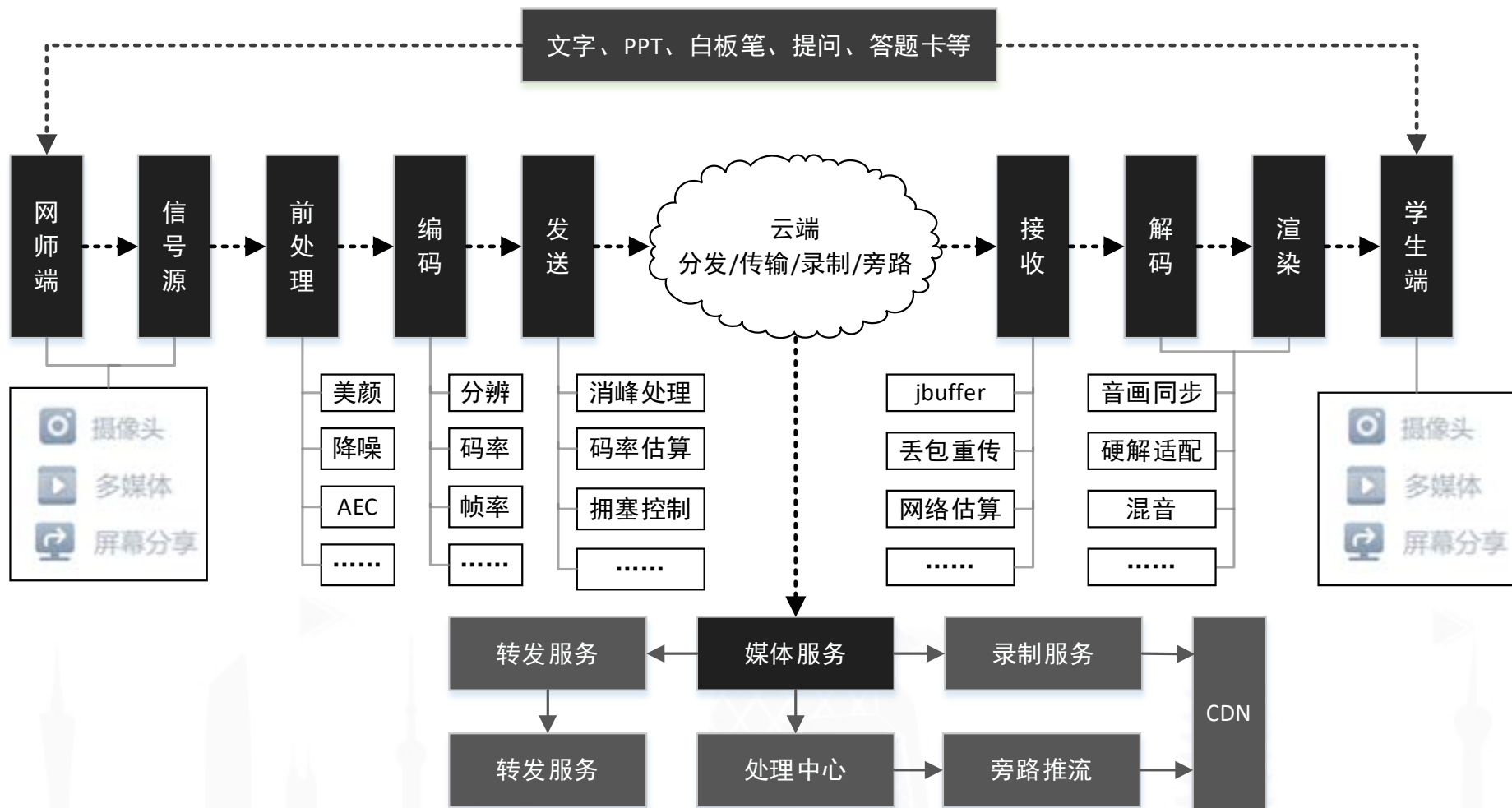
PART THREE

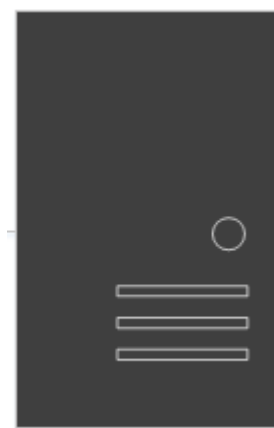
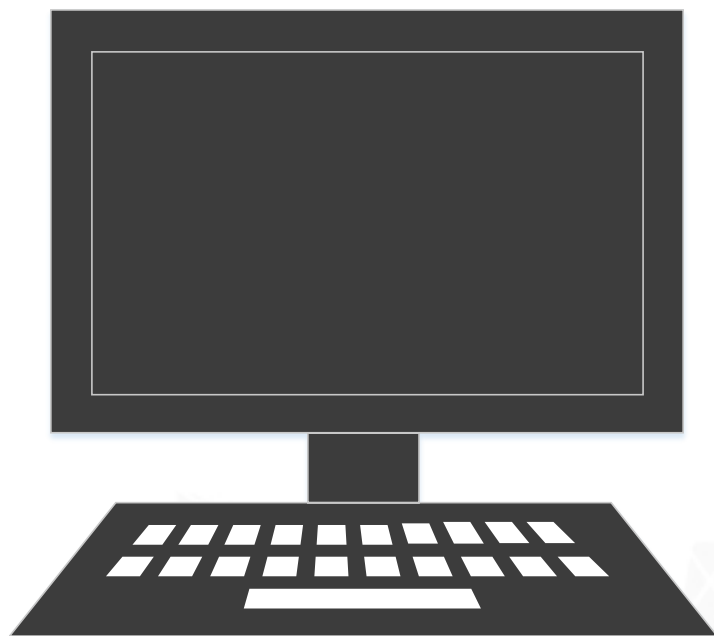
服务端架构演进

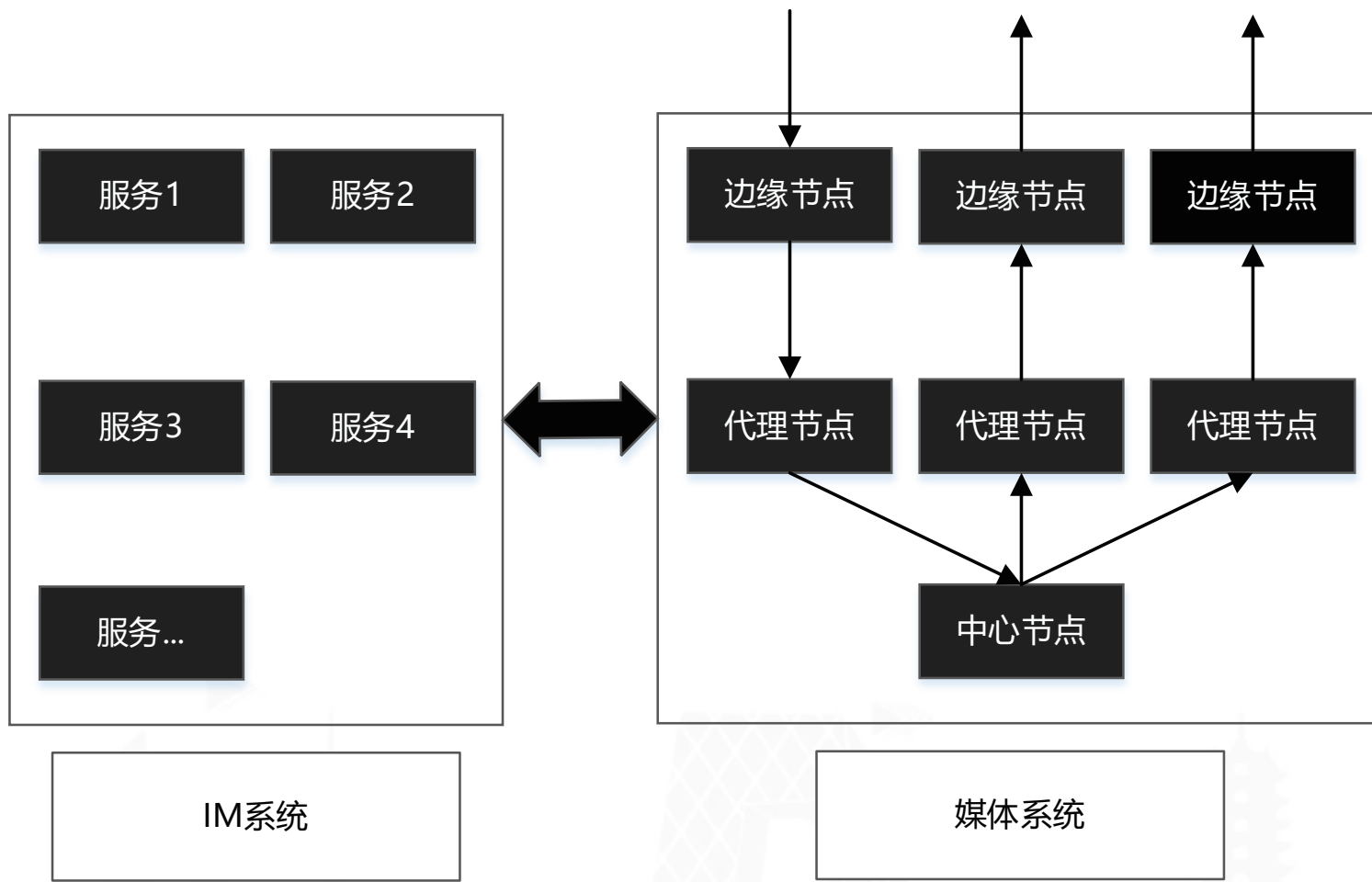
Server architecture evolution



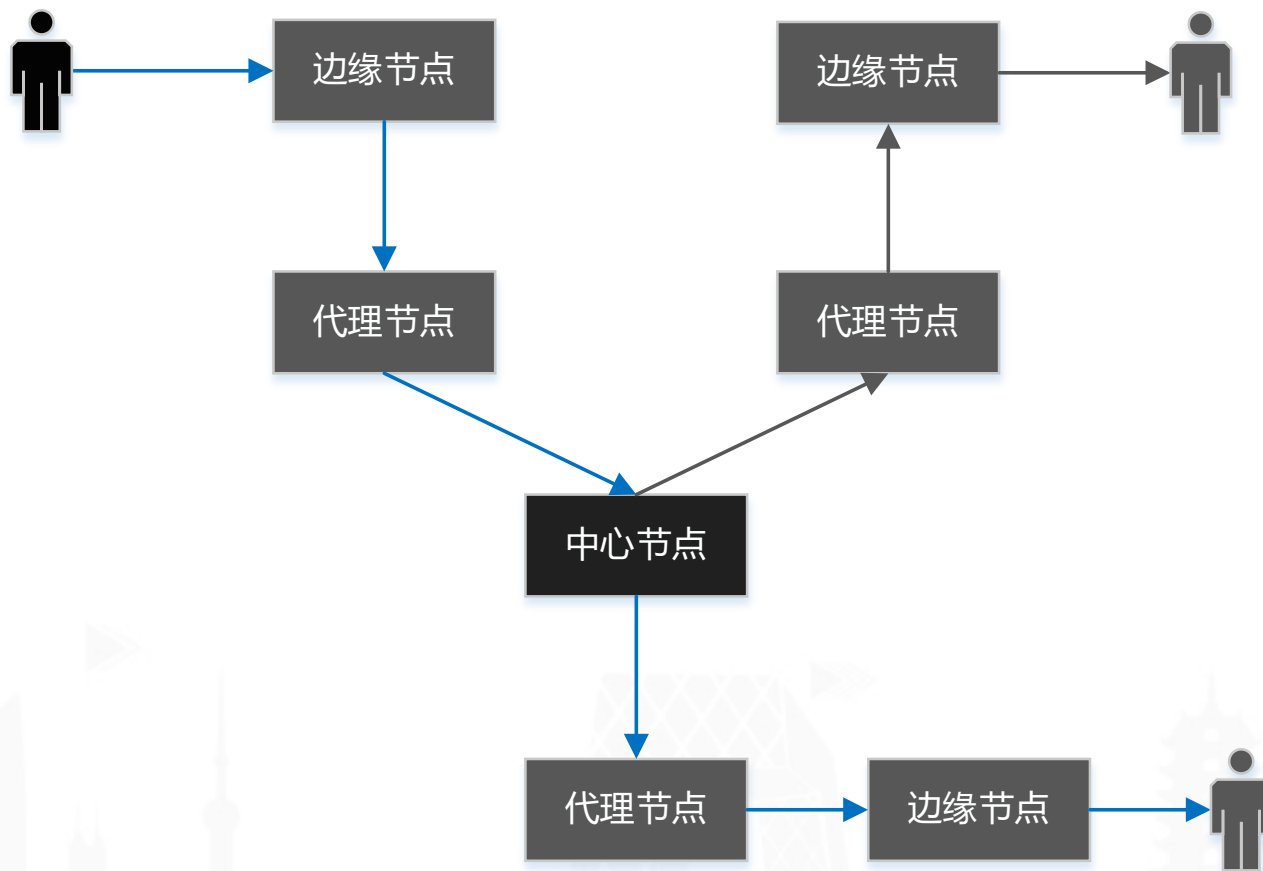
媒体架构



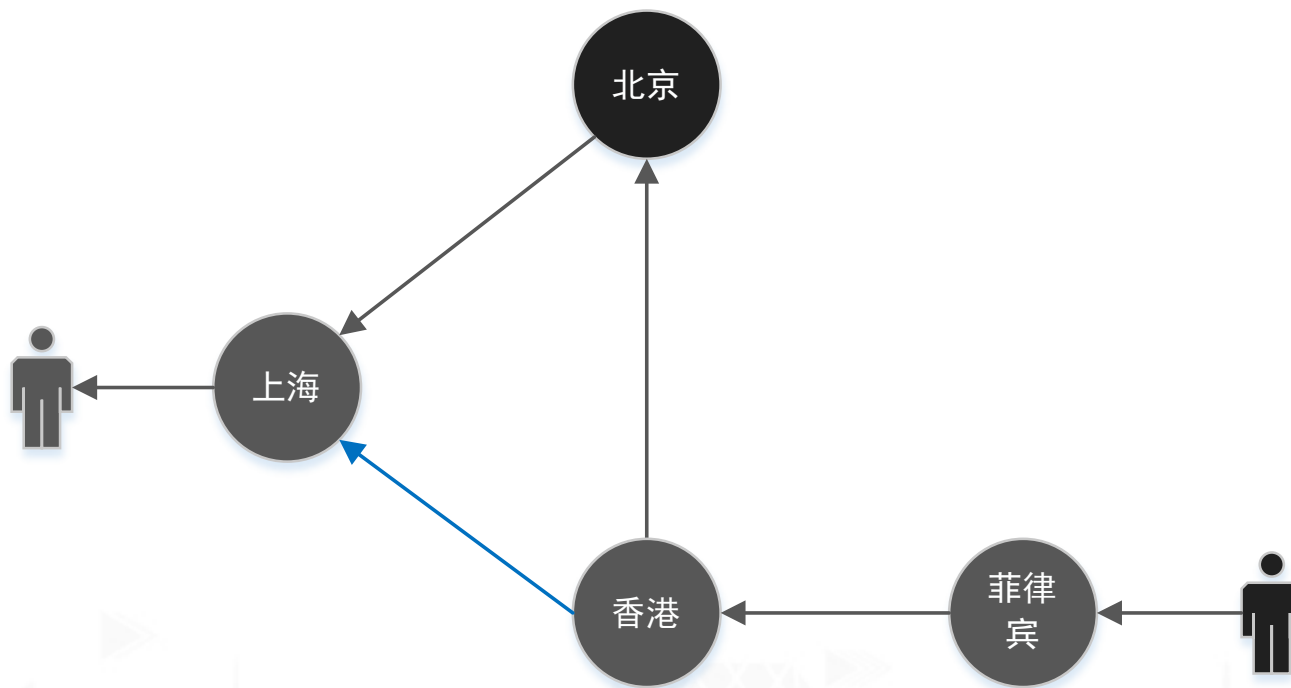




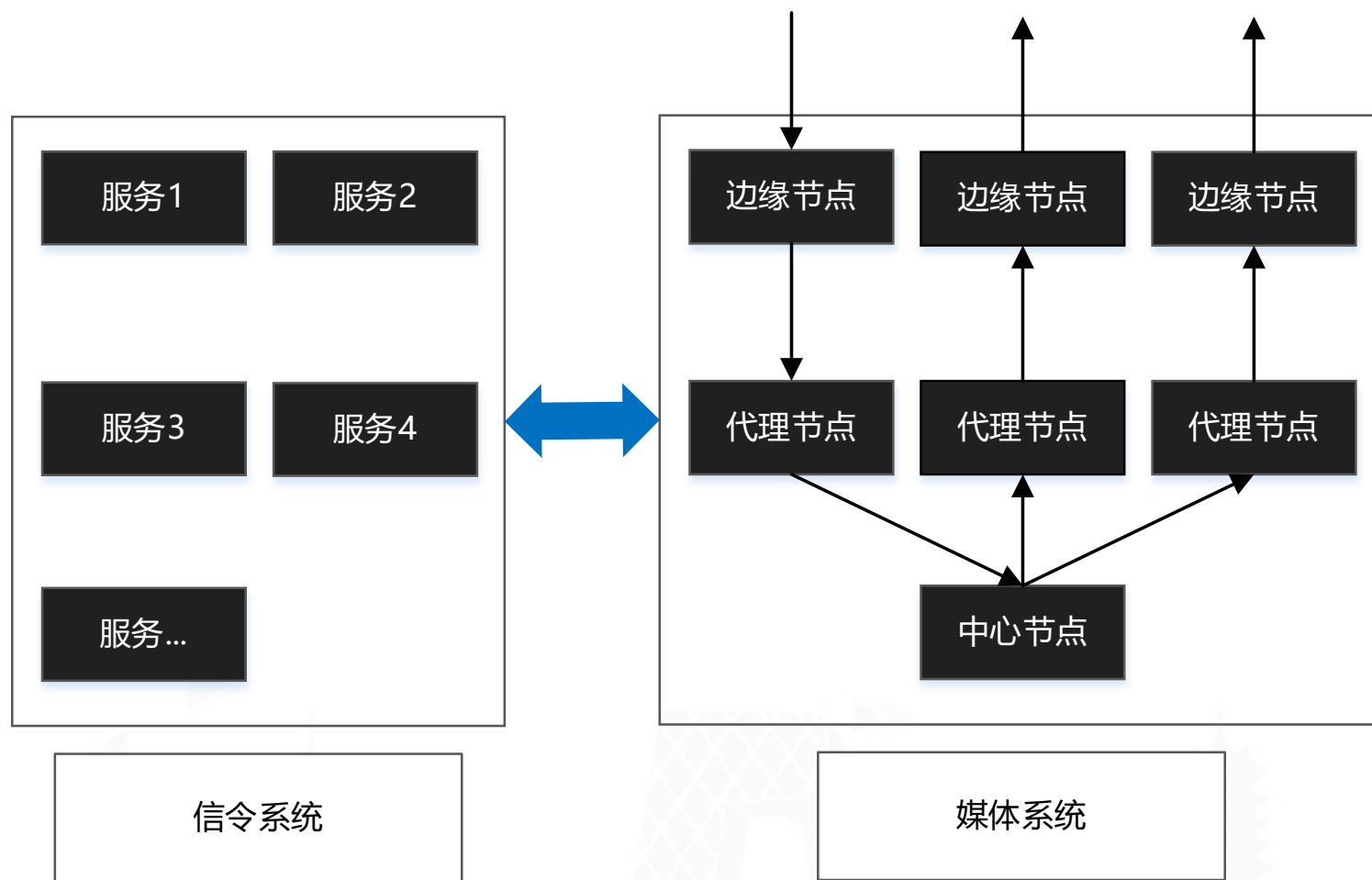
▶ 中心节点问题

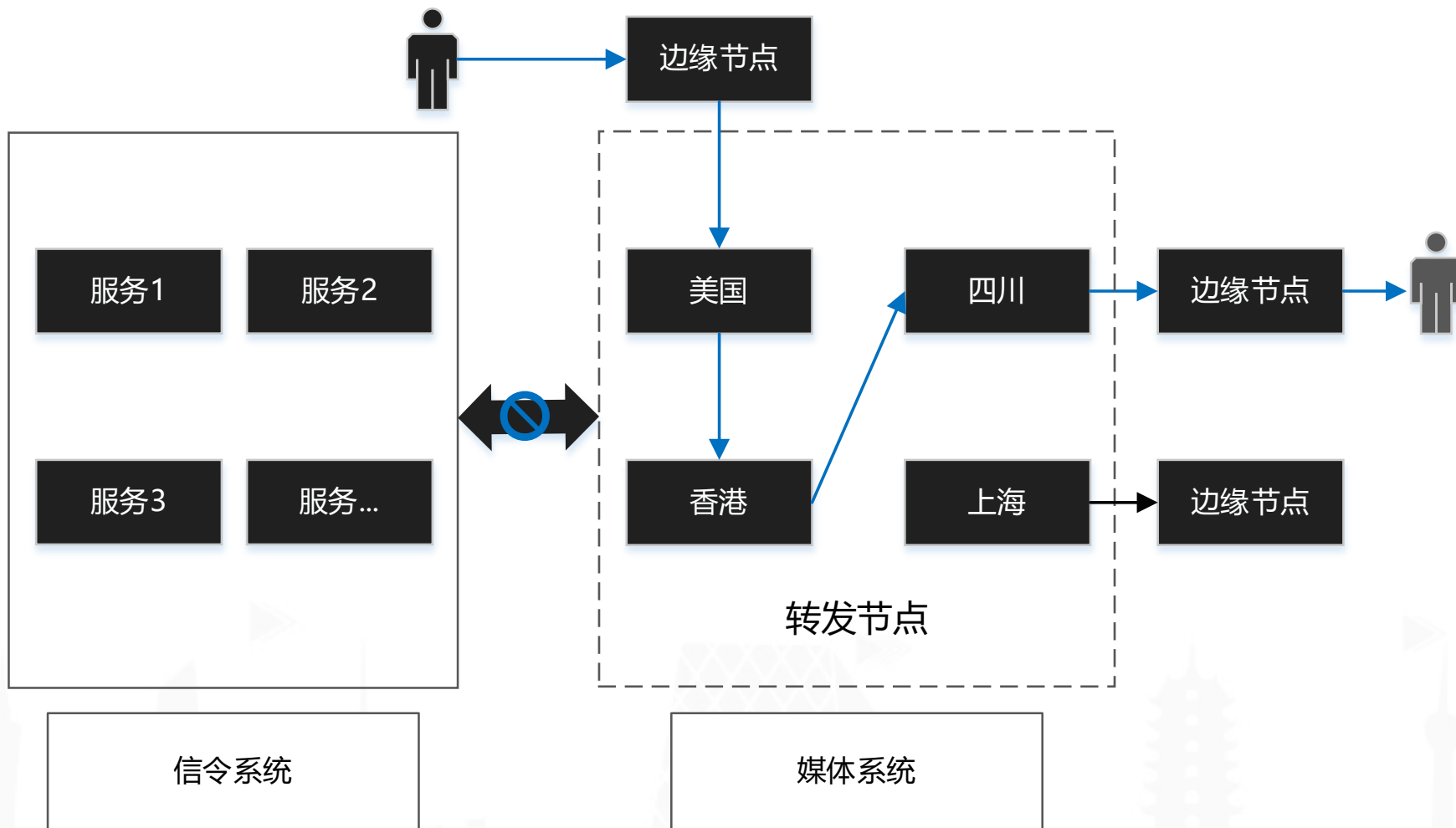


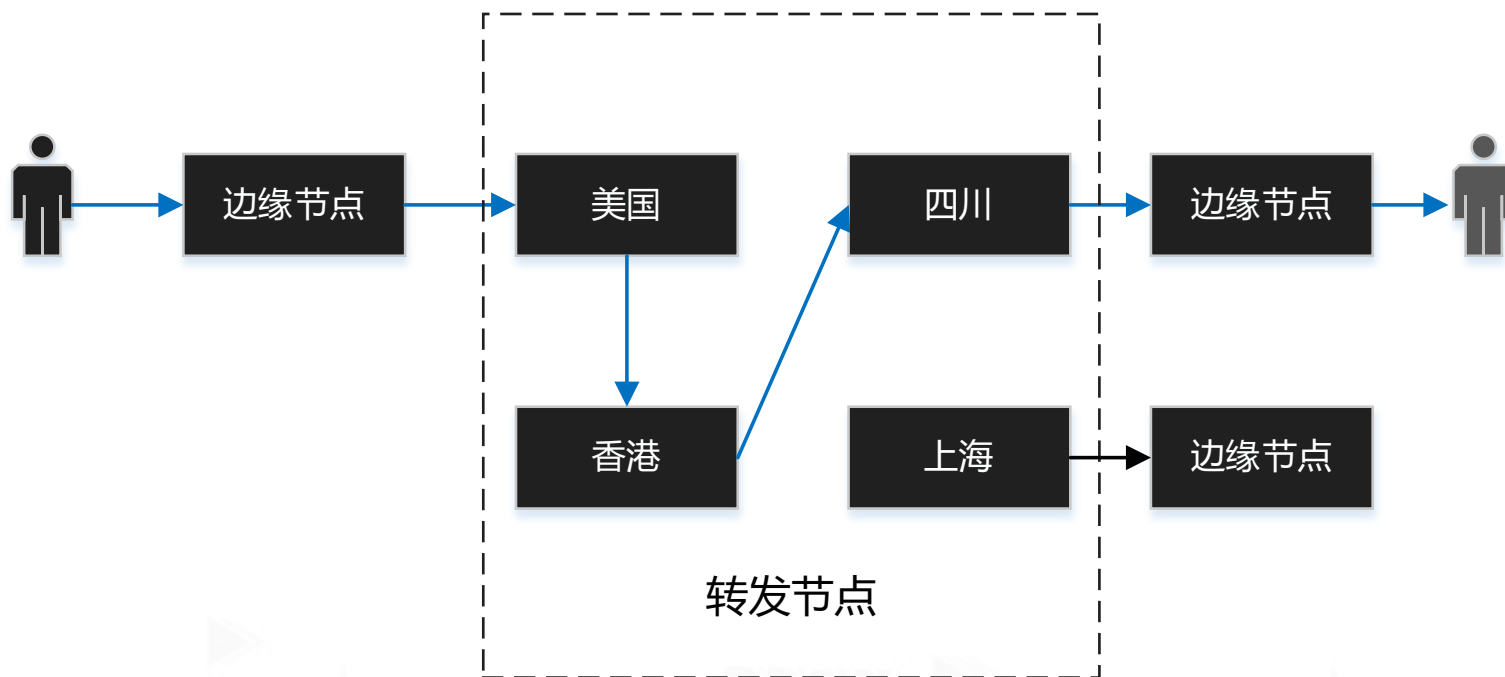
▶ 中心节点问题



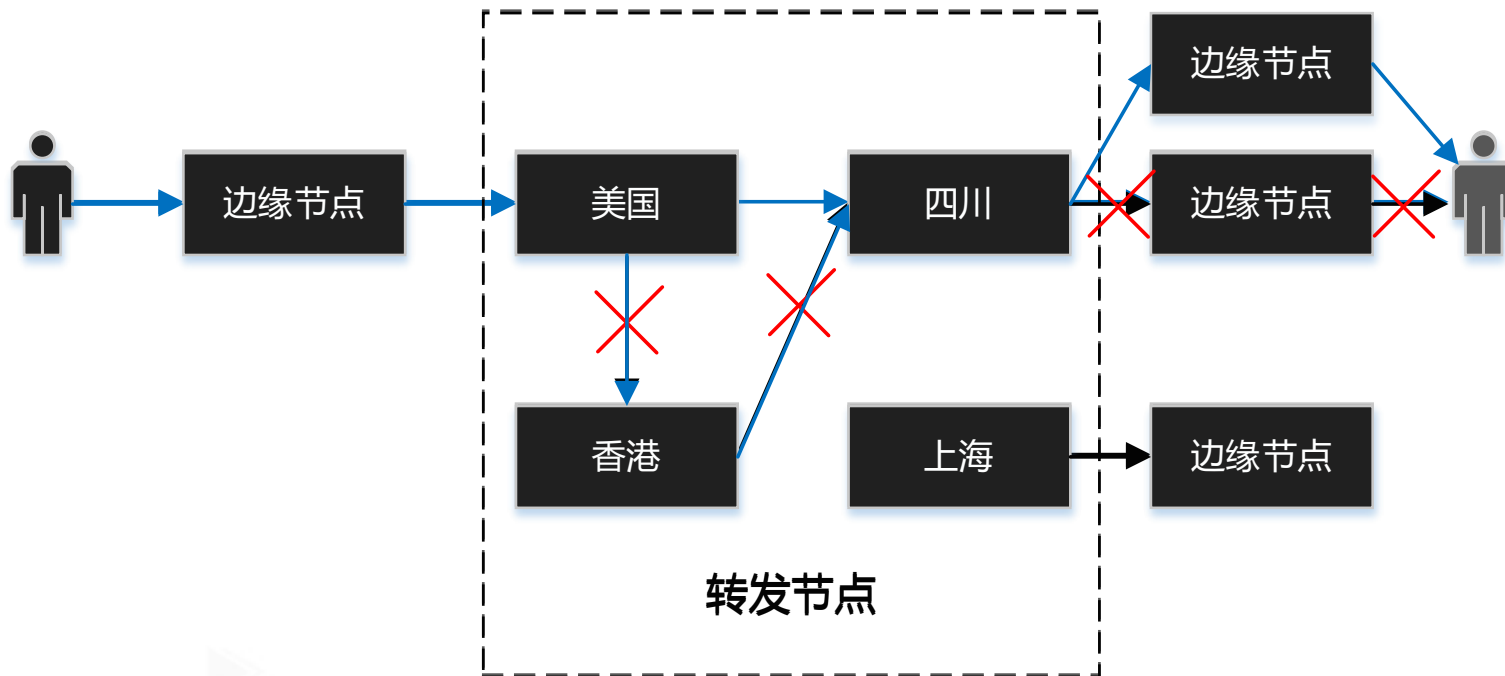
▶ 系统耦合问题







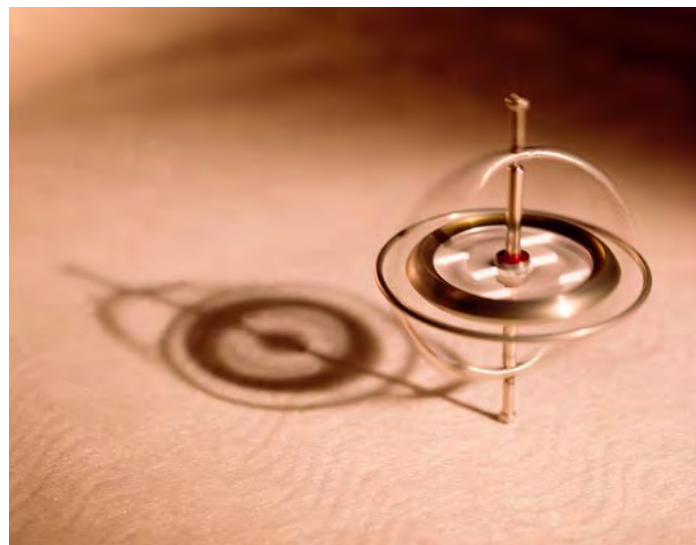
失效转移



设计原则



快速

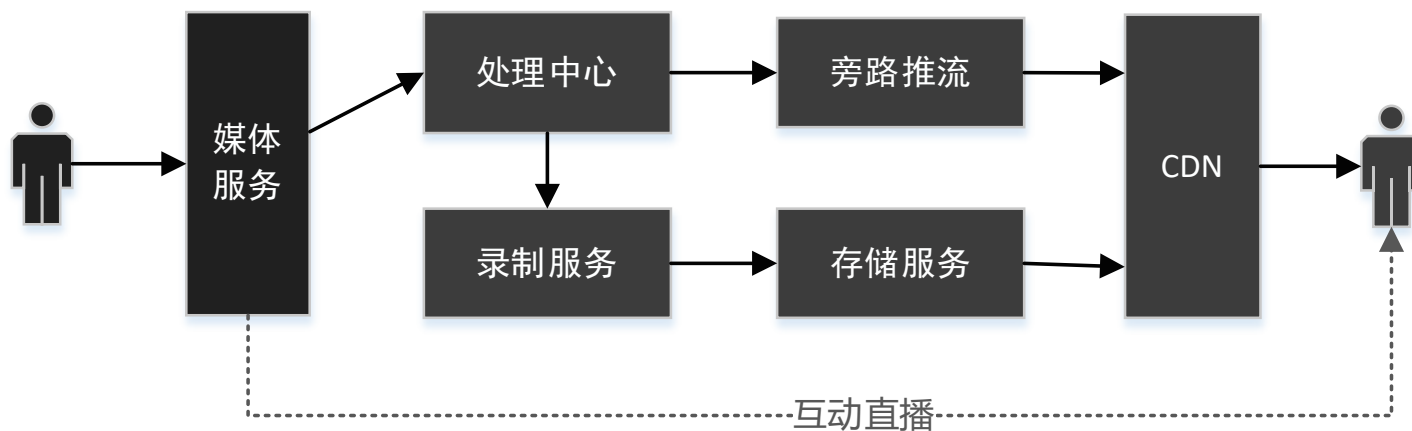


稳定

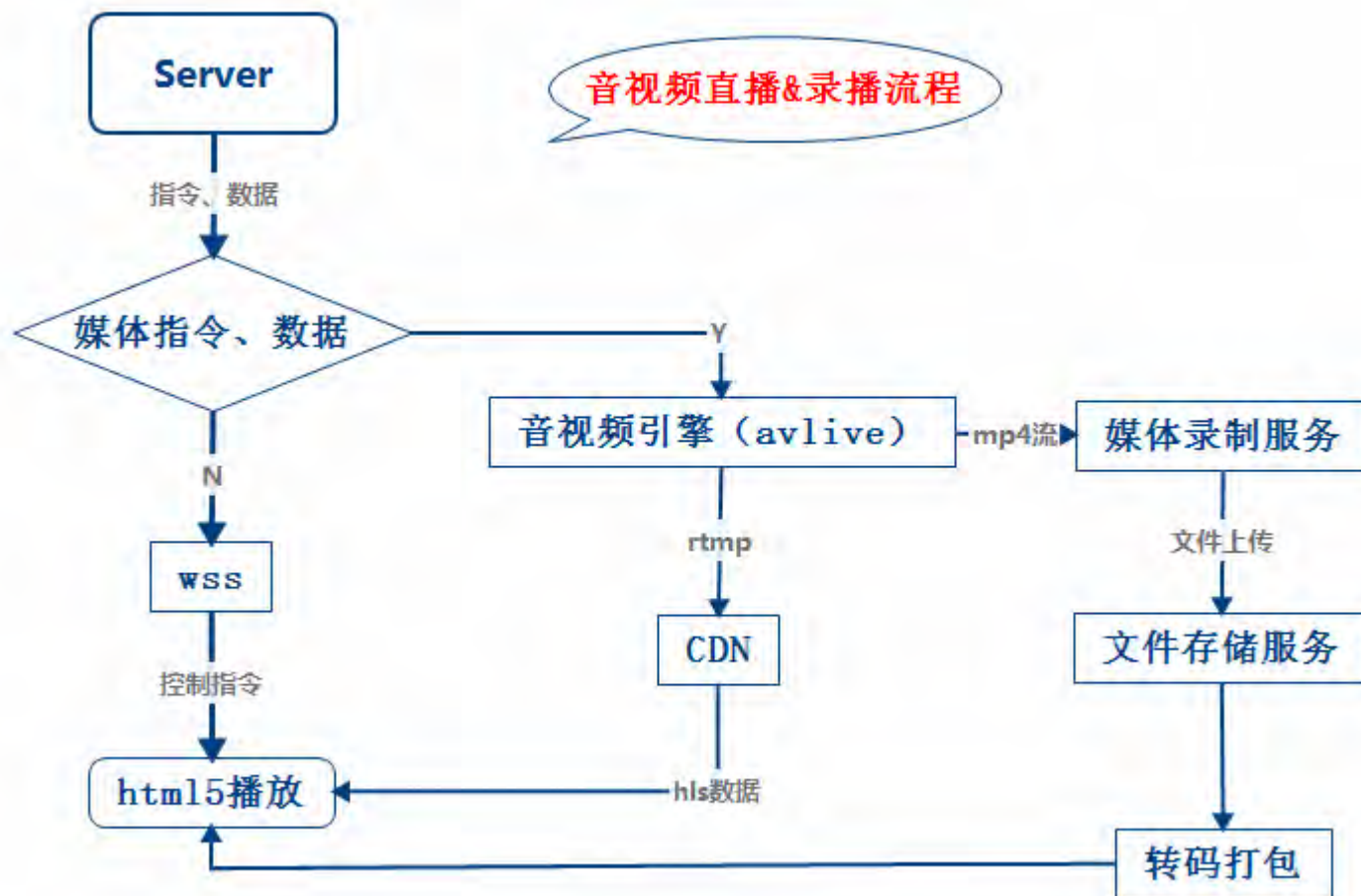
PART FOUR

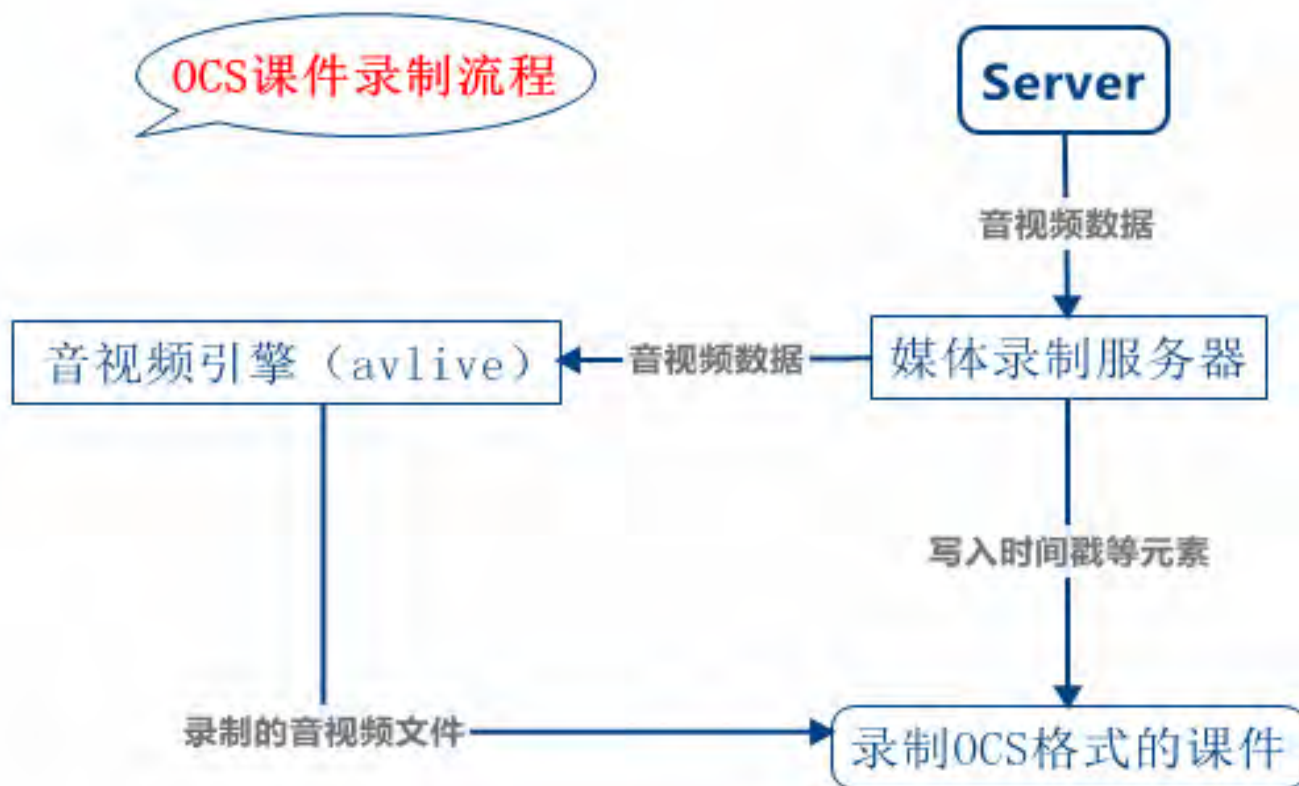
录制回顾以及旁路推流

Recording system and streaming

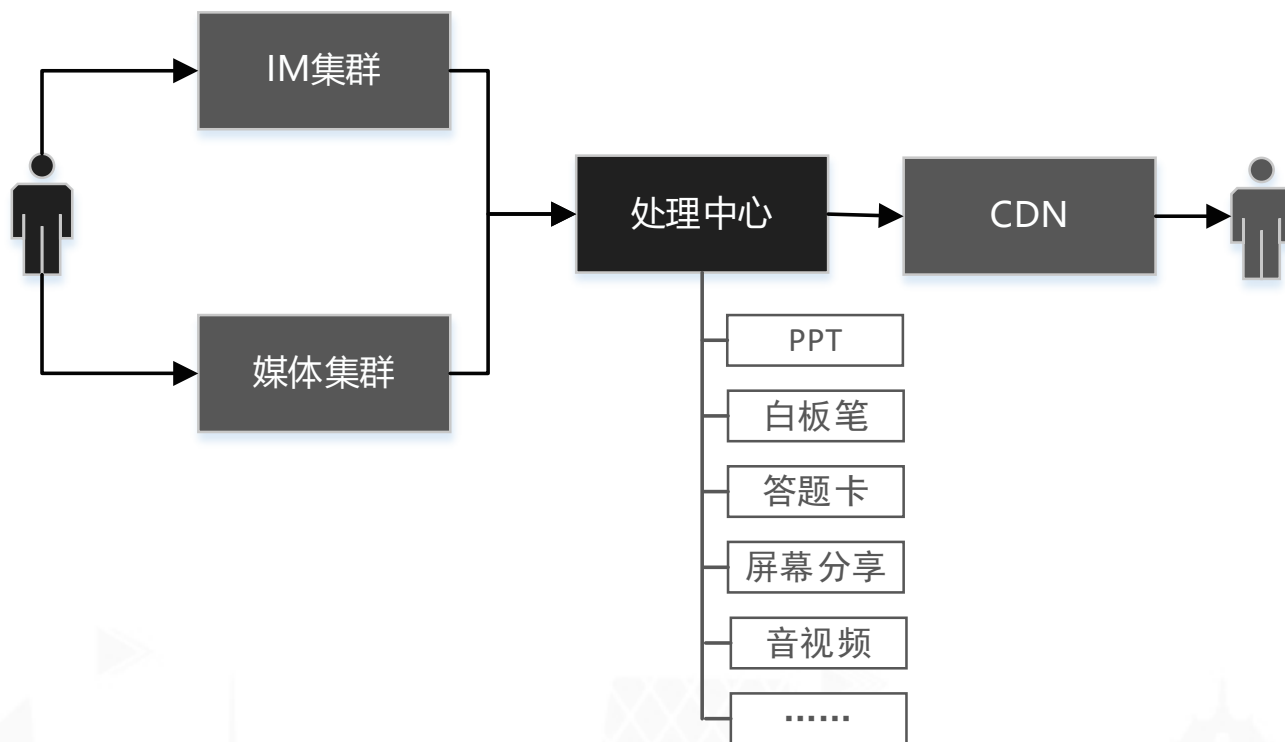


音视频直播&录播流程





The screenshot displays the OCS Editor interface. The main window shows a lesson slide titled "Vocabulary Learning: About Traveling". The slide content includes the word "opposite" in large green letters, its phonetic transcription "[ˈɒpəzɪt]", and a small audio player icon with the text "点击聆听指示". To the right of the text is a colorful winter-themed map with a red path. The path starts at a yellow box labeled "You" and ends at another yellow box labeled "Xiaoming". The map features various winter scenes like snow, trees, houses, and a car. The interface also includes a left sidebar with a page list, a bottom timeline with a video player, and a right sidebar with styling options.



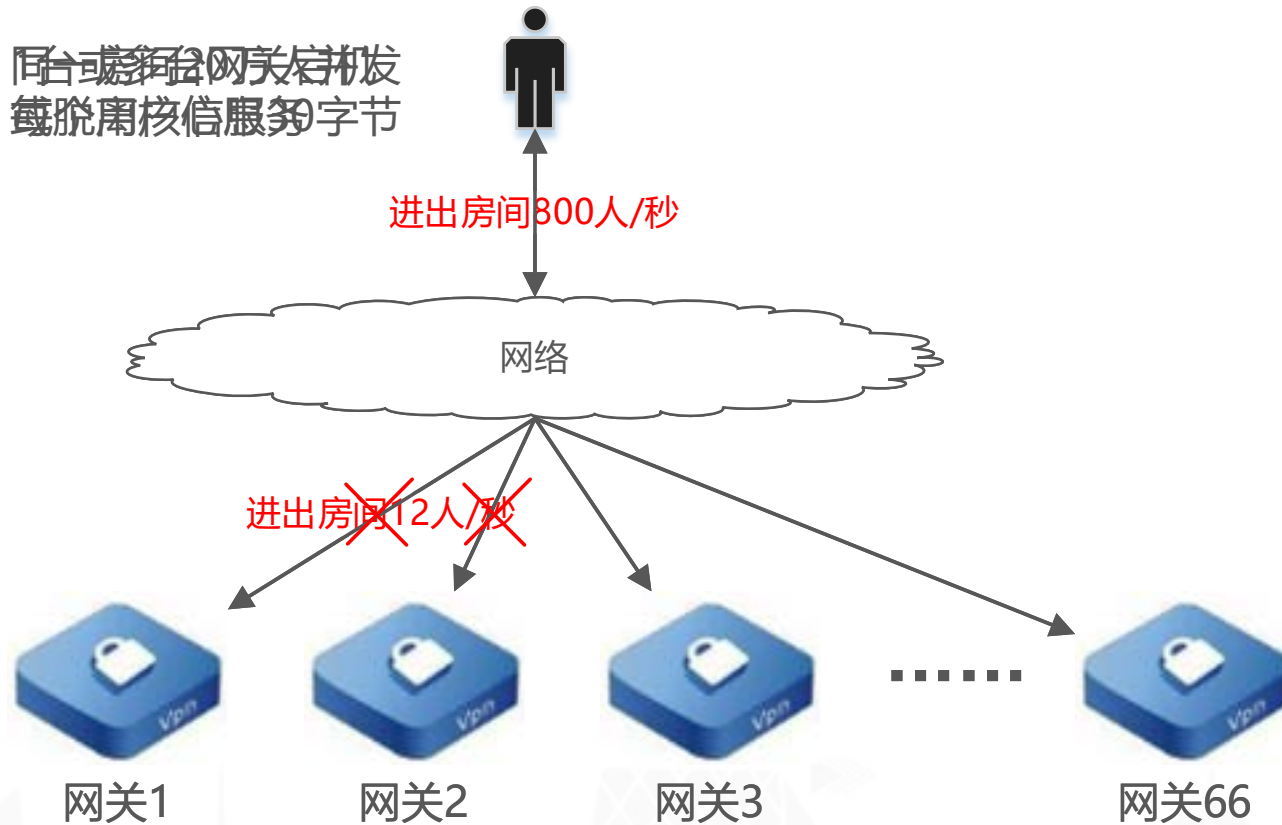
方案	每个子系统 GPU数量	每个子系统并发数	每台机器子系统数	每台机器并发数
██████████	0	30	1	30
intel GPU高密度	1	50	16	800
██████████	2	120	1	120

PART FIVE

高并发场景案例分析

Case Analysis of High Concurrency Scenario

200,000人在同一个教室的场景如何处理？



通常教室拉取数据流量 $30300 \times 20000 \times 46.8 = 45.76\text{Mb}$
每堂课所需网关流量 $7451761800 \times 46.8 = 524.67\text{Mb}$

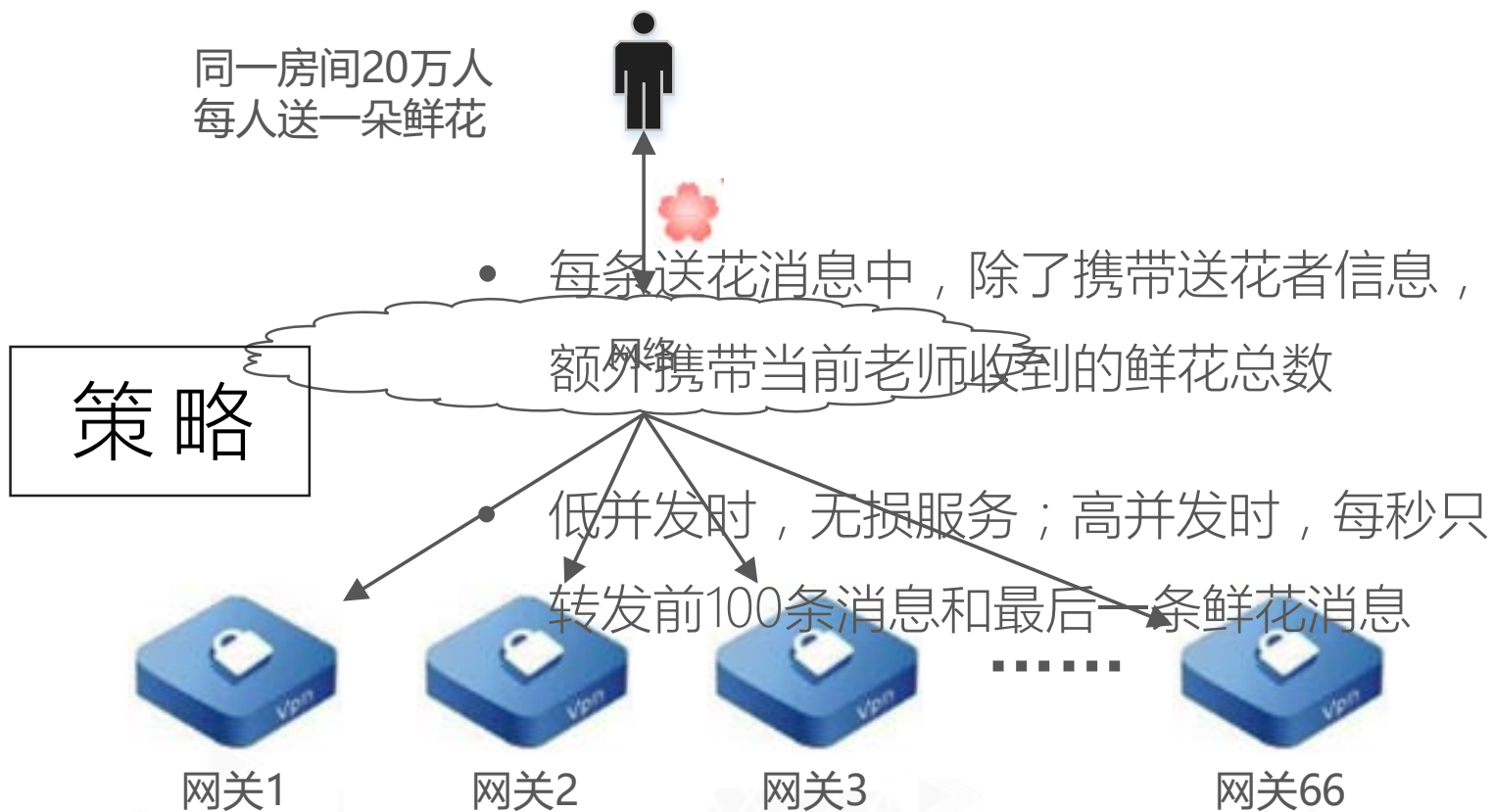
问题 & 策略

问题

客户端带宽消耗太高、进入教室慢、
服务并发处理量太大

策略

1. 精简信息+详细信息
2. 数据版本机制，一定版本范围内只处理数据变化



单台服务器瞬间消息量: $3000 \text{人} \times 200,000 \text{次} = 600,000,000 \text{条}$

单个客户端瞬间消息量: $1 \text{朵} \times 200,000 \text{人} = 200,000 \text{条}$

THANK YOU



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LiveVideoStackCon

聚音视 研修不止于形



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