LiveVideoStackCon

WebRTC媒体服务—TMS的演进

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主要内容

I. Why WebRTC?

II. How WebRTC works.

III. Open source WebRTC servers.

IV. TMS（Tutormeet Media Server）.

Tutormeet+

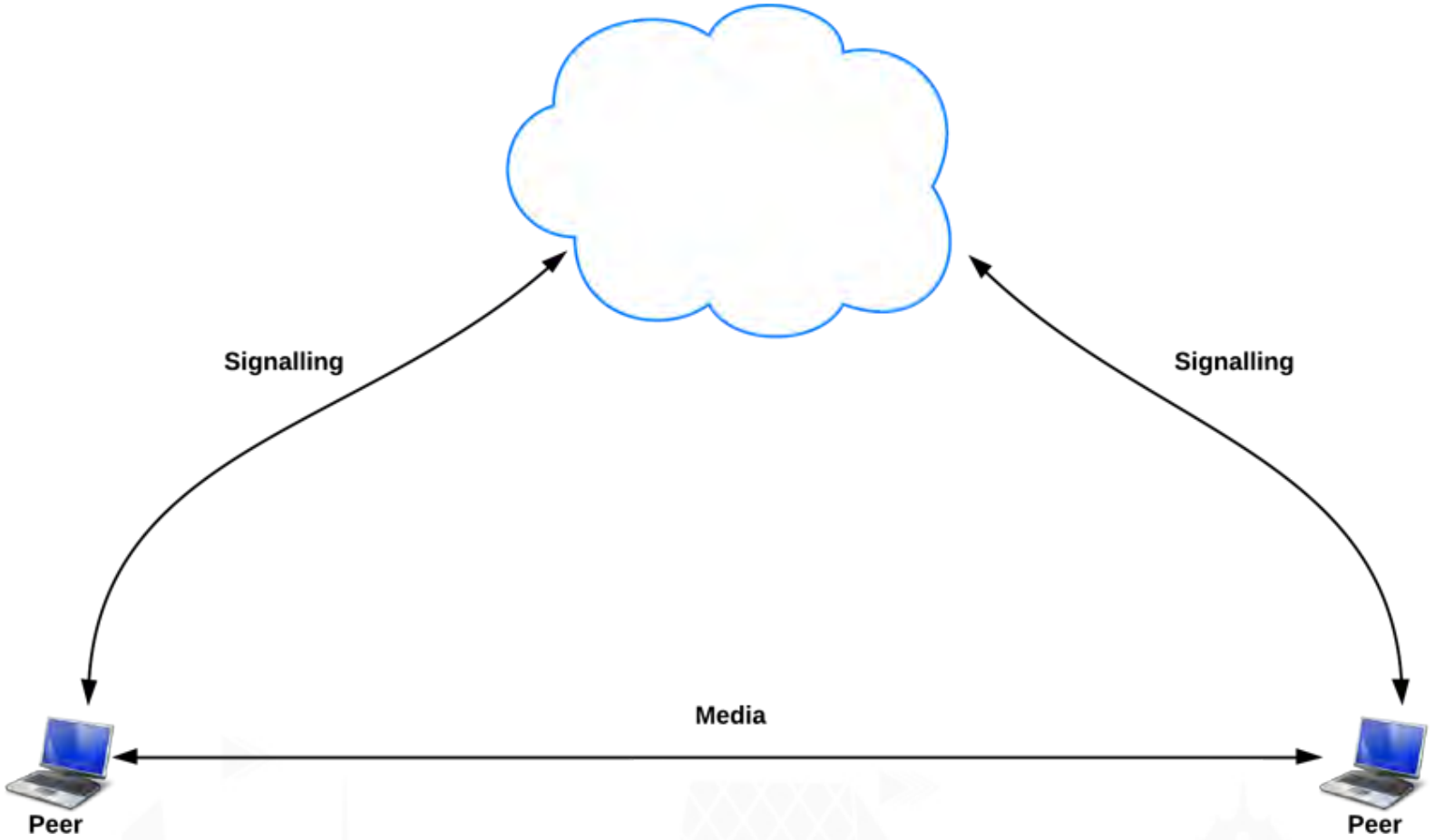
- 低延时
- 流畅清晰
- Web端“无缝”支持

WebRTC

tutorabc vipjr

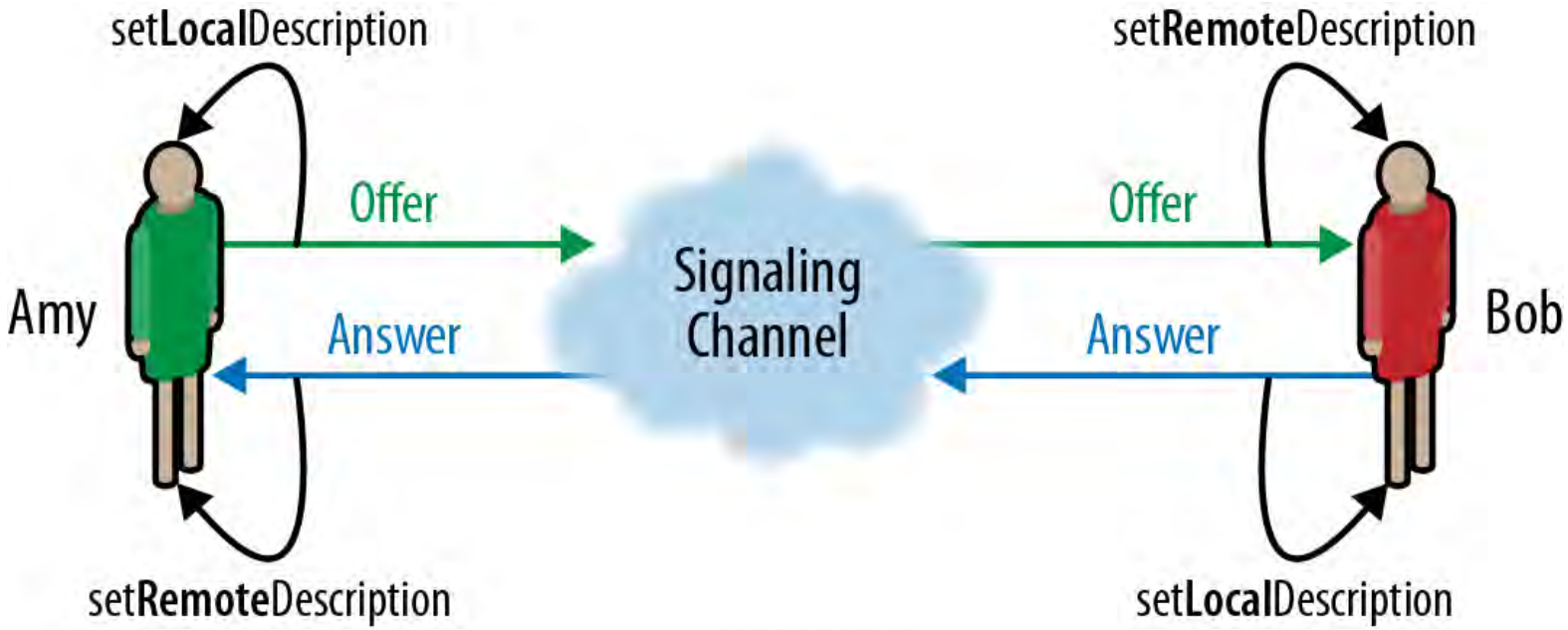
How WebRTC works?

WebRTC



- Signaling negotiate
- Media transport

SDP negotiate



```
v=0
o=- 20518 0 IN IP4 0.0.0.0
s=-
t=0 0
a=ice-options:trickle
a=group:BUNDLE audio video

m=audio 54609 UDP/TLS/RTP/SAVPF 109 0 8
a=mid:audio
a=sendrecv
a=rtpmap:109 opus/48000/2
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
a=maxptime:120
a=ice-ufrag:074c6550
a=ice-pwd:a28a397a4c3f31747d1ee34
a=fingerprint:sha-256 19:E2:1C:3B :4B:9F:81:E6:B8:5C:F4…
a=rtcp-mux
a=rtcp-fb:109 nack
a=ssrc:12345
a=candidate:0 1 UDP 2122194687 192.168.1.4 61665 typ host
a=candidate:1 1 UDP 1685987071 24.23.204.141 54609 typ
srflx raddr 192.168.1.4 rport 61665
(略)
```

[RFC4566] - Session Origin Information

[I-D.ietf-mmusic-trickle-ice]
[I-D.ietf-mmusic-sdp-bundle-negotiation]

[RFC4566]

[RFC3264]can send and recv audio
[I-D.ietf-payload-rtp-opus] - Opus Codec
48khz, 2 channels

[RFC5245] - ICE user fragment
[RFC5245] - ICE password
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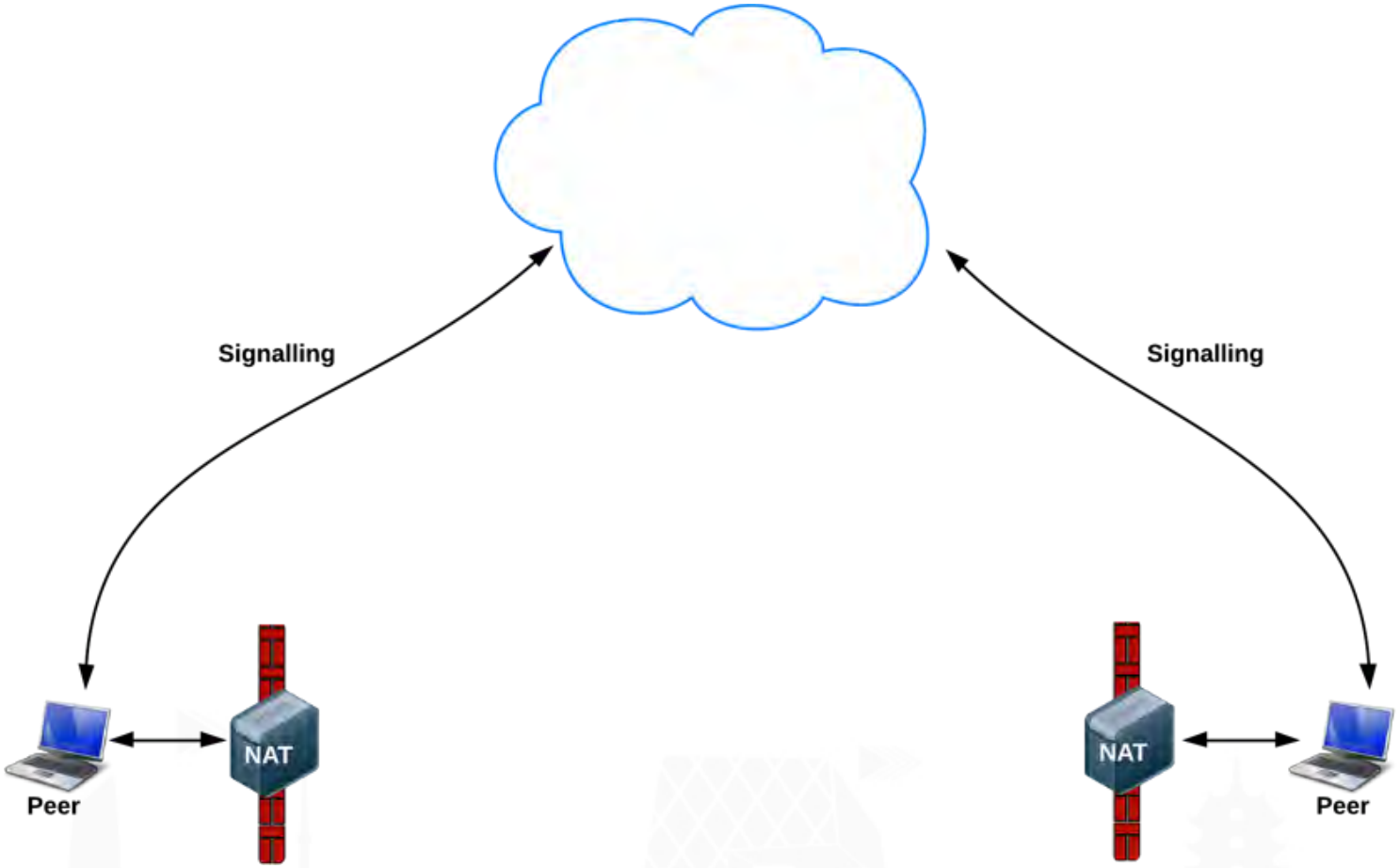
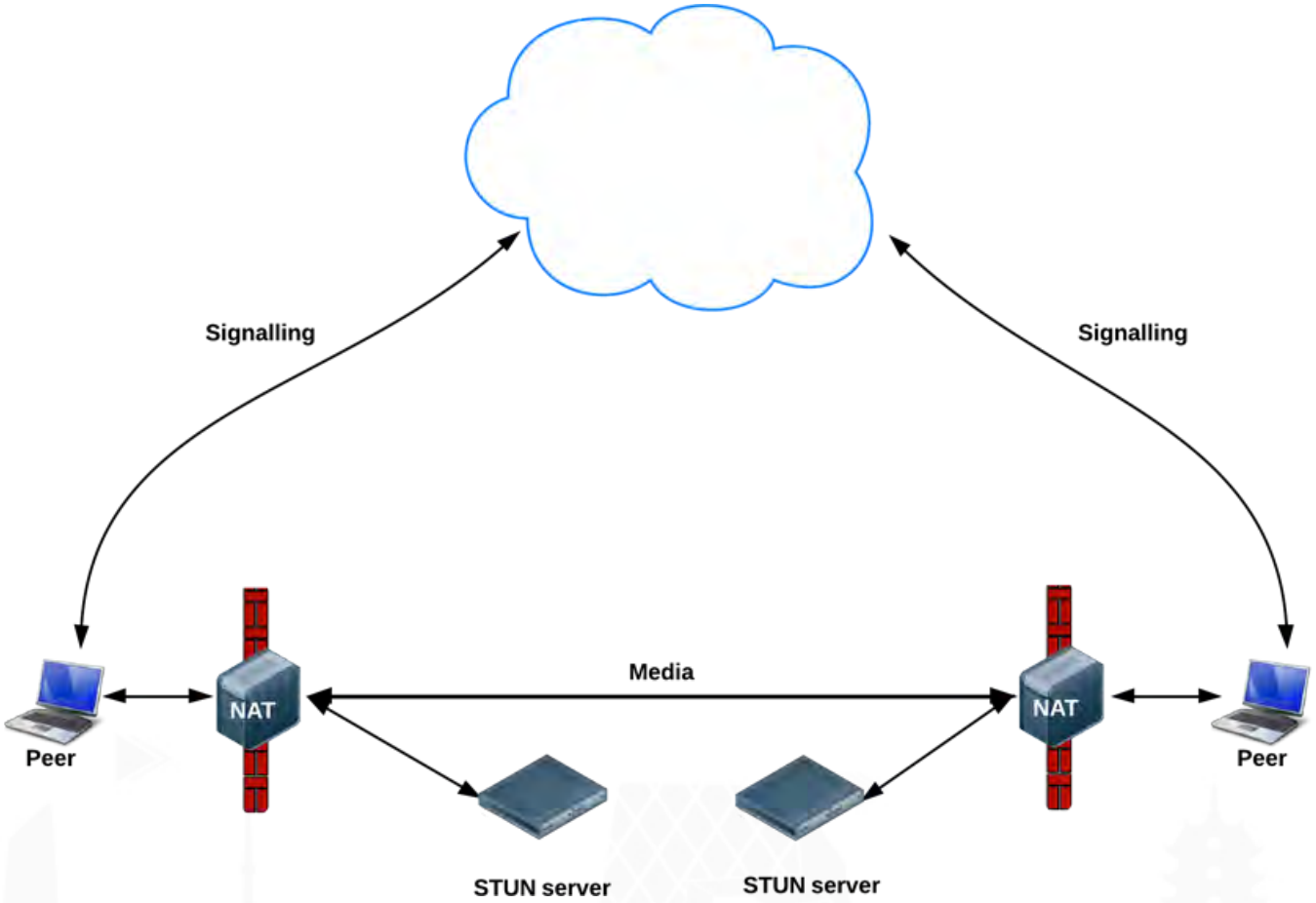
[RFC5761] - can perform RTP/RTCP Mux
[RFC5104] - support NACK

[RFC5245] - ICE Host Candidate
[RFC5245] - ICE Server Reflexive
Candidate

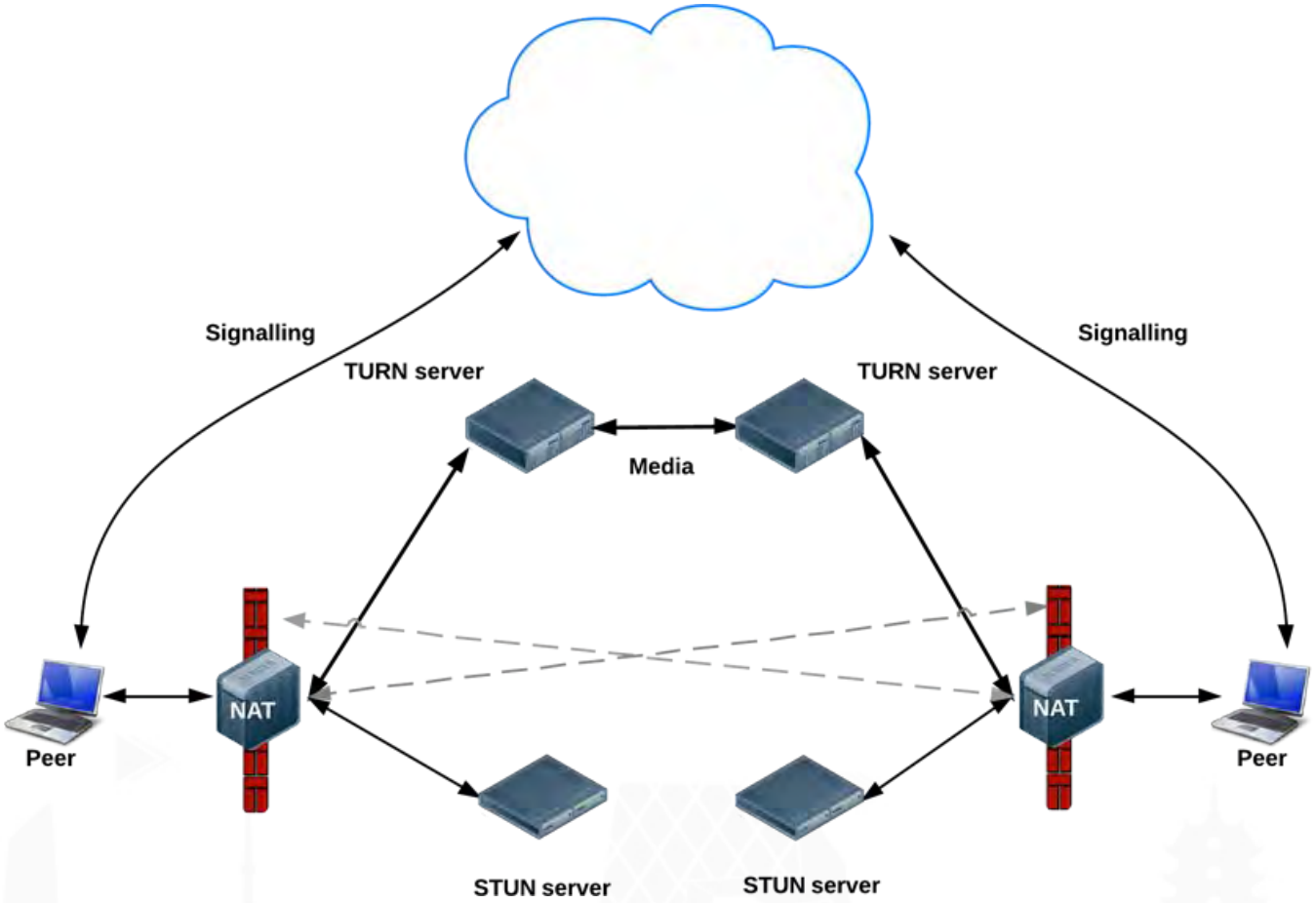
User behind NAT



STUN


Signalling
Signalling
Media
NAT
NAT
Peer
Peer
STUN server
STUN server

TURN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TURN server
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a=rtpmap:109 opus/48000/2
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a=rtpmap:8 PCMA/8000
a=maxptime:120
a=ice-ufrag:074c6550
a=ice-pwd:a28a397a4c3f31747d1ee34
a=fingerprint:sha-256 19:E2:1C:3B :4B:9F:81:E6:B8:5C:F4…
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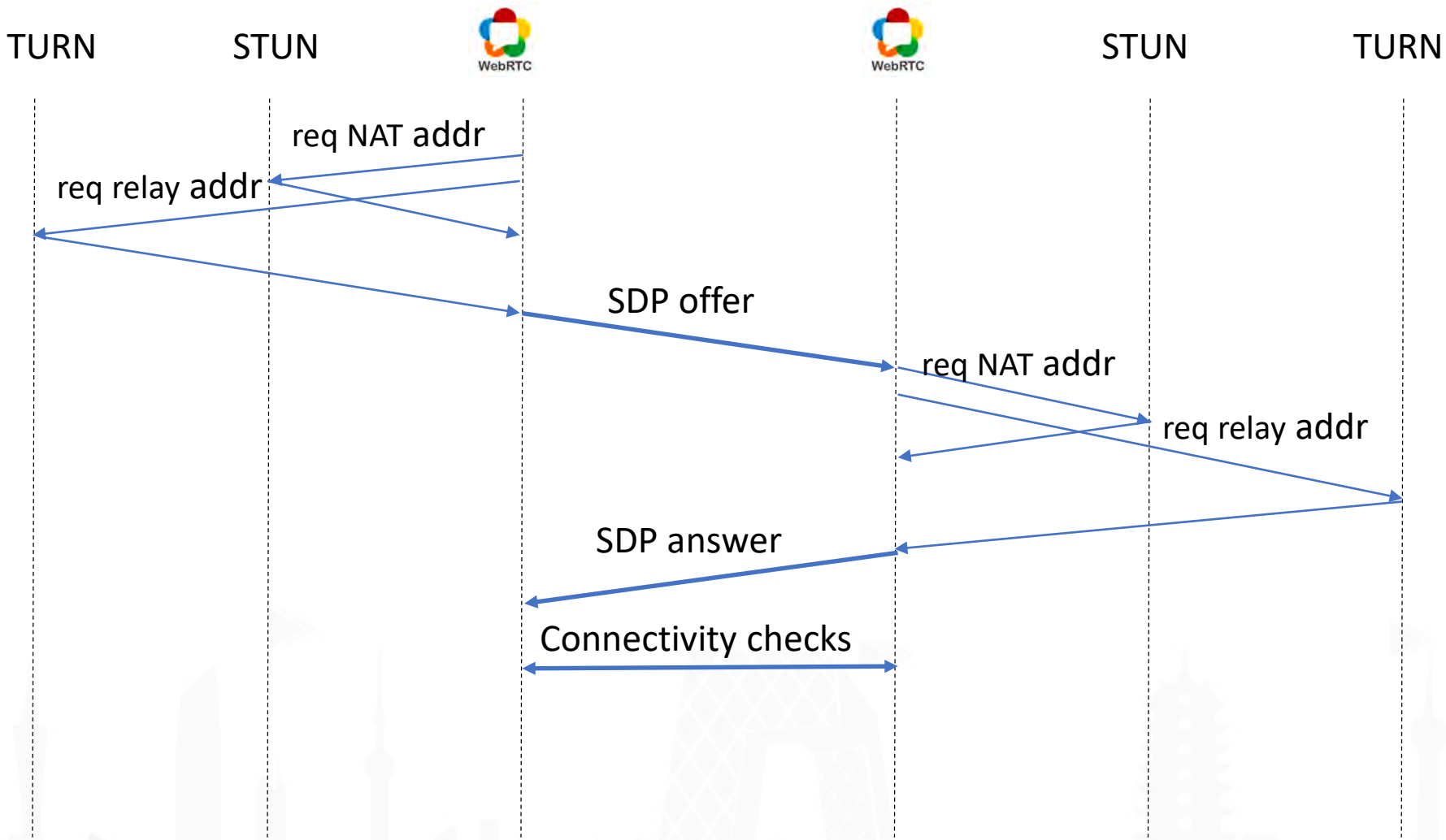
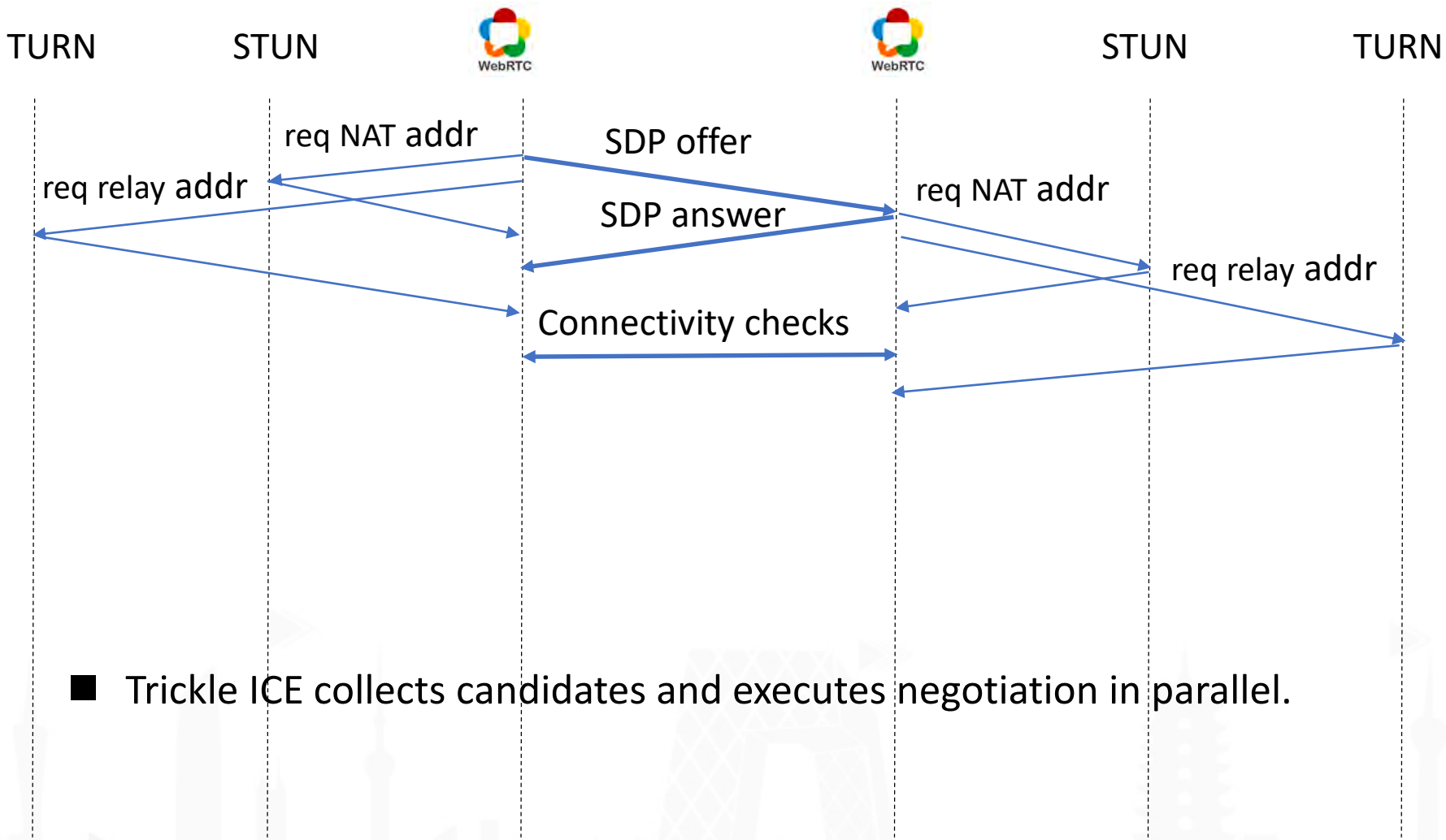
Default ICE



- Too slow!

Trickle ICE



- Trickle ICE collects candidates and executes negotiation in parallel.

```
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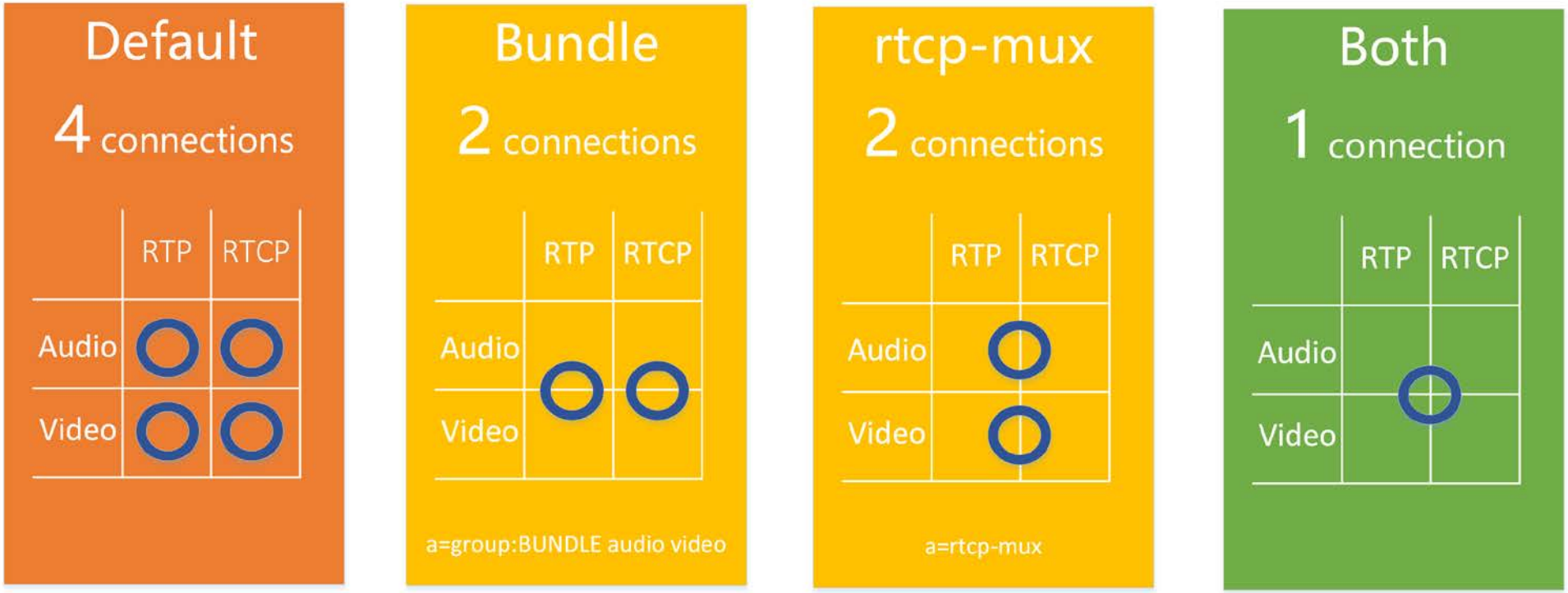
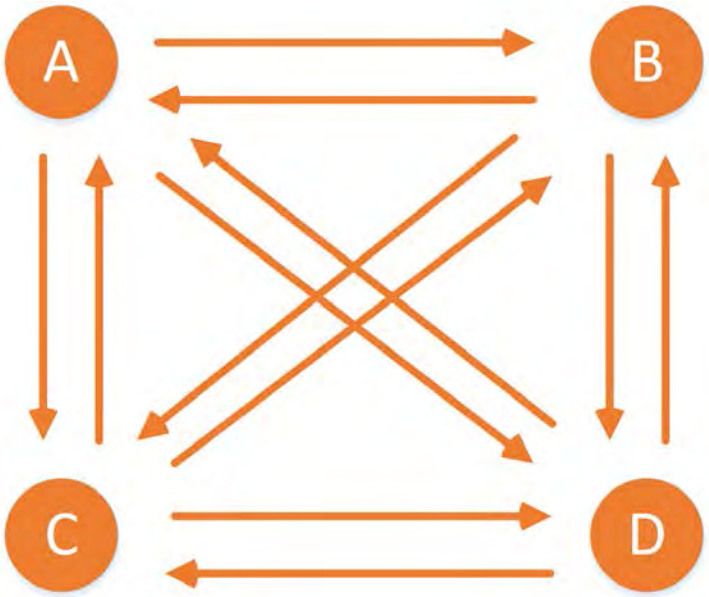
Bundle & rtcp-mux

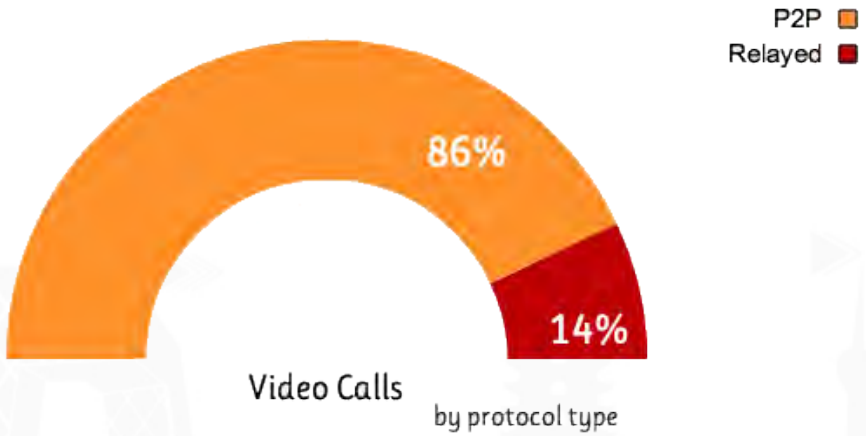


- Reduce ICE setup time
- Optimize resources

P2P

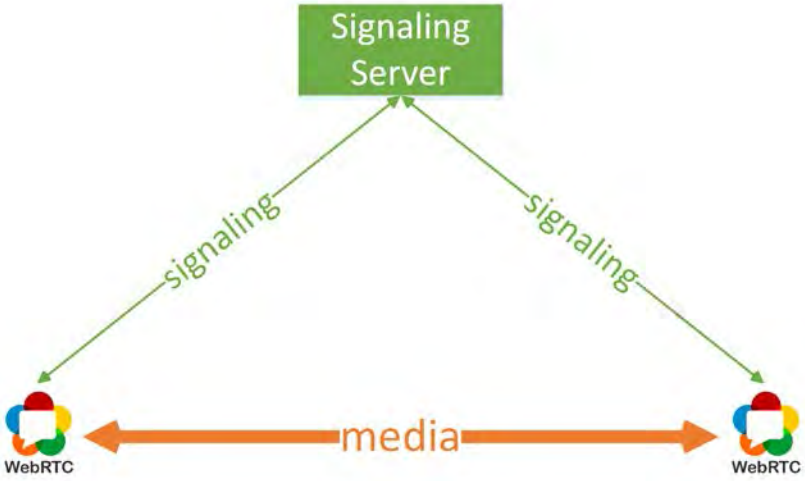
- Pros:
  - 节省服务端流量
- Cons:
  - 用户连接数过多，带宽压力大
  - 数据不经过server
  - NAT可能失败



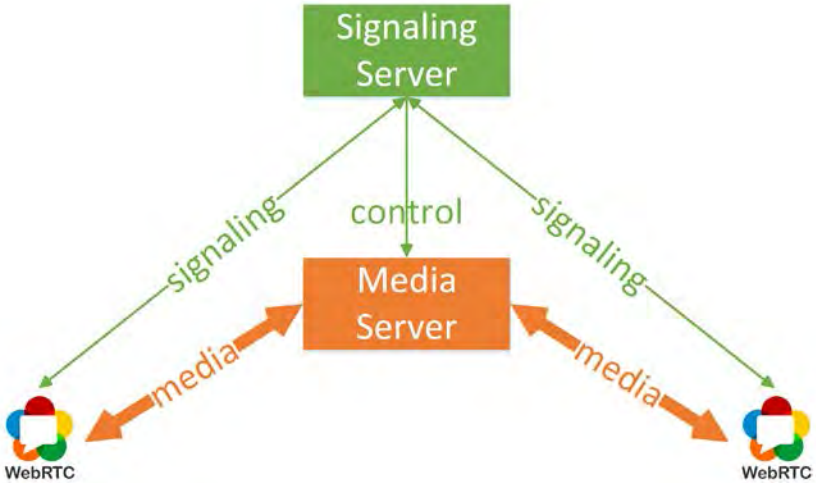


Peer-Server-Peer

P2P vs P-Server-P



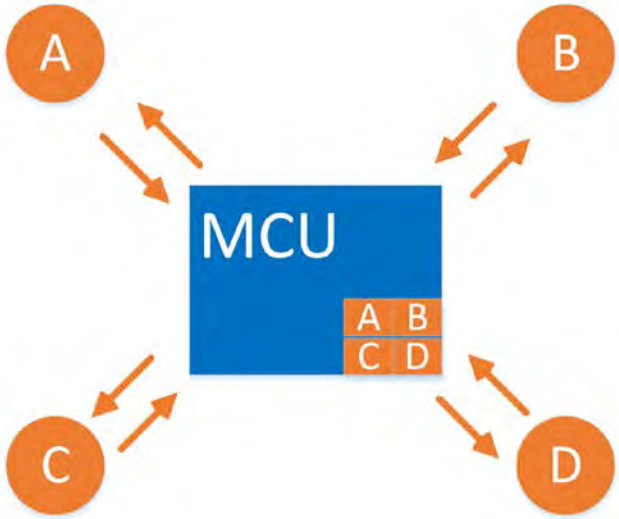
P2P

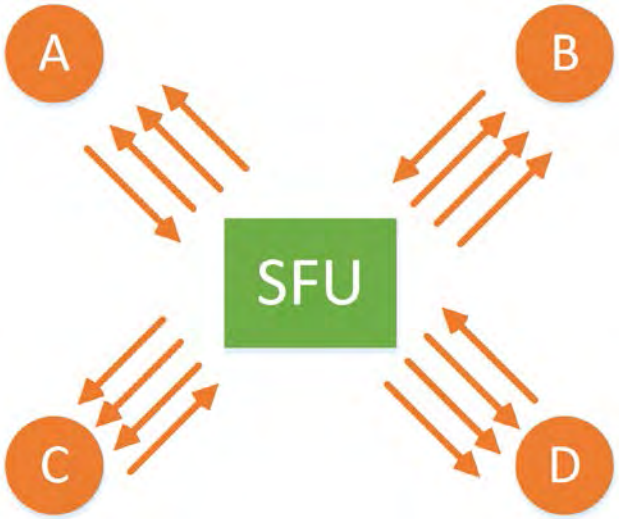


P-Server-P

Peer-Server-Peer

MCU vs SFU





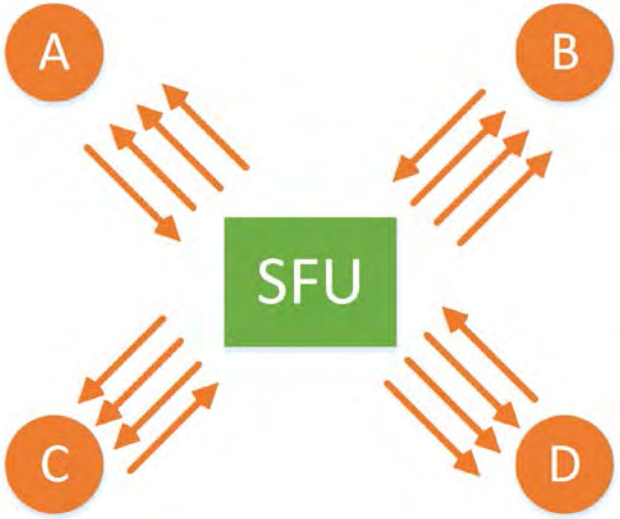
MCU (Multipoint Conferencing Unit)

- 性能消耗大
- 实现复杂度高
- 视频布局不灵活
- 增加延时

SFU (Selective Forwarding Unit)

- 需接收多路媒体流
- 但真实场景:
  - ✓ AUDIO
    - 很少多人同时说话
    - VAD&DTX
  - ✓ VIDEO
    - “接收N路小分辨率的流”与“接收1路大分辨率的流”的流量与CPU消耗并不是N倍

SFU challenges

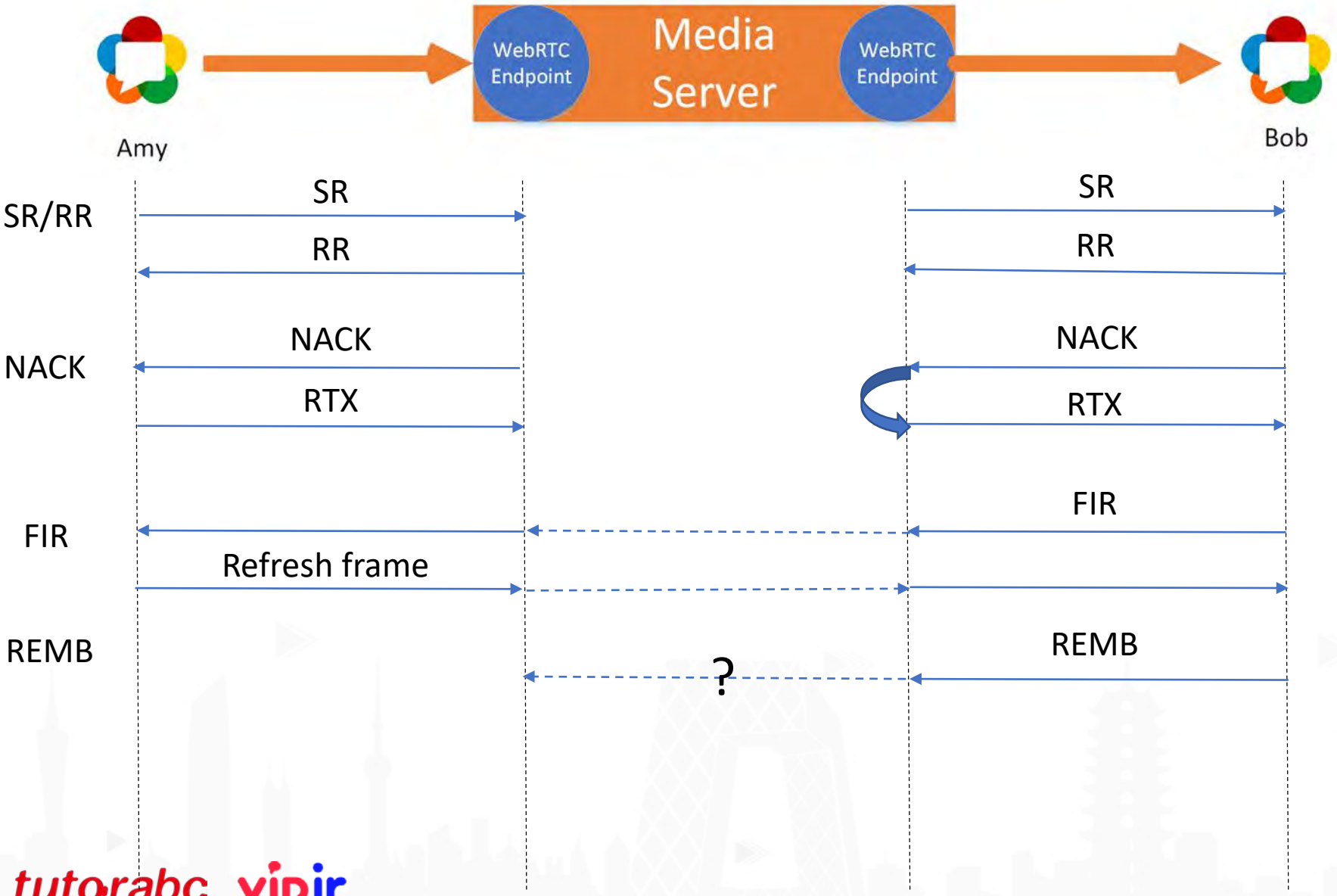


- RTCP termination
- Adaptive bitrate
- Transport robustness
- Various networks

RTCP termination

- SR/RR (Sender Report/Receiver Report) [RFC3550]
- NACK (Negative Acknowledgments) [RFC4585]
- FIR(Full Intra Request) [RFC5104]
- PLI(Picture Loss Indication) [RFC4585]
- REMB(Receiver Estimated Maximum Bitrate) [draft-alvestrand-rmcat-remb-03]
- TMMBR(Temporary Maximum Media Stream Bit Rate Request) [RFC5104]

RTCP termination



simulcast


```
...
a=rid:1 send pt=98;max-width=1280;max-height=720;
a=rid:2 send pt=100;max-width=640;max-height=360;
a=simulcast: send 1;2
...
```

SVC


```
…
a=rtpmap:96 H264/90000
a=fmtp:96 profile-level-id=4d0028; packetization-mode=1;max-fr=30;max-fs=8040
a=rtpmap:97 H264/90000
a=fmtp:97 profile-level-id=4d0028;packetization-mode=1; max-fr=15;max-fs=1200
a=rtpmap:100 H264-SVC/90000
a=fmtp:100 profile-level-id=4d0028;packetization-mode=1;  max-fr=30;max-
fs=8040
a=depend:100 lay m1:96,97;
…
```

Transport Robustness

- Retransmission (NACK)
  - ✓suitable if RTT low
- Forward Error Correction (FEC)
  - ✓payload-format specific FEC (suitable for audio)
  - ✓Block-based FEC

Open source WebRTC servers

Open source

- Kurento
  - https://www.kurento.org/
- Janus
  - https://janus.conf.meetecho.com/
- Licode
  - http://lynckia.com/licode/
- Jitsi
  - https://jitsi.org/

Kurento Media Server

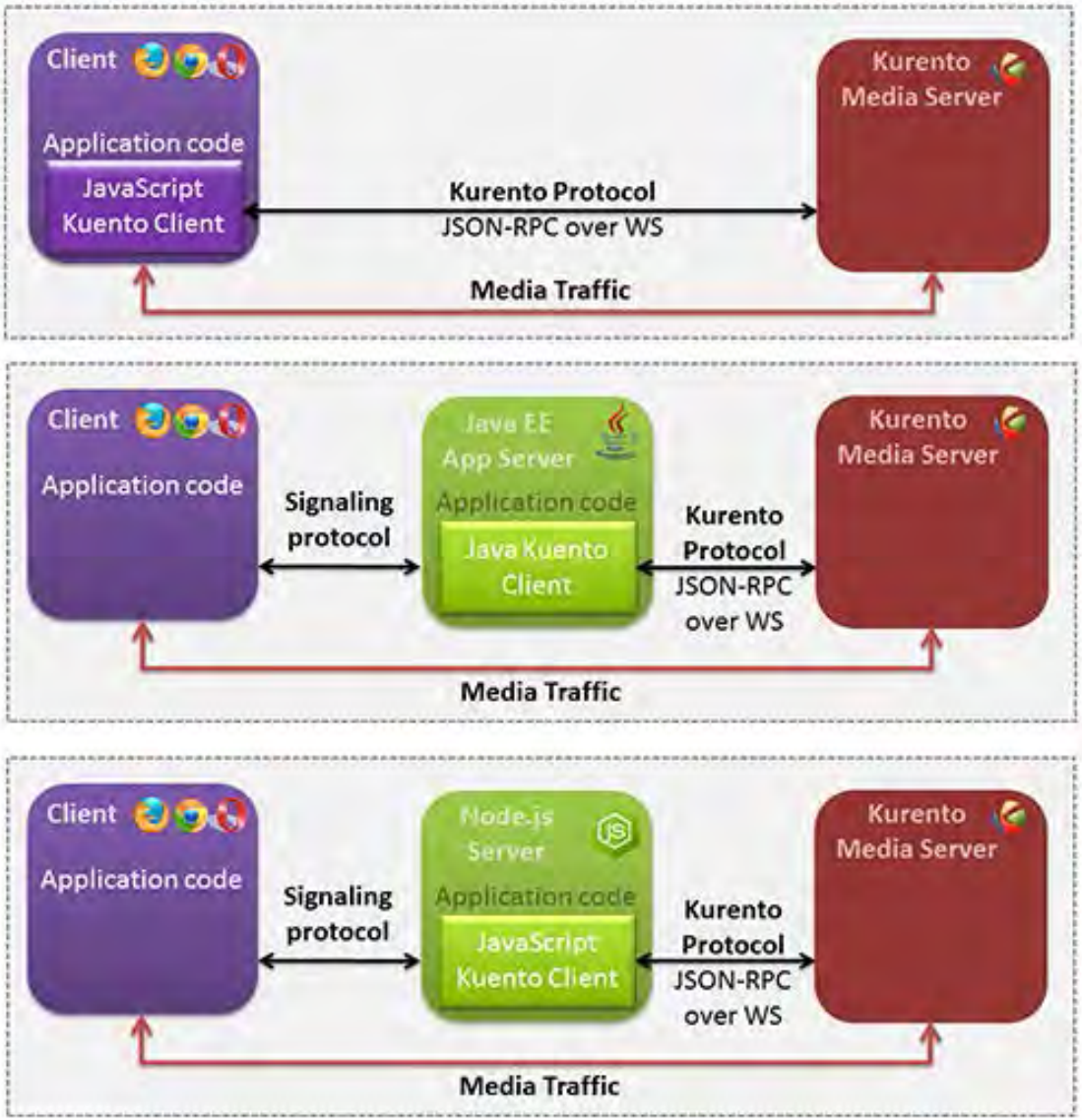
What common WebRTC Media Servers do:

- Transcoding
- MCU
- Recording

What Kurento Media Server adds:

- Flexible processing
- Augmented reality
- Blending
- Mixing
- Analyzing
- Etc.

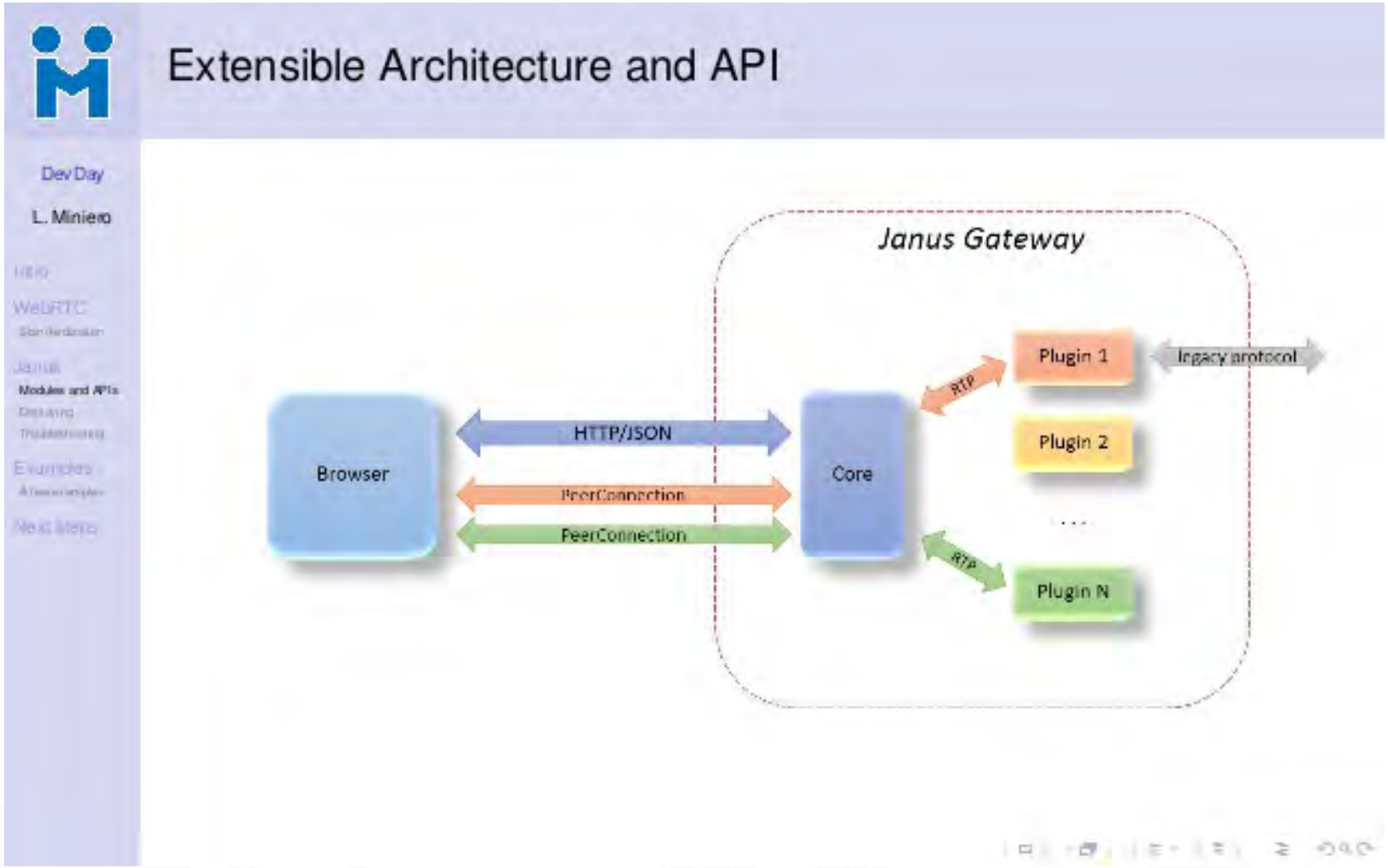
Kurento Media Server



Kurento Media Server

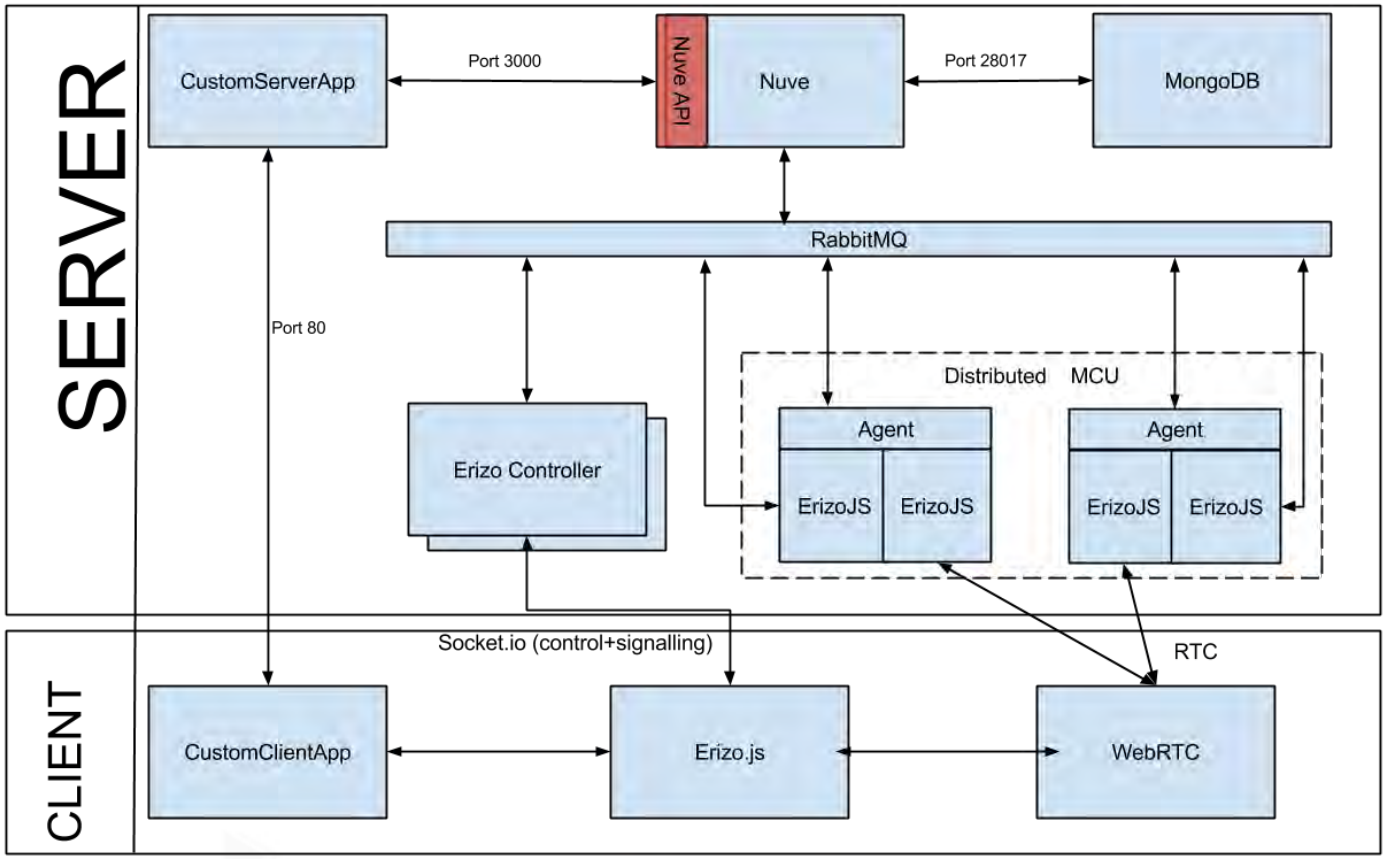
- Pros
  - 功能强大
  - 模块清晰、文档丰富
- Cons
  - 性能较低（GStreamer）
  - 不够稳定、内存较高
  - 团队转向收费版，开源版本更新不再活跃

Janus



- Pros
  - core与plugins分离，结构清晰
  - 基于plugin可定制化开发
- Cons
  - core/plugins之间的交互较为晦涩
  - 弱网处理能力有待优化
  - 细节坑较多，例如WS断开后，立即free所有media resources

Licode



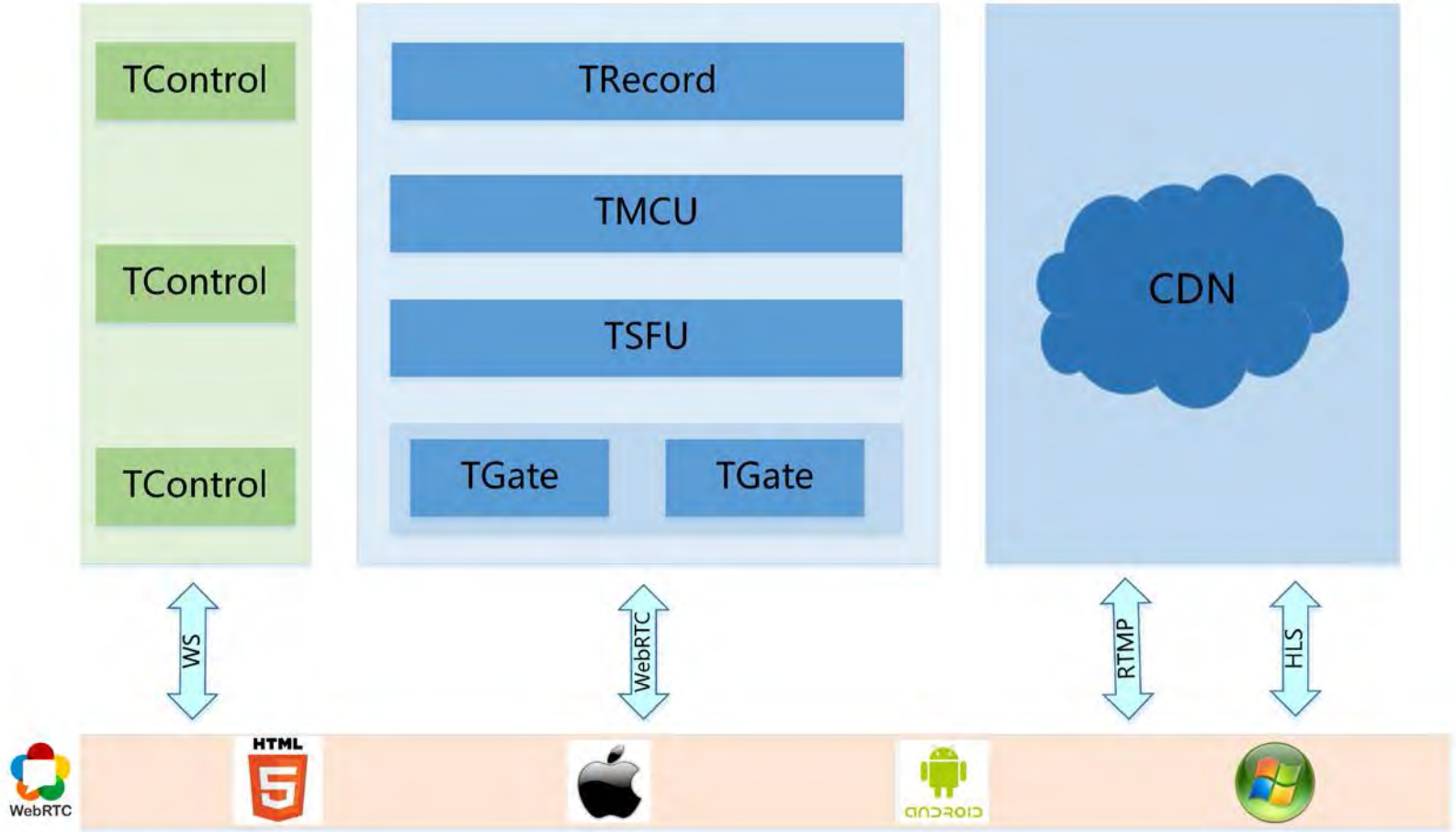
Nuve: Manages services, rooms, users, tokens and balances.
MongoDB: Stores rooms and tokens.
Erizo Controler: Manages Control, signalling and data streams.
MCU: Erizo Agent+ErizoJS
RabbitMQ: Handles all the messages among the components of Licode.

Licode

- Pros
  - 项目功能较全面，考虑了鉴权、扩展等
- Cons
  - 文档不全、且更新不及时，缺少示例
  - 模块拆分较多，且命名不易理解
  - 不支持Data Channel

TMS

TMS


TControl
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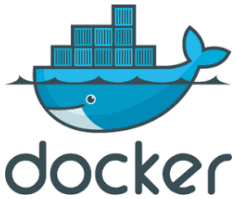
TRecord
TMCU
TSFU
TGate
TGate
CDN
WS
WebRTC
RTMP
HLS
WebRTC
HTML
ANDROID

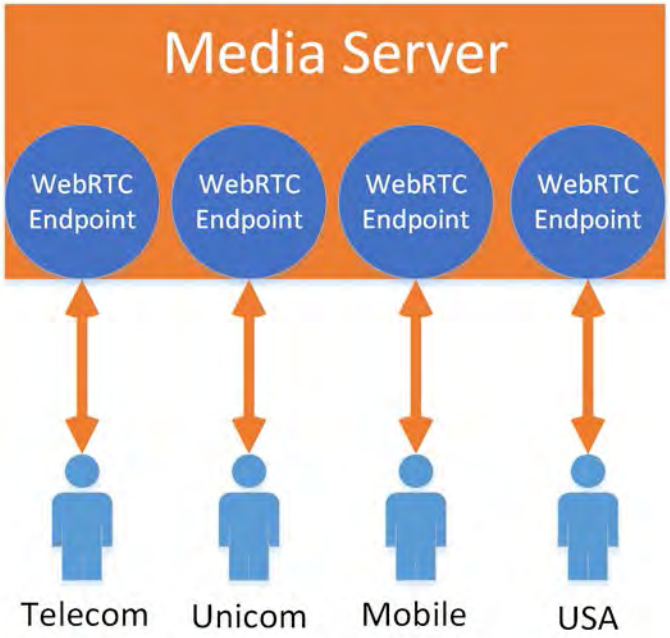
TMS

- OVERVIEW
  - Golang & C++
  - Docker
  - Consul & registrator



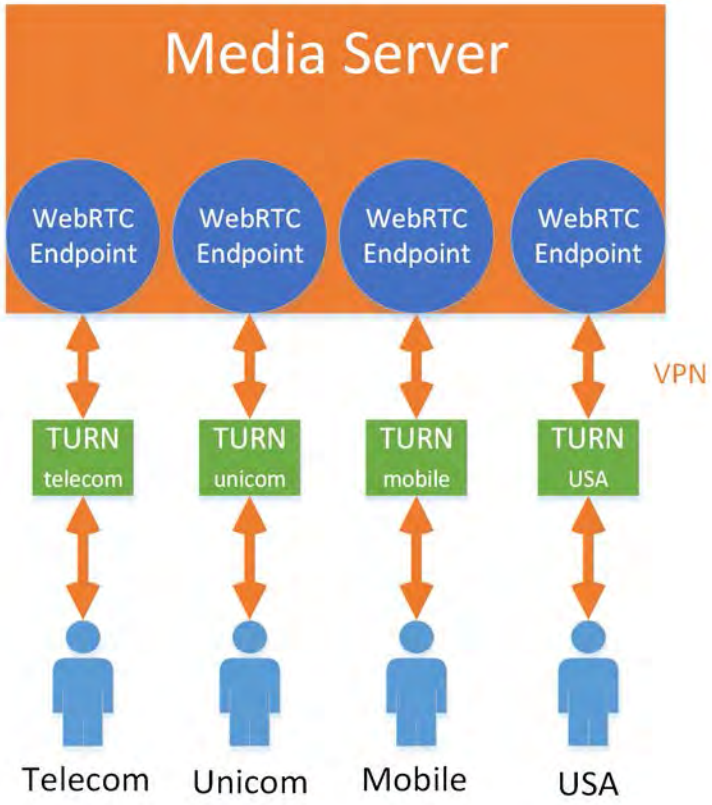
- KERNEL MODULES
  - WebRTC protocol
  - SFU = tsfu + tgates
  - WebRTC->RTMP

Various networks



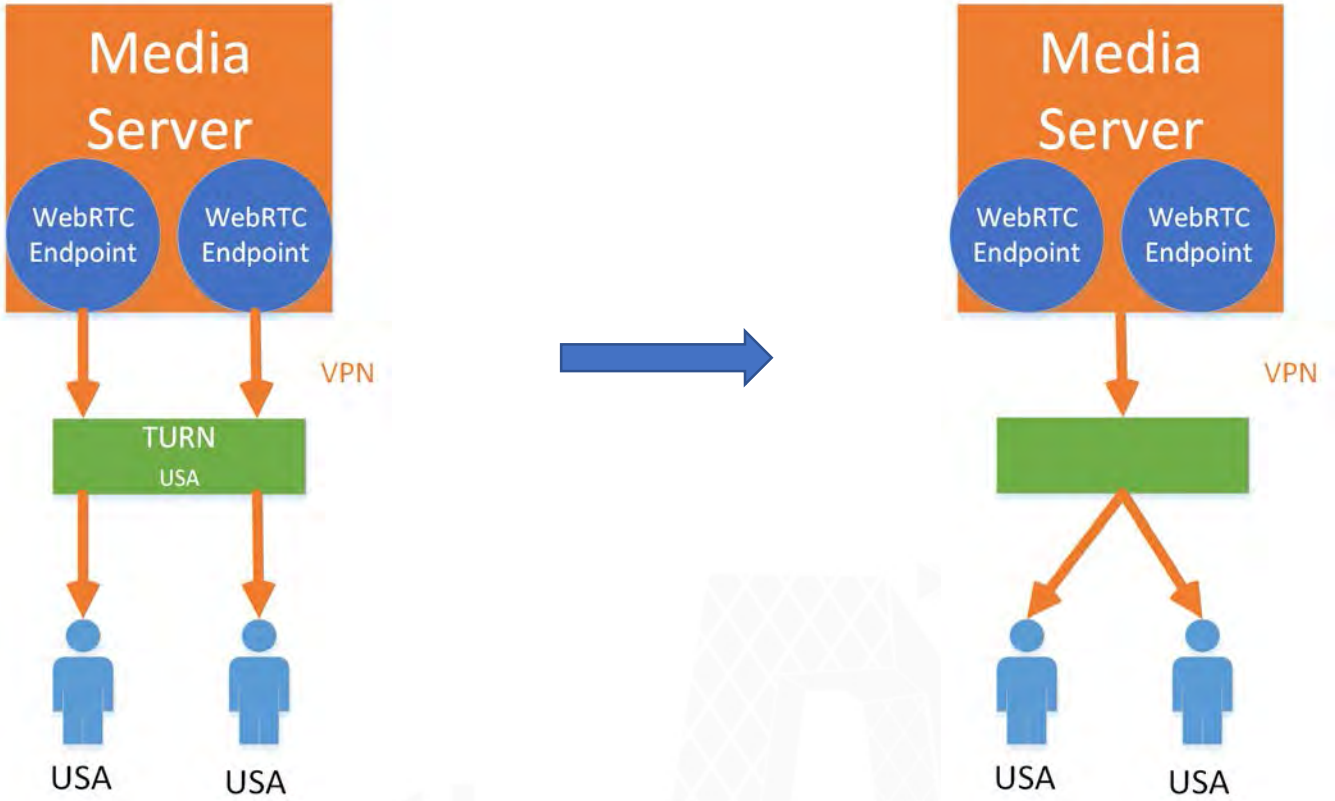
如何覆盖不同用户的各种网络类型?

TURN as edge

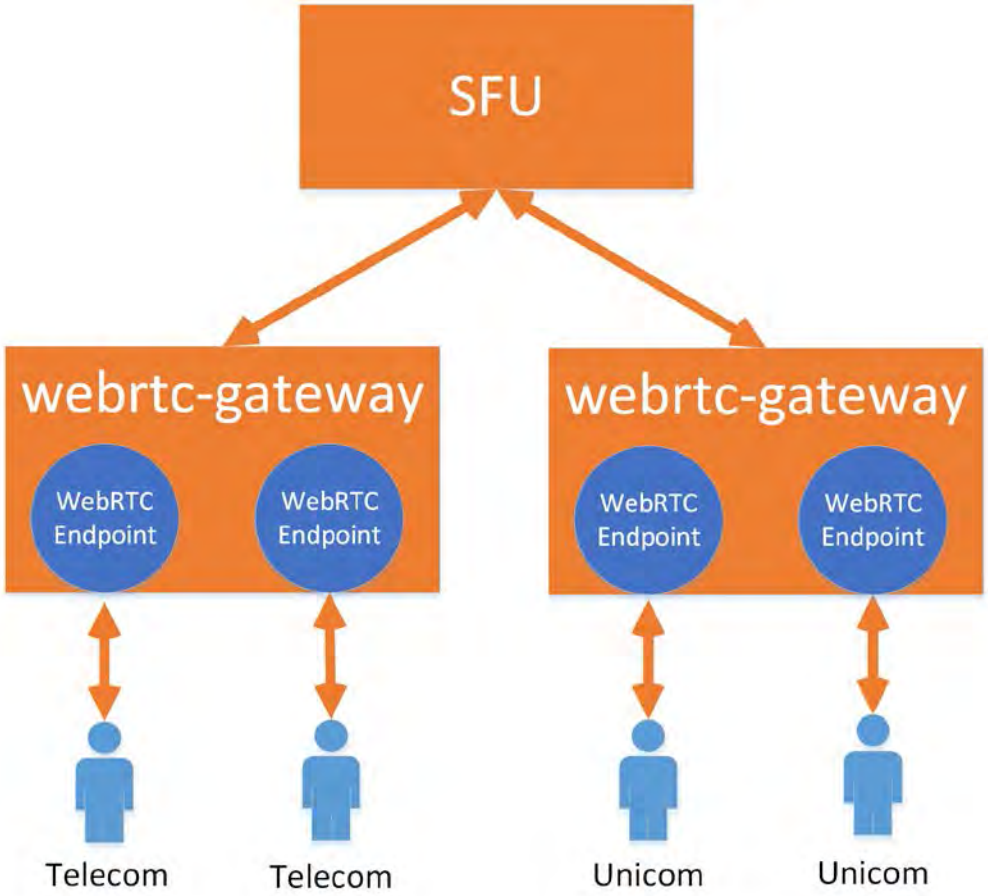


Cons

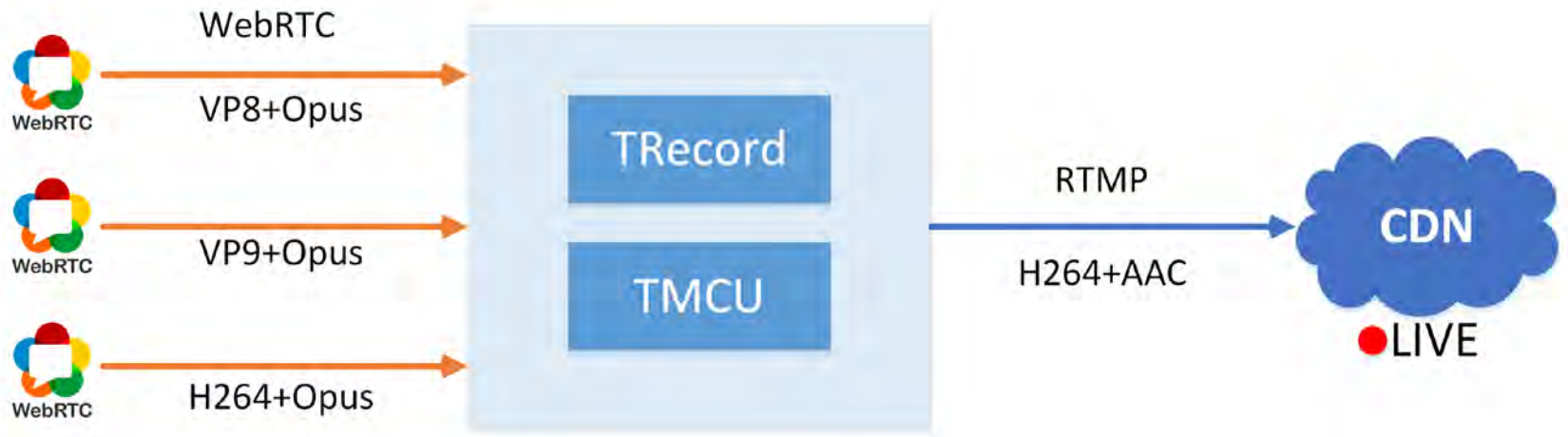
- MediaServer->TURN的流量冗余
- 房间人数受限（单台机器支持的WebRTC连接有限）
- 网络连接、业务逻辑、媒体转码都集中在一台服务上



WebRTC-Gateway



WebRTC->RTMP



- Jitter buffer: reorder, jitter
- Timestamp: lip-sync

Dashboard


TM_Plus | System Overview
System Uptime
8.3 weeks
Virtual CPUs
32
RAM
62.80 GiB
Memory Available
94%
CPU Usage
Load Average
Memory
Memory Distribution
Forks
Processes
Docker Dashboard
Memory usage
CPU usage
Filesystem usage
18%
0.12%
0.95%
Container CPU usage
Container Memory Usage
Container Network Input
Container Network Output
Mark: 100
Transfer
00:56
00:56
912345
912345
912345
912345
Apple Wu
I still can't hear anything.
Madison Perkins
try to get some help from IT.
您好，请问目前上课状况是否正常呢?
Keytar McSweeney's Williamsburg, readymade leggings try-hard 90's street art letterpress hoodie occupy Wes Anderson Banksy.
发送

TMS features

- Distributed SFU
- High performance (CPU reduced up to 60-70% compared to KMS)
- Supports deployment under public cloud, private cloud or hybrid cloud.
- Covering varying networks of users.
- Supports bypass live using RTMP/HLS.
- P2P for 1v1/small class, SFU for middle/big class, RTMP/HLS for super big class.

Thank You

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