

Network Aware 5G Cloud Interactive Service **----Cloud Gaming**

Tencent Future Network Lab

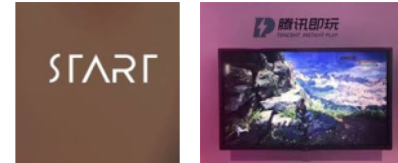
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Industrial Background



- Tencent Cloud Gaming

- Tencent Instant Play and Tencent START



- Already started the Collaboration with three Chinese Operators to provide cloud gaming services

- SonyPlayStationNow



- <https://www.trustedreviews.com/opinion/what-is-playstation-now-a-guide-to-sony-s-streaming-service-2920562>

- Microsoft xCloud



- <https://blogs.microsoft.com/blog/2018/10/08/project-xcloud-gaming-with-you-at-the-center/>

- Liquidsky iCDN

- <https://enterprise.liquidsky.com/technology.html>

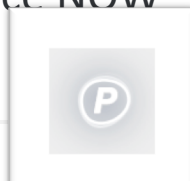
- Google Cloud



- nVIDIA GeForce NOW



- PaperSpace



Advantages of Cloud Gaming



- Quick start & less local installation
 - No need to download gaming software for installation thus saving the time to start, time spend include both the download and installation time
- Less CPU power required for rendering
 - No need to perform rendering with high-end processors
- More device availability
 - Game can be played in most devices even without high end processors
 - Seamless switch
- Less Piracy
 - Games are played on or rely on cloud servers

Cloud Gaming v.s. Traditional Application



Cloud Gaming vs. Traditional Gaming

- Volume
 - 30Mbps vs. 300kbps
- User Client
 - Any equipment with decoder vs. Need expensive GPU
- Technical
 - I,P frame vs. Operation instruction

Cloud Gaming vs. Live streaming and video conference

- Client Side
 - No buffer or very small buffer vs. 2-8 seconds buffer
- Delay Tolerance
 - Sensitive <100ms mostly vs. Several seconds

Interactive service is regarded as a potential killer application in 5G

Tencent at SA2 5G—Cloud Gaming 5G-AIS

SA WG2 Meeting #133

S2-1906833

May 13 – May 17, 2019, Reno, USA

(e-mail revision 3 of S2-1906718)

Source: Tencent, China Telecom, China Mobile, China Unicom, OPPO, ZTE, Samsung, Xiaomi, Broadcom, vivo, AT&T, KT, Verizon UK LTD, Huawei, Hisilicon

Title: New Work Item on 5G System Enhancement for Advanced Interactive Services

Document for: Approval

Agenda Item: 7.1

Abstract: New work item on 5G system enhancement for advanced interactive services

3GPP™ Work Item Description

For guidance, see [3GPP Working Procedures](#), article 39; and [3GPP TR 21.900](#). Comprehensive instructions can be found at <http://www.3gpp.org/Work-Items>

Title: 5G System Enhancement for Advanced Interactive Services

Acronym: 5G_AIS

Unique identifier: TBD

1 Impacts

Affects:	UICC apps	ME	AN	CN	Others (specify)
Yes		X	X	X	
No					
Don't know	X				X

2 Classification of the Work Item and linked work items

2.1 Primary classification

This work item is a ...

X	Feature
	Building Block
	Work Task
	Study Item

- TD S2-1905394 (WID NEW) New Work Item on 5G System Enhancements for Interactive Cloud Services. (Source: Tencent, China Telecom, China Mobile, China Unicom, OPPO, ZTE, Samsung, Xiaomi). (Revision of TD S2-1904560).

Document for: Approval.

Abstract: Revision of SID proposal in SA WG2#132, based on comments received, revised as a WID proposal focusing on QoS aspects corresponding to SA WG1 outcome.

Discussion and conclusion:

Revision of TD S2-1904560 from S2#132.

Plenary session:

- It was clarified that in creating this WID, the scope has been narrowed to meet comments previously made on the proposal. Qualcomm commented that the numbers should be removed from the justification as KPIs are still under discussion in SA WG1 and SA WG4. AT&T asked whether this was related to interactive services or specifically cloud-based services. Ericsson asked why a separate WID is considered needed as this could be included in the existing work. Intel asked why Bit rate is included here. It was explained that this is in response to SA WG4 requests. Other issues were raised and This was left for off-line discussion and revised in TD S2-1906507. Further issues were raised and this was left for off-line discussion and revised in TD S2-1906718. This was left for e-mail approval.

e-mail approval comments:

- Shabnam provides rev1. Shabnam provides rev2 small correction. Lei OK. Laeyoung provides rev3. Lei OK with rev3. e-mail revision 3 agreed. Revised to TD S2-1906833. **Approved.**

Cloud Gaming with Tencent MEC

Present

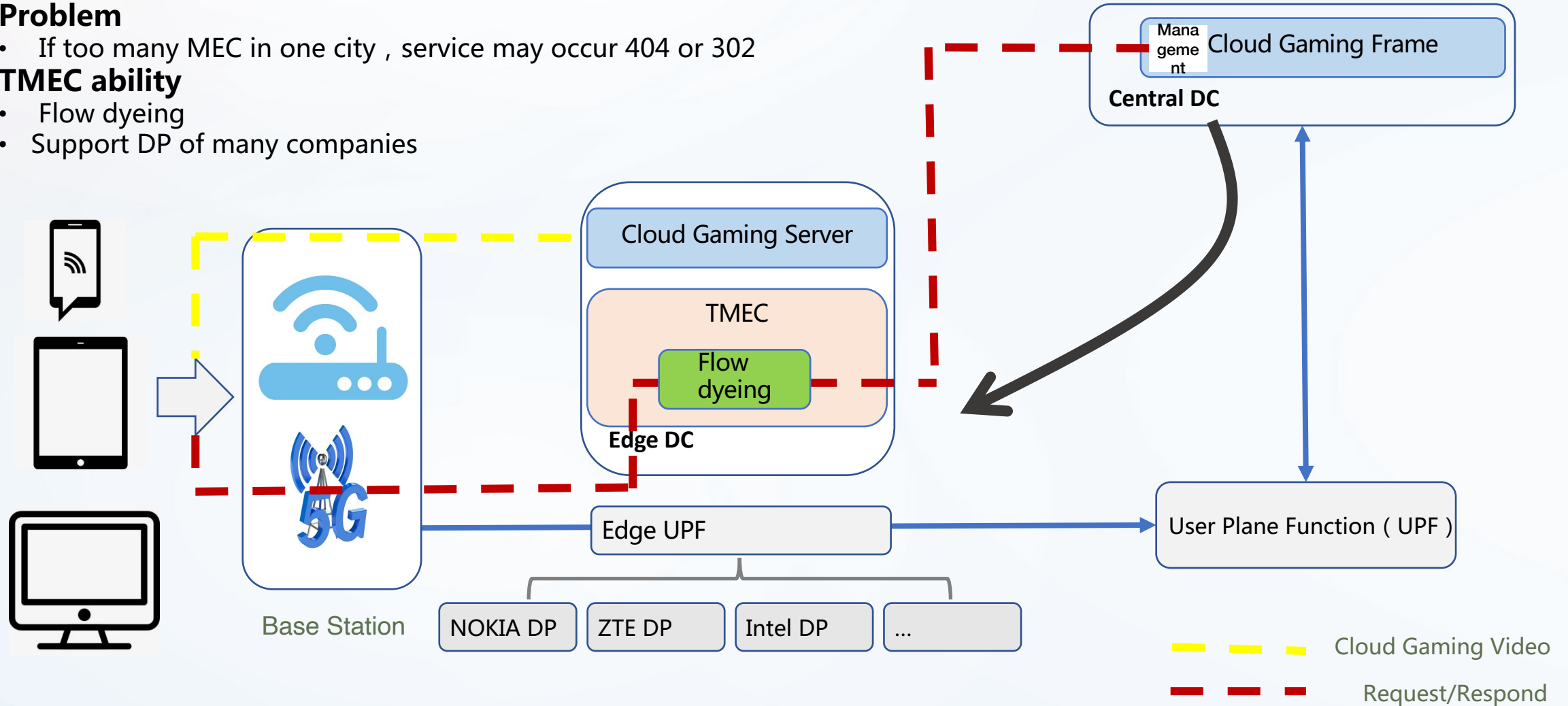
- Resource Allocation in Cloud Gaming are based on IP, which can only show the city level.

Problem

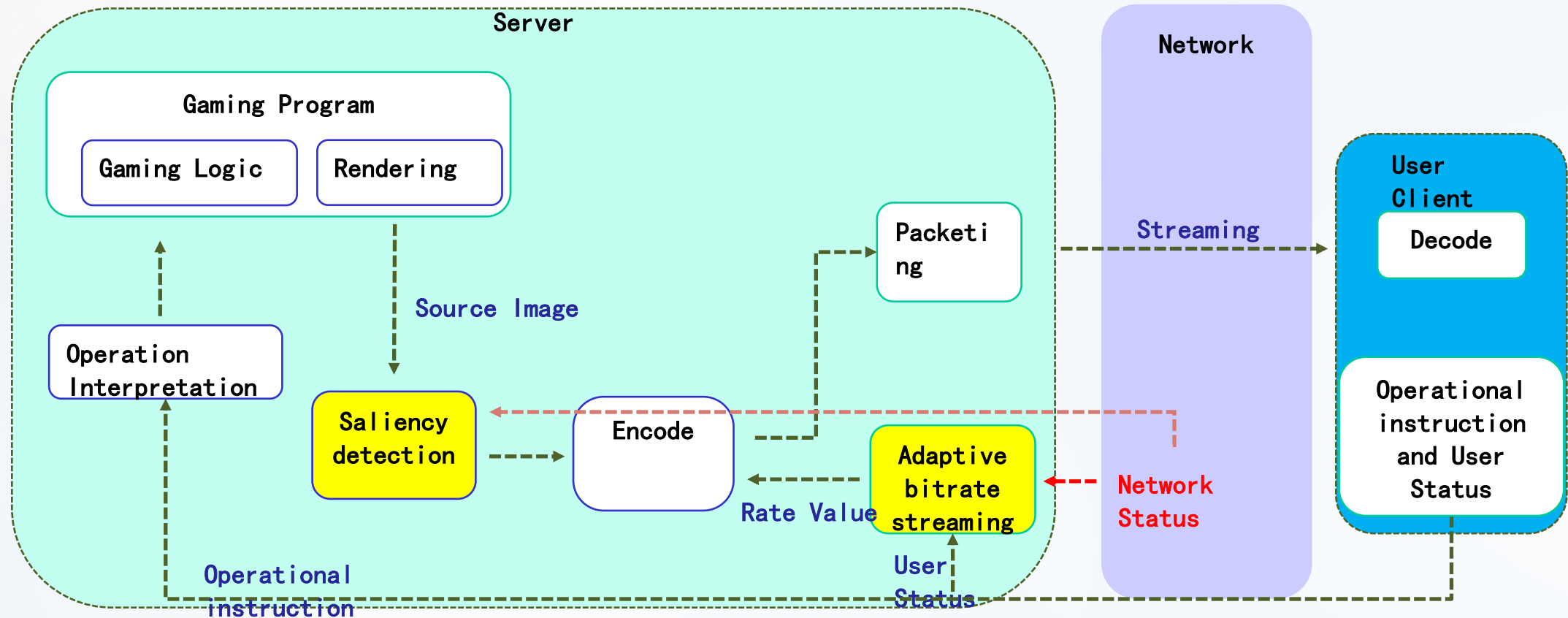
- If too many MEC in one city , service may occur 404 or 302

TMEC ability

- Flow dyeing
- Support DP of many companies



Cloud Gaming System



Saliency Detection and Video Compression

Problem:

Huge Video Size vs. Limited Bandwidth  Delay and Jitter

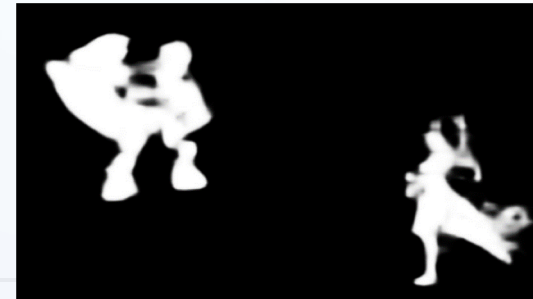
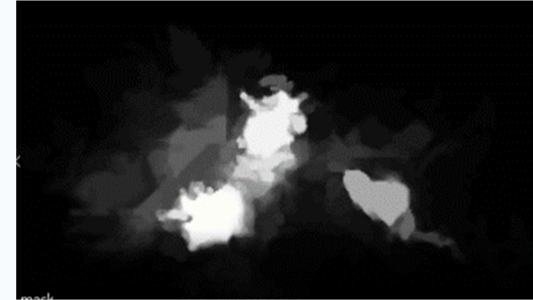
High Quality and High Delay  Low Quality and Low delay

Saliency Detection :

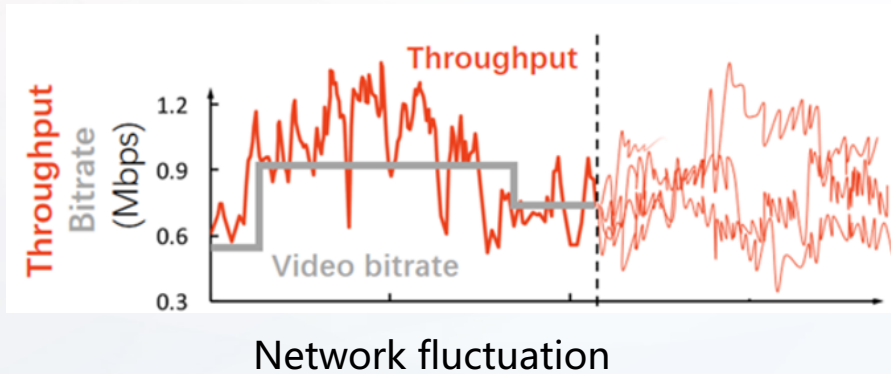
- 1 Find the region of Interest
- 2 Saving bandwidth without harming users ' experience
- 3 Reducing peak bitrate

Our Work:

- 1 Increase the detection accuracy → Saving about 30% bandwidth under same QoE
 - 2 Reduce detection speed → only **10ms-30ms**
 - 3 Changing algorithms and rate allocation (in one frame) **based on the network status**
- Balance between detection delay and detection accuracy



Adaptive Bitrate Streaming



High rate may cause delay
Low rate may harm the quality of experience

Most users are in wireless network (60% ↑ keep increasing)

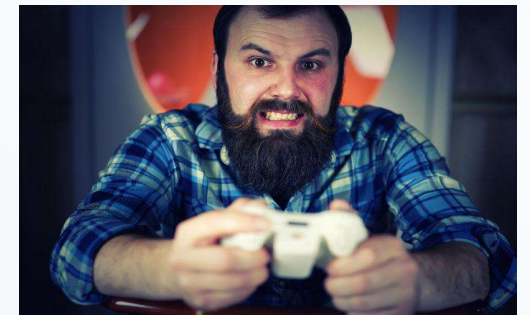
To avoid large delay and guarantee quality: Video rates need to change with the network

Traditional Methods :

- Reaction lag
- Difficult on Trade off between Rate and Delay
- Rely on **Client Buffer**



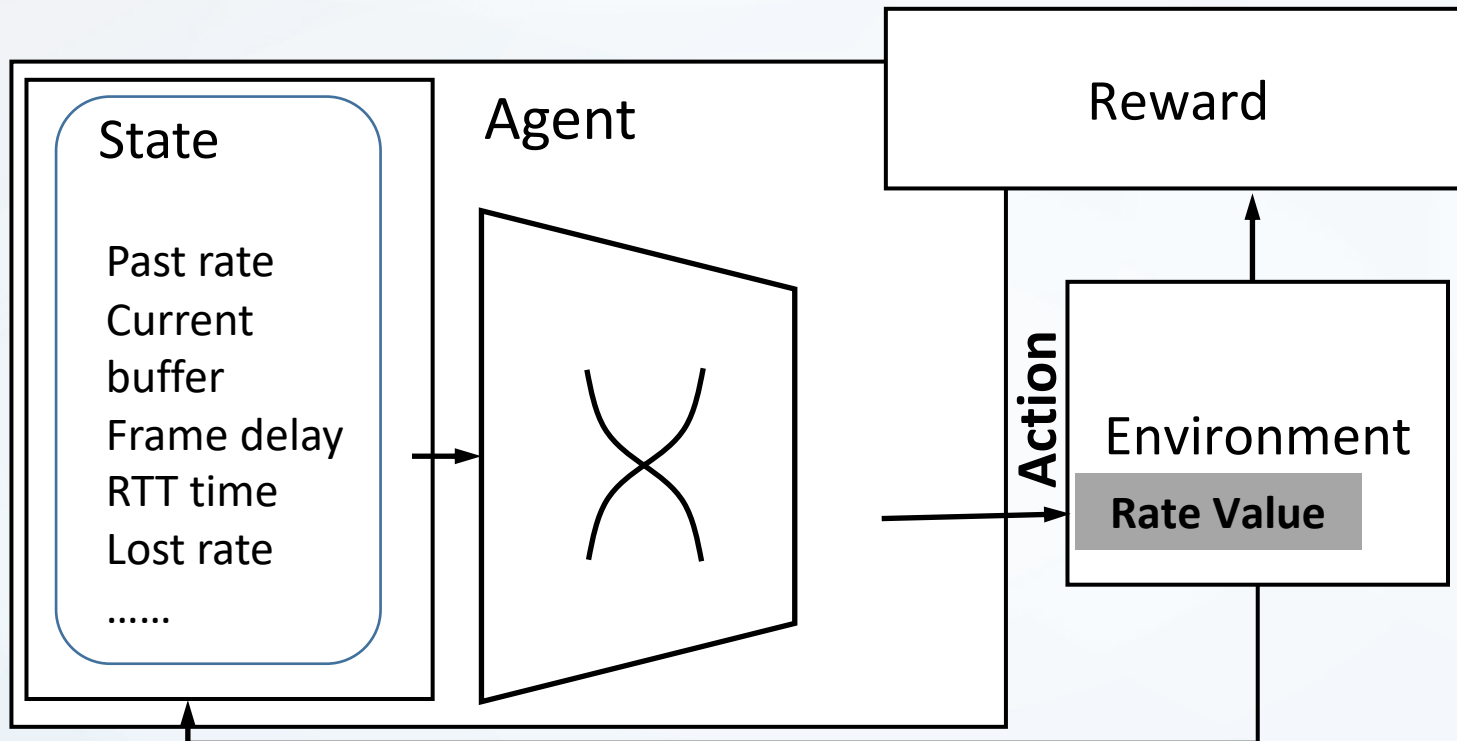
Not applicable to
cloud gaming



Adaptive Bitrate Streaming

Our Work:

- **AI-based method (RL) to improve accuracy in cloud gaming environment**
- **ABR on Delay Sensitive Scenario (Without Buffer)**
- **Collecting Network Information (both from user client and server) to predict the best video rate**



	Traditional	AI-based
Bandwidth	25M+ (PC) 10M (Mobile)	15M-20M (PC) <8M (Mobile)
delay > 200ms	Once every 2 minute	Once every 4 minute
Score (Dealy+rate+ switch frequency)	1700+	2800+ (much higher)

Network Aware Application

Data Source: Client side; Server side; Network side

Goal: Predict the change of network; balance between delay and rate

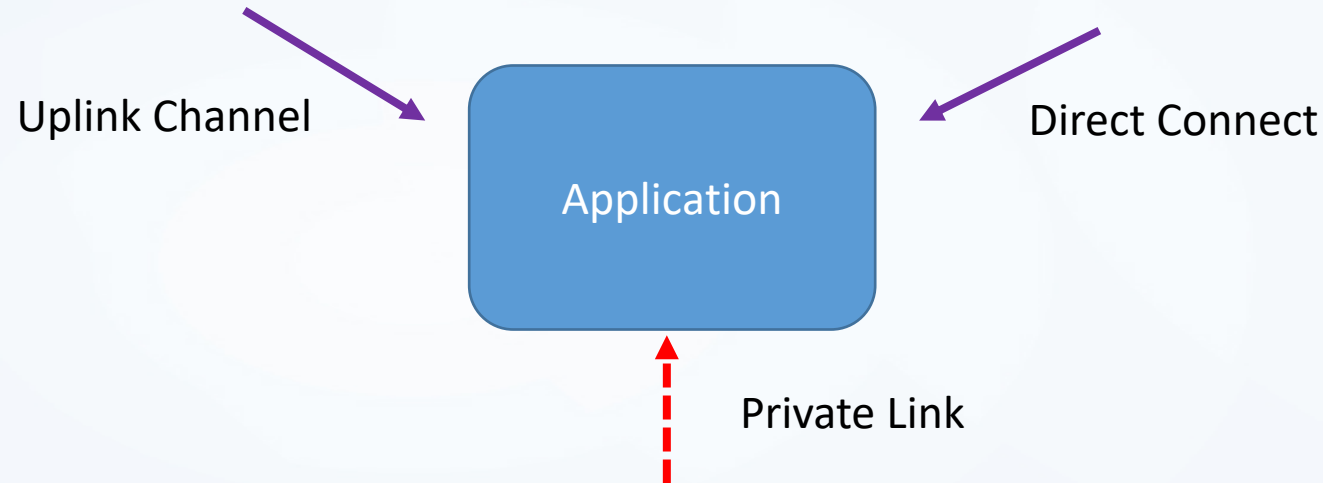
Future: Need more kinds of information which can reflect the network status (from operator and MEC)

Network Capability Exposure :

- More information type reflect network status to help Reinforcement Learning → predict network performance
- More frequency and more precise to help increase accuracy → to millisecond level and user level

Client Information (frame delay,
buffer status)

Server Information (RTT time ,
video rate, frame rate, frame size...)



Network Information (loss rate, cell load,
mobile position information...)

Thank you !

5G network slicing for Cloud Gaming

- 1 Enhancing the experience of cloud gaming, reduce latency
- 2 Provide classified protection to users according to the different needs

3 slicing modes

- Mobile number
- application
- position

