

Rel-18 SA2 SID on QoS Enhancements for High Data Rate and Low Latency (HDRLL) Services

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- HDRLL means high data rate and low latency already specified in TS 22.261 per SA1 NCIS work item.
- HDRLL services have requirements on **both high data rate & low latency** among which cloud gaming is a typical example.
- Game contest, Tele-operated driving and real-time Digital Twin network also relies on HDRLL technologies.
- *While people are still seeking 5G killer applications compared with 4G, HDRLL services has demonstrated strong motivation for 5G evolution.*



Cloud Gaming



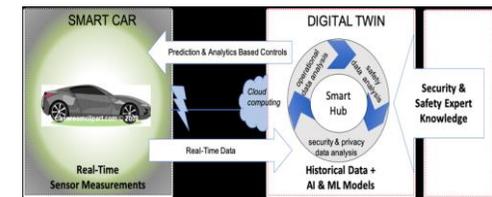
Cloud AR/VR



Live Streaming



Tele-operated Driving



Realtime Digital Twin

<https://www.gsma.com/futurenetworks/wiki/cloud-ar-vr-whitepaper/>

<https://www.epiphany.com/blog/live-streaming-events/>

<https://webarchiv.typo3.tum.de/TUM/visiom/en/forschungsfelder/teleoperated-driving/index.html>

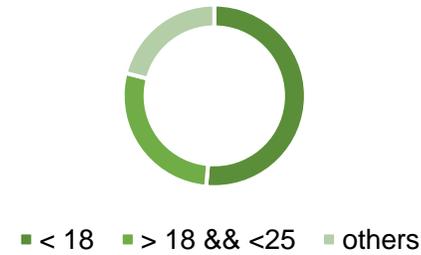
https://www.researchgate.net/figure/The-Digital-Twin-role-for-security-and-safety-validation-of-AD_fig2_335699194

Global Rollout of Cloud Gaming as an HDRLL services

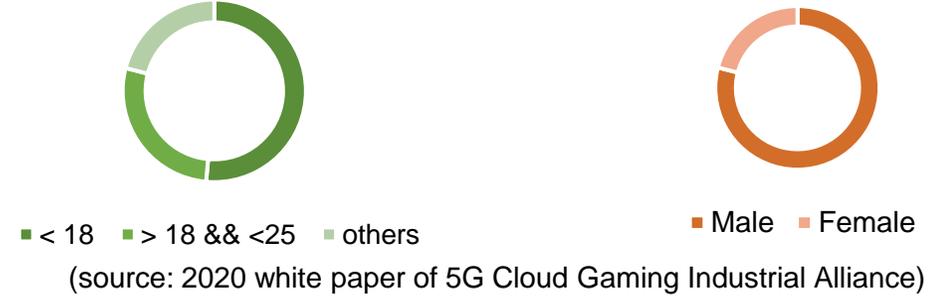
- Cloud gaming user # reaches **163 million** and market scale increase from **580 million RMB @2019** to **3260 million RMB @2020**,
(source: 2020 white paper of 5G Cloud Gaming Industrial Alliance)

- By 2023, more than **2100 million** smart phone users (with 42.5% as 5G) which are potential cloud gaming users.
 - Tencent has provided 110+ games over three cloud gaming platforms.
 - # of games by other cloud gaming providers:
 - EA Play (80+)
 - UBISOSFT(100+)
 - GAMEPASS(100+)
 - STADIA(100)
 - luna(70)
 - PlayStation Now (700+)
- (source: www.newzoo.com)

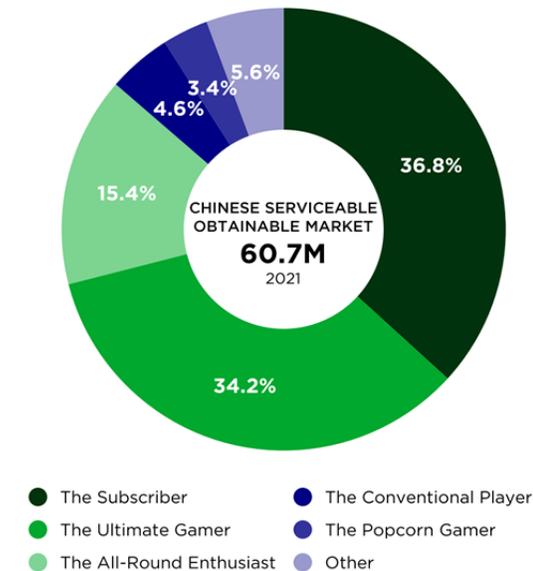
Cloud gaming user distribution by Age



Cloud gaming user distribution by gender



Chinese cloud gaming serviceable obtainable market* | 2021

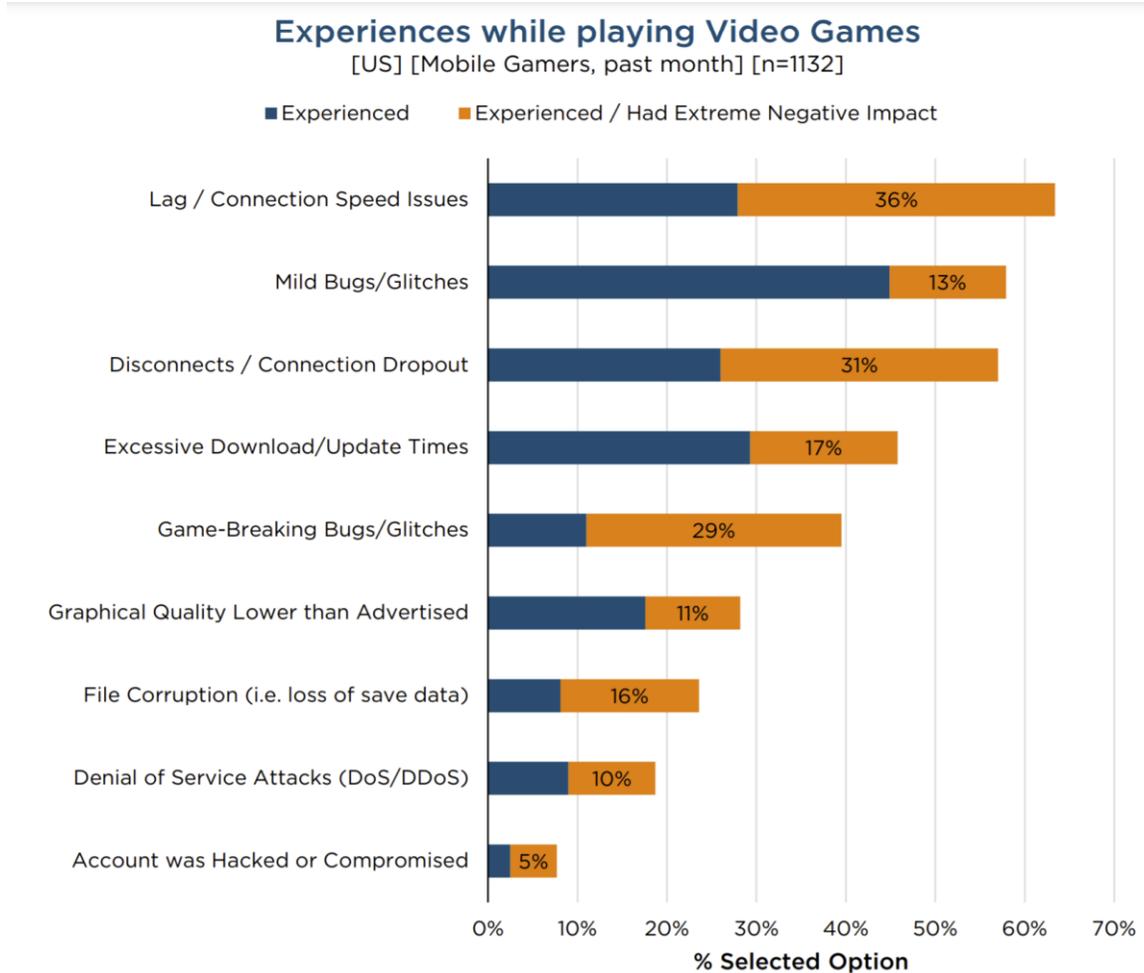


(Source: www.newzoo.com)

Operation & User Experiences Issues of HDRLL Services

- Lag and connection is a key reason impacts experiences of video games

- Picture and voice frozen as well as jump pictures still cause pain to high end users



Cloud Gaming/AR/VR



Video Conference



Game Contest



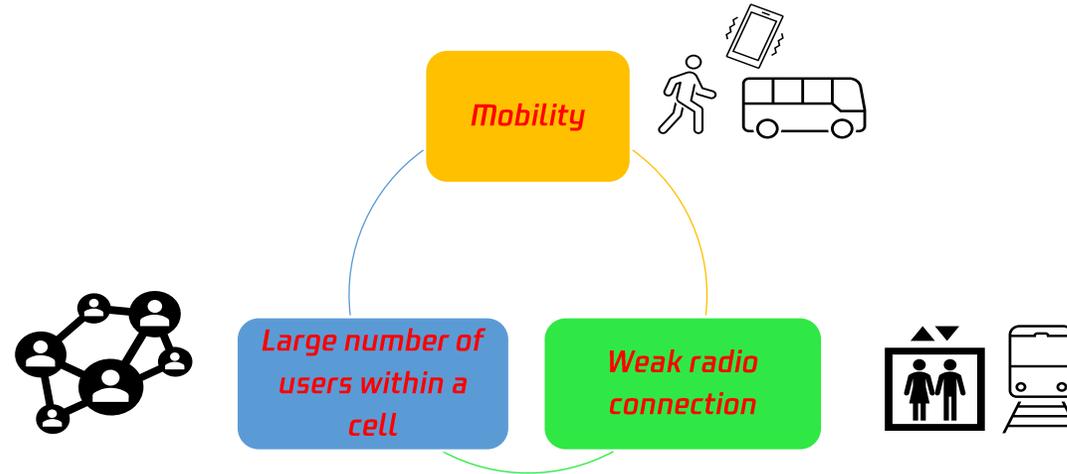
Live Show



- Adequate remote video quality plus real-time delivery of driving command are still challenge for ToD as a HDRLL service.



- **Three major problems** impacting user experiences of HDRLL observed by Tencent

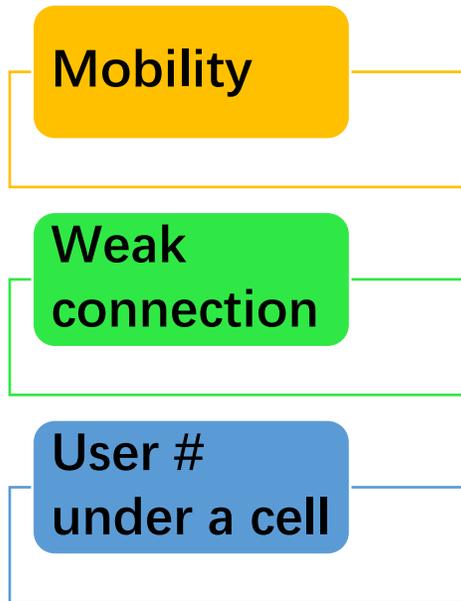


- **Important but Limited** Work are done in pre-Rel-18 so far
 - The GBR QoS Flow and Guaranteed Bit Rate are used to guarantee the QoS requirements, QNC and AQP mechanisms are introduced in Rel-15/16.
 - New 5QI(s) to be defined in Rel-17 for the HDRLL with 5G_AIS in order to satisfy QoS requirements of the HDRLL services. QoS parameters e.g. periodicity conveyed to RAN reusing TSCAI per IIoT work item.
 - However, as an ISP & Game/Video/Cloud/... service provider, we believe these mechanisms are still not sufficient for HDRLL services to handle the very high data rate under network dynamics related to the three problems mentioned above.

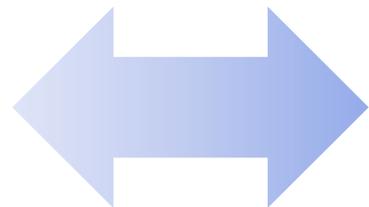


- We propose SA2 to have further study in Rel-18 to enhance 5G system to accommodate QoS requirements of various HDRLL services including cloud gaming, game contest, tele-operated driving etc.

Major problems



Four potential issues & technical direction for enhancement



#1. Data rate fluctuation

#2. AF Unawareness of Congestion

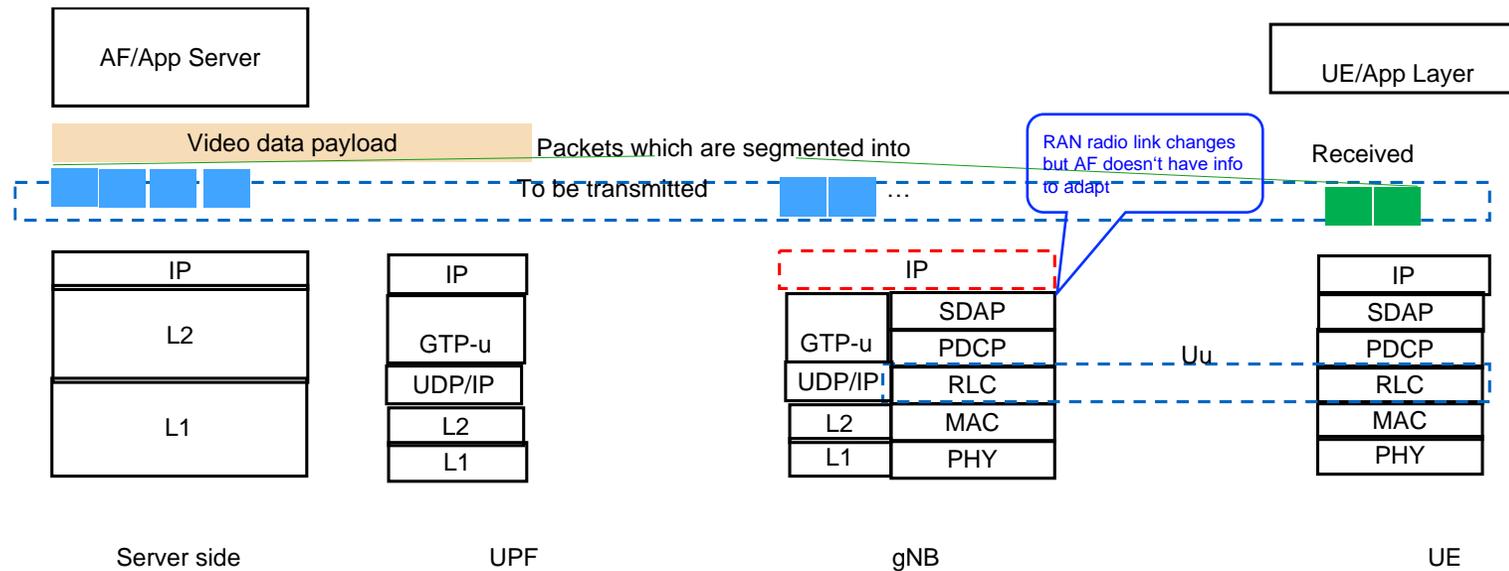
#3. Ineligible packet drop

#4. Jitter



#1. Data Rate Fluctuation

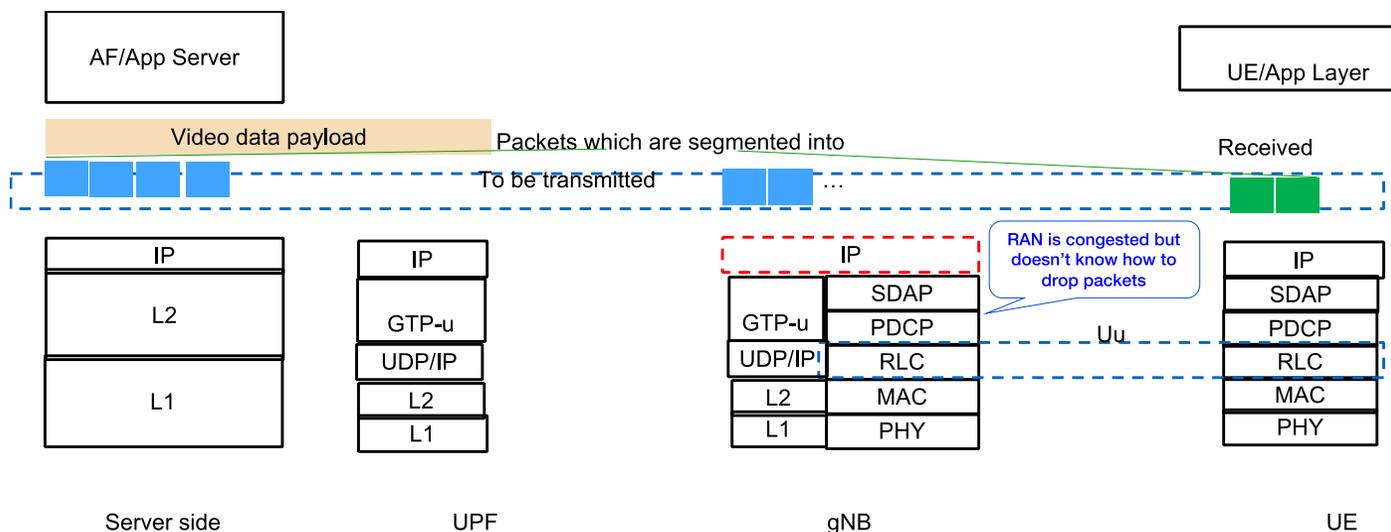
- HDRLL services e.g. cloud gaming are characterized by heavy burst high peak-to-average ratio in terms of data rate. AF may have capability to adjust the data rate in a big range which bring a good chance for adaptation.
- However, The AF may have limited capability to detect and predict the quick data rate change of 5G network, thus the AF can not quickly adjust its codec with the quick data rate fluctuation.



=> SA2 needs to investigate to whether and how 5GS expose the network information to AF to support quick fluctuation of HDRLL data rate

#2. AF Unawareness of Congestion

- If radio link capacity is degraded and HDRLL AF continues to send data in high rate, there is user data congestion in the RAN and RAN may drop packet(s) during the congestion state.
- Lacking of timely and early notification from 5G network, AF may not have real-time assistance information to adjust the codec and rendering parameters to help the 5GS quickly recover to normal state from congestion state for the HDRLL service.

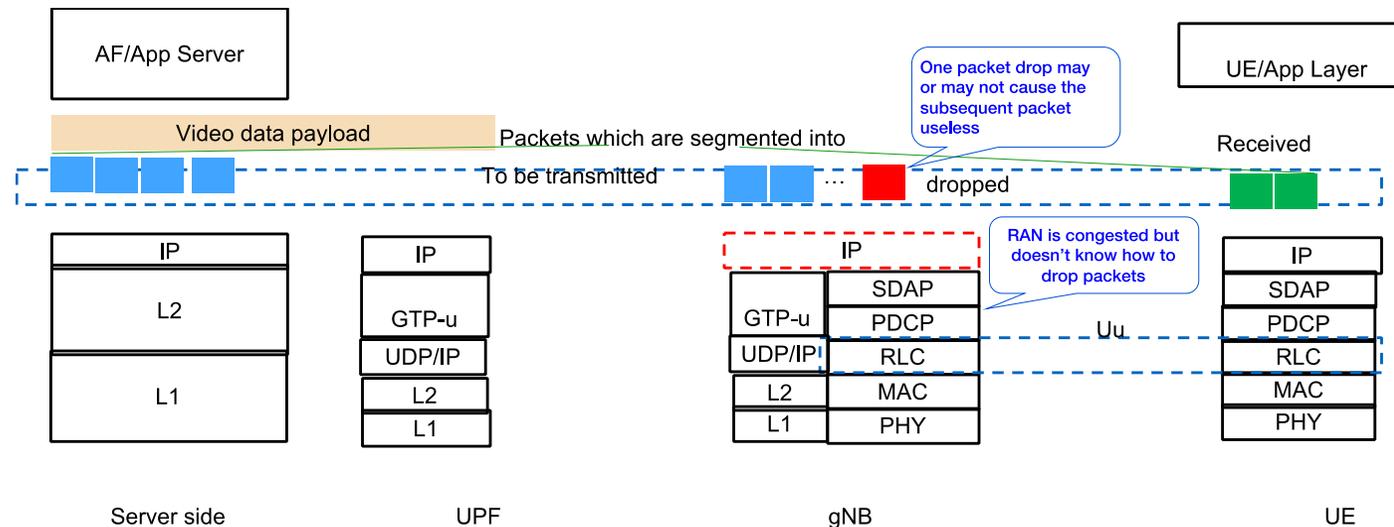


=> SA2 needs to investigate the QoS enhancement to enable AF to help the 5GS quickly recover from congestion for the HDRLL service.



#3. Ineligible Packet Drop

- If there is data congestion in the RAN, and if the RAN decides to drop IP packet(s) during the congestion state, the RAN may not have an eligible way to drop the least important packets because the 5GC did not convey such information to the RAN.
- For a sequence of IP packets which are related to each other which needs to be received together by the receiver side, if one packet is dropped, those subsequent packets becomes useless, while transmitting of such packets will still occupy wired and wireless radio resources.



=> SA2 needs to investigate the how to enhance packet drop mechanism to tackle congestion, reduce resource wasting & useless packets.



#4. Jitter

- Jitter is very important service characteristics for HDRLL services.
- Jitter brings challenges to render processing for cloud gaming and also latency compensation in game contest, the less the jitter, the easier for application layer to perform user experience optimization.

=> SA2 needs investigate QoS enhancement to decrease the jitter for the HDRLL services.

- A new SID is needed to study potential QoS enhancements for HDRLL services in SA2 with the purpose to
 - To minimize the impact of data rate fluctuation [2 TU]
 - To support quick recover from the congestion [2 TU]
 - To support eligible drop packet, reduce resource wasting and useless packets [3 TU]
 - To decrease the jitter for the HDRLL services [4 TU]
 - Policy to support the QoS enhancements [1 TU]



Thanks!