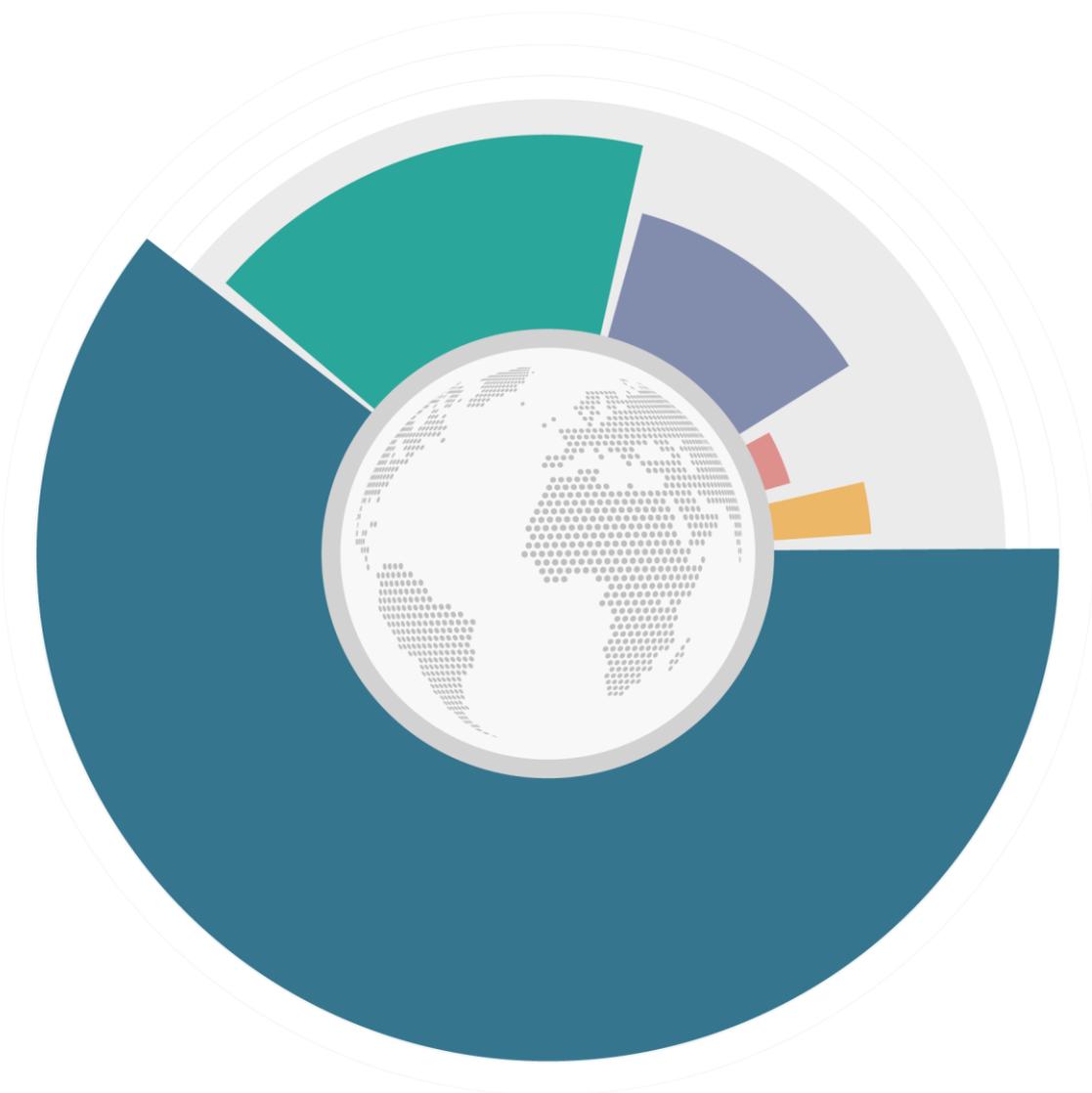


# Video Big Data

## The Top 10 Most Demanding Videos on the Net



Huawei iLab Video Gene Big Data Team

# Contents



## CONTENTS

01

Top 10 Most Demanding Videos on the Net

02

Top 10 Most Demanding 4K Videos on the Net

03

Top 10 Most Demanding 1080p Videos on the Net

04

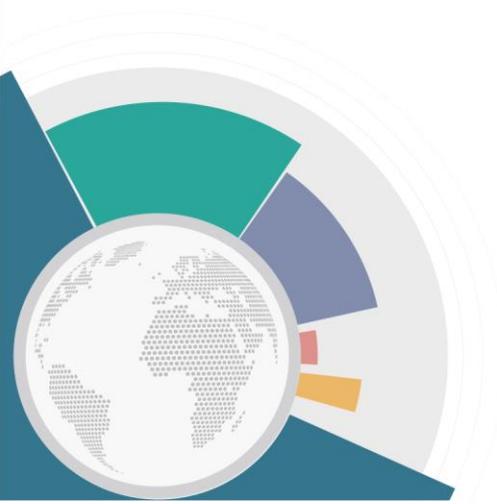
Top 10 Most Demanding 720p Videos on the Net

05

Conclusion and Future Prospects

06

Appendix: Data Sources and Definition



# 「Introduction」

Recently, **Huawei iLab video gene big data team** completed the gene-sequencing analysis of **200,000** videos from across six mainstream Chinese and international video platforms, namely YouTube, Netflix, Le.com, iQiyi, Youku, and Tencent. Video bandwidth was the first big data gene collected by the team. Using big data analysis of the video bandwidth gene, Huawei iLab began releasing the "Video Big Data" series of big video data analysis reports from 2017. This document is the first in that series, "The Top 10 Most Demanding Videos on the Net", which looks at which current over-the-top (OTT) videos have the highest network requirements by examining their bite rate, frame rate, resolution, and bandwidth requirements.

## Key Discoveries

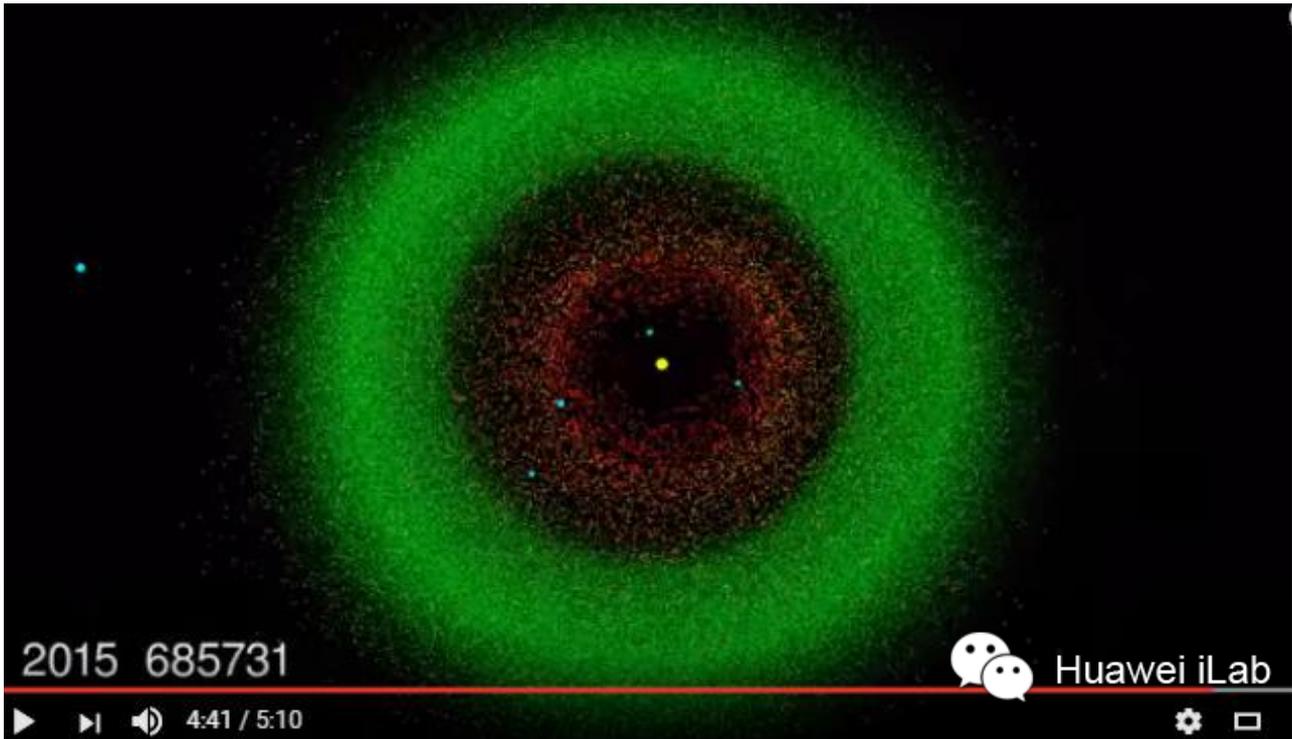
1. All of the top 10 videos with the highest network bandwidth requirements are relatively short videos hosted on YouTube, with eight of them being 8K videos and two of them 4K.
2. Whether video playback is smooth depends on the following three factors: average bit rate and bit rate burst size; the video transmission, playback, and buffering mechanisms of the OTT player; and whether a user is skipping through the video.
3. The peak bandwidth requirement of the number one 8K video during periods of burst bit rate is over 200 Mbit/s. 8K is still in the early stages of development, and so as frame rates and color depth increases it is expected that requirements will reach over 300 Mbit/s for 8K videos. (bandwidth requirements hereinafter refers to burst bandwidth requirements)
4. The bite rate bandwidth requirement of the number one 4K video is over 100 Mbit/s. Bandwidths of 50 Mbit/s can provide experience assurance for common 4K, but bandwidths of 100 Mbit/s are required for ultra 4K.
5. There are no 8K videos on Chinese OTT video platforms yet, and the 4K videos that these platforms offer are only "pseudo" 4K. The top 10 4K videos within China have an average bit rate of around 5.3 Mbit/s, which is below the entry-level criteria for 4K. The top 10 4K videos on YouTube have an average bit rate of 29.1 Mbit/s, showing that Chinese OTT platforms have a long way to go to catch up with their international counterparts.
6. Chinese OTT 1080p and 720p videos have low bit rates, but their bandwidth requirements are higher than equivalent OTT videos from outside of China. The bandwidth requirement of the most demanding 1080p video in China is 20 Mbit/s, while that of the most demanding 720p video in China is 10 Mbit/s. The bandwidth requirement of the most demanding 1080p video outside of China is 50 Mbit/s, while that of the most demanding 720p video outside of China is 25 Mbit/s.
7. The top 10 videos include three 8K VR and two 8K high dynamic range (HDR) videos. The top 10 4K videos include three gaming videos that feature a frame rate of 60 fps. With the rapid development of the VR industry, of HDR gaming and technology, and of live sports streaming, network bandwidth requirements are skyrocketing.

# 1 Top 10 Most Demanding Videos on the Net

Rank	Video name	Content	Resolution	Bit rate (Mbps)	Length (s)	Frame rate (FPS)	Bandwidth requirement (Mbps)	Bandwidth /bit rate ratio	ICP
1	Asteroid Discovery - 1970-2015 - 8K resolution	Science	8K	81.0	310	30	206.9	2.6	YouTube
2	NORWAY 8K	Scenic	8K	81.1	213	30	196.9	2.4	YouTube
3	The Las Vegas Strip - 8K 3D 360 Degree Video	Scenic	8KVR	129.1	278	30	134.2	1.0	YouTube
4	Cars on a Roundabout - Leaving a Car Show, October 2015	Cars	4K	75.3	637	50	119	1.6	YouTube
5	8K [ULTRA-HD] 4320p VIDEO TEST	Scenic	8K HDR	63.0	62	30	84.3	1.3	YouTube
6	8K 4320P HDR] TOKYO HDR Time Lapse in 8K	Scenic	8K HDR	62.8	126	30	83.2	1.3	YouTube
7	360°, Angel Falls, Venezuela. Part I. Aerial 8K video	Scenic	8KVR	57.7	119	30	81.3	1.4	YouTube
8	Tigers Go For A Swim In 360!!	Scenic	8KVR	72.0	224	30	72.1	1.0	YouTube
9	"Henosis" (8K SHORT FILM)	Humanities	8K	40.6	211	24	71.1	1.8	YouTube
10	Asteroid Discovery - 1970-2015 – 4K resolution	Science	4K	34.1	310	30	70.2	2.1	YouTube

YouTube is the world's largest video platform. Therefore it should come as no surprise that **every one of the top 10 most demanding videos on the Internet are hosted on YouTube**, with eight of these being 8K videos and the remaining two being 4K videos. **The bandwidth requirement of the 8K video in first place is over 200 Mbit/s. With 8K technology still being in the early stages of development, it is expected that in future as frame rates and color depth increases, requirements will grow to reach 300 Mbit/s.**

- 1. First place:** an 8K recording of the discovery asteroids. An infrared telescope was used to scan the entire night sky, and more than 500,000 asteroids that posed a potential threat to Earth were recorded.



The asteroids appear deceptively close to one another in the video. In fact, even at the highest resolution each pixel represents a distance of about 311,000 miles. This is most likely why the video needed to be recorded at such a high resolution and bit rate. It is also worth mentioning that [the 4K resolution version of this same video also earned a place on the list, coming in at number 10](#), proving that this video really can claim to be the most demanding on the Internet.

2. **Second place:** a video of a Norwegian landscape. Norway's breathtakingly beautiful countryside is shown in the highest 8K resolution.



Interestingly, in the video's comments it became clear that people were using the video as a benchmark to test the speed and performance of their PCs.



**Downstream01** 1 个月前

The issue is bandwidth, not your hardware (unless you have a *real* potato).

回复 · 1 赞 1 评



**Zen Loda** 1 个月前

I just got my 100mbps docsis 3.0 installed and thats why im here to test it.

回复 · 1 赞 1 评

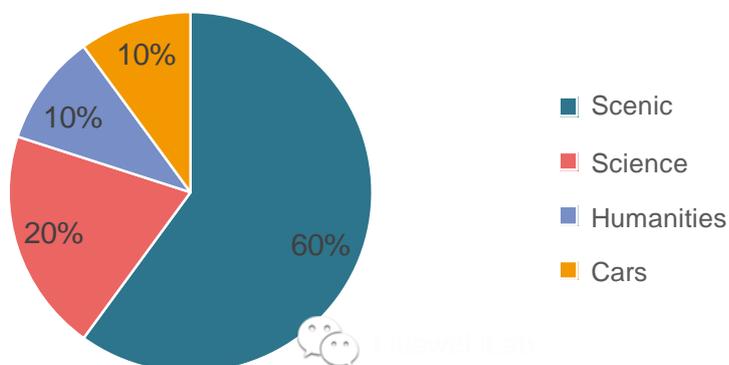
- Third place:** an 8K 3D VR video clip of a trip to Las Vegas. The video has a resolution of 7904x7904, as well as [an average bit rate of 129 Mbit/s](#), the highest of the videos in the top 10.



However, despite featuring the highest bit rate, the bandwidth requirements are significantly less than the videos in first and second place. Analysis showed that this is because it has a relatively even bit rate sequence, without any significant bursts in transmission. Therefore we can see that **when it comes to how much bandwidth a video requires, while average bit rate is very important, the bit rate sequence and burstiness are more important.**

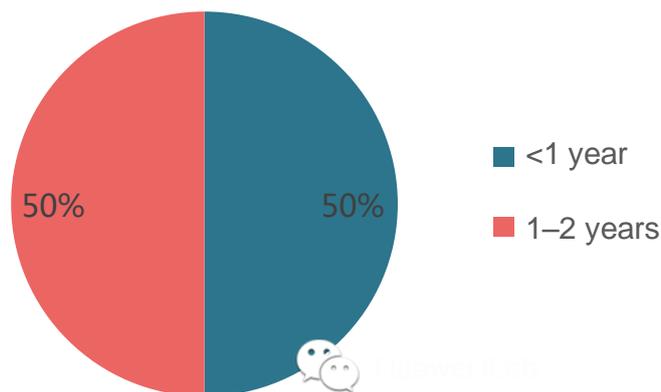
- Most are relatively short videos:** Of the 10 most demanding online videos, **nine are five minutes or less, the shortest is just one minute, and the longest is 10 minutes.** The videos are mostly of landscapes and scenery, but there are also videos about technology, humanities, and cars.

### Top 10 Video Content Distribution



5. **8K VR videos make up 30%:** Among the top 10 videos, features three 8K VR videos, occupying third, seventh, and eighth place positions, meaning that 8K VR videos account for 30% of the top 10. **8K VR videos are becoming a reality, and are already starting to put pressure on network bandwidth.** As it stands, 8K VR videos can only satisfy entry-level VR experience expectations. For a better experience, the future will include panoramic 16K or even resolutions of 24K or more, which will pose even higher requirements on network bandwidth.
6. **HDR provides a superior experience:** **Two of the top 10 videos are two HDR videos,** occupying fifth and sixth place positions. HDR provides a better visual experience while also improving the bit rate of the video.
7. **No video is older than two years:** Every entry in the list of top 10 most demanding videos on the net was **released within the last two years.** As time goes on, higher and higher quality videos will emerge, further increasing bandwidth pressure as they do.

### Top 10 Video Age Distribution



8. **When it comes to quality, there is still room for improvement.**
  - Frame rate: Almost all videos in the top 10 have **a frame rate of 30 fps or less.** Only one video on the list features a higher frame rate, the fourth place video about cars which boasts 50 fps.
  - Color depth: Every video **featured an 8-bit color depth.** No videos on the list supported a 10-bit wide color gamut (WCG).

## 2 Top 10 Most Demanding 4K Videos on the Net

### 2.1 The Top 10 4K Videos

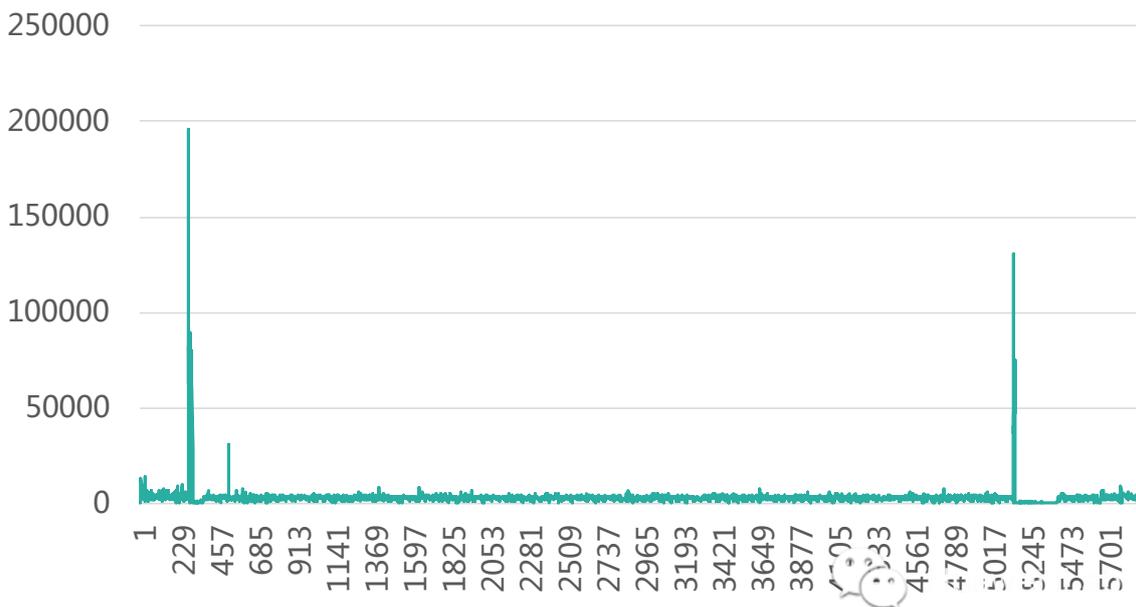
Rank	Video name	Content	Resolution	Bit rate (Mbps)	Length (s)	Frame rate (FPS)	Bandwidth requirement (Mbps)	Bandwidth /bit rate	ICP
1	Cars on a Roundabout - Leaving a Car Show, October 2015	Cars	4K	75.3	637	50	<b>119</b>	1.6	YouTube
2	Asteroid Discovery - 1970-2015 – 4K resolution	Science	4K	34.1	310	30	<b>70.2</b>	2.1	YouTube
3	别碰我闺蜜	Film	4K	3.17	5481	25	<b>56.9</b>	17.9	iQiyi
4	EDEN - drugs (VR Experience)	Entertainment	4K VR	13.5	297	30	<b>50.8</b>	3.8	YouTube
5	BATTLEFIELD 4 FPS ULTRA 200% SCALE   GTX 980 TI SLI   8K RESOLUTION	Gaming	4K	26.8	390	60	<b>42.1</b>	1.6	YouTube
6	I GOT A TRACTOR IN GHOST RECON WILDLANDS!	Gaming	4K	25	275	60	<b>38.9</b>	1.6	YouTube
7	Augmented - A 360 VR Action Experience (Ep. 1)	Humanities	4K VR	18.7	211	30	<b>37.2</b>	2.0	YouTube
8	Battle Test - A Nissan Rogue 360° VR Experience	Gaming	4K VR	31.6	166	60	<b>35.3</b>	1.1	YouTube
9	Rogue One: Recon - A Star Wars 360 Experience	Entertainment	4K VR	19.3	107	30	<b>34.7</b>	1.8	YouTube
10	If Elections Were Sports (360° VR Video)	Entertainment	4K VR	21.3	237	30	<b>33.6</b>	1.6	YouTube

- The videos are relatively short:** The top 10 most demanding 4K videos in terms of network requirements are all YouTube videos of under 10 minutes.
- First place:** a recording of various cars leaving a car club. The high quality was probably used in order to capture the close-up details of how these cars move. The 4K video featured **a 50 fps frame rate, a bit rate of 75 Mbit/s, and burst bandwidth requirements of 119 Mbit/s**. This video also reached fourth place on the preceding general top 10 list.



3. **Second place:** a 4K version of the aforementioned asteroid video. The 8K version came first in the preceding list, and so details of it will not be repeated here.
4. **Third place:** the only video on the list to be hosted on a Chinese OTT video platform. The average bit rate is only 3 Mbit/s, but the bandwidth requirement during burst **exceeds 50 Mbit/s**. By examining a waveform graph of the video's real-time bit rate, we can see that the bit rate reaches peaks of 200 Mbit/s, which is responsible for the high burst bandwidth requirements.

别碰我闺蜜 Real-Time Bit Rate



5. **50 Mbit/s bandwidth is enough for common 4K experiences, but ultra 4K requires 100 Mbit/s:** Of the top 10 most demanding 4K videos, six require less than 50 Mbit/s, and four require between 50 Mbit/s and 100 Mbit/s. This demonstrates that while 50 Mbit/s is enough to meet the common 4K experience requirements of current OTT platforms, for ultra 4K experiences 100 Mbit/s or more is required.
6. **VR videos account for half:** Five of the top 10 most demanding 4K videos are **VR videos**, reflecting the impact of VR on a video's bandwidth requirements.
7. **Average bit rate of over 20 Mbit/s:** The average bit rate of the top 10 most demanding 4K videos exceeds 20 Mbit/s, with most videos having a bit rate between 20 and 30 Mbit/s.
8. **High frame rate:** Four of the top 10 most demanding 4K videos have **frame rates of 50 or 60 fps**, while the remaining six have 30 fps. The videos with the highest frame rates are mostly of video games or car races. As the game and live sports streaming industries continue to develop, bandwidth requirements will increase in turn.
9. At the time of this document's release, data regarding Netflix's 4K video services has not been collected. The description on Netflix's official website states that 25 Mbit/s or more is needed to guarantee stable 4K playback using its service.

## 2.2 The Top 10 4K Videos in China

Rank	Video name	Content	Bit rate (Mbps)	Length (s)	Frame rate (FPS)	Bandwidth requirement (Mbps)	Bandwidth /bit rate	ICP
1	别碰我闺蜜	Movie	3.17	5481	25	56.9	17.9	iQiyi
2	寻找冥王星	4K VR	8.2	464	25	30.7	3.8	iQiyi
3	龙虎少年	Movie	4.3	4080	25	26.5	6.1	iQiyi
4	茉莉威龙	Movie	5.6	4897	25	24.8	4.4	iQiyi
5	奇怪的地	Movie	6.1	7467	24	23.1	3.8	iQiyi
6	魔兽	Movie	6.2	7409	24	23	3.7	iQiyi
7	深海X异种	Movie	5.5	3703	25	22.1	4.0	iQiyi
8	碟中谍5：神秘国度	Movie	5.2	7576	25	21.5	4.1	iQiyi
9	我的少女时代	Movie	5.3	7996	24	21	4.0	iQiyi
10	湄公河行动	Movie	3.5	7428	24	20.7	5.9	iQiyi

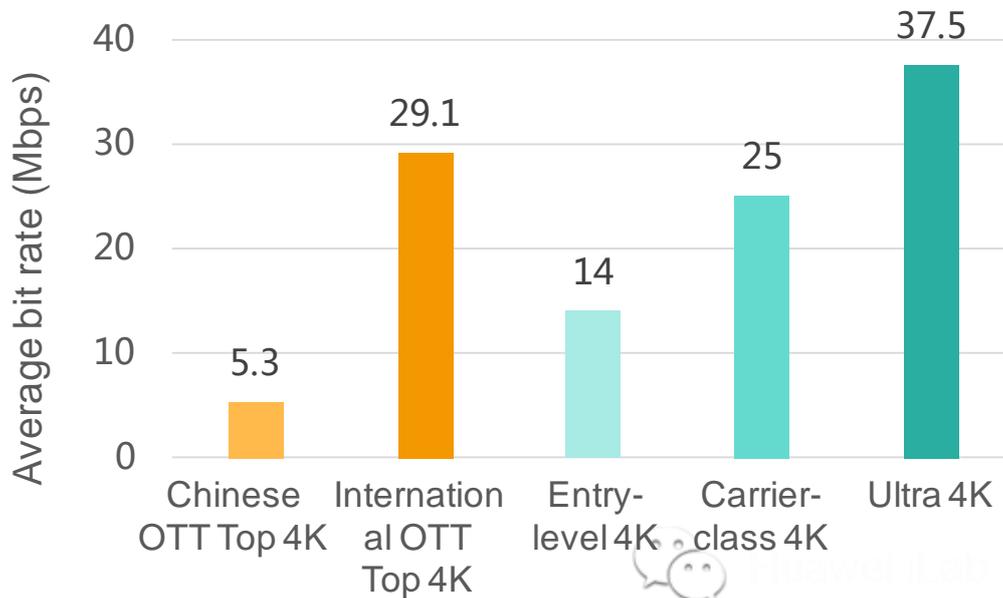
- 1. Full movies on iQiyi:** The Top 10 most demanding 4K videos in China are all hosted on the iQiyi platform (at the time of this document's release, data regarding Le.com's 4K video services has not been collected). Most of these videos are movies with a duration of over an hour, with only a single one being a short VR video.
- 2. "Pseudo" 4K:** Whether in terms of bit rate or frame rate data, the YouTube videos from the international top 4K videos list have a significant lead over those on the China-specific list. None of the top 10 4K videos in China meet entry-level 4K requirements, and so they can be called "pseudo" 4K.

Additional information: In 2016, Huawei issued the Experience-Driven 4K Bearer Network White Paper, which noted:

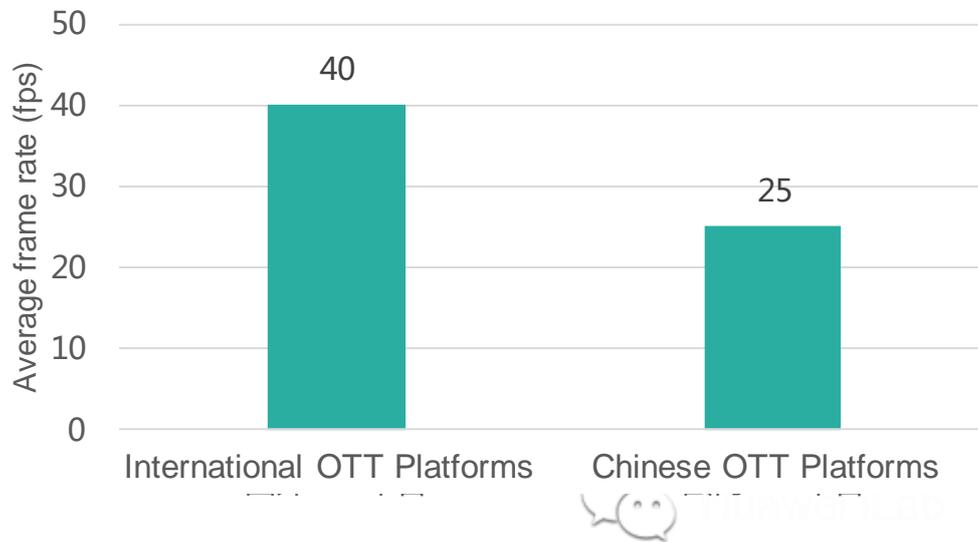
- The average bit rate requirement for entry-level 4K VoD is 12 to 16 Mbit/s.
- The average bit rate requirement for carrier-class 4K VoD is 20 to 30 Mbit/s.

The average bit rate for the top 10 4K videos in China is just 5.3 Mbit/s, which does not meet entry-level 4K requirements. Therefore, these videos can be called "pseudo" 4K videos.

### Chinese and International OTT Platforms: Top 10 4K Video Average Bit Rate Comparison

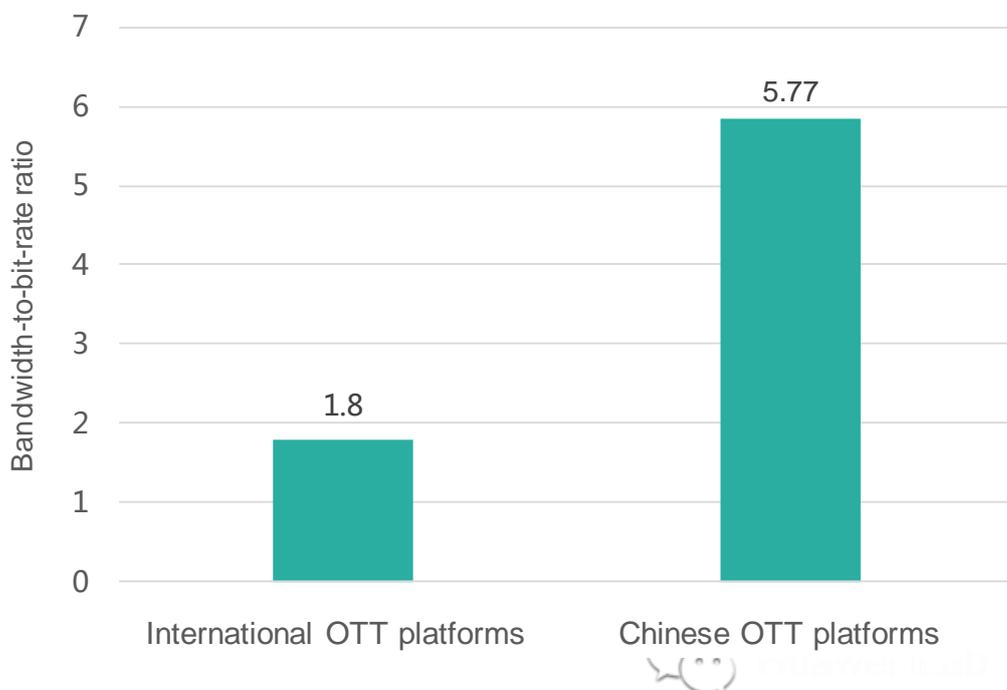


### Chinese and International OTT Platforms: Top 10 4K Video Average Frame Rate Comparison



3. **Low bite rates but high bandwidth requirements:** Chinese 4K videos have low bit rates but still do not in turn have low bandwidth requirements. The most demanding 4K video in China has a bandwidth requirement of over 50 Mbit/s, more than five times the bit rate. This shows that in China, real-time bite rate bursts are *relatively large for 4K videos*.

### Chinese and International OTT Platforms Top 10 4K Video Bandwidth-to-Bit-Rate Comparison

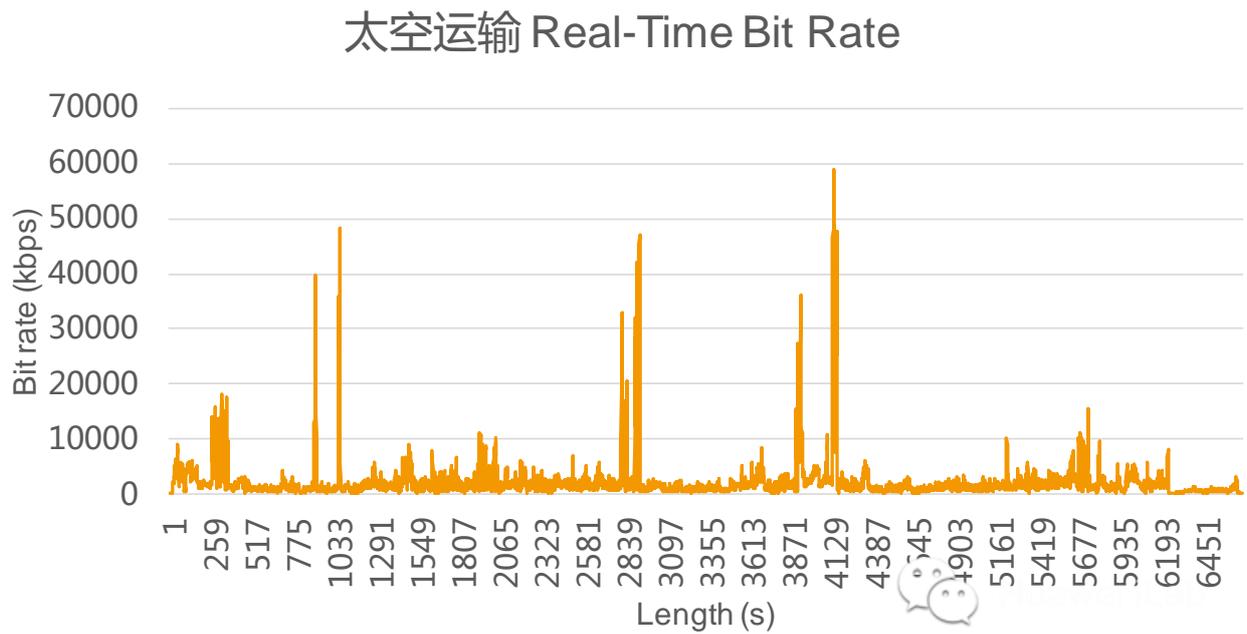


## 3 Top 10 Most Demanding 1080p Videos on the Net

### 3.1 The Top 1080p Videos

Rank	Video name	Type	Average bit rate (Mbps)	Frame rate (FPS)	Coding format	Length (s)	Bandwidth requirement (Mbps)	Bandwidth requirement/average bit rate	ICP
1	杀了我	Movie	3.1	24	AVC	5239	52.8	17.1	Youku
2	太空运输	Movie	2.2	24	AVC	6688	40.4	18.4	Youku
3	恐怖阁楼	Movie	2.3	24	AVC	3633	39	16.7	Youku
4	QUALIDEA CODE	Animation	3.2	24	AVC	1414	37.9	11.9	Youku
5	别碰我闺蜜	Short movie	2.8	25	HEVC	360	33.2	11.8	iQiyi
6	罪魔女	Movie	3.1	24	AVC	3438	31.6	10.1	Youku
7	多纳英文绘本	English picture book	3.3	25	AVC	379	26.9	8.2	Youku
8	穿越时空的少女_0_1	Movie	3	24	AVC	5901	24.7	8.2	Le.com
9	羁绊者	Animation	3.1	24	AVC	1434	23.9	7.6	Youku
10	分歧者2-绝地反击	Movie	2.2	24	AVC	7116	23.6	10.8	Youku

- All from China:** Every one of the 10 most demanding 1080p videos on the net is hosted on **Chinese OTT video platforms**, with most of them being hosted on Youku.
- High bandwidth requirements:** The bandwidth requirement of the most demanding 1080p video on the net is **over 50 Mbit/s**.
- High bandwidth requirements but low bit rate:** The bit rates of the 10 most demanding 1080p videos on the net are all 2 to 4 Mbit/s, with an average bit rate of **2.8 Mbit/s**. Looking at the characteristics of these 10 videos, we can see that this discrepancy between bandwidth requirements and bit rate is due to large bursts in bit rate. For any of the 10 videos, the average bandwidth must be twelve times higher than the bit rate to ensure smooth skipping.



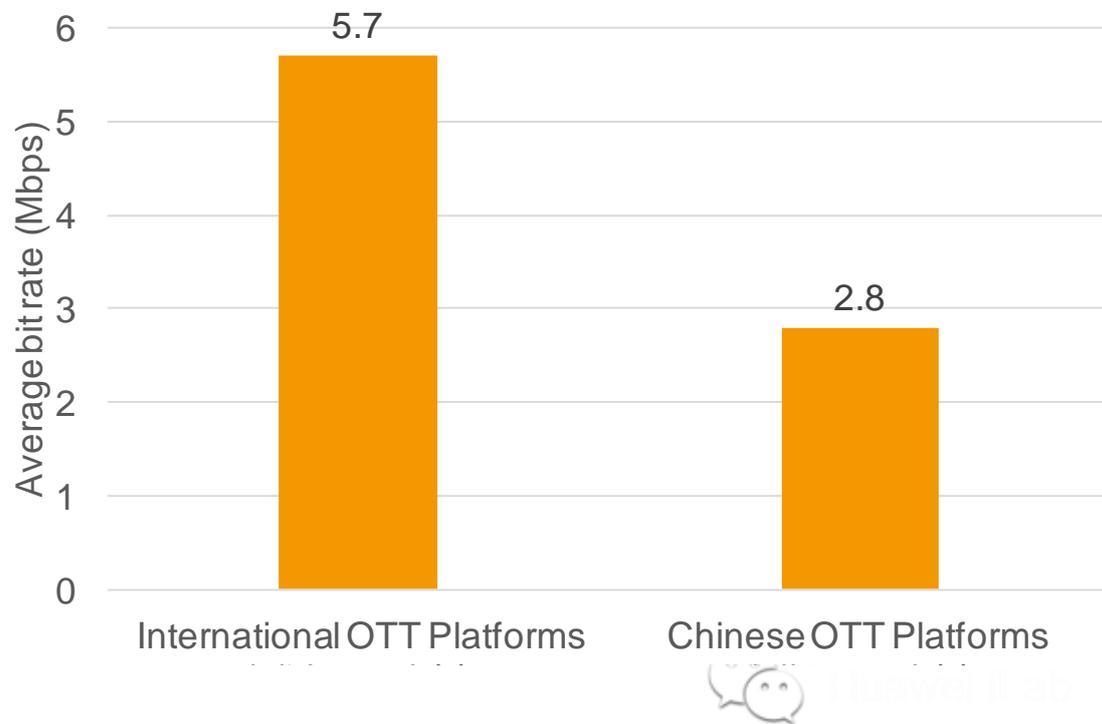
- Many long videos:** Unlike 8K and 4K videos, where short videos tend to be the most demanding, the 1080p videos with the highest requirements are mostly **movies or feature-length animations**.

### 3.2 Top 10 1080p Videos Outside of China

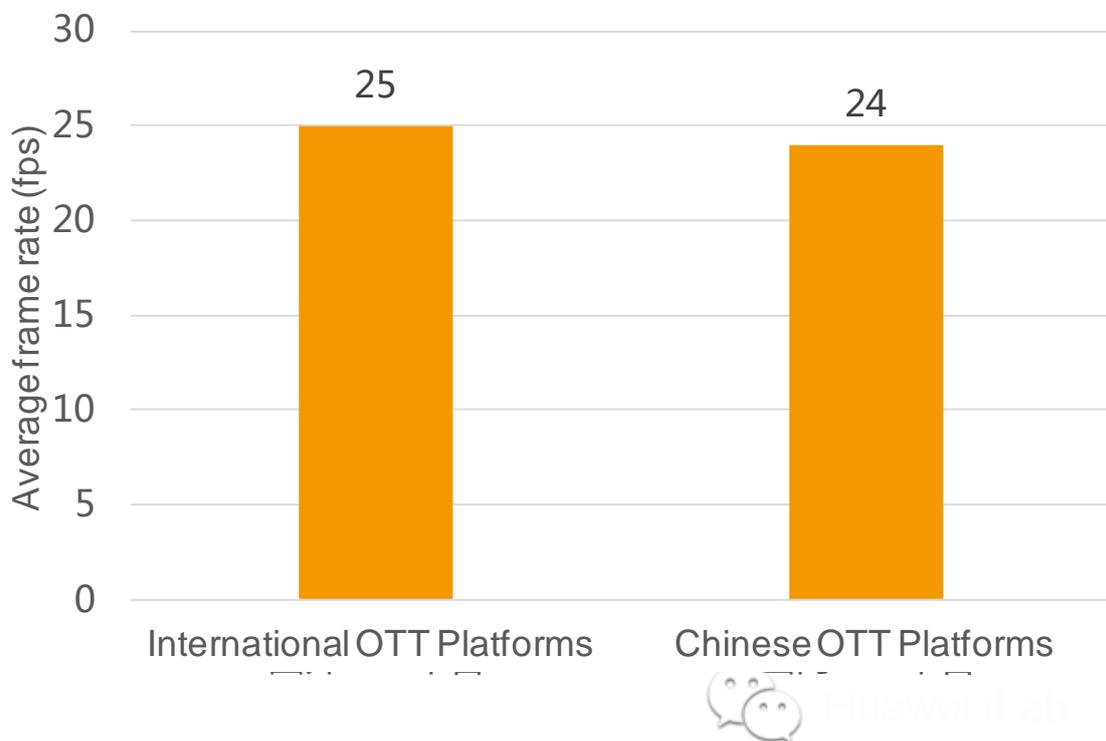
Rank	Video name	Type	Average bit rate (Mbps)	Frame rate (FPS)	Coding format	Length (s)	Bandwidth requirement (Mbps)	Bandwidth requirement /average bit rate	ICP
1	Mr.PelliKoduku - Telugu Latest Full Movies - Sunil, Isha Chawla - Sri Balaji Video	Movie	2.7	24	AVC	8220	16.5	6.2	YouTube
2	Josh - Full Length Telugu Movie - Naga Chaitanya, Kartheeka	Movie	1.8	25	VP9	10020	13.8	11.1	YouTube
3	EDEN - drugs (VR Experience)	Music VR	3.7	30	VP9	297	11.3	3.1	YouTube
4	Иван Царевич и Серый Волк - 2. Мультфильм. Полная версия.	Animation	3.9	24	VP9	4380	11.1	2.9	YouTube
5	Destiny	Movie	7.5	24	AVC	5880	10.9	1.5	Netflix
6	History of the Eagles	Movie	7.3	24	AVC	11220	10.8	1.5	Netflix
7	Amores Perros	Movie	7.5	24	AVC	9240	10.8	1.4	Netflix
8	Mumbai Cha Raja	Movie	7.5	24	AVC	4560	10.8	1.4	Netflix
9	All American High Revisited	Movie	7.5	24	AVC	4920	10.8	1.4	Netflix
10	Grace of Monaco	Movie	7.5	24	AVC	6120	10.8	1.4	Netflix

- 1. Average bit rate is twice as high as inside China:** The most top 10 demanding 1080p videos on the net outside of China generally have bit rates falling in the 3 to 8 Mbit/s range, averaging out to 5.7 Mbit/s. Both figures are around twice as high as the corresponding statistics for the top 10 most demanding 1080p videos inside China.

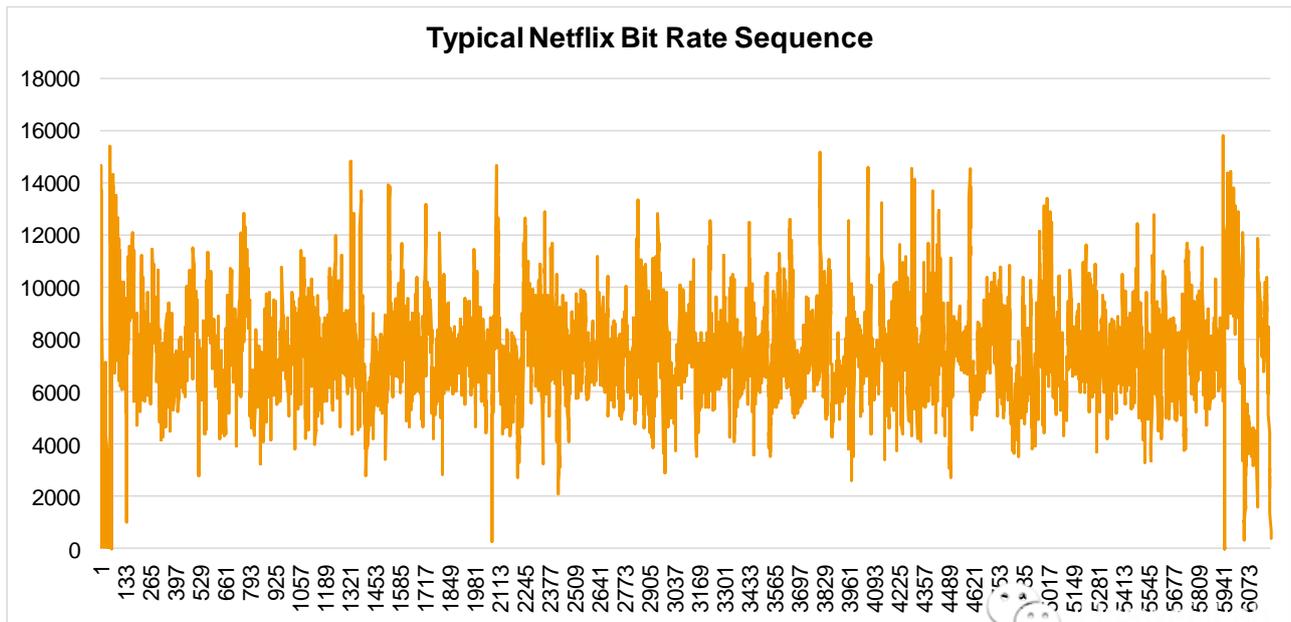
### Chinese and International OTT Platforms: Top 10 1080p Videos Average Bit Rate Comparison



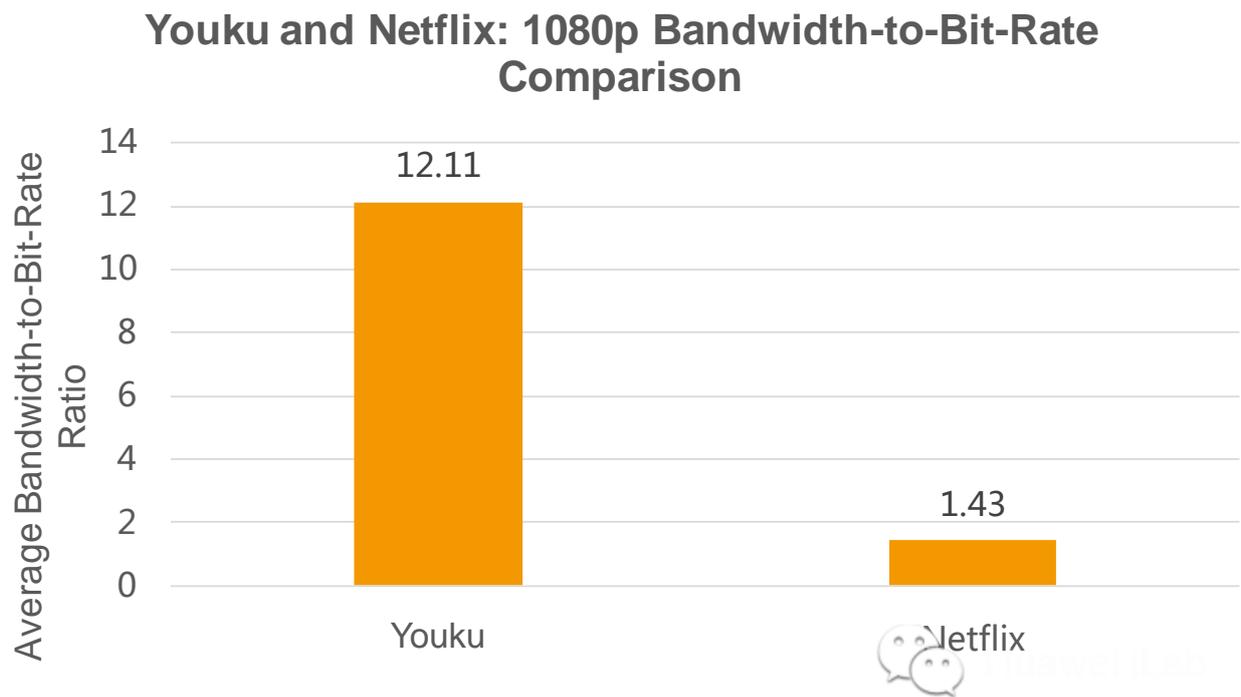
### Chinese and International OTT Platforms: Top 10 1080p Videos Average Frame Rate Comparison



2. **Lower bandwidth than inside China:** The most demanding 1080p video outside China only has bandwidth requirements of around 16 Mbit/s.
3. **Netflix has lower bandwidth requirements than Chinese videos but a higher bit rate:** Because **Netflix bit rate control is stable and prevents burst from occurring**, as shown in the following figure, the bandwidth reaches 1.4 to 1.5 times the average bit rate, ensuring smooth playback at all times.



Comparing the Youku and Netflix videos that make up the greater part of the top 10 most demanding 1080p video lists for China and outside of China, we can see that there is a stark difference in bandwidth requirements: The Youku videos require the bandwidth to be 12 times larger than the average bit rate in order to ensure smooth playback, but Netflix videos require just 1.5 times the bandwidth.



- 4. Mostly long videos:** Most of the top 10 most demanding 1080p videos on the net have **similar durations to feature-length movies**, with nine that are longer than 60 minutes, including six Netflix videos.

## 4 Top 10 Most Demanding 720p Videos on the Net

### 4.1 The Top 10 720p Videos

Rank	Video name	Type	Average bit rate (Mbps)	Frame rate (FPS)	Coding format	Length (s)	Bandwidth requirement (Mbps)	Bandwidth requirement /average bit rate	ICP
1	杀了我	Movie	1.6	24	AVC	5246	22.7	14.1	Youku
2	一生只爱你	TV series	3.2	25	AVC	2729	21.1	6.6	Youku
3	QUALIDEA CODE	Animation	1.6	24	AVC	1416	19.6	12.0	Youku
4	太空运输	Movie	1.2	24	AVC	6691	19.4	16.2	Youku
5	恐怖阁楼	Movie	1.2	24	AVC	3636	18.7	15.6	Youku
6	高楼大劫案	Movie trailer	2.7	24	AVC	176	17.4	6.6	Youku
7	朋友也上床	Movie trailer	2.4	24	AVC	156	16.3	6.9	Youku
8	穷神来了	Animation	2.4	25	AVC	1419	15.9	6.5	Youku
9	铁道游击队 第二部	TV series	1.3	25	AVC	2441	15.8	12.3	Youku
10	命运石之门	Animation	1.2	25	AVC	1433	15.5	13.0	Youku

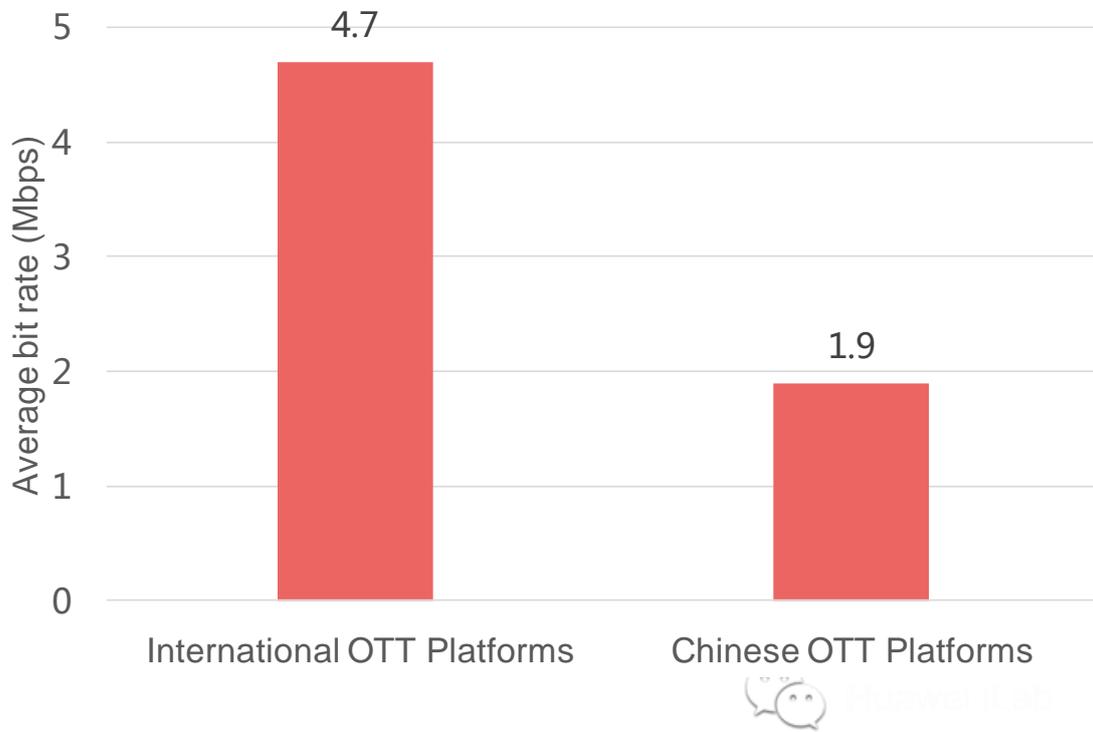
- All from China:** As with 1080p, the top 10 most demanding 720p videos on the net are all hosted on a Chinese OTT platform, specifically Youku.
- High bandwidth requirements:** The average bit rate of the top 10 most demanding 720p videos on the net is about 1.9 Mbit/s, but bandwidth requirements are relatively high. The first place video has bandwidth requirements of over 20 Mbit/s, and requires 25 Mbit/s to ensure smooth playback.
- Mostly long videos:** The top 10 most demanding 720p videos on the net are mostly long videos such as movies, TV series, and animations. However, two of the videos were movie trailers of under three minutes.

## 4.2 The Top 10 720p Videos Outside of China

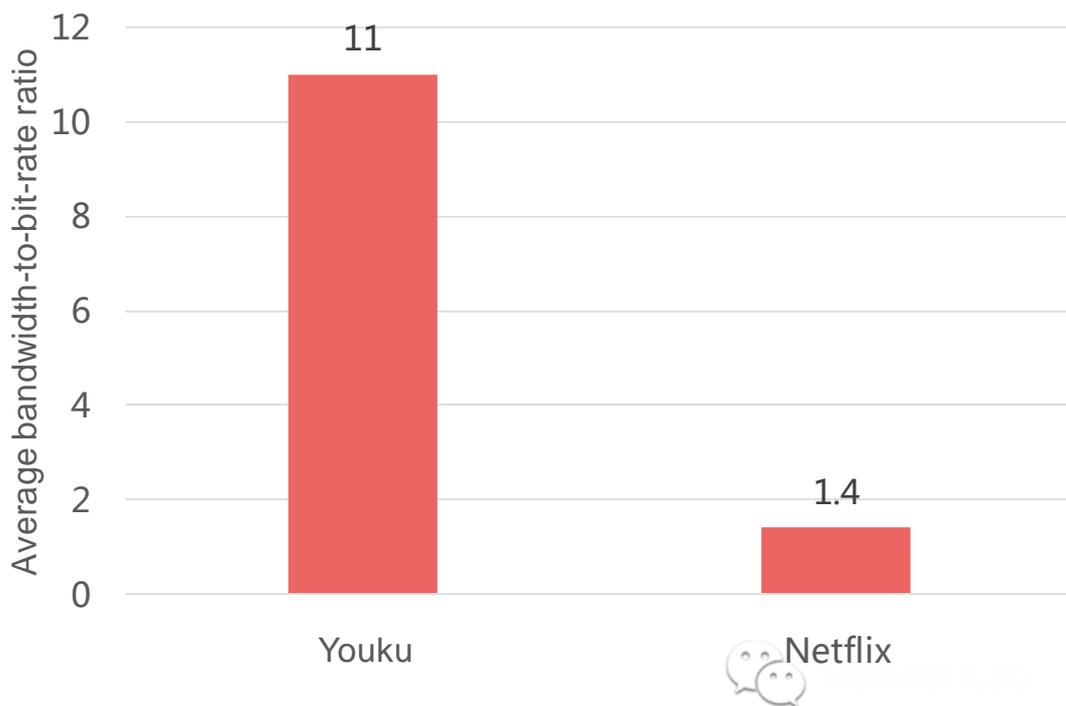
Rank	Video name	Type	Average bit rate (Mbps)	Frame rate (FPS)	Coding format	Length (s)	Bandwidth requirement (Mbps)	Bandwidth requirement /average bit rate	ICP
1	Age of Champions	Movie	6.5	24	AVC	4140	8.8	1.4	Netflix
2	Friday Night Tykes	Movie	6.5	24	AVC	2587	8.5	1.3	Netflix
3	Hard Labor	Movie	5.6	24	AVC	6000	8.2	1.5	Netflix
4	Иван Царевич и Серый Волк - 2. Мультфильм. Полная версия.	Movie	1.8	24	VP9	4380	6.5	3.6	YouTube
5	History of the Eagles	Movie	4.3	24	AVC	11220	6.4	1.5	Netflix
6	帕布洛·艾斯科巴的時代	Movie	4.6	24	AVC	2772	6.4	1.4	Netflix
7	Amores Perros	Movie	4.4	24	AVC	9240	6.4	1.4	Netflix
8	Heart of the Country	Movie	4.4	24	AVC	5340	6.3	1.4	Netflix
9	Flamenco, Flamenco	Movie	4.4	25	AVC	5760	6.3	1.4	Netflix
10	Heart of the Country	Movie	4.4	24	AVC	5340	6.3	1.4	Netflix

- Mostly Netflix movies:** The majority of the 720p videos with the highest bandwidth requirements outside of China are movies hosted on Netflix.
- Bit rate 2.5 times that of videos on the Chinese list:** As with 1080p, 720p videos on the Netflix platform have a much higher average bit rate than the listed videos inside China, with Netflix video bit rate averaging **around 4.7 Mbit/s** and Chinese videos averaging around 1.9 Mbit/s. Quality is much higher also, with a frame rate of 24 to 25 fps.
- Low bandwidth requirements:** The first place video has a bandwidth requirement of **less than 10 Mbit/s**.
- Bandwidth and bit rate ratio comparison:** When comparing the most demanding 720p videos on Youku and Netflix, a similar pattern emerges to the comparison between 1080p videos on these platforms. The Youku videos require bandwidth that is 11 times higher than the average bit rate in order to ensure smooth playback, whereas the Netflix videos require only 1.5 times.

### Chinese and International OTT Platforms: Top 10 720p Videos Average Bit Rate Comparison



### Youku and Netflix 720p Bandwidth-to-Bit-Rate Comparison



## 5 Conclusion and Future Prospects

Online video streaming has already become mainstream, and network bandwidth limitations have become the key factor adversely affecting user experience. After the in-depth analysis of the highest quality videos of each video resolution, we can see that the single most demanding video on the net has a bandwidth requirement of more than 200 Mbit/s, the most demanding 4K video has a bandwidth requirement of over 100 Mbit/s, and the most demanding 1080p video has a bandwidth requirement of over 50 Mbit/s. In 2015, the US government redefined broadband standards, meaning that only connections of 25 Mbit/s or above can be called broadband. However, 25 Mbit/s is still a fairly low, conservative definition for broadband, as it can only meet international the requirements for smooth 1080p video streaming and cannot ensure the same for 4K video content.

Through comparisons between OTT video inside and outside of China, we can see that, when it comes to the number and quality of 8K and 4K high-resolution videos, there is a large gap between Chinese ICPs and ICPs in the rest of the global market.

When it comes to 1080p videos, Chinese OTT videos have low bit rate but high network bandwidth requirements. Outside of China, Netflix does very well at user experience. It achieves this by ensuring high-quality while fully controlling bit rate burst. Because of this, the stable bandwidth only needs to be 1.5 times the video bit rate to ensure smooth video playback.

Analysis shows us that bandwidth requirements are not wholly dependent on average bit rate, and that bit rate sequence also plays a key role. Huawei iLab video gene big data team will continue to collect big data regarding video bandwidth genes, and then further expand this effort from VoD to live-streaming, from entertainment to social networks. This information will be analyzed and used to construct better video networks and contribute to building a better-connected world.

## 6 Appendix: Data Sources & Definition

### Sample scope:

- International OTT video platforms: YouTube, Netflix
- Chinese OTT video platforms: Youku, Tencent, iQiyi, Le.com
- Sample range: over 200,000 online videos from 2011 to 2017

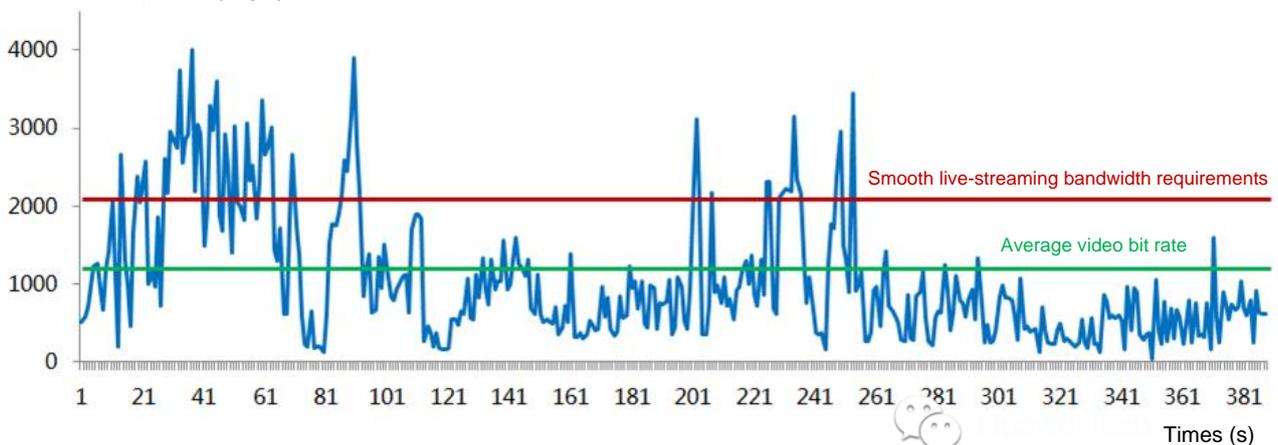
### Analysis tool:

Huawei iLab Internet video playback bandwidth analysis tool

### Data definition:

- Video playback bandwidth requirement: the bandwidth required for the video to play smoothly even when users skip through to any point in the video, after necessary buffering. OTT video mainly uses the variable bite rate (VBR) encoding scheme. Using average bit rate as a reference point for bandwidth requirement does not guarantee smooth video playback, as shown in the following example. iLab used a proprietary tool to analyze the sampled video playback processes and simulate skipping through the videos for analysis. After the necessary data buffering is complete, videos can be played smoothly if they have the required bandwidth.

Real-time bit rate (kbps)



- **Video quality:** This document mainly analyzes network bandwidth requirements of online videos. Bandwidth quality is used to refer to video bit rate, resolution, frame rate, color depth, and color gamut, and does not consider the video content quality.

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