



Email: [hwilab@huawei.com](mailto:hwilab@huawei.com)

Huawei official website: <http://www.huawei.com/en/ilab>

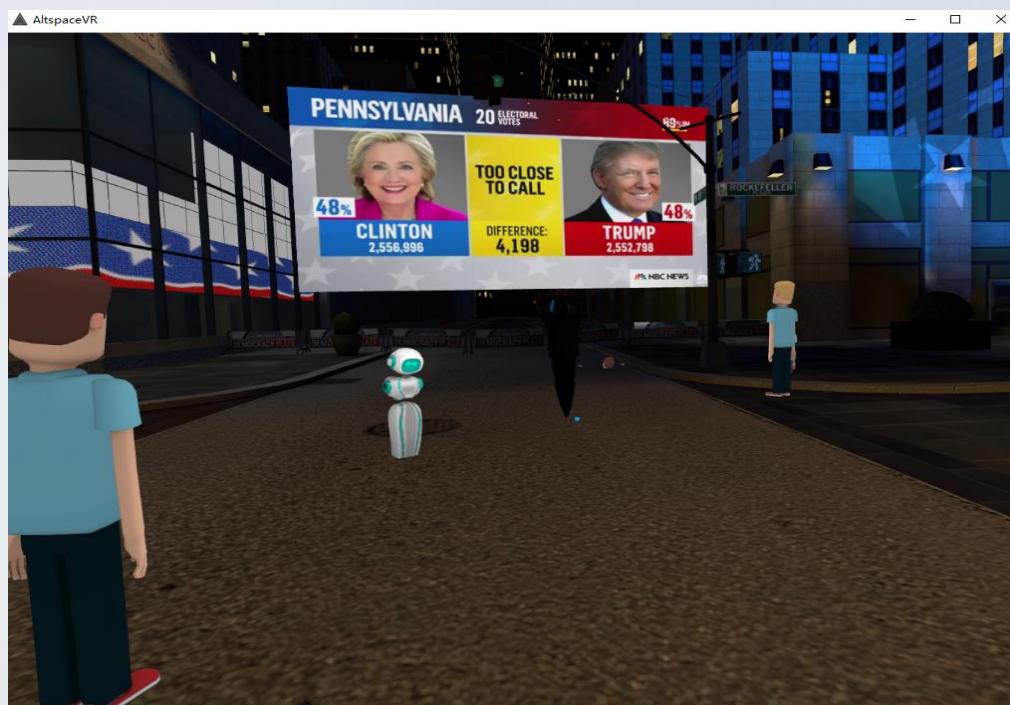
#### Copyright Statement

- This document is developed by Huawei iLab. Huawei iLab may supplement or amend related information at any time without prior notice.
- This document is copyrighted by Huawei iLab, and photos from the Internet are copyrighted by their original authors. Do not distribute this document without permission. After being authorized by Huawei iLab, state the source "Huawei iLab" when distributing this document.
- This document cannot be used as a basis for investment or research decision-making, or as a basis or proof for ethical, responsibility, or legal purposes, either expressed or implied.

## Social VR's Development, Experience, and Network Requirements



During the 2016 US presidential election, AltSpace VR company established a virtual world space in NBC News Democracy Square in New York, letting global VR users dress as cartoon characters and watch NBC election live. People can come close to and communicate with each other. They can even use floating emoticons to express their feelings. The square has become a place for social gathering. And this is social VR.



For a long time, Huawei iLab has made in-depth research on social VR and has carried out systematic analysis on core elements, key technologies, application experience, network requirements, network traffic, and influence of social VR application. Huawei iLab also puts forward an important viewpoint that social VR will change future communications. The key findings are as follows:

1. Social VR is a virtual reality concept for multiple scenarios. Social networking makes VR a way of communication and **the next-generation communication platform**.
2. The evolution of social VR is a continuous process centered on two core concepts of **Avatar and Share**.
3. The continuous evolution of social VR will provide a stronger social presence for users. Its sense of reality imposes higher requirements on network bandwidth. At the same time, the timeliness and synchronization of social activities in Avatar are guaranteed by **low network latency (reduced from 100 ms to 10 ms)**.

4. The transformation from State status share to Environment share and then to Experience share implies that more information is shared between user groups in the virtual world. The information of Environment share has increased **from several hundreds of KB to tens of MB** compared with that of State status share.
5. Multiple messages may be shared among multiple users in social VR. Consequently, the required bandwidth no longer increases linearly ( $n$  times) with the number of users. Instead, the required bandwidth increases non-linearly by  $k*n$  times.
6. Currently, the bandwidth consumption of typical social VR applications is nearly **100 times** that of traditional social applications. Future global social network users will exceed 3 billion. Assume that 1% users of traditional social platforms will turn to social VR applications and participate in online social activities simultaneously, the traffic will exceed **800 Tbit/s**, undoubtedly posing great challenges to networks.
7. From current VR industry development, **8K or even higher full-view resolution, single-lens 2K display technology, spatial audio, and experience sharing mode integrating Avatar and 360° real-time views** are required features of the future social VR products.



## 1. Social VR, a Virtual Reality Concept of Cross-Application Scenarios, Will Change the Ways of Communication

Mark Zuckerberg, the founder of Facebook, believes that VR will become the third-generation computing platform following personal computers and smart phones. As a company providing social networking services, Facebook naturally uses social activities as a starting point to VR services. Therefore, social VR, a brand-new concept, has swept across the world since Facebook's announcement of its acquisition of Oculus and setting up a social VR team in 2014.

Social VR is a concept of cross-application scenario. Users can do solo VR activities alone, such as VR shopping, VR education, and VR apartment-viewing. After the introduction of social VR elements, however, individual behavior becomes group ones, thereby accelerating the popularization of VR services and applications. Happiness sharing brings more happiness. Watching live sports games or concerts with friends in social VR mode is more attractive and immersive than in solo VR mode.

**Huawei iLab believes that social VR enables people from different areas to connect each other in a virtual world, bringing physically separated users together in a virtual world. Information sharing, virtual environment and experience have become a revolutionary way of communication.**



## 2. Core Elements of Social VR: Avatar & Share

Social VR also has the two core elements of real social activities: members and sharing.

Members are the primary entity of social activities. In social VR, it appears as Avatar, which refers to the reappearance of a simulated image or a real person image. Users can achieve social connections in the virtual world through Avatar.

Sense of Reality Provided by Avatar	Low	Medium	High
Visual Image	Cartoon characters	CG model players	Videos of real persons
Auditory Perception	No direction or distance	Distance but no direction	Spatial audio
Facial Expression	None	Simple expression tracing	People's expression
Posture	For head	For head and hands	For body
Degree of Freedom	3DoF	Discontinuous 6DoF	Continuous 6DoF

Continuous improvement on Avatar's sense of reality provides stronger social presence to users. It also poses new requirements and challenges for networks in both latency and bandwidth.

In social activities, human facial expressions and movements are often real-time reactions to certain events. This means high requirements on network latency. The synchronization of Avatar's actions, voices and events viewed by viewers requires low network latency. We need to do more experiments and tests to obtain quantitative conclusions.

In addition, Avatar has evolved from a simple cartoon image to a vivid life-image, which means Avatar can no longer simply rely on a little information about location transmitted through Internet to get rendered by using local resources. Instead, extra real-time video flows are needed and overlaid onto the virtual environment.

Sharing is an important part in socializing. In social VR, users share information, environment and experience with other users through Avatar to achieve a sense of immediacy.

We believe that the transformation from State status share to Environment share and then to Experience share implies a growth of shared information among user groups in the virtual world.

- State status share only transmits simple state information among users, and Avatar image is not necessary.
- In Environment share, users share virtual environment information of a special chat room. Such a virtual environment is relatively stable and the shared information is limited.
- As for Experience share, users need to continuously switch and synchronize information changes of the virtual environment brought by VR applications because Experience share has deeply integrated scenarios with social activities. Therefore, a variety and large amount of data is exchanged. In addition, we believe that, because of multiple information flows among users and consequent increase in connections, the linear relationship between the required network bandwidth and the number of users in traditional digital media services (such as OTT video) no longer applies. We will do more tests to figure out a quantitative relationship.

Typical Classifications of Sharing	State status share	Environment share	Experience share
Avatar	Optional	Included	Included
Shared Data	Host user's status information	Fixed chat room activities launched by the host user	Information about the virtual world and social activities of all users
Relationship Between Social Activities and Scenarios	Separated	Grafted	Integrated
Virtual Environment	Irrelevant to sharing	Relatively fixed without changes	Change along with social activities
Amount of Uploaded Information	Simple & small	Relatively limited	Enormous & diversified

Huawei iLab believes that the evolution of social VR is an ongoing process centered on two core concepts of Avatar and Sharing. Gradually improving the sense of reality of Avatar and share's virtual environment demands large bandwidth and low latency.



### 3. Mainstream Social VR Application Analysis of 2016

Mainstream social VR platforms or applications launched by the end of 2016 include Oculus, Vive platform main interface, Oculus Social, vTime, Surreal VR, AltSpace VR, and Facebook social VR (Demo). Avatar images are gradually getting rich and virtual environment under Share mode is increasingly improving. This document describes only Facebook social VR (Demo). For other application analysis, see the *Social VR Research Reports: Next-Generation Communication Platform Experience and Network Requirements* to be released by Huawei iLab.

Facebook social VR (Demo): a new-generation social VR demo released by Zuckerberg on the Oculus Connect 3 Conference on October 6, 2016. From the details of the concept demo, for the first time, Avatar has recognizable facial features, accurate lip synchronization, wonderful facial expressions with negligible defects and various lifelike body languages. The Share mode provides richer shared virtual environments and integrates 360° videos of real world scenarios where social activities like video chatting and taking selfies are also introduced.



Virtual on-site launch



Free swimming in submarine world



Games interaction



Video chatting



### 4. Social VR Turns Individual Behavior into Group Practice, Promoting the Exponential Growth of Network Traffic

AltSpace VR is taken as an example to show the social VR's network requirements.

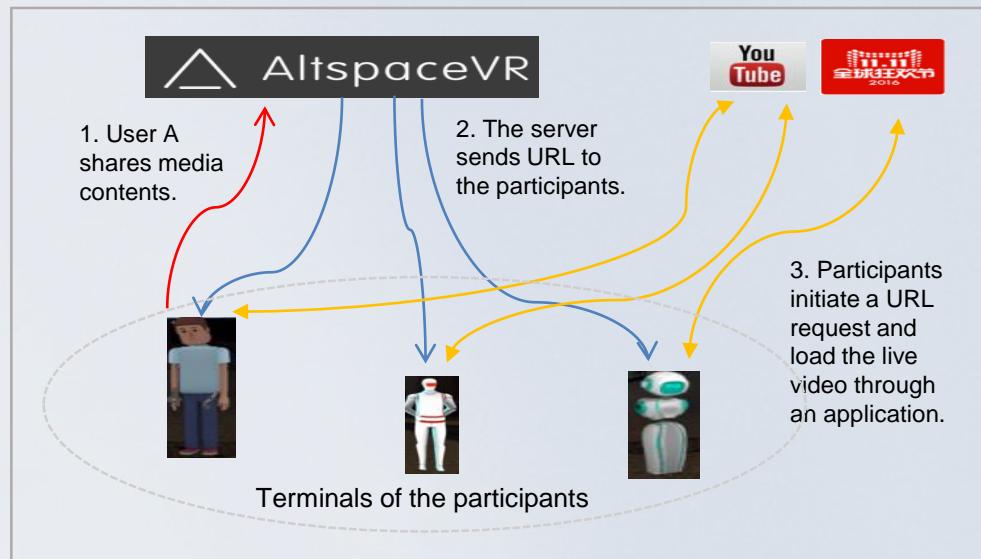
1. Initial loading of the virtual environment: AltSpace VR virtual environment is constructed on Unity 5, and the size is 50-150 MB respectively. However, virtual environment images can only be rendered out when the loading is completed. Therefore the initial loading will pose high requirements on bandwidth. Subsequent loading in the virtual environment can be cached locally.

Table: Minimum bandwidth requirements for initial loading in a virtual environment

Size of Virtual Environment	Required Bandwidth (Mbit/s)				
	1S	2S	3S	5S	10S
70 MB	560	280	187	112	56
100 MB	800	400	267	160	80
200 MB	1600	800	533	320	160
300 MB	2400	1200	800	480	240
500 MB	4000	2000	1333	800	400

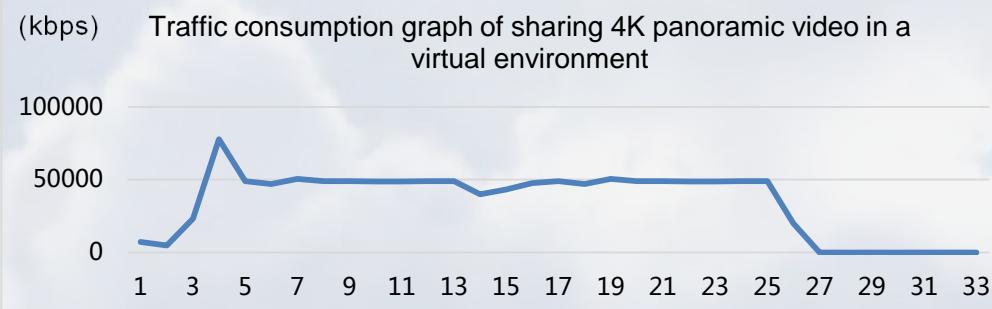
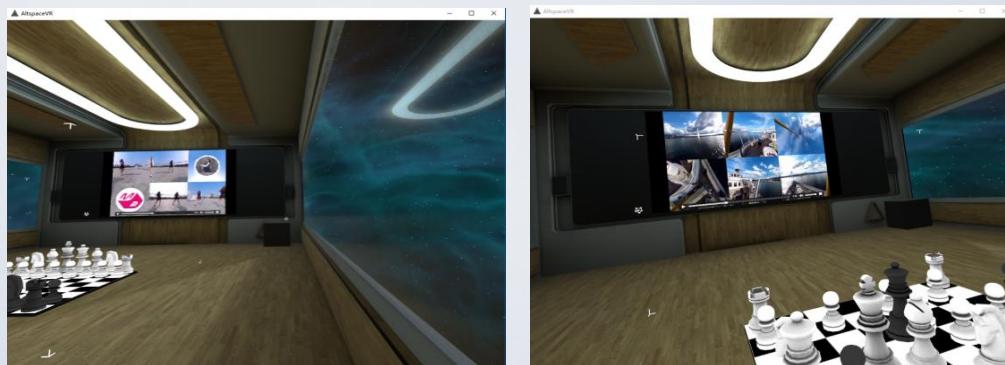
2. Social action among Avatars: games interaction and tools operation have relatively low bandwidth requirements while bandwidth consumption of voice chatting has a tolerance of 40–60 kbit/s and increases with the number of Avatars as a multiplying factor. Participants are from different regions and real-time interaction poses high requirements on network latency. High network latency will lead to out-of-sync communications, thereby becoming one of the main obstacles of user experience.
3. Media content sharing: the virtual environment of AltSpace VR provides a virtual large screen for participants to share information. They can share online multimedia contents such as pictures, audios and videos, whose traffic demands are equivalent to that of on-demand online contents. Under such a sharing mode, information sharing and communications maybe out-of-sync due to the differences in network and operation time of different users.

### Sharing process of media contents by AltSpace users



Participant A shares an online 360° panoramic video from Youku VR application that has a resolution of 2880 x 1992 and a frame rate of 25 fps. Traffic consumption of watching such a video by participant B is shown in the following figure (50M bandwidth network environment). According to the figure, it is obvious that the traffic consumed in social VR not only from its own interactive Avatar but also from other shared information flows.

### Sharing online 4K video in a virtual environment



According to the data and prediction from statistic by 2015, there will be 2.95 billion social media users by 2020. By the end of September 2016, Facebook's monthly active users exceeded 1.7 billion and daily active users added up to 1.1 billion. The number of Chinese WeChat users has also increased rapidly and exceeded 800 million.

Huawei iLab has respectively analyzed the social activities of four users according to traditional social networking applications and social VR users' behavior habits. The traffic consumption of the four users in 5 minutes is as follows:

- WeChat is selected as a representative of traditional social applications. According to the WeChat user behavior report released by Tencent Penguin Intelligence in 2016, TOP 3 social content preferences are Moments (58%), chatting (53.5%) and WeChat official account browsing (39.8%). For typical social scenarios, total traffic consumption in 5 minutes amounts to 10.1 MB. The following table provides the detailed data.

Traffic consumption for 5-minute social activities on WeChat						
Content Type	Voice	Text	Video	Images	Testing Time	Traffic Consumption
Moments Browsing	None	900 characters	2 small videos (resolution of 240x340)	35	1.9 min	1.8 MB (50 pieces of Moments)
Social Chatting	—	—	Number of selected video participants	—	1.8 min	7.8 MB
Content on Official Accounts (articles)	None	1500 characters	None	42	1.3 min	553.4 KB
Total Traffic Consumption	Traffic consumption totals 10.1 MB					

- As for social VR, we use AltSpace VR as an example. The traffic consumption for 5-minute social activities totals 1001 MB if the number of Avatar is 4. Here is the specific statistics:

Traffic consumption for 5-minute social activities on AltSpace VR			
Type	Initial Loading in a Virtual Environment	Media Content Sharing	Avatar
Traffic Consumption	56 MB	937 MB	8.43 MB
Total Traffic Consumption	Total traffic consumption amounts to 1,001.43 MB		

From the foregoing comparison, the bandwidth consumption of current typical social VR is nearly 100 **times** that of the traditional social application under the condition of an equal number of users.

As VR/AR technologies and mobile internet develop, social applications have come to a new phase. Social VR will bring brand new experience. Such social applications featured "real" panoramic video scenario, vivid Avatar image, audio and video chatting, videos sharing, shopping and sight-seeing require an even greater amount of internet traffic. At the same time, these applications can provide real-world fun of socializing to attract more users. Future global social network users will amount to more than 3 billion. If 1% of these users turn to social VR applications and participate in the online social activities, the traffic will exceed **800 Tbit/s**, undoubtedly posing great challenges to networks.



### 5. Road to Future: From Solo VR to Social VR as Next-Generation Communications

VR is a brand new platform. Applications for consumers and industries keep mushrooming. Social VR is a brand new concept, **and it can seamlessly connect various scenarios and applications of solo VR** and integrate basic necessities of life into a virtual world. With the improvement of the industry, technologies and experience, solo VR will surely evolve towards social VR and have Avatar and Experience share mode featured by even higher sense of reality, **thereby becoming a way of communication and next-generation communication platform.**

Based on current VR industry development, Huawei iLab considers that, in order to provide better user experience and root social VR in users' habits, future social VR products must have the following basic features:

- 8K and even higher full-view resolution
- 2K resolution and auxiliary displays for a single eye
- Spatial audio that can create sound effect based on the Avatar's distance and direction
- Based on an experience share mode of 360° video real scenarios, Avatar can be integrated into scenarios, thereby achieving scenery, sports games and concerts experience sharing.

Huawei iLab will conduct related researches and expect to work with industry partners to construct leading prototypes of social VR and facilitate the development of the industry. We are willing to establish a next-generation communication platform and make contributions to a better connected world.

