In 360-degree video, users are placed inside the video and can "look around" in different directions. This is similar to 3D games, except that the environment is not synthetic 3D graphics, but consists of actual video feeds. 360-degree video uses either a panoramic camera placed in the middle of the scene, or multiple cameras, pointing at different angels, placed either around or in the middle of the scene. During playback, the viewer can control the viewing direction using the mouse/keyboard, or more recently, by naturally moving his/her head towards the direction of the view, as done in recent commercial products such as Google Cardboard, Oculus Rift, Samsung Gear VR, HTC Vive, etc., which have recently become very popular with mass consumers, offering basic demos and simple applications, some of which can be seen in YouTube's 360° Videos Channel, for example.

Research Opportunities:

- *Heterogeneity*

Different receivers have different bandwidth, display size, and processing power. To provide a high quality experience, the transmitted video to each receiver should be customized for that receiver.

- *Continuous look around*

The user can interactively choose the viewpoint in the scene. But if that specific viewpoint has not been captured by a camera, a virtual view corresponding to that viewpoint must be generated. Such a virtual view is created from the neighboring views using some kind of side information. Clearly, the quality of the side information can strongly affect the quality of the synthesized view.

- *Rate Allocation*

Rate allocation in 360-degree video is a challenging issue since the overall rate and the rate necessary for decoding each view are constrained in the delivery architecture.