In free-viewpoint video, there is a recent trend to represent scene objects as solids rather than using multiple depth maps. Point clouds have been used in computer graphics for a long time, and with the recent possibility of real-time capturing and rendering, point clouds have been favored over meshes in order to save computation. Each point in the cloud is associated with its 3D position and its color. We devise a method to compress the colors in point clouds, which is based on a hierarchical transform and arithmetic coding. The transform is a hierarchical sub-band transform that resembles an adaptive variation of a Haar wavelet. The arithmetic encoding of the coefficients assumes Laplace distributions, one per sub-band. The Laplace parameter for each distribution is transmitted to the decoder using a custom method. The geometry of the point cloud is encoded using the well-established octtree scanning. Results show that the proposed solution performs comparably with the current state-of-the-art, in many occasions outperforming it, while being much more computationally efficient. We believe this paper represents the state of the art in intra-frame compression of point clouds for real-time 3D video.