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| Project | **HMD based 3D Content Motion Sickness Reducing Technology**  <<http://sites.ieee.org/sagroups-3333-3/> **>** |
| Title | **Input contribution documents for IEEE 802 meeting at Berlin** |
| DCN | **3-17-0053-00-0002** |
| Date Submitted | **July 21, 2017** |
| Source(s) | Beom-Ryeol Lee [lbr@etri.re.kr](mailto:lbr@etri.re.kr) (ETRI)  Dongil Dillon Seo [dillon@volercreative.com](mailto:dillon@volercreative.com) (VoleRCreative)  Sangkwon Peter Jeong [ceo@joyfun.kr](mailto:ceo@joyfun.kr) (JoyFun Inc.) |
| Re: | Session #2, NY, USA |
| Abstract | This document is contained to input contribution documents for IEEE 802 meeting at Berlin. |
| Purpose | This document has purpose to information sharing that input contribution documents for IEEE 802 meeting at Berlin. |
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| Project | **IEEE 802.21 Working Group for Media Independent Services**  **<**[**http://www.ieee802.org/21/**](http://www.ieee802.org/21/)**>** |
| Title | **Invitation for IEEE P3333.3 Network TG** |
| DCN | **21-17-0029-00-0000** |
| Date Submitted | **June 29, 2017** |
| Source(s) | Dongil Dillon Seo [dillon@volercreative.com](mailto:dillon@volercreative.com) (VoleRCreative)  Sangkwon Peter Jeong [ceo@joyfun.kr](mailto:ceo@joyfun.kr) (JoyFun Inc.) |
| Re: | Session #81, Berlin, Germany |
| Abstract | We are planning to hold a meeting for IEEE P3333.3 from July 24 to 27 in New York, USA and we encourage the members from IEEE 802.21 to attend. |
| Purpose | Requesting to participate in IEEE P3333.3 meetings |
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Title: Invitation to IEEE P3333.3 (HMD based 3D Content Motion Sickness Reducing Technology)

Project Website: <http://sites.ieee.org/sagroups-3333-3/>

* When: 24 July 2017 ~ 27 July
* Where: IEEE Office in NY (3 Park Ave, New York, NY 10016)
* Registration: Deadline: 12:00 AM EST, Sunday, July 09, 2017 (<https://iecs.memberclicks.net/index.php?option=com_mc&view=mc&mcid=form_239420>)
* Input Contribution: <https://mentor.ieee.org/3333.3/documents>
* Meeting Agenda

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| --- | --- | --- | --- | --- |
|  | **Monday**  **(July 24, 2017)** | **Tuesday**  **(July 25, 2017)** | **Wednesday**  **(July 26, 2017)** | **Thursday**  **(July 27, 2017)** |
| **AM-1**  **8:00-10:00a** | Registration | Open Discussion  (HF & Med) | Open Discussion  (Sensors) | Discussing Future Roadmap |
| **AM-2**  **10:30-12:30** | Open Plenary  Roll Call  Reviewing last meeting minutes  (Introducing participants) | Open Discussion  (Tools & Content) | Open Discussion  (Lens) | Closing Plenary |
| **PM-1**  **1:30 – 3:30p** | Introducing P3333.3  Introducing TG (3 TGs first) | Open Discussion  (Display) | Summarizing standard requirements |  |
| **PM-2**  **4:00 – 6:00p** | Discussing rest of TGs | Open Discussion  (Network) | Electing TG Chairs  (3 Remaining) |  |

\* R&R: Roles & Responsibilities

* IEEE P3333.3 is an international working group created to provide standards on the reduction of motion sickness caused VR HMDs as the VR industry is actively in needs of the solution to this problem. We are going to kick off our very first meeting to discuss how we can tackle this problem by offering a place for the global experts to gather together and openly discuss about this matter. We sincerely hope that the participants in this meeting will be able to share their know-hows to come up with some great ideas that will help the industry to solve this problem. The meeting is scheduled to begin on July 24 and will be held for 4 days. Since this is a gathering of international experts, all meetings will be in English and no translation service is provided. We strongly encourage you to participate to help us and the VR industry on this matter so the industry will take another leap forward.
* Please submit any input contribution documents you may have for the meeting by July 20 if you have any to document repository as it will facilitate the meeting process. The final meeting agenda for any presentations will be announced on July 20. Should you have any preference on the presentation schedule, please let us know and we will do our best to accommodate your request.

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| Project | **IEEE 802.21 Working Group for Media Independent Services**  **<**[**http://www.ieee802.org/21/**](http://www.ieee802.org/21/)**>** |
| Title | **Network Requirement for HMD based VR Service** |
| DCN | **21-17-0030-00-0000** |
| Date Submitted | **June 29, 2017** |
| Source(s) | Sangkwon Peter Jeong [ceo@joyfun.kr](mailto:ceo@joyfun.kr) (JoyFun Inc.)  Dongil Dillon Seo [dillon@volercreative.com](mailto:dillon@volercreative.com) (VoleRCreative) |
| Re: | Session #81, Berlin, Germany |
| Abstract | In order to minimize the motion sickness a user experience while using a VR HMD, the current hardware manufacturers suggest that we need to run the VR content at least over 90 Hz and to minimize the screen door effect while looking at the display screen, the display resolution should be at least 4K UHD. Also, to create more immersive and uninterrupted VR experience, wireless HMD is required. However, such conditions are currently difficult to achieve because of the unreadiness of hardware and the unavailability of fast and stable wireless network. Hence, it is important to discuss what specifications for wireless network are required to create an ideal VR service environment. |
| Purpose | Provide specific network requirements for VR service and reflect these technical requirements to IEEE 802.21 standards. |
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VR HMD(Virtual Reality Head Mounted Display) display two separate but identical images for left and right eye respectively in order to create stereoscopic image. Also, it uses a pair of fish eye lenses to maximize the field of view so that the user does not see the display edges and believes that he is seeing the virtual world with his own eyes, not through a display. This usage of fish eye lenses distorts the images displayed on the screen life Figure 1 and enlarges field of view, we are only perceiving 45% of the actual screen resolution. This is the reason why the VR HMD manufacturers are suggesting to use 4K UHD display to provide the visual fidelity we are commonly seeing from most popular TV sets, which is 1080p FHD display.

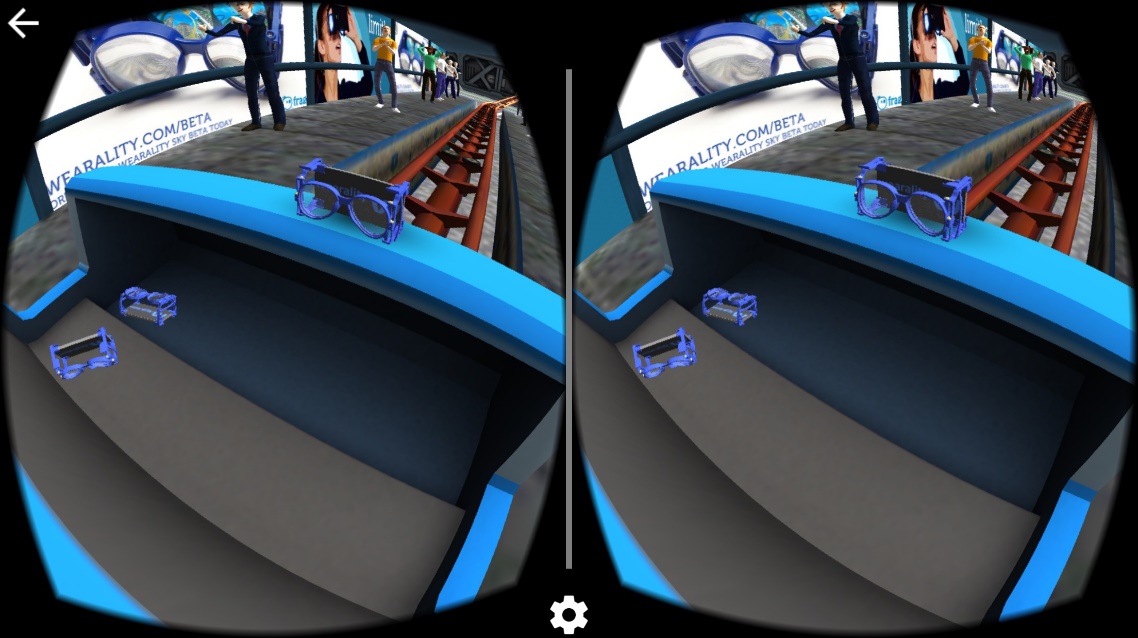


Figure 1. Stereoscopic image for VR HMD

4K UHD resolution offers 3840 x 2160 pixels. It means that an image requires 1G size and the VR content service which requires 90 FPS would require 18 Gbps data transfer rate.

Equation: resolution × 24bit (color) × frame rate = data capacity

Even if the movie clip data is compressed, 1 Gbps data transfer rate needs to be guaranteed

Table 1. IMT-2020 vs WLAN vs IMT-Advanced

|  |  |  |  |
| --- | --- | --- | --- |
|  | IMT-Advanced | WLAN(802.11ac) | IMT-2020 |
| Peak data rate | 1 Gbps | 7Gbps | 20 Gbps |
| User experienced data rate | 10 Mbps  (urban/suburban) | 300Mpbs  (urban/suburban) | 100 Mbps (urban/suburban), 1Gbps (hotspots) |
| Mobility | 350 Km/h | N/A | 500 Km/h |
| Area traffic capacity | 0.1 Mbps/ m2 | N/A | 10 Mbps/ m2 |

Refer to Table 1, minimal data transfer rate for VR service would require at least IMT-Advanced wireless network; and 802.11ac or above WLAN or IMT-2020 wireless network will be necessary to create smooth VR service environment.

However, only IMT-2020 specifications are available and its technological implementation standards are not yet ready whereas VR already has commercial services ready. Hence, we are currently facing a situation where content is ready to be served but the network infrastructure is not ready to accommodate the needs. Therefore, it would be great if IEEE 802 can examine the industry requirements and provide standards for a secured and stable wireless network infrastructure that the industry can use to provide VR content services.

Especially, IEEE 802.21 is working on network handover issues and it would be worthwhile to examine different cases where VR service may leverage its standards on network handover.

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| Project | **IEEE 802.21 Working Group for Media Independent Services**  **<**[**http://www.ieee802.org/21/**](http://www.ieee802.org/21/)**>** |
| Title | **Network Requirement according to compression CODEC for 4K UHD Service** |
| DCN | **21-17-0032-00-0000** |
| Date Submitted | **July 6, 2017** |
| Source(s) | HyeonWoo Nam [hwnam@dongduk.ac.kr](mailto:hwnam@dongduk.ac.kr%20() (Dongduk Women’s University)  JinHo Jeong jiniehee@gmail.com (Greencloud Co., Ltd.)  Sangkwon Peter Jeong [ceo@joyfun.kr](mailto:ceo@joyfun.kr) (JoyFun Inc.,) |
| Re: | Session #81, Berlin, Germany |
| Abstract | It is the fact that it is sympathizing altogether between the VR professionals that 4K UHD quality is needed for the VR service in which QoE(Quality of experience) is guaranteed. And for this, it is natural that the network environment of the mass and high efficiency is needed.  Therefore, it has to know whether the some transfer rate is required for the transmission of the ultra high resolution video data more than 4K UHD. At this time, the compression due to codec of the video file has to be considered.  This contribution text provides and shares the information for this. |
| Purpose | Necessary on transfer rate is made an inquiry in order to send video data of the ultra high resolution like the VR contents. And when Handover occurs on network, the possibly generate Issue and the provision about this are trying to be recognized. |
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1. **Definition**
   1. **Full-HD (Full High Definition):** a set of [HDTV](https://en.wikipedia.org/wiki/High-definition_television) [high-definition video](https://en.wikipedia.org/wiki/High-definition_video) modes characterized by 1080 horizontal lines of vertical [resolution](https://en.wikipedia.org/wiki/Display_resolution) for progressive scan.
   2. **4K UHD (4k Ultra High Definition)**: the digital video format which the International Telecommunication Union (ITU) approves as one among the next generation high definition video quality standard corresponding to standard of the aspect ratio 16:9 and number of pixels 8,294,400 and screen resolution 3840X2160. 4K UHD applies for the video having the number of pixels of the quadruple in comparison with the Full HD.

**NOTE.** Table 1 shows the result that it compares HD, Full-HD, and 4K UHD.

*Table 1 Comparison of Pixel and Resolution*

|  |  |  |
| --- | --- | --- |
| Method | Pixel | Resolution |
| HD | 1,036,800 | 1,366 x 768 |
| Full-HD | 2,073,600 | 1,920 x 1,080 |
| 4K UHD | 8,294,400 | 3,840 x 2,160 |

**NOTE.** Figure 1 shows the video quality of the Full-HD and 4K UHD. It can know that video quality of 4K UHD is superior.



*Figure 1 Quality Comparison of Full-HD and 4K UHD*

**NOTE.** Table 2 shows that resolution of the most of latest smart phones can apply for 4K UHD.

*Table 2 Resolution Comparison of Typical Smartphone*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **SAMSUNG** | | | **LG** | | **APPLE** | |
| **Product** | **Galaxy S8** | **Galaxy S8+** | **Galaxy Note 8** | **G6** | **G6+** | **iphone 7** | **iphone 7+** |
| **Resolution** | **2960x1440** | **2960x1440** | **2560x1440** | **2880x1440** | **2880x1440** | **1920x1080** | **1920x1080** |

* 1. **Bit Rate:** the data size of the bit unit which has to handle per second. The bps (bit per second) is used as the unit.

**NOTE.** The bit rate of the video is the sum of the video area bit rate and audio area bit rate. The bit rate of the video which is not compressed can be calculated with the following equation.

Video Area Bit Rate=(Y Resolution+Cb Resolution+Cr Resolution)×# of Quantization Bit×fps (1)

Audio Area Bit Rate=Sampling Rate×Sampling Bit×# of Channel (2)

Video Bit Rate=Video Area Bit Rate+Audio Area Bit Rate (3)

**EXAMPLE.** The following equation is the example of computation of the bit rate of the non-compressed 4KU HD video made of (Stereo, 16bit, 48KHz) audio and (8bit, YCbCr 4:2:2 sampling, 29.97 fps) video. At this time, the bit rate gets to become larger if the bit depth becomes larger.

Video Area Bit Rate: (3840×2160+1920×2160+1920×1080)×8×90=10,450,944,000≒10.451 Gbps

Audio Area Bit Rate: 48000×16×2=1536000bps=1500Kbps≒1.46 Mbps

Video Bit Rate: 10.451Gbps+1.46Mbps≒10.452 Gbps

* 1. **CBR (Constant Bit Rate)**: the way that it compresses each frame comprising the video into the uniform capacity.
  2. **VBR (Variable Bit Rate):** the way that it analyze the difference of each frames and stores as the relative low capacity in the part the movement writing and stores as the high-capacity in the part which there is a lot of the movement. i.e. the way that it compresses into the capacity which is not fixed according to the movement of the image inside.

**NOTE.** When encoding the video files of which the content and size is the same, the quality of the video is higher than VBR to apply CBR but the operation time and performance which is high in the encoding and decoding process is needed.

* 1. **Frame Rate:** the size of the frame which it has to handle per second. It is the meaning like the fps (frame per second).

1. **Kind of Compression Codec**
   1. **H.264 (MPEG-4 AVC (Advanced Video Coding)):** the most widely used file format for the recording, compression and distribution of the video.

*Table 3 level-wise feature of the H.264*

| Level | Maximum Bitrate for Profile (Kbps) | | | Maximum Resolution@Maximum Frame Rate |
| --- | --- | --- | --- | --- |
| BS, Main, Extended | High | High 10 |
| 1.0 | 64 | 80 | 192 | 128×96@30.9, 176×144@15.0 |
| 1b | 128 | 160 | 384 | 128×96@30.9, 176×144@15.0 |
| 1.1 | 192 | 240 | 576 | 176×144@30.3, 320×240@10.0, 352×288@7.5 |
| 1.2 | 384 | 480 | 1,152 | 320×240@20.0, 352×288@15.2 |
| 1.3 | 768 | 960 | 2,304 | 320×240@36.0, 352×288@30.0 |
| 2.0 | 2,000 | 2,500 | 6,000 | 320×240@36.0, 352×288@30.0 |
| 2.1 | 4,000 | 5,000 | 12,000 | 352×480@30.0, 352×576@25.0 |
| 2.2 | 4,000 | 5,000 | 12,000 | 352×480@30.7, 352×576@25.6, 720×480@15.0, 720×576@12.5 |
| 3.0 | 10,000 | 12,500 | 30,000 | 352×480@61.4, 352×576@51.1, 720×480@30.0, 720×576@25.0 |
| 3.1 | 14,000 | 17,500 | 42,000 | 720×480@80.0, 720×576@66.7, 1280×720@30.0 |
| 3.2 | 20,000 | 25,000 | 60,000 | 1280×720@60.0, 1280×1024@42.2 |
| 4.0 | 20,000 | 25,000 | 60,000 | 1280×720@68.3, 1920×1080@30.1, 2048×1024@30.0 |
| 4.1 | 50,000 | 62,500 | 150,000 | 1280×720@68.3, 1920×1080@30.1, 2048×1024@30.0 |
| 4.2 | 50,000 | 62,500 | 150,000 | 1280×720@145.1, 1920×1080@64.0, 2048×1080@60.0 |
| 5.0 | 135,000 | 168,750 | 405,000 | 1920×1080@72.3, 2048×1024@72.0, 2048×1080@67.8, 2560×1920@30.7, 3672×1536@26.7 |
| 5.1 | 240,000 | 300,000 | 720,000 | 1920×1080@120.5, 2560×1920@51.2, 3840×2160@31.7, 4096×2048@30.0, 4096×2160@28.5, 4096×2304@26.7 |
| 5.2 | 240,000 | 300,000 | 720,000 | 1920×1080@172.0, 2560×1920@108.0, 3840×2160@66.8, 4096×2048@63.3, 4096×2160@60.0, 4096×2304@56.3 |

**NOTE.** When the Frame Rate of 5.1 and 5.2 level supporting 4K UHD from H.264 is 31.7 fps and 66.8 fps, the Bit Rate needs 240 Mbps, 300 Mbps, 720 Mbps. If the Frame Rate of the video used in VR contents service is 90 fps, the maximum bit rate, as to the treble gets to grow bigger than the value in Table 3.

* 1. **H.265 (HEVC, High Efficiency Video Coding):** a video compression standard, one of several potential successors to the widely used AVC (H.264 or MPEG-4 Part 10). In comparison to H.264, H.265 offers about double the data compression ratio at the same level of video quality, or substantially improved video quality at the same bit rate. It supports resolutions up to 8192×4320, including 8K UHD.

*Table 4 level-wise feature of the HEVC*

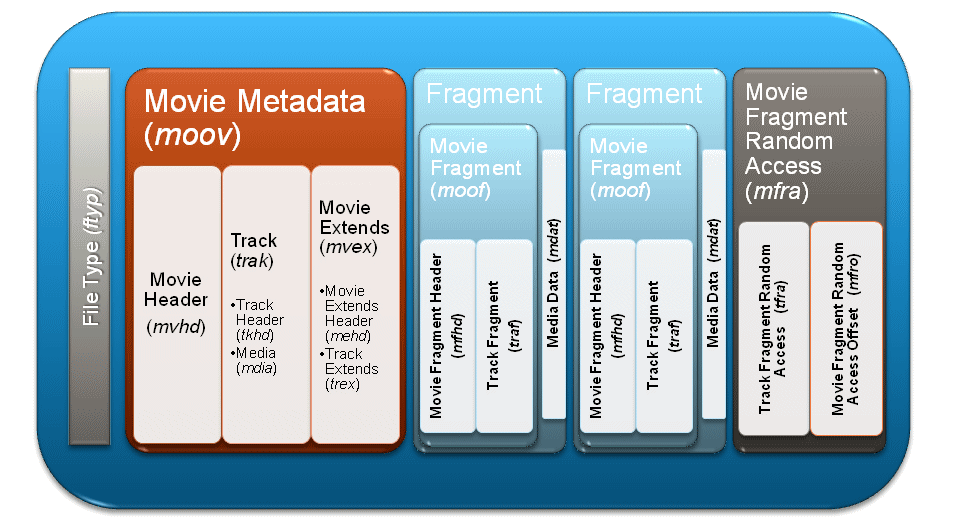
|  |  |  |  |
| --- | --- | --- | --- |
| Level | Maximum Bit Rate(Kbps) | | Maximum Resolution@Maximum Frame Rate |
| Average VBR | Maximum VBR |
| 1 | 128 | - | 128×96@33, 176×144@15.0 |
| 2 | 1,500 | - | 176×144@100.0, 352×288@30.0 |
| 2.1 | 3,000 | - | 352×288@60.0, 640×360@30.0 |
| 3 | 6,000 | - | 640×360@67.5, 720×576@37.5, 960×540@30.0 |
| 3.1 | 10,000 | - | 720×576@75.0, 960×540@60.0, 1280×720@33.7 |
| 4 | 12,000 | 30,000 | 1280×720@68.0, 1920×1080@32.0, 2048×1080@30.0 |
| 4.1 | 20,000 | 50,000 | 1280×720@136.0, 1920×1080@64.0, 2048×1080@60.0 |
| 5 | 25,000 | 100,000 | 1920×1080@128.0, 3840×2160@32.0, 4096×2160@30.0 |
| 5.1 | 40,000 | 160,000 | 1920×1080@256.0, 3840×2160@64.0, 4096×2160@60.0 |
| 5.2 | 60,000 | 240,000 | 1920×1080@300.0, 3840×2160@128.0, 4096×2160@120.0 |
| 6 | 60,000 | 240,000 | 3840×2160@128.0, 7680×4320@32.0, 8192×4320@30.0 |
| 6.1 | 120,000 | 480,000 | 3840×2160@256.0, 7680×4320@64.0, 8192×4320@60.0 |
| 6.2 | 240,000 | 800,000 | 3840×2160@300.0, 7680×4320@128.0, 8192×4320@120.0 |

**NOTE.** H.265 supports the maximum 300 fps and the maximum bit rate is the value based on 4:2:0 profile. If it is the profile supporting 4:2:2 and 4:4:4, the maximum bit rate, as to 1.25 times and 1.5 times get to grow bigger than the value of the Table 4.

**NOTE.** When the Frame Rate of 6, 6.1 and 6.2 level supporting 4K UHD from H.265 is 128 fps, 256 fps, 300 fps, the bit rate which is less than H.264 is needed. However, when comparing with H.264, it is on the rise as the problem that operation capacity more than the five times and two times is required in the encoding and decoding process.

The compression is needed so that the user can take advantage of VR contents smoothly. The H.264 and H.265 can be considered in order to compress the high definition high-quality video. If the HD channel 2 streams can be transmitted from 6MHz bandwidth which generally H.264 uses for the broadcasting, H.265 can transmit the HD channel 4 streams from 6MHz same bandwidth. Moreover, the H.265/MVC for 3D broadcasting is ready.

The operation capacity additionally needed for codec is not issued on network. However, it is needed for the transmission without any error of the video file on network to understand codec and compression file system.



*Figure 2 Architecture of Video File*

The network of the good quality in which the contents can be steadily transmitted is needed in order to serve the stable QoE for the virtual reality service user.

When the data file is divided into the packet unit and it is transmitted, it has to be careful so that lost doesn't may come to the packet in which MVHD (Movie Header) is contained. But when File is transmitted from network, network doesn't have the way in which it can recognize the packet lost. Therefore, it is the best way that it guarantees so that the total packet can be altogether normally transmitted.

It is the alternative would better securing the large-scale buffer for the stable mass file streaming. However, the memory Issue of the device has to be together considered. Particularly, IEEE 802.21 is the committee dealing the Handover issue. Therefore, the encoding problem and decoding problem that it can be generated in Handover is considered, it is necessary to suggest the solutions.

In the encoding problem and decoding problem that it can be generated in Handover, is there what?

July 13, 2017

**To:**

Dillon Seo, P3333.3 Chair

cc: Sangkwon Peter Jeong, P3333.3 Liaison

**Subject:** Response to IEEE P3333.3 Liaison Letter from IEEE 802.21 Working Group

Dear Dillon,

The 802.21 Working Group (WG) wishes to thank the VR HMD based 3D Content Motion Sickness Reducing Technology Working Group (IEEE P3333.3) for sending the liaison letter on developing the network requirements to reduce the motion sickness people experience while using a VR (Virtual Reality) HMD (Head Mounted Display). The IEEE 802.21 WG also thanks to the members of IEEE P3333.3 Working Group for participating in IEEE 802.21 July, 2017 plenary meeting and presenting the scope and high level objectives of IEEE P3333.3 work items.

The IEEE 802.21 WG looks forward to complementing the efforts of IEEE P3333.3 network work item by initially creating an Interest Group, the purpose of which will be to investigate and understand the issues related to networking aspect of VR HMD based 3D Content Motion Sickness. The IEEE 802.21 WG would like to request the access to the IEEE P3333.3 WG private document server for its Interest Group members. The IEEE 802.21 WG also invites the members of IEEE P3333.3 to participate in this effort and help understanding the requirements of motion sickness that are relevant to this activity.

Following are the dates and locations on upcoming IEEE 802.21 meetings:

September 10-15, 2017, Hilton Waikoloa Village, Kona, Hawaii, USA

November 5-10, 2017, Caribe Hotel and Convention Center, Orlando, Florida, USA

Best Regards,

Subir Das, Chair IEEE 802.21 WG

cc: Paul Nikolich, Chair IEEE 802 LMSC