BEN: I'm Ben Shirley. I'm a Senior Lecturer at the University of Salford. I do a lot of work on audio‑related accessibility research, as a result of which I have had the pleasure of working with some of these people. Welcome to the accessible immersive experiences’ session. The format of this session will involve Slido and a lot of questions from you guys, I hope. I hope you have lots of questions as we go through.

What I'm going to do, first of all, is go through the members of the panel and allow them to introduce themselves and explain what they do in immersive experiences and where they see accessibility fitting into it in the hope it will stimulate a few questions.

I suspect that almost everybody in this room has a slightly different idea of what an immersive experience is. Hopefully this initial round will give people a clue of the kind of things that we're talking about. Feel free to chip in on Slido as we go through and we'll get to your questions once we've been around the panel. Okay.

So first up we have just to briefly introduce people, we have Larry here who is Senior Director and Head of Accessibility at Verizon; we have got Rupert Brun, who is a Broadcast Consultant, currently working with Fraunhofer; we have got Chris Hughes, who works upstairs with me at Salford and is currently working on the iMac project; and, on the far side there, we have Jamie Hindhaugh, who is Chief Operating Officer of BT Sport.

Larry, can you kick us off and tell us about what you do in immersive experiences and accessibility. I shall hand you the clicker.

LARRY: If you can't see the screen, I'm appearing in black and white today. It is a corporate look and feel, everyone else is in colour. I'm Head of Accessibility for Verizon Media, a division of Verizon that is orientated towards the media and content.

I'm sure you have heard of Yahoo and many other brands. The accessibility team is making the products fully accessible as you have been hearing throughout the day. We focus on that. We have a small but a mighty team., 50% of which are attending the conference this week.

So, because we have been allowed to take on challenges around new and innovative technologies in the field, we, when we were bought, when Yahoo was bought by Verizon Media, a sister organisation was producing videos, augmented, virtual reality video.

That is a definition of immersive experiences, for shorthand we call it XR, X stands for variable, put whatever you like in the X but for us at Verizon Media and because our accessibility group was given this free hand we decided, because we could, we wanted to take on the question: If we are producing content that’s submersive, we should make it accessible. We happen to have a partnership. Let's see if there is a slide with Cornell Tech, a university ... there we go. In New York. It's a university in New York City. They have been receiving funds from one of our organisations, AOL, and they approached us. You see that the slide says July 2019, in January, a professor there said, "We are working on this question of virtual reality at accessibility, would you like to put together a workshop?" I said, yes. We decided to call together people we knew, Cornell Tech throughout the academic field, and Verizon Media through the tech world. We thought that the time was now.

We have been involved in gaming, we know the world of gaming, is the first step into virtual reality and gamers have been good on making their technology accessible. But we knew, or at least we had been saying, everyone on the panel has been saying that virtual reality has been the next big thing, it has been for two decades, maybe more but we are getting a sense it is going mainstream. We realise if we waited for it to go mainstream and then address accessibility, then it would be too late.

So, we put out a call to all of our connections throughout the world of accessibility and technology and the response was enormous. I see many people who attended the XRX symposium in the audience as they thought it was the right thing to do. We had an array of leaders with disabilities and users and academics and Microsoft and Google and Adobe and Oculus Rift, and Magic Leap, who hired a full-time accessibility manager. The companies don't all have that yet but they will. For a full day we hammered it out to address this technology.

I love it when we tell people that we have now an XR access symposium, they say, really you are making virtual reality accessible to blind people, how do you do that? My answer is, "I have no idea." But people really care and they are dedicated to this. Many in the room today, Chris from Google for one. We broke into 12 breakout groups to deal with issues like Haben was talking about, haptics, from learning developments, lifelong learning, sound and image recognition. We talked all day, an amazing event. From that day we put together XR access, a website that we have, we have xraccess.org. Six working groups, we have volunteers dedicating their time to lead the groups, really all over the world. We are joining together on a regular basis. We have an executive committee made up with people from the tech sector with disabilities, we are hammering this out. It is not a short-term project; we assume it will take a long time. We know that people want to get together, we are and we have, from today.

From next June, the folks from Immersive Accessibility are putting together a workshop all day in Barcelona at the IMX Conference that will be posted on the website. We are having a call for parents; we are calling for it right now. If you have something you would like to present in mid-June about XR Access, we are to join together to be a part of the main conference at IMX, it will keep going and going, another symposium and we are really putting a call out to as many people as possible to join us and I am looking forward to working on the Imac project. They are the cutting-edge on the tools we need and the demonstrations of it. A couple of things, how ... how is the time?

BEN: You have a minute.

LARRY: Our company has been doing virtual storytelling. We did a story about the anniversary of the Stonewall riots in New York City. An environment, immersive, you can feel like how that was, what it was like. We thought, how to make that accessible, right now we are going with handheld mobile devices. We are looking at, hey, we are a commercial company, we are using ads. Lots of shopping that is using VR, we are using image recognition, speech recognition, voice in, voice out, to make the commercial aspects of augmented and virtual reality accessible as well.

Microsoft has done remarkable work with seeing VR, plug-ins into lenses where there is a full array of technologies to enhance the experience already in virtual reality for a hollow lens that was developed by an intern at Microsoft who was also the Cornell Tech. That is the last of my slides. You can go to the website; we are ready to work with all of you.

BEN: Thank you very much, Larry. We heard a plug for the Imac project. That is good. As I am involved with the IMX conference in June, I will give an additional plug, it is in Barcelona, a nice place to be in June if you have something interesting to present or wish to know more about what is going on in that order.

So, over to Chris Hughes, if I can hand you that.

CHRIS: Thank you very much. It is very exciting to be here. Thank you for inviting me, for the introduction. As Ben introduced, we both worked for University of Salford. It says something about one of my frustrations of the academic world, that we both work in accessibility. I was there for two years before I realised his office was 40 steps, I counted from my own. Now we have found each other, it is quite an exciting time!

So, I am an electorate at University of Salford. Based in computer science so, a technologist. I like playing and solving problems with computers. I am heavily involved in the immersive accessibility project that was referred to. In that project, I get to work with a consortium of impressive people all the way from industry, academia, broadcasters, bringing together all that we think that we need in order to develop that kind of full solution.

So, I like to plug the project at every possibility. This is one of them to tell you a little of what we are doing. I will talk over this. On our website, if you are interested in what we are doing, there are loads of great videos to tell you about it. This is a nice visual too, it’s in the background to give you a teaser as to what goes on.

Within the project we had 30 months, we were focused on the idea of immersive accessibility. So, by immersive accessibility, I mean immersive video. This is where we are creating the illusion that the content is all around you. That it works to the point where you feel some kind of presence as you feel you are actually immersed within the environment. Although the broadcasters are very much interested in playing with 306-degree video, what they can, do if it is the next big thing, we did a full survey of 360-degree players that exist and the accessibility is very limited. We found that most of them attempt to do work with subtitles, they lift from what happens in the TV world and try to put it directly into a 360-degree space. None of the existing platforms have really focus on how audio description may work or sign language may work when it comes to this environment.

So, the project has focused on completing an end-to-end workflow solution that allows us to start at the beginning with a suite of tools to allow us to create sign language and audio description subtitles within the 360-degree space all the way through a player that we have at the end of the process.

It is a European-funded project. So, the player, it is completely Open Source, we are making it available for anyone who wishes to use it and all of the research along the way. The follower follows a user-centric methodology.

In the immersive 360-degree world people were guessing about what may work in the space. We have been lucky we were in the project that we had the space to talk to users, to find out what they want, the focus groups that allow us to find out initial ideas, then we could have several cycles of development to build prototypes and to take back to them, to find out what works, what does not. As well as in the project, is developing a player and the tools in the pipeline we have a massive amount of research and information that is all published that tells us about what the users want, how they feedback and respond to things. So you can see in the background this is a few screenshots of one of the videos, you can basically use the player, it is web-based, it works nicely on any platform, so whether that is a head, mouth display, so you are immersed are on the mobile phone to move around and look and feel you are in the environment, it works nicely across the board but we have built in on the top all of the accessibility services you may expect.

So, yes. I am keen to plug the player and the project at any opportunity, so if anyone is interested in this, do talk to me, I can point to you to the demos and we have a great website to tell you about it.

BEN: That is great. How long does the project have to run?

CHRIS: It is a 30-month project, running to April. So, we have been through two development cycles, we are now at the point where we will push out to a larger scale open pilot. That is an exciting time. A couple of the broadcasters involved in the project are embedding it on to the website and pushing it to users in the wild, as it were.

This is a good time for broadcasters and content creators to get involved in the project because the tools are there, I guess.

CHRIS: Absolutely.

BEN: Thank you very much. Next, we will go to Rupert Brun. Now I have worked with Rupert for a number of years when he was at the BBC previously and now, he is working as a consultant. I have worked with his colleagues at Fraunhofer on a number of different areas around accessibility and immersive audio and so on. So, if I can hand over to you to explain some of what you have been doing.

RUPERT: I want to ask a question for those of you who watch television. How many of you have struggled to hear what has been said because the background music has drowned it out? Yes, lots and lots. About a decade ago, I learned this was a growing problem.

Firstly, we have an ageing population. Secondly, the ways we create and consume media are diversifying very rapidly. It used that be that we all watched television on a big box this size, with decent loud speakers which gave great sound. As technology has advanced, televisions have gotten thinner and thinner. They have very small loud speakers, very often pointing down or pointing backwards. Particularly with the inexpensive models it can be quite hard to understand what is being said. And then we consume virtual reality and consume content from our mobile devices on the underground train where it is very noisy. The whole experience is diversifying very rapidly. I realised this was going to make this problem far worse.

So, I started looking for people to work with and I met up with Fraunhofer and six months later we did an experiment from the Wimbledon Tennis Championships in London we had a web player that allowed you to watch the matches from Centre Court and a single slider control that let you rebalance the sound. If you pushed it one way you got very clear commentary and virtually no sound from the court. If you pushed it the other way, you got the sound of the court with all of the baseline grunting, as people were serving the ball, and virtually no commentary.

I learnt a few things from that. I, first of all, learnt that the audience and the public liked it and they understood it and they wanted it. I also learnt that the BBC were doing a good job of creating a sound balance that was in the middle of the range that people wanted but that almost anybody wanted! If you are focused on the game and you know your tennis, you don't want the commentator, you want the immersive experience of being on Centre Court at Wimbledon and watching that match. If you have a hearing impairment and you are making the dinner to watch this thing, you need the commentary to be loud and clear otherwise you're not able to follow it otherwise. I realised from those things I'd learned that there was potential in this.

So, let's fast forward nine years later, where have we got to? Fraunhofer have turned these ideas into an open international standard called MPEGH audio and it is on the air in South Korea. If you go there, perhaps we should all go, you can actually have on your television screen controls that will let you adjust the sound balance. How you do that is something that we need to do some more work on. I'm an audio engineer; I'm happy to have my television screen covered in controls and sliders and meters and play with all of that! Apparently, some people don't want that! So, what we offer are some simple pre-sets where you can have the broadcast mix or you can have one with a dialogue boosted or one with the audio description enabled, you can choose different languages. It is not just of benefit for an accessibility use, you could, for example, if you are watching a football match and it is Liverpool versus Arsenal, you don't want to hear cheering when Arsenal score, you want to hear the boos. You could decide who you sit with.

There are huge potential uses for it in addition to the accessibility benefits. It also does the immersive with sound going up and down, forward and backwards and left and right, we can do it with the sound bar underneath the television. We don't need big loud speakers anymore. What is good about this is that the accessibility features are part and parcel of the whole offering, there is no incremental cost to the content creators in creating those or in the consumer products in incorporating them. If they're going to do MPEGH audio, you will get the lot. There is no excuse for a poor accessibility experience, it's all there.

We have consumer products and we have a full range of commercially available production tools to create the content code, distribute it, it works on television and online. So that's what I've been doing. I'm very much looking forward to some questions when we've got past the introduction from the other members.

BEN: Thank you very much, Rupert. I'm particularly interested by the way in which the accessibility features are just another part of the personalisation features so it becomes a standard feature set which sounds like it's something that is a lot easier to pitch and to sell to broadcasters and so on. Okay. Jamie, over to you.

JAMIE: I'm the broadcaster you are pitching to! I have worked with Rupert as well but we've never had a conversation before this and we're doing something similar actually which is quite interesting. I will take you on a little story. I'm from BT Sport. I joined from the BBC to help launch and set up our live sport UK‑only sports network, which is online and on television. We have been around about seven years in quite a competitive market. We have built up quite a solid reputation around using innovation to take people closer to the action. So, we were the first live sports broadcaster in the world for 4K, first live sports broadcaster in the world to deliver Dolby immersive sound, and the first to do 12 cameras with 360‑degree coverage.

On 29th July ‑‑ this is not a sales pitch by the way ‑‑ it is a story to take you through where we're going, and it will make sense. But on 29th July this year we did something which I was very proud of: we launched a new channel called BT Sport Ultimate. BT Sport Ultimate is literally the title is about giving the audience the ultimate viewing experience. It is about building trust with audiences and not having to talk about 4K, WCG, DA, et cetera. What it does is very, very clever. I think it is anyway. It is one channel that will determine what platform you're on, what connectivity you have, and what subscription you have. It will serve a variant of that content. So, if you've got a fantastic 4K TV, you will get 4K HDI. If you are on your mobile, you will get HD/HDR. If you have an old TV, you will get 4K HDR. You get the picture. It is about being very clever and serving one channel to very many different people.

Now the challenge with that, that's the ultimate viewing experience for about 90% of our audience. The thing that really interests us is around the fairness agenda actually and it is about if you go to the heart of what sport is, it's a real social experience. Therefore, how do we through BT Sport Ultimate create a more inclusive environment which means it is truly sociable for everybody regardless of challenges they may have. We've been doing some work with research and development and looking at what I should have mentioned is BT Sport Ultimate is delivered over IP. What this means now is as a broadcaster you are not doing one to many anymore, you are doing one‑to‑one and that's really important in this.

We have been working on a technology called object‑based broadcasting. I'm not sure people will understand what that is so I will just give you a little definition to help understand it. Think of a sandwich, think of two slices of bread. They could be brown, wholemeal or white. Think about that as your channel wrap. Think about the sandwich, you could have ham, pickle, you could have cheese or tomato or cucumber. Dependent on your taste you may choose a different colour wrap and you may choose different ingredients. If you think about that as a broadcast feed ‑‑ are you staying with me ‑‑ where each one of those ingredients is a package and each one of those packages is content that we create and curate. This is what our object‑based broadcasting will do and where the BT Sport Ultimate experience will come from.

We are far down the line here and we will be launching something next year and this will become a feature of the ultimate viewing experience. Rupert has touched on it. So audio, if you are hard of hearing you may want to turn the commentator up and down or the background sound up and down, that's our standard provision under BT Sport Ultimate. If you are a Liverpool fan, you can turn Michael Owen down!

Colourblindness: It is a really, really important facet and people may not realise it but 99% of people with colourblindness are male. Football is very difficult to watch. So, having an opportunity to be able to select a variant of the live game that is adapted for colourblind people means you can still all watch it in a shared experience but you choose it in that way. Different audio, one of the things we are looking at to launch this is about blind commentary, which is different from radio commentary and it is different from TV commentary. What we want is people to be able to select in a live environment, I want blind commentary rather than this. You create this everyone getting together and everyone joining in. The other thing, this is a really, really simple thing but I think it is effective people who are hard of sight, it is two‑fold. Firstly, we are going to give people the opportunity to make the score clock bigger or smaller. So, depending on where you are sitting, you can create in a live environment that different experience.

Graphics overlays: sometimes either the colour of the graphics is wrong, the detail of the graphics is wrong so let's give people the opportunity to select different graphics that suit their needs better in a live environment. Also, the last thing on this, which I think is really, really important as well is we still have the old‑fashioned broadcast of one‑to‑many. If we put a programme out that goes lovely on a large television screen, we do the same version on a mobile phone which to be honest is awful. Even with the best eyesight in the world you can't read some of those graphics. We are looking for you to be able to decide the device you are on and select the best graphic overlay that best suits your requirements. It is really, really exciting technology.

This isn't just cuckoo land, we are doing a massive event next year around this with all of the aspects I have just spoken about, we are looking for BT Sport Ultimate to become the truly inclusive relationship and to enjoy sport together, which I think is what my job should be.

BEN: It is fascinating. It sounds again like the accessibility element has become part of a personalisation package, as a broader approach to it. Following up on one of the points you are saying about colourblindness, the top question we have at the moment on Slido: "Is there any way of making snooker on TV more accessible to a colourblind viewer?" It reminded me of that famous bit of commentary on the BBC ‑‑ was it on the BBC ‑‑ "For those with a black and white TVs, the blue ball is the one behind the green!" Very helpful! So, Jamie, what's the solution for colourblindness in football?

JAMIE: Yes...

BEN: I imagine it is the same solution.

JAMIE: There is software out there, it is working out how you make that software available with the broadcast feed. What it actually does is change or enhance the variants so you can see the difference between colours. I get quite prolific on Twitter and we get a lot of feedback. Every now and then ‑‑ I do listen to it ‑‑ we will do a graphics overlay where we have done blue on black, which actually if you are colourblind is bloody useless. So, there is technology there and we're looking at this mechanism to give people that opportunity to select that but also allow them to select it but other people in the room can still watch the live sport at the same time.

BEN: Yes. Now, that's really helpful. Here's another one for you, Jamie: "Why have BT Sport Ultimate on its own, why not have it for everyone? Does it cost more?" That's the most popular question, which suggests a lot of potential custom for the channel.

JAMIE: We're a paid TV service anymore. You have to pay us to get BT Sport. The ultimate viewing experience for me has to be everything, which has been more of a challenge. So 4K, we did live AK in Amsterdam, it will be coming very soon with us. Again, I'm not going to be talking about BT Sport are now AK, what I want people to do is that BT Sport Ultimate is the ultimate viewing experience that gives you all of these different aspects and yes, it costs a little bit more. Over time I believe it will become standard. It is challenging but it is also a fantastic opportunity to allow people to enjoy sport in a very different way.

BEN: There are a couple of questions around VR and AR, what research is being done to date to understand the barriers with using VR and AR. For visual impairment there are clear barriers there, another related one around, it has fallen off the screen somewhere ... around somebody not having come across useful solutions for VR and AR and accessibility. Larry, is that something you have looked at in the XL forum?

LARRY: Absolutely. The initial questions, how we map out linear solutions for the media with the environment. So, thinking about close captioning, we are subtitling, great work done by both the BBC and Imac, the interesting question of the immersive environment, where to put the captions? The bottom centre is default, if I am sitting here and Ben is talking to someone else, I am listening in, should I have his captions here? Or turn this way, the captions get larger. The BBC did interesting research that concluded that we need more research!

BEN: All good research does that!

LARRY: But the issue really is, how to take what we have today and go far beyond that. Solutions are being in the middle of development, the Imac editing tool has interesting ways of indicating where the captions are coming from, using colour, arrows and the same for description in an immersive environment for a blind person. Audio description exists but if you are blind in an environment, how do you know if there is anything to see? Bacons? Gestures? Haptics? And the Imac means you u can go to a time and a place you can hear a beacon, a sound, all different ways of indicating that there is something to be described for you. We considered something called countries description, where you can use haptics or any number of ways of signalling to people there is something out there for you to absorb. It is all in development now. I would not say there is anything available commercially in the field yet but that is absolutely what our XRX initiative is studying.

CHRIS: One of the real beauties of this for me, is so, the action is happening there but mostly, I am interested in what is happening behind that is really difficult then if you have a disability, you cannot follow the audio queues for example that tell you that the action is behind you. As Larry said, a lot of what we have done in terms of the ImAc player we look at ways of indicating where the person speaking is. So, we don't want to force you to follow the main action, as I say, if you are watching the opera, it is more interesting to see what the conductor is doing or what is happening behind you in a field somewhere.

So, we have trialled various different approach, such as using arrows that give you the indicator that the action is behind you. Or a radar display to use, it is all about customise and choice, what you find the best approach to use.

I think it is also important to remember in terms of immersive content, it is a combination of things, it is not just video or audio. 360 degrees video, we have fantastic amber sonic sound. You can create sound that feels behind you and create the queues for the person that is speaking, you can hear it behind you, or you have the video and you can create the queues in there as well. It is an important point that all of the things are there, if some of the queues don't work for you, then that is at the point where we need extra information.

BEN: All of the sources of information are for different specific needs apply equally to gaming as to VR and AR?

LARRY: The gamers have done great work. Captioned games have been around for years. Insets where you can focus on a particular area, we are learning a lot from that community, this is a foundation called Able Gamers that have delved into that, mostly around ability impairments but also looking at sensory. So, we are learning from the gamers but they have their own world and we are looking to extend to everyone who may benefit.

RUPERT: An opportunity with we get immersive audio that moves around the room when you are consuming media, it comes with audio description, it is possible for the user to decide where in the room the audio description voice should come from. If you move from the screen to be a voice near the shoulder of the person who wants audio description, there are two benefits. The first, it does not have to be as loud in order to be understandable as it is separated in space from all of the other sounds and the other advantage it is less distracting for those watching the content with you who don't need it. This is technically possible but yes to persuade the broadcasters in Europe to use them and find out how they work for you which we cannot do until it is experienced.

LARRY: There is interesting mainstream application, that is the Bose sunglasses, they are doing really interesting immersive work in audio, $200, you get spatial audio in various environments it points where we can go with audio only immersion. It is really interesting. I don't know, if they even realised what they were creating that may help people with disabilities, Bose but we give them a pat on the back for that.

BEN: On the audio theme, one question, how do you see immersive audio experiences driving innovating talk podcasts in the future? Rupert?

RUPERT: It is a good question. I had not thought about immersive podcasts. Radio dramas, that is an area. If we move from the traditional podcast content of a couple of people sitting and chatting and thinking about it as delivering spoken word over the internet, so that it can be personalised. Certainly, radio drama is a clear area where you could make it more accessible for people.

Drama in general, this is a lot of work being done by Ben and his colleagues in Salford around making drama easier to understand because in a drama it is not just the dialogue you need to hear in order to understand what is going on, it might be that some of the other sounds like a gunshot or a car pulling up or a door slamming are also important to understanding the story.

They have been doing some really good work on the narrative importance of the different sound elements that could be delivered over an IP platform as a podcast, for example, so that you can have one simple control that lets you decide how important you want the speech and the sounds that are important to the narrative to be, how loud and clear they should be compared with all of the rest which is just pointing the scene. One simple control can change the prominence of those things in a sophisticated way, so you have a nice, easy user interface and get a good experience and you don't just get the sounds boosted but hear the sounds that are important hearing the story. If we can get that incorporated to podcasts, we are on to a winner.

BEN: Thank you very much. I am not able to plug things being the Chair but I am grateful you are plugging it for me. Very kind.

RUPERT: You can thank me later!

BEN: In terms, I guess we are talking about object-based media, rather than immersive media, is there a down side to these potential for personalisation? Can there be too much?

RUPERT: It can be presented in ways that are too complex for people. That's a hurdle we have to overcome working with the manufacturer of consumer equipment. Another challenge I met from the industry is that the sound balancers will spend hours, days, even weeks finally crafting the sound balance and then you say, "The public can mess with this and change it around." And some of them react badly and don't want you to be able to alter their finally crafted sound balance.

But I find that most people, when I talk to them about it, they realise that actually, this is really liberating, you are going to create content that people listening on televisions with small speakers and who have a hearing impairment are able to engage with, the dialogue must be louder than it needs to be for people with normal hearing and a really good home cinema system. So, one sound balance system will not work for all, if they try to do that to create a perfect balance, it is perfect for them in the room they created and no good for anyone else. The industry is realising that allowing them to tweak with the finely crafted sound balance within parameters is liberating and a real creative tool and it is not going to degrade the original artistic intent. It will make the original artistic intent available to a wider range of people on a wider range of devices, but it takes a while for the seasoned professionals to make that journey.

LARRY: The user interface, some of the worst UIs have been developed by TV manufacturers and cable and set top box manufacturers. Downsizing is now a challenge. Make it easy for people to make it best for them, to make the personalisation best for them that is a challenge.

JAMIE: Can I come back on this, Ben? A challenge that we have is we are Ofcom compliant, so we have experienced sound mixers. A really good example is Celtic/Rangers, sectarian chanting. So, we mix the sound to ensure that it does not come through as in the Ofcom licence we could be at risk of breach or complaint. The challenge that we are looking at is by allowing people to turn down the commentary or turn the background noise, we are talking to Ofcom to make them aware of the technology. It opens up the challenges. It is an interesting one and also an interesting opportunity to look at what we are doing.

What is important to flag is the more packages that I create to give more choice, the more intensive it is. At the moment I am doing a live feed with a single graphics overlay in the middle ground. In the new world, I will probably have to create four, five, six different graphic overlays to go with the feed so that people can select the ones that they want.

There is more work required for the right reasons on the ground but we have to think of our obligations around Ofcom, you start asking the question, which feed were you watching and can you track that and flash the imagery. All of these sorts of things must be thought about in the rounds of offering choice.

BEN: It is interesting, the Old Firm game and the elements of sound. You would not want to accidentally push up -- and one of the questions that popped up here along what somebody said about being able to, I think Rupert, about not wanting to hear when the Chelsea fans cheer when there is a goal scored, there is a risk it creates an echo chamber. I wonder if there is a link between the question and what you are saying in terms of if you can choose an area of that ground, there are risks around it, potentially, you must be careful how the personalisation was presented?

JAMIE: We have looked at part of the OBB roll-out, giving people different commentary depending on the teams that they support. We talked about this; it is like doing an election special with screens flying in everywhere. And at the heart of what we are trying to do is to enable people to understand and to enjoy the sport the best that they can. I think that the focus should be on enabling more people to sit together to watch the sport, and that is where the opportunity is, the challenge is that people try to do gimmicky stuff that looks good for two minutes and then the people don't use.

BEN: It seems that the technologies facilitating the immersive experience are also facilitating new ways of providing access services and new ways for people to be able to better experience immersive experiences. As a brief finishing thing I wonder if you can each say what does the future look like in terms of accessible immersive experience and what is the time line. Larry, first.

LARRY: I like the idea we have been talking about, that is personalisation. As technologies in a non-invasive way begin to learn how we use them, they should shape to our needs. If, for instance, you are constantly moving the audio up and down as it is not working for you or you are hard of hearing it would be nice if it just adjusted and said, this person needs a boost in the mid-range. Let's set it that way and recognising that the wife was in the room, she has perfect hearing she does not need that. The immersive and the flexible interfaces, that they learn from you, it would be a great timeline. The easy stuff we can do within a year. Captioning, description, taking what we know but we want to go beyond that, I see two, three years. We want to apply image recognition, speech recognition to all of the platforms, speech in, speech out, it is not that far in the future. The next five. We are good then to have accessible immersive experiences.

RUPERT: I see a future where the content creator creates one thing which contains all the different elements and the information needed to ensure that you get the best possible experience whatever device you decide to consume it on, whatever environment you're in and whatever your needs may be without you having to even think about it. It will just happen and you will get the best possible experience.

Timeline: I don't see it happening on broadcast television, over the air stuff any time soon because there isn't the bandwidth. But I think some of the European broadcasters will start delivering it over their online IP‑based services within the next year, I think we will say some stuff happening. It will be experimental and only occasional at first and it will become time to become the norm but I'm pretty confident we will see something in the next year.

BEN: How soon for the ImAc?

CHRIS: ImAc‑wise, we have got to the end of several cycles and we have an open pilot about to start so actually ours will become available very soon. The future is an interesting direction. I mean, I agree with everything that has been said from the perspective that it should be ‑‑ we should be developing one product. At the moment, we're developing a movie and then the accessible version, or the accessibility services on the side. In terms of the future, I really do see this inclusive scenario where it is one product and then it is down to customisation and you just turn on what you want or you render in whatever way you want it to work for you. I think that will be a much more exciting place. In terms of time frames for that happening, as established in conversations earlier, I can never work out time frames! I build a prototype in the lab and I expect somebody to be using it the next day! That's as unrealistic as I ever get in terms of time frames. I think we're going to see a trend and start to see things improve now and it will continue for many years to come.

BEN: What does the future look like and what is the timeline?

JAMIE: I think it will be the ultimate experience ‑‑ excuse the pen ‑‑ I will be bold, 2020. There you go!

BEN: Next year. We've got a launch date or a launch year!

JAMIE: Throw a few months out!

BEN: We will wait to see. Thanks very much to the panellists. For me, it's been a really interesting conversation around not just accessibility but how that's embedded in personalisation as a whole, which sounds like a great sell into the broadcasters and so on to make sure that material becomes accessible. So, if you could give them a traditional round of applause for their input.