PAUL NICHOLLS: OK, so we're going to make a start if we could have some quiet at the front here, please. So first of all, thanks for Jeff from CG Architects and Marion from Autodesk for inviting me back this year. This is my second year at Autodesk University.

Yeah, Factory Fifteen are a relatively young company. We're five years old. We're London-based, and we work in film, animation, various different medias, architectural visualization. We're all architecturally trained, but we did our master's in architecture and fiction. So it's a slightly different way into the industry. And that's sort of why we have quite a lot of different strings to our bow in some ways.

So we kind of develop our own narratives, our own stories, our own projects essentially. So we're not just a service provider, although we do do that as well, obviously, for architects, and developers, and advertising. But everyone in the studio sort of comes from a multidisciplinary background. We don't really have anyone that works purely in architectural visualization. And the whole team kind of expands through lots of different medias.

We've recently moved studios. This is our new studio, which has a kind of gallery at the front of it. So the whole idea with the new studio is that we would operate more within the art space a little bit as well. And we have a different-- a platform to showcase our own work, but also invite other people into the space to exhibit. We also have a dedicated VR area where we do lots of different testing in R&D for different kinds of projects, both commercial and noncommercial.

But again, we do lots of different pieces of work. We do concept art. So this is a piece that I showcased last year that we developed for a potential film that was being developed at the time. This is, again, for a TV show that has come back actually. We did this a few years ago, a whole sequence of design work and visualization for a guy who was writing a novel. So we're trying to get clients that allow us to express both forms of our arts that we like to do. One is design, because, again, we're architects, but on the more fictitious side.

And the other one is visualization. So we try and find projects that facilitate both needs.

And then a range of different things-- this was for, again, another TV show, which is an interpretation of *20,000 Leagues Under the Sea.* And this was one of our own short films that we did quite a few years ago now called *Jonah,* which involved design of cities, but also design of underwater. We also do-- again, we like to experiment in other forms of media. This was a dome projection project that we did for the SAT last year called *Cocoon.* And again, we don't like to limit ourself to photorealistic. We often prefer a more stylistic approach to visualization. This was a still from a film that we did for HWKN here in the States earlier on this year.

But we also do the more typical photorealistic stuff as well, obviously. Again, these were some projects for HWKN. This is a still from a project that we've just finished, actually, a film for American client which I can't say much about. But it's all about representing a building for a potential new type of interactive theater, so a theater which has been designed around technology or augmented reality, virtual reality. But this is our show reel, which should give you a flavor of the work that we do, if I just can get the sound on.

[VIDEO PLAYBACK]

[SOUND EFFECT]

[MUSIC PLAYING]

[END PLAYBACK]

So the concept of today's presentation is a bit of an experiment for me. What I'm trying to do is show our process essentially. Often we get asked-- you know, the work that we do on paper or on the screen is very different, or it looks very different. But my response is always the same thing, that we-- the approach that we have, both creative and technical, is sort of the same.

So on the surface, we have two very different projects here. We have a film

for the World Cup in Qatar, what is a very commercial architectural visualization project. And then you have a project like *ANA,* which was a proof of concept TV show for the History Channel. So on paper, they couldn't be more different. But again, the creative and technical process was exactly the same. And I'm going to hopefully illustrate that. We have a few minor differences, but predominately, exactly the same.

And just to note, we're quite a small team. Were about 12 people full-time. At any one moment, we have three to four freelancers in the studio. So we're not like a huge team or anything. But hopefully, I'm going to show you that we try and work on a scale of project sometimes bigger than what our studio should be able to produce-- or hopefully, we should say.

But any project starts with the storyboarding phase. So the *4th Precinct* was no different. It had a kind of-- this is almost exactly what we would propose to a client, you know? We have a narrative overview where we give a few lines, to the client, of our general approach to the project.

We'll then show them a general film structure. In this particular project, like most stadiums these days, there was a big emphasis on legacy, and obviously, while showcasing the tournament itself. So this project more than most, because the legacy was almost the main starting point with the design, because the stadium itself was going to be transformed into apartments with a park inside it instead of being kept as a football stadium, or a kind of athletic stadium, or whatever like there sometimes happens-- so what we wanted to do was to kind of cut between tournament and legacy quite dynamically.

And in some of our original proposals, this became very, very dynamic. We were cutting back and forth using kids playing football inside the new park, cutting that with the actual football game in tournament mode. And that got developed over the time to be kind of these four main chunks, basically. So anything that's blue is tournament mode, and anything that's brown is the legacy mode. And that's how we kind of illustrated it to the client.

So we didn't storyboard it from a shot-by-shot way as you would, perhaps,

more traditionally. But it was more these kind of areas that we were proposing. Because we didn't want to try and fix ourself too early, at this stage, to a shot-by-shot narrative. We wanted to kind of propose these different areas.

We did have a few shots in mind, like this huge timelapse shot that we proposed. And that will be the one shot that I'll be breaking down in detail for this project. So each project, I'll be breaking down one-- the most ambitious shot from each project in a lot more technical detail.

So here, we transfer to legacy mode after we've gone through this huge timelapse, because we started off in tournament mode. We follow a family, particularly these two kids who end up playing football within the park. And then we transition to tournament mode, where we see a game going on.

There's a foul, there's a free kick, and the main player scores. And then you realize, when you cut back to legacy mode, that the guy that scored is actually the dad of the kid who was playing football. So it's quite a sweet little story where the kid is kind of emulating the celebration of the dad. And then we finally reveal the full stadium in its full context.

Now, *ANA* had a slightly more traditional approach. It was a shot-by-shot narrative, because it had to be, because it was being proposed, quite literally, to the History Channel. So it would be-- this is how you would typically lay out storyboards to that kind of client, which is shot number and action. So you'd have to visibly see what's going on in the shot on what's happening for every single frame that you would draw. And these are some of the frames and the level of detail that you would go to.

And often, even at this stage, it's starting to inform the production design of some of these environments. Because in this project, we had to build everything, both physically and digitally. So we were building the apartment, literally, within a shell. And we were building a lot of the factory floor stuff, including importing lots of mechanical robots from the Japanese company called FANUC.

Obviously, from there, we jump straight into previsualization. From the *4th*

Precinct--

[VIDEO PLAYBACK]

[BIRDS CHIRPING]

[END PLAYBACK]

--this is just an idea of-- I think this could be just the first-- the shot I'm talking about. I don't think it's the whole thing, but it's the dramatic pull-out of the timelapse. And this will just show how crude we start.

[VIDEO PLAYBACK]

[BIRDS CHIRPING]

Actually, this is more or less the whole thing. But I'll pause it after the initial timelapse.

[BIRDS CHIRPING]

[CROWD CHEERING]

[MUSIC PLAYING]

[STREET NOISE]

[END PLAYBACK]

And you know, it's quite funny to watch when you look back at it. But everything that's hand-animated with characters, our main animator will just do these quick, crude animations to communicate the concept. Here, we're transitioning using the kid kicking the football to the dad kicking the football in tournament mode. And we have quite dynamic cuts between big, wide shots of the stadium itself-- important for the architect, obviously-- and you know, action shots and close-up shots of the crowd and the players themself.

But it's amazing-- I always find it amazing, when you look back at these things, just how similar all the shots are, even camera positions and everything, to the actual final result. You know, 95% of these shots exist in the final film that I'll show you at the end. Then he celebrates. And then you cut to the kid celebrating as well. You get the idea.

So *ANA* was probably the most effort we've ever put into a previs. Because it had such a tight shooting schedule, we had to use our pre-production time most effectively. And this was a real challenge to get right. And we had to work with a DoP, Director of Photography, who wasn't used to working-- or looking at previs. So we had to kind of bring him in and educate him into the process so that he could help inform the camera moves before we even got to set. So this was quite important.

And we even went as far as to start to try and light things in previsualization just to get an idea of where we would start to light and put lighting on the actual set. And by this time, when we did the previs, we knew we were shooting-- or we did eventually, once we developed into the previs. So we could actually start building scenes and sets to scale, to the actual environment we would be shooting in. So this whole process informed the filming, but also the production design that we had with our production designer.

[VIDEO PLAYBACK]

[MUSIC PLAYING]

So this is just a few clips from the previs. It was quite a long project, so I'll show a few clips.

- Ana, how long is this going to take?

- Give me one moment. The backlog
is currently 83 minutes. Your train
leaves at 17:03. Have them
[INAUDIBLE] to be delivered at
21:30 once you're back from the bar.

Shall I push everything back?

- [SIGH] .

- I think I can fix it for you, but I need
you to override the system for me.
The forecast says there's 92%
chance of rain later this evening.

[END PLAYBACK]

PAUL NICHOLLS: So that was the scene of Jim in his office. He's talking to the computer software ANA, who is essentially tricking him into giving her full control over the factory that he's operating. It's a car manufacturing factory. So that's kind of establishing Jim's relationship with the operating system. And then this is when he goes, actually, down to the factory floor itself and investigates what's going on, because ANA's behaving in a strange way.

[VIDEO PLAYBACK]

[MUSIC PLAYING]

- ANA, request temporary shutdown
of processing line 783 alpha, please.
ANA, repeat, request shutdown of
processing line 783 alpha. ANA,
respond. [SIGHING]

[GASP] ANA?

Ugh!

ANA-- ANA, what have you done? ANA--

[POWER SHUTTING OFF]

[MUSIC PLAYING]

[MACHINERY RUNNING]

- Update complete.

[END PLAYBACK]

PAUL NICHOLLS: It goes on. So, so much of that actually made the final film. It's unbelievable considering how much more work, after that, was done to get it to be finished. But it just-- it helped everyone. It helped lighting department, it helped the production design, everything. It informed in the whole process, really.

So filming-- back to the *4th Precinct.* So this was quite an ambitious-- both projects were actually two-day shoots. So everything had to be done in two days for both films. We shot this film in Spain, mainly in Malaga football stadium, which was a real kind of win for us, being able to shoot there. Because there was lots of other stadiums, both in the UK and Spain, that we looked at. But this one was the kind of class that we needed in terms of the lighting.

Even though we were replacing all of the grandstands, the pitch was of good quality. And the positions we could get the camera in were very realistic to a real football game. So that's what we did. We positioned all of our cameras as it would be-- apart from the on-pitch cameras, they're all kind of reasonably realistic football cameras. So that was quite important.

We filmed on lots of different rigs, Easyrigs. This was our football team, which we ended up accumulating from different people around Spain. They're all semiprofessional football players, but they didn't play in a team together. So we got a football coach assistant, an ex-professional from Malaga football team who helped us kind of coordinate the team and plan all the action. And these are some shots of the shoot and some of the positions we were able to get the camera in. We shot on some insane zoom lenses, like a 270 zoom lens like the real football zoom lenses.

And I think this is the shot. So again, when we do the previs, we didn't know

how we were going to do this shot. It was quite a brave thing, I think, for us, looking back at it, to kind of propose this shot to the client, this huge timelapse shot, when we weren't really too sure how to do it. We ended up shooting it on a drone camera, from the ball out to the extent that we could get into the far corner of the building. And then we transitioned to a digital camera to complete the shot.

So *ANA*-- and I think that might be actually a little-- yeah, sorry, so here's the shot. Didn't play automatically. So the kickoff-- it's the beginning of the tournament. And the camera pulls back into the far corner. The funny thing about this is that we probably did this about seven times. The first time we did it, the camera was perfect.

But after about four seconds, the team had scored, which wasn't-- which wasn't the idea. And then they went off on this huge celebration out in the far corner. And we were just like, that wasn't supposed to happen. You just need to kick it about for a bit, guys. Don't-- you know, take it easy. But yeah, no, so we have to do it a few times. And then obviously, after that, the camera wasn't right for about five goes. And we were losing the light, so it was a bit frustrating.

In *ANA,* really ambitious more set-up than anything else. It took us a long time to find the right partners to do this in. We needed to find a space, but we also needed to find somewhere where we could bring lots of props in to kind of-- we knew we didn't want to do all of the foreground stuff in CG, because it just wouldn't be convincing. We didn't have the time or the manpower to do all this stuff in CG.

So we eventually managed to get FANUC on board in their operations in the middle of England, a place called Coventry where I'm from. And so it was quite funny going back to my hometown and doing this little film. But we used one of their warehouses where they make all of the Aston Martin cars, actually, is what-- they actually machine them all there.

And they had some engineers come and set these robots up for us and program them to move in certain ways. And then we went to a local

scrapyard, and found loads of car body parts, and then bolted them to these robots, and actually had them moving around like a production facility. So it gave us an incredible sense of realism for this factory that we weren't going to get anywhere else.

Because the problem with the real factories is that they just don't give you access anywhere near the robots. And they're all kind of caged off. There's some fantastic ones in England. There's a big BMW one, very futuristic. But there's just know no chance of actually filming them. So we brought in some trucks worth of props. Our production designer, with our help, kind of went to lots of different places, bunged them all into this truck, and then laid them out as much as we can to screen and layer the foreground so that we were only dealing with the background in 3D.

So this is a picture from set where you can see the robots and the panels we were using to screen off the space. And also, gave us a clearer cut line to kind of rotoscope out. And then also, an idea of this kind of stylized lighting we were using, of these kind of warm and almost Michael Bay style kind of warm and cold lighting that he seems to do all the time for *Transformers.*

But yeah, again, a very complex shoot, lots of props, lots of different positions camera-wise. But a lot of this was being fed through from the previs. And we had-- we generated the shot list from the previs. This is the main channel, which we had to digitally extend in most of the shots.

And this is an example of the shot. And this was probably the most mental shot we've ever done, because it starts off in the nighttime. We have three flashing lights in different positions flashing at any one moment, representing the sparks from where this thing is being constructed, the robot. And the camera is upside down and then rotates with the robot, which isn't, obviously, in the shot. And then we have another massive door which opens, flooding the light in with natural light-- super complex 3D shot.

This was the last shot we did, I think, 1:00 AM in the morning. And the camera crew were only contracted till, I think, 11 o'clock. And they were all moaning. And it was-- you know, they were threatening to leave. It was super

stressful. Luckily, the main DoP was on our side. And he kind of got his team together. But it was a very stressful moment.

We filmed this, maybe, twice. And it was kind of-- that was it. There was no going back. This was-- we didn't really know how fast the robot was going, so everything had to be kind of anticipated. We basically-- we didn't have any kind of placeholder for where the robot was moving to. So we just thought, if we have to extend the shot or change the length of time, we'll do it in post-production. We'll ramp it, in After Effects or whatever, to kind of get the timing right.

Modeling and design is probably the biggest difference between these two projects. You know, the *4th Precint,* you have a stadium, you know? It's reasonably easy to kind of create these things with the help of scattering tools and the base geometry that the architect would have supplied us. We added a lot of detail, of course. And then it's just a case of tracking it. But obviously, we had to create the environment and the context and detail up the landscape for all of the scenes, and get it to work, and obviously, light it.

And there were some materials which needed a sign-off from a client which we do these little spin-arounds for, some of the tiles which had to be kind of 3D in a certain way, you know? And we'd just send these basic stills to the client to sign off certain materials. There were a few additional assets at the beginning, like the lantern and some of the boats, which had to be developed in a bit more detail, but a reasonably easy modeling process.

From *ANA,* it was a completely different story. We had to design very complex robot arms, and robot mechs, and all sorts of stuff. But that was obviously a lot more fun to work on. So the way I started this process was to collage and sketch very, very quickly. And these are some basic collages that were done at the beginning for the hanging robot arm or the vat. So the idea was that this was a 3D printing arm, and the vat was a kind of storage for all of the 3D printing material.

And then a basic three 3D model would be made to communicate the mechanic of it, the way it was going to move and animate, and the different

layers. And then that was taken to the detail stage where we would model it all in lot more detail and figure out how it was all working. Some of this stuff was going to be seen very close to the camera, especially the actual head. We actually decided to build the head in reality so that we could use it as a prop on set.

This is a still of the 3D model. So we gave this 3D model to our model maker who then manufactured it from lots of different techniques, both hand and vacuum forming 3D printing. And these are some details of the model. And it's amazing how close the guy got to the 3D model in the real version.

And these are some tests after the shoot with the HGRI of the real location of the actual, whole thing so we could see how it's working with the lighting. It's slightly harder to see on this screen. But this is the actual, physical thing. These were some production shots of him making it at the top, and then the actual, final model at the bottom there. And it's got little lights that lights up and things. It was quite a fun process.

The mech started off with some really quick sketches in ZBrush. These are some ZBrush model sketches where we kind of just sculpt these things quite quickly. We also started a different approach. We had two different people working together, one doing the sketches in 3D, one doing more collages in 2D-- so exploring slightly different techniques to develop the overall form and the kind of details we were looking at. And then this is the final model that we made of the actual mech. And we went for this kind of almost like guerrilla style of robot with an interchangeable magazine head, which we quite liked, almost like a magazine of a gun, but on a mech scale.

And we had certain shots for the film where we were going to see the feet in great detail. So we modeled the feet in a lot more detail than the rest of it, subtle things like the ANA logo on the back here. And even the barcode number has ANA and things like that on it.

We did a few turntables of some of the other assets. So some of the physical things we were able to get on set, we actually had to model them. Because we had to set extend everything. So all of the assets on set, we

photographed in detail and modeled so that we could kind of extend the set effectively.

We had to obviously build the basic form of the warehouse so we could use that for the extension as well. And then this is an example of one of the bigger shots where you see all of that come together. So only the robots on the ground here, in the foreground, on the actual ground, and all of this stuff is real. And then, all of the stuff hanging, obviously, in the background is all extended digitally.

Animation-- so *4th Precinct,* we have-- the first thing that has to be done is tracking, obviously. So you know, this one was actually surprisingly difficult to track, actually. It looks simple. But what I find with the drone cameras is that they have a certain level of sharpening and stabilization in post-process, which actually means that it's somewhat tricky to get a solid track on it. But the old tea pot test was successful in this case.

And then it was a case of, OK, this is a very complex shot with lots of layers. We had to kind of break it down for our artists to understand what needed to be animated and where. So we did these quick, little sketches which show the pitch has to be removed. What does that look like, you know? None of us really knew. What machines do they use, you know? And this starts to create a asset list and a kind of style for, you know, what the texture looks like underneath the pitch for example.

Then the tiers have to be removed. What kind of machines and cranes do they use for that? You know, external building complete-- we had two layers of car park need to be built above the pitch. So there are two new floors as the camera pulls out. You know, what does that look like when you add these kind of things together-- so going back to architecture school a little bit and understanding how this all works.

Obviously, we want lots of scaffolding everywhere, which helped a lot to hide and masks certain things. Shops and things get put in, you know, basic boarding and signs, construction of all the main buildings just with scaffolding, as discussed. Hotel-- same thing. And then the central plaza--

you know, material being brought in by trucks, and lots of grass and things growing, and trees being put up, mud everywhere, that kind of stuff.

So the next phase is getting into the animation a little bit more. So we're starting to see the stadium put in with the track. And then, what we do initially is just to kind of previs out things in layers and then animate things on a very basic level. And then, this gives us sort of like a timing code to kind of work towards in a lot more detail. So we'll kind of crudely bash everything out. As you see, hey, we've actually extended the camera digitally in a fluid way so that we don't get any sort of harsh transition between where the real camera finishes and the digital camera begins.

And what that does is it creates a document like this, which is this horrendous model sheet. So all of the shots-- all of the files on the left here are models. And then on the right is where they appear in the animation. So now we have, OK, this model needs to animate from this bit to this bit. And we have a clear idea of what to do. And once that's created, it's easy for multiple people to work on it. Before that, you know, it's got to be led by one person, one senior artist, before anyone else can kind of get involved.

And what that starts to look like in some of the layers is like-- all of the animation was done in stepped keys. So in Max, there's a little-- on the bottom, the little-- you can't see it. It's off screen. But you have a default way you can make your keys animate. By default, it's a smooth Bezier in and out. You can change that very easily to just the sharp line, which means that whenever you animate something, if you animate something from here to here, it will just pop into place at that key frame.

So that's simply what we did on every single object and light in this scene. We just stepped key frame everything slightly so that they kind of pop in. And all of the models are beneath the stadium. So everything just kind of pops up at any one moment. And the model splits up into so many layers and so many different models that you have lots of different camera files that then reference in just the bits that you need. And then you render everything to the same folder within each file.

So you can see here that, beneath the model, you have all of the assets, a horrendous amount of stuff.

AUDIENCE: Is this all being rendered at once? Or are you doing it in [INAUDIBLE] phases, processing--

PAUL NICHOLLS: It's all being rendered into one sequence. But it's being rendered from, like, 15 different camera files with different models xrefed into it basically. That was the only way we could get it to work. There was no way of rendering everything at once with a scene like this with-- I mean, you can see just how many lights there are inside the buildings that were all animated and moving. And you can see, here, the layers of concrete as they animate up. If you skip back and forward, you can see the difference in the scene.

You have things like the crowd and how the crowd is animated. That was all done in Forest Pack with volume boxes, which then pop into place to say, anything within this volume has to disappear. And we did that with a combination of seed changing animating effects, which allow the crowd a certain moment to kind of speckle. We did it with-- even the materials had to be the same thing. So we wanted tracks on the mud, which were all displacement, which had to be kind of animated in this same kind of stepped way. Nothing could be smooth.

And then you kind of get the effect of, like, this, we have all the cranes slightly moving, the trees kind of putting up. This was one of the layers, for example. And then a lot of that together, you start to see the effect. We had the players to deal with. So at a certain frame, everything's in fast motion. So we had to match position, all of the players from a certain key frame of the real footage, so all of their positions was exactly the same. And then from that moment onwards, we are rendering the digital players in fast motion and no longer the real players. So we had to have a smooth transition of a clean plate of the pitch with no players with digital players.

So *ANA,* the animation-- again, a bit different, but always starts with tracking. So we have the tracking markers here on the floor, which helped a bit. Again, extremely complicated to track this shot, mainly because it's all flashing. But it

worked in the end, after a few days.

You have the animation of the assets themselves with the robot arms kind of like printing, which have all sorts of little mechanics and things that are animating within it. And then, you have the mech, which went through several iterations of animation and style. Again, it being quite heavy and almost apelike the way it walks was the kind of theme. And then, obviously, animating to camera-- important.

And then, you have the rendering phase. So for *4th Precinct,* this shot, we had to do most of it in Chalk to kind of get it to work. We had to figure out how many days we wanted it to last. I think we went for a 2 and 1/2-day cycle in the end. This was to kind of show the animation of that first section with the players and how that was working. This was a still rendered test that we would sign off first, and before going too far.

And for *ANA,* it was much simpler, the lighting initially, with the base lighting at least, because we had the HGRI of the whole space. So we took a few of these for certain shots, some closer to the objects than others depending on what we were doing. But obviously, for the main shot, this was a generic, in the middle of the room HGRI.

And then, this just gives you an idea of the model here. So on the left, we have the camera. And on the right, he's just kind of showing you the scene. So we built the basic box. And then we-- for this scene, because we had a flashing light, we couldn't use the HGRI, actually, for this particular scene. Because we weren't going to get the flashing light reflections off the environment.

So what we did was just simply camera projected the footage onto some basic geometry and then used that for the reflections of the actual mech. But then we have all these Hungaroflash lights to deal with. So each of these lights I'm clicking on-- you might or might not be able to see-- has loads of key frames, which is just manually animated on and off to when the footage is animating.

And we have a kind of cool light on each one. And we have them in three

different positions, photographing where those lights were, actually, in real life locations. So once we kind of built the whole scene digitally as it was in reality, then it just became a case of rendering out tests and seeing if the lighting was overall working.

We had lots of different custom lights on the actual mech itself. You can see here, as I zoom in, on different parts of the mech, it was glowing, and activating, and animating on in certain moments as it kind of stood up. Everything kind of turns on.

And then you see it as it kind of walks out here. And we had to do a lot of-- if you watch the screen on the right, the mech actually slips and moves quite substantially off course as the camera rotates. And this was what I was saying about not having a prop walking with the mech speed to follow on camera. So we had to sort of customize and slow down the mech at this moment as he walks out. And we weren't too concerned that he was out of position, because we weren't really looking at the ground or context of where we saw him.

And then you can see, from the outside, we simply have a big light and a plane animating upwards, emulating that big day daylight that we have outside. And you can see the animated footage on the rest of the geometry. And here are some render tests of the actual mech in isolation where we can see the different frames with flashing lights, and the different frames not in flashing light, and then as it walks by. So we can see that's sort of working.

Compositing *4th Precinct*-- again, I find it always quite useful to show the NUKE files and things. But this was probably set up a bit more complicated than it needed to be. But it was a reasonably complicated comp getting this to work with the different layers and the different rendered files that had to be switched on and off and blended between the clean and non-clean version of the pitch. So we roto painted all of the players out within a certain frame range so we had a clear pitch. And that allowed us to have that switch between the real players and the digital players.

We had a few different blend nodes going on between different comps of the

same render where we had the football scene, and the nighttime scene, and the daylight scene at the end. So what we're doing there is essentially comping it three times independently so that we didn't have to have lots of animated grade nodes everywhere kind of adjusting to the different lighting conditions. We just comped it three times and then switched and blended between those comps when we needed to. And you can see, here, the result of that.

So all of the trees were done in SpeedTree. And they had to be animated over a much longer period of time and then squashed down to the right frame range. So that gives it that kind of flicker animated effect.

For *ANA,* we did it in lots of different phases. This was actually previs that we rendered out as a PNG sequence. The PNG sequence in previs, you get the alpha. So that means we could actually test just the previs in comp. And I thought to myself, if I can get it to look good in comp with the previs, I'll be able to do it with the real render. And so this also informed how the animated nodes were in NUKE. Because this one did have to have a lot of animated grade nodes matching, frame for frame, what was going on in the footage. But this is just with a previs.

That's actually my sister-in-law to be holding-- activating that door there, who had to be manually painted out. And then we have the same shot. This is just the clean version of the shot, I think, without her and without the lights kind of painted off the floor.

And then we have the set extension previs where we see, OK, we're defining exactly where we're animating or set extending. And then in NUKE, this was a really fun but challenging shot to work on, again, because the render only took you so far with the flashing lights. So everything had to be kind of animated manually. You have the original footage here, the cleaned plate.

And then you have, each layer-- this is like the background layer that fades in now-- each layer of stuff for render would be precomped and rendered out as a separate EXR sequence to keep the main comp very simple. But then, you see here, the Hungaroflash group is just lots and lots of different grade

nodes with masking from different element channels to match the footage at any one moment. If you turn them off, it looks nothing like the plate. So they're all being used on these different channels to grade every element with an animated node. So again, just like in Max, where you're animating the light on and off, I'm kind of animating the grade node every frame when it flashes. So it was a very, very laborsome, time-consuming process to go through.

And you can see the effect of that here. You're flashing lights without the grade and then flashing lights with the grade, and it being a lot more seamless. Again, with the previs, and then with the render non-graded, and then the render graded with the same kind of effects going on with animating the nodes in NUKE, additional effects like sparks. And then, this is the final shot with the kind of blurriness, bleeding in and out of consciousness as our character, Jim, is slowly dying.

And then, what I'm going to show you now is the whole final films for both projects. So starting with *4th Precinct,* you get an idea of the whole-- how those two shots sit in the context of the whole thing.

[VIDEO PLAYBACK]

[RUSHING WATER]

[MUSIC PLAYING]

[FIREWORKS]

[STREET NOISE]

[CROWD CHEERING]

[CONSTRUCTION NOISES]

[END PLAYBACK]

Oops.

[VIDEO PLAYBACK]

[MUSIC PLAYING]

[STREET NOISE]

[CROWD NOISE]

[CROWD BOOING]

[CROWD CHEERING]

Supreme Committee-- who calls themself the Supreme Committee?

[END PLAYBACK]

Yeah, it's a bit jittery on the projection, but you get the idea. Oop. So *ANA,* I'm going to play the full cut, actually. The full cut includes-- the whole project was sort of an experiment for the production company who had the relationship with the History Channel in the first place to show how they could tell a story using archive as well as well as drama and narrative basically. So this project started off with-- before we even were thinking about the shoot, we were kind of cutting together news footage basically.

And this version will never get on the internet, because we don't have any rights to this news footage. But it helped us tell the story in the context of how this computer software got where it was in the first place. So yeah, the narrative explores how we have advanced through technology and invented these things which-- presumably to help us. But then, obviously, doesn't turn out that way.

[VIDEO PLAYBACK]

[MUSIC PLAYING]

[TEXT PRINTING TO SCREEN]

- The world's first single-chip microprocessor--

- Supercomputers like this Cray X-M-

-

- It's really nice having a computer tasked--

- It's doing it a lot more accurately.

PAUL NICHOLLS: Can we turn up the sound a little bit? Can we turn up the sound a little bit?

- Fits inside the left ventricle.

- You can go anywhere on the net.

- Cool.

- So Deep Blue has responded.

- Whoa, Kasparov has resigned.

- As I move my hand--

- Google.

- Wikipedia.

- Things like Facebook--

- We are calling it iPhone.

- Please place item in the bagging area.

- This is Watson.

- This is a revolution, and her name

is ANA. As humans, we can only process a fraction of the information in the world. ANA can think 8 billion times faster than us and can gather information instantly, from every single connected device across the planet.

- Your phone, your house, your car, your life-- all synchronized and controlled by this amazing new system.

- Your old device tells you you're running late for a meeting. ANA has already rescheduled the meeting and rerouted your car.

- ANA knows my eating habits better than I do. I mean, she must save me at least $100 on groceries alone.

- She makes informed decisions, responds to your unique demands, and will learn to know you better than you know yourself.

- I was stuck in a meeting. ANA arranged with my friend Lisa to pick my son up from school as she was in the area. Like, she figured out Lisa was my closest friend just from my call history.

- ANA noticed my heart rate was low and booked me in with my doctor before I even knew I was sick.

- This company that no one had heard of last year, today, is floated on the stock market for twice the value of Apple.

- What is really an unprecedented technological tour de force.

- We're excited to announce we have 500 million active users.

- We need to unleash the power of new technology.

PAUL NICHOLLS: Got that one wrong.

- What kind of-- what kind of law would govern--

PAUL NICHOLLS: Wrong prediction there.

- --a machine that can think for itself?

- We say fight back.

- There's an old saying goes, don't put all your eggs in one basket.

- Who really, then, has control? It's insane.

- We need to get a grip on ourselves. We need to understand what we have done with the technology that we have created. We have created a monster, and we have let that monster into our home.

- With artificial intelligence, we are summoning the demon.

- Breaking news now with Brian Sullivan. Brian.

- Hey, Sue. Yeah, American Airlines having some problems with the nationwide computer system. They are telling NBC News that they have a system-wide outage across the United States with their computer system. It is delaying some flights. It is hurting their check-in process as well. That's all we've got coming into NBC and CNBC right now. But as we get more--

- I know you're about to meet your friend, Jim. But we have a growing vehicle backlog of 57 minutes. I've run initial analysis. And I can get on top of that if you give me security clearance.

- You know I should get authorization for that.

- The backlog is reaching critical levels.

- ANA, the backlog's still building. What's going on? ANA? ANA? ANA, request temporary shutdown of processing line 763 alpha, please. ANA, repeat, request shutdown of

processing line 763 alpha.

- We interrupt you just for a moment. We've got some breaking news.

- We have some break-- we have some breaking news.

- This is such a widespread network outage. We don't know if it was a cyber-attack.

- Fatal error message that appeared on millions of computer screens worldwide.

- And states of emergency are in effect in a number of places.

- What's going on? And I told my sources, it is a national security issue.

- There's other things happening in America and happening elsewhere.

- The number of dead increasing.

- The military has been called in to help.

- Do not try to drive north, south, east, or west. Stay home.

[MUSIC PLAYING]

[END PLAYBACK]

PAUL NICHOLLS: So Richard Brake, the guy who starred in that, he's actually the lead White

Walker in *Game of Thrones.* That was my fun facts about the cast. I think when we were talking to him at the beginning of the process, I wasn't actually really doing my job and trying to get to know him as a director. I was more just quizzing him on *Game of Thrones.* And I was trying to get inside information.

But yeah, so anyway, hopefully that gives you an idea of how different-- those two projects couldn't be more different on the outside when you watch them. But for us, the technical and most of the creative process was exactly the same. So hopefully that proves something. But yeah, thank you very much.

[APPLAUSE]