



ISOLATION STORIES

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COVER IMAGE

The Last Kingdom © Netflix 2020



As the UK emerges very carefully from lockdown, we talk to post-production companies about their experiences

REMOTE FUTURE GETS CLOSE

Isolation in any form is inevitably harmful. Unless you're a world-renouncing Carthusian monk, you will struggle with it for long periods. What the UK's Covid-19 lockdown experience has shown us is that our creative and technical selves will not be bowed by such hardships. All of the post-production studios we talked to throughout the lockdown were already on the route to some flavour of continuity for their artists when the lockdown was announced. Some of the bosses even put mental health high on the agenda, along with bleeding-edge technology, like PC over IP, which follows the classic thin client proposal.

As we go to press, we are learning about the new measures for productions to start – obviously with a huge amount of care and a huge amount of clarity about what is or isn't insured. As Sir Winston Churchill said, "Never waste a good crisis", so also expect as-yet-unknown or relatively unknown technology to come to the fore.

Julian Mitchell

JULIAN MITCHELL EDITOR

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SET-UP

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DEAD TO ME SEASON 2

Toby Oliver ACS was the DOP for the second season of Netflix's dramedy *Dead to Me*, although due to local union rules he wasn't able to operate any of the three Sony Venice cameras and their Cooke S7/i full-frame lenses. Pictured above is Oliver with his camera package. Listen to the full interview in *DEFIANT* issue five at definitionmagazine.com. 

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FROM DARKROOM TO SPARE ROOM

We speak to three visual effects companies to see how they're navigating this new reality of remote working

WORDS CHELSEA FEARNLEY

As the world responds to the coronavirus pandemic and the entertainment industry is forced to stop production on shows and films, post-production houses are still finding ways to keep the wheels turning.

Freefolk, a visual effects company based in Soho, was working on the second series of Netflix's *Cursed* when the lockdown came into effect. Thankfully, the company was set up to work on it remotely, with key hardware and infrastructures already in place.

The managing director, Vittorio Giannini, explains: "We already had a VPN, firewall and fibre, because we need to remote access the system on occasion for client deliveries and technical issues, which is done by our technical staff. Our artists are also quite geeky, so they themselves already had some really great kit at home. Three weeks prior to the PM's announcement, we decided to extend the disciplines that were

set up for remote access to ensure that each artist would be able to work remotely should a lockdown happen."

With this preparation, Giannini was also able to re-evaluate Freefolk's remote software solution and try out new ones. "We decided to switch to HP RGS and, within a couple of weeks, our pipeline team had configured and rolled it out across the whole company. The only issue we had was with the broadband connections that our artists had at home, which we can only influence up to a certain point. But we were lucky that we were able to foresee what was coming, which gave our artists plenty of time to upgrade their plans."

THE HOME SET-UP

Companies like Vine FX and Coffee & TV were already familiar with the concept of remote working. Vine FX had been moving around, operating out of various cutting rooms in London, as well as setting up



“The communication part of remote working has been the biggest challenge”

on-set at Leavesden Studios for the *Harry Potter* film franchise, before settling in Cambridge in 2016. Its founder, Michael Illingworth, says: "While working on *Harry Potter* and *Fantastic Beasts*, I found a great team of artists who I didn't want to part with when we moved to Cambridge. They were based in London, Greece, Bulgaria and Australia, so I tried to find a way to retain those members of staff, and still give them the same experience as working in our new office. We invested heavily in Teradici PCoIP technology, which enabled us to place all of our artist workstations into our data centre. This made for a pleasant and quiet working environment, but it also allowed our remote artists to have a direct connection to our systems, so there was no need to upload/download material for them to work on. It's a smooth working set-up and a stroke of luck that we had it up and running well before the coronavirus crisis."

Coffee & TV started out as a remote working company back in 2012. Its founder, Derek Moore, says: "The idea was not to create a big post-production monster, but make a flexible, well-connected, remote-





ABOVE Paul Harrison, head of colour at Freefolk, enjoying his dog's company while working from home **BELOW** Rob Sheridan, a nuke artist at Freefolk

working team. This changed slightly as the company found recognition and we needed a central base to address our clients, but remote working has always been in our DNA. The only challenge this time was that all of our artists had to do it at the same time, which slowed things down a bit for our flame artists, who are painting on pixels and need the speed.”

Like Vine FX, Coffee & TV is also equipped with Teradici PCoIP technology. The company found that when it was using Teradici over a VPN, which is what it is generally set up with, there was a bottleneck in the connection for the flame artists and all other artists trying to access the server and render farm at the same time. “We work closely with Escape Technology, which provides engineering support, and it was able to get our Teradici system working through PCoIP for our flame artists ahead of the pandemic. It essentially outputs our graphics card into a PCI card, which, over the network, streams the pixels and displays it on the artist's screens. It's much quicker,” explains Moore.

ART OF COMMUNICATION

With visual effects artists, colourists and editors working off-site, communication is of the greatest importance. Meetings are conducted through Microsoft Teams, Slack and Zoom, and are done so regularly.

Illingworth has a Zoom call with his team at 9.30am every morning. “The need for us to communicate and understand what everyone is doing has become really important. You can't just have a moment of chit-chat by the coffee machine anymore.”



Morning meetings are kept to 30 minutes maximum, because Illingworth understands the need for more flexibility at this difficult time: “We're asking a lot of employees to be in their houses all day; they might have children or pets to care for, and they're juggling that on top of work. It's contained when you're in an office; you go to work and that's your work life, and then you go home and that's your home life. So, we've removed some of the set hours from people's weeks; they can take lunch or go for a walk whenever they want to.”

Moore is also someone who misses those nuanced coffee-machine moments,

stating: “It's hard to get an accurate sense of what an employee is going through when you're not stood in front of them.” He adds: “The communication part of remote working has been the biggest challenge, because we're a creative collaborative – no one can produce anything brilliant on their own. We've been working hard on ways of staying connected and being able to communicate fluidly. For example, we do company meetings every morning, individual team meetings every day and we also do interim project meetings, to communicate who's doing what and find out what is and isn't working.” →

“We’re living through one of those pivotal moments where things will be changed forever”

But it’s not just the employees adjusting; studios and production companies are also adapting to the new norm, providing notes and feedback virtually, but most importantly, securely. Giannini says: “A lot of our work has to do with client presentations, where clients physically come into our space and review various shots, but we’ve been able to do that virtually by sending QuickTimes and using various software that everyone connects to. It’s important to note that the projects we work on are heavily NDA’d, so we’ve updated our firewalls and made sure that we’re all covered to work on them at home.”

FULL STEAM AHEAD

And there is work to be done. Compared to other members of the below-the-line community affected by the coronavirus pandemic and the production shutdowns it spurred, post-production artists are uniquely positioned; they can create content from nothing and aren’t dependent on having things shot.

“Films are obviously a big part of what we do,” agrees Moore. “But we’re also able to produce amazing, photorealistic content from scratch. And, although we have seen a drop in demand, there are still brands, people and advertisers with important messages that need to be communicated at this time. We’ve just finished an advertisement, which was a direct response to the coronavirus situation, from Facebook.” He continues: “Facebook was



ABOVE Visual effects company, Vine FX, has transitioned to remote working in response to the coronavirus crisis. Here are some of the team’s working-from-home set-ups

asked by the British retail consortium to help amplify the message about not panic-buying and to shop responsibly, so they asked us to produce some content, which they could push on their platform to try and allow people to be a bit more circumspect when it comes to their consumption.”

There is, of course, concern that work will dry up if production doesn’t resume soon and all the post-production work is complete. But Illingworth, whose company is located in the UK’s home of tech, has managed to find work outside of film: “We’ve been working with Microsoft for some time, and we’ve got an assignment with them this summer. We’re not sure what we’ll be working on just yet, but we think it has something to do with a game engine we’re building assets for. So hopefully that will keep us ticking through the summer.”

Speculative guesses run anywhere from the end of June and potentially through winter, though timelines are entirely unknown. Once production does start up again, it will be months until it reaches post-production, and the world is preparing for a period of time without new content.

THE MODERN OFFICE

However, if there’s one positive to come out of the coronavirus pandemic, it’s the lessons learnt from lockdown. Technology has enabled post-production artists to

work in increasingly flexible ways – and companies, for the most part, are embracing its potential.

Illingworth, Moore and Giannini agree they can benefit from giving employees the opportunity to work remotely, but it’s still important to offer them the option of space. Giannini says: “We’re living through one of those pivotal moments where I think things will be changed forever. Our company was very much used to being in an office and working together. I think we will still do that, because nothing beats the immediacy of being in the same room and working together as a team. But where I think remote working will come into play is when we need to expand our team; we can rotate staff, so some work at home part of the week and are in the office for the rest. It’s important everyone feels engaged and part of a team by being in the same space.”

Illingworth refers to this experience as “eye-opening”, as he marvels at the efficiency of his team, despite their separation from one another. He says: “It’s a great experiment, asking what would happen if we all had to work remotely. Well, we’re in it, we’re experiencing it and it’s not so bad. And, I dare say it, when we get back to the office, we might even be in a situation where we’ve all got our headphones in and we’re in a big group meeting, but we’re doing it via Zoom.”



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BACK TO ITS ROOTS

VFX supervisor Theo Demiris talks about creating the visuals for the latest Pinocchio feature, which draws upon Carlo Collodi's original story

WORDS CHELSEA FEARNLEY / PICTURES ONE OF US

Matteo Garrone's film adaptation of *Pinocchio* combines the sentimentality and surreality of Carlo Collodi's original story and rescues the puppet from its saccharine Disney rendition. With a script pricked by themes of suffering, exploitation and death, it offers much more than the animation of a boy whose nose grew too big when he told a lie – something that only happens twice.

In an interview with Theo Demiris, VFX supervisor at the studio One of Us, he recalls meeting with Garrone early on to discuss how it would look. "Like the script, we drew inspiration from the original material and Carlo Chiostri's illustrations. We also studied etchings by Francisco Goya, whose compositions of the bleak social, economic and political levels of 19th-century Italy permeated Collodi's story."

Demiris adds that the film is a homage to Italy in those times, and that an emotional understanding of how that might have felt was incredibly important to its Roman auteur. "Garrone had longed to film *Pinocchio* ever since he was a little boy, when he drew his first storyboard. He is like a human lie detector when it comes to emotion; he instinctively knows what feels right and what doesn't," says Demiris.

EARLY INVOLVEMENT

Through pre-production and a three-month shoot in Italy, Demiris built a relationship of trust with Garrone, developing an understanding of his aesthetic intentions. "Being involved in the project early on was so important: I was able to witness the organic evolution of the script and characters, and in doing so I developed a deeper understanding

of the film's tone, which gave me more autonomy over the visuals," he explains.

This style of working is also unique to One of Us; the boutique studio has built a reputation in recent years around its attention to immense collaboration. "We like to offer the filmmaker a journey; where we facilitate their vision on-set and bring it to life in post-production," says Demiris.

Being on-set was also an opportunity for Demiris to have an ongoing dialogue with Mark Coulier and Pietro Scola. Coulier is a double Oscar-winning prosthetic and makeup artist known for his work on the *Harry Potter* films, and Scola is Garrone's friend and character concept artist.

"It was technically useful for me to see how the characters were being formed – even to the point of discussing casting with Garrone, because it fed into our joint goal of

“They’re not supposed to look 100% real, they’re a mix between human and animal”



wanting to achieve something that looked seamless; where viewers wouldn't be able to tell what is digital and what is in-camera effects,” he says.

HYBRID CHARACTERS

The characters in Garrone's world are created with an artisanal approach, blending prosthetics, makeup and VFX. The digital effects are blended with the makeup and layered over facial prosthetics, making the characters appear extraordinarily real. “The design of the characters is based on old paintings; they're not supposed to look 100% real, they're a mix between human and animal,” explains Demiris.

Pinocchio is played by child actor Federico Ielapi. His woodified face really is very strange. It doesn't look like that of any sort of boy, but rather a man or woman or cyborg in early middle age. “It's why it didn't matter if he was cast male or female,” explains Demiris.

The talking tuna, who befriends Geppetto and Pinocchio after he rescues them, closely resembles The Moon from *The Mighty Boosh* (or the French film, *A Trip to the Moon*, depending on your knowledge of cultural references), but is wonderful in its fairytale bizarreness. “Maurizio Lombardi, who was cast as the tuna, had makeup and prosthetics on his face, but his body was submerged deep into the water so it wasn't visible. Then on his back he wore a prop that resembled the shape of a tuna, and this gave me the interaction I needed from the water to create the digital body.”

Other zoomorphic characters include the snail, who acts as the maid to Pinocchio's blue-haired fairy protector, and Grillo, the grasshopper mentor that Disney reimagined as Jiminy Cricket. With the exception of CG antennae, both wore makeup and prosthetics to aid their performance. “Coulter and I discussed which parts of these characters needed to be moving – and if they could be moved practically. The snail was designed to be huge, so we needed to be mindful of what she [Maria Pia Timo] would be experiencing and how the surrounding actors would be reacting,” explains Demiris.

DIGITAL DONKEY

The donkey that Pinocchio transforms into – as all naughty boys do – is composed of real and digital shots. “The transformation is digitally driven; with hands and arms morphing into hooves and legs. Then there's a section which includes a real donkey, but he becomes completely CG when he is thrown into the ocean,” says Demiris. “I took a lot of photographs of the real donkey, depicting its different angles, to ensure the CG one was a perfect match. I then applied all the usual →

LEFT Maurizio Lombardi, who played the Tuna, wearing the prosthetics for his performance







LEFT Federico Ielapi was transformed into Pinocchio using prosthetics, makeup and VFX

steps for creating a realistic creature, which involves building it from the ground up; starting with bones and muscle, then adding skin and fur before finally animating it.”

He reveals that this was less complicated than working on half-prosthetic, half-digital characters, because with those there is no clear connection point. “You shouldn’t be able to tell where prosthetics end and CG begins. They need to blend into one and move as one. Lombardi, who played the tuna, for example, he wouldn’t move like a fish, he would move like a human. My job was to take his performance and add a moving fish behind him and somehow make the whole thing work as one character,” he explains.

LENS DATA

Demiris trusted Cooke’s/i Technology lens metadata, which was supplied by DOP



“You shouldn’t be able to tell where prosthetics end and CG begins. They need to blend into one and move as one”

Nicolai Brüel throughout the shoot, for creating these hybrid characters. “We have had similar metadata delivered to us with image sequences before, but this was the first time we were fully in control of the workflow from start to finish and were able to properly integrate the technology into our pipeline,” he says. “It all comes down to recreating the exact movement and properties of the camera in the digital world, and having access to all of that information meant that we could quickly solve the camera and recreate it with precision.”

Demiris found that the most useful lens data elements were focal length, focal distance, lens model and lens serial number. “The benefit of having all that data is that it never lies. Any other way is prone to error. You can rely on handwritten data sheets taken on set, but people are often tired and make mistakes and, of course, it takes time. Time to write them down, time to dig them up and log them, time to access them and

then use them. Knowing there is an entire database automatically recorded and easily accessible meant less time organising and more time making beautiful images.”

When creating the young puppet’s nose as it grew in response to his lies, Demiris used lens metadata to ensure a seamless image. He explains: “We had to perfectly track the camera movements as well as Pinocchio’s head and torso in order to then replace the nose and parts of the head. The result is a mixture of prosthetics and VFX that is so well-integrated it’s very difficult to tell where one ends and the other begins.” Pinocchio’s long wooden conk is charmingly done here, with little CG woodpeckers sitting serenely on top of it.

BEAUTIFUL ITALY

Trusting the working-class settings and sympathies of his source material, Garrone crafted a fable set in feudal Tuscany, where much of the film was shot. “I think that’s also why it looks so nice, there’s authenticity to the visuals,” enthuses Demiris. “Some other scenes were shot in Puglia and Rome, but it is all Italy-based. It’s Italian in its soul. There is also the exception of the breaching of the whale that swallows Pinocchio, and the 40-second shot of the drowning donkey being enveloped by fish. Those had to be CG, of course.”

Pinocchio has been nominated for Italy’s David di Donatello VFX Award and will hopefully translate into a solid box office hit outside of its home territory. 

PINOCCHIO WAS THEATRICALY RELEASED IN ITALY ON 19 DECEMBER 2019, BUT IS YET TO HAVE A RELEASE DATE ELSEWHERE



ON LOCATION WITH SAMSUNG'S NEW PORTABLE SSD T7 TOUCH

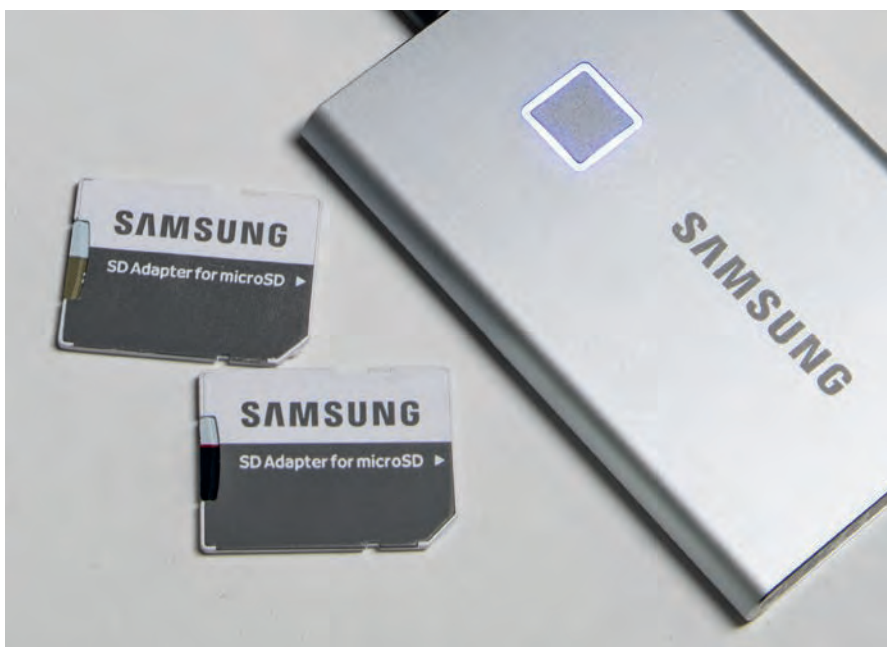
Photographer and magazine editor Will Cheung needed fast, reliable memory on the move – and it needed to be compact and secure, too. With its key user benefits, Samsung's superfast Portable SSD T7 Touch seemed perfect for his workflow

WITH THE LATEST digital cameras shooting high-megapixel stills and 4K video, the image creator's need for fast, high-capacity and totally reliable storage has never been more important.

Samsung has been the world's number-one brand for flash memory since 2002, with all firmware and components including DRAM and NAND memory produced in-house, so it was no surprise that the brand's new Portable SSD T7 Touch is packed full with the latest technology. Its USB 3.2 Gen 2 interface enables outstandingly rapid data transfer speeds, with a read rating of up to 1050MB/s and a write speed of 1000MB/s. To give these figures some context, these read/write speeds are twice as fast as its predecessors, and 9.5 times faster than an external hard drive. What's more, this lightning-fast performance comes in a palm-sized device so it is very compact, too.

"When packing for an assignment, a full backpack is the norm," says magazine editor and photographer, Will Cheung. "By the time I have packed a camera, a backup body, three or four lenses, filters, spare batteries and a laptop, my photo backpack is heavy enough to make it a strain to get it on my back. When I'm flying, loading it into the overhead baggage compartment can be a struggle. Speaking quite honestly, the last thing I need is a large external hard drive to take on my travels. So it is a tremendous benefit that the Samsung Portable SSD T7 Touch weighs in at just 58 grams and has the footprint of a credit card.

"The Portable SSD T7 Touch's lightning-fast performance makes life easier and it is a joy being able to move files so quickly"



ABOVE The Samsung Portable SSD T7 Touch offers read/write speeds of up to 1050/1000MB/s

"In fact, the Samsung portable drive is so light and compact that I usually carry it in my pocket for convenience. For me, that has two benefits, especially when travelling. Travel inevitably means waiting, so once I find a seat, I can get out the laptop, quickly locate and hook up the portable drive and do some editing or backing up. There's always something to be done."

The Samsung Portable SSD T7 Touch uses an USB 3.2 Gen 2 interface and has embedded PCIe NVMe technology. This makes dealing with big files – whether a batch of Raw files straight out of the

camera, working on complex, multilayered image files or editing a video project – very efficient for a smooth, frustration-free workflow for Cheung.

"After a day's shoot, I like to back up what is on my camera memory cards as soon as I possibly can. It's not that I have had any issues with my camera memory cards, but the fact is that one day a card will be lost. The idea that I could lose what I have worked hard to capture is frightening. As a photographer, I can travel many miles, get up (or stay up) at silly o'clock and wait an age for the right light, and having all that effort go down the drain because of a technical glitch or physical mishap is enough to make me feel ill.

"The thing is, I am like that with all my images – not just those of commercial significance, but also family snapshots,



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which are just as precious, although in a different way. Each shot has its own uniqueness,” he explains.

“The Portable SSD T7 Touch’s lightning-fast performance, without doubt, makes life easier and it is a joy being able to move files so quickly when I want to work offline. Hanging around for a folder full of images to download is a thing of the past. Moving a 250MB document to the desktop off the drive is amazing – it’s almost instant. I timed copying a 36GB folder of images on to the desktop of my 2017 laptop running the latest OS at 59 seconds. That’s brilliant and definitely helps with workflow,” Cheung enthuses.

Reliability and security are keywords of the Portable SSD T7 Touch. It is available in 500GB, 1TB and 2TB sizes and in silver or black finishes. The robust metal body that encases the solid state drive (SSD) means the unit can withstand a drop from up to two metres. The Portable SSD T7 Touch also comes with a three-year limited guarantee.

For security, the drive has AES 256-bit encryption, and the supplied Samsung Portable SSD app gives users the option of password or fingerprint protection. The app also has an automatic update function, so it is no trouble at all to keep up with the latest firmware updates.

“The Portable SSD T7 Touch’s password or fingerprint protection offers

great peace of mind,” says Cheung. “I take enormous care of the drive when I am travelling around, but the unimaginable can happen and the prospect of having all my data out of my hands is scary.

“So the first thing I did when I got the Samsung portable drive was to set up its password protection and, naturally, I utilised the fingerprint security option, too. It was fast to set up, and I love being able to gain access to the drive’s contents by placing my right forefinger on the glowing blue LED square. Very handily, this LED also lights up when the portable drive is working, so it’s a welcome visible reminder not to unplug the drive until it turns off.

“The physical reliability of the Samsung SSD T7 Touch seems to be beyond reproach, too. I’m not sure if Samsung’s testing procedure includes carrying the unit around in a pocket for a couple of weeks, but that has been my reliability test and so far, so good. The metal casing has no give, so even sitting down on it inadvertently a couple of times when it was in my back pocket was not an issue, and the Samsung portable drive performed impeccably.”

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IMAGES The portable SSD is both password and fingerprint protected, for ultimate peace of mind



IMAGES Behind-the-scenes shots of Series 4, including use of DJI's Osmo Pocket camera by director Andy Hay and the T-Rex periscope lens

BIRTH OF A NATION

The Last Kingdom is a historical TV series based on the books by Bernard Cornwell. One of the DOPs from Series 4, Tim Palmer, describes the filming process

WORDS JULIAN MITCHELL / PICTURES CARNIVAL PRODUCTIONS / TIM PALMER

Series 4 of *The Last Kingdom* was shot in Hungary in the summer of 2019. The sun was high and the wind from the Urals was a problem for the electricians, who weren't keen on building high lighting structures or silk coverings on the plains to control the sunshine. Skilled BSC member, Tim Palmer, was clever enough and experienced in shooting in high sun enough to frame shots in just the right way not to bring shadows on to the actor's faces.

"I've had a lot of experience of shooting in countries where the sun is very high. Even at high noon, if you angle things just so, you can make that sun be slightly backlit just enough so you keep the shadows off the faces. It just required a lot of planning and sun mapping from me in the prep period to know every location we went to, so I could chart the path of the sun," he recalls.

As for the practical differences between this series and the last, Palmer explains: "*The Last Kingdom* alternates between a summer and a winter shoot. Season 3 was winter, so this season was shot in the summer. We filmed from early April to the end of October – I was there until the end of July.

"That really affected how it was shot, because we weren't dealing with snow and cold weather, but we were having to deal with other problems, which were very strong and high sunlight and a bleached-out, barren landscape. There were shorter nights for

“We were having to deal with strong and high sunlight and a bleached-out, barren landscape”

night shoots, for instance. What Carnival (the production company) said from the outset was that the crew was not going to work against the weather as they had in Season 2. They tried to shade the sunlight off and looked for locations that didn't look too summery, a bit more cooler with lots of shade. We used the best of what we had.”

BASED ON FACT

The Last Kingdom is based on historical events that took place around 800 AD, when the Vikings were seeking to overthrow the Saxons in England. But not just to pillage – to put down roots in areas called Wessex and Mercia. The story hinges on a single character, who was born a Saxon but grew up a Viking, hence his confusion of loyalty, which keeps his character arc always in flux.

Tim Palmer shared shooting duties with two other DOPs and ended up shooting episodes 1, 2, 5 and 6 of *The Last Kingdom*. DOP Sergio Delgado shot episodes 3, 4, 7 and 8 and Ashley Rowe shot episodes 9 and 10.

If you haven't seen the series on Netflix, then imagine *Game of Thrones* without the fantasy element and especially without the dragons! There are similar ongoing conflicts,

treachery, power plays and battles but, unlike *Game of Thrones*, the battle scenes are not on a grand canvas and devoid of VFX. In fact, Palmer's reference for them was the opening scenes from the movie *Jacob's Ladder*, the disturbing Vietnam War PTSD horror. "It was that type of fast-and-furious, confused battle that the director really responded to. I find that, with those battles, as long as the fight coordinators know what they're doing and can communicate clearly to the stuntmen – who made up the bulk of the fighters – everything goes well," Palmer explains.

As for shooting these conflicts: "It generally was a question of breaking the fight down into bite-sized chunks of 20-second portions with the three cameras we used. You shoot each side with a roving camera in between. Then shoot it four or five times with different-sized lenses, then you probably have a pass with a handheld Steadicam just going through the action, seeing and grabbing what you can. You then have all the coverage you need. Each of those 20-second chunks takes two to three hours to film."

HANDHELD SHOW

While the majority of *The Last Kingdom* is handheld, Palmer used a jib arm for some of the forest scenes, as it was hard to bring along anything larger. There was bigger telescopic tech used for some of the boat scenes, as well as blue screen and night-for-day techniques. There were also drone shots, mostly for the battle scenes, to create swooping shots or a bird's-eye view, but these also helped place the opposing sides in place to help viewers follow what was going on.

The Last Kingdom book series has 12 books, so hopefully we'll see more of Uhtred the Dane Slayer as England is gradually formed through conflict. We can't wait!

Hear the full interview with Tim Palmer about *The Last Kingdom* in issue 5 of *DEFIANT* at definitionmagazine.com

THE LAST KINGDOM IS CURRENTLY STREAMING ON NETFLIX



ALL THAT JAZZ

Netflix musical drama *The Eddy*, set among Paris's vibrant jazz scene, fuses the convention-breaking camerawork of the French new wave with a modern sensibility

WORDS JULIAN MITCHELL / PICTURES NETFLIX

When you've already directed critically acclaimed films like *La La Land*, *First Man* and *Whiplash*, where do you go from there? Well, Damien Chazelle's next project is not a film, but rather an eight-part Netflix Original drama called *The Eddy*. Chazelle directed two episodes of the new series, which takes place in the vibrant, multicultural neighbourhoods of contemporary Paris, with the story revolving around the eponymous jazz club. And it's filmed with all the freestyling improvisation of an accomplished musical ensemble.

"What was most important to creating this show was an understanding of jazz," explains Julien Poupard, AFC, who was DOP on episodes 3, 4, 7 and 8 of *The Eddy*, and is also known for his work on the 2019 film, *Les Misérables*. "I felt I had to feel like a jazz musician in order to be confident that my camera movement was in syncopation with the performances."

DAMIEN CHAZELLE

Chazelle himself is no stranger to portraying music on screen. He studied filmmaking at Harvard and made live jazz performances a feature of his first film, *Guy and Madeline on a Park Bench* (which was shot in black & white on 16mm), before making the breakthrough hit *Whiplash*, inspired by his own earlier experiences as a jazz drummer at high school in New Jersey. His next film, the musical romance *La La Land*, is about a jazz pianist and recalls Technicolor musicals like *An American in Paris*. However, for the grungy nightclub scene in *The Eddy*, the director chose a vérité style, using the 16mm format, which, albeit not an officially recommended capture format for Netflix, was approved on the merit of the creative vision.

"Damien wanted to shoot film, because he loves film and I've shot on film for the major part of my career," explains cinematographer Éric Gautier, AFC, who

IMAGES The cast included Amanda Stenberg, Joanna Kulig and André Holland. DOP Marie Spencer below





“Film just seemed the right medium to capture the spirit of the nouvelle vague, but trained on a modern story”



set the tone for the series in the first two episodes, which were directed by Chazelle. “It just seemed the right medium to capture the spirit of the nouvelle vague, but trained on a modern story set in the Paris of today.”

FRENCH NEW WAVE

The Eddy was scripted by Jack Thorne, also known for his work on *His Dark Materials*. It charts the struggles of Elliot Udo, who is played by André Holland. Elliot is an American co-owner of a Parisian jazz club and manager of the house band. Not only is his business partner, Farid, involved in some questionable practices, but when Elliot's teenage daughter, Julie, arrives in Paris to live with him, his personal and professional worlds start to unravel.

Chazelle and Gautier, along with Poupard and Marie Spencer (DOP on episodes 5 and 6), as well as directors Alan Poul, Houda Benyamina and Laïla Marrakchi, were all part of creative discussions. One obvious touchstone was the French new wave, which broke the rules of filmmaking in the sixties and gave the camera a new sense of liberty. But the most important inspiration for the team was the jazz itself – not least because the music in the series is filmed live.

Poupard explains: “Damien and Éric encouraged our actors and musicians to

improvise and they also encouraged me to capture that energy by improvising the camera movement and the composition – and by taking risks.” If that meant that certain shots were under- or overexposed, or the framing on the (largely handheld) camerawork wasn't quite perfect, this only added to the raw quality of the aesthetic.

“Any odd piece of framing, flaring or exposure was interesting to us, because we didn't want to build an image that was too perfect,” Poupard adds. “Only by permitting ourselves the freedom to move the camera with the rhythm of the moment could we arrive at the true emotion of the characters.”

16MM FILM

In preparation, Poupard threw himself into Paris' vibrant jazz scene. “There are a lot of small clubs in the 20th arrondissement that attract a young crowd,” he points out. “I went to a lot of concerts, which was fantastic preparation.”

The series features a number of new jazz songs by *Jagged Little Pill* producer Glen Ballard, which are performed in rehearsals, auditions, open-mic nights, concerts, jam sessions and spontaneous scenes where characters start playing a piano or trumpet.

The 16mm footage was scanned to 4K at the end of post, while the rest of the series was shot digitally in native 4K. →



ABOVE A behind-the-scenes shot of André Holland as Elliot Udo, with DOP Julien Poupard

This presented the filmmakers with an interesting challenge, Poupard says.

“Damien, Eric and I discussed how we could best translate the aesthetic to digital and concluded that we shouldn’t try to match it exactly. The aim was to find a close match of the colour, contrast and lighting, while at the same time leaving room to interpret our episodes differently.”

Narratively, this made sense, since each of the episodes focuses on a different character’s story. Aesthetically, too, it is in keeping with the goal of retaining idiosyncrasies in the raw footage, rather than seeking total control over the image.

“For me, it was important not to do the same thing all the time,” Poupard says. “Not to exactly match Éric’s work and not to establish too rigorous a formula.”

RED HELIUM

Gautier explains they felt the Red Helium 8K sensor was the best option for carrying over the film look, and the best digital system for transitioning the workflow. “Red offered a texture that was not too far from

film and better than other digital cinema cameras for what we wanted to achieve.”

Poupard adds that the Red Helium was chosen primarily because he could crop the Super 35 8K sensor to match that of Super 16, but still record at 4K resolution. “Shooting with a sensor the same size as Super 16, rather than cropping in post, gave us exactly the same angle of view and the same depth-of-field.”

To maintain visual consistency, they retained the same set of Zeiss Classic T2.1 glass used in the first episodes. Gautier’s gaffer, Eric Baraillon, also worked with Poupard and Spencer throughout their shoot. The show went through an ACES colour pipeline, aided by Gautier’s long-time colourist, Isabelle Julien. Colour scientist Florine Bel also provided Julien support for episodes 3 and 4.

“ACES is a huge colour space, so we had to create a special LUT,” explains Poupard. “We shot Redcode Raw and made tests to find the right shade of each blue and red. If we had too much colour in the frame we had to shut down, say, the blue and the



green. It was very complex.” The deliverable to Netflix had an aspect ratio of 1.85 and was in both HDR and SDR. “We shot for HDR delivery but didn’t have HDR monitoring on-set,” says Poupard. “In the final grade, we graded in HDR before Isabelle made the conversion for SDR.”

Having set the template for the series, Gautier is keen that a second series – should one be greenlit – take on the baton and experiment further. “I’d like to see an evolution in stylistic differences in mood and lighting that we began with this series, but taken further,” he insists. “Nothing should stand still.”

Constant evolution – just like the best free jazz. **🎧**

“The aim was to find a close match of the colour, contrast and lighting, while leaving room to interpret our episodes differently”

THE EDDY WAS RELEASED WORLDWIDE ON NETFLIX ON 8 MAY



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CANON C300 MARK III

Ollie Kenchington, creative director and post specialist, reviews the new Canon EOS C300 Mark III

It was late in 2011 that the Canon corporation invited the world's video technology journalists to Paramount studios in LA to witness and report on a significant event. It seems absurd now to think nobody knew what the announcement was, even waiting to go in to the 500-seater Paramount Theatre the moment seemed bigger than a mere new camera announcement. But the original EOS C300's DNA is strong and its roadmap long enough now to validate such a huge product announcement. We're still feeling its impact nine years later.

The new EOS C300 Mark III will be familiar to previous models' owners: the stubby form factor (though less so third time around) that heralded the move to smaller cameras, the buttons that easily fall to hand and the broadcast-ready internals that made the world's TV companies buy them in their droves.

As a production company, we already own the Canon C200, which we use as our A camera. We have an EOS R, which we use as a B cam

ABOVE C300 is less stubby, but button placement and broadcast-ready internals are similar to previous models

and I think, like a lot of people, that the natural progress from those two cameras is a C300 Mark III and an EOS R5. The Mark III is a huge step up for us. Even mundane things are a big deal, such as the speed of operations and the start-up times, when you're turning on a camera and having to wait 20 seconds for it to get going. But with the Mark III, you turn it on and you're ready in four.

The new camera is slightly heavier than the C200 and has the →

"THE NEW EOS C300 MARK III WILL FEEL FAMILIAR TO PREVIOUS MODELS' OWNERS"

“CANON CLAIMS MORE THAN 16 STOPS OF RANGE”

expansion arrangement that you can build on to with options like different I/Os and battery plates.

The body for the C300 Mark III is the same as the C500 Mark II, which was introduced when that camera came along last year. From a form factor point of view it's compact and sturdily built, everything is easily accessible and the button layout is consistent with all of Canon's cinema EOS cameras. So, from a muscle memory point of view, there's a very low learning curve. The only minor gripe, which for me isn't a huge problem because we mainly work in corporates so we don't have anywhere near the level of high-end audio, is that the audio controls on the right-hand side as you're looking at the camera aren't optimally placed. I'm just glad coming from the C200 to see timecode in the body.

FANTASTIC SLOW MOTION

Being in lockdown, my time with the camera was limited as was what I could shoot, so it was the children in the garden and so on. You're getting 120 frames per second in 4K Raw Super 35 mode whatever your base frequency is and it's great. This is quite unquantifiable but there's something – a certain feel of lustre or smoothness – to the look of 120p. It doesn't appear to be making many



ABOVE Ollie Kenchington, owner of award-winning Korro Films, loved the versatile C300 Mark III



image quality compromises in order to hit those frame rates. This seems to be consistent with what Canon is telling us about the new processor and sensor, which are in this camera. They appear to be unlocking very nice quality high frame rates.

Dual gain output isn't the dual ISO feature that other cameras already have. Dual gain is slightly different. The keyword here is gain, which is basically an amplification of the signal. This amplification is an opportunity for the imaging system to introduce noise; it's like raising the gain with microphones, which has similar noise-inducing problems or the potential for those. What Canon's new dual gain output feature gives you, before the signal actually passes through the A/D conversion, is two different gain amplification processes: one that is optimised for highlight and high saturation areas and one that

is optimised for low light and noise areas. Both are tuned to do the best they can for those different areas, which is better than one process for the whole spectrum.

The signal is then recombined, giving you the best of both worlds. The advantage of this is a cleaner and lower noise floor, giving you better low-light capabilities. In fact, it gives you back an extra stop of dynamic range. Canon claims more than 16 stops of range because of this.

TESTING NEW DYNAMIC RANGE

For me, the testing for this was basically to point the camera at high dynamic range scenes. For example, I went to a local wood where there's a tall and dense canopy of trees with big gaps between them as they're pine. So there's enough opportunity for the sunlight to get through and →



BELOW The only minor gripe Kenchington had was that the audio controls weren't optimally placed

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TOP-TEKS

on to the forest floor. What you get are areas of grass covered with this sunlight. It's an incredibly challenging environment to film in. You're trying to manage the difference between the shadows on the bark of the trees and the direct sunlight hitting the grass in the same shot.

So I pointed the camera at that scene, came back and graded it and I was very happy with the amount of detail that I could pull out of that image. It's kind of mind boggling and a huge step from what I have been used to – it's a really fantastic image.

Another cool thing about DGO or dual gain output is, because it's happening before the A/D converter stage, it's an analogue process; you're benefiting from that low noise even if you're shooting Cinema Raw Light so it does make a cleaner Raw image and makes me more inclined to shoot this way in the future. Using the CFexpress cards in the new camera is initially expensive, but because of its support I think the prices will come down so Raw recording will

be more of a normal way to go. It's an incredibly fast read/write card so it makes offloading all of that data easier and quicker. I was offloading a full mag of 512 GB, which was taking about 30 minutes to transfer. This is much faster than with my old CFast 2.0 card.

So, in the future I think there will be many more times I will shoot with Cinema Raw Light, but the XF-AVC codec is tried and tested and we've still got 120fps in that mode and, of course, the codec is still benefiting from the dual gain output so a cleaner signal. As far as I know, the only time the DGO isn't benefitting the image is if you're shooting in any codec above 60fps. In all other situations, you are getting the benefit of getting that DGO, even in Raw.

The big news for the dual pixel autofocus system is that it stills works at 120fps, which is very cool. The face tracking doesn't work at 120fps or anything above 60fps, object tracking also doesn't work above those numbers. I'm not even sure if the



Canon EOS C300 Mark II's autofocus works at 120fps.

CONCLUSION

When I was shooting with the C300 Mark III, I looked at the rushes and realised I had shot mostly Raw and hadn't meant to. I would normally get a few shots in to test it and then stick to lower bit rates, but I can see myself shooting on it all the time, depending on how many cards I've got. It's a versatile camera and I loved it.

Hear Kenchington's full interview in *DEFIANT* issue 4 at definitionmagazine.com 

BELOW The C300 Mark III features dual gain output – two different gain amplification processes for light and dark areas

“BIG NEWS FOR THE DUAL PIXEL SYSTEM IS IT STILL WORKS AT 120FPS, WHICH IS COOL”



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The story of *The Stranger* lends itself well to Quibi's premise, which is that you can watch shows on your phone either vertically or horizontally.

DOP Paul Yee says: "In pre-production, we tested shooting in portrait against landscape and it became apparent to us what does and doesn't work. A two shot, for example, can be challenging in portrait – as can a scene with multiple people ping-ponging dialogue at the same time. But outside of that, we came to realise that simple lateral actions, such as a character walking across a frame, felt better than panning and scanning with that character, as you would in landscape. This drove us to develop a list of rules and principles for shooting in portrait."

The series was shot in 6K on a Sony Venice with Panavision Primo 70s. A Sony Rialto was also used to get the camera into the show's tighter spaces. Yee explains: "Even though it was a bit of a task to switch to Rialto mode, it was important for us, as we were shooting in a car so much. In particular, because we did all of the car scenes practically, on a real road, rather than in a studio, it helped to reduce the amount of inherent bounce a camera has by having a smaller body mounted on."



SONY

SPECIFICATION

SENSOR – FORMAT AND SIZE

Full-frame 6K 6048x4032, 36x24mm CMOS

FRAME RATES

24fps 6K, 60fps 4K

LENS MOUNT

PL, E

RECORDING OPTIONS

4096x2160 XAVC, ProRes 422, 59.94p, MPEG-4 H.264/AVC

EXPOSURE LATITUDE

15+ stops

RECOMMENDED KIT

The kit recommended to accompany the Sony Venice from the experts at CVP

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CAMERA LISTINGS



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ALEXA LF



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ALEXA MINI



ARRI
ALEXA MINI LF



ARRI
ALEXA SXT W

SPECIFICATION

SENSOR – FORMAT AND SIZE	Full-frame CMOS, 36.70x25.54mm – 4448x3096, ø 44.71mm	Super35 CMOS, 28.25x18.17mm – 3840x2160, ø 33.59mm	Large format Arri Alev III (A2X) CMOS sensor with Bayer pattern colour filter array	Super35 CMOS, 28.25x18.17mm – 3840x2160, ø 33.59mm
FRAME RATES	Arriraw: 0.75-150fps ProRes: 0.75-100fps	Arriraw: 0.75-30fps, ProRes 0.75-200fps	LF Open Gate ProRes 4.5K: 0.75 – 40 fps; LF Open Gate Arriraw 4.5K: 0.75-40fps; LF 16:9 ProRes HD: 0.75-90fps LF 16:9 ProRes 2K: 0.75-90fps	Arriraw and ProRes: 0.75-120fps
LENS MOUNT	LPL, PL	LPL, PL, EF, Leitz M, B4 w/Hirose connector	LPL lens mount with LBUS connector PL-to-LPL adapter Leitz M mount (available from Leitz)	LPL, PL
RECORDING OPTIONS	4448x3096 Arriraw and ProRes 4.5K open gate and 2.39:1, 3840x2160 Arriraw and ProRes 16:9	3840x2160 ProRes4K, 3424x2202 Arriraw, 2880x2160 Arriraw and ProRes, 1920x1080 ProRes HD and Anamorphic	MXF/Arriraw MXF/Apple ProRes 4444 XQ MXF/Apple ProRes 4444 MXF/Apple ProRes 422 (HQ)	3424x2202 Arriraw and ProRes, 3414x2198 ProRes, 2880x2160 Arriraw and ProRes, 2560x2146 ProRes and Anamorphic
EXPOSURE LATITUDE	14+ stops from EI 160-3200	14+ stops from EI 160-3200	14+ stops over the entire sensitivity range from EI 160 to EI 3200 as measured with the Arri Dynamic Range Test Chart (DRTC-1)	14+ stops from EI 160-3200



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DESIGN**
URSA MINI PRO G2



CANON
EOS C200



CANON
EOS C300 MARK II

SPECIFICATION

SENSOR – FORMAT AND SIZE	25.34x14.25mm – 4.6K 22x11.88mm – 4K	Super35 CMOS 25.34x14.25mm, 4608x2592	Super 35mm CMOS, 4096x2160	Super 35mm CMOS, 4096x2160s
FRAME RATES	23.98, 24, 25, 29.97, 30, 50, 59.94 and 60fps supported	Blackmagic Raw 4.6K to 120fps, UHD windowed 150fps, HD windowed 300fps, ProRes 4.6K to 80fps, UHD windowed 120fps, HD windowed 240fps.	4K 24/25/30/50p. HD 120fps	4K 30/29.97/25/24/23.98p, 2K 60/59.94/50/30/29.97/25/24/23.98fps
LENS MOUNT	N/A	EF, PL, B4, F	EF	EF (PL optional upgrade)
RECORDING OPTIONS	CinemaDNG Raw 3:1 – 180MB/s CinemaDNG Raw 4:1 – 135MB/s	4608x2592, 4608x1920 (4.6K 2.40:1), 4096x2304 (4K 16:9), 4096x2160 (4K DCI), 3840x2160 (Ultra HD), 3072x2560 Anamorphic	4096x2160, 3840x2160, 2048x1080, 1920x1080, Cinema Raw Light, XF-AVC, MP4	4096x2160, 3840x2160, 2048x1080, 1920x1080, XF-AVC
EXPOSURE LATITUDE	N/A	15 stops	15 stops	15 stops

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POCKET CINEMA 4/6K

Arri A3X CMOS sensor,
54.12x25.58mm, 6560x3100

Arriraw: 20-60fps

XPL

6560x3100, 5120x2880, 4320x3096,
4448x3096 and: 3840x2160 Arriraw

14+ stops from EI 160-3200

Super35 CMOS, 28.25x18.17mm –
3840x2160, ø 33.59mm

Arriraw: 0.75-48fps,
ProRes 0.75-200fps

LPL, PL, EF, Leitz M,
B4 w/Hirose connector

3840x2160, 3200x1800, 2048x1152,
1920x1080 ProRes, 2880x1620
Arriraw

14+ stops from EI 160-3200

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and 60 fps. Off-speed frame rates
up to 60p

B4 2/3in

3840x2160, 1920x1080,
CinemaDNG Raw, ProRes 4444,
DNxHQ

12+ stops

Single CMOS, 13.056mmx7.344mm

HD 1080p23.98, 24, 25, 29.97, 30,
50, 59.94, 60
Ultra HD 2160p23.98, 24, 25,
29.97, 30

Active MFT

3840x2160, 1920x1080, 1280x720,

11 stops

Four Thirds CMOS, 18.96x10mm,
4096x2160 or 6144x3456 Super 35
sensor for the 6K camera

4K – 23.98, 24, 25, 29.97, 30, 50,
59.94, 60fps, windowed HD 120fps
6K – up to 4KDCI23.98, 4KDCI24,
4KDCI25, 4KDCI29.97

Active MFT/Active EF for 6K camera

4K – up to 4096x2160, 10-bit ProRes
422 and 12-bit BRaw
6K – up to 6144x3456, 50fps,
ProRes 422 HQ QuickTime, BRaw

13 stops for both cameras

Canon

CANON
EOS C700

Canon

CANON
EOS C700 FF

Canon

CANON
EOS C500 MARK II

JVC

JVC
GY-HM250E

JVC

JVC
GY-HM500/550

Super 35mm CMOS, 4622x2496

4K Raw 60/59.94/50/30/29.97/
25/24/23.98fps, up to 120fps with
external recorder, 2K cropped to
240fps

EF, (PL and B4 mount
adapter options)

4096x2160, 3840x2160,
2048x1080, 1920x1080, Canon Raw,
XF-AVC, ProRes

15 stops

Full-frame CMOS, 38.1mmx20.1mm,
5952x2532

5.9K Raw 60/59.94/50/30/29.97/
25/24/23.98fps, 2K cropped to
168fps with external recorder

Canon EF mount with Cinema
Lock/PL mount (Cooke/i
Technology compatible)

4096x2160, 3840x2160,
2048x1080, 1920x1080, XF-AVC,
ProRes, 5952x3140, 5952x2532,
4096x2160, 3840x2160
2048x1080 Canon Raw to recorder

15 stops

5.9K full-frame CMOS sensor

Cinema Raw Light:
5952x3140/4096x2160:
1-60fps/2048x1080 (2K Crop)
1-120fps

Canon EF mount. B4 mount lens via
adapter accessory (EF or PL)

Cinema Raw Light:
5952x3140, 2.1Gbps, 30mins
4096x2160, 1Gbps, 65mins
2048x1080, 250Mbps, 270mins

N/A

Single 1/2.3in CMOS sensor,
12.4 megapixels

3840x2160/30p, 120fps HD

Fixed lens

4:2:2 50Mbps 4K Ultra HD recording
live streaming and full-screen
graphic overlay

N/A

Single 1in 4K CMOS sensor

3840x2160/50-60p

Fixed lens

4K UHD 50/60p Apple
ProRes 422 10-bit

N/A

CAMERA LISTINGS

	 JVC GY-LS300	 PANASONIC AU-EVA1	 PANASONIC AG-DVX200	 PANASONIC VARICAM PURE
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SPECIFICATION

 SENSOR – FORMAT AND SIZE	AltaSens Super 35 13.5-megapixel CMOS	Super35 5.7K 5720x3016	Four Thirds-type MOS 4096x2160	Super 35 MOS, 8.9 megapixels
 FRAME RATES	4096x2160 Cinema 4K and 2048x1920 Cinema 2K recording modes. 4K 30p, HD to 120fps	60fps/50fps for 4K/UHD. Up to 120fps/100fps for 2K/Full HD. 240fps/200fps (cropped)	DCI 4K: 24p, UHD 4K: 60p, 50p, 30p, 25p, 24p, HD 120fps	4096x2160 59.94p, 50p, 29.97p, 25p, 24p, 23.98p, 3840x2160 59.94p, 50p, 29.97p, 25p, 23.98p. 120fps uncompressed Raw 4K
 LENS MOUNT	Micro Four Thirds	EF	Fixed lens	PL
 RECORDING OPTIONS	4:2:2 50Mbps HD to 60p 4K Ultra HD recording 150Mbps, 24p/30p	4.2.2 10-bit – Video Codec up to 400 Mbps. V-Log & V-Gamut. 5.7K Raw output. Dual Native ISO 800 & 2500	4096x2160 (4K), 3840x2160 (UHD), 1920x1080 HD/AVCHD, MOV, MP4 100Mbps 4K, 200Mbps HD	Raw, 4096x2160 (4K), 3840x2160 (UHD), ProRes 4444HQ/422HQ/ DNxHR HQX, DNxHR444
 EXPOSURE LATITUDE	N/A	14 stops	12 stops	14 stops

	 RED HELIUM 8K	 RED MONSTRO 8K	 RED RANGER NOW WITH GEMINI AND HELIUM SENSORS	 SONY FS7 & FS7 II
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SPECIFICATION

 SENSOR – FORMAT AND SIZE	Helium 8K 8192x4320, 35.4 megapixels, 29.90x15.77mm CMOS	Monstro 8192x4320, 35.4 megapixels, 40.96x21.60mm CMOS	Ranger 8192x4320, 35.4 megapixels, 40.96x21.60mm CMOS	Super 35, single-chip Exmor 4096x2160 CMOS
 FRAME RATES	60fps at 8K full format (8192x4320), 75fps at 8K 2.4:1 (8192x3456), 120fps at 4K full format (4096x2160), 150fps at 4K 2.4:1 (4096x1728), 240fps at 2K	60fps at 8K full format (8192x4320), 75fps at 8K 2.4:1 (8192x3456), 120fps at 4K full format (4096x2160), 150fps at 4K 2.4:1 (4096x1728), 300fps at 2K	60fps at 8K full format (8192x4320), 75fps at 8K 2.4:1 (8192x3456), 120fps at 4K full format (4096x2160), 150fps at 4K 2.4:1 (4096x1728), 300fps at 2K	60p DCI4K, 4K. 180fps HD
 LENS MOUNT	EF, F, PL, Leica M	EF, F, PL, Leica M	PL with supporting shims	E
 RECORDING OPTIONS	Redcode Raw, ProRes 4444 XQ, 422 HQ, DNxHR HQX	Redcode Raw, ProRes 4444 XQ, 422 HQ, DNxHR HQX	Redcode Raw, ProRes 4444 XQ, 422 HQ, DNxHR HQX	4096x2160 XAVC-I 59.94P 600Mbps, XAVC-L, 29.97P, 100Mbps. MPEG-4 H.264/AVC
 EXPOSURE LATITUDE	16.5+ stops	17+ stops	17+ stops	14 stops

Panasonic.

PANASONIC
VARICAM LT

Panasonic.

PANASONIC
VARICAM 35

PANAVISION
DXL2

RED

RED
DRAGON-X 5K

RED

RED
GEMINI 5K

Super 35 MOS, 8.9 megapixels

Super35 MOS, 8.9 megapixels

16-bit, 35.5-megapixel CMOS.
40.96mmx21.60mm (diagonal:
46.31mm). Resolution is 8192x4320

Dragon-X 5K, 5120x2700,
25.6x13.5mm CMOS

Gemini 5K 5120x3000,
30.72x18.0mm CMOS

4096x2160 – 59.94p, 50p, 29.97p,
25p, 24p, 23.98p, 3840x2160 –
59.94p, 50p, 29.97p, 25p, 23.98p.
240fps 2K/HD

4096x2160 – 59.94p, 50p, 29.97p,
25p, 24p, 23.98p, 3840x2160 –
59.94p, 50p, 29.97p, 25p, 23.98p.
240fps 2K/HD

Up to 60fps at 8K Full-Frame
(8192x4320), 75fps at 8K 2.4:1
(8192x3456)

96fps at 5K full format (5120x2700),
120 fps at 5K 2.4:1 (5120x2160),
300fps at 2K (2048x1080)

75fps at 5K full height 1.7:1
(5120x3000), 96fps at 5K full format
(5120x2700), 120fps at 5K 2.4:1
(5120x2160), 120fps at 4K full format
(4096x2160), 240fps at 2K

EF, PL

35mm PL

PL

EF, F, PL, Leica M

EF, F, PL, Leica M

AVC-I 4K and 2K, AVC-I,
ProRes 4444, 444, 422 HD

AVC-I 4K and 2K, AVC-I, ProRes
4444, 444, 422 HD

In Raw 8K you get Redcode, 8K
Raw, 5:1 vista vision, 60fps, 72@7K,
80@6K, 96@5K

Redcode Raw, ProRes 4444 XQ,
422 HQ, DNxHR HQX

Redcode Raw, ProRes 4444 XQ,
422 HQ, DNxHR HQX

14 stops

14 stops

N/A

16.5+ stops

16.5+ stops

SONY

SONY
F5

SONY

SONY
F55

SONY

SONY
VENICE

SONY

SONY
PXW-FX9

Z CAM

ZCAM
E2E

Super 35, single-chip Exmor
4096x2160 CMOS

Super 35 single-chip 4096x2160
CMOS with global shutter

Full-frame 6K 6048x4032,
36x24mm CMOS

6K full-frame Exmor R sensor

4/3in WDR CMOS Sensor

59.94fps at 4K, 120p 2K

23.98fps 4K, 180fps 2K

24fps 6K, 60fps 4K

Upto DCI 4K 4096x2160
subsampling from 6K

4K at 30fps 10-bit colour

PL, FZ

PL, FZ

PL, E

Autofocus with all E-mount lenses

MFT

4096x2160 Raw and XAVC 59.94p,
MPEG-4 H.264/AVC

4096x2160 XAVC 59.94p,
MPEG-4 H.264/AVC

4096x2160 XAVC, ProRes 422,
59.94p, MPEG-4 H.264/AVC

Upto AVC-I QFHD 59.94p mode VBR,
MAX bit rate 600Mbps, MPEG-4
AVC/H.264

10-bit 4:2:0 H.265 internal and
10-bit 4:2:2 output to HDMI.
10-bit 4:2:2 ProRes internal once
licence is granted

14 stops

14 stops

15+ stops

15+ stops

14+ stops

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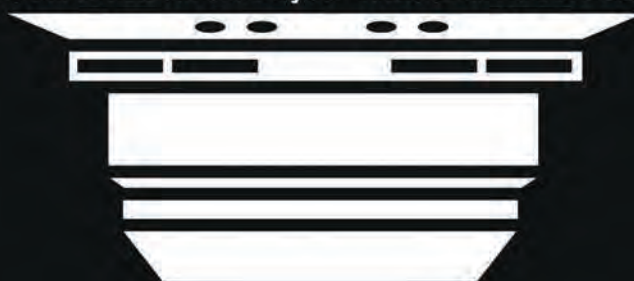
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