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NEW 27in iMac

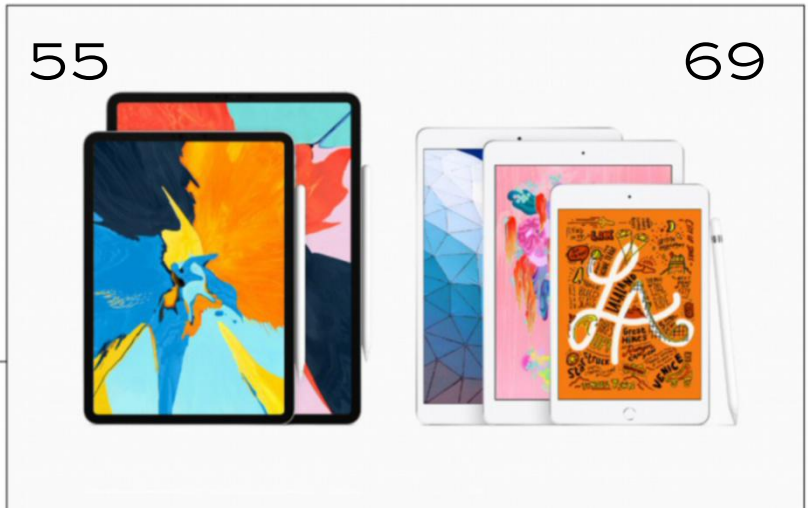
REVIEWED

21in iMac, iPad Air, iPad mini

CONTENTS

NEWS

REVIEWS



CONTENTS

FEATURES

OPINION

Apple's Q2 2019 results

Results reveal Apple is doing just fine. **Michael Simon** reports

Phone sales might be levelling off, but Apple is doing just fine. Apple has announced its second quarter results for 2019, and it's clear that the shift in it business model is in full swing. While it still posted revenue of $58 billion, iPhone sales were relatively flat, posting just $31 billion compared to $37.5 billion in the same 2018 quarter. Apple stopped breaking out unit sales last quarter, but it sold 52 million units in the year-ago quarter.

Elsewhere, Apple is looking stronger than ever, particularly when it comes to Services. Apple reported a record $11.5 billion tally for the category (which includes Apple Music, digital sales, and Apple Pay) versus $9.2 billion last year. It was the first time Services broke the $11 billion mark. Paid subscriptions were a major part of that, nearly topping 400 million for an increase of 30 million over the previous quarter.

iPad sales were also up, no doubt buoyed by the release of the fifth-gen iPad mini and the new iPad Air. The iPad posted $4.9 billion in sales versus $4.1 billion in 2018's second quarter. Tim Cook noted that the "blockbuster" quarter represented Apple's "strongest iPad growth in six years, and we are as excited as ever about our pipeline of innovative hardware, software and services." Mac sales were relatively flat at $5.5 billion as compared to $5.8 billion last year.

Wearables were another bright spot. Apple sold $5.1 billion worth of Apple Watches, AirPods, and other accessories in the quarter, a 30 percent increase over the year-ago quarter. Tim Cook said Apple's Wearables division is now about the size of a Fortune 200 company. Additionally, he noted that Apple's installed base set a new record.

For the third quarter, Apple expects to post revenue between $52.5 billion and $54.5 billion, which could represent a return to growth. In the third quarter of 2018, Apple posted quarterly revenue of $53.3 billion. In after-hours trading, Apple's stock spiked more than $10 on the news.

Tim Cook talks regulation, values, health, and more

In an interview at the Time 100 Summit, Apple's CEO spoke broadly about a wide range of issues. **Jason Cross** reports

Tim Cook is not one of Time's 100 most influential people of 2019. Nonetheless, as a three-time honouree of that list, he was invited to be interviewed by Nancy Gibbs at the Time 100 Summit. As expected, Cook didn't

reveal any details about new products, software, or services. Instead, the questions posed and answers given were broad, touching on Cook's and Apple's values, and how technology fits into the world we live in. Here's some of what he said about a variety of issues. Quotes have been lightly edited for clarity.

On Apple's values

"I've always deeply felt that people should have values, a corporation is nothing more than a collection of people, and therefore by extension a corporation should have values.

"We've always had a set of things that were really important to us and that we felt said something about us. Part of that is how we treat the environment, part of that is evangelizing and advocating for high-quality public education, and privacy – before anybody was talking about privacy. This has been at the depths of who we are as a company.

"As I look at the world today, the issues that we face cannot be addressed solely by government. We should not be looking for government to solve all the problems. It takes the public sector, the private sector, and academia working together to solve some of these huge problems. Climate change is not going to be solved by government, as just one example. So we readily step up and participate in the conversations, because we think how we do what we do says as much about us as what we do."

Cook's list of Apple values shouldn't surprise anyone who has paid attention to the company over

the years. Apple talks about its efforts in privacy, the environment, and education nearly every time it gets on stage to announce a new product or service. His views on the need for companies to 'step up' to work with governments and academia to solve big global problems is also well-known, but his specific comment about climate change might be contentious.

On political influence

"I would hope that every CEO would stand up and represent their employees. And yes, at the end of the day you do upset some people when you do this. But I try not to get wrapped up in a pretzel about who we upset, because at the end of the day we'll be judged more by did we stand up for what we believe in, not necessarily do they agree with

When it comes to political influence Tim Cook says that Apple focuses "on policies, not politics"

me. I think still, people appreciate that even when they do disagree. We've taken some unpopular positions, I recognize that. But we do them out of believing deeply that they're right, and that we have a unique lens.

"We focus on policies, not politics. We do not focus on politics. And I recognize that everything, unfortunately these days, tends to break down that way. But we focus on the policy itself.

"This is probably not known to a lot of people in here, but Apple doesn't have a PAC [Political Action Committee]*. Apple's probably the only large company, or one of the very few, that doesn't have a PAC. I refuse to have one because it shouldn't exist! I think the people that should be able to donate are people who can vote."*

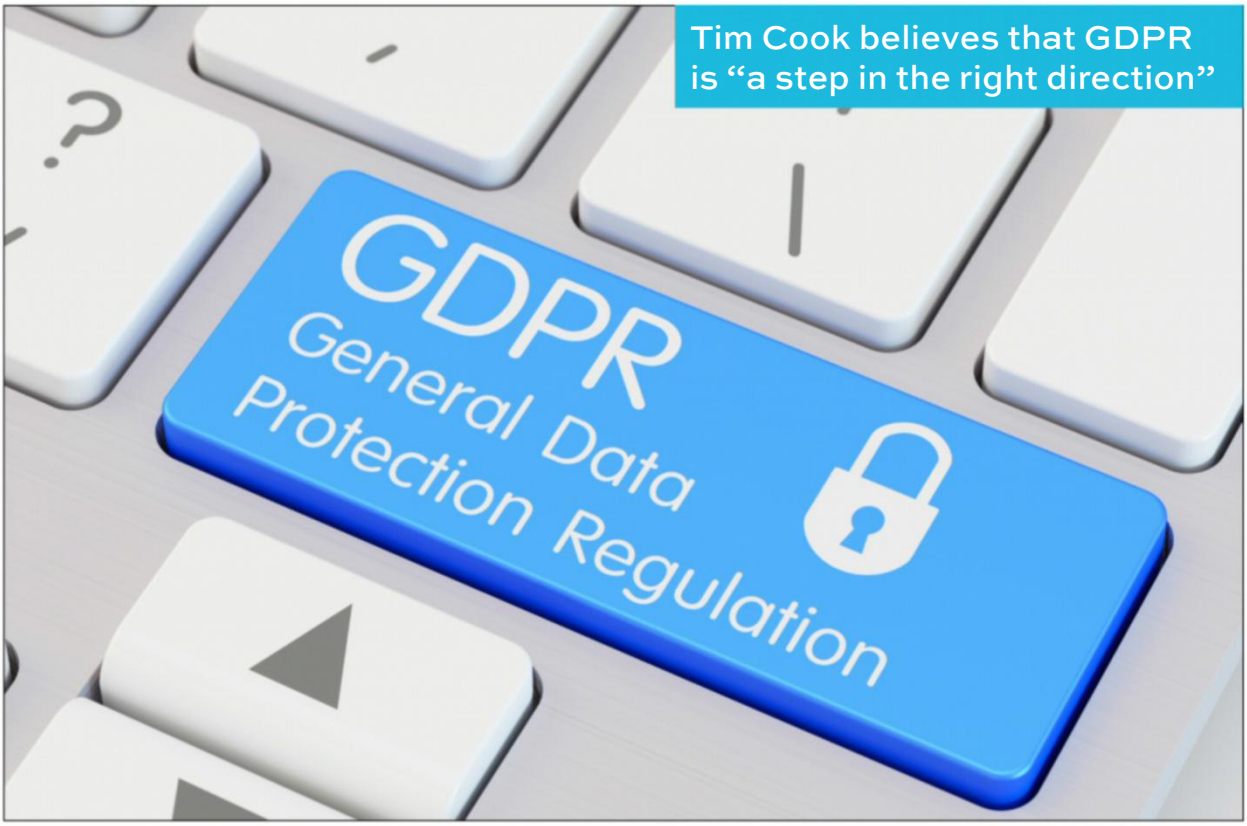
Cook is right that Apple has no political action committee pushing dark money to candidates, but his line that "people that should be able to donate are people who can vote" rings a bit hollow. The company spends millions of dollars a year paying lobbying firms to influence politicians. It may not be a PAC, and it's definitely transparent, but it's hardly just voting individuals donating to politicians.

He went so far as to say, "the company donates zero to political candidates" and while that is technically true, some of the money that Apple spends on lobbying firms like Capitol Tax Partners and Franklin Square Group absolutely ends up in the hands of political candidates – it is ultimately the very reason for their existence.

On regulation of the tech sector

"I think that there are some serious issues with tech. Even though I am a deeply free market person in mindset, and believe that some unexpected things can happen in regulation…we all have to be intellectually honest. We have to admit that what we're doing isn't working. That technology needs to be regulated.

"There are now too many examples where the 'no rails' have resulted in a great damage to society. When things are out in society and they don't represent the true cost, then you have to do something about it. You either have to reflect it from a cost point of view so that you're valuing things properly or you have to regulate it.



Tim Cook believes that GDPR is "a step in the right direction"

"I've been on the regulation kick, which surprised even me, for a while, because I didn't see companies laying the basic rails in place, and then refusing to step over those."

Cook went on to answer a question about how confident he was that we'd be able to end up with smart regulation of the tech sector.

"I'm not confident, is the short version of the statement. I think this is an example where Europe is more likely to come up with something. The GDPR isn't ideal, but GDPR was a step in the right direction… this is on the privacy side, obviously. I don't think it's a save-all end-all, I think there's plenty of things that it didn't do that it needs to do, but I think it's a step in the right direction. It may be that the centre of gravity in moving the ball forward, in privacy, may be in Europe. It may eventually come to the US. We are advocating for regulation, because I do not see another path at this point."

Certainly, privacy and security are core Apple values, and it makes sense to fight for that across the tech sector. Such regulations would also be good business for Apple, as it would cost many of its competitors much more to comply with strict privacy regulations.

On Donald Trump

"I would never talk about conversations that I've had with the President. Regardless of who

the President is. I don't think it's proper to do that. The things that I'm passionate about as the leader of Apple is getting DACA fixed, getting the immigration system working for America, including fixing these green card backlogs. We have people who are in 90-plus year backlogs on green cards. Trade is very important. I think it's good for America and we have to figure out how it's good for everyone, not just a set of people in America but good for everyone."

On education

"When your founder doesn't have one [a four-year college degree]*, it kind of says a lot about what people can do without a college education. I think fundamentally we have, as a society, gotten too much ingrained in what is the pedigree, what is the degree, all this kind of stuff, and lost sight of the humanity in the conversation.*

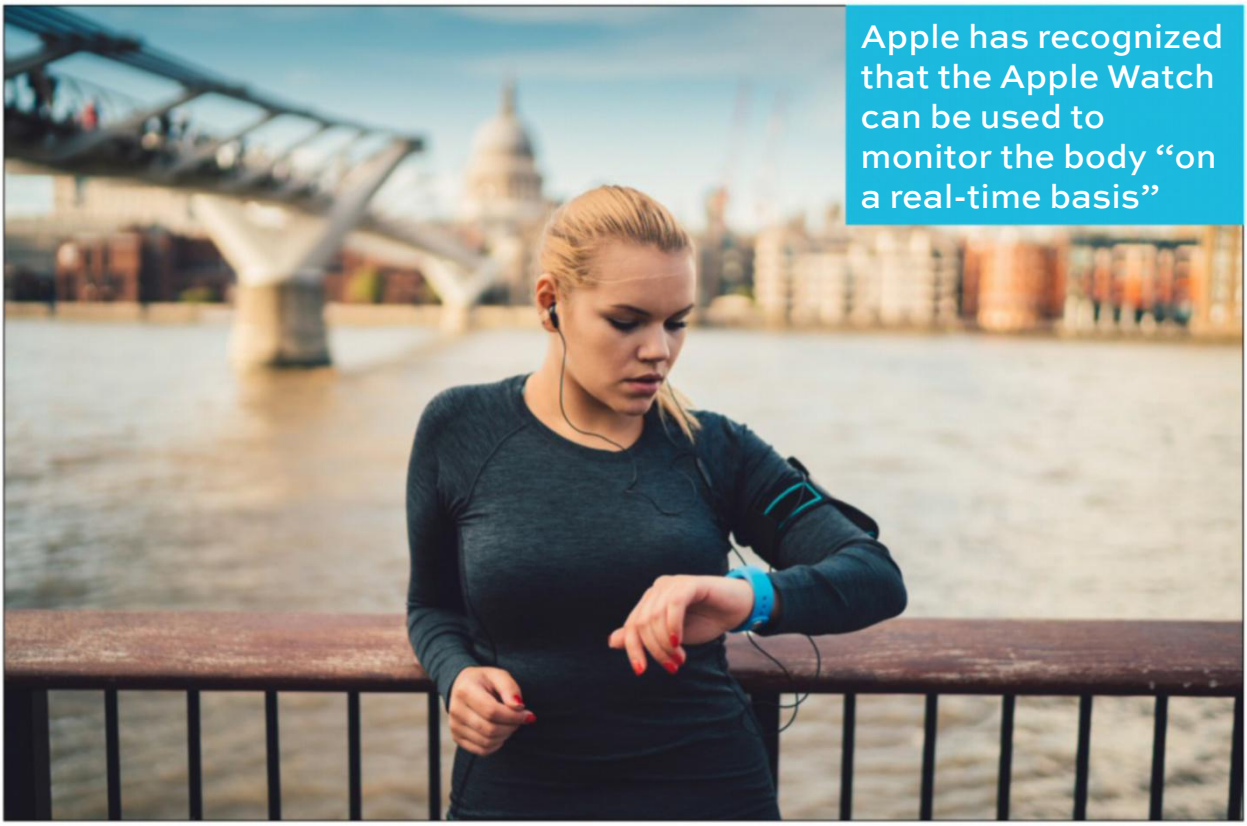
"We're out pushing on getting every kid to learn coding. I think every kid in the world should learn to code. I think it's the most important second language you can learn. It's a global language. There's no such thing in the world, it's the only one. And it's a way to express yourself, whether your passion is in the sciences or the arts. And I think software is touching our lives everywhere.

"I'm not saying everyone needs to become a programmer. I'm saying that like the basics of mathematics and history and so forth, it's a core skill that kids need to have. And equally important in our view is creativity skills.

"As math[s] and science has been recognized as being very important, unfortunately the arts have been gutted from too many of our schools. So basic creativity skills are not taught in a lot of schools. So we've designed our own curriculum called 'Everyone can Create' and we've made it available to all schools in the world. Many, many schools are now picking this up."

On health

"We began to recognize it was a big idea to monitor your body on a real-time basis, versus just going to the doctor once a year and having different vital signs checked. So with the Watch we focused initially on wellness and heart. Last year, as you



Apple has recognized that the Apple Watch can be used to monitor the body "on a real-time basis"

know, we launched the Series 4 that has an EKG in it. I'm getting tons of notes from all the different countries that we've launched in, saying 'oh my god, I found out I had this serious problem…I went to the doctor and he or she told me I would have died if I wouldn't have known this'. This is what the people are telling me. I think it's a big idea to monitor your body. As we pull this string more, we recognize more and more things we can uniquely do.

"We're at the early stages of this with the Watch, and obviously we're working on a bunch more things. I do think there will be a day we look back and say Apple's greatest contribution to mankind has been in healthcare. I think that will happen."

That's a huge statement. One could legitimately credit Apple with the 'home computer' as a very concept, rather than computers only being for business. Then the iPhone changed our expectations for smartphones forever. To say these accomplishments will be eclipsed by Apple's contribution to healthcare is bold. Apple would have to do vastly more than it has done so far for this to be even remotely true.

On excessive phone use

"Some users, primarily focused on their kids, feel that their kids are using their devices too much. However, as we look at it, it's also the parent that is using them too much. We all are, or many of us are.

"Apple has never wanted to maximize user time. We've never been about that. We're not

motivated to do that from a business point of view and we're certainly not motivated from a values point of view. What we want to do is give you a tool that empowers you to do things you couldn't do otherwise. We want to enable things for your life, and empower you to have experiences that you couldn't have.

"It is clear that there are certain apps that people can get in the mindset of just scrolling through mindlessly, continually picking up their phones to see what is happening at this second.

"So, we looked at this, and we said, number one, people should know what they are doing. There is a human trait in all of us to underestimate the degree of something bad we are doing. If you ask

Tim Cook says that "Apple has never wanted to maximize user time"

someone how many calories they had yesterday, I bet they're going to say less than they had. If they ask you how much exercise you did they'll probably overestimate it.

"I've gone in and gutted the number of notifications [I receive]*. I really asked myself, do I really need to be getting thousands of notifications per day? It's not something that is adding value to my life or is making me a better person. So I went in and chopped that. Every time you pick up your phone it means you're taking your eyes off whoever you're dealing with or talking with. If you're looking at your phone more than you're looking in somebody else's eyes, you're doing the wrong thing!*

"We want to educate people about what they'd doing. This thing will improve through time just like everything else we do. We'll innovate there as we do in other areas. Basically, we don't want people using their phones all the time. This has never been an objective for us."

Cook may be right about the purpose and motivation of the iPhone, and Screen Time does a great job of telling people how much they are using their phones. There's obviously so much more Apple could do in this area. It could give you proactive warnings about apps that you appear to be using too much, and make it easier for the system to differentiate between notifications that are of real importance (such as a home security system) and those that can wait (like social networking apps).

Apple recalls wall plug adaptors over safety fears

Find out if your plug is affected. **Karen Haslam** reports

Apple has announced that it is recalling a number of wall plug adaptors due to safety concerns, including the kind used here in the UK. According to the tech giant: "In very rare cases, affected Apple three-prong wall plug adaptors may break and create a risk of electrical shock if touched."

It says that the risks are only associated with adaptors that shipped with Macs and some iOS devices between 2003 and 2010, in addition to the three-pronged plug included in the World Travel Adaptor Kit.

Is your plug is included in Apple's recall?

While it's a long time since these particular adaptors were sold, it's possible that you are still using one, so it's worth checking. Apple says that the affected three-prong plug adaptors are white and have no letters on the inside slot where it attaches to the main Apple power adaptor. If you can see letters on the back of your three-pronged plug, then it is one of the newer ones. Newer adaptors also have a dimple on either side to make pulling them out easier and are slimmer than the older generation (see below).

How to get Apple to exchange a plug

You can get your plug exchanged at an Apple Retail Store (**fave.co/2PEhJMQ**), or via an Authorized Apple Service Provider (**fave.co/2qTHkGE**). You will also need to obtain your serial number as Apple says it will need to verify your Mac, iPad, iPhone or iPod serial number as part of the exchange process.

Newer adaptors have a dimple on either side

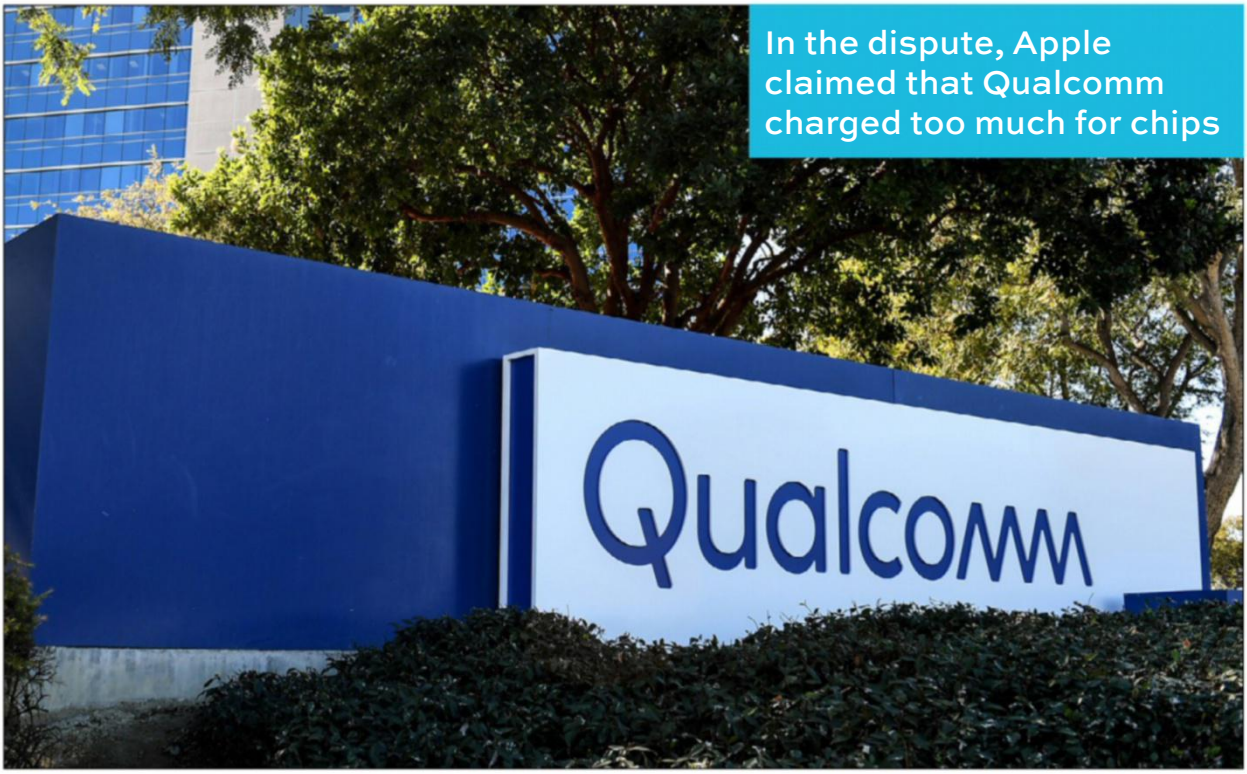
Apple and Qualcomm settle legal differences

Surprisingly Apple didn't win. **Michael Simon** reports

Just when their legal battle was beginning the trial phase, Apple and Qualcomm have ironed out their differences in a surprise settlement. The terms of the agreement include the dismissal of all litigation between the two companies, as well as any pending cases brought by Apple's global contract manufacturers. It basically returns the relationship to the way it was before the allegations started flying.

Most notably, Apple has agreed to pay Qualcomm a one-time payment of an undisclosed sum, as well as royalties going forward. Both companies issued short press releases to announce the agreement, but it's hard to find much good news in it for Apple. Qualcomm is getting paid and keeps Apple as a customer, and there's no indication they will be changing their business practices.

Why this matters: While the Qualcomm case has yet to have a material impact on iPhone sales or users, it was certainly a cloud hanging over Apple's most popular product. The fact of the matter is Apple needs Qualcomm, especially if Intel wasn't able to provide a solid road map for 5G. The settlement clears the deck for Apple to continue



In the dispute, Apple claimed that Qualcomm charged too much for chips

using Qualcomm's chips and opens up a potentially quicker road to 5G adoption.

A surprising about-turn

In the dispute, Apple claimed that Qualcomm charged too much for chips and licensing fees, and argued that: "Qualcomm has used its monopoly... to set unfair prices and stifle competition and dictate terms to some of the biggest, most powerful companies in the world."

In his opening statement, CNET reports that Apple attorney Ruffin Cordell argued Qualcomm refused to provide processors unless a licensing agreement was signed, effectively allowing the company to "double-dip" on fees. "The other thing it does is allow them to charge patent royalties that are far in excess of that fair and reasonable level," he said.

A few hours later, however, Apple changed its tune. Not only did it agree to write Qualcomm a cheque, Apple also entered into a six-year licence with Qualcomm, including "a two-year option to extend, and a multi-year chipset supply agreement".

That means future iPhones could, and very well may, return to using Qualcomm modems, which likely paves the way for a faster route to 5G. While it was never confirmed that Apple had settled on a specific supplier for its first 5G iPhone, Apple currently sources LTE modems in the iPhone XS from Intel. However, recent rumours suggest that Apple soured on its deal with Intel and was exploring other options. While it's unlikely that this

year's iPhone would have a 5G modem, next year's likely will, and chip buys at Apple's magnitude need to be made sooner than later.

A deal with Apple would have been a major coup for Intel, but with friendlier relations between Apple and Qualcomm that's seriously in doubt. And by in doubt, we mean never happening, since Intel announced hours later that it has abandoned its plans for a 5G smartphone modem.

Still, the timing of this announcement is nothing less than shocking. Apple and Qualcomm have been fighting court battles for months and many more were presumably on the horizon. Just last month, an International Trade Commission judge ruled that iPhones infringed on a Qualcomm patent and should be banned from sale, while a second judge said the patents were invalid. Neither of those decisions matter now.

Apple and Qualcomm have been battling in court since 2017, but 15 April marked the first day of a high-profile jury trial. Qualcomm is being sued separately by the Federal Trade Commission over anti-competitive pricing.

27in iMac (2019)

RATING: ★★★★☆

Price: **£1,749 (inc VAT)** from **fave.co/2DFsg5C**

The iMac is 21 years old in August, and we had been hoping for a redesign of the iconic all-in-one Mac to mark the occasion. Sadly that is not to be, but there are some significant changes to what's on the inside. And it's what's on the inside that counts, right?

The 27in iMac (2019) has more powerful processors with 6 cores (and an 8-core build-to-order option), improved graphics cards (including

the Radeon Pro Vega) and faster RAM, making it a much more impressive machine than its 2017 equivalent. In this review we are looking at the bottom-of-the-range 27in iMac, with its 3GHz 6-core 8th generation i5 processor. We've also benchmarked the build-to-order 3.6GHz 8-core 9th-generation Intel Core i9 model, which could be seen as competition for the iMac Pro.

Price

The 2019 iMac pricing remains the same, in fact, this hasn't changed since Apple adjusted it in October 2016. Here's how it breaks down:

£1,749: 3GHz 6-core 8th-gen i5, Retina 5K, 1TB Fusion Drive, 8GB 2,666MHz RAM, Radeon Pro 570X (+4GB memory)
£1,949: 3.1GHz 6-core 8th-gen i5, Retina 5K, 1TB Fusion Drive, 8GB 2,666MHz RAM, Radeon Pro 575X (+4GB memory)
£2,249: 3.7GHz 6-core 9th-gen i5, Retina 5K, 2TB Fusion Drive, 8GB 2,666MHz RAM, Radeon Pro 580X (+8GB memory)

Build-to-order options for £1,749 model

£180/£540: 16GB/32GB RAM
£180: 2TB Fusion Drive
£90/£270/£630: 256GB/512GB/1TB SSD

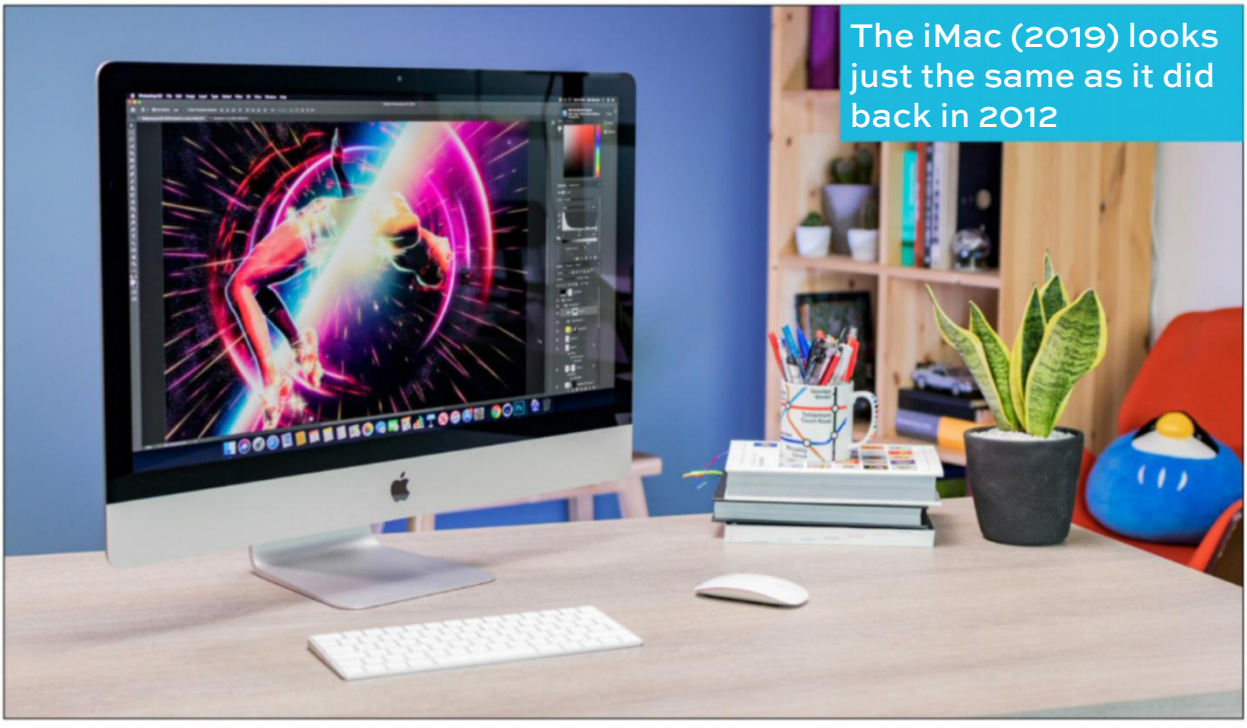
Design

The iMac (2019) looks just the same as it did back in 2012 when Apple slimmed down the case design.

Even in 2012, the design didn't change significantly from the original aluminium iMac that was introduced back in 2007, or the unibody aluminium design of 2009. This is the longest Apple has gone without refreshing a product's design.

But does the lack of physical change really matter? The iMac is still a beautiful-looking computer, perhaps Apple chief design officer Jonathan Ive got the design so spot on ten years ago that nothing needs to change on the outside.

However, the design does have its faults. We, like many others, position our iMac on top of a hardback book in order to have the screen at an ergonomically-friendly height. This is necessary because it is not possible to adjust the height of the display, beyond tilting it to face upwards or downwards very slightly.



The iMac (2019) looks just the same as it did back in 2012

The screen is probably the iMac's most striking feature, and yet, around it are inch-wide bezels and at the bottom a 2.5in aluminium section. Apple has been reducing the bezels on its MacBooks, iPhones and iPads, and we'd love to see it do the same on its iMac line-up. If it did so, then we could see a 30in panel in the same size case.

Display

Apple's 27in iMac has a 5K (5,120x2,880) Retina display, with 500 nits brightness and 10-bit colour. That basically means that the screen is 43 percent brighter than the pre-2017 iMacs, and capable of reproducing even more colours: a total of 1 billion.

The 5K display is better quality than the panels used by most designers

The 5K display is actually a higher resolution and better quality than the panels used by most designers. Some might balk at the fact that Apple opts to match the DCI-P9 colour space, meaning the display can only output about 92 percent of the Adobe RGB colour space, however, it is incredibly accurate according to tests.

The screen is a good reason to upgrade if your existing Retina iMac is a pre-2017 model. And if you are using a non-Retina display, then prepare to be astonished – this is one of the best 5K screens you can buy.

Hardware

Processor

The latest 27in iMacs benefit from two generations of processor options. The entry-level and mid-range models offer 8th-generation Coffee Lake Intel processors, which is an upgrade from the 7th-generation Kaby Lake processors in the 2017 iMacs and jump from four- to six cores.

The top-of-the-range 27in iMac has a 9th-generation processor – which is still Coffee Lake, but is able to accommodate additional cores compared to the 8th generation – up to eight cores (octa-core) in the build-to-order option.

We have benchmarked the 3GHz 6-core 8th-generation entry-level 27in model and the build-to-order 3.6GHz 8-core 9th-generation iMac. We also looked at the 3GHz 6-core 8th-generation 21.5in iMac, which is a useful comparison with the 27in as while the processor is the same the graphics card

is different. We also have data for the iMac Pro, all of which can provide a clearer picture of where the iMac falls in the Apple line-up.

The 8th generation processors are from 2018, but the 9th generation Coffee Lake Refresh processors were introduced in January 2019.

The processors are as follows:

- 3GHz 6-core 8th-gen i5, i5-8500
- 3.1GHz 6-core 8th-gen i5, i5-8600
- 3.7GHz 6-core 9th-gen i5, i5-9600KF
- 3.6GHz 8-core 9th-gen i9, i9-9900KF (build to order)

As you'd expect, the Geekbench multi-core scores for the 27in 3GHz processor and the same 3GHz chip in the 21.5in iMac were very similar. 20,890 for the 21.5in compared to 20,943 for the 27in. This is already a superior score to that seen from the 2017 equivalent models, where we saw 14,106 and 14,017 respectively.

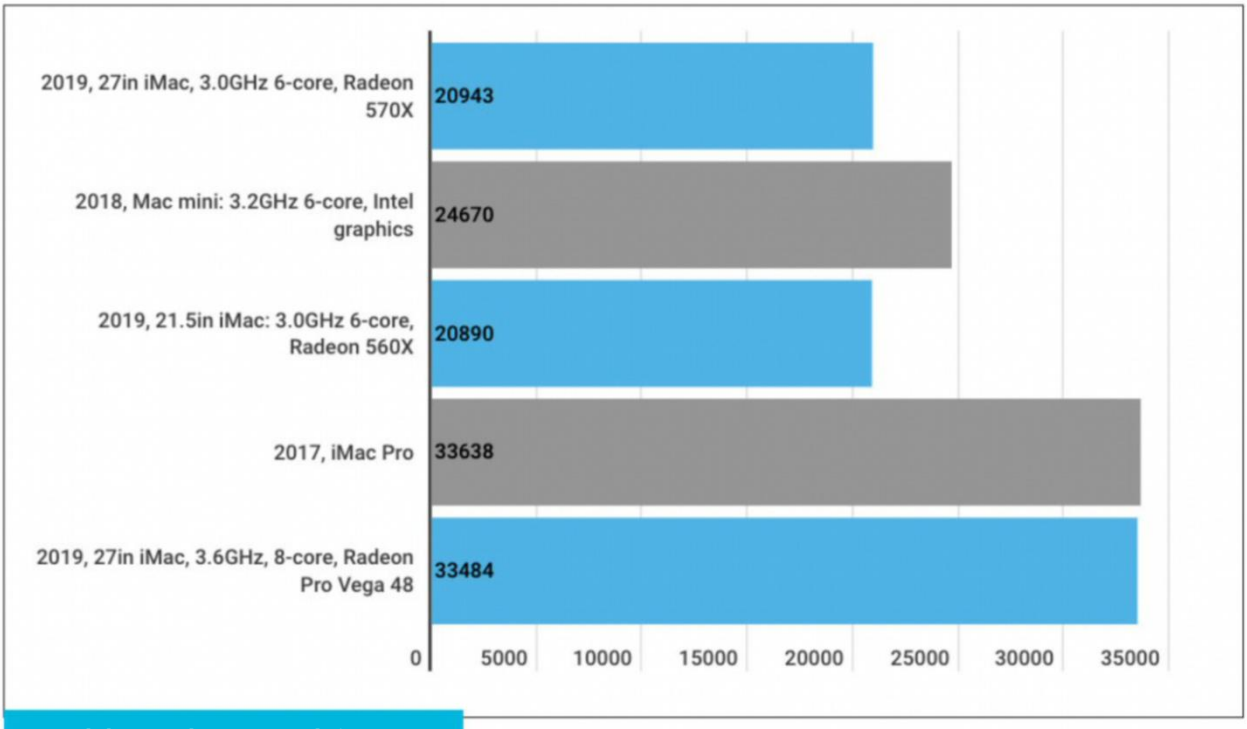
However, the most impressive score came from the 3.6GHz 8-core 9th-gen i9 processor, here we saw 33,484, which compares very favourably to the 33,638 we saw from the iMac Pro. (Note we ran the Geekbench tests on the older iMacs back in 2017, so there could be discrepancies due to the different version of macOS and the different version of Geekbench, but this should give a good indication of the speed bump you can expect).

As we mention in our review of the 21.5in iMac (2019) (see **page 41**), the 3GHz 6-core processor

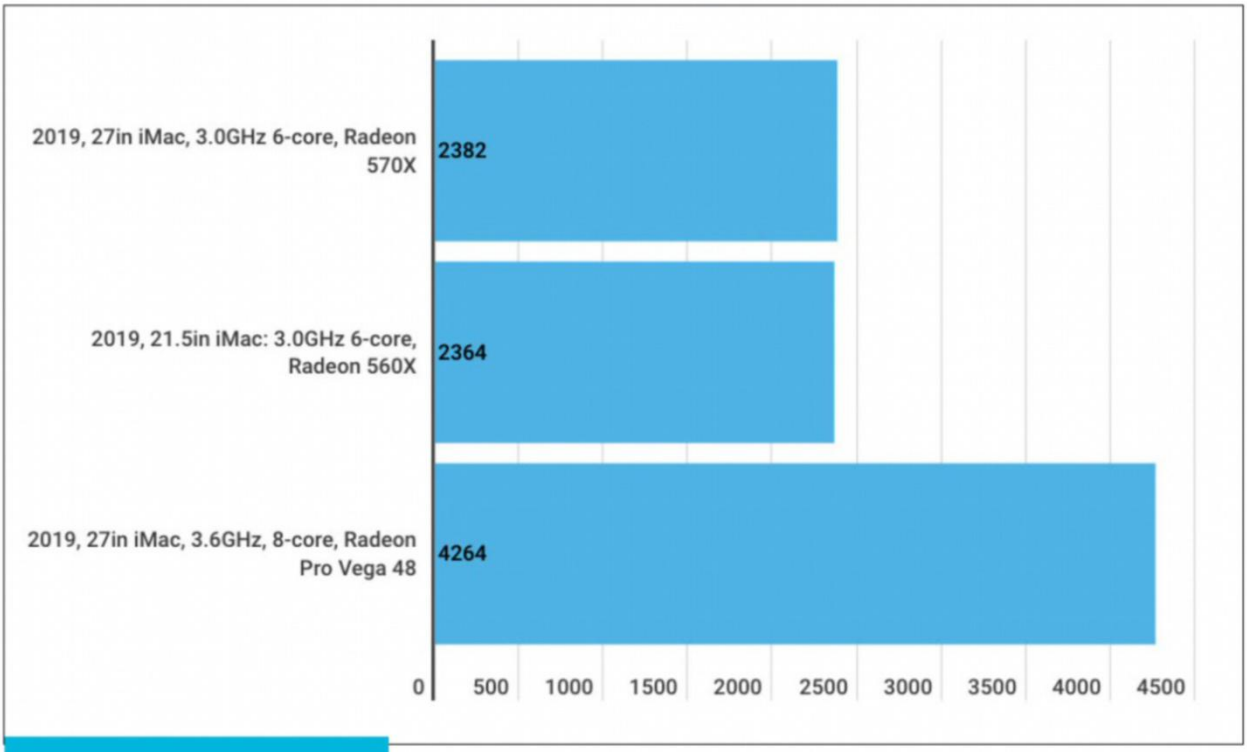
shared by the entry-level 27in and the top-of-the-range 21.5in model is also shared by the Mac mini (2018). Unfortunately, we haven't tested that Mac mini, so we can't confirm our suspicions that the processor score may turn out to be higher on the Mac mini thanks to the SSD. However, we do have the scores for the 3.2GHz 6-core build-to-order option on the latest Mac mini (24,670), and the 3.6GHz quad-core mini (14,453).

Based on this, we think it's likely you will see a decent speed bump if you exchange the Fusion Drive that comes as standard in the iMacs for an SSD. We'll talk more about the storage options below.

We also ran the Cinebench R20 CPU test. Unfortunately, because this is a new benchmark,



Geekbench 4 (multi-core)



Cinebench R20 CPU

we can't compare the previous generation's score (which used an earlier version of Cinebench). However, we do have the equivalent scores for the build-to-order 3.6GHz 8-core i9 and the iMac Pro, which makes for an interesting comparison.

For the 27in 3GHz, 6-core, 27in iMac, with 570X Graphics, we saw a Cinebench R20 CPU score of 2,382 compared to 2,364 for the 3GHz, 6-core, 21.5in iMac, with 560X Graphics. The 3.6GHz 8-core 9th-generation Core i9 iMac we also had on test scored 4,265.

Graphics

Alongside the processor the other major change inside the iMac (2019) is the graphics card, which

is the main difference between the 3GHz 21.5- and 27in iMacs. Here we see: a boost from the Radeon Pro 570 with 4GB video memory in 2017's £1,749 model to a Radeon Pro 570X with 4GB memory in the 2019 model; an upgrade from the Radeon Pro 575 with 4GB in 2017 to the Radeon Pro 575X with 4GB memory in the £1,949 2019 model; and an improvement from the Radeon Pro 580 with 8GB memory to the Radeon Pro 580X with 8GB in the top-of-the-range £2,249 model.

In addition, there is a build-to-order option of a Radeon Pro Vega 48 with 8GB memory (for £405 – this option is only available on the top-of-the-range iMac).

It used to be that only the 27in iMacs offered discrete graphics card options, which would have been a good reason to choose the larger model over the smaller. However, in 2017 all models bar the entry-level 21.5in gained discrete Radeon Pro graphics cards, so it is no longer necessary to choose a 27in iMac to take advantage of superior graphics. The 27in models do offer better graphics cards than the 21.5in Macs though, so expect to see better scores in graphics related tests.

We ran the new Cinebench R20 CPU tests as mentioned above. With this test Maxon is focused on the CPU, but based on heavy graphic use.

With a view to getting an even closer look at the graphics capabilities, we ran the Open GL and Metal Geekbench graphics tests. We did see some interesting differences between the slightly different graphics cards used in the otherwise

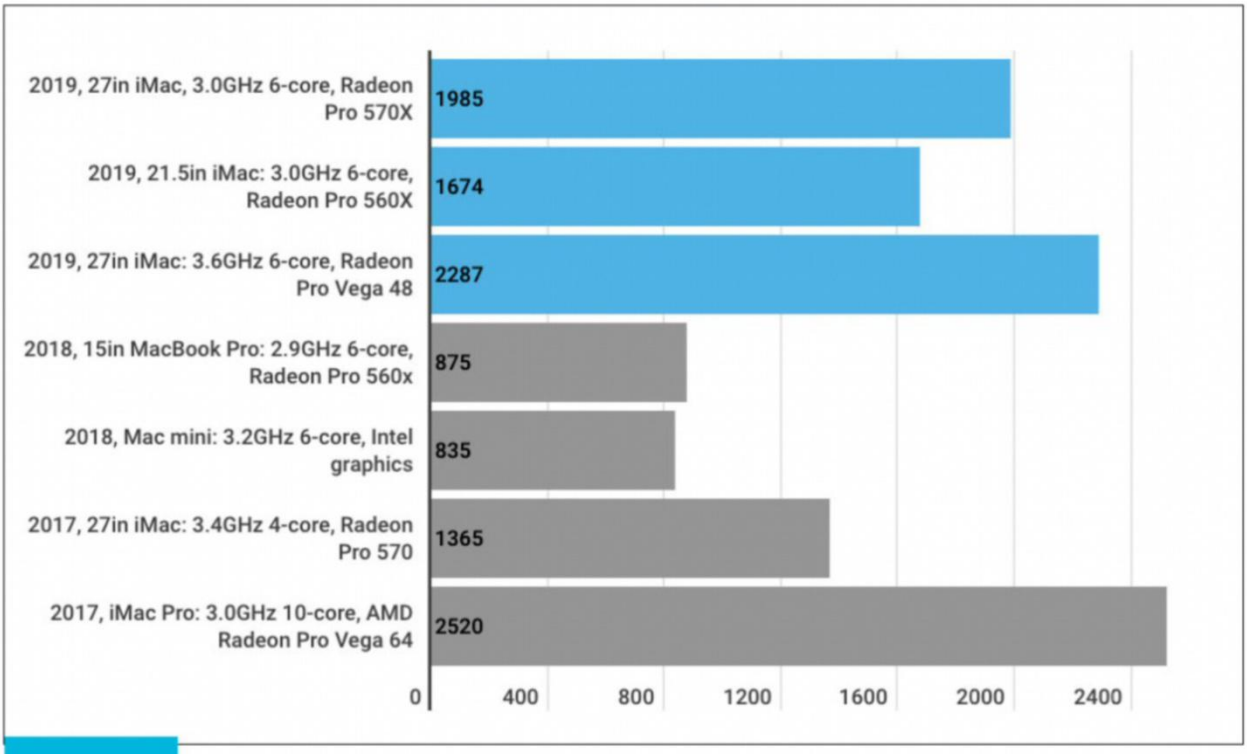
identically specified 3GHz 21.5in and 27in iMacs. In the Geekbench Compute Open CL tests we saw 64,202 for the 21.5in with its Radeon Pro 560X with 4GB compared to 88,014 for the 27in with its Radeon Pro 570X with 4GB memory. We saw a similar leap with the Geekbench Compute Metal test, a leap from 63,487 for the 21.5in to 92,489 for the 27in iMac. The leap you see with the Radeon Pro Vega 48 in the build-to-order i9 iMac with 3.6GHz 8-core processor is astonishing: 143,010 for the Metal test and 137,943 for Open CL.

We also ran the Unigene Valley benchmark, and in that case we do have comparable scores from other Macs, although it's worth noting that these benchmarks were performed in older versions of macOS.

This is where you can really see the difference between the iMac with its discrete graphics and the Mac mini (2018) and its integrated graphics. The score is double what the 6-core 3.2 Mac mini saw, and considerably higher than the 2017 equivalent. The 'X' might look like a minor difference in generations, but you can expect a decent boost.

If you are running graphics-intensive apps, then these discrete graphics options will be very attractive. The 27in iMac offers the best graphics options – and is the only option if you want the Radeon Pro Vega 48 – but they don't represent the huge leap from the 21.5in iMac that they used to.

Now, the 21.5in iMac offers the same Radeon Pro 555X and Radeon Pro 560X as the 15in MacBook Pro, which is considered by many to be a great



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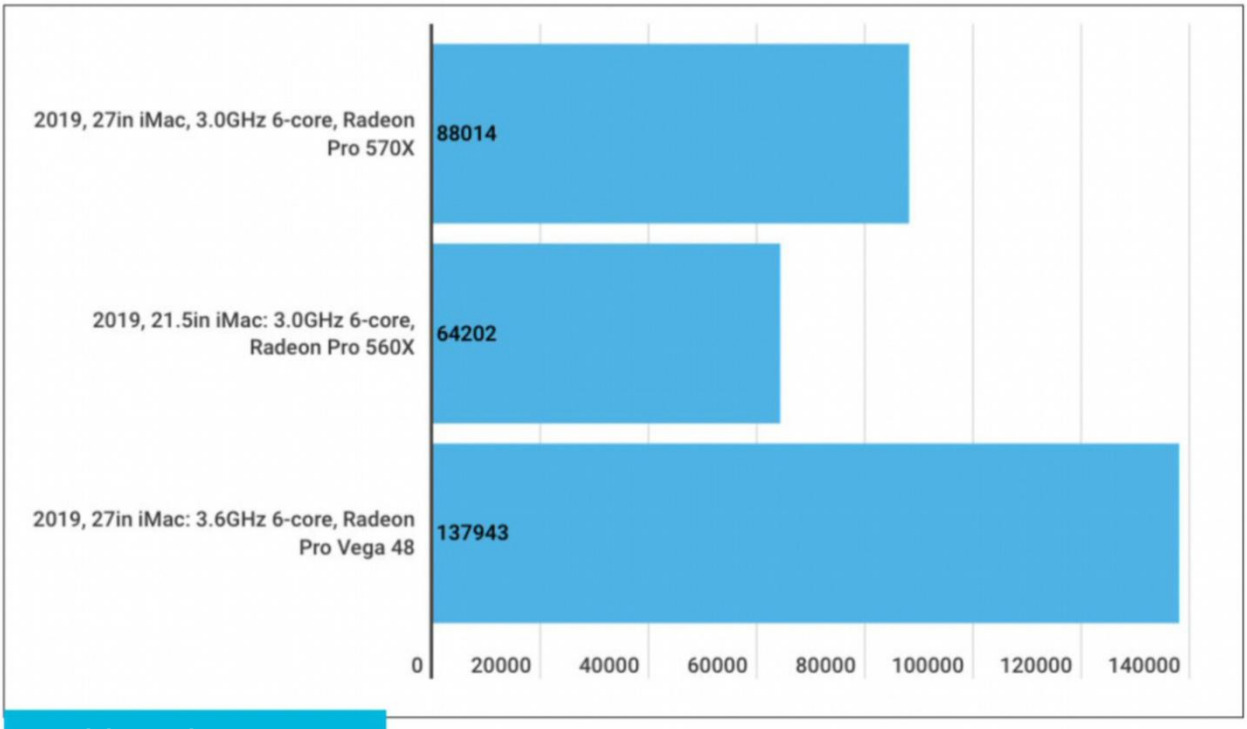
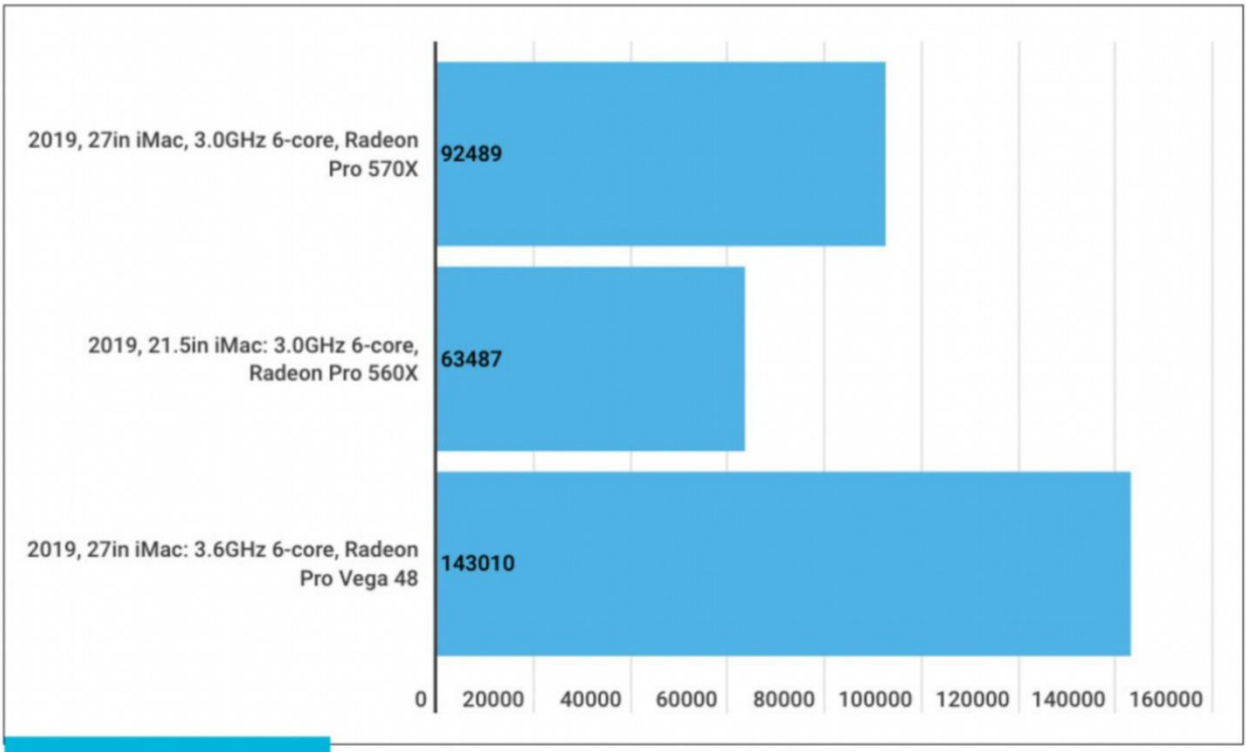


Geekbench Open CL



Geekbench Metal

option for creative professionals. Chances are the bigger 5K screen will more than justify your choice to get the 27in rather than the 21.5in iMac, though.

RAM

There's one final change between the 2017 and 2019 models. Apple has tweaked the RAM from 2,400- to 2,666MHz. Every 27in iMac gets this new, faster RAM, but only the top-of-the-range 3GHz 21.5in model does.

In real terms this improved RAM will give users an increase in speed because it is able to transfer data faster and process operations quicker. If you are looking for a reason to choose the 27in iMac over the 21.5in model, the fact that RAM is easily

upgradable in the 27in iMac thanks to a hatch on the back is likely to sway you.

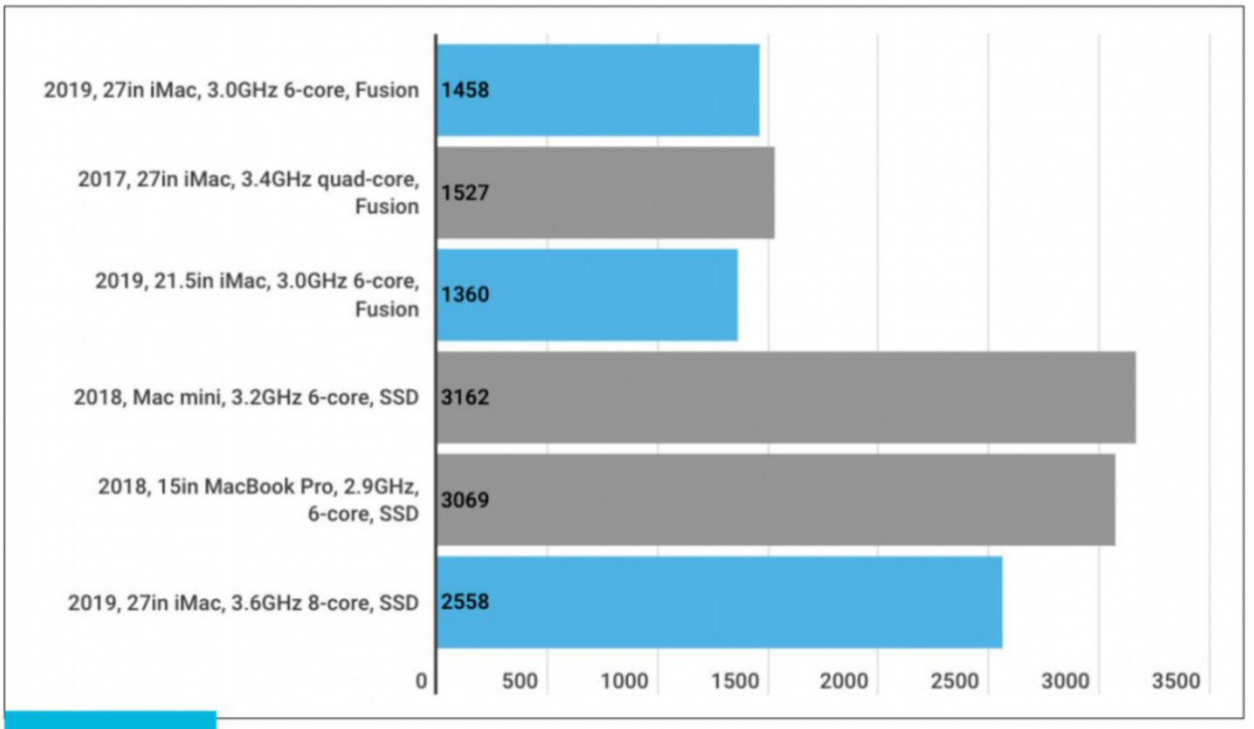
Officially, the RAM inside the 21.5in iMac can't be updated, but that's not entirely true. In 2017, iFixit noted that rather than being soldered onto the motherboard, the RAM inside the 21.5in iMac is located in a RAM hatch behind the logic board, so it is accessible. I's not something we'd recommend trying at home, though. We assume that Apple hasn't soldered the RAM in place in 2019, but it definitely hasn't made it any easier to access the RAM in the 21.5in model, so, for now, the 27in iMac is the best option if you think you might want to upgrade the RAM at some point in the future.

Speaking of RAM upgrades, the 27in iMac can take up to 64GB RAM, but only in the £1,949 and £2,249 models, not the entry-level 27in iMac that we looked at, which maxes out at 32GB RAM.

Storage

The storage options haven't changed, but they are worthy of note because they are one of the biggest disadvantages of the iMac range – if you need 1TB, then you may have to settle for a slower hard drive rather than stump up an extra £630 for the faster 1TB SSD.

Apple's solution to the problem of slow hard drives is the Fusion Drive, which combines a 1TB hard drive with a little SSD so that some things can load from the SSD, and therefore appear instantaneously, and others can be stored on the hard drive. A Fusion Drive is a faster option than

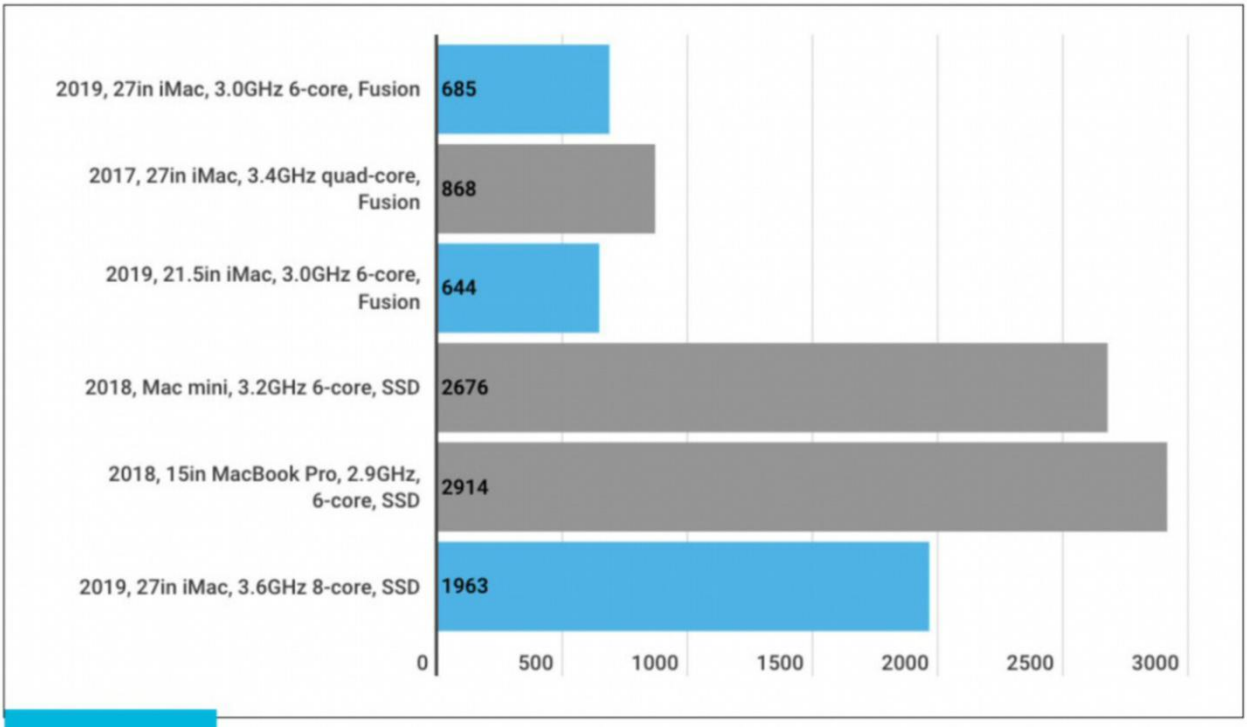


AJA Read

a standard hard drive (like the one found in the entry-level 21.5in iMac) but an SSD is even faster.

You probably don't need 1TB of storage so much that it justifies being lumbered with a 5,400rpm hard drive, even if there is a SSD included with it – and that SSD is about 24GB, smaller than when Apple first introduced the Fusion drive. We think that hard drive will undo all the good work of the other components inside the iMac, so upgrade to an SSD, you can choose a 256GB SSD for £90, and if you really need more storage then get an external drive or use iCloud (2TB costs £6.99 per month).

We ran a storage benchmark on the two iMacs with Fusion drives we were evaluating as well as the 27in build-to-order model that came with a 512GB SSD. In the above benchmarks, you can see how



AJA Write

much better the SSDs perform in the Mac mini and the MacBook Pro models compared to the slower iMac Fusion Drives. It's odd that the SSD in the 27in iMac seems to perform less well than that in the MacBook Pro and Mac mini though.

Connectivity

There is no change here from the iMac (2017), although if you are upgrading from an earlier model then you'll be gaining two Thunderbolt 3 ports (which double up as USB Type-C ports). In addition, you will find four USB-A ports, like the kind used on the iPhone charger and sorely missed from all Apple's laptops bar the older MacBook Air model. It might be old tech, but many of us still have mice and keyboards that we want to plug in to our Mac.

The connectivity options are the same as those on the iMac (2017)

Verdict

The 27in iMac (2019) is impressive and the build-to-order options, such as the 8-core 9th generation Intel processor and the Radeon Pro Vega 48 graphics card are first-class. Our only real criticism is that there is less of a gap between the 21.5in and 27in iMacs than there used to be. This is great news to anyone who wants all that power for less money, but when it comes to the 27in iMac you get the feeling that you are paying a lot more to get the bigger screen.

Is the 27in display worth an additional £300? It is certainly beneficial if you have a lot of windows open, or if you need work on an image at a very high magnification, or use Final Cut Pro for multichannel editing, for example. The 5K display on the iMac is as good, if not better than any other 5K display out there – and it costs considerably less, and comes

with a computer. If you need the bigger screen, then it's definitely worth the extra expense. There is also the fact that only the 27in iMac offers 64GB RAM, the Vega graphics card, and the 9th-generation Intel processors.

We are disappointed that Apple hasn't given the iMac a new look, though. The iMac hasn't changed its appearance since 2012, and the aluminium iMac arrived even longer ago in 2009. This would be forgivable if the iMac design was perfect, but it isn't. The wide bezels are a waste of space and the screen can't be positioned ergonomically. If a 27in iMac screen is beautiful imagine what a 30in iMac screen would be like.

If you need a new iMac now then the 2019 updates bring it in to line with the MacBook Pro with up to six-cores, faster RAM, and better graphics cards. If you can hang on for another year or two we are hoping for a new iMac with reduced bezels and an even bigger screen. Surely that's not too much to ask. **Karen Haslam**

Specifications

£1,749 model

- 27in (5,120x2,880) Retina 5K display
- macOS Mojave
- 3GHz 6-core Intel Core i5 processor (Turbo Boost up to 4.1GHz)
- Radeon Pro 570X GPU with 4GB of VRAM
- 8GB (two 4GB) of 2,666MHz DDR4 memory; four SO-DIMM slots, user accessible. Configurable to 16- or 32GB

- 1TB Fusion Drive. Configurable to 2TB Fusion Drive or 256GB, 512GB or 1TB SSD
- Wi-Fi 802.11ac
- Bluetooth 4.2
- 3.5mm headphone jack
- SDXC card slot
- 4x USB 3 ports (compatible with USB 2)
- 2x Thunderbolt 3
- 10/100/1000BASE-T Gigabit Ethernet (RJ-45 connector)
- Kensington lock slot
- FaceTime HD camera
- 650x516x203mm
- 9.42kg

21.5in iMac (2019)

RATING: ★★★★☆

Price: **£1,149 (inc VAT)** from **fave.co/2IQCqop**

We'd love to be starting with a celebration of a new-look iMac for the 2019, but unfortunately the latest iMac looks just the same as it did back in 2012 when Apple slimmed down the design that was first introduced in 2007. As we mentioned in the previous review, it's the longest Apple has gone without giving a Mac a design refresh.

However, there are changes to the processor, graphics card options and the RAM. We'll look

at these in more detail below. But, suffice to say, they do mean that the iMac (2019) is a much more powerful machine than its 2017 equivalent. And, chances are, what matters to you is how well your Mac stands up to the demands of modern day apps rather than whether it looks ultra-modern.

In this review we are looking at the top-of-the-range 21.5in iMac, with its 3GHz 6-core 8th generation i5 processor.

Price

£1,249: 3.6GHz quad-core 8th-gen i3, Retina 4K, 1TB hard drive, 8GB 2,400MHz RAM, Radeon Pro 555X

£1,449: 3GHz 6-core 8th-gen i5, Retina 4K, 1TB Fusion drive, 8GB 2,666MHz RAM, Radeon Pro 560X

Build-to-order options for £1,449 model

£180: 3.2GHz 6-core 8th-generation Intel Core i7 processor, Turbo Boost up to 4.6GHz

£180/£540: 16GB 2,666MHz DDR4 memory/32GB 2,666MHz DDR4 memory

£315: Radeon Pro Vega 20 with 4GB of HBM2 memory

£90/£270/£630: 256GB/512GB/1TB SSD storage

Design

We are disappointed that the iMac design hasn't changed in all these years. We expect Apple to take a lead in design and not leave something looking the same for a decade.

Then again, we're not asking for change for change's sake. It's still a good-looking machine, so somehow doesn't look dated after all these years, but the design does have its faults.

As with the 27in model, we have to position our iMac on top of a book in order to have the screen at an ergonomically-friendly height. The inability to adjust the height of the screen, beyond tilting it to face upwards or downwards, is frustrating. This is the main request from many users.

The display is surrounded by inch-wide bezels and at the bottom there's a 2.5in aluminium section. We'd love to see Apple slim the bezels down to accommodate a larger panel. If you measure the entire screen diagonally it's 24in, so there's potential for the iMac display to increase to 24in without getting much bigger. For now, if you

want a bigger screen, then the 27in is the iMac to choose and that's quite a jump in size.

Display

The screen is one of the biggest differences between the entry-level 2.3GHz iMac and the other 21.5in models. The 21.5in Retina iMac has 4,096x2,304 pixels, compared to 1,920x1,080 on the entry-level option, 500 nits and 10-bit colour. This means the latest iMacs are 43 percent brighter than previous models, and capable of reproducing 1 billion colours, compared to millions of colours on the 2.3GHz iMac.

Hardware

Processor

The new 21.5in iMacs (2019) benefit from 8th-generation Coffee Lake Intel processors. This is an upgrade from the 7th-generation Kaby Lake processors in the previous iMacs.

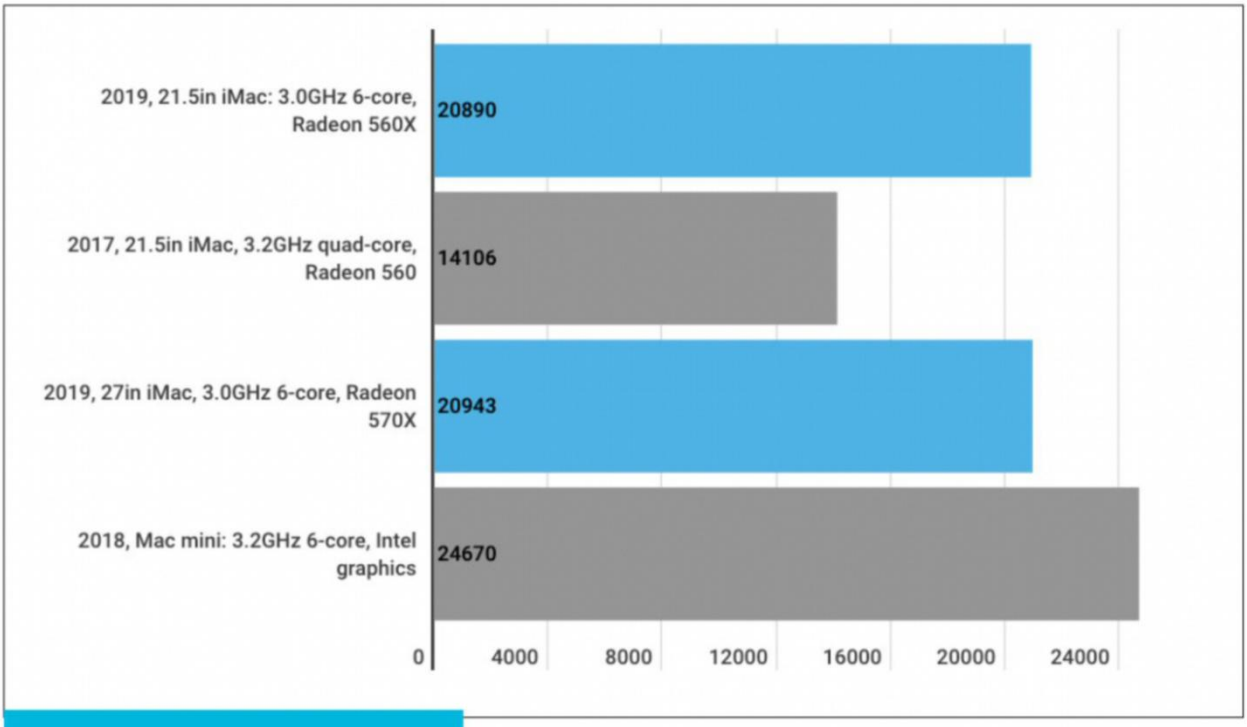
One of the biggest advantages of Coffee Lake over Kaby Lake is the leap in terms of the number of cores. For the first time there is a 6-core option on the 21.5in iMac. It's this 3GHz 6-core machine we are testing here, the alternative is a 3.6GHz quad-core iMac. (That's six 3GHz cores versus four 3.6GHz cores).

The quad-core option comes at a slightly more attractive price of £1,249, but it has some limitations in comparison to the 6-core model. The processor is an i3, rather than an i5, which means that it isn't able to Turbo Boost (an Intel technology

that enables the processor to accelerate – or overclock – when high performance is required). As a result, when Turbo Boost kicks in, the 3GHz 6-core iMac can actually achieve 4.1GHz. The extra processing cores will be an advantage if you work with demanding apps, such as video, audio or image-editing software. The processors inside the 21.5in iMac (2019) are as follows:

- 3.6GHz quad-core Core i3-8100
- 3GHz 6-core 8th-gen Core i5-8500
- 3.2GHz 6-core 8th-gen Core i7-8700 (build to order)

We've run benchmarks on the new iMacs to see just what a difference there is compared to the 2017



Geekbench 4 (multi-core)

generation. Back then we reviewed the 3.4GHz quad-core, 21.5in iMac, with the Radeon Pro 560 graphics. Like our review unit, that was the top-of-the-range 21.5in model.

In the Geekbench single core test we saw gains over the 2017 3.4GHz model, with the older iMac having scored 4,894 compared to 5,372. That's despite the individual cores having a slower clock speed this time round. As you'd expect the multi-core score was significantly higher for the 2019 model. It's important to note that those results were using a slightly older Geekbench, and that those Macs were running Sierra as opposed to Mojave. However, even with these discrepancies, the difference is clear.

Another interesting comparison is with the 27in iMac (2019) that we have also been testing. Both iMacs have exactly the same processor so, as expected the Geekbench scores were very similar, although the 27in model did see a marginally better result in the multi-core test.

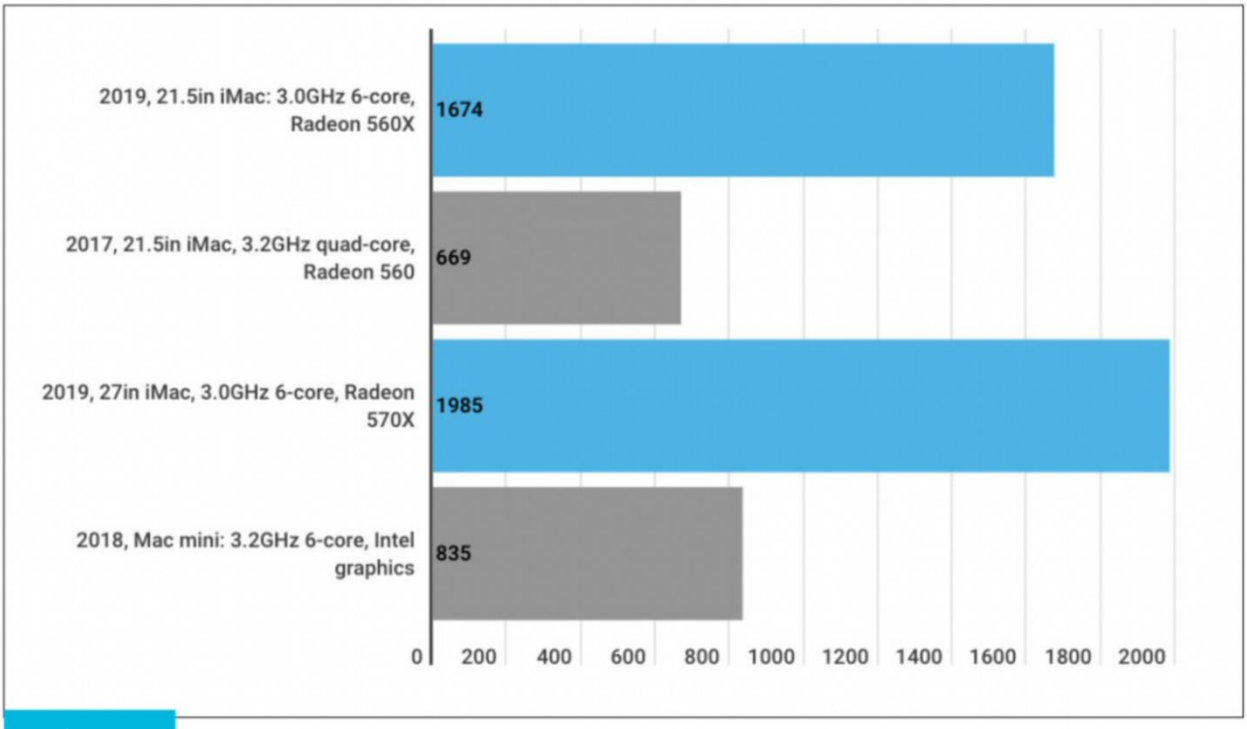
We also have the scores for the 3.2GHz 6-core built to order option on the Mac mini, and the 3.6GHz quad-core Mac mini. This is an interesting comparison because the Mac mini has a SSD and its higher scores certainly seem to indicate that the SSD makes a considerable difference.

What this tells us is that you will see a decent speed bump from the 2017 to the 2019 iMacs, but that choosing an SSD instead of a Fusion Drive is likely to improve things as well, we'll talk more about the storage options below.

Graphics

The other major change inside the iMac (2019) is the graphics card. Here we see a boost from the Radeon Pro 555 with 2GB video memory in 2017's £1,249 model to a Radeon Pro 555X with 2GB memory in the 2019 model, and a boost from the Radeon Pro 560 with 4GB in the 2017 model to the Radeon Pro 560X with 4GB in the 2019 model.

Graphics capabilities is a big differentiator between the Retina and non-Retina iMac models. The older entry-level model has an Intel Iris Plus Graphics 640 integrated into the CPU so it doesn't have its own memory. Back in 2015 all the 21.5in iMacs, even the top-of-the-range, 4K iMac, featured Intel Iris Pro Graphics 6200. Now all but the entry-level system have discrete Radeon Pro graphics



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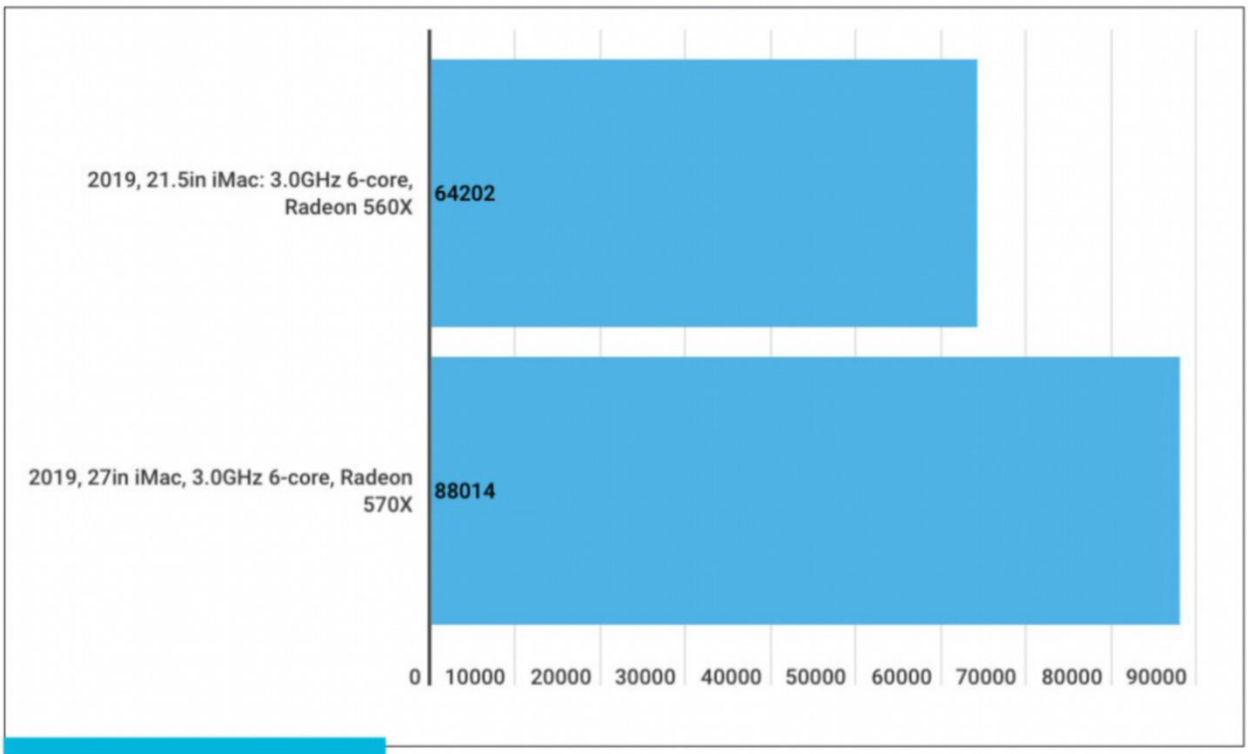
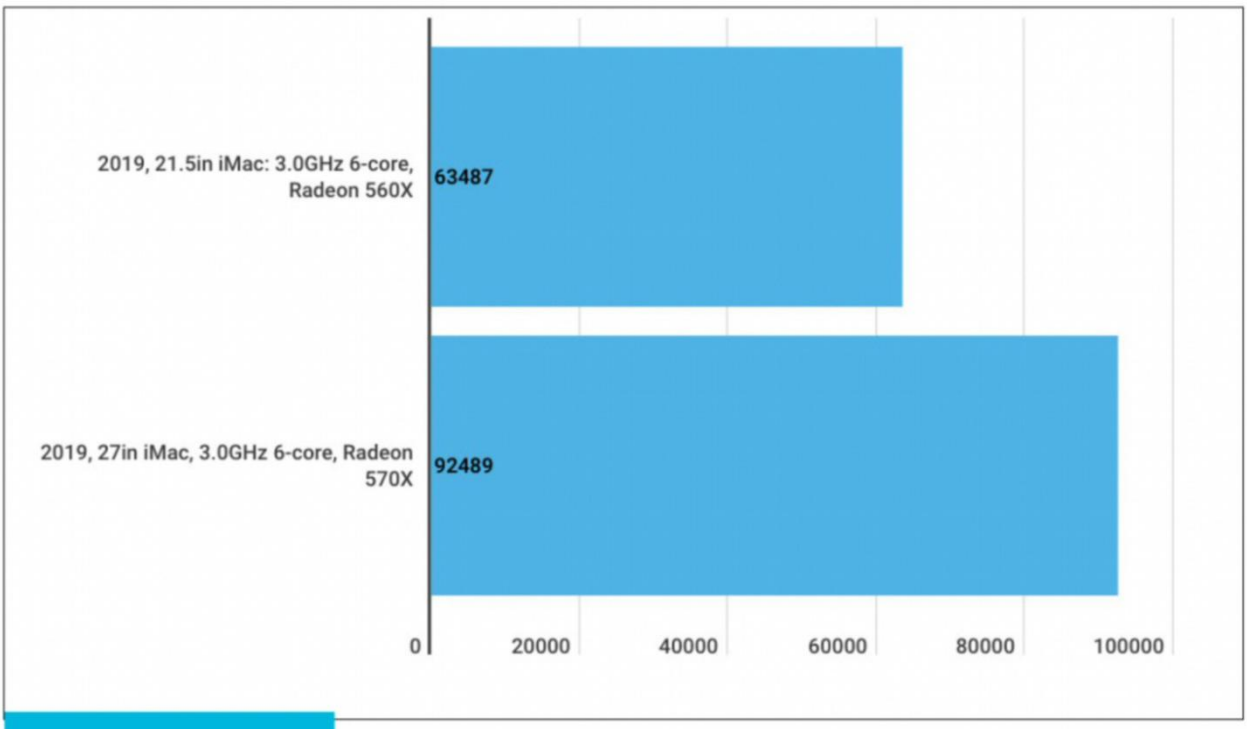


Geekbench Open CL



Geekbench Metal

cards. So, if you are upgrading from a pre-2015 iMac you will benefit greatly.

We ran the Geekbench graphics tests and we saw some interesting differences between the graphics cards used in the otherwise identically specified 3GHz 21.5- and 27in iMacs.

We also ran the Unigene Valley benchmark, and we have comparable scores from other Macs (although it's worth noting that these benchmarks were performed in older versions of macOS).

This is where you can really see the difference between the iMac with its discrete graphics and Mac mini (2018) and its integrated graphics. The scores leave the mini for dust.

If you are running graphics intensive apps then these discrete graphics options are a significant benefit of the iMac range when compared to the Mac mini and the 13in MacBook Pro as both offer only integrated graphics. Incidentally, the 15in MacBook Pro (2018) offers the exact same discrete graphics options as the new 21.5in iMacs, although in that case the Radeon Pro 555X comes with 4GB of memory rather than 2GB.

RAM

There's one final change between the 2017 and 2019 models. Apple has tweaked the RAM from 2,400- to 2,666MHz, but only in the top of the range, 3GHz 21.5in model. The faster RAM will speed up operations and transfer data quicker.

The main factor against the 21.5in iMac is that the RAM isn't easily upgradable (on the

27in iMac there is a hatch that can be opened so that new RAM can be added).

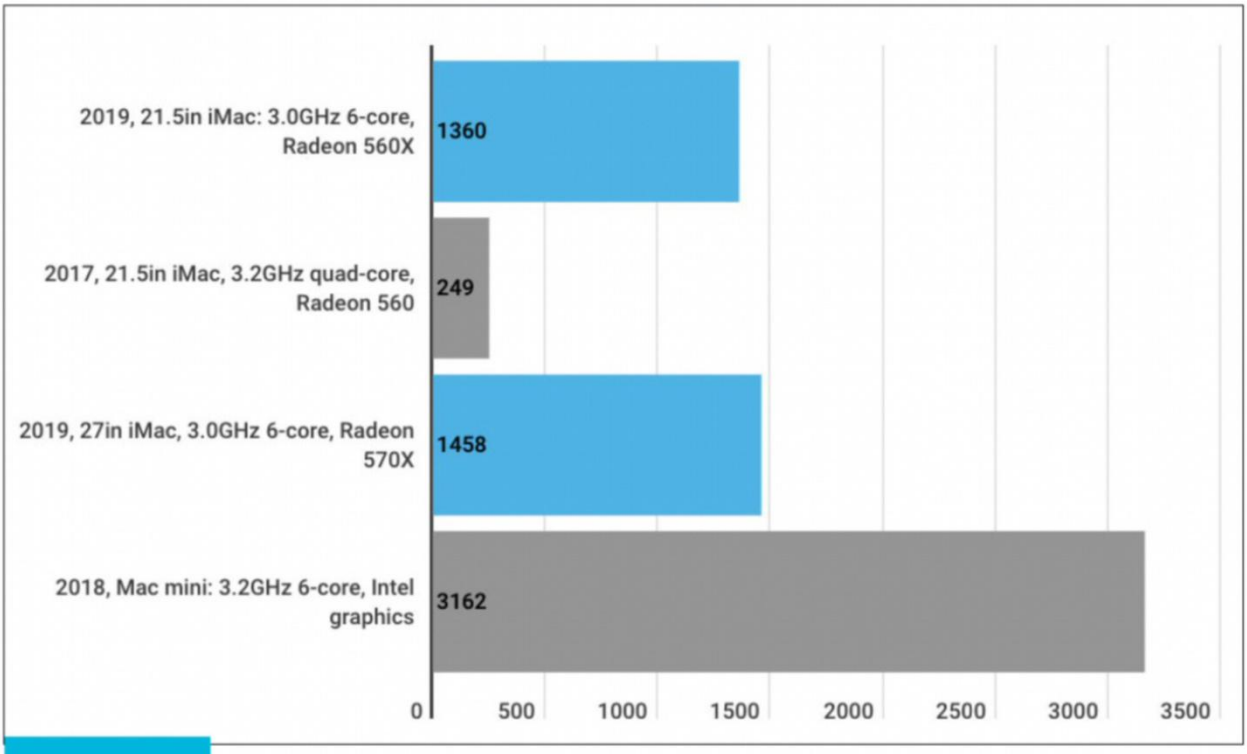
Officially, the RAM inside the 21.5in iMac can't be updated, but that's not entirely true. Regarding the 2017 iMac, iFixIt noted the RAM was located in a hatch behind the logic board, rather than soldered onto the motherboard as was the case previously. So the RAM is accessible, but it's not something we'd recommend trying at home (and it would void your warranty if you did). We assume that the situation is the same in 2019 and that Apple hasn't decided to solder the RAM in place.

Storage

The storage options haven't changed and that's a disappointment because they are one of the biggest disadvantages of the iMac range.

A 1TB hard drive is still the standard option for the entry-level 2.3GHz iMac and the mid-range model. Some people might feel that they need 1TB of storage, however, it's our opinion that probably you don't need this amount storage so much that it justifies being lumbered with a 5,400rpm hard drive. This will somewhat undo all the good work of the other components inside the iMac so avoid a model with a traditional hard drive.

Luckily you do have options. If you are really convinced that you need 1TB of storage then Apple offers a Fusion Drive, which combines a 1TB hard drive with a small amount of flash storage. As the name suggests, this gives you the best of both worlds in as much as your Mac can store some data



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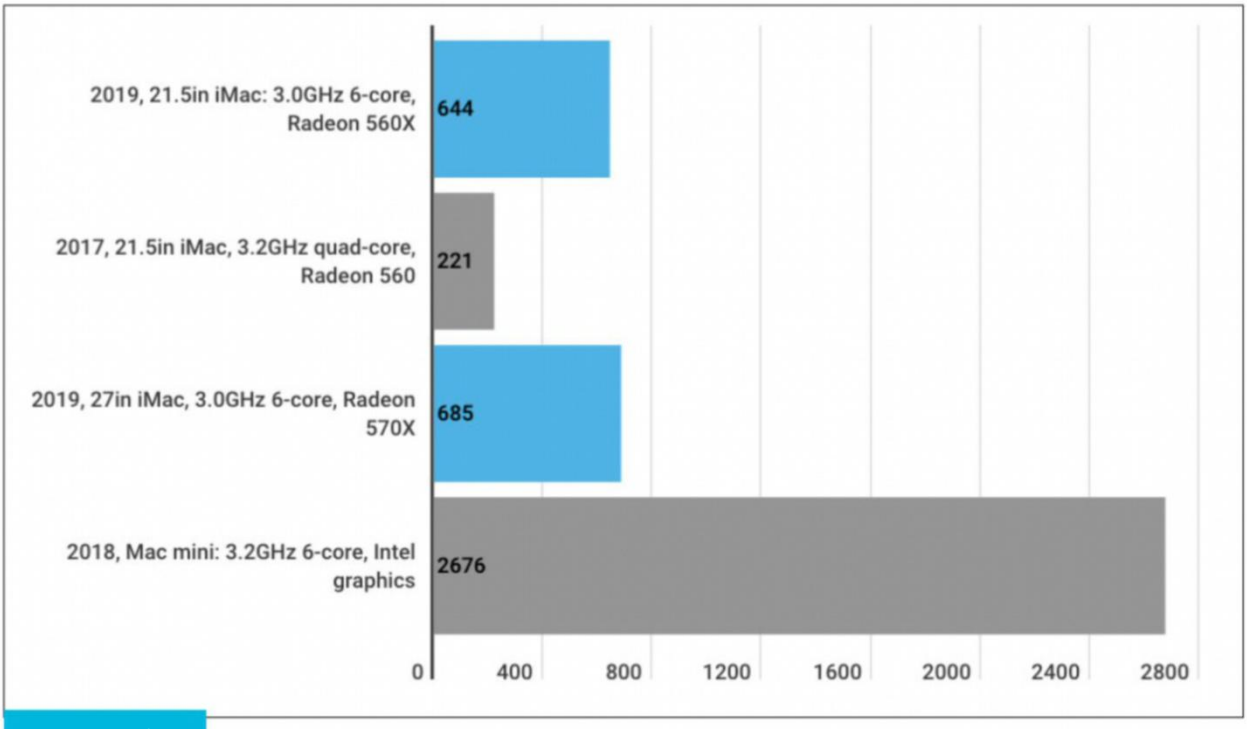


AJA Write

in the flash memory, which will speed things up a bit because accessing it will be almost instantaneous.

We ran a storage benchmark on the two iMacs we were evaluating. Our results on **page 51** show how much better the SSD performs in the Mac mini compared to the Fusion Drive equipped 2019 iMacs.

It's worth noting that in 2017 Apple improved the SSD storage, claiming it was 50 percent faster, with write speeds of 3Gb/s. So, even if you have an iMac with an SSD from before 2017, you will experience a boost in comparison.

Connectivity

Again, there is no change here from the iMac (2017), although if you are upgrading from an earlier model you'll be gaining two Thunderbolt 3 ports (which double up as USB Type-C sockets).

The 21.5in iMac has four USB 3 ports and two Thunderbolt sockets

You will also find four of the older USB-A ports – and given these are now sorely missed from all Apple's laptops (bar the older MacBook Air), this is definitely a factor in favour of the iMac. It might be old tech, but many of us still have mice, keyboards and other devices that we want to plug in to our Mac. Not to mention the iPhone charger that comes in the box.

Verdict

We are disappointed that Apple hasn't given the iMac a new look – it hasn't changed in appearance since 2012. This would be forgivable if the iMac design was perfect, but it isn't. The wide bezels are a waste of space and the screen can't be positioned ergonomically apart from the angle. MacBooks might make up the majority of Apple's Mac sales, but we'd still appreciate some design love for the iMac and so would people that use them every day.

This is an update for those looking for a performance boost and in that respect, the 21.5in iMac (2019) is excellent and bring it in line with the MacBook Pro. Up to six-core Intel processors, faster RAM and better Radeon graphics cards are all welcome additions on the inside. It's a worthy update, but we are hoping for better things next time Apple updates the iMac. **Karen Haslam**

Specifications

£1,449 model

- 21.5in (4,096x2,304) Retina 4K display
- macOS Mojave

- 3GHz 6-core Intel Core i5 (Turbo Boost up to 4.1GHz). Configurable to 3.2GHz 6-core Intel Core i7 (Turbo Boost up to 4.6GHz)
- Radeon Pro 560X with 4GB of VRAM. Configurable to Radeon Pro Vega 20 with 4GB of VRAM
- 8GB of 2,666MHz DDR4 memory. Configurable to 16GB or 32GB
- 1TB Fusion Drive. Configurable to 256-, 512GB or 1TB SSD
- Wi-Fi 802.11ac
- Bluetooth 4.2
- 3.5mm headphone jack
- SDXC card slot
- 4x USB 3 ports (compatible with USB 2)
- 2x Thunderbolt 3
- 10/100/1000BASE-T Gigabit Ethernet (RJ-45 connector)
- Kensington lock slot
- FaceTime HD camera
- 528x450x175mm
- 5.66kg

iPad Air (2019)

RATING: ★★★★½

Price: **£479 (inc VAT)** from **fave.co/2KXYbnY**

As we reported last month, the Air is back. Apple unexpectedly revived its old iPad Air branding (discontinued in 2017) in a surprise announcement in March, unveiling a powerful, mid-priced, mid-sized tablet with an A12 processor and support for the Apple Pencil. But will the Air float your boat? In this review we put it through our rigorous speed, graphics and battery tests, and evaluate design, specs and pricing, to find out if Apple has hit the sweet spot.

Price

The 9.7in iPad (2018) is still on sale, starting at £319 from **fave.co/2Dyf6HG**, and that remains the benchmark for a budget iPad. The new Air is pitched a little higher, while remaining more affordable than the iPad Pro models further up the scale.

£479: 64GB, Wi-Fi
£629: 256GB, Wi-Fi
£599: 64GB, cellular
£749: 256GB, cellular

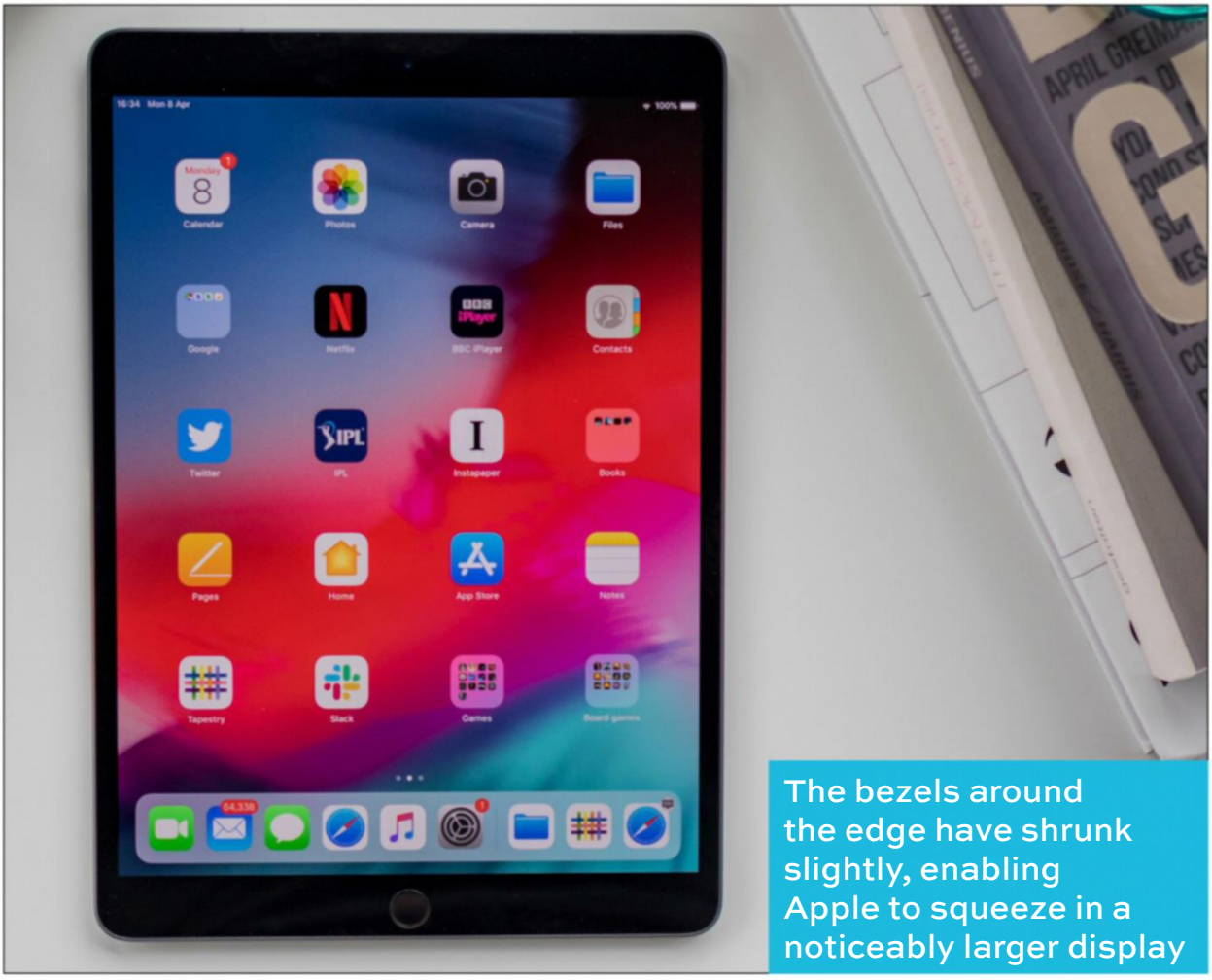
Design

Continuing the in-betweener theme, the Air has an improved design compared to the 9.7in iPad with, among other improvements, a larger screen and thinner body, but stops short of the radical changes seen in the Pro models.

Display

So the bezels around the edge have shrunk slightly, enabling a higher screen-to-body ratio and allowing Apple to squeeze in a noticeably larger display without bulking out the chassis too much. But the Home button remains – whereas the 2018 Pro models ditched the Home button (and Touch ID, replaced by Face ID), which made possible an almost all-screen design. In other words, this is a compromise between the triple ideals of low price, familiarity, and optimum design.

A bezel tweak can only achieve so much, and to accommodate the bigger screen the Air has



The bezels around the edge have shrunk slightly, enabling Apple to squeeze in a noticeably larger display

been made taller and a little wider than the 2018 iPad, although the far slimmer profile (6.1mm, down from 7.5mm) means it's actually 13- to 14g lighter. Note that the 11in iPad Pro is 5.9mm, so this isn't the slimmest mid-size tablet on Apple's books – although it is the lightest.

iPad Air (2019): 250.6x174.1x6.1mm; 456g/464g (Wi-Fi/cellular)
9.7in iPad (2018): 240x169.5x7.5mm; 469g/478g
11in iPad Pro: 247.6x178.5x5.9mm; 468g/468g

The antenna unit on the cellular model now matches the colour of the rest of the back

A less immediately obvious change from the 9.7in iPad – but one we're very happy to report – is the restoration of the laminated screen. For cost reasons the 2017 and 2018 9.7in iPad models both have unlaminated screens, which bend inwards very slightly when pressed and feel a bit cheap. That isn't an issue here.

Headphone port

The antenna unit on the cellular model now matches the colour of the rest of the back, rather than being a cheap-looking matte black as on the 2018 iPad. And Apple has included a Pro-style Smart Connector for the Smart Keyboard.

We find the Smart Keyboard quite hard to type on at this size (the 12.9in version is much more comfortable), but it's still a quantum leap forward

from on-screen typing and a big benefit for business types on the go – especially considering how much cheaper this device is than the Pro models you previously had to buy to get a Smart Connector.

But other than the changes outlined above, and a couple of seemingly inconsequential tweaks to the position of ports and buttons, the Air follows the same design as the 9.7in iPad . To be clear, that's not a bad thing. It's a beautiful and practical design that looks brilliant and feels great in the hand (and, because you get the curved under-edges rather than the newer squared-off design, it's actually easier to pick up than the Pro).

Plus, you get a headphone port, which is something Pro owners have to manage without.

Smart Connector

As is standard for iPads, the Air comes in silver, gold and Space Grey. We tested a Space Grey unit, but would always vote for gold given the choice.

Performance

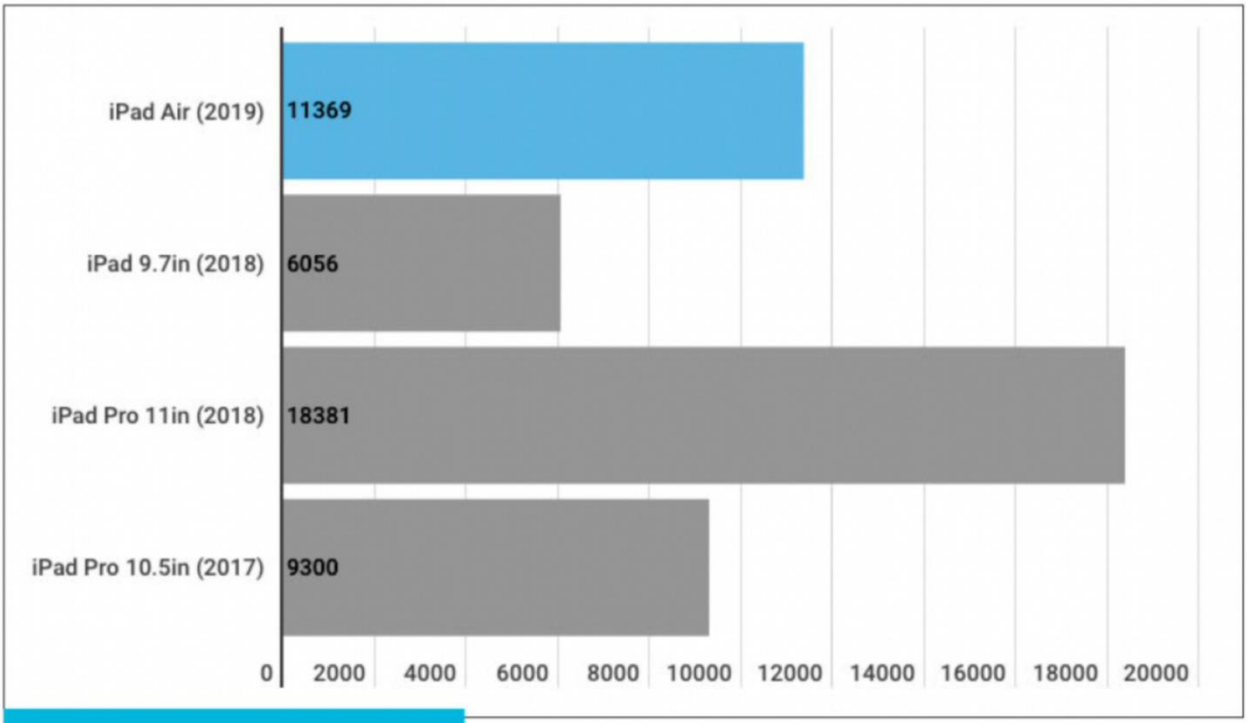
Speed and graphics

Apple has equipped the Air with an A12 Bionic chip – the latest generation of its mobile processor line. As before this is a compromise, since the souped-up A12X version in the Pro iPads is even faster, but it's still an impressive inclusion at this price and a big step up from the A10 Fusion in the 9.7in iPad.

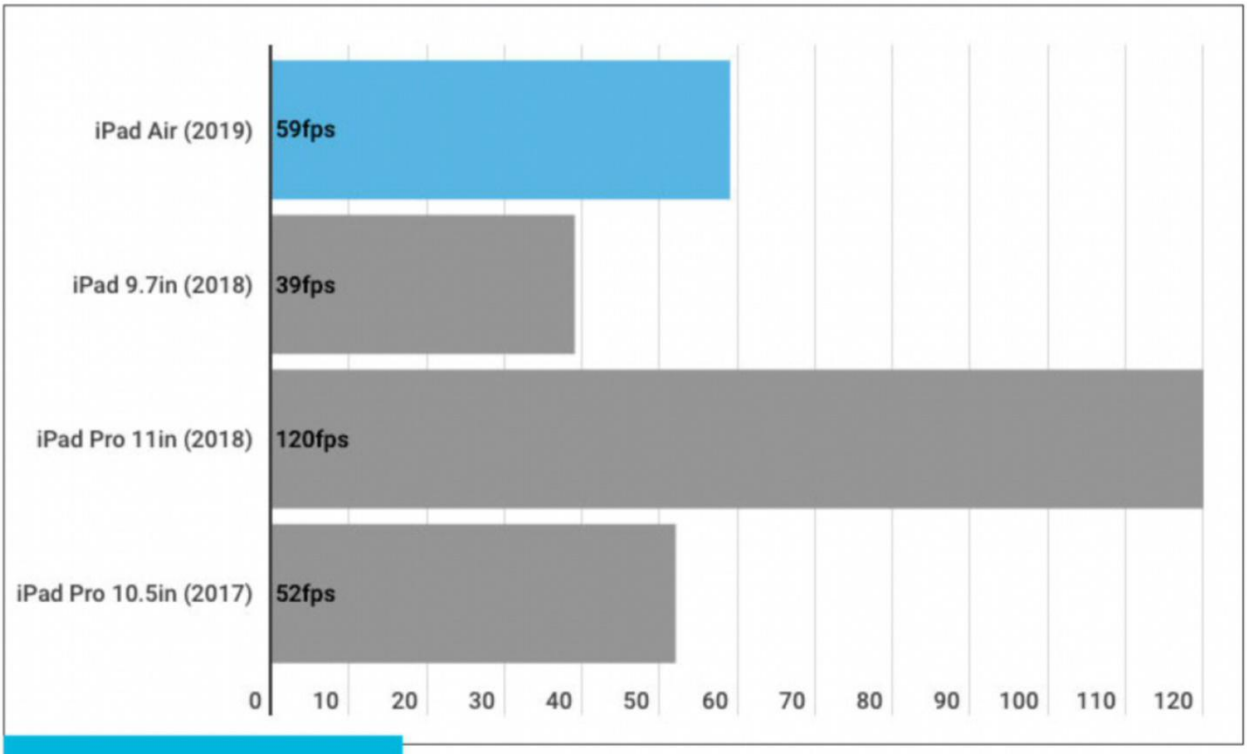
The A12 is complemented by 3GB of RAM, an increase from 2GB in 2018. (The Pros are available with either 4- or 6GB.)

The Air, which scored 11,369 in the multi-core section of the Geekbench 4 CPU test, wasn't far off doubling the performance of last year's 9.7in model (6,056). It was in turn fairly easily beaten by the 11in iPad Pro (18,381), but was noticeably faster than the Pro from one generation previously (9,300).

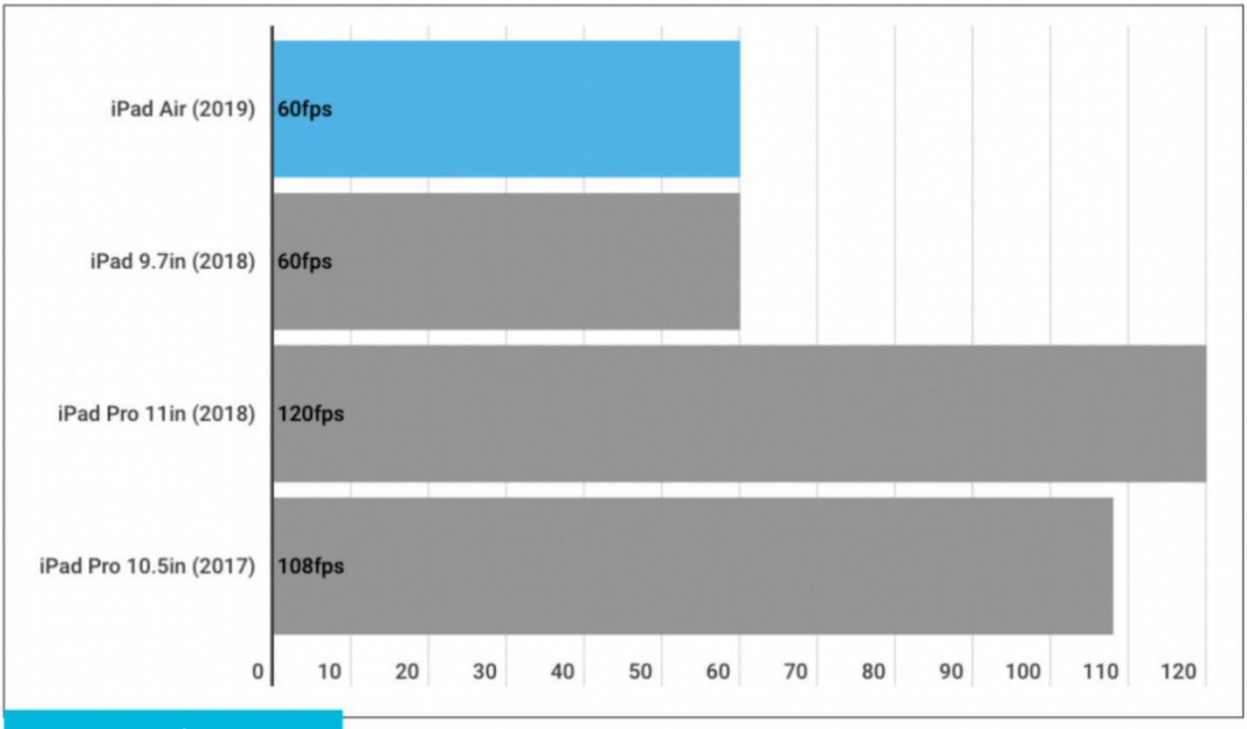
To evaluate graphical processing power we use the GFXBench Metal app, and here again we saw a huge step up in performance from the 9.7in iPad and playable frame rates right up to the hardest benchmarks. Performance was admittedly not comparable to the 11in iPad Pro, which was streets ahead throughout, but in most of the tests the Air was able to beat the 2017 Pro convincingly. If you're a creative professional looking to use the most demanding video and image processing apps,



Geekbench 4 (multi-core)



GFXBench Manhattan



GFXBench T-Rex

or a gamer with an eye on the most graphically advanced titles, then you might be advised to plump for an A12X device. But for almost all of us the iPad Air's excellent performance will be more than enough, and offers plenty of future-proofing.

Battery life

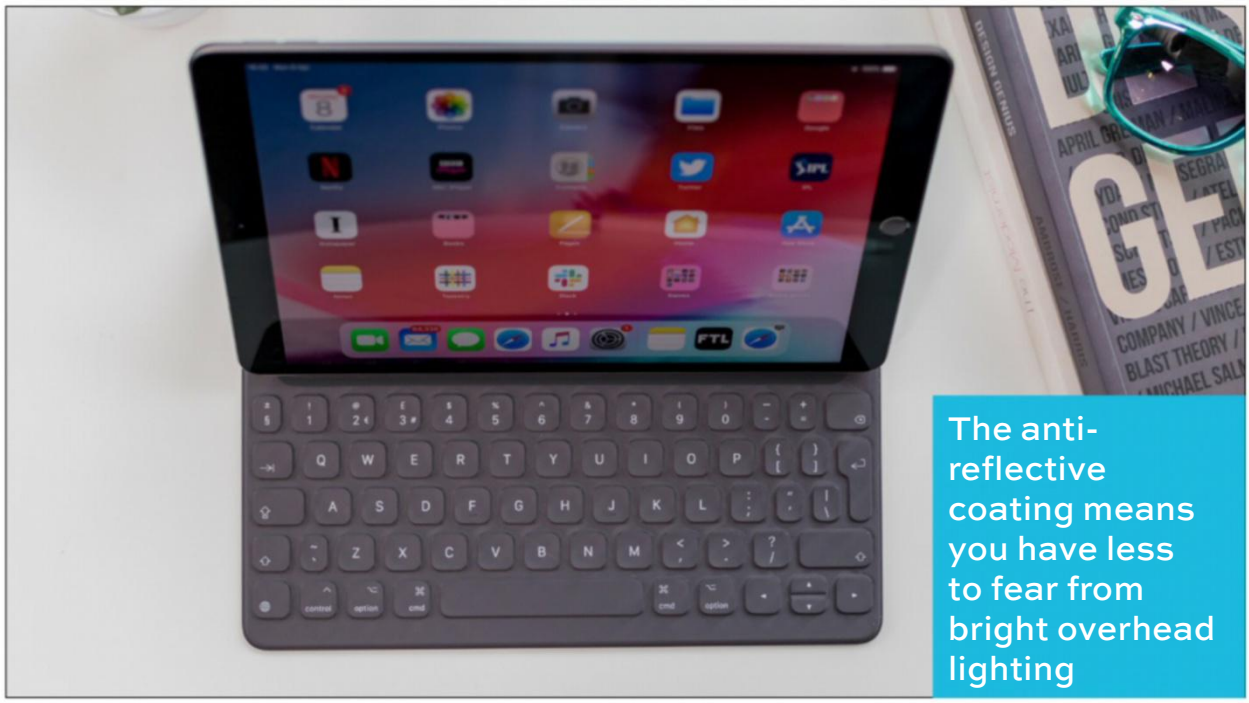
The Air has a 30.2Wh rechargeable battery, and Apple reckons this is good for around 10 hours of Wi-Fi browsing. This was borne out in testing: it lasted nine hours, 24 minutes in Geekbench 4's battery benchmark, which is considerably more demanding than real-world use. That's almost identical performance to the 11in Pro (nine hours, 32 minutes), and much better than the 9.7in iPad, which lasted six hours, one minute.

Our Air was bundled with a 10W charger, with which it went from empty to 13 percent power in 30 minutes – pretty slow going. We've heard that in some areas the Air is supplied with a 12W charger, which will yield better speed.

Display

Despite the continuing presence of large bezels around edge, the Air's screen is a pleasure and a triumph, with numerous improvements from the 9.7in iPad.

Resolution is up, albeit only by enough to maintain Retina-standard pixel density (264ppi) across a larger area. It looks fantastic: sharp, bright, colourful. Thanks to the new inclusion of True Tone it provides a consistent output in varied



The anti-reflective coating means you have less to fear from bright overhead lighting

conditions, and the anti-reflective coating means you have less to fear from bright overhead lighting. Interacting with the screen feels great, thanks to the lamination already mentioned and the virtually instant response. It would be easy for Apple fans to take this for granted, but not all tablets give such a convincing illusion that you are physically moving around the on-screen elements.

Cameras

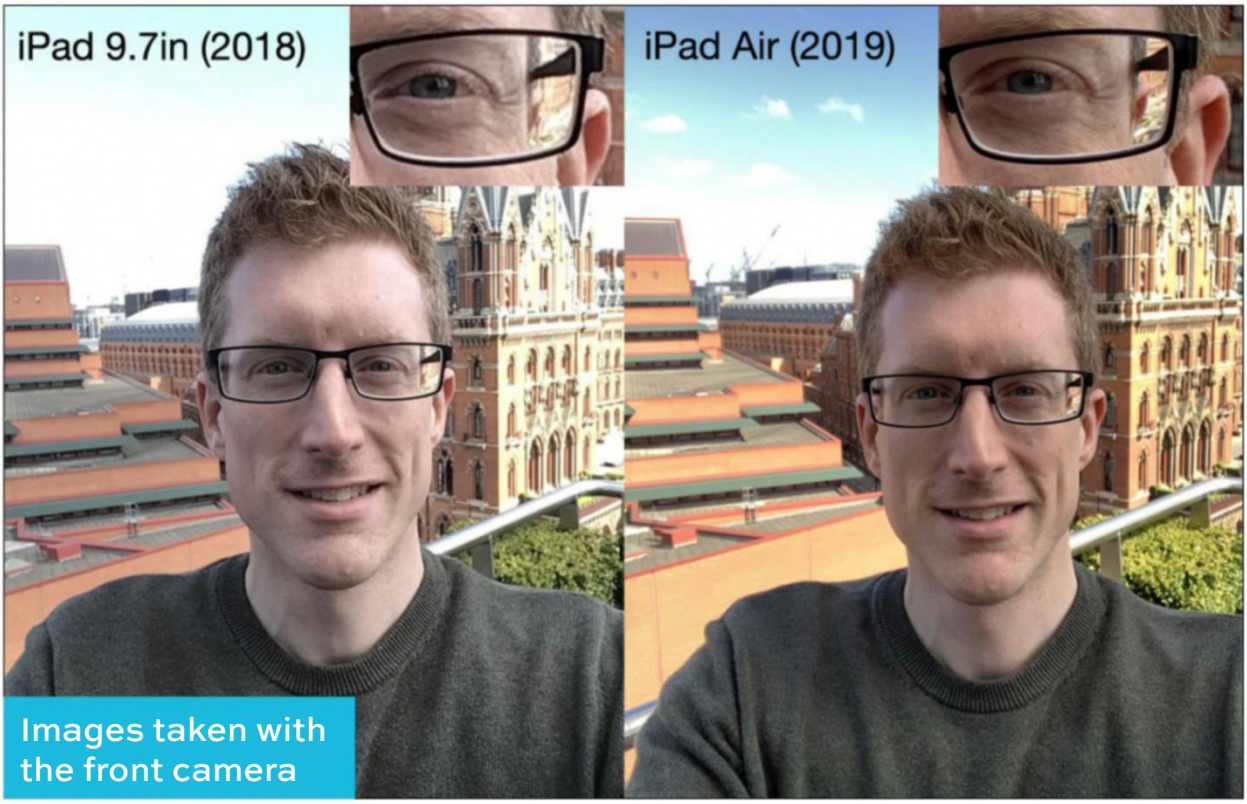
The Air has an 8Mp rear camera, same as on the 9.7in iPad – a respectable inclusion that provides reliably decent images rather than anything spectacular. (We asked Apple if the A12's neural engine would provide any of the same algorithmic photographic benefits as on the iPhone XS, but the company played this down.)

Photo of St. Pancras Renaissance Hotel London taken with the Air's rear 8Mp camera

The front camera, on the other hand, is vastly improved: 7Mp and 1080p video, up from 1.2Mp and 720p video in the iPad 9.7in. Which makes sense; few people use a mid-size tablet to take pictures of nice views, but most iPad owners will enjoy the benefit of an improved front camera for FaceTime and selfies.

Apple Pencil support

Good news/bad news: the Air is Pencil-compatible, but only with the less good first-gen model, which charges awkwardly via the Lightning port. We



Images taken with the front camera

prefer the Apple Pencil (2018), which attaches magnetically and charges wirelessly, but that remains exclusive to the 2018 iPad Pro models.

Other specs

That's most of the specs and features worth highlighting, but we'll spare a few words for the storage, which has been doubled at each tier from last year: 64- and 256GB, up from 32- and 128GB. That's perhaps more significant than it sounds, because it means the entry-level model has plenty of storage for the average user, whereas before we recommended paying extra for the upper tier.

Touch ID is now second-gen, which is faster and more reliable than the first-gen version used

previously; eSIM is supported; Bluetooth has been bumped from 4.2 to 5.0, and you now get gigabit LTE. All these changes are from the 9.7in iPad (2018), and are matched by the 11in iPad Pro .

Software

The iPad Air comes with the latest version of Apple's iOS operating system pre-installed: at time of writing, that means iOS 12.2. iOS is slick and fast – slicker and faster than ever, thanks to optimization in the version 12 update – and known for its robust security. It is a little harder to customize than Android, but the default setup is easier and in our opinion more enjoyable to use.

Unless you're willing to jailbreak your device, you'll only be able to download software from the official App Store; still, there are more than a million vetted, iPad-optimized apps on there. Premium and big-name apps are likely to come to iOS before Android because iPad owners are more willing to spend money.

As well as the speed boost (of interest mainly to owners of older devices), iOS 12 added Screen Time, a feature to help you monitor and limit app and device usage. And group FaceTime calls were added in iOS 12.1.

Verdict

The iPad Air is a collection of compromises, and in almost every area there's another tablet out there that's better: the 9.7in iPad is cheaper, the iPad mini more portable (see **page 69**), the 11in iPad Pro

For most people this is now the iPad to pick

more future-proofed for very demanding apps. But as an all-round package this is vastly appealing and quite possibly the best (or at least best-value) model Apple has to offer.

It's a fast machine with a large and well-specified screen, long battery life and attractive (if old-fashioned) design – the old familiar Home button and particularly the headphone port will be seen as plus points by many. The front-facing camera provides high-quality FaceTime video and selfies, and while the rear camera is less impressive this is a sensible area for a mid-size tablet to cut costs.

Talking of which, £479 (for the perfectly adequate base storage allocation) is good value for all the goodies just mentioned. Those on a

tight budget should choose the 9.7in iPad, and a Pro model is probably better for a creative professional, but for most people this is now the iPad to pick. **David Price**

Specifications

- 10.5in laminated Retina (2,224x1,668; 264ppi) LED-backlit Multi-Touch display, 500 nits brightness, True Tone, supports Apple Pencil
- iOS 12.2
- A12 Bionic chip with Neural Engine and M12 coprocessor
- 3GB RAM
- 64GB, 256GB storage
- 8Mp rear-facing camera: f/2.4, 1080p HD video, Slo-mo (120fps), Live Photos
- 7Mp front-facing camera: f/2.2, 1080p HD video at 30fps, Retina Flash
- Wi-Fi (802.11a/b/g/n/ac)
- Bluetooth 5.0
- Gigabit-class LTE
- Fingerprint scanner
- Stereo speakers
- Dual microphones
- Headphone jack
- Nano-Sim and eSIM
- Lightning port
- 30.2Wh rechargeable battery: claimed battery life of 10 hours on Wi-Fi
- 250.6x174.1x6.1mm
- 456g/464g (Wi-Fi/cellular)

iPad mini (2019)

RATING: ★★★★☆

Price: **£399 (inc VAT)** from **fave.co/2DyVlQ9**

This wasn't meant to happen. The mini hadn't been updated since 2015 and was left out in the cold, costing more than the larger 9.7in iPads that were released since. We thought Apple had left it for dead.

The introduction of this 2019 model is a surprise – it's barely different on first glance and yes, those bezels sure look huge after the past four years of

consumer technology working towards bezel-less displays. But I've been pleasantly surprised by the mini, finding that I pick it up far more often than I do with a larger iPad.

Using devices more is sometimes a bad thing, but this iPad lends itself to reading far more than it does scrolling through endless timelines. It's not an iPad for Instagram or Twitter. At its heart it's a great eReader, news app displayer and Netflix enabler.

Unlike Apple's other iPads it's not striving to replace your laptop, but instead quietly does some things better than one. If you don't mind the ageing design, the smallest iPad could be a better option for you than any other.

Price

The iPad mini (2019) starts at the same price as its ancient predecessor at £399. This price gets you 64GB (256GB is also available) and represents an excellent upgrade and price considering the substantial internal upgrades.

Design

There are two things that make the iPad mini (2019) a great iPad. One is its portability, and one is its sheer processing power. Yes, we know this is basically the same design as the first iPad mini in 2012, but wait. Ever since the 12.9in iPad Pro was introduced in 2015, Apple has concentrated on larger tablet displays. With the 10.5in screens joining the standard 9.7in iPad sizes, we've been led to believe bigger is better.

The iPad mini's size makes it a great choice for the daily commute

It's no surprise given Apple, and everyone else, has done the same with their smartphones. But when I started using the iPad mini it reminded me of the pure convenience of a small tablet – something around the size of a book (and thinner) that you can carry about unnoticed. It's only 300g and displays most content better than your phone can.

With those phones getting bigger and better, you may have found your tablet use declining. But I found the iPad mini was irresistible because of its size and I used it in meetings, at home and on the bus far more than the larger iPads that I've reviewed over the years. It measures 203.2x134.8x6.1mm, which is thinner than an iPhone XS. On the bottom are two stereo speakers, which sound clear and

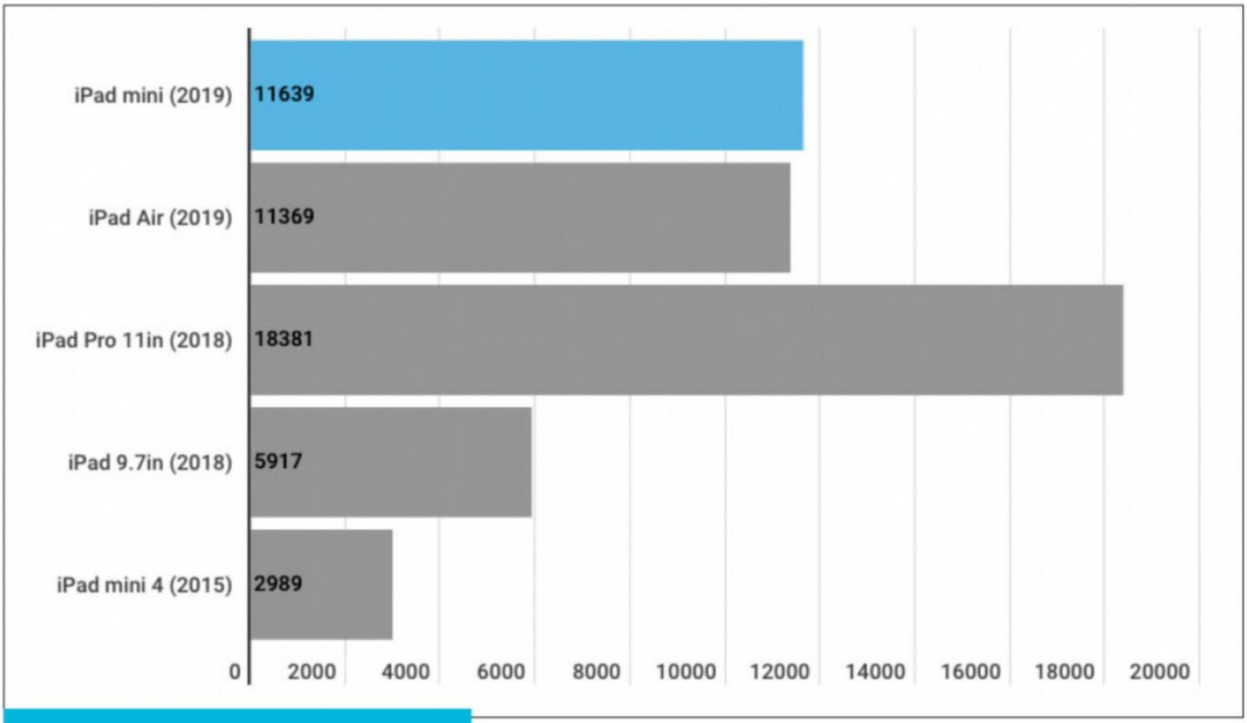
have enough bass for a tablet this small, but will get covered up naturally when held, particularly for landscape games.

Performance

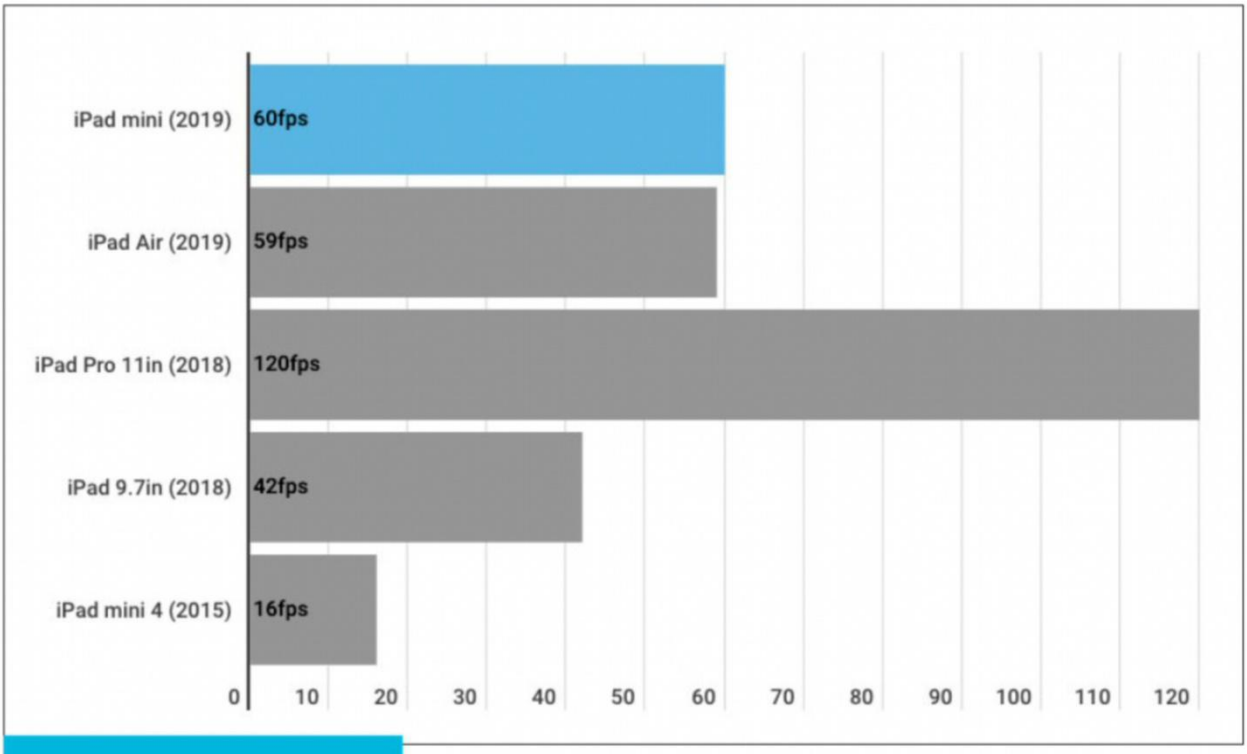
The iPad mini is very powerful thanks to the A12 Bionic chip. This is the same processor found in the iPhone XS and XR, meaning the iPad mini is the cheapest Apple hardware with this extremely fast silicon inside.

By this point there's not even much point in comparing it to the A8 processor in the iPad mini 4 that this new model replaces – the new one is so, so much better. At the time of release, it is practically the most powerful mobile chip money can buy.

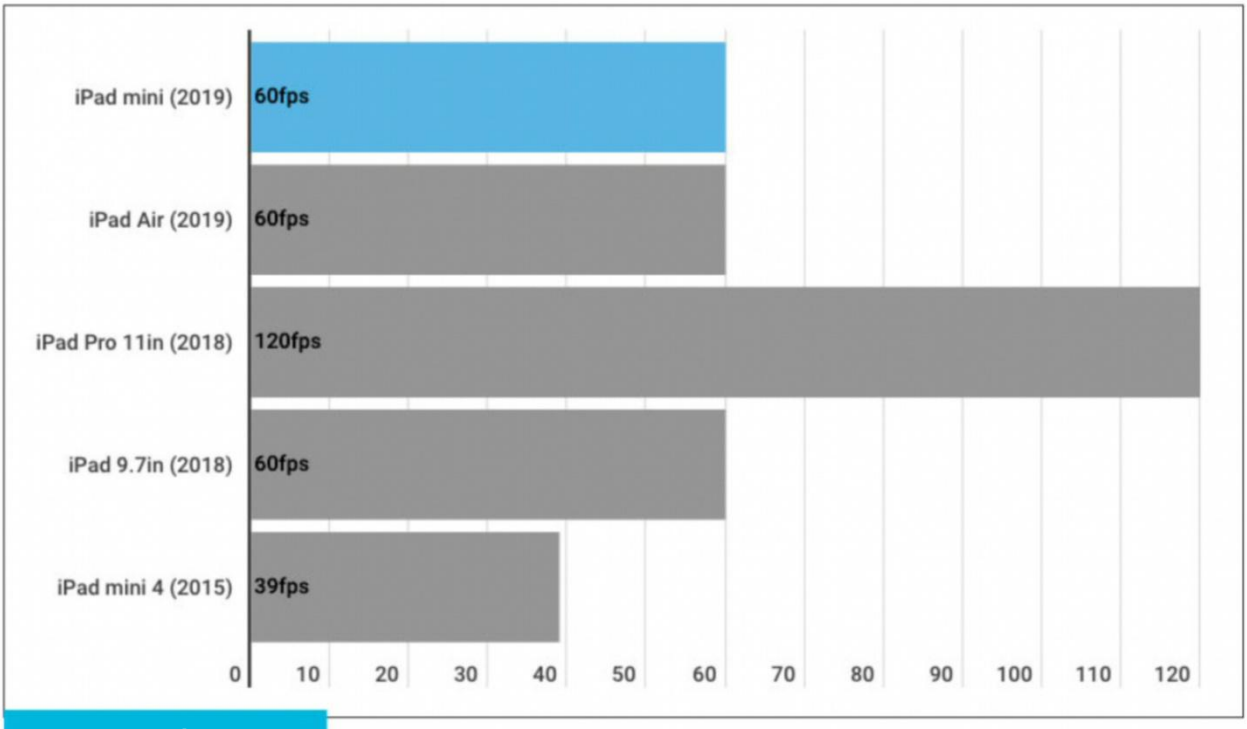
But if you really must know, here you go:



Geekbench 4 (multi-core)



GFXBench Manhattan



GFXBench T-Rex

Geekbench clocks the CPU speed and GFXBench measures the GPU – the latter shows the iPad Pro's 120Hz frame rates at play, but note how much more powerful the 2019 iPad mini is than 2018's larger, regular iPad.

We also compared it to the iPad Air announced on the same day. The mini really is excellent value for the performance you're getting here. The most expensive version (256GB with 4G) costs £669 – £100 cheaper than the cheapest iPad Pro.

Apple's claim of 10 hours of battery life when "surfing the web on Wi-Fi, watching video or listening to music" proved accurate in our testing, though as expected I found it drained much faster when on 4G or video calling. I had to charge it about once every three days, but I also personally never let my tech get down into the red.

Software

Inside the iPad mini's frame, the A12 drives a ferociously fast operating system. iOS 12 undergoes more scrutiny when it's on an iPad Pro and said to be able to replace a laptop, but when it's running on the smallest iPad it's undoubtedly the best software on a casual-use tablet.

I've reviewed many consumer Android tablets – none of them are preferable to the convenience and polish of an iPad.

On the iPad mini apps open and close instantly and games flow unhindered, even high-end demanding titles such as Fortnite. It's by far the best software experience on a tablet this small and

iOS 12 on the iPad mini: (l-r) widget screen, home screen, settings app

is as smooth as the iPhone XS that costs around £600 more if we are talking base model pricing.

Display

The LCD display is well calibrated and laminated, so it does not have a gap between the surface and the screen like the cheapest 9.7in iPad does. You also get True Tone for the first time on an iPad mini, so the screen (optionally) adjusts the white balance depending on the ambient light.

And while it supports the first-gen Apple Pencil and the requisite apps, the screen doesn't have Apple's 120Hz ProMotion tech found in the iPad Pro models that makes scrolling even smoother. Apple has admitted that it took ages to update the iPad mini because it assumed tablet buying would veer towards larger displays. In the tech world we knew that the ageing 2015 hardware of the iPad mini 4

wasn't the best buy, but that didn't deter people from still purchasing it because of the size. There's clearly still demand for the 7.9in display. Turns out most people don't care about the large bezels.

You also get second-gen Touch ID, which is excellently responsive. I didn't miss Face ID all that much, though that might be different when it comes to an iPhone. The things I do on the iPad mini don't really require it.

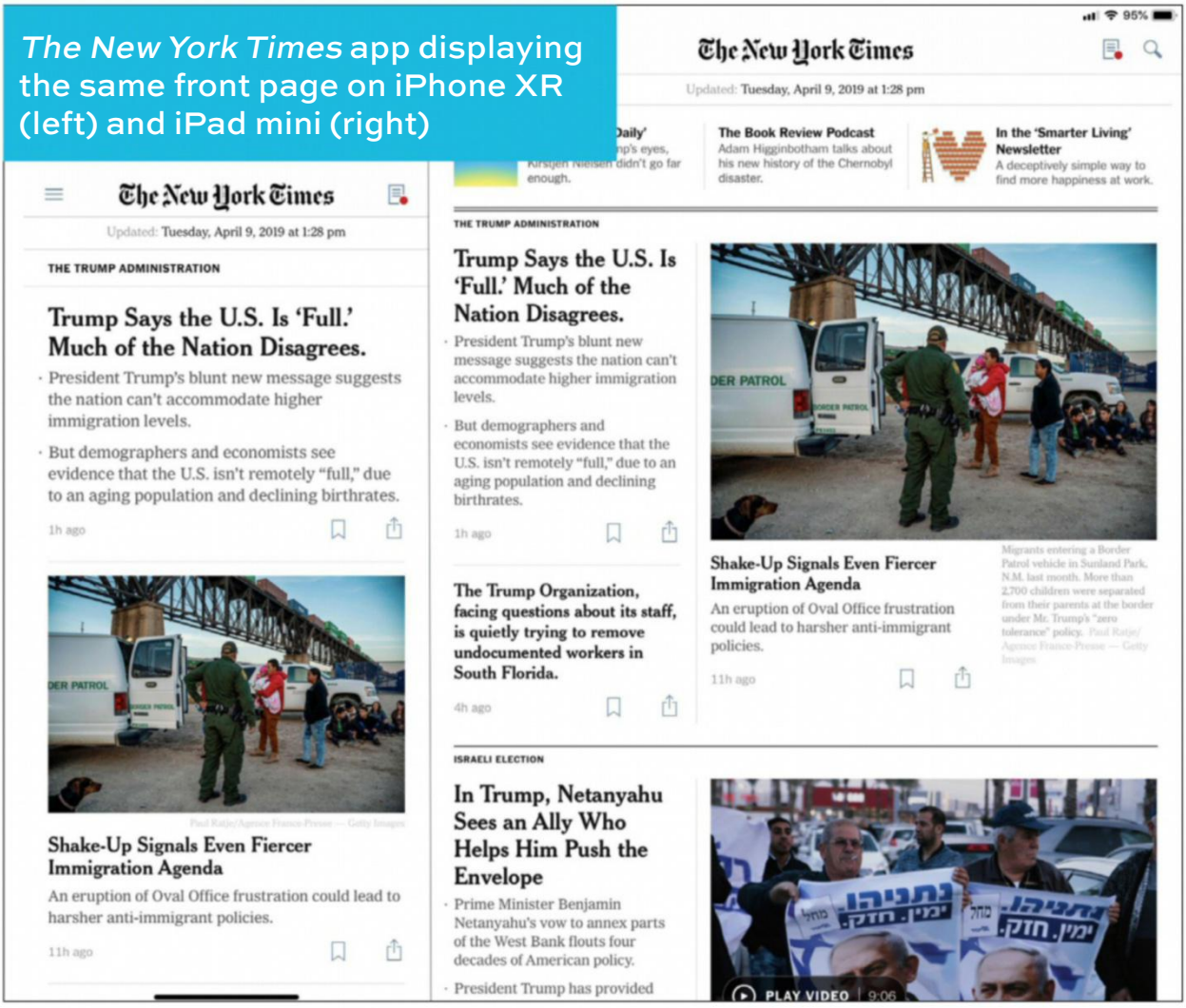
Middle ground

What I found more than anything is that the mini managed to take me away from my phone and bring me down from my computer. It sits in the middle in size, but also in use case. This is why I like it.

What I mean is that I did not feel compelled to load up Twitter or Instagram on it because of the size. Instead, I found myself opening the *New York Times*, Apple News or Feedly apps to read the headlines on the bus on a display that has room to breathe. While doing this I pinged over to Pocket Casts and got a podcast on the go. Sure, I could have done these things on a phone, but without the constant message notifications rolling in and a larger 16:9 display to enjoy newspaper style content on, I was personally chuffed.

My use of the mini took me away from social media and WhatsApp, and provided me with a device that let me read and didn't distract.

This was accentuated even more by the 4G review unit Apple provided me with (the cheapest iPad mini is Wi-Fi only). I put my second SIM in it



The New York Times app displaying the same front page on iPhone XR (left) and iPad mini (right)

and it meant that I could watch YouTube on the bus, check personal emails and research a holiday – again, things that we all do on our phones but is easier on a larger screen, though not a screen so large that I felt like an idiot for using it on the number 30.

Pencil me in

One thing I personally did not use much was the Apple Pencil, which the iPad mini (2019) now

supports. Apple's suggestion that the mini would make a great digital notebook is cute, and you may be someone who would genuinely use the tablet as a way to back up handwritten notes, and the advantage of cloud-stored notes is evident.

Apple would, of course, like you to own multiple iPads and flit between sizes as task dictates, but then again with two Apple Pencils that support different models, this is user hostile. If you wanted the iPad mini and an iPad Pro (2018), you'd need both models of Pencil. And sure, the second-generation Apple Pencil is 'better' but the first-gen Pencil is absolutely fine, and paired with the base iPad mini it's the cheapest way to use one. I remain sceptical that many artists will opt for the iPad mini over the iPad Pro with its better display and larger digital canvas, but there might be a niche. It probably didn't cost much for Apple to add the support to the mini and eke out a few more Pencil purchases from curious customers.

Cameras

And yes, the iPad mini has a camera on the back. If you really want to be that person holding it at head height to take a picture of the Eiffel Tower, then I'll try not to judge you. The 8Mp lens is nowhere near as good as something on any recent iPhone, but it'll do.

Better used is the front-facing 7Mp 1080p FaceTime camera. I used the iPad mini for a fair few video calls and it was a great experience. But any close inspection on still images from either camera

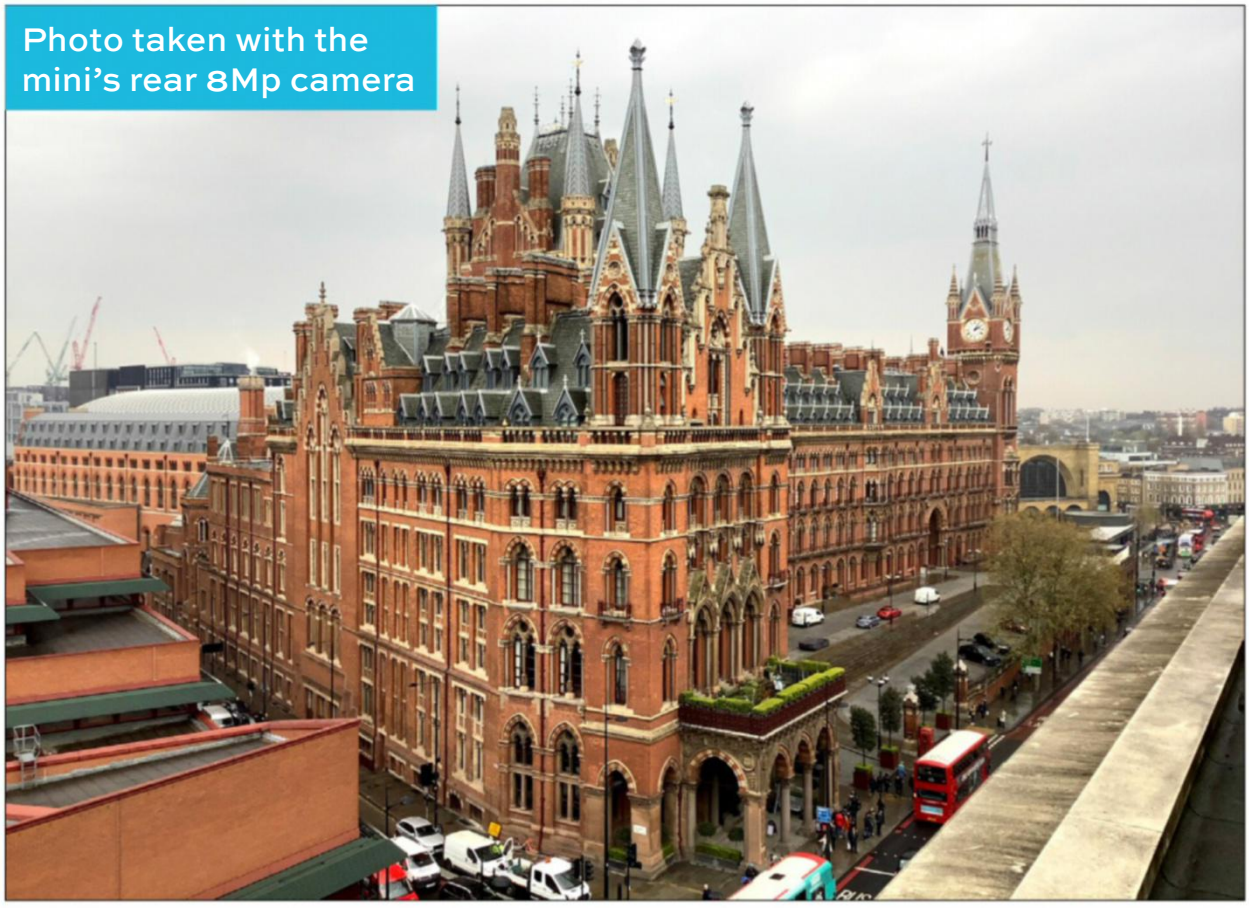


Photo taken with the mini's rear 8Mp camera

shows these are not great quality photos, with a lot of noise when zoomed in.

Verdict

The iPad mini lives on in a very capable package that includes the blazingly fast A12 chip. It's the cheapest hardware with Apple's latest processor. The ageing design is a downside, but this iPad design is a classic and we don't think it'll put


Selfie shot

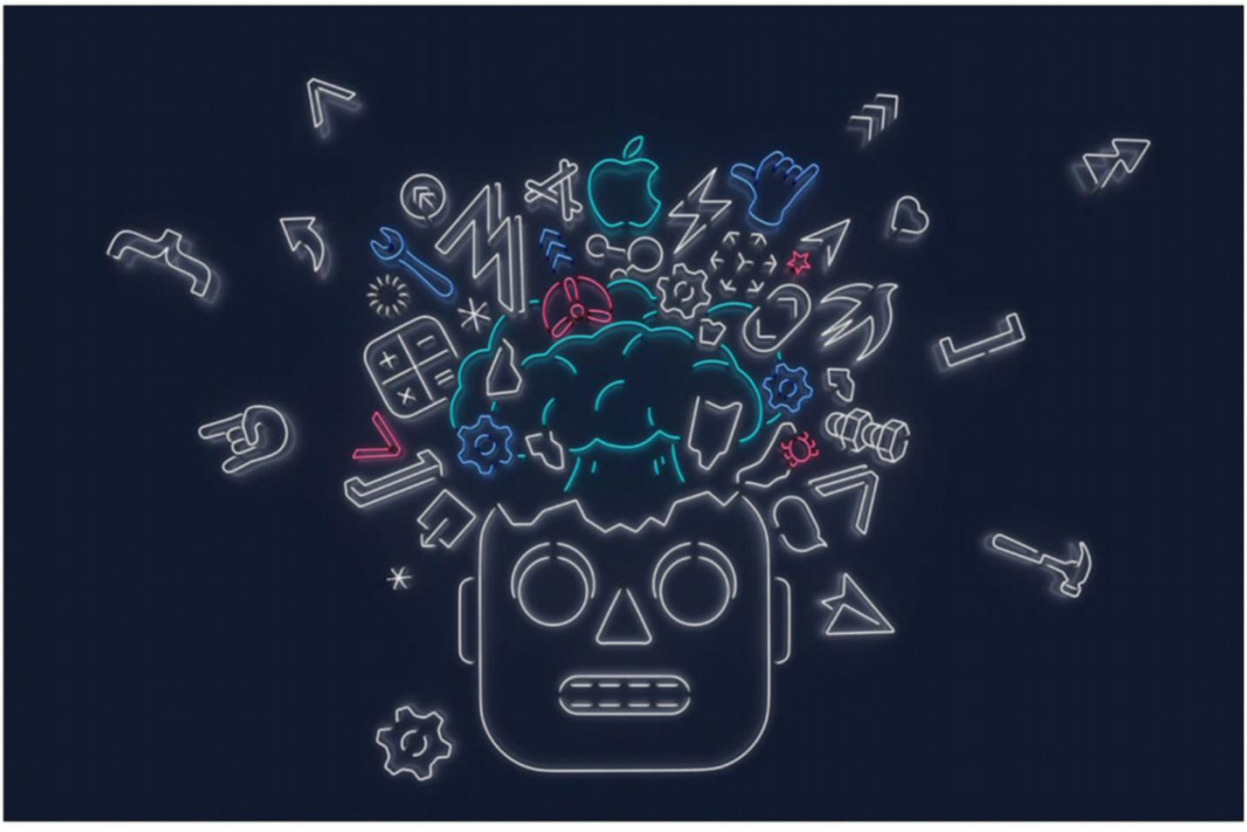
many people off – it doesn't us. With a headphone jack, outstanding performance, Pencil support and unrivalled portability in the tablet market, the mini (2019) is an excellent upgrade on a product we thought was set to bow out. **Henry Burrell**

Specifications

- 7.9in laminated Retina (2,048x1,536; 326ppi) LED-backlit Multi-Touch display, 500 nits brightness, True Tone, supports Apple Pencil
- iOS 12.2
- A12 Bionic chip with Neural Engine and M12 coprocessor
- 3GB RAM
- 64GB, 256GB storage
- 8Mp rear-facing camera: f/2.4, 1080p HD video, Slo-mo (120fps), Live Photos
- 7Mp front-facing camera: f/2.2, 1080p HD video at 30fps, Retina Flash
- Wi-Fi (802.11a/b/g/n/ac)
- Bluetooth 5.0
- Gigabit-class LTE
- Touch ID scanner
- Stereo speakers
- Dual microphones
- Headphone jack
- Nano-Sim and eSIM
- Lightning port
- 19.1Wh rechargeable battery: claimed battery life of 10 hours on Wi-Fi
- 203.2x134.8x6.1mm
- 300.5g/308.2g (Wi-Fi/cellular)

Big changes to Siri, AR, and more could transform the Apple ecosystem

If the reported changes are true, then the Apple ecosystem is about to get a lot stronger. **Jason Cross** reports



A fascinating report at 9to5Mac offers a sneak peek at some of the announcements Apple has in store for developers at WWDC in June. Previous reports have focused on changes coming to iOS 13 and macOS 10.15, but this leak

is all about the tools developers use to make apps and services on Apple's platforms. If they prove true, it could mean a big improvement in the way we use our iPhones, iPads, and Macs.

Siri stretches out

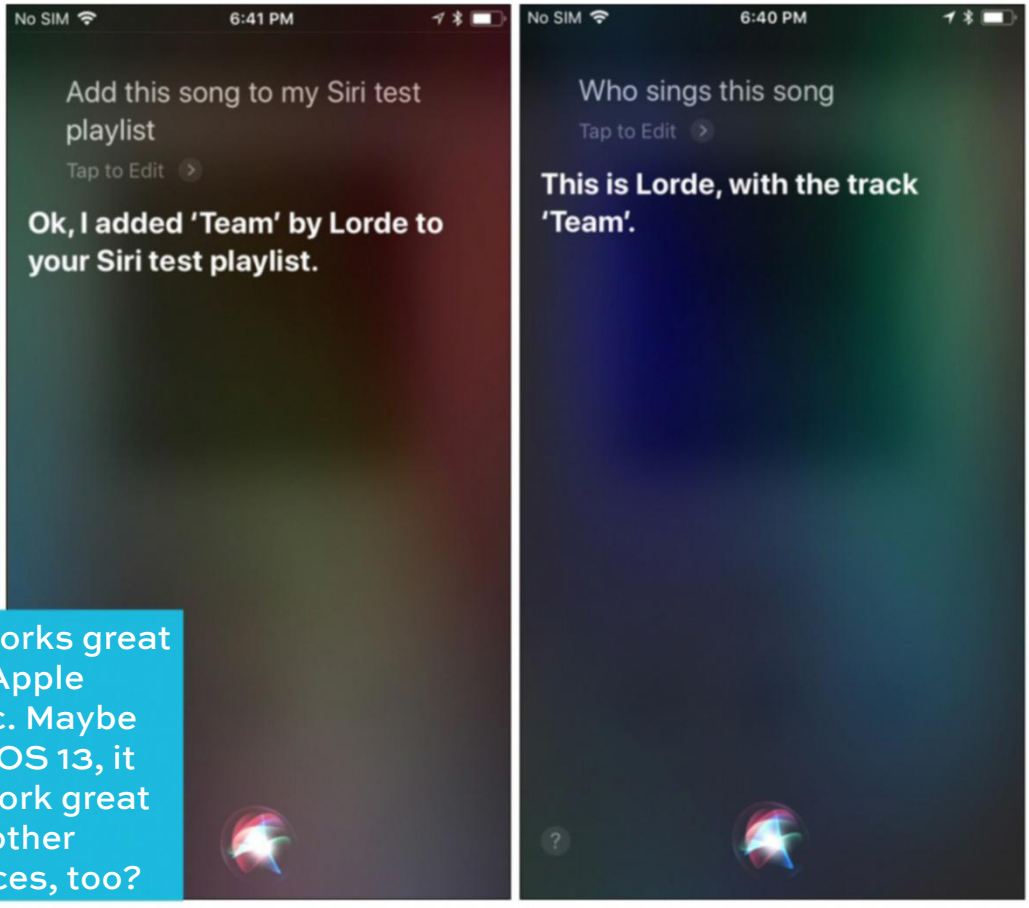
We're certainly not the only ones lamenting the current state of Siri and the way Apple squandered an early lead in AI assistants. Apple's got a lot of work to do to make Siri better in many ways, but the 9to5Mac report gives us a clue that at least some of Siri's shortcomings may be addressed in the new versions of Apple's operating systems.

The report claims that developers can make use of new Siri intents, including "media playback, search, voice calling, event ticketing, message attachment, train trip, flight, airport gate and seat information".

Third-party developer support is divided into domains (broad categories like 'Fitness' or 'Messaging') and intents (specific functions your app would like to enable with Siri, like 'start a workout' or 'send a message').

This list of new intents is exciting in part because it seems to hint at new domains.

When it comes to support non-Apple apps, services, and devices, Siri's got one big problem: it doesn't work with enough stuff. Look at Apple's developer guidance for domains and intents (**fave.co/2PBTgb8**) and you'll see obvious missing pieces. For example, there's no media playback domain at all. Which is why you can use



Siri works great with Apple Music. Maybe with iOS 13, it will work great with other services, too?

Siri to control your device with generic commands like 'next track' and 'volume up' but you can't use Siri to control any media playback other than Apple Music with commands like 'play my Discover Weekly playlist on Spotify' or 'play *Queer Eye* on Netflix' (the latter command just opens the show's page in the TV app, rather than jumping right into Netflix).

Apple needs to do more than just give developers more ways to hook their apps and services into Siri. Siri needs better voice recognition, and improved ability to answer general questions, and vastly expanded HomeKit integrations. Maybe those things are coming as

well, but at the very least, it's great to see Apple opening Siri up to more integrations with more kinds of apps.

Expect lots of iOS-born apps to your Mac

In macOS Mojave, we have only four apps, all made by Apple, that make use of its 'Marzipan' framework for bringing iOS app to the Mac: News, Voice Memos, Stocks, and Home. Apple calls this a 'sneak peek' at the technology. A way for the company to test what it means for the Mac to run apps made with the UIKit tools made for iOS developers with a minimum of code changes.

The 9to5Mac story paints a picture sure to result in an absolutely explosion of UIKit apps on your Mac.

Perhaps the most shocking statement is this: "Enabling Mac support for an existing iOS app is as easy as checking a checkbox in the target settings in Xcode, much as you would to add iPad support to an iPhone-only app."

If it really is that easy to bring iOS-native apps to the Mac, we can expect a near-instant flood of thousands such apps. I suspect that 9to5Mac's source was being a little hyperbolic, and that there are certain requirements that must be met before a developer can port an iOS app to Mac with just a checkbox. Apps that use some third-party libraries probably won't be so easy to bring over. And Apple will probably have design requirements for app approval, like making sure it works properly with mouse and keyboard.

Last year, Apple told us it's bringing Mac and iOS development closer together. This year, it may reveal that they will be closer than we imagined

To help prevent UIKit apps from feeling like running an iPhone emulator on your Mac, Apple is adding some significant new API for developers. UIKit apps will reportedly be able to access the touch bar and menu bar, and open multiple windows on the Mac. iPad apps that support Split View will resize more like regular Mac apps do. These additions alleviate most of the biggest concerns from Mac fans who are disappointed by the four UIKit apps Apple released with macOS Mojave.

With these features, it's not at all hard to imagine that, a year from now, we will all regularly use several Mac apps that are born from iOS apps, especially as developers come to grips with how to use cloud storage to keep your data in sync

and learn to adjust their interfaces appropriately to each platform.

Hopefully, Apple is planning to better unify its iOS and Mac App Stores. We want to be able to buy an app once and get it on all supported platforms (if the developers want to sell it that way). We want know if that app we're looking at on our iPhones has a Mac app, and vice-versa.

This could have a huge impact on Mac sales. The iOS market is many times larger than the Mac market. When Apple can run ads showing how their laptop runs all those apps you love from your iPhone, it may be the strongest selling point for Macs in a decade.

Augmented reality continues to improve

Apple is serious about augmented reality (AR), and continues to push hard on improving its ARKit tools for developers.

We saw a lot of improvements in ARKit 2 with iOS 12, and it looks like iOS 13 will continue to make AR apps more powerful an easy to make. Apple is adding a new Swift-only framework with a companion app that lets developers create AR apps in a more visual way.

ARKit will be able to detect human poses, which will be critical for making virtual objects interact with real people. And game developers can make AR apps that use touchpads and deliver AR sound with stereo headsets.

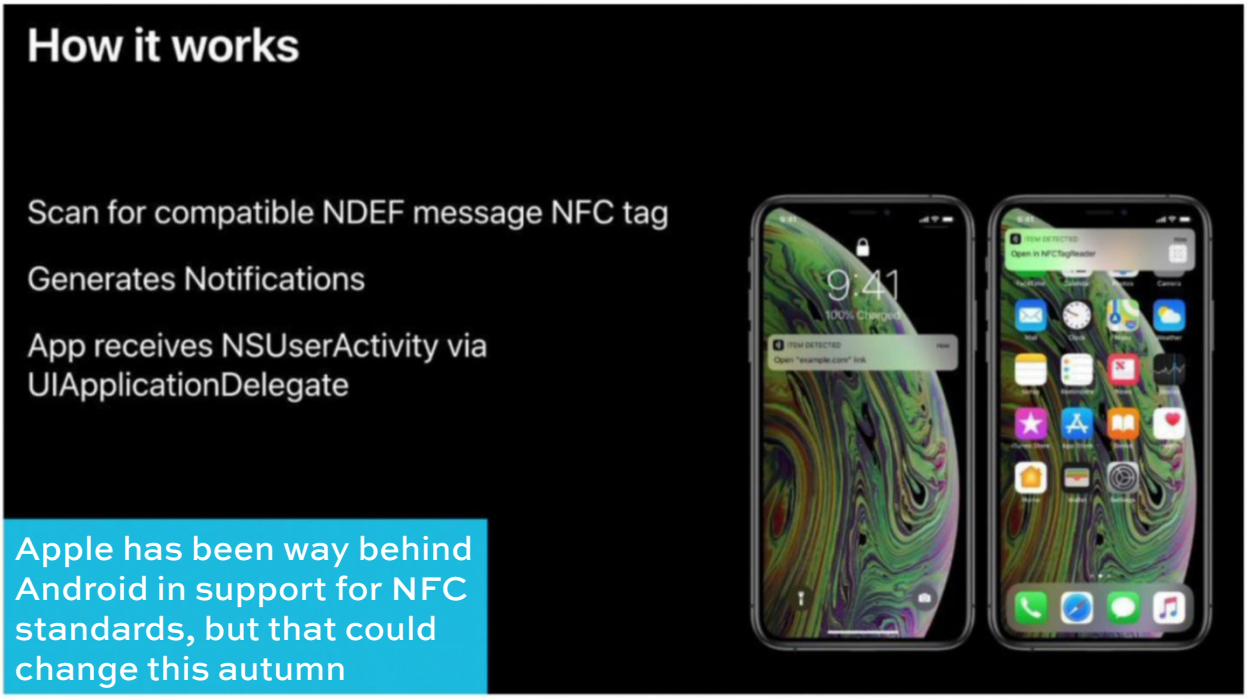
ARKit has seen some mixed success. There are quality AR apps out there, and the technology

ARKit, and its apps, continue to improve. But it won't really take off until Apple integrates augmented reality into its core apps

works well, but it's not yet the sort of thing the average person uses on a daily basis. Apple's only real built-in AR app is Measure, which is definitely not the transformative experience AR needs to go mainstream. Better tools for developers is key, but it's also going to be important for Apple to integrate augmented reality into its own core apps of the iPhone, and make it truly useful.

Building a stronger foundation for NFC, haptics, and machine learning

Currently, the NFC tools for iOS only allow developers to read tags formatted with the NFC Data Exchange Format (NDEF). This will be expanded to allow devs to read ISO7816, FeliCa, or MiFare formats.



Apple has been way behind Android in support for NFC standards, but that could change this autumn

That's going to allow developers to make iPhone apps that work with a much larger variety of card-tap systems. From student IDs to vending machines to public transportation passes and even corporate lock keycards, the vast majority of NFC stuff in the world uses one of those four formats. With this expanded NFC support, the right apps could allow you to replace nearly every card in your life.

The iPhone's Taptic Engine is a visceral feedback experience unmatched by any other smartphone. Until now, developers have had very limited ability to create their own haptic feedback. The 9to5Mac story claims that devs will be given a lot more control over the Taptic Engine, which will make our apps feel better. Literally.

Apple's machine-learning framework, Core ML, is getting an update, too. Currently, developers

train a machine-learning model, and then deploy it, using Core ML to run that fixed model in their apps. The new update will allow developers to actually update the model on device. This will let apps that use machine learning to get smarter or more accurate without requiring an app update.

Other parts of Core ML will be enhanced, too. The machine vision get a built-in image classifier, and developers will be able to use Core ML to analyse audio.

These changes mean a lot more flexibility for developers, so it's likely we'll see more apps that use Core ML to leverage the powerful Neural Engine hardware in modern iPhones.

On the Mac side, there's a new API for writing device drivers and new file provider extensions that should help with the way cloud services integrate with Finder.

Welcome into the walled garden

Taken individually, each of these new features is a nice update that could enhance certain kinds of apps. If you look at them as a whole, a pattern emerges.

Apple isn't exactly tearing down its 'walled garden' ecosystem, but it is making it easier for more apps and services to visit and mingle. Our iPhones and iPads and Macs will, simply put, 'work with more stuff'. More services, more hardware. Development tools are always meant to allow app makers to make better apps, and these are no different. But there appears to be

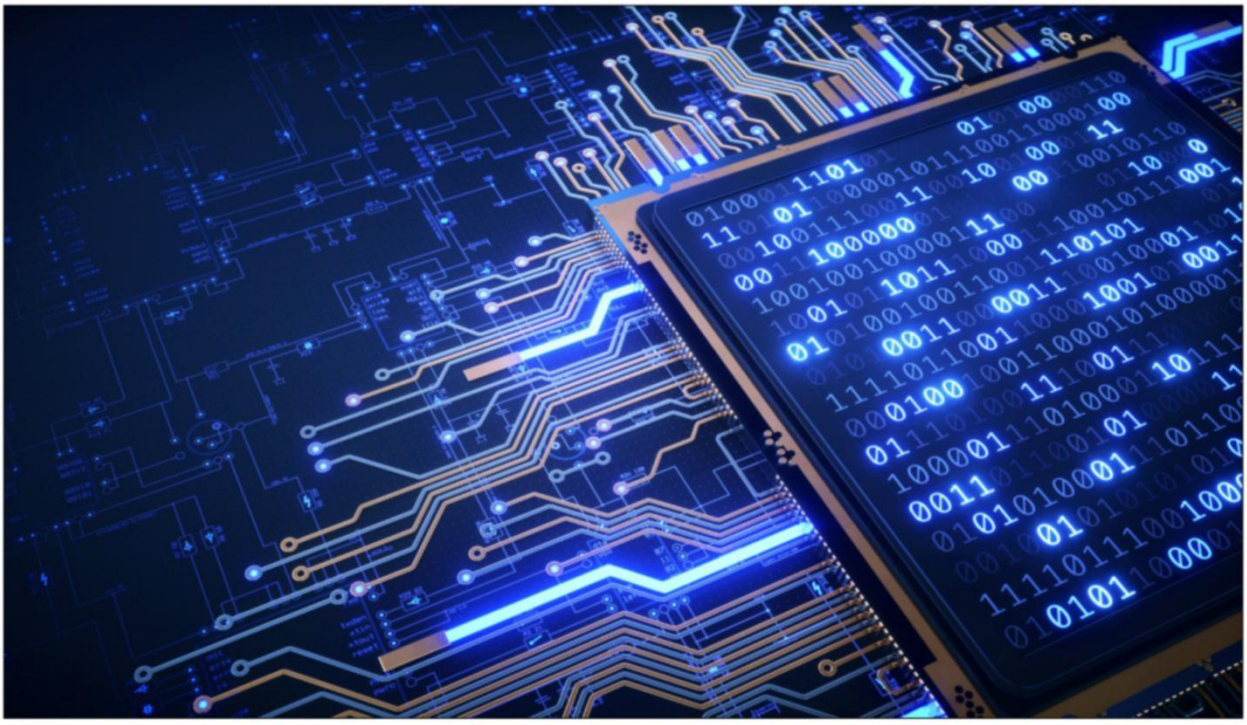
a concerted effort to help make sure those apps work better on your Apple device, to allow them to integrate more completely.

Combine these alleged developer tools updates with previous rumours about iOS 13 and macOS 10.15, and Apple's autumn operating system releases start to look like a turning point in the way we use Apple gear. A 'better together' approach where Apple welcomes more services, standards, and apps, while simultaneously strengthening the bond between its devices.

This doesn't mean it will be easier to leave the Apple ecosystem. Quite the contrary: you'll have less incentive to leave when your favourite apps and services work better with your Apple device, and when they more seamless work together.

What we might expect from Apple's A13 chip

The A13 will surely be Apple's fastest iPhone chip yet, but the focus will likely be on the Neural Engine. **Jason Cross** reports



We're still a long way away from hearing anything official about Apple's next system-on-a-chip. The A13 is likely to be unveiled in September, along with the new iPhones it will power. But the design, manufacture, and testing of these chips takes years, far too long for Apple to suddenly make radical changes. The A13 design is likely, for all intents and purposes, set in stone by now.

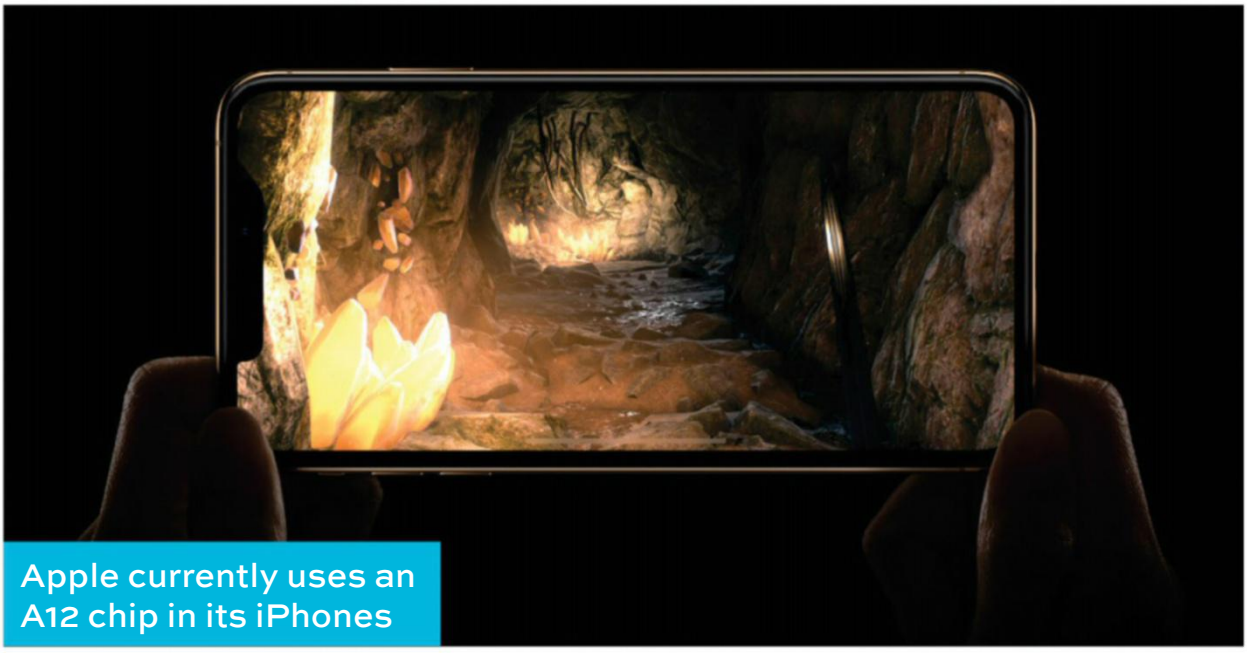
By looking at past A-series chips and extrapolating from what we know of the manufacturing process Apple will use this year, we can get a reasonable picture about what to expect from the A13 chip. It will almost certainly be the fastest SoC Apple has ever developed for iPhones, but exactly how fast can we expect?

Built on an improved 7nm process

For the A13, we can expect Apple to stick with its manufacturing partner TSMC, which has a firm lead in chip manufacturing technology. But TSMC is not yet ready to make another leap to a new chip process node, as it did in jumping from 10- to 7nm last year. The 5nm transition will probably be ready in time for the 2020 iPhone, but this year's model will still be built with a 7nm process.

That doesn't mean we can't expect any improvements on the manufacturing side. TSMC is currently ramping up its '7nm+' process, which use EUV (Extreme Ultraviolet) lithography for some of the chip layers. This should allow chips with better density (about 20 percent more logic in the same area) and power efficiency (about 10 percent better).

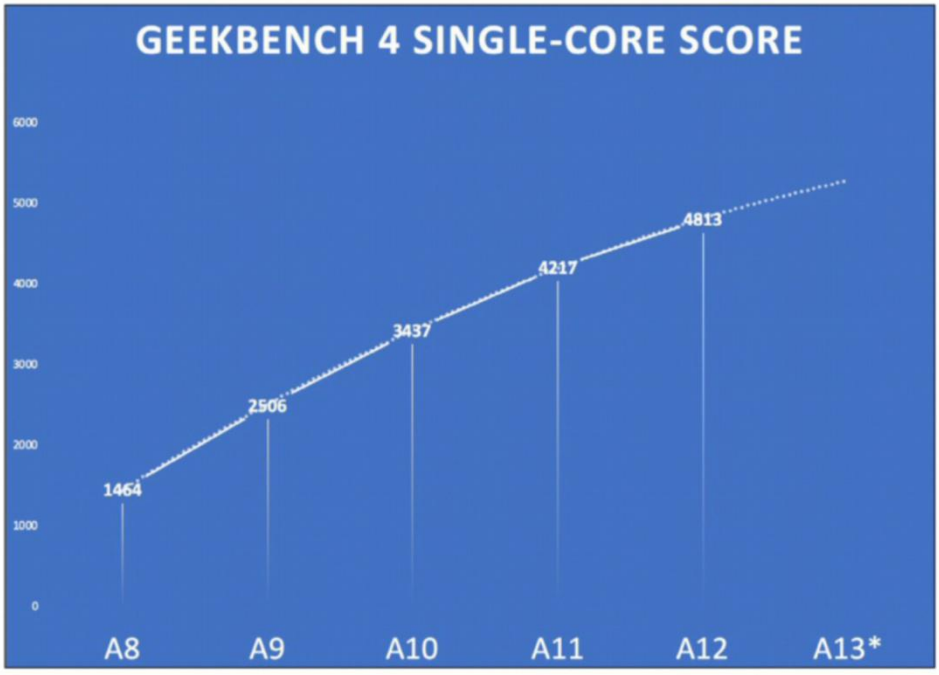
A recent report from the Chinese site Commercial Times claims that Apple will be the first company to use a new, as yet unheard of '7nm Pro' process from TSMC for the A13. It's not clear if this is an enhanced version of the regular 7nm process or the EUV 7nm+ process, but it's clear that Apple intends to release the A13 with



Apple currently uses an A12 chip in its iPhones

the best manufacturing technology possible, and that we can expect improvements over the 7nm process used in the A12 and A12X.

The A12 increased transistor Apple's count to 6.9 billion, but the die area was around 83mm^2 – far from the largest chip Apple's ever put in an iPhone. In fact, it's the smallest iPhone chip, in terms of area, in nine years, and the A5 and A10 were each over 120mm^2. In other words, Apple's iPhone chips are usually larger than the A12, and particularly so when producing a new chip with the same manufacturing process as the year before. It would be a conservative guess to assume that the A13 would be around 25 percent larger (roughly 103mm^2) and, together with the increased density of TSMC's improved process, carry a transistor count of around 10 billion. That's the equivalent of the A12X in the iPad Pros.

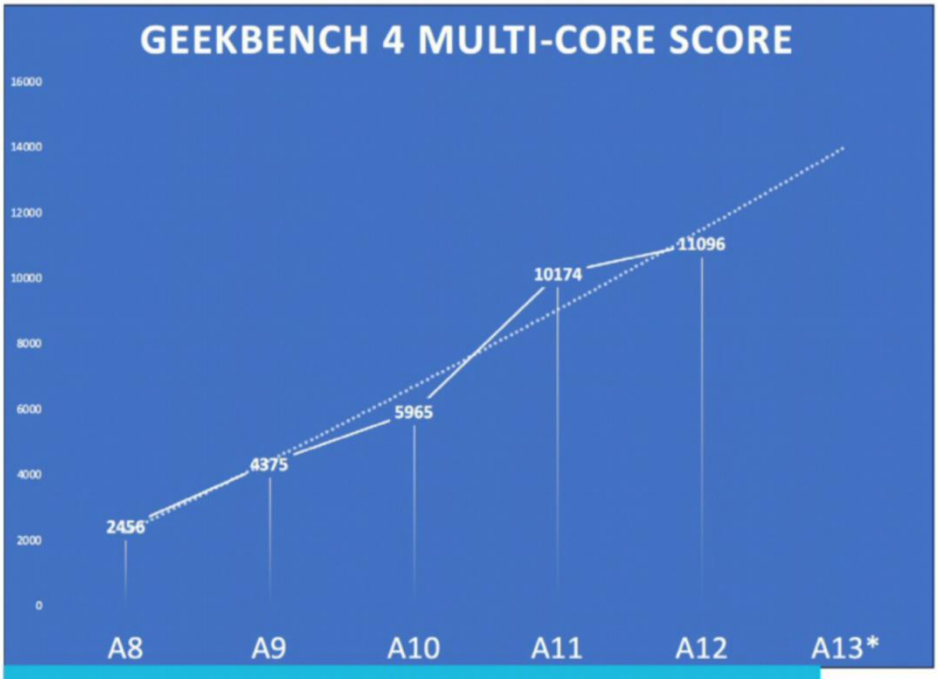


Apple has industry-leading single-threaded performance. That's likely to continue

CPU performance

While I expect the A13 to have nearly the same transistor count as the A12X, I don't think Apple will spend its transistor budget the same way; doubling up the high-power CPU cores from two to four. Rather, I suspect Apple will continue to have two high-performance CPU cores and four energy-efficient cores, with an outside chance of increasing the high-performance core count from two to three.

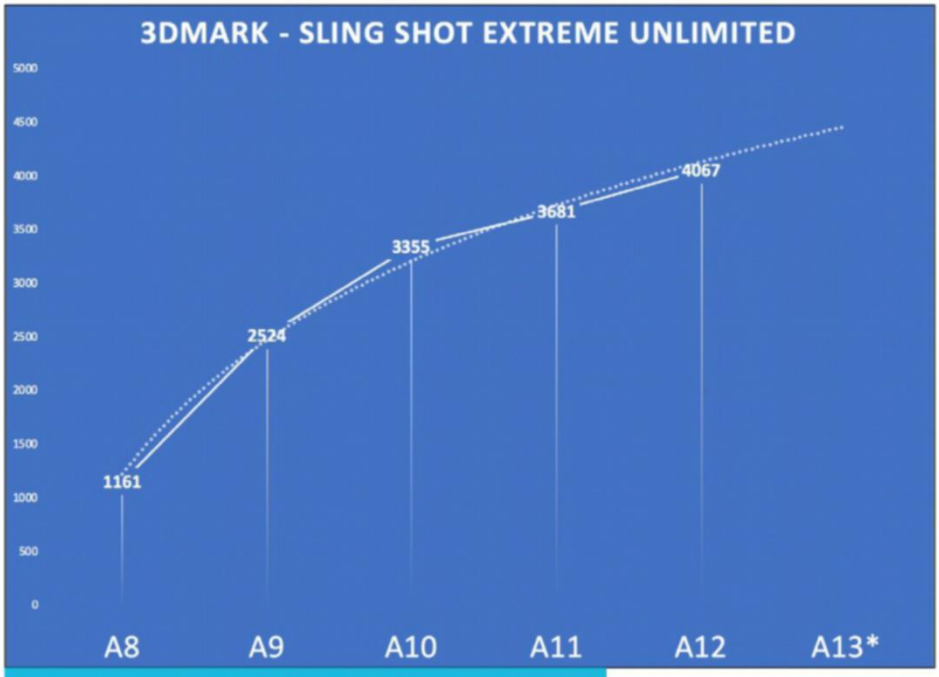
Apple will likely rely on some architectural tweaks and perhaps better peak clock speeds to increase CPU performance. After all, its chips are already the fastest around, and it won't take much to hold on to that crown. The firm's single-core CPU performance gains have been remarkably steady



Apple's multi-core performance is already stellar; a modest improvement is all that's required to be the fastest phone on the market

in recent years. If the trend holds, we'll be looking at a Geekbench 4 single-core CPU score of around 5,200. That blows the doors off any Android phone and even most thin-and-light laptops.

Multi-core performance is harder to predict. The trend line is skewed by the fact that multi-core performance took a big leap from the A10 to the A11, due to a design change that allowed all the low-power and high-power cores to work together at once. If Apple doesn't add any more cores, the multi-core performance of the A13 will land somewhere between 12,200 and 12,500, because the individual cores will get faster. If Apple adds a third high-performance CPU core, that number will leap to somewhere around 15,000 to 16,000.

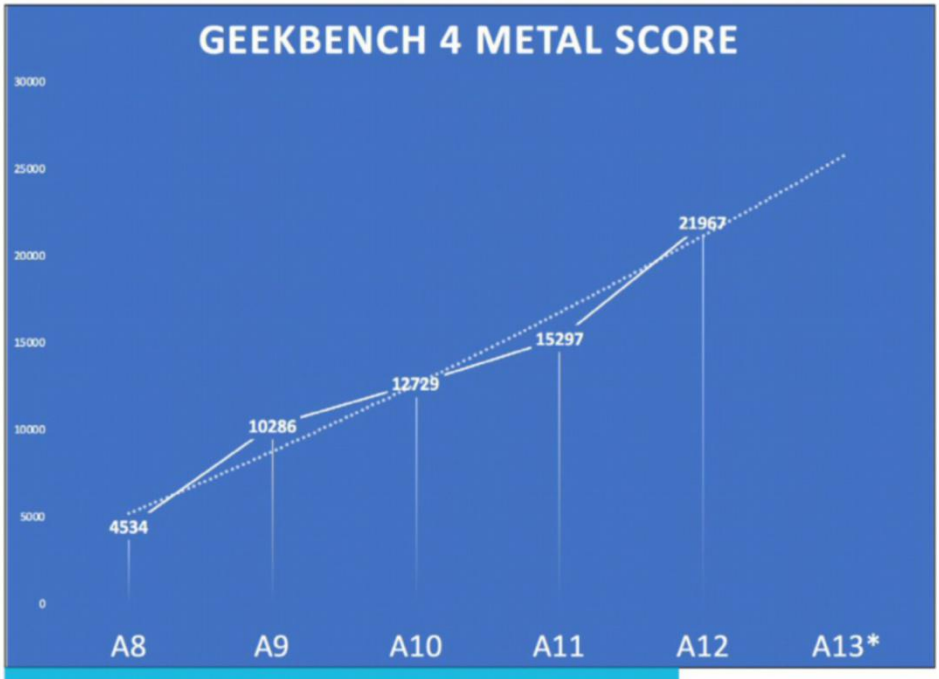


Graphics performance is starting to plateau, and without a big boost in memory bandwidth, that probably won't change

Graphics performance

Graphics performance is critical to Apple, and will be especially important as it launches its Apple Arcade service with premium, top-tier games. We can look at two aspects of graphics performance – the ability to render traditional 3D scenes like games, and the ability to use the GPU for complex non-graphics compute (such as image processing).

Traditional graphics performance has been increasing at a steady rate over the past few generations of A-series processors. It is often limited by memory bandwidth, which doesn't often make a big leap from one year to the next. If we think the trend will continue, we can expect



Graphics compute performance, however, has plenty of room to grow. It's more useful to Apple's software than ever, so expect significant gains

a 3DMark Sling Shot Extreme Unlimited score of around 4,500. It's a huge improvement for Apple, but not as fast as the very latest Qualcomm chips.

Apple seems to be leaning more in the direction of making its chips faster when using its own Metal API, both for graphics and compute. I think that trend will continue, and while the GPU probably won't see the big Metal performance leap it did from the A11 to the A12, we're probably still going to get a Geekbench 4 Compute score of well over 25,000.

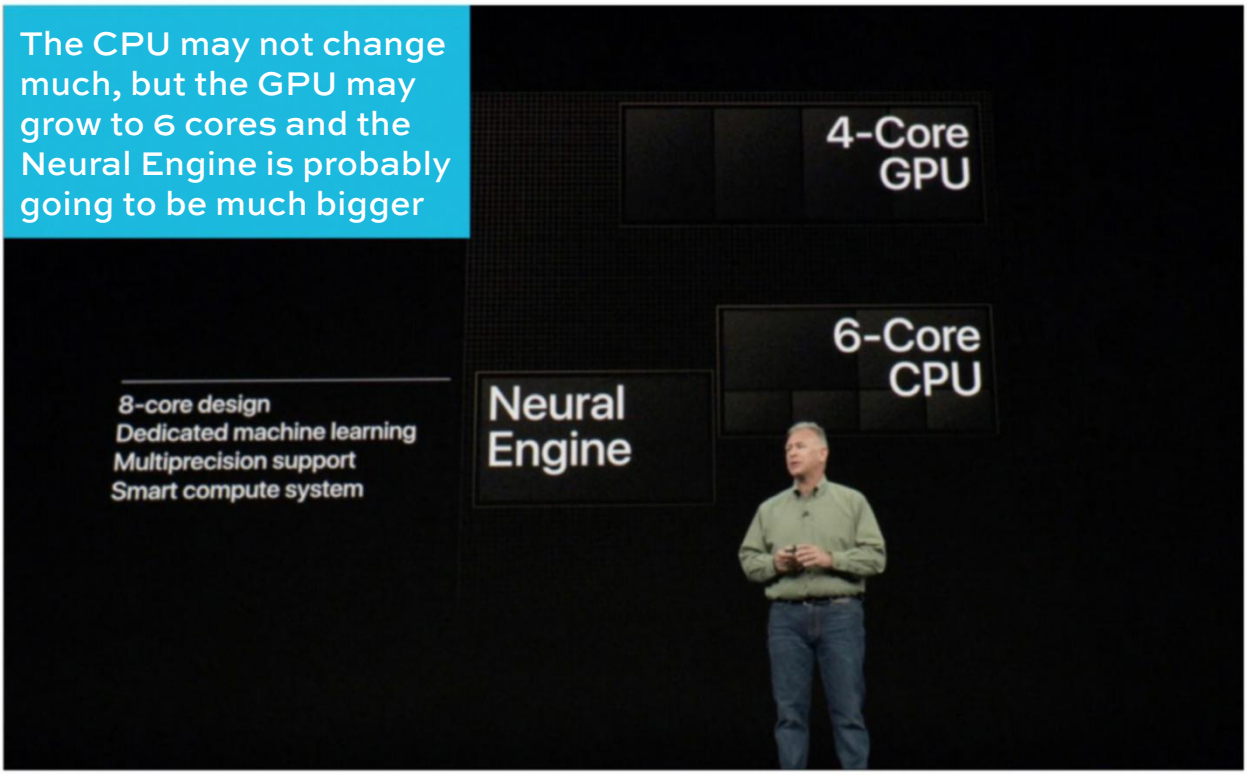
Image processing and Neural Engine

I started this examination by stating I believe Apple will make the A13 about 25 percent larger than

the A12, while also using a manufacturing process that lets it cram more transistors into a smaller area. The result would be a chip of around 10 billion transistors – an increase of more than 40 percent over the A12. So if the CPU and GPU will achieve only modest and predictable improvements from design tweaks and clock speed improvements, where will Apple spend all that extra transistor budget? I think that the company is going to continue to drive very heavily in the direction of on-device machine learning and image processing.

Last year, Apple improved the Neural Engine in the A12 by far more than expected. The A11's Neural Engine can do 600 billion operations per second, and Apple made the A12 about eight times faster at 5 trillion operations per second. I'm not sure we'll

The CPU may not change much, but the GPU may grow to 6 cores and the Neural Engine is probably going to be much bigger



see a leap that big, but Apple may well achieve a 3x to 5x improvement with some smart design improvements and a much bigger transistor budget.

Machine Learning and AI are critical parts of the iPhone experience, from taking better photos and videos to augmented reality and Siri. If Apple announced that the A13's Neural Engine could do 20 trillion operations per second, I would be impressed, but not surprised.

The image signal processor used to process data from the camera sensors is another critical component that is hard to benchmark, but Apple invests heavily in it every year. It is used in conjunction with the Neural Engine and GPU to improve photos and video quality. Apple will improve it again this year. It might even be one of the first to include hardware to encode and decode the new AV1 video codec, a royalty-free video compression standard expected to succeed today's HEVC, AVC, and VP9 formats. If you don't know what all that means, just know that most web video (think YouTube) will probably transition to this new video format in a couple years. It's extremely efficient and isn't wrapped up in a web of complex royalties.

Still no 5G

While the modems in iPhones aren't part of Apple's A-series processor, it's worth discussion what we should expect this year. You're going to hear a lot about 5G this year, and carriers will try to push customers toward new 5G phones this autumn. But make no mistake: 5G is in its infancy. The networks

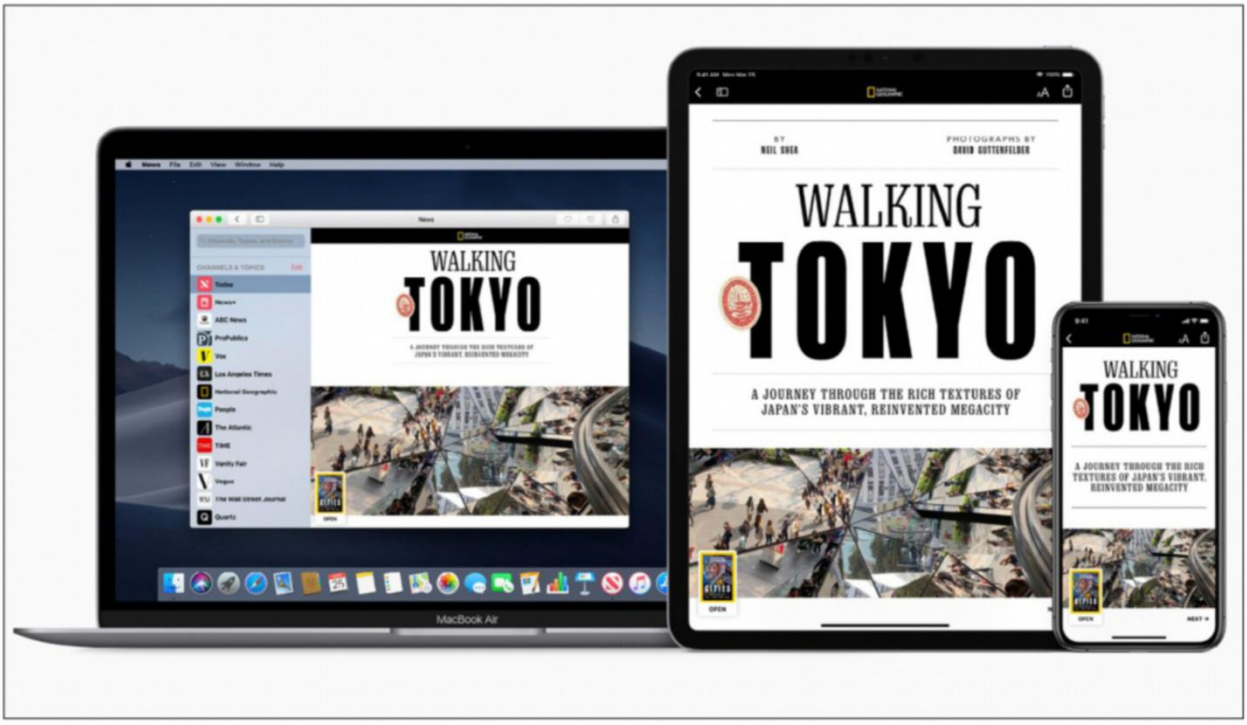
are small and limited, and will remain so through 2019. The mobile modems that enable 5G are still pretty inefficient.

You'll get a 5G iPhone some day, but not until 2020 or maybe even 2021. It will simply take that long to get reliable and power-efficient modems for iPhones, together with enough network coverage to do really good hardware and software testing. Apple doesn't just sell iPhones to a few million early adopters, after all. A new iPhone model can expect to sell over 100 million units in its first year, and Apple just isn't going to take the risk on networking gear that might provide an unsatisfactory user experience.

There's been a persistent rumour of Apple working on its own 5G cellular modems, but you shouldn't expect that in 2019. Expect the A13 in the iPhone this year to be paired with the latest Intel modem, likely the XMM 7660. It's much like the XMM 7560 in the iPhone XS today, but with support for higher maximum speeds and compatibility with more LTE bands.

The Mac is becoming more like iOS, and I like it

iOS does many things better. **Jason Snell** reports



I fell in love with the Mac nearly 30 years ago, in the autumn of 1989. It's been the centre of my tech world ever since, and I've been writing about it professionally for 25 years. And yet these past months, I've noticed something strange creeping into my thoughts occasionally while I sit at my desk working on my iMac Pro: iOS does this better.

It's disconcerting, after three decades, to suddenly find that manipulation of files and folders in the Finder has gone from being business as usual

to seeming like it's more fuss and effort than is necessary. And yet that's where I am now, thanks to a couple of years of using an iPad Pro rather than a MacBook Air whenever I'm away from my desk.

I'm in an iOS state of mind

The Finder has been the core of the Mac experience since the very beginning. Visually managing files and folders is what has defined the Mac for decades. And yet, with iOS, Apple chucked all of that out for an app-centric view of the world.

As a Mac user, I have struggled with iOS's attempts to prevent me from thinking in terms of documents rather than apps. And to a certain point, this was the right thing to do. iOS started out denying any possibility for files and folders to be relevant, and that extremism was unreasonable for a lot of use cases. But today's iOS provides a bit more balance, thanks to the Files app and various cloud services. I can manage files when I need to on iOS – and forget about them when I don't.

Contrast that with my Mac, when I receive a file that I've transferred from an iPad via AirDrop. The file pops into the Downloads folder. I need to copy it to the right location, requiring me to open a new Finder window, navigate to the proper folder, then go back to the Downloads folder (or a pop-up stack in the Dock, if there aren't multiple files), and drag and drop. I'm often opening multiple Finder windows to drag things around and view projects I'm working on. Sometimes they overlap and hide one another, so I open a new Finder window... only

The app-centric view of iOS provides a more efficient way of working with files

to later discover I've got five windows viewing the same folder scattered across my desktop.

This is the way it's always been, more or less – but all of a sudden it's started to feel archaic. I value my Desktop as a collection of in-progress files, and some manual organization feels useful, but for the most part using the Finder feels like fiddly non-work, like rearranging your desk or reorganizing your bookshelf as a way to procrastinate before getting back to your actual work.

Using iOS has made me appreciate its more app-centric view. To access my current story list on the Mac, I go to the Finder, make a new window, and click on a shortcut in the sidebar to view a particular Dropbox folder. Yes, I could place an alias out on the desktop, or use a tool like Default Folder to force the default view of BBEdit's File > Open command

to the proper folder... and, come to think of it, I might start doing that, since it is closer to how iOS does things. On my iPad, I open 1Writer (my iOS text editor of choice) and use a sliding pane that displays the contents of that same Dropbox folder. Tapping the icon to create a new file creates it, by default, in that folder. I never need to leave 1Writer to open, create, rename, or email a file.

The other side of the fence

There are, of course, numerous ways that the Mac provides more power and flexibility than iOS. That's what makes the Mac so great. My Mac gives me access to powerful command-line features that bubble beneath the surface of the interface.

That said, there are some places where simplification can have power. To me, Shortcuts is a second take on Automator that corrects most of the original utility's failings. While I rely on Automator every day, It's mostly for executing scripts. The promise of easily welding together different apps via Automator workflows never really came to fruition for me, largely because individual app-based actions were few and far between – and when they existed, they were largely opaque.

Shortcuts is hardly an easy-to-use tool, but it's streets ahead of Automator. There are a dozen things I want to see improved about Shortcuts, but I'd take it as a replacement for Automator this autumn if it also let me run AppleScripts and shell scripts. While I don't want the Mac to give up its power and flexibility, there are a lot of places

Apple's Shortcuts app in iOS is a second take of the Mac's Automator app

where a simplified approach should be the default – and is potentially better, or at least not worse, than the Mac status quo. The Mac approach of an infinite number of overlapping windows of arbitrary sizes is a classic – but might a different approach to full-screen, split-view, and side-snapped windows be easier, cleaner, and more efficient?

Using so much of the iPad Pro has also convinced me that it's time for the Mac to adopt touchscreens, at least as an option. Being able to touch my iPad's screen, even when attached to a keyboard, is an improvement. No, I don't think you should be forced to touch a screen to use a Mac – just as keyboards and (hopefully someday) mice are not required on iOS. But why not provide users with more options?

I'm not excited about being forced to change the way I've used my Mac for 30 years... but if I wanted to change because the new method was better, I'd be ready to move. And in some ways my perspective seems to have already shifted.