iPhone XS and XS Max Teardown

Last year’s iPhone X had a weird name and the...

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INTRODUCTION

Last year's iPhone X had a weird name and the most advanced internals we'd ever seen in a teardown. This year Apple turns it up to eleven with the bafflingly-named iPhone XS and XS Max. In a teardown first, we're taking apart both phones simultaneously—so grab ahold of your Roman numerals and let's get started.

Huge thanks to our friends at Circuitwise for hosting us in Sydney, Australia, where iPhones launch early and all the Apple Stores are upside-down—and to our pals at Creative Electron, for their incredible imagery and appropriate use of the letter X.

Link up with us on Facebook, Instagram, and Twitter. We've got a newsletter too, if you're the email type.

TOOLS:

- iOpener (1)
- Halberd Spudger (1)
- Tweezers (1)
- Phillips #00 Screwdriver (1)
- Tri-point Y000 Screwdriver (1)
- Suction Handle (1)
- P2 Pentalobe Screwdriver iPhone (1)
- Spudger (1)
- Nylon Tipped Tweezers (1)

Step 1 — iPhone XS and XS Max Teardown



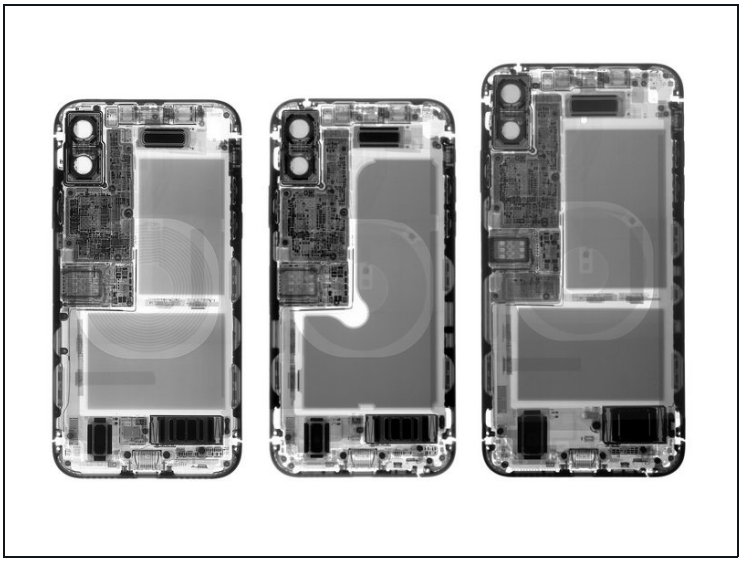




- After its complete makeover last year, the new iPhone looks very familiar—looks like we're back on a *tick/tock* upgrade cycle for now. Here's what we know:
  - Hexa-core A12 Bionic SoC with a "next-generation" Neural Engine
  - 5.8" (2436 × 1125) and 6.5" (2688 × 1242) 458 ppi Super Retina OLED displays with True Tone, wide color gamut, and 3D Touch
  - 12 MP rear cameras (wide-angle and telephoto) with ƒ/1.8 and ƒ/2.4 apertures and OIS, and 7 MP selfie cam paired with TrueDepth FaceID hardware
  - 64 GB of onboard storage (256 and 512 GB optional configs)
  - Gigabit-class LTE (not 5G) as well as 802.11a/b/g/n/ac Wi-Fi w/MIMO + Bluetooth 5.0 + NFC
  - Improved dust and water resistance with an IP68 rating

Step 2





- We aren't one to judge a book by its Gorilla Glass cover, but these covers don't suggest that much has changed since the last X we saw on this table.
- ... Besides the luxurious gold color and the new XL size option, that is.
- Thankfully, Creative Electron gives us a sneak peek at any hidden plot twists we might be in for. (Their high-tech technique still uses X-rays, which is still pronounced "ex-rays.")

Step 3





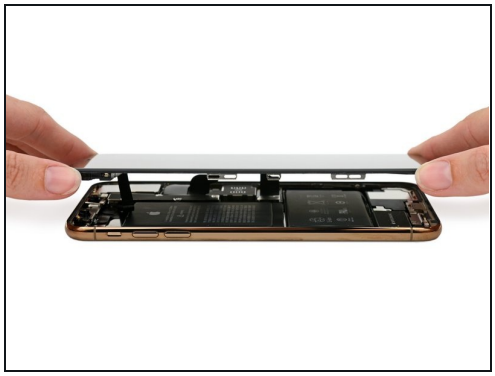
- Here we have all our ~~exes~~ erm, *tens* lined up.
- We notice an extra antenna band has moved in where our left-side mic-hole friends used to live. Rumor has it this is for "Gigabit LTE," and it seems to make a difference.
- Our teardown engineer doubles up on the drivers, demonstrating excellent dual-driver discipline as the teardown-ing commences.

Not pictured: our teardown engineer's extra right hand.

Step 4







- Apple may be changing up their naming scheme, but we're glad they left the opening procedure alone.

- Our iOpener pulls double duty to soften the hidden adhesive, and then a suction handle and a halberd spudger come in to free the display.
  - Though we feared Apple might pile on more adhesive to achieve that new IP68 rating, we fared no worse opening these phones than we did with ye olde IP67-rated predecessors.

Step 5







- We're a little short-handed in this 2-for-1 teardown, so we called in some local muscle to help kick things off.
  - It turns out lack of opposable thumbs slows things down a little, but our drivers make it so easy even a kangaroo can do it.

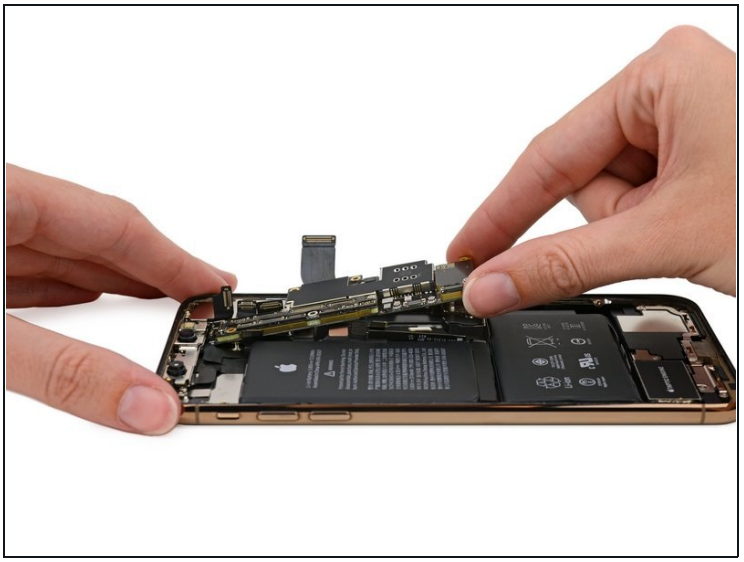
- With the displays out of the way, we start to notice a few differences between the XS and XS Max.
  - The Taptic Engine inside the XS Max has been resized—big phone, bigger vibrations?

  - The XS Max also gets an extended logic board, with one of the display connectors moved to the bottom.

  - The XS battery looks weird, and new, while the XS Max battery sticks to a familiar design.

Step 6

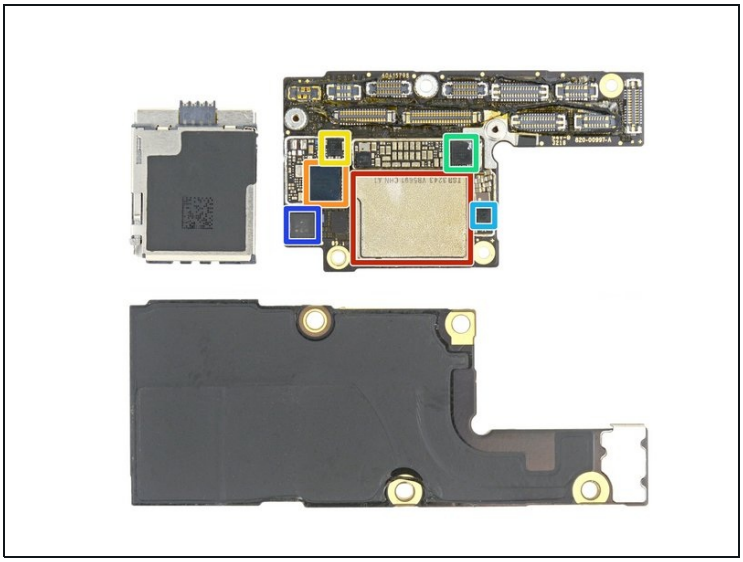


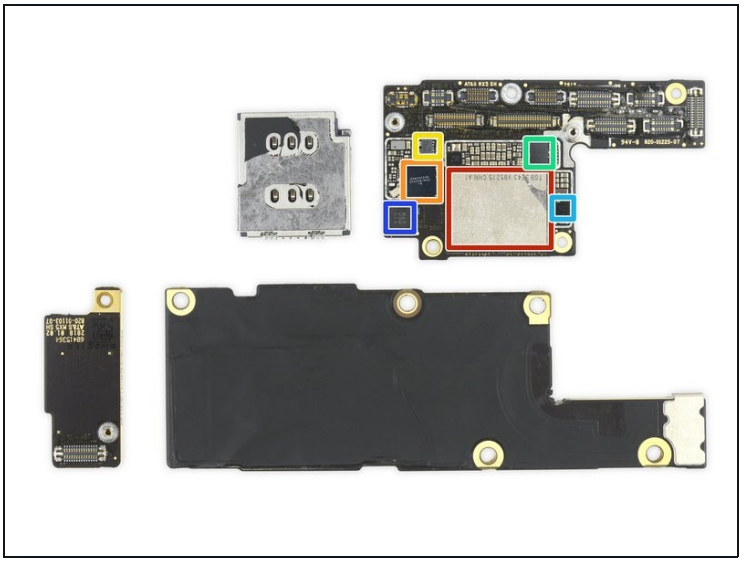


- On the hunt for signs of improved ingress proofing, we turn our attention to the largest unsealed gap in the device—the SIM card slot.
  - Although shaped a little differently, upon closer inspection the gaskets (the important bits) look largely unchanged from last year's iteration. That said, if we were in China there would be a whole other side to this SIM story.

- With the topside set of peripherals dispatched, we can finally turn our attention to the most important part of every S-series iPhone—the logic board!

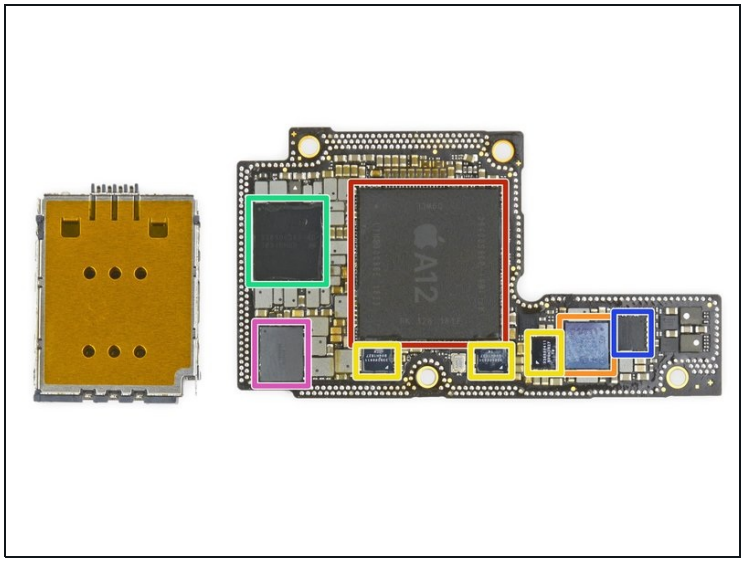
Step 7

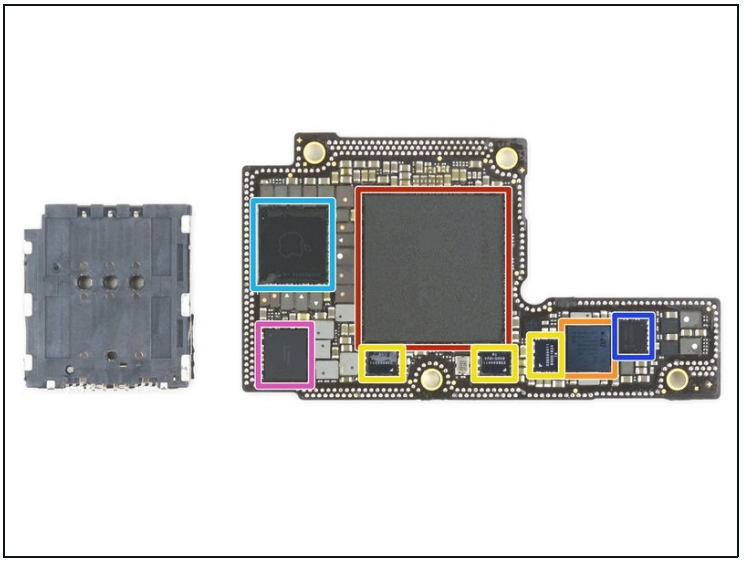




- Having seen this kind of logic board once already, we've gotten pretty good at pulling this PCB sandwich apart. Let's see what's on top of the top layer (XS on left, XS Max on right):
  - Toshiba TSB3243VB5275 64 GB NAND flash storage
  - Apple/Cirrus Logic 338S00248 audio codec
  - Cypress CPD2104 USB-C port controller
  - NXP Semiconductor CBTL1612 display port multiplexer
  - Texas Instruments SN61280E battery boost converter
  - Bosch Sensortec accelerometer/gyroscope

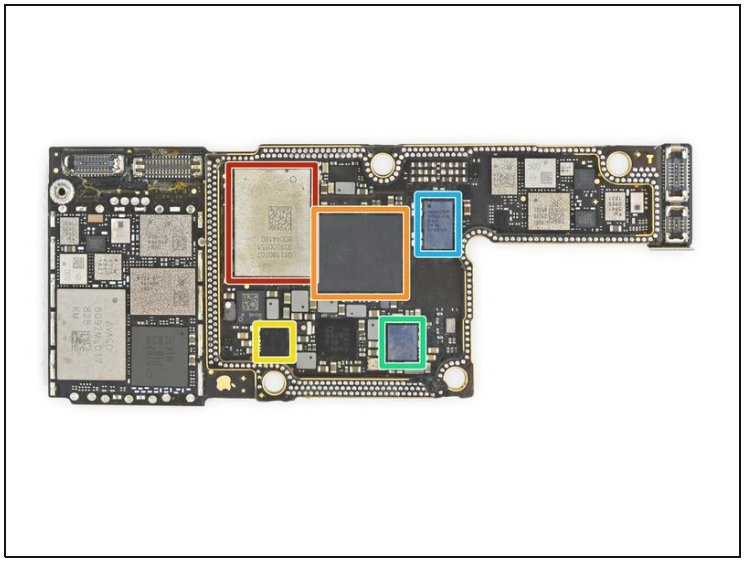
Step 8

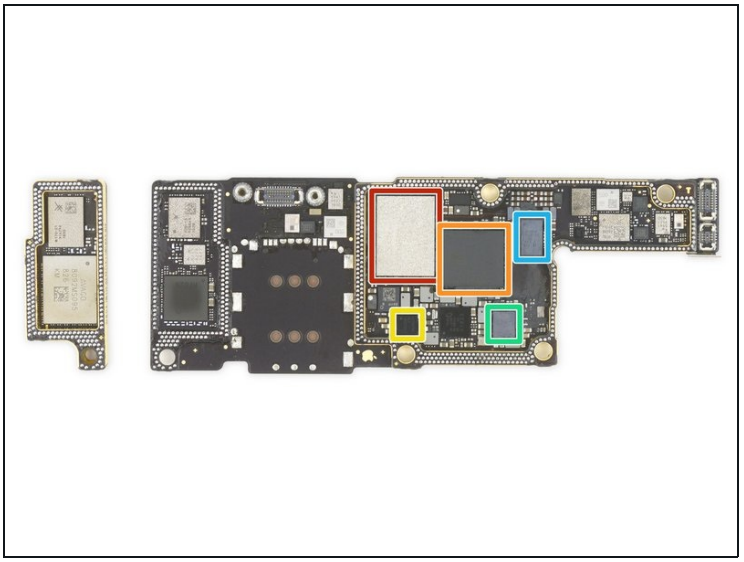




- Computer, zoom in and enhance the under-side of the top board:
  - Apple APL1W81 A12 Bionic SoC layered over Micron MT53D512M64D4SB-046 4 GB LPDDR4X SDRAM
  - STMicroelectronics STB601A0 power management IC (possibly for Face ID)
  - 3x Apple/Cirrus Logic 338S00411 audio amplifiers, two for stereo and one for haptics
  - Apple/Dialog Semiconductor 338S00383-A0 power management IC
  - Apple 338S00456 power management IC
  - Apple/Dialog Semiconductor 338S00375 system power management IC
  - Texas Instruments SN2600B1 battery charger IC

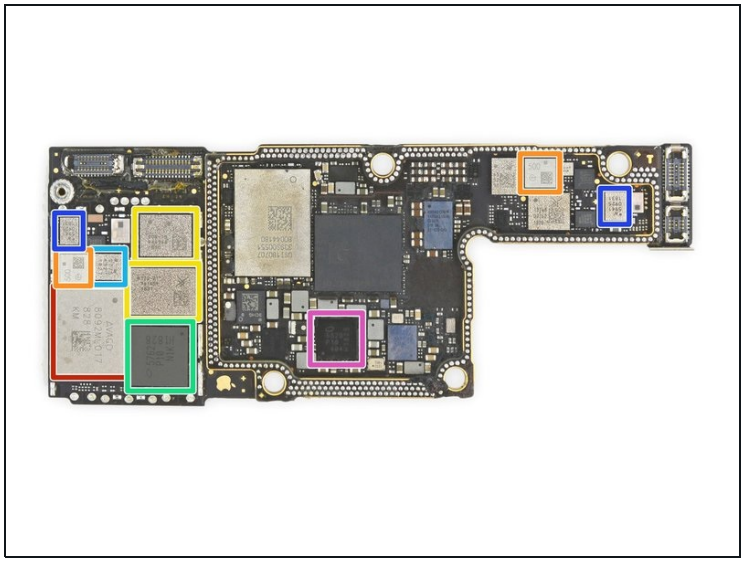
Step 9

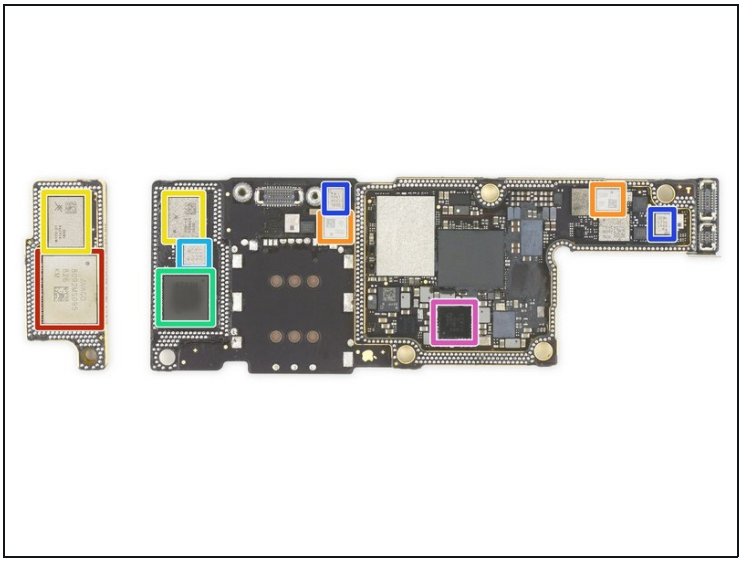




- Digging a little deeper, we find the RF board (XS on left, XS Max on right):
  - Apple/USI 339S00551 (XS) and 338S00540 (XS Max) WiFi/Bluetooth SoC
  - Intel PMB9955 (likely XMM7560) baseband processor/modems
    - Sorry, Qualcomm fans.
  - ST Microelectronics ST33G1M2 32 bit MCU with ARM SecurCore SC300
    - This is the same embedded SIM (eSIM) that we found in the Apple Watch Series 3 and the Google Pixel 2 XL.
  - NXP 100VB27 (SN100V) NFC controller
  - Broadcom BCM59355A wireless charging module

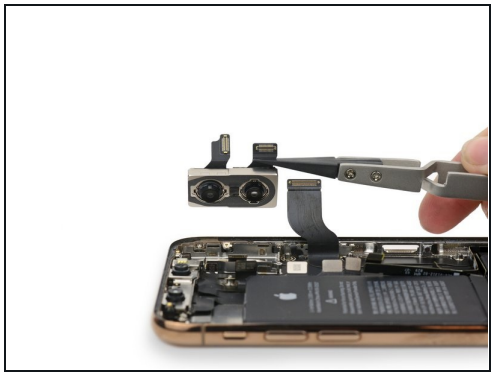
Step 10



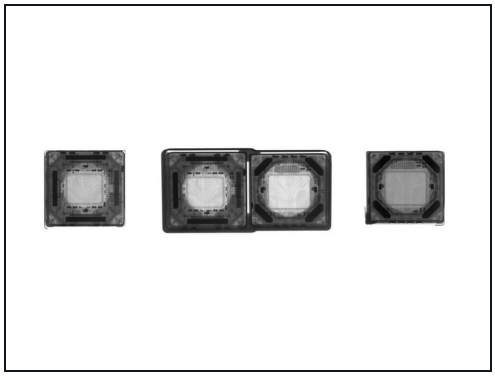


- RF board part two:
  - Avago AFEM-8092M high/mid band power amplifier duplexer (PAD)
  - Murata 500 4x4 MIMO duplexer
  - Skyworks 206-15 and 170-21 power amplification modules
  - Intel PMB5762 RF transceiver
  - Skyworks S775 RF switch
  - Skyworks 5941 GPS low-noise amplifiers
  - Intel PMB6829 power management IC

Step 11







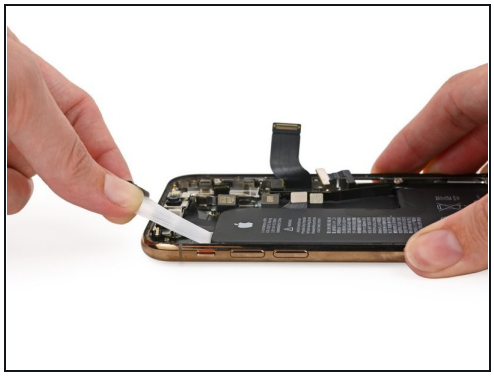
- Time to talk cameras! The S-year often comes with a camera upgrade, and Apple had a lot to say about these new sensors.
  - The wide-angle sensor size has been increased by 32%.
  - Pixel size has also been bumped, bringing better low-light performance and contributing to the new "Smart HDR" feature.

    Only time will tell if bigger pixels can help beat last year's impressive Pixel 2 camera.

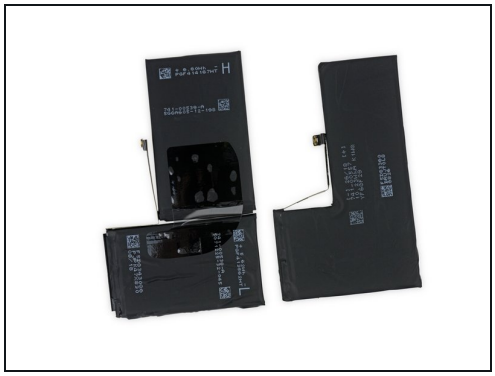
- There was one thing Apple forgot to mention about the new camera: all that 32% had to go somewhere, and it turns out the camera bump had to grow a little—your iPhone X case may not fit your iPhone XS.

- **Teardown Update**: We did a little testing, and the XS and XS Max camera modules appear to be identical—meaning you can swap the same camera between models with no problem.

Step 12







- After dissecting the brains and the eyes, we take a look at the brawn powering these phones.

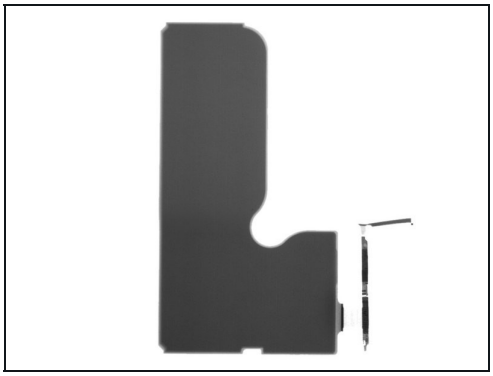
- The XS packs a 10.13 Wh battery (2,659 mAh at 3.81 V), weighing 39.5 g—slightly downgraded from last year's X.
  - But this decrease in capacity comes with a wild new battery configuration. Rather than using two cells to fill this L-shaped recess, Apple has constructed an all-new single-cell battery.

- The XS Max battery unsurprisingly comes out on top capacity-wise, with 12.08 Wh (3,179 mAh at 3.80 V), and weighing 46.6 g. No single-cell here, though!

ⓘ These are both in the ballpark of the S9 and S9+ batteries, but far smaller than that of the Note9.

Step 13







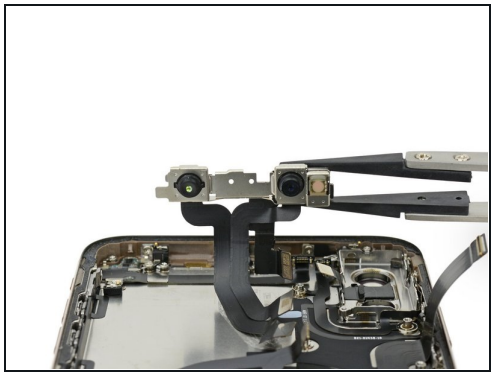
- Let's take a deep dive into Apple's battery origami:

- Since 2015 when the 12" MacBook was announced with a terraced battery, Apple has increasingly sought to take advantage of every bit of space in the chassis of their devices using contoured batteries.

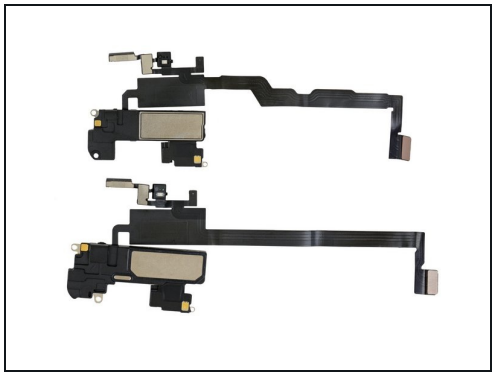
- These patents show solutions they have found to get around tricky problems like thermal expansion, using different layer sizes and precisely folding electrode sheets cut into complex shapes to fit those contours.
  - What's interesting is that this single-cell does a better job of utilizing space, but packs less punch.

- The extra corners and edges of the single-cell battery in the XS will be prone to extra stress—it will be interesting to see how this new battery performs as it ages.

Step 14







- What was revolutionary last year is quickly becoming standard equipment—both the XS and the XS Max come equipped with a sensor array for Apple's fancy Face ID technology.

- Time to fish out the noisemakers! The Taptic engine and loudspeaker come out in an assembly, but easily separate for modular replacement.

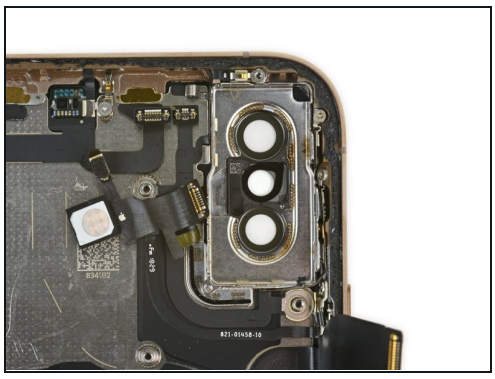
  The XS Max features a slightly beefier set of feedback units, but both Taptic engines follow the same designs of yore.

- Speaking of same, the earpiece speaker assemblies match *almost* identically across the XS and XS Max, with just a bit of extra speaker volume for Max.

Step 15







- As we scrape the bottom of the phone we find some tasty display chips, and a barrel of tiny cables in the body.

- It looks like the rear glass is still sandwiched between the camera bump and the frame with dozens of tiny welds.

  Despite the many improvements this phone received, it's got the same iPhone 8/iPhone X back glass construction, meaning one tiny crack calls for a whole chassis replacement.

Step 16



- Our synchronized two-phone teardown has come to a tidy conclusion.
- We suspect this marks the beginning of a new era in iPhone battery design—the carefully contoured single-cell concept is limited to the smaller XS for now, but we expect to see it again soon. iPhone XR, perhaps?
- Huge thanks again to our gracious hosts at Circuitwise in Sydney, Australia, and to our best buds over at Creative Electron for their stunning X-ray photography.
- Oh, and one more thing: it's time to assign an overall repairability score.

Step 17 — Final Thoughts



- The iPhone XS and XS Max both earn a **6 out of 10** on our repairability scale (10 is the easiest to repair):
  - Critical display and battery repairs remain a priority in the iPhone's design.
  - A broken display can be replaced without removing the biometric Face ID hardware.
  - Liberal use of screws is preferable to glue—but you'll have to bring your Apple-specific drivers (Pentalobe and tri-point) in addition to a standard Phillips.
  - Waterproofing measures complicate some repairs, but make difficult water damage repairs less likely.
  - Glass on front and back doubles the likelihood of drop damage—and if the back glass breaks, you'll be removing *every* component and replacing the entire chassis.