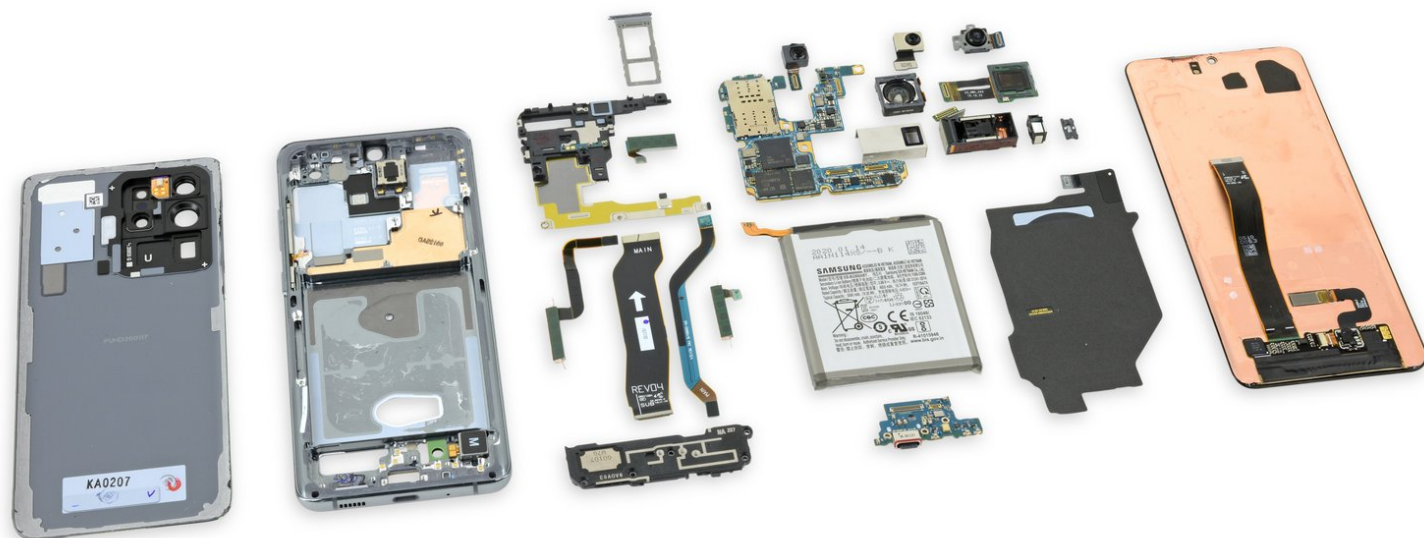




# Samsung Galaxy S20 Ultra Teardown

An iFixit teardown of the Samsung Galaxy S20 Ultra. We take a 100x-zoom look at the 108 MP camera sensor and maybe even coherently explain pixel binning.

Written By: Taylor Dixon



# INTRODUCTION

What's bigger than a Plus, faster than a Note, and has even more cameras than a Max? Why, it's the newest, most expensivest phone in the Galaxy: the Samsung Galaxy S20 *Ultra*. Join us for a teardown of this gargantuan, quad-eyed, nona-binning pocket computer.

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## TOOLS:

- [Heat Gun](#) (1)
- [Heavy-Duty Suction Cups \(Pair\)](#) (1)
- [iFixit Opening Picks \(Set of 6\)](#) (1)
- [Tweezers](#) (1)
- [Phillips #00 Screwdriver](#) (1)
- [Hot Air Rework Station Hakko FR-810](#) (1)
- [Spudger](#) (1)

## Step 1 — Samsung Galaxy S20 Ultra Teardown



- Samsung's motto for this massive phone could well be "no spec left behind." Pick a spec, and Samsung has dialed it all the way up to eleven —er, twenty. Just look at these numbers:
  - 6.9" Quad HD+ Dynamic AMOLED Infinity-O Display (3200x1440, 511ppi), 60 or 120 Hz refresh rate
  - Snapdragon 865 processor paired with 12 GB of LPDDR5 RAM (16 GB optional)
  - 128 GB flash storage (512 GB optional) expandable via MicroSD
  - 5,000 mAh battery
  - Cameras, just a few: 12 MP  $f/2.2$  ultra-wide; 108 MP  $f/1.8$  wide-angle; 48 MP  $f/3.5$  telephoto. Plus a mere 40 MP  $f/2.2$  selfie camera
- Now we know what happened to Galaxies S11 through S19: This phone *ate* them. It's a monster.

## Step 2



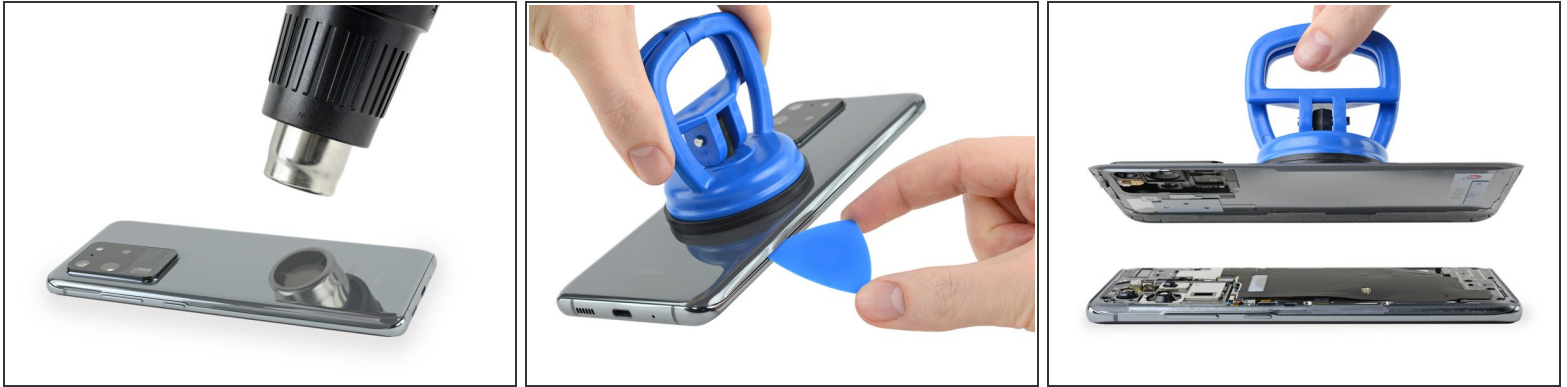
- Samsung just brought the biggest contender to the Camera Bump Contest—the one you didn't know was happening—and now it's over! Everybody go home.
- Technically you *could* make a bigger bump, but at some point it just becomes a thicker phone body with no bump at all. *Crazy talk*, we know.
- Here's a nifty visual comparison with the iPhone 11 Pro Max with its raised triple bump, and the Note10+5G with its single [Martinsville Speedway](#) bump.
- Our unit might be defective—we couldn't find anywhere to plug in our headphones. And the Bixby button is gone, so who are we supposed to loudly complain to?

## Step 3



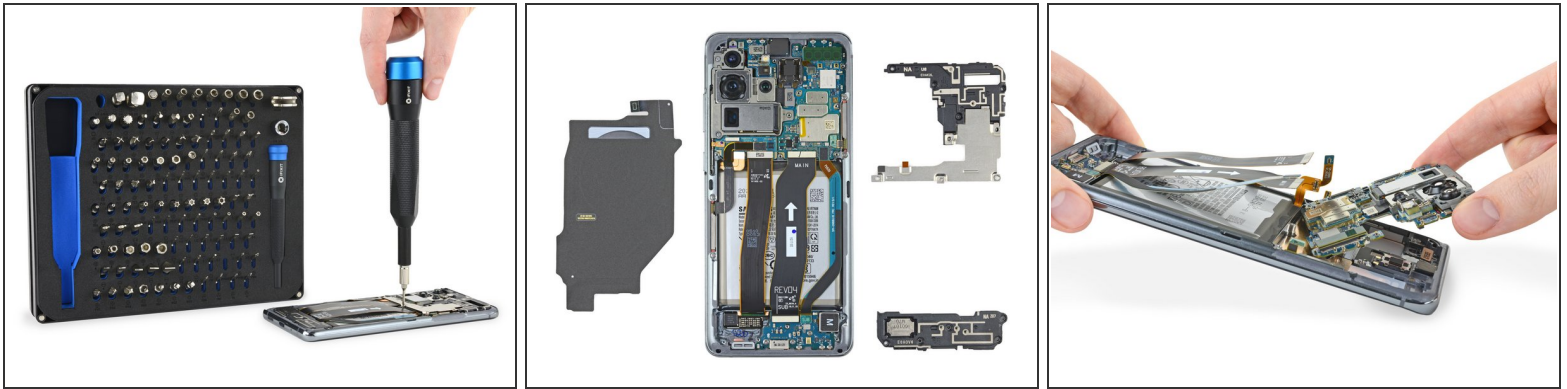
- While we warm up our tools, our pals at [Creative Electron](#) warm up the Ultra—with some X-rays.
- We're seeing a lot of internal similarities to last year's Note10+5G, including those mmwave antennas embedded into the frame and an [earpiece speaker](#) that fires upward from behind the display.
- Some differences are subtle, but here's one that's not: check out that enormous zoom camera near the power buttons. It takes up the space of two or three regular-sized camera modules. More on that in a bit!

## Step 4



- Per our usual SOP ([Samsung Opening Procedure](#)), we start looking for a way in through the back, leading the way with some heat.
- ❗ The adhesive here *seems* tougher than usual for Samsung, but we're not certain whether it's just normal variation or something more nefarious.
- Luckily, we brought our ultra-sized suction cup for such occasions.
- With all that adhesive, we're relieved that the back comes off without any cable-snapping booby traps.
- ❗ Look at the [cone-shaped extensions](#) on those camera modules! No wonder that camera bump is so thick. Samsung is done with the [Sony sensors that everyone else is using](#) and has decided to make their own modules for the S20.

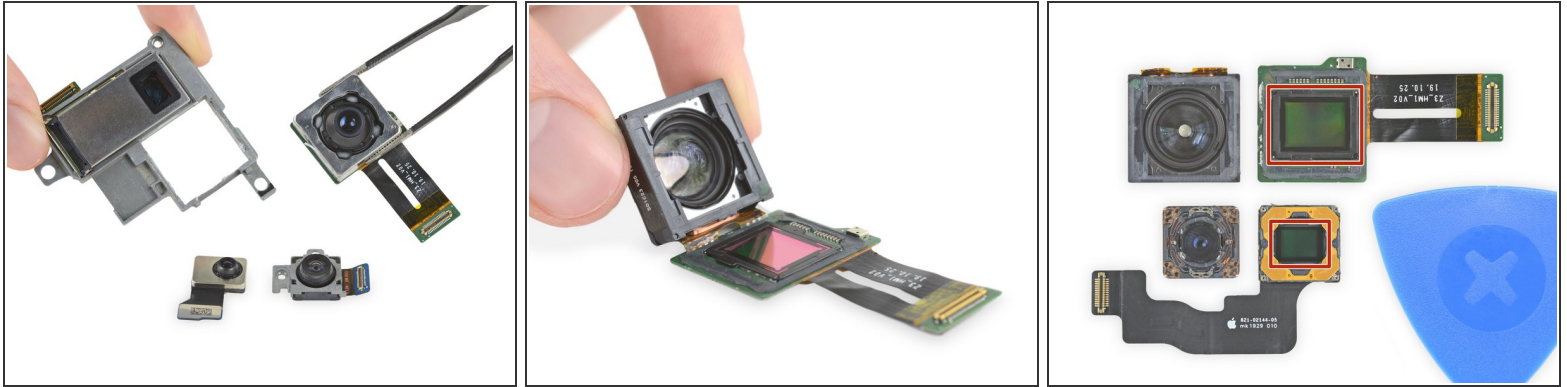
## Step 5



- We continue to raid the toolbag for bigger and beefier tools—like this [Manta kit](#) driver, which works equally well for swatting away screws and smashing walnuts. Just don't mix them up.
  - ❗ These screws are all named Phillip. We like Phillip; it's a solid name for a screw.
- With the top layer of antennas, speaker, and charge coils flipped aside, we get a clear look at the internals. It does look a *lot* like a [Note10+ 5G](#) in there, if you eliminated the stylus and used that space for more battery.
- ★ Stay tuned for our [teardown wallpaper](#) post! We'll have your Ultra wallpapers, as well as your Plus and your standard S20.
- We waste no time extracting the main board, which comes so laden with cameras, millimeter-wave hardware, and extra board layers that it feels like only half a victory. Time to start chucking things over-board.



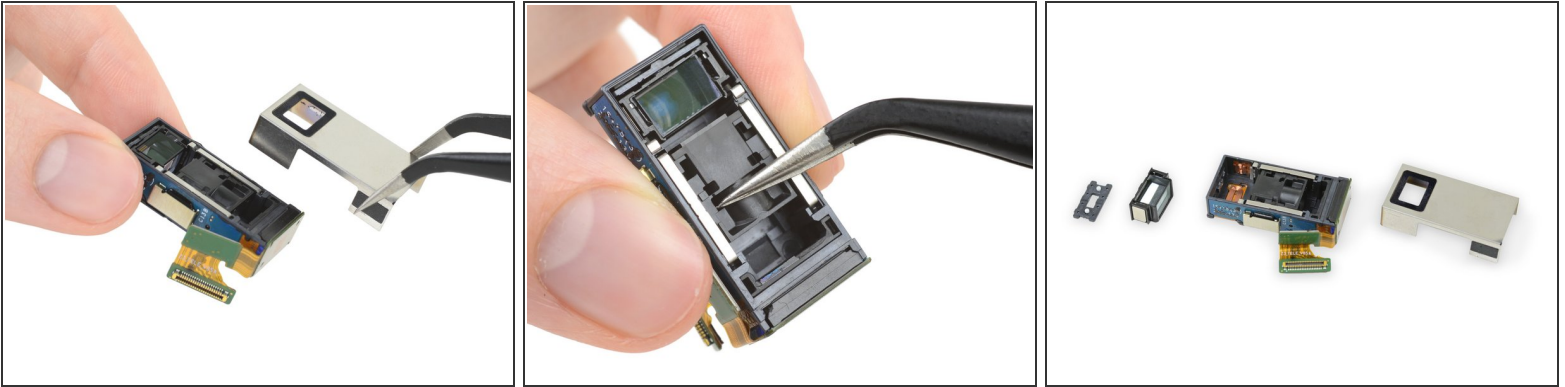
## Step 6



- We can't resist cracking open the massive 108 MP wide-angle camera after we pull it free—Samsung hasn't been shy about this sensor's capabilities.
  - The sensor covers over *double* the surface area of the iPhone 11 Pro's 12 MP primary sensor, shown here for comparison.
- Bigger sensors and more pixels don't always mean better images, though! 108 *million* pixels crammed into [a 9.5 mm x 7.3 mm rectangle](#) makes for some very tiny pixels, and that [tends to produce noisy images in low-light conditions](#).
- Samsung claims that this new sensor is able to shoot clear photos even in low light conditions thanks to a new [barrier built around each pixel](#), plus a 3x3 pixel binning method they're calling "nona-binning" (3x3=9, hence the *nona*).
  - ❗ [Pixel binning](#) is a fancy term for combining groups of pixels to gather more light. The result is a brighter—though lower-resolution—photo that hopefully has less noise.
  - ★ Binning *isn't* your [average, everyday downsampling](#). All of this pixel partying happens at the hardware level, eliminating conversion errors.

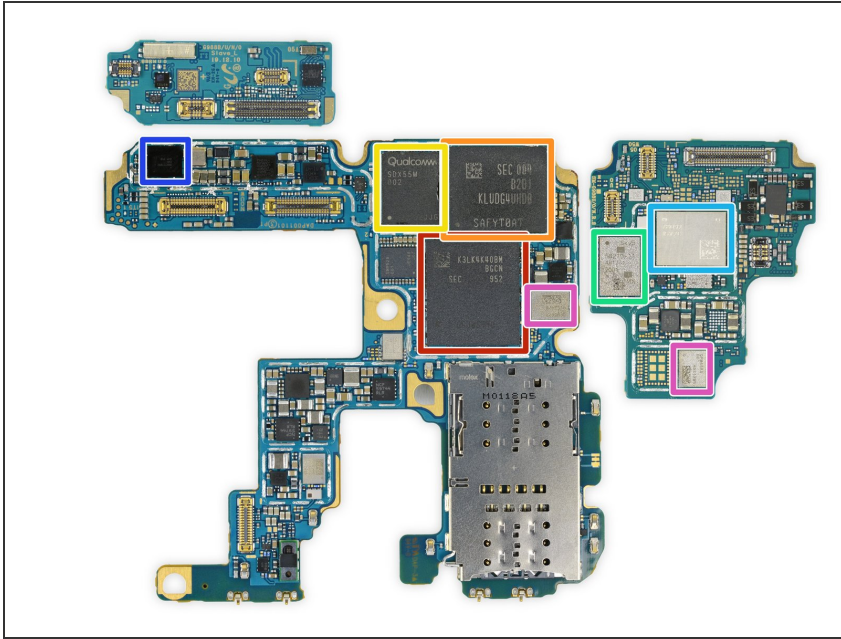


## Step 7



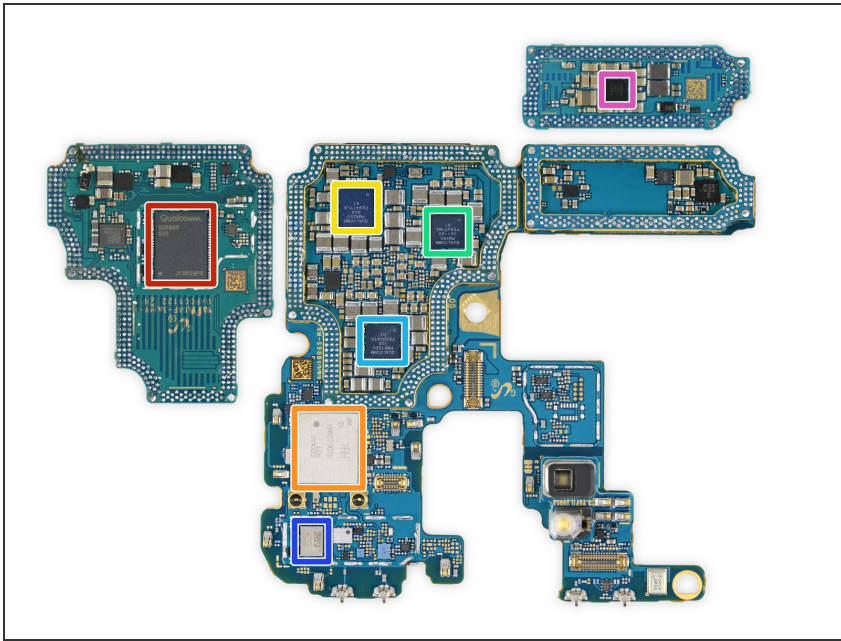
- Here's an unusual thing: this camera module takes up a lot of lateral ... *space*. Samsung is so proud of this particular camera that they [advertise it right on the camera bump](#). Let's see what's inside.
- How do you fit a stack of "zoom" lenses into a smartphone that's only 8.8 mm thin? Samsung says: turn it sideways. Instead of focusing your image directly onto the sensor, this camera uses a prism to bounce the light *sideways* at a 90-degree angle.
- It certainly is impressive! After passing through the prism—which has its own *optical image stabilizer*—the image barrels through a [sliding box full of telephoto lens](#), and finally hits the sensor mounted at the end of the tunnel.
- The lens itself is good for a (fixed) 4x magnification—the rest comes from a combination of sensor cropping and binning (48 megapixels pared down to 12) and standard digital zoom, to get to 100x.
- With the prism lifted out, we can see the copper coils and magnets surrounding it, and the tiny white bearings on the supporting bracket. The prism moves back and forth against that bracket to compensate for your shaky hands.

## Step 8



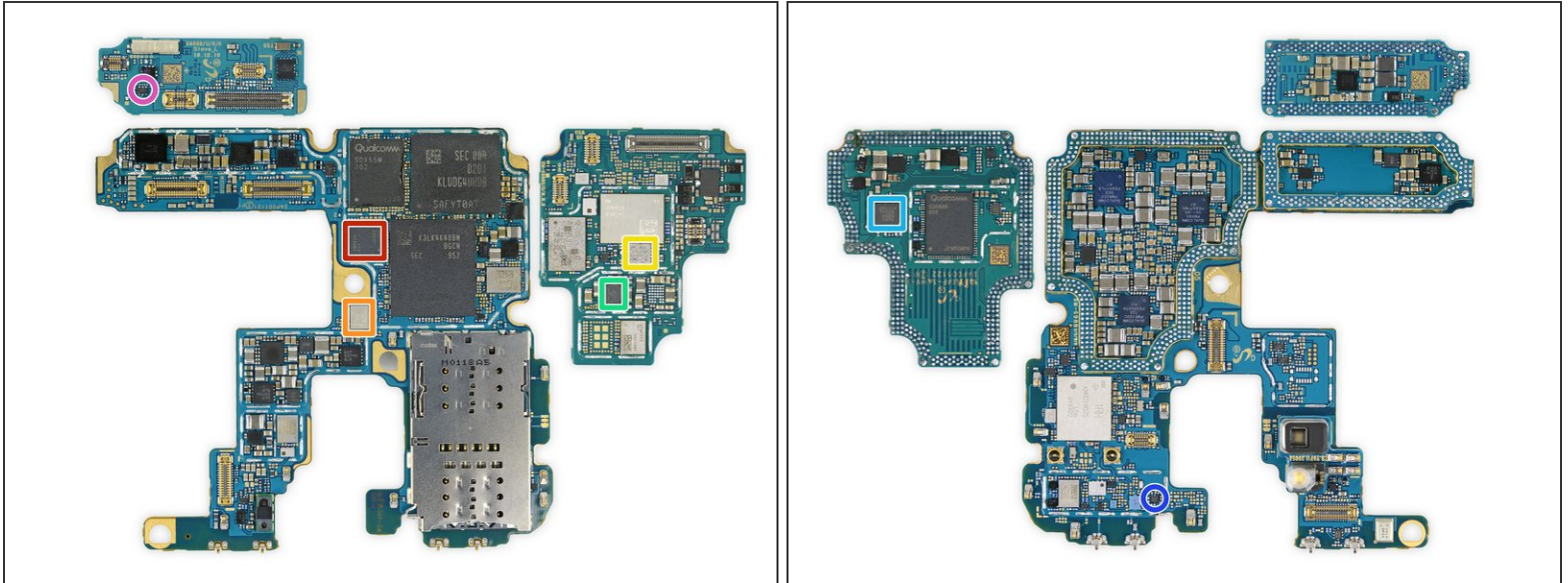
- With all shields down, we can get a better look at the silicon hiding beneath:
  - Samsung K3LK4K40BM-BGCN 12 GB LPDDR5 RAM layered over Qualcomm [865](#) SoC
  - Samsung [KLUDG4UHDB-B2D1](#) 128 GB UFS 3.0 flash storage
  - Qualcomm [SDX55M](#) 2nd-gen 5G modem
  - Skyworks [SKY58210-11](#) RF Front-End Module
  - Qorvo QM78092 Front-End Module
  - Maxim MAX77705C power management IC
  - Qualcomm QPM5677 and QPM6585 5G power amplification modules

## Step 9



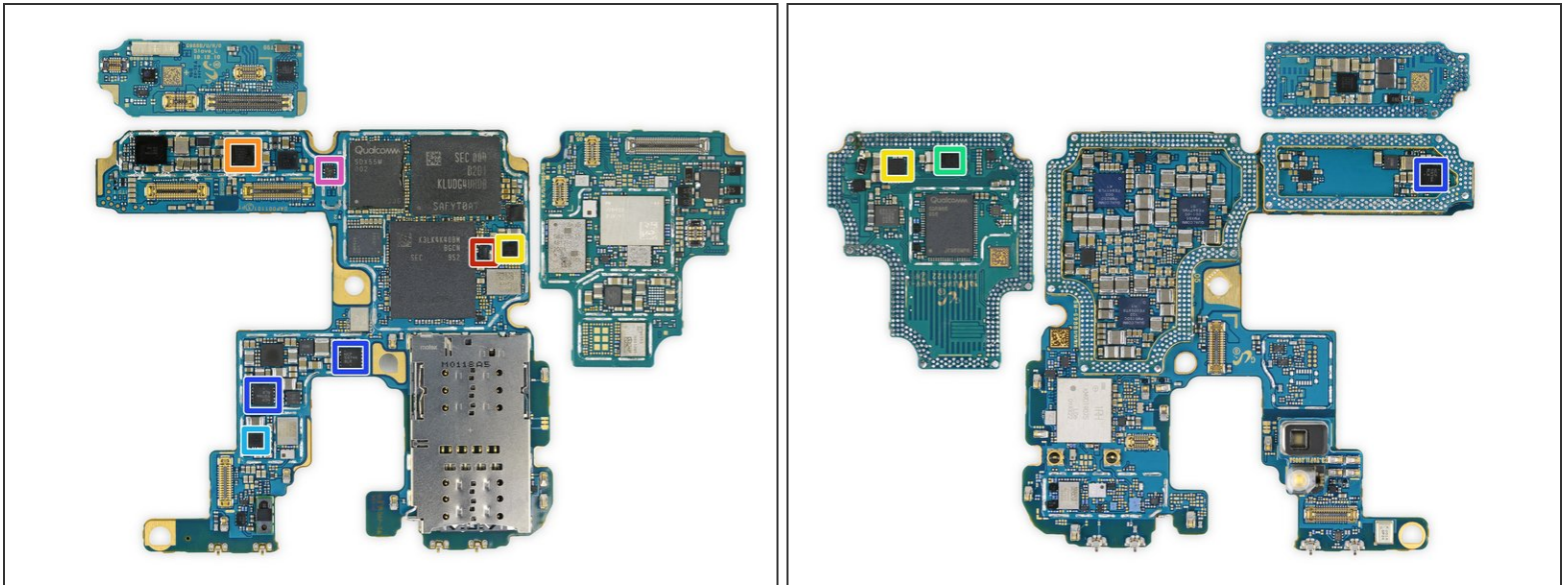
- But wait! Flippin' the boards over reveals even more flippin' chips:
- Qualcomm SDR865 RF Tranceiver
- Murata KM9D19075 Wi-Fi & Bluetooth Module
- Qualcomm PM8250 power management IC
- Qualcomm PMX55 power management IC
- Qualcomm PM8150C power management IC
- Qualcomm QDM4870 front-end module
- Silicon Mitus SM3080 power management IC

## Step 10



- You've already seen the heavy hitters—here are some bonus chips:
  - Qualcomm SMR526 RF transceiver
  - Qualcomm QDM5872 front end module
  - Skyworks SKY77365-11 quad-band GSM/GPRS/EDGE power amplifier module
  - Qualcomm QET5100 envelope tracker module
  - NXP Semiconductor [SN110U](#) NFC controller w/ Secure Element and eSIM
  - NXP Semiconductor [BGU8103](#) GPS/GLONASS/Galileo/BeiDou low noise amplifier
  - NXP Semiconductor [NCX2200](#) low voltage comparator

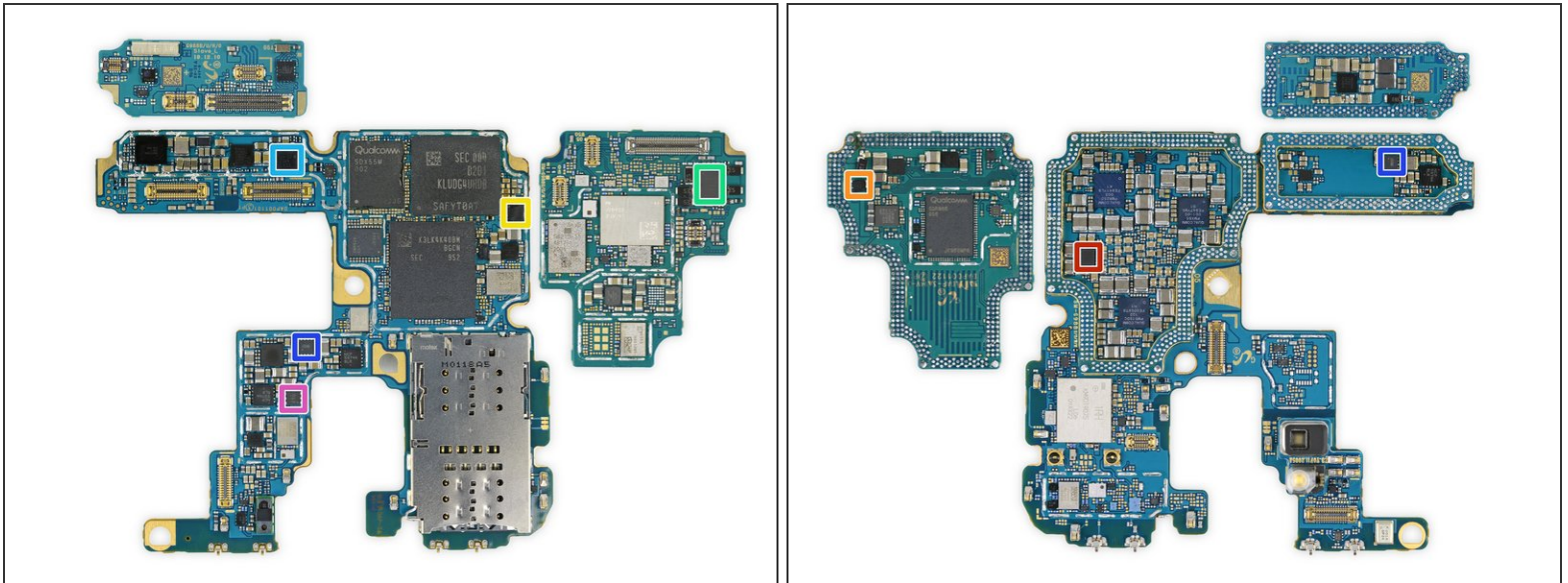
## Step 11



- And the bonus bonus chips:
  - Qualcomm PM3003A power management
  - NXP Semiconductor [PCA9468](#) high-current fast charger
  - Cirrus Logic CS35L40 audio amplifier
  - Cirrus Logic [CS40L25](#) Class D haptic driver
  - Maxim Integrated [MAX77816](#) buck-boost regulator w/ 5 A switches
  - ON Semiconductor [NCP59744](#) dual-rail LDO regulator
  - Vishay [DG2730](#) 2-port USB 2.0 high speed switch



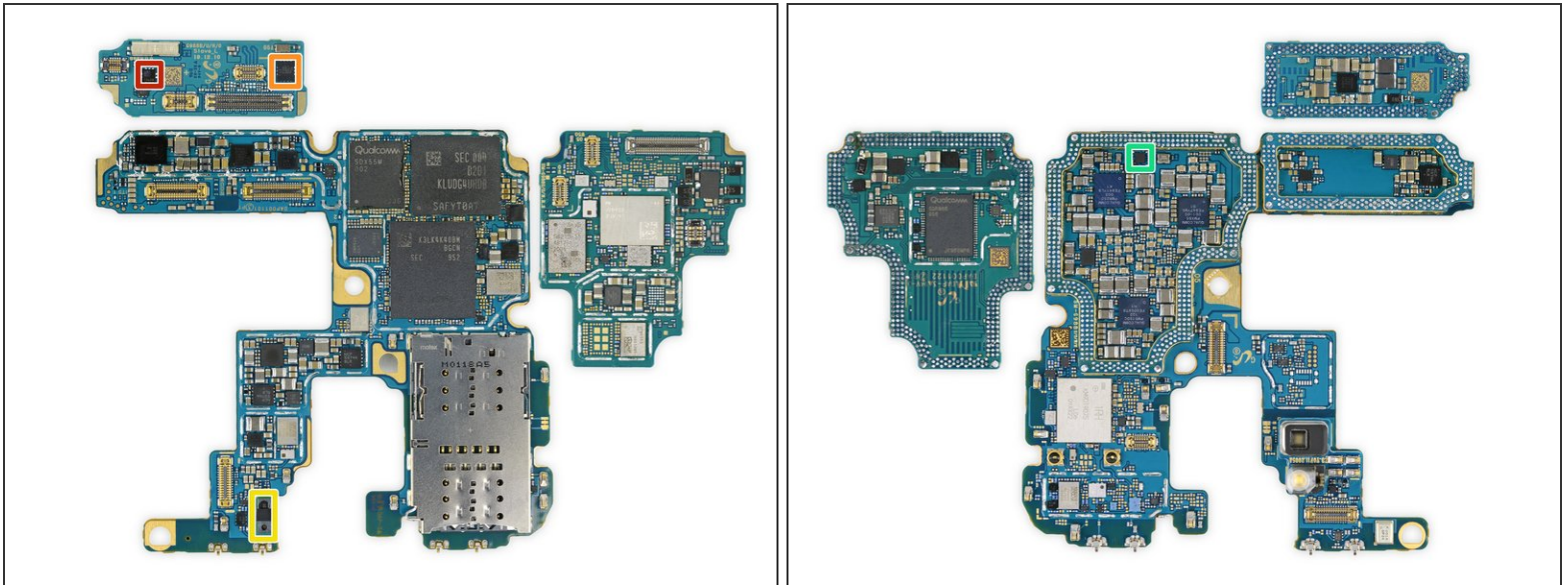
## Step 12



- IC Identification, continued:

- Qualcomm [QET6100](#) envelope tracker
- Samsung S2MIS0A MST Driver
- STMicroelectronics [STM32G071EB](#) 32-bit ARM Cortex-M0+ microcontroller w/ 128 KB flash
- Samsung S2MIW04X power management
- Likely ON Semiconductor FPF3788UCX OVP load switch
- Silergy DC-DC converter
- Richtek [RT8010GQW](#) DC-DC converter

## Step 13



- Let's take a closer look at the sensors hiding all over this board:
  - STMicroelectronics [LPS22HD](#) pressure sensor
  - STMicroelectronics [LSM6DSO](#) accelerometer
  - Likely an Austria Micro Systems [TMD4903](#) color/proximity sensor w/ IR emitter
  - Likely a Bosch Sensortec [BMM150](#) geomagnetic sensor

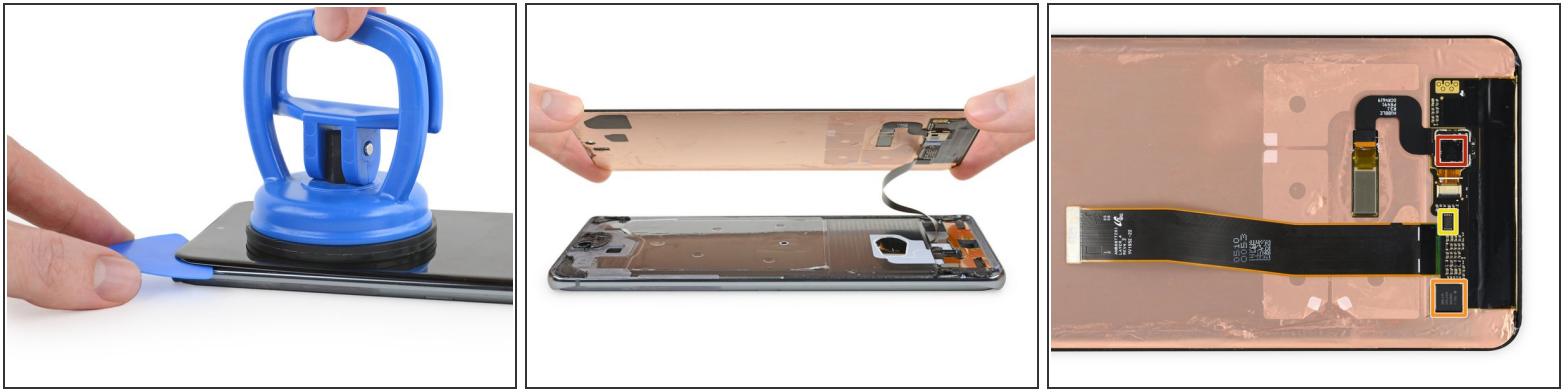


## Step 14



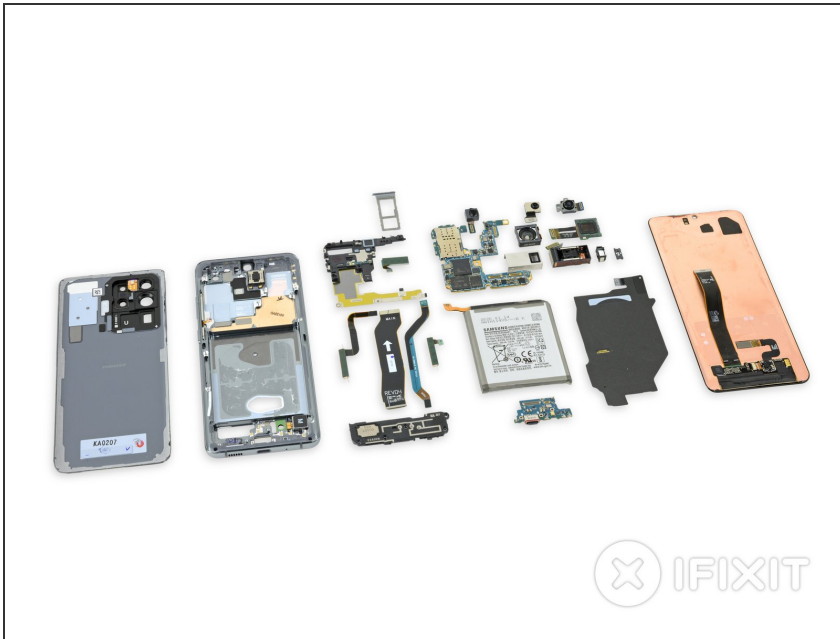
- Our oversized suction cup makes a second appearance for this stubbornly adhered battery. That, plus some isopropyl alcohol insertion, are just enough to free it.
  - ❗ It's gruesome glue, and almost looks like [Venom](#) got a hold of this battery and just won't let it go.
- This ultra-large battery boasts 5000 mAh running at 3.86 V, for a total 19.30 Wh.
  - ❗ That's a huge increase over its contemporaries—most notably the iPhone 11 Pro Max at [15.04 Wh](#), and the Galaxy Note 10+ 5G at [16.56 Wh](#).
- Looking around the fringes of the phone for any hiding bits, we find a millimeter-wave antenna stuffed along an edge next to a copper heat diffuser—a very [familiar](#) arrangement.

## Step 15



- That 120 Hz screen refreshes so much faster, but comes off about the same speed as before (slowly and painfully).
- Comparing this to the [Note10+ display](#), there's no obvious indication that this one has the faster refresh rate. It does look a bit more streamlined though—Samsung managed to consolidate down to a single ribbon cable, simplifying repairs a bit.
- On-board silicon includes:
  - Qualcomm QBT2000 [3D Sonic Sensor](#) controller
  - Samsung S6SY79AX Touchscreen Controller
  - Winbond [W25Q80EWUXIE](#) 8 Mb Serial NOR Flash
- Appropriately, the codename for this "space zoom" phone is.... *Hubble*. As we all know, the Hubble space telescope worked [perfectly at launch](#), never needing a single repair.

## Step 16



- Samsung continues to push boundaries, but this time in a less bendy form-factor. While smartphone designs have slowly converged on the same giant black glass slab, we found some interesting things packed inside the S20 Ultra!
- It would be easy to dismiss things like 5G (that only works one block at a time in the world's biggest cities) or crazy-high-pixel-density and periscope cameras as gimmicks, but sometimes novel little hardware additions turn into pretty big deals (selfie cameras, anyone?).
- In a world of iterations and safe bets, it's refreshing to see Samsung continue to do what Samsung does best: pack phones full of zany technology and see what sticks.
- Unfortunately, Samsung isn't pushing any boundaries repair-wise, as evidenced by this phone's repairability score...

## Step 17 — Final Thoughts

### REPAIRABILITY SCORE:



- Samsung's Galaxy S20 Ultra earns a **3 out of 10** on our repairability scale (10 is easiest to repair):
  - The fasteners, all identical Phillips screws, only require one driver and can't be mixed up, simplifying repair.
  - Many components are modular and independently replaceable, but the missing headphone jack means double duty and wear for the USB-C port.
- Every repair starts with painstakingly un-gluing the fragile glass rear cover.
- Replacing the glued-down battery is tougher than ever, especially with board interconnect cables to work around.
- All-too-common display repairs require either a complete teardown or replacing half the phone.