Can a $100 iPad Case Improve 3G Data Power? Lab Test!

by Jon Phillips

Were I to tell my most perpetually indignant friend that his tablet's 3G radio is prone to regular performance drops of up to 75 percent, he would likely enter apoplectic rage.

Such is the emotional fabric of the modern tech enthusiast. We're already concerned about overloaded data networks that can't handle too many simultaneous user requests, and Apple's iPhone 4 "antennagate" imbroglio, rightly or wrongly, has left conspiracy-minded consumers wary of self-sabotaging hardware.

But now a company called Pong Research is spreading word of a proximity sensor inside the iPad 2 Wi-Fi + 3G that reduces the tablet's 3G radio output by some 6 dBm, or about three-quarters of its total transmission strength. The sensor is tripped whenever it comes within 10 mm of a solid object — which could be anything from human flesh to an iPad case that snugly ensconces the tablet's chassis.

Apple doesn't mention the proximity sensor in any of its marketing materials or user manuals, and it declined to comment for this article. But the sensor is referenced in Apple's filings with the FCC, which make frequent reference to a 3G radio "back-off" mode.

So what is Pong's stake in the game? The company specializes in third-party iPhone and iPad cases marketed as providing consumers with additional protection from the electromagnetic radiation emitted by their devices. As a side benefit, Pong's iPad 3G case purportedly *doesn't* trip the proximity sensor. Other third-party cases, Pong says, trip the sensor and leave the user with reduced 3G power.

To validate Pong's claims, I visited Cetecom Inc., an FCC compliance lab, and observed while technicians tested the iPad 3G case under the full scrutiny of

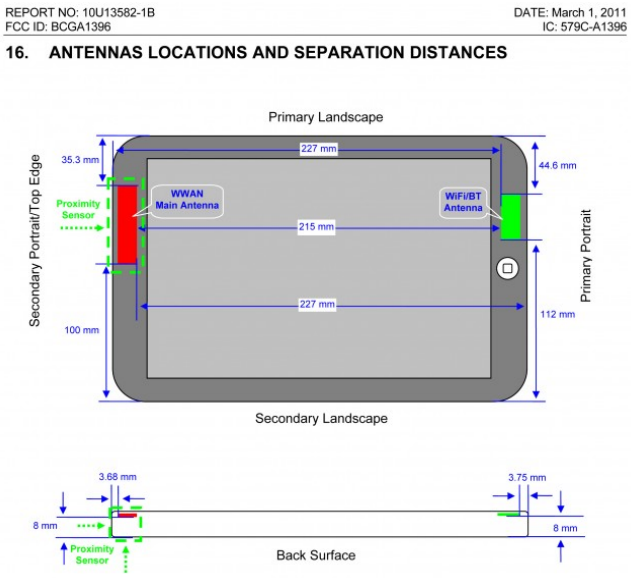
scientific inquiry. But before I reveal the test results, let's dig a little deeper into the iPad's proximity sensor. Why did Apple include a potential data governor in the 3G version of its tablet, and what effect does its back-off mode *really* have on real-world 3G data connections?

Down the FCC Rabbit Hole

Unless you burrow your way into a cryptic database of public FCC filings, it's near impossible to find any evidence of an iPad proximity sensor. Indeed, simple Google searches only reveal speculation about the features a proximity sensor might provide were one to be deployed in Apple's tablet. One thread of what-if-ing from January posits an auto-unlocking function that would be triggered as soon as a user picks up the device.

But evidence of the proximity sensor can indeed be found in a report prepared for Apple by Compliance Certifications Services (CCS), and submitted to the FCC on March 1, 2011. Titled "SAR Evaluation Report," the document chronicles a series of tests to determine how much electromagnetic radiation a user might absorb from the iPad's wireless communications hardware. SAR stands for "specific absorption rate," and is the metric by which the FCC measures radiation exposure to the human body.

Deep inside the report, CCS makes note of the iPad's proximity sensor in a section titled "Power Reduction By Sensing." In summary, when the proximity sensor comes within 10 mm of a solid object, it triggers a "back-off" mode that reduces the power of the iPad's 3G radio (which, along with the sensor itself, resides to the right of the front-facing camera in the iPad 2 Wi-Fi + 3G). CCS ran a series of tests to determine not only the degree of power reduction across various radio bands, but the effect of power reduction on SAR.



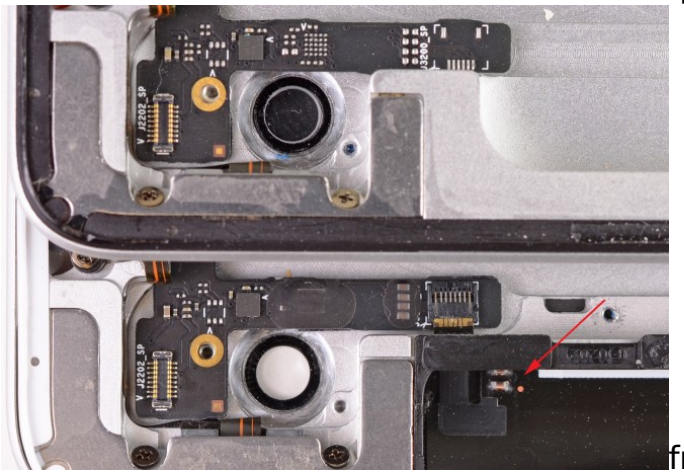
While Apple wouldn't comment on the sensor, it's easy to glean the sensor's intent from both its cause-and-effect properties, and the fact it plays such a big part in a report on radiation absorption.

"It looks like the sensor is looking for human tissue next to the antenna, and if it sees it, it backs off the transmit power," says Francis Sideco, iSuppli's senior

principal analyst for wireless communications. “You would assume that the FCC had some kind of requirements that the iPad had to meet.”

Like iSuppli’s senior wireless expert, even the teardown mavens at iFixit were unaware of the proximity sensor before I showed them FCC documentation. But in typically intrepid iFixit fashion, they got right down to business, and unearthed what they suspect could be the physical component itself.

Says iFixit’s Miro Djuric: “The only component that I could see that could *possibly* be the proximity sensor is a teeny tiny component that’s attached to the black plastic bar contained in the 3G version. That component is completely missing



from the Wi-Fi version, which allows us to conclude that the Wi-Fi version doesn’t need it.”

And why did Apple put the sensor in the iPad?

Djuric posits: “It’s to limit the amount of SAR exposure a user would get, should they place themselves next to the iPad while it’s transmitting information — for example, falling asleep on top of the iPad while watching a lame movie on Netflix. The impact of radiation decreases dramatically with distance, so you’re a lot safer with your iPad six inches from your head than you are with it pressed right up to your face.”

While the SAR Evaluation Report from CCS makes frequent reference to the proximity sensor, it doesn’t describe its operation or even intent. For this information, readers are directed to a separate document titled “Operational Description” — a report that’s been tagged “Permanent Confidential” by the FCC, and is unavailable for public review.

Pong’s Secret Weapon: Radiation Redistribution

So we know the proximity sensor exists, and that it attenuates 3G radio power. Our line of inquiry now turns to Pong Research, and its marketing claims.

Pong makes two promises about its case: First, that its case won’t trigger the proximity sensor, while competing cases will. “The proximity sensor is triggered not just by the human body, but by any solid. As a result, all commercial cases for the iPad 2 also cause the proximity sensor to trigger, which can reduce your transmission power by up to 75 percent,” the

company writes.

The company's sensor solution is fairly straightforward: Its case has a cut-out over the part of the iPad where the proximity sensor is located — a strategy that can be employed by any case manufacturer that knows about the sensor, and is concerned about the tablet's back-off mode.

Pong's second promise is more ambitious. It says its case includes an integrated circuit board designed to "couple passively" with the tablet's own 3G antenna, and redistribute 3G radiation away from the user's body.

"Normally, the radiation from the iPad is concentrated near the antenna," says Ryan McCaughey, the Chief Technology Officer at Pong Research. "The Pong case redistributes the 3G radiation over a larger area to reduce the intensity and lower SAR. It's a passive device, and doesn't amplify the signal."

This is a completely separate matter from the proximity sensor, and it's Pong's raison d'être. As as a safety measure, FCC regulations limit SAR levels for partial-body exposure to up to 1.6 W/kg (watts/kilogram), and whole body exposure to up to 0.08 W/kg. But Pong caters to consumers who worry that even FCC-approved levels of radiation might have long-term health implications. Pong's phone cases, and now their iPad cases, promise extra protection by redistributing radiation away from the consumer's body.

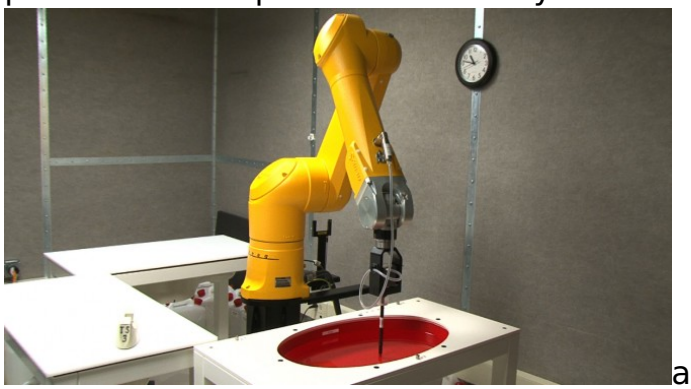
Bold claims. How would they hold up in Cetecom's lab?

Testing the Body Phantom

Located in the business park sprawl of Milpitas, Califorinia, Cetecom Inc. is easy to miss, with a nondescript, near-featureless exterior. But walk down its hallways, and you'll discover the company is home to hardcore testing chambers filled with massive robotic arms, gigantic wall-mounted turntables, and sensitive electronics equipment calibrated to the nth degree. Cetecom is a major player in FCC compliance testing, and graciously agreed to help us validate Pong's claims.

Our first series of tests delved into SAR — specific absorption rate, or, in lay terms, how much radiation one's body may receive from handling the iPad Wi-Fi + 3G. We first ran the test with the iPad alone, sans case, and then repeated the regimen with the Pong case attached. According to Pong, its case should reduce SAR by about two-thirds.

The SAR testing apparatus in an impressive set-up. The device under review is carefully positioned below a basin filled with a special liquid solution called a “body phantom.” The phantom is mostly water with a small amount of ethanol,



and simulates the electrical properties of body tissue.

Above the basin moves a probe controlled by an industrial-strength robotic arm. The probe enters the phantom, and does a precise area scan, searching for electromagnetic hotspots where the iPad is radiating the most. Once identified, hotspots are investigated further with a more penetrating volume scan, which ultimately yields the SAR numbers supplied to the FCC.

Our results? The Pong case delivered all the radiation protection it advertises.

Before we ran the tests, the company provided me with documents from its own SAR testing. On the 1880MHz WCDMA 3G radio band, Pong’s paperwork shows that a “naked” iPad emits an average SAR of 1.44 mW/g (milliwatts per gram), while an iPad with Pong’s case attached lowers SAR to 0.445 mW/g.

At Cetecom, we tested the very same radio band, and observed that same two-thirds reduction in SAR. (Per an agreement with Cetecom, I won’t be sharing specific numbers from the tests I observed in their lab.)

In total, it’s an impressive product for anyone concerned about receiving excessive amounts of radiation while holding an iPad in the throes of 3G transmission. (We found the same results when we tested Pong’s iPhone case in 2009.)

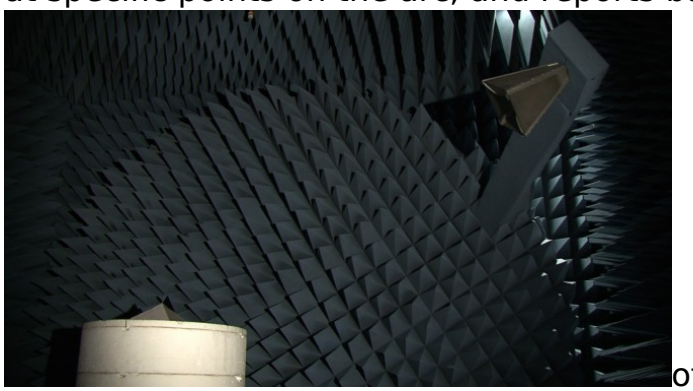
So that’s SAR. What about Pong’s claims that its case doesn’t trip the proximity sensor, unlike other third-party cases?

Inside the Anechoic Chamber

To test the power of the iPad’s 3G radio — and to determine what *really* happens when the proximity sensor is tripped — we entered Cetecom’s over-the-air testing facility. Testing apparatus is spread across two rooms: an anechoic chamber covered top to bottom with foam pyramids that absorb stray radio waves, and an external room filled with equipment that measures the procedures occurring inside the chamber itself.

Inside the anechoic chamber, we placed the iPad 2 on a pedestal that rotates 360

degrees. On the wall of the chamber is a massive turntable with a 3G antenna attached. To build a 3D model of the iPad 2's 3G transmission strength, the pedestal rotates in a circle while the turntable-mounted antenna sweeps across a 165-degree arc across an opposing axis. The antenna measures 3G signal strength at specific points on the arc, and reports back to the testing equipment in the



other room.

We ran three tests: the iPad 2 transmitting "naked," the tablet transmitting while seated in the Pong case, and the tablet transmitting while seated in another third-party case that firmly grips the entire bottom and sides of the iPad's chassis.

Our results at Cetecom perfectly mapped against the numbers CCI provided in its SAR Evaluation Report filed with the FCC. In this report, CCI indicates average 3G power drops from 22.4 dBm to 16.4 dBm when the proximity sensor back-off is triggered.

Just as Pong promised, we saw this 6 dBm reduction in our own testing: The iPad transmitted at full power when running naked and when seated in the Pong case, but its power attenuated when seated in the other third-party case. Because the dBm scale is logarithmic and not linear, this seemingly small reduction in power actually represents a power drop in the neighborhood of 75 percent.

But what does a 75 percent reduction really mean to users tapping into 3G in the field?

If you're currently using a third-party iPad 2 case that trips the tablet's proximity sensor, you really only need to be concerned about the tablet's ability to connect to faraway cell towers. According to McCaughey, Pong's CTO, "Reducing a phone or tablet's 3G signal strength will decrease the range within which the device can connect to a tower. A 75 percent reduction in transmission power, for example, produces a 50 percent smaller connectivity range."

Sideco, iSuppli's wireless expert, adds a bit more texture. He points out that out the tablet's radio strength affects the 3G uplink, and not the downlink, which is most central to the consumer experience — i.e., we typically download much more data than we ever upload.

Nonetheless, says Sideco, "The power back-off could impact acknowledgements by the application or the device going back to a server or base station. Therefore, you definitely want to optimize your power to balance what is needed or available

versus its impact on battery life."

Sideco also points out that a 6 dBm drop might never be noticed by the user. "If the RF conditions are very clean, and you are also close to the tower, you might not even need anywhere near 16dB of power," he says. "The reduction only really comes into play in the boundary conditions where maximum transmission power is required."

So, in the final analysis, what are we to make of Pong's unique case design?

It's a very expensive accessory at $100, but it's made of a durable Lexan material that's soft to the touch, and looks nearly as smart as leather. This isn't a gaudy case. It reeks of purpose-built seriousness befitting Pong's intentions. And the case not only seats the iPad 2 with a firm grip, it also includes a unique folding cover that can be be arranged in a variety of stand configurations.

But when push comes to shove, you wouldn't spend $100 for aesthetics and a clever kickstand. You would buy the Pong case because you're concerned about radiation exposure, and want to ensure you're getting every bit of 3G power your iPad can muster.

To this end, the Pong case clearly, unequivocally delivers on both counts.

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