Cellular carrier certification requirements

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So you want to sell a product with cellular in it, but you have no details on cellular carrier and agency certifications? Here's the skinny. Disclaimer, these details were correct as of this writing. These details change continuously; consult an expert when you need to start making decisions to ensure you have the most up to date information.

First we need some definitions:

Who cares:

1) Government agencies. The Federal Communications Commission in the US and Industry Canada in Canada. In Europe, each government has an agency that cares, but as long as they're part of the European Union, there is only one set of tests that you need to pass. Typically, the test report is requested the first time the product is imported for sale in a particular country. You care because each of these agencies has the power of law to prevent you from selling your product. This is enforced by fine and injunction.

2) Industry test enforcement entities. Mainly we're referring to PTCRB, which oversees device certification for member carrier networks. This does not currently include Verizon or Sprint, though it may soon apply to Sprint's LTE offerings. You care because without passing PTCRB testing none of the member carriers will allow more than a handful of your devices on their network. PTCRB enforces Idle Mode, Intentional Radiator RSE, receiver flatness, and SIM interface tests with pass/fail

requirements. They also perform TIS & TRP testing and document the results, however, PTCRB itself does not currently have a pass/fail criteria. TIS/TRP requirements are currently enforced only by certain carriers, namely AT&T and Rogers.

3) Carriers. The carriers are the ones who actually enforce PTCRB and/or their own carrier specific testing and requirements. Carriers will insist you comply or they won't let any meaningful number of devices on their network. This applies for both MNOs and MVNOs as the MVNOs are held responsible by the big carriers for compliance of their customers' devices.

Now that we've covered who's involved, we'll move on to the actual requirements. These are only the main test items.

Radio and Electronics Performance & Compliance Measurements:

1) Total Isotropic Sensitivity (TIS) - this is a swept measurement integrated over a sphere of the device's radiated receiver sensitivity. The device is placed in an anechoic chamber and then the device, antennas or both are rotated in order to take measurements from every direction (30 degree steps). The measurements are then integrated to get a single number. For cellular modules with a known tested receive sensitivity, this measurement is a reflection of antenna performance and device electronics implementation.

2) Total Radiated Power (TRD) - this is the same integrated sweep described above, but it is a measurement of the radiated transmit power of the device. This is correlated mainly to antenna performance.

3) Radiated Spurious Emissions (RSE), aka Intentional Radiator - this is a measurement of the radio emissions from a device while it's transmitting. The goal is to ensure that the device is only radiating on the frequency it's supposed to and that any emissions on other frequencies meet or exceed the relevant agency requirements.

4) Part 15b, aka Idle mode emissions, aka, Unintentional Radiator, Radiated Spurious Emissions - this is the same measurement as RSE but done when the cellular device is synced to the network but with no connection active. Note that PTCRB limits follow ETSI limits, not FCC limits.

5) SIM testing - for devices with SIM cards, there are electrical requirements associated with the SIM card holder and electrical interface including ESD, electrical interface and protocol implementation.

6) Specific Absorption Rate (SAR) - this is a measurement of how much RF energy is absorbed by nearby human tissue in the normal use-case application of the radio device. Basically, if your device's antenna is closer than 20 cm to a human under normal usage, you care about this, but it's pretty hard to fail under normal circumstances.

There are also a whole host of network protocol tests, but these are largely covered by the assumption that your device is using a pre-approved cellular module. We'll mention any major exceptions by carrier.

Failures: There are literally dozens of ways to fail the above items and it's a major balancing effort to manage the tradeoffs of device requirements, device cost, development cost, time to market, mechanical details, antenna choices and environmental details to bring a product to market. Experience is key in ensuring product success.

U.S. Carrier Requirements

Each carrier has its own unique requirements that change, so it's important to talk to your carrier to get the updated details BEFORE you start your product development. These details can dramatically affect your business case.

All U.S. carriers require your device to be FCC approved. Most cellular modules have an FCC ID and grant that defines how the module can be used. If your product uses the cellular module the way the grant states, you can simply re-use the FCC ID of the module and no further FCC testing is needed. If the product doesn't comply with the existing FCC grant, your device will need FCC testing at the device level and you'll get your own

FCC ID. The FCC testing is the easy part. It's quite common to do FCC testing for cellular M2M devices, often because there are multiple transmitters in a device and/or the device is used close to human tissue.

T-Mobile primarily cares about PTCRB certification. It doesn't currently enforce TIS/TRP. PTCRB certification normally runs around $25,000 and you pay a third-party lab for that testing. PTCRB tests occur on all bands supported by the device regardless of what bands your carrier may use. T-Mobile uses slightly different bands than most North American GSM carriers so this can be confusing when you have to test on the 850MHz band even though T-Mobile doesn't use that band.

AT&T requires PTCRB certification, minimum performance for TIS/TRP and its own network certification. If you use an AT&T approved cellular module, the AT&T carrier certification is almost automatic. This is the exact same PTCRB testing done for T-Mobile or any of the GSM carriers. But if your device is 3G, there is some additional testing.

Verizon doesn't do TIS/TRP and they rely on your FCC compliance for RSE conformance. The main testing for Verizon is associated with how your device behaves on its network. Things like how often you try to associate on the network; do you disconnect form the network properly; does your device respond to network commands properly, etc. Many of these factors are built into the cell module's firmware but many others are not. This is just one example where reusing known-tested firmware from an experienced integrator can make a big difference (6 months and $100,000 type of difference) in your product development. Testing for Verizon can range from $15,000 to free depending on the deployment size and how

much Verizon believes in your product. Verizon will choose to subsidize testing based on the business case. This testing can be done by Verizon's own test lab or a number of third-party labs.

Sprint does its own TIS/TRP testing and has quite aggressive requirements for performance. They also do network protocol testing for network control of the device called OMA testing. Sprint testing is free the first pass through Sprint's own lab. Sprint also has partner third-party labs that charge for testing.

With all certification testing, you should expect to pay for pre-scans and other outside lab services regardless of what the carrier may or may not charge for testing. Waiting to use "free" test services often results in months of extra development time waiting in line for those resources. There are several very cost-effective third-party labs, many of which are certified test partners for various carriers. Using an outside lab and spending a few thousand bucks to keep your project moving as quickly as possible is money well spent. The longer projects drag on in calendar days, the more overhead those projects consume so it's easy to pay $3,200 for a pre-scan and easily make that money back in not having to pay overhead costs for project management, meetings, accounting, etc. over the several months of waiting to get into a "free" lab.

There are a wide array of factors affecting what testing your new cellular device will need. Some key decisions to make early are what your geographic market is and what carrier you want to use in that market or markets. These are key business decisions that interact with hardware choices, test requirements and fundamental business cases. Your most cost effective path will be to pull in an expert who deals with these issues all the time and let them help you get your product off to a solid head-start. There is no substitute for experience and frankly it's a lot cheaper than learning the hard way.

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