

EXPLAINED

Relevant for: Science & Technology | Topic: IT, Internet and Communications

An aircraft approaches to land at San Diego International Airport in San Diego, California on January 6, 2022.

The story so far: The [rollout of the 5G 'C-band' spectrum](#) (3.7 GHz-3.98 GHz) in the United States, on January 19, 2022 — after a pushback since December 2021 (the original rollout date) — led to several airlines, including Air India, temporarily [cancelling their flights to the U.S. over fears of spectrum interference](#) with crucial aircraft navigation systems. An aircraft type largely affected in this was the Boeing 777. The two major telecom firms concerned, Verizon and AT&T, also took cognisance of appeals by the Federal Aviation Administration (FAA) and airlines about their worries, leading U.S. President Joe Biden to put out a statement on January 18, 2022. Called the "[Statement by \[U.S.\] President \[Joe\] Biden on 5G Agreement](#)", he "wanted to thank Verizon and AT&T for agreeing to delay 5G deployment around key airports and to continue working with the Department of Transportation on safe 5G deployment at this limited set of locations." It added, "... My team has been engaging non-stop with the wireless carriers, airlines, and aviation equipment manufacturers to chart a path forward for 5G deployment and aviation to safely co-exist – and, at my direction, they will continue to do so until we close the remaining gap and reach a permanent, workable solution around these key airports." However, a spokesperson for one of the telecom firms concerned added: "We are frustrated by the FAA's inability to do what nearly 40 countries have done, which is to safely deploy 5G technology without disrupting aviation services, and we urge it to do so in a timely manner."

An aviation expert said that the main worry is of 'radio emissions' at the top of the C-band's 3.98 GHz frequency 'bleeding over' into the 4.2 GHz-4.4 GHz band used by civil aircraft radio altimeters.

Editorial | [Technology tangle: On 5G services and flight disruptions](#)

The FAA has said that there are differences in the way 5G technology has been deployed in other countries. These include lower power levels; frequencies that are 'of a different proximity to frequencies that are used by aviation equipment' and a different placement of antennas in the vicinity of airports. This includes antennas that point downwards to minimise the risk of interference with aircraft systems.

In Europe, 5G services are in the 3.4 GHz-3.8 GHz range. In Korea, they are in the 3.42 GHz-3.7 GHz range.

In U.S. airspace, which the FAA calls "the most complex in the world", the initial stages of 5G use will try and mirror the safeguards used in France. But even here, there are differences. In France, for example, the 5G power level (on average, 631 Watts) is still lower than what it would be in the U.S. (on average, 1,585 Watts). The planned buffer zones around airports in the U.S. will protect only the last 20 seconds of the flight. France has a permanent safeguard of protecting the last 96 seconds of a flight. It has a condition too that the antenna angle has to have a downward tilt to limit potential interference. In addition, antennas at an estimated 20 major airports have to be tilted away from flight paths. The height of a 5G antenna and the power of the signal are the factors that determine how close it can be allowed near an airport or a flight path.

U.S. airlines report only minor impact from 5G deployment

The buffer zones around an estimated 50 U.S. airports will be designed to try and keep 5G signals and aircraft separate.

In Japan, three frequency bands have been allocated for 5G: the 3.7 GHz band (3.6 GHz-4.1 GHz), 4.5 GHz band (4.5 GHz–4.6 GHz), and the 28 GHz band (27.0 GHz–29.5 GHz), according a special article published in 2020 in the *NTT Docomo Technical Journal*.

Another report in a leading technology news publication says that the Electronic Navigation Research Institute, National Institute of Maritime, Port and Aviation Technology, Japan had conducted a study on 5G interference with radio altimeters, and submitted its findings to the International Civil Aviation Organisation (ICAO) in March 2021. The detailed experiments and practical tests used altimeters manufactured by Rockwell Collins and Honeywell, which are the key suppliers to aircraft manufacturers, Airbus and Boeing.

One of the findings was that there would need to be “at least 60 MHz” of what was called a ‘guard band’ to avoid interference with radio altimeters. Its additional finding was the need to locate the high-power 5G base station 200 metres away from the approach path of an aircraft. The findings were made after ensuring that the antennas were pointed downwards.

The Cellular Operators Association of India, the Directorate General of Civil Aviation and the Airports Authority of India did not respond to a query by *The Hindu*. However, an aviation expert says 5G in India will largely be in the 3.3 GHz-3.67 GHz band.

It says that the delays to the 5G rollout have helped it in ‘processing 5G transmitter location and power level information’. Further, under what is called an Alternative Method of Compliance (AMOC) process, it has collaborated with airlines ‘on how they can demonstrate altimeters are safe and reliable in certain 5G C-band environments’. At certain airports, the FAA has determined that airlines can use GPS-guided approaches. Importantly, the FAA has said while the steps taken could reduce potential 5G interference, they do not eliminate them totally. Therefore, there will still be notices to flight crew that alert them about the presence of 5G. If an aircraft does not have an approved altimeter, the restrictions that have been highlighted in these notices to crew will kick in.

Between January 16 and January 20, 2022, the FAA issued approvals clearing 78% of the commercial fleet of airlines to perform low-visibility landings at airports where the 5G C-band is in use. These are aircraft models with one of the 13 cleared altimeters — a range of Boeing aircraft (including the Boeing 777 and Boeing 787), most Airbus planes (including the A320, A350 and A380) and some models of regional jets. Following this, a number of airlines have begun resuming flights within and to the U.S.

In an operations bulletin to flight crew, issued on January 19, 2022 — seen by *The Hindu* — and applicable to the Boeing 777 aircraft family, Boeing has highlighted ‘limitations that prohibit certain operations that require radio altimeter data when in the presence of 5G C-Band interference’, as identified via notices to air crew. A rider, however, was that the FAA approved aircraft flight manual would supersede the information given in the said bulletin in case of a conflict.

The Boeing bulletin has detailed the potential effects on radio altimeter indications and key aircraft control systems. Some of the alerts are about erroneous configuration warnings and indications not showing on the primary flight display. It adds that crew who experienced anomalies should notify air traffic control as soon as possible and make an entry in the technical log. Pilots have been asked to submit a detailed report on any adverse event on the reporting form available on the FAA website.

In a notification of January 14, 2022, the FAA will require operators of Boeing 787s to take additional precautions when landing on wet or snowy runways at airports in the vicinity of a 5G C-band facility. It says the interference with the aircraft's radio altimeter could prevent engine and braking systems from transitioning to landing mode, with a potential to affect the aircraft from stopping on the runway.

A senior commander who operates Boeing aircraft told *The Hindu* that on his 18-hour flight from a destination in South Asia to the U.S. on January 21, 2022, "the flight crew reported no changes" while in U.S. airspace and landing in a 5G environment.

In response to a query by *The Hindu*, an Airbus spokesperson said: "Regarding the 5G rollout, as part of a wider industry coalition, we continue to work with the FAA and other involved agencies to study the issue further and work toward solutions."

In response to a query by *The Hindu*, William Raillant-Clark, Communications Officer, Office of the Secretary General, International Civil Aviation Organization (ICAO) said: "The allocation of radio frequency bands is outside ICAO's mandate as the international standard setting body for aviation. ICAO is nonetheless working very closely with state regulators to better understand their positions. ICAO has received information from a number of States, including Australia, Brazil, France, Japan and the United Kingdom, that they are conducting on-going studies into the 5G and radio altimeter interference issue.

"I can confirm that ICAO is concerned by the apparent lack of a consistent standardized approach between States as they proceed with the rollout of 5G. Frequency ranges slated for 5G use vary from State to State and how close they come to the radio altimeter band — there is a very substantive difference in the prescribed maximum radiated power of the 5G base stations from one State to another. ICAO has shared these concerns with regulators and has asked them to prioritise the safety of the public when deciding how to enable cellular broadband/5G services in radio frequency bands near the bands used by radio altimeters," he said.

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The chips are Intel's first effort in many years in the market and will take on leader Nvidia, which had graphics chips sales of \$9.8 billion in its most recent fiscal year, a 29% increase.

The concept car uses less than 10 kWh of electrical energy to travel 100 km. When translated into fossil-fuel consumption, this is around 1 litre per 100 km.

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