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5G Challenges for Aviation

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Many airlines in the USA have warned that 5G could ground planes and wreak havoc at airports[1]. AT&T and Verizon were getting all set to roll out the 5G service on some airports. Many CEOs of major carriers have written to the Biden administration to review the introduction of 5G services as these could interfere with sensitive instruments, especially the approach aids. It is feared that this impact could actually be catastrophic. Such fears had been expressed earlier also by some experts. Yet, in this high-speed data-centric world the 5G will also bring many advantages. There is thus a need to understand the advantages and challenges of 5G to aviation.

What is 5G?

5G is the 5th generation global wireless mobile network standard, services of which began being launched in 2019[2]. It supports faster connectivity between individuals, machines, objects, and devices, for the Internet of Things (IoT). It delivers higher multi-Gbps peak data speeds, has ultra-low latency, and higher reliability. 5G services cover low (600–900 MHz), mid (2.3–4.7 GHz) and high-band frequencies up to 24-54 GHz and in the process expand spectrum usage. Modulating the digital signal across several different channels to reduce interference. The 4G wavelengths had a range of about 15 kilometres as such the cell towers could be at larger distances. In the case of 5G, a reliable signal, would be only till 1,000 feet[3]. The towers would perhaps have to be at even lesser distances. This would mean the need for a much larger number of cell towers. For using the three separate frequency bands, each will require a specific antenna.

Interestingly, 1G standard was set in the 1980s. The 3G brought mobile data in the 2000s. 4G in the 2010s introduced mobile broadband. 5G will support all types of industrial operations, it will greatly accelerate the global economy. For aviation per se, data rates up to 20 Gbps, it will support faster communication between sensors and other on-board systems, artificial intelligence (AI) applications for quicker and autonomous decision making, and greater authority to uninhabited systems, especially as required in autonomous drones and autonomous cars. It will support mission-critical communications. Because of the larger bandwidth, the networks may not just be for cell phones, but will also be used by internet service providers (ISP) services to laptops and desktop computer users. This would mean competition for cable ISPs. Over 1.7 billion subscribers are expected to ride on 5G networks globally by 2025. Meanwhile the Chinese are already testing 6G technology, which will be 10-20 times faster than 5G, in their labs.

Airfield Navigation Aids

All airfields have many radio navigation aids. Non-directional Radio Beacon (NDB) operates between 190 and 1750 kHz[4]. VHF Omni-directional Range (VOR) uses 108.0 to 117.95 MHz.

TACAN operates in Ultra High Frequency (UHF) band (300 MHz to 3 GHz). Distance Measuring Equipment (DME) from 960 MHz to 1215 MHz. Instrument Landing System (ILS) localizer in 108.10 to 111.95 MHz, and Glide Path 329.15 MHz, to 335.00 MHz. All GPS satellites broadcast on at least two carrier frequencies: L1, at 1575.42 MHz, and L2, at 1227.6 MHz (newer satellites also broadcast on L5 at 1176 MHz)[5]. The aircraft radio altimeters operate in the 4200-4400 MHz band. The C-Band[6] covers 4.0 to 8.0 GHz, and is used for many satellite communications transmissions, some Wi-Fi devices, and some surveillance and weather radar systems. C-Band is also used for satellite TV since many years. Some 5G providers, including Verizon and AT&T of USA are going to use C-Band.

5G Aviation Safety Concerns

It can be seen that certain navigation aids could have interference in the wide spectrum coverage of 5G. The FAA has warned that potential interference could affect sensitive instruments such as altimeters and affect low-visibility operations[7]. The level of interference in the proposed 5G operations would depend on exact frequencies, power levels, and tower proximity to flight operations, among others. Experts feel that the interference will be much more on a certain type of radio altimeter antennae. This could have flight safety implications. The choice now would be between grounding the aircraft with certain radio altimeter antennae, or to move the towers away, or reducing their power output near the airport. The 5G roll-out is important and cannot be stopped. The issue is who between the two, airlines and the 5G operators will have to make major amends. Till the aircraft bare upgraded, the low visibility approaches will not be allowed. Such airports and heliports are being identified where C-band 5G is being activated. Major radio altimeter producers like Honeywell Industries, have been asked to study and comment. If concerns are genuine, it could mean spending huge sums and man-hours to redesign, procure and install new radar altimeters across the military and civil fleets.

Interference with GPS signals could be serious at low-levels or terminal approaches. For military, night, or bad weather missions at low-level or even helicopter missions at low level could be affected. Imagine an autonomous UAV landing on a ship deck or even on a runway. Knowing whether your system is suffering from interference will be important, else it could catastrophic. The military airborne platforms will have to replace their radar altimeters. Changing an altimeter on a stealth-coated aircraft would be a costly exercise. Terrain Avoidance and Warning Systems (TAWS) also use GPS. Unmanned future urban air mobility would also have to factor in safety related to 5G. The radio altimeter transition could take many years. The 5G spectrum is quite near that of passive remote sensing satellites used for weather and earth observation[8]. Especially those that monitor water vapour. Interference could impact numerical weather prediction. Some are

predicting up to a 30 per cent reduction in the weather forecast reliability. Perhaps a larger frequency buffer zone may prevent this. The issue is under discussion between various agencies.

Satellite Operations

U.S. National Aeronautics and Space Administration (NASA) and Federal Aviation Administration (FAA) are working closely to look at satellite communications and data clashing with 5G in C-Band. The satellite operators use 3.7-3.98 GHz. When they release this spectrum band for 5G, they will get compensated for the proceeds. They will then be able to move to another zone. The same compensation will not be available to airlines.

Impact is Global

The Boeing 787 and Boeing 737-800 are known to be affected, among many others, and there are thousands of these two types themselves flying worldwide. Both Boeing and Airbus are concerned about the negative impact on the aviation industry because of the need to modify aircraft and the grounding time business loss. The modifications themselves could be long drawn as they will require analysing and testing. 5G has already been rolled out in some countries without similar checks or concerns. These include major airline operators like the UK, France, Japan, Australia, and China. Some of them may not yet be using the C-Band extensively. All these countries would have to take a fresh look at safety issues. Meanwhile any disruption in aviation operations, which are already at a low due to the coronavirus, would have serious economic implications for all airlines and countries. It will not only disrupt passenger travel, but also the logistic operations, which include corona related medical supplies.

Measures to Reduce Interference

Clearly lower power levels near airports, shifting antenna position downwards and away from flight path, and selecting frequencies that do not clash with aircraft equipment are some of the ways. Till then, landing weather minima would have to be raised. This will affect a large number of flights affected by winter fog or round the year rain. Aviation is expanding, and 5G has to come in, so compromise solutions have to be found for the time being. Later long-term solutions like redesigning the radio altimeters or moving 5G out of this narrow frequency band would have to be decided. Till then, the only way is to create some low power buffer zones around the airports. Airlines are seeking around 2 miles (3.2km) from the airport runways.

5G Applications at Airports

There are many airports activities that will be supported by 5G. These include virtual engine inspections and diagnostic checks that engineers of a maintenance agency will be able to do at

customer locations. Even technicians training will be possible using 5G network streamed high-definition video. 5G networks will allow tethered mobility for luggage. 5G will support faster check-in and boarding processes. 5G will ease the task of air traffic and radar control. It will also support the ground movement of aircraft and vehicles. “Leveraging 5G for speed and data density will enable better monitoring and analysis of assets in and around the airport,” says SITA vice president of communication and data exchange Gilles Bloch-Morhange[9].

5G Hardware Security Issues

China is one of the major manufacturer of 5G hardware, both for networks and handsets. The world has been concerned about Chinese companies like Huawei and ZTE for embedding snooping espionage devices in the hardware. ZTE has Chinese government participation, and Huawei was founded by a former Deputy Regimental Head in the People's Liberation Army. China claims to have 70% of global 5G stations[10]. There are other 5G equipment manufacturers like Samsung, Nokia, LG, Qualcomm, AT&T, Cisco and Ericsson, among others, albeit their equipment is expensive. Clearly, the equipment that move the largest data traffic would be open to larger snooping or attack. Higher speed and much larger connected systems make security more complex. Though the Chinese have denied it, many countries have banned Chinese hardware.

5G Health Concerns

Since the 5G towers are required to be much closer, the numbers will have to be large. That would mean higher continuous exposure to radio-frequency (RF) radiation to a much larger population all the time. This combined with transmissions coming down from many more satellites could pose radiation hazards. Yet the scientific consensus is that 5G technology is as safe as the 4G, and fears of cancer, infertility, autism, tumours and Alzheimer’s disease have no scientific medical backing.

5G in India

South Korea, China, and the United States are the leading countries in the 5G roll-out. As of October 2021, Commercial 5G was available in 1.336 cities in 61 countries across the world[11]. According to the Ookla 5G Map, there were 5G deployments in 112 countries as of November 30, 2021[12]. India had taken a wait and watch approach till 5G issues settled down. It had followed a similarly laid-back approach in 3 and 4G. 5G is expected to roll out in India by the end of 2022[13]. DoT has announced the list of 13 cities that would get 5G services this year. The 5G spectrum is likely to be auctioned by mid-2022. India will also have to wait and watch about the security and aviation safety concerns.

NOTES

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