



5G Radio Altimeter Interference

Online Workshop for the NAM/CAR/SAM Regions on Aviation Risk Mitigation Measures Due to the Implementation of 5G Frequencies

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Agenda

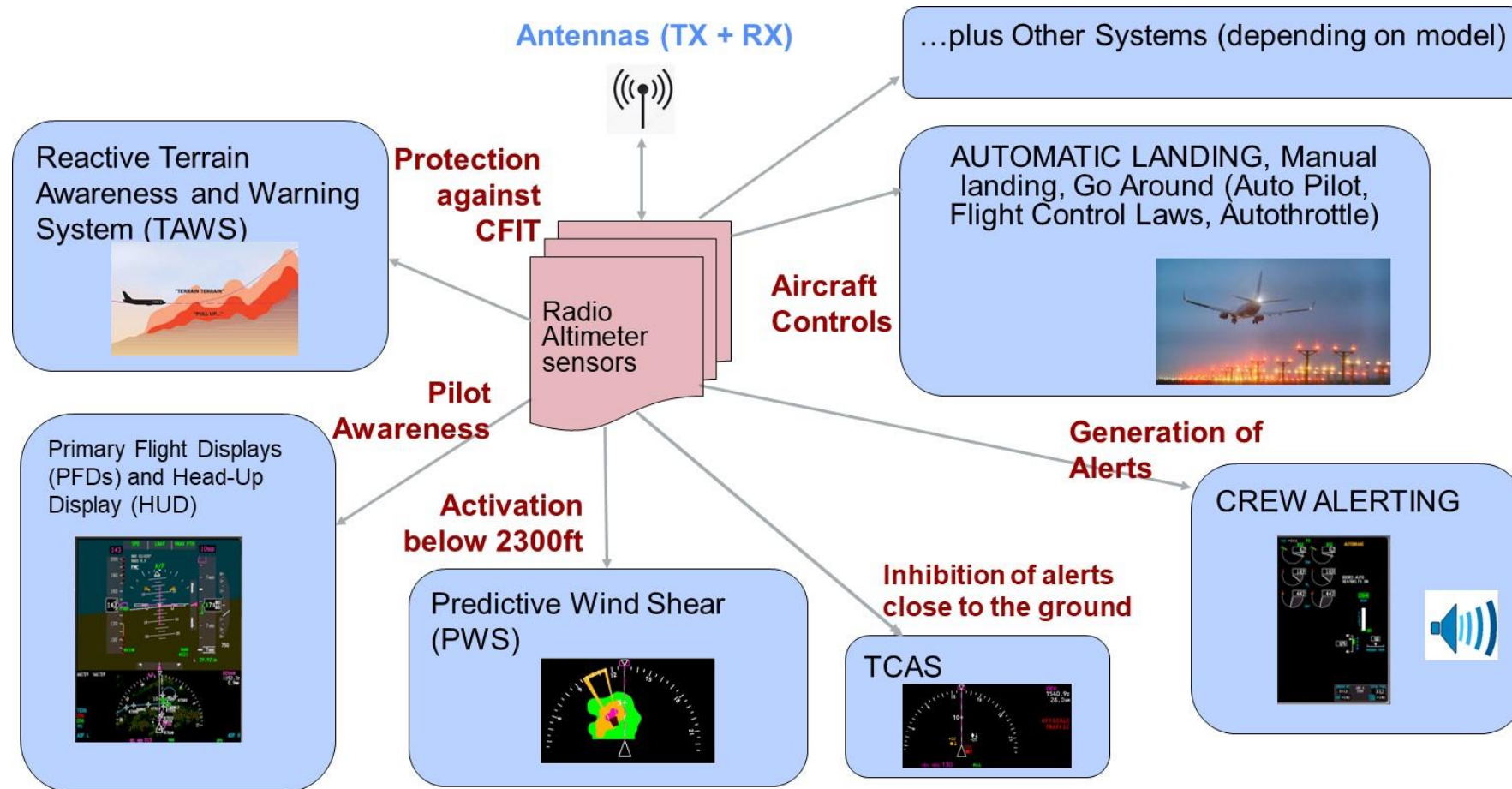
- Problem and Impacts
- 5G Spectrum
- Representative 5G Implementations
- Aerospace Industry Efforts
- Roadmap to Safety
- Variables Affecting Interference Potential
- Q & A

The Problem and Impacts

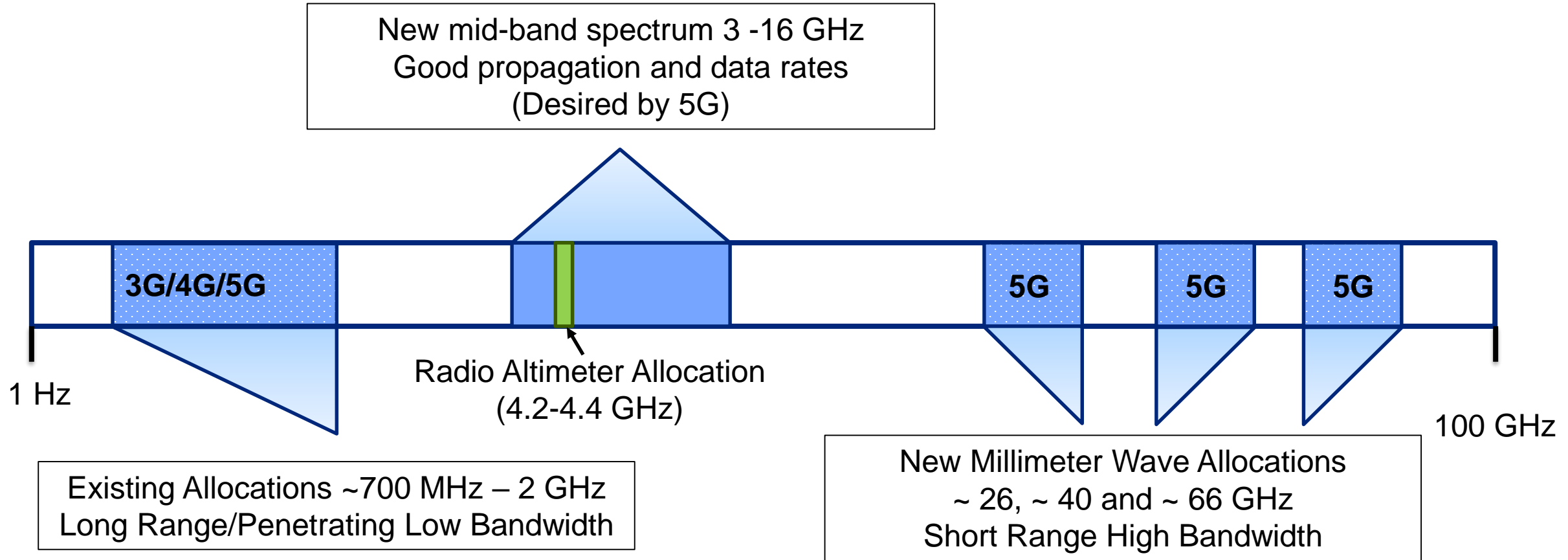
- Governments around the world are implementing 5G cellular systems in frequency ranges adjacent to or near the radio frequency band used by radio altimeters.
- The aviation industry and aviation regulators are concerned these 5G deployments will cause interference to radio altimeters operating in the radio frequency band 4.2 - 4.4 GHz.
- Concerns are based on a study done by industry and the U.S. Federal Aviation Administration (FAA) via the RTCA organization.
 - The study concluded 5G transmissions can interfere with radio altimeters
 - Study was limited to regulations issued by the U.S. Federal Communications Commission (FCC) permitting 5G to operate in the radio frequency band 3.7 – 3.98 GHz and was limited to review of only 9 radio altimeters
- As a result of the study, alerts for 5G interference were issued by the Civil Aviation Authorities (CAAs) of France, Canada, Australia, New Zealand, Czech Republic, Saudi Arabia, Oman and United Arab Emirates.

The Problem and Impacts

- Boeing supports having more 5G available for consumers. However, 5G should not risk public and aviation safety.
- Potential impacts to airplane systems:



5G Spectrum



* Not to scale

5G systems only impact public safety near the radio frequency band used by the radio altimeter

Representative 5G Implementations

Countries set their own regulatory constraints on 5G

Country	Frequency Range	Power Limit (dBm/MHz)
United States	3700-3980 MHz	65.15 Rural/62.15 Non-Rural Areas
UK	3400-3800 MHz	58
Japan	3400-4100 MHz, 4600-4700 MHz	56 (avg per sector)
Brazil	3300-3700 MHz	55
Ireland	3410-3800 MHz	61
Denmark, Finland, Sweden	3400-3800 MHz	61
Czech Republic	3400-3800 MHz	61
Canada	3450-3650 MHz	61
Romania	3490-3800 MHz	55
Saudi Arabia	3400-3800 MHz	58
Europe	3400-3800 MHz	61 - Recommended

Country	Frequency Range	Licensed Power Limit (dBm/MHz)
France	3400-3800 MHz	Between 55.44 and 60.34
New Zealand	3410-3580 MHz	Between 52.2 and 65.2

Aerospace Industry and Aviation Regulator Efforts

- Developing modifications to existing altimeters to be more robust against interference.
 - RTCA/EUROCAE updating Minimum Operational Performance Standards (MOPS) via SC-239/WG-119 to ensure sufficient immunity to foreseeable interference.
 - New MOPS must be validated
 - FAA will issue a Technical Standard Order (TSO) with equipment requirements
 - Radio altimeter manufacturers build to that TSO, then test and secure approval from FAA
 - Aircraft manufacturers or radio altimeter manufacturer must obtain a modified Type Certificate (aircraft maker) or Supplemental Type Certificates (radio altimeter maker) from the FAA to install new radio altimeters on each aircraft model
 - Availability of new radio altimeters for installation will likely be constrained by production
 - US FAA continues to issue Airworthiness Directives while working to upgrade all altimeters
 - European Aviation Safety Agency (EASA) issued a Continuation Airworthiness Review Item to investigate the vulnerability of Radio Altimeters to 5G signals, and is engaging with European spectrum regulators.
 - European Conference of Postal and Telecommunications Administrations (CEPT) is studying compatibility between 5G and Radio Altimeters

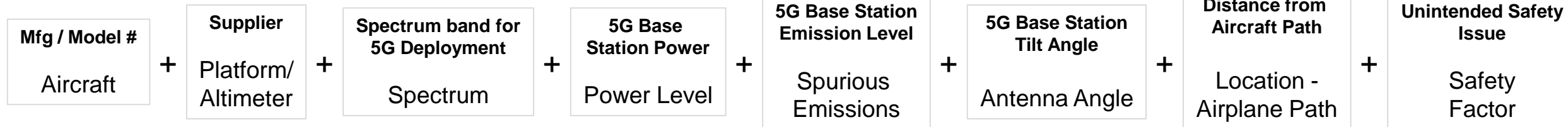
Boeing is participating actively in all these initiatives

Roadmap to Safety

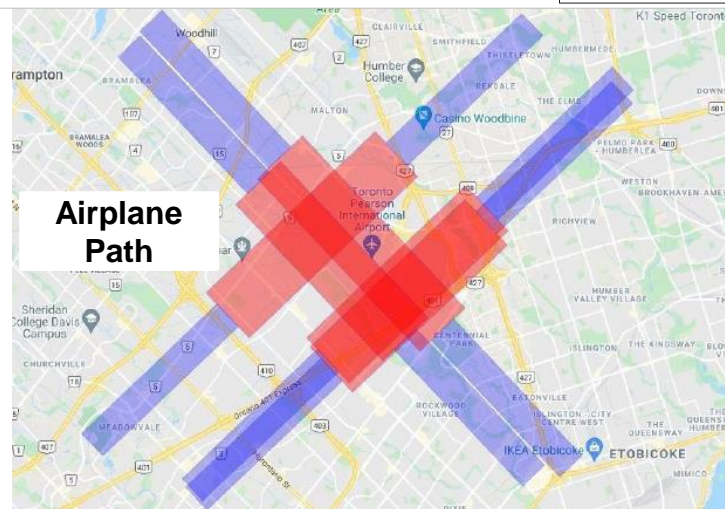
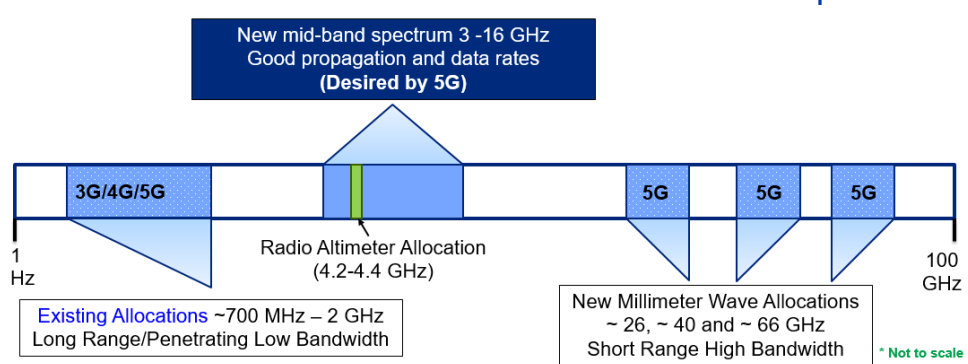
- Efforts are vigorous.
 - Working to finalize radio altimeter standards
 - Test and certify altimeters and aircraft (every make and model must be certified)
 - Install via retrofit and new installations in every aircraft and helicopter requiring an altimeter
- Until changes can be made:
 - Mitigations to 5G deployment, power levels and antenna tilt limitations need to be recognized and adopted
 - Important to build a working relationship between Aviation and Telecom regulators

Variables Affecting Interference Potential

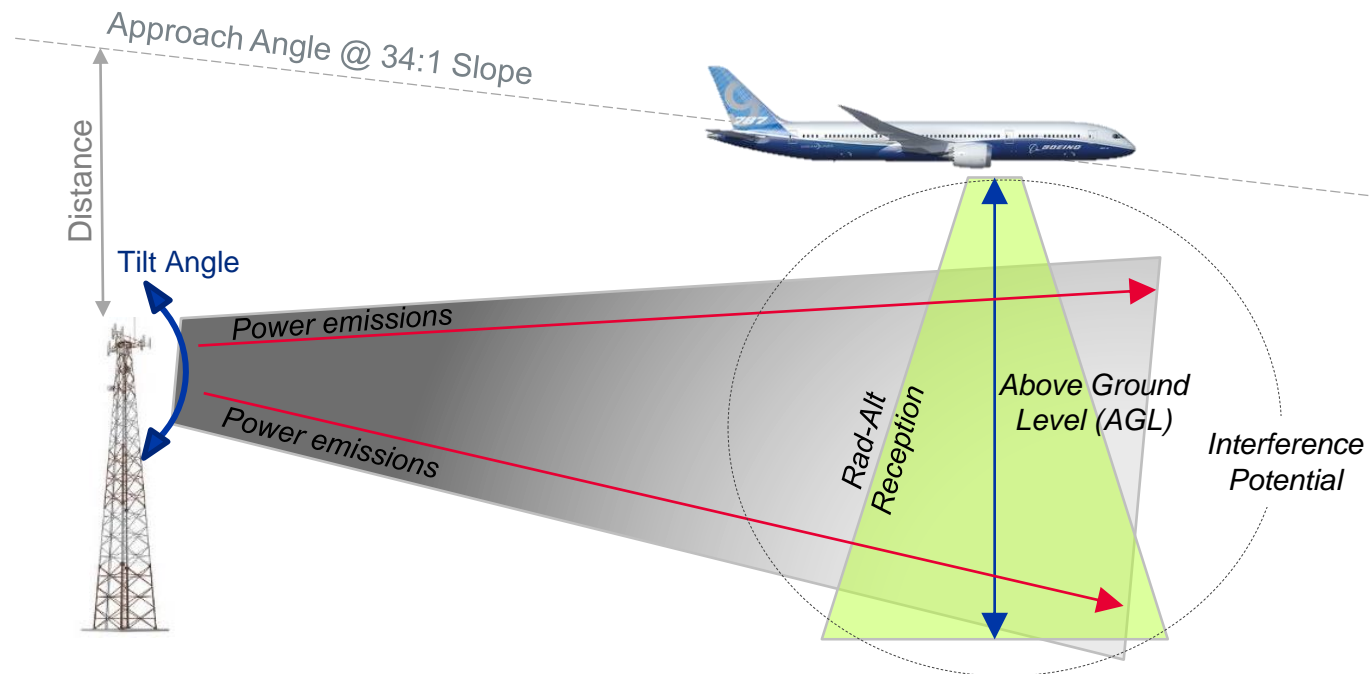
Elements:



5G Spectrum



Example:
Blue: reduced power base stations
Red: no 5G stations permitted



5G Interference into Radio Altimeters is a Global Problem

- Interference to Radio Altimeters is a public safety issue!
- Interference can cause numerous aircraft safety hazards
- Restricting deployment and providing mitigations along flight paths and airports will help significantly
- National Aviation and Telecom regulators need to work together
- Your support is critical to maintaining public safety

■ Q & A

Boeing can Support and Collaborate on Efforts

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