

# Electromagnetic Compatibility Concerns for Aircraft Wi-Fi Installations



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# Wi-Fi EMC Concerns

- **Installation of aircraft Wi-Fi networks facilitates use of passenger and crew Wi-Fi enabled computers and other portable devices**
- **These portable Wi-Fi devices contain intentional RF transmitters that may be located throughout the aircraft**
- **Immunity of aircraft systems to Wi-Fi transmitter RF varies across aircraft, systems, and installations**



# Wireless Networks on Aircraft

- **Most installations for passenger-enabled wireless RF networks use IEEE 802.11a, b, or g protocols**
- **Protocols use digital spread spectrum techniques**
- **Wi-Fi is an implementation of the IEEE 802.11a, b, or g protocols and is a trademark of the Wi-Fi Alliance**
- **The Wi-Fi Alliance provides a designation of worldwide interoperability and quality**



# IEEE 802.11a, b, and g Networks

- **In the US, these networks operate in the 2400 to 2483.5 MHz and 5150 to 5825 MHz bands (FCC 47 CFR 15.247 and 15.407)**
- **Authorized to transmit up to one watt with up to 6 dBi antenna gain (4 watts effective isotropic radiated power) in the US**
- **Other nations have different frequency band limits and output power limits**



# RF Field Strength from Wi-Fi Transmitters

- The RF field strength that Wi-Fi transmitters create at aircraft systems depend on the:
- **Power** of the Wi-Fi transmitter
- **Proximity** of the Wi-Fi transmitter to the aircraft systems

# Wi-Fi Field Strengths

- **100 mW Wi-Fi transmitter with 6 dBi antenna creates on the order of 10 volts per meter at a distance of 30 cm (12 inches)**
- **1 watt Wi-Fi transmitter with same antenna would create on the order of 30 v/m at 30 cm**

# Aircraft System Immunity to Wi-Fi Transmitters

- **Aircraft electrical and electronic systems have a wide range of immunity to Wi-Fi radiated fields**
- **The immunity depends on the HIRF requirements for the aircraft**
- **These requirements vary based on the criticality of the system, and the vintage of the aircraft**



# Aircraft System Immunity to Wi-Fi Transmitters

- **Systems determined to have potentially catastrophic failure conditions tend to have high verified RF immunity based on HIRF requirements**
  - On the order of 50 to 100 v/m average
- **Less critical systems have lower or no verified RF immunity**
  - On the order of 0.5 to 20 v/m average





# Issue Paper Requirements

- **Wireless RF network installation issue paper requires demonstration of aircraft system immunity to portable Wi-Fi transmitters**
- **Assumes transmitters operate at FCC authorized power (1 watt plus 6 dBi gain)**
- **This provides margin for typical Wi-Fi portable devices (50 to 100 mW transmitter power)**



# Wi-Fi EMC Test Experience

- **One case of blanking on primary flight displays**
- **Most other EMC tests have shown no effects**
  - Airline EMC tests for mobile phones showed effects on certain smoke detectors and cabin PA systems
  - Certain automatic external defibrillators (AED) showed interference with audio callouts

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