

EMF Compliance Challenges in 26 GHz Wi-Fi Deployment

Understanding Power, Safety, and Spectrum Efficiency

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The Context

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- 26 GHz = millimeter-wave band ($\lambda \approx 1.15$ cm)
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- Enables ultra-high data rates and small-cell coverage
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- Used for 5G FR2 networks; proposed for Wi-Fi (WoMT)
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- 5G uses beam scheduling and duty-cycle control
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- Wi-Fi lacks these mechanisms → continuous radiation
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- TEC public EMF limit: 5 W/m² (6-minute average)

What is EIRP – Effective Isotropic
Radiated Power

EMF Basics and Formula

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- Power density (S) = $\text{EIRP} / (4 \pi R^2)$
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- Safe distance (R_{safe}) = $\sqrt{(\text{EIRP} / (4 \pi \times 5))}$
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- For safety: $S \leq 5 \text{ W/m}^2$
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- 5G NR controls EMF by:
 - - Narrow beam steering
 - - Millisecond-level beam scheduling
 - - Dynamic power adaptation
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- Wi-Fi = single beam, always ON → higher time-averaged EMF

EIRP Sensitivity – EMF vs Range

100 MHz BW Size

EIRP (dBm)	EIRP (W)	Safe Distance R_{safe} (m)	Range vs 75 dBm
75	31,622	22.4	1.0×
65	3,162	7.1	0.32×
55	316	2.2	0.10×
45	31.6	0.7	0.03×
33	2.0	0.18	0.008×

Observations:

- At 75 dBm, safe clearance ≈ 22 m $\rightarrow$ impractical indoors
- Every -20 dB $\rightarrow$ 10× reduction in range
- At 33 dBm, coverage $\approx 1\%$ of macro range
- Either unsafe or inefficient $\rightarrow$ no middle ground

Note – if the BW is increased to 1000 MHz then safe distance for 75 mtr = 71 meters

Visual Trade-offs



- ⚠️ High EIRP (>65 dBm): Violates TEC 5 W/m² limit



- ✅ Low EIRP (<40 dBm): Safe, but range collapses 100×



- 5G solves it with time-averaged beams (scheduler + duty cycle)



- Wi-Fi lacks power shaping → continuous exposure



- Without control, 26 GHz Wi-Fi = either unsafe or wasteful

Tower Co-location Tightens EMF Rules

- Tower sites host 700/900 MHz macro antennas
- Composite EMF compliance uses worst-case band
- Low frequencies penetrate deeper → tighter exposure limit
- Multi-band towers often evaluated at $1\text{-}2 \text{ W/m}^2$ ($700,900 \text{ div } 400$)
- Adding 26 GHz Wi-Fi increases total EMF load
- Hence, tower-mounting tightens, not relaxes, EMF compliance

OR use high (36 meters) independent towers which raises costs

Key Takeaways

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- 26 GHz Wi-Fi lacks beam scheduling → continuous radiation
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- High EIRP breaches TEC 5 W/m² limit
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- Reducing EIRP kills range (10× loss per -20 dB)
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- 5G manages EMF via beam duty-cycle & adaptive power
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- Tower co-location makes compliance tougher
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- Conclusion: 26 GHz use is viable only with 3GPP-style beam management