High Gain Wideband Planar Aperture Antenna Array for 5G Millimeter-Wave Applications

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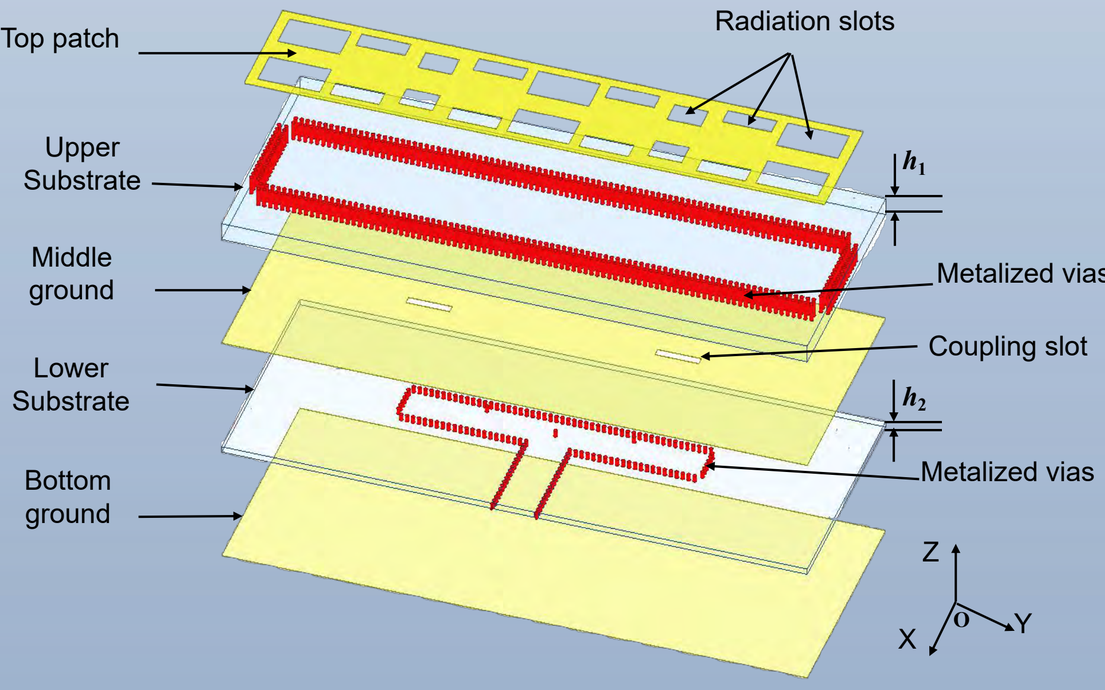
Introduction

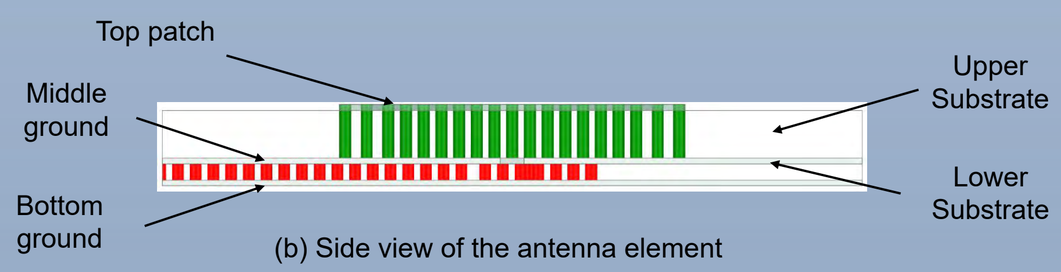
- Type of high gain antenna
  - **High gain antennas：** patch array antenna, grid array antenna , etc. But narrow bandwidth and low efficiency.
  - **Conventional aperture antennas:**horns and lens antennas, etc. . But high profiles.
  - **Planar Aperture Antenna Array (PAAA)**: Higher gain, low profile and easy to package and integrate.
- A novel high gain PAAA for 5G millimeter-wave point-to-point communication applications is proposed. The element covers from 26.2 to 29.5 GHz (12.2%) with a peak gain of 19 dBi. And a 4×2-element PAAA also covers from 25.9 to 29.6 GHz (13.3%) with a peak gain of 26.7 dBi.

I. Planar Aperture Antenna Element

A. Structure of the proposed antenna element



(a) 3D exploded view of the antenna element



(b) Side view of the antenna element

Fig. 1. Geometry of the planar aperture antenna element.

B. Design principle

- **The Radiation Structure** (Upper Substrate)**:**
  - An opening cavity (metal strips + metalized vias): helping achieve high gain
  - Multiple cross-shaped patches: shielding the reverse field for every half wavelength
- **The Feed Structure** (Lower Substrate):
  - Fed by a coupling slot on a SIW

C. The simulated performances of the antenna element

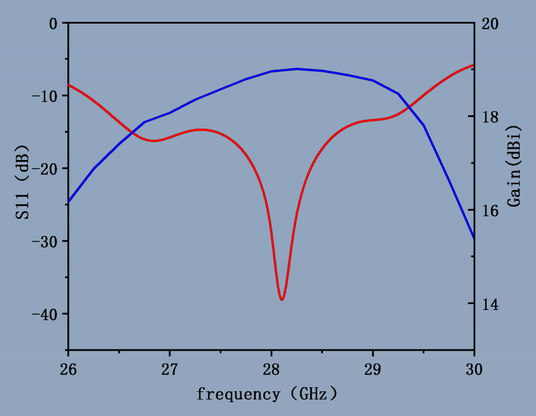
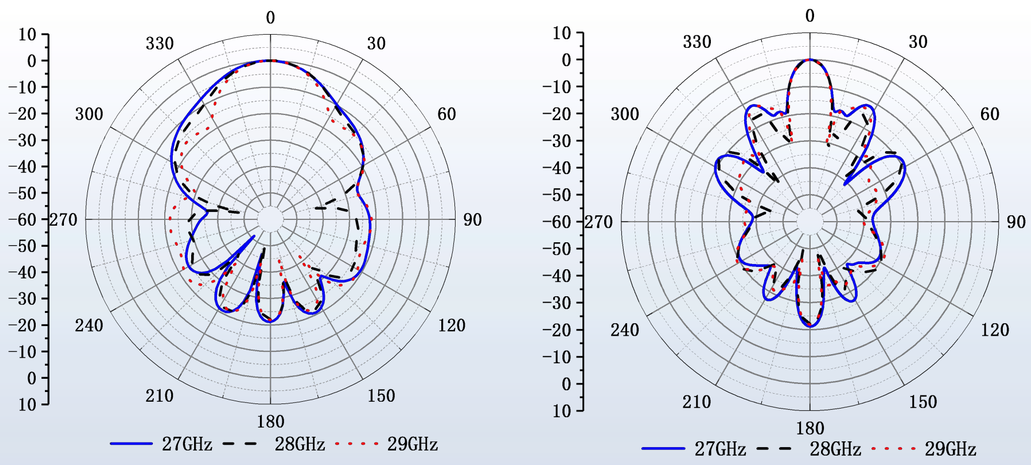


Fig. 2. Reflection coefficient (|S11|) and gain of antenna element.

- The operation bandwidth ($|S_{11}|$ < -10dB) is 12.2% from 26.2 to 29.6 GHz with a peak gain of 19dBi.



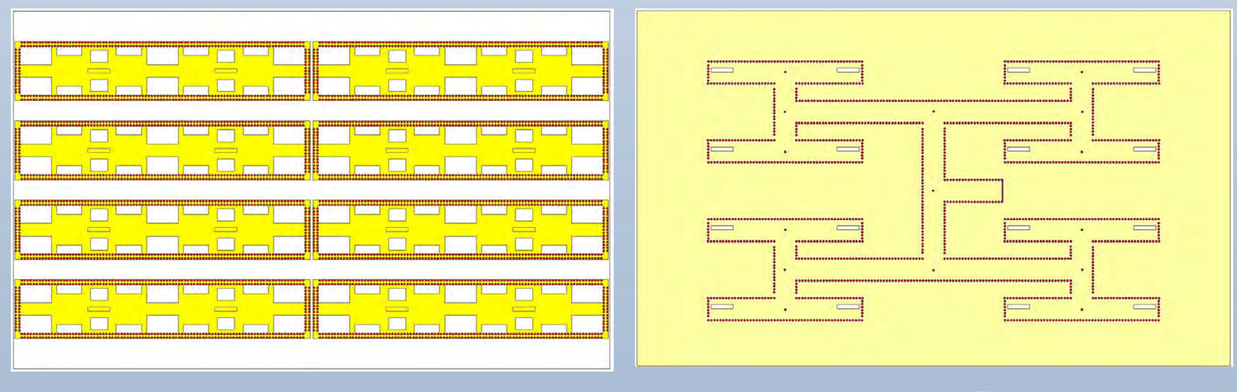
(a) E-plane (b) H-plane

Fig. 3. E-plane and H-plane radiation pattern of antenna element.

- The radiation patterns in E- and H-plane are stable over the operation band.

II. 4×2-elelment PAAA

A. Structure of the proposed antenna array



(a) Upper substrate (Top view) (b) Lower substrate (Top view)

Fig. 4. Geometry of the planar aperture antenna array.

B. The simulated performances of PAAA

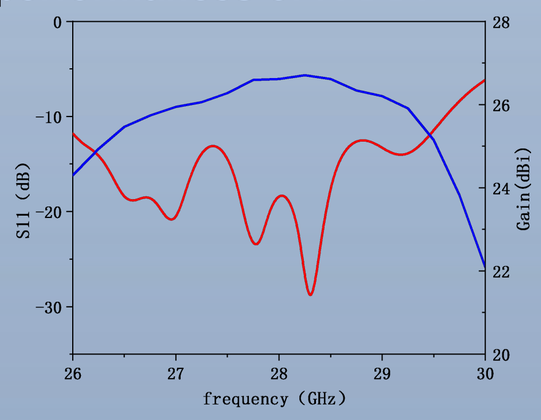
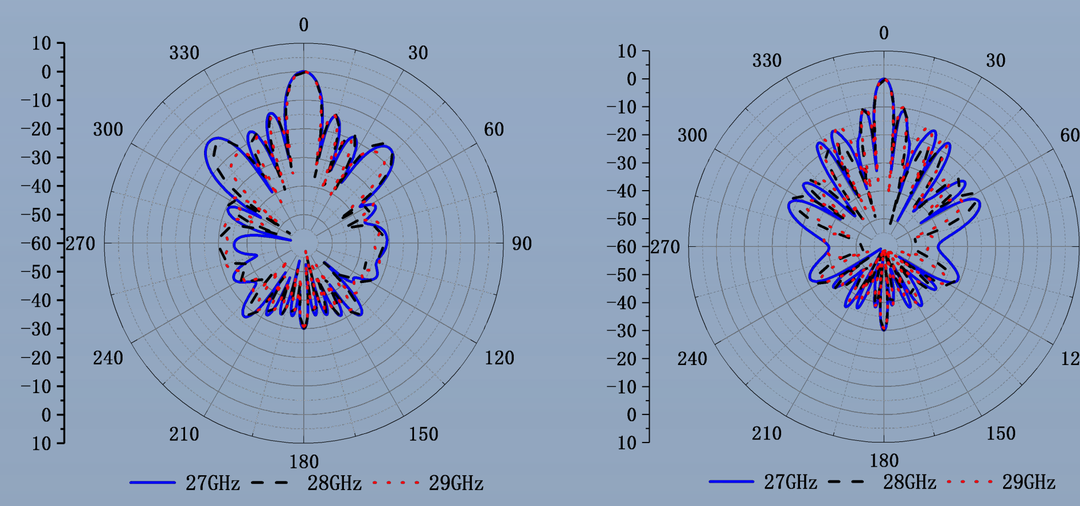


Fig. 5. Reflection coefficient (|S11|) and gain of antenna array.

- The operation bandwidth ($|S_{11}|$ < -10dB) is 13.3% from from 25.9 to 29.6 GHz with a peak gain of 26.7dBi.



(a) E-plane (b) H-plane

Fig. 6. E-plane and H-plane radiation pattern of antenna array.

- The radiation patterns in E- and H-plane are stable over the operation band.

III. Conclusion

- This paper presents a novel millimeter-wave planar aperture antenna array featuring high gain, low profile, and high aperture efficiency.
- This antenna array is a good candidate for 5G millimeter-wave point-to-point communication applications.