Effects due to Antenna Mount in Base Station Antenna Measurements

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Abstract- **Cellular Base Stations require efficient performance validation methods. One performance criterion is the radiation pattern. Our measurements show a radiation pattern change caused by the antenna mount structure, though industry guidance [1] does not yet control or mention this aspect of the test configuration. Consequently, the current guidance leads toward lack of repeatability. We recommend industry guidance be amended to include post-BSA distance as a test configuration parameter.**

Measured Data is presented showing radiation pattern dependencies upon the mount in a CATR implementation. Explanations as to the Root Cause are stated.

Key words: Point Souce Compact Antenna Test Range, Base Station Antenna..

I. INTRODUCTION

Test configurations should include all conditions that affect the radiation patterns. Current industry guidance [1] omits the post-to-antenna distance, Figure 1. We study test conditions with a Base Station Antenna (BSA) mounted near (a) and far (b) from a post.

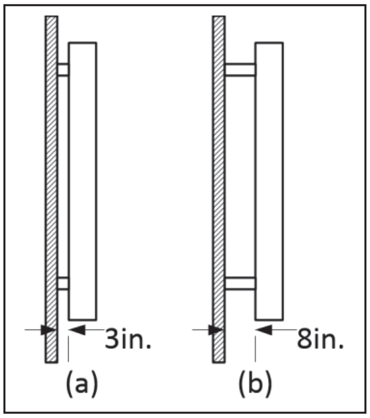

Figure 1. Test Configurations

The test configurations yield noticeably different radiation patterns, for example, Figure 2. .

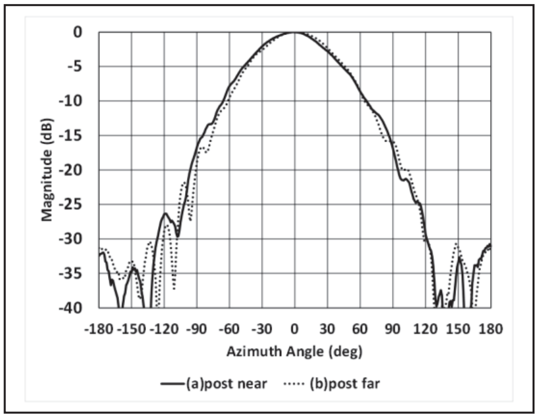

Figure 2. 2.4 GHz Radiation pattern under differing test conditions

Note in Figure 2. , 10 dB ripple in the (b) trace at azimuth angle -91 degrees. This indicates an extraneous signal only about 6 dB below the direct-path signal (found by consulting Figure 3. [2][3]).

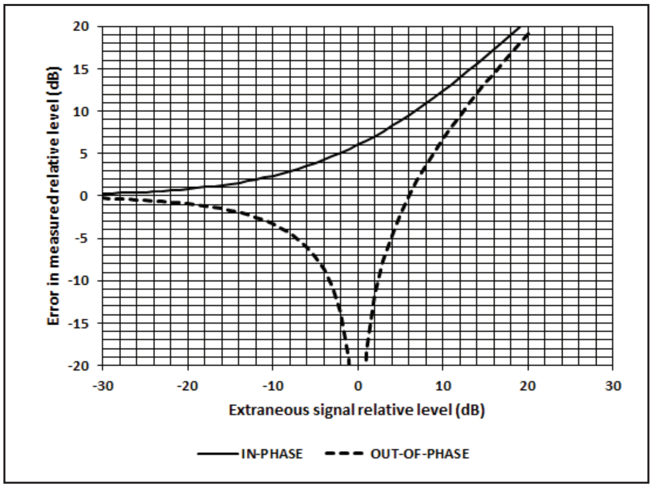

Figure 3. Possible error in measured relative pattern level due to extraneous signals[2]

An investigation began into this problem, which, in the end, led to the conclusion of a post-to-antenna distance dependency, and the need for industry guidance to be amended to include post-BSA distance as a test configuration parameter.

II. Investigation

Following established methods [4], we seek the origin of extraneous signal(s) that could cause the observed 10 dB ripple in Figure 2. (b). The established method calls for an assessment of the *incident field* (from narrow angles in relation to the range axis), and assessment of the *wide angle field.* Then, *Frequency domain reflectometry* corroborates the conclusion that post and mount interaction are the root cause. Finally, the "3inch test configuration" of Figure 1. (a) confirms the root cause and concludes the investigation.

A. *Assesment of the incident field*

A field probe mechanism Figure 4. yields measurements Figure 5.

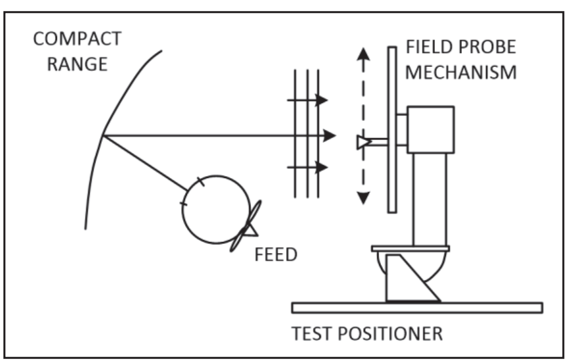

Figure 4. Field Probe Configuration

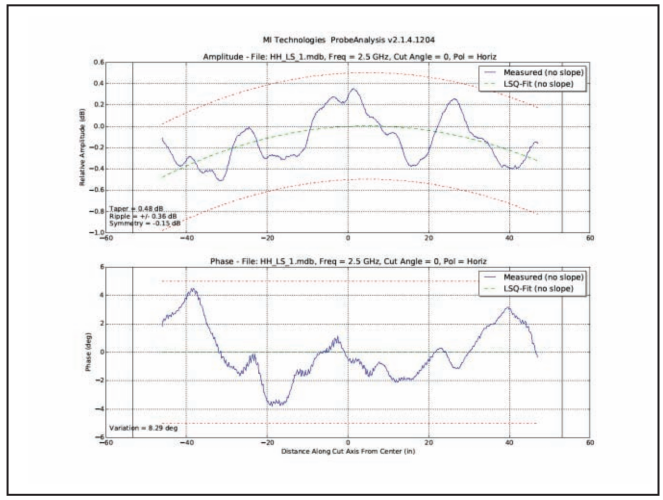

Figure 5. Horizontal field probe cut made at horizontal polarization

We study Figure 5. to determine the level of suppression of extraneous energy coming from directions generally in front of the test zone. Amplitude peak-to-peak ripple of 0.72dB indicates an extraneous signal level relative to the direct-path of -27dB [2]. This level is much lower than the --6dB level we are investigating, and consequently rules out the incident field as a root cause of the problem. Next we consider the wide-angle field

B. *Assesment of wide-angle field*

Assessment of the wide angle field is through either the Pattern Comparison or Longitudinal field probe technique.

1) *Pattern Comparison*

Pattern comparisons carried out at different longitudinal positions via the floor slide showed no change in the ripple behavior. Therefore the origin of extraneous signal(s) is not from the chamber walls or reflector, rather they must originate somewhere above the floor slide.

Various experimental absorber treatments above the floor slide but below the post-antenna mount showed no change in the ripple behavior. .

2) *Longitudinal field probe pattern*

A measurement of relative power versus longitudinal distance, via a floor slide, showed no significant ripple behavior.

Therefore, since neither pattern comparison nor longitudinal field probe patterns indicated the presence of wide-angle extraneous signal(s) outside the BSA-pole region, suspicion shifts to within that physical region.

C. *Frequency-Domain Reflectometry*

We collected radiation pattern data across a 1GHz bandwidth with a 5MHZ step size (201 frequency points). Time information then generated via a discrete Fourier transform, and then experimentation with time gating allowed separation of reflections. This effort supported the existing evidence that the offending extraneous signal(s) were in the region near the BSA and pole mount. The time resolution was not fine enough with 1GHz bandwidth to separate reflections suspected in our case to be about 8inches or less from the BSA.

It was deemed prudent to change the test configuration from a ~8inch BSA-post distance to something smaller.

D. Three-inch separation configuration

At frequency 2.4GHz studied here, the wavelength of measurement is 5 inches. Decreasing the BSA-post distance from 8 to approximately three inches (from 1.6 λ to 0.6 λ) reduced the period of the ripple to less than one (Figure 1. (a) and Figure 2. a).

. We note the interaction between BSA and post is not eliminated, rather, it remains between two structures BSA and post that are now close enough to each other to not "beat".

In order to prevent "beating," we recommend the BSA-post distance not exceed one wavelength Figure 6.

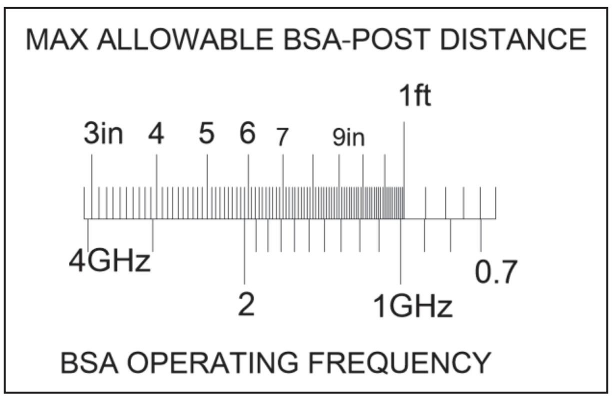

Figure 6. "Not-to-exceed" BSA-post distance

III. CONCLUSION

Measurement shows the mount apparatus of a base station antenna has a noticeable effect on the observed radiation pattern. Industry guidance [1] should be amended to include an additional test configuration parameter we call "BSA-to-pole" mount. This parameter should minimally include, as part of the measurement, a record of the geometry of the BSA-pole mount, as well as the pole material. Further, industry participants may decide to expand guidance in scope to specify and constrain the BSA-to-pole mount to some agreed geometry and material.

Current industry guidance, without a record of the test condition, renders the test not repeatable.

IV. REFERENCES

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