Mobile TV reception

Maximizing mobile reception requires that broadcast antennas have the proper amount of vertical polarization.

BY BILL AMMONS

The introduction of ATSC-M/H mobile TV is going to be an exciting new chapter for many broadcasters. The old model of only serving viewers in a fixed location is being tested as many viewers will be on the move, either on foot or using some form of transportation.

With ATSC-M/H in action, your viewers are on the move in dynamic reception environments. The antenna in most cases is not in a horizontal position to take advantage of the polarization that many stations transmit in.

The main reason for the desirability of circularly or elliptically-polarized transmit antennas is because with a linearly polarized transmit antenna, as the television signals propagate from the transmitting to the receiving site, the polarization can be rotated due to the influence of external magnetic fields from sources such as the earth itself or large metallic structures like buildings that may have a magnetic moment.

This is referred to as Faraday Rotation. If the signals arrive cross-polarized from the transmitting to the receive antenna, the attenuation can be severe enough to cause the loss of signal to your mobile viewers. Adding a vertical component to your signal can greatly enhance reception of the station.

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Slot antennas

The slot antenna is a TEM-Mode coaxial structure. Coupling structures inside the pylon will distort and couple to the fields in this coaxial antenna, causing a voltage to be applied directly across each of the slots in the antenna. This voltage alternates from plus to minus and back again at the channel frequency of operation.

The length of the slots is adjusted so that the oscillating electric fields that develop across the gap that the slot creates will launch a radiating system of fields, propagating away from the antenna.

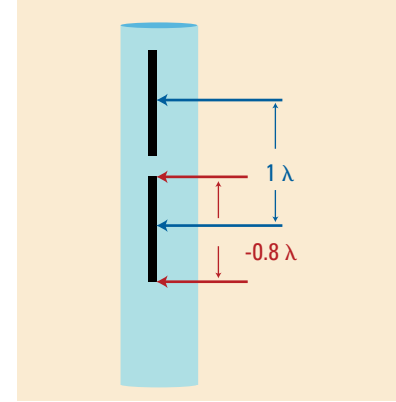

Figure 1. Shown here is a two-bay H-Pol slot antenna.

If the coaxial pylon antenna is oriented vertically, with the slots cut in the outer conductor oriented vertically as well, the electric fields across these slots will be oriented horizontally. Figure 1 depicts a two bay H-Pol slot antenna.

Polarizer elements are mounted on either side of the slot. The polarizers are about 1/8 λ each and launch a vertically polarized electromagnetic field one-quarter of a cycle or 90 degrees later than the horizontal field. When the axial ratio between the two fields is unity, we have circular polarization (C/P). When the horizontal field is stronger than the vertical, we have elliptical polarization. For ATSC-M/H, a 70/30 to 50/50 H to V ratio is ideal.

Figure 2 on page 14 shows the two-bay slot antenna with the added polarizers. The amount of vertical component is controlled by the

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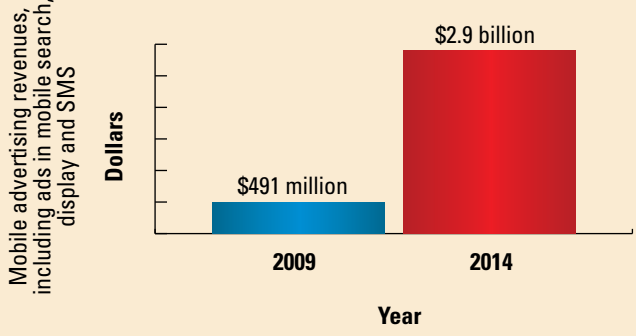
Mobile advertising revenues will grow from $491 million in 2009 to $2.9 billion in 2014.



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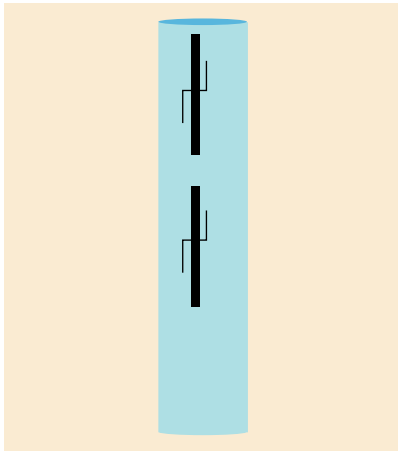

Figure 2. The amount of vertical compenent in this two-bay slot antenna is controlled by the placement and distance of the polarizers from the slot surface.

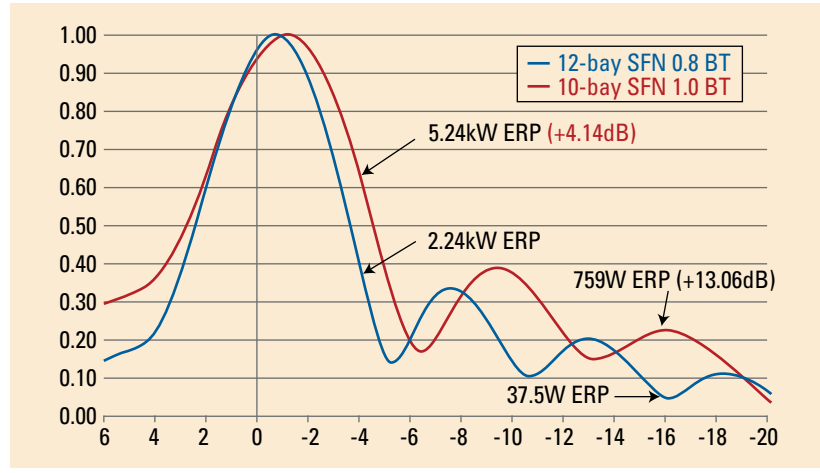

Figure 3. Shown here is a comparison of a 12-bay slot antenna and a 10-bay slot antenna. The 10-bay antenna produces a 4.14dB hotter signal downtown and a 13.06dB better signal at the base of the mountain.

placement and distance of the polarizers from the slot surface.

Fixed OTA and ATSC-M/H reception goals

Trying to cover a broad area for OTA reception is changing with the introduction of mobile TV. Depending on your market, there could be a large cluster of mobile TV viewers fairly close in to your transmitter site. These clusters could include a major university or an entertainment district like the Las Vegas strip. Let's look at a few examples of how some small changes in transmitting antenna design can make a big difference in how well your new mobile viewer will be able to watch.

Project number one is a new LD station that's 1800ft above a valley floor. The station needs to cover up to 40mi out to hit outlying cable heads and OTA viewers. At the same time, the closest population is only a few miles away at a depression angle of -16 degrees. The core downtown area is -4 degrees below the horizon and is a prime target for mobile TV viewing. Here, the station has plenty of transmitter power available and wants to shoot for C/P to ensure the best coverage from the close in foothills to downtown.

We looked at two antenna patterns, a 12-bay slot antenna and a 10-bay slot antenna. (See Figure 3.) In both cases, we want about 95 percent of peak field at the horizon to hit the distant viewers. For mobile TV, we have two targets to hit: saturate the downtown core at -4 degrees and ensure maximum coverage to the close-in area down to -16 degrees. In this case, the 10-bay antenna produces a 4.14dB hotter signal downtown, and a 13.06dB better signal at the base of the mountain. The ERP down to -18 degrees is always 15 percent of peak field or better, for a minimum ERP of 337W. For this application, we need 1.72kW of TPO. We have 1.8kW available, so this antenna is a perfect fit. This would be a good fit in a market like El Paso, TX; Phoenix; Boise, ID; or Vancouver, BC.

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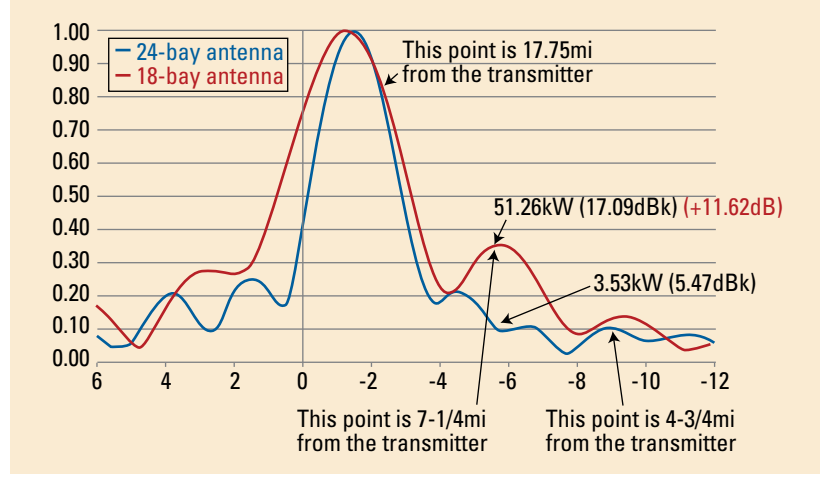

Figure 4. Shown here is a comparison of a 24-bay antenna (blue line) with a beam tilt of 1.5 degrees and an elevation gain of 22.3, and an 18-bay low RFR antenna (red line) with an elevation gain of 19.5.

This article originally appeared in the February 2011 issue of *Broadcast Engineering* magazine.

The second project is a full-power UHF station that wants to replace its antenna with a new C/P model. The station sits on a 7700ft site overlooking the metropolitan area below.

The station has a couple of goals and constraints to guide this project. It needs to cover the valley and wants to put as much signal as possible over a large university located about 7mi from the transmitter. The farthest point in the metropolitan area is 17-3/4mi away, with nothing but mountains beyond that. Close to the transmitter site, new homes have crept to within 4-3/4mi of the site and are at a depression angle of -9 degrees. In addition to the metropolitan area, the transmitter feeds a number of translators and CATV headends that are between 1/2 and two degrees below the horizon.

The old antenna (depicted by the blue line in Figure 4 on page 14) is a 24-bay antenna with a beam tilt of 1.5 degrees and an elevation gain of 22.3. There is a lot of headroom in the transmitter, so going to a lower gain antenna might help increase field strength. Looking at several options brought us down to an 18-bay low RFR antenna (depicted by a red line in Figure 4) with an elevation gain of 19.5. The secondary lobe of the antenna is at six degrees below the horizon and is aimed at the university. Compared to the old antenna, the new antenna will deliver a signal that is 11.6dB stronger there. In most other places, there will a 1dB or 2dB increase in signal strength — pulling some viewers back from the "digital cliff edge."

Mobile TV will be an important part of TV broadcasting. How successful it will be depends on how well the station can deliver a reliable product to the viewers.

Conclusion

Mobile TV will be an important part of TV broadcasting. How successful it will be depends on how well the station can deliver a reliable product to the viewers. Some additional planning and analysis of your antenna options can go a long way to make that happen. BE

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This article originally appeared in the February 2011 issue of *Broadcast Engineering* magazine.