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ANTENNAS AND ATSC 3.0 – A KEY DECISION

If you want to build an ATSC 3.0-ready facility, either as part of the repack or on your own, one of the most important decisions that you will need to make will be whether to add vertical polarization to your antenna system. Adding vertical polarization can be a significant cost. Station managers need to be familiar with the cost/benefit of this decision.

RECOMMENDATION:

Most stations should plan to add 20% to 30% vertical radiation to their antenna system.

WHY IS IT IMPORTANT TO ADD VERTICAL POWER?

Adding vertical power is a key decision for a few reasons.

First, obviously, antennas are at the top of the tower. They're big. And they're hard to get up there. Adding vertical polarization means hoisting a heavier, more complicated antenna that can do both horizontal and vertical polarization, or else adding a second antenna to augment an existing horizontal antenna. Neither is easy.

Second, vertical power means bigger transmitters. That's because any power that you radiate vertically is *added* to what you already are radiating horizontally. So, for example, if you currently operate a 10kw transmitter into a horizontal antenna and you want to add the same amount of power into a vertical antenna, you will need a 20kw transmitter – twice as much. You will pay more for the transmitter, more to run power to the transmitter, maybe more for expanded HVAC in the transmitter room, and you'll have bigger power bills. If you're really unlucky, you may also need to install bigger transmission line too.

These first two points mean that adding vertical power to your facility could be expensive.

If you're being repacked and you need a new antenna, the FCC will reimburse what a horizontal antenna would have cost but not the added cost of the vertical components. Manufacturers have said they will break out the vertical cost so you can document the repack-reimbursable cost to the FCC. Likewise, the FCC will pay the cost of the transmitter you would have needed to deliver a horizontal signal to the antenna at your authorized power. But if you add vertical power and need a bigger transmitter to do it, you will pay the differential. If you're not being repacked, of course, you'll pay all these costs yourself.

HOW MUCH VERTICAL POWER?

A key question for any station, repacked or not, is how much vertical power to add. The more vertical power you need, the more expensive it is likely to be to add it.

One would think that having equal vertical and horizontal power would be ideal to reach all antennas. Over many years of engineering practice, PMC's engineering consultant Fred Baumgartner has learned that this is often not true. Fred's experience has been that having 20% to 30% power in the vertical plane is better in practice for television. Fred has found that having no vertical power is bad, but having too much is inefficient and can actually degrade reception. Fred's experience is consistent with recommendations that we heard at the recent PBS TechCon meeting: most manufacturers and engineers seem to be recommending 20% to 30% vertical power.

WHAT IS VERTICAL POWER AND WHY IS IT IMPORTANT?

From the beginning, TV has been transmitted in the horizontal plane because horizontal waves travel over the horizon better and go farther. Horizontal polarity means that the radio waves from the TV transmitting antenna travel parallel to the ground. That's why roof top TV antennas have metal elements that come out of the sides, parallel to the ground, and not pointed up and down.

Antennas with elements that point up and down are "vertical." A receiver with an antenna that points up won't pick up a television signal very well. Most car antennas, for instance, are vertical. They don't work well for TV.

Mobile devices and home routers can be horizontally or vertically polarized. In effect, we have to think about them as being random. Vertical radiation also helps to penetrate buildings, so it's important to have radiation in both horizontal and vertical planes if you want your signal to be picked up by these devices inside buildings.

Even in our present ATSC 1.0 world, vertical power improves coverage and many stations have already added a vertical component to their signal. With vertical power, reception in urban areas is better (because of building penetration) and chances are better that a viewer with an indoor antenna will receive a usable signal too.

Vertical power is particularly important for the coming ATSC 3.0 world. ATSC 3.0 gateway/Wi-Fi devices will have built-in antennas that will respond best to vertical signals. ATSC 3.0 is also designed to work better with indoor antennas connected to televisions and to mobile receivers. Some vertical power will help these indoor antennas, too. Overall, vertical polarization will maximize the benefit of the improved transmission scheme. Eventually, ATSC 3.0 may be built into smartphones, into entertainment and information centers in automobiles, and other mobile consumer devices with vertical antennas. All of this points to adding vertical power now.

Having said all of this, nothing prevents a station from radiating an ATSC 3.0 signal from a horizontal-only antenna. Particularly for stations that are *not* being repacked, a reasonable option would be to move to ATSC 3.0 and continue to use your current horizontal antenna system (provided it can handle the increased power requirement – see below) and add some vertical polarization in the future.

IF I'M REPLACING MY ANTENNA, WHAT ELSE SHOULD I THINK ABOUT?

With the advent of next generation TV in the offing, there are two other factors that stations should consider in their antenna design:

The first is null fill.

Since the beginning of TV, antennas have been designed to deliver power to the horizon. Actually, the power is slightly "beam-tilted" downward – power above the horizon is wasted as no one lives in space. But if an audience member lives relatively close to a station's tower, the more likely it is that the TV station's signal will be too high to hit the receiving antenna well. "Null fill" pushes power down at lower angles to cover those living from a few miles to a dozen or so miles from the tower. That can be a lot of people, or very few depending on where the antenna is located.

The second is power handling capacity.

ATSC 3.0 has a higher "crest factor," or peak power level than our current ATSC 1.0 has. This means the antenna system has to handle more signal. In addition, a new antenna will likely include some provision for vertical power radiation, adding to the amount of power passing through the antenna. An antenna radiating ATSC 3.0 therefore needs to be capable of handling more power than an antenna radiating ATSC 1.0. In addition, antennas often are hit by lightning. The antenna system needs to handle lightening-generated power spikes. Like rogue waves in the ocean, all of these energies can sometimes line up – making a large wave with lots of voltage and current that can harm the antenna if it isn't designed for this. Too much power or significant energy spikes can cause insulation and other antenna components to breakdown.

Antennas are never easy to fix and you can't live without one – so being able to handle the extra power peaks in Next Generation TV is important. This may require an antenna with twice the power handling capability of your present design. Fred knows of no antenna that can be economically modified to handle extra power after it is constructed – so you really need to design your antenna system in anticipation of ATSC 3.0.

Antennas often last decades – if they are built to handle the power required. This is not an area to cut corners.

CONCLUSION:

Best case scenario: you can purchase an antenna and transmitter that can accommodate what you will need for Next Generation TV and have a good part the cost paid from repack funds. Especially if you are being repacked and will have the costs of a new antenna covered by the repack fund, you should consider adding 20% to 30% vertical power at your own cost. Ideally, the cost-differential to get a transmitter, transmission line, filter, and antenna that can serve you in the next generation is affordable and of course, it is a good investment.

PUBLIC MEDIA COMPANY INITIATIVES

Public Media Company has been working for the last few years to help public television stations prepare for the auction, the repack, and the coming opportunities with ATSC 3.0. PMC is currently forming a Public Media Ventures Group, a small group of stations that want to lead the development of innovative revenue and service models under ATSC 3.0. PMC has assembled a team with deep experience in both public media and commercial television to work with the Public Media Ventures Group, and will bring in leading thinkers and entrepreneurs in broadcasting and allied communications fields to brief the Public Media Ventures Group members. The team currently includes Vinnie Curren, Mark Erstling, Fred Baumgartner, Marc Hand and Evran Kavlak. We are finalizing the membership of this group so if you are interested, contact us soon.

In addition, PMC has arranged a $20 million+ loan fund to help stations cover the costs of the repack and ATSC 3.0 conversion. More information is available here:

http://www.publicmedia.co/public-television-financing-program/

PMC is also working with stations on post-auction channel-sharing opportunities.

PMC provides a variety of brokerage, financing, business planning and general consulting services to stations and operates Channel-X and VuHaus.

Please feel free to contact us if you any questions about this article or if we may be helpful to you as you plan for the future.

THE PMC NEXT GENERATION TV CONSULTING TEAM (more to be added):

Marc Hand is the c.e.o. and co-founder of Public Media Company. As c.e.o., Marc builds strategic public media alliances, educates financial institutions on public media investments, and provides expertise on all aspects of public media transactions based on his 30-year career as a public and commercial media advisor and owner of commercial stations. Marc spent five years at the Station Resource Group helping public radio stations expand services via acquisitions, collaborations and partnerships, leading to the development of Public Media Company in 2001.

Fred Baumgartner is an engineering consultant to Public Media Company. Fred has worked in broadcast engineering at Nautel, Harris Communications, and Qualcomm and has extensive experience as at the station level in AM and FM radio and TV.

Vinnie Curren served as Chief Operating Officer of the Corporation for Public Broadcasting for nearly a decade. As COO for CPB, Vinnie had overall responsibility for managing CPB's policy, grant-making and station support activities. While at CPB Vinnie was also deeply involved in spectrum policy and advocated for public television's interests in the spectrum auction at the highest levels of the FCC. Since leaving CPB and forming Breakthrough Public Media Consulting Vinnie has been particularly focused on helping public television stations leverage the power of ATSC 3.0.

Mark Erstling is a highly regarded public media consultant who has worked in public broadcasting for four decades. He has a demonstrated record of successful administrative experience at the national level. His experience includes development of strategies, policies and standards that advance the interests of public media enterprises. He has held a number of key national strategic public media roles, including Executive Vice President and COO of APTS, and Senior Vice President for System Development and Media Strategy at the Corporation for Public Broadcasting.

Evran Kavlak is the director of consulting and research at Public Media Company. Evran works with a broad range of organizations ranging from startups to the largest public broadcasters. He develops performance dashboards, peer-group analyses, business plans and overall industry trend reports (radio, TV, new media) for senior management and board-level decision makers. Evran manages all aspects of the Public Radio Fund including assessing credit risk, structuring loans, and monitoring loan activity. He also manages the Public Television Financing Program, a $20 million+ loan fund that assists public TV stations with their financing needs. He holds a master's degree in finance from California State University in San Diego and a bachelor's degree in management engineering from Istanbul Technical University in Turkey.