



Case Study

Maintaining Target Market Coverage
with a Directional FM AUX Antenna

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Executive Summary

Auxiliary antennas must stay within the coverage contour of the main antenna, regardless of whether both antennas are located at the same geographical site. This can create challenges when an auxiliary antenna is installed at a different location from the main antenna. Even though the AUX facility operates from a separate site, its radiated power must remain within the protected contour of the main antenna.

To meet this requirement, the auxiliary antenna is typically operated at a reduced effective radiated power (ERP) until its predicted coverage fits within the licensed contour. While this approach is compliant, it can significantly reduce coverage in key areas, including the station's intended target market.

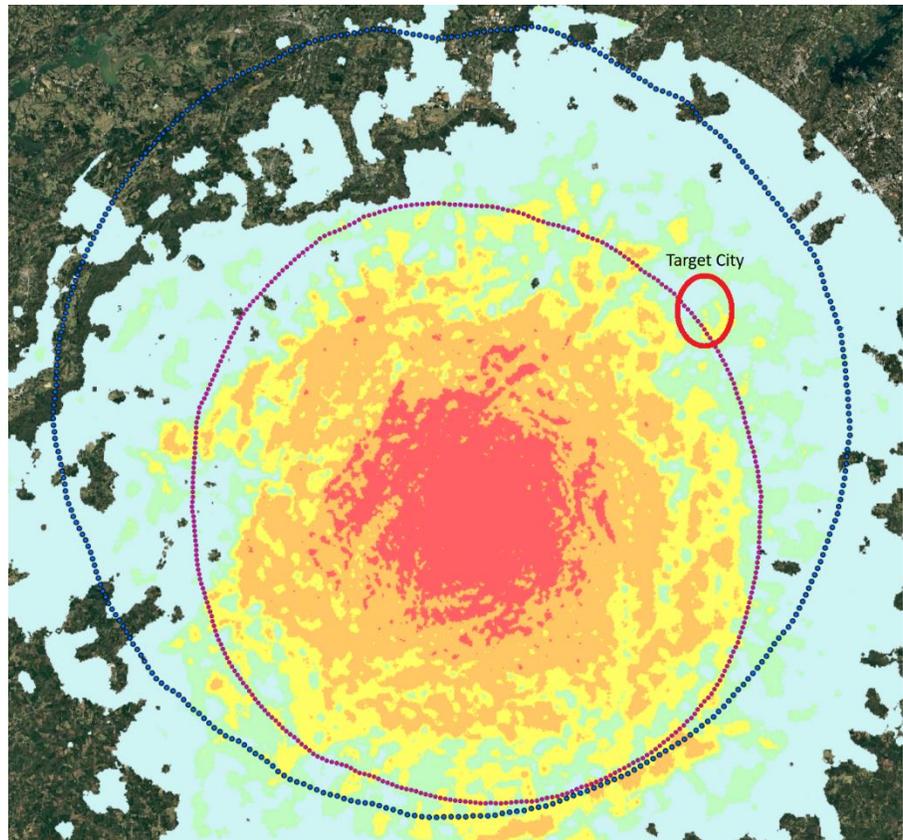
This report presents a case study of a displaced FM auxiliary antenna installation. The main antenna for this station is licensed as omni-directional with the FCC. By reviewing the FCC rules governing auxiliary facilities, it was determined that the auxiliary antenna could be directionalized to maintain coverage of the target area while remaining fully compliant with FCC requirements. This case study examines an FM installation and demonstrates how directionalizing the AUX antenna could provide substantially improved coverage of the target city compared to an omni-directional auxiliary antenna operating at reduced power.

Problem Statement

Normally, a displaced omni-directional auxiliary antenna has its ERP reduced until its azimuth pattern fits within the licensed contour of the main antenna. While this approach satisfies regulatory requirements, it can result in significantly reduced coverage compared to the main antenna, and coverage may no longer reach the station's target location.

Figure one below illustrates how coverage toward a station's target location, and overall coverage, can be substantially reduced when operating from a displaced AUX antenna.

Figure 1: Difference between main antenna and auxiliary antenna coverage.
Blue Dots – Main Coverage
Red Dots – Auxiliary Coverage



This problem can be addressed by directionalizing the auxiliary antenna to provide coverage to the target city while remaining fully compliant with FCC rules.

Regulatory Considerations

A review of the FCC rules governing auxiliary antennas shows that it is permissible to intentionally directionalize an auxiliary antenna, provided that the resulting radiation pattern does not extend beyond the protected contour of the main antenna. The relevant language from Title 47 for FM auxiliary antennas is provided below, with the most applicable portions highlighted.

§ 73.1675 Auxiliary antennas

(a)

(1) An auxiliary antenna is one that is permanently installed and available for use when the main antenna is out of service for repairs or replacement. An auxiliary antenna may be located at the same transmitter site as the station's main antenna or at a separate site. **The service contour of the auxiliary antenna may not extend beyond the following corresponding contour for the main facility:**

(i) AM stations: The 0.5 mV/m field strength contours.

(ii) FM stations: The 1.0 mV/m field strength contours.

(iii) TV stations: The noise limited contour as defined in [§ 73.619\(c\)](#).

(iv) Class A TV stations: The protected contours defined in [§ 73.6010](#).

Regulatory Excerpt: 47 CFR § 73.1675 – Auxiliary Antennas
(Highlighted portions relevant to FM facilities)

This rule establishes that the auxiliary antenna can be directionalized to get more coverage and better coverage towards a target area.



It needs to be considered that the auxiliary license needs to be filed as directional, which brings on extra cost. The extra cost comes from needing a pattern study to be done, FCC licensing fees, and a survey cost after installation. The incremental cost required to directionalize the displaced auxiliary facility is minimal when compared to the operational benefit of maintaining a strong, reliable signal in the core coverage area. This is particularly important for market-leading stations that may need to operate on auxiliary service for an extended duration, where preserving audience reach and signal integrity is critical.

Coverage Comparison: Omni vs. Directionalized

The pattern from the problem statement can be compared to a pattern that has been directionalized to get improved coverage overall, and towards a target city. Below is the coverage of the AUX antenna that has been directionalized towards the target city.

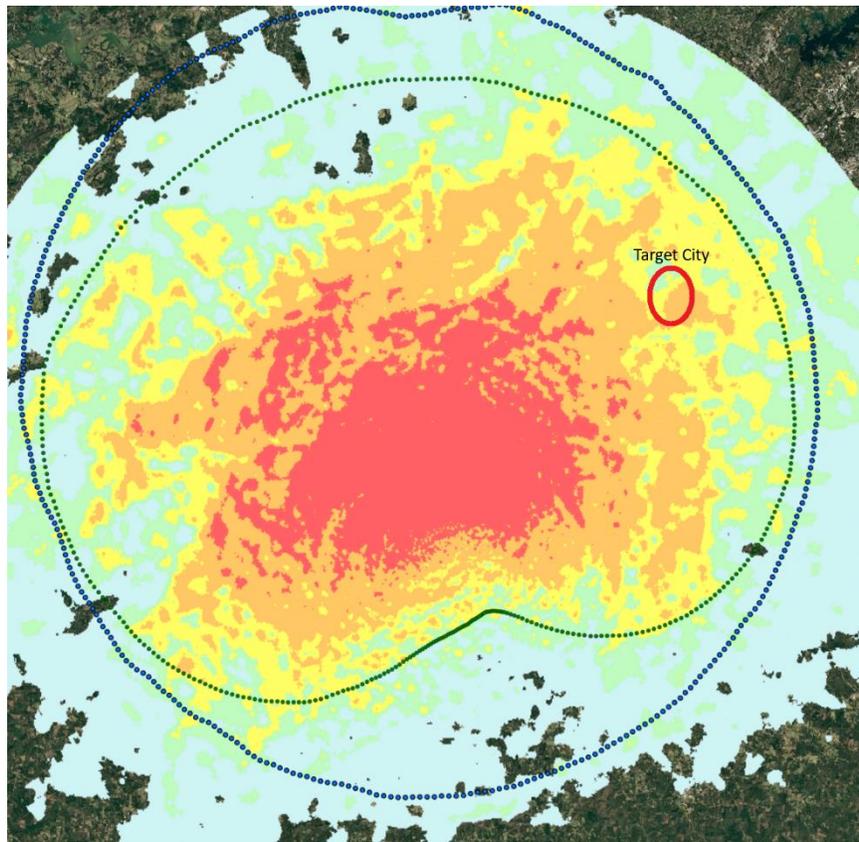
Figure 2: Difference between main antenna and directionalized auxiliary antenna coverage.

Blue Dots – Main Coverage

Green Dots – New Auxiliary Coverage

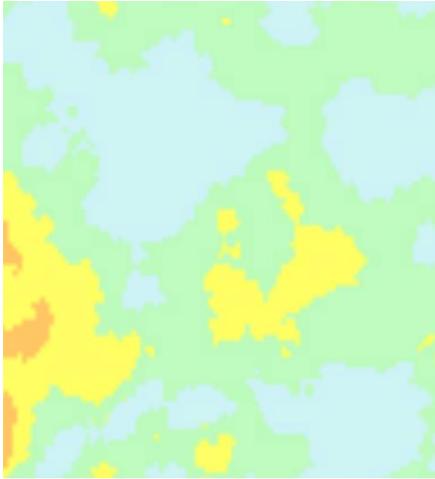
Field Strength

	30 - 42 dB μ V/m
	42 - 48 dB μ V/m
	48 - 54 dB μ V/m
	54 - 66 dB μ V/m
	66 - dB μ V/m

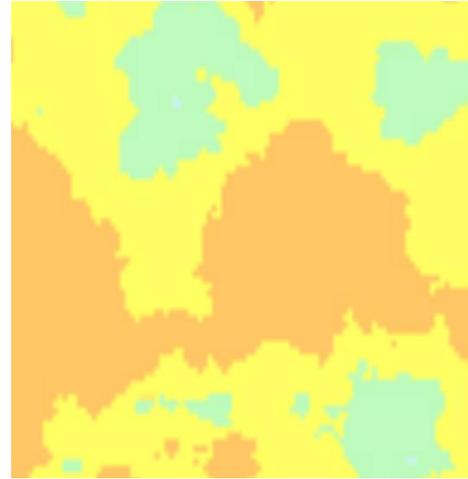


Compared to the reduced ERP radiation pattern, the overall coverage is much better. The field strength of the signal is also significantly higher at the target city. This can be seen better in Figure 3, which is zoomed in on the target city for both pattern types.

Un-Directionalized



Directionalized



Field Strength

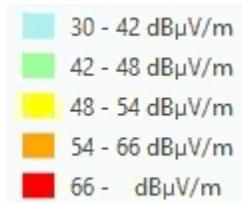


Figure 3: Zoomed in comparison of the target cities coverage with an un-directionalized antenna (Left), and directionalized antenna (Right)

Figure 3 shows most of the target cities coverage is on the weak end of the field strength gradient (30-42 dB μ V/m and 42-48 dB μ V/m). When the pattern is directionalized the field strength goes up significantly at the target city (48-54 dB μ V/m and 54-66 dB μ V/m).

It should also be noted that the station gets much higher ERP with the directionalized pattern because the azimuth pattern fits within the contour of the main antenna better. The ERP for the un-directionalized antenna had to be reduced to 10kW, and the directionalized antenna could run at 70kW.

Advantages of Computer Simulation

We can use Ansys HFSS to simulate and easily design a directional solution tailored to the customers' needs at any given site. In this case the pattern needed to be directionalized towards the north-west to get the best overall coverage, and good coverage of the target city. Figure 4 below shows the model setup in HFSS before and after directionalizing it.

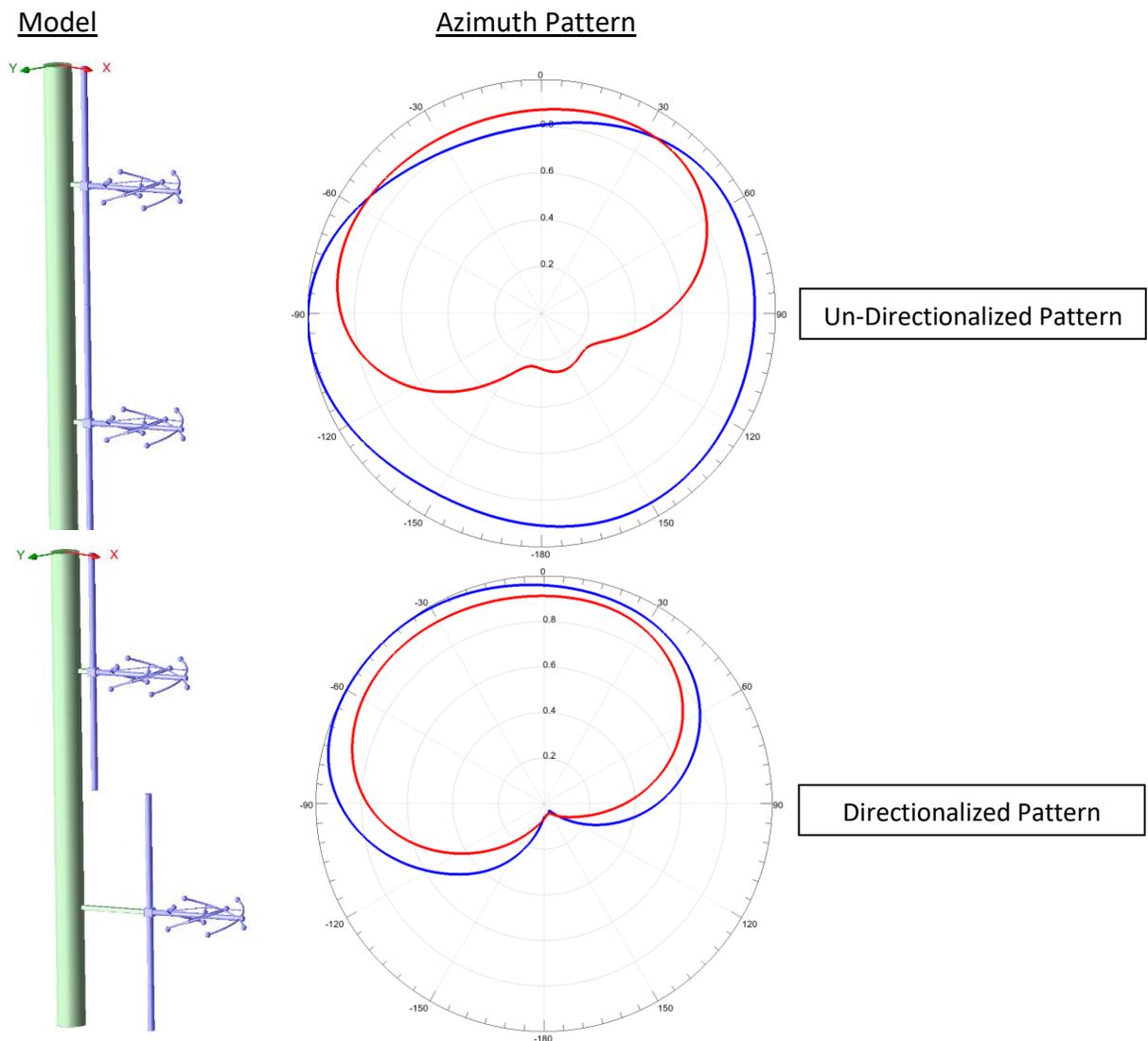


Figure 4: The simulation model and azimuth patterns for this case study.
 Blue – Horizontal Azimuth Pattern Red – Vertical Azimuth Pattern



This station was mounting their antenna on a support pole. The support pole was quickly modeled, and the antenna could be pointed towards the direction that gives them the best overall coverage and target city coverage. A variable amount of directivity can also be added to achieve best coverage.



Key Takeaways

A displaced omni directional auxiliary antenna can have significantly reduced coverage compared to the main antenna if it has its ERP reduced to fit within the main antenna's FCC contour. The AUX antenna can be directionalized to fit better within the contour of the main antenna.

The benefit of doing this is getting better coverage of a target area if there is a large city that the station wants to maintain coverage of. The overall coverage will also be better because the directionalized azimuth pattern will fit better within the contour of the main, so ERP will not need to be reduced as much.

The drawbacks of doing this are cost related. The AUX license will need to be filed as a directional antenna instead of omni directional which comes with some added cost. These costs are relatively minimal if this is for a market-leading station where audience reach and signal integrity is critical.