ANTENNAS: WHY IS SIZE IMPORTANT?

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INTRODUCTION

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This problem particularly applies in the United States, where many operators do not own their own tower assets, and must lease space on third-party towers. Lease costs can be high—as much as $100 per diameter-foot, per month. The FCC part 101 regulations do not prescribe the size of an antenna directly, but instead specify certain key transmission parameters that can only be met by larger antennas. Thus for the 6GHz band the smallest useable antenna is 6 feet in diameter.

The contribution of tower leasing to the total cost of ownership (TCO) of microwave systems is significant—more than 60 percent over 10 years, so any steps that can reduce or mitigate the size of the antennas required will have a direct effect on lower overall operational costs.

This briefing paper explores the issues surrounding antenna size in fixed microwave link applications, and the current efforts within the industry and the FCC to reform and update the regulations that dictate minimum antenna sizes.

THE REGULATORY BACKGROUND

The FCC prescribes a certain minimum level of performance (within part 101) to obtain the most efficient use of the radio spectrum. In each microwave band these performance criteria equate to two categories of antenna: category A and category B, with category B being a slightly lower performance option. The licensing conditions for a link will stipulate which category of antenna should be used, and this is decided upon during the link coordination process. This is important because while there is growth in the demand for spectrum, the amount of available spectrum is a finite resource. The three most important aspects that are influenced by antenna characteristics are frequency reuse, the risk of being interfered with and the risk of causing interference. All three of these phenomena are directly related to the radiation pattern of the antenna.

Where an antenna provides a radiation pattern with a narrow main beam and smaller side lobes, this will enable more frequency reuse as spectrum outside of the main beam is likely to be available for other links. Also with a narrower beam the likelihood of causing interference to neighboring links is reduced, and as the antenna characteristics apply in both the transmit and receive directions, the antenna characteristics also mean that the link is less prone to interference.

The combination of higher tower rental costs, higher shipping costs and higher installation costs are all directly related to antenna size together with the cost of the antenna itself.

While the above appears to be just what everyone concerned with the microwave industry desires, this does come at a price. This price is an economic one and is the combination of higher tower rental costs, higher shipping costs and higher installation costs, which are all directly related to antenna size together with the cost of the antenna itself. In addition, in some locations there are an increasing number of objections being made based on the unsightly appearance of the larger antennas and towers that are needed to support them.

In its recent Notice of Proposed Rule-Making (NPRM), 10-153, the FCC raised the question of allowing the use of smaller antennas. This was an opportunity for industry to propose alternatives to the current situation and hopefully persuade the FCC to allow the use of smaller antennas in certain circumstances.

ECONOMIC CONSIDERATIONS

Recent price pressure has seen the cost of radios fall in real terms. However, the same cannot be said for the cost of the antenna and the tower rental charges. Thus, these have become an even larger percentage of the overall cost of installing and running a microwave link. If either or both of these factors can be reduced then the effect on the running costs could be dramatic. The following chart shows a breakdown of the costs over a 10 year period for a microwave link with 3-foot antennas.

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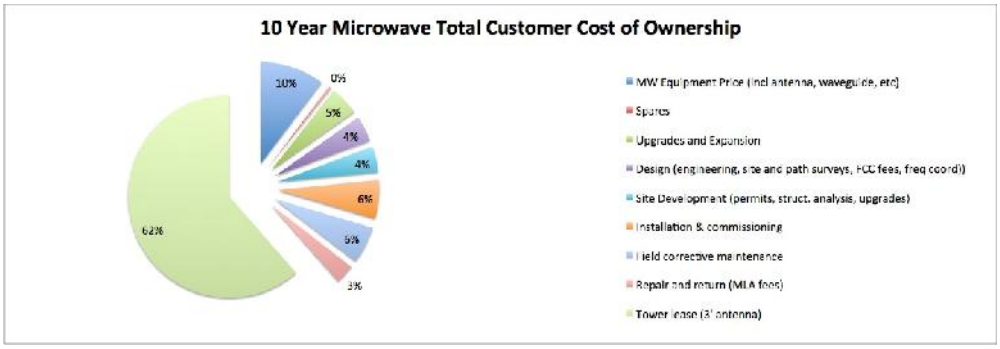

Figure 1. Tower costs make up the lion's share of the total cost of ownership of microwave backhaul. Reducing antennas sizes would reduce the tower cost for about a 20 percent reduction in total cost.

As can be seen from above, 62 percent of the total customer cost is for tower rental, and tower rental is directly proportional to antenna size, so reducing the antenna size from 3 feet to 2 feet would generate 33 percent savings of the tower costs—equivalent to approximately 20 percent savings of the total cost (Figure 1). An additional cost benefit with smaller antennas would be lower-cost mounting hardware, and the smaller antenna would be both lighter and have less wind resistance.

THE COMSEARCH PROPOSAL

In response to the FCC NPRM 10-153 question on reducing antenna sizes, Comsearch proposed subdividing the category B performance requirements in the 6, 18 and 23 GHz bands to provide the microwave community with the option of being able to utilize smaller antennas in these bands. This proposal provides for either 4-foot or 3-foot antennas in the 6 GHz band, 1-foot antennas in the 18 GHz band and 8-inch antennas in the 23 GHz band. These are reductions from the current sizes of 6 feet for 6 GHz, 2 feet for 18 GHz and 1 foot for 23 GHz. This equates to a 50 percent reduction in two of the bands and a 33 percent reduction in the higher band.

Although the Comsearch response only covered these bands in detail, its submission does call for a thorough review of antenna performance requirements with the intent of determining where further relaxations could be made.

Aviat Networks' position is that where the risk of interference is minimal, smaller antennas should be allowed as this lowers the total running cost for point-to-point links and would increase the viability of lower traffic rural links.

WHAT'S NEXT?

Many industry stakeholders commented back to the FCC 10-153 NPRM process, proposing a relaxation in the antennas sizes. Aviat Networks' position is that where the risk of interference is minimal, smaller antennas should be allowed as this lowers the total running cost for point-to-point links and would increase the viability of lower traffic rural links.

As we have seen, antenna size is primarily a tradeoff between performance and cost. The performance requirements are laid down by the various regulations, but do they always have to be so stringent?

In crowded areas—both in geographic and spectrum terms—high-performance antennas are critical to being able to utilize spectrum in the most efficient manner. However, in areas where link density and/or spectrum availability is not at a premium, a lower specification—and therefore size—antenna could be deployed. In FCC terms, this would mean allowing the use of category B antennas on a more widespread basis or even something more relaxed, such as Comsearch's "category B2" proposals in the nominated bands.

On 9 August 2011, the FCC issued a further notice of proposed rulemaking that sought comment on whether to liberalize rules to allow smaller antennas in the 6, 18 and 23 GHz bands without materially increasing interference.