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RF Transmission Hardware (Antennas)

INTRODUCTION

Radio Frequency (RF) technology forms a large branch of Electrical Engineering. The basis of this technology comprises the use of antennas, transmission lines, waveguides and electromagnetic field (emf) principles [2]. The combination of the stated topics, along with more complex ideas, allows for the transmission and receiving of frequencies; these frequencies exist within the range of 20 kHz to 300 GHz [3]. Applications of the sort include AM/FM radio, navigation, position location, radar, cellular phone communication, etc. [1]. Among the myriad of applications in RF technology, data transmission forms the basis on which applications are derived. This fact brings us to the apparatus which performs the data transmission, aka antennas. This paper reviews the hardware used for the transmission of the described Radio Frequencies.

COMMERCIAL ANTENNA PRODUCTS

The type of RF transmission hardware used will depend on several factors, including but not limited to: range of transmission, power consumption, precision and accuracy [4]. Considering the factors, it follows such that one can get lost in the many form factors of this technology (from satellites to tv remotes). Therefore, the commercial products aspect of this paper will examine the state-of-the-art technology in omnidirectional RF transmission hardware.

Industry leaders in this field tend to lean towards government contracting work, where companies like General Dynamics, Northrop Grumman, BAE Systems, etc. are found. The products made by these companies are not made available to the public. However, aside from the defense contractors, take, for example, Southwest Antennas & Pasternack [7]. Both of these companies provide several omnidirectional antenna solutions. In particular, there are two comparable Omni antennas sold by these companies: the PE51061 by Pasternack & the 1085-222 by Southwest.

The PE51061 has frequency ranges from 2.4 to 2.5 GHz, 50W power handling & a max gain of 8 dB in Omni radiation pattern ($194); whereas the 1085-222 has frequency ranges from 2.2 to 2.5 GHz, 50W power handling & a max gain of 6 dB in Omni radiation pattern ($250) [5,6]. Both similar in power handling, the PES51061 is more limited to what output frequencies it can produce, in turn, this can result in difficulties with signal interference [3]. Although the 1085-222 lacks in maximum gain (fewer range capabilities) [3], it makes up in the sense of ruggedness. Southwest Antennas are designed for heavy-duty applications, providing weatherproof seals to protect against all sorts of contamination. Three times the

mass of the 1085-222, the PE51061 has approximately the same dimensions as the 1085-22. Choosing between these comparable technologies, one must consider specific use cases.

UNDERLYING TECHNOLOGY IN ANTENNA PARAMETERS

The variety of antennas include: Wire, Travelling Wave, Reflector, Microstrip, Log-Periodic, Aperture [4]. The varied use cases are mainly based on range, gain and weight; of which, antenna properties are governed by the size, shape and material make-up. A fundamental property is the antenna radiation pattern, this characterizes the directional relative distribution of power radiated by an antenna [7]. Described in the commercial products section, examined is the omnidirectional antennas, whereas there exist antennas with several directional capabilities. Two additional fundamental properties are the antenna efficiency and bandwidth. Efficiency is dependent on the polarization (electric field direction) and operating environment. The antenna bandwidth determines the range of frequencies in which the system can operate under (radiate/receive energy) [9].

TECHNOLOGY IMPLEMENTATION OF RF TRANSMSSION HARDWARE

Implementation of RF transmission hardware requires the use of both a transmitter and a receiver (transceiver). The transceiver hardware component call for antennas, transmission lines, amplifiers, attenuators and typically a microcontroller.

First, the microcontroller would generate a signal to be transmitted by the antenna. Next, the signal that is to be transmitted propagates within waveguides that, when combined, form transmission lines. During the signal's propagation, it could be learned that the signal's power needs adjustment. The signal may become weak due to the line impedance, or the signal may contain more power than the antenna is rated for. In any case, there are circuit components that account for either case: attenuators are used to decrease the power of a signal without distortion and amplifiers are used to increase the magnitude of the signal. Next, the signal reaches the antenna where it is finally transmitted wirelessly. Lastly, there is a receiver that picks up the transmitted signal and repeats the listed process in reverse order [8].

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