CHALMERS – Space, Earth and Environment

RRY100 – Satellite Communications 2024

Homework 4

”Omni-directional and directional antennas”

Deadline 2024-10-09, 07:59

Some antennas types have omni-directional antenna pattern, e.g. dipoles, loops, and broadside arrays, while other antennas types have a directional antenna pattern, e.g. horn antennas and reflector antennas. As examples, Figure 1a schematically shows the radiation pattern of an omni-directional, and Figure 1b the radiation pattern of a directional antenna with one single main-lobe and negligible side- and back-lobes. The radiation intensity of an antenna is measured in [W/unit solid angle].

a) The radiation intensity of an omni-directional antenna, shown in Fig. 1a, can be expressed by:

$$U_{\mathrm{O}} \quad = \quad B_{\mathrm{O}} \cdot |\sin^n(\theta)| \tag{1}$$

b) The radiation intensity of a directive antenna, shown in Fig. 1b, can be expressed by:

$$U_{\mathrm{D}} \quad = \quad B_{\mathrm{D}} \cdot \cos(\theta) \tag{2}$$

For the directional antenna the radiation intensity (Fig. 1b) exists only in the upper hemisphere, i.e. for $(0 \leq \theta \leq \pi/2, 0 \leq \phi \leq 2 \cdot \pi)$.

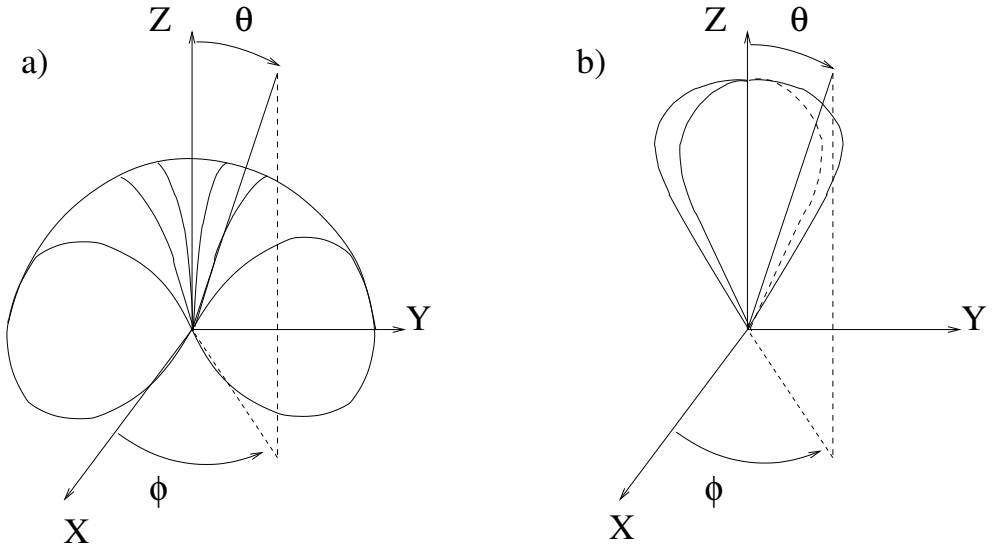

Figure 1: Radiation intensity pattern of a) an omni-directional antenna, and b) a directional antenna with a single main-lobe and negligible side- and back-lobes.

Questions:

1. What is the directivity of an omni-directional antenna of type a) that has a half-power beamwidth (HPBW) of $\theta_{3\mathrm{dB}} = 90^{\mathrm{o}}$?
2. What is the directivity of a directive antenna of type b)?