



How did German radio beams reach distant English cities during WWII? [closed]

Asked 5 years ago Modified 5 years ago Viewed 499 times



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💡 This question appears to be about **engineering**, which is the application of scientific knowledge to construct a solution to solve a specific problem. As such, it is off topic for this site, which deals with the **science**, whether theoretical or experimental, of how the natural world works. For more information, see [this meta post](#).

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During WWII, the Germans were using radio beacons (the "*Knickebein*" system) to guide their bombers into English territory. They set up two beacons, one in Kleve, a city in West Germany, and one at Stollberg Hill (North Frisia). The two radio beams intersected over Derby.



The Knickebein system supposedly relied on line-of-sight propagation, but the distance between these locations is simply too great to allow for LOS. According to [William CY Lee \(page 350, equation 11.3.1\)](#),

the radio horizon (i.e. the service range of the beacons) can be calculated as $R = \sqrt{2h_a} + \sqrt{2h_b}$ where R is the distance in miles, h_a is the aircraft altitude and h_b is the ground-station antenna height in feet. If we plug in the numbers (say, the height of the beacon in Kleve (239ft) and the flight height of the German bombers (19,200ft)), we get a maximum beam range of 217,8 miles. However, Derby and Kleve are far away from each other, about 330 miles. So how could the *Knickebein* beams reach Derby?

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edited Aug 18, 2019 at 17:35

asked Aug 18, 2019 at 15:29

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208k

48

570

2.3k

[Hepper](#)

51

4

Check the frequency and propagation characteristics of that frequency. Remember you receive radio broadcasts when you can't see the antenna. – [Jon Custer](#) Aug 18, 2019 at 16:23

The frequency was 30-33MHz. – [Hepper](#) Aug 18, 2019 at 16:37

1 Answer

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**1**

As pointed out by Hepper and Jon Custer, at the frequencies of operation of the system, significant bending of the radio waves will occur along with reflection off the ionosphere- making over-the-horizon transmission easy.



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answered Aug 18, 2019 at 17:11



[niels nielsen](#)

96.6k 18 135 254



Using the atmosphere itself as a waveguide – [DakkVader](#) Aug 18, 2019 at 17:51

not exactly- 30MHz has a wavelength of 10 meters, and the atmosphere is way thicker than that. – [niels nielsen](#) Aug 18, 2019 at 18:36

I always thought that (V)HF radio waves do not bend. – [Hepper](#) Aug 18, 2019 at 18:53

30 megahertz is not vhf, and its waves do bend and bounce. the ability to bend gradually goes away above that frequency, and by the time you are at ~50 megahertz, you are in the line-of-sight regime. 100MHz is line-of-sight only. – [niels nielsen](#) Aug 18, 2019 at 19:49

The German Knickebein radar stations emitted guide beams. The bombers had to follow this beam in order to reach their target. Wouldn't ionospheric refraction/reflection obscure the path of the beam? – [Hepper](#) Aug 18, 2019 at 20:26
