

Problem IV.1 ... slow connection

3 points; (chybí statistiky)

Remote access is often used while observing with telescopes at the La Silla observatory in Chile. When measuring the data transfer speed, we usually get a time of $t = 213$ ms for the signal passage from Prague to the observatory and back. How could such a connection be realized? Consider these two cases: The data transfer works via geostationary telecommunication satellites or a fiber optic connection. Dodo is observing remotely.

Geostationary satellites are located approximately $H = 36\,000$ km above the Earth's equator. For the round trip of the signal (from Prague to the observatory and back), we must overcome at least four times this distance. At the speed of light, this takes $T_1 \geq 4H/c = 480$ ms. Therefore such a fast connection cannot be realized via a satellite on a geostationary orbit.

Now consider the fiber optic connection. The distance from Prague to La Silla over the surface of the Earth is approximately $d = 12\,100$ km. The usual speed of light in optical fibers is given by their refractive index and is roughly $v = 200\,000$ km·s⁻¹. If the optical fiber was laid out directly between the two endpoints, connecting them through the shortest possible path over the Earth's surface, the round trip would take $T_2 = 2d/v = 121$ ms. Considering that the connection is actually not direct and the signal can be delayed because of reasons other than the direct travel time itself, the time $t = 213$ ms seems realistic for this type of connection.

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