

**Why 50 ohm coax ?** (taken from [http://www.hut.fi/Misc/Electronics/docs/wiring/cable\\_impedance.html](http://www.hut.fi/Misc/Electronics/docs/wiring/cable_impedance.html))

Standard coaxial line impedance for r.f. power transmission in the U.S. is almost exclusively 50 ohms. Why this value was chosen is given in a paper presented by Bird Electronic Corp.

Different impedance values are optimum for different parameters. Maximum power-carrying capability occurs at a diameter ratio of 1.65 corresponding to 30-ohms impedance. Optimum diameter ratio for voltage breakdown is 2.7 corresponding to 60-ohms impedance (incidentally, the standard impedance in many European countries).

Power carrying capacity on breakdown ignores current density which is high at low impedances such as 30 ohms. Attenuation due to conductor losses alone is almost 50% higher at that impedance than at the minimum attenuation impedance of 77 ohms (diameter ratio 3.6). This ratio, however, is limited to only one half maximum power of a 30-ohm line.

In the early days, microwave power was hard to come by and lines could not be taxed to capacity. Therefore low attenuation was the overriding factor leading to the selection of 77 (or 75) ohms as a standard. This resulted in hardware of certain fixed dimensions. When low-loss dielectric materials made the flexible line practical, the line dimensions remained unchanged to permit mating with existing equipment.

The dielectric constant of polyethylene is 2.3. Impedance of a 77-ohm air line is reduced to 51 ohms when filled with polyethylene. Fifty-one ohms is still in use today though the standard for precision is 50 ohms.

The attenuation is minimum at 77 ohms; the breakdown voltage is maximum at 60 ohms and the power-carrying capacity is maximum at 30 ohms.

Another thing which might have lead to 50 ohm coax is that if you take a reasonable sized center conductor and put a insulator around that and then put a shield around that and choose all the dimensions so that they are convenient and mechanically look good, then the impedance will come out at about 50 ohms. In order to raise the impedance, the center conductor's diameter needs to be tiny with respect to the overall cable's size. And in order to lower the impedance, the thickness of the insulation between the inner conductor and the shield must be made very thin. Since almost any coax that *\*looks\** good for mechanical reasons just happens to come out at close to 50 ohms anyway, there was a natural tendency for standardization at exactly 50 ohm.