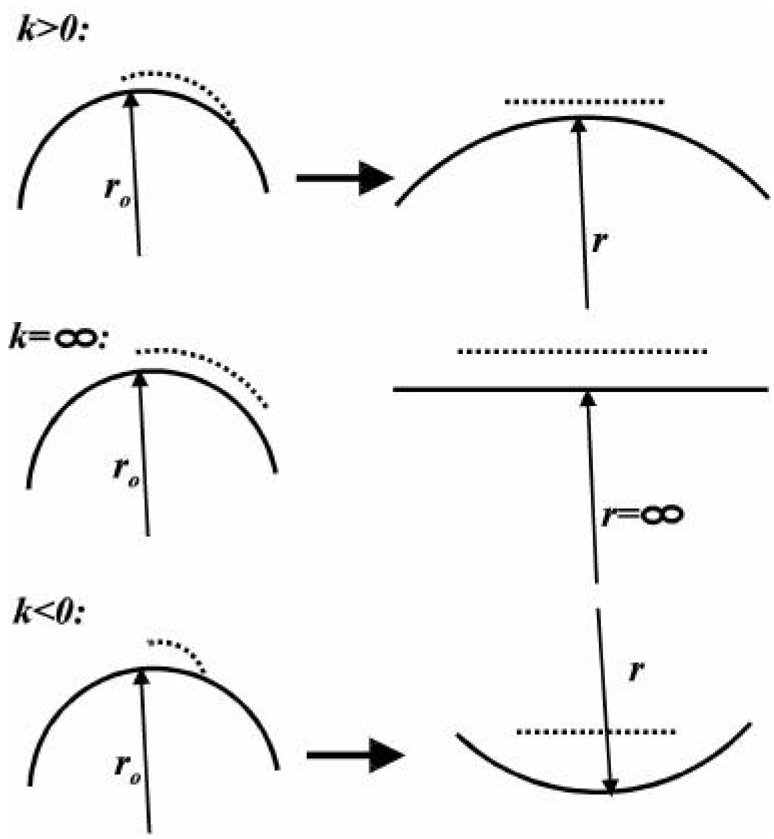
The following are some of the questions raised during our classes and my answers to them. Don't trust my answers all the times. You are welcome to question, challenge and discuss about them.

Question #1: What is the real meaning of the k-factor? When is it positive, negative and infinite?

My answer: The k-factor is a measurement of the effective earth radius when the normally-non-straight radio line-of-sight path is considered. In other words, the k-factor measures how the earth curvature you "see" when you "fly" like radio waves along the radio path and consider yourself flying in a straight line. That is, the k-factor gives us the relative curvature of the real earth in reference to the radio path if it is considered as a straight line.

To compute the k-factor, the original system is redrawn in such a way that the radio path becomes straight. Correspondingly, the curvature of the earth will be changed. The changed earth is then considered as the effective earth. The ratio of the radius *r* of the effective earth to the radius of the real earth r_o is then considered as the k factor. If the centre of the effective earth is on the same side of the real earth, the k is positive; otherwise it is negative. The following figures illustrate the concept:



Terminology:

transmission level point (TLP): In a telecommunications system, a test point, *i.e.*, a point where a signal may be inserted or measured, and for which the nominal power of a test signal is specified. *Note 1:* In practice, the abbreviation, TLP, is usually used, and it is modified by the nominal level for the point in question. For example, where the nominal level is 0 dBm, the expression 0 dBm TLP, or simply, 0TLP, is used. Where the nominal level is -16 dBm, the expression -16 dBm TLP, or -16TLP, is used. *Note 2:* The nominal transmission level at a specified TLP is a function of system design and is an expression of the design gain or loss. *Note 3:* Voice-channel transmission levels, *i.e.*, TLPs, are usually specified for a frequency of approximately 1000 Hz. *Note 4:* The TLP at a point at which an end instrument, *e.g.*, a telephone set, is connected is usually specified as 0 dBm.

psophometer: An instrument that provides a visual indication of the audible effects of disturbing voltages of various frequencies. *Note:* A psophometer usually incorporates a weighting network. The characteristics of the weighting network depend on the type of circuit under investigation, such as whether the circuit is used for high-fidelity music or for normal speech.

pWp: *Abbreviation for* **picowatts, psophometrically weighted**

pWp0: *Abbreviation for* **picowatts, psophometrically weighted,** measured at a zero-dBm transmission level point.

dBc: *Abbreviation.* dB relative to the carrier power.

dBi: *Abbreviation.* In the expression of antenna gain, the number of decibels of gain of an antenna referenced to the zero dB gain of a free-space isotropic radiator.

dBm: *Abbreviation.* dB referenced to one milliwatt. (188) *Note 1:* dBm is used in communication work as a measure of absolute power values. Zero dBm equals one milliwatt. *Note 2:* In DOD practice, unweighted measurement is normally understood, applicable to a certain bandwidth, which must be stated or implied. *Note 3:* In European practice, psophometric weighting may be implied, as indicated by context; equivalent to dBm0p, which is preferred.

dBm(psoph): Noise power in dBm, measured with psophometric weighting where

$$dBm(poph)=10log_{10}(pWp) - 90$$

where *pWp* is power in picowatts psophometrically weighted.

dBmV: *Abbreviation.* dB referenced to one millivolt across 75 ohms. (188) *Note:* This reference is not equivalent to dBm; it is, in fact, 1.33×10^{-5} milliwatts.

dBm0: Power in dBm referred to or measured at a zero transmission level point (0TLP). *Note 1:* A 0TLP is also called a point of zero relative transmission level (0 dBr0). (188) *Note 2:* Some international documents use dBm0 to mean noise power in dBm0p (psophometrically weighted dBm0). In the United States, dBm0 is not so used.

dBm0p: Noise power in dBm0, measured by a psophometer or noise measuring set having psophometric weighting.

dBr: *Abbreviation.* The power ratio, expressed in dB, between any point and a reference point selected as the zero relative transmission level point. *Note:* Any power expressed in dBr does not specify the absolute power. It is a relative measurement only.

dBrn: *Abbreviation*. dB above reference noise. *Note 1:* Weighted noise power in dB is referred to 1.0 picowatt. Thus, 0dBrn = –90 dBm. Use of 144-line, 144-receiver, or C-message weighting, or flat weighting, must be indicated in parentheses as required. (188) *Note 2:* With C-message weighting, a one-milliwatt, 1000-Hz tone will read +90 dBrn, but the same power as white noise, randomly distributed over a 3-kHz band will read approximately +88.5 dBrn (rounded off to +88 dBrn), because of the frequency weighting. *Note 3:* With 144 weightings, a one-milliwatt, 1000-Hz white noise tone will also read +90 dBrn, but the same 3-kHz power will only read +82 dBrn, because of the different frequency weighting.

dBa: *Abbreviation for* **decibels adjusted.** Weighted absolute noise power, calculated in dB referenced to 3.16 picowatts (–85 dBm), which is 0 dBa. (188) *Note:* The use of F1A-line or HA1-receiver weighting must be indicated in parentheses as required. A one-milliwatt, 1000-Hz tone will read +85 dBa, but the same power as white noise, randomly distributed over a 3-kHz band (nominally 300 to 3300 Hz), will read +82 dBa, due to the frequency weighting. *Synonym* **dBrn adjusted.**

dBa(F1A): Weighted absolute noise power in dBa, measured by a noise measuring set with F1A-line weighting. (188) *Note:* F1A weighting is no longer used for DOD applications.

dBa(HA1): Weighted noise power in dBa, measured across the receiver of a 302-type or similar subscriber set, by a noise measuring set with HA1-receiver weighting. (188) *Note:* HA1 weighting is no longer used in DOD applications.

dBa0: Noise power in dBa referenced to or measured at zero transmission level point (0TLP), also called a point of zero relative transmission level (0 dBr). (188) *Note:* It is preferred to convert noise readings from dBa to dBa0, as this makes it unnecessary to know or state the relative transmission level at the point of actual measurement.

dBrn adjusted: *Synonym* **dBa.**

dBrnC: Weighted noise power in dBrn, measured by a noise measuring set with C-message weighting.

dBrnC0: Noise power in dBrnC referred to or measured at a zero transmission level point (0TLP).

dBrn(f_1-f_2): Flat noise power in dBrn, measured over the frequency band between frequencies f_1 and f_2.

dBrn(144-line): Weighted noise power in dBrn, measured by a noise measuring set with 144-line weighting.

dBv: *Abbreviation*. dB relative to 1 volt peak-to-peak. *Note:* The dBv is usually used for television video signal level measurements.

dBW: *Abbreviation*. dB referenced to one watt.

dBx: *Abbreviation*. dB above reference coupling. *Note:* dBx is used to express the amount of crosstalk coupling in telephone circuits. dBx is measured with a noise measuring set. [From Weik '89]

Convolution Codes

Two web sites provide excellent explanations on the concept of the convolutional codes. They are:

http://www.complextoreal.com/convo.htm

and

http://cnx.org/content/m10181/latest/

You may also search for other sites or library books on digital signal processing for the topics.

Question #2: On page 525, the text seems to indicate -116dBm = 7*m*V/m and 39dB*m* = -95dBm. How are they derived?

My answer: Please see pages 829-830 of the textbook for the conversion with the following background knowledge:

1) The electric field intensity **E** is in the unit of V/m.
2) 39dB*m* actually means 39dB*mV/m* =20log|**E**|(*mV/m*)
3) The power density in free space produced by the field is $\frac{|\mathbf{E}|^2}{h}$ in the unit of W/m^2. h is the wave impedance equal to 377Ω.
4) The signal power collected by a receiving antenna from free space is equal to $P_r = \frac{|\mathbf{E}|^2}{h} A_e$ where $A_e = \frac{l^2}{4p} G_r$ is the effective area of the receiving antenna. l is the wavelength and G_r is the gain of the receiving antenna.
5) The equivalent voltage induced on the receiver can be $V = \sqrt{\frac{P_r}{Z_o}}$ with Z_o being the impedance specified at the input of the receiver.