COAXIAL CABLE COMPARISONS

**** Actual cables sometimes exhibit lower losses than those specified and often vary slightly from manufacturer to manufacturer. ****

WHAT DOES IT ALL MEAN ?

From the table of coax info below, it indicates that with 33 metres of standard poythene inner RG58 cable, the loss of signal at 400 MHz is going to be about 13dB. With low loss Cellfoam RG58 it reduces to 6.3dB and with Cellfoil it should be about 4.7dB. With RG213 coax (poly inner), it is only 5.0dB. When you consider that this figure represents the signal level drop between the bottom of the antenna and the receiver input, it is easy to see why you must use a short length of good quality cable if it is going to work efficiently.

13dB = 1/20th of the original signal power level is available from the output end of the cable
9.5dB = approx 1/10th
6.7dB = approx 1/4
5.4dB = approx 1/3

It soon becomes evident why we use low loss cable like CNT-400 or LMR-400 which has a loss of about 2.6dB for the same 33 metre cable run at 400MHz when we really want a good low loss system.

An extra note about the likes of RG6 and RG11 coaxial cables as used for TV signal distribution : You may see a reference to "tri-shield" and "quad-shield" but this construction does not affect the actual loss (/ attenuation) in the cable - only it's shielding factor.. i.e. the probability of something inducing signals into the coax inner from other wiring (eg power & lighting) within the premises or from other local RF sources (eg transmitters). The only truly "100% shielded" cables are those with completely continuous jackets like heliax, not multi-layer wound aluminium-tape jackets like quad-shield RG6 - which come very close.....

SELECTING THE RIGHT COAX CABLES & UNDERSTANDING THE "LOSS" VALUES

EXAMPLE : A PROJECT FOR WLAN USE

For those interested in using extension coax cables for Wireless LAN (WLAN) applications, take note of the following....
In the following examples we will ignore connector loss - which is minimal with high quality connectors when correctly terminated.

As an example, let's say you want a 20 metre extension cable to go from the wireless lan card (SMA Reverse Gender) to an 18dBi external antenna with an N connector.

You contemplate using RG58CU (cheap stuff, easy to find..) - the cable loss is 18dB at 2.4GHz negating all of your antenna gain. Connectors are available in various qualities to go onto the ends of the cables but note that these are generally crimp style and must be correctly terminated to minimise loss.

That loss is far too high so let's look at RG58 low loss (foam dielectric, easy enough to find but just a little more expensive) - - the cable loss is 11.4dB at 2.4GHz negating a good portion - 63% - of your antenna gain. This means that your system gain is now around 6.6dBi. Again, connectors are available in various qualities to go onto the ends of the cables but note that these are generally crimp style and must be correctly terminated to minimise loss. Use better quality to make sure that this loss is really minimised.

Yet another alternative : RG213U (poly dielectric, easy enough to find but just a little harder to handle) - - the cable loss is 7.8dB at 2.4GHz negating some 43% of your antenna gain. Problem : SMA reverse gender connectors are not available to fit this size cable so you must split it into 2 cables - the main cable which is N to N style connectors plus a "tail" of N to SMA reverse gender. Normally we recommend "tails" of up to 500mm as a maximum value and generally draw this back to 300mm to minimise loss. Let's say we elect to use a 19.7 metre RG213U cable plus a 300mm "tail". We have 7.6dB main cable loss plus a 0.3dB tail loss so at 7.9dB (giving 44% effective antenna gain) very similar to having a cable for the entire length. The effective antenna gain is now around 10dBi, not bad but can we do better ?

Lets' get serious now : LMR400 / LM400 / CNT400 - all basically the same cable but made by different manufacturers to the same general specification (foam dielectric, harder to find, harder to handle and more expensive and mainly only crimp connectors to suit) - the cable loss is 4.6dB at 2.4GHz negating just 25% of your antenna gain. Same problem : SMA reverse gender connectors are not available to fit this size cable so you must split it into 2 cables - the main cable which is N to N style connectors plus a "tail" of N to SMA reverse gender. Normally we recommend"tails" of up to 500mm as a maximum value and generally draw this back to 300mm to minimise loss. Lets say we have a 19.7 metre LMR400 cable plus a 300mm "tail". We have 4.53dB main cable loss plus a 0.3dB tail loss giving an overall 27% loss - not quite as good as having a CNT400 cable for the entire length but unavoidable becasue we can't get SMA connectors to suit this cable style. The total cable loss plus antenna gain gives an overall system gain of a little over 12dBi - a far cry from using cheap RG58 !

Now you may say, is the 2dB worth the extra cost over the RG213 ? Since 3dB represents a 2:1 power ratio or a 4:1 voltage ratio, the signal voltage at the far end is basically tripled by using the CNT400 cable. What about the foam RG58 ?- it ended up with a system gain of just 6.6dBi so only about 6dB worse than the CNT400 installation. Now just remember that the extra 6dB happens in both directions - transmit and receive. It means that the incoming signals from the WLAN link at the far end are also attenuated by that extra 6dB as well and if you have a questionable path in the first place then your data rate may fall considerably as soon as it starts raining ! If your need is for stable signal path, spend the money.

If you want to spend big money, look at the full heliax style cables but remember that you still need a "tail" on the end and you may find that the "tail" has more loss then the entire heliax cable run. Connectors for heliax often run upwards of $50/$60 each (2 required) and new heliax cable is usually at least $15/metre, usually more. Not a move for those "faint of wallet" but if performance is the target, spend the money.....

Cable Type	Insulation Type	Attenuation dB/metre 2.4GHz	Attenuation dB/metre 5.8GHz
RG174	PE	1.20	1.85
RG316	PTFE	1.10	1.70
RG58CU	PE	0.90	1.40

RG58U	Foam	0.57	0.89
LMR195	Foam	0.56	0.88
RG213U	PE	0.39	0.51
C2FP	Foam	0.23	0.36
LMR400 , CNT400	Foam	0.23	0.35
LDF4/50A	Foam (Heliax)	0.13	0.21
LDF5/50A	Foam (Heliax)	0.08	0.13
PE : Polyethylene (ie normal low cost coax)			
PTFE : Teflon			
Note : The dB/metre value is based on power loss			

TYPICAL COAXIAL CABLE DATA

Type	Nom. Imp Z_o	Outer Dia. (mm)	Nom loss (dB/100m) @ 50 MHz	Attenuation (dB/100m)				Vel. Factor %	Cap. pF/m	Voltage Rating {V_{rms}}
				100 MHz	200 MHz	400 MHz	1GHz			
RG - 6A/U	75	7.0	4.73	6.37	8.89	13.1	~26	82	53.1	2700
RG - 8/U	52	10.3	5.2	7.2	10.5	15.4	29.2	66	96.8	5000
RG - 9/U	51	10.67	5.2	7.2	10.5	15.4	29.2	66	98.4	5000
RG - 11/U	75	10.29	4.3	6.6	9.5	13.8	23.3	66	67.3	5000
RG - 58/U	53.5	4.95	10.2	14.8	22.3	32.8	55.8	66	93.5	1900
RG - 58A/U	50	4.95	10.8	16.1	23.9	37.7	70.5	66	101	1900
RG - 58C/U	50	4.95	10.8	16.1	23.9	37.7	70.5	66	101	1900
RG-58 Cellfoam (9001)	50	4.9	9.6	12.7	18.9	27.4	51.1	76	-	-
RG-58 Cellfoil (9006)	50	5.1	6.6	9.5	14.1	19.3	34.9	80	-	-
RG - 59/U	73	6.15	7.9	11.2	16.1	23.3	39.4	66	68.9	2300
RG - 59B/U	75	6.15	7.9	11.2	16.1	23	39.4	66	67.3	2300
RG - 62/U	93	6.04	6.2	8.9	12.5	17.7	28.5	84	44.3	700

RG - 62B/U	93	6.15	6.6	9.5	13.8	20	36.1	84	44.3	700
RG - 122/U	50	4.06	14.8	23	32.8	49.9	87	66	101	1900
RG - 141A/U	50	4.83	6.9	10.5	15.4	22.6	42.7	69.5	95.1	1900
RG - 142B/U	50	4.95	8.9	12.8	18.4	26.9	44.3	69.5	95.2	1900
RG - 174/U	50	2.56	21.7	29.2	39.4	57.4	98.4	66	101	1500
RG - 178B/U	50	1.83	34.4	45.9	62.3	91.9	150.9	69.5	95.1	1000
RG - 179B/U	75	2.54	27.9	32.8	41.0	52.5	78.7	69.5	64	1200
RG - 180B/U	95	3.56	15.1	18.7	24.9	35.1	55.8	69.51	49.2	1500
RG - 187A/U	75	2.66	27.9	32.8	41	52.5	78.7	69.5	64	1200
RG - 188A/U	50	2.59	31.5	37.4	46.6	54.8	101.7	69.5	95.2	1200
RG - 196A/U	50	1.93	34.4	45.9	62.3	91.9	150.9	69.5	95.2	1200
RG - 213/U	50	10.29	5.2	7.2	10.5	15.4	29.2	66	101	5000
RG - 214/U	50	10.8	5.2	7.2	10.5	15.4	29.2	66	101	5000
RG - 223/U	50	5.38	10.1	14.8	21	30.2	53.5	66	101	1900
RG - 303/U	50	4.31	6.9	10.5	15.4	22.6	42.7	69.5	95.2	1900
RG - 316/U	50	2.49	30.8	34.1	43.3	54.1	101.7	69.5	95.2	1200
BEL 9913	50	10.29	3.0	4.6	5.9	8.5	14.8	84	78.7	-
CNT-400	50	10.29	2.9	4.3	5.5	8	12.7	85	-	-
LM-400	50	10.29	2.8	3.9		9.1	13.8	85	77.1	2500