Practical High Speed Design, Part 1 of 3 Q & A

Question/Comment	**Response**
Is it true that the shorter the trace, the less the effect of the higher dielectric constant material?	That is correct, in that there is overall less loss. However, when you take in account the situation on a loss/length you still have a problem with the higher permittivity.
Do you have any good design material for differential coplanar waveguide equations, or any free software that allows you to design it?	TXLINE from National Instruments and Saturn make free software available for designing CoPlanar Waveguides (CPW).
To the presenter, do you have a book that you would recommend that covers these topics?	Not any specific book mainly because each book has pros and cons and I feel that there has never been an eclectic book that combines all the key issues without getting overly mathematical.
What is a drawback of using a lower permittivity material? Why not always use lower permittivity material?	Mainly cost. FR4 is the cheapest material out there.
Do I understand correctly that a thinner FR4 dielectric would then have less attenuation on the signal? Such as a higher number of layers makes each dielectric thinner than the same total board thickness with fewer layers…	That is correct.
I need to design layer stackup for specific impedances. Need tools to do that. Does Altium have the tools included?	Altium Designer currently does not have this ability. This requires a 3D field solver, which is not a trivial piece of code to develop. Here at Nine Dot Connects, we are the VAR for In-Circuit Design. They have a tool called 'iCD Design Integrity' which provides a simple to use, robust stack up planner. Please check out our website for more details: http://ninedotconnects.com/products-icd-design-integrity

It's clear that lower epsilon requires wider trace to maintain Zo, but what do you do in a dense design with no space for wider traces? In other words, how 'un-optimal' it can be before it stops working in order to gain in other areas? "Tradeoffs" is the name of the game!	Compromise is definitely the name of the game. The purpose of the presentation was not to talk about the width of the strip to generate 50 ohms. I mentioned that only to make sure that the audience knows that the Zo was taken into consideration. Creating a tradeoff matrix is the end goal but takes a complete picture to start rating the matrix items.
If lower dielectric material is better, why does the common FR4 material have such a high dielectric?	When FR4 was invented in 1968, the circuit speeds were not an issue. FR4 was designed to be flame retardant.
Besides cost, does a lower permittivity material grow trace width, possibly impacting the size/density of the overall layout?	In general, you would not route on such a thick material so the width would not be a problem.
One thing that would be nice to cover, if possible, in later webinars is what is 'good enough' when it comes to signal integrity and losses due to materials.	'Good enough' is when communication between two points is successful with no errors. If you can predict that, you can name your own price! However, that is not practical hence the reason we have the concept of BER (Bit Error Rate) and correction. Only years of experience will get you close to understanding how much loss is okay. Most people want to know it will work on the first run so all issues are considered and designed out as much as possible.
It looks like the calculation of 47% at 25GHz for RO4350 wasn't correct in the spreadsheet. it shows < -2.2dB, or 77%	If I understand your question correctly, at 25GHz the 47% comes from the difference between the two materials so that using the FR4 drops the signal 53% from the loss created by the RO4350. The -2.2 dB you are referring to is the loss that the RO4350 contributes. Insertion loss of 2.2 = 10^(2.2/-20) = 77% signal still present. Recall that S21 is the ratio of Vo to Vi.

The loss simulation showed gave lower loss for Rogers at 25 GHz than lower frequencies. This seems unrealistic and I don't know where it comes from. Also, this obviously does not take into account metal losses and changing skin depth.	That is a valid observation about the rising response and this will need to be investigated further. HFSS (High Frequency Structure Simulator) does take into consideration skin depth and conductor losses. According to Rodgers calculator those losses at the markers should be 0.46, 1.3, and 2.2 so the simulation was very close at 25GHz (2.3). *See graph below:*

Freq	Diel Loss	Cond Loss	Total Loss/in	4
1	-0.0120	-0.0160	-0.0290	-0.1160
2	-0.0250	-0.0260	-0.0520	-0.2080
3	-0.0380	-0.0350	-0.0730	-0.2920
4	-0.0510	-0.0430	-0.0950	-0.3800
5	-0.0640	-0.0510	-0.1160	-0.4640
6	-0.0780	-0.0590	-0.1370	-0.5480
7	-0.0910	-0.0670	-0.1590	-0.6360
8	-0.1040	-0.0750	-0.1800	-0.7200
9	-0.1180	-0.0830	-0.2010	-0.8040
10	-0.1320	-0.0900	-0.2220	-0.8880
11	-0.1450	-0.0980	-0.2440	-0.9760
12	-0.1590	-0.1050	-0.2650	-1.0600
13	-0.1730	-0.1130	-0.2860	-1.1440
14	-0.1880	-0.1200	-0.3080	-1.2320
15	-0.2020	-0.1270	-0.3300	-1.3200
16	-0.2160	-0.1340	-0.3510	-1.4040
17	-0.2310	-0.1420	-0.3730	-1.4920
18	-0.2450	-0.1490	-0.3950	-1.5800
19	-0.2600	-0.1560	-0.4170	-1.6680
20	-0.2750	-0.1630	-0.4380	-1.7520
21	-0.2900	-0.1700	-0.4600	-1.8400
22	-0.3050	-0.1770	-0.4820	-1.9280
23	-0.3200	-0.1840	-0.5040	-2.0160
24	-0.3350	-0.1910	-0.5270	-2.1080
25	-0.3500	-0.1980	-0.5490	-2.1960