

To: 3P Customers and Business Partners

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3P Newsletter No. 2/2009

Connecting Hardware Challenges

Writing "re-embedding" is certainly not a printing error. People being too focused on yesterdays de-embedding connecting hardware technology will probably believe that it is a mistaken writing of "de-embedding" or a close variant to this measurement technology. After all, the difference is only one letter ! However, this change of letter covers a technical revolution, which will shake the copper cabling market in the near future. There will be benefits for producers, and end users, installers and distributors will see connecting hardware with less variability in specified performance. The vast majority of producers will only get the benefits after a learning period with dispair and desperation, as I wrote in 3P Newsletter No. 1/2009. The present 3P Newsletter will provide details of the new test method, indicate a way to get there and discuss the benefits for the market.

The only specification available today is TIA/EIA-568-B.2-10 published last summer. In the not too distant future I expect that the re-embedding technology will be specified in both new TIA standard (ANSI/TIA/EIA-568-C.2) and IEC standards.

Principles of Re-Embedding Technology

The performance of connecting hardware depends on the inserted RJ 45 plug. This is, and has always been, the case and has in the past made it necessary for the producers to qualify a certain category of connector using a wide range of different performing plugs. For installers and end users it is necessary to use a relevant category of patch cords as the installation performance will otherwise become negatively affected causing high risk of installation failure.

For the re-embedding technology **only one plug** is used for the testing of the connecting hardware. In stead of actually inserting a range of tightly specified plugs to demonstrate

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performance this is done using software simulation. The performance of the connecting hardware without plug is calculated from the above described one plug measurement. The specified mated connecting hardware performance covering the full range of plugs is now just calculated from "vector" mating of the connecting hardware performance without plug (re-embedding operation). The calculation of performance for each RJ 45 plug type is carried out using the vector applicable for the plug in question. Basically, what you do is to calculate performance instead of actually inserting each of the many plugs.

This may sound easy, and it actually is when you know how. However, it is critically important that you use the right plug, equipment and artifacts, understand and carry out a correct calibration, and have the correctly working data processing programmes. There are many challenges in getting it right the first time.

Benefits of the Re-Embedding Technology

The new re-embedding technology will not significantly change life for the end users and installers. Connecting hardware will have less variability of specified performance due to the better qualifying test method, and the range of useable patch cords of a certain category will still be the same. Patch cord performance will still be as critical as before.

The performance of connecting hardware is more correctly identified by the re-embedding technology. No traditional pyramide impedance matching is involved as this is now more correctly done using short leads and mounting on specially designed PCBs. The re-embedding may therefore give a little different performance of connecting hardware than the earlier conventional types of testing. This does not, of course, imply risk of network operation failure of already installed and working connecting hardware. It just means that you will get less variability in performance when purchasing connecting hardware developed using the re-embedding technology.

The greatest benefits of the new test method applies for the connecting hardware producers. Measurement of connecting hardware performance will be more fast and easy and the battery of different plugs are not needed anymore. No pyramids are applied and the measuring set-up can be made using a PCB based plug called "Salsa", which has very little variability in performance between different plug samples. This means that changing of the Salsa type test plug will usually not significantly change calibration settings, and measurements have very low uncertainty (3P therefore uses the Salsa type test plugs in our measurements). Also important is that portable equipment has been developed to allow production type measurement of main transmission parameters, i.e forward direction return loss and near end crosstalk.

Market Expectations

I expect that the re-embedding technology will be made mandatory in new specification(s) in the summer of this year. It is obvious that this test method is the only realistic alternative for the Category 6_A / Category 6A connecting hardware as the Category 6 pyramide type of testing is having unacceptable high uncertainty in the high frequency range. However, this test method can also conveniently be used for Category 5e and Category 6 connecting hardware and will in this case offer benefits in simplification in testing and improved consistency of measurements.

Category 6 measurements can be carried out by just changing bandwidth to 250 MHz, and Category 5e measurements can be made after just changing the plug vectors and bandwidth. The same test set-up, test plug and calibration are used in all cases.

I therefore expect that the re-embedded test method will also soon replace the "de-embedded" or "pyramide" type testing.

Producer Specific Information

Implementation of the re-embedding test method will be difficult and frustrating for most producers. 3P knows from own experience that there will be times of despair when measurements do not succeed as planned and when software is playing with you. We also know the great benefits when the new measurements are running fast and smoothly without the need for pyramide and many plugs. In the last part on this 3P Newsletter I will provide some guide on how to get the re-embedding test method working. The following six steps are involved:

- a: Understanding the method
- b: Deciding the test variant (leaded test plug or Salsa solution)
- c: Ordering equipment
- d: Ordering / preparing artifacts
- e: Getting data processing programmes (for instance based on Excel)
- f: Comparing the first test results with experienced testing authorities

a: Understanding the method

A necessary first step will be to get a copy of the latest available standard, and read and understand the extensive information about the test method. At the time of this 3P Newsletter it means purchasing TIA/EIA-568-B.2-10.

Support documents have been prepared by various companies and are often extremely useful in providing understanding. I will later communicate public availability of such documents if allowed by the sources.

b: Deciding the test variant (leaded test plug or Salsa solution)

The specified test method includes both a leaded test plug and a Salsa (PCB based) test plug solution. 3P strongly recommends the Salsa solution. As mentioned before, this is because the Salsa plugs have very uniform performance and the uncertainty of the test method is very low. This is of course fundamentally important as the performance of highest categories of connecting hardware will often be close to the limit. A high uncertainty will therefore imply a risk of failure alone due to uncertainty of the measurement.

There are, however, some practical consequences regarding this choice. The artifacts to be used are different, and as far as 3P knows the NEXT reverse artifacts are not yet commercially available. Before selecting this method one should make sure that these NEXT reverse artifacts can be found. 3P will be happy to supply information on how to get these artifacts when official information is hopefully soon published.

c: Ordering equipment

Equipment is available from SMP as it is written in detail in the earlier referenced specification. SMP provided guidance to which PCB's are required when 3P was purchasing the equipment. 3P will also be available with a component list for the Salsa solution.

Typical costs and timescale for delivery should be requested from SMP. When 3P ordered the equipment the delivery time was some months and the investment was around 15.000,- US dollars. However, both delivery time and costs might of course be quite different today.

d: Ordering / preparing artifacts

It should be stressed that artifacts are needed for the calibration measurements. These artifacts are different for the leaded plug and Salsa solution, and availability is also described in the above referenced test specification. A few artifacts can be prepared internally. 3P will be available for information about artifacts needed for the Salsa solution.

e: Getting data processing programmes (for instance based on Excel)

More and more new testing technologies are based on computer processing of data, 3P always uses Excel. This is therefore not special for the re-embedding testing, but the complexity of programming is. It will surely be most helpful if you have access to already working processing programmes, and otherwise you should consider the necessary time for software development.

f: Comparing the first test results with experienced testing authorities

When the first measurements are carried out you need to ask yourself if the measurements are actually correct. Some first guide would be to measure a known Cat. 6 connector and compare with the results from the pyramide type testing. However, as written earlier an exact match can not be expected as the two methods may give a little different result. This is nevertheless a good guide to know if the re-embedding measurements are quite off.

Another way of verification is to compare with the production type testing if you have this accessible at the time. Both NEXT and return loss in forward direction should show closely similar performance using the two different test methods.

The final approval of your re-embedded testing is to compare with the measurement results of one or even better more experienced measurements authorities. This is done by having measurements of a specific connector sample carried out by your own and by experienced testing laboratories. A closely similar result will be an approval of your measuring capability.



I appreciate that it may not be easy to find experienced companies which offer to carry out comparative testing, and testing of products with know performance will fortunately get you almost there. However, successfully concluded comparative testing is still the ultimate way to get assurance that your re-embedding testing facility is working correctly.

Yours sincerely,
3P Third Party Testing

A handwritten signature in purple ink that reads "Poul Villien". The signature is written in a cursive style with a large initial 'P'.

Poul Villien