

# White Paper

## NVP, what is it for?



In this paper, Simon Robinson, Excel Product Manager, explains the term NVP and how it is used in infrastructure data cabling.

### NVP, what is it for?

NVP, yet another acronym to understand in infrastructure cabling... NVP is a property of copper data cabling that is, hopefully, stated on specification sheets and required to carry out testing, but why?

Firstly, NVP stands for Nominal Velocity of Propagation. It is the speed at which the data signals travel down the cable expressed as a percentage of the speed of light in a vacuum. So a typical NVP

for an unscreened cable may be 69% (sometimes expressed as 0.69). The speed of light in a vacuum (designated by the letter  $c$ ) is a constant and is  $299\,792\,458\text{ ms}^{-1}$  (metres per second) – far easier to quote the percentage than use the value.

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### What is NVP used for?

Part of the requirement of testing is to record the length of a copper data cable. This can be done manually by reading the cable sheath, and hoping that the metre marks are reasonably accurate and then recording it. This is not very easy once the cable is installed and would also require manual input in the test results. So by knowing the speed that the signal is transmitted down the cable it is a simple matter of the test equipment using:

$$\text{Distance} = \text{Speed} \times \text{Time}$$

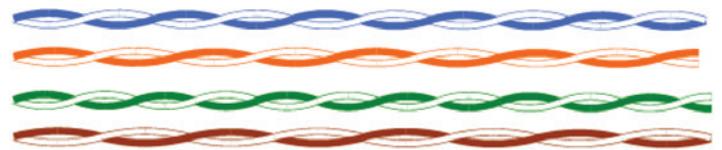
The testers measure the delay in the signal (time) and use the speed (NVP x  $c$ ).

### Which length is used?

There are in fact different lengths when looking at a twisted pair cable.

- Sheath Length
- Copper Length

The Sheath Length is the physical length and most cables, including Excel, have metre marks to aid this measurement. Copper Length is the actual length of the copper conductors. Data cables are constructed of twisted pair cables. Each of the four pairs has a different twist rate, and so is of different length.



### 4 Pairs of different twist rates

Different twist rates are used on the pairs to improve the performance and reduce cross talk issues. These different lengths accounts for the delay skew (see below). When the length of the cable is referred to in cable or installation design it is the sheath length that is the measurement.

Attenuation (Insertion Loss) is directly proportional to the length of the installed cable. The longer the cable the more the signal is attenuated or lost.

### Why is the length important?

Attenuation (Insertion Loss) is directly proportional to the length of the installed cable. The longer the cable the more the signal is attenuated or lost. The components for infrastructure cabling systems up to and including Class FA are designed to ensure that the insertion loss does not exceed certain values when the channel length is at a maximum of 100 m. By specifying these limits, applications can be developed knowing that they will work on compliant Generic Cabling systems. As mentioned above, the twist rates of each pair, is different within the sheath. The different lengths of the pairs means that the delay (the time taken for the signal to be carried down the cable) will be different across the pairs. The difference in delay between the longest and shortest pair is the delay skew. It is important that the delay skew is within limits to ensure that the applications, that use multiple pairs, will function correctly.

## How is NVP calculated?

The standards use the delay measured at 10 MHz of the shortest pair on 100 m (sheath length) of the cable.

### Example – Excel Category 6 Unscreened Cable – LSOH

Delay measured at 10 MHz of shortest pair (lowest value)  
= 497.075 ns (nanoseconds)

=  $497.075 \times 10^{-9}$  seconds

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Speed} = \frac{100 \text{ m}}{482.675 \times 10^{-9}}$$

$$\text{Speed} = 207\,178\,743 \text{ ms}^{-1}$$

Therefore

$$\text{NVP} = \frac{\text{Speed}}{c}$$

$$\text{NVP} = \frac{207\,178\,743 \text{ ms}^{-1}}{299\,792\,458 \text{ ms}^{-1}}$$

$$\text{NVP} = 0.69 = 69\%$$

## Finding the NVP

The NVP of data cables are stated on specification sheets and often stored in the test equipment as well under the manufacturers name – for example Excel. These are, as the name implies, are nominal values and may vary between batches. For improved accuracy the actual batch of cable being used on a given installation can be checked. The NVP can be measured using field test equipment such as the Fluke DTX-1800. A known length (using cable sheath length measurement) permanent link is connected to the field tester. The field testers have a function to calculate the specific NVP without going through the above calculation.

### In summary

NVP, Nominal Velocity of Propagation, is the fraction or percentage of the speed of light that is used to express the equivalent speed that signals travel down the length of the constructed cable. This speed is used to measure the length of the cable. Knowing the length of the installed cable is important to ensure that it meets the specification and therefore will support the stated applications.

*This White Paper has been produced by Simon Robinson, Product Manager, on behalf of Excel*

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