Why 100v line?

Let's say you've been asked to provide a PA system for a large outdoor fete. You only need it for speech and possibly low-level background music, but you need a lot of speakers to cover the area and they're all some distance apart. This would present an absolute nightmare if you wanted to use a 'standard' low impedance PA amp and speakers. For a start, the distances involved between amp and speakers are pretty large, hundreds of metres or more. Sure, you could run a low impedance system, but you'll need to compete with extremely high losses in the cables. Either you put up with stupidly large voltage drops, or you use very bulky cable. Either way, its kludgy at best and very inconvenient. That's assuming your amp is even happy with driving such long lengths of cable.

That's just the start. Now imagine you need 15 speakers to cover the area. How are you going to wire these and still present a suitable impedance load to the amp? You could do it by wiring in series-parallel combinations, but the wiring would soon become a rats nest, and for temporary events you want the installation to be as quick and painless as possible to set up and tear down.

What's the difference?

In a 100v line system, the amp and every individual speaker is fitted with a transformer with a high impedance primary and low impedance secondary. The primary is the 100v line side, and the secondary is connected to the speaker driver. If you're even slightly familiar with Ohms law, perhaps you're starting to see the advantages here already. With this system we increase the line voltage in a tradeoff to decrease current, whereas a standard low impedance system operates at high currents and relatively low voltages.

100v vs low impedance:

As we've already covered, our high impedance system passes less current down the cables than the equivalent low impedance setup. The higher voltage and lower current are a major advantage in long distance cable runs, as the power loss in the cable is proportional to its length and the square of the current flowing within it. Not that dissimilar to the national grid - pylons support high voltage transmission cables carrying hundreds of kilovolts at comparitively low current, substations use large transformers to decrease this voltage to something more useful to us at higher current. Even if we do lose a few volts down the cables in our 100v line system it isn't too critical, the voltage loss expressed as a percentage is relatively low.

Of course, that isn't the only advantage. We can also add all our speakers in parallel without having to worry too much about impedance. This means no messing around with series/parallel wiring combinations and no rats nest of cable. You can daisy chain from speaker to speaker, break out from a central point in a star wiring scheme, or pretty much whatever else takes your fancy as long as everything remains in parallel.

It is important to realise that this system does have limitations. For a start, each speaker has to contain its own line transformer. When we're only talking low wattage this isn't a major problem, but it does add to the weight, bulk and cost of the speaker. Frequency response is also limited - remember that these transformers are having to deal with a wide frequency range and we can't expect them to be efficient across such a broad spectrum. If you want low frequency bass and crisp, clear highs then you can forget 100v line, its applications lie within speech and low level background music applications at outdoor events or in large buildings such as shops and hospitals.

There are some factors that need to be considered when designing your system. As a golden rule, the total wattage of all speakers in the system should NOT exceed the output wattage of the amplifier. You can

combine different wattage speakers into the same system if you wish, but only if the combined power of all the speakers is not greater than the output power of the amp. You will find the transformers in some speakers have a number of wattage taps that you can select from, for example a 15w speaker might have 5, 10 and 15w taps. Select whichever is most appropriate to your needs, if you want to combine many speakers on the same line then it makes sense to use the lower wattage taps. You could have twice as many speakers driven from the same amp if you used the 5w tap as opposed to the 10w.

As mentioned previously, 100v systems require smaller cable conductors than low impedance systems. However, you still do need to choose the right cable for the job. While these systems can and will run on bell wire, this is only suitable for low wattage systems over relatively short distances. The graph below gives general guidance on choosing the correct type of cable for your application. If you know the distances you're working with and the total power of the system then simply follow along the X and Y axis until the two lines meet, and choose the size of cable above the point where the two lines intercept.

The graph assumes a two core sheathed cable, which is probably the type you are most likely to encounter in a 100v PA system. The figures given are for the worst case scenario with the system running absolutely flat out, in many cases it may be possible to use a smaller cable than suggested by the graph if you are only running the system at low power. If you wire your speakers in a daisy-chain fashion then only the initial cable between the amp and first speaker will carry the full wattage of the system, the further down the cable you get the lower the load and thus the smaller the cable you can use.