

**A good place to start with an overview of wire and cable in general and technology and Ultralink in specific is the following. It is the complete and unedited interview done for the August 2004 issue of Home Theater Magazine by Scott Messer.**



## 20 Questions for Ultralink's Don Bouchard

High-end cable is a subject that often inspires passionate opinions. Don Bouchard—the Vice President of Sales and Marketing for Ultralink/XLO, a manufacturer of high-performance A/V cables and connectors—discusses the cable terms you need you know and offers his insight on the benefits of high-end cable. Due to space restraints, we could only publish excerpts here. To read the complete transcript of the interview, including an in-depth discussion of the various technologies employed in cable manufacturing, visit our Website at [www.hometheatermag.com](http://www.hometheatermag.com).

*by Scott Messler*

### Can you tell us a little about your background?

I started in the specialty A/V business in 1972. Since then, I've worked for a number of audio companies, including Ohm Acoustics, Dahlquist, and with Mark Levinson at Cello.

### What brought you to Ultralink/XLO?

I had almost made the decision to semi-retire when a mutual friend of mine and the Ultralink/XLO folks told me that they had something special going on. He felt we were perfectly suited for each other, and he was right.

**Was there a certain event that opened your ears to the benefits of using high-quality cables?**

I confess to being a true audiophile and music lover. I was with Mark Levinson in the Cello studio one evening, and he was recording the famous jazz sax player Chico Freeman. We were doing some direct live-to-recorded listening. It was going well, but there was something in the live performance that the recorded one lacked, even though the playback was in exactly the same acoustic space and just moments after the actual live performance. At one point, we changed the speaker wires, and suddenly it all came together. All of us in the room experienced the same thing the minute the first notes were played with the new cable. The five or six of us, including the musicians, just took a big breath and smiled. Suddenly that wonderful Cello System had become magical, and it was the change of the cables that let it out. From that day on, I realized how important cables are in the final performance of any A/V system.

**What would you say to the skeptics, people who believe that you can't hear or see the difference between high-performance cables and inexpensive, off-the-shelf cables?**

I'd point out the difference between belief and knowledge. I know from first-hand experience that a quality signal-delivery system is as important as any other major component in the system. More than anything else, it determines the context that allows an accurate evaluation of all the other components' performances.

**How would you help demystify the world of high-end cables?**

The wire-and-cable component is the single most pervasive element in the entire system, connecting every piece of hardware to the next. Short of the final transducers—the loudspeakers and display—the cables have the greatest potential to screw things up. Without a well-designed, properly conceived signal-delivery system of quality cables, you simply leave an awful lot of the performance that you paid for in the box. It's unrealized potential. Many hobbyists, even those who are among the faithful cable lovers out there, consider cables to be like spices in a great recipe. Throw in a dash more brilliance to compensate for a bit of dullness in the speakers. Their new CD transport seems a bit bright and etched; to correct this, they put in some cables that have been reviewed as soft and mellow. In my view, this is all wrong. The cables are a main dish, not a seasoning. They're a major contributor to the complete experience of the meal, from appetizer to desert.

**Is there a certain price point when the user should invest in high-quality cables?**

A good rule of thumb is to begin your cable-system budget at the price of the most expensive component in the system. In a well-designed, properly balanced system, this should give you all of the performance that the hardware is capable of delivering without going cable crazy.

**Does Ultralink/XLO have a particular philosophy regarding the transmission of audio and video?**

Absolutely. Get out of the way. As I mentioned before, the signal delivery component is the most pervasive element in the entire system. Yet, unlike the other components, whose job is to do something, the wire and cable's job is to do *nothing*, letting the other components reveal to their fullest ability the performance of the musicians and the filmmakers. It is staggeringly difficult to make a cable that does nothing except let the other components talk to each other. Things *like* to do something. They like to leave their mark. A lot of cables—especially when casually mixed and matched and not carefully considered—simply act as a series of filters, each one progressively decoupling you from the experience that you want and pay for.

**Do you have any interesting anecdotes about the results of upgrading an existing system to high-quality cables?**

Just last summer, I was in Brazil and we had just won Best Sound of Show at the Brazilian High End Show. We were invited by a world-famous audiophile to visit him at his estate and demonstrate our cables in his system. We were thrilled at the invitation and opportunity. After a full day and two wonderful nights in the palatial, rain-forest setting, listening and watching, changing out one cable at a time from the dozens of costly brand-name cables in the system to XLO, we totally transformed what was already one of the finest systems I've ever experienced into something that exceeded even my wildest expectations for total system performance. Everyone agreed: the system owner, his full-time engineer, and his audiophile friends. It was very late (actually very early), and our local distributor began to pack up the demo cables so that we could move on to the next client. The system owner practically screamed, "Stop! What do you think you're doing?" "Putting the system back the way it was." "Oh no," he said, "wait a minute." He then disappeared into another room and immediately returned, tossing a fat roll of U.S. dollars into our Brazilian distributor's hands. "These cables now are mine. You will not leave with them. My system will not go back to what it was." After much cajoling, he allowed us to "borrow" his cables—"but only for two days"—to complete our demonstrations around the country. His chef and serving staff then served us a wonderful seven-course meal on a deck overlooking his valley and rainforest. It was fantastic!

**If a well-designed wire-and-cable system offers such performance improvement in a million dollar system, do you find that one will offer similar enhancements to systems at other price levels?**

Absolutely. We've seen and heard it dozens of times over the full spectrum, from very modest systems to the most extravagant ones. That's one thing about Ultralink/XLO; we make products from the entry-level Ultralink Mach-1 cable to the most expensive XLO Limited Edition, which are among the most respected in the world because they perform.

**If you could only afford to upgrade one set of cables in your system, which would it be? Which would make the biggest noticeable impact?**

That's a great question that I simply can't answer because it's different for each system. My suggestion is to go about it scientifically. Visit your dealer and bring home a complete cable system: power, signal, analog, digital, speaker, audio, and video. Then begin swapping them out with what you have in place right now. Re-cable the whole thing, one cable at a time. Each cable swap should bring about an audible or visible performance change. Make note of the results, especially the improvements with the most impact. Start there, with the goal of eventually replacing them all. For each system, the order of change will be different; but, I assure you, in every system, the net result will be a transformation and improvement equal to or greater than upgrading every other component in the system one level (or more) and at a much lower price tag. You won't get any help or insight in this from the megastores, but many A/V specialist dealers, especially members of the Professional AudioVideo Retailers Association, will be happy to help you come up with a plan to upgrade the cable system over a period of time. Beware, however, the temptation will be to just go into the other room and bring out a wad of cash and send the dealer home. You won't want your system back the way it was either.

**What differentiates Ultralink/XLO from a lot of the other high-end cable companies?**

The differences are what brought me here. The first thing is that we're a prime manufacturer of wire and cable. We make the stuff. We buy raw materials—raw copper and blocks of dielectric materials. We machine our own connectors. We roll our own. Just a few months ago, we purchased 1.5 million pounds of raw copper. We make OEM cable for others, including many brands you'd know that I can't mention, as well as our own Ultralink and XLO brands. We make our cable (not just our packaging) in North America: XLO mostly in California and Ultralink mostly in Toronto, Canada, although we do a bit of crossover between our brands and factories. Almost all of the other high-end cable companies are marketing companies only. They import completed or almost completed goods (usually from China), package the product, and sell it as their own. "Made in the USA" doesn't mean what you think it does. Virtually all of the hundreds of cables out there come out of the same few overseas factories. Being a true manufacturer makes a fundamental difference in the way we approach things because we have total control over our product: conception, design, material selection, actual manufacturing, termination with our own connectors, quality control, packaging and post-sale service and support.

The other cable marketing companies each seem to have one thing on which they hang their hats—conductor composition, dielectric material, the geometry of the assembly, or the brilliance of their heavenly-inspired wire-guru. The reason for this is simple. Differentiation of a category that is, in the main, mostly un-differentiated is extremely difficult. One approach to cables simply can't work for all the things that we ask wire and cable to do. Look at the huge range of applications that fall into the single "cable" category. Low voltage/high voltage, low current/high current, low bandwidth/high

bandwidth, analog/digital, audio/video, short run length/ long run—the list goes on. It should be obvious that the things that make a good phono cable or digital video cable aren't the same as what will make a good speaker wire or power mains cable. There is no single magic-bullet technology. An interconnect will work as a speaker cable and vice-versa. For that matter – so will a bridge support cable. Dressing them up in different skin and soldering different plugs on the end doesn't change what they really are. The fact is that that these generic, multi-application products do work – they just don't work well.

As an engineering- and performance-driven manufacturing company, we produce application-specific products that are each designed and manufactured for that application, using all appropriate materials, techniques, and technologies. We don't have to use a single type of cable for multiple applications to keep purchase quantities high and prices low. That's why— even within a brand and a line of Ultralink and XLO products—we use different design, materials, and construction - ones specific to the job that we're asking of that cable. They look different because they are different, and we're asking them to do different jobs. It isn't marketing vocabulary and magic fairy dust. It's pure design, the best materials (many of which are available exclusively to us), our own manufacturing, and 100 percent quality control, which allows us to offer a lifetime warranty.

Only then does the marketing come in. Frankly, for years we've done a much better job of making the product than marketing it. That's changing. The marketing is important, but we believe that you have to have a superior, seriously differentiated product first. Then, when you go out and market it, you have something to say beyond tricky marketing and vocabulary. As my father always used to tell me, "Then it has the extra-special added benefit of really being the truth." And, best of all, it doesn't have to cost more. Because we really are the manufacturer, there are at least several fewer layers of profit taking involved that add no value to the product. Being closer to the customer allows our prices on North American-engineered products manufactured with the finest materials available to be equal to or even less than the imported, repackaged brands, large and small.

**There are a lot of technical terms used in describing cables and connectors. Can you explain some of these and how they affect the end user? Let's start with "time aligned."**

Time alignment can have two meanings, both of which refer to frequency-related phase shift.

1. First, in describing a product's frequency response, we normally speak of "flat" response as being the ideal. What this refers to is the fact that, if all of the frequencies passed by a particular product are passed at the same amplitude—whether the same as, increased over, or reduced from source level—the chart that would describe that frequency response would be a straight horizontal (flat) line. Most products, however, are not flat in their frequency response because, for a variety of reasons, they are more efficient at some frequencies than others. They therefore produce or reproduce greater or

lesser amplitudes at different frequencies. Each of these differences in relative amplitude produces changes in the effective phase of the passed signal at that frequency, with each 6 decibels of frequency-response difference (as relative to other passed frequencies) producing a phase shift of 90 degrees. Large amounts of phase shift can strongly affect a signal's sound, but most cables and most electronics don't produce large amounts of phase shift.

2. Loudspeakers, however, do produce large amounts of phase shift, as do their associated crossover networks. As applied to speakers, time alignment usually refers to moving the drivers of a multi-driver system to such positioning that a pulse signal reproduced by all of the system's drivers at a given instant will arrive at a given point as a single coherent positive or negative pressure wave. A time-aligned crossover is designed to produce the same effect without moving the drivers by slightly changing the signal's arrival time at each driver electrically to compensate and correct for their physical misalignment. For proper imaging, it's important that all of the frequencies produced arrive at the listening position at the same time, hence the term "time aligned." Generally speaking, only cables that are poorly designed (very high capacitance or inductance) or use purposely frequency-selective design elements (magic boxes, for example) have to worry about time alignment. Several of our Ultralink speaker-wire products use a multiple gauge construction to go that last step in providing a properly in-phase or time-aligned signal to the speakers. From that point on, it's up to the speakers and the room acoustics.

### **How does multiple-gauge construction help?**

Multiple gauge refers to the practice of using bundled wires of several different thicknesses in an attempt to overcome skin effect phase shift. By providing thinner wires positioned at the outside of the cable bundle, the higher frequencies will be less affected by the skin effect phase shift, while the lower frequencies have thicker wires deeper in the bundle to allow them better performance at deep run depths with the cable construction. The effect of this type of construction is small compared with other, more-fundamental issues like conductor material and purity; however, if everything else is right, attention to the fine details provides a superior signal delivery.

### **What about conductor material, purity, and "oxygen-free copper"?**

OK. Conductor material first: the copper-versus-silver battle. There are those who tout silver as their primary conductor material. For the most part, those who favor silver do so mistakenly. Their reason for thinking that it must be better (despite the evidence of their ears that it isn't) comes from looking at comparisons of the conductivity (or its converse, resistivity) of copper and silver. Silver is, in fact, the best conductor known, with copper being second best, with 9 percent lower conductivity (or, if you prefer, 11 percent higher resistance). The trouble with this assumption is that silver is a better conductor than copper for direct current, or DC. There's no application of DC in audio, video, or data distribution—never. Audio/video/data signals are all alternating current, or AC—always. For AC, copper is usually the better conductor by a good margin.

## **Is there an application where silver is the best choice?**

The only application where silver, if used to full advantage, can be better is for very high-frequency signal transmission. It has application in high-definition video cables, if properly designed, and in the newer digital video cables. Ultralink uses some silver in our Videophile Reference Series of high-def analog, DVI and HDMI digital video cables. XLO's new VUE video cables are made of a special silver-based alloy. But, for virtually all other applications, our high-purity, lab-grade copper is the best conductor to use and, despite the impression, much more expensive than silver. Currently, the 6N lab-grade copper that we use is several times more expensive than pure silver. We use it even in our least expensive Ultralink cables because it's better, not because it's cheaper.

## **What does 6N mean?**

The copper's purity is important for several reasons. Except in purposely alloyed copper (brass, for example), the impurities are usually found not so much within the copper crystals as between them. Practically any element can appear as an impurity in copper, but by far the most common are oxygen, sulfur, and the three metals of the iron triad: iron, nickel, and cobalt. The least pure copper (other than copper alloys) is Electro Tough Pitch (ETP), which is used to make U.S. pennies and ordinary house or appliance wiring; even it is at least 98 percent pure and highly conductive. Oxygen Free High Conductivity (OFHC) copper is normally regarded as being at least 99 percent pure and is just slightly more conductive than ETP. The purest copper known to exist is 99.99997 percent pure—that's six nines before the first non-nine digit, hence the term 6N. It may seem like the difference between OFHC copper and 4N or 6N copper is small, but remember that each additional N represents a tenfold decrease in impurities. Some manufacturers have claimed to develop coppers of greater purity than 6N, but, seeing as there's no equipment known that can measure copper purity beyond 6N, it doesn't seem likely.

## **Why is 6N important?**

Purity's real importance has very little to do with conductivity. Much more important is its effect the passing of low-level signals, which we know is where all of the music's texture and fine detail lies. It also is frequently the determining factor is squeezing the last bit of fine resolution, color, and shadow detail out of a high-def video display. Oxygen in the copper forms copper oxide at the junctures of adjoining copper crystals. Copper oxide is a semi-conductor, and these very tiny incursions of copper oxide are in fact little diodes, which act to limit and polarize very low-level signal transmission. The ferrous metal impurities, which also concentrate at crystal junctures, can be magnetized and, once magnetized, they act to limit and polarize very low-level signal flow. The result is a substantial degradation of imaging, resolution, and overall sound quality because it's precisely in this low-level information that the magic resides. Increased copper purity means increased detail and resolution because it removes those things that limit it. Higher-purity copper is usually made by a refining process that includes a series of melting, impurity separation, and recasting that results in fewer, longer crystals per

volume of metal. Reducing the number of crystals reduces the number of crystal junctures, which give fewer places for impurities to concentrate and create problems. That's a major reason why it sounds and looks better.

6N copper is also far more flexible and reliable to terminate. The prime failure mode in premium cables is termination failure, and the 6N copper remains much more flexible and less brittle after being heated and soldered to the connector; hence, it's much more reliable. This is particularly important in cable constructs that feature many ultra-thin separate conductors carrying a low-level, high-bandwidth signal like DVI, HDMI, and other HD video signals. We even use a proprietary process that actually micro-welds the conductor to the pins, requiring much less injection of foreign metal into the signal path.

### **Does the conductor or wire size make a difference?**

Sure it does. Bigger, fatter conductors will carry more signal with less loss. However, there is a downside. The tendency of higher frequencies to travel on the outside of the conductor means that the wire assembly's geometry makes a huge difference in performance. Our XLO Limited Edition speaker cable is actually made up of multiple small-gauge conductors carefully wound around a Teflon variant core so that there's never skin effect. All of the conductors are at the shallow, skin level. Only at the two termination points do they come together to make up a conductor whose total thickness is a whopping 6 AWG.

Another thing is that all gauges aren't created equal. Each country can designate its own gauge table. Most reputable companies use AWG, which is American Wire Gauge and is, therefore, standardized to a point. However, testing has shown that what many companies refer to as 12-gauge wire is simply two strands more than 14-gauge, 16-gauge is two strands more than 18-gauge, and so on. With the copper content being an important cost contributor, it's easy to see why some might fudge on this key specification. Again, being a prime manufacturer gives Ultralink/XLO total control over our finished product. If we say 16 or 12 or even 6 AWG, it's guaranteed to be a minimum of that number. We're not dependant on a factory 8,000 miles away and won't cut cost corners in this way.

### **You mentioned terminations and connectors as being important. How does gold plating affect the performance?**

Very simply, the copper conductor—which oxidizes over time, especially at the tips where it's exposed to air—is plated with gold, which doesn't oxidize. The trouble is, it's not exactly that simple. Most everyone doesn't plate the gold directly to the copper conductor; they use a nickel substrate to make the gold prettier, shinier, smoother—better audio jewelry. Unfortunately, also as we discussed above, nickel is one of the ferrous metals and gets magnetized by any electrical current. The metal's magnetic field varies with the electrical signal and, even after the signal passes, it retains a residual magnetic charge. Remember in science class when you wound the wire around the nail and hooked it up to the battery? Even after you disconnected the battery, the nail attracted other nails. The nickel substrate between the copper conductor and the gold plating acts the same

way. To my way of thinking, having little magnets in your signal path is a bad concept. That's why all Ultralink and XLO connectors are pure 24-carat-gold plated directly to the conductor without any nickel at all. The connector is a bit more yellow and not quite as shiny, but then it isn't jewelry—its performance as a signal-delivery component is its only function and direct plating to the conductor is the best way to do that.

As the actual manufacturer of our products, we design, machine, and plate our own connectors. This makes a difference. It assures tighter connector tolerances. Another big additional benefit to making our own connectors is constant impedance from tip to tip, as designed and specified. This is particularly important in video and digital applications, since most finished cables don't deliver the required impedance end to end. By the time the factory in China heats the wire up and solders off-the-shelf bulk connectors to it, the impedance can vary all over the map. The display device is looking for a true 75 ohm; if it doesn't get it, performance suffers noticeably. These are two of the areas where only Ultralink brand products met the stringent specs for many of NASA's connection product requirements and are why our products are flying in space. Imagine the cost of a service call to the Hubble telescope.

### **Two other techie terms: capacitance and impedance.**

The major electrical characteristics of a cable are resistance (R), capacitance (C), and inductance (L). Resistance is determined only by the type and amount of the conductor material. The more conductor, the greater the diameter and the lower the resistance, which means that less current or signal is lost as heat—a good thing. But remember our discussion earlier about wire gauge and skin effect, so it isn't just a matter of building big, fat wires. Capacitance and inductance are both determined primarily by how far apart the cable's two conductors are from each other and what the material is that separates them. Capacitance and inductance are in an inverse relationship to each other. This means that the more capacitance is present (because the wires are closer together), the less inductance there will be; the farther the wires are apart, the greater will be the inductance and the less will be the capacitance.

### **Is there an ideal ratio?**

Most good cable designers seek a balance of capacitance and inductance, with both designed to be as little as possible. This is important because too much cable capacitance or inductance can negatively affect frequency response, and the balance that a cable has in these areas is critical to its performance.

### **How about twisted-pair configurations and the terms shielded, double shielded, and quad shield?**

In order for signal to be passed through an electrical circuit, there must be two wires, one coming in from the source and one returning to it. These are the pairs referred to by the term "twisted pair." The two wires are twisted together (wound one over the other) as a form of mutual shielding: Each wire, to at least some degree, acts as a shield for the

other, and overall signal-to-noise ratio is improved. Over distance, the twists cancel out noise.

Shielding is used to protect cables from induced noise resulting from the collapse of electromagnetic fields in the cable's vicinity: EMI and RFI. When a shield is used, the noise that might otherwise affect the cable's signal-bearing conductors is induced in the shield instead of the protected conductors and is dumped harmlessly to ground. I need to point out that grounding is essential to the operation of a shield. An ungrounded shield is not a shield at all.

By the same token, the more effectively the shield is grounded, the better it will function. The terms double-, triple-, and quad-shielded, although descriptive of the number of layers of shielding material used (wire braid, metal foil, etc.) are actually misleading: Because the layers are all in electrical contact with each other and/or grounded to the same point, they all really constitute only a single shield. The improvement that comes from more layers of shielding is not as a result of there being more layers; it's because the greater amount of shielding material makes a better path to ground and therefore allows the shield to be more effective.

One important thing to consider is that much of the science used in high-end cable design came from the original stuff out of Bell Laboratories. Bell is a telephone company. They're very interested in the performance characteristics of wire over incredibly long distances. However, in the A/V realm, our interest lies in how wires perform over relatively short run lengths. This makes a huge difference. Over long runs, cable characteristics and aberrations have a tendency to average each other out of the equation. In short runs, they simply don't have the distance to do so. If a cable has a peculiar characteristic, you're very likely to see and hear it in a short run. Quite frankly, the scientific basis that our engineers use is markedly different. I think that our guys know more about how wires perform in short lengths than anyone else in the world and that changes how effective our products are in functioning as a do-no-harm signal-delivery system.

**Another part of a cable that gets mentioned is the dielectric. How does it affect the signal?**

The terms dielectric and insulation are synonymous, so let's take a look at what the dielectric does, besides keeping you from getting shocked when you pick up a wire. The dielectric material picks up and stores a charge, like a little capacitor, as an electrical signal passes through the conductor. Since we're dealing with AC, a split second later, the signal direction changes, the magnetic and electrical fields generated by that signal collapse and then re-establish themselves from the signal going in the opposite direction. This collapse of the fields releases energy directly into the signal path, a very bad thing. Management of this phenomenon is what most of the real science and art of high-end cable design is all about.

Hard vacuum is the best insulator (dielectric) possible, but it's not usable. Air is next, but it's not practical. Teflon, made by the DuPont Company, is next best; it's very usable and practical, but it's also very expensive. Despite all the rhetoric, pretty much everybody has to use the same exact stuff for Teflon dielectric because DuPont only makes a handful of different kinds of Teflon commercially available, and most of them go into frying pans and on the bottom of bass boats. They just aren't appropriate for dielectric use in wire and cable.

Only one kind of extrudable Teflon is available to the industry at large, so everybody uses the same stuff and just calls it by exotic names or weaves it differently. Micro-porous Teflon is such a case. Ultralink/XLO doesn't have to use standard Teflon when it's not perfect for the application. We use more-advanced materials, including a number of Dupont Teflon-variant materials not available to the commercial market. A few years ago, we won the prestigious Plunkett Award from DuPont for our innovative use of Teflon. As a result, we are a part of their extended R&D program. We have access to a huge range of Teflon-variants that no one else does. If we need a material with specific dielectric characteristic for a given application and design, we can get it. Others have to make due with the standard, commercially available stuff and the marketing departments try to make it sound exotic or proprietary.

**Some manufacturers highly tout “Faster Signal Transfer” as one of their benefits. What is your take on this?**

They use the term “Faster signal transfer”, referring to the time a signal takes to travel through a length of cable as compared with the time required to traverse the same distance at the speed of light. This is known as the cable's velocity of propagation and is almost entirely dependent on the materials constituting the cable's dielectric. In fact, except for video, digital and other very high-frequency applications, velocity of propagation is almost entirely irrelevant. What people hear or see as fast in a cable usually refers to the cable's ability to pass clean transient information. This does in large part have to do with the insulating materials used, but it has practically nothing to do with the cable's velocity of propagation. This is a perfect example of smoke-and-mirrors in cable marketing. (more on this “faster signal transfer” issue in the answer to the next question)

**When it comes to two of the most controversial aspects of cable marketing—cable directionality and cable burn in—are they fact or fiction?**

Fact, on both counts.

Earlier we talked about copper-oxide impurities at the juncture between the copper crystals in the matrix and how they have a tendency to act as little diodes. Diodes pass current better in one direction than another. This slight polarization characteristic makes the cables do so, as well. It's subtle but noticeable as a bit more natural and open sounding. Unfortunately, there's absolutely no way of telling which direction is the best one in a predictable way on the spool. You must listen to it—and do so before you mark

it for directionality. We listen to every batch of cable and then clearly mark the directionality of that spool and the cable so that it's always right. Many companies don't do this. Knowing the effect to be a subtle one in most cases and that there is a 50 percent chance of the direction being right; they just mark the cable's signal flow as it comes off the spool without listening. So, in that case and for that product, it would be a fictional feature. In our case, it's very real.

The cable burn-in question is a tricky and controversial one, indeed. The conductor doesn't burn-in; the dielectric changes with use and burns in. Therefore, the cable's characteristics that allow it to pass a signal without altering it change. Now here's a real puzzler. The traditional view of how a cable works—electrons charging down a length of cable at a high percentage of the speed of light—is probably not accurate and certainly not complete. It can be hypothesized that the signal is actually being carried by the fields and not the wire: The proof that this might be the case is found in the fact that identical lengths of cable with identical conductors and identical construction geometry but different dielectrics sound different and have different velocities of propagation. If the wire were carrying the signal, one would expect identical wires to have identical performance, which is not the case.

No less a scientist and audio expert than Dick Olsher once wrote that the actual velocity of electrons in copper was approximately 13.5 meters per second or just under 30 miles per hour, much slower than the speeds at which we know signals travel. There's significant evidence that the fields are changed as they pass through the dielectric and that, mutually, the dielectric is changed by the influence of the fields. The passage of current through the cables and the fields associated with it appear to "form" the dielectric and reduce the negative capacitive discharge effects of the cable.

Further empirical evidence would suggest that regular use of the cable is necessary to keep the dielectric properly formed. If the cable is unused for a period of time, it appears to lose this forming effect and needs to be re-burned-in. One could hypothesize that the natural motion of atomic and subatomic particles, called Brownian Motion, would tend to randomize and disorder the dielectric without the regular application of the forming factor, which in this case is the simple use of the product to pass signal. Another case of use it or lose it.

**Since we're discussing cables and signal quality, do you think the question of AC power quality is a valid issue and viable consideration for the customer?**

I do. Enough so that Ultralink/XLO is coming out with a complete line of power-conditioning products very soon (UltraPower). We currently do a good business in premium AC Mains power cables under both the XLO and Ultralink brands, sold to customers who see and hear everyday the differences that these products make in their systems. In some systems, cleaning up the power with the addition of a quality power conditioner and the replacement of the included cable with a well-designed premium power cable alone can make more audible and visible difference than upgrading the components or adding an image multiplier or scaler.

### **Do you have any thoughts on wireless versus wired signal transmission?**

Wired transmission will likely remain better than wireless for quite some time. This is because wireless transmission must always rely on transmitter and receiver components that, although they could be made to the same quality level as a good cable, never are. Manufacturing economies always win out over quality when a product must compete for business in the mass market.

Even more important, perhaps, is the tremendous bandwidth requirement that would be necessary for wireless transmission of high-resolution audio and video. The national governments own the airwaves, and they jealously protect them and charge dearly for their use. Just look at the controversy over freeing up the bandwidth used now for analog TV. Billions of dollars are involved.

Then there's the reliability issue. Think of the billions invested in cell-phone technology and how (un)reliable they are. Imagine checking "Can you hear me now?" each time you fired up your theater system. Then when the neighbors (who would be sharing the same bandwidth for their system) decided it was time to watch a movie, your system would momentarily drop the call due to over-loaded bandwidth limitations. In my opinion, wireless will be no more than a low-end, low-fi solution for a very long time to come.

### **What are your thoughts on FireWire, Ethernet, Internet, and CAT-5 cabling?**

Well, like it or not (and I certainly don't) the specialty A/V industry is little more than a flea on the back of the dog that is the computer industry. The big manufactures will always be trying to integrate (force-feed) the technologies and standards of the much larger computer business into our world. They are behind the theory that "good enough" is acceptable. I violently disagree. Good enough isn't! These technologies offer lots of convenience, control, and gee-whiz factors but little or no actual performance improvement and, in fact, generally seriously compromise the performance potential of a medium.

Just think of the number of "ultimate" performance technologies that have been announced with great fanfare, produced, and then become obsolete in just a few years. With the implementation of each of these new standards come many other problems for the people out there in the trenches integrating and implementing them in reliable ways into customers' homes and lives. Just think of how many millions of dollars companies spend on their IT budgets to keep their computer networks up and running reliably and how frequently they fail. I don't think that our market wants to transport these problems into their homes.

There is one constant on which you can depend, though. The people who will solve those problems—making it easy for the average customer to come home and escape into a wonderful world of music and film—are the manufacturers, dealers, and custom installers

of the specialty A/V industry, not the computer types. Ultralink/XLO is proud to be numbered on the right side of that line.

**How do you think the Internet has effected shopping for home theater equipment?**

It's a great resource to use for researching and learning. There's a tremendous amount of information out there, but also some misinformation. However, the Internet can never provide the actual listening and viewing experience. The people that manufacture the products are looking for the opportunity to offer you that experience. We think that is what you really want; to be able to make a fully informed decision about your home entertainment purchase. The internet simply can't provide that ultimate decision maker – the actual performance experience itself. A specialist audio/video dealer/installer is worth his weight in gold and will make sure that the system and experience live up to expectation.

**What do you hope to see happen in the near future for the home entertainment market?**

There has been an increasing awareness and availability of higher-resolution video content and displays. Unfortunately, audio has taken some steps backward with the gross popularity of lower-resolution formats. The sound does matter. It matters greatly and I look forward to the day when audio will re-establish itself as a priority. John Q Public needs to demand better sound just as he demands better video. System designers, dealers, and installers who sell and install demonstrably better sounding systems will find a market willing to pay for that performance difference. In many cases it will be the difference that makes the difference when it comes time for the customer to decide with whom they choose to do business.

**Are there any things that have taken place in this industry that you would consider to be a step in the wrong direction?**

Yes indeed. The commoditization of it. "Good enough" can be bought at lower and lower prices, at more and more places, with less and less effort or concern about actually listening to it or looking at it first. Even in the custom world, too often – especially on the audio side – absolute performance takes a back seat to other considerations. People aren't buying boxes. They are investing in the entertainment experience of music and film for their homes and quite frankly, "Good enough – isn't". [Here, here!—ed.]

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