

## **Commercial - Residential “STRUCTURED INSIDE PREMISE WIRING”**

### **Why Structured Wiring**

A study released in 2003 surveyed residential builders and developers. The “Builders of broadband networks project report” informs us that 75% of the developers responding said they include broadband in some of their properties and almost 65% said they offer structured wiring in their communities when requested. A recent 2004 report shows that the percentage is now up to 85%.

One third (1/3) of those responding said they offered structured wiring as a standard. NAHBRC and CEA also stated in the 2004 “State of the Builder Technology Market”, that 47% of all new homes built in the U.S. are being structurally wired, up 19% from 2002 and 42% in 2003. By 2007 that number should be 61%. One builder in Arizona said, “We feel that by installing cutting-edge technology, we are able to provide a truly custom home designed to enhance our clients’ lifestyles.” Structured wiring, once installed, even in a uniform community, where every house looks the same, marks it as being different and custom.

Promoted as the “fourth utility”, structured wiring is sometimes called the “digital plumbing”. The wiring becomes the building blocks of the home technology market. It’s not about coax and Cat 5e; it’s about the ability to have four computers sharing the Internet and a printer at the same time. It’s about having between 4 to 8 phone lines wired throughout the home, and it’s about enjoying TV in every room of the home. It’s about convenience and ubiquity.

The study also reported that the average cost of structured wiring a single family home was \$1,200 to \$1,600 depending upon the square footage and number of outlets in the installation. If the average home is 2,265 square feet, as stated by NAHB, the additional cost for the home is between .51 and .53 cents per square foot. The same study shows that one (1) out of every four (4) home builders consider structured wiring as the major selling point to their business. This reality does not seem to be regionally dominated. The main reason given by homebuilders on why they do not install structured

wiring was because “they need more information” and “were uncertain about it benefits and how it works”.

When you ask a builder to define his company’s selling advantage over other builders, one of the top five reasons answered was “we build a quality home”. Structured wiring help define what a quality home really is all about. Just as you would not think about building a home and leaving out an AC receptacle in the bathroom, structured wiring should also be considered as a necessity. Building better performing homes makes good sense. New home buyers remain satisfied longer when they live in a home that is affordable, comfortable, technologically up to date and problem-free. Better performing homes are less expensive to operate, service and warranty while at the same time generating referrals. Understanding the home buyer’s needs and implementing best practices will result in a high performance home that will excite the buyer and protect his investment. At the same time the builder is assured that his investment into the home will generate additional profits.

Builders should regularly evaluate construction procedures and documentation to ensure that they are using the best possible products, procedures and practices. Structured wiring eliminates one stress point for the builder during construction and also eliminates multiple stress points for the home buyer. Quality assurance needs to be taken seriously during construction or all the design and engineering efforts are worthless. A homeowner may well live happily in his new home even if the walls in his home don’t seem to be straight to him, or even if the floor seems to be uneven as if he is traveling down hill or up hill in several rooms. But if you leave out a phone jack in the living room, or TV jack out of the bedroom, the homeowner is now under additional stress and that will reflect back to the builder as “a lack of concern for the buyers needs”. Ensuring superior quality enables a successful builder to charge a premium over his competitors and still gain market share in his area. Structured wiring may well be the catalyst that helps the builder to become a market leader. Where many builders hope to attain market share by lowering prices, a great builder increases market share by building a better, more complete, home; especially with Structured wiring. Influence buyers needs, show them that they can’t live the lifestyle they imagined without Structured wiring in every room of the home.

Remember, to you it may be a building, to your customers, its home!

## **Home Office**

SOHO, small office home office, is rapidly becoming the buzz word for the telecommuters. Imagine a housewife wanting to earn extra income or surf the Internet for coupons or articles. She is in need of a fast connection. This home based scenario is an example of the fact that as many as one third of the workforce telecommute at least one day a week and the number is presently over one-million homes. The homeowner may not know at the time he purchases the home or builds the home just where he wants his desk, chair or bed. Structured wiring allows for this dilemma and prepares the whole house. With up to (4) four incoming phone lines, Cat 5E offers the SOHO added performance and number of locations over one cable. Once wired, the printer, fax and other added peripherals can be shared by the whole family. This networking is one of the major advantages of Structure wiring.

## **Standardization of Cabling Installation practices**

The cabling industry in the United States follows the ANSI/TIA/EIA standard; American National Standards Institute, Telecommunications Industry Association, Electronics Industries Alliance. These standards were formed to provide consistency in design and cabling perimeters. These standards insure proper physical requirements are met in order to comply with today's needs and be prepared for future expansion. Standards provide clear objectives so that you know what you are designing to in order to reach that goal. Standards are developed as the result of a move in technology and customer needs. Standards allow you to know that your equipment will work within the defined communication system.

There are many types of cabling networks, a previous article dealt with single family home practices only but this article will deal with the in-home technology practices for single family as well as condo's, apartment buildings , garden and high rise units, hotels, MDUs, MTUs.

## **Structured wiring**

Structured wiring systems simplify and enhance a homebuyer's lifestyle. It is flexible and easy for the homebuyer to use and reconfigure when needed, just plug and play. Structured wiring is the essential component of a quality modern home and offers a clean and professional appearance to technology.

Some builders have for many years allowed their customers to ask for phone and Cable TV wires to be placed anywhere in the home. Recently some have even helped the homeowner choose CAT 5e wiring locations for their Internet. Today's structured cabling is much more complicated and specifications are much more stringent. Today's cabling infrastructures require proper placements in behind the walls as well as in the crawl spaces or attics. Cat 5e's maximum cable length must be maintained under (90 meters/ 295 feet) as well as proper distance from electromagnetic interference (EMI) objects and hot water pipes. Nearly all builders insist that their structured wiring be a "composite wire". This wire is composed of an outer protective jacket surrounding several cables incased inside. The most common used of these types consists of one quad shield RG6 CATV coax wire and two Cat 5e wires. Other types can have any number of Cat 3, Cat 5e, Quad RG6, fiber and others. This composite structure allows the installer to run one cable and place three or more wires in the same location at the same time. Cat 5e comes in both shielded and unshielded types, plenum, riser and other ratings. All coaxial cables are shielded and are usually rated as 60%, 90%, tri-shield and Quad, etc. They also can be specified as riser, plenum, etc.

## **Anyone can do**

Most builders believe that any electrician or construction person can run wire inside a home; after all, how difficult can it be? Structured cabling is in fact very fragile and must have trained personnel installing all wires. Each of the cables inside the composite jacket must maintain their own individual maximum pulling length, pulling pressure, bending radius and integrity. Failure to maintain these standards in Cat 5e cabling can result in slower than desired Internet speeds, crosstalk on phone lines, etc. Failure in RG 6 coax can result is high frequency roll-off (high channel problems) and

problems with various channels; excessive attenuation and poor return loss (ghosting).

While troubleshooting a problem at an upscale apartment complex, the customer complained that he received all the channels but channel 20. Sure enough, the coax passed every channel with nominal attenuation, but sucked out channel 20 completely. A nail hole or hammer blow had damaged the cable to eliminate only one channel in the present existing lineup.

Some builders have had such a hard time finding qualified installers that they have formed their own separate company and have their employees trained to BICSI standards, (Building Industry Consulting Service International). Local codes and regulations must be maintained at all times while adhering to national ANSI and National Electrical Code standards. Many counties now mandate that all installers be low voltage certified.

A builder's best practices and procedures need to be passed onto the selling staff and the specifications, scope of work, designs, location of outlets, documentation, etc. should be known by all employees on the team. You do know that selling a home is a team effort and not just a salesmen's job? Effective training programs includes all personnel, combines different forms such a walk through in a new home, design layout on a floor plan, on-line training from various sites, mentoring from one personnel to another, consistent inside all regions or divisions. Codes and local needs need to be taken in consideration at all times. All new personnel need to be trained as soon as possible and existing personnel need to be kept up to date. Any member of the team, sales as well as quality control, etc should be able to recognize a problem.

## **Recording**

ANSI/TIA/EIA-606 (Administration Standards) specifies records that must be keep on commercial projects. Although no permanent records are required for private premises, testing and record keeping is very important. All records, for commercial installation, should be triplicate with the builder insuring he maintains a copy at all times in his office. A floor plan should be marked with the location of each type of wire, its length and test results. A copy of this plan should be placed in the structured wiring cabinet and one

back at the home office. Some techs keep a copy in a three ring binder of their own for future references.

All wires should be marked at the cabinet location that corresponds to the floor plan. The time saved by not marking wires will be spent two fold later when the installer has to trace the wires to see where they go or the homeowner has to have a return for the technician to mark the cable for plug and play. A separate drawing of the cabinet itself should also be kept in the cabinet and at the other locations mentioned above. This drawing when compared to the floor plan drawing will show all wires run back to the cabinet and which wires have been activated and which are spares or not activated at certain locations. In some cases, a floor plan may be available from the architects or contractor that will show where the various components are to be installed. This diagram will be the initial starting point. Use color pencils or pens to show routing of cables from outlets to the home run enclosure. Some industrious installers even use AutoCAD to generate this plan. If you use coded words or phrases to mark the wires, be sure to also have a legend sheet available for the homeowner and for the next technician to use. It is a good idea not to use coded words but to spell out with a labeler, just what the wire is for or where it goes. On commercial installations, labeling is mandated by the TIA specifications. Two quad 6 cables can also be run from the outside demarcation point of the home or apartment, to the home run enclosure to allow one wire for CATV signal to enter the home and another to allow satellite signals to enter the home. This extra cable can also be used as a spare in places where the first wire goes bad as in the example stated above. Remember to locate all outlets at the proper height as specified by the plans. Make sure to check with the foreman on site and when in doubt, locate all outlets at the same height as the electrical receptacle.

It is a good idea to have a written bill of materials with you when you enter the job site. This will help keep you on tract as to what you are suppose to do and will go along with the floor plan to insure all equipment is installed.

Visual documentation is very important. Some installers take digital photos of every prewire job location and some use videotape. In this way documented cable runs can be confirmed for later upgrades. These photos can be transferred to a CD or disk and a copy left with the homeowner. This is also a very good way to train new salesmen and staff on just what it is you do every day and how it affects the home.

A room-by-room punch list is also very important. Was the outlet set to the proper height? Was the outlet on straight? Was the correct outlet installed in the proper room? Was the proper colored wall plate attached? Have a punch list for both prewire and the completed home.

## **Testing**

All cable used in the home or premise should be tested both before the walls are closed up with sheet rock and after the project is complete to insure all cables have not been damaged during construction or after. Many times a misplaced nail or screw can damage a piece of cabling during construction. By testing both before and after, the cabling contractor can insure that it was not his practices but the other trades that caused the problem. Many times the dual testing will show up problems that can be fixed before the homeowner even knows they had a problem. Someone has aptly said, “you get what you inspect, not what you invest.” Many builders will outsource this requirement to another company so as to have checks and balances. A good, well executed visual inspection, will sometimes pass an installation, where each wire is visually inspected at the points where damage could incur. The only problem is many visuals really can't reveal the stress of a cable if it is pulled too tightly.

All cables should be certified by professional test equipment not just verified. Verification test confirms that the installer has followed the basic cable procedures and installation practices, which includes cable placement, cable protection techniques, and proper connections to ensure cable continuity. Testing separates your business from the competition in a non-commercial home site. Specification of work (SoW), which is used in the commercial arena, is just now entering the residential installations. It promotes certification as the only method to properly insure compatibility. A TIA specification sheet details the exact test to be run on a commercial job.

In 2002, fewer than 20% of all structured wiring systems were tested during the installation or after completion in a residential home. One manufacturer states the 50% of all installation problems are related to cabling issues, not software or component issues. Testing adds value to the home and gives the homeowners assurance that the system will work. Testing also confirms to the installer a “job well done” and avoids costly service calls. One

contractor said that on a 5,000 square foot house he was building, there were over 50 Cat 5e wires and when the technician went to hook up the system, 2 of these had problems or would not work. One of the cables could be re-pulled while the other could not. The cable contractor explained that he should have tested the wiring before the walls went up, because he was unable to determine where or when the problem really occurred. The contractor lost the majority of any profit on the job when he was made to repair the faults. The homebuilder/developer has made the contractor since that one job; certify all wires from that time forward. Commercial contractors rely on the TIA specifications to instruct the installer on the proper test to be performed.

All coax cables should be tested with a white noise generator that is capable of creating noise from zero (0) dB to twenty (20) dB and from 5 MHz to 2,150 MHz. This signal is then displayed on a Spectrum Analyzer. Once this white noise is displayed, the technician can see instantly before him, any suck-outs, attenuation, or damage to the RF integrity.

All Cat 5e cables should be certified and tested with a meter capable of detecting cross talk, excessive radius bends, continuity, length, delay, skew, return loss, polarity activity, faults, split pairs, missed wires, bare wires, wire mapping, power sum, opens, shorts, reversals, bandwidth and others. Remember to record all readings. Cat 5e cables should be used for both the Internet wiring and the telephone wiring. This will insure that up to four (4) phones lines could be in service at all locations at the same time. Cat5e also insures that the High Speed Internet will be able to operate at maximum speeds without slow downs due to discontinuity.

## **Wall plates or Jacks**

Structured cabling has progressed a long way since it was first introduced. Wall jacks come in many colors and types. Molded jacks have the outlets imbedded into the plastic as a single unit. These can be single outlets such as a single TV, single Telephone, single data Cat 5e and any other single type. They come in dual types, triple, quad, and all the way up to six (6) on one plate.

Component jacks are modular. They come with one (1), two (2), three (3), four (4), or six (6) holes. The jacks that fit into these holes come in a variety of colors. The blank plates themselves also come in various colors. While doing a fraternity for the University of Florida, where there were two (2) students per room, we ran two (2) Cat 5e cables and made one outlet jack blue and the other orange on a single white wall plate.

When running composite cabling to a location, remember to allow enough room in the wall jack box location or junction, to hold all the cabling. A typical location jack would have two (2) Cat 5e cables and one (1) quad shield RG 6 coax and be very tight. Most often these cables are run behind “mud rings” and not into an enclosed housing. This is actually the better way and allows for more flexibility for the cables. If the specifications call for an outlet enclosure, be sure to over size the box to hold all the cables without excessive bends. In a high rise or multi-floor building, where outlets are called for along the outside walls, these are usually cut into the brick or concrete wall. It becomes important to make sure over size boxes are at these locations. The bending radius of the cables demands that space be allowed in the boxes. Too tight of a bend will cause distortions of the signal or High Speed.

## **Safety Practices**

In your effort to work efficiently and quickly, don't over look basic safety. Many premise wiring jobs, especially those that are multi story require a hard hat to help prevent injuries.

The Structured wiring contractor should always have a first aid kit with him at all times in his vehicle or on site in order to help prevent minor injuries from becoming infected. A copy of approved first aid procedures should be kept in the first aid kit.

All ladders should be OSHA approved types and used properly. Most contractors will only used wooden or fiberglass ladders in hopes of reducing hazards from electrical shock. Commercial job sites won't allow metal ladders under any circumstances for insurance reasons. Avoid using home made ladders if at all possible. These make shift ladders, made from 2x4's can be very unstable and dangerous. Sometimes this can not be avoided and under those circumstances, the installer shall report to his supervisor the

situation as he sees it as well as put the contractor on notice that hazards may develop on this job site. Where possible, the installer, under these circumstances, should be prepared to use his own ladder.

Protective eye wear is very important to be worn at all times especially while drilling or working around others using power tools. It is also a good practice to wear this protection when cutting or trimming wires. Many floor areas are full of dust and sand. High winds can sometimes create hazardous situations for the installer. Most sites may not have windows installed by the time the wires are being pulled.

Honor any and all firewalls that may be present. If you must go through a firewall, use proper firewall kits or procedures to correct the entry. When running through fire-resistant floors, pack and fill the opening to comply with all local building and fire codes. Remember to follow all NEC electrical codes especially for grounding also.

Grounding is very important. It is not recommended that one end of the cabling be grounded inside the structure enclosure but only outside. This single ended grounding will help prevent the buildup of a potential difference between the two ends of the cabling and allow all cabling to be bonded together at a single point outside the home or building. We do not want lightning to enter the building in order to be grounded but should be grounded outside.

Remember to dress properly. Don't treat this job casually. Always wear proper shoes and clothing. It would be a good idea to have a uniform with the company name and employee name on all shirts. Part of the installation is showing your professionalism. If you don't have the persons name on the shirt, have a separate ID badge that the employee can wear as a clip on to his shirt or belt. Most contractors and builders don't enjoy loud music on the job of any sort. Never wear headphones to listen to your music; this is very dangerous since you will not be able to listen to others calling out to you if a problem arises. It's a good idea to not carry a radio or CD player to the job. Always watch your language. Remember this is someone's home and the homeowner can always stop by at anytime and inspect the work. You need to show your professionalism at all times and maintain a good attitude. Most builders have in their ethics statement that "music or loud boom boxes are not allowed on this site".

Remember to carry a flashlight to the site. Even if you are wiring a home in the middle of the day, possible rain and dark clouds can make running wires difficult to see. Once the home has been “dried in”, a term used to confirm the roof is on and the house is dry, extra light may be needed, especially up in the attic way, next to the roof or in a closet way.

Remember to use proper extension cords. If you use battery-operated drills, remember to keep the battery charged in order to reduce stress on you and the drill. All electrically powered equipment must be kept in good operating order and clean. Remember that even though a house has been “dried in”, water can be on the floor due to no windows or doors yet and blowing rain. It is not a good time to be using old, worn, extension cords.

## **Routing and procedures**

All cabling, running from the wall outlets to the structured wiring enclosure, should be handled with great care. This is not the time to be in a hurry. As the cabling is run from the wall box or mud ring, never staple the wires to the stud. If you can, use tape or omega type holders to help secure the cabling. Stapling the cable could put undue pressure on the cable and cause deformity, which in turn causes impedance mismatch and other problems. Always run the cabling straight up to the rafters or joist of the roof and then over to the home run structured wiring enclosure box where possible. In some cases where the outlet is below a window, you will have to run horizontal wiring. All cabling needs to be home run back to the structured wiring box, without splices, bridging or daisy chains. Do not lay the cables on the floor of the attic where they could get stepped on at a latter date. Always allow slack in the attic and remember to not exceed the bending radius or pulling pressure of each cable. While attaching cabling, do not allow pressure to be place on the cabling that exceeds the manufactures specifications. This is also true after the pre-wire, so that the weight of the cables in a bundle will not put undue stress on the cables and damaged them. The bundle from the attic to the structured wiring enclosure should be supported properly to relieve stress. Use Velcro straps, 1.5 to 2” wide instead of tie raps. Bungi cords or support braces can be used to support the entire bundle along several lengths of the bundle along with strap harnesses. This Velcro comes in many widths and colors such as black, blue, orange, yellow, etc. You could decide to use a different color on each traveling

bundle so as to help locate where the wires originated, such as upstairs verses downstairs or living room verses kitchen. You can also use many different colors of Cat 5e to mark where the cables are going, such as blue for bedroom, yellow for living room, etc, unless you are using a composite cable. These colors can also be used to mark apartment numbers. Blue for apartment one, Yellow for apartment two and so on. I always use a composite cable with an outside jacket marked with footage measurements. This helps me locate and relieve undo stress on the cabling and the inside wires which are Cat 5e for Internet and Telephone, and quad 6 coax. Note that white coax should not be used outdoors but is expected indoors. Sequential footage marks on the outside of the jacket to always tell how much footage is left on the spool as specified by FCC part 68.213c. Special spools can be ordered, in that the 500' mark, is on the outside of the spool and 1' marks are on the inside. Therefore if you run 125' off the reel, the number showing on the wire on the reel is 375'. That's the footage left on the spool. The manufacturer will also place your name and telephone number on the outside jacket. The name can be added at no extra cost as long as you order 25,000 feet on the first order. The sequential footage markings are special and add \$2 to each spool. All manufactures must have footage marks on their cables, but the numbering will be random. You could get a spool that starts at 55,235 and goes to 55,735. The next spool could be 43,112 as a starting point.

Avoid crossing over electrical wiring while running cabling. If you must cross an electrical wire it is important to run the cabling at 90 degrees to the electrical wiring. This procedure will help reduce the problems and in most cases cancel the effects of EMI inducement. Remember to ground properly as noted above.

In most homes; all cabling can be run bare and not be enclosed in a conduit. If conduit is needed, most states will allow both PVC and metal types. All incoming cables from the outside to the inside should be in conduit even in a signal family home. Metal is mandatory when you are crossing through a firewall area and commercial construction. Any number of methods can be used to place the cabling inside the conduit. Short runs, those under 100' can usually use a fish tape. Longer runs may require using air-propelled or vacuum methods and a pull string enclosed to help with the installation. Remember the maximum bending diameter of UTP Cat 5e is 4 times its diameter with pulling tension of 25 pounds maximum. I try to explain this to a customer in this manner. Attach a fish scale to the wall, shoulder height,

and pull until you see the scale read 25 pounds. When they do this, they get a better idea of just how fragile Cat 5e can be. Remember to not exceed the maximum length of 295 feet, 90 meter, from point A to point B locations. This is very critical. In many buildings, the contractor has run all the cables to one end of the building. When this is done, like in a 12 to 16 unit apartment complex, the length from one end to the end apartment can be over 250 feet making cat5e near to impossible to run for Internet. Make it your business to bid the project with notes that the cabling must come from both ends on large buildings and if not, you can not be responsible for the cabling performance.

When pulling cables from floor to floor, always pull cables from the top floors down to the bottom floors. Gravity will help with the pull in your favor instead of against. This will also reduce stress on the cables as bundles are gathered. In one job, we had 40 Cat 5e cables in one bundle from the top floor to the bottom. The weight of these cables were considerable and we used all the cautions mentioned above to secure and safeguard the cables. Even so, the cable weight was difficult to handle.

The maximum number of cables in a bundle should not exceed 49 cables unless special supports are used. If you do run over 50 cables in a single bundle, remember to follow closely the manufacturer's guidelines. Remember to allow slack out of each cable box or cable spool. In this way there will not be tension on the cable as it is placed along the pulling area. Always allow loops at several locations along long runs. The Cat 5e will tend to curl when it leaves the spool and as the slack is taken up watch out to make sure no kinking of the cable occurs. Keep in mind that these various slack locations and spool locations can create a hazard where people walk. Always avoid the possibility of other workers stepping on any slack for their safety and for the performance of the cables.

All cables should be labeled before the run is begun. When I know that I am pulling a wire from the east wall of the master bedroom to the structured wiring enclosure, I label this cable as such, and then pull that run. In this way I eliminate any possibility of mislabeling in the enclosure.

Remember to always clean up after any installation. Although it is a construction site, it is still someone's home. This should help to eliminate accidents from occurring also. A clean site reflects on the tradesman and his company as being a quality installer. All empty spools or boxes should not

be left on the job site but placed back in the installer's vehicle. Some contractors have a dumpster present on the job site for use by all trades. If this is the case, these dumpsters may be used. Remember to check to make sure these dumpsters can be used before dumping spools in them. Dispose of all personal debris such as bags, cups, left over food and others items brought to the site. It should not be the contractor's responsibility to clean up after you.

## **Wall Mount Enclosure**

Choosing the proper manufacturer to use for you structured wall mount enclosure is very important. In almost every case, wall jacks and plates will work with any manufacturer's equipment. The problem arises during the prewire stage. When I choose manufacturer ABC as my enclosure during the prewire stage, I can usually only use his products in the enclosure. Most enclosures have a special way of mounting the modules and the modules are of a certain size and shape that may only fit in manufacturers ABC holders.

Time should be spent up front determining which products you feel will fit the bill for your needs. Price is a very critical factor. Some manufacturers enclosures may be less cost then others but his modules may be twice as much; thus causing the project to come in too expensive when compared to XYZ manufacturers' cost. The way I decided what I would use was to get all manufacturers catalogs and review the way their products mounted in the box, space allotted for spare wires, modules shape, cost of modules, expansion capabilities, grounding procedures, electrical outlet, etc. Although I was only wiring for the "builders trinity", telephone, data and TV; I needed a manufacturer that offered audio modules, satellite modules, fiber modules, wireless modems and routers, jumpers, punch down accessories, wiring kits, blocks, tools, blanks, patch panels, amplifiers, management control and software, hinged door, ventilation, video, Cat 5e and Cat 6, etc. Some installations are so large that the installer must install two metal enclosures to handle all the equipment. Some installers will use a 28" enclosure for the equipment and a separate 18" enclosure just above the main enclosure to handle cable slack. Remember to check where this enclosure will go before you run the wiring. Once all the wires are run to one location in the attic and then are being placed into the enclosure inside the wall, the wires in the attic may be directly in the way of anyone ever using the attic for storage or walking up in the attic for other repairs. Do not

block the attic pull down door from being utilized. In some cases, the cabling may have to be placed in conduit and run into the enclosure to prevent this blockage. Most counties specify exactly how the cables are to be attached to the rafters in the attic every other beam.

Make sure to mount the wall enclosure inside the home and not in the garage or other non-air conditioned areas. The heat from the CATV amplifier, modem, router and other equipment may cause excessive collective heat and the modules life will be short lived. The collective heat also may cause a fire hazard if installed outside the air-conditioned areas of the house. Coaxial and Cat 5e cables can become brittle over the years when installed over hot water pipes or in dry hot environments that are excessive.

Most cabling installers will handle alarm and security systems but will usually install a separate enclosure for this equipment and keep it out of the integrated enclosure. These systems require battery backup and other special concerns. There is no set business practice to follow and the alarm enclosure may be mounted in a non-air conditioned area. In many individual residential home sites, the alarm panel is placed inside the structured wiring box.

It is a good practice to add a primary protector on the outside of the home to protect the coax from lightning and other (EMI) Electro Motive Interference forces. I use the TII industries Coaxial Lightning Surge protector. This device is made by a company with 35 years experience in stopping lightning at the outside of the home and preventing it from entering the home. It acts both as a ground block for the outside sheath or braid and also a protector on the center conductor. This device is around \$6.00 and is recommended for every installation. The TII device will pass up to 2.125 GHz and the match to 75 ohms is better than the coax itself. I mount this device inside the outside (NID) Network Interface Device. It can be mounted in the open and should have weatherproof boots attached to help prevent water from entering the connectors.

A typical power strip will not take the place of an outside primary protector. Inside electrical power strips are designated as a secondary protector. After repeated hits, these secondary protectors will fail without warning. One hard hit would permanently take it out. Surges don't need to take out the protector in order to damage equipment. The repeated small surges will eventually take out an audio or video product even though it was not a large

surge. If you VCR flash 12:00, you have a potential problem. Many homeowners routinely unplug their electrical equipment from the power to stop the lightning from coming in on the groundside or secondary of the electrical wiring. A primary protector only protects the coax and not the electrical side. Many manufacturers such as Raban labs protect the electrical circuits.

Check to make sure the structured enclosure manufacturer allows for multiple knockouts for entry of cabling? Do they supply plugs to cover up opened knockouts? How do they handle the electrical outlets for the enclosure? All enclosures tend to be 14.5" wide so they can be recessed between wall studs on 16" centers and typical heights are from 14 to 42 inches. Most enclosures are white with a white door. Some enclosures use a hinged door others use a plate door configuration that screws on. This is where the front enclosure door has pre-drilled holes that line-up with the pre-drilled holes in the enclosure and the front faceplate is screwed into position. Both types are okay and the contractor should ask the homeowner or homebuilder which he prefers. We always use the hinged door type and in some cases they are hinged and vented.

It is not necessary for the enclosure to have its own breaker. This is not necessary because of the current needed. The most current the equipment would draw is usually under one amp. Most installers ask for this option in order to allow the installer to kill the circuit if needed, to work on the panel.

### **Cost verses convenience**

The cost to install a complete structurally cabled home makes the installation very affordable. We all know it is cheaper to add a wire behind the wall now during the prewire stage then a month after the home is complete. Some installers can charge as much as \$200 to add an outlet in a convenient spot and up to \$500 when they have to do extra ordinary labor.

The cost to prewire a new home averages about \$50 per location. Some installers charge a little more if the home is over a certain square footage. If a home is a three (3) bedroom and calls for one outlet in each bedroom and one in the family room / living room, the cost is usually small, approximately \$50 per location to prewire. In most planned home, the homeowner usually agrees to add 2 additional locations in the three

bedrooms and one additional in the bath for phone, kitchen for all three services and additional outlets in the family room / living room. This is now 9 additional outlets we are proposing. This 9 locations times \$50 is the only expense upfront that the homeowner or contractor has to pay. In my cases, the installer would supply the metal-hinged door enclosure free during the prewire stage if 8 or more locations are chosen in a home 1,600 square feet or smaller. Some installers charge between \$75 - \$125 for the enclosure. When the homeowner moves in, or is about to move in, he determines which of the locations in the rooms he wants activated. The cost per outlet could be \$25 per location to trim out. If the homeowner still only wanted the four (4) locations activated, his cost would be only \$100. But, if he changes his mind next year and wants a computer desk in the bedroom on the wall opposite the telephone outlet, the wires are behind the wall and can be activated for a \$25 outlet fee plus labor and trip charge. The modules to activate the four (4) outlets having cable TV, telephone, and data would be under \$700. A homeowner with the four (4) outlets spoken about above could be in his home for under \$1,100. Installers should certify cabling during prewire and after equipment has been added. The cost is usually around \$200 and meets the TIA-570A recommended requirements.

What does adding structured wiring do for the resale value? In speaking before a local real estate group on structured wiring, I posed this question. Almost half present had a situation where they had sold a home with these features. Their answers ranged from \$5,000 to \$7,500 it added to the price for the seller. A rule of thumb given to me by the local president was 5% higher price. On a \$100,000 home, the cost to add structured wiring would be under \$1,500 (1.5%) and the selling would be \$5,000 (5%). This is one of the few amenities that allow you to use it for the years you own the home and sell it for more than you paid for it. The realtors also mentioned that it makes the home easier to sell because of the multiple locations for possible TV, data and phone.

### **Structured wiring awareness**

High-end homeowners and their architects understand structured cabling. They desire multiple telephone outlets, TV outlets and data outlets. Some are SOHO, small office home office, and require several phone lines in

several locations in the same room. High-end builders have learned to listen to their customers. Some high-end homebuilders are still using single wiring technology and in effect making these new home installations obsolete. Many homeowners are very impressed by the “future proofing” ability of structured cable. Marketing is needed to instruct the builders on why structured wiring is necessary. I speak to builders often about the need to be kept up to date on technologies. Most listen and incorporate changes, while some are still unwilling to change their attitude about technology. One person wrote that a new home built today, without structured wiring, would contain 1950 era technology wiring. The FCC has allowed homeowners to file a class action suit against builders who advertise structured wiring but did not deliver a system conforming and performing to TIA standards. Many times it is the homeowner who has to pay to have the problem corrected. Having Cat 5e on one wall and telephone on another and TV on the third is not structured wiring.

Some homeowners are aware of the structured wiring needs but are unsure about what it cost. They don't understand the need to get the technician or contractor of the system in while the home is being designed. They may not realize that this is a free service offered to the homeowner by the installer. The system needs to be designed to handle the needs of the present homeowner and the potential of new buyers. Remember when you are considering a structured wiring situation; you always want to design for present needs and resell.

### **Other items**

Other items not elaborated in this article are detailed specifications of firewall procedures, pulleys when needed, terminating tools, and punch down techniques, hand and power tools needed, etc. Also not detailed were proper procedures for striping off the outer jack, cable pairing, and others. Cat 6 was also left out but will be part of another article later describing the difference between Cat 5e and Cat 6 along with information on the Cat 6 consortium.

## **Training**

Any cable installer interested in learning how to install properly all the different types of communications wires mentioned above and others should consider taking a BICSI course called “Residential Cabling”. The SCTE course on “Broadband Premise” may be a starting point if you are not in an area where BICSI courses are taught. The BPS test can be taken on line after the book has been read and the installer has filled out the proper on-line registration. The BPS is not as intense as the BICSI course but will go a long way towards getting the installer ready to take the BICSI course.

Many manufacturers offer training also. Some are free and some have a small fee. Some are taught at conventions and some at electrical wholesale houses such as CED, Graybar, Hughes, etc. Before you choose a manufacturer to buy from, it would be a good idea to attend their training.

BICSI is the only recommended training facility for commercial installers. This organization requires that the certification be up graded periodically through training modules and continuous education credits.

## **Warranty**

Under most circumstances the cabling carries a minimum of 15 years warranty. By certifying the system and offering a maintenance contract, you can easily guarantee this performance. Most equipment manufacturers have a one-year warranty on all the modules and some carry 2 and 3 years. When you offer a maintenance contract to the homeowner, you can extend this warranty to two (2) or three (3) years. The manufacturer I use offers various warrantees, a 15 and 30-year.

## **Low Maintenance doesn't mean no maintenance:**

The maintenance of the inside structured cabling is in most cases the responsibility of the tenant or homeowner. The telephone company will diagnose and repair problem for a fee. Simple voice communication may be acceptable on inferior wire. Problems with low connection speeds, poor throughput and frequent dropped calls is a result of using materials that haven't met the FCC standards or was improperly installed. The installer

cannot afford to use substandard materials during construction or overlooking basic construction practices.

The installer should offer a maintenance contract to the homeowner on his inside wiring. Rodents and weather can place the cabling in danger. Lightning can get into the system even with the best protection and rodents are known to chew into the cables. Once the cabling has been certified, you should offer the homeowner a contract to come back once a year and re-certify the cabling. The charge is agreed to up front and the homeowner knows that each wire is being protected. When you return to perform the test, the homeowner usually asks for an addition or a change, creating an opportunity to create addition value for them and you.

The contract should cover the certification cost and the test that are being run. A brief explanation on each test and what it certifies should be included. The contract should spell out that if a wire is found to be defective or not up to standards, you will replace the cable or reroute the signal in order to maintain proper performance. The contract is for certification only and all repairs made are on time and material.

Written June 23<sup>rd</sup>, 2005  
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