

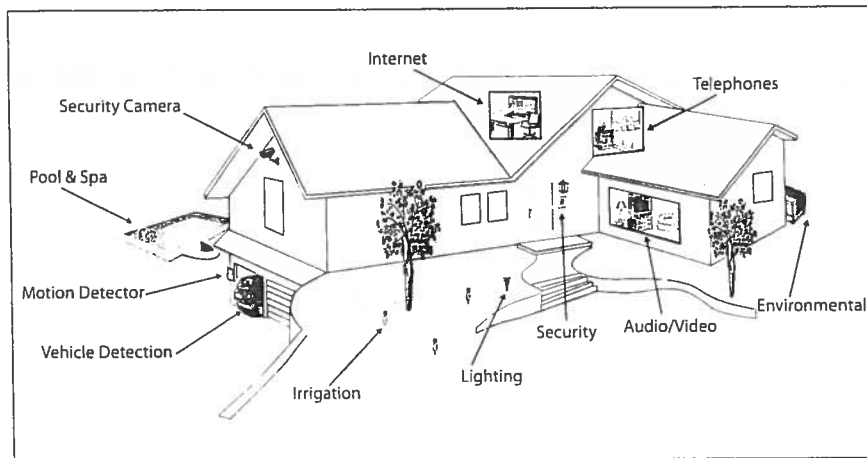
Chapter 10

Configuring and Installing Structured Cabling Systems

Typical Residential Cabling

In a typical residential dwelling, each system (phone, television, HVAC, security, sound, etc.) has its own cabling and the type of cable used by each system is unique. Phone wiring in several existing dwellings may still consist of the older style quad wire; however, current standards require Category 5e or Category 6 UTP to be installed in all renovations and new construction of single and multi-dwelling residential buildings.

Television wiring is typically 75 ohm coaxial cable. The current standards recommend, at a minimum, the use of Series 6 coaxial cable. HVAC and security systems utilize multi-conductor cables, sometimes solid conductor, sometimes stranded conductor and in some cases Category 3 through Category 5e UTP is used to connect the devices used in these systems. Sound systems typically employ heavier-gauge stranded wires.



Residential Cabling

Traditional Telephone Wiring

Older styles of residential telephone wiring consisted of either quad wire or twisted pair wire. Quad wire (also known as POTS wire for Plain Old Telephone Service) is made up of four insulated conductors that are not twisted around one another. The red and green wires make up a pair, which is used for line 1. The yellow and black wires make up a second pair, used for line 2.

Twisted pair telephone wire comes in pair counts from two- to six-pair. The white/blue pair is used for line 1, and the white/orange pair is used for line 2.

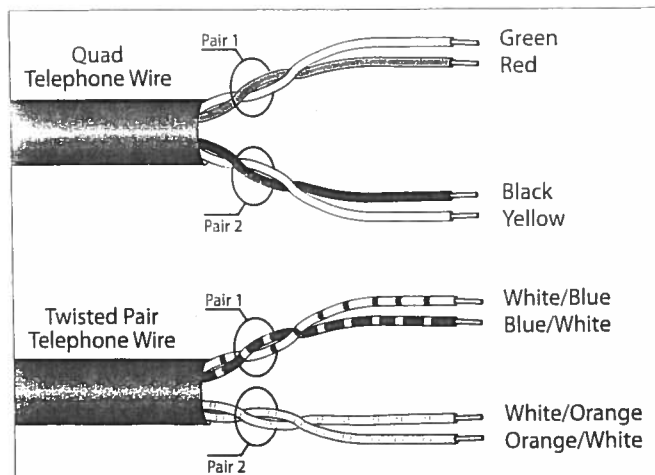


Figure 10.2

Legacy Residential Telephone Wiring

The use of legacy types of telephone wiring were eliminated by a January 10, 2000 FCC ruling that set new minimum quality standards for telephone inside wiring using Category 3 cable. Title 47 Code of

Federal Regulation (CFR) Part 68.213 *Installation of other than “fully protected” non-system simple customer premises wiring* part (c) states:

Material requirements. (1) For new installations and modifications to existing installations, copper conductors shall be, at a minimum, solid, 24 gauge or larger, twisted pairs that comply with the electrical specifications for Category 3, as defined in the ANSI/EIA/TIA Building Wiring Standards.

Effective 180 days after the FCC ruling, POTS wire installed in a residence for telecommunications use was considered illegal.

ANSI/TIA/EIA-570-B Residential Telecommunications Cabling Standard

Because of the widespread acceptance of the ANSI/TIA/EIA-568 **Commercial Building Telecommunications Cabling Standard**, the TIA decided to develop a similar wiring standard for residential cabling. The ANSI/TIA/EIA-570-B *Residential Telecommunications Infrastructure Standard* (April 2004) defines the requirements for residential telecommunications cabling. These requirements are based on the facilities that are necessary for existing and emerging telecommunications services. The cabling infrastructure specifications within the 570-B Standard are intended to include support for voice, data, video, multimedia, home automation systems, environmental control, security, audio, television, sensors, alarms, and intercom. The 570-B Standard is intended to be implemented for new construction, additions, and remodeled single and multi-tenant residential buildings. This Standard also applies to the telecommunications cabling within or between structures and includes the cabling within a single-dwelling unit and the backbone cabling.

This ANSI/TIA/EIA-570-B Standard replaces ANSI/EIA/TIA-570-A, published in September 1999. The ANSI/TIA/EIA-570-B Standard incorporates and refines the technical content of:

- ANSI/TIA/EIA-570-A-1, *Residential Telecommunications Cabling Standard; Addendum 1 – Security Cabling for Residences*
- ANSI/TIA/EIA-570-A-2, *Residential Telecommunications Cabling Standard; Addendum 2 – Control Cabling for Residences*
- ANSI/TIA/EIA-570-A-3, *Residential Telecommunications Cabling Standard; Addendum 3 – Whole-Home Audio Cabling for Residences*

The incorporation and refinement of these cabling references and their inclusion into the ANSI/TIA/EIA-570-B Standard basically standardizes types of cabling that have been commonly installed in residences for years.

The 570-B Standard is intended to be in conformance with Part 68 of the FCC Rules and Regulations, the *National Electrical Code*, and the *National Electrical Safety Code*. It is very important to note that the Standard makes it clear that the cabling for a dwelling shall comply with applicable local codes and regulations, which shall take precedence over the requirements in the Standard.

NEC® Requirements

The 2008 *National Electrical Code* added a requirement to Chapter 8 mandating that any new dwelling construction have a minimum of at least one communications outlet installed. **Article 800.156 Dwelling Unit Communications Outlet** states:

For new construction, a minimum of one communications outlet shall be installed within the dwelling and cabled to the service provider demarcation point.

The *NEC®* makes no attempt to provide a location for the communications outlet nor does it provide for minimum media requirements. However, Chapter 8 attempts to provide guidance to “acceptable industry practices” through a Fine Print Note (FPN) under Article 800.24 Mechanical Execution of Work. This FPN makes reference to the *ANSI/TIA/EIA-570-B Residential Telecommunications Infrastructure Standard*.

Grades of Residential Cabling

Within the 570-B Standard, there are two grades of cabling defined for residential units – Grade 1 and Grade 2. A grading system was established in the 570-B Standard based upon services that are expected to be supported within each residential unit and to assist in the selection of the cabling infrastructure. For home automation and security systems cabling requirements, the Standard refers the installer to the manufacturer’s recommendations.

Grade 1

For each cabled location, Grade 1 provides a generic cabling system that meets the minimum requirements for telecommunications services. For example, this grade provides for telephone, satellite, community antenna television (CATV), and data services. Grade 1 specifies that twisted-pair cable and coaxial cable be placed in a star topology. Grade 1 cabling minimum requirements are for one 4-pair UTP cable that meets or exceed the requirements for Category 5e cabling, which are a minimum of one 75-ohm coaxial cable and the respective connectors at each telecommunications outlet (TO) and distribution device (DD). Installation of Category 6 cable in place of Category 5e cable is recommended to facilitate future upgrading to Grade 2.

Grade 2

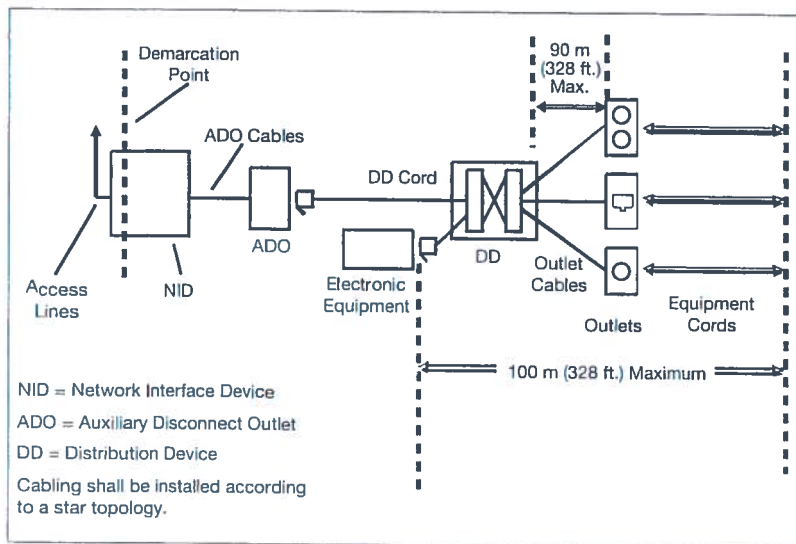
For each cabled location, Grade 2 provides a generic cabling system that meets the requirements for basic, advanced, and multimedia telecommunications services. This grade provides for both current and developing telecommunications services. Grade 2 specifies twisted-pair cable, coaxial cable, and optional fiber optic cable, all placed in a star topology. Grade 2 cabling minimum requirements are for two 4-pair UTP cables and associated connectors that meet or exceed the requirements for category 5e cabling; in addition two 75-ohm coaxial cables and associated connectors, and optionally, 2-fiber optical fiber cabling, are required. Installation of Category 6 cabling in place of category 5e cabling is recommended.

Residential Cabling Architecture

Referring to **Figure 10.2**, the demarcation point is the point of interface between access providers and customer facilities. The demarcation point may be evidenced by a network interface device (NID) that is provided and installed by the access provider and which may contain an entrance bridge. For single-family residences, the demarcation point is usually located on the outside of an exterior building wall. Where the total length of cabling from the demarcation point to the furthest outlet exceeds 492 feet (150 meters), the access provider shall be notified at the design stage to accommodate transmission requirements.

Figure 10.3

Standard Residential Cabling System Components



An auxiliary disconnect outlet (ADO) provides the means for the tenant to disconnect from an access provider. It is desirable to co-locate the ADO with the distribution device (DD). The Standard says “the ADO and the DD shall be located indoors and be readily accessible”.

ADO cables extend services from the demarcation point to the ADO. Where a single residential unit is part of a multi-residential building, the ADO cables may extend from the common telecommunications room (CTR) to the ADO in the tenant space.

A DD shall be provided within each residence. The DD is a cross-connect facility used for the termination and connection of outlet cables, DD cords, equipment cords, and in some cases ADO cables. The DD is used for connection of access providers to the residence and to facilitate moves, adds, and changes of premises cabling within the residence. Access to the building electrical ground shall be provided within five feet (1.5 meters) of the DD, in accordance with applicable codes.

Note: Distribution Devices may be known as Structured Media Centers (SMC), Media Convergence Centers, etc.

Outlet cable provides the transmission path from the DD to the outlet. The length of each outlet cable shall not exceed 295 feet (90 meters). The 295 foot (90 meters) length allows an operational length of 328 feet (100 meters) including patch cords or jumper wire and equipment cords.

Recognized outlet cables include:

- 4-Pair 100-ohm UTP (category 5e, 6)
- Series 6 coaxial (commonly known as RG6), tri- or quad-shield
- Series 59 coaxial (commonly known as RG59) for baseband closed-circuit television (CCTV) only
- Optical fiber (50/125 μm , 62.5/125 μm multi-mode and single-mode)

A minimum of one outlet location shall be cabled within each of the following rooms (where applicable):

- kitchen
- each bedroom
- family/great room
- den or study

The telephone service provider's drop wire is terminated in the Network Interface Device (NID). After electrical (overvoltage) protection is applied, the pairs are terminated on modular jacks in the NID. The Auxiliary Disconnect Outlet (ADO) cable plugs into the NID and extends the circuits to the ADO.

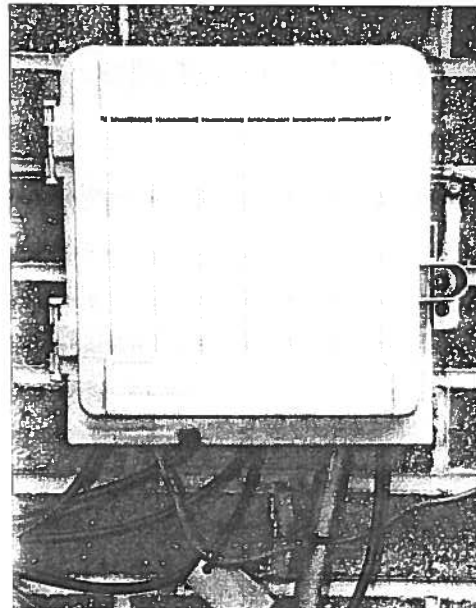
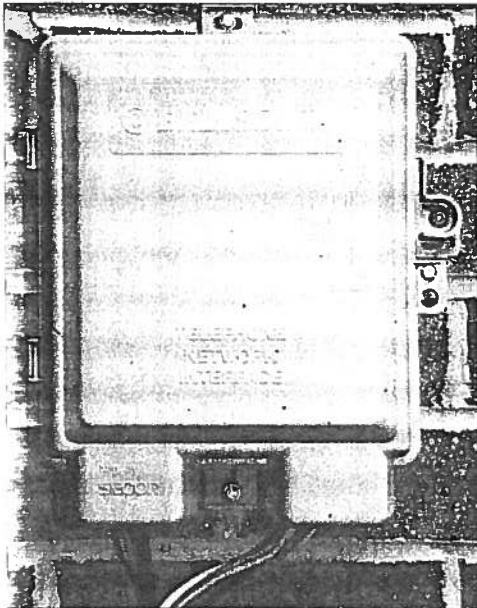
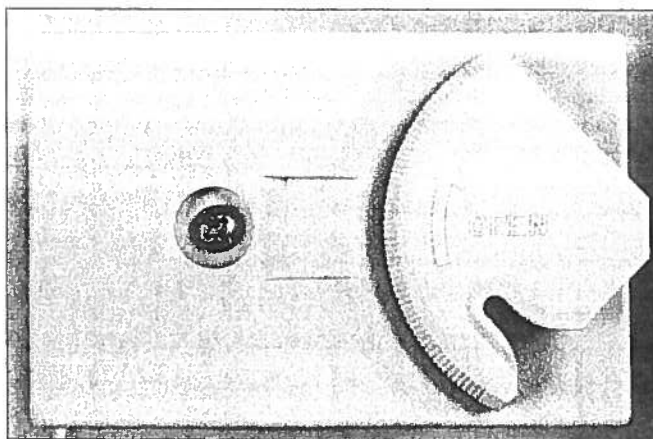


Figure 10.4
Residential Telephone Wiring Network Interface Device (NID)

Figure 10.5
CATV Network Interface Device

Figure 10.6
Basic Auxiliary Disconnect Outlet (ADO)

An auxiliary disconnect outlet (ADO) provides the means for the tenant to disconnect from an access provider. This ADO device can be used for verifying whether the access provider signal has been dropped or if there is an internal wiring problem. This is accomplished by taking a phone from the dwelling or a lineman's butt set and plugging it into the jack. If the phone operates, the fault is in the residential wiring. If the phone does not operate, the access provider must be contacted to start a repair ticket.



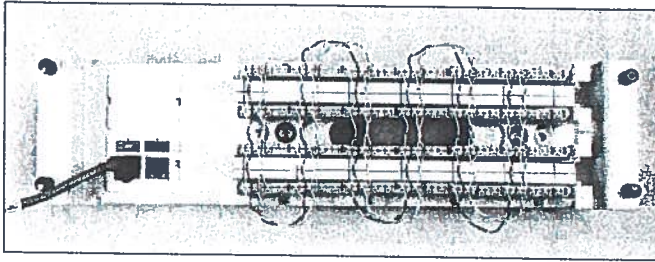


Figure 10.7
Auxiliary Disconnect Outlet
(ADO) with Bridging Block
Allowing the Multiple
Appearance of a Single Line

not cut, the wire. Using a second paired cross-connect wire, multiple (combine) every second pair position, beginning with position 2. The result will be the interconnection of positions 2, 6, 10, 14, 18, and 22.

This arrangement provides the ability to multiple the appearance of a single telephone line (or control port) up to six times on a single row of a 110 block. An additional row on the 110 terminal block is wired in the same manner to provide for the second controller port. Successive rows are used for additional controller ports as shown in Figure 10.7.

A bridging block may be constructed using a 110 terminal block and wired as in Figure 10.7 as follows:

Beginning at the top row, paired cross-connect wire is used to multiple every First pair position, beginning with position 1. The result will be the interconnection of positions 1, 5, 9, 13, 17, and 21. The D-impact tool must be set to seat, but

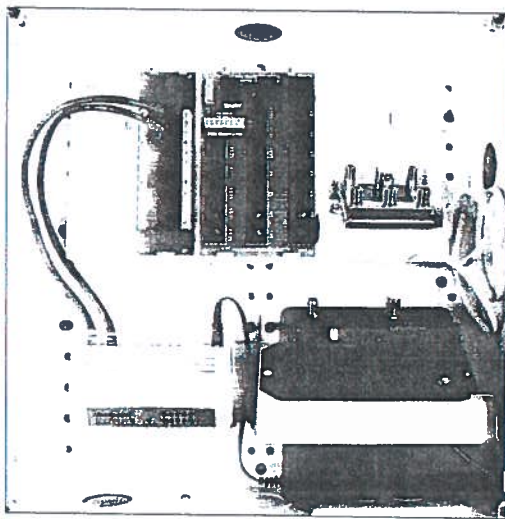


Figure 10.8
ADO and Distribution
Device in One Package:
Leviton's Structured
Media Center (SMC) with
Voice, Data and Video
Connections

The Distribution Device (DD) is used for connection of access providers to the residence and to facilitate moves, adds, and changes of premises cabling within the residence. The DD may be designed to distribute any and all of the following: A/V, whole house or zone audio, CATV, CCTV, security, and home automation control (HVAC, lighting, irrigation, etc.).

A sufficient number of telecommunications outlet locations should be planned to prevent the need for extension cords. An outlet location should be provided in each room and additional outlet locations provided within unbroken wall spaces of 12 feet (3.7 meters) or more. Additional outlet locations should be provided so that no point along the floor line in any wall space is more than 25 feet (7.6 meters) from an outlet location in that space.

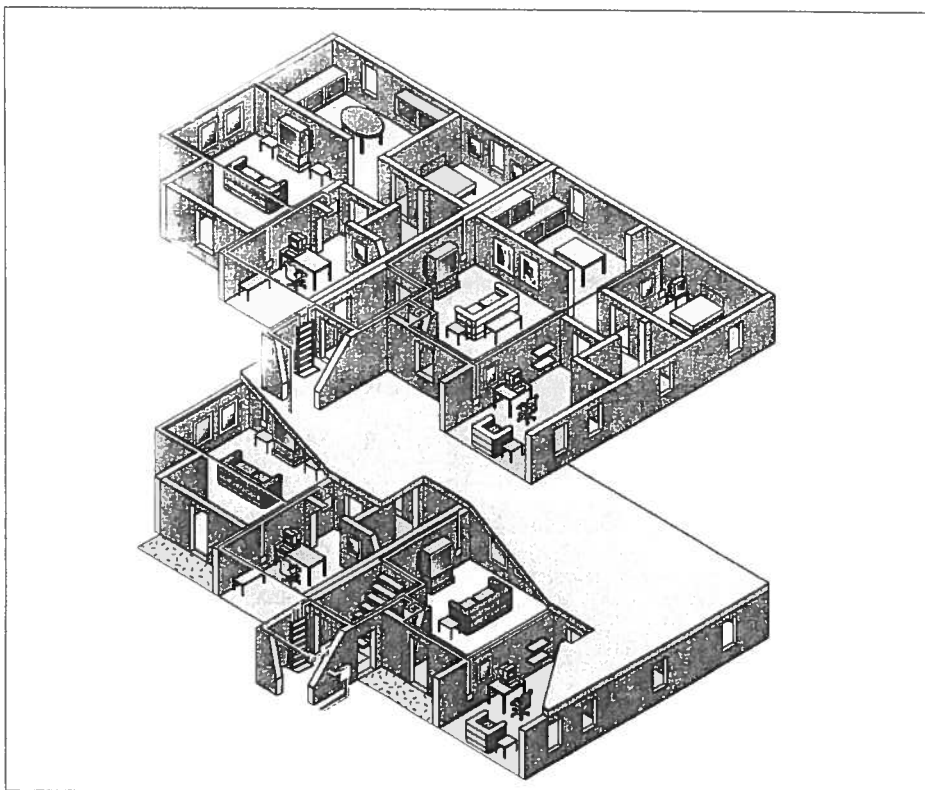
UTP cables shall be terminated on 8-position 8-conductor outlets using the T568A configuration.

Coaxial cable is used for satellite, CATV, and CCTV systems. Satellite and CATV systems shall use Series 6 outlet cable. Coaxial backbone cable shall be used for Series 6, 11, or hard-line trunk. Series 59 cable may only be used for baseband CCTV systems and for patch and equipment cords.

Coaxial cables shall meet the requirements of SCTE IPS-SP-001 or ANSI/SCTE 15 2001 as specified up to a bandwidth of 1000 MHz for CATV or 2200 MHz for satellite. Coaxial cables are to be terminated with F-type coaxial connectors.

Multi-Dwelling Unit Basic Design Considerations and Recommendations

1. A minimum of one outlet location should be cabled in each of the following rooms:
 - Kitchen
 - Bedroom
 - Family/Great Room
 - Den/Study
2. Cables should be home run from outlets to the Distribution Device.
3. The Distribution Device should be centrally located in a climate-controlled location to minimize cable run lengths.
4. Minimum recommended service cables to the Distribution Device:
 - Two Cat 5e/6
 - Two RG6
 - Four RG6 from digital satellite dish mounting location for Single Dwelling Units (SDUs)
5. A 120VAC, 15A non-switchable duplex electrical outlet should be provided within the Distribution Device.



Residential Cabling
Distribution

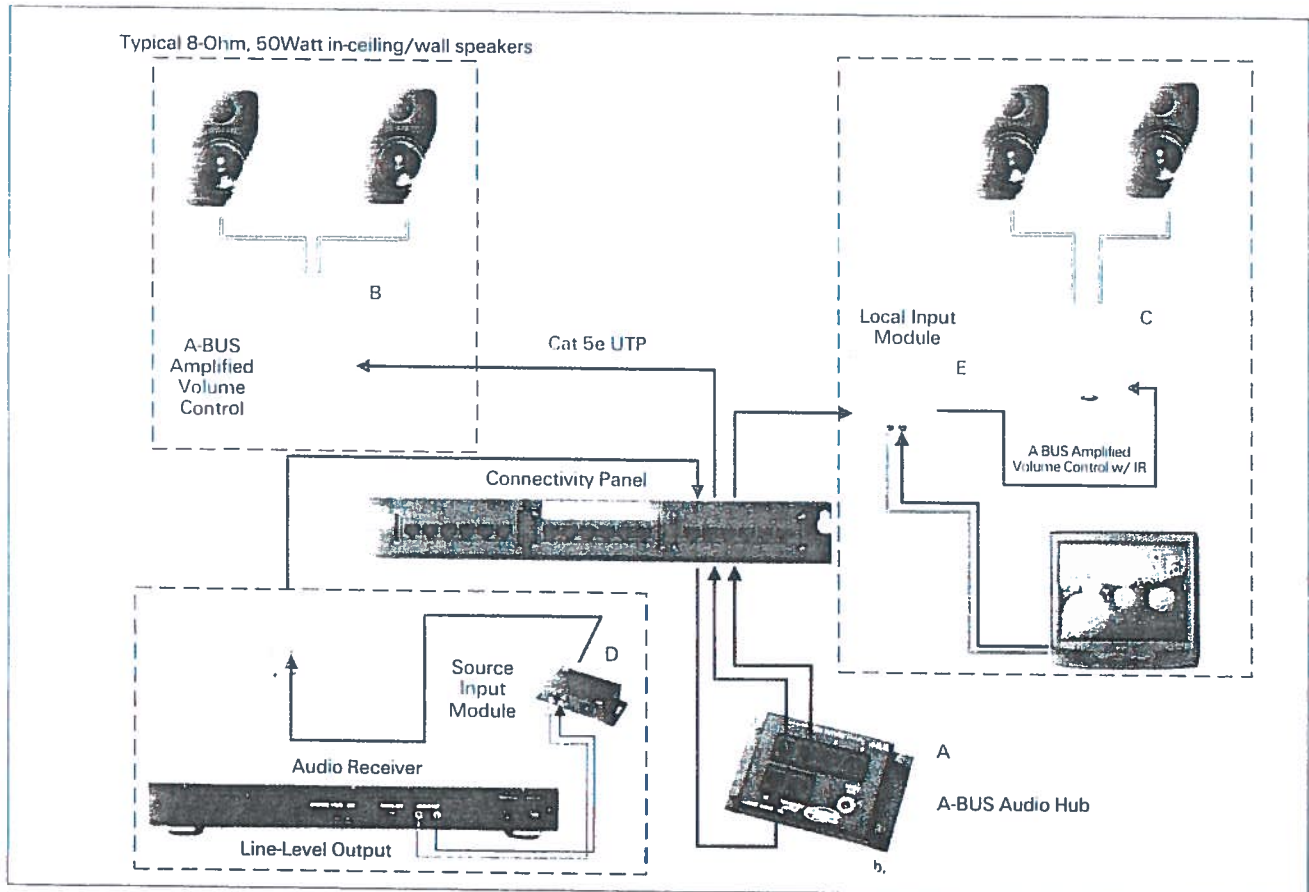
Distributed Audio

Example of a Basic Residential Audio Distribution System using A-Bus Technology
 Courtesy of Tyco Electronics
 (A-BUS is a trademark of Leisuretech Electronics Pty Ltd.)

Figure 10.10 shows a basic configuration of a residential distributed audio system. In this type of system audio is distributed and controlled over UTP using A-Bus.

Line-level audio, IR, and source on/off status is distributed from a central source (for example, PC, TV, CD player, etc.) over Cat 5 or better cabling to amplified volume control modules located in each room thus eliminating the need for a separate amplifier.

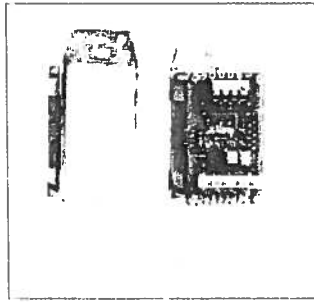
Any Cat 5e/6 outlet jack can be used for audio distribution by simply connecting the source input module using a standard Cat 5 patch cable, then making the appropriate connection in the Media Convergence Center (MCC). Speaker cable (16 AWG recommended) is only required between the volume control and speaker pair located in each room. Volume controls are available with or without IR capability.



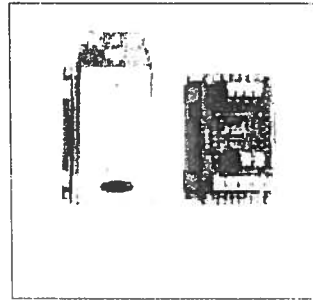
A-BUS Distribution Hubs support up to four zones. The number of zones can be expanded by adding additional hubs via the expansion port. Local input modules allow each audio zone to be used for independent listening. See Figures 10.10a - 10.10e.



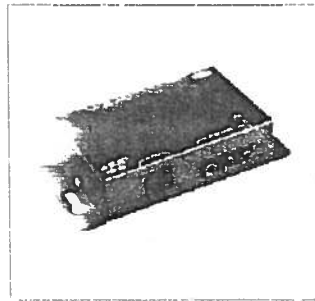
4-Port Hub Kit w/Power Supply



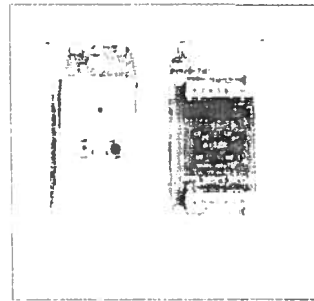
Amplified Volume Control



Amplified Volume Control w/IR



Source Input Module

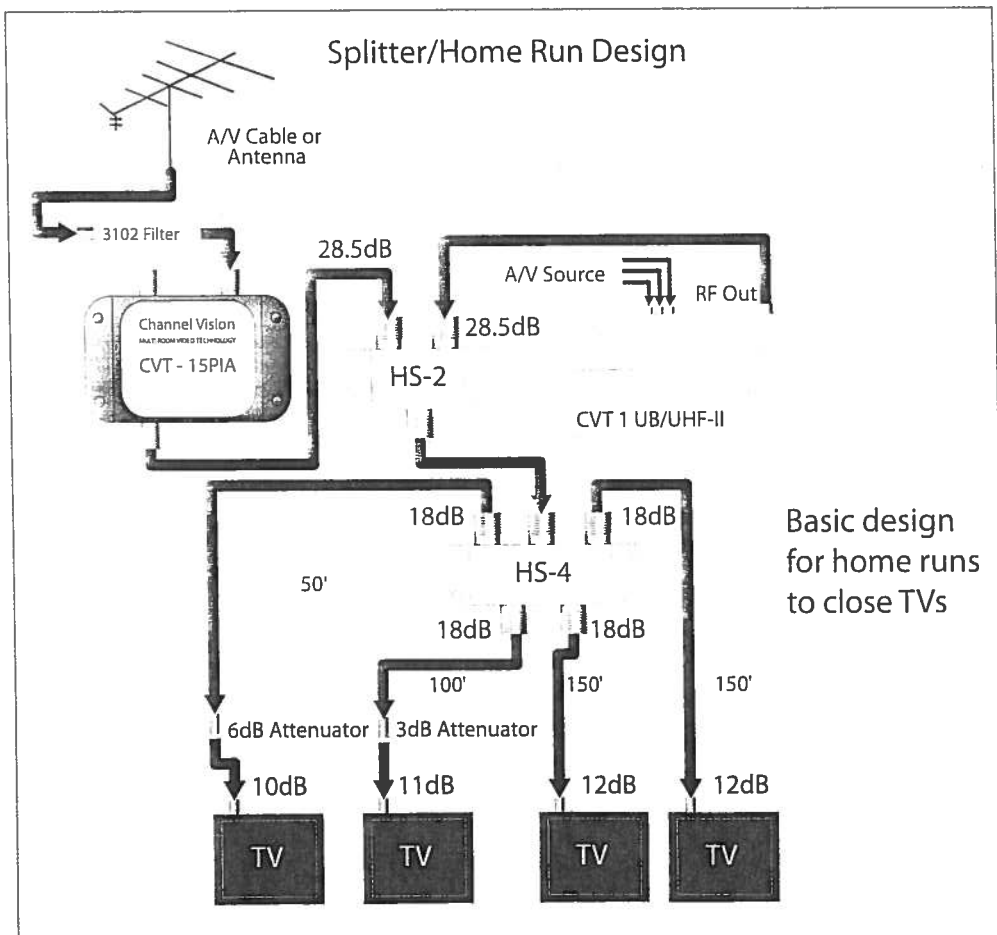


Local Input Module

Figure 10.12 provides an example where off-air signals or CATV signals coming into the home are combined with an A/V source (This could be a central DVD changer, for example.). The signals are then distributed through the home using a combiner and a 4-way splitter. In this example, signal loss through the combiner is 3.5 dB. There is another 7dB loss by passing through the 4-way splitter. Every time a pass-thru device or splitter is added, the video signal is reduced.

Notice that the cable lengths vary as they travel to the different television sets. Losses in the coax are based on the type of coax used and its length. Because of the short runs to the first and second TVs (from the right) the signals would be to “hot” for the front end (tuner) of the TV. Ideally, there should be between 10 dB and 12 dB (and in no case higher than 15dB) of video signal at the TV for best picture quality. Because of the high signal level being supplied to the first two TV sets, attenuators need to be added to reduce the video signals to acceptable levels.

To maintain signal quality and to reduce standing waves (impedance mismatches) that will degrade picture quality, all unused video outlets should be terminated using 75 ohm terminators.



Example of Video Losses throughout the Distribution System *Courtesy of Channel Vision*

Shared Sheath

Shared sheath can be multiple signals on one four-pair cable or it can also be multiple systems on one four-pair cable. Shared sheath has gained favor mainly with A/V and multimedia applications.

Because of the high bandwidth performance of a Category 6 cable or Category 5e, 6, 6A and 7 PIMF cable, sheath sharing might be considered to send voice, video, and data over a single 4-pair cable. The signals are placed on the cable and split back out at the telecommunications outlet by the use of a balun type device. Shared Sheath is considered as application non-specific, and is often described as being "Open Architecture". The ANSI/TIA/EIA-568 **Commercial Building Telecommunications Cabling Standard** does not exclude the use of shared sheath and provides some guidance on shared sheath multi-pair UTP cables in Annex B.

In applications using shared sheath, telephone or data will appear on pins 1, 2, 3, 4, 5, and 6; video on pins 7 and 8, provided that 100BaseT, 1000BaseTX Ethernet or Token Ring is used and not the 4-pair transmission Ethernet scheme such as 1000BaseT. 100BaseT or 1000BaseTX uses two pairs (1, 2 and 3, 6) for transmit and receive. Please note that 1000BaseTX has been a commercial failure because in the early development of this standard, 1000BaseTX required the use of Category 6 cabling. When the Standard was implemented, Category 6 was not widely deployed and therefore use of the 1000BaseTX Standard would require the replacement of the installed Category 5 and 5e cable plant. 1000BaseT, however, had the ability to run on a properly installed Category 5 cabling system installed after 1995. This meant that building owners did not have to replace their cable plant to run Gigabit Ethernet.

Analog Voice	1-pair
VoIP	2-pairs
Video over IP	2-pairs
CATV	1-pair w/balun
CCTV	1-pair w/balun
10/100BASE-T	2-pairs

Table 10.1
Some Examples of Applications and Pair-Count



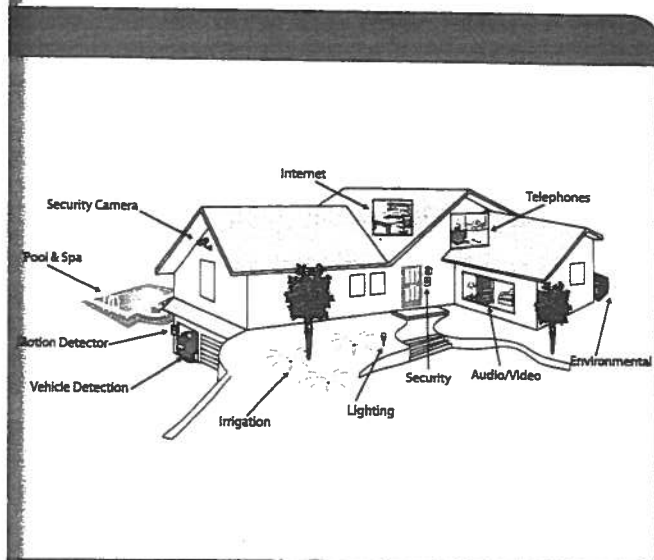
Lesson 13: Residential Telecommunications Cabling

Reference

1. *Configuring and Installing Structured Cabling Systems Text* (Chapter 10)

Introductory Information

Traditionally, each system (phone, television, HVAC, security, sound, etc.) in a residential living unit has its own cabling. The ANSI/TIA/EIA-570-B Residential Telecommunications Cabling Standard (April 2004) defines requirements for residential telecommunications cabling. These requirements are based on the facilities that are necessary for existing and emerging telecommunications services. Single and multi-tenant residential buildings should have cabling installed that complies with the requirements of the ANSI/TIA/EIA-570-B Residential Telecommunications Cabling Standard. This will assure the ability to support long-term connectivity needs. In this lesson, you will learn about the 570-B Standard.



Learning Objectives

After completing this lesson, you will be able to:

1. Identify the standard for residential telecommunications cabling.
2. Define the minimum requirements for Grade 1 and Grade 2 residential telecommunications cabling.
3. Identify the elements of a residential telecommunications cabling system.

Questions

1. Residential structured cabling is designed and installed according to the ____?____ topology.
 - a. ____ ring
 - b. ____ bus
 - c. ____ star
 - d. ____ linear
2. The Residential Telecommunications Cabling Standard is ____?____.
 - a. ____ ANSI/TIA/EIA-568-B.1
 - b. ____ ANSI/TIA/EIA-569-B
 - c. ____ ANSI/TIA/EIA-606-A
 - d. ____ ANSI/TIA/EIA-570-B
3. Grade 1 residential cabling requires a minimum of ____?____ for each cabled location.
 - a. ____ One Cat 3 UTP and one coax
 - b. ____ One Cat 5e UTP and one coax
 - c. ____ Two Cat 5e and one coax
 - d. ____ Two Cat 5e and two coax
4. Grade 2 residential cabling calls for a minimum of ____?____ for each cabled location.
 - a. ____ One Cat 3 UTP and one coax
 - b. ____ One Cat 5e UTP and one coax
 - c. ____ Two Cat 5e and one coax
 - d. ____ Two Cat 5e and two coax

Lesson 13: Residential Telecommunications Cabling

Lesson 13

- Fiber optic cabling is optional for _____.
 - Telephone service
 - Grade 1 cabling
 - Grade 2 cabling
 - HVAC controls
- To comply with the Standard, modular outlets must be wired according to _____.
 - USOC RJ31X
 - USOC RJ61X
 - TIA/EIA 1568-A
 - TIA/EIA 1568-B
- According to the 570-B Residential Standard, which level of cabling is achieved by utilizing two-Series 6 coaxial cables and two-CAT 5e cables at each outlet?
 - Grade 1
 - Grade 2
 - Grade 3
 - Grade 4
- When trouble-shooting a problem in a residential single-family dwelling that is attributed to a lack of dial-tone at the outlets in the dwelling, at which residential structured cabling system component within the dwelling would you be able to disconnect the premise cabling system from the service provider's network?
 - the SMC
 - the ADO
 - the NID
 - the DD
- The ANSI/TIA/EIA-570-B Residential Standard requires that all 8P8C modular termination be accomplished using the _____ termination pattern.
 - T568-A
 - T568-B
 - USOC
 - USMC
- According to the Residential Standard 570-B, the cabling topology that shall be used is the _____ topology.
 - ring
 - bus
 - tree
 - homerun
- Access to the electrical ground shall be provided _____ of the distribution device?
 - within 1' (.3 m)
 - within 5' (1.5 m)
 - within 10' (3 m)
 - not in the scope of this standard
- What is the name of the grey/green plastic box that is mounted to many homes and that serves as a Demarc for the local carrier?
 - Name the four minimum locations to be wired within each residence.
- When trouble-shooting a problem in a residential single-family dwelling that is attributed to a lack of dial-tone at the outlets in the dwelling, at which residential structured cabling system component within the dwelling would you be able to disconnect the premise cabling system from the service provider's network?
 - the SMC
 - the ADO
 - the NID
 - the DD
- The ANSI/TIA/EIA-570-B Residential Standard requires that all 8P8C modular termination be accomplished using the _____ termination pattern.
 - T568-A
 - T568-B
 - USOC
 - USMC