Hotel Technology Infrastructure

Developed by
American Hotel & Lodging Association’s Technology Committee
This guide was written by Mark Haley and developed by the Technology Committee of the American Hotel & Lodging Association with a grant from the American Hotel & Lodging Foundation.

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Welcome to the AH&LA Technology Committee’s Hotel Technology Infrastructure Guidebook. The AH&LA Technology Committee is pleased to present this manual for specifying voice and data requirements in hotels. This Guidebook is one of a series designed by the AH&LA Technology Committee to familiarize hotel owners, operators, and developers with the fundamentals of technology in the hotel environment.

This Guidebook provides an overview of cabling infrastructure requirements for a broad range of property-level hotel technology applications. Some of these applications include voice and data in guestrooms and public spaces as well as administrative voice and data, including telephone (also known as Private Branch Exchange, or PBX), Property Management Systems (PMS), Point of Sale systems (POS), video (free-to-guest, pay-per-view, and interactive), locking systems, high-speed Internet access (HSIA), and more. The intended audience is hotel operators or developers with no particular technology or engineering background. Rather than being a treatise on cable plant engineering, the discussion is organized to answer such questions as “What do I do in my guestrooms about voice communications?” The Additional Resources section on page 41 contains a variety of technical and laymen’s resources for more detailed information, if required.

Overview

The material is presented in sufficient detail to provide the foundation of bid specifications for cabling contractors engaged by the hotel operator or developer in a new build or renovation scenario. If the property is installing a new system rather than undergoing renovation, then the principles described herein still apply and may be implemented on as-needed basis.
The property owner or manager seeks three simple things from the cable plant:

- That it support the installed systems today, without failures.
- That it be a cost-effective installation.
- That it be maintainable and upgradeable with the life of the asset.

Most computer systems likely to be installed in a hotel today connect telephones, terminals, printers, and hosts via one of four types of communication protocol.¹ Using the principles in this Guidebook and some planning, you will be able to support all of these devices through a single wall plate without rewiring for many years into the future.

The challenge for the hotelier is to define an infrastructure that supports all of these communications methods today and those that may come tomorrow, and to maintain the cable plant in the future. The most effective way to meet this challenge is to treat the cable plant as its own system, integral to the building and part of the real asset, much like plumbing or electricity.

Contrast this structured and systematic approach with the way businesses used to pull cable—dedicated home runs of radically different cable types, each with different termination pin-outs, with device relocations and replacement dependent on pulling a new cable from the host to the device every time.

This systems approach affords a long-term view (at least 10 years) of the cable plant asset. Many structured cable system installations are sold with 10-, 15-, and even 25-year warranties.² Over this kind of lifecycle, the value of the maintainable and fully documented cable plant exceeds the initial cost many times over.

The foundation of this systems approach to building infrastructure is known as the Telecommunications Industry Association/Electronics Industry Alliance (TIA/EIA) 568 Commercial Building Telecommunications Cabling Standard. This is a voluntary standard maintained by the EIA and the TIA under the auspices of the American National Standards Institute (ANSI).

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¹ The four types of communications protocol are analog voice, digital voice, TCP/IP over Ethernet, and RS-232 serial.
² Recognize that these warranties mean that the cable plant will perform in accordance with today’s TIA/EIA 568 standard for 25 years, not that the technology in place in 10 years may not need a different standard.
Since these organizations published the initial standard in 1991, it has won broad acceptance and continues to evolve.

Other relevant standards include:
- TIA/EIA 569—Cabling Pathways
- TIA/EIA 606—Administration
- TIA/EIA 607—Grounding & Bonding
- National Electric Codes (NEC)
- National Fire Protection Association Codes
- Construction Specification Institute Division 16—Electrical specifications for construction
- Local building codes

Formal discussion of these other standards is generally beyond the scope of this Guidebook, but many of the concepts presented here are drawn from them.

In the succeeding sections of this Guidebook, we will provide concepts and recommendations for applying the TIA/EIA 568 standard in the hotel industry for key parts of the hotel, including guestrooms, administrative areas, and public space. Additional sections will provide detail on coaxial cable support for Master Antenna Television (MATV) systems and alternatives to TIA/EIA 568 for delivering high-speed Internet access (HSIA) into guestrooms. Then we will discuss how to source a qualified cable plant designer or installer and provide sources of additional information.

The entire Guidebook equips a hotel owner or developer to build out the cable plant as a value-added component of the hotel that will support the needs of the building’s users and owners for many years to come.

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3 Telecommunications cabling will probably be pulled out of Division 16 and put into its own unit, Division 17, in the near future.
Systems Approach
The cable plant needs to be treated as a building infrastructure system of its own, much like the electrical, plumbing, or heating, venting, and air conditioning (HVAC) system. This infrastructure perspective means using a structured hierarchy of modular elements that are independent of the applications they support. You will use identical cable plants and often the same ones for analog voice communications, digital voice communications, and a broad range of data applications, including PMS, POS, lock system terminals, and more.

Planning and configuring the cable plant needs to be an integral part of the design-build process. Designing the cable plant after construction has progressed beyond a certain point leads to costly rework if the conduit provisions prove inadequate. Design the cable plant before you pour concrete.

You may choose to use the modularity and flexibility of the systems approach to support a physically separation of computer system devices into independent local area networks (LANs). Conversely, you may treat them as terminals on a single LAN supporting all of the applications in the property. Larger properties with more devices and more applications will need more segmentation.

Architecturally, this approach to cabling is called a “star topology.” It is analogous to the airlines' hub-and-spoke route maps, far more efficient than the old routes of point-to-point scheduling.

The elements of the cable plant include all of the components required to connect a telephone or a computer back to the appropriate host device in a hierarchical star topology, as shown in Figure-1.
Main Cross-Connects: Also known as main distribution frames, or MDFs, generally a field of color-coded punchdown blocks (often referred to as “110” or “110-type” blocks) and often patch panels located on a plywood backboard\(^4\) in the primary data center or telecommunications room (TR). PBX and host computer ports are attached to the “host” side of these cross-connects.

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\(^4\) Backboards should be _-inch plywood, painted, and equipped with a grounding bushing.
Backbone: Also known as risers. May be either copper or fiber-optic cable. Generally run vertically to TRs on each or staggered floors of the building (one sometimes finds a TR on every third floor,\(^5\) supporting the floor above, the floor below, and the floor it is on), or horizontally to different buildings in a campus environment. The backbone connects the “house” side of the MDFs to the intermediate cross-connects located in the intermediate TRs.

Telecommunications Rooms: TRs should be secured, illuminated, free of dust, environmentally controlled (air conditioned with own thermostat, 50°-75°F), and have adequate 120V AC (120 volts of alternating current electrical service) power to support the installed load. TRs must have grounding points consistent with TIA/EIA 607 and the NEC.\(^6\) Do not use TRs as storage or work areas.

The main TR or data center is an “equipment room” under TIA/EIA 568, sharing the characteristics of TRs, but will hold PBXs, servers, and other equipment as well as wiring and hubs. Ideally, a hotel will have a single secured equipment room housing PBXs, servers, in-room entertainment racks, routers, and the MDF. Do not site the equipment room in a remote location. Rather, place it in a central location to avoid distance limitations.

\(^5\) Be sure to factor in “missing” 13th floors in assigning TRs under this scheme.
\(^6\) Telecommunications grounding and bonding must be part of the building’s grounding infrastructure.
**Intermediate Cross-Connects:** Also known as intermediate distribution frames, or IDFs. Connect the backbone on the “host” side of the cross-connect to horizontal distribution to telephones, computers, and terminals in work areas or guestrooms on the “house” side. Consolidation points (CPs) are typically punchdown blocks used as part of the horizontal distribution to a given location such as a guestroom, which is in effect a satellite IDF. IDFs often require 120V AC power nearby for HSIA switches, MATV amplifiers, and so on.

**Figure-3:** Intermediate Distribution Frame Supporting Both Fiber-Optic and Copper Cable

**Horizontal Distribution:** Usually four twisted pair Category 5e copper cables running from the IDFs to the telecommunications outlets at the work areas. May be bundled to service a satellite distribution frame or patch panel. Fiber is also used for horizontal distribution, especially for long or high-demand routes.
**Cable:** May be made of either copper or fiber optics in a variety of sizes and pair counts. Copper cable is usually rated by “category,” where the higher the number means higher throughput capacity. The 568 standard specifies Category 5e (Cat 5e) for most voice and data applications. Category 6 is expected to be ratified by the standards bodies in the near future, although there are several Category 6 systems in the market today. Category 7 is in the U.S. market, but not yet ratified. Category 3 and lower capacity cables are not recommended.

A crucial element in maintaining the rating of a Cat 5e cable is keeping the twists in the pairs of conductors intact to within 1/2 inch of each termination and limiting the total length of all patch cables in the channel to less than 10 meters. The total length (including all patch cables) of a copper horizontal channel should be kept less than 100 meters, according to the standard, with fiber used for longer runs.

Fiber-optic cable is usually used for backbone applications, and may be used for horizontal distribution as well. Typically, two-fiber multimode cable of either 62.5/125 \( _{m} \) or 50/125 \( _{m} \) may be used for either horizontal or backbone applications.

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7 One \( _{m} \) equals one micron, a unit of measure also known as micrometer.
Telecommunications Outlets: Typically wall plates with one or more connectors built into them. Most cable channels terminate in a modular connector punched down to either the T568A or T568B configuration. RJ-45 is the most common connector type used, with the smaller RJ-11 connector form factor used for some analog voice terminations. MATV telecommunications outlets terminate in an F-Type connector for coaxial cable.

Figure-5: Quad RJ-45 Telecommunications Outlet labeled for Voice and Data
The T568A\textsuperscript{a} termination assigns eight color-coded conductors to each of four pairs as follows:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Pair</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>White/Green</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Green</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>White/Orange</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Blue</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>White/Blue</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>Orange</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>White/Brown</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>Brown</td>
</tr>
</tbody>
</table>

The T568B termination uses the same pair and color assignments, switching the positions of pairs 2 and 3.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Pair</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>White/Orange</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Orange</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>White/Green</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Blue</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>White/Blue</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>Green</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>White/Brown</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>Brown</td>
</tr>
</tbody>
</table>

**Figure-6: Applying the TIA/EIA 568 Standard in Hotels**

TIA/EIA 568 does not tell you how to cable a hotel. It defines in great detail what the characteristics of the components defined above should be in any commercial building. We will present the application of the standard in terms of the following assumptions:

- There are at least two analog telephone lines per standard guestroom, with provisions for future use of digital telephone instruments.
- Data service is provided to the guestrooms, independent of the administrative network.
- Most hotel systems will be resources on a LAN.
- The LAN may or may not be segmented by application.

These assumptions may not hold for all properties in all market segments.

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8 The U.S. federal government publication NCS, FTR 1090-1997 only recognizes T568A.
Most hotel companies today require or recommend true two-line service to guestrooms. Some observers debate the continued demand for this requirement as cell phones proliferate and call volumes drop, but we believe it remains a useful recommendation for most hotels. Note that a hotel wishing to use more advanced digital or VoIP (Voice over IP; using the Internet protocol to carry both voice and data to a terminal device) phones in guestrooms will still need to offer analog phone service in each room for modem users.

**Key Principles**

1. Document the cable plant. That means labeling both ends of every cable run, labeling each outlet cover, certifying all terminations with electronic test devices, and keeping a database of the runs. Require as-built documentation and maintain it.

2. Evaluate your cable plant *every time* you open the walls of your building. Take advantage of every opportunity to improve or upgrade the facility in renovations.

3. Identify a single product line of TIA/EIA products and use that line exclusively to ensure consistency. Manufacturers include Ortronics, Avaya,9 NordX, Siemon, and others.

4. Use Cat 5e or better for all copper applications. It does not cost much more than Cat 3 and offers more flexibility and performance. As the standard evolves and specifies Cat 6 and Cat 7 cable, install that.

5. Use separate voice and data MDFs to enhance manageability.

6. Avoid lighting fixtures, elevator shafts, or other sources of electromagnetic radiation in cable routes. Anything with a motor can emit some amount of interference.

7. In general, use conduit, cable trays, or hangers for all cable runs.

8. Local building codes will require conduit in many instances. Use plenum-rated cable for all non-conduit installations in any ceiling space used for air exchange. Do not allow cables to lie directly on suspended ceilings, even in a non-plenum space.

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9 Formerly Lucent Technologies, originally AT&T.
 Assume growth. Use conduit sufficiently larger than the cable running through it to pull more in the future (40 percent fill maximum). The longer the run or the more bends in it, the larger the required conduit diameter relative to fill.

 Ensure that installers use care in pulling cable, avoiding excessive bending, excessive pull tension (<25#), chafing, or abrading.

 Make extensive use of patch panels to facilitate changes and reduce the required skill levels for people making changes.

 Never use flat “silver satin” type patch cords. Use round twisted-pair cables labeled Cat 5e.

 Do not use splices or bridge taps. Do not split pairs from a Cat 5e channel to support multiple devices.

 Ensure that all cable terminations maintain the twists in the cable to within a 1/2 inch of the termination.

 IA/EIA 568 has two different specifications for terminating cables in plugs and jacks, known as T568A and T568B. Either will work, but pick one, use it exclusively, and know which one you use.
Note the following distance limitations for copper cable under TIA/EIA 568 for data applications:

- 90 meters (295 feet) maximum of backbone cable with no intermediate cross-connects.
- 90 meters (295 feet) maximum of horizontal cable.
- 10 meters (33 feet) maximum combination length of work area cables, patch cords, and equipment cable. This limitation includes patch cables in cross-connect fields. Longer runs will require fiber.
- Note that voice applications will operate over much longer channel lengths than data.
TELECOMMUNICATIONS OUTLETS

A major decision in any cabling project is determining the number of cable terminations in telecommunications outlets in any given location. The table below is intended to facilitate that decision. Note that, in general, the more telecommunications outlets required in a given location, the more AC electrical power outlets required.

<table>
<thead>
<tr>
<th>Table of Recommended and Minimum Telecommunications Outlets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area</strong></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>Data Center</strong></td>
</tr>
<tr>
<td>“Equipment Room” in 568 terms</td>
</tr>
<tr>
<td><strong>Guestrooms</strong></td>
</tr>
<tr>
<td><strong>Voice</strong></td>
</tr>
<tr>
<td><strong>Data</strong></td>
</tr>
<tr>
<td><strong>MATV</strong></td>
</tr>
<tr>
<td>Area</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>Voice</td>
</tr>
<tr>
<td>Data</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>
### Administrative Locations

<table>
<thead>
<tr>
<th>Area</th>
<th>Assumptions</th>
<th>Recommended</th>
<th>Minimum</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice</td>
<td>Most administrative locations will require voice and data, with most voice applications using digital telephones.</td>
<td>A single digital voice telecommunications outlet supporting multiple voice lines for most administrative users with voice mail.</td>
<td>Analog voice service to administrative locations.</td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>Most administrative applications today can reside on a single logical network, but some applications may require dedicated cabling. Some franchisors require an “airgap” between any device on their reservations network and any other network.</td>
<td>Two data terminations per administrative location.</td>
<td>One data termination per administrative location.</td>
<td>Administrative networks should be kept physically or logically separate from guest networks. Front desk locations typically require additional terminations due to the number of devices located there.</td>
</tr>
<tr>
<td>Other</td>
<td>As required. Do not forget MATV service from rooftop or other location of satellite reception dish or antennae. Best to penetrate roof during construction, before sealing and warranty.</td>
<td>As required.</td>
<td>As required.</td>
<td>Timeclocks, access control solenoids, cafeteria POS, cafeteria TV, and so on all require consideration.</td>
</tr>
</tbody>
</table>
Figure-8 is an annotated markup of a fully-loaded voice and data communication configuration for an upper-upscale guestroom. This example assumes that the room will be equipped with two analog voice lines and MATV via coaxial cable, but will be “future-proofed” with a cable plant that can support digital telephones and TV over Cat 5e in the future without pulling additional cable.

**SIDF:** Cat 5e 110-type punchdown block behind an access panel in the guestroom. Host side runs 25-pair bundled cable to IDF in TR via horizontal distribution. House side runs to work areas as identified on the following page.
**Bedside:** Two Cat 5e drops for analog voice applications mounted in a duplex faceplate. Quad 120V AC power.

**Desk Area:** Two Cat 5e drops for data applications, two for analog voice mounted in a quad faceplate above desk. Quad 120V AC power above desk.

**Television(s):** Both RG-6/U coax and Cat 5e drops mounted in either one duplex or two simplex faceplates. Duplex 120V AC power. Pull two strands from TV to desk, leave in wall with 1-meter service loop at each end.

**Mini-Bar:** Cat 5e drop mounted in simplex faceplate. Duplex 120V AC power.

**Bathroom:** One Cat 5e drop for voice applications, one for MATV and RG-6/U coax.\(^{10}\) Duplex 120V AC power.

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\(^{10}\) Omit unless a luxury hotel installing bathroom televisions. Bathrooms are not a good environment for either televisions or wiring due to moisture and temperature.
Overview

As of this writing, most industry observers believe that travelers will eventually come to expect HSIA in hotel guestrooms. The same observers share little consensus regarding how this amenity will be funded and delivered. The AH&LA Technology Committee recommends that new builds or major renovations implement Cat 5e or better structured cabling systems supporting data to the guestrooms. Routers, switches, and hubs to support the guestroom broadband service can easily be added or changed by service providers or the hotel itself once the horizontal and backbone distribution is in place.

Some hotels will feel competitive pressures to provide HSIA service in the near term, without a major renovation facilitating installing Cat 5e horizontal distribution to guestrooms. Numerous vendors are in the marketplace with products that provide in-building distribution over existing Cat 3 cable, coexisting with analog voice traffic. There are multiple variations of how this is done, but most involve some form of DSL (Digital Subscriber Line) modem mounted in the wall behind the faceplate connected to a DSLAM (Digital Subscriber Line Access Multiplexer), which then is connected to a router on the public Internet. A property can reduce the total cost per room of these solutions by using port-sharing devices, reducing the number of DSLAM ports required. The most common variations found in the hotel marketplace are based on technology endorsed by an industry consortium called the HomePNA (Home Phone Networking Alliance, also HPNA).

Cable modems, which use the MATV system to distribute access to the Internet, are another option. While popular in residential applications, cable modems have had less penetration in the hotel market.
These coexistence tactics for delivering horizontal distribution over existing Cat 3 wiring can in fact function, with the notable virtue of rapid and inexpensive installation. However, performance, consistency, and manageability are significantly stronger with a structured Cat 5e implementation for data only.

**Elements of an HSIA Solution**

Any guestroom HSIA solution must address the following elements:

- **Connection point in the guestroom:** Typically an RJ-45 receptacle in a wall-mounted faceplate. Sometimes found on a “puck” or “sled-like” device. Some devices support Universal Serial Bus (USB) interfaces as well as Ethernet from the guest’s laptop.

- **In-building distribution:** As noted above, Cat 5e in a structured cabling system is the recommended vehicle, with coexistence over Cat 3 voice cable a second choice. Cat 5e solutions will require hubs and switches. Cat 3 coexistence solutions will require some form of DSL/DSLAM or similar modem and multiplexer.

- **Subscriber Management Services (SMS):** A server, probably located in the hotel, that controls user log-on, billing, PMS interface, and reporting. Usually also controls the home page that the guest first sees. A key function of an SMS application is to “spoof” the user’s laptop into believing that it is attached to whatever network it expects to be attached to so that no changes are required to the guest’s laptop configuration. The SMS products in the market vary widely in how effectively they handle this requirement.

- **Connection to the public Internet:** Usually via a router supporting a T-1 or fractional T-1 circuit to the Internet. As a general rule, resale networks should be kept physically and logically isolated from administrative networks. Many franchisers require an “airgap” separation from their reservations networks.

- **End-user support:** Who do guests call when they have a problem connecting? Very few guest service agents are skilled in troubleshooting TCP/IP connections. Typically, the service provider will offer end-user support services via telephone, sometimes for a fee charged to the hotel.
CONNECTIONS TO EXTERNAL NETWORKS

As described above, most hotels have business reasons for connections to two or more data networks, typically the public Internet and a private network delivering reservations traffic. Some management companies may use another private network for accounting or other internal functions as well. There are also highly effective ways to make a public Internet connection function as a Virtual Private Network (VPN) with both the security of a private network and the cost-effectiveness of the Internet.

These external networks are connected to the hotels in a number of ways.

**T-1:** A T-1 circuit is a large-capacity digital circuit that can carry 1.5 megabits per second (Mbps) of data or up to 23 simultaneous voice conversations. A T-1 is a dedicated access connection that is always up, always connecting two points (typically the hotel and the carrier's (ATT, Worldcom, Sprint, etc.) nearest point-of-presence (POP). Many hotel companies use T-1 circuits in the hotels with a few channels of frame relay\(^\text{11}\) data network and the balance used for voice, so that the voice traffic subsidizes the cost of the reservations data network.

**Fractional T-1:** Uses only a portion of a full T-1 capacity for the data network at a lower cost. The remaining channels are simply not used. Often abbreviated as “frac T.”

**Integrated Services Digital Network (ISDN):** Many T-1 lines are provisioned as ISDN circuits, called Primary Rate Interfaces (PRI). Another type of ISDN service is called Basic Rate Interface (BRI), using two channels bearing traffic and a signaling channel. An ISDN connection to the public Internet will yield up to 128k of total bandwidth and may be either dial-up or dedicated. Some mission-critical networks use dial-up ISDN circuits as automatic fallbacks in case the primary network (typically a dedicated T-1) fails.

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\(^{11}\) Frame relay is a very popular type of WAN for data applications, used by most hotel brands for reservations distribution.
Digital Subscriber Line (DSL): In addition to using DSL variants for in-building distribution, DSL has become a popular vehicle for cost-effective dedicated Internet connections for residential and small business applications. DSL services are available at various bandwidths, often with a higher download capacity than upload capacity (“asymmetric”).

Analog Voice\textsuperscript{12} Trunks: The basic plain old telephone service (POTS) provided by two wires for every voice circuit, very similar to most residential telephone services. Analog POTS trunk service in hotels and other business is largely being pushed aside by more efficient digital services terminating on the PBX, but it still has a place both for fallback in case a T-1 fails and for analog voice lines independent of the hotel PBX.

A large hotel with extensive meeting space and Internet resale will want one or more T-1s for resale purposes only. Smaller properties might service their resale demand with “frac T” or DSL services.

The data component of any of these external network connections usually terminates on a router, which looks at each packet of information and determines where it needs to be routed to next. Switching, firewall, and Network Address Translation (NAT) functions are often provided by additional devices located at the router or built into a multifunction router device.

\textsuperscript{12} Don’t forget that modems and fax machines require analog service, not digital. Your digital PBX can present both digital and analog ports as required.
Master Antenna Television (MATV) services are required to deliver broadcast, cable, pay-per-view, and various interactive services to guestrooms. Traditionally, MATV has been delivered by RG-6/U coaxial cable (very similar to the cable TV coax service in your home). More recently, in-room service providers have entered the market delivering pay-per-view, interactive, and Internet services over Cat 5e rather than coax. Typically, these providers will still require coax to distribute free-to-guest programming.

Today, developers should install both coax and Cat 5e for MATV support in a new build or major renovation as a form of future-proofing. Installing coax only to support MATV risks limiting future choices for in-room services.

Use your in-room services vendor for final design and specifications of your MATV system, particularly for the selection and installation of amplifiers, mixers, and filters. The AH&LA Technology Committee cautions developers against allowing the provider to install and own the cable plant, however. While it is often attractive to push the cabling cost back to the vendor, a poorly structured agreement can greatly limit the hotel’s future choices and subject the cable plant asset to mechanic’s liens or other encumbrances in the event that the provider does not fulfill its obligations. Better to own the MATV cable plants yourself as an asset, built to the specifications of the provider.

Coaxial cable plants share many similarities to the structured Cat 5e systems defined in TIA/EIA 568, with backbone and horizontal distribution. Loop-through designs are not recommended. Riser or backbone distribution generally calls for RG-11/U coaxial cable. Long runs (more than 500 feet) require.500 (or larger) hardline backbone. Horizontal distribution to the guestrooms will generally utilize RG-6/U cable. Use conduit according to local building codes.
Provide dedicated riser cabling, with spare capacity, from the data center to the rooftop to support satellite dishes and antennae. This riser should terminate in a 4-inch weather-capped conduit in a rooftop location with an unobstructed view of the southern sky.\(^{13}\) It is also wise to install a 3-inch antenna mast during construction.

\(^{13}\) Geosynchronous satellites are over the equator, so Northern Hemisphere locations need a southern line-of-site to "see" the satellite.
Wireless data communications have attracted a great deal of attention in the marketplace, with the promise of eliminating a lot of the headaches associated with cable. They also attract attention for being perceived as insecure. The most widely-used wireless networking standard at this time is known as 802.11b or “Wi-Fi.”

Any wireless network requires one or more access points, typically placed in a ceiling or TR, which is then wired back to a router in the equipment room. Therefore, a wireless network still requires a structured cabling system, but less horizontal cable. This can be a real advantage in guestrooms, but it requires that guests have the cards for their laptops, be prepared to install them, and accept the perceived security risks. Subscription-based services can overcome those issues, but at that point, the guest is a customer of the wireless service provider, not of the hotel.

A successful wireless data installation is dependent on properly positioning and tuning the access points. Proper positioning requires a formal engineering survey using test equipment. Place the access points properly and run horizontal cable to them, rather than placing access points where the cable happens to be. Access points generally require 120V AC power.

Other useful wireless data applications in the hotel environment include:

- Pool and beach bar areas to support handheld POS applications.
- Resale for special events in locations that are not normally cabled (golf courses, parking lots, etc.).
- Temporary use during renovations or administrative office relocations.

Another type of wireless opportunity is the ability to lease rooftop space to cellular telephone or other radio system providers for their antennae. This can be a lucrative, all-profit source of cash for essentially no work.
Overview

Most telecom and electrical vendors are familiar with TIA/EIA 568. Their skill levels in implementing it will vary widely. If you use a full-service PBX service vendor, you will find that it can provide you most cabling services, it already knows your facility, and it has a business relationship with you. Likewise, your in-room service provider should have comparable skills, knowledge, and relationship. Your responsibility is to ask them for an installation compliant with this Guidebook and TIA/EIA 568 and ensure that the installation is tested and documented. Ask them about professional or vendor certifications.

To ensure a fully-compliant cable plant for large or sophisticated installations, especially new builds, look for the RCDD certification. A Registered Communications Distribution Designer certificate indicates that the holder has demonstrated a broad range of expertise in the detailed design and implementation of cable plants. The RCDD professional designation requires passing a formal exam, proof of several years of design experience, and regular recertification. The RCDD designation is awarded by the Building Industry Consulting Service International (BICSI) professional association. BICSI also has a certification program for installers and offers a variety of educational opportunities for those pursuing these designations.

Vendors are another source of certification. Most of the manufacturers of integrated Cat 5e cable, connectors, and so on offer certification in using their product lines. If a vendor proposes using a given product line, ask whether it is certified in it. Manufacturer’s warranties are typically valid only if sold and installed by a certified distributor. Many of the manufacturers’ Web sites allow you to search for their distributors by location. See Additional Resources on page 41.

However you source cabling contractors, demand testing and certification in addition to as-built documentation of the cable plant. Although testing may seem expensive, it is nothing compared to going back later to do the job over.
Components of a Cable Plant Request for Proposal

When you are buying cable plant infrastructure sourcing and installation in a new-build or renovation scenario, the developer, project manager, or general contractor should use a structured bidding process. You should include the following elements in a Request for Proposal (RFP).

- Provide an overall description of the project and the project management.

- Provide marked-up samples of the most current available drawings with accompanying narrative describing requirements at the telecommunications outlet level in detail. See Figure-8 on page 12 for an example.

Require the following components in the response document:


- Identification of what manufacturer’s components will be used and a statement of certification on that product line.

- A statement of experience with projects similar in scope and nature, particularly hotels.

- A statement of full compliance with TIA/EIA 568, 569, 606, and 607 and all local and national codes that apply (see Figure-1 on page 12).

- A narrative describing the backbone media and horizontal distribution proposed to satisfy the telecommunications outlet requirements for guestrooms, administrative locations, public space, and BOTH.

- Estimated conduit sizes and counts required for riser applications.

- Certificates of liability and workmen’s compensation insurance coverage in amounts proportional to the scale of the project.

- Compliance with union membership requirements as per the overall project or local custom.
In the Scope of Work section of the RFP, include the following:

- Complete turn-key services, including design, build, source, install, cross-connect, test, certify, and document.

- Delivery of as-designed plans to project management before work begins.

- Labeling of all cables at both ends according to a documented and consistent labeling nomenclature. Labeling of all telecommunications outlet faceplates, patch panels, and distribution frames.

- Wire-map and swept frequency testing and certification of the installed plant as compliant with the electrical characteristic requirements of TIA/EIA 568. See page 39.

- Delivery of as-built plans to project management with the test and certification results.
CABLE PLANT TEST MEASUREMENTS FOR CATEGORY 5e SYSTEM

Ultimately, determining compliance with the TIA/EIA standard is defined by electronic testing of the installed system along the dimensions described below. Part of purchasing your cable plant installation is to demand testing of the installed plant along each of these measures and certification that the as-built cable plant meets or exceeds standards on each measure and documentation of the cable plant, again, as-built. “As-built” is not always the same as “as-designed.” “Channel testing” (of the entire channel, from work area to data center) is preferable to “permanent link” (horizontal distribution) testing.

The relevant measures over 1-100MHz frequency ranges for Cat 5e 24 AWG 100Ω (Size 24 American Wire Gauge with 100 ohms of resistance) twisted-pair cable are:

- **Wire Map:** Tests that all eight conductors maintain continuity and are properly paired and terminated according to T568A or T568B.
- **Length:** Tests that the physical length of the permanent link is less than 100 m, including patch cords.
- **Insertion loss:** Measures signal loss, 24 dB (decibels).
- **Near-end crosstalk (NEXT) loss:** Measures signal coupling from one pair to another, 30.1 dB.
- **Power sum near-end crosstalk (PSNEXT) loss:** Measures total crosstalk on receive pairs, 27.1 dB.
- **Equal-level far-end crosstalk (ELFEXT):** Measures signal coupling from a near-end pair into another pair measured at the far end, 17.4 dB.
- **Power sum equal-level far-end crosstalk (PSELFEXT):** Measures total crosstalk on receive pairs at far end, 14.4 dB.
- **Return loss:** Measures reflected energy caused by impedance variation in the cable plant, 10 dB.
• Propagation delay: Measures time required for a signal to travel from one end of the channel to the other, 548 ns (nanosecond-1 billionth of a second).

• Delay skew: Measures differences in propagation delay from the fastest pair to the slowest, 50 ns.

• Recognize that the numeric values shown above are informational. Pass/Fail values on certain measures vary by frequency, test method, temperature, or other variables.

Your cable installer should agree to provide you with test equipment print-outs indicating Pass/Fail for each termination on each of the measures above. If it refuses to do this kind of testing, it is not the right contractor for a full-building or mission-critical job.

Testing is essentially an automated, “push-button” task using an electronic device and a skilled operator. The number of measures and complexity of calculations may make it seem like a lot of work, but in fact, it is done by a sophisticated machine. Typically, wire maps are done with simple devices as terminations are made, and swept frequency channel testing is done later with more expensive and sophisticated devices.
**ADDITIONAL RESOURCES**

**General Information on Cabling**
http://www.lodgenet.com
Detailed MATV/CATV specifications available for download.

http://www.cableu.net
Absolutely outstanding source for information on copper and fiber cabling in general and TIA/EIA 568. Offers training programs on-line or for sale, as well as testing products and tools.

http://www.smartwire.com/techcontents.htm
Very good site with overview and detail on both TIA/EIA 568 and MATV cabling. Sponsored by a cable distributor.

http://global.ihs.com
Purchase the actual standards documents (via download of PDF).

http://www.connectworld.net/
Large technical library; “virtual mall” of distributors.

http://www.omedacom/cim/
Site to subscribe to e-mail newsletter Cabling World.

**Trade and Professional Associations**
http://www.bicsi.org/index.htm
Home page for BICSI, with information on the RCDD professional designation, variations on it, and the Installers certification program.

http://www.tiaonline.org
Home page for the Telecommunications Industry Association, a sponsor of the 568 and other standards; markets various trade shows and educational offerings.

http://www.eia.org/
The Electronics Industry Alliance, the co-sponsor of 568.
Manufacturer and Distributor Sites

http://anixter.com/
Full-line distributor.

http://avaya.com/
Formerly Lucent Technologies; markets the “Systemax” product line.

http://www.cables-unlimited.com/index.html
Multiline distributor.

http://www.nordx.com/public/htmen/0_0.asp
Markets the IBDN product line. Spun off from Nortel Networks.

http://ortronics.com/
Markets comprehensive structured cabling product line and systems, with a strong certification program.

http://www.panduit.com/
Full-line manufacturer.

http://www.siemon.com
Full-line manufacturer with strong certification program and educational offerings.