Structured Wiring for the Classroom

Cabling installation in schools has never been as important or complex as it is today since technology is being integrated into nearly every aspect of the learning process. Many schools now have wiring closets or entire server rooms that provide the backbone for data communications, including Internet access throughout the building. In classrooms mobile audio/video carts have been replaced with projectors, interactive whiteboards and displays mounted throughout the room. Wall plates now provide easy access to multiple connection types and allow audio/video cabling to be installed behind walls, through ceilings and under raised floors.

Flexibility remains a key concern as schools must continually adjust to meet the needs of students. For example, what was a traditional classroom today may be converted into a computer lab next semester. Also, the school may decide that it wants to add digital signage throughout the building to communicate important news and announcements in real-time. All of these changes impact the cabling infrastructure of the school and can determine the difference between a major renovation project and a simple upgrade process.

Types of Cabling Solutions

There are two main cabling solutions that are geared specifically for classrooms. Each is geared for specific circumstances and presents advantages and disadvantages depending on such factors as the available pathway, purpose of the room now and in the future and time allotted for the installation.

Modular cabling systems are commonly referred to in the industry as “rapid runs”, and they simplify the installation process. Because they consist of three main parts – a runner cable, flying lead and wall plate – they form a modular system in which parts can be matched as needed. For example the runner cable has ability to carry multiple signal types over the same cable. This means that a single cable can be installed and carry the necessary signal types. Note that digital signals and analog systems require different runner cables. The flying lead is the connection to the source or display device, while the wall plate provides the connection at the wall. The benefit of this system is that it requires no field termination of connectors and installs easily in conduit, even when challenged with ninety degree turns.

Because the runner cable’s internal construction can support more than one signal type, the ends of the cable can be replaced as an upgrade path rather than replacement of the entire cable itself. As a result, modular systems serve as a great solution when changes to the connection types become necessary in the future. This may occur if hardware is upgraded from analog to digital for example, or the room is reconfigured for a purpose other than its original design.

There are, however, several limitations with modular solutions. Although a large number of common configurations are available, modular solutions cannot account for all configurations such as those that may be outside of the norm. Also, modular systems are perceived as being higher priced than traditional cabling solutions. While it is true that the added labor involved in manufacturing modular solutions increases the cost of the components, the benefits provided in terms of time savings due to pre-terminated connections, make these systems very cost effective once installation time and cost are taken into account.

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The other type of system is the traditional or "classic" cabling. These cables are terminated to pass-through wall plates and are typically offered in unique configurations not available in modular solutions. While traditional cabling is sometimes lower in cost, installation time can be longer than with modular systems because they require field termination.

There are several drawbacks to traditional cabling systems. Full size A/V connectors on cables do not install well in conduits. Because the connectors are factory terminated, the connections cannot be changed to accommodate hardware or room changes in the future. Multiple connections and bend radius of each cable requires deep wall mount boxes which can negatively impact the aesthetics of the room and can be easily damaged.

A good rule of thumb when determining the appropriate type of cabling for a classroom is to select a modular solution when a new school is being constructed, and choose a traditional system when the room is being upgraded or retrofitted.

In new construction, classrooms have conduit pathways to accommodate A/V cabling. Most conduits installed are approximately 1½ to 3 inches in diameter. It is important to note that additional cabling, such as telephone and network, may also be run through the conduit alongside the A/V cabling. The size limitations of the conduit and the presence of the other cabling make installation of traditional cables difficult. The ease of installation makes modular cable systems the recommended solution for new build installations.

In retrofit applications, the cabling pathway is limited or non-existent. Depending on the year of the school's initial build, some conduit may exist for running cabling. If no conduit is present, or the path is not routed to the desired locations, a raceway is affixed to classroom walls. Many sizes of raceway are available, making it easy to accommodate various cables with different sizes. The open design of raceway permits the use of traditional cables.

Additional Considerations

Deciding on what type of cabling system to use is based on many factors. However, the factors listed above, such as cabling pathway available, future upgrade path and wall box size do not provide all of the information required to make the decision. It is also important to consider the user's needs and A/V equipment requirements. Selecting a cabling system that supports these needs allows for maximum utilization of the classroom's A/V equipment. The following considerations must also be taken into account when selecting the proper cabling system for any installation.

Cost

Cost is an important consideration when selecting a cable system for A/V infrastructure. Modular cabling systems will typically have a higher initial cost than traditional cabling systems. There are more components required for a modular cabling system, and those components are typically more expensive. Depending upon the install environment, installation cost of a modular cabling system may be less than a traditional cabling install. If the installation environment requires that cabling be pulled through conduit, then a modular cabling system would be less expensive to install. Installing traditional cabling in a conduit requires that the connector be field terminated which adds additional expense. If the environment does not require cable to be pulled through conduit, then the installation costs for traditional or modular cabling would be equivalent. Upgrading a modular cabling system requires that only the interchangeable ends of the cable be replaced so it is typically less expensive than upgrading a traditional cabling system. Upgrading a traditional cabling system typically requires that the entire cable be replaced.

Time

If the installation environment requires that cable be pulled through conduit, then installing a modular cabling system will typically take less time than a traditional cabling system because no field termination is required. Modular cabling systems also provide a time savings if the system ever needs to be upgraded. A traditional cable system requires that the entire cable be replaced, whereas a modular cabling system only requires that the interchangeable ends be replaced for an upgrade.

Environment
It is important to consider the environment where the cabling system will be installed. Local fire and building codes will dictate any cabling jacket requirements for each individual installation location. Cabling that will be installed in raceway outside of a wall typically will not require any specific type of fire rating. Cabling that is installed within a wall will typically require an in-wall rating, e.g. CL2, CL3, CMG, etc. Cabling that is installed within a dropped ceiling or raised floor will typically require a plenum rating, i.e. CMP. It is of upmost importance to check local requirements before installing any cable within a school building in any environment.

Finishing the connection
An important consideration with both cabling systems is how the connection will be completed at the source device and at the display. Typically the connection at the display will be a direct cable connection from the cabling system. However, the source device will typically be connected to the head end of the cabling system through a wall plate. When selecting a wall plate, it is important to consider the size of the plate and the material used to construct the plate.

Consider all future applications when selecting the size of the plate. Many wall plates are offered in single, double, triple, and even quadruple gang sizes. Keystone ports are often found on the larger wall plates in addition to the A/V ports required for the cabling system. The keystone ports may be used for additional audio/video or data communication ports.

In a school environment it is possible that an audio/video wall plate may be damaged. This is why the material used to construct the plate should be an important consideration. Many manufacturers offer wall plates constructed from aircraft grade aluminum. This material will give the wall plate a much longer life span in a potentially harsh environment, but using this type of material may add additional cost. If the wall plate will be used in a location where damage is not likely, then installing a wall plate made of a less expensive material, such as plastic, may be a more economical option.

Distance
The length of the cabling system is an important consideration of any A/V cable install. If the cabling distance from the source device to the display is longer than the limitation of the source device, then a signal booster may be required. Below is a list of common A/V signal types and their length limitations.

Official length limitations: These standards have been defined by industry associations.

DisplayPort —15 meters (about 49ft)
DVI digital—5 meters (about 16.5ft)

Unofficial length limitations: These signaling methods do not really have a defined maximum length. The limitations listed here are based on common real-world experience. Use these as a guideline—your application may allow for a longer cable run, or may call for a shorter distance. Check with your equipment manufacturer—they may specify a maximum cable length. The best advice for these types of cables is to use as short of a cable as you can.

Audio (line level)—150ft
Audio (speaker level)—500ft (use lower gauge wire as distance increases)
Audio (digital coax)—50ft
Audio (digital optical)—16.5ft
Component Video—150ft
Composite Video—150ft
HDMI—16.5ft without a booster
Modulated RF (CATV, SATV)—150ft (use RG-6 coaxial wire)
S-Video—150ft
VGA (laptop output) —35-50ft without a booster/amplifier
VGA (desktop output) —75-100ft without a booster/amplifier

Preventing Interference

When installing a cabling system within a wall or ceiling it is important to avoid the potential interference hazards. Shielding within A/V cables is designed to prevent low levels of interference from affecting the A/V signal. AC power cables and fluorescent lighting are the biggest source of electromagnetic interference (EMI) in the school environment. Installing A/V cabling near these sources of interference greatly increases the likelihood that the A/V signal will be negatively impacted. It is important that A/V cabling be installed as far away as possible from any source of interference. If it is not possible to move the A/V cabling far enough away from the sources of EMI, then additional measures must be taken, such as enclosing the cable within metal conduit. Even coiling an A/V cable within a ceiling or wall has the potential to introduce interference into the signal. Interference introduced into the signal may manifest as static or lines in video, or hissing or popping in audio.

Considering the factors listed above will give a fairly accurate picture of the best structured wiring solution for an A/V installation within a classroom. Selecting the best solution ensures that the schools needs are met on multiple levels including budget, time and overall system performance. In summary, carefully selecting the best solution not only results in meeting the school's need, but also allows teachers to effectively use the classroom's A/V systems as an educational tool.

Selecting Classroom Cabling Summary

Installation Factor	RapidRun	Classic
Maximum Distance	150'	75'
Through Conduit	Strong Fit	X
Through Raceway	X	Strong Fit
Through Plenum Space	Strong Fit	Strong Fit
No In-Wall Installation	X	Strong Fit
Wall Plate Termination	Strong Fit	Strong Fit
Upgradeable	Strong Fit	X
Resolution Required	UXGA	SXGA
Cost	Premium	Moderate
Purchase Process	Spec	Bid

Cabling Infrastructure Examples

Modular Cabling System

Traditional Cabling System