Technical Reference
Choosing the Right Patch Panels

Category 5e, 6, or Augmented Category 6? IDC punchdown, or modular? T568A or T568B? Shielded or unshielded?

Will I choose the right Ethernet patch panel for my application? Will this choice work with future applications? Am I getting the best overall value?

How do I ensure the integrity of my network? Can the infrastructure grow and change without service disruptions?

With all the choices you face as you design your network and select equipment, including the available Ethernet patch panels, it's easy to become confused and frustrated. Ultimately your choice of Ethernet panels should fit the applications you plan to run. ADC KRONE has written this short tutorial to guide you through these decisions, to make them as painless as possible and offer you the best solution for your network.

First, answer a few key questions. Your answers will help guide you in the decision process. Each of the most popular options available are explained, so you can draw conclusions based on your network needs.

Discovery Questions

- What applications are you or do you plan to run in this facility? Take into account not only what you are doing today, but what you probably will be doing tomorrow i.e. 10/100BASE-T? 1000BASE-T? 10GBASE-T?
- What type of LAN network are you designing? Data centre? Data backbone? Workstation?
- Is the project a new network installation or an addition to an existing network?
- Is the installation being built to expand existing capacity with current data capabilities or is it for new, faster data applications?

Answers to these questions will guide you to a particular cable type, a particular data patch panel, and the means to terminate the cable into the patch panel – whether the terminations into the patch panel involve cable terminations, pre-wired telco-type multi-pair cable ends, or standard RJ45 cable ends.

The general guidelines for network transmission capabilities segment the data network; Data Centre and data network backbone system applications require the highest level of transmission capabilities, while feeds to work areas generally require less. However, all network connectivity should be designed with only the highest network engineering standards available.

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So, which should you use? There is quite a bit of misleading information in the industry on this subject, the biggest myth being that Class E is required to run Gigabit Ethernet over copper (1000BASE-T). However, as of this writing, the ISO/IEC and EN recommends Class E or Class D as the minimum cabling for new network infrastructure installations.

When do I use Class E or Class D? Does the application standard (i.e. 1000BASE-T etc.) specify Class E as a minimal requirement? The ISO/IEC, EN, TIA and IEEE 802.3an committee have developed standards for 10 Gigabit Ethernet over twisted pair copper cabling. This standard will require a Class E_A (Category 6a) system to run the standard 100 metres length. The good news is that Class E_A, as is the case with all standards, will be backward compatible and will have no trouble running existing applications such as 10/100BASE-T and 1000BASE-T.

The TrueNet® CopperTen™ System is ADC KRONE's version of Class E_A (Category 6a). It provides not only support for the transmission protocols of today, such as 10/100/1000Mbps, but also that of the future with 10Gbps. It is worth noting that the complexity of Class E_A is transparent to the end user and installer. The products have simply been modified to overcome the shortcomings of standard Class E (Category 6) to achieve the desired signal to noise ratios, taking into account bundled crosstalk, to be compatible with the IEEE802.3an requirements.

Cable Type Summary

The chart below summarises the industry standard UTP cable types used in current networking installations for 100m channels.

Class (Category)	Bandwidth	10/100BASE-T	1000BASE-T	10 GBASE-T
Class D (Cat 5e)	100MHz	Yes	Yes	No
Class E (Cat 6)	250MHz	Yes	Yes	No
Class E_A (Cat 6a)	500MHz	Yes	Yes	Yes
Class F	600MHz	Yes	Yes	Yes
Class F_A	1000MHz	Yes	Yes	Yes

In addition to the cabling described above, you should understand the issues of cable shielding, and stranded versus solid cable.

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Shielded vs. Unshielded Twisted Pair

Unshielded twisted pair (UTP) cabling provides immunity to electromagnetic interference (EMI) with the properties of the two conductors that make up a transmission pair being twisted together. When UTP cabling encounters electrical interference, the noise crossing the twisted pairs is cancelled by the twists in the cable (called "Common Mode Rejection").

Standard Category 5e, 6 and 6a cables contain four twisted pairs of conductors. For 10BASE-T and 100BASE-TX applications, only two pairs are used, one for the transmit circuit and one for receive circuit. For 1000BASE-T and 10GBASE-T all four pairs are required.

There are actually two methods of shielding a twisted pair cable. **Screened twisted pair cable (ScTP or F/UTP)** provides an overall screen of metal foil around the four pairs of conductors, but each individual twisted pair is unshielded. **Shielded twisted pair cable (S/FTP)** has each individual pair shielded, plus an overall screen around the four individually shielded pairs. The legacy token ring IBM Type 1 cable and Category 7 are examples of shielded cable. Shielded cable requires metal encapsulated connectors that bond the cable shield to the telecommunications ground, in order to carry the interfering signals safely away for a superior EMC performance compared to standard UTP.

Another advantage of the S/FTP cable with individually shielded pairs (PIMF – Pair In Metal Foil) is the superior headroom in NEXT, ACR etc. Because of the added costs and more complex installation issues, UTP has the majority of the global market.

Stranded vs. Solid Conductor Cable

Stranded cable is flexible and often used for patch cords and work area cords. Stranded cable is used for shorter patching applications due to its flexible cable construction, but also exhibits higher attenuation due to the smaller diameter conductors, and as such should not be used for long, permanent installations. Solid conductor cable is used for the "horizontal" cable runs from the telecommunications room to the work area wall outlet. The typical gauge for Category 5e cable is 24 AWG. Category 6/6a is 23 AWG – the larger conductor diameter improves attenuation characteristics and signal-to-noise ratio versus the smaller conductor diameter of Category 5e.

Patch Panel Rear Termination Options

Popular choices for patch panel rear terminations include insulation displacement connection (IDC) termination, and connectorised cable end terminations (RJ45 and RJ-21X). Most popular data patch panels are designed using IDCs, often requiring the manual punchdown termination of each individual wire.

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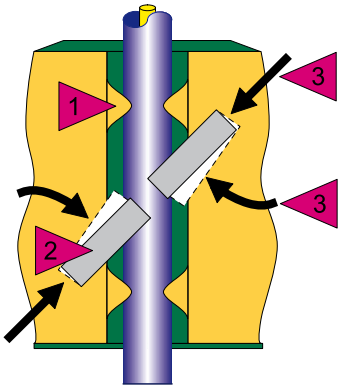
The majority of ADC KRONE's panels use LSA-PLUS® contact technology. The contacts grip the conductor at a 45° angle providing lower resistance and superior torsional force and are capable of accepting multiple and stranded conductors.

For patch panel to patch panel connections in a Data Centre or telecommunications room, pre-terminated cable assemblies and connectorised patch panels can improve installation time. Pre-connected solutions do require up-front planning – the distances between panels must be determined so the correct cable assembly length can be ordered.

RJ45-to-RJ45 and RJ45-to-RJ-21X panels are the two most popular pre-connected systems. The RJ-21X, also known as 50-pin telco or 25-pair Amphenol connectors, is popular because six 4-pair Ethernet (1000BASE-T) or twelve 2-pair Ethernet (10/100BASE-T) circuits can be terminated at one time on a panel using the correct multi-pair cable assembly. The main requirement for 25-pair cable and connectors is the PowerSum NEXT or PSNEXT.

The LSA-PLUS® Contact Difference

1. Insulation clamping ribs hold the wire securely and isolate the contact area from vibration and mechanical stress.
2. Contact tags at 45° angles across the axis of the wire make a solid, gas-tight connection.
3. Unique axial and torsional restoring forces maintain a durable connection.



Effects of LSA-PLUS® contact on wire:

Positioning contacts at a 45° angle leaves more wire between contact points and provides a more reliable, stress-resistant connection.

Effects of other traditional contacts on wire:

Positioning contacts at a 90° angle produces a point of weakness subject to possible breakage.

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Cable Management

Network performance can be significantly impacted if cables are difficult to manage and easily damaged. Careful attention should be paid to the cable management scheme that surrounds patch panels and systems equipment.

Ideally, all equipment is permanently terminated in a cross-connect field so that moves, adds, and changes are done using semi-permanent patch cords. This enables circuit rerouting, upgrades for systems equipment, and routine maintenance with less downtime – and less chance for damaging active equipment ports and cables.

At a minimum, the network should include the following characteristics:

- *Access to cables.* Especially as rack density increases, it is important that cables can be easily identified and traced for moves, adds and changes. Otherwise, simple rearrangements turn into hours of technician time and downtime.
- *Cable routing.* Establishing defined cable routing paths within racks, between racks, and between equipment rooms ensures that patch cords and cables remain organised and neat. This increases both the service life of cables and the availability of services for users.
- *Physical protection and storage.* Cables dangling from overhead or laying direct on the floor invite problems. The proper method is to provide storage within each rack so that inadvertent damage and downtime is avoided.