Practical Networking

PRACTICAL NETWORKING .NET

Ethernet Wiring

DECEMBER 8, 2015 by ed harmoush 41 comments

Ethernet is a family of specifications that governs a few different things: It c
100BASE-TX, 1000BASE-T, etc…). It describes how to send bits (1s and 0s) a
those bits into meaningful frames.

Initially, this article was meant to just cover the basic differences and use-ca
But in light of our mission statement, we thought the topic of Ethernet Wiring

We'll start off with a disambiguation of all the terminology that gets thrown a
couple basic questions: Why do we need crossover cables vs straight-throug
transmitted across the wire? Finally, we'll wrap things up with a look at the st

- Terminology
- Why Crossover?
- Auto MDI-X
- Why Twisted Pair?
- Gigabit Ethernet

Terminology

If you've been around the networking world for even a short duration, you've
cabling. Terms like Ethernet, Twisted Pair, RJ45, Shielded, and Unshielded.

But what do each of these terms mean? How are they different from one anc
bluntly, yes – these terms are often misused. Let's take a look.

8P8C

This is the specification that governs the physical connector on either end of

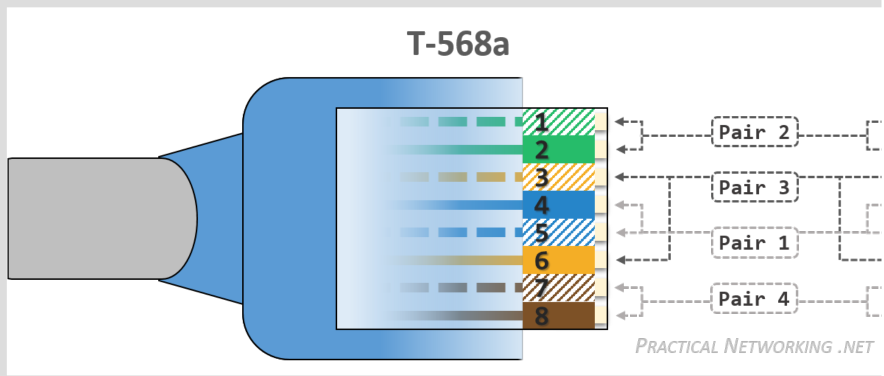
regulates that there are **8 P**ositions and **8 C**ontacts. It also defines the desig
plug that terminates the cable.

RJ45

Registered **J**ack standard number **45** specifies the amount of wires in the ca

8P8C physical connector.

Specifically, RJ45 defines two wiring standards: **T568a** and **T568b**:



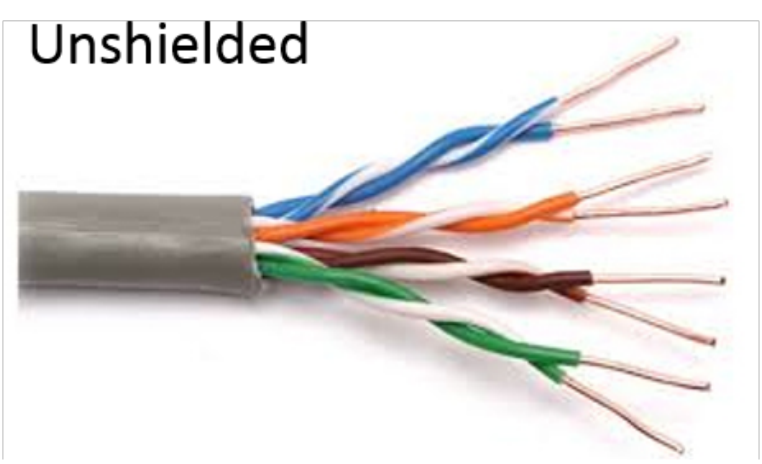
Notice the only real difference between the two standards are the colors of w

> Often the term RJ45 is used to refer to the 8P8C connector itself, but this
> the 8P8C connector, but specifies a different ordering to the wires inside.
> as well that define a plethora of other combinations of wires and physical

Twisted Pair

Twisted Pair wiring is a strategy that uses a pair of wires which are twisted a
We will look at why this crucial strategy is important later on in this article, b
effects of Crosstalk and Electromagnetic Interference (EMI).

There are two prominent types of Twisted Pair wiring, a Shielded variant and



Unshielded Twisted Pair (UTP)

This is the more commonly deployed variation. There is no additional shieldi
UTP can carry a signal reliably due to innate features of twisted pair wiring. V
article.

UTP is less expensive, more (physically) resilient, and more flexible. These a

Shielded Twisted Pair (STP)

STP has additional shielding around each pair of wires and then one more sh
the electromagnetic noise that occurs when signals travel through a wire.

That said, if any part of the shielding is damaged, or if the wires aren't perfec
shielding can act as an antenna and introduce additional electromagnetic no

Moreover, the STP wire must also be coupled with shielded 8P8C connectors
the full end-to-end spectrum of the wire.

As you can imagine, STP is the more expensive variant. STP is also more fra
if the wire is bent excessively. As a result, it hasn't seen as much widespread

STP is typically reserved for use in areas with extreme levels of electromagn
over or near any sort of power generator or heavy machinery.

Ethernet

As was said before, Ethernet is a family of specifications that governs a few
wiring specifications: 10BASE-T, 100BASE-TX, 1000BASE-T, and so on.

Ethernet also describes how to send bits (1s and 0s) across each wire, as we
frames. For example, Ethernet states that the first 56 bits of every frame mu
The next 8 bits must be "10101011" (known as the Start of Frame delimiter).
next 48 bits are the Source MAC address; and so on, until the entire frame ha

Below, we'll describe some of the wiring standards specified by the Ethernet

BASE T* Terminology

This *set* of terms all refer to how the wires are used inside the cable. For inst
receiving, how they transmit signals, and at what voltages?

There are three parts to this term, so let's discuss them each individually firs

100 BASE-T

The number at the beginning simply refers to the speed of the wire in **M**
Mega**b**its **p**er **s**econd (**Mbps**). A wire rated at 100 Mbps can theoreticall
to roughly 12.5 **M**ega**B**ytes **p**er **s**econd (**MBps**). Notice the capital ***B*** vs t

An Ethernet cable rated at this speed is sometimes also referred to as *F*
cable which is rated at 10 Mbps, or *Gigabit Ethernet* which is rated at 10

100 BASE-T

The term *base* is short for *base*band signaling. Its counterpart is *broad*b
the difference between them was baseband signaling sends digital sign
analog signals across the medium.

The difference between a digital signal and an analog signal is the numb

An analog signal can represent a theoretical infinite amount of values. F
a green pixel, and another voltage might represent a red pixel, and so on
across the wire.

A digital signal can represent a finite amount of values – typically just tw
sent across a digital wire, a stream of 1's and 0's would be transmitted.
values as a series of numbers, perhaps based upon the RGB color code

The main difference being, at any given time on an analog wire, a pletho
Whereas on a digital wire, at any given time the signal can either only re

This allowed digital transmission to be more error resistant as the wire's
into two possible values (1 or 0). Whereas an analog signal is more pro
will change what the other end interprets entirely.

This image illustrates the effect very plainly. Notice as the signal quality
or a 0, and therefore still display the image without any visible distortion
degradation in the signal causes the receiver to interpret the wrong colo
image is from a blog post by Antenna Direct in Australia.

100 BASE-T

The "***–T***" stands for **T**wisted Pair. This is in contrast to other wiring stan
maximum ranges of **2**00~ and **5**00 meters, or ***-SR*** and ***-LR*** which are **S**h

With each individual part defined, we can now look at the two prominent spe
specifications for Gigabit Ethernet later on in this article):

100BASE-T4

100BASE-T4 uses all four pairs in the bundle (all eight wires). One pair is
used solely for Receiving signals (RX). The remaining two pairs can be u
wire to negotiate which of the remaining pairs are used for what.

T4 is one of the earlier specifications for Twisted Pair, and doesn't see r
design for very little gain over the 100BASE-TX iteration described next.

100BASE-TX

100BASE-TX uses only two pairs, one dedicated to TX, and the other de
unused. You could very well construct a 100BASE-TX wire which only ha
but often the other four wires are still included mostly as place holders f
compatibility.

100BASE-TX (with all eight wires) is the commonly used Fast Ethernet s
as simply T. Again, T is meant to refer to the category of Twisted Pair op
using the pairs at pin-positions 1&2 and 3&6.

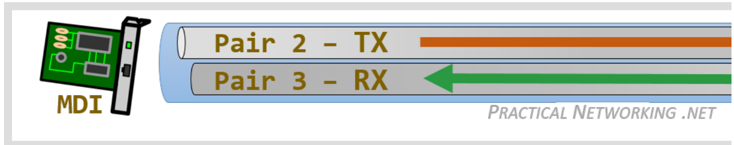
The point of defining each term above, independent from the others, is to giv
what each term means. In practice, despite knowing the true meaning of the
term, even if it might be slightly incorrect — a little inaccuracy can sometime

Why Crossover

There are many guides on the internet that describe *when* you need to use a
few sources really explain why it matters, or exactly how it works. In this sec

The 100BASE-TX and 10BASE-T specifications both call for 8 wires in a twis
pairs, only two will actually be used: pair 2 and pair 3. Each individual wire in
can only ever cross any *one* wire in *one* direction.

In order to attain full-duplex communication, some wires are permanently se
other wires are permanently set aside for communication in the opposite dir



The configuration of the Network Interface Card (NIC) will determine which p

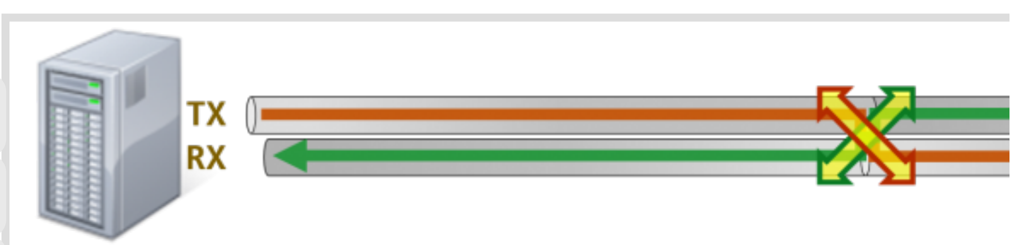
A NIC that transmits (TX) signals over pair 2 (pin 1&2) and receives (RX) sigr
Interface (**MDI**) NIC. While a NIC that does the opposite (TX on pair 3, and R)
Crossover (**MDI-X**).

PC to PC

A PC uses an MDI NIC, which means PCs always transmit on pair 2, and rece
other are both trying to transmit over pair 2, it would lead to a collision of the
on pair 3.

As a result, the pin-pairs need to be crossed on the wire, so that what is sent
and vice versa.

Here is a simplified illustration (the colors below are irrelevant, they simply ir
of the communication):



Notice both PCs can transmit signals through a dedicate channel, and due tc
giant X), both PCs can receive what the other transmitted from a dedicated c

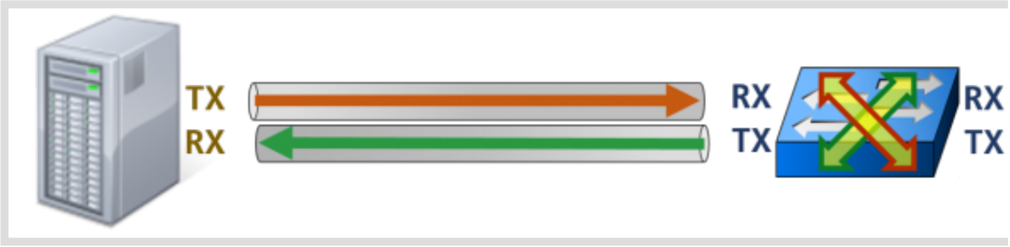
Hence, a connection from **a PC directly to another PC requires a crossover c**

PC to Switch to PC

A switch is a device that is meant to facilitate communication between two I

uses the MDI-X specification, which means a switch always transmits on pai
NIC on a PC).

This causes the switch to have a *built-in crossover function*. The wire doesn't
care of it:



As you can see, **a PC connected to a switch can simply use a straight-throu**
The end to end path remains consistent: every device is transmitting on its T

PC to Switch to Switch to PC

We discussed earlier that two PCs connected directly to each other require a
pairs for TX and RX. Similarly, two Switches connected to each other also us

As a result, we have to account for this by introducing yet another crossover

From the diagram above, we see that **a switch connected to another switch**

In this way, the end to end path remains consistent. The PCs are both transm
each direction and step along the path always goes from a TX pair to an RX

Routers and Hubs

But what of routers and hubs? What type of NIC do they use?

It turns out, a Router, like a PC, uses the MDI specification – TX on pair 2, an
PC in any of the illustrations above with a Router, and can easily determine w

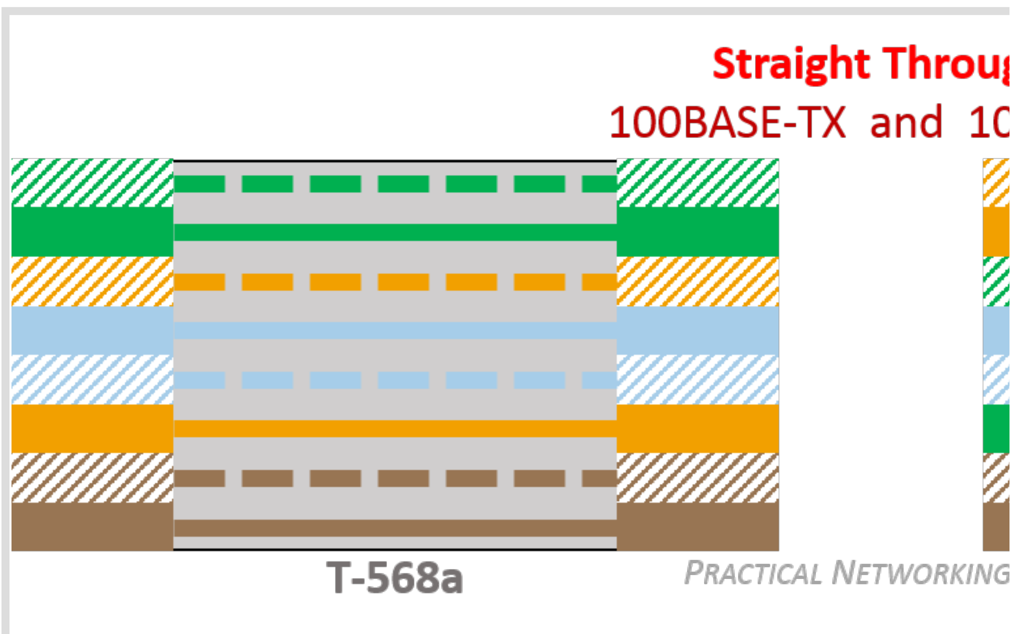
and which would require a crossover cable.

Furthermore, a Hub's ports use the MDI-X specification – TX on pair 3, and R
above with a Hub and can also easily determine what cables are required.

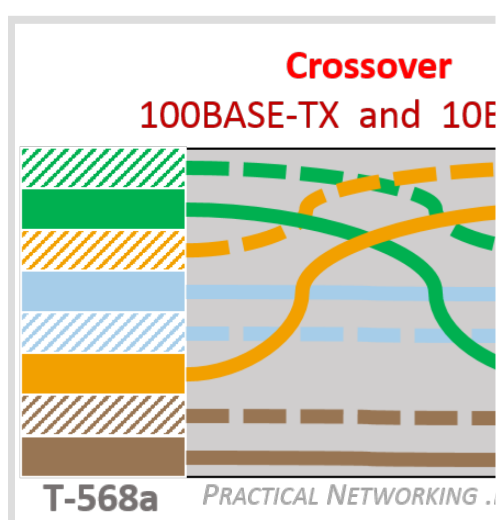
Ethernet Cable Wiring Diagram

Recall that there are two standards for the colors in the RJ45 specification: T
side of a Twisted Pair wire is what determines whether the cable is straight-t

To make a Straight-through cable, simply order the wires on both sides of the
T568b):



To make a Crossover cable, simply use one standard on one side, and the ot



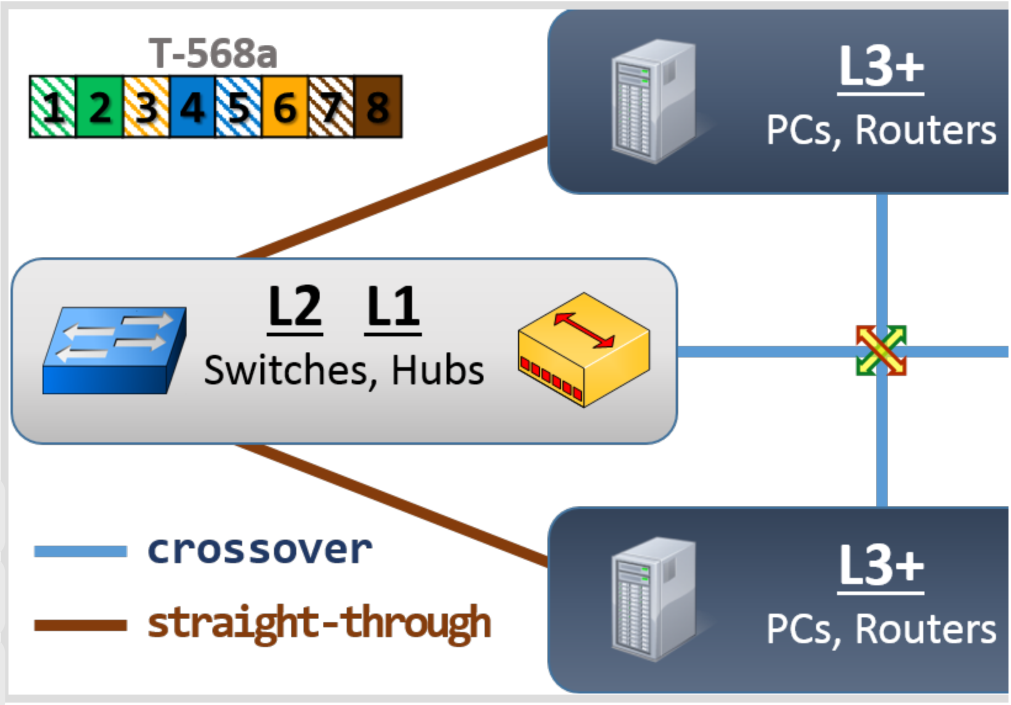
Note that wire pair 1 and pair 4 are not used (the blue and brown wires). You all, but this would make keeping the remaining wires in the proper order rath

Moreover, since they are not used, they do not need to be crossed in a cross require using all 8 wires, and often all pairs are crossed for consistency. We

And lastly, remember that the signal doesn't really care what color the wire is other, communication will work. You could use all green wires, and as long a (and vice versa), you would have a fully functioning cross-over wire. But just a cable would be a nightmare to maintain.

Easy Memorization Chart

We can aggregate everything we learned above regarding crossover wires ar



A benefit to how the graphic above is displayed is that it makes it very easy t and L3+ on top and bottom and connect everything to each other. The lines t connecting devices that operate at those layers of the OSI model. The lines t through cable.

In summary:

An **L1** or **L2** device connected to another **L1** or **L2** device requires a **crossove**
An **L1** or **L2** device connected to a **L3+** device requires a **straight-through** ca
An **L3+** device connected to another **L3+** device requires a **crossover** cable.

Or even simpler:

Like devices require a **crossover** cable.
Unlike devices require a **straight-through** cable.

Auto MDI-X

Despite the simplicity of knowing when to use a straight-through cable verse of course), the fact that a choice exists at all has caused all sorts of downtin industry.

As a result, a feature was created which allows the two devices to dynamica necessary. This feature is known as Automatic MDI-X, or Auto MDI-X.

Auto MDI-X allows the use of a straight-through cable for every connection whether they need to inverse their TX and RX pairs.

Auto MDI-X is an optional feature for 100BASE-T implementation, and a requ

How does Auto MDI-X Work?

But how does Auto MDI-X work? How do the two parties determine which pa should be used for RX? Which of the two parties should switch the TX and R at the inner workings of Auto MDI-X in this section.

Remember, the goal of the Crossover cable is to ensure one party's TX pins a successful communication down a cable, a TX wire cannot be connected to specification, and the opposing NIC must use the MDI-X specification. Here

Both parties start by generating a random number in the range of 1-2047. If t NIC to the MDI-X standard. If the random number is even, that party configur sending link pulses through their elected TX wire pairs.

If both parties are successfully receiving the other's link pulses on their RX w
successfully transmitting on their TX wire pairs, and receiving on their RX wi

If both parties are not receiving the other's link pulses, then they must have b
number. Therefore, one of the parties must switch their TX and RX wire pairs

But the parties can't *both* switch to the opposite specification, because then
a system was devised that randomly switches the pairs at random intervals

That randomly generated number from earlier (1-2047) gets cycled forward i
vs MDI-x). But that number cannot simply be increased by one, because ther
to odd. In other words, if *both* parties had elected MDI originally, they would t
wire pair to be connected to a TX wire pair.

Instead, that number is cycled forward through what is known as a Linear-Fe

A Linear-Feedback Shift Register (LFSR) is an algorithm that cycles through
ever repeating a number until every number has been reached. The numbers
(aka not sequentially but in a consistent order).

For example, if the two parties picked a starting value of 1000 and 2000, wh
odd or even would be completely random. However, if both parties randomly
identical sequences through the LFSR.

This cycle happens every 62 milliseconds, with a random variance of +/- 2m
and the other party was planning to switch at 64ms, there would be 4ms wh
stops further cycling and completes the AutoMDI-X process.

This process continues as many times as is necessary until the two peers h

But this begs the question, what are the odds of both pairs picking the exact
they cycle their number. We can determine this with a little math.

The odds of picking the same starting value are 1 in 2047. The odds of picki
odds of both parties both switching their MDI/MDI-X specification at the exa

The cycle happens every ~62 ms, which means in a full second there are 16

the exact same cycle timing for the entire second are 1 in 4,294,967,296 (4.2
both parties starting with the exact same random number are 1 in 8,791,798
worst this will only cost you an extra second of waiting for the link to come u

Why Twisted Pair?

It is often simply accepted as fact that most networks use Twisted Pair wirir
Twisted Pair has made it the predominant cabling method in computer netw

There are two main reasons, and both have to do with **E**lectro**m**agnetic **I**nter
wires greatly reduces the outbound EMI emission. The second reason is that
inbound, or induced, EMI.

Both of these are very desirable traits when the wire is often closely bundled
or wiring closets).

Reducing EMI Emission

It is a fact of life that any signal or electrical current running through a wire e
wires – also known as Crosstalk. This EMI emission can be compensated fo
devised a clever method to negate the effects of Crosstalk.

His strategy was to use two separate wires — one of them sending the *origin*
the signal. This causes both wires to emit the exact inverse EMI from each o

To put it in simpler terms, if one wire transmits +10v of electrical current and
-10v of electrical current and consequentially leak -0.01v of EMI. Their comb

This is referred to in the electrical engineering world as a *Balanced Pair*, and
TX- wire.

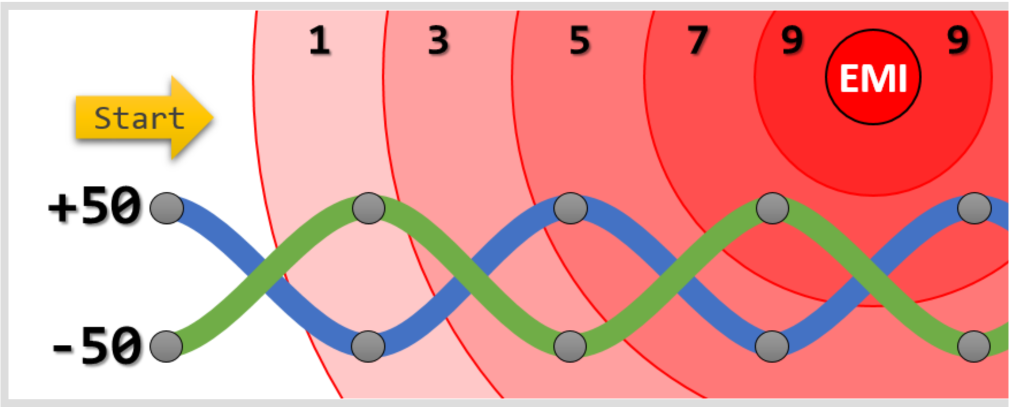
This allows you to use wiring schemes that don't require heavy investments
Unshielded Twisted Pair (UTP) cabling in the networking world. However, so
will look into why they are *twisted* next.

Negating Absorbed EMI

Despite strategies like the Balanced Pair described above, there is no getting
(EMI). Stray radio frequencies, wireless internet, Bluetooth, spy satellites, and

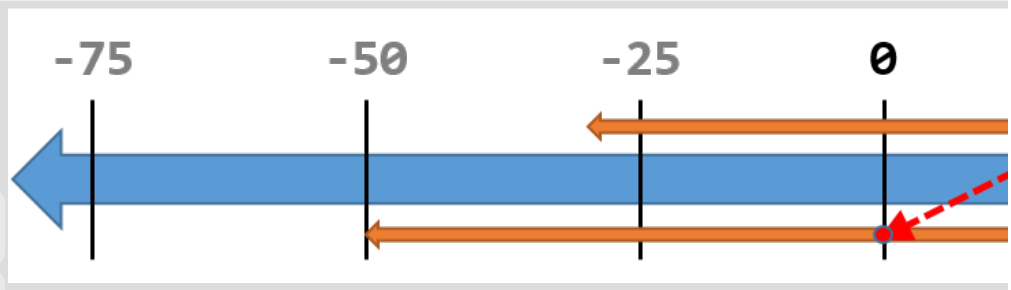
But Alexander Graham Bell came through for us again, and devised a brillian

The basic concept takes advantage of EMI being stronger the closer in proxi
being closest to the EMI source, they will each absorb an equal amount of in



The blue wire starts with +50v, and the green wire starts with the exact inver
wave that surrounds the EMI source impacts the wires progressively less an
and bottom of each twist), both wires end up receiving +22v of interference.

Even though the final voltage received on the right side of the wire is differer
throughout the twisted pair of wires: it is always 100v apart. The EMI affecte
difference of the final values (100v), and display it on a number line to deterr



It should be said that the numbers used above were greatly simplified in c
emission only affects signaling in the range of micro-volts (μV) — which is
remain true: because the original and inverse signals are being sent, the n
of the twists, both wires are equally exposed to the same amount of interf

Sending Bits

If you recall, data is sent across a cable in a digital signal, which is to say, as
Pair wire used to send actual data across the wire? We will use a bit of an ov

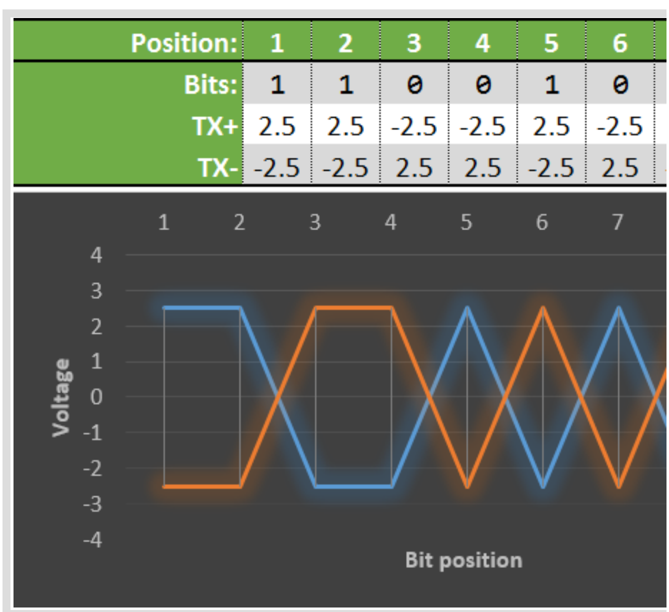
Sending a signal down the wire is nothing more than applying voltage to the
agree on a clock rate, also known as frequency, which determines how long
purpose of this simplified example, we will refer to this as the *position*. At an
0 being sent down the wire.

Different standards call for different voltage levels, and for the purpose of th
matter. But we will proceed to describe it using 100BASE-TX which prescribe

To send a 1 in a given *position*, the transmitter will send +2.5v down the TX+
the TX+ wire.

The TX- wire will always do the exact inverse: -2.5v to send a 1, and +2.5v to

This is what it would look like to send a binary string of 110010101110:

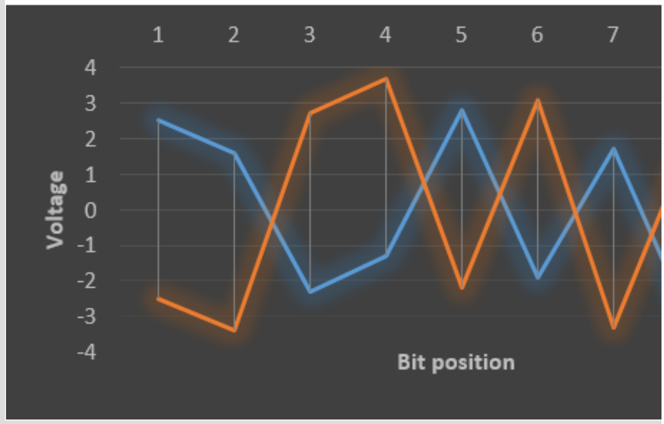


Position:	1	2	3	4	5	6
Bits:	1	1	0	0	1	0
TX+	2.5	2.5	-2.5	-2.5	2.5	-2.5
TX-	-2.5	-2.5	2.5	2.5	-2.5	2.5

Note that the graph above does not depict the *physical layout* of the wire (ak
represents the alternating +2.5 and -2.5 volts being sent down the TX+ and t
be) uniform across the length of the wire. As we pointed out before, you can
voltage of each other, and everything is neat and horizontally symmetrical.

Along the wire, noise is introduced from various EMI sources. We'll apply a d
stream and take a look at what is received on the other end:

Induced Noise:	0	-0.9	0.2	1.2	0.3	0.6
Bits:	1	1	0	0	1	0
Net TX+	2.5	1.6	-2.3	-1.3	2.8	-1.9
Net TX-	-2.5	-3.4	2.7	3.7	-2.2	3.1



Notice the graph is no longer as neat and symmetrical. The wires are still se
value. Our nice and neat values of +2.5v and -2.5v are gone.

BUT, the receiver isn't looking for exactly +2.5v or -2.5v. Instead, it is simply l
wire sent the hire voltage, then the signal for that position must have been a
signal for that position must have been a 0.

Or, to put it simply, on the graph above, if the blue line is on top, the transmitt
then the transmitted bit is a 0.

Notice also that even though the values were affected by EMI, they were bot
down by the same amount. At any time on the receiving graph, the value of t
like they were in the sending graph. As we discussed earlier, this is due to th

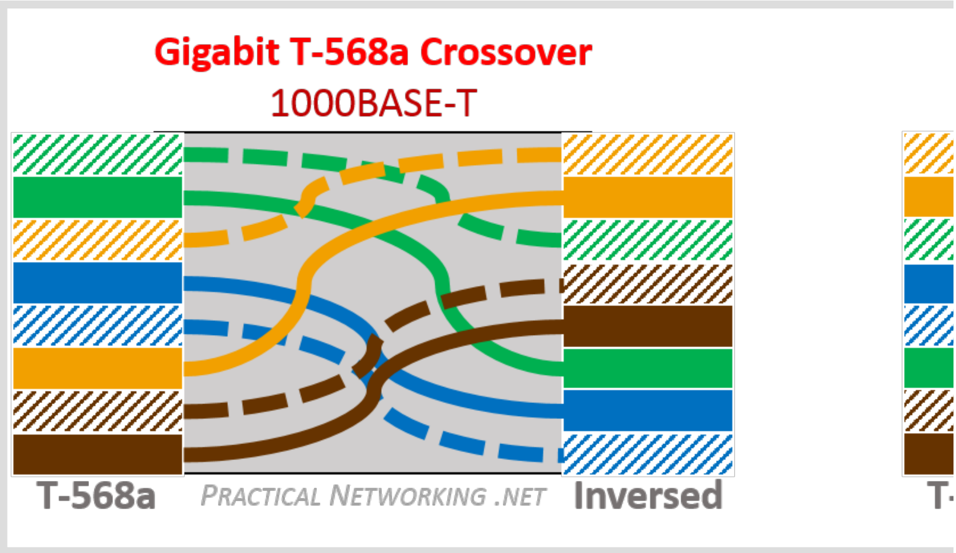
In this way, the receiving end can piece together the signal, one bit at a time,
originally sent. As you can see, UTP is not immune to noise, but it has functi

Gigabit Ethernet

We've discussed Fast Ethernet (100 Mbps) in great detail. Now we move on

The first major difference is the gigabit standards require the use of all four
utilizes two pairs of wires. As a result, in Gigabit Ethernet, all four pairs must

If you recall, there are two wiring specifications proposed by the RJ45 stand
what each of them look like when all four pairs are crossed:



That said, Gigabit Ethernet requires Auto MDI-X. As a result, you are safe to s
the NICs determine whether they need to simulate a crossing of the wire pai

There are two wiring specifications within the Gigabit Ethernet standard:

1000BASE-TX

This standard of Gigabit Ethernet uses all four pairs, but it dedicates two

Conceptually, this is a simpler process than how 1000BASE-**T** operates,
cables that have already been run from the common Category 5 or 5e to
TX has not seen much adoption in the industry.

1000BASE-T

This is the predominant Gigabit Ethernet standard. It uses all four pairs
pairs can be used for *both* RX and TX, at the *same* time. This is done wit
that in more depth in the next section.

The primary benefit to this wire standard is you can achieve gigabit tran
without being forced to upgrade all your twisted pair cables tot he more

1000BASE–**T** cable is often incorrectly referred to as 1000BASE–**TX**. This
predominant cable was 100BASE–**TX**. Frequently, the cabling standards a
as 10/100/1000 BASE–**TX**. In reality, the most popular wiring specificat
TX, and **1000**BASE–**T**.

Full Duplex on a Single Wire Pair

We learned in the last section that 1000BASE-T can send and receive signal
discuss how this is possible in this section. First, we'll start with an analogy

Have you ever talked to someone on the phone and could tell that they put y
voice echoed back? This is an outcome of your voice being played on their s
being picked back up by their own phone's microphone. This is known as an

High end speakerphones can negate this effect by extracting the sound wav
what the microphone is picking up — this process is known as **Echo Cancell**

Echo cancellation is also the basic concept which allows a Gigabit Ethernet
at the *same* time. The basic premise is if you know what you sent, you can e

Recall that sending a signal is nothing more than applying voltage to a wire.
reading the voltage observed on a wire.

If a sender applies voltage to a single wire in the following pattern:

```
+0.5v ,   +1v ,  -2v  ,  -1v
```

And at the same time that same sender reads the voltage and observes the

```
+1.5v ,    0v , -2.5v ,  +1v
```

The sender can subtract the two sets of values to determine what voltage th

```
 +1v   ,   -1v , -0.5v ,  +2v
```

In this way, the same wire can be used to both send and receive signals (dat

Again, these values are merely examples in order to explain the basic conce
account for induced EMI and electrical echoes along the copper wire itself. I
the perspective of a single wire in a twisted pair – the opposite wire would s
earlier.

Using this strategy, all four wire pairs can be used for both TX and RX at the
therefore still use the same strategies to negate the inbound and outbound E

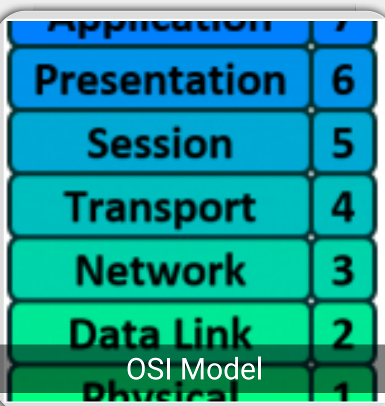
Summary

If you've made it this far, then you now know just how much there is to Ether
learn about it over the years and publish this article. So much technology go
cables without a second thought.

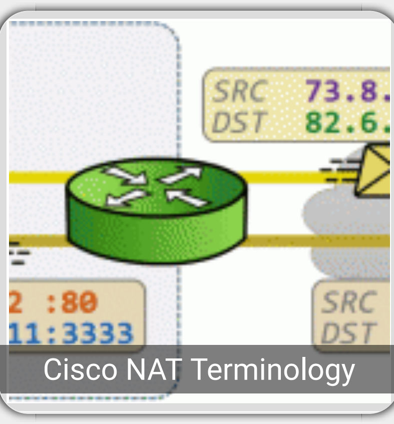
Ethernet wiring is definitely full of technology that we easily take for granted
in order to remain (relatively) simple.

4 Shares

Related Articles



OSI Model



Cisco NAT Terminology

filed under: stand alone tagged with: ccna

Comments

Bobbo says

July 22, 2016 at 8:59 pm

Heck of a job there, it ablstuoely helps me out.

Reply

Ed Harmoush says

July 22, 2016 at 9:51 pm

Glad you liked it, Bobbo. Thanks for the read!

Reply

Jason Chesla says
September 6, 2016 at 8:22 am

Great piece of content here. Very good and I like the graphics!

Reply

Ed Harmoush says
September 7, 2016 at 4:05 pm

Hi Jason, glad you enjoyed it. Thanks for the comment!

Reply

Mike says
November 13, 2016 at 3:47 am

Great article, very easy to read and full of details. I think it would be worth ment
a) "Millions of bits per second (Mbps)." can be abbreviated to "Megabits per se
"millions of bits" in a conversation,
b) modern switches/routers don't require crossover cables anymore to connec

Reply

Ed Harmoush says
December 19, 2016 at 11:42 am

Hi Mike, glad you enjoyed the article. Good point about Millions of Bits vs Me
not requiring crossover cables anymore, that is a function of AutoMDX, whic
the feedback!

Reply

Scott says
December 14, 2016 at 6:11 pm

Great article, very well written and easy for a semi-technical mind to grasp. This
Thank you!!!

Reply

Rj45 wiring says

December 22, 2016 at 8:02 pm

nice work thank you for scharing this post

Reply

Aman says

January 5, 2017 at 3:13 am

Great article and appreciate the effort you have put in to describe every bit pati
Bookmark'd..

Reply

James Marsh says

January 16, 2017 at 8:32 am

Fantastic explanation !

Reply

Ray says

February 2, 2017 at 5:01 pm

another badass high quality breakdown, I love this site!!

Reply

Full duplex MDIX says

May 17, 2017 at 5:17 pm

Hello,

Thank you for sharing it! I have a question for 1000 base T and Auto MDIX

Since 1000 BASE T is full duplex, each pair can transmit and receive, then why i

Reply

Ed Harmoush says

May 19, 2017 at 8:38 am

Full Duplex on each wire pair still require a coordinated channel between the
dedicated channels, upon which signals can be sent in both directions.

Reply

Full duplex MDIX says

March 14, 2018 at 3:46 pm

Thank you for your kind reply. In that case, the purpose of of the Auto MD
100BASE-T, it is used to pair the Tx to the Rx. For 1000BASE-T, it is used t
channel A on the other device.Is that correct? thanks

Reply

Ed Harmoush says

March 20, 2018 at 4:27 pm

Yes and no =).

For 100BASE-T, the purpose of Auto MDIX is to establish *two* channels

```
[ 2---2    3---3 ]  (standard straight through),
[ 2---3    3---2 ]  (standard cross over)
```

One channel (represented by `---`) is used for data transfer one directi
other direction. The remaining pin-pairs are unused so what they are c

For 1000BASE-T, the purpose of Auto MDIX is to establish *four* channe

```
[ 2---2    3---3       1---1    4---4 ]  (standa
[ 2---3    3---2       1---4    4---1 ]  (standa
```

All four channels are used for data transfer in both directions.

If for some reason pin pair #2 was connected to pin pair #4, the link w
the process described above only runs on pin pair #2 and #3 — the res
crossed.

Reply

Ramya J says

June 23, 2017 at 6:29 am

Really good article. Thank you very much.

Reply

Mangesh Wadurkar says

July 28, 2017 at 8:08 am

Thanks for spreading knowledge

Reply

John says

September 12, 2017 at 6:28 am

Thank you for your excellent articles. Unfortunately it is rare to find information

I have a question though regarding your explanation of “broadband” and “baseb T”. In my mind, that section leaves one with the impression that “analog = broa baseband signals partake of the advantages which digital signals offer over an have a broadband signal carry digital information by digitally modulating an ana Would you care to clarify? Thanks.

Please keep up the great work!

Reply

Jerry says

October 25, 2017 at 2:21 am

Even if there was such a thing as a crossover cable for 1000base-t (there isn’t), you wired that cable, if you flipped it end to end, the wiring would be different. T purposely alternated between tip/ring (or -/+), you would never have two tips (w would never have two +’s or two -‘s next to each other).

Reply

Ed Harmoush says

October 25, 2017 at 7:54 am

Hi Jerry,

There is a thing as a crossover cable for 1000base-t, they just aren’t needed

Flipping a cable “end-to-end” isn’t the same as a crossover cable, that would
are switched. (aka, 1 with 8, 2 with 6, etc).

By contrast, a crossover cable, has each *pair* flipped. Pair 1 (pins 4&5) is swi
switched with Pair 3 (pins 3&6).

Finally, the position of the wires in the 8P8C connector do not designate wha
final position in the 8P8C connector, the white/color is always wrapped with
negated) throughout the path of the twisted pair — not in the final few centir

Reply

Joy says
November 19, 2017 at 7:50 am

Great article !!
1.Why do they use serial cables that are low speed compared to ethernet cable

Reply

Ed Harmoush says
April 16, 2018 at 11:40 am

Honestly, I don’t see serial cables used very much these days. They are refer
imagine because they provide a good illustration of point to point links. But i
days.

Reply

DJ says

April 15, 2018 at 7:22 pm

Great post thank you for all the time and effort put into the phrasing and diagra
2018

Reply

Ed Harmoush says

April 16, 2018 at 11:41 am

Glad you enjoyed them, DJ. =)

Reply

hocthietkenoithatarcline.tumblr.com says

May 15, 2018 at 1:35 pm

This excellent wwebsite truly has aall of the information I wanted concerning this subjecct and didn't know who to ask.

Reply

nikta says

June 30, 2018 at 11:57 pm

great job! it has all the information some one need to know and the way you de
knowledge:)

Reply

long prom dress says

July 30, 2018 at 5:13 am

Howdy would you mind letting me know whjich hosting company you're using? I've loaded your blog in 3 completely different internet browsers and I must ssay this blog loads a lot quicker then most. Can you suggest a goood internet hosting provider at a reasonable price? Cheers, I appreciate it!

Reply

Prachi p Shaha says

August 15, 2018 at 6:09 am

Awesome Content

Reply

FrankP says

November 15, 2018 at 3:29 am

Great page, thanks.

Spotted one typo: "Typical EMI emission only affects signaling in the range of r
See if you can get a mu in there 🙂

Reply

Ed Harmoush says

December 4, 2018 at 6:24 pm

Glad you liked it. Great catch, fixed it!

Reply

ONURCAN KAYMAK says

November 26, 2018 at 8:44 am

I just encountered your page by chance while grinding for CCNA exam,You reall
describing essential informations for real networking,Thanks you so much for y

Reply

amit says

April 25, 2019 at 1:52 pm

fantastic articles ! feel like I am in a class and there is a perfect teacher, keepin
something and yet, is easy to digest.

Reply

Dalip says

July 10, 2019 at 8:21 am

I have a NetGear Prosafe GS108T switch. I am connecting 4wire cable to it (M1

link.
I am wondering because only pins 1,2,3 and 6 are phsyically connected, Pins 5,
switch is not able to auto-negotiate down to 100M. Is that correct? Now If i con
established.

Reply

Ed Harmoush says
July 10, 2019 at 8:36 am

That seems reasonable. If a gigabit link tries to auto-negotiate the speed an
the link down. Maybe try hard setting the speeds to 100, see if that gets you

Reply

Minato says
July 20, 2019 at 2:00 pm

Why pair 1 is blue wires instead of green?

Reply

Kushina says
July 20, 2019 at 2:05 pm

How do I know Which devices like to transmit on 3,6 instead of 1,2?

Reply

kevin says
July 20, 2019 at 2:10 pm

Is there any way to know that both devices transmit on same pin pair?

Reply

Ed Harmoush says
July 22, 2019 at 1:50 pm

The effect would be the inability to communicate on the given wire. That
communicating on the same pin pairs.

Reply

Ed Harmoush says
July 22, 2019 at 1:49 pm

That answer is in this section. But the summary is PC's and Router's use MD
MDI-X specification (TX on Pair 3). But remember, this is for the 100 Base T
four pairs for both TX and RX.

Reply

John says
December 14, 2019 at 2:54 pm

Mr. Harmoush,

I've worked in the IT field for over 20 years. I've sat in many classrooms and rea
prepare for certification exams. (Novell Netware 3.x, 4, and 5; Windows NT 4, A
many others.)

I have never, over the course of those 20+ years, had the understanding of Ethe
abilities and your willingness to share your knowledge with others.

I listed some of the training courses I've taken over the years not to promote m
courses I've completed over the years – and to make clear that I'm qualified to
EXCEPTIONAL trainer/teacher. You are clearly the latter – EXCEPTIONAL!

Warm Regards,
John

Reply

Ed Harmoush says
December 14, 2019 at 5:15 pm

Whoa John. Thank you so much for the very kind words. I'm blushing ;).

Glad you enjoyed the resources on the blog. Thanks again for posting!

PS: Spreading the word about the content here is always appreciated, but of

Reply

Speak Your Mind

Name *

Email *

Website

Post Comment