

# User Friendly

LACS  
A Computer and  
Technology  
User Group

## IN THIS ISSUE

### LACS 2025 ROSTER



A new LACS roster is in the center of this issue. All, and only, members, received a paper copy of the this edition. Please **save the roster** so you will have it if needed. It will not be emailed nor posted on the website.

From Your President / Editor	2
General Meeting Report	3
Floppy Disks, Those Old Memories	4
How To Get Larger Text on Your iPhone	5
How To Use Gmail Offline Mode	5
What Is Spam & Why Is It Called That?	7
LACS Information	8, 9
<b>Zoom Meetings</b>	<b>1, 8, 9, 20</b>
LACS Calendar	9
Members Helping Members	10
Officers, Directors & Leaders	11
Fiber Optics or Data Comm	12
Special Offers	18
Laughing Out Loud	18
Membership Information	19



**LACS IS A MEMBER OF  
APCUG**  
An International  
Association of Technology  
and Computer User Groups  
[www.apcug2.org](http://www.apcug2.org)  
[www.facebook.com/APCUG](https://www.facebook.com/APCUG)  
[www.X.com/apcug](https://www.X.com/apcug) (Twitter)

## TUESDAY, MAY 13, 2025 GENERAL MEETING

**Topic: Bitwarden**

**Speaker: John Kennedy**

Member of the East-Central Ohio Technology User Club and the APCUG Speakers Bureau; APCUG Advisor for Regions 3 and 6.

**Meeting time: 7:00 - 9:00 PM – Via Zoom**

**Socializing and Questions & Answers: 6:30 - 7:00**

Are you using a password manager? Do you try to remember your usernames and passwords? Keep them in a notebook? On your hard drive? John talks about why you should use a password manager and what **the FREE Bitwarden** can do for you. Two main reasons he uses a password manager are speed and convenience.

### Meet Our Presenter

John Kennedy taught children for 25 years and computer skills to middle school students for 10 years. He **uses** the Linux operating system. Since retiring he has spoken to many internet, conference and APCUG audiences. John also tries to help solve Windows and Linux users' problems. He manages the APCUG Zoom Account, hosting many Wednesday Workshops and Saturday Safaris. He spoke to us on Free and Open-Source Software in 2022 and on *Any Desk* in 2023.



### TO JOIN THE LACS GENERAL MEETING May 13, 2025

LACS members on the PC Groups.IO list will receive the Zoom link to this meeting before or on **May 11**. Click on it to enter the meeting. Guests may ask for the link by emailing Leah Clark at [leahjc@sbcglobal.net](mailto:leahjc@sbcglobal.net) before or on **May 11**.

See pages, 8, 9, 10, and 20 for help in using Zoom, or email Leah with questions.

See more information about LACS at [www.lacspc.org](http://www.lacspc.org).

 FROM YOUR PRESIDENT / EDITOR 

LACS 2025 ROSTER

See the new 2025 LACS roster in the center of this issue.  
Please keep it available so you have it when needed.



Thank you.

*Note that only LACS members will receive the roster. It will not be online.*

WELCOME NEW MEMBERS TO LACS

Dave Brown, former TUGNET member

LACS Board Openings

**We still have openings for a board secretary and one director position.** We especially need a secretary to stay in compliance with our 501(c)(3) non-profit status. We can't keep LACS a viable organization without volunteers.

We will help you. Why not give it a try?

SPRING CLEAN YOUR ONLINE LIFE

A sloppy digital life can make your data harder to find and leaves your personal information vulnerable to bad actors. With a few steps, you can keep yourself and your family safe online with a squeaky clean digital life.

Declutter at least once a year –  
<https://www.staysafeonline.org/articles/spring-clean-your-online-life>

From [apcug2.org](http://apcug2.org)

APCUG VIDEOS ON YOUTUBE

Check this out for almost unlimited learning.

<https://www.youtube.com/@APCUGVideos/videos>



## GENERAL MEETING REPORT

By Leah Clark, LACS President/Editor

April 8, 2025

Topic: Google from 30,00 Feet

Speaker: Rob Truman

APCUG Speakers Bureau

[Computer Booters of Sun Lakes Computer Club](#), AZ

First, our member, Larry McDavid, gave a short presentation on local weather tracking. He told us how to use a computer to monitor and analyze local weather. He showed pictures of the weather station he set up at his home, and he explained the parts. He sent links to our Groups.io email list to learn about weather forecasting and conditions.

Rob Truman gave us an overview of several Google products. The name “Google” is derived from the term “Googol” which is 1 followed by 100 zeros.

### Google Products and Services

- Gmail
  - Calendar
  - Contacts
  - Keep
- Google Drive
  - Docs
  - Sheets
  - Slides
- Google Maps
- Google Earth
- Google Meet
- Google Forms
- Google Chrome Browser
- Android
- YouTube
- Google Translate
- Google Assistant
- ChromeOS
- Gemini
- Google Books
- Google Images
- Google News

Rob told us that Google is not a technology company. It is an advertising company. It uses the information it acquires from your use of its products to sell ads.

**Search:** Rob showed a video about Google Search, showing ways of searching for information, including looking for businesses “near

me,” solving math problems, converting measurements like kilometers to miles, defining words, translating languages, weather at any place, distance between places, driving directions, and shipping tracking. When searching, be as specific as you can.

**Gmail:** Google email is web-based. Gmail is very customizable using **Settings**. There are features to keep the inbox organized, delete unwanted messages, archive messages, apply labels to messages, search for messages, unsend an email, and schedule when to send an email. Rob explained the difference between labels and folders, the advantages of labels, and how to filter incoming emails by your preset criteria. The Gmail Side Panel provides quick access to various Google apps, like Calendar, Keep for notes, Contacts, and Tasks.

**Google Drive** is a cloud-based storage service. Rob defined the Cloud as a “hard drive somewhere else.” You can access your information on any device with an internet connection. Security is good but not fool-proof. Google includes 15 GB of free storage with every account. Google Storage includes your Gmail, Google Drive, and Photos. Google Drive offers features to help you manage and organize your files. You can share large attachments via Gmail, and you can allow multiple people to edit the same file to collaborate on a project.

**Google Drive for Desktop (formerly Google Drive Sync):** This allows you to access the same file on multiple machines, Windows and MacOS, and to open files and folders offline.

Go to <https://support.google.com/drive> for more information.

**YouTube** is a free video-sharing website. After you sign in, the YouTube homepage will appear; sign in with your Google account. Use the guide on the left to navigate the site quickly. Type in what you are look-

ing for. Search the same way as in Google Search.

Rob then opened up the meeting for Q and A. Look at YouTube videos and tutorials to learn more about filters to sort or delete emails. Rob showed the website, GCFglobal at <https://edu.gcfglobal.org> which has over 200 tutorials. You can select Google to learn more about Gmail functions.

LACS members and guests received a link to the recording of this presentation so they can access the details of every topic covered.

After the presentation, attendees tried to troubleshoot a problem a member was having with the camera on his new computer. There was also discussion among members who are involved as Community Emergency Response Team (CERT) volunteers and/or are Amateur Radio Operators (Hams). LACS members have expertise and knowledge on many subjects. ❖

## FLOPPY DISKS THOSE OLD MEMORIES

By **Dick Evans**

Dave's Computer Tips, March 7, 2025  
[dave@davescomputertips.com](mailto:dave@davescomputertips.com)

*In this article, originally published in 2019, Dick takes a look back at his extensive experience with floppy disks. A look back at a look back from the sadly late and very much missed Dick Evans.*

I know I am dating myself, but I programmed computers a while back that used 8-inch floppy disks. They were called floppy because when you held one side, they would actually bend. The most common size held 80 KB of data. That does not seem like much, but that was much more than an 80-column punch card. Our old keypunch equipment was replaced with one writing to floppies instead of punch cards.



Then, the IBM PC and many others came out with 5.25-inch floppies. Instead of 80 KB, the most common were capable of holding up to 360 KB of data and worked like the 8-inch variety but in a smaller package.

I remember the excitement years later when the 3.5-inch floppy was introduced. The hard cases they were made out of did not bend like the old ones, but the nickname stuck. It was smaller than its predecessors and held much more data. Imagine this tiny device holding 1.44 MB of data— more than 18,000 punch cards.

When Windows 95 came out, it was distributed on twenty-one 1.44 MB floppies. If today's Windows 10 was on floppies, it is estimated it would take 2,778 of them. Imagine that installation!

I once had a Sony digital camera with a floppy drive built in. It made it easy to take pictures that could be read on any computer.

Because of that digital camera, I have years of pictures stored on that old media and have been slowly going through boxes of them to move them to my desktop computer and Google Photo's Cloud. I was using an old Windows 7 computer with a 3.5-inch floppy drive.

After the update to Windows 10, that floppy disk no longer worked. I looked around and found others with floppy drive issues and some who were able to use them. It looked like a driver and/or a motherboard issue. Perhaps you have had the same problem.

Recently, I did some additional searching and found that there are newer 3.5" external

USB drives that are said to work with Windows 10. I ordered one from Amazon, plugged it in, and it works great. No driver is needed — plug and play — it works on my desktop and laptop.



Now, I can slowly go through all those old floppy disks. I wonder how I will get it to read those old Zip Drives. ❖

## HOW TO GET LARGER TEXT ON YOUR IPHONE

By [Carol Bratt](#), February 13, 2025

### Daves Computer Tips

dave@davescomputertips.com

Many folks complain that the text on their iPhones is much too small and difficult to read. Well, if you are one of those folks, relax, and I will tell you how to rectify the situation so that it is very easy to read. You can adjust the size of the text on your iPhone so that it is precisely right for you.

Follow the steps below to learn how:

1. Go to **Settings | app.**
2. Tap **Accessibility.**
3. Tap **Display & Text Size.**
4. Tap **Larger Text.**

See? Easy peasy, right?

Would you also like to adjust your keyboard and position? Well, you have absolutely come to the right place!

Follow the steps below to learn how:

1. Go to Settings.
2. Tap **Accessibility.**
3. Tap **Keyboards.**
4. Tap **Full Keyboard Access.**

Adjust your keyboard size and position.

Again, easy peasy right?

Now, here is a nice little extra:

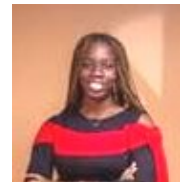
You can also pinch to change the text size in a text message. Pinch in to make the text smaller, and pinch out to make it larger. ❖

## HOW TO USE GMAIL OFFLINE MODE TO MANAGE EMAILS WITHOUT INTERNET

By **Chizara Ibeakanma**

Plateau User Group, Inc

Gazette, February 2025



- What Is Gmail Offline Mode?
- How to Enable Gmail Offline Mode
- Managing Emails in Offline Mode

What if you could check emails and draft replies even without an internet connection? With Gmail's Offline Mode, you can. This feature lets you access your inbox, read messages, and compose emails that will be sent once you're back online.

### What Is Gmail Offline Mode?

Gmail Offline Mode allows you to access, read, and manage your emails even when you don't have an internet connection. Instead of being completely cut off from your inbox, you can continue working as if you were online, and any emails you compose will be stored in an Outbox folder and sent automatically once your device reconnects.

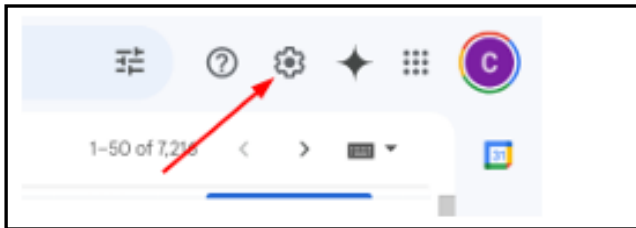
This feature is especially useful when traveling, working in areas with unstable internet, or during unexpected network outages. Gmail Offline syncs your recent emails so you can still search for messages, open attachments, and respond to emails without disruption.

If you're using a work or school account, you might need an administrator to enable this feature. Once set up, you can access Gmail offline through Google Chrome, ensuring you stay productive even without a stable connection.

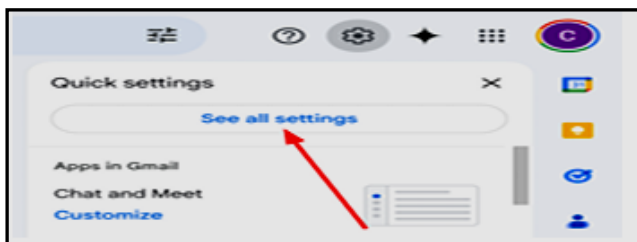
### How to Enable Gmail Offline Mode

To enable Gmail Offline Mode, you'll need to use Google Chrome, as it doesn't work in other browsers or Incognito mode. Start by opening Gmail in Chrome on your computer by visiting mail.google.com.

In the top right corner, tap the settings icon.



A Quick Settings panel will appear on the right. Tap **See all settings** to open the full settings page.



From the list of tabs at the top, select "Offline." Make sure the "Enable offline mail" option is checked.

Once enabled, you can adjust settings like how many days of emails to sync. Gmail will store these messages on your device, letting you access them without an internet connection. You'll also see how much storage is

being used and can choose whether to keep or remove offline data when you log out.

After setting your preferences, save the changes. If you plan to use Gmail offline frequently, bookmarking mail.google.com in Chrome can make access easier.

Remember that offline access needs to be enabled separately on each device where you want to use it.

### Managing Emails in Offline Mode

Once Gmail Offline Mode is enabled, you can continue handling emails almost as if you were online. You can open Gmail in Chrome and access your inbox, search for past emails, read messages, and even compose replies. The only difference is that emails you send won't be delivered immediately—they'll be stored in a new "Outbox" folder and automatically sent once your device reconnects to the internet.

Searching for emails in offline mode works efficiently because Gmail stores synced messages on your device. However, it is important to remember that only emails from the selected sync period (such as the last 7, 30, or 90 days) will be available. If you need an older email that wasn't synced, you'll have to wait until you're back online.

Attachments are also affected when using Gmail Offline Mode. If an email was already synced with an attachment, you can view it without an internet connection. However, downloading new attachments or sending emails with large files will require waiting until connectivity is restored.

To keep things organized, you can move emails to different folders, archive conversations, or even delete unwanted messages. These changes will still sync with your online Gmail account the next time you're connected. If you compose a new email, Gmail will notify you that it's offline, but it will queue the message for sending automatically.

Using Gmail Offline Mode effectively means planning ahead—if you know you'll be without the internet for a while, syncing more days' worth of emails can give you access to a broader range of conversations. With these capabilities, you can stay productive even when the internet is out of reach. ❖

## WHAT IS SPAM & WHY IS IT CALLED THAT?

By Cyn Mackley

Cyn's Tech Tricks

cynstechtips@cynmackley.com

In the digital world, spam refers to unwanted and unsolicited messages, usually emails or texts. But why “spam”? You can thank Monty Python. Back in 1970, the comedy group performed a sketch about a restaurant where nearly every dish contained SPAM (the canned meat), and the word was repeated endlessly. Tech nerds picked up the term to describe annoying, repetitive junk messages.

And here we are.



But not everything you don't like in your inbox is technically spam. If you signed up for a newsletter and later decided you didn't want it, that's just an unwanted email. Legitimate companies don't want to spam you; in fact, they

actively try to remove disinterested recipients because sending emails to people who ignore them hurts their deliverability rates. So, if you stop interacting with real businesses, they might just fade away on their own.

On the other hand, scam emails are sent by bad actors who don't care whether you want them or not. Their goal is to trick you into clicking, sharing personal information, or even sending money. These emails often pose as banks, delivery companies, or even people you know.

Understanding the difference is key to handling spam properly.

### The Best Defense: Let Spam Filters Do Their Thing

Since blocking spam is like playing whack-a-mole, the next best thing is **training your spam filter**. Email services like Gmail and Outlook have built-in filters that move junk to the spam folder. But they're not perfect. If you keep marking spam emails as junk, the system learns over time. Just don't forget to check your spam folder occasionally—sometimes legit emails end up there by mistake.

Spam filters work based on patterns; they look for:

- Suspicious sender addresses
- Poorly written messages with spelling errors
- Too many links or attachments
- Keywords often associated with spam (like “urgent,” “free money,” or “limited time offer”)

However, spammers are always adapting, so filters require continuous updates. Training them by marking real spam and rescuing false positives is key. ❖

## LACS INFORMATION

### HOW TO JOIN LACS'S MAIL LIST

LACS has an active general email list: [PC@LACS.Groups.IO](mailto:PC@LACS.Groups.IO) which goes to all members on the list. Members will receive meeting notices and Zoom links via this list. You can also ask questions, offer suggestions, and help others.

New LACS members should receive an invitation to join our list with two weeks to accept. Other LACS members who want to join the list should send an email to Larry McDavid, our Groups.IO Coordinator. (See your roster for contact info.)

He will send you an invitation to join. If you have any problems or questions about joining, please contact Larry.

### USING PAYPAL OR ZELLE

**To pay LACS by Zelle**, log into your bank with your username and password.

Select **Transfer Money > Send Money with Zelle**. Follow the instructions. The recipient is **Los Angeles Computer Society**. Select **Send by email**. The email address is: [lacomputersociety@gmail.com](mailto:lacomputersociety@gmail.com). Add a note telling what the payment is for and your contact information.

The wording may be a little different on your bank's site.

**To pay LACS by PayPal**, go to this link:

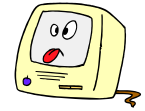
[www.paypal.com/paypalme/00001024](https://www.paypal.com/paypalme/00001024)

and then click on **Send**. Log in to your PayPal account or sign up for an account so that PayPal will know where to get the money to send. Follow the prompts. Enter the amount to pay, then click on **Add a note**. Say what the payment is for. If it is for dues, add your physical and email addresses, preferred phone number, and if you want a hard copy or the electronic version of the newsletter.

Email questions to Gavin Faught. See our roster for his contact info.

### FIX YOUR PC FOR FREE?

LACS member and presenter, **Jim McKnight**, has an open offer to LACS members to diagnose, repair, disinfect, or upgrade members' PC's for free. There are certain limitations to Jim's offer, so see the details by clicking the "Fix my PC for Free?" link at [www.jimopi.net](http://www.jimopi.net).



Non-members can wisely invest in a one-year **new regular** LACS membership (\$40.00), and Jim will fix your PC problem, too. Contact Jim for specific considerations.

### CHANGE CONTACT INFORMATION

Go to [www.lacspc.org](http://www.lacspc.org). Click on **Join LACS** in the bar under the picture. Under **Membership Update**, select **Click Here** to select either the DOC or PDF form. Fill it out; email it with your changes to Leah Clark. See the LACS roster or pages 9 or 10 of UF.

Or mail it to

Los Angeles Computer Society  
11664 National Blvd. #343  
Los Angeles, CA 90064-3802.

### ATTENDING A ZOOM MEETING

LACS members who are on our PC email list will receive a link, meeting ID, Passcode, and instructions to attend the LACS general meetings a few days before the meeting.

**Please let Leah Clark know by the morning of the meeting if you don't have it or have a problem.**

**You can put an icon to the link on your desktop so it's handy at meeting time.**

1. Right-click a blank spot on your desktop.
2. Select **New** from the drop-down menu.
3. Select **Shortcut**.
4. Type or copy and paste the link in the box that says "Type the location of the item."
5. Click **Next**.
6. Type a name for the shortcut.
7. Click **Finish**.



## LACS CALENDAR



### LACS Board Meeting, Monday, May 5

**Time:** 7:00 P.M. (Open from 6:30 P.M.)

**Place:** Wherever you are via Zoom

### LACS General Meeting: Tuesday, May 13

**Time:** 7:00 P.M. (Open from 6:30 P.M.)

**Place:** Wherever you are via Zoom

Please log in early so we can start on time. Allow time to be sure you have the link, or to solve any issues before the meeting starts.

**May 1,** May Day  
**May 5,** LACS Board Meeting  
**May 11,** Mother's Day  
**May 13,** LACS General Meeting  
**May 26,** Memorial Day



HAPPY  
Mother's  
DAY



## VISIT OTHER APCUG COMPUTER USER GROUPS AND SEE THEIR NEWSLETTERS

LACS heartily welcomes visitors from other user groups, and we are welcome to join other groups' meetings.

Go to [www.APCUG2.org](http://www.APCUG2.org) . Click on **Member Benefits**, then on **Groups Sharing Meetings** or on **Newsletters Online**.

## UPCOMING MEETINGS/EVENTS

**May 13:** Bitwarden  
John Kennedy

**June 10:** TBA

**July 8:** TBA

Please watch your email and *User Friendly* for changes and updates.

## ZOOM MEETINGS

Members on our PC email list will receive, via email, an invitation to join LACS Zoom general meetings. Click on the URL in the invitation before the meeting and follow the prompts.

If you have any questions or if you don't receive the link by the morning of the meeting day, contact Leah Clark at

[leahjc@sbcglobal.net](mailto:leahjc@sbcglobal.net)

## ZOOM RECORDINGS

**LACS members and meeting guests will receive links to the recordings of Zoom meetings via email.**

## HYPERLINKS

Underlined text (blue in the color edition) in *User Friendly* usually means it's a hyperlink to a website. Click on the link in the online version to see the referenced place. You can also copy and paste it into your browser's search or address bar.

## USER FRIENDLY BACK ISSUES AND INDEXES

See back issues of *User Friendly* at <http://www.lacspc.org/category/user-friendly/>. For indexes to past issues, go to <https://www.lacspc.org/category/uf-index/>

To find a specific article or topic, use the search box on the right.

## MEMBERS HELPING MEMBERS

LACS members volunteer to help other members solve hardware and software problems by telephone or during the hours listed below. Select the topic from the list and then contact a person whose number is listed next to it.

**Find a helper's email address and phone number on your roster.** If you don't have your roster, call 424-261-6251. Only members in good standing may receive a roster. We hope you find this LACS free service useful.

**If you are experienced using a particular program or hardware, please volunteer to be a consultant. You don't have to be an expert.** To volunteer for this list or to make corrections, please email Leah Clark at [leahjc@sbcglobal.net](mailto:leahjc@sbcglobal.net) or call her at 424-261-6251.

Android Smartphones - 5	Mozilla Firefox - 4, 7	Photoshop Elements - 2
Apple devices - 7	MS Excel - 5, 7, 8	Quicken - 5, 8
Anti-Malware and Backup - 4, 5	MS Word - 1, 3, 5, 8	Thunderbird - 4
Dragon Naturally Speaking - 3	MS Outlook - 1, 5	Utilities - 4, 5
Genealogy - 5	MS PowerPoint - 5, 7	Windows - 4, 5
Groups.IO - 9	MS Publisher - 2	WordPerfect - 5
Hardware - 4	PDF - 5, 8	Zoom - 2, 6
Lotus Word Pro, Approach - 4		

Preferred Time for Phone Calls			
Number	Name	From	To
1	Beckman, Loling	10:00 AM	6:00 PM
2	Clark, Leah	7:00 AM	5:00 PM
3	Hershman, Irv	11:00 AM	11:00 PM
4	McKnight, Jim	8:00 AM	7:00 PM
5	Nordlinger, Stephanie	9:00 AM	5:00 PM
6	Presky, Mark	Any	Any
7	Van Berkomp, Paula	9:00 AM	5:00 PM
8	Wilder, Joan	9:00 AM	9:00 PM
9	McDavid, Larry	Contact by email	

**Note:** Times are Pacific Times

**OFFICERS, DIRECTORS AND LEADERS**

TITLE	NAME	TERM
President	Leah Clark	2025
Vice President	Stephanie Nordlinger	2025
Secretary	<b>Open</b>	2025
Treasurer	Gavin Faught	2025
Director	Loling Beckman	2025
Director	Donna Benton	2025
Director	Mark Presky	2025
Director	Irv Hershman	2026
Director	Jim McKnight	2026
Director	<b>Open</b>	2026
Director	Paula Van Berkom	2026
APCUG Representative	Leah Clark	
Corporate Counsel	Stephanie Nordlinger	
Database Manager	Loling Beckman	
Groups.IO Email Lists	Larry McDavid	
Newsletter Editor	Leah Clark	
Program Chair	Stephanie Nordlinger	
Publicity – Press	Mark Presky	
Publicity – Online Media	<b>Open</b>	
Quick Consultants	Leah Clark	
Webmaster	Paula Van Berkom	

**Mailing Address:** 11664 National Blvd., #343, Los Angeles, CA 90064-3802

**Website:** <https://lacspc.org>

**Contact the President/Editor at 424-261-6251.** Follow the prompts. This is a Google Voice number.

Please use your LACS roster for email addresses and phone numbers to contact any officer, board member or other member. If necessary, you may leave a message at the above number. **Only LACS members may receive a roster.**

**Please note:** The 2025 roster is in the middle pages of the May User Friendly. It was mailed to all LACS members, including those who usually receive only the electronic version. The roster will not be sent to anyone electronically. Be sure to keep it where you can find it when you need it.

## FIBER OPTICS OR DATA COMM

By **Larry McDavid**, LACS member and Groups.IO Coordinator

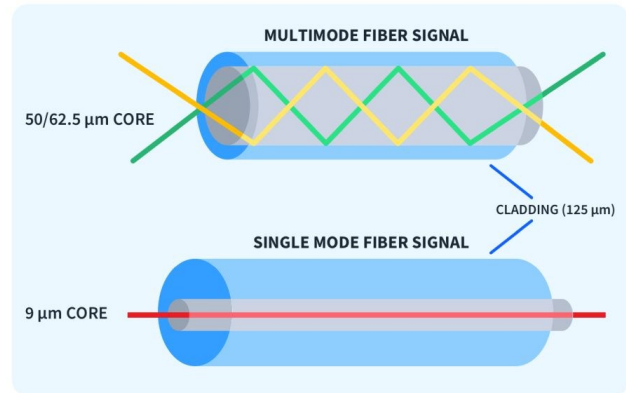
(Data Comm" is the exchange of digital information between two or more locations.)

A friend recently needed to extend a gigabit Ethernet connection to an adjacent building and chose to use fiber optics because of the nearly 150-foot distance and cost. He was successful, and I decided to improve my understanding of fiber optics for Data Comm. I quickly discovered there is a complex nomenclature and alphabet soup of acronyms associated with fiber optics. Learning the essentials turned into a journey, and I want to share what I learned. My goal is not to engineer a system but to give you the information you need to make informed decisions when selecting components to use.

### FIBER OPTIC BASICS

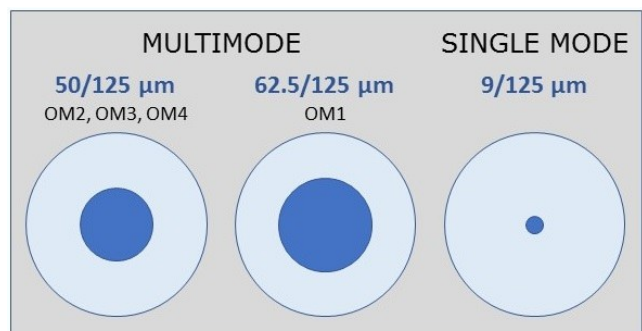
First, let's talk about the optical fiber itself. Fiber optics use **light to send data over very small diameter glass fibers. The light can be of three commonly used** infrared wavelengths, but all are longer wavelength than the human eye can see. It is unsafe to look down any fiber optic cable, but if you did, you would see no light! For safety, you could project the light from the fiber optic cable onto reflective paper, but you would still see no light. The infrared light used in fiber optics is produced by a laser diode or a light-emitting diode (LED). Lasers produce coherent light; LEDs do not. Optical fiber is identified as either single-mode (SM) or multimode (MM) based on the coherence of the light it can carry. Single-mode fiber excels in long-distance, high-bandwidth applications, while multimode fiber has been used for shorter-distance, cost-sensitive installations. Today, single-mode fiber is more common in Data Comm.

Single-mode optical fibers are glass waveguides that propagate only a single optical mode produced by a laser diode. The physical design of an SM fiber is a two-concentric-



part glass cylinder that is 125 microns in diameter (that's only five one-thousandths of an inch, slightly larger in diameter than a hair) over its outer glass cladding. The inner "core" (where the laser diode light propagates) is about 9 microns or about one-tenth the diameter of a human hair.

Multimode glass fibers are glass waveguides that can propagate many optical modes produced by a non-coherent LED. The physical design of an MM fiber is similar to that of an SM fiber with the same 125-micron clad diameter but with a larger inner core, usually 50 microns in diameter (about the diameter of a human hair).



Please note the size of the light-carrying inner glass fiber: It is so small it is almost invisible to the naked eye. That glass fiber is clad with more glass that does not actually carry the light but just serves to protect the tiny signal-carrying glass fiber. This glass fiber is smaller than any copper wire you will likely ever encounter, yet it can carry data at much higher rates than any wired Internet access you can get. As discussed later, a single optical fiber can carry data in both directions.

Whether single-mode or multimode, the clad fiber is always covered in some kind of protective plastic layer to protect the glass cladding from moisture and physical damage, bringing the final diameter of the protected clad fiber to 250 microns. An additional protective outer plastic jacket provides an extra layer of defense against damage and bending, bringing the finished diameter to about 3 mm or about 1/8 of an inch. Fiber manufacturers use many kinds of plastic for these layers to prevent fire/smoke hazards, and to reduce friction when pulling through conduit. Direct burial fiber often includes an additional helical steel layer to protect against burrowing animals.

There are inexpensive “Fault Finder” tester tools that use visible red light sent down the fiber cable. If there is a break in the fiber, red light is visible at the break through a plastic sheaf. This won’t work for an armored cable.



100 Foot Armored Cable With SC Connectors

### FIBER OPTIC CONNECTORS

These small glass fiber cables need to be connected together and to various electronic devices, so pluggable connectors are used. These connectors come in a large variety of types and have evolved substantially over the years fiber has been used. Today, for Data Comm, two types of connectors are common: SC (Square or Subscriber Connector) and the smaller LC (Lucent Connector, named for the company that developed it). Fiber optic cables can also be spliced by fusing the glass, but that requires very special equipment and is not often attempted by end users.



SC Connector



Ferrule LC Connector



It is noteworthy that, when connected, the glass fiber must actually touch in physical contact with another fiber or the electronic/optical interface device. The end of the glass fiber and its cladding are bonded within a ceramic ferrule 2.5 mm diameter for an SC connector and 1.25 mm diameter for the smaller LC connector. The objective is to precisely align the small innermost glass fiber to ensure optimal light transmission.

It is vital that the end of the glass fiber be polished and smooth. Over the years, various types of ferrule-end polishes have been developed, but today, two polishes are standard: UPC (Ultra Physical Contact) and APC (Angled Physical Contact). The connector must ensure both alignment and physical contact of the polished optical surfaces. The connectors include an internal spring that forces the ferrule ends together when mated.



The “Ultra” in UPC means that the ferrule end is more highly polished and the shape better controlled than in the earlier “PC” polish. UPC ferrule-end polish is more common in fiber optics for Data Comm. The ferrule end is highly polished and with a slight convex curvature. Visually, the ferrule end looks square. Today, most data comm systems use the UPC polish even if the polish is not specified.

The APC ferrule-end polish is angled 8 degrees and polished flat. The angle ensures any reflected light is directed into the fiber cladding and absorbed rather than transmit-

ted back down the fiber. Reflected light can degrade very high-performance optical systems, but is less of a problem in Data Comm applications. The orientation of the angled flat on APC connectors is carefully maintained by a key in the connector. When two APC cables are mated, the ferrules are oriented so that the angled flat surfaces touch each other over the flat surfaces. City-wide, multigigabit systems often use APC polish connectors, but local Data Comm networks more often use UPC polish connectors. Multimode fiber connectors typically use UPC ferrule-end polish.

The ferrule-end polish is clearly indicated by the standard for connector body color: UPC polish connectors are BLUE, while APC polish connectors are GREEN. This is true for both SC and LC fiber connectors. It is vitally important that only like polishes be mated. Mating a UPC cable to an APC cable can damage the connectors, limit the number of successful connector matings, and degrade optical performance. There are even short fiber patch cables available with UPC on one end and APC on the other end for use when different types of cables must be connected.

It is convenient to purchase fiber optic cables pre-terminated with connectors on both ends. These can be short, small, and flexible “patch” cables, but can also be much longer and armored cables meant to pull through conduit (that’s what all that orange tubing you see being installed underground actually is.) The connectors, either SC or LC, are factory-installed with either UPC or APC polish. Again, the connector color indicates the type of ferrule-end polish.

There are also field-installable connectors for high-volume applications. These require some specialized tooling to install. They are seldom practical for small, casual fiber users. Cleanliness is important to fiber optic performance. The fiber is so small that connector interfaces must be kept clean or performance

is seriously degraded. There is a wide array of single-use and wound-cartridge cleaning supplies available. It is good practice to clean the connector ferrule end and its mate every time a fiber connector is mated.

### SENDING DATA IN BOTH DIRECTIONS

Data communication implies data travel in both directions. Multiconductor Ethernet (e.g. CAT5 and CAT6) cables have separate copper wires for the Receive and Transmit directions. Separate Receive and Transmit single-optical-fiber cables were originally used; even today, most MM fiber cables are Duplex, meaning two fibers in one jacket. A dual-fiber connector on each end terminates separate fibers for the Receive and Transmit directions. This effectively doubles the number of fibers needed for MM cables, but simpler electronics and easier installation keep this duplex MM fiber approach cost effective. Most pre-terminated MM fiber cable is duplex with dual connectors.

### DUPLEX MULTIMODE FIBER CABLE



However, fiber optic technology has evolved, and now SM fiber cables offer higher bandwidth, much longer distance performance, and allow a single fiber cable to provide both Receive and Transmit directions. The “BiDi” (Bi-Directional) electronics required is somewhat more expensive, but the cost difference between duplex MM fiber and BiDi SM fiber is decreasing.

**How is it possible to use one fiber for both Receive and Transmit directions?**

Remember, we are talking about light traveling inside a glass fiber, and that light can have different wavelengths or “color”. BiDi fiber systems use a different wavelength light for Receive and for Transmit within the same single-fiber cable. This technology is called Wavelength Division Multiplexing (WDM) and has evolved so much and has become so economical, that it has become the standard today because it reduces the number of fiber cables needed. The electronic device connected to the fiber cable is more complex as a different wavelength laser diode is needed at each end of the fiber link, and additional light-beam splitting optics are needed. (See *image on page 16*)

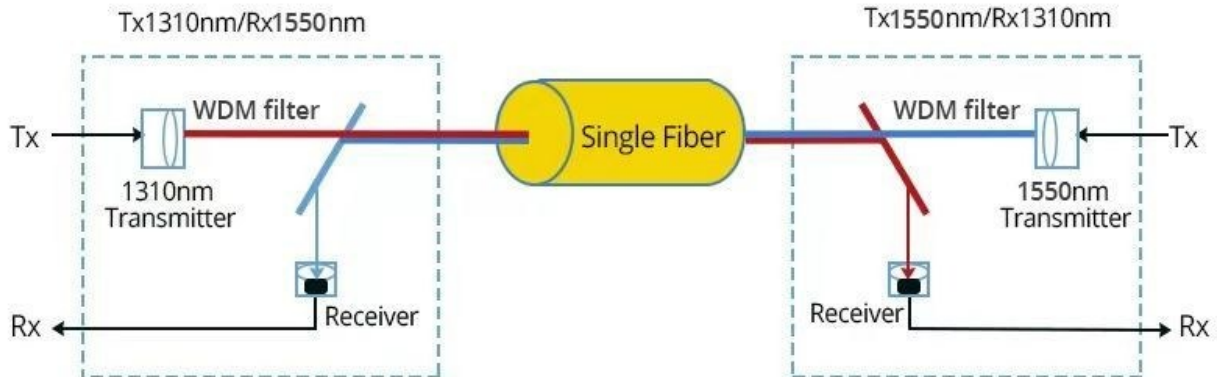
BiDi devices specify a particular pair of light wavelengths used; different manufacturers use different wavelengths, so one must be careful not to mix the wavelengths used. These devices are typically sold in pairs so that you always get devices with the correct pair of wavelengths.

That’s a very brief overview of fiber optic cables and connectors, but it explains the most important details. I will next describe the devices needed to extend an Ethernet connection. These devices and the many kinds of cables and connectors are all offered by online retailers, including Amazon. However, you need to understand all those acronyms to know what to select!

### USING FIBER OPTICS TO EXTEND AN ETHERNET CONNECTION

Fiber optic cables use a glass fiber, and Ethernet cables use copper wires. Optoelectronics are required to convert one to another. The key device is a Media Converter, and it features a fiber optic connector and an Ethernet RJ-45 connector. Fiber optic technology is capable of very high data rates, so typical media converters are rated for up to Gigabit Ethernet. That’s 1000 Mbps (Megabits per second), faster than most

# Wavelength Division Multiplexer



Internet Service Providers (ISPs) offer today. 10 Gbps and even 100 Gbps devices are available but not yet for typical home use.

The media converter is an electronic device, so it needs power, typically supplied by a small modular plugin power supply. The converter typically has front panel indicator LEDs to show the presence of data, speed of data and power; these LEDs are often grouped and labeled “FX” for Fiber Transmit and “TX” for Twisted Pair Transmit (that means Ethernet twisted pair copper cables, commonly known as CAT5 or CAT6 cables). There is a RJ-45 8-pin connector for an Ethernet cable.

There must also be a fiber optic connector in the media converter; different converters use different approaches for that fiber connector. The lowest-cost media converters have a built-in, integral fiber connector. There is another standard commonly seen in larger data centers that provides the capability to change the type of connector used.

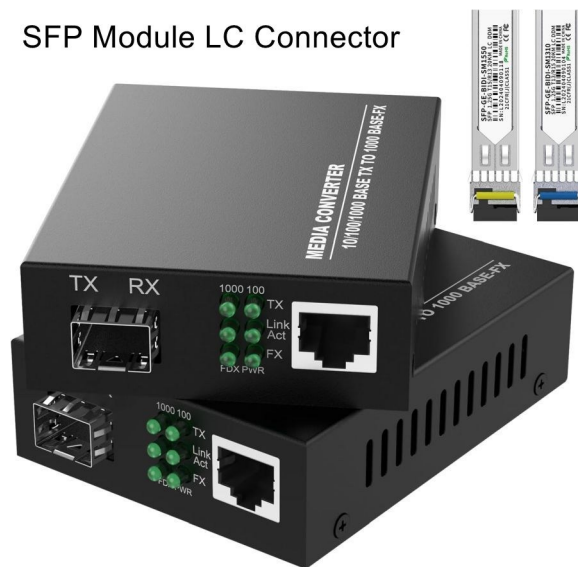
In this case, an additional module plugs into the media converter, and this module has the fiber connector. This approach uses Small Form-factor Pluggable (SFP) modules that fit into an opening in the media converter and it allows one converter to be adapted to different kinds of connectors by changing the SFP module. Various fiber optic connectors and wired connectors are available in SFP modules.

## MEDIA CONVERTERS

Internal SC Connector



SFP Module LC Connector





Whether using media converters with internal, built-in fiber connectors or with interchangeable SFP modules, the fiber connectors can be either SC or LC. If you buy media converters using SFP modules you could in the future, change the type of fiber connector by replacing the SFP module without replacing the entire media converter or other data device. Both media converter types are readily available at on-line retail stores. Unless you anticipate the need to change connector type in the future, it is more economical to buy media converters with integral SC or LC connectors.

Remember that two media converters will be needed, one at each end of the fiber optic cable; media converters are typically sold in pairs for one combination price. You can also purchase a variety of SFP modules independently to suit your specific needs. The SFP interface is standardized and is found on media converters, large data router/switches, and other data center devices.

Typical pairs of both types of media converters are seen on page 16. The type using SFP modules is shown with the SFP BiDi modules ready to insert into the converter front panel. Labels on each SFP module identify the transmit and receive wavelengths used. The SFP modules have a bail release to grab to ease their removal from the media converter; these bails are often colored to indicate the transmit light wavelength, usually BLUE for 1310 nm and YELLOW for 1550 nm.

Yes, these are the same colors used to indicate UPC and APC ferrule-end polish but that is coincidental. Note that an Ethernet-to-fiber-to-Ethernet link using SFP modules will have one SFP of each transmit wavelength and bail color in the media converter at opposite ends of the link. Other wavelengths and other colors are common, but there is no standard; you must use an SFP pair with matching wavelengths. Media converters with integral fiber connectors will have the wavelengths

marked in labeling.

These options seem clear (and should be), but there is a problem. I have yet to find an advertised media converter or an SFP module that specifies the fiber optic connector ferrule-end polish. They all have fiber connectors, either SC or LC, but what polish does that connector use? Extensive online searching suggests that if the fiber connector ferrule-end polish is not specified, that polish is UPC, not APC. Why is this? The only justification for omitting this important detail I can imagine is that UPC polish is more common in Data Comm than is APC. In fact, I found one online comment stating, "APC polish is unheard of in Data Comm." I can't verify that statement, but I find that lack of specificity of ferrule-end polish a poor practice. Intermating APC and UPC may work ok for shorter distances and a few mate/demate cycles, but it is poor practice at best.

I subsequently visited a local fiber optics manufacturer and fiber installer. The staff there confirmed that LAN Data Comm installations use UPC polish connectors perhaps 99% of the time and that SFP modules offer only UPC polish connectors.

### FINAL CONSIDERATIONS

When running fiber optic cables through walls, between buildings, or underground, it is convenient to protect even armored fiber cables within plastic conduit, especially if running the cable outdoors or underground. Some armored fiber cables are safe to direct-bury, and all have a steel helical wrap under the outer jacket to inhibit chewing by burrowing animals.

However, the jacket is usually black and might go unseen if digging. Orange corrugated High Density Polyethylene (HDPE) non-split loom tubing or conduit will make the fiber cable more visible and add some protection. A 1-inch inside diameter loom

or conduit will make the armored cable with an attached connector easy to pull through. A rope or fish tape must be carefully attached when pulling to prevent bending the fiber cable or stressing the connector.

### WHAT ABOUT THE PRICE OF FIBER OPTICS?

The technology has matured, and volumes are high, so the prices have dropped. Surprisingly, fiber optic cables may actually cost less than Ethernet cables today. A 100-foot long, outdoor, steel-armored fiber optic cable pre-terminated with SC/UPC connectors costs about \$30. A pair of media converters with integral fiber optic connectors and power supplies costs about \$40. If you want future alternative interchangeable connectors provided by SFP modules, a pair of those media converters costs about \$65. The same hardware could easily expand the Ethernet extension length to thousands of feet at gigabit speed. I see this as a real bargain!

This should give you a working knowledge of fiber optics for data comm and of the many acronyms widely used. You should now be able to select appropriate fiber optic parts and a media converter pair to allow you to extend a local Ethernet connection over long distances. Fiber optic components are surprisingly inexpensive today. Buying preterminated fiber cables means no special tools are needed. ❖

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### LAUGHING OUT LOUD

**Q:** Why did the fiber optic cable start a band?

**A:** Because it had great connections and always delivered a light show!

*From ChatGPT*

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