



The science behind the report:

# Store, access, and share files faster and more efficiently

This document describes what we tested, how we tested, and what we found. To learn how these facts translate into real-world benefits, read the report *Store, access, and share files faster and more efficiently*.

We concluded our hands-on testing on November 21, 2018. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on November 21, 2018 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

## Our results

We recorded all measurements in seconds.

Testing on macOS®			
Desktop Sync Clients	Google Drive	OneDrive for Business	Percentage difference
Uploading a 4.03GB ISO	138.1	878.8	84.29%
Uploading a 1.93GB MP4	69.0	334.6	79.38%
Downloading a 4.03GB ISO	304.7	236.4	-28.89%
Downloading a 1.93GB MP4	144.9	103.7	-39.73%
Google Chrome™	Google Drive	OneDrive for Business	Percentage difference
Uploading a 4.03GB ISO	86.2	818.3	89.47%
Uploading a 1.93GB MP4	40.4	358.5	88.73%
Downloading a 4.03GB ISO	68.7	260.7	73.65%
Downloading a 1.93GB MP4	31.4	442.9	92.91%
Google Chrome	Google Drive	SharePoint Online	Percentage difference
Uploading a 4.03GB ISO	86.2	851.8	89.88%
Uploading a 1.93GB MP4	40.4	380.6	89.39%
Downloading a 4.03GB ISO	68.7	363.7	81.11%
Downloading a 1.93GB MP4	31.4	168.1	81.32%

Testing on macOS®			
Apple Safari	Google Drive	OneDrive for Business	Percentage difference
Uploading a 4.03GB ISO	81.6	553.2	85.25%
Uploading a 1.93GB MP4	36.4	246.4	85.23%
Downloading a 4.03GB ISO	163.4	260.7	37.32%
Downloading a 1.93GB MP4	72.2	101.8	29.08%
Apple Safari	Google Drive	SharePoint Online	Percentage difference
Uploading a 4.03GB ISO	81.6	746.3	89.07%
Uploading a 1.93GB MP4	36.4	236.5	84.61%
Downloading a 4.03GB ISO	163.4	229.5	28.80%
Downloading a 1.93GB MP4	72.2	106.8	32.40%

Testing on Windows 10			
Desktop Sync Clients	Google Drive	OneDrive for Business	Percentage difference
Uploading a 4.03GB ISO	1,089.1	1,411.2	22.82%
Uploading a 1.93GB MP4	491.0	539.5	8.99%
Downloading a 4.03GB ISO	251.6	270.6	7.02%
Downloading a 1.93GB MP4	128.8	121.9	-5.66%
Google Chrome	Google Drive	OneDrive for Business	Percentage difference
Uploading a 4.03GB ISO	407.6	395.9	-2.96%
Uploading a 1.93GB MP4	238.3	181.2	-31.51%
Downloading a 4.03GB ISO	137.7	328.2	58.04%
Downloading a 1.93GB MP4	61.6	144.7	57.43%
Google Chrome	Google Drive	SharePoint Online	Percentage difference
Uploading a 4.03GB ISO	407.6	326.1	-24.99%
Uploading a 1.93GB MP4	238.3	168.6	-41.34%
Downloading a 4.03GB ISO	137.7	356.7	61.40%
Downloading a 1.93GB MP4	61.6	151.9	59.45%
Internet Explorer 11	Google Drive	OneDrive for Business	Percentage difference
Uploading a 4.03GB ISO	144.0	1224.4	88.24%
Uploading a 1.93GB MP4	68.2	549.0	87.58%
Downloading a 4.03GB ISO	85.3	262.1	67.46%
Downloading a 1.93GB MP4	36.0	105.8	65.97%

Testing on Windows 10			
Internet Explorer 11	Google Drive	SharePoint Online	Percentage difference
Uploading a 4.03GB ISO	144.0	1,190.3	87.90%
Uploading a 1.93GB MP4	68.2	518.8	86.85%
Downloading a 4.03GB ISO	85.3	322.8	73.57%
Downloading a 1.93GB MP4	36.0	102.7	64.95%

Testing on mobile			
iOS native applications	Google Drive	OneDrive for Business	Percentage difference
Previewing a 10MB PDF	2.2	2.5	12.00%
Opening a 1.3MB DOCX	2.4	5.0	52.00%
Opening a 1MB XLSX	2.2	7.1	69.01%
Opening a 4.4MB PPTX	1.4	5.0	72.00%
iOS native applications	Google Drive	SharePoint	Percentage difference
Previewing a 10MB PDF	2.2	2.6	15.38%
Opening a 1.3MB DOCX	2.4	4.5	46.67%
Opening a 1MB XLSX	2.2	4.2	47.62%
Opening a 4.4MB PPTX	1.4	5.1	72.55%
Android™ native applications	Google Drive	OneDrive for Business	Percentage difference
Previewing a 10MB PDF	2.1	3.3	36.36%
Opening a 1.3MB DOCX	3.4	5.2	34.62%
Opening a 1MB XLSX	1.9	5.8	67.24%
Opening a 4.4MB PPTX	2.4	5.4	55.56%
Android native applications	Google Drive	SharePoint	Percentage difference
Previewing a 10MB PDF	2.1	3.9	46.15%
Opening a 1.3MB DOCX	3.4	6.3	46.03%
Opening a 1MB XLSX	1.9	6.2	69.35%
Opening a 4.4MB PPTX	2.4	6.6	63.64%

# System configuration information

## The laptops we used for testing

System	Apple MacBook Pro® 2017	Dell™ XPS™ 13 9370
Processor		
Vendor	Intel®	Intel
Model number	Core™ i5-7360U	Core i7-8550U
Core frequency (GHz)	2.3	1.80
Number of cores	2	4
Cache (MB)	4	8
Memory		
Amount (GB)	8	8
Type	LPDDR3	LPDDR3
Speed (MHz)	2133	1866
Integrated graphics		
Vendor	Intel	Intel
Model number	Iris Plus Graphics 640	UHD Graphics 620
Storage		
Amount (GB)	128	256
Type	PCIe-based flash	NVMe™
Connectivity/expansion		
Wireless internet	802.11a/b/g/n/ac	802.11a/b/g/n/ac
Bluetooth	4.2	4.2
USB	2 x USB-C	3 x USB-C
Thunderbolt	2 x 2	N/A
Battery		
Type	Lithium-polymer	Lithium-ion
Size	Integrated	Integrated
Rated capacity (WHR)	54.5	52
Display		
Size (inches)	13.3	13.3
Resolution	2560 x 1600	1920 x 1080
Touchscreen	No	No

System	Apple MacBook Pro® 2017	Dell™ XPS™ 13 9370
Operating system		
Vendor	Apple	Microsoft
Name	macOS Mojave	Windows 10
Build number or version	10.13.6	1809
BIOS		
BIOS name and version	N/A	Dell XPS 13 9370 1.5.1
Dimensions		
Height (inches)	0.59	0.46
Width (inches)	11.97	11.88
Depth (inches)	8.36	7.84
Weight (lbs.)	3.02	2.80

## The mobile devices we used for testing

System	Apple iPhone X 64GB	Google Pixel 2
Processor		
Vendor	Apple	Qualcomm
Model number	A11	Snapdragon 835
Core frequency (GHz)	2.39	2.35
Number of cores	6 (2x Monsoon + 4x Mistral)	8 Qualcomm Kryo 280
Memory		
Amount (GB)	3	4
Type	LPDDR4X	LPDDR4X
Graphics		
Vendor	Apple	Qualcomm
Model number	M10	Adreno 540
Storage		
Amount (GB)	64	64
Type	NAND Flash	NAND Flash
Connectivity		
Wireless internet	802.11a/b/g/n/ac	802.11a/b/g/n/ac
Cellular	LTE	LTE
Bluetooth	5.0	5.0

System	Apple iPhone X 64GB	Google Pixel 2
Battery		
Type	Lithium-ion	Lithium-ion
Size	Integrated	Integrated
Rated capacity	10.35 Wh	2700 mAh
Display		
Size (inches)	5.8	5.0
Type	AMOLED touchscreen	AMOLED touchscreen
Resolution	1125 x 2436	1920 x 1080
Operating system		
Vendor	Apple	Google
Name	iOS	Android
Build number or version	12.1	9
Dimensions		
Height (inches)	5.65	5.70
Width (inches)	2.79	2.70
Depth (inches)	0.30	0.30
Weight (oz.)	6.14	5.01

## About our testing

We used the following indicators to determine precisely when a file upload or download began and ended with the native desktop sync client:

- The Google Drive icon on both Microsoft Windows and macOS animates while any kind of file processing is in progress. When you click the icon in the system tray (Windows) or menu bar (macOS), a balloon appears to show which files are uploading/downloading. We started timing as soon as the status text indicated “Syncing” and a progress bar first appeared. We stopped timing when the status text indicated “Updated just now.”
- The OneDrive for Business icon on both Windows and macOS changes when it is actively syncing files. Similar to Google Drive, when you click the icon in the system tray (Windows) or menu bar (macOS), a balloon appears to show upload/download status. On macOS, we started timing as soon as the status text indicated “OneDrive is updating files,” and stopped timing when the status text indicated “OneDrive is up to date.” On Windows, we started timing when the status bar’s animated progress bar first appeared, and stopped timing when it indicated “OneDrive is up to date.”

## Network infrastructure

For our testing, we used two of each device under test. We connected the two devices in each pair to separate wireless networks. The devices were connected to the 5GHz band of identical, 802.11ac-based TP-Link AC1750 wireless routers. We configured each router identically but set them to use different channels to ensure minimum interference from nearby networks.

## Devices

- Dell XPS 13 (Windows 10)
- Apple MacBook Pro 13” (macOS Mojave 10.14)
- Google Pixel 2 (Android 9)
- Apple iPhone X (iOS 12.1)

## OS and browser versions

- macOS Mojave 10.14
  - Chrome 70.0.3538.110
  - Safari 12.0
- Windows 10
  - Chrome 70.0.3538.110
  - Internet Explorer 11.134.17763.0
- Android 9
- iOS 12.1

## File corpus (sizes are approximate)

- SampleISO.ISO - 4.33 GB
- SampleVideo.MP4 - 1.93 GB
- SampleDOCX.DOCX - 1.3 MB
- SamplePPTX.PPTX - 4.4 MB
- SampleXLSX.XLSX - 1 MB

## Hardware/software matrix

- Windows 10 (Dell XPS 13)
  - Google Drive
    - Backup and Sync native application
    - Google Chrome
    - Internet Explorer 11

- OneDrive for Business
  - ♦ OneDrive native application
  - ♦ Google Chrome
  - ♦ Internet Explorer 11
- SharePoint Online
  - ♦ Google Chrome
  - ♦ Internet Explorer 11
- macOS (13" MacBook Pro)
  - Google Drive
    - ♦ Backup and Sync native application
    - ♦ Google Chrome
    - ♦ Safari
  - OneDrive for Business
    - ♦ OneDrive native application
    - ♦ Google Chrome
    - ♦ Safari
  - SharePoint Online
    - ♦ Google Chrome
    - ♦ Safari
- Android (Google Pixel 2)
  - Google Drive mobile app
  - OneDrive mobile app
  - SharePoint mobile app
- iOS (iPhone X)
  - Google Drive mobile app
  - OneDrive mobile app
  - SharePoint mobile app

## Test practices

- We ran each individual test at least three times each to determine variability and ensure consistent and reliable results. After three consecutive runs of sufficiently low variability, we recorded the median run as the test result.
- We logged in to all relevant services on all test devices before starting testing
- For the mobile device tests, we opened files accessed from each cloud storage mobile app in their respective productivity apps. For example, we opened a spreadsheet hosted in Google Drive in the Google Sheets mobile app and opened a spreadsheet hosted in OneDrive or SharePoint Online in the Microsoft Excel mobile app.
- We performed all tests between two identical sets of devices (with the exception of the mobile device tests, which require only a single device) connected to separate but otherwise identical wireless networks on a 1Gbps business-class internet connection.
- We performed all mobile tests with no other applications running in memory.
- We closed all applications between test runs.

## Running the Windows and macOS tests

### Uploading a file with a desktop sync client

1. Navigate to the Documents folder, and prepare the stopwatch.
2. Right-click the test file, and click Copy.
3. Navigate to the desktop sync folder for the cloud storage solution under test on the local machine.
4. Right-click the desktop sync folder for the cloud storage solution under test, and simultaneously click Paste and start the stopwatch.
5. When the file has completely uploaded, stop the stopwatch.
6. Record the result.
7. Delete the file from the cloud storage solution under test, and wait for the files to completely sync.

## Downloading a file with a desktop sync client

1. Quit the desktop sync client for the cloud storage solution under test.
2. Open a browser, and navigate to the browser-based interface of the cloud storage solution under test.
3. Prepare the stopwatch.
4. Click the test file, drag it over the browser-based interface's cloud storage folder, and drop the file.
5. When the file has completely uploaded via the browser-based interface, launch the desktop sync client for the cloud storage solution under test and simultaneously start the stopwatch.
6. When the file has finished synchronizing to the laptop under test and the application's icon in the system tray or menu bar returns to its default state, stop the stopwatch.
7. Record the result.

## Uploading a file with a browser-based interface

1. Navigate to the browser-based interface for the cloud storage solution under test.
2. Prepare the stopwatch, and select the file(s) to be uploaded:
  - a. When uploading a file in Google Drive in the browser, click New, and select File upload.
  - b. When uploading a file in OneDrive for Business or SharePoint Online in the browser, click Upload, and select Files.
3. Simultaneously start the stopwatch and click Open to start the upload.
4. Watch the progress bar, and when the upload has completed, stop the stopwatch.
5. Record the result.

## Downloading a file with a browser-based interface

1. Navigate to the browser-based interface for the cloud storage solution under test.
2. Prepare the stopwatch, and select the file to be downloaded.
3. Simultaneously start the stopwatch and click Download.
4. When the download completes, stop the stopwatch.
5. Record the result.

## Running tests on iOS/Android apps

### Previewing a PDF file in the mobile app

1. Open the mobile app for the cloud storage solution under test.
2. Prepare the stopwatch, and navigate to the folder containing the PDF.
3. Simultaneously start the stopwatch and tap on the PDF to preview it.
4. When the preview fully loads, stop the stopwatch.
5. Record the result.
6. Delete the PDF, close the app from memory, and re-upload the PDF via the desktop sync client.

### Opening a file in the mobile app

1. Open the mobile app for the cloud storage solution under test.
2. Prepare the stopwatch, and navigate to the folder containing the file under test.
3. Simultaneously start the stopwatch and tap on the file under test to open it in the native mobile productivity app unless otherwise noted:
  - a. When testing PPTX or DOCX files in SharePoint and OneDrive for Android, tap on the file under test to open the in-app preview, and simultaneously start the stopwatch and tap the icon to open the file in its respective mobile productivity app.
  - b. When testing PPTX or DOCX files in OneDrive for iOS, tap on the "... " to the right of the file under test, and simultaneously start the stopwatch and tap the Edit button.
  - c. When testing PPTX or DOCX files in SharePoint for iOS, tap on the file under test to open the in-app preview, and simultaneously start the stopwatch and tap the icon to open the file in its respective mobile productivity app.
4. When the file fully loads and is editable, stop the stopwatch.
5. Record the result.
6. Delete the file, close the cloud storage solution app, close the productivity app, remove both from memory, and re-upload the file via the desktop sync client.

Read the report at <http://facts.pt/918g5o> ►

This project was commissioned by Google.



Facts matter.®

Principled Technologies is a registered trademark of Principled Technologies, Inc.  
All other product names are the trademarks of their respective owners.

**DISCLAIMER OF WARRANTIES; LIMITATION OF LIABILITY:**

Principled Technologies, Inc. has made reasonable efforts to ensure the accuracy and validity of its testing, however, Principled Technologies, Inc. specifically disclaims any warranty, expressed or implied, relating to the test results and analysis, their accuracy, completeness or quality, including any implied warranty of fitness for any particular purpose. All persons or entities relying on the results of any testing do so at their own risk, and agree that Principled Technologies, Inc., its employees and its subcontractors shall have no liability whatsoever from any claim of loss or damage on account of any alleged error or defect in any testing procedure or result.

In no event shall Principled Technologies, Inc. be liable for indirect, special, incidental, or consequential damages in connection with its testing, even if advised of the possibility of such damages. In no event shall Principled Technologies, Inc.'s liability, including for direct damages, exceed the amounts paid in connection with Principled Technologies, Inc.'s testing. Customer's sole and exclusive remedies are as set forth herein.