



The science behind the report:

# Collaborate and communicate 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 [Collaborate and communicate faster and more efficiently](#).

We concluded our hands-on testing on January 3, 2019. 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®			
Google Chrome™	Gmail	Outlook Online	Percentage difference
Opening a cloud-hosted 1.3MB document from share link	1.5	3.2	53.13%
Opening a cloud-hosted 1.3MB spreadsheet from share link	5.3	4.2	-26.19%
Opening a cloud-hosted 4.4MB presentation from share link	2.9	3.9	25.64%
Sending/receiving an email with a 1.3MB DOCX attachment	15.4	2.5	-516.00%
Sending/receiving an email with a 1.3MB XLSX attachment	24.9	7.0	-255.71%
Sending/receiving email with a 4.4MB PPTX attachment	16.0	3.6	-344.44%
Saving a 25MB JPG attachment to cloud storage	2.8	9.8	71.43%
Uploading a 25MB JPG attachment to email	2.3	6.3	63.49%
Receiving a calendar invitation	5.0	2.0	-150.00%
Uploading a 10MB PDF attachment to calendar invite	1.7	2.5	32.00%
Previewing a 10MB PDF attachment from calendar invite	1.4	3.6	61.11%

Testing on macOS®			
Apple Safari	Gmail	Outlook Online	Percentage difference
Opening a cloud-hosted 1.3MB document from share link	1.6	4.2	61.90%
Opening a cloud-hosted 1.3MB spreadsheet from share link	4.2	4.7	10.64%
Opening a cloud-hosted 4.4MB presentation from share link	2.3	3.1	25.81%
Sending/receiving an email with a 1.3MB DOCX attachment	15.6	3.6	-333.33%
Sending/receiving an email with a 1.3MB XLSX attachment	26.6	10.2	-160.78%
Sending/receiving an email with a 4.4MB PPTX attachment	16.7	4.1	-307.32%
Saving a 25MB JPG attachment to cloud storage	2.9	10.4	72.12%
Uploading a 25MB JPG attachment to email	2.0	6.6	69.70%
Receiving a calendar invitation	5.3	1.9	-178.95%
Uploading a 10MB PDF attachment to calendar invite	2.3	2.6	11.54%
Previewing a 10MB PDF attachment from calendar invite	1.3	1.9	31.58%

Testing on Windows 10			
Google Chrome	Gmail	Outlook Online	Percentage difference
Opening a cloud-hosted 1.3MB document from share link	2.0	4.0	50.00%
Opening a cloud-hosted 1.3MB spreadsheet from share link	5.3	3.6	-47.22%
Opening a cloud-hosted 4.4MB presentation from share link	2.7	3.1	12.90%
Sending/receiving an email with a 1.3MB DOCX attachment	15.0	2.5	-500.00%
Sending/receiving an email with a 1.3MB XLSX attachment	26.4	9.1	-190.11%
Sending/receiving an email with a 4.4MB PPTX attachment	16.1	3.7	-335.14%
Saving a 25MB JPG attachment to cloud storage	2.9	16.4	82.32%
Uploading a 25MB JPG attachment to email	2.5	6.0	58.33%
Receiving a calendar invitation	5.7	1.9	-200.00%
Uploading a 10MB PDF attachment to calendar invite	2.9	2.5	-16.00%
Previewing a 10MB PDF attachment from calendar invite	1.2	4.3	72.09%

Testing on Windows 10			
Microsoft Edge	Gmail	Outlook Online	Percentage difference
Opening a cloud-hosted 1.3MB document from share link	3.2	5.0	36.00%
Opening a cloud-hosted 1.3MB spreadsheet from share link	6.2	4.4	-40.91%
Opening a cloud-hosted 4.4MB presentation from share link	3.6	4.4	18.18%
Sending/receiving an email with a 1.3MB DOCX attachment	15.9	2.6	-511.54%
Sending/receiving an email with a 1.3MB XLSX attachment	26.4	7.2	-266.67%
Sending/receiving an email with a 4.4MB PPTX attachment	16.9	3.9	-333.33%
Saving a 25MB JPG attachment to cloud storage	2.8	19.7	85.79%
Uploading a 25MB JPG attachment to email	2.2	10.0	78.00%
Receiving a calendar invitation	5.4	2.1	-157.14%
Uploading a 10MB PDF attachment to calendar invite	2.3	2.9	20.69%
Previewing a 10MB PDF attachment from calendar invite	1.0	4.0	75.00%

Testing on mobile			
iOS native applications	Gmail	Outlook Online	Percentage difference
Previewing a 1.3MB DOCX	2.2	1.9	-15.79%
Previewing a 1.3MB XLSX	5.8	5.6	-3.57%
Previewing a 4.4MB PPTX	2.0	2.2	9.09%
Previewing a 25MB JPG	4.8	4.7	-2.13%
Receiving a calendar invitation	10.1	4.6	-119.57%
Previewing a 10MB PDF attachment to calendar invite	2.5	2.8	10.71%
Android™ native applications	Gmail	Outlook Online	Percentage difference
Previewing a 1.3MB DOCX	4.7	4.3	-9.30%
Previewing a 1.3MB XLSX	4.7	3.7	-27.03%
Previewing a 4.4MB PPTX	4.4	3.9	-12.82%
Previewing a 25MB JPG	4.4	4.4	0.00%
Receiving a calendar invitation	151.8	34.9	-334.96%
Previewing a 10MB PDF attachment to calendar invite	2.5	3.4	26.47%

# 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
Operating system		
Vendor	Apple	Microsoft
Name	macOS Mojave	Windows 10
Build number or version	10.13.6	1809

System	Apple MacBook Pro® 2017	Dell™ XPS™ 13 9370
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
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

System	Apple iPhone X 64GB	Google Pixel 2
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

# How we tested

## 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. We connected the devices 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)

- SampleDOCX.DOCX - 1.3 MB
- SamplePPTX.PPTX - 4.4 MB
- SampleXLSX.XLSX - 1 MB
- SampleJPG.JPG - 25 MB
- SamplePDF.PDF - 10 MB

## 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.
- Before testing started, we logged in all test devices to all relevant services.
- For the mobile device tests, we opened cloud-hosted files in their respective mobile 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 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.
- Before beginning tests that required opening a cloud-hosted document, presentation, or spreadsheet via share link or previewing an attachment, we sent an email containing the share link or attachment to the target device.
- We performed all mobile tests with no other applications running in memory and we closed all applications between test runs. On mobile devices, we enabled push notifications for all relevant apps.

## Running the Windows and macOS tests

### Opening a cloud-hosted document, spreadsheet, or presentation from emailed share link in online editor

1. Open a browser window, and navigate to Gmail or Outlook Online.
2. Prepare the stopwatch.
3. Navigate to the email containing the share link for the document under test.
4. Simultaneously start the stopwatch and click the share link to open the document in its respective online editor.
5. When the document has loaded and is editable, stop the stopwatch.
6. Record the result.

### Receiving an email with attachment

1. Open a browser window, and navigate to Gmail or Outlook Online on Laptop 1.
2. Repeat on Laptop 2.
3. Compose a new email on Laptop 1:
  - a. In Gmail, click Compose.
  - b. In Outlook Online, click New.
4. Attach the appropriate file to the email:
  - a. In Gmail, click Attach files, navigate to and select the correct file, and click Open.
  - b. In Outlook Online, click Attach, click Computer, navigate to and select the correct file, and click Open.
5. Enter the email address of the user logged into Laptop 2 in the To field, and enter a subject line.
6. Prepare the stopwatch.
7. Simultaneously start the stopwatch and click Send.
8. When the email appears in the inbox on Laptop 2, stop the stopwatch.
9. Record the result.

### Uploading a 25MB JPG image as an attachment

1. Open a browser window, and navigate to Gmail or Outlook Online.
2. Compose a new email:
  - a. In Gmail, click Compose.
  - b. In Outlook Online, click New.
3. Prepare the stopwatch.
4. Attach the 25MB JPG image to the email:
  - a. In Gmail, click Attach Files, and navigate to and select the correct file.
    - i. Do not click Open yet.
  - b. In Outlook Online, click Attach, click Computer, and navigate to and select the correct file.
    - i. Do not click Open yet.
5. Simultaneously start the stopwatch and click Open.
6. When the progress bar underneath the attachment icon is full and the attachment has fully uploaded, stop the stopwatch.
7. Record the result.

### Saving a 25MB JPG image to cloud storage

1. Open a browser window, and navigate to Gmail or Outlook Online.
2. Prepare the stopwatch.
3. Navigate to the email containing the 25MB JPG attachment.
4. Simultaneously start the stopwatch and click the link to save the attachment to its respective cloud storage:
  - a. In Gmail, click Save to Drive on the attachment thumbnail.
  - b. In Outlook Online, click Save to OneDrive link beneath the attachment thumbnail.
5. When the image has been successfully saved to cloud storage, stop the stopwatch:
  - a. In Gmail, the "Save to Drive" icon stops animating and a dialogue appears confirming it has successfully been saved to Google Drive.
  - b. In Outlook Online, the icon stops animating and the "Save to OneDrive" link text changes to "Saved to Attachments".
6. Record the result.

## Receiving a calendar invitation

1. Open a browser window, and navigate to Gmail or Outlook Online on Laptop 1.
2. Repeat on Laptop 2.
3. Create a new calendar invite on Laptop 1:
  - a. In Gmail, navigate to Google Calendar, click Create, and click More Options.
  - b. In Outlook Online, click the drop down arrow next to New, and select Calendar event.
4. Fill out the calendar invite title and time and add the email address of the user logged into Laptop 2 under Guests (Google Calendar) or People (Outlook Online).
5. Prepare the stopwatch.
6. Send the invitation:
  - a. In Google Calendar, click Save.
  - b. When prompted, simultaneously start the stopwatch and click Send when prompted "Would you like to send invitation emails to Google Calendar guests?"
  - c. In Outlook Online, simultaneously start the stopwatch and click Send.
7. When the email calendar invite appears in the inbox on Laptop 2, stop the stopwatch.
8. Record the result.

## Uploading a 10MB PDF attachment to a calendar invite

1. Open a browser window, and navigate to Google Calendar or Outlook Online.
2. Create a new calendar invite on Laptop 1:
  - a. In Google Calendar, click Create, and click More Options.
  - b. In Outlook Online, click the drop down arrow next to New, and select Calendar Event.
3. Prepare the stopwatch and the PDF file you are attaching:
  - a. In Google Calendar, click the Add Attachment icon, click Upload and Select Files from your computer, select the correct PDF file, and click Open.
  - b. In Outlook Online, click Attach, click Computer, and select the correct PDF file.
4. Simultaneously start the stopwatch and upload the attachment:
  - a. In Google Calendar, click Upload.
  - b. In Outlook Online, click Open.
5. When the upload progress bar indicates that the attachment has been fully uploaded, stop the stopwatch.
6. Record the result.

## Previewing a 10MB PDF attachment to a calendar invite

1. Open a browser window, and navigate to Gmail or Outlook Online.
2. Click the email containing the calendar invite.
3. Prepare the stopwatch.
4. Simultaneously start the stopwatch and click the PDF attachment in the invite.
5. When the PDF preview screen has fully loaded and displays the PDF, stop the stopwatch.
6. Record the result.

## Running tests on iOS/Android apps

### Previewing an email or calendar invite attachment in the mobile app

1. Open the Gmail or Outlook mobile app under test.
2. Prepare the stopwatch.
3. Navigate to the email or calendar invite containing the attachment.
4. Simultaneously start the stopwatch and click the attachment to open it in a preview window.
5. When the attachment preview has fully loaded, stop the stopwatch.
6. Record the result.

### Receiving a calendar invitation

1. Open the Google Calendar or Outlook mobile app under test on Smartphone 1 and ensure Smartphone 2 is powered on.
2. Create a new calendar invite on Smartphone 1:
  - a. In Google Calendar, click the plus icon in the bottom right, and click Event to create a new calendar event.
  - b. In Outlook, click the calendar icon in the bottom right, and click the plus icon in the top right to create a new calendar event.
3. Fill out the calendar invite title and time and add the email address of the user logged into Smartphone 2 under Add Guests (Google Calendar) or People (Outlook).

4. Prepare the stopwatch.
5. Send the invite:
  - a. In Google Calendar on iOS, simultaneously start the stopwatch and click Save.
  - b. In Google Calendar on Android, click Save, and simultaneously start the stopwatch and click Send.
  - c. In Outlook on both iOS and Android, simultaneously start the stopwatch and click the checkmark icon in the top right.
6. When the email calendar invite push notification appears on Smartphone 2, stop the stopwatch.
7. Record the result.

Read the report at <http://facts.pt/uwsgu0> ►

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