

**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION**

WSOU INVESTMENTS, LLC d/b/a
BRAZOS LICENSING AND
DEVELOPMENT,

Plaintiff,

v.

GOOGLE LLC,

Defendant.

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CIVIL ACTION NO. 6:20-cv-578

JURY TRIAL DEMANDED

ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff WSOU Investments, LLC d/b/a Brazos Licensing and Development (“Brazos” or “Plaintiff”), by and through its attorneys, files this Complaint for Patent Infringement against Google LLC (“Google”) and alleges:

NATURE OF THE ACTION

1. This is a civil action for patent infringement arising under the Patent Laws of the United States, 35 U.S.C. §§ 1, *et seq.*, including §§ 271, 281, 284, and 285.

THE PARTIES

2. Brazos is a limited liability corporation organized and existing under the laws of Delaware, with its principal place of business at 605 Austin Avenue, Suite 6, Waco, Texas 76701.

3. On information and belief, Google is a Delaware corporation with a physical address at 500 West 2nd Street, Austin, Texas 78701.

JURISDICTION AND VENUE

4. This is an action for patent infringement which arises under the Patent Laws of the United States, in particular, 35 U.S.C. §§ 271, 281, 284, and 285.

5. This Court has jurisdiction over the subject matter of this action under 28 U.S.C. §§ 1331 and 1338(a).

6. This Court has specific and general personal jurisdiction over the defendant pursuant to due process and/or the Texas Long Arm Statute, because the defendant has committed acts giving rise to this action within Texas and within this judicial district. The Court's exercise of jurisdiction over the defendant would not offend traditional notions of fair play and substantial justice because the defendant has established minimum contacts with the forum. For example, on information and belief, the defendant has committed acts of infringement in this judicial district, by among other things, selling and offering for sale products that infringe the asserted patent, directly or through intermediaries, as alleged herein.

7. Venue is proper in this Court pursuant to 28 U.S.C. §§ 1391 and 1400(b). Google is registered to do business in Texas. Google has offices in this District, has transacted business in this District, and has committed acts of direct and indirect infringement in this District. Google also has a regular and established place of business in this District, as set forth below.

8. Since 2007, Google has employed "hundreds" of employees in this District in Austin, Texas.¹ As of August 2018, Google had more than 800 employees in Austin.² By June of 2019, Google had more than 1,100 employees in Austin.³ In January 2019, it was reported that Google "signed a lease for an entire 35-story tower that has started construction just east of the Central Library in downtown Austin."⁴ Google's 35-story tower in Austin "will have 790,000

¹ According to Gerardo Interiano, Google's public affairs and government relations manager, in a statement. See <http://www.statesman.com/business/google-lease-200-000-square-feet-new-downtown-austin-tower/SANZSa3du8QQ4k8ytOC2rJ/>

² See <https://www.statesman.com/news/20190131/source-google-to-occupy-35-story-office-tower-in-downtown-austin>

³ See <https://www.bizjournals.com/austin/news/2019/06/14/google-confirms-austin-expansion-will-begin-moving.html>

⁴ *Id.*

square feet of space, enough to potentially house about 5,000 people.”⁵



Source: <https://www.statesman.com/news/20190131/source-google-to-occupy-35-story-office-tower-in-downtown-austin>

9. Articles report that Google’s office in Austin would “would certainly be one of its most expansive offices in North America.”⁶

10. Google has 300,000 square feet of office space in Austin, Texas, at 500 West 2nd Street.⁷ Google also has offices on North MoPac Expressway,⁸ University Park, and Austin’s Children Museum.⁹

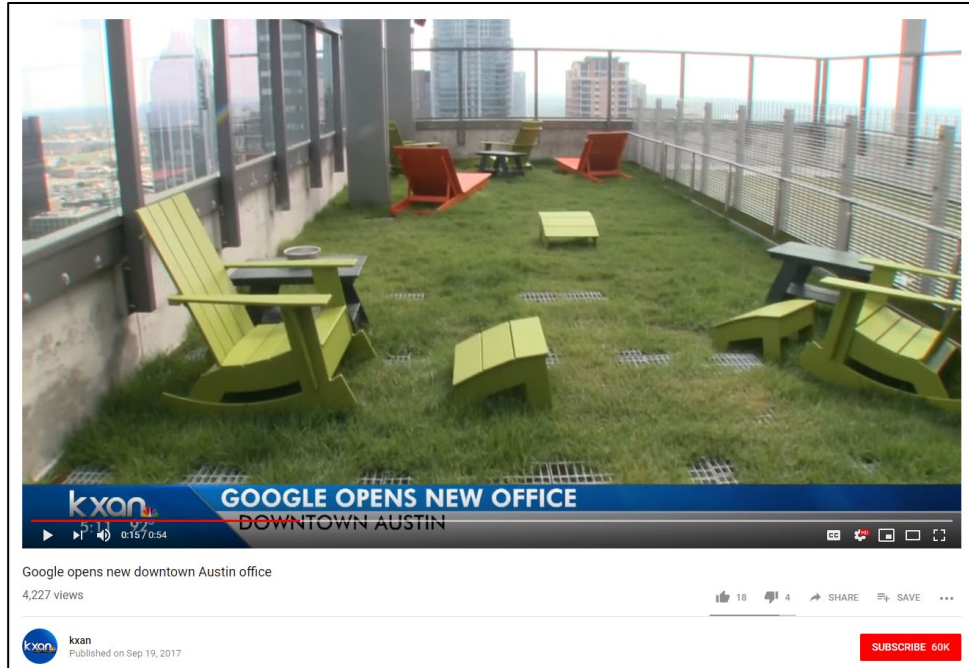
⁵ *Id.*

⁶ See <https://9to5google.com/2019/01/31/google-signs-lease-austin-campus/>

⁷ See <https://www.bizjournals.com/austin/news/2020/02/27/google-to-invest-10b-in-offices-and-data-centers.html>

⁸ See <https://www.google.com/intl/en/about/locations/?region=north-america>

⁹ See <http://www.statesman.com/business/google-lease-200-000-square-feet-new-downtown-austin-tower/SANZSa3du8QQ4k8ytOC2rJ/>



Source: <https://www.youtube.com/watch?v=RKA1RJYGOYQ>



Source: <https://www.bizjournals.com/austin/news/2019/10/28/inside-austins-coolest-offices.html#g/419929/15>

11. Google has, as of June 2020, fifty (50) job postings for Austin, TX.¹⁰

12. Google's taxed appraised property values in Travis County (Austin) are approximately \$1 billion.¹¹ Google's taxed appraised property values in McLennan County (Waco) are approximately \$75,000.¹² Google's taxed appraised property values in Bexar County (San Antonio) are approximately \$50 million.¹³ Google's taxed appraised property values in El Paso are approximately \$258,000.¹⁴

13. Operationally, Google is a multinational technology company that collects, stores, organizes, and distributes data. In addition to its service model for distribution of data (e.g., movies, search results, maps, music, etc.), Google has an expansive regime that gathers data on residents of this District through the hardware devices it sells (e.g., phones, tablets, and home audio devices) and, also, through the operating systems and apps it provides. As an example, Google gathers data when a resident runs its operating systems and apps (e.g., location services).¹⁵ As another example, Google gathers data when a resident interacts with Google's plethora of services such as search, email, and music and movie streaming. See <https://safety.google/privacy/data/> (indicating that Google gathers data from "things you search for," "Videos you watch," "Ads you view or click," "Your location," "Websites you visit," and "Apps, browsers, and devices you use to access Google services"). As yet another example, Google gathers data by listening and recording everything a resident says within proximity of one of its products, such as Google

¹⁰

<https://careers.google.com/jobs/results/?company=Google&company=YouTube&hl=en&jlo=en-US&location=Austin,%20TX,%20USA>

¹¹ See <http://propaccess.traviscad.org>

¹² See https://propaccess.trueautomation.com/clientdb/Property.aspx?cid=20&prop_id=378970

¹³ See https://bexar.acttax.com/act_webdev/bexar/showdetail2.jsp?can=000001265355,

¹⁴ See <http://www.epcad.org/Search?Keywords=GOOGLE+INC&Year=2019>

¹⁵ See e.g., "AP Exclusive: Google tracks your movements, like it or not,"

<https://apnews.com/828aefab64d4411bac257a07c1af0ecb/AP-Exclusive:-Google-tracks-your-movements,-like-it-or-not>

Home.¹⁶ Others have reported that Google gathers “where you’ve been,” “everything you’ve ever searched – and deleted,” “all the apps you use,” “all of your YouTube history,” “which events you attended, and when,” “information you deleted [on your computer],” “your workout routine,” “years’ worth of photos,” and “every email you ever sent.”¹⁷

14. Google takes these massive amounts of gathered data on residents of this District and monetizes them, for example, through targeted advertising. Some have reported that “creepy” advertisements for items never searched for, but only spoken out loud, appeared. *See e.g.*, <https://www.youtube.com/watch?v=zBnDWSvaQ1I> (conducting test on the term “dog toys” spoken out loud, but never searched; tester claims targeted “dog toy” advertisements only appeared after speaking the phrase out loud).

15. In addition to extensive data gathering of information on residents of this District, Google has a substantial presence in the District directly through the products and services Google provides residents of this District (some of which also gather data).¹⁸ One of Google’s main businesses in this District is delivering information, including digital content such as movies, music, apps, and advertising.

16. Google describes itself as an “information company.”¹⁹ Its vision is “to provide

¹⁶ *See* <https://www.unilad.co.uk/technology/google-is-listening-to-everything-we-say-and-you-can-hear-it-back/> (“Tech giant and the font of all pub quiz knowledge, Google, can quietly record many of the conversations that people have in close proximity to its products.”).

¹⁷ *See* <https://www.theguardian.com/commentisfree/2018/mar/28/all-the-data-facebook-google-has-on-you-privacy>.

¹⁸ Non-limiting examples include Google Search, Maps, Translate, Chrome Browser, YouTube, YouTube TV, Google Play Music, Chromecast, Google Play Movies and TV, Android Phones, Android Wear, Chromebooks, Android Auto, Gmail, Google Allo, Google Duo, Google+, Google Photos, Google Contacts, Google Calendar, Google Keep, Google Docs, Google Sheets, Google Slides, Google Drive, Google Voice, Google Assistant, Android operating system, Project Fi Wireless phone systems, Google Pixel, Google Home, Google Wifi, Daydream View, Chromecast Ultra.

¹⁹ *See* “This Year’s Founder’s Letter” by Alphabet CEO, Sundar Pichai, <https://blog.google/inside-google/alphabet/this-years-founders-letter/>.

access to the world’s information in one click,” and its mission is “to organize the world’s information and make it universally accessible and useful.”²⁰ Making information available to people wherever they are and as quickly as possible is critical to Google’s business.

Google Global Cache (GGC)

17. As Google’s CEO, Sundar Pichai, explains, “We want to make sure that no matter who you are or where you are or how advanced the device you are using—Google works for you.”²¹ To meet this goal, Google developed a content delivery network that it calls the Edge Network.

18. One non-limiting example of physical presence in this District is Google’s Edge Network. Google provides web-based services, such as YouTube, YouTube TV, and Google Play, to users throughout the world. These services are in high demand. Google reports that Google Play reaches more than 1 billion Android users and that YouTube serves over 1.8 billion users per month.²² Studies show that YouTube alone is responsible for approximately 20% of all internet traffic.²³ YouTube TV, which has been described as an “add-on to YouTube” allows Google to essentially become the local TV provider for residents of this District. For example, residents in this District obtain local Waco-Temple-Bryan area channels such as KXXV, ABC (Channel 25); KBTX, CBS (Channel 3) or KWTX, CBS (Channel 10); KCEN NBC (Channel 5); and KCEN, Fox (Channel 6).²⁴ To verify a resident should receive such local channels, Google verifies a location of such resident.

²⁰ See <http://panmore.com/google-vision-statement-mission-statement>.

²¹ See e.g., <http://time.com/4311233/google-ceo-sundar-pichai-letter/>.

²² See <https://www.theverge.com/2018/5/3/17317274/youtube-1-8-billion-logged-in-monthly-users-brandcast-2018>

²³ See <https://www.sandvine.com/hubfs/downloads/archive/2016-global-internet-phenomena-report-latin-america-and-north-america.pdf> and <http://testinternetspeed.org/blog/half-of-all-internet-traffic-goes-to-netflix-and-youtube/>

²⁴ See, e.g. <https://thestreamable.com/markets/waco-temple-bryan-tx>.

19. Google's Edge Network, itself, has three elements: Core Data Centers, Edge Points of Presence, and Edge Nodes. The Core Data Centers (there are eight in the United States) are used for computation and backend storage. Edge Points of Presence are the middle tier of the Edge Network and connect the Data Centers to the internet. Edge Nodes are the layer of the network closest to users. Popular content, including YouTube TV, YouTube, video advertising, music, mobile apps, and other digital content from the Google Play store, is cached on the Edge Nodes, which Google refers to as Google Global Cache or "GGC."

20. Google Global Cache is recognized as "one of Google's most important pieces of infrastructure,"²⁵ and Google uses it to conduct the business of providing access to the world's information. GGC servers in the Edge Nodes function as local data warehouses, much like a shoe manufacturer might have warehouses around the country. Instead of requiring people to obtain information from distant Core Data Centers, which would introduce delay, Google stores information in the local GGC servers to provide quick access to the data.

21. Caching and localization are vital for Google's optimization of network resources. Because hosting all content everywhere is inefficient, it makes sense to cache popular content and serve it locally. Doing so brings delivery costs down for Google, network operators, and internet service providers. Storing content locally also allows it to be delivered more quickly, which improves user experience. Serving content from the edge of the network closer to the user improves performance and user happiness. To achieve these benefits, Google has placed Edge Nodes throughout the United States, including in this District. Google describes these nodes as the workhorses of video delivery.

22. Just like brick-and-mortar stores, Google's GGC servers independently determine

²⁵ See <http://blog.speedchecker.xyz/2015/11/30/demystifying-google-global-cache/>.

what content to cache based on local requests. The GGC servers in Google’s Edge Nodes include software that Google refers to as “µstreamer.” µstreamer is responsible for serving video content from YouTube and other Google services, along with other large content such as Google Play applications and Chrome downloads. It operates on a content-delivery platform at the edge of Google’s network called “bandaid”; it does not run in the core (except for some internal testing purposes), unlike the majority of the Google services, such as search or gmail.

23. Using µstreamer and bandaid, a GGC server handles requests directly from its clients, predominantly YouTube’s video players. When such a request is received, if the content is stored in the node’s local cache, the node will serve it to the end user, improving the user experience and saving bandwidth. If cache-eligible content is not already stored on the node, and the content is cache-eligible, the node will retrieve it from Google, serve it to the user, and store it for future requests.

24. µstreamer is largely autonomous, in the sense that almost all decisions related to serving a particular request are made locally, without coordinating with other servers. Like a brick-and-mortar store sells directly to customers from inventory and stocks that inventory based on local customer demand, µstreamer in each GGC node decides—independently from other nodes in Google’s Edge Network— whether to serve requested content, whether to cache content, and whether to send requests to other servers.

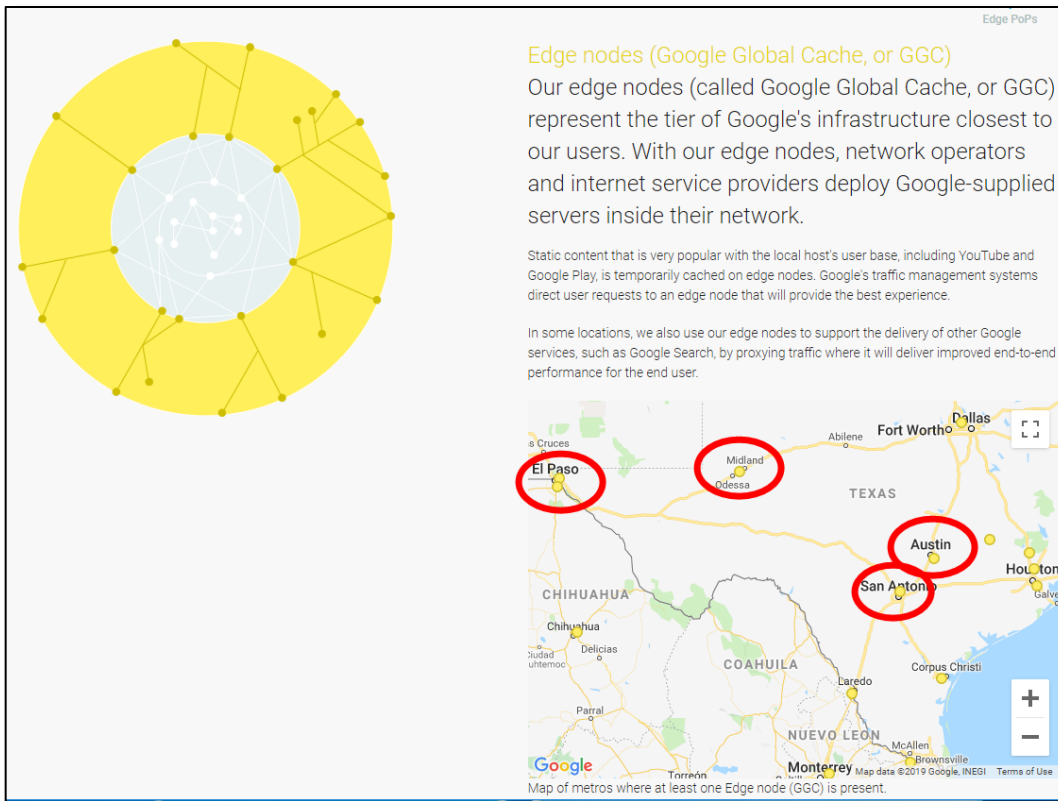
25. Google’s GGC servers are housed in spaces in the District leased by Google. Google’s GGC servers are housed in spaces leased by Google from Internet Service Providers (ISPs) whose networks have substantial traffic to Google and are interested in saving bandwidth. Hosting Google servers allows ISPs to save both bandwidth and costs, as they do not incur the expense of carrying traffic across their peering and/or transit links.

26. When an ISP agrees to host a GGC server, the parties enter into a Global Cache Service Agreement, under which Google provides:

- hardware and software—including GGC servers and software—to be housed in the host’s facilities;
- technical support; service management of the hardware and software; and
- content distribution services, including content caching and video streaming.

In exchange, the host provides, among other things, a physical building, rack space where Google’s computer hardware is mounted, power, and network interfaces. All ownership rights, title, and intellectual property rights in and to the equipment (i.e., the hardware and software provided by Google) remain with Google and/or its licensors.

27. 27. Multiple ISP hosted GGC servers are in this District. Google’s website identifies Midland, El Paso, Austin, and San Antonio as GGC server locations. Each of these cities is located in this District.



Source: <https://peering.google.com/#/infrastructure>

28. The Office of Telecommunications Services for the University of Texas, for example, is an ISP that hosts two GGC servers in Austin, Texas.²⁶

29. Google caches content on the GGC servers located in this District.

30. Google's GGC servers located in this District cache content that includes, among other things: (i) video advertising; (ii) apps; and (iii) digital content from the Google Play store.

31. Google's GGC servers located in this District deliver cached content for the items in the preceding paragraph to residents in this District.

32. Google generates revenue (i) by delivering video advertising, (ii) from apps, and (iii) from digital content in the Google Play store.

²⁶ See <https://it.utexas.edu/ots-caching-and-peering>

33. Google treats its GGC servers in this District the same as it treats all of its other GGC servers in the United States.

34. The photograph below shows an “illustrative picture” of a Google GGC server.


Google Global Cache

Motivation

- Explosion of broadband access and rich, multimedia content continues to drive demand on Internet backbone networks
- This increases the cost of Internet Service Providers (network upgrades, transit costs, etc..)

Google Global Cache

- Allows Large ISP to serve content from the edge of their own network.
- Eases backbone congestion on the service provider’s network well as traffic on peering and transit links
- Saves money and improves users’ experience accessing Google services.
- GGC can be also deployed in IXPs, to server content to participants, locally!



(illustrative picture)

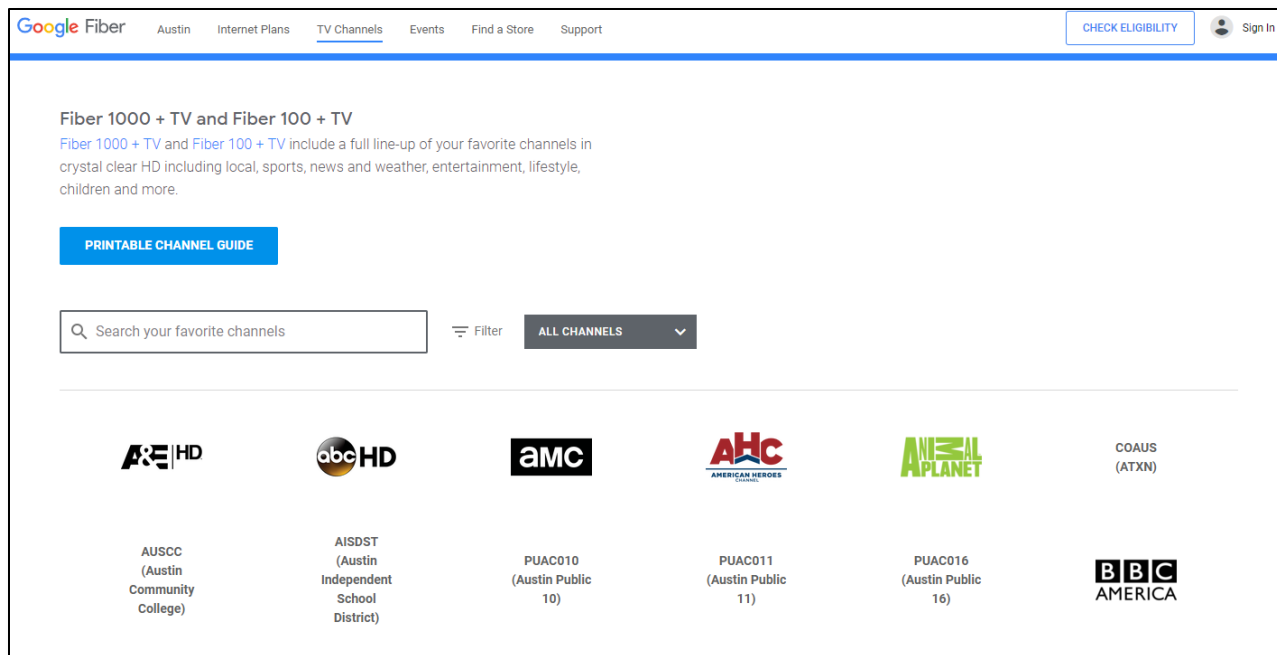
Source: <https://www.wired.com/2010/03/google-traffic/>

35. Google not only exercises exclusive control over the digital aspects of the GGC, Google, but also exercises exclusive control over the physical server and the physical space within which the server is located and maintained.

Google’s Communication Services

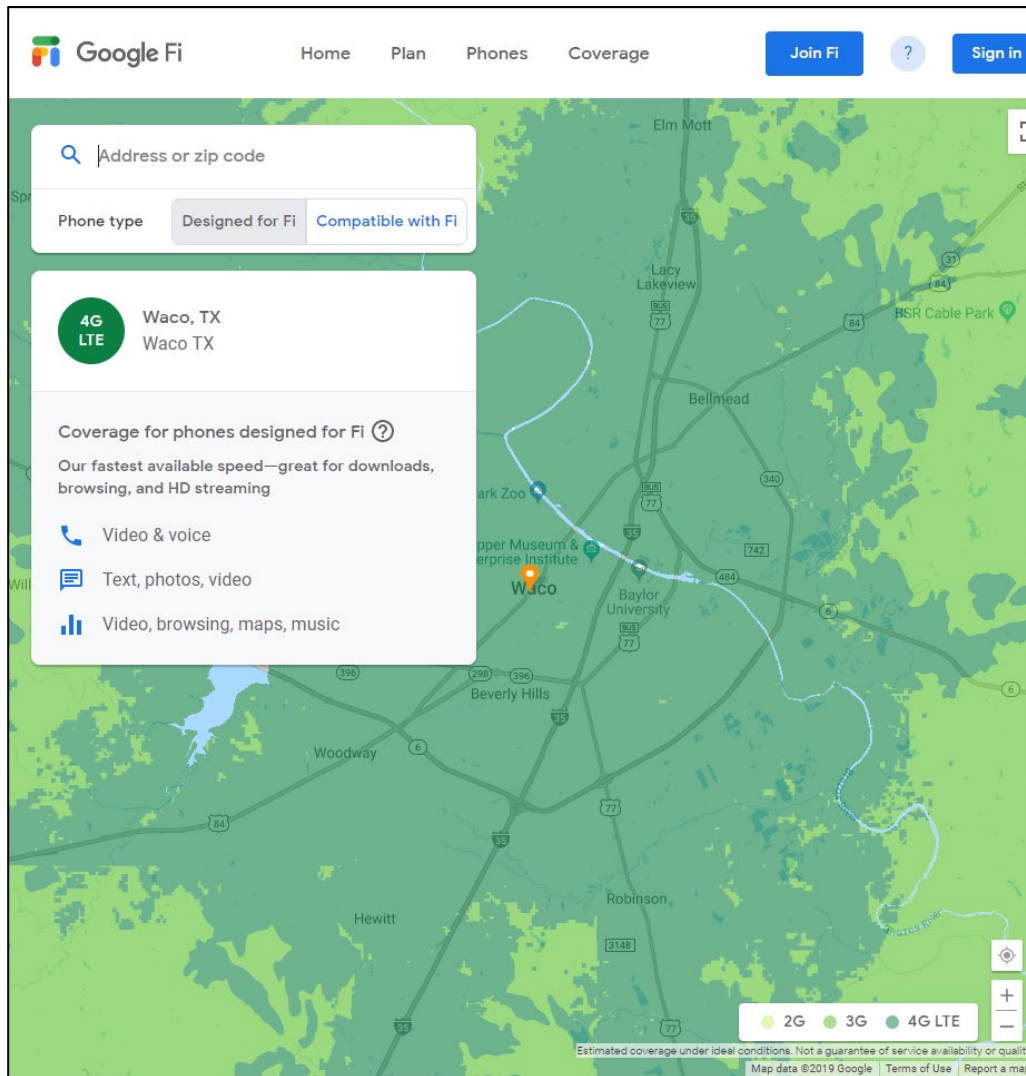
36. Google provides both data and television services to both San Antonio and Austin.²⁷

²⁷ <https://fiber.google.com/ourcities/>



Google’s Cell Phone Service (aka Google Fi)

37. Google also provides phone, messaging, and data services in this District from its wireless phone services called Google Fi. Via the Google Fi service, Google provides its customers voice and high-speed data coverage (4G LTE) for cities such as Waco.



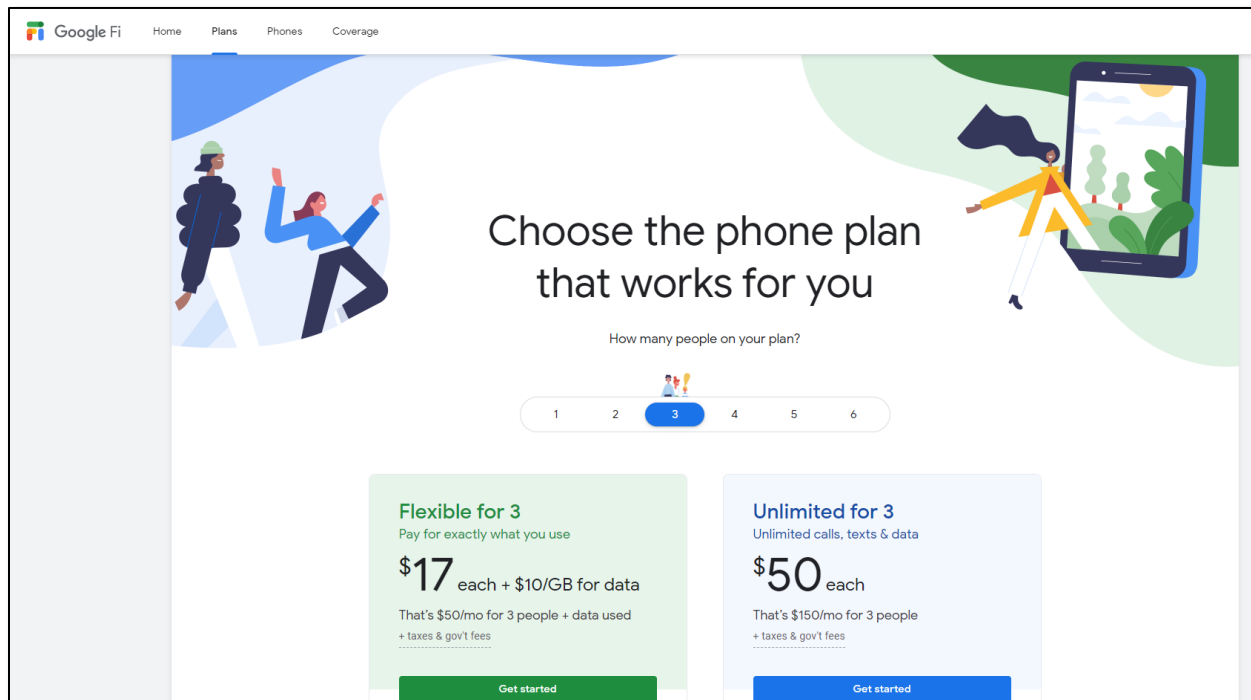
Source: <https://fi.google.com/coverage?q=Waco,%20tx>

38. The cell towers used for Google’s services are fixed geographical locations. They are “regular” and “established” because they operate in a “steady, uniform, orderly, and methodical manner” and are sufficiently permanent. They are “of the defendant” because Google has contractual and/or property rights to use the cell towers to operate its business. Google also ratifies the service locations through its coverage lookup service.

39. With this coverage lookup service, Google advertises its ability to provide cell coverage in this District and its selected cell towers in and near this District to provide the

advertised coverage (e.g., 2G, 3G, or 4GLTE) depending on the location in the District. See <https://fi.google.com/coverage?>. Google is not indifferent to the location of its cell towers. It “established” and “ratified” their geographic placement to achieve specific business purposes.

40. Residents of this District also directly contract with and are billed by Google for these services as their telecommunications provider.



Source: <https://fi.google.com/about/plan>

41. Google also determines which cell tower a particular Google Fi customer will use while within the District.

✓ What determines when Project Fi moves me between cellular networks?

When multiple carriers are available, Project Fi will move you to the network that our analysis shows will be fastest in your current location, whether that is 4G LTE, 3G, or 2G. We’re constantly learning and improving, to account for factors such as newly-built towers or newly-available radio frequencies. And if your current network is providing weak or no coverage, we’ll adjust in real time to find you a stronger connection.

Source: <https://fi.google.com/about/faq/#network-and-coverage-4>

COUNT ONE - INFRINGEMENT OF U.S. PATENT NO. 9,335,825

42. Brazos re-alleges and incorporates by reference the preceding paragraphs of this Complaint.

43. On May 10, 2016, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 9,335,825 (“the ‘825 Patent”), entitled “Gesture control.” A true and correct copy of the ‘825 Patent is attached as Exhibit A to this Complaint.

44. Brazos is the owner of all rights, title, and interest in and to the ‘825 Patent, including the right to assert all causes of action arising under the ‘825 Patent and the right to any remedies for the infringement of the ‘825 Patent.

45. Google makes, uses, sells, offers for sale, imports, and/or distributes in the United States, including within this judicial district, products such as, but not limited to, products that emit electromagnetic waves and measure the responses reflected therefrom from a human body (e.g. a hand) (collectively, the “Accused Products”).

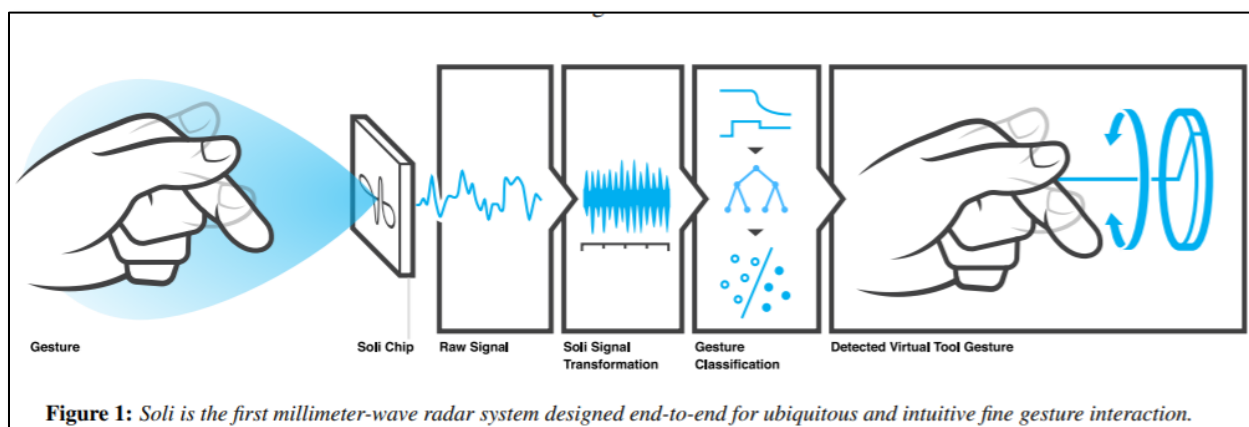
46. The Accused Products support include Google products that use Soli including, but not limited to, Google’s Pixel 4 and Pixel 4XL (collectively “Google Pixel 4”).

47. Google Pixel 4 is a smartphone designed by Google. The Google Pixel 4 ships with a new chip called Soli, which includes a built-in radar designed to allow a user to be able to make hand gestures to control the phone. This chip, along with software, provides a gesture detection functionality for the phone that Google has named Motion Sense.

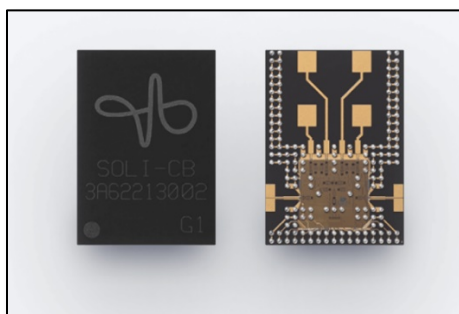
We built Soli from the ground up from an impossible idea: to create a radar small enough to fit into a smart watch. Over the course of five years, we invented, designed and built the Soli radar chip and platform, taking it from early-stage prototypes to a single solid-state component that can be integrated into consumer devices.

Soli will ship in the Google Pixel 4¹ phone after years of iterative design and engineering, working with experts in semiconductor design, signal digital processing, algorithm development, machine learning and interaction design.

Source: <https://atap.google.com/soli/technology/V>

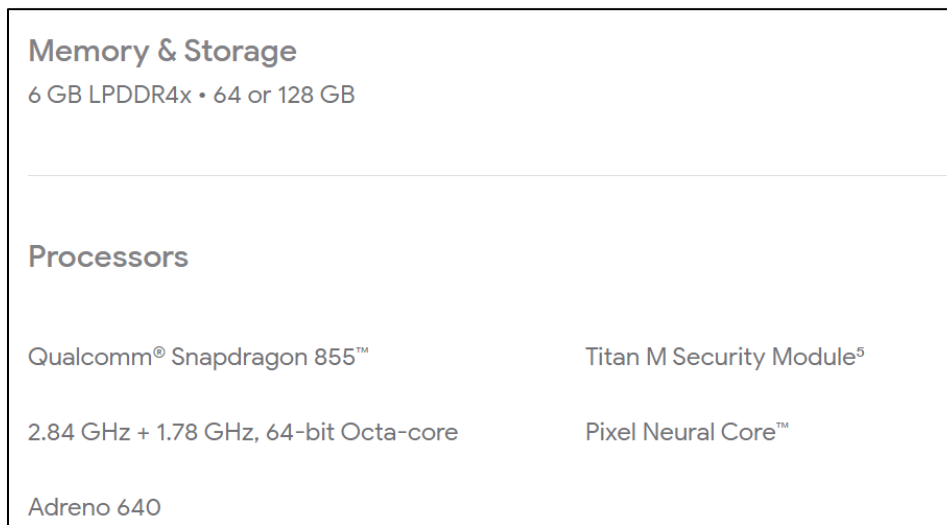


Source: <https://dl.acm.org/doi/pdf/10.1145/2897824.2925953?download=true>



Source: <https://atap.google.com/soli/>

48. The Google Pixel 4 ships with a Qualcomm Snapdragon 855 as the main processor, among other miscellaneous specialized processing chips.



Source: https://store.google.com/us/product/pixel_4_specs

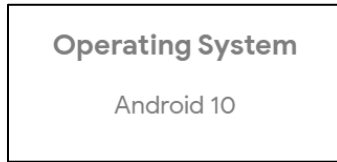
49. The Google Pixel 4 ships with 6 GBs of RAM and either 64 or 128 GB of storage space, depending on the model. Both the RAM and the storage space are used to store and execute computer code with the phone's processor.



Source: https://store.google.com/us/product/pixel_4_specs, Page

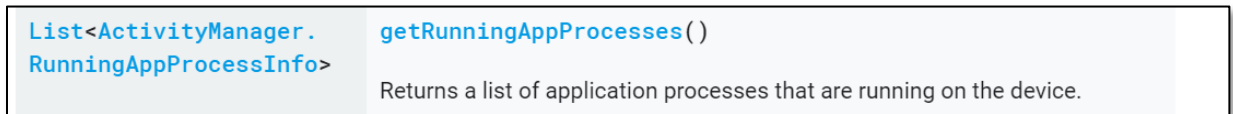
50. The Google Pixel 4 comprises and runs the Android smartphone operating system (OS), which is configured to detect that an application is being started on the apparatus, among other functions.

51. Google Pixel 4 comes installed with the Android 10 operating system. As the operating system, Android is responsible for detecting and keeping track of applications running on the phone.



Source: https://store.google.com/us/magazine/compare_pixel?togglers=pixel_4.

52. An example of the Android OS keeping track of applications running on the phone is the ActivityManager class in the Android API. As part of the Android developer API, the ActivityManager class keeps track of and reports information about running applications on the device. Below is an example of one of the methods provided by the Android OS API's ActivityManager class.



Source: <https://developer.android.com/reference/android/app/ActivityManager>

53. The Soli chip, as a component of the Google Pixel 4, functions as a continuous wave doppler radar. A continuous wave doppler radar is a radar that emits electromagnetic radiation at all times. By measuring the Doppler Shift of the reflected electromagnetic radiation,

the radar can extract information about the motion vector, speed, and rate of acceleration on an object.

Principle of Operation

As opposed to pulsed radar systems, continuous wave (CW) radar systems emit electromagnetic radiation at all times. Conventional CW radar cannot measure range because there is no basis for the measurement of the time delay. Recall that the basic radar system created pulses and used the time interval between transmission and reception to determine the target's range. If the energy is transmitted continuously then this will not be possible.

CW radar can measure the instantaneous rate-of-change in the target's range. This is accomplished by a direct measurement of the *Doppler shift* of the returned signal. The Doppler shift is a change in the frequency of the electromagnetic wave caused by motion of the transmitter, target or both. For example, if the transmitter is moving, the wavelength is reduced by a fraction proportional to the speed it is moving in the direction of propagation. Since the speed of propagation is a constant, the frequency must increase as the wavelength shortens. The net result is an upwards shift in the transmitted frequency, called the Doppler shift.

<https://fas.org/man/dod-101/navy/docs/es310/cwradar/cwradar.htm>

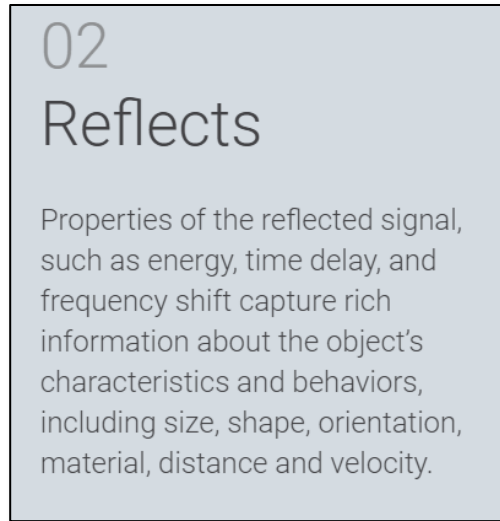
54. The Soli chip constantly emits shortwave radio signals that are reflected at least in part by the human body. The chip measures the temporal and frequency changes of the reflected signal, or the Doppler Shift, to gather information about the environment.

01

Emits

Soli's radar emits electromagnetic waves in a broad beam. Objects, such as a human hand, within the beam scatter this energy, reflecting some portion back towards the radar antenna.

Source: <https://atap.google.com/soli/technology/>



Source: <https://atap.google.com/soli/technology/>

55. When the Android OS determines that a running application has a Motion Sense gesture available to use, a blue glow is displayed at the top of the screen to indicate such, and the radar contained in the Soli chip is confirmed to be on in response to the Motion Sense enabled application being run.

When Motion Sense is on and active:

- You'll sometimes see a light blue glow at the top of the screen. This glow shows you that a quick gesture is available, or that you just used a gesture.

Source: <https://support.google.com/pixelphone/answer/9517454?hl=en>

56. The Soli chip in the Google Pixel 4 contains an antenna array that functions as a radar receiver, that receives radio signals of the same type transmitted by the Soli radar. This radar

receiver is configured to receive the transmitted radio waves reflected by a gesture by the user of the phone.

4.7 3D spatial hand tracking

The novel Soli sensing paradigms described above enable fine finger and gesture tracking in constrained mobile applications. We can easily augment these capabilities with traditional radar spatial positioning to track the hand as a whole without significantly increasing hardware or computational complexity. The Soli sensor uses a 2x2 element receive antenna array and two switched transmitters that allow 2D digital beamforming and 3D localization. Discussion of large scale hand tracking is beyond the scope of the current paper.

Source: <https://dl.acm.org/doi/pdf/10.1145/2897824.2925953?download=true>

01

Emits

Soli's radar emits electromagnetic waves in a broad beam. Objects, such as a human hand, within the beam scatter this energy, reflecting some portion back towards the radar antenna.

Source: <https://atap.google.com/soli/technology/>

02

Reflects

Properties of the reflected signal, such as energy, time delay, and frequency shift capture rich information about the object's characteristics and behaviors, including size, shape, orientation, material, distance and velocity.

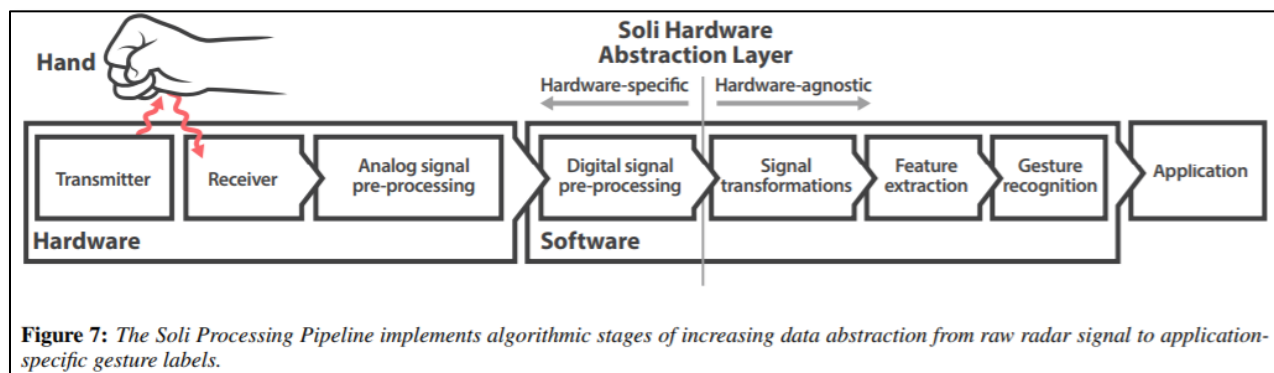
Source: <https://atap.google.com/soli/technology/>

57. The Soli chip in the Google Pixel 4 includes a doppler radar that detects time-varying modulation caused by gestures made by a user of the device. The radar emits radio waves and records temporal (time-varying) variations in the received radar signals. The reflection of the radio waves made by the user's hand gestures causes changes in the properties of radio waves, such as changes in frequency, which are detected by the Soli chip's receiver and recorded. In the figure below is a representation of the Soli chip emitting the radar signal and detecting the reflected radio waves. The Soli chip collects data sets of Doppler values. Gestures are extracted from the obtained data sets.

7 Gesture Recognition with Soli

The fundamental approach to gesture recognition with Soli is to exploit the temporal accuracy of radar. Therefore, we recognize gestures directly from temporal variations in the received radar signal by extracting and recognizing *motion signatures* in the Soli transformations. This is contrary to many existing gesture sensing approaches that are primarily spatial and explicitly estimate a hand pose or skeletal model prior to recognizing gestures [Romero et al. 2013; Keskin et al. 2013]. In addition to exploiting the temporal accuracy of radar, Soli's gesture recognition was designed to (i) maintain the high throughput of the sensor to minimize latency; (ii) exploit advantages of using multiple antennas to maximize SNR and improve recognition accuracy; (iii) provide both discrete and continuous predictions³; (iv) be computationally efficient to work on miniature, low-power devices, e.g. smart watches.

Source: <https://dl.acm.org/doi/pdf/10.1145/2897824.2925953?download=true>



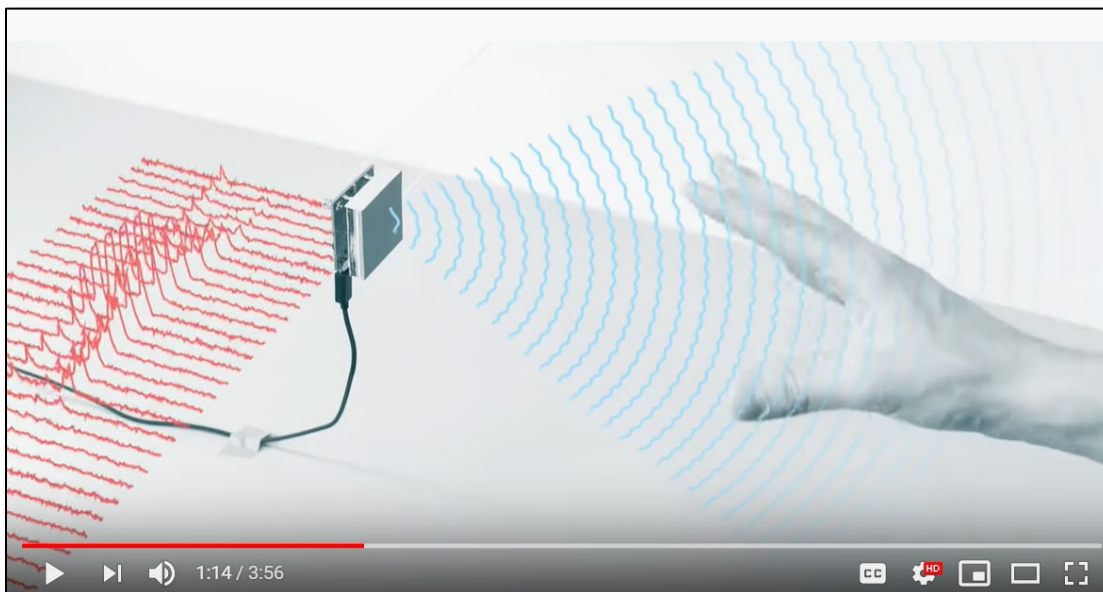
Source: <https://dl.acm.org/doi/pdf/10.1145/2897824.2925953?download=true>

03

Recognizes

By processing the temporal signal variations and other captured characteristics of the signal, Soli can distinguish between complex movements to understand the size, shape, orientation, material, distance and velocity of the object within its field.

Source: <https://atap.google.com/soli/technology/>



Source: <https://www.youtube.com/watch?v=0QNiZfSsPc0>

After the preprocessing stage, a set of signal representations, i.e. *transformations*, are computed using algorithms and techniques described for fast and slow time measurements earlier in the paper. We currently compute I/Q, range-Doppler, range profile, micro-Doppler, fast time spectrogram and three-dimensional spatial profile. These representations provide high-level intuitive insight into the hand's radar response and are *agnostic to specific hardware and modulation schemes*. In other words, any application or algorithm developed on top of these transformations will theoretically work on any radar. Thus these transformations constitute a radar HAL.

Once the transformations are computed, a set of low-dimensional *features* are extracted from the transformation data. The features include, but are not limited to, fine displacement, total measured energy, measured energy from moving scattering centers, scattering center range, velocity centroid, and many others. The design of features that enable robust gesture tracking is a combination of art and science, requiring creative analysis of the data, as well as domain knowledge about the radar and gestures to be captured. Due to the novelty of the current work, we are not aware of any prior art in selection of these features.

Source: <https://dl.acm.org/doi/pdf/10.1145/2897824.2925953?download=true>

The resulting three-dimensional range-Doppler array $RD(r, v, T)$ maps the reflected energy from each scattering center to its range $r_i(T)$ and velocity $v_i(T)$ at time T . The energy return from distinct scattering centers are thus resolvable if *any* of the following criteria are met (see Figure 6 above for examples):

1. their *separation in range* is greater than the range resolution, determined by $\frac{c}{2BW}$,
2. their *difference in velocity* is greater than the Doppler velocity resolution, determined by $\frac{\lambda}{2T_{cp_i}}$, or
3. they are detectable only in *disjoint coherent processing time windows*.

Source: <https://dl.acm.org/doi/pdf/10.1145/2897824.2925953?download=true>

58. The Google Pixel 4 uses a trained machine learning algorithm to classify the data received from the Soli Chip doppler radar as one of the various predetermined user input commands. Based on the application and specific use case, different predetermined gestures may

be detected. For example, many music players are configured to skip a track when the predetermined gesture of a hand swipe is detected.

Skip songs

You can wave across your phone to skip a song, or go back to a song you just played. This gesture works with most music apps, and still works if the app isn't open or your screen is off.

1. Play a song on a music app.
2. To skip to the next song, wave your hand over the phone from left to right.
3. To go back to the last song, wave your hand over the phone from right to left.

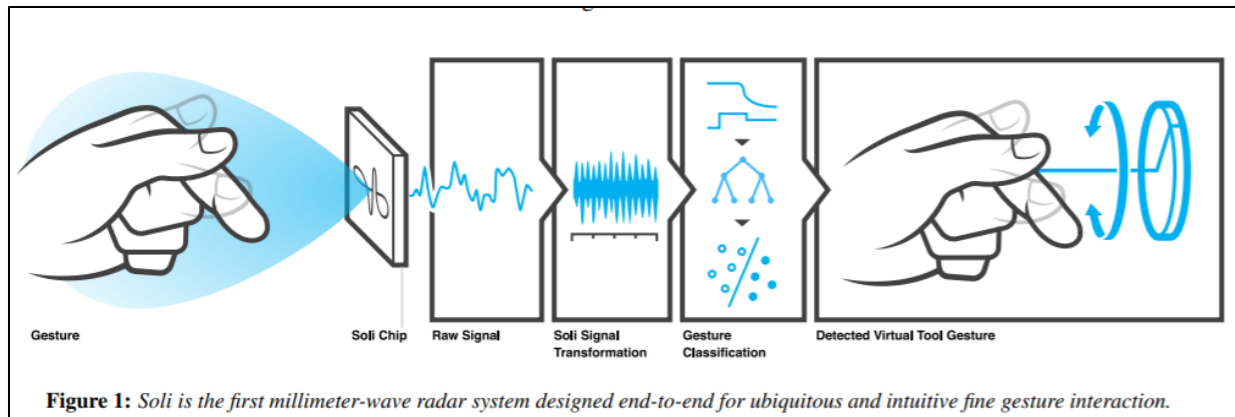
Source: <https://support.google.com/pixelphone/answer/9517454?hl=en>

59. After executing mathematical feature extraction, machine learning classifiers and algorithms are employed to determine which gesture corresponds to the detected radio inputs. The below figures include examples of the specific gestures that can be recognized as user input commands.

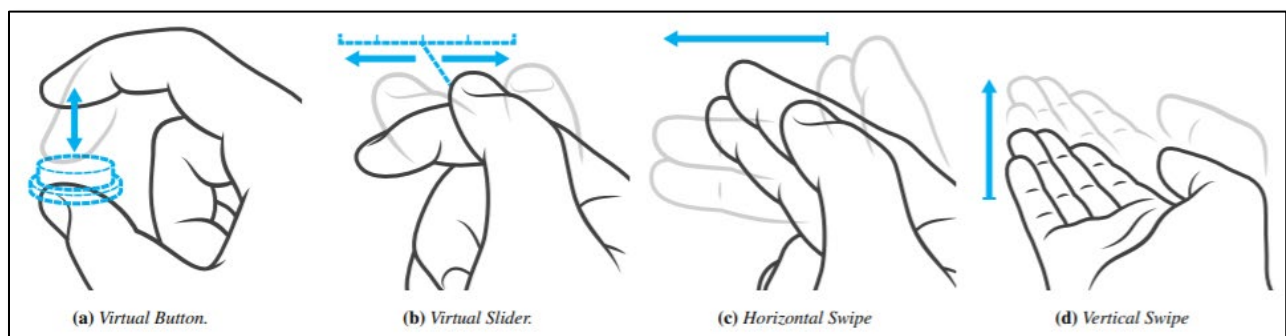
1. *Feature Extraction:* Low-dimensional and gesture-specific features are computed from the transformations;
2. *Gesture Inference:* Gesture recognition is performed using appropriate machine learning classifiers; and
3. *Filtering:* Temporal and contextual filtering is performed to improve the quality of recognition.

We discuss these three blocks of the Soli gesture recognition pipeline in the rest of this section.

Source: <https://dl.acm.org/doi/pdf/10.1145/2897824.2925953?download=true>



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60. After detecting a user gesture via the doppler radar and classifying the gesture via the classification algorithm, the Google Pixel 4 uses the sensed commands as user input. Various applications can make use of the gestures to control functionalities within them. Examples of gestures detected via the Motion Sense radar functionality provided by the Soli chip being used as input to control operations in various applications include “Virtual Button,” “Virtual Slider,” “Horizontal Swipe,” and “Vertical Swipe.”



61. In one application, the phone detects the user “waving” to virtual creatures on the screen as an input, which causes the virtual creatures to wave back. In another, a wave of the hand is detected and interpreted to allow users to skip songs in their music playlists. The below figures

are two frames from a YouTube video that demonstrates the predetermined user input of hand swiping with Motion Sense to skip a music track in the music application running on the phone.

POKÉMON

Wave Hello

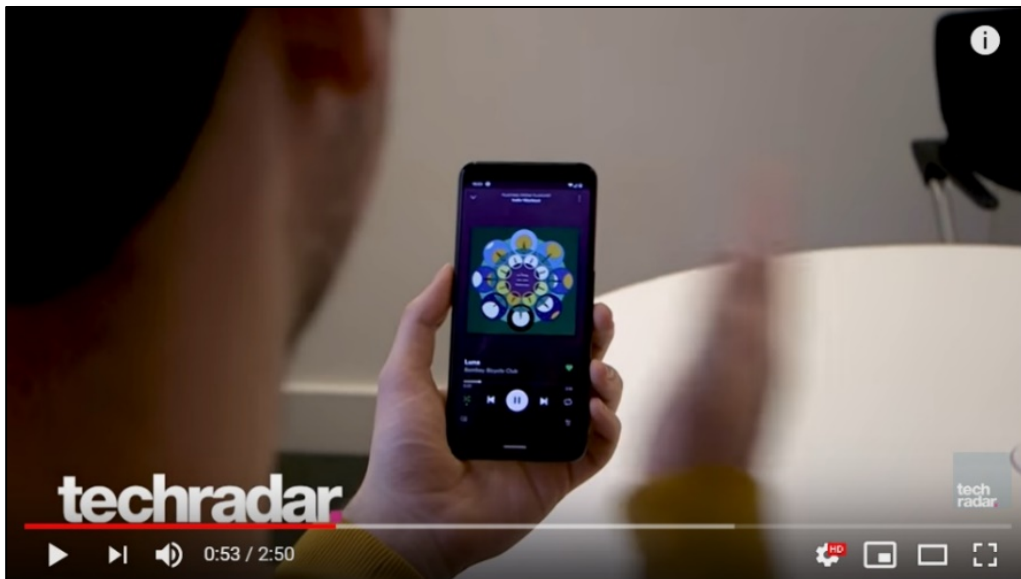
Get to know the newest Pokémon, Grookey, Scorbunny, and Sobble, from Pokémon Sword and Pokémon Shield video games – as well as a few favorites – in a new interactive way with Motion Sense™. Wave above your phone to say hello to Pikachu, reach and pet Eevee, swipe above the phone to fire up Scorbunny, and more. Or have them journey alongside you all day on your Pixel 4's wallpaper!



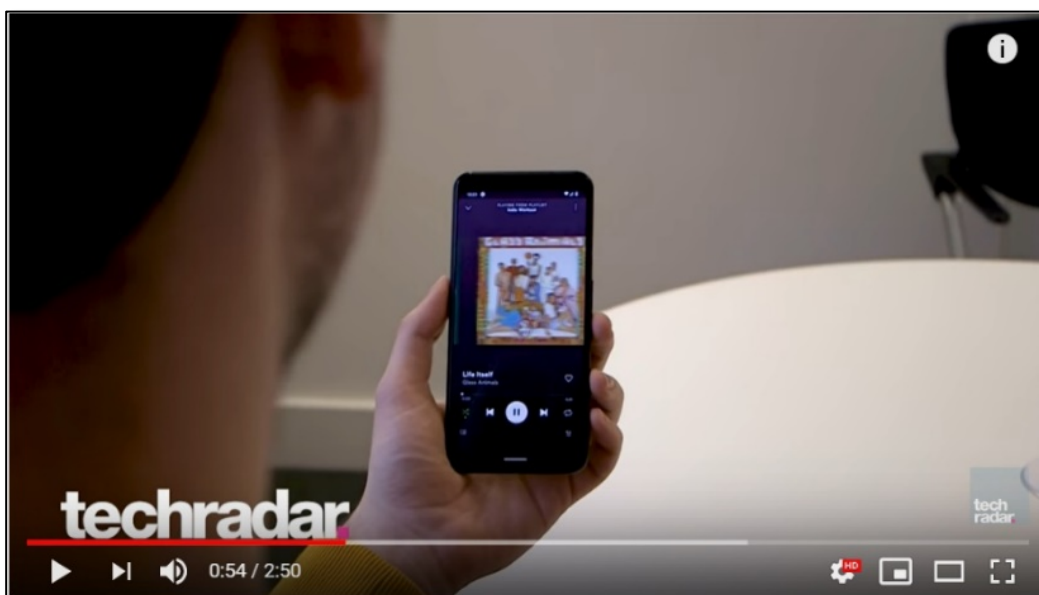
Navigate your music.

With Quick Gestures, a wave of the hand above the screen allows you to skip songs and navigate your music.¹

Source: <https://atap.google.com/soli/>



Source: <https://www.youtube.com/watch?v=dDqH9EstUsA>



Source: <https://www.youtube.com/watch?v=dDqH9EstUsA>

62. In view of preceding paragraphs, each and every element of at least claim 1 of the '825 Patent is found in the Accused Products.

63. Google continues to directly infringe at least one claim of the '825 Patent, literally or under the doctrine of equivalents, by making, using, selling, offering for sale, importing, and/or distributing the Accused Products in the United States, including within this judicial district,

without the authority of Brazos.

64. Google has received notice and actual or constructive knowledge of the '825 Patent since at least the date of service of this Complaint.

65. Since at least the date of service of this Complaint, through its actions, Google has actively induced product makers, distributors, retailers, and/or end users of the Accused Products to infringe the '825 Patent throughout the United States, including within this judicial district, by, among other things, advertising and promoting the use of the Accused Products in various websites, including providing and disseminating product descriptions, operating manuals, and other instructions on how to implement and configure the Accused Products. Examples of such advertising, promoting, and/or instructing include the documents at:

- <https://atap.google.com/soli/>
- <https://atap.google.com/soli/technology/>
- <https://support.google.com/pixelphone/answer/9517454?hl=en>
- <https://dl.acm.org/doi/pdf/10.1145/2897824.2925953?download=true>
- https://store.google.com/us/product/pixel_4_specs
- https://store.google.com/us/product/pixel_4
- https://store.google.com/us/magazine/compare_pixel?toggler1=pixel_4
- <https://developer.android.com/reference/android/app/ActivityManager>
- <https://www.youtube.com/watch?v=0QNiZfSsPc0>
- <https://www.youtube.com/watch?v=dDqH9EstUsA>
- <https://fas.org/man/dod-101/navy/docs/es310/cwradar/cwradar.htm>

66. Since at least the date of service of this Complaint, through its actions, Google has contributed to the infringement of the '825 Patent by having others sell, offer for sale, or use the Accused Products throughout the United States, including within this judicial district, with

knowledge that the Accused Products infringe the '825 Patent. The Accused Products are especially made or adapted for infringing the '825 Patent and have no substantial non-infringing use. For example, in view of the preceding paragraphs, the Accused Products contain functionality which is material to at least one claim of the '825 Patent.

JURY DEMAND

Brazos hereby demands a jury on all issues so triable.

REQUEST FOR RELIEF

WHEREFORE, Brazos respectfully requests that the Court:

(A) Enter judgment that Google infringes one or more claims of the '825 Patent literally and/or under the doctrine of equivalents;

(B) Enter judgment that Google has induced infringement and continue to induce infringement of one or more claims of the '825 Patent;

(C) Enter judgment that Google has contributed to and continue to contribute to the infringement of one or more claims of the '825 Patent;

(D) Award Brazos damages, to be paid by Google in an amount adequate to compensate Brazos for such damages, together with pre-judgment and post-judgment interest for the infringement by Google of the '825 Patent through the date such judgment is entered in accordance with 35 U.S.C. § 284, and increase such award by up to three times the amount found or assessed in accordance with 35 U.S.C. § 284;

(E) Declare this case exceptional pursuant to 35 U.S.C. § 285; and

(F) Award Brazos its costs, disbursements, attorneys' fees, and such further and additional relief as is deemed appropriate by this Court.

Dated: June 29, 2020

Respectfully submitted,

/s/ James L. Etheridge

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