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Chinese multinational technology company Huawei Technologies Co., Ltd.Logo since 2018Headquarters in Shenzhen,Guangdong, ChinaNative name华为技术有限公司Romanized nameHuáwéi jìshù yǒuxiàn gōngsīCompany typePrivateISINHK0000HWEI11IndustryTelecom equipmentNetworking equipmentConsumer electronicsSemiconductorsArtificial intelligenceAutomationCloud computingInternet of thingsFounded15 September 1987; 37 years ago (1987-09-15)FounderRen ZhengfeiHeadquartersShenzhen, ChinaArea servedWorldwide (except India)Key peopleRen Zhengfei (CEO)Liang Hua (chairman)Meng Wanzhou (deputy chairwoman & CFO) He Tingbo (Director)ProductsMobile and fixed broadband networksConsultancy and managed servicesMultimedia technologyCordless phones SmartphonesTablet computersDonglesSmart TVHIMAHarmonyOSEulerOSBrandsHuaweiRevenue CN¥862.1 billion (US$118.1 billion) (2024)[1]Operating income CN¥79.3 billion (US$10.8 billion) (2024)Net income CN¥62.5 billion (US$8.5 billion) (2024)[2]Total assets CN¥1,290.1 billion (US$176.8 billion) (2024)Total equity CN¥544.6 billion (US$74.6 billion) (2024)Number of employees208,000 (2024)[3]ParentHuawei Investment & Holding[4]SubsidiariesCaliopaChinasoft InternationalFutureWei TechnologiesHexaTierHiSiliconWebsitewww.huawei.com Huawei"Huawei" in Simplified (top) and Traditional (bottom) Chinese charactersSimplified Chinese华为Traditional Chinese華為Literal meaning"Splendid Achievement" or "Chinese Achievement"TranscriptionsStandard MandarinHanyu PinyinHuáwéiIPA[xwǎ.wéi] ⓘYue: CantoneseYale RomanizationWàah-wàihJyutpingWaa4-wai4IPA[wɑ.wɛj˩]Southern MinHokkien POJHôa-uîHuawei Technologies Co., Ltd.Simplified Chinese华为技术有限公司Traditional Chinese華為技術有限公司TranscriptionsStandard MandarinHanyu PinyinHuáwéi Jìshù Yǒuxiàn Gōngsī Yue: CantoneseJyutpingwaa4 wai4 gei6 seot6 jau5 haan6 gung1 si1 Huawei Technologies Co., Ltd. ("Huawei" sometimes stylized as "HUAWEI"; /ˈhwɑːweɪ/ HWAH-way; Chinese: 华为; pinyin: Huáwéi) is a Chinese multinational corporation and technology company headquartered in Longgang, Shenzhen, Guangdong. Its main product lines include telecommunications equipment, consumer electronics, electric vehicle autonomous driving systems, and rooftop solar power products. The company was founded in Shenzhen in 1987 by Ren Zhengfei, a veteran officer of the People's Liberation Army (PLA).[5] Initially focused on manufacturing phone switches, Huawei has expanded to more than 170 countries to include building telecommunications network infrastructures, providing equipment, operational and consulting services, and manufacturing communications devices for the consumer market.[6] It overtook Ericsson in 2012 as the largest telecommunications equipment manufacturer in the world.[7] Huawei surpassed Apple and Samsung, in 2018 and 2020, respectively, to become the largest smartphone manufacturer worldwide.[8][9] As of 2024, Huawei's biggest area of business is in telecommunications equipment. Its largest customer is the Chinese government.[10] Amidst its rise, Huawei has been accused of intellectual property infringement, for which it has settled with Cisco.[11] Questions regarding the extent of state influence on Huawei have revolved around its national champions role in China, subsidies and financing support from state entities,[12] and reactions of the Chinese government in light of opposition in certain countries to Huawei's participation in 5G.[13] Its software and equipment have been linked to the mass surveillance of Uyghurs and Xinjiang internment camps, drawing sanctions from the United States.[14][15][16] The company has faced difficulties in some countries arising from concerns that its equipment may enable surveillance by the Chinese government due to perceived connections with the country's military and intelligence agencies.[12][17] Huawei has argued that critics such as the US government have not shown evidence of espionage.[18] Experts say that China's 2014 Counter Espionage Law and 2017 National Intelligence Law can compel Huawei and other companies to cooperate with state intelligence.[19] In 2012, Australian and US intelligence agencies concluded that a hack on Australia's telecom networks was conducted by or through Huawei, although the two network operators have disputed that information.[20][21] In January 2018, the United States alleged that its sanctions against Iran were violated by Huawei, which was subsequently restricted from doing business with American companies. The US government also requested the extradition of Huawei's chief financial officer from Canada. In June 2019, Huawei cut jobs at its Santa Clara research center, and in December, Ren said it was moving the center to Canada.[22][23] In 2020, Huawei agreed to sell the Honor brand to a state-owned enterprise of the Shenzhen government to "ensure its survival" under US sanctions.[24] In November 2022, the Federal Communications Commission (FCC) banned sales or import of equipment made by Huawei out of national security concerns,[25] and other countries such as all members of the Five Eyes, Quad members India and Japan, and ten European Union states have since also banned or restricted Huawei products.[26][27][28][29][30] According to the company founder Ren Zhengfei, the name Huawei comes from a slogan he saw on a wall, Zhonghua youwei meaning "China has achievements" (中华有为; Zhōng huá yǒu wéi), when he was starting up the company and needed a name.[31] Zhonghua or Hua means China,[32] while youwei means "promising/to show promise."[33][34] Huawei has also been translated as "splendid achievement" or "China is able," which are possible readings of the name.[35] In Chinese pinyin, the name is Huáwéi,[36] and pronounced [xwǎwěɪ] in Mandarin Chinese; in Cantonese, the name is transliterated with Jyutping as Waa4-wai4 and pronounced [wɑ.jwɛj˩]. However, the pronunciation of Huawei by non-Chinese varies in other countries, for example "Hoe-ah-wei" in Belgium and the Netherlands.[37] The company had considered changing the name in English out of concern that non-Chinese people may find it hard to pronounce,[38] but decided to keep the name, and launched a brand recognition campaign instead to encourage a pronunciation closer to "Wah-Way" using the words "Wow Way".[39][40] Ren states, "We will not change the name of our brand and will teach foreigners how to pronounce it. We have to make sure they do not pronounce it like 'Hawaii.'"[5]:85 In the 1980s, the Chinese government endeavored to overhaul the nation's underdeveloped telecommunications infrastructure. A core component of the telecommunications network was telephone exchange switches, and in the late 1980s, several Chinese research groups endeavored to acquire and develop the technology, usually through joint ventures with foreign companies. Ren Zhengfei, a former deputy director of the People's Liberation Army engineering corps, founded Huawei in 1987 in Shenzhen. The company reports that it had RMB 21,000 (about $5,000 at the time) in registered capital from Ren Zhengfei and five other investors at the time of its founding, when each contributed RMB 3,500.[41] These five initial investors gradually withdrew their investments in Huawei. The Wall Street Journal has suggested, however, that Huawei received approximately "$46 billion in loans and other support, coupled with $25 billion in tax cuts" since the Chinese government had a vested interest in fostering a company to compete against Apple and Samsung.[12][42] Ren sought to reverse engineer foreign technologies with local researchers. China borrowed liberally from Qualcomm and other industry leaders (PBX as an example) in order to enter the market. At a time when all of China's telecommunications technology was imported from abroad, Ren hoped to build a domestic Chinese telecommunications company that could compete with, and ultimately replace, foreign competitors.[43] During its first several years the company's business model consisted mainly of reselling private branch exchange (PBX) switches imported from Hong Kong.[44][45] Meanwhile, it was reverse-engineering imported switches and investing heavily in research and development to manufacture its own technologies.[44] By 1990 the company had approximately 600 R&D staff and began its own independent commercialization of PBX switches targeting hotels and small enterprises.[46] In order to grow despite difficult competition from Alcatel, Lucent, and Nortel Networks, in 1992 Huawei focused on low-income and difficult-to-access market niches.[5]:12 Huawei's sales force traveled from village to village in underdeveloped regions, gradually moving into more developed areas.[5]:12 The company's first major breakthrough came in 1993 when it launched its C&C08 program-controlled telephone switch. It was by far the most powerful switch available in China at the time. By initially deploying in small cities and rural areas and placing emphasis on service and customizability, the company gained market share and made its way into the mainstream market.[47] Huawei also won a key contract to build the first national telecommunications network for the People's Liberation Army, a deal one employee described as "small in terms of our overall business, but large in terms of our relationships".[48] In 1994, founder Ren Zhengfei had a meeting with General Secretary of the Chinese Communist Party Jiang Zemin, telling him that "switching equipment technology was related to national security, and that a nation that did not have its own switching equipment was like one that lacked its own military." Jiang reportedly agreed with this assessment.[44] In the 1990s, Canadian telecom giant Nortel outsourced production of their entire product line to Huawei.[49] They subsequently outsourced much of their product engineering to Huawei as well.[50] Another major turning point for the company came in 1996 when the government in Beijing adopted an explicit policy of supporting domestic telecommunications manufacturers and restricting access to foreign competitors. Huawei was promoted by both the government and the military as a national champion, and established new research and development offices.[44] Huawei OfficesIn Vilnius, LithuaniaIn Voorburg, NetherlandsIn Markham, Ontario, Canada Beginning in the late 1990s, Huawei built communications networks throughout sub-Saharan Africa and the Middle East,[51] with its first entrance into the African telecommunications market in 1998.[52]:9 It has become the most important Chinese telecommunications company operating in these regions.[51] In 1997, Huawei won a contract to provide fixed-line network products to Hong Kong company Hutchison Whampoa.[47] Later that year, Huawei launched wireless GSM-based products and eventually expanded to offer CDMA and UMTS. In 1999, the company opened a research and development (R&D) centre in Bengaluru, India to develop a wide range of telecom software.[46] Huawei received support as part of China's Go Out policy beginning in the late 1990s.[52]:8 In May 2003, Huawei partnered with 3Com on a joint venture known as H3C, which was focused on enterprise networking equipment. It marked 3Com's re-entrance into the high-end core routers and switch market, after having abandoned it in 2000 to focus on other businesses. 3Com bought out Huawei's share of the venture in 2006 for US$882 million.[53][54] In 2004, Huawei signed a $10 billion credit line with China Development Bank to provide low-cost financing to customers buying its telecommunications equipment to support its sales outside of China. This line of credit was tripled to $30 billion in 2009.[55] In 2005, Huawei's foreign contract orders exceeded its domestic sales for the first time. Huawei signed a global framework agreement with Vodafone. This agreement marked the first time a telecommunications equipment supplier from China had received Approved Supplier status from Vodafone Global Supply Chain.[56][non-primary source needed] In 2007, Huawei began a joint venture with US security software vendor Symantec Corporation, known as Huawei Symantec, which aimed to provide end-to-end solutions for network data storage and security. Huawei bought out Symantec's share in the venture in 2012, with The New York Times noting that Symantec had fears that the partnership "would prevent it from obtaining United States government classified information about cyber threats".[57] In May 2008, Australian carrier Optus announced that it would establish a technology research facility with Huawei in Sydney.[58] In October 2008, Huawei reached an agreement to contribute to a new GSM-based HSPA+ network being deployed jointly by Canadian carriers Bell Mobility and Telus Mobility, joined by Nokia Siemens Networks.[59] Huawei delivered one of the world's first LTE/EPC commercial networks for TeliaSonera in Oslo, Norway in 2009.[46] Norway-based telecommunications Telenor instead selected Ericsson due to security concerns with Huawei.[60] In July 2010, Huawei was included in the Global Fortune 500 2010 list published by the US magazine Fortune for the first time, on the strength of annual sales of US$21.8 billion and net profit of US$2.67 billion.[61][62] In October 2012, it was announced that Huawei would move its UK headquarters to Green Park, Reading, Berkshire.[63] Huawei has also expanded its operations in Ireland since 2016. As well as a headquarters in Dublin, it has facilities in Cork and Westmeath.[64] In September 2017, Huawei created a Narrowband IoT city-aware network using a "one network, one platform, N applications" construction model utilizing Internet of things (IoT), cloud computing, big data, and other next-generation information and communications technology. It aims to be one of the world's five largest cloud players in the near future.[65][66] In 2017, Huawei and the government of Malaysia began cooperating to develop public security programs and Malaysian Smart City programs, as well as a related lab in Kuala Lumpur.[67]:82 In April 2019, Huawei established the Huawei Malaysia Global Training Centre (MGTC) at Cyberjaya, Malaysia.[68] Huawei has had a major role in building, by 2020, approximately 70% of Africa's 4G networks.[52]:9[67]:76 In November 2020, Telus Mobility dropped Huawei in favor of Samsung, Ericsson, and Nokia for their 5G/Radio Access Network[69] Huawei has been a major player in African technology markets and investment since their commencement of operations in Kenya in 1998.[70] Today, Africa is one of Huawei's largest overseas markets.[71] In 2017, Huawei launched RuralStar to provide rural areas with access to technology and network connectivity. The systems work through solar-powered small cell base stations that connect to a central network via wireless backhaul, extending mobile coverage to remote and underserved areas with minimal infrastructure.[72] In October 2018, Huawei and HENGTONG Group announced the start of production for the Pakistan and East Africa Connecting Europe (PEACE) cable project. The cable went live in December 2022 with a design capacity of 16Tbit/s per fiber pair.[73] In February 2023, Huawei joined the UNESCO Global Alliance for Literacy (GAL) as an associate member.[74] Huawei partners with UNESCO's Global Skills Academy, which trains students through an online IT program to equip them with practical skills.[75] The Leadership, Employability, Advancement, and Possibility program (LEAP) is a collaboration between Huawei and the African Telecommunications Union (ATU) to teach IT training, certification courses, and employable digital skills in sub-Saharan Africa. The original program sought to equip 100,000 individuals with digital skills, but Huawei announced a new goal of an additional 150,000 individuals at the LEAP Summit 2024 in Shanghai.[76][77] This expansion builds on Huawei's goal to equip individuals with digital skills to meet their estimate that over 230 million jobs in sub-Saharan Africa will require digital expertise.[77] Huawei Music is the default music streaming platform on Huawei devices, and it boasts 32 million active daily users in China as of 2018.[78] That year, Huawei also launched an initiative to expand usership in Africa, putting most of their efforts into South Africa. The initial release of the software in South Africa included a limited library that was 80% South African music, although officials announced that international music would be added later.[78] Beyond their streaming services, Huawei Music has also invested substantially in South African artists, events, and music businesses. Notably, Huawei released a platform called Huawei Culture Club that displays upcoming shows, events, and DJs performing in South Africa. Huawei Culture Club was listed as an official sponsor for Ultra Music Festival 2015, which is among the largest electronic festivals in Africa.[79] In 2020, Huawei Music partnered with top artists in Kenya, Nigeria, and Africa, having them publish their playlists for listeners to rate and enjoy on the Huawei Music app. Audiences were able to vote on their favorite playlist, and the winner was featured on the app for the rest of the year.[80] Huawei expo at IFA 2018 in Berlin By 2018, Huawei had sold 200 million smartphones.[81] In 2019, Huawei reported revenue of US$122 billion.[82] By the second quarter of 2020, Huawei had become the world's top smartphone seller, overtaking Samsung for the first time.[9] In 2021, Huawei was ranked the second-largest R&D investor in the world by the EU Joint Research Centre (JRC) in its EU Industrial R&D Investment Scoreboard[83] and ranked fifth in the world in US patents according to a report by Fairview Research's IFI Claims Patent Services.[84][5]:10 However, heavy international sanctions saw Huawei's revenues drop by 32% in the third quarter of 2021.[85] Linghao Bao, an analyst at policy research firm Trivium China said the "communications giant went from being the second-largest smartphone maker in the world, after Samsung, to essentially dead."[86] By the end of third quarter in 2022, Huawei revenue had dropped a further 19.7% since the beginning of the year.[87] Yet, for the seventh consecutive year, Huawei remained the top patent applicant for patents filled under the PCT, with 6494 published applications in 2023.[88] By mid-2024, the company had recovered after a brief decline in turnover and profit and continued its expansion. Most foreign parts in the supply chain were successfully replaced by domestic products in a relatively short period of time. In the first quarter of 2024, the company's profits increased nearly six-fold compared to the previous year to just under US$2.7 billion.[89] On 21 June 2024, Huawei announced that HarmonyOS is now installed on over 900 million devices and has become the second most popular mobile OS in China.[90] Huawei classifies itself as a "collective" entity and prior to 2019 did not refer to itself as a private company. Richard McGregor, author of The Party: The Secret World of China's Communist Rulers, said that this is "a definitional distinction that has been essential to the company's receipt of state support at crucial points in its development".[91] McGregor argued that "Huawei's status as a genuine collective is doubtful."[91] Huawei's position shifted in 2019 when Dr. Song Liuping, Huawei's chief legal officer, commenting on the US government ban, said: "Politicians in the US are using the strength of an entire nation to come after a private company." (emphasis added).[92] Ren Zhengfei is the founder and CEO of Huawei and has the power to veto any decisions made by the board of directors.[93][94] Huawei also has rotating co-CEOs.[5]:11 Huawei disclosed its list of board of directors for the first time in 2010.[95] Liang Hua is the current chair of the board. As of 2019[update], the members of the board are Liang Hua, Guo Ping, Xu Zhijun, Hu Houkun, Meng Wanzhou (CFO and deputy chairwoman), Ding Yun, Yu Chengdong, Wang Tao, Xu Wenwei, Shen-Han Chiu, Chen Lifang, Peng Zhongyang, He Tingbo, Li Yingtao, Ren Zhengfei, Yao Fuhai, Tao Jingwen, and Yan Lida.[96] Guo Ping is the Chairman of Huawei Device, Huawei's mobile phone division.[97] Huawei's Chief Ethics & Compliance Officer is Zhou Daiqi,[98] who is also Huawei's Chinese Communist Party Committee Secretary.[99] Their chief legal officer is Song Liuping.[92] At its founding in 1987, Huawei was established as a collectively owned enterprise.[5]:213 Collectively owned enterprises were an intermediary corporate ownership status between state-owned enterprises and private businesses.[100][5]:213 The Chinese government began issuing licenses for private businesses starting in 1992.[5]:213 Huawei states it is an employee-owned company, but this remains a point of dispute.[93][101] Ren Zhengfei retains approximately 1 percent of the shares of Huawei's holding company, Huawei Investment & Holding,[101] with the remainder of the shares held by a trade union committee (not a trade union per se, and the internal governance procedures of this committee, its members, its leaders or how they are selected all remain undisclosed to the public) that is claimed to be representative of Huawei's employee shareholders.[93][102] The company's trade union committee is registered with and pays dues to the Shenzhen federation of the All-China Federation of Trade Unions, which is controlled by the Chinese Communist Party.[103] About half of Huawei staff participate in this structure (foreign employees are not eligible), and hold what the company calls "virtual restricted shares". These shares are non-tradable and are allocated to reward performance.[104] When employees leave Huawei, their shares revert to the company, which compensates them for their holding.[105] Although employee shareholders receive dividends,[102] their shares do not entitle them to any direct influence in management decisions, but enables them to vote for members of the 115-person Representatives' Commission from a pre-selected list of candidates.[102] The Representatives' Commission selects Huawei Holding's board of directors and Board of Supervisors.[106] Academics Christopher Balding of Fulbright University and Donald C. Clarke of George Washington University have described Huawei's virtual stock program as "purely a profit-sharing incentive scheme" that "has nothing to do with financing or control".[107] They found that, after a few stages of historical morphing, employees do not own a part of Huawei through their shares. Instead, the "virtual stock is a contract right, not a property right; it gives the holder no voting power in either Huawei Tech or Huawei Holding, cannot be transferred, and is cancelled when the employee leaves the firm, subject to a redemption payment from Huawei Holding TUC at a low fixed price".[108][93] Balding and Clarke add, "given the public nature of trade unions in China, if the ownership stake of the trade union committee is genuine, and if the trade union and its committee function as trade unions generally function in China, then Huawei may be deemed effectively state-owned."[93] Tim Rühlig, a Research Fellow at the Swedish Institute of International Affairs, asked Huawei for a response to the Balding and Clarke paper; the "information provided by Huawei gives an indication of how difficult it is to run an independent company in such a crucial sector in China".[109] After the publication of Balding and Clarke's paper, Huawei has "engaged in a PR blitz to manufacture an image of a transparent company".[110] Academic Toshio Goto of the Japan University of Economics has disagreed with Balding and Clarke's assessment of Huawei employee shareholders' ownership.[111]:13 Goto writes that the Huawei's ownership structure is a function of its formation amid the Chinese reforms, with the only mechanism for concentrating employee ownership under Shenzen's 1997 Provisions on State-owned Company Employee Stock Option Plans being to do so via Huawei's trade union.[111]:25 In contrast to Balding and Clarke, Goto writes that the Huawei's virtual shares are substantially equivalent to voting stock, and that nominal ownership through the trade union does not change the legal and financial independence of employee ownership from the union itself.[111]:25 Goto concludes that the firm is effectively owned by employees and therefore it is not effectively state-owned.[111]:25 In analyzing Huawei's corporate governance and ownership structure, Academic Wang Jun of the Chinese University of Politics and Law also rejects the argument that Huawei is a state-owned enterprise controlled by a labor union, writing that normative practices and legal requirements distinguish between the shareholding vehicle of union-held employee assets and assets belonging to the union itself.[112] Academics Kunyuan Qiao of Cornell University and Christopher Marquis of the University of Cambridge likewise conclude that Huawei is a private company owned collectively by its employees and is neither owned nor controlled directly by the Chinese government.[5]:11 Academics Steve Tsang and Olivia Cheung write that Huawei is a private company.[113]:131 Likewise, academics Simon Curtis and Ian Klaus write that Huawei is not state-owned, but is a private company which the Chinese government views as a national champion.[67]:156–157 In 2021, Huawei did not report its ultimate beneficial ownership in Europe as required by European anti-money laundering laws.[110] In August 2019, Huewei hired the law firm Sidley Austin to lobby in the US after restrictions were placed by the Trump administration. Export controls, trade, sanctions, "and other national security-related topics" were listed on disclosure filings, according to Politico.[114] In July 2021, Huawei hired Tony Podesta as a consultant and lobbyist, with a goal of nurturing the company's relationship with the Biden administration.[115][116] Huawei has also hired public relations firms Ruder Finn, Wavemaker, Racepoint Global, and Burson Cohn & Wolfe for various campaigns.[117] In January 2024, Bloomberg News reported that Huawei ended its in-house lobbying operations in Washington, D.C.[118] In March 2025, Huawei lobbyists were banned from accessing the European Parliament following the arrests of several Huawei staff accused of bribery, forgery, and money laundering.[119][120][121] In April 2025, the European Commission announced that it "shall not meet with any lobby groups and/or trade associations that represent Huawei's interests and/or speak on its behalf" in response to the investigation.[122] According to its CEO and founder Ren Zhengfei, Huawei's corporate culture is the same as the culture of the CCP, "and to serve the people wholeheartedly means to be customer-centric and responsible to society."[5]:9 Ren frequently states that Huawei's management philosophy and strategy are commercial applications of Maoism.[5]:11 Ren states that in the event of a conflict between Huawei's business interests and the CCP's interests, he would "choose the CCP whose interest is to serve the people and all human beings".[5]:11 Qiao and Marquis observe that company founder Ren is a dedicated communist who seeks to ingrain communist values at Huawei.[5]:9 2018 2019 2020 2021 2022 2023 2024 Total revenue (CNY¥ bn) 721 858 891 636 642 704 862 Operating profit (CNY¥ bn) 73.2 77.8 72.5 121 42.2 104 79.3 Net profit (CNY¥ bn) 59.3 62.6 64.6 113 35.5 86.9 62.5 Total assets (CNY¥ bn) 665 858 876 982 1,063 1,263 1,290 References [123] [123] [123] [123] [123] [124] [125] Huawei P9 was the first smartphone to be co-engineered with a Leica camera. As of the beginning of 2010[update], approximately 80% of the world's top 50 telecoms companies had worked with Huawei.[126] In 2016, German camera company Leica has established a partnership with Huawei, and Leica cameras will be co-engineered into Huawei smartphones, including the P and Mate Series. The first smartphone to be co-engineered with a Leica camera was the Huawei P9.[127] As of May 2022, Huawei partnership with Leica had ended.[128][129] In August 2019, Huawei collaborated with eyewear company Gentle Monster and released smartglasses.[130] In November 2019, Huawei partners with Devialet and unveiled a new specifically designed speaker, the Sound X.[131] In October 2020, Huawei released its own mapping service, Petal Maps, which was developed in partnership with Dutch navigation device manufacturer TomTom.[132] Huawei offers mobile and fixed softswitches, plus next-generation home location register and Internet Protocol Multimedia Subsystems (IMS). Huawei sells xDSL, passive optical network (PON) and next-generation PON (NG PON) on a single platform. The company also offers mobile infrastructure, broadband access and service provider routers and switches (SPRS). Huawei's software products include service delivery platforms (SDPs), base station subsystems, and more.[133] As of 2023, telecoms-network equipment remains Huawei's core area of business, which constituted half of its revenues for the year.[10] Huawei Marine Networks delivered the HANNIBAL submarine communications cable system for Tunisie Telecom across the Mediterranean Sea to Italy in 2009.[134]:310 Huawei Marine is involved in many fiber-optic cable projects connected with the Belt and Road Initiative.[67]:78 Huawei Marine completed the China-Pakistan Fiber Optic Project which runs along the China-Pakistan Economic Corridor.[67]:78 In 2018, Huawei Marine completed the South Atlantic Interlink (SAIL) Cable System which runs from Kribi, Cameroon to Fortaleza, Brazil.[67]:78 It also built the Kumul Domestic Fiber Cable from Indonesia to Papua New Guinea.[67]:78 As part of the Smart Africa project, Huawei Marine built the 2,800 mile fiber-optic network Guinea Backbone Network.[67]:78 Huawei Global Services provides telecommunications operators with equipment to build and operate networks as well as consulting and engineering services to improve operational efficiencies.[135] These include network integration services such as those for mobile and fixed networks; assurance services such as network safety; and learning services, such as competency consulting.[133] A Huawei Band 7 fitness tracker in Wilderness Green colour Huawei's Devices division provides white-label products to content-service providers, including USB modems, wireless modems and wireless routers for mobile Wi-Fi,[136] embedded modules, fixed wireless terminals, wireless gateways, set-top boxes, mobile handsets and video products.[137] Huawei also produces and sells a variety of devices under its own name, such as the smartphones, tablet PCs, earbuds and Huawei Smartwatch.[138][139] See also: HiSilicon Through its wholly owned subsidiary, HiSilicon, Huawei is one of the largest domestic designers of chips in China. It frequently partners with Semiconductor Manufacturing International Corporation (SMIC) to manufacture its chips. As of April 2024, Huawei is also building or supporting the construction of five semiconductor fabs.[140] Main article: List of Huawei phones Huawei is the second-biggest smartphone maker in the world, after Samsung, as of the first quarter of 2019. Their portfolio of phones includes both high-end smartphones, its Huawei Mate series and Huawei Pura series, and cheaper handsets that fall under its Honor brand.[141] Cheaper handsets fall under its Honor brand.[142] Honor was created in order to elevate Huawei-branded phones as premium offerings. In 2020, Huawei agreed to sell the Honor brand to a state-owned enterprise of the Shenzhen municipal government. Consequently, Honor was initially reported to be cut off from access to Huawei's IPs, which consists of more than 100,000 active patents by the end of 2020, and additionally cannot tap into Huawei's large R&D resources where $20 billion had been committed for 2021. However, Wired magazine noted in 2021 that Honor devices still had not differentiated their software much from Huawei phones and that core apps and certain engineering features, like the Honor-engineered camera features looked "virtually identical" across both phones.[24][142] The Huawei P30 with rear triple-lens Leica optics camera In July 2003, Huawei established their handset department and by 2004, Huawei shipped their first phone, the C300. The U626 was Huawei's first 3G phone in June 2005 and in 2006, Huawei launched the first Vodafone-branded 3G handset, the V710. The U8220 was Huawei's first Android smartphone and was unveiled in MWC 2009. At CES 2012, Huawei introduced the Ascend range starting with the Ascend P1 S. At MWC 2012, Huawei launched the Ascend D1. In September 2012, Huawei launched their first 4G ready phone, the Ascend P1 LTE. At CES 2013, Huawei launched the Ascend D2 and the Ascend Mate. At MWC 2013, the Ascend P2 was launched as the world's first LTE Cat4 smartphone. In June 2013, Huawei launched the Ascend P6 and in December 2013, Huawei introduced Honor as a subsidiary independent brand in China. At CES 2014, Huawei launched the Ascend Mate2 4G in 2014 and at MWC 2014, Huawei launched the MediaPad X1 tablet and Ascend G6 4G smartphone. Other launched in 2014 included the Ascend P7 in May 2014, the Ascend Mate7, the Ascend G7 and the Ascend P7 Sapphire Edition as China's first 4G smartphone with a sapphire screen.[143] In January 2015, Huawei discontinued the "Ascend" brand for its flagship phones, and launched the new P series with the Huawei P8.[144][145] Huawei also partnered with Google to build the Nexus 6P which was released in September 2015.[146] In May 2018, Huawei stated that they will no longer allow unlocking the bootloader of their phones to allow installing third party system software or security updates after Huawei stops them. [147] Huawei is currently the most well-known international corporation in China and a pioneer of the 5G mobile phone standard, which has come to be used globally in the last few years.[148] Main article: Huawei MateBook series Huawei Matebook 2-in-1 tablet In 2016, Huawei entered the laptop markets with the release of its Huawei MateBook series of laptops.[149] They have continued to release laptop models in this series into 2020 with their most recent models being the MateBook X Pro and Matebook 13 2020.[150] Main article: Huawei Mate series § Tablets The Huawei MatePad Pro, launched in November 2019, after that, subsequent releases of their MatePad tablet line.[151] Huawei is number one in the Chinese tablet market and number two globally as of 4Q 2019.[152] Main article: Huawei MateStation series The MateStation S and X was released in September 2021 among successor releases of variants, marking Huawei entrance into the workstation, desktop PC space with All-in-one and Thin client PCs.[153][154] Main article: Huawei Watch The Huawei Watch is an Android Wear-based smartwatch developed by Huawei. It was released at Internationale Funkausstellung Berlin on 2 September 2015. Since 2020, Huawei released subsequent models based on in-house operating systems, from earlier LiteOS (discontinued) models, to later HarmonyOS (active) models.[155] It is the first smartwatch produced by Huawei.[155] Their latest watch, Huawei Watch Ultimate Design, announced on 25 September 2023, was released 4 October 2023 worldwide.[156] Main article: EMUI Emotion UI (EMUI) was a ROM/OS developed by Huawei Technologies Co. Ltd. and based on Google's Android Open Source Project (AOSP). EMUI is pre-installed on most Huawei Smartphone devices and its subsidiaries the Honor series.[157] This section is an excerpt from HarmonyOS.[edit] HarmonyOS (HMOS) (Chinese: 鸿蒙; pinyin: Hóngméng; trans. "Vast Mist") is a distributed operating system developed by Huawei for smartphones, tablets, smart TVs, smart watches, personal computers and other smart devices. It has a microkernel design with a single framework: the operating system selects suitable kernels from the abstraction layer in the case of devices that use diverse resources.[158][159][160] Huawei Mobile Services (HMS) is Huawei's solution to GMS (Google Mobile services) for Android - providing many of the same features for app developers. It also serves as the umbrella brand for Huawei's core set of mobile applications, including Huawei AppGallery, which was created as a competitor to Google's Play Store. In December 2019, Huawei unveiled HMS version 4.0, and as of 16 January 2020, the company reported that it had signed up 55,000 apps using its HMS Core software.[161] MetaERP is an proprietary enterprise resource planning (ERP) solution launched on April 24, 2023. The company began with a manufacturing resource planning (MRP) solution in 1996. It upgraded its legacy ERP system from third-party American suppliers, followed by further improvements for internal management. Since the United States Entity List of May 2019 barred American software technology companies from supplying ERP systems to Huawei prompted the company to develop an in-house ERP system for the next following three years.[162][163] MetaERP targets mid-sized and large enterprises. For ease of migration to the ERP system, it consists of the following modules such as Financials and Operations, Sales Enterprise, Marketing, Customer Service, Field Service, and Project Service Automation using its Linux-based EulerOS server operating system and GaussDB relational database management system.[164] After launch in 2023,[165] the first batch of large-scale switching was carried out in May 14 midnight, across Asia-Pacific, Europe, Middle East and Central Asia, Southern Africa, and Latin America. The business covers ICT and Huawei Cloud, alongside terminals and other industries. Over thousands of employees in 75 countries use MetaERP in stable operation post-launch.[166] MetaERP currently handles 100% of Huawei's internal business and most of the 80% of its business operations.[167] In November 2024, Huawei announced its plans to start mass-producing advanced artificial intelligence chips within the first quarter of 2025. This chip named Ascend 910C has been made by top Chinese contract chipmaker Semiconductor Manufacturing International Corp (SMIC) via its N+2 process.[168] Huawei Ascend chips rely on Huawei's Compute Architecture for Neural Networks (CANN) software ecosystem, which is a competitor to Nvidia's CUDA ecosystem.[169] In 2020 Huawei launched browser, which was released in over 170 countries. Huawei Browser is made explicitly for HMS (Huawei Mobile Services) ecosystem.[170] The browser is a fork of Chromium project.[171] See also: Harmony Intelligent Mobility Alliance and Yinwang Huawei has secured collaboration with a few automakers including Seres, Chery, BAIC Motor, Changan Automobile, GAC Group and JAC Group.[172] Main article: AITO (marque) The Aito brand (问界 Wenjie) is Huawei's premium EV brand in cooperation with Seres. In December 2021, the AITO M5 was unveiled as the first vehicle to be developed in cooperation with Huawei. The model was developed mainly by Seres and is essentially a restyled Seres SF5 crossover.[173] The model was sold under a new brand called AITO, which stands for "Adding Intelligence to Auto" and uses Huawei DriveONE and HarmonyOS, while the Seres SF5 used Huawei DriveONE and HiCar.[174] AITO M5 AITO M7 AITO M9 Main article: Avatr Technology The Avatr (阿维塔 Aweita) brand is an electric vehicle brand by Changan Automobile and CATL, with driver assist systems provided by Huawei.[175] Avatr 11 Avatr 12 Avatr 07 Main article: Luxeed The Luxeed (智界 Zhijie) brand is Huawei's premium EV brand in cooperation with Chery, with the first vehicle being the Luxeed S7, previously called the Chery EH3,[176] an upcoming premium electric executive sedan due to be unveiled in Q3 2023, and would be the first car to have the Harmony OS 4 system on board.[177] Luxeed S7 Luxeed R7 This paragraph is an excerpt from Stelato.[edit] Stelato (Chinese: 享界; pinyin: Xiǎngjiè) is a Chinese premium electric vehicle brand established in 2024. The brand operates under Harmony Intelligent Mobility Alliance (HIMA), a collaboration between in Huawei. Stelato S9 This paragraph is an excerpt from Maextro.[edit] Maextro (Chinese: 尊界; pinyin: Zūnjiè) is a Chinese ultra-luxury electric vehicle brand established in 2024 by JAC Group. It is part of Huawei's HIMA multi-brand collaboration model, where Huawei handles product creation and design, provides technologies such as full-stack ADAS solutions and infotainment systems, and provides powertrain components, while JAC is responsible for chassis engineering and manufacturing of vehicles.[178] Huawei entered the photovoltaic (PV) market in 2011, and opened an Energy Center of Competence in Nuremberg, Germany the same year.[179] In September 2016, Huawei integrated new manufacturing capabilities into its Eindhoven hub in the Netherlands, where it can produce 7,000 inverter units per month.[179] In October that same year, Huawei entered the North American market and formed a strategic partnership with Strata Solar.[179] In April 2017, Huawei enters the residential solar market with the launch of its string solar inverters and DC power optimizers,[179] later also solar batteries. Some of its solar products are also sold under the "iStore" brand in Australia from 2024 onwards.[180] As of 2022, Huawei is the largest producer of solar inverters in the world with a 29% market share, which saw a significant shipment increase of 83% compared to 2021.[181] Huawei's global growth has largely been driven by its offering of competitive telecommunications equipment at a lesser price than rival firms.[182]:95 Huawei Technologies Co. Ltd. was the world's largest telecom equipment maker in 2012[7] and China's largest telephone-network equipment maker.[183] With 3,442 patents, Huawei became the world's No. 1 applicant for international patents in 2014.[184] In 2019, Huawei had the second most patents granted by the European Patent Office.[185] In 2021, the World Intellectual Property Organization (WIPO)'s annual World Intellectual Property Indicators report ranked Huawei's number of patent applications published under the PCT System as 1st in the world, with 5464 patent applications being published during 2020.[186] The Madrid Yearly Review ranked Huawei's number of marks applications filed under the Madrid System as 9th in the world, with 78 trademarks applications submitted during 2023.[187] As of 2023[update], Huawei is the leading 5G equipment manufacturer and has the greatest market share of 5G equipment and has built approximately 70% of worldw

technicians must have pushed the update through the network on behalf of China's spy agencies. Huawei said updates would have required authorization from the customer and that no tangible evidence was presented. China's Ministry of Foreign Affairs called the accusation a "slander". Australian telecom operators Optus and Vodafone disputed that they were compromised.[20][21] Senior security officials in Uganda and Zambia told The Wall Street Journal that Huawei played key roles enabling their governments to spy on political opponents.[13] Several IT sources told Le Monde that inside the African Union headquarters, whose computer systems were supplied by Huawei,[13] data transfers on its servers peaked after hours from January 2012 to January 2017, with the AU's internal data sent to unknown servers hosted in Shanghai.[228] In May 2019, a Huawei Mediapad M5 belonging to a Canadian IT engineer living in Taiwan was found to be sending data to servers in China despite never being authorized to do so, as the apps could not be disabled and continued to send sensitive data even after appearing to be deleted.[229] At the end of 2019, United States officials disclosed to the United Kingdom and Germany that Huawei has had the ability to covertly exploit backdoors intended for law enforcement officials since 2009, as these backdoors are found on carrier equipment like antennas and routers, and Huawei's equipment is widely used around the world due to its low cost.[230][231] The United Kingdom established a lab that it ran, but which was paid for by Huawei, to evaluate Huawei equipment.[134]:322 After eight years of study, the lab did not identify any Huawei backdoor, but concluded that Huawei's equipment had bugs that could be exploited by hackers.[134]:322 Yale University economist Stephen Roach stated in 2022 that there was no hard evidence to support the allegations of Huawei having a backdoor for industrial espionage other than one arguable instance,[189]:118 which was when UK telecom Vodafone disclosed in 2011 that its Italian fixed line network contained a security vulnerability in its Huawei-installed software.[189]:118–119 Huawei fixed the vulnerability at Vodafone's request.[189]:118 There was no report of any suspicious data capture or systems control activity.[232][189] Vodafone was satisfied with the outcome and thereafter increased its reliance on Huawei as an equipment-supplier.[189]:118 A 2012 White House-ordered security review found no evidence that Huawei spied for China and said instead that security vulnerabilities on its products posed a greater threat to its users. The details of the leaked review came a week after a US House Intelligence Committee report which warned against letting Huawei supply critical telecommunications infrastructure in the United States.[233] Huawei has been at the center of concerns over Chinese involvement in 5G wireless networks. In 2018, the United States passed a defense funding bill that contained a passage barring the federal government from doing business with Huawei, ZTE, and several Chinese vendors of surveillance products, due to security concerns.[234][235][236] The Chinese government has threatened economic retaliation against countries that block Huawei's market access.[209] Similarly in November 2018, New Zealand blocked Huawei from supplying mobile equipment to national telecommunications company Spark New Zealand's 5G network, citing a "significant network security risk" and concerns about China's National Intelligence Law.[237][238] Huawei was involved in developing the United Kingdom's 5G network, which initially led to serious policy and diplomatic disagreements between the UK and the United States, which opposed Huawei's involvement.[67]:77 Between December 2018 and January 2019, German and British intelligence agencies initially pushed back against the US' allegations, stating that after examining Huawei's 5G hardware and accompanying source code, they have found no evidence of malevolence and that a ban would therefore be unwarranted.[239][240] Additionally, the head of Britain's National Cyber Security Centre (the information security arm of GCHQ) stated that the US has not managed to provide the UK with any proof of its allegations against Huawei and also their agency had concluded that any risks involving Huawei in UK's telecom networks are "manageable".[241][240] The Huawei Cyber Security Evaluation Centre (HCSEC), set up in 2010 to assuage security fears as it examined Huawei hardware and software for the UK market, was staffed largely by employees from Huawei but with regular oversight from GCHQ, which led to questions of operating independence from Huawei.[242] On 1 October 2020, an official report released by National Cyber Security Centre noted that "Huawei has failed to adequately tackle security flaws in equipment used in the UK's telecoms networks despite previous complaints", and flagged one vulnerability of "national significance" related to broadband in 2019. The report concluded that Huawei was not confident of implementing the five-year plan of improving its software engineering processes, so there was "limited assurance that all risks to UK national security" could be mitigated in the long-term.[243] On 14 July 2020, the United Kingdom Government announced a ban on the use of company's 5G network equipment, citing security concerns.[244] In October 2020, the British Defence Select Committee announced that it had found evidence of Huawei's collusion with the Chinese state and that it supported accelerated purging of Huawei equipment from Britain's telecom infrastructure by 2025, since they concluded that Huawei had "engaged in a variety of intelligence, security, and intellectual property activities" despite its repeated denials.[206][245] In November 2020, Huawei challenged the UK government's decision, citing an Oxford Economics report that it had contributed £3.3 billion to the UK's GDP.[246] In March 2019, Huawei filed three defamation claims over comments suggesting ties to the Chinese government made on television by a French researcher, a broadcast journalist and a telecommunications sector expert.[247] In June 2020 ANSSI informed French telecommunications companies that they would not be allowed to renew licenses for 5G equipment made from Huawei after 2028.[248] On 28 August 2020, French President Emmanuel Macron assured the Chinese government that it did not ban Huawei products from participating in its fifth-generation mobile roll-out, but favored European providers for security reasons. The head of the France's cybersecurity agency also stated that it has granted time-limited waivers on 5G for wireless operators that use Huawei products, a decision that likely started a "phasing out" of the company's products.[249] In February 2020, US government officials claimed that Huawei has had the ability to covertly exploit backdoors intended for law enforcement officials in carrier equipment like antennas and routers since 2009.[230][231] In mid July 2020, Andrew Little, the Minister in charge of New Zealand's signals intelligence agency the Government Communications Security Bureau (GCSB), announced that New Zealand would not join the United Kingdom and United States in banning Huawei from the country's 5G network.[250][251] In May 2022, Canada's industry minister Francois-Philippe Champagne announced that Canada will ban Huawei from the country's 5G network, in an effort to protect the safety and security of Canadians, as well as to protect Canada's infrastructure.[252] The Canadian federal government cited national security concerns for the move, saying that the suppliers could be forced to company with "extrajudicial directions from foreign governments" in ways that could "conflict with Canadian laws or would be detrimental to Canadian interests". Telcos will be prevented from procuring new 4G or 5G equipment from Huawei and ZTE and must remove all ZTE- and Huawei-branded 5G equipment from their networks by 28 June 2024.[253] This section is an excerpt from Extradition case of Meng Wanzhou.[edit] Meng Wanzhou during her house arrest in Vancouver in 2021 On December 1, 2018, Meng Wanzhou, the board deputy chairperson and daughter of the founder of the Chinese multinational technology corporation Huawei, was detained upon arrival at Vancouver International Airport by Canada Border Services Agency (CBSA) officers for questioning, which lasted three hours.[254][255] The Royal Canadian Mounted Police subsequently arrested her on a provisional U.S. extradition request for fraud and conspiracy to commit fraud in order to circumvent U.S. sanctions against Iran.[254][256] On January 28, 2019, the United States Department of Justice formally announced financial fraud charges against Meng.[257][258] The first stage of the extradition hearing for Meng began Monday, January 20, 2020, and concluded on May 27, 2020, when the Supreme Court of British Columbia ordered the extradition to proceed.[259][260] During the extradition courtroom proceedings, Meng's lawyers made several allegations against the prosecution, including allegations of unlawful detention of Meng,[261] unlawful search and seizure,[262] extradition law violations,[263] misrepresentation,[264][265][266] international law violation,[267] and fabricated testimonies by the CBSA,[268] each of which were responded to by the prosecution.[269][270][271][272] In August 2021, the extradition judge questioned the regularity of the case and expressed great difficulty in understanding how the Record of Case (ROC) presented by the US supported their allegation of criminality.[273][274][275] On September 24, 2021, the Department of Justice announced it had reached a deal with Meng to resolve the case through a deferred prosecution agreement. As part of the deal, Meng agreed to a statement of facts that said she had made untrue statements to HSBC to enable transactions in the United States, at least some of which supported Huawei's work in Iran in violation of U.S. sanctions, but did not have to pay a fine nor plead guilty to her key charges.[276][277][278] The Department of Justice said it would move to dismiss all charges against Meng when the deferral period ends on 21 December 2022, on the condition that Meng is not charged with a crime before then.[279] Meng was released from house arrest and left Canada for China on September 24, 2021; hours after news of the deal, Michael Spavor and Michael Kovrig, two Canadian citizens whose arrest in mainland China were widely seen as retaliation for Meng's arrest in Canada, were released from detention in China and flown back to Canada.[280] On December 2, 2022, the presiding judge dismissed the charges against Meng following the United States government's request.[281] Further information: Allegations of intellectual property infringement by China Huawei has settled with Cisco Systems, Motorola, and PanOptis in patent infringement lawsuits.[11][282][283] In 2018, a German court ruled against Huawei and ZTE in favor of MPEG LA, which holds patents related to Advanced Video Coding.[284] Huawei has been accused of intellectual property infringement.[285][286] In February 2003, Cisco Systems sued Huawei Technologies for allegedly infringing on its patents and illegally copying source code used in its routers and switches.[287][non-primary source needed] By July 2004, Huawei removed the contested code, manuals and command-line interfaces and the case was subsequently settled out of court.[288] As part of the settlement Huawei admitted that it had copied some of Cisco's router software.[289] At the 2004 Supercomm tech conference in Chicago, a Huawei employee allegedly opened up the networking equipment of other companies to photograph the circuit boards.[289][290] Brian Shields, former chief security officer at Nortel, said that his company was compromised in 2004 by Chinese hackers; executive credentials were accessed remotely, and entire computers were taken over. Shields does not believe Huawei was directly involved but thinks that Huawei was a beneficiary of the hack. Documents taken included product roadmaps, sales proposals, and technical papers.[290] Nortel sought for but failed to receive help from the Royal Canadian Mounted Police. The Canadian Security Intelligence Service said it approached the company but was rebuffed.[291][49] Cybersecurity experts have some doubts about a hack of such magnitude as described by Shields, calling it "unlikely".[291] An extensive analysis by University of Ottawa professor Jonathan Calof and recollections of former Nortel executive Tim Dempsey place the blame mostly on strategic mistakes and poor management at Nortel. On the other hand, some employees recall when Huawei or a front company returned a fibre card to Nortel disassembled, around a time when knock-offs products emerged in Asia. There remains a suspicion that industrial espionage brought down or at least accelerated Nortel's demise.[290] In 2017, a jury found that Huawei had misappropriated trade secrets of T-Mobile US but awarded damages only for a breach of supplier contract; it did not compensate T-Mobile for claims of espionage.[292] In February 2020, the United States Department of Justice charged Huawei with racketeering and conspiring to steal trade secrets from six US firms.[293] Huawei said those allegations, some going back almost 20 years, had never been found as a basis for any significant monetary judgment.[294][293] Leaked documents obtained by The Washington Post in 2019 raised questions about whether Huawei conducted business secretly with North Korea, which was under numerous US sanctions.[295] Further information: Persecution of Uyghurs in China and Xinjiang internment camps Huawei has been accused of providing technology used in the mass surveillance and detention of Uyghurs in Xinjiang internment camps, resulting in sanctions by the United States Department of State.[14][296][15][297] Documents show that it has developed facial recognition software that recognizes ethnicity-specific features for surveillance[16][298] and filed a patent in China for a technology that could identify Han and Uyghur pedestrians.[299] The company and its suppliers have also been accused of using forced labor.[300][301] Huawei denied operating such technology.[302] On 8 October 2023, former MI6 spy Aimen Dean posted on X that Israel's failure to detect the Hamas-led attack on Israel was due partly to its militants use of Huawei phones, tablets and laptops, elaborating that US tech companies barring of Huawei had forced it to develop its own systems that were not easy to hack except by China.[303][304] In January 2024, Netgear, a computer networking company based in San Jose, California, filed a lawsuit with a California federal court against Huawei, claiming the company broke the United States antitrust law by withholding patent licenses, in addition to allegations of fraud and racketeering.[305][306] In 2014, Der Spiegel and The New York Times reported that, according to global surveillance disclosures, the National Security Agency (NSA) infiltrated Huawei's computer network in 2009. The White House intelligence coordinator and the FBI were also involved. The operation obtained Huawei's customer list and internal training documents. In addition, the company's central email archive was accessed, including messages from founder Ren Zhengfei and chairwoman Sun Yafang. So much data was gathered that "we don't know what to do with it", according to one document. The NSA was concerned that Huawei's infrastructure could provide China with signals intelligence capabilities. It also wanted to find ways to exploit the company's products because they are used by targets of interest to the NSA.[307] In 2023, the Chinese government officially acknowledged that the NSA's hacking had occurred.[308] In March 2025, Huawei became the focus of a corruption investigation in Brussels, Belgium, involving allegations of bribery targeting the European Parliament.[309] Belgian federal prosecutors are investigating potential "active corruption within the European Parliament," with sources indicating that the alleged bribery was intended to benefit Huawei.[310] The investigation has drawn comparisons to the 2022 Qatargate scandal and has renewed concerns about lobbying practices within the EU.[310] In May 2025, lobby organization SolarPower Europe removed Huawei as a member.[311] Further information: United States sanctions against China In August 2018, the National Defense Authorization Act for Fiscal Year 2019 (NDAA 2019) was signed into law, containing a provision that banned Huawei and ZTE equipment from being used by the US federal government, citing security concerns.[312] Huawei filed a lawsuit over the NDAA 2019 in March 2019,[313] alleging it to be unconstitutional because it specifically targeted Huawei without granting it a chance to provide a rebuttal or due process.[314] The federal judge dismissed the lawsuit in February 2020, concluding that U.S. Congress acted within its powers by including the restriction in the NDAA 2019.[315][316] Additionally, on 15 May 2019, the Department of Commerce added Huawei and 70 foreign subsidiaries and "affiliates" to its Entity List under the Export Administration Regulations, citing the company having been indicted for "knowingly and willfully causing the export, re-export, sale and supply, directly and indirectly, of goods, technology and services (banking and other financial services) from the United States to Iran and the government of Iran without obtaining a license from the Department of Treasury's Office of Foreign Assets Control (OFAC)".[317] This restricts US companies from doing business with Huawei without a government license.[318][319][320] Various US-based companies immediately froze their business with Huawei to comply with the regulation.[321] The May 2019 ban on Huawei was partial: it did not affect most non-American produced chips, and the Trump administration granted a series of extensions on the ban in any case,[322] with another 90-day reprieve issued in May 2020.[323] In May 2020, the US extended the ban to cover semiconductors customized for Huawei and made with US technology.[324] In August 2020, the US again extended the ban to a blanket ban on all semiconductor sales to Huawei.[324] The blanket ban took effect in September 2020.[325] Samsung and LG Display were banned from supplying displays to Huawei.[326] The sanctions regime established in September 2020 negatively affected Huawei production, sales and financial projections.[327][328][329] However, on 29 June 2019 at the G20 summit, the US President made statements implicating plans to ease the restrictions on US companies doing business with Huawei.[330][331][332] Despite this statement, on 15 May 2020, the U.S. Department of Commerce extended its export restrictions to prevent Huawei from producing semiconductors derived from technology or software of US origin, even if the manufacturing is performed overseas.[333][334][335] In June 2020, the Federal Communications Commission (FCC) designated Huawei a national security threat, thereby barring it from any US subsidies.[336] In July 2020, the Federal Acquisition Regulation Council published a Federal Register notice prohibiting all federal government contractors from selling Huawei hardware to the federal government and preventing federal contractors from using Huawei hardware.[337] In November 2020, President Donald Trump issued an executive order prohibiting any American company or individual from owning shares in companies that the United States Department of Defense has listed as having links to the People's Liberation Army, which included Huawei.[338][339][340] In January 2021, the Trump administration revoked licenses from US companies such as Intel from supplying products and technologies to Huawei.[341] In June 2021, the FCC voted unanimously to prohibit approvals of Huawei gear in US telecommunication networks on national security grounds.[342] In June 2021, the administration of Joe Biden began to persuade the United Arab Emirates to remove the Huawei Technologies Co. equipment from its telecommunications network, while ensuring to further distance itself from China. It came as an added threat to the $23 billion arms deal of F-35 fighter jets and Reaper drones between the US and the UAE. The Emirates got a deadline of four years from Washington to replace the Chinese network.[343] A report in September 2021 analyzed how the UAE was struggling between maintaining its relations with both the United States and China. While Washington had a hawkish stance towards Beijing, the increasing Emirati relations with China have strained those with America. In that light, the Western nation has raised concerns for the UAE to beware of the security threat that the Chinese technologies like Huawei 5G telecommunications network possessed. However, the Gulf nations like the Emirates and Saudi Arabia defended their decision of picking Chinese technology over the American, saying that it is much cheaper and had no political conditions.[344] After President Joe Biden signed into law the Secure Equipment Act of 2021, on 25 November 2022, the FCC issued a ban on Huawei for national security reasons, citing the national security risk posed by the technology owned by China.[345] In May 2024, the U.S. Department of Commerce revoked some export licenses that allow Intel and Qualcomm to supply Huawei with semiconductors.[346][347] In March 2025, the FCC opened an investigation into Huawei and other Chinese companies regarding operations in the U.S. in violation of restrictions.[348] Before the 15 September 2020 deadline, Huawei was in "survival mode" and stockpiled "5G mobile processors, Wifi, radio frequency and display driver chips and other components" from key chip suppliers and manufacturers, including Samsung, SK Hynix, TSMC, MediaTek, Realtek, Novatek, and RichWave.[325] Even in 2019, Huawei spent $23.45 billion on the stockpiling of chips and other supplies in 2019, up 73% from 2018.[325] In May 2020, SMIC manufactured 14 nm chips for Huawei, which was the first time Huawei used a foundry other than TSMC.[349] In July 2020, TSMC confirmed it would halt the shipment of silicon wafers to Chinese telecommunications equipment manufacturer Huawei and its subsidiary HiSilicon by 14 September.[350][351] On its most crucial business, namely, its telecoms business (including 5G) and server business, Huawei has stockpiled 1.5 to 2 years' worth of chips and components.[352] It began massively stockpiling from 2018, when Meng Wanzhou, the daughter of Huawei's founder, was arrested in Canada upon US request.[352] Key Huawei suppliers included Xilinx, Intel, AMD, Samsung, SK Hynix, Micron and Kioxia.[352] On the other hand, analysts predicted that Huawei could ship 195 million units of smartphones from its existing stockpile in 2021, but shipments may drop to 50 million in 2021 if rules are not relaxed.[325] In late 2020, it was reported that Huawei had planned to build a semiconductor manufacturing facility in Shanghai that did not involve US technology.[353] The plan may have helped Huawei obtain necessary chips after its existing stockpile became depleted, which would have helped the company chart a sustainable path for its telecoms business.[353] Huawei had also planned to collaborate with the government-run Shanghai IC R&D Center, which is partially owned by the state-owned enterprise Hua Hong Semiconductor.[353] Huawei may have been purchasing equipment from Chinese firms such as AMEC and NAURA Technology Group, as well as using foreign tools which it could still find on the market.[353] In August 2023, the Semiconductor Industry Association (SIA), a US trade association, alleged that Huawei was building a collection of secret semiconductor-fabrication facilities across China, a shadow manufacturing network that would let the company skirt US sanctions.[354][355][356] Huawei was receiving an estimated $30 billion in state funding from the government at the time and had acquired at least two existing plants, with plans to construct at least three others.[354][356] The United States Department of Commerce had put Huawei on its entity list in 2019,[356] eventually "prohibiting it from working with American companies in almost all circumstances." However, if Huawei were to function under the names of other companies without disclosing its own involvement, it might have been able to circumvent those restrictions to "indirectly purchase American chipmaking equipment and other supplies that would otherwise be prohibited."[354] On 6 September 2023, Huawei launched its new Mate 60 smartphone.[357] The phone is powered by a new Kirin 9000s chip, made in China by Semiconductor Manufacturing International Corp (SMIC).[358] This processor was the first to use the new 7 nanometre SMIC technology. TechInsights had stated in 2022 that it believed SMIC had managed to produce 7 nm chips, even though faced by a harsh sanctions regime, by adapting simpler machines that it could still purchase from ASML.[358] Holger Mueller of Constellation Research Inc. said that this showed that the US sanctions might have had the effect of sending China's chip-making industry into overdrive: "If SMIC really has perfected its 7nm process, this would be a major advance that can help Huawei remain at the forefront of the smartphone industry."[359] TechInsights found evidence that the processor had been manufactured using SMIC's N+2 7 nm node.[360] One of its analysts, Dan Hutcheson, who had led the breakdown of the new device, stated that it demonstrates "impressive technical progress China's semiconductor industry has made" despite not having EUVL tools, and that "the difficulty of this achievement also shows the resilience of the country's chip technological ability". However other analysts have said that such an achievement may lead to harsher sanctions against it.[361] Main articles: Deepin and Harmony OS After the US sanctions regime started in summer 2018, Huawei started working on its own in-house operating system codenamed "HongMeng OS": in an interview with Die Welt, executive Richard Yu stated in 2019 that an in-house OS could be used as a "plan B" if it were prevented from using Android or Windows as the result of US action.[362][363][364] Huawei filed trademarks for the names "Ark", "Ark OS", and "Harmony" in Europe, which were speculated to be connected to this OS.[365][366] On 9 August 2019, Huawei officially unveiled Harmony OS at its inaugural HDC developers' conference in Dongguan with the ARK compiler which can be used to port Android APK packages to the OS.[367][368] In September 2019, Huawei began offering the Linux distribution Deepin as a pre-loaded operating system on selected Matebook models in China.[369] Whereas at first the official Huawei line was that Harmony OS was not intended for smartphones, in June 2021 Huawei began shipping its smartphones[370] with Harmony OS by default in China (in Europe it kept Android, in its own version EMUI, as the default). The operating system proved a success in China, rising from no market share at all to 10 per cent of the Chinese market for smartphones within two years (from mid-2021 to mid-2023), at the expense of Android.[371] In 2013, Taiwan blocked mobile network operators and government departments from using Huawei equipment.[372] In 2018, Japan banned Huawei from receiving government contracts.[26][30][373] In 2019, Vietnam left Huawei out of bids to build the country's 5G network out of national security concerns.[374][375] Following the initial 2020–2021 China–India skirmishes, India announced that Huawei telecommunication gear would be removed from the country and that the company would be blocked from participating in India's 5G network out of national security concerns.[376][27] Ten out of the 27 European Union member states have regulatory frameworks curbing Huawei products. They range from bans, higher barriers to approval, refusal to renew licenses, and unimplemented proposals.[29][377] Having previously banned Huawei from participating in its 5G auction, Brazil reversed its position in early 2021 and allowed Huawei to participate.[113]:131 In May 2022, Canada's government banned Huawei and ZTE equipment from the country's 5G network, with network operators having until 28 June 2024 to remove what they had already installed. The ban followed years of lobbying from the US, part of the Five Eyes intelligence alliance that also includes Australia, Canada, New Zealand, and the UK.[378][379] Australia and New Zealand have also banned or restricted Huawei products.[380] In October 2022, the UK extended the deadline by a year to the end of 2023 for removing core Huawei equipment from network functions. The ban, originally announced in 2020 following US pressure, calls for the phasing out of all Huawei gear from UK's 5G network by the end of 2027, which remains unchanged.[381] Per an August 2023 decree on 5G network development, Costa Rica barred firms from all countries that have not signed the Budapest Convention on Cybercrime.[382][383] The decree affects Chinese firms like Huawei, as well as firms from South Korea, Russia and Brazil, among others.[382] In July 2024, the German government announced a deal with telecommunication companies in the country to remove Chinese 5G equipment, including from Huawei, by 2029.[384] In June 2025, Taiwan added Huawei to its export control list.[385] Western distrust and targeting of Huawei is generally viewed by the Chinese public as unjustified.[182]:66 This has led to a perspective in the Chinese public and among city governments that patronizing Huawei helps support China in geopolitical and technological competition with the United States.[182]:66 Huawei has thus received high levels of support in terms of public sentiment which its rival firms do not benefit from to the same extent.[182]:66 Huawei's top position in China's smart cities technology market has in particular been boosted by these sentiments.[182]:66

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Compared to 4G, 5G networks offer not only higher download speeds, with a peak speed of 10 gigabits per second (Gbit/s),[a] but also substantially lower latency, enabling near-instantaneous communication through cellular base stations and antennae.[1] There is one global unified 5G standard: 5G New Radio (5G NR),[2] which has been developed by the 3rd Generation Partnership Project (3GPP) based on specifications defined by the International Telecommunication Union (ITU) under the IMT-2020 requirements.[3] The increased bandwidth of 5G over 4G allows them to connect more devices simultaneously and improving the quality of cellular data services in crowded areas.[4] These features make 5G particularly suited for applications requiring real-time data exchange, such as extended reality (XR), autonomous vehicles, remote surgery, and industrial automation. Additionally, the increased bandwidth is expected to drive the adoption of 5G as a general Internet service provider (ISP), particularly through fixed wireless access (FWA), competing with existing technologies such as cable Internet, while also facilitating new applications in the machine-to-machine communication and the Internet of Things (IoT), the latter of which may include diverse applications such as smart cities, connected infrastructure, industrial IoT, and automated manufacturing processes. Unlike 4G, which was primarily designed for mobile broadband, 5G can handle millions of IoT devices with stringent performance requirements, such as real-time sensor data processing and edge computing. 5G networks also extend beyond terrestrial infrastructure, incorporating non-terrestrial networks (NTN) such as satellites and high-altitude platforms, to provide global coverage, including remote and underserved areas. 5G deployment faces challenges such as significant infrastructure investment, spectrum allocation, security risks, and concerns about energy efficiency and environmental impact associated with the use of higher frequency bands. However, it is expected to drive advancements in sectors like healthcare, transportation, and entertainment. Mobile base station at Hatta city, UAE 5G networks are cellular networks,[5] in which the service area is divided into small geographical areas called cells. All 5G wireless devices in a cell communicate by radio waves with a cellular base station via fixed antennas, over frequencies assigned by the base station. The base stations, termed nodes, are connected to switching centers in the telephone network and routers for Internet access by high-bandwidth optical fiber or wireless backhaul connections. As in other cellular networks, a mobile device moving from one cell to another is automatically handed off seamlessly. The industry consortium setting standards for 5G, the 3rd Generation Partnership Project (3GPP), defines "5G" as any system using 5G NR (5G New Radio) software—a definition that came into general use by late 2018. 5G continues to use OFDM encoding. Several network operators use millimeter waves or mmWave called FR2 in 5G terminology, for additional capacity and higher throughputs. Millimeter waves have a shorter range than the lower frequency microwaves, therefore the cells are of a smaller size. Millimeter waves also have more trouble passing through building walls and humans. Millimeter-wave antennas are smaller than the large antennas used in previous cellular networks. The increased data rate is achieved partly by using additional higher-frequency radio waves in addition to the low- and medium-band frequencies used in previous cellular networks. For providing a wide range of services, 5G networks can operate in three frequency bands—low, medium or high. 5G can be implemented in low-band, mid-band or high-band millimeter-wave. Low-band 5G uses a similar frequency range to 4G smartphones, 600–900 MHz, which can potentially offer higher download speeds than 4G: 5–250 megabits per second (Mbit/s).[6][7] Low-band cell towers have a range and coverage area similar to 4G towers. Mid-band 5G uses microwaves of 1.7–4.7 GHz, allowing speeds of 100–900 Mbit/s, with each cell tower providing service up to several kilometers in radius. This level of service is the most widely deployed, and was deployed in many metropolitan areas in 2020. Some regions are not implementing the low band, making Mid-band the minimum service level. High-band 5G uses frequencies of 24–47 GHz, near the bottom of the millimeter wave band, although higher frequencies may be used in the future. It often achieves download speeds in the gigabit-per-second (Gbit/s) range, comparable to co-axial cable Internet service. However, millimeter waves (mmWave or mmW) have a more limited range, requiring many small cells.[8] They can be impeded or blocked by materials in walls or windows or pedestrians.[9][10] Due to their higher cost, plans are to deploy these cells only in dense urban environments and areas where crowds of people congregate such as sports stadiums and convention centers. The above speeds are those achieved in actual tests in 2020, and speeds are expected to increase during rollout.[6] The spectrum ranging from 24.25 to 29.5 GHz has been the most licensed and deployed 5G mmWave spectrum range in the world.[11] Rollout of 5G technology has led to debate over its security and relationship with Chinese vendors. It has also been the subject of health concerns and misinformation, including discredited conspiracy theories linking it to the COVID-19 pandemic. The ITU-R has defined three main application areas for the enhanced capabilities of 5G. They are Enhanced Mobile Broadband (eMBB), Ultra Reliable Low Latency Communications (URLLC), and Massive Machine Type Communications (mMTC).[12] Only eMBB is deployed in 2020; URLLC and mMTC are several years away in most locations.[13] Enhanced Mobile Broadband (eMBB) uses 5G as a progression from 4G LTE mobile broadband services, with faster connections, higher throughput, and more capacity. This will benefit areas of higher traffic such as stadiums, cities, and concert venues.[14] 'Ultra-Reliable Low-Latency Communications' (URLLC) refers to using the network for mission-critical applications that require uninterrupted and robust data exchange. Short-packet data transmission is used to meet both reliability and latency requirements of the wireless communication networks. Massive Machine-Type Communications (mMTC) would be used to connect to a large number of devices. 5G technology will connect some of the 50 billion connected IoT devices.[15] Most will use the less expensive Wi-Fi. Drones, transmitting via 4G or 5G, will aid in disaster recovery efforts, providing real-time data for emergency responders.[15] Most cars will have a 4G or 5G cellular connection for many services. Autonomous cars do not require 5G, as they have to be able to operate where they do not have a network connection.[16] However, most autonomous vehicles also feature tele-operations for mission accomplishment, and these greatly benefit from 5G technology.[17][18] The 5G Automotive Association has been promoting the C-V2X communication technology that will first be deployed in 4G. It provides for communication between vehicles and infrastructures.[19] A real time digital twin of the real object such as a turbine engine, aircraft, wind turbines, offshore platform and pipelines. 5G networks helps in building it due to the latency and throughput to capture near real-time IoT data and support digital twins. Mission-critical push-to-talk (MCPTT) and mission-critical video and data are expected to be furthered in 5G.[20] Fixed wireless connections will offer an alternative to fixed-line broadband (ADSL, VDSL, fiber optic, and DOCSIS connections) in some locations. Utilizing 5G technology, fixed wireless access (FWA) can deliver high-speed internet to homes and businesses without the need for extensive physical infrastructure. This approach is particularly beneficial in rural or underserved areas where traditional broadband deployment is too expensive or logistically challenging. 5G FWA can outperform older fixed-line technologies such as ADSL and VDSL in terms of speed and latency, making it suitable for bandwidth-intensive applications like streaming, gaming, and remote work.[21][22][23] Sony has tested the possibility of using local 5G networks to replace the SDI cables currently used in broadcast camcorders.[24] The 5G Broadcast tests started around 2020 (Orkney, Bavaria, Austria, Central Bohemia) based on FeMBMS (Further evolved multimedia broadcast multicast service).[25] The aim is to serve unlimited number of mobile or fixed devices with video (TV) and audio (radio) streams without these consuming any data flow or even being authenticated in a network. Main article: Voice over NR 5G networks, like 4G networks, do not natively support voice calls traditionally carried over circuit-switched technology. Instead, voice communication is transmitted over the IP network, similar to IPTV services. To address this, Voice over NR (VoNR) is implemented, allowing voice calls to be carried over the 5G network using the same packet-switched infrastructure as other IP-based services, such as video streaming and messaging. Similarly to how Voice over LTE (VoLTE) enables voice calls on 4G networks, VoNR (Vo5G) serves as the 5G equivalent for voice communication, but it requires a 5G standalone (SA) network to function.[26] This article possibly contains unsourced predictions, speculative material, or accounts of events that might not occur. Information must be verifiable and based on reliable published sources. Please help improve it by removing unsourced speculative content. (January 2022) (Learn how and when to remove this message) 5G is capable of delivering significantly faster data rates than 4G (5G is approximately 10 times faster than 4G),[27][28] with peak data rates of up to 20 gigabits per second (Gbps).[29] Furthermore, average 5G download speeds have been recorded at 186.3 Mbit/s in the U.S. by T-Mobile,[30] while South Korea, as of May 2022[update], leads globally with average speeds of 432 megabits per second (Mbps).[31][32] 5G networks are also designed to provide significantly more capacity than 4G networks, with a projected 100-fold increase in network capacity and efficiency.[33] The most widely used form of 5G, sub-6 GHz 5G (mid-band), is capable of delivering data rates ranging from 10 to 1,000 megabits per second (Mbps), with a much greater reach than mm Wave bands. C-Band (n77/n78) was deployed by various U.S. operators in 2022 in the sub-6 bands, although its deployment by Verizon and AT&T was delayed until early January 2022 due to safety concerns raised by the Federal Aviation Administration. The record for 5G speed in a deployed network is 5.9 Gbit/s as of 2023, but this was tested before the network was launched.[34] Low-band frequencies (such as n5) offer a greater coverage area for a given cell, but their data rates are lower than those of mid and high bands in the range of 5–250 megabits per second (Mbps).[7] In 5G, the ideal "air latency" is of the order of 8 to 12 milliseconds i.e., excluding delays due to HARQ retransmissions, handovers, etc. Retransmission latency and backhaul latency to the server must be added to the "air latency" for correct comparisons. Verizon reported the latency on its 5G early deployment is 30 ms.[35] Edge Servers close to the towers have the possibility to reduce round-trip time (RTT) latency to 14 milliseconds and the minimum jitter to 1.84 milliseconds.[36] Latency is much higher during handovers; ranging from 50 to 500 milliseconds depending on the type of handover[citation needed]. Reducing handover interruption

expected to cause interference with C-Band satellite stations, which operate by receiving satellite signals at 3.4–4.2 GHz frequency.[178] This interference can be mitigated with low-noise block downconverters and waveguide filters.[178] In regions like the US and EU, the 6 GHz band is to be opened up for unlicensed applications, which would permit the deployment of 5G-NR Unlicensed, 5G version of LTE in unlicensed spectrum, as well as Wi-Fi 6e. However, interference could occur with the co-existence of different standards in the frequency band.[179] There have been concerns surrounding the promotion of 5G, questioning whether the technology is overhyped. There are questions on whether 5G will truly change the customer experience,[180] ability for 5G's mmWave signal to provide significant coverage,[181][182] overstating what 5G can achieve or misattributing continuous technological improvement to "5G",[183] lack of new use case for carriers to profit from,[184] wrong focus on emphasizing direct benefits on individual consumers instead of for Internet of Things devices or solving the last mile problem,[185] and overshadowing the possibility that in some aspects there might be other more appropriate technologies.[186] Such sort of concerns have also led to consumers not trusting information provided by cellular providers on the topic.[187] Main article: 5G misinformation Further information: Wireless device radiation and health There is a long history of fear and anxiety surrounding wireless signals that predates 5G technology. The fears about 5G are similar to those that have persisted throughout the 1990s and 2000s. According to the US Centers for Disease Control and Prevention (CDC) "exposure to intense, direct amounts of non-ionizing radiation may result in damage to tissue due to heat. This is not common and mainly of concern in the workplace for those who work on large sources of non-ionizing radiation devices and instruments."[188] Some advocates of fringe health claim the regulatory standards are too low and influenced by lobbying groups.[189] An anti-5G sticker in Luxembourg There have been rumors that 5G mobile phone use can cause cancer, but this is a myth.[190] Many popular books of dubious merit have been published on the subject[additional citation(s) needed] including one by Joseph Mercola alleging that wireless technologies caused numerous conditions from ADHD to heart diseases and brain cancer. Mercola has drawn sharp criticism for his anti-vaccinationism during the COVID-19 pandemic and was warned by the Food and Drug Administration to stop selling fake COVID-19 cures through his online alternative medicine business.[189][191] According to The New York Times, one origin of the 5G health controversy was an erroneous unpublished study that physicist Bill P. Curry did for the Broward County School Board in 2000 which indicated that the absorption of external microwaves by brain tissue increased with frequency.[192] According to experts[vague] this was wrong, the millimeter waves used in 5G are safer than lower frequency microwaves because they cannot penetrate the skin and reach internal organs. Curry had confused in vitro and in vivo research. However Curry's study was widely distributed on the Internet. Writing in The New York Times in 2019, William Broad reported that RT America began airing programming linking 5G to harmful health effects which "lack scientific support", such as "brain cancer, infertility, autism, heart tumors, and Alzheimer's disease". Broad asserted that the claims had increased. RT America had run seven programs on this theme by mid-April 2019 but only one in the whole of 2018. The network's coverage had spread to hundreds of blogs and websites.[193] In April 2019, the city of Brussels in Belgium blocked a 5G trial because of radiation rules.[194] In Geneva, Switzerland, a planned upgrade to 5G was stopped for the same reason.[195] The Swiss Telecommunications Association (ASUT) has said that studies have been unable to show that 5G frequencies have any health impact.[196] According to CNET,[197] "Members of Parliament in the Netherlands are also calling on the government to take a closer look at 5G. Several leaders in the United States Congress have written to the Federal Communications Commission expressing concern about potential health risks. In Mill Valley, California, the city council blocked the deployment of new 5G wireless cells."[197][198][199][200][201] Similar concerns were raised in Vermont[202] and New Hampshire.[197] The US FDA is quoted saying that it "continues to believe that the current safety limits for cellphone radiofrequency energy exposure remain acceptable for protecting the public health".[203] After campaigning by activist groups, a series of small localities in the UK, including Totnes, Brighton and Hove, Glastonbury, and Frome, passed resolutions against the implementation of further 5G infrastructure, though these resolutions have no impact on rollout plans.[204][205][206] Low-level EMF does have some effects on other organisms.[207] Vian et al., 2006 finds an effect of microwave on gene expression in plants.[207] A meta-analysis of 95 in vitro and in vivo studies showed that an average of 80% of the in vivo research showed effects of such radiation, as did 58% of the in vitro research, but that the results were inconclusive as to whether any of these effects pose a health risk.[208] Main article: COVID-19 misinformation § 5G mobile-phone networks The World Health Organization published a mythbuster infographic to combat the conspiracy theories about COVID-19 and 5G As the introduction of 5G technology coincided with the time of the COVID-19 pandemic, several conspiracy theories circulating online posited a link between COVID-19 and 5G.[209] This has led to dozens of arson attacks being made on telecom masts in the Netherlands (Amsterdam, Rotterdam, etc.), Ireland (Cork,[210] etc.), Cyprus, the United Kingdom (Dagenham, Huddersfield, Birmingham, Belfast and Liverpool),[211][212] Belgium (Pelt), Italy (Maddaloni), Croatia (Bibinje)[213] and Sweden.[214] It led to at least 61 suspected arson attacks against telephone masts in the United Kingdom alone[215] and over twenty in The Netherlands. In the early months of the pandemic, anti-lockdown protesters at protests over responses to the COVID-19 pandemic in Australia were seen with anti-5G signs, an early sign of what became a wider campaign by conspiracy theorists to link the pandemic with 5G technology. There are two versions of the 5G-COVID-19 conspiracy theory:[189] The first version claims that radiation weakens the immune system, making the body more vulnerable to SARS-CoV-2 (the virus that causes COVID-19). The second version claims that 5G causes COVID-19. There are different variations on this. Some claim that the pandemic is coverup of illness caused by 5G radiation or that COVID-19 originated in Wuhan because that city was "the guinea-pig city for 5G". Main articles: 5G Evolution, LTE Advanced Pro, and LTE AdvancedThis section needs expansion. You can help by adding to it. (October 2023) In various parts of the world, carriers have launched numerous differently branded technologies, such as "5G Evolution", which advertise improving existing networks with the use of "5G technology".[216] However, these pre-5G networks are an improvement on specifications of existing LTE networks that are not exclusive to 5G. While the technology promises to deliver higher speeds, and is described by AT&T as a "foundation for our evolution to 5G while the 5G standards are being finalized", it cannot be considered to be true 5G. When AT&T announced 5G Evolution, 4x4 MIMO, the technology that AT&T is using to deliver the higher speeds, had already been put in place by T-Mobile without being branded with the 5G moniker. It is claimed that such branding is a marketing move that will cause confusion with consumers, as it is not made clear that such improvements are not true 5G.[217] With the rollout of 5G, 4G has become more available and affordable, with the world's most developed countries having >90% LTE coverage.[218] Because of this, 4G is still not obsolete even today.[219] 4G plans are sold alongside 5G plans on US carriers,[220] with 4G being cheaper than 5G.[221] This section needs to be updated. Please help update this article to reflect recent events or newly available information. (April 2019) Cellular network standards and generation timeline. In April 2008, NASA partnered with Geoff Brown and Machine-to-Machine Intelligence (M2Mi) Corp to develop a fifth generation communications technology approach, though largely concerned with working with nanosats.[222] In August 2012, New York University founded NYU Wireless, a multi-disciplinary academic research centre that has conducted pioneering work in 5G wireless communications.[223] On October 8, 2012, the UK's University of Surrey secured £35M for a new 5G research centre, jointly funded by the British government's UK Research Partnership Investment Fund (UKRPIF) and a consortium of key international mobile operators and infrastructure providers, including Huawei, Samsung, Telefónica Europe, Fujitsu Laboratories Europe, Rohde & Schwarz, and Aircom International. It will offer testing facilities to mobile operators keen to develop a mobile standard that uses less energy and less radio spectrum, while delivering speeds higher than current 4G with aspirations for the new technology to be ready within a decade.[224][225][226][227] On November 1, 2012, the EU project "Mobile and wireless communications Enablers for the Twenty-twenty Information Society" (METIS) started its activity toward the definition of 5G. METIS achieved an early global consensus on these systems. In this sense, METIS played an important role in building consensus among other external major stakeholders prior to global standardization activities. This was done by initiating and addressing work in relevant global fora (e.g. ITU-R), as well as in national and regional regulatory bodies.[228] That same month, the ijOIN EU project was launched, focusing on "small cell" technology, which is of key importance for taking advantage of limited and strategic resources, such as the radio wave spectrum. According to Günther Oettinger, the European Commissioner for Digital Economy and Society (2014–2019), "an innovative utilization of spectrum" is one of the key factors at the heart of 5G success. Oettinger further described it as "the essential resource for the wireless connectivity of which 5G will be the main driver".[229] ijOIN was selected by the European Commission as one of the pioneering 5G research projects to showcase early results on this technology at the Mobile World Congress 2015 (Barcelona, Spain). In February 2013, ITU-R Working Party 5D (WP 5D) started two study items: (1) Study on IMT Vision for 2020 and beyond, and; (2) Study on future technology trends for terrestrial IMT systems. Both aiming at having a better understanding of future technical aspects of mobile communications toward the definition of the next generation mobile.[230] On May 12, 2013, Samsung Electronics stated that they had developed a "5G" system. The core technology has a maximum speed of tens of Gbit/s (gigabits per second). In testing, the transfer speeds for the "5G" network sent data at 1.056 Gbit/s to a distance of up to 2 kilometers with the use of an 8*8 MIMO.[231][232] In July 2013, India and Israel agreed to work jointly on development of fifth generation (5G) telecom technologies.[233] On October 1, 2013, NTT (Nippon Telegraph and Telephone), the same company to launch world's first 5G network in Japan, wins Minister of Internal Affairs and Communications Award at CEATEC for 5G R&D efforts.[234] On November 6, 2013, Huawei announced plans to invest a minimum of $600 million into R&D for next generation 5G networks capable of speeds 100 times higher than modern LTE networks.[235] On April 3, 2019, South Korea became the first country to adopt 5G.[236] Just hours later, Verizon launched its 5G services in the United States, and disputed South Korea's claim of becoming the world's first country with a 5G network, because allegedly, South Korea's 5G service was launched initially for just six South Korean celebrities so that South Korea could claim the title of having the world's first 5G network.[237] In fact, the three main South Korean telecommunication companies (SK Telecom, KT, and LG Uplus) added more than 40,000 users to their 5G network on the launch day.[238] In June 2019, the Philippines became the first country in Southeast Asia to roll out a 5G broadband network after Globe Telecom commercially launched its 5G data plans to customers.[239] AT&T brings 5G service to consumers and businesses in December 2019 ahead of plans to offer 5G throughout the United States in the first half of 2020.[240][241][242] In 2020, AIS and TrueMove H launched 5G services in Thailand, making it the first country in Southeast Asia to have commercial 5G.[243][244] A functional mockup of a Russian 5G base station, developed by domestic specialists as part of Rostec's digital division Rostec.digital, was presented in Nizhny Novgorod at the annual conference "Digital Industry of Industrial Russia".[245][246] 5G speeds have declined in many countries since 2022, which has driven the development of 5.5G to increase connection speeds.[247] ^ When there is only one user in the network ^ Hoffman, Chris (January 7, 2019). 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The participating associations were ARIB/TTC (Japan), China Communications Standards Association, Telecommunications Industry Association (North America) and Telecommunications Technology Association (South Korea). The agreement was established in December 1998. Ultra Mobile Broadband (UMB) was a 3GPP2 project to develop a fourth-generation successor to CDMA2000. In November 2008, Qualcomm, UMB's lead sponsor, announced it was ending development of the technology, favoring LTE instead.[1] 3GPP2 should not be confused with 3GPP; 3GPP is the standard body behind the Universal Mobile Telecommunications System (UMTS) that is the 3G upgrade to GSM networks, while 3GPP2 was the standard body behind the competing 3G standard CDMA2000 that is the 3G upgrade to cdmaOne networks that was used mostly in the United States (and to some extent also in Japan, China, Canada, South Korea and India). GSM/UMTS were the most widespread 2G/3G wireless standards worldwide. Most countries used only the GSM family. A few countries, including China, the United States, Canada, Ukraine, Trinidad and Tobago, India, South Korea and Japan, used both standards. 3GPP2 had its last activity in 2013,[2] and the group has been dormant ever since. The 3GPP2 website was taken offline in 2023, primarily due to CDMA carriers deploying 3GPP's LTE instead of UMB the decade prior and later shutting down CDMA networks making the 3GPP2 redundant and unneeded. However, as of 2024 the 3GPP2 website has since come back online. ^ Qualcomm halts UMB project, Reuters, 13 November 2008 ^ "3GPP2 Technology Webinar". 3GPP2. 3GPP2 Official Web site About 3GPP2 TIA – U.S. 3GPP2 Standards Developer This article about wireless technology is a stub. You can help Wikipedia by expanding it.vte Retrieved from " 7Mobile telecommunications standards body 3rd Generation Partnership ProjectAbbreviation3GPPFormation1998; 27 years ago (1998)TypeStandards organizationRegion served WorldwideWebsitewww.3gpp.org The 3rd Generation Partnership Project (3GPP) is an umbrella term for a number of standards organizations which develop protocols for mobile telecommunications. Its best known work is the development and maintenance of:[1] GSM and related 2G and 2.5G standards, including GPRS and EDGE UMTS and related 3G standards, including HSPA and HSPA+ LTE and related 4G standards, including LTE Advanced and LTE Advanced Pro 5G NR and related 5G standards, including 5G-Advanced An evolved IP Multimedia Subsystem (IMS) developed in an access independent manner 3GPP is a consortium with seven national or regional telecommunication standards organizations as primary members ("organizational partners") and a variety of other organizations as associate members ("market representation partners"). The 3GPP organizes its work into three different streams: Radio Access Networks, Services and Systems Aspects, and Core Network and Terminals.[2] The project was established in December 1998 with the goal of developing a specification for a 3G mobile phone system based on the 2G GSM system, within the scope of the International Telecommunication Union's International Mobile Telecommunications-2000, hence the name 3GPP.[3] It should not be confused with 3rd Generation Partnership Project 2 (3GPP2), which developed a competing 3G system, CDMA2000.[4] The 3GPP administrative support team (known as the "Mobile Competence Centre") is located at the European Telecommunications Standards Institute headquarters in the Sophia Antipolis technology park in France.[5] The seven 3GPP Organizational Partners are from Asia, Europe and North America. Their aim is to determine the general policy and strategy of 3GPP and perform the following tasks: The approval and maintenance of the 3GPP scope; The maintenance of the Partnership Project Description; Take the decision to create or cease a Technical Specification Groups, and approve their scope and terms of reference; The approval of Organizational Partner funding requirements; The allocation of human and financial resources provided by the Organizational Partners to the Project Co-ordination Group; Act as a body of appeal on procedural matters referred to them. Together with the Market Representation Partners (MRPs) perform the following tasks: The maintenance of the Partnership Project Agreement; The approval of applications for 3GPP partnership; Take the decision against a possible dissolution of 3GPP. The Organizational Partners are:[6] Organizational Partners Organization Country/region Website Association of Radio Industries and Businesses (ARIB) Japan ARIB Alliance for Telecommunications Industry Solutions (ATIS) USA ATIS China Communications Standards Association (CCSA) China CCSA European Telecommunications Standards Institute (ETSI) Europe ETSI Telecommunications Standards Development Society (TSDSI) India TSDSI Telecommunications Technology Association (TTA) South Korea TTA Telecommunication Technology Committee (TTC) Japan TTC The 3GPP Organizational Partners can invite a Market Representation Partner to take part in 3GPP, which: Has the ability to offer market advice to 3GPP and to bring into 3GPP a consensus view of market requirements (e.g., services, features and functionality) falling within the 3GPP scope; Does not have the capability and authority to define, publish and set standards within the 3GPP scope, nationally or regionally; Has committed itself to all or part of the 3GPP scope; Has signed the Partnership Project Agreement. As of January 2025[update], the Market Representation Partners are:[6] Market Representation Partners Organization Website 5G-ACIA 5G Automotive Association 5G Americas Deterministic Networking Alliance (5GDNA) 6G Smart Network and Services Industry Association (6G-IA) 5G Slicing Association (5GSA) 5G Media Action Group (5G-MAG) Automotive Edge Computing Consortium (AECC) Broadband India Forum Cellular Operators Association of India (COAI) China Society of Automotive Engineers (CSAE) CTIA Global Satellite Operators Association (GSOA) Global Certification Forum (GCF) Global mobile Suppliers Association (GSA) GSMA IPV6 Forum Next Generation Mobile Networks (NGMN) Public Safety Communication Europe (PSCE) Forum Small Cell Forum TCCA TD Industry Alliance Wireless Broadband Alliance 3GPP standards are structured as Releases. Discussion of 3GPP thus frequently refers to the functionality in one release or another. Version[7] Released[8] Info Phase 1 1992 GSM Features Phase 2 1995 GSM Features, EFR Codec, Release 96 1997 Q1 GSM Features, 14.4 kbit/s User Data Rate, Release 97 1998 Q1 GSM Features, GPRS Release 98 1999 Q1 GSM Features, AMR codec, EDGE, GPRS for PCS1900 Release 99 2000 Q1 Specified the first UMTS 3G networks, incorporating a CDMA air interface[9] Release 4 2001 Q2 Originally called the Release 2000 – added features including an all-IP Core Network[10] Release 5 2002 Q1 Introduced IMS and HSDPA[11] Release 6 2004 Q4 Integrated operation with Wireless LAN networks and adds HSUPA, MBMS, enhancements to IMS such as Push to Talk over Cellular (PoC), GAN[12] Release 7 2007 Q4 Focuses on decreasing latency, improvements to QoS and real-time applications such as VoIP.[13] This specification also focus on HSPA+ (High Speed Packet Access Evolution), SIM high-speed protocol and contactless front-end interface (Near Field Communication enabling operators to deliver contactless services like Mobile Payments), EDGE Evolution. Release 8 2008 Q4 First LTE release. All-IP Network (SAE). New OFDMA, FDE and MIMO based radio interface, not backwards compatible with previous CDMA interfaces. Dual-Cell HSDPA. UMTS HNB. Release 9 2009 Q4 SAES Enhancements, WiMAX and LTE/UMTS Interoperability. Dual-Cell HSDPA with MIMO, Dual-Cell HSUPA. LTE HeNB. Evolved multimedia broadcast and multicast service (eMBMS). Release 10 2011 Q1 LTE Advanced fulfilling IMT Advanced 4G requirements. Backwards compatible with release 8 (LTE). Multi-Cell HSDPA (4 carriers). Release 11 2012 Q3 Advanced IP Interconnection of Services. Service layer interconnection between national operators/carriers as well as third-party application providers. Heterogeneous networks (HetNet) improvements, Coordinated Multi-Point operation (CoMP). In-device Co-