REVIEW OF THE SPECIFICATIONS AND FEATURES OF DIFFERENT SMARTPHONES MODELS

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By

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1. Introduction:

A smartphone is a portable device that combines mobile telephone and computing functions into one unit. It is a cellular telephone with an integrated computer and other features not originally associated with telephones such as an operating system, web browsing, multimedia functionality, the ability to run software applications, along with core phone functions such as voice calls and text messaging.

Smartphones typically contain a number of metal–oxide–semiconductor (MOS) integrated circuit (IC) chips, include various sensors that can be leveraged by pre-included and third-party software (such as a magnetometer, proximity sensors, barometer, gyroscope, accelerometer and more), and support wireless communications protocols (such as Bluetooth, Wi-Fi, or satellite navigation).

The best phones offer you everything you want from a mobile device. They deliver great cameras, the performance you need to multitask and enough battery life.

The existing brands for Smartphones nowadays are: Samsung, Xiaomi, iPhone, Nokia, Huawei, Google Pixel, HTC, Asus, LG, Alcatel, Infinix, Panasonic,

BlackBerry, Tecno, TCL, Oppo, Realme, Gionee, ZTE, Sony, Vivo, Lava, Lenovo, Microsoft, and Motorola.

The most popular brands of smartphones are: Samsung, Apple, Huawei, Xiaomi, Oppo, Vivo, Realme, Sony.

Choosing a smartphone for yourself not easy task. Factors that affect your choices of Smart phone are: price range, features, the operating system you prefer, the important specs for you.

To help you to pick the best smartphone for you, I provide here briefer review for the specifications of different types of smartphones along with some helpful customer reviews in order to see ow the customers evaluate the product.

This report consists of the following sections:

1. Price comparison of different budget smartphone models.

2. The differences between 2G, 3G, 4G LTE, 5G networks and WIFI.

3. The differences between NFC and Bluetooth.

4. The differences Android and iOS.

5. How to choose a smartphone by brand, carrier, or features.

6. How to keep your phone from overheating.

7. Security issues according to Check Point.

8. Samsung.

9. Xiaomi Redmi.

10. Xiaomi Poco.

11. Apple.

12. Nokia.

13. Huawei.

14. Google Pixel.

15. Microsoft.

16. Realme.

17. Sony.

18. Others mobile brands: HTC, Asus, LG, Alcatel, Infinix, Panasonic, BlackBerry, Tecno, TCL, Gionee, ZTE, Oppo, Vivo, Lava, Lenovo, Motorola, Meizu, Honor, OnePlus.

19. References.

2. Price comparison of different budget smartphone models:

In this section, I will just list different budget smartphone models along with their prices for sake of price comparison.

Smartphone Brand	**OS**	**Smartphone model example**	**Average price of the Smartphone model example**
Samsung	**Android**	Samsung Galaxy M12 -Released 2021, April 30 -212g, 9.7mm thickness -Android 11, One UI Core 3.1 -32GB/64GB/128GB storage, microSDXC	181 EURO
Xiaomi	**Android**	Xiaomi Redmi 9 -Released 2020, June 10 -198g, 9.1mm thickness -Android 10, MIUI 11 -32GB/64GB/128GB storage, microSDX	137 EURO
Xiaomi Poco	**Android**	Xiaomi Poco M3 - Released 2020, November 27 - 198g, 9.6mm thickness - Android 10, MIUI 12	168 EURO

		- 64GB/128GB storage, microSDXC	
iPhone	**iOS**	Apple iPhone 12 -Released 2020, October 23 -164g, 7.4mm thickness -iOS 14.1, up to iOS 15 -64GB/128GB/256GB storage, no card slot - Support 5G network	725 EURO (Price with 5G)
Nokia	**Android**	Nokia 5.4 -Released 2020, December 25 -181g, 8.7mm thickness -Android 10, up to Android 11 -64GB/128GB storage, microSDXC)	166 EURO
Huawei	**Android**	Huawei Nova 7i -Released 2020, February 14 -183g, 8.7mm thickness -Android 10, EMUI 10, no Google Play Services -128GB storage, NM	240 EURO
Google Pixel	**Android**	Google Pixel 5 - Released 2020, October 15 - 151g, 8mm thickness - Android 11 - 128GB storage, no card slot	895.00 EURO (Price with 5G)

		- Support 5G network	
Microsoft	**Android**	Microsoft Surface Duo - Released 2020, September 10 - 250g, 9.9mm thickness - Android 10 - 128GB/256GB storage, no card slot	600 EURO
Microsoft	**Microsoft Windows 10**	Microsoft Lumia 950 -Released 2015, November -150g, 8.2mm thickness -Microsoft Windows 10 -32GB storage, microSDXC	280 EURO
Realme	**Android**	Realme 6 - Released 2020, March 11 - 191g, 8.9mm thickness - Android 10, Realme UI - 64GB/128GB storage, microSDXC	215 EUR
HTC	**Android**	HTC Wildfire E3 -Released 2021, April 11 -186g, 9mm thickness -Android 10 -64GB/128GB storage, microSDXC	130 EUR
Asus	**Android**	Asus ROG Phone 3 -Released 2020, July 23	590 EURO (Price with 5G)

		-240g, 9.9mm thickness -Android 10, up to Android 11, ROG UI -128GB/256GB/512GB storage, no card slot - Support 5G network	
LG	**Android**	LG W41 Pro -Released 2021, March 03 -201g, 9.3mm thickness -Android 10 -128GB storage, microSDXC	180 EUR
Alcatel	**Android**	Alcatel 3X (2020) -Released 2020, June -186g, 9.1mm thickness -Android 10 -64GB/128GB storage, microSDXC	142 EURO
Infinix	**Android**	Infinix Hot 10 -Released 2020, October 17 -195g, 8.9mm thickness -Android 10, XOS 6.0 -64GB/128GB storage, microSDXC	161 EURO
Panasonic	**Android**	Panasonic Eluga I7 - Released 2019, July - 168g, 9.3mm thickness - Android 9.0 - 16GB storage, microSDXC	115 EURO
BlackBerry	**Android**	BlackBerry KEY2.	500 EURO

		-Released 2018, June. -168g, 8.5mm thickness. -Android 8.1. -64GB/128GB storage, microSDXC	
Tecno	**Android**	Tecno Spark 6 -Released 2020, September 25. -9.2mm thickness. -Android 10, HIOS 7.0. -64GB/128GB storage, microSDXC.	110 EURO
TCL	**Android**	TCL 20 5G - Released 2020, December 07 - 206g, 9.1mm thickness - Android 10, TCL UI - 128GB/256GB storage, microSDXC - Support 5G network	300 EURO (Price with 5G)
Oppo	**Android**	Oppo A16 - Released 2021, July 17 - 190g, 8.4mm thickness - Android 11, ColorOS 11.1 - 32GB/64GB/256GB storage, microSDXC	160 EURO
Gionee	**Android**	Gionee M15 - Released 2021, May 28 - 9mm thickness - Android 11	180 EURO
ZTE	**Android**	ZTE Axon 20 4G	370 EURO

		- Released 2020, December 04 -198g, 8mm thickness -Android 10, MiFavor 10.5 -128GB storage, microSDXC	
Sony	Android	Sony Xperia 10 III -Released 2021, June 11 -169g, 8.3mm thickness -Android 11 -128GB/256GB storage, microSDXC - Support 5G network	410 EURO (Price with 5G)
Vivo	Android	Vivo Y72 5G -Released 2021, March 31 -193g, 8.5mm thickness -Android 11, Funtouch 11.1 -128GB storage, microSDXC - Support 5G network	270 EURO (Price with 5G)
Lava	Android	Lava Z6 - Released 2021, January 11 - 190g, 9mm thickness - Android 10 - 64GB storage, microSDXC	110 EURO
Lenovo	Android	Lenovo Tab P11 -Released 2021, February 10	200 EURO

		-490g, 7.5mm thickness -Android 10 -64GB/128GB storage, microSDXC	
Motorola	Android	Motorola Edge 20 - Released 2021, August 27 - 185g, 8.3mm thickness - Android 11 - 128GB storage, microSDXC - Support 5G network	250 EURO (Price with 5G)
Meizu	Android	Meizu X8 -Released 2018, October -160g, 7.8mm thickness -Android 8.0, Flyme UI -64GB/128GB storage, no card slot	200 EURO
Honor	Android	Honor X20 -Released 2021, August 13 -192g, 8.5mm thickness -Android 11, Magic UI 4.2 -128GB/256GB storage, no card slot - Support 5G network	250 EURO (Price with 5G)
OnePlus	Android	OnePlus 8 -Released 2020, April 21 -180g, 8mm thickness	395 EURO (Price with 5G)

		-Android 10, up to Android 11, OxygenOS 11 -128GB/256GB storage, no card slot - Support 5G network	

There is no prefect phone: As example here comparison between the most three popular brands

- Realme 6 – the best telephone quality (zero problems), overall by far the lowest SAR value, best cameras, 90 Hz display refresh rate, fastest UFS memory, best audio performance over 3,5mm jack, and lowest heat output under heavy usage. On the flip side, navigation is barely ok, display could be brighter (it struggles under direct sunlight) and has the lowest autonomy because of battery capacity (it‘s still very good).
- Samsung M31 – the best navigation (very precise), very high quality display (excluding differences between AMOLED and IPS LCD) but is 60 Hz, and by far the longest autonomy thanks to huge battery. One UI is probably the best. On the flip side, SoC is bad – not only performance wise, but it heats like crazy – left back side heat up between 41,2 and 43,6 C under heavy usage. Speaker has average loudness (way lower than other two models), and telephony has a bit of problems.
- Redmi Note 9 Pro – IR blaster, super-fast WiFi (almost double), relatively high navigation precision, very high quality IPS display but is 60 Hz, best speaker (a bit better than 6 which is a needle louder), great autonomy. On the flip side it‘s heaviest (209g!), MIUI is bloated plus ads,

telephony is not perfect, pictures with narrow dynamic range, and gaming is limited to 30 fps.

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3. The differences between 2G, 3G, 4G LTE, 5G networks and WIFI:

It would be self-defeating if a mobile device, such as a smartphone or tablet, could only connect to the Internet when plugged into a landline. It also wouldn't be much fun if a fantastic piece of technology and engineering took five minutes to load a webpage. So, mobile devices need to connect wirelessly and quickly, hence the two wireless broadband methods: cellular and WiFi.

1. What are the G's for?
Each G is simply a different generation, for example, 2G literally means “second generation.” The generations are ever-higher industry standards of speed, so an area with 3G service will always be faster than an area with 2G, but slower than an area with 4G. 5G is the latest speed improvement. It's only just now becoming available in certain areas, and many smartphones don't have 5G antennas yet. Speed also depends on the device being used, since older devices can't use the full power of an area with higher coverage. A 3G phone will work in an area with 4G coverage, but will only connect at 3G speeds, and likewise, a 4G phone will work in an area with 2G, but only connect at 2G speeds.

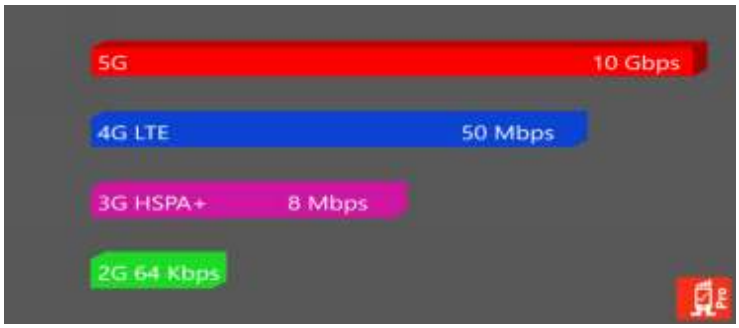
2. What's WiFi?

In contrast, WiFi is a connection standard provided by a wireless network. A wireless network is in turn provided by any other device that connects into another Internet access, which is typically a physical line but can be 3G. That device then translates its own Internet connection into a WiFi network that other devices can share. The idea is one device opens the access for other devices, essentially taking one for the team. WiFi networks have a limited range, generally about the area of a house. They can be private, in which case you need to know a password to have access, or they can be an open, public “hotspot,” allowing any device with WiFi capabilities to log in. Enabling WiFi on a mobile device means you've set that device to look for an existing network and allow you access if it's an open hotspot or if you know the password to a private network. As a rule, WiFi provided by anything other than another mobile device is faster than 4G. WiFi networks are fairly common, as most coffee shops, restaurants, libraries, and bookstores have either free hotspots or will give out a password to paying customers. If you have access to WiFi, it's generally best to use it. Using WiFi is usually faster than cellular and it doesn't use your cellular data plan, which can save money. A few final notes about cellular devices that can provide WiFi hotspots, they do this by translating their cellular connection into a WiFi network. The practical purpose is to allow the many WiFi-only mobile devices, such as some iPads and e-readers, internet access wherever you can set up your 4G device.

3. 3G, 4G, 5G or the secretly common 2G are provided by cell towers, just like for regular cell phones. Cell towers are operated by cellular companies like Verizon, ATT, Sprint, and T-Mobile. You pay a fee for cellular service. Anywhere covered by a cell tower has access to this kind of broadband Internet and email, webpages, and apps all send and receive data over the cellular network. However, some cell towers are older than others and are only equipped to provide a certain generation of service. 5G often requires new towers and antenna locations, so, only a few areas have 5G coverage, while most have 4G. 4G is fast enough to stream videos, but 5G offers even faster speeds. But it requires an upgrade of both mobile devices and cellular equipment.

Simply, the "G" stands for "GENERATION". While connected to the internet, the speed of the connection depends upon the signal strength that is shown in abbreviations like 2G, 3G, 4G, 5G, etc. on any mobile device. Each generation of wireless broadband is defined as a set of telephone network standards that describe the technological implementation of the system.

The aim of wireless communication is to provide high quality, reliable communication just like wired communication and each new generation represents a big leap in that direction. Mobile communication has become more popular in the last few years due to fast reform in mobile technology. For the comparison of 2G, 3G, 4G, and 5G we first need to understand the key features of all these technologies.



4. SECOND GENERATION (2G)

2G refers to the second generation of mobile networks based on GSM. The radio signals used by the 1G network were analog, while 2G networks were digital. 2G capabilities were achieved by allowing multiple users on a single channel via multiplexing. During 2G, cellular phones were used for data along with voice. Some of the key features of 2G were:

- Data speeds of up to 64 kbps
- Use of digital signals instead of analog
- Enabled services such as SMS and MMS (Multimedia Message)
- Provided better quality voice calls
- It used a bandwidth of 30 to 200 KHz

5. THIRD GENERATION (3G)

The 3G standard utilizes Universal Mobile Telecommunications System (UMTS) as its core network architecture. 3G networks combines' aspects of the 2G network with new technologies and protocols to deliver a significantly faster data rate. By using packet switching, the original technology was improved to allow speeds up to 14 Mbps. It used Wide Band Wireless Network that increased clarity. It

operates at a range of 2100 MHz and has a bandwidth of 15-20 MHz some of the main features of 3G are:

- Speed of up to 2 Mbps
- Increased bandwidth and data transfer rates
- Send/receive large email messages
- Large capacities and broadband capabilities
- International Mobile Telecommunications-2000 (IMT-2000) was the specifications by the International Telecommunication Union for the 3G network; theoretically, 21.6 Mbps is the max speed of HSPA+.

6. FOURTH GENERATION (4G)

The most important 4G standards are WiMAX and LTE. While 4G LTE is a major improvement over 3G speeds, it is technically not 4G. What is the difference between 4G and LTE?

Even after it was widely available, many networks were not up to the required speed of 4G. 4G LTE is a “fourth generation long term evolution”, capable of delivering a very fast and secure internet connection. Basically, 4G is the predetermined standard for mobile network connections. 4G LTE is the term given to the path which has to be followed to achieve those predefined standards. Some of the features of 4G LTE are:

- Support interactive multimedia, voice, and video.

- High speed, high capacity and low cost per bit (Speeds of up to 20 Mbps or more.)
- Global and scalable mobile networks.
- Ad hoc and multi-hop networks.

7. FIFTH GENERATION (5G)

5G networks operate on rarely used radio millimeter bands in the 30 GHz to 300 GHz range. Testing of 5G range in mmWave has produced results approximately 500 meters from the tower. Using small cells, the deployment of 5G with millimetre wave based carriers can improve overall coverage area. Combined with beamforming, small cells can deliver extremely fast coverage with low latency. Low latency is one of 5G's most important features. 5G uses a scalable orthogonal frequency-division multiplexing (OFDM) framework. 5G benefits greatly from this and can have latency as low as one millisecond with realistic estimates to be around 1 – 10 seconds. 5G is estimated to be 60 to 120 times faster than the average 4G latency. Active antenna 5G encapsulated with 5G massive MIMO is used for providing better connections and enhanced user experience. Big 5G array antennas are deployed to gain additional beamforming information and knock out propagation challenges that are experienced at mmWave frequency ranges. Further, 5G networks clubbed with network slicing architecture enables telecom operators to offer on-demand tailored connectivity to their users that are adhered to

Service Level Agreement (SLA). Such customized network capabilities comprise latency, data speed, latency, reliability, quality, services, and security.

8. The following is the comparison between 2G, 3G, 4G, and 5G. The comparison of 2G, 3G, 4G, and 5G clearly shows the differences in the technologies. The comparison of 2G, 3G, 4G, and 5G also makes it evident that 5G is going to be one of the most ambitious leaps in the history of cell network technologies.

Comparison	2G	3G	4G	5G
Introduced in year	1993	2001	2009	2018
Technology	GSM	WCDMA	LTE, WIMAX	MIMO, mm Waves
Access system	TDMA, CDMA	CDMA	CDMA	OFDM, BDMA
Switching type	Circuit switching for voice and packet switching for data	Packet switching except for air interference	Packet switching	Packet switching
Internet service	Narrowband	Broadband	Ultra broadband	Wireless World Wide Web
Bandwidth	25 MHz	25 MHz	100 MHz	30 GHz to 300 GHz
Advantage	Multimedia features (SMS, MMS), internet access and SIM introduced	High security, international roaming	Speed, high speed handoffs, global mobility	Extremely high speeds, low latency
Applications	Voice calls, short messages	Video conferencing, mobile TV, GPS	High speed applications, mobile TV, wearable devices	High resolution video streaming, remote control of vehicles, robots, and medical procedures

Network	Peak speed	Average speed
5G	10 Gbps	400 Mbps
4G	1 Gbps	50 Mbps

4. The differences between NFC and Bluetooth:

1. Bluetooth is a wireless protocol for exchanging data over short distances from fixed and mobile devices, creating personal area networks. There are two important parameters of Bluetooth devices - class and supported profiles.

- "Class" signifies the distance at which a Bluetooth connection is possible. Most mobile devices are Class 2, which means they have a range of up to 10 m. Class 1 devices are rare and have a range of up to 100 feet.
- A "profile" is a type of Bluetooth connection. The most common are the Headset (HSP) and Hands-free (HFP) profiles that enable the device to connect to a wireless headset or hands-free.

Some other profiles are OBEX (OBject EXchange) which allows transfer of files, contacts and events; A2DP, which adds support for streaming of stereo sound and AVRC, which allows remote control of playback.

2. NFC is a short-range high frequency wireless communication technology that enables the exchange of data between devices over about a 10 cm distance. NFC is an upgrade of the existing

proximity card standard (RFID) that combines the interface of a smartcard and a reader into a single device. It allows users to seamlessly share content between digital devices, pay bills wirelessly or even use their cellphone as an electronic traveling ticket on existing contactless infrastructure already in use for public transportation. The significant advantage of NFC over Bluetooth is the shorter set-up time. Instead of performing manual configurations to identify Bluetooth devices, the connection between two NFC devices is established at once (under a 1/10 second). Due to its shorter range, NFC provides a higher degree of security than Bluetooth and makes NFC suitable for crowded areas where correlating a signal with its transmitting physical device (and by extension, its user) might otherwise prove impossible. NFC can also work when one of the devices is not powered by a battery (e.g. on a phone that may be turned off, a contactless smart credit card, etc.).

5. The differences Android and iOS:

Google's Android and Apple's iOS are operating systems used primarily in mobile technology, such as smartphones and tablets. Android, which is Linux-based and partly open source, is more PC-like than iOS, in that its interface and basic features are generally more customizable from top to bottom. However, iOS' uniform design elements are sometimes seen as being more user-friendly.

You should choose your smartphone and tablet systems carefully, as switching from iOS to Android or vice versa will require you to buy apps again in the Google Play or Apple App Store. Android is now the world's most commonly used smartphone platform and is used by many different phone manufacturers. iOS is only used on Apple devices, such as the iPhone.

	Android	**iOS**
Developer	Various, mostly Google and Open Handset Alliance	Apple Inc.
Initial release	September 23, 2008	July 29, 2007
Latest stable release and Updates	Android 11	iOS 14.1 and iPadOS 14.1
Customizability	A lot. Can	Limited unless

	change almost anything.	jailbroken
Source model	Open source	Closed, with open source components.
File transfer	Easier than iOS. Using USB port and Android File Transfer desktop app. Photos can be transferred via USB without apps.	More difficult. Media files can be transferred using iTunes desktop app. Photos can be transferred out via USB without apps.
Widgets	Yes, except on lock screen	Yes, except on lock screen
Internet browsing	Google Chrome (other browsers are available). Any browser app can be set as default. Ad blocking is supported with Firefox.	Safari. Any browser app can be set as default but they all use the same rendering engine (Safari/Webkit) behind the scenes. Ad blocking is supported via content blockers like Firefox Focus.
Web mapping service	Google Maps	Apple Maps (default). Google Maps also

		available via a separate app download, but not as default.
Available language(s)	100+ languages	40 languages
Video chat	Google Meet and other 3rd party apps	FaceTime (Apple devices only) and other 3rd party apps
Virtual assistant	Google Assistant	Siri
Available on	Many phones and tablets. Major manufacturers such as Samsung, Oppo, OnePlus, Vivo, Honor and Xiaomi. Android One device are pure Android. Pixel line of devices is made by Google, using almost pure version of Android	iPod Touch, iPhone, iPad, Apple TV (2nd and 3rd generation)