

# Camera phone

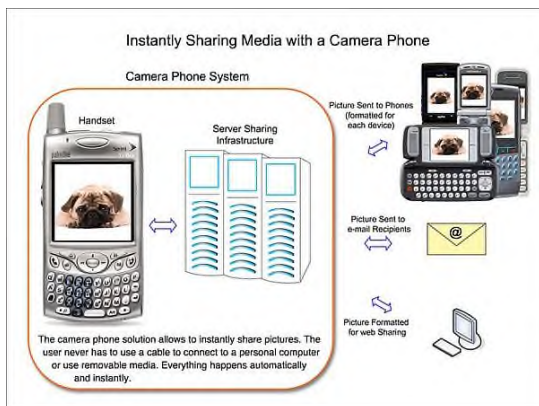
For the song by The Game, see [Camera Phone \(song\)](#).

See also: [Mobile phone](#) and [Videophone](#)

A **camera phone** is a mobile phone which is able to cap-

features and picture quality, and are branded as both mobile phones and cameras.

The principal advantages of camera phones are cost and compactness; indeed for a user who carries a mobile phone anyway, the addition is negligible. Smartphones that are camera phones may run mobile applications to add capabilities such as [geotagging](#) and [image stitching](#). A few high end phones can use their touch screen to direct their camera to focus on a particular object in the field of view, giving even an inexperienced user a degree of focus control exceeded only by seasoned photographers using manual focus. However, the touch screen, being a general purpose control, lacks the agility of a separate camera's dedicated buttons and dial(s).



*The camera phone solution allows instant sharing of pictures. As it's automatic and instant, the user does not have to use a cable or removable media to connect to a personal computer.*

ture [photographs](#). Most camera phones also record video. The first camera phone was sold in 2000 in Japan, a J-Phone model, about a decade after the first digital camera was sold in Japan in December 1989.<sup>[1]</sup>

Most camera phones are simpler than separate digital cameras. Their usual fixed-focus lenses and smaller sensors limit their performance in poor lighting. Lacking a physical shutter, some have a long shutter lag. Flash, where present, is usually weak. Optical zoom<sup>[2]</sup> and tripod screws are rare and none has a hot shoe. Some also lack a USB connection or a removable memory card. Most have Bluetooth and WiFi, and can make [geotagged photographs](#).

Some of the more expensive camera phones have only a few of these technical disadvantages, but with bigger image sensors (a few are up to 1"), their capabilities approach those of low-end point-and-shoot cameras. In the smartphone era, the steady sales increase of camera phones caused point-and-shoot camera sales to peak about 2010 and decline thereafter. Most model lines improve their cameras every year or two.

Some smartphones only have a menu choice to start a camera application program and an on-screen button to activate the shutter.<sup>[3]</sup> Others also have a separate camera button, for quickness and convenience. A few camera phones are designed to resemble separate low-end digital compact cameras in appearance and to some degree in

## 1 Technology

Some camera phones use CMOS image sensors, due to largely reduced power consumption compared to CCD type cameras, which are also used, but not in today's camera phones. Some of today's camera phones even use more expensive Back Side Illuminated CMOS which use energy lesser than CMOS, although more expensive than CMOS and CCD.

Images are usually saved in the JPEG file format, except for some high-end camera phones which have also RAW feature and the Android (operating system) 5.0 Lollipop has facility of it. The wireless infrastructure manages the sharing. The lower power consumption prevents the camera from quickly depleting the phone's battery. In any case, an external battery or flash can be employed, to improve performance.

As camera phone technology has progressed over the years, the lens design has evolved from a simple double Gauss or Cooke triplet to many molded plastic aspheric lens elements made with varying dispersion and refractive indexes. The latest generation of phone cameras also apply distortion (optics), vignetting, and various optical aberration corrections to the image before it is compressed into a .jpeg format.'

Most camera phones have a digital zoom feature. A few have optical zoom. An #External camera can be added, coupled wirelessly to the phone by Wi-Fi. They are compatible with most smartphones.

Android Lollipop 5.0 allows apps to take RAW format pictures.<sup>[4][5]</sup> Windows Phones can be configured to operate as a camera even if the phone is asleep.

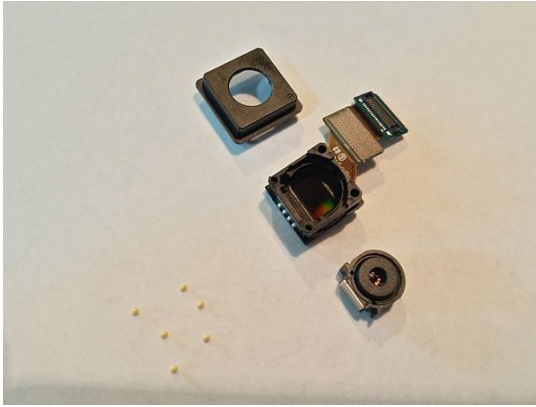


Image showing the components in the Samsung Galaxy S5 camera, including the floating element group, suspended by ceramic bearings and a small rare earth magnet.



Image showing the six molded elements in the Samsung Galaxy S5

## 2 Directory

Phones usually store pictures and video in a directory called /DCIM in the internal memory. Some can store this media in external memory (Secure digital card or USB on the go pen drive).

## 3 History



The Nokia N8 smartphone is the first Nokia smartphone with a 12-megapixel autofocus lens, and is one of the few camera phones (the first was Nokia N82) to feature Carl Zeiss optics with xenon flash.

The camera phone, like many complex systems, is the result of converging and enabling technologies. There are dozens of relevant patents dating back as far as 1956. Compared to digital cameras of the 1990s, a consumer-viable camera in a mobile phone would require far less power and a higher level of camera electronics integration to permit the miniaturization.

The CMOS active pixel sensor “camera-on-a-chip” developed by Dr. Eric Fossum and his team in the early 1990s achieved the first step of realizing the modern camera phone as described in a March 1995 Business Week article. While the first camera phones, as successfully marketed by J-Phone in Japan, used CCD sensors and not CMOS sensors, more than 90% of camera phones sold today use CMOS image sensor technology.

Over the years there have been many videophones and cameras that have included communication capability. Some devices experimented with integration of the device to communicate wirelessly with Internet, which would allow instant media sharing with anyone anywhere. For example, in 1995 Apple experimented with the Apple Videophone/PDA.<sup>[6]</sup> There were several digital cameras with cellular phone transmission capability shown by companies such as Kodak, Olympus in the early 1990s.<sup>[7]</sup> There was also a digital camera with cellular phone designed by Shosaku Kawashima of Canon in Japan in May 1997.<sup>[8]</sup>



June 11, 1997, Santa Cruz, CA: Image taken by Philippe Kahn after his daughter's birth and instantly shared with more than 2000 people around the world.

On June 11, 1997, Philippe Kahn shared instantly the first pictures from the maternity ward where his daughter Sophie was born. He wirelessly transmitted his cell phone pictures to more than 2,000 family, friends and associates around the world. Kahn's wireless sharing software and camera integrated into his cell phone augured the birth of instant visual communications.<sup>[9][10]</sup> Kahn's cell phone transmission is the first known publicly shared picture via a cell phone.<sup>[11]</sup>

In Japan, two competing projects were run by Sharp and Kyocera in 1997. Both had cell phones with integrated



Typical camera phone photograph

cameras. However, the Kyocera system was designed as a peer-to-peer video-phone as opposed to the Sharp project which was initially focused on sharing instant pictures. That was made possible when the Sharp devices was coupled to the Sha-mail infrastructure designed in collaboration with American technologist, Kahn. The Kyocera team was led by Mr. Kazumi Saburi.<sup>[12]</sup>

In 1995, work by James Greenwold of Bureau Of Technical Services, in Chippewa Falls, WI, was developing a pocket video camera for surveillance purposes. By 1999, the Tardis recorder was in prototype and being used by the government. Bureau Of Technical Services, advanced further by the patent # 6,845,215,B1 on Body-Carryable, digital Storage medium, Audio/Video recording Assembly.

Cameras on cell phones proved popular right from the start, as indicated that the J-Phone in Japan had more than half of its subscribers using cell phone cameras in two years. The world soon followed. By 2003, more camera phones were sold worldwide than stand-alone digital cameras. In 2005, Nokia became the world's most sold digital camera brand. In 2006, half of the world's mobile phones had a built-in camera.

In 2006, Thuraya released the first satellite phone with an integrated camera. The Thuraya SG-2520 was manufactured by a Korean company called APSI and ran Windows CE.

By 2007, the first cell phones and other consumer products appeared using the Tardis technology to make the move from still cameras to full motion video.

In 2008, Nokia sold more camera phones than Kodak sold film based simple cameras, thus becoming the biggest manufacturer of any kind of camera.

In 2010, the worldwide number of camera phones totaled more than a billion.<sup>[13]</sup> Most mobile phones, even inexpensive ones, were being sold with a camera. High end camera phones usually had a relatively good lens and high resolution, but a small sensor.

Twelve-megapixel camera phones have been produced by at least two companies.<sup>[14][15]</sup> To highlight the capabilities of the Nokia N8 (Big CMOS Sensor) camera, Nokia created a short film, *The Commuter*, in October 2010. The seven-minute film was shot entirely on the phone's 720p camera. A 14-megapixel smartphone with 3x optical zoom was announced in 2010.<sup>[16]</sup>

In 2012, Nokia announced Nokia 808 PureView. It features a 41-megapixel 1/1.2-inch sensor and a high-resolution f/2.4 Zeiss all-aspherical one-group lens. It also features Nokia's PureView Pro technology, a pixel oversampling technique that reduces an image taken at full resolution into a lower resolution picture, thus achieving higher definition and light sensitivity, and enables lossless zoom.

In mid-2013, Nokia announced the Nokia Lumia 1020. It had an improved version of the 41-megapixel sensor and ran Windows Phone 8 unlike the 808 PureView which was the last phone to run Nokia's Symbian OS.

### 3.1 Multimedia Messaging Service

Main article: [Multimedia Messaging Service](#)

Camera phones can share pictures almost instantly and automatically via a sharing infrastructure integrated with the carrier network. Early developers including Philippe Kahn envisioned a technology that would enable service providers to "collect a fee every time anyone snaps a photo."<sup>[9]</sup> The resulting technologies, Multimedia Messaging Service and Sha-Mail were developed parallel to and in competition to open Internet based mobile communication provided by GPRS and later 3G networks.

The closed sharing infrastructure was critical and explains the early successes of J-Phone, DoCoMo in Japan, Sprint, and other carriers worldwide.

The first commercial camera phone complete with infrastructure was the J-SH04, made by Sharp Corporation, had an integrated CCD sensor, with the Sha-Mail (Picture-Mail in Japanese) infrastructure developed in collaboration with Kahn's LightSurf venture, and marketed from 2001 by J-Phone in Japan today owned by Softbank.

The first commercial deployment in North America of camera phones was in 2004. The Sprint wireless carriers deployed over one million camera phone manufactured by Sanyo and launched by the PictureMail infrastructure (Sha-Mail in English) developed and managed by LightSurf.

Users of early camera phones were held captive by the MMS business model. While phones had internet connectivity, working web browsers and email-programs, the phone menu offered no way of including a photo in an email or uploading it to a web site. Connecting cables or

removable media that would enable the local transfer of pictures were also usually missing.

Modern smartphones have more connectivity and transfer options with photograph attachment features.

## 4 Manufacturers

Major manufacturers include Toshiba, Sharp, Nokia, Sanyo, Samsung, Motorola, Siemens, Sony Mobile, and LG Electronics. Resolution is typically in the range of one tenth to one half as many megapixels as contemporary low end compact digital cameras.

Major manufacturers of cameras for phones include Toshiba, ST Micro, Sharp, Omnivision, and Aptina (Now part of ON Semiconductor).

## 5 External camera

During 2003 as camera phones were gaining popularity in Europe some phones without cameras had support for MMS and external cameras that could be connected with a small cable or directly to the data port at the base of the phone. The external cameras were comparable in quality to those fitted on regular camera phones at the time, typically offering VGA resolution.

In 2013-2014 Sony and other manufacturers announced add-on camera modules for smartphones called lens-style cameras. They have larger sensors and lenses than those in a camera phone but lack a viewfinder, display and most controls. They can be mounted to an Android or iOS phone or tablet and use its display and controls. Lens-style cameras include:

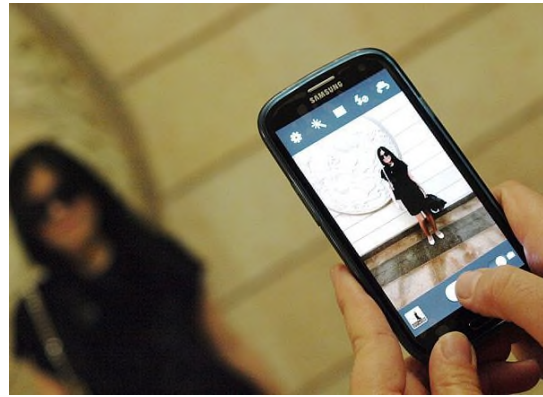
- Sony SmartShot QX series, announced and released in mid 2013. They include the DSC-QX100/B,<sup>[17]</sup> the large Sony ILCE-QX1, and the small Sony DSC-QX30.
- Kodak PixPro smart lens camera series, announced in 2014.<sup>[18]</sup>
- Vivicam smart lens camera series from Vivitar/Sakar, announced in 2014.<sup>[19]</sup>

External cameras for thermal imaging also became available in late 2014.<sup>[20]</sup>

## 6 Social impact

See also: *Selfie*

Personal photography allows people to capture and construct personal and group memory, maintain social relationships as well as expressing their identity.<sup>[21]</sup> The hundreds of millions<sup>[22]</sup> of camera phones sold every year



*Taking a photograph with cell phone.*

provide the same opportunities, yet these functions are altered and allow for a different user experience. As mobile phones are constantly carried, camera phones allow for capturing moments at any time. Mobile communication also allows for immediate transmission of content (for example via Multimedia Messaging Services), which cannot be reversed or regulated. Brooke Knight observes that “the carrying of an external, non-integrated camera (like a DSLR) always changes the role of the wearer at an event, from participant to photographer”.<sup>[23]</sup> The cameraphone user, on the other hand, can remain a participant in whatever moment they photograph. Photos taken on a cameraphone serve to prove the physical presence of the photographer. The immediacy of sharing and the liveness that comes with it allows the photographs shared through cameraphones to emphasize their indexing of the photographer.

While phones have been found useful by tourists and for other common civilian purposes, as they are cheap, convenient, and portable; they have also posed controversy, as they enable secret photography. A user may pretend to be simply talking on the phone or browsing the internet, drawing no suspicion while photographing a person or place in non-public areas where photography is restricted, or perform photography against that person’s wishes. At the same time, camera phones have enabled every citizen to exercise her or his freedom of speech by being able to quickly communicate to others what she or he has seen with their own eyes. In most democratic free countries, there are no restrictions against photography in public and thus camera phones enable new forms of citizen journalism, fine art photography, and recording one’s life experiences for facebooking or blogging.

Camera phones have also been very useful to street photographers and social documentary photographers as they enable them to take pictures of strangers in the street without them noticing, thus allowing the artist/photographer to get close to her or his subjects and take more livelife photos.<sup>[24]</sup> While most people are suspect of secret photography, artists who do street photography (like Henri Cartier-Bresson did), photojournalists

and photographers documenting people in public (like the photographers who documented the Great Depression in 1930s America) must often work unnoticed as their subjects are often unwilling to be photographed or are not aware of legitimate uses of secret photography like those photos that end up in fine art galleries and journalism.

As a network-connected device, megapixel camera phones are playing significant roles in crime prevention, journalism and business applications as well as individual uses. They can also be used for activities such as voyeurism, invasion of privacy, and copyright infringement. Because they can be used to share media almost immediately, they are a potent personal content creation tool. On January 17, 2007, New York City Mayor Michael Bloomberg announced a plan to encourage people to use their camera-phones to capture crimes happening in progress or dangerous situations and send them to emergency responders. Through the program, people will be able to send their images or video directly to 911.<sup>[25]</sup>

Enforcing bans on camera phones has proven nearly impossible. They are small and numerous and their use is easy to hide or disguise, making it hard for law enforcement and security personnel to detect or stop use. Total bans on camera phones would also raise questions about freedom of speech and the freedom of the press, since camera phone ban would prevent a citizen or a journalist (or a citizen journalist) from communicating to others a newsworthy event that could be captured with a camera phone.

From time to time, organizations and places have prohibited or restricted the use of camera phones and other cameras because of the privacy, security, and copyright issues they pose. Such places include the Pentagon, federal and state courts,<sup>[26]</sup> museums, schools, theaters, and local fitness clubs. Saudi Arabia, in April 2004, banned the sale of camera phones nationwide for a time before realloving their sale in December 2004 (although pilgrims on the Hajj were allowed to bring in camera phones). There is the occasional anecdote of camera phones linked to industrial espionage and the activities of paparazzi (which are legal but often controversial), as well as some hacking into wireless operators' network.

Camera phones have also been used to discreetly take photographs in museums, performance halls, and other places where photography is prohibited. However, as sharing can be instantaneous, even if the action is discovered, it is too late, as the image is already out of reach, unlike a photo taken by a digital camera that only stores images locally for later transfer (however, as the newer digital cameras support Wi-Fi, a photographer can perform photography with a DSLR and instantly post the photo on the internet through the mobile phone's Wi-Fi and 3G capabilities).

In Ireland the annual "RTE 60 second short award" was won by 15-year-old Laura Gaynor, who made her winning cartoon, "Piece of Cake" on her Sony Ericsson C510

camera phone.

In 2012, Director/writer Eddie Brown Jr, made the reality thriller "Camera Phone" which is one of the first commercial produced movies using camera phones as the story's prospective. The film is a reenactment of an actual case and they changed the names to protect those involved.

Some modern camera phones (in 2013-2014) have big sensors, thus allowing a street photographer or any other kind of photographer to take photos of similar quality to a semi-pro camera.

Apart from street photographers and social documentary photographers or cinematographers, camera phones have also been used successfully by war photographers.<sup>[27]</sup> The small size of the camera phone allows a war photographer to secretly film the men and women who fight in a war, without them realizing that they have been photographed, thus the camera phone allows the war photographer to document wars while maintaining her or his safety.

## 7 Notable events involving camera phones

- The 2004 Indian Ocean earthquake was the first global news event where the majority of the first day news footage was no longer provided by professional news crews, but rather by citizen journalists, using primarily camera phones.
- On November 17, 2006, during a performance at the Laugh Factory comedy club, comedian Michael Richards was recorded responding to hecklers with racial slurs by a member of the audience using a camera phone. The video was widely circulated in television and internet news broadcasts.
- On December 30, 2006, the execution of former Iraqi dictator Saddam Hussein was recorded by a video camera phone, and made widely available on the Internet. A guard was arrested a few days later.<sup>[28]</sup>
- Camera phone video and photographs taken in the immediate aftermath of the 7 July 2005 London bombings were featured worldwide. CNN executive Jonathan Klein predicts camera phone footage will be increasingly used by news organizations.
- Camera phone digital images helped to spread the 2009 Iranian election protests.
- Camera phones recorded the BART Police shooting of Oscar Grant.

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