

MODERN WIRELESS COMMUNICATION **SYSTEM**

SUBJECT CODE : 21EC0103T

UNIT-5 NOTES

“Mobile Data Services & Short Range Network”

CSE – III Year, Semester 5, Section-D

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Mobile data services

A mobile data service allows a Mobile application to gain access to the source data of a map document through a web service. To create a mobile data service, you first need to create a map document containing the data you want to be accessible, and then share the map as a service with the Mobile Data Access capability enabled.

Preparing the map document

A general principle to follow when creating a map document is to make it simple. For example, you should consider data generalization, such as polygon smoothing and reduced raster resolution, for background or reference layers. This will allow your maps to be drawn faster. Also, it's recommended that you simplify the map symbology, since the display sizes of the devices are normally limited.

Although a wide variety of data formats are supported for display in your mobile apps, only enterprise geodatabase data will give your mobile apps the ability to post updates back to the server.

Any map document participating in a mobile data service must be fixed, since the service synchronizes data between the client and server. If the extent of the mobile service on the client does not match that of the server, synchronization will fail..

Publishing the map document as a mobile data service

Note the URL of the mobile data service.

- **`http://gisserver.domain.com:6080/arcgis/services/folder/service/servicetype`**

The URL is displayed on the **Mobile Data Access** tab of the *Service Editor*.

The service URL is then used by your mobile app to connect to and retrieve data from Server (e.g ArcGIS server).

Consuming a mobile data service

Mobile data services are intended primarily for use within your own organization. Mobile data services are accessed through the SOAP protocols.

Mobile Phone can view map services through REST without the Mobile Data Access capability .which is enabled the Feature Access capability on the map service.

You can connect to and preview this mobile web service in or preview the XML file returned from this server by typing the following URL in the web browser:

Mobile messaging & Types

Mobile messaging has revolutionized how people communicate with each other and businesses. But more than one mobile message type is available to users and companies.

1. Short message service (SMS)

SMS is one of the most common forms of mobile messaging. SMS, a short message service, is a standard text message sent using a cellular signal.

SMS is limited to 160 characters per message and is strictly text-based. It costs pennies per message for users in the U.S. without an unlimited messaging plan.

It is a great two-way communication tool for businesses, friends, family, and more.

People in America text twice as much as they call.

2. Multimedia messaging service (MMS)

MMS, short for multimedia messaging service, is sent over a cellular signal like SMS, but it has key differences. In particular, MMS is a text message accompanied by a media file, like a photo, video, or link.

MMS allows users to send messages with more than 160 characters and can be more engaging than a text-only message. But, MMS requires more data to send and receive than other types of text messages. It also costs a bit more to send than an SMS.

People around the world, converse with friends, family, colleagues and businesses. Many companies use MMS messages to customers to showcase their products or services visually.

3. Instant messaging (via the internet)

Unlike SMS and MMS, instant messaging uses the internet to send and receive messages. Examples of instant messaging applications are WhatsApp, Facebook Messenger, KakaoTalk, Kik, and Line.

Instant messaging is not limited by character count, but it does require both users to have the same application. For example, if you're using Facebook Messenger, you can't send a message to someone on WhatsApp.

But, instant messaging allows users to send and receive more than just text messages — they also enable the sending and receiving of videos, photos, links, GIFs, and files. Some instant messaging applications also support phone calls, which operate via the internet.

Instant messaging applications are popular for users who want to communicate globally without paying hefty cellular bills.

4. Push notifications

Push notifications are clickable pop-up messages from an application. Often, a user must enable them before apps can send them. Once enabled, companies can send essential announcements to users. It's important to note that push notifications don't appear in the app but are sent to the home or lock screen of a mobile phone.

There are several types of push notifications, including banner notifications (Short messages popping up) and badge notifications (a small red circle that pops up to let users know how many notifications or messages they have in the application.)

5. In-app messages

In-app messages, as the name suggests, are messages users only receive when actively using a mobile application. These messages help keep users engaged, feel rewarded, or push them to convert.

For example, when users enter the app, companies can share a welcome message to alert them about new deals or things happening with the brand.

6. Rich Communication Services (RCS)

RCS is a messaging as a platform technology developed by Google. It is considered an alternative to traditional text messaging. The idea is that with RCS technology, consumers can get an app-like messaging experience through their phone's native messaging system. Users of RCS messaging can send richer and more engaging messages, including seeing and receiving read receipts and higher-quality images.

On the business side, brands are getting creative on how to use RCS to communicate with customers.

The Wireless Web

The wireless web represents the combination of two innovative technologies— wireless communications and the Internet.

The wireless web (a Broadband service) works by transmitting Internet data via RF, or Radio Frequency. This service is commonly known as "Wi-Fi" (Wireless Fidelity). It's a broad term for accessing the web, internet and other services, like email and chat, without being tethered to a wire. It includes public and private hotspots, internet access via cell phones, and other fix or mobile wireless access services.

Wireless frees the Internet from location and time, and opens up new ways to extend existing applications as well as create new ones.

High-speed networks, synchronization, and voice recognition play a role in realizing the potential of the wireless web.

What is a Wireless Network or Wi-Fi? A wireless network refers to a computer network that makes use of Radio Frequency (RF) connections between nodes (RF CMOS (radio frequency CMOS), power MOSFET and LDMOS (lateral diffused MOS) devices) in the network. Wireless networks are a popular solution for homes, businesses, and telecommunications networks.

The Wireless contribution to web:

Wireless brings three new dimensions to the web:

1)localization: (the ability to geographically locate wireless devices using the global positioning system (GPS)) - users can enter their street location on a PDA and receive information about nearby shops, restaurants, or clubs, sorted by distance and with walking directions)

2)personalization: (wireless network providers already track user identity for billing purposes),

3)immediacy: (Wireless has ability to immediately deliver or push information (like e-mail header alerts, full-text e-mail, paging, and file downloads to users) when they need. The net effect is new opportunities for building trusted and sustainable relationships with customers and suppliers as well as efficiently utilizing an increasingly mobile workforce.

Some **advantages of wireless networks** include:

- **Mobility-** Stay connected while moving around, and access documents, apps etc.
- **Flexibility-**Wireless networks support a wide range of devices.
- **Ease of installation at low cost**
- **Scalability-**Wireless networks are easy to scale.
- **WLANS** enables computing to happen anywhere, even when carrying high data loads and advanced web...

First - Internet from dial-up to high-speed broadband connections, then, a wireless Web. This fast-evolving wireless ecosystem that combines the greater speeds and higher data volumes of today's wireless networks (such as 3G-HSPA, LTE) with the growing numbers of smart phones boasting bigger screens, better touch pads, and more processing power.

Constraints (limitations)-The small screens available on most cell phones and PDAs provide only a few lines of text, and the limited bandwidth of most wireless networks greatly constrains the amount of information that can be delivered to wireless devices.

Question: Which software interface will organize and manage the wireless Web?

Apple's success had made it the industry leader. A year after the company released its iPhone, Apple introduced a mobile-applications platform (known as the App Store), which, at its inception, hosted 500 programs, created entirely by third-party developers. The popularity of the App Store—to both consumers and developers—has resulted in a dramatic increase in the number of applications available. Other developers lagged far behind.

Once browsing experience improved, more control of what the Web delivers have shifted from app stores to mobile operating systems such as Google's Android and others.

Wireless Web Performance Issues

Results show that the wireless network bottleneck can lead to inefficient HTTP performance, inefficient TCP performance, packet losses, and network thrashing, depending on the characteristics of the Web traffic generated. Solving these issues is important to improve wireless Web performance.

Introduction of Wireless technologies have revolutionized the way people think about networks. The mobile user can operate the mobile network "anytime, anywhere". At the same time, the Web has made the Internet available to the masses, through its TCP/IP protocol stack and the principle of layering. The next step in the wireless Internet evolution is the convergence of these technologies to enable the "wireless Web" in the classroom, the office, and the home.

In most cases, the performance problems arise from the wireless network bottleneck, but the bottleneck manifests itself in subtle ways, because of multi-layer protocol interactions. Examples of these interactions include the inefficiencies of non-persistent HTTP over TCP, the congestion response of TCP to wireless packet losses, and the combination of these two effects.

TCP has flow control, congestion control, and error recovery mechanisms to provide reliable data transmission between a source and a destination. The robustness of TCP allows it to operate in many network environments. The Hyper-Text Transfer Protocol (HTTP) is a request response application-layer protocol layered on top of TCP. HTTP is used to transfer Web documents between Web servers and Web clients. Overall Web performance depends on the performance of Web clients, the Web server, and the network in between. The main challenge for Web content delivery in wireless networks is the wireless channel, which has limited bandwidth, high error rates, and interference from other users. The concern is that TCP and HTTP performance may degrade over wireless networks.

Wireless Application Opportunities

Wireless opens up opportunities for business-to-consumer (B2C), business-to-business (B2B), and business-to-employee (B2E) enterprise integration.

1.Business-to-consumer (B2C) interaction. Companies reach out directly to consumers.

2.Business-to-business (B2B) commerce. It opens connections to suppliers and partners (movement and management of physical goods). Wireless has been used for supply chain management (SCM) and enterprise resource planning (ERP).

3.Business-to-employee (B2E) interaction. It introduced efficiencies into an organization by making corporate data available to mobile workers. Mobile professionals can access e-mail attachments and documents from cell phones, pagers, PDAs, and notebook PCs.

In **travel**, wireless application provides Easy Reservations It enables users to book hotel and travel arrangements by entering city codes on their cell phones. The wireless site uses profile information that users provide when they register for the service.

Restaurants: Locating nearby restaurants is a natural fit for wireless' ability to provide localized services.

Food Delivery: Home food delivery is growing as an Internet-based service and is moving to wireless.

Business-to-Enterprise (B2E) wireless applications

- **Sales Force Automation (SFA)-** Without returning to the office, a salesperson can gather and analyze information for a customer call using data from the company's inventory, the customer database, and accounts receivable.

- **Customer Relationship Management (CRM)**- Manages prospects and customers effectively using call centers, telemarketing, and direct marketing operations, as well as Internet applications
- **Enterprise resource planning (ERP)**- This increases enterprise resources such as human resources, machinery and equipment, legal positions, and financial situations.
- **Order Fulfillment and Distribution** Wireless technology can be used to assure speedy delivery of ordered merchandise. This saves 3 to 5 percent of operating costs.

Synchronization

Synchronization is a technology for making two sets of data identical. While most mobile devices provide some capability for synchronizing their data with network applications and desktop computers, almost all devices work with specific platforms, data types, and communications media.

Synchronization is important in maintaining consistency in wireless B2E interaction. For mobile devices, synchronization can occur in two directions:

Synchronize networked data with any mobile device.

Synchronize a mobile device with any networked data.

Synchronization Standard SyncML is a protocol (for sending messages between devices) based on the Extensible Markup Language (XML), supported by IBM, Lotus, Motorola, Nokia, Palm, Psion, and Starfish for synchronizing data across portable devices.

Voice XML (Voice Extensible Markup Language)

It is an text-based language for creating automated voice services for wireless phones and voice-enabled devices. It can be moved across the Internet just as easily as web pages encoded with HTML.

Web servers deliver not just "web pages" but "voice pages" that describe a series of interactive dialogs between a user and a cell phone or voice-enabled PDA

Aimed at companies looking to deliver integrated voice and data services, the voice portal consists of an Intel server with specialized digital signal processing (DSP) circuitry for speech processing and recognition.

Example of a VoiceXML document (controlling the interaction between a user and a mobile commerce site:

```
<form id=get_card_info>
<block> We now need your credit card type, number, and expiration date.</block>
<field name="type">
<prompt count="1">What kind of credit card do you have?</prompt>
<prompt count="2">Sorry I didn't understand what you said. What kind of card?</prompt>
<grammar>
visa {visa}
| master [card] {mastercard}
| amex {amex}
| american [express] {amex}
</grammar>
<help> Please say Mastercard, Visa, or American express. </help>
</field>
<!-- The grammar for type="digits" is built in. -->
<field name="num" type="digits">
<prompt count="1">What's your card number?</prompt>
```

```
<prompt count="2">Card number?</prompt>
<dtmf maxdigits=16/>
<catch event=HELP>
<if cond="type == 'amex'">
Please say or key in your 15 digit card number.
<else/>
Please say or key in your 16 digit card number.
</if>
</catch>
```

Wireless Application Protocol

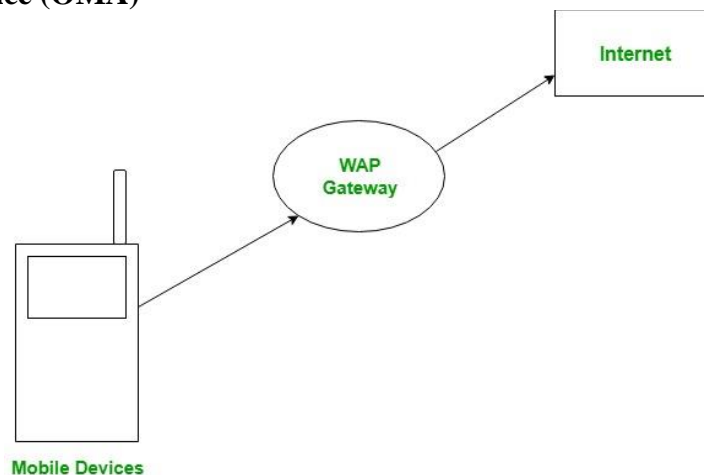
The Wireless Application Protocol (WAP) is a set of communication protocols and an application programming model based on the World Wide Web (WWW). Its hierarchical structure is quite similar to the TCP/IP protocol stack design.

What is Wireless Application Protocol (WAP)?

Wireless Application Protocol (WAP) is a specification for a set of communication protocols to standardize the way wireless devices, such as mobile phones and radio transceivers, can be used for internet access, including email, the web, newsgroups and instant messaging.

It uses the markup language WML (Wireless Markup Language and not HTML), WML is defined as an XML 1.0 application. It enables the creation of web applications for mobile devices. In 1998,

WAP Forum was founded by Ericson, Motorola, Nokia and Unwired Planet protocol In 2002, WAP forum was merged with various other forums in the industry resulting in the formation of **Open Mobile Alliance (OMA)**



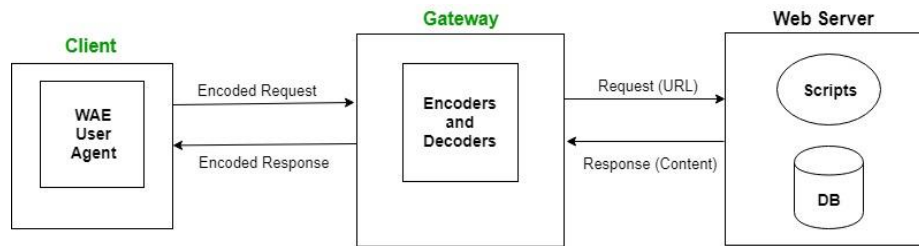
The WAP protocol was optimized for the high-latency, low-bandwidth mobile networks of the time, which were notorious for dropping the connection before a page could fully render.

The Wireless Markup Language (WML) format allowed webpages to render without regard for a user's mobile hardware, much like Hypertext Markup Language (HTML) code can be rendered by any browser, regardless of what type of hardware the browser is running on.

WAP Model

The WAP model works similarly to the traditional client-server model but It specifies a proxy server that acts as an interface between the wireless domain and core wired network. This proxy server, also known as a WAP gateway, is responsible for a wide variety of functions such as protocol translation and optimizing data transfer over the wireless medium. This gateway's job is to act as an intermediary between mobile devices and the internet.

Mobile devices of the time lacked the hardware resources commonly found in today's devices. As such, devices were usually equipped with lightweight mobile browsers, also known as mini-browsers or micro-browsers. The user opens the mini-browser in a mobile device. He selects a website that he wants to view. The mobile device sends the URL encoded request via network to a WAP gateway using WAP protocol.



The WAP gateway translates this WAP request into a conventional HTTP URL request and sends it over the internet. The request reaches to a specified web server and it processes the request just as it would have processed any other request and sends the response back to the mobile device through WAP gateway in WML file which can be seen in the micro-browser.



How a WAP gateway provides web content for mobile devices

The WAP Architecture has been designed to closely follow the web. The only difference is the presence of the WAP gateway is translating between HTTP and WAP.

WAP Client

The three sections to be mentioned regarding WAP client are WAE user agent, WTA user agent and WAP stack.

- **WAE user agent** – Wireless application environment user agent is the browser that renders the content for display.
- **WTA user agent** – Wireless telephony application agent receives compiled WTA files from WTA server and executes them.
- **WAP stack** – WAP stack allows the phone to connect to the WAP gateway using the WAP Protocols.

Application Server

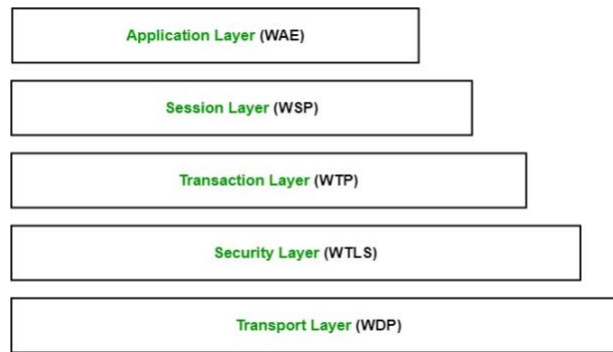
The element in the network where the information (web, WAP) applications reside are WAP proxy, WAP gateway or WAP server –

Proxy – This is an intermediary element acting both as a client and as a server in the network it is located between client and server. The client sends requests to it and it retrieves and caches the information needed by contacting the origin Server.

Gateway – This is an intermediary element usually used to connect two different types of networks.

WAP Gateway is basically software that is placed between a network that supports **WAP and IP packet network** such as Internet.

WAP Protocol stack



1.Application Layer: This layer contains the Wireless Application Environment (WAE). It contains mobile device specifications and content development programming languages like WML. It is intended for the development and execution of portable application and services. WAE consists of two different user agents located on client side.

The WAE user agent consists of browser and the text message editor along with the WTA user agent.

2.Session Layer: This layer contains Wireless Session Protocol (WSP). It provides fast connection suspension and reconnection. Contains the following components –

Connection Oriented Session Services – These operate over WTP.

Connectionless Session Services – These operate directly over WDP.

Session services – These functionalities help to set up a connection between a client and server using primitive messages.

3.Transaction Layer: This layer contains Wireless Transaction Protocol (WTP). It runs on top of UDP (User Datagram Protocol) and is a part of TCP/IP and offers transaction support for requests & responses to servers.

4.Security Layer: This layer contains Wireless Transport Layer Security (WTLS). It offers data integrity, privacy, secure connection and authentication.

It is based on **SSL (Secure Socket Layer)**. It provides services that ensure privacy, server authentication, client authentication and data integrity.

A Standard SSL session is opened between the web server and the WAP gateway, and WTLS session is initialized between the **gateway** and the **mobile device**. The encrypted content is sent through this connection from the server to the gateway, which translates it and sends it to mobile phone. The transaction between **SSL** and **WTLS** takes place in the memory of the WAP gateway.

5.Transport Layer: This layer contains Wireless Datagram Protocol. It presents consistent data format to higher layers of WAP protocol stack. It manages privacy, authentication and data integrity through public key cryptography.

This is connected with the bearer service offered by the operator. Bearer services are the communication between the mobile phone and the base stations. They include **SMS, CSD, USSD, GSM, GPRS, DECT, CDMA, FDMA, and TDMA**.

The physical layer prepares the data to be sent from the mobile device over the air services and sends the data using bearer service implemented in the network that the device is operating in. **WDP** has an interface with various bearer networks, so it must have a bearer specific implementation. WDP is the only layer that must be rewritten to support different bearer networks. The WTP layer implements a simple **request-response transaction** oriented protocol instead of the three-way-handshake connection mechanism.

6. Wireless Datagram Protocol, an adaptation layer for consistent data formats in the other layers that defines how data flows to the sender from the receiver.

Why Use WAP?

The following advantages for wireless network operators, content producers, and end users were put out by WAP when it was first introduced in 1999:

Operators of wireless networks and mobile phones: WAP was created with the intention of enhancing already-existing wireless data services, such as voicemail, and facilitating the creation of new mobile applications. Without making any further infrastructure adjustments or phone modifications, these applications might be created.

Content Provider: For third-party application developers, WAP opened up a market for extra applications and mobile phone features. It was suggested that developers use the WML programming language to write applications for mobile devices.

End users: Access to online services like banking, entertainment, messaging, and other information on mobile devices should be simple and safe for users of mobile phones. WAP could also permit access.

Advantages of Wireless Application Protocol

- Rapidly evolving technology. Made broad internet access possible with mobile device.
- Improved access speeds through data compression and helped reduce the number of timeouts and connection failures that had previously plagued mobile access.
- Totally free of cost.
- Can be used over multiple platforms.
- Neither it nor network standards are affected.
- Higher controlling possibilities are offered.
- It follows a model that is similar to the Internet.
- You can send and receive real-time data with WAP.
- WAP is supported by the majority of current mobile phones and devices.

Disadvantages of Wireless Application Protocol

- Slow connection speed is slow and less number of connections
- At some places it is very difficult to access the Internet, and also at some places it is totally impossible.
- Less secure.
- WAP provides a small User interface (UI).
- Mobile browsers lacked the capabilities of modern browsers.

Few Questions

1. Why do we need WAP?

Internet access was only accessible from your computer until the release of the first WAP devices. With WAP, you may now use your mobile phone to use the Internet to interact with other people. large global communication and data sharing are therefore expanded.

2. What is a Micro WAP Browser?

There is a WAP browser available as well, just like your personal internet browser. Micro WAP Browser is the name of the browser used to access websites using a WAP device.

3. What is WAP 2.0?

WAP 2.0, which was introduced in 2002, is only a combination of end-to-end HTTP and XHTML. The gateway and custom protocol suite that were used to communicate with have been removed.

WEB (SITE) DESIGN

Web design encompasses many different skills and disciplines in the production and maintenance of websites. The different areas of web design include web graphic design; user interface design (UI design); authoring, including standardized code and proprietary software; user experience design (UX design); and search engine optimization.

THE IMPORTANT ELEMENTS TO BE REMEMBERED BEFORE A WEBSITE DESIGN

1 Navigation-The website design should be easy to navigate and the menu items should easily accessible from any page.

2 Visual Design-People are visually oriented creatures, and utilizing great graphics is a good way to make your website more appealing.

3 Content

Content plays a major role in search engine placement. Website text should be informative, easy to read, and concise to make it engaging, effective and popular.

4 Web Friendly-It is important that the website works on all the major browsers.

5 Interaction-A truly effective website design engages your visitors immediately and continues to hold their attention through EVERY page, as well as influences them to contact you.

6 Information Accessibility

As all visitors are not interested in the entire site, but only in few information, its important to place key information in plain site, in an area that is easily accessible.

7 Intuitiveness - A great website anticipates what your visitor is thinking and caters directly to their needs. It's important that your website have a landing page that is directly relevant to what they searched for rather than forcing them to filter through all of your information..

8 Branding-Your website should be a direct reflection of your business and your brand.

9 Turnaround Time-The website customers should not consume long time to get the site up and running.

10 Conversion-Your website can be the most important client generator your business can have, and must place the primary emphasis on bringing in new clients and making additional services available to existing clients through increased awareness of all the services you offer.

How to design a website — step-by-step tutorial

Your website serves as the online representation of your business. A thoughtful, user-friendly website engages your audience and guides them towards your desired goal. Here are the steps for designing a website:

1. Define your website's purpose

Your website's purpose will determine which platform and layout will work best for you, what content you need, and how to optimize your site to accomplish your goal.

Start by creating a site for your business/ a portfolio to display your work/ promoting an event, or publishing blog posts.

Next, consider who your target audience is. Conduct thorough research into your audience's preferences, interests, and pain points.

This will help you set the key objectives you aim to accomplish through your website. It can solve problems or meet the needs of your target audience. As you change and refine your purpose, periodically review it to make sure it is still aligned with your users' needs and current market trends.

Let's look at the purpose of a few different kinds of websites:

- **Online stores**, also called ecommerce sites, are sites used to sell products or services online. An effective online store allows customers to find the products they are looking

for, product information, content related to the products sold on the site, & finally purchase items conveniently

- **Portfolio sites** showcase work projects, skills, or achievements. Visitors will explore and evaluate the showcased work. It should be easy for users to understand and engage with.
- **Business websites** -These sites act as a central hub where users can learn about the company, the products or services it offers, and engage with its offering. Its purpose is to encourage customers to make a purchase.
- **Event pages**:- To promote upcoming events — like conferences or festivals — and give potential visitors the information they need to attend. These sites may give visitors a schedule of the event, a page to purchase tickets, or information about places to stay near the venue.
- **Blogs** are generally websites that publish new articles or content regularly to inform or entertain visitors. The purpose of a blog could be to sell products, share information, or encourage engagement from readers.

2.Choose a platform

When choosing a platform to create your website, you'll need to consider which features and capabilities are required to achieve your site's goal.

If you're new to building websites, you may want to opt for a simpler, easier to use website builder that handles more of the process for you. If you're more experienced, have some coding knowledge, and need a more advanced website, you may want a more capable platform to host your site.

You should evaluate each platform based on factors like ease of use, customization options, scalability, and available templates.

When selecting a platform to build your site here are a few features you should look for:

- **Quick site creation**- Create site, may be in just a couple of hours.
- **Responsive web design**.- It must be easy to use on both mobile and desktop devices.
- **Project workflows**.-If you plan on having multiple users editing and publishing on your website, you'll want a content management system (CMS) that allows you to build a common shared environment with grouped resources and shared assets.
- **Content insights**.- Collect feedback & find out which pages need to be improved.
- **Pricing options**.- Spend on website based on how much your business will generate revenue for you. Spend within your budget.
- **Versatility**.- Most website builders will allow you to build whatever you need, whether you're building an ecommerce store with thousands of products or publishing your first post on your blog.

3.Pick a layout

Next you need to decide what your site will look like and how your content will be arranged on the page. You'll usually have the option to use a drag-and-drop editor to lay out your site or select from prebuilt templates. You should make it easy for users to quickly find the most important information on the page.

Whether you opt for a single-page layout, multi-page structure, or a grid-based design the most important consideration should be seamless and intuitive navigation. As we mentioned before, you need to make sure your site is responsive so that users on different screen sizes and device types can easily navigate your site.

4.Create and gather content

The next step after laying out your website is to source or create the content your site will display. The specific content types you'll need — and how much of it — will depend on your site's purpose. Your content could include images, text, logos, videos, and more. Whatever you publish should help you get users closer to taking the desired action on your pages.

Quality over quantity

Always stress on high-quality, impactful images than confusing or low-quality content.

Always craft the original and engage content that communicates your message clearly. Your content should be relevant, concise, and easy to read quickly.

5.Design the website elements

While every website is different, here are some elements you need to consider as you create a positive user experience on your website:

- **Site architecture** Your pages should be organized and visitors should be able to find the most important pages on your site quickly in the navigation bar
- **Navigation menu.** Your navigation menu should include links to the most important pages on your site & should be responsive so that it works properly on all devices.
- **Colors.** The colors you use on your website should align with your brand guidelines. Create a harmonious color palette to use on your website.
- **Fonts.** Like colors, you should select fonts that align with your brand guidelines. You also need to prioritize fonts that are legible — even on small screens.
- **Header and footer.** Your header should help users clearly identify your website with your logo. Your footer should include contact information, social media links, and a way for users to sign-up for your email list.

Motion. Animations and other moving elements help keep users on your site longer, but can also slow load times or distract users from the content that matters. So they should be used judiciously.

6.Add pages

Now that we've sorted out what your website will look like, it's time to start tying everything together and make sure that the website's structure is functional and user-friendly. Here are some basic pages that almost every website needs to have:

- **Homepage.** Homepage could include a description of your core features or services, customer testimonials, and contact information.
- **About.** This page is to share your company's mission, background, team members &/or introduce your brand, organization, or yourself to site visitors.
- **Contact.** Your customer service team with your email address, phone number, and mailing address for contact.
- **Product page.** A product page provides detailed information about the features, specifications, benefits, and pricing for a product. The goal is to convince potential customers to make a purchase.
- **Blog.** Your blog page is for sharing information that your customers may be interested in/ informational content that explains how your product works etc.
- **FAQ.** Similar questions raised by customers repeatedly can be answered.

7.Optimize the experience

Once website is functional and running, it's time to make sure your site is having as much of an impact as possible. Optimize the user experience by keeping visitors engaged with your site and moving towards becoming customers.

8.Test your website

After publishing your website, test your website regularly to make sure no pages or elements have broken or resources loading slowly due to server issues. Make sure users are experiencing your site as you intended.

You can use [A/B testing](#) to test new pages or designs so you can continuously improve the results you get from your website.

9. Get started with your own website

After learning above & getting guidance from successful websites, start designing a website which is an iterative process. Create a website that leaves a lasting impression on your visitors.

Get a product demo to find out more about how Experience Manager can help you create your own site for your business. Get an [SSL certificate](#) to ensure your website is secure. [SSL is part of Google's search ranking algorithm](#), so an [SSL certificate](#) can help you rank higher in search.

Modern Website Design Tips (after Vitaly Friedman)

- **Skip the guesswork.** Create tasks that mirror real-life situations. Always get feedback.
- **Keep your design clear,** fresh & easy to understand for everyone
- **Make sure everyone has a good experience.** Pay attention to color contrast, typography, font sizes, and tab target sizes.
- **Feel the vibes.** Understand users' emotional responses and brand perception through feedback.
- **Embrace the quirks.** Imperfections and human mistakes make the design interesting.
- **Change is good.** Be open to trying new things, making improvements, and bringing innovations.
- **Stir up some emotions.** Aim to surprise, delight, or even challenge your users
- **Add a sprinkle of humor.** Injecting some fun into unexpected places feels right at home.

Case study: Enhancing UX Design for Blenz Website

[Forge & Smith](#) revamped Blenz, a Canadian coffee chain website for better UX and engagement — the results were stunning.

22% increase in engaged sessions.

103% increase in page views.

What is wireless network planning?

Wireless network planning is the process of strategizing and architecting a wireless network design that provides adequate coverage, security and capacity. In this process, network engineers evaluate existing network infrastructure, floor plans, application and network performance, capacity requirements and many other factors.

How to start wireless network planning and design

Nine main areas network teams should consider when starting the wireless planning process.

1. Coverage

Organization needs coverage which is referred to the geographic location that receives wireless access.

In this step, network teams look into geographical considerations, like site locations, but also assess environmental and seasonal factors, peak business times, holidays or special events, to determine ideal performance requirements throughout the year.

Teams should also pay attention to difficult coverage areas that might have thick walls, metal environments, refrigeration or other factors that could interfere with radio frequency (RF).

2. Capacity

Capacity refers to how much traffic a wireless network can support, considering speeds, latency and bottlenecks.

Find out how many users are currently on the network and approximate how many might join in the near future. Find out the types of clients the wireless network needs to support, bandwidth expectations, necessary data rate etc..

3. Applications

The third phase is to find business priorities, including mission-critical applications and workflows. Is it a voice or video application that requires low latency? Is it a nonwork-related application, like Netflix or YouTube? Also evaluate data-heavy and bandwidth-intensive applications, like IoT and video streaming, and plan capacity and policies accordingly.

4. Security

Steps to secure the wireless network, teams should look into security features, like wireless intrusion prevention and detection, two-factor authentication, role-based access and firewalls.

5. Simplicity

The fifth phase in wireless network planning is to simplify, specifically when looking into management. Network teams benefit from automation that assists with troubleshooting and reduces time spent on menial, routine management tasks.

6. Redundancy

IT teams should next focus on how to support the business in case something goes wrong with the network. Determine how to ensure redundancy for cloud connectivity and edge devices, in addition to traditional facility components.

7. Network integration

This phase of wireless network planning helps teams pinpoint end-to-end network visibility and integration needs (power, scalability etc.)

8. Management

The next step consider how a network management platform handles all the different network components, such as APs, switches and software-defined WAN management. Smaller organizations can work with AP clusters that offer lower management overheads, while larger organizations benefit from cloud-based management that provides better scalability and redundancy.

9. Site survey

Another important step in wireless planning is to conduct a site survey. Performing a wireless site survey is the backbone for figuring out how much equipment you need, the best placement for that equipment, and best installation techniques to install that equipment based on your unique environment.

Wireless site surveys differ in type. A predictive site survey is done prior to creating a wireless design or if they're moving to new locations. A passive site survey helps teams collect information about a site after they install equipment. An active site survey analyzes the wireless network in full operation. Each survey type helps organizations determine AP position, RF, capacity, quality of service, potential interference and other metrics.

Short-range wireless network/ communication technology

It is a communication method based on radio waves that is used to transmit data and information over relatively short distances. Compared with traditional wired communication methods, short-range wireless communication technology does not require physical connections and can provide more flexible and convenient data transmission solutions.

One of the **advantages** of short-range wireless communication technology is that it allows freer communication between devices. There is no need to worry about the length of the cable or the compatibility of the connecting plug. Short-range wireless communication technology can realize plug-and-play between devices, greatly simplifying the installation and wiring process of the equipment. In addition, short-range wireless communication technology also provides greater flexibility and mobility, allowing devices to be moved between different locations without worrying about communication interruption.

Disadvantages: First of all, since wireless communication is affected by the environment, such as obstacles, interference sources, etc., the signal transmission distance and quality may be limited. In addition, because wireless communications use shared spectrum resources, interference may occur between devices, resulting in reduced communication quality or slower data transfer rates.

The security may also present challenges, requiring additional security measures to protect data transmission and storage.

Despite some limitations, short-range wireless communication technology is still widely used in various fields. From home networks and smart homes to industrial automation and the Internet of Things, short-range wireless communication technology provides us with convenient data transmission and information exchange methods, which has greatly promoted the development and application of modern technology.

1.Wi-Fi technology

In theory, with WiFi technology, the user is located in a certain area around the access point, but if blocked by a wall, the effective transmission distance inside the building will be less than outdoors. WiFi technology is mainly used in buildings and places where it is inconvenient to install cables, such as shopping malls, airports, home wireless networks, airports, hotels, and other public hotspots, saving a lot of cable laying costs.

2.Bluetooth technology

This is an open global specification for wireless data and voice communications. The technology applied by Bluetooth technology is to establish a universal short-range wireless interface in the communication environment between fixed or mobile devices. The Bluetooth module transmission band is the world-wide 2.4GHz ISM band. It provides a transmission rate of 1Mbps and a transmission distance of 10m.

Disadvantages of Bluetooth technology: chip size and price are difficult to reduce, anti-interference is not strong, transmission distance is too short, information security issues, etc.

3.ZigBee technology

ZigBee technology is mainly used between various electronic devices within short distances, and the data transmission speed is not high. The name ZigBee comes from the communication method used by bee colonies to survive and thrive. Bees dance in zigzags, sharing the location, distance and direction of newly discovered food. ZigBee can be said to be a brother of the same Bluetooth family. This family uses the 2.4GHz frequency band and uses frequency hopping technology. But ZigBee is simpler and slower than Bluetooth, with lower power consumption and cost. The basic rate is 250kb/s. When it is reduced to 28kb/s, the transmission range can be

extended to 134m, which can achieve higher reliability. It can also connect to 254 nodes and networks. Better support for games, appliances, devices and home automation applications than Bluetooth.

4. IrDA technology

IrDA technology is a technology that uses infrared rays for point-to-point communication and is the first technology to realize wireless personal area networks (PAN). At present, its software and hardware technology are very mature, supporting IrDA on small mobile devices such as PDAs, mobile phones, laptops, printers and other products.

Advantages: No need to apply for use rights, low-cost infrared communication, small size, low power consumption, convenient connection, simple and easy to use required for mobile communications, small infrared radiation angle, and high transmission security.

Disadvantage: This technology can only be used for connections between two (not multiple) devices. Bluetooth technology does not have this limitation, so IrDA's current research direction is to solve the line-of-sight transmission problem and improve the data transmission speed.

5.NFC- Near Field Communications

Short-range wireless communication technology standards such as RFID (contactless radio frequency identification) promoted by Philips, Nokia and Sony. Unlike RFID, NFC uses two-way identification and connection. The operation is within the frequency range of 13.56MHz and the distance is 20cm. NFC was originally just a combination of remote control identification and network technology, but now it has gradually developed into a wireless connection technology. NFC provides data security. Using NFC, multiple devices (such as digital cameras, PDAs, set-top boxes, computers, mobile phones, etc.) can be wirelessly interconnected and exchange data and services with each other. Likewise, building a Wi-Fi family of wireless networks requires devices with multiple computers, printers, and other wireless cards. Some technical experts have also been asked to complete the work. After setting up NFC on the access points, you can communicate if two of them are off, much easier than setting up a Wi-Fi connection.

6.UWB ultra-wideband technology

UWB is also called wireless carrier communication technology. Because it uses nanosecond-scale non-sinusoidal narrow pulses instead of sine wave carriers to transmit data, UWB can transmit signals with a very wide bandwidth. According to the FCC regulations in the United States, it occupies a large spectrum. UWB occupies more than 500MHz of frequency band in the 3.1 to 10.6GHz frequency band.

UWB has developed rapidly in recent years because it can achieve high-speed data transmission using low-power, low-complexity transceivers. Using low-power pulses, data can be transmitted over a very wide spectrum and utilize spectrum resources without causing significant interference to traditional narrowband wireless communication systems. **Advantages:** Low system complexity, low power spectral density of transmitted signals, insensitivity to channel fading, low interception capability, and high positioning accuracy. It is particularly suitable for high-speed wireless access in high-density multi-path sites such as indoors, and for building efficient wireless LANs and wireless personal LANs (wpan). UWB is mainly used in narrow range, high-resolution radar and imaging systems that can be penetrated by walls, floors, and human bodies.

In addition, this new technology is also suitable for LANs and PANs that require very high speeds (above 100Mb/s), where optical fiber is expensive. Generally, UWB can achieve transmission performance of up to hundreds of Mbps within 10m, mostly for indoors\

7.IEEE 802.15.4

IEEE 802.15.4 is created to support point-to-point links and wireless sensor networks. Several wireless standards use the 802.15.4 standard as the PHY/MAC base

The standard defines 3 basic frequency distances. The most commonly used band is the global 2.4 GHz ISM band. The basic data rate is 250kbits /s. The other range is the 902-928 MHz ISM band (10 channels) in the United States. Data rate is 40kbits /s or 250kbits /s.

All 3 ranges are modulated using DSSS with BPSK or offset QPSK. The minimum defined power level is -3 dBm (0.5 mW). 0 dBm is the widely used power level. A 20 DBM level is for remote applications. Its typical range is no more than ten meters.

8.IEEE 802.22

The IEEE 802.22 standard, also known as the Wireless Area Network (WRAN) standard, is one of the latest IEEE wireless standards. It is designed for use on unused broadcast television channels without a license, called white space. The frequency range of 6 MHz channels are from 470 MHz to 698 MHz. However, the standard has not been commonly adopted. White space radio uses proprietary protocols and wireless standards.

802.22 radios use frequency-flexible circuits to scan unused channels and listen for potential interference signals. A base station communicates radially with multiple fixed-location users to obtain Internet access or other services.

The standard offers sufficient spectral efficiency to meet multiple user channels with download speeds of up to 1.5 Mbit /s and upload speeds of 384 kbit/s. The maximum data rate per 6mhz channel is between 18 and 22mbits /s. The biggest advantage of the 22 is that it uses both VHF and low UHF frequencies and can provide very long-range connections. With a maximum allowable effective isotropic radiated power (EIRP) of 4 W, a base station range of 100 km (almost 60 mi) is possible.

9.ISM band

The most commonly used ISM frequency band is 2.4- to 2.483-ghz for Wi-Fi, cordless phones, Bluetooth, 802.15.4 radio, etc. The second most popular band is the 902-928-mhz band.

Other widely used ISM frequencies are 315 MHz for RKE applications and garage door opening and 433 MHz for remote temperature monitoring. Other less commonly adopted frequencies are 13.56 MHz, 27 MHz, and 72 MHz.

10.Radio frequency identification

Radio Frequency Identification (RFID) is mainly used to identify, locate, track and manage inventory. A nearby reader sends a high-power RF signal to power the passive tag and then reads the data stored in the tag's memory.

RFID tags are flat, cheap, small and can be attached to anything that needs to be identified or monitored. RFID adopts the ISM frequency of 13.56 MHz, but other frequencies are also used, including 125 kHz, 134.5 kHz, and frequencies in the 902-928-MHz range.

11. 6- LoWPAN

6LoWPAN refers to IPv6 protocols in low-power wireless PANs. Developed by the IETF, it offers a way to transmit IPv4 and IPv6 Internet protocols over low-power wireless mesh networks and peer-to-peer links. The RFC4944 also allows the implementation of the IoT on the smallest remote devices. This protocol provides encapsulation and header compression routines for 802.15.4 radio.

12. Z – wave

Z-wave is a short range wireless mesh network technology with up to 232 nodes. The wireless transceiver operates in the ISM band (908.42 MHz) in the United States and Canada but uses other frequencies according to national regulations. The modulation mode is GFSK. Data rates

include 9600 bits/ SEC and 40 bits/ SEC. In free-space conditions, the distance can be up to 30 meters. The range of penetration through the wall is much shorter. Z-wave's main applications are thermostats, door locks, home automation, lighting, smoke detectors, security and other household appliances.

13. Other wireless communication technologies

SIM-pass technology is a combination of DI card technology and SIM card technology, and is called a dual-interface SIM card. SIM-pass is a multifunctional SIM card that supports contact and contactless working interfaces. The contact interface implements the SIM function, and the contactless interface implements the payment function. These are compatible with multiple smart card application specifications.

Comparison between UWB, WIFI, Zigbee, and Bluetooth

Items	Working frequency band	Standard of globalization	Communication range	Communication speed	Encryption mode	Application field
UWB	3.1GHz~10.6GHz	null	>100m	>100Mb/s	THSS	Home network
Wi-Fi	2.4GHz	IEEE 802.11b	100m	11Mb/s	WPA/PSK	Connected to the network
ZigBee	2.4GHz	IEEE 802.15.4	10~20m	20K~250Kb/s	AES-128	The sensor network
Bluetooth	2.4GHz	IEEE 802.15.1	1~10m	10Mb/s	PIN code	Mobile devices

Typical applications of short-range wireless communication technology

Wireless is a simple and low-cost addition to almost any new product, and it can also improve convenience, performance, or marketing.

Household

Home consumer electronics are loaded with wireless. Almost all entertainment products have IR remote controls. Energy metering and accessory monitors, remote thermometers, wireless thermostats, and other weather monitors, security systems, garage door openers, smart parking sensors are also connected to the wireless network. Almost every family has Wi-Fi connection.

Commercial

Wireless temperature and humidity monitoring, lighting control and wireless thermostats are commonly used in commercial applications. Some video surveillance cameras use wireless instead of coaxial cables. Wireless payment systems for mobile phones promise to revolutionize commerce.

Industry

Wired connections are gradually replaced by wireless in the industry. Remote monitoring of flow, humidity, temperature, and pressure are common applications. Wireless control of robots, industrial processes and machine tools promotes convenience and boosts the economy in industrial Settings. M2M technology opens the door to many applications like automobile positioning (GPS) and monitoring vending machines. The IoT is mostly wireless. Radio frequency identification technology makes it possible to track and locate almost anything more easily.

The Unlicensed Spectrum

The radio frequency (RF) spectrum is vital for wireless communications infrastructure. Most operations on the RF spectrum require a license provided by a national regulatory body or the government. However, many countries have allocated some spectrum for unlicensed use. Unlicensed spectrum bands can be general purpose or application specific.

The importance of unlicensed spectrum lies in the fact that it is a medium for inexpensive connectivity in rural/remote areas and source of innovation by serving as a barrier-free and cost-effective platform for testing and implementing of new technologies.

The specific frequency bands that we request for unlicensing are: 433-434 MHz, 902-928 MHz, 1880-1900 MHz, 2483-2500 MHz, 5150-5350 MHz, and 5725-5775 MHz. These demands reflect the widespread market adoption in countries where these bands have already become unlicensed.

Interference concerns to licensed users was the predominant reason for the limited allocation of unlicensed spectrum,

Technological advancements such as Wireless Local Area Network (WLAN), Ultra Wide Band (UWB), Radio Frequency Identification (RFID), Near -Field Communication (NFC) systems, and others have demonstrated that when an opportunity for cost-efficient and flexible spectrum usage is presented in the form of unlicensed spectrum, the market is likely to respond through innovation and expansion. Unlicensed spectrum, by not requiring operators to obtain a costly license and special permission for its use, is an inexpensive and barrier-free option for meeting communication requirements. Applications Areas include mobile broadband, wireless healthcare; smart grid communications; inventory management; access control; mobile payments; fleet management etc. Findings indicate that 80 percent of wireless healthcare, 70 percent of smart grid communications, and 40 to 90 percent of mobile broadband data to smartphones and tablets are operated on unlicensed radio spectrum. The unlicensed 902-928 MHz frequency range in the United States, for example, has fostered the growth of wireless technology for smart grid communications.

Unlicensed spectrum have been used to create community-wide wireless communication networks in rural India. These networks facilitate initiatives such as e-governance services, distance education, telemedicine, and e-commerce.

Local media are also large beneficiaries of this inexpensive and accessible internet

The Indian Department of Telecommunications (DoT) requires operators to obtain a license before being granted the right to use radio spectrum. There are exceptions to this rule, such as the Citizens Band in the 27 MHz range and the Wi-Fi bands in the 2.4 GHz and 5.8 GHz ranges. India's National Telecom Policy 2012 recognizes the need to reserve more frequencies for unlicensed use. However, the country is still behind when compared to unlicensed spectrum availability in the U.S. and UK which have already integrated innovative spectrum management techniques in their telecom policies.

India needs to follow suit in order to provide connectivity to remote/rural regions and encourage further innovation in the telecom domain.

Some of the prominent unlicensed frequencies in the U.S. are:

Band	Frequencies (MHz)
ISM/ Spread Spectrum	902-928, 2400-2483.5 & 5725-5850
Unlicensed PCS	1910-1930 & 2390-2400
Millimeter Wave	59,000-64,000
U-NII	5150-5350 & 5725-5825
Millimeter Wave (Expansion)	57,000-59,000

Innovations in Unlicensed Spectrum Bands

Unlicensed spectrum enables decentralized innovation in wireless technologies very much like internet technologies. Special permission is not needed to deploy and test new technology on the unlicensed frequencies. Some technologies which have emerged due to unlicensed spectrum policies are Wi-Fi, FMC-enabling technologies such as UMA, DECT, as well as RFID, Bluetooth, Zigbee, etc.

The development of Wi-Fi was triggered by the FCC's decision in 1985 to allow unlicensed spread spectrum systems in the 915 MHz, the 2.4 GHz and 5.8 GHz bands allocated for industrial, scientific and medical (ISM) applications. In 1986, a working design was applied in the Wireless LAN. Later a group from CEPT recommended the opening of the 2.4 GHz band meant for ISM applications for the unlicensed utilization of Radio-LAN devices.

Unlicensed spectrum in India

Perspectives on Spectrum Allocation and Unlicensing of Spectrum

The Indian Supreme Court, by ruling of February 1995, declared airwaves to be public property. The landmark ruling was made by Justice P.B. Sawant and Justice S. Mohan. The decision specified that the use of airwaves "has to be controlled and regulated by a public authority in the interests of the public and to prevent the invasion of their rights." It would be in the greater interest of the public to exempt additional spectrum from licensing. Presently a large part of the RF spectrum is controlled by the government, with only a minimal amount of frequencies being allocated for unlicensed use. However policy makers are beginning to recognize the importance of allocating more unlicensed spectrum.

Existing licence-exempt bands in India

Unlicensed Frequency Ranges in India	Application/Specifications
50-200 kHz	Very low power devices
13553-13567 kHz	Very low power radio frequency devices, indoor only
26.957 MHz-27.283 MHz	Low power wireless equipment (max. Effective Radiated Power of 5 watts)
335 MHz	Low power wireless equipment for the remote control of cranes
402-405 MHz	Medical RF wireless devices (max. radiated power of 25 microwatt) with channel emission band width within 300 kHz
865-867 MHz	Low power wireless device (max. transmitter power of 1 watt-4 watts Effective Radiated Power) with 200 kHz carrier bandwidth
865 MHz - 867 MHz	Radio Frequency Identification Devices (RFID) (MTP of 1 watt-4 watts ERP) with 200 kHz carrier band width
2400 MHz - 2483.5 MHz	Low power wireless equipment (e.g. Wi-Fi) (max. transmitter output power of 1 watt-4 watts ERP) with spectrum spread of 10 MHz or higher
5150 MHz-5350 MHz	Low power equipment for Wireless Access Systems (max. mean Effective Isotropic Radiated Power of 200 mW and max. mean Effective Isotropic Radiated Power density of 10 mW/MHz in any 1 MHz bandwidth) indoor Only
5725 MHz-5825 MHz	Low power equipment for Wireless Access Systems (MMEIRP of 200 mW and MMEIRP density of 10 mW/MHz in any 1 MHz bandwidth) indoor Only
5825 MHz- 5875 MHz	Low power equipment (MTP of 1 watt-4 watts ERP) with spectrum spread of 10 MHz or higher

Bands requiring de-licensing in India:

Requested Frequency Ranges for Unlicensing	Application	Current Allocation	Countries/Regions Where Exemption is in Place
433 MHz-434 MHz	Data telemetry	Low power short range devices	Australia, Singapore, Malaysia, European Union and New Zealand
902-928 MHz	Low power wireless equipment	<ul style="list-style-type: none"> • 902.5-915 MHz: Additional requirements of cellular telephone systems, train control and mobile train radio systems • 900 MHz band: Micro cellular low powered telecommunication systems • 926-926.5: low power cordless telephone systems 	U.S.
1880 MHz-1900 MHz	Low power cordless communication	Micro cellular wireless access systems (fixed/mobile) based on TDD access techniques	Europe
2483 -2500 MHz	Broadband Access	_____	_____
5150- 5350 MHz	Broadband Access	Low power equipments for wireless access systems indoor only	U.S., UK

Impact of Unlicensed Spectrum on Rural Broadband and Mass Media

Communities that lack the infrastructure required for data connectivity and communications are deprived of the vast economic and social benefits of Information and Communication Technologies (ICTs). To address this digital divide, many communities have opted for wireless network systems based on license-exempt spectrum such as Wi-Fi. As the ITU Secretary General's introduction at the World Summit on Information Society stated, "...indeed, it is precisely in places where no infrastructure exists that Wi-Fi can be particularly effective, helping countries to leap-frog generations of telecommunications technology and infrastructure to empower their people". Community wireless networks using unlicensed frequencies have the potential to provide marginalized communities with low cost and accessible sources of local information, as well as connection to the rest of the world at an affordable cost. Such networks can facilitate initiatives like telemedicine, e-governance, e-commerce, e-learning, and telephony service through Voice over Internet Protocol (VoIP) at a much lower cost.

Wireless LAN Architecture:

Local area network (LAN):

A set of computers, computational systems, units, and devices, for example, mobile phones, printers, laptops, smart sensors, and smart labels, networked using a standard suite of protocols. Local refers to some defined area or a set of nearby or distant stations.

Wireless LAN (WLAN)

(Also called WiFi (Wireless fidelity))

IEEE 802.11a, 802.11b, ... 802.11g standards recommended for WLAN in mobile communication and for establishing communication between mobile devices and Internet or other networks.

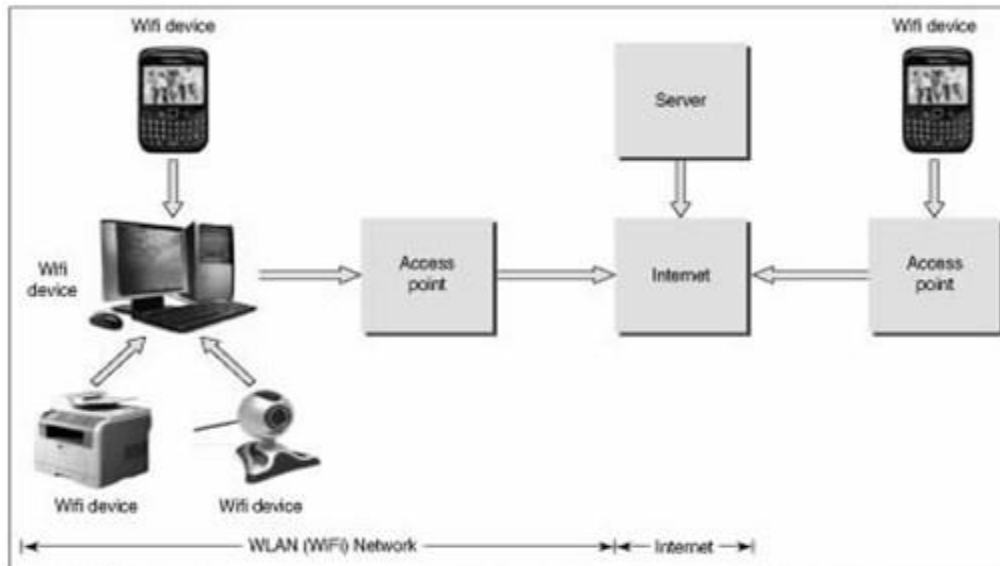


Figure WLAN network connected to the Internet and remote the enterprise server

Wireless LAN Architecture: Two service sets in the WLAN architecture

- Basic Service set (BSS)— Set A has nodes which connect to an access-point
- Independent basic service set (IBSS)— Set B do not connect to any access-point

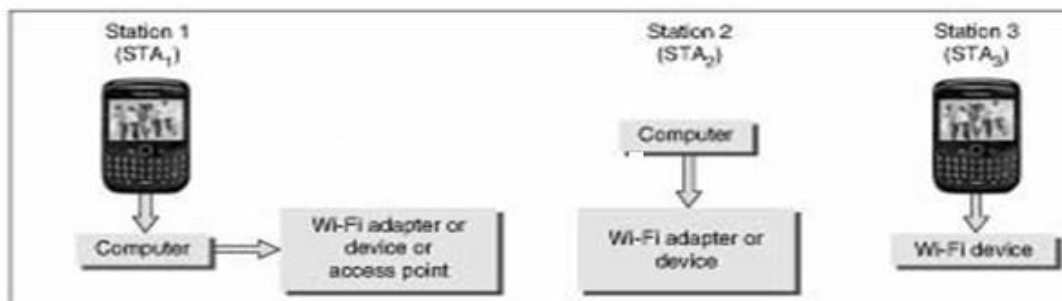


Figure WLAN network stations

- IBSSs do not connect among themselves

BSS: Basic Service set (BSS) A (See fig. next)

BSS devices in each set interconnect to the access-point using 802.11

- Form a single station STA_A of WLAN using same frequencies for radio
- The BSS station interconnects to other stations through access-points

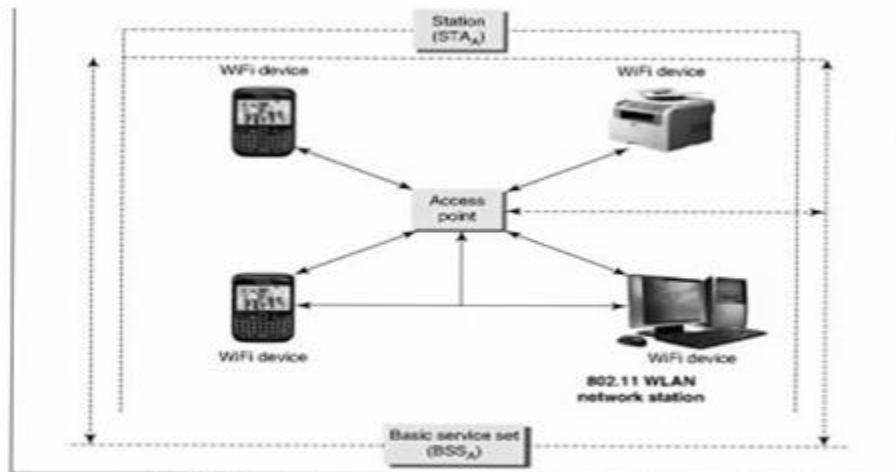


Figure BSS which also has an access-point for connectivity to a distribution system or extended service set

IBSS Set B

- Set B has several stations STA_B , STA_C ,
- WLAN Supports both access-point-based fixed infrastructure WLAN network using BSSs
- Ad-hoc peer-to-peer data routing network using IBSS stations
- A mobile phone, TV with a set-up box, security system, and computer at home
- Form a WLAN station and can use the same frequency band for radio
- Since it does not have an access-point to a distribution system or ESS, the station is a part of an IBSS
- These devices can also have Bluetooth OBEX exchange between mobile phone and computer

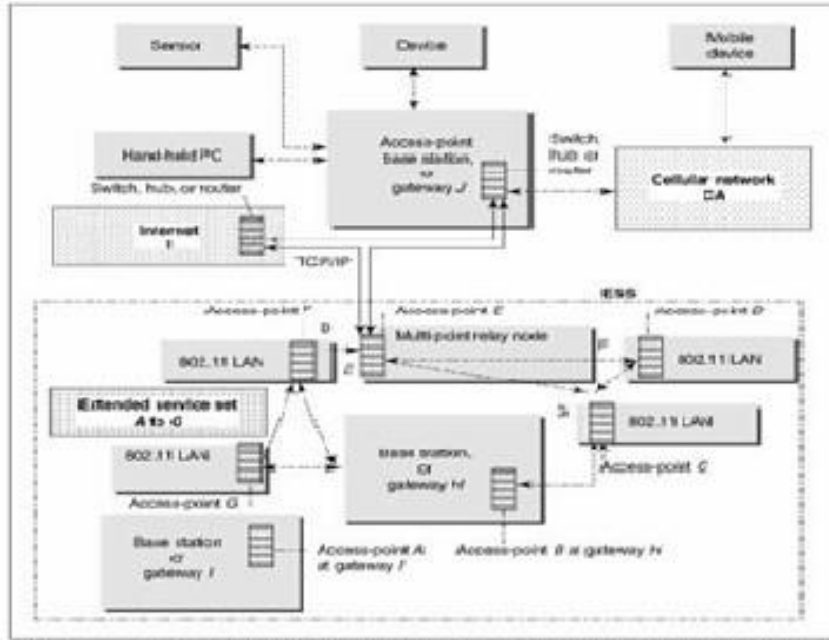


Figure 802.11 LAN access points of the distribution systems networked together using E-SS

Node in WLAN

Each node of a station uses the same frequency band if it is at a distance from another station or a distinct frequency band if it is not distant enough from another station

- Node at a station can communicate directly to an access-point (in BSS)
- To another node at another station through the access-point
- Communicate among themselves after forming an ad-hoc or any other type of network (forexample, Bluetooth) using same frequency band for each node.

Distributed Systems:

The wireless BSS may or may not provide sufficient coverage.

Functions :

- Perform address to destination mapping.
- Seamless integration of multiple mobile devices in the BSS.

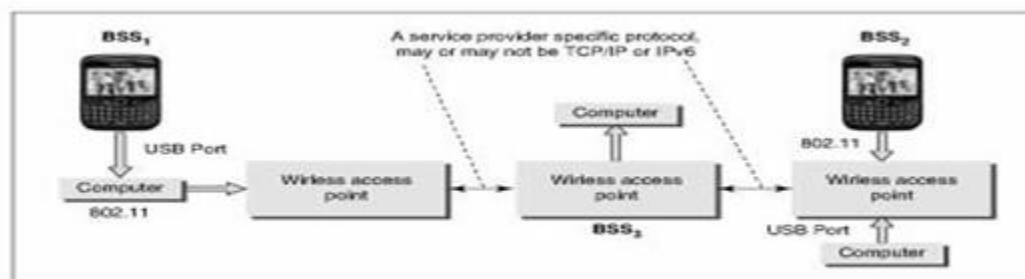
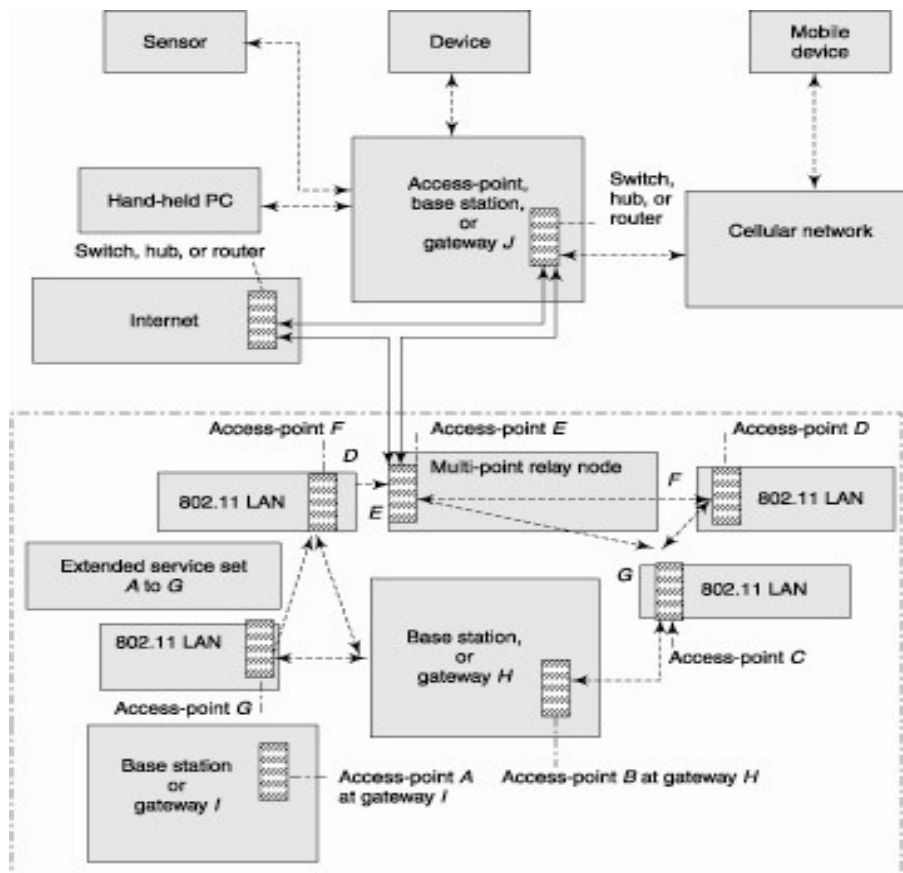


Figure Distributed systems interconnected by wireless access points

Extended Service Set (ESS):

- Functions as a distribution system possessing an ID, called ESSID

- The 802.11 provides the definition for ESSID, but the distribution system network protocols are not defined within 802.11
- Internet can be deployed by WLAN distribution system.
- Access-points exist at the base stations or gateways *J and H*
- An access-point also present at a multi-point relay node, *E*



Wireless LAN Protocol layers (IEEE 802.11):

- Each layer has specific protocols to send the bits to next layer
- Open System interconnection (OSI) model Physical (layer 1) layer
- Data link (layer 2)
- Network (layer 3)
- Transport (layer 4)
- Session (layer 5)
- Presentation (layer 6)
- Application (layer 7) layer
- Reception In the order—layer 1 to layer 7
- Transmission in the reverse order—layer 7 to layer 1
- Each layer adds additional headers (messages) in specific formats so that at the receiver, these headers are stripped and the actions and operations specified by the header fields take place

- May not have all the 7 layers
- Some layers functions may be assigned the functions of the neighboring layer(s)
- The functions of a layer can also be divided amongst sub layers
- **IEEE 802.x set of protocols defined for networking**
- **802.1** [x = 1] gives specifications for bridging of sub layers LLC (logic link control) and MAC (medium access control)
- For management of layers 1 and 2
- x = 2 gives specifications for LLC sub-layer at layer 2
- x = 1 and 2 specifications common to all standards in 802.x for x = 3 and above
- x = 3 gives the specifications for MAC sub-layer of layer 2 and physical layer for wired LAN, called Ethernet
- Upper layers common in protocols 802.x
- x = 10 gives the security specifications for layers 2 and above and is common in protocols 802.1y
- x = 1; y = 1 means 802.11
- x = 1; y = 5 means 802.15
- x = 1; y = 6 means 802.16

802.11 standard— a suite of WLAN protocols:

For the MAC sub-layer of layer 2 and physical layer (layer 1), which includes security 802.10 specifications

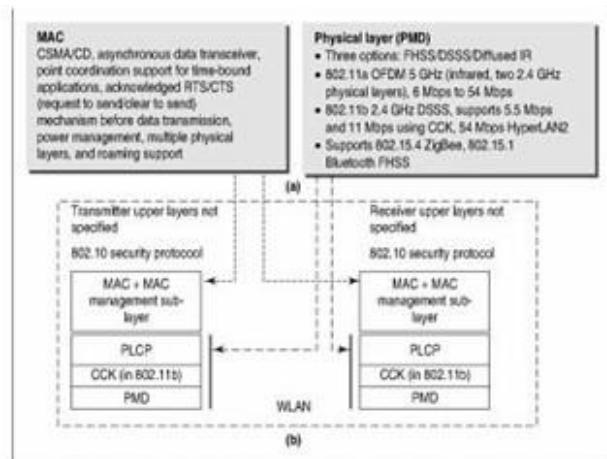
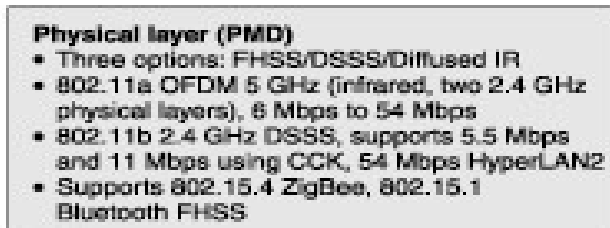


Figure (a) Functions of MAC and physical layer (b) Basic protocols layers in 802.11 in receiver and transmitter

Physical layer:-The layer which transmits or receives the signals through wireless

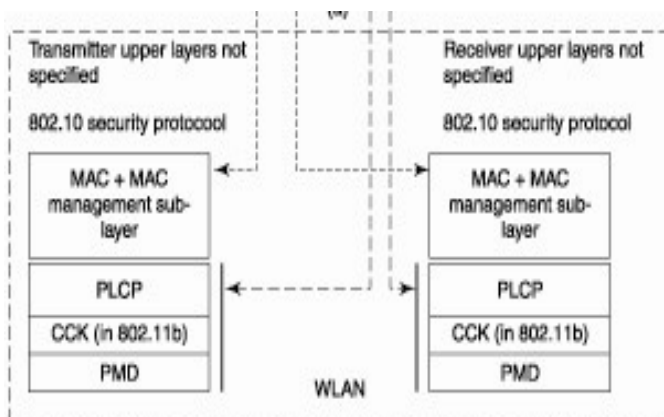


communication or through wire, fiber, or microwave after formatting or multiplexing

MAC

CSMA/CD, asynchronous data transceiver, point coordination support for time-bound applications, acknowledged RTS/CTS (request to send/clear to send) mechanism before data transmission, power management, multiple physical layers, and roaming support

Basic protocols layers in IEEE 802.11:



Physical layer two sub-layers

- PMD (physical medium dependent) sub-layer
- PLCP (physical layer convergence protocol) sub-layer
- There is an additional sub-layer in 802.11b □ CCK (complementary code keying) for data rates of 5.5 Mbps by QPSK to map 4 bits and 11 Mbps 8-QPSK to map 8 bits simultaneously
- PMD protocol:
- Specifications of the modulation and coding methods
- Service access-point with 1 Mbps or 2 Mbps data rate to MAC layer
- FHSS—radiated at 10 mW, 100 mW, and 1 W as per country-specific restrictions
- Modulation 1 Mbps Gaussian BPSK or 2 Mbps Gaussian QPSK
- **DSSS**—using 11-bit Barker code radiated at 10 mW, 100 mW, and 1 W as per country-specific restrictions and 1 Mbps or 2 Mbps data rates (symbol rates)
- DSSS transmission characteristics—negligible interference and multi-path delay spread
- Modulation—DQPSK, 11-bit code—11 Mchip/s, Scrambling done by a polynomial $G_0 = z^7 + z^4 + 1$
- **PPM** (Pulse Position Modulation)—a modulation method. 16-PPM is used for 1 Mbps and 4-PPM for 2 Mbps data rate
- 16-PPM means that a code is transmitted for each quad of 4 bits and is positioned in one of the 16 slots (a slot is a 16-bit long sequence of bits, each slot-bit separated by 250 ns)
- PPM method involves 250 ns pulses of diffused infrared (IR) for 10 m range within a room

- IR does not pass through walls and thus provides isolation from neighboring room nodes

PLCP Sub-layer

- Specifies sensing of the carrier at the receiver and packet formation at the transmitter
- The different transmission and reception protocols (FHSS, DSSS, and diffused IR) specified for the PMD
- Thus a convergence protocol sub-layer required in between the PMD and MAC sub-layers
- PLCP sub-layer protocol prescribes the standard procedure for convergence of PMD to MAC at receiver and from MAC to PMD at transmitter
- MAC and MAC Management sub layers
- MAC sub-layer specifies CSMA/CD (CSMA/Collision Detect), RTS/CTS, and PCF mechanisms
- Sub-layer specifies MAC management

CSMA/CD

- Point coordination support for time-bound applications
- Acknowledged RTS/CTS (request to send/clear to send) mechanism before the data transmission.

Functions of MAC management sub-layer

1. Roaming management

The access-point registers or deregisters the devices after the scanning

New device registration provisions for device association at new access-point when it roams into the new area from another access-point area

2. Internal receiver clocks are synchronized, which is necessary

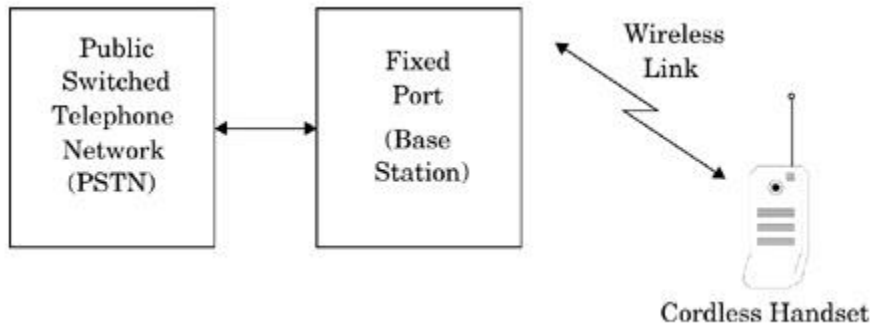
Generation of beacon signals is also part of management functions.

A BSS periodically sends beacon signals, which contain—(i) time stamp for synchronizing node clock and (ii) power management and roaming data

3. Transmitter switches to power-save mode after each successful data transmission for power management periodically activating the sleep mode

Buffering by a receiver and starting processing after enough data received in buffer also saves power

CORDLESS TELEPHONY



- Cordless Telephone Systems are full duplex communication systems that use radio to connect a portable handset to a dedicated base station, which is also connected to a dedicated telephone line with a specific telephone number on PSTN.
- The fixed port of a cordless telephone is nothing but the base unit on which cordless handset is placed, is connected to a telephone line and an adapter to produce a dc supply for various electronic circuits inside the base unit.
- The communication between the base unit and the handset is wireless and the range is limited to 50 meters.
- In the base unit all call processing circuits like amplifiers and also ring circuit is present. In addition a transceiver is also present which is used for communication with the handset.
- In handset also the transceiver along with an antenna, amplifier, microphone and loud speaker are present.
- 1st generation cordless telephone systems could cover only distance of a few ten meters(approximately 50m)and can be operated solely as extension telephones to a transceiver connected to a subscriber line on the PSTN and are primarily for in-home use.
- 2nd generation cordless telephone systems could cover distance of a few hundred meters which allows subscribers to use their handsets at many outdoor locations within urban centers.
- Cordless telephone systems provide the user with limited range and mobility, as it is not possible to maintain a call if the user travels outside the range of the base station.
- DECT standard for wireless communication in cordless telephony
- The DECT standard is widely established for wireless communication between the base and the handsets. Standardization and DECT-GAP allow devices from different manufacturers to be used with a base. Within Europe, DECT uses a frequency range between 1.88 and 1.90 gigahertz. Elsewhere range varies. Operated in certified countries. Text messages can also be transmitted to a handset via DECT.
- Cordless telephony via Wi-Fi, also available, but due to limited range, has not prevailed

Telephone standards, such as PHS and DECT, have blurred the once clear-cut line between cordless and mobile telephones by implementing cell handoff (handover); various advanced features, such as data-transfer; and even, on a limited scale, international roaming. Base station needs power from mains & the cordless handset contains a rechargeable battery,

In the United States, seven frequency bands have been allocated by the Federal Communications Commission for uses that include cordless phones. These are:

- 1.7 MHz (1.665–1.770 MHz, narrow-band FM)
- 27 MHz, near the Citizens Band (CB) Radio service .Signals were FM - frequency modulation.
- 43–50 MHz (Base: 43.72–46.97 MHz, Handset: 48.76–49.99 MHz, FM)
- 900 MHz (902–928 MHz, allocated in 1993)
- 1.9 GHz (1920–1930 MHz, developed in 1993 and allocated in October 2005.
- 2.4 GHz (2400–2500 MHz, allocated in 1998)
- 5.8 GHz (5725–5875 MHz, allocated in 2003 due to crowding on the 2.4 GHz band)

43–50 MHz cordless phones had a large installed base by the early 1990s, and featured shorter flexible antennas and automatic channel selection. Due to their popularity, an overcrowding of the band led to an allocation of additional frequencies.

Advanced models began to use voice inversion as a basic form of scrambling to help limit unauthorized eavesdropping. These phones share the 49.8 MHz band (49.830 - 49.890) with some wireless baby monitors.

900 MHz cordless phones are rarely sold but have a huge installed base. Features include even shorter antennas, up to 30 auto selecting channels, and higher resistance to interference.

Newer Digital Spread Spectrum (DSS) variants spread their signal over a range of frequencies, providing more resistance to signal fade. This technology enabled the digital information to spread in pieces among several frequencies between the receiver and the base, thereby making it almost impossible to eavesdrop on the cordless conversation.

The 1.9 GHz band is used by the DECT 6.0 phone standard and is considered more secure than the other shared frequencies.

In Europe, the 1.9 GHz (1880–1900 MHz) band was set aside for the DECT phone standard from its inception.

Performance

Many cordless phones in the 21st century are digital. Digital technology has helped provide clear sound and limit casual eavesdropping. Many cordless phones have one main base station and can add up to three or four additional bases. This allows for multiple voice channels that allow three-way conference calls between the bases.

"Plain old telephone service" (POTS) landlines are designed to transfer audio with a quality that is just adequate for the parties to understand each other. Typical bandwidth is 3.6 kHz;

Causes of limitation (bad voice quality):

Sidetone: hearing one's own voice echoed in the receiver speaker

Interference from noise within the cordless telephone system

Non-availability of full frequency response

Most manufacturers claim a range of about 30 metres (98 ft) for their 2.4 GHz and 5.8 GHz systems.

Higher frequency often brings advantages. The 900 MHz and 2.4 GHz band are increasingly being used for a host of other devices, including baby monitor, microwave oven, Bluetooth, and wireless LAN. It is also possible for a cordless phone to interfere with the 802.11a wireless standard, as the 802.11a standard can be configured to operate in the 5.8 GHz range. However, this can easily be fixed by reconfiguring the wireless LAN device to work in the 5.180 GHz to 5.320 GHz band.

The newer 1.9 GHz band is reserved for use by phones that use the DECT standard,

Security

Many analog phone signals are easily picked up by radio scanners, allowing anyone within range to listen in on conversations (though this is illegal in many countries). Though many such analog models are still produced, modern digital technology is available to reduce the risk of eavesdropping. Digital Spread Spectrum (DSS) typically uses frequency hopping to spread the audio signal (with a 3 kHz bandwidth) over a much wider range of frequencies in a pseudorandom way. Spreading the signal out over a wider bandwidth is a form of redundancy, and increases the signal-to-noise ratio, yielding longer range and less susceptibility to interference. Higher frequency bands provide more room for these wide-bandwidth signals.

Cordless phone handsets

Roaming cordless phone handsets exist which are not tethered to any particular base station, but which also do not use traditional mobile (cellular) phone networks. These most commonly use digital technologies like DECT, .4 GHz unlicensed spectrum, or 802.11a/b/g standards-based wireless LAN technology.

Cordless telephony via Wi-Fi

Its limited range compared to DECT, sometimes inadequate **bandwidths** due to parallel data transmission on the Wi-Fi network (since phones and other devices share the bandwidth); it is of not much in use.

IrDA (Infrared Data Association) - definition

It is a standard for transmitting data using an infrared port, from one IR device to another. Transfer speeds are roughly the same as traditional parallel ports.

Infrared connectivity is an old wireless technology used to connect two electronic devices. It uses a beam of infrared light to transmit information and so requires direct line of sight and operates only at close range.

IrDA defines the protocol standard for short range exchange of data over infra-red, for applications like that of PAN

One can connect to internet from laptop via mobile using IrDA (PC link software is used)

IR was superseded by Bluetooth, which has the advantage of operating at longer distances (around 30 feet) and being omnidirectional.

Many home devices such as TVs and DVD players still use IR remote controls.

IrDA devices require no FCC certification, and you can use them on board airlines during flight.

Untangling IrDA and Bluetooth

The Bluetooth is a RF-based, short-range wireless technology. But its cost is high. Complexity is another problem.

Initially the lack of standardization at the upper protocol layers slowed the adoption of IrDA technology.

Currently, the IrDA has published specifications for using infrared to connect to LANs, exchange calendar and address-book data, download images from digital cameras, and even communicate with wristwatches.

However by now, the Bluetooth SIG (Special Interest Group, caught up and eventually replace IrDA.

There are two basic reasons to use a short-range wireless connection: One is to get rid of a cable between two devices, and the other is to allow ad-hoc, or “spontaneous,” connections. Cable connections are prone to wear and tear. Adhoc connections allow users to quickly exchange business cards

Bluetooth's raw data rate is 1 Mbps. If you need more than that, IrDA can go to 4 or 16 Mbps. If the devices are going to be more than 1m apart when they are communicating, you will probably have to go with Bluetooth. The IrDA specification defines a range of 0 to 1m within a 30° cone. Therefore, the receiver must be no more than 1m from the transmitter and within a 30° cone emanating from the transmitting infrared LED. In practice, the actual distance between the two devices can be 2m or more if you align the transmitter and the receiver along the same axis.

If you can't guarantee a line-of-sight connection between the devices, you will have to use RF. The Bluetooth specification built security into the lower levels of the protocol—but at a price.

The directionality of infrared light not only makes IrDA devices inherently more secure than RF devices but also makes them less susceptible to interference. IrDA is far more mature technology compared to Bluetooth

Another advantage of Bluetooth is that you can use it for point-to-multipoint applications. (IrDA limits you to point-to-point connections.)

Bluetooth and IrDA can be used in the same device, as they are complimentary rather than competing.

A closer look

The lowest layer of IrDA, IrPHY (infrared physical layer), represents the IR transceiver. The IrPHY is always a hardware device and usually consists of a photodiode for the receiver, an infrared emitter for the transmitter, and an analog circuit for encoding the data and framing. The

next layer is the IrLAP (Infrared Link Access Protocol). The IrLAP establishes and maintains a reliable data connection between two IrDA devices.

The third protocol layer is called the IrLMP (Infrared Link Management Protocol) which allows multiple clients to use the same physical IrDA port and resolves address conflicts between devices. The IrLMP also contains the IAS (Information Access Service), which acts as a “yellow pages” of services available on the device.

There are many other protocols. Tiny Transport Protocol, IrOBEX (Infrared Object Exchange Protocol), IrCOMM (Infrared Communications Protocol), IrLAN (Infrared Local Area Network) etc.

Bluetooth devices have a greater range, can communicate through walls and people, and don't require alignment to work.

Difference between IrDA and Bluetooth

IrDA	Bluetooth
Infrared light as communication media.	Radio frequency of 2.4 GHz is used as communication.
It has max data rates is 4Mb per second.	It has max data rates is 1Mb per second.
Infrared only works between two devices at a time.	Bluetooth can work with as many as mobile device.
The open loop control system is more sensitive to noise.	The close loop control system is less sensitive to noise.
Its communication range is up to at least 1m.	Its communication range up to 100m.
IrDA has strong security.	Bluetooth has less security.
It has point to point connection with narrow angle of 30 degree.	It has multipoint connection with Omni-directional.
IrDA is useful in LAN (Local Area Network) technology.	Bluetooth is useful in personal area network .
Communication is blocked by obstacles that block light as infrared light is used in line of sight.	Communication is not blocked by obstacles that block light as radio waves are used.
It has poor accuracy.	It has better accuracy.

IRDA: Enhancing Connectivity through Infrared Communication

Applications of IRDA:

IRDA finds applications in numerous fields, owing to its wireless and reliable nature. Some of its prominent applications include:

a. Wireless Data Transfer: IRDA enables the wireless transfer of data between devices, allowing users to exchange files, documents, and multimedia seamlessly.

b. Remote Control Systems: IRDA is widely used in remote control systems, such as TV remotes, air conditioning remotes, and home automation devices. It allows users to operate these systems wirelessly, providing convenience and ease of use.

c. Printing and Scanning: IRDA is utilized in wireless printing and scanning applications. By leveraging IR technology, users can print documents or scan images without the need for physical connections.

d. Mobile Payments: Some smartphones and devices equipped with IRDA can perform mobile payments by securely exchanging transaction data with point-of-sale (POS) terminals.

e. Healthcare and Wearable: In the healthcare industry, IRDA is used for communication between medical devices, such as blood glucose meters and insulin pumps. It is also integrated into wearable devices for fitness tracking and health monitoring.

Conclusion:

IRDA, the Infrared Data Association, has revolutionized the way devices communicate wirelessly. By utilizing infrared light waves, IRDA enables efficient and reliable data transfer between various devices, ensuring seamless connectivity. Its universal standardization, data formats, and protocols have made it a preferred choice in applications ranging from wireless data transfer to remote control systems, printing, scanning, mobile payments, and healthcare. As technology continues to evolve, IRDA will likely remain an essential component in facilitating effective and secure wireless communication.

Understanding Bluetooth Technology

Bluetooth technology allows devices to communicate with each other without cables or wires. Bluetooth relies on short-range radio frequency, and any device that incorporates the technology can communicate as long as it is within the required distance.

Many personal electronic devices (PEDs) use Bluetooth technology. For example, you may be able to operate your computer with a wireless keyboard or use a wireless headset to talk on your mobile phone.

What are some security concerns?

Depending upon how it is configured, Bluetooth technology can be fairly secure. You can take advantage of its use of key authentication and encryption or just personal identification numbers (PINs)

On discovery of Bluetooth device, unsolicited message/ accessing or corrupting your data ("bluesnarfing") can be possible. Also, viruses or other malicious code can take advantage of Bluetooth technology to infect other devices. Results- data may be corrupted, compromised, stolen, or lost.

How can you protect yourself?

- Disable Bluetooth when you are not using it.
- Use Bluetooth in "hidden" mode. When Bluetooth is enabled, make sure it is "hidden," not "discoverable."
- Be careful where you use Bluetooth. Be aware of your environment when pairing devices
- Evaluate your security settings. Examine your settings, particularly the security settings, and select options that meet your needs without putting you at increased risk.
- Take advantage of security options like authentication and encryption offered by your bluetooth

Bluetooth operates within the unlicensed, business, scientific, and clinical (ISM) bands from 2.4 GHz to 2.485 GHz.(UHF radio waves in ISM bands); transmission power is limited to 2.5 milliwatts,

Depending upon the version, it presents information up to at least 1 Mbps or 3 Mbps. The spreading method that it uses is FHSS (Frequency-hopping unfold spectrum). A Bluetooth network is called a piconet and a group of interconnected piconets is called a scatter net.

The transmission capacity of Bluetooth is 720 kbps.

Architecture of Bluetooth

The architecture of Bluetooth defines two types of networks:

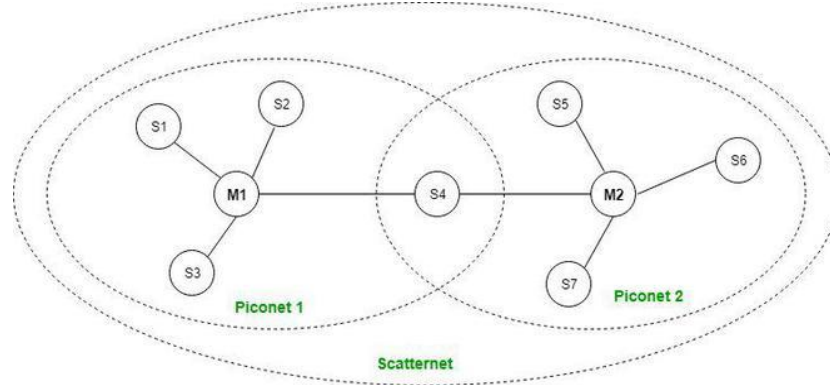
Piconet

Piconet is a type of Bluetooth network that contains one primary node called the master node and seven active secondary nodes called slave nodes. Thus, we can say that there is a total of 8 active nodes which are present at a distance of 10 meters. The communication between the primary and secondary nodes can be one-to-one or one-to-many. Possible communication is only between the master and slave; Slave-slave communication is not possible. It also has 255 parked nodes, these are secondary nodes and cannot take participation in communication unless it gets converted to the active state.

Scatternet

It is formed by using various piconets. A slave that is present in one piconet can act as master or we can say primary in another piconet. This kind of node can receive a message from a master in one piconet and deliver the message to its slave in the other piconet where it is acting as a

master. This type of node is referred to as a bridge node. A station cannot be mastered in two piconets.

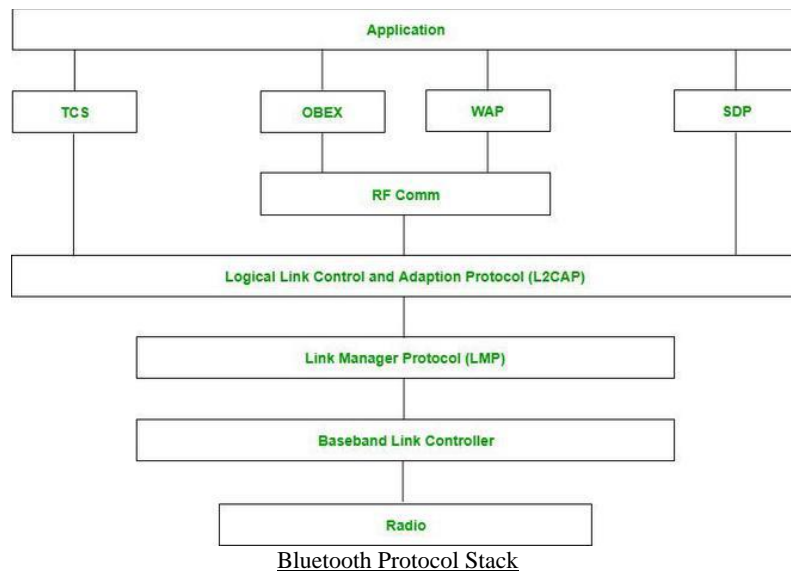


Bluetooth Architecture

The master clock ticks with a period of 312.5 μ s, two clock ticks then make up a slot of 625 μ s, and two slots make up a slot pair of 1250 μ s. In the simple case of single-slot packets, the master transmits in even slots and receives in odd slots. The slave, conversely, receives in even slots and transmits in odd slots. Packets may be 1, 3, or 5 slots long, but in all cases, the master's transmission begins in even slots and the slave's in odd slots. The master chooses which slave device to address; typically, it switches rapidly from one device to another in a round-robin fashion.

Bluetooth Protocol Stack

- **Radio (RF) Layer:** It performs modulation/demodulation of the data into RF signals. It defines two types of physical links: connection-less and connection-oriented.
- **Baseband Link Layer:** The baseband is equivalent to the MAC sublayer in LANs. It performs the connection establishment within a piconet, addressing, packet format, timing and power control.
- **Link Manager Protocol Layer:** It performs the management of the already established links which includes authentication and encryption processes.
- **Logical Link Control and Adaption (L2CAP) Protocol Layer:** It is also known as the heart of the Bluetooth protocol stack. It allows the communication between upper and lower layers of the Bluetooth protocol stack. It also performs segmentation and multiplexing.
- **Service Discovery Protocol (SDP) Layer:** It allows discovering the services available on another Bluetooth-enabled device.
- **RF Communication Layer:** It provides a serial interface with WAP and OBEX. The protocol is based on the ETSI standard TS 07.10.
- **OBEX:** It is short for Object Exchange. It is a communication protocol to exchange objects between 2 devices.
- **WAP:** It is short for Wireless Access Protocol. It is used for internet access.
- **TCS:** Telephony Control Protocol - provides telephony service. The basic function of this layer is call control (setup & release) and group management for the gateway serving multiple devices.
- **Application Layer:** It enables the user to interact with the application.



Types of Bluetooth

Various types of Bluetooth are available in the market nowadays. Let us look at them.

- **In-Car Headset:** One can make calls from the car speaker system without the use of mobile phones.
- **Stereo Headset:** To listen to music in car or in music players at home.
- **Webcam:** One can link the camera with the help of Bluetooth with their laptop or phone.
- **Bluetooth-Equipped Printer:** The printer can be used when connected via Bluetooth with mobile phone or laptop.
- **Bluetooth Global Positioning System (GPS):** To use Global Positioning System (GPS) in cars, one can connect their phone with car system via Bluetooth to fetch the directions of the address.

Applications of Bluetooth

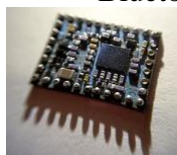
- In wireless PANs, and LANs.
- Connect a digital camera wireless to a mobile phone.
- It can transfer data in terms of videos, songs, photographs, or files from one cell phone to another cell phone or computer.
- It is used in the sectors of Medical healthcare, sports and fitness, Military.

Advantages

- It is a low-cost and easy-to-use device.
- It can also penetrate through walls.
- It creates an Ad-hoc connection immediately without any wires.
- It is used for voice and data transfer.

Disadvantages

- It can be hacked and hence, less secure.
- It has a slow data transfer rate of 3 Mbps.
- Bluetooth communication does not support routing.



Ericsson Bluetooth module PBA 313 01/2S R2A.

Originally, Gaussian frequency-shift keying (GFSK) modulation was the only modulation scheme available. Since the introduction of Bluetooth 2.0+EDR, $\pi/4$ -DQPSK (differential quadrature phase-shift keying) and 8-DPSK modulation may also be used between compatible devices.

Bluetooth device power by class

<u>Class</u>	<u>Maximum permitted power</u>	
	<u>mW</u>	<u>dBm</u>
1	10–100	+10–+20
1.5*	2.5–10	+4–+10
2	1–2.5	0–+4
3	0.01–1	–20–0

* Class 1.5 included in Class 1 for BR/EDR

Historically, the Bluetooth range was defined by the radio class, with a lower class (and higher output power) having larger range. Factors affecting range are the data rate, protocol (Bluetooth Classic or Bluetooth Low Energy), transmission power, and receiver sensitivity, and the relative orientations and gains of both antennas.

Bluetooth applications are for indoor conditions, where attenuation of walls and signal fading due to signal reflections make the range far lower than specified line-of-sight ranges

Bluetooth profile, deciding applications

To use Bluetooth wireless technology, a device must be able to interpret certain Bluetooth profiles. For example,

- The Headset Profile (HSP) connects headphones and ear buds to a cell phone or laptop.
- The Health Device Profile (HDP) can connect a cell phone to a digital thermometer or heart rate detector.
- The Video Distribution Profile (VDP) sends a video stream from a video camera to a TV screen or a recording device.

Bluetooth – Smart Phones

What is Bluetooth?

With Bluetooth, you can connect 2 or more devices wirelessly. Over the years, Bluetooth has improved in several areas. All the Bluetooth versions are backwards compatible. This means that a device with a newer Bluetooth version can connect to a device with an older version.



You can wirelessly connect two devices, such as a smartphone and a smartwatch or car kit, via Bluetooth. But you can also use it to wirelessly play music from your smartphone on your Bluetooth speaker or to transfer files and photos between two devices. All smartphones nowadays have Bluetooth, and new smartphones have at least Bluetooth 5.0. This version is faster and has a longer range.

Bluetooth 5

Bluetooth 5 is faster in data transfer and more energy efficient compared to previous versions. In addition, the range is longer: devices connect over a distance of up to 40 meters. This is 4 times further than with older versions. This is useful, for example, when you have a number of smart devices connected to each other at home.

Bluetooth 5.0 version of the Bluetooth wireless communication standard, commonly used for wireless headphones and other audio hardware, as well as wireless keyboards, mice, speakers, trackers, and game controllers. Bluetooth is also used for communication between various smart home and Internet of Things (IoT) devices.

The Future of Bluetooth: What to Expect

Multi-stream

Multi-stream is a feature that allows for multi-device support using Bluetooth. Using this feature, you can connect to two devices at once and switch between them with ease.

Multi-channel audio codec

The LC3 audio codec provides high-quality audio streaming by increasing the bitrate. This means that Bluetooth will offer better sound quality than previous versions of Bluetooth. And it accomplishes this at half the earlier SBC codec's bitrate.

Because LC3 requires less bandwidth to carry larger amounts of data because of the lower bitrate, less power is consumed. This benefits the battery life of your smartphone.

Assistive listening

Assistive listening devices (ALDs) are becoming more common in vehicles, homes, and offices around the world. ALDs allow people with hearing impairments to hear sound clearly by sending an incoming signal through an earpiece worn by the user. The technology behind these devices relies heavily on frequencies transmitted over Bluetooth headsets.

Bluetooth 5.0 vs 5.1 vs 5.2 vs 5.3:

Bluetooth 5.3 versus its predecessors

In the middle of 2016, Bluetooth 5.0—a major advancement that doubled transfer rates, quadrupled ranges and maintained low power consumption with an eye on the Internet of Things—arrived. It also enabled more data to be sent in each message. In terms of numbers, the transmission rate reached 50 Mb/s and the range reached 240 meters.

Bluetooth 5.1 (Year 2019) which centered on location and enabled devices to pinpoint the exact location of other connected devices within a few centimeters, was a major advancement. One could determine the direction a signal is coming from.

Bluetooth 5.2, commonly referred to as Bluetooth LE Audio: It is a standard that was released at the beginning of 2020, and it enhances energy efficiency and sound quality in all connected devices used for audio tasks. The Low Complexity Communication Codec (LC3) is a novel codec that enables simultaneous audio transfer to several devices and can more effectively compress and decompress the data being transported.

TCL P Series | 3.1 Channel Dolby Audio Soundbar with Wireless Subwoofer uses Bluetooth 5.2 technology.

Bluetooth 5.3: Released in May 2022. Depending on the required bandwidth, this version offers lower consumption when in use, connections with less interference, greater connection security, and better quality always.

TCL C Series | 5.1.2 Channel Dolby Atmos Soundbar with Wireless Subwoofers and TCL X Series | 7.1.4 Channel Dolby Atmos Soundbar with Wireless Subwoofers use Bluetooth 5.3 technology.

Bluetooth 5.3 offers several enhancements over Bluetooth 5.0, focusing on efficiency and reliability in wireless communications. Key improvements include:

- **Channel Classification:** Bluetooth 5.3 enhances device connectivity by avoiding congested channels, thus reducing interference and improving reliability.
- **Connection Sub-rating:** This feature significantly reduces power consumption by allowing devices to switch to sleep modes more quickly and wake up without delay, extending battery life for connected devices.
- **Improved Attribute Protocol (ATT):** Bluetooth 5.3 optimizes data transmission processes to enhance responsiveness and efficiency.

These features collectively contribute to a more robust, power-efficient, and user-friendly Bluetooth experience compared to Bluetooth 5.0.

Bluetooth 5.3 VS 5.1

Bluetooth 5.3 offers several incremental improvements over Bluetooth 5.1, mainly focusing on efficiency and reliability. Key enhancements include:

Channel Classification: Bluetooth 5.3 introduces better channel selection to avoid interference, improving the reliability of connections.

Connection Sub-rating: This feature minimizes power consumption by managing how devices communicate, allowing them to remain connected with less frequent communication.

Enhanced Attribute Protocol (ATT): Optimizes data transmission, reducing delay and enhancing overall efficiency.

These updates ensure better device interoperability and extended battery life.

Bluetooth 5.3 vs 5.2

The primary differences between Bluetooth 5.2 and Bluetooth 5.3 are improvements in efficiency and connectivity management. Bluetooth 5.3 introduces Channel Classification which enhances the ability to avoid interference by identifying and avoiding congested channels. Another significant feature is Connection Sub-rating, which reduces the power consumption by improving the way devices remain connected without actively communicating. These advancements are designed to enhance device interoperability, improve the reliability of connections, and extend battery life in connected devices.

What is Improved in Bluetooth 5.3?

Bluetooth 5.3 is a minor update to the Bluetooth 5 standard that includes the following improvements:

The biggest one is the support for Periodic Advertising Enhancement: Normally, Bluetooth transmitting devices will send the same data out many times to make sure it is received, but this innovation means that the received data only needs to be examined once and duplicates will be instantly deleted. Even receiving devices may benefit from this efficiency in terms of energy savings. This allows for better discovery and tracking, especially in crowded environments such as stadiums or shopping malls where there are many Bluetooth Low-Energy (BLE) devices operating at once.

Another improvement is related to encryption key size control enhancements: now you can specify whether you want your device to use longer keys or faster encryption algorithms; depending on what you need (speed vs security). When transmitting data, Bluetooth devices frequently encrypt it to safeguard it. The security of this encryption is in part dependent upon the length of the key. The ability of the host to specify a minimum key size reduces the amount of back-and-forth communication between the transmitter and receiver on this issue.

Connection Sub rating. This feature enables quick switching between low-duty and heavy-duty cycles, which is meant to improve user experience. For example, Bluetooth hearing aid users will typically have their device on a low-duty cycle, but the quicker it can switch to a high-duty cycle when they receive a call or play music from their smartphone, the better for the user experience.

Channel Classification Enhancement. When data packets are transferred over many frequencies, this improvement enables channel classification on the part of peripheral Bluetooth devices. This was previously only feasible through the Central device, but the new approach will reduce the likelihood of packet collisions and boost throughput.

Again Bluetooth 5.0 : Low Energy for Wireless Headphones (and More)

Importantly, all the improvements being made to Bluetooth are to Bluetooth Low Energy specification, not to the classic Bluetooth radio that uses more power. With Bluetooth 5.0, all audio devices communicate over Bluetooth Low Energy, which means reduced power usage and longer battery life.

Notably, Apple's AirPods don't use Bluetooth 5.0. They use Bluetooth 4.2

Dual Audio

Bluetooth 5.0 also enables "Dual Audio" on the Samsung Galaxy. Just connect two Bluetooth audio devices to your phone, turn on the Dual Audio feature, and you're ready to go.

THE BEST BLUETOOTH SPEAKERS

More Speed, Distance, and Throughput

Bluetooth 5.0's primary benefits are improved speed and greater range. In other words, it's faster and can operate over greater distances than older versions of Bluetooth.

The official Bluetooth marketing material from the Bluetooth standard organization advertises that Bluetooth 5.0 has four times the range, two times the speed, and eight times the broadcasting message capacity of older versions of Bluetooth. Again, these improvements apply to Bluetooth Low Energy, ensuring devices can take advantage of them while saving power.

With Bluetooth 5.0, devices can use data transfer speeds of up to 2 Mbps, which is double what Bluetooth 4.2 supports. Devices can also communicate over distances of up to 800 feet (or 240 meters), which is four times the 200 feet (or 60 meters) allowed by Bluetooth 4.2. However, walls and other obstacles will weaken the signal, as they do with Wi-Fi (although a better wireless router will help things).

FEATURES WE WANT EVERY FLAGSHIP ANDROID PHONE TO HAVE

You can already get devices that support Bluetooth 5.0 today, like iPhones, Samsung Galaxy, and any other Android phone. You'll also need Bluetooth 5.0 peripherals, however.

Because Bluetooth is backwards compatible, your Bluetooth 5.0 and older Bluetooth devices will work together. It's a bit like upgrading to a new, faster Wi-Fi standard. Even after you get a new router that supports faster Wi-Fi, you have to upgrade all your other devices, too. But your older Wi-Fi-enabled devices can still connect to your new wireless router, just at a slower speed than the router supports.

Bluetooth version 6.0

The Bluetooth Special Interest Group (SIG) has unveiled the highly anticipated Bluetooth Core Specification version 6.0, marking a significant leap forward from the previous major update, Bluetooth 5, which was introduced in 2016.

Key Features of Bluetooth 6.0

1. Bluetooth Channel Sounding

One of the standout innovations in Bluetooth 6.0 is the introduction of Bluetooth Channel Sounding. This feature enables ultra-precise distance measurement between devices, achieving accuracy down to the centimetre level. The implication is it's easier to locate lost items with pinpoint precision. Additionally, Bluetooth Channel Sounding bolsters security for digital key solutions, ensuring that only authorized users within a defined proximity can gain access to secured areas.

2. Decision-Based Advertising Filtering

Bluetooth 6.0 also introduces a smarter way to handle advertising data through Decision-Based Advertising Filtering. This feature optimizes how devices process incoming advertisements. Decision-Based Advertising Filtering acts as an intelligent gatekeeper; it evaluates the relevance of the data received on the main channel and decides whether to process additional details from extra channels. This streamlined approach not only enhances efficiency but also conserves battery life by reducing unnecessary data processing.

3. Advertiser Monitoring

Another notable enhancement is Advertiser Monitoring. This capability enables devices to track when other devices of interest enter or exit their range. This stops unnecessary energy consumption and optimizes connectivity interactions.

4. ISOAL Enhancement

Bluetooth 6.0 brings significant improvements to audio applications with ISOAL (Isochronous Audio Layer) enhancements. This update reduces latency and boosts reliability—crucial for scenarios where real-time audio is essential (such as in live streaming or immersive audio experiences).

Bluetooth 6.0 is set to revolutionize how we interact with Bluetooth technology, offering more precise tracking, smarter data handling, and improved audio performance.

Google Gemini AI chatbot introduces new features

Google has introduced two new features for its Gemini AI chatbot. 'Go Live with Gemini' allows real-time, spoken conversations, while the second feature provides Google Workspace users with additional information links in responses. These updates aim to enhance communication, productivity, and access to comprehensive knowledge.

The goal of this feature is to provide quick and easy communication, whether users are brainstorming ideas, simplifying complex topics, or rehearsing for an important conversation.

The second feature enables Google Workspace users access to additional information on topics directly within Gemini's responses.

The "Go Live with Gemini" feature will help the coders to engage in natural, spoken conversations with the chatbot.

FUTURE PHONES

New Features Likely to come up in near future smartphones

1. Photonic Crystal Displays

Research and development is now pointing to photonic crystals, adapt too well to varying light conditions.

Instead of giving off bright light like LCD or OLED displays, a photonic crystal display features nanostructures that adapt and modify themselves according to the amount of ambient light in a given environment. Although the photonic screen requires an external light source in order to be visible, this could easily be integrated into the body of the phone

Apple and Google have been making some pretty big investments in photonics, and, back in 2013, Samsung had already demonstrated the concept of a flexible phone that utilized a photonic crystal display. Chances are we'll start seeing these display put into smartphones within the next few years.

2. Nano-Tech Batteries

In 2015, a Israeli tech company StoreDot revealed a customized Samsung Galaxy S5 with a nano- technology-utilizing battery that could charge from 0 to 100 percent in less than a minute. In its current state of development, the StoreDot battery only lasts about two-thirds of the time of a conventional lithium-ion smartphone battery. However, it shouldn't take too long for the company to improve the technology. StoreDot has already received substantial investments from Samsung, and is in discussions with manufacturers about integrating its battery into future smartphones.

3. Liquid Buttons

Tactus Technology had developed a keyboard that uses special micro fluidics technology which drives small amounts of liquid into invisible pockets that rest over the typing pad on a smartphone. When the user brings up the touchscreen keyboard, the pockets instantly fill with liquid which has the effect of physically raising the buttons.

4. Headphone Surround Sound

With a 7.1 mobile audio solution for smartphones that promises to faithfully recreate the sound of specific listening environments using even the simplest pair of headphones. The higher processing power of new smartphones should be able to support the advancement in audio technology.

5. Biometric Authentication

Qualcomm has developed a new type of ultrasonic fingerprint scanner using a piezoelectric layer that creates ultrasound. In addition to mapping your finger, the scanner features greatly increased resolution, which is also an enhanced security benefit.

6. Virtual Reality

The new 4K displays that will be rolled out on new smartphones, are ideal for VR applications. Once inserted into a head-mounted device, the phone itself will act as the VR headset's display and 4K resolution will be instrumental in providing an immersive, non-pixelated experience.

7. Graphene

Since its development for practical application in 2004, graphene has been praised as "wonder material". It's thin, lightweight, flexible, transparent and over 200 times stronger than steel. It's also one of the best materials for conducting electricity, which makes it ideal for use in electronic devices.

Incorporating graphene into smartphones could allow for designs to be ultra-thin, transparent, flexible and virtually indestructible. Recently, there have been a few breakthroughs by phone manufacturers who have been playing around with graphene.

8. No SIM Cards

Apple and Samsung are making strides to rid the world of the physical presence of SIM cards by replacing them with an electronic version.

By having a programmable SIM integrated into your phone, you'll essentially be able to switch between networks without having to request a new SIM card. It will be quite handy for anyone travelling or living abroad who wants to get set up with a local number.

9. Pressure-Sensitive Screens

The Force Touch on the Apple Watch has demonstrated that companies already have the ability to manufacture screens that are capable of sensing pressure. Controls that can distinguish between a light tap from a firm press will give users even more ways to manipulate their phones

10. Flawless Voice Interaction

Voice interaction has been around for a while now and incremental improvements over the years have led to the development of virtual personal assistants. Now, the algorithms used in voice-assisted applications are moving ahead quickly. It won't be long before the A.I. becomes so intuitive that it will start giving you advice that seems to pre-empt your very thoughts.

11. Innovative Medical Apps

Recently, scientists developed an app called Athelas which makes use of a lens attachment to track malaria and cancerous cells as they move through a patient's blood. This innovation has prompted scientists to look for other ways that smartphones could be used to track highly infectious diseases, such as Ebola, to gain a better understanding of how they move and spread.

Using an inexpensive phone add-on called PCR that's able to tag and track pathogens in the blood, diseases should be able to be diagnosed within hours or even minutes. The smartphones could soon bring about a revolution in medical care.

12. Smart Cameras

In 2015, Qualcomm demoed a camera that showed it was capable of identify the objects it was looking at. The system works by comparing real world objects to a huge reference database stored on the device. Best of all, it's possible to train the software to understand ever more things. This technology could have enormous potential and enable cameras to do all sorts of clever and useful things relating to the real world environment.

Just as with your smartphone, Internet access enables a smart watch with whole world of potential capabilities, like message notifications, GPS navigation and calendar synchronization. And of course, a Bluetooth connection to your phone means the watch can help you place calls or send and receive messages.

Samsung, Sony, Qualcomm, Motorola, Nissan, Adidas and Timex already sell versions of smart watches. Blackberry, Toshiba, LG, Google and Apple have also joined or are ready to join.

Future Phone Will Likely Be Smarter, Faster and More Flexible

Phone-makers are using AI and foldable designs to make mobile devices fresh and interesting again.

Smartphones are getting exciting again thanks to AI, foldable screens and other developments.

Expect big changes to come to new phones in 2024 that stretch beyond the processor and camera upgrades we typically see each year.

New AI-fueled features could make phones much smarter, potentially turning them into capable personal assistants rather than pocket-sized portals to the internet. In addition, foldable

phones are inching closer to their breakout moment thanks to clever design improvements, cementing their place in the smartphone market.

Apart from, AI, charging speeds are faster, meaning you no longer have to carve out as much time to top off your phone. Tech companies are also making phone last longer, lessening their impact on the environment and possibly benefiting your wallet.

AI is coming for your phone in 2024

Artificial intelligence has played an important part in smartphones for years, particularly when it comes to features like facial recognition, photography and language translation. However, generative AI -- the tech that powers ChatGPT and creates answers based on training data in response to prompts -- brings new capabilities that go beyond unlocking your phone or blurring the background of a photo. Instead of working passively in situations like these, generative AI-powered features are meant to be used in more proactive ways.

Google showcased this with the launch of its Pixel 8 lineup, which uses AI to power new photo editing tricks, like moving and resizing individual subjects and altering facial expressions. Google's new phones can also generate fresh wallpaper based on specific themes from scratch., Google Assistant with Bard, the upgraded virtual helper will be able to handle tasks such as summarizing important points from email inbox and writing social media captions for photos. It'll be available for both Android devices and iPhones.

Qualcomm, which creates the chips that power phones from companies including Samsung and OnePlus, designed its new mobile processor around generative AI. The Xiaomi 14 and 14 Pro, the latest flagship devices from the world's third-largest phone manufacturer, according to IDC, are among the first devices to be powered by this new Snapdragon 8 Gen 3 chip..

A new chip will also make it possible to zoom out on an image taken on your phone and generate details to expand the frame, making it look like you took the photo using an ultrawide lens.

Samsung recently announced a new AI experience for phones called Galaxy AI and its own generative AI model. Galaxy AI will include a feature called AI Live Translate Call that can translate audio in real time.

Apple is expected to infuse its next major iPhone update, in September, with new AI features too.

Foldable phones – 2023,2024

Google's Pixel Fold and the Samsung Galaxy Z Fold are among the contenders in the growing foldable market. It's not just the brains of our phones that are evolving; it's their shapes, too. Different companies are slowly introducing their foldable phones.

Beyond more choice, the quality of foldable phones improved in 2023, too -- particularly when it came to flip phones. The Motorola Razr Plus and Samsung Galaxy Z Flip 5 each gained a larger external cover screen, making them more useful when closed.

But foldables took a step toward becoming more affordable in 2023,

In 2024 and beyond, foldable phones are expected to grow in popularity. The growth comes at a time when the overall smartphone market has been shrinking.

Phones that can charge faster and last longer

The OnePlus 11 charges faster than most phones.

Foldable screens are smarter Some smartphone-makers shortened the time it takes to replenish your phone's battery.

One such example comes from the new Xiaomi 14 phone, which has faster 90-watt charging compared with the previous version's 67-watt charging.

Android favorite OnePlus typically stands out for its speedy charging. Faster charging combined with more energy-efficient chips

Future Phones-Special Features-Educational tools

As more than one in three school children now possess a mobile phone, the prospect of mobile devices serving as versatile tools for learning and teaching gains credibility.

Eco-friendly and refurbished smartphones

In a constant quest to reduce their ecological footprint, companies are actively exploring ways to make their products more environmentally sustainable, and smartphone manufacturers are no exception. Researchers are delving into sustainable materials and cleaner energy charging methods.

Under-display cameras

The Samsung Galaxy Z Fold 5

Samsung is currently the sole smartphone manufacturer capable of concealing a camera beneath the display of a commercially available smartphone. This pioneering technology, known as UDC (Under Display Camera), made its debut in the Galaxy Z Fold 3 and, three years later, continues to be a standout feature in the new Galaxy Z Fold 5.

Regarding the hardware aspect, Samsung maintains the use of the same 4MP UDC camera for the Galaxy Z Fold 5, consistent with its implementation in the previous Z Fold 4 and Z Fold 3 models. This 4MP Under Display Camera boasts an f/1.8 aperture, 2.0-micron pixels, and an 80-degree field of view.

True to its name, the Under Display Camera is positioned discreetly behind the 7.6-inch Dynamic AMOLED 2X display of the Galaxy Z Fold 5. It remains hidden behind a circular region that is only partially obscured by display sub-pixels, allowing it to capture light and produce photos while maintaining an almost imperceptible presence.

Hopefully, eventually phone makers will be able to completely hide the front-facing camera, which would give us an immaculate display that reaches every edge of the phone. This would be a welcome upgrade for people who like to stream TV shows and films on their travels.

Zero ports and wireless charging

With wireless charging (earlier unreliable) speeds increasing dramatically each year, it's becoming ever-more likely that they'll push out charging cables in the next several years.

Rather than having to leave our phones plugged in for hours at a time to get a full charge, fast wireless charging will allow us to simply put our phones down for 15 or so minutes, get all the charge we need, and carry on our day.

FUTURE PHONES-Best upcoming phones for 2024 and 2025.

Flagships, foldable, midrange's and affordable models - there's an upcoming phone for all budgets

From hero handsets and foldable flagships to affordable mid-rangers, there's never a shortage of shiny new upcoming phones to get excited about.

Along with what you can expect – specs, camera capabilities and software smarts.

EXAMPLES OF FUTURE PHONES - Apple iPhone 16 series

Apple has now revealed the iPhone 16, 16 Plus and iPhone 16 Pro and Pro Max (no, it wasn't renamed the iPhone Ultra).

This year there are larger Pro variants, with 6.3in and 6.9in screens rumored. They also have a dedicated Camera button for content creators which also works with Apple Intelligence, alongside the returning Action button (which now filters down to the standard

iPhone 16 models). There are some decent camera upgrades, too, with both models now getting the 5x periscope zoom.

Honor Magic V3

Expect a book-style foldable that's an incredible 4.35mm thick when unfolded, and weighs just 226g. That's a whole lot lighter than the Samsung Galaxy Z Fold6. The 6.43in cover screen and 7.92in inner display both use LTPO 1-120Hz adaptive OLED panels. There's also a 5150mAh battery with 66W wired and 50W wireless charging.

Also included, a 50MP main camera with optical image stabilization, 50MP periscope zoom with 3.5x magnification, and a 40MP ultra-wide lead the photography charge

Apple iPhone SE 4

Apple's most affordable iPhone model will apparently inherit styling from the iPhone 14, with flat sides and a 6.1in OLED screen bringing the SE bang up to date.

The next SE will probably arrive in March 2025, as this tends to be when Apple introduces new iPhone SE models. There's still a chance it could appear alongside the iPhone 16

OnePlus 13

It's likely for OnePlus' next 'flagship killer' phone, albeit for China only. A global launch should follow in 2025. Early whispers suggest a colossal 6000mAh battery, which is bigger than anything in the mainstream mobile world right now. A Snapdragon 8 Gen 4 chipset should also appear.

Samsung Galaxy Z Flip6

Finally closes the gap between Samsung's foldable phones and the more mainstream Galaxy S series, with a potent Snapdragon 8 Gen 3 for Galaxy chipset, larger 4000mAh battery, and 50MP main camera sensor.

Samsung Galaxy Z Fold6

The world's most popular book-style foldable has slimmed down a teeny tiny bit for its sixth generation. Shorter but wider dimensions add 1mm to the outer screen and 2mm to the inner one. The frame has been flattened and given a matte finish to better mimic the Galaxy S24 Ultra. Inside there's a Snapdragon 8 Gen 3 for Galaxy chipset and extra large vapor chamber to keep it cool. A similar trio of cameras and same battery capacity as last year mean this foldable is all about the software, with lots of Galaxy AI additions.

CMF Phone 1

Nothing's bargain-focused sub-brand has diluted down the already affordable A 50MP main camera takes impressively good photos, and the modular accessories make it truly unique.

Xiaomi 14

The more mainstream of Xiaomi's two 14 series models has a compact 6.36in screen, but that doesn't mean it had to skimp on hardware. A sizeable battery capacity, Snapdragon 8 Gen 3 chipset, and a trio of very capable Leica-tweaked rear cameras make it a true rival to the likes of Samsung's Galaxy S24.

Xiaomi 14 Ultra

Best camera hardware. A 1in sensor main camera with variable aperture, twin telephotos with OIS and an ultra-wide with an equally high pixel count

OnePlus 12

OnePlus' latest flagship killer is expected to land in Europe imminently. We know exactly what to expect: the OnePlus 12 will land with a 6.82in AMOLED screen good for

astounding 4500nits peak brightness, a Snapdragon 8 Gen 3 CPU, and a three-lens rear camera setup headlined by a Sony-developed LYTIA stacked sensor.

Samsung Galaxy S24 and Galaxy S24 Plus

Bigger batteries, brighter displays and an unwavering focus on on-device AI help them stand out, with the larger of the two also getting a higher screen resolution and faster wired charging.

Samsung Galaxy S24 Ultra

The new hero of the Galaxy line-up has a titanium frame and Corning Gorilla Armor glass, making it super tough as well as super luxurious. That screen is flat now, rather than curved, and there's a Snapdragon 8 Gen 3 lurking underneath for serious power. AI is a big deal this year, being baked in to multiple apps and especially useful for generative photo edits.

Mobile operating system (OS)

A mobile operating system (OS) is the software that runs on mobile devices such as smartphones, tablets, and smartwatches. It manages the hardware and software resources of the device and provides a platform for running applications.

They are responsible for managing the input and output of data from the device, allocating memory for running applications, and providing a platform for running different programs.

The mobile OS is responsible for controlling and managing various functions and features of the mobile device, such as making phone calls, sending text messages, accessing the internet, and running applications. It enables the user to interact with a device through a graphical user interface (GUI).

Mobile OSs are designed to be lightweight and efficient, to provide a smooth user experience on limited hardware resources such as low-powered processors, small amounts of memory, and limited battery life. They also typically provide connectivity to various networks such as cellular networks, Wi-Fi, and Bluetooth.

It provides a framework for mobile apps to run on top of and acts as an interface between the hardware and the user.

There are several mobile operating systems available, with the most popular ones being:

1.Android: Developed by Google, Android is the most widely used mobile operating system globally. It is based on the Linux kernel and is open-source, which means that developers can modify and customize it to suit their needs. It has a broader demographic range due to its compatibility with various devices and manufacturers.

2.iOS: Developed by Apple, iOS is the operating system that runs exclusively on Apple devices, such as iPhones, iPads, and iPods. It is a closed-source operating system, which means that it can only be modified by Apple. It offers a seamless and user-friendly experience and is known for its high level of security.

3.Windows Mobile or Window phone: Developed by Microsoft, Windows Mobile is a mobile operating system that runs on smartphones, tablets and other mobile devices. It is based on the Windows CE operating system and provides a similar user interface to the Windows desktop operating system. It has a tile-based interface that makes it easy to navigate and use.

4.BlackBerry OS: Developed by BlackBerry, this mobile operating system was widely used in the past. It is a closed-source operating system, known for its security features, messaging capabilities and support for enterprise-level communication.

5.Tizen: Developed by Samsung and the Linux Foundation, Tizen is an open-source operating system that runs on Samsung smartphones & smartwatches and other devices. It is based on Linux and supports both native and web-based applications.

It is known for its lightweight, flexibility, fast performance and compatibility with various devices. It supports a variety of programming languages.

6.KaiOS - An emerging mobile operating system that powers feature phones and low-cost smartphones.

There are also other mobile operating systems, such as Ubuntu Touch, and Sailfish OS, but they are not as widely used as the ones mentioned above.

It is important for users to choose a mobile device with an OS that suits their needs and preferences.

Vital Role of Mobile Operating Systems

The Mobile OS forms an integral link between the underlying hardware of a mobile device and the software — the apps that users interact with. It is responsible for managing the device's resources, including memory management, handling system inputs and outputs, syncing data, and enforcing security protocols. A stable and efficient OS ensures optimal performance of mobile apps and provides a rich user experience.

Well-versed knowledge of Mobile OSs can help in:

- Recognizing the different hardware capabilities accessed by the OS, enabling developers to effectively utilize device features.
- Comprehending the unique security protocols of each OS, crucial for developing secure apps.
- Navigating the app approval and distribution process on each platform's app store.

Important Terminologies:

Android Open Source Project: a project undertaken by a coalition of mobile phone manufacturers and other interested parties, under the leadership of Google. The purpose of the project is to develop the Android platform for mobile devices.

jailbreak: the removal of restrictions placed on a mobile operating system to give the user greater control over the mobile device.

near-field communication: a method by which two devices can communicate wirelessly when in close proximity to one another.

real-time operating system: an operating system that is designed to respond to input within a set amount of time without delays caused by buffering or other processing backlogs

The Ericsson R380, released in 2000, was the first cell phone marketed as a smartphone. The arrival of the iPhone in 2007 changed this. The sleek, simple design of Apple's mobile OS, called iOS, gave the device an intuitive user interface. In addition to the iOS, the iPhone has a baseband processor that runs a real-time operating system (RTOS). This enables the phone to exchange data with the network.



Operating systems on mobile devices have multiple limitations; however, the data input hardware and software can vary greatly, even within one device. One requirement of a good mobile operating system is that it be able to efficiently respond to a variety of data input methods.

MOBILE FEATURES

Mobile OSs share many similarities with desktop and laptop OSs. However, mobile OSs are more closely integrated with touch-screen technology. Mobile OSs also typically feature Bluetooth and Wi-Fi connectivity, global positioning system (GPS) navigation, and speech recognition. Furthermore, many new smartphones are equipped with hardware that supports near-field communication (NFC). NFC allows two devices to exchange information when they

are placed close to one another. NFC uses radio frequency identification (RFID) technology to enable wireless data transfers. A major benefit of NFC is its low power usage, which is particularly critical to mobile devices. Mobile technology such as NFC facilitates numerous business transactions, including mobile payment systems at the point of sale.

Although there remain some significant differences between desktop OSs and mobile OSs, they are rapidly converging. Cloud computing enables users to share and sync data across devices, further narrowing the differences between smartphones and PCs.

While computers such as typical/mobile laptops are "mobile", the operating systems used on them are usually not considered mobile, as they were originally designed for desktop computers that historically did not have *mobile* features. This "fine line" distinguishing mobile and other forms has become blurred in recent years, due to the fact that newer devices have become smaller. Key notabilities blurring this line are the introduction of tablet computers, light laptops, and the hybridization of the two in 2-in-1 PCs.

SECURITY CONCERNS

Hackers have been able to sweep up many users' private information by scanning large crowds for mobile devices with unsecured Bluetooth connections. The ability to capture private data so easily creates major vulnerabilities for identity theft. To combat this threat, Apple has integrated fingerprint recognition into its iOS and newer versions of the iPhone.

Both Android and iOS now include features that help a user to locate and recover a mobile device that has been lost or stolen. Mobile owners can go online to geographically locate the device using its GPS data. The owner can also remotely lock the device to prevent its use by anyone else. It can even cause the device to emit a loud alarm to alert those nearby to its presence.

IMPACT

Mobile OSs and the apps that run on them have revolutionized the way in which people conduct their daily lives. Thanks to mobile OSs, users can track personal health data, transfer funds, connect with social media, receive GPS and weather data, and even produce and edit photo and audiovisual files, among other activities.

Custom ROMs are an alternative to Android..

What is a Smartphone/ mobile application?

These applications are computer program or software designed to run on a smartphone, computer, tablet or other electronic devices. Apps have a design intended for a specific function. Most apps relate to a business or service, but this is not true in all cases. For example, gaming applications often have no relation to a business as far as concerns the user.

Mobile applications often stand in contrast to desktop applications which are designed to run on desktop computers, and web applications which run in mobile web browsers rather than directly on the mobile device. Mobile apps interact with the device's hardware (camera, GPS, sensors) and software (OS, other apps) to deliver functionality.

Types of mobile apps

There are three main types of mobile applications. Here's a detailed explanation of web-based, native and hybrid apps:

Web-based app

A web-based app requires Internet access to use and stores all application data online. This application type's code (web technologies) is Javascript, HTML5 or CSS. It requires less memory space on your device. Examples are -Notebook, Netflix and Dropbox. Most, if not all, user data is stored in the cloud.

Native app

Native apps are applications built for a specific mobile platform. For example, Samsung native applications are only accessible on Samsung devices. iOS or Android. Web apps are written in HTML5 or CSS. Native apps may offer higher performance compared to other app.

Hybrid app

Hybrid apps are applications that combine the efficacy of native apps and web-based apps, and support both types of technology. Often have a lower performance rate and therefore provide a less valuable experience for the end-user.

Where to get mobile apps?

The most common way to get mobile apps is to download them from an app store. Examples of application stores include Microsoft Store, Blackberry World, Windows Phone Store, Opera Mobile Store and Samsung Apps. Applications are also available for purchasing and downloading from company websites.

What is the difference between a mobile app and a website?

Mobile apps are programmes that are downloaded and installed on a mobile device. Mobile apps are necessary to download to access their content, yet most mobile apps don't require an Internet connection to use. Websites are web-based pages originally designed for desktop computers that are now typically adapted to mobile device formats. Websites are accessible through an Internet browser, meaning an Internet connection is necessary, but downloading additional apps isn't.

Individuals use mobile apps for a broad variety of tasks and purposes. Like:-

<ul style="list-style-type: none">• Social Media Platforms• Banking• Learning• finding driving directions• making calculations• news & weather	<ul style="list-style-type: none">• taking and editing photos and videos• finding hotel rooms• ordering transportation• translating languages• gaming• managing	<ul style="list-style-type: none">• documenting events in photo books, journals or travel diaries• <u>factory automation</u>• <u>GPS and location-based services</u>• order-tracking• ticket purchases,
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<ul style="list-style-type: none"> updates • watching movies and television shows • tracking our diets and workouts • keeping in touch via chat apps and social media applications • reading e-books • listening to music 	<ul style="list-style-type: none"> productivity • dating • searching for entertainment • using utility apps such as barcode scanners for nutritional information • putting in grocery orders • checking the weather • checking traffic • User Profiling 	<ul style="list-style-type: none"> • setting alarms and reminders • shopping online • ordering delivery • e-mail clients • Online shopping • In addition to developers creating new mobile apps regularly, individuals can often find new uses for current apps and features.
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How businesses use mobile apps

<ul style="list-style-type: none"> • Operate business more efficiently • file documents • communicate with stakeholders • extend their customer base • offer easier access to products, services and information to the customer • enable employees to perform business 	<ul style="list-style-type: none"> • functions outside of the office • employ brand advocacy and awareness • provide customer service • manage inventory • share content and workplace updates • provide increased value to customers
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Examples of popular mobile apps

Microsoft Word: You can access, write, edit and print documents using Microsoft word from any device.

Facebook: Manage your personal and business pages on this social media platform from all devices.

Adobe Photoshop: Edit, enhance, send and print your photos and videos with Adobe Photoshop.

Text Grabber: Translate between any two languages using type, photo and voice.

Duolingo: Learn a new language on this mobile app by talking, listening and typing.

Capital One: Manage your banking information, checking account and credit lines through banking applications such as this one.

MyFitnessPal: Log your meals, workout, water consumption, steps and weight in this health tracking application.

Weather Channel.

It's the world's most-downloaded weather app. Essentials — current outside temperature, “feels like” temperature, precipitation, weather alerts and hourly forecast — are front and center with no scrolling required. The app's real champ is its radar: you can view storm patterns based on your exact location.

Google Calendar.

It works seamlessly with Gmail.

Careers/ employment that involve working with apps

App developer: App developers innovate, design and update programmes for mobile devices, the web and specific operating systems. The app development process is:

Strategy -- Planning -- Design -- App. Development -- Testing -- Deployment

UI designer: UI, or User Interface Designers, design the screens of an application.

Software engineer: Create the tools to develop the application software.

Instructional technologist: Work with instructors and designers to decide on the best uses for instruction-based technology.

Customer support specialist: Provide support and information to customers about business operations, services and products through mobile application platforms.

Mobile app developer: They are software engineers who focus on app development. They create, program, test and maintain mobile application platforms.

App support specialist: Work in a company's IT department. They help application users with the ease of use and functionality of the company's software applications.

Social media coordinator: Manage a company's public relations and social presence using Apps. They also research marketing trend.

Brand ambassador: Promote and brand and its products and services using Apps.

Business managers: Managers in various departments, such as operations and human resources, sometimes use mobile applications to communicate with employees, partners, clients and other stakeholders. They may also use mobile apps to manage business functions and increase efficiency.

Mobile apps trends

Use of mobile apps is more than traditional desktop computers for digital activities More & more people worldwide getting access. It's gaining popularity.

Prediction-There to soon be hundreds of billions of annual mobile app downloads.

Large markets with potential consumers worldwide. Financial value of mobile apps can keep increasing.

Some pre-installed apps can be removed by an ordinary uninstall process, thus leaving more storage space for desired ones. Where the software does not allow this, some devices can be rooted to eliminate the undesired apps.

Some apps are freeware, while others have a price, which can be upfront or a subscription. Government regulatory agencies began trying to regulate and curate apps, particularly medical apps. Mobile apps are playing an ever-increasing role within healthcare and when designed and integrated correctly can yield many benefits.

Developing apps for mobile devices requires considering the constraints. Mobile devices run on battery and have less powerful processors than personal computers and also have more features such as location detection and cameras. Developers also have to consider a wide array of screen sizes, hardware specifications and configurations. Mobile apps are first tested within the development environment using emulators and later subjected to field testing. Emulators provide an inexpensive way to test applications on mobile phones to which developers may not have physical access.

Mobile user interface (UI) Design is also essential Its design's goal is primarily for an understandable, user-friendly interface.

Distribution

The three biggest app stores are Google Play (80% free download) for Android, App Store for iOS, and Microsoft Store for Windows 10, Windows 10 Mobile, and Xbox One.

Enterprise management

Mobile application management (MAM) describes software and services responsible for provisioning and controlling access to internally developed and commercially available mobile apps used in business settings. It also looks at security aspects.

App wrapping vs. native app management

Data theft is not just the loss of confidential information, but makes companies vulnerable to attack and blackmail.

Professional mobile application management helps companies protect their data. One option for securing corporate data is app wrapping. But there also are some disadvantages like copyright infringement or the loss of warranty rights. Alternatively, it is possible to offer native apps securely through enterprise mobility management. This enables more flexible IT management as apps can be easily implemented and policies adjusted at any time.

Advantages of mobile apps

There are numerous advantages to using mobile apps, namely:

1. Convenience. Mobile apps can be downloaded and installed on a device, allowing users to access the app's functions and services at any time, from anywhere.
2. Personalization. Mobile apps can be customized to meet the specific needs of individual users, providing a personalized experience.
3. Offline access. Many mobile apps can be used offline, providing access to important information and features even when an internet connection is not available.
4. Push notifications. Mobile apps can send push notifications to users, providing real-time updates on important information and events.
5. Accessible anytime, anywhere on mobile devices.
6. Access to device-specific functionalities like GPS, camera, and sensors.

Disadvantages of mobile apps

1. Limited functionality. Mobile apps are designed to provide specific functions and services, and they might not be able to provide the same level of functionality as a desktop application.
2. Limited compatibility. Mobile apps are designed to run on specific mobile operating systems, and they might not be compatible with all devices.
3. Security concerns. Mobile apps can access sensitive information on a device, and they might not have the same level of security as a desktop application.
4. Limited updating capability. Some mobile apps might not be easily updated, and users might need to download a new version of the app to access the latest features.
5. Higher cost for building separate apps for iOS and Android.
6. Frequent updates are needed for compatibility with new OS versions.
7. Takes up device storage space.

How are Mobile Applications Built?

1. Concept

Define the app's purpose, target audience, and core features. Conduct market research and competitor analysis to refine the idea.

2. Design

Create the app's user interface (UI) and user experience (UX). Develop wireframes and prototypes to visualize the layout and functionality, ensuring the app is intuitive.

3. Development

Write the code using programming languages like Swift for iOS or Kotlin for Android.

JavaScript: Used for cross-platform development. It's widely supported and versatile. This stage involves multiple iterations to add and refine features.

4. **Testing**

Perform rigorous testing to identify and fix bugs. This includes functional, usability, and performance testing to ensure smooth operation.

5. **Deployment**

Submit the app to app stores like the Apple App Store or Google Play Store for review.

Once approved, the app becomes available for users to download..

As with the rapid prevalence of smartphone apps in our daily life, there is a vast number of app data collected that can be summarized into four types: **installed app lists, app usage records, app installation behaviors and app metadata**. Since a smartphone is usually tightly associated with one same user, the apps on smartphones convey lots of personal information, which we roughly divide into five categories: **demographic attributes, personality traits, psychological status, personal interests, and life styles**.

Various forms of online communities, such as chat rooms, weblogs, or bulletin board systems provide social support. Some smartphones now include biometric safeguards and data encryptions to ensure user confidentiality, privacy, and confidentiality remain key concerns.

Current Trends

- Integrating AI functionality and capability into a smartphone application is a current trend. There are two main approaches to integrating AI into smartphone applications: (1) “in-app-based” and (2) Application Programming Interface (API) service-based. An in-app-based model is built within a computer and deployed into the smartphone bundled with the application.

In contrast, the API service-based approach integrates AI functionality via an API protocol\This approach allows more complex models to run and has better result – but at higher maintenance costs.

- **Smartphone Health Applications**

Smartphone applications are the latest and most innovative tools targeting various mental health issues including depression, panic disorder, generalized anxiety disorder, phobias, obsessive compulsive disorder, eating disorders, and addictions

Community attitudes toward undertaking mobile phones as personal tools for health and mental health monitoring, clinical trials must be explored adequately. There lies opportunity to significant reduction in health-risk behaviors. Reaching low-income and minority users will be helpful for wider acceptance of this technology

- **Smartphone Application in subject area of Computer Science**

A smartphone application is a software interface that interacts with hardware systems to manage and monitor them, analyze data from sensors, and retrieve information from the cloud for insights using machine learning algorithms.

- **Smart agriculture using renewable energy and AI-powered IoT**

Smartphone applications fetch data from the cloud where the predicted results from the machine learning algorithms occur