

Wireless Fundamentals



U.S. Cellular.



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Learning

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How to Use this Guide

Notes for the facilitator are in **bold**. These statements are not meant to be spoken aloud when presenting the content.

Legend

 Mouse Click	Indicate to click to start or advance animation.	 Reference	Indicate reference to participant guide or handout.
 Raise Hand	Indicate participants raise hand in response to a question.	 Activity	Indicate individual, small group, or class activity.
 Demonstration	Indicate computer demonstration.	 Video	Indicate play video.

Facilitator Responsibilities

Before the Session

Task	Resource
Display the PowerPoint for participants.	
Verify the video plays with sound	

Wireless Fundamentals

2 hours



Welcome participants



This presentation provides a general understanding of the wireless industry and its technology. It covers:

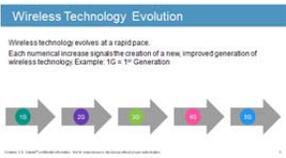
- Evolving wireless technology
- Wireless network parts
- The future of wireless technology



The first commercial wireless networks were built in the 1980's.

The first cellular service launched in 1983.

Today, you use your device to make and receive calls, send text, image, and video messages, and access data services from all over the world!



Wireless technology continues to evolve at a rapid pace.

This evolution of each generation is annotated with a number and the letter G (For example, 1G, 2G, 3G). Each numerical increase signals the creation of a new improved generation of wireless technology.



1G was the first generation of analog wireless network technology.

Its capacity and scalability were limited. First cell phones were large, had little battery life, and costly brick and bag phones. Some phones were installed in vehicles.

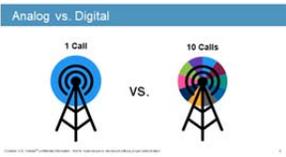
How much do you think a phone cost?

How long do you think it took to charge a phone?

- The phones weighed 1.75 pounds (approximately the weight of a pineapple), had 30 minutes of talk time, took 10 hours to charge and cost \$4,000.

Text messaging was not available.

There are no download speeds as 1G had no data capabilities.



The change from analog to digital was made for several reasons.

Analog technology didn't fully use the signal between the phone and the cellular network. Digital technology compresses your voice and allows between 3-10 calls to occupy the same space as a single analog call.

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There are a number of benefits of digital technology:

- Better sound quality
- More security to prevent eavesdropping
- Longer battery life
- Increase call capacity
 - Several calls now use the same space as a single call
- Supports next generation services such as data



2G was the first generation of digital technology to provide cellular service to a much larger customer base.

Cell phones began to decrease in size and more features became available, including text messaging.

- Device weight decreased by 525%, charge time decreased, and talk time increased.

How long do you think it would take for a game like Candy Crush to download?

Click to advance slide.

Download speeds were so slow that:

- Candy Crush would take 47 minutes to download
- One episode of The Voice would take seven hours to download



3G introduced mobile broadband and smartphones, increased data speeds and security, and new services such as internet access and video messaging.

The first smartphone was sold by IBM in 1994, but smartphones didn't gain popularity until the network could support the device functions.

The first iPhone was unveiled in 2007.

Download speeds improved:

- Candy Crush now takes 58 seconds to download
- One episode of The Voice takes 4.5 hours to download

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4G, also known as LTE (Long Term Evolution), improved on 3G technology by increasing capacity and speed. VoLTE (Voice over LTE) enables voice calling and data usage at the same time.

Smartphones are more powerful, customers started using tablets, and smart devices are more prevalent.

- Smart watches
- Bluetooth speakers
- WiFi cameras

Data is 10 times faster than 3G:

- Candy Crush downloads in 8 seconds
- One episode of The Voice downloads in 43 seconds



5G is the next generation of wireless technology. The new technology uses wider bandwidth, advanced antenna technology, and communication links.

- The network carries more data but shorter distances, which is why advanced antenna technology is needed.

Device-to-device communication is when devices that are close together communicate with each other without someone telling them.

- Think about self-driving cars; the cars need to talk while on the road so they don't crash into one another. One car needs to know the car in front of it is slowing down to make a turn.

Download speeds are expected to be up to 100 times faster than 4G.

Future devices will be:

- More powerful
- Lighter (think smart watch)
- All about apps

Wireless carriers are currently building their 5G networks.

- Both the device and the network need to be equipped with 5G technology for a true 5G experience



Wireless customers stay connected using a wireless network.

The wireless network parts send voice and data from the sender to the receiver.

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Wireless Network Parts



There are a number of different parts that complete the wireless network and allow calls, messages, and data usage.

A cell tower houses electronic equipment needed to conduct wireless communication. This is also known as a cell site.

Click to advance slide.



A cell is a geographical area covered by a cell tower, which are strategically placed to create a network of cells enabling mobility.

Click to advance slide.



The switch receives either a data or voice request and routes the request to its destination.

Click to advance slide.



The satellite provides location services to customers who enable this on their wireless device. This network part is only used for location services, such as maps.

Click to advance slide.



The devices, such as smartphones and tablets, establish voice and/or data connections.

Click to advance slide.

The messaging center routes, forwards, and stores text and picture messages. This network part is only used for text and picture messaging services.

Example: Mobile to Mobile Call



What components do you think are used when calling from a cellphone to another cellphone?

Click to advance slide.



When a mobile-to-mobile call is made, the call travels from the first phone to the nearest cell tower to connect to the network.

Click to advance slide.



The call connection travels to the switch.

Click to advance slide.



The switch routes the call to the cell tower closest to the recipient.

Click to advance slide.



The cell tower closest to the recipient sends the call to the receiving device and the connection is made.

Click to advance slide.



Now, you and your friend are talking.

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Example: Messaging



What components do you think are used when sending a text or picture message?

Click to advance slide.



When a message is sent, it travels from the first phone to the nearest cell tower to connect to the network.

Click to advance slide.



The connection travels to the messaging center.

Click to advance slide.



The platform routes the call to the cell tower closest to the recipient.

Click to advance slide.



The cell tower closest to the recipient sends the message to the receiving device.

Click to advance slide.



Now, your friend can see the message.

Example: Internet Access



When you access an app or search the internet from your phone, it travels from your phone to the nearest cell tower to connect to the network.

Click to advance slide.



The connection travels to the switch to complete the request.

Click to advance slide.

Internet access is established.

Now, you can access the app or the search results from the internet.

Example: Location Services (GPS)



Location services must be enabled on a device to use GPS.

Multiple satellites and the wireless device talk to one another to establish the device location.

The device works with the satellites and towers for assisted GPS.

Now, you can use your map app.



Play video for participants by clicking on the slide. A webpage opens to play the video. Use the video link below, if needed.

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

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Internet of Things (IoT) is the future of wireless technology. Multiple components make up an IoT ecosystem.



Let's look at the different components of an IoT ecosystem. People interact with the IoT ecosystem via applications and devices.

Click to advance slide.

Applications are downloaded to a wireless device and interact with smart devices.



Click to advance slide.

IoT devices are remotely controlled and/or connected to one another in a network.



Programmable sensors are embedded in devices and applications to gather information such as temperature, sound, light, and motion and then used to adjust the environment.

Click to advance slide.



Internet and cloud services process data sent from sensors and devices.

Click to advance slide.



Platforms contain software used to connect and control IoT devices. For example, you can connect your wearable device to a platform.

Click to advance slide.

Networks contain the wireless technology, standards, and protocols that tie IoT components together.



IoT is used in many industries and businesses.

How do you think different businesses use IoT technology and components?

Click to advance slide.



The transportation industry uses IoT to track deliveries, monitor drivers, and run diagnostics on equipment.

Click to advance slide.



The education industry uses IoT connected devices to monitor resources like buses.

Click to advance slide.



The construction industry uses IoT by adding sensors to buildings for energy management and placing Radio-Frequency Identification (RFID) tags to materials and equipment to help with inventory management.

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The healthcare industry uses IoT wearable sensor technology on their patients, which allows nurses and doctors to closely monitor and track their biological information.

Click to advance slide.



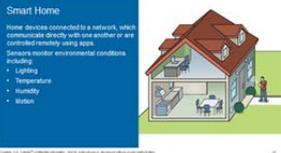
The agriculture industry uses IoT to help farmers monitor their crops, track livestock, monitor farm equipment, and capture product delivery.

Click to advance slide.

The retail industry uses IoT to communicate with shoppers, control inventory, generate paperless receipts, and automate online deliveries.



Let's look at how these components come together in the different industries to create a connected community.



A smart home contains devices connected to a network. These devices communicate directly with one another or are controlled remotely using applications.

Sensors monitor:

- Lighting
- Temperature
- Humidity
- Motion



What types of things can smart appliances do in the home?

Click to advance slide.



Smart appliances can:

- Start laundry
- Adjust the temperature
- Turn lights on and off
- Open or close the garage door
- Record TV programs
- Monitor the house



What can security cameras do for homeowners?

Click to advance slide.



Smart security cameras can:

- Monitor pets
- Display who is at the door
- Send alarms or alerts

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Fleet Asset Management

Companies such as Uber use fleet management software to improve operations, lower costs, and increase productivity by:

- Monitoring vehicle speed and location
- Tracking driver routes and hours
- Sending alerts if a vehicle is idling too long
- Verifying delivery/arrival times

Businesses store IoT data on cloud servers so they can:

- Plan more efficient routes
- Create maintenance schedules for equipment



Companies such as Uber use fleet management software to track driver routes, hours, and speed.

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What other companies may use or benefit from this technology?

- UPS
- FedEx
- Lime Scooters
- Amazon

Environmental Monitoring

Sensors:

- Reduce water usage, water runoff, and energy costs
- Increase crop yields and profits

Sensor technology monitors and/or controls:

- Farm equipment
- Soil and air conditions
- Irrigation systems



The benefits of environmental monitoring include:

- Reduced water usage, water runoff, and energy costs
- Increased crop yields and profits

Sensor technology monitors and controls:

- Farm equipment
- Soil and air conditions
- Irrigation systems

Farmers place sensory in fields and connect them to farm equipment such as tractors, and use the sensors to plow precise, straight rows.

Farmers use sensors to control irrigation systems to water crops.

Summary

1. Wireless Technology
2. Network Parts
3. Future of Wireless

We covered a lot of information on wireless technology today.

Technology continues to evolve at a rapid pace. 5G is the next step in wireless, bringing new technology. What will 6G bring?

There are many different network parts that enable calls, messages, and data functionality.

The Internet of Things (IoT) continues to evolve wireless technology and benefit consumers and businesses.

Are you ready to be part of designing and building what comes next?