

iPhone Battery and Performance

Understand iPhone performance and its relation to your battery. - Apple

Your iPhone is designed to deliver an experience that is simple and easy to use. This is only possible through a combination of advanced technologies and sophisticated engineering. One important technology area is battery and performance. Batteries are a complex technology, and a number of variables contribute to battery performance and related iPhone performance. All rechargeable batteries are consumables and have a limited lifespan—eventually their capacity and performance decline so that they need to be replaced. As batteries age, it can contribute to changes in iPhone performance. We created this information for those who would like to learn more.

About lithium-ion batteries

iPhone batteries use lithium-ion technology. Compared with older generations of battery technology, lithium-ion batteries charge faster, last longer, and have a higher power density for more battery life in a lighter package. Rechargeable lithium-ion technology currently provides the best technology for your device. [Learn more about lithium-ion batteries.](#)

How to maximize battery performance

“Battery life” is the amount of time a device runs before it needs to be recharged. “Battery lifespan” is the amount of time a battery lasts until it needs to be replaced. One factor affecting battery life and lifespan is the mix of things you do with your device. No matter how you use it, there are ways to help. A battery’s lifespan is related to its “chemical age,” which is more than just the passage of time. It includes different factors, such as the number of charge cycles and how it was cared for. [Follow these tips](#) to maximize battery performance and help extend battery lifespan. For example, keep iPhone half-charged when it’s stored for the long term. Also avoid charging or leaving iPhone in hot environments, including direct sun exposure, for extended periods of time.

When batteries chemically age

All rechargeable batteries are consumable components that become less effective as they chemically age.

As lithium-ion batteries chemically age, the amount of charge they can hold diminishes, resulting in shorter amounts of time before a device needs to be recharged. This can be referred to as the battery’s maximum capacity—the measure of battery capacity relative to when it was new. In addition, a battery’s ability to deliver maximum instantaneous performance, or “peak power,” may decrease. In order for a phone to function properly, the electronics must be able to draw upon instantaneous power from the battery. One attribute that

affects this instantaneous power delivery is the battery's impedance. A battery with a high impedance may be unable to provide sufficient power to the system that needs it. A battery's impedance can increase if a battery has a higher chemical age. A battery's impedance will temporarily increase at a low state of charge and in a cold temperature environment. When coupled with a higher chemical age, the impedance increase will be more significant. These are characteristics of battery chemistry that are common to all lithium-ion batteries in the industry.

When power is pulled from a battery with a higher level of impedance, the battery's voltage will drop to a greater degree. Electronic components require a minimum voltage to properly operate. This includes the device's internal storage, power circuits, and the battery itself. The power management system determines the capability of the battery to supply this power, and manages the loads in order to maintain operations. When the operations can no longer be supported with the full capabilities of the power management system, the system will perform a shutdown to preserve these electronic components. While this shutdown is intentional from the device perspective, it may be unexpected by the user.

Preventing unexpected shutdowns

With a low battery state of charge, a higher chemical age, or colder temperatures, users are more likely to experience unexpected shutdowns. In extreme cases, shutdowns can occur more frequently, thereby rendering the device unreliable

or unusable. For iPhone 6, iPhone 6 Plus, iPhone 6s, iPhone 6s Plus, iPhone SE, iPhone 7, and iPhone 7 Plus, iOS dynamically manages performance peaks to prevent the device from unexpectedly shutting down so that the iPhone can still be used. This performance management feature is specific to iPhone and does not apply to any other Apple products.

This performance management works by looking at a combination of the device temperature, battery state of charge, and battery impedance. Only if these variables require it, iOS will dynamically manage the maximum performance of some system components, such as the CPU and GPU, in order to prevent unexpected shutdowns. As a result, the device workloads will self-balance, allowing a smoother distribution of system tasks, rather than larger, quick spikes of performance all at once. In some cases, a user may not notice any differences in daily device performance. The level of perceived change depends on how much performance management is required for a particular device.

In cases that require more extreme forms of this performance management, the user may notice effects such as:

- Longer app launch times
- Lower frame rates while scrolling
- Backlight dimming (which can be overridden in Control Center)
- Lower speaker volume by up to -3dB
- Gradual frame rate reductions in some apps
- During the most extreme cases, the camera flash will be disabled as visible in the camera UI

- Apps refreshing in background may require reloading upon launch

Many key areas are not impacted by this performance management feature. Some of these include:

- Cellular call quality and networking throughput performance
- Captured photo and video quality
- GPS performance
- Location accuracy
- Sensors like gyroscope, accelerometer, barometer
- Apple Pay

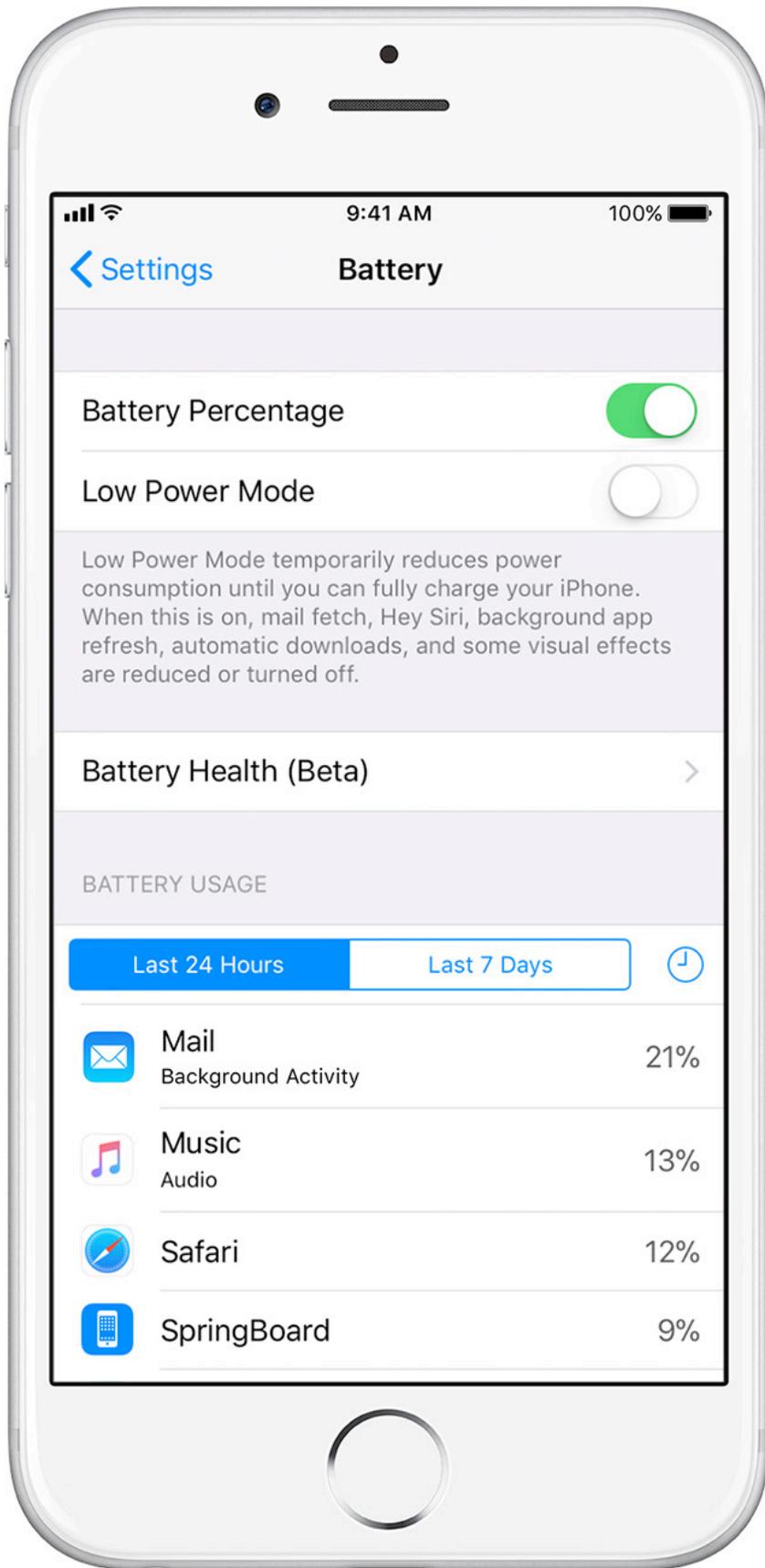
For a low battery state of charge and colder temperatures, performance management changes are temporary. If a device battery has chemically aged far enough, performance management changes may be more lasting. This is because all rechargeable batteries are consumables and have a limited lifespan, eventually needing to be replaced. If you are impacted by this and would like to improve your device performance, replacing your device battery can help.

For iOS 11.3 Beta

iOS 11.3 improves this performance management feature by periodically assessing the level of performance management necessary to avoid unexpected shutdowns. If the battery health is able to support the observed peak power requirements, the amount of performance management will be lowered. If an unexpected shutdown occurs again, then

performance management will increase. This assessment is ongoing, allowing more adaptive performance management.

iPhone 8, iPhone 8 Plus, and iPhone X models use a more advanced hardware and software design that provides a more accurate estimation of both power needs and the battery's power capability to maximize overall system performance. This allows a different performance management system that more precisely allows iOS to anticipate and avoid an unexpected shutdown. As a result, the impacts of performance management may be less noticeable on iPhone 8, iPhone 8 Plus, and iPhone X. Over time, the rechargeable batteries in all iPhone models will diminish in their capacity and peak performance and will eventually need to be replaced.



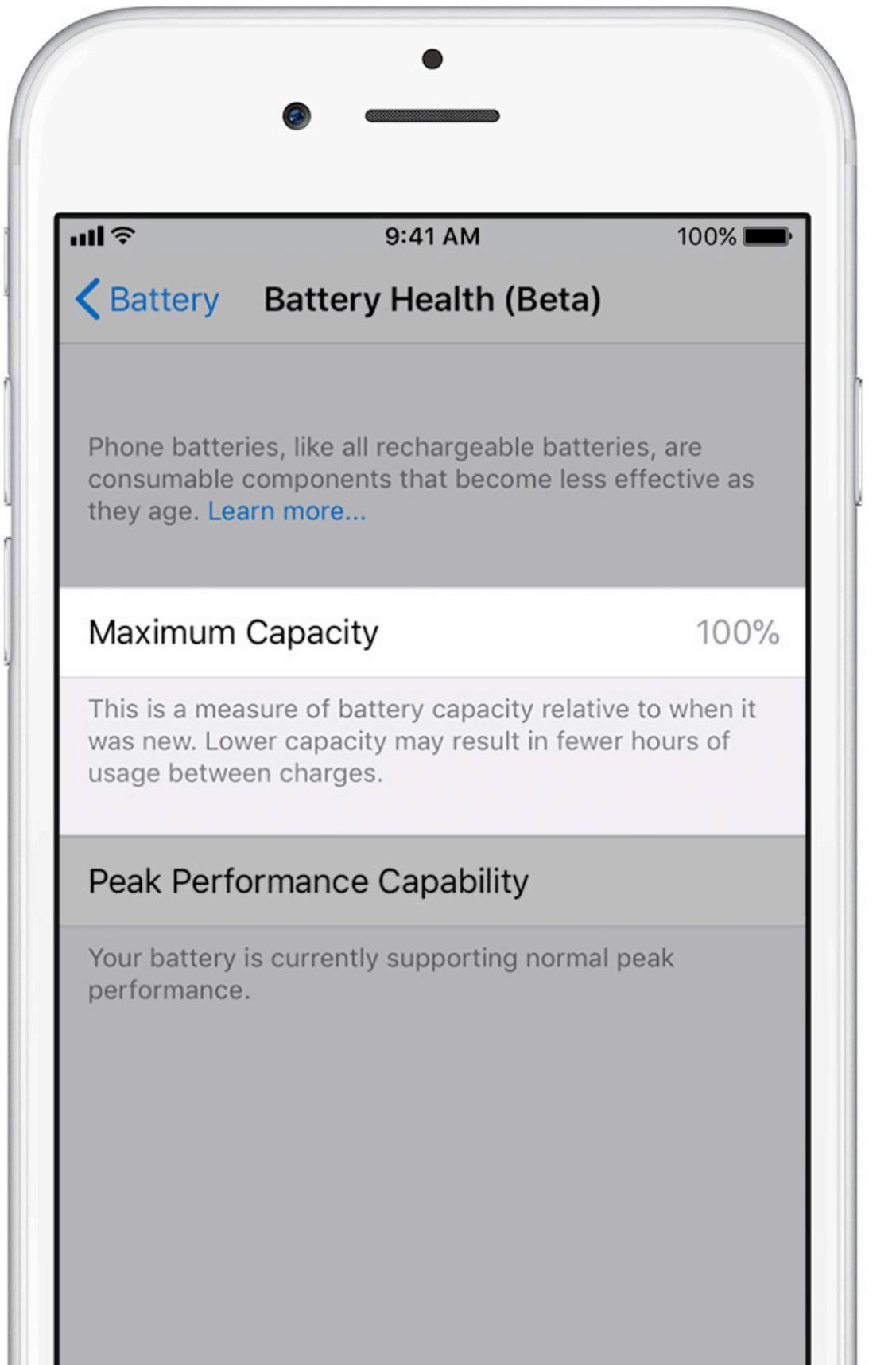
Battery Health

For iPhone 6 and later, iOS 11.3 adds new features to show battery health and recommend if a battery needs to be replaced. These can be found in Settings > Battery > Battery Health (Beta).

Additionally, users can see if the performance management feature that dynamically manages maximum performance to prevent unexpected shutdowns is on and can choose to turn it off. This feature is enabled only after an unexpected shutdown first occurs on a device with a battery that has diminished ability to deliver maximum instantaneous power. This feature applies to iPhone 6, iPhone 6 Plus, iPhone 6s, iPhone 6s Plus, iPhone SE, iPhone 7, and iPhone 7 Plus.

(Note: Devices updating to iOS 11.3 will initially have performance management disabled; it will be reenabled if the device subsequently experiences an unexpected shutdown.)

All iPhone models include fundamental performance management to ensure that the battery and overall system operates as designed and internal components are protected. This includes behavior in hot or cold temperatures, as well as internal voltage management. This type of performance management is required for safety and expected function, and cannot be turned off.



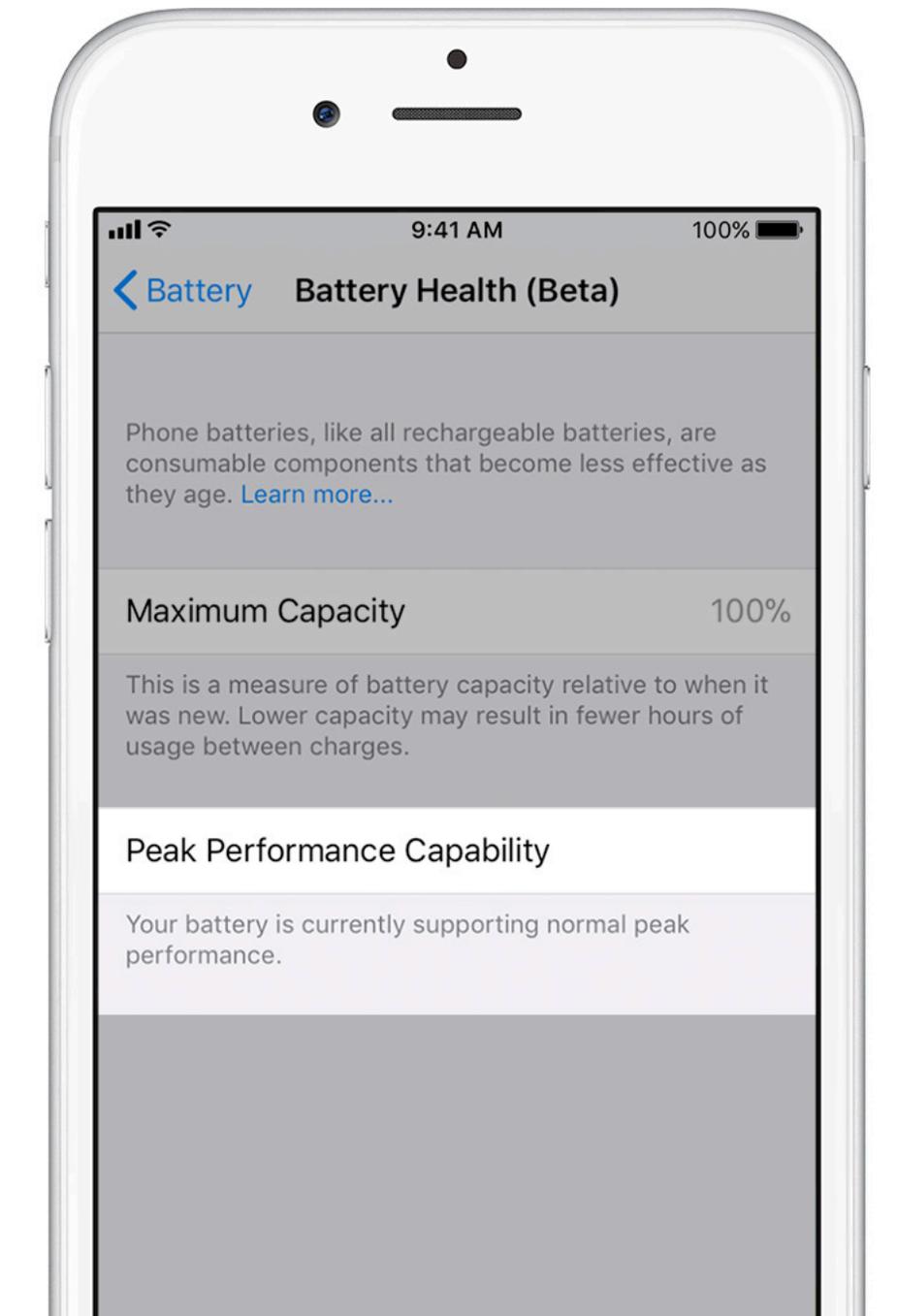
Your battery's maximum capacity

The Battery Health screen includes information on maximum battery capacity and peak performance capability.

Maximum battery capacity measures the device battery capacity relative to when it was new. Batteries will start at 100% when first activated and will have lower capacity as the battery chemically ages which may result in fewer hours of usage between charges.

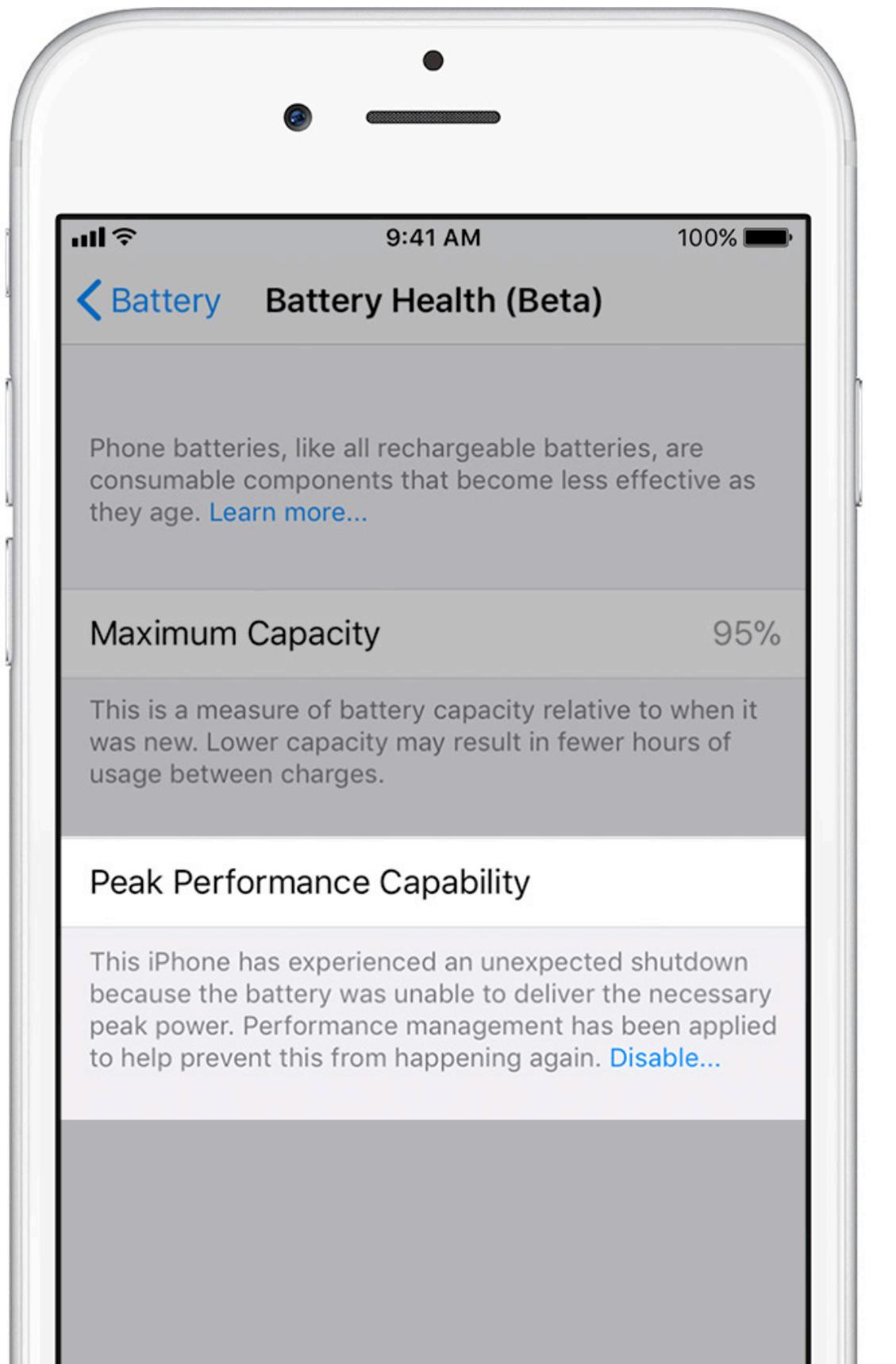
A normal battery is designed to retain up to 80% of its original capacity at 500 complete charge cycles when operating under normal conditions. The one-year warranty includes service coverage for a defective battery. If it is out of warranty, Apple offers battery service for a charge. [Learn more about charge cycles.](#)

As your battery health degrades, so can its ability to deliver peak performance. The Battery Health screen includes a section for Peak Performance Capability where the following messages may appear.



Performance is normal

When the battery condition can support normal peak performance and does not have the performance management features applied, you'll see this message:
Your battery is currently supporting normal peak performance.

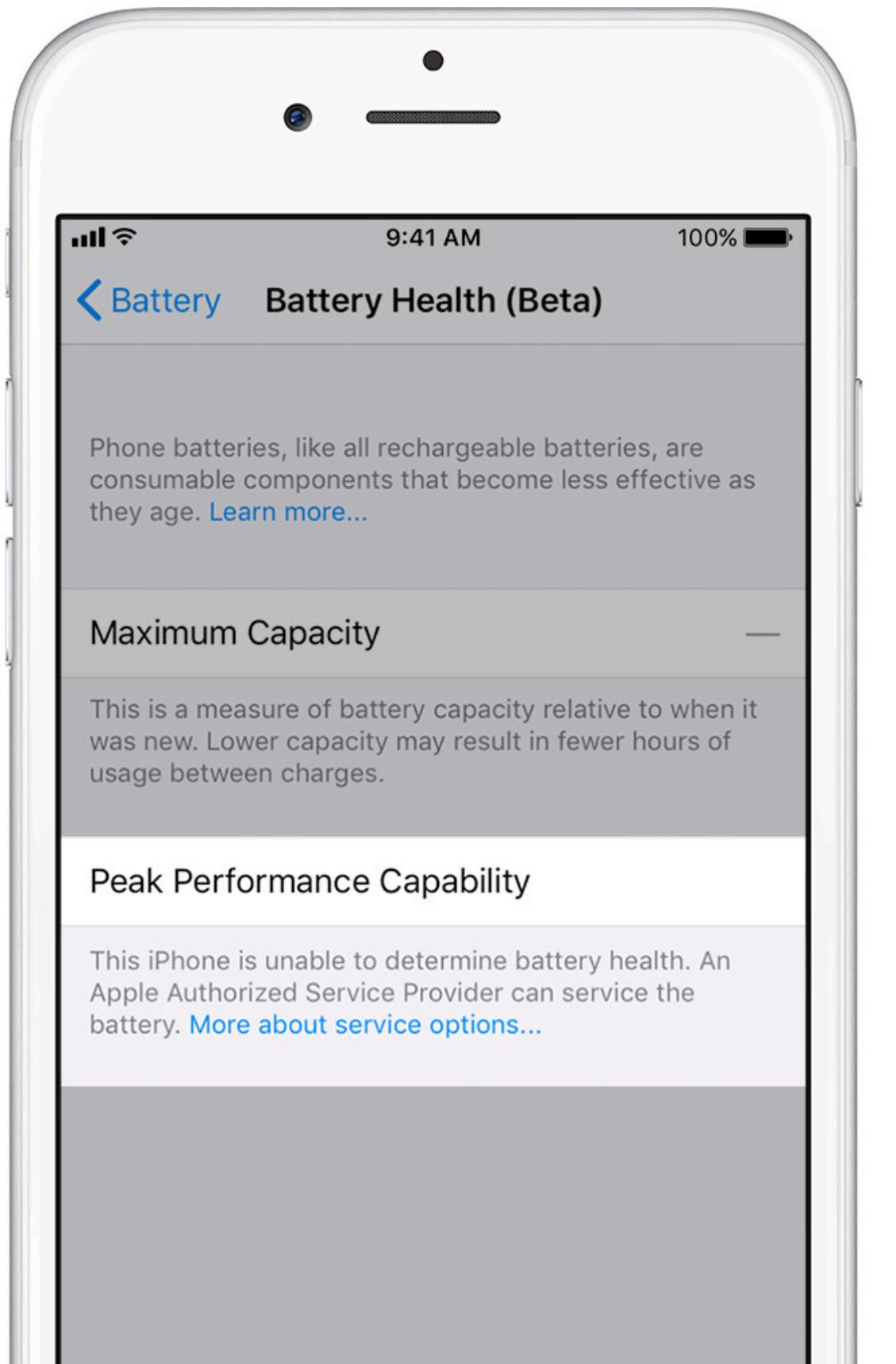


Performance management applied

When the performance management features have been applied, you'll see this message:

This iPhone has experienced an unexpected shutdown because the battery was unable to deliver the necessary peak power. Performance management has been applied to help prevent this from happening again. Disable...

Note that if you disable performance management, you can't turn it back on. It will be turned on again automatically if an unexpected shutdown occurs. The option to disable will also be available.



Signal strength icon, Wi-Fi icon, 9:41 AM, 100% battery icon

[← Battery](#) **Battery Health (Beta)**

Phone batteries, like all rechargeable batteries, are consumable components that become less effective as they age. [Learn more...](#)

Maximum Capacity —

This is a measure of battery capacity relative to when it was new. Lower capacity may result in fewer hours of usage between charges.

Peak Performance Capability

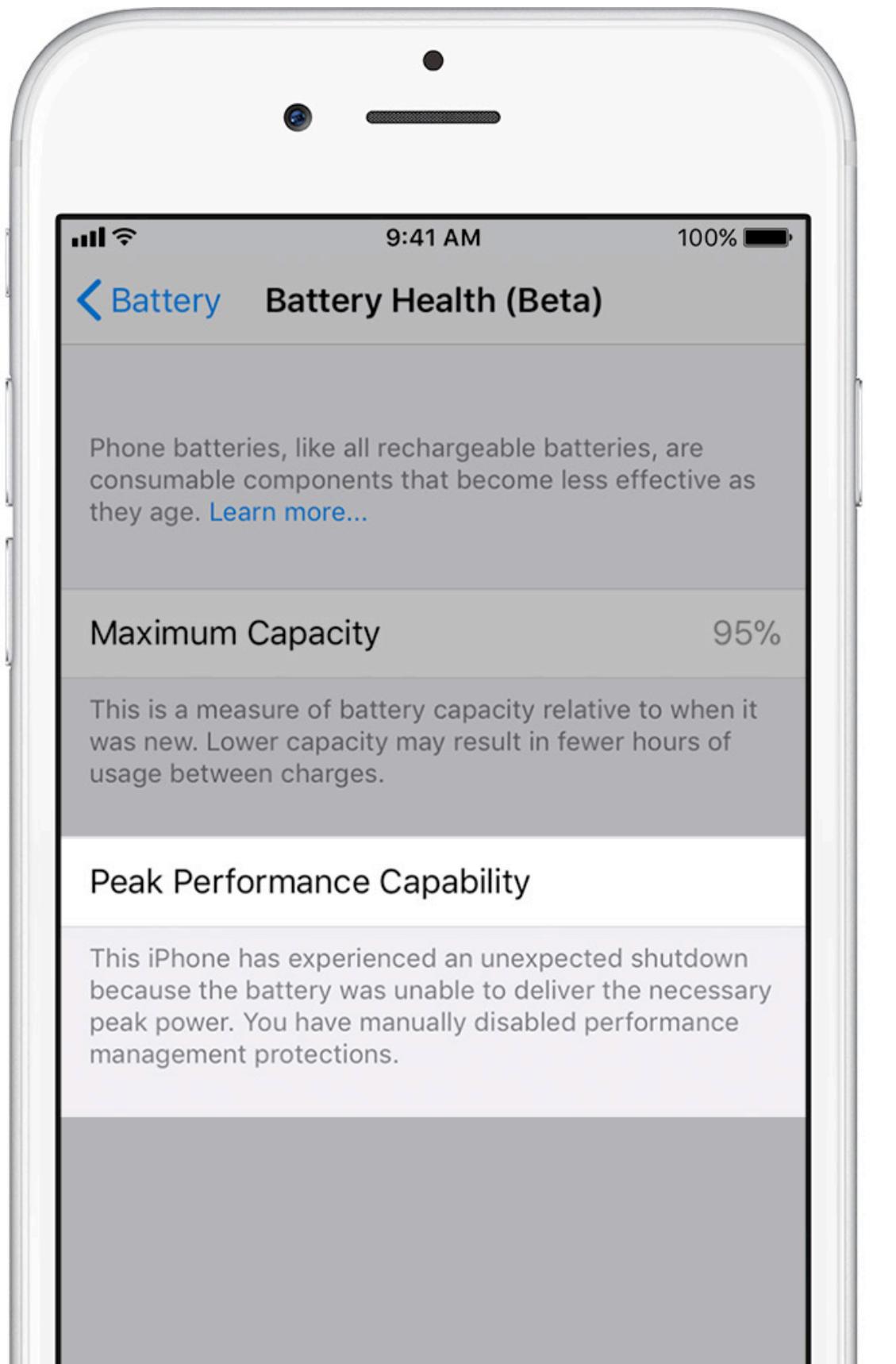
This iPhone is unable to determine battery health. An Apple Authorized Service Provider can service the battery. [More about service options...](#)

Battery health unknown

If iOS is unable to determine the device battery health, you'll see this message:

This iPhone is unable to determine battery health. An Apple Authorized Service Provider can service the battery. More about service options...

This may be due to having an improperly installed battery or an unknown battery part.

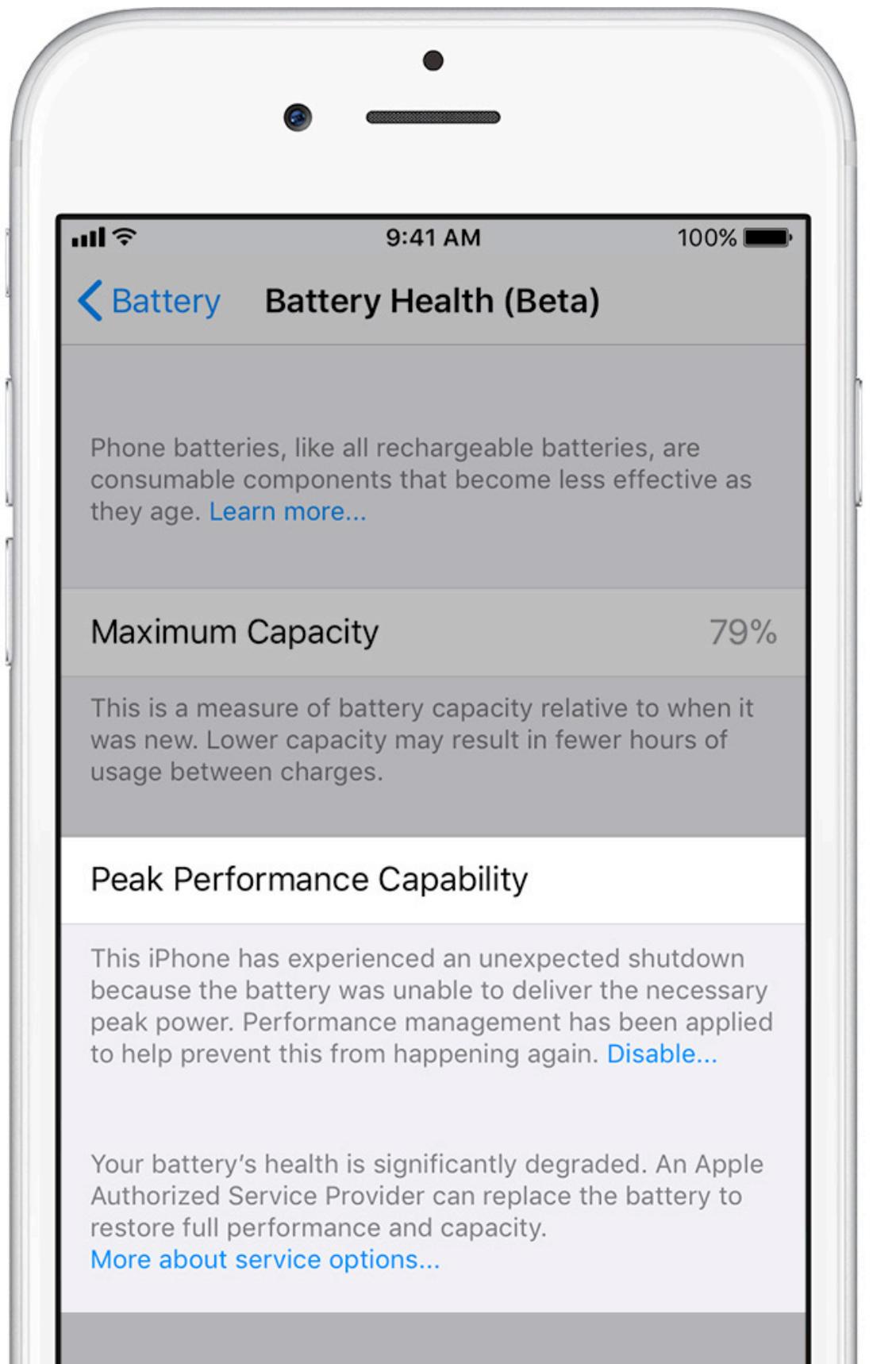


Performance management turned off

If you disable the applied performance management feature, you'll see this message:

This iPhone has experienced an unexpected shutdown because the battery was unable to deliver the necessary peak power. You have manually disabled performance management protections.

If the device experiences another unexpected shutdown, the performance management features will be re-applied. The option to disable will also be available.



Battery health degraded

If battery health has degraded significantly, the below message will also appear:

Your battery's health is significantly degraded. An Apple Authorized Service Provider can replace the battery to restore full performance and capacity. More about service options...

This message does not indicate a safety issue. Your battery can still be used. However, you may be experiencing more noticeable battery and performance issues. A new replacement battery will improve your experience.

Getting further assistance

If your device performance has been impacted by an aged battery and you would like to get help with a battery replacement, [contact Apple Support](#) for service options.

[Learn more about battery service and recycling.](#)

Published Date: Feb 16, 2018

original article:

<https://support.apple.com/en-us/HT208387>