Developing Wireless CarPlay Systems

Session 717

Tanya Kancheva, CarPlay Engineering
Wireless CarPlay
Wireless CarPlay
Using Wireless CarPlay
Getting Started
Getting Started

Pair by plugging in
Getting Started

Pair by plugging in

Pair without plugging in
Pair by Plugging In

Steps

Plug in

CarPlay starts

Enable wireless CarPlay
CarPlay Starts
Use Wireless CarPlay with “My Car”?

CarPlay automatically connects your iPhone to your car’s built-in display, and can access your phone while it is locked.

Enable Wireless CarPlay

Use USB Only
Pairing Complete
Pairing Complete

CarPlay will work wirelessly the next time the user enters the car.
Pairing Complete

CarPlay will work wirelessly the next time the user enters the car

Additional confirmation not required on the car’s display
Pair Without Plugging In

Steps

Start CarPlay setup

Select device to pair

CarPlay starts
Start CarPlay Setup
Start CarPlay Setup

Press and hold the voice control button on the steering wheel
Start CarPlay Setup

Press and hold the voice control button on the steering wheel

Use the car’s native UI

• Add a CarPlay device
• Add a Bluetooth device
If your car supports wireless CarPlay, press and hold the voice control button on your steering wheel to start CarPlay setup.
If your car supports wireless CarPlay, press and hold the voice control button on your steering wheel to start CarPlay setup.

AVAILABLE CARS

My Car
Select Device to Pair

Selection initiated from iPhone

Open Bluetooth settings on your device and select “My Car.”
Select Device to Pair
Selection initiated from the car via CarPlay menu

List of discovered CarPlay devices
Select Device to Pair
Selection initiated from the car via Bluetooth menu

List of discovered Bluetooth devices
Select Device to Pair
Selection initiated from the car via Bluetooth menu

Use CarPlay with “John’s iPhone?”

Use Bluetooth
Enable CarPlay
CarPlay Starts

Connecting
Check "John's iPhone" to complete pairing.
CarPlay Starts
Reconnecting
Reconnecting

CarPlay starts automatically
Reconnecting

CarPlay starts automatically

Last user mode
Handling Multiple Devices
Handling Multiple Devices

Multiple devices
• Wireless devices
• Wired and wireless devices
Handling Multiple Devices

Multiple devices

- Wireless devices
- Wired and wireless devices

Allow the user to choose the active CarPlay device
Choosing the Active CarPlay Device
Choosing the Active CarPlay Device

Show all CarPlay devices
Choosing the Active CarPlay Device

Show all CarPlay devices

Indicate active CarPlay device

Choose CarPlay Device

- John’s iPhone
- Mani’s iPhone
- Mariana’s iPhone
Choosing the Active CarPlay Device

Show all CarPlay devices
Indicate active CarPlay device
Don’t show USB or Wi-Fi symbols

Choose CarPlay Device
- John’s iPhone
- Mani’s iPhone
- Mariana’s iPhone
Notifications when Devices are Connected

- Show when first iPhone is connected, and CarPlay won’t be visible
- Show when a second iPhone is connected over USB
- Do not show when wireless devices join the network
Developing Wireless CarPlay Systems
Developing Wireless CarPlay Systems

Hardware requirements
Setup and pairing
Reconnecting
Wireless considerations
Developing Wireless CarPlay Systems

Hardware requirements
Setup and pairing
Reconnecting
Wireless considerations
Hardware Requirements

Bluetooth

Wi-Fi

Location
Bluetooth

Used for discovery and reconnection only

Support for communication protocols (SDP, iAP2), 2.1 + EDR

Bluetooth Extended Inquiry Response (EIR)
Wi-Fi

Used for video, audio, and CarPlay protocol, including iAP2

Wi-Fi Alliance certified access point

5 GHz, 802.11ac recommended

Apple Device Information Element

Interworking Information Element
Location

Required because iPhone could be in pocket or bag

GNSS receiver

Speed sensor

Dead reckoning
Developing Wireless CarPlay Systems

- Hardware requirements
- Setup and pairing
- Reconnecting
- Wireless considerations
Developing Wireless CarPlay Systems

Hardware requirements
Setup and pairing
Reconnecting
Wireless considerations
Head Unit Components for CarPlay Setup
Head Unit Components for CarPlay Setup

Head Unit
Head Unit Components for CarPlay Setup

- Head Unit
- Wi-Fi
- USB
# Head Unit Components for CarPlay Setup

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Head Unit Components for CarPlay Setup

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- Plug-in
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Boot Sequence After Head Unit Reset

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Boot Sequence After Head Unit Reset

- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi
- USB
Boot Sequence After Head Unit Reset

1. Head Unit
2. Plug-in
3. Bluetooth
4. Wi-Fi
5. USB

USB On
Boot Sequence After Head Unit Reset

- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi
- USB

- Wi-Fi On
- USB On
Boot Sequence After Head Unit Reset

- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi
- USB

- Wi-Fi On
- DHCP active
- USB On
Boot Sequence After Head Unit Reset

- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi
- USB

- Launch Bonjour
- BT On
- Wi-Fi On
- USB On
- DHCP active
Boot Sequence After Head Unit Reset

- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi
- USB

Launch Bonjour
Launch CarPlay Plug-in
BT On
Wi-Fi On
USB On
DHCP active
Boot Sequence After Head Unit Reset

Head Unit | Plug-in | Bluetooth | Wi-Fi | USB
---|---|---|---|---
Launch Bonjour | BT On | Wi-Fi On | USB On
Launch CarPlay Plug-in | DHCP active

Ready for CarPlay
Getting Started
Getting Started

Pair by plugging in
Getting Started

Pair by plugging in

• Out-of-band pairing over USB
Getting Started

Pair by plugging in

• Out-of-band pairing over USB

Pair without plugging in
Getting Started

Pair by plugging in
• Out-of-band pairing over USB

Pair without plugging in
• Bluetooth pairing
Out-of-Band Pairing over USB

- Head Unit
  - Plug-in
  - Bluetooth
  - Wi-Fi
- iOS
- iPhone

Car
Native UI
Out-of-Band Pairing over USB

User plugs in iPhone

Car

Native UI
Out-of-Band Pairing over USB

User plugs in iPhone

USB role switch
Out-of-Band Pairing over USB

- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi
- iOS
- iPhone

Car

Native UI

User plugs in iPhone

USB role switch

CarPlay connected
Out-of-Band Pairing over USB

Head Unit → Plug-in → Bluetooth → Wi-Fi → iOS → iPhone

Car → Native UI → Apple CarPlay → connected iPhone
Out-of-Band Pairing over USB

- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi
- iOS
- iPhone

Car

Native UI

iAP2 over USB
(Wireless & wired CarPlay DeviceTransportIdentifier OOBTPairing)

iPhone

CarPlay connected
Out-of-Band Pairing over USB

CarPlay session established over USB

iAP2 over USB (Wireless & wired CarPlay DeviceTransportIdentifier OOBBTTPairing)

Use wireless CarPlay?
- Yes
- No
Out-of-Band Pairing over USB

Head Unit → Plug-in → Bluetooth → Wi-Fi → iOS → iPhone

CarPlay session active over USB

Car

Native UI

iPhone

Use wireless CarPlay?
Yes
No
Out-of-Band Pairing over USB

- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi
- iOS
- iPhone

Car

CarPlay UI

Screen session setup

Audio session setup

CarPlay session active over USB

iPhone

Use wireless CarPlay?

Yes

No
Out-of-Band Pairing over USB

User says yes

Audio session setup

Screen session setup

CarPlay session active over USB
Out-of-Band Pairing over USB

Head Unit — Plug-in — Bluetooth — Wi-Fi — iOS — iPhone

Car — CarPlay UI — CarPlay session active over USB — iPhone — CarPlay connected
Out-of-Band Pairing over USB

CarPlay session active over USB

iAP2 over USB
(OOOBTPairingLink
KeyInformation)

CarPlay UI

Car

Plug-in
Bluetooth
Wi-Fi

iOS

iPhone

iPhone connected
Out-of-Band Pairing over USB

CarPlay session active over USB

iAP2 over USB
(000BBTPairingLinkKeyInformation)

DeviceName
DeviceTransportIdentifier
LinkKey

CarPlay UI

Car

Head Unit

Plug-in
Bluetooth
Wi-Fi

iOS

iPhone
Out-of-Band Pairing over USB

Head Unit

Plug-in

Bluetooth

Wi-Fi

iOS

iPhone

Car

CarPlay UI

CarPlay session active over USB

CarPlay connected
Out-of-Band Pairing over USB

Car → CarPlay UI → Device stored → CarPlay session active over USB → iOS → iPhone

- Car
- CarPlay UI
- Device stored
- CarPlay session active over USB
- iOS
- iPhone
Out-of-Band Pairing over USB

Car

CarPlay UI

Device stored

CarPlay session active over USB

iAP2 over USB (OOOBTPairing CompletionInformation)

iPhone

CarPlay connected
Out-of-Band Pairing over USB
Out-of-Band Pairing over USB

CarPlay session stays over USB
Out-of-Band Pairing over USB

CarPlay session stays over USB

No Bluetooth communication between head unit and iPhone
Out-of-Band Pairing over USB

CarPlay session stays over USB

No Bluetooth communication between head unit and iPhone

Store paired device as last connected device or preferred device
Out-of-Band Pairing over USB

CarPlay session stays over USB

No Bluetooth communication between head unit and iPhone

Store paired device as last connected device or preferred device

After ignition cycle, Bluetooth reconnection starts wireless CarPlay
Out-of-Band Pairing over USB

CarPlay session stays over USB

No Bluetooth communication between head unit and iPhone

Store paired device as last connected device or preferred device

After ignition cycle, Bluetooth reconnection starts wireless CarPlay

• Wireless CarPlay not started if iPhone is simply unplugged
Bluetooth Pairing
Bluetooth Pairing

Press and hold the voice control button on the steering wheel
Bluetooth Pairing

Press and hold the voice control button on the steering wheel

Use the car’s native UI
Bluetooth Pairing

Press and hold the voice control button on the steering wheel

Use the car’s native UI

- Add a CarPlay device
Bluetooth Pairing

Press and hold the voice control button on the steering wheel

Use the car’s native UI

• Add a CarPlay device
• Add a Bluetooth device
Discovering CarPlay Devices over Bluetooth

User initiates Bluetooth pairing

Car

Plug-in, Bluetooth, Wi-Fi

iOS, iPhone
Discovering CarPlay Devices over Bluetooth

User initiates BT pairing

Car Plug-in Bluetooth Wi-Fi iOS iPhone

BT Discoverable
Discovering CarPlay Devices over Bluetooth

User opens Bluetooth Settings

User initiates BT pairing

BT Discoverable

Car

Plug-in

Bluetooth

Wi-Fi

iOS

iPhone

User opens Bluetooth Settings
Discovering CarPlay Devices over Bluetooth

User initiates BT pairing

BT Discoverable

BT Discoverable and Scanning

User opens Bluetooth Settings
Option 1) Selecting a Car to Pair to from iOS

Head Unit | Plug-in | Bluetooth | Wi-Fi
---|---|---|---

BT Discoverable

BT Discoverable and Scanning

iPhone

Bluetooth Settings
Option 1) Selecting a Car to Pair to from iOS

- Add new device
- Search for My Car on your device
Option 1) Selecting a Car to Pair to from iOS

1. In your car, ensure the Bluetooth is Discoverable and Scanning.
2. Add a new device on your iOS device.
3. Search for "My Car" on your iOS device.
4. Pair your iPhone to your car via Bluetooth.

Diagram:
- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi
- iOS
- iPhone
- Car
- Add new device
- Search for My Car on your device
- BT Discoverable
- BT Discoverable and Scanning
- Bluetooth Settings
- My Car
Option 1) Selecting a Car to Pair to from iOS

 iPhones Bluetooth Settings

Option 1) Selecting a Car to Pair to from iOS

User selects a vehicle to pair

Car
- Add new device
- Search for My Car on your device

Bluetooth
- BT Discoverable
- BT Discoverable and Scanning

iOS
- Discoverable
- Scanning

iPhone
- Bluetooth Settings
- My Car
### Option 2) Discovery Through Existing BT Menus

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<tr>
<td><strong>Car</strong></td>
<td></td>
<td><strong>BT</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td><strong>Available Bluetooth devices</strong></td>
<td><strong>Discoverable and Scanning</strong></td>
<td><strong>Bluetooth Settings</strong></td>
<td><strong>My Car</strong></td>
<td><strong>iPhone</strong></td>
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</table>
Option 2) Discovery Through Existing BT Menus

Available Bluetooth devices:
- John's iPhone
- Mani's iPhone

User selects a device to pair.

Bluetooth Discoverable and Scanning:
- John's iPhone
- Mani's iPhone

BT Discoverable and Scanning:
- My Car

iOS:
- Bluetooth Settings

iPhone:
- My Car
### Option 2) Discovery Through Existing BT Menus

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<td>Bluetooth Settings</td>
<td>My Car</td>
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<tr>
<td>Available Bluetooth devices</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
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<td>Mani's iPhone</td>
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</table>

- Bluetooth devices available in the car include John's iPhone and Mani's iPhone.
- Bluetooth settings in the iOS of the iPhone allow discovery and scanning of available Bluetooth devices.
Option 2) Discovery Through Existing BT Menus

Available Bluetooth devices
- John's iPhone
- Mani's iPhone

User selects a vehicle to pair
Option 3) CarPlay Specific Discovery

Head Unit | Plug-in | Bluetooth | Wi-Fi | iOS | iPhone
--- | --- | --- | --- | --- | ---

- Car
  - Available CarPlay devices
    - John's iPhone
    - Mani's iPhone

BT | Discoverable and Scanning |
--- | --- |

BT | Discoverable and Scanning |
--- | --- |

iPhone

Bluetooth Settings

My Car
Option 3) CarPlay Specific Discovery

Query for Apple CarPlay Bluetooth EIR to display only CarPlay-capable devices
Option 3) CarPlay Specific Discovery

Query for Apple CarPlay Bluetooth EIR to display only CarPlay-capable devices
Option 3) CarPlay Specific Discovery

Query for Apple CarPlay Bluetooth EIR to display only CarPlay-capable devices
Option 3) CarPlay Specific Discovery

Query for Apple CarPlay Bluetooth EIR to display only CarPlay-capable devices
Connecting iAP2 over Bluetooth

- Head Unit
  - Plug-in
  - Bluetooth
  - Wi-Fi
- iOS
- iPhone

Car
  - Bluetooth pairing
  - Connecting to John's iPhone

iPhone
  - Bluetooth Settings
  - "My Car" connecting
Connecting iAP2 over Bluetooth

Connect iAP2 over BT (Wireless & wired CarPlay, DeviceTransportIdentifier, WirelessCarPlayUpdate, AccessoryWiFiConfiguration)

Head Unit | Plug-in | Bluetooth | Wi-Fi | iOS | iPhone

Car
- Bluetooth pairing
- Connecting to John's iPhone

iPhone
- Bluetooth Settings "My Car" connecting
Connecting iAP2 over Bluetooth

- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi
- iOS
- iPhone

Car
- Bluetooth pairing
- Connecting to John's iPhone

Connect iAP2 over BT
(Wireless & wired CarPlay, DeviceTransportIdentifier, WirelessCarPlayUpdate, AccessoryWiFiConfiguration)

iPhone
- Use wireless CarPlay?
  - Yes
  - No
Connecting iAP2 over Bluetooth

Connect additional Bluetooth profiles only if operating in the 5GHz band
Identifying a CarPlay-Enabled Device

Car

- Bluetooth pairing
- Connecting to John's iPhone

Head Unit

Plug-in → Bluetooth → Wi-Fi → iOS → iPhone

- Use wireless CarPlay?
  - Yes
  - No
Identifying a CarPlay-Enabled Device

- Bluetooth pairing
- Connecting to John's iPhone

iPhone
- Use wireless CarPlay?
  - Yes
  - No
Identifying a CarPlay-Enabled Device

Show CarPlay related UI only if the device supports CarPlay
Handling for a User-Consent Screen

Car
- Use CarPlay with John's iPhone
- Use Bluetooth
- Enable CarPlay

iOS

iPhone
- Use wireless CarPlay?
  - Yes
  - No
Handling for a User-Consent Screen

Car
- Use CarPlay with John's iPhone
- Use Bluetooth
- Enable CarPlay

User says yes

iPhone
- Use wireless CarPlay?
  - Yes
  - No

User says yes
Handling for a User-Consent Screen

Car
- Use CarPlay with John’s iPhone
  - Use Bluetooth
  - Enable CarPlay

iAP2 over BT (RequestAccessoryWiFiConfiguration)

iOS

iPhone
- Use wireless CarPlay?
  - Yes
  - No

User says yes
Handling for a User-Consent Screen

Do not provide the Wi-Fi credentials until the user has confirmed CarPlay.
Handling for a User-Consent Screen

Do not provide the Wi-Fi credentials until the user has confirmed CarPlay.
Connecting to Wi-Fi

Head Unit — Plug-in — Bluetooth — Wi-Fi — iOS — iPhone

Car
Apple CarPlay
Connecting to John's iPhone

iPhone
Home Screen
Connecting to Wi-Fi

Car

Apple CarPlay

Connecting to John's iPhone

iAP2 over BT (AccessoryWiFiConfiguration)

iOS

iPhone
Connecting to Wi-Fi

Car
- Apple CarPlay
  - Connecting to John's iPhone

iAP2 over BT (AccessoryWiFiConfiguration)

WiFi Scan

iOS device joins the AP

iOS

iPhone

Home Screen
Selecting a CarPlay Device

Car

- Apple CarPlay
- Connecting to John's iPhone

Head Unit

Plug-in
Bluetooth
Wi-Fi

iOS

iPhone

Bonjour discovery (CarPlay and CarPlay Control services)

Home Screen
Selecting a CarPlay Device

Bonjour discovery
(CarPlay and CarPlay Control services)

CarPlay Control Service connect
(John’s iPhone)

Head Unit | Plug-in | Bluetooth | Wi-Fi | iOS | iPhone

Car
Apple CarPlay
Connecting to John’s iPhone

iPhone
Home Screen
Starting a CarPlay Session

- Head Unit
  - Plug-in
  - Bluetooth
  - Wi-Fi
- iOS
- iPhone

Car
  - Apple CarPlay
  - Connecting to John's iPhone

iPhone
  - Home Screen
Starting a CarPlay Session

- Car
  - Apple CarPlay
  - Connecting to John's iPhone

- CarPlay Session setup

- Head Unit
  - Plug-in
  - Bluetooth
  - Wi-Fi

- iOS

- iPhone
  - Home Screen
Starting a CarPlay Session

- Car
  - Apple CarPlay
  - Connecting to John's iPhone
- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi
- iOS
- iPhone
- CarPlay Session setup
- iAP2 over CarPlay setup
- Home Screen
Starting a CarPlay Session

Head Unit

- Plug-in
- Bluetooth
- Wi-Fi

Car

Apple CarPlay
Connecting to John's iPhone

iOS

iPhone

CarPlay connected
Starting a CarPlay Session

- Car
- Apple CarPlay
- Connecting to John's iPhone

- Head Unit
- Plug-in
- Bluetooth
- Wi-Fi

- iOS
- iPhone

disableBluetooth()
Starting a CarPlay Session

Apple CarPlay

Connecting to John's iPhone

disableBluetooth()

disable BT

disconnect all BT profiles, including iAP2

Head Unit

Plug-in

Bluetooth

Wi-Fi

iOS

iPhone

Car

CarPlay

iPhone connected
Starting a CarPlay Session

If operating in 2.4 GHz band, disallow all Bluetooth connections and scanning.
Starting a CarPlay Session

- **Head Unit**
  - Plug-in
  - Bluetooth
  - Wi-Fi

- **iOS**
  - iPhone

**Car**
- Apple CarPlay
- Connecting to John's iPhone

**iPhone**
- CarPlay connected
Starting a CarPlay Session

Head Unit

Plug-in
Bluetooth
Wi-Fi

Screen setup
Audio setup

iOS

iPhone

Car

CarPlay UI

iPhone connected

CarPlay

connected
Setup and Pairing

General considerations
After setup is complete, the CarPlay UI must be displayed
Setup and Pairing

General considerations

After setup is complete, the CarPlay UI must be displayed.

CarPlay may request to play music playback after setup is complete.
Setup and Pairing

General considerations

After setup is complete, the CarPlay UI must be displayed.

CarPlay may request to play music playback after setup is complete.

Store device as last connected device.
Setup and Pairing
General considerations

After setup is complete, the CarPlay UI must be displayed

CarPlay may request to play music playback after setup is complete

Store device as last connected device

• Reconnect automatically when user returns to the car
Developing Wireless CarPlay Systems

- Hardware requirements
- Setup and pairing
- Reconnecting
- Wireless considerations
Developing Wireless CarPlay Systems

Hardware requirements
Setup and pairing
Reconnecting
Wireless considerations
Reconnecting
General considerations
On ignition, arbitrate between USB and wireless reconnection
On ignition, arbitrate between USB and wireless reconnection

Transport used for CarPlay depends on availability and connection sequence
Reconnecting
General considerations

On ignition, arbitrate between USB and wireless reconnection

Transport used for CarPlay depends on availability and connection sequence

Always check for CarPlay availability on device
Reconnecting
General considerations

On ignition, arbitrate between USB and wireless reconnection

Transport used for CarPlay depends on availability and connection sequence

Always check for CarPlay availability on device

After reconnection restore last user mode
Reconnecting
General considerations

On ignition, arbitrate between USB and wireless reconnection

Transport used for CarPlay depends on availability and connection sequence

Always check for CarPlay availability on device

After reconnection restore last user mode

Don’t interrupt active CarPlay session
Reconnecting
Common scenarios
Reconnecting
Common scenarios
### Reconnecting

**Common scenarios**

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<th>When is iPhone plugged in?</th>
<th>Common scenario</th>
<th>Transport used for CarPlay</th>
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# Reconnecting

## Common scenarios

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<td>Single iPhone</td>
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When is iPhone plugged in?  
- Single iPhone
## Reconnecting

Common scenarios

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<td>Never</td>
<td>Morning commute</td>
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Single iPhone
## Reconnecting

### Common scenarios

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<td>Wireless</td>
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<tr>
<td>During drive</td>
<td>Charging during evening commute</td>
<td>Wireless</td>
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**Single iPhone**
## Reconnecting

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<tr>
<td>Before ignition</td>
<td>Re-entering car at gas station</td>
<td>USB</td>
</tr>
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<td>Common scenario</td>
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<td>During drive</td>
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<td>Before ignition</td>
<td>Re-entering car at gas station</td>
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<tr>
<td></td>
<td>When the driver sits down</td>
<td>Long trip</td>
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# Reconnecting

## Common scenarios

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<tr>
<td>When the driver sits down</td>
<td>Long trip</td>
<td>First available</td>
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**Single iPhone**

**More than one iPhone**
## Reconnecting

### Common scenarios

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<td>During drive</td>
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<td>When the driver sits down</td>
<td>Long trip</td>
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<td>More than one iPhone</td>
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Reconnecting
Bluetooth device connection flow
Reconnecting
Bluetooth device connection flow

Wait for Bluetooth and Wi-Fi to boot up
Reconnecting
Bluetooth device connection flow

Wait for Bluetooth and Wi-Fi to boot up

Confirm last connected device is a CarPlay device
Reconnecting
Bluetooth device connection flow

Wait for Bluetooth and Wi-Fi to boot up

Confirm last connected device is a CarPlay device

Confirm CarPlay is not already active
Reconnecting
Bluetooth device connection flow

Wait for Bluetooth and Wi-Fi to boot up

Confirm last connected device is a CarPlay device

Confirm CarPlay is not already active

• Compare to saved DeviceTransportIdentifier
Reconnecting
Bluetooth device connection flow

Wait for Bluetooth and Wi-Fi to boot up
Confirm last connected device is a CarPlay device
Confirm CarPlay is not already active
• Compare to saved DeviceTransportIdentifier
Reconnect iAP2 over Bluetooth
Reconnecting
Bluetooth device connection flow

Wait for Bluetooth and Wi-Fi to boot up

Confirm last connected device is a CarPlay device

Confirm CarPlay is not already active
• Compare to saved `DeviceTransportIdentifier`

Reconnect iAP2 over Bluetooth

Confirm CarPlay is available using `WirelessCarPlayUpdate`
Reconnecting
Bluetooth device connection flow

Wait for Bluetooth and Wi-Fi to boot up

Confirm last connected device is a CarPlay device

Confirm CarPlay is not already active

• Compare to saved `DeviceTransportIdentifier`

Reconnect iAP2 over Bluetooth

Confirm CarPlay is available using `WirelessCarPlayUpdate`

Wait for CarPlay control discovery and connect
Reconnecting
USB device connection flow
Reconnecting
USB device connection flow

Wait for the user to connect a device over USB
Reconnecting
USB device connection flow

Wait for the user to connect a device over USB
Confirm CarPlay is not already active
Reconnecting
USB device connection flow

Wait for the user to connect a device over USB

Confirm CarPlay is not already active

• Compare to saved DeviceTransportIdentifier
Reconnecting
USB device connection flow

Wait for the user to connect a device over USB

Confirm CarPlay is not already active

• Compare to saved DeviceTransportIdentifier

Confirm CarPlay is available on the device
Reconnecting
USB device connection flow

Wait for the user to connect a device over USB

Confirm CarPlay is not already active

• Compare to saved DeviceTransportIdentifier

Confirm CarPlay is available on the device

• USB Vendor Request GetSupportedCapabilities
Wait for the user to connect a device over USB.

Confirm CarPlay is not already active.

- Compare to saved `DeviceTransportIdentifier`.

Confirm CarPlay is available on the device.

- USB Vendor Request `GetSupportedCapabilities`.

USB Role Switch and iAP2 over USB.
Reconnecting
USB device connection flow

Wait for the user to connect a device over USB

Confirm CarPlay is not already active
• Compare to saved `DeviceTransportIdentifier`

Confirm CarPlay is available on the device
• USB Vendor Request `GetSupportedCapabilities`

USB Role Switch and iAP2 over USB

Wait for CarPlay control discovery and connect
Reconnecting
Reconnecting

Multiple devices may be available
Reconnecting

Multiple devices may be available

• USB only
Reconnecting

Multiple devices may be available

- USB only
- Wireless only
Reconnecting

Multiple devices may be available

• USB only
• Wireless only
• Both USB and wireless
Reconnecting

Multiple devices may be available

• USB only
• Wireless only
• Both USB and wireless

Users can choose any available device
Reconnecting

Multiple devices may be available
  • USB only
  • Wireless only
  • Both USB and wireless

Users can choose any available device
  • Reconnect using available transport
Reconnecting after Disconnect
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<tr>
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<tbody>
<tr>
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Developing Wireless CarPlay Systems

Hardware requirements
Setup and pairing
Reconnecting
Wireless considerations
Developing Wireless CarPlay Systems

Hardware requirements
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Wireless performance depends on various characteristics
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• Wi-Fi protocol (802.11n or 802.11ac)
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- Wi-Fi protocol (802.11n or 802.11ac)
- Configuration (SISO or MIMO)
- Frequency band (2.4 GHz or 5 GHz)
Wireless Considerations

Wireless performance depends on various characteristics:
- Wi-Fi protocol (802.11n or 802.11ac)
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Wireless performance depends on various characteristics
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• Wi-Fi protocol (802.11n or 802.11ac)
• Configuration (SISO or MIMO)
• Frequency band (2.4 GHz or 5 GHz)
• Presence of other wireless technologies in same frequency band
• Additional services (Internet data or others)

Satisfy throughput and latency requirements in all possible coexistence scenarios
5 GHz Frequency Band
5 GHz Frequency Band

Highly recommended for wireless CarPlay
5 GHz Frequency Band

Highly recommended for wireless CarPlay

More channels for wireless usage
5 GHz Frequency Band

Highly recommended for wireless CarPlay

More channels for wireless usage

Less interference from other wireless systems
5 GHz Frequency Band

Highly recommended for wireless CarPlay

More channels for wireless usage

Less interference from other wireless systems

Less congested
2.4 GHz Frequency Band
2.4 GHz Frequency Band

Not recommended for wireless CarPlay

Highly congested

May be required for in-vehicle use in some regulatory domains
2.4 GHz Frequency Band

Not recommended for wireless CarPlay

Highly congested

May be required for in-vehicle use in some regulatory domains

If operating in this frequency band
2.4 GHz Frequency Band

Not recommended for wireless CarPlay

Highly congested

May be required for in-vehicle use in some regulatory domains

If operating in this frequency band

• Disable Bluetooth scanning and reconnections during active CarPlay sessions
2.4 GHz Frequency Band

Not recommended for wireless CarPlay

Highly congested

May be required for in-vehicle use in some regulatory domains

If operating in this frequency band

• Disable Bluetooth scanning and reconnections during active CarPlay sessions
• If providing LTE connectivity on Band 40, use channels 6 or 11
Multiple Wi-Fi Access Points
Multiple Wi-Fi Access Points

Use different channels if operating in same frequency band
Multiple Wi-Fi Access Points

Use different channels if operating in same frequency band

Provide same services on all access points with same SSID and password

• Use different SSID and password if offering different services
Multiple Wi-Fi Access Points

Use different channels if operating in same frequency band

Provide same services on all access points with same SSID and password
• Use different SSID and password if offering different services

Don’t use hidden SSIDs for CarPlay
Internet Data Connectivity
Internet Data Connectivity

Communicate status of Internet data connectivity

• Apple Device IE
• Interworking IE
Internet Data Connectivity

Communicate status of Internet data connectivity

• Apple Device IE
• Interworking IE

Notify iPhone of changes
Internet Data Connectivity

Communicate status of Internet data connectivity

• Apple Device IE
• Interworking IE

Notify iPhone of changes
• Module installed or removed
Internet Data Connectivity

Communicate status of Internet data connectivity
• Apple Device IE
• Interworking IE

Notify iPhone of changes
• Module installed or removed
• Connectivity no longer possible due to a failure
Internet Data Connectivity

Communicate status of Internet data connectivity
• Apple Device IE
• Interworking IE

Notify iPhone of changes
• Module installed or removed
• Connectivity no longer possible due to a failure
• Service contract expired or renewed
More Information

# Related Sessions

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