Advances in CarPlay Systems

Tom Powell, Car Experience Engineering
Tanya Kancheva, Car Experience Engineering
Irregularly shaped display support
Second screen support
Dynamic screen sizes
Hey Siri
Irregularly shaped display support
Second screen support
Dynamic screen sizes
Hey Siri
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content

Car Display
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content
Irregularly Shaped Display Support

Declare areas of the screen for CarPlay to render interactive content

Car Display

CarPlay Image Area
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content

Car Display

CarPlay Image Area
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content

Car Display

Bezel

CarPlay Image Area
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content

Car Display

View Area →

Bezel →

CarPlay Image Area

Car Display
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content
Irregularly Shaped Display Support

Declare areas of the screen for CarPlay to render interactive content

- View Area
- Safe Area
- CarPlay Always Visible Area

Car Display
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content

Car Display

CarPlay Image Area
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content
Irregularly Shaped Display Support
Declare areas of the screen for CarPlay to render interactive content

- View Area
- Safe Area
- CarPlay Always Visible Area
Irregularly shaped display support

Second screen support

Dynamic screen sizes

Hey Siri
Irregularly shaped display support
Second screen support
Dynamic screen sizes
Hey Siri
Second Screen Support
Display an additional CarPlay user interface in another screen

Center Console Display
CarPlay User Interface
Second Screen Support
Display an additional CarPlay user interface in another screen

Instrument Cluster

Center Console Display
Second Screen Support
Display an additional CarPlay user interface in another screen
Second Screen Support
Display an additional CarPlay user interface in another screen

H.264 Stream 2

CarPlay Content

Instrument Cluster

H.264 Stream 1

CarPlay User Interface

Center Console Display
Second Screen Support
Display an additional CarPlay user interface in another screen
Second Screen Support
Display an additional CarPlay user interface in another screen

Instrument Cluster

Center Console Display

H.264 Stream 1

H.264 Stream 2

H.264 Stream 3

CarPlay User Interface
Second Screen Support
Second Screen Support

Maneuver instructions provided by Apple Maps
Second Screen Support

Maneuver instructions provided by Apple Maps

Map provided by Apple Maps
Second Screen Support

Maneuver instructions provided by Apple Maps

Map provided by Apple Maps

Independent night mode per H.264 stream
Second Screen Support

Maneuver instructions provided by Apple Maps

Map provided by Apple Maps

Independent night mode per H.264 stream

Vehicle controls what type of content is drawn into each H.264 stream
Second Screen Support

Maneuver instructions provided by Apple Maps

Map provided by Apple Maps

Independent night mode per H.264 stream

Vehicle controls what type of content is drawn into each H.264 stream

Heads-up displays continue to use metadata (iAP2 Route Guidance)
Second Screen Support
Display an additional CarPlay user interface in another screen
Second Screen Support
Display an additional CarPlay user interface in another screen
Second Screen Support
Display an additional CarPlay user interface in another screen
Second Screen Support
Display an additional CarPlay user interface in another screen

Instrument Cluster

H.264 Stream 2

iAP2 Route Guidance

10.53 am | Apple Store San Francisco

iAP2 Now Playing

Flume - Hi This Is Flume (Mixtape)

55 mph

John Doe

4:32

MUTE
Second Screen Support
Display an additional CarPlay user interface in another screen

Instrument Cluster

H.264 Stream 2

iAP2 Route Guidance

10.53 am | Apple Store San Francisco
Flume - Hi This Is Flume (Mixtape)

iAP2 Now Playing

John Doe
4:32

iAP2 Communications

9:41 am
55 mph

9:41 am
MUTE
Second Screen Support
Display an additional CarPlay user interface in another screen

Instrument Cluster

H.264 Stream 2

iAP2 Route Guidance

10.53 am | Apple Store San Francisco

iAP2 Now Playing

Flume - Hi This Is Flume (Mixtape)

iAP2 Communications

55 mph

iAP2 Call Controls

John Doe
4:32

iAP2 Communications

9:41 am
Second Screen Support
Display an additional CarPlay user interface in another screen

Instrument Cluster

iAP2 Route Guidance

H.264 Stream 2

iAP2 Now Playing

iAP2 Communications

iAP2 Call Controls

10.53 am | Apple Store San Francisco

Flume - Hi This Is Flume (Mixtape)

55 mph

John Doe

4:32
Second Screen Support
Display an additional CarPlay user interface in another screen

H.264 Stream 2

iAP2 Route Guidance

iAP2 Now Playing

iAP2 Communications

iAP2 Call Controls

Instrument Cluster

55 mph

10.53 am | Apple Store San Francisco

Flume - Hi This Is Flume (Mixtape)

John Doe

4:32

9:41 am

10.53 am | Apple Store San Francisco

Flume - Hi This Is Flume (Mixtape)

John Doe

4:32

9:41 am
Second Screen Support
Display an additional CarPlay user interface in another screen

Instrument Cluster

- iAP2 Route Guidance
- H.264 Stream 2
- iAP2 Call Controls
- iAP2 Communications
- iAP2 Now Playing
- Flume - Hi This Is Flume (Mixtape)
- 55 mph
- 9:41 am
- 10:53 am | Apple Store San Francisco
- John Doe
- 4:32
Second Screen Support
Display an additional CarPlay user interface in another screen

Instrument Cluster

- iAP2 Route Guidance
- H.264 Stream 2
- iAP2 Now Playing
- iAP2 Communications
- iAP2 Call Controls

- 10.53 am | Apple Store San Francisco
- Flume - Hi This Is Flume (Mixtape)
- 55 mph
- John Doe
Second Screen Support
Display an additional CarPlay user interface in another screen
Second Screen Support
Display an additional CarPlay user interface in another screen.
Second Screen Support
Display an additional CarPlay user interface in another screen
Second Screen Support
Display an additional CarPlay user interface in another screen
Second Screen Support
Display an additional CarPlay user interface in another screen

55 mph

H.264 Stream 2

10:53 am | Apple Store San Francisco
Flume - Hi This Is Flume (Mixtape)

H.264 Stream 3

9:41 am

Instrument Cluster
Second Screen Support
Display an additional CarPlay user interface in another screen
Second Screen Support
Display an additional CarPlay user interface in another screen
Second Screen Support
Display an additional CarPlay user interface in another screen
Irregularly shaped display support

Second screen support

Dynamic screen sizes

Hey Siri
Irregularly shaped display support
Second screen support
Dynamic screen sizes
Hey Siri
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

CarPlay User Interface

Center Console Display
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

View Area 1

View Area 2

CarPlay User Interface

Center Console Display

Center Console Display
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Center Console Display

Resize button

CarPlay User Interface

Center Console Display
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Instrument Cluster

55 mph

Flume - Hi This Is Flume (Mixtape)

10:46 am | Apple Store San Francisco
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Instrument Cluster

55 mph

John Doe
4:32

MUTE

9:41 am
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Instrument Cluster
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Instrument Cluster

55 mph

John Doe
4:32

MUTE
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

View Area 1
Safe Area

Instrument Cluster
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Instrument Cluster
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

View Area 2
Safe Area
Transition Time 3000 ms

Instrument Cluster
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Instrument Cluster
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Instrument Cluster
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

View Area 1 to View Area 2 Transition

Instrument Cluster
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

View Area 1 to View Area 2 Transition

Instrument Cluster
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Available for center console and instrument cluster displays
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Available for center console and instrument cluster displays

CarPlay-provided button on center console allows user to trigger resize
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Available for center console and instrument cluster displays

CarPlay-provided button on center console allows user to trigger resize

Specify duration of the transition
Dynamic Screen Sizes
Dynamically change the size of the CarPlay user interface

Available for center console and instrument cluster displays

CarPlay-provided button on center console allows user to trigger resize

Specify duration of the transition

Synchronize visual transitions between native and CarPlay UI
Irregularly shaped display support
Second screen support
Dynamic screen sizes
Hey Siri
Irregularly shaped display support
Second screen support
Dynamic screen sizes
Hey Siri
Hey Siri
Hey Siri

Invoke Siri by simply using your voice
Hey Siri

Invoke Siri by simply using your voice

Siri activates instantaneously when using a button press
Hey Siri

Invoke Siri by simply using your voice

Siri activates instantaneously when using a button press

Continue listening to music while interacting with Siri
System Overview

Accessory
- Mixer
- Voice Activity Detector
- Keyword Detector
- CarPlay Communication Plug-in
- Audio Ring Buffer
- Echo Cancellation
- Noise Reduction

iPhone
- Siri

Second Pass Voice Trigger Detector
System Overview

Accessory

- Mixer
- Voice Activity Detector
- Keyword Detector
- CarPlay Communication Plug-in
- Audio Ring Buffer
- Echo Cancellation
- Noise Reduction

iPhone

- Siri
- Second Pass Voice Trigger Detector
System Overview

Accessory
- Mixer
- Voice Activity Detector
- Keyword Detector
- CarPlay Communication Plug-in
- Audio Ring Buffer
- Echo Cancellation Noise Reduction

iPhone
- Siri
- Second Pass Voice Trigger Detector

Always On Microphone
Accessory

Voice Activity Detector

Keyword Detector

Mixer

CarPlay Communication Plug-in

Audio Ring Buffer

Echo Cancellation Noise Reduction

Always On Microphone

Siri

iPhone

Second Pass Voice Trigger Detector
System Overview

Accessory

- Voice Activity Detector
- Keyword Detector

CarPlay Communication Plug-in

- Audio Ring Buffer
- Echo Cancellation Noise Reduction

iPhone

- Siri

Second Pass Voice Trigger Detector

Always On Microphone

Voice Trigger Detector

Mixer

Mixer

Audio Ring Buffer
System Overview

- Accessory
  - Mixer
  - Voice Activity Detector
  - Keyword Detector
  - CarPlay Communication Plug-in
  - Audio Buffer
  - Audio Ring
  - Echo Cancellation
  - Noise Reduction

- iPhone
  - Siri
  - Second Pass Voice Trigger Detector

- Always On Microphone
  - Aux In Audio
System Overview

Accessory
- Mixer
- Voice Activity Detector
- Keyword Detector
- CarPlay Communication Plug-in

Audio Ring Buffer
- Echo Cancellation Noise Reduction

iPhone

Always On Microphone
System Overview

Accessory
- Mixer
- Voice Activity Detector
- Keyword Detector

CarPlay Communication Plug-in

iPhone
- Always On Microphone
- Echo Cancellation Noise Reduction
- Audio Ring Buffer
- Siri
- Siri
- Voice Activity Detector
- Keyword Detector
- Mixer
- Audio Ring Buffer
- Echo Cancellation Noise Reduction
- Always On Microphone
System Overview

- Accessory
  - Mixer
  - Voice Activity Detector
  - Keyword Detector
  - CarPlay Communication Plug-in
- Always On Microphone
  - Echo Cancellation
  - Noise Reduction
- Audio Ring Buffer
- Aux In Audio
- iPhone
  - Siri
System Overview
System Overview

Accessory

Mixer

Voice Activity Detector

Keyword Detector

CarPlay Communication Plug-in

Audio Ring Buffer

Echo Cancellation Noise Reduction

Always On Microphone

Media

Aux Out Audio

Siri

iPhone

Mixer

Aux In Audio
System Overview

Accessory

- Mixer
- Voice Activity Detector
- Keyword Detector

CarPlay Communication Plug-in

- Audio Ring Buffer
- Echo Cancellation
- Noise Reduction

Media

- Aux Out Audio

iPhone

- Siri

Always On Microphone

- Aux In Audio
System Overview

Accessory

Mixer

Voice Activity Detector

Keyword Detector

CarPlay Communication Plug-in

Audio Ring Buffer

Echo Cancellation Noise Reduction

Always On Microphone

Media

Aux Out Audio Alternate

Siri

iphone

Aux In Audio
Vehicle System Requirements
Vehicle System Requirements

Always on microphone input stream processed within the vehicle
Vehicle System Requirements

Always on microphone input stream processed within the vehicle

Continuous echo cancellation and noise reduction
Vehicle System Requirements

- Always on microphone input stream processed within the vehicle
- Continuous echo cancellation and noise reduction
- Voice activity detector
Vehicle System Requirements

Always on microphone input stream processed within the vehicle

Continuous echo cancellation and noise reduction

Voice activity detector

Keyword detector
Vehicle System Requirements

Always on microphone input stream processed within the vehicle

Continuous echo cancellation and noise reduction

Voice activity detector

Keyword detector

Audio mixer for Siri audio, media playback, and navigation prompts
More Information

developer.apple.com/wwdc19/252