

SONOS®

Sonos System Overview

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1 Introduction

This paper presents a high-level outline of the various products that make up the Sonos Wireless HiFi System.

If you are a software developer and wish to integrate a music service using Sonos our Music API Web Services, sign up on Sonos Labs (<http://musicpartners.sonoslabs.com>) to begin the submission process and gain access to the latest documentation.

2 Sonos Wireless HiFi System

The Sonos Wireless HiFi System plays all the music you want, all over your house—from the bedroom to the backyard—and lets you control it all from the palm of your hand. Sonos gives you instant access to millions of songs and stations including dozens of online music services, thousands of free Internet radio stations, and music libraries stored on a computer or in the cloud.

Figure 1 shows the various components of the Sonos Wireless HiFi System.

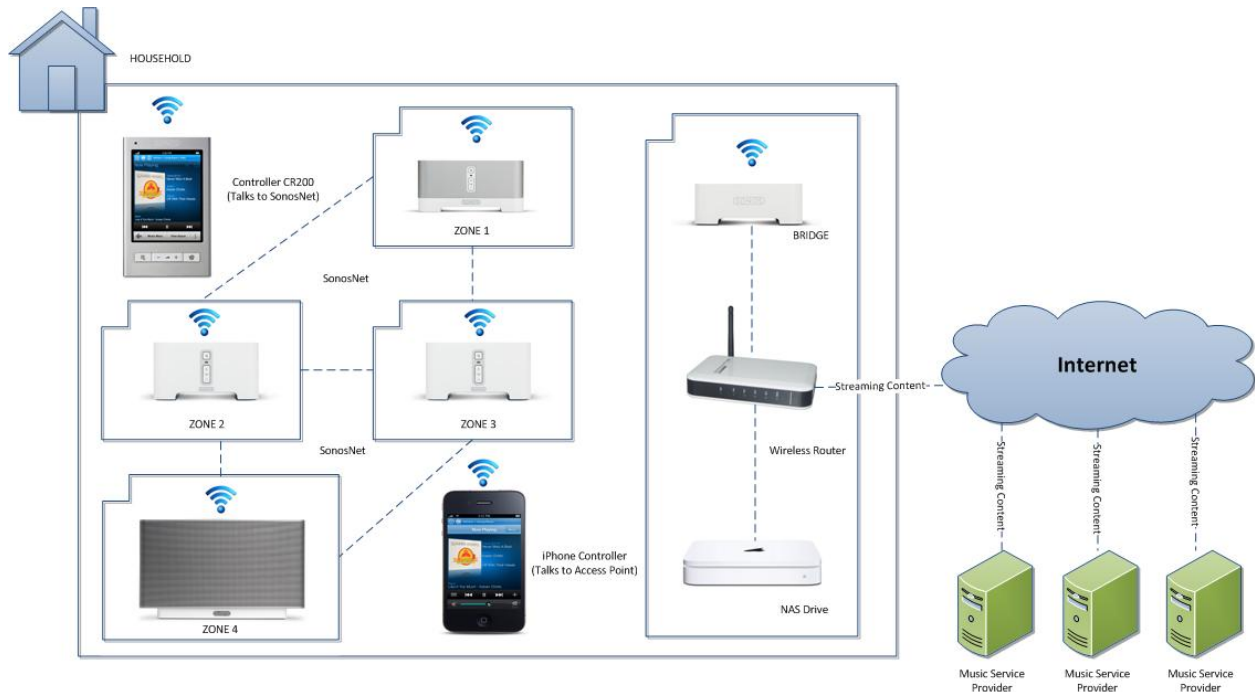


Figure 1: Components of the Sonos Wireless HiFi System

2.1 Sonos Players

A Sonos player is a Sonos component that can play audio on its own without being bonded to another Sonos product (to act as if they are a single player). For more information about bonding, see section 4, Group Management.

Sonos players include:

- **The SONOS PLAY:5** is a high-performance all-in-one wireless speaker that delivers crystal-clear, room-filling sound using a five-way speaker system driven by five digital amplifiers.
- **The SONOS PLAY:3** is an all-in-one wireless speaker that delivers pure, clear, room-filling sound using a three-driver system. Two PLAY:3s can be bonded as a stereo pair for stereo sound or as rear speakers for a SONOS PLAYBAR home theater system.
- **The SONOS PLAY:1** is the most compact Sonos speaker, with two custom-designed drivers, one for a 3.5 in (9 cm) mid-woofer and one for a tweeter, each with a dedicated amplifier. Two PLAY:1s can be paired for stereo sound or as rear speakers for a SONOS PLAYBAR in a home theater system.
- **The SONOS PLAYBAR** is a full-theater HiFi soundbar with a sophisticated nine speaker design that connects to HDTV with a single cable and plays all sources connected to the TV, including cable/SAT boxes, Blu-ray players, and game consoles. It is compatible with Dolby® Digital and PCM.
- **The amplified SONOS CONNECT:AMP** has a built-in 55W per channel digital amplifier. Just add speakers to bring superior audio quality to any room.
- **The non-amplified SONOS CONNECT** connects directly to a home theater receiver, stereo system, or other audio device, so customers can instantly integrate these devices into their Sonos system.

2.2 Sonos Accessories

A Sonos accessory is a Sonos component that is designed to play audio only when it is bonded with a player or to expand SonosNet (a dedicated wireless mesh network exclusively for Sonos components). For more information about SonosNet, see section 3.2, SonosNet Setup. Sonos accessories include:

- The **SONOS SUB** is a wireless subwoofer that adds a dimension of deep bass to your music listening experience. The SUB is bonded with a player during setup; it is not a stand-alone product.
- The **SONOS BRIDGE** is a wireless access point that allows for fast, easy setup of a Sonos system. Connect the BRIDGE to a broadband router to instantly activate the SonosNet wireless mesh network, then place all other Sonos components anywhere in the house. The BRIDGE does not play audio.

2.3 Sonos Controllers

Sonos controllers let you control the music in any room from anywhere in the house. You can instantly find and play songs from a wide variety of music services, thousands of free Internet radio stations, and music files stored on any computer on the network or in the cloud. Use a controller to search for songs, control the volume, play the same track in every room, or choose different songs for different rooms. Mix and match controllers for ultimate flexibility.

- **Sonos Controller for Android** is a free app that transforms an Android smartphone or tablet into a controller for the Sonos Wireless HiFi System. Download the Sonos Controller App from the store on your device.

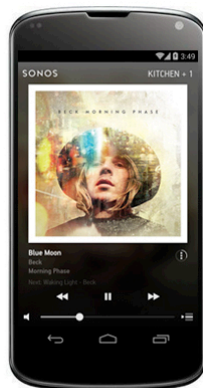


Figure 4: Sonos Controller for Android Phone

- **Sonos Controller for iPhone and iPad** are free apps that turn an iPhone®, iPod® touch, or iPad™ into a full-fledged Sonos controller. Download the Sonos Controller App from the store on your device.

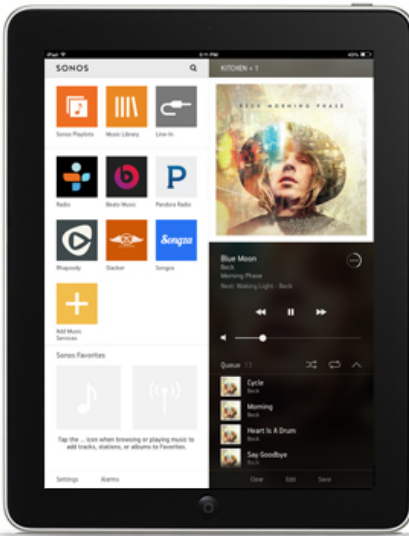


Figure 6: Sonos Controller for iPad

- **Sonos Controllers for Mac and PC** are free software applications that let you control Sonos from any computer in the house. Download the free Sonos software app from the Sonos website (www.sonos.com/support).

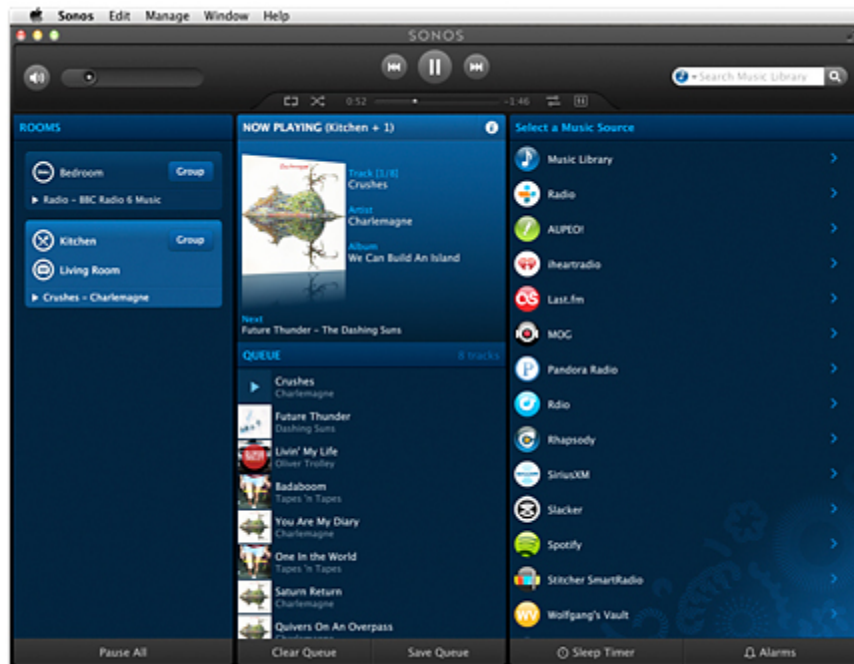


Figure 7: SONOS Desktop Controller software

- **SONOS CONTROL** is a dedicated wireless controller with full-color VGA display and an ultra-responsive touch screen. Pick it up or touch the screen and it's instantly on, ready to play music (This product is no longer manufactured).



Figure 5: SONOS CONTROL

3 Wireless Mesh Network

Each Sonos product is network-enabled with Ethernet, wireless interfaces, or both and uses TCP/IP to communicate. You can set up the Sonos Wireless HiFi System wirelessly (standard setup), or by connecting a Sonos product to your router with an Ethernet cable (BRIDGE setup). If you connect a Sonos component to your router, the Sonos system establishes and uses SonosNet, a secure wireless mesh network to communicate and stream music throughout the household. (Connect a BRIDGE to your router if you won't listen to music in this location, or connect a player to have audio available.) If you set up Sonos wirelessly, Sonos components communicate using over the home's wireless network.

SonosNet is a secure, AES-encrypted, peer-to-peer wireless mesh network that provides stable, reliable audio playback.

Sonos components communicate directly with each other, so each component expands the network. Each Sonos product is network enabled with an Ethernet interface, a wireless interface, or both so you can choose to set up the Sonos system to use either SonosNet (by connecting one Sonos product to your router) or your wireless network. If you plug a Sonos product into your router, all of your Sonos components will use SonosNet to communicate with each other.

When the Sonos Wireless HiFi System is set up, a **household** is created. A household is limited to thirty-two components each of which must be on the same IP subnet.

3.1 Standard Setup

In a standard wireless network, coverage radiates outward from a central router or access point. The further a wireless client is from this central point, the weaker the signal between the two will be.

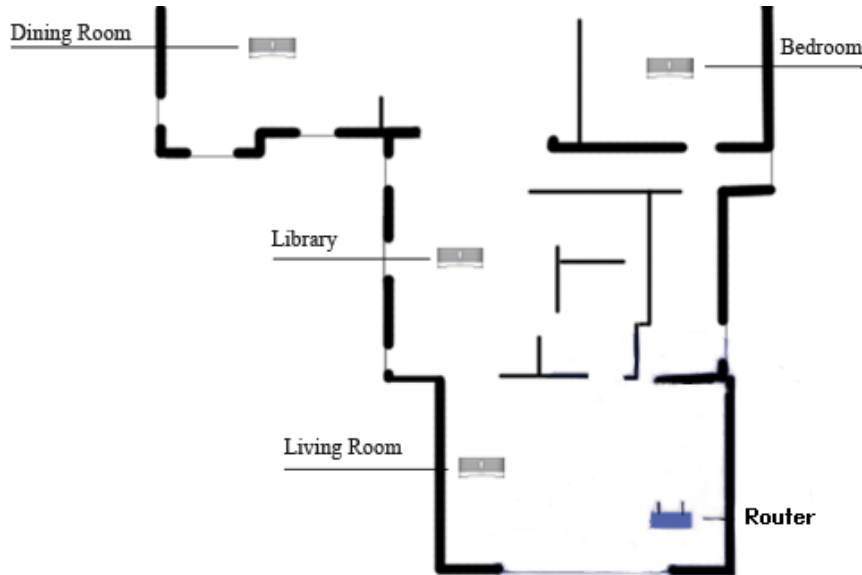


Figure 2: Standard Wireless Network

In Figure 2 above, each Sonos component talks to the wireless router. Therefore, for homes with wireless connectivity issues, or those with a large number of Sonos players, standard wireless setup may not be the best choice.

3.2 SonosNet™ Setup

SonosNet is different because each Sonos product is both a network client and access point. Instead of merely accessing the network, each component also expands it. Sonos components communicate with every other Sonos component in wireless range, ensuring multiple, redundant paths for data to travel. While each component must be within range of at least one other component, they don't need to be within range of the central point.

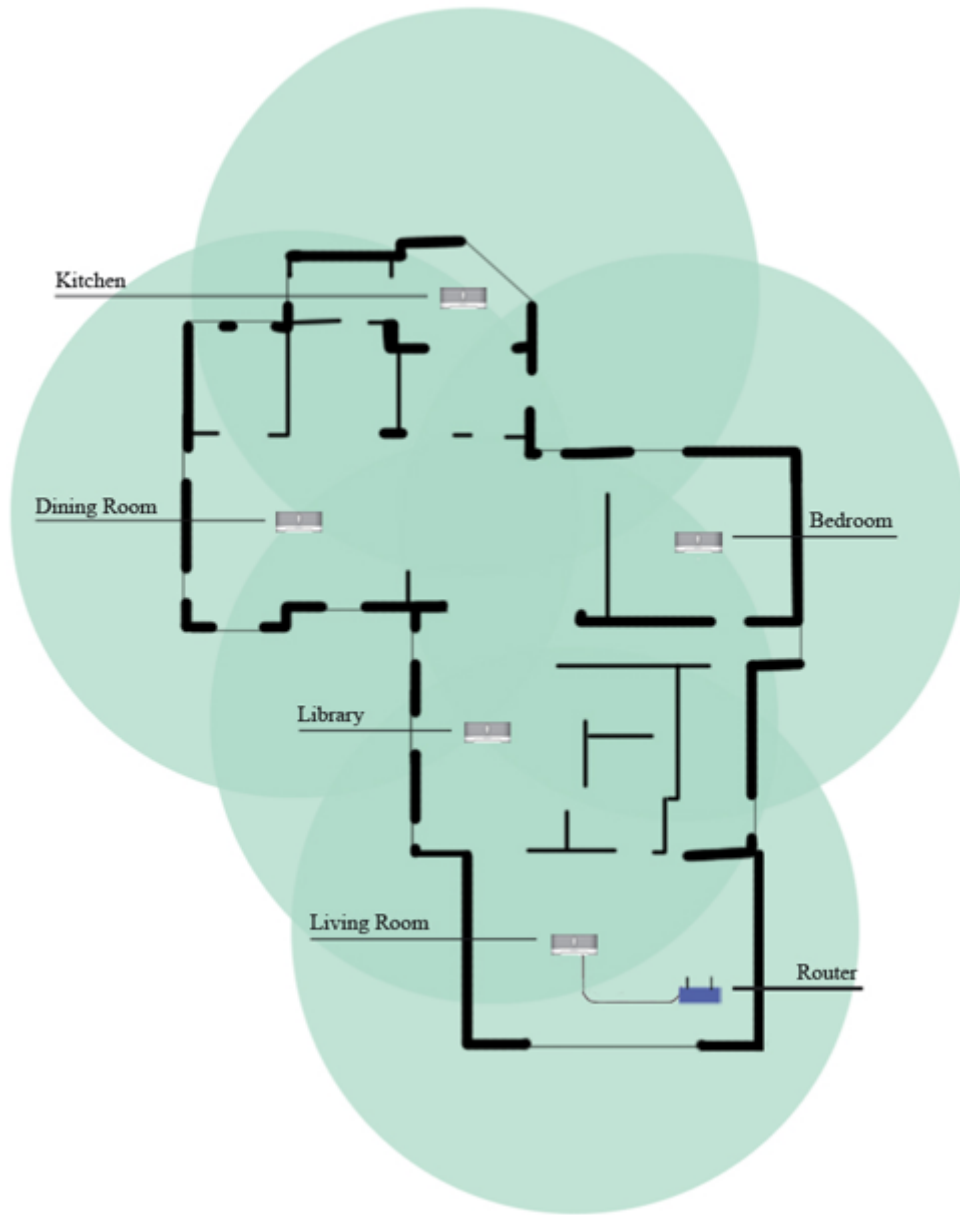


Figure 3: SonosNet

In Figure 3 above, the green circles represent SonosNet. Since each Sonos component both uses and extends SonosNet, simply by communicating with another Sonos component SonosNet is expanded to provide whole-house coverage. Note that the Sonos component nearest to the router is connected via an Ethernet cable.

As a music distribution method, there are some advantages to setting up Sonos to communicate over SonosNet rather than the home's wireless network.

- **Reliability** – Because SonosNet is a separate high-performance wireless network exclusively for Sonos components, this setup is recommended when wireless connectivity issues are present in a home. SonosNet adapts to changing wireless conditions and uses multiple wireless connections between Sonos products to provide a stable system even under adverse conditions.

- **Ease and simplicity** – SonosNet requires no configuration other than the press of two buttons as part of the setup process. Standard wireless setup, while also easy, requires entry of the wireless network’s password.
- **Security** – SonosNet protects the household without the need for special keys or pass-phrases.

4 Group Management

The multi-room aspect of the Sonos Wireless HiFi System allows you to simultaneously play the same song, or different songs, in up to thirty-two rooms in a household (a household consists of Sonos components on the same IP subnet). The Sonos system is unique in that it allows you to dynamically group rooms to play the same song synchronously. The resulting multi-room **player group** can be controlled using any Sonos controller. For example, you can raise and lower the volume and control audio playback (for example, play or pause a track, go to the next track, and so on) of a group of players.

This requires that each Sonos component have access to the audio data. In the Sonos architecture, this is achieved by requiring that all Sonos components be members of a player group in order to play audio, and selecting a lead player, called the **group coordinator**, to distribute the audio data to the other group members. Group membership can be changed “on the fly” by linking and unlinking rooms without restriction. This flexibility is achieved by a dynamic handoff of the lead Sonos component role. To ensure the handoff is free from audio interruptions, both existing and new lead components access the same content simultaneously for a limited period of time.

Currently Sonos supports 32 rooms in a household. For best customer experience, we recommend all music partners support 32 different streams to these different groups.

Group management is a key benefit of owning a Sonos system. It allows you to play any music in any room of your house. In a typical home there will be several rooms that are set up to play music, for example, the living room, kitchen, master bedroom, and the patio. Each room (or group) can play different music, or any combination of rooms can be joined together to form a group that will play music in perfect synchronization. **Party Mode** refers to the situation when all the player groups in a house are combined to play music in synchrony.

4.1 Bonded Components

Sonos components can be **bonded** to act as if they are a single player. A bonded set of components, such as a SUB and a PLAYBAR, act as a single player with one volume level and display one player name on the controller menu. Bonded components also play music in synchrony, but separate out certain frequencies or channels. The table below shows the difference between grouped components and bonded sets of components.

Functionality	Grouped Components	Bonded Set of Components
Volume Control	Individual volume controls per player	Single volume control for set
Product Name Display	Displays original (multiple) player names on menu	Displays as single player on menu
Audio Characteristics	Audio characteristics of player are always individually maintained	Audio characteristics adjusted based on role

5 Music

The Sonos Wireless HiFi System is designed to take advantage of your existing audio content, either over the Internet via subscription-based music services or Internet radio or stored locally. Sonos products do not store audio content locally; rather they provide an enumerated index of the available audio. The index is either created by the Sonos Wireless HiFi System itself, or it is generated by a music service application and presented via the Sonos system.

The Sonos Wireless HiFi System is designed to play uncompressed, compressed, unencrypted, and encrypted file formats/streams. To ensure audio quality is preserved, the Sonos system always transmits the content in its original format, and the content is only decoded when it is played on a Sonos component. The system is designed to be secure and to provide several protection layers to ensure that the integrity of the audio content is preserved. Encrypted content remains encrypted when transmitted throughout the household, and is only decrypted when it is to be played on a Sonos player.

The Sonos Music API is designed to be flexible to support evolving music business models. Currently music categories that can be played on Sonos include on demand music, smart radio, and streaming radio, described below.

5.1 On Demand Music

Music services (for example, Rhapsody and Spotify) allow you to search, select, and play specific songs and albums from a music service. On demand music can be added to the **Sonos Queue**.

The queue represents a list of audio resources to be played by Sonos players. When one track finishes playing, the next track in the queue is played. A Sonos queue can be saved as a **Sonos Playlist** to be accessed later. The queue can be edited to change the track order or to remove tracks.

On demand tracks have full **seek** capability, meaning that you can skip back and forth to the next and previous tracks and the player head can be moved within a track.

5.2 Smart Radio

Smart radio stations (or channels) provide a stream of continual tracks, but you can't select specific songs. You can often provide a **seed** artist or track and the channel will play similar music as a continual stream of tracks. Alternatively, channels can be themed. For example a stream of 60s hits can be provided. Pandora Radio stations, Last.fm stations and Rhapsody Channels are examples of smart radio products.

Smart radio tracks have limited seek capability. While it is common to be able to skip ahead to the next track, often you cannot skip back to a previously played track or seek within a track. Some services also limit the number of skips that can be made in a given time period.

Unlike on demand tracks, smart radio tracks do not appear in the queue.

Most smart radio stations also provide rating functionality. For example Pandora Radio allows you to express likes and dislikes for the currently playing song by clicking on a "Thumbs Up" or "Thumbs Down" icon. You can tailor your future listening experience by liking and disliking songs.

5.3 Streaming Radio

Streaming radio stations provide a continual stream of content, but not as individual tracks. This type of music is similar to traditional broadcast radio or Internet radio stations. Streaming radio stations have no seek capability. For example, it's not possible to skip forward within a radio station, and there is no concept of skipping to the next radio station. Streaming radio stations do not appear in the queue.

6 Sonos Labs

After years of working with leading music services, Sonos has designed industry-leading APIs and a program to make it fast, easy, and seamless to get connected to Sonos. The Sonos Music API (SMAPI) is an open web-services API that provides a consistent way for content to be delivered by web-based music services to the Sonos system.

To learn more, sign up on Sonos Labs (<http://musicpartners.sonolabs.com>) and review the latest documentation.